

CC-Link IE Field Network Basic Supporting e-F@ctory

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CC-Link IE networks using Ethernet technology are spreading in the manufacturing fields of automobiles, liquid crystal displays/semiconductors, etc. requiring high-speed/large-capacity communication. On the other hand, in the global market including Asia, there is an increasing demand for products for small-scale systems, with an emphasis on cost effectiveness. In a small-scale system, it is necessary to reduce not only the product cost, but also the setting/start-up and maintenance costs, and to improve ease of use. While attention is paid to the IoT (Internet of Things), there is increasing demand for network compatibility among equipment and systems, which has been difficult to achieve due to the time and cost of development required. To meet these demands, we have developed an open network for small-scale systems: the “CC-Link IE Field Network Basic,” which operates on standard Ethernet (Fig. 1).

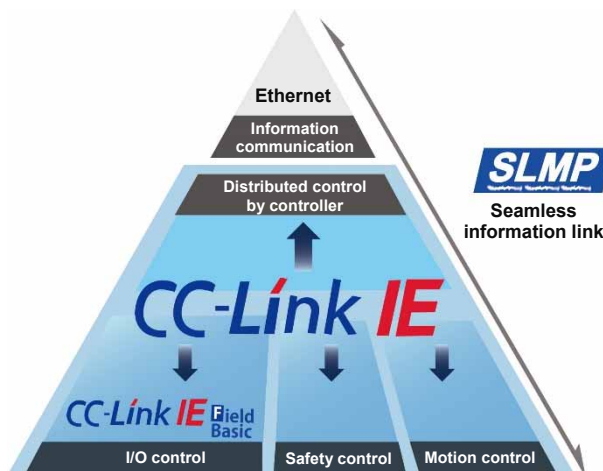


Fig. 1 Positioning of CC-Link IE Field Network Basic

1. Specifications of CC-Link IE Field Network Basic

Table 1 shows the specifications of CC-Link IE Field Network Basic, which is a protocol that can be established by software alone using standard Ethernet communication. The topology complies with that of the Ethernet, and is basically a star type. A line type topology can be supported by using a slave station with a built-in switch function (function with two Ethernet ports that allows packet relay using the switch function IC). In communication, the master station transmits the request via broadcast, and the slave station returns the response

Table 1 Specifications of CC-Link IE Field Network Basic

Item	Specification
Communication speed	100 Mbps
Installation type	Software
Topology	Star, line
Cable	Ethernet category 5 or higher
Number of maximum stations connected	64
Number of occupied slave stations	1 to 16
Cyclic communication	Control signal (bit data) 8192 bits maximum RX (slave → master) 4096 points RY (master → slave) 4096 points Control data (word data) 4096 words maximum RWr (slave → master) 2048 points RWw (master → slave) 2048 points
Combination with Ethernet standard protocol	Allowed

via unicast, achieving cyclic communication (Fig. 2). Cyclic communication is a function that regularly updates the distributed shared memory, which is shared between the master station (controller) and each slave station (target control station). In this CPU module (MELSEC iQ-R series) connected to 16 slave stations, the link scan time (time required for all stations to transmit control data to the master station) is 10 ms or less.

2. Features of CC-Link IE Field Network Basic

2.1 Seamless information link

CC-Link IE Field Network Basic is the protocol of the application layer. Below the application layer, the protocol is equivalent to the standard Ethernet protocol (Fig. 3). Accordingly, combination with other protocols (HTTP/FTP/SLMP, etc.) operated on standard Ethernet is possible. Also, on an Ethernet-based wireless system, packet priority control, etc. can be used. This can put the IT system in the level above the machine at the production site into One Network; this feature can easily achieve the e-F@ctory solution.

2.2 Establishment of highly cost-effective system

2.2.1 Wire-saving by combination with TCP/IP communication

Since the combination with TCP/IP communication is allowed, a special line for control is not required. This enables the existing network to be used and the network types to be unified. The resultant wire saving reduces the cost (Fig. 4).

2.2.2 CPU module supporting master station

Since the CPU module (MELSEC iQ-R series/iQ-F series/Q series/L series) has the built-in master station function of CC-Link IE Field Network Basic, a special network module is not required and the network can be established with the minimum configuration.

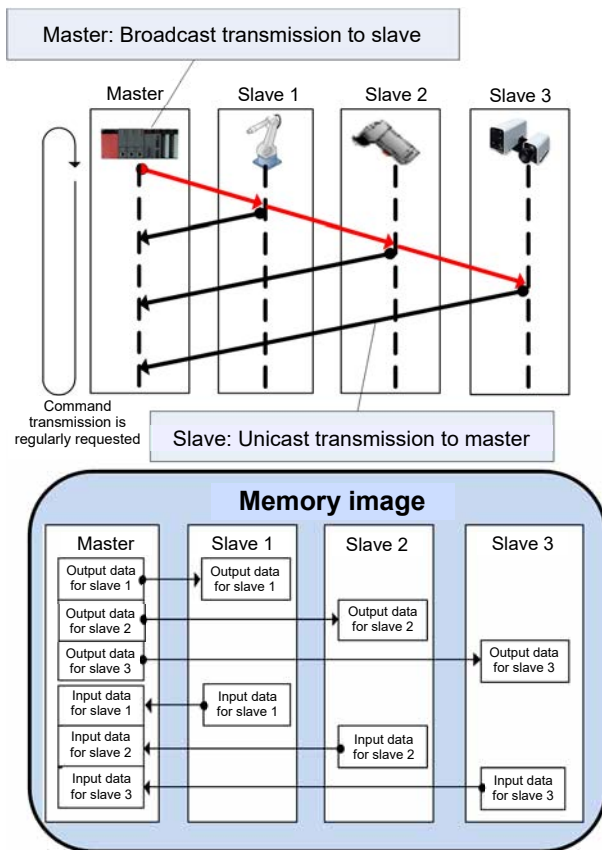


Fig. 2 Communication system of CC-Link IE Field Network Basic

2.2.3 Using general-purpose Ethernet products at 100 Mbps

In CC-Link IE Field Network Basic, existing general-purpose Ethernet equipment can be used, eliminating the need for a special hub or cables. Thus, it is not necessary to purchase a new unit and the system can be built at low cost.

2.3 Reduction of system establishment time

2.3.1 Achieving cyclic communication without programming

For communication via Ethernet, it has conventionally been necessary to define the request/response messages and prepare the program. In CC-Link IE Field Network Basic, cyclic communication can be performed through parameters settings by defining the IP address and subnet mask of the master station, the IP address and subnet mask of the slave station, and the device to be refreshed. In this way, it is not necessary to set the request/response messages or the program considering the protocol (Fig. 5).

This feature can reduce the time taken to establish the system and ensure that the slave unit is controlled only by a user to manage the data link status. The maintenance cost can also be reduced.

2.3.2 Simple setting of slave unit

When the parameters are set, a compatible unit on the Ethernet line is detected using the engineering tool, and the IP address, etc. necessary for connection can be changed through the online network. Using CSP+ (unit profile compatible with common protocol connecting FA units), which describes the parameter information, etc. for the slave units, specific parameters for each slave unit can be changed by using the engineering tool through the online network. This provides a simple way to not only set the parameters for the master station, but also those for the slave stations.

2.4 Reducing down time of the system with diagnostic function

In CC-Link IE Field Network Basic, the communication status or operation status of the slave

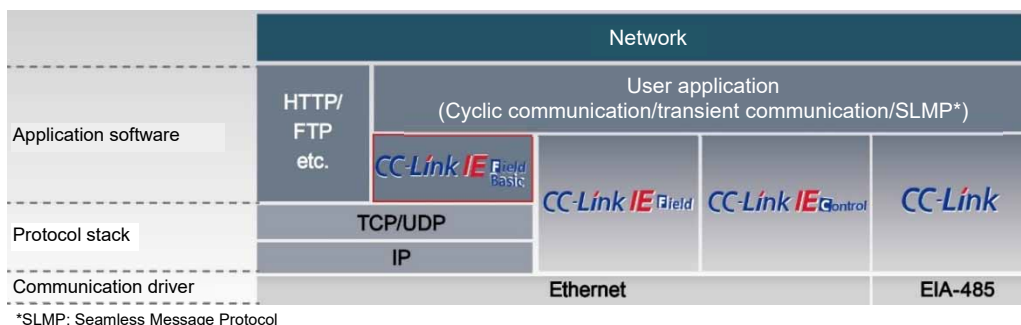


Fig. 3 Protocol layer of CC-Link IE Field Network Basic

station is obtained from the cyclic data and is integrally controlled in the master station. This information can be checked by monitoring the diagnostics screen using the engineering tool. The location of a problem can be seen at a glance (Fig. 6). If a problem occurs, troubleshooting can be performed even by someone without expertise, by displaying the cause and corrective action on the diagnostics screen. This feature reduces the system down time if a problem occurs.

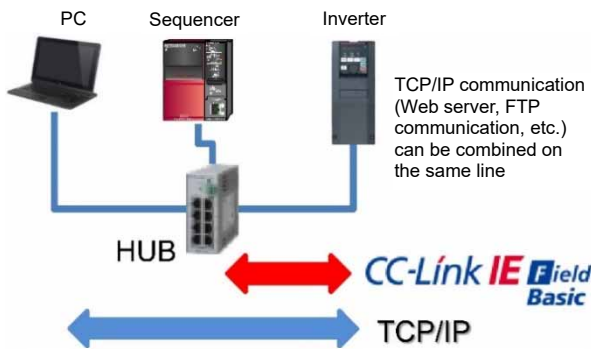


Fig. 4 Combination with TCP/IP communication

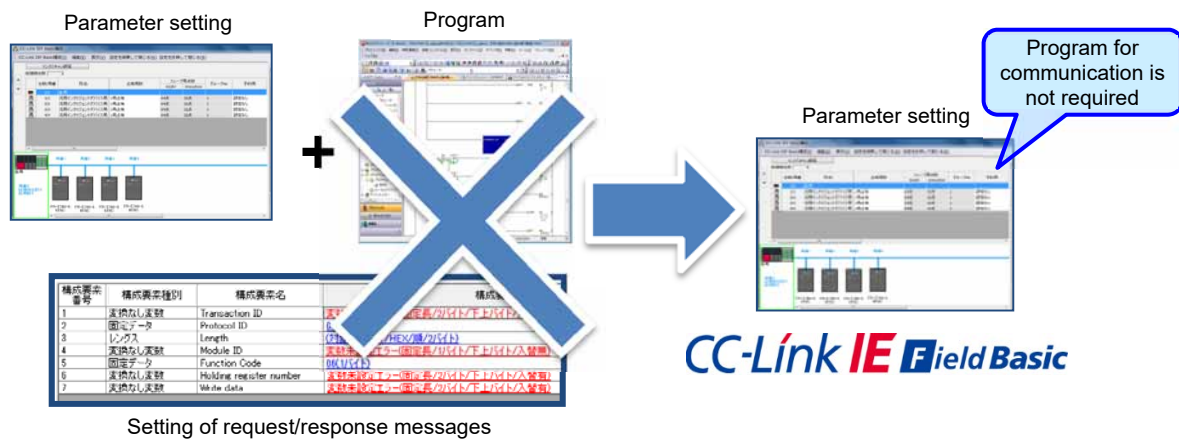


Fig. 5 Simple setting

Information that can be monitored:

- Settings (IP address, reserved station, etc.)
- Link scan time
- Data link status
- Error code

エラー詳細

詳細情報
データリンクが異常になっている局があります。

異常要因
以下の原因が考えられます。
(1) マスタ局またはローカル局のネットワークケーブルが間違っている可能性があります。
(2) 子局の局番設定が間違っている可能性があります。
(3) 子局の伝送速度設定範囲外、またはマスタ局と子局で伝送速度が異なっている可能性があります。
(4) ケーブルの断線、短絡、誤配線、接続不良、仕様範囲外の可能性があります。
(5) 伝送ケーブルにノイズが入っている可能性があります。
(6) 局番設定が正しいか確認してください。
(7) 電源が入っていないまたは電圧仕様範囲外の局がある可能性があります。
(8) マスタ局の局番が以外に設定されている可能性があります。
(9) マスタ局のスイッチ設定が誤りがある可能性があります。

トラブルシューティング
以下の処置を実施してください。
(1) マスタ局のネットワークケーブルを確認してください。異常局がローカル局の場合は、ローカル局のネットワークケーブルを確認してください。
(2) 異常局の局番設定が正しいか確認してください。
(3) 異常局の伝送速度の設定が、マスタ局の設定と同じか確認してください。
(4) ケーブルが断線していないか確認してください。
(5) 伝送ケーブルと動力線が近接していないか、FG(動力)系GNDと分離されているか確認してください。ノイズ対策を実施するか、システム全体の伝送速度を落としてみてください。
(6) 局番設定が、CC-Linkシステムの最終端に接続しているか、使用しているケーブルの種類にあった終端抵抗を接続しているか確認してください。

Fig. 6 Troubleshooting

2.5 Developing compatible products simply by installation of software

CC-Link IE Field Network Basic is the protocol of the application layer. It can be additionally installed on the hardware for standard Ethernet. Since installation by software is allowed, the development period is reduced, and since special hardware is not required, the unit price is lower.

3. Conclusion

This paper describes the development background, features and applied technology of CC-Link IE Field Network Basic. We will continue to respond to the ever-changing market status and the needs of users to reinforce the link with our FA units and promote attractive product manufacturing.

Reference

- (1) Hisafumi Komoto: CC-Link IE Field Network, Mitsubishi Denki Giho 88, No. 3, 179-182 (2010).