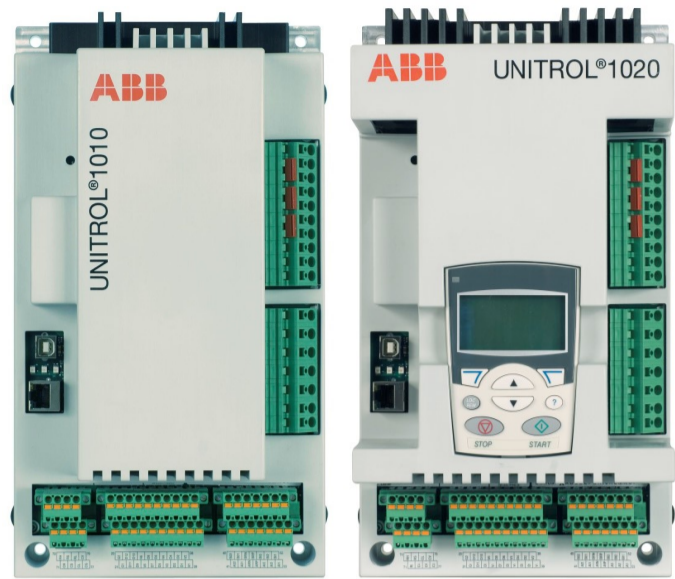




ABB EXCITATION SYSTEMS

# UNITROL<sup>®</sup> 1010 and UNITROL<sup>®</sup> 1020

## Quick installation guide



### Product package

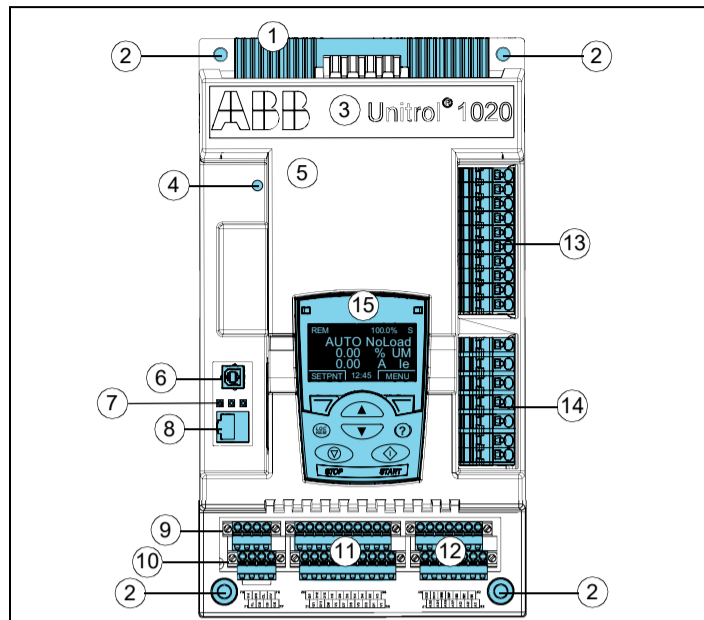
Contents of the product package:

- UNITROL 1000 series AVR
- Special red USB cable that is used to power and to connect with the AVR. Keep this USB cable in a safe place.
- Red jumper blocks (3 pcs.)
- Quick installation guide and test certificate

Make sure that all of the listed items are in the product package and that there is no damage to the items.

### Hardware overview

Primary parts of the AVR. Refer to the *User Manual* for more information.



No.	Description	No.	Description
1	Heat sink	9	RS-485 (X1300) terminal
2	Mounting holes	10	CAN (X1302) terminal
3	Unit type designation	11	Digital I/Os
4	Warning LED	12	Analog I/Os
5	Front cover	13	Power terminals • Protective earth (PE) • Input power $U_{PWR}$ • Auxiliary power $U_{AUX}$ • Excitation output
6	USB port	14	Measurement terminals $U_M$ , $U_{NET}$ , $I_M$
7	Status LEDs	15	Control panel (UNITROL 1020 only)
8	Ethernet port		

### Warning and status indicators

Color	Description
<b>Amber</b>	<b>Warning LED</b> Flashes: Do not do work on the AVR! The internal voltage is more than 30 V DC.
<b>Green</b>	<b>Operating status</b> ON: Device controllers are active Flashes: Device software is active
<b>Yellow</b>	<b>Excitation status</b> ON: Excitation is active Flashes: A limiter is active
<b>Red</b>	<b>Alarm status</b> ON: An alarm or a trip is active Flashes: • Startup failure • Parameter download failure • Excitation output is blocked

### Mechanical installation

For detailed information on mechanical installation, refer to the *User Manual*.

Install the AVR in an indoor area that is dry and dust-free, and that does not contain volatile gases, acid fumes or similar hazards.

Examine the installation area and refer to technical data to make sure that:

- The maximum ambient temperature is in the permitted range.
- The vibration is limited and within the permitted class.
- The ingress protection and pollution degree are suitable.
- The EMC environment is suitable.

Installation requirements:

- Install the AVR vertically to make sure that cooling operates correctly.
- Free space requirements:
  - 50 mm above the AVR
  - 20 mm below the AVR
  - 10 mm on the left and right sides of the AVR

- Make sure that there is sufficient cooling air flow around the AVR.

- Make sure that other devices do not blow hot air on to the AVR.

- The AVR is designed to be installed with suitable hardware to an installation plate.

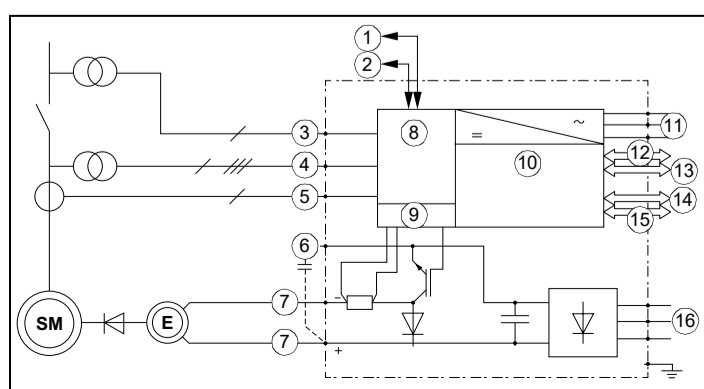
- Make sure that the frame of the AVR is electrically grounded (PE) to the installation plate with a grounding wire ( $\geq 4 \text{ mm}^2$ ) through a mounting hole. Use toothed washers to get a good electrical ground contact.

Installation procedure:

1. Refer to Dimensions for the mounting hole dimensions.
2. Make the appropriate holes in the installation plate.
3. Attach the AVR to the installation plate with suitable hardware, for example, M6 screws to a torque of 10 Nm. The mounting holes have a diameter of 6.5 mm.
4. Make sure that there is a good electrical ground connection between the installation plate and the AVR. The installation plate must be electrically grounded (PE).

### Electrical installation

For detailed information on electrical installation, refer to the *User Manual*.



No.	Description	No.	Description
1	Digital I/Os Max. cable length 30 m	9	Power electronics control (PWM)
2	Analog I/Os Max. cable length 30 m	10	Communication MCU
3	Network voltage measurement $U_{NET}$	11	Control Power Supply input AUX L1-L3
4	Machine voltage measurement $U_M$	12	Ethernet connection Max. cable length 100 m
5	Machine current measurement $I_{M2}$	13	USB connection Max. cable length 3 m
6	External capacitor ExCap (-)	14	RS-485 connection Max. cable length 500 m
7	Excitation output $I_e$ & $U_e$	15	CAN connection Max. cable length 3 m
8	Measurement and control unit (DSP)	16	Excitation Power Supply input PWR L1-L3

**CAUTION!** Separate control (I/O) cables from the excitation (power and measurement) cables to avoid electromagnetic interference.

Cable dimension requirements:

Connection type	Cross-section area requirement	
Excitation cables Terminals 1 to 17	0.2 to 4 mm <sup>2</sup>	AWG 24 to AWG 10
Control cables (I/O) Terminals 20 to 77	0.2 to 2.5 mm <sup>2</sup>	AWG 24 to AWG 12

### Grounding

Connect the AVR to the protective earth at terminal 17 with a 4 mm<sup>2</sup> grounding wire.

Make an additional grounding connection through the mounting holes to the installation plate (if it is connected to the protective earth) or with a 4 mm<sup>2</sup> cable to the protective earth.

Make sure that the grounding connections are as short as possible.

Additional signal ground terminals are provided for the control cables.

### Inrush current limitation

The large internal DC capacitor of the AVR can cause a high inrush current especially with a strong voltage source.

**WARNING!** To prevent damage to the AVR, make sure that the inrush current is not more than 200 A for 10 ms.

To prevent damage to the AVR from a high inrush current:

Method	Description
Shunt supply	The excitation power is taken from the generator output over a shunt transformer. Use an excitation supply transformer with a maximum power of 10 kVA.
PMG supply	The excitation power is taken from a permanent magnet generator (PMG). The maximum permitted output power of the PMG is 10 kVA.
Auxiliary windings	The excitation power is taken from an additional stator winding of the generator.
Auxiliary supply	The excitation power is taken from an auxiliary power source. Use an excitation supply transformer with a maximum power of 10 kVA.
DC battery	The excitation power is taken from a battery. Limit the inrush current with a resistor.

To calculate the inrush current, you can use a capacitor voltage of 0 V at startup. The external resistor for a 200 V AC input is typically 1.5  $\Omega$ .

### Power and measurement terminals

Terminals	Type	Ref.	Label	Signal description
Power terminals		17	PE	Protective earth
		16 <sup>+</sup>	PWR L1	Input power L1
		15 <sup>+</sup>	AUX L1 (+)	Auxiliary supply L1
		14 <sup>+</sup>	PWR L2	Input power L2
		13 <sup>+</sup>	AUX L2 (-)	Auxiliary supply L2
		12 <sup>+</sup>	PWR L3	Input power L3
		11 <sup>+</sup>	AUX L3	Auxiliary supply L3
		10	IE+	Exciter current +
		9	IE-	Exciter current -
		8	ExCap (-)	External capacitor -
Measurement terminals		7	ML1	Machine voltage L1
		6	ML2	Machine voltage L2
		5	ML3	Machine voltage L3
		4	NW1	Network voltage L1
		3	NW3	Network voltage L3
		2	MC2+	Machine current +
		1	MC2-	Machine current -

1) To reduce wiring, you can connect each phase of the excitation power inputs (PWR) and auxiliary power supply inputs (AUX) with the included jumpers.

### Commissioning

For detailed instructions on commissioning, refer to the *User Manual*.

Commissioning procedure overview:

1. Make sure that all of the connections are correct and safe.
2. Download the configuration file to the AVR. Make sure that the parameters are correct.
3. Examine the digital and analog I/Os in standstill.
4. Do tests with the machine:
  - a) Standstill
    - Measure resistance of exciter stator winding.
  - b) No load condition
    - Increase the speed of the machine to nominal.
    - Start excitation in Manual mode and increase the manual setpoint until machine voltage is 50%.
    - Use CMT 1000 to verify the AVR measurements and compare them with other equipment used, such as protection devices.
    - Increase the setpoint until the machine voltage is 100% and tune the AVR with the AVR tuning assistant.
    - Do step response tests to examine performance in Manual mode and Auto mode.
  - c) Machine connected to grid
    - Select AUTO (voltage regulator).
    - Increase the AUTO setpoint to verify the polarity of the of  $I_M$  measurement. Q must increase.
  - d) Do step response tests to examine performance in Auto mode and direct VAR regulator modes.
5. Finalizing commissioning
  - a) Save the parameters on the AVR and verify the status with CMT 1000.
  - b) Save backup files for project documentation.

**WARNING!** To prevent unstable regulation and damage to the machine, do tests for all used regulator modes and limiters.

**WARNING!** If you use synchronization, refer to the procedure in the user manual. Take special care with synchronization to prevent physical injury or death, or damage to the equipment.

### Safety instructions

Read the safety instructions in the *User Manual*.

- WARNING!** Obey the safety instructions to prevent physical injury or death, or damage to the equipment.
- Read and make sure that you understand the operating and safety instructions before you operate the unit.
- If you are not a qualified electrician, do not do electrical installation or maintenance work.
- Use personal protective equipment, such as, safety shoes and gloves.

Obey these safety precautions before you do work on the system:

1. Clearly identify the work location and equipment.
2. Disconnect all possible voltage sources. Make sure that reconnection is not possible. Lock out and tag out.
  - Open the main disconnecting device of the AVR.
  - Disconnect any external power sources from the control circuits before you do work on the control cables.
  - If you have a permanent magnet generator connected to the AVR, disconnect it from the AVR with a safety switch or by other means.
  - After you disconnect the AVR, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you continue.
  - Do not do work on the AVR when the amber warning LED flashes.
3. Protect any other energized parts in the work location against contact.
4. Take special precautions when you are near bare conductors.
5. Measure that the installation is de-energized.
  - Use a multimeter with an impedance of at least 1 Mohm.
  - Make sure that the voltage between the AVR input power terminals (PWR L1, PWR L2 and PWR L3) and the grounding terminal (PE) is near 0 V.
  - Make sure that the voltage between the AVR output terminals (IE+, IE- and ExCap) and the grounding terminal (PE) is close to 0 V.
6. Install temporary grounding as required by the local regulations.
7. Ask for a permit to work from the person in control of the electrical installation work.

### Residual danger areas

**WARNING!** Do not do work on the AVR when the amber warning LED flashes.

- When the AVR operates,
- The voltage in the power section can be up to 300 V AC and the short-circuit current is very high.
  - The voltage in the control cabinet is more than 50 V.

When the AVR is disconnected from power supplies, the large capacitors in the AVR hold a charge for some time. Wait for at least 5 minutes for the capacitors to discharge before you do work on the AVR. An amber warning LED flashes if the internal voltage is more than 30 V DC.

Warning labels are attached to all of the cubicle doors to warn personnel against opening the doors during operation.

If the device is built into a larger system, additional warning labels are attached to the inside of the cubicle doors and to the covers of the power converter modules.

Consider the residual danger areas when you do work on the excitation system:

- Danger from live equipment inside the excitation system, if the protective covers are removed.
- Hazardous voltages from the rotor field winding and the secondary side of the excitation transformer.
- Danger from charged capacitors if a cabinet door is open immediately after the system stops.
- Danger from main and auxiliary voltages when cubicle doors are open.

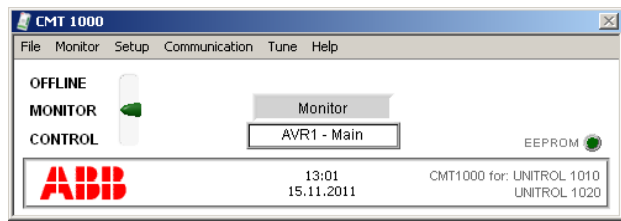
### Introduction

This document is a quick installation guide for the UNITROL 1010 and UNITROL 1020 automatic voltage regulator. Make sure that you read and understand this document before you install or use the product. This document is meant only as a brief guide to the product. For detailed information on the product, refer to the *User Manual*.

### Device description

UNITROL 1010 and UNITROL 1020 are automatic voltage regulators (AVR) for synchronous machines of up to 80 MVA. The AVRs can be used for the excitation of indirectly excited synchronous machines and motors. The AVRs can also operate as a reactive power regulators, power factor regulators or field current regulators.

## CMT 1000 commissioning and maintenance tool



You can set the parameters of the AVR with the CMT 1000 commissioning and maintenance tool PC application for Microsoft Windows. CMT 1000 connects to the AVR through the USB port or Ethernet port. An Ethernet connection permits access to the AVR from remote locations. For more information on CMT 1000, refer to the *User Manual*.

### Operation

The AVR is controlled by analog and digital I/Os. You can also use control signals by remote access over MODBUS.

Use CMT 1000 only to set parameters and operation and not as an operator interface.

For detailed information on operation, refer to the *User Manual*.

### Technical data

	UNITROL 1010	UNITROL 1020
Local control panel	No	Yes
Ingress protection rating	IP20	IP20
Power electronic output		
AC nominal input voltage	0 to 250 V AC	0 to 250 V AC
Frequency	25 to 600 Hz	25 to 600 Hz
DC nominal input voltage	0 to 300 V DC	0 to 300 V DC
Maximum peak input voltage (non-sinusoidal)	420 V <sub>p</sub>	420 V <sub>p</sub>
Minimum required start voltage	N/A	N/A
Auxiliary supply (controller input)		
AC nominal input voltage 3-phase	9 to 250 V AC	9 to 250 V AC
AC nominal input voltage 1-phase	16 to 250 V AC	16 to 250 V AC
Frequency	40 to 600 Hz	40 to 600 Hz
DC nominal input voltage	18 to 300 V DC	18 to 300 V DC
Maximum peak input voltage (non-sinusoidal)	420 V <sub>p</sub>	420 V <sub>p</sub>
Excitation output		
Continuous current at 55 °C	10 A DC	15 A DC 20 A DC <sup>1)</sup>
Overload current for 10 seconds at 55 °C	25 A DC	38 A DC
Exciter current measurements		
Full range	0 to 38 A	0 to 38 A
Accuracy / Resolution	< 1% / < 100 mA	< 1% / < 100 mA
Machine and net measurements		
Machine voltage, 1-, 2-, or 3-phase	Up to 500 V AC <sup>2)</sup>	Up to 500 V AC <sup>2)</sup>
Machine current, 1-phase	1 to 5 A AC	1 to 5 A AC
Network voltage, 1-phase	Up to 500 V AC	Up to 500 V AC
Frequency range	10 to 150 Hz	10 to 150 Hz
Accuracy (-40 °C to 70 °C / at 25 °C)	±1% / 0.1%	±1% / 0.1%
Voltage regulation		
AVR response time (3-phase / 1-phase measurement)	< 20 ms / < 50 ms	< 20 ms / < 50 ms
PWM limitation	0.5 to 99%	0.5 to 99%
Digital inputs and outputs		
Numbers of digital I/Os (inputs / in or out / output)	4 / 8 / 0	4 / 8 / 0
Digital I/O voltage	24 V	24 V
Analog inputs and outputs		
Number of analog inputs/outputs	3 / 2	3 / 2
Analog I/O range	±10 V	±10 V
Communication interfaces		
Ethernet (cable length < 100 m)	10 / 100 MBit/s	10 / 100 MBit/s
USB version (use the provided red USB cable only)	1.0, 1.1, 2.0	1.0, 1.1, 2.0
CAN (cable length < 3 m)	Only for connections between UNITROL 1000 devices.	

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

2) Machine voltage measurement above 250 V AC requires the connection of the machine star point to earth (PE).

### UL ratings

To use the AVR in a UL compliant way, consider the following:

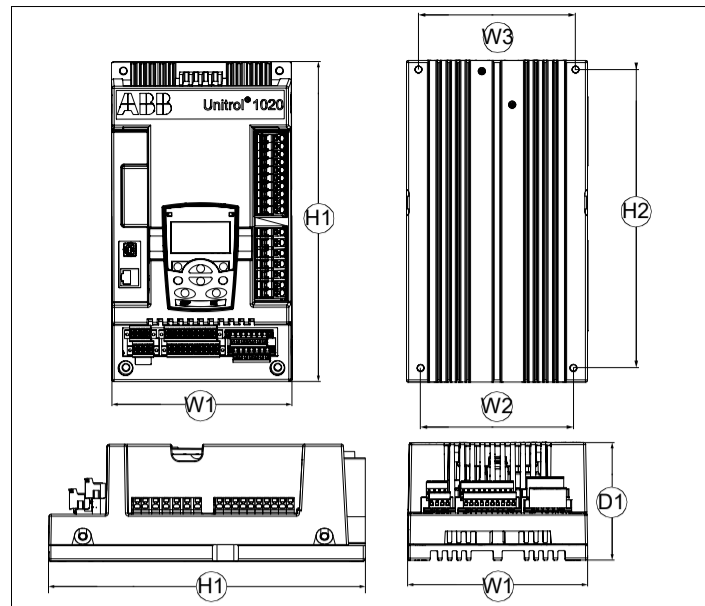
- Electrical ratings for 55 °C surrounding air temperature
- Maximum surrounding air temperature 55 °C – 70 °C with derating as follows
  - UNITROL 1010 maximum output capability: 5 A/150 V
  - UNITROL 1020 maximum output capability: 10 A/150 V
- Use only 60/75 °C rated wires
- For use in a Pollution Degree 2 Environment

Grounding conductor terminal is plainly identified with "PE".

Excitation inputs PWR L1, PWR L2 and PWR L3 must be protected by a circuit breaker rated at 480V/277 V AC, maximum 15 A when supplied from an AC source or listed class RK5 fuse rated at 300 V DC, maximum 15 A when supplied from a DC source.

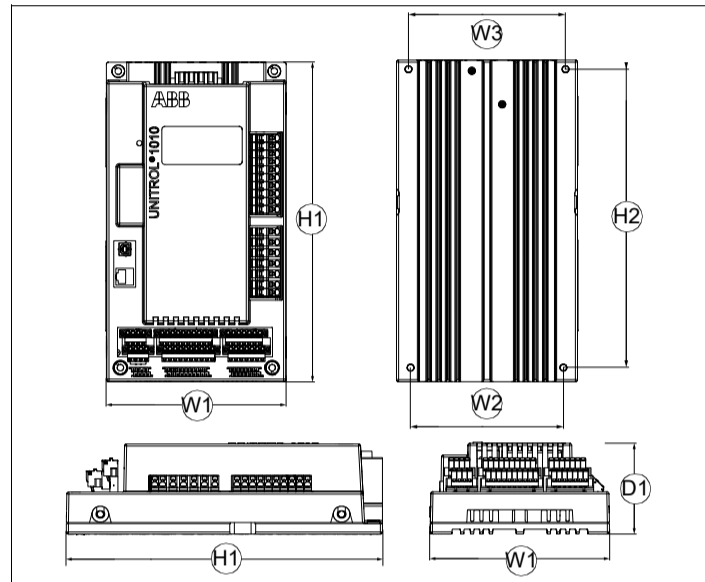
## Dimensions

### UNITROL 1020



Dimensions and weights													
D1		W1		W2		W3		H1		H2		Weight	
mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	kg	lb
111	4.3	170	6.7	143.5	5.6	147.5	5.8	302	11.9	280	11.0	3.8	8.4

### UNITROL 1010



Dimensions and weights													
D1		W1		W2		W3		H1		H2		Weight	
mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	kg	lb
85	3.3	170	6.7	143.5	5.6	147.5	5.8	302	11.9	280	11.0	2.8	6.2

## Device connections

Terminal	Signal	Circuit
7 = ML1 6 = ML2 5 = ML3	Machine Voltage three-phase U <sub>M</sub> • Machine L1 • Machine L2 • Machine L3 Warning: If U <sub>m</sub> > 250 V AC, then the star point must be connected to PE. Machine Current single-phase I <sub>M2</sub> • Machine Current + • Machine Current - Machine Voltage single-phase U <sub>M</sub> • Main L1 • Main L3 Machine Voltage three-phase with ground U <sub>M</sub> • Machine L1 • Machine L2 • Machine L3	External SM ML1 ML2 ML3 max. 500 / 0.2 VA 1) MC2+ 1A / 5 A MC2- 0.1 VA 1) External ML1 ML2 ML3 max. 500 / 0.2 VA 1) External ML1 ML2 ML3 max. 500 / 0.2 VA 1) L1 L2 L3
4 = NW1 3 = NW3	Line voltage measurement single-phase U <sub>NET</sub> Network L1 Network L3 1) You must ground PT & CTs.	External NW1 NW3 max. 500 / 0.2 VA 1)
37 = D1 36 = D2 35 = D3 34 = D4 31 = D5 30 = D6 29 = D7 28 = D8	Digital input/output 1 Digital input/output 2 Digital input/output 3 Digital input/output 4 Digital input/output 5 Digital input/output 6 Digital input/output 7 Digital input/output 8  <b>CAUTION!</b> When configured as outputs, do not connect DIO1...DIO8 directly to the 24 V supply (causes a short circuit via internal transistor).	External 20...28V V2 24V D1 ADC G1 2k External 24V V1 20...28V D1 max. 150 mA
39 = V1 38 = V2 33 = V3 32 = V4	24 V power 24 V power 24 V power 24 V power	External 24V V1 V2 D1 max. 150 mA
20 = G2 21 = G1	GND GND	External G1
53 = AI1, 52 = BI1 51 = AI2, 50 = BI2 49 = AI3, 48 = BI3	Analog Inputs AIx/BIx  Signal bandwidth 100 Hz	External 10V DC 47k 100k 47k 100k 47k AGND -10V DC 47k External max. ±10 V AI1 BI1 100k 47k 100k 47k
47 = ARP 45 = ARN	+10 V pos Ref -10 V neg Ref	External 10V DC 47k 100k 47k 100k 47k AGND -10V DC 47k
BRP = 46 BRN = 44	GND Positive Reference GND Negative Reference  R = 10 kΩ (±5 V input range)	External max. ±10 V AI1 BI1 100k 47k 100k 47k

Terminal	Signal	Circuit
53 = AI1, 52 = BI1 51 = AI2, 50 = BI2 49 = AI3, 48 = BI3	Analog Inputs digitally assigned AIx/BIx	External 10V DC 47k 100k 47k 100k 47k AGND -10V DC 47k
43 = AO1 41 = AO2 42 = BO1 40 = BO2	Analog Outputs AOx to BOx (AGND = BO1, BO2)  Max. output current: 10 mA	External max. ±10 AO1 BO1

### Certifications

The applicable certifications are shown on the product's type label.



### Related documents

Document	Code
UNITROL® 1010 User Manual (English)	3BHS335648 E81
UNITROL® 1020 User Manual (English)	3BHS335648 E82
UNITROL® 1000 Control SW manual (English)	3BHS399489 E02
UNITROL® 1000 Commissioning instructions (English)	3BHS399489 E01
UNI1000 Modbus Address table (English)	3BHS358281 E81
UNI1000 Modbus Reference Manual (English)	3BHS358281 E80
UNI1000 Railway Type Test Summary (English)	3BHS258571 E44
UNI1000 Type Test Summary (English)	3BHS258571 E41
Release Notes HW/SW (English)	3BHS355555 E02

### Support information

ABB Switzerland Ltd  
Static Excitation Systems, Voltage Regulators and Synchronizing Equipment  
CH-5300 Turgi / Switzerland

Internet: <http://www.abb.com/unitrol>

24 h hotline for urgent service inquiries: +41 844 845 845

E-mail contact for questions and support:

[unitrol1000.supportline@ch.abb.com](mailto:unitrol1000.supportline@ch.abb.com)

### Documentation, software and tools

You can get access to the latest documentation, software and tools for the AVR on the myABB business portal.

To get access:

- Go to <https://myportal.abb.com> in your web browser.
- Select Log In.
  - If you have an ABB account, you can sign in with your email and password.
  - If you do not have an ABB account, refer to How to register to the myABB business portal.
- After you log in, the myABB dashboard opens.
- On the myABB dashboard, find the myExcitation widget. For information on how to register to the myExcitation widget, refer to How to register to the myExcitation widget.
- In the myExcitation widget in the myABB business portal, select GO TO ABB LIBRARY.
- ABB Library opens.
- In the left-hand menu, select Category > ABB products > Power Electronics > UNITROL Excitation Systems > UNITROL 1000 > UNITROL 1010 or UNITROL 1020.
- Select your documentation. You can search for documents by categories and by document kind.
- You can also download the documents to your computer.

### How to register to the myABB business portal:

- Select Sign up below the LOGIN button.
- Fill in the registration form.
- Select Sign up.
- ABB sends you an email for activation of your ABB account.
- In the email, select ACTIVATE ACCOUNT.
- You now have an access to the myABB business portal.

### How to register to the myExcitation widget:

- In the myExcitation widget in the myABB business portal, select GET ACCESS.
- Fill in the registration form.

After registration, you can get access to UNITROL 1000 series documents and tools on the ABB Library.

