UniGear *type ZS1*

SSC (Switchgear System Connectivity)
UniGear type ZS1 SSC (Switchgear System Connectivity)

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1 – State of the Art of M.V. Switchgear

At the moment, electric power distribution switchgear for indoor use is designed as a sequence of one or more panels. Each panel has a piece of primary apparatus, such as a circuit-breaker or an isolator, and a certain amount of secondary apparatus, such as protection relays, measuring instruments, pushbuttons, and other mixed apparatus. This apparatus is generally mounted inside the low voltage compartment. In each panel, wired in accordance with the detailed functions requested by the Customer, all the apparatus is connected inside and towards the field by means of point-to-point wiring. The secondary apparatus shares the information of the analog and digital signals for interlocks, protection coordination by means of these wired connections. The cabling is strictly dependent on each single plant, and the secondary apparatus is highly customised. As a result there are long times in all the secondary engineering, design, construction, testing, start-up and putting into service stages. The conventional solution normally has a low level of integration of the control, measurement and protection functions with a heavy impact on the number of low voltage components and on the cabling. Furthermore, the conventional solution has little flexibility in the case of modifications during the work.

2 - Switchgear System Connectivity

ABB is always working to look for innovative solutions in the Medium Voltage sector, both for primary and secondary distribution. The SSC solution is the result obtained following continual development of technology. The high level of flexibility and of possible configurations obtained with this system are achieved by integration and rationalisation of all the low voltage components. The SSC (Switchgear System Connectivity) is an automation solution based on introduction of a digital high speed communication bus, to be able to replace the point-to-point connections inside Medium Voltage switchgear.

The digital high speed bus selected as the solution for the SSC is the CAN (Controller Area Network). The REF542plus multi-function protection and control unit and the I/O modules are provided with a specific CAN interface. The CAN interface is able to manage the following:
- Digital Inputs/Outputs.
- Analog Inputs/Outputs (0-20mA, 4-20mA, PT100).
All these signals are shared on the CAN field bus by means of messages between the protection and control unit and/or the CAN units of third parties (such as the I/O modules, sensors, etc.).

3 - Fields of Application

The CAN system (Controller Area Network) is a bus system used in a wide range of applications. This system, which is normally used to physically connect two or more pieces of “micro-controller-based” apparatus, was officially introduced on the market in 1986. The main fields of application of the CAN system include:
- Automobiles;
- Trucks and buses;
- Passenger and goods trains;
- Electronics for naval application;
- Electronics for aeroplanes and aerospace vehicles;
- Industrial automation;
- Medical apparatus.
4 - Reference Standards

The SSC system based on CAN protocol is an International Standard defined in ISO 11898 “Interchange of digital information – controller area network for high-speed communication”. Along with the protocol itself, the conformity tests are defined in accordance with the ISO 16845 Standards: “Controller area network – conformance test plan”.

5 - Main Functions

The SSC system makes it possible to have a high level of standardisation since the standardised cabling of the main switchgear components (secondary engineering) do not depend on the plant or on the Customer.

The vertical wired inside the panels, made in the conventional way (circuit-breaker, earthing switch, transformers, etc), which leaves and arrives in the REF542plus protection and control unit, is simplified.

The new standard interfaces of the Medium Voltage switchgear towards the outside are:
- Serial bus (e.g. Connection to SCADA systems);
- Intelligent centralised I/O modules (e.g. DCS, PLC, etc.) as requested by the Customer.

From the above, it can be deduced that the new secondary parts of the switchgear are made up of:
- REF542plus protection and control unit with specific bus interface;
- conventional I/O modules replaced by intelligent I/O modules;
- Point-to-point inter-panel cabling replaced by the digital bus.

All this leads to a drastic reduction in the complexity of the cabling.

With regard to the engineering part, the cabling which is now conventional becomes software managed by a graphic engineering tool. Therefore there is:
- A system which is fully configurable via software;
- High modularity of the solutions proposed.

The software design tool allows configuration and analysis of the whole electrical network and configuration of the system by means of a laptop PC connected directly to the SSC network.

SSC – details of integration in Medium Voltage Switchgear
6 - **REF542plus Protection and control unit**

The REF542plus unit integrates all the secondary functions for Medium Voltage switchgear in a single device:
- Protection;
- Control;
- Measurement;
- Monitoring and watchdog;
- Communication.

Medium Voltage switchgear provided with the REF542plus unit becomes a complete and efficient system for the power distribution and management.

The wide variety of protection functions available makes the unit suitable for any type of application.

The REF542plus unit is able to manage four different communication protocols which allow direct access to any architecture of a control system. Furthermore, the CAN interface is present, which can allow connection to the SSC system.

The REF542plus unit is made up of two parts, a basic unit and a local detached human-machine interface (LD HMI), connected together by a serial cable.

The basic unit houses the power supply, the main module, the binary and analog Input/Output modules as well as optional modules for additional functions.

The HMI interface is a user-friendly unit for local control of the Medium Voltage switchgear and is used to locally control the switching parts, to set the protection parameters and to display the events and measurements.

7 - **Intelligent modules**

With the SSC solution, the Customer terminal boxes of the whole switchgear are grouped together in a single instrument compartment are of "intelligent" type, i.e., connected to the digital bus.

A Customer terminal box for the SSC system consists compulsorily of a first interface module, a last terminal module and inside it, it can contain both input and output analog or digital modules.

In the case where there is a higher number of modules than those allows (no.110 modules per terminal box) or if the space available in the instrument compartment is exceeded (linked to the width of the panel), it is necessary to provide another Customer terminal box, with the relative interface and terminal modules.

8 - **System Architecture**

The system foresees that all the controls and signals of every functional unit (panel) be connected to the REF542plus unit present in the same functional unit.

All the REF542plus units present in all the functional units belonging to a piece of switchgear are connected together by means of a CAN communication bus.

The intelligent Input/output terminals at which the Customer is headed are also connected to the CAN communication bus.

The Customer terminals are all concentrated in a functional unit (generally the busbar or measurement riser) or in a dedicated low voltage panel, separate from the Medium Voltage switchgear.
9 - Conventional vs. SSC Solution

The instrument compartment wired conventionally is a highly complex solution and takes up a lot of space:
- High number of Input / Output terminals;
- Greater number of cards required in the multi-function protection and control units.

The solution wired using the SSC system would provide the following:
- Reduced and standardised cabling;
- Engineering carried out at software level;
- High level of diagnosis.

The intelligent Input/output modules are installed inside the empty Medium Voltage units (measurement and/or bus riser unit).

10 - Main Advantages

High level of reliability and continuous Monitoring of the system

The system SSC, compared with conventional point-to-point cabling, offers greater reliability. Continuous monitoring is carried out of the connections and function of each module connected in the network, considerably increasing the system watchdog. Monitoring and automatic control of the digital bus is carried out. This means the malfunction of a component and/or of the digital bus itself is detected and signalled in real time.

Maximum service continuity and great safety for the personnel

Malfunction of a REF542 plus protection and control unit does not jeopardise the function of the system and vice versa the digital bus does not jeopardise the function of the protection. All this leads to a drastic reduction in ordinary plant maintenance with consequent increase in safety.

Watchdog

The Medium Voltage switchgear designed with the SSC system shares all the information contained inside the REF542 plus protection and control unit and intelligent modules on the digital bus and which can therefore be read both internally and externally. This information is available locally (e.g. Human Machine Interface) and is also available remotely by means of the supervision system (e.g. SCADA).

Drastic Reduction in Design and Delivery Times of the Switchgear

The SSC system allows a considerable saving in delivery times of the Medium Voltage switchgear since the design process goes from being serial to parallel.

This is linked to the fact that this switchgear does not require customisation (at electric cabling level) depending on the plant or differences in the protection functions or control unit.

At design level it allows simple implementation of the design specifications and has a very reduced impact on the modifications required at the last minute both to the diagrams and to additional of any intelligent I/O modules.
By moving the intelligence closer to the process within the Medium Voltage switchgear, the following benefits are obtained:
- Reduction in construction times: customised solutions are not required in the protection and control functions of the units;
- Reduction of engineering: highly standardised components are used.

**Drastic Reduction in Plant Modification and any Extension Times**

There is an increase in flexibility with the SSC system, which allows extension and updates to the plant logics simply by increasing the intelligent modules in relation to those already existing, without having to carry out an modification to the existing cabling on the Medium Voltage switchgear. The only activity to be carried out is implementation of the new intelligent modules and the relative cross reference in the software of the SSC.

**Drastic Reduction in Installation and Putting into Service Times**

For the installation and putting into service activities on site, there is a notable reduction in the commissioning times with consequent solution of cabling problems during assembly of the panels.

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**Example of SSC system architecture**

![Diagram of SSC system architecture](image)

- Digital Bus
- Protection and Control Unit
- Standard Cabling
- Circuit-breaker
- Communication System of the External Station
- Software Engineering
- Standard external connections to the switchgear (binary and analog I/O) as requested.
- Intelligent Input/Output Modules
- Panel A
- Panel B
- Additional panel or unit with empty low voltage compartment (e.g., Riser Unit)