

PRODUCT BROCHURE

UNITROL® 1000

Compact and powerful
automatic voltage regulators



- Stable and reliable control, even in the harshest environment
- Scalable product for machines that range from 100kVA to 80MVA
- Common tools and simulation models
- Grid code compliant with all required functionalities and services

UNITROL® 1000

The UNITROL 1000 product family covers a wide range of applications for voltage regulation tasks of a synchronous generator or motor up to 80MVA. It sets a new benchmark for the global industry with respect to functionality, reliability and connectivity.

ABB is the world leading volume supplier of high quality UNITROL automatic voltage regulators (AVR) and static excitation systems (SES) that offers solutions for any type and size of power plant with high return on investment.

UNITROL 1000 provides compact and reliable solutions. Various built-in control software functions, robust mechanical and electrical design enable a wide range of applications.

Main features

- Compact and robust AVR for excitation current up to 20 A
- Separate communication and control processors
- Wide range of built-in control software functions
- Ethernet-based fieldbus interface
- Wide range of power input voltage, for AC and DC input
- Flexible and freely configurable measurements and inputs/outputs (I/Os)

Wide range of applications

- Land-based power plants based on diesel or gas engines, gas or steam turbines and hydro turbines
- Marine: electrical propulsion and auxiliary supply
- Traction: diesel electric locomotives
- Wind: based on direct connected synchronous machines
- Synchronous motors
- Variable speed application

Key benefits

Stable and reliable control of your machine

- Highly integrated and robust AVR for harsh industrial environment. Stable and accurate regulation even with highly disturbed voltages

AVR for various applications

- Fully configurable I/Os and measurement inputs and user-specific configurable fieldbus interface enable easy plant integration

Easy operation, monitoring and maintenance of the system

- Intuitive and user-friendly commissioning tool

Full support for grid codes

- Certified AVR according to German grid code including verified simulation models, capable of analyzing dynamic net faults (FRT)
- Built-in Power System Stabilizer (option), simulation models and grid code studies available

Efficient product life cycle management

- Extended life time of your assets with minimum costs

Professional technical help always within your reach

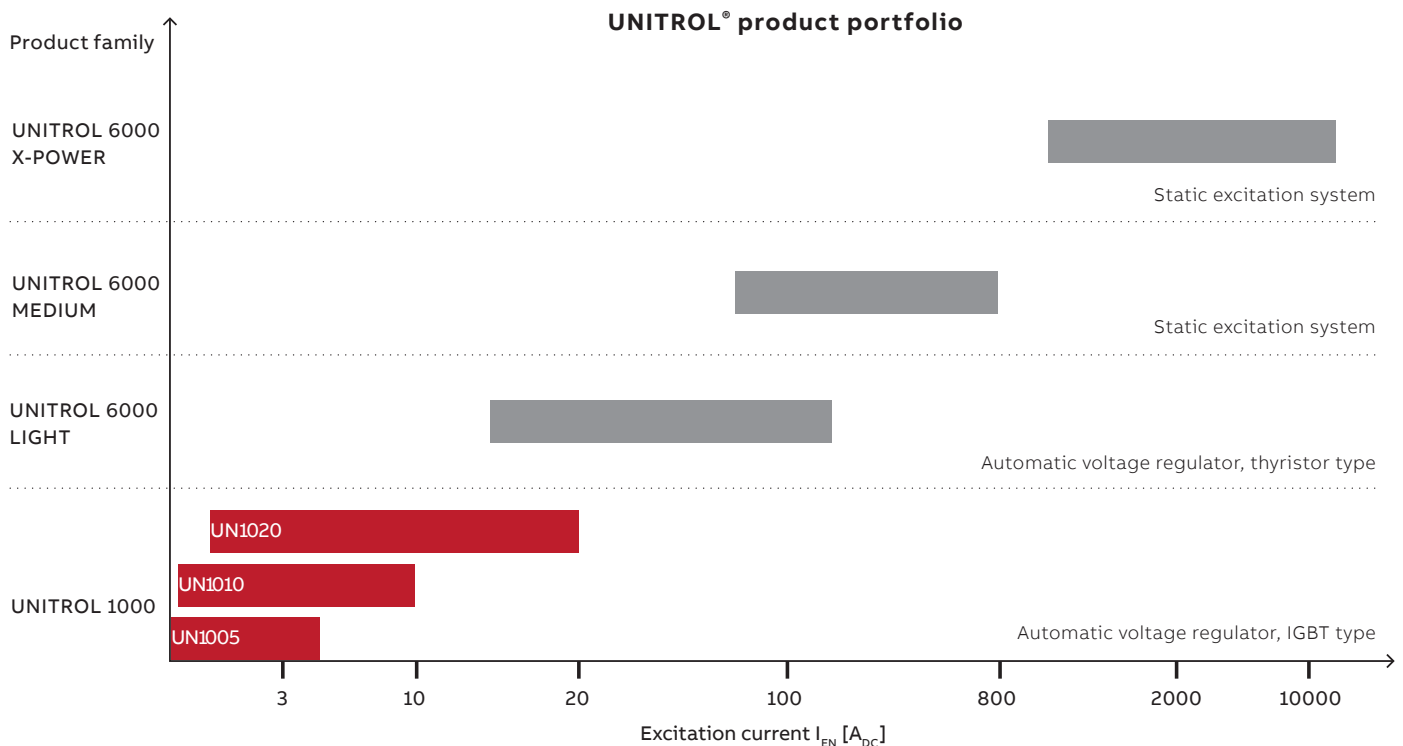
- ABB's global excitation service network



UNITROL 1005, UNITROL 1010 and UNITROL 1020 are the latest products of the UNITROL 1000 family. For most reliable operation, the communication and control tasks are split into separate controllers. The non-volatile flash memory of the AVR stores events and data logs to enable fault analysis and fast trouble shooting. Time synchronization is done over Ethernet communication, and the events and data logs are time-stamped.

UNITROL 1000 is provided with modern communication ports like Ethernet and USB for connection of the PC-based commissioning tool CMT 1000.

Besides it is possible to power up the controller of the device via USB port. Thus the user can download files or configure the device even when no input power is available. The AVR output stage is based on proven IGBT technology, which allows AC and / or DC voltage inputs from different sources. UNITROL 1005, UNITROL 1010 and UNITROL 1020 are designed for a wide range of ambient temperature and harsh environmental conditions.



UNITROL® 1010 and UNITROL® 1020

UNITROL 1020 combines high performance control and power circuits with a simple mechanical design. The construction provides a platform for a broad range of applications, including those in highly demanding environmental conditions.

Furthermore, high levels of EMC immunity is achieved through separation of the power and measurement terminals from the I/O connectors.

Polymer housing

- Protects all live parts to prevent electric shocks.

USB port

- Connects the CMT1000 (commissioning and maintenance tool)
- Device configuration, event and data upload without any control supply voltage possible

Indication LEDs

- Green: Power ON, blinking indicates software is running
- Yellow: Excitation ON, blinking indicates Limiter is active
- Red: Alarm, blinking indicates start up error

Ethernet port

- Connects the CMT1000
- Remote access over Modbus TCP

Solid aluminium base plate

- Robust mechanical design allows use in high vibration applications.

Power and measurement terminals

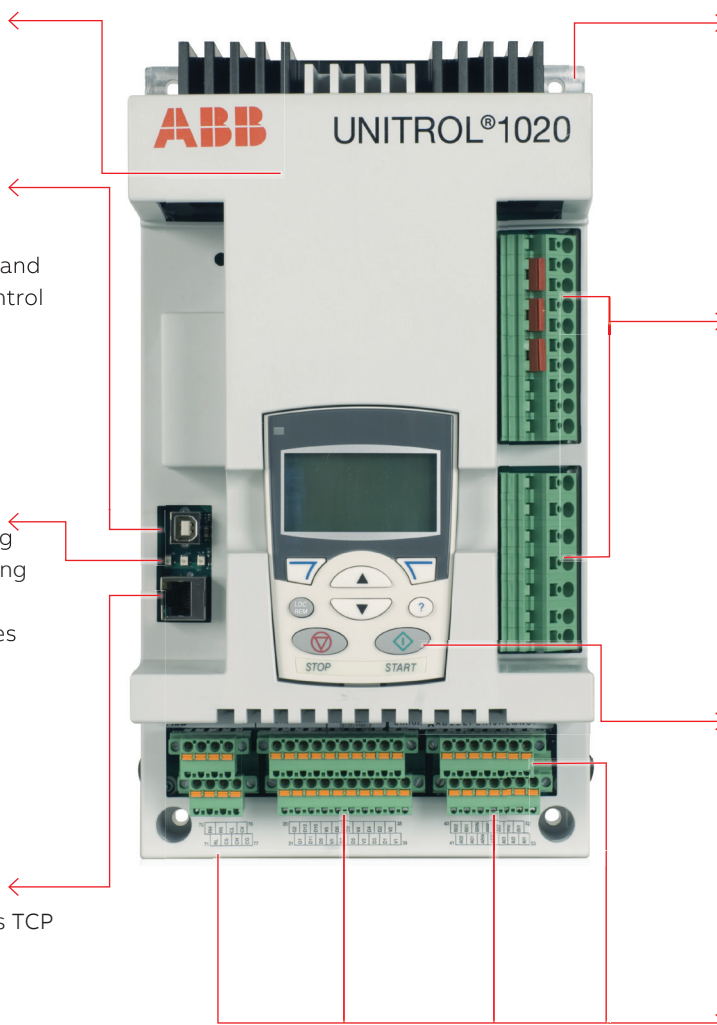
- Specified up to 30A continuous current and cable up to 4 mm² (AWG 24–10)
- Tension spring terminals for reliable connection
- Easy access over test points

Local human interface

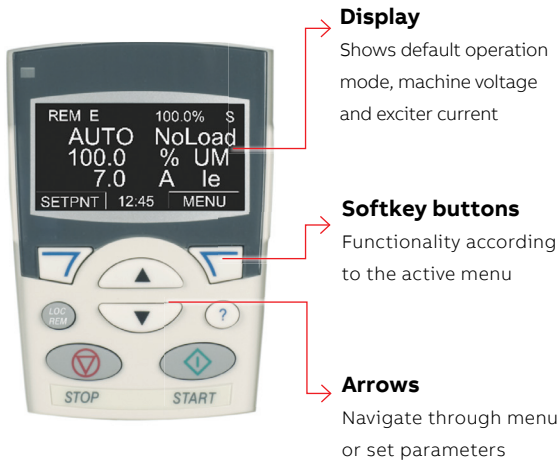
- Intuitive local control panel for indication of AVR status, active limiters and measurements
- Local control can be taken over to change parameters

Analog and digital inputs and outputs, serial fieldbus

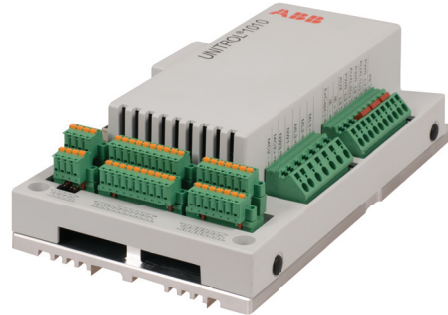
- Tension spring connectors allow reliable wiring and fast replacement



Local human-machine interface of the UNITROL 1020 provides immediate data on AVR status.

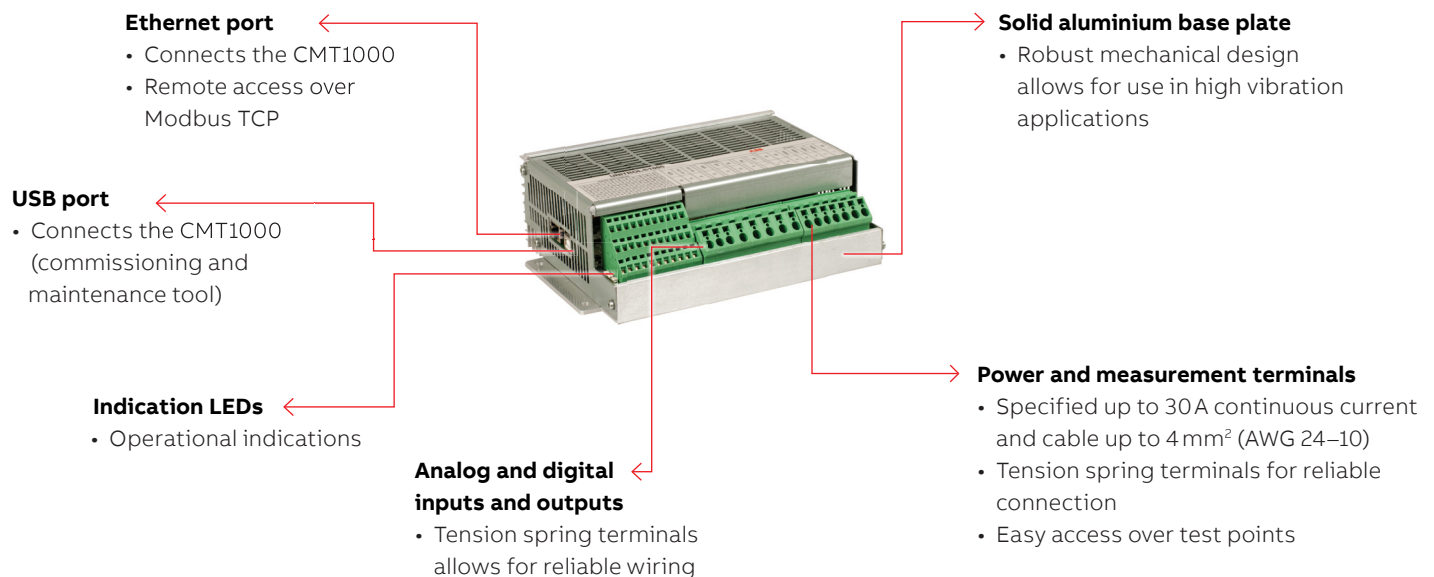


UNITROL 1010 is a compact device supporting a subset of UNITROL 1020 and is designed for excitation currents up to 10 A nominal. It supports the same interfaces and has the same mechanical footprint as UNITROL 1020.



UNITROL® 1005

UNITROL 1005 is the most compact UNITROL 1000 device and is designed for excitation currents up to 5 A nominal.



UNITROL® 1000 hardware types

Hardware types overview	UNITROL 1005	UNITROL 1010	UNITROL 1020
Excitation current	5 A cont., 10 A ceiling @ 70° C ambient temp.	10 A cont., 25 A ceiling @ 55° C ambient temp.	20 A cont., 38 A ceiling @ 55° C ambient temp.
Separate terminals for aux power supply	NO	YES	YES
Human interface	NO	NO	YES
Analog and digital I/Os	<ul style="list-style-type: none"> Digital: 4 outputs, 8 inputs Analog: 2 outputs 	<ul style="list-style-type: none"> Digital: 8 I/Os, 4 inputs Analog: 3 inputs, 2 outputs 	<ul style="list-style-type: none"> Digital: 8 I/Os, 4 inputs Analog: 3 inputs, 2 outputs
Interfaces	<ul style="list-style-type: none"> USB Ethernet 	<ul style="list-style-type: none"> USB RS485 / (CAN) Ethernet 	<ul style="list-style-type: none"> USB RS485 / (CAN) Ethernet
Mechanicals	<ul style="list-style-type: none"> IP20 	<ul style="list-style-type: none"> IP20 	<ul style="list-style-type: none"> IP20
Certifications	<ul style="list-style-type: none"> CE, DNV/GL, Traction 	<ul style="list-style-type: none"> CE, cUL, DNV, GL, CCS, Traction 	<ul style="list-style-type: none"> CE, cUL, DNV, GL, CCS, Traction

Order codes

UNITROL 1010 and UNITROL 1020

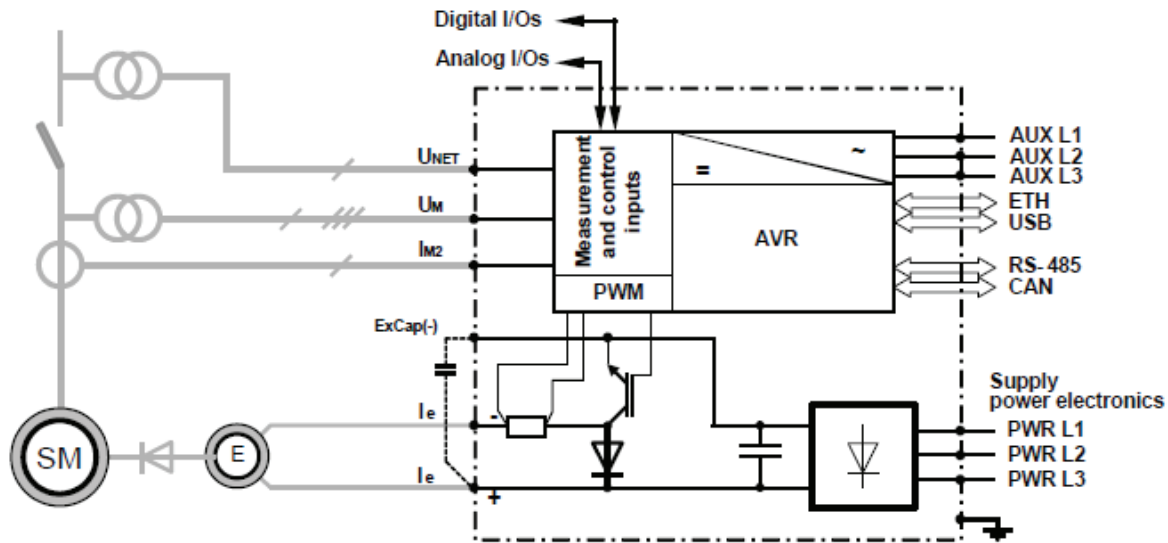
MATERIAL DESCRIPTION	ORDER CODE
UNITROL 1010-0002 LIGHT	3BHE035301R0002
UNITROL 1010-0003 BASIC	3BHE035301R0003
UNITROL 1020-0003 BASIC	3BHE030579R0003
UNITROL 1020-0006 FULL	3BHE030579R0006
UNITROL 1020-0007 FULL + PSS	3BHE030579R0007

UNITROL 1005

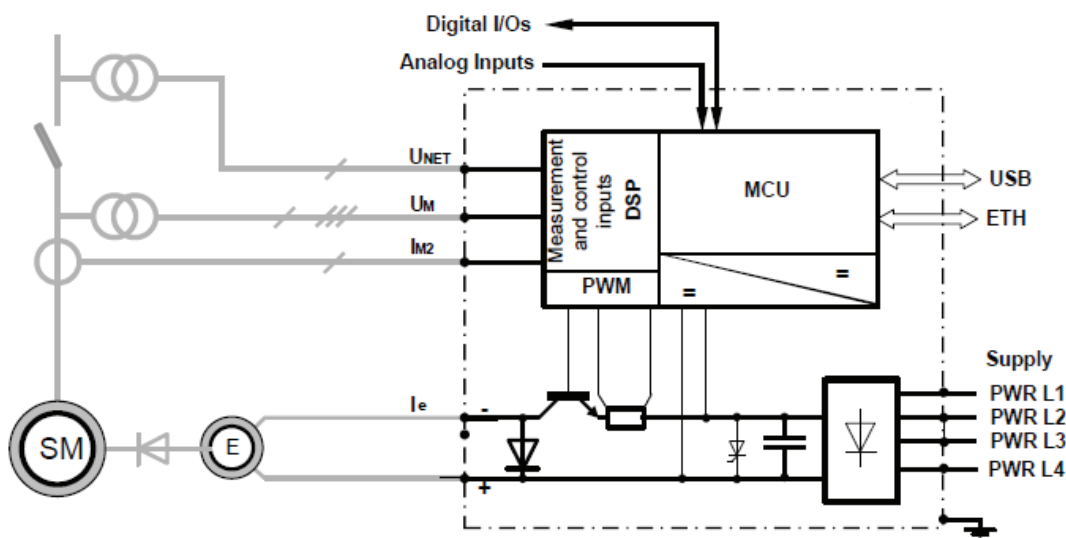
MATERIAL DESCRIPTION	ORDER CODE
UNITROL 1005-0011 ECO	3BHE043576R0011
UNITROL 1005-0012 LIGHT	3BHE043576R0012

Connection diagrams

UNITROL 1010 and UNITROL 1020



UNITROL 1005



Technical data

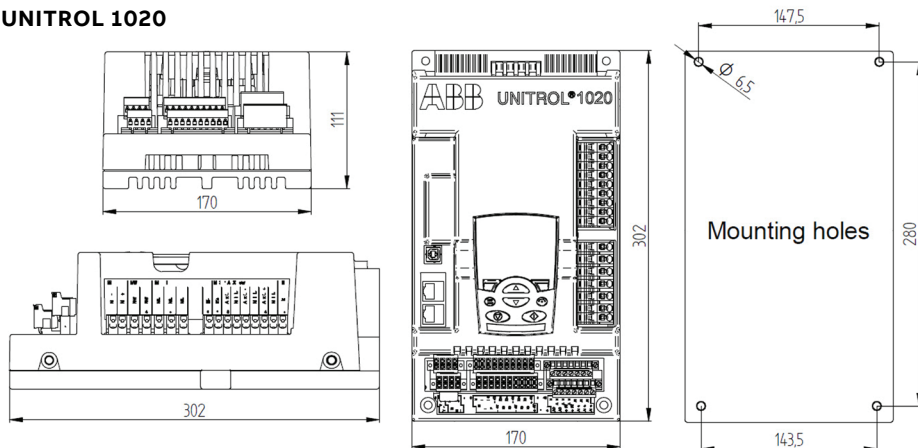
	UNITROL 1005	UNITROL 1010	UNITROL 1020
POWER ELECTRONIC INPUT (AC/DC)			
AC nominal input voltage	16 to 250 V _{AC}	0 to 250 V _{AC}	0 to 250 V _{AC}
Frequency	25 to 600 Hz	25 to 600 Hz	25 to 600 Hz
DC nominal input voltage	18 to 300 V _{DC}	0 to 300 V _{DC}	0 to 300 V _{DC}
Max. peak input voltage (non sinusoidal)	420 V _p	420 V _p	420 V _p
Min. required start voltage	6 V _{AC} / 10 V _{DC}	N/A	N/A
AUXILIARY SUPPLY (CONTROLLER) INPUT			
AC nominal input voltage 3-phase	not supported	9 to 250 V _{AC}	9 to 250 V _{AC}
AC nominal input voltage 1-phase	not supported	16 to 250 V _{AC}	16 to 250 V _{AC}
Frequency	not supported	40 to 600 Hz	40 to 600 Hz
DC nominal input voltage	not supported	18 to 300 V _{DC}	18 to 300 V _{DC}
Max. peak input voltage (non sinusoidal)	not supported	420 V _p	420 V _p
EXCITATION OUTPUT			
Continuous current at 55 °C	8 A _{DC}	10 A _{DC}	15 A _{DC} 20 A _{DC} ¹⁾
Overload current for 10 sec. 55 °C	16 A _{DC}	25 A _{DC}	38 A _{DC}
EXCITER CURRENT MEASUREMENTS			
Full range	0 to 25 A	0 to 38 A	0 to 38 A
Accuracy / Resolution	< 1 % / < 20 mA	< 1 % / < 100 mA	< 1 % / < 100 mA
MACHINE AND NET MEASUREMENTS			
Machine voltage, 1-, 2- or 3-phase	up to 500 V _{AC}	up to 500 V _{AC} ²⁾	up to 500 V _{AC} ²⁾
Machine current, 1-phase	1 to 5 A _{AC}	1 to 5 A _{AC}	1 to 5 A _{AC}
Network voltage, 1-phase	up to 500 V _{AC}	up to 500 V _{AC}	up to 500 V _{AC}
Frequency range	10 to 150 Hz	10 to 150 Hz	10 to 150 Hz
Accuracy (-40° to 70°C / at 25°C)	± 1% / 0.1%	± 1% / 0.1%	± 1% / 0.1%
VOLTAGE REGULATION			
AVR response time (3-phase / 1-phase meas.)	< 20 ms / < 50 ms	< 20 ms / < 50 ms	< 20 ms / < 50 ms
PWM limitation	0.5 to 99 %	0.5 to 99 %	0.5 to 99 %
DIGITAL INPUTS AND OUTPUTS			
Numbers of digital inputs / outputs input only / in or out / output only	8 / 0 / 4	4 / 8 / 0	4 / 8 / 0
Digital IO voltage	24 V	24 V	24 V
ANALOG INPUTS AND OUTPUTS			
Number of analog inputs / outputs	2 / 0	3 / 2	3 / 2
Analog IO range	± 10 V / 0 ... 20 mA	± 10 V	± 10 V
COMMUNICATION INTERFACES			
Ethernet (cable length < 100 m)	10 / 100 MBit/s	10 / 100 MBit/s	10 / 100 MBit/s
USB version (cable length < 3 m)	1.0; 1.1; 2.0	1.0; 1.1; 2.0	1.0; 1.1; 2.0
CAN (cable length < 3 m)	not supported	Only for connections between UNITROL 1000 devices	Only for connections between UNITROL 1000 devices

1) 3-phase power supply and external 1 mF capacitor required to operate UNITROL 1020 between 15 A and 20 A nominal excitation current.

2) UNITROL 1010 and UNITROL 1020, machine voltage measurement above 250 VAC requires connection of machine star point to earth (PE).

Mechanical dimensions

UNITROL 1020

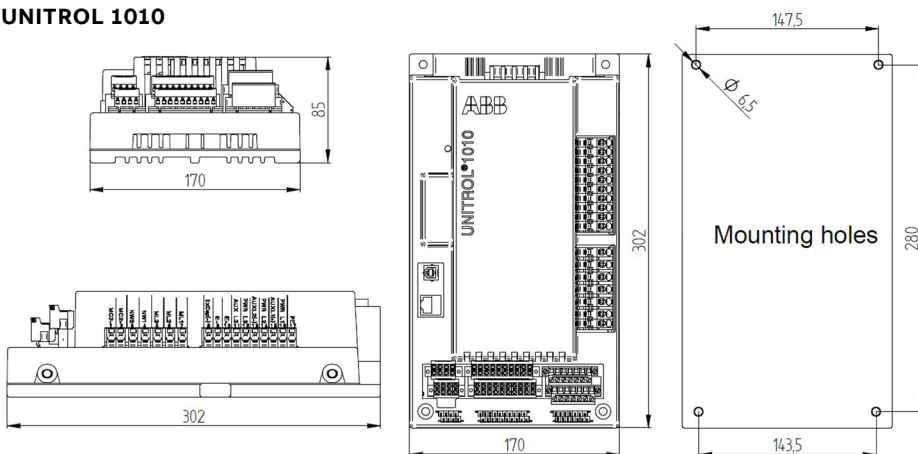


Dimensions, L x W 302 x 170 mm
Height 111.4 mm
Weight 3.8 kg

Front view

Top view

UNITROL 1010

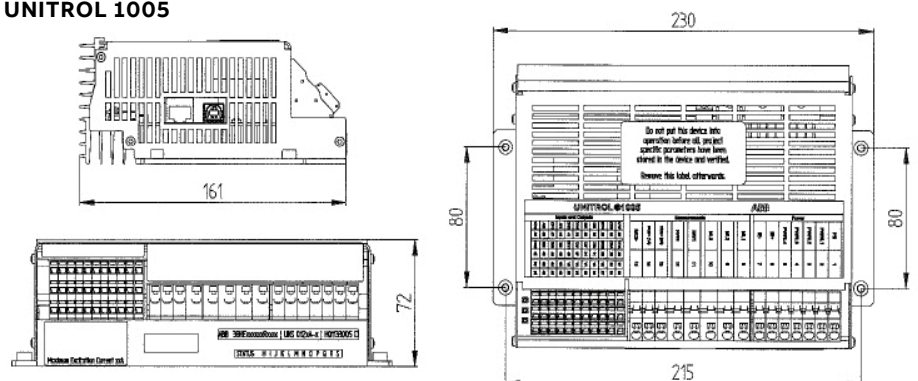


Dimensions, L x W 302 x 170 mm
Height 85 mm
Weight 2.8 kg

Front view

Top view

UNITROL 1005



Dimensions, L x W 230 x 161 mm
Height 72 mm
Weight 1.5 kg

Front view

Top view

Remark: The dimensions are given in millimeter (mm)

Control Software

ECO:

The ECO version covers essential functionality for cost sensitive applications.

LIGHT:

The light version adds to ECO standard functions as rotating diode monitoring and remote control via modbus. Furthermore, a simplified data logger called history logger allows the user to track the last two hours of operation for analyzing.

BASIC:

The BASIC version is the ideal solution for applications with multiple machine operating on the same busbar. Accurate reactive load sharing via serial communication (VDC) and fast automatic synchronization are the key functionalities. Furthermore, a dual-channel functionality and motor start sequence functionality are supported.

FULL:

Complex and demanding projects often ask for transient recorders and plant clock synchronized data logger function. The FULL version has the capacity to meet these requirements.

Power system stabilizer (PSS)

PSS can be an option to provide standard IEEE 421.5-2005 2A / 2B / 2C function. The PSS provision is nowadays included in most grid codes. The PSS is used for effective damping of power oscillations caused by the physical power grid.

Software upgrades can be ordered and easily enabled by password over the CMT1000, even while the unit is in operation.

Common software and tool for the complete UNITROL 1000 product portfolio:

All UNITROL 1000 products are based on the same target software source code, therefore equal performance can be seen with UNITROL 1010/20 as well as with UNITROL 1005. The same simulation models can be used for the entire UNITROL 1000 product family, making UNITROL 1000 products suitable for very demanding grid code applications.

UNITROL 1000 software functions overview

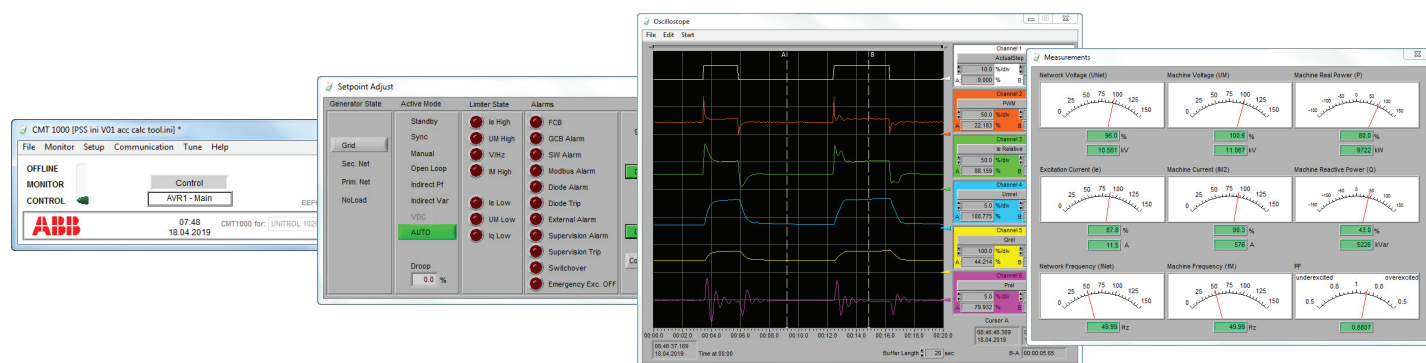
	Software functions	UNITROL 1005		UNITROL 1010		UNITROL 1020	
ECO	<ul style="list-style-type: none"> • AVR / FCR / PF / VAR • Limiters • Protection / Monitoring • Soft start • Voltage matching 	ECO	LIGHT	LIGHT	BASIC	BASIC	FULL
LIGHT	<ul style="list-style-type: none"> • History logger • Modbus TCP with operator select • Rotating diode monitoring 						
BASIC	<ul style="list-style-type: none"> • Reactive load sharing via RS485 (VDC) • Dual channel • Auto-synchronization (SYNC), 60 / 50 / 16.7 Hz • Motor start support (only for UNITROL 1020) 						
FULL	<ul style="list-style-type: none"> • Event logger • Data logger • Real-time clock • Time synchronization by SNTP 						
OPTION	<ul style="list-style-type: none"> • Power system stabilizer (PSS) 						

Commissioning and maintenance tool

CMT1000

CMT1000 is a commissioning and maintenance tool for the UNITROL 1000 product family. The tool is used to setup all parameters and tune the PID to guarantee stable operation. The CMT1000 software allows an extensive supervision of the system, which helps the user to identify and locate problems during on-site commissioning.

The CMT1000 is connected to the UNITROL 1000 via USB or Ethernet port, where Ethernet connection allows remote access over 100 meters.



Main window

- Indication of access mode and device information
- Change of parameter is only possible in CONTROL access mode
- LED symbol indicates that all parameters are stored on non-volatile memory

Setpoint adjust window

- Overview of all control modes, alarms, generator and active limiters status
- Set point adjustment and application of steps for tuning of the PID

Oscilloscope

- 6 signals can be selected out of 20 recorded channels
- The time resolution is 50 ms
- Files can be saved to PC for further investigation

Measurement

- All measurements on one screen

Grid code compliance functionality

Specific AVR functionalities to support grid stability

Super imposed PF/VAR controller with LVFRT and OVVRT support function:

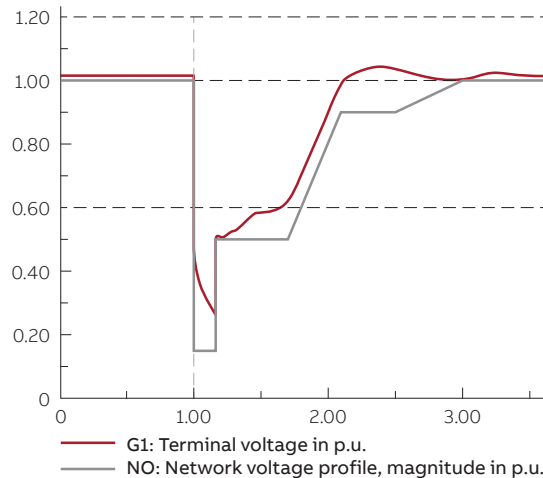
UNITROL 1000 device provide as standard function super imposed PF/VAR controller, which allow to separate a dynamic control for minimum PQ Limiter and a slow control for PF/VAR set point. The control structure will support network dips by stabilizing the network. Furthermore dynamic detection of FRT will allow to regulate set point dynamically to avoid heavy reactive power overshoot to the network.

IEEE Power System Stabilizer

UNITROL 1010 and UNITROL 1020 provides Power System Stabilizer (PSS) as SW Option. PSS is implemented according to IEEE Std. 421.5 PSS 2A/2B/2C. The objective of PSS equipment is to increase the generator exciter's contribution to improving the stability of the highest possible operation range of the generator.

UNITROL 1000 provides special feature to support application with reciprocate engine as:

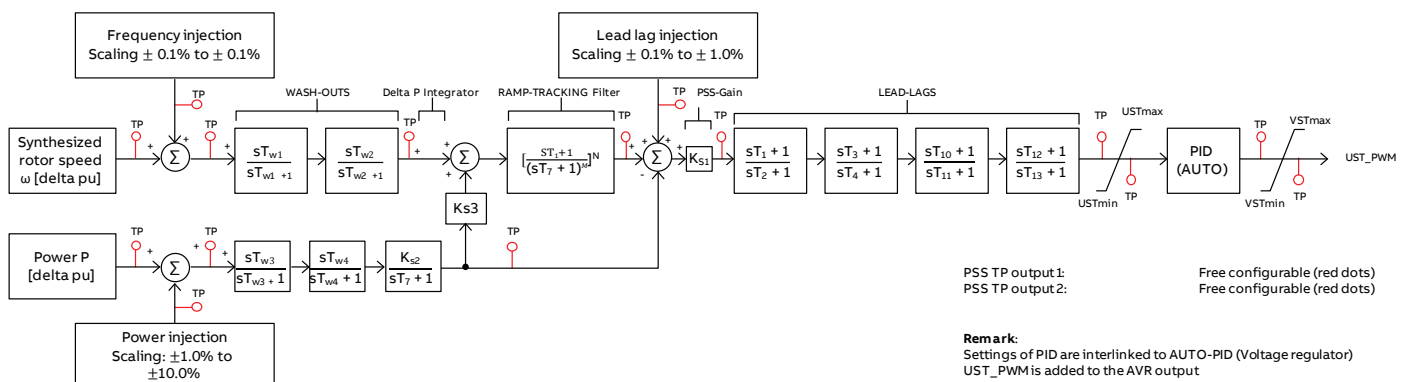
- Cylinder firing frequency filter to damp natural oscillations of the engine
- Common voltage step along multiple machines to test performance of a complete power plant, where multiple machines are connected via one common step up transformer
- Integrated injection signal generator to run frequency response analysis without any additional equipment



Example of fault ride-through defined grid code. ABB offers grid code compliant studies in order to prove stability under all circumstances.

In addition, ABB provides several levels of service:

- Calculation of PSS parameter
- Simulations of reference step responses
- Stability simulations for various different network conditions
- On-site tuning service



Computer representation of PSS according to IEEE Std. 421.5 2A/2B/2C with noise injection and test points.

Grid code compliance certification

ABB's UNITROL 1000 excitation products are certified according to German grid codes (VDEAR-N 4110 and VDE-AR-N 4120)

ABB successfully passed the most difficult certification process based on hardware in the loop setup and received a component certificate for its UNITROL 1000 devices. Test procedure covered 3-phase and 2-phase low- and high-voltage fault ride-through (FRT). UNITROL 1000 devices demonstrated excellent performance in supporting the network during and after fault conditions. The component certificate includes accurate Power Factory model, where simulation results match the measurements. The certification process required separate measurement by an external measurement company and verification of simulation results by a certification company.

UNITROL 1000 user benefits include:

- Controller fulfills latest German grid code requirements
- No re-certification of PGU (power generating unit) required in case of AVR firmware update / exchange with another certified ABB device
- State-of-the-art simulation model available, accuracy requirements according to German grid code are met
- Simple integration of the AVR simulation model in a generator simulation model

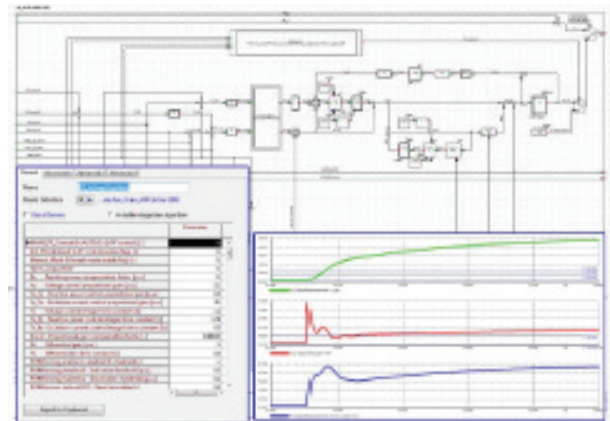


ABB provides different level of simulation models:

- Generic IEEE models
- Detailed computer representation to build customer specific models
- Malab Simulink model
- Power Factory model with parameter loading script

(Detailed computer representation, ML/SL and Power Factory model are disclosed only with signed non-disclosure agreements)

UNITROL 1000 systems

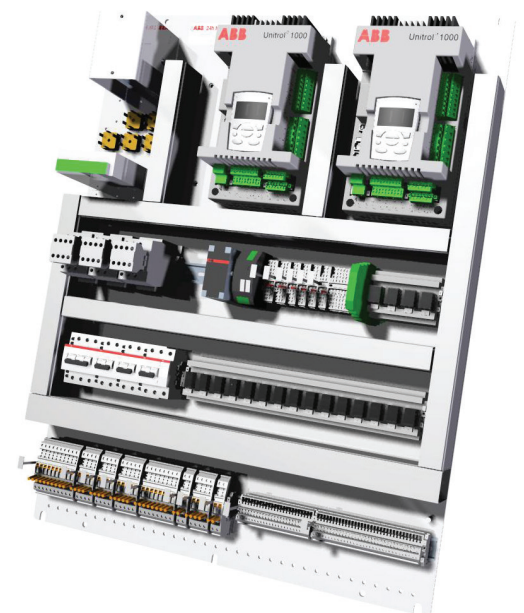
ABB provides over 100 years of experience in building project specific engineered systems for any applications. ABB offers various different systems depending on the need of the customer:

In addition, ABB provides several levels of service:

- Single channels systems
- Dual channel systems
- Mounting on a plate or in a cubicle

Systems include protection breaker and exciter field breaker. They are fully tested in the ABB factory and AVR setting can be ordered preset. Ask our experts for more information on:

- Multiple power input sources
- Synchronization of your machine
- I/O extension with external programmable logic controller over field bus



Service and support

For life cycle management or technical support, the worldwide network of UNITROL specialists is at your service.

Installation and commissioning

The professionalism, extensive experience and multilingual skills of ABB's engineers ensure a satisfactory installation and commissioning.

Training

ABB offers standard and customized training courses for UNITROL excitation systems. On-site training options are also available. For more details, contact your service representative today!

e-Learning

With the UNITROL 1000 interactive e-learning program you decide where and when you learn. The program covers general excitation knowledge as well as detailed product handling know-how.

UNITROL 1000 global support organization

A team of qualified engineers located in different ABB organizations worldwide are ready to support you with your most challenging enquiries and application requirements.

Life cycle management

ABB's excitation systems life cycle management model helps the customers to extend and maximize the life cycle of their assets at minimum costs. Depending on the product's life cycle phase, the service specialists recommend necessary actions and approach the clients pro-actively to inform them on all maintenance, service and upgrade necessities.

Examples of life cycle services:

- Technical support for optimized reliability
- Spare parts delivery
- Preventive and corrective maintenance
- Upgrade and modernization



Additional information

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