DS Agile A301
Substation Gateway

The DS Agile gateways perform the communication interface between the electrical substation and the area dispatch centres (SCADA), allowing SCADA operators to control and monitor remotely the substation in coherence with the operation of the whole area of the electrical grid.
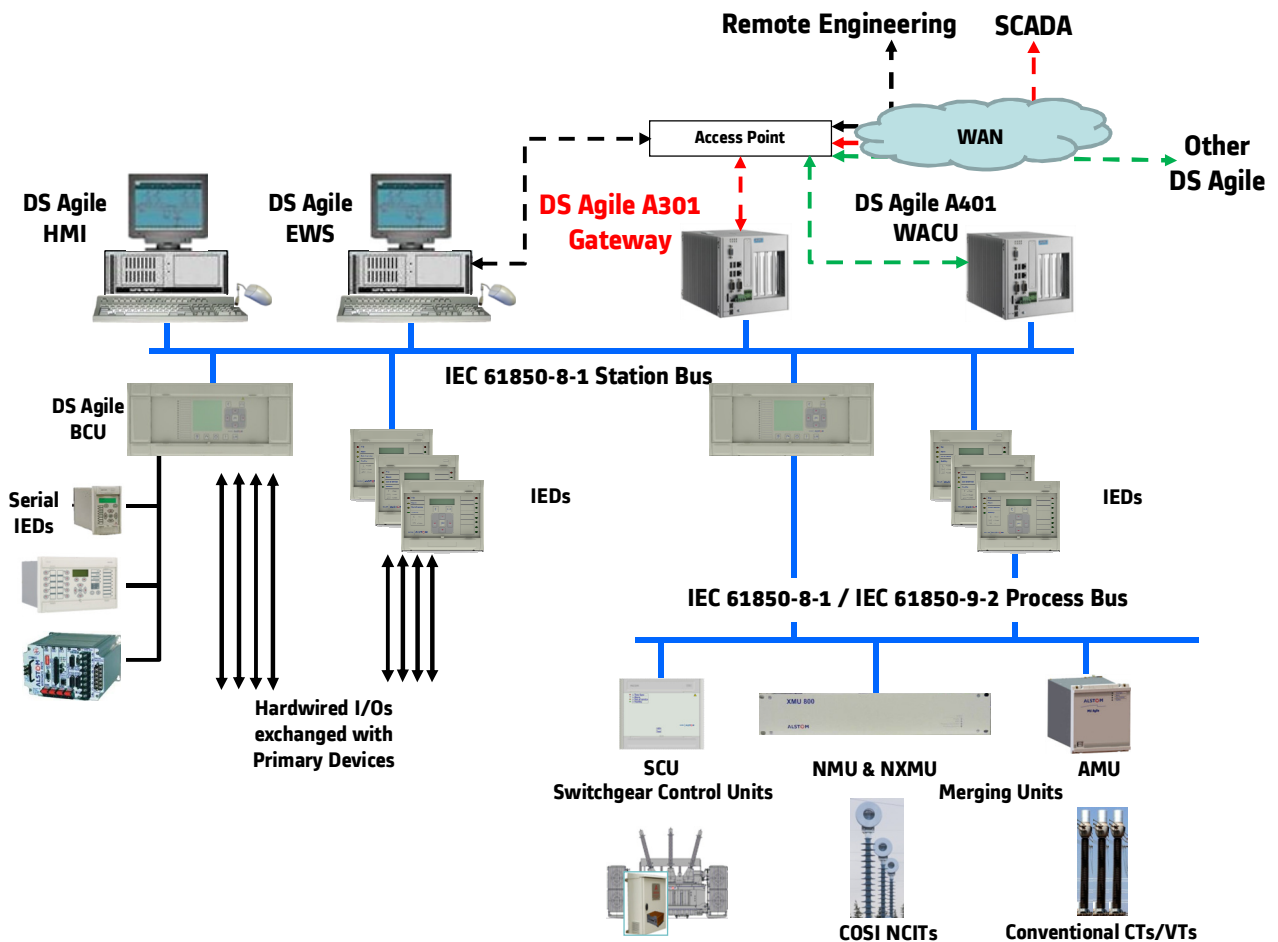
A301 Gateway role

The main functions of the DS Agile A301 Gateway are to transmit:

- substation indications and measurements to the dispatch centre,
- dispatch centres' commands to the substation control system

This role is performed within the structure of the Energy Management System (EMS) of the overall grid. Consequently, the A301 Gateway has to exchange data with one or several remote centres such as national dispatch centre, regional dispatch centres for Transmission and/or Distribution, area maintenance centre, etc.

This, combined with the communication protocols within the grid, has an impact on the number of A301 gateways required per DS Agile control system, their internal modularity and eventual redundancy.

A301 Gateway within a DS Agile Digital Control System (DCS)

ALSTOM

A301 Gateway – the Alstom's PC-based ruggedised SCADA interface

Robustness is achieved through stringent test and qualification process and a hardware design that excludes rotating parts (hard disk, fan). It benefits from the field experience acquired from the previous gateway version, A300.

The DS Agile Gateway software is also supported by other PC-based DS Agile platforms, based on communication protocol specificities and eventual client preferences.

Note: The DS Agile C264 Bay Control Unit (BCU) can also perform the function SCADA level interface depending on communication protocols and system size (see details in the DS Agile C264 Bay Controller manual).

A301 Gateway communication protocols

The DS Agile A301 Gateway supports three different types of communications:

- **Slave communication** with upper level SCADA or control systems and remote engineering centres over:
    - serial protocols such as IEC 60870-5-101, MODBUS, DNP3
    - IP protocols (IEC 60870-5-104; IEC61850-8-1; OPC (if OS is not Windows XPe)

and within the DS Agile system:

- **Client-Server communication** over the DCS Station Bus with its IEC 61850-8-1 devices (DS Agile HMIs, bay controllers, IEDs)
- **Master communication** with cluster of IEDs or complex sub-system through IEC 60870-5-101 or IEC 60870-5-104

CUSTOMER BENEFITS

- A multi-protocol gateway to interface with SCADA level

- The DS Agile A301 Gateway can manage up to 4 protocols and up to 8 channels

- Rugged solution qualified for electrical substation

- Interchangeable with former MiCOM A300 model

A301 Gateway operation modes

In order to avoid conflict between SCADA, Substation and bay-level control points, each control into the electric substation is subject to checking. The following checks are managed by the DS Agile Gateway on the following operation modes:

- **Substation Remote / Local mode**

    The DS Agile Gateway checks the Local/Remote Substation mode to allow SCADA control only when the control is configured for exploitation check and Substation is in Remote mode.

- **SBMC mode**

    During site-testing phases, a bay can be set in Site-Based Maintenance Control (SBMC) mode.
    Any control received from the SCADA and configured for SBMC is rejected to SCADA and not transmitted to the bay.
    The supervisory data from the bay are configured and filtered by the DS Agile Gateway avoiding to transmit non-significant data.

- **Taking Control mode**

    This specific SCADA control - "Taking Control" - allows the SCADA to switch substation exploitation mode from Local to Remote and to take control on one SCADA port. Only controls received on this port will be accepted by the DS Agile Gateway

A301 Gateway redundancy

The A301 Gateway supports several redundancy modes:

- Two identical DS Agile gateways (cluster of gateways)

- Redundant protocols (Main and Standby) on a single DS Agile Gateway (identical or same protocol with separate dynamic data to be transmitted when asked by SCADA).

- Dual-link protocol (same protocol and data on a redundant link managed by SCADA), either on a same Gateway or on two different Gateways (for the latter, one link per Gateway)

Acquisitions of system information are sent simultaneously to the two A301 gateways. The SCADA - as master of the communication scheme - is in charge of choosing the DS Agile gateway(s) it needs to communicate with. The SCADA chooses to communicate with the relevant gateway via the Main channel, or Alternate channel, or both at a time.

In all cases, the two computers have the same hardware configuration, the same OS version and same installation parameters.

A301 Gateway time management

There are several means to time-synchronise the different components of a DS Agile system:

- An external clock (GPS type usually) can distribute the time synchronisation signal (IRIG-B) to each DS Agile components.

- Generally, in order to limit the associated cabling, the IRIG-B signal is cabled directly to the System Master Clock (one -or two when redundant- C264 Bay Control Unit), which distributes the time synchronisation to the DS Agile components via the IEC 61850 backbone, as shown here. The System Master Clock acts as a SNTP server.

- An alternative to the use of System Master Clock is to use a SNTP server hosted into one PC of the system, typically that of DS Agile HMI. Then, all IEC 61850 devices are SNTP clients.

DS Agile standard time synchronisation scheme
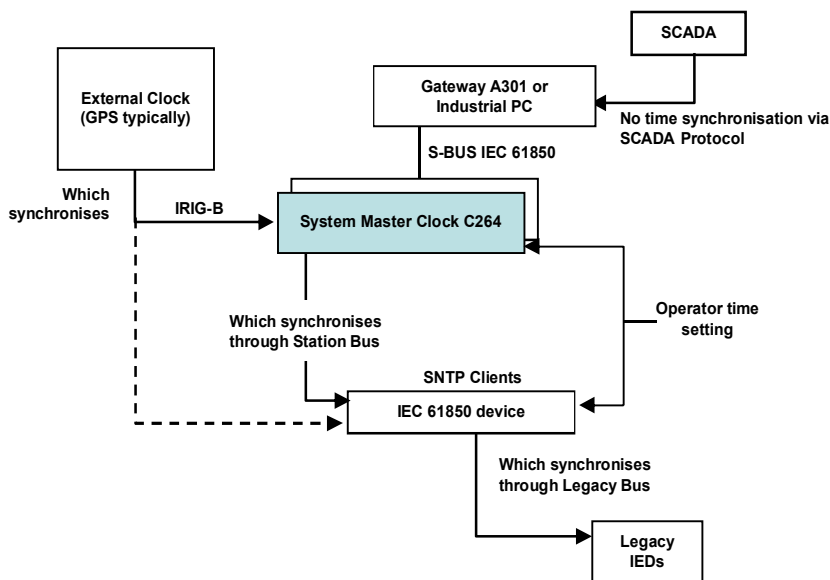
Some serial SCADA protocols can also deliver the time synchronisation signal to the DS Agile Gateway.

- This signal is updating the date and time of a clock embedded in a PCI slot of the Gateway. This clock delivers the IRIG-B signal to the System Master Clock.

- The clock used can also be connected to a GPS aerial to get the IRIG-B input.

- The resulting scheme is shown here:

  • Priority is given to the synchronisation via the GPS clock. When faulty, DS Agile automatically switches to synchronisation mode via the SCADA protocol and reverts to the GPS mode once recovered.

  • Priority management between the different modes prevents eventual toggling.

Example of time synchronisation via a serial SCADA protocol
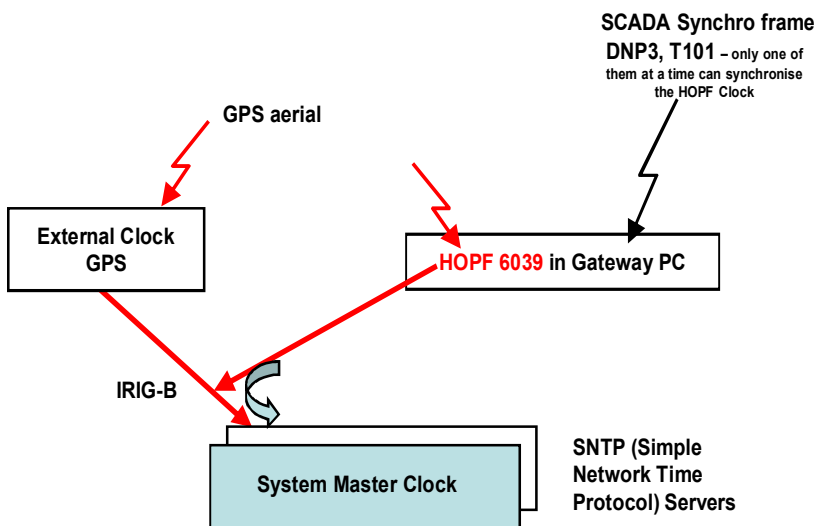
The data received from the Station Bus (SBUS) servers are time-stamped with UTC (Coordinated Universal Time). For protocols T101 and T104, data sent to the SCADA may be time-stamped with the DS Agile GTW local time (which may be different from UTC). This choice is defined during the configuration step (available values "UTC" or "Local" for "time reference" attribute of the related protocol). For the other available SCADA protocols, no change is made on the time stamping of the data sent to the SCADA.

When the SCADA protocol is IEC-60870-5-104, the A301 Gateway can be time-synchronised by it and in turn act as a SNTP server for the remaining DS Agile components. In this case, no additional clock is needed in A301 Gateway.

A301 Gateway automatic start

This feature is supported by A301 Gateway, with an additional launcher when Windows XPe Operating System.
It allows for a quick start of the gateway when booting DS Agile, limiting the use of keyboard, mouse and display to advanced maintenance phases.

Process interface

In a DS Agile system, direct process acquisition is done by C264 Bay Control Units and IEDs. All data are presented on the Station Bus IEC 61850-8-1. The DS Agile Gateway gets all supervisory information on Station Bus network and stores them into its kernel. It is then able to transmit all data to the SCADA when it asks for them. The A301 Gateway has several protocols implemented into DLL. There is one DLL started per communication link with the SCADA to allow possibly several ways of transmission of the same data

The DS Agile Gateway is composed of three modular parts:
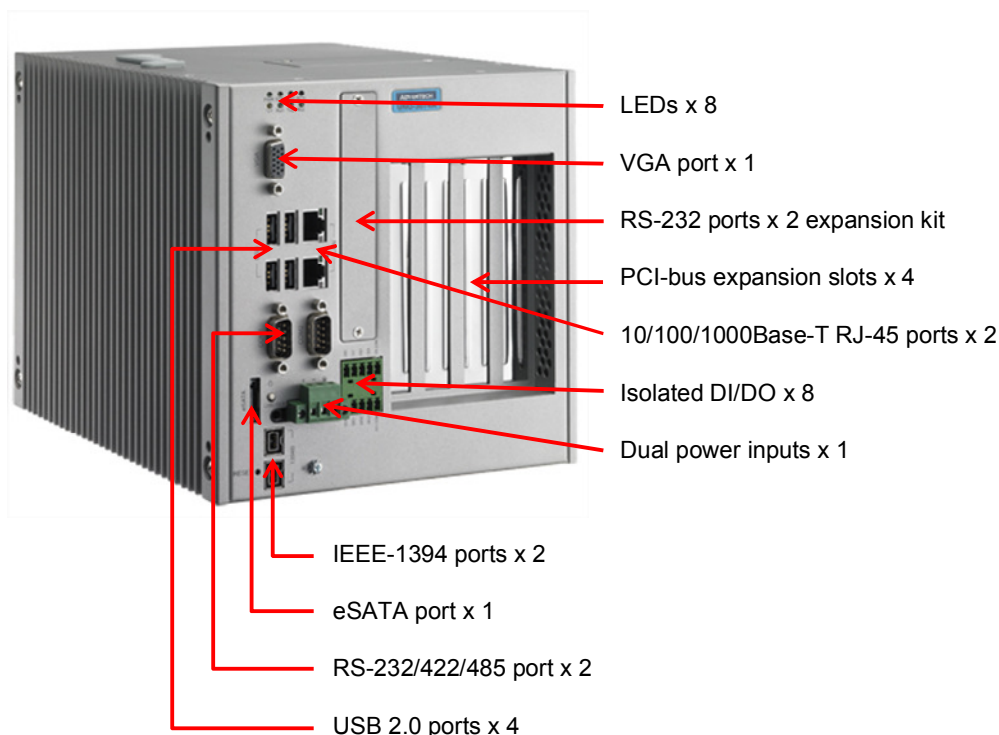
- Acquisition DLL
  - IEC 61850 agency
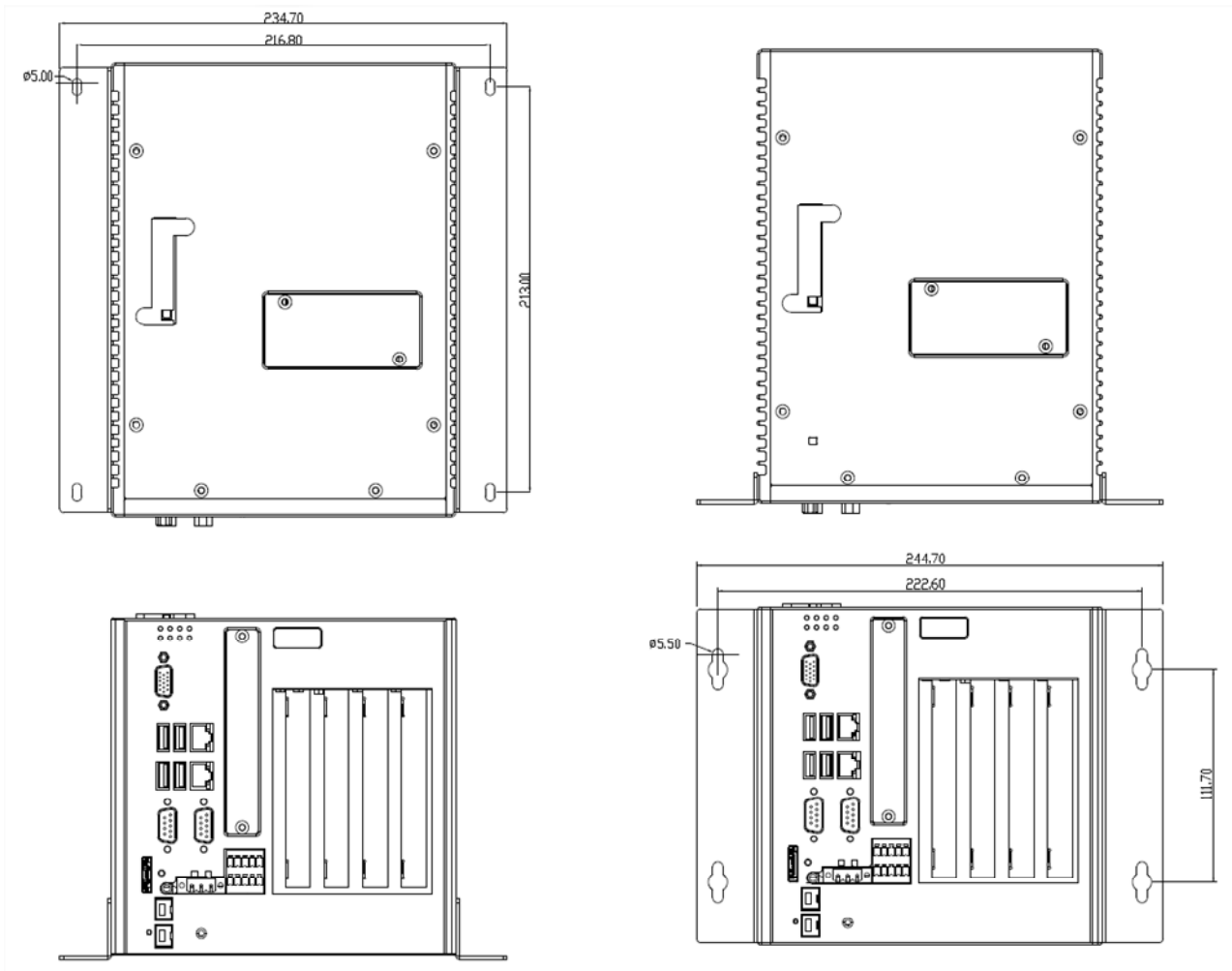- Kernel storing data changes
- Protocol DLL
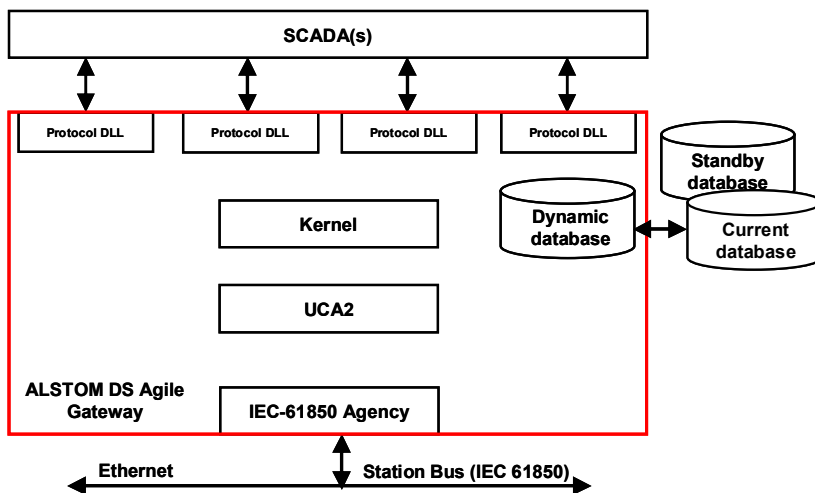
To know the data to be captured on Station Bus and their respective mapping on SCADA protocol, the DS Agile Gateway uses a current database loaded from its flash disk at start-up. A second or stand-by database is used for new database download while current is running.

Database management, database switch-over and database downloading tool (DS Agile SMT) obey to the same rules as other main components of DS Agile.

DS Agile A301 Gateway front view description

- LEDs x 8
- VGA port x 1
- RS-232 ports x 2 expansion kit
- PCI-bus expansion slots x 4
- 10/100/1000Base-T RJ-45 ports x 2
- Isolated DI/DO x 8
- Dual power inputs x 1
- IEEE-1394 ports x 2
- eSATA port x 1
- RS-232/422/485 port x 2
- USB 2.0 ports x 4

DS Agile A301 Gateway dimensions

When A301 Gateway is to replace the former version A300 in a control panel, a special kit (PM81new brackets kit and adaptor) can be ordered to allow for installing the A301 using the same spacing of external hole fixing.
Otherwise, when not replacing A300 Gateway, PM80 standard brackets are to be used.

A301 with its additional 2 RS-232 ports and with PM81 brackets (left) and SM81 brackets (right):
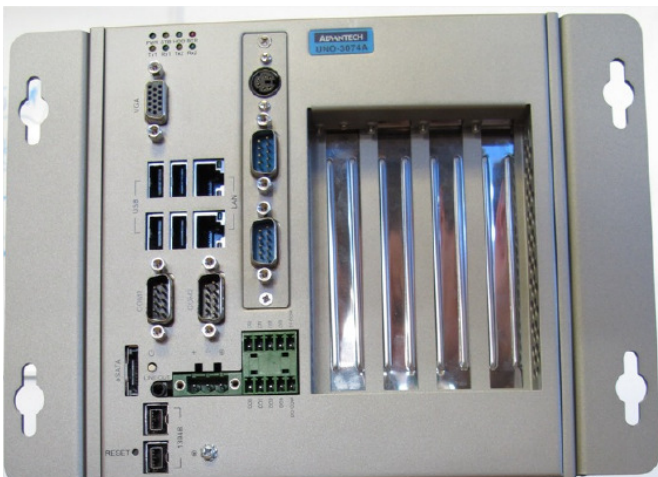
A301 Gateway technical data

General

Certification	CE, FCC Class A, UL, CCC	**Dimensions (WxHxD)**	181 x 238 x 177mm (7.5"x9.3"x7")
Power consumption	25W (base configuration)	**Enclosure**	Aluminium + SECC
Power requirement	9 – 36Vdc (e.g. 24Vdc @ 3A), AT/ATX power mode by jumper selection	**Mounting**	Wall mount, stand, panel
Power input	24Vdc dual	**Weight**	5kg
OS	Windows XP embedded, Windows 7, Windows embedded Standard 2009 (WES 2009)	**System Design**	Fan less with no internal cabling

System hardware

CPU	Intel ATOM D510 1.66GHz	**Interface for display**	DB15 VGA connector, 1600x1200 @85Hz
Memory	2 GB DDRII SDRAM built-in, 4 GB Compact Flash instead of HDD	**Storage Compact Flash**	1 x internal type I/II CF slot 1 x external type I/II CF slot
Battery back-up SRAM	512kB	**Storage HDD**	Not used in this ruggedised application
Expansion slots	4 x PCI V2.2 slots	**LEDs indicators**	8 for Power, Standby, HDD, SRAM battery, RX/TX for COM ports
PCI slot Power	Total combined < 40W		
Watchdog Timer	Programmable, intervals from 1 to 255 sec	**Alstom range of Switches**	External or internal (PCI slots) to A301. For additional ports or medium (TX or FX, multi-mode or single mode) or medium duplication.

Ports, I/O interface

LAN	2 x 10/100/(*)1000 Base-T RJ-45 ports, supports teaming, built-in boot ROM and IEEE 1588 hardware support	**Serial speed RS-232** **Serial speed RS-422/485**	50 bps up to 115.2 kbps 300 bps up to 921.6 kbps
Serial Ports	2 x RS-232/422/485 DB9 connectors, automatic RS485 data flow control	**Optional I/O** **Digital Inputs**	PS2/KB/MS, 2 x COM-232, 2 USB, LPT 4 x DI, 1,500 Vdc isolation, 50-70Vdc over voltage protection
Additional serial ports	2 x RS-232 (option needed for A301)	**Digital Outputs**	4 x DO, 1,500 Vdc isolation, 200mA max/DO sink current
USB ports	5 x USB 2.0 (one internal), 2 x USB pin header	**Telecommunication links supported**	PSTN modem, radio link through modem, PLC, leased lines, Ethernet, etc.

Environmental tests

Tests	Standard	Conditions
Dry heat	IEC60068-2-2	70°C / 24h
Cold	IEC60068-2-1	-20°C / 24h
Damp heat storage	IEC60068-2-56	+60°C / 95% humidity / 24h
Low temperature storage	IEC60068-2-1	-40°C / 24h
Temperature cycle	IEC60068-2-14	+40°C / 95% humidity / 24h
Thermal profile	IEC60068-2-2	28.3°C/60°C: 6h each
Cold start	IEC60068-2-1	-20°C / 20 cycles of on/off
Power ON/OFF	IEC60068-2-1; IEC60068-2-2	-20°C: 1000 power on, 1000 power off +70°C: 1000 power on, 1000 power off

Mechanical tests

Tests	Standard	Conditions
Random vibration (operation)	IEC60068-2-64	0.092G^2/Hz, 2 G$_{rms}$, 5-500Hz, X, Y and Z axis, 1h per axis
Sine vibration (non-operation)	IEC60068-2-64	2 G$_{rms}$, 5-500Hz, 1 Octave / min, X, Y and Z axis, 1h per axis
Package drop	Federal Standard 101 Method 5007 Testing procedure B	One corner, three edges, 6 faces, 92cm
Shock (operation)	IEC60068-2-27	Half-sine wave, 50G, pulse duration 11ms, six sides, each 3 times

EMC tests

Tests	Standard	Conditions
Conducted emission measurement	EN 55022/1998+A1:2000+A2:2003 EN55011:1998+A1:1999+A2:2000 (G1 class A) EN 61000-6-4 52001) : CISPR 11 class A (1990)	NA on power supply: the equipment is not intended to be connected to AC main supply. Ethernet com port: 55011 Groupe1 class A; 150kHz to 30MHz
Radiated emission measurement	EN 55022/1998+A1:2000+A2:2003 EN55011:1998+A1:1999+A2:2000 (G1 class A) EN 61000-6-4 52001) : CISPR 11 class A (1990)	30MHz – 1GHz Class A
Power harmonic measurement	EN 61111-3-2/2000	NA on power supply: the equipment is not intended to be connected to AC main supply
Voltage fluctuations	EN 61111-3-3/1995+A1:2001	NA on power supply: the equipment is not intended to be connected to AC main supply
Electrostatic discharge immunity	IEC 61000-4-2 (2001) EN55024 (1998)+A1(2001)+A2(2003) EN 61000-6-2:2001	8kV (Air); 4kV (contact)
Radiated emission measurement	IEC 61000-4-3 (2002) EN55024 (1998)+A1(2001)+A2(2003) EN 61000-6-2:2001	Level 2 and 3 3V/m and 10V/m; 80~to 1000MHz 3V/m; 1400 to 2000MHz 1V/m; 2000 to 2700MHz
Electrical fast transient/burst	IEC 61000-4-4 (2004) EN55024 (1998)+A1(2001)+A2(2003) EN 61000-6-2:2001	Power line: +/-0,5kV; 2kV Signal control line: +/-0,5kV; 1kV
Surge immunity	IEC 61000-4-5 (2001) EN55024 (1998)+A1(2001)+A2(2003) EN 61000-6-2:2001	DC input and DC output power ports: 1,2/50 (8/20); +/-0,5kV (CM); +/- 0,5kV (DM)
Conducted disturbance immunity	IEC 61000-4-6 (2003) EN55024 (1998)+A1(2001)+A2(2003) EN 61000-6-2:2001	0,15MHz to 80MHz; 3V$_{rms}$ and 10V$_{rms}$ (CM)
Power frequency magnetic field	IEC 61000-4-8 (2001) EN55024 (1998)+A1(2001)+A2(2003) EN 61000-6-2:2001	50Hz; 1A/M 50Hz; 30A/M

Electrical tests

Tests	Standard	Conditions
AC Voltage dips and interruptions	IEC 61000-4-11 (2004) EN55024 (1998)+A1(2001)+A2(2003) EN 61000-6-2:2001	NA on power supply: the equipment is not intended to be connected to AC main supply

Performances

DS Agile general features	Context	Performances
Number of IEC 6180-8-1 devices	DS Agile components: HMI, BCU, IED, Gateway	256
Binary inputs		2,048 / device
Measurements		512 /
Counters		64 / device
Output controls		1,024 / device
Set point outputs (binary and analogue)		512 / device
Maximum number of gateways		Function of number of IEC 61850-8-1 Clients per C264
A301 availability - MTBF	Environment: GB; Temperature: 30°C Quality: Level II ; Stress: 50%	34 years
A301 availability - MTTR	Typical	15 min
Typical CPU workload	2 serial SCADA protocol, 1 IP SCADA protocol, one Bay Controller	Less than 10%
Maximum data points handled		The linked list that manage events can memorise 15,000 events by protocol process
Response time	- Time to receive a response after sending a request	100 ms
	- Time between DI change of state at BCU and gateway reception	500 ms
	- Time between AI change of value at BCU and gateway reception	Sampling period + 1 s
	- Time between gateway control initiation and DO activation	750 ms
	- To a SCADA request after the parameter settings phase for the parameters, synchronisation pre and post transmission times:	less than 30 ms regardless of the protocol
Reports / events buffered in case of avalanche or temporary loss of communication with SCADA	- Reports/Events available to SCADA upon recovery of communication	At A301 level, 1,000 per Gateway, typically 2 Gateways
	- Buffered reports available per C264	100 when on BCU function, or 1,000 when on RTU function.
	- Buffered measurements at C264	latest ones

Options

The following devices are optional, to be defined when ordering.

IEC-61131 software and associated hardware for advanced automation	DS Agile WACU A401 is the product to be ordered	**Standard mounting kits of brackets**	Stand mounting: ref. UNO-SM80 Panel mounting: ref. UNO-PM80 Wall mounting: ref. UNO-WM80
Application needing additional RTX OS	DS Agile WACU A401 is the product to be ordered	**Mounting kits of brackets when replacing a A300 Gateway**	Stand mounting: ref. UNO-SM81 Panel mounting: ref. UNO-PM81 Adaptor side mounting kit (for side to side to A300 installation)
2 additional RS-232 serial ports	Needed for A301 application (reference: UNO-WM80-AE) – includes PS/2 port	**Crossover Ethernet cable**	To connect A301 to a SCADA simulator or a network analyser
Display 1600x1200 @ 85Hz	To be connected on DB15 VGA connector, for installation phase and advanced maintenance only	**Mouse and keyboard**	These standard devices can be connected to USB ports for advanced maintenance or to PS/2 port (PS/2 adaptor cable)

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