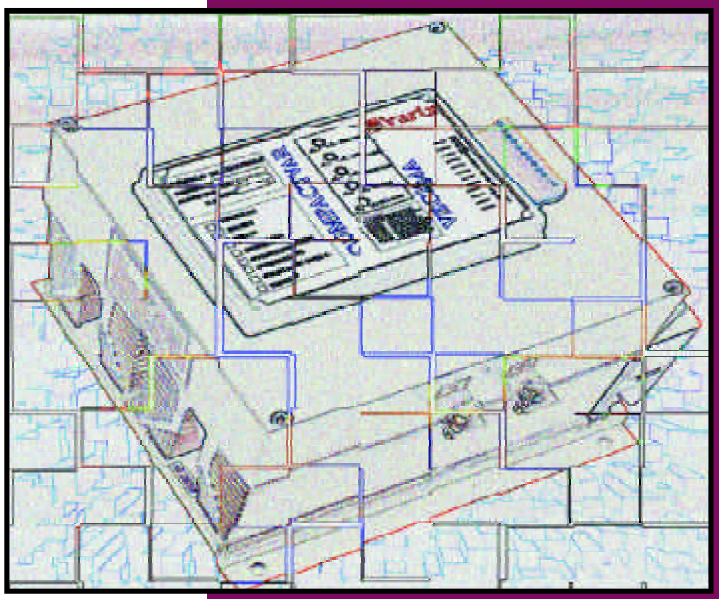
Varixx
INNOVATION

Bulletin 209EE

VEC204D Multifunction Regulator



Compact Static Exciter / Driver

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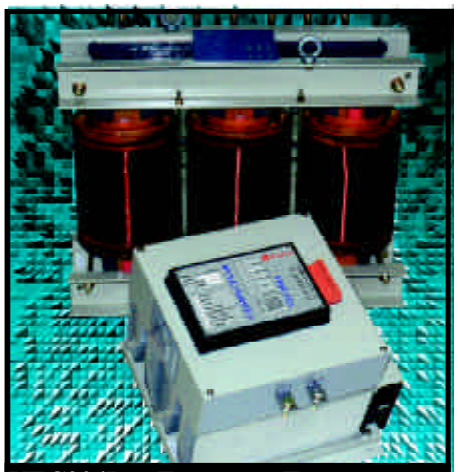
VEC204D Static Exciters
BULLETIN 209EE

COMPACTVAR

VEC204D/1/F/50



VEC204D + EXCITATION TRANSFORMER

The VEC 200 series is a product family that includes AVRs (Automatic Voltage Regulators) for Generators, Static Exciter and Drivers for Synchronous Motors and Alternators, High Current Controlled Rectifiers or Simple 1 quadrant DC Motor Drives. The VEC204D is a multifunction Regulator / Exciter / Driver well suited to Synchronous Motors applications.
The VEC204D is an economical multifunction, monoboard architecture, plug in, reliable product with good performance.
The VEC204D incorporate some functions and protections features. The type of control signal can be chosen when ordering.
The VEC204D has separate P + I + D adjustments that together with its sensing characteristics enable it to fit in virtually any process. Five adjustments are available at the front panel.
Eight LED indicates its functions and failure conditions.
Eight DIP Switches at front panel, simplify the selection of functions.
The removable connector allows the control module to be cahnged easily.
The VEC204DC control module is the core of the system. Wen plugged into a power module, from 10 to 2000 Amperes, air cooled or to 50000 Ampere water cooled, a final compact exciter can be formed or if mounted inside a panel, with auxiliary equipment (such as Circuit Breaker, Crowbar, Fuses and Transformers), a complete Generator or Synchronous Motor Exciter, Rectifier or DC Motor Drive can be created.
The VEC204D is a good choice for reliable and economical equipment, with good performance. The monoboard architecture, encapsulated Plug In module allows a high tolerance to hostile environments and to vibrations besides allowing easy maintenance with a simple module change. The power semiconductors used in equipment to 1250 Amperes are encapsulated insulated base types, wich are highly reliable and allow for simple and clean assembly.
The control module can be used with a controlled thyristor bridge, phase angle controlled or a diode bridge with Step Down Chopper with IGBT (lower dead time operation).
There are two modes of Droop compensation available for Power Factor regulation or for paralleling generators: by an external power factor transducer or by an internal power factor transducer included in the module. The P.F. sensed by the Power Factor transducer is added to the sensing signal for the "Droop by Reactive Power Factor Compensation" method.
The Firing modules are fully encapsulated in high insulation epoxy resins (20000 V/mm) with optical isolation.
The diodes, thyristor or IGBT modules are isolated base types with high reliability, simple an clean assembly and ease of maintenance.

The VEC204D (series VEC 20X) is a good choice for a synchronous motors exciter. It can also be used as an AVR / Exciter for generators, rectifiers or simple speed regulation for DC motors.

The product has been made mainly to achieve high reliability and simplicity.

It has applications for machines of up to 30.000 KVA or rectifiers to 50.000 Amperes.

The plug in monoboard encapsulated architecture, allowsfor simple, clean and reliable assembly.

The digital function selection allows easy commissioning and use.

The LED indicators and DIP switches make the equipment friendly and intuitive.

Five options of input signals are available.

A complete line of Exciter, including digital types is available.

- **Application:** Driver and Static Exciter for Synchronous Motors and Generators, AVRs, Rectifier, DC motors Drive.
- **Available control signal:**

0 to 5 V, 0 to 10 V, Potentiometer, 0 to 20 mA, 4 to 20 mA.

- **Modes:** Main variable regulation with Droop by secondary variable (Compound), allowing power factor regulation for synchronous motors and reactive droop compensation for parallel operated generators or speed regulation for DC motors.

Trips: Oversensing (main variable), Oversensing (secondary variable), Overtemperature, Loss of signal and Surge Overcurrent on IGBT (optional).

- **Indicators:** Power On, Enable, Droop, Signal Loss, Oversensing main, Oversensing secondary, Overtemperature, and Surge Overcurrent on IGBT.

Function Selections: 8 Digital Switches (DIP Switchs).
Bridges: 3Phases or 2Phases, fully controlled Tyristor Bridge or 3Phase Diode Bridge plus Step Down Chopper.

Synchronous Motors:

• **Field Current Regulator or Power Factor Regulator for Brushless Synchronous Motors or Auxiliary Rotary Exciter to 50 Amperes field current, or Static Exciters for Collector Ring type Synchronous Motors to 2000 Amperes field current:**

This mode allows regulations of the excitation current and/or the polar angle (power factor) at the set point. The regulation can be done by closed loop constant current or with droop by Polar Angle (Power Factor) or by pure closed loop power factor regulation. The possibility of maintaining both loops closed, with an adjusted percentage of compounding allows for stable operation. It is difficult to achieve stability in regulators with only P.F. regulation mode. The Power Factor is digitally measured, by means of signals from a P.T. and a C.T. in the stator circuit or by an external transducer like the GE Multilin SPM.
The regulation can be selected for "Constant Field Current", "Field current regulation with Reactive Droop Compensation" (or "Constant Power Factor if Droop is settled to 100%").
The protection functions "Loss of Signal", "Field Overcurrent" and "Exciter Overtemperature" are active in this mode.
Some parameters can be adjusted on the front panel: Proportional gain (P - a pure proportional action), Integration time (I - a integration time action), Derivative time (D - a pure derivative action), Current or Power Factor scale and Droop percentage of Droop from 0 to 100%.
In this application, with a Collector Ring motor or Brushless Motor with Varixx M1 type "Control Box" inside, the field is applied near the end of the starting period. For a brushless motor with Varixx "Control Box" type M2 inside, the field can be applied at the beginning of the starting period.
The discharge resistor (shunt resistor) must be applied during the whole starting time (in Collector Ring type motors) by a contactor or by a special Crowbar from Varixx. The Crowbar is much more reliable (the possibility of a nom application of the resistor is virtually none).
The power module is connected to an exciter transformer that provides insolation and an appropriate voltage to get the correct field ceilling voltage (Compliance).

Generators:

• **AVR (Automatic Voltage Regulator): Voltage Regulator for brushless generators or generators with external auxiliary rotating exciter to 50 amperes field current or Static Exciter for collector ring type generators to 2000 Amperes field current:**

This mode allows a constant voltage to be kept at the generator output and it allows for reactive current compensation in parallel operated generators for KVAR sharing with other machines or with the electrical supplier network. The reactive load sharing is achieved by the "Droop" method based in the measured machine's Power Factor.
The power factor is digitally measured, by means of signals from a P.T. and a C.T. in the stator circuits or by an external transducer, like the GE Multilin SPM model. In both cases the Droop rate can be adjusted from 0 to 10%.
The regulation can be selected by an external command, for "Constant Voltage" or "Compound Voltage with Reactive Droop Compensation".
The protection functions "Loss of Signal", "Generator Overvoltage" and "Exciter Overtemperature" are active in this application.
Some parameters can be adjusted on the front panel: Proportional gain (P - pure proportional action), Integration time (I - a integration time action), Derivative time (D - pure derivative action), Voltage scale or Power Factor scale and Droop percentage from 0 to 10%.
Automatic Build Up with manual enabling is available in this mode.

Rectifiers:

• **Voltage or Current Regulator for Air-cooled Rectifiers to 2000 Amperes or Water-cooled Rectifiers to 50000 Amperes for electrolyses (for hydrogen production), chemical cells, aluminum reduction, galvanic metal deposition, Industrial rectifiers and others:**

Thes mode allows the output voltage or current to be kept stable even in the presence of variations of the load or line.
The mode can be selected to constant current, constant voltage or compounded.
The protection functions "Loss of Signal", "Overcurrent" or "Overvoltage" and "Exciter Overtemperature" are active in this mode.
Some parameters can be adjusted on the front panel: Proportional gain (P - a pure proportional action), Integration time (I - a integration time action), Derivative time (D - a pure derivative action), Voltage scale or Current scale and Droop percentage.
Additionaly, rising and falling ramps can be generated by external accessories such as a programmable digital potentiometer from Varixx.
The complete rectifier in a metallic panel can be combined with PLC for control and fault memorization, circuit breakers, fuses, cooling systems with valves, heat exchangers, pumps and other protection relays such as flux relay, pressure relay and so on. Varixx is able to construct rectifiers to 150.000 Amperes.

CC Motors:

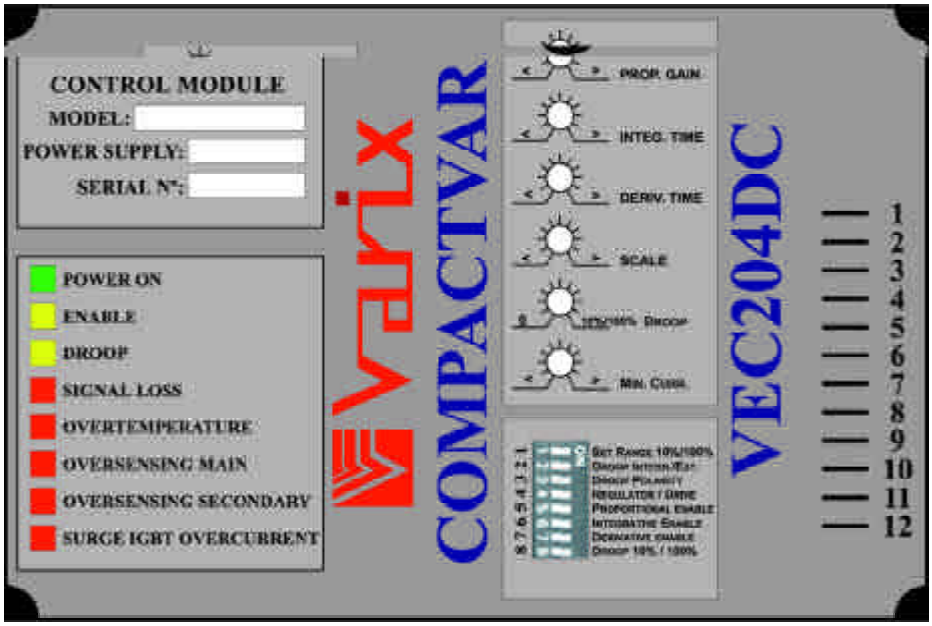
Simple AC/DC Drive, for one quadrant DC motor speed control. Applied in process that does not need braking or inversion of rotation direction.

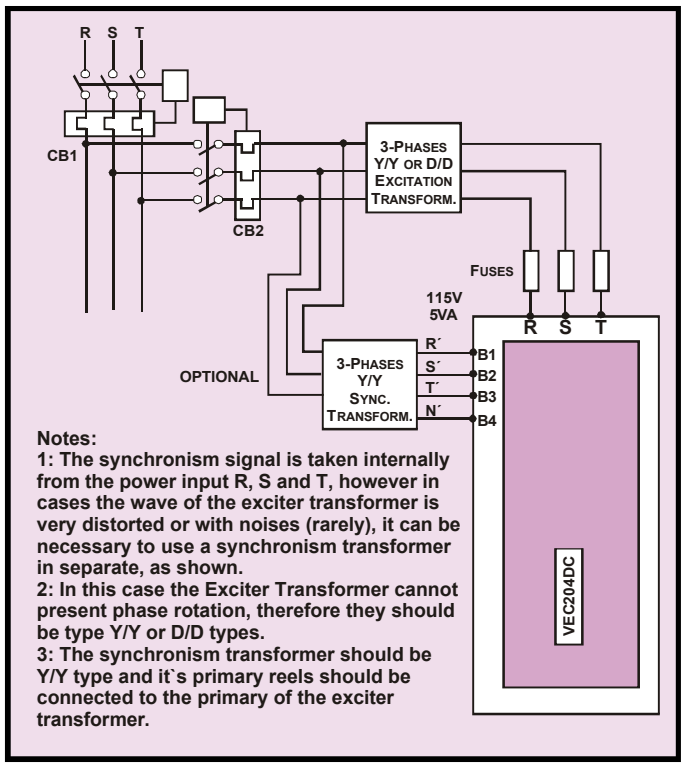
This regulator is optimized for use in Synchronous motors excitation, so in this mode of use a restricted set of of resources are usesd to keep the motor current/speed at a constant set point.
The speed is sensed by a feedback signal provided by a tachogenerator or DC transducer.

The regulation mode is by speed closed loop plus current closed loop to achieve stability.
The protection functions “Loss of Signal”, “Overcurrent” or “Overspeed” and “Drive Overtemperature” are active in this mode.

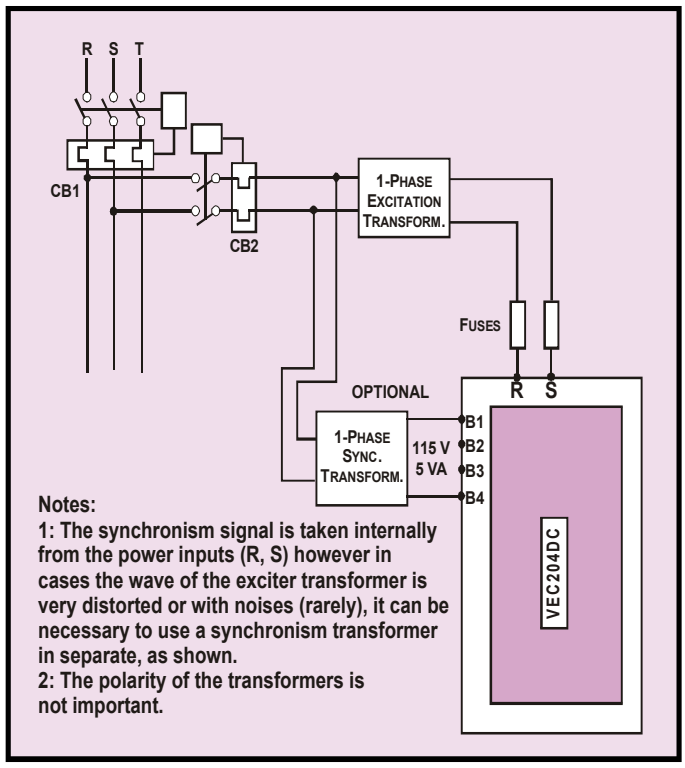
	STATIC EXCITER TYPE PHASE ANGLE WITH THYRISTOR BRIDGE						
Models VEC204D	Nominal Current (A)	Maxim. Current (1min) (A)	Surge Current (10 mS) (A)	Fan Forc./ Natural	Wide (W) mm	High (H) mm	Long (L) mm
0025	25	75	350	N	225	290	200
0050	50	150	700	N	240	290	270
0100	100	300	1900	F	290	290	270
0150	150	450	3600	F	340	290	270
0200	200	600	5200	F	377	290	270
0250	250	750	5200	F	377	330	270
0300	300	900	6600	F	377	380	300
0400	400	1200	8000	F	377	430	300
0500	500	1500	8000	F	377	480	300
0650	650	1950	12500	F	377	530	330
0750	750	2250	14500	F	377	580	330
1000	1000	2800	14500	F	540	850	315
1250	1250	3250	15000	F	540	850	315
1500	1500	3750	19000	F	540	950	315
1750	1750	4375	19000	F	800	800	390
2000	2000	5000	30000	F	800	900	390

	PWM TYPE STATIC EXCITER WITH IGBT STEP DOWN CHOPPER						
Models VEC204D	Nominal Current (A)	Maxim. Current (1min) (A)	Surge Current (10 mS) (A)	Coolin. Forc./ Natural	Wide (W) mm	High (H) mm	Long (L) mm
0025	25	50	100	N	225	300	200
0050	50	100	200	N	240	290	270
0100	100	200	400	F	290	290	270
0150	150	300	600	F	340	290	270
0200	200	400	800	F	377	280	270
0250	250	500	1000	F	377	330	300
0300	300	600	1200	F	377	380	300
0400	400	800	1600	F	377	430	300
0500	500	1000	2000	F	377	480	300





Notes:
1: The synchronism signal is taken internally from the power input R, S and T, however in cases the wave of the exciter transformer is very distorted or with noises (rarely), it can be necessary to use a synchronism transformer in separate, as shown.
2: In this case the Exciter Transformer cannot present phase rotation, therefore they should be type Y/Y or D/D types.
3: The synchronism transformer should be Y/Y type and it`s primary reels should be connected to the primary of the exciter transformer.



Notes:
1: The synchronism signal is taken internally from the power inputs (R, S) however in cases the wave of the exciter transformer is very distorted or with noises (rarely), it can be necessary to use a synchronism transformer in separate, as shown.
2: The polarity of the transformers is not important.

DIP Switch selections:

- **S1- "Setting Range 10%/100%":** Selects setting range: narrow or wide.
- **S2- "Droop Internal/External":** Selects the power factor transducer source for the "Droop" signal.
- **S3- "Droop Polarity":** Selects the polarity actuation of the Droop signal (internal or external).
- **S4- "Regulator / Drive":** When "OFF" the "Normal" mode is selected, with regulation based on the error signal. When "ON" the "Drive" mode is selected and the output is proportional only to sthe set point signal (reference). In this case there is not a closed loop and the equipment is simply a Drive for external regulators or manual adjustment.
- **S5- "Proportional Gain":** Enables the pure proportional gain error amplifier. The value is adjusted on the front panel for the best response, without oscillations and with minimum overshoot and undershoot. It is used in almost all applications.
- **S6- "Integrative Time":** Enables the I portion of the error amplifier. The integrative time is adjusted in the front panel for the best stability, to get the minimum overshoot, undershoot and the fastest reaction time possible. Usually it is used in almost all applications.
- **S7- "Derivative Time":** Enables the pure derivative gain error amplifier. The value is adjusted on the front panel for the fastest reaction time, but without oscillations and to get the minimum overshoot, and undershoot possible. It is used in very few applications.
- **S8- "Droop Scale 10% / 100%":** When "OFF" the 10% scale is selected for use with generator Droop (for reactive load sharing). When "ON" (100%) the 100% scale is selected for use with synchronous motors (for constant power factor regulation) or DC motors (for speed regulation).

LED indicators:

- **L1- "Power ON":** (Green) - Indicates that the equipment is powered ON.
- **L2- "Enable":** (Yellow) - Indicates that the equipment is enabled by a signal at the corresponding connector.
- **L3- "Droop":** (Yellow) - Indicates that there is a Droop command at the corresponding connector.
- **L4- "Signal Loss":** (Red) - Indicates "Loss of Signal" (set poit signal loss). This function is enabled by the enable signal at the corresponding connector. The condition is maintained (memorized) until a "Reset" signal or power down occurs or the "Enable" is inhibited.
- **L5- "Overtemperature":** (Red) - Indicates an overtemperature condition at the power devices heater exchange.
- **L6- "Main Oversensing Trip"** - (Red): Indicates a trip by excess in the primary variable at connector 6. The trip condition is maintained (memorized) until a Reset signal or power down occurs or the "Enable" is inhibited.
- **L7- "Secondary Oversensing Trip"** - (Red): Signalizes a trip by excess in the secondary variable at connector 5. The trip condition is memorized until a Reset signal, inhibition or power down occurs.
- **L8- "Surge overcurrent on IGBT"** - (Red) - Only utilized on the PWM Step Down Chopper Type. Indicates (do not inhibits output) a surge overcurrent on the IGBT. It is auto resetable on pulse by pulse base.

Note: All protection functions from L4 to L7 have a 0.25 second time delay to avoid erroneous tripping.

Frontal Adjustments:

- **P1- "Proportional Gain":** adjustable from 0 to 100% of the factory predefined value. Active if selected at the corresponding DIP switch. As this is a pure proportional amplifier, the adjustment mainly influences the dynamic regulation. It must be adjusted to get the fastest compensation for input changes but without instability.
- **P2- "Integration Time":** This is a integrative gain amplifier adjustable from 0 to 100% of the factory predefined value. Active if selected at the corresponding DIP switch. It must be adjusted to get the best stability possible with minimum overshoot and undershoot. This portion of error amplifier is mainly responsible for the static regulation and it must be selected in almost all cases.
- **P3- "Differentiation Time":** adjustable from 0 to 100% of the factory predefined value. Active if selected at the corresponding DIP switch. It allows a fast compensation of dynamic variations. Normally utilized for generators with slow response time. It must be adjusted to get the fastest response and the best stability. This portion of error amplifier is mainly responsible for dynamic regulation.
- **P4- "Scale":** "End of Scale" calibration if a 100% scale is selected at DIP switch S1, or calibration of the nominal value for mid- scale (if 10% selected at DIP S1).
- **P5- "Droop":** Adjustable from 0 to +10% Droop if DIP switch S8 is 'OFF". A 10% compounding rate results with 90º lagging or leading polar angle of synchronous motors and generators rotors. If DIP switch S8 is "ON" the adjustment is from 0 to 100% from the feedback signal for the synchronous motor power factor or the DC motor speed. Normally used from 0 to 5% for parallel operating generators and from 50% to 80% for synchronous motors to get constant power factor operation, maintaining the current closed loop, for stability. For DC motors with tachometer feedback it is usually set from 50% to 80% due to the same reason.
- **P6- "Minimun Current":** Used mainly in synchronous motors application, it avoids that the excitation current can drops bellow the preset value, avoiding that the motor de-synchronize.

Control Module Electrical Data:

The side table shows the electrical data of the inputs and outputs of the control module, for both connectors (the front connector and the rear side DB15 connector).
Also the signals connected to the power module are shown.
The chosen order of some signals allows the various options to be shown separately. Each piece of equipment comes with a customdata sheet filled in with the actual data type and values. The custom data sheet also shows other important information including signals, date of delivery, guarantee period, input and output data etc. The user's manual includes this bulletin, electrical drawings, mechanical drawings, Start Up instructions and the custom data sheet.

	CONNECTOR	Signal Type	Minim.	Nominal	Maxim.	Units
Top Connector						
Set Point Opt 1 (V/Pot)	4 / 3	Input Voltage	0	--	5	V DC/10 K Ohm
Set Point Opt. 2 (V/Pot)	4 / 3	Input Voltage	0	--	10	VDC/10 K Ohm
Set Point Opt. 3/4 (I)	4 / 3	Input Current	0/4	--	20	mA (250 Ohms)
Droop Signal Opt. 1	5 / 3	Input Voltage	0	--	5	VDC (10 KOhm
Droop Signal Opt. 2	5 / 3	Input Voltage	0	--	10	VDC(10 K Ohm
Droop Signal Opt. 3/4	5 / 3	Impedance		250		Ohms
CT Fase S (P. F. Sensing)	7 / 3	Input Current	15	100	1000	mA (250 Ohms)
Sense Input Opt. 1	6 / 3	Input Voltage	—	5	—	Volts
Sense Input Opt. 1	6 / 3	Input Impedance	—	10 K	—	Ohms
Sense Input Opt. 2	6 / 3	Input Voltage	—	10	—	Volts
Sense Input Opt. 2	6 / 3	Input Impedance	—	10 K	—	Ohms
Sense Input Opt. 3/4	6 / 3	Input Cur./Imped.	0-4/250		0-4/250	mA/Ohms
Enable Input	8 / 3	Current Source	—	10	—	mA DC
Droop Input	9 / 4	Current Source	—	10	—	mA DC
Reset Input	10 / 3	Current Source	—	10	—	mA DC
Fail Relay Contact	11 / 12	Voltage	—	—	240	VAC
Fail Relay Contact	11 / 12	Voltage	—	—	30	VCC
Fail Relay Contact	11 / 12	Current	—	—	1	A AC
Fail Relay Contact	11 / 12	Current	—	—	0,25	A CC
Power Supply Input	1 / 2	Voltage	92 / 176	115 / 220	138 / 264	V AC
Power Supply Input	1 / 2	Power	—	6	—	Watts
DB25 Connector						
Firing Signal/Commom	DB10 toDB15 / DB9	Output Volt	10	11	12	Volts DC
Firing Signal	DB10 toDB15 / DB9	Output Current	—	—	20	mA DC
+ V Output (p/IGBT)	DB3	Source V / I	—	—	12 / 50	VCC / mA CC
IGBT O. C. Input (Fail)	DB4	V / Impedance	—	12 / 10 K	—	V / K ohm
Over Temp. SPST	DB2 - DB5	V / I	—	10 / 5	—	V DC / mA CC
Sensing Phase RT	DB1 - DB5	V / Impedance	10 / 10K	—	50 / 10K	V DC / Ohms
Synch / Common	DB 6/7/8 - DB5	Input Voltage	10	20	28	V AC
Synch / Common	DB 6/7/8 - DB5	Input Impedance	—	15K	—	Ohms
Power Module						
Sensing Phase RT	B9 / B10	Voltage / Power	60 / 3	115 / 3	150 / 3	Volts / VA
Build Up Enable	B7 / B8	Voltage / Curr.		12 / 30		VCC / mADC
Opt. Synch Signal	B1 / B2 / B3 / B4	Voltage	60	115	150	V AC / 3 Watts
Fan Power Supply	B5 / B6	Voltage	92 / 176	110 / 220 see Tag	138 / 264	V AC

Special Adjustment for Synchronous Motors Application.

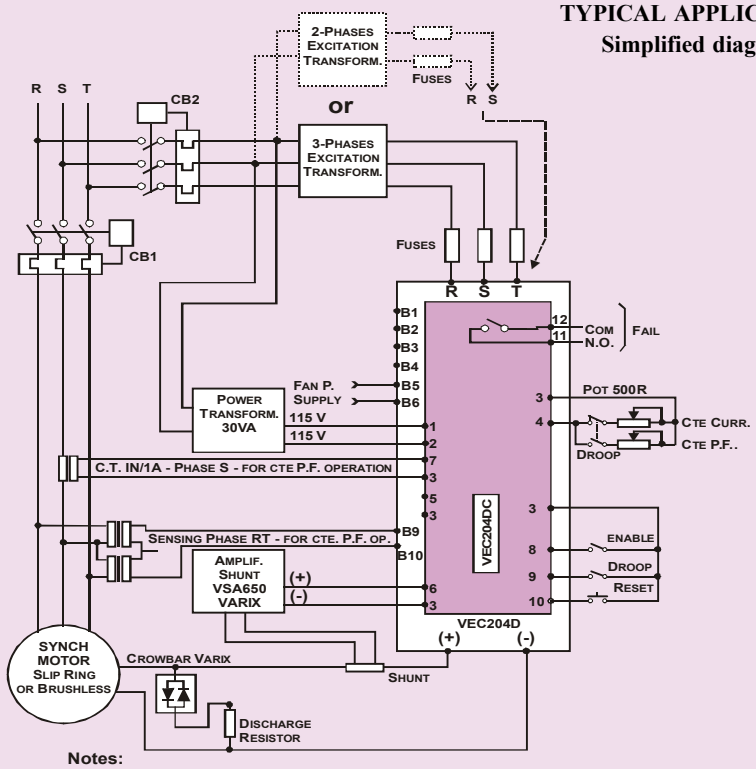
The control module has in its posterior part, an adjustable potentiometer (trimpot), placed exactly in this part by precaution. This trimpot is to adjust the minimum current that the exciter can supply to load and it is very important for application in synchronous motors with operation in "Constant Power Factor" mode. In this application, case the motor has a very variable or pulsed load, in the moment of a sudden retreat of the load, the exciter, in the attempt of compensating the power factor, would totally remove the excitation for some instants, what would take the motor to lose the synchronism (Step Out). This way the exciter, in this application mode, should be adjusted to supply at least a minimum current that doesn't take the motor to de-synchronize with no load or light load. This trimpot is only adjusted once, during the start up. To adjust it, disconnects the control module of the power module and adjust it at 30% of the scale for example. Test the equipment with motor stopped and with the current set point adjusted to minimum. Readjust the trimpot until get the requested current.

FUNCTIONS FOR EACH APPLICATION TYPE:

The side table shows the functions available to each application, with the type of action (selection or adjustment) and the range of adjustment.
When a trip occurs, the output will be inhibited, the LED will be lit and the trip relay will be energized.
There is a time delay of 0.5 seconds for the effective actuation of the protection.
The error amplifier is a selectable P + I + D type. This way it can be adapted to virtually any application because of its versatility. The user can select and adjust the response types needed.
The second portion, the "I" error amplifier, is mainly responsible for the static regulation. Its Integration time is adjustable from 0 to 100%. This portion of error amplifier needs to be selected in almost all applications.
The first portion of the error amplifier is a pure proportional gain amplifier and it is mainly responsible for dynamic regulations. It is usually used in almost all applications, to improve the system response time and obtain fast corrections. It must be adjusted to avoid instability and yet get fast response time with low overshoot and undershoot.
The third portion of the error amplifier is a pure derivative gain amplifier and it is mainly responsible for dynamic regulations. It is necessary in a very few applications, to increase the stability and obtain fast corrections. It must be adjusted as low as possible for stability and better response time.

FUNCTIONS	SYNC MOTOR	GENERATOR	RECTIFIER	DC MOTOR	
	Type / Default	Type / Default	Type / Defaut	Type / Default	Opt./Selec./Adj
0 TO 10 VOLTS SET	Option	Option	Option	Option	Opt.
0 TO 5 VOLTS SET	Option	Option	Option	Option	Opt.
0 OR 4 TO 20 MA SET	Option	Option	Option	Option	Opt.
POTENTIOMETER SET	Option	Option	Option	Option	Opt.
10% / 100% SET (SEL. / ADJ.)	0 - 10% / 0 - 100%	0 - 10%	0 - 100%	0 - 100%	S1
PROPORTIONAL GAIN	Adj. 1 - 50	Adj. 1 - 50	Adj. 1 - 50	Adj. 1 - 50	P1 / S5 ON
INTEGRATIVE TIME	Sel./ 0 / 0.01-1S	Sel./ 0 / 0.01-1S	Sel./0/0.01-1S	Sel./0/0.01-1S	P2 / S6 ON
DERIVATIVE TIME	Sel./ 0 / 0.01-1S	Sel./ 0 / 0.01-1S	Sel./0/0.01-1S	Sel./0/0.01-1S	P3 / S7 ON
VOLTAGE REGULATION	N.U.	Option	Option	N.U.	Opt.
CURRENT REGULATION	Option	N.U.	Option	Option	Opt.
REACIVE DROOP COMPENSATION	Sel./Adj. 0 to 100%	Sel./Adj.0 to 10%	N.U.	N.U.	P5 / S8
POWER FACTOR REGULATION (INTERNAL / EXTERNAL)	Sel./Adj. 0 to 100% Compound w/ Curr.	Sel./ Adj. 0 to100% Compound w/ Volt.	N.U.	N.U.	P5 / S8
SCALE ADJUST	+/- 10%	+/- 10%	+/- 10%	+/- 10%	P4
DROOP INTERNAL / EXTERNAL	Select	Select	Select	Select	S2
DROOP POLARITY	Select	Select	Select	Select	S3
REGULATOR/ DRIVE OPERATION	Select	Select	Select	Select	S4
DROOP RANGE	Select /Adjust 0 - 10% / 0 - 100%	Select /Adjust 0 - 10% / 0 - 100%	Select /Adjust 10% / 100%	Select /Adjust 10% / 100%	P5 / S8
SIGNAL LOSS	OK	OK	OK	OK	L4
OVER SENSING TRIP	Select / 120%	Select / 120%	Select / 120%	Select / 120%	S2 / L4
OVER TEMPERATURE TRIP	90º C	90 C	90º C	90º C	L5
SURGE IGBT OVER CURRENT	Option.	Option.	Option.	Option.	L8
POWER ON INDICATION	OK	OK	OK	OK	L1
ENABLE INDICATION	OK	OK	OK	OK	L2
DROOP INDICATION	OK	OK	OK	OK	L3
FAIL INDICATION	OK	OK	OK	OK	L4/L5/L6/L7
TRIP INDICATION	OK	OK	OK	OK	L8

TYPICAL APPLICATION
Simplified diagram

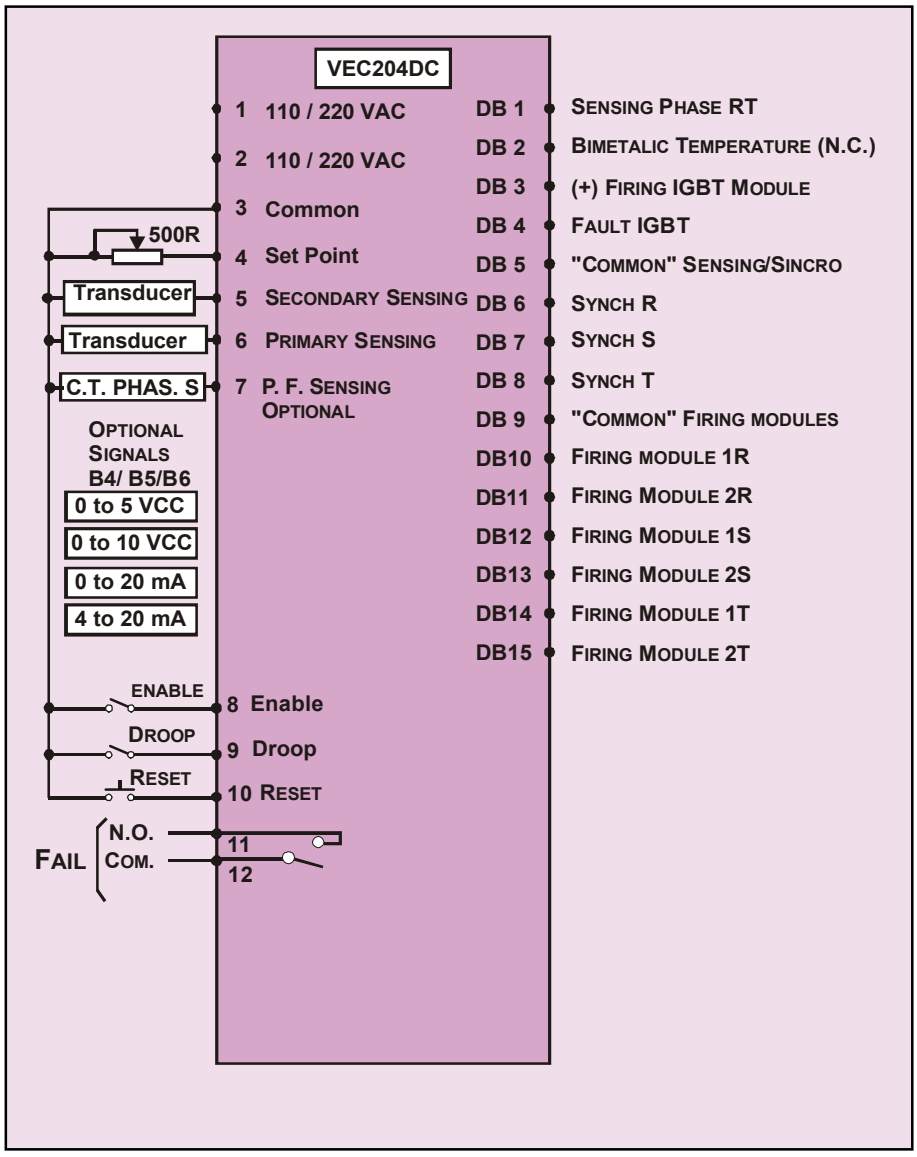


Notes:
1: All Wires to connector 3 (Common) must be connected straight to it.
2: For 2-Phases Excitation Transformer / P.M.G. or CC P.M.G. it is necessary the use off the PWM model.
3: For 3-Phases Excitation Transformer / P.M.G. both types could be used (PWM or Phase Angle).

CONTROL MODULE VEC204DC

The side drawing shows the connections to the top connector and rear connector (DB15) of the VEC204DC.

The connectors 1 and 2 are plugged to the command power supply of 110 or 220 VAC depending on the model.
Connector 3 is the common connector for all the inputs.
Connector 4 is the set point input. This input can be chosen when ordering (0 to 5 VDC or 0 to 10 VDC or 500 ohms digital scale potentiometer, 0 to 20 mA or 4 to 20 mA).
Connector 6 is the input for the primary variable or main variable (equal signal options). This signal can be provided by an insolated shunt amplifier, a hall sensor, a voltage transducer, etc.
Connector 5 is the secondary input signal or Droop signal (equal signal options). This signal can be provided by a Power Factor Transducer (Ex: GE-Multilin SPM model), Hall Effect sensor, tachogenerator, etc.
Connector 7 is the input for an optional current transformer for power factor sensing (Polar Angle sensing) for synchronous motors and generators (for internal power factor transducer). The voltage phase is measured at connector B9 and B10 of the power module and routed to connector DB1 and DB5 of control module; in this way the C.T. must be on the cable corresponding to connector B2 (the middle cable). The DIP switch S2 selects one of the transducer, external or internal.
The connector 8 is the input for a dry contact for the "Enable" command.
Connector 9 is the input for a dry contact for the "Droop" command.
Connector 10 is the input for a dry contact for the "Reset" command. When a trip occurs, the condition is maintained until a Reset signal or power down occurs, or the enable is inhibited.
Connectors 11 and 12 are the N.O. Dry contacts of the fail indication relay.
DB1 is the input for sensing RT phase for the internal Power Factor Transducer (common at DB5).
DB2 is the input for a N.C. dry contact of a temperature sensor.
Connectors DB3 and DB4 are used for connection of an optional IGBT firing module (only in models with PWM chopper control). DB3 is the +V supply and DB4 is the input for an overcurrent trip signal from the IGBT firing module.
Connectors DB5 to DB8 are the inputs for synchronizing signal. Connectors DB9 to DB15 are the outputs for the thyristors firing modules (DB10 to DB15) or the IGBT (DB10 and DB11).
The Control Module and the firing modules are fully encapsulated with high insolation epoxy resins. (20000 V/mm).



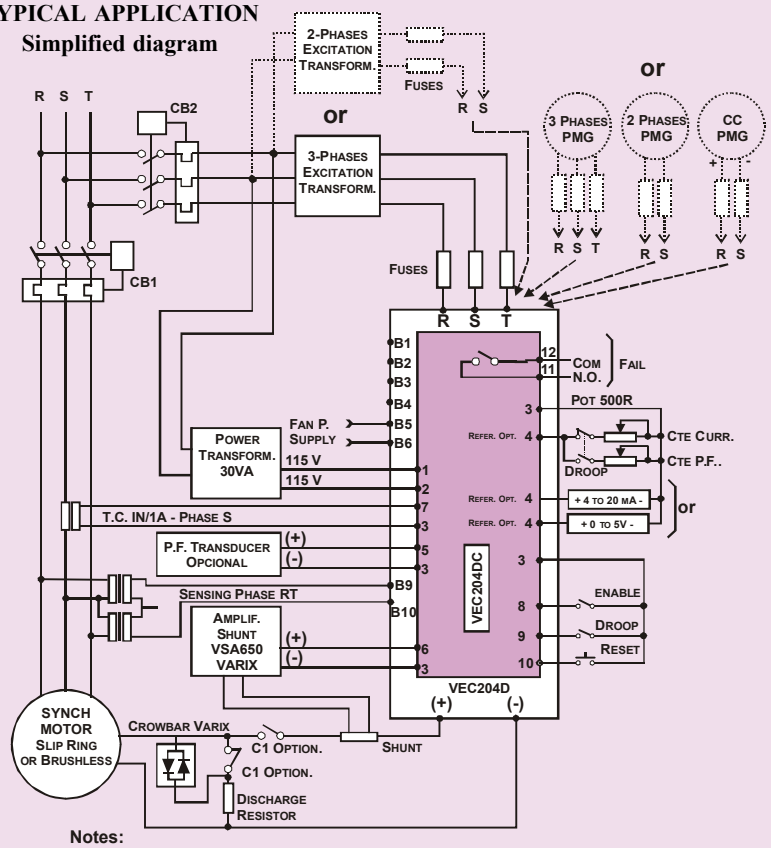
Synchronous Motor Exciter:

This application is for all types of synchronous motors: "Collector Ring", "Brushless" or "Collector Ring with Auxiliary Rotary Exciter".

Important Points for Wiring and Start Up:

- Selects the DIP for synchronous motor as shown at table. Normally S1 ON, S4 OFF, S5 OFF, S6 ON, S7 OFF, S8 ON, S2 and S3 as required.
- The excitation transformer must have an adequate power rate.
- The fuses must be ultra-fast types with adequate i^2T (see custom data sheet).
- The synchronism for firing tyristors is taken internaly from power inputs, but there are an optional input for external synch at the connectors B1, B2, B3 with common at B4, for cases that the signal at power imputs are too dirty. The secondary voltage must be according to the data table. Normally not used.
- The C.T. for power factor sensing must be on the correct motor power cable.
- The C.T. must have a secondary rating of maximum 1 Amperes and minimum 15 mA. A C.T. with secondary rate of 5 Amperes will damage the module.
- If the user chooses to use an external transducer for power factor measuring, the transducer must supply the correct voltage to the module, corresponding to total scale from totally inductive to totally capacitive. The center scale voltage must be equal to unity power factor.
- For field current sensing an isolated shunt amplifier can be used with an output corresponding to the scale of the module (VSA605A Varix). It can also be a hall sensor.
- The control signals are commented on the control module drawing sheet.
- For "Collector Ring" motors or "Brushless" motors with M1 type Control Box inside (GE -Varixx), the field must be applied at 95% to 99% of the synchronous speed, preferably with a "Field Application Relay" with polar angle sensing such as the VR 9045A Varix or GE - Multilin SPM model.
- For "Brushless" motors with M2 type Control Box (GE - Varixx) the field can be applied when starting begins.
- At the Start Up, before enabling the Droop/Power Factor, the correct polarity of the signal should be verified. The excitation current can be raised to get a P.F. of 0.85 capacitive. If the voltage is greater than that with unity P.F., the polarity is correct. If not, change the polarity of the C.T. or change the DIP switch S3 (Droop polarity). In normal operation the Droop command must be closed 2 to 5 seconds after applying the field or with the load application command (FCX relay) to avoid overshooting or instability.
- For "Collector Ring" type motors a field discharge resistor (shunt resistor) must be applied during the whole starting period, by a field contactor or by a more reliable "Crowbar" (Varixx).
- B9 and B10 are the connectors for sensing the voltage phase angle (by the internal power factor transducer). They must be connected at the cables which are not used for sensing the current phase angle (the middle cable in this case). The nominal voltage is 115 VAC (60V to 150 V).
- Usually, during the starting period, the mode must be "Constant current". A few seconds after starting the mode can be changed to "Droop". This way overshooting is avoided because during starting period the power factor of motor is near 0,2 inductive.
- For this application adjust the pot P6 to obtain a minimum excitation current (for example 20% of teh nominal) as required, even with the set point at zero.

TYPICAL APPLICATION
Simplified diagram



Notes:
1: The Circuit Breaker CB2 and its connection is not used in case off P.M.G. - Permanent Magnet Generator.
2: IF used with P.M.G. with 2 Phases connect input T together input R
3: Connect Power Input (1 and 2) to P.M.G. if it's voltage range is adequate.
4: The CT and PT at connectors 7/3 and B9/B10 substitutes the Power Factor Transducer at connectors 5/3 for Droop purpose.
5: All Wires to connector 3 (Common) must be connected straight to it.
6: For 2-Phases Excitation Transformer / P.M.G. or CC P.M.G. it is necessary the use off the PWM model.
7: For 3-Phases Excitation Transformer / P.M.G. both types could be used (PWM or Phase Angle).

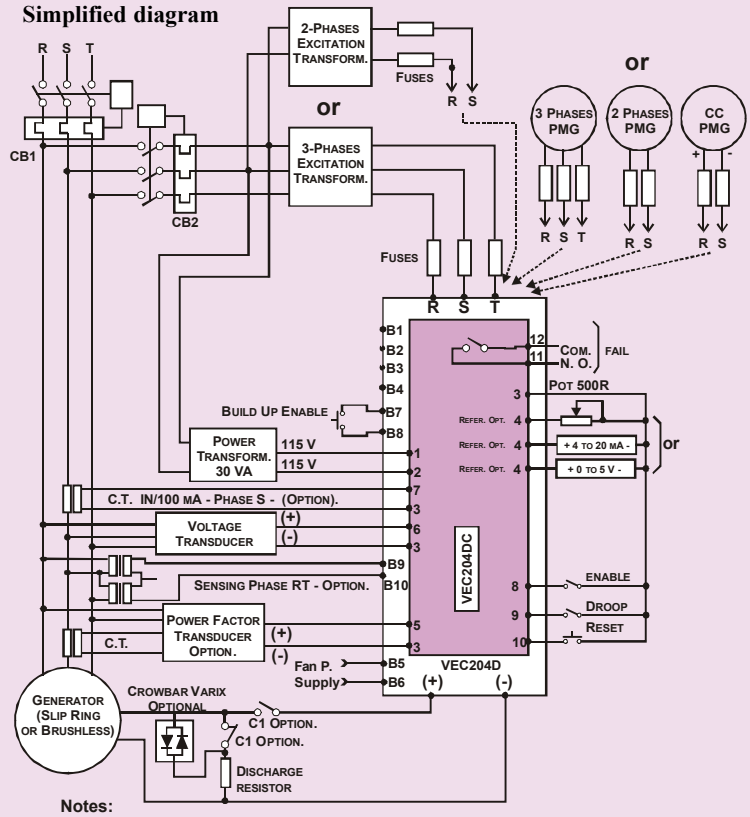
GENERATORS EXCITERS:

This application is for all types of alternators: "Collector Ring", "Brushless" or "Collector Ring with Auxiliary Rotary Exciter".

IMPORTANT POINTS FOR WIRING AND START UP:

- Select the DIP as shown in the table on page I8 for generators. Normally S1 OFF, S4 OFF, S6 ON, S8 OFF, and S2, S3, S5, S7 as required.
- The excitation transformer must have adequate power and voltage to get the correct ceilling voltage.
- The fuses must be ultra-fast types with adequate I^2T (see custom data sheet).
- The synchronism for firing tyristors is taken internaly from power inputs, but there are an optional input for external synch at connectors B1, B2, B3 with comon at B4, for cases that the signal at power inputs are too dirty. The secondary vltage must be according to the data table. Normally not used.
- The C.T. for power factor sensing must be on the correct motor power cable.
- The C.T. must have secondary rating of maximum 1 Ampere and minimum 15 mA. A C.T. with secondary rate of 5 Ampere will damage the module.
- If the user chooses to use an external transducer for power factor, the transducer must supply the correct voltage to the module, corresponding to total scale, from totally inductive to totally capacitive. The center scale voltage must be equal to unity power factor.
- For voltage sensing an insolated transducer cam be used with output corresponding to mid-scale of the module. It is preferable that at nominal voltage of the generator the transducer output is at mid-scale.
- The control signals are commented on control module drawing sheet.
- The excitation must be applied only at nominal speed.
- At the Start Up, before enabling definitively the Droop/Power Factor function, the correct polarity of the signal should be verified. The generator can be inductively loaded to get a P.F. close to 0.80 inductive. Open and close the Droop command. With Droop active the generator output voltage should fall a little. If not, change the polarity of the CT or change the DIP switch S3 (Droop polarity). In normal operation the Droop command must be closed for parallel operation and opened for single operation. This way you get better static regulation in single mode.
Refers to the specific bulletin for parallel operated generators from Varixx.
- B9 and B10 are the connectors for sensing the voltage phase angle (by the internal power factor transducer). They must be connected at the cables which is not used for sensing the current phase angle (the middle cable in this case). The nominal voltage is 115 VAC (60V to 150 V).
- Usually, in single mode operation (not parallel) the mode must be "Constant voltage" (without Droop). This will improve the static regulation.

TYPICAL APPLICATION
Simplified diagram



Notes:
1: The Circuit Breaker CB2 and its connection is not used in case off P.M.G. - Permanent Magnet Generator.
2: The Build Up Enable button is not used in case off use with P.M.G.
3: IF used with P.M.G. with 2 Phases connect input T together input R.
4: Connect Power Input (1 and 2) to P.M.G. if it's voltage range is adequate
5: The CT and PT at connectors 7/3 and B9/B10 substitutes the Power. Factor Transducer at connectors 5/3 for Droop purpose.
6: All Wires to connector 3 (Common) must be connected straight to it.
7: For 2-Phases excitation Transformer / P.M.G. or CC P.M.G. it is necessary the use off the PWM model.
8: For 3-Phases Excitation Transformer / P.M.G. both types could be used (PWM or Phase Angle).

RECTIFIERS:

IMPORTANT POINTS FOR WIRING AND START UP:

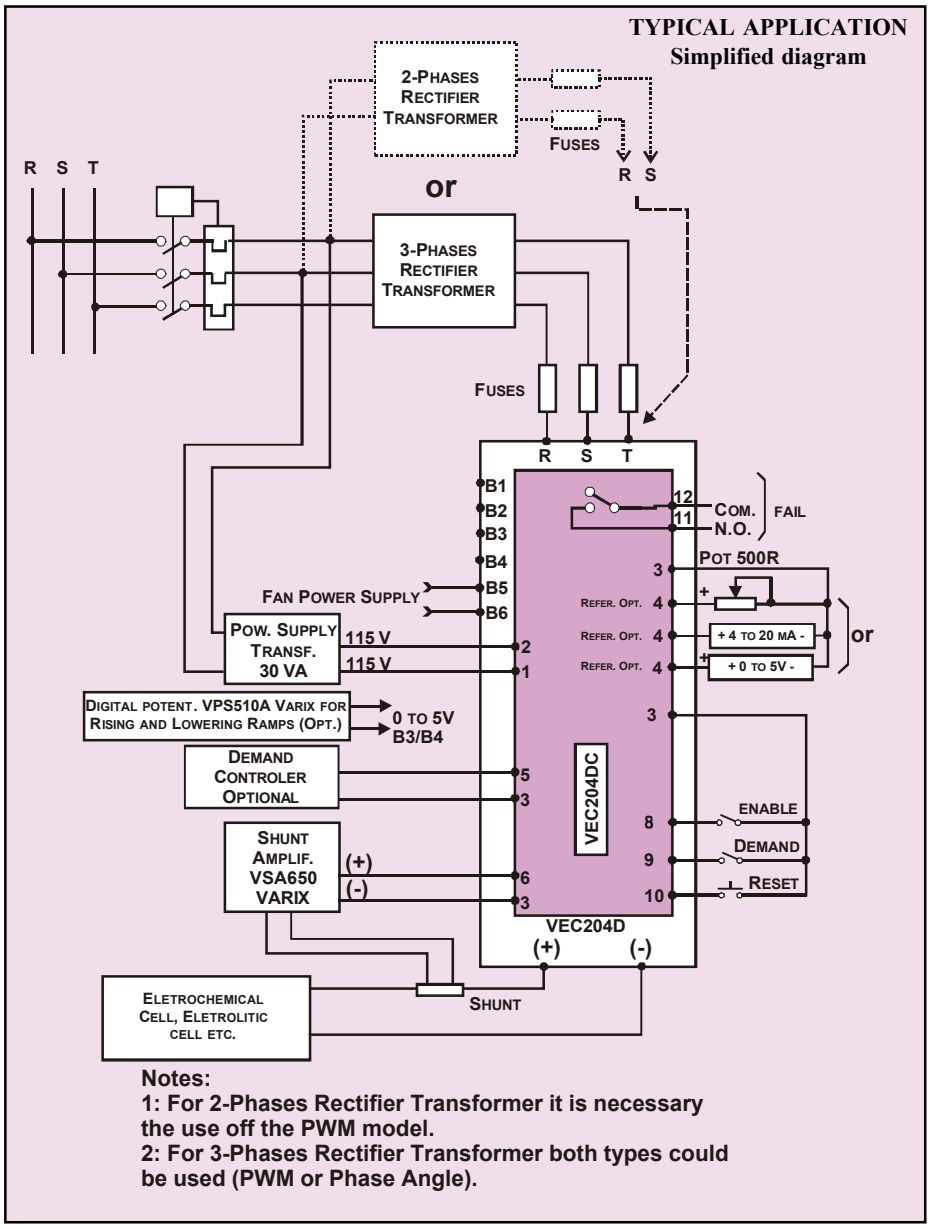
- Select the DIP switch as shown in the table on page I8 for rectifiers. Normally S1 ON, S4 OFF, S5 OFF, S6 ON, S7 OFF, and S2, S3, S8 as required.
- The main transformer must have adequate power and voltage to get the correct compliance.
- The fuses must be ultra-fast types with adequate i^2T (see custom sheet).
- The synchronism for firing thyristors is taken internaly from power inputs, but there are an optional input for external synch at connectors B1, B2, B3 with comon at B4, for cases that the signal at power inputs are too dirty. The secondary voltage must be according to the data table. Normally not used.
- For current sensing an insolated Shunt amplifier can be used or a transducer with an output corresponding to the scale of the module.
- The control signals are commented at the control module drawing sheet.
- For rectifiers that need rising and falling ramps a digital programmable potentiometer can be used (VSP510A Varixx).
- An optional demand control could reduce the output power at hours with an excess of demand power.

Notes:

1- If used for external synch, the Inputs B1, B2, B3 and B4 can be wired to a 3-Phase or Open Delta transformer (B4 at neutral or common of Star) without phase rotation and 115 VAC secondary (model / 1).

2- The Diagram is a simplified version.

3- Is advisable that signal connections be made with shielded cable with the shield connected to connector 3.

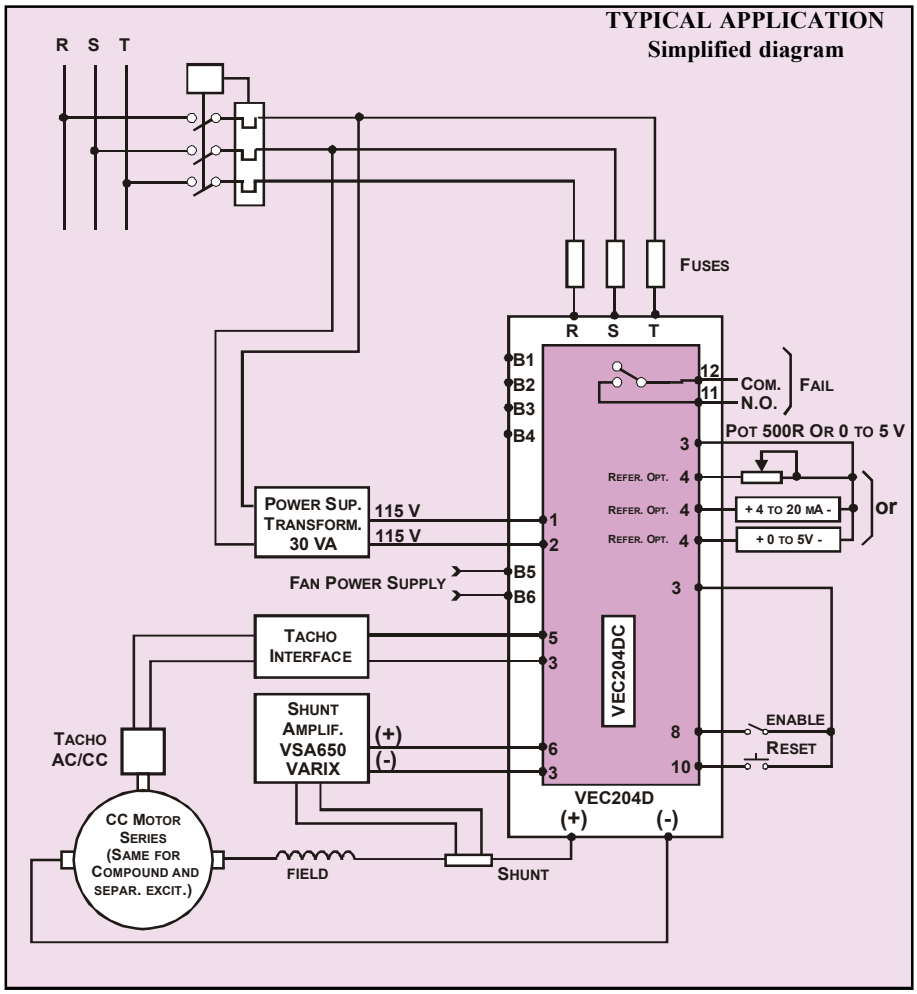


DC Motors

Important points for wiring and Start Up.

- Selects the DIP switchs according to the rectifier table. Normally S1 ON, S4 OFF, S6 ON, S8 ON, and S2, S3, S5, S7 as required.
- All generic recommendations of the other applications are valid.
- The synchronism for firing tyristors is taken internaly from power inputs, but there are an optional input for external synch at connectors B1, B2, B3 with comon at B4, for cases that the signal at power inputs are too dirty. The secondary voltage must be according to the data table. Normally not used.
- The signal provided by a tachometer must have an adequate scale according to the module input scale.
- This application only provides one direction rotation with no braking capabilities (one quadrant).
- The Droop (Compound) adjustment must be between 50% to 80% to get simultaneous current and speed regulation.

Note: This is a side application only, for processes not requiring precise speed regulation. There are more specialized regulators for this kind of use. (With pure speed regulation and current limitation).



Notes:

1- If used for external synch, the Inputs B1, B2, B3 and B4 can be wired to a 3-Phase or Open delta transformer (B4 at neutral or common of Star) without phase rotation and 115 VCA secondary (model /1).

2- The Diagram is a simplified version.

3- It is advisable that signal connections be made with shielded cable with shield connected to connector 3.

Accessories:

- Ultra-fast fuses.
- Power transformers.
- Synchronism and sensing transformers.
- Shunt amplifier: VSA650A (60 mv/5V isolated).
- Digital Potentiometer + servo controller: VSP510A.
- Multi-turn potentiometer panel with digital scale: VP1020E.
- "Field Application Relay": VR9045.
- "Field Ground Fault Relay": VR9030A.
- "Field Overvoltage Relay": VR9031A.
- "Step-Out/Polar Angle Relay": VR9035A.
- "Field Loss Relay": VR9034A.
- Other protection relays.
- Control Box (M1 or M2).
- Crowbar.

Spare parts:

- **Control Module:** VEC204DC/X/X/X/X/X/X.
- **Firing Modules:** VDE115A
- **VV1 and VV2: -** Fans - see custom data sheet at manual.
- **VRN1 and VRN2: -** Thermostats - see custom data sheet at manual.
- **VC12: -** 12 way female connector.
- **VS204/3E**: - synchronism module.
- **VBU200A/xxx:** Build Up Module.

Static Exciter with VEC 204D, for 6000 HP Synchronous Motor

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ORDER CODE

VEC204D/X/X/XXXX/XXX/X/X/X/X

A B C D E F G H

A	POWER SUPPLY	1 = 110 VAC 2 = 220 VAC 3 = OTHER
B	TYPE	F3 = 3-PHASE ANGLE CONTROL F2 = 2-PHASE ANGLE CONTROL P3 = 3-PHASE BRIDGE / PWM P2 = 2-PHASE BRIDGE / PWM
C	CURRENT	NOMINAL CURRENT
D	VOLTAGE	NOMINAL VOLTAGE
E	OPERATION POINT ADJUST	1 = 0 TO 5 VOLTS / POTENTIOMET. 2 = 0 TO 10 VOLTS / POTENTIOM. 3 = 4 TO 20 mA. 4 = 0 TO 20 mA.
F	POWER FACTOR SYGNAL	1 = 0 TO 5 VOLTS / POTENTIOMET. 2 = 0 TO 10 VOLTS / POTENTIOM. 3 = 4 TO 20 mA. 4 = 0 TO 20 mA.
G	CURRENT INPUT SYGNAL	1 = 0 TO 60 mV. 2 = 0 TO 5 VOLTS
H	FAN	0 = W/O FAN 1 = 120 VAC 2 = 220 VAC

EXAMPLE:
VEC204D/1/F3/100/150/1/2/2/0: Synchronous Motor Exciter, 110 VAC Power Supply, 3-Phase Fire Angle Tyristor Bridge, 100 Amper Nominal Current, 150 V Nominal Tension, 0 to 5 VCC / Potentiometer Settling, 0 to 10 VCC Power Factor Signal, 0 to 5 VCC Current Signal Sensing, W/O Fan.

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