



Anywire Corporation

AnyWire DB A20 Series
User's Manual
RS-485 Modbus Gateway
AG20-485MD

Ver. 1.2 July 27, 2009

Integration of bit control and
information transmission

Wiring saving system

AnyWire DB A20 Series

PMA-0533D

Cautionary Instructions

Cautions about this manual

1. Please deliver this manual to end-users.
2. Read this manual thoroughly to understand the contents before operating this product.
3. This manual explains the details of functions equipped with this product, but does not guarantee that the product will match a customer's particular purpose.
4. Any reproduction or copying of this manual in whole or in part is expressly prohibited without permission.
5. Information in this manual may be subject to change without notice in the future.

Warning displays



A "WARNING" indicates a potentially hazardous situation which, if not handled correctly, could result in personal serious injury or death.



A "CAUTION" indicates a potentially hazardous situation which, if not handled correctly, could result in personal injury or property damage.

Safety precautions



- ◆ The AnyWire system does not include any control functions to ensure safety.
- ◆ In any of the following cases, pay special attention to use with appropriate allowance for ratings and functions and implement safety measures such as a fail-safe design and consult us for:
 - (1) Applications which require a high degree of safety
 - Applications predicted to have a great impact on human life or property
 - Medical equipment, safety equipment, etc.
 - (2) When used in systems which require a higher degree of reliability
 - Use in vehicle control, combustion control equipment, etc.
- ◆ Make sure to turn off the system power before installation or replacement work.
- ◆ Use the AnyWire system within the range of specifications and conditions defined in this manual.



- ◆ Do not turn on the 24V power supply before completing wiring and connection of the entire AnyWire system.
- ◆ Use a stable, 24V DC power supply for AnyWire system equipment.
- ◆ Although the AnyWire system has high noise resistance, keep transmission cables and I/O cables away from high-voltage and power cables.
- ◆ Be careful to prevent any waste metal from entering inside of units or connector parts, especially during wiring.
- ◆ Mis-wiring may damage equipment. Pay attention to the cable length and layout in order to prevent connectors and cables from being removed.
- ◆ Do not solder a stranded wire to be connected to the terminal block; otherwise a contact failure may occur.
- ◆ If the wiring length of the power cable is long, voltage drops will occur and may cause shortages of the power voltage of remote slave units. In that case, connect local power supply units to ensure the specified voltage.
- ◆ Install the product by avoiding the following places:
 - Where exposed to direct sunlight or the ambient operating temperature exceeds the range of 0°C to 55°C
 - Where the operating relative humidity exceeds the range of 10% to 90% or condensation occurs due to rapid temperature changes
 - Where there is corrosive or inflammable gas
 - Where subjected to direct vibration or shock
- ◆ Tighten terminal screws securely to avoid malfunctions, etc.
- ◆ When storing the product, avoid high temperatures and humidity. (Ambient storage temperature: -20°C to 75°C)
- ◆ Incorporate the emergency stop circuit or interlock circuit for safety in an external circuit other than the AnyWire system.

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1 Overview

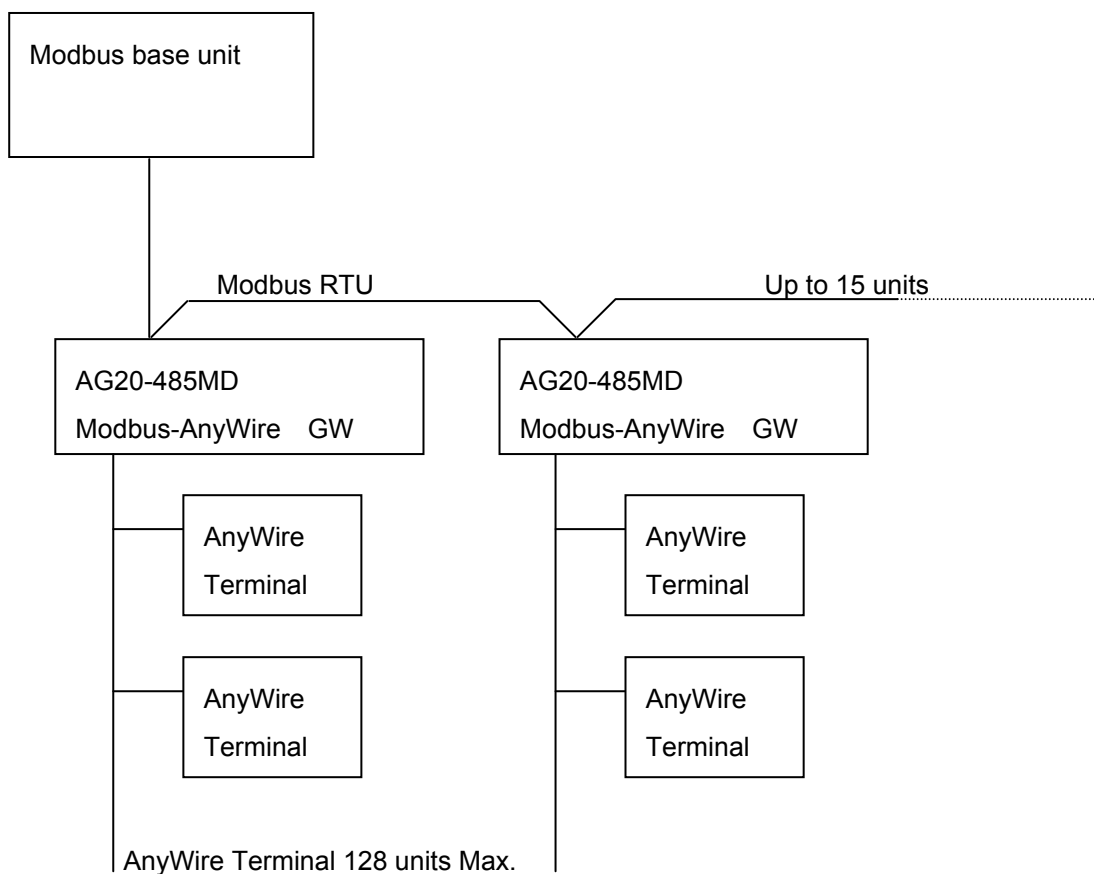
This machine can control input/output signals and collect data as a master interface of the AnyWire DB A20 series by connection to a PLC equipped with Modbus protocol of RS-485. The AnyWire system is a high speed, highly reliable wiring saving system with its own transmission method.

Note) AnyWire is a registered trademark of AnyWire Corporation.

The AnyWire DB A20 series is a transmission system with a full-duplex transmission function. The transmission distance 50 m / 100 m / 1 km / 3 km, and number of transmission points can be selected with the switch.

Disconnection can be detected even for branch wires.

This unit allows to input/output the maximum input 512 points and output 512 points.



Specifications

2 Specifications

2.1. General specifications

Operating power voltage	Transmission line: 24V DC +15 to -10% (21.6 to 27.6V DC)
Operating ambient temperature	0 to +55°C
Operating ambient humidity Storage ambient humidity	10 to 90%RH (No condensation)
Storage ambient humidity	-20°C to +75°C
Atmosphere	No corrosive or inflammable gas
Vibration proof	JIS C 0040 compliant
Noise proof	1200 Vp-p (pulse width 1 μ s)

2.2. Performance specifications

Transmission clock	2 kHz	7.8 kHz	31.3 kHz	125 kHz
Maximum transmission distance	3 km	1 km	200 m	50 m
Transmission method	Full-duplex total frame cyclic method			
Connection mode	Bus type (Multi drop method, T-branch method, Tree branch method)			
Transmission protocol	Dedicated protocol (AnyWire Bus Protocol)			
Error control	Double collation system			
Number of connecting IO points	Max. 1024 points (Input 512 points / Output 512 points)			
Connecting units	Max. 128 units (fan-out = 128) Note) AnyWire DB A20 series product: fan-in = 1			
RAS functions	Transmission cable disconnection position detecting function, transmission cable short-circuit detecting function, transmission power supply drop detecting function			
Connection cable	Multi-purpose 2 line cable/4 line cable (VCTF 0.75 ~ 1.25 mm ²) Dedicated flat cable (0.75 mm ²), Multi-purpose electric wire (0.75 ~ 1.25 mm ²)			
Power supply	Voltage: 24V DC +15% ~ -10% (21.6 ~ 27.6V DC) Ripple 0.5 Vp-p or less Current: 0.5 [A] (When 128 terminal units are connected, load current is not included)			

■ **Transmission cycle time**

(Unit: ms)

Transmission clock	Cycle value settings	64 points (Input 32) (Output 32)	128 points (Input 64) (Output 64)	256 points (Input 128) (Output 128)	512 points (Input 256) (Output 256)	1024 points (Input 512) (Output 512)
	2kHz		27.2	43.6	76.3	142
7.8kHz		6.8	19.1	35.5	68.3	134
31.3kHz		1.8	2.8	4.8	8.9	17.1
125kHz		0.5	0.8	1.3	2.3	4.4

Caution: [1] Transmission cycle time is a value between one cycle time and two cycle times.

[2] In order to ensure that an input signal responds, issue an input signal longer than two cycle times.

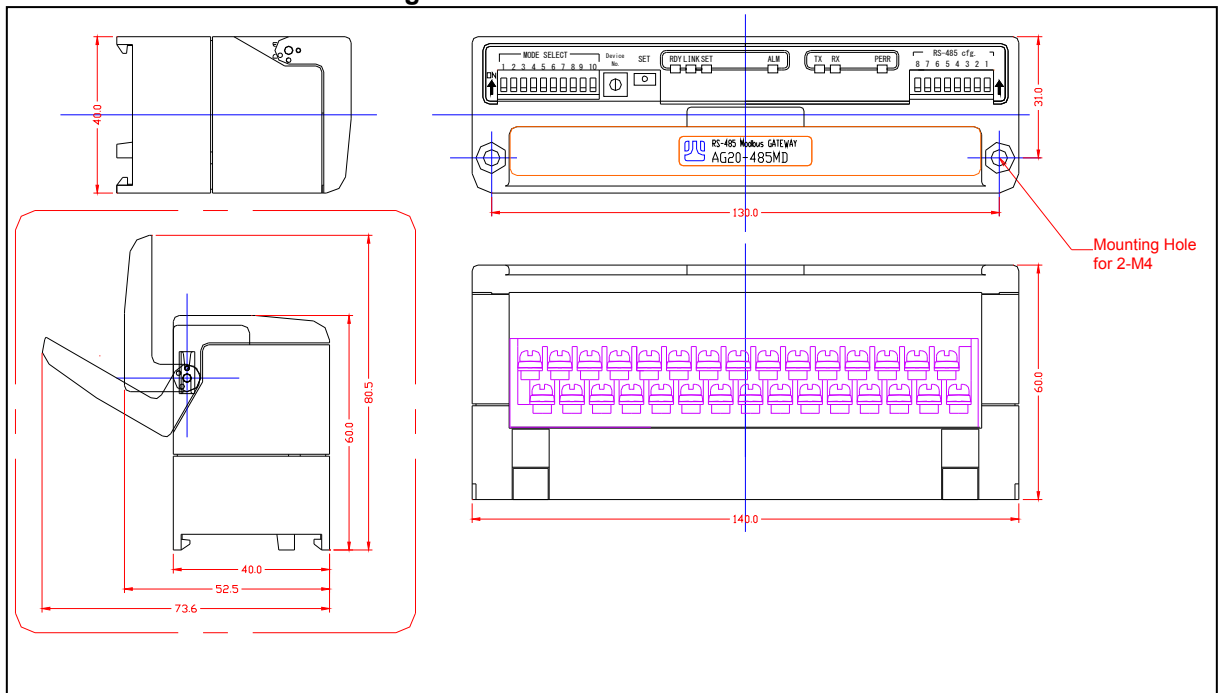
2.3. RS-485 Modbus connection specifications

Physical layer	RS-485 compliant
Transmission speed	38400 bps 19200 bps Switched with the switch.
Data length	8-bit fixation
Parity	No / Even / Odd Switched with the switch.
Stop bit	1-bit fixation
Protocol	Modbus RTU (Refer to the protocol item.)
Area code setting	1 to 15
Maximum number of connection	15
Timeout time between characters	5 ms
Reception timeout time	5 ms
Error detection	CRC-16

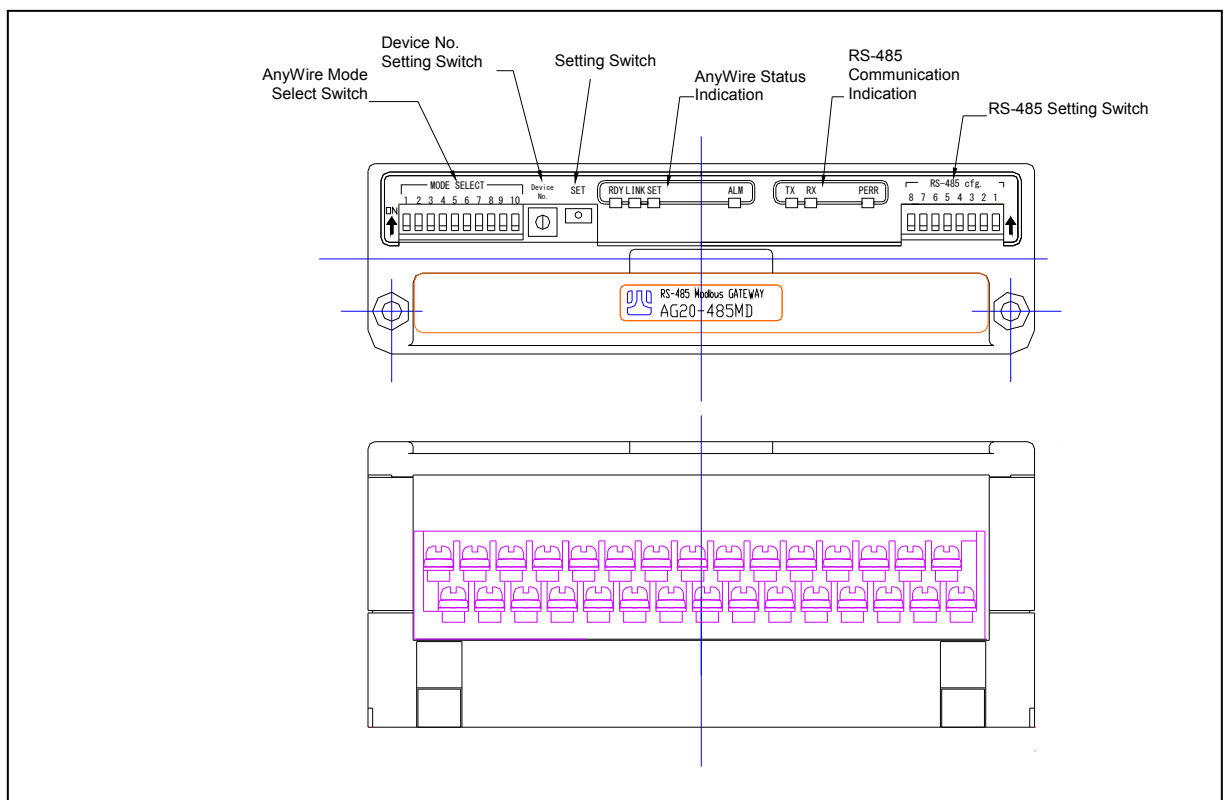
Specifications

2.4. Dimensional outline drawing and name of each part

Dimensional outline drawing



Name of each part



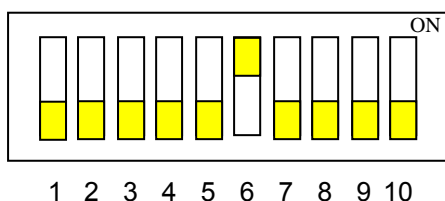
3 Operation Mode

3.1. Operation mode setting (MODE SELECT)

The settings of transmission such as selection of transmission speed (transmission distance) are made with “Mode Select Switch” on this machine.

Moving the knob in the arrow direction of “ON” on the switch, the status is turned ON.

- SW: 9, 10 Select transmission speed (transmission distance) as shown in the following table.
- SW: 6 Sets the full-duplex (DB A20 series) specification with the switch ON.
Do not change it.
- SW: 5, 7, 8 Not used. Keep the switch OFF.
- SW: 1 to 4 AnyWire transmission point number setting



Specification	Transmission speed setting (SW: 9, 10)	
	9	10
2 kHz (3 km)	OFF	OFF
7.8 kHz (1 km)	OFF	ON
31.3 kHz (200 m)	ON	OFF
125 kHz (50 m)	ON	ON

3.2. Input and output point number setting (MODE SELECT)

Transmission point number setting (SW: 1 to 4)				Point number
1	2	3	4	
x	x	x	x	32 points (IN16/OUT16)
o	x	x	x	64 points (IN32/OUT32)
x	o	x	x	128 points (IN64/OUT64)
o	o	x	x	256 points (IN128/OUT128)
x	x	o	x	512 points (IN256/OUT256)
o	x	o	x	1024 points (IN512/OUT512)
Other than those above				Do not set.



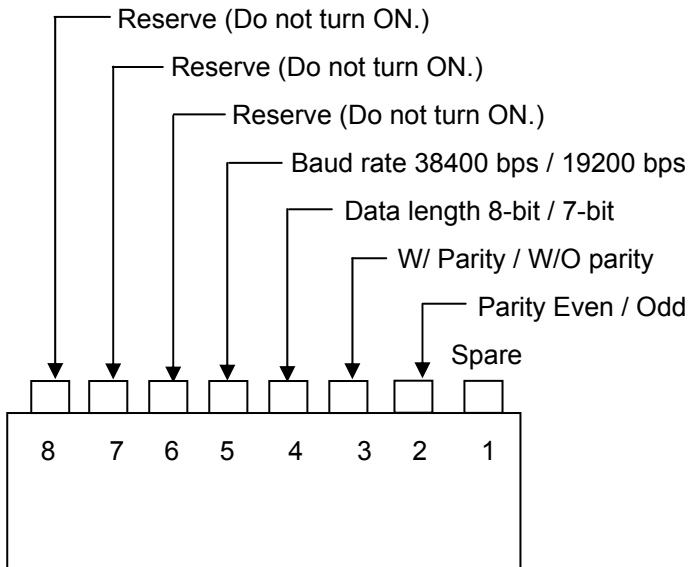
CAUTION

- Make sure to turn off the power supply before setting the DIP switch.
- Make sure to set the DIP switch according to the transmission specification to be used.
- Unless the DIP switch coincides with the transmission specification of the slave unit connected to this unit, transmission cannot be correctly made, or a malfunction may result.

Operation Mode

3.3. RS-485 communication settings

RS-485 communication baud rate, etc., is set with the “RS-485 setting switch.”



RS-485 setting

1	Spare	Spare
2	Parity	OFF: Even ON: Odd
3	Parity	OFF: No ON: Yes
4	Data length	OFF: 8-bit ON: Not allowed
5	Baud rate setting	OFF: 38400 bps ON: 19200 bps
6 - 8	Spare	Spare

Stop bit is 1-bit fixation.

3.4. Device no. setting

The number of this unit on Modbus is set with the “Device No. setting switch.”

1 to F can be set. Point the arrow to the set value.

In addition, pay attention so as not to overlap with the numbers of other devices.



4 Memory Map

Word address	Byte address		Description	
00H	01H	00H	Input area 512 points (64 byte)	
1FH	3FH	3EH		
20H	41H	40H	Output area 512 (64 byte)	
3FH	7FH	7EH		
40H	81H	80H	Ready flag	Error flag
41H	83H	82H	Spare	Number of error addresses
42H	85H	84H	Spare	Reset of error address
43H	87H	86H	Spare	
47H	8FH	8EH		
48H	91H	90H	Error address area	
57H	AFH	AEH		
58H	B1H	B0H	Spare	
7FH	FFH	FEH		

5 Monitoring Function

Overview

The slave units of the AnyWire DB A20 series have their own unique IDs (= address set values), and a slave unit which has an ID which was sent from the master returns responses to the ID, then detects for disconnection and checks for existence of a slave unit.

This machine stores an ID of the slave unit which is connected at that time by “the automatic address recognition operation” (described later) into FLASH ROM. This information is stored even if the power is turned off.

Then registered IDs are sequentially sent out, and if there is no response to them, disconnection is displayed by the “ALM” LED of this machine. In addition, error flag is returned, thereby the addresses of the slave units having errors can be known.

5.1. Automatic address recognition

Storing addresses of the connected slave units into FLASH ROM of this machine is called “Automatic address recognition.”

Procedure

1. Check that all of the slave units operate normally.
2. Press the “SET” switch on the machine until the “SET” LED (Orange) lights.
3. If the “SET” LED lights for a while and then turns off, storage of an address has been completed.



- Automatic address recognition operation cannot be carried out at the time of an error in an AnyWire Bus such as a short-circuit, after the power is turned on, or for approximately 5 seconds after resetting.

5.2. Monitoring operation

Addresses registered in this machine are sequentially sent out, and if there is no response to them, disconnection is displayed by the “ALM” LED.

Bit 3 of the error flag is set to “1.”

This error information is retained until the power is turned off or the error is reset.

(Refer to the error status item.)

6 Error Status

The status of a transmission line can be known by the error status.

The error status consists of a number of addresses from which an error flag and disconnection are detected and the 16 error addresses. If any error by disconnection occurs, the applicable slave unit can be known from the information of the number of addresses and information on an error address.

If there are 16 or more error addresses, 16 addresses are displayed sequentially in the order of the most recent number.

Correspondence between error information and data memory is as follows.

Word Address	Byte Address		Description	
40H	81H	80H	Spare	Error flag
41H	83H	82H	Spare	Number of error addresses
⋮	⋮	⋮	⋮	⋮
48H	91H	90H	Error address 1	
49H	93H	92H	Error address 2	
4AH	95H	94H	Error address 3	
⋮	⋮	⋮	⋮	⋮
56H	ADH	ACH	Error address 15	
57H	AFH	AEH	Error address 16	

6.1. Error flag

An error flag can be read by setting the offset address to 80H.

The number of error addresses can be read by setting the offset address to 82H.

This status can also be displayed by the “ALM” LED.

The associated bit becomes “1” if any error occurs.

Bit 3 is retained until the power is turned off, or an error is reset (described later).

Bit 0, 1 and 2 become “0” when an error status is cancelled. They are not retained.

Bit 0	Short-circuit between D and G
Bit 1	Short-circuit between D and 24V
Bit 2	24V is not supplied, or voltage is low.
Bit 3	Disconnected. Or slave unit failed, or power is not supplied.
Bit 4 to 15	Reserved

Error Status

6.1.1. Reset method of error status

Write "1" into the data memory area of the offset address 84H and then write "0" in the same area.

If an error such as disconnection is eliminated, the disconnection flag is reset to "0" and the number of error addresses is also reset to "0."

Unless an error condition is eliminated, the number of error flags and error addresses are set, and the error addresses are set again.

An error is also cleared by turning on power again.

Offset Address	Description
84H	Error reset output

6.2. Error addresses

When disconnection and/or abnormality in a terminal occur, up to 16 error "IDs (addresses)" corresponding to the offset addresses "90H to AFH" are written.

The values are held until the error is reset (see item 6.1.1) or the power of the unit is turned off.

Bit 15 to Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Spare (0)	Spare	I/O	A8	A7	A6	A5	A4	A3	A2	A1	A0

Bit 0 to 8 (A0 to A8) : A value of ID is displayed in binary. E.g.) Address 112 = 001110000

Bit 9 (I/O) : It indicates input terminal or output terminal. Input = 1, Output = 0.

7 LED Display

LED indicating state of this machine

LED	Name	Color	Indication	
RDY	Power supply 24V	Green	Lit	24V power supply is being conducted.
			Unlit	No power is supplied.

LED indicating AnyWire Bus status

LED	Name	Color	Indication	
LINK	Transmission display	Green	Flashing	This unit is operating.
			Unlit	This unit has an error.
SET	Display on address recognition operation	Orange	Lit	In automatic address recognition operation.
			Unlit	In normal transmission.
			Flashing	Writing in EEPROM.
ALM	Alarm display	Red	Lit	Disconnection of AnyWire transmission line D, G.
			Slow flashing ^{*1}	Short-circuit between D and G, or short-circuit between D and 24V.
			Quick flashing ^{*2}	24V is not supplied or voltage is low.
			Unlit	In normal transmission.

*1: "Slow flashing" is flashing of an approximately 1 second period.

*2: "Quick flashing" is flashing of an approximately 0.2 second period.

LED indicating state of RS-485

LED	Name	Color	Indication	
RX	RX	Green	Flashing	It flashes while receiving a signal.
TX	TX	Green	Flashing	It flashes while transmitting a signal.
PERR	Parity error	Green	Lit	It lights in the event of a parity error.
			Unlit	It is unlit during normal state.

8 Connection

8.1. AnyWire Bus/Power supply connection unit

Connect the power supply of this machine and a transmission signal of the AnyWire Bus.

16 D	17 24V	18 24V	19 24V
0 G	1 0V	2 0V	3 0V

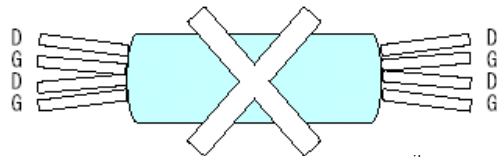
D	Transmission cable
G	Transmission cable
24V	Connect a regulated 24V DC power supply.
0V	<p>Terminals with the same marks for respective 24V and 0V short circuit internally.</p> <p>Power supply with capacity of current necessary for load and slave unit and +0.5A or more</p>

Connect D and G to D and G of the slave unit, respectively.
(See the instruction manual of each unit.)



CAUTION

- Do not send some transmission lines (D, G) in a multicore cable all together. If sent all together, the equipment will malfunction due to crosstalk.

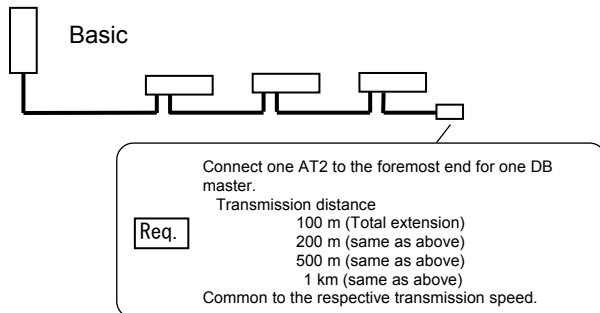


- The diameter of a transmission cable should be 0.75 mm² and above for up to 200 mm of transmission distance and 0.9 mm² and above for more than 200 mm of transmission distance.
- The lower limit of the power-supply voltage is 21.6V and above for up to 200 mm of transmission distance and 24V for more than 200 mm of transmission distance.
- Watch out for voltage drop by cable. Voltage drop will cause the equipment to malfunction. If the voltage drops significantly, supply power on the terminal side (local power supply).
- Do not solder wires connected to the connector terminal. The wire may loosen, resulting in a contact failure.

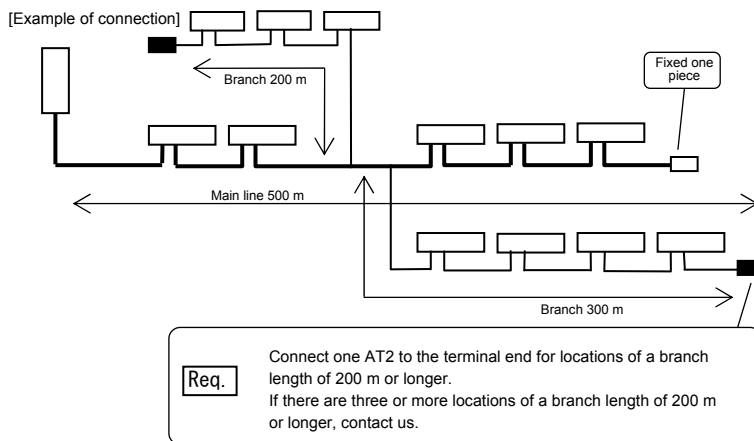
8.2. Terminator

In order to ensure more stable transmission quality, connect a terminator (**AT2**) to the **AnyWire** transmission line end.

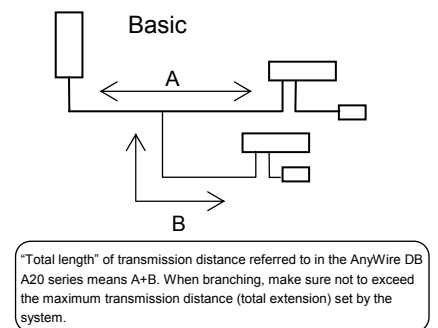
■ Connection of terminator



■ Branch of transmission line (Transmission distance 1 km specification)



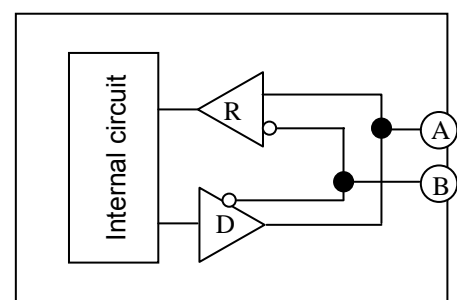
■ Total length



8.3. RS-485 connection unit

Connect transmission signal of RS-485.

25	26	27	28	29	30
NC	SG	NC	NC	A	B
10	11	12	13	14	15
NC	NC	NC	NC	NC	NC



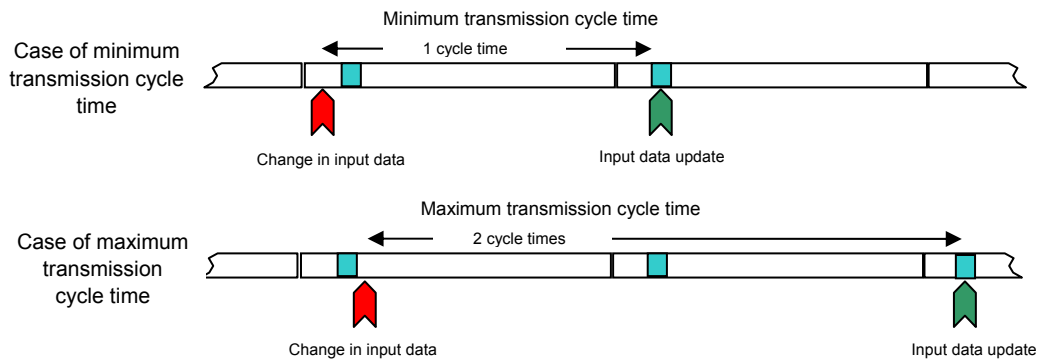
A	RS-485 signal
B	RS-485 signal
SG	Signal ground
NC	Do not connect to anything.

For the terminator of the RS-485 signal, confirm the specification of the Modbus communication.

9 Transmission Required Time

9.1. In the case of input

Because the master side does not update data (double collation) unless the same data consecutively continues two times, the transmission cycle time requires transmission time of a minimum one cycle time and maximum two cycle times. Signals of two cycle times or less may not be captured depending on the timing. Therefore, in order to ensure a response, provide an input signal of two cycle times or longer.



9.2. In the case of output

Because the slave unit side performs double collation, it requires a transmission time of a minimum one cycle time and maximum two cycle times similar to the case of input.

Terminology

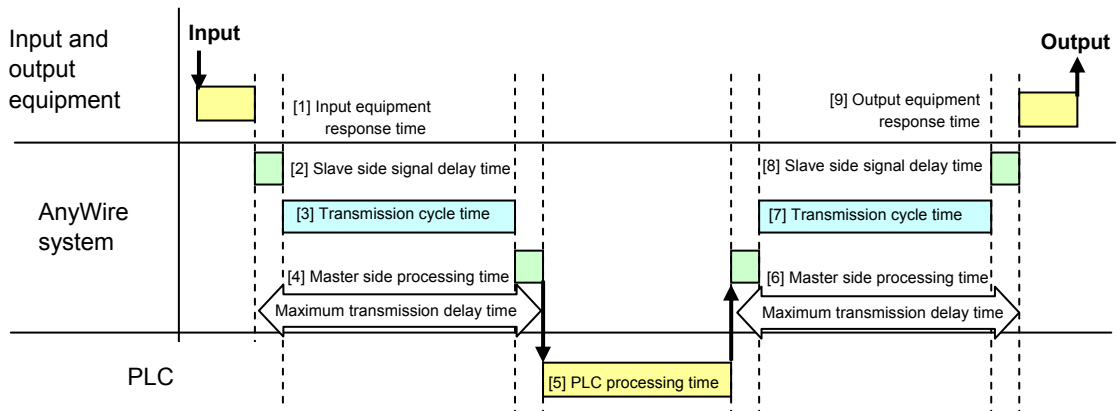
Transmission cycle time: Repeated transmission time of actual data transmitted

Maximum transmission delay time: Processing time on master side

+ Transmission cycle time

+ Signal delay time on slave side

Response delay time is as shown in the following diagram.



10 RS-485 Modbus RTU Protocol

10.1. Function code

This machine corresponds to the codes in the following table as a function of Modbus communication.

Code No.	Function	Description
4 (04h)	Register reading	Up to 64 (128 byte) can be read out.
16 (10h)	Register writing	Up to 64 (128 byte) can be written.

10.2. Read out command (function code 4)

Message from base machine

Device No.	Function code	Address*	Number of words	CRC
Xxh	04h	xxxxh	xxxxh	xxxxh

*"Address" in this section means a "word address."

Response of this machine

Device No.	Function code	Number of data**	First data Upper byte	First data Lower byte	Last data Lower byte	CRC
Xxh	04h	xxh	xxh	xxh	xxh	xxxxh

**"Number of data" in this section means "number of bytes" of data to be written.

Communication example)

In the case where two words are read out from the head (address 0000h) of input area of this machine (device No. "5") (Assuming that the value of 0000h = 1234h, and the value of 0002h = 5678h.)

●Request message●

<05 04 00 00 00 02 (CRC)>

●Response message●

<05 04 04 12 34 56 78 (CRC)>

10.3. Write in command (function code 16)

Message from base machine

Device No.	Function code (16)	Address	Number of words	Number of data**	First data Upper byte	First data Lower byte	}	Last data Lower byte	CRC
Xxh	10h	xxxxh	xxxxh	xxh	xxh	xxh		xxh	xxxxh

**“Address” in this section means a “word address.”

**“Number of data” in this section means “number of bytes” of data to be written.

Response of this machine

Device No.	Function code (16)	Address	Number of words	CRC
Xxh	10h	xxxxh	xxxxh	xxxxh

Communication example)

In the case where the value of data 0000h = 1234h, value of 0002h = 5678h, value of 0004h = 9ABCh and value of 0006h = DEF0h are written in four words from the head (address 0020h) of the output area of this machine (device No. “5”).

●Request message●

<05 10 00 20 00 04 08 12 34 56 78
9A BC DE F0 (CRC)>

●Response of message●

<05 10 00 20 00 04 (CRC)>

10.4. Calculation of CRC

Calculate CRC-16 (cyclic redundancy check) from the device No. to the front of the CRC storage position and store the result (calculated 16-bit data) in ascending order.

Method for calculating CRC (generating polynomial: X16+X15+X2+1)

- [1] Calculate XOR between the first data and (FFFFh).
- [2] Shift the result to the right by 1-bit.
- [3] If there is a carry in the shift result, calculate XOR between the result of [2] and (A001H).
- [4] Repeat [2] and [3] until the result is shifted eight times.
- [5] Calculate XOR between the next data and the results.
- [6] Repeat [2] to [5] until the last data.
- [7] Store the results in the CRC storage position in ascending order.

11 Troubleshooting

First, check the following:

- (1) The "RDY" lamps for all units of the equipment shall light up.
- (2) The "LINK" lamps for all units of the equipment shall flash.
- (3) The power voltages for all units of the equipment shall be in a range from 21.6 to 27.6V.
- (4) Wiring and connection shall be secured.
- (5) Address setting shall be correct, and not be duplicated.
- (6) Transmission speeds for all units of the equipment are identical.

Checklist by symptom

Symptom	Check Item
Data cannot be input/output.	<p>AG20-485 side MODE SELECT switch is correctly set. I/O configuration set by MODE SELECT switch is consistent with I/O number specified by the software.</p> <hr style="border-top: 1px dashed black;"/> <p>Slave unit side Power is supplied to the slave unit. Address of slave unit is correctly set. Slave unit of the same specification as that of AG20-485 (such as transmission clock and number of input and output) is used.</p>
ALM LED (red) is lighting.	D, G lines are not disconnected. Address automatic recognition operation is correctly performed. Screws on the terminal blocks are not loosened.
ALM LED (red) is flashing slowly.	D, G lines are not short-circuited. D does not contact 24V.
ALM LED (red) is flashing quickly.	Voltage of 24V DC power supplied to AG20-485 is normal.

12 Warranty

- Warranty period

The warranty period of a delivered product shall be one (1) year after delivery at the place specified by an orderer.

- Scope of Warranty

In the event that a failure occurs under normal use conditions within the product specification range in accordance with this user's manual during the warranty period above, the failed portion of that equipment shall be replaced or repaired without charge.

However, in the case where a delivered product falls under any of the following, it shall be excluded from the scope of warranty:

- (1) In the case where the failure was caused by improper handling and use by the customer.
- (2) In the case where the failure was caused by a reason other than the delivered product.
- (3) In the case where the failure was caused by alteration or repair by a person other than supplier.
- (4) In the case where the failure was caused by a natural disaster and others for which the supplier has no responsibility.

"Warranty" in this section means the warranty of a single delivered product and we assume no responsibility for any damages caused by a failure of the delivered product.

13 History of Changes

Version	Date	Change Description
Preliminary version	2005.01.11	Released.
1.0	2007.07.30	Item 3-2 "Device No. Setting" added. Warranty added. Contact information changed.
1.1	2007.09.26	Stop bit added. Error reset area changed to 84H.
1.2	2009.07.27	Memory address (word address) corrected.



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