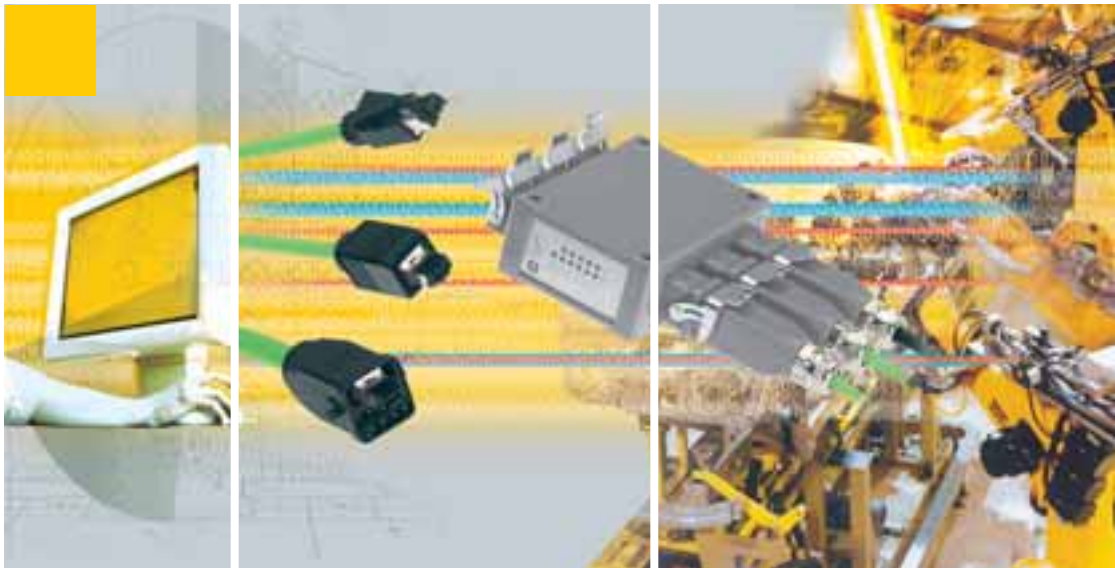
HARTING



Solutions for Industrial Ethernet

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HARTING People | Power | Partnership

Quality Connections Worldwide

HARTING was founded in 1945 by the family that still owns the company.

Today, HARTING employs around 2,300 people worldwide, including 150 qualified engineers. The sales team, including more than 100 sales engineers is in daily contact with our customers.

The company is one of the world's leading manufacturers of connectors, and currently have 33 subsidiary companies in Europe, the United States and Asia. In several product ares, HARTING is a market leader.

Great emphasis is placed on close links with customers, including the provision of a 'Just-in-Time'-Service to ensure rapid delivery to key customers.

HARTING products are designed and manufactured using the latest automated techniques, from CAD systems in the research and development department to automatic production techniques on the assembly lines.

Production and quality control is based on a 'zero-error' philosophy which can only be reached by the continuous successful implementation of fully automated production techniques. The organisation and procedures for quality assurance are based on the EN ISO 9001 standard. A total of 60 engineers and other employees, most of whom are trained and qualified to standards laid down by the DGQ (German Association of Quality) or the SAQ (Swiss Association of Quality), are employed solely on quality-assurance activities.

Solutions for Industrial Ethernet

General information

It is the user's responsibility to check whether the components illustrated in this catalogue comply with different regulations from those stated in special fields of application which we are unable to foresee.

We reserve the right to modify designs in order to improve quality, keep pace with technological advancement or meet particular requirements in production.

Industrial Ethernet – General information

What is Ethernet?

Ethernet is a well established specification for serial data transmission, originally published by Xerox in 1975. In 1985 Ethernet was standardised in IEEE 802.3, since when it has been extended a number of times. "Classic" Ethernet operates at a data transmission rate of 10 Mbit/s.

Since the 1990s, Ethernet has developed in the following areas:

– Transmission media

– Data transmission rates
- Fast Ethernet at 100 Mbit/s (1995)
- Gigabit Ethernet at 1 Gbit/s (1999)
- There are plans for Ethernet running at 10 gigabits

– Networked topologies
- Switched Ethernet

– Industrial Ethernet

Nowadays Ethernet is the most widespread base technology in the world in commercial DP systems, and is also gaining importance in industrial automation. The use of Ethernet creates a homogenous and standardised communication infrastructure, extending seamlessly from the office environment to the machine.

Classic Ethernet (Shared Ethernet)

All network users have the same rights under Ethernet. Any user can exchange data of any size with another user at any time.

Because Ethernet was conceived as a logical bus system, any network device that is transmitting is heard by all other users. Each Ethernet user filters the data packets that are intended for it out from the stream, ignoring all the others. Telegrams that are intended for all devices are an exception to this rule. These are known as broadcast or multicast telegrams.

The CSMA/CD network access procedure

In Classic Ethernet, also frequently called shared Ethernet, all the network users share one collision domain. In Ethernet, network access is controlled by the CSMA/CD procedure (Carrier Sense Multiple Access with Collision Detection).

If a network user wishes to transmit data, it first checks whether the network is free (carrier sense). If so, it starts to transmit data. At the same time it checks whether other users have also begun to transmit (collision detection). If that is the case, a collision occurs. All the network users concerned now stop their transmission, wait for a period of time determined according to a randomising principle, and then start transmission again.

The result of this is that the time required to transmit data packets depends heavily on the network loading, and cannot be determined in advance. The more collisions occur, the "slower" the entire network becomes. Shared Ethernet therefore only has limited suitability for industrial automation.

The physical size of the network is also limited. It depends on the data rate being used and on the maximum permissible transmission time of data packets.

Approaches to improved performance

A number of approaches have been tried to improve performance:

Segmentation: -> subdividing the collision domains

Higher bandwidths: -> Fast Ethernet, Gigabit Ethernet

Switching: -> Switched Ethernet

and combinations of these.

Only with the implementation of these approaches does Ethernet become interesting and useful for industrial automation. For this reason, only Switched Ethernet and Fast Ethernet will be considered further in the following chapters.

Ethernet installations are primarily characterised by two parameters: the Category of the cable (Category) and the Class of the channel (Class).

Ethernet transmission media in common use

Description	Meaning	Distance
10 Mbit/s system		
10 Base T [FD]	2 conductor pairs, min. Category 3, UTP and STP	>100 m
10 Base FX [FD]	Fibre-optic cable	Depends on fibre type
100 Mbit/s system (Fast Ethernet)		
100 Base TX [FD]	2 conductor pairs, Category 5, UTP and STP	100 m
100 Base FX [FD]	Fibre-optic cable	Depends on fibre type

[FD] = Full-duplex operation possible

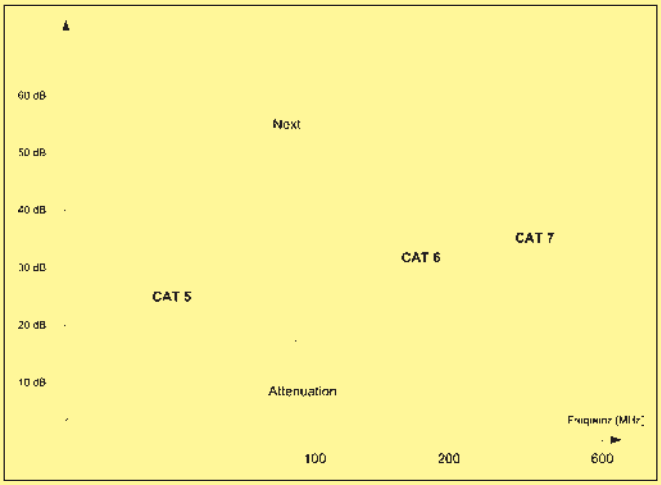
The cable is identified by its Category in accordance with its electrical transmission and high-frequency properties, as follows:

Category 1: not specified
Category 2: up to 1 MHz
Category 3: up to 16 MHz
Category 4: up to 20 MHz
Category 5: up to 100 MHz
Category 6: up to 250 MHz
Category 7: up to 600 MHz

The channel is the point-to-point part of the transmission process, and is specified as follows:

Class A: up to 100 kHz
Class B: up to 1 MHz
Class C: up to 16 MHz
Class D: up to 100 MHz
Class E: up to 250 MHz
Class F: up to 600 MHz

The higher the alphabetical sequence of the letter, the tougher are the requirements on the transmission channel, and therefore also on the cable. If, for instance, only Category 5 components are used in a system, the capacity of a Class D cable is required. The same applies to Category 6 and Class E, as to Category 7 and Class F.



Next = Near end crosstalk

Fast Ethernet

Fast Ethernet, according to IEEE 802.3, is not a new standard, but an extension of Classic Ethernet to include the following new properties:

- A data rate of 100 Mbit/s
- Switching
- Full duplex operation

These form the basis of industrially useful Ethernet networks. Autonegotiation provides compatibility with Classic Ethernet in accordance with IEEE 802.3.

Switched Ethernet

Definition

Switched Ethernet refers to a network in which each Ethernet user is assigned a port in a switch.

Switches separate former collision domains into individual point-to-point connections between the network components and the relevant user equipment.

Preventing collisions makes the full network bandwidth available to each point-to-point connection. The second pair of conductors in the Ethernet cable, which otherwise is necessary for the detection of collisions, can now be used as an additional transmission medium, so providing a significant increase in data transfer rate.

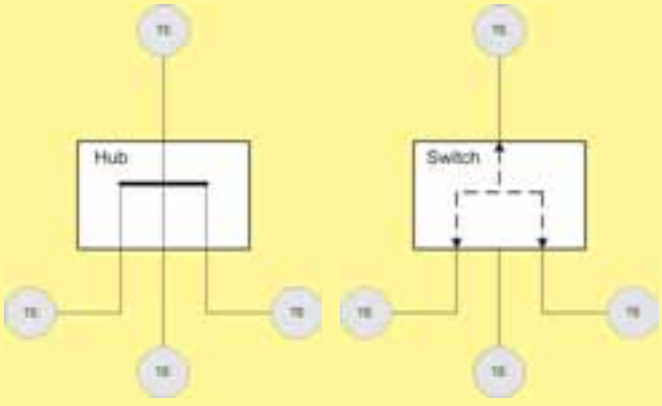
The use of switches allows any desired network configuration, such as star, ring, tree or linear, to be implemented.

Switched Ethernet offers the following important advantages:

- The possibility of scaling the collision regions to match the needs of the application, going as far as fully collision-free networks in which only one user is assigned to each port
- Very fast packet transfer between the collision regions
- A considerable increase in data transfer rate through "true" full duplex operation
- Preventing collisions allows deterministic operation

Network size

There is no theoretical limit to the physical extent of a Switched Ethernet network. The maximum length of conductor between the ends of a point-to-point connection is only determined by the physical transmission properties and is, according to the specification, 100 m. In practice, the connectors and cables used have a decisive effect on the transmission length that can actually be achieved.



TE = Terminal Equipment

The switch – the central network component in Switched Ethernet

Switches are active infrastructure components that operate according to IEEE 801.3 on layer 2 of the OSI reference model. Switches analyse all the data packets as they arrive, directing them on to the port where the corresponding user is located. Only multicast and broadcast telegrams are an exception to this. They are passed on to all the active ports and switches.

Each switch requires an address/port assignment table in order to correctly redirect the telegrams. The assignment of a destination address to a specific port in the switch is stored in this table. The destination address of an incoming data packet is analysed with the aid of this table, and the data packet is passed on immediately to the corresponding port. The address/port assignment table is usually generated and maintained automatically by the switch in a self-learning process. One switch can learn several thousand addresses. This is necessary when more than one item of user equipment is connected to one or more ports. This allows a number of independent subnets to be connected to one switch.

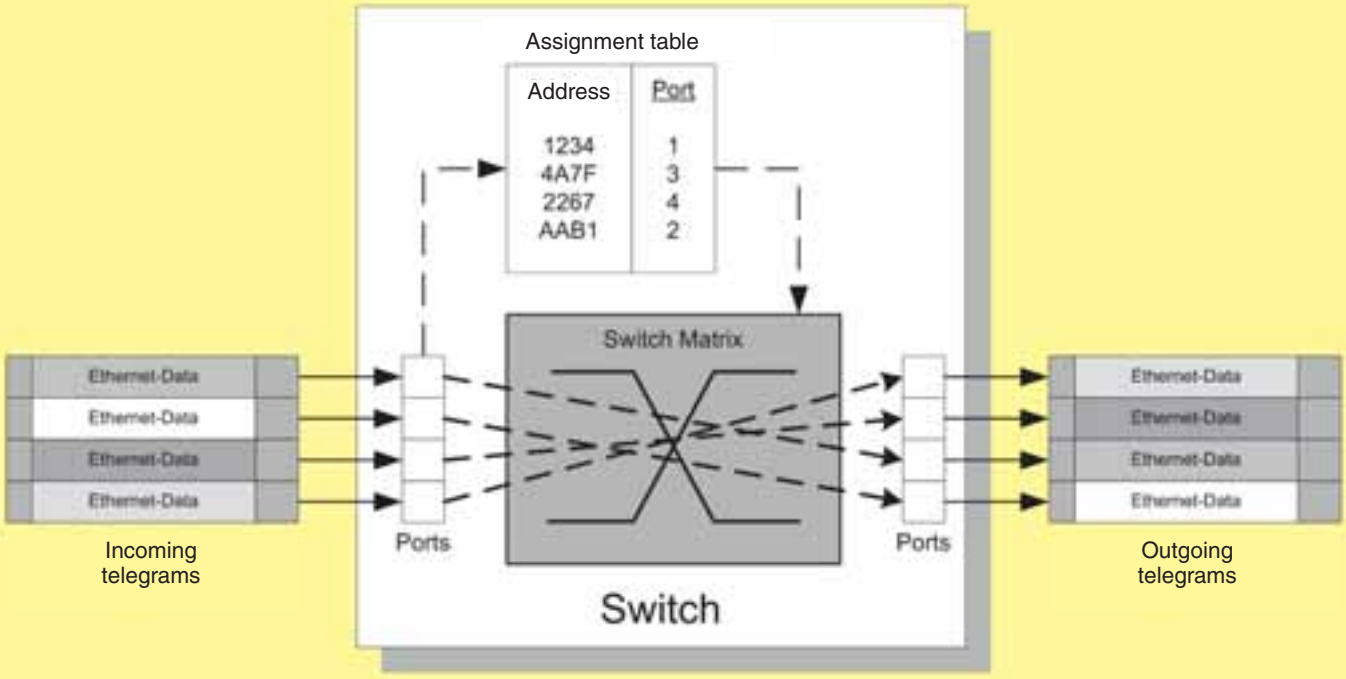
In this way, each of the ports in a switch generates its own collision region. This prevents data collision with users attached through other ports. In Switched Ethernet, only one user is assigned to any port. In this way collisions are avoided altogether. Guaranteed freedom from collisions provides a significant increase in the effective data transfer rate. Additionally, full duplex operation is now possible, since one pair of conductors in the Ethernet cable, otherwise required to detect collisions, can be used as an additional data transfer medium. With Fast Ethernet operating in full duplex mode (100 Base TX), 100 Mbit/s can be transferred simultaneously in the two directions. This corresponds to doubling the data rate.

Thanks to the switching technology it is possible to construct Industrial Ethernet networks that satisfy the requirements both for reliability and for real-time performance.

Different types of switches

Switches are chiefly distinguished according to the following features:

Modes of operation:	Store and forward Cut-through Modified cut-through
Blocking:	Blocking Non-blocking
Management:	Managed Unmanaged



Principle of a switch

A comparison of the operating modes

Store and forward (Figure 1)

In this mode of operation, the switch temporarily stores the entire data packet, checks it for errors and, if it is free of errors, passes it on to the appropriate port.

Cut-through / Modified cut-through (Figure 2)

In this mode of operation only enough bytes from the data packet are placed into temporary storage as are necessary for the evaluation in the address/port assignment table.

Once this has been done, all the incoming bytes from the data packet are passed on immediately to the corresponding port without any intermediate storage.

In modified cut-through, the switch waits for precisely 64 bytes before making a decision according to the address/port assignment table.

Blocking

A switch has a certain number of ports available to it, and these are connected through the switch matrix. If the switch matrix is capable of handling all the connections without delay at full data rate immediately, then it is called a non-blocking switch. If the number of simultaneous connections at full data rate is limited, the switch is said to be blocking.

Management

An unmanaged switch handles all the data traffic on the basis of the address/port assignment table. The user has no options for manipulating this.

A managed switch controls the data flow in accordance with certain parameters or rules. The basis for this activity is provided by the switch management software. Modern switches support SNMP management and web-based management. These provide a variety of options for manipulation by the user. The capabilities of the management software differ from one switch to another.

Time behaviour

In Switched Ethernet, all the uncertainties of time that result from Ethernet's collision management algorithm (CSMA/CD) are eliminated. If correctly dimensioned, Switched Ethernet thus becomes a deterministic system. For the purposes of industrial automation it is necessary to select the switches and to dimension the network in such a way that the switches operate within their deterministic range under all operating conditions.

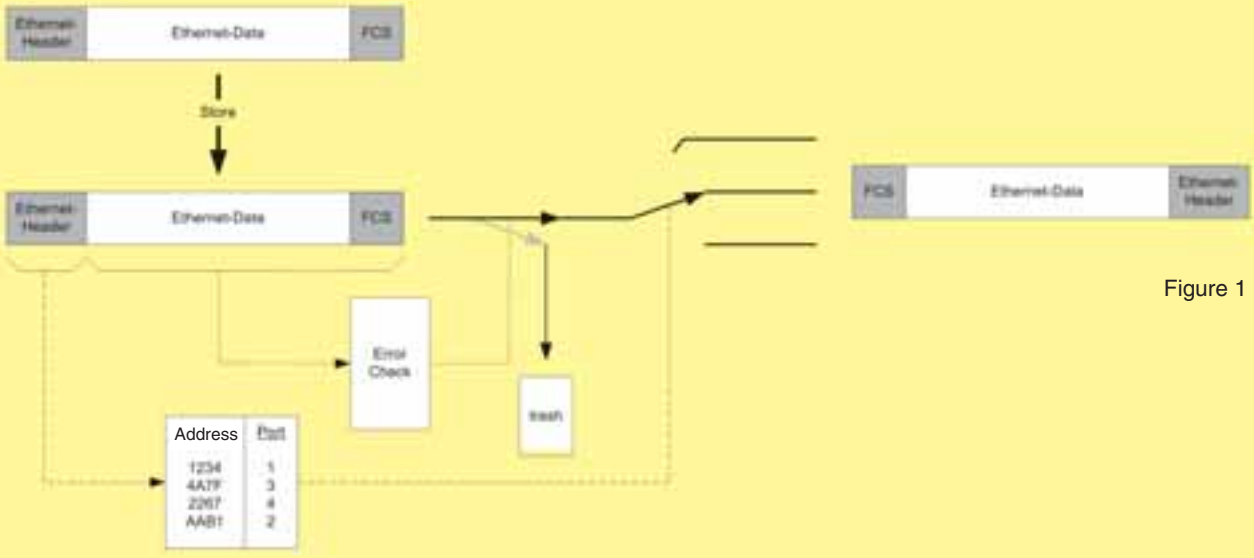


Figure 1

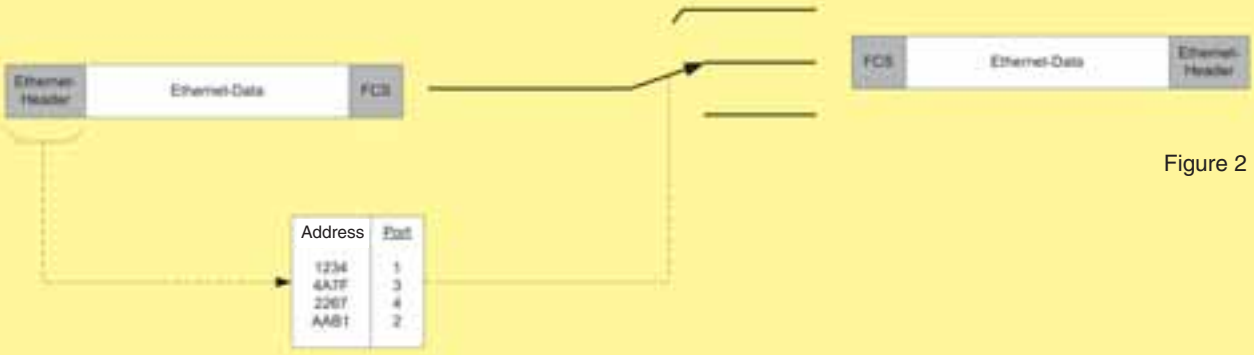


Figure 2

The Industrial Ethernet network

General requirements for Industrial Ethernet networks

The international standard ISO/IEC 11801 and its European equivalent, EN 50173, define an application-neutral standard form of information networking for a building complex. The contents of the two standards are largely identical. Both standards assume that the buildings are used in a way similar to an office, and aim to be neutral towards particular applications. The specific requirements for Ethernet networks in industrial environments, such as

- equipment-specific cabling
- individually adapted levels of networking for each machine/plant
- linear network structures
- robust, industrial cables and connectors meeting special requirements for EMC, temperature, humidity, dust and vibration

are not considered in either of these standards.

	Office areas	Production and other industrial areas
Installation conditions	• Fixed basic installation in the building • Cables laid in false floor • Devices connected at workstation vary frequently • Prefabricated connecting cables • Largely standard work places (desk with PC, …) • Tree network structures	• Wiring depends heavily on the equipment • Equipment-specific cabling • Connection points are rarely modified • Device connections may be assembled on site • Each machine/plant requires individual levels of networking • Linear or (redundant) ring network structures are common
Transmission capacity	• Large data packets (e.g. images) • Medium network availability • Transmission time on the scale of seconds • Predominantly acyclic transmission • No isochronism	• Small data packets (measurement data) • Very high network availability • Transmission time on the scale of microseconds • High proportion of cyclic transmission • Isochronism
Environmental requirements	• Moderate temperatures • Low dust levels • No humidity • Little shock or vibration • Low EMI exposure • Low mechanical hazard • Low UV radiation • Very little chemical hazard	• Extreme temperatures • High dust levels • Humidity possible • Vibrating machines • High EMI exposure • Risk of mechanical damage • UV exposure out of doors • Chemical hazard from oily or aggressive atmospheres

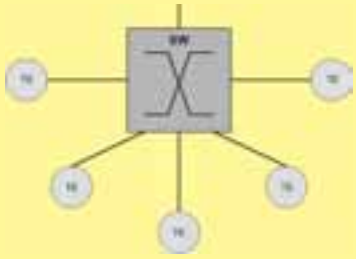
Table: Differing requirements of office and industrial areas

Network topologies

The topologies of Industrial Ethernet networks are oriented toward the requirements of the equipment that must be connected. Star, linear, tree and ring structures are amongst the most common. In practice, a real installation often consists of a mixture of the individual structures considered below.

Star

A star structure is characterised by a central signal distributor (switch) with single connections to all the network's end devices. Star network structures are best applied to areas where the density of devices is high and the physical distances between them is small, such as small production cells or an individual production machine.



SW = Switch
TE = Terminal Equipment

Star structure

Tree

A tree topology is formed when a number of stars are combined into one network. It is used when a complex installation is divided into smaller regions.

Linear

A linear structure can be implemented by a switch close to the end device requiring connection, or by a switch integrated into the end device. Linear structures are most often used in installations that are physically extensive, such as conveyor systems, and for the connection of manufacturing cells.

SW = Switch
TE = Terminal Equipment

Linear structure

Ring (redundancy)

If the ends of a line are closed by an additional connection, a ring structure results. Ring topologies are used to protect against line breaks or the failure of one network component in installations with high requirements for availability.

PROFInet® transmission system and wiring

The "PROFInet® transmission system and wiring" guideline defines a method of cabling for Industrial Ethernet, suitable for industrial application, on the basis of the fundamental requirements of ISO/IEC 11801.

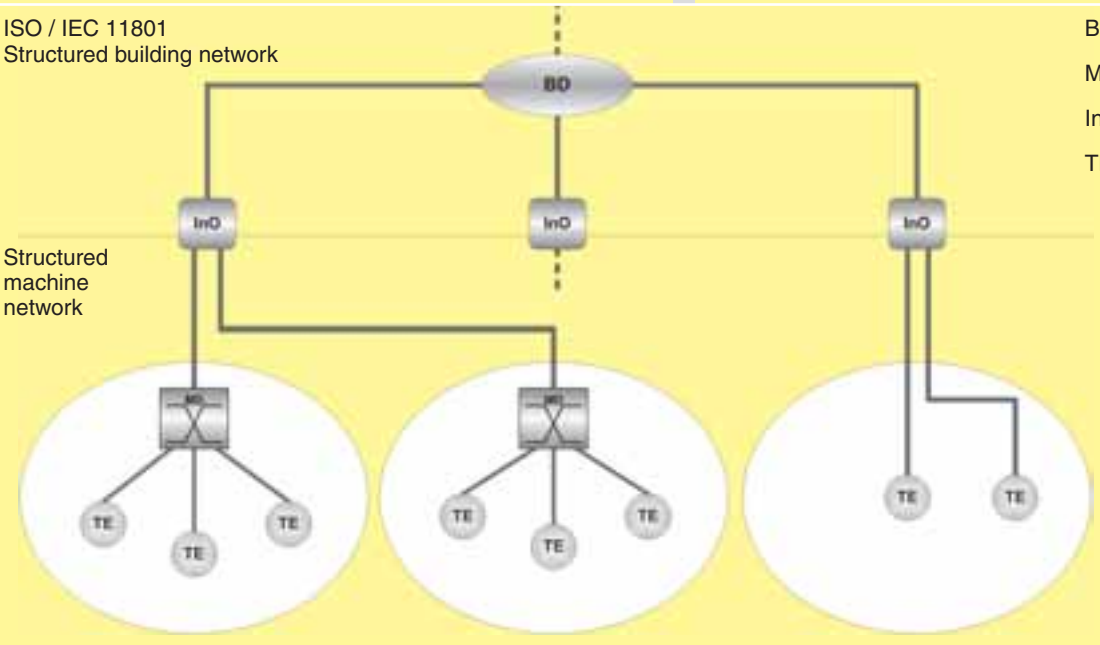
The PROFInet® guideline sets new standards, because:

- The component manufacturer is provided with unambiguous interface specifications
- The user is provided with simple rules for the installation
- He is therefore able to implement networks without additional Ethernet-specific planning, as with a field bus.

The PROFInet® guideline specifies cables and connectors with which the user can create an installation without special calculations relating to the transmission routes.

Detailed information can be found on the internet under www.profibus.com

ISO / IEC 11801
Structured building network



BD = Building Distributor
MD = Machine Distributor
InO = Industrial Outlet
TE = Terminal Equipment

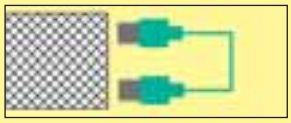
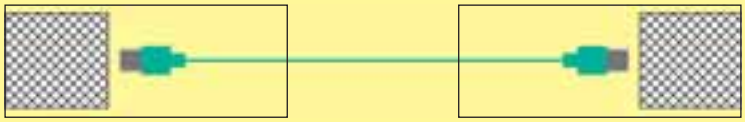
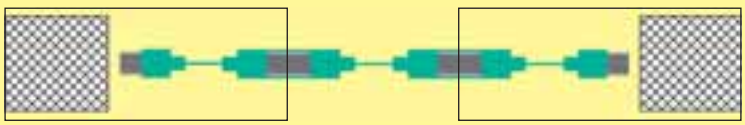
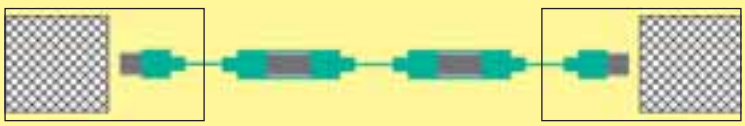
Structured machine network

Manufacturing plant

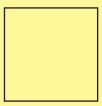
Cabling

Cables in an industrial environment may be exposed to extreme mechanical stresses. To ensure adequate mechanical protection special industrialised cable may be required, and this can have an effect on the transmission properties, which may mean that only relatively short transmission routes can be implemented. Signal transmission along symmetric copper cables (twisted pair) must be in accordance with 100 BASE-TX at 100 Mbit/s (Fast Ethernet). The transmission medium contains two pairs of twisted, screened copper cables (twisted pair or star quad) with a characteristic impedance of 100 Ohms. Only screened cables and connectors are permitted. The individual components must satisfy the requirements for Category 5 in accordance with ISO/IEC 11801. The entire transmission route must satisfy the requirements for Class D in accordance with ISO/IEC 11801. Removable connections on the cable side are made using either RJ 45 or M12 male connectors. On the device connections are in the form of female mating connectors. Connecting cables (device connecting cables and routing cables) accordingly have male connectors at both ends. Each device is connected through an active network component. The transmission cable therefore has identical connectors at both ends which simplifies installation as the connecting cable fulfils the function of a patch lead. The maximum cable length is 100 metres.

As long as the cable and the connectors meet with the above specifications a maximum cabling length of 100 m can be achieved with up to six connector pairs. The combination of a male and female connector is regarded as one pair.

Wiring example	Number of connector pairs	Maximum cabling length
	2	100 m
	2	100 m
	2	100 m
	4	100 m
	4	100 m
	6	100 m
	6	100 m


TE = Terminal Equipment
PMD = PROFInet® Machine Distributor


Area "inside"


Connector


Connector coupling

Table: Transmission route lengths

Connectors

An important criterion for industrial applications is the ease with which connection equipment can be handled on site. Connectors for M12 and for RJ 45 are available for this purpose. They can easily be assembled on site using standard tools.

In the control cabinet area, PROFInet® uses RJ45 in an IP 20 implementation. It is compatible with office connectors.

HARTING RJ Industrial® IP 20 Data

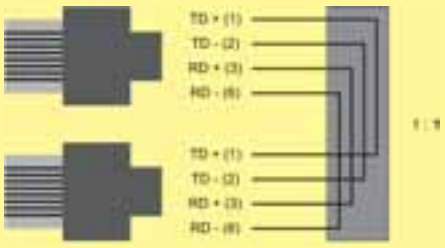
Connectors outside the control cabinet must be capable of withstanding the stresses of industrial applications. RJ 45 or M12 connectors with protection to IP 65 or IP 67 are used in this environment. The RJ 45 in IP 65 / IP 67 implementation has a robust housing with push pull locking. Special versions allow a level of protection up to IP 68 to be achieved. The M12 connectors use the screened, D-coded, 4-pin version, as included by DKE for Industrial Ethernet in the IEC standard.

HARTING RJ Industrial®
IP 67 Push Pull
and *HARAX*® M12-L shielded

Hybrid connectors can be used where distributed field devices require connection to both the data network and to a low voltage power supply. A fully contact-protected connector allows the connectors to be identical at both ends, since the integrated contact protection means that it is not necessary to alternate between male and female contact. An RJ 45 providing IP 67 protection is used to connect twin-pair, screened data lines for communication and four electrical contacts provide connection to the power supply.

HARTING RJ Industrial® IP 67 Hybrid

Connector assignment



RJ 45

Signal	Function	Conductor colour	Pin assignment	
			RJ 45	M12
TD+	Transmission Data +	Yellow	1	1
TD-	Transmission Data -	Orange	2	3
RD+	Receiver Data +	White	3	2
RD-	Receiver Data -	Blue	6	4

Switches

Switches are devices located in the transmission path between end devices, and which regenerate signals they receive before passing them on to their destinations. They are used to construct networks, and permit data communication over long distances. Switches suitable for PROFInet® are designed for Fast Ethernet (100 Mbit/s, IEEE 802.3u) and for full duplex transmission. In full duplex operation, a switch simultaneously sends and receives data at the same port. Collisions do not occur. No bandwidth is therefore lost through the Ethernet collision process. Network planning is made significantly more straightforward, because it is not necessary to examine route lengths within a collision domain. Industrialised switches are used for applications in the industrial environments. Switches designed for the office environment can only be used under certain conditions. One reason for this is that they are not suitable for harsh industrial surroundings. Secondly, large numbers of ports can become expensive.

Industrial Outlets

The interface between the structured building network in accordance with ISO/IEC 11801 and the PROFInet® plant cabling is provided by the Industrial Outlet, or InO. Its function corresponds to the socket outlet used in the office environment. The InO is manufactured to meet protection levels IP 65 / IP 67 and is suitable for the harsh conditions found in the industrial environment.

Source: PROFInet® Technologie und Anwendung (PROFInet® Technology and Application), November 2002
PROFInet® transmission system and wiring, November 2002

Glossary

10 Base T

The standard for data transmission of 10 Mbit/s Ethernet through unscreened twisted pair cables (Category 3, 4 or 5). Each connection is made using two pairs of wires, one pair being used for data transmission and the other for data reception.

10 Base FX

The standard for data transmission of 10 Mbit/s Ethernet through optical fibres. Each connection is made using two fibres, one fibre being used for data transmission and the other for data reception.

100 Base TX

The standard for data transmission of 100 Mbit/s Ethernet through twisted pair cables (Category 5). Each connection is made using two pairs of wires, one pair being used for data transmission and the other for data reception.

100 Base FX

The standard for data transmission of 100 Mbit/s Ethernet through optical fibres. Each connection is made using two fibres, one fibre being used for data transmission and the other for data reception.

Autonegotiation

A procedure defined in Fast Ethernet in which the devices agree a transmission mode with one another before the actual data transmission begins (100 Mbit/s or 10 Mbit/s, full or half duplex).

Autocrossing (1:1 cable; cross-over cable)

This function makes it possible to cross the send and receive lines of twisted pair interfaces automatically. Devices such as switches that support this function can be joined through a cable that is wired 1:1 instead of a cross-over cable.

AWG (**A**merican **W**ire **G**auge)
The AWG value describes a cable in terms of the wire thickness and the permissible attenuation.

Depending on the structure of the cable:

AWG 22 corresponds to a conductor wire gauge of 0.33 - 0.38 mm²
AWG 24 corresponds to a conductor wire gauge of 0.21 - 0.25 mm²
AWG 26 corresponds to a conductor wire gauge of 0.13 - 0.15 mm²

Broadcast telegram

A broadcast telegram is defined as a call to all network devices ("one to all").

CSMA/CD procedure
Carrier **S**ense **M**ultiple **A**ccess/**C**ollision **D**etection

Access procedure in Ethernet according to IEEE 802.3. Before sending a message, each network user first checks whether the transmission medium is free (Carrier Sense). It then begins to transmit, checking at the same time whether other devices (Multiple Access) have also begun to transmit data. If two or more devices transmit at the same time, a collision takes place. The devices stop transmitting their data (Collision Detection). After a randomly chosen time the next attempt is made when the line is free. In the CSMA/CD procedure the physical size of the network is limited by the maximum permissible transmission time of the data signals across the network, and this depends on the data rate.

Ethernet

The name of a data network that has been standardised in IEEE 802.3 since 1985. The term "Ethernet" is often used as a general term, without distinguishing between the different versions (Ethernet, Fast Ethernet etc.).

Fast Ethernet

A fast data network specified in IEEE 802.3 in 1995. Important parameters: transmission speed 100 Mbit/s, variable packet length 64 - 1522 bytes (with optional 4 byte tag field).

FEXT (**F**ar **E**nd **C**ross **T**alk)

A form of crosstalk in which the signals from devices located at the opposite ends of a twisted pair cable are superimposed on one another.

Full Duplex

A mode of operation in which one device can simultaneously send and receive data.

Gigabit Ethernet

A fast data network specified in IEEE 802.3 in 1999. Important parameters: transmission speed 1000 Mbit/s, variable packet length 64 – 1518 bytes.

Half Duplex

A mode of operation in which a device either sends or receives data at any one time. Collision detection is active in Ethernet for half duplex operation. The physical size of the network is limited by the transmission time delays in the devices and the transmission media.

Hub
The central point in a star arrangement.

A hub – often also called a star coupler – can be used to connect a number of devices in a star arrangement. In this arrangement, data packets must take turns to pass through the hub one after another. Data packets received at one port are immediately transmitted again on all the other ports.

Industrial Ethernet

A name for the form of Ethernet used in automation engineering. Because of the conditions encountered in industrial applications, the network components must withstand greater ranges of temperature and satisfy tougher requirements in terms of availability and reliability of the network.

Collision Domain

The CSMA/CD access procedure restricts the transmission time of a data packet from one network device to another. In accordance with the data rate, this yields a spatially limited network referred to as a collision domain. The maximum size of a collision domain is 4250 m at 10 Mbit/s (Ethernet) and 412 m at 100 Mbit/s (Fast Ethernet). If a connection operates in full duplex mode, the physical size can exceed these limits, because collisions do not then occur. This requires bridges or switches to be used.

LAN (Local Area Network)

A name for local networks extending up to 10 km.

Multicast Telegram

A multicast telegram is sent to a group of defined receivers. This group can be reached through one address (cf. Broadcast Telegram).

NEXT (**N**ear **E**nd **C**ross **T**alk)

A form of crosstalk in which the signals from devices located at the same end of a twisted pair cable are superimposed on one another.

POF (**P**lastic **O**ptical **F**ibre)

A name for an optical fibre whose core and sheath are formed of plastic. POF fibres have a typical core diameter of 0.98 mm.

PROFInet®

A network concept that defines the communication from the field level to the control level utilising Profibus and Ethernet, along with a model for the network engineering of the entire plant. See also: www.profibus.com

Queue / Queuing

Queue is a general term for a series of elements or tasks awaiting sequential processing. In a data transmission system, a queue is a number of messages or data packets that are waiting for further processing or to be transmitted elsewhere. They are temporarily sorted, and are processed one after another under the control of appropriate queueing procedures.

Segmentation / Network Segmentation

Network segmentation is used to set limits to collision domains, allowing Ethernet networks to achieve higher performance. A network can be segmented with the aid, for instance, of switches.

Switched Network

A name for an Ethernet network constructed using switches.

Active and passive network components

General information

ESC 67-10 TP05U
Fast Ethernet Switch for industrial applications

General description

Switches divide former collision domains into point-to-point connections between the network components and the user equipment involved. Constructing the network this way prevents collisions.

The ESC 67-10 TP05U Fast Ethernet Switch allows up five items of user equipment to be connected through shielded twisted pair cable in accordance with IEC 802.3. The protection level, temperature range and mechanical stability satisfy the toughest demands. The Fast Ethernet Switch can therefore be directly used in industrial environments.

It allows the amount of cabling needed to construct industrial networks to be reduced. The ESC 67-10 TP05U facilitates any kind of network configuration. All connections are plugged, which means that assembly is fast and reliable. All Ethernet interfaces are protected against over-voltage.

Advantages

- High IP 65 / IP 67 protection level
- Robust metal housing
- Can be used directly in industrial environments
- EMI, temperature range and mechanical stability for the toughest demands
- PROFInet® compatible

Application fields

- Industrial automation
- Automotive industry
- Wind power
- Power distribution systems

Technical characteristics

Function Ethernet Switch in accordance with IEEE 802.3, store and forward switching mode non-blocking, 5 ports unmanaged, autocrossing, autonegotiation, Ethernet (10 Mbit/s) and Fast Ethernet (100 Mbit/s) diagnostic LEDs (link status, data)

Mechanical data

Hood type	Robust metal hood of zinc die-cast
Dimensions	45 x 120 x 87 (W x D x H in mm, without connectors)
Mounting	35 mm top-hat rail according to DIN EN 60715, vertical wall mounting, horizontal wall mounting
Protection level	IP 65 / IP 67

Power supply

Input voltage	24 V DC (18 ... 30 V DC)
Current consumption	100 mA at 24 V DC
Connections	Compatible with Han® 4A connector, redundant power supply

Ethernet Interface

Ports	5 x 10/100 Base-TX, twisted pair, data transmission rate 10 or 100 Mbit/s
Cable	Shielded twisted pair (STP) and unshielded twisted pair (UTP), Category 5
Cascade depth Linear / star structure	Any
Maximum cable length	100 m (with Category 5 cable) in accordance with EN 50 173-1
Available device	HARTING RJ Industrial® IP 67 Data 3A, HARTING RJ Industrial® IP 67 Push Pull, *HARAX*® M12-L with D-coding

Environmental conditions

Operating temperature range	-40 °C … +70 °C
Relative humidity for operation	30% to 95%, non-condensing

Mechanical stability

Shock / vibration	IEC 68-2-27-Ea / IEC 68-2-6-Fc

EMI

Interference immunity	EN 61000-4-2 … EN 61000-4-6
Interference emission	EN 50011, Class A

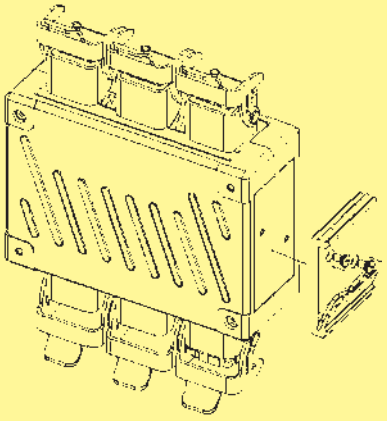
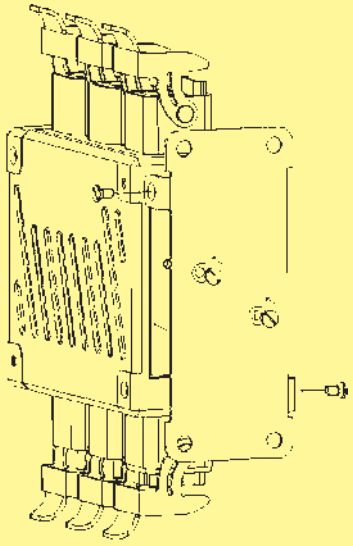
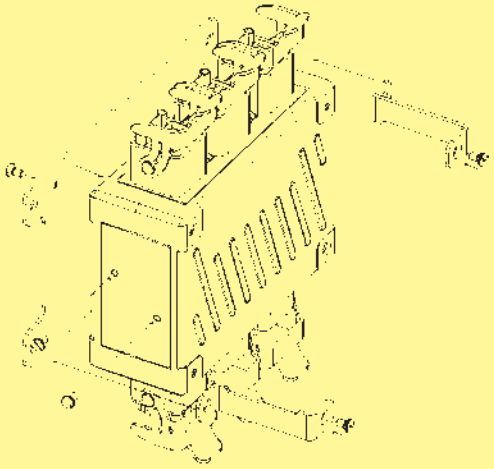
Ordering information

Switch type	Part No.	Specification
ESC 67-10 TP05U HARTING RJ Industrial® IP 67 Data 3A	20 70 305 3921	PROFInet
ESC 67-10 TP05U HARTING RJ Industrial® IP 67 Push Pull	20 70 305 3931	
ESC 67-10 TP05U M12 D-coding	20 70 305 3941	

Switch type	Identification	Part No. Power termination	Part No. Ethernet termination
ESC 67-10 TP05U HARTING RJ Industrial® IP 67 Data 3A			
	Straight metal hood, metric	19 20 003 1440[1)]	
	Protection cover Han® 3A	09 20 003 5422	09 20 003 5425
	Han® 4A female insert	09 20 004 2711	
	Metal cable gland IP 65, metric M20, cable diameter: 5 - 9 mm	19 00 000 5080	
	Connector set HARTING RJ Industrial® IP 67 Data 3A, metal		09 45 115 1100
	Coding pin set		09 45 820 0000
ESC 67-10 TP05U HARTING RJ Industrial® IP 67 Push Pull			
	HARAX® M12-L circular connector	21 03 212 2305	
	Connector set HARTING RJ Industrial® IP 67 Push Pull		09 45 145 1100
ESC 67-10 TP05U M12 D-coding			
	HARAX® M12-L circular connector	21 03 212 2305	
	HARAX® M12-L circular connector, shielded		21 03 281 1405
	Protection cover M12	21 01 000 0003	21 01 000 0003

Further connectors can be found in our catalogue “Heavy Duty Han® connectors”.

[1)] Order insert fixing screw 09 20 000 9918 separately

Identification	Part No.	Drawing
Set for top-hat rail mounting in accordance with DIN EN 60715	20 80 000 0003	
Set for vertical wall mounting	20 80 010 0001	
Set for horizontal wall mounting	20 80 010 0002	

General information

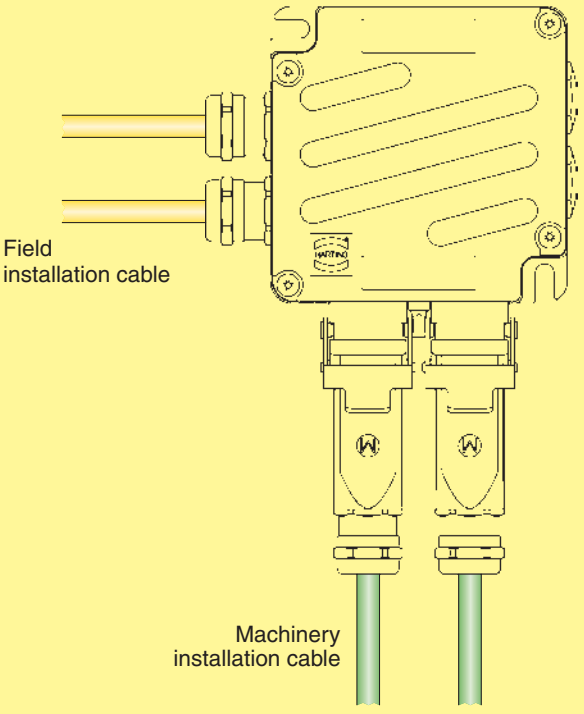
Industrial Outlet INO 67-30 TP02

General description

The Industrial Outlet permits a structured building cable link in accordance with ISO/IEC 11801 for industrial areas.

The Industrial Outlet INO 67-30 TP02 can be mounted very simply on walls or beams internally or externally. The proven LSA+ cable termination technology means that the cables can be installed quickly and easily. Lockable, plug-in RJ 45 cables make the work of extending the Ethernet network into the production level simple.

In the version with HARTING RJ Industrial® IP 67 Data 3A, the Industrial Outlet provides the interface to the Ethernet cabling as specified for PROFInet®.



Industrial Outlet for PROFInet®
(left hand cable entry selected)

Advantages

- High IP 65 / IP 67 protection level
- Robust metal housing
- Can be used directly in industrial environments
- Easy mounting on walls or beams
- LSA+ connection technology makes installation straightforward
- Optimum connector technology with high data security
- PROFInet® compatible

Technical characteristics

Mechanical data

Hood type	Robust metal hood of aluminium die-cast
Dimensions	105 x 120 x 42 (W x D x H in mm, without covers; without cable gland)
Mounting	Wall mounting
Weight	app. 0.6 kg
Protection level	IP 65 / IP 67

Ethernet Interface

Suitable for	Ethernet, Fast Ethernet
Transmission characteristics	In accordance to Category 5, ISO/IEC 11801:2002 and EN 50 173-1
Cable termination	2 x LSA+ connection technology 2 x mateable exit (RJ 45, fit for industrial use)
Available mating interfaces	HARTING RJ Industrial® IP 67 Data 3A *HARAX®* M12 with D-coding

Environmental conditions

Operating temperature range	0 °C … +55 °C
Relative humidity for operation	30% to 95%, non-condensing

Mechanical stability

Shock / vibration	IEC 68-2-27-Ea / IEC 68-2-6-Fc

EMI	Interference immunity	EN 61000-4-2 … EN 61000-4-6

Ordering information

Industrial Outlet type	Part No.	Specification
INO 67-30 TP02 HARTING RJ Industrial® IP 67 Data 3A with four cable entries	20 70 302 4921	PROFInet
INO 67-30 TP02 M12 D-coding with four cable entries	20 70 302 4941	

Industrial Outlet type	Identification	Part No.
INO 67-30 TP02 HARTING RJ Industrial® IP 67 Data 3A	Metal cable gland IP 65, metric M20, cable diameter: 5 - 9 mm	19 00 000 5080
	Metal blanking piece IP 65, metric M20	19 00 000 5070
	Connector set HARTING RJ Industrial® IP 67 Data 3A, metal	09 45 115 1100
	Coding pin set	09 45 820 0000
INO 67-30 TP02 M12 D-coding	Metal cable gland IP 65, metric M20, cable diameter: 5 - 9 mm	19 00 000 5080
	Metal blanking piece IP 65, metric M20	19 00 000 5070
	HARAX® M12-L circular connector, shielded	21 03 281 1405

Connectors

HARTING RJ Industrial®
Ethernet connector family

The modular HARTING RJ Industrial® family of connectors is based on the standard RJ 45 connector pattern, and is specifically developed for use in harsh industrial environments. It points the way forward in connecting Ethernet devices in industrial applications. In many circumstances it is necessary for connectors to be assembled on site, regardless of whether they are being used for power or communication. HARTING are making consistent use of their *HARAX*® rapid termination technology, which has been proven in many industrial applications. With *HARAX*® the user can terminate the cable at the connectors without the need for special tools. The design of the HARTING RJ Industrial® family of connectors allows for quick and easy termination and connection to Ethernet devices in either data only or hybrid networks.

HARTING RJ Industrial® is the only RJ 45 connector in the world that allows robust Ethernet cables with a solid and stranded AWG 22 cross section to be connected using IDC technology. The heart of each of these connectors is the RJ 45 data module with fast termination technology. This functions without needing to strip insulation from the cores and without special tools, creating a gas-tight connection, secure against vibration. The data module has four *HARAX*® fast termination contacts. These make reliable contact with stranded, industry-standard Category 5 cables with dimensions from AWG 22 to 24, and solid cables with conductor cross-sections from AWG 22 to 23.

HARTING have developed a complete family of connectors around this innovative data module, meeting all the needs of industrial environments. Solutions for IP 20 and IP 67 protection levels, standard, push pull and latching clip-locks are available.

Data and hybrid cables can be used. The user can fit stranded cores with a cross section of 1.5 mm² for the IDC power contacts on the Hybrid version, and these can be loaded with up to 16 A.

At the device end, panel feed throughs or couplings integrated directly into the device can be accomodated. Consistent application of SMD components for both data and power at the device end keeps manufacturing costs low, and permits high packing density within the assembly.

Field assembly of Industrial Ethernet connectors

The facility of on-site assembly was given high priority in the development of the new HARTING RJ Industrial® family of connectors. As a result, the connector is not just quicker to terminate, but is also easier to handle due to the reduced number of individual parts.

All of the HARTING RJ Industrial® range can be re-terminated up to ten times. An electrician can carry out assembly of the IP 20 Data version on site in less than one minute, while the IP 67 Hybrid version requires less than three minutes. Dismantling is just as quick. New operatives can also learn the individual steps involved very quickly and carry them out reliably.

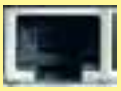
Another advantage of the quick-connection technology is provided by the industrial-quality screening of the data module in the connector. Termination of the screen which in the past has been achieved by crimping is no longer necessary. In the RJ Industrial connection technology, a pair of screening plates are simply pushed over the data module, and pressed together with an audible "click". With this, complete, 360 degree connection of the screen and the sheath is achieved.

Various special tools for handling the RJ 45 data module and the power leads are unnecessary. HARTING supplies all the components in a complete set.

Specified for PROFInet®

From the very beginning, HARTING saw it as their task to set a broad standard for Ethernet in industrial environments through a uniform connector solution. Through its involvement in the PNO (PROFIBUS Nutzerorganisation e.V.), the IAONA (Industrial Automation Open Networking Alliance e.V.), the DKE (Deutsche Kommission Elektrotechnik Elektronik Informationstechnik) and also with the IEC (International Electrotechnical Committee), HARTING contributed to advancing the specification of industry-standard Ethernet connectors. At the beginning of 2003, the PNO decided to use the HARTING solution of the RJ Industrial family as the general concept for PROFInet®.

In addition to this an international standardisation process was initiated, because the HARTING approach is not a proprietary system, but an open solution for Industrial Ethernet interfaces.

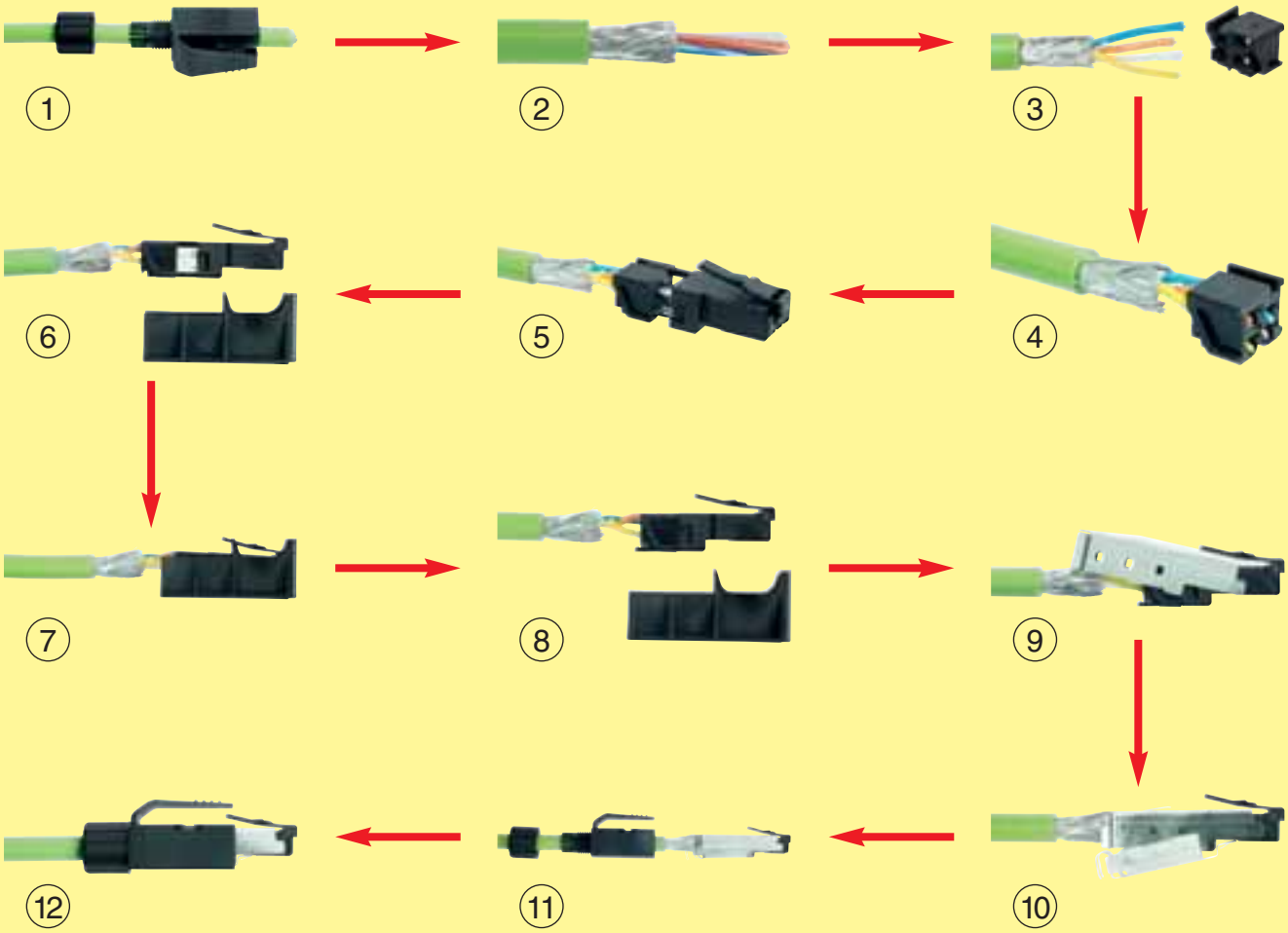
	Device side				
Cable side		IP 20 Data Standard RJ 45 jack 	IP 67 Push Pull 	IP 67 Hybrid 	IP 67 Data 3A 
	IP 20 Data 	✓	✓	✓	✓
	IP 67 Push Pull 		✓		
	IP 67 Hybrid 			✓	
	IP 67 Data 3A 			✓	✓

Mating compatibility of the HARTING RJ Industrial® family

Assembly operations
HARTING RJ Industrial® IP 20 Data

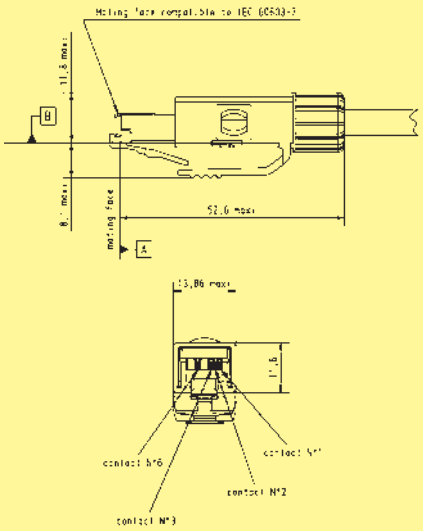
Only a few steps are necessary to quickly and reliably connect an Industrial Ethernet cable to a HARTING RJ Industrial® connector with IDC connection technology.

1. Push the housing complete with cable gland over the cable outer insulation
2. Strip the correct length of outer insulation and screening braid
3. Prepare the cores to match the splicing piece in accordance with the colour code
4. Insert the cores into the splicing piece to the required depth
5. Place the splicing piece on the RJ 45 data module and engage it
6. Place the data module and the splicing piece into the supplied IDC assembly tool
7. Press the data module and the IDC assembly tool together, to make the insulation displacement contact
8. Remove the assembled data module from the IDC assembly tool
9. Put on the upper screen plate, and push it over the cable screen
10. Put the lower screen plate in place, and latch it to the upper screen plate with an audible click
11. Push the housing over the assembled data module, latching it into place with an audible click
12. Tighten the cable gland



PROFInet

IP 20 Data connectors

Identification	Part No.	Drawing	Dimensions in mm
Connector set incl. housing, cable gland and instruction manual	09 45 151 1100		

Technical characteristics

Transmission properties in accordance with Category 5 ISO/IEC 11 801:2002 and EN 50173-1

Protection level:	IP 20
Mating interface:	RJ 45 in accordance with IEC 60603-7
Wire gauge data[1]:	AWG 22 - 24 stranded AWG 22 - 23 solid
Temperature range:	-40 °C … +70 °C
Cable sheath diameter:	6.5 mm - 6.9 mm
Mating cycles:	min. 750
Housing material:	Thermoplastic, black

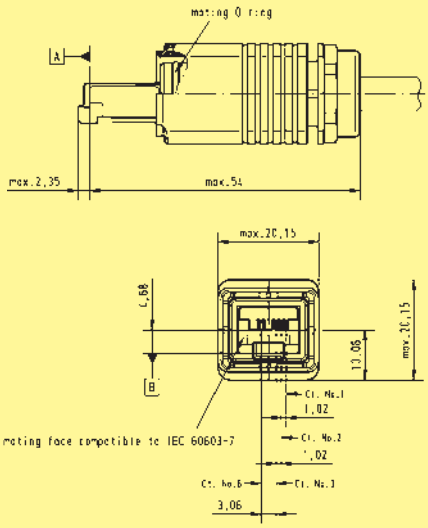
General information

The IP 20 Data connector is the smallest and only RJ 45 Ethernet connector in the world to which AWG-22 cables can be connected with IDC technology. The connector is designed with a standard grid of just 14 mm, which guarantees maximum packing density in the application. An additional latching clip on the housing makes its significantly easier to unlock the connector.

This connector can be assembled on site, permitting Industrial Ethernet installation cable to be connected directly to IP 20 devices located inside a control cabinet. Special panel feed through to provide the transition between protection level IP 67 and IP 20 is therefore not necessary. This lessens the installation work required from the customer, while the reduced number of contact points offers increased reliability.

[1] Details see technical data sheet

IP 67 Push Pull connectors

Identification	Part No.	Drawing	Dimensions in mm
Connector set incl. housing, cable gland and instruction manual	09 45 145 1100		

Technical characteristics

Transmission properties in accordance with Category 5 ISO/IEC 11 801:2002 and EN 50173-1

Protection level:	IP 67
Mating interface:	RJ 45 in accordance with IEC 60603-7
Wire gauge data[1]:	AWG 22 - 24 stranded AWG 22 - 23 solid
Temperature range:	-40 °C … +70 °C
Cable sheath diameter:	6.5 mm - 7.2 mm
Mating cycles:	min. 750
Housing material:	Thermoplastic, black

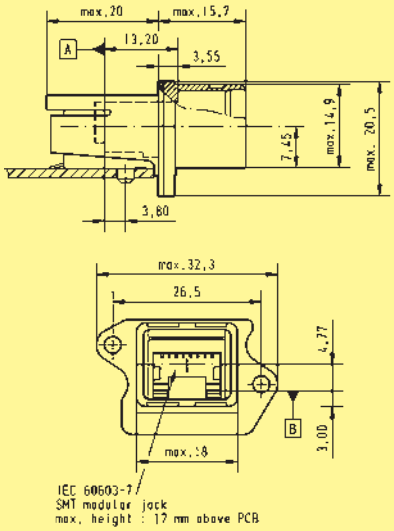
General information

The IP 67 Data version in a push pull housing is an entirely new development with innovative housing locking technology. The housing of the connector is locked tightly to the hood by means of a locking sleeve that surrounds it. The connector can be locked and unlocked using one hand and only minimal force. In spite of its high degree of protection, the housing is very compact, and is ideally suited for compact industrial applications.

The HARTING RJ Industrial® Push-Pull is thus the smallest IP 67 Industrial Ethernet connector based on RJ 45 with IDC connection technology in the world.

[1] Details see technical data sheet

IP 67 Push Pull panel feed through

Identification	Part No.	Drawing	Dimensions in mm
Panel feed through set incl. housing and instruction manual	09 45 245 1100		

Technical characteristics

Transmission properties in accordance with Category 5 ISO/IEC 11 801:2002 and EN 50173-1

Protection level:	IP 67
Mating interface internal and external:	RJ 45 jack in accordance with IEC 60603-7
Temperature range:	-40 °C … +70 °C
Panel cut out:	21 x 27 mm
Mating cycles:	min. 750
Housing material:	Thermoplastic, black

General information

The IP 67 Data version in a push pull housing is an entirely new development with innovative housing locking technology. The housing of the connector is locked securely to the hood by means of a surrounding locking sleeve. In spite of the high degree of protection, the panel feed through is very compact, having a space requirement of just 21 x 27 mm, the same space as for a M12 connector.

The Push Pull panel feed through is compatible with RJ 45 connectors, which means that standard patch cables for service and test purposes can also be used here.

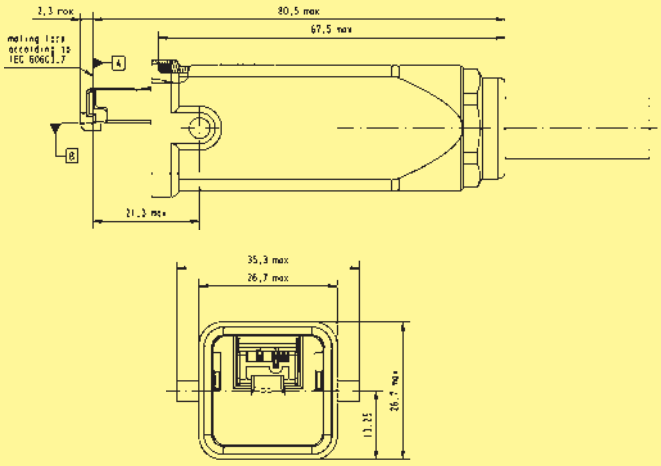
The data lines are connected at the rear via an RJ 45 jack meeting IP 20.

IP 67 Data 3A connectors

Identification	Part No.
Connector set incl. housing, cable gland and instruction manual	
Plastic version	09 45 125 1100
Metal version	09 45 115 1100
Coding pin set	09 45 820 0000

Drawing

Dimensions in mm



Technical characteristics

Transmission properties in accordance with Category 5 ISO/IEC 11 801:2002 and EN 50173-1

Protection level:	IP 67/65
Mating interface:	RJ 45 in accordance with IEC 60603-7
Wire gauge data[1]:	AWG 22 - 24 stranded AWG 22 - 23 solid
Temperature range:	-40 °C … +70 °C
Cable sheath diameter:	6.5 mm - 6.9 mm
Mating cycles:	min. 750
Housing material:	Thermoplastic, black Zinc die cast, grey

General information

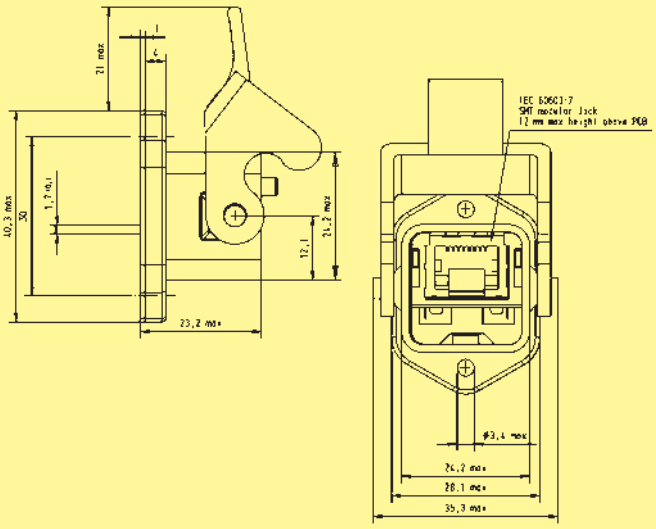
The IP 67 Data version of the RJ Industrial is based on the RJ 45 Data module, integrated into a standard Han® 3A industry housing that can be used for most industrial applications. The housing is optionally available in plastic or metal, and offers protection level IP 67/65.

Implementing a uniform pattern for all the connectors based on the Han® 3A contour for data and hybrid solutions means that all versions are plug-compatible for data signals. Optional coding prevents incorrect mating up to four different connectors.

[1] Details see technical data sheet

IP 67 Data 3A panel feed through

Identification	Part No.	Drawing	Dimensions in mm
Panel feed through set incl. housing and instruction manual			
Plastic version	09 45 225 1100		
Metal version	09 45 215 1100		
Coding pin set	09 45 820 0000		



Technical characteristics

Transmission properties in accordance with Category 5 ISO/IEC 11 801:2002 and EN 50173-1

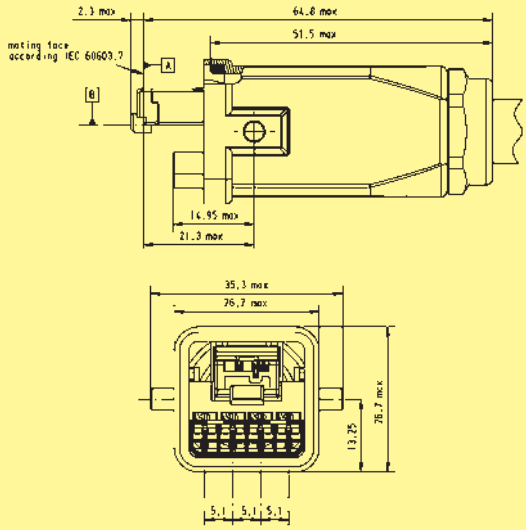
Protection level:	IP 67/65
Mating interface internal and external:	RJ 45 jack in accordance with IEC 60603-7
Panel cut out:	22 x 22 mm
Temperature range:	-40 °C … +70 °C
Mating cycles:	min. 750
Housing material:	Thermoplastic, black Zinc die cast, grey

General information

The IP 67 panel feed through data version of the RJ Industrial is based on an RJ 45 jack, integrated into a Han® 3A housing that can be used for most industrial applications. The housing is optionally available in plastic or metal, and offers protection level IP 67/65.

Implementing a uniform plug pattern for all the connectors based on the 3A contour for data and hybrid solutions means that all versions are plug-compatible for data signals. Optional coding prevents incorrect mating up to four different connectors. The panel feed through is compatible with RJ 45 connectors, which means that standard patch cables for service and test purposes can be used. The data lines are connected at the rear via an RJ 45 jack meeting IP 20.

IP 67 Hybrid connectors

Identification	Part No.	Drawing	Dimensions in mm
Connector set incl. housing, cable gland and instruction manual	09 45 125 1300		

Technical characteristics

Transmission properties in accordance with Category 5 ISO/IEC 11 801:2002 and EN 50173-1

Protection level:	IP 67
Mating interface:	RJ 45 in accordance with IEC 60603-7 plus 4 x power supply
Wire gauge data:	AWG 22 - 24 stranded AWG 22 - 23 solid
Wire gauge power supply:	1.5 mm² stranded
Working voltage power supply:	24 V
Working current power supply:	16 A
Temperature range:	-40 °C … +70 °C
Cable sheath diameter:	10 mm - 11 mm
Mating cycles:	min. 500
Housing material:	Thermoplastic, black

General information

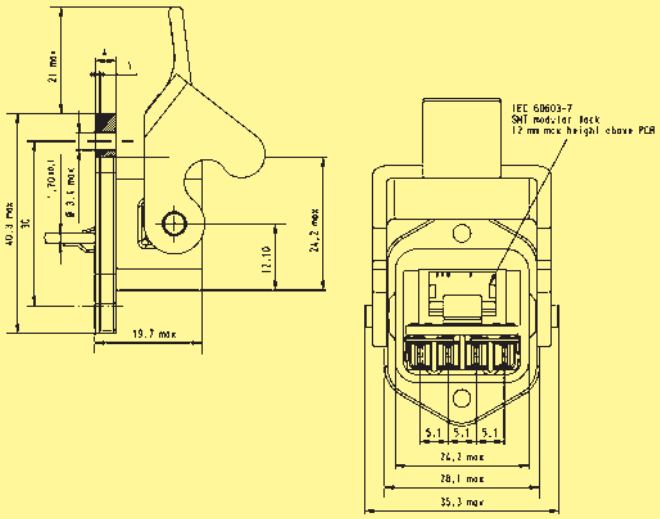
In the RJ Industrial Hybrid connector, HARTING has developed an interface solution that integrates the data lines and the power supply into one connector for hybrid Ethernet networks. The connector's geometry nevertheless maintains a clear separation between the data and the power contacts. This brings a significant reduction in the costs of installation and of field devices suitable for industrial application with hybrid cabling.

The four power contacts of the hybrid module have also been designed with *HARAX*® rapid termination technology, allowing stranded cables of up to 1.5 mm² to be connected.

The physical length of the hybrid IP 67 version of the industry standard Han® 3A housing has been reduced by 30 per cent, making it significantly easier to handle and to use in compact industrial applications.

PROFInet

IP 67 Hybrid panel feed through

Identification	Part No.	Drawing	Dimensions in mm
Panel feed through set incl. housing and instruction manual	09 45 225 1300		
Coding pin set	09 45 820 0000		

Technical characteristics

Transmission properties in accordance with Category 5 ISO/IEC 11 801:2002 and EN 50173-1

Protection level:	IP 67
Mating interface external:	RJ 45 jack in accordance with IEC 60603-7 plus 4 x power supply
Mating interface internal:	RJ 45 jack in accordance with IEC 60603-7 plus 4 x power supply with cage clamp 1.5 mm²
Working voltage power supply:	24 V
Working current power supply:	16 A
Panel cut out:	22 x 22 mm
Temperature range:	-40 °C … +70 °C
Mating cycles:	min. 500
Housing material:	Thermoplastic, black

General information

In the RJ Industrial Hybrid connector, HARTING has developed an interface solution that integrates the data lines and the power supply into one connector for hybrid Ethernet networks. The connector's geometry nevertheless maintains a clear separation between the data and the power contacts. This brings a significant reduction in the costs of installation and of field devices suitable for industrial application with hybrid cabling.

The panel feed through is compatible with RJ 45 connectors, which means that the standard patch cables for service and test purposes can be used. The data lines are connected at the rear via an RJ 45 jack, while the power lines use a cage clamp terminal.

M12-L, shielded

Transmission characteristics in accordance with DIN 50 173-1

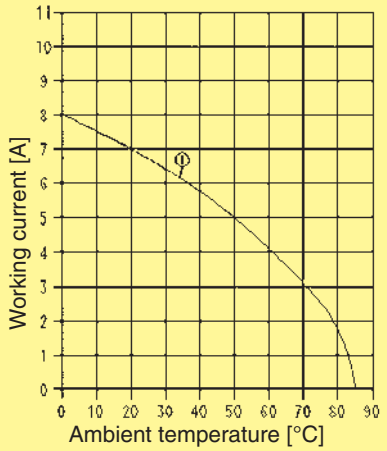
Working voltage	32 V
Working current (see current carrying capacity)	4 A
Coding	D
Wire gauge	0.25 mm² - 0.34 mm² AWG 24 - AWG 22 stranded
Diameter of individual strands	> 0.1 mm
Conductor insulation material	PVC
Conductor diameter	1.2 mm - 1.6 mm
Cable diameter	5.5 mm - 7.2 mm
Working temperature	-25 °C ... +85 °C
Temperature during connection	-5 °C ... +50 °C
Protection level	IP 67
Number of terminations with same cable cross section	10

Current carrying capacity

The current carrying capacity is limited by maximum temperature of materials for inserts and contacts including terminals. The current capacity-curve is valid for continuous, not interrupted current-loaded contacts of connectors when simultaneous power on all contacts is given, without exceeding the maximum temperature.

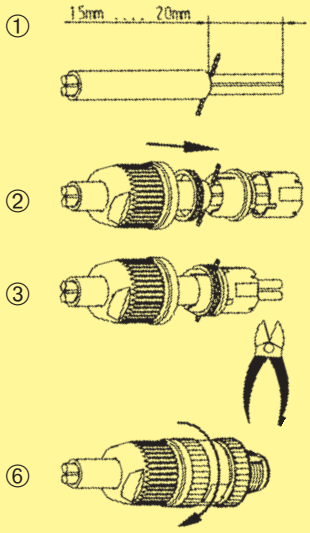
Control and test procedures according to DIN IEC 60 512-3.

M12-L, shielded



1 = Wire gauge 0.34 mm²

Assembly details

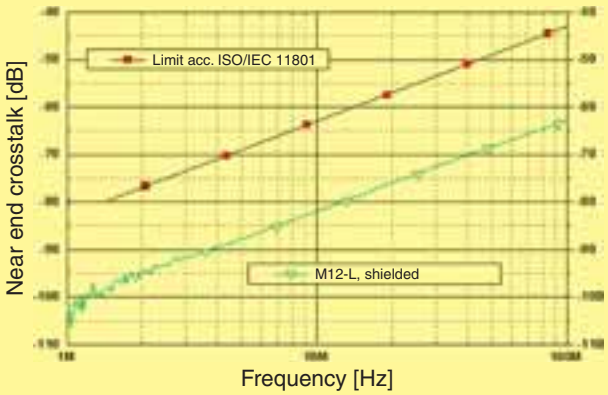


1. Remove cable sheath
2. Put screening braid in place, and fix with sliding ring
3. Assemble *HARAX*® elements
4. Cut off the ends of the cables at the splicing ring and the screening braid at the sliding ring
5. Screw tight
6. The coupling ring must be screwed as far as the stop on the contact carrier.

Attention!
For reconnection cut off the used cable end and repeat steps 1 to 6.

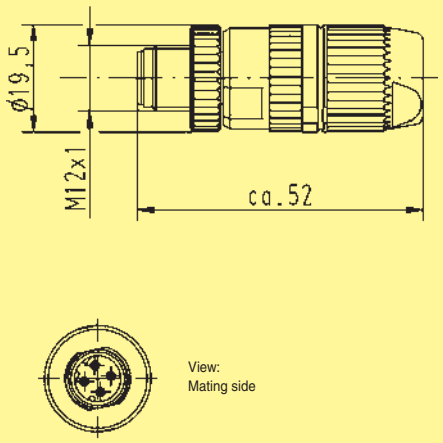
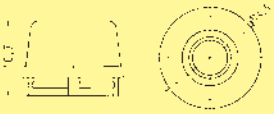
General information

Screening attenuation diagram



The *HARAX*® principle

- The cores are terminated automatically by screwing the coupling ring onto the contact carrier. This guides the cores through ducts in the splicing ring, positioning them accurately. A new design of insulation displacement contact blade, guided by contact ducts permits the individual cores to be terminated reliably.
- The screening braid is passed laterally through the slotted seal, and is fixed by a sliding ring. The sliding ring provides a transition between the screen and the housing.
- After tightening the coupling ring, the sealing ring provides cable strain relief and protection to IP 67 against dust and water spray.

Identification	Series	No. of contacts	Part No.	Drawing	Dimensions in mm
Circular connector M12-L, shielded male D-coding for Ethernet straight version	M12	4	21 03 281 1405		
Seal M12-L	M12		21 01 010 2003		

4 contacts + screening
+ 2 power contacts
For use in Han® 3A hoods with metric cable gland

Description

The Han-Brid® series combines a data and power interface for industrial communication in the smallest possible space.

The components in this hybrid connector family all contain the facility to load power contacts rated at 50 V 10 A to provide a power supply for distributed devices. This means that a power supply can be provided to all devices in a bus structure via a single connector.

- Han-Brid® Quintax 3A for 4-wire bus systems and Ethernet networks with continuous screen connection.

The contact inserts can be used either in the standard plastic housing or the metal housing from the Han® 3A series. The protection level of the housings corresponds to DIN EN 60 529, IP 65.

Power supply

- Standard Han D® male and female crimp contacts
- Rated current: 10 A
- Rated voltage: 50 V
- Connection range: 0.14 to 2.5 mm² stranded
- Approval: UL

Data interface

- Can be connected to screened 4-wire cables
- Can be used for all 4-wire bus systems
- Accepts screened cable with a diameter from 3 to 9.5 mm
- Continuity of screen is independent of housing potential
- Cable connection in accordance with DIN EN 50 173, Category 5

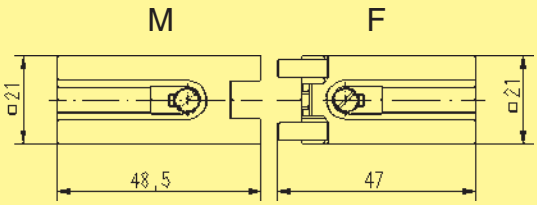
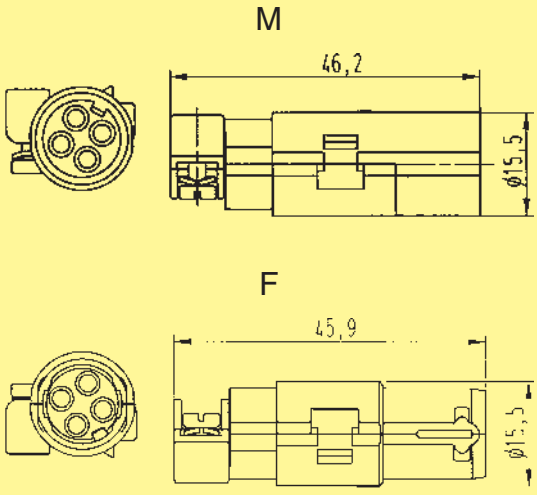
Technical characteristics

Transmission properties in accordance with Category 5 ISO/IEC 11 801:2002 and EN 50173-1

Protection level	IP 65
Wire gauge data:	0.14 - 2.5 mm² stranded AWG 26 - 14
Wire gauge power supply:	0.14 - 2.5 mm² stranded AWG 26 - 14
Temperature range:	-40 °C … +70 °C
Cable sheath diameter:	3 mm - 9.5 mm
Mating cycles:	≥ 500

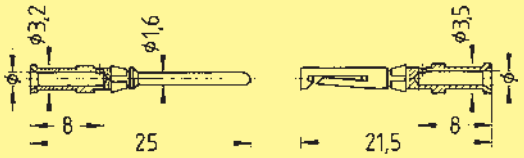
Han-Brid® Quintax 3A

4 contacts + screening
+ 2 power contacts
For use in Han® 3A hoods with metric cable gland

Identification	Cable-Ø mm	Part No. Male insert (M)	Part No. Female insert (F)	Drawing	Dimensions in mm
Quintax insert	–	09 15 003 3001	09 15 003 3101		
Quintax Z contact Zinc alloy Order crimp contacts separately see page 02.16	3 - 9,5	09 15 004 3013	09 15 004 3113		
Cable clamp for cable diameter 3 - 6 and 6 - 9.5 mm is supplied with the inserts					

Identification	Wire gauge (mm²)	Part No. Male contacts	Part No. Female contacts
Crimp contacts			
silver plated	0.14-0.37	09 15 000 6104	09 15 000 6204
	0.5	09 15 000 6103	09 15 000 6203
	0.75	09 15 000 6105	09 15 000 6205
	1.0	09 15 000 6102	09 15 000 6202
	1.5	09 15 000 6101	09 15 000 6201
	2.5	09 15 000 6106	09 15 000 6206
gold plated	0.14-0.37	09 15 000 6124	09 15 000 6224
	0.5	09 15 000 6123	09 15 000 6223
	0.75	09 15 000 6125	09 15 000 6225
	1.0	09 15 000 6122	09 15 000 6222
	1.5	09 15 000 6121	09 15 000 6221
	2.5	09 15 000 6126	09 15 000 6226

Drawing / Dimensions in mm



Wire gauge (stranded)		ø	Stripping length
0.14-0.37 mm²	AWG 26-22	0.90 mm	8 mm
0.5 mm²	AWG 20	1.10 mm	8 mm
0.75 mm²	AWG 18	1.30 mm	8 mm
1 mm²	AWG 18	1.45 mm	8 mm
1.5 mm²	AWG 16	1.75 mm	8 mm
2.5 mm²	AWG 14	2.25 mm	6 mm

Identification	Wire gauge (mm²)	Part No.	
HARTING-crimping tool with locators for all Han D® contacts 0.14 - 1.5 mm²		09 99 000 0021	
BUCHANAN-crimping tool for all Han D® contacts 0.14 - 4.0 mm²		09 99 000 0001	
Locator		09 99 000 0311	
Plug gauge			
	0.14-0.25	09 99 000 0203	
	0.37	09 99 000 0125	
	0.5-1.0	09 99 000 0007	
	1.5	09 99 000 0008	
	2.5	09 99 000 0007	
Removal tool for Han D® contacts		09 99 000 0012	

Accessories




Hoods

- Han® 3A hood with integral sealing – Protection level: IP 65
  IP 67 under preparation
- Plastic versions
- Metal versions
- EMC versions
- Han® HPR (pressure tight and EMI protected)
- Han-Brid® Quintax can be fitted exclusively in hoods with metric threads

Further information can be found in our catalogue “Heavy Duty Han® connectors”

Identification		Part No.	Drawing	Dimensions in mm
Hood				
straight, metric	Plastic grey	19 20 003 0423[1)]		
	Plastic black	19 20 003 0426[1)]		
	Metal	19 20 003 1443[1)]		
	HPR	19 40 003 0400		
Hood				
right angled, metric	Plastic grey	19 20 003 0623[1)]		
	Plastic black	19 20 003 0626[1)]		
	Metal	19 20 003 1643[1)]		
Housing				
	Plastic grey	09 20 003 0320		
	Plastic black	09 20 003 0327		
	Metal	09 20 003 0301		
	HPR	09 40 003 0301		
Cable to cable hood				
metric	Plastic grey	19 20 003 0720		
	Plastic black	19 20 003 0727		
	Metal	19 20 003 1750		
Cable gland				
metric, M20,				
cable-Ø 5 - 9 mm	Plastic grey, IP 65	19 00 000 5180		
cable-Ø 5 - 9 mm	Metal, IP 65	19 00 000 5080		
cable-Ø 6 - 12 mm	Plastic black, IP 65	19 00 000 5132		
Protection cover Han® 3A				
	Plastic black	09 20 003 5409[1)]		
	Metal	09 20 003 5425[1)]		

[1)] with integral sealing

System cables

Cable for Industrial Ethernet

Description	Part No.	Technical characteristics
Industrial Ethernet Shielded Twisted Pair Standard Cable meeting the Category 5 cabling standard. Specially for industrial applications in structured cabling of Ethernet networks. Radially symmetrical structure, with four solid AWG 22/1 cores arranged as star quad. Particularly good immunity to electro-magnetic interference through double screening. The cable is specially designed for assembly to the HARTING RJ Industrial® family of connectors. Length: 100 m reel	09 45 600 0100	**Electrical properties** Cabling standard in accordance with ISO/IEC 11801:2002: Category 5 Loop resistance: max. 124 Ohm / km Insulation resistance: min. 500 MOhm x km Characteristic impedance at 1 MHz .... 100 MHz: (100 ± 15) Ohm Near end crosstalk attenuation at 100 MHz (typical): 50 dB / 100 m Far end crosstalk attenuation at 100 MHz (typical): 45 dB / 100 m Attenuation coefficient at 100 MHz (typical): 19.5 dB / 100 m **Mechanical properties** Wire type: 2YY(ST)CY 2X2X0.64/1.5-100 GN Sheath: PVC green dia. (6.5 ± 0.2) mm Cores: solid, AWG 22/1 (dia. 0.64 mm) Core colour sequence: white - yellow - blue - orange Service temperature: -40 °C … +70 °C Installation temperature: -20 °C … +60 °C Storage/transport temperature: -40 °C … +70 °C Minimum bending radius: Multiple bending 15 x diameter One time 10 x diameter Max. permissible tension: 150 N

Cable for Industrial Ethernet

Description	Part No.	Technical characteristics
Industrial Ethernet Shielded Twisted Pair Trailing Cable meeting the Category 5 cabling standard. Specially designed for industrial application of Ethernet cables in power chains and moving machine parts. Radially symmetrical structure, with four stranded AWG 22/7 cores arranged in star quad format. Particularly good immunity to electromagnetic interference through double screening. This cable is specially designed for assembly to the HARTING RJ Industrial® family of connectors. Halogen-free and silicone-free polyurethane (PUR) external sheath. Length: 100 m reel	09 45 600 0101	**Electrical properties** Cabling standard in accordance with ISO/IEC 11801:2002: Category 5 Loop resistance: max. 120 Ohm / km Insulation resistance: min. 500 MOhm x km Characteristic impedance at 1 MHz .... 100 MHz: (100 ± 15) Ohm Near end crosstalk attenuation at 100 MHz (typical): 50 dB / 100 m Far end crosstalk attenuation at 100 MHz (typical): 45 dB / 100 m Attenuation coefficient at 100 MHz (typical): 22 dB / 100 m **Mechanical properties** Wire type: 2YH(ST)C11Y 2X2X0.75/1.5-100 LI GN VZN FRNC Sheath: PVC green dia. (6.5 ± 0.2) mm Cores: stranded, AWG 22/7 (dia. 0.75 mm) Core colour sequence: white - yellow - blue - orange Service temperature: -40 °C … +70 °C Installation temperature: -20 °C … +60 °C Storage/transport temperature: -50 °C … +70 °C Minimum bending radius: Multiple bending 15 x diameter One time 10 x diameter Max. permissible tension: 150 N

Cable assemblies for Industrial Ethernet

Description			Part No.	Technical characteristics	
Assembled and Tested System Cables for the structured cabling of Industrial Ethernet networks in accordance with the PROFInet® guideline, based on RJ 45 connectors and AWG 22/1 (solid) Shielded Twisted Pair Cable.				Cable type:	HARTING RJ Industrial® Ethernet Shielded Twisted Pair Standard Cable, AWG 22/1 (solid)
				Mating face:	RJ 45 in acc. with IEC 60603-7
				Transmission properties in accordance with ISO/IEC 11 801:2002:	Class D, 100% tested
IP 20	Length:	1.5 m	09 45 751 1123	Connectors:	2x HARTING RJ Industrial® IP 20 Data with IDC fast termination technology
		3.0 m	09 45 751 1125		
		5.0 m	09 45 751 1127	Protection level:	IP 20
		10.0 m	09 45 751 1151		
		20.0 m	09 45 751 1153		
		50.0 m	09 45 751 1156		
		100.0 m	09 45 751 1161		

Pin assignment in accordance with PROFInet® specification:

Signal	Function	Conductor colour	RJ 45 pin no. right	RJ 45 pin no. left
TD+	Transmission Data+	Yellow	1	1
TD-	Transmission Data-	Orange	2	2
RD+	Receiver Data+	White	3	3
RD-	Receiver Data-	Blue	6	6

Further system cables available on request.

Cable assemblies for Industrial Ethernet

Description			Part No.	Technical characteristics	
Assembled and Tested System Cables for the structured cabling of Industrial Ethernet networks in accordance with the PROFInet® guideline, based on RJ 45 connectors and AWG 22/1 (solid) Shielded Twisted Pair Cable.				Cable type:	HARTING RJ Industrial® Ethernet Shielded Twisted Pair Standard Cable, AWG 22/1 (solid)
				Mating face:	RJ 45 in acc. with IEC 60603-7
				Transmission properties in accordance with ISO/IEC 11 801:2002:	Class D, 100% tested
IP 65 / 67	Length:	1.5 m	09 45 715 1123	Connectors:	2x HARTING RJ Industrial® IP 67 Data 3A metal with IDC fast termination technology
metal		3.0 m	09 45 715 1125		
		5.0 m	09 45 715 1127	Protection level:	IP 65 / 67 (when mated)
		10.0 m	09 45 715 1151		
		20.0 m	09 45 715 1153		
		50.0 m	09 45 715 1156		
		100.0 m	09 45 715 1161		

Pin assignment in accordance with PROFInet® specification:

Signal	Function	Conductor colour	RJ 45 pin no. right	RJ 45 pin no. left
TD+	Transmission Data+	Yellow	1	1
TD-	Transmission Data-	Orange	2	2
RD+	Receiver Data+	White	3	3
RD-	Receiver Data-	Blue	6	6

Further system cables available on request.

Production plants – worldwide

Espelkamp / Germany – Plant 1

Espelkamp / Germany – Plant 2

Espelkamp / Germany – Plant 3

Espelkamp / Germany – Plant 4

Espelkamp / Germany – Plant 5

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