UM-TS03***-E020

PROGRAMMABLE CONTROLLER

PROSEC T3

ASCII INTERFACE MODULE

AS311

USER'S MANUAL

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

Safety Precautions

- This module (AS311) has been designed for Toshiba's Programmable Controller PROSEC-T3 (hereafter called T3). Use this module only on the T3's rack.
- Read the Safety Precautions described on the T3 User's Manual before using the T3 and this module.
- Follow the instructions described on this manual and on the T3 User's Manual when installing and wiring the T3 and this module.
- Do not touch the connector pins or components on the printed circuit board of this module.
- The maximum number of AS311s that can be controlled by one T3 is not limited by software. However, this module consumes maximum 1 A of internal 5 Vdc power. Confirm that the total 5 Vdc consumed current per one power supply module is within the limit (7A).

Symbols Used In This Manual

Pay attention to information preceded by the following symbols.

Refers to helpful suggestions on how to operate effectively.

Refers to information considered essential for full understanding of operation. And refers to conditions that could damage the equipment or render it temporarily inoperative.

About This Manual

About This Manual

This manual explains the specifications and operations of the ASCII Interface Module (AS311) for Programmable Controller T3. Read this manual carefully before using the AS311 module.

Inside This Manual

This manual consists of six sections and an appendix as follows.

Section 1 Overview
Introduces The AS311. Outline of the function, applications and the external features are provided in this section. Read this section at first to understand the general operation of the AS311. The switch settings of this module are also explained in this section.

Section 2 Specifications
Provides the functional and the transmission specifications of the AS311. Refer to this section to confirm the application limitations.

Section 3 Cable Connections
Provides the information for hardware preparations. The transmission cable connection is explained in this section.

Section 4 Register Configuration
Explains the memory contents of the AS311. This information is important to interchange data between T3 and AS311.

Section 5 Operation Procedure
Provides the information to design the T3 program for using the AS311. Some sample programs are provided in this section. Read this section carefully for programming.

Section 6 RAS Information
Provides the helpful information for RAS (Reliability, Availability and Serviceability). Also, lists the check points in case of unexpected operations.

Appendix
The specifications of READ and WRITE instructions are described. These instructions are used for interchanging data between T3 and AS311.

Related Manuals

The following related manuals are available for T3. Besides this manual, read the following manuals for your better understanding.

T3 User's Manual - Hardware
This manual covers the T3's main body and basic I/O - their specifications, handling, maintenance and services.

T3 User's Manual - Functions
This manual explains the functions of the T3 and how to use them. The necessary information to create user program is covered in this manual.

T-series Instruction Set
This manual provides the detailed specifications of instructions for Toshiba's T-series Programmable Controllers.

T-PDS (Ver. 1.4) Basic Operation Manual
This manual explains how to install the T-series program development system (T-PDS) into your computer and provides basic programming operations.

T-PDS (Ver. 1.4) Command Reference Manual
This manual explains the T-series program development system (T-PDS) in detail.

T-PDS (Ver. 1.6) Expanded Functions
This manual explains the expanded functions on the T-PDS version 1.6. This manual supplements the T-PDS (Ver.1.4) Command Reference Manual.

T-series Computer Link Function
This manual provides the information for a computer to communicate with T3 through the T-series Programmable Controller's Computer Link function.

Terminology

The following terms and abbreviations are used in this manual.

- ASCII: American Standard Code for Information Interchange
- EIA: Electronic Industries Association
- I/O: Input/Output
- LED: Light Emitting Diode
- RS-232C: An EIA standard for data transmission
- RS-422: An EIA standard for data transmission

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Section 1

AS311 Overview

1. AS311 Overview

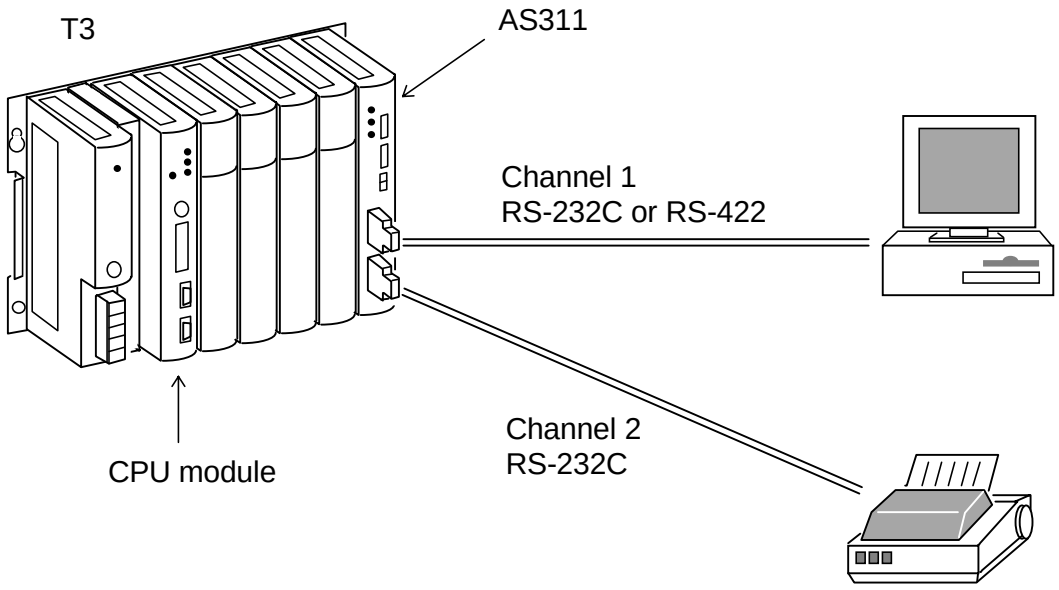
1.1 Introduction

The ASCII interface module AS311 (hereafter called AS311) is a general purpose data communication module for Toshiba's Programmable Controller PROSEC-T3 (hereafter called T3). By using the AS311, T3 can communicate with external devices, such as a micro computer, bar code reader, printer, display device, sensor, etc., through the serial interface RS-232C or RS-422.

The AS311 has two ports of the serial interface. One port (channel 1) can be selected either RS-232C or RS-422 by switch setting. The other port (channel 2) is RS-232C interface. These two ports can be used independently for data receiving and transmitting.

The transmission is asynchronous (start-stop system).
ASCII is used as the transmission data code.

The figure below shows the typical system configuration.



NOTE

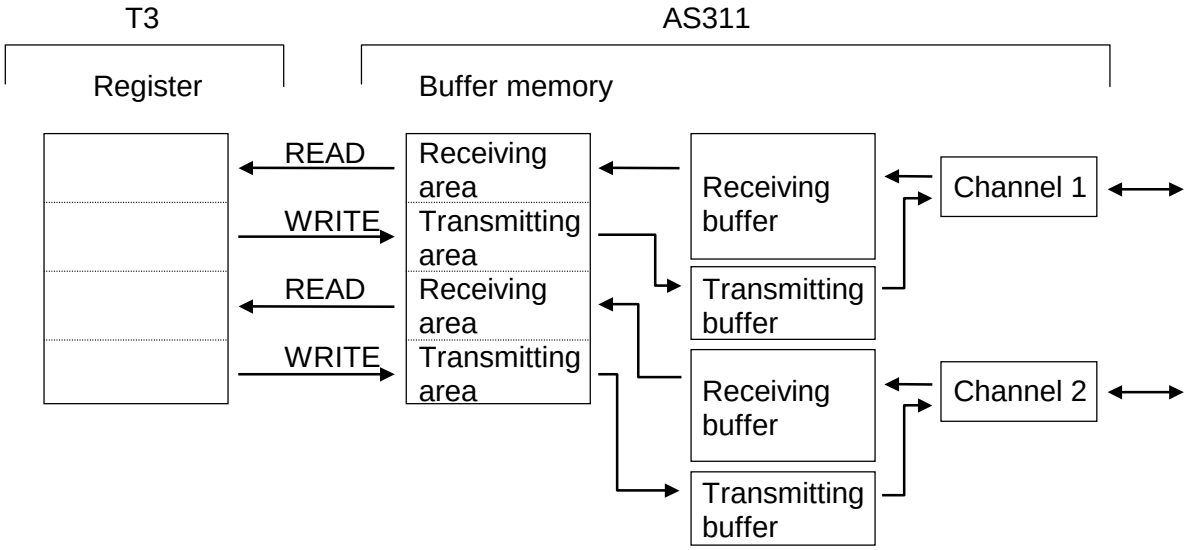
The maximum number of AS311 that can be controlled by one T3 is not limited by software. However, this module consumes maximum 1 A of internal 5 Vdc power. Confirm that the total 5 Vdc consumed current per one power supply module is within the limit (7 A).

1.2 AS311 functions

From the point of view of T3, the AS311 works as communications driver. The followings are the simplified explanations for T3 and AS311 functions.

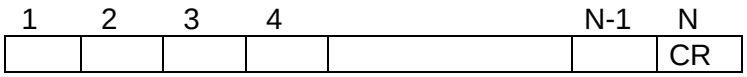
When a message (one set of transmission characters) is received by AS311, the flag which indicates the receiving complete will come ON. T3 can check the flag status then read the message from the AS311 by using the READ instruction.

In case of transmitting a message (one set of transmission characters) from T3 through AS311, T3 writes the message into the AS311 by using the WRITE instruction, then sets the flag which instruct the AS311 to start transmitting the message.



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

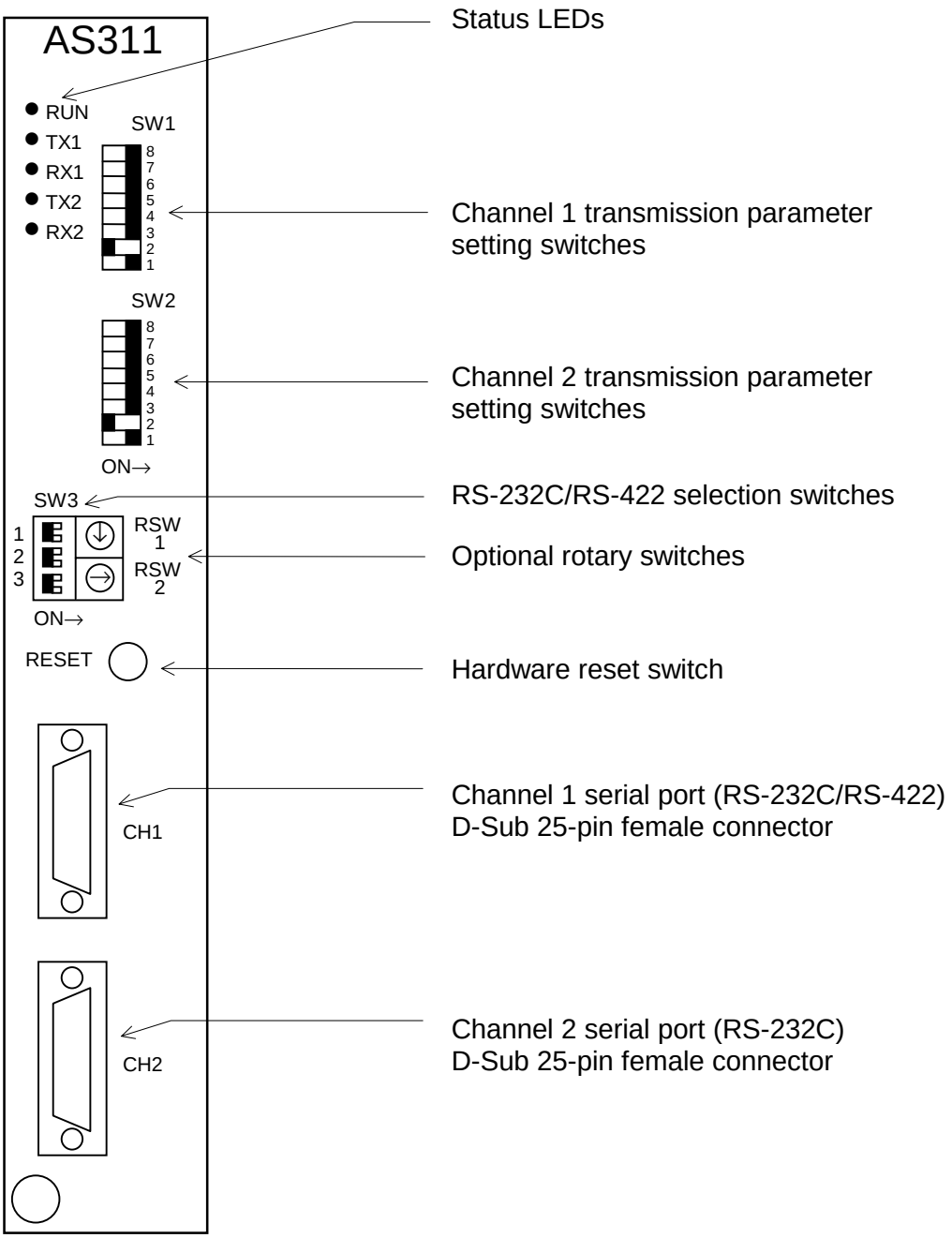
Applicable message format (default trailing code):



N: message length = 896 bytes max.

In other words, the AS311 cannot be used for the data communication in which the transmission message is ended by two or more types of trailing code.

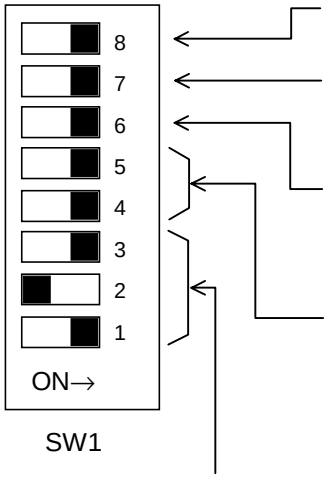
1.3 External features



Status LEDs

- RUN: Lit when AS311 is operating normally
- TX1: Lit while transmitting data from channel 1
- RX1: Lit while receiving data to channel 1
- TX2: Lit while transmitting data from channel 2
- RX2: Lit while receiving data to channel 2

SW1 — channel 1 transmission parameter setting switches



No.8 … No use (set always ON)

No.7	OFF	ON
Stop bit	2 bit	1 bit

No.6	OFF	ON
Data bit length	7 bit	8 bit

No.5	OFF	ON	ON
No.4	OFF/ON	OFF	ON
Parity	None	Even	Odd

No.3	OFF	OFF	OFF	OFF	ON	ON	ON
No.2	OFF	OFF	ON	ON	OFF	OFF	ON
No.1	OFF	ON	OFF	ON	OFF	ON	OFF
Baud rate	300	600	1200	2400	4800	9600	19200

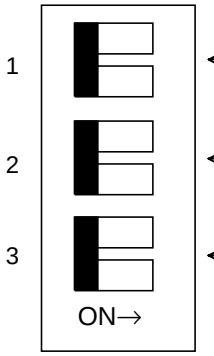
SW2 — channel 2 transmission parameter setting switches

Used to set the transmission parameters for channel 2. The functions of each switch are the same as the SW1. Set the transmission parameters independently for channel 1 and channel 2.

NOTE

The factory settings of the SW1 and SW2 are as shown above figure. That is, 1 stop bit, 8 data bits, odd parity and 9600 bps.

SW3 — RS-232C/RS-422 selection switches (for channel 1)



Used to select the interface of the channel 1 either RS-232C or RS-422.

No.1	OFF	ON
Interface	RS-232C	RS-422

Used to connect the terminating resistor (120 Ω) between RXDA and RXDB. (Effective for RS-422)

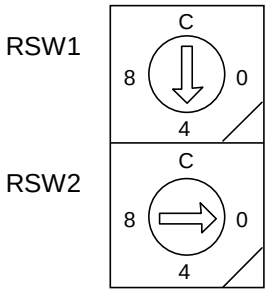
No.2	OFF	ON
Terminating	Not connect	Connect

Used to connect the terminating resistor (120 Ω) between CTSA and CTSB. (Effective for RS-422)

No.3	OFF	ON
Terminating	Not connect	Connect

NOTE The switches No.2 and No.3 should be set to ON when the AS311 is configured as terminal station on the RS-422 transmission line. The factory settings of the SW3 are all OFF.

RSW1/RSW2 — Optional rotary switches



Always set the RSW1 to 4 and the RSW2 to 0. (Other settings are for future use)

Do not set other than above, otherwise the AS311 will not work correctly.

Hardware reset switch

When this switch is pressed, the AS311 will be reset. Use this switch when you have changed the switch settings.

Channel 1 and channel 2 serial ports

Used to connect the serial transmission line (RS-232C or RS-422). D-Sub 25-pin female connectors are provided on the AS311.
The pin assignment is as follows.

Channel 1 (RS-232C/RS-422)				Channel 2 (RS-232C)		
1	FG	↔		1	FG	↔
2	TXD	→	for RS-232C	2	TXD	→
3	RXD	←		3	RXD	←
4	RTS	→		4	RTS	→
5	CTS	←		5	CTS	←
6				6	DSR	←
7	SG	↔		7	SG	↔
8				8		
9	5 Vdc	→		9	5 Vdc	→
10	TXDA	→	for RS-422	10		
11	RXDA	←		11		
12	RTSA	→		12		
13	CTSA	←		13		
14				14		
15				15		
16				16		
17				17		
18				18		
19				19		
20	DTR	→	for RS232C	20	DTR	→
21	TXDB	→	for RS-422	21		
22	RXDB	←		22		
23	RTSB	→		23		
24	CTSB	←		24		
25				25		

- The arrow on the above figure shows the signal direction.
- FG is connected with the T3's frame ground internally. (both channels)
- DTR and RTS are ON while power is on.
- Data transmitting is available when CTS is ON. DSR has no effect for transmission.
- Pin 9 (5 Vdc) can be used to supply 5 Vdc power. (total max. 50 mA)

Section 2

Specifications

2. Specifications

2.1 General specifications

Item	Specifications	Remarks
Power voltage	5 Vdc (supplied from back plane bus)	
Current consumption	1.0 A (5 Vdc) maximum	Note (1)
Environmental conditions	Conforms to T3 specifications	
Insulation resistance	10 MΩ (500 Vdc)	Note (2)
Withstand voltage	500 Vac - 1 minute	Note (2)
Size	T3 I/O module size (1 slot)	
Weight	500 g	

Note (1) The T3's power supply module can supply maximum 7 A of internal 5 Vdc. Check that the internal 5 Vdc current consumption per one power supply module does not exceed the limit.

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

2.2 Functional specifications

Item	Specifications
Module type	Serial communication interface
I/O allocation type	iX+Y 4W
Buffer memory capacity	448 words x 4 (accessed from T3 by READ/WRITE instruction)
Transmission interface	2 channels; Channel 1 … RS-232C or RS-422 (selectable) Channel 2 … RS-232C
Display	Status LEDs; RUN … lit when operating normally TX1 … lit while transmitting data from channel 1 RX1 … lit while receiving data to channel 1 TX2 … lit while transmitting data from channel 2 RX2 … lit while receiving data to channel 2
Connectable devices	Computer, bar code reader, display device, sensor, printer, or other serial ASCII device
RAS function	Self diagnosis, watch dog timer (200 ms), transmission error check, etc.

2.3 Transmission specifications

Item	Channel 1	Channel 2
Interface	RS-232C or RS-422	RS-232C
Transmission mode	Full-duplex	
Synchronizing	Start-stop method (asynchronous)	
Transmission speed	300, 600, 1200, 2400, 4800, 9600, 19200 bps	
Frame format	Start bit 1 bit Data 7 or 8 bits Parity even / odd / none Stop bit 1 or 2 bits	
Transmission code	ASCII	
Message length	Max. 896 bytes	
Configuration	One to one (Note)	
Transmission distance	Max. 15 m (RS-232C) Max. 1 km (RS-422)	Max. 15 m
Connector	D-sub 25-pin female	D-sub 25-pin female

Note) In case of RS-422 interface, multiple devices can be connected to one AS311 if the connected RS-422 devices work as slave stations and support multi-point connection. That is, the connected RS-422 devices must have the transmission generators which support the passive state. Also, the RS-422 devices must support the message format which contains the selecting address. In this case, the number of the connected RS-422 devices is limited up to 10.
On the other hand, the AS311's transmission generator does not support the passive state. Therefore the AS311 must be the master station in the one-to-N configuration.

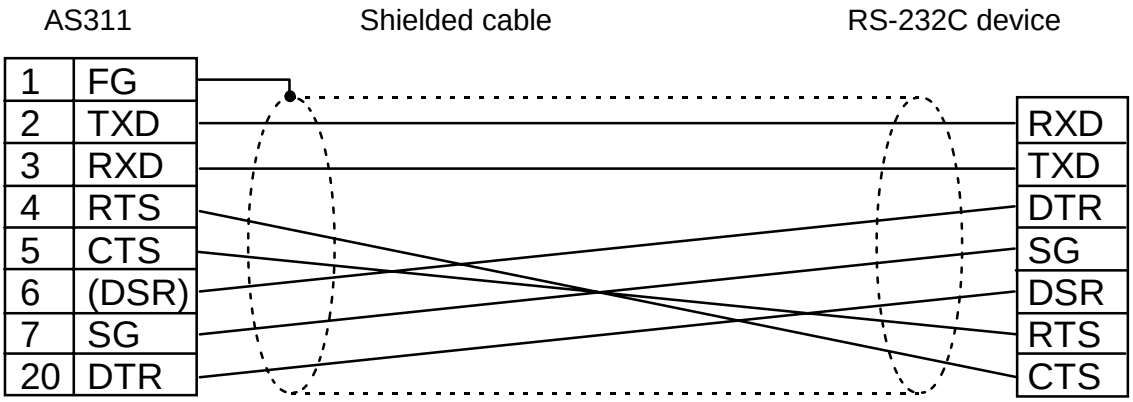
Section 3

Cable Connections

3. Cable Connections

3.1 RS-232C connection

The following figure shows the RS-232C connection.



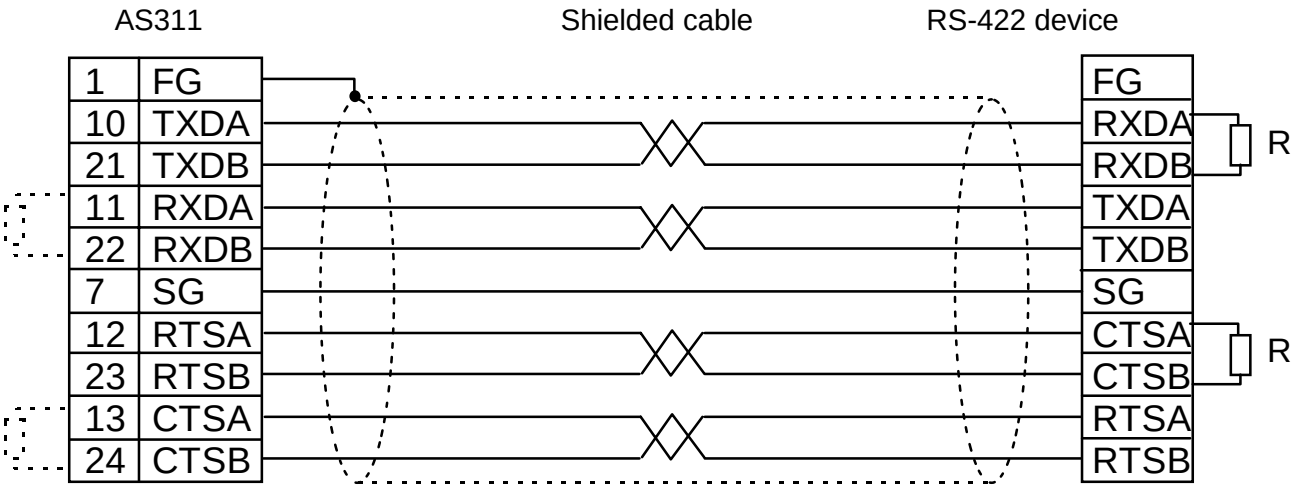
(1) DSR is supported only on the channel 2.
(2) Connect SG each other.
(3) Use shielded cable. The cable shield should be connected to FG at one end.
(4) It is recommended to use twisted cable for noise immunity.

NOTE

Do not connect or remove the connector while the AS311 is powered. Otherwise, it will cause damage to the AS311.

3.2 RS-422 connection

The channel 1 can be selected either RS-232C or RS-422. The following figure shows the RS-422 connection.



(1) On the AS311, connect the built-in terminating resistors (120 Ω) between RXDA and RXDB and between CTSA and CTSB by setting switches. (Set the SW3-2 and SW3-3 to ON)
(2) On the RS-422 device, connect the terminating resistors R (120 Ω - 1/2 W) between RXDA and RXDB and between CTSA and CTSB.
(3) Connect SG each other.
(4) Use shielded twisted-pair cable. The A (+) and B (-) of the same signal should be paired.
(5) The cable shield should be connected to FG at one end.

NOTE

Do not connect or remove the connector while the AS311 is powered. Otherwise, it will cause damage to the AS311.

Section 4

Register Configuration

4. Register Configuration

4.1 I/O allocation and I/O registers

The AS311 has the I/O type '**i X+Y 4W**' for I/O allocation. When the automatic I/O allocation is performed with mounting the AS311, the following I/O allocation table will be created in the T3.

(T-PDS screen example - in the case that AS311 is mounted on Slot 0 of Unit 0)

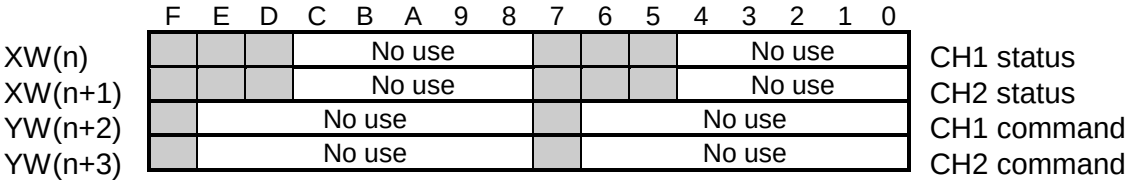
<I/O Allocation>

----Unit #0----		----Unit #1----		----Unit #2----		----Unit #3----	
Slot	I/O	Slot	I/O	Slot	I/O	Slot	I/O
PU	[ ]	0	[ ]	0	[ ]	0	[ ]
0	[iX+Y 4W]	1	[ ]	1	[ ]	1	[ ]
1	[ ]	2	[ ]	2	[ ]	2	[ ]
2	[ ]	3	[ ]	3	[ ]	3	[ ]
3	[ ]	4	[ ]	4	[ ]	4	[ ]
4	[ ]	5	[ ]	5	[ ]	5	[ ]
5	[ ]	6	[ ]	6	[ ]	6	[ ]
6	[ ]	7	[ ]	7	[ ]	7	[ ]
7	[ ]	8	[ ]	8	[ ]	8	[ ]
8	[ ]	9	[ ]	9	[ ]	9	[ ]
9	[ ]	10	[ ]	10	[ ]	10	[ ]

Then, 4 I/O registers, XW(n), XW(n+1), YW(n+2) and YW(n+3), are assigned to the AS311.
In the above example, XW000, XW001, YW002 and YW003 are assigned.

Note that the I/O type has '**i**' designation. It means that the T3 will not update the assigned I/O registers in the batch I/O processing. To read or write data through the I/O registers, the Direct I/O instruction (FUN235) or the direct I/O designation (I/IW and O/OW instead of X/XW and Y/YW) is necessary.
The reason of that is because the reading and writing timings are important for handshaking between T3 and AS311. Refer to section 5.

The following table shows the functions of I/O registers assigned to the AS311.



Register	Bit	Name	Description
XW(n) (CH1)	F	Write ready	1: ready to write data (transmit) for channel 1
	E	Transmit complete	1: transmitting has been completed normally
	D	Transmit error	1: transmitting has been canceled by error
	C - 8	–	No use (always 0)
	7	Read ready	1: ready to read the received data
	6	Receive complete	1: receiving for channel 1 has been completed
	5	Receive error	1: receiving error has occurred
	4 - 0	–	No use (always 0)
XW(n+1) (CH2)	F	Write ready	1: ready to write data (transmit) for channel 2
	E	Transmit complete	1: transmitting has been completed normally
	D	Transmit error	1: transmitting has been canceled by error
	C - 8	–	No use (always 0)
	7	Read ready	1: ready to read the received data
	6	Receive complete	1: receiving for channel 2 has been completed
	5	Receive error	1: receiving error has occurred
	4 - 0	–	No use (always 0)
YW(n+2) (CH1)	F	Transmit start	Set to 1 to start transmitting data from channel 1
	E - 8	–	No use (set to 0)
	7	Read start	Set to 1 to start reading data for channel 1
	6 - 0	–	No use (set to 0)
YW(n+3) (CH2)	F	Transmit start	Set to 1 to start transmitting data from channel 2
	E - 8	–	No use (set to 0)
	7	Read start	Set to 1 to start reading data for channel 2
	6 - 0	–	No use (set to 0)

NOTE

These bits are used for handshaking between T3 and AS311. The detailed function and timing are explained in section 5.

4.2 AS311 buffer memory

As explained in the previous section, the I/O registers that are assigned to AS311 are used to control the reading and writing timings (handshake) between T3 and AS311.

On the other hand, for exchanging the transmission data between T3 and AS311, the AS311's buffer memory is used.

This section explains the buffer memory contents and how to access the buffer memory.

4.2.1 Memory map

The AS311 has the buffer memory that is used to exchange data with T3. The overall map of the buffer memory is as follows.

Address	Word data	
0	Status and command	4 words - same data as I/O registers
4	Parameter	124 words - transmission parameters, etc.
128	Channel 1 reading (receiving) data area	448 words
576	Channel 1 writing (transmitting) data area	448 words
1024	Channel 2 reading (receiving) data area	448 words
1472	Channel 2 writing (transmitting) data area	448 words
1920	Access inhibited	128 words

4.2.2 Buffer memory access

T3 can read the AS311's buffer memory contents by using READ instruction (FUN237). Also, T3 can write data into the buffer memory by using WRITE instruction (FUN238).

READ instruction (FUN237)

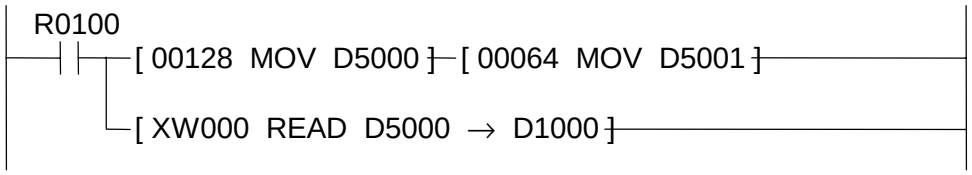
Expression:

—[(A) READ (B) → (C)]—

Operands:

(A): I/O register (XW/YW) assigned to the AS311
(B): Starting address of the buffer memory to be read
(B)+1: Number of words to be read (max. 256)
(C): Starting register of the destination

Example:



When R0100 is ON, 64 words of buffer memory data starting with address 128 are read from the AS311 which is allocated to XW000. And the data are stored in D1000 and after.

WRITE instruction (FUN238)

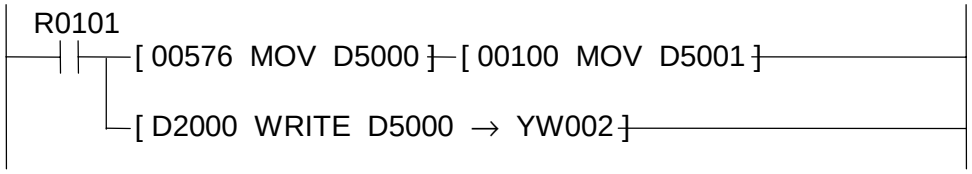
Expression:

—[(A) WRITE (B) → (C)]—

Operands:

(A): Starting register of the source
(B): Starting address of the buffer memory to be written
(B)+1: Number of words to be written (max. 256)
(C): I/O register (XW/YW) assigned to the AS311

Example:



When R0101 is ON, 100 words of data starting with D2000 (D2000 to D2099) are written into the buffer memory address 576 and after of the AS311 which is allocated to YW002.

4.2.3 Parameter area

The parameter area of the buffer memory contains the following contents.

Address			Address		
0	CH1 status	Status and command	64		Reserved
1	CH2 status		65		
2	CH1 command		66		
3	CH2 command		67		
4	Status 1	CH1, CH2 common parameters	68		
5	RSW1/2 information		69		
6	SW1 information		70		
7	SW2 information		71		
8			72		
9			73		
10			74		
11			75		
12	Command 1		76		
13			77		
14			78		
15			79		
16	CH1 receive error	CH1 parameters	80	CH2 receive error	CH2 parameters
17	CH1 transmit error		81	CH2 transmit error	
18	CH1 channel status		82	CH2 channel status	
19	CH1 receive length		83	CH2 receive length	
20			84		
21			85		
22			86		
23			87		
24	CH1 trailing code		88	CH2 trailing code	
25	CH1 time-out check		89	CH2 time-out check	
26			90		
27			91		
28			92		
29			93		
30			94		
31			95		
63			127		

Note: Blanks are for future use. (Reserved)

4. Register Configuration

Status and command (0 - 3)

The addresses 0 to 3 store the same data as the I/O registers that are assigned to the AS311.
Refer to section 4.1 for details.

0	CH1 status	= XW(n)
1	CH2 status	= XW(n+1)
2	CH1 command	= YW(n+2)
3	CH2 command	= YW(n+3)

Status 1 (4)

The address 4 shows the AS311 module status. If an error has occurred in the AS311, the error code is stored here.

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

Bit F	RDY (Ready)	1 = operating normally 0 = under initialization or error state
Bit E	ERR (Error)	1 = error state 0 = no error (normal)
Bit 7-0	Error code	Shows the detected error item if ERR is 1. (H00 when normal) See section 6.2.1 for details.

RSW1/2 information (5)

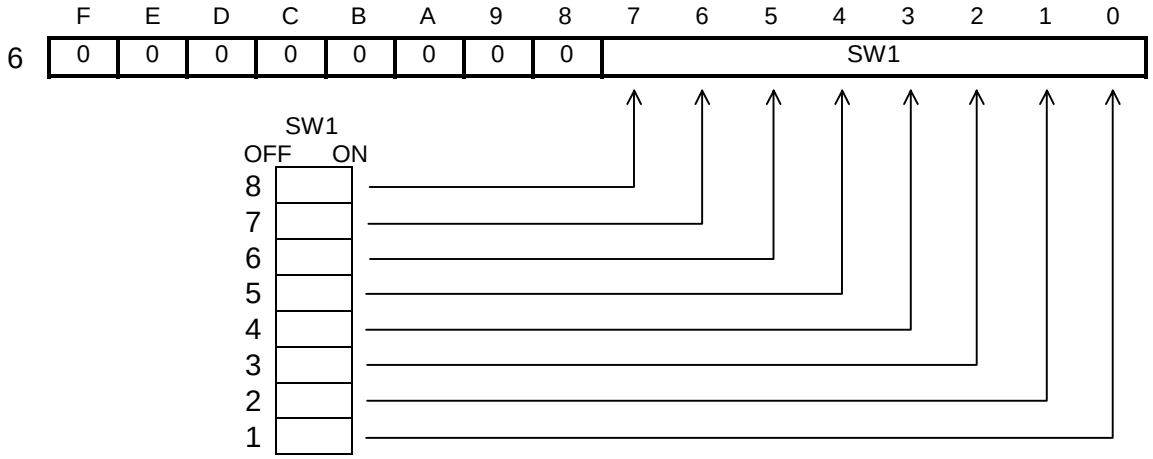
The address 5 stores the rotary switches RSW1 and RSW2 setting status.

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
5	0	0	0	0	0	0	0	0	RSW1				RSW2			

Bit 7-4	RSW1	Stores the rotary switch 1 (RSW1) setting status. 0 - F
Bit 3-0	RSW2	Stores the rotary switch 2 (RSW2) setting status. 0 - F

SW1 information (6)

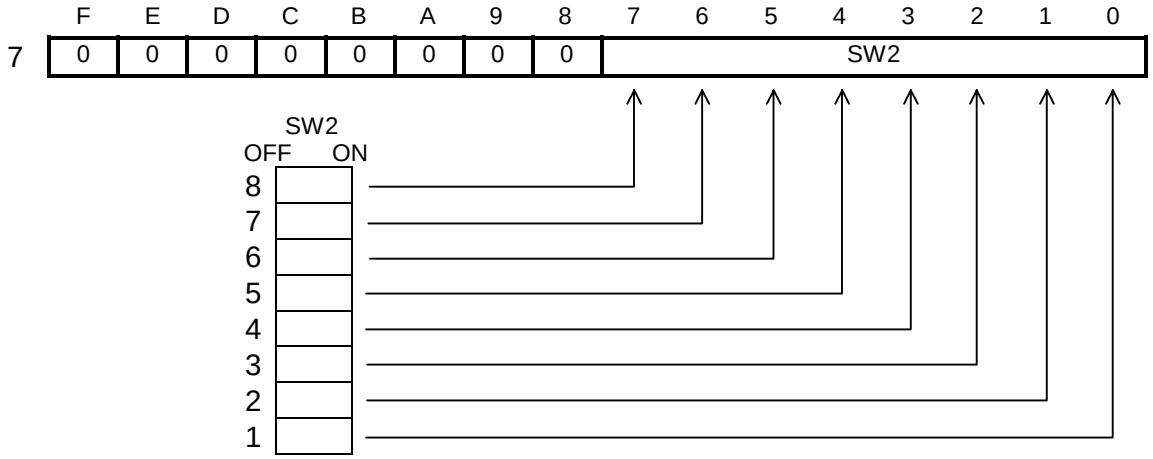
The address 6 stores the setting status of the channel 1 transmission parameter setting switches (SW1).



ON: 1 OFF: 0

SW2 information (7)

The address 7 stores the setting status of the channel 2 transmission parameter setting switches (SW2).



ON: 1 OFF: 0

Command 1 (12)

The address 12 is used to reset the AS311 by T3 program.
Two types of reset commands are available, hot reset and cold reset.
The hot reset is used to change the trailing code and the time-out check time settings.
The cold reset is used to initialize the AS311. The trailing code and the time-out check time will be reset to the default setting. The operation of the cold reset is the same as the hard reset switch and power on initialization.
Refer to sections 5.5, 5.6 and 5.7 for these functions.

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

Bit F	RST (Reset)	1 = reset request 0 = normal (no reset request)
Bit 7-0	Command number	HFE = hot reset HFF = cold reset

CH1 receive error (16) and CH2 receive error (80)

The address 16 (for channel 1) and the address 80 (for channel 2) indicate the error contents if an error has been detected in receiving a message. This information is set during the received message read sequence.
Refer to section 6.2.3 for details.

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
16 or 80	0	0	0	0	BRK	PE	FE	OE	Receive error code							

Bit B	BRK (Break)	1 = break detected 0 = normal
Bit A	PE (Parity error)	1 = parity error 0 = normal
Bit 9	FE (Framing error)	1 = framing error 0 = normal
Bit 8	OE (Overrun error)	1 = overrun error 0 = normal
Bit 7-0	Receive error code	Shows the error code regarding received message. (H00 when normal) See section 6.2.3 for details.

CH1 transmit error (17) and
CH2 transmit error (81)

The address 17 (for channel 1) and the address 81 (for channel 2) indicate the error contents if an error has occurred during message transmitting. This information is set during the write sequence for message transmitting.
Refer to section 6.2.4 for details.

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
17 or 81	0	0	0	0	0	0	0	0	Transmit error code							

Bit 7-0	Transmit error code	Shows the error code for transmitting. (H00 when normal) See section 6.2.4 for details.

CH1 channel status (18) and
CH2 channel status (82)

The address 18 (for channel 1) and the address 82 (for channel 2) indicate the control signal status. This information is always updated.

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
18 or 82	0	0	0	0	0	0	0	IDL	DSR	0	0	0	CTS	1	0	0

Bit 8	IDL (Idle)	1 = transmitter is idle state 0 = transmitter is non-idle state
Bit 7	DSR (Data set ready)	1 = DSR is ON 0 = DSR is OFF Note (1)
Bit 3	CTS (Clear to send)	1 = CTS is ON 0 = CTS is OFF

Note: (1) The channel 1 does not support DSR. Therefore, bit 7 of the address 18 is always 0.
(2) The bit 2 is always 1.

CH1 receive length (19) and
CH2 receive length (83)

The address 19 (for channel 1) and the address 83 (for channel 2) indicate the length of the received message (number of bytes). This information is set during the received message read sequence.

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
19 or 83	Received message length															

Bit F-0	Received message length	Shows the received message length (bytes). 0 - 896

CH1 trailing code (24) and
CH2 trailing code (88)

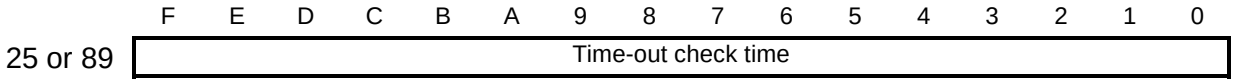
The address 24 (for channel 1) and the address 88 (for channel 2) store the trailing codes. The default setting is H0D (CR code).
To change the trailing code, write the desired code into this address then write the hot reset command into the Command 1 (12). See section 5.6 for this procedure.

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
24 or 88	0	0	0	0	0	0	0	0	Trailing code							

Bit 7-0	Trailing code	Stores the trailing code. Initial value at power on is H0D (carriage return).

CH1 time-out check (25) and
CH2 time-out check (89)

The address 25 (for channel 1) and the address 89 (for channel 2) store the time-out check times. If the time between each receiving character exceeds the specified time-out check time, it becomes the receiving time-out error. The default setting is 1 second. To change the setting, write the desired data into this address then write the hot reset command into the Command 1 (12). See section 5.7 for this procedure.



Bit F-0	Time-out check time	Stores the time-out check time (0.1 s units). Valid data range is 1 to 600 (0.1 to 60 s). If 0 or more than 600 is specified, the time-out check will not work. Initial value at power on is 10 (1 s).

4.2.4 Receiving and transmitting data area

The receiving and transmitting data area is provided to exchange the communication characters between T3 and AS311. The address ranges in the AS311 buffer memory are as follows.

Address	Word data	
128	Channel 1 reading (receiving) data area	448 words
576	Channel 1 writing (transmitting) data area	448 words
1024	Channel 2 reading (receiving) data area	448 words
1472	Channel 2 writing (transmitting) data area	448 words

When AS311 receives a message (one set of transmission characters), AS311 sets the characters into the receiving data area starting with the address 128 or 1024. Then T3 can read these characters from the receiving data area by using READ instruction.

When T3 attempts to send a message via AS311, T3 writes the characters into the transmitting data area starting with the address 576 or 1472 by using WRITE instruction, and instructs AS311 to start transmitting. AS311 recognizes from the character stored in the starting address (576 or 1472) to the trailing code character as the one set of transmitting message.

Refer to section 5 for message receiving/transmitting procedure.

Section 5

Operation Procedure

5. Operation Procedure

5.1 Transmission 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 5.6 for setting the trailing code other than CR.

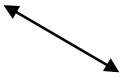
The maximum length of a message is 896 bytes. An example of the message is shown below.

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.

When the above message is received or transmitted, the data arrangements in the T3 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

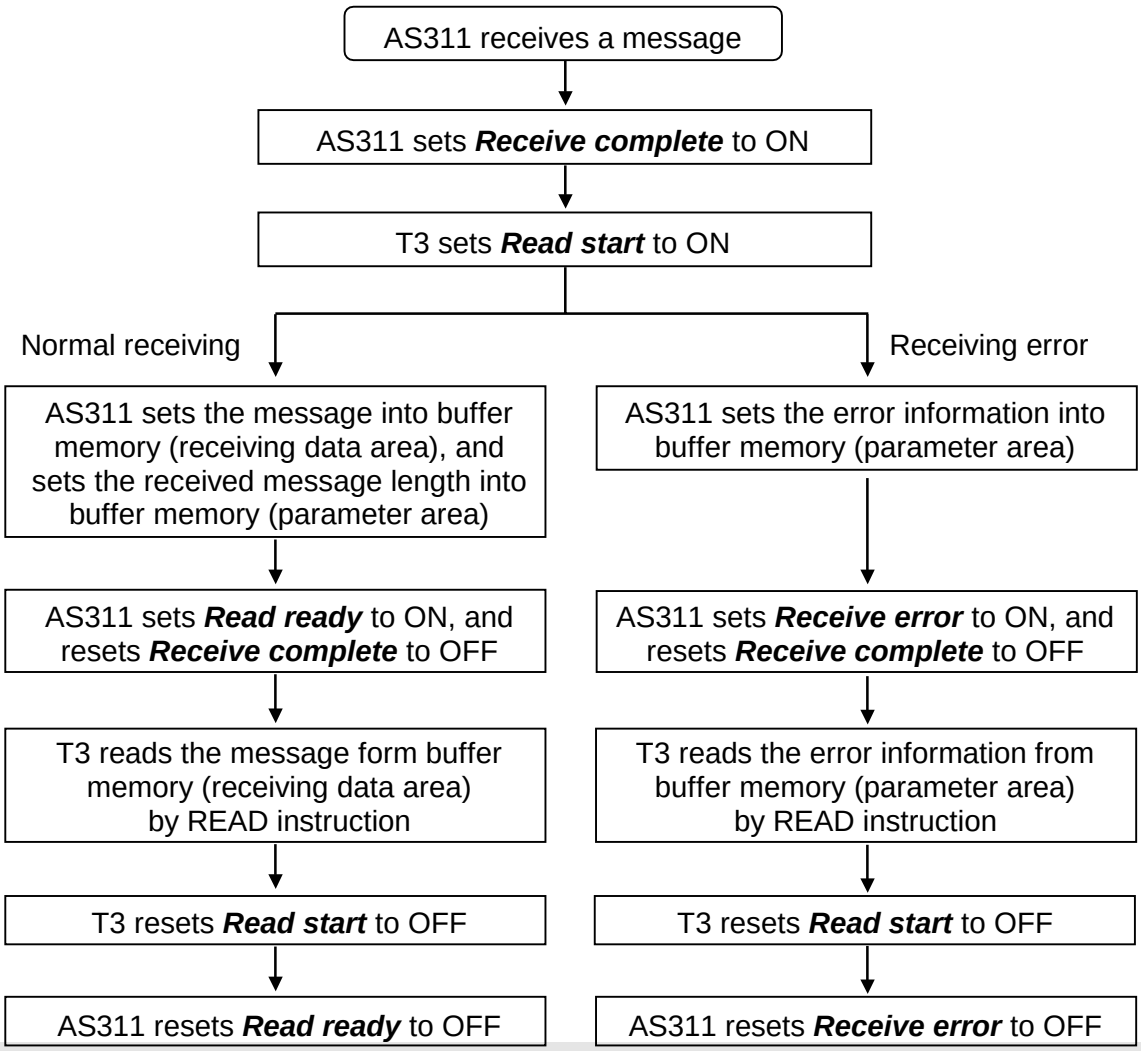
5.2 Received message read sequence

5.2.1 Flag control timing

In case of receiving a message, the following flags are used for handshaking between T3 and AS311. These flags are the bits of the I/O registers assigned to the AS311. Refer to section 4.1.

Read ready	Bit 7 of XW(n) for channel 1 or XW(n+1) for channel 2
Receive complete	Bit 6 of XW(n) for channel 1 or XW(n+1) for channel 2
Receive error	Bit 5 of XW(n) for channel 1 or XW(n+1) for channel 2
Read start	Bit 7 of YW(n+2) for channel 1 or YW(n+3) for channel 2

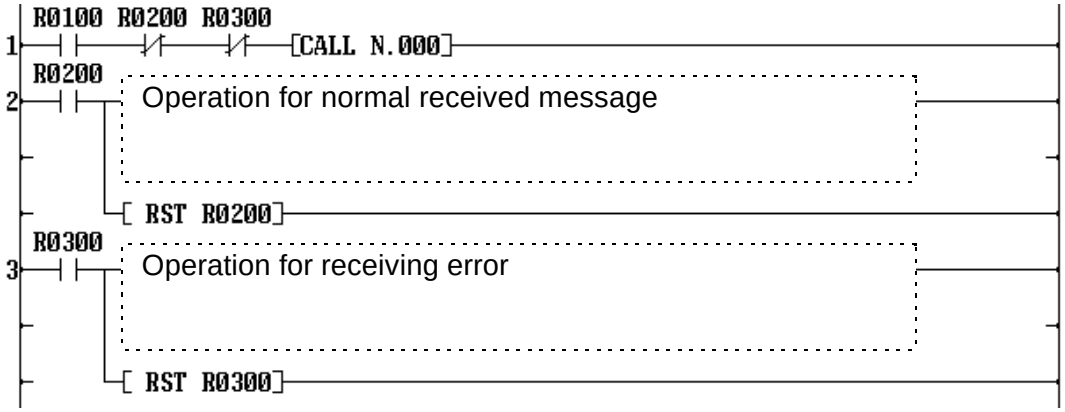
The message receiving procedure is as follows. It is called “received message read sequence”.



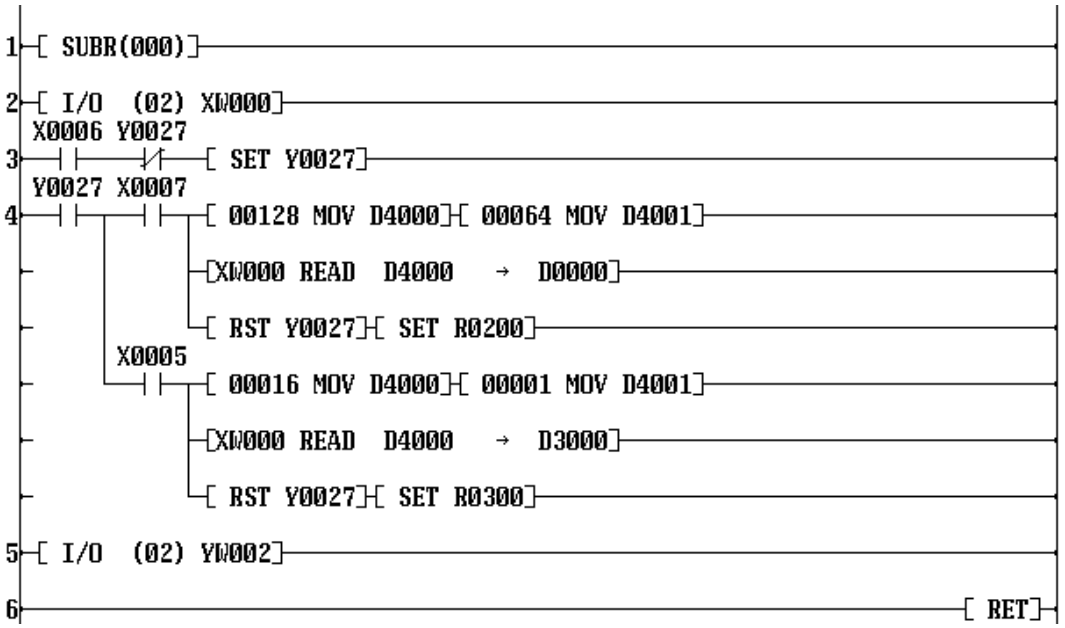
5.2.2 T3 sample program for message receiving

A sample program for the “received message read sequence” is shown below. This sample program is for the channel 1 of the AS311 that is allocated to XW000 - YW003.

(Main program)



(Subroutine No. 0)



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

R0100 AS311 status (ON when ready) - Refer to section 5.4
R0200 Receiving normal complete (comes ON when receiving is complete normally)
R0300 Receiving error complete (comes ON when receiving error has occurred)

X0006 Receive complete flag
X0007 Read ready flag
X0005 Receive error flag
Y0027 Read start flag

D0000 - D0063 Received message is stored here
D3000 Receiving error information is stored here
D4000 - D4001 Parameters for READ instruction

This sample program works as follows.

Main program
- Rung 1: Calls Subroutine No. 0 when the AS311 is normal and both R0200 and R0300 are OFF.
- Rung 2: When R0200 comes ON (normal receiving), performs the necessary operation for the received message, then resets R0200 to OFF.
- Rung 3: When R0300 comes ON (receiving error has occurred), performs the error processing, then resets R0300 to OFF.

Subroutine No. 0
- Rung 1: Indicates the entry of Subroutine No. 0.
- Rung 2: Reads XW000 and XW001 from the AS311 by direct I/O instruction.
- Rung 3: Sets Y0027 (Read start flag) to ON if X0006 (Receive complete flag) is ON.
- Rung 4: When X0007 (Read ready flag) comes ON, reads the received message from the AS311's buffer memory, 64 words starting with address 128, by READ instruction, and stores it into D0000 and after. Then resets Y0027 (Read start flag) to OFF, and sets R0200 to ON.
  When X0005 (Receive error flag) comes ON, reads the error information from the AS311's buffer memory, 1 word of address 16, by READ instruction, and stores it into D3000. Then resets Y0027 (Read start flag) to OFF, and sets R0300 to ON.
- Rung 5: Writes YW002 and YW003 into the AS311 by direct I/O instruction.
- Rung 6: Indicates the return of Subroutine No. 0.

5. Operation Procedure

Explanation for this sample program:

(1) The “received message read sequence” is programmed on Subroutine No. 0.
(2) The Subroutine No. 0 is called from Main program with resetting R0200 and R0300 to OFF.
(3) When a message is received normally, R0200 will come ON and the message (ASCII characters) will be stored in D0000 to D0063. In this sample program, the received message length information (buffer memory address 19) is not used. The maximum length of a message is 128 bytes (64 words) because the number of read words of the READ instruction is programmed as 64 words.
(4) When an error has occurred in receiving the message, R0300 will come ON and the error information will be stored in D3000. For details of the error information, refer to section 6.2.3.

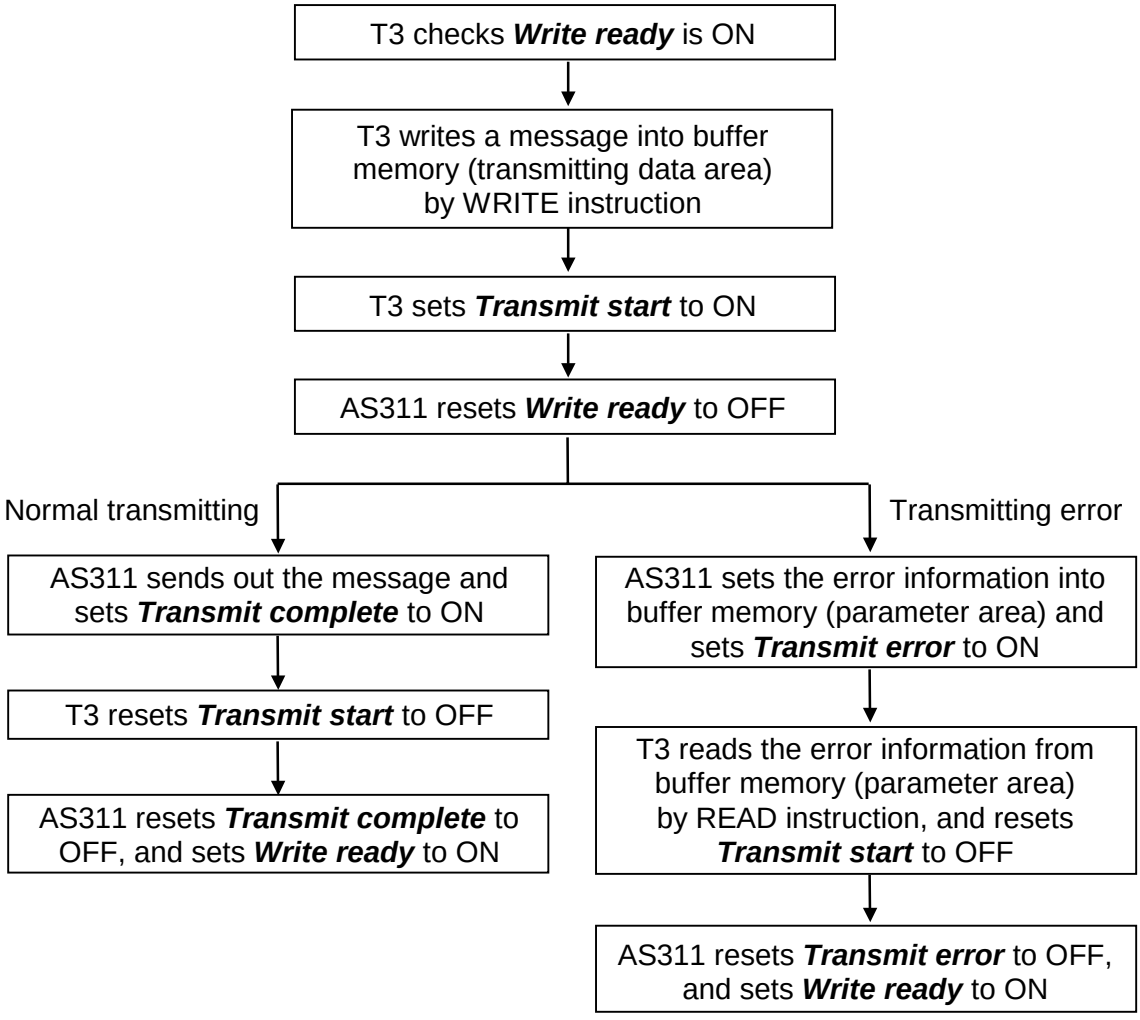
5.3 Write sequence for message transmitting

5.3.1 Flag control timing

In case of transmitting a message, the following flags are used for handshaking between T3 and AS311. These flags are the bits of the I/O registers assigned to the AS311. Refer to section 4.1.

Write ready	Bit F of XW(n) for channel 1 or XW(n+1) for channel 2
Transmit complete	Bit E of XW(n) for channel 1 or XW(n+1) for channel 2
Transmit error	Bit D of XW(n) for channel 1 or XW(n+1) for channel 2
Transmit start	Bit F of YW(n+2) for channel 1 or YW(n+3) for channel 2

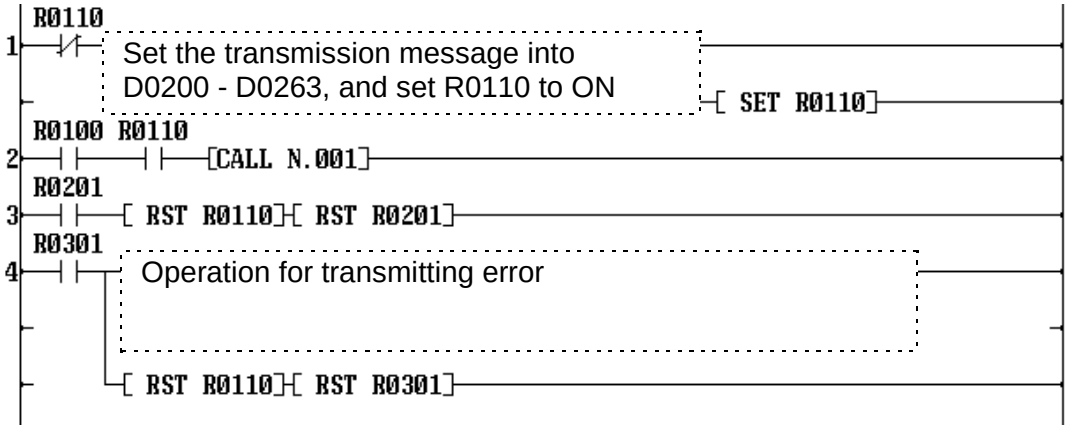
The message transmitting procedure is as follows. It is called “write sequence for message transmitting”.



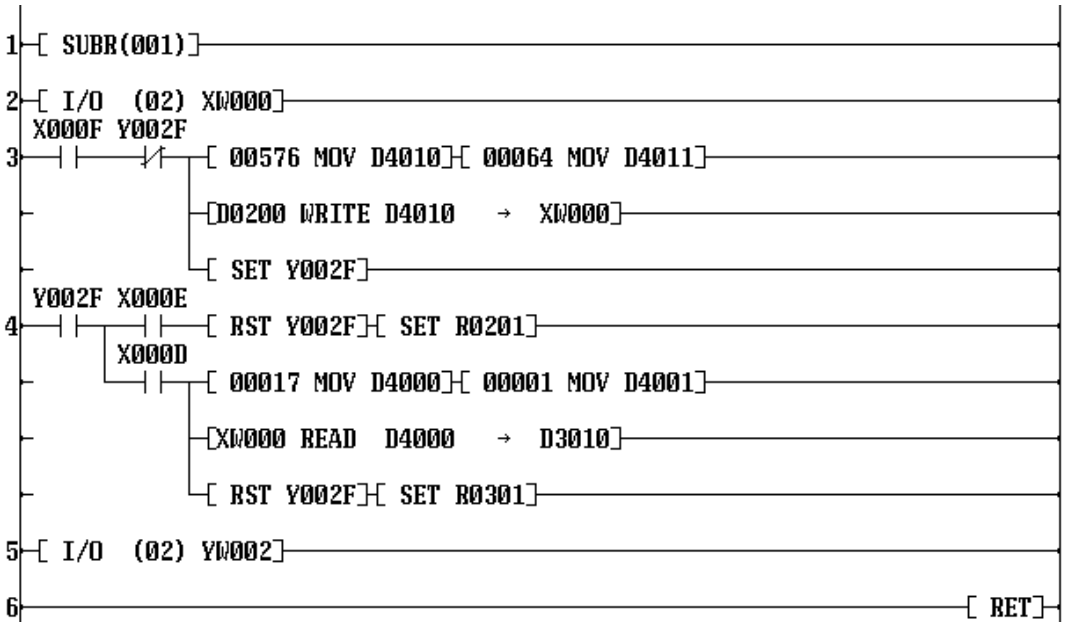
5.3.2 T3 sample program for message transmitting

A sample program for the “write sequence for message transmitting” is shown below. This sample program is for the channel 1 of the AS311 that is allocated to XW000 - YW003.

(Main program)



(Subroutine No. 1)



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

R0100	AS311 status (ON when ready) - Refer to section 5.4
R0110	Internal flag to start transmitting
R0201	Transmitting normal complete (comes ON when transmitting is complete normally)
R0301	Transmitting error complete (comes ON when transmitting error has occurred)

X000F	Write ready flag
X000E	Transmit complete flag
X000D	Transmit error flag
Y002F	Transmit start flag

D0200 - D0263	Transmitting message is set here
D3010	Transmitting error information is stored here
D4010 - D4011	Parameters for WRITE instruction
D4000 - D4001	Parameters for READ instruction

This sample program works as follows.

Main program
- Rung 1: Prepares a transmission message and sets it into D0200 and after (maximum 64 words in this sample). Then sets R0110 to ON.
- Rung 2: Calls Subroutine No. 1 when the AS311 is normal and R0110 is ON.
- Rung 3: When R0201 comes ON (normal transmitting), resets R0110 and R0201 to OFF.
- Rung 4: When R0301 comes ON (transmitting error has occurred), performs the error processing, then resets R0110 and R0301 to OFF.

Subroutine No. 1
- Rung 1: Indicates the entry of Subroutine No. 1.
- Rung 2: Reads XW000 and XW001 from the AS311 by direct I/O instruction.
- Rung 3: When X000F (Write ready flag) is ON, writes the message that is stored in D0200 to D0263 into the AS311's buffer memory, 64 words starting with address 576, by WRITE instruction, and sets Y002F (Transmit start flag) to ON.
- Rung 4: When X000E (Transmit complete flag) comes ON, resets Y002F (Transmit start flag) to OFF, and sets R0201 to ON.
  When X000D (Transmit error flag) comes ON, reads the error information from the AS311's buffer memory, 1 word of address 17, by READ instruction, and stores it into D3010. Then resets Y002F (Transmit start flag) to OFF, and sets R0301 to ON.
- Rung 5: Writes YW002 and YW003 into the AS311 by direct I/O instruction.
- Rung 6: Indicates the return of Subroutine No. 1.

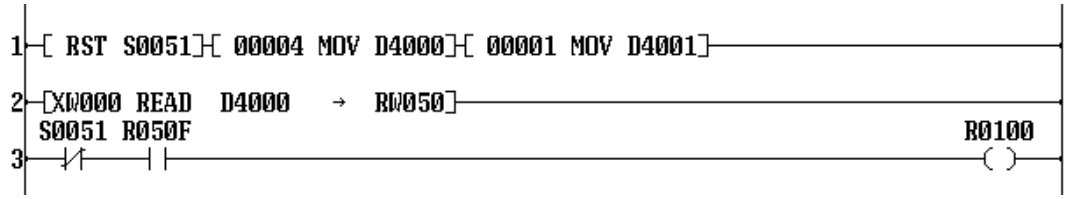
5. Operation Procedure

Explanation for this sample program:

(1) The “write sequence for message transmitting” is programmed on Subroutine No. 1.
(2) To start transmitting, set the message (ASCII characters) into D0200 and after. Then set R0110 to ON.
The message length is maximum 128 bytes (64 words) in this sample program.
(3) When R0110 is set to ON while the AS311 is ready, the Subroutine No. 1 will be called and the message transmitting will be started.
(4) When the message is transmitted normally, R0201 will come ON. Then R0110 will be reset to OFF.
(5) When an error has occurred in transmitting the message, R0301 will come ON and the error information will be stored in D3010. For details of the error information, refer to section 6.2.4.

5.4 Checking the AS311 operation status

AS311 operation status information is stored in the AS311's buffer memory address 4 (Status 1). T3 can read this information by using READ instruction.
A sample program is shown below. This sample program is for the AS311 that is allocated to XW000 - YW003.



The above sample program works as follows.

- Rung 1: Resets S0051 (Instruction error flag) to OFF, and sets parameters for the READ instruction.
- Rung 2: Reads the operation status information from the AS311's buffer memory address 4 (Status 1).
- Rung 3: When S0051 (Instruction error flag) is OFF and R050F (Ready) is ON, turns R0100 to ON.

It means that the AS311 is operating normally when R0100 is ON.
If R050E (Error) is ON, the AS311 is in error state. In that case, the error code is stored in the lower 8 bits of RW050. For the error code, refer to section 6.2.1.
If S0051 (Instruction error flag) is ON, it means that an error has occurred during the READ instruction execution.

5.5 Resetting the AS311 by software

AS311 can be reset by T3 program. Two types of resetting are available, cold reset and hot reset.
The cold reset is used to reset the AS311 error state. When the cold reset is executed, the AS311 will be initialized. The trailing code and the time-out check time are also reset to the default settings. This function is the same as pressing the hardware reset switch and power on initialization.
On the other hand, the hot reset is used to change the trailing code and/or the time-out check time.

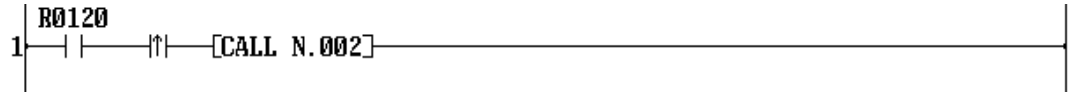
For executing these functions, write the following data into the AS311's buffer memory address 12 (Command 1). The data writing into this address must be one-shot.

Clod reset: H80FF
Hot reset: H80FE

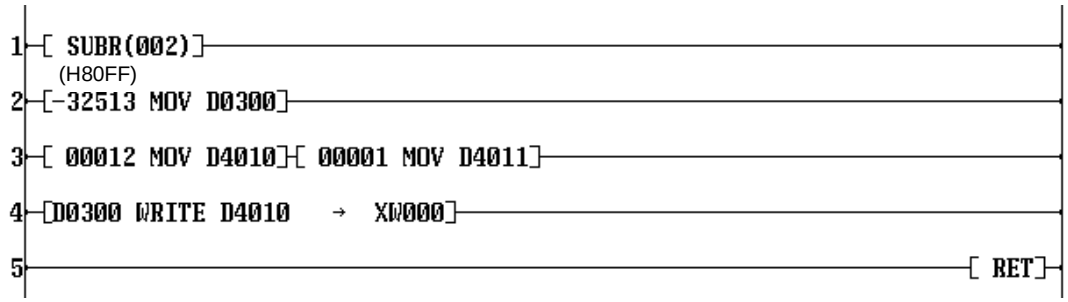
The written data will be cleared to 0 by AS311 when the operation is completed.

A sample program for the cold reset is shown below. This sample program is for the AS311 that is allocated to XW000 - YW003.
In this sample program, the cold reset operation will be started by setting R0120 to ON.

(Main program)



(Subroutine No. 2)



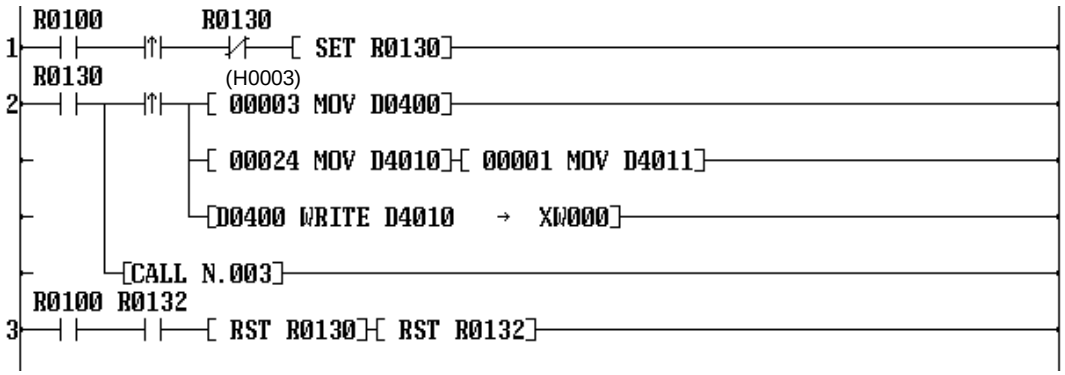
For the hot reset, refer to sections 5.6 and 5.7.

5.6 Setting the trailing code

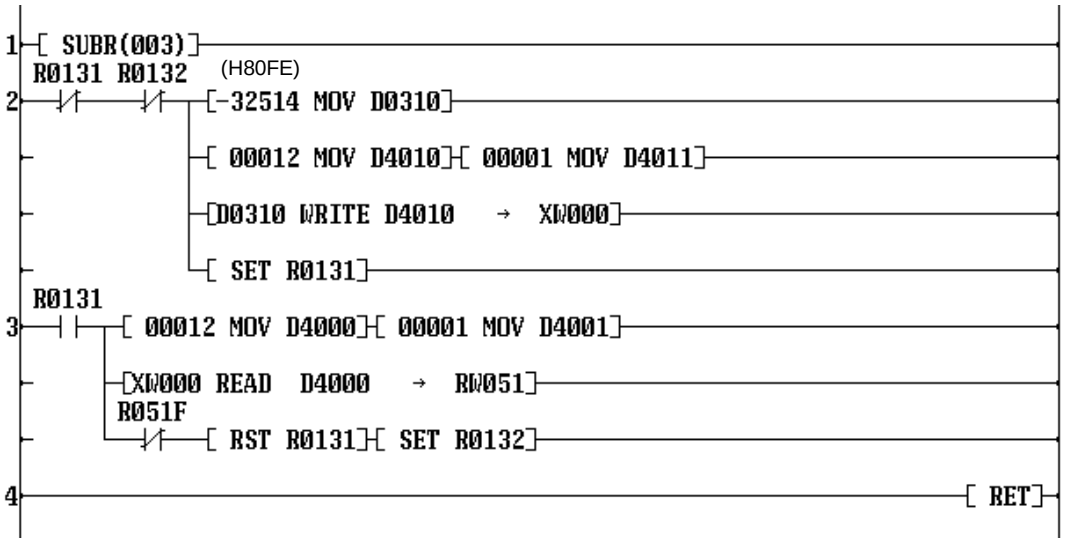
The default setting of the trailing code is CR (carriage return code = H0D). The trailing code can be changed by T3 program.
To do this, write desired trailing code into the AS311's buffer memory address 24 (CH1 trailing code) and/or address 88 (CH2 trailing code), and execute the hot reset (refer to section 5.5).

A sample program is shown below. This sample program is for the AS311 that is allocated to XW000 - YW003.
In this sample program, the trailing code changing routine will be executed once when the AS311 status is changed to ready (R0100 comes ON - refer to section 5.4), and the channel 1 trailing code will be changed to H03.
If the channel 2 trailing code and/or the time-out check time are also changed, write these data on the Main program Rung 2 before calling Subroutine No. 3 in the same manner.

(Main program)



(Subroutine No. 3)



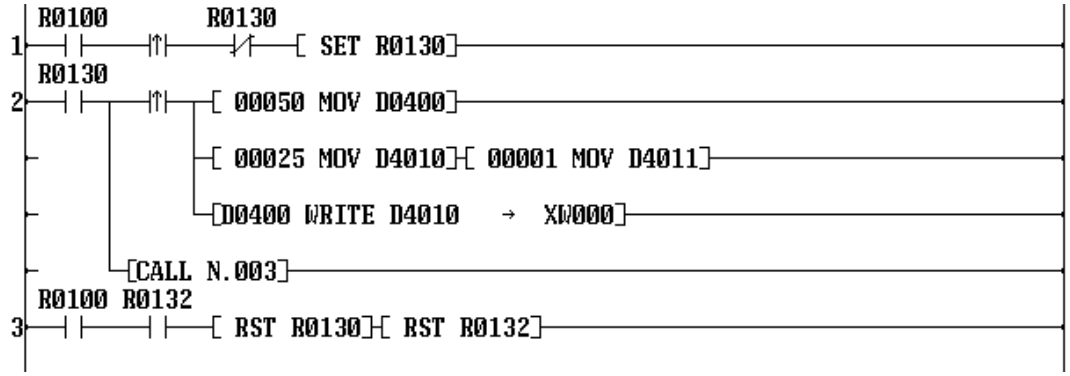
5.7 Setting the time-out check time

The default setting of the time-out check time is 1 second. The time-out check time can be changed by T3 program. The valid setting range is 0.1 to 60.0 seconds in 0.1 second units. Refer to section 4.2.3.

To change the time-out check time, write desired value into the AS311's buffer memory address 25 (CH1 time-out check) and/or address 89 (CH2 time-out check), and execute the hot reset (refer to section 5.5).

T3 program for this purpose is almost same as that for setting the trailing code (refer to section 5.6). Only the difference is writing the time-out check time instead of the trailing code. See Rung 2 of the following sample. In this sample, the channel 1 time-out check time is changed to 5 seconds.
If the channel 2 time-out check time and/or the trailing code are also changed, write these data on the Main program Rung 2 before calling Subroutine No. 3 in the same manner.

(Main program)



Section 6

RAS Information

6. RAS Information

6.1 LED indication

On the AS311, five status LEDs are provided as follows. These LEDs are useful to check the AS311 operation status and the communication status.

- RUN
- TX1
- RX1
- TX2
- RX2

RUN	Indicates the AS311 operation status. Lit when the AS311 is in ready state. Not lit when the AS311 is in error or under initialization.
TX1	Indicates the channel 1 communication status. Lit while some data is transmitting from the AS311.
RX1	Indicates the channel 1 communication status. Lit while some data is receiving into the AS311.
TX2	Indicates the channel 2 communication status. Lit while some data is transmitting from the AS311.
RX2	Indicates the channel 2 communication status. Lit while some data is receiving into the AS311.

6.2 Buffer memory information

Various RAS information are stored in the AS311's buffer memory. These information can be read by READ instruction. When some abnormality has occurred, check these information.

6.2.1 Module status

Address 4 of the buffer memory stores the AS311 module status.

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

Bit F	RDY (Ready)	1 = operating normally 0 = under initialization or error state
Bit E	ERR (Error)	1 = error state 0 = no error (normal)
Bit 7-0	Error code	Shows the detected error item if ERR is 1. See the table below (H00 when normal)

Error code	Type of error	Description	Status
H01	CPU error	CPU error has been detected during initialization.	Operation is stopped.
H02	ROM error	ROM error has been detected during initialization.	Operation is stopped.
H03	RAM error	Work RAM error has been detected during initialization.	Operation is stopped.
H04	Buffer memory error	Buffer memory error has been detected during initialization.	Operation is stopped.
H05	Switch setting abnormal	Switch setting abnormality has been detected during initialization.	Operation is stopped.
H10	Watchdog timer error	Watchdog timer error has occurred during operation.	Operation is stopped. Cold reset will be effective.
H11	Trap interrupt error	Trap interrupt has occurred by detecting illegal instruction during operation.	Operation is stopped. Cold reset will be effective.
H12	Buffer memory time-out error	Buffer memory time-out has occurred during operation.	Operation is stopped. Cold reset will be effective.

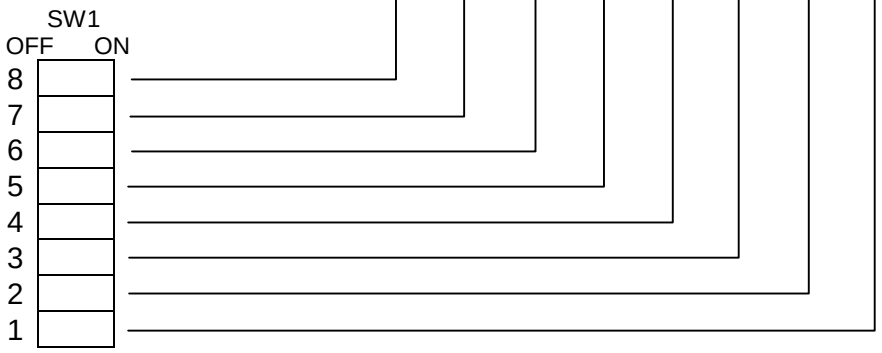
6.2.2 Switch setting status

Addresses 5, 6 and 7 of the buffer memory store the switches setting status. Check that the information agrees with the physical setting status if some abnormality has occurred.

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
5	0	0	0	0	0	0	0	0	RSW1				RSW2			

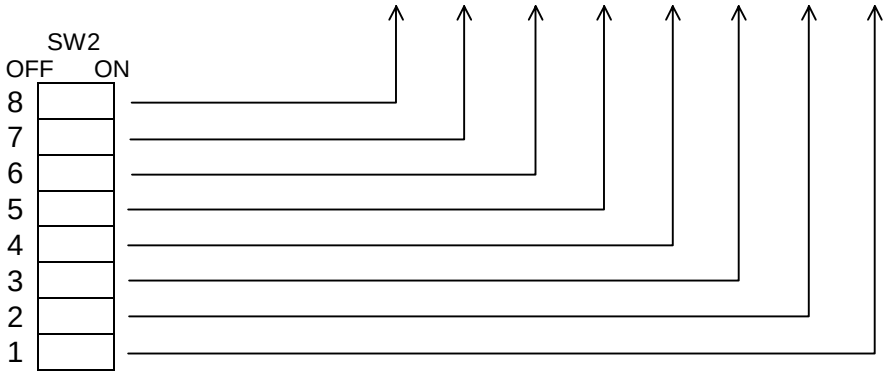
Bit 7-4	RSW1	Stores the rotary switch 1 (RSW1) setting status. 0 - F
Bit 3-0	RSW2	Stores the rotary switch 2 (RSW2) setting status. 0 - F

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
6	0	0	0	0	0	0	0	0	SW1							



ON: 1 OFF: 0

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
7	0	0	0	0	0	0	0	0	SW2							



ON: 1 OFF: 0

6.2.3 Error information for data receiving

Address 16 for channel 1 and address 80 for channel 2 store the error information for data receiving.

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
16 or 80	0	0	0	0	BRK	PE	FE	OE	Receive error code							

Bit B	BRK (Break)	1 = break detected 0 = normal When break has been detected, receive buffer is cleared. The next message can be received.
Bit A	PE (Parity error)	1 = parity error 0 = normal When parity error has occurred, the message is disabled. The next message can be received.
Bit 9	FE (Framing error)	1 = framing error 0 = normal When framing error has occurred, the message is disabled. The next message can be received.
Bit 8	OE (Overrun error)	1 = overrun error 0 = normal When overrun error has occurred, the message is disabled. The next message can be received.
Bit 7-0	Receive error code	Shows the error code regarding received message. See the table below. (H00 when normal)

Error code	Type of error	Description	Status
H01	Receive time-out error	Specified time-out check time has elapsed between characters.	The rest of the message will be received as the next.
H02	Message length error	The message length has exceeded the limit. (896 bytes)	The message is disabled. The next message can be received.
H03	Receive buffer overflow	Receive buffer overflow has occurred.	The message is disabled. The next message can be received.

6.2.4 Error information for data transmitting

Address 17 for channel 1 and address 81 for channel 2 store the error information for data transmitting.

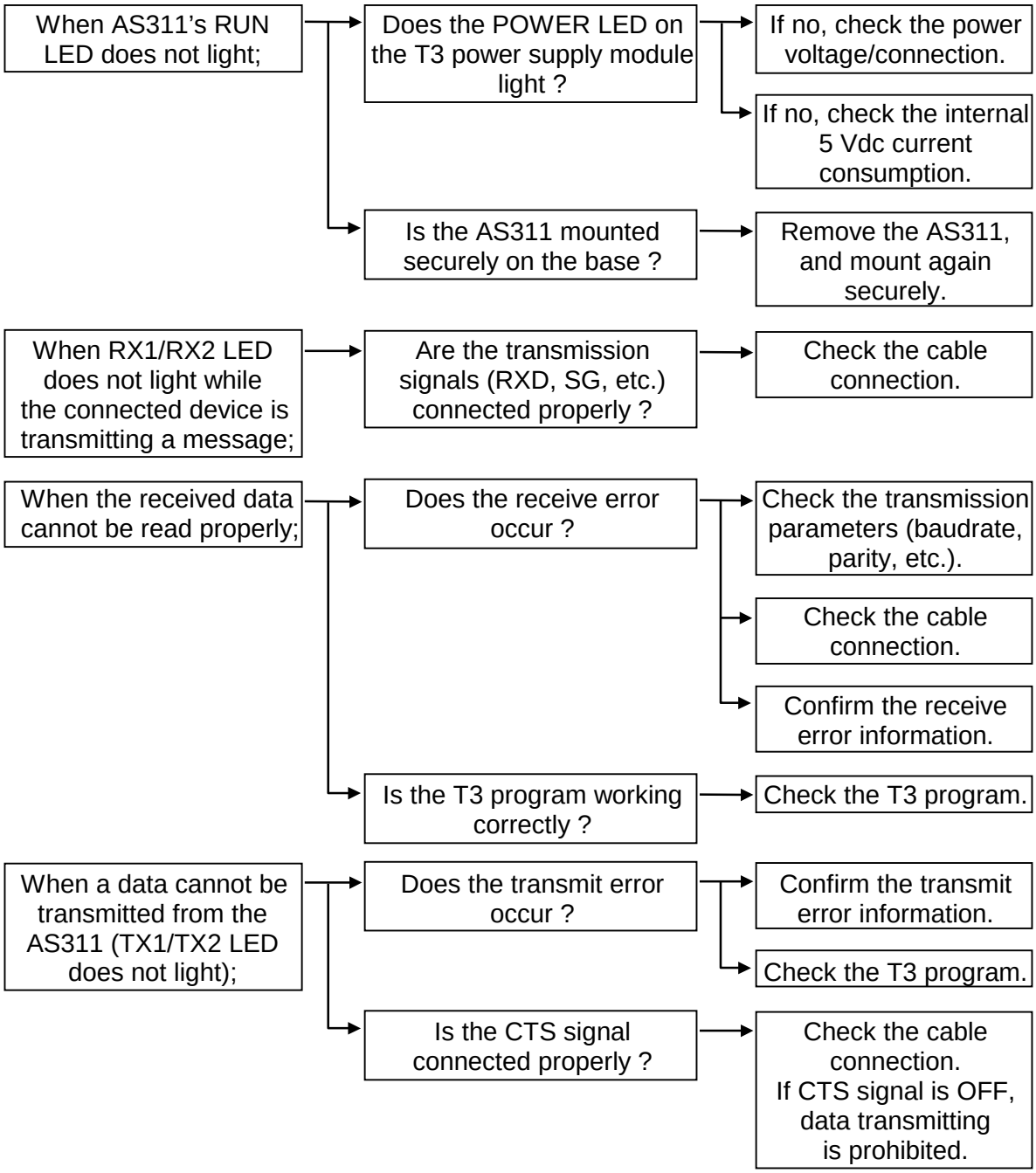
	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
17 or 81	0	0	0	0	0	0	0	0	Transmit error code							

Bit 7-0	Transmit error code	Shows the error code for transmitting. See the table below. (H00 when normal)

Error code	Type of error	Description	Status
H01	Trailing code missing	The trailing code has not been written into the buffer memory.	The message is disabled. The next message can be transmitted.

6.3 Trouble shooting

When AS311 does not work properly, check the following points.



Appendix

Appendix

A.1 Specification of the READ instruction

FUN 237 Special module data read (READ)
Reads designated range of data from the special module.
Input → [A READ B → C] → Execution output

Function

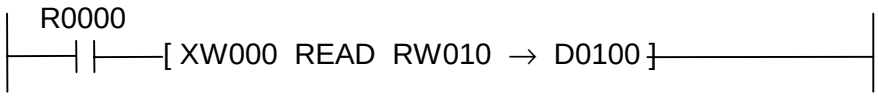
- This instruction reads data from the buffer memory of the special module that is designated by operand A, and stores them in T3's registers starting with operand C.
- The transfer source address (buffer memory address) is designated by operand B.
- The transfer size (number of words) is designated by operand B+1.

Input	Action	Output	ERF
OFF	No execution	OFF	
ON	Normal execution	ON	
	Error (see Note 2)	ON	ON

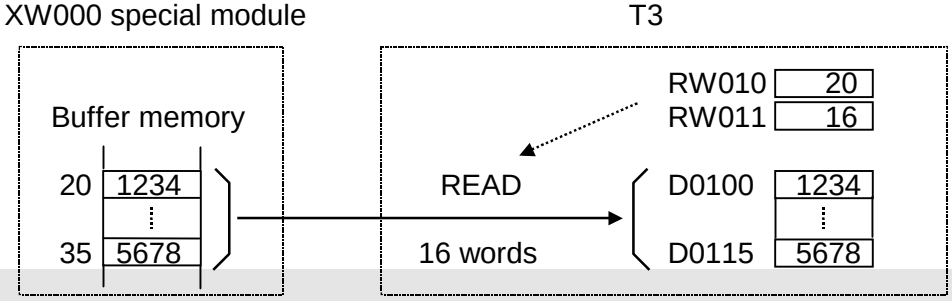
Operand

		Device										Register															Constant	Index
Opr	Name	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	Special module											√	√														√	√
B	Transfer parameter											√	√	√	√	√	√	√	√	√	√							
C	Top register of destination												√	√	√	√	√	√	√	√	√							√

Program example

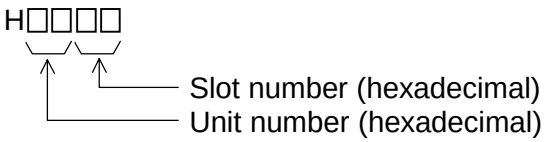


- When R0000 is ON, the buffer memory data of the size indicated by RW011, starting with the address indicated by RW010 of the special module allocated to XW000, are read and stored in D0100 and after.
- The maximum number of words to be read is 256 words.



Note 1) The special module can be designated not only by the assigned register, but also by the mounting position. The mounting position is designated by a constant data for the operand A as follows.

(Unit number) × 256 + (Slot number)



Unit number	Hexadecimal
0	H00
1	H01
2	H02
3	H03

Slot number	Hexadecimal
0	H00
1	H01
2	H02
3	H03
4	H04
5	H05
6	H06
7	H07
8	H08
9	H09
10	H0A

For example, if a special module is mounted on Slot-4, Unit-0 (basic unit) and allocated to XW008 - YW011, the following two READ instructions function the same.

——[XW008 READ RW010 → D0100]——

——[H0004 READ RW010 → D0100]——

Note 2) The READ instruction is not executed as error in the following cases. In these cases, ERF (instruction error flag = S0051) is set to ON.

- When the operand A is other than a valid constant (see Note 1) or XW/YW register.
- When the designated special module has been disconnected.
- When no answer error occurs with the designated special module.
- When the number of words transferred exceeds 256 words.
- When the source table of transfer is out of the valid range.
- When the destination table of transfer is out of the valid range.

A.2 Specification of the WRITE instruction

FUN 238 Special module data write (WRITE)
Writes designated range of data into the special module.
Input → Execution output ———[A WRITE B → C]———

Function

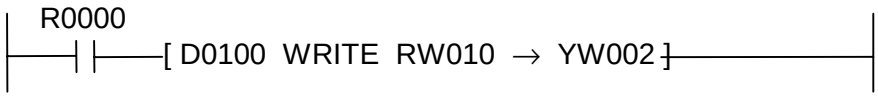
- This instruction transfers data stored in T3's registers starting with operand A into the buffer memory of the special module that is designated by operand C.
- The destination address (buffer memory address) is designated by operand B.
- The transfer size (number of words) is designated by operand B+1.

Input	Action	Output	ERF
OFF	No execution	OFF	
ON	Normal execution	ON	
	Error (see Note 2)	ON	ON

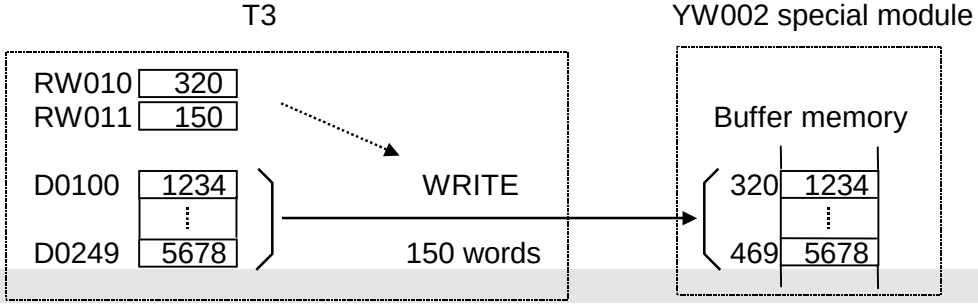
Operand

		Device										Register															Constant	Index
Opr	Name	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	Top register of source											√	√	√	√	√	√	√	√	√	√							√
B	Transfer parameter											√	√	√	√	√	√	√	√	√	√							
C	Special module											√	√														√	√

Program example

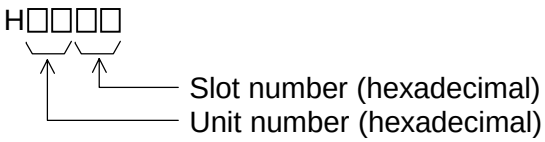


- When R0000 is ON, the register data of the size indicated by RW011, starting with D0100, are transferred to the buffer memory starting with the address indicated by RW010 of the special module allocated to YW002.
- The maximum number of words to be transferred is 256 words.



Note 1) The special module can be designated not only by the assigned register, but also by the mounting position. The mounting position is designated by a constant data for the operand C as follows.

(Unit number) × 256 + (Slot number)



Unit number	Hexadecimal
0	H00
1	H01
2	H02
3	H03

Slot number	Hexadecimal
0	H00
1	H01
2	H02
3	H03
4	H04
5	H05
6	H06
7	H07
8	H08
9	H09
10	H0A

For example, if a special module is mounted on Slot-2, Unit-1 (expansion unit #1) and allocated to XW020 - YW023, the following two WRITE instructions function the same.

——[D0100 WRITE RW010 → XW020]——

——[D0100 WRITE RW010 → H0102]——

Note 2) The WRITE instruction is not executed as error in the following cases. In these cases, ERF (instruction error flag = S0051) is set to ON.

- When the operand C is other than a valid constant (see Note 1) or XW/YW register.
- When the designated special module has been disconnected.
- When no answer error occurs with the designated special module.
- When the number of words transferred exceeds 256 words.
- When the source table of transfer is out of the valid range.
- When the destination table of transfer is out of the valid range.

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