



MECHATROLINK-III

Specifications for Certification Test



MECHATROLINK Members Association

Manual No. MMA TDEP 027A

This document is the test specifications for the conformance test and interoperability test.

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1 Scope

These specifications stipulate the verification tests for checking the conformance and interoperability of units and devices manufactured based on the MECHATROLINK specifications.

The MECHATROLINK certification test is a verification test on the communication section of the tested equipment (the unit of device that is subjected to the certification test), and it is not intended to guaranty the performance or other qualities of the tested equipment.

2 MECHATROLINK Certification Test

The following four types of verification are undertaken in the MECHATROLINK certification test.

No.	Verification Type	Brief Description
1	Check on circuitry and parts used in the communication section	It is checked, by reference to drawings and the part list, whether the design conforms to the MECHATROLINK standard circuit.
2	Hardware certification test	<ol style="list-style-type: none"> 1. Compliance test A check is carried out using Ethernet compliance test equipment. 2. Noise tolerance test A fast transient cable radiated noise test is performed on the specified system configuration, and it is checked that the system has a noise tolerance of at least the stipulated value.
3	Conformance test	It is checked whether communication that correspond to the MECHATROLINK protocol are being carried out.
4	Interoperability test	A continuous operation test (2 hours) is performed on the specified system configuration and it is checked that no abnormality occurs.

3 Check on Circuitry and Parts Used in the Communication Section

It is checked, by reference to documents such as drawings, the part list and so on, whether the design conforms to the MECHATROLINK standard circuit.

3.1 Check on the Communication Circuit

Check that the circuit conforms to the standard circuit.

3.2 Check on Specified Parts

Check that the stipulated parts are used.

3.3 Check on LEDs

Check if the LEDs are installed as stipulated.

4 Hardware Certification Test

The following tests shall be performed for the MECHATROLINK-III hardware certification test.

- ① Compliance test
- ② Noise test (cable radiation)

This test is a MECHATROLINK-III connection verification test for the tested equipment and does not guaranty the performance or quality of the tested equipment.

4.1 Compliance Test

Implement an electrical test of the physical layer using an oscilloscope manufactured by Agilent Technologies and the option software provided as an accessory with it.

4.1.1 System Configuration

Equipment and software used

Oscilloscope model:	DSA90804A (manufactured by Agilent Technologies)
Model of probe used:	1134A (manufactured by Agilent Technologies)
Name of option software:	N9352A Ethernet electrical characteristic verification/compliance software (manufactured by Agilent Technologies)

4.1.2 Details of the Option Software

The software used serves to automatically implement the electrical tests on the physical layer described in IEEE 802.3-2005 and ANSI X3.263-1995 and the main test points are as follows.

- Differential Output Template
- Differential Output Voltage
- Rise and Fall Times
- Duty Cycle Distortion
- Transmit Jitter
- Waveform Overshoot

The test results are output in HTML format (see next page).


 Report Style
 Compact **Verbose**

Ethernet Test Report

Overall Results: 0 of 13 Tests Failed

Test Configuration Details	
Test Session Details	
Infiniium SW Version	05.20.0001
Infiniium Model Number	DSO81204A
Infiniium Serial Number	No Serial
Last Test Date	4/7/2007 5:39:38 PM

Summary of Results

Margin Thresholds	
Warning	< 2 %
Critical	< 0 %

Pass	Test Name	Spec Range	Measured Value	Margin
✓	1000 Base-T, Point A Peak Output Voltage(w/o Disturbing Signal)	(670.0mV to 820.0mV)	765.9mV	36.1 %
✓	1000 Base-T, Point B Peak Output Voltage(w/o Disturbing Signal)	(670.0mV to 820.0mV)	759.2mV	40.5 %
✓	1000 Base-T, Difference A,B Peak Output Voltage(w/o Disturbing Signal)	< 1.00%	880m%	12.0 %
✓	1000 Base-T, Point C Peak Output Voltage(w/o Disturbing Signal)	< 2.00%	50m%	97.5 %
✓	1000 Base-T, Point D Peak Output Voltage(w/o Disturbing Signal)	< 2.00%	410m%	79.5 %
✓	1000 Base-T, Point A Template Test(w/o Disturbing Signal)	No Mask Failures	0.000	0.0 %
✓	1000 Base-T, Point B Template Test(w/o Disturbing Signal)	No Mask Failures	0.000	0.0 %
✓	1000 Base-T, Point C Template Test(w/o Disturbing Signal)	No Mask Failures	0.000	0.0 %
✓	1000 Base-T, Point D Template Test(w/o Disturbing Signal)	No Mask Failures	0.000	0.0 %
✓	1000 Base-T, Point F Template Test(w/o Disturbing Signal)	No Mask Failures	0.000	0.0 %
✓	1000 Base-T, Point H Template Test(w/o Disturbing Signal)	No Mask Failures	0.000	0.0 %
✓	1000 Base-T, Point G Droop Test(w/o Disturbing Signal)	> 73.10%	95.51%	30.7 %
✓	1000 Base-T, Point J Droop Test(w/o Disturbing Signal)	> 73.10%	95.06%	30.0 %

Fig. 4-1 Example Test Result Report

4.1.3 Judgment Criterion for Pass/Fail

The criterion of judgment for a pass shall be that there is no fail result for any test point.

4.1.4 Other Considerations

In order to implement this test, the stipulated data pattern must be output when the power is turned on.

The PHY mode settings of the standard circuit are measurable patterns, and so must be implemented in accordance with the specifications. The mode settings are as follows.

- Full duplex
- No auto negotiation
- Idle pattern output

4.2 Noise Immunity Test

The noise test point for MECHATROLINK-III is cable radiation noise in the fast transient noise (burst noise) covered by IEC61000-4-4.

If the equipment to be tested is a master device, use a slave (such as a servo drive) as the test equipment, and if the equipment to be tested is a slave device, use a master device (controller) as the test equipment. There shall be one unit of tested equipment and one unit of test equipment, and the communication shall be carried out between them.

4.2.1 System Configuration

Cable length: 50 m with core
 Point of application: 0.5 m from the tested equipment

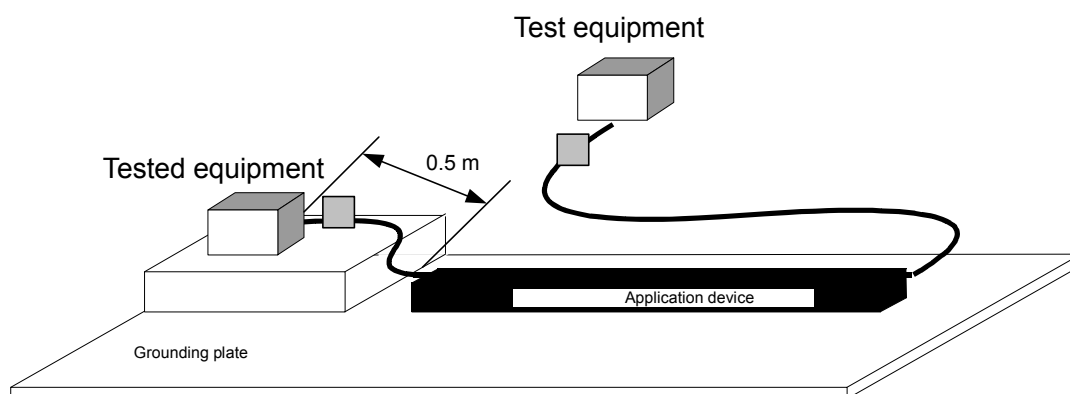


Fig. 4-2 Test Configuration

4.2.2 Test Specifications

A fast transient/cable radiation noise test shall be carried out in conformity with IEC61000-4-4 (level 3).

After starting communications of the tested equipment, apply radiation noise (± 1000 V) to the MECHATROLINK cable between the tested equipment and the test equipment for one minute.

Set cyclic communication as the MECHATROLINK communication setting for the tested equipment, and make the transmission cycle/communication cycle the shortest time supported by the tested equipment. Make the number of transmission bytes the maximum number of bytes supported by the tested equipment.

Although the between-station transmission distance for MECHATROLINK-III is 100 m, make the distance 50 m for the certification test.

4.2.3 Judgment Criterion for Pass/Fail

Apply ± 1000 V (level 3) for 1 minute. During this time, operation must proceed normally with no communication abnormalities.

4.3 Check on LEDs (Link LEDs)

4.3.1 Test Specifications

Check that an LED for indicating the link status is installed for each MECHATROLINK port installed on the product, and that the LEDs light in accordance with the connection status with other LEDs.

Check the other LEDs (connect, error) in “5 Conformance Test”.

4.3.2 Judgment Criterion for Pass/Fail

The link LEDs shall light and go out correctly in accordance with whether or not there is a connection with other modules.

5 Conformance Test

Trace the MECHATROLINK commands/responses supported by the tested equipment on the MECHATROLINK network, and check that the data in the frames conform to the specifications.

5.1 Required Specifications

5.1.1 Required Specifications for the Master Device

A master device must satisfy any one of the categories 1 to 3 in the table below. However, it is possible to decide, as product specifications, the installation of specifications other than the command profiles mandatorily installed for each category and the mandatory communication specifications. (Example: In addition to the standard servo profile that is the mandatory installed profile for a master device in category 1, the standard I/O profile can also be supported. The master device will still be handled as a category 1 master device.)

Table 5-1 Categories and Required Specifications

Category	Mandatory Installed Profile	Mandatory Communication Specifications	
Category 3	1. Standard servo 2. Stepping motor driver 3. Standard I/O 4. Inverter	Transmission cycle [ms]	All of 0.5/1
		Number of transmission bytes [bytes]	Servo, stepping motor: All of 32/48 Inverter: All of 16/32 I/O: All of 16/32/48/64
		Communication modes	Synchronous mode and asynchronous mode
		C2 master	Presence of C2 master supported
Category 2	1. Standard servo 2. Stepping motor driver 3. Standard I/O	Transmission cycle [ms]	All of 0.5/1
		Number of transmission bytes [bytes]	Servo, stepping motor: All of 32/48 I/O: All of 16/32/48/64
		Communication modes	Support for the synchronous mode exclusively, the asynchronous mode exclusively, or both of these modes
		C2 master	Presence of C2 master supported
Category 1	1. Standard servo	Transmission cycle [ms]	1
		Number of transmission bytes [bytes]	Either of 32 and 48
		Communication modes	Support for the synchronous mode exclusively, the asynchronous mode exclusively, or both of these modes
		C2 master	Presence of C2 master supported

Note: 1. There must be conformity with all of the points stated in the Mandatory Installed Profile and Mandatory Communication Specifications columns in the table above. However, since the mandatorily installed commands are fixed for each profile, refer to the individual specifications. Also note that, in addition to fulfilling the specifications detailed in the table above, it is possible to install other specifications as additional specifications.

Note: 2. The number of transmission bytes, transmission cycle and communication modes supported must operate in any combination. For example, if the device is a category 3 master, it is not possible to set product specifications where “synchronous communication mode, 32-byte, 2 ms” is possible but “synchronous communication, 48-byte, 2 ms” cannot be supported.

5.1.2 Required Specifications for Slave Devices

For a slave device it is necessary to decide the command group to be installed in conjunction with the product type and specifications, to install the mandatory commands for that command group, and to fulfill the mandatory communication specifications. However, it is permissible to install other commands in the relevant command group in addition to these mandatory commands, and to support other transmission cycles in addition to the mandatory communication specifications.

Table 5-2 Required Specifications for Slave Devices

Mandatory Installed Command Group	Mandatory Communication Specifications	
Install any of the following: Standard servo Stepping motor driver Standard I/O Inverter	Transmission cycle [ms]	All of 0.5/1/2/4
	Number of transmission bytes [bytes]	Servo, stepping motor: All of 32/48 Inverter: All of 16/32 I/O: Depends on the product specifications
	Communication modes	Synchronous mode, and asynchronous mode (However, the asynchronous mode is an option for I/O.)
	Address range	03Hex to EFHex

Note: 1. There must be conformity with all of the points stated in the Mandatory Installed Command Group and Mandatory Communication Specifications columns in the table above. However, since the mandatory installed commands are fixed for each command group, refer to the individual specifications.

Note: 2. The number of transmission bytes, transmission cycle and communication modes supported must operate in any combination. For example, it is not possible to set product specifications where “synchronous communication mode, 32-byte, 2 ms” is possible but “synchronous communication, 48-byte, 2 ms” cannot be supported.

5.2 Conformance Test for a Master

Trace the MECHATROLINK commands supported by the tested equipment on the MECHATROLINK network and check that the data in the frames conform to the specifications.

5.2.1 Test Configuration

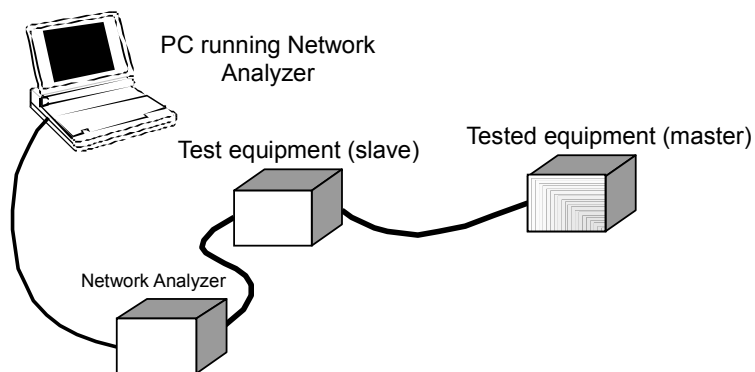


Fig. 5-1 Test Configuration

Use MECHATROLINK cables of the stipulated type. The cables connecting the tested equipment, the test equipment and the Network Analyzer can each be of any length.

Note that if the configuration indicated above cannot be achieved, it is also acceptable, for example, to place the Network Analyzer between the tested equipment (master) and the test equipment (slave).

5.2.2 Test Items

The test items to be undertaken differ depending on the functions that the tested equipment supports.

If the product is one that only establishes a connection in asynchronous communication, then only the test points that relate to asynchronous communication are applied. If the product is one that supports synchronous communication and asynchronous communication, then both tests are applied.

Note that the “abnormal performance test” cited in the list of test points below is not taken as a pass/fail criterion, but you are strongly recommended to undertake this test.

Table 5-3 List of Test Points (Master)

Test Category	Test Subcategory	Test Content	Test Table No.
Initial setting	Initialization	- Establishment of connection (asynchronous)	Table 5-4
		- Establishment of connection (synchronous)	Table 5-8
Cyclic transmission (asynchronous)	Normal performance test	- Transmission frame format Common commands Inverter Servo drive Stepping motor drive I/O	Table 5-5
		- Slave communication interrupted	Table 5-6
	Abnormal performance test	- Slave communication interrupted → reset	Table 5-7
		- WDT updating	Table 5-9
Cyclic transmission (synchronous)	Normal performance test	- Transmission frame format Common commands Inverter Servo drive Stepping motor drive I/O	Table 5-10
		- Slave communication interrupted	Table 5-11
		- Slave communication interrupted → reset	Table 5-12
	Abnormal performance test	- WDT stop	Table 5-13

5.2.3 Test Specifications

Implement master device tests under the following conditions.

■ Test Conditions

Transmission cycle	Implement the test with the minimum transmission cycle among the mandatory transmission cycles in the relevant category.
Communication cycle	Implement the test at a multiple of one of the transmission cycle (communication cycle = transmission cycle).
Number of transmission bytes	Implement the test with the maximum available number of transmission bytes.
Synchronous communication /asynchronous communication	Implement the test in the synchronous communication mode. If the device also supports the asynchronous communication mode, the connection establishment test only should also be implemented in the asynchronous communication mode. If the device supports only the asynchronous communication mode, implement the test with asynchronous communication.
Retry	If it is possible to make a retry setting, implement the test with the minimum settable value.
C2 master	Implement the test with the setting supporting a C2 master.
Command check	Implement any commands from among those that are available, under the conditions above.

■ Test Tables: Asynchronous Communication

Table 5-4 Initial Setting (Establishment of Connection (Asynchronous))

Test category	Initial setting
Test content	Establishment of connection (asynchronous)
Test procedure	Check the DISCONNECT and CONNECT command/response frames and sequence.
Evaluation criteria	<ul style="list-style-type: none"> a) Check that commands are issued from the tested equipment in the order DISCONNECT → CONNECT. b) Check that the asynchronous setting has been made for the CONNECT command frame. c) Check that the CONNECT command is transmitted continuously until a connection is established.

Table 5-5 Cyclic Transmission (Asynchronous) (Transmission Frame Format)

Test category	Cyclic transmission (asynchronous)
Test content	Transmission frame format
Test procedure	Check the command/response frames after communication has been established.
Evaluation criteria	Check that all of the mandatory commands, and any command from among the available optional ones, can be transmitted. (This depends on the function specification of the product. Companies subject to testing shall apply based on the product manual.)

Table 5-6 Cyclic Transmission (Asynchronous) (Slave Communication Interrupted)

Test category	Cyclic transmission (asynchronous)
Test content	Slave communication interrupted
Test procedure	a) After communication has been established, disconnect the communication cable. b) Check the command/response frames.
Evaluation criteria	a) Check that communication errors are detected, and that the tested equipment carries out error processing (that it issues the DISCONNECT command, SV_OFF command, CMD_CANCEL bit, etc.). (The error processing shall conform to the product specifications of the tested equipment.) b) Check that the error LED lights, or that the indicator displays ERR.

Table 5-7 Cyclic Transmission (Asynchronous)
(Slave Communication Interrupted → Reset)

Test category	Cyclic Transmission (Asynchronous)
Test content	Slave communication interrupted → reset
Test procedure	a) After communication has been established, disconnect the communication cable, then after the elapse of at least 5 seconds reconnect the communication cable. b) Check the command/response frames.
Evaluation criteria	a) Check that communication errors are detected, and that the tested equipment carries out error processing (that it issues the DISCONNECT command, SV_OFF command, CMD_CANCEL bit, etc.). (The error processing shall conform to the product specifications of the tested equipment.) b) Check that commands are issued in the order DISCONNECT → CONNECT.

■ Test Tables: Synchronous Communication

Table 5-8 Initial Setting (Establishment of Connection (Synchronous))

Test category	Initial Setting
Test content	Establishment of connection (synchronous)
Test procedure	Check the DISCONNECT and CONNECT command/response frames and sequence.
Evaluation criteria	<ul style="list-style-type: none"> a) Check that commands are issued from the tested equipment in the order DISCONNECT → CONNECT. b) Check that the synchronous setting has been made for the CONNECT command frame. c) Check that the CONNECT command is transmitted continuously until a connection is established.

Table 5-9 Cyclic Transmission (Synchronous) (WDT Updating)

Test category	Cyclic transmission (synchronous)
Test content	WDT updating
Test procedure	After establishment of a synchronous connection, check the WDT/RWDT of the command/response frame.
Evaluation criteria	Check that WDT/RWDT are updated every communication cycle.

Table 5-10 Cyclic Transmission (Synchronous) (Transmission Frame Format)

Test category	Cyclic transmission (synchronous)
Test content	Transmission frame format
Test procedure	After establishment of a synchronous connection, check the command/response frame.
Evaluation criteria	Check that all of the mandatory commands, and any command from among the available optional ones, can be transmitted. (This depends on the function specification of the product. Companies subject to testing shall apply based on the product manual.)

Table 5-11 Cyclic Transmission (Synchronous) (Slave Communication Interrupted)

Test category	Cyclic transmission (synchronous)
Test content	Slave communication interrupted
Test procedure	<ul style="list-style-type: none"> a) After establishment of a synchronous connection, disconnect the communication cable. b) Check the command/response frames.
Evaluation criteria	<ul style="list-style-type: none"> a) Check that communication errors are detected, and that the tested equipment carries out error processing (that it issues the DISCONNECT command, SV_OFF command, CMD_CANCEL bit, etc.). (The error processing shall conform to the product specifications of the tested equipment.) b) Check that the error LED lights, or that the indicator displays ERR.

Table 5-12 Cyclic Transmission (Synchronous)
(Slave Communication Interrupted → Reset)

Test category	Cyclic transmission (synchronous)
Test content	Slave communication interrupted → reset
Test procedure	<ul style="list-style-type: none"> a) After synchronous communication has been established, disconnect the communication cable, then after the elapse of at least 5 seconds reconnect the communication cable. b) Check the command/response frames and sequence.
Evaluation criteria	<ul style="list-style-type: none"> a) Check that communication errors are detected, and that the tested equipment carries out error processing (that it issues the DISCONNECT command, SV_OFF command, CMD_CANCEL bit, etc.). (The error processing shall conform to the product specifications of the tested equipment.) b) Check that commands are issued in the order DISCONNECT → CONNECT. c) Go to the synchronous communication status and check that WDT/RWDT updating is being performed.

Table 5-13 Cyclic Transmission (Synchronous) (WDT Stop)

Test category	Cyclic transmission (synchronous)
Test content	WDT stop
Test procedure	<ul style="list-style-type: none"> a) After establishment of a synchronous connection, stop the WDT of the test equipment (slave). b) Check the command/response frames.
Evaluation criteria	<ul style="list-style-type: none"> a) Check that communication errors are detected, and that the tested equipment carries out error processing (that it issues the DISCONNECT command, SV_OFF command, CMD_CANCEL bit, etc.). (The error processing shall conform to the product specifications of the tested equipment.) b) Check that the error LED lights, or that the indicator displays ERR.

5.3 Conformance Test for Slaves

Trace the responses to the MECHATROLINK commands supported by the tested equipment on the network, and check that the data format conforms to the MECHATROLINK command specifications.

5.3.1 Test Configuration

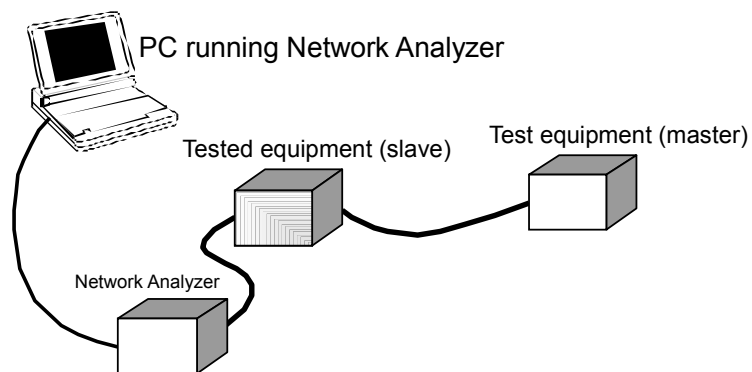


Fig. 5-2 Test Configuration

Use MECHATROLINK cables of the stipulated type. The cables connecting the tested equipment, the test equipment and the Network Analyzer can each be of any length.

Note that if the configuration indicated above cannot be achieved, it is also acceptable, for example, to place the Network Analyzer between the test equipment (master) and the tested equipment (slave).

5.3.2 Test Items

The test items to be undertaken differ depending on the functions that the tested equipment supports.

If the product is one that only establishes a connection in asynchronous communication, then only the test points that relate to asynchronous communication are applied. If the product is one that supports synchronous communication and asynchronous communication, then both tests are applied.

Note that the “abnormal performance test” cited in the list of test points below is not taken as a pass/fail criterion.

Test Category	Test Subcategory	Test Content	Test Table No.
Initial setting	Initialization	- Establishment of connection (asynchronous)	Table 5-14
		- Establishment of connection (synchronous)	Table 5-21
Cyclic transmission (asynchronous)	Normal performance test	- Transmission frame format Common commands Inverter Servo drive Stepping motor drive I/O	Table 5-15
	Abnormal performance test	- Master communication interrupted	Table 5-16
		- Master communication interrupted → reset	Table 5-17
		- Master power supply interrupted	Table 5-18
		- Master power supply interrupted → reset	Table 5-19
		- Abnormal command	Table 5-20

Test Category	Test Subcategory	Test Content	Test Table No.
Cyclic transmission (synchronous)	Normal performance test	- Transmission method (single transmission /consecutive transmission)	Table 5-22
		- WDT updating	Table 5-23
		- Transmission frame format Common commands Inverter Servo drive Stepping motor drive I/O	Table 5-24
	Abnormal performance test	- Master communication interrupted	Table 5-25
		- Master communication interrupted → reset	Table 5-26
		- Master power supply interrupted	Table 5-27
		- Master power supply interrupted → reset	Table 5-28
		- Abnormal command	Table 5-29
		- WDT stop	Table 5-30
		- Phase control	Table 5-31
Check on station numbers			Table 5-32
Check on MDI files			Table 5-33
Check on common parameters			Table 5-34

5.3.3 Test Specifications

Implement slave devices tests under the following conditions in the corresponding communication specifications.

■ Test Conditions

Transmission cycle	Implement the test with the minimum transmission cycle in the mandatory specifications.
Communication cycle	Implement the test at a multiple of one of the transmission cycle (communication cycle = transmission cycle).
Number of transmission bytes	Implement the test with the maximum available number of transmission bytes.
Synchronous communication /asynchronous communication	Implement the test in the synchronous communication mode. If the device also supports the asynchronous communication mode, the connection establishment test only can also be implemented in the asynchronous communication mode. If the device supports only the asynchronous communication mode, implement the test with asynchronous communication.
Retry	Implement the test with a retry setting of "0".
C2 master	Implement the test with the setting supporting a C2 master.
Command check	Implement all of the available commands under the conditions stated above.

■ Test Tables: Asynchronous Communication

Table 5-14 Initial Setting (Establishment of Connection (Asynchronous))

Test category	Initial setting
Test content	Establishment of connection (asynchronous)
Test procedure	Check the DISCONNECT and CONNECT command/response frames and sequence.
Evaluation criteria	<p>a) Check that commands are issued from the test equipment in the order DISCONNECT → CONNECT, and that the corresponding response is returned from the tested equipment.</p> <p>b) Check that the connect LED lights after the establishment of a connection.</p>

Table 5-15 Cyclic Transmission (Asynchronous) (Transmission Frame Format)

Test category	Cyclic transmission (asynchronous)
Test content	Transmission frame format
Test procedure	After the establishment of communication, check the frames of the responses to all of the mandatory commands and any optional commands. If subcommands can be used, check frames with any required combination of main commands and subcommands.
Evaluation criteria	<p>Check that the responses to the available relevant commands of the tested equipment are normal.</p> <p>(This depends on the function specification of the product. Companies subject to testing shall apply based on the product manual.)</p>

Table 5-16 Cycle Transmission (Asynchronous)
(Master Communication Interrupted)

Test category	Cyclic transmission (asynchronous)
Test content	Master communication interrupted
Test procedure	<p>a) After communication has been established, disconnect the communication cable.</p> <p>b) Check the command/response frames.</p>
Evaluation criteria	Check that communication errors are detected, and that the tested equipment behaves in accordance with the product specifications. Check that the equipment shifts to the asynchronous communication status.

Table 5-17 Cyclic Transmission (Asynchronous)
(Master Communication Interrupted → Reset)

Test category	Cyclic transmission (asynchronous)
Test content	Master communication interrupted → reset
Test procedure	<p>a) After communication has been established, disconnect the communication cable, then after the elapse of at least 5 seconds reconnect the communication cable.</p> <p>b) Check the command/response frames.</p>
Evaluation criteria	<p>a) Check that communication errors are detected, and that the tested equipment behaves in accordance with the product specifications. Check that the equipment shifts to the asynchronous communication status.</p> <p>b) After connecting the cable, check that the tested equipment shifts to the asynchronous communication status on issuing DISCONNECT → CONNECT.</p> <p>c) Check that the error LED lights, or that the indicator displays ERR.</p>

Table 5-18 Cyclic Transmission (Asynchronous)
(Master Power Supply Interrupted)

Test category	Cyclic transmission (asynchronous)
Test content	Master power supply interrupted
Test procedure	<p>a) After communication has been established, turn off the power supply to the master.</p> <p>b) Check the command/response frames.</p>
Evaluation criteria	<p>a) Check that communication errors are detected, and that the tested equipment behaves in accordance with the product specifications. Check that the equipment shifts to the asynchronous communication status.</p> <p>b) Check that the error LED lights, or that the indicator displays ERR.</p>

Table 5-19 Cyclic Transmission (Asynchronous)
(Master Power Supply Interrupted → Reset)

Test category	Cyclic transmission (asynchronous)
Test content	Master power supply interrupted → reset
Test procedure	<p>a) After communication has been established, turn off the power supply to the master, then after the elapse of at least 5 seconds, turn the power supply to the master back on.</p> <p>b) Check the command/response frames.</p>
Evaluation criteria	<p>a) Check that communication errors are detected, and that the tested equipment behaves in accordance with the product specifications. Check that the equipment shifts to the asynchronous communication status.</p> <p>b) After the test equipment's power supply has been reset, check that the tested equipment shifts to the asynchronous communication status on issuing DISCONNECT → CONNECT.</p>

Table 5-20 Cyclic Transmission (Asynchronous) (Abnormal Command)

Test category	Cyclic transmission (asynchronous)
Test content	Abnormal command
Test procedure	<ul style="list-style-type: none">a) After communication has been established, send a command that the tested equipment doesn't support (an abnormal command) from the test equipment to the tested equipment.b) Check the response from the tested equipment.
Evaluation criteria	<ul style="list-style-type: none">a) Check that the tested equipment detects command errors, and that an error response such as "Invalid Command" is returned.b) Check that the error LED lights, or that the indicator displays ERR.

■ Test Tables: Synchronous Communication

Table 5-21 Initial Setting (Establishment of Connection (Synchronous))

Test category	Initial setting
Test content	Establishment of connection (synchronous)
Test procedure	Check the DISCONNECT and CONNECT command/response frames and sequence.
Evaluation criteria	<ul style="list-style-type: none"> a) Check that commands are issued from the test equipment in the order DISCONNECT → CONNECT, and that the corresponding response is returned from the tested equipment. b) Check that the equipment shifts to the synchronous communication status, and WDT/RWDT updating is carried out. c) Check that the connect LED lights after the establishment of a connection.

Table 5-22 Cyclic Transmission (Synchronous) (Transmission Method (Single Transmission/Consecutive Transmission))

Test category	Cyclic transmission (synchronous)
Test content	Transmission method (single transmission/consecutive transmission)
Test procedure	<ul style="list-style-type: none"> a) After establishment of a synchronous connection, send a command that the tested equipment (slave) supports. b) Check the transmission timing from sending the command to sending of the response from the slave.
Evaluation criteria	After establishment of a synchronous connection, check if communication is carried out in a transmission timing that accords with the specified settings (transmission method (single transmission/consecutive transmission), ratio of transmission cycle and communication cycle). (Compatibility with consecutive transmission is determined by the product specifications.)

Table 5-23 Cyclic Transmission (Synchronous) (WDT Updating)

Test category	Cyclic transmission (synchronous)
Test content	WDT updating
Test procedure	After establishment of a synchronous connection, check the WDT/RWDT of the command/response frame.
Evaluation criteria	Check that WDT/RWDT are updated every communication cycle.

Table 5-24 Cyclic Transmission (Synchronous) (Transmission Frame Format)

Test category	Cyclic transmission (synchronous)
Test content	Transmission frame format
Test procedure	After the establishment of communication, check the frames of the responses to all of the mandatory commands and any optional commands. If subcommands can be used, check frames with any required combination of main commands and subcommands.
Evaluation criteria	Check that the responses to the available relevant commands of the tested equipment are normal. (This depends on the function specification of the product. Companies subject to testing shall apply based on the product manual.)

Table 5-25 Cyclic Transmission (Synchronous)
(Master Communication Interrupted)

Test category	Cyclic transmission (synchronous)
Test content	Master communication interrupted
Test procedure	a) After synchronous communication has been established, disconnect the communication cable. b) Check the command/response frames.
Evaluation criteria	Check that communication errors are detected, and that the tested equipment behaves in accordance with the product specifications. Check that the equipment shifts to the asynchronous communication status.

Table 5-26 Cycle Transmission (Synchronous)
(Master Communication Interrupted → Reset)

Test category	Cyclic transmission (synchronous)
Test content	Master communication interrupted → reset
Test procedure	a) After synchronous communication has been established, disconnect the communication cable, then after the elapse of at least 5 seconds reconnect the communication cable. b) Check the command/response frames.
Evaluation criteria	a) Check that communication errors are detected, and that the tested equipment behaves in accordance with the product specifications. Check that the equipment shifts to the asynchronous communication status. b) After connecting the cable, check that the tested equipment shifts to the synchronous communication status on issuing DISCONNECT → CONNECT. c) Check that the error LED lights, or that the indicator displays ERR.

Table 5-27 Cyclic Transmission (Synchronous) (Master Power Supply Interrupted)

Test category	Cyclic transmission (synchronous)
Test content	Master power supply interrupted
Test procedure	<p>a) After synchronous communication has been established, turn off the power supply to the master.</p> <p>b) Check the command/response frames.</p>
Evaluation criteria	Check that communication errors are detected, and that the tested equipment behaves in accordance with the product specifications. Check that the equipment shifts to the asynchronous communication status.

Table 5-28 Cyclic Transmission (Synchronous)
(Master Power Supply Interrupted → Reset)

Test category	Cyclic transmission (synchronous)
Test content	Master power supply interrupted → reset
Test procedure	<p>a) After synchronous communication has been established, turn off the power supply to the master, then after the elapse of at least 5 seconds, turn the power supply to the master back on.</p> <p>b) Check the command/response frames.</p>
Evaluation criteria	<p>a) Check that communication errors are detected, and that the tested equipment behaves in accordance with the product specifications. Check that the equipment shifts to the asynchronous communication status.</p> <p>b) After the test equipment's power supply has been reset, check that the tested equipment shifts to the synchronous communication status on issuing DISCONNECT → CONNECT.</p> <p>c) Check that the error LED lights, or that the indicator displays ERR.</p>

Table 5-29 Cyclic Transmission (Synchronous) (Abnormal Command)

Test category	Cyclic transmission (synchronous)
Test content	Abnormal command
Test procedure	<p>a) After synchronous communication has been established, send a command that the tested equipment doesn't support (an abnormal command) from the test equipment to the tested equipment.</p> <p>b) Check the response from the tested equipment.</p>
Evaluation criteria	<p>a) Check that the tested equipment detects command errors, and that an error response such as "Invalid Command" is returned.</p> <p>b) Check that the error LED lights, or that the indicator displays ERR.</p>

Table 5-30 Cyclic Transmission (Synchronous) (WDT Stop)

Test category	Cyclic transmission (synchronous)
Test content	WDT stop
Test procedure	<ul style="list-style-type: none"> a) After synchronous communication has been established, stop the WDT of the test equipment (master). b) Check the command/response frames.
Evaluation criteria	<ul style="list-style-type: none"> a) Check that communication errors (WDT errors) are detected, and that the tested equipment behaves in accordance with the product specifications. Check that the equipment shifts to the asynchronous communication status b) Check that the error LED lights, or that the indicator displays ERR.

Table 5-31 Cyclic Transmission (Asynchronous) (Phase Control)

Test category	Cyclic transmission (synchronous)
Test content	Phase control
Test procedure	<ul style="list-style-type: none"> a) After synchronous communication has been established, stop the WDT of the test equipment (master) to cause the tested equipment to shift to phase 2. b) Transmit the phase 3 command from the test equipment and check that an alarm occurs. c) After transmitting the SYNC_SET command from the test equipment to shift to phase 3, transmit the phase 3 command again and check that operation is normal.
Evaluation criteria	<ul style="list-style-type: none"> a) Communication errors (WDT errors) must be detected. (Check e.g. on the alarm indicator.) b) Check that an alarm occurs in test procedure b). c) Check that there is a normal response in response to the phase 3 command transmitted in test procedure c).

Table 5-32 Checking Station Numbers

Test category	Check on station numbers
Test content	The station numbers must correspond to the settable range of 03HEX to EFHEX.
Test procedure	Check connection with the smallest value and largest value station numbers.
Evaluation criteria	Check that connection and operation take place normally.

Table 5-33 Checking MDI Files

Test category	Check on MDI files
Test content	Check the syntax of the MDI file.
Test procedure	Perform a basic syntax check on the MDI file.
Evaluation criteria	Check that the basic syntax of the MDI file is composed in accordance with the code.

Table 5-34 Checking Common Parameters

Test category	Check on common parameters
Test content	Check that there is correspondence with the common parameters in accordance with the standards.
Test procedure	<ul style="list-style-type: none">a) Check the parameter list in the instruction manual and check that the parameters are configured in accordance with the standards.b) Check that read/write operation of any selected common parameters can be performed normally from the master.
Evaluation criteria	<ul style="list-style-type: none">a) Check that the common parameters in the instruction manual have been prepared in accordance with the standards.b) Check that it is possible to access common parameters normally from the master.

6 Interoperability Test

6.1 Interoperability Test for Masters

6.1.1 Test Configuration

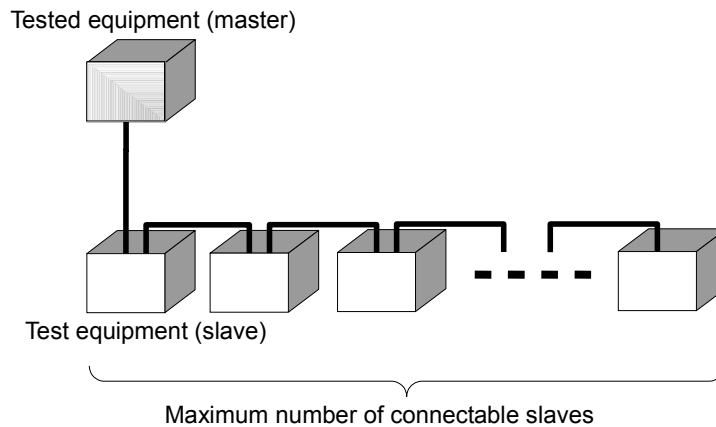


Fig. 6-1 Test Configuration

Make the system configuration one with the maximum number of connectable slaves as stated in the product specifications for the tested equipment (master).

6.1.2 Test Specifications

The tested equipment (master) carries out communication cyclically using arbitrary commands that are supported by the test equipment (slaves). Check that no communication error has occurred after 2 hours of continuous operation.

6.2 Interoperability Test for Slaves

6.2.1 Test Configuration

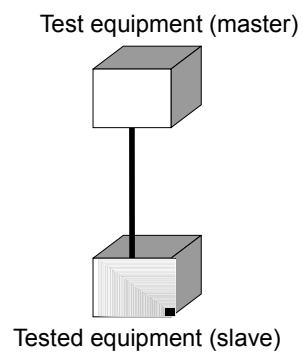


Fig. 6-2 Test Configuration

Use a configuration in which one tested equipment (slave) is connected to the test equipment (master).

6.2.2 Test Specifications

The test equipment (master) carries out communication cyclically using arbitrary commands that are supported by the tested equipment. Check that no communication error has occurred after 2 hours of continuous operation.

Revision History

The revision dates and numbers of the revised manuals are given on the bottom of the back cover.

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