

VR9045D

Field Application Relay



Description

VR9045D 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.

VR9045D is a relay designed to apply the field of Collector Ring Synchronous Motors at the correct Rotation and Polar Angle for optimum synchronization. The input signal is derived from the field's Shunt Resistor, which during acceleration provides a load for the voltage induced in the field. During motor start-up, this resistor is electrically connected in parallel with the motor field via a Field Contactor or Crowbar.

In addition to detecting the motor's rotation and the correct Polar Angle for the Field Application, VR9045D also incorporates a function that allows it to identify that the motor has entered reluctance synchronism, thus commanding the application of the field. Another function also makes it possible to detect failure to accelerate the engine correctly within the programmed time by generating a Trip signal.

A second output (FCX) enables the motor to start charging after the motor field is applied by the FAR (Field Application Relay) output. A selectable function for attempting automatic resynchronization is also available. 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 (VR9035B for example) and a PLC that monitors the number of attempts. If the relay receives an external resynchronization signal, the field is immediately removed (opens FAR relay) and the motor starts operating as an induction motor, avoiding violent current oscillations in the stator, and a new Field Application is attempted at the correct Polar Angle if the rotation has not fallen below the specified speed.

- › 8 selectable speed ranges (0,5 to 4Hz or 93,33% to 99,16%).
- › 8 start time selection ranges, from 5 to 40 seconds.
- › FAR (Field Application Relay) function by Polar Angle and Rotation.
- › FCX function for loading release.
- › Resync function for attempted resynchronization.
- › Function for monitoring erroneous insertion of Discharge Resistors (RDs) after synchronization.
- › Step Out detection function if Crowbar Varixx is used instead of the RD insertion contactor.

- › FAR, FCX and TRIP outputs via relays.
- › Field signal output from 10 to 300VAC.
- › LED indication of actuation and faults.
- › Standard DIN box, for rail or screw fixing.
- › Start, Resync and Reset signal inputs via dry contacts (10mA/12VDC optically coupled).

VR9045D is a relay from the VR90XX family, developed to integrate excitation systems for Collector Ring Synchronous Motors. This type of motor requires the field to be applied at a well-defined moment, close to the synchronous speed and with a favorable Polar Angle, so that synchronization occurs without transients and large current oscillations in the stator. The relay also provides Field Application in the case of reluctance synchronization.

In addition to these functions, VR9045D relay provides a trip signal in two possible conditions: failure to accelerate the motor in the allotted time and incorrect insertion of the RDs. This last function becomes Step Out detection, i.e. desynchronization if a Crowbar is used to insert the RDs into the starter, as there will be an AC voltage induced in the field automatically coupled to the RDs.

› Main Features

- › **Construction:** In a DIM box for use on a rail or with screw.
- › **Power Supply:** 110VAC or 220VAC/3VA, selected on request.
- › **Permissible Range of Field Induced Voltage:** 10 to 500VAC.
- › **Slip Selection Ranges (or rotation in %) for Field Application:** 0,5Hz / 99,16% - 1 HZ / 98,33% - 1,5 Hz / 97,50 - 2 Hz / 96,6 - 2,5 HZ / 95,83% - 3 Hz / 95% - 3,5 Hz / 94,16 - 4 Hz / 93,33%.
- › **Start Time Selection Ranges:** 5, 10, 15, 20, 25, 30, 35, 40.
- › **Output Relay:** Dry contact for up to 2A/250VAC or 0,5A/50VDC.
- › **Functions Selectable by Front DIPs Switches:** Slip or Excitation Permit Speed in 8 bands; Predicted Start Time; Resynchronization Function Enablement; RDs/ Step Out Erroneous Insertion Supervision Enablement.
- › **Voltage/Field Frequency Sensing Input Impedance:** 10 K ohms.
- › **LED Indication:** Power; FAR; FCX; Tripped.
- › **Time to Performance and FCX after FAR:** 3 sec.
- › **Delay for Resynchronization Attempt after Resync Signal:** 3 sec.
- › **Start, Resync and Reset Inputs:** By dry contacts. I Source = 10mA/12VDC.
- › **Reluctance Synchronization:** Detectable for Field Application after predicted acceleration time.
- › **Types:** Type 1 with “Normally Open” Start and Trip contacts and Type 2 with “Normally Closed” Start and Trip contacts.

Slip/Rotation Selection

SLIP (S) HERTS/SPEED %			
ON	OFF	NORMAL Hz/%	EXTEND Hz/%
-	S1, S2, S3	0.5/99.16	1/98.33
S1	S2, S3	1/98.33	2/96.66
S2	S1, S3	1.5/97.50	3/95.00
S1, S2	S3	2/96.66	4/93.33
S3	S1, S2	2.5/95.83	5/91.66
S1, S3	S2	3/95.00	6/90.00
S2, S3	S1	3.5/94.16	7/88.33
S1, S2, S3	-	4/93.33	8/86.66

Start Time Selection

STARTING TIME			
ON	OFF	NORMAL SEC.	EXTEND SEC.
-	S4, S5, S6	2.5	5
S4	S5, S6	5	10
S5	S4, S6	7.5	15
S4, S5	S6	10	20
S6	S4, S5	12.5	25
S4 S6	S5	15	30
S5, S6	S4	17.5	35
S4, S5, S6	-	20	40

Resync Function Selection

ON	OFF	RESYNC
S7	-	ENABLE
-	S7	DISABLE

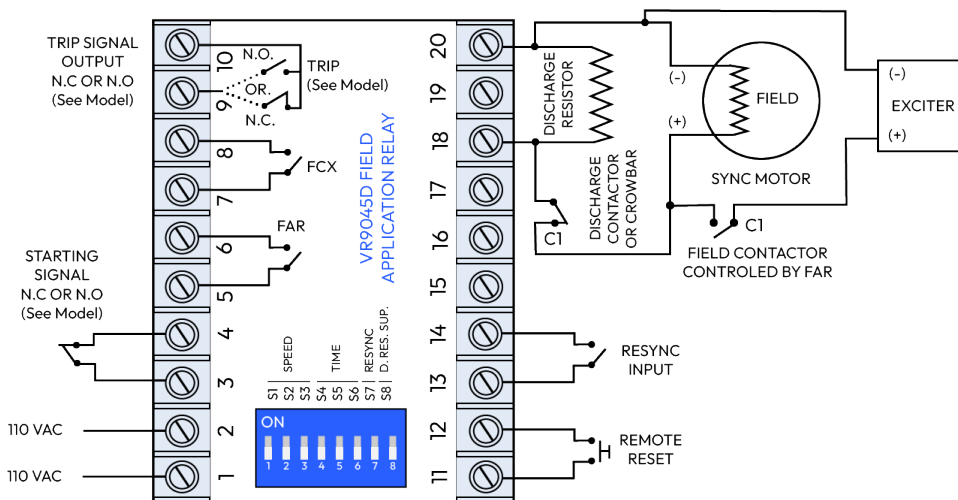
Selection of RDs/Step Out Function and Supervision

ON	OFF	RDs Supervision/Step Out
S8	-	ENABLE
-	S8	DISABLE

Start Up Procedures

- › 1. Perform an complete start without the Field Application to timing the start-up time.
- › 2. Set DIPs S4, S5 and S6 to the start-up immediately above the one measured.
- › 3. Set DIPs S1, S2 and S3 to the slip at which the field can be applied. If a very low value is chosen (0,5 for example) with a high load, the motor may not reach this speed and be tripped. Normally 4 is a value that suits most applications. Lower values for systems with smaller loads can be tried to ensure minimum torque pulsation in the Field Application.
- › 4. Let S7 OFF. Resync function is rarely used. It can normally be used for systems with fast load peaks, which can lead to the motor becoming out of sync. It also requires a relay for Step Out detection.
- › 5. The RDs Supervision/Step Out can be enabled or not. For systems with Crowbar and Resync function enabled, it must be left on.

Application Example (Simplified)



The diagram above shows the relay's basic connections. A dry contact must be connected to terminals 3 and 4, which for the Type 1 relay must be "Normally Open" and for the Type 2 relay (see model) must be "Normally Closed" (normally an auxiliary contact for the motor's stator circuit breaker).

The field and resistance contactor (C1) must be controlled by FAR relay (terminals 5 and 6). The resistance application contact must be Normally Closed. A Varixx Crowbar can also be used for this function. The FCX contact closes 3 seconds after FAR and can be used to enable the motor load and P.F. regulator.

> Theory of Operation

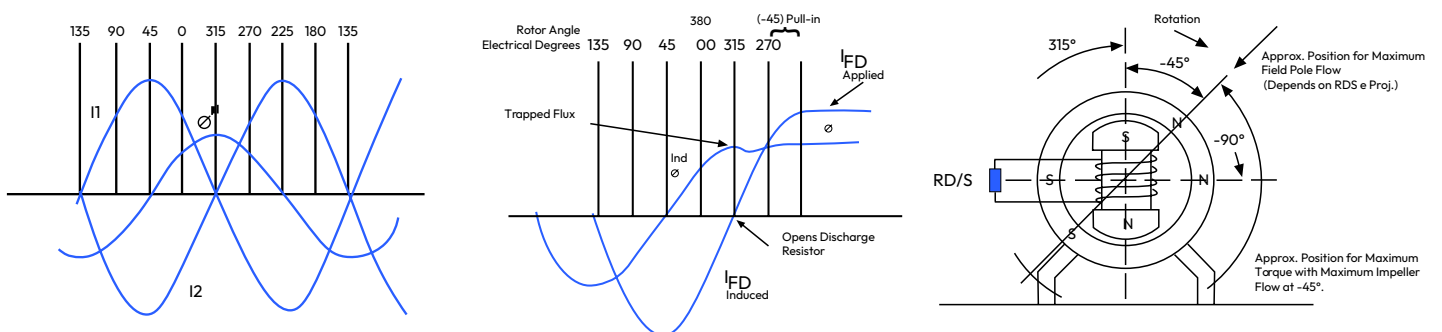
During acceleration of Collector Ring motors, DC voltage should not be applied to the field (Rotor) as this would not allow the motor to accelerate and high torque and stator current oscillations would occur, which could damage the motor or system. The motor initially starts as an induction motor with a torque called Starting Torque. After synchronization, the torque will depend on the flux produced by the excitation and the torque will become Synchronous Torque.

When starting, the motor behaves like a current transformer, inducing an alternating current of the same frequency as the mains in the rotor (field). The frequency decreases to zero as the motor accelerates. This current would produce very high voltages in the field if the Discharge Resistors (DRs) were not connected to the field. Graph 1 shows the Stator (I_1) and Rotor (I_2) currents and the flux. The maximum flux occurs when I_2 passes through zero.

The rotor angle at which the currents pass through zero depends on the relationship between reactance and resistance in the field circuit (Rotor). At the beginning of the Start at high frequency, the reactance is high and the angle is close to -90° . At the end of the Start, at low frequency, the reactance is low and due to the RDs the angle is approximately 0° . When the Electrical Angle of the stator is close to -45° (or 270°), the torque increases due to the growth of the flux. At this point there will be maximum torque and maximum flux, with the rotor's Polar Angle at the ideal field application point for the motor to synchronize immediately, without major oscillations.

At the opening of the field resistor (RDs) the flux is maintained (Trapped) and the application of the field will maintain the flux at the required value, with the rotor angle at the ideal alignment point for synchronization (Pull In). A possible occurrence with lightly loaded motors is synchronization by reluctance. At synchronous speed, the rotor poles are slightly magnetized, resulting in a small torque that can bring the motor into synchronization without the application of a field.

In this case the relay applies the field and two possibilities can occur: the first is that the alignment of the magnetic north and south poles by the reluctance coincides with the poles produced by the applied field. In this case there will be no oscillation. In the second case, the poles do not coincide and there will be a single oscillation until the poles are correctly realigned. It should be noted that if the load on the shaft is too great for the starting torque, the motor will not accelerate sufficiently and will be tripped by the relay after the programmed time.



> User Manual

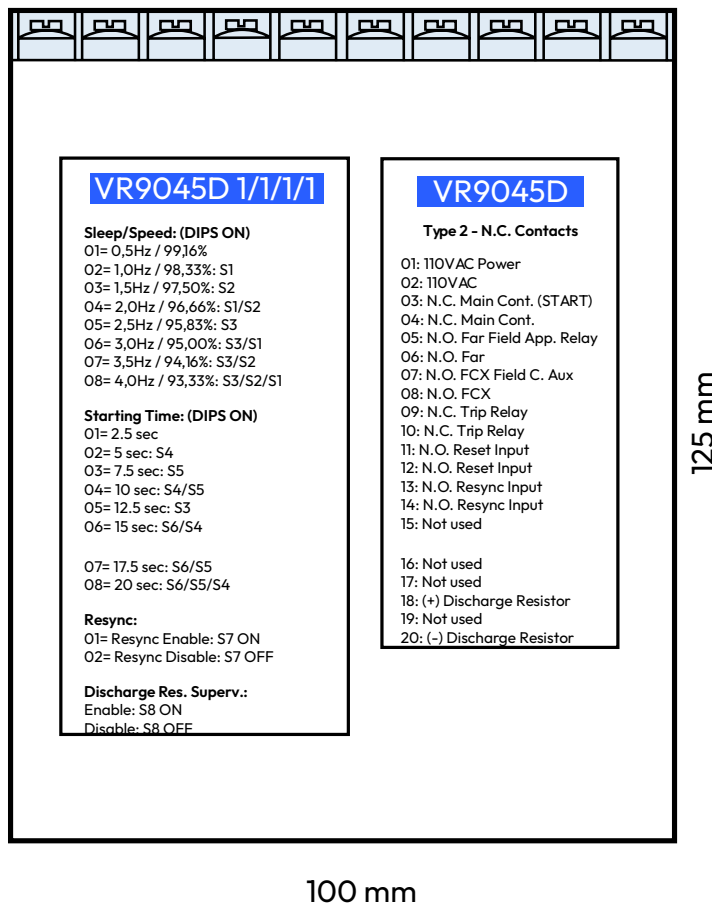
This bulletin can accompany a piece of equipment purchased. In this case, a customization sheet is attached, containing the data relating to the specific type purchased, as well as useful information for the future, such as order number, date of purchase, serial number and other data, in addition to 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.

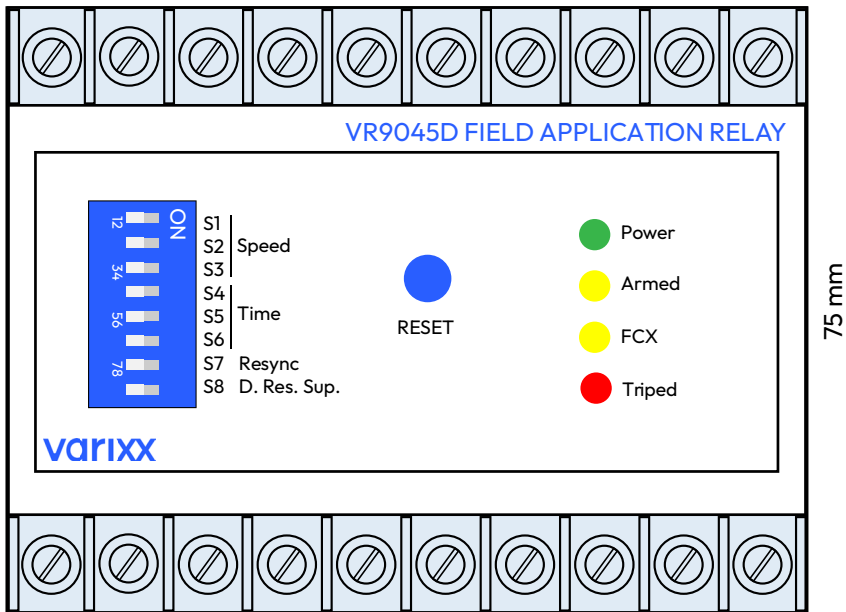
> Application

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	
VR9045D / X / X / X / X	
<div style="display: flex; justify-content: space-around;"> [A] [B] [C] [D] </div>	
[A] Power Supply	1= 110 VAC 2= 220 VAC 3= Other - Type
[B] Slip (S) %	1= Normal (0,5 to 4) 2= Extended (1 to 8) 3= Other - Type
[C] Start Time (seconds)	1= Normal (2,5 to 20) 2= Extended (5 to 40) 3= Other - Type
[D] E/S Type	1= Contacts N. Open 2= Contacts N. Closed

EXAMPLE:

VR9045D/1/1/1/1: 110 VAC Power Supply; Slip Range (S) = 0,5% to 4%; Start Time Range = 2,5 to 20 seconds; Input/Output Type = "Normally Open" (Starting and Trip).

Other Varixx Products

- › **Static Exciters and AVR:** Varixx has a complete range of Static Exciters for motors and generators, with dozens of models of servo drives and AVR, 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 available, such as Soft Start, Soft Stop, Energy Saver, Booster, Brake e diversas proteções.
- › **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.

VR9045D

Field Application Relay

TECHNICAL BULLETIN VR9030A

varixx

Rua Phelippe Zaidan Maluf, 450 – Piracicaba – SP

Distrito Industrial Unileste – CEP 13422.190 fone: (19) 34244000 /

(19) 33016900 / Fax: (19)34244001

Mais informações: info@varixx.com.br

Conheça nosso site: www.varixx.com.br

Dois anos de garantia para toda linha suporte técnico especializado em todo o Brasil

VR9045D é Marca Registrada da Varixx
Varixx e os seu logo são marcas registradas
Outras marcas são registradas por seus respectivos proprietários