TOSHIBA

PROGRAMMABLE CONTROLLER

PROSEC **T2E/T2N**

USER'S MANUAL

– Enhanced Communication Function –

Main Menu
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.
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Safety Precautions

This manual is prepared for users of Toshiba's Programmable Controller T2E and T2N.
Read this manual thoroughly before using the T2E and T2N. Also, keep this manual and related manuals so that you can read them anytime while the T2E/T2N is in operation.

Hazard Classifications

In the manuals related to the T2E/T2N, 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 "T2E User's Manual"or "T2N User's Manual" before using the T2E/T2N.

- Carefully connect the communication cable. Wrong connection can cause damage to the product.

About This Manual

This manual provides all the information you need to wire, set-up and operate the T2E's optional communication cards (CM231E and CM232E) / the T2N's built-in communication function. For your better understanding of the T2E/T2N, read the following manual at first to understand the T2E/T2N system, then read this manual.

T2E User's manual   UM-TS02E∗∗-E001
T2N User's manual   UM-TS02N∗∗-E001

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
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

Section 1

Overview

1.1   Preparation for using Enhanced communication function

<T2E>
The T2E's serial communication function can be expanded by adding the optional communication card. This card is mounted in the T2E CPU module.
The two types of the optional communication cards, CM231E and CM232E, are available depending on the serial interface. Either one can be mounted in the T2E.

Type	Serial interface	Cable connection	Remarks
CM231E	RS-485 interface	6-pin terminal block	Battery mounted
CM232E	RS-232C interface	D-sub 9-pin female	Battery mounted

CPU bus connector

Serial interface connector

Battery
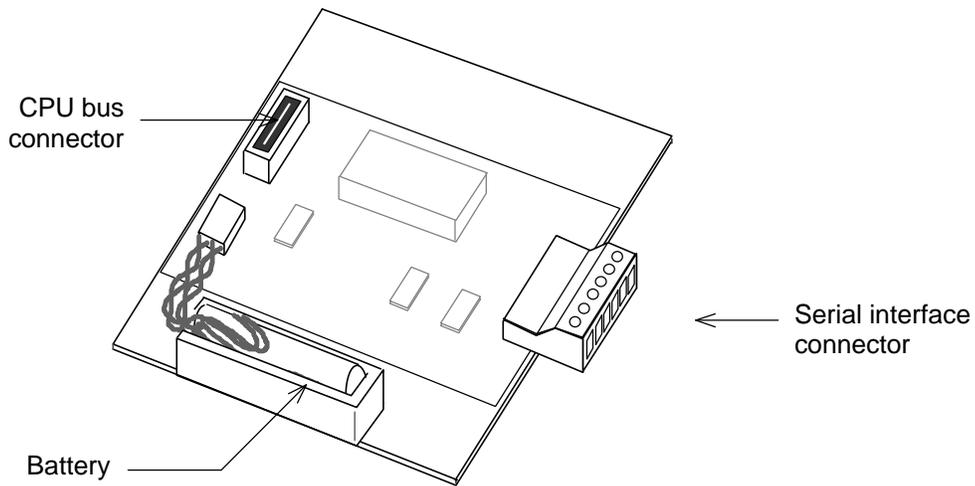
<T2N>
The T2N has built-in communication function as same as the T2E with the optional communication card. Either RS-485 or RS-232C can be used for the serial communication by selecting the DIP switch on the back of the T2N CPU module.

DIP-SW.1	Serial interface	Cable connection	Remarks
OFF	RS-485 interface	D-sub 15-pin female	
ON	RS-232C interface	D-sub 15-pin female	
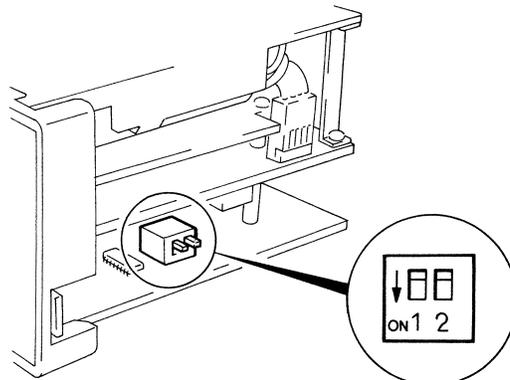
1.2 Function overview

By adding the optional communication card in the T2E or by using the built-in communication port in the T2N, one of the following communication functions can be used.

- Communication with a master computer (Computer link mode)
- Data linkage between two T2Es or two T2Ns or T2E/T2N (Data link mode)
- Active communication with serial ASCII devices (Free ASCII mode)

The operation mode is selected by the DIP switch provided on the T2E/T2N CPU module.
Refer to section 1.4.

Computer link mode

The computer link mode is used to connect between the T2E/T2N and a master computer.

When each T2E holds the CM231E (RS-485 type) or when selecting RS-485 interface in the T2N, up to 32 T2Es/T2Ns 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 T2E/T2N
- Writing data (register/device value) into the T2E/T2N
- Monitoring the T2E/T2N's operation status (RUN/HALT/ERROR)
- Controlling the T2E/T2N's operation mode (RUN/HALT)
- Program up-loading from the T2E/T2N
- Program down-loading into the T2E/T2N

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

One-to-N configuration
(T2E with CM231E)
(T2N : RS-485)

Master Computer

RS-485 (1 km max.)

T2E/N   T2E/N   T2E/N

• • •

Max. 32 T2Es

One-to-one configuration
(T2E with CM232E)
(T2N : RS-232C)

Master Computer

RS-232C
(15 m max.)

T2E/N
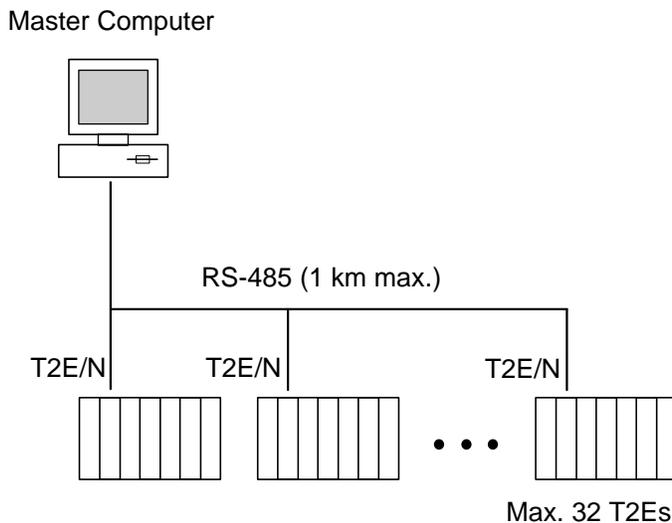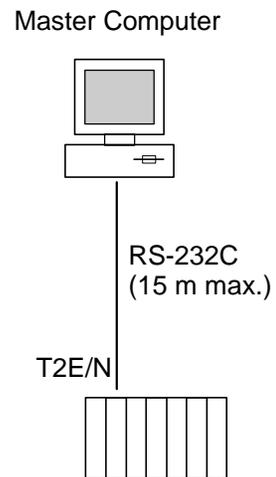
Data link mode

The data link mode is used to connect two T2Es or two T2Ns or each T2E/T2N.
Each 16 words data is automatically exchanged between the station number 1
T2E/T2N and the station number 2 T2E/T2N. No user program for this data linkage is
required.

For this function, one T2E/T2N must be set to station number 1, and the other must be
set to 2.
The file registers F0000 to F0031 (32 words) are used for this data linkage.
The data update cycle of these 32 words is approx. 50 ms. (not synchronized with
T2E/T2N's program scan)

T2E/T2N (Station No. 1)   T2E/T2N (Station No. 2)

RS-485, 1 km max. (CM231E)

RS-232C, 15 m max. (CM232E)

Station No. 1   Station No. 2

F0000		F0000
⋮	→	⋮
F0015		F0015
F0016		F0016
⋮	←	⋮
F0031		F0031
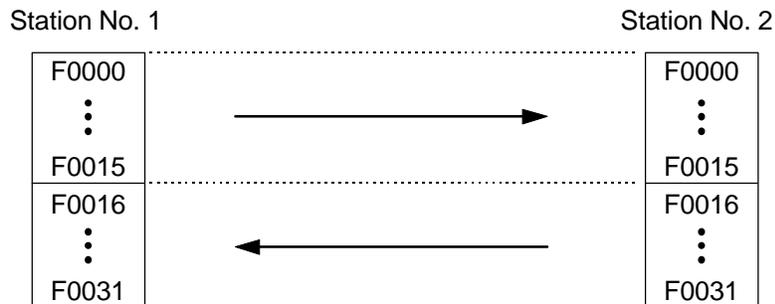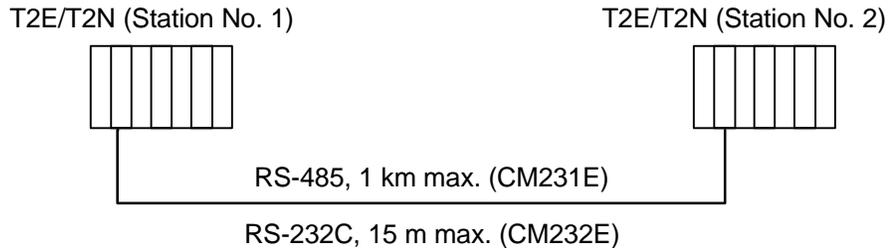
1. Overview

Free ASCII mode

The free ASCII mode is used to connect between the T2E/T2N and various serial ASCII devices, such as a micro computer, bar code reader, printer, display, etc.
By using this mode, the T2E/T2N can work as a communication master. Therefore, the T2E/T2N 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.

T2E with CM231E or T2N   T2E with CM232E or T2N

RS-232C
(15 m max.)

RS-485 (1 km max.)

| Serial ASCII device | Serial ASCII device | • • • | Serial ASCII device |

Max. 32 devices

| Serial ASCII device |

In this mode, user defined ASCII messages can be transmitted and/or received through the serial port of the optional communication card (CM231E or CM232E) in the T2E or the built-in serial port in the T2N.

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):

1	2	3	4		N-1	N
						CR

N: message length = 512 bytes max.

In other words, the T2E/T2N cannot be used for the data communication in which the transmission message is ended by two or more types of trailing code.

1.3 Installation of the optional communication card (only for T2E)

The optional communication card (CM231E or CM232E) is mounted in the T2E CPU module. The installation procedure is shown below.

① Remove the blank cover for the optional serial port from the T2E CPU module.

② In case of the CM231E, remove the terminal connector of the serial port.

③ Insert the optional communication card into the front panel of the T2E CPU module.

④ Securely connect the CPU bus connector of the T2E CPU module and the optional communication card.

⑤ Fasten the optional communication card to the T2E CPU module using the fixing tool.
The fixing tool is supplied with the optional communication card.

1.4 Operation mode selection

The operation mode of the optional communication card / the built-in communication port is selected by the DIP switch provided on the T2E/T2N CPU module.
The operation mode is internally set at the timing of power-up. Setting changes while power on is not effective.

Front of the T2E
CPU module

Front of the T2N
CPU module

DIP switch

Enhanced communication port Terminal block (RS485) or D-sub 9-pin connector (RS-232C)
(provided on the optional communication card)

Enhanced communication port D-sub 15-pin connector
RS-485 or RS-232C (selectable)

DIP switch

OFF ←

P *1
ROM
R / S
CM0
CM1
COM

Optional mode setting of communication function

CM0	CM1	Mode
OFF	OFF	Computer link mode
ON	OFF	Data link mode
OFF	ON	Free ASCII mode
ON	ON	Reserve
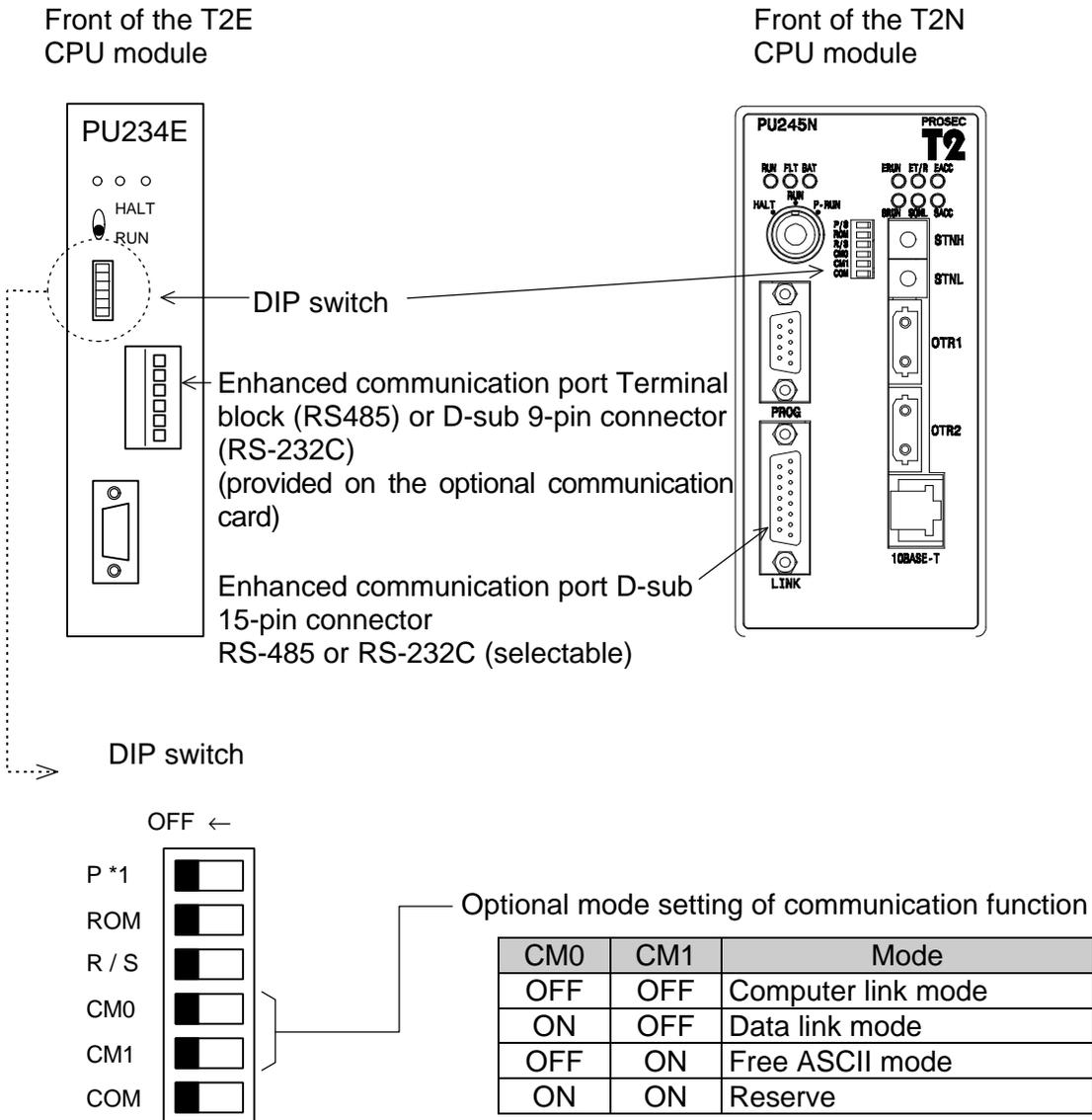
NOTE *1)   This switch is P/S in the case of T2N.

Section 2

Specifications

2. Specifications

2.1 General specifications (T2E's optional communication card)

Item	Specifications	Remarks
Power voltage	5 Vdc (supplied from CPU module)	
Current consumption	200 mA or less	Note (1)
Environmental conditions	Conforms to T2E specifications	
Insulation	500 Vac	Note (2)
Weight	100 g	

Note (1) The T2E's power supply module can supply maximum 2.5 A for the internal 5 Vdc power. Check that the internal 5 Vdc current consumption does not exceed the limit.

Note (2) Between interface connector pins and internal circuit.

2.2 Transmission specifications

- **Computer link mode**

Item	CM231E (T2E)	RS-485 (T2N)	CM232E (T2E)	RS-232C (T2N)
Interface	Conforms to RS-485 (4 or 2-wire system)		Conforms to RS-232C	
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 (Note)			
Protocol	T-series computer link protocol (ASCII), T-series programmer protocol (Binary)			
Configuration	One to N (32 max.)		One to one	
Transmission distance	1 km max.		15 m max.	
Cable connection	6-pin removable terminal block	D-sub 15-pin connector (female)	D-sub 9-pin connector (female)	D-sub 15-pin connector (female)

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. Specifications

- **Data link mode**

Item	CM231E (T2E)	RS-485 (T2N)	CM232E (T2E)	RS-232C (T2N)
Interface	Conforms to RS-485 (4-wire system)		Conforms to RS-232C	
Transmission mode	Full-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 (not synchronized with the T2E/T2N's program scan)			
Configuration	One to one			
Transmission distance	1 km max.		15 m max.	
Cable connection	6-pin removable terminal block	D-sub 15-pin connector (female)	D-sub 9-pin connector (female)	D-sub 15-pin connector (female)

- **Free ASCII mode**

Item	CM231E (T2E)	RS-485 (T2N)	CM232E (T2N)	RS-232C (T2N)
Interface	Conforms to RS-485 (4 or 2-wire system)		Conforms to RS-232C	
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 (Note)			
Transmission code	ASCII			
Message length	512 bytes max.			
Configuration	One to N (32 max.)		One to one	
Transmission distance	1 km max.		15 m max.	
Cable connection	6-pin removable terminal block	D-sub 15-pin connector (female)	D-sub 9-pin connector (female)	D-sub 15-pin connector (female)

Note)   Total number of the bits of the frame must be 10 or 11 bits.
For example, when 7 data bits and no parity is selected, the stop bit length must be 2 bits.

2. Specifications

Note) The following combinations of frame format are available.

Start bit	Data Length	Parity	Stop bit
1	7	non	2
1	7	even/odd	1
1	7	even/odd	2
1	8	non	1
1	8	non	2
1	8	even/odd	1

Section 3

Computer Link Mode

3. Computer Link Mode

3.1 Computer link function

The computer link mode is used to connect between the T2E/T2N 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 T2E/T2N
- Writing data (register/device value) into the T2E/T2N
- Monitoring the T2E/T2N's operation status (RUN/HALT/ERROR)
- Controlling the T2E/T2N's operation mode (RUN/HALT)
- Program up-loading from the T2E/T2N
- Program down-loading into the T2E/T2N

When each T2E holds the CM231E (RS-485 type) or when selecting RS-485 interface in the T2N, up to 32 T2E/T2Ns can be connected to a master computer on the RS-485 communication line. (one-to-N configuration)

In case of the CM232E (RS-232C type) or selecting RS-232C interface in the T2N, one T2E/T2N can be connected to a master computer through the RS-232C communication line. (one-to-one configuration)

In the computer link system, the T2E/T2N waits for receiving a request message issued from the master computer.
When a request message is issued, the T2E/T2N checks the station number contained in the request message. And when the station number designation matches the T2E/T2N's station number setting, the T2E/T2N processes the request and returns the response.
This is why each T2E/T2N must have a unique station number in the one-to-N configuration. Otherwise, more than T2E/T2Ns 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.
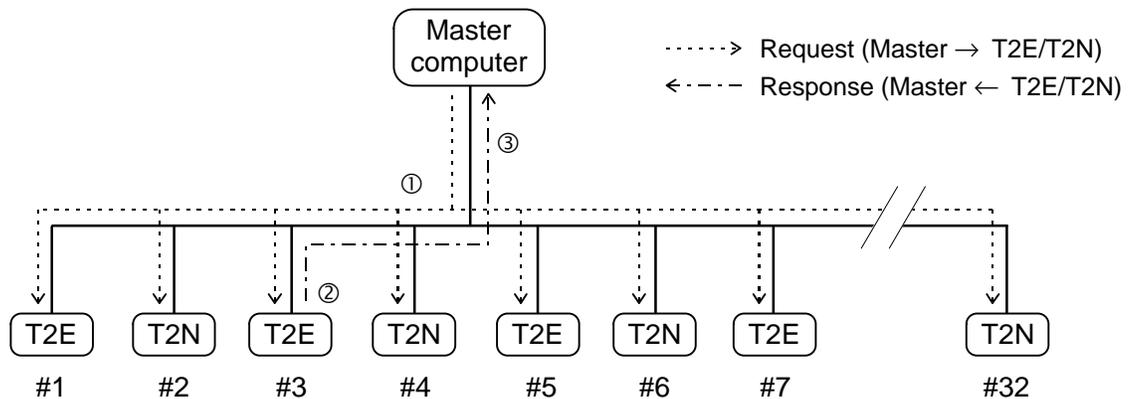
① The request message is sent from the master to all the connected T2E/T2Ns. (request for station #3 in this example)

② The request message is interpreted and processed in the T2E which has the same station number as request. (station #3 T2E 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 T2E/T2N's system information memory.

Supplementary function for computer link

The following supplementary function are prepared for applying to various system control using computer link function.

	Name	Function
S158	Peripheral support priority	OFF : normal operation ON : Peripheral support processing (Computer link) is executed in one scan time.
SW038	Response delay mode on the programmer port	Setting value : 0-30 A response message is issued from the T2E/T2N after (setting value *10) ms.
SW057	Response delay mode on the enhanced communication port	Setting value : 0-30 A response message is issued from the T2E/T2N after (setting value *10) ms.

3.2   System configuration

The following figure shows the system configuration.

With using the CM231E (RS-485 type) in the T2E or selecting RS-485 interface in the T2N, one-to-N configuration (N is max. 32) is available. If the master computer has RS-232C interface only, the RS-232C/RS-485 converter (ADP-6237B) can be used.

When the CM232E (RS-232C type) is used in the T2E or when RS-232C interface is selected in the T2N, one-to-one configuration is available without need of the converter.

One-to-N configuration
(T2E with CM231E)
(T2N : RS-485)

One-to-one configuration
(T2E with CM232E)
(T2N : RS-232C)

Master Computer

Master Computer

RS-232C/RS-485 converter

ADP-6237B

RS-485 (1 km max.)

RS-232C (15 m max.)

T2E/N   T2E/N   T2E/N   T2E/N

• • •

Max. 32 T2Es
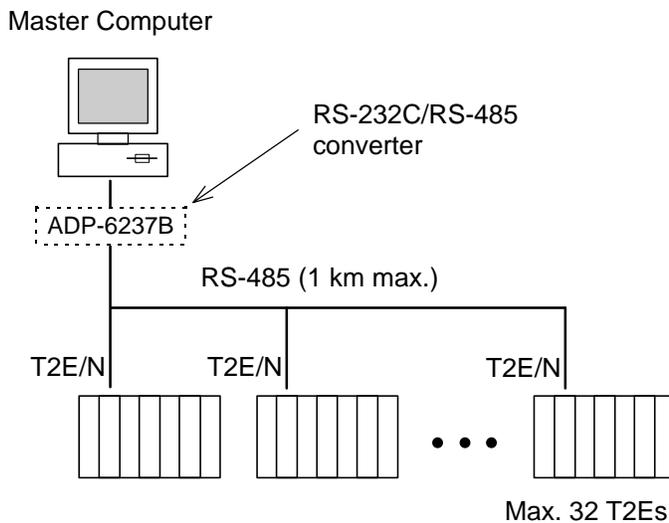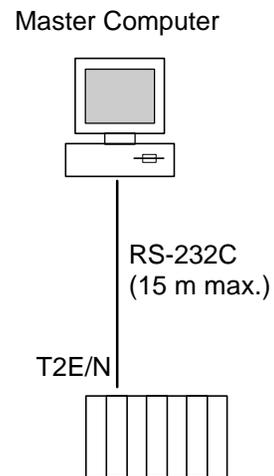
3.3   Setup procedure

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

T2E/T2N power off	
Communication wiring	Connect the T2E/T2N to the master computer by RS-485 or RS-232C interface. Refer to section 3.4
Communication function Operation mode setting	Select the computer link mode by setting the T2E/T2N's DIP switch. Refer to section 3.5
T2E/T2N power on	
Communication parameter setting (in HALT mode)	Set the station number, baudrate, parity, data bit length, and stop bit. Refer to section 3.6
Writing into the EEPROM (in HALT mode)	
Master computer side programming for communication	Refer to section 3.7 and the separate "T-series Computer Link manual" for the computer link protocol
Computer link operation is started	

3.4   Cable connection

3.4.1   RS-485 cable connection

Cable connection examples show as below.
- Below figure shows an example of cable connection using the RS-232C/RS-485 converter (ADP-6237B).
- Use shielded twisted-pair cable for data communication suited to RS-485 standard. The cable shield should be connected to single -point ground.

<T2E>Using the CM231E (RS-485) — One to one configuration

Master computer		RS-232C/RS-485 converter (ADP-6237B)			T2E (CM231E)
TXD		3	RXD	TXA	RXA
RXD		2	TXD	TXB	RXB
RTS		5	CTS	RXA	TXA
CTS		4	RTS	RXB	TXB
SG		7	SG	SG	SG
DTR		6	DSR	TERM	TERM
DSR		20	DTR	FG	
CD		8	CD		
		1	FG		

RS-232C (15 m max.)

RS-485 (1 km max.)

25-pin connector   Terminal block
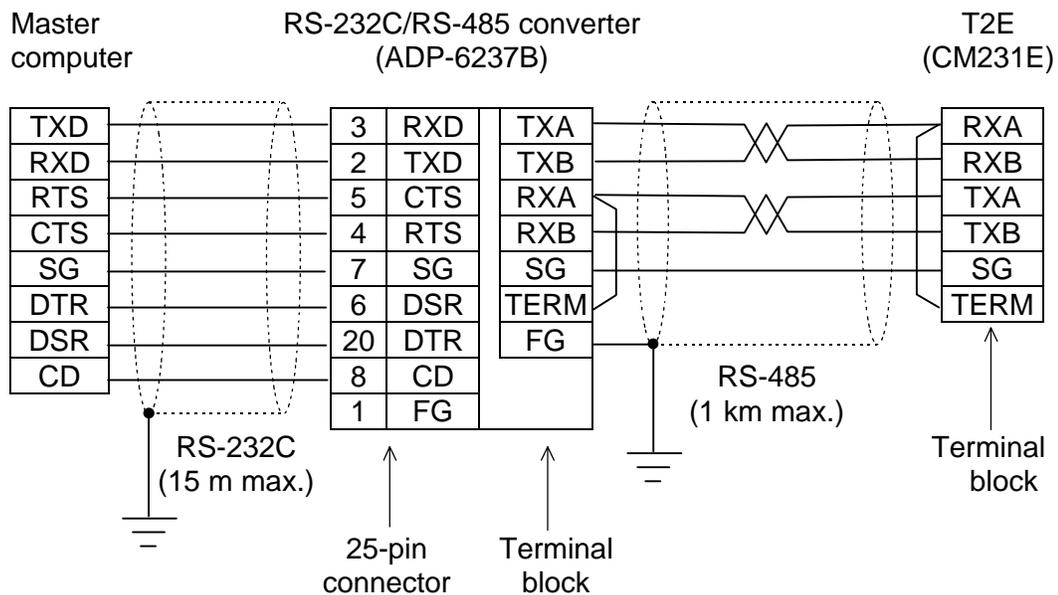
Terminal block

- On the CM231E, removable terminal block is provided for cable connection.
- Short between RXA and TERM for termination at both the CM231E and the ADP-6237B.
- If the master has RS-485 (or RS-422) interface and the CM231E is connected to the master directly, connect termination resistor 1/2 W - 120 Ω between RXA and RXB at the master end.

3. Computer Link Mode

<T2N>Using RS-485 interface — One to one configuration

| Master computer | RS-232C/RS-485 converter (ADP-6237B) | | | | T2N |
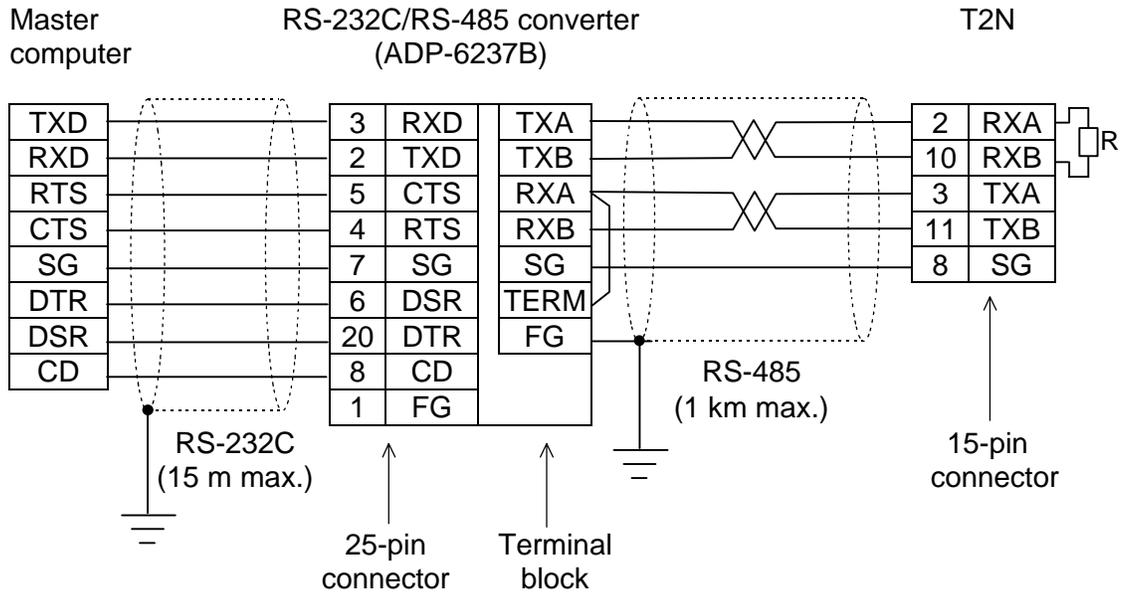
- On the T2N's built-in serial port, D-SUB 15pins female connector is provided for cable connection. Use D-SUB 15pins male connector for cable side connetor.
- Short between RXA and TERM for termination at the ADP-6237B and connect termination resistor 1/2 W - 120 Ω between RXA and RXB at the D-SUB 15pins connector.
- If the master has RS-485 (or RS-422) interface and the T2N is connected to the master directly, connect termination resistor 1/2 W - 120 Ω between RXA and RXB at both the master end and the T2N.
- We recommend using relaying terminal block to connect termination resistor at the T2N end. The length between relaying terminal block and the T2N should be within 3m.

Using the CM231E (RS-485) / T2N— One to N configuration
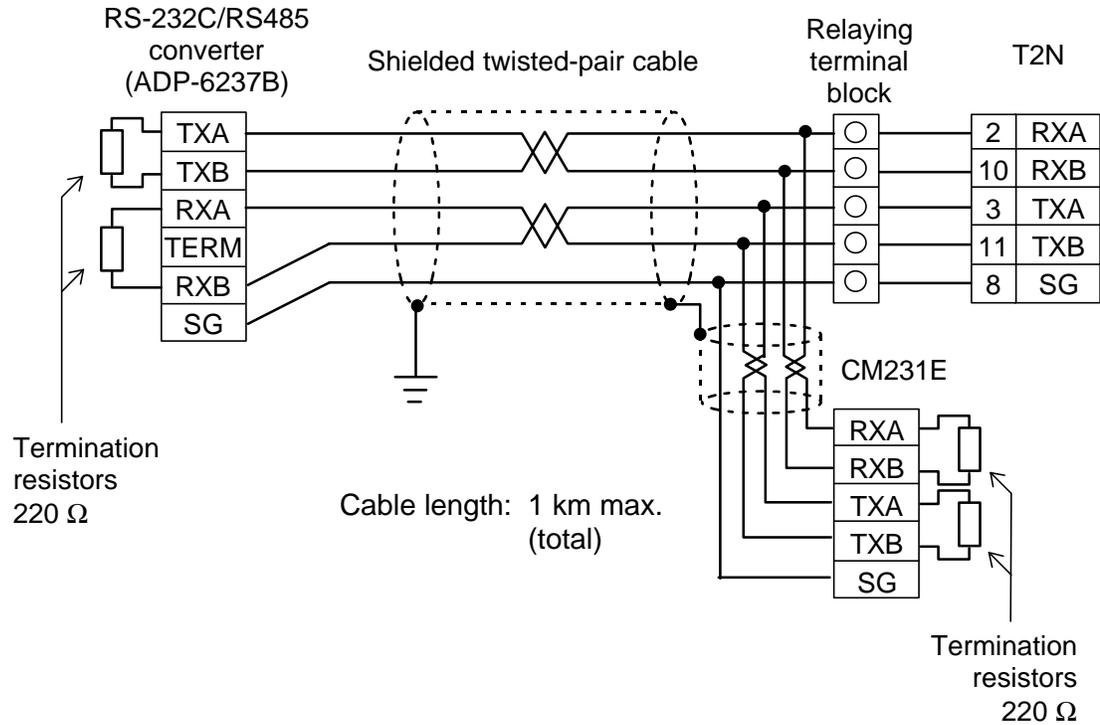
- On the CM231E, removable terminal block is provided for cable connection.
- Connect termination resistor 1/2 W - 220 Ω between RXA and RXB, and between TXA and TXB at the both terminal stations.
- Use shielded twisted-pair cable for data communication suited to RS-485 standard. The cable shield should be connected to single-point ground.

3. Computer Link Mode

3.4.1 RS-232C cable connection

Cable connection examples show as below.

- Use shielded twisted-pair cable for data communication suited to RS-232C standard. The cable shield should be connected to single -point ground.

<T2E>Using the CM232E (RS-232C)

15 m max.

- On the CM232E, D-Sub 9-pin female connector is provided. Use D-Sub 9-pin male connector as cable side.
- RTS signal (pin 7) of the CM232E is ON while power on.

<T2N>Using RS-232C interface

15 m max.
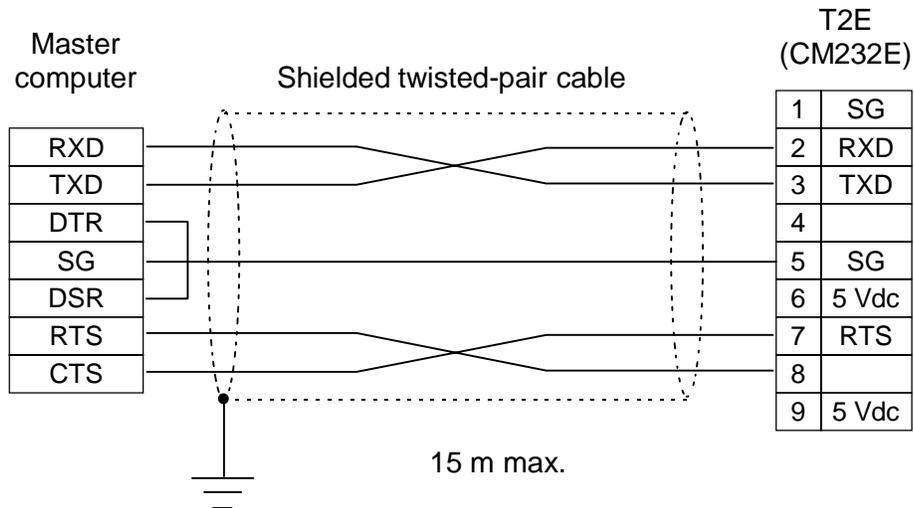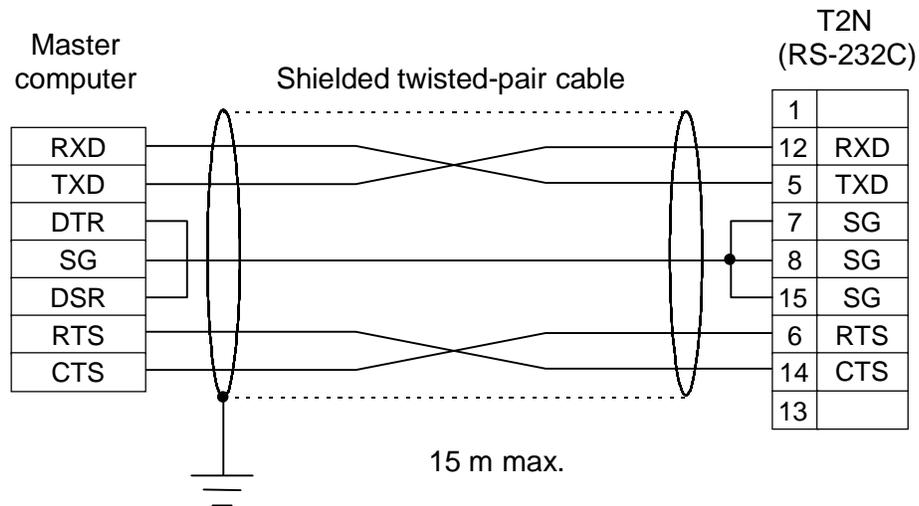
- On the T2N, D-Sub 15-pin female connector is provided. Use D-Sub 15-pin male connector as cable side.
- RTS signal (pin 6) of the T2N is ON while power on.

3.5 Mode setting

The operation mode of the T2E/T2N's enhanced communication function is selected by the DIP switch provided on the T2E/T2N CPU module.
The operation mode is internally set at the timing of power-up. Setting changes while power on is not effective.

To select the computer link mode, set the DIP switch as follows. Refer to section 1.4.

<T2E>
   DIP switch

        OFF ←

P

ROM

R / S

CM0   ←   OFF

CM1   ←   OFF

COM

<T2N>
   DIP switch

        OFF ←

P/S

ROM

R/S

CM0

CM1

COM

3.6 Communication parameter setting

The communication parameter is set by writing it into the system information memory of the T2E/T2N.

Turn the T2E/T2N to HALT mode, then set the communication parameter in the system information.

(T-PDS screen example)

```
        <System Parameters>

11. Program Size Setting    [10]kSteps    14. Scan Time Setting   [   ]x10mS

12. Sampling Buffer Size  [    ]kWords    15. Subprogram Execution Time
                                                  1 ～ 100 mS   [    ]mS
13. Retentive Memory Area
              RW000  ～  [    ]           16. Timer Interrupt Interval
              T000   ～  [    ]                  2 ～ 1000 mS  [    ]mS
              C000   ～  [    ]
              D0000  ～  [    ]           17. Computer Link Settings
                                                Station No.     [ 1]
14. 10mS Timer                                  Baud rate    [ 9600]BPS
              T000   ～  [ 63]                   Parity       Non  Odd  Even
                                                Data length     [8]Bit
15. Start Mode                                  Stop bit      1    2
                  Stanby    Auto
```

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

After the communication parameter setting, write it into the T2E/T2N's built-in EEPROM before turning off power.

3.7   Computer link protocol

This section introduces the general message format of the T-series computer link protocol and the types of commands.
For details of the T-series computer link protocol, refer to the separate manual **"T-series Computer Link Operation Manual".**

General message format

Number of bytes   Max. 255 bytes

1	2	3	4	5	6	7					
(	A	ADR	CMD		DATA		&	SUM	)/;	CR	

Checksum creation range

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:

(	A	0	1	S	T	&	9	7	)	CR

'(' = H28
'A' = H41
'0' = H30
'1' = H31
'S' = H53
'T' = H54
'&' = H26

H197 ←—— Sum

Lower two digits
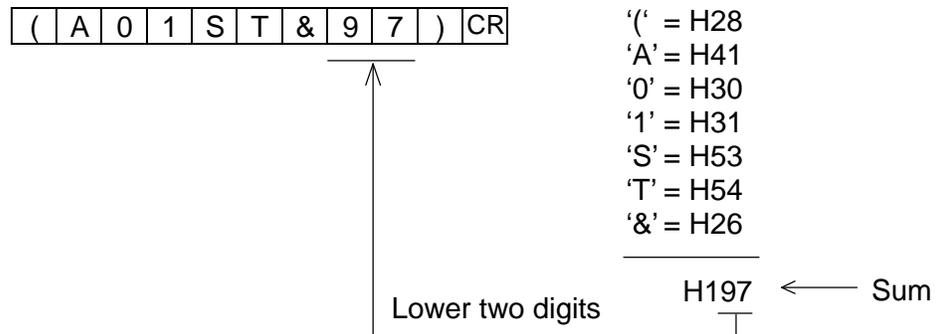
3. Computer Link Mode

List of computer link commands

The following computer link commands are available.

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 T2E/T2N	EE	Response only
TS	Test	Loop back test T2E/T2N returns the same text	TS	
ST	PLC Status Read	Reads T2E/T2N operation status	ST	
ER	PLC Error Status Read	Reads error code registered in the T2E/T2N	ER	
DR	Data Read	Reads registers/devices data from the T2E/T2N	DR	
DW	Data Write	Writes registers/devices data into the T2E/T2N	ST	
SR	System Info 1 Read	Reads T2E/T2N's system information 1	SR	
S2	System Info 2 Read	Reads T2E/T2N's system information 2	S2	
TR	Diagnostic Message Read	Reads user-defined error information from the T2E/T2N	TR	
RT	Clock-calendar Read	Reads clock-calendar data from the T2E/T2N	RT	
WT	Clock-calendar Write	Writes clock-calendar data into the T2E/T2N	ST	
EC	PLC Control	Changes T2E/T2N operation status	ST	
BR	System Info Block Read	Reads T2E/T2N's system information, block by block	BR	
RB	Program Block Read	Reads T2E/T2N's program, block by block	RB	
BW	System Info Block Write	Writes T2E/T2N's system information, block by block	ST	
WB	Program Block Write	Writes program, block by block	ST	

NOTE   For details of the T-series computer link protocol, refer to the separate manual **"T-series Computer Link Operation Manual".**

Section 4

Data Link Mode

4. Data Link Mode

4.1 Data link function

The data link function performs data linkage between two T2Es or two T2Ns or each T2E/T2N. 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 T2E/T2N 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 T2E/T2N, as same as the computer link setting.

The file registers F0000 to F0031 (32 words) are used for this data linkage.
The station No. 1 T2E/N sends the data of F0000 to F0015 to the station No. 2 T2E/N.
The station No. 2 T2E/N sends the data of F0016 to F0031 to the station No. 1 T2E/N.

Station No. 1   Station No. 2

F0000	→	F0000
F0015		F0015
F0016	←	F0016
F0031		F0031
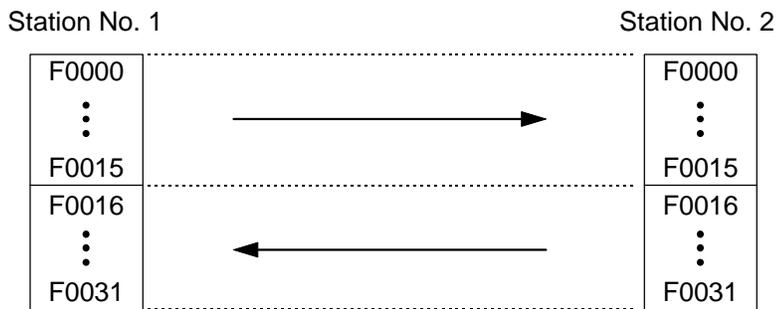
The data update cycle of these 32 words is approx. 50 ms. Note that the link data update timing is not synchronized with T2E/T2N's program scan. That is, the received data will be changed in a scan.

4.2 System configuration

In the case of the T2E, each T2E CPU must hold the optional communication card (CM231E or CM232E).

T2E/T2N (Station No. 1)   T2E/T2N (Station No. 2)

RS-485, 1 km max. (CM231E)

RS-232C, 15 m max. (CM232E)
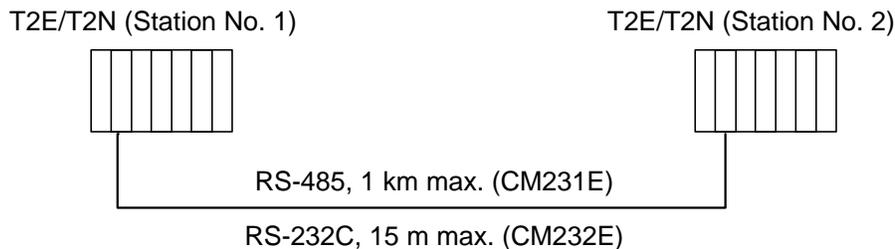
4.3   Setup procedure

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

```
        ┌────────────────────────┐
        │    T2E/T2N power off    │
        └────────────────────────┘
                    │
                    ▼
        ┌────────────────────────┐ ............  Connect the two T2E/T2Ns by RS-485 or
        │   Communication wiring │               RS-232C interface. Refer to section 4.4
        └────────────────────────┘
                    │
                    ▼
        ┌────────────────────────┐ ............  Select the data link mode by setting the
        │  Communication function│               T2E/T2N's DIP switch. Refer to section 4.5
        │  Operation mode setting│
        └────────────────────────┘
                    │
                    ▼
        ┌────────────────────────┐
        │    T2E/T2N power on     │
        └────────────────────────┘
                    │
                    ▼
        ┌────────────────────────┐ ............  Set the station number to 1 or 2.
        │  Station number setting│               Refer to section 4.6
        │    (in HALT mode)      │
        └────────────────────────┘
                    │
                    ▼
        ┌────────────────────────┐
        │  Writing into the EEPROM│
        │    (in HALT mode)      │
        └────────────────────────┘
                    │
                    ▼
        ┌────────────────────────┐
        │        RUN mode         │
        └────────────────────────┘
                    │
                    ▼
        ┌────────────────────────┐
        │   Data link operation   │
        │      is started         │
        └────────────────────────┘
```

Follow the above procedure for both station No. 1 and station No. 2 T2E/T2Ns.

4.4 Cable connection

4.4.1 RS-485 cable connection

Cable connection examples show as below.
- Use shielded twisted-pair cable for data communication suited to RS-485 standard. The cable shield should be connected to single -point ground.

<T2E>Using the CM231E (RS-485)
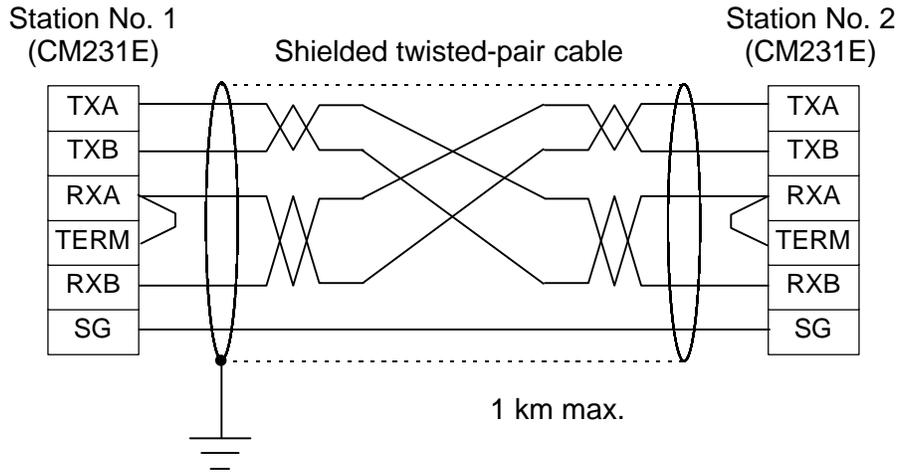
- On the CM231E, removable terminal block is provided for cable connection.
- Short between RXA and TERM for termination at both the CM231Es.

<T2N>Using RS-485 interface
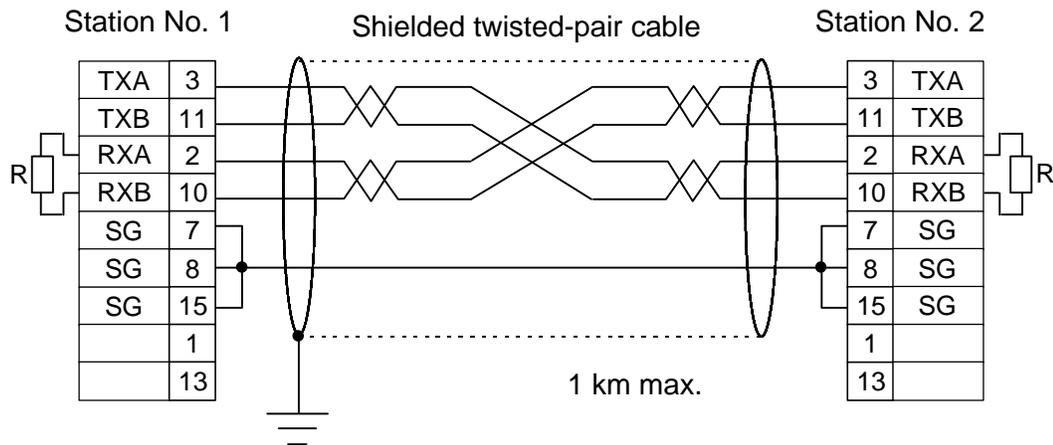
- On the T2N, D-SUB 15pins female connector is provided for cale connection. Use D-SUB 15pins male connector for cable side connector.
- Connect termination resistor 1/2W - 120Ω between RXA and RXB at both the T2Ns.

<T2E/T2N>Using the CM231E (RS-485) and RS485 interface

Station No. 1
T2E (CM231E)   Shielded twisted-pair cable   Station No. 2
                                                            T2N

TXA	
TXB	
RXA	
TERM	
RXB	
SG	

3	TXA
11	TXB
2	RXA
10	RXB
7	SG
8	SG
15	SG
1	
13	

R

1 km max.
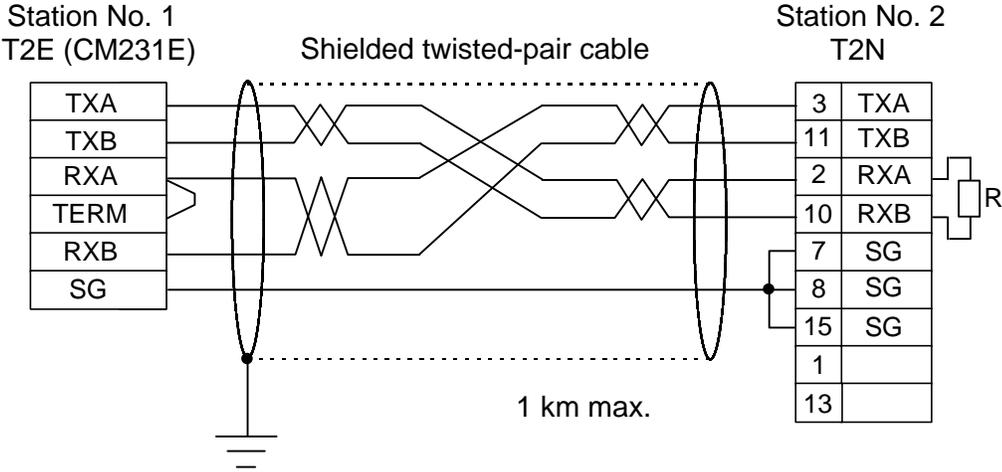
- On the CM231E, removable terminal block is provided for cable connection.
- On the T2N, D-SUB 15pins female connector is provided for cale connection. Use D-SUB 15pins male connector for cable side connector.
- Short between RXA and TERM for termination at both the CM231Es.
- Connect termination resistor 1/2W - 120Ω between RXA and RXB at the T2N.

4.4.2　RS-232C cable connection

Cable connection examples show as below.
- Use shielded twisted-pair cable for data communication suited to RS-232C standard. The cable shield should be connected to single -point ground.

<T2E>Using the CM232E (RS-232C)

Station No. 1
(CM232E)　　　Shielded twisted-pair cable　　　Station No. 2 (CM232E)

SG	1		1	SG
RXD	2		2	RXD
TXD	3		3	TXD
	4		4	
SG	5		5	SG
5 Vdc	6		6	5 Vdc
RTS	7		7	RTS
	8		8	
5 Vdc	9		9	5 Vdc

15 m max.
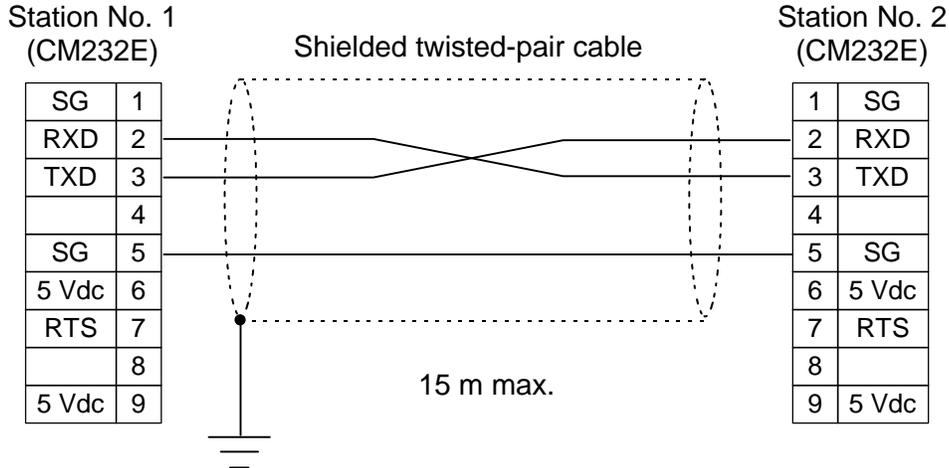
- On the CM232E, D-Sub 9-pin female connector is provided. Use D-Sub 9-pin male connector as cable side.

<T2N>Using RS-232C interface
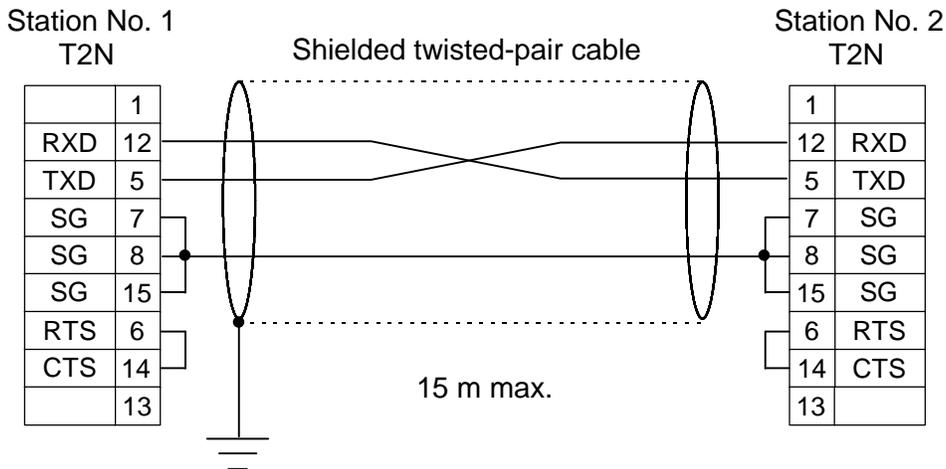
Station No. 1
T2N　　　Shielded twisted-pair cable　　　Station No. 2 T2N

	1		1	
RXD	12		12	RXD
TXD	5		5	TXD
SG	7		7	SG
SG	8		8	SG
SG	15		15	SG
RTS	6		6	RTS
CTS	14		14	CTS
	13		13	

15 m max.

- On the T2N, D-SUB 15pins female connector is provided for cable connection. Use D-SUB 15pins male connector for cable side connector.

<T2E/T2N>Using the CM232E (RS-232C) and RS-232C interface
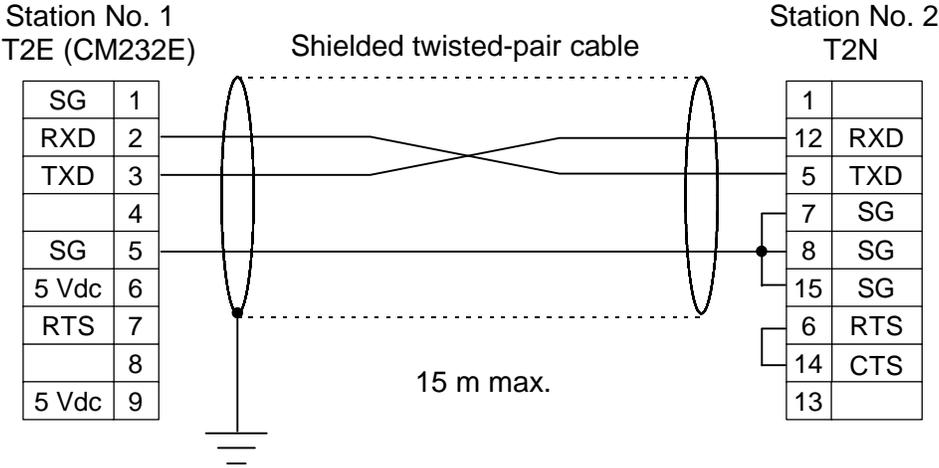
Station No. 1
T2E (CM232E)

Shielded twisted-pair cable

Station No. 2
T2N

SG	1
RXD	2
TXD	3
	4
SG	5
5 Vdc	6
RTS	7
	8
5 Vdc	9

1	
12	RXD
5	TXD
7	SG
8	SG
15	SG
6	RTS
14	CTS
13	

15 m max.

- On the CM232E, D-Sub 9-pin female connector is provided. Use D-Sub 9-pin male connector as cable side.
- On the T2N, D-SUB 15pins female connector is provided for cable connection. Use D-SUB 15pins male connector for cable side connector.

4.5 Mode setting

The operation mode of the T2E/T2N's enhanced communication function is selected by the DIP switch provided on the T2E/T2N CPU module.
The operation mode is internally set at the timing of power-up. Setting changes while power on is not effective.

To select the data link mode, set the DIP switch as follows. Refer to section 1.4.
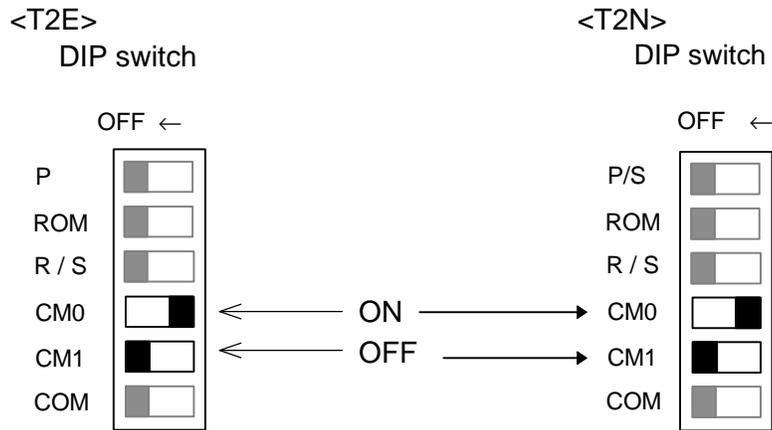
4.6 Communication parameter setting

To use the data link mode, one T2E/T2N 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 T2E/T2N.

Turn the T2E/T2N to HALT mode, then set the station number (1 or 2) in the system information.

(T-PDS screen example)

```
        <System Parameters>

11. Program Size Setting    [10]kSteps    14. Scan Time Setting  [   ]x10mS

12. Sampling Buffer Size [    ]kWords    15. Subprogram Execution Time
                                              1 ~  100 mS   [   ]mS
13. Retentive Memory Area
              RW000  ~ [    ]           16. Timer Interrupt Interval
              T000   ~ [    ]                 2 ~ 1000 mS  [   ]mS
              C000   ~ [    ]
              D0000  ~ [    ]           17. Computer Link Settings
                                              Station No.    [ 1]    <
14. 10mS Timer                                Baud rate    [ 9600]BPS
              T000   ~ [ 63]                   Parity       Non  Odd  Even
                                              Data length     [8]Bit
15. Start Mode                                Stop bit       1    2
              Stanby    Auto
```

Set the station number here.
Other parameters are ignored.

After the station number setting, write it into the T2E/T2N'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
S068D	Indicates the link partner's (T2E/T2N's) operation mode ON: RUN mode OFF: HALT or ERROR mode
S068E	Indicates the communication status ON: Normal OFF: Communication error

NOTE

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

4.8   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 S068D and S068E.
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.
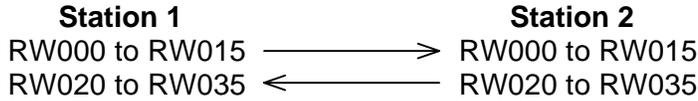
Station 1		**Station 2**
RW000 to RW015	⎯⎯⎯⎯⎯⟶	RW000 to RW015
RW020 to RW035	⟵⎯⎯⎯⎯⎯	RW020 to RW035
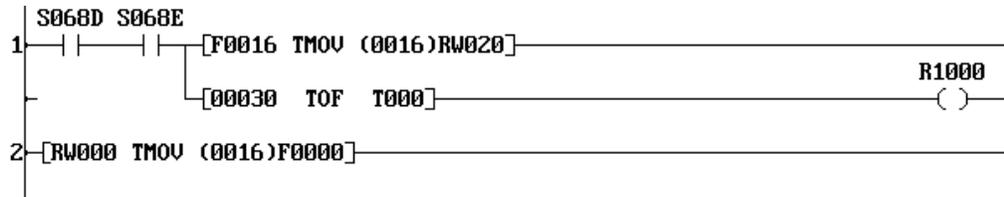
Station 1 program

```
   | S068D S068E
 1 |──┤ ├──────┤ ├──┬─[F0016 TMOV (0016)RW020]───────────────────────────────────┐
   |                │                                                      R1000 │
   |                └─[00030  TOF  T000]──────────────────────────────────────( )─┤
   |                                                                              │
 2 |─[RW000 TMOV (0016)F0000]──────────────────────────────────────────────────────┤
   |                                                                              │
```

Rung 1: When both S068D and S068E are ON (data link normal), R1000 is set to
ON, and received 16 words data of F0016 to F0031 are transferred to
RW020 to RW035.
If S068D or S068E 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 F0000 to F0015.
These data are transmitted to the station 2 T2E/T2N.
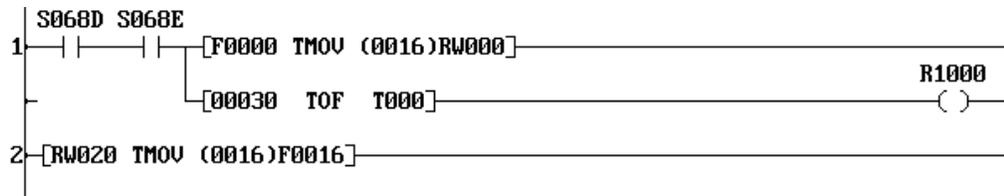
Station 2 program

```
   S068D S068E
1 ──┤ ├──────┤ ├──┬─[F0000 TMOV (0016)RW000]───────────────────────────────────────
   │                                                                          R1000
   ├            └─[00030  TOF  T000]─────────────────────────────────────────( )───
2 ─[RW020 TMOV (0016)F0016]─────────────────────────────────────────────────────
```

Rung 1: When both S068D and S068E are ON (data link normal), R1000 is set to ON, and received 16 words data of F0000 to F0015 are transferred to RW000 to RW015.
If S068D or S068E 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 F0016 to F0031. These data are transmitted to the station 1 T2E/T2N.

Section 5

Free ASCII Mode

5. Free ASCII Mode

5.1 Free ASCII communication function

The free ASCII mode is used to connect between the T2E/T2N and various serial ASCII devices, such as a micro computer, bar code reader, printer, display, etc.
By using this mode, the T2E/T2N can work as a communication master. Therefore, the T2E/T2N 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 serial port of the optional communication card (CM231E or CM232E) in the T2E or the built-in serial port in the T2N..

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):

1	2	3	4		N-1	N
						CR

N: message length = 512 bytes max.

In other words, the T2E/T2N cannot be used for the data communication in which the transmission 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 T2E/T2N'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 T2E/T2N 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.
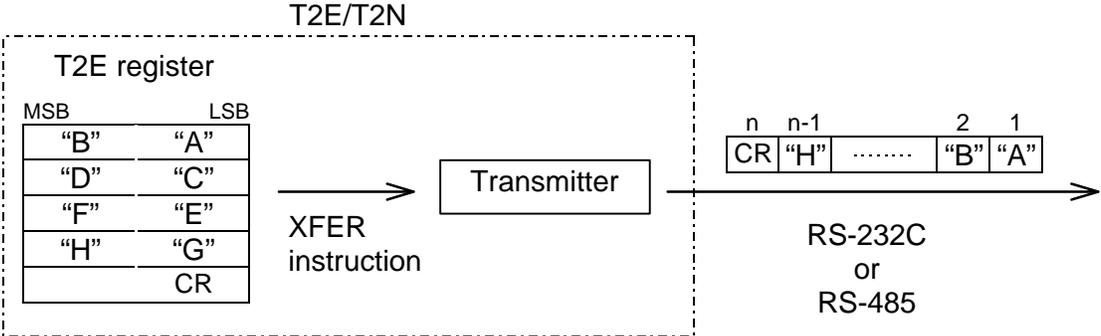
Receiving:

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 T2E registers in the format of ASCII character.
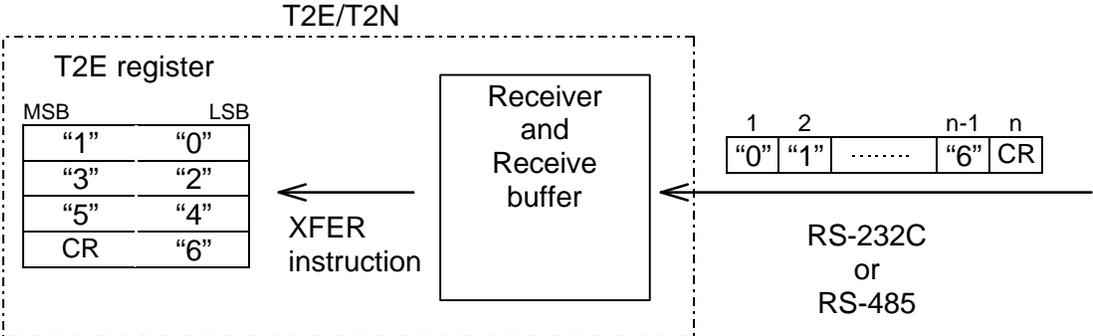
The T2E/T2N supports the hexadecimal to ASCII conversion (HTOA) instruction and the ASCII to hexadecimal conversion (ATOH) instruction. These instructions are useful to handle ASCII characters. Refer to section 5.9.

5. Free ASCII Mode

5.2 System configuration

The following figure shows the system configuration.
The T2E is connected to the serial ASCII device(s) through RS-485 (CM231E) or
RS-232C (CM232E). The T2N is connected to the serial ASCII device(s) through
RS-485 or RS-232C on the built-in serial port.

T2E with CM231E or   T2E with CM232E or
T2N (RS-485)   T2N (RS-232C)

RS-485 (1 km max.)   RS-232C
                                                      (15 m max.)

| Serial ASCII device | Serial ASCII device | ● ● ● | Serial ASCII device | | Serial ASCII device |

Max. 32 devices
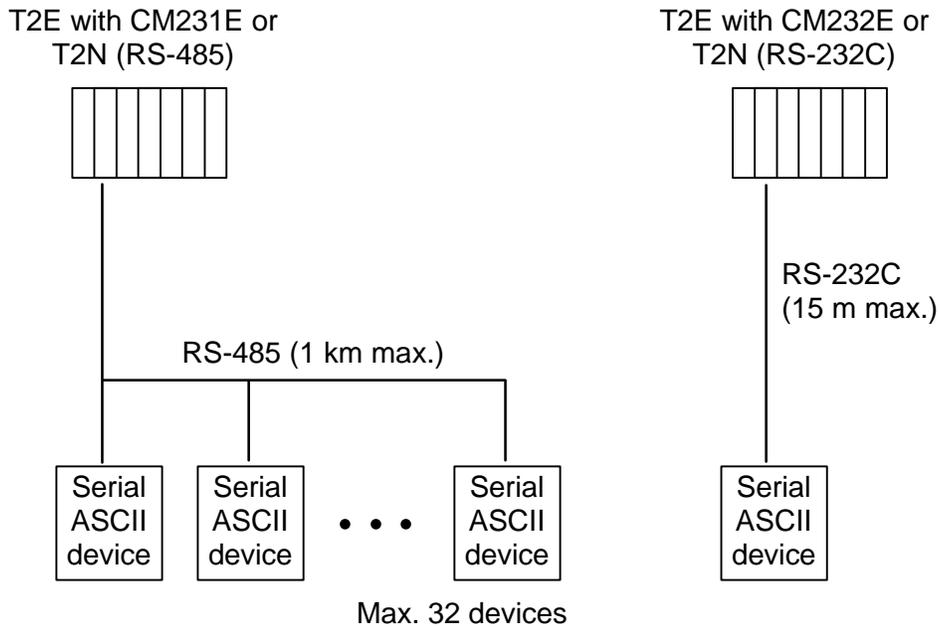
4or2 wire system selecting function (RS-485)
Either 4-wire system control or 2-wire system control can be selected in order to
connect various serial ASCII device(s) by using the following special function device.

	Name	Function
S688	RS-485 Wiring configuration	OFF : 4-wire system ON : 2-wire system(This function is available when selecting 9600 or 19200bps.)

5.3　Setup procedure

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

```
┌─────────────────────────────┐
│     T2E/T2N power off        │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐        Connect the T2E/T2N to the serial ASCII
│    Communication wiring      │········ device(s)   by RS-485 or RS-232C
└─────────────────────────────┘        interface. Refer to section 5.4
              │
              ▼
┌─────────────────────────────┐
│   Communication function     │        Select the free ASCII mode by setting the
│   Operation mode setting     │········ T2E/T2N's DIP switch. Refer to section 5.5
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│     T2E/T2N power on         │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│  Communication parameter     │        Set the baudrate, parity, data bit length,
│          setting             │········ and stop bit. Refer to section 5.6
│     (in HALT mode)           │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│   User program making        │
│  including communication     │········ Refer to section 5.8 for communication
│     (in HALT mode)           │        (transmitting and receiving messages)
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│  Writing into the EEPROM     │
│     (in HALT mode)           │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│         RUN mode             │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│    Free ASCII operation      │
│        is started            │
└─────────────────────────────┘
```

5. Free ASCII Mode

5.4   Cable connection

5.4.1   RS-485 cable connection

Cable connection examples show as below.
- Use shielded twisted-pair cable for data communication suited to RS-485 standard. The cable shield should be connected to single -point ground.

<T2E>Using the CM231E (RS-485) ─── One to one configuration : 4-wire system

1 km max.
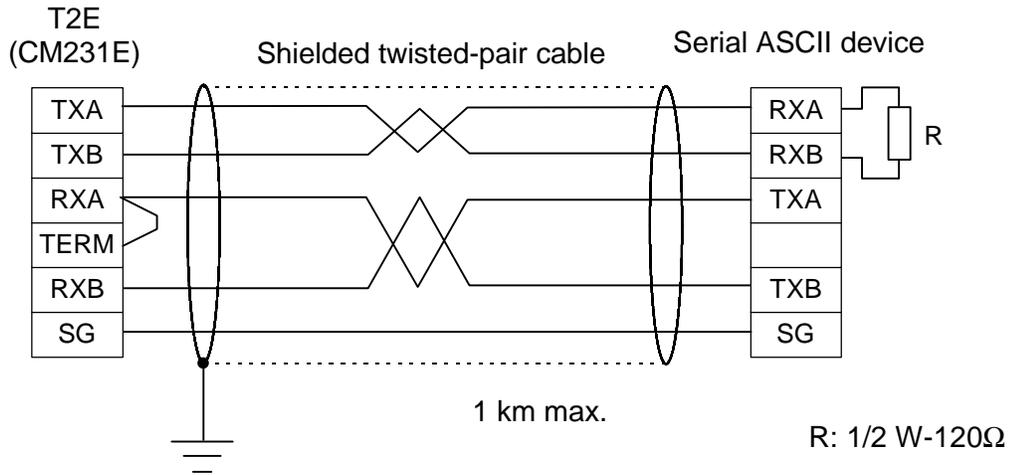
R: 1/2 W-120Ω

- On the CM231E, removable terminal block is provided for cable connection.
- Short between RXA and TERM for termination at the CM231E.
- Connect termination resistor 1/2 W - 120 Ω between RXA and RXB at the serial ASCII device.

<T2E>Using the CM231E (RS-485) ─── One to one configuration : 2-wire system

1 km max.

R: 1/2 W-120Ω

- On the CM231E, removable terminal block is provided for cable connection.
- Short between RXA and TERM for termination at the CM231E.
- Connect termination resistor 1/2 W - 120 Ω between RXA and RXB at the serial ASCII device.

<T2N>Using RS-485 interface — One to one configuration : 4-wire system

On the T2N, D-SUB 15pins female connector is provided for cable connection. Use D-SUB 15pins male connector for cable side connector.
Connect termination resistor 1/2 W - 120 Ω between RXA and RXB at both the T2N's connector and the serial ASCII device.

<T2N>Using RS-485 interface — One to one configuration : 2-wire system

On the T2N, D-SUB 15pins female connector is provided for cable connection. Use D-SUB 15pins male connector for cable side connector.
Connect termination resistor 1/2 W - 120 Ω between RXA and RXB at both the T2N's connector and the serial ASCII device.

5. Free ASCII Mode

5.4.2 RS-485 cable connection — One to N configuration

Cable connection examples show as below.
- Use shielded twisted-pair cable for data communication suited to RS-485 standard. The cable shield should be connected to single -point ground.

<T2E>Using the CM231E (RS-485) — One to N configuration : 4-wire system
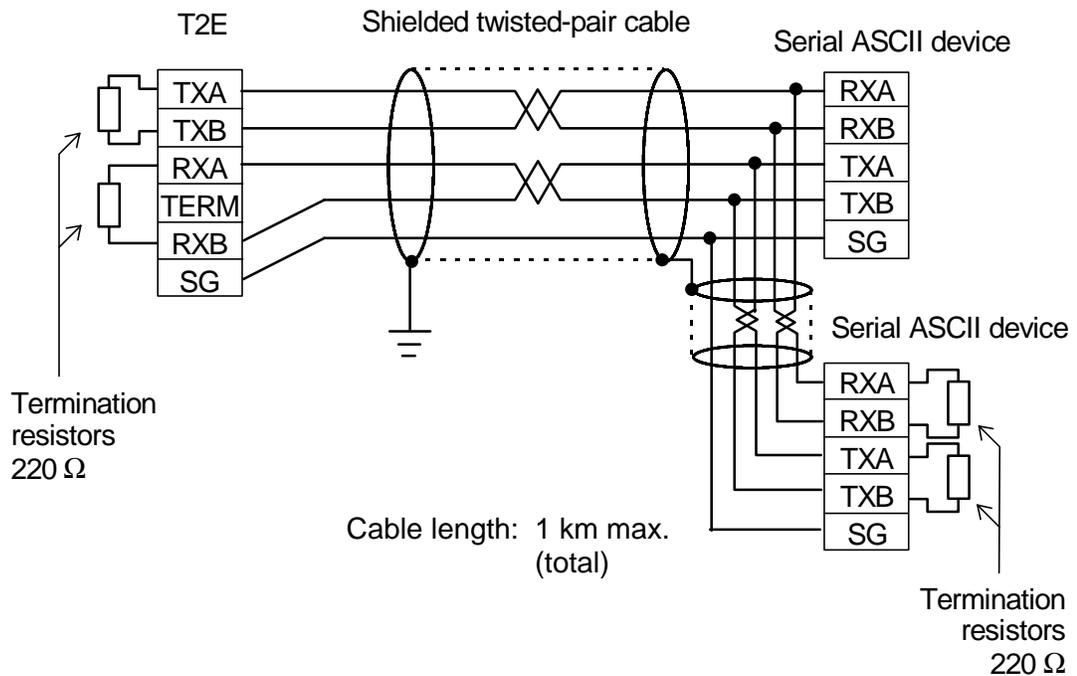
- On the CM231E, removable terminal block is provided for cable connection.
- Connect termination resistor 1/2 W - 220 Ω between RXA and RXB, and between TXA and TXB at the both terminal stations.

<T2N>Using RS-485 interface — One to N configuration : 4-wire system
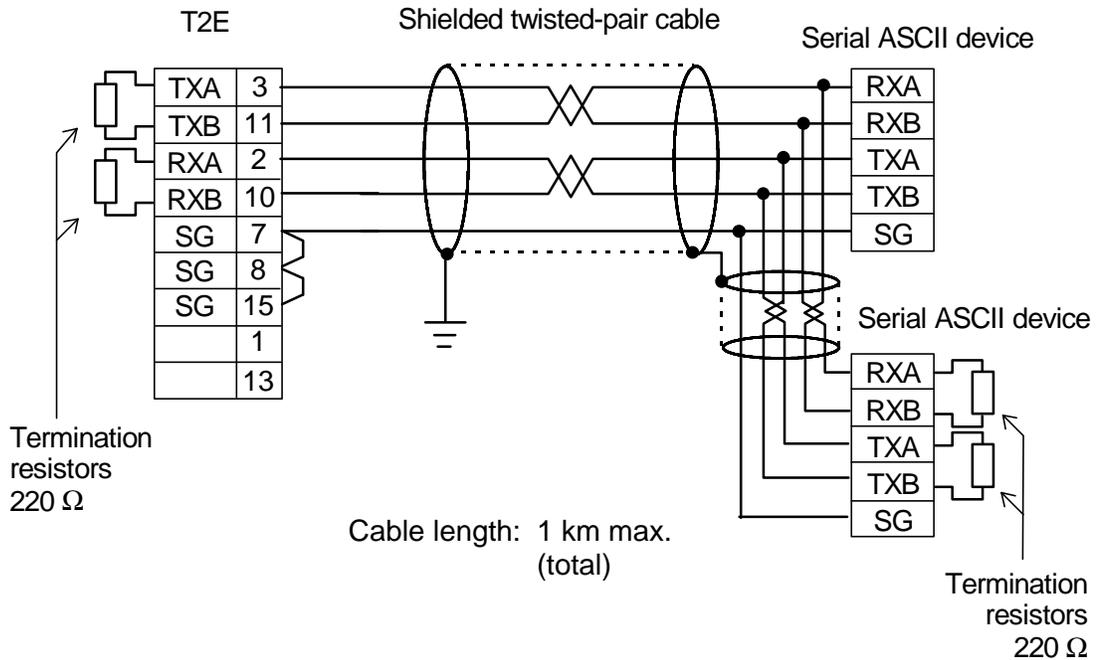
- On the T2N, D-SUB 15pins female connector is provided for cable connection. Use D-SUB 15pins male connector for cable side connector.
- Connect termination resistor 1/2 W - 220 Ω between RXA and RXB, and between TXA and TXB at the both terminal stations.

5. Free ASCII Mode

5.4.3   RS-232C cable connection — **One to one configuration**

Cable connection examples show as below.
- Use shielded twisted-pair cable for data communication suited to RS-232C standard. The cable shield should be connected to single -point ground.

<T2E>Using the CM232E (RS-232C)
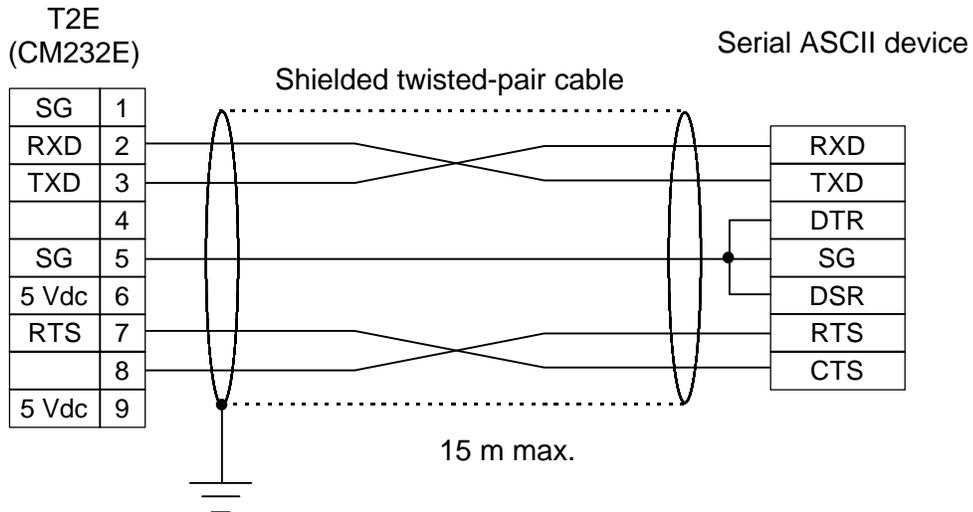
- On the CM232E, D-Sub 9-pin female connector is provided. Use D-Sub 9-pin male connector as cable side.
- RTS signal (PIN 7) of the CM232E is ON while power on.

<T2N>Using RS-232C interface
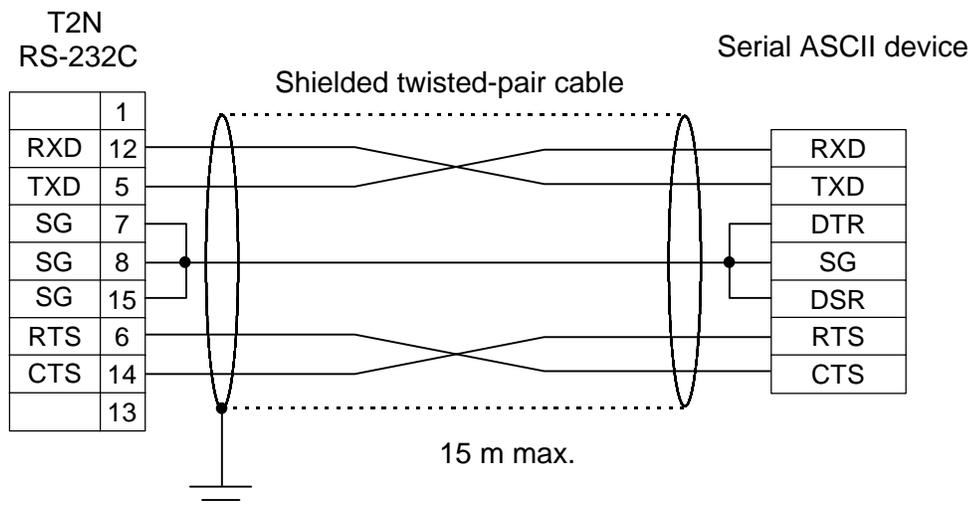
- On the T2N, D-SUB 15pins female connector is provided for cable connection. Use D-SUB 15pins male connector for cable side connector.
- RTS signal(pin 6) of the T2N is ON while power on.

5.5 Mode setting

The operation mode of the T2E/T2N's enhanced communication function is selected by the DIP switch provided on the T2E/T2N CPU module.
The operation mode is internally set at the timing of power-up. Setting changes while power on is not effective.

To select the free ASCII mode, set the DIP switch as follows. Refer to section 1.4.

5.6   Communication parameter setting

The communication parameter is set by writing it into the system information memory of the T2E/T2N.

Turn the T2E/T2N to HALT mode, then set the communication parameter in the system information.

(T-PDS screen example)

```
        <System Parameters>

11. Program Size Setting    [10]kSteps    14. Scan Time Setting  [  ]x10mS

12. Sampling Buffer Size  [    ]kWords    15. Subprogram Execution Time
                                                1 ~  100 mS   [   ]mS
13. Retentive Memory Area
              RW000  ~  [   ]            16. Timer Interrupt Interval
              T000   ~  [   ]                  2 ~ 1000 mS  [   ]mS
              C000   ~  [   ]
              D0000  ~  [   ]            17. Computer Link Settings
                                              Station No.    [ 1]
14. 10mS Timer                                Baud rate    [ 9600]BPS    ←
              T000   ~  [ 63]                  Parity      Non  Odd  Even
                                              Data length    [8]Bit
15. Start Mode                                Stop bit    1    2
              Stanby    Auto
```

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

After the communication parameter setting, write it into the T2E/T2N'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 T2E/T2N 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
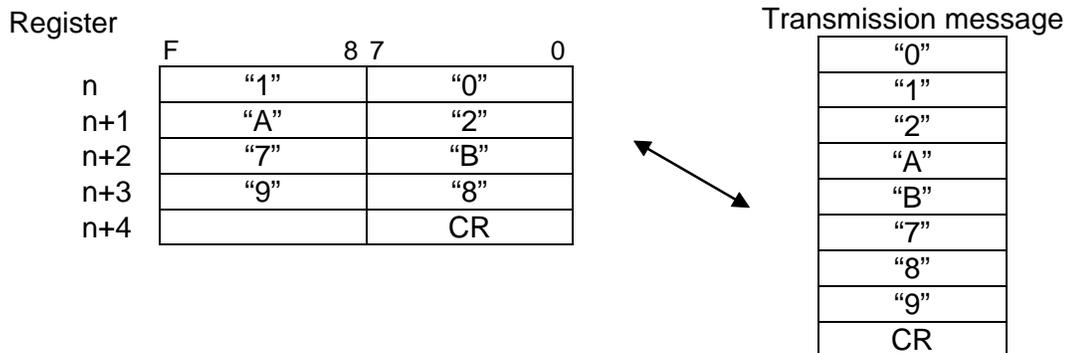
5. Free ASCII Mode

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 SW068 at the first scan.

```
         F                8  7                     0
SW068  ┌──────────────────┬──────────────────────┐
       │       H00        │   New trailing code   │
       └──────────────────┴──────────────────────┘
```
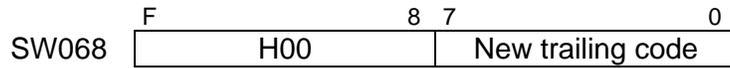
Sample program:

(Sub-program 1)

```
     │  (H0003)
  1 ─┤ [ 00003 MOV SW068]───────────────────────────────────────────────
     │
  2 ─[END ]───────────────────────────────────────────────────────────────
     │
```
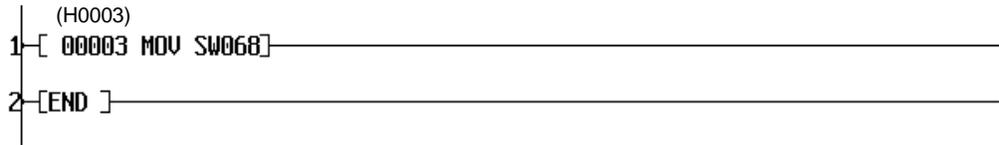
The above program is an example to change the trailing code to H03. The new trailing code H0003 is written into SW068 in the sub-program 1 (initial program).

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

	F 8 7 0	
A	H00 | H30	Optional communication card
A+1	H0000	(receiving)

Operand *B*: Parameter

	F 0	
B	Transfer length	256 (256 words) fixed
B+1	Execution status	
B+2	Receive message length (bytes)	
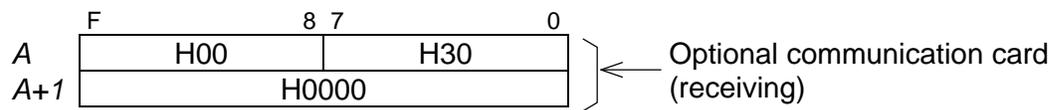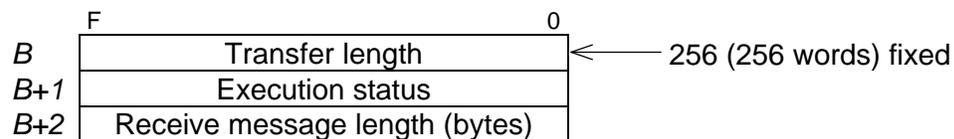
Operand *C*: Destination register

	F 8 7 0	
C	H00 | Register type	Indirectly designated register
C+1	Starting register address	H00: XW/YW
		H01: W
		H02: LW
		H03: RW
		H04: D
		H05: F
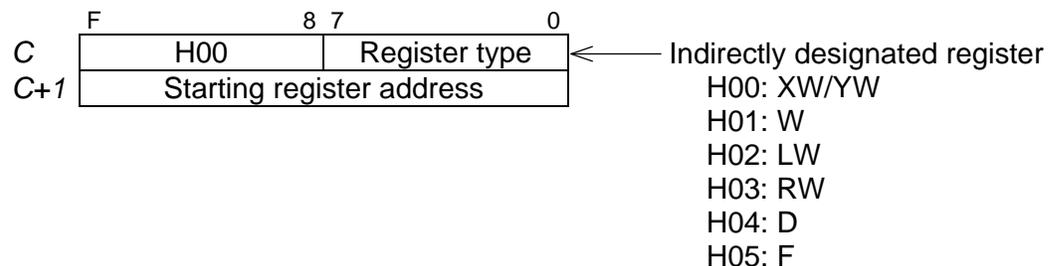
Operation:

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)

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

Baudrate	Time-out setting
300, 600, 1200 bps	30 seconds
2400 bps	15 seconds
4800 bps	7 seconds
9600 bps	3 seconds
19200 bps	1.5 seconds

Sample program:

```
1 ─┤↑├─┬[ 00048 MOV D1000]─[ 00000 MOV D1001]──────────────────────
       ├[ 00004 MOV D1002]─[ 01100 MOV D1003]──────────────────────
       └[ 00256 MOV D1004]─[ 00000 MOV D1005]─[ 00000 MOV D1006]────
   R0100 R0101 R0102
2 ─┤ ├──┤/├──┤/├─┬[ RST S0051]─[D1000 XFER  D1004   →   D1002]──────
               S0051
                 ├─┤/├─┬[D1005  =  00000]─[D1006 <> 00000]─[ SET R0101]─
                       │
                       └[D1005 <> 00000]───────────[ SET R0102]──────
               S0051
                 └─┤ ├──
   R0100
3 ─┤N├───[ RST R0101]─[ RST R0102]──────────────────────────────────
```

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 optional communication card.

XFER instruction (message send):

Input   —[*A*   XFER   *B*   →   *C*   ]—   Output

Operand *A*: Source register
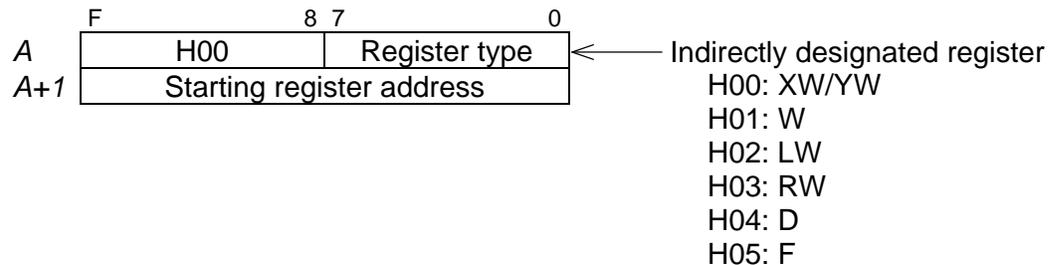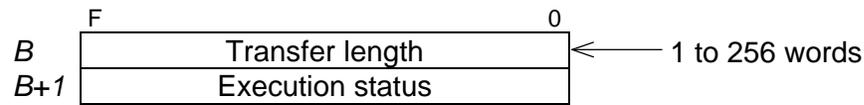
	F	8 7	0
A	H00	Register type	
A+1	Starting register address		

←——— Indirectly designated register
H00: XW/YW
H01: W
H02: LW
H03: RW
H04: D
H05: F

Operand *B*: Parameter

	F	0
B	Transfer length	
B+1	Execution status	

←——— 1 to 256 words

Operand *C*: Destination

	F	8 7	0
C	H00	H30	
C+1	H0000		

←—— Optional communication card (sending)
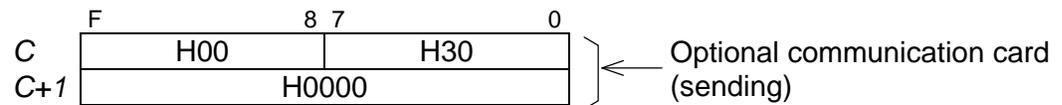
Operation:

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

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

Baudrate	Time-out setting
300, 600, 1200 bps	30 seconds
2400 bps	15 seconds
4800 bps	7 seconds
9600 bps	3 seconds
19200 bps	1.5 seconds

Sample program:

```
1 ─┤↑├──┤ 00004 MOV D1010 ┤┤ 01500 MOV D1011 ┤─────────────────────
    ├────┤ 00048 MOV D1012 ┤┤ 00000 MOV D1013 ┤─────────────────────
    └────┤ 00256 MOV D1014 ┤┤ 00000 MOV D1015 ┤─────────────────────
   R0200 R0201 R0202
2 ─┤ ├──┤/├───┤/├──┤ RST S0051 ┤┤D1010 XFER  D1014   →  D1012 ┤──────
                    S0051
                    ─┤/├────┤D1015   =  00000 ┤┤ SET R0201 ┤─────────
                      R0201
                      ─┤/├────┤D1015  <>  00001 ┤───────────┤ SET R0202 ┤───
                    S0051
                    ─┤ ├───────────────────────────────────────
   R0200
3 ─┤N├────┤ RST R0201 ┤┤ RST R0202 ┤───────────────────────────────
```
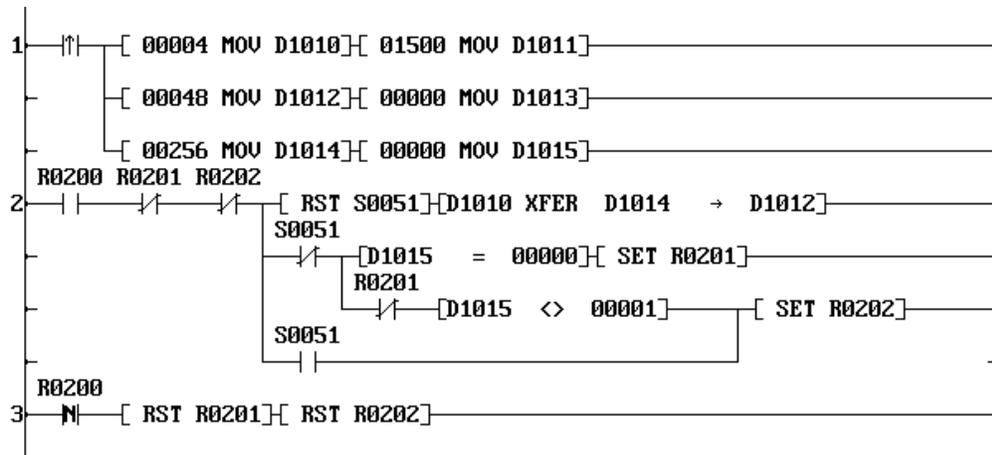
Rung 1: Sets the parameters for the XFER instruction.
The registers of 256 words starting with D1500 are reserved to store the transmitting message.

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.
While a message is transmitting, do not change the contents of the transmitting message which has been set in D1500 and after.

5.8.4   Reset operation

By setting S068F to ON, resetting the free ASCII mode operation is available.
During the reset, the following re-initialization is processed.
- Initializes the serial port (RS-485 or RS-232C)
- Initializes the receive buffer and the receive error information
- Resets the trailing code based on the data of lower byte of SW068

When the reset operation is completed, S068F is automatically reset to OFF.
The free ASCII mode operation should be re-started after confirming S068F is
returned to OFF.

NOTE

If S068F is set to ON during a message receiving, the reset operation is
started after the message receiving is finished.

5. Free ASCII Mode

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 ↔ CPU register
- CPU register ↔ Expanded F register (IC memory card or T2E/T2N's internal memory)
- CPU register ↔ TOSLINE-S20 (here called S20, for T2E)/TOSLINE-S20LP(here called S20LP, for T2N)
- CPU register ↔ EEPROM (D register)
- CPU register ↔ T2E communication card / T2N

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																Con-stant	Index
		X	Y	S	L	R	Z	T.	C.	I	O	XW	YW	SW	LW	RW	W	T	C	D	F	IW	OW	I	J	K		
A	Source parameter											√	√	√	√	√	√	√	√	√	√							√
B	Transfer size											√	√	√	√	√	√	√	√	√	√							√
C	Destination parameter											√	√	√	√	√	√	√	√	√	√							√

Source parameter

A	Bank / CH	Type
A+1	Leading address	

Transfer size and status

B	Transfer size
B+1	Status flag (max. 16 words)
B+16	

Destination parameter

C	Bank / CH	Type
C+1	Leading address	

- Refer to the following table for contents of each designation.
- The status flag is created when S20 is designated as transfer source or T2E communication card /T2N is designated as source/destination.

Transfer parameter table

	Transfer object	Bank / CH	TYPE	Leading address	Transfer size	Status flag
CPU register	XW/YW register	0	H00	0 to 511 (T3H) 0 to 255 (T3) 0 to 63 (T2/T2E)	1 to 256 (T3H/T3) 1 to 64 (T2/T2E/T2N)	None
	W register	0	H01	0 to 2047 (T3H/T2N) 0 to 1023(T3/T2/T2E)	1 to 256	None
	LW register	0	H02	0 to 255 (T3H/T3/T2/T2E/T2N)	1 to 256	None
	RW register	0	H03	0 to 999 (T3H) 0 to 511 (T3) 0 to 255 (T2N) 0 to 127 (T2/T2E) 0 to 63 (T1)	1 to 256 (T3H/T3) 1 to 128 (T2/T2E/T2N) 1 to 64 (T1)	None
	D register	0	H04	0 to 8191 (T3H/T3/T2N) 0 to 4095 (T2/T2E) o to 1023 (T1)	1 to 256	None
	F register	0	H05	0 to 32767 (T3H) 0 to 8191 (T3) 0 to 1023 (T2/T2E/T2N)	1 to 256	None
Expanded F register (IC memory card)		1 to 15 (T3H/T3/T2)	H05	0 to 8191	1 to 256	None
		1 or 2 (T3H)	H06	0 to 65535 (Bank 1) 0 to 57343 (Bank 2)	1 to 256	None
Expanded F register (T2E/T2N internal memory)		1 to 3 (T2E/T2N)	H05	0 to 8191	1 to 256	None
TOSLINE-S20 scan memory		1 or 2 (T3H/T3) 1 (T2/T2E)	H10	0 to 1023 (S20)	1 to 256	Yes [*1]
TOSLINE-S20LP scan memory		1 or 2 (T3H) 1 (T2N)	H10	0 to 4095 (S20LP)	1 to 256	Yes [*1]
EEPROM (D register)		0	H20	0 to 8191 (T3H/T3) 0 to 4095 (T2/T2E/T2N) 0 to 511 (T1)	Source (read): 1 to 256 Destination (write): 1 to 128 (T3H) 1 to 64 (T3) 1 to 32 (T2/T2E/T2N) 1 to 16 (T1)	None
T2E communication card / T2N		0	H30	0	1 to 256 [*2]	Yes [*3]

*1) When S20 is transfer source, the scan healthy map is created. (max. 16 words)
    In case of S20LP, no status flag is added.
*2) When the T2E communication card / T2N is transfer source (receiving), the transfer size must be 256
    (fixed).
*3) When the T2E communication card / T2N is transfer source (receiving), 2 words of status flag is added.
    When it is destination (transmitting), 1 word of status flag is added.

5. Free ASCII Mode

CPU register ↔ T2E communication card / T2N

\<Receiving\>

Operation:

When the instruction input is ON, one set of message (from start character to the trailing code) which is received by the T2E communication card / T2N 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:

```
  R0000
1 ─┤ ├────[D0000  XFER   D0002   →   D0005]───────────────────────
```

Source designation			Transfer size		Destination designation		
D0000	H00	H30	D0002	00256 (fixed)	D0005	H00	H04
D0001	00000		D0003	*Execution status*	D0006	00100	
			D0004	*Message length*			

Communication card   D0100 (CPU register)
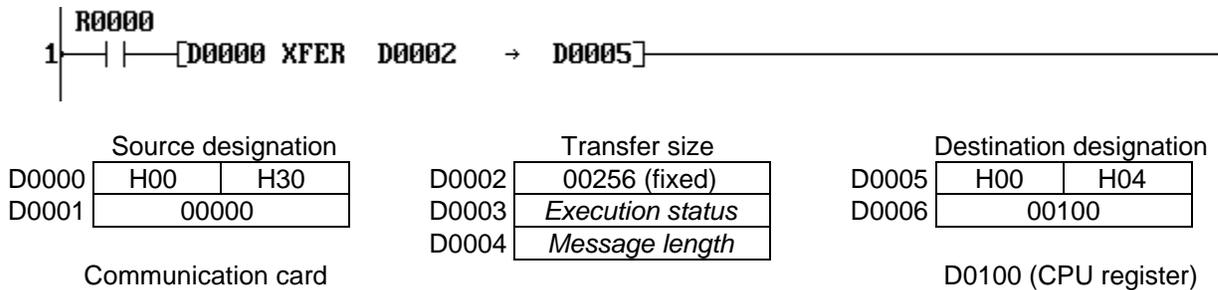
When R0000 is ON, one set of received message is read and stored in D0100 and after.

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)

Baudrate	Time-out setting
300, 600, 1200 bps	30 seconds
2400 bps	15 seconds
4800 bps	7 seconds
9600 bps	3 seconds
19200 bps	1.5 seconds

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

Remarks:

The instruction error flag (S0051) comes ON in the following cases. (no operation)
- The leading address for the communication card designation is other than 0.
- Transfer size is other than 256.
- Mode setting of the communication card is not the free ASCII mode.
- This instruction is programmed in the sub-program #1.

<Transmitting>

Operation:

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 T2E communication card / T2N. The execution status is stored in the status flag.
The instruction input must be kept ON until the transmitting operation is complete.

Example:

```
  | R0001
 1├──┤ ├───[D0010 XFER  D0012  →  D0015]─────────────────────────────
  |
```

Source designation			Transfer size		Destination designation	
D0010	H00	H04	D0012	00012	D0015	H00	H30
D0011	00500		D0013	*Execution status*	D0016	00000

D0500 (CPU register)   Communication card

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 T2E communication card / T2N.

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

Baudrate	Time-out setting
300, 600, 1200 bps	30 seconds
2400 bps	15 seconds
4800 bps	7 seconds
9600 bps	3 seconds
19200 bps	1.5 seconds

Remarks:

The instruction error flag (S0051) comes ON in the following cases. (no operation)
• The leading address for the communication card designation is other than 0.
• Transfer size is out of the range of 1 to 256.
• Mode setting of the communication card is not the free ASCII mode.
• This instruction is programmed in the sub-program #1.

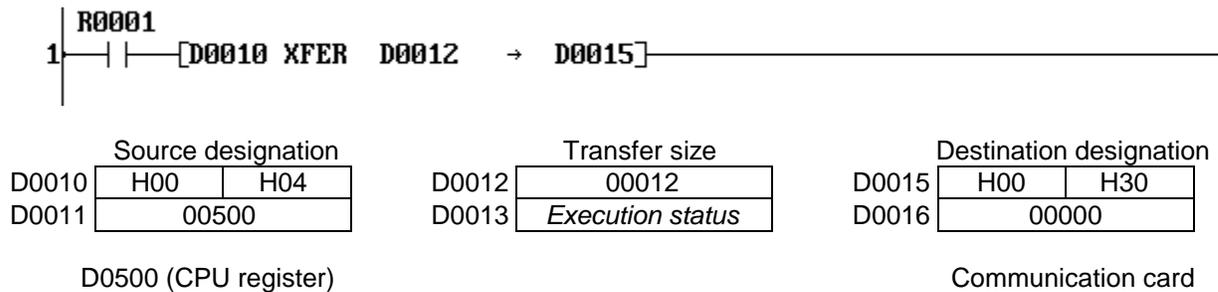### 5.9.2　HEX to ASCII conversion (HTOA)

FUN 62	HTOA	HEX to ASCII conversion

Expression

Input　—[*A*　HTOA (*n*)　*B*]— Output

Function

When the input is ON, the hexadecimal data of *n* registers starting with *A* is converted to the 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.

When index or constant value is set as source *A*., this function can be performed under the condition that n is equal to 1. If n is more than 1, a boundary error is occured.

Execution condition

Input	Operation	Output
OFF	No execution	OFF
ON	Normal execution	ON

Operand

	Name	Device										Register													Con-stant	Index
		X	Y	S	L	R	Z	T.	C.	I	O	XW	YW	SW	LW	RW	W	T	C	D	F	IW	OW	I	J	K		
A	Source											√	√	√	√	√	√	√	√	√	√	√		√	√	√	√	√
n	Size																										1 - 32	
B	Destination											√	√	√	√	√	√	√	√	√	√		√					√

Example

```
  R0010
1─┤ ├────[RW100  HTOA (04) D0220]──────────────────────────
```
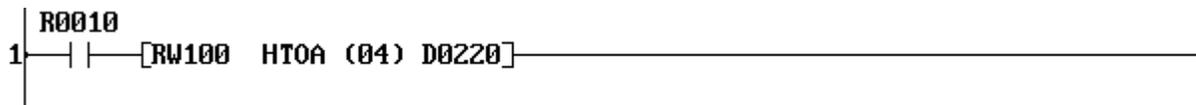
When R0010 is ON, 4 words data of RW100 to RW103 are converted into ASCII characters, and stored in 8 words registers starting with D0220.

	F　　　　　　0
RW100	H0123
RW101	H4567
RW102	H89AB
RW103	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)

5.9.3 ASCII to HEX conversion (ATOH)

FUN 66	ATOH	ASCII to HEX conversion

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 to the 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.
When index or constant value is set as source *A*., this function can be performed under the condition that n is equal to 1. If n is more than 1, a boundary error is occured.

Execution condition

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

Operand

	Name	Device										Register														Con-stant	Index
		X	Y	S	L	R	Z	T.	C.	I	O	XW	YW	SW	LW	RW	W	T	C	D	F	IW	OW	I	J	K	stant	
A	Source											√	√	√	√	√	√	√	√	√	√	√		√	√	√	√	√
n	Size																										1 - 64	
B	Destination											√	√	√	√	√	√	√	√	√	√		√					√

Example
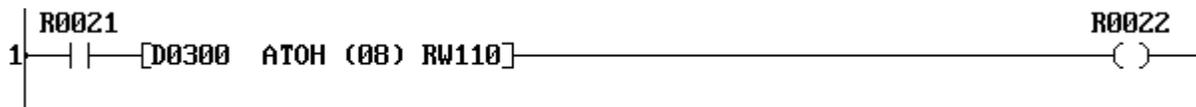
When R0021 is ON, the ASCII characters stored in 8 words of D0300 to D0307 are converted into hexadecimal data, and stored in 4 words registers starting with RW110.

If the source table (D0300 to D0307) contains invalid characters (other than "0" to "F"), the instruction is not executed and the output (R0022) stays OFF.
If the word number of conversion is odd, the lower 2 digits of last data on the destination table is unknown. Therefore set even value to the word number of conversion.

5.10   Sample programs

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

A sample program for the T2E 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)   Mode setting of the optional communication card (CM231E or CM232E):
        Select the free ASCII mode by setting the DIP switch on the T2E's front panel.
        (CM0 = OFF, CM1 = ON)

  b)   Communication parameter setting:
        Set the T2E'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 T2E's stop bit length should be set to 1 bit.

  c)   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) T2E 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)

```
                    MAIN PROGRAM            BLOCK 1
  |
1 |-|^|------------------------------------------------------ [MCS ]    Initialize
  |
  |
2 |[ 00004 MOV D0000][ 00010 MOV D0001][ 00048 MOV D0002][ 00000 MOV D0003]-   Parameter setting for
  |                                                                            XFER (send)
  |
3 |[ 00007 MOV D0004][ 00000 MOV D0005]-------------------------------------
  |
  |
4 |[ 00004 MOV D0010][ 00040 MOV D0011]-------------------------------------   Parameter setting for
  |                                                                            XFER (receive)
  |
5 |[ 00256 MOV D0012][ 00000 MOV D0013][ 00000 MOV D0014]------------------
  |
  |
6 |------------------------------------------------------------- [MCR ]
  |                                                        R0002          Change detect of
7 |[D0015  <>  D0016][D0015  MOV D0016]---------------------------( )--    frequency
  |                                                                        designation (D0015)
  | R0000
8 |-|P|--['(01PFA00C400)  '      ASC D0020]-----+ ----------------------[]   Send message
  |                                             |                           create
  | R0001                                       |                           (Station 01)
  |-|P|--['(01PFA00C600)  '      ASC D0020]-----+
  |                                             |                           Command (FA00)
  | R0000                                       |
  |-|N|-+['(01PFA00C000)  '      ASC D0020]-----+                           Following commands
  |     |                                                                   are used
  | R0001|                                                                    "C400": Forward
  |-|N|-+                                                                      "C600": Reverse
  |                                                                            "C000": Stop
  | R0003                                                                      "E000": Reset
  |-|P|-+['(01PFA00E000)  '      ASC D0020]-----+
  |     |
  | R000F|
  |-|P|-+
  |
  | R0002                                                                   Operation frequency
  |-|  |-+['(01PFA010000)  '      ASC D0020]-----+                          (FA01)
  |      |
  |      |                                                                  Converts hex data of
  |      +[D0015  HTOA (01) D0024]----------------+                         D0015 into ASCII
  |
  |[]----[H0D00  OR   D0026  -> D0026][ SET R000D][ 00020 MOV D0017] --------   Adds trailing code
  |                                                                             (H0D)
```

```
    R000D T.000                                                          Message for Status
 9 -|/|---|/|--[00060  TON  T000]['(01RFE01)      '       ASC D0030]--------[]    read
                                                                         Address FE01 read

    []----[H0D00  OR   D0034 -> D0034][ SET R000E][ 00030 MOV D0017] --------    Adds trailing code
                                                                         (H0D)

    R000E R000D                                                          Message send timing
10 -|/|---| |---|^|-+[D0017  MOV D0001][ SET R000A] -----------------------    create

    T.000             |
    -|P|------------+


    R000A                                                                Message send
11 -| |-+[D0000 XFER  D0004 -> D0002]------------------------------------

         |
       +[D0005   = 00001]-|v|--[ RST R000A] -----------------------------


    R000A                                                                Message receive
12 -|/|-+[D0002 XFER  D0012 -> D0010]------------------------------------

        |S0051                                                R0009
       +-|/|--[D0014 <> 00000] -------------------------------------- ( )--

    R0009 R000D                                                          Received message
13 -| |---| |--[D0020   = D0040][D0022   = D0042][D0023   = D0043] -------[]    check for Command

    []----[D0024  = D0044][D0025   = D0045][ RST R000D][ RST R0003] --------


    R0009 R000E                                                          Received message
14 -| |---| |--[D0030   = D0040][D0032   = D0042][D0033   = D0043]          []    check for Status read

    []----[ RST R000E][D0044  ATOH (02) RW001][D0041  AND  HFF00  -> D0039]


    R000D                                                       R000F    Timing create for
15 -| |-+[00300   TON  T001][ RST R000D][ RST R000E][ RST R000A]-----+-( )    Reset command

    R000E|R000E                                                      |
    -| |-+-| |--[D0039   = 29184]------------------------------------ +


    R000F                                                                Flags and frequency
16 -| |--[ 00000 MOV D0015][ RST R0000][ RST R0001]                       data clear for Reset
                                                                         command

17 [END ]----------------------------------------------------------------
```

5. Free ASCII Mode

B. Data linkage among four T2Es

This is an example of data linkage among four T2Es which have the CM231E.
In this example, T2E (M) works as communication master using the free ASCII mode. And other T2Es work as slaves using the computer link mode.

```
                    ┌─────────────┐
                    │  T2E (M)    │
                    │ (Free ASCII)│
                    └──────┬──────┘
                           │
          ┌────────────────┴──────┬────────────────┐
   ┌──────┴──────┐        ┌───────┴─────┐   ┌───────┴──────┐
   │  T2E (S1)   │        │  T2E (S2)   │   │  T2E (S3)    │
   │(Computer link)│      │(Computer link)│ │(Computer link)│
   └─────────────┘        └─────────────┘   └──────────────┘

     Station 1              Station 2          Station 3
```
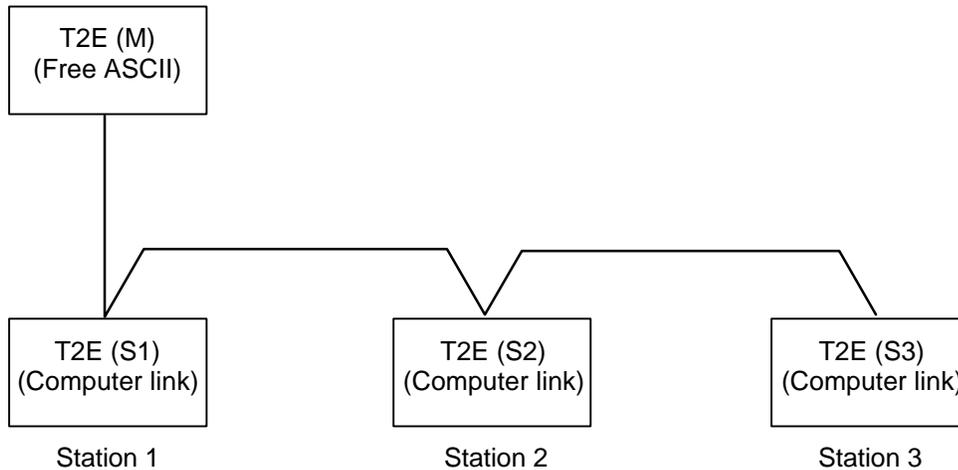
In this configuration, only T2E (M) requires the communication program. Other T2Es, S1, S2 and S3, do not require any communication program.

In this sample program, the following data link assignment is used.
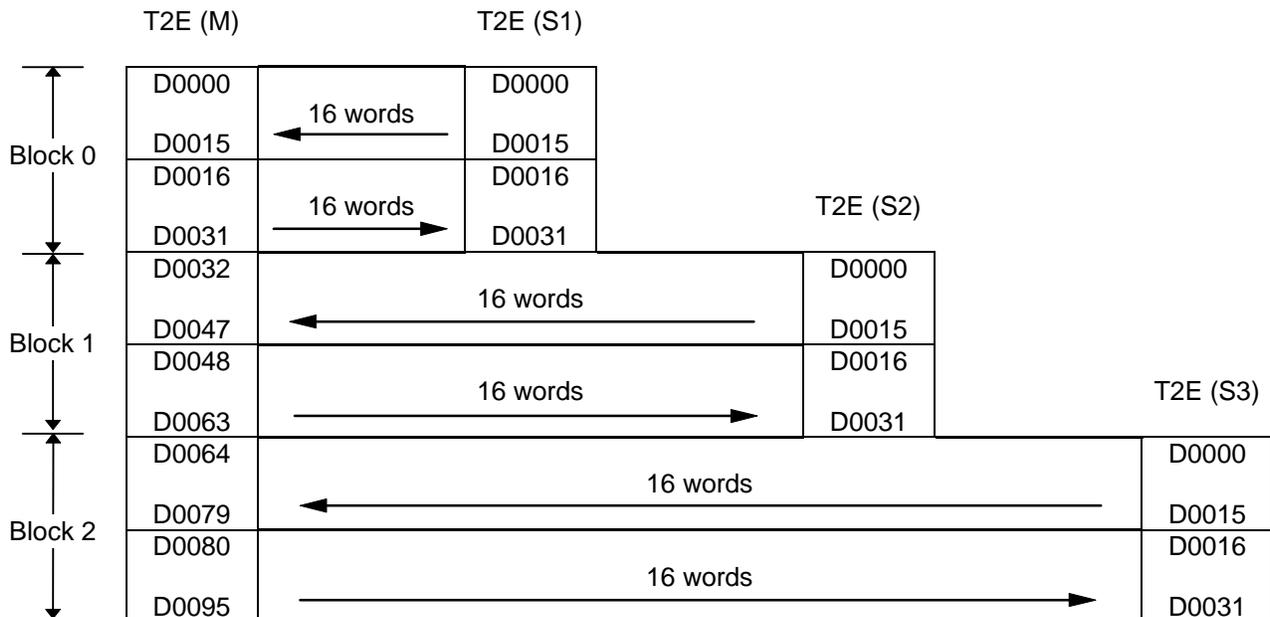
(1)   Communication port setting

a)   Mode setting of the optional communication card (CM231E):
Set the mode by the DIP switch on the T2E's front panel.

T2E (M) ... Free ASCII mode (CM0 = OFF, CM1 = ON)
T2E (S1), T2E (S2) and T2E (S3) ... Computer link mode (CM0 = OFF, CM1 = OFF)

b)   Communication parameter setting:
Set all the T2E's communication parameters as same. The following settings are recommended.

Baudrate: 19200 bps
Data bits: 8 bits
Parity: Odd
Stop bit: 1 bit

Station number is needed FOR the slave T2Es.

T2E (S1):   Station number = 1
T2E (S2):   Station number = 2
T2E (S3):   Station number = 3

(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)   T2E 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 T2E (S1) ... ON when normal
R0012:   Link status for T2E (S2) ... ON when normal
R0013:   Link status for T2E (S3) ... ON when normal

D3000 - D3255:   Reserved area for message transmitting
D3400 - D3655:   Reserved area for message receiving
D4000 - D4007:   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

5. Free ASCII Mode

T2E (M) Program:

```
        Main program            Block    1

1 -|^|-+[ STIZ (16) R0000]-------------------------------------
      |
      +[ 00001 MOV D4000]-------------------------------------

2 [STIN R0000]-----+[D4000  HTOA (01) D4001] --------------------------
                   |
                   +[D4000  -    00001 -> D4003] -------------------------
                   |
                   +[D4003  *    00032 -> D4005•D4004]
                   |
                   +------------------------------------- [STOT R0001]

3 [STIN R0001]-----+[RW100  <>  00000][ RST R1000] ----------------------
                   |
                   +[RW100  =  00000]------------------------- [STOT R0002]

4 [STIN R0002]-----+-|^|-+['(A00ST         '      ASC D3000]----------------
                   |     |
                   |     +[D4002 MOV D3001][ 03369 MOV D3003]----------------
                   |     |
                   |     +[ SET R1000]-------------------------
                   |R1001
    ·|             +-| |------------------------------------- [STOT R0003]
                   |R1002                        I
                   +-| |--[D4000  MOV I   ][ RST R0010]---------- [STOT R000A]
                                                              R0020
5 [STIN R0003]------+[D3001  = D3401][D3002  = D3402] --------------( )--
                   |                                          R0021
                   +[D3404  AND  HFF00  -> D4007][D4007  = 12800]-( ) --------
                   |R0020 R0021                    I
                   +-| |---| |--[D4000  MOV I   ][ SET R0010][STOT R0004]
                   |R0020                        I
                   +-|/|-+[D4000  MOV I   ][ RST R0010]------[STOT R000A]
                   |R0021|
                   +-|/|-+

6 [STIN R0004]------+[RW100  <>  00000][ RST R1000] ----------------------
                   |
                   +[RW100  =  00000]------------------------- [STOT R0005]

7 [STIN R0005]-----+-|^|-+['(A00DRD000,16) '      ASC D3000] --------------
                   |     |
                   |     +[D4002 MOV D3001][ 00013 MOV D3007]----------------
                   |     |
                   |     +[ SET R1000]-------------------------
                   |R1001
                   +-| |------------------------------------- [STOT R0006]
                   |R1002                        I
                   +-| |--[D4000  MOV I   ][ RST R0010]---------- [STOT R0007]
```

Step	Description
	Step sequence initialize Initial station No. =1
	D4002 = station No. in ASCII
	D4004 = data block starting address D0000, D0032 or D0064
	ST (status read)
	3369 = H0D29 = CR, ")"
	Normal (R1001=ON)
	Communication error (R1002=ON)
	Sets R0011, R0012 or R0013 if communication is normal and the PLC is RUN
	12800 = H0200 = (RUN)
	DR (data read) 16 words starting from D0000
	13 = H000D = CR

```
                                                                    R0022
 8 [STIN R0006]-----+[D3001  = D3401][D3002  = D3402] --------------( )--
                    |R0022
                    +-| |-+[D4004  MOV  I  ] -----------------------------
                    |                     I
                    |     +[D3403  ATOH (32) D0000] ----------------------
                    |                                 I
                    |     +[D4000  MOV  I  ][ SET R0010]------+-----[STOT R0007]
                    |R0022                        I          |
                    +-|/|--[D4000  MOV  I  ][ RST R0010]-----+

 9 [STIN R0007]-----+[RW100  <>  00000][ RST R1000] -----------------------
                    |
                    +[RW100   =  00000]--------------------------[STOT R0008]

10 [STIN R0008]------+-|^|-+['(A00DWD016,16, '      ASC D3000] --------------
                     |
                     |    +[D4002  MOV D3001] -----------------------------
                     |
                     |    +[D4004   +   00016 ->  I   ] ------------------------
                     |
                     |    +[CALL N.000]---------------------------------------
                     |
                     |    +[ SET R1000]---------------------------------------
                     |R1001
                     +-| |---------------------------------------[STOT R0009]
                     |R1002                        I
                     +-| |--[D4000  MOV  I  ][ RST R0010] -----------[STOT R000A]
                                                                     R0023
11 [STIN R0009]-----+[D3401  = D3001][D3402  = 21587] --------------( )--
                    |R0023                        I
                    +-| |--[D4000  MOV  I  ][ SET R0010]-----+-----[STOT R000A]
                    |R0023                        I          |
                    +-|/|--[D4000  MOV  I  ][ RST R0010]-----+

12 [STIN R000A]-----+[RW100  <>  00000][ RST R1000] -----------------------
                    |
                    +[RW100   =  00000]--------------------------[STOT R000B]

13 [STIN R000B]-----+[ +1  D4000][D4000   >  00003][ 00001 MOV D4000] --------
                    |
                    + ------------------------------------------[STOT R0000]
```

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

DW (data write)
16 words starting
from D0016

Subroutine 0:
prepares writing data
from Hex to ASCII

21587 = H5453
            = "TS"
Checking for normal
response

Increases the station
No., 1 to 3

5. Free ASCII Mode

```
     Main program              Block    255                          Communication
                                                                  ⌐driver routine
1 -|^|-+[ 00048 MOV RW110][ 00000 MOV RW111]-------------------------
       |
       |
       +[ 00004 MOV RW112][ 03000 MOV RW113]-------------------------  Parameter setting
       |
       |
       +[ 00004 MOV RW114][ 03400 MOV RW115]-------------------------
       |
       |
       +[ 00256 MOV RW116][ 00000 MOV RW117][ 00000 MOV RW118]--------
  R1000 R1008 R1009
2 -| |---|/|---|/|-+[ RST S0051][RW112 XFER  RW116  ->  RW110]--------
                   |S0051
                   +-|/|-+[RW117  =  00000][ SET R1008]----------------  Message transmitting
                   |     |R1008                                          routine
                   |     +-|/|--[RW117 <>  00001]-----+[ SET R1009] -----------
                   |S0051                              |
                   +-| |-----------------------------+
  R1008 R1001 R100A
3 -| |---|/|---|/|-+[ RST S0051][RW110 XFER  RW116  ->  RW114]--------
                   |S0051
                   +-|/|-+[RW117  =  00000][RW118 <>  00000][ SET R1001] -----  Message receiving
                   |     |                                                      routine
                   |     +[RW117 <>  00000]-----+[ SET R100A] ----------------  Time-out = 1 sec.
                   |S0051                        |
                   +-| |-----------------------+
                   |
                   +[00010  TON T255][ SET R100B] ---------------------------
  R1009
4 -| |-+[ SET R1002]----------------------------------------------
       |
  R100A|
  -| |-+
       |                                                          Normal:  R1001=ON
  R100B|                                                          Error:   R1002=ON
  -| |-+
  R1000
5 -|/|--[ 00000 MOV RW100]------------------------------------------


     Subroutine              Block     1

1 [ SUBR(000)]------------------------------------------------------  Subroutine 0:
                                                                     Prepares writing data
2 [ 00000 MOV  J   -----------------------------------------------   text

3 [ FOR 00016]----------------------------------------------------
   I             J              J                                    Converts from Hex to
4 [D0000  HTOA (01) D3007][ 08236 MOV D3009] ---------------------  ASCII

5 [ +1   I  ][ J     +   00003 ->   J   ]------------------------    8236 = H202C
                                                                         = "," (comma)
6 [NEXT]----------------------------------------------------------
            J
7 [ 03369 MOV D3006]----------------------------------------------

8 -------------------------------------------------------------[ RET]
```

Appendices

1. T2E CM232E Connector pin assignment
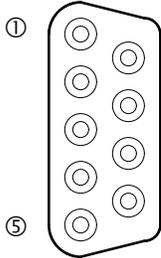
No.	Name
1	SG
2	RXD
3	TXD
4	NC
5	SG
6	5Vdc
7	RTS
8	NC
9	5Vdc

2. T2N RS-485/RS-232C Connector pin assignment
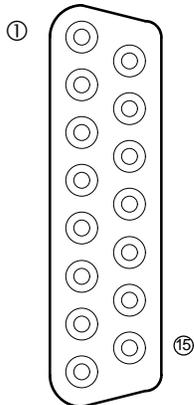
No.	Name	Use
1	NC	-
2	RXA	RS-485
3	TXA	RS-485
4	NC	-
5	TXD	RS-232C
6	RTS	RS-232C
7	SG	Common
8	SG	Common
9	NC	-
10	RXB	RS-485
11	TXB	RS-485
12	RXC	RS-232C
13	NC	-
14	CTS	RS-232C
15	SG	Common

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