

ABB Relays' custom engineered protection and control systems

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ABB Network Control
& Protection

Relays

A broad range of protective relays for generators, substations and transmission/distribution lines make up the foundation of our product program. The most recent of these relays are

included in this Buyer's Guide and can easily be specified and ordered using the guidelines given in this catalogue.

Systems

Complete systems and projects with total responsibility for protection and control concepts, setting calculations, design, manufacturing, testing and commissioning have become a speciality at ABB Relays.

The main purpose of the ABB protection and control systems is to contribute to the continuous delivery of electric energy. For this reason the maxim of our engineers is to ensure the availability of the vital secondary functions:

- Protection and other local functions must continue to work even if communication links fail.
- The electrical process during fault resp. emergency conditions is too fast to wait for the transfer of commands between the control center and the bays in the stations. All the vital functions have to be performed decentralized and close to the main process.

Thanks to the PYRAMID concept ABB Relays are offering coordinated, unified and decentralized control and protection systems on different levels.

Coordinated means a combination of control and protection without losing the autonomy of protection.

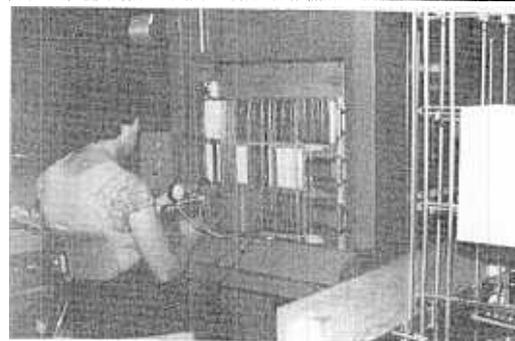
Unified means that all data and commands in the system are accessible in the same way via the common communication system.

Decentralized means that both the data and functions are distributed and handled in the closest possible proximity to the process regarding functional requirements.

The purchase of a completely wired and tested system gives single supplier systems responsibility and warranty on all parts and workmanship. Also, single point contact is provided by a project engineer assigned to follow the system order during design, assembly, testing and shipment.

The protective relays and control units required are specified after careful study of the actual power system and optimally selected for each particular case.

Each protection system delivered is accompanied by detailed and individually generated documentation, available in various languages, made with the aid of computers.



Computer aided system wiring

The documentation accompanying the systems includes the following:

- Equipment list
- Single-line diagram
- Cubicle layout drawing
- Terminal block layout drawing
- Ac-dc schematics
- Wiring diagram/table
- Terminal arrangements

The documentation of the whole coordinated protection and control systems consists of documents like:

- Conceptual overview diagrams
- Necessary overview panels
- Layout of mimic panels
- Specification and addressing of signals
- MMI pictures of switchgear components
- Logic diagrams
- Documentation on system configuration and settings
- Different connecting diagrams

If requested, the drawings listed above are submitted to the customer for review and approval.

ABB Relays is able to render assistance and recommendations during the preparation of concepts and specifications for protection and control systems. ABB Relays can also assist the customer with network studies and calculations.

Systems (cont'd)



System design

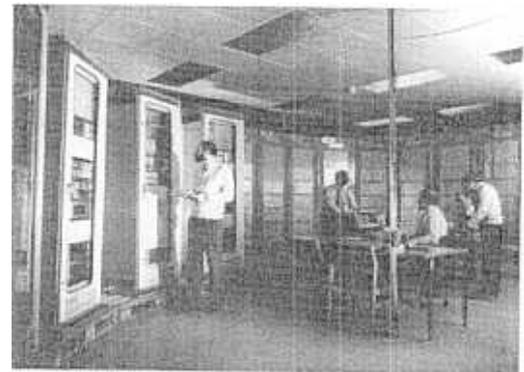
The quality assurance of ABB protection and control systems is based on the ISO 9001 standard.

ABB Relays offers a wide scale of testing facilities. Our network simulators have all the facilities to test the protection systems, either based on particular network parameters or by injection of computed transient signals (EMTP). Acceptance tests are a rule with ABB protection systems. Routine testing is carried out by highly skilled specialists using dedicated, computer controlled testing equipment and test records.

To further ensure compliance with customer specifications and allow smooth and efficient processing of an order, complete information should be supplied with the order. The information required is:

- Single-line ac diagram of the protected gear, showing ratings, CT and PT ratios and connections.
- Specifications concerning desired protection and/or control functions as well as necessary in- and outputs.
- Schematics and wiring diagrams for coordination
- Dc control voltage(s)
- Desired wording on name plates
- Panel type with options, if required
- Customer cable entrance
- Preferences, if any, such as panel layout, terminal layout, etc.

To assist the customer in supplying this information and to make it easier for him to correctly and completely specify his desired installation, our systems design specialists prepare questionnaires for most of our systems.



Network simulation

The supply of completely wired and tested systems simplifies installation and commissioning. ABB Relays has specialists able to carry out commissioning work, all over the world.

As a result of the merger of various companies ABB Relays is able to offer different modular protection systems. The main systems are: COMBIFLEX, MODURES, SPACOM and ANSI-compatible systems.

Consulting and
calculations

ABB Relays can assist the customer when starting to specify his protection and control system. Using different network calculating programs, which are available within ABB, the network can be investigated under different conditions. The short-circuit and earth fault calculations can be performed by taking the load flow into account. Based on the calculated results, on specific customer conditions and on the experience the optimal protection and control concept will be proposed.

The service of ABB Relays can include setting calculations and proposal for settings within considered part of the network. Verification of instrument current transformers can be also included. The programs e.g. RCALC are available for checking the settings of distance protections for the actual application.

Some of the calculating programs are also adapted for the use on personal computers, with menu-driven user-friendly MMC and available on request.

Engineering tools

Different engineering tools are used in ABB Relays and the most important are mentioned below.

Hardware engineering

The CAE tool consists of the basic software type DDS-C and additional engineering packages of system-specific design (i.e. packages for engineering of COMBIFLEX and MODURES systems).

This installation keeps the quality of the produced documents on a very high level because of the common data base used in the system and reduces the engineering time drastically.

Software engineering

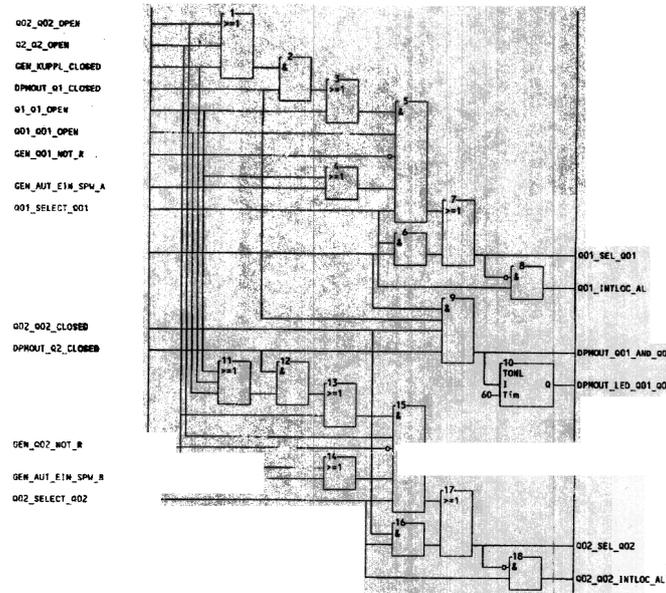
- **FUPLA**

May be used for adding additional functions in the RE.316 and RE.216 protection and control systems.

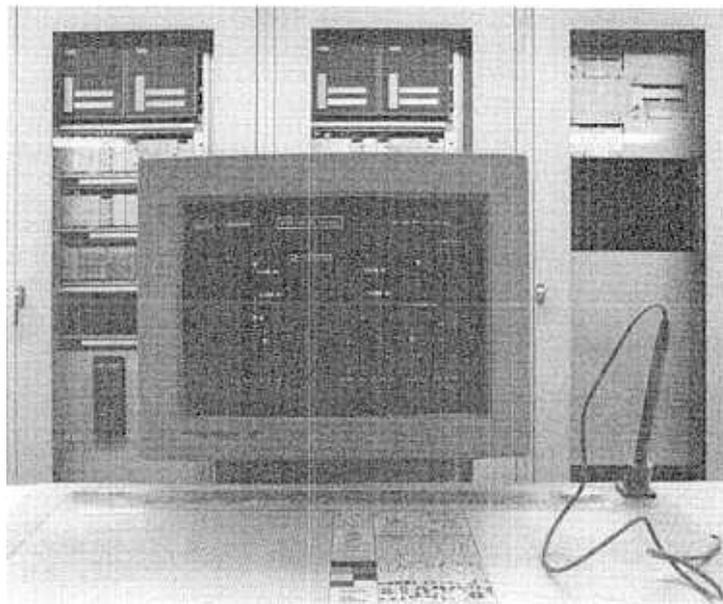
- **CESC program**

This is used for signal engineering in SCS 100 Substation Control Systems.

With our system design specialists and the engineering tools available, we are in a position to supply customized solutions of protection and control systems, including MODURES, SPACOM, COMBIFLEX or ANSI-compatible systems.



Example of custom engineered logic, made by means of FUPLA



CESC helps to model the substation on the screen

Testing of systems

Because of customized solutions the testing of protection and control systems requires highly educated and skilled personnel.

In addition the testing equipment has to be extremely flexible. For testing e.g. the busbar protection any configuration of a busbar system can be perfectly simulated to test the functionality on the one-to-one principle. The protection system tested on this principle will operate on site immediately and it will not be necessary to loose valuable time for the search of mistakes.

The installations simulator, shown in the picture

allows busbar and breaker failure protection schemes to be tested for installations containing from one to four seats of busbars and up to 40 outgoing feeders with all sectionalizers and bus couplers taken into account.

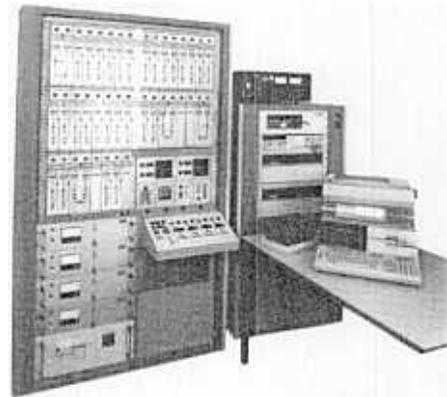
Automatic measurement and recording of pick-up values is controlled by a software package. The measuring program performs the actual measurements in accordance with the configuration and input data and prints out the results.

Similar and adequate equipment is used for testing of other protection and control systems.

Testing of systems (cont'd)



Computer aided testing



Simulator for testing of any configuration of busbar protection

ENCLOSURE / Beilage: 11 PAGE / Seite : 1
Ikmin MEASUREMENT/Messung Ikprism 1000 A

FDR	BUSBAR	Iksak	PHASE R	PHASE S	PHASE T			
Abg	Schiene	Iksak	Phase R	Phase S	Phase T			
1	1A	10.00A	10.23A	2.00%	10.38A	4.00%	10.25A	3.00%
2	1A	10.00A	10.29A	3.00%	10.25A	3.00%	10.31A	3.00%
3	1A	10.00A	10.17A	2.00%	10.41A	4.00%	10.31A	3.00%
4	1A	5.00A	5.18A	4.00%	5.17A	3.00%	5.14A	3.00%
5	1A	12.50A	12.86A	3.00%	13.00A	4.00%	13.04A	4.00%
6	1A	12.50A	12.77A	2.00%	12.77A	2.00%	12.77A	2.00%
7	1A	8.33A	8.45A	1.00%	8.61A	3.00%	8.40A	1.00%
8	1A	12.50A	12.82A	3.00%	12.82A	3.00%	12.85A	3.00%
1	2A	10.00A	10.34A	3.00%	10.15A	2.00%	10.28A	3.00%
2	2A	10.00A	10.39A	4.00%	10.22A	2.00%	10.37A	4.00%
3	2A	10.00A	10.43A	4.00%	10.32A	3.00%	10.25A	3.00%
4	2A	5.00A	5.20A	4.00%	5.14A	3.00%	5.17A	3.00%
5	2A	12.50A	13.05A	4.00%	12.92A	3.00%	12.83A	3.00%
6	2A	12.50A	12.79A	2.00%	12.93A	3.00%	12.81A	2.00%
7	2A	8.33A	8.53A	2.00%	8.59A	3.00%	8.50A	2.00%
8	2A	12.50A	12.73A	2.00%	12.92A	3.00%	12.88A	3.00%

Part of test protocol of busbar protection

Commissioning

Within ABB Relays a number of commissioning engineers are available to perform or supervise the commissioning of entire protection and control systems.

System commissioning ensures full functionality of the customer's system, together with the

issue of complete and updated documentation illustrating its final design.

The customer's personnel may participate in the commissioning process, in order to be able to perform the maintenance work, once the station has reached the stage of normal operation.



Commissioning and education on site



Service testing

Education

For the training of planning engineers and users of protection and control system there are education centres in our "Centres of Excellence" and in addition in some local centres. These centres arrange courses in English and other languages, dealing with the following topics:

- Basis of protection and station control
- Distribution equipment
- Line protection basic, advanced, numerical
- Busbar-, breaker backup protection
- Generator-, transformer-, motor protection
- Station control

The courses are accompanied by "hands-on-training" (settings, parametrization etc.) sessions. The courses are concentrated on the

basis, functionalities and systems of each topic. Products from the different ABB Relays lines are presented as examples and for the hands-on-training sessions. The courses may be booked separately for each topic.

For maintenance and trouble-shooting special courses are arranged, dealing with the specified equipment and tailored to the particular level of knowledge.

Normally the courses are held in education centers, but can also be held on site on demand.

A catalog, listing all standard courses, their content and the conditions, dates and booking procedures, is issued each autumn.



Motivated participants on a training course

**Management of large
and risky projects**

This can only be performed by an organization with sufficient experience and know-how and with the necessary financial strength. To check this ability many investors of large projects carry out a prequalification procedure.

ABB Relays has very good references in this aspect and can show a long list of successful prequalifications and of large projects managed.

**Overall Technical Data
of ABB Systems**

Auxiliary supply:

In most cases the auxiliary supply is derived from the station battery via a dc/dc converter. Versions of the dc/dc converter are available for connection to different standardized dc voltages with wide operating ranges.

Standard ac current and voltage inputs:

The relay inputs are designed for the following rated values:

- current: 1 and 5 A
- voltage: 110 V
- frequency: 50 and 60 Hz

Serial communication

The standard serial communication interface for all numerical relays is the OBI (object bus interface) to the SPA bus. This interface is already available today for the most of the numerical relays. The optical SPA bus with 9600 kBits/sec is dedicated to ABB Relays. Other interfaces are provided on request.

If an international standard for communication in substations is available, this standard will be provided.

Output contacts:

As a rule, the relay outputs are required to trip

circuit breakers, actuate signals or perform control duties. The ABB systems therefore have powerful contacts for direct operation of CB coils. On request, ABB systems can be equipped with fast master relays or with lockout relays. A typical short-time rating is 30 A, 0.2 s.

Static tripping units for extremely fast protection systems are also available.

Ambient conditions:

The relays withstand the following temperature ranges:

- data guaranteed: -5°C to +55°C
- operates without damage: -25°C to +70°C

Insulation and disturbance tests:

Each product included within a system is tested routinely with a dielectric test. Impulse voltage and disturbance tests are only carried out as type tests.

In addition, systems are tested routinely as follows:

- Dielectric test: 2.0 kV ac, 1 min., acc. to IEC 255-5
- resp. 1.5 kV, 60 Hz, 1 min., acc. to ANSI 37.90

The insulation resistance measurement is carried out at 500 V dc.

Overall Technical Data of ABB Systems (cont'd)	<p>Earthquake tests: Typical assemblies have been tested according to the following recommendations:</p> <ul style="list-style-type: none"> - Regulatory Guide 1,100 (US-NRC), "Seismic Qualifications of Electric Equipment", March 1973 	<ul style="list-style-type: none"> - IEE Standard 344, "Recommendation Practices for Seismic Qualification of Class 1 Equipment for Nuclear Power Generating Stations", 1975.
ANSI-compatible systems	<p>In addition to the systems according to IEC standards, complete electromechanical, static and power line carrier teleprotection systems, for the control and protection of generating stations, power lines and substations, fully comply-</p>	<p>ing with ANSI standards, can be delivered. The ANSI standard requirements for all equipment, documents, drawings, symbols, dimensions and measuring systems are fully complied with.</p>
References	<p>Relay mounting systems 1MDB14003-EN Relay and control cubicles 1MDB14004-EN</p>	<p>PYRAMID Selection Guides 1MDB00004-EN 1MDB01002-EN</p>