



ABB EXCITATION SYSTEMS

UNITROL® 1010 and UNITROL® 1020

Quick installation guide



Product package

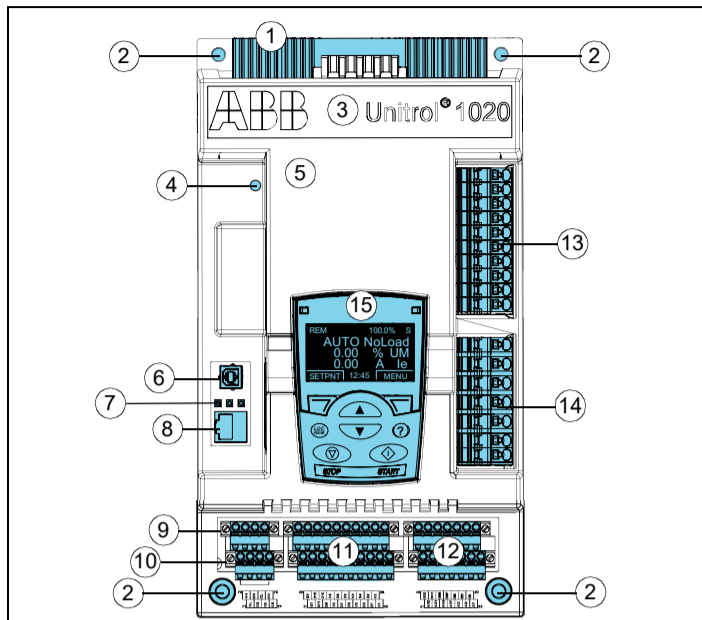
Contents of the product package:

- 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 <ul style="list-style-type: none"> • Protective earth (PE) • Input power U_{PWR} • Auxiliary power U_{AUX} • Excitation output
6	USB port	14	Measurement terminals <ul style="list-style-type: none"> U_M, U_{NET}, I_M
7	Status LEDs	15	Control panel (UNITROL 1020 only)
8	Ethernet port		

Warning and status indicators

Color	Description
Amber	Warning LED Flashes: Do not do work on the AVR! The internal voltage is more than 30 V DC.
Green	Operating status ON: Device controllers are active Flashes: Device software is active
Yellow	Excitation status ON: Excitation is active Flashes: A limiter is active
Red	Alarm status 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.

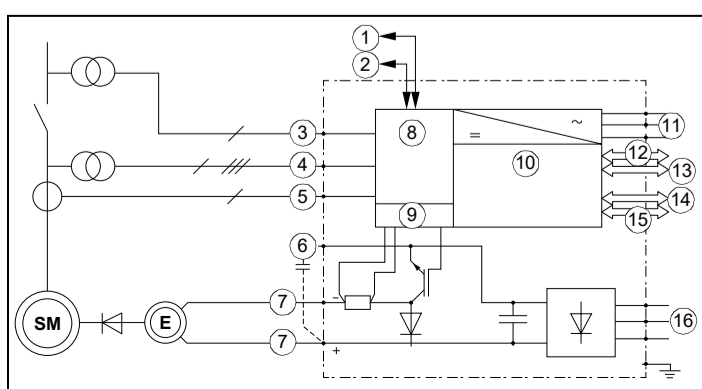
- Make sure that the frame of the AVR is electrically grounded (PE) to the installation plate with a grounding wire ($\geq 4 \text{ mm}^2$) through a mounting hole. Use toothed washers to get a good electrical ground contact.

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_M	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 ²	AWG 24 to AWG 10
Control cables (I/O) Terminals 20 to 77	0.2 to 2.5 mm ²	AWG 24 to AWG 12

Grounding

Connect the AVR to the protective earth at terminal 17 with a 4 mm² 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 mm² 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 Ω .

Power and measurement terminals

Terminals	Type	Ref.	Label	Signal description
	Power terminals	17	PE	Protective earth
		16 ¹	PWR L1	Input power L1
		15 ¹	AUX L1 (+)	Auxiliary supply L1
		14 ¹	PWR L2	Input power L2
		13 ¹	AUX L2 (-)	Auxiliary supply L2
		12 ¹	PWR L3	Input power L3
		11 ¹	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.