MiCOM C264

Modular substation controller

Alstom's C264 substation controller is a sophisticated solution supporting many applications and functions for substation control, communication, monitoring, protection and automation.

Flexibility, reliability and ease of use are among the top features required in a substation computer; the MiCOM C264 has these features.

A combination of dual redundant fibre optic Ethernet, modular I/O, an expandable design and an extensive library of functions make the C264 the ideal solution for a wide array of applications in substation digital control systems.

In addition to the traditional data management (inputs and outputs) the MiCOM C264 can be used as a:

- > Remote Terminal Unit (RTU)
- > Bay computer
- > Feeder manager (protection & control)
- > Substation automation processor
- > Sequence of Events Recorder (SER)
- > Automatic Voltage Regulator (AVR)
- > Measurement centre
- > Load shedding controller
- > Protocol converter
- > Substation gateway

Customer benefits

- Flexible, modular, expandable design, supporting many applications
- Suitable for retrofitting and modernizing existing installations
- Provides both legacy and cutting edge communication interfaces
- LCD graphical display for user-friendly local control, monitoring, and maintenance
- Proven solution, with more than 30,000 units installed worldwide

Seamless modernisation of existing installations

The C264 provides seamless integration with existing substation assets, thanks to its flexible interfaces and native expandability. Its powerful processing, communication and configuration facilities make it the ideal tool for upgrading substation supervision, automation and maintenance.

Innovative real-time automation schemes

MiCOM C264 enables innovative automation schemes thanks to extremely fast (event driven) Programmable Scheme Logic (PSL) and robust Programmable Logic Control (PLC).

Optimised engineering

The multifunctional capabilities of the C264 optimise system engineering as fewer devices result in less wiring, training and maintenance.

Applications

Bay/substation interlocking

Alstom's C264 provides two methods of interlocking:

- A logical equation based method
- A topology based method, using predefined rules and substation topology

Interlocks are managed as close to the process as possible in order to provide the best security of operation. Interlocking conditions are graphically displayed in order to immediately identify the interlocking conditions (if any) and make the appropriate changes before issuing the command.

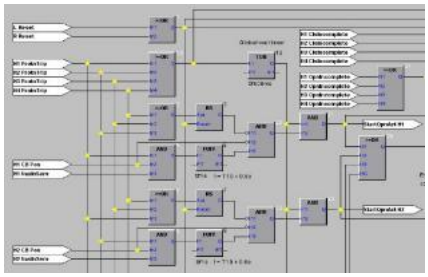

Figure 1 Sample logical equations

Trip circuit supervision

The purpose of this function is to supervise the continuity of the trip circuit of a circuit breaker. Two options are available: two wires or four wires. The two-wire option verifies the trip circuit continuity when the circuit breaker is closed.

The four-wire option permits verification of the continuity whether the CB is open or closed. In the case of single phase circuit breakers the C264 can supervise the continuity of the trip circuit separately for each phase.

Automatic Voltage Regulation (AVR)

The Automatic Voltage Regulation (AVR) function is used to automatically maintain the correct secondary side voltage of a tap changing transformer.

AVR in the MiCOM C264 is a compact voltage regulation solution for IEC61850 systems in electrical substations. It is able to manage one transformer or up to four transformers in parallel.

C264 AVR provides:

- Active and reactive compounding in order to maintain the voltage at a remote location
- Homing in order to adjust a transformer to the voltage of the busbar to which it will be connected
- For transformers in parallel: Minimizing circulating current method, master/follower mode
- Optimised transformer ratio

Auto-recloser

The MiCOM C264 can manage one auto-recloser per bay (up to 12 bays per unit). The integrated auto-reclosers can operate in 1 phase and/or 3 phase mode. Up to four auto-reclosing cycles are available and the time delay for each is independently configurable. Auto reclosers can be initiated either internally in the bay unit or via external protection devices using digital inputs.

Synchro-check

The synchro-check function can be used in conjunction with automatic or manual reclosure. The function (limited to one bay) determines the difference between the amplitude, phase angles and frequencies of two voltage vectors and uses this information to determine whether or not to close the breaker. Locking and coupling modes are available and a deadline and dead bus logic are also included.

IED gateway and data concentrator

One of the main features of the C264 is to concentrate and process data. This information can come from a variety of sources, both analogue and digital. For example, when re-using existing equipment, analogue data can be acquired directly from current and voltage transformers and digital data can be acquired over serial communication links or via hardwired links.

The MiCOM C264 manages many types of data: tap positions, controls, measurements, disturbance records, settings, etc. Each item of qualified data is uniquely referenced in order to ensure full consistency of the information, as well as allowing it to be re-used in other parts of the system.

Figure 2 MiCOM C264 front view (40TE variant)

Remote Terminal Unit (RTU)

The MiCOM C264 can be used as a Remote Terminal Unit (RTU), offering a powerful solution for SCADA communication, Sequence of Event Recording (SER), and can be integrated into a substation Digital Control Systems (DCS).

- Up to 5012 digital inputs
- Up to 1024 digital outputs
- Up to 15 independent acquisition racks, communicating over Ethernet
- Up to 4 serial links on a rack (RS232/RS485/optical)
- Up to 2 simultaneous SCADA connections
- Up to 16 IEDs connected via each RS485 serial interface

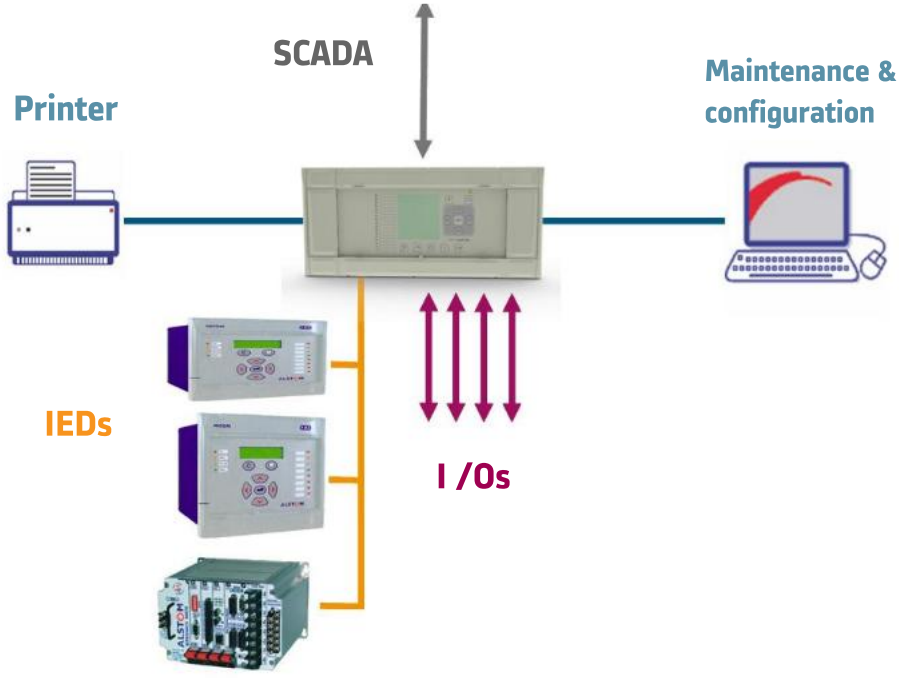

Figure 3 Simple Alstom's DCS architecture using a single C264 substation controller

Sequence of Events Recorder (SER)

A reliable Sequence of Events Recorder (SER) is integrated into the MiCOM C264 for accurate event monitoring in electrical substations. Benefiting from accurate time synchronisation, maintenance over Ethernet and an expandable architecture, the SOE function is able to locally store and print up to 2000 time stamped events with a 1ms resolution. The 200 most recent events can be viewed on the local LCD screen. It also offers printer status monitoring.

Feeder protection and control

The MiCOM C264 provides feeder management functionality through an optional independent dedicated module, hosting powerful protection and automation functions. An efficient one box solution for HV and MV applications such as:

- MV feeder lines,
- Overhead lines and underground cables (back-up protection on HV systems)
- Insulated, solid or resistance earthed and Petersen coil earthed neutral system,
- Industry, Transport
- Generator and transformer schemes

The C264 substation bay controller supports the following protection functions:

- Phase & earth overcurrent (50/51, 50N/51N),
- Phase & earth directional overcurrent (67, 67N),
- Wattmetric (32N),
- Negative sequence overcurrent (46).
- Undercurrent (37),
- Undervoltage (27) and Overvoltage (59) and residual Overvoltage (59N)
- Over and Under-frequency (81O/81U),
- Rate of frequency change (81R)
- Thermal overload (49)
- Breaker failure (50BF)

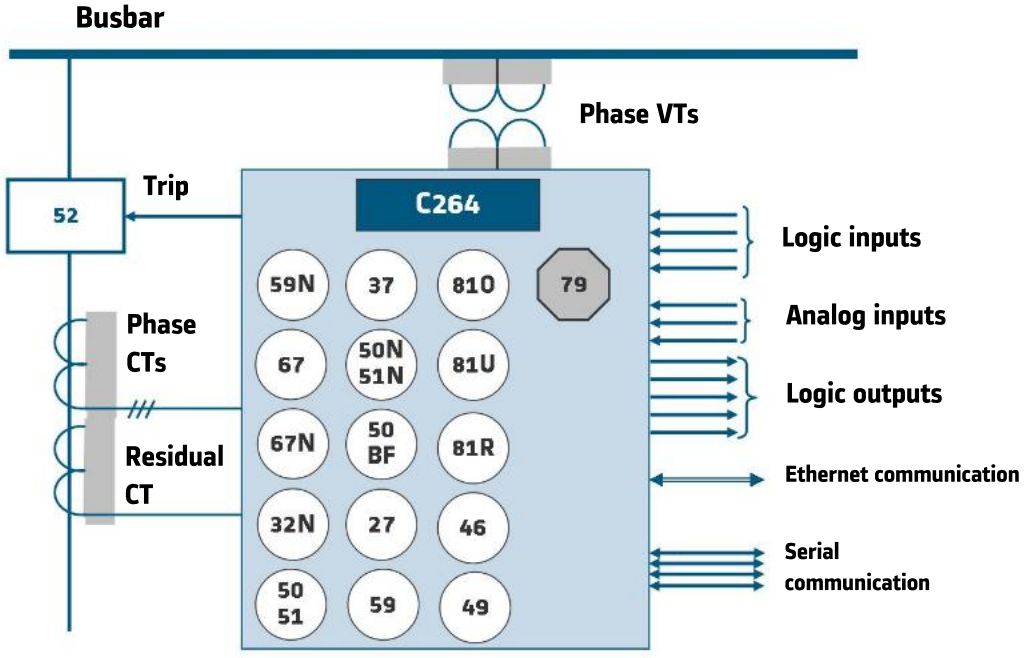

Figure 4 Protection functions in the MiCOM C264

Features

Communication protocols

Alstom's MiCOM C264 is fully compatible with many communication standards such as UCA2/IEC 61850, IEC 60870-5-104, DNP3, IEC 60870-5-101/103, and MODBUS.

Redundancy

At substation level and / or bay level an optional redundant C264 can be used to avoid the loss of critical functions.

Digital inputs

The MiCOM C264 offers five types of digital inputs:

- Single point
- Double point
- Multiple point
- System input for internal C264 information
- Logical combination of digital inputs

All inputs are acquired and time-stamped with an accuracy of 1 ms.

Digital input processing

In addition to de-bouncing many customisable filtering functions can be used to process digital inputs, including:

- Toggle filtering
- Persistence filtering
- Motion filtering
- Undefined state filtering

Additionally a digital input can be manually suppressed, substituted, forced invalid and detected as faulty. Digital inputs can then be transmitted on the substation LAN using the desired protocol.

Binary counters

Two types of binary counter are available; single counters for single data points and double counters for double data points. Counters can be transmitted periodically or on request. In the event of a supply interruption the counters can resume from their previously stored values.

Digital outputs

Digital outputs can be used to apply a switching voltage to an external device. These outputs can be controlled in one of three ways:

- Select Before Operate once (SBO once)
- Select Before Operate many (SBO many)
- Direct execution

The SBO once mode is used for controls via set points or ancillary devices, as well as synchronised or non-synchronised circuit breakers, transformers, disconnectors and earthing switches. The SBO many (selection, execution, and de-selection) control sequence is used for the control of transformers.

Encoded digital data

The MiCOM C264 can interpret a group of digital inputs as an encoded digital value. Binary, Binary Coded Decimal (BCD), gray code, decimal and 1 among N types of encoding can all be processed. These values can represent data such as process measurements and tap positions.

Analogue inputs

Analogue measurements can be acquired from either an analogue input board, a transducerless measurement board (for current and voltage transformers) or via a communication network.

Analogue outputs

Analogue outputs can be used to interface with auxiliary devices (measurement viewers, generators, motors, etc). The Analogue outputs are powered from an external supply (48VDC) and can maintain their value even if the C264 is powered down.

Measured and derived values

Directly measured values of voltage and current can be measured using the transducerless measurement board. Many different values can be calculated from the measured values including:

- RMS currents and voltages
- Network frequency and phase angle
- Active, reactive and apparent powers – total and per phase
- Power factor
- Sequence components
- Derivatives: dF/dt, dV/dt, etc

Figure 5 MiCOM Alstom C264 rear view (40TE variant)

Waveform recording

The MiCOM C264 provides two types of waveform recording, Fast Waveform Record (FWR), which stores samples at the maximum sampling frequency and Slow Waveform Record (SWR), which stores RMS measurements over a longer period. Both modes can run simultaneously. Recording can be triggered by, the change of state of binary digital inputs/outputs, measurement threshold violations and a request from an operator. Waveform records are stored using COMTRADE 2001 binary format.

Power quality

Alstom's C264 can measure the percentage Total Harmonic Distortion (THD) (up to and including 15th harmonic) and the Total Demand Distortion (TDD) on voltage and currents.

Self monitoring

Comprehensive self-monitoring procedures, including power-on and continuous testing, ensure that internal hardware or software errors are detected and do not cause malfunctions. If a fault is detected an alarm will be issued and/or the watchdog contacts will change state depending on the fault severity.

Maintenance web server

The maintenance web server can be used to visualise maintenance data (Hardware/Software, Communication, I/O values) and to download the up-to-date event log. It is directly accessible with a standard Internet Browser.

Programmable logic

An operator can configure specific control sequences or automation schemes (e.g. automatic switching, System Integrity Protection Schemes (SIPS), load shedding). Such applications can be based on local or remote data. Similarly the outputs can perform local or remote actions. Programmable logic can be implemented in the C264 using either Programmable Scheme Logic (PSL) or the Programmable Logic Controller (PLC). PSL is for fast automation applications (<5ms). It is event-driven and so there is no cycle time. The optional PLC tool is fully compliant with IEC 61131-3. It can be used for complex or sequential automation applications.

Local interface for control, operation and display

The control of switching devices is possible using a keypad and a graphical backlit LCD. Operations can be performed in a simple and intuitive way via up to 12 switchable displays for bay control. Additionally there are dedicated panels for monitoring (i.e. measurements, events list, alarms, etc.), display and maintenance. If required the operator panel can be mounted separately from the C264 (up to five meters away). Access barriers can be used to guard against inadvertent or unauthorised operations.

Event logging

Up to 2,000 events can be stored in non-volatile memory. The events are time stamped and stored in chronological order.

Time synchronization

The MiCOM C264 internal clock can be synchronised via:

- An operator
- IRIG–B GPS clock (via the IRIG-B input)
- Ethernet SNTP server
- Remote SCADA (DNP3.0, IEC60870-5-101 or IEC60870-5-104)

In addition, the MiCOM C264 can be configured as an SNTP server on an Ethernet network.

Configuration & settings

Based on pre-defined libraries, individual configurations can be created rapidly. It is possible to modify the C264's settings on line, with the MiCOM S1 setting Tool (over Ethernet). The MiCOM C264 provides two configuration databases: one active and one inactive for fast and secure switching in case of system configuration changes.

Ethernet communication

The MiCOM C264 is natively equipped with 2 independent Ethernet ports to connect to two separate LANs such as the local Station Bus and a remote SCADA. Integrated redundant fibre optic Ethernet switches are optionally available, utilizing Alstom's advanced Self Healing Ring and Dual Homing Star protocols.

Performance and capabilities

I/O processing capabilities

Including direct and IED points, the C264 can process up to:

- 5012 Digital inputs
- 1024 Digital outputs
- 1024 Analogue inputs
- 128 Digital counters
- 128 Digital setpoints
- 4 Current Transformers (CTs)
- 5 Voltage Transformers (VTs)
- 16 IEDs per serial link
- 64 Tap position indications

Local HMI

Detachable up to 5 or 15 meters (optional)

Storage capacities

The following records are stored in non-volatile memory:

- 2000 events, 1 ms time stamped, in the Sequence of Event log (circular buffer)
- Up to 8 Slow or Fast Waveform Records (SLW or FWR)
- FWR records store up to 8 analogue measurements (32 samples per cycle) and up to 128 digital inputs/outputs. The total recording time is equal to 9.6s
- SWR records store up to 8 RMS measurements (time calculation settable from 1 cycle to 1 hour) and up to 128 digital inputs/outputs. The total recording size is equal to 5000 values

Five waveform and disturbance files from IED devices connected to the C264.

Communication capabilities

Ethernet communication:

- 10/100 Base-TX, auto-crossing or 100 Base-FX
- Protocols include UCA2 or IEC 61850, IEC 60870-5-104 (Multi-client) or DNP3.0 IP
- Embedded Ethernet switch module with up to six ports (permitting a compact connection of various devices or input/output extensions)

Serial communication:

- Up to two SCADA or four IED links per device
- SCADA protocol can be switched between DNP3.0, IEC 60870-5-101 & MODBUS
- IED Protocol can be switched between DNP3.0, IEC 60870-5-103, MODBUS & IEC 60870-5-101
- Transmission rate is configurable up to 38.4 kbps

Multi-bay management

Management of up to 128 bays per unit is possible. Multi-bay panels manage graphically up to 12 panels with a maximum of eight animated devices per panel on the local LCD.

General accuracy

- 1 ms clock accuracy when synchronising via SNTP or IRIG-B input.
- 1 ms time tagging of Digital inputs
- Digital outputs operating time, typically <7 ms.
- Analogue inputs are accurate to 0.1% of the full scale on the transducer.
- Programmable Scheme Logic execution time is < 5 ms.
- The configurable automation functions on the Programmable Logic Controller (PLC) can be scheduled from 50 ms up to several seconds.

Direct CT/VT accuracy

- 64 sampled values per period
- 0.2% accuracy for AI and RMS values full scale
- 0.5% accuracy for P, Q, S calculations
- 0.5% accuracy for Sequence components (Id, Ii, Io, Vd, Vi, Vo) and power factor
- 0.01Hz accuracy for frequency
- 1° accuracy for Phase angles
- Calculation up to 15th harmonic.

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