VR9035B

Step Out/P.F Relay

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varixx

Description

VR9035B is a member of the family of low-cost, dedicated-function relays for applications in control and protection systems for Synchronous Motors and Generators. Unlike multi-function relays, the use of several relays with dedicated functions allows you to choose only the functions you require while reducing complexity. In addition, if one of the system's relays fails, it can be replaced locally or removed from the system by "By Pass" for emergency operation.

VR9035B is a relay designed to protect against loss of synchronization and excess Polar Angle in Synchronous Motors and Generators. The input signals come from a voltage transformer connected between two phases of the machine and from a current transformer sensing the phase not used by the Voltage Transformer.

In addition to sensing the machine's Polar Angle, VR9035B also incorporates a function to identify if the motor has lost synchronization (Step Out). An N.O. (Resync) contact sends a signal to the Field Application relay for an automatic resynchronization attempt. Automatic resynchronization can be used in systems where there is a possibility of desynchronization (Step Out) due to high peak loads. To use this function, you need another Step Out detection relay (VR9045, for example) and a PLC that monitors the number of attempts.

Loss of synchronism in an excited synchronous machine causes large oscillations in the Stator current, putting the entire system at risk. In this case, it is necessary to immediately remove the excitation, with the motor operating as an induction motor for an attempt at resynchronization or total shutdown of the motor.

Excessive Polar Angle (which defines Power Factor) in both backward and forward can be detrimental to the machine or the system, allowing a Trip signal for this condition. Step Out detection sensitivity setting and two selectable detection types make it possible to disregard any noise on the line that could be misinterpreted as Step Out.

- Two separate selectable protections: Step Out and Polar Angle; two selectable Step Out detection modes.
- Four selectable Step Out detection sensitivity ranges.
- Resync signal in case of Step Out.
- Selectable Trip function to allow use of Resync signal.
- Voltage signal: 115 VAC -30%/+15%.
- Current signal: 100mA to 1A.
- LED indication of actuation and faults.
- Standard DIN box, for rail or screw fixing.
- Enable and Reset signal inputs via dry contacts (10mA/12VDC optically coupled).
- Test and Reset buttons on the front.
- 110VAC or 220VAC defined on request.
- Polar Angle limits defined on request and factory pre-set.
- Voltage signal output proportional to P.F. for measurement.

VR9035B is a relay from the VR90XX family, developed to integrate excitation systems for Synchronous Motors and Generators. This type of machine needs to operate synchronously with the mains. If it loses synchronism, it can generate violent oscillating currents in the Stator and must be switched off (more usual) or resynchronized.

The relay also provides protection for excess Polar Angle in advance and delay, which would cause power factors to be out of specification. For both types of protection, VR9035A relay provides trip or non-trip selection, which allows the Resync signal to be used optionally.

Any disturbances in the network that could be interpreted as a loss of synchronism can be overlooked by adjusting the sensitivity and choosing between the two types of Step Out detection available, depending on the user's line conditions.

> Main Features

› **Construction:** In a DIM box for use on a rail or with screws.

› **Power Supply:** 110VAC or 220VAC (-30%/+15%)/3VA (selected on request).

› **Permissible Voltage Sensing Range (B11 and B12):** 20 to 150VAC.

› **Permissible Current Sensing Range (B14 and B15):** 30mA to 1,5A.

› **Step Out Detection Sensitivity Selection Ranges:** 4.

› **Output Relay:** Dry contact for up to 2A/250VAC or 0,5A/50VDC.

› **Functions Selectable by Front DIPs Switches:** Lead Polar Angle sensing enable (Forward and Backward); Step Out detection sensitivity selection; Step Out trip enable; Excess Polar Angle trip enable.

› **Voltage Sensing Input Impedance:** 20K ohms.

› **Current Sensing Input Impedance:** 1,5 ohm for 1A/15 ohm for 100mA.

› **LED Indication:** Power; Armed; Polar Angle; Step Out and Resync.

› **Trip Time per Polar Angle:** 0,3 sec.

› **Trip Time per Step Out:** 0,1 sec.

› **Enable and Reset Inputs:** By dry contacts. I Source = 10mA/ 12VDC.

› **Resync Signal:** Dry contact Normally Open.

› **Trip Signal:** SPDT dry contacts (N.O, Common, N.C).

› **Power Factor Proportional Voltage Output Signal:** 0 to 5VDC (2,5VDC = unity P.F).

Polar Angle Sensing Selection

ON	OFF	POLAR ANGLE SENSING
S1	-	Enable Lead Pol.Ang.
-	S1	Disable Lead Pol. Ang.
S2	-	Enable Lag Pol. Ang.
-	S2	Disable Lag Pol. Ang.

Step Out Sensing Selection

ON	OFF	STEP OUT TYPE SENSING
S3	-	Type 1 Step Out Enable
-	S3	Type 1 Step Out Disable
S4	-	Type 2 Step Out Enable
-	S4	Type 2 Step Out Disable

Step Out Detection Sensitivity Selection

S6	S5	STEP OUT PICK UP
OFF	OFF	Level 1 - Most Sensible
OFF	ON	Level 2
ON	OFF	Level 3
ON	ON	Level 4

Selection of RDs/Step Out Function and Supervision

ON	OFF	TRIP CONTROL
S7	-	Step Out Trip Enable
-	S7	Step Out Trip Disable
S8	-	Polar Angle Trip Enable
-	S8	Polar Angle Trip Disable

Start Up Procedures

› **1.** The relay is already factory-set for the requested forward and reverse Polar Angles (see ordering table).

› **2.** On first start-up, to check the correct polarities of the voltage and current sensors, leave S1, S2, S3, S4, S5 and S6 in "ON" and S7 and S8 in "OFF" so that no trip occurs if the connections are incorrect. For safety's sake, the Stator current should be monitored carefully and a manual trip provided if necessary.

› **3.** Observe the indication LEDs to check that everything is correct. If the motor is synchronized and the Step Out indication LED is active, disable the two types of Step Out detection on dips S3 and S4. Enable only one of them at a time to determine which is reporting incorrectly. This can be due to noise on the line causing erroneous detection, as the sensitivity must be very high to detect the first pole slip. Only leave the type that doesn't detect these noises enabled. Experiment with the sensitivity selection. All sensitivity selection ranges are safe, so give preference to the least sensitive to avoid erroneous detection.

› **4.** Change the excitation (which changes the Polar Angle) and check the output signal at terminals 3 and 4. If it is incorrect, start again with an inversion of the current sensing signals (terminals 14 and 15).

› **5.** Once everything has been checked, enable the trips on DIPs S7 and S8. The "Resync" function is rarely used (it can usually be used for systems with fast load peaks, which can lead to the motor becoming out of sync). It works in conjunction with a field application relay and a PLC to monitor resynchronization attempts and subsequent tripping.

› Theory of Operation

Synchronous Motors work, as the name suggests, synchronized with the mains, i.e. the slip is zero. Their rotor poles rotate synchronously with the poles of the Stator's rotating field. The motor's excitation directly influences the Polar Angle, altering the machine's Power Factor. Greater excitation or a decrease in the load makes the Power Factor capacitive and less excitation or an increase in the load makes the P.F. inductive. The motor's exciter and control modules ensure that the excitation is applied at the right time and adjust the Polar Angle automatically. However, violent load surges or a fault in the excitation system can lead to the motor becoming out of sync or to Polar Angles outside the system specification. De-synchronization of an excited motor leads to significant oscillatory surges in the Stator current, and it must be tripped or de-excited to attempt synchronization again.

In the case of generators operating in parallel with the grid or other generators, the process is similar. A generator that is out of sync or has the wrong Polar Angle can “Motorize”, working as a motor or load for other generators, consuming power from the system. In the case of generators, the Exciter or AVR determines the best division of reactive loads. A fault in any of the system’s AVRs can lead to an incorrect Power Factor and compromise system safety. VR9035B relay monitors precisely these two possibilities: Step Out or desynchronization, used in motors and Polar Angle (by Power Factor), used in Synchronous Motors and Generators.

A machine with a unity Power Factor has the Stator current in phase with the voltage. Inductive Power Factor (lagging Polar Angle) have the current lagging behind the voltage and capacitive Power Factors have the current ahead of the voltage. By monitoring this lag, the Polar Angle can be determined.

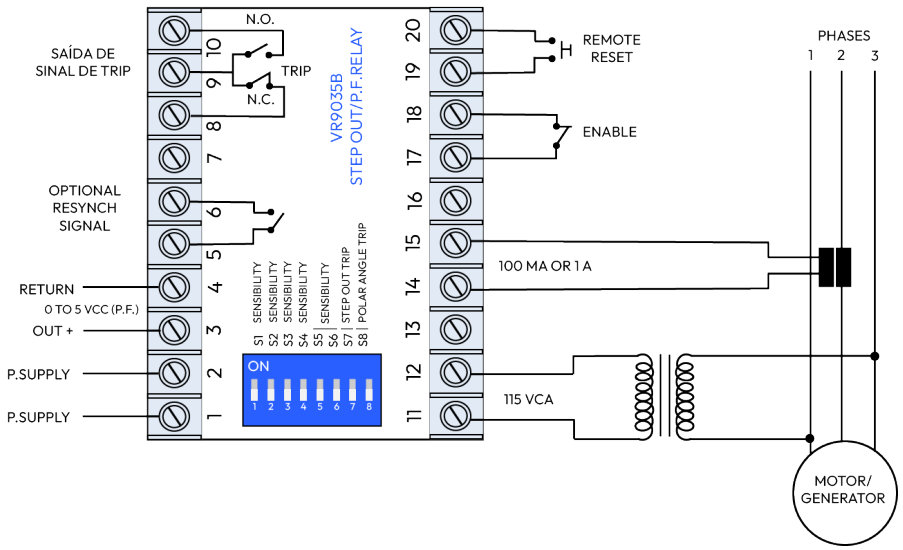
On the other hand, the phenomenon of Step Out or de-synchronization in Synchronous Motors is different because it leads to rotor slip and constant oscillation of the Polar Angle, with the Power Factor oscillating. It must therefore be detected differently, by monitoring the passage of current in counter-phase to the voltage, which constitutes desynchronization. The Polar Angle reading alone may not detect desynchronization, hence the importance of the two detection systems.

Application Example (Simplified)

The diagram below shows the relay’s basic connections. A Normally Closed dry contact must be connected to terminals 17 and 18, which opens after a few seconds following machine excitation (normally the FCX contact of the Field Application relay).

The voltage and current sensors must be connected in accordance with the phases in the diagram, and the CT must be in the phase not used by the voltage transformer. 0 a 5 VDC signal is proportional to the machine’s Power Factor and mirrors its Polar Angle. This signal can be connected to an analog or digital indicator.

Resync signal is specifically for use with Synchronous Motors and is rarely used. To use it, you must inhibit the trip signal and connect the Resync signal to the Field Application relay, which must have an input for it. On receiving this signal, the Field Application relay removes the excitation from the motor and tries to apply it again synchronously.



> User Manual

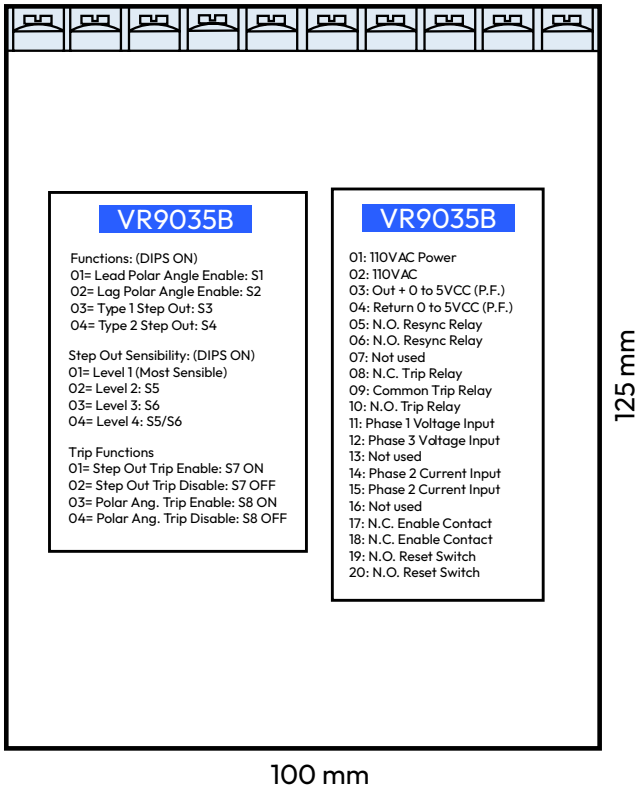
This bulletin can accompany a piece of equipment purchased. In this case, a customization sheet is attached, containing the data relating to the specific type purchased, as well as useful information for the future, such as order number, date of purchase, serial number and other data, in addition to the conditions of supply and a sheet with the Varixx standard warranty terms or negotiated warranty. Any additional information deemed necessary, such as installation conditions, will make up the user manual. It is therefore advisable to keep the manual in a safe place.

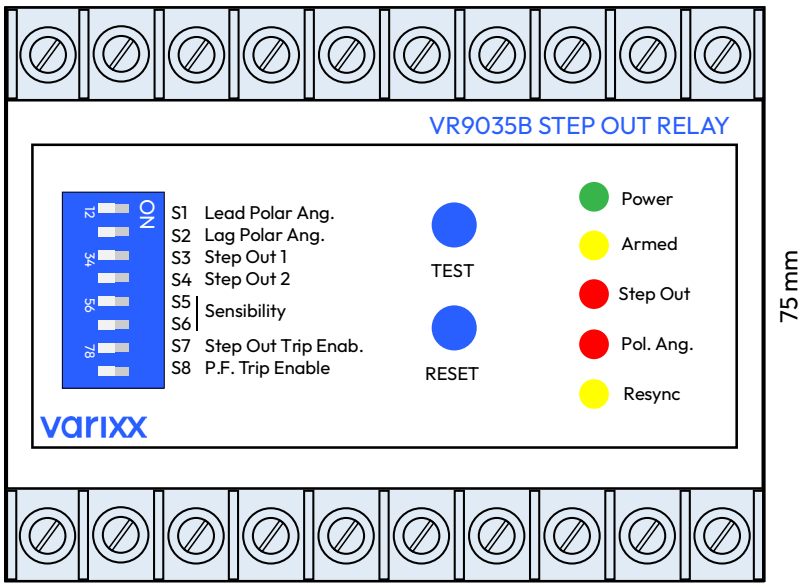
> Application

The user must fully understand the characteristics, limitations and protections before specifying and applying any equipment. Among the most important aspects are the following: maximum currents and voltages, precautions against electromagnetic noise or ripple in the signals that could interfere with them and, above all, a thorough understanding of the equipment's operating characteristics.

The application drawing in this bulletin is provided as an example. It is up to the user to correctly dimension and design the actual application. Varixx can supply all the necessary engineering as well as complete equipment and systems.

Outline





ORDER CODE

VR9035B / X / X / X

A B C

A	Power Supply	1= 110 VAC 2= 220 VAC 3= Other - (Type)
B	Lead Polar Angle Trip	1= P.F.= 0.7 Lead 2= P.F.= 0.8 Lead 3= P.F.= 0.9 Lead
C	Lag Polar Angle Trip	1= P.F.= 0.7 Lag 2= P.F.= 0.8 Lag 3= P.F.= 0.9 Lag

EXAMPLE:
VR9035B/1/1/2: 110 VAC Power Supply; Polar Angle Delay Trip (Inductive) pre-set to Power Factor 0,7 Inductive.
Forward Polar Angle Trip (Capacitive) pre-set to Power Factor 0,8 (Capacitive).

Other Varixx Products

› **Static Exciters and AVRs:** Varixx has a complete range of Static Exciters for motors and generators, with dozens of models of servo drives and AVRs, including digital ones. In addition to components, Varixx also supplies complete excitation systems.

› **Large Rectifiers:** Controlled, air-cooled or water-cooled, up to 100.000 Amps.

› **Power Controllers:** Single-phase, Two-phase and Three-phase, up to 2000 Amps, PWM or Phase Angle.

› **Solid-State Contactors and Static Switches:** Single-phase, Two-phase and Three-phase, up to 2000 Amps, for high switching frequencies.

› **Soft Starters:** Up to 1200 nominal Amps, with all the usual features avaible, such as Soft Start, Soft Stop, Energy Saver, Booster, Brake and various protections.

› **Chopper for DC Motors:** Applicable in overhead cranes, monorails, transport trolleys, etc.

› **Chopper for Ring Motors:** Replaces the various rotor resistor banks and provides linear control.

› **Protection relays for Motors and Generators:** Lowcost line, in DIM boxes, with excellent reliability and ease of application.

› **Signal Transmitters for RTD and Thermocouples:** Compact and encapsulated, with 4 to 20mA true output two-wire, no separate power supply required.

› **Crowbar and Active Transient Suppressors:** Applicable to motor and generator excitation.

› **Integrated Systems and Complete Solutions:** For any type of industrial application.

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TECHNICAL BULLETIN VR9035B

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