CC-Link IE

Ethernet-based Open Network

CC-Link IE Controller Network
Cable Installation Manual

CC-Link CLPA PARTNER ASSOCIATION

This manual describes items related to the construction of a network that employs CC-Link IE controller network compatible products, including the matters to be studied in advance, onsite cable installation work check items, and cable installation precautions. We hope that you will utilize this manual to ensure smooth construction of a CC-Link IE controller network.

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Chapter 1 NETWORK CABLE INSTALLATION PROCEDURE

The following describes the CC-Link IE controller network cable installation procedure.

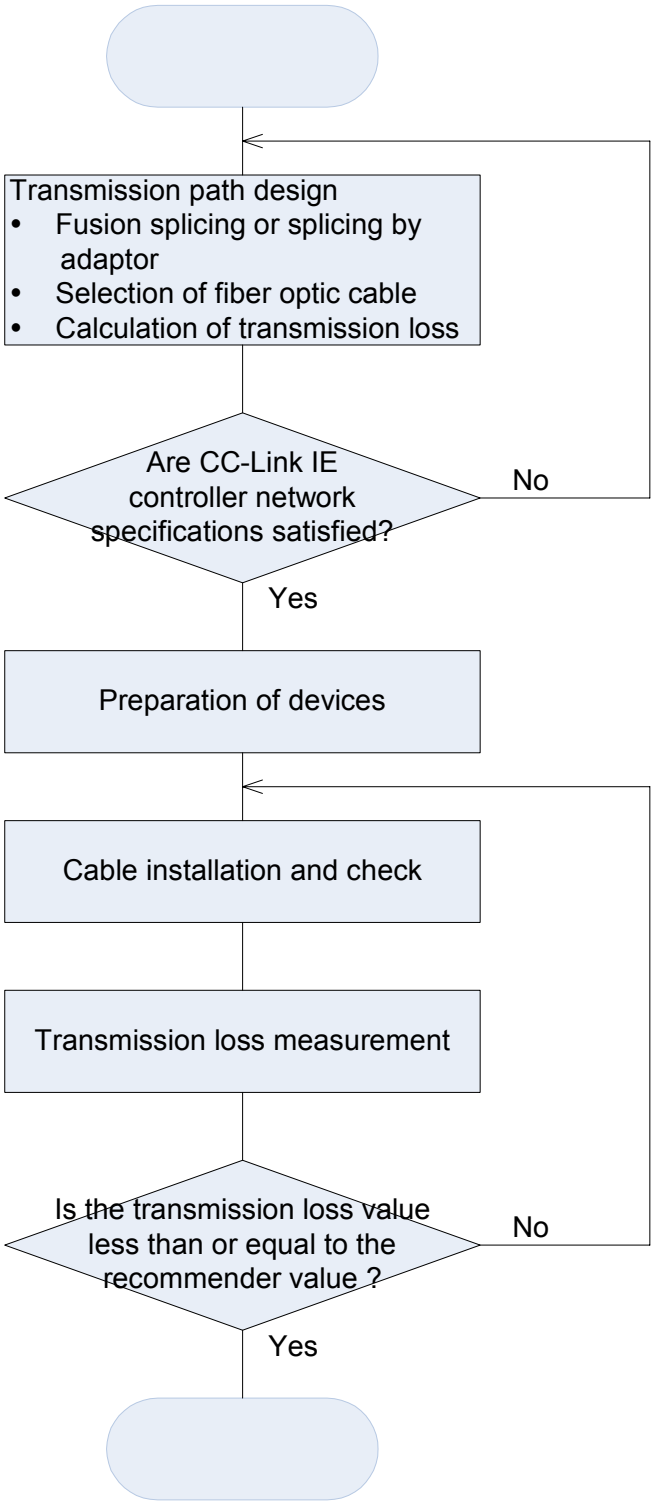


Figure 1 Cable Installation Procedure

Chapter 2 NETWORK SPECIFICATIONS

The CC-Link IE controller network is an Ethernet-based loop topology network that employs IEEE802.3 1000Base-SX technology in its physical layer and data link layer. Table 1 describes the communication specifications related to CC-Link IE controller network cable laying.

Table 1 Communication Specifications

Item		Specification
Communication speed		1Gbps
No. of connected nodes per network		120 nodes (1 control node, 119 normal nodes)
Type of cable		Fiber optic cable (multimode fiber)
Total cable length		66,000m (with 120 nodes connected)
Maximum distance between nodes		550m
Maximum number of networks		239
Topology		Dual loop
Fiber optic cable specifications		IEEE802.3 1000Base-SX (MMF) compatible fiber optic cable
	Standard	IEC60793-2-10 Types A1a.1 (50/125μm multimode)
	Transmission loss (max)	3.5 dB/km or less [λ=850nm]
	Transmission band (min)	500 MHz/km or greater [λ=850nm]
Connector specifications		Duplex LC Connector (LCF connector)
	Standard	IEC61754-20: Type LC connector
	Insertion loss	0.3 dB or less
	Polishing method	PC polishing

Chapter 3 SELECTING THE CONNECED DEVICES

3.1 Fiber Optic Cable

With the CC-Link IE controller network, it is recommended that you use IEC compliant CLPA recommended fiber optic cable.

Table 2 below describes the representative specifications.

Table 2 Fiber optic Cable Specifications

No.	Item		Specifications
1	Fiber optic type		1000Base-SX compatible multimode GI fiber optic
2	Compliant standard		IEC60793-2-10 A1a .1
3	Core	Material	Silica glass
		Outer diameter	50±3μm
4	Clad	Material	Silica glass
		Outer diameter	125±2μm
5	Primary coating	Outer diameter	0.25 mm
6	Secondary coating	Outer diameter	0.9±0.1 mm
7	Cord	Outer diameter	2.0 ± 0.2mm x 2 (2.0×4.0mm)
8	Operating temperature		-20 to 60°C
9	Permissible bending radius		15mm (after cable installation)
			30mm (during cable installation)
10	Transmission loss		3.5dB/km or less [λ=850nm]
11	Transmission band		500MHz/km or greater [λ=850nm]

3.2 Optical Connector

With the CC-Link IE controller network, it is recommended that you use IEC compliant CLPA recommended optical connectors.

Table 3 below shows the representative specifications.

Table 3 Optical Connector Specifications

No.	Item	Specifications
1	Optical connector type	Duplex LC Connector (LCF connector)
2	Compliant standard	IEC61754-20: Type LC connector
3	Insertion loss	0.3dB or less (with respect to master fiber)
4	Return loss	20dB or greater
5	Polishing method	PC polishing

Chapter 4 CALCULATING AND CHECKING THE TRANSMISSION LOSS VALUE

During optical cable installation, confirm that the transmission loss between nodes is less than or equal to the recommended transmission loss value.

4.1 Calculating the Transmission loss Value

Calculate the transmission loss value using the calculation formula below, and confirm that the value is less than or equal to the recommended transmission loss value (4.5dB).

Transmission loss value (dB) = Fiber optic transmission loss standard value (dB/km) x Fiber optic cable length (km) ·····[1]
+ Fusion splicing loss value (dB/location) x Number of fusion splicing (locations) ·····[2]
+ Adapter splicing loss value (dB/location) x Number of adapter splicing (locations) ·····[3]

[1] Fiber optic cable transmission loss standard value (dB/km): According to Fiber Optic Cable Specification

[2] Fusion splicing loss value (dB/location): 0.2dB or less/location

[3] Connector adapter splicing loss value (dB/location): According to optical connector type and manufacturer

Transmission loss value (dB) ≤ 4.5 (dB) …CLPA recommended value

[Calculation example]

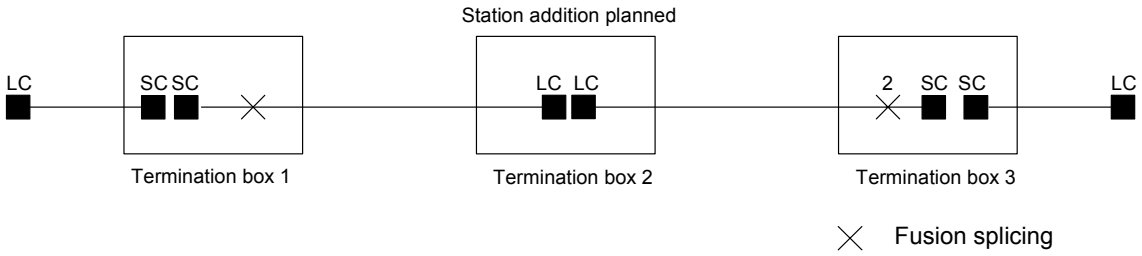
Conditions:

GI fiber optic (transmission loss value: 3.5dB/km) Total cable length of 550m

Table 4 Examples of Connector Adapter Splicing Loss Value

Connector Type	No. of Cores	Polishing Method	Fiber Optic Type		Remarks
			SM (dB or less)	GI (dB or less)	
SC	Single-core	PC polishing	0.7	0.4	Reference value
LC			0.5	0.3	

Note: The values above differ according to manufacturer.
For details, check with the adapter manufacturer.



[1] Cable transmission loss | [2] Fusion splice connection loss | [3] Connector adapter connection loss

Transmission loss value (dB) = (3.5dB/km×0.55 km) + (0.2db x 2 locations)+ (0.4dB x 2 locations + 0.3 db x 1 location)

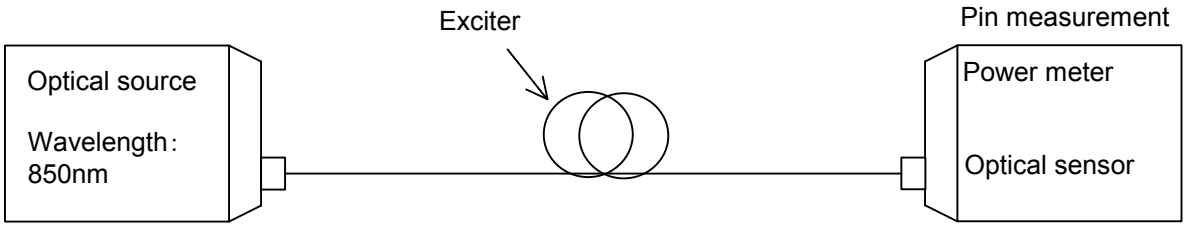
= 3.425(dB)

4.2 Transmission loss Measurement Method

Measure the transmission loss between nodes following the procedure below, and confirm that the measured value is less than or equal to the transmission loss value calculated in Section 4.1.

(1) Measuring the optical input Pin (Standard outgoing beam: Measured cable incoming beam)

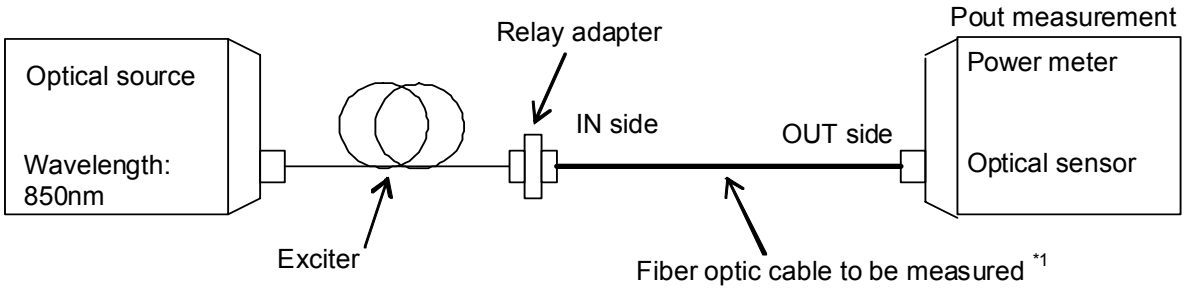
[1] Connect an exciter.



[2] Set the mode to dBm mode and measure Pin [dBm].

(2) Measuring the optical output Pout (measured cable outgoing beam)

[1] Connect the relay adapter and optical fiber cable to be measured to the exciter.



*1 Including all adapter splicing locations and fusion splicing locations (including all splicing locations between nodes).

[2] Measure Pout (dBM) in dBm mode.

(3) Transmission loss value Px [dB]

P x [dB] = Pin [dBm] − Pout [dBm] − Pc [dB] (Adapter splicing loss when connected with exciter)

(4) Since the CC-Link IE controller network uses a two-core optical fiber cable, measure the second fiber optic core in the same manner.

Chapter 5 PRECAUTIONS

5.1 Installing the Cable

During fiber optic cable installation, be sure to follow the following precautions.

- Cable path
  - Use a pit or cable rack for the cable routing as far as possible.
  - When using conduit, ensure that the inner diameter of the conduit is large enough to accommodate the dimensions of the cable connector. When providing a pull box in the conduit, select a box that satisfies the cable's permissible bending radius.
  - Use a dedicated cable routing path as far as possible. When sharing the path with other cables, lay the fiber optic cable last.
  - Use a path into which water or oil cannot enter, and which will not reach temperatures higher or lower than the applicable temperature specifications of the cable.
- Pipe path
  - Install the cable without directly pulling the cable. Instead, fix the cable onto a pulling rope or the like. Depending on the cable specification, cables that can be directly pulled also exist. Check with the manufacturer.
- Precautions for cable pulling
  - Pull the cable from the leading end at a pulling speed of 10m/min or less. Make sure that the tension applied to the cable is even, and pull the cable at a tension half or less than the permissible tension.
  - Establish a bending radius during pulling that is at least two times the minimum permissible bending radius or higher.
  - Take care that the cable does not become entangled during installation. Particularly, certain hanger rollers are structured in such a way that readily causes entanglement. When installing lengthy cables, it is recommended that you use a wire wheel.
  - Make sure that kinks are not created in the cable.
- Protection with respect to permissible tension
  - When installing the cables vertically or when using aerial installation, support the cable so that the tension caused by its own weight does not exceed the permissible tension.

- Prevention of moisture permeation
  - In general, the optical fiber itself has poor water resistance. Permeation of water from the optical cable ends may have adverse effects in the long term. Additionally, there have been cases where the condensation that arises due to temperature gradients within the laid optical cable route permeates the optical cable, resulting in adverse effects. When installing the optical cable, be sure to make the optical cable ends waterproof.
- Protection of connector section
  - Protect the connector section with a vinyl hose, pulling eye, or the like when laying the cable. Do not pull the connector section. The connector section is especially sensitive to impact and tension.
- Other
  - Seal both ends of the cable at a time other than when installing the cable to prevent water seepage.
  - The ends of the fiber optic cable are sharp. Be careful during handling.
  - Do not touch or bump the end of the optical connector.

5.2 Fusion Splicing and Adapter Splicing

The length of the optical fiber cable can be extended by using a fusion splice or relay adapter. When making each connection, be sure to note the following.

- Fusion splicing precautions
  - Execute the fusion splicing work following the procedure described in the user's manual of the fusion splicer (or other tool) used. Additionally, be sure to follow the stated precautions.
  - Do not splicing the cable if the core optical fiber is twisted.
- Protection of connected locations
  - Make sure that tension is not applied to fusion splicing locations or adapter splicing locations at the termination box. Additionally, make sure to maintain the required space for installing the termination box. Although the size required increases with increases in the number of connected units, prepare a space approximately 15cm x 10cm in size, minimum. The termination box differs according to the number of units connected, connection type, and cable form to be connected. For details, check with the fiber optic cable manufacturer.
- Splicing loss
  - Loss occurs at fusion splicing locations and adapter splicing locations. Check the information described in Chapter 4, and confirm that the transmission loss is less than or equal to the acceptance value.

Direct any inquiries regarding this manual to:

CC-Link Partner Association
6F Meiji Yasuda Seimei Ozone Bldg., 3-15-58, Ozone, Kita-ku,
Nagoya 462-0825, Japan
TEL :+81-52-919-1588
FAX :+81-52-916-8655
URL :http:/www.cc-link.org/
E-Mail :cc-link@post0.mind.ne.jp

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