Varix

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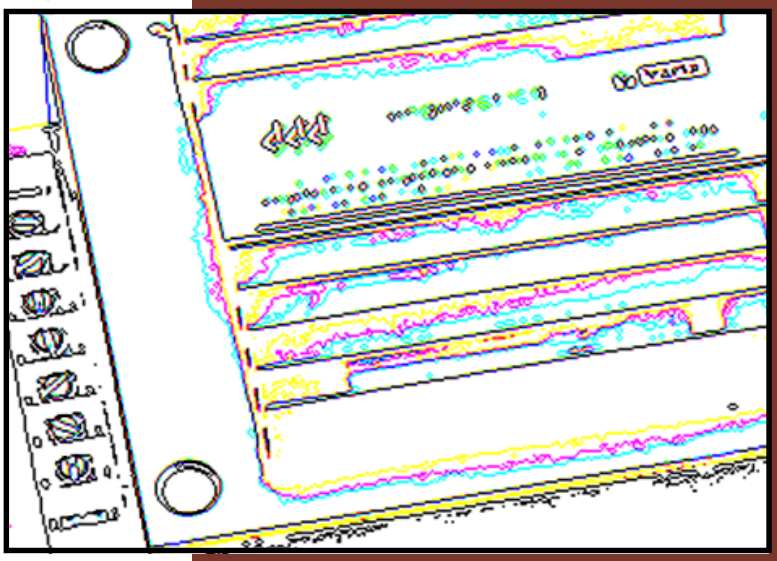
bulletin 219AE

Synchronism controllers



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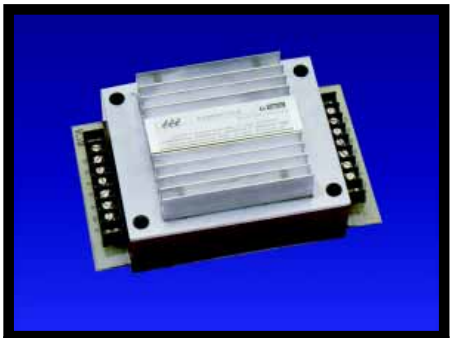
Synchronism Controllers



M2 Type Control Box

M1 Type Control Box

The Types M1 and M2 Varix Control Box are compact built modules, fully encapsulated, to fit inside Brushless Synchronous Motors.

Synchronous Motors, are motors that by their special construction and by an application of an adequate excitation current in motor field, make their velocity synchronous with the stator-rotating field caused by line frequency, with null slip. Additionally, by varying the excitation rate, we can define its Power Factor, either inductive or capacitive or even unity. This way they have many advantages when compared to squirrel cage motors. The Synchronous motors could be inclusively utilized to replace large capacitor banks to compensate low power factor systems. In this case the motor runs freely, without load at its shaft.

The M2 type Control Box witch is more powerful, is normally used in large motors. This type is able to provide automatic application of excitation current, so the system doesn't need to worry about the timing. This way the external excitation current in the exciter field could be applied just at the Start of the motor, which would guarantee its synchronization.

The M2 type provides several functions: During the starting it provides the Crowbar function, applying the discharge resistor in the motor field, to limit the induced tension to safe values. Near the final of the starting the M2 CB begins to apply the excitation current to the field, intermittently, considering the best polar angles, providing best acceleration rates and torque to improve the Pull-in. This way the motor doesn't depend only on its auxiliary squirrel cage to start. At the end of the starting time, just near the synchronous speed, the CB applies continuously the excitation in the motor field, at the best polar angle to guarantee effective pull-in. Finally, after the synchronization, in the event of a transient pulse greater than the firing level, The M2 CB applies the discharge resistor by a short time, lowering the transient voltage.

The M1 type Control Box only provides the crowbar functions, to limit the induced tension in the motor field during the starting. Normally it is applied to relatively lower capacity motors or relatively lights starting torque loads. With the M1 type the system can not apply the excitation to the exciter field at the beginning of the starting. The excitation must be applied near the end of starting, controlled by a timer or speed switch. This way the field is excited at the same moment that the external excitation is applied, without polar angle sensing. The crowbar function remains active during the normal operation of the motor, applying the discharge resistor by a short moment, in case of transients.

Both types use advanced technology, with firing circuit with optic insulation, providing better reliability and better insulation values, better noise immunity and, in case of M2, lower consumption and heating.

Both types are mechanical and electrical compatible with General Electric and Saratoga correlated models but they have improved internal components and circuitry.

Control Box M2:

Application: Synchronous Brushless motors.
Functions: Crowbar, synchronous and pulsed exciter current application to improve acceleration rates, Synchronous continuous exciter current application and momentary discharge resistor application during normal operation in case of transients with voltage above the threshold level.
Threshold level: 230 VCC.
Consumption: <50 mA.
Nominal supply voltage: 125VCC.
Continuous tolerable supply voltage): 60 to 200 VCC.
Number of controllable tyristors: 3.
Firing technique: Static with optic insulation.
Gate current: 1Ampèr.
Insulation: 5000 V.
Maximum admissible field induced voltage: 800 VAC (with RD applied).
Maximum recommendable field voltage: 600 VAC (with RD applied).
Set points: 2, adjustable (two different ranges).
Maximum air temperature: 75ºC

The M1 and M2 types control boxes are applied inside synchronous motors, to provide induced voltage limiting and field excitation functions.

The M2 type provides field-induced voltage limiting (Crowbar), at starting and normal operation.

The M2 type, provide the same functions and add the function of synchronous exciting current application, pulsed near the final of the starting range, and continuous just near the synchronous speed, both at the optimum polar angle, to get maximum efficiency in pull-in.

CONTROL BOX

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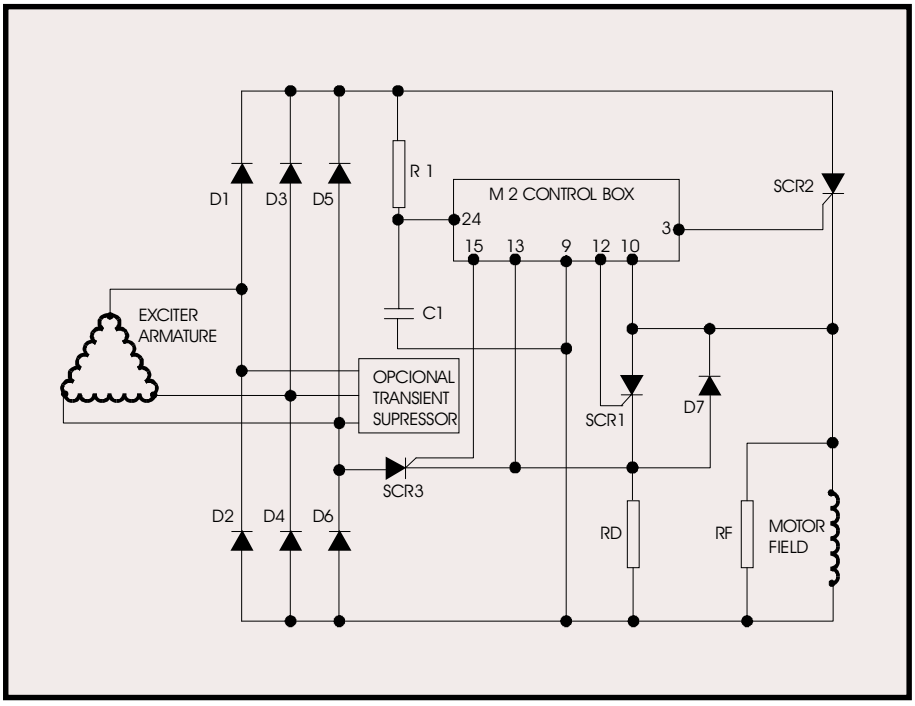


M2 Type Control Box Description:

Compact built, fully epoxy resin sealed, to be mounted inside Synchronous Brushless Motors.

The M2 Type provides four functions: 1- Induced motor field voltage limiting (Crowbar); 2 - Pulsed synchronous motor field current application, at final speed range, to improve acceleration rate and pull-in; 3- Polar angle dependant, continuous motor field current application near synch speed, to provide guaranteed Pull-in; 4 - Transient voltage value limitation during normal operation, by short time discharge resistor application.

The firing of tyristor that applies the excitation current is optically coupled, providing guaranteed firing to any size tyristor, low consumption and reliability.

There is a model that can synch fire two parallels tyristors for large current applications.

The M2 CB senses continuously the speed (Rotation) and the polar angle, during the starting, using a signal extracted from the discharge resistor RD.

An inside step down power supply regulates the voltage supplied by the diode bridge to the electronic circuits inside the CB.

An exciter field excitation must be applied at the beginning of the starting, to provide power to CB and be available to automatic synchronous motor field current application.

The crowbar function is not dependent on supply and remains active in case the external excitation is not applied or fails.

The M2 type CB has two adjustable set points, externally accessible. After the motor gets the speed of set point 1, CB initiates the synchronous pulsed application of the field current excitation, at the optimum polar angle. At the moment that the motor gets the speed of set point 2, the motor field current excitation is continuously applied at the optimum polar angle.

See available models ahead.

M2 Type Control Box - Application

The left side circuit shows a typical application for the M2 type Control Box.

The RF resistor provides a way to fast rising of SCR2 current, compensating the low rate rising of motor field current due to its high inductance. Typical values are from 200 to 500 ohms.

The RD resistor is selected to limit the induced motor field voltage to acceptable values during the starting (Maximum recommendable voltage is 800VAC)

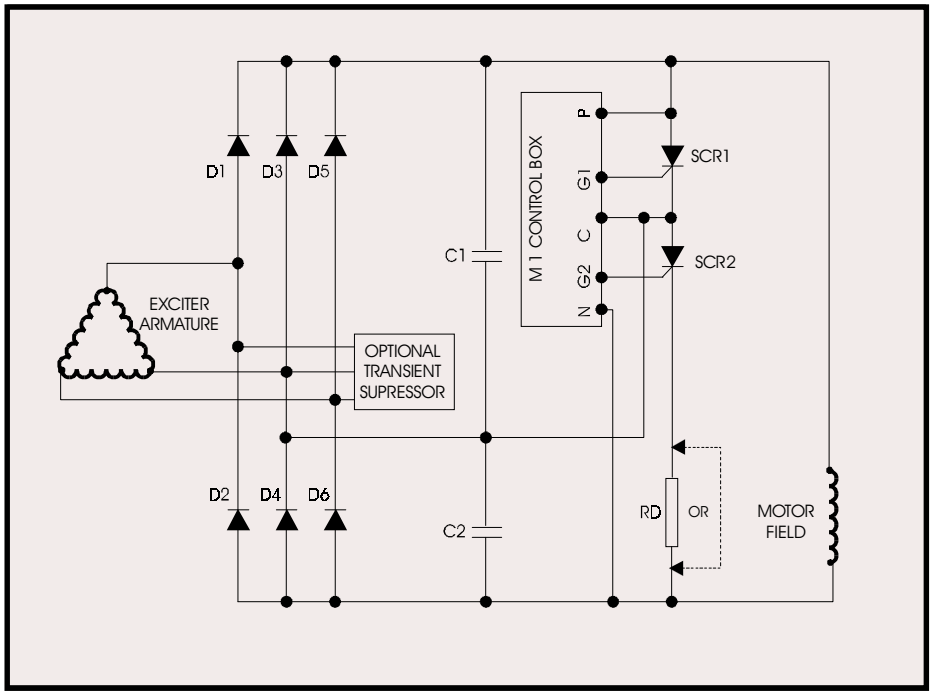
The SCR1 tyristor and the D7 diode perform part of the crowbar circuit and must be selected by the discharge current over RD during the starting. The forward blocking voltage of SCR1 must be lower than the reverse blocking voltage of the bridge diodes D1 to D6 and the motor field insulation. (Example: 600 V). This way, in an eventual CB or gate cable fail, the tyristor could be self fired by excess of forward blocking voltage, protecting the field, diodes and CB integrity. The diodes D1 to D6 must be selected by the field exciting current, (example: 2 x (Iexc/3)). The reverse diodes blocking voltage must be at least 1000 Volts.

The R1 resistor and C1 capacitor provide a transient filter to the CB supply. Typical values are R1= 150 ohms e C1= 3uF, polypropylene type with proper voltage insulation.

The optional transient suppressor could be built with varistors or capacitor with adequate values.

The SCR2 tyristor must be selected considering the field current added to the current in the discharge resistor in case of momentary application of discharge resistor caused by a transient during normal operation. The forward blocking voltage of SCR2 must be at least 1200 Volts.

The SCR3 tyristor provides the forcing blocking of SCR1 during normal operation. It must be selected considering the surge current caused by application of phase tension of the diode bridge over RD.



M1 Type Control Box - Description:

Compact built, fully epoxy resin sealed, to be mounted inside Synchronous Brushless Motors.

The M1 Type provides three functions: 1- Induced motor field voltage limiting (Crowbar); 2- Provides transients filter function; 3 - Transient voltage value limitation during normal operation, by short time discharge resistor application.

The firing of tyristors is optically coupled, providing guaranteed firing to any size tyristor, low consumption, noise immunity and reliability.

The M1 CB has pre-trigger circuit, adjusted to a threshold 15% lower than the firing threshold level. This way it prevents erroneous firing by dv/dt, during normal operation, after starting.

The M2 type provides synchronous firing of the two series mounted tyristors. This way it increases the reliability and reduces the Ton time, reducing the overshoot.

It has filters to prevent dv/dt firing and general filters for transient reduction.

The M1 type CB has voltage equalization circuit for the series tyristors and constant current injection circuits by optic couplers.

The M1 type CB has current amplifier circuit to guarantee firing of external tyristors.

M1 Type Control Box - Characteristics:

Function: Limitation of induced motor field voltage during starting and limitation of surges and transients level during normal operation (Crowbar).

Threshold level: 230 V

Pre-trigger level: +200 V

Gate current: 1Ampèr.

Time Constant of the filter: 10 uS

Firing time (Ton): < .01 mSeconds for 250V step.

Controllable tyristor quantity: 2

Maximum ambient temperature (internally the motor): 75 ºC.

Consumption: negligible

Insulation: > 5000 V.

Maximum admissible induced field voltage: 800 VCA (with RD applied).

Maximum recommendable induced field voltage: 600 VCA (w/ RD applied).

M1 Type Control Box - Application

The left side circuit shows a typical application for the M1 type Control Box.

The diodes D1 to D6 must be selected by the field exciting current, (Example: 2 x (Iexc/3)). The reverse diodes blocking voltage must be at least 1000 Volts.

The SCR1 and SCR2 tyristor must be selected by the discharge current over RD, during the starting. The forward blocking voltage must be lower than the reverse blocking voltage of the bridge diodes D1 to D6 and the motor field insulation. (Example: 600 V). This way, with an eventual CB or gate cables fail, the tyristor could be self fired by excess of forward blocking voltage, protecting the field, diodes and CB integrity.

The RD resistor is selected to limit the induced motor field voltage to acceptable values during the starting (Maximum recommendable = 600V). Commonly it is zero ohms. C1 and C2 provide equalization and filtering.

CONTROL BOX

MODELS:

M1 Control Box Model: VCSM1.A
(See general characteristics)

M2 Control Box Models:
(See general characteristics)

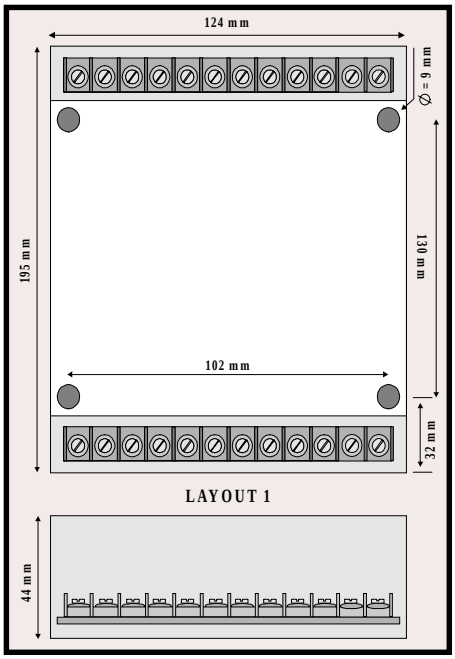
Models: VCSM.B and VCSM.B2*
Application: Normal or low acceleration rate motors/loads.
Set point 1 (for pulsed field current application): adjustable from 85% to 98% of synchronous speed.
Set point 2 (for continuous field current application): adjustable from 95% to 100% of synchronous speed.

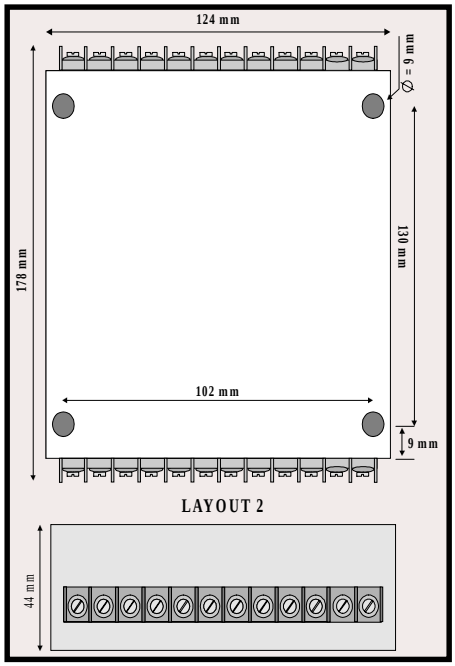
Models: VCSM.BE and VCSM.BE2*
Application: Fast acceleration rate motors/loads.
Set point 1 (for pulsed field current application): adjustable from 60% to 95% of synchronous speed.
Set point 2 (for continuous field current application): adjustable from 80% to 100% of synchronous speed.

* The models with final 2 have outputs for two parallel tyristors.

Factory adjusts: Each CB is sold with user's manual, with test and calibration procedures and a sheet with its characteristics and factory calibrations.

OUTLINE:





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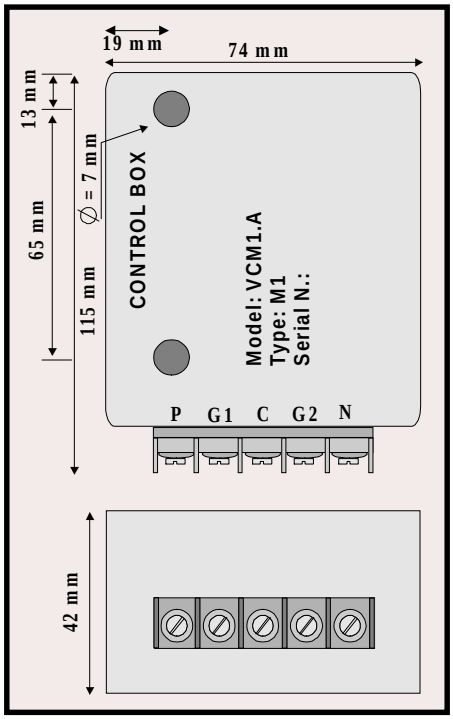

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