Installation Guide

Revision History

Revision No	Description	Date
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1.0	Updated for English and incorporated additional information.	12/12/2002
1.10	Edited for North America market – Only Belden & Mitsubishi cables are available in North America market	12/12/2002
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1.50	Removed the specific cable information (refer to CC-Link web site for specific cable information). Added other information for general Installation (such as number of Devices on Network, equations for the number of stations). Added additional grounding information from the CC-Link Cable wiring manual.	10/21/2005
1.60	Incorporated comments from CLPA-HQ. Clarified the use of both CC-Link Version 1.10 Cable and CC-Link Version 1.0 Cable in section 2.3. Added the CC-Link Version 1.10 Cable information to Table 2.5. Corrected the Terminating Resistor value for CC-Link Version 1.0 Cables. Clarified the Minimum Cable Bending Radius table titles in section 4.1.	12/02/2005

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Chapter 1: Introduction

1.1 Definitions and Terminology

Station

A device that exists on the *CC-Link* network, where the station number assignment can be from 0 to 64. A station may be one of the following device types:

Master Station

This station controls the entire CC-Link network. The Network control information (parameters) is stored in this station. One master station is required per network. Multiple Masters are not allowed on the network. A Standby Master Station may also be on the network, although while the Master is operating properly, this Standby Master Station acts as a Local Station. The station number for the Master station is always fixed to zero (0).

Standby Master Station

A station that replaces the Master Station to continue the data link in case the original Master Station stops functioning. A Standby Master Station has the same functions as those of the Master Station and functions as a Local Station under normal conditions.

Slave Station

A designation for a generic non–Master Station. Valid station numbers are 1 – 64.

Local Station

A device that can use bit data, word data, and transient messaging. This type of device can receive and transmit transient messages indirectly to other Local Stations as well as the Master Station. This is different than an Intelligent Device station in that the Local Station can receive and transmit transient messages to other Local Stations as well as the Master. A Local Station is not limited to receiving and transmitting transient messages to and from the Master station. This type of device may include HMI devices, Intelligent Motor Starters, Motion Control devices, PLC products, etc.…

Intelligent Device Station

A device that can use bit data, word data, and transient messaging. This type of device can only receive and transmit transient messages via the Master Station. This type of device may include HMI devices, Intelligent Motor Starters, Motion Control devices, etc.…

Remote Station

A generic name for the Remote I/O stations and Remote Device stations.

Remote Device Station

A station that can use both bit data and word data. This device may occupy multiple stations. This type of device may include analog modules, indicators, digital modules, solenoid valves, or any other type which requires a word (16 bit data type) for communication information.

Remote I/O Station

A station that can only use bit data. This device can only occupy one station. This type of device may include digital modules, solenoid valves, sensors, or any other type which could communication its information strictly via bit values.

Data

Information value stored in the Master or Slave for transmission on the CC-Link Network.

Word data

Information that may represent an analog value or any information value between "-32,768 and 32,767" in signed decimal, between "0 and 65535" in unsigned decimal, and between "0 and FFFFh" in hexadecimal. This data type occupies 16 bits of data space.

Bit data

A Single piece of information that is represented as either 0 (OFF) or 1 (ON) and occupies 1 bit of data space.

RWr, RWw

Expressions used to indicate Remote registers (16 bit word data) used by the CC-Link Master and Slave devices. The areas that store this information are expressed as RWr and RWw. The input data (read area) is RWr and output data (write area) is RWw in the Master station. Word data is transmitted from the Master station to the Slave stations using the cyclic Broadcast transmission. Word data is transmitted from the Slave station to the Master stations using the poll response transmission.

RX, RY

An expression to indicate Remote input (RX) and remote output (RY) bit registers (1 bit data) used by the CC-Link Master and Slave devices. The input data (read area) is Rx and output data (write area) is Ry in the Master station. Bit data is transmitted from the Master station to the Slave stations using the cyclic Broadcast transmission. Bit data is transmitted from the Slave station to the Master stations using the poll response transmission.

Broadcast Polling

The method for communication in the CC-Link Network where the Master sends a message to all stations simultaneously (Broadcast) with each station's Output data, then individually polls (Polling) each station for their individual station's Input data.

Branch Line

The cable branched off from the trunk line. The length of a branch line is the length of the individual cable branched off from the trunk line. The Total Branch Line Length is the total of all the individual branch line lengths combined. A branch line may be a T-Branch connection which is a simple wired connection to split off the main trunk line. A branch line may also be a powered connection using a repeater.

Cable

Use *CC-Link* approved and conformance tested cable (Shielded, 3-core twisted pair cable). When the generic term "*CC-Link* certified cable" is used it refers to any of the certified cables that are listed on the CC-Link Partner Association web site. (www.cclinkamerica.org)

Connection Method

The basic connection for *CC-Link* is a multi drop 'daisy-chain' connection. A T-branch connection is allowed in network speeds of 625Kbps or less. A branch connection topology is allowed for all network speeds when a repeater is used in the branch connection design.

Cyclic Transmission
The periodic transmission of data across the network. This type of communication is the standard method of data communication and occurs every cycle. The data in this type of communication is not addressed to a specific station and is intended for use by the entire network. Each device therefore reads the portion of the transmission that is intended for it. The Cyclic transmission data is embedded within the standard cyclic transmission.

Extended Cyclic Settings
This setting defines the number of cycles by which the complete data packet is divided. Therefore this also defines the number of cycles that are required to update the device with all new information. In the extended cyclic transmission (Ver.2), the extended cyclic points can be set as 2 times, 4 times or 8 times of the normal cyclic transmission points.

Extended Cyclic Transmission
Cyclic communication where the complete data packet is divided into multiple sub-packets for transmission over multiple cycles. Therefore the total data size for each device and the entire network is increased. The maximum number of link points for the cyclic communication cycle is increased to 128 points (64 words) per occupied station.

HMI
An abbreviation of the Human Machine Interface term. This device enables a human being to interface with a machine or equipment, using visual and interactive methods, such as touch switches, monitoring screens, etc.

Number of Devices
The number of Devices that are physically connected to a single CC-Link network.

Number of Occupied Stations
The number of stations (occupying one stations worth of memory area) used by a single slave device in a network. Between one to four stations can be set depending on the number of data required by the specific device. This is shown as 'occupying n station' in this manual. Important: A Remote I/O station can only occupy one (1) station.

Number of Stations
The total number of stations occupied on the CC-Link network. This may be different than the Number of Devices on the network, due to devices occupying multiple stations.

PLC
Programmable Logic Controller

RAS functions
Abbreviated from Reliability, Availability, and Serviceability.
A generic term used to describe the easy use of automated equipment.

Station number
This number is used to distinguish between stations on the CC-Link network. When assigning stations to the CC-Link network, unique station numbers (without duplication) must be used.

Terminating Resistor

Terminating resistors are attached at both ends of the network. This resistor reduces reflected wave at the termination point and prevents the disturbance of the data signal.

Cyclic Message Transmission

A message communication between two stations. This type of communication is beyond the standard cyclic communication and does not occur every cycle. The data in this type of communication is addressed to a specific station and not intended for use by the entire network. The Cyclic Message transmission data is embedded within the cyclic I/O data packet within the standard cyclic transmission. Cyclic Message transmission data occupies the data space normally reserved for the cyclic I/O data, therefore the cyclic I/O data is not included in the standard cyclic transmission when a Cyclic Message transmission occurs.

Transient Message Transmission

A non-cyclic message communication between two stations. This type of communication is beyond the standard cyclic communication and does not occur every cycle. The data in this type of communication is addressed to a specific station and not intended for use by the entire network. The Transient Message transmission data is appended to the regular cyclic I/O data within the standard cyclic transmission. The cyclic I/O data is still included in the standard cyclic transmission even when a Transient Message transmission occurs.

Trunk Line

The main cable running between the terminating resistors and connecting devices, this main cable does not including any branch lines. The length of the trunk line is length of that cable running between the terminating resistors, not including any branch lines.

Maximum Transmission Distance

Maximum transmission distance refers to the total cable length from terminating resistor to terminating resistor including any T-Branch Drop(s) or other multi-drop connection(s). The maximum transmission distance depends on communication speed and the type of *CC-Link* cable used. The maximum transmission distance is shown in Figure 1.1.

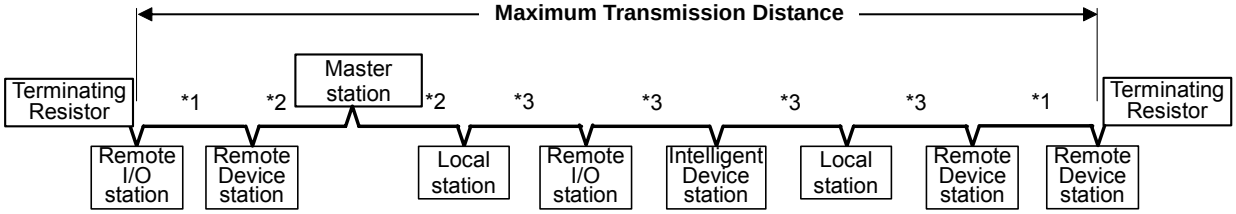


Figure 1.1 Transmission and Cable Distances

Station–to–Station Cable Length

Station–to–station cable length refers to the length of cable between one station and another station. The station–to–station cable length depends on station type, *CC-Link* Version and type of *CC-Link* cable. Shown in Figure 1.1 are individual cable lengths between devices (*1, *2, *3), these lengths are referenced throughout Section 2.

CC-Link version

Version 1.00	Original version
Version 1.10	The station-to-station cable length decreased to a minimum of 20 cm, improving wiring performance. *Device and cable specifications changed.
Version 2.00	System and per-station data volume increased to a maximum of 8 times. ***Cable specifications not changed from Ver.1.10.**

Chapter 2: *CC-Link* Implementation Specifications

2.1 *CC-Link* Version 1.10 & Version 2.0 Systems

This section is specific to those *CC-Link* compatible products that have satisfied the *CC-Link* Version 1.10 & Version 2.0 specification[4] and are identified as follows:

1) "*CC-Link*" logo (shown below) is attached to the device (Device body, Manual, Catalog, package etc)

CC-Link®

2) "*CC-Link* Version 1.10" or "*CC-Link* Version 2.0" is described within the packaging or documentation. (Documentation, Name plate, Catalog, Package, etc)

1) Standard *CC-Link* Version 1.10" or "*CC-Link* Version 2.0" Certified cable

Characteristic Impedance	110 Ω				
Station-to-Station cable length *1, *2, *3	≥ 20cm				
	Total Cable Distance & Communication Speed				
Communication speed	156 Kbps	625 Kbps	2.5 Mbps	5 Mbps	10 Mbps
Maximum Transmission Distance	1200 m	900 m	400 m	160 m	100 m

Table 2.1 *CC-Link* Version 1.10 & Version 2.0 Certified Cable

*1 Cable length between Remote I/O Stations, Remote Device Station and Remote I/O Station, and Remote Device Stations

*2 Cable length between Master and adjacent station

*3 Cable length between Local, Intelligent device and adjacent station

4 The CLPA recommends using *CC-Link* Version 1.10 or Version 2.0 certified products when requesting *CC-Link* compatible products.

Version 1.10 and Version 2.0 compatible products can be used together while still maintaining complete Version 1.10 and Version 2.0 compatibility. When the term '*CC-Link* Version 1.10 Certified Cable' or '*CC-Link* Version 2.0 Certified Cable' is used, it can refer to any of the certified standard (non high-flex) cables listed on the official CC-Link web site. (www.cclinkamerica.org)

In a system which uses different *CC-Link* Cable Version 1.10 types, the following rule applies:

Transmission Distance[5] = [Length of *CC-Link* Version 1.10 Cable (type a)] + …
[Length of *CC-Link* Version 1.10 Cable (type x)]

2) High Flexible *CC-Link* Version 1.10 Certified cable

Characteristic Impedance	110 Ω				
Station-to-Station cable length *1, *2, *3	≥ 20cm				
	Communication speed & Total Cable Distance				
	156 Kbps	625 Kbps	2.5 Mbps	5 Mbps	10 Mbps
'-7' High Flex Cable (70%)	840 m	630 m	280 m	112 m	70 m
'-5' High Flex Cable (50%)	600 m	450 m	200 m	80 m	50 m
'-3' High Flex Cable (30%)	360 m	270 m	120 m	40 m	30 m

Table 2.2 *CC-Link* Version 1.0 High Flexible Cable

Three different types of high flex cables are available: '-7' (70%); '-5' (50%); '-3' (30%)

In a system, which uses both *CC-Link* Version 1.10 Certified Cable and *CC-Link* Version 1.10 High Flexible Cable, the following rule applies:

Transmission Distance[5] = [Length of *CC-Link* Version 1.10 Cable] +
([Length of '-7' product Cable] / 0.7) + ([Length of '-5' product Cable] / 0.5) +
([Length of '-3' product Cable] / 0.3)

This equation can also be used if a combination of, but not all of the cables are used. Set the cable length value of the cable(s) that is not used to zero.

[5] The calculated Transmission Distance can not exceed the Maximum Transmission Distance according to Table 2.1 *CC-Link* Version 1.10 Certified Cable.

2.2 *CC-Link* Version 1.0 System

If any device, including the cable, is *CC-Link* Version 1.0 compatible, follow these requirements.

Characteristic Impedance				100 Ω				
				Station-to-Station cable length				
Between Master/Local, Intelligent device station and Remote I/O, Remote device station *2, *3				≥ 1 m (Independent of Communication Speed)				
Between Master/Local, Intelligent device station and Local, Intelligent Device stations. *2, *3				≥ 2 m (Independent of Communication Speed)				
	Station-to-Station cable length							
Communication speed	156 Kbps	625 Kbps	2.5 Mbps	5 Mbps		10 Mbps		
Between Remote I/O, Remote device stations and Remote I/O, Remote device stations (shortest cable) *1	≥ 30 cm	≥ 30 cm	≥ 30 cm	≥ 60 cm	30 - 59 cm	≥ 1 m	60 - 99 cm	30 - 59 cm
Maximum Transmission Distance	1200 m	600 m	200 m	150 m	110 m	100 m	80 m	50 m

Table 2.3 *CC-Link* Version 1.0 Certified Cable

2.3 **Combined Versions System:**

If any product, including the cable, is an earlier version (i.e. Version 1.0) follow the specification for the device with the lowest revision level. Version 1.0 cable from different manufacturers cannot be used together in the same system. It is not recommended to use both *CC-Link* Version 1.10 Cable and *CC-Link* Version 1.0 Cable on the same system, although it is allowed.

If a system, which uses both *CC-Link* Version 1.10 Cable and *CC-Link* Version 1.0 Cable, then follow the specifications for the *CC-Link* Version 1.0 Cable installation.

It is not allowed to use both *CC-Link* Version 1.0 Cable and *CC-Link* Version 1.10 High Flexible Cable on the same system.

2.4 **Branch Connection**

1) **Repeater is not used**

When a repeater is not used, a branch line (T-Branch) can not branch off from another branch line. When a repeater is not used, and a T-Branch branch line is incorporated into the network configuration, the maximum network speed is 625kbps.

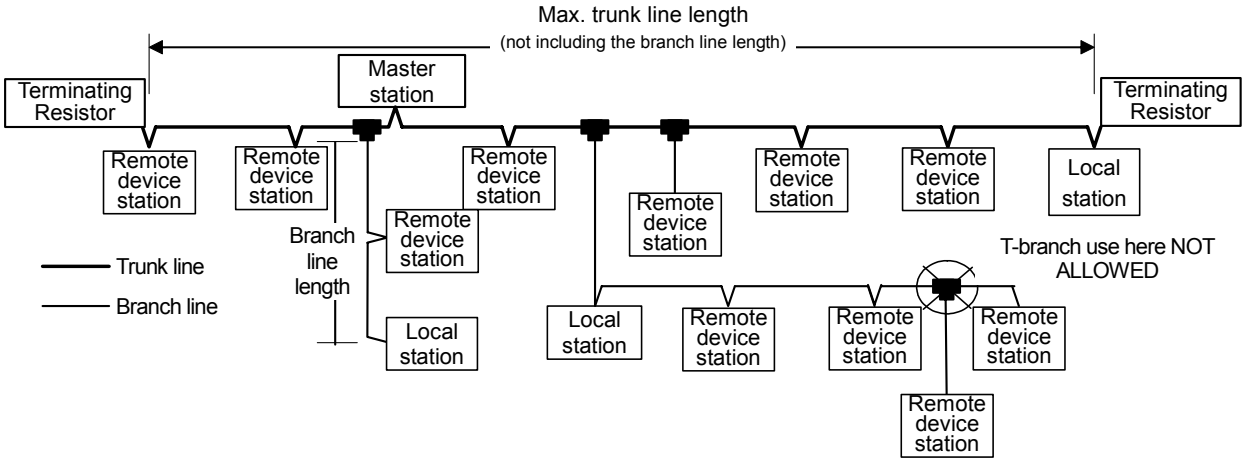


Figure 2.1 Branch Connection (When repeater is NOT used)

Communication speed	156kbps	625kbps	2.5M, 5M & 10M network speeds not allowed
	Station-to-Station Cable Length		
Between master and local stations, intelligent device station, and adjacent stations *2 *3	≥ 1m		For a system configured only with remote I/O stations and remote device stations
	≥ 2m		For a system configuration that contains local stations or intelligent device stations
Between remote I/O stations and remote device stations *1	≥ 30cm		
Maximum No. of stations connected per branch line	6		See communication specification for the total number of connected stations
Maximum trunk line length	500m	100m	The length of the cable between terminating resistors. The branch line length is not included.
Total branch line length	200m	50m	Total length of all branch lines.
Maximum individual branch line length	8 m		Cable length per branch line
Total transmission distance	700 m	150 m	(Trunk line length + all branch line lengths)

Table 2.4 Communication Speed and Cable Length
For Branch Connection (When repeater is NOT used)

2) **Repeater is used**

Using a repeater enables the user to connect a branch at every communication speed. Using a repeater also allows the user to extend cable transmission distance (see tables 2.5, 2.6 & 2.7). If a repeater is used and a branch line is incorporated into the network configuration using only a T-Branch connector (not a powered repeater), the maximum network speed is again only 625kbps. Only if all branch line connections incorporate a repeater, is the network capable of operating at all communication speeds.

NOTE: When repeater is used, the procedure is not specific to *CC-Link*; it depends upon the type of repeater used. The following indicates *CC-Link* product specific requirements.

NOTE: Depending upon the Repeater module, a Terminating Resistor may be necessary at the end of the branch connection, see the Repeater module specifications for connection requirements.

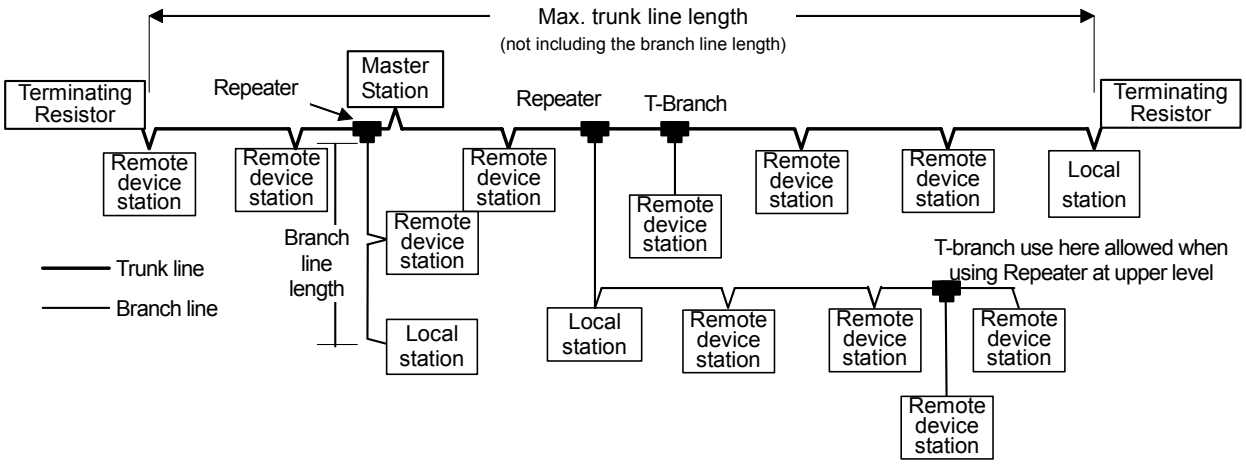


Figure 2.2 Branch Connection (When repeater is used)

Note in Figure 2.2 that the network contains a non-powered T-Branch connection, therefore according to the network requirements; the maximum network operating is 625k. Table 2.4 Communication Speed and Cable Length requirements still apply to this network because of the non-powered T-Branch connections.

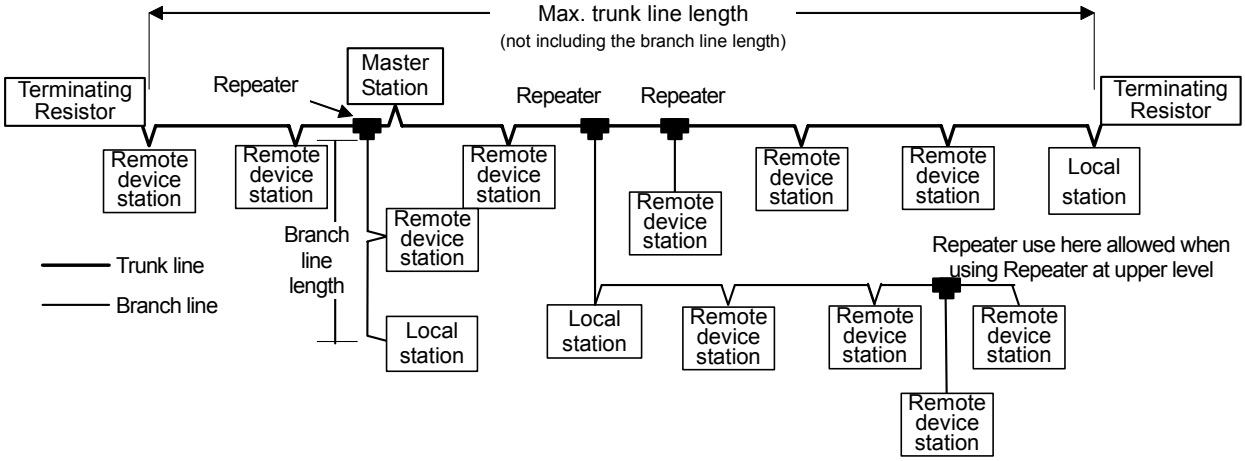


Figure 2.3 Branch Connection (When repeater is always used)

Note in Figure 2.3 that the network contains all powered repeaters at the T-Branch connections, therefore according to the network requirements, the network may operate at any speed up to 10M.

Communication speed	156Kbps	625Kbps	2.5Mbps	5Mbps	10Mbps
Maximum No. of stations connected to the branch line (Per branch)	No limit (Within No. of *CC-Link* specification)				
Maximum trunk line length	Total Trunk and Branch length not to exceed Transmission distance of *CC-Link* system				
Maximum branch line length	Total Trunk and Branch length not to exceed Transmission distance of *CC-Link* system				
Max. No. of station per segment [6]	10				
Total transmission distance (Trunk line length + branch line length) Version 1.10 cable	13200m	9900m	4400m	1760m	1100m
Total transmission distance (Trunk line length + branch line length) Version 1.0 cable	13200m	6600m	2200m	1650m	1100m

Table 2.5 Communication Speed and Cable length
For Branch Connection (When repeater is used)

[6] Segment refers to the total number of *CC-Link* system devices on a branch from terminating resistor to terminating resistor on multi-drop system when using a repeater.

Communication speed	156Kbps	625Kbps	2.5Mbps	5Mbps	10Mbps
Station to station cable length	Same as *CC-Link* specification				
Maximum No. of stations connected to the branch line (Per branch)	Not limited (remain within *CC-Link* specification)				
Maximum trunk line length	Total Trunk and Branch length not to exceed Transmission distance of *CC-Link* system				
Maximum branch line length	Total Trunk and Branch length not to exceed Transmission distance of *CC-Link* system				
Maximum optical fiber cable length between repeater(s)	500m (SI optical fiber cable) 1000m (QSI optical fiber cable)				
Max. No. of stations per segment [6]	3				
Total transmission distance (QSI optical cable)	7800m	6600m	4600m	3640m	3400m

Table 2.6 Communication Speed and Cable Length (Optical Repeater module (SI/QSI))

Communication speed	156Kbps	625Kbps	2.5Mbps	5Mbps	10Mbps
Station to station cable length	Same as *CC-Link* specification				
Maximum No. of stations connected to the branch line (Per branch)	Not limited (remain within *CC-Link* specification)				
Maximum trunk line length	Total Trunk and Branch length not to exceed Transmission distance of *CC-Link* system				
Maximum branch line length	Total Trunk and Branch length not to exceed Transmission distance of *CC-Link* system				
Between repeater max. optical fiber cable length	2000m				
Max. No. of stations per segment [6]	2				
Total transmission distance (QSI optical cable)	7600m	6700m	5200m	4480m	4300m

Table 2.7 Communication Speed and Cable Length (Optical repeater module (GI))

3) **Star Configuration**

A Star Configuration is considered a modification of a branch connection; with multiple connections at one point where the interval between branch connections is zero. A non-powered T-Branch hub at the multiple branch connection point may be used for network speeds less than 2.5Mbps. The use of a powered repeater hub at the multiple branch connection point is required for network speeds greater than 625kbps. Using a powered repeater also allows the user to extend cable transmission distance (see tables 2.5, 2.6 & 2.7).

NOTE: Depending upon the Repeater hub module, a Terminating Resistor may be necessary at the end of the branch connection, see the Repeater module specifications for Terminating Resistor connection requirements.

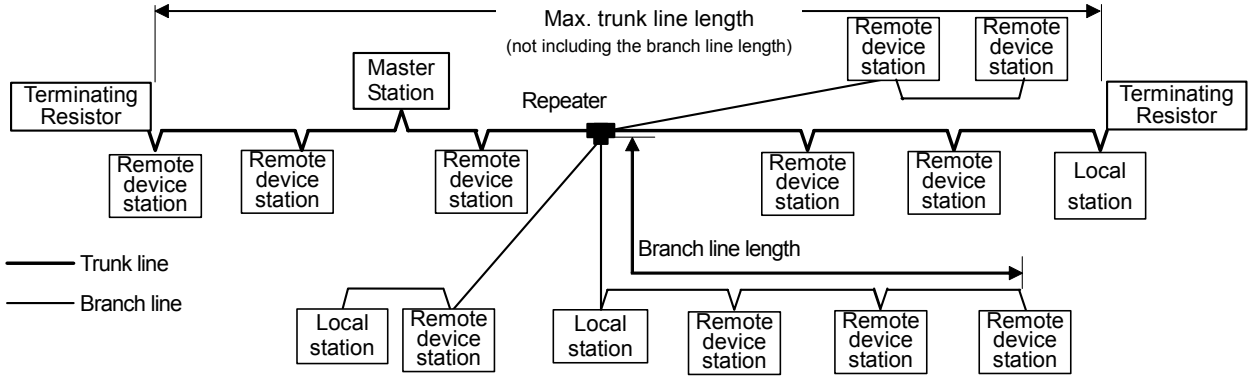


Figure 2.4 Star Configuration Connections

2.5 **Number of Connected Network Devices**

The number of devices that can be connected to the *CC-Link* network varies, depending upon the version of the devices on the system (Version 1.1, Version 2, etc…), the type of device (remote I/O, Remote Device, Intelligent, etc…) as well as the number of occupied stations for each device.

1) **Version 1.10 (or earlier) System**

The two calculations for determining the number of allowable *CC-Link* devices in a version 1.10 system are as shown below. Both of the equations must be satisfied for the network to function properly.

(1 χ a) + (2 χ b) + (3 χ c) +(4 χ d) ≤ 64 stations
- a: Number of modules occupying 1 station
- b: Number of modules occupying 2 stations
- c: Number of modules occupying 3 stations
- d: Number of modules occupying 4 stations

(16 χ A) + (54 χ B) + (88 χ C) ≤ 2304
- A: Number of Remote I/O stations (maximum of 64)
- B: Number of Remote Device stations (maximum of 42)
- C: Number of Local and Intelligent Device stations (maximum of 26)

2) **Version 2.0 System**

The four calculations for determining the number of allowable *CC-Link* devices in a version 2.0 system are as shown below. Each of the four equations must be satisfied for the network to function properly.

(a+a2+a4+a8) + [(b+b2+b4+b8)χ2] + [(c+c2+c4+c8)χ3] + [(d+d2+d4+d8)χ4] ≤ 64

[(aχ32) + (a2χ32) + (a4χ64) + (a8χ128)] + [(bχ64) + (b2χ96) + (b4χ192) + (b8χ384)]
+ [(cχ96) + (c2χ160) + (c4χ320) + (c8χ640)]
+ [(dχ128) + (d2χ224) + (d4χ448) + (d8χ896)] ≤ 8192

[(aχ4) + (a2χ8) + (a4χ16) + (a8χ32)] + [(bχ8) + (b2χ16) + (b4χ32) + (b8χ64)]
+ [(cχ12) + (c2χ24) + (c4χ48) + (c8χ96)] + [(dχ16) + (d2χ32) + (d4χ64) + (d8χ128)]
≤ 2048

	Number of modules occupying			
	1 station	2 stations	3 stations	4 stations
Single setting (1χ)	a	b	c	d
Double setting (2χ)	a2	b2	c2	d2
Quadruple setting (4χ)	a4	b4	c4	d4
Octuple setting (8χ)	a8	b8	c8	d8

(16 χ A) + (54 χ B) + (88 χ C) ≤ 2304
- A: Number of Remote I/O stations (maximum of 64)
- B: Number of Remote Device stations (maximum of 42)
- C: Number of Local and Intelligent Device stations (maximum of 26)

2.6 *CC-Link* Scan Time Calculations

1) Link Scan Time (LS) without transient communications

This is the calculation to determine the estimated Link Scan Time (LS) of a CC-Link network where the network does not contain any faulty stations[7]:

LS = BT {29.4 + (NI * 4.8) + (NW * 9.6) + (N * 32.4) + (ni * 4.8) + (nw * 9.6)} + ST [µs]

This is the calculation to determine the estimated Link Scan Time (LS) of a CC-Link network where faulty stations exist (including error invalid stations and temporary error invalid stations)[7]:

LS = BT {29.4 + (NI * 4.8) + (NW * 9.6) + (N * 32.4) + (ni * 4.8) + (nw * 9.6)} + ST + {# communication faulty stations * 48 * BT * #retries} [µs]

BT: Constant (Transmission speed)

Transmission speed	156kbps	625kbps	2.5Mbps	5Mbps	10Mbps
BT	51.2	12.8	3.2	1.6	0.8

NI: Last station number (including number of occupied stations although excluding number of reserved stations)

NW: Last Remote Device, Intelligent Device or Local station (Including number of occupied stations although excluding number of reserved stations)

These must be a multiple of 8.

Last station number	1 to 8	9 to 16	17 to 24	25 to 32	33 to 40	41 to 48	49 to 56	57 to 64
NI, NW	8	16	24	32	40	48	56	64

N: Number of connected stations (excluding reserved stations)
ni: a + b + c (excluding reserved stations)
nw: b + c (excluding reserved stations)
ST: Constant (It should be the largest value from ① to ③.
When b = 0, ② should be ignored and, when c = 0, ③ should be ignored.)
① 800 + (a * 15)
② 900 + (b * 50)
③ When c < 26: 1200 + (c * 100)
When c > 26: 3700 + {(c - 26) * 25}

a: Total number of occupied stations for Remote I/O stations
b: Total number of occupied stations for Remote Device stations
c: Total number of occupied stations for Intelligent Device (including Local) stations

[7] This scan time calculation does not include time for transient communication

2) **Link Scan Time (LSt) with transient communications**

This is the calculation to determine the estimated Link Scan Time including transient transmissions (LSt) of a CC-Link network where the network does not contain any faulty stations:

LSt = BT {29.4 + (NI * 4.8) + (NW * 9.6) + (N * 32.4) + (ni * 4.8) + (nw * 9.6)} + ST + BT (180 + 40.8 * ni) [µs]

This is the calculation to determine the estimated Link Scan Time including transient transmissions (LSt) of a CC-Link network where faulty stations exist (including error invalid stations and temporary error invalid stations):

LSt = BT {29.4 + (NI * 4.8) + (NW * 9.6) + (N * 32.4) + (ni * 4.8) + (nw * 9.6)} + ST + BT (180 + 40.8 * ni) + {# communication faulty stations * 48 * BT * #retries} [µs]

Chapter 3: *CC-Link* Accessories

3.1 *CC-Link* Certified Cable Specifications

Specifications for *CC-Link* certified cables can be obtained from the CC-Link Partner Association web site (www.cclinkamerica.org).

3.2 Terminating Resistor

The specification of the Terminating Resistor for *CC-Link* is as follows:

Cable	Terminating Resistor
CC-Link Version 1.0 Cables	110 Ω ±5% ½ W
CC-Link Version 1.10 High Flexible Cable	110 Ω ±5% ½ W
CC-Link Version 1.10 Cables	110 Ω ±5% ½ W

Table 3.1 Terminating Resistor Specifications

3.3 Power Supply

Power supply for *CC-Link* communication only is not necessary. Refer to the power supply specification of the specific partner vendor for the power requirements of the specific product being used.

3.4 **Connector**

Connector specifications for use between *CC-Link* cables are as follows. Note any of these can be used for connection from control panel to outside.

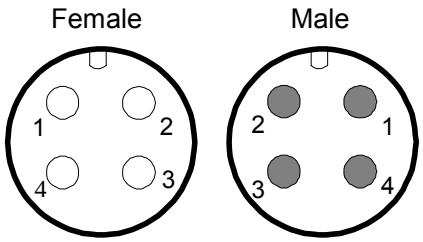
	M12 (Micro) type	Contact CLPA[8] Pin position
Resistance of conductor	≤ 5m Ω	
Thickness of Gold plate	≥ 0.1 μm	
Type of water proof	IP67 (JIS C 0920)	
Pin position	Pin 1: SLD Pin 2: DB (White) Pin 3: DG (Yellow) Pin 4: DA (Blue)	

Table 3.2 Specification of M12 (Micro) types (4 conductor)

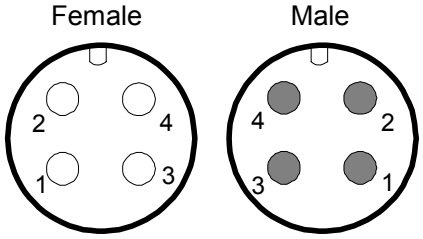
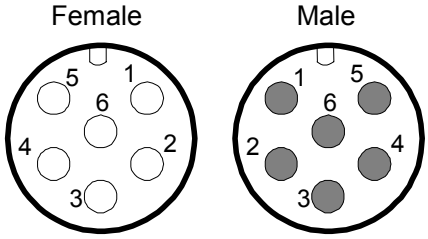
	M12 (Mini) type	Contact CLPA[8] Pin position
Resistance of conductor	≤ 5m Ω	
Thickness of Gold plate	≥ 0.1 μm	
Type of water proof	IP67 (JIS C 0920)	
Pin position	Pin 1: SLD Pin 2: DB (White) Pin 3: DG (Yellow) Pin 4: DA (Blue)	
Pin position	Pin 1: DA (Blue) Pin 2: DB (White) Pin 3: DG (Yellow) Pin 4: 24 VDC Pin 5: 24 GND Pin 6: SLD	

Table 3.3 Specification of M12 (Mini) types (4 conductor & 6 conductor)

[8] Contact partner vendor as described in CC-Link products catalog published by CLPA or on the CLPA web site (http://www.cclinkamerica.org).

<table>
<tr><td></td><td>Connector type</td><td rowspan="4">Contact

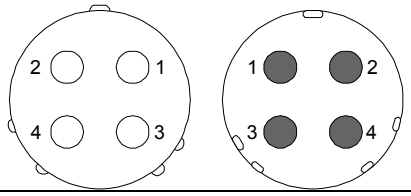
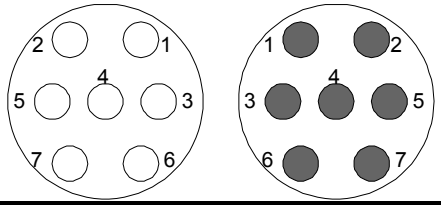
CLPA[8]</td></tr>
<tr><td>Contact resistance</td><td>≤ 5m Ω</td></tr>
<tr><td>Thickness of gold plate</td><td>≥ 0.5 μm</td></tr>
<tr><td>Type of Water proof</td><td>IP67 (JIS C 0920)</td></tr>
<tr><td>Conductors</td><td colspan="2">Pin position</td></tr>
<tr><td>4 conductors</td><td>Pin 1: DA (Blue)
Pin 2: DB (White)
Pin 3: DG (Yellow)
Pin 4: SLD</td><td>Female Male
  </td></tr>
<tr><td>7 conductors
(with power conductor)</td><td>Pin 1: DA (Blue)
Pin 2: DB (White)
Pin 3: DG (Yellow)
Pin 4: N.C.
Pin 5: +24V
Pin 6: 24G
Pin 7: SLD</td><td>Female Male
  </td></tr>
</table>

Table 3.4 Waterproof Connector type (4 conductor, 7 conductor)

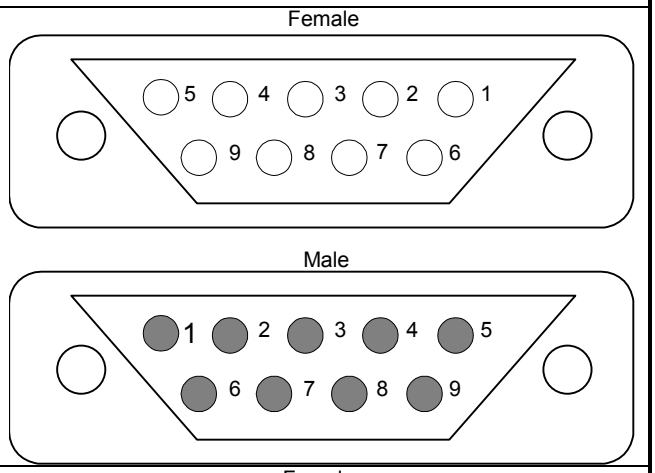
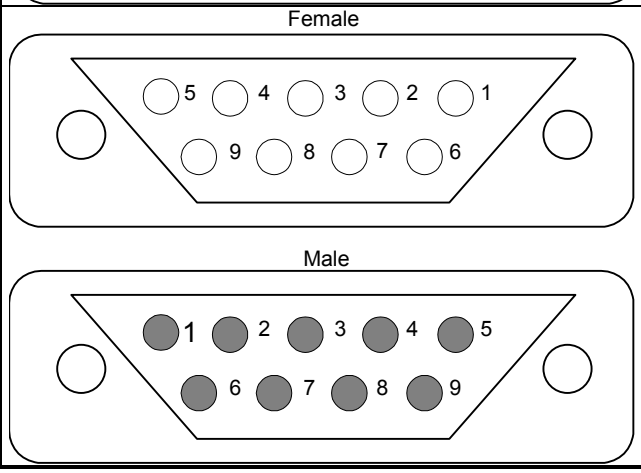
	Connector type	Contact
Contact resistance	≤ 5m Ω	CLPA[9]
Thickness of gold plate	≥ 0.5 μm	
Conductors	Pin position	
4 conductors	Pin 1: N.C. Pin 2: N.C. Pin 3: DA (Blue) Pin 4: DG (Yellow) Pin 5: N.C. Pin 6: N.C. Pin 7: N.C. Pin 8: DB (White) Pin 9: N.C. Note: connect shield to metal outer shell of 9–Pin D–Shell	
6 conductors (with power conductor)	Pin 1: +24V Pin 2: N.C. Pin 3: DA (Blue) Pin 4: DG (Yellow) Pin 5: N.C. Pin 6: 24G Pin 7: N.C. Pin 8: DB (White) Pin 9: N.C. Note: connect shield to metal outer shell of 9–Pin D–Shell	

Table 3.5 9–Pin D–Shell Connector type

Chapter 4: Layout Design Considerations

4.1 Minimum Bending Radius of Cable

Keep the minimum bending radius as stated when using *CC-Link* Cable. Not maintaining the minimum bending radius may cause breakage or other damage to the cable.

	Minimum radius at cable turns
During Installation	≥ 10x outside diameter of cable
After Installation (during operation)	≥ 4x outside diameter of cable

4.2 Tension

Keep tension on cable as small as possible. If the tension on the cable is too great, it may cause a disconnection at the connector, breaking the cable, or the possibility of not maintaining the cable characteristics. Avoid twisting cable when releasing/removing cable from storage.

At Connector location: Keep the allowable tension to the following minimum:
Allowable tension[9] (N) = 68.6 (Unit permissible tension of conductor N/mm^2) x (Number of cable cores) x (sectional area of conductor)

At standard cable location: Design cable layout and length such that no additional tension is created within the cable. Design cable and connections at their most suitable length.

4.3 Radiated - Induced Noise

In order to prevent induced noise, keep communication cable as far away (electrically and mechanically) from other cables (power line, etc.) as possible. It is recommended that the communication cable be kept a minimum distance of ≥ 100mm from any power line. Avoid communication cable setup within the same conduit or set in parallel with any external power wiring (120VAC). Avoid communication cable setup on a control panel where high voltage devices are mounted. If necessary, attach a surge absorber on devices that radiate noise. Do not connect non *CC-Link* compatible products (lightning arrestor, etc) with *CC-Link* communication line. This causes digital noise reflection and/or attenuation and communication failures. If it becomes necessary to cross the *CC-Link* communication cable and power cables, cross the cables at right angles to each other to reduce any radiated or induced noise.

[9] Presented by communication cable expert committee at The Japanese Electric Wire & Cable Makers' Association. "Investment Vol. #117, How to select and use communication cable" in Chapter 4 (Section 4.2). Permissible tension of cable (April 1994).

4.4 **Connection with a Non-Stationary Device**

Use the *CC-Link* Version 1.0 High Flexible Cable when connecting to devices which potentially move or have a moving part. Implement the following design considerations in order to prevent premature cable failure.

- Design cable binding such that the fastener will not scratch the cable coating.
- Design should include location and type of fastener.
- Avoid fastening cable where it moves.
- Avoid a design which twists and un-twists the cable.
- Design and install cable length to avoid both excess tension and excess cable.
- Avoid bending cable more than the minimum bending radius of the cable.

Chapter 5: Network Layout Design Guide

5.1 **Design Selection Process**

Prior to designing the *CC-Link* Network layout, choose which network property is most important to the network setup. The selection properties to choose from are:

- Network Communication Speed
- Transmission Distance (either Maximum or Station to Station)
- Specific *CC-Link* cable type

If the selection is the Network Communication Speed proceed to Section 5.2;
If the selection is Transmission Distance proceed to Section 5.3; or
If the selection is a Specific *CC-Link* cable type proceed to Section 5.4.
Take into account any necessary layout design considerations noted in Chapter 4.

5.2 **Network Transmission Speed Selection**

1) Select a desired Network Transmission Operational Speed according to the requested *CC-Link* Network Operational requirements.

2) Prepare a preliminary network layout with desired cable distances (both the Maximum Transmission Distance and Station to Station cable lengths), taking into account the desired *CC-Link* Transmission Operational Speed.

3) Select an approved *CC-Link* certified cable, remembering to account for the desired *CC-Link* Operational Speed and preliminary network layout.

4) Once the Speed, Distance and Cable have been selected, verify the selections meet the *CC-Link* Network Requirements. Use the tables in Chapter 2, according to the selected cable, to verify the selections. Depending upon the selections and requirements, a branch – with or without a repeater – may be necessary. If the layout and selections do not meet the *CC-Link* Requirements, a modification of one of the network selections will be necessary. Once a network selection has been modified, repeat the verification process. If the *CC-Link* requirements are still not met, it may be necessary to start from the beginning of the Design Selection Process, modifying more than one selection.

5) Once the design and layout meet all the *CC-Link* Network requirements, the Network Design Layout process is complete. Proceed to Section 6.

5.3 **Transmission Distance Selection**

1) Select a desired Transmission Distance (either the Maximum or Station to Station) according to the requested *CC-Link* Network Operational requirements.

2) Prepare a preliminary network layout with desired cable distances (both the Maximum Transmission Distance and Station to Station cable lengths).

3) Select either the certified cable or the network speed.

   - Select an approved *CC-Link* Certified cable, remembering to account for the preliminary network layout. Or…

   - Select a Network Transmission Operational Speed, remembering to account for the preliminary network layout.

4) Select either the network speed or the certified cable – depending upon the selection in Step 3.

   - If the certified cable was selected in Step 3, then select a desired Network Transmission Operational Speed according to the preliminary network layout and selected cable. Or…

   - If the speed was selected in Step 3, then select an approved *CC-Link* certified cable, remembering to account for the preliminary network layout and selected speed.

5) Once the Distance, Cable, and Speed have been selected, verify the selections meet the *CC-Link* Network Requirements. Use the tables in Chapter 2, according to the selected cable, to verify the selections. Depending upon the selections and requirements, a branch – with or without a repeater – may be necessary. If the layout and selections do not meet the *CC-Link* Requirements, a modification of one of the network selections will be necessary. Once a network selection has been modified, repeat the verification process. If the *CC-Link* requirements are still not met, it may be necessary to start from the beginning of the Design Selection Process, modifying more than one selection.

6) Once the design and layout meet all the *CC-Link* Network requirements, the Network Design Layout process is complete. Proceed to Section 6.

5.4 **Specific *CC-Link* Cable Selection**

1) Select an approved *CC-Link* certified cable according to the requested *CC-Link* Network Operational requirements.

2) Prepare a preliminary network layout with desired cable distances (both the Maximum Transmission Distance and Station to Station Cable Lengths), taking into account the desired *CC-Link* cable.

3) Select a Network Transmission Operational Speed, remembering to account for the preliminary network layout and the selected *CC-Link* cable.

4) Once the Cable, Distance, and Speed have been selected, verify the selections meet the *CC-Link* Network Requirements. Use the tables in Chapter 2, according to the selected cable, to verify the selections. Depending upon the selections and requirements, a branch – with or without a repeater – may be necessary. If the layout and selections do not meet the *CC-Link* Requirements, a modification of one of the network selections will be necessary. Once a network selection has been modified, repeat the verification process. If the *CC-Link* requirements are still not met, it may be necessary to start from the beginning of the Design Selection Process, modifying more than one selection.

5) Once the design and layout meet all the *CC-Link* Network requirements, the Network Design Layout process is complete. Proceed to Section 6.

Chapter 6: Cable Preparation Guide

6.1 **Remove *CC-Link* Cable Coating**

Remove *CC-Link* cable coating (being careful not to scratch shield mesh), this should be about 50mm.

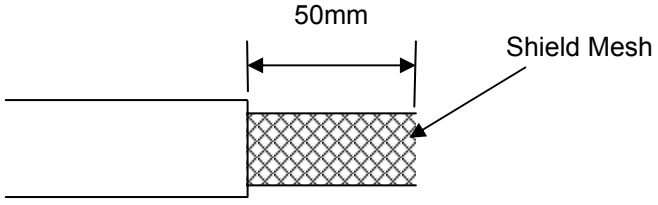


Figure 6.1 Removed Cable Coating

6.2 **Process *CC-Link* Cable Shield**

In addition to the signal wires, there is one bare drain wire (stranded wire mesh and bare wire).

Connect shield mesh and drain wire together to create one wire. Coat both wires with isolation tube.

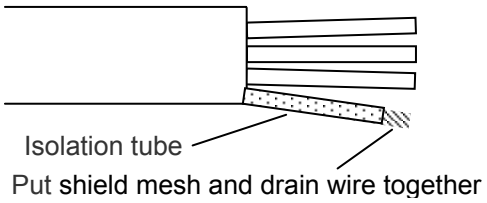


Figure 6.2 Process Shield

6.3 Remove *CC-Link* Cable Signal Wire Coating

Remove coat from each signal wire according to size of Crimp connector, this should be about 3mm.

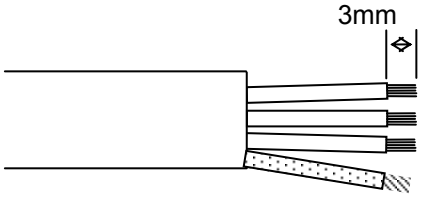


Figure 6.3 Remove signal wire coat

6.4 Attach *CC-Link* Cable to Crimp Connector

Attach a crimp style connector to each signal wire and the shield (Drain wire). Use the appropriate pressure to attach the connector to each wire.

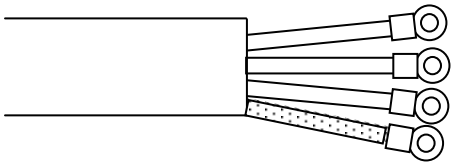


Figure 6.4 Crimp Style Connector

6.5 Signal Conductor Labels

Label each signal wire (including the Ground) according to Table 6.1.

Terminal	Signal conductor
DA	Blue
DB	White
DG	Yellow
SLD	Ground (shield)

Table 6.1 Terminal and Signal Conductor Labels

Chapter 7: Cable Installation Guide

7.1 **Connect Terminating Resistor to *CC-Link* Cable**

Connect the appropriate Terminating Resistor, as shown in Table 3.1 Terminating Resistor Specification (Page 18), at both ends of the network, between DA and DB, as shown in Figure 7.1 below. The symbol “TR” represents the Terminating Resistor on each end of the network.

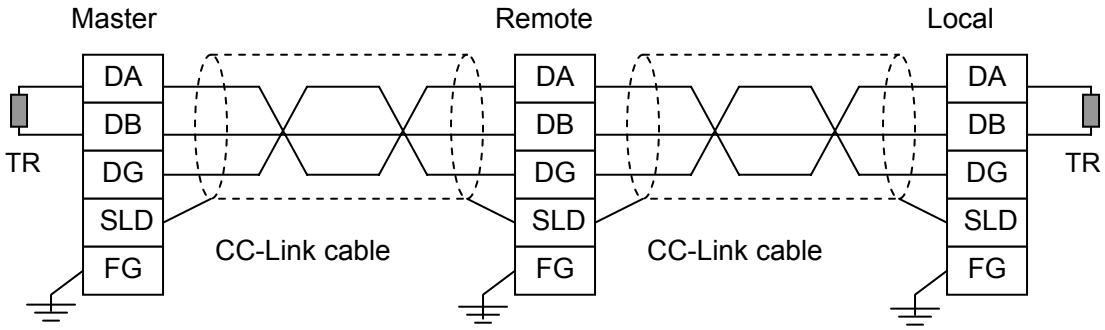


Figure 7.1 Terminating Resistor Connection

1) **Branch Connection**

1) When repeater is not used (T-Branch connection)

Connect Terminating Resistor as noted at each end of the trunk line. The resistor is connected between DA & DB.

2) When powered repeater is used

Use Terminating Resistor included in Repeater module and do not connect an additional resistor at the repeater module. Connect Terminating Resistor at each end of the trunk line. Depending upon the Repeater module, a Terminating Resistor may be necessary at the end of the branch connection, see the Repeater module specifications for Terminating Resistor connection requirements.

3) Star Configuration

Use the same rules designed for when a powered repeater is used, see above.

7.2 **Connect Shield Line with Ground**

Connect both edges of shield wire for *CC-Link* cable with “SLD” of each module. Connect “FG” of each module independently. Always ground the FG terminals to the protective ground conductor. (Ground resistance: ≤ 100 Ω)

If an independent ground is not used, use common ground according to the Figure 7.2. ”SLD” and “FG” of each module are connected together inside of the module. Refer to Figure 7.2 about how to connect to the proper ground point.

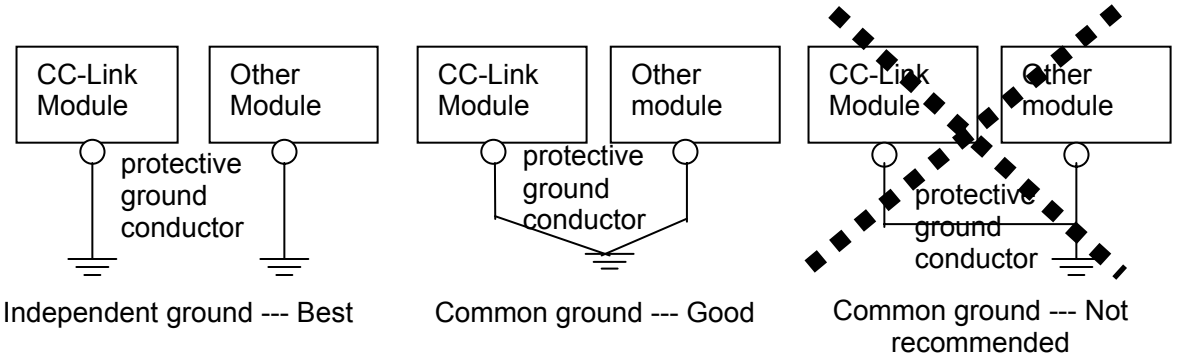


Figure 7.2 Shield Ground Connection

7.3 **Ground Types and Supplemental Information**

1) Grounding types

1) Protective Grounding – protects from electric shocks and ground faults
2) Functional Grounding – ensures communication reliability

The grounding of the shield wire of the CC-Link dedicated cable is functional grounding to ensure communication reliability.

2) Supplements to grounding methods

For protective grounding or functional grounding, use independent grounding (Figure 7.3) or common grounding where cables are wired individually up to the grounding point (Figure 7.4).

In the case of common grounding (Figure 7.4), noise may enter the functional grounding from the protective grounding, making CC-Link communication instable. Especially when common grounding is used for the protective grounding and functional grounding (shield wire of CC-Link dedicated cable) of drive devices such as inverter and servo, the possibility of instable communication will increase.

1) For the ground wire of the functional grounding, use a copper wire with a diameter of 1.6mm or more diameter or 2mm^2 or more.
2) For the ground wire up to the grounding point, it is recommended to use the thickest possible copper wire (14mm^2 or more recommended) and as short a distance as possible.
3) Do not tie the ground wire of the functional grounding together with the protective grounding wire, power cable, etc… (Noise may enter the ground wire, making communication unstable).

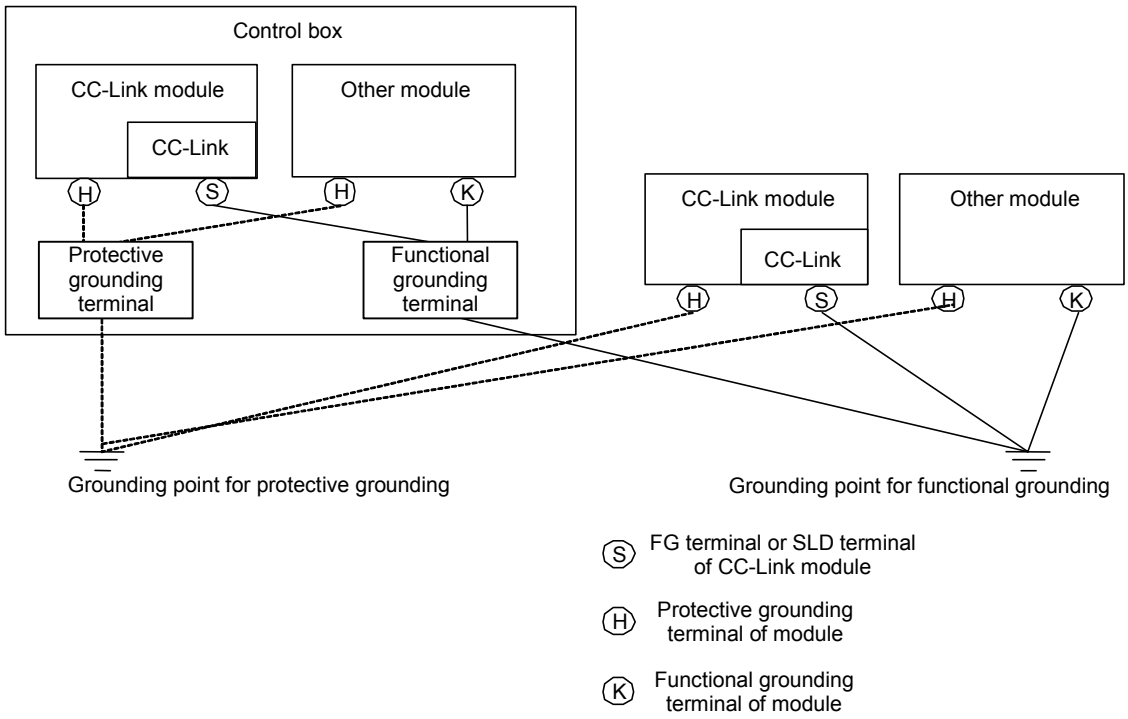


Figure 7.3 Independent grounding example

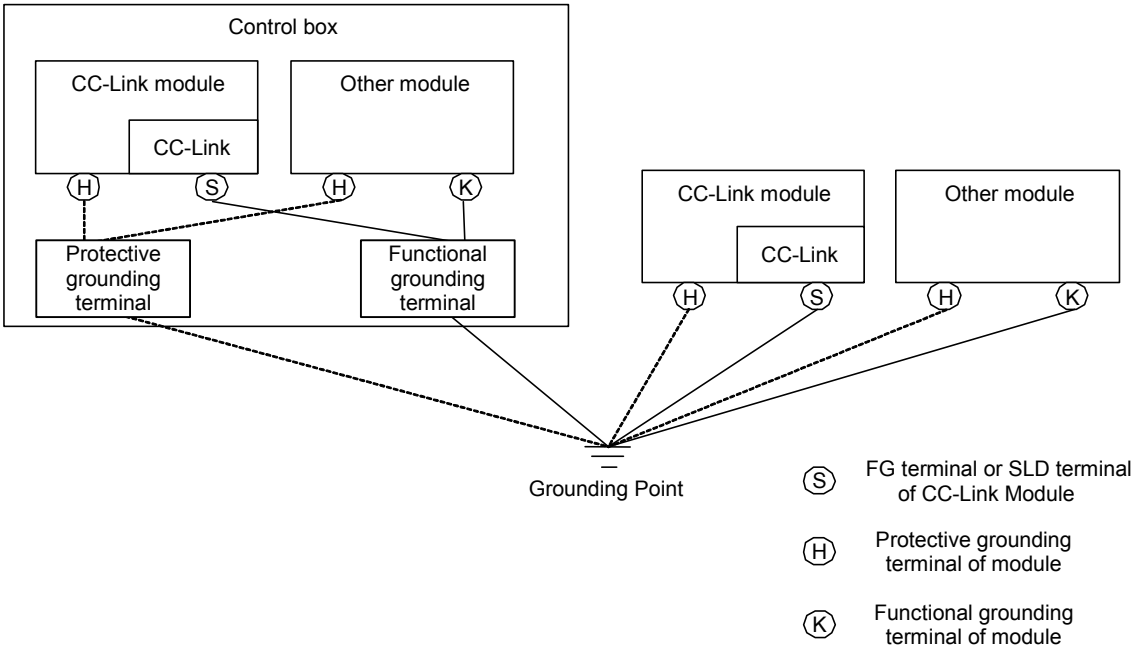


Figure 7.4 Common grounding example

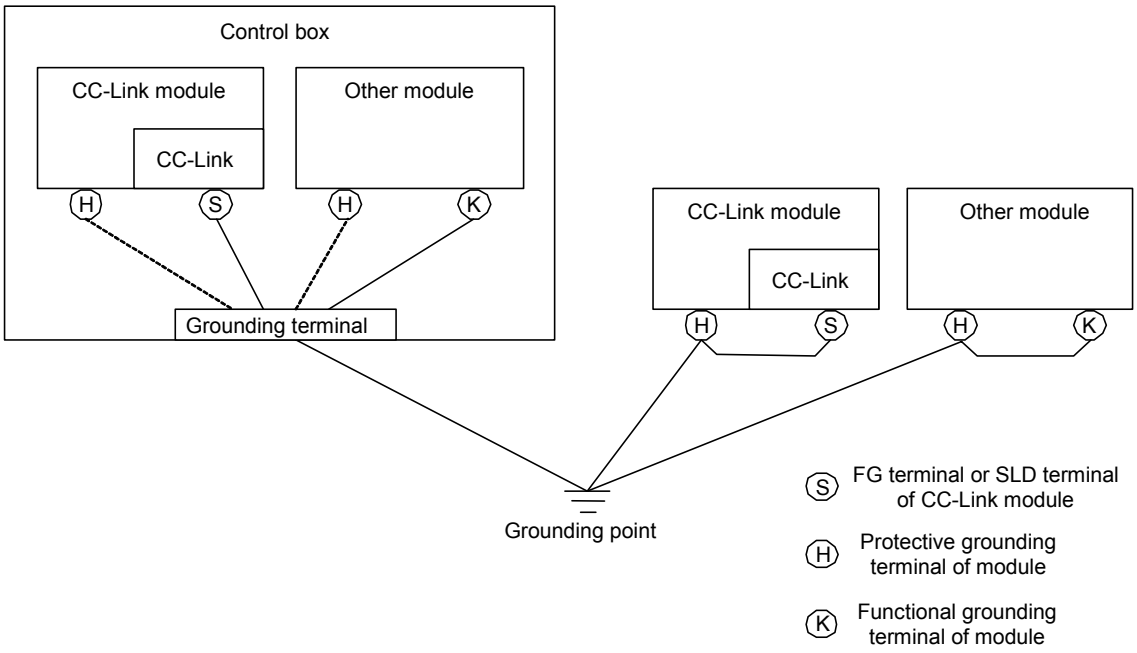


Figure 7.5 Common grounding example

3) Wiring example of common grounding

The following shows the wiring example of common grounding.

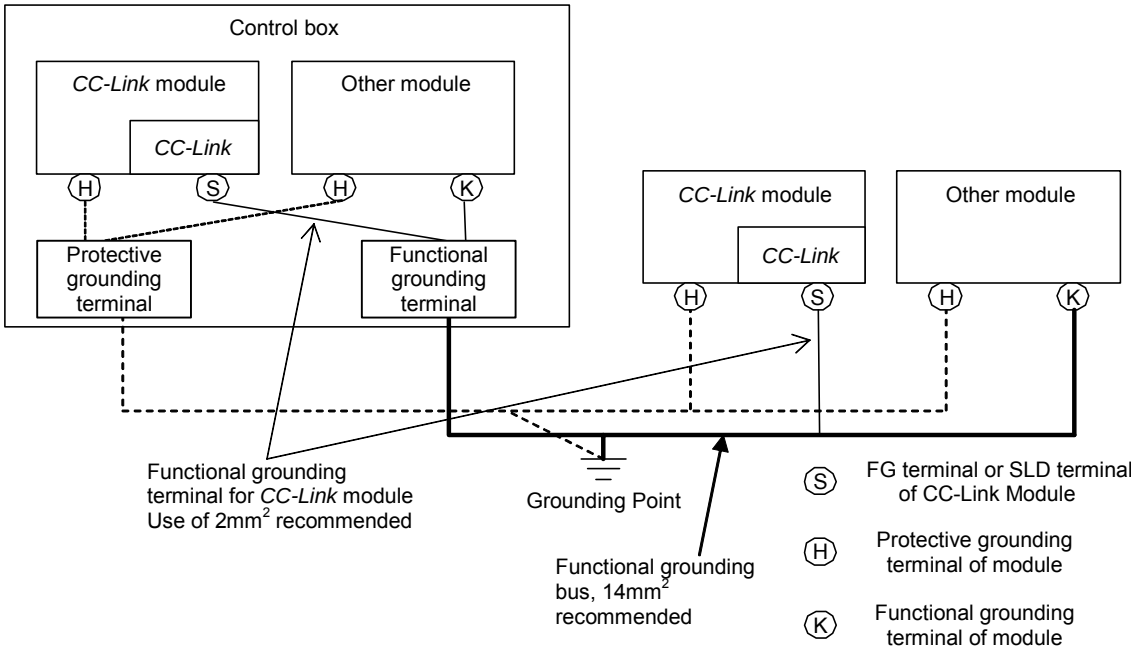


Figure 7.6 Common grounding example

CC-Link Partner Association (CLPA)		
Location	Headquarters - Japan	North America
Address	Chusanren Building 1F, 3-12-13, Shirakabe, Higashi-Ku	500 Corporate Woods Parkway
City, Country	Nagoya-Shi, Aichi, Japan 461-0011	Vernon Hills, IL 60061 - USA
Telephone	+81-52-936-6050	(847) 478-2341 or (847) 478-2647
FAX	+81-52-936-6005	(847) 876-6611
URL	http://www.cc-link.org/	http://www.cclinkamerica.org/
e-mail	cc-link@post0.mind.ne.jp	Info@CCLinkAmerica.org