

FA Network

The field of FA (factory automation) has seen widespread use of various network systems intended for wiring saving, intelligent system construction and other purposes. Such network systems are called FA network, field network, field bus and so on, among which “open network”, the specifications of which have been opened to the public, have been widely used, leading many manufacturers to develop and sell products linked to it. The following describes the network that KURAMO has been working on.

Stratification of FA Network

The network used in a factory is hierarchically classified into such strata as illustrated in the following chart according to the location where it is used or information flowing through it, although this chart is only one example of its hierarchical classification, which can be made in various other ways.

Information Network

This network refers to LAN linking PCs in the office and a network linking factories.

Controller Level Network

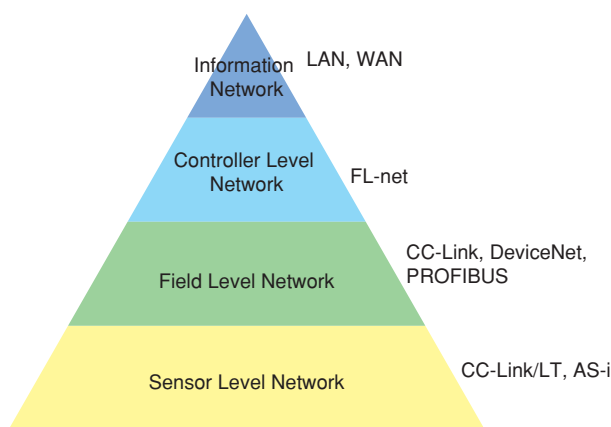
This network is mainly intended as a network for PLC-to-PLC communication, finding use in synchronization between PLCs, production control between lines and other similar applications.

Field Level Network

This network is intended as a network for in-line equipment control, providing communication between PLC and various pieces of field equipment.

Sensor Level Network

This network is intended as a network for control of equipment and I/O in panels, instruments and other devices, finding dedicated use in communication of switch/sensor bit data and other data, the volume of which is relatively small.



Any exchange of information between or among the strata of the network can be achieved using gateway or other similar device for such information exchange.

CC-Link



Description of CC-Link

CC-Link is a network proposed by the CC-Link Partner Association (CLPA) to serve as a field level network linking between PLC and various pieces of field equipment. Since its specifications were initially formulated by Mitsubishi Electric Corporation, CC-Link has found widespread application, providing 10Mbps high-speed communication speed. With the member partners of the CC-Link Partner Association numbering 745 as of March 2006, CC-Link, gaining increased participation not only of domestic makers, but also overseas makers, have seen increased cases of its adoption overseas.

CC-Link Versions

CC-Link has undergone version upgrade on each occasion of function addition or improvement with its version upgraded to Ver.2.0. as of August 2006. The history of the version upgrades of CC-Link is as follows.

CC-Link Ver.	Description
1.00	Original release of CC-Link
1.10	This version allowed more convenient inter-station cable lengths of 20cm or more. This specification change affects network devices and network cables.
2.00	This version provides an 8-fold increase in the volume of data communication in the system and per station.

CC-Link Cable Versions

CC-Link cables are available in two types — Ver.1.00 and Ver.1.10, the latter of which is the latest in the cable specifications. Therefore, CC-Link Ver.2.00 system is to be networked using Ver.1.10 cables. At present, we offer two types of cables for CC-Link — Ver.1.00 and Ver.1.10. We recommend use of our Ver.1.10 cables for your CC-Link system to be newly installed in future.

CC-Link Connection Specifications

■ Connection cable

CC-Link connection is to be made using specially designed cables (Three-core). For connection to your CC-Link system to be newly installed, we basically recommend use of Ver.1.10 type cables.

■ CC-Link cable length

Ver.1.10 type standard cable provides maximum transmission distance indicated in the following table if it is connected without T-branching and using repeater unit.

Communication speed	156kbps	625kbps	2.5Mbps	5Mbps	10Mbps
Station-to-station cable length ^{※ 1}	20cm or more				
Maximum total cable length ^{※ 2}	1200m	900m	400m	160m	100m

※ 1: Minimum cable length between adjacent pieces of equipment ※ 2: Upper limit on the total sum of cable lengths between one terminal CC-Link equipment and the other terminal CC-Link equipment

For mobile cable, the maximum total cable length is shorter than that for the standard cable. The mobile cable is available in three types in terms of its transmittable length relative to that of the standard cable, specified as 30%, 50% and 70%, which are represented as -3, -5 and -7 added to the end of their respective corresponding codes. For example, KURAMO's FANC-110SBZ-5 has its maximum transmittable distance specified as 50m at 10Mbps. When 10m of the mobile cable (50% type) is used at 10Mbps with the rest connected using the standard cable of permissible length up to 80m, both cables allow the connection to be made with a total length of up to 90m. For details, refer to the CC-Link Installation Manual.

■ Other CC-Link cable connection

CC-Link at communication speed 625Kbps/156Kbps allows cable networking with T-branching connection, while permitting the use of repeater unit to extend the network to more than the corresponding maximum total cable length specified in the above table. For details, refer to the CC-Link Partner Association's homepage (<http://www.cc-link.org>) and CC-Link Installation Manual.

Reference: CC-Link Partner Association's homepage (<http://www.cc-link.org>)

CC-Link/LT



Description of CC-Link/LT

CC-Link/LT is a low-level network proposed by the CC-Link Partner Association to serve as a sensor level network mainly intended for control of equipment and I/O in panels, instruments and other devices. Designed to improve the connection saving efficiency in CC-Link, CC-Link/LT allows one-cable connection of communication line and communication power supply line as a whole.

CC-Link/LT Connection Specifications

■ Connection cable

CC-Link/LT connection is to be made using specially designed flat cables, cabtyre cords (VCTF), specially designed mobile cables.

■ Connection specifications

CC-Link/LT is designed to allow bus connection including T-branching with its communication speed, maximum main line length, branch line length and other specifications as summarized in the following table.

Communication speed	2.5Mbps	625kbps	156kbps	Remarks
Max. number of units connected (per branch line)	8station			
Max. main line length	35m	100m	500m	Cable length between terminators (not including branch line length)
T-branching interval	Not restricted			
Max. branch line length	4m	16m	60m	Cable length per branch
Total branch line length	15m	50m	200m	Total sum of branch line lengths

For details, refer to the CC-Link Partner Association's homepage (<http://www.cc-link.org>)

Reference: CC-Link Partner Association's homepage (<http://www.cc-link.org>)

DeviceNet



Description of DeviceNet

DeviceNet is a network proposed by ODVA (Open DeviceNet Vendor Association) to serve as a field level network linking between PLC and various pieces of field equipment. DeviceNet has found widespread application worldwide, especially in North America with the members of ODVA numbering 279 as of August 2006, allowing its relevant network access equipment to be available in every district of the world. DeviceNet is designed to communicate at a speed of 500kbps, which is low compared to other networks, although it is characterized by its high network efficiency, providing a high-speed response. In addition, DeviceNet is designed with a connection system using specially designed cable integrating communication line/communication power supply line, allowing star connection, multi-drop, T-branching and other connection with a high degree of freedom.

DeviceNet Connection Specifications

■ Connection cable

DeviceNet connection is to be made using specially designed cables integrating communication line/communication power supply line as specified in DeviceNet connection specifications. KURAMO offers DeviceNet cables in two types — THIN and THICK.

■ Connection specifications

DeviceNet is designed to allow star connection, multi-drop, T-branching and other connection with a high degree of freedom. The DeviceNet's maximum trunk line length varies according to the communication speed and the type of the connection cable used (THIN/THICK) as shown in the following table, which also shows its maximum drop branch line length and total drop line length at 125kbps/250kbps/500kbps.

Communication speed		125kbps	250kbps	500kbps
Trunk line length for cable type	THICK	500m	250m	100m
	THIN	100m	100m	100m
Max. drop line length		6m	6m	6m
Total drop line length		156m	78m	39m

Reference: ODVA Japan's homepage (<http://securesite.jp/ODVA/Index.html>)

PROFIBUS



Description of PROFIBUS

PROFIBUS is a field bus developed jointly by Siemens, Bosch, ABB and others in Germany in 1980s, which has now become an open network, finding most widespread use throughout the world, centering around Europe, under the PROFIBUS Association. PROFIBUS is available in two types allowing it to be properly used according to its intended application — PROFIBUS-DP intended for FA (factory automation) and PROFIBUS-PA intended for PA (process automation). PROFIBUS-DP is recognized as an open field bus with the highest communication speed of 12Mbps. PROFIBUS-PA is designed to comply with the electrical specifications specified in IEC61158, meeting the two-wire bus powered communication line and explosion-proof enclosure requirements.

PROFIBUS-DP Connection Specifications

■ Connection cable

PROFIBUS-DP connection is to be made using specially designed cables with characteristic impedance of 150 Ω .

■ Connection specifications

PROFIBUS-DP is designed to provide such communication speeds and transmission distances as shown in the following table when connected using the specially designed cables mentioned above. Notwithstanding this, however, it is recommended that PROFIBUS-DP, when operated at high communication speed of 3Mbps or above, should be connected with equipment-to-equipment cable length of 1m or above. For details, refer to the “Instructions on PROFIBUS DP Cable and Equipment Installation” and other appropriate publications issued by Japanese PROFIBUS Organization.

Communication speed	9.6kbps	19.2kbps	93.75kbps	187.5kbps	500kbps	1.5Mbps	12Mbps
Distance/Segment	1200m	1200m	1200m	1000m	400m	200m	100m

Reference: Japanese PROFIBUS Organization's homepage (<http://www.profibus.jp/index.html>)

CompoNet

Description of CompoNet

CompoNet is a network for sensor & actuator that was made specifications by ODVA in 2006. (It is high-speed reply of about 1msec per 1,000 points, 384 number of the biggest nodes, the maximum input and output is 2,560 points) The network is used two type cable, one is versatility round cable (VCTF) at low cost, and the other is excellent workability flat cable. The CompoNet is excellent network having high-speed communication, easy wiring, informatization and good cost-performance.

CompoNet Connection Specifications

■ Connection cable

CompoNet is possible to use, Exclusive Flat cable I (sheathless type), Exclusive Flat cable II (sheath type), Round cable I (VCTF cable of two conductors) and Round cable II (VCTF cable of four conductors).

Our company provides four cables which adapted to CompoNet specification.

Exclusive Flat cable I : KOMP-F I , Exclusive Flat cable II : KOMP-F II ,

Round cable I : KOMP-R I , Round cable II :KOMP-R II

■ Connection specifications

CompoNet is possible to do wiring with the high degree of freedom, like T-branch. Maximum length of trunk line differ with communication speed, cable type and within/without branch lines. The following table shows communication specification of CompoNet.

Transmission speed	Cable type	Trunk line Max. length (※1) (The max. length at the time of repeater use)	Max. length of one branch line (※1)	Total branch line length (※1)	Branch line part restrictions	Number of Slave units connected to one branch line	Max. sub-branch line length (※1)	Total sub-branch line length (※1)	Total number of Slave units (※1), (※2)
4Mbps	Round cable I, II Flat cable I, II	30m (90m)	0m	0m	—	—	0m	0m	32set
3Mbps	Round cable I, II Flat cable I, II	30m (90m)	0.5m	8m	3line/m	1set	0m	0m	32set
1.5Mbps	Round cable I	No branch line	100m (300m)	—	—	—	—	—	32set
		Branch lines are included.	30m (90m)	2.5m	25m	3line/m	3set	0m	0m
	Round cable II Flat cable I, II	30m (90m)	2.5m	25m	3line/m	3set	0.1m	2m	32set
93.75kbps	Round cable I	500m (1500m)	6m	120m	3line/m	1set	0m	0m	32set
	Round cable II Flat cable I, II	200m (600m)	Flexible wiring is available if the total wiring length is 200m or less. (※1)						32set

Reference: CompoNet Adaptation of CIP, Edition 1.7

- ※ 1 : Per one segment.
- ※ 2 : A repeater is included.

Industrial Ethernet

Ethernet is a computer network system standardized by IEEE802.3, finding widespread use in offices and households as a LAN system. Ethernet is available in various types according to its communication speed — including 10BASE-T, 100BASE-TX and 1000BASE-T.

Application of Ethernet to Industrial Networks

Due to its versatility, high speed, future prospect and low cost, Ethernet has found its active adoption in industrial network as its physical layer as evidenced by ODVA's EtherNet/IP, PROFIBUS' PROFINET, JEMA's FL-net and other industrial networks' approaches toward Ethernet.

Some industrial networks have also worked on application of Ethernet not just by replacing their network media with Ethernet, but by putting its advantage of seamless linkage with information network to use to enhance transparency between and among the strata of the network and improve HMI (Human-Machine Interface) by introducing Web technology, thereby covering all its levels from “controller” to “sensor” by Ethernet in future.

■ Cables Applicable to Industrial Ethernet

Industrial Ethernet, although allowing use of ordinary LAN cables used in general offices for connection, may require use of double-shield type, oil resistant type and other special cables when connected in industrial factories or shop floors under harsher environment than offices.