

INTRODUCTION

Before installation and operation of the ERC Statohm 5, DC drive, read this instruction manual carefully. Installation should only be done by a fully qualified licensed electrician. The ERC Statohm 5, DC drive is only a portion of a complete drive system. Refer to the instruction manuals of the other components in the system for details about auxiliary equipment and the DC motor. This user's manual does not purport to cover all details or variations of DC drive installation, operation or maintenance.

CAUTION

Before MEGGER or DIELECTRIC testing the DC motor.
 Disconnect the DC motor from the Statohm 5.
 Megger or dielectric testing will damage the semiconductors in the Statohm 5.

Note:

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ERC Statohm 5 DC Drive Common Specifications

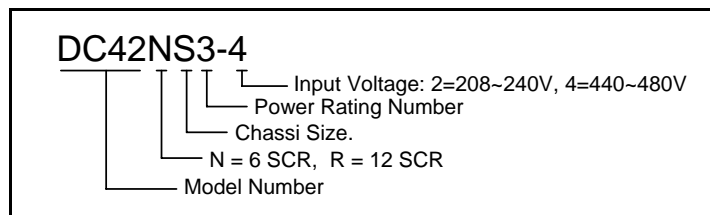
Input Power	3 Phase Input Voltage	200V _{AC} ~ 204V _{AC} or 440V _{AC} ~ 480V _{AC} , Nominal range ±10%
	1 Phase Input Voltage	110V _{AC} ~ 120V _{AC}
	Input Frequency	50 Hz or 60 Hz
Output Power	Armature Starting Amperage & Starting Regenerating Amperage	Adjustable up to 200% for up to one minute (Default is 150%)
	Field	1 phase, SCR phase control, Amperage Regulation Circuit 0.8A ~ 30A.
	Field Economy	When stopped the field is reduced to 1/3, this feature can be disabled.
	Field Weakening	Only for motors with DC tachometers. The field can be reduce down to 1/3 of full field. below 1/2 is not recommend Crossover voltage can be adjusted down to 60% of full armature voltage. Notes: Field Weakening is used to extend speed and / or adjust torque. The crossover voltage is the armature voltage when field weakening begins.
Motor Regulation Features	Speed Regulation	Armature feedback regulation ±2%, Ratio 1:100 DC tachometer feedback regulation ±0.5%, Ratio 1:100 DC tachometers from 18V/1000RPM up to 100V/1000RPM
	Acceleration & Deceleration	0.7 to 120 seconds, each independently adjustable.
	Braking (12 SCR drives only)	Regenerates power to lines
	Amperage Limit (i.e. Current Limit)	Adjustable up to 150%. 12 SCR drives have independent forward and reverse current limits.
Control Input & Output Features	Speed Adjustment (i.e. Speed Reference Signal) (6 SCR drives)	V _{REF} 0 to 8V with internal voltage supply, R _{L(IN)} 100kΩ V _{REF} 0 to 10V, auxiliary voltage supply required, R _{L(IN)} 100kΩ
	Speed Adjustment (12 SCR drives only)	Reverse Terminal (37)
		V _{REF} ±8V with internal voltage supply, R _{L(IN)} 100kΩ
		V _{REF} ±10V, auxiliary voltage supply required, R _{L(IN)} 100kΩ
	Jog	0 ~ 20% of maximum speed, independent acceleration adjustment
	Emergency Stop (E. Stop)	Controlled deceleration or coast to stop.
	PC (i.e. Enable)	Safety feature to detect Pre-operation Conditions are met before the drive is enabled to start.
	Zero speed Detect relay	ZD relay has adjustable trip voltage. SPDT 0.5A / 250V _{AC}
	Fault Trip relay	FT relay, SPDT 0.5A / 250V _{AC}
	Field Loss relay	FL relay, SPDT 0.5A / 250V _{AC}
	Armature Ammeter output	0 ~ 1mA
	Field Ammeter output	0 ~ 1mA
	Speed Meter output	0 ~ 1mA
Master Slave operation	One master drive and one slave drive	
	One master drive and one slave drive with master speed gain	
Fault Diagnosis and Protection	Instantaneous Overload Trip (OC)	ST overload relay (i.e. Shunt Trip) switches at 250% of armature rating, SPDT 0.5A / 250V _{AC}
	One Minute Delay Over Amperage (OL)	150% of the motors' rating was exceeded for more than one minute.
	High / Low Input Voltage (LVL)	±15% of input voltage.
	Phase Error (PH)	Detects connection error of L1S, L2S and L3S.
	Tac Generator Loss (TG)	User has choice of stop or full speed when TG loss is detected.
	Field Loss (FL)	Detects when field current is 13% below normal.
	SCR Thyristor Over Heat (OH)	85°C / 185°F thermostat switches off motor.
Fuse Blown (FU)	Signal light indicates when AC input fuse has blown.	
Environment	Storage Temperature	-40° F to +140° F (-40° C to +60° C)
	Ambient Operating Temperature	-14° F to +104° F (-10° C to +40° C)
	Relative Humidity	95% max., no condensation allowed
	Atmosphere	Avoid iron dust particles and corrosive gases , example: Ocean air.
	Ventilation	Mount in an ventilated enclosure in the lengthwise vertical position with 5" (125mm) of air space on all sides and 2" (50 mm) of air space on front side.

Section 2.1) Receiving & Storage

When you receive the ERC Statohm 5 DC drive, avoid shock or vibration when unloading and transporting the unit. This can damage the semiconductors or other components. Immediately upon receipt, inspect the unit for the following;

- Check to be certain the unit is clean of packing materials. If materials such as plastic or foam will burn if it comes in contact with high voltage, foam sometimes explodes.
- Check for damage incurred during shipment, dents, scratches, ect.
- Inspect mechanical the parts, loose screws, terminals, hinges, ect.
- Inspect the circuit cards, damaged, loose or shorted electronic components or loose plugs.
- If you find damage do not connect power to it. The unit must be replaced or repaired. Connecting power could result in fire or further damage and void the warranty.
- Promptly report damage or problems you found during inspection to Electric Regulator Corp., Telephone (760) 438-7873 or Sales@ElectricRegulator.com
- Store the ERC Statohm 5 in a clean dry place, in the package it was shipped. Avoid storing the unit in a location with high temperatures, humidity, dust or corrosive gases. Outdoor storage is not recommended.

Section 2.2) Model Number Scheme



Section 2.3) Statohm 5 model numbers, ampere and horsepower ratings

Model Number	42NS1-* 42RS1-*	42NS2-* 42RS2-*	42NS3-* 42RS3-*	42NS4-* 42RS4-*	42NM2-* 42RM2-*	42NM3-* 42RM3-*	42NL1-* 42RL1-*	42NL2-* 42RL2-*	42NL4-*	42NL5-*	42NL7-*
Max., Armature Amperes	37A	70A	110A	180A	400A	550A	720A	910A	1100A	1400A	1800A
Input 200~240V, Arm 240V	7 HP	15 HP	25 HP	45 HP	100 HP	125 HP	200 HP	250 HP	300 HP	---	---
Input 440~480V, Arm 500V	14 HP	30 HP	50 HP	90 HP	200 HP	250 HP	400 HP	500 HP	600 HP	750 HP	1000 HP

Section 2.4) Operating Environment

The ERC Statohm 5 DC drive should be located in a operating environment that meets the following conditions.

- Ambient Temperature between 14° to 104° Fahrenheit (-10° to 40° Celsius).
- Relative Humidity Avoid locations exceeding 90% humidity.
- Condensation Do not locate the unit where condensation occurs.
- Corrosion Avoid locations with corrosive gases or liquids; examples: ocean air, ammonia, sulfur.
- Contamination Avoid locations subject to dust or iron particles.
- Hazardous Gases & Liquids Do not locate the unit where it is subject to combustible or flammable gases or liquids.
- Ventilation Mount the unit in a lengthwise vertical position to ensure proper cooling ventilation. Provide not less than 5 inches (125 mm) of clear space on all sides of the unit. If the unit is in a sealed enclosure, provide adequate ventilation for air flow from top to bottom.
- Shock & Vibration Avoid mounting the unit in a location subject to shock or vibration.

Section 3) Power & Control Circuit Wiring Introduction

The ERC Statohm 5 is only one part of an entire drive system. The drive system engineer should supply a wire diagram and/or wire connection net list (i.e. net list) for the drive system's control panel, switch panel, DC motor and other auxiliary equipment.

For easier installation we recommend the power circuit should be installed first and the control circuitry second.

WARNING

Separate over current protection is required by the national electric code. The user is responsible for conforming with the national electric codes and all applicable local codes which govern such practices such as wiring protection, grounding, disconnects and other current protection.

Power Circuit Wiring

NOTICE

Make all power circuit connections in accordance with the drive system engineer's wire diagram or the elementary wire diagrams provided in this manual. The power circuit includes terminals L1, L2, L3, L1F, L2F, L1S, L2S, L3S, A+, A-, F+, F- and 115V.

Section 3.1) AC Power Connections

- View the Wire Size Tables on page 77 and Elementary Wiring Diagrams on the proceeding pages.
- Connect the three phase AC power to the buss terminals marked: L1, L2, L3 and to terminals L1S, L2S, L3S that supply the SYNC card and to L1F, L2F that supply the field.
- Connect the single phase 110 ~ 120 V_{AC} power to the terminals marked L1C and L2C.

Section 3.2) Ground in accordance with national and local electrical codes and regulations.

Section 3.3) Phase Sequence Test

The Statohm 5 PH signal light indicates if the phase of L1, L2 and L3 are in the same sequence as L1S, L2S and L3S.

Switch on the AC power, if the PH light is off the phase sequence is correct. If the PH light is on, the phase sequence is wrong. To correct the phase sequence, switch off the power. Check L1S is connected to buss bar L1, check L2S is connected to buss bar L2 and L3S is connected buss bar L3. If they are correct, check the plugs the synchronization card, View the diagram on page 56.

Section 3.4) Fuse Replacement

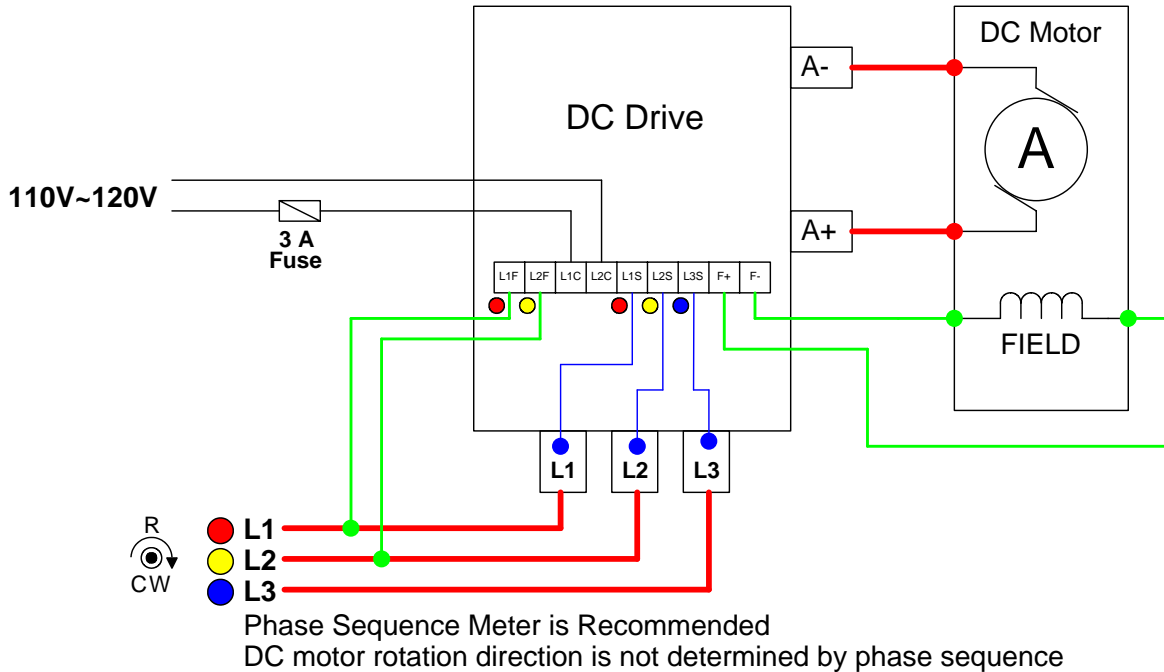
When replacing fuses on the "M3" and "L" model drives, keep the fuse relay # G310000 MS3V 2-5 attached to the side of the fuse. The replacement fuse doesn't include the fuse relay. The fuse relay can be used again. Note: "S" models and the "M2" model don't have fuse relays.

If you can not get replacement fuses from your local electrical supply. Replacement fuses are available from Electric Regulator.

Section 3.5) Standard Power Connections

Not all applications required contactors, the majority of drive systems don't have contactors. If your system requires an AC contactor or DC contactor, see the proceeding pages.

Elementary Power Connection Diagram



Three phase AC power lines and armature power lines are shown in red

Field input power lines and field output power lines are shown in green

Secondary Three phase AC power lines are shown in blue

Single phase 110V~120V power lines are shown in black

WARNING

If the blue lines L1S, L2S and L3S are incorrectly connected in relationship to L1, L2 and L3 will result in the "PH" light on.

IMPORTANT

If the green L1F and L2F are incorrectly connected in relationship to L1, L2 will result in the field amperage not adjusting high enough.

POWER ON SEQUENCE

The main three phase power connected to L1S, L2S and L3S must be on prior to the 110V~120V single phase power, otherwise the low voltage light will be on.

VOLTAGE

Check if the Statohm 5 model number is the right voltage for the three phase input voltage.

The last number in model number indicates the input voltage,

Model numbers ending in 2 indicates 200V~240V three phase input voltage.

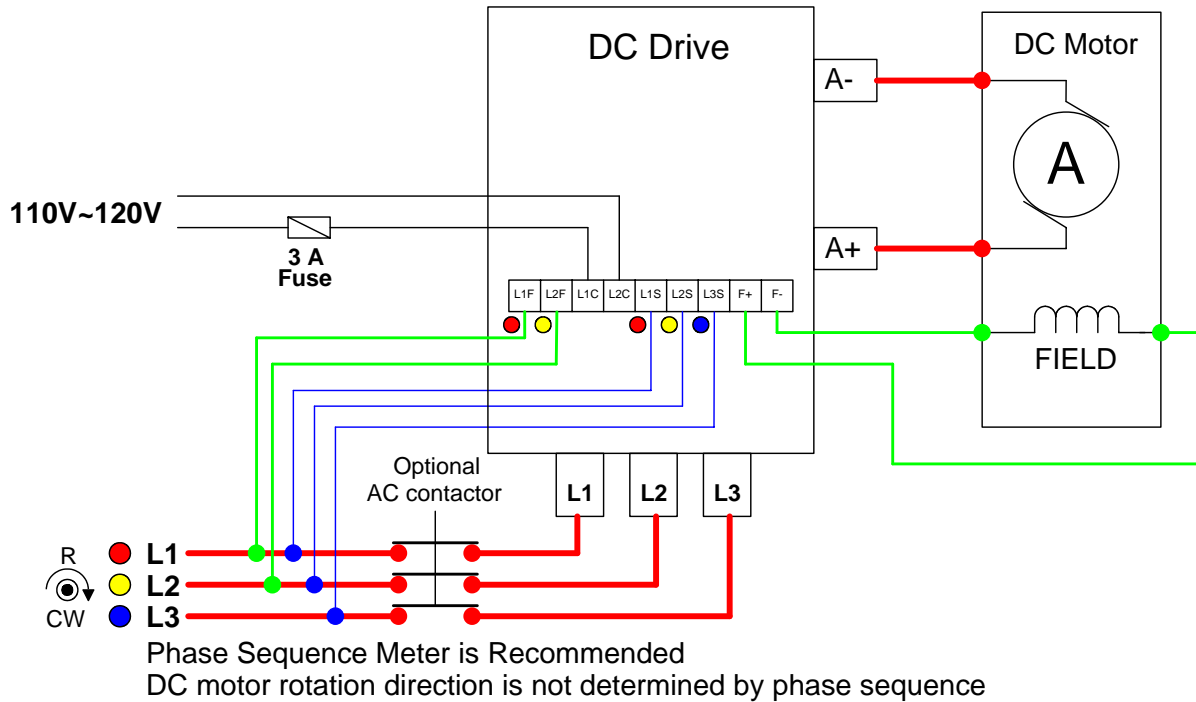
Model numbers ending in 4 indicates 440V~480V three phase input voltage.

Example: Model number 42NM-2-4 input voltage is 440V~480V.

Section 3.6) AC contactor

Not all applications required contactors, the majority of drive systems don't have contactors. Below is a elementary diagram of AC contactor circuit.

Elementary Power Connection Diagram with optional AC Contactor



Three phase AC power lines and armature power lines are shown in red

Field input power lines and field output power lines are shown in green

Secondary Three phase AC power lines are shown in blue

Single phase 110V~120V power lines are shown in black

WARNING

If the blue lines L1S, L2S and L3S are incorrectly connected in relationship to L1, L2 and L3 will result in the "PH" light on.

IMPORTANT

If the green L1F and L2F are incorrectly connected in relationship to L1, L2 will result in the field amperage not adjusting high enough.

POWER ON SEQUENCE

The main three phase power connected to L1S, L2S and L3S must be on prior to the 110V~120V single phase power, otherwise the low voltage light will be on.

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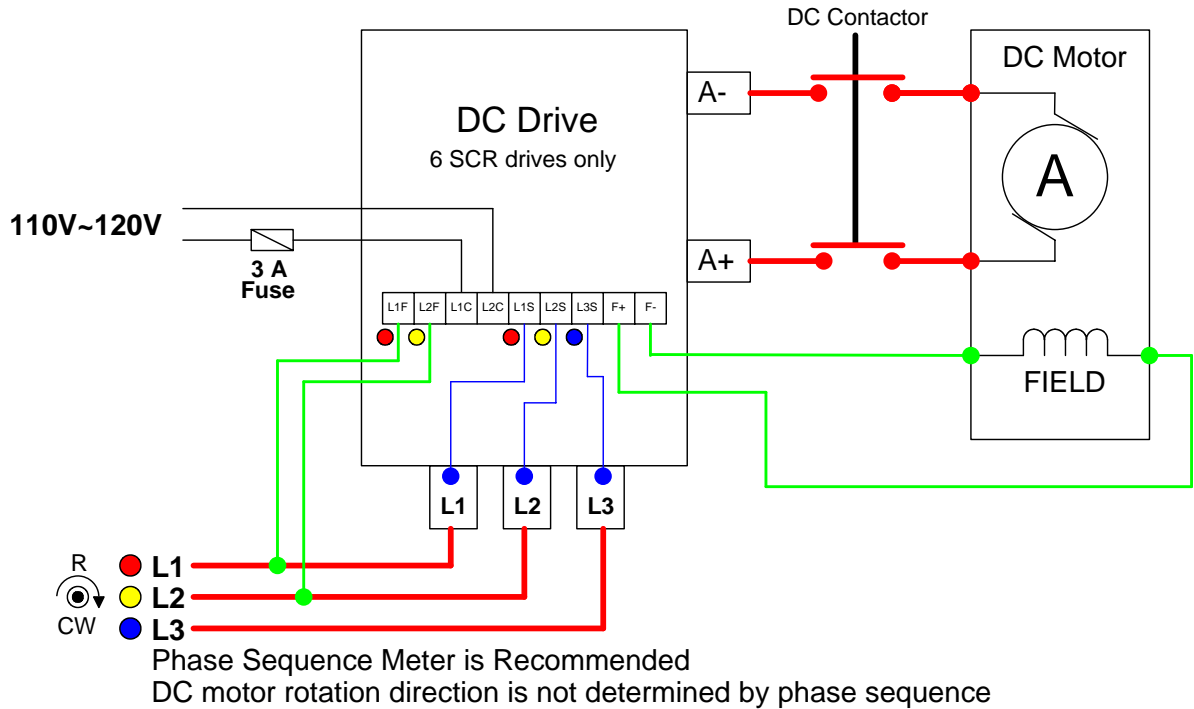
Model numbers ending in 4 indicates 440V~480V three phase input voltage.

Example: Model number 42NM-2-4 input voltage is 440V~480V.

Section 3.7) DC contactor

Not all applications required contactors, the majority of drive systems don't have DC contactors. Below is a elementary diagram of DC contactor circuit.

Elementary Power Connection Diagram with optional DC Contactor



Important !!!

Close the DC contactor before engaging Run (terminal 34), not simultaneously.
 If Run is engaged before the DC contactor is closed, the motor will run away accelerate.
 The motor should be stationary before closing the DC contactor.
 Closing the DC contactor when the motor is rotating can seriously damage the drive.
 Zero motor speed detection circuit (A.K.A. Anti Plugging circuit) is strongly recommended.

Warning, don't use a DC contactor with a 12 SCR, regenerative drive.

- DC contactor can only be used with a 6 SCR, DC drive.
- A freewheeling rectifier is strongly recommended..
- The motor must be stationary before closing the DC contactor, Anti-plugging circuit is strongly advised to detect if the motor is generating voltage. If the motor is rotating and generating voltage when the DC contactor is closing, the motor voltage can cause damage to the DC drive and possibly the machinery.

**Note: Electric Regulator prefers AC contactors.
 DC contactors can lead to a variety of problems.**

We recommend power circuit voltage test, prior to installing the control circuit wiring.

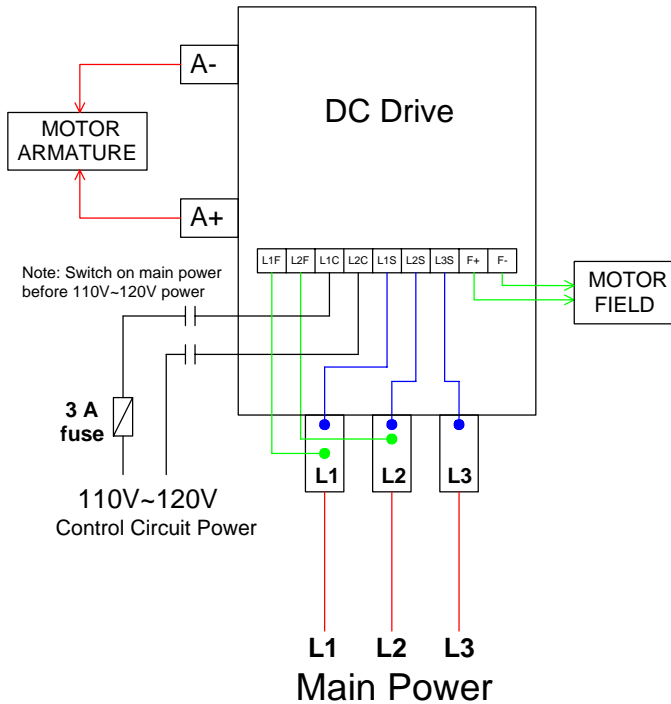
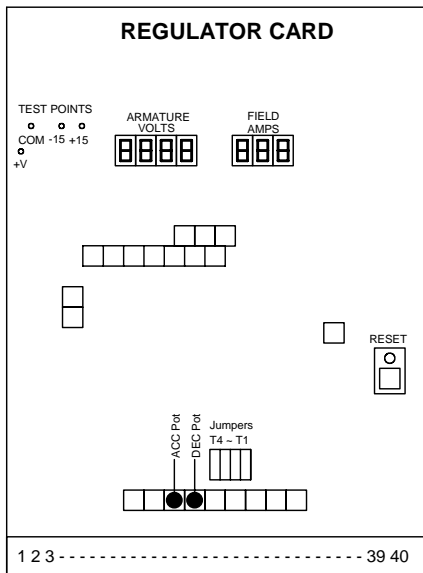
Section 3.8) Check all of the following before applying power.

- Check for any loose connections of all of the power circuit terminals and fuses.
- Carefully inspect for frayed braids of wire.
- Use an Ohm meter to check isolation between wires and ground.
- First switch on the main three phase power.
- Second switch on the single phase control circuit power.
- With out the control circuit wiring, the ES fault signal light on the regulator card will be on, this is normal.
- If other fault signal lights are on, this is the time to correct the problem.

Section 3.8) Voltage Checks

Never measure voltage test points when the motor is running.

Item	Measuring Location	Voltage
3 Phase AC Input Power	AC Input Power Buss (L1-L2) (L1-L3) (L2-L3)	Within $\pm 10\%$ of Rated Voltage
Field AC Input Power	Terminal Block L1F and L2F	Within $\pm 10\%$ of Rated Voltage
Single Phase Input Power	Terminal Block L1C and L2C	110 V _{AC} to 120 V _{AC}
Signal Relay Power	Test Points on Regulator Card +V to Com	23V _{DC} $\pm 3V$
Positive and Negative Power Supplies	Test Points on Regulator Card (+15 to Com) (-15 to Com)	(+15 V _{DC} $\pm 0.5V$) (-15 V _{DC} $\pm 0.5V$)



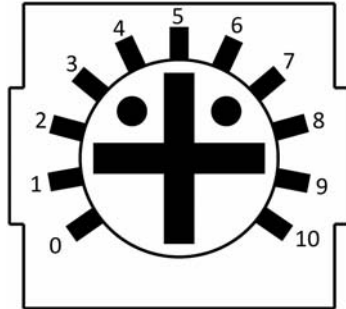
Section 4.1) Potentiometer position

Through out this manual you will see references to potentiometer (POT) adjustment positions.
These diagrams depict potentiometer adjustment positions



Important: Use a Phillips tip size #0 screwdriver to adjust the pots

Each mark is a tenth of a turn



Section 4.3) PC (Enable Drive)

- The PC terminal 36, enables the drive before start. This is a safety to detect when external Pre-operational Conditions (PC) are satisfied. Example: The safety door must be closed. If your application doesn't require PC, connect a jumper wire from 35 to 36.
- **Important note:** If you have a DC armature contactor, the contactor must be closed before engaging PC. If PC is engaged when the armature contactor is open, when the contactor closes the motor will **run away accelerate!!!**

Section 4.4) Run and Stop (i.e. Start and Stop)

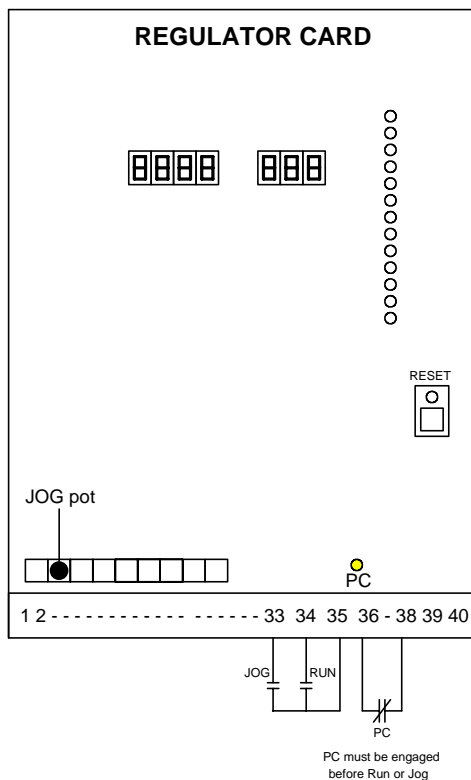
- Start the motor by engaging terminals 34 (Run) to 35 (Com).
- The connection from 34 to 35 must be sustained while the motor is running
- To stop disengage (open) terminals 34 and 35.
- Note: Three line sustaining circuit is recommended for the start stop circuit.

Section 4.5) Jog

- Jog is engaged by terminals 33 (Jog) to 35 (Com).
- The Jog pot adjusts the jog speed from 0 to 20% of run's maximum speed.
- Note: Momentary button is recommended for Jog.

Important !!! PC terminal 36 must be engaged and the yellow PC light on, before run or jog.

Note: Run and Jog both have the same acceleration and deceleration times.



Section 4.6) Emergency Stop (E Stop)

- Emergency Stop (E Stop) is a normally closed circuit connected to terminals 40 and 38.
- **Important**, Don't restart until after the motor comes to a complete stop. Starting before the motor is stopped, can cause extensive damage.

Emergency Stop has two options.

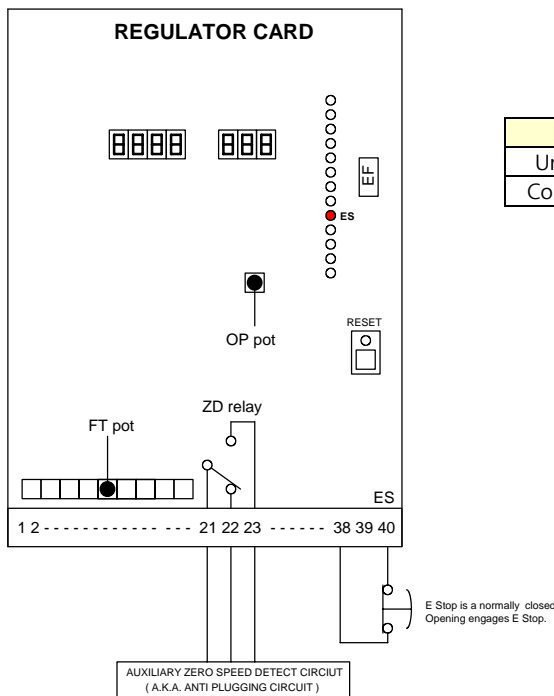
Option 1) Coast to stop, EF jumper off.

Option 2) Controlled deceleration stop, EF jumper on.

- To enable controlled deceleration E Stop, put the EF jumper ON
- The "FT" pot adjusts the E. Stop deceleration time. The E. Stop deceleration time is equal to or less than the "DEC" pot setting.

The regulator card has a zero motor speed detect relay (i.e. ZD relay)

- When the motor is coasting or decelerating quickly the motor generates electric power that can damage the drive if the motor is restarted before the motor stops. We strongly recommend zero motor speed detect circuit (a.k.a. Anti Plugging Circuit)
- The ZD relay is very use full for a auxiliary anti plugging circuit.
- Proper adjustment of the OP pot is required for the ZD relay to switch at the right time.
- Adjusting the OP pot too low will cause the ZD relay to buzz.



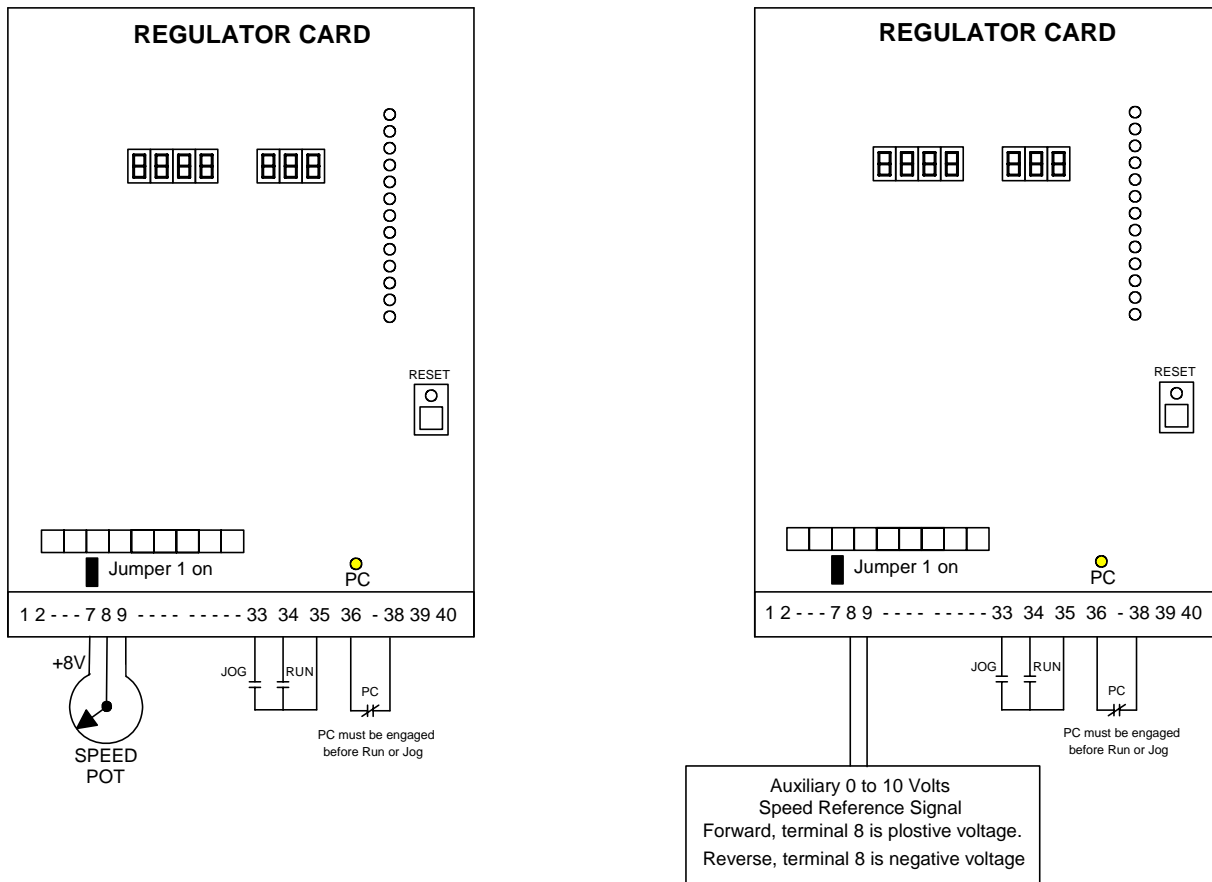
Emergency Stop mode	Jumper Setting
Uncontrolled Coast to Stop	Jumper EF - Off
Controlled Deceleration Stop	Jumper EF - On

Section 4.7) Speed Potentiometer (Speed Adjustment)

- The speed adjustment pot is connected to terminals 7, 8 and 9.
- We recommend a 500 ohm or 1000 ohm potentiometer.
- The factory default speed reference voltage is 0 to 8 volts for 6 SCR drives.
- The factory default speed reference voltage is plus and minus 8 volts for 12 SCR drives. Negative voltage is for reverse. When terminal 37 receives a signal the polarity terminal 7 changes to minus 8 volts.
- If you have an auxiliary 0 to 10 volt speed reference signal, remove jumper 1 on the regulator card. Note: If the voltage exceed 10 volts, the armature voltage will exceed the setting of the MAX pot.

Example: When the speed reference signal is 10V and the MAX pot is adjusted to 500VDC. If the speed refrence increases to 11 volts, the armature voltage will go to 550V.

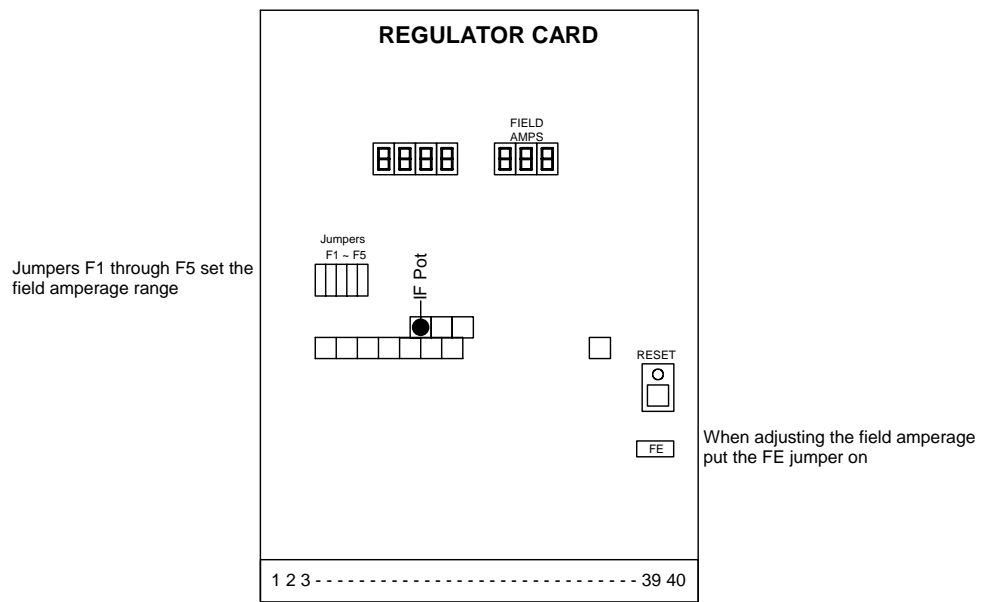
- When 12 SCR drives have an auxilary speed reference signal, termianl 37 is non functional. Reverse rotation require a plus and minus 10 volts, minus 10 volts for reverse.



Section 4.8) Field Amperage Adjustment

Warning, never disconnect the field power while the motor is running.

- Read the motor data plate to find the field amps.
- Read the field jumper table in section 4.9, to determine the jumper setting.
- Set the "F" jumper and switch on the power.
- Temporally disable field economy by putting on the FE jumper.
- Adjust the IF pot until the field amp meter reads the amperage required.
- If the amperage is too low, check the "F" jumper setting. If the jumper setting is correct. You may have a wiring error, if L1F and L2F are incorrect, the field amps will be too low.



Note: The field is a amperage circuit, not a voltage circuit. Priority is the correct field amperage. The field voltage normally varies with temperature

Section 4.9) Field Ampere Jumper Table

"S1A" Model Ampere Range	"S1, S2, S3 & S4" Models Ampere Range	"M2 & M3" Models Ampere Range	"L1 & L2" Models Ampere Range	"XXL Models Ampere Range	Jumper Settings
4.3 ~ 7.1	6.0 ~ 10	10A ~ 17A	15A ~ 25A	34A ~ 57A	F1 - On F2, F3, F4, F5 - Off
2.1 ~ 4.3	3.0 ~ 6.0	5A ~ 10A	7.5A ~ 15A	17A ~ 34A	F2 - On F1, F3, F4, F5 - Off
1.4 ~ 2.1	2.0 ~ 3.0	3.3A ~ 5A	5.0A ~ 7.5A	11A ~ 17A	F3 - On F1, F2, F4, F5 - Off
0.7 ~ 1.4	1.0 ~ 2.0	1.7A ~ 3.3A	2.5A ~ 5.0A	5.8A ~ 11A	F4 - On F1, F2, F3, F5 - Off
0.6 ~ 0.7	0.8 ~ 1.0	1.3A ~ 1.7A	2.0A ~ 2.5A	4.6A ~ 5.8A	F5 - On F1, F2, F3, F4 - Off
0.3 ~ 0.6	0.5 ~ 0.8	0.8A ~ 1A	1.3A ~ 2.0A	3.0A ~ 4.6A	No Jumpers On F1, F2, F3, F4, F5 - Off

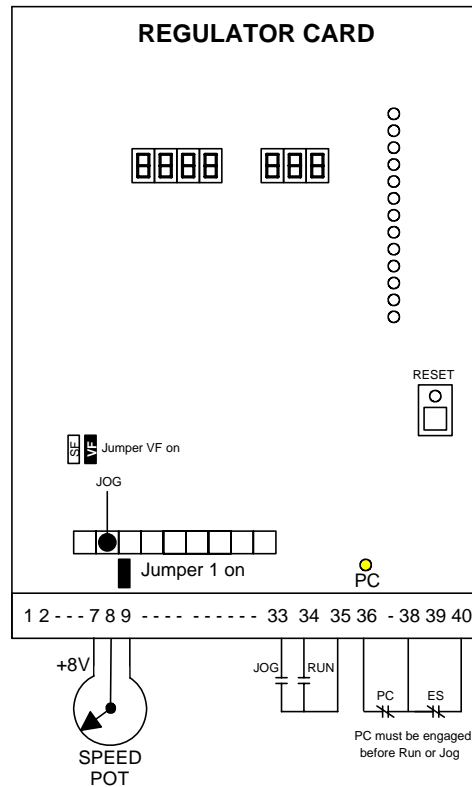
Section 4.9) Test Run

We advise running the motor in Jog for the first test run. Normally the factory jumper settings and potentiometer adjustments are satisfactory for test run in jog. The installer should adjust the motor field amperage.

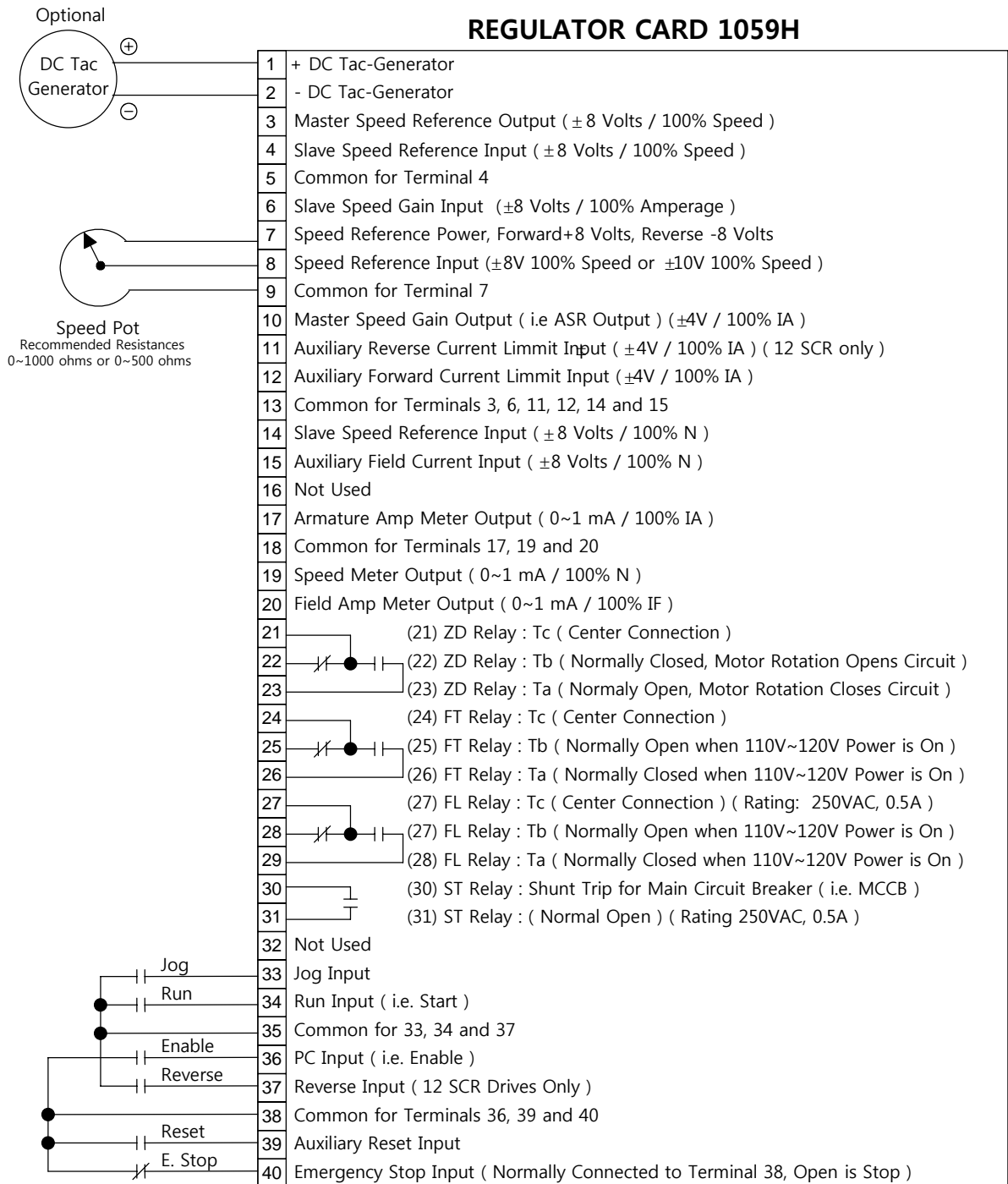
- Confirm emergency stop circuit is closed.
- Set the JOG pot to an intermediate position.
- In armature feedback (VF jumper on) engage jog the motor to confirm proper operation.
- If the motor runs in the wrong direction, check the field polarity terminals F1, F2 or the armature polarity A+, A-.

Section 4.10) Test Run in Tac Generator Feedback

- First in armature feedback jog the motor to confirm the tac generator polarity is correct, regulator card terminal 1 is positive, terminal 2 is negative.
- When the motor is stopped, change jumpers to tac feedback, move jumper VF to jumper SF.
- Start the motor with jog, if the motor rapidly accelerates past 20% of the motor's base speed. Stop and check if the tac feedback wires are connected properly and if the tac generator brushes are good.



Regulator Card Terminals



Note: The voltage of terminals 33, 34, 36, 37, 39 and 40 should be equal to the voltage of test point +V

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Section 5.1) Introduction to the Motor Field

Importance of the Field

The field power is vital to the operation of DC motors. The field induces resistance in the armature, without the field the armature has very little resistance.

- **Never disconnect the field power when the motor is running!!!**
- Don't adjust the field amperage too low.
- Before field weakening, read the motor data plate to find the minimum field amperage. Most motor data plates don't have the minimum field amperage. If so, don't go below 30% of full field or exceed the motors maximum speed rating.
- If the field does not have power, don't apply power to the armature.

Example: When a 100 HP DC motor is running at full load; the armature is 500 volts, 150 amps. The armature has an effective resistance of 3.333 ohms. If the field power is disconnected the armature resistance will drop to about 0.08 ohms (virtually zero), the armature current will immediately go up to 6,250 amps. Within milliseconds both the motor and drive will incur serious damage that can be irreparable.

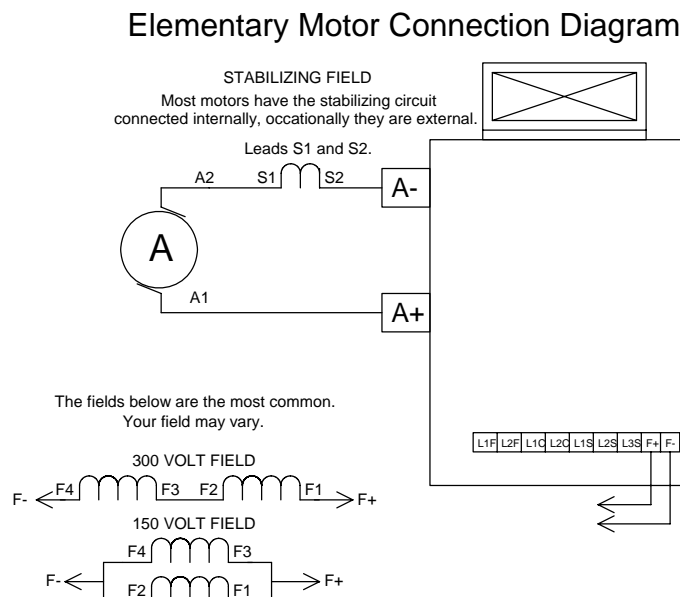
Field Voltage

The field is a ampere circuit, the field voltage will vary with temperature.

Example: The 3212AT frame, 100 HP, DC motor field current is specified to be 3.5 amps. When the motor is cold, 20°C (68°F) the field resistance is 66.8 ohms, the voltage would be 234 volts. When the motor warms up to about 40°C (104°F) the field resistance will increase to 85.7 ohms and the field voltage will rise to 300 volts.

Section 5.2) Stabilizing field winding

Modern DC motors have the stabilizing field connected internally. Older DC motors sometimes have field stabilizing terminals S1 and S2. Below is a diagram of how to connect the stabilizing field winding.



Section 5.3) Field Economy

When the motor is not running, full field power is not necessary. Field economy reduces the field power, when the motor is stopped and the PC light has been off approximately six to eight seconds. When the motor is started full field power is automatically reapplied.

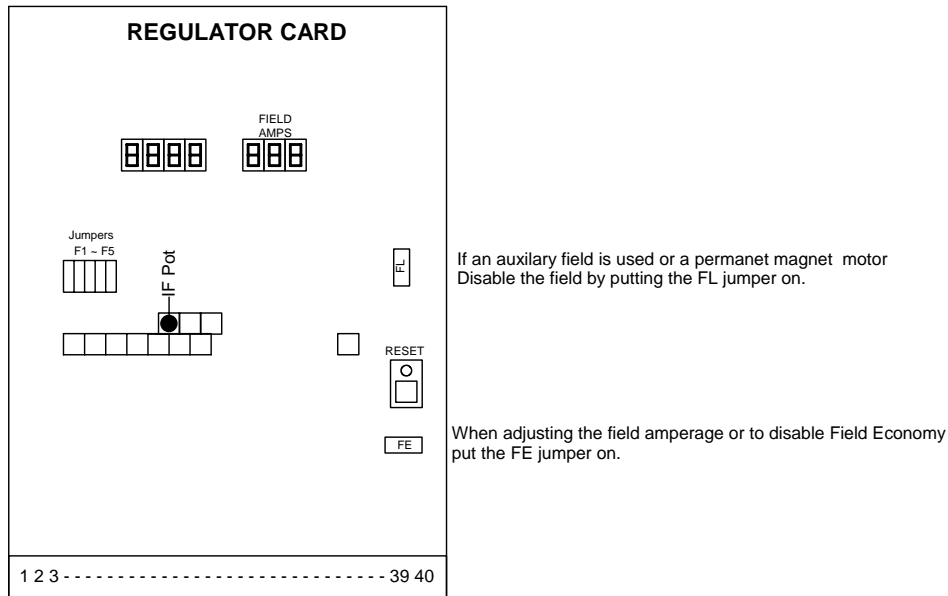
If you want to disable field economy put the jumper FE on.

Note: If the motor is in a location where condensation occurs, we recommend keeping power to the field with Field Economy on all the time (24/7).

Section 5.4) Field Disable

The field is disabled when the motor has a permanent magnet field or auxiliary field power.

To disable the field loss detection circuit, put the jumper FL on and don't connect power to L1F and L2F. Note: The yellow "F" light will remain on when the field is disabled.



Field Loss

The 1059A regulator card has field loss protection circuit that shuts off the motor if the field goes below 1/6 of full field.

Field Voltage Regulation

If the application requires field voltage regulation to interface with your equipment. The optional IFC 1084 card is available, contact Electric Regulator and see page 68, section 9.1 .,

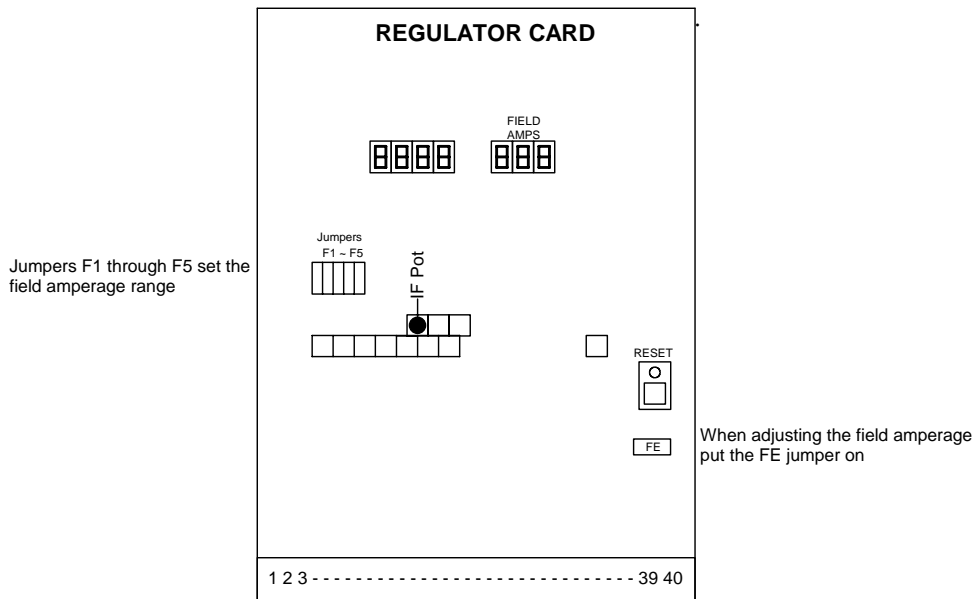
Fields above 25 Amperes

If the motor has a field above 25 Amperes, the Statohm 5, 41 series drive and 41FS field supply is required, contact Electric Regulator and see page 68, section 9.2 .,

Section 5.5) Field Amperage Adjustment

Warning, never disconnect the field power while the motor is running.

- Read the motor data plate to find the field amps.
- Read the field jumper table below, to determine the jumper setting.
- Temporally disable field economy by putting on the jumper FE.
- Set the "F" jumper and switch on the power.
- Adjust the IF pot until the field amp meter reads the amperage required.
- If the amperage is too low, check the "F" jumper setting. If the jumper setting is correct. You may have a wiring error. If L1F and L2F are incorrect, the field amps will be too low.



Note: The field is a amperage circuit, not a voltage circuit. The priority is the correct field amperage, the field voltage normally varies with temperature

Section 5.6) Field Amperage Jumper Table

"S1A" Model Ampere Range	"S1, S2, S3 & S4" Models Ampere Range	"M2 & M3" Models Ampere Range	"L1 & L2" Models Ampere Range	"XXL Models Ampere Range	Jumper Settings
4.3 ~ 7.1	6.0 ~ 10	10A ~ 17A	15A ~ 25A	34A ~ 57A	F1 - On F2, F3, F4, F5 - Off
2.1 ~ 4.3	3.0 ~ 6.0	5A ~ 10A	7.5A ~ 15A	17A ~ 34A	F2 - On F1, F3, F4, F5 - Off
1.4 ~ 2.1	2.0 ~ 3.0	3.3A ~ 5A	5.0A ~ 7.5A	11A ~ 17A	F3 - On F1, F2, F4, F5 - Off
0.7 ~ 1.4	1.0 ~ 2.0	1.7A ~ 3.3A	2.5A ~ 5.0A	5.8A ~ 11A	F4 - On F1, F2, F3, F5 - Off
0.6 ~ 0.7	0.8 ~ 1.0	1.3A ~ 1.7A	2.0A ~ 2.5A	4.6A ~ 5.8A	F5 - On F1, F2, F3, F4 - Off
0.3 ~ 0.6	0.5 ~ 0.8	0.8A ~ 1A	1.3A ~ 2.0A	3.0A ~ 4.6A	No Jumpers On F1, F2, F3, F4, F5 - Off

Section 5.7) Field Weakening

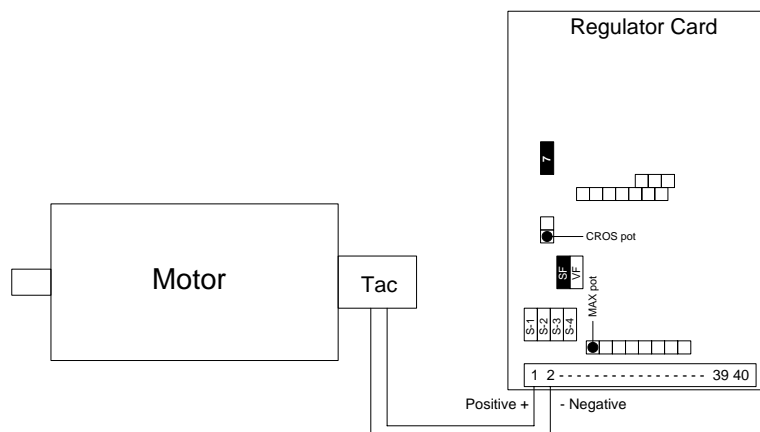
- Field weakening reduces the field amperage resulting in higher motor speed.
- Field weakening is only for motors with DC tac generators.
- First step, we strongly recommend test running in armature feedback.
- Second step, we strongly recommend test running in tac feedback., adjust the CROS pot to 5/10, (Strait Up) adjust the MAX pot to the correct armature voltage.
- Third step, enable field weakening by putting both jumpers 7 and 8 on.
- In field weakening mode the CROS pot adjusts the armature voltage. Run the motor, it will not reach the previous armature voltage, stop the motor. Estimate CROS pot adjustment for the target armature voltage. Start the motor and view the armature voltage. You may have to repeat this process several times until the armature voltage is with-in plus or minus 20 volts or the target armature voltage. Then you can slowly adjust the CROS pot while the motor is running.
- Adjust the MAX pot to the speed required, this often requires additional adjustments of the CROS pot to reduce the armature voltage, then adjust the MAX pot again. Several adjustments of MAX and CROS are often required to reach the right result. **Warning, when adjusting the MAX pot, watch the field amp meter, never go below the motors minimum field amperage.**
- Changing the DC tac voltage jumper may be required.

Motor Speed Feedback	Jumper Settings
Armature Voltage	VF - on, SF - off, 7 - off
DC Tac-Generator	VF - off, SF - on, 7 - off
Field Weakening	VF - off, SF - on, 7 - on 8 - on

Calculate the maximum tac voltage.

Example, the tac is 50V per 1000 rpm and field weakening is to 2100 RPM. The maximum voltage will be 105V (2.1 x 50 = 105) jumper S-2 would be appropriate (88V~127V). Regardless of how high the MAX pot is adjusted the speed will not exceed 127 volts or 2540 RPM.

DC Tac Voltage	Jumper Settings
41V ~ 60V	S1, S2, S3, S4 - Off
60V ~ 88V	S1 - On, S2, S3, S4 - Off
88V ~ 127V	S2 - On, S1, S3, S4 - Off
127V ~ 172V	S3 - On, S1, S2, S4 - Off
172V ~ 250V	S4 - On, S1, S2, S3 - Off



Section 5.8) Armature Feedback Maximum Speed Adjustment

- Read the motor data plate to confirm the maximum armature voltage.
- The MAX pot adjusts the maximum armature voltage (i.e. Maximum Speed).

Section 5.9) Tac Generator Feedback Maximum Speed Adjustment

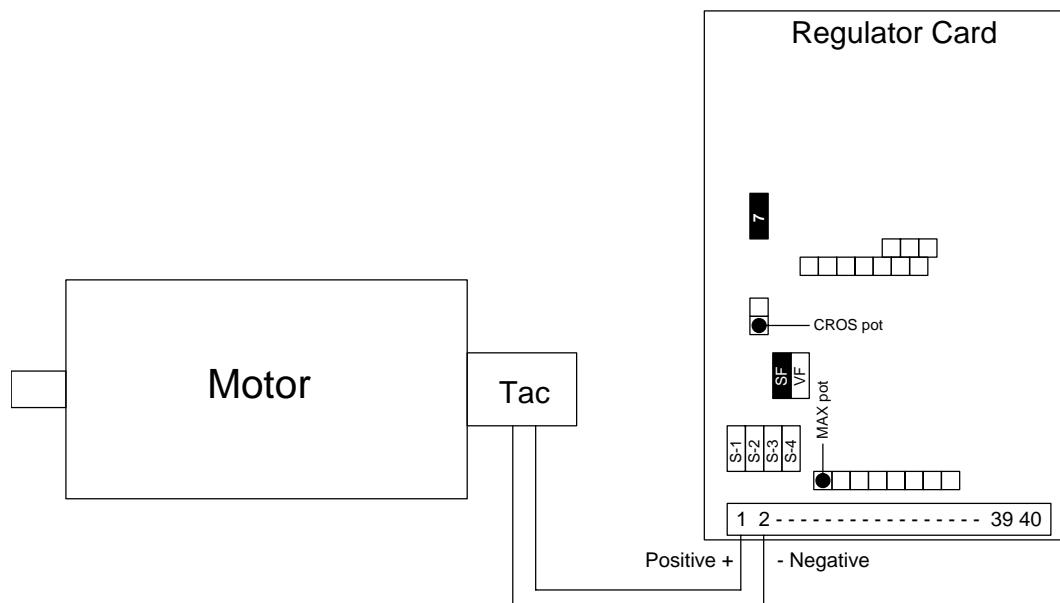
- Read the motor’s data plate to confirm the maximum armature voltage, base speed and maximum mechanical speed.
- The MAX pot adjusts the maximum armature voltage (i.e. Maximum Speed).
- Read the DC tac generator’s data plate to confirm the volts per revolution.
- Read the tables below to confirm jumpers are set for correct DC tac feedback voltage.
- Example: If you have a 50V_{DC}/1000 RPM Tac and your application requires 1750 RPM. Multiply 1.75 X 50 = 87.5 V_{DC}. Select the voltage range of 60V ~ 88V, jumper S-1. Regardless of how high the MAX pot is adjusted the speed will not exceed 88V limit of jumper S-1.

Field Weakening Maximum Speed Adjustment

See section 5.7 for Field Weakening instructions

Motor Feedback	Jumper Settings
Armature	VF - On SF - Off
DC Tac Generator	VF - Off SF - On
Field Weakening	VF - Off SF - On 7 - On

DC Tac Generator Voltage	Jumpers
41V ~ 60V	S1, S2, S3, S4 - Off
60V ~ 88V	S1 - On S2, S3, S4 - Off
88V ~ 127V	S2 - On S1, S3, S4 - Off
127V ~ 172V	S3 - On S1, S2, S4 - Off
172V ~ 250V	S4 - On S1, S2, S3 - Off



Section 5.10) Acceleration & Deceleration Time Adjustment

Acceleration Time is also known as Ramp Up.

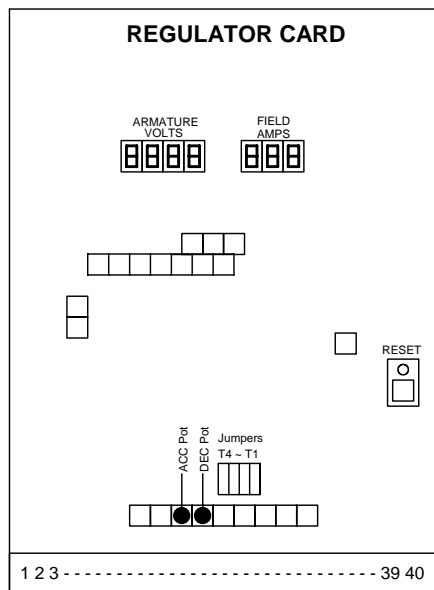
Deceleration Time is also known as Ramp Down.

Read the jumper table below and selected the ramp time.

- Adjust ACC pot and DEC pot will adjust the time within the range of the jumper setting.
- Example, When jumper T2 is on, the ramp time will be no faster than 3 seconds and no slower than 20 seconds.
- Example, Ramp up time of 10 seconds with T2 jumper on, adjust the ACC pot to 4.1/10 position. The calculations are (20 seconds -3 seconds = 17) then (10 seconds - 3 seconds = 7) then (17/10=1.7) finally (7 seconds / 1.7 = 4.1) the ACC pot position should be 4.1 for 10 second ramp up acceleration time).

Acceleration and Deceleration Jumper Table
(AKA Ramp Time Jumper Table)

Time Range	Jumper Setting
0.7 ~ 6 Sec.	T1 - On T2, T3, T4 - Off
3 ~ 20 Sec. (default)	T2 - On T1, T3, T4 - Off
7 ~ 60 Sec.	T3 - On T1, T2, T4 - Off
14 ~ 120 Sec.	T3, T4 - On T1, T2 - Off



Section 5.11) Zero motor rotation detection relay and signal light adjustment

The regulator card has a motor rotation detection circuit (i.e. Zero Detection, ZD). The ZD circuit has a SPDT relay on terminals: 21 center pole, 22 normally closed, 23 normally open and a signal light marked ZDL. The switch point of the ZD circuit is set by the OP pot. The switch point adjustable over a range of 0 to 25% of full speed.

- While the motor is stopping adjust the OP pot to the desired switch point.
- The ZDL light is on when the motor is running and off when the motor is stopped.
- Note: Adjusting the OP pot too low can cause the ZD relay to buzz when the motor is stopped.

Section 5.12) Zero Armature Voltage Adjustment

The ZERO pot adjusts the minimum armature voltage, the voltage range is 0 to 3 Volts.

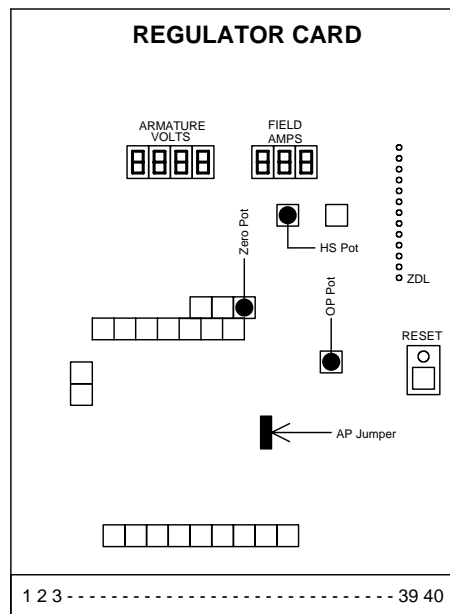
Section 5.13) Zero Speed Adjust (12 SCR Drives Only)

12 SCR drives that start and stop with a small load, may require special adjustment to make smooth starts, stops and remain stationary when stopped. This problem is common in tac feedback.

- To obtain best results, we recommend using an oscilloscope to view the signal across A+ and A-.
- Turn the acceleration and deceleration pots full clockwise (slow).
- Set the speed pot to zero. If the motor turns, adjust the ZERO pot until the motor is at a standstill.
- Regenerative drives with tac feedback sometimes exhibit instability is at low speeds and during start and stop. Removing the AP jumper will stabilize the problem. Sometimes placing a capacitor in parallel with the speed feedback opamp resistor will solve the problem.
- If problems persists, see the next section, Zero Speed Hysteresis Adjustment.

Section 5.14) Zero Speed Hysteresis Adjustment (12 SCR Drives Only)

The regulator card switches the motor from forward to reverse by changing the polarity of the speed reference voltage. Ripple from the tac generator or armature feedback affects the speed regulation circuit. To minimize the effect of ripple from this feedback. A Hysteresis circuit adjusts the input sensitivity of the to the reverse switch logic. The "HS" pot is typically is somewhere about 2.5 /10 scale. If the motor is frequently reversed with light load, adjust the "HS" pot clockwise. The Hysteresis circuit is an imprecise adjustment. Set the pot and wait some time for the drive to stabilize before making another adjustment. Avoid making an excessive number of adjustments.

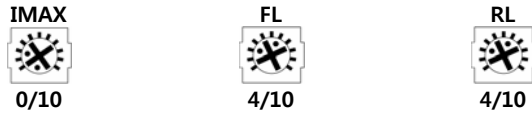


Section 5.15) Armature Amperage Adjustment (i.e. Current Limit)

- Read the motor data plate to find the motor’s rated amperage.
- Current Limit is adjusted by the IMX pot.
- The following adjustments should be done with DC amp meter or estimate the IMAX pot adjustment. If you don’t have a DC amps meter, use a AC clamp on meter and multiply by the square root of two (1.414). See example in the next line.
- Example: The AC line amps are 109Aac x 1.414 = 154Adc armature amps.
- Read the armature amperage jumper table to find the “A” jumper your motor requires.

The IMX pot will adjust the amperage with in the range of the jumper selected.

Turn the IMAX pot full counter clockwise (0/10). Adjust the FL and RL pots to 4/10 scale.

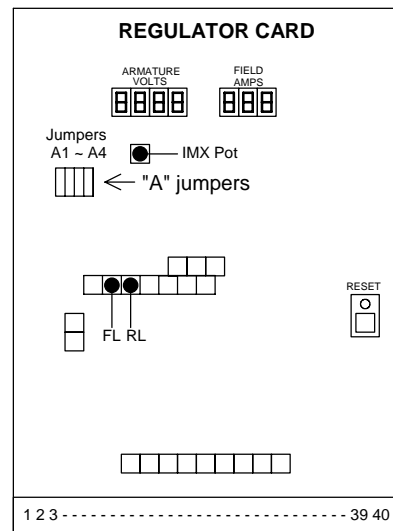


Run the motor at full load and adjust IMX pot to the motor’s rated amperage.

If running the motor under full load is not possible or a amp meter is not available, go to Estimating adjusting the IMAX pot.

Estimating the IMAX pot adjustment

Example: The Statohm 5 model number 42NS-4-4 armature jumper is set A-4,the IMX pot will adjust the amperage from a minimum of 38 amps to a maximum of 62 amps, the range is 24 amps (38-62=24). Each mark on the pot is 2.4A (24/10=2.4). If the motor is rated at 50 amps, 12 amps above 38. 12 amps / 2.4 amps per graduate mark equals 5 or 5/10 Adjust the IMX pot to 5/10



Armature Amperes Jumper Table

“S1” Model Ampere Range	“S1A, S2” Model Ampere Range	“S3” & “S4 ” Model Ampere Range	“M2” &“M3” Model Ampere Range CT-2027	“L1 & L2” Model Ampere Range CT-2028	Jumper Settings
14 ~ 23	55A ~ 90A	180A ~ 300A	366A ~ 600A	730A ~ 1,200A	A1, A2, A3, A4 - On
12 ~ 20	48A ~ 81A	161A ~ 270A	322A ~ 538A	640A ~ 1,100A	A1, A2, A3 - On A4 - Off
8.6 ~ 14	35A ~ 58A	120A ~ 190A	230A ~ 384A	460A ~ 770A	A1, A3 - On A2, A4 - Off
6 ~ 10	25A ~ 42A	83A ~ 140A	166A ~ 277A	330A ~ 560A	A1 - On A2, A3, A4 - Off
4.5 ~ 7.5	18A ~ 30A	60A ~ 100A	120A ~ 200A	240A ~ 400A	A2 - On A1, A3, A4 - Off
3.5 ~ 5.9	14A ~ 23A	46A ~ 78A	93A ~ 150A	190A ~ 300A	A3 - On A1, A2, A4 - Off
2.8 ~ 4.7A	11A ~ 19A	38A ~ 63A	75A ~ 125A	150A ~ 250A	A4 - On A1, A2, A3 - Off

Section 5.16) Forward and Reverse Current Limits (Reverse, 12 SCR, Regenerative Drives Only)

The forward and reverse current limits can be independently adjusted.

- FL pot adjusts forward current limit.
- RL pot adjusts reverse current limit (12 SCR drives only)

When the IMAX pot was adjusted the FL pot and RL pot must be at 4/10.

FL or RL are a percentage of the IMAX pot

Potentiometer	50%	100%	150%	200%
FL	2/10	4/10	6/10	8/10
RL (12 SCR only)	2/10	4/10	6/10	8/10



Section 5.17) One Minute Current Overload Adjustment

The Statohm 5 will permit exceeding the current limit (IMAX) for one minute.

The factory default setting is 150% for one minute (IA pot set 7/10)

Adjust the IA pot when the **motor is not running**.

Important !!! Permitting one minute overload can result in speed instability.

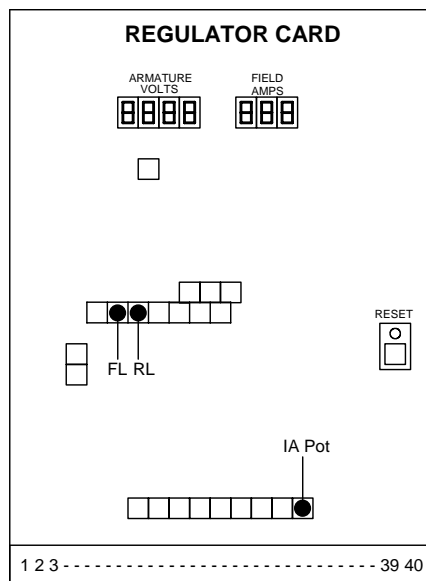
If the motor is continuously over loaded the speed will slowly fluctuate up and down. In this circumstance we recommend adjusting the IA pot to 4.7/10 or with the aid of an Amp-meter.

Potentiometer	100%	150%	200%
	No Overload Time	1 Minute Overload	1 Minute Overload
IA	4.7/10	7/10	9/10



Section 5.18) Instantaneous Current Overload Shut-Off

When the motor exceeds 250% of it's rated amperage (IMX pot), the regulator will instantaneously shut-off the motor. This circuit is not adjustable and cannot be overridden.

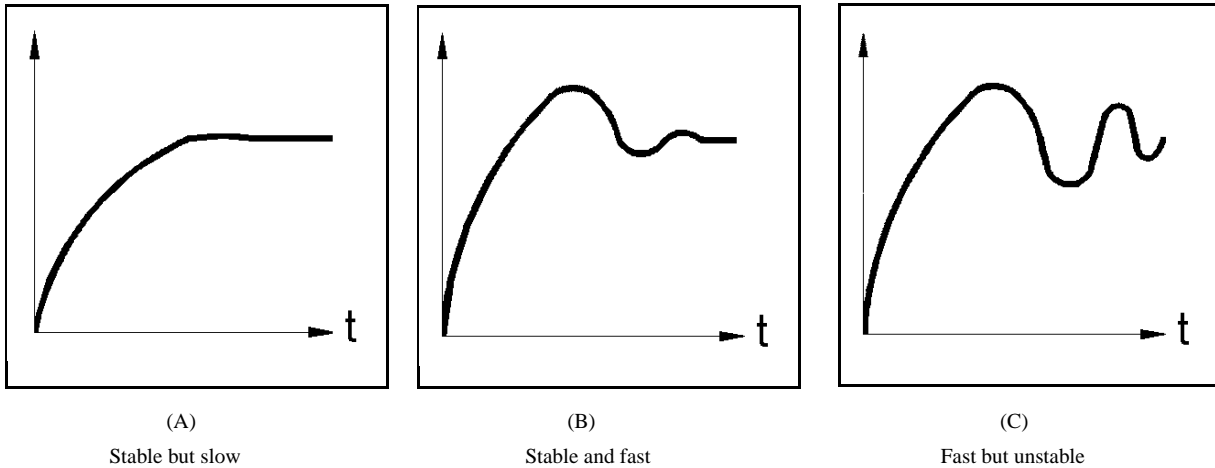


Section 5.19) Speed Overshoot and Stability (i.e. Speed Response)

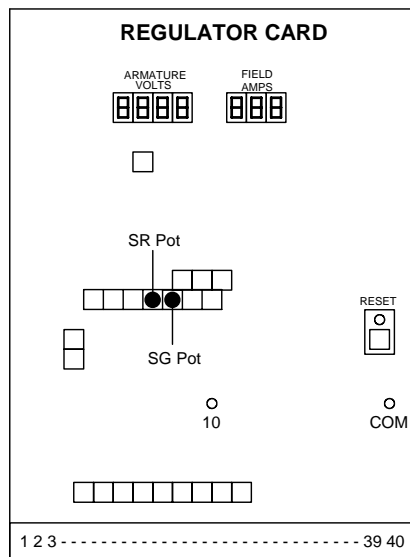
Overshoot and stability are adjusted at the factory but sometimes operating conditions at the site may require additional adjustment.

To view the motor’s overshoot and stability attach an oscilloscope to test points 10 and COM or to the tac feedback wires.

- Adjust the ACC and DEC pots for fast operation (turn the pots counter clockwise).
- Set the JOG pot full clockwise. If jog is not available set the master speed control to 20% of full speed.
- Start the motor, while the motor is rapidly accelerating observe the oscilloscope and compare to the drawings in Fig. 5-19.
- Optimum is one overshoot peak as in figure B, To adjust overshoot use the SR pot.



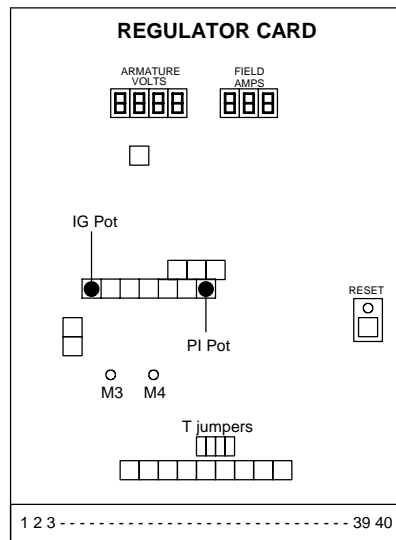
- After the SR pot has been adjusted. Return the ACCEL, DECEL and JOG pots to their normal positions.
- Start the motor and observe the oscilloscope. After overshoot has occurred, observe the stability of the motor.
- To further adjust stability, use the SG pot.



Section 5.20) Automatic Speed Regulation (ASR) or (Speed PID)

The ASR feedback loop is adjusted at the factory. If adjustment of the SR and SG pot does not produce satisfactory results. Adjustment of the PI pot may be necessary.

- Record the factory setting of the PI pot ____ /10. If you don't know the original factory position typically was high 9/10 or 10/10.
- To increase overshoot adjust the PI pot clockwise.
- To decrease overshoot adjust the PI pot counterclockwise.



Section 5.21) Current Gain Loop Adjustment (i.e. Amperage PID)

Important before adjusting the current gain (IG pot), check if your machine can sustain rapid acceleration, if not don't perform this adjustment.

The regulator card has two control loops. The armature voltage feedback loop (speed feedback loop) and a secondary armature amperage feedback loop. The amperage feedback loop is adjusted by the "IG" pot (i.e. Current Gain). The IG pot is adjusted at the factory but if the current response and stability is poor, adjust the IG pot according to the following instructions.

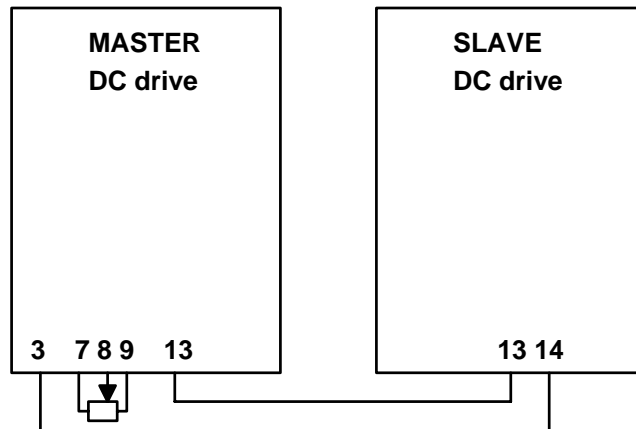
- Connect a jumper from M3 to M4. remember to remove the jumper after completing adjustments.
- Write down the pot settings of FL, RL, DEC, ACC and JOG for readjustment after completion of IG adjustment. Adjust FL and RL to 3/10 scale, adjust DEC and ACC to full counter clockwise and adjust JOG to full clockwise. If jog is not available set the master speed control to 20% of full speed.
- Remove all the jumpers from T1, T2, T3, T4 this sets acceleration time to 0.6 seconds.
- Observe the wave form of the armature by connecting an oscilloscope to TP10 and COM. Compare the wave form to figures (a) and (b).
- If the wave form is unstable, make small counter clockwise adjustments to the IG pot.
- If the current response is too slow, make small clockwise adjustments to the IG pot.

Section 5.22) Master Slave Operation

The Statohm 5 can be configured for Master Slave operation with or without Master speed gain.

- Terminal 3 is the master speed reference output.
- Terminal 14 is the slave speed reference input.
- Terminal 13 is the commons for both master and slave.

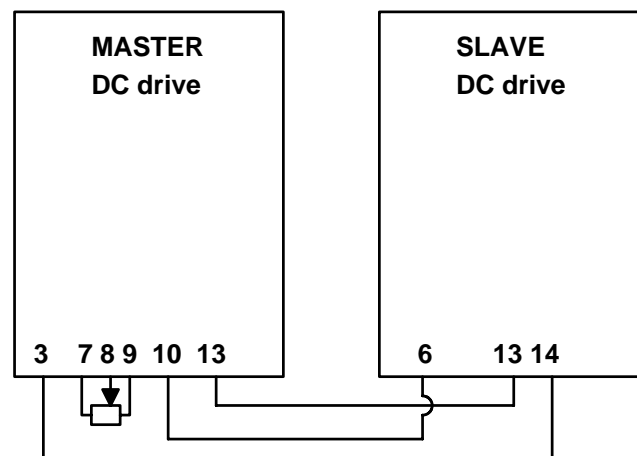
Master Slave with-out Master speed gain



Master Speed Gain permits the speed overshoot, stability to be controlled by the master drive.

- Terminal 10 is the master speed gain output.
- Terminal 6 is the slave speed gain input.

Master Slave with Master speed gain



Section 5.23) Torque Control (i.e. Winder Control)

Torque Control requires a 0 to 4 volt signal connected to regulator card terminals 11, 12 and 13.

- Terminal 12 is Forward Torque Control
- Terminal 11 is Reverse Torque Control when applicable.
- Terminal 13 is Common.
- The signal should be a little higher than the line speed.
Winder Motor RPM x Package Circumference (i.e. Diameter x 3.14)

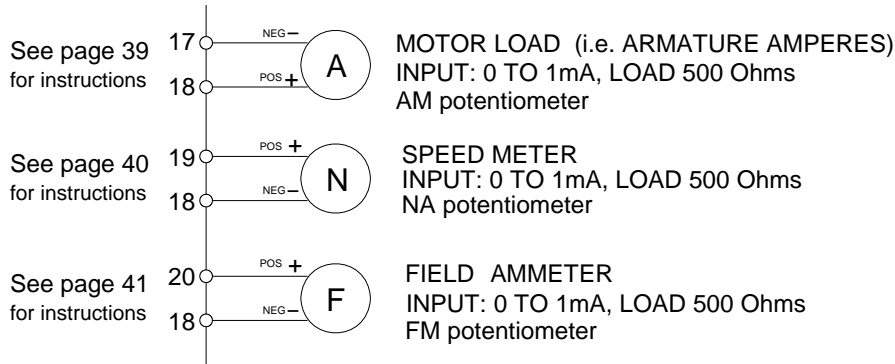
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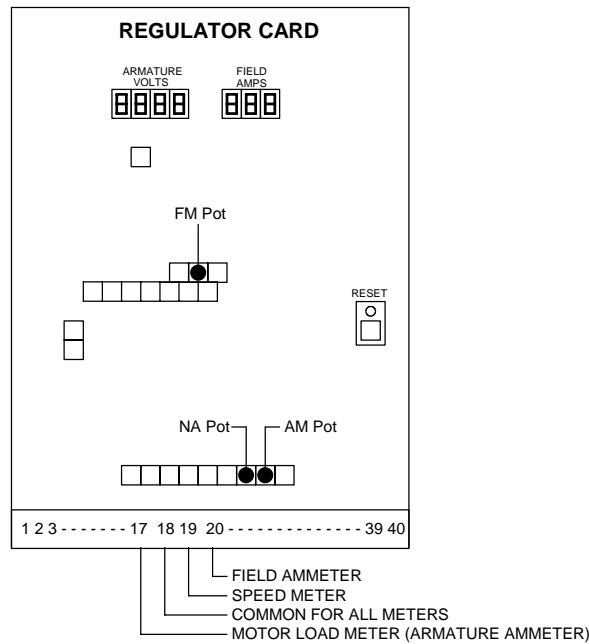
Section 6.1) Meters Overview

Electric Regulator offers optional analog meters and digital meters. The Statohm 5 has three meter outputs:

- Motor Load (i.e. Armature Amperage)
- Motor Speed
- Field Amperage

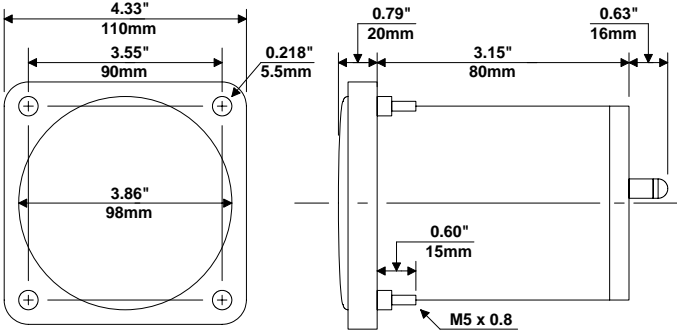


If the meter outputs are connected to other apparatus, such as PLC or meters not supplied by Electric Regulator. The output signal is intended to be a 0~1mA signal. The AM, FM and NA pots will adjust their signal up to 1.5mA but the voltage will not exceed 2V.



Section 6.2) Meter Dimensions

Electric Regulator offers analog meters.



Analog Meter Dimentions

Analog Meters are stocked in the following scales, other scales are available by special order

Meters for 6 SCR/Thyristor Drives
0 to 100%
0 to 150%
0 to 50 Amps
0 to 100 Amps
0 to 200 Amps
0 to 400 Amps
0 to 2000 RPM

Meters for 12 SCR Drives (Regenerative Drives)
-100%, 0, +100%, Center Zero
-150%, 0, +150%, Center Zero
-100, 0, +100 Amps, Center Zero
-200, 0, +200 Amps, Center Zero
Higher scales are available

Section 6.3) Armature Amperage Measurement

Three methods of measuring the motors armature amperage

- Shunt and meter method is good but uncommon.
- DC clamp on meters are convenient but often unreliable. The saw tooth wave form created by SCR phasing often causes problems for DC clamp on meters, see oscilloscope view diagram below.
- AC clamp on meters require doing some math but is the most common method. Note: Measure all the phases for the phase load balance. Up to 5% imbalance is normal, up to 10% is considered acceptable.

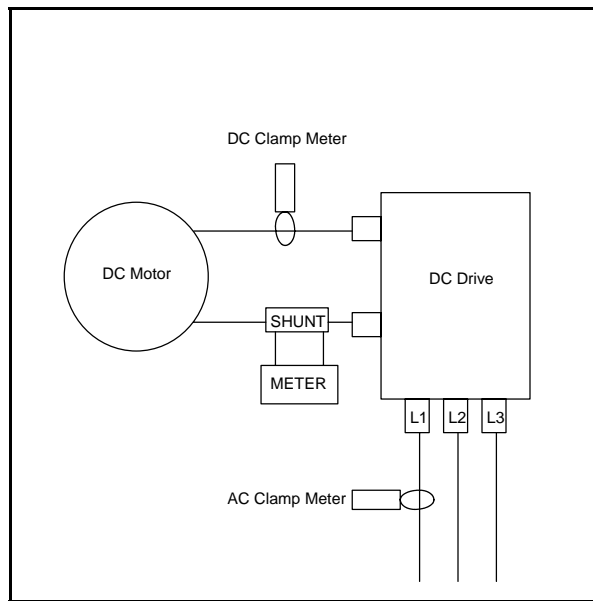
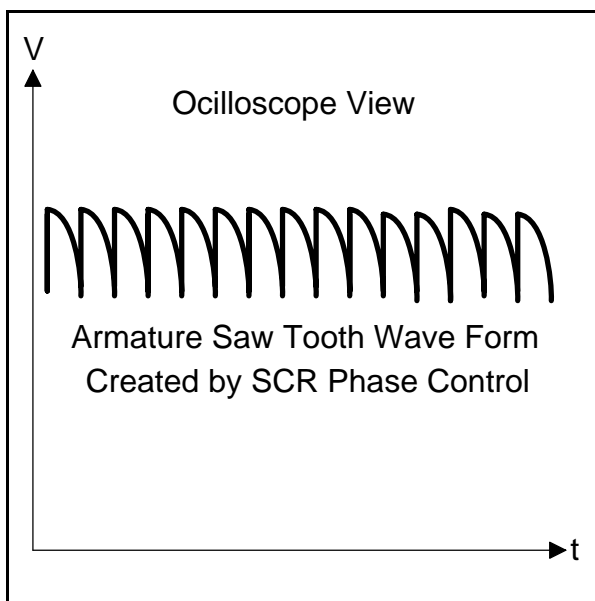
AC Clamp on meter example:

Step 1) Measure the amperage of each phase (L1, L2 and L3) if they are within 5% of each other, proceed to step 3.

Step 2) If the amperage difference is more than 10%, read page 46, section 7.2 about balancing phase amperage. Note: Line voltage normally changes through the day.

Step 3) Multiply the phase amperage by the square root of two or 1.414

Example: The AC clamp on meter reads 109A, multiply by 1.414 is 154A armature amps.



Section 6.4) Motor Load Meter (i.e. Armature Ammeter) Wiring and Calibration

- The motor load meter connects to terminals 17 and 18 and is intended to be 0 to 1mA, The AM pot can adjust the signal up to 1.5mA but the voltage will not exceed 2 volts.
- Example, Electric Regulator’s meters have a 500Ω load resistance, the voltage will be 0.5V at 1mA.
- If you have a 12 SCR drive the signal will be ± 1 mA.

Jumper and Potentiometer Settings

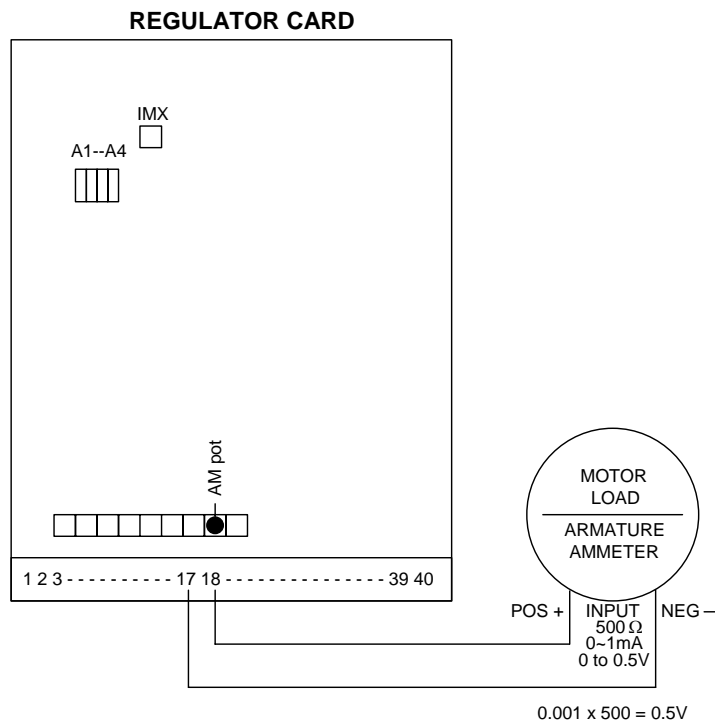
Before calibrating the ammeter make all final jumper settings and pot adjustments.

- Make final setting of jumpers A1, A2, A3 and A4.
- Make final adjustment of the IMX pot.
- If any of these settings are changed afterwards, calibrate this meter again.

How to calibrate the load meter (ammeter).

- An independent ammeter for reference is required to calibrate the ammeter.
- A higher load is recommended
- The AM pot adjusts this meter
- Run the motor at a steady level speed and load when you are adjusting the AM pot. After each adjustment wait a second or two before continuing.

Example: If you are unable to run the motor at full load you will need to calculate the meter signal amperes at the load you are running. If you have a meter that is 100A (1mA = 100A) but you are only able to load the motor to 50A. Adjust the AM pot so the signal will be 0.5mA when the meter is reading 50A. Afterwards if any of the pots or jumpers are changed, the AM pot will need to be adjusted again.



Section 6.5) Speed Meter Wiring and Calibration

- The speed meter connects to terminals 18 and 19, the signal is intended to be 0 to 1 mA, the NA pot will adjust the signal up to 1.5mA but the voltage will not exceed 2V.
- Example, Electric Regulator’s meters have a 500Ω load resistance, the voltage will be 0.5V at 1mA.
- If you have a 12 SCR drive the signal will be ± 1 mA.
- The application determines the units and the scale of the meter.

Jumper and Potentiometer Settings

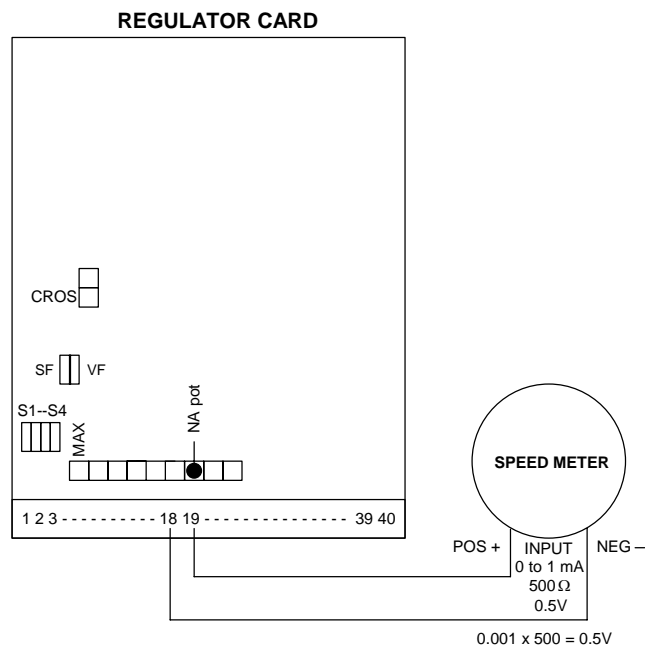
Before calibrating the ammeter make all final jumper settings and pot adjustments.

- Make all final jumpers settings.
- Make all final potentiometers adjustments.
- If any of the jumpers or pots are changed after calibrating the speed meter, recalibration of the speed meter is required.

How to calibrate the speed meter.

- An independent speed measurement meter for reference is required to calibrate the speed meter. You can improvise by using an voltmeter to measure the armature voltage or DC tac voltage. Then use the voltage to calculate the speed.
- The NA pot adjusts the speed meter.
- Run the motor at a steady level full speed and adjust the NA pot until the speed meter equals the independent speed measurement.

Example: If you are unable to run the motor at full speed you will need to calculate the meter signal amperes at the speed you are running. If you have a meter that is 2000RPM (1mA = 2000RPM) but you are only able to run the motor at 1750RPM. Adjust the AM pot so the signal will be 0.875mA when the meter is reading 1750 RPM. Afterwards if any of the pots or jumpers are changed, the AM pot will need to be adjusted again.



Section 6.6) Auxiliary Field Ammeter Wiring and Calibration

- The auxiliary field ammeter connects to terminals 18 and 20 and is intended to be 0 to 1mA. The FM pot can adjust the signal up to 1.5mA but the voltage will not exceed 2 volts.
- Example, Electric Regulator’s meters have a 500Ω load resistance, the voltage will be 0.5V at 1mA.
- Disabling field economy while adjusting the field is recommended. Putting the FE jumper on, disables field economy. Remember afterwards to put the FE jumper on.

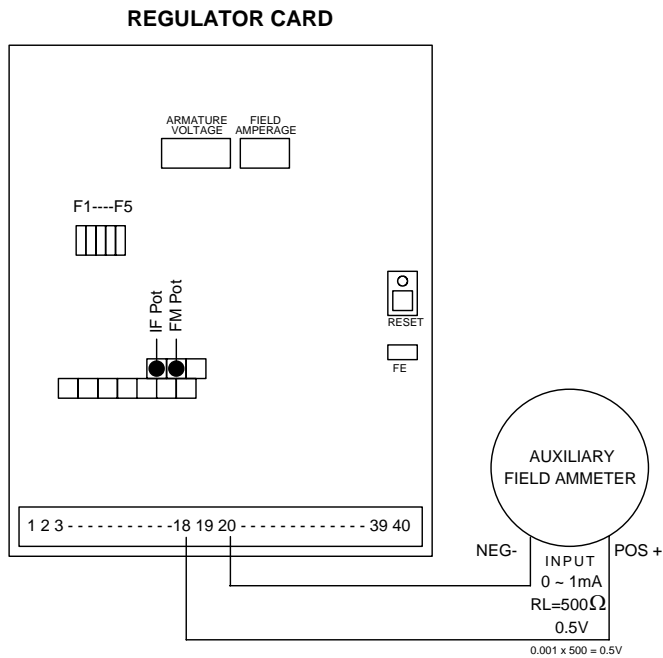
Jumper and Potentiometer Settings

Before calibrating the ammeter make all final jumper settings and pot adjustments.

- Make final settings to jumpers F1, F2, F3, F4 and F5
- Make final adjustments to the IF pot.
- If any of these settings are changed after calibrating the field ammeter, recalibration of the field ammeter is required.

How to calibrate the ammeter.

- The field ammeter on the regulator card is normally sufficient as a reference to calibrate the auxiliary field ammeter.
- Put the FE jumper on.
- The FM pot calibrates the auxiliary field ammeter
- Energize the field and adjust the FM pot until the field ammeter equals the reference ammeter.



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Section 7.1) Trouble Shooting

Trouble shooting may require the following test equipment:

- Multimeter
- DC Ammeter
- Oscilloscope with a isolation transformer that is not grounded or connected to neutral and a 10X probe or higher. See the section about oscilloscopes.

When a problem occurs. Write detailed notes of the operating conditions when the problem occurred. Check the Regulator card, if any of the red signal lights are on. Refer to the list below and correct the problem. After the problem has been corrected it may be necessary to press the reset button before operation.

"TG" Tach Generator Loss

Light's when the regulator card is not receiving a signal voltage from the DC tach generator.

"OC" Instantaneous Over Current

When 250% of the motor's rated current is exceeded. The instantaneous over current circuit will shut off the motor.

"OL" One Minute Delay Over Current Shut Off

When 150% of the motor's rated current is exceeded for more than one minute. The time delay over current circuit will shut off the motor.

"FU" Fuse Blown

One or both of the AC input fuses have blown.

"LV" Low input Voltage

The AC input voltage is more than 10% below normal.

"PH" Phase Sequence Error

Indicates when connections L1S, L2S and L3S are incorrect, see page 56, section 7.17

"FL" Field Loss

The field input current is below 13% of normal.

"OH" SCR Over Heat

A thermostat on the SCR heat sink trips at 185°F (85°C) shutting off the motor.

"ES" Emergency Stop

Signals when the emergency stop system is engaged.

Section 7.2) Phase Amperage Load Balance

If the drive is running rough, phase amperage load balance is normally not the problem, check the following.

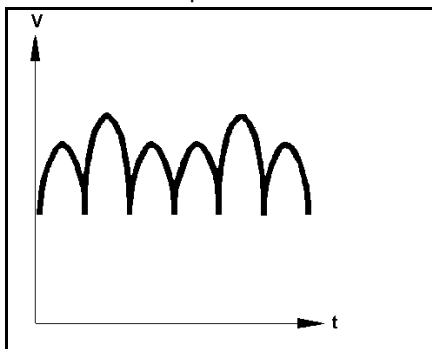
- ✓ Tac generator brushes may need replacing.
- ✓ Improper tac generator coupling.
- ✓ Check the DC motor brushes for wear.
- ✓ One or more of the SCR are failing,, see section 7.22 on page 61.
- ✓ Insufficient gain of the ACR amplifier.
- ✓ Pulse card maybe failing, see section 7.22 on page 61.
- ✓ Ribbon cables to plugs CN24 and or CN3 maybe faulty and need to be replaced.
- ✓ Read more in section 7.22 on page 61

Phase load balance adjustments are made at the factory. Changing them is not recommended.

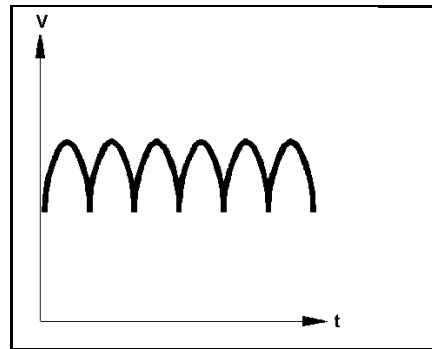
Observing and Adjusting Phase Amperage Load Balance

To observe the phase load balance connect an oscilloscope to test points 10 and com.

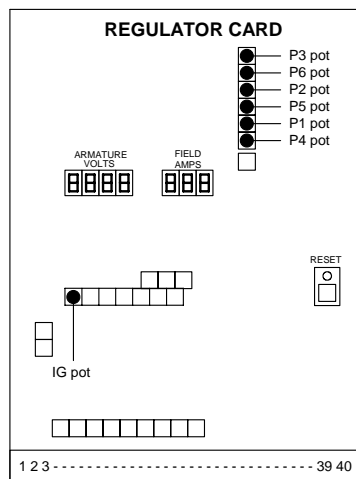
- Run the motor at a steady speed and observe the wave from. Adjust the speed and load until a stable wave form is displayed.
- If an unbalanced current wave form is displayed. Adjust pots P1 through P6 in the following sequence. P1, P6 ... P2, P4 ... P3, P5
- If improvement is not sufficient adjust the IG pot slightly counter clockwise and repeat adjusting the P pots.
- If one or several of the wave forms are unstable, the SCR are faulty, adjusting the phase load pots will not solve the problems



Unbalanced



Balanced



Section 7.3) Problem: Motor won't start but none of the red signal lights are on.

Check the following:

- Jumper JP-10
- Speed Reference Voltage is wrong
- Regulator Card Power
- Measure test point "4" while run is engaged.

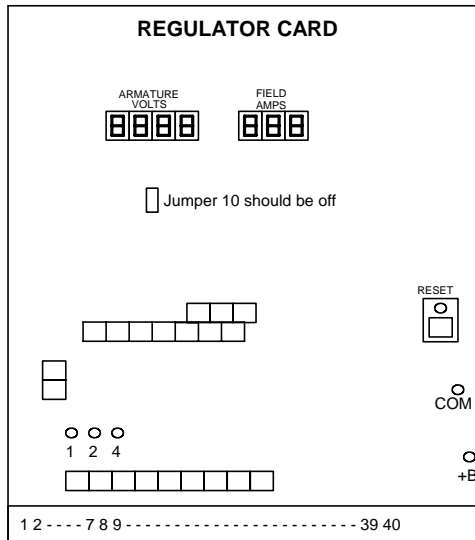
Recommendations:

Jumper JP-10 must be off. The motor will not run when this jumper is on.

Check if the speed pot is connected correctly to terminals 7, 8 and 9, see section 4.7 on page 16. If an auxiliary speed reference is used, check if the voltage polarity of terminals 8 and 9 are correct, see section 4.7 on page 16.

Measure test point +B, it should be somewhere about $25V_{DC}$

Test point "4" is the acceleration and deceleration ramp signal. When run is engaged voltage should ramp up to $8V_{DC}$ or for reverse $-8V_{DC}$.



Section 7.4) Problem: Motor Runaway

Check the following:

- TG Jumper must be on
- Tac-Generator circuit.
- Tac-generator feedback:
Check the voltage of test point "1".
- Armature feedback:
Check the voltage of test point "2".
- Armature feedback: Check the armature voltage plug connected to the bottom left corner of the synchronization card.
- Check the field amperage and voltage.
- Power to L1F and L2F for the field is not correct.
- The motor's field is not correctly connected.
- Check jumper settings and continuity.
- Speed pot connection error.

Recommendations:

The TG jumper must be on for both Armature and Tachometer feedback. TG - On

Check if the tach generator circuit wiring is faulty.
Check if the polarity is correct,
Regulator card terminal 1 is positive
Regulator card terminal 2 is negative.
Read the section about DC tac-generator feedback.

Test point "1" normal voltage range is -0.02 to $-8.5 V_{DC}$
If no voltage is present at test point "1" Check wire connections. If wire connections are good. The regulator card may need to be replaced.

Check voltage of test point "2". The normal voltage range is $+0.02$ to $+8.5 V_{DC}$
If no voltage is present at test point "2" Check wire connections. If wire connections are good. The regulator card may need to be replaced.

If this plug is not connected or reversed the motor will run away. The correct sequence is red wire right (H) and white wire left (N). See bottom of page 39 for details.

If field amperage is insufficient, the motor may not start. Check if the field voltage is some were about right. For a motor with a 300V field, when the motor is cold the field voltage is typically some were between 200V to 300V. If the voltage is too low the field maybe in the early stages of failing.

Line L1 and L2 must be connected respectively to L1F and L2F. If these connections are not correct, the field voltage will be too low, causing the motor to run fast.

See section page 9, Elementary Power Connection Diagram

Check if SF, TG, TL and S1-S4 are set right and the continuity is good.

The speed potentiometer is connected to regulator card terminals 7, 8 and 9. An error will cause a variety of problems, including motor run-away. Read section 4.7 on page 16 to correct this problem.

Section 7.5) Problem: Fuses blow immediately after start and the "OC" light is on.
 Alternately, The "OC" light comes on when the power is switched on.

Section 7.5A) Problem: SCR Troubleshooting, see SCR failure, highlighted in yellow.

Check the following:

- The DC armature circuit is shorted.
- The motor is stalled or locked.
- SCR failure (i.e. Thyristor)
- Improper setting of amperage limit (i.e. current limit) or over amperage protection circuits.
- Measure voltages of test points "1" - "6".
- On the sync card measure the resistance between CT1R & CT1W and CT2R & CT2W on the SYNC card.
- Rapid load change or motor commutator flash-over.
- Check for the presence of a surge during the operation of the external contactor or relays.

Recommendations:

- Check the DC power circuit.
Meggering the motor maybe required.
- Check the load on the machine and if the movement is locked.
- View the SCR modules for damage, often black burned material is visible in the area on the sides of the SCR modules. Upon closer examination, you will find a hole or holes on the side of the failed SCR module. Sometimes the SCR package may not have visible signs of failure. This makes identifying the failed SCR problematic. Measuring the SCR gate resistance can provide a useful clue identifying the failed SCR. The SCR gates are connected to the Pulse Card. Measure the resistance at the plug, it is typically between 15 ohms to 25 ohms.

Example: If the gate measures 2 ohms, it is definitely bad, if it measures 10 ohms, it is suspect or if it measures 30 ohms, it is also suspect.
- Check if jumpers A1-A4 are set right and the continuity is good. Read the section about armature amperage adjustment.
- If voltage is present when the motor is stopped the regulator card may need to be replaced.
- The normal resistance is only a few ohms or less. If the circuit is open or the resistance is high. The CT may have failed
- Check the machine load and if the motor commutator has electrical arcing (flash-over).
- If a surge is present, install a line reactor.

Section 7.6) Problem: Unstable Speed

Check the following:

- Measure the regulator card test points "+" and "-" to "com".
- Measure the voltage of regulator card test point "4"
- Unstable field voltage.
- Improper installation of the tac generator or the tac-brushes are worn.
- Unstable Input Power
- Improper adjustment of "SR" or "SG".
- Excessive field weakening.
- Repetitively exceeding current limit.
- SCR has failed
- Ribbon Cable
- Pulse Card (this is rare)

Recommendations:

- The normal voltages are +15V_{DC} and -15V_{DC} respectively. If they are not nominal the SYNC card may need to be replaced.
- If there is any variation. Check the speed pot wiring.
- If both the regulator card jumper 7 is on and jumper VF is on, the speed will be unstable. Read the sections 5.8 and 5.9 on page 25 about Armature Feedback and Tac-Generator Feedback.
- Check the tac-generator's brush wear.
Check the tac's mounting, coupling and wiring.
- Check for unstable input power voltage, L1, L2 and L3. If the voltage is unstable the problem must be corrected.
- See page 30, section 5.19
- Field weakening applications. The field should not go below 1/3 to 1/6 of normal full field.
Example: Full field is 300V_{DC} . Field weakening to 100V_{DC} or less will cause unstable motor speed. A special regulator card PN 1059A-11 is required.
- The drive is repeatedly exceeding current limit. The factory default settings permits one minute of operation at 150% of current limit.. Or 110% for ten minutes. Then the speed is reduced to 100% current limit. After several minutes the current is permitted to go back up to 150% for one minute. This process will repeat indefinitely.
- A SCR has failed and must be replaced.
Note: If one SCR failed with 480V_{AC} input voltage, the armature will not exceed 458V_{DC}.
- Inspect the ribbon cables connecting the regulator card to the sync card and pulse card. Check that the ribbon cable plugs are seated properly in to sockets or if the ribbon cable is damage. The ribbon cable connecting the regulator card to sync card is the more likely problem. For more information see section 7.22 on page 60.
- For information about pulse card trouble shooting see section 7.22 on page 60.

Section 7.7) Problem: Motor will not go to full speed.

Check the following:

- Insufficient voltage.
- Phase Loss
- Insufficient amperage.
- Measure voltage of test point "4"
- Measure 3 phase input voltage.
- Improper calibration of speed meter
- Field amperage is too high.
- Load exceeds the motor's rating.

Recommendations:

Adjust the "MAX" pot. (Do not exceed motor's rating)

Three possible reason for phase loss.
 One fuse has blown.
 One SCR has failed.
 One input phase is lost due to external fault.
 With 480V_{AC} input power if one phase is missing the armature voltage will not exceed 460V_{DC} typically caused by one of the above problems.

Read pages 28 and 29.

Normal is about 8 volts or in reverse -8 volts.

Should be within ±10%

Check the speed with another speed meter for comparison.

Check the field amperage with the motor's data plate. The field amps are the priority, the field voltage normally varies with temperature.

Section 7.8) Problem: Excessive overshoot and undershoot.

Check the following:

- The acceleration or deceleration time is too short for the load's large inertia.
- Excessive overshoot, undershoot and unstable level speed.

Recommendations:

Adjust "ACC" or "DEC" pots.
 Read page 26, section 5.10 Acceleration and Deceleration Time Adjustment

Improper adjustment of the speed regulation loop.
 Adjust "SR", "SG" and "PI" pots. Read page 30 and 31, sections 5.19, 5.20 and 5.21

Section 7.9) Problem: "OL" signal light (Over Load)

Check the following:

- Overload of motor.
- Check field amperage.
- Improper setting of "IA" pot.

Recommendations:

The "OL" signal light may turn on if an intermittent load exceeds the square root mean value of 100%.
 Check the intermittent load of the motor.

Low field amperage reduces the power of the motor.

Read pages 28 and 29 sections 5.15, 5.16, 5.17 and 5.18

Section 7.10 Problem: The ES, OH, LVL signal lights are on and can not be reset.

Check the following:

The CN1 plug on the Regulator card.
The SYNC card maybe loose.

Recommendations:

Check if plug CN1 is properly plugged.

On the regulator card, check voltage terminal 35 to +B and terminal 38 to +B. The voltage should be $25V_{DC} \pm 3V_{DC}$

If $25V_{DC}$ is not present the single phase $120V_{AC}$ transformer may be damaged, check the transformer. If the transformer is good, the SYNC card should be replaced.

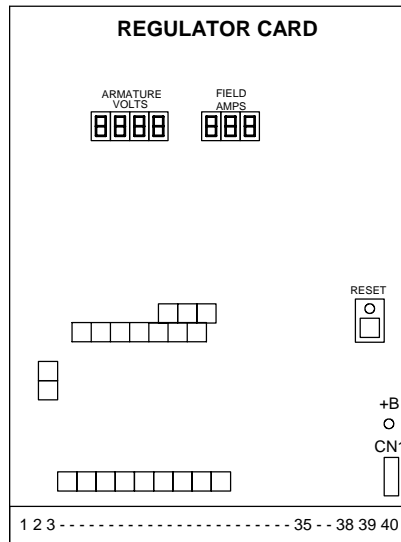
Section 7.11) Problem: Signal lights R and PC are on, the F, AP, ZD flash and the relays buzz.

Check the following:

Check the armature connections.

Recommendations:

The armature circuit is bad or intermittent. Trouble shoot and correct the problem.



Section 7.12) Problem: The armature amperage is too high at low speed with small load.

Check the following:

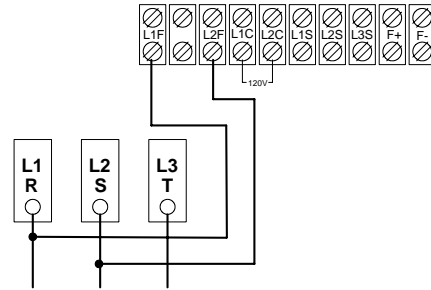
Read the field specifications on the motor's name plate. Then measure the field current and voltage to determine if they comply with the specifications.

Note: Remember to disable field economy when measuring the field. Field economy is disabled by placing the FE jumper on.

Recommendations:

One of three problems are possible:

1) If the field input power is incorrectly connected. The field amperage will be too low. The motor will draw too many amperes during start and run too fast if the load is not large. Common mistakes are L3 is connected to L1F or L2F or the single phase 110V ~ 120V is connected to L1F and L2F. The correct connections are shown below.



2) The field insulation is deteriorating and beginning to fail. The current is jumping from one winding to the next. The field is controlled by an amperage regulating circuit. The amperage is normal but not making enough ampere turns. This results in the field being too weak, replace the motor.

3) If the motor was recently rewound and the motor starts normally but after reaching a speed then starts to draw to many amps. Then one of the field poles is the wrong polarity. The company that rewound the motor can correct this problem.

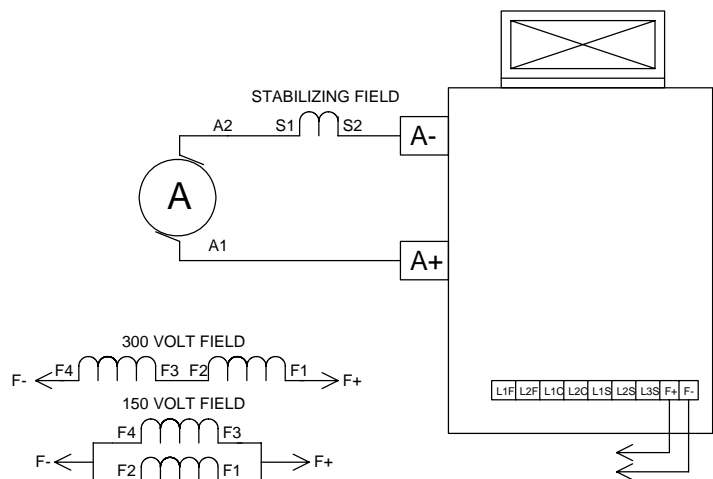
Section 7.13) Problem: During acceleration or heavy load the field amperage is too low.

Check the following:

Check the motor terminal box for leads S1 and S2. The letter "S" stands for Stabilizing field. Not all motors have leads S1 and S2. If S1 and S2 are present and not connected, the diagram to the right shows how to connect them. If the motor doesn't have leads S1 and S2, then the stabilizing field is connected internally.

Diagram

Elementary Motor Connection Diagram



Section 7.14) Problem: FL light is on (Field loss is detected)

Check the following:

Check the motor's data plate field specifications. Measure the field amperage and voltage to determine if they are within specifications.

Note: Remember to disable field economy when making field measurements.

Recommendations:

If the field current is too low and the voltage corresponds to the field resistance. The IF pot or F jumper is set too low.

If the field current and voltage are correct. The IF pot or F jumper could be set too high.

If the field will not adjust high enough regardless of the IF pot or jumper setting. The power connections to L1F and L2F are incorrect, check the phasing

Note: The field is a amperage regulation circuit, but the field voltage will not exceed 70% \pm 5% of the AC voltage connected to terminals L1F and L2F.

Note: If the field amperage is below 13% the of what it should be, FL light will switch on.

Example: The Statohm 5 drive, model 42NS-1-4, jumper F1 is on and the IF pot is adjusted to full (10/10) the amperage should be 7.1 amps.

The motor data plate reads, field 0.83A and 281 ohms at 25°C. When the motor warms up the field resistance will increase and stabilize somewhere about 360 ohms.

When the motor is cold, the drive will apply full voltage to the field attempting to reach 7.1A, the field voltage will be above 300V, the amperage will exceed 14 % of 7.1A.

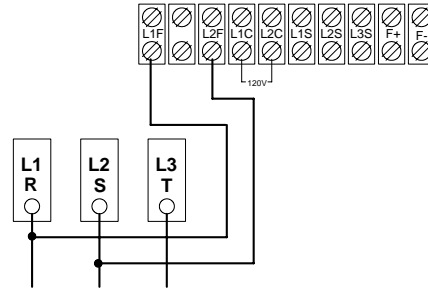
As the motor warms up the field resistance increases and the amperage decreases. When the field amperage goes below 0.92A (13% of 7.1A) the FL light will switch on and the motor will stop.

The best setting for a motor with 0.83 amp field would be jumper F5 (0.6 ~1.2 amps).

Section 7.15) The red “FL” light is dimly lit but field loss is not detected

Check the following:

An error was made connecting power to the field. Line 3 (L3) is connected to either L1F or L2F. The correct connections are shown in the diagram to the right.



Section 7.16) Regulator Card Connections and Motor Speed Adjustment is Abnormal

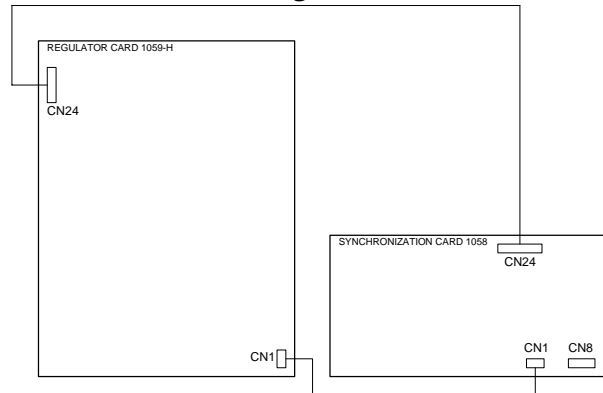
Warning !

Incorrect connections will irreparably damage the regulator card and synchronization card. Carefully refer to the diagram to ensure correct connections.

Problem: Motor Speed Adjustment is Abnormal:

Inspect all ribbon cables for damaged and if they are securely plugged in to the receptacle. Damaged ribbon cable result in variety abnormalities. Often motor speed adjustment becomes unpredictable.

Diagram



Section 7.17) Problem: The PH light is on

Check the following:

Several problems are possible.

1) Power lines L1, L2 and L3 should be connected respectively to terminals L1S, L2S and L3S. See the diagram to the left.

Also check the plugs on the synchronization card. L1S goes to R4 (red wire) L2S goes to S4 (white wire) L3S goes to T4 (blue wire). See diagram to the left.

2) Possibly transformers TR1, TR2 or TR3 has failed. Disconnect leads to terminals L1S, L2S and L3S and measure the resistance between these terminals. The normal resistance should be $1.4k\Omega, \pm 10\%$. Also visually inspect the transformer wires connecting to the sync card for breakage.

3) Look at jumpers J4T, J3T and J2T located above the transformers. Check if any of these jumpers are missing or was placed on incorrectly.

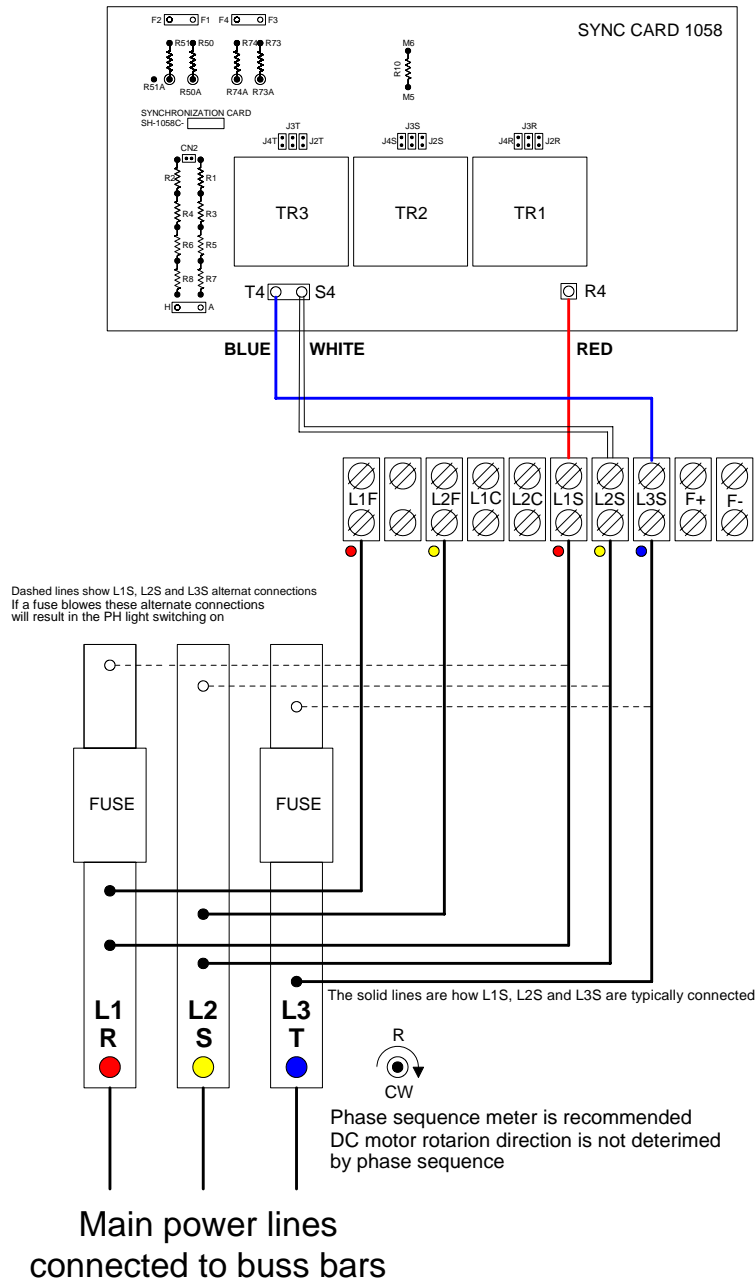
4A) When the motor is running if the PH light switches on. The phase load may not be balanced. The most common reason for this problem is unequal phase voltage. This occurs when the voltage of one phase is 25% below the others. This problem is often caused by loose power connections.

4B) When the motor is running if the PH light switches on. The SCR's may not be phase correctly. Read sections 6.1 and 6.1A.

5) If L1S, L2S and L3S are alternately connected. Alternat connections are shown as dashed lines in the diagram to the left. If a fuse blows the PH light will switch on.

6) On rare occasions the incoming power is faulty. Shut off the power, disconnect L1, L2 and L3 form the drive and connect them to a AC motor, 5HP or more should be sufficient. Switch on the power, if the motor does not run or does not run normally, then the incoming power is faulty.

Diagram



If new installation results in PH light on. Then check that the phase sequence red, yellow, blue is CW or R. If you don't have a phase sequence meter. Then make certain L1S, L2S, L3S, L1F and L2F are correct, Next don't change them, only exchange main power lines L1 and L2.

Note: The PH light does not detected SCR failure.

Section 7.17 continued) Problem: The PH light is on

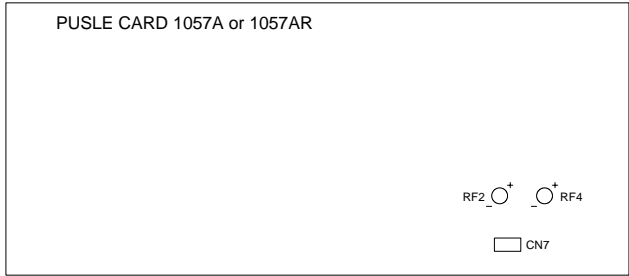
7) The Pulse Card number 1057A or 1057AR may have failed.
 Note: Pulse Card failure is unusual.

Measure the DC voltage of diode modules RF2 and RF4. It should be between 22VDC to 26VDC.
 If no voltage is present then measure the AC voltage of plug CN7, it should be 18VAC to 20VAC.

If CN7 has good voltage then the pulse card has failed.

If CN7 voltage is bad, then investigate the blue and white twisted pair wires that go to transformer part number 2021-L. Transformer failure is very rare. It is much more likely the wires are damaged.

Diagram



Diodes RF2 and RF4 voltage should measure between 22VDC to 26VDC

The blue and white wires plugged into CN7 voltage should measure 18VAC to 20VAC

Section 7.18) OC light switches on immediately when starting

This could be a phase sequence problem. It is possible to have the phase sequence wrong and not have the PH light switch on. See section 7.17 on page 56 for more information.

Section 7.19)

The MAX pot or CROS pot will not adjust up to full armature voltage.

Example:

The input voltage is 480V_{AC}, the armature should be 500V_{DC}. But the MAX pot or CROS put will not adjust the armature voltage above 460V_{DC}.

1) Check the input voltage

Check the voltage of L1, L2 and L3.

2) Check the fuses

If the fuses are good, the next possibility is SCR failure.

3) Check the SCR's

Recommendation A,

Use a AC clamp on ammeter to check if each phase is drawing amps. If a phase is not drawing amps, the SCR module in that may have failed or is not receiving a gate signal. Note: Often clap on meters don't read small amperages.

Recommendation B,

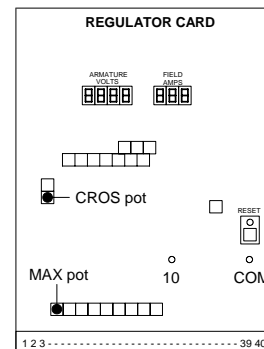
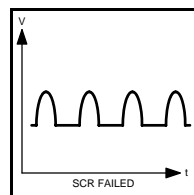
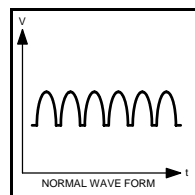
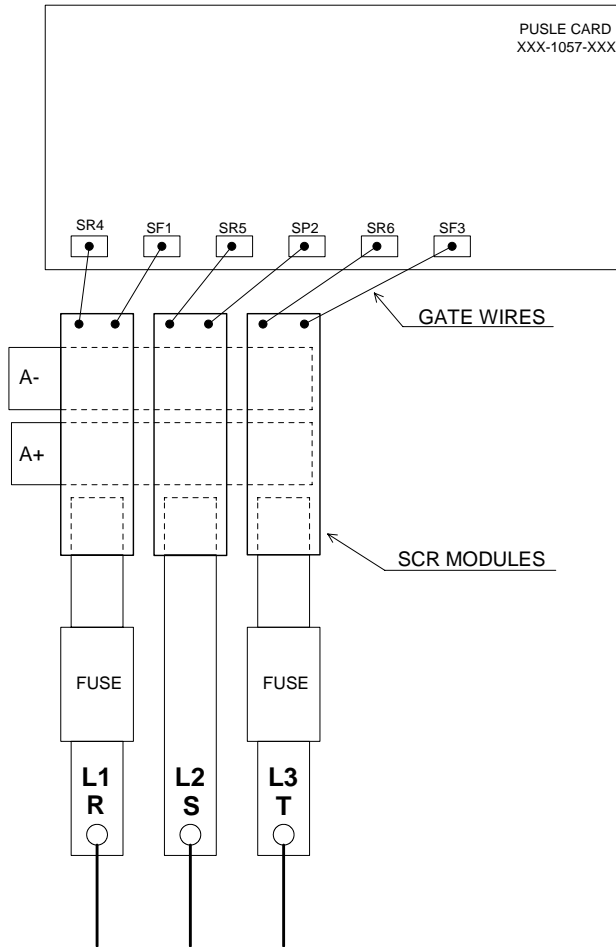
Look at the SCR modules, located under the synchronization card. If you see blacken area near a module, look to see which module has a hole on the side.

Recommendation C,

Check the gate wires connected to the SCR modules and the pulse card.

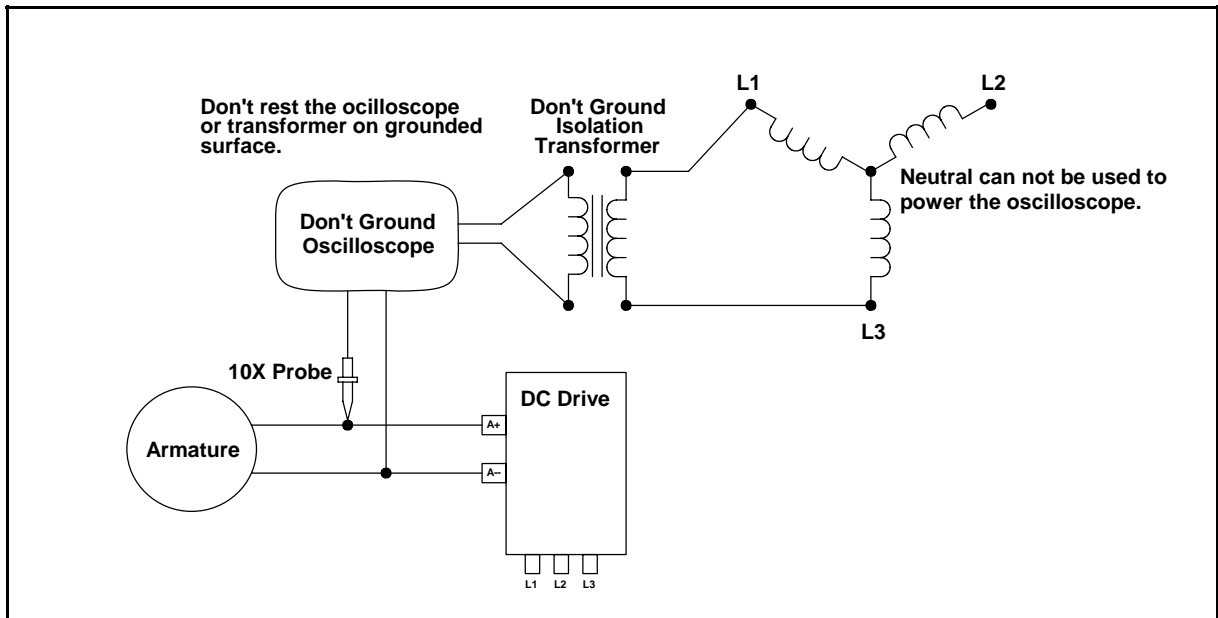
Recommendation D,

If recommendations B and C look good. Connect a oscilloscope to regulator card test points 10 and COM. Then run the motor at full speed and look at the wave form. If there is a large space between the waves, a SCR has failed or is not being switched on.



Section 7.20) Oscilloscope connected to armature or field

Viewing the armature voltage with a oscilloscope requires special care. The oscilloscope can not be grounded. The oscilloscopes power can not be grounded or connected to neutral. The oscilloscope and isolation transformer can not rest on a grounded surface, such as the floor or metal electrical enclosure. Resting the oscilloscope and transformer on a non-conductive surface such as sheet of plywood or thick card board often provides sufficient isolation from ground. A expensive oscilloscope is not require, a inexpensive CRT oscilloscope is recommended.



Viewing the field voltage with an oscilloscope also requires the same special care plus additional precautions. Before starting the motor, first view the field voltage to ensure the oscilloscope is set up correctly. Take extra precautions so that the field can not be accidentally grounded while the motor is running. If the field were to be accidentally grounded while the motor is running will result in catastrophic damage to the motor and the drive, that would requiring replacement of the drive and expensive repair or replacement of the motor.

Section 7.21) Problem: The FU light is on

Check the following:

If pressing the reset button on the regulator card does not clear the FU light, then several problems are possible.

- 1) First and most obvious is a fuse has blown and needs to be replace.
- 2) When the fuse was replace possibly wires F1, F2, F3 and F4 were not connected correctly. See the diagram to the right for the correct connections.
- 3) If the wire connections appear to be correct and the FU light problem continues. Unplug the wires from the Synchronization card and then switch on the power. If the FU light is off, then the problem is in the fuses or the wiring.

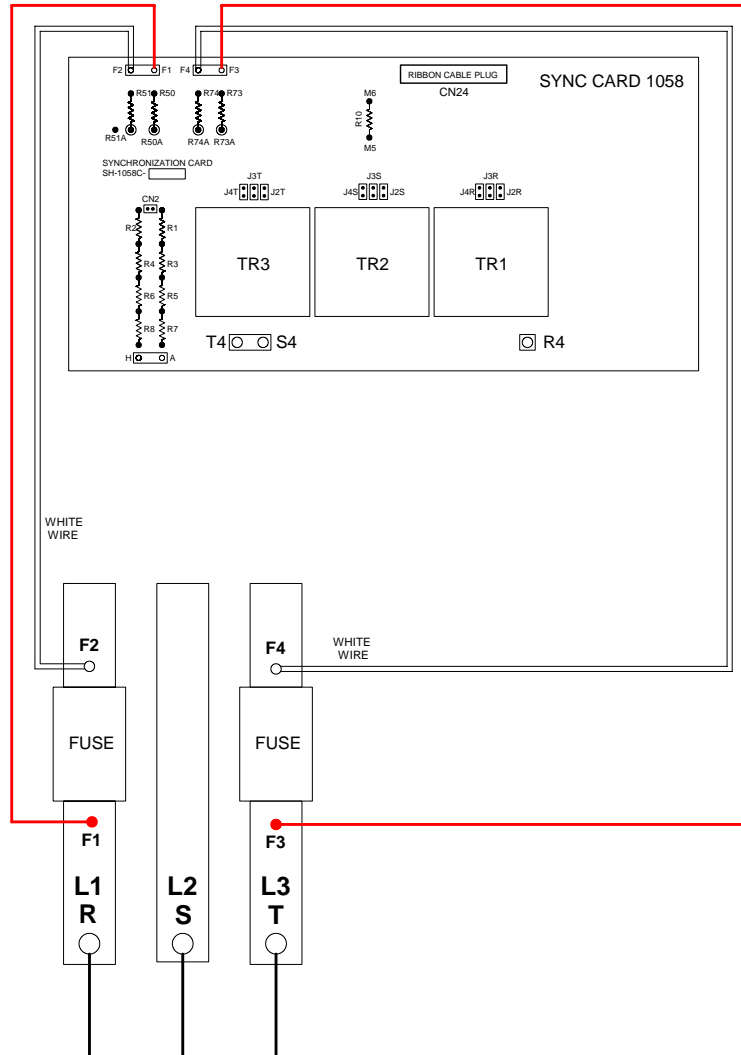
If the FU light is on, then the problem is one of the following:

The Synchronization card

The Ribbon Cable connecting to the Regulator Card.

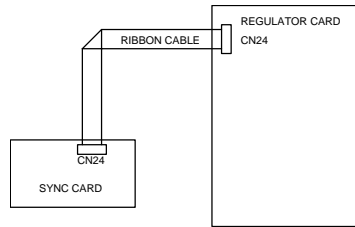
The Regulator card, this is unlikely.

Diagram

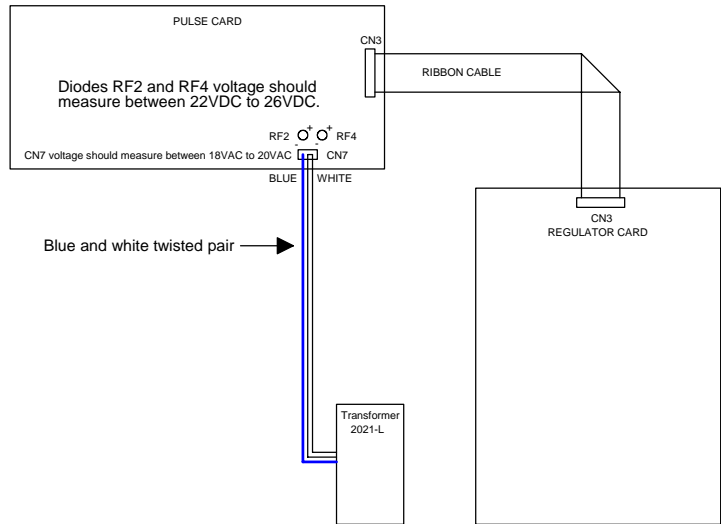


Section 7.22) Problem: The drive is running too fast or slow, erratically or is pulsing

1) If the drive speed is unstable or too fast or slow in relation to the speed pot position. This could be a faulty ribbon cable plugged into CN24 on the Regulator card and the Sync card. See diagram to the right.



2) If the drive is erratic, the pulse card maybe the problem. Measure the DC voltage of diode modules RF2 and RF4, see the diagram to the right. If the voltage is incorrect, measure the AC voltage of the plug CN7.



If the voltages are correct, then replace the ribbon cable plugged to CN3 on the Pulse card and Regulator card.

3) The drive is pulsing, this is often a SCR in the early stages of failure. Trouble shooting SCR requires expensive test equipment. Call Electric Regulator for advice. Tel. 760-438-7873

4) The drive is not running smoothly. This could be the tac-generator brushes are worn down and need replacing. Also check the DC motor brushes, they should be replaced regularly.

5) Less likely problems are:

The motor starts and runs normally, then after warming up, it runs too fast. The motor field insulation is failing.

The motor runs at normal speed then when a load is applied it slows down. The armature windings are slowly burning out.

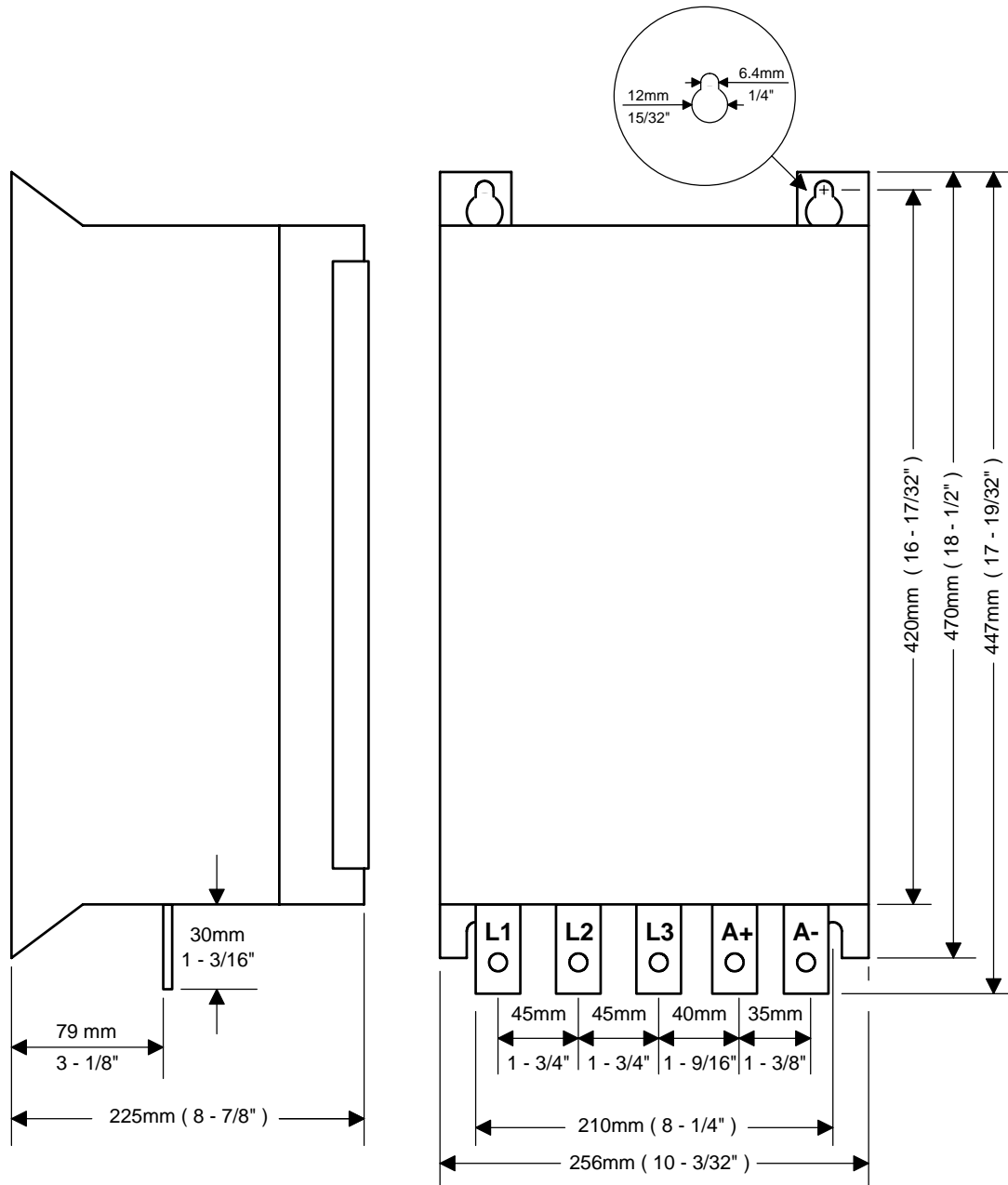
Improper tac-generator coupling

Insufficient gain of the ACR amplifier.

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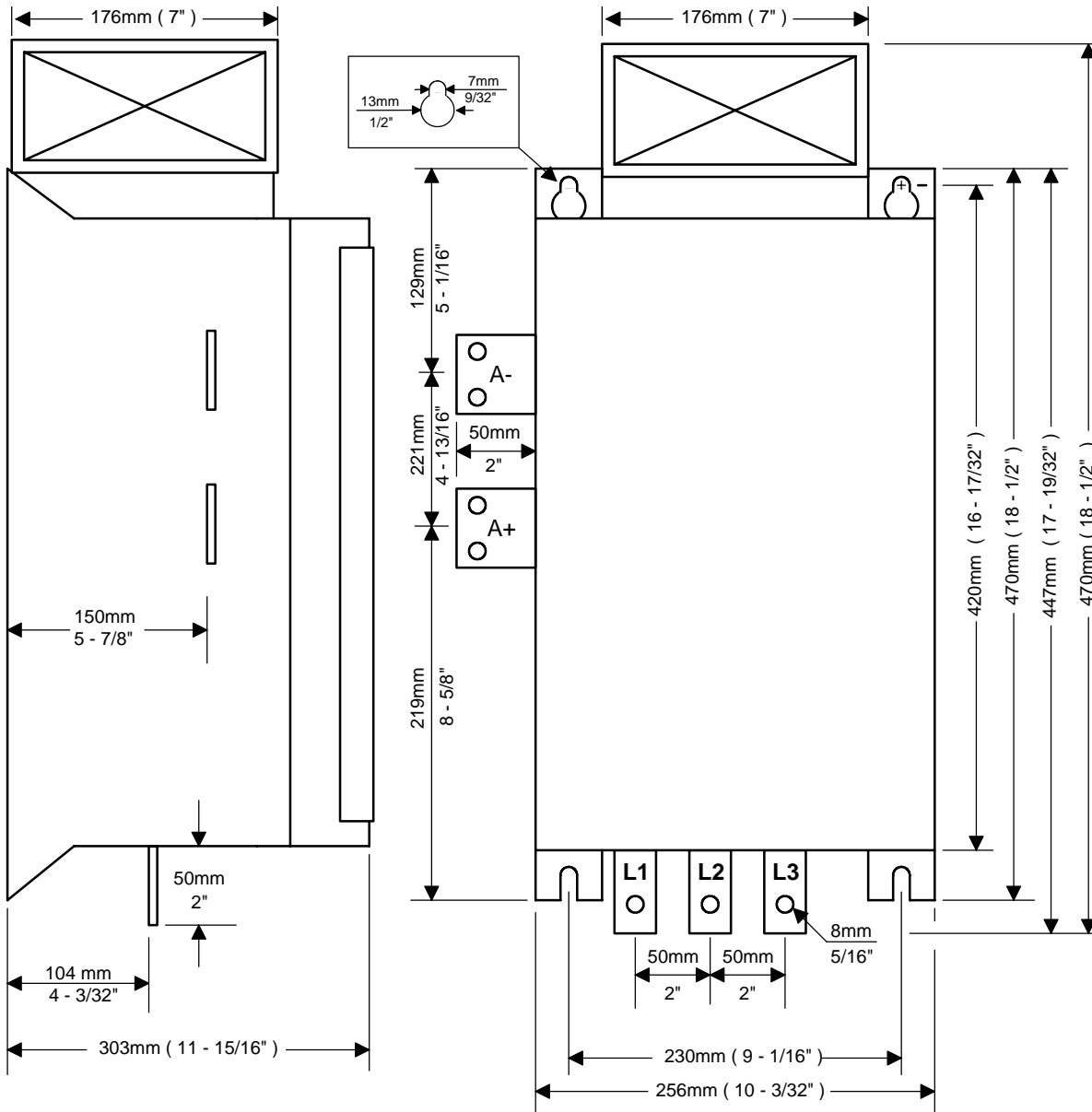
S Model Chassis

Model Number	Maximum Armature Amps	240 V _{DC} Arm Max., HP	500 V _{DC} Arm Max., HP
DC42*S-1-*	31 A _{DC}	7 ½ HP	15 HP
DC42*S-2-*	70 A _{DC}	15 HP	30 HP
DC42*S-3-*	110 A _{DC}	25 HP	50 HP
DC42*S-4-*	180 A _{DC}	50 HP	100 HP



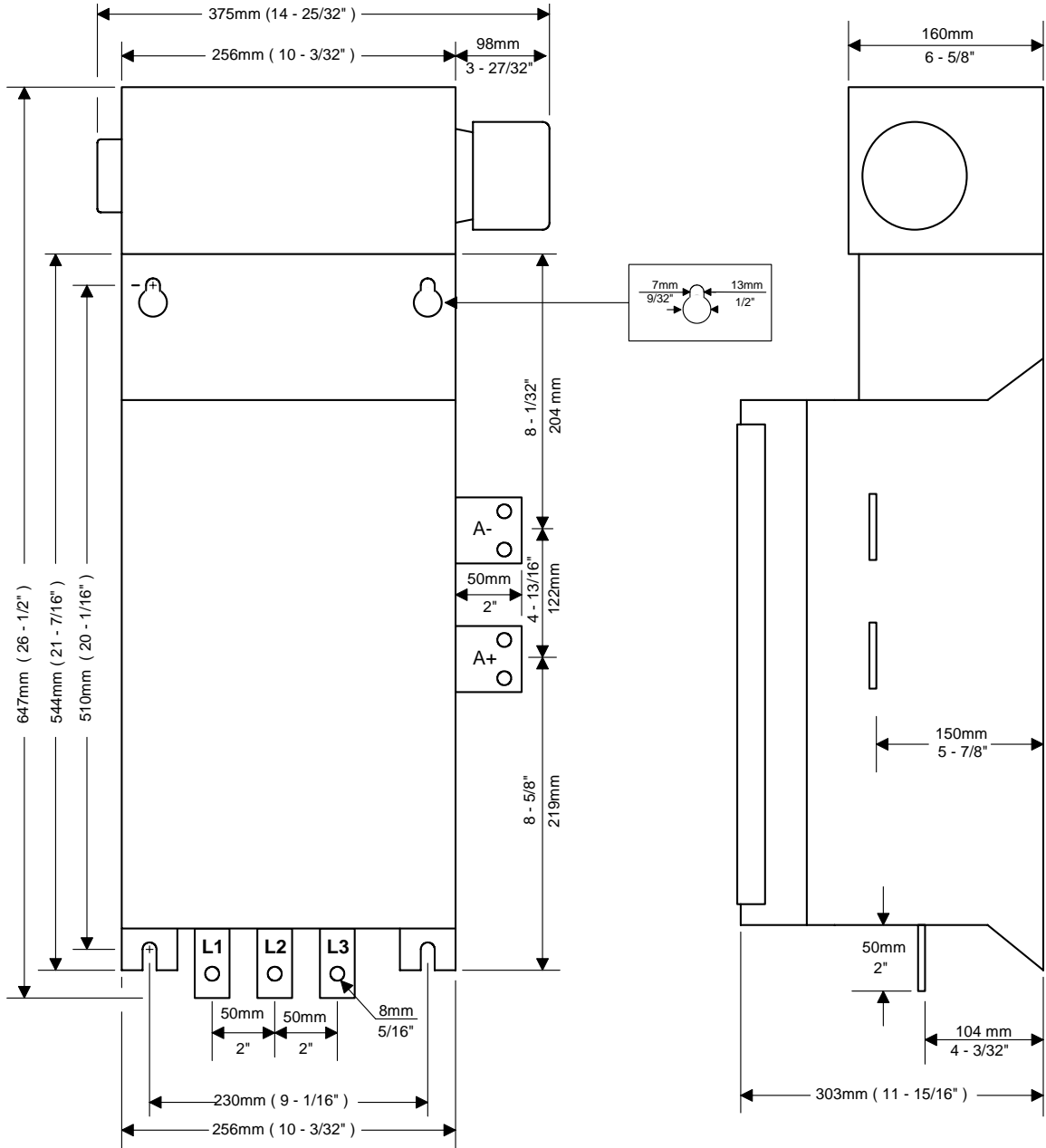
M-2 Model Chassis

Model Number	Maximum Armature Amps	240 V _{DC} Arm Max., HP	500 V _{DC} Arm Max., HP
DC42*M-2-*	400 A _{DC}	100 HP	200 HP



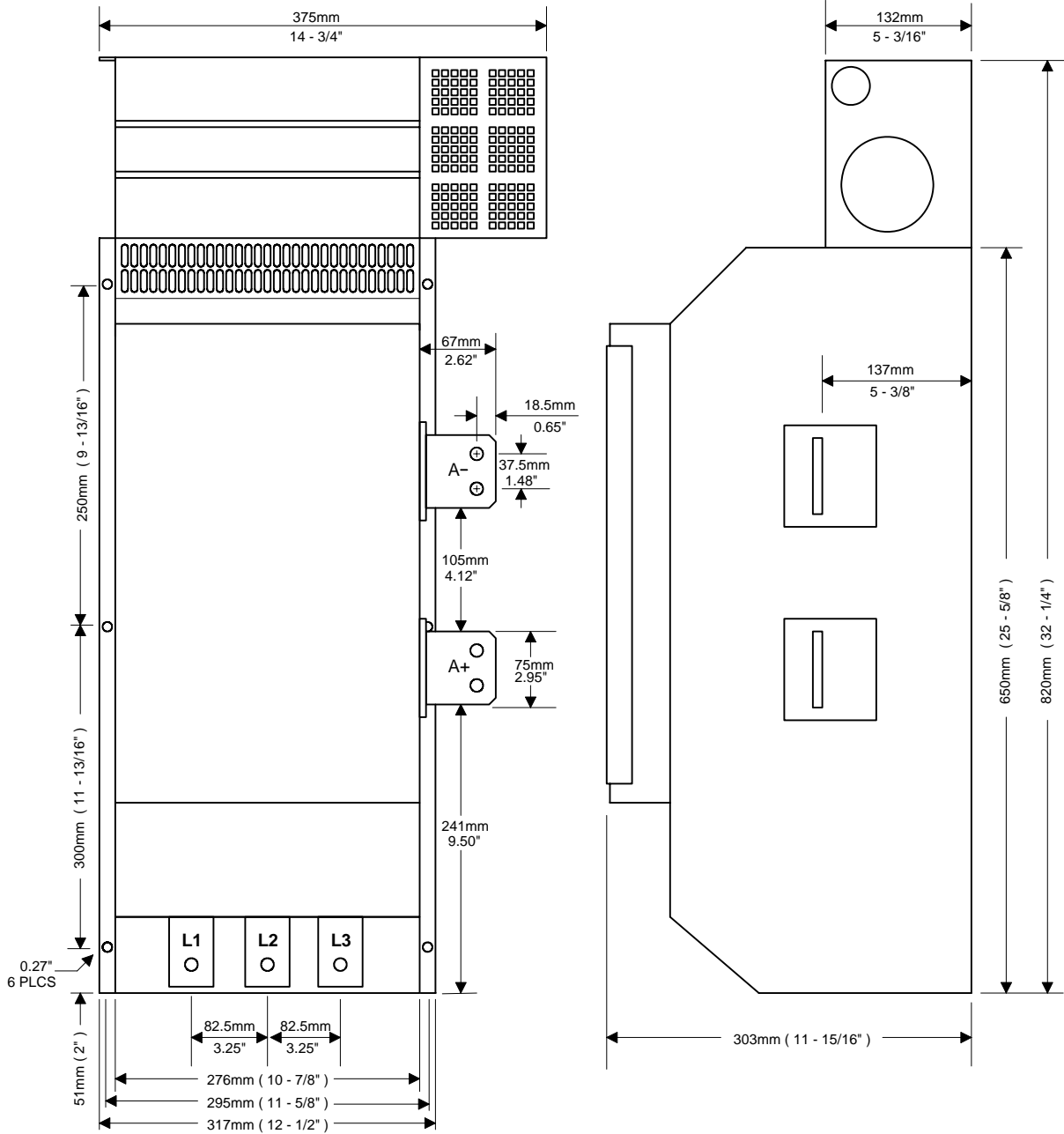
M-3 Model Chassis

Model Number	Maximum Armature Amps	240 V _{DC} Arm Max., HP	500 V _{DC} Arm Max., HP
DC42*M-3-*	550 A _{DC}	150 HP	300 HP



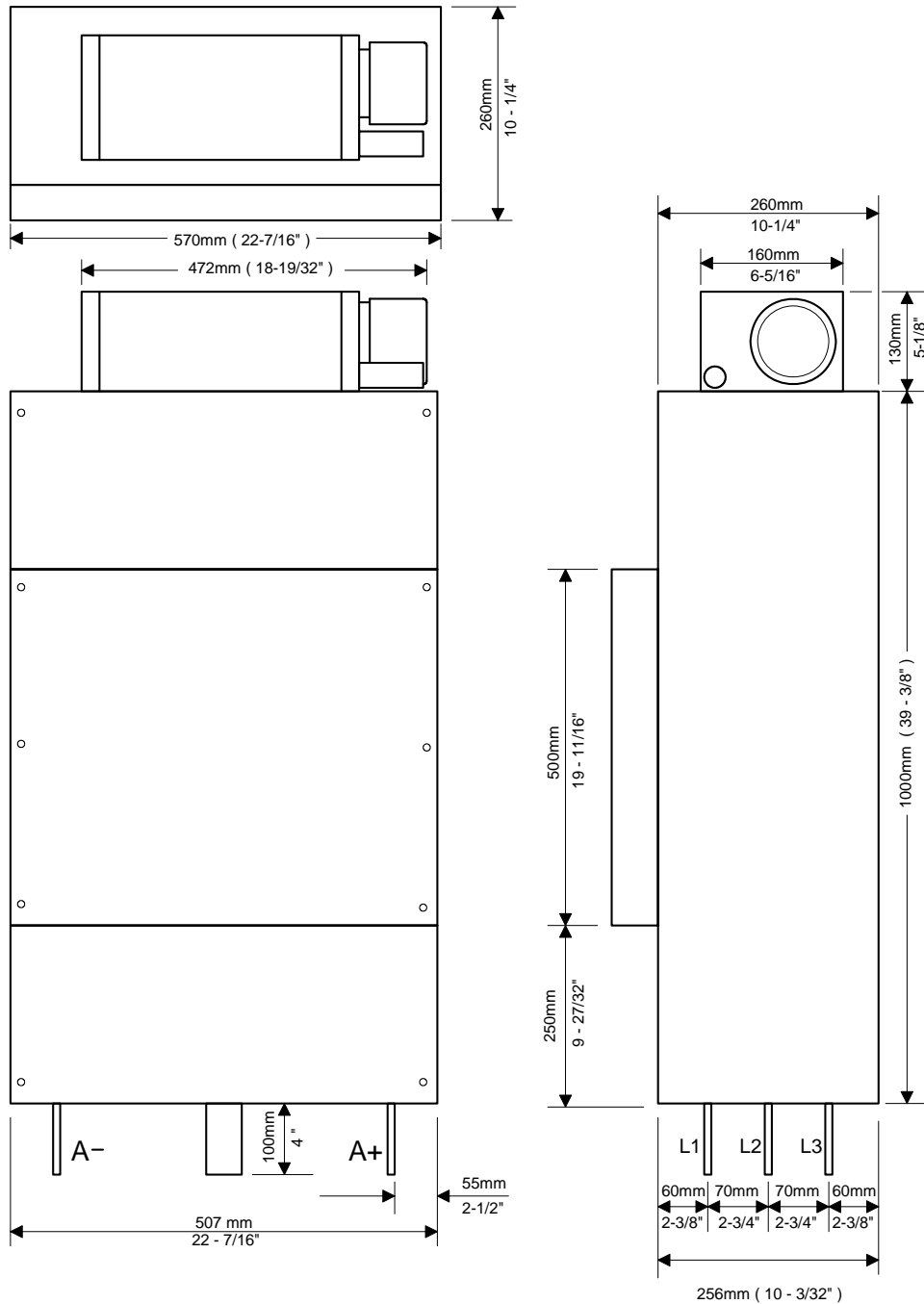
L-1 Model Chassis

Model Number	Maximum Armature Amps	240 V _{DC} Arm Max., HP	500 V _{DC} Arm Max., HP
DC42*L-1-*	720 A _{DC}	200 HP	400 HP



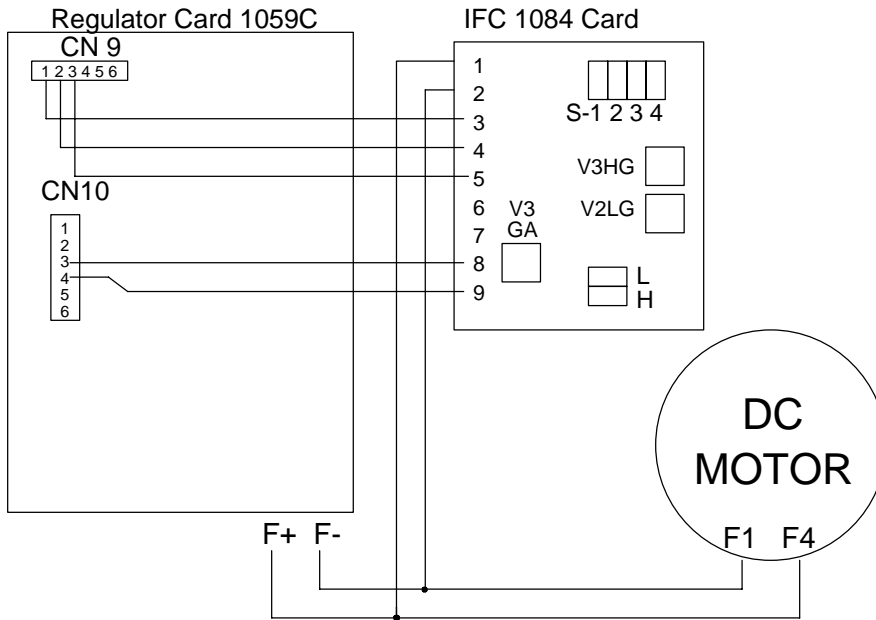
L-2 Model Chassis

Model Number	Maximum Armature Amps	240 V _{DC} Arm Max., HP	500 V _{DC} Arm Max., HP
DC42*L-2-*	910 A _{DC}	250 HP	500 HP



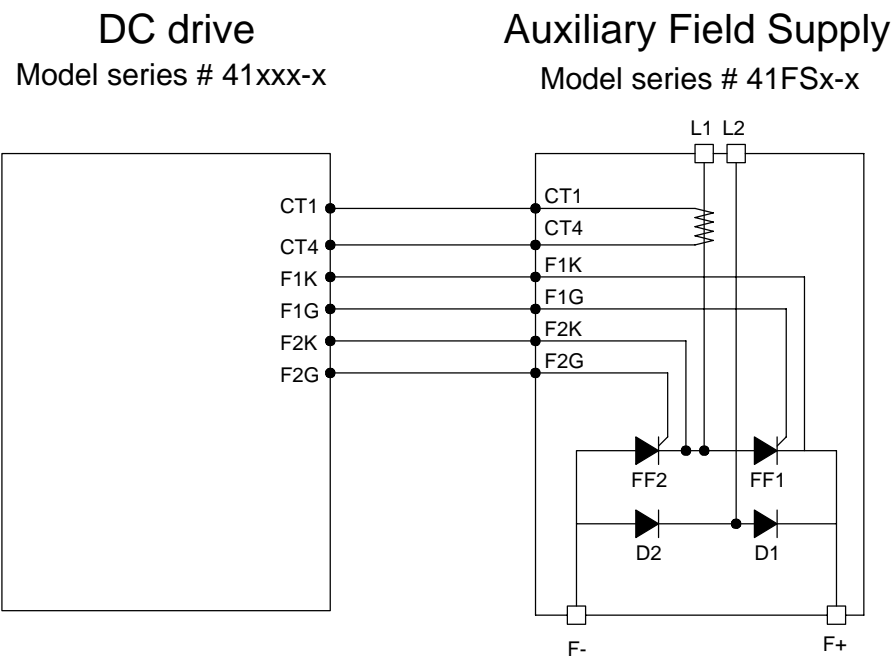
Section 9.1) IFC 1084 card connections (Optional Accessory)

The IFC 1084 is for field voltage regulation.



Section 9.2) 41FS Auxiliary Field Supply for High Amperage Fields

The 41FS is an option for motors with high field amperage.



Section 9.3) The Synchronization Card 1058C (i.e. SYNC CARD 1059C) can be change to work with different model drives and input voltage by changing jumpers on the sync card, regulator card and the R10 resistor.

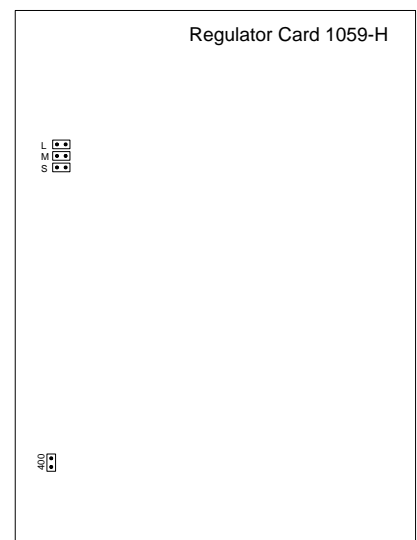
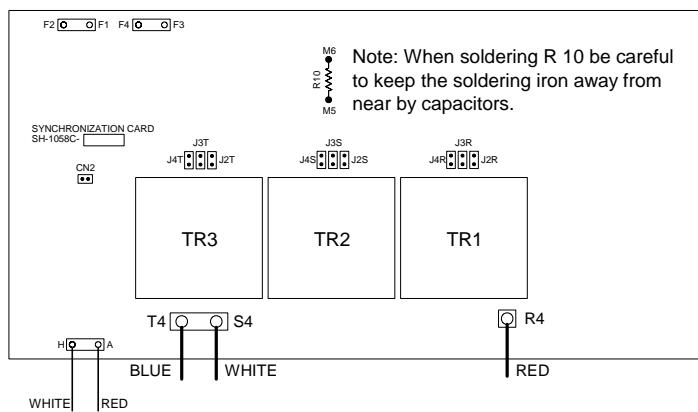
Part Number	Input Voltage	Armature Voltage
1058C-01	200V ~ 240V	240V
1058C-02	400V ~ 480V	500V

Input Voltage 200V ~ 240V, 3PH Armature 240V

Model Number	Resistor R10	Transformers TR1, TR2, TR3 Jumpers	Regulator Card 1059-H Jumpers
42NS1-2 42RS1-2	66.5 ohm ½ watt, tolerance +/- 2%	J2T, J2S, J2R - ON J3T, J3S, J3R - OFF J4T, J4S, J4R - OFF	Jumper 400 - OFF Jumper S - ON Jumpers M and L - OFF
42NS2-2 42RS2-2 42NS3-2 42RS3-2 42NS4-2 42RS4-2	47.5 ohm ½ watt tolerance +/- 2%	J2T, J2S, J2R - ON J3T, J3S, J3R - OFF J4T, J4S, J4R-OFF	Jumper 400 - OFF Jumper S - ON Jumpers M and L - OFF
42NM2-2 42RM2-2	28 ohm ½ watt tolerance +/- 2%	J2T, J2S, J2R - ON J3T, J3S, J3R - OFF J4T, J4S, J4R - OFF	Jumper 400 - OFF Jumper M - ON Jumpers S and L - OFF

Input Voltage 440V ~ 480V, 3PH Armature 500V

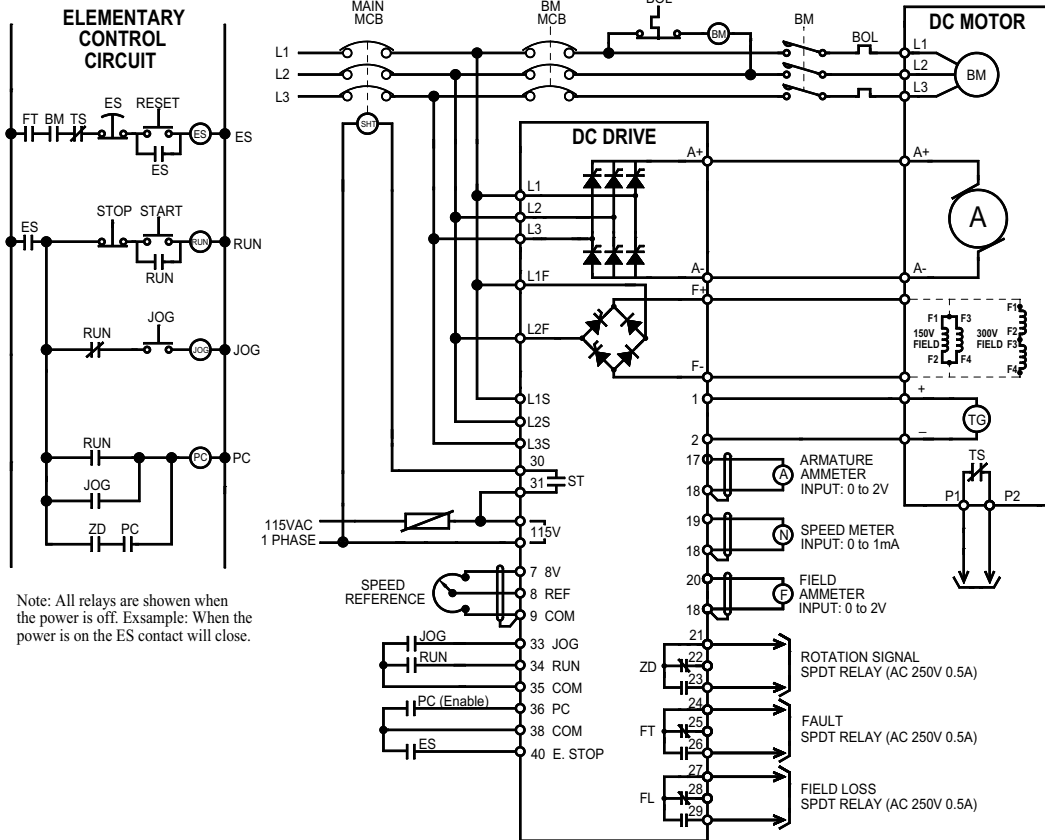
Model Number	Resistor R10	Transformers TR1, TR2, TR3 Jumpers	Regulator Card 1059-H Jumpers
42NS-1-4 42RS-1-2	66.5 ohm ½ watt tolerance +/- 2%	J2T, J2S, J2R - OFF J3T, J3S, J3R - OFF J4T, J4S, J4R - ON	Jumper 400 - ON Jumper S - ON Jumpers M and L - OFF
42NS-2-4 42RS-2-4 42NS-3-4 42RS-3-4 42NS-4-4 42RS-4-4	47.5 ohm ½ watt tolerance +/- 2%	J2T, J2S, J2R - OFF J3T, J3S, J3R - OFF J4T, J4S, J4R - ON	Jumper 400 - ON Jumper S - ON Jumpers M and L - OFF
42NM-2-4 42RM-2-4	28 ohm ½ watt tolerance +/- 2%	J2T, J2S, J2R - OFF J3T, J3S, J3R - OFF J4T, J4S, J4R - ON	Jumper 400 - ON Jumper M - ON Jumpers S and L - OFF
42NM-3-4 42RM3-4	19 ohm 1 Watt tolerance +/- 2%	J2T, J2S, J2R - OFF J3T, J3S, J3R - OFF J4T, J4S, J4R - ON	Jumper 400 - ON Jumper M - ON Jumpers S and L - OFF
42NL-1-4 42RL-1-4 42NL-2-4 42RL-2-4	19 ohm 1 Watt tolerance +/- 2%	J2T, J2S, J2R - OFF J3T, J3S, J3R - OFF J4T, J4S, J4R - ON	Jumper 400 - ON Jumper L - ON Jumpers M and L - OFF



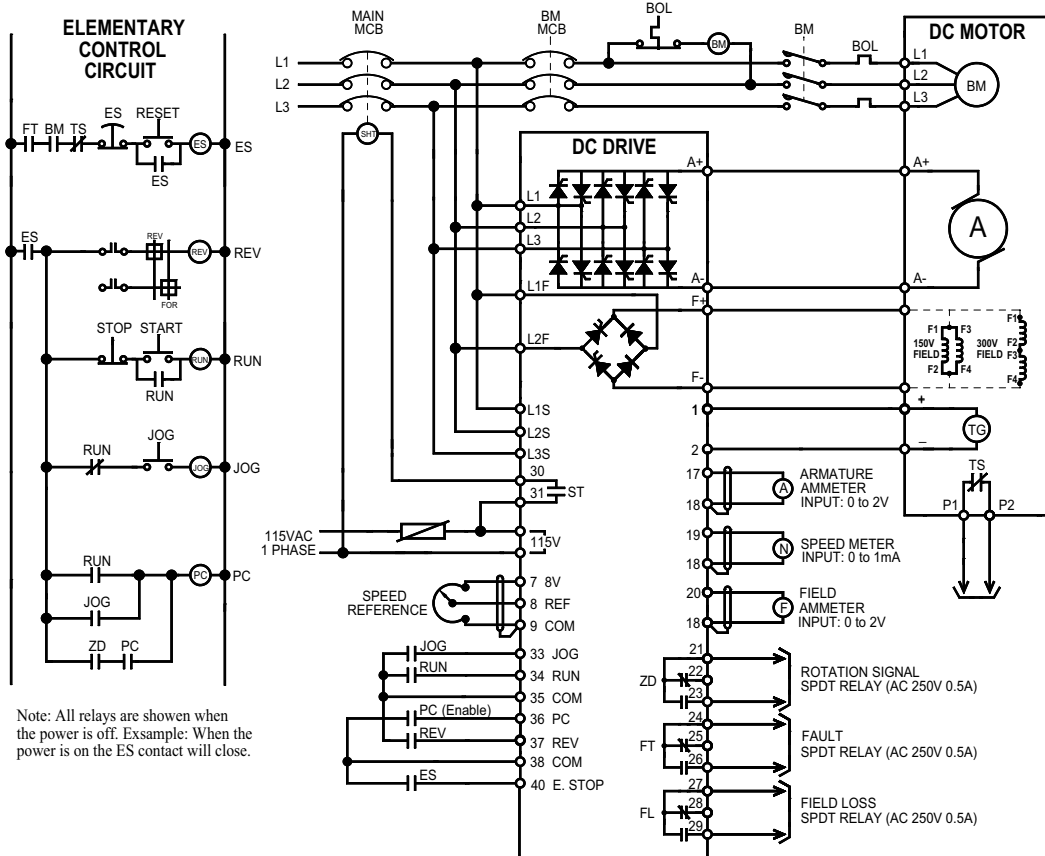
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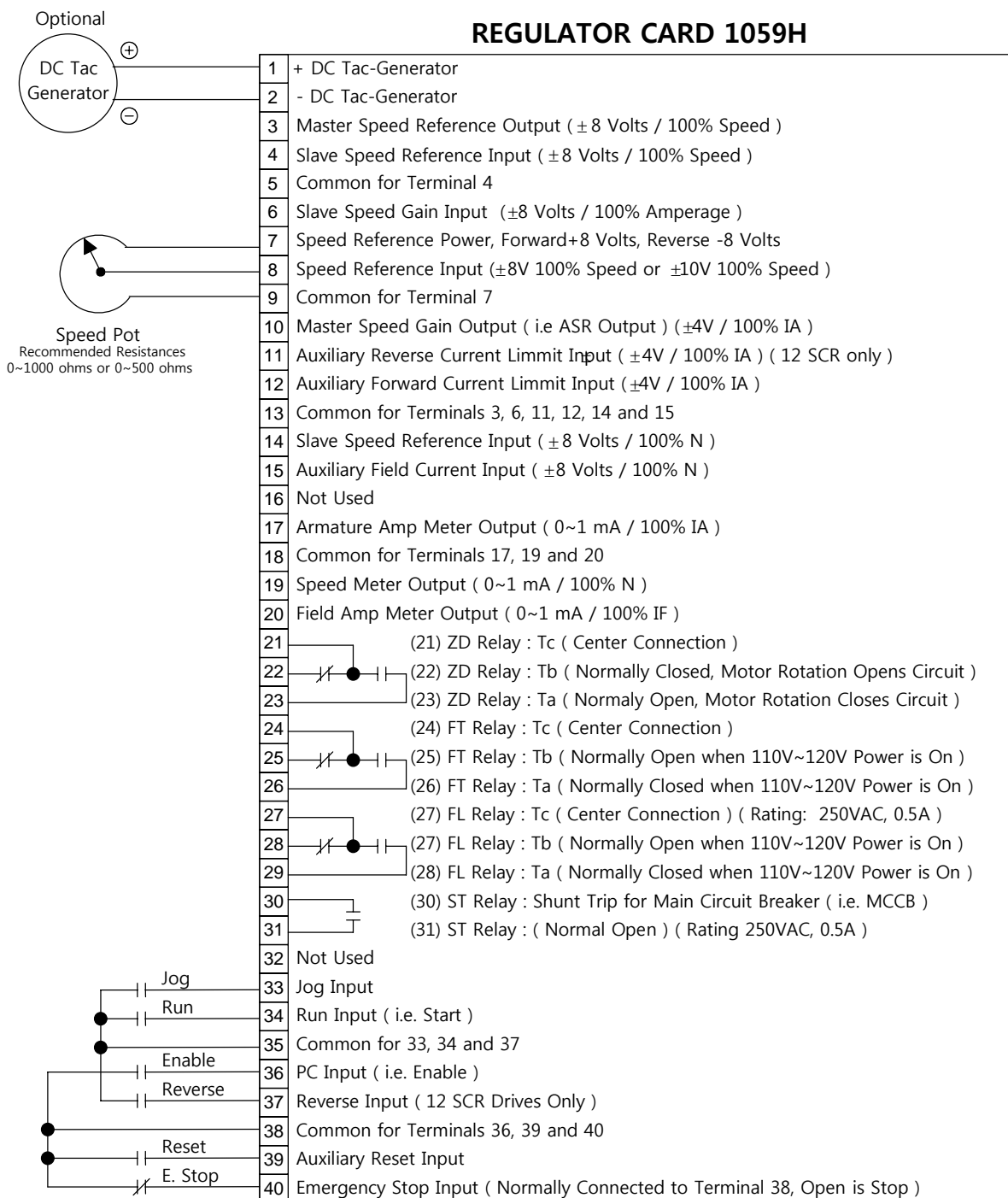
2 QUADRANT, 6 SCR



4 QUADRANT, 12 SCR, REVERSING & REGENERATIVE BRAKING



Regulator Card Terminals



Note: The voltage of terminals 33, 34, 36, 37, 39 and 40 should be equal to the voltage of test point +V

POTENTIOMETER TABLE

POT.	Description
5A*	Factory Reserve, Do not adjust.
ACC	Acceleration Time Adjustment
AM	Aux., Armature Ammeter Calibration Adjustment
CROS	Field weakening Crossover Point
DEC	Deceleration Time Adjustment
DG*	PID Lead Compensation (i.e. ASR Lead Comp)
FL*	Forward Ampere Limit (Forward Current Limit)
FT	E. Stop Decel (Jumper EF is on)
FM	Aux., Field Ammeter Calibration Adjustment
HS	Zero Speed Hysteresis
IA*	Current Limit (Maximum Armature Amperage)
IF	Field Amperage
IG*	Current Gain (Ampere Gain)
IMX	Armature Amperage Reference Point
JOG	Jog Speed
LV*	Low Input Voltage Shut Off Level (set at factory)
LIF	Field Amperage Meter Calibration (on Regulator Card)
LVA	Armature Voltage Meter Calibration (on Regulator Card)
MAX	Maximum Speed
NA	Aux., Speed Meter Calibration Adjustment
OP	ZD Relay Switch Point
PI*	PID
-R	For/Rev Speed Balancing
RL	Reverse Ampere Limit (Reverse Current Limit)
SG	Speed Gain (i.e. Speed Stability)
SR	Speed Response (i.e. Speed Overshoot)
P1*	1F/1R SCR Phasing Balancing
P2*	2F/2R SCR Phasing Balancing
P3*	3F/3R SCR Phasing Balancing
P4*	4F/4R SCR Phasing Balancing
P5*	5F/5R SCR Phasing Balancing
P6*	6F/6R SCR Phasing Balancing
ZERO	Zero Speed Adjustment (Minimum Armature Voltage)

Note: * We strongly suggest the user not change the factory setting.

RED SIGNAL LIGHT TABLE

Red lights signal problems that must be corrected

Light	Description
ES	Emergency Stop
FLL	Field Loss (Lights when current is 13% or less)
FU	Fuse Blown
LVL	Low Voltage Level (Lights when voltage is 70% or less)
OC	Instantaneous Over Current Shut Off (see IA pot)
OH	Over Heat
OL	60 Second Current Overload
PH	Phase Loss & Phase Sequence Error
TGL	Tac Generator Signal Loss

YELLOW SIGNAL LIGHT TABLE

Yellow lights signal when the function is on or off

Light	Description
AP	Auto Precondition
F	Field
JOG	Jog in Operation
P	PI Gain (for special applications only)
PC	Pre-Condition (i.e. Enable System before start)
R	Reverse (12 SCR Drive Only)
RUN	Run (i.e. Start)
ZDL	Zero Detect (Detects Motor Rotation)

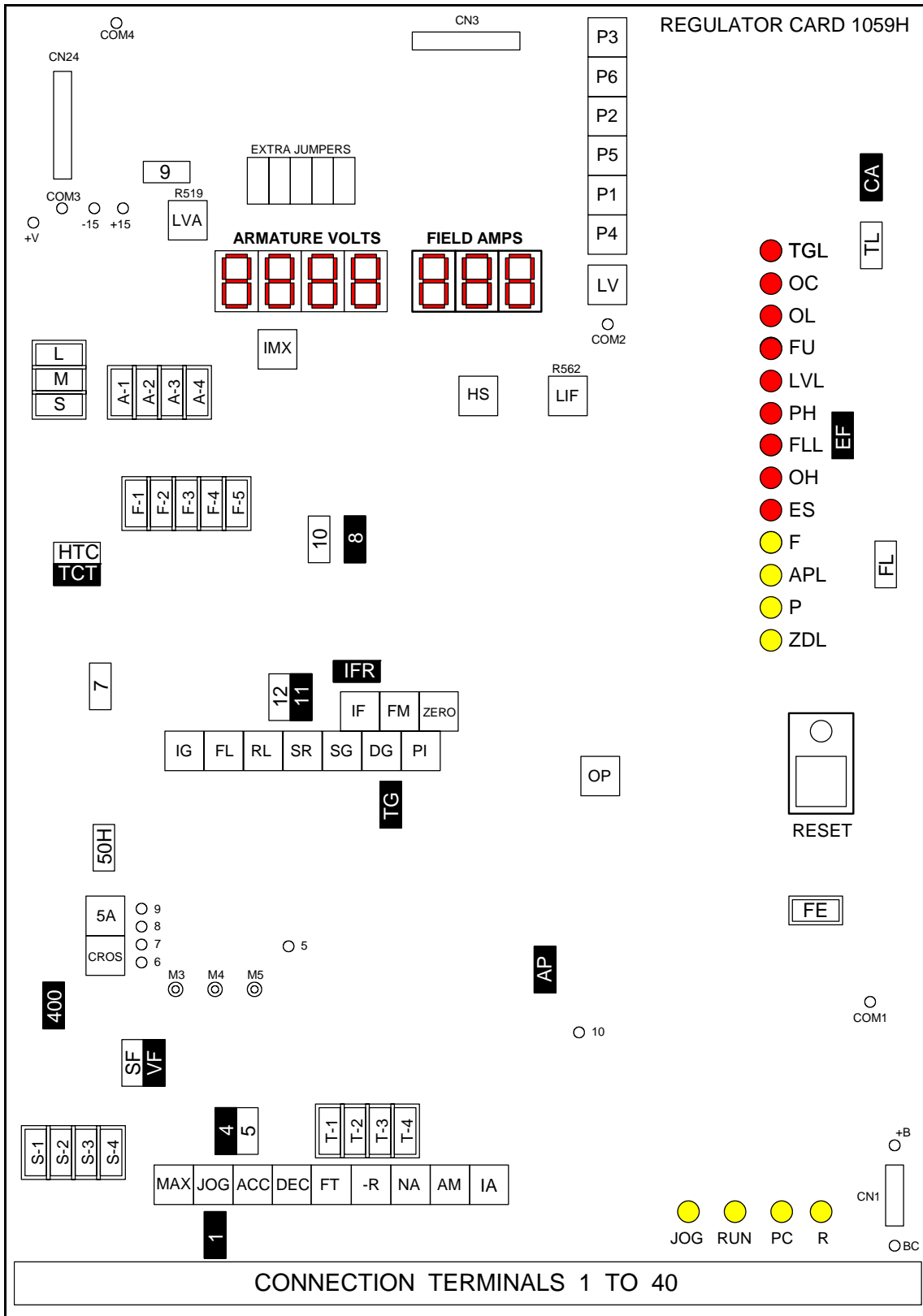
JUMPER TABLE

Jumper	Description
400	Input voltage: 440V~480V-ON, 208V~240V-OFF
50H	50 Hz Power-ON / 60 Hz Power-OFF
A1~A4	Armature Ampere Range Settings
AP*	Manufacturer test use only, normal is jumper on
CA	Field Weakening Ratio: Below 1/2 -ON / Above 1/2 -OFF
EF	E. Stop: Controlled Decel: Enable-ON / Disable-OFF
F1~F5	Field Ampere Range
FE	Field Economy: Enable-OFF/ Disable-ON
FL	Field Loss Signal: Enable-OFF / Disable -ON
HTC	Hall Effect Transformer for Field Amperage Special order option, Normal is jumper off
IFR	Internal Field Regulator: ON External Field Regulator: OFF
JP-1	Speed Reference Scale: 8V - ON / 10V - OFF
JP-4	Jog Signal: Enable -ON / Disable -OFF
JP-5	Jog PID: Enable-ON / Disable -OFF
JP-7	Field Weakening: Enable-ON / Disable -OFF
JP-8	Field Ampere Regulation: Enable-ON / Disable -OFF
JP-9	Driver Test: Enable-ON / Disable -OFF
JP-10*	Calibrate AM pot to zero: Normal is jumper on
JP-11*	Manufacturer test use only, normal is jumper on
JP-12*	Manufacturer test use only, normal is jumper off
L	Models DC42NL-*-* or DC42RL-*-* jumper ON
M	Models DC42NM-*-* or DC42RM-*-* jumper ON
S	Models DC42NS-*-* or DC42RS-*-* jumper ON
S1~S4	DC Tac-Generator Voltage
SF	Tac Feedback: Enable-ON / Disable -OFF (i.e. Speed Feedback)
T1~T4	Accel and Decel Time Range (See Section 3.6)
TCT	Current Transformer for Field Amperage, Normal is jumper on
TG	Tac Feedback ASR: Enable-ON / Disable -OFF
TL	Tac Loss: Enable-ON / Disable -OFF
VF	Armature Feedback: Enable-ON / Disable -OFF (i.e. Voltage Feedback)

Note: * We strongly suggest the user not change the factory setting.

TEST POINT TABLE

Test Point	Description
TP-1	Tac Feedback Reference Voltage (8V _{DC} / Max. Speed)
TP-2	Arm Feedback Reference Voltage (7.5V _{DC} / Max. Speed)
TP-4	Accel & Decel Voltage Ramp (+8 V _{DC} / Max.)
TP-5	ASR Voltage (+4 V _{DC} / Rated Current)
TP-6	ACR Voltage (-8 V _{DC} / Max.)
TP-7	Field Current Reference Voltage (2V _{DC} / Max. IF)
TP-8	Field Current Reference (-7.9 ~ -1.3V _{DC})
TP-9	Reference Input for Fire Block Test (factory use only)
TP-10	Armature Current Oscilloscope Connection Point
15	+15 Volt Power Supply (±0.5 V)
-15	-15 Volt Power Supply (±0.5 V)
+V	Internal Relay Power (23V _{DC} ±3V)
+B	Regulator Card Relay Power (20 V _{DC} ±4V _{DC})
BC	Regulator Card Relay Power Common for +B
COM1	COM1, COM2, COM3 and COM4 All serve as common for TP1 through TP10 and +15, -15, +V
COM2	
COM3	
COM4	



Jumper On
 Jumper Off
 User Selects Jumper
 440V~480V input power, jumper 400 is on.
 200V~240V input power, jumper 400 is off.

The jumper settings in this diagrams are for armature feedback operation.
 The input power voltage is 440V~480V.

Quick Reference Jumper Tables

Make all jumper settings prior to applying power.

Field Amperage

"S1" Model Ampere Range	"S1A, S2, S3 & S4" Models Ampere Range	"M2 & M3" Models Ampere Range	"L1 & L2" Models Ampere Range	"XXL Models Ampere Range	Jumper Settings
4.3 ~ 7.1	6.0 ~ 10	10A ~ 17A	15A ~ 25A	34A ~ 57A	F1 - On F2, F3, F4, F5 - Off
2.1 ~ 4.3	3.0 ~ 6.0	5A ~ 10A	7.5A ~ 15A	17A ~ 34A	F2 - On F1, F3, F4, F5 - Off
1.4 ~ 2.1	2.0 ~ 3.0	3.3A ~ 5A	5.0A ~ 7.5A	11A ~ 17A	F3 - On F1, F2, F4, F5 - Off
0.7 ~ 1.4	1.0 ~ 2.0	1.7A ~ 3.3A	2.5A ~ 5.0A	5.8A ~ 11A	F4 - On F1, F2, F3, F5 - Off
0.6 ~ 0.7	0.8 ~ 1.0	1.3A ~ 1.7A	2.0A ~ 2.5A	4.6A ~ 5.8A	F5 - On F1, F2, F3, F4 - Off
0.3 ~ 0.6	0.5 ~ 0.8	0.8A ~ 1A	1.3A ~ 2.0A	3.0A ~ 4.6A	No Jumpers On F1, F2, F3, F4, F5 - Off

Armature Amperage

"S1" Model Ampere Range	"S1A, S2" Model Ampere Range	"S3" & "S4" Model Ampere Range	"M2" & "M3" Model Ampere Range CT-2027	"L1 & L2" Model Ampere Range CT-2028	Jumper Settings
14 ~ 23	55A ~ 90A	180A ~ 300A	370A ~ 600A	730A ~ 1,200A	A1, A2, A3, A4 - On
12 ~ 20	48A ~ 81A	161A ~ 270A	320A ~ 580A	640A ~ 1,100A	A1, A2, A3 - On A4 - Off
8.6 ~ 14	35A ~ 58A	120A ~ 190A	230A ~ 380A	460A ~ 770A	A1, A3 - On A2, A4 - Off
6 ~ 10	25A ~ 42A	83A ~ 140A	170A ~ 280A	330A ~ 560A	A1 - On A2, A3, A4 - Off
4.5 ~ 7.5	18A ~ 30A	60A ~ 100A	120A ~ 200A	240A ~ 400A	A2 - On A1, A3, A4 - Off
3.5 ~ 5.9	14A ~ 23A	46A ~ 78A	93A ~ 150A	190A ~ 300A	A3 - On A1, A2, A4 - Off
2.8 ~ 4.7A	11A ~ 19A	38A ~ 63A	75A ~ 130A	150A ~ 250A	A4 - On A1, A2, A3 - Off

Motor Feedback

Feedback	Jumper Settings
Armature	VF, TG - On SF, TL - Off
DC Tachometer Generator	SF, TG, TL - On VF - Off

DC Tac-Generator Voltage

Example: The DC tac is 50V_{DC}/1000 RPM and the DC motor's maximum speed is 2150 rpm $2.15 \times 50 = 107.5$ Volts. Select voltage range 88V~127V., jumpers S2- On / S1, S3, S4 - Off

Tac-Generator Maximum Voltage	Jumper Settings
41V ~ 60V	S1, S2, S3, S4 - Off
60V ~ 88V	S1 - On S2, S3, S4 - Off
88V ~ 127V	S2 - On S1, S3, S4 - Off
127V ~ 172V	S3 - On S1, S2, S4 - Off
172V ~ 250V	S4 - On S1, S2, S3 - Off

Field Regulation

Field Operation	Jumper Settings
Constant Field (default)	J8 - On J7 - Off
Field Weakening (DC Tac Feedback Only)	J7, J8 - On
Field Economy	Enable: FE - Off (default) Disable: FE - On
Disable the Field	FL- On Don't connect power to F+ and F-

Acceleration & Deceleration Time Range

Time Range	Jumper Setting
0.7 ~ 6 Sec.	T1 - On T2, T3, T4 - Off
3 ~ 20 Sec. (default)	T2 - On T1, T3, T4 - Off
7 ~ 60 Sec.	T3 - On T1, T2, T4 - Off
14 ~ 120 Sec.	T3, T4 - On T1, T2 - Off

Wire Size Tables

440V_{AC} ~ 480V_{AC} 3 Phase, 60Hz Input Power

HP	Full Load AC Amps	Minimum Wire Size for 40 ft length	Circuit Breaker AC Amps at 600V _{AC}
5	8.6	14 AWG	10
7.5	11	14 AWG	15
10	13.5	12 AWG	20
15	21	10 AWG	30
20	27	8 AWG	35
25	34	8 AWG	40
30	40	6 AWG	50
40	54	4 AWG	70
50	67	4 AWG	90
60	80	3 AWG	100
75	99	1 AWG	125
100	133	00 AWG	175
125	167	0000 AWG	225
150	202	250 MCM	300
200	266	(2) 000 AWG	400
250	375	(2) 250 MCM	500

500V_{DC} Armature

HP	Full Load DC Amps	Minimum Wire Size for 40 ft length	DC Fuse Amps (if used)
5	10	12 AWG	15
7.5	12	12 AWG	20
10	15	10 AWG	25
15	23	8 AWG	35
20	30	8 AWG	45
25	38	6 AWG	60
30	45	4 AWG	70
40	60	3 AWG	100
50	75	2 AWG	150
60	90	1 AWG	150
75	110	00 AWG	200
100	148	0000 AWG	250
125	185	300 MCM	300
150	218	(2) 000 AWG	400
200	295	(2) 250 MCM	600
250	408	(2) 350 MCM	600

300 V_{DC} Field

Wire Size for 40 ft Length

- 0.1A ~ 6A : 16 AWG
- 6A ~ 12A : 14 AWG
- 12A ~ 25A : 10 AWG

208V_{AC} ~ 240V_{AC} 3 Phase, 60Hz Input Power

HP	Full Load AC Amps	Minimum Wire Size for 40 ft length	Circuit Breaker AC Amps at 250V _{AC}
5	17	12 AWG	25
7.5	25	10 AWG	30
10	32	8 AWG	40
15	49	6 AWG	70
20	63	4 AWG	90
25	79	3 AWG	100
30	93	1 AWG	125
40	124	00 AWG	175
50	156	000 AWG	200
60	184	0000 AWG	225
75	229	300 MCM	300
100	300	500 MCM	400
125	380	(2) 250 MCM	500
150	450	(2) 350 MCM	600

240V_{DC} Armature

HP	Full Load DC Amps	Minimum Wire Size for 40 ft length	DC Fuse Amps (if used)
5	19	10 AWG	25
7.5	28	8 AWG	40
10	36	6 AWG	50
15	54	4 AWG	70
20	70	2 AWG	100
25	87	1 AWG	150
30	105	0 AWG	150
40	139	0000 AWG	200
50	173	250 MCM	250
60	205	300 MCM	300
75	254	500 MCM	400
100	337	(2) 250 MCM	600
125	325	(2) 350 MCM	600
150	504	(2) 500 MCM	800

150 V_{DC} Field

Wire Size for 40 ft Length

- 0.1A ~ 6A : 14 AWG
- 6A ~ 12A : 10 AWG
- 12A ~ 25A : 8 AWG

ERC Statohm 5 DC Drive Common Specifications

Input Power	3 Phase Input Voltage	200V _{AC} ~ 204V _{AC} or 440V _{AC} ~ 480V _{AC} , Nominal range ±10%
	1 Phase Input Voltage	110V _{AC} ~ 120V _{AC}
	Input Frequency	50 Hz or 60 Hz
Output Power	Armature Starting Amperage & Starting Regenerating Amperage	Adjustable up to 200% for up to one minute (Default is 150%)
	Field	1 phase, SCR phase control, Amperage Regulation Circuit 0.8A ~ 30A.
	Field Economy	When stopped the field is reduced to 1/3, this feature can be disabled.
Motor Regulation Features	Field Weakening	Only for motors with DC tachometers. The field can be reduce down to 1/3 of full field. below 1/2 is not recommend Crossover voltage can be adjusted down to 60% of full armature voltage. Notes: Field Weakening is used to extend speed and / or adjust torque. The crossover voltage is the armature voltage when field weakening begins.
	Speed Regulation	Armature feedback regulation ±2%, Ratio 1:100 DC tachometer feedback regulation ±0.5%, Ratio 1:100 DC tachometers from 18V/1000RPM up to 100V/1000RPM
	Acceleration & Deceleration	0.7 to 120 seconds, each independently adjustable.
	Braking (12 SCR drives only)	Regenerates power to lines
Control Input & Output Features	Amperage Limit (i.e. Current Limit)	Adjustable up to 150%. 12 SCR drives have independent forward and reverse current limits.
	Speed Adjustment (i.e. Speed Reference Signal) (6 SCR drives)	V _{REF} 0 to 8V with internal voltage supply, R _{L(IN)} 100kΩ
		V _{REF} 0 to 10V, auxiliary voltage supply required, R _{L(IN)} 100kΩ
	Speed Adjustment (12 SCR drives only)	Reverse Terminal (37)
		V _{REF} ±8V with internal voltage supply, R _{L(IN)} 100kΩ V _{REF} ±10V, auxiliary voltage supply required, R _{L(IN)} 100kΩ
	Jog	0 ~ 20% of maximum speed, independent acceleration adjustment
	Emergency Stop (E. Stop)	Controlled deceleration or coast to stop.
	PC (i.e. Enable)	Safety feature to detect Pre-operation Conditions are met before the drive is enabled to start.
	Zero speed Detect relay	ZD relay has adjustable trip voltage. SPDT 0.5A / 250V _{AC}
	Fault Trip relay	FT relay, SPDT 0.5A / 250V _{AC}
	Field Loss relay	FL relay, SPDT 0.5A / 250V _{AC}
	Armature Ammeter output	0 ~ 1mA
	Field Ammeter output	0 ~ 1mA
	Speed Meter output	0 ~ 1mA
Master Slave operation	One master drive and one slave drive	
	One master drive and one slave drive with master speed gain	
Fault Diagnosis and Protection	Instantaneous Overload Trip (OC)	ST overload relay (i.e. Shunt Trip) switches at 250% of armature rating, SPDT 0.5A / 250V _{AC}
	One Minute Delay Over Amperage (OL)	150% of the motors' rating was exceeded for more than one minute.
	High / Low Input Voltage (LVL)	±15% of input voltage.
	Phase Error (PH)	Detects connection error of L1S, L2S and L3S.
	Tac Generator Loss (TG)	User has choice of stop or full speed when TG loss is detected.
	Field Loss (FL)	Detects when field current is 13% below normal.
	SCR Thyristor Over Heat (OH)	85°C / 185°F thermostat switches off motor.
	Fuse Blown (FU)	Signal light indicates when AC input fuse has blown.
Environment	Storage Temperature	-40° F to +140° F (-40° C to +60° C)
	Ambient Operating Temperature	-14° F to +104° F (-10° C to +40° C)
	Relative Humidity	95% max., no condensation allowed
	Atmosphere	Avoid iron dust particles and corrosive gases , example: Ocean air.
	Ventilation	Mount lengthwise vertical position, 5"/125 mm air space on all sides and 2"/50 mm air space on front side in ventilated enclosure.

Model Ampere and Power Ratings

Model Number	42NS1-*	42RS1-*	42NS2-*	42RS2-*	42NS3-*	42RS3-*	42NS4-*	42RS4-*	42NM2-*	42RM2-*	42NM3-*	42RM3-*	42NL1-*	42RL1-*	42NL2-*	42RL2-*	42XXNL4-*	42XXNL5-*	42XXNL7-*	Above 1000
Max., Current	37A	70A	110A	180A	400A	550A	720A	910A	1,100A	1,400A	1,800A									
Input 208~240V, Arm	7 HP	15 HP	25 HP	45 HP	100 HP	125 HP	200 HP	250 HP	300 HP	---	---									
Input 380~410V, Arm	3 kW	20 kW	32 kW	58 kW	130 kW	165 kW	233 kW	375 kW	---	---	---									
Input 440~480V, Arm	14 HP	30 HP	50 HP	90 HP	200 HP	250 HP	400 HP	500 HP	600 HP	750 HP	1,000 HP									
Input 575~600V, Arm	---	36 HP	60 HP	108 HP	240 HP	300 HP	480 HP	600 HP	720 HP	900 HP	1,200 HP									

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