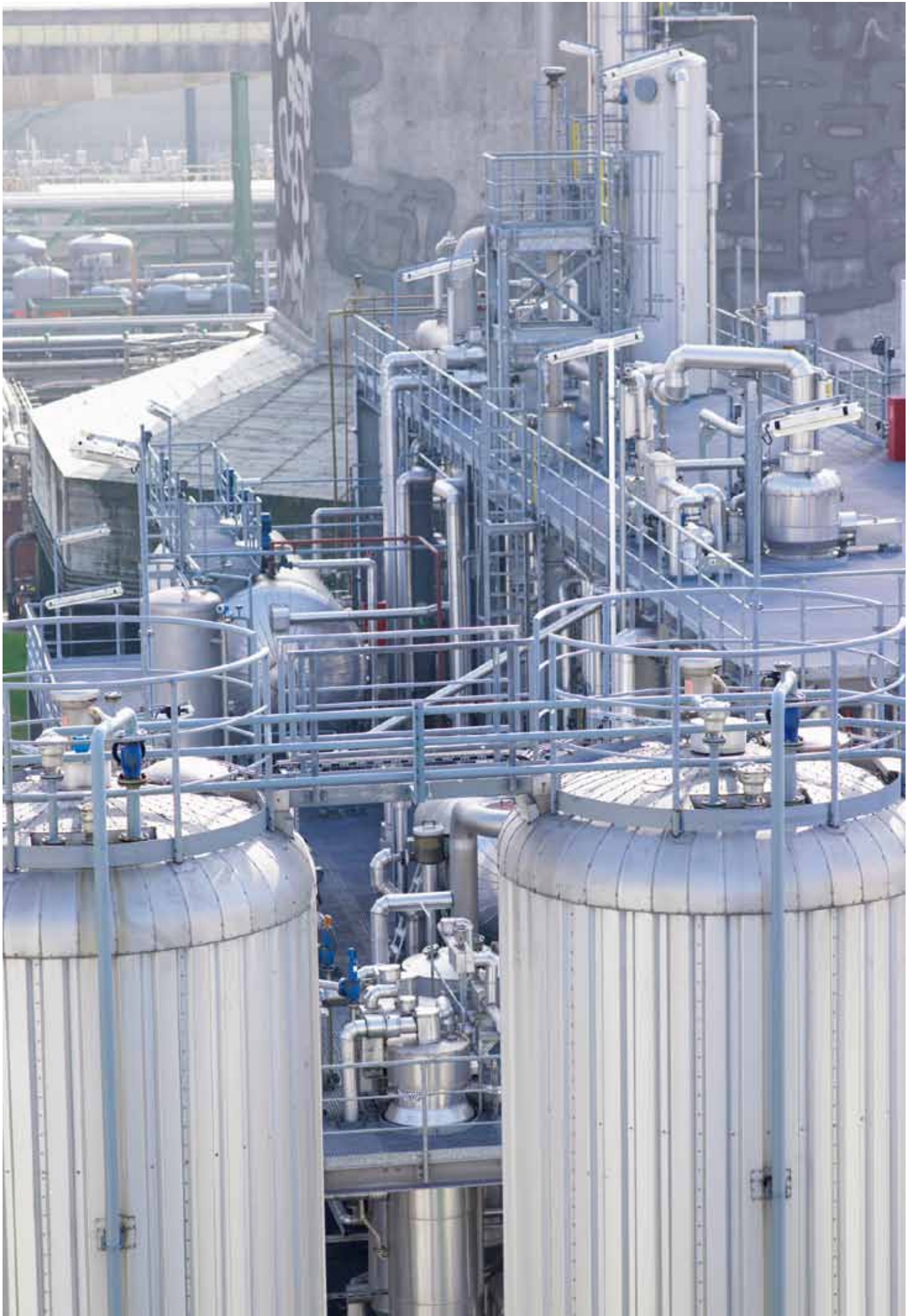# Freelance
The hybrid process control system
System description

Contents

Freelance:
The hybrid process control system

Freelance, the hybrid process control system combines the best of both worlds, DCS and PLC. It offers PLC size and price with functionality of a DCS. The integrated environment facilitates engineering, commissioning, maintenance and fieldbus management. The intuitive operator interface enables easy operation and diagnostics of the entire system.

The objective of process industry companies today is clearly defined: increased automation at lower cost.

Today, people are impressed by the global success story of Freelance, with more than 15,000 applications covering almost all sectors of industry.

Freelance provides powerful automation that is not only cost-effective in terms of hardware and software, but is also very easy to use. The advanced design of Freelance makes the system ideal for numerous applications in power, process or environmental technology plants.

Cost cutting is the essential benchmark for engineering tools. With Freelance this scenario is filled with several items:

– Use of only one engineering tool (Control Builder F) to configure the entire system, consisting of automation functions, graphics, the operator interface, fieldbus lines (Profibus, Foundation Fieldbus, HART, etc.), and field devices
– Automatic generation of the entire communication between controllers and operator stations
– System-wide single source data treatment for controllers, operator stations, and field devices, leading to data consistency within the entire system
– Uniform, system-wide plausibility check of user programs covering all process and operator stations up to intelligent field devices. The plausibility check includes the formal check for completeness and consistency of the user programs
– Graphical configuration with high-performance editors in programming languages according to IEC 61131-3
  – Function block diagram (FBD)
  – Ladder diagram (LD)
  – Instruction list (IL)
  – Sequential function chart (SFC)
  – Structured text (ST)
– Extensive function block library, to which user defined function blocks can be added; macro libraries and graphic symbols to create graphics and faceplates for user defined function blocks

Hydro power plant Ryburg-Schwörstadt

– Integration of any PROFIBUS-DP and PA slave using the concept of the generic slave (via a GSD-file) with the possibility of configuring these components in user-defined dialogs
– Integration of PROFIBUS devices using FDT technology
– And finally by reusing well tested solution again and again

The same user-friendly configuration and support features also apply to operation. The operator is supported by a mechanism providing not only information from the plant but also operating hints, which can serve as simplified SOP (Standard Operating Procedure). For this purpose, for example, an intuitive operator interface, logs, and sophisticated alarm and message management function are available.

The quality of Freelance is also reflected in the robust hardware.

In cases where demands on availability are particularly high, it is possible to configure the controller including the modules

redundantly. Fieldbus lines, the system bus, and the operator stations can also be configured redundantly. Redundant configuration is done without any additional engineering effort.

The Freelance control system provides powerful automation that is cost-effective and easy to use. Freelance is ideally suited to applications requiring simple handling and attractively-priced hardware and software in power, process or environmental industry.

It is a sound investment in the future, with a straightforward and clearly designed system based on the motto:

Minimum engineering – maximum automation

System architecture

Freelance provides an operator level and a process level. The operator level contains the functions for operation and observation, archives and logs, trends and alarms. Open-loop and closed-loop control functions are processed in the controllers which communicate with actors and sensors in the field.
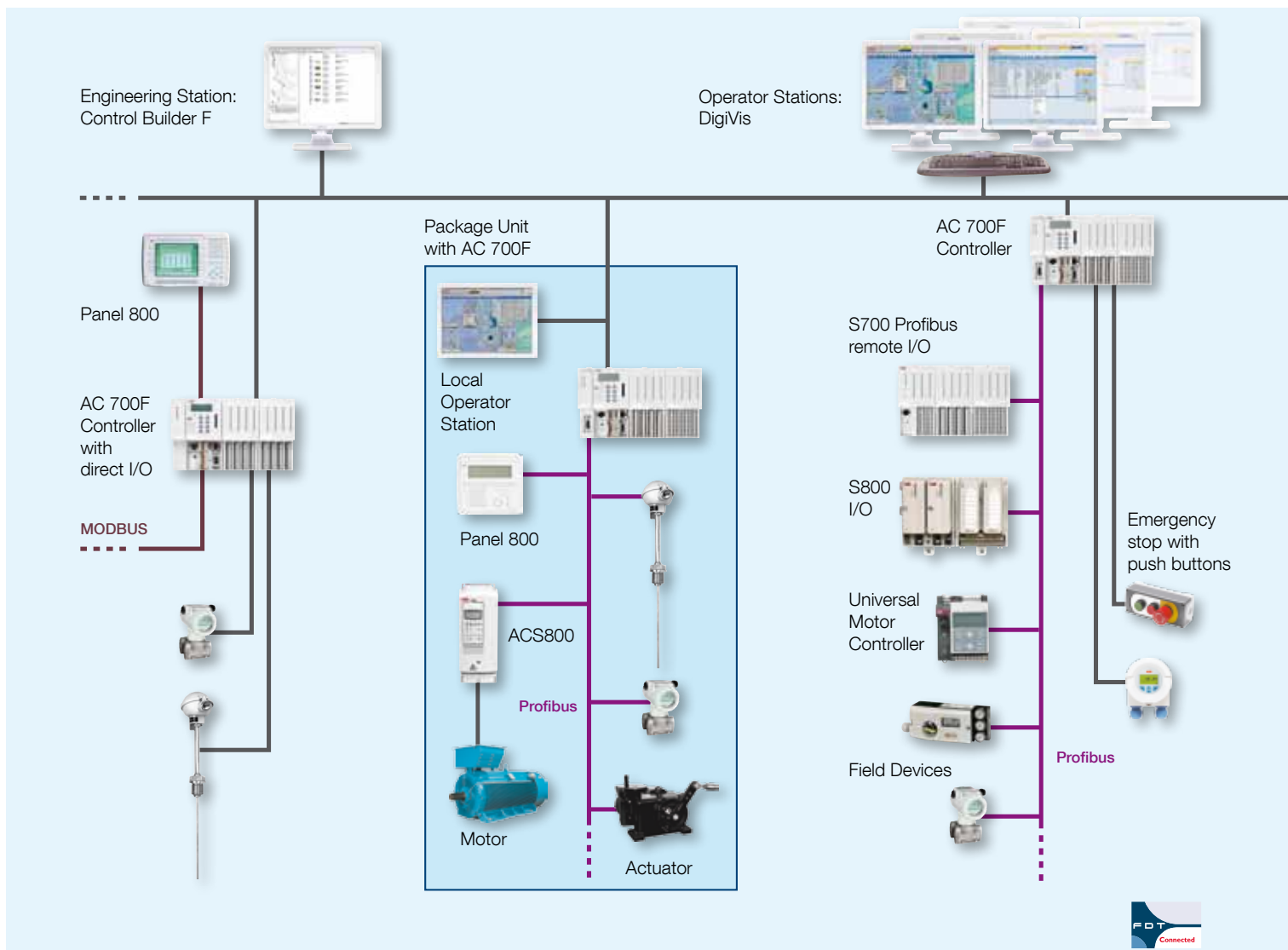
The DigiVis operator level
The DigiVis operator stations use PC hardware, either standard or industrialized in line with the application, running under the Microsoft Windows operating system. DigiVis supports dual-monitor operation, which offers the benefit to stay continuously tuned with essential information like the alarm list, while inspecting at the same time the progress of a sequential function chart.

The Control Builder F engineering station is used to configure and commission the system. Usually, portable equipment such as laptops, which allow configuration both in the office and on site, is used. The operator level PCs can also be used as engineering station. A permanent connection to the engineering system is not necessary.

The Freelance process level
A Freelance system can consist of between one and several AC 700F and AC 800F controllers and can be extended with different types of I/O units. You have the option of configuring your system either standard or fully redundant.

AC 700F is meant for applications with up to 300 I/O signals per AC 700F controller. This PLC-like controller comes with a very small footprint. S700 direct I/O modules can be directly plugged to the controller module. The connection to the

Engineering Station:
Control Builder F

Operator Stations:
DigiVis

Panel 800

AC 700F
Controller
with
direct I/O

MODBUS

Package Unit
with AC 700F

Local
Operator
Station

Panel 800

ACS800

Profibus

Motor

Actuator

AC 700F
Controller

S700 Profibus
remote I/O

S800
I/O

Universal
Motor
Controller

Field Devices

Emergency
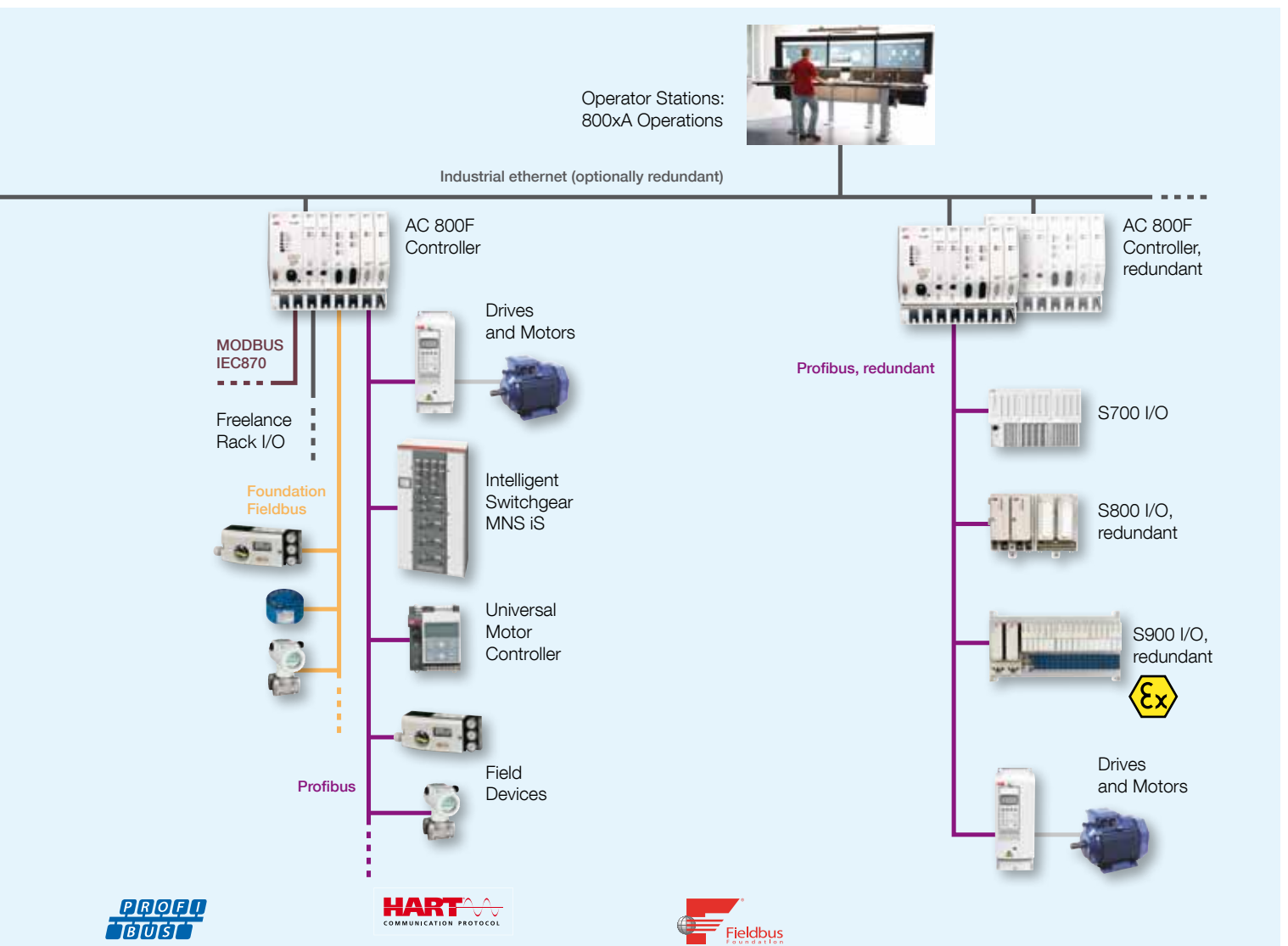stop with
push buttons

Profibus

Freelance control network is achieved via Ethernet as for all other controllers. This allows among other advantages to place AC 700F directly in the field where needed, offering a very flexible and cost-effective solution when intelligent I/O modules are needed. S700 I/O modules can also be connected via Profibus. This allows for high flexibility in installation.

AC 800F can be equipped with a set of fieldbus modules, covering all major fieldbuses used in process automation. With AC 800F you have the option to run these controllers either redundantly (CPU redundancy, fieldbus module redundancy) or non-redundantly. With both controllers, fieldbus-compliant components such as remote I/O, field devices, and network components can be used. ABB offers equipment for standard and hazardous area applications.

System communication

The operator and the process level communicate via the control network, which is based on Standard Ethernet. You can choose between various transmission media such as twisted pair or fiber optic cable. The system components use a specific protocol called DMS, which is an enhanced MMS (Machine Message Specification) protocol. This protocol can be utilized by 3rd party network subscribers using the application interface DMS-API. This is a „C" programming interface for MS Windows to enable programmers to create tailored solutions. A more standardized and generic approach to connect to the system is provided by the Freelance OPC server to access real-time process values (DA) and alarms/events (AE) from the Freelance system.

The PLC Integration feature for DigiVis allows for integration of 3rd-party systems into Freelance via OPC.

Operator Stations:
800xA Operations

Industrial ethernet (optionally redundant)

AC 800F Controller

AC 800F Controller, redundant

MODBUS IEC870

Freelance Rack I/O

Profibus, redundant

S700 I/O

Drives and Motors

Foundation Fieldbus

Intelligent Switchgear MNS iS

S800 I/O, redundant

Universal Motor Controller

S900 I/O, redundant

Profibus

Field Devices

Drives and Motors

PROFIBUS

HART COMMUNICATION PROTOCOL

Fieldbus Foundation

The controllers

AC 800F Controller

AC 700F Controller

The process level is the domain of controllers. Together with the enginering tool, their functions and modularity define the ease of use, scalability, and performance of a DCS system. Freelance comes with two different types of controllers, AC 700F and AC 800F.

A Freelance system can consist of one or several AC 700F and/or AC 800F controllers. It can be extended with fieldbuses, field devices and remote I/Os. With AC 800F you have the option of configuring your system optionally redundant.

AC 700F, which comes along with a very small footprint, is particularly suitable for small applications consisting of very few to several hundred I/O signals. Applications can easily be distributed to several controllers. Up to eight direct S700 I/O modules can be plugged to the controller. AC 700F can also be extended with Profibus Remote I/O units. AC 800F stands for "field controller". A single controller is able to feed several fieldbus lines running the main fieldbuses of process industries, Modbus, Profibus and Foundation Fieldbus. And for sure, via intelligent remote
I/Os the HART protocol is supported as well.

Both controller types can be used side by side within a project and can easily communicate with each other via the Ethernet based control network. The Engineering is performed with one engineering tool, Control Builder F. All function blocks and pre-engineered functions are available for both controllers in the same way.

AC 700F
The AC 700F controller comes in a really small footprint and with high signal density of S700 I/O. The S700 I/O modules are directly connected to the controller via a physical connection. A maximum of eight modules can be connected to one controller.

S700 Remote I/O can also be connected via Profibus. Of course, any other Profibus remote I/O can be connected.

In addition, field devices can be connected to AC 700F. Thanks to the flexibility of Ethernet and its small footprint, AC 700F can also be placed in junction boxes in non-hazardous areas out in the field as competitive, intelligent Ethernet I/O.

The AC 700F controller, as a member of Freelance, has numerous advantages over a PLC based solution: The hybrid process control system simplifies engineering, commissioning, and maintenance of the automation system. Visualization is directly incorporated into the engineering, making configuration particularly straightforward. Small or distributed plant components can now be implemented cost effectively by using AC 700F. The competitive advantage is clear: the same engineering, operation and maintenance method for all plant components hand in hand with the well-known ease of use of Freelance.

The AC 700F hardware

AC 700F comes with a modular design. The base elements are different types of terminal units, for the CPU module and for S700 I/O modules. Both, screw type and spring type terminal units are available. The modules can be easily plugged to the terminal units and then the terminal units can be plugged one to the other. The entire controller and the I/O modules are then mounted on a DIN rail.

The CPU and the local S700 I/O modules communicate very fast. I/O scan times of 2 ms are possible. Short circuit and line break detection is realized for each channel. The temperature range of AC 700F extends from 0° to 60° C (32 °F .. 140 °F). Certificates according to CE, UL, and GL enables AC 700F to be used in a wide variety of applications. S700 I/O can be connected directly to the controller, or remote via Profibus. See "S700 I/O Modules" on page Seite 17 for details.

AC 700 CPU plugged on terminal unit

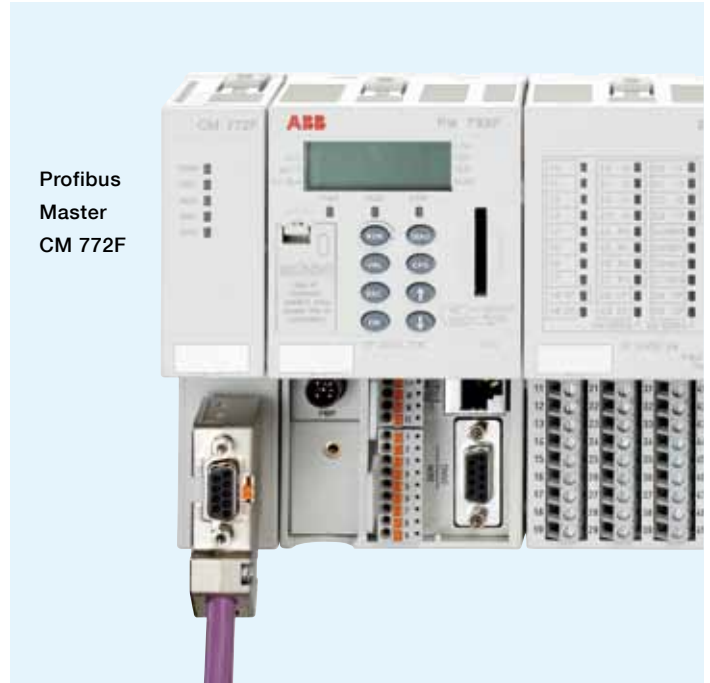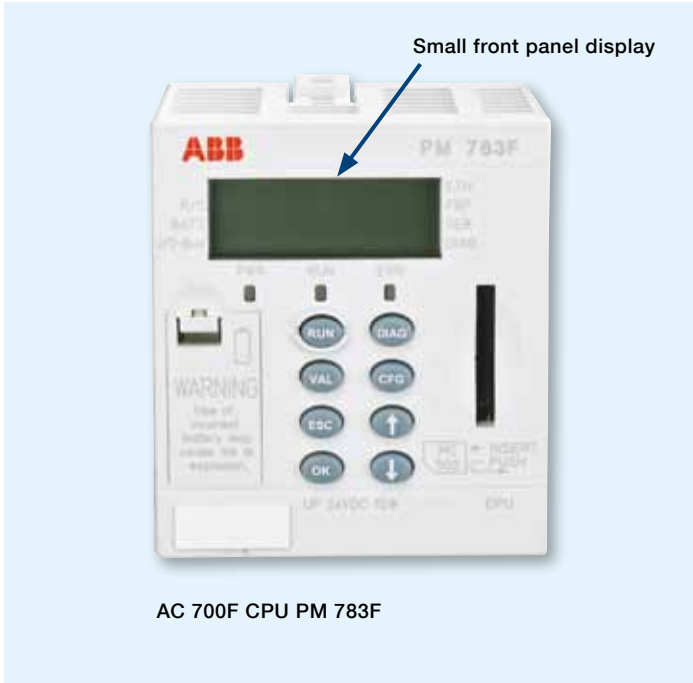**S700 I/O module plugged on terminal unit**
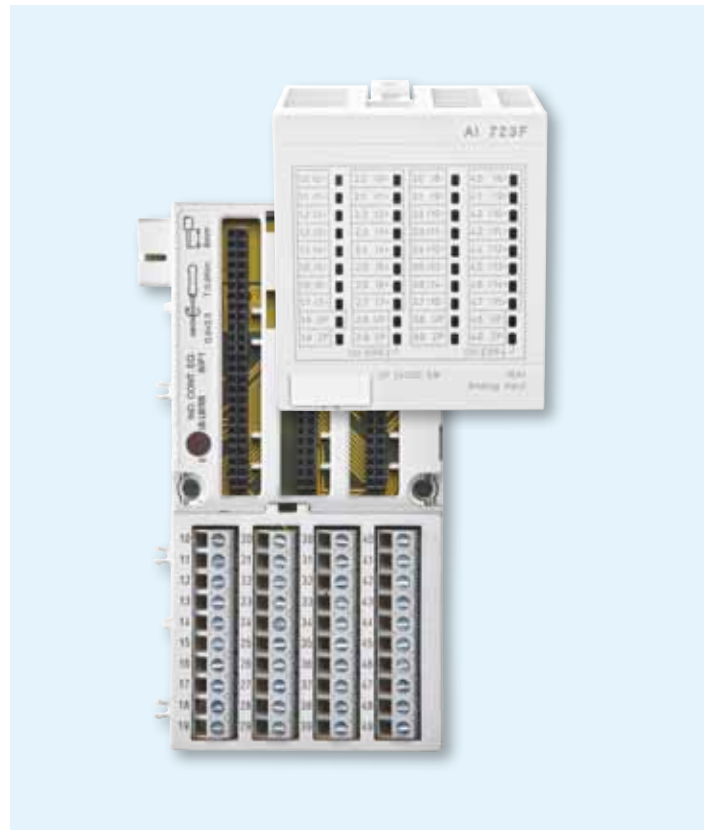
The CPU module

The CPU module is equipped with a high-performance processor allowing for fast cycle times. It comes with on-board 10/100 MBit/s Ethernet network connection used for communication between controllers, operator stations, and engineering tool. Two serial line interfaces complement the connectivity. One interface can be used for Modbus communication while the other is used for diagnostics. For demanding applications, eight cyclic and priority driven tasks with adjustable cycle time can be configured, as well as a PLC type task, which runs as fast as possible. This multi-tasking scenario enables engineers to design applications that reflect all demands of process control, while at the same time balancing the CPU load. This keeps the resources needed in a project at the minimum.

The small front panel display shows in a very easy and efficient manner diagnostics information directly at the module.

Small front panel display

AC 700F CPU PM 783F

Profibus
Master
CM 772F

AC 700 CPU PM 783F

Processor Motorola Power PC (MPC8247)	
Max. number of I/O Modules	8
Serial interface "SER" (COM1)	Physical link: configurable for RS-232 or RS-485 (from 1200 bps to 38400 bps) Connection: pluggable terminal block, spring connection Usage: as Modbus ASCII / RTU (Master/Slave)
Serial interface "DIAG" (COM2)	Physical link: RS-232 Connection: SUB-D Female connector Usage: for diagnostics
Onboard network interface	1 x Ethernet (RJ45)
Certificates	CE, GL, UL

CM 772F Profibus Master

Protocol	DP-V0/V1 protocol
Baud rate	9.6 kBit/s to 12 MBit/s
Connector	D-SUB, 9-pole, female

AC 800F

The AC 800F controller has a modular structure. The CPU is designed as a backplane to which various modules – power supply units, Ethernet or fieldbus modules – can be attached in line with the application. On the fieldbus side, modules for PROFIBUS-DPV1, FOUNDATION Fieldbus HSE, MODBUS (master/slave, RTU or ASCII), IEC 60870-5-101 and CAN for Freelance Rack I/O are available.

The fieldbus line and the connected field devices are entirely configured and parameterized using the engineering tool Control Builder F. No further external tools are needed for configuration. Fieldbus and device configuration can be performed offline without connection to the field devices.

In case of Profibus, field devices or slaves can be integrated into the system using device specific GSD[1] files or DTMs[2]. If for a certain device no DTM is available, generic GSD files of Profibus slaves can be used instead. Together with S900 remote I/O, HART variables are cyclically available as process data.

In case of FOUNDATION Fieldbus, configuration takes place using device specific CFF[3] or DD[4] files. Field devices are connected to H1 links, which in turn are connected via LD 800HSE linking devices to the high-speed HSE subnet.

Even a single AC 800F controller can be connected to both buses, Profibus and Foundation Fieldbus at the same time. This makes it very convenient to run loops of an FF application using control in the field technology, while at the same time gathering fast binary data via high-speed Profibus using remote I/Os.

Furthermore Freelance Rack I/O can be connected to the AC 800F. In this case, the CAN module is used. This allows you to operate five I/O racks, typically up to 1000 I/Os, for each AC 800F. Each I/O rack is equipped with a link module and up to nine I/O modules and can be mounted separately at a distance of up to 400 m from the AC 800F.

The basic unit with CPU

The core element of the AC 800F controller is a high-performance processor with rapid bit processing properties making it ideal for use in automation technology.

AC 800F

CPU	32-bit super scalar RISC processor with rapid bit processing
RAM	4 MB S-RAM or 16 MB (SD-RAM) for application with battery backup
Task execution	Cyclic (confi gurable cycle times from 5 ms) Event-driven (predefi ned events) As fast as possible (PLC mode)
Interfaces	Ethernet PROFIBUS FOUNDATION Fieldbus Station bus (CAN bus)
	Serial: RS485/422/232 Modbus protocol (master or slave, RTU or ASCII) Telecontrol protocol in accordance with IEC 60870-5-101
Ambient temperature	0...60°C (32...140°F), no forced cooling required
Certificates	CE NAMUR UL ISA-S71.04 (G3 severity level)

[1] GSD = Device Master Data, abbreviation for the german term "Gerätestammdaten". A GSD is the device database file (also called "device datasheet")
[2] DTM = a device driver based on FDT technology
[3] CFF= Capabilities File
[4] DD = Device Description

Fieldbus modules

The AC 800F uses the fieldbus modules to collect and process real-time and diagnostic data. Up to four fieldbus modules can be mounted into one AC 800F. The fieldbus modules have the following tasks and characteristics:

– Electrical isolation between the process and the Controller
– Status LEDs for each module
– Independent fault detection and fault signaling
– Connection of the fieldbus segments and subnets
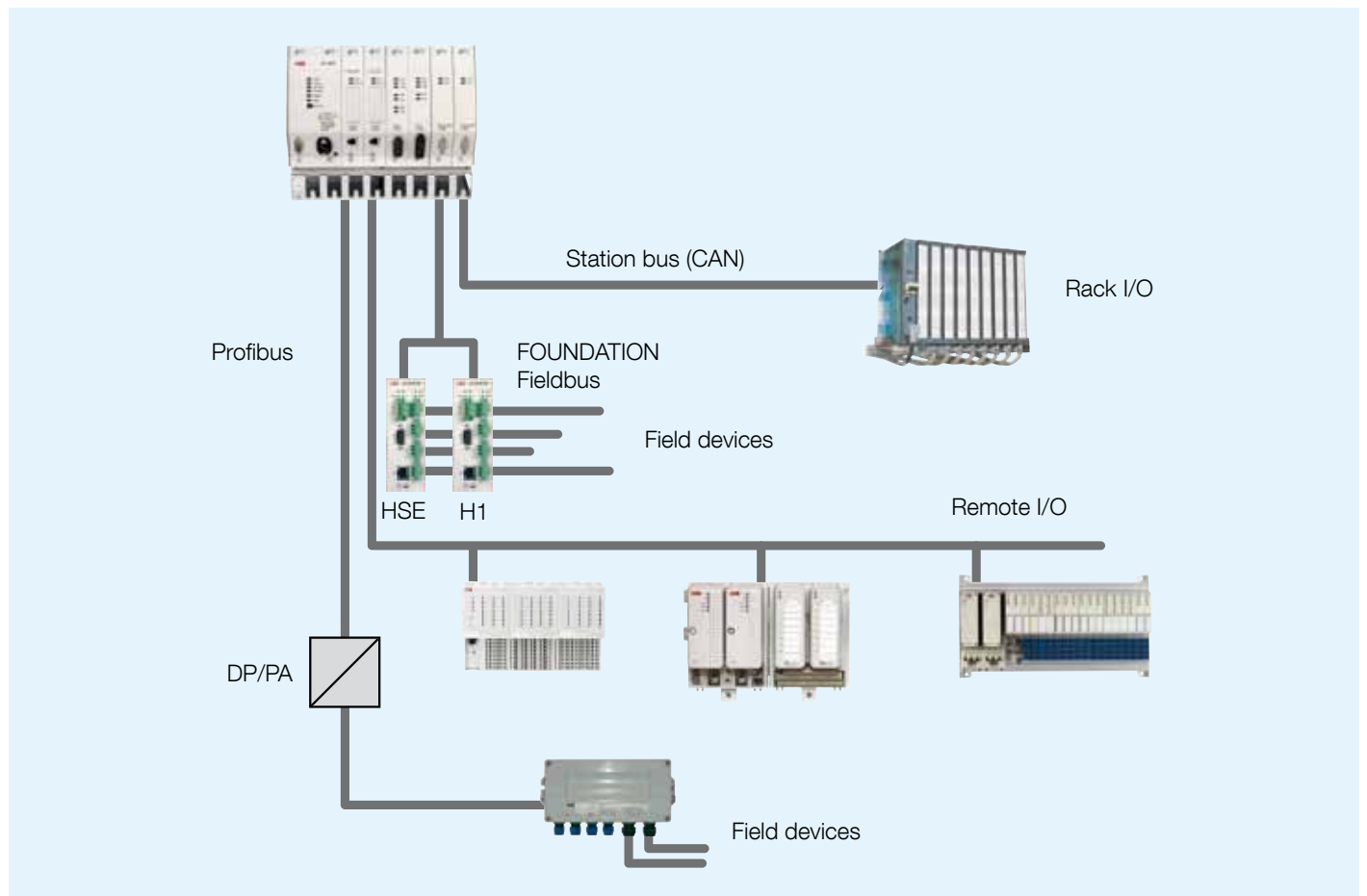
Mechanical design of AC 800F

The AC 800F controller has a mechanical design similar to that used in programmable logic controls. Its front panel connection technique makes it exceptionally easy to assemble and to service.

Mounting on the wall can be achieved very easily. All AC 800F modules are inserted into slots from the front and secured in

position with screws. The modules are activated using a lock switch, which conceals the upper screw opening. The lock switch must be opened to reach the upper screw opening.

All modules are surrounded by a metal housing, which gives them optimum mechanical and electrical protection.

All housing materials used are simply screwed together, allowing them to be separated for future recycling. Last but not least, Freelance has taken environmental protection into account by using a minimal amount of paint.

Station bus (CAN)

Rack I/O

Profibus

FOUNDATION
Fieldbus

Field devices

HSE   H1

Remote I/O

DP/PA

Field devices

Functions

The scope of functions provided by the Freelance system corresponds to the basic supply defined in IEC 61131-3, in addition to numerous other high performance, industry-proven functions and function blocks. They are accommodated in a function block library and can be expanded by user-specific function blocks. While designing the station and during configuration, the processing capacity and speed of the controller can be easily adapted to the demands of the automation task. Program execution in the controller is based on a task oriented, real-time multitasking operating system, leading to a flexible strategy for processing programs.

Different modes are available for user task execution:
– Up to eight tasks with individual cycle times between 5 ms and 24 hours
– Processing as fast as possible (PLC mode)

Along with the user tasks, system tasks are automatically made available. These tasks are executed once in case of the following events:
– RUN
– STOP
– COLD START
– WARM START (voltage restored)
– REDUNDANCY TOGGLE
– ERROR

Ethernet modules

Controllers, operator stations, and engineering stations communicate with each other via the Ethernet based control network.

Functions and function blocks

Analog value processing	– Input and output conversion – Linearization – Delay and dead-time fi lter – Average/extreme value determination in time – Setpoint adjustment – Counter with analog input – Time scheduler	Monitoring	– Analog and binary monitoring – Event monitoring – Audible alarm control – Connection monitoring
		Acquisition	– Disturbance course acquisition, trend acquisition
		Arithmetic functions	– Basic arithmetic functions, numerical functions – Logarithmic functions – Trigonometric functions – Analog value and time limitation
Binary value processing	– Binary output, monostable – Input and output delay – Pulse/time counter, pushbutton		
		Modbus functions	– Master and slave functions
PID loops	– Continuous controllers – Step controllers – On/off controller, three-position controller – Ratio controller – Basic functions – Auto-tuning	PROFIBUS	– DPV1 master functions for AC 800F
		Phase logic processing	– Interface module for batch applications
Open-loop control	– Individual drive functions – Sequence control, dosing circuits		
Logic functions	– Logic processing – Average/extreme value determination – Comparator, binary switch – Multiplexer – Converter (data type & code) – Flip-fl op, edge detection – String blocks – radio controlled adjustment of daylight-saving time		

PROFIBUS DP/PA Linking Device

The PROFIBUS Power Hub is an interface between the PROFIBUS DP and the PROFIBUS PA. Combining a PROFIBUS Power Hub with a field barriers and segment protectors makes it possible to connect field devices to a control system, which are located in intrinsic safe areas. The field barriers and segment protectors can be connected to the non-intrinsically safe outputs (trunks) of PROFIBUS Power Hub. The recommended PROFIBUS Power Hub is a device from Pepperl+Fuchs (http://www.pepperl-fuchs.com).

FOUNDATION Fieldbus Linking Device LD 800HSE

LD 800HSE serves as a gateway between High Speed Ethernet (HSE Subnet) and the FOUNDATION Fieldbus field devices on H1 links. The scheduling and provision of data from one H1 link to another is established by the communication between field devices. LD 800HSE establishes this communication. The communication works independently on how the devices are connected: on the same H1 link, on different H1 links connected to one LD 800HSE or on H1 links connected to different LD 800HSEs at the same HSE subnet.

LD 800HSE is also designed for redundancy.

Fieldbus infrastructure

To protect fieldbus segments and links, appropriate fieldbus barriers can be used. For H1 links, power conditioners have to provide sufficient current. Furthermore proper network switches should be used to connect AC 800F FF modules and several LD 800HSEs.

Details of the fieldbus modules

Type	Channels	Function	Modules per controller
CAN module	3	Connection of up to 5 Freelance I/O racks	1
Serial module	2	RS232/RS422/RS485 configurable for MODBUS, IEC 60870-5-101 telecontrol protocol	4
PROFIBUS module	1	Full-value PROFIBUS DPV1 Master	4
FF-HSE module	1	For the connection of up to 10 LD 800HSE Linking Devices with 10/100 MBaud autosense twisted pair connection	4

Ethernet modules for the system bus

Type	Channels	Function
Ethernet module EI 813F	1	twisted pair connection 10 base T for connection to hubs or switches
Ethernet module EI 811F	1	BNC connection 10 base 2 for thin coaxial cable(Cheapernet), 10 MBit/s
Ethernet module EI 812F	1	AUI connection 10 base 5 and 10 base FL via coupler

Remote I/O

The PROFIBUS Master module enables connection of remote I/O units such as S700, S800, or S900 Remote I/O. The new S700 I/O is meant for basic applications where traditionally PLC I/Os have been used. Whereas the S800 is generally used in process automation, the S900 is preferred, due to its extended channel diagnostics and intrinsic safety, in the chemicals segment and in areas where explosion protection is required.

S700

S800

S900

One of the benefits using remote I/O is that it can be placed in junction boxes in the field and not in the control room.

S700

S700 I/O can be used as direct I/O for AC 700F. S700 can be used as Profibus remote I/O at AC 700F, AC 800F or other Profibus Masters.

One of the S700 I/O benefits is the small footprint - the modules are featured with a high packing density, several modules are available with inputs and outputs mixed in one module. Currently, 14 different module types are available covering a wide variety of applications.

For further details, see the Freelance Product Catalog 3BDD015188.

S800

S800 I/O is a comprehensive, distributed and modular process I/O system that communicates with controllers via Profibus. Installation in the field, close to sensors and actuators, S800 I/O greatly reduces the installation cost by reducing the cost of cabling. It is possible to exchange modules and reconfigure the system during operation. Redundancy options in all areas allow a high degree of availability. For harsh environments, the I/O modules are compliant to G3 severity level of ISA-S71.04, Environmental Conditions for Process Measurement and Control Systems. A pass-through feature makes it possible to configure and examine all HART-compliant field devices directly from the control systems engineering tool.

For further details, see S800 Brochure 3BSE009891.

S900

The remote S900 I/O system can be installed directly in zone 1 and zone 2 hazardous areas.

It communicates with the control system level using the Profibus standard, therefore reducing marshalling and wiring costs. The system is sturdy, error-tolerant and easy to service. Moreover, the S900 I/O system is characterized by a compact design, cyclical transmission of secondary HART variables, parameterization and diagnosis of all HART field devices via the fieldbus. Its redundancy ensures maximum availability.

Integrated disconnection mechanisms allow replacement during operation, meaning that there is no need to interrupt the primary voltage in order to exchange the power supply units.

For further details, see S900 Brochure 3BDD013133.

S700 I/O Modules

Module Name	Channels	Description	Direct I/O	Remote I/O (Profibus)	Required Terminal Unit
DC 732F	16 DI, 16 DC	16 channels are assigned as digital inputs, while the remaining. 16 channels can be configured as input or as output.	Yes	Yes	TU 715F (screw type) or TU 716F (spring type)
AI 723F	16 AI	16 AI: +-10 V, 0/4-20 mA 24 VDC, Pt100 12 bit + Sign, 2-wire, 24 VDC 5 W For 3-wired connections two channels are required	Yes	Yes	TU 715F (screw type) or TU 716F (spring type)
AX 722F	8 AI, 8 AO	Eight of these channels can be individually configured as inputs, which can again sense voltage, current, or temperatures. Four channels can be configured as analog voltage outputs (-10 V to +10 V) or analog current outputs (0 … 20 mA or 4 … 20 mA), four channels can provide voltage signals in the range from -10 V to +10 V. 8 AI: +-10 V 0/4-20 mA 24 VDC, Pt100 8 AO: +-10 V 0/4-20 mA 24 VDC. 12 bit + Sign, 2-wire, 24 VDC 5 W	Yes	Yes	TU 715F (screw type) or TU 716F (spring type)
AO 723F	16 AO	16 configurable analog outputs in two groups. 16 AO: +-10 V, 0/4-20 mA max. 8 AO usable as current outputs 12 Bit + sign, 2-wire, 24 VDC 8 W	Yes	Yes	TU 715F (screw type) or TU 716F (spring type)
DX 722F	8 DI, 8 DO Relay	8 digital inputs 8 relay outputs with one switch-over contact each 8 DI: 24 VDC 8 DO: relay contacts, 24 VDC, 230 VAC 1/3-wire, 24 VDC 2 W	Yes	Yes	TU 715F (screw type) or TU 716F (spring type) or TU 731F (screw type) or TU 732F (spring type)
DX 731F	8 DI, 4 DO Relay	8 digital inputs 230 V DC in two groups. 4 relay outputs (2.4...2.7), with one switch-over contact each 8 DI: 230 VAC 4 DO: relay contacts, 24 VDC, 230 VAC 2-wire, 24 VDC 2 W	Yes	Yes	TU 715F (screw type) or TU 716F (spring type) or TU 731F (screw type) or TU 732F (spring type)
AI 731F	8 AI	8 configurable analog inputs in two groups. Thermocouple, RTD, mV/V, mA, kOhm and 24 VDC 15 Bit + sign, 2-, 3- and 4-wire, 24 VDC 5 W	Yes	Yes	TU 715F (screw type) or TU 716F (spring type)
CD 722F	2 ENC, 2 PWM, 2 DI, 8 DC	Frequency input module. 2 Counter Inputs: 5/24 VDC, 1 Vpp sinus, fmax 300 kHz 2 DO: 24 VDC/0,1 A, pulse width PWM 2 DI: 24 VDC 8 DI/DO: 24 VDC/0,5 A 1/2-wire, 24 VDC 100 W	No	Yes	TU 715F (screw type) or TU 716F (spring type)
AC 722F	8 AI/AO	8 analog inputs/outputs in one group, each can be used as input or output. 8 AI/AO: +-10 V, 0/4-20 mA, RTD 12 Bit + sign, 2-wire, 24 VDC 5 W	No	Yes	TU 715F (screw type) or TU 716F (spring type)
AX 721F	4 AI, 4 AO	4 configurable analog inputs in one group. 4 configurable analog outputs in one group. 4 AI: +-10 V, 0/4-20 mA, RTD, 24 VDC 4 AO: +-10 V, 0/4-20 mA 12 Bit + sign, 2-wire, 24 VDC 5 W	No	Yes	TU 715F (screw type) or TU 716F (spring type)
DI 724F	32 DI	32 digital inputs 24V DC in four groups. 32 DI: 24 VDC 1-wire, 24 VDC 1 W	No	Yes	TU 715F (screw type) or TU 716F (spring type)

S700 I/O Modules

Module Name	Channels	Description	Direct I/O	Remote I/O (Profibus)	Required Terminal Unit
DC 722F	16 DI/DC	16 configurable digital inputs/outputs in one group, each of which can be used – as an input, – as a transistor output with short-circuit and overload protection with 0.5 A rated current or – as a re-readable output (combined input/output) and can be addressed accordingly. Two 24 V DC 0.5 A sensor power supplies with short-circuit and overload protection (i.e. it can take 2/3-Wire Wet Contacts as DIs)	No	Yes	TU 715F (screw type) or TU 716F (spring type)
DC 723F	24 DI/DC	One 24 V DC 0.5 A sensor power supply with short-circuit and overload protection – 24 digital Inputs/Outputs 24 V DC in one group, each of which can be used – As an input, – As a transistor output with short-circuit and overload protection with 0.5 A rated current or – As a re-readable output (combined input/output) and can be addressed accordingly	No	Yes	TU 715F (screw type) or TU 716F (spring type)
DA 701F	16 DI, 4 AI, 2 AO, 8 DC	30 channels – 16 digital inputs, 24 V DC – 4 analog inputs, voltage, current and RTD, resolution 12 bits plus sign – 2 analog outputs, voltage and current, resolution 12 bits plus sign – 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.	No	Yes	TU 715F (screw type) or TU 716F (spring type)

AX 722 F

DX 731

DC 732F
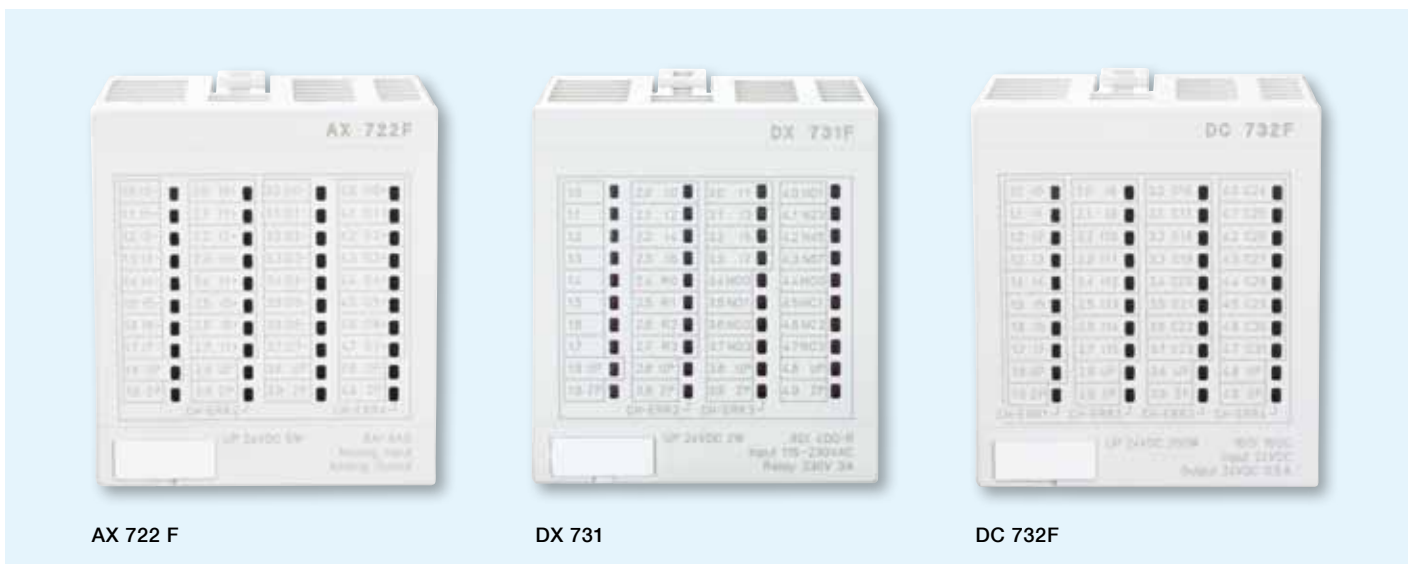
Field devices

Freelance enables you to connect and configure PROFI-BUS DP and PROFIBUS PA devices. For connection of PROFIBUS PA devices the PROFIBUS Power Hub must be used in between the controller and the field devices.

For FF, the LD 800HSE Linking Device allows you to connect and configure FOUNDATION Fieldbus H1 devices. The configuration of control in the field with FOUNDATION Fieldbus is supported by Freelance.

HART devices can be connected using HART compliant modules of S800 or S900 remote I/O. If the HART devices are connected to S900, certain S900 modules can be used to transfer additional HART values to the cyclical I/O mapping. This makes it possible to use the second or third measured values of a HART device in the AC 800F controller as an input for applications.

An example is the use of ABB's 2600T series multivariable transmitters. Such a transmitter sends its pressure process value as 4..20 mA signal and in addition the temperature and the differential pressure as secondary measurement values via HART communication. With these three values the flow can be calculated.

Having three measured values on a single transmitter allows for smarter design and cost savings.

System communication

Control network

The control network interconnects the Controllers, operator stations and engineering station in the Freelance system.

The control network complies with the Ethernet Standard according to DIN/ISO 8802, Part 3 (IEEE 802.3) and can be used with twisted pair or coaxial cable. It is also possible to use a combination of these standards or to implement 1-GBit/s components within a network as high-speed backbone.

Freelance uses confirmed and unconfirmed services. The unconfirmed UDP service is used for screen updating and lateral communication between controllers. The confirmed TCP/IP service is used for alarming and trend archiving.

The control network has the following features:
The control network has the following features:
– The ability to cover long distances
– A high data throughput
– A flexible network layout
– Easy connection to a higher plant management level
   through the OPC standard
– Pre-programmed routines in the event of errors
– Excellent EMC properties
– Ability to switch bus members on and off during operation
– Highest availability through redundancy

OPC

Freelance provides an OPC gateway (server), which allows OPC clients to access data and alarms from the Freelance controllers. The OPC server also allows access to the DPV1 parameters and user parameters of PROFIBUS and HART devices. In the case of HART devices, this is only possible if they are connected to an S900 remote I/O unit. For Freelance version 8.2 and higher, the parameters of FOUNDATION Fieldbus devices can also be accessed. It is possible to limit access to this data at the OPC gateway such that an OPC client cannot see certain tags and variables at all, can only read other tags and variables, or has both read and write access to certain tags and variables.

The DigiVis operator station has a built-in OPC client, which permits you to access data from external OPC servers. Using this, for example, data from third-party controllers with OPC support can be integrated into a custom graphic in DigiVis. With Version 9.2, when using DigiVis PLC Integration, also Faceplate creation and Alarm & Events are supported.

As several OPC gateways can be used in the Freelance system, server redundancy can be established using OPC clients that support this function. The Control Builder F engineering software supports this with the redundant OPC gateway configuration.

The trend server option provides a special OPC gateway that is used by the DigiVis operator stations for user-defined trend displays. Access to the trend server is fixed to "read only", and all trend variables are automatically available. There is one trend server per Freelance system.

DMS-API

The DMS Application Programming Interface provides C programmers with a Windows interface through which they can access internal Freelance communications services. This enables them to create their own Windows applications that can read online data from the Freelance system and create values.

The operator level with DigiVis

The operator stations

The operator stations of the Freelance system run on common, low-cost PCs or, in special cases industrial PCs.

The DigiVis software, based on Microsoft Windows as a graphical user interface, enhances the ease of use and the performance of process operation. In addition, you can also use any PC peripherals such as monitors, printers, mouses and keyboards that are available on the market for Windows-compliant PCs. The operation (DigiVis) and engineering (Control Builder F) functions can also be performed together on one PC. The DigiVis operator interface offers the following features:

– Transparent and rapid operation due to a clearly structured information hierarchy
– User-specific function key assignment for fast display selection
– A large number of pre-engineered displays
– Rapid and secure action in case of process alarms
– Trend displays with archiving
– Logging of all operator actions, including name and timestamp
– System diagnostics, even down to the field device, allowing extended field device diagnostics
– Uniform process alarm and message concept and clearly arranged display of messages and operator hints

– Up to 16 user groups/access profiles, with up to 1000 users, specific password for each user (with optional Security Lock software)
– Various language versions: English, Chinese, German, Spanish, Brazilian Portuguese, Swedish, Russian, Polish, French, and Japanese*
– A control aspect, providing access to automatically generated dynamic interlocking displays for the selected tag (in connection with OPC or trend server)
– External aspects, providing access to additional information such as PDF documentation, live videos from the plant, standard operational procedures (SOPs), etc.
– Configurable voice output on the PC for process alarms
– Dual-monitor operation on a single PC, with one mouse and one keyboard

Process visualization is supported by:
– Plant-specific custom graphic displays
– Faceplates for process points (tags)
– Up to 15 plant areas with plain text labeling

* more to come

Graphic display with faceplates
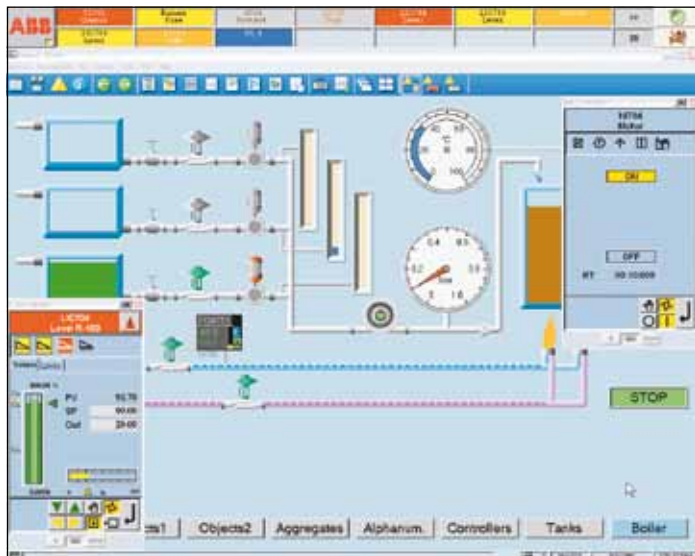
Plant-specific displays

Plant-specific displays geared to the specific demands of the plant operator can be configured to depict process activities.

Static sections of the graphic displays can be created using the graphics editor. In addition, you also have the option of inserting such static sections in the form of bitmaps, created by any other graphic editor, scanner, or digital photograph. Current process data or process states can be animated at every suitable position using features such as bar graphs, level indicators and trend windows.

Depending on process states, graphic symbols can, flash, change color and position or be replaced in the graphic display. Tags can be viewed either via faceplates in the graphic displays or via the standard group displays.

Display selector fields or buttons can be used to set up a specific selection hierarchy within custom graphics for operation. The number of custom graphics available in DigiVis is limited only by the hard disk capacity.

Excel Reporting

With Version 9.2, the Excel Reporting functionality offers more flexibilty for reporting functions in DigiVis, e.g. for shift logs. Due to the Excel functionality, also calculations like min, max, average, or sum are available.

Excel Report
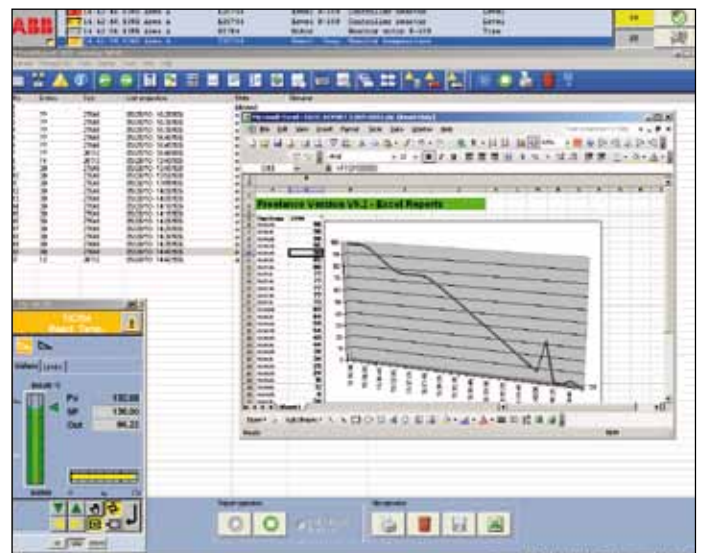
Pre-engineered, ready-to-use displays

Pre-engineered displays are adapted to the needs of process control engineering with regard to structure and information content. The following displays are available:
– Overview display
– Group display
– Faceplate
– SFC display
– Time scheduler display
– Trend display
– Web display
– Message list and operator hint list
– Logs
– System display for hardware diagnostics

Therefore, most functions already have fully prepared displays for operation and observation, and can be used without any further programming.

Overview display

The process information for the entire plant is presented in a condensed manner in a single overview display. It offers facilities for selecting the group, graphic, SFC, Web, time scheduler and trend displays. Logs can also be called up directly from the overview display. Up to 96 displays (16 lines, each with 6 displays per line) can be shown in the overview display. The group display symbols within the overview display also feature dynamic updating of tags, allowing disturbance states to be detected rapidly through appropriate symbols and colors. If required, you can also set a graphic display of your choice as overview display. It then replaces the standardized overview display.
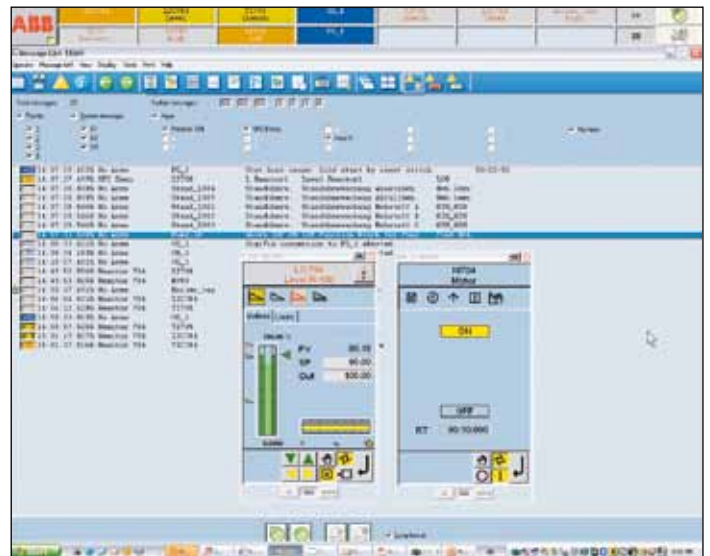
Faceplates

Faceplates allow both overview and detailed information to be obtained simultaneously. Since faceplates are predefined, they are available immediately in the system following the definition of a tag, without any additional programming.

This is also the case for user-defined faceplates. Therefore, faceplates can be displayed together with standardized and freely designed displays. A selected tag can always be displayed via its faceplate.

Overview display
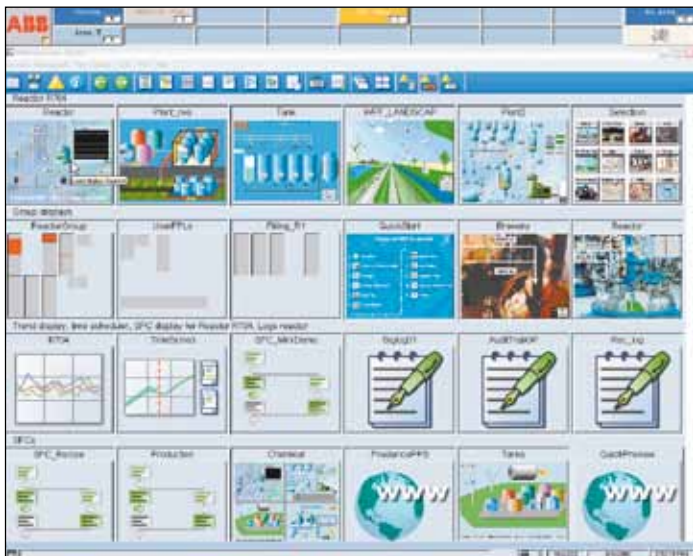
Faceplates

Group display

The group display is a combination of several faceplates and contains detailed information about associated tags. All functions, including PID-loops, time and monitoring functions as well as open-loop control functions, can be displayed and operated.

To provide a quick source of information, analog values are displayed as colored bars. To allow more precise reading, they are also shown as alphanumeric values. Pending disturbance states in the respective variables can be detected immediately through a change in color and flashing, and can be acknowledged directly in the faceplate or message list. Configured limits can be additionally displayed as symbols. You can create your own faceplates for user-defined function blocks.

SFC display

The sequential function chart (SFC) based on the IEC 61131-3 standard is viewed in a standardized SFC display showing the current program state of the sequential function chart.

In the SFC display, you see the actual processing status, where already finished and coming steps are marked with different colors. Disturbance states, such as non-fulfilled process criteria or time outs can be easily detected by a color change within a criteria window for steps and transitions. Furthermore, a display selection can be configured for each step and transition. The variables shown in the criteria window can be operated.

An SFC overview display allows direct access to a step or transition, and the desired information can be selected immediately. This is particularly beneficial in the case of complex open-loop control structures, when rapid intervention by the operator is essential. The Control Aspect allows the animated display of the transition program, similar to the commissioning display in Control Builder F.

The display is generated automatically and is an alternative to the criteria window, which allows you to configure a standardized, reduced display of the criterias.

Time scheduler display

The time scheduler module makes it possible to define analog variables during a pre-defined time by default, e.g. as a set point value for a connected controller. The current set point is determined from a series of up to 32 configured values describing a set point curve. The time scheduler display is easy to operate. Apart from enabling the switching of operation modes, it also permits the modification of the current set point. Manual alterations to the set point are displayed in a separate curve.

Group display
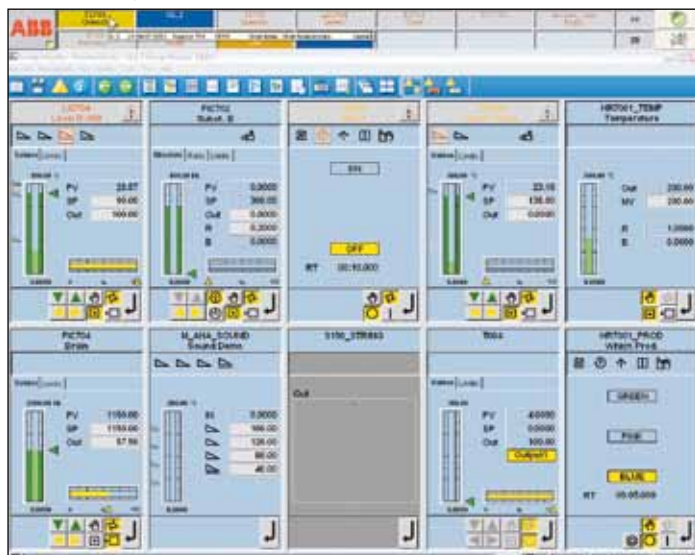
SFC display
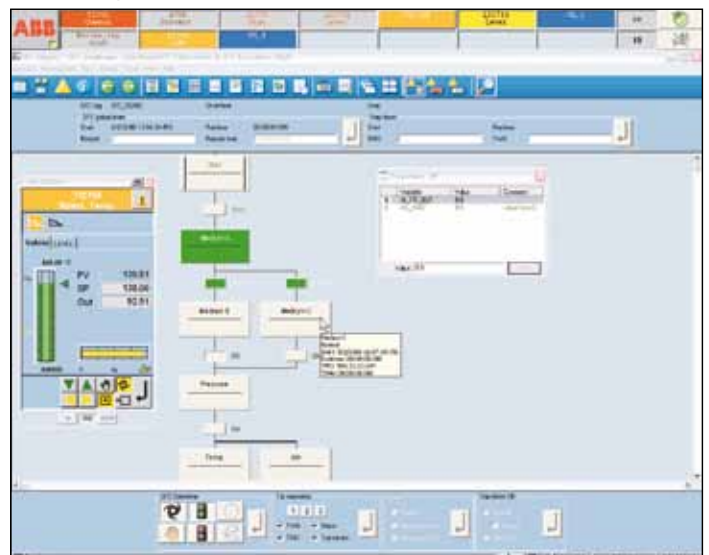
A manual set point can be defined by offsetting the configured set point. A return (time-delayed) to the original value is possible at any time. A program can be executed cyclically or by stating a certain number of runs.

Web display

The Web display provides a simple way to display web pages on the operator station, without covering the message line. For example, this allows you to observe the picture of a camera using a built-in Web server, making it easy to monitor flames or observe chimneys. However, in addition to showing Web pages, it is also possible to start other applications and display documents using this display type.

Trend display and archiving

The chronological sequence of analog and binary process variables can be displayed as a trend display.

The following can be shown in one trend display:
– Up to six signals in different colors
– The associated measuring point name with short text
– The current measured value with scale and unit used
The trend display can be altered by:
– Moving the time axis to show previous values
– Hiding trends
– Increasing and decreasing the signal range

– Selecting specific settings for each trend progression (e.g. color or interpolation)
– Highlighting individual trend curves
– Using a variable time range (seconds through to weeks)

If a trend display is configured with archiving, the measured values are recorded as a cyclical function of the operator station. The archived values can be backed up on any data medium or sent via file transfer protocol (FTP) to any subscriber on the Ethernet.

They are then available for further evaluations and can be exported in CSV[3] format using the separate DigiBrowse software. The original data is binarycoded and therefore protected against manipulation.

User-defined trend displays

Operators can compile any process values in a trend display themselves by selecting the required process values from a list of all variable names. No additional engineering effort is necessary. The task of archiving this trend data on the hard disk of the operator station PC can also be carried out easily in the same way.
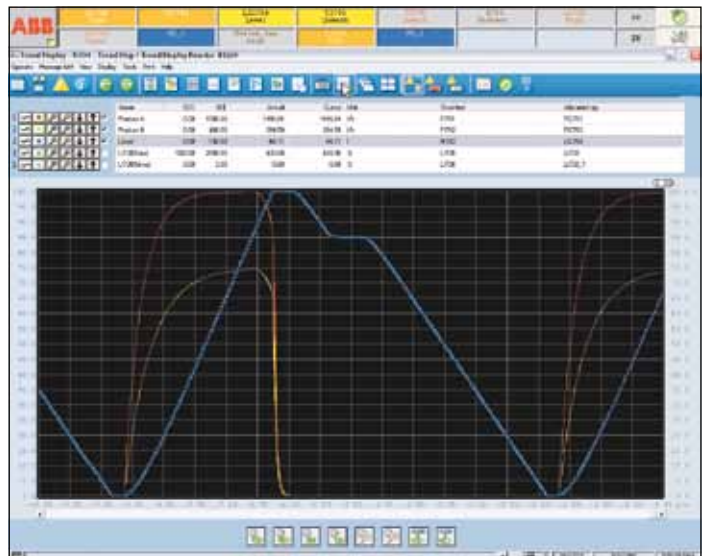
A prerequisite for user-defined trends is that the system contains a trend server.

[3] CSV=comma separated value, a format in which data can easily be imported into Microsoft Excel and evaluated

Time scheduler display
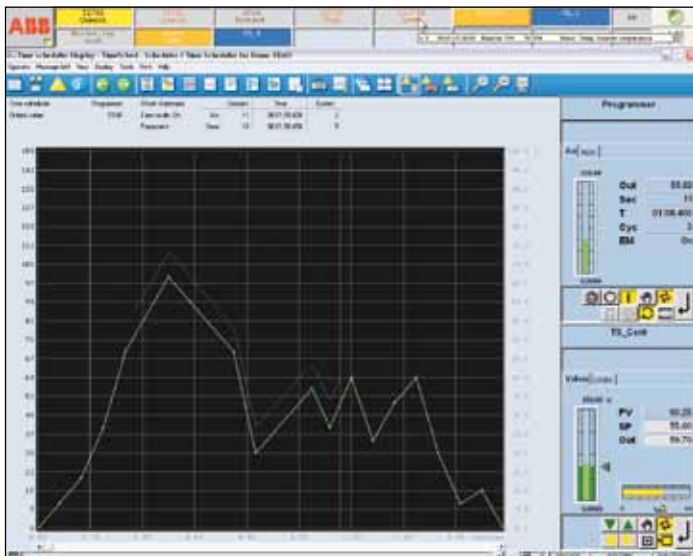
Trend display

Messages and operator hints

Process disturbances are detected by the controllers and forwarded to the operator stations with a timestamp.

The Freelance system allows the following message types: system alarm (S1-S3), process alarm (P1-P4) fault message and operator hint message (P5). Process alarm are divided into fault messages (P1-P3) and switching messages (P4). When parameterizing the function blocks, it is possible to assign up to 4 messages to its limit monitoring units integrated into the block. Whereas the internal controller time is generally used for the timestamp for messages, you also have the option of using a special function block to assign external timestamps to alarms. In this way, for example, you can generate an alarm from a device connected to the Modbus in the correct chronological order with the device's timestamp. Different methods of acknowledgement can be selected for each priority level. Incoming messages are displayed in different colors, along with the name and disturbed status of the tag in accordance with their priority.

Message line

The upper area of the display is always reserved as a message line for the higher-level display of all message types from the entire process.

The message line optionally displays either the newest or oldest messages, as well as buttons for acknowledging messages and viewing operator hints. There is also a field for indicating overflow, a field for acknowledging alarms and a field showing the number of unacknowledged messages in the message list. For quick operation, the faceplate of the disturbed tag can be accessed directly from the message line.

Operators can choose between three different message line views:
– Standard view
– Area view: shows in which areas alarms are present
– List view: like a short message list

Message list

The message list offers an overview of all pending messages. It features a chronological list of fault, switch and system alarm messages. The latest message is placed at the beginning or end of the list, as configured. This message sequence can be altered by configuration.

Just as in the message line, different priorities are color-coded. Messages can be acknowledged both by block and by page. To provide a better overview, the user can filter certain priorities or plant areas on the screen display.

Other displays belonging to the tag, such as faceplates, graphic or trend displays, can be selected via tag specific aspect navigation from the message list simply by a right-click.
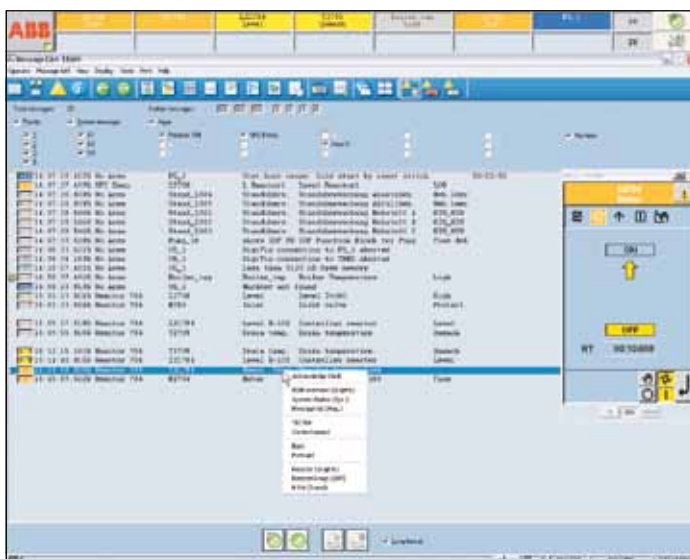
Standard view

Area view

List view

Message list

Operator hint list

A hint for the operator can be configured for each process alarm or event. Hints are intended to inform the operator about the cause of the message or about the procedure to be adopted for eliminating a process alarm. If necessary, hints can also provide further user help.

All configured hints are displayed in the hint list. Faceplates or other displays can also be called up directly from the hint list to operate a tag or analyze critical process situations.

Logging

Logs are used to document events, states and sequences from the process. Log files can be displayed on the screen, printed, and saved on a CD, DVD, or memory stick for further evaluation. In addition, the archived files can be automatically sent to any subscriber on the Ethernet via the file transfer protocol. The DigiBrowse software makes it possible to view the data and to convert it into ASCII (CSV file) for further evaluation, for instance using Excel.

The Freelance system features the following log types:

Signal sequence log

The signal sequence log is used for logging events such as process and system messages, switching messages and hints. Even operator intervention can be logged in detail together with the user name and timestamp. The user can determine which message priorities are to be logged. Process

messages and alarms are logged with time stamps of 1 ms resolution. "Signal sequence log 1" allows the operation of a line printer in order to immediately print every alarm when it is received.

Operation log

At certain intervals or in certain situations, the plant log records the current values or states of process variables. It can run cyclically, or can be started and stopped manually or by an event. The output format is freely configurable as table or fill-in-the-blanks text.

Disturbance course log

The disturbance course log is used to examine the course of disturbances. The process values before and after a disturbance are recorded with a high time resolution and archived in an operator station. Four logs of each type can be configured in one operator station.

System diagnostics

The current state of the hardware and software of a Freelance system is shown in the automatically generated system display. Here, information can be obtained in various degrees of detail about the status of an individual controller to a specific field device.

The simple system display is available to all operators of a DigiVis operator station. Additional information is also available for field devices on PROFIBUS or FOUNDATION Fieldbus.

Operator hint list
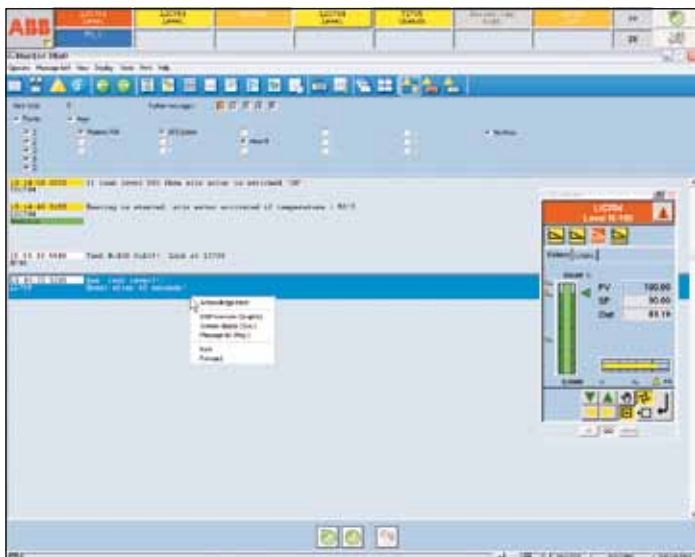
Easy system diagnostics with the system display
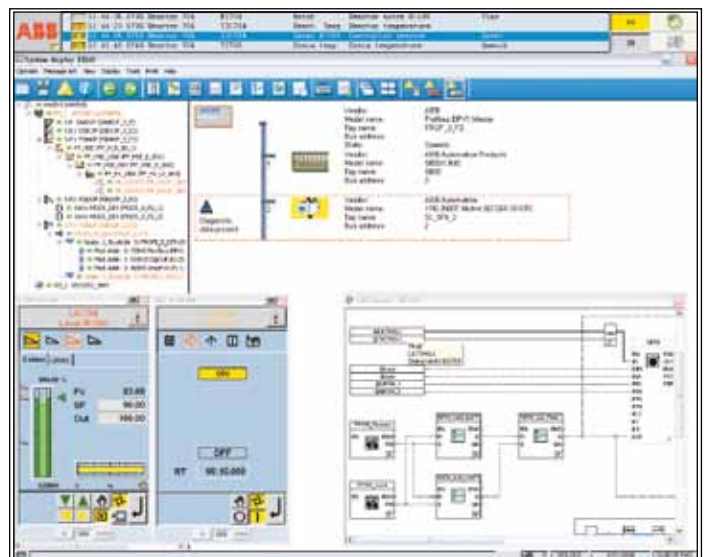
System 800xA components can be added to the Freelance system to meet additional requirements (extended automation)

800xA Operations (operation and observation)

DigiVis makes it possible to operate and observe all controllers in one Freelance system. In the case of 800xA Operations, in contrast, ABB offers a very convenient means of connecting several Freelance systems to a common operator level in very large plants.

Here, the relevant faceplates are generated automatically for all tags in the connected Freelance systems. DigiVis and 800xA Operations are compatible, meaning that both operator levels can be used together, for instance DigiVis in the local control room and 800xA Operations in the head office.

Batch processing in Freelance

Freelance is also ideally suited for batch automation in accordance with ISA S88. In this case, 800xA Batch Management software is used, which has been optimized for Freelance. Again, the system structure can be designed very flexibly.

Standard operation can either remain on DigiVis, with parallel batch management workstations and appropriate servers, or operation, observation and batch management can be carried out entirely using 800xA.

Configuration and commissioning with Control Builder F

Control Builder F is the engineering tool of Freelance. It is used for configuration and commissioning of all automation functions. Furthermore, the operator interface DigiVis will not only be configured with Control Builder F, also process graphics, which can dynamically indicate for example the status of a process, can be created.

The entire Freelance system can be configured either online, while Control Builder F is connected to a controller, or offline. For offline configuration, no controller is needed. The application program, that was created during offline configuration, can later on be downloaded to a controller.

In particular, this is also true for FOUNDATION Fieldbus configurations. Control Builder F can be used to generate the control-in-the-field application even without any devices being available.

Control Builder F offers the following features for configuration, parameterization and commissioning:
– A single software tool for configuration of the automation functions, the operator interface with displays and logs, and fieldbus parameters:
  – Graphical configuration with powerful editors according to IEC 61131-3 in any of the following programming languages:
  – Function block diagram (FBD)
  – Instruction List (IL)
  – Ladder diagram (LD)
  – Sequential function chart (SFC)
  – Structured text (ST)

– A function block library with more than 220 tried and tested functions, greatly exceeding the basic ones outlined in IEC 61131-3
– An extensive macro library containing more than 200 graphic symbols, which can be extended by the user
– A project tree for flexible program generation and transparent program structuring
– Verification of automation functions, with the chance to find and remove errors quickly and easily
– Convenient cross-reference function allowing variables and tags to be found easily in any editor right up to the graphic display
– Importing and exporting of programs, displays, variables, tags and parts of the project tree
– Password protection to prevent unauthorized project modification
– Password protection for user-defined function blocks
– Uniform and auto-generated system-wide graphical documentation of the entire user program, system communication and all field device parameters
– Integrated online help
– Project file (application) backup on any data medium (hard disk, CD, memory stick, etc.). The project file includes the complete project with all programs, graphics, controllers, and field device parameters.
– Testing and simulation of user programs (e.g. interlocks) even without connected hardware using the controller emulator
– Bulk data manager allows to import signal lists from planning tools via Excel and fast duplicating of typical solutions

Project tree

The project tree is the central instrument for managing the entire user program and commissioning. All project configuration data is displayed as a tree structure. Within the project tree:

– The configuration data in a project is structured
– Task levels and cycle times are defined
– Programs are assigned to the task levels
– Programs, displays and logs can be opened for editing, copied and moved
– Programs are checked for plausibility and their processing status displayed
– Project configuration data is exported and imported
– User programs are loaded into the process and operator stations

Project data base

All configured signals, variables and tags are managed in the Freelance system as lists in a common project database:
– List of variables (inputs, outputs, internal variables)
– Tag list (function blocks)
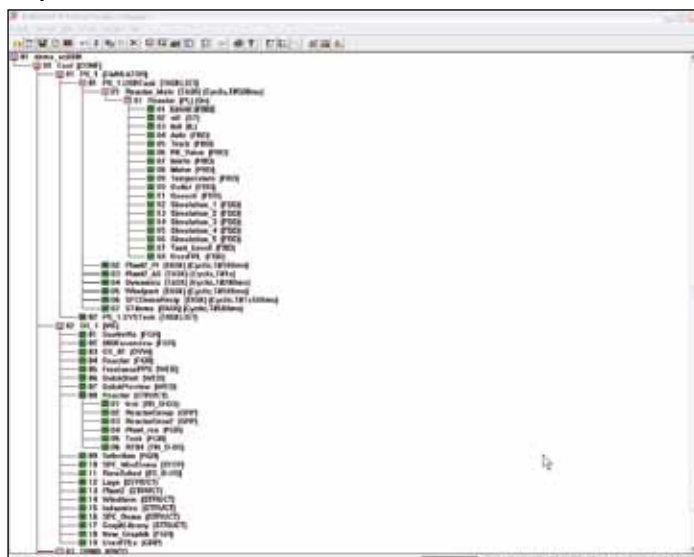– Graphics
– Programs

Because the database is system-wide, data only needs to be entered once, avoiding further potential errors during configuration. The single project database file makes archiving or backup ease of use.

The list of variables and tags is created automatically when a user program is generated.

Other list functions include:
– Project-wide modification of name, comments, data or module type
– Search and display based on specified search criteria
– Cross-reference function permitting rapid, systemwide location of all programs and displays in which a selected variable or tag is used

Project tree

Tag list with cross references
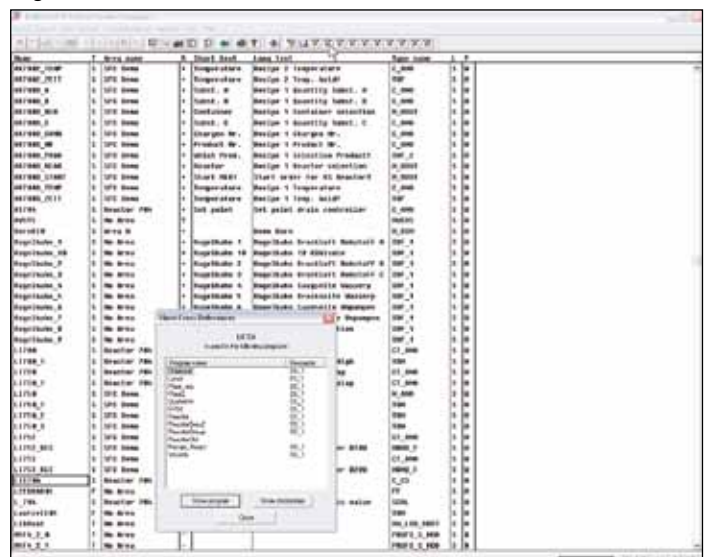
Configuration of automation functions

Configuration of function block diagrams

The function block diagram (FBD) is a graphical programming language.

It keeps one or several function blocks. The inputs and outputs of the function blocks can be connected to create the signal flow. Control Builder F checks if the terminals of two function blocks can be connected.

Inputs are always displayed on the left and outputs always on the right of a function block. With variables, values can be referenced from one diagram to another one. Two different access types to variables are available: read and write access. While write variables are written by a single function block, read variables can be used by several blocks.

The layout of the terminals and the color of signal flow lines provide information about the data type.

All parameters of the function blocks are defined in the function block diagram. Clearly structured and easy to understand parameter dialogs, in which all block-specific entries can be made, are available. Once completed, the function block diagram can be verified using a plausibility check for errors or syntactic accuracy. Any errors or warnings are displayed in a list, and it is possible to navigate directly to the source of the error by simply clicking on the relevant line in that list.

The cross references in a program can be displayed for the whole system. The corresponding displays or programs can be called up directly in order to gain easy access to the variables tags referred to.

A function block diagram (FBD program) is configured as follows:
– Define name for FBD program
– Open editor for FBD program
– Select function blocks - Position in the graphic area
– Connect functions with the signal flow lines
  – Enter input and output variables
– Define parameters for the functions
– Check FBD program for plausibility
– Correct any syntax errors

Workflow with Bulk data manager

Tag lists or I/O lists from customers can easily be imported into the system using the Bulk Data Manager in Freelance.

Typical combinations of function blocks can easily be instantiated or parameters can be adapted in an Excel-sheet.

This feature is useful in the planning phase or basic engineering especially for bigger projects.

Program with parameterization screen and plausibility check error messages
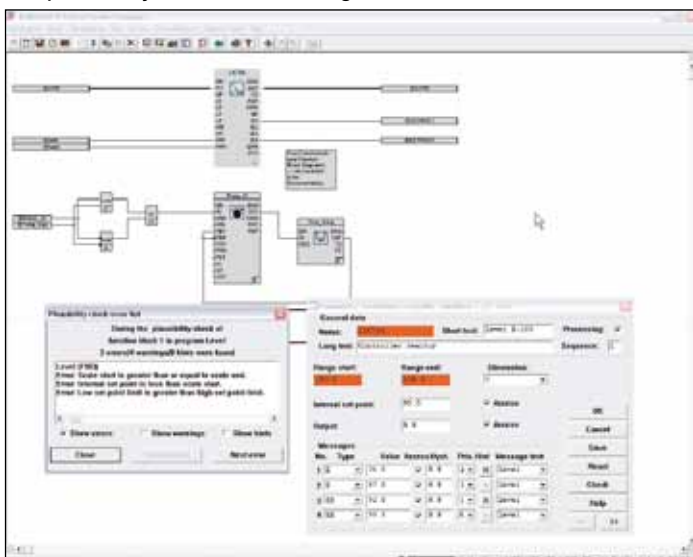
Configuration of sequential function charts

The sequential function chart (SFC) readily allows transparent, graphical creation of sequential control programs. To create an SFC program, steps are configured with assigned actions (commands) and transitions with step-enabling conditions. Programs (function block diagram, ladder diagram, structured text, or instruction list) can be assigned to the steps and transitions. A further feature of the sequential function chart is the facility for creating alternative and parallel branches as well as the synchronization of these sequential structures. At the same time as the sequential function chart is configured, the SFC display for operation and observation on the operator station is generated automatically.

### Configuration of structured text

Structured text is one of the text-oriented programming languages of IEC 61131-3, in which program processing is determined by instructions. All functions and function blocks can also be used in ST programs. The scope of the functions is partly covered by the ST operands. Function blocks can be used in the ST program following declaration.

Parameter definition of the function blocks also takes place in the same way as in the ladder diagram or function block diagram. In contrast to that of the function block diagram (FBD), the scope of functions of the structured text also includes conditional commands and loop commands, which are called using appropriate key words. The processing sequence is determined from the order of the commands in the ST editor. The only way to specifically change the order is to insert loop commands.

Configuration of instruction lists

All Freelance processing functions can be defined by the instruction list (IL). The scope of the instruction list exceeds that of the function block diagram and sequential flow chart, as jump commands and program loops can also be programmed. The operands can be displayed and entered with a selection list according to IEC 61131-3. Parameter definition of the function blocks also uses the same parameter definition screens as those used in the function block diagram.

SFC program
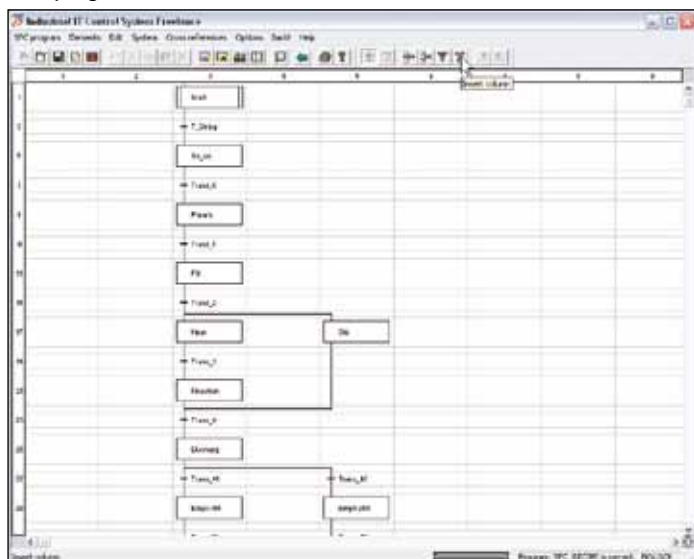
IL program
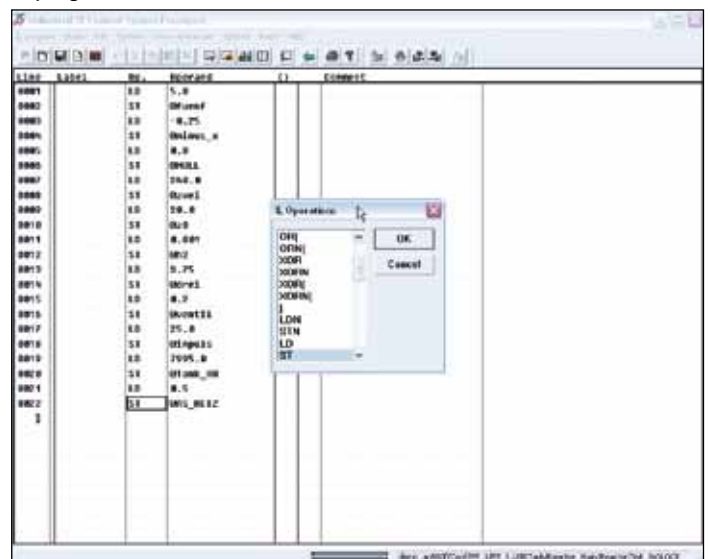
Configuration of ladder diagrams

Along with the function block diagram (FBD) and sequential function chart (SFC), the ladder diagram (LD) is also one of the graphical languages of the IEC 61131-3.

The ladder diagram language originates from the area of electromagnetic relay systems and describes the flow of current through individual rungs. The boundaries of a rung are defined on the right and left side by devices known as power rails, which have the logical state 1 (current is flowing). A rung is created with the elements of the ladder diagram (links, contacts and coils).

Functions and function blocks in the ladder diagram can be called up and used in the same way as in the function block diagram. Parameters are also defined for function blocks using the same parameter screens.

Configuration of operation and observation functions

The following functions can be configured for operation and display:
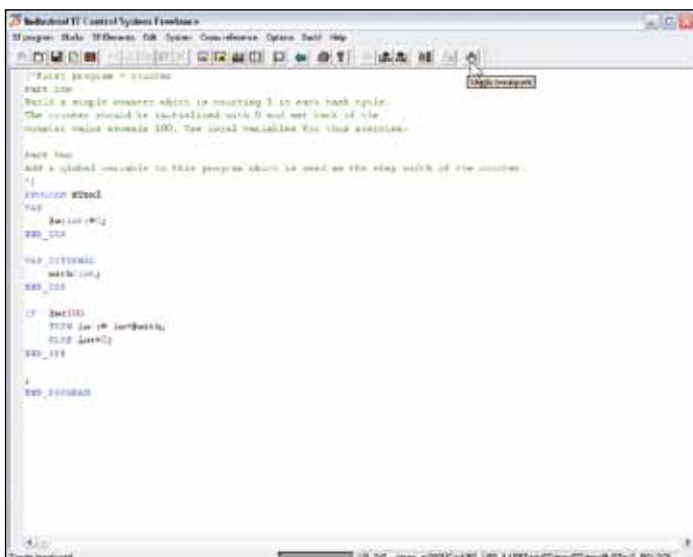– Custom graphic displays
– Web displays
– Standard display types: overview display, group display, trend display, time scheduler display
– SFC display
– Signal sequence, disturbance course and plant log
– Message list and message line
– Operator hint list.

Since the common system database is automatically accessed while configuring these functions, there is no need to re-enter the data.

Standardized displays (pre-engineered)
Standard displays can be configured very easily using Control Builder F. To configure a group display, for example, it is only necessary to select the tags via the selection list. The entry is made automatically. In this manner, up to 10 large analog faceplate tags can be entered per group display. The configuration procedure for the overview display is equally simple, as the containing displays are entered from a selection list.

Structured text

Freely configurable graphic displays

Plant-specific graphic displays can be constructed for displaying the process.

The graphic displays contain static and dynamic display elements.

The static part of the plant display – the background display – is composed of separate graphic elements which can be modified in color, line type and filling pattern and can, for example, display the schematic plant layout

The following constructional aids in the system make it easier to create displays:

– Static elements such as lines, polylines, rectangles, poly-gons, ellipses, arcs and texts are created, for example, by specifying the start and end points.
– Display sections already created can be duplicated, moved, rotated in 90° steps, transposed or superimposed.
– The combination of several graphic elements can be saved as a macro and stored in libraries to be used when desired.
– The zoom function facilitates precise construction of the individual graphic display elements.
– Import of bitmap files facilitates the generation of static background displays.

The process variables are displayed in the dynamic section of the display – the foreground display. Specific process variables can be visualized simply by making the display elements dynamic. The following types of dynamic elements can be used:

– Bar graphs and dynamic filling set to operate in different directions
– Superimposed numerical values and text variables
– Trend window
– Color change or symbol change to depict states
– Continuous or discrete position modifications of the graphic symbol
– Keys (buttons) for the direct execution of actions (e.g. write value or similar)
– Animated objects, e.g. mixers that turn realistically
– Tool tips

Selection fields can be defined at any position so that the operator can access any other displays using the mouse or keyboard.
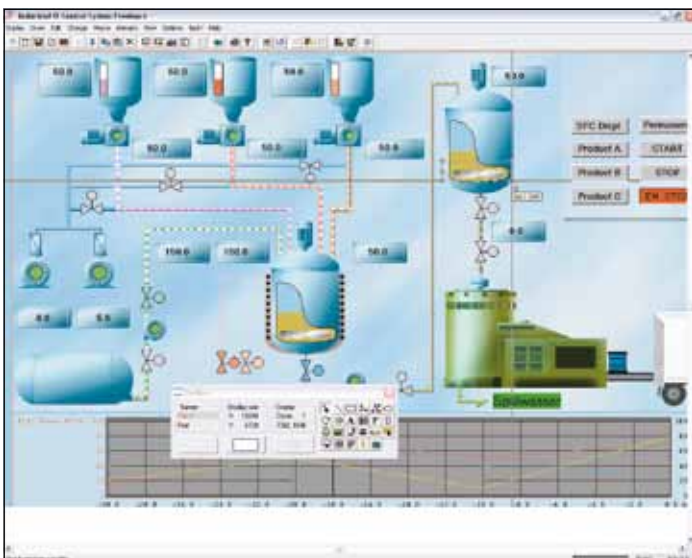
Graphic display for four plant sections
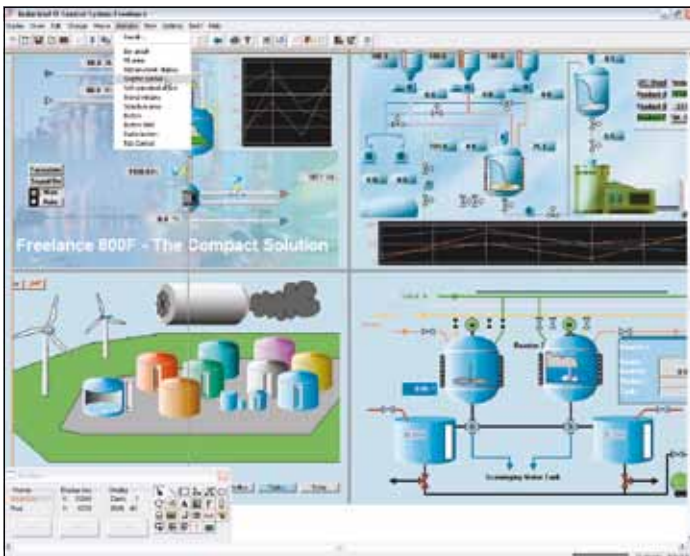
Graphic display with online help for the macro library
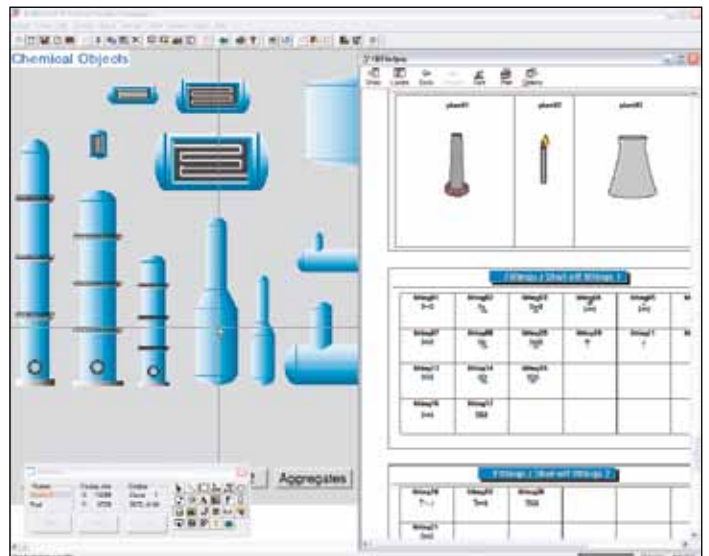
Graphics editor

Hardware structure

The required hardware structure can be configured in a graphical system overview and the system communication can also be defined there. It is possible to assign particular DigiVis operator stations to specific controllers. Furthermore, detailed information can be obtained on the operator and controllers, together with their modules and the controllers with their connected fieldbus lines. In the station overview display, the operator and controllers can be equipped using selection lists. Specifications for processing, display and I/O channel assignment can be made for the individual modules of the controllers. And all this with just a few clicks.
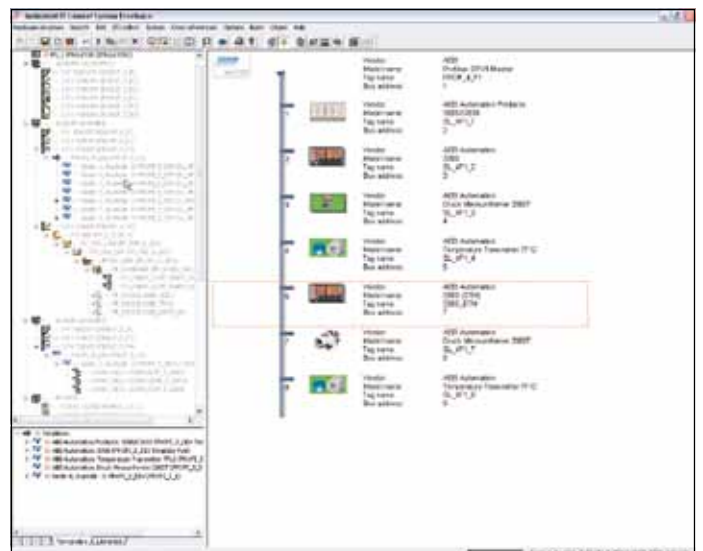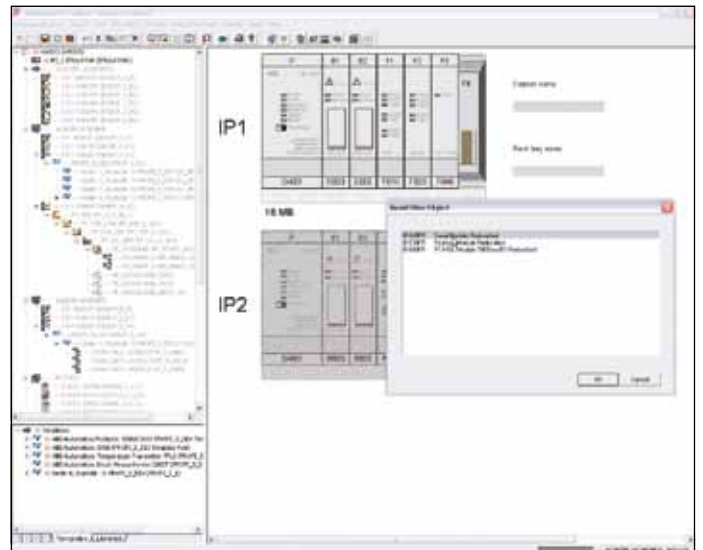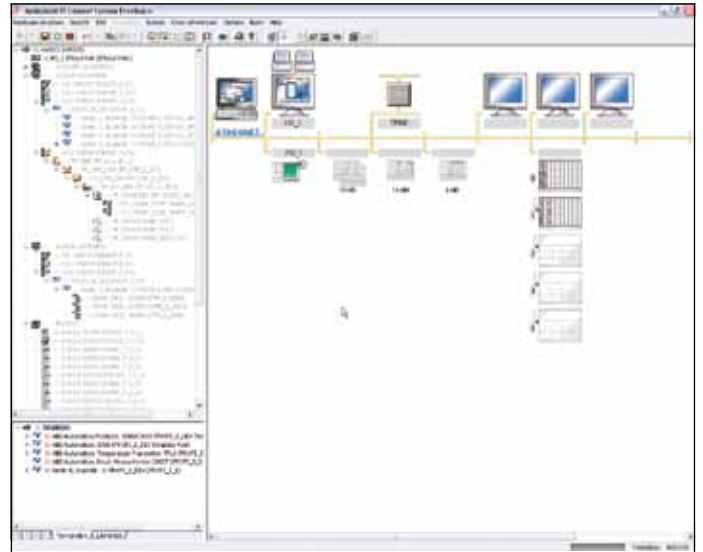
Fieldbus and field device configuration

The respective bus parameters, for instance the baud rate, number of subscribers and time constants, can be set for each fieldbus module. Control Builder F also suggests a setting for the bus parameters in line with how the fieldbus is equipped. This makes work easier for those new to the subject.
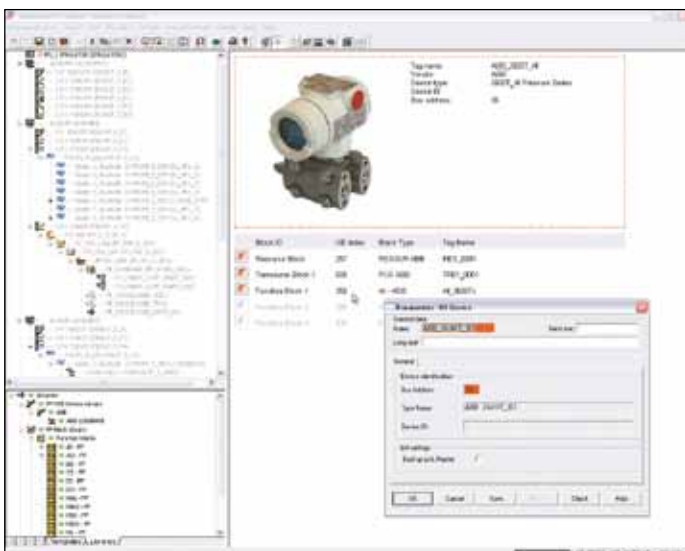
PROFIBUS

In the configuration view of the fieldbus line, new PROFIBUS slaves can be integrated into the fieldbus line using a GSD-file or FDT/DTM technology.

Using the template concept, it is also possible to integrate completely pre-configurable PROFIBUS slaves by means of drag and drop. The intelligent DP/PA Linking Device is transparent with regard to configuration, allowing PA devices to be viewed as if they were connected to the PROFIBUS DP. Parameter definition screens are then available in the device display for defining parameters for both remote I/O and PA field devices.

**1 Definition of the hardware structure | 2 Configuration of AC 800F
3 Configuration of the fieldbus line (PROFIBUS)**

Configuration of the fieldbus line (FF)

HART

HART devices connected to the S800 or S900 Remote I/O can be configured with the aid of HART DTMs. For S900, also HART templates can be used. They consist of preconfigured DPV1 services which tunnel a HART command via the PROFI-BUS to the HART device on the analog channel of a particular S900 I/O module. Users can also create HART templates themselves.

FOUNDATION Fieldbus

The devices are configured in the feedforward part by linking the Device Description (DD) files. This makes it possible to configure the FF without the field devices being physically connected to the controllers.

The devices are configured on the H1 links of the LD 800HSE Linking Devices. As Control Builder F supports control in the field for FF devices, it is possible to configure function charts that interconnect the function blocks in the individual FF devices. Control Builder F then automatically generates a process that is passed on to the Link Active Scheduler (LAS). Redundant Link Active Schedulers are also supported. However, it is also possible to use the FF devices "only" as I/O suppliers, and use the function blocks in the controllers.

Graphical documentation

The fully graphical forward documentation allows configured programs and displays to be printed. The documentation is always up-to-date, as the current configuration data is accessed. Various sorting criteria, such as drawing numbers, assure an orderly and transparent output of the data to be documented.

The scope of documentation can be specified as desired by the user, such as:
– Program and display contents, cross references, parameter definition data and comments
– System overview and hardware configuration

The documentation specification can be stored for future use. The FBD, IL, LD, SFC and ST programs, displays, etc. are documented in the form in which they appear on the screen. Using Freelance documentation management, complete or partial project documentation can be produced without effort. It is also possible to include bitmaps (such as customer logos) in the drawing footer.

Commissioning

During commissioning, the user programs are loaded into the operator and controllers. It is also possible to:
– Load modifications
– Start and stop controllers
– Start, stop or reset tasks
– Define and activate parameters for function blocks
– Define and activate parameters for field devices
– Display, set and track process values
– Combine any process values at any time in a trend window
– Perform version and status checks
– Perform system diagnoses right up to the field device

Displaying process states

The editors for displaying the configured programs can also be accessed during commissioning. As opposed to during configuration, the process states of the I/O variables are also displayed in the program. The status of the binary process signals is displayed in the FBD display by a change in the graphical representation of the signal flow lines.

Value and trend windows are available for displaying process values. They offer an optimal overview of the current process values for commissioning and test purposes.

Here, the user is not restricted to the display of I/O variables for the program currently shown on the screen. Variables from other programs and/or controllers can also be displayed, as well as values from connections between various function blocks of the current program.

Modifying parameters

Parameters can also be modified during the commissioning phase, allowing optimal program settings for the process. These parameters can be altered from either the engineering station or the operator station. Whether the changes made are retained permanently or only temporarily is decided by the commissioner.

Through a parameter upload, it is possible to view all parameter modifications made in a particular period of time and to select those which are to be saved in order to be used at the next cold start.

Other features allow you to force inputs and outputs and to specify new values for simulation purposes.

Trend and value window during commissioning
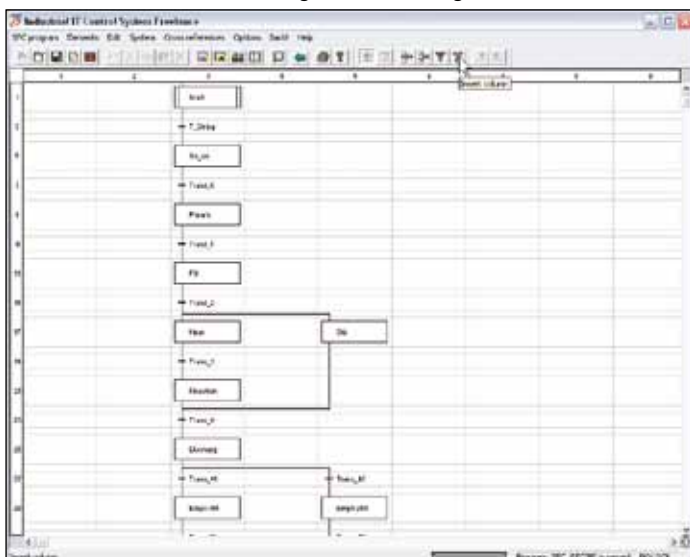
Fieldbus line during commissioning
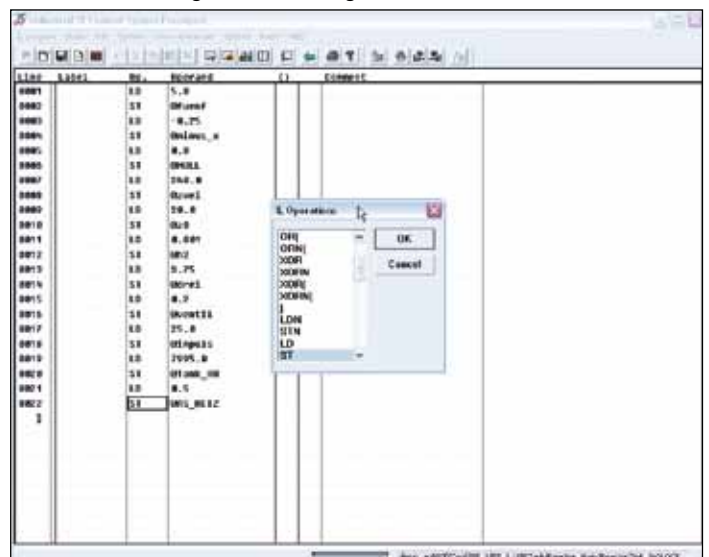
Commissioning the fieldbus lines

PROFIBUS

The fieldbus line overview shows whether the configured PROFIBUS I/O and PA devices are available. In addition, the bus can be scanned using Control Builder F in order to detect new or incorrectly configured devices. Such devices can then be given the correct address from Control Builder F via the PROFIBUS.

During commissioning, Freelance allows you to compare configured parameters with the parameters that exist in the device. This makes it possible to detect device parameters that have been changed locally and transfer them to the configuration by means of uploading. When the PROFIBUS device transmits diagnoses, they can be displayed by Control Builder F. When FDT/DTM technology is used, specific diagnostic options can be used, provided that the device manufacturer has incorporated such options in the DTM.

Individual PROFIBUS devices can be removed from cyclical data traffic in order to perform maintenance without it being necessary to stop the fieldbus.

FOUNDATION Fieldbus

Live lists displaying which devices exist are available for HSE and H1.

During commissioning, Freelance allows you to compare configured parameters for the device modules with the parameters that exist in the device. This makes it possible to detect device parameters that have been changed locally and transfer them to the configuration by means of uploading.

The Link Active Scheduler (LAS) can be stopped in order to interrupt processing of the control loops in a control loops in an H1 link.

"New value" window: defining field device parameters during commissioning
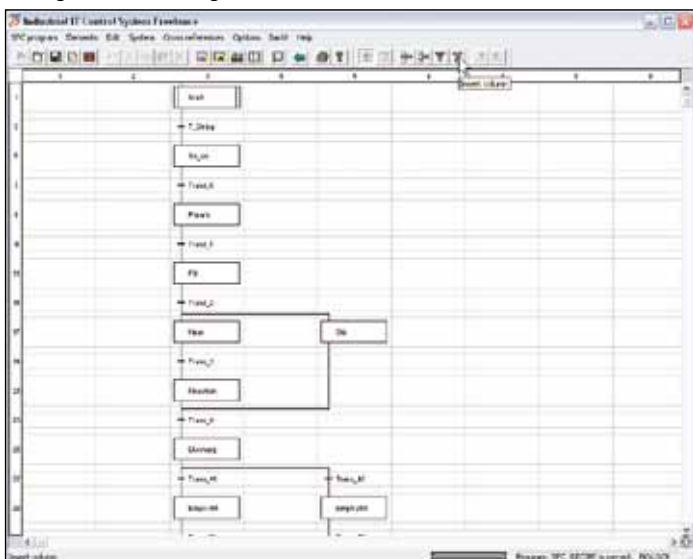
Online diagnosis of fieldbus components
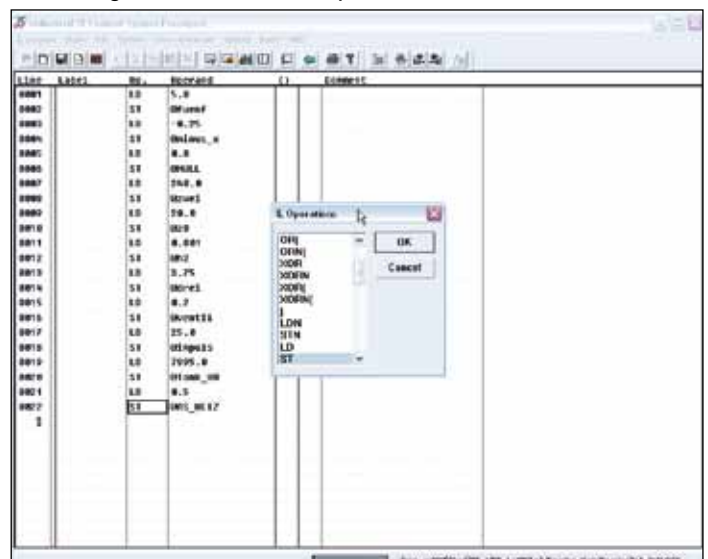
Engineering and services

ABB Automation is one of the world's largest suppliers of equipment, systems and services for measurement and process automation.

A crucial factor in maintaining this market position is the quality of our products, from manufacture right through to services. The DQS Certificate based on DIN ISO 9001 awarded to ABB Automation as farback as 1990 bears testimony to this fact. The same applies for the EQNet Certificate based on ISO 9000/ EN 29000.

However, Freelance includes more than just outstanding technical features. We have also paid a great deal of attention to rational planning, installation and modification processes, allowing you to perform engineering and maintenance activities quickly and cost-effectively. Or, if you prefer, our highly-qualified specialists can perform these activities for you, including:
– Planning and engineering
– Installation planning and execution
– Plant documentation
– Commissioning
– Technical training
– After-sales service
– Upgrades and performance improvements
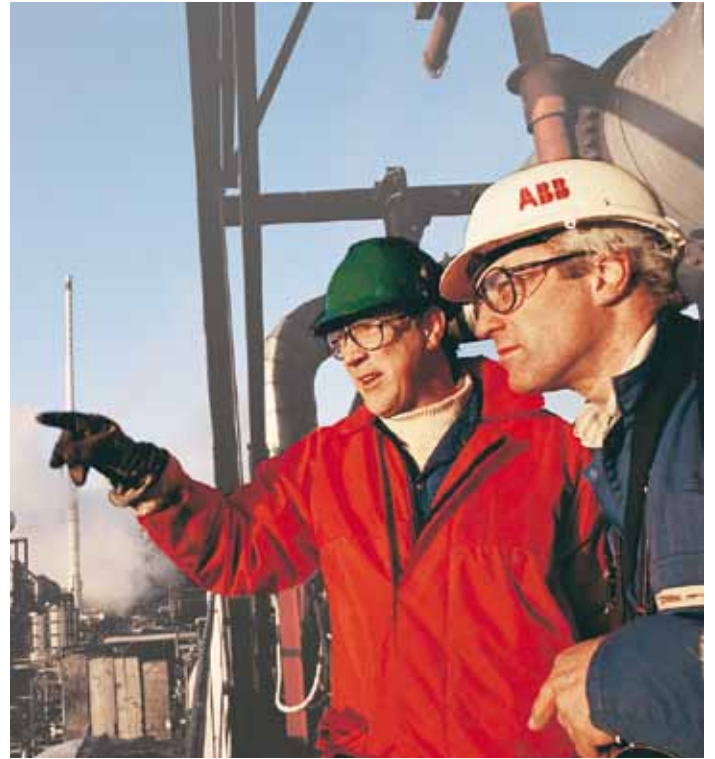
Our instrumentation and control specialists, or our certified partners in system integration, will be happy to assist you in planning and implementing your automation project. ABB Automation's staff can also work with you to plan and implement the installation of a Freelance system in your plant.

Under this arrangement, the ABB Automation Engineering Department will compile the specific project documentation for you. This can include functional diagrams, circuit diagrams, configuration documentation, and operating documentation including system descriptions and instructions for operation, modes of operation and plant maintenance.

At many sites, ABB Automation has its own commissioning engineers who work together with planning engineers, process instructors and operators to commission your plant, optimize it, perform a test run and hand over the system to the operator.

To make sure your operators are fully knowledgeable in the operation of the Freelance compact control system, we offer a range of technical training courses.

In addition, we offer a computer-based training program for Freelance on a multimedia DVD. This will provide you with the basic knowledge you need for configuration, therefore allowing you to start using the system very quickly and efficiently.

Finally, the ABB Automation Service Department provides maintenance services for all Freelance systems and peripheral modules. When it comes to rectifying a fault, we provide you quickly with the necessary specialists and spare parts.

Freelance system data

Controller

Functions:
– Analog value processing
– Binary value processing
– PID loops
– Open-loop control
– Logic and arithmetic processing
– Trend acquisition
– Disturbance course log
– Modbus coupling (master and slave)
– Send and receive blocks
– Phase logic interface (for Batch applications)

Task execution:
– Cyclical processing with selectable cycle times from 5 ms
– Fastest-possible processing (PLC mode)

Process interface for AC 800F:
– Flexible positioning for fieldbus modules
– Replaceable during operation

Electromagnetic compatibility (EMC):

– 2004/108/EC: Complies with the European directive
– EN 61000-6-2: Electromagnetic compatibility (EMC) – Generic standards, Immunity for industrial environments
– EN 61000-6-4: Electromagnetic compatibility (EMC) – Generic standards, Emission standard for industrial environments
– 2006/95/EC: Low Voltage Directive

Ambient Conditions AC 700F / S700 I/O

Operating conditions:
– Ambient Temperature: 0 °C (32 °F)...+60 °C (140 °F) (horizontal mounting of modules) no fan required 0 °C (32 °F)...+55 °C (131 °F) for FieldbusPlug
– Humidity: Maximum 95%, without condensation

Mechanical features:
– Shock: 15 g (0.53 oz), 11 ms, half-sinusoidal
– Vibration: 2 Hz...15 Hz, continuous 3.5 mm (0.1379 inch) 15 Hz...150 Hz, continuous 1 g (0.04 oz) (4 g (0.14 oz) in preparation)

Ambient Conditions AC 800F

Operating conditions:
– Ambient temperature: 0 °C (32 °F)...+60 °C (140 °F)
– No fan required
– Permitted relative humidity: ≤ 80% annual average, no condensation; ≤ 95% for 30 days a year

Mechanical features:
– Shock: 30 g/11 ms / 3 time to each axis
– Vibrations: 3x5 cycles, 2 g/0.15 mm/5...150 Hz

Operator station

Functions:
– Plant-specific graphics:
  – Single displays with mini trend display
– Standardized displays:
  – Overview display
  – Group display
  – SFC display
  – Trend display
  – Time scheduler display
  – System display
  – Faceplates
  – Message list and operator hint list
  – System diagnosis
  – Control aspect (shows configuration)
– Archiving
– Logging
- Excel Reporting
- PLC Connect

Display:
– Display update: approx. 1 s
– Display build-up time: 1...2 s

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