6F3B0252

TOSHIBA

UM-TS01***-E003

PROGRAMMABLE CONTROLLER

PROSEC **T1/T1S**

USER'S MANUAL

– Communication Function –

Contents

TOSHIBA CORPORATION

Important Information

Misuse of this equipment can result in property damage or human injury.
Because controlled system applications vary widely, you should satisfy yourself as to the acceptability of this equipment for your intended purpose.
In no event will Toshiba Corporation be responsible or liable for either indirect or consequential damage or injury that may result from the use of this equipment.

No patent liability is assumed by Toshiba Corporation with respect to use of information, illustrations, circuits, equipment or examples of application in this publication.

Toshiba Corporation reserves the right to make changes and improvements to this publication and/or related products at any time without notice. No obligation shall be incurred other than as noted in this publication.

Publication number: UM-TS01∗∗∗-E003
1st edition July 1996, 2nd edition April 1998

Safety Precautions

This manual is prepared for users of Toshiba's Programmable Controller T1 and/or T1S. Read this manual thoroughly before using the T1/T1S. Also, keep this manual and related manuals so that you can read them anytime while the T1/T1S is in operation.

Hazard Classifications

In the manuals related to the T1/T1S, the following two hazard classifications are used to explain the safety precautions.

⚠ WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Even a precaution is classified as CAUTION, it may cause serious results depending on the situation. Observe all the safety precautions described on this manual.

Safety Precautions

⚠ CAUTION

- Read the Safety Precautions described in the "T1/T1S User's Manual – Basic Hardware and Function –" before using the T1/T1S.
- Carefully connect the communication cable. Wrong connection can cause damage to the product.

About This Manual

About This Manual

This manual provides all the information you need to wire, set-up and operate the T1/T1S's serial communication function.
This manual is divided into two parts as follows.

Part 1 T1/T1S Programmer Port Function
The programmer port of the T1 or T1S can be used to communicate with a master computer, an operator interface unit, or an other T-series PLC with active communication function (Free ASCII mode), using the T-series computer link protocol, as well as to communicate with the T-series programmer (T-PDS or HP911A). The interface of the programmer port is RS-232C. Part 1 describes the functions of the T1/T1S programmer port.

Part 2 T1S RS-485 Port Function
The T1S has a second serial communication port. The interface of this port is RS-485. This RS-485 port and the programmer port can work independently.
One of the following three operation modes can be selected for the RS-458 port.
Part 2 describes how to use these functions.

- Computer link mode: Used to communicate with a master computer, etc. to configure SCADA/MMI system, using the T-series computer link protocol. In this mode, the T-series programmer (T-PDS) can also be connected to this RS-485 port for remote programming/monitoring purpose.
- Data link mode: Used to configure data link system between two T1Ss or between T1S and T2E/T2N. This is easy and inexpensive data link system. No special program for this data link is required.
- Free ASCII mode: This is an active communication function used to communicate with other serial interface devices, using ASCII characters. By using this mode, the T1S can act as communication master for connecting with bar-code reader, printer, weigh scale, Toshiba inverters (VF-S7/A5), other T-series PLCs, etc.

For your better understanding of the T1/T1S, read the following manual at first to understand the T1/T1S system, then read this manual.

T1/T1S User's manual – **Basic Hardware and Function** – UM-TS01∗∗∗-E001

Contents

Terminology

The following is a list of abbreviations and acronyms used in this manual.

μs	microsecond
ASCII	American Standard Code for Information Interchange
bps	bit per second (transmission speed)
CCITT	Consultative Committee in International Telegraphy and Telephony
CPU	Central Processing Unit
EIA	Electronic Industries Association
H	hexadecimal (when it appears in front of an alphanumeric string)
I/O	Input/Output
LED	Light Emitting Diode
MMI	Man Machine Interface
ms	millisecond
RS-232C	An EIA standard for data transmission less than 15 m in length
RS-485	An EIA standard for data transmission less than 1 km in length
SCADA	Supervisory Control And Data Acquisition
Vac	AC voltage
Vdc	DC voltage

Contents

Contents

Contents

Contents

PART 1 T1/T1S Programmer Port Function

Section 1
Overview

1. Overview PART 1

1.1 Computer link function

The T1/T1S's programmer port supports the computer link function as well as communication with the programmer.

The programmer port can accept the T-series computer link commands.
By preparing the communication software based on the protocol described in this manual on the master computer (computer, operator interface unit, etc.), the following functions become available by the master computer.

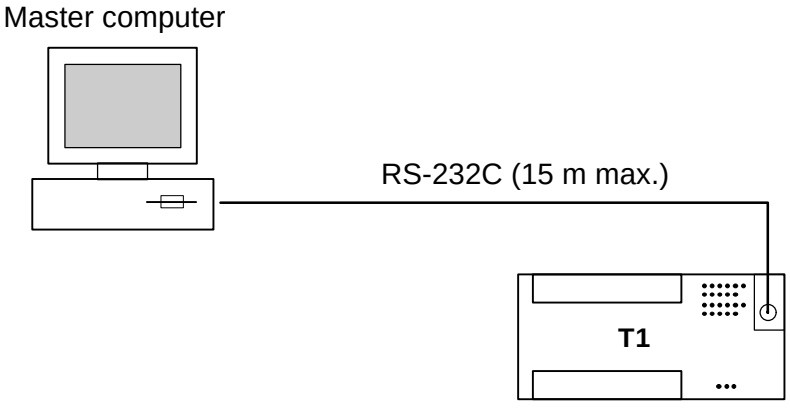
- Reading data (register/device value) from the T1/T1S
- Writing data (register/device value) into the T1/T1S
- Monitoring the T1/T1S's operation status (RUN/HALT/ERROR)
- Reading the error code from the T1/T1S
- Reading the clock/calendar data from the T1S (T1S only)
- Writing the clock/calendar data into the T1S (T1S only)
- Controlling the T1S operation mode (T1S only)
- Program up-loading from the T1S (T1S only)
- Program down-loading into the T1S (T1S only)

Using the computer link function, you can connect a master computer or an operator interface unit with the T1/T1S, and can configure a SCADA/MMI system.

1.2 System configuration

The interface of the T1/T1S's programmer port is RS-232C. Without using a conversion adapter, the RS-232C serial port of the master computer can be connected to the T1/T1S's programmer port directly. (One-to-one configuration)

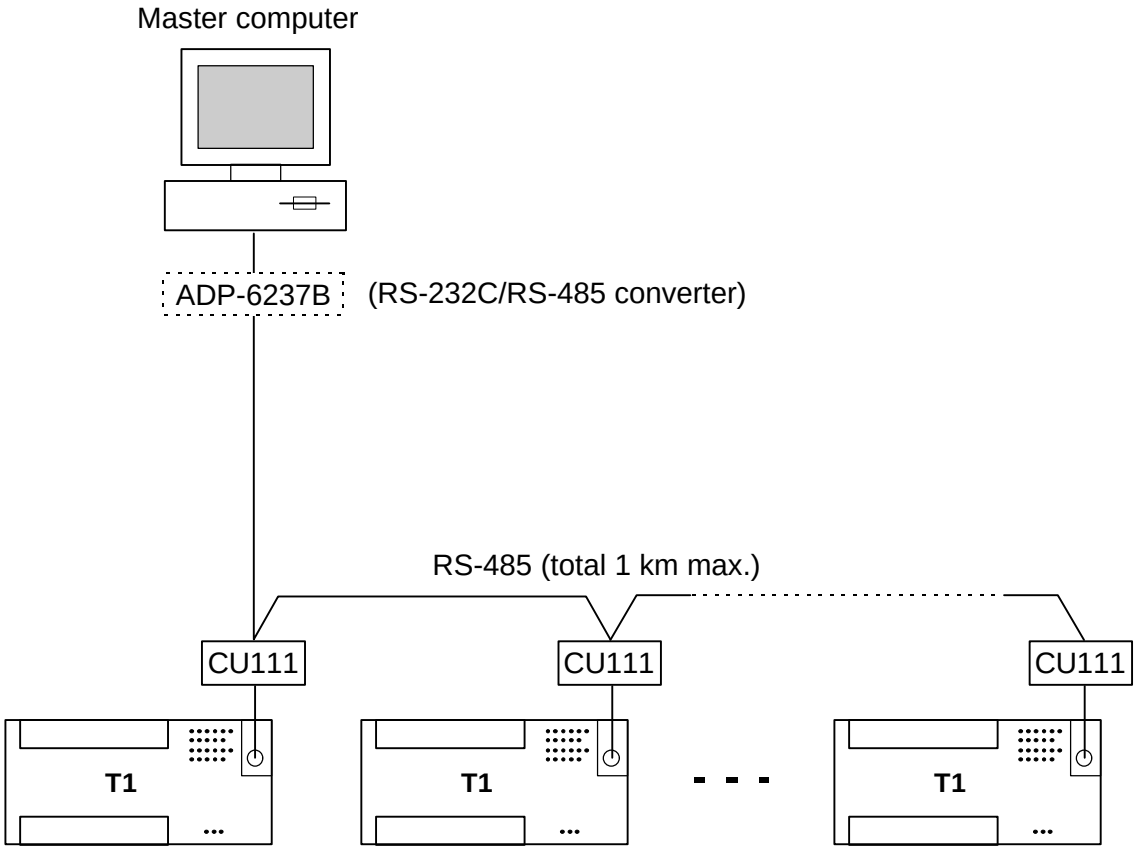
One-to-one configuration:



NOTE A 2 m length computer link cable with T1/T1S programmer port connector is optionally available (type: PT16S). See section 2.2.

On the other hand, when two or more T1/T1S's are connected with a master computer, the multi-drop adapters (CU111) can be used. (One-to-N configuration)

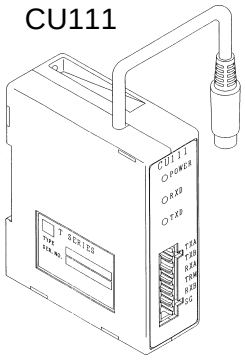
One-to-N configuration:



(32 T1/T1S's max.)

- The CU111 is the RS-232C/RS-485 converter dedicated for the T1/T1S.
- If the master computer have RS-232C interface but not RS-485, the RS-232C/RS-485 converter (ADP-6237B) can be used.

CU111



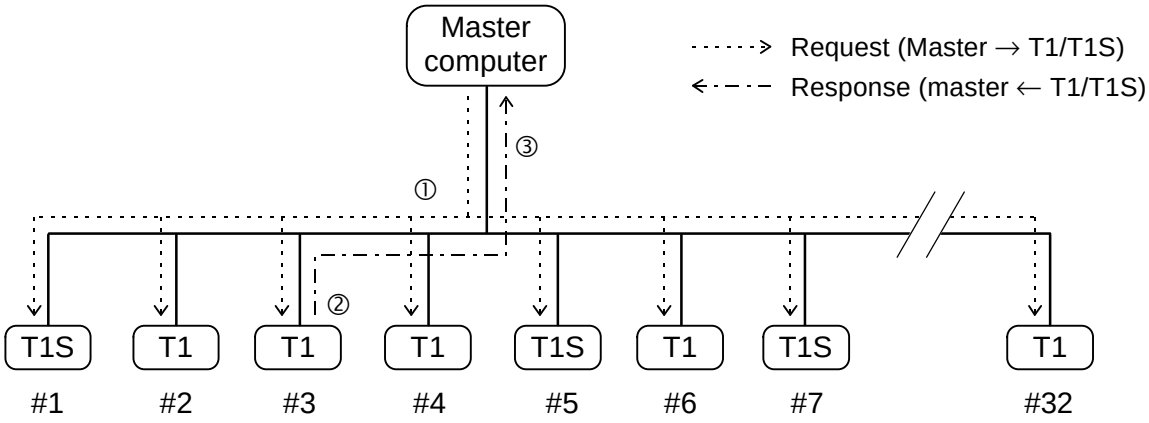
NOTE

(1) In the standard T1 version 1.00, the station number is not checked. Therefore, the T1 version 1.00 cannot be used for one-to-N configuration.
(2) Programmer (T-PDS) connection with station number is supported by the T1 version 1.20 or later, and the T1S.

1.3 Communication overview

In the computer link system, the T1/T1S waits for receiving a request message issued from the master computer.
When a request message is issued, the T1/T1S checks the station number contained in the request message. And when the station number designation matches the T1/T1S's station number setting, the T1/T1S processes the request and returns the response.
This is why each T1/T1S must have a unique station number in the one-to-N configuration. Otherwise, more than one T1/T1S may attempt to process the request, resulting in faulty response.

The following figure illustrates the processing sequence executed when a request to station number 3 is issued.



① The request message is sent from the master to all the connected T1/T1S. (request for station #3 in this example)

② The request message is interpreted and processed in the T1/T1S which has the same station number as request. (station #3 T1 in this example)

③ Processing result is returned as response to the master.

NOTE

Available station number is 1 to 32. The station number is set in the system information memory (T1), or in the special register SW36 (T1S).
Refer to sections 4.1 and 4.2.

PART 1 T1/T1S Programmer Port Function

Section 2
Specifications

2. Specifications PART 1

2.1 Transmission specifications

Item	Specifications
Interface	Conforms to RS-232C (RS-485 when used with CU111)
Transmission distance	15 m max. (RS-232C) 1 km max. (RS-485 by using CU111)
Configuration	One-to-one (RS-232C) One-to-N (RS-485 by using CU111, N is 32 max.)
Station number	1 to 32 (set in T1/T1S's memory)
Transmission mode	Half-duplex
Synchronizing	Start-stop system (asynchronous)
Transmission speed	9600 bps (fixed)
Start bit length	1 bit (fixed)
Data bit length	8 bits (fixed)
Parity	Odd parity / none parity
Stop bit length	1 bit (fixed)
Message length	255 bytes max.
Error check	Parity, check-sum
Response delay time	0 - 300 ms (user setting)

NOTE

(1) The station number and parity (odd or none) can be set by user. Transmission speed, start bit, data bit, and stop bit settings are fixed as above. Refer to sections 4.1 and 4.2.

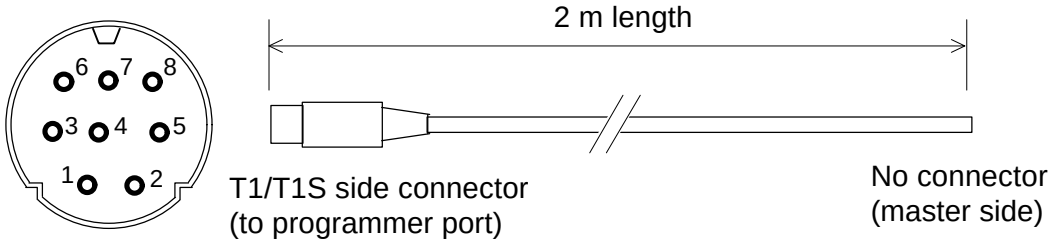
(2) The response delay time can be set by user. (0 to 300 ms, 10 ms units) Refer to section 4.3.

(3) For the standard T1, no parity and response delay time settings are available with version 1.20 or later.

2.2 Optional computer link cable

The 2 m cable used to connect the T1/T1S's programmer port connector with a master computer is optionally available. (Type: PT16S)

T1/T1S side connector
(Pin side view)



Pin No.	Signal name	Description	Wire color	Signal direction
1	5 Vdc	–	Brown	–
2	GND	–	Red	–
3	5 Vdc	–	Orange	–
4	RTS (RS)	Request to send	Yellow	T1/T1S → Master
5	SG	Signal ground	White	T1/T1S ↔ Master
6	TXD (SD)	Transmitted data	Blue	T1/T1S → Master
7	CTS (CS)	Clear to send	Purple	T1/T1S ← Master
8	RXD (RD)	Received data	Gray	T1/T1S ← Master

NOTE

Wires of pins 1, 2 and 3 are not used for RS-232C transmission.
Do not connect these wires.

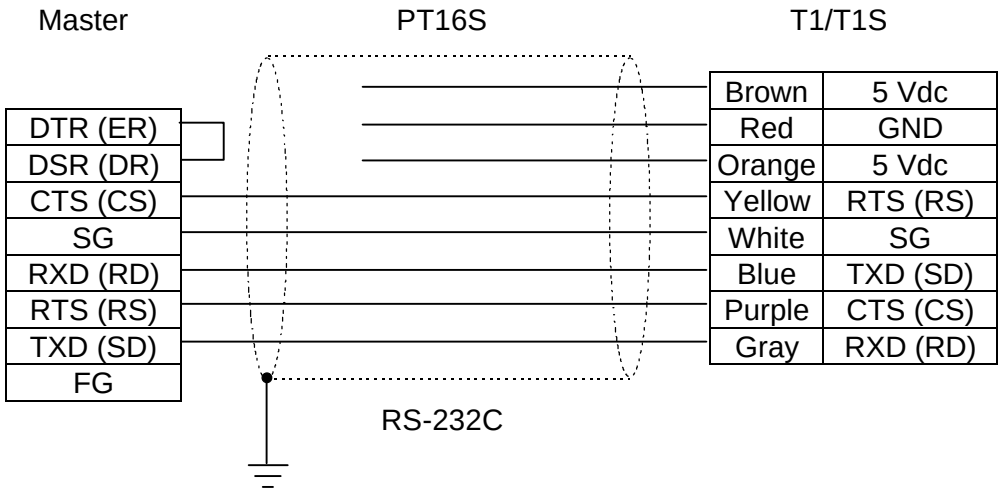
PART 1 T1/T1S Programmer Port Function

Section 3
Cable Connections

3. Cable Connections PART 1

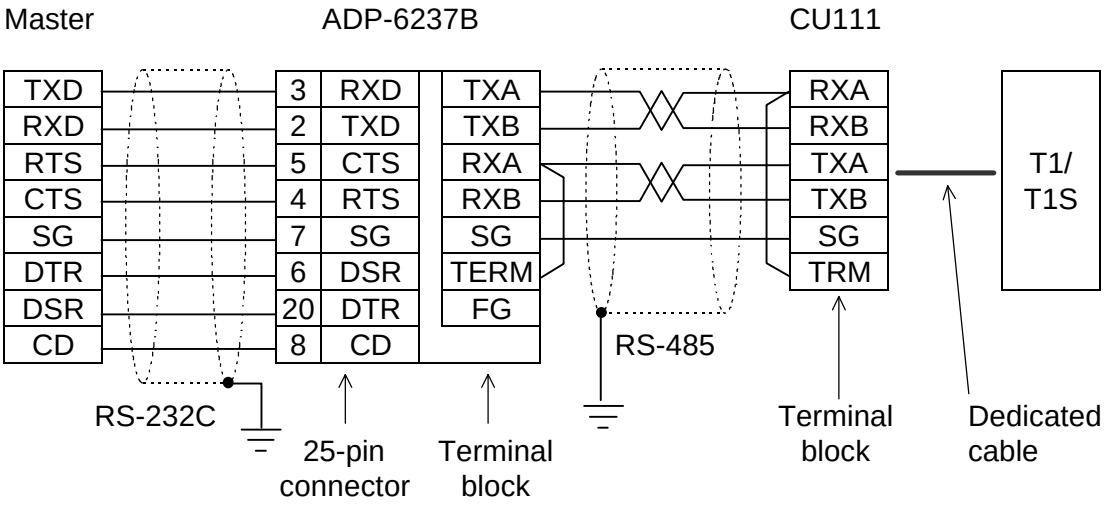
3.1 One-to-one configuration

When one T1/T1S is connected to a master computer, the cable connections should be as follows. The optional computer link cable (PT16S) is used for the connection.



- Wires of brown, red and orange should not be connected. These wires should be terminated without connecting each other.
- RTS signal of the T1/T1S is always ON.
- The T1/T1S can transmit data when CTS signal is ON.

Using the multi-drop adapter CU111, one-to-one connection via RS-485 is also available. In this case, the RS-232C/RS-485 converter ADP-6237B can be used.



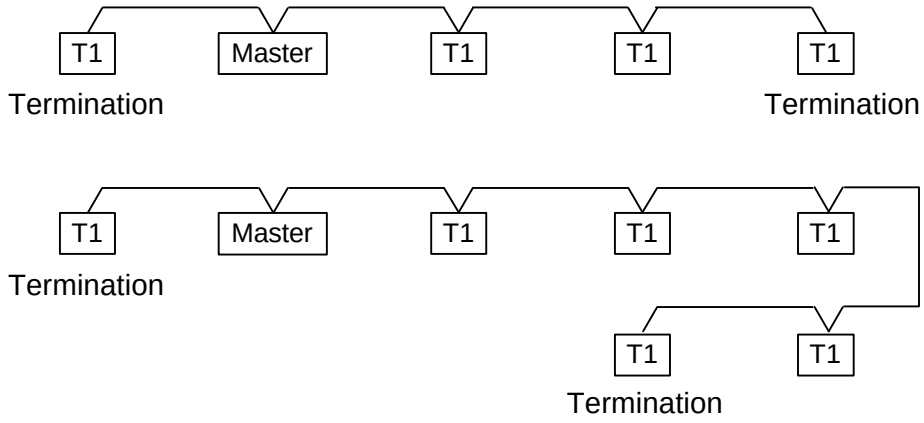
- Short RXA and TERM (TRM) terminals at both the CU111 and the ADP-6237B.
- Use shielded twisted-pair cable for noise immunity. The cable shield should be connected to ground.

3.2 One-to-N configuration

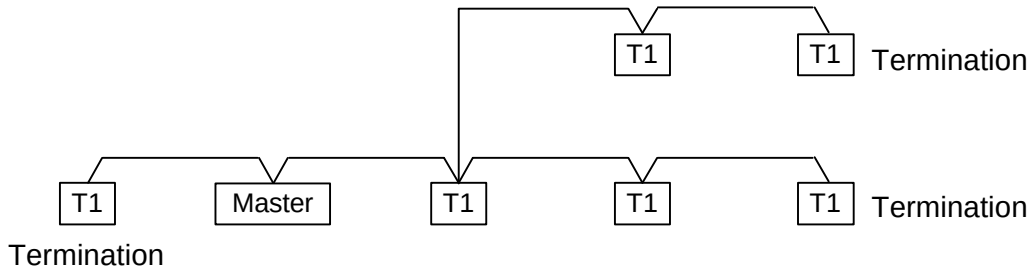
By using the multi-drop adapter CU111, two or more T1/T1S's (up to 32) can be connected to a master computer.

In this case, the RS-485 transmission line should be terminated at both ends.

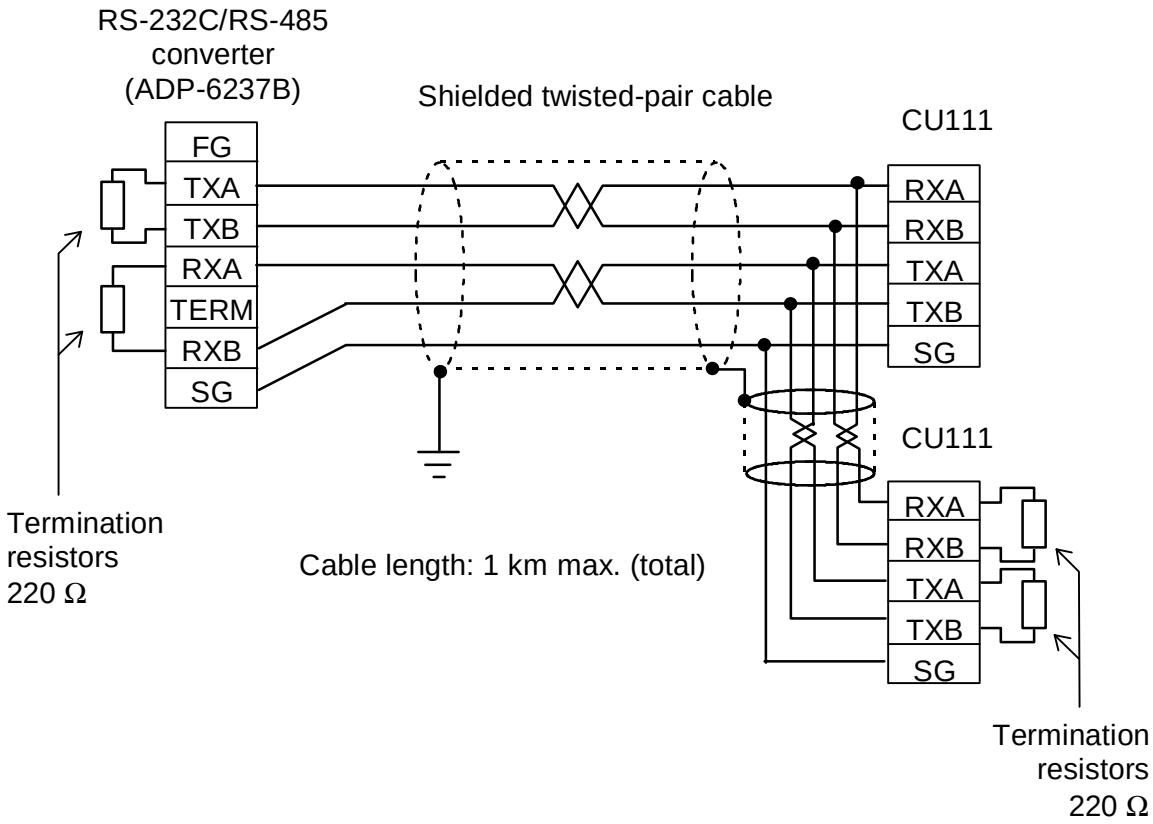
< Available connection >



< Unavailable connection >



Termination resistors (1/2 W - 220 Ω) should be connected between TXA and TXB, and RXA and RXB, at each end of the line (at both termination stations).



- Connect termination resistors (1/2 W - 220 Ω) between TXA and TXB, and RXA and RXB, at each end of the line (at both termination stations).
- Use shielded twisted-pair cable for noise immunity. Connect the cable shield each other, and connect it to ground. (Single point grounding)
- When a terminal block is used to branch off the line, the branch should not exceed 3 m cable length from the terminal block to the CU111 or the master computer.
- For RS-232C side connections, refer to section 3.1.

PART 1 T1/T1S Programmer Port Function

Section 4
Communication Parameter Settings

4. Communication Parameter Settings PART 1

4.1 Settings for T1

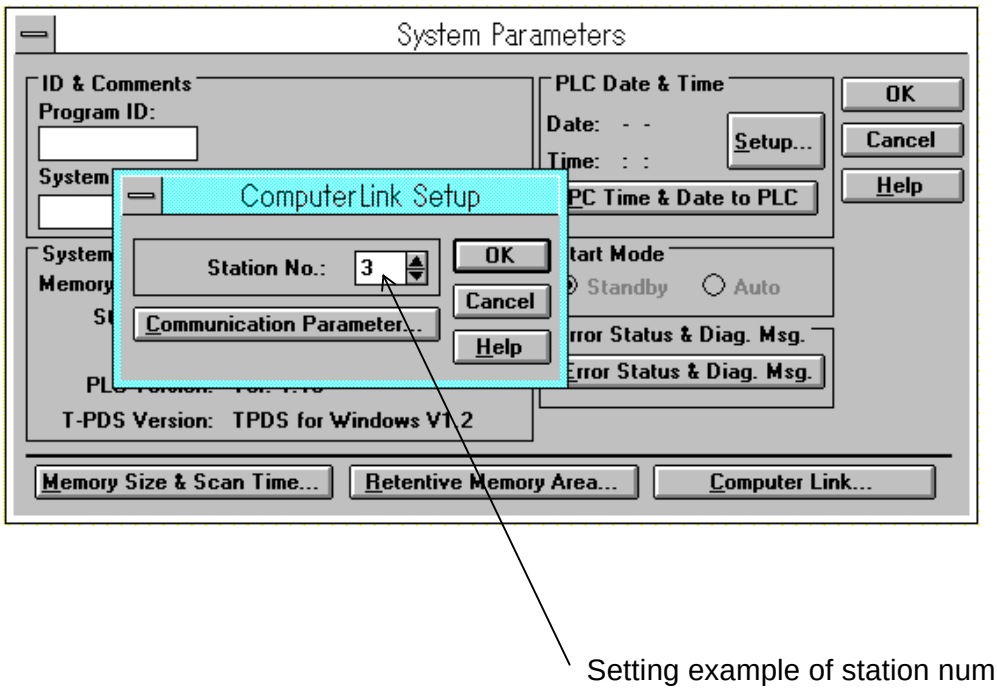
The communication parameters (station number and parity) are set by writing them into the system information memory of the T1.
Other communication parameters are fixed. Refer to section 2.1.

4.1.1 Station number

The station number can be selected from 1 to 32 (decimal).

Turn the T1 to HALT mode, then set the station number in the system information.

(T-PDS screen example)



Setting example of station number 3.

After setting, write it into the T1's built-in EEPROM before turning off power.

NOTE

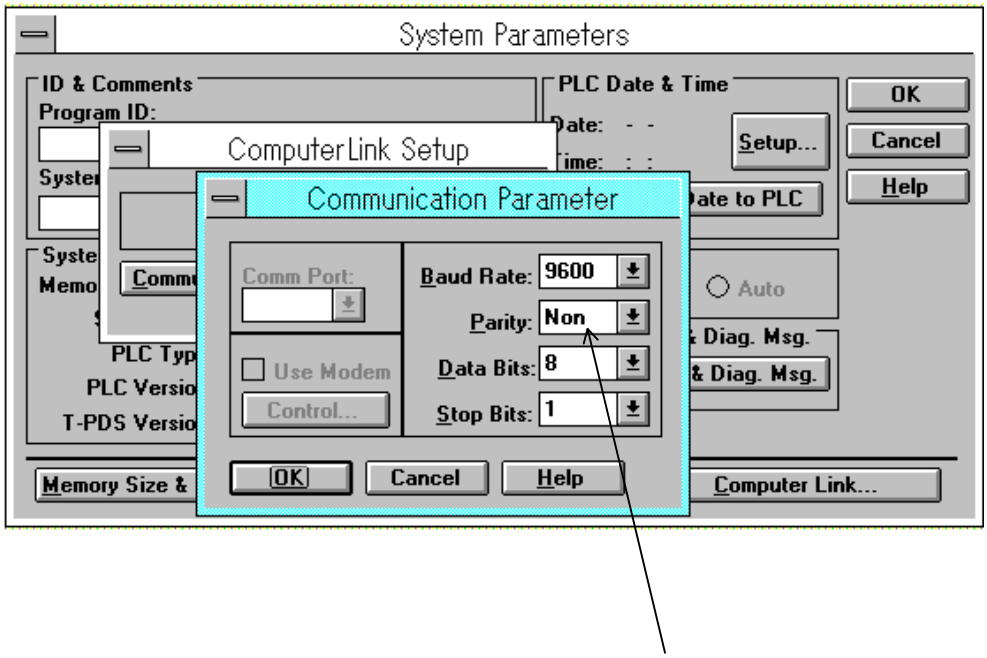
(1) The default setting of the station number is 1.
(2) In the standard T1 version 1.00, the station number is not checked. Therefore, the T1 version 1.00 cannot be used for one-to-N configuration.
(3) Programmer (T-PDS) connection with station number is supported by the T1 version 1.20 or later, and the T1S.

4.1.2 Parity

Parity setting can be selected either odd or none. The even parity is not supported. The default is odd parity. The none parity is normally used for modem connection.

Turn the T1 to HALT mode, then set the parity in the system information.

(T-PDS screen example)



Setting example of none parity.

After setting, write it into the T1's built-in EEPROM before turning off power.

NOTE

(1) The default setting of the parity is odd.
(2) In the standard T1, the parity setting is possible with the version 1.20 or later. With the versions before 1.20, only odd parity is available.

4. Communication Parameter Settings PART 1

4.2 Settings for T1S

In case of the T1S, the communication parameters (station number and the parity) of the programmer port are set by writing them into the special registers (SW).
Other communication parameters are fixed. Refer to section 2.1.

4.2.1 Station number

The station number is set by writing the data from 1 to 32 (decimal) into SW36.

Turn the T1S to HALT mode, and write the station number into SW36. After writing, execute the EEPROM write command. And cycle power off and on again. Then the setting will be effective.

Address	Name	Data range
SW36	PRG port station address	1 to 32 (decimal)

NOTE
(1) The default setting of the station number is 1.
(2) If the data is out of the valid range, the T1S works as station number 1.

NOTE
This setting is not saved by the peripheral tools (the programmer or the program storage module RM102).
Therefore, even when you load the T1S program by using the peripheral tool, you must set the data for the T1S manually as mentioned above.

4.2.2 Parity

Parity setting can be selected either odd or none. The even parity is not supported. The default is odd parity. The none parity is normally used for modem connection.

Turn the T1S to HALT mode, and write the parity setting (0 = none, 1 = odd) into SW37. After writing, execute the EEPROM write command. And cycle power off and on again. Then the setting will be effective.

Address	Name	Data range
SW37	PRG port parity	0 = none, 1 = odd

NOTE
(1) The default setting of the parity is odd.
(2) If the data is out of the valid range, the T1S works as odd parity.

NOTE
This setting is not saved by the peripheral tools (the programmer or the program storage module RM102).
Therefore, even when you load the T1S program by using the peripheral tool, you must set the data for the T1S manually as mentioned above.

4.3 Response delay time setting

The response time from the programmer port of the T1/T1S can be changed. The possible setting is as follows.

Internal processing time + (0 to 300) ms (10 ms units)

This function is useful when a wire-less modem is used.

To set the response delay time, turn the T1/T1S to HALT mode, and write the delay time (0 to 30) into SW38. After writing, execute the EEPROM write command. And cycle power off and on again. Then the setting will be effective.

Address	Name	Data range
SW38	PRG port response delay	0 to 30 (decimal) (0 to 30 : 0 to 300 ms)

NOTE

(1) In case of standard T1, this function is available with version 1.20 or later.
(2) If the set data is out of the valid range, it is limited by 30 (300 ms).

NOTE

This setting is not saved by the peripheral tools (the programmer or the program storage module RM102).
Therefore, even when you load the T1S program by using the peripheral tool, you must set the data for the T1S manually as mentioned above.

4.4 Peripheral support priority mode

In the T1/T1S, the peripheral support processing (computer link service) is executed at the bottom of each scan with the time limit of 2 ms to minimize the extension of scan time.

However the T1S can work with the peripheral support priority mode. In this mode, the computer link service is executed without a break. By using this mode, the communication response becomes quick although the scan time is extended at the time.

To select the peripheral support priority mode, set the special relay S158 to ON by user program.

Address	Name	Function
S158	Peripheral support priority mode	When ON, the peripheral support priority mode is selected.

NOTE

This function is possible only in the T1S.

PART 1 T1/T1S Programmer Port Function

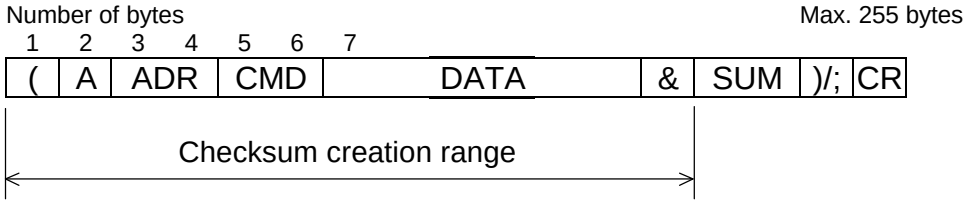
Section 5

Computer Link Protocol

5. Computer Link Protocol PART 1

5.1 Message format

The T1/T1S supports the subset of the T-series PLC computer link commands. The general message format of the T-series PLC computer link is shown below.



Text contents

(..... Start code (H28) – 1 byte
A ..... Format identification code (H41) – 1 byte
ADR .... Station number – 2 bytes
01 (H3031) through 32 (H3332)
CMD .... Command – 2 bytes
DATA ... Data field – depending on the command (max. 244 bytes)
& ..... Checksum delimiter (H26) – 1 byte
SUM .... Checksum – 2 bytes
ASCII code of the lowest one byte of the sum obtained by adding from the start code '(' to the checksum delimiter '&'.
Refer to section 5.3.
) ..... End code (H29) – 1 byte
Normal case
; ..... End code (H3B) – 1 byte
In case of halfway of entire data for BR, RB, BW, and WB commands
CR ..... Carriage return code (H0D) – 1 byte

5.2 Transmission rules

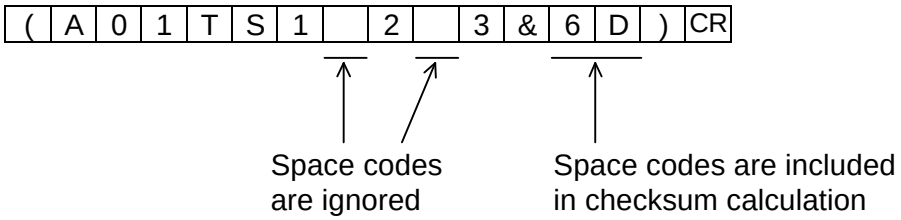
The following transmission rules are applied to the computer link communication.

(1) The T1/T1S is always waiting for a request command issued from the master computer. The T1/T1S will not transmit any message without receiving a request.

(2) 8-bit ASCII is used as transmission code.

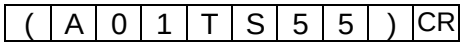
(3) The transmission speed and the frame format is as follows.
9600 bps
1 start bit
8 data bits
Odd or none parity (user setting)
1 stop bit

(4) If some space codes (H20) are included in the request message, they are ignored. However, the space codes are included in checksum calculation.

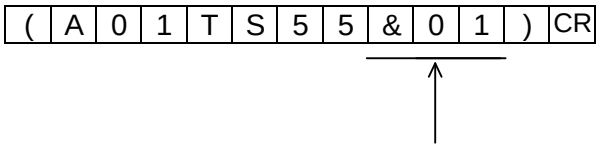


(5) Checksum can be omitted in the request message issued from the master computer. In the response message issued from the T1/T1S, checksum is always added.

Request message



Response message



(6) The T1/T1S ignores all the data received before the start code '('.

(7) Message receiving is completed only after the end code ')' and CR have been received. If the end code without CR, or vice versa, is received, it causes transmission error.

NOTE

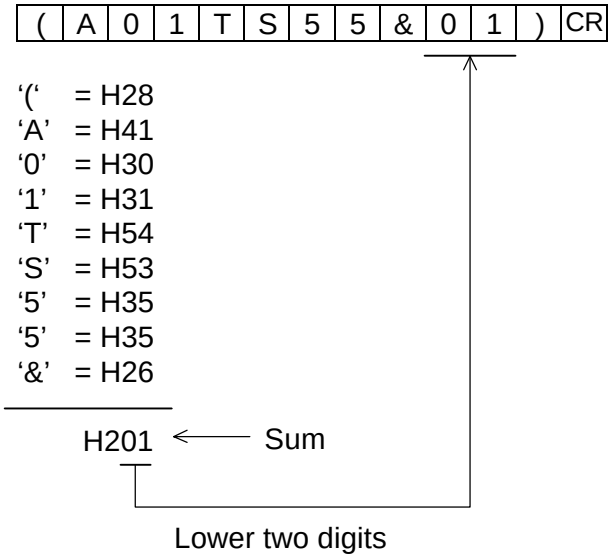
(1) The T1/T1S checks the request message receiving time. If the receiving time from the start code '(' to CR exceeds 3 second, the T1/T1S judges as transmission error. In this case, no response will be returned from the T1/T1S.

(2) In the one-to-N configuration, when a T1/T1S finishes to send a response message, the T1/T1S releases the transmission line in 10 ms (max.). Until the transmission line is released, other T1/T1S cannot send any message. Therefore, the master computer should wait to send next request message for at least 10 ms after previous response reception.

5.3 Checksum creation

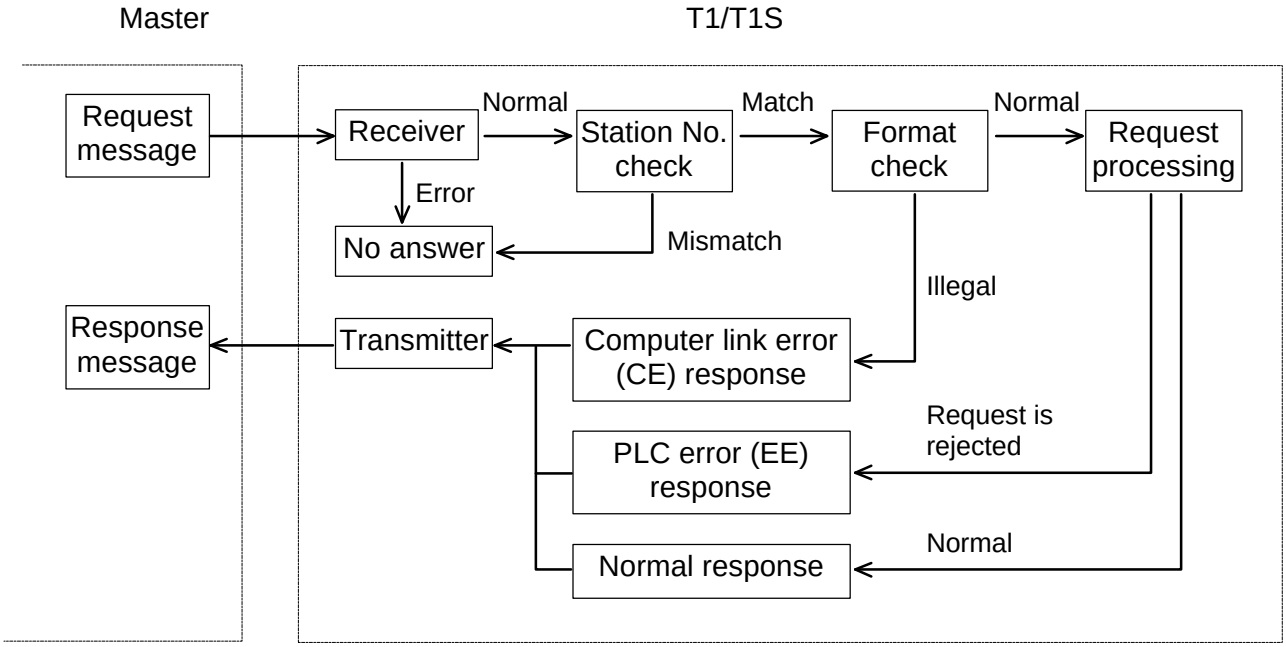
Checksum is a error check code to check validity of the received message.
The checksum is the ASCII code of the lower two digits of the sum obtained by adding the hexadecimal data from the start code '(' to the checksum delimiter '&'.

Example:



5.4 Internal process flow

The following diagram illustrates the T1/T1S internal process flow for the computer link function.



NOTE

As for the T1 version 1.00, the station number (ADR field in the request message) is not checked. Therefore, the T1 version 1.00 cannot be used for one-to-N configuration.

PART 1 T1/T1S Programmer Port Function

Section 6

Commands

6. Commands PART 1

6.1 List of commands

The following computer link commands are available for the T1/T1S.

Request command	Function name	Description	Response command	Remarks
–	Computer Link Error Response	Format error was detected in the request message	CE	Response only
–	PLC Error Response	The request command was rejected by T1/T1S	EE	Response only
TS	Test	Loop back test -- T1/T1S returns the same text	TS	
ST	PLC Status Read	Reads T1/T1S operation status	ST	
ER	PLC Error Status Read	Reads error code registered in the T1/T1S	ER	
DR	Data Read	Reads registers/devices data from the T1/T1S	DR	
DW	Data Write	Writes registers/devices data into the T1/T1S	ST	
RT	Clock/calendar Read	Reads clock/calendar data (date & time) from the T1S	RT	T1S only
WT	Clock/calendar Write	Writes clock/calendar data (date & time) into the T1S	ST	T1S only
SR	System Information 1 Read	Reads system information 1 from the T1S	SR	T1S only
S2	System Information 2 Read	Reads system information 2 from the T1S	S2	T1S only
EC	PLC Control	Changes the T1S operation mode	ST	T1S only
BR	System Information Block Read	Reads system information from the T1S block-by-block	BR	T1S only
RB	Program Block Read	Reads program from the T1S block-by-block	RB	T1S only
BW	System Information Block Write	Writes system information into the T1S block-by-block	ST	T1S only
WB	Program Block Write	Writes program into the T1S block-by-block	ST	T1S only

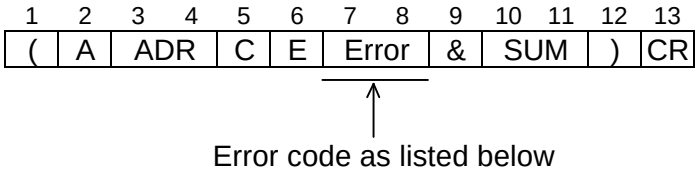
The above commands are subset of the entire T-series computer link commands.

6.2 Computer Link Error Response (CE)

When the T1/T1S detects a parity error, checksum error, format error, etc., the T1/T1S will respond ‘CE’ with the error content.

Request message – Any command

Response message



Error	Error name	Description
01	Command error	Received command is illegal
02	Format error	Received message format is invalid
03	Checksum error	Checksum mismatch is detected

Execution example

Example 1)

Request (A01SS&96)
Response (A01CE01&D9)

Command error (01) ... Illegal command (SS)

Example 2)

Request (A01DRRW,5&90)
Response (A01CE02&DA)

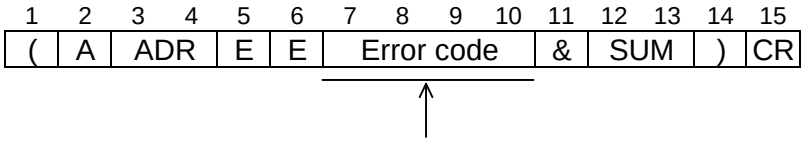
Format error (02) ... Missing the starting register address

6.3 PLC Error Response (EE)

When the T1/T1S receives an unacceptable command, the T1/T1S will respond 'EE' with the error content.

Request message – Any command

Response message



Error code	Error name	Description
0040	I/O bus error	I/O bus error has been detected
0041	I/O mismatch	Registered I/O allocation table and actual I/O configuration are not identical
0042	I/O no answer	No response from I/O module has been received
0043	I/O parity error	I/O bus parity error has been detected
0046	Illegal I/O register	Excess I/O register allocation has been detected
0051	Communication busy	The T1/T1S is busy in processing for other peripheral communications
0052	Format error	Received request is invalid (detected by the T1/T1S)
0080	No END/IRET error	END or IRET instruction has not been programmed
0081	Pair instruction error	Illegal combination of pair instructions has been programmed
0082	Operand error	Illegal operand has been detected
0083	Invalid program	Program abnormality has been detected
0086	No subroutine entry	Subroutine corresponding to CALL instruction has not been programmed
0087	No RET error	RET (subroutine return) instruction has not been programmed in a subroutine
0088	Subroutine nesting error	Nesting level of subroutines exceeds the limit
0089	Loop nesting error	Nesting of FOR-NEXT loop has been programmed
0098	Invalid function instruction	Function instruction which is not supported by T1/T1S has been programmed

Error code	Error name	Description
0106	Password protect	Requested operation is protected by password
0110	Illegal instruction	Illegal instruction has been detected
0111	Register address error	Excess register address range has been programmed
0113	Memory full	Program memory is insufficient for the requested command
0114	Mode mismatch	Received command is invalid in the current T1/T1S operation mode
0115	Register address/ size error	Specified register range exceeds the limit
0121	Duplicate entry No.	Multiple subroutines which has same subroutine number have been programmed

Execution example

Example)

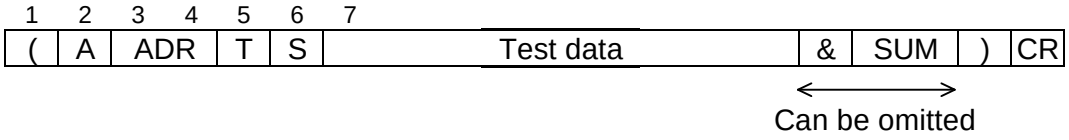
Request (A01DRD1000,32&1C)
Response (A01EE0115&41)

Register address/size error (0115) ... 32 registers starting with D1000 are specified for T1. (Address range over)

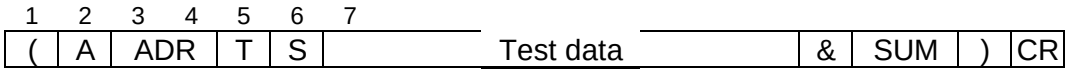
6.4 Test (TS)

This command is used to test the communication between the master computer and the T1/T1S. When the T1/T1S receives the Test command 'TS', the T1/T1S will return the same message to the master.

Request message



Response message



'CE' or 'EE' is returned if communication error has occurred.

- The maximum size of the Test data field is 244 bytes.
- Any ASCII characters except for the followings can be used.

'(' H28
'&' H26 — Error (CE) is returned
')' H29
CR H0D
' ' H20 (space code) — Omitted

Execution example

Example 1)

Request (A01TS123456789&74)
Response (A01TS123456789&74)

Example 2)

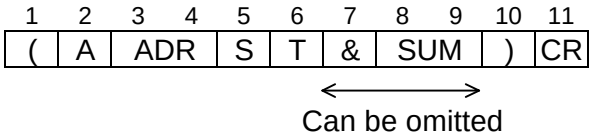
Request (A01TSABC def&AC)
Response (A01TSABCdef&8C)

Space code (H20) is omitted.

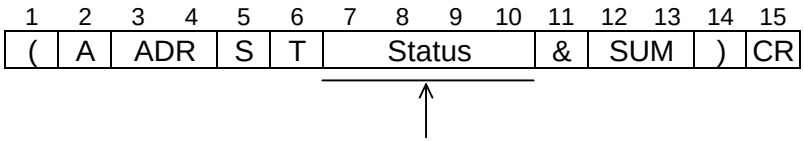
6.5 PLC Status Read (ST)

This command is used to read the T1/T1S operation status.

Request message

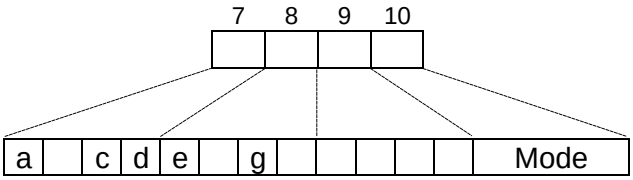


Response message



'CE' or 'EE' is returned if communication error has occurred.

- The Status field shows the T1/T1S operation status.



a = 1 : Battery alarm
c = 1 : TOSLINE-F10 error
d = 1 : Computer link error
e = 1 : Constant scan time over
g = 1 : Under program down-loading

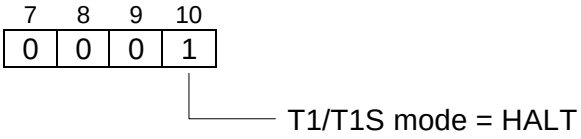
Mode: T1/T1S operation mode
1 = HALT
2 = RUN
3 = RUN-F
4 = HOLD
6 = ERROR

Other bits are not used. (Reserved)

Execution example

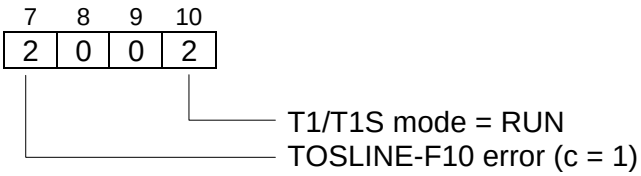
Example 1)

Request (A01ST&97)
Response (A01ST0001&58)



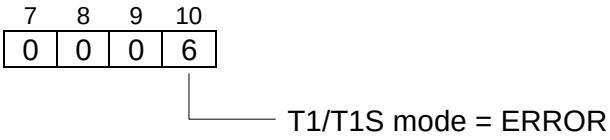
Example 2)

Request (A01ST&97)
Response (A01ST2002&5B)



Example 3)

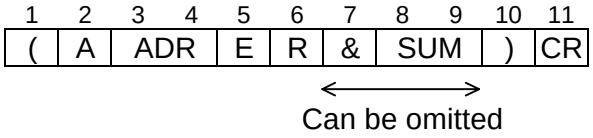
Request (A01ST&97)
Response (A01ST0006&5D)



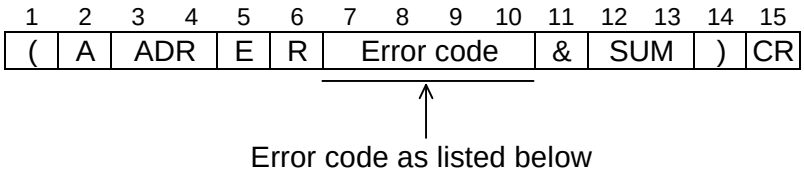
6.6 PLC Error Status Read (ER)

If an error has occurred in the T1/T1S, this command can be used to read the error cause.

Request message



Response message



'CE' or 'EE' is returned if communication error has occurred.

- The Error code field shows the most latest error status recorded in the T1/T1S's event history table.

Error code	Error name	Description
0000	–	No error recorded
0010	System power on	Power on (no error)
0011	System power off	Power off (no error)
0020	RAM check error	RAM read/write error has been detected
0021	Program BCC error	Program BCC (memory check code) error has been detected
0022	Battery voltage drop	Data invalidity of RAM (back-up area) has been detected
0023	EEPROM BCC error	BCC error of built-in EEPROM has been detected
0026	EEPROM warning	EEPROM write operation has exceeded 100,000 times
0030	System RAM check error	System RAM read/write error has been detected
0031	System ROM BCC error	BCC error of system ROM has been detected

Error code	Error name	Description
0032	Peripheral LSI error	CPU hardware error has been detected
0033	Clock-calendar check error	Invalid clock-calendar data has been detected
0034	Illegal system interrupt	Unregistered interrupt has occurred
0035	WD timer error	Watchdog timer error has occurred
0040	I/O bus error	I/O bus error has been detected
0041	I/O mismatch	Registered I/O allocation table and actual I/O configuration are not identical
0042	I/O no answer	No response from I/O module has been received
0043	I/O parity error	I/O bus parity error has been detected
0046	Illegal I/O register	Excess I/O register allocation has been detected
0064	Scan time over	Scan time has exceeded 200 ms
0080	No END/IRET error	END or IRET instruction has not been programmed
0081	Pair instruction error	Illegal combination of pair instructions has been programmed
0082	Operand error	Illegal operand has been detected
0083	Invalid program	Program abnormality has been detected
0086	No subroutine entry	Subroutine corresponding to CALL instruction has not been programmed
0087	No RET error	RET (subroutine return) instruction has not been in a subroutine
0088	Subroutine nesting error	CALL instruction has been programmed in a subroutine (subroutine nesting)
0089	Loop nesting error	Nesting of FOR-NEXT loop has been programmed
0098	Invalid function instruction	Function instruction which is not supported by T1/T1S has been programmed
0110	Illegal instruction	Illegal instruction has been detected
0111	Register address error	Excess register address range has been programmed
0112	Boundary error	Illegal register address is designated by index modification
0121	Duplicate entry No.	Multiple subroutines which has same subroutine number have been programmed

Execution example

Example 1)

Request (A01ST&97)
Response (A01ST0002&59) – RUN mode

Request (A01ER&87)
Response (A01ER0010&48)

7	8	9	10
0	0	1	0

— System power on (normal)

Example 2)

Request (A01ST&97)
Response (A01ST0006&5D) – ERROR mode

Request (A01ER&87)
Response (A01ER0064&51)

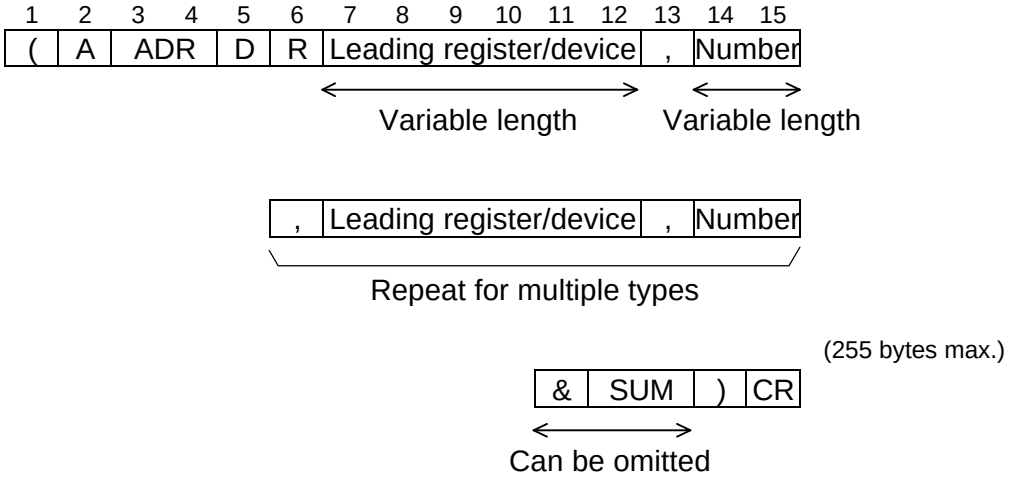
7	8	9	10
0	0	6	4

— Scan time over

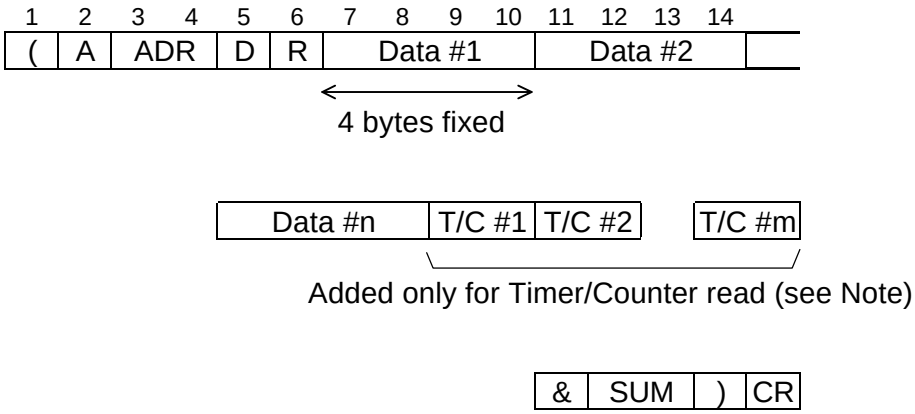
6.7 Data Read (DR)

This command is used to read the data of registers and/or devices consecutively.
Multiple types of registers/devices can be specified at a time.
Total up to 32 registers/devices data can be read.

Request message



Response message



'CE' or 'EE' is returned if communication error has occurred.

- This command reads the data of specified number of registers/devices starting with specified address.
- Multiple types of registers/devices can be specified at a time.
- Total up to 32 registers/devices data can be specified at a time. However, note that the maximum request message length is limited to 255 bytes.
- Upper 0 can be omitted for the leading register/device address and the number. E.g., R0009 → R9, 05 → 5
- If the number is 1, the number field can be omitted.
- The leading register/device and the number are separated by ',' (comma).
- In the response message, the data are packed in the specified order.
- Each data is expressed in 4 digits hexadecimal format. For a device, '0000' and '0001' represent OFF and ON respectively.

(1) In case of Timer/Counter register read, the Timer/Counter device data (2 bytes each) corresponding to the Timer/Counter register are added. When the Timer/Counter is time-up/count-up, the device data is '01'. Otherwise, it is '00'.

(2) The types of register/device which can be specified are as follows.
Register:
XW, YW, SW, RW, T, C, and D
(Index registers I, J, K cannot be specified)
Device:
X, Y, S, and R
(Timer/Counter devices T./C. cannot be specified)

Execution example

Example 1)

Request (A01DRRW1,3&BF)
Response (A01DR1EB922F122A8&2F)

3 registers starting with RW01
RW01 = H1EB9, RW02 = H22F1, RW03 = H22A8

Example 2)

Request (A01DRRW4&63)
Response (A01DR004E&5F)

RW04 (Number field omitted)
RW04 = H004E

Example 3)

Request (A01DRX4,3,D100,2&D0)
Response (A01DR0001000000010 2A30508&6B)

X004 to X006 and D0100 and D0101
X004 = ON, X005 = OFF, X006 = ON, D0100 = H02A3, D0101 = H0508

Example 4)

Request (A01DRT0,2,D0,1&65)
Response (A01DR005B00330100E054&C2)

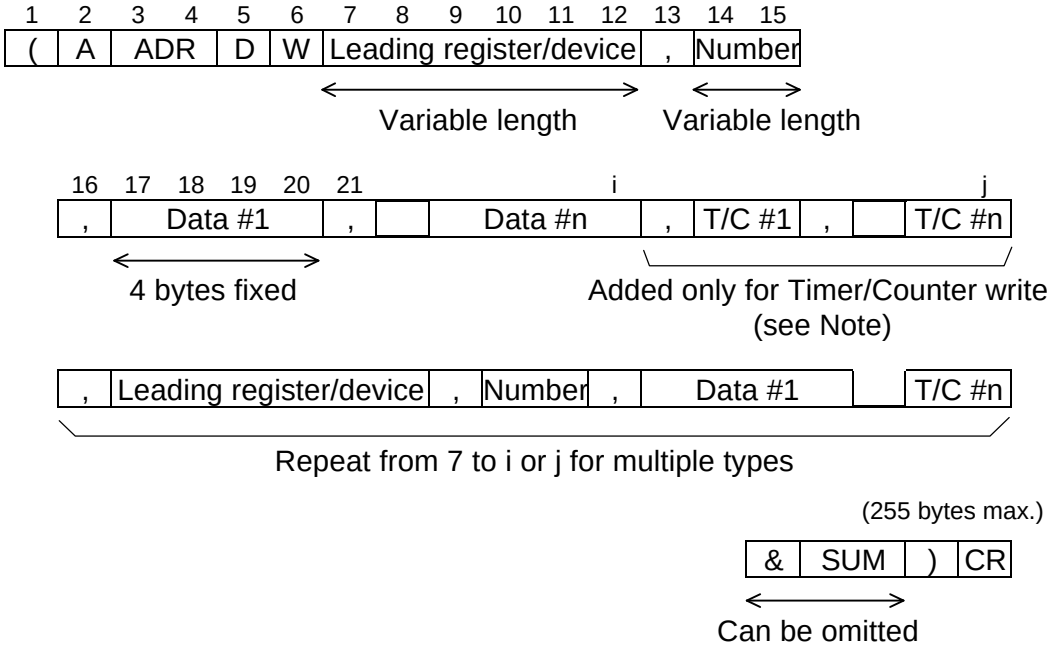
T000, T001 and D0000
T000 = H005B, T.000 = ON .... time-up
T001 = H0033, T.001 = OFF
D0000 = HE054

NOTE As for the standard T1 versions 1.00 and 1.10, the device whose bit position is A to F cannot be specified. For example, R00A cannot be specified. In this case, 'CE' will be responded.

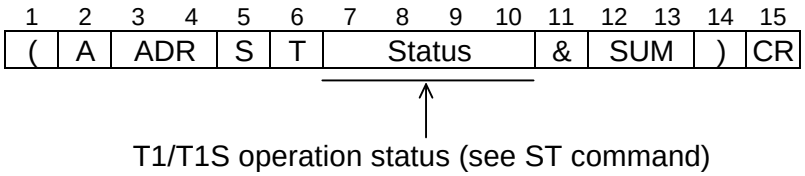
6.8 Data Write (DW)

This command is used to write the data into the T1/T1S's registers and/or devices consecutively. Multiple types of registers/devices can be specified at a time.
Total up to 32 registers/devices data can be specified.

Request message



Response message



'CE' or 'EE' is returned if communication error has occurred.

- This command writes the data into the specified number of registers/devices starting with specified address.
- Multiple types of registers/devices can be specified at a time.
- Total up to 32 registers/devices data can be specified at a time. However, note that the maximum request message length is limited to 255 bytes.
- Upper 0 can be omitted for the leading register/device address and the number. E.g., R0009 → R9, 05 → 5
- The leading register/device, the number, and each writing data fields are separated by ',' (comma).
- Each data is expressed in 4 digits hexadecimal format. (fixed length)
  For a device, '0000' and '0001' represent OFF and ON respectively.

NOTE

(1) In case of Timer/Counter register write, the Timer/Counter device data (2 bytes each) corresponding to the Timer/Counter register should be added. If the Timer/Counter device is set to ON, it should be '01'. Otherwise, it should be '00'.

(2) The types of register/device which can be specified are as follows.
Register:
XW, YW, SW, RW, T, C, and D
(Index registers I, J, K cannot be specified)
Device:
X, Y, S, and R
(Timer/Counter devices T./C. cannot be specified)

Execution example

Example 1)

Request (A01DWRW1,3,FFFF,5A5A,0011&0E)
Response (A01ST0002&59)

Writes HFFFF, H5A5A and H0011 into RW01, RW02, and RW03 respectively

Request (A01DRRW1,3&BF)
Response (A01DRFFFF5A5A0011&4C)

Read-back confirmation by using DR command

Example 2)

Request (A01DWD100,2,FFFF,EFFF,R20,5,0001,0001,0000,0000,0001&25)
Response (A01ST0002&59)

Writes HFFFF and HEFFF into D0100 and D0101, and writes ON, ON, OFF, OFF, ON into R020 R021, R022, R023, R024 respectively

Request (A01DRD100,2,R20,5&FA)
Response (A01DRFFFFEFFF0001000100000000001&78)

Read-back confirmation by using DR command

NOTE

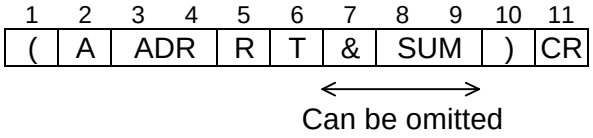
(1) As for the standard T1 versions 1.00 and 1.10, the device whose bit position is A to F cannot be specified. For example, R00A cannot be specified. In this case, 'CE' will be responded.

(2) Upper 0 suppression for Data field is not possible. The Data field must be 4 digits.

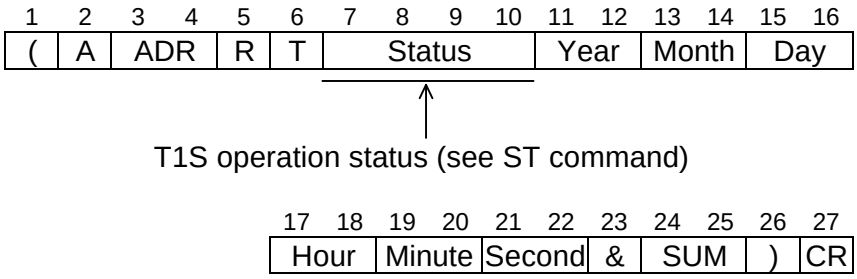
6.9 Clock/calendar Read (RT)

This command is used to read the T1S's built-in clock/calendar data.
This command is available only for the T1S.

Request message



Response message



'CE' or 'EE' is returned if communication error has occurred.

- The clock/calendar data are expressed by 2 digits decimal format.

Execution example

Example 1)

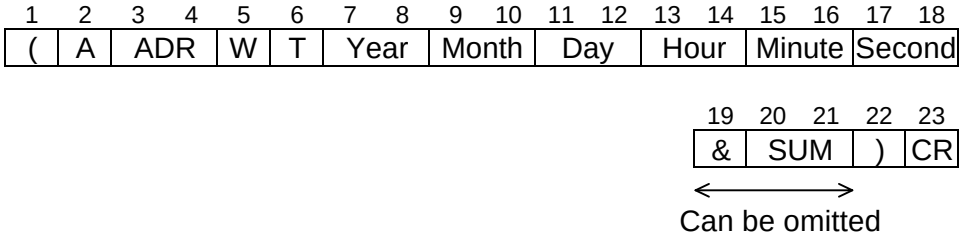
Request (A01RT&96)
Response (A01RT0002980414115723&C5)

April, 14, 1998 11:57:23
PLC status = H0002 (RUN)

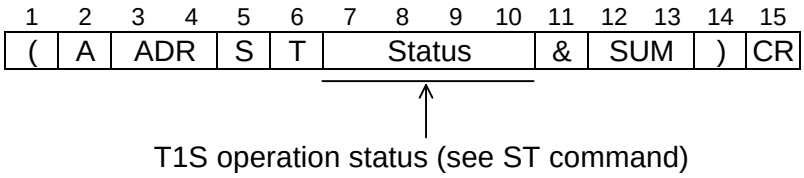
6.10 Clock/calendar Write (WT)

This command is used to set the T1S's built-in clock/calendar data.
This command is available only for the T1S.

Request message



Response message



'CE' or 'EE' is returned if communication error has occurred.

- The clock/calendar data are expressed by 2 digits decimal format.

Execution example

Example 1)

Request (A01WT980414120000&F8)
Response (A01ST0002&59)

Normal complete – April, 14, 1998 12:00:00

Example 2)

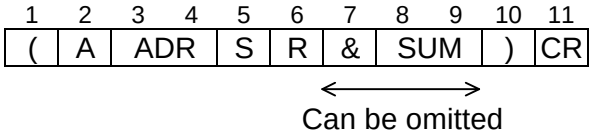
Request (A01WT980414120080&00)
Response (A01EE0052&41)

PLC Error Response (Error 0052: Format error)

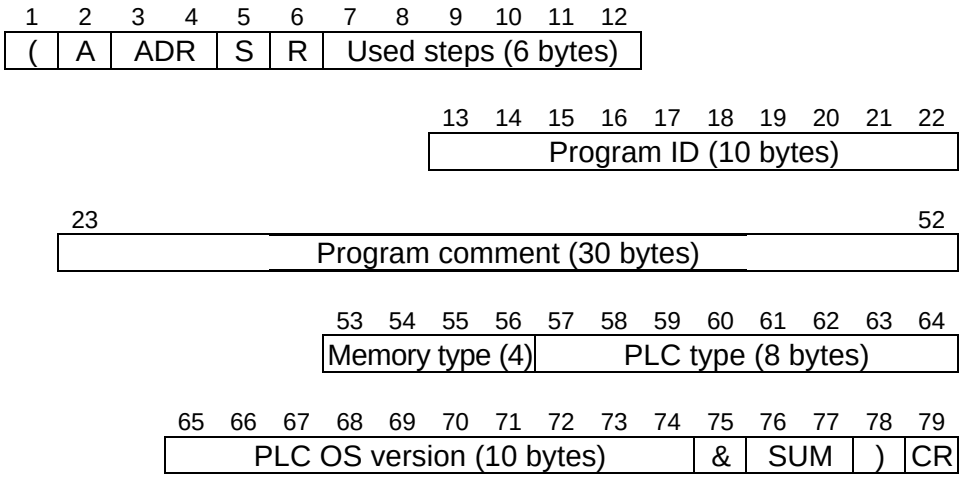
6.11 System Information 1 Read (SR)

This command is used to read the T1S's system information (part 1).
This command is available only for the T1S.

Request message

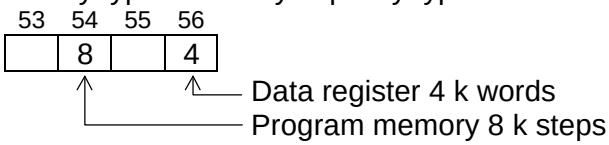


Response message



'CE' or 'EE' is returned if communication error has occurred.

- Used steps: Program steps used in the user program (Decimal format)
- Program ID: Registered name of the user program
- Program comment: Registered comment for the user program
- Memory type: Memory capacity type of the T1S



- PLC type: PLC model name (T1S)
- PLC OS version: T1S firmware version number

Execution example

Example 1)

Request (A01SR&95)
Response (A01SR000208SAMPLE T1S Sample Program 4/14/98 8 4T1S Ver. 1.01 &BA)

Used steps = 208 steps
Program ID = SAMPLE
Program comment = T1S Sample Program 4/14/98
Memory type = 8 k steps/4 k words
PLC type = T1S
PLC OS version = Ver. 1.01

6.12 System Information 2 Read (S2)

This command is used to read the T1S's system information (part 2).
This command is available only for the T1S.

Request message

1	2	3	4	5	6	7	8	9	10	11
(	A	ADR		S	2	&	SUM		)	CR

Can be omitted

Response message

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
(	A	ADR		S	2	P.size		S.buffer		Retentive (RW)				Retentive (T)			

19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Retentive (C)				Retentive (D)				Constant scan				Sub. time limit			

35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Timer interrupt				Stn No.		Baud rate						Parity		Data bit		Stop bit	

53	54	55	56	57
&	SUM		)	CR

'CE' or 'EE' is returned if communication error has occurred.

- P. size: Program size setting – "04" (4k steps) or "08" (8k steps) in the T1S
- S. buffer: Sampling buffer size setting – "01" (1k words) fixed in the T1S
- Retentive: Retentive memory area settings for RW, T, C and D (Decimal)
- Constant scan: Constant scan interval setting (Decimal, in ms units) ("0000" if floating scan)
- Sub. time limit: Time limit for subprogram execution (Decimal, in ms units) – "0000" fixed in the T1S
- Timer interrupt: Timer interrupt interval setting (Decimal, in ms units) ("0000" if not used)
- Stn No.: Station number setting for the RS-485 port (Decimal)
- Baud rate: Baud rate setting for the RS-485 port (Decimal) (Space code (H20) is inserted into upper 0)
- Parity: Parity setting for the RS-485 port – "00" (none), "01" (odd) or "02" (even)
- Data bit: Data bit length for the RS-485 port – "07" (7 bits) or "08" (8 bits)
- Stop bit: Stop bit length for the RS-485 port – "01" (1 bit) or "02" (2 bits)

Execution example

Example 1)

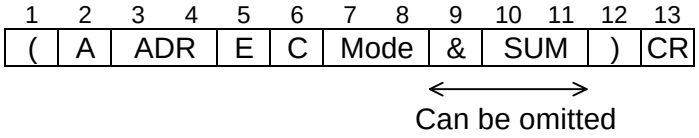
Request (A01S2&75)
Response (A01S2080101270031003105110050000000100 2 9600000801&B5)

Program size setting = 8 k steps
Sampling buffer size setting = 1 k words (fixed)
Retentive memory area (RW) = RW000 to RW127
Retentive memory area (T) = T000 to T031
Retentive memory area (C) = C000 to C031
Retentive memory area (D) = D0000 to D0511
Constant scan interval = 50 ms
Subprogram execution time limit = 0 ms (fixed)
Timer interrupt interval = 10 ms
Station number = 2
Baud rate = 9600 bps
Parity = None
Data bit length = 8 bits
Stop bit length = 1 bit

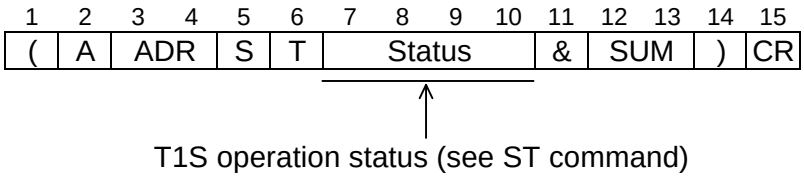
6.13 PLC Control (EC)

This command is used to control the T1S operation mode.
This command is available only for the T1S.

Request message



Response message



'CE' or 'EE' is returned if communication error has occurred.

- The Mode field of the request message specify the T1S mode to be changed.
  01 ... HALT
  02 ... RUN
  03 ... RUN-F
  04 ... HOLD
  06 ... Error reset
  07 ... HOLD reset

- The Status in the response message shows the T1S mode after changed as per request.

- This command is not valid when the T1S's operation mode switch is in HALT. (except Error reset)

Execution example

Example 1)

Request (A01EC02&DA)
Response (A01ST0002&59)

Changing HALT to RUN – Normal complete

Example 2)

Request (A01EC04&DC)
Response (A01ST0004&5B)

Changing RUN to HOLD – Normal complete

Example 3)

Request (A01EC02&DA)
Response (A01EE0114&4C)

Command RUN during RUN mode – Mode mismatch (0114)

Example 4)

Request (A01ER&87)
Response (A01ER0041&4C)

PLC error status read – I/O mismatch (0041)

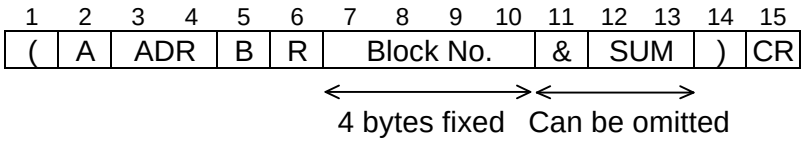
Request (A01EC06&DE)
Response (A01ST0001&58)

Command Error reset – Normal complete

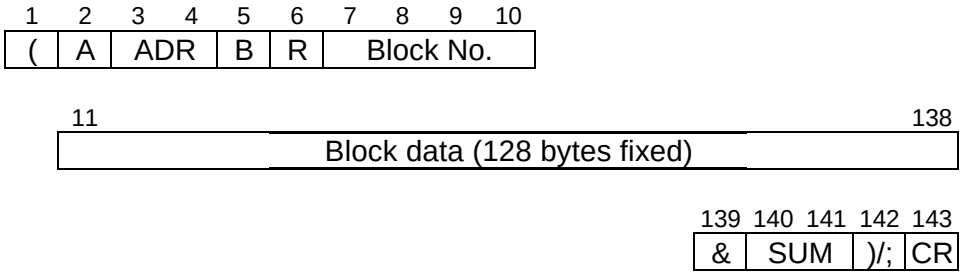
6.14 System Information Block Read (BR)

This command is used to read the system information from the T1S block-by-block. The BR command and the RB command are used in combination for program up-loading.
This command is available only for the T1S.

Request message



Response message



'CE' or 'EE' is returned if communication error has occurred.

- The T1S's system information memory contents are read by specifying the block number.
- The size of one block is 128 bytes.
- Block number is 0000 to 0015 (16 blocks). This command should be used from block 0000 through 0015 consecutively.
- The end code ";" (H3B) is returned for block 0000 to 0014 to show a halfway block. And normal end code ")" (H29) is returned for block 0015 to show the final block.

Execution example

Example 1)

Request (A01BR0000&44)
Response (A01BR000076732000220020202020202020202020202020202020
2020202020202020202020202020202020202020202020202020202
020202020202020202020202020&D5;

Request (A01BR0001&45)
Response (A01BR00011C00FFFFFFFFFFFFFFFF0000000012000080103008981
000000000000000000000000000000000000000000000000000000000
000000000000000000000000&E2;

⋮

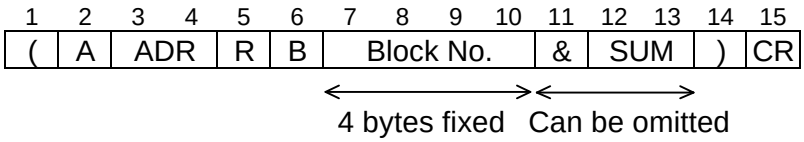
Request (A01BR0015&4A)
Response (A01BR0015000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000
000000000000000000000000&4A)

The system information block read operation is completed normally.

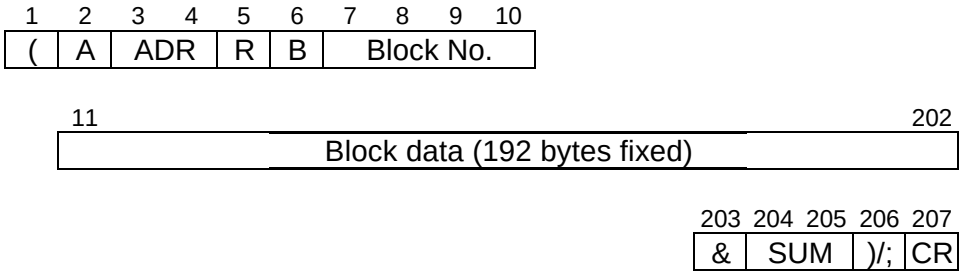
6.15 Program Block Read (RB)

This command is used to read the user program from the T1S block-by-block.
The BR command and the RB command are used in combination for program up-loading.
This command is available only for the T1S.

Request message



Response message

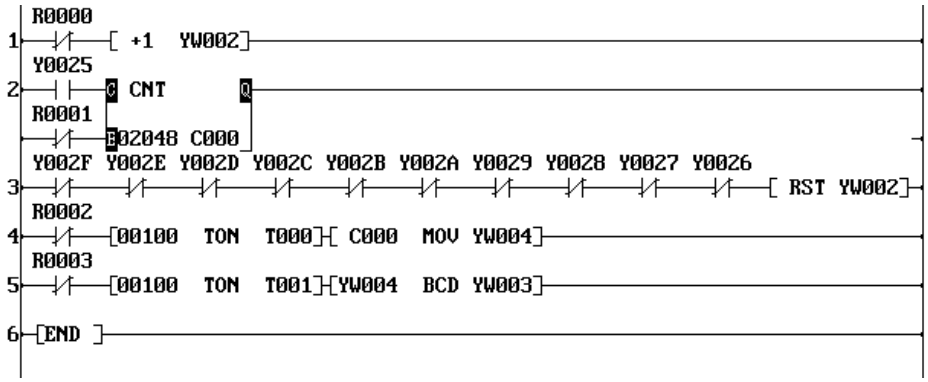


'CE' or 'EE' is returned if communication error has occurred.

- The T1S's user program memory contents are read by specifying the block number.
- The size of one block is 192 bytes.
- Block number is 0000 to 1007 (1008 blocks). This command should be started with block 0000 and in order.
- The normal end code ")" (H29) is returned if the block is the final. Otherwise, ";" (H3B) is returned.

Execution example

Example 1)



Request (A01RB0000&44)
Response (A01RB00002C000003220038000805 2B00080204300254F000181
F00030300083802F4C002E4C002D4C002C48002B48002A48002
948002848002748002640573000802043800281C00020364000502
800800160804043800381C008203640005BE00080404&2F;

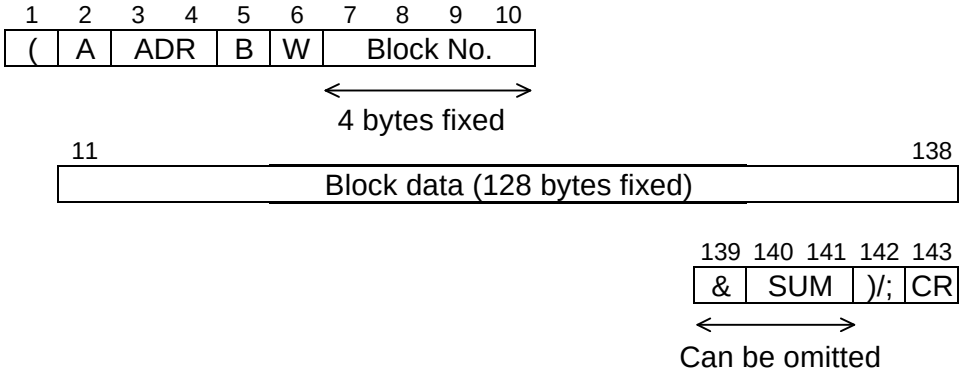
Request (A01RB0001&45)
Response (A01RB000108030407000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000&5B)

The program block read operation is completed normally.
(Number of blocks is 2)

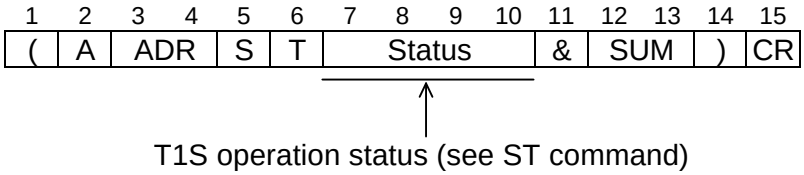
6.16 System Information Block Write (BW)

This command is used to write the system information data obtained by using the BR command into the T1S memory block-by-block.
The BW command and the WB command are used in combination for program down-loading.
This command is available only for the T1S.

Request message



Response message



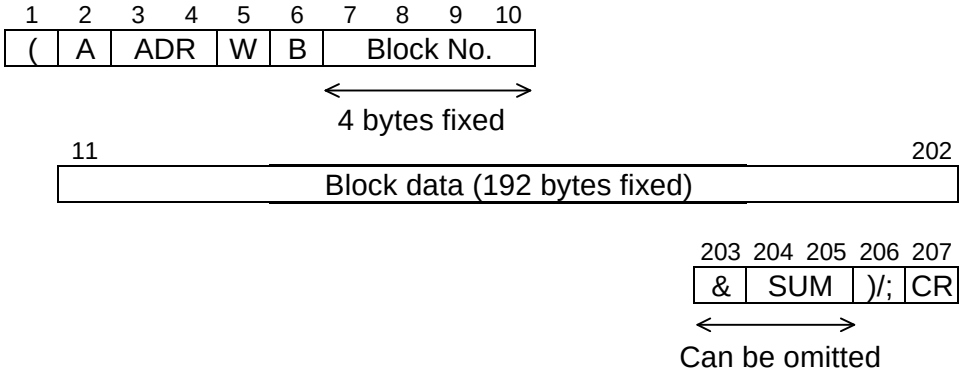
'CE' or 'EE' is returned if communication error has occurred.

- The system information contents are written into the T1S memory by specifying the block number.
- The size of one block is 128 bytes.
- Block number is 0000 to 0015 (16 blocks). This command should be used from block 0000 through 0015 consecutively.
- The end code ";" (H3B) must be used for block 0000 to 0014 to show a halfway block. And normal end code ")" (H29) must be used for block 0015 to show the final block.

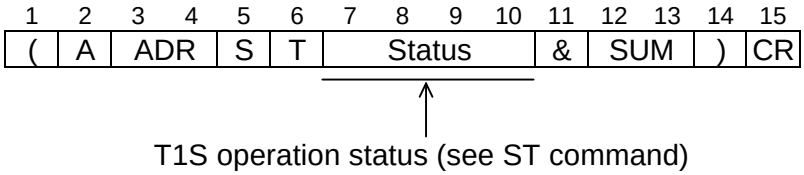
6.17 Program Block Write (WB)

This command is used to write the user program data obtained by using the RB command into the T1S memory block-by-block.
The BW command and the WB command are used in combination for program down-loading.
This command is available only for the T1S.

Request message



Response message



'CE' or 'EE' is returned if communication error has occurred.

- The user program contents are written into the T1S memory by specifying the block number.
- The size of one block is 192 bytes.
- Block number is 0000 to 1007 (1008 blocks). This command should be started with block 0000 and in order.
- The end code ";" (H3B) must be used for halfway blocks. And normal end code ")" (H29) must be used for the final block.

PART 2 T1S RS-485 Port Function

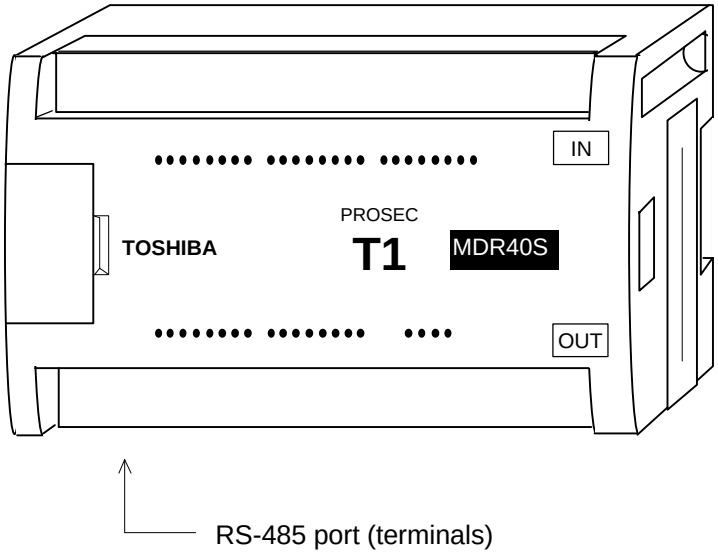
Section 1
Overview

1. Overview PART 2

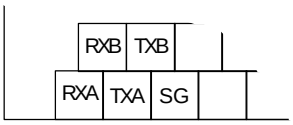
1.1 Function overview

The T1S has an RS-485 port as a standard feature. This RS-485 port and the programmer port can work independently.

T1S (T1-40S) external feature



Terminal arrangement of the RS-485 port



By using this RS-485 port, one of the following communication functions can be used.

- Communication with a master computer (Computer link mode)
- Data linkage between two T1Ss (Data link mode)
- Active communication with serial ASCII devices (Free ASCII mode)

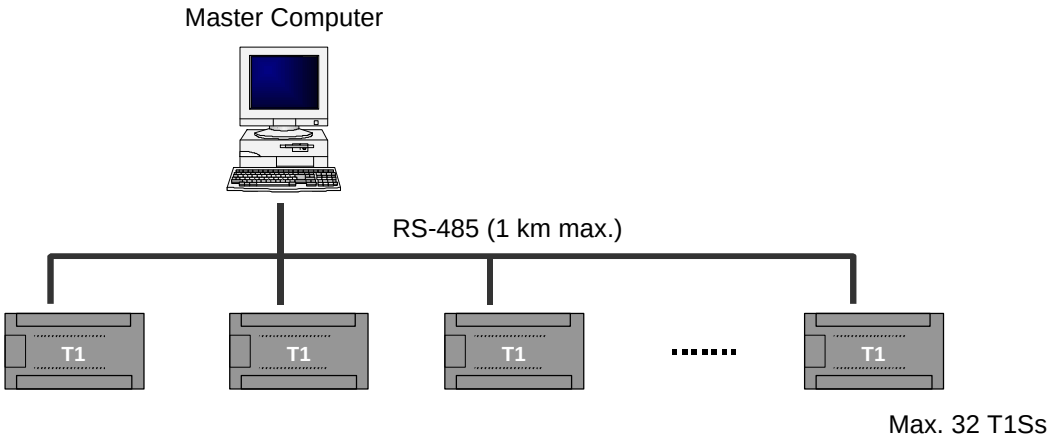
The operation mode is selected by the data set in SW56. Refer to section 1.2.

NOTE The standard T1 does not have the RS-485 port.

Computer link mode

The computer link mode is used to connect between the T1S and a master computer. Up to 32 T1Ss can be connected to the master computer on the RS-485 communication line.
By preparing the communication software based on the Toshiba's computer link protocol on the master computer, the following functions become available by the master computer. The computer link protocol is a simple ASCII message communication system.

- Reading data (register/device value) from the T1S
- Writing data (register/device value) into the T1S
- Monitoring the T1S's operation status (RUN/HALT/ERROR)
- Reading the error code from the T1S
- Reading the clock/calendar data from the T1S
- Writing the clock/calendar data into the T1S
- Controlling the T1S operation mode (RUN/HALT)
- Program up-loading from the T1S
- Program down-loading into the T1S



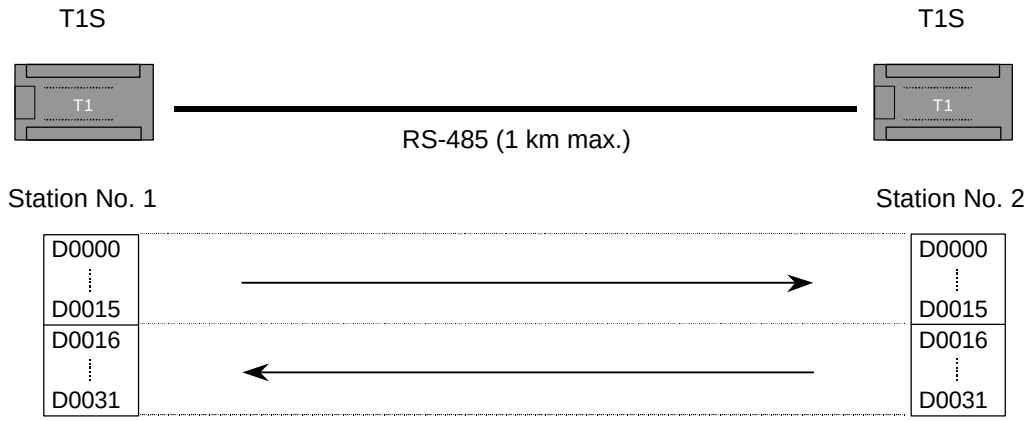
Of course, T-series PLC programming software (T-PDS) can also be used in this computer link system.

Data link mode

The data link mode is used to connect two T1Ss.
Each 16 words data is automatically exchanged between the station number 1 T1S and the station number 2 T1S. No user program for this data linkage is required.

For this function, one T1S must be set to station number 1, and the other must be set to 2.

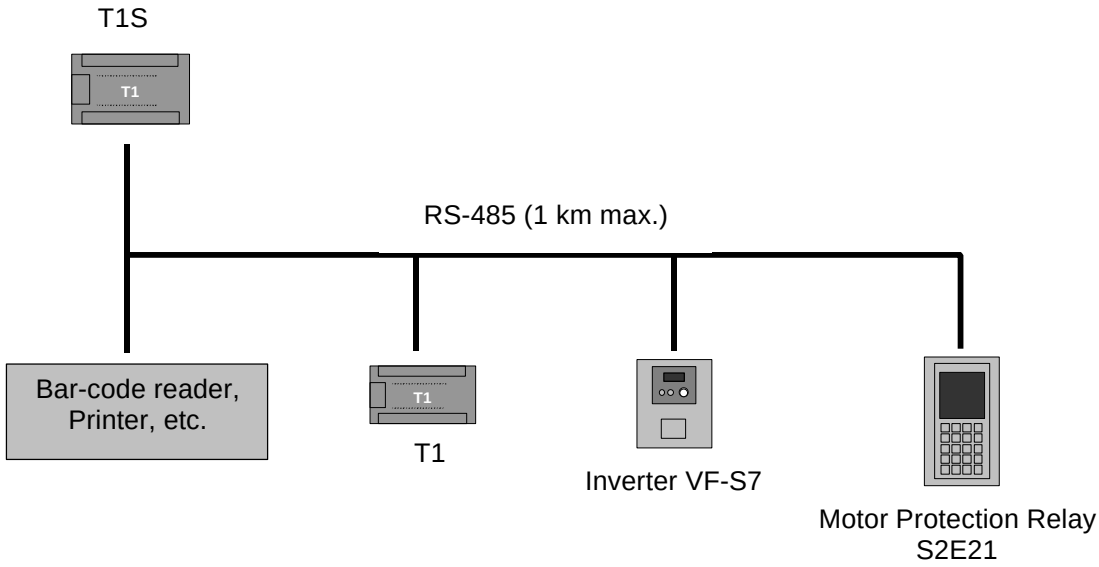
The data registers D0000 to D0031 (32 words) are used for this data linkage.



NOTE By using this function, data linkage between T1S and T2E/T2N is also available.

Free ASCII mode

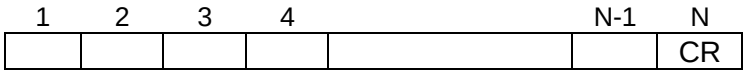
The free ASCII mode is used to connect between the T1S and various serial ASCII devices, such as a micro computer, bar code reader, printer, display, etc.
By using this mode, the T1S can work as a communication master. Therefore, the T1S can communicate with other PLCs using the computer link protocol, and can control variable speed drives (such as Toshiba's VF-S7) using its communication protocol.



In this mode, user defined ASCII messages can be transmitted and/or received through the RS-485 port.

The ASCII message (one set of transmission characters) means a string of ASCII characters which is ended by a specified trailing code. The default setting of the trailing code is CR (carriage return code = H0D).

Applicable message format (default trailing code):



N: message length = 512 bytes max.

In other words, the T1S cannot be used for the data communication in which the trailing code may be appeared in the middle of the message (binary transmission) or the message is ended by two or more types of trailing code.

1.2 Operation mode selection

The operation mode of the RS-485 port is decided by the data of the special register SW56.
This data is stored in the built-in EEPROM by executing the EEPROM write command. The T1S reads this data at power-on initialization, and decides the mode.

To set the mode, turn the T1S to HALT mode, and write the mode data (see table below) into SW56 using the programmer. After writing, execute the EEPROM write command. And cycle power off and on again. Then the selected mode will function.

Address	Name	Data range
SW56	RS-485 port operation mode	0 = Computer link mode 1 = Data link mode 2 = Free ASCII mode

If the set data is out of the valid range, the T1S regards as the computer link mode.

This mode data is not saved by the peripheral tools (the programmer or the program storage module RM102).
Therefore, even when you load the T1S program by using the peripheral tool, you must set the mode for the T1S manually as mentioned above.

PART 2 T1S RS-485 Port Function

Section 2
Specifications

2. Specifications PART 2

2.1 Computer link mode

Item	Specification
Interface	Conforms to RS-485 (4-wire system)
Transmission mode	Half-duplex
Synchronizing	Start-stop method (asynchronous)
Transmission speed	300, 600, 1200, 2400, 4800, 9600, 19200 bps
Frame format	Start bit 1 bit (fixed) Data 7 or 8 bits Parity even / odd / no Stop bit 1 or 2 bits
Protocol	T-series computer link protocol (ASCII), T-series programmer protocol (Binary)
Response delay time	0 to 300 ms (user setting)
Configuration	One to N (32 max.)
Transmission distance	1 km max.
Cable connection	Terminal block (removable)

NOTE

Total number of the bits of the frame must be 10 or 11 bits.
For example, when 8 data bits and even parity is selected, the stop bit length must be 1 bit.

2.2 Data link mode

Item	Specifications
Interface	Conforms to RS-485 (4-wire system)
Transmission mode	Half-duplex
Synchronizing	Start-stop method (asynchronous)
Transmission speed	19200 bps
Protocol	Special
Link data capacity	16 words (station No. 1 → station No. 2) 16 words (station No. 2 → station No. 1)
Link data update cycle	Approx. 50 ms + scan times of both stations (synchronized with the T1S's program scan)
Configuration	One to one
Transmission distance	1 km max.
Cable connection	Terminal block (removable)

2.3 Free ASCII mode

Item	Specifications
Interface	Conforms to RS-485 (2-wire or 4-wire system)
Transmission mode	Half-duplex
Synchronizing	Start-stop method (asynchronous)
Transmission speed	300, 600, 1200, 2400, 4800, 9600, 19200 bps
Frame format	Start bit 1 bit (fixed) Data 7 or 8 bits Parity even / odd / no Stop bit 1 or 2 bits
Transmission code	ASCII
Message length	512 bytes max.
Configuration	One to N (32 max.)
Transmission distance	1 km max.
Cable connection	Terminal block (removable)

NOTE

Total number of the bits of the frame must be 10 or 11 bits.
For example, when 8 data bits and even parity is selected, the stop bit length must be 1 bit.

PART 2 T1S RS-485 Port Function

Section 3
Computer Link Mode

3. Computer Link Mode PART 2

3.1 Computer link function

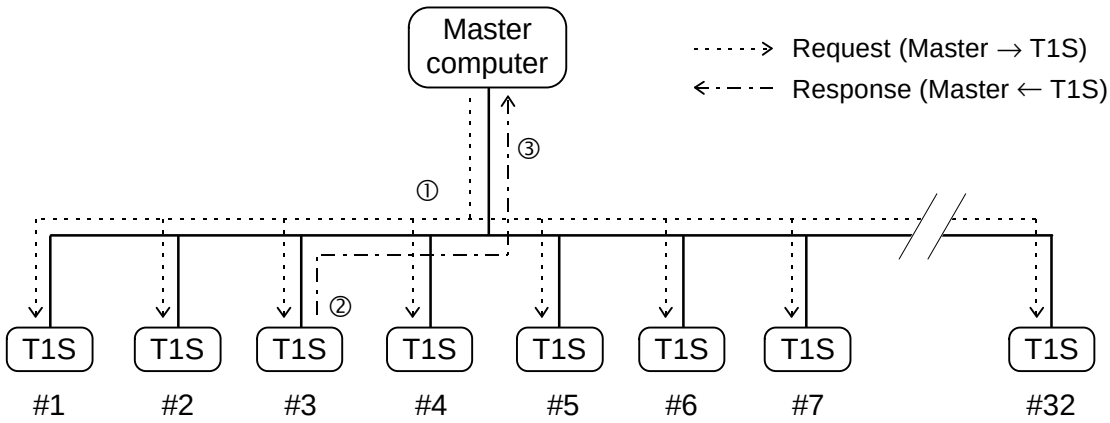
The computer link mode is used to connect between the T1S and a master computer. By preparing the communication software based on the Toshiba's computer link protocol on the master computer, the following functions become available by the master computer. The computer link protocol is a simple ASCII message communication system.

- Reading data (register/device value) from the T1S
- Writing data (register/device value) into the T1S
- Monitoring the T1S's operation status (RUN/HALT/ERROR)
- Reading the error code from the T1/T1S
- Reading the clock/calendar data from the T1S
- Writing the clock/calendar data into the T1S
- Controlling the T1S operation mode (RUN/HALT)
- Program up-loading from the T1S
- Program down-loading into the T1S

Up to 32 T1Ss can be connected to a master computer on the RS-485 communication line. (one-to-N configuration)

In the computer link system, the T1S waits for receiving a request message issued from the master computer.
When a request message is issued, the T1S checks the station number contained in the request message. And when the station number designation matches the T1S's station number setting, the T1S processes the request and returns the response. This is why each T1S must have a unique station number in the one-to-N configuration. Otherwise, more than one T1Ss may attempt to process the request, resulting in faulty response.

The following figure illustrates the processing sequence when a request to station number 3 is issued.



① The request message is sent from the master to all the connected T1Ss. (request for station #3 in this example)

② The request message is interpreted and processed in the T1S which has the same station number as request. (station #3 T1S in this example)

③ Processing result is returned as response to the master.

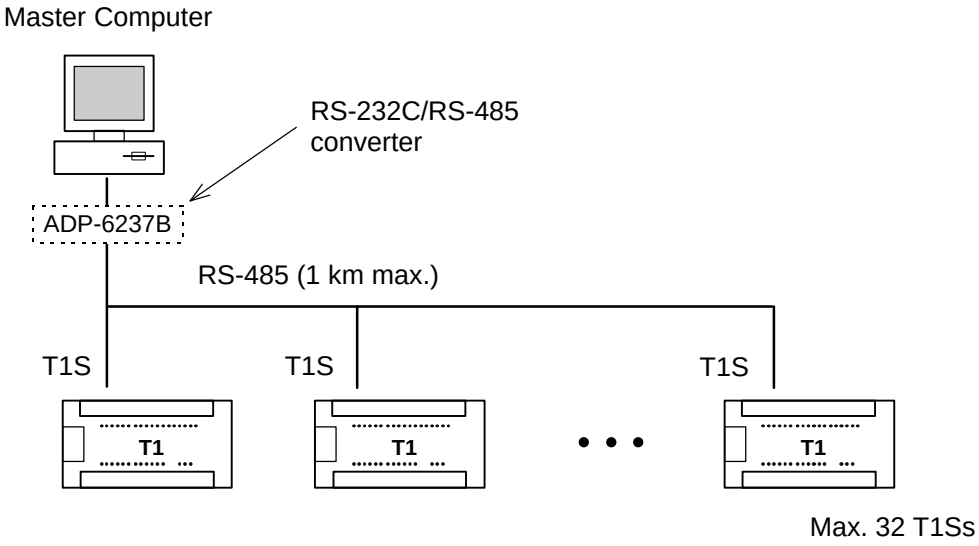
NOTE Available station number is 1 to 32. The station number is set in the T1S's system information memory.

3.2 System configuration

The following figure shows the system configuration.

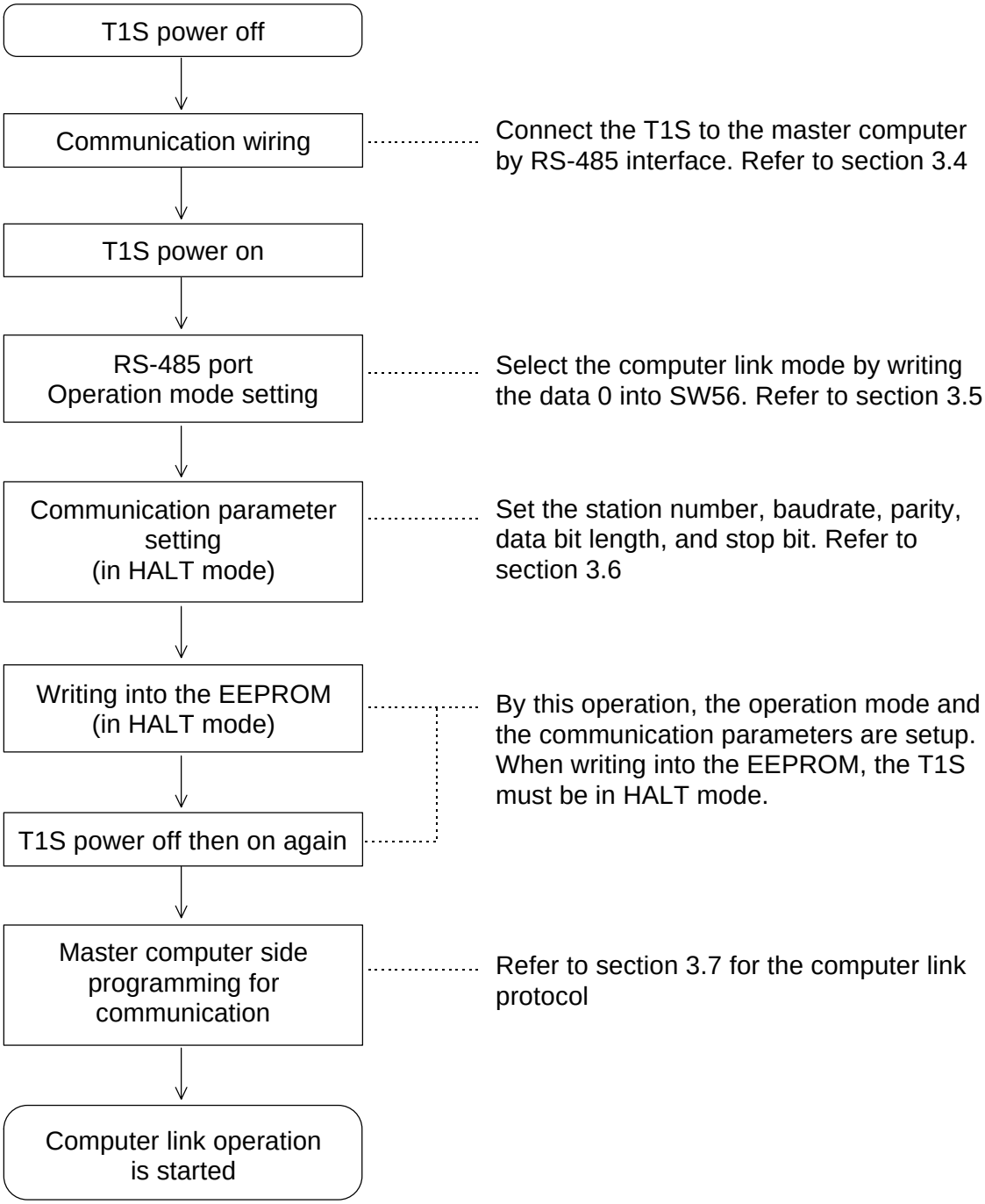
On the RS-485 communication line, up to 32 T1Ss can be connected.
If the master computer has RS-232C interface only, the RS-232C/RS-485 converter (ADP-6237B) can be used.

One-to-N configuration



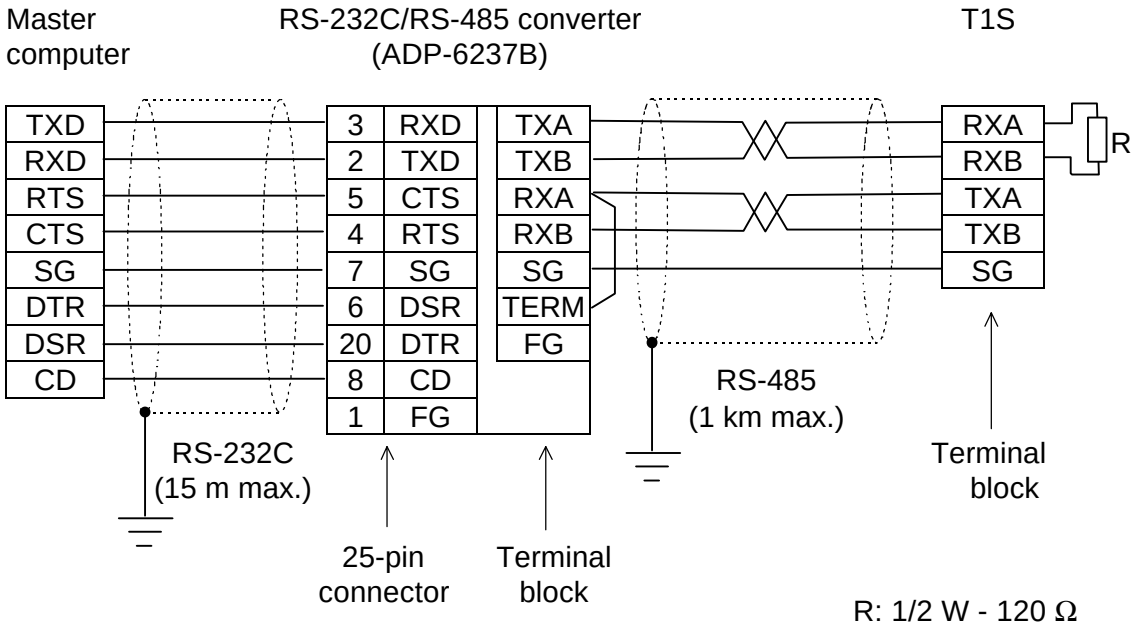
3.3 Setup procedure

The following chart shows the setup procedure of the computer link mode.



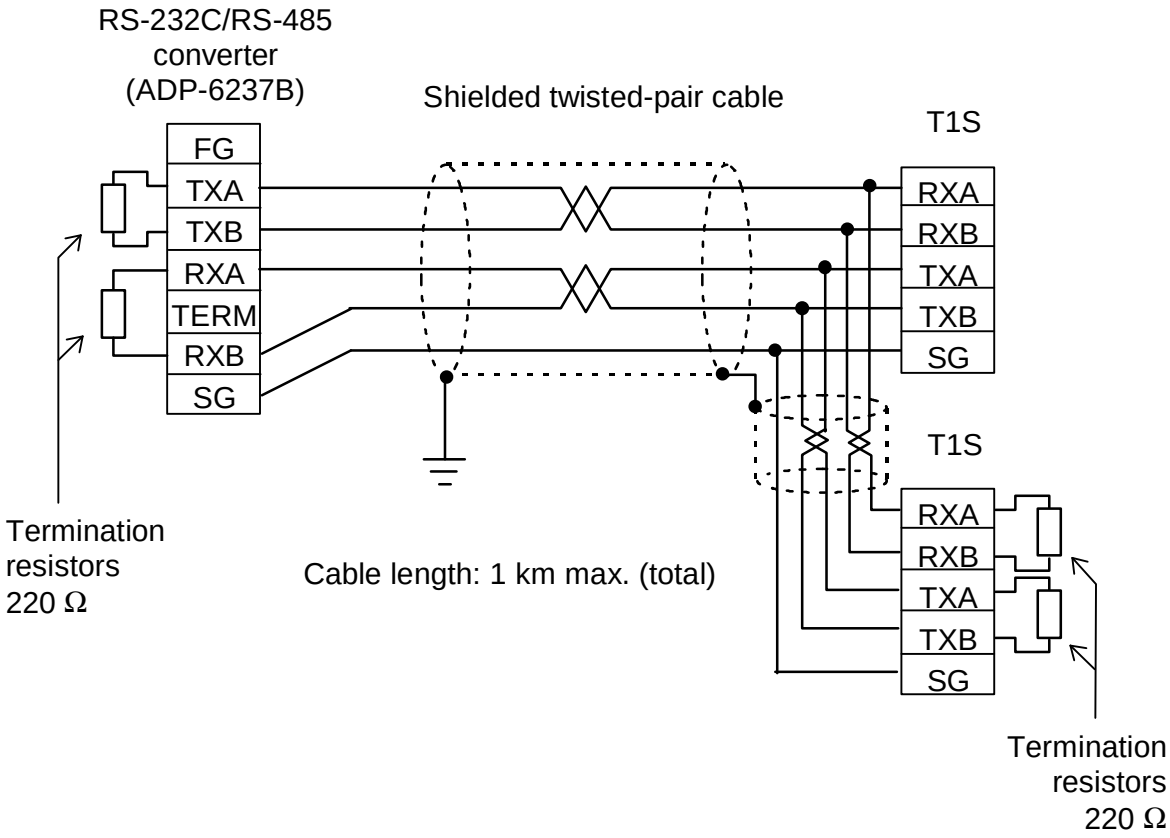
3.4 Cable connection

One to one configuration



- Above figure shows an example of cable connection using the RS-232C/RS-485 converter (ADP-6237B).
- Connect termination resistor 1/2 W - 120 Ω between RXA and RXB at the T1S.
- Short between RXA and TERM for termination at the ADP-6237B.
- If the master has RS-485 (or RS-422) interface and the T1S is connected to the master directly, connect termination resistor 1/2 W - 120 Ω between RXA and RXB at the master end.
- Use shielded twisted-pair cable for data communication suited to RS-485 standard. The cable shield should be connected to ground.

One to N configuration



- Connect termination resistors (1/2 W - 220 Ω) between TXA and TXB, and RXA and RXB, at each end of the line (at both termination stations).
- When a terminal block is used to branch off the line, the branch should not exceed 3 m cable length from the terminal block to the T1S or the master computer.
- Use shielded twisted-pair cable for data communication suited to RS-485 standard. Connect the cable shield each other, and connect it to ground. (Single point grounding)

3. Computer Link Mode PART 2

3.5 Mode setting

The operation mode of the RS-485 port is decided by the data of the special register SW56.
This data is stored in the built-in EEPROM by executing the EEPROM write command.
The T1S reads this data at power-on initialization, and decides the mode.

To select the computer link mode, follow the procedure below.

(1) Turn the T1S to HALT mode
(2) Write **0** into **SW56** by using the programmer
(3) Execute the EEPROM write command
(4) Turn off power
(5) Turn on power again

Then the T1S's RS-485 port functions as the computer link mode.

NOTE The default setting of SW56 is 0. (Computer link mode)

NOTE This mode data is not saved by the peripheral tools (the programmer or the program storage module RM102).
Therefore, even when you load the T1S program by using the peripheral tool, you must set the mode for the T1S manually as mentioned above.

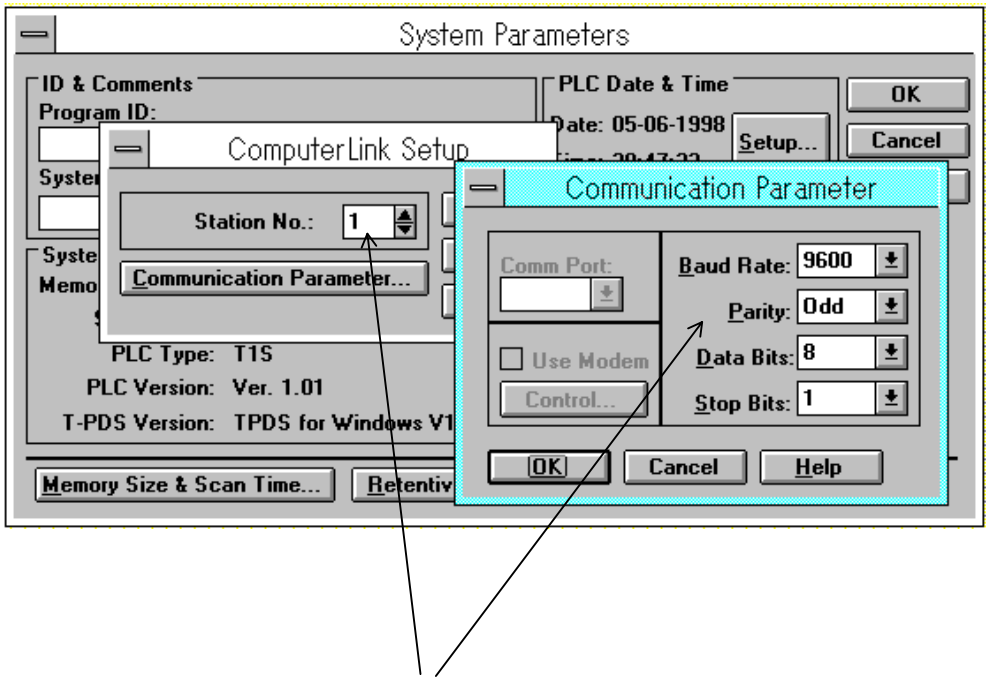
3.6 Communication parameter setting

3.6.1 Transmission parameters

The transmission parameters are set by writing it into the system information memory of the T1S.

Turn the T1S to HALT mode, then set the communication parameter in the system information.

(T-PDS screen example)



Set station number, baudrate, parity, data bit length, and stop bit.

After the communication parameter setting, write it into the T1S's built-in EEPROM before turning off power.

NOTE

The default settings are as follows.

- Station number = 1
- Baudrate = 9600 bps
- Parity = odd
- Data bits = 8 bits
- Stop bit = 1 bit

3.6.2 Response delay time setting

The response time from the RS-485 port in the computer link mode can be changed. The possible setting is as follows.

Internal processing time + (0 to 300) ms (10 ms units)

This function is useful when a wire-less modem is used.

To set the response delay time, turn the T1S to HALT mode, and write the delay time (0 to 30) into SW57. After writing, execute the EEPROM write command. And cycle power off and on again. Then the setting will be effective.

Address	Name	Data range
SW57	RS-485 port response delay	0 to 30 (decimal) (0 to 30 : 0 to 300 ms)

NOTE If the data is out of the valid range, it is limited by 30 (300 ms).

NOTE This setting is not saved by the peripheral tools (the programmer or the program storage module RM102).
Therefore, even when you load the T1S program by using the peripheral tool, you must set the data for the T1S manually as mentioned above.

3.6.3 Communication priority mode

In the T1S, the peripheral support processing (computer link service) is executed at the bottom of each scan with the time limit of 2 ms to minimize the extension of scan time.

However the T1S can work with the peripheral support priority mode. In this mode, the computer link service is executed without a break. By using this mode, the communication response becomes quick although the scan time is extended at the time.

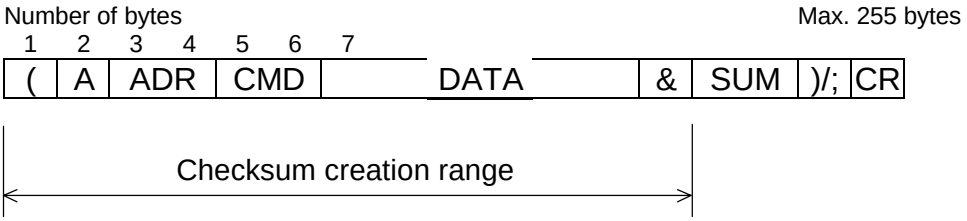
To select the peripheral support priority mode, set the special relay S158 to ON by user program.

Address	Name	Function
S158	Peripheral support priority mode	When ON, the peripheral support priority mode is selected.

NOTE This mode setting is effective commonly for both programmer port and the RS-485 port.

3.7 Computer link protocol

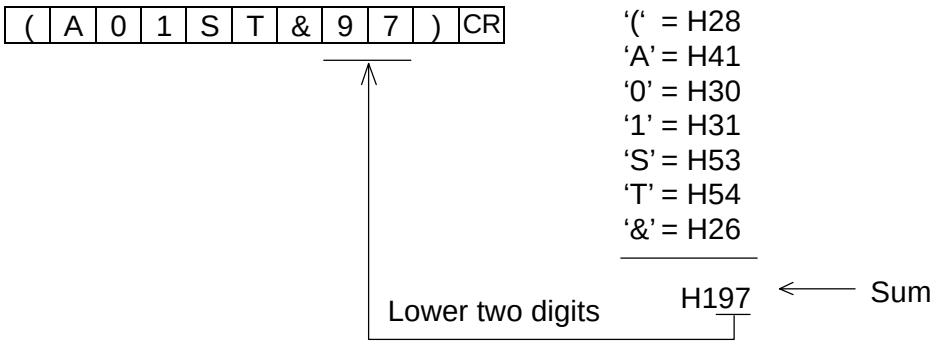
General message format



Text contents

(..... Start code (H28) – 1 byte
A ..... Format identification code (H41) – 1 byte
ADR .... Station number – 2 bytes
01 (H3031) through 32 (H3332)
CMD .... Command – 2 bytes
DATA ... Data field – depending on the command (max. 244 bytes)
& ..... Checksum delimiter (H26) – 1 byte
SUM .... Checksum – 2 bytes
ASCII code of the lowest one byte of the sum obtained by adding from the start code '(' to the checksum delimiter '&'.
See Note below.
) ..... End code (H29) – 1 byte
; ..... End code (H3B) – 1 byte
in case of halfway of entire data
CR ..... Carriage return code (H0D) – 1 byte

NOTE Checksum creation example:



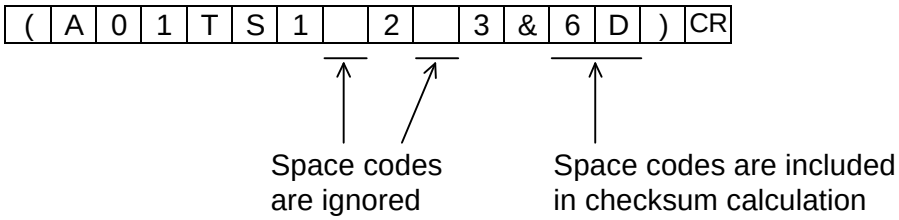
Transmission rules

The following transmission rules are applied to the RS-485 computer link communication.

(1) The T1S is always waiting for a request command issued from the master computer. The T1S will not transmit any message without receiving a request.

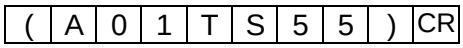
(2) 7 or 8-bit ASCII is used as transmission code.

(3) If some space codes (H20) are included in the request message, they are ignored. However, the space codes are included in checksum calculation.

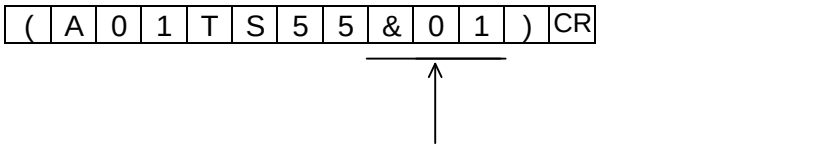


(4) Checksum can be omitted in the request message issued from the master computer. In the response message issued from the T1/T1S, checksum is always added.

Request message



Response message



(5) The T1S ignores all the data received before the start code '('.

(6) Message receiving is completed only after the end code ')' and CR have been received. If the end code without CR, or vice versa, is received, it causes transmission error.

(7) The T1S checks the request message receiving time. If the receiving time from the start code '(' to CR exceeds the time limit below, the T1S judges as transmission error. In this case, no response will be returned from the T1S.

Baudrate	Time limit
300 bps	96 s
600 bps	48 s
1200 bps	24 s
2400 bps	12 s
4800 bps	6 s
9600 bps	3 s
19200 bps	1.5 s

(8) In the one-to-N configuration, when a T1S finishes to send a response message, the T1S releases the transmission line in 10 ms (max.). Until the transmission line is released, other T1S cannot send any message. Therefore, the master computer should wait to send next request message for at least 10 ms after previous response reception.

3. Computer Link Mode PART 2

List of computer link commands

The following computer link commands are available for the T1S.

Request command	Function name	Description	Response command	Remarks
–	Computer Link Error Response	Format error was detected in the request message	CE	Response only
–	PLC Error Response	The request command was rejected by T1/T1S	EE	Response only
TS	Test	Loop back test -- T1/T1S returns the same text	TS	
ST	PLC Status Read	Reads T1/T1S operation status	ST	
ER	PLC Error Status Read	Reads error code registered in the T1/T1S	ER	
DR	Data Read	Reads registers/devices data from the T1/T1S	DR	
DW	Data Write	Writes registers/devices data into the T1/T1S	ST	
RT	Clock/calendar Read	Reads clock/calendar data (date & time) from the T1S	RT	
WT	Clock/calendar Write	Writes clock/calendar data (date & time) into the T1S	ST	
SR	System Information 1 Read	Reads system information 1 from the T1S	SR	
S2	System Information 2 Read	Reads system information 2 from the T1S	S2	
EC	PLC Control	Changes the T1S operation mode	ST	
BR	System Information Block Read	Reads system information from the T1S block-by-block	BR	
RB	Program Block Read	Reads program from the T1S block-by-block	RB	
BW	System Information Block Write	Writes system information into the T1S block-by-block	ST	
WB	Program Block Write	Writes program into the T1S block-by-block	ST	

For details of each command, see Part 1 Section 6 of this manual.

PART 2 T1S RS-485 Port Function

Section 4
Data Link Mode

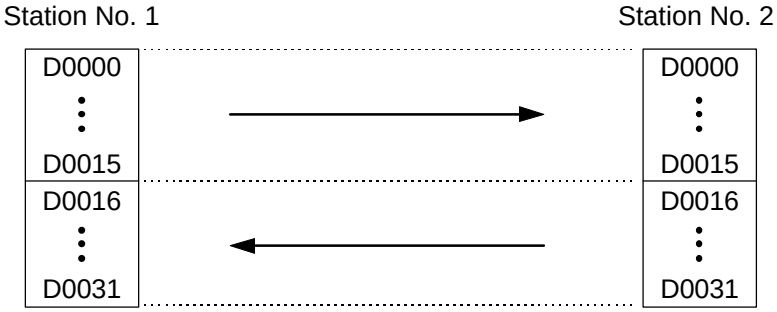
4. Data Link Mode PART 2

4.1 Data link function

The data link function performs data linkage between two T1Ss. No user program for this data linkage is required.
By using this function, two stations data linkage system can be configured easily.

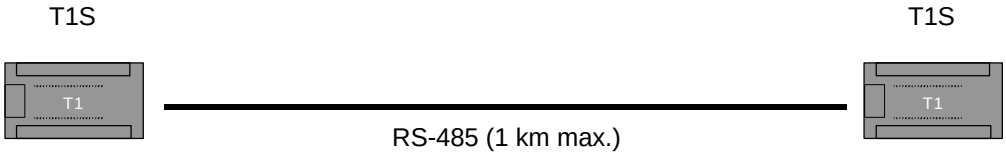
For this function, one T1S must be set to the station No. 1, and the other must be set to the station No. 2. The station number is set by writing it into the system information memory of the T1S, as same as the computer link setting.

The data registers D0000 to D0031 (32 words) are used for this data linkage.
The station No. 1 T1S sends the data of D0000 to D0015 to the station No. 2 T1S.
The station No. 2 T1S sends the data of D0016 to D0031 to the station No. 1 T1S.

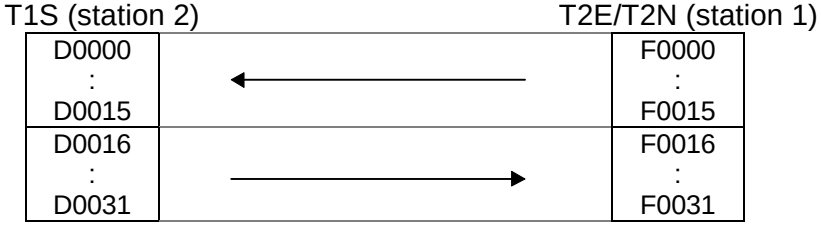


The data update cycle of these 32 words is approx. 50 ms + scan times of both T1Ss.
The link data update timing is synchronized with T1S's program scan.

4.2 System configuration

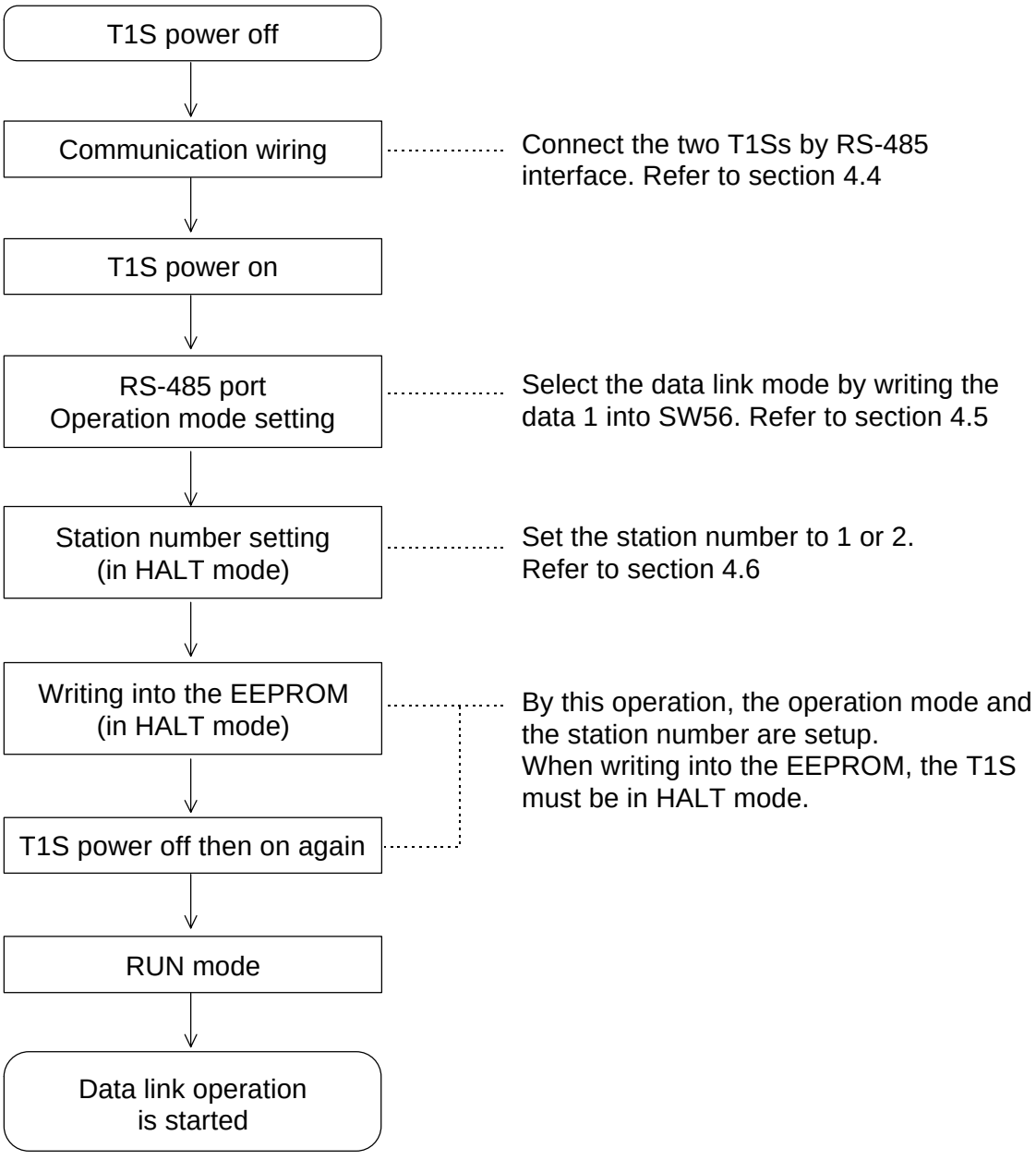


NOTE The T1S's data link mode is compatible with that of T2E/T2N. Therefore using this data link mode, easy data linkage between T1S and T2E or T2N is possible. In this case, the link data assignment is as follows.



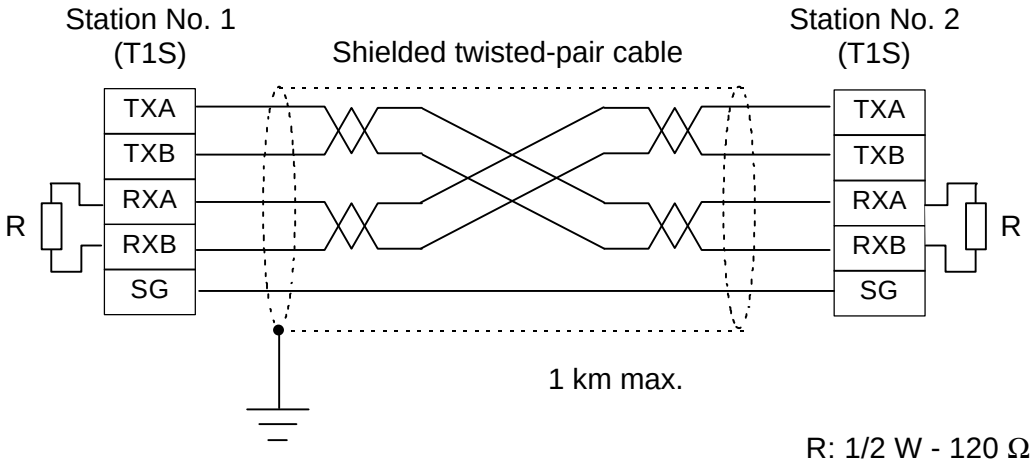
4.3 Setup procedure

The following chart shows the setup procedure of the data link function.



Follow the above procedure for both station No. 1 and station No. 2 T1Ss.

4.4 Cable connection



- Connect termination resistor 1/2 W - 120 Ω between RXA and RXB at both the T1Ss.
- Use shielded twisted-pair cable for data communication suited to RS-485 standard. The cable shield should be connected to ground.

4.5 Mode setting

The operation mode of the RS-485 port is decided by the data of the special register SW56.
This data is stored in the built-in EEPROM by executing the EEPROM write command. The T1S reads this data at power-on initialization, and decides the mode.

To select the data link mode, follow the procedure below.

(1) Turn the T1S to HALT mode
(2) Write **1** into **SW56** by using the programmer
(3) Execute the EEPROM write command
(4) Turn off power
(5) Turn on power again

Then the T1S's RS-485 port functions as the data link mode.

NOTE The default setting of SW56 is 0. (Computer link mode)

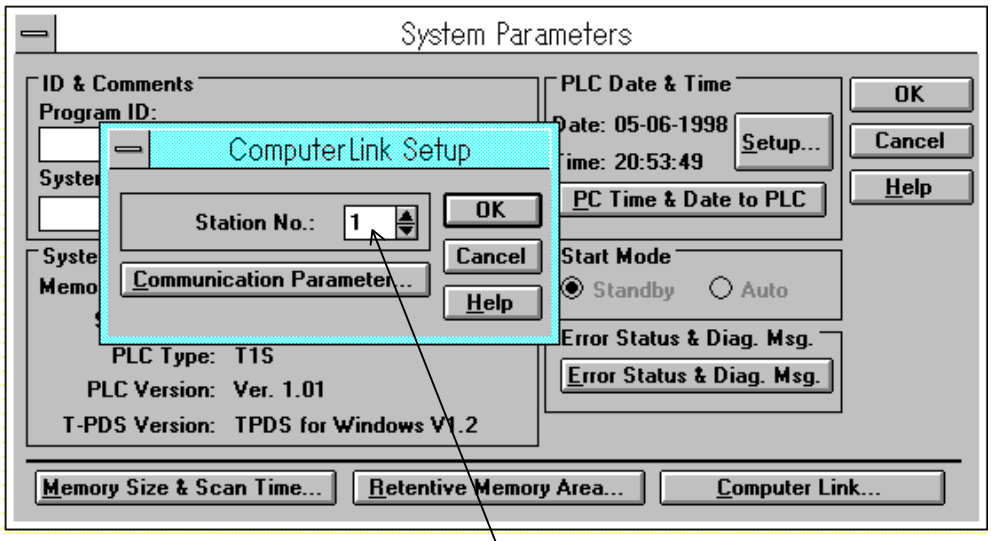
NOTE This mode data is not saved by the peripheral tools (the programmer or the program storage module RM102).
Therefore, even when you load the T1S program by using the peripheral tool, you must set the mode for the T1S manually as mentioned above.

4.6 Communication parameter setting

To use the data link mode, one T1S must be set to the station No. 1, and the other must be set to the station No. 2. The station number is set by writing it into the system information memory of the T1S.

Turn the T1S to HALT mode, then set the station number (1 or 2) in the system information.

(T-PDS screen example)



Set the station number here.
Other parameters are ignored.

After the station number setting, write it into the T1S's built-in EEPROM before turning off power.

4.7 RAS information

To watch the normal data link operation, the following flags are provided.
Use these flags in the program to check the validity of received data.

Device	Function
S058D	Indicates the link partner's (T1S's) operation mode ON: RUN mode OFF: HALT or ERROR mode
S058E	Indicates the communication status ON: Normal OFF: Communication error

These flags indicate the most recent status. That is, they are not latched.

PART 2 T1S RS-485 Port Function

Section 5
Free ASCII Mode

5. Free ASCII Mode PART 2

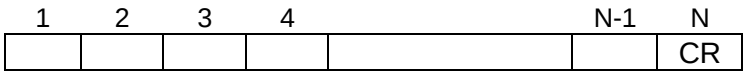
5.1 Free ASCII communication function

The free ASCII mode is used to connect between the T1S and various serial ASCII devices, such as a micro computer, bar code reader, printer, display, etc.
By using this mode, the T1S can work as a communication master. Therefore, the T1S can communicate with other PLCs using the computer link protocol, and can control variable speed drives (such as Toshiba's VF-S7) using its communication protocol.

In this mode, user defined ASCII messages can be transmitted and/or received through the RS-485 port.

The ASCII message (one set of transmission characters) means a string of ASCII characters which is ended by specified trailing code. The default setting of the trailing code is CR (carriage return code = H0D).

Applicable message format (default trailing code):



N: message length = 512 bytes max.

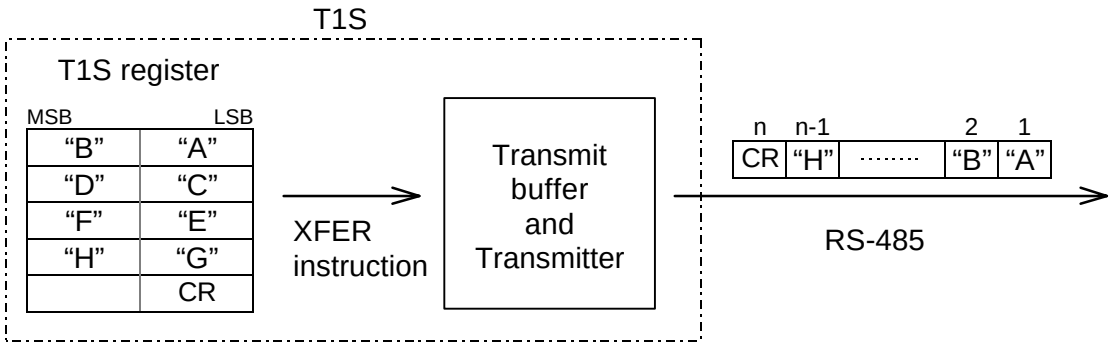
In other words, the T1S cannot be used for the data communication in which the trailing code may be appeared in the middle of the message (binary transmission) or the message is ended by two or more types of trailing code.

NOTE The Free ASCII mode works as half-duplex communication system. Therefore, simultaneous operation of transmitting and receiving is not possible.

In the free ASCII mode, communication (message transmitting and receiving) is controlled by T1S's user program.
The expanded transfer (XFER) instruction is used for transmitting and receiving messages.

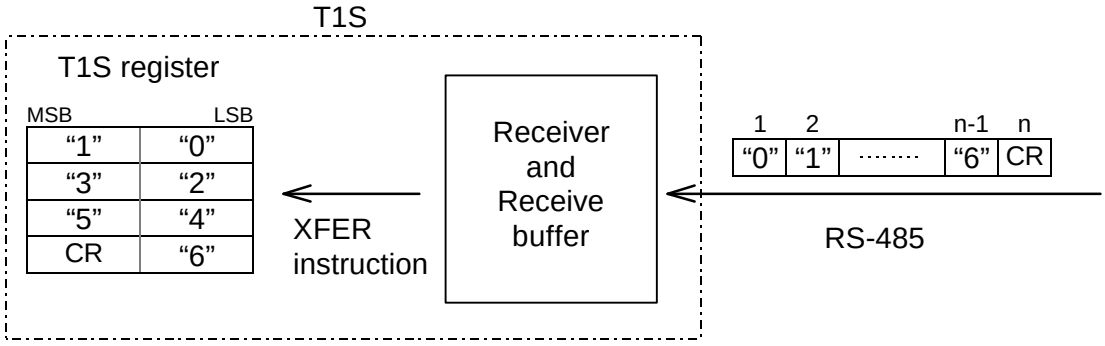
Transmitting:

To transmit, the user prepares the message in the T1S registers in the format of ASCII character. The message must be ended by a specified trailing code. Then executes the XFER instruction to start transmission.



Receiving:

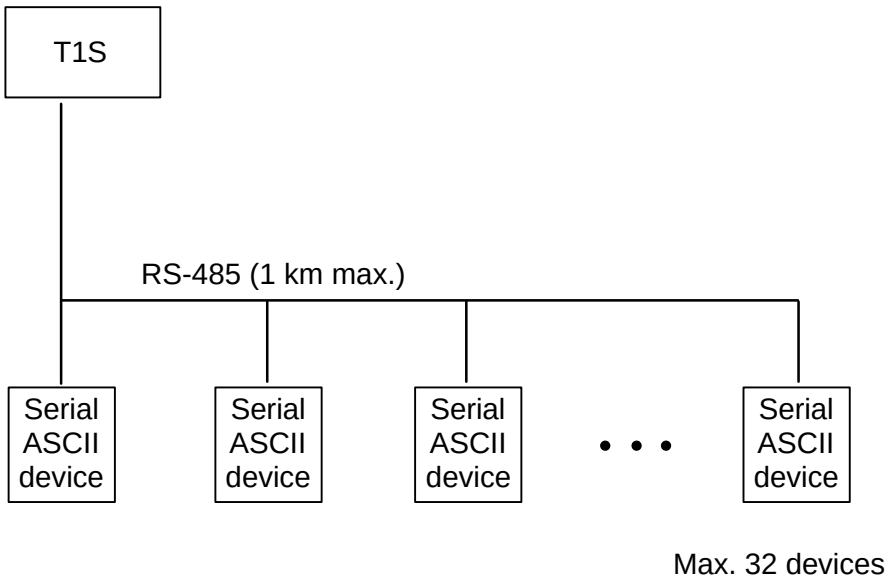
When a message is received, it is stored in the receive buffer. Then, by using the XFER instruction, the message is read and stored in the designated T1S registers in the format of ASCII character.



The T1S supports the hexadecimal to ASCII conversion (HTOA) instruction and the ASCII to hexadecimal conversion (ATOH) instruction. These instructions are useful to handle ASCII characters. Refer to section 5.9.

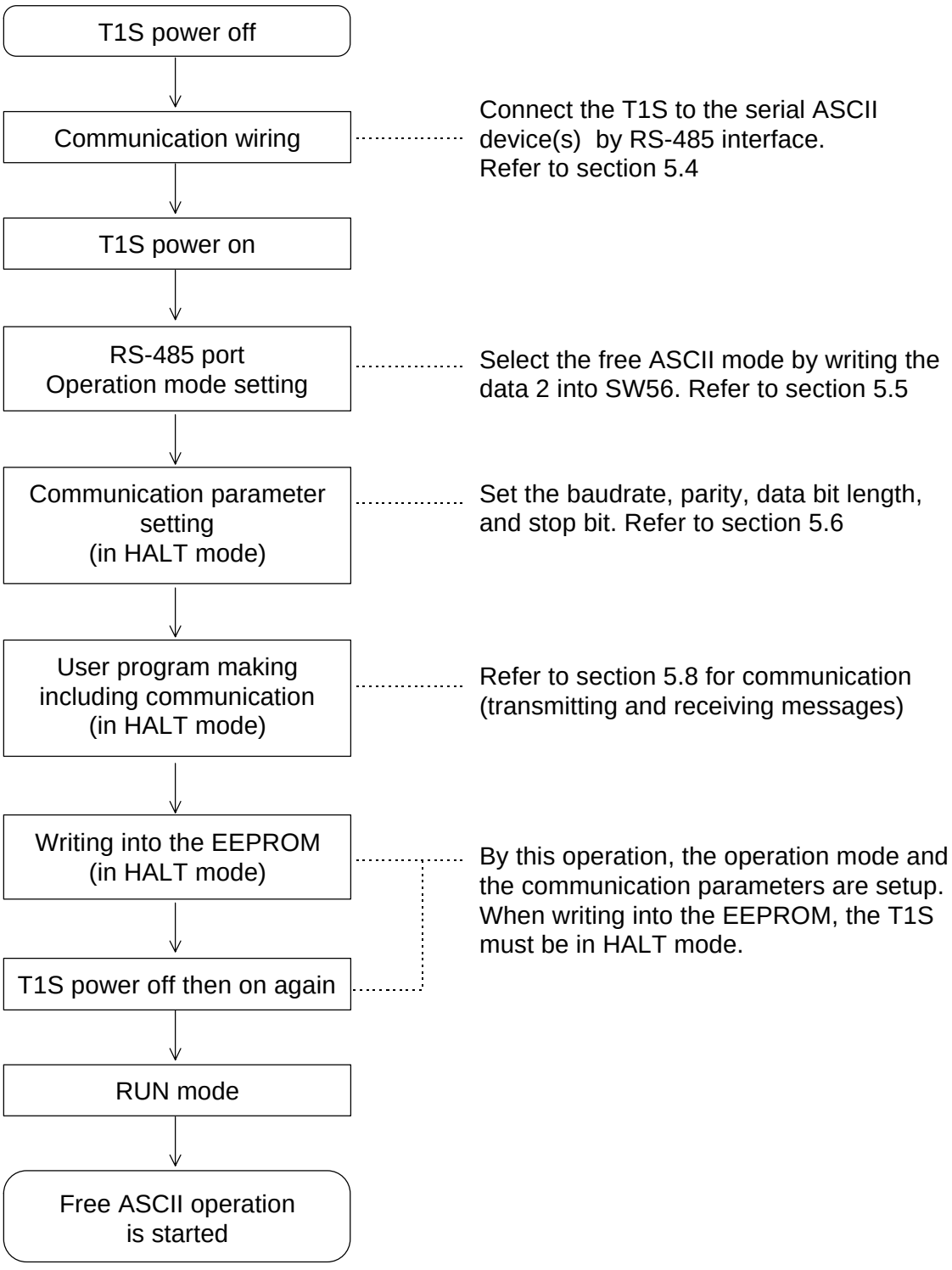
5.2 System configuration

The following figure shows the system configuration.
The T1S is connected to the serial ASCII device(s) through RS-485 interface.



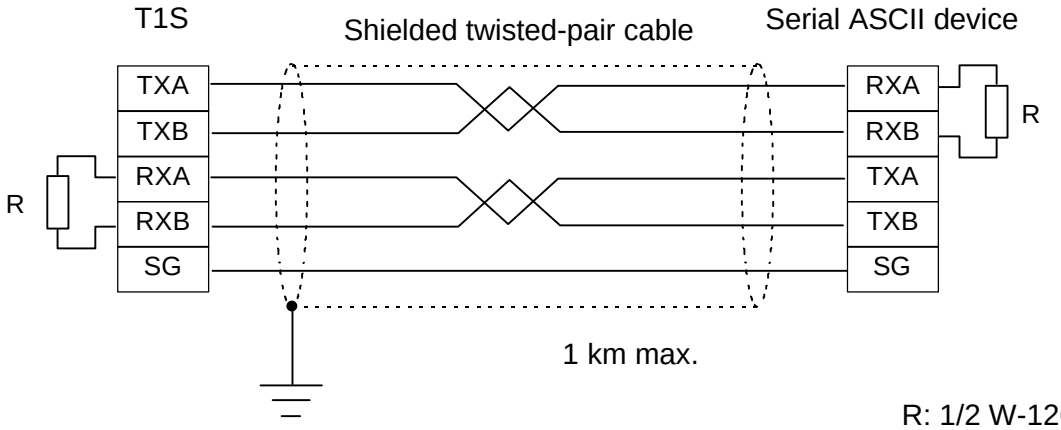
5.3 Setup procedure

The following chart shows the setup procedure of the free ASCII communication function.



5.4 Cable connection

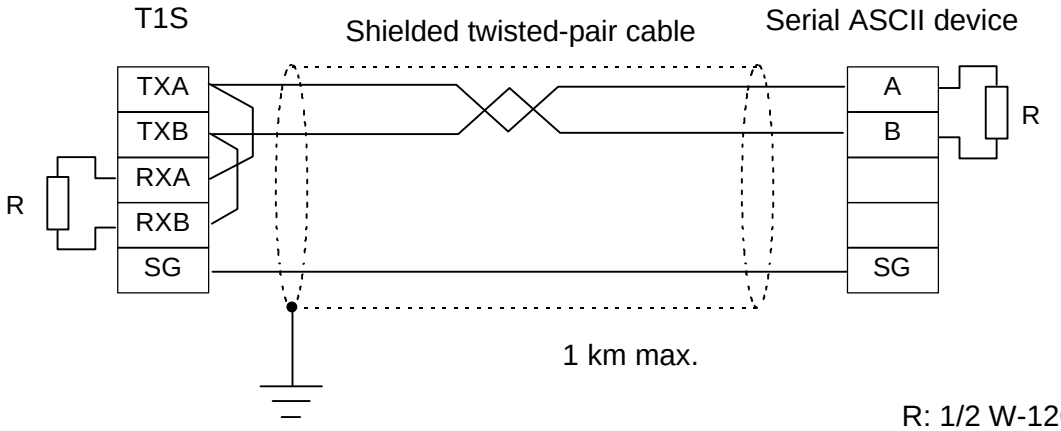
One to one configuration (4-wire system)



R: 1/2 W-120 Ω

- Maximum cable length is 1 km.
- Connect termination resistor 1/2 W - 120 Ω between RXA and RXB at the T1S and the serial ASCII device.
- Use shielded twisted-pair cable for data communication suited to RS-485 standard. The cable shield should be connected to ground.

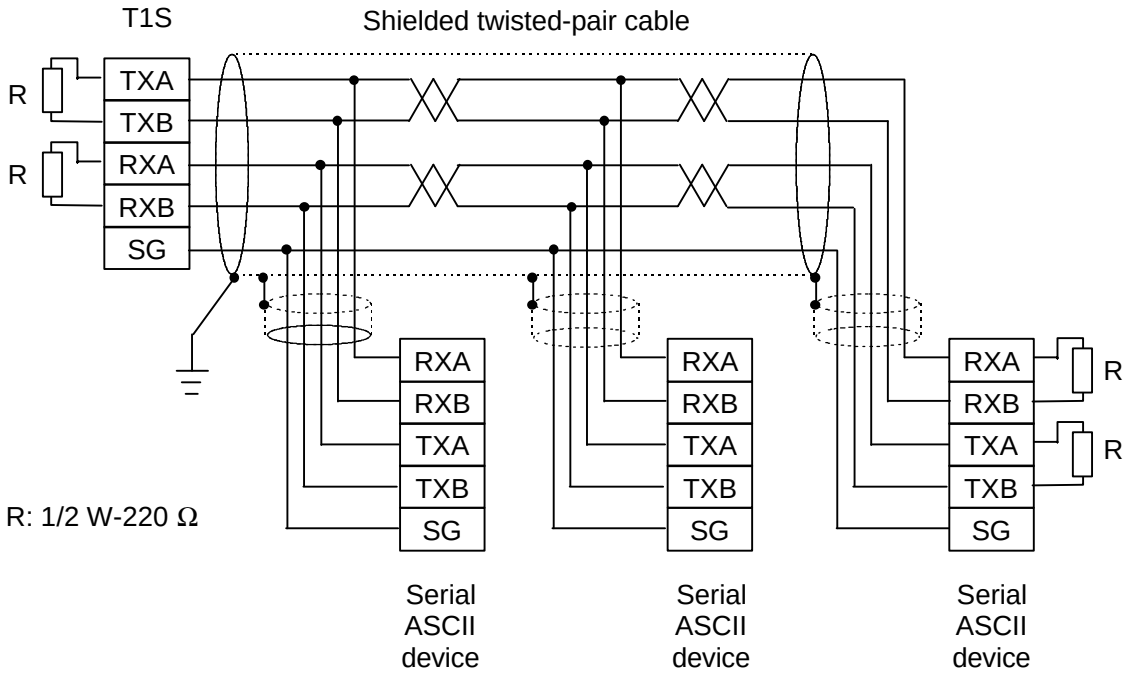
One to one configuration (2-wire system)



R: 1/2 W-120 Ω

- Maximum cable length is 1 km.
- Short TXA and RXA, and TXB and RXB at the T1S.
- Connect termination resistors 1/2 W - 120 Ω between RXA and RXB at the T1S and signal A and signal B at the serial ASCII device.
- Use shielded twisted-pair cable for data communication suited to RS-485 standard. The cable shield should be connected to ground.

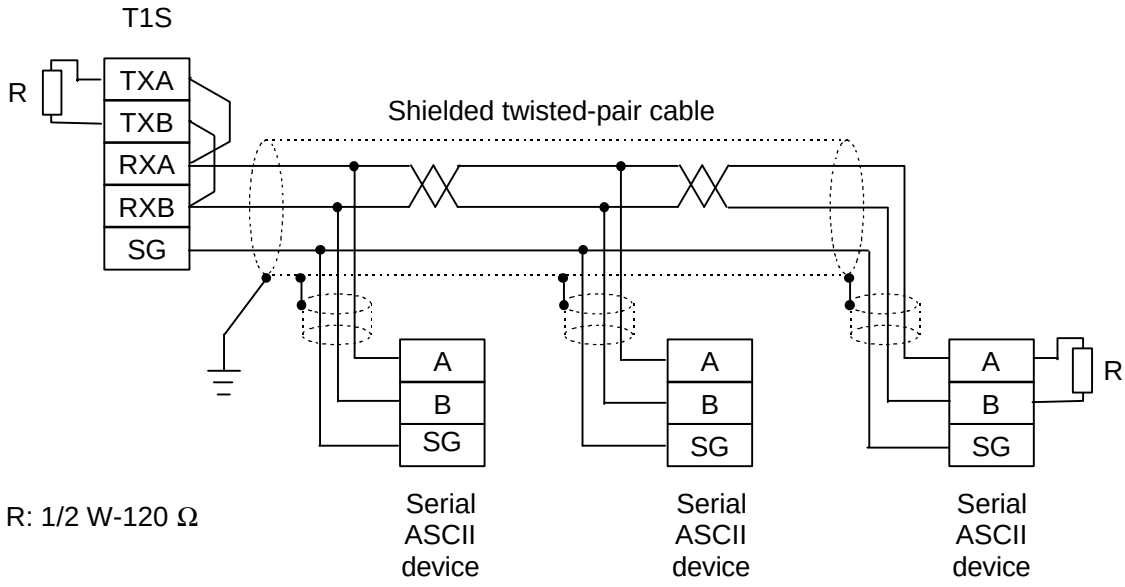
One to N configuration (4-wire system)



- Maximum total cable length is 1 km.
- Connect termination resistor 1/2 W - 220 Ω between RXA and RXB, and between TXA and TXB at the both terminal stations.
- The length of the branch line should be less than 3 m.
- Use shielded twisted-pair cable for data communication suited to RS-485 standard. The cable shield should be connected each other and connected to ground.

5. Free ASCII Mode PART 2

One to N configuration (2-wire system)



- Maximum total cable length is 1 km.
- Short TXA and RXA, and TXB and RXB at the T1S.
- Connect termination resistor 1/2 W - 120 Ω between line A and line B at the both terminal stations.
- The length of the branch line should be less than 3 m.
- Use shielded twisted-pair cable for data communication suited to RS-485 standard. The cable shield should be connected each other and connected to ground.

5.5 Mode setting

The operation mode of the RS-485 port is decided by the data of the special register SW56.
This data is stored in the built-in EEPROM by executing the EEPROM write command.
The T1S reads this data at power-on initialization, and decides the mode.

To select the free ASCII mode, follow the procedure below.

(1) Turn the T1S to HALT mode
(2) Write **2** into **SW56** by using the programmer
(3) Execute the EEPROM write command
(4) Turn off power
(5) Turn on power again

Then the T1S's RS-485 port functions as the free ASCII mode.

NOTE The default setting of SW56 is 0. (Computer link mode)

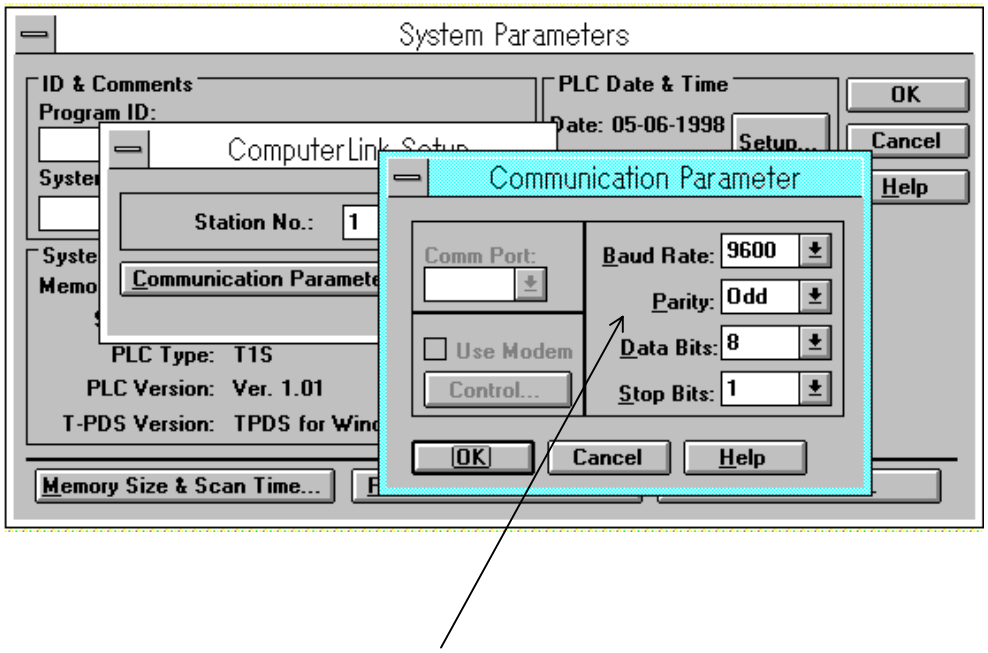
NOTE This mode data is not saved by the peripheral tools (the programmer or the program storage module RM102).
Therefore, even when you load the T1S program by using the peripheral tool, you must set the mode for the T1S manually as mentioned above.

5.6 Communication parameter setting

The communication parameter is set by writing it into the system information memory of the T1S.

Turn the T1S to HALT mode, then set the communication parameter in the system information.

(T-PDS screen example)



Set baudrate, parity, data bit length, and stop bit.
Station number is ignored.

After the communication parameter setting, write it into the T1S's built-in EEPROM before turning off power.

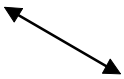
5.7 Message format

The transmission message is composed by ASCII characters and a specified trailing code. The default setting of the trailing code is CR (carriage return code = H0D). Refer to section 5.8.1 for setting the trailing code other than CR.
The maximum length of a message is 512 bytes. An example of the message is shown below.

1	2	3	4	5	6	7	8	9
“0”	“1”	“2”	“A”	“B”	“7”	“8”	“9”	CR

In the above figure, “x” means an ASCII character. For example, “0” is H30.
The number (1 to 9) shown on each character means the order of transmitting or receiving.
When the above message is received or transmitted, the data arrangements in the T1S registers are as follows.

Register	F 8	7 0
n	“1”	“0”
n+1	“A”	“2”
n+2	“7”	“B”
n+3	“9”	“8”
n+4		CR



Transmission message

“0”
“1”
“2”
“A”
“B”
“7”
“8”
“9”
CR

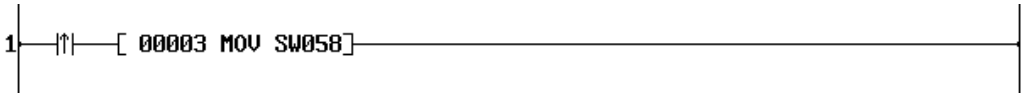
5.8 Programming

5.8.1 Changing the trailing code

The default setting of the trailing code is CR (carriage return code = H0D).
The trailing code can be changed by writing the desired code into SW058 at the first scan.

	F 8	7 0
SW058	H00	New trailing code

Sample program:



The above program is an example to change the trailing code to H03. The new trailing code H0003 is written into SW058 at the first scan.

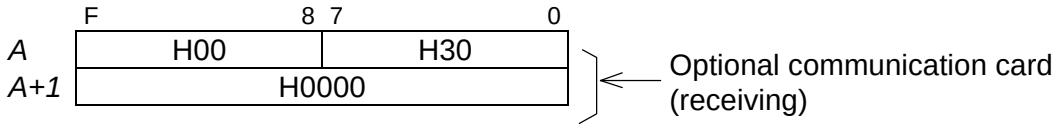
5.8.2 Data receive operation

When a message is received, it is stored in the receive buffer. The receive buffer is a temporally memory, which has 512 bytes capacity. The expanded transfer (XFER) instruction is used to read the message from the receive buffer and to store it into user registers.

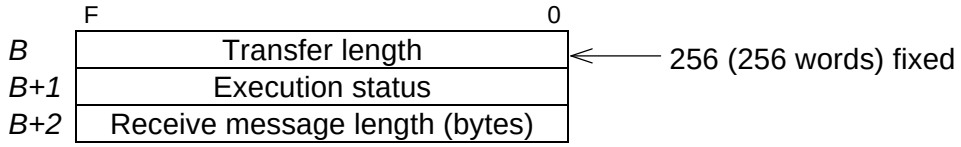
XFER instruction (message receive):

Input —[*A* XFER *B* → *C*]— Output

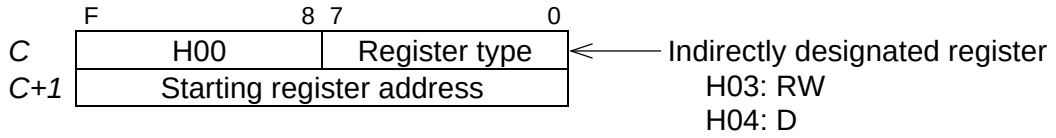
Operand *A*: Source



Operand *B*: Parameter



Operand *C*: Destination register



Operation:

When the input condition of the XFER instruction comes ON, the read operation is started. The execution status is monitored by *B+1* as follows.

B+1 (Execution status): H0000 … Normal complete
H0001 … Communication error (parity error, framing error)
H0002 … Message length over (more than 512 bytes)
H0003 … Receive buffer over flow
H0004 … Receive time-out (see below)
H0006 … Multiple execution error (other receiving routine is under executing)

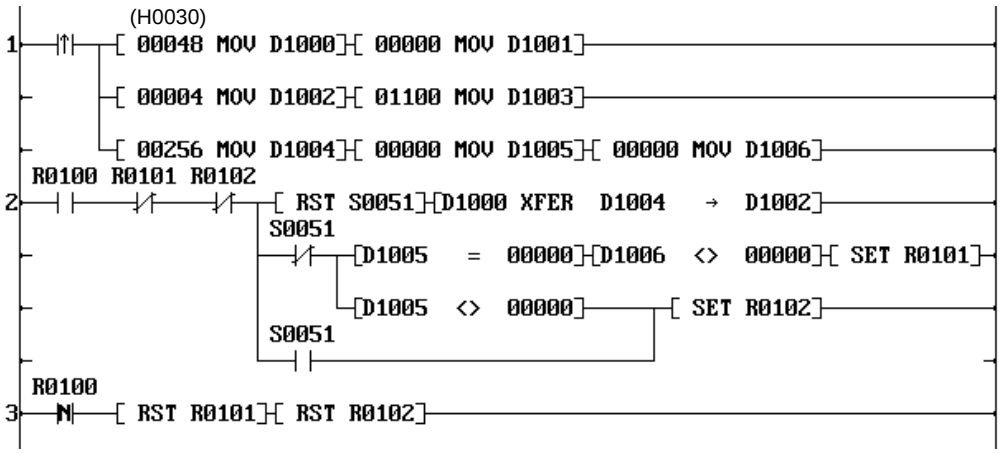
5. Free ASCII Mode PART 2

The receive time-out is detected when the time from the starting character to the trailing code exceeds the following time.

Baudrate	Time-out
300 bps	30 s
600 bps	15 s
1200 bps	12 s
2400 bps	8 s

Baudrate	Time-out
4800 bps	4 s
9600 bps	3 s
19200 bps	1.5 s

Sample program:



Rung 1: Sets the parameters for the XFER instruction.
The registers of 256 words starting with D1100 are reserved to store the received message.

Rung 2: When R0100 is set to ON, the read operation is started.
If the operation is completed normally, the received message is stored in D1100 and after, and R0101 is set to ON.
If the message could not be received normally by some error, R0102 is set to ON.

Rung 3: When R0100 is reset to OFF, the result status (R0101 and R0102) are reset to OFF.

When using the above sample program as a part of entire application program, set R0100 to ON in the main processing part at first. When a message is received, R0101 (at normal) or R0102 (at error) comes ON. Then reset R0100 and carry out necessary processing for the received message. When the result status shows normal complete (R0101 is ON), the received message has been stored in D1100 and after.
When it becomes ready to receive the next message, set R0100 to ON again.

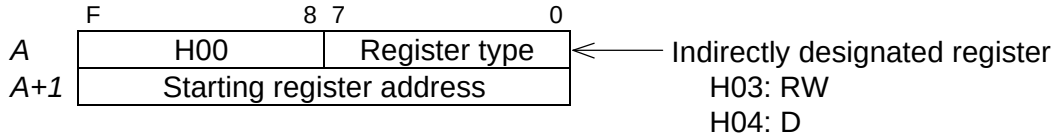
5.8.3 Data send operation

The expanded transfer (XFER) instruction is used to send the message through the RS-485 port.

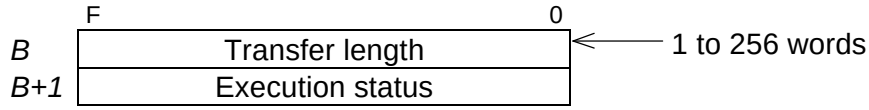
XFER instruction (message send):

Input —[*A* XFER *B* → *C*]— Output

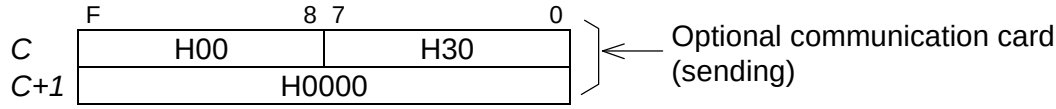
Operand *A*: Source register



Operand *B*: Parameter



Operand *C*: Destination



Operation:

When the input condition of the XFER instruction comes ON, the message prepared in the registers starting with *A* is transmitted.
The execution status is monitored by *B+1* as follows.

B+1 (Execution status): H0000 … Normal complete
H0001 … During transmitting the message
H0002 … Communication busy (other receiving or transmitting routine is under executing)
H0003 … During the reset operation
H0004 … Send time-out (see below)
H0005 … Send message length error (no trailing code in the source table)

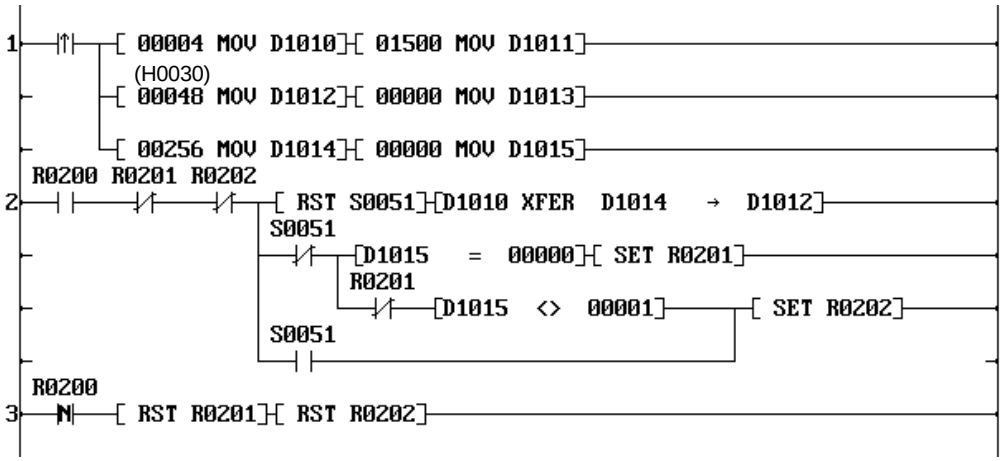
5. Free ASCII Mode PART 2

The send time-out is detected when the time from the starting character to the trailing code exceeds the following time.

Baudrate	Time-out
300 bps	30 s
600 bps	15 s
1200 bps	12 s
2400 bps	8 s

Baudrate	Time-out
4800 bps	4 s
9600 bps	3 s
19200 bps	1.5 s

Sample program:



Rung 1: Sets the parameters for the XFER instruction.
The registers of 256 words starting with D1500 are reserved to store the transmitting message.

Rung 2: When R0200 is set to ON, the message stored in the D1500 and after are transmitted.
If the operation is completed normally, R0201 is set to ON.
If some error has occurred during the operation, R0202 is set to ON.

Rung 3: When R0200 is reset to OFF, the result status (R0201 and R0202) are reset to OFF.

When using the above sample program as a part of entire application program, write the transmitting message (including the trailing code) in D1500 and after, and set R0200 to ON in the main processing part. By this operation, message transmitting is started. When the message transmitting is completed, R0201 (at normal) or R0202 (at error) comes ON. Confirm these result status and reset R0200 to OFF.

5.8.4 Reset operation

By setting S058F to ON, resetting the free ASCII mode operation is available. During the reset, the following re-initialization is processed.

- Initializes the RS-485 serial port
- Initializes the transmit and receive buffers, and the error information
- Resets the trailing code based on the data of lower byte of SW058

When the reset operation is completed, S058F is automatically reset to OFF. The free ASCII mode operation should be re-started after confirming S058F is returned to OFF.

If S058F is set to ON during a message receiving, the reset operation is started after the message receiving is finished.

5. Free ASCII Mode PART 2

5.9 Related instruction

5.9.1 Expanded data transfer (XFER)

FUN 236	XFER	Expanded data transfer

Expression

Input –[*A* XFER *B* → *C*]– Output

Function

When the input is ON, data block transfer is performed between the source which is indirectly designated by *A* and *A+1* and the destination which is indirectly designated by *C* and *C+1*. The transfer size (number of words) is designated by *B*.
The transfer size is 1 to 256 words. (except for writing into EEPROM)
Data transfer between the following objects are available.

- CPU register (RW or D) ↔ EEPROM (D register)
- CPU register (RW or D) ↔ T1S RS-485 port (T1S only)

Execution condition

Input	Operation	Output	ERF
OFF	No execution	OFF	–
ON	Normal execution	ON	–
	When error is occurred (see Note)	ON	Set

Operand

	Name	Device						Register										Constant	Index
		X	Y	R	S	T.	C.	XW	YW	RW	SW	T	C	D	I	J	K		
A	Source parameter							√	√	√	√	√	√	√					
B	Transfer size							√	√	√	√	√	√	√					
C	Destination parameter								√	√	√	√	√	√					

Parameters

Source parameter

A	Type
A+1	Leading address

Transfer size and status

B	Transfer size
B+1	Status flag for RS-485 port
B+2	(max. 2 words)

Destination parameter

C	Type
C+1	Leading address

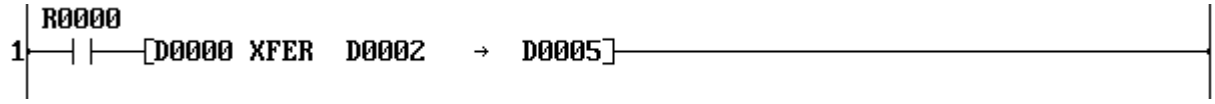
Register type	Type code	Leading address	Transfer size
RW register (RAM)	H0003	0 to 63 (T1) 0 to 255 (T1S)	1 to 64 (T1) 1 to 256 (T1S)
D register (RAM)	H0004	0 to 1023 (T1) 0 to 4095 (T1S)	1 to 256
D register (EEPROM)	H0020	0 to 511 (T1) 0 to 2047 (T1S)	1 to 16 (if destination, T1) 1 to 32 (if destination,T1S) 1 to 256 (if source)
T1S RS-485 port	H0030	0 (fixed)	1 to 256

CPU register ↔ T1S RS-485 port (T1S only)

<Receiving>

When the instruction input is ON, one set of message (from start character to the trailing code) which is received by the RS-485 port is read from the receive buffer, and stored in the CPU registers. The transfer size is fixed to 256 words. The execution status and the message length (in bytes) are stored in the status flag.
The instruction input must be kept ON until the receiving operation is complete.

Example



	Source designation
D0000	H0030
D0001	00000

T1S RS-485 port

	Transfer size
D0002	00256 (fixed)
D0003	Execution status
D0004	Message length

	Destination designation
D0005	H0004
D0006	00100

D0100 (CPU register)

When R0000 is ON, one set of received message is read and stored in D0100 and after.

Execution status: H0000 ... Normal complete
H0001 ... Communication error (parity error, framing error)
H0002 ... Message length over (more than 512 bytes)
H0003 ... Receive buffer over flow
H0004 ... Receive time-out (from start character to the trailing code) (see table below)
H0006 ... Multiple execution error

Baudrate	Time-out
300 bps	30 seconds
600 bps	15 seconds
1200 bps	12 seconds
2400 bps	8 seconds
4800 bps	4 seconds
9600 bps	3 seconds
19200 bps	1.5 seconds

Message length: 0 ..... No receive message
1 to 512 ... Message length in bytes

Note

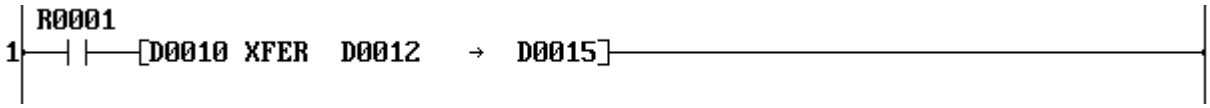
- The XFER instruction is not executed as error in the following cases. In these cases, the instruction error flag (ERF = S051) is set to ON. If the ERF is set to ON once, it remains ON until resetting to OFF by user program.
  (1) The leading address for the RS-485 port designation is other than 0.
  (2) Transfer size is other than 256.
  (3) Mode setting of the RS-485 port is not the free ASCII mode.
  (4) This instruction is programmed in the sub-program #1.

5. Free ASCII Mode PART 2

<Transmitting>

When the instruction input is ON, one set of message which is stored in the source table (from start character to the trailing code) is transmitted through the RS-485 port. The execution status is stored in the status flag.
The instruction input must be kept ON until the transmitting operation is complete.

Example



	Source designation	
D0010	H00	H04
D0011	00500	

	Transfer size
D0012	00012
D0013	Execution status

	Destination designation	
D0015	H00	H30
D0016	00000	

D0500 (CPU register) T1S RS-485 port

When R0001 is ON, one set of message (ended by the trailing code) stored in the range of D0500 to D0511 (12 words) is transmitted through the RS-485 port.

Execution status: H0000 ... Normal complete
H0001 ... During transmitting the message
H0002 ... Communication busy
H0003 ... During the reset operation
H0004 ... Send time-out (from start character to the trailing code) (see table below)
H0005 ... Send message length error (no trailing code in the source table)

Baudrate	Time-out
300 bps	30 seconds
600 bps	15 seconds
1200 bps	12 seconds
2400 bps	8 seconds
4800 bps	4 seconds
9600 bps	3 seconds
19200 bps	1.5 seconds

Note

- The XFER instruction is not executed as error in the following cases. In these cases, the instruction error flag (ERF = S051) is set to ON. If the ERF is set to ON once, it remains ON until resetting to OFF by user program.
  (1) The leading address for the RS-485 port designation is other than 0.
  (2) Transfer size is out of the range of 1 to 256.
  (3) Mode setting of the RS-485 port is not the free ASCII mode.
  (4) This instruction is programmed in the sub-program #1.

5.9.2 HEX to ASCII conversion (HTOA)

FUN 062	HTOA	Hex to ASCII conversion

T1S only

Expression

Input –[*A* HTOA (*n*) *B*]– Output

Function

When the input is ON, the hexadecimal data of *n* registers starting with *A* is converted into ASCII characters and stored in *B* and after. The uppermost digit of source *A* is stored in lower byte of destination *B*, and followed in this order. The allowable range of *n* is 1 to 32.

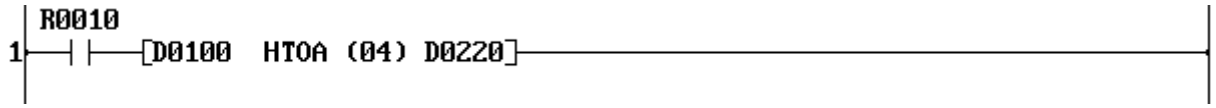
Execution condition

Input	Operation	Output
OFF	No execution	OFF
ON	Execution	ON

Operand

	Name	Device						Register										Constant	Index
		X	Y	R	S	T.	C.	XW	YW	RW	SW	T	C	D	I	J	K		
A	Source							√	√	√	√	√	√	√	√	√	√	√	
n	Data size																	1 - 32	
B	Destination								√	√	√	√	√	√					

Example



When R010 is ON, 4 words data of D0100 to D0103 are converted into ASCII characters, and stored in 8 words registers starting with D0200.

	F 0
D0100	H0123
D0101	H4567
D0102	H89AB
D0103	HCDEF

Converted →

	F 8	7 0
D0220	“1” (H31)	“0” (H30)
D0221	“3” (H33)	“2” (H32)
D0222	“5” (H35)	“4” (H34)
D0223	“7” (H37)	“6” (H36)
D0224	“9” (H39)	“8” (H38)
D0225	“B” (H42)	“A” (H41)
D0226	“D” (H44)	“C” (H43)
D0227	“F” (H46)	“E” (H45)

Note

- If index register (I, J or K) is used for the operand *A*, only *n* = 1 is allowed. Otherwise, boundary error will occur.

5. Free ASCII Mode PART 2

5.9.3 ASCII to HEX conversion (ATOH)

FUN 063	ATOH	ASCII to Hex conversion

T1S only

Expression

Input –[*A* ATOH (*n*) *B*]– Output

Function

When the input is ON, the ASCII characters stored in *n* registers starting with *A* is converted into hexadecimal data and stored in *B* and after. The lower byte of source *A* is stored as uppermost digit of destination *B*, and followed in this order. The allowable ASCII character in the source table is “0” (H30) to “9” (H39) and “A” (H41) to “F” (H46). The allowable range of *n* is 1 to 64.

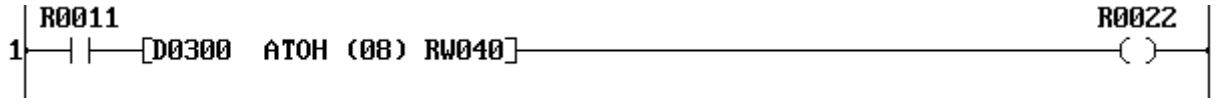
Execution condition

Input	Operation	Output	ERF
OFF	No execution	OFF	–
ON	Normal execution	ON	–
	Conversion data error (no execution)	OFF	Set

Operand

	Name	Device						Register										Constant	Index
		X	Y	R	S	T.	C.	XW	YW	RW	SW	T	C	D	I	J	K		
A	Source							√	√	√	√	√	√	√	√	√	√	√	
n	Data size																	1 - 64	
B	Destination								√	√	√	√	√	√					

Example



When R011 is ON, the ASCII characters stored in 8 words of D0300 to D0307 are converted into hexadecimal data, and stored in 4 words registers starting with RW040.

	F 8	7 0
D0300	“1” (H31)	“0” (H30)
D0301	“3” (H33)	“2” (H32)
D0302	“5” (H35)	“4” (H34)
D0303	“7” (H37)	“6” (H36)
D0304	“9” (H39)	“8” (H38)
D0305	“B” (H42)	“A” (H41)
D0306	“D” (H44)	“C” (H43)
D0307	“F” (H46)	“E” (H45)

Converted →

	F 0
RW040	H0123
RW041	H4567
RW042	H89AB
RW043	HCDEF

Note

- If index register (I, J or K) is used for the operand *A*, only *n* = 1 is allowed.
- If *n* is odd number, lower 2 digits of the last converted data will not be fixed, Use even for *n*.

Appendix

Appendix

A.1 Computer link sample communication program

A simple send/receive test program is shown below for your reference. In this program, the communication parameters are set as 9600 bps, no parity, 8 data bits and 1 stop bit. This program is written in BASICA language.

```
100  '******************** INITIALIZE *************************
110  CLS
120  ON ERROR GOTO 650
130  '************ COMMUNICATION INITIALIZE ************
140  OPEN "COM1:9600,N,8,1" AS #1
150  '******************** KEY INPUT *************************
160  TEXT$="":DAT$=""
170  PRINT "INPUT DATA   = ";
180  IF DAT$=CHR$(&HD) THEN 230
190    DAT$=INKEY$:PRINT DAT$;
200    TEXT$=TEXT$+DAT$
210  GOTO 180
220  '***************** CHECKSUM MAKE *******************
230  SUM=0
240  L=LEN(TEXT$)
250  SD$=LEFT$(TEXT$,(L-2))+"&"
260  FOR I=1 TO L-1
270    A$=MID$(SD$,I,1)
280    SUM=SUM+ASC(A$)
290    NEXT I
300  SUM$=HEX$(SUM)
310  SUM$=RIGHT$(("0"+SUM$),2)
320  SD$=SD$+SUM$+")"+CHR$(&HD)
330  '******************** SEND DATA *************************
340  PRINT "SEND DATA    = ";
350  PRINT SD$;
360  PRINT #1,SD$;
370  '******************* RECEIVE DATA *********************
380  RD$="":A$="":B$="":STIME=INT(TIMER)
390  PRINT "RECEIVE DATA = ";
400  IF B$=CHR$(&HD) THEN 480
410    IF INT(TIMER)-STIME > 3 THEN PRINT "TIME-OUT": GOTO 630
420    IF LOC(1)=0 THEN 470
430      A$=INPUT$(LOC(1),#1)
440      RD$=RD$+A$
450      B$=RIGHT$(A$,1)
460      GOTO 420
470    GOTO 400
480  PRINT RD$;
490  PRINT
```

Appendix

```
500  '*************** CHECKSUM CHECK ********************
510  SUM=0
520  L=LEN(RD$)
530  FOR I=1 TO L-4
540    A$=MID$(RD$,I,1)
550    SUM=SUM+ASC(A$)
560    NEXT I
570  SUM$=HEX$(SUM)
580  SUM$=RIGHT$(("0"+SUM$),2)
590  TESTSUM$=MID$(RD$,L-3,2)
600  IF SUM$<>TESTSUM$ THEN PRINT "CHECKSUM ERROR": GOTO 630
610  '
620  GOTO 150
630  CLOSE #1: END
640  '
650  '****************** GENERAL ERROR ******************
660  PRINT "ERROR"
670  CLOSE #1
680  RESUME 100
```

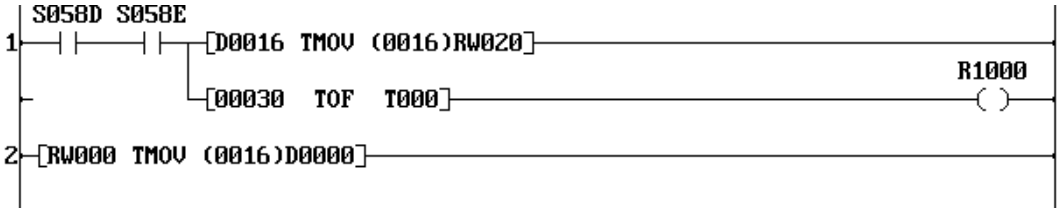
Appendix

A.2 Data link mode T1S sample program

One sample program using the data link mode is shown below.
In this program, the data link status is checked each other by S058D and S058E.
16 words data of RW000 to RW015 are sent from station 1 to station 2. And 16 words data of RW020 to RW035 are sent from station 2 to station 1.

Station 1		**Station 2**
RW000 to RW015	⟶	RW000 to RW015
RW020 to RW035	⟵	RW020 to RW035

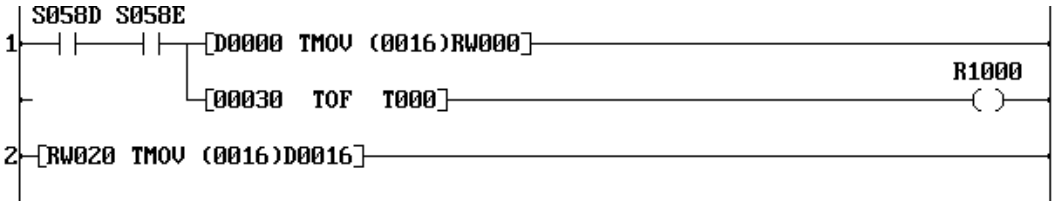
Station 1 program



Rung 1: When both S058D and S058E are ON (data link normal), R1000 is set to ON, and the received 16 words data of D0016 to D0031 are transferred to RW020 to RW035.
If S058D or S058E comes OFF and stays more than 300 ms (data link error), R1000 is reset to OFF.

Rung 2: 16 words data of RW000 to RW015 are transferred to D0000 to D0015. These data are transmitted to the station 2 T1S.

Station 2 program



Rung 1: When both S058D and S058E are ON (data link normal), R1000 is set to ON, and the received 16 words data of D0000 to D0015 are transferred to RW000 to RW015.
If S058D or S058E comes OFF and stays more than 300 ms (data link error), R1000 is reset to OFF.

Rung 2: 16 words data of RW020 to RW035 are transferred to D0016 to D0031. These data are transmitted to the station 1 T1S.

Appendix

A.3 Free ASCII mode T1S sample program

1. Variable speed drive (Toshiba's VF-S7) control

A sample program for the T1S to control the variable speed drive, VF-S7, is shown here. For details of the serial communication function of the VF-S7, read the separate manual "VF-S7 Serial Communication Function".

(1) Communication port setting

a) Free ASCII mode setting of the T1S:
Select the free ASCII mode by setting the value 2 into SW56.

b) Communication parameter setting:
Set the T1S's communication parameters (baudrate, data bit length, parity and stop bit length) to be matched the VF-S7's setting.
The VF-S7's setting at factory shipment is as follows.
Baudrate: 9600 bps (changeable)
Data bits: 8 bits (fixed)
Parity: Odd (changeable)
The T1S's stop bit length should be set to 1 bit.

c) Resetting the T1S:
Execute the EEPROM write command, and cycle power off and on again. Then the T1S is set to the free ASCII mode with the specified communication parameters.

d) Communication time-out setting of VF-S7:
To let trip the VF-S7 at the case of communication error, enable the time-out function of the VF-S7. To do this, set the monitor time on the VF-S7's parameter F803.
In this sample program, the VF-S7's operation (start and stop) is controlled through the serial communication. However, for actual application, it is recommended to use the terminal inputs for the signals F (forward) and R (reverse) even if the frequency is controlled through the serial communication.

(2) Communication commands used in this sample program

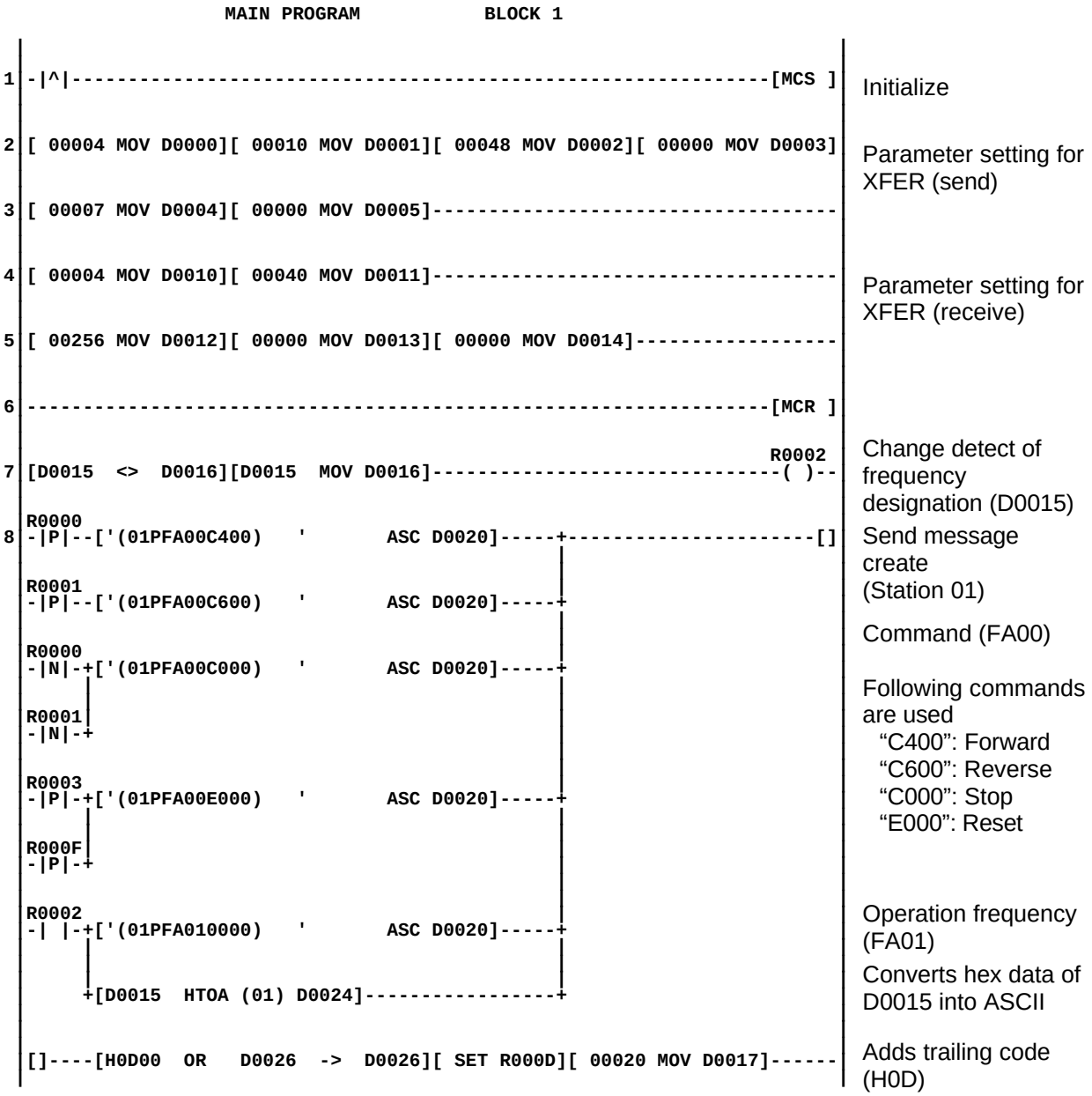
In this sample program, the following commands (function numbers) are used.
The VF-S7's station number is assumed as 01.

FE01 Operation status (read)
FA00 Control command (write) – forward / reverse / stop / reset
FA01 Operation frequency (write)

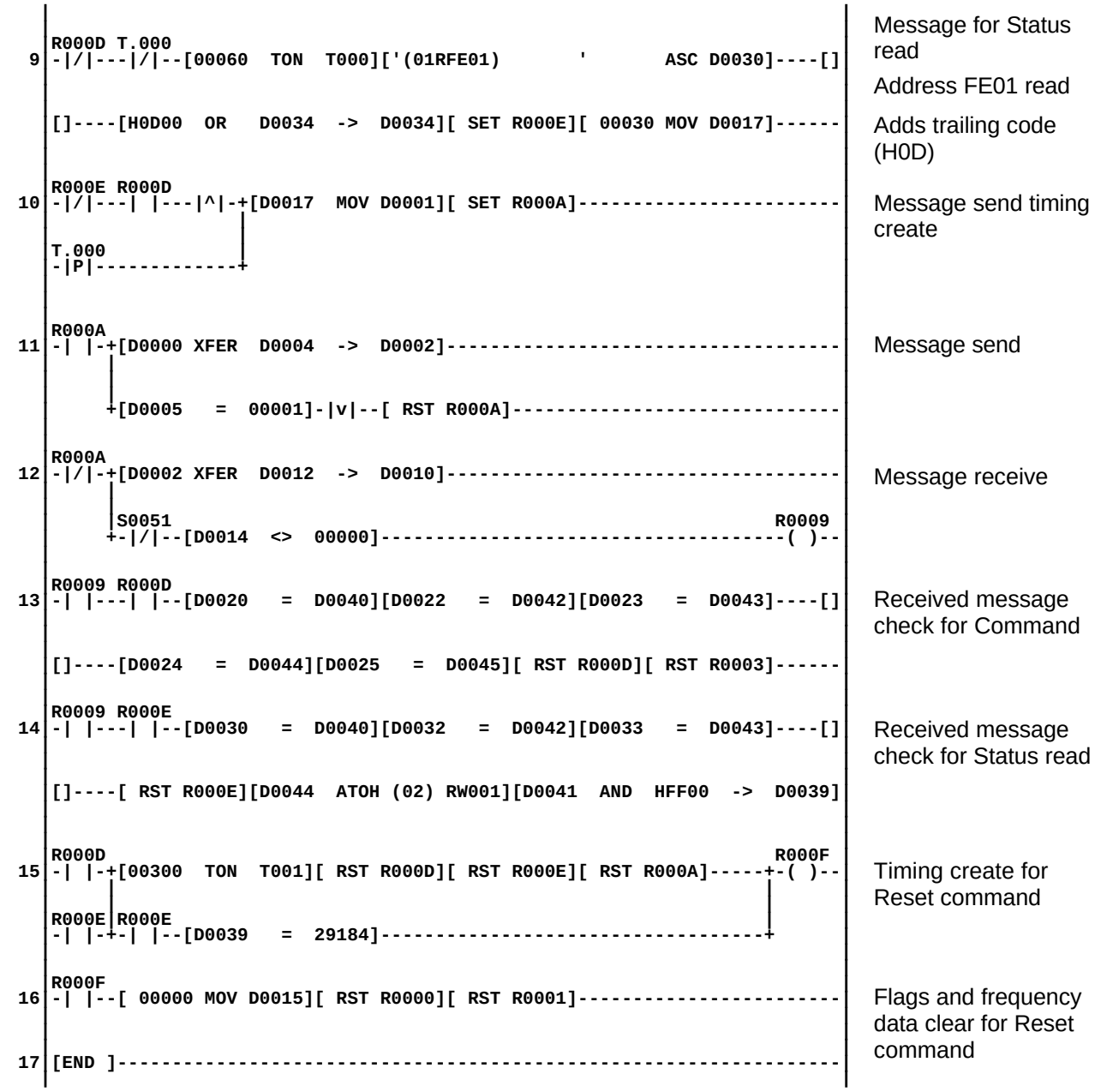
(3) T1S sample program

In this sample program, the following devices/registers are assigned.

D0015: Operation frequency (0 to 6000, 0.01 Hz increments)
R0000: Forward command (ON for start / OFF for stop)
R0001: Reverse command (ON for start / OFF for stop)
R0019: Status (forward: OFF / reverse: ON)
R001A: Status (stop: OFF / run: ON)



Appendix



Message for Status read

Address FE01 read

Adds trailing code (H0D)

Message send timing create

Message send

Message receive

Received message check for Command

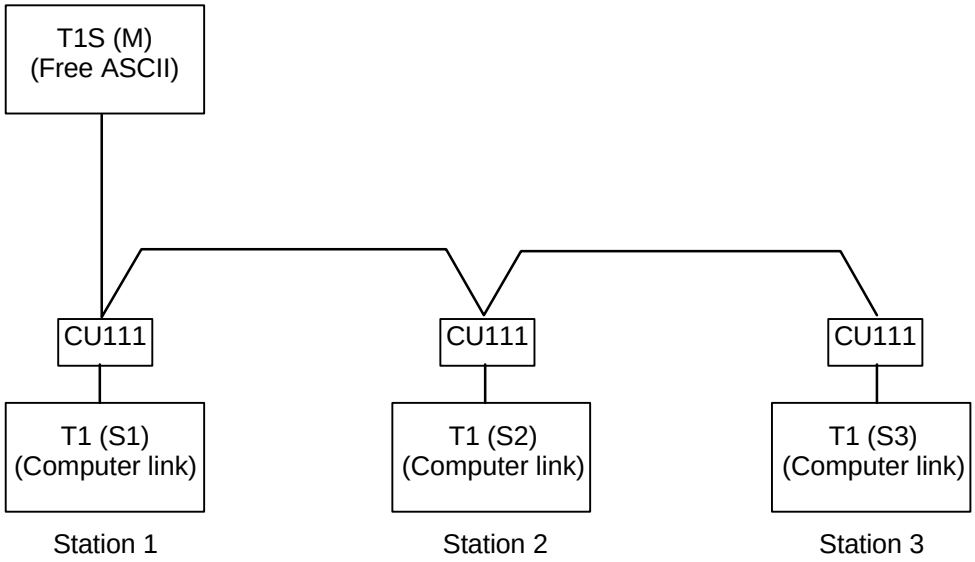
Received message check for Status read

Timing create for Reset command

Flags and frequency data clear for Reset command

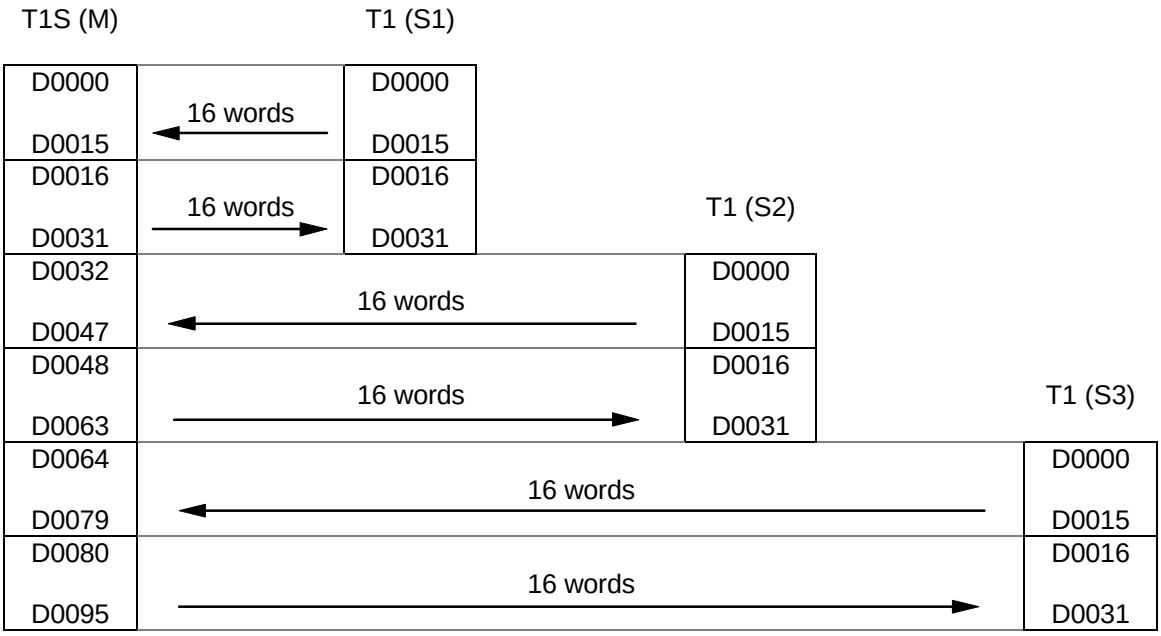
2. Data linkage between T1S and three T1s

This is an example of data linkage between the T1S and the standard T1s.
In this example, T1S (M) works as communication master using the free ASCII mode. And other T1s work as slaves using the CU111 (computer link function).



In this configuration, only T1S (M) requires the communication program. Other T1s, S1, S2 and S3, do not require any communication program.

In this sample program, the following data link assignment is used.



Appendix

(1) Communication port setting

a) Mode setting of the T1S:
Set the mode by writing the following data into SW56.

T1S (M) ... Free ASCII mode (SW56 = 2)

b) Communication parameter setting:
Set all the T1S and T1 communication parameters as same. The following settings are recommended.

Baudrate: 9600 bps
Data bits: 8 bits
Parity: Odd
Stop bit: 1 bit

Station number is needed for the slave T1s.

T1 (S1): Station number = 1
T1 (S2): Station number = 2
T1 (S3): Station number = 3

c) Resetting the T1S and T1s:
Execute the EEPROM write command. For the T1S, cycle power off and on again to set the free ASCII mode.

(2) Communication protocol used in this sample program
In this sample program, the following computer link commands are used.

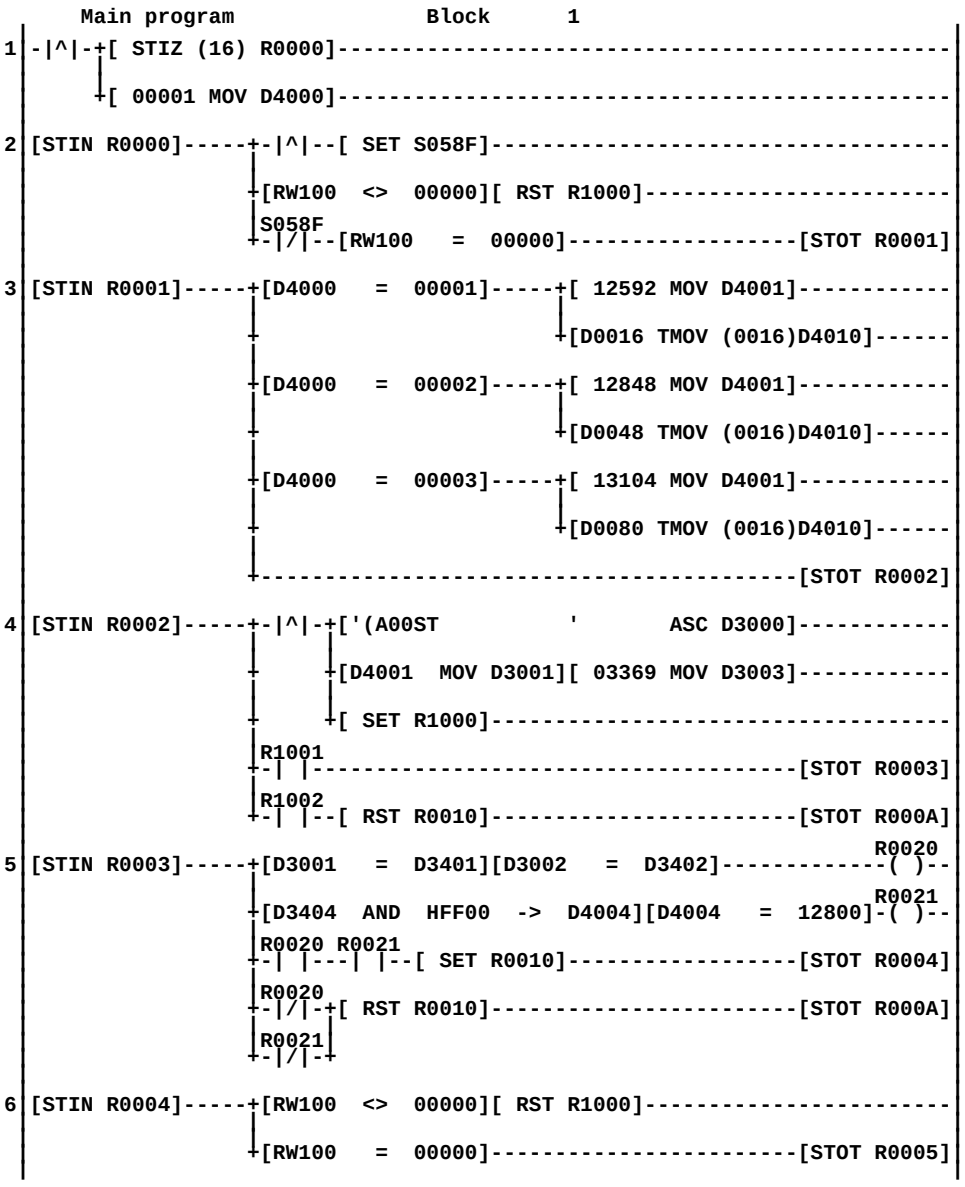
ST (status read)
DR (data read)
DW (data write)

(3) T1S sample program
In this sample program, the following devices/registers are assigned.

D0000 - D0095:	Link data as shown on the previous page
R0011:	Link status for T1 (S1) ... ON when normal
R0012:	Link status for T1 (S2) ... ON when normal
R0013:	Link status for T1 (S3) ... ON when normal
D3000 - D3255:	Reserved area for message transmitting
D3400 - D3655:	Reserved area for message receiving
D4000 - D4061:	Internal work data
R0000 - R000F:	Internal flags for sequence
R0020 - R0022:	Internal flags
R1000 - R100F:	Control flags for message transmitting/receiving
RW110 - RW118:	Parameters for message transmitting/receiving
T255:	Response time-out check

Appendix

T1S (M) Program:



Step sequence initialize
Initial station No. =1

RS-485 port and flags initialization

D4001 = station No. in ASCII

D4010 - D4025 = writing data (16 w)

ST (status read)

3369 = H0D29 = CR, ")"

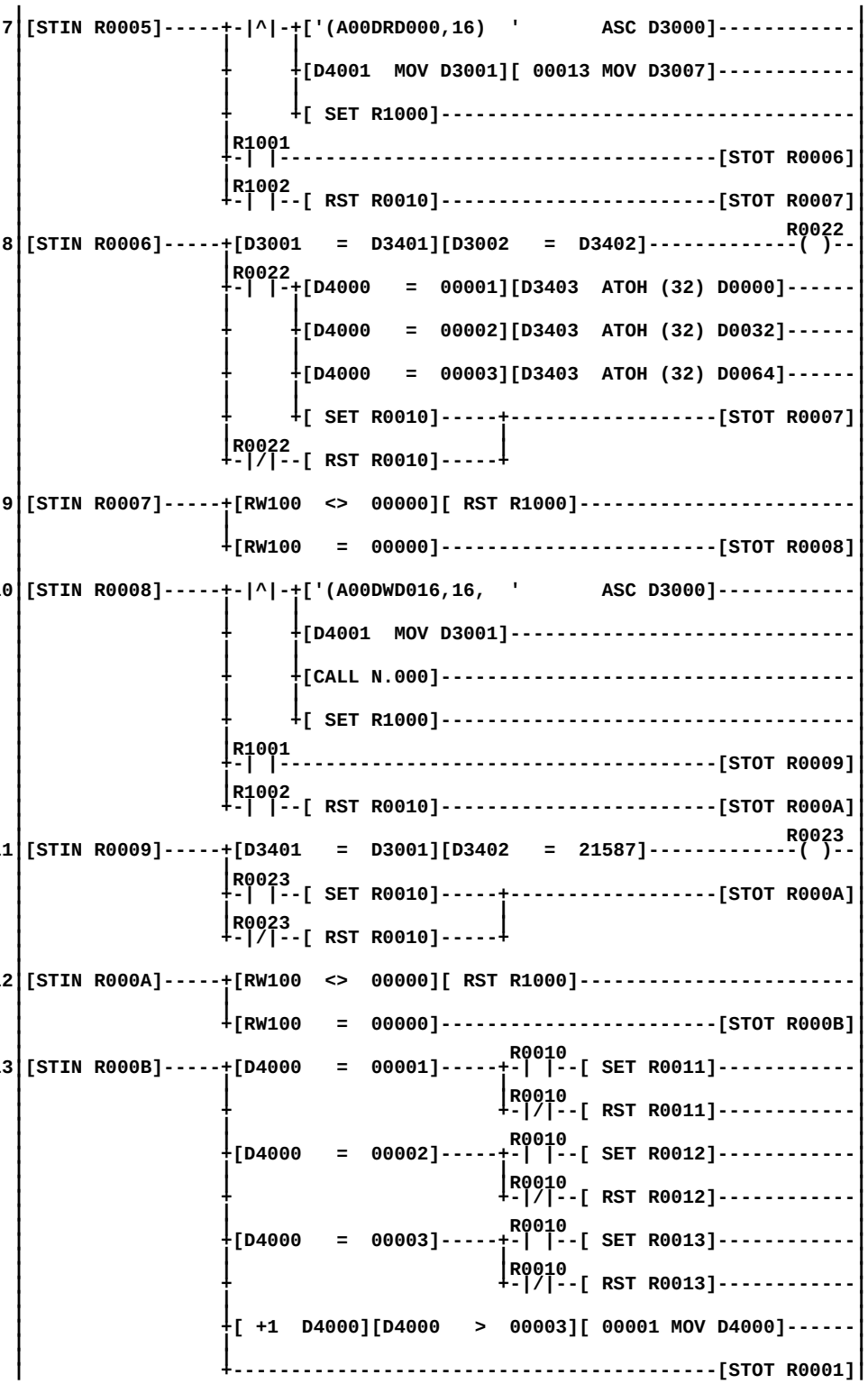
Normal (R1001=ON)

Communication error (R1002=ON)

Sets R0010 if communication is normal and the PLC is RUN

12800 = H3200 = (RUN)

Appendix



DR (data read)
16 words starting from D0000

13 = H000D = CR

Converts from ASCII to Hex and stores them into the corresponding block

DW (data write)
Write into 16 words starting from D0016

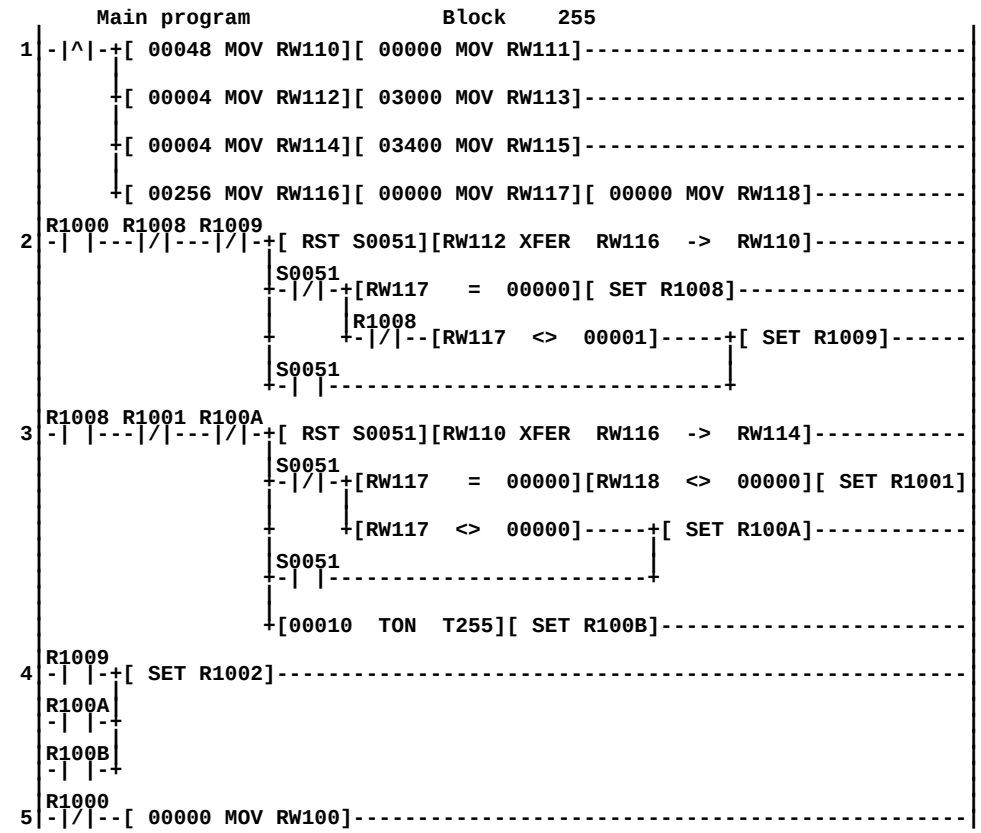
Subroutine 0: prepares writing data from Hex to ASCII

21587 = H5453
= “TS”
Checking for normal response

Set the status flug
R011 for station 1
R012 for station 2
R013 for station 3

Increases the station No., 1 to 3

Appendix



Communication driver routine

Parameter setting

Message transmitting routine

Message receiving routine
Time-out = 1 sec.

Normal: R1001=ON
Error: R1002=ON

```
     Main program                Block    256
1 |[END ]-------------------------------------------------------------|
```

```
     Subroutine                  Block      1
1 |[ SUBR(000)]-------------------------------------------------------|
2 |[ 00000 MOV  I   ][ 00000 MOV  J   ]---------------------------------|
3 |[D4010  HTOA (16) D4030]---------------------------------------------|
4 |[ FOR 00016]---------------------------------------------------------|
     I         J         I         J         J
5 |[D4030  MOV D3007][D4031  MOV D3008][ 08236 MOV D3009]---------------|
6 |[ I      +    00002 ->   I   ]-----------------------------------------|
7 |[ J      +    00003 ->   J   ]-----------------------------------------|
8 |[NEXT]---------------------------------------------------------------|
               J
9 |[ 03369 MOV D3006]---------------------------------------------------|
10|-------------------------------------------------------------[ RET]|
```

Subroutine 0:
Prepares writing data text

Converts from Hex to ASCII

8236 = H202C
= “,” (comma)

3369 = H0D29
= CR, “)”

TOSHIBA

TOSHIBA CORPORATION
Industrial Equipment Department
1-1, Shibaura 1-chome, Minato-ku
Tokyo 105-8001, JAPAN
Tel: 03-3457-4900 Fax: 03-5444-9268