Hubbell Industrial Controls, Inc.

S^2MC Compact Static Reversing Controller

4922c
Instruction Manual
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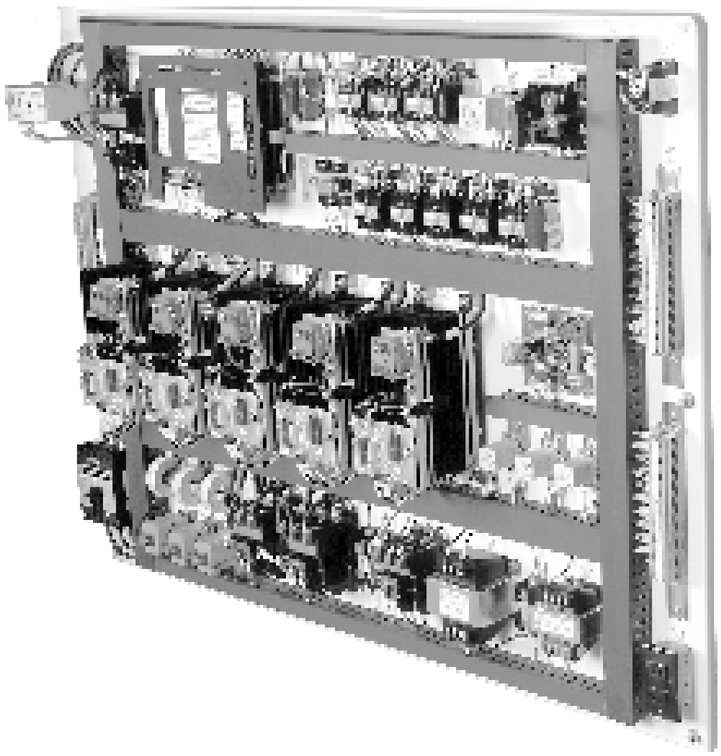
Hubbell Compact Static Reversing Controller for Hoists without Load Brakes



General Description

The Type 4922C Static Reversing Controller is a solid state adjustable speed motor controller utilizing compact unitized construction and providing speed regulated control of wound rotor motors. The motor speed is controlled by varying the motor primary voltage via primary SCR bridges, and the direction of motor rotation is controlled by selecting the appropriate SCR bridges for the commanded function. The adjustable speed control unit varies the SCR bridge firing signals and the SCR bridge selection in response to a changing motor speed reference signal. The retarding torque during the reduced speed lowering operation is provided by motor counter torque. The retarding torque during full speed lowering can be provided by true motor and system regeneration. Motoring to counter torque transitions and vice versa are automatic and are controlled by the adjustable speed control unit in response to motor loading conditions.

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Static Control Panel Layout

The start-up adjustments of the 4922C Static Control Controller involve setting the control potentiometers and jumper plugs, verifying relay operation and wiring connections. Prior to installing and adjusting this equipment, it is important to fully understand the equipment, components, controls and adjustments.

This section will provide an understanding of the 4922C controller. On the following pages are a flow diagram of primary components, a control board with major components called out, and a detailed view and description of the Adjustable Speed Controller.

ASC	Adjustable Speed Control
MS	Master Switch
PS	Pendent Station
PLC	Programmable Logic Control
RES	Resistor
TCM	Tach Continuity Module
TOS	Tach/ Overspeed Switch
TPM	Thyristor Power Module/SCR

Figure 1, Flow Diagram of Primary Components

Adjustable Speed Controller

Following is a description of the adjustments and their functions located on the Adjustable Speed Controller. Refer to figure 2 for their respective locations.

Permissive Jumper (PERM)

This jumper has two positions. The left position is the "Setup" position and allows the ramp circuit adjustments to be made without operating the firing circuits. The right position is the normal "Run" position. In this position the firing circuit permissive signal is active and the firing circuits will operate. Note: with the jumper in the "Setup" position, the remaining control circuit will be active and holding brakes may be released when direction control commands are issued. To prevent unintended motion, disable the brake control circuit by removing the brake circuit fuses.

Ramp Select Jumper (RAMP SEL)

This jumper has two positions. The upper position, "Internal", is the most common position, and connects the internal ramp signal to the speed regulator circuit. The lower position, "External", is used when the speed regulator circuit is to operate with an outside reference signal such as when two or more drives are to be speed matched from a common ramp signal. Unless the application involves a speed matching function with two or more drives operating in a "Master/ Slave" arrangement, place the Ramp Select jumper in the "Internal" position.

RPM Select Jumper (RPM SEL)

This jumper has five positions, and provides the correct scaling factor for the system tachometer based on the synchronous speed of the driven motor.

The jumper positions available are: 1800, 1200, 900, 720 and 600 rpm

For systems not using a Tachometer/Overspeed Switch assembly, place the RPM Select jumper in the corresponding synchronous speed position for the motor used. If a Tachometer/Overspeed Switch assembly is used, place the RPM Select jumper in the 1200 rpm position. This is necessary because the incorporated tachometer is geared for 1200 rpm operation at motor synchronous speed.

Torque Select Jumper (T/L SEL)

This jumper is used to select the limited torque value supplied by the motor during counter-torque and plugging operations. The "HI" position, recommended for hoisting applications, limits motor torque to 200–250% during counter torque. The "MED" position limits torque to 150%, and the "ADJ" position provides an adjustable range of 50% to 150%. Initially place this jumper in the "HI" position.

Plugging/ Counter-Torque Relay Jumper (J10 J9)

This jumper is used to select the operation conditions for the external plugging/counter torque relay.

In the right position, "CNTR", the relay will operate whenever the motor is operating in counter-torque. In the left position, "PLUG", the relay will operate only during a commanded plugging direction change. Most applications will use the right counter torque position, "CNTR".

Speed Trim Potentiometer

The Speed Trim Potentiometer is used to make fine adjustments in system speed. In typical single motor applications or in multi-motor applications where the motors operate independently, this adjustment should be set to the "50" position. In "Master/Slave" speed matching applications with the Master drive set to the "50" position, this adjustment allows the "Slave" drive to be trimmed to match the speed of the "Master" drive. Initially, set this pot to the "50" position.

Minimum Speed Potentiometer

The Minimum Speed Potentiometer sets the minimum speed signal level out of the ramp circuit. Typically, this potentiometer is set at the "20" position.

Maximum Speed Potentiometer

The Maximum Speed Potentiometer determines the amount of scaling that is applied to the input speed reference signal. After the minimum speed signal level has been set, this adjustment will set the full speed level of the input speed reference signal. Typically, this potentiometer is set to the "80" position.

Input Offset Potentiometer

This potentiometer is used to remove residual first point master switch or pendant speed reference signal arising from a speed reference potentiometer without an off-point shorting band. Initially, this potentiometer should be set to the "35" position.

Ramp Time Potentiometer

The Ramp Time potentiometer sets the slope of the output ramp signal to the speed regulator circuit. The adjustment range is from 0.5 seconds at the full counterclockwise position to 10.0 seconds at the full clockwise "100" position. This adjustment determines how quickly the ramp output signal is allowed to increase or decrease. Initially, this potentiometer is set fully counterclockwise to the "0" position.

Torque Limit Set

This potentiometer sets the value of limited motor torque during counter-torque or plugging operations when the torque select jumper, described above, is placed in the "ADJ" position. The adjustment range is from 50% to 150%. Initially, set this potentiometer fully clockwise to the "100" position.

LSR Trim Potentiometer

This adjustment is located directly on the main regulator board and sets the motor speed value above which the "LSR" LED will light, and the LSR relay will pick up. The pickup adjustment range is 15% at full counterclockwise to 35% when fully clockwise. Set this potentiometer mid range for a 25% pickup.

HSR Trim Potentiometer

This adjustment is located directly on the main regulator board and sets the motor speed value above which the "HSR" LED will light, and the HSR relay will pick up. The pickup adjustment range is 85% at full counterclockwise to 100% when fully clockwise. Set this potentiometer fully counterclockwise.

Gain Potentiometer

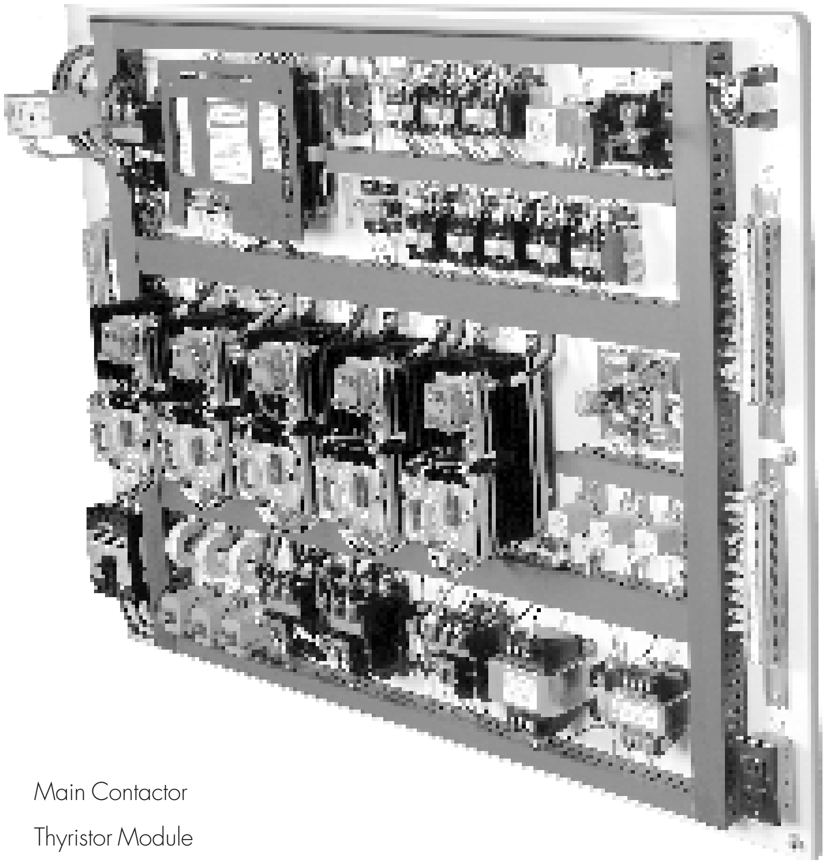
This potentiometer is located on the main regulator board and is used to adjust system stability. Initially, set this potentiometer mid range.

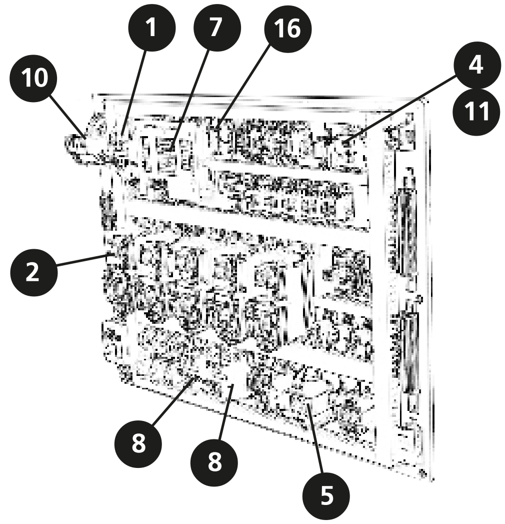
Null Potentiometer

This potentiometer is located on the main regulator board and is used to adjust the speed regulator offset. This is a factory adjustment and needs no further attention. Should the setting of this potentiometer be disturbed, return the setting to a mid range position.

Figure 2, Variable Speed Controller Adjustments, Pontentiometers, Test Points, Jumpers & LEDs

Major Components





Shown is a typical hoist application controller arrangement for motors in the 75–100 hp (460V) range.

1 Main Contactor

2 Thyristor Module

3 Main Circuit Breaker

4 Control Circuit Disconnect

5 Control Transformer

6 Tach. Continuity Module

7 Adjustable Speed Control Module

8 Secondary Contactor

9 Full Speed Contactor

10 Overload Relays

11 Fuses

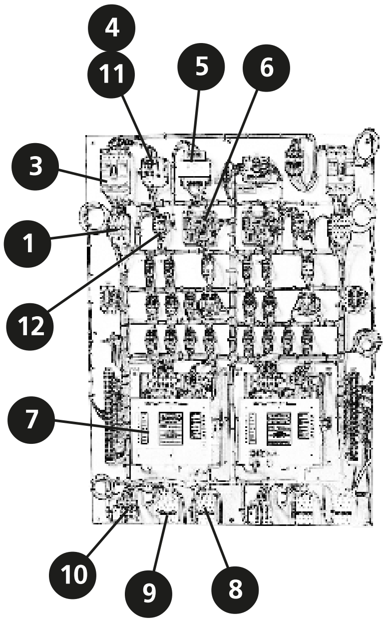
12 Brake Relay

13 Step Reference Board *(not shown)*

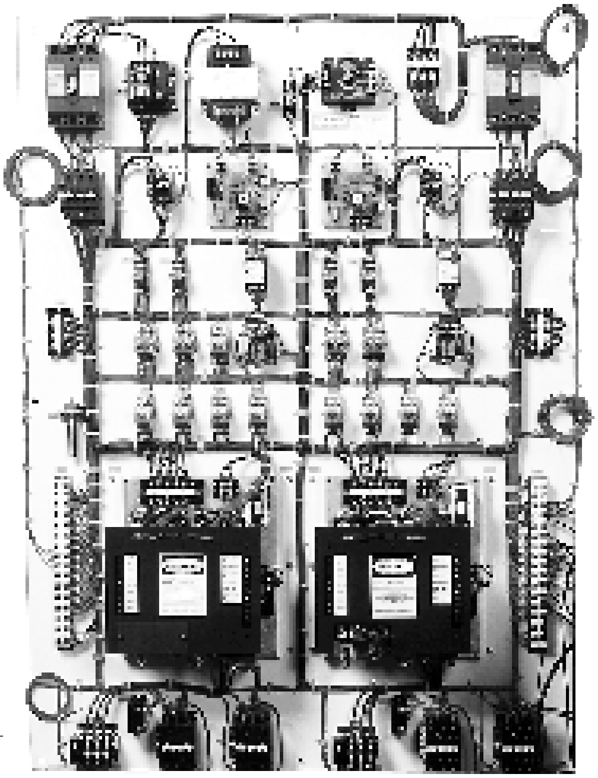
14 Main Knife Switch *(not shown)*

15 Control Knife Switch *(not shown)*

16 Synchronizing Transformers



Shown is a typical dual hoist application controller arrangement for motors in the 40–50 hp (460V) range.



Installation & Adjustment

Prior to attempting to fine tune the installation of this equipment, completely familiarize yourself with all the major components and adjustments discussed on the previous pages.

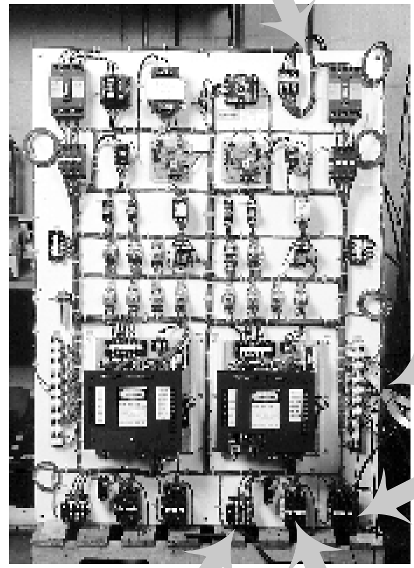
Note: The equipment as shipped from Hubbell's factory is fully tested and factory preset. This procedure is for fine tuning the installation. If a particular function or aspect of this panel is not operating properly, the problem is usually in the field wiring.

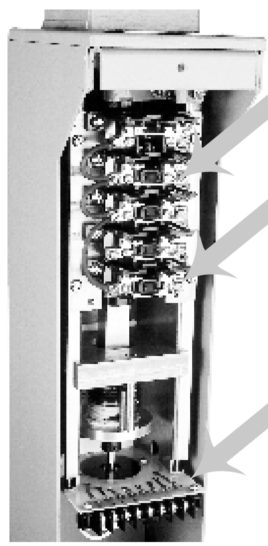
Initial Inspection & Installation

1. Upon receipt, check each item. If shipping damage is evident, contact the carrier immediately.
2. Maximum storage temperature should not exceed 70°C (158°F). Typical operating ambients should not exceed 55°C (131°F). Minimum ambient temperature must not be less than –40°C (–40°F). Avoid contaminated atmospheres.
3. Install resistors. Exercise caution when wiring as the resistor element operates at 375 °C (707°F).
4. Install the master switch(es), pendant and/or radio receiver.
5. Wire equipment per wiring diagrams. Observe local code for correct wire size, grounding, etc.

Master Switch, Pendant, and/or Radio Control Setup

6. Become familiar with the various wiring connections coming into the panel. Identify the main power leads, master switch leads, "T" & "M" motor leads, overload relays and any control options provided with the system.
7. Remove the cover from the Master Switch, pendant, and/or open the radio control cabinet.
8. Check that all the contacts in the master switch or pendant are free and moving properly. If so equipped, check that the radio control output relay contacts are closing in the correct sequence.
9. Identify the full speed contacts. Verify that they are the last to close when the master switch, pendant, and/or radio control transmitter lever is moved to the last speed point in each direction.
10. The Type 4216 Master Switch is typically supplied with a 2k , 0° dead band, center tapped speed reference potentiometer. Check the off-point position of the Master Switch potentiometer by measuring the resistance between Terminals 2 and 4 on the potentiometer assembly. The off-point resistance should be 0–5 . If this resistance range is not present, mechanical adjustment will be needed:

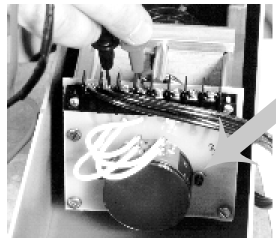




a. Use a $^{3}/_{32}$" allen wrench to slightly loosen the two allen screws that clamp the potentiometer to the potentiometer assembly.

b. While reading the resistance between Terminals 2 & 4, carefully rotate the potentiometer until an ohmmeter reading of 0–5 is obtained.

c. Carefully tighten the allen screws and reverify the ohmmeter reading on Terminals 2 & 4 of the potentiometer assembly.



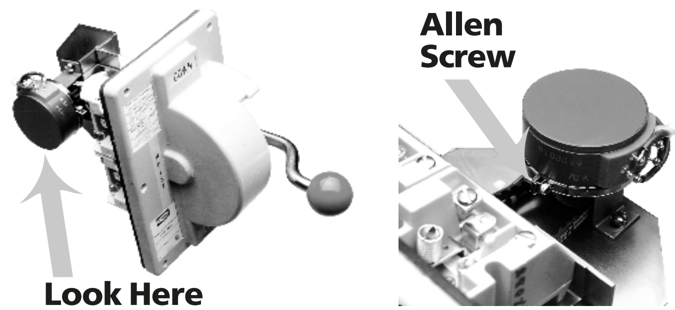
11. Type 4211 Master Switches or PBC/WPBC Pendant inserts are typically suppled with a single 2k , 0° dead band, center tapped belt drive speed reference potentiometer. Check the off-point position of the insert potentiometer by measuring the resistance between Pins 2 and 4 on the potentiometer body. The off-point resistance should be 0–5 . If this resistance range is not present, mechanical adjustment will be need.

a. Use a $^{3}/_{32}$" allen wrench to slightly loosen the circumferential potentiometer clamp.

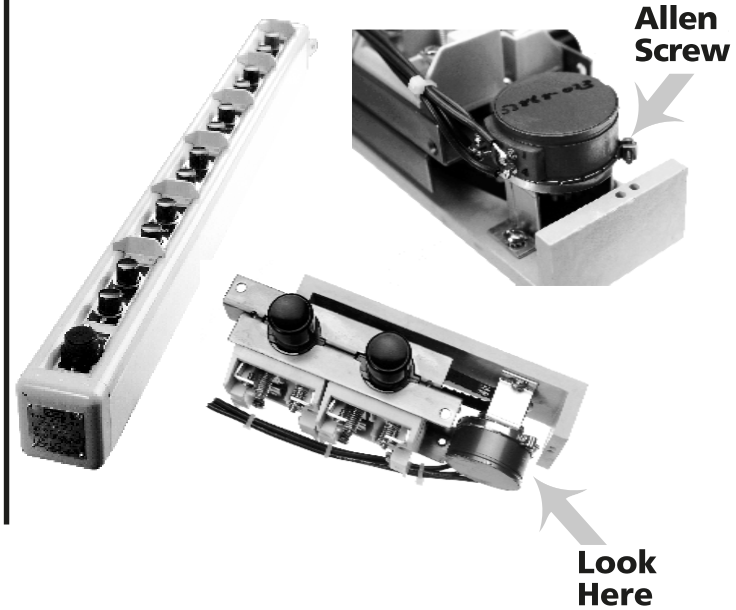
b. While reading the resistance between Pins 2 & 4, carefully rotate the potentiometer until an ohmmeter reading of 0–5 is obtained.

c. Carefully tighten the potentiometer clamp and reverify the ohmmeter reading on Pins 2 & 4 of the Pendant insert or 4211 Master Switch potentiometer.

Type 4211 Master Switch Potentiometer Locations



PBC/WPBC Pendant Potentiometer Locations



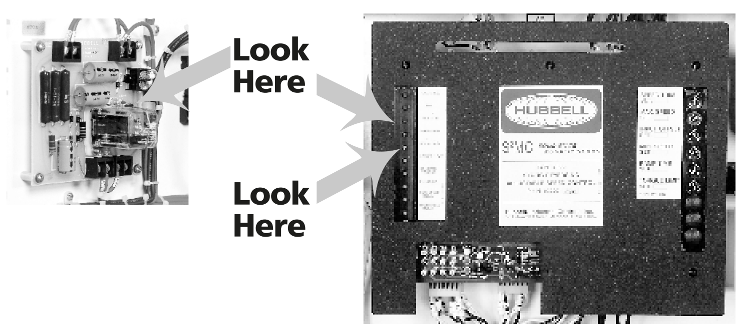
12. For Radio/Pendant or Radio/Cab installations, the remaining start-up instructions should be followed using the Pendant or Master Switch as the control device. At the end of the procedure, the Radio Receiver speed output signal can then be set to match the Pendant or Master Switch speed signal. This start-up sequence results in uniform speed range performance for all controlling methods.

Controller Power and Off-Point Sequence

13. Set the Off-Point Timer (if equipped) for a minimum time delay.

14. Using a digital voltmeter, check the three phase power at the Circuit Breaker.

15. Close the Circuit Breaker and then the Control Knife Switch. The "Tach Continuity" LED, and either the "Hoist" or "Lower" LED should light up on the Adjustable Speed Control (ASC) module. If the control has a Tach Continuity Module, the LED on this assembly should be lit. If these LEDs aren't lit check/replace the fuses in the Control Knife Switch, check the Tachometer wiring and connections, check the Overload Contacts, and check the wiring into the Circuit Breaker.



Controller Speed Reference Setup and Sequence

16. Turn off the power by turning off the Circuit Breaker and Control Knife Switch.

17. Remove the access cover from the ASC. Using a digital voltmeter (DVM) set to read 20VDC, place the black common meter probe tip into TP8. Place the red meter probe tip into TP1.

18. Move the "Permissive" jumper from the "RUN" position to the "SETUP" position.

Note: Holding brakes may be released during the remaining setup procedure. To prevent unintended movement, disable the brake control circuit by removing the brake circuit fuses.

19. Verify that the "Ramp Select" jumper on the ASC is set "INT" position.

20. Verify that the adjustment potentiometers are set to the factory initial/typical positions. (see Typical Setting table or factory preset label)

21. Close the Circuit Breaker and then the Control Knife Switch. The "Tach Continuity" LED should light again on ASC.

22. The speed reference voltage from the Master Switch or Pendant should be positive for the Hoist direction and negative for the Lower direction. Select the Lower direction with the Master Switch or Pendant. The voltage readings on the DVM should be negative. When the Hoist direction is selected, the voltage should be positive. If the DVM readings are reversed, reverify and correct the wiring between the 4922C Control Panel and the Master Switch/Pendant.

23. Verify the control sequence by operating the Master Switch or Pendant. Observe the "Permissive" lights on the ASC and the contactor/relay operation on the panel. (see Control Sequence table)

The following setup will use Lower commands, therefore, a negative voltage on the digital voltmeter is expected.

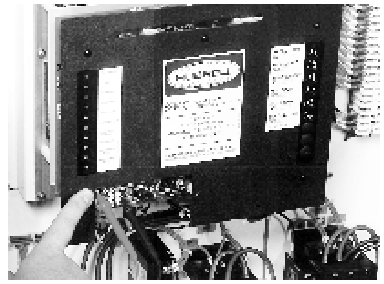
24. A typical speed range is 10 to 1 with maximum stepless speed equal to 5.0V, and minimum speed equal to 0.5V.

25. Move the Master Switch or depress the Pendant button until first point Lower is obtained. The "Run", "Permissive", and "Lower" LEDs should light.

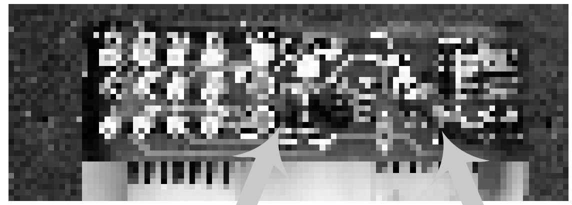
26. The DVM should read –0.5V ±0.05V.

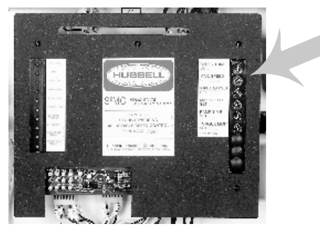
27. Move the Master Switch to the Full Lower position or completely depress the "Lower" Pendant button. The "Full Speed" LED on the ASC should light.

28. Back off the Master Switch handle or Pendant "Lower" button position until the full speed contact in the Master Switch or Pendant opens. The "Full Speed" LED on the ASC should go out.



TP Locations

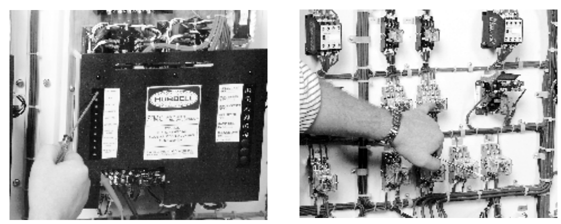


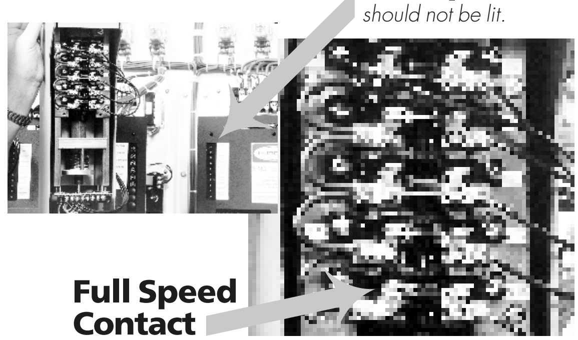


Typical Settings

Potentiometer	Setting
Speed Trim	50
Max. Speed	80
Input Offset	35
Min. Speed	20
Ramp Time	0
Torque Limit	100

Control Sequence



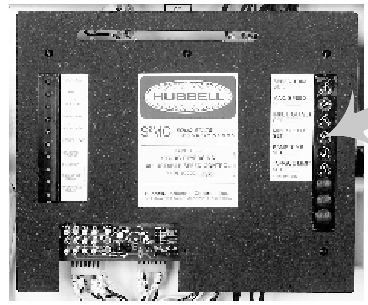


29. The voltage reading on the DVM should be –5.0V ±0.05V.

30. If the readings in Step 26 and Step 29 are not obtained proceed with Step 31. If the readings are correct, skip to Step 39.

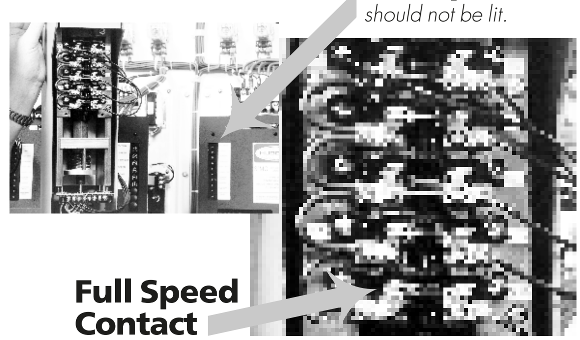
31. Move the Master Switch or depress the Pendant button until first point Lower is obtained. The “Run”, “Permissive”, and Lower” LEDs should light.

32. Set the “Min Speed” potentiometer full counterclockwise. Rotate the “Input Offset” potentiometer on the ASC until the DVM reads 0V ±0.05V.



33. Move the Master Switch fully in the Lower direction or depress the Lower pendant button. The “Full Speed” LED on the ASC should go on.

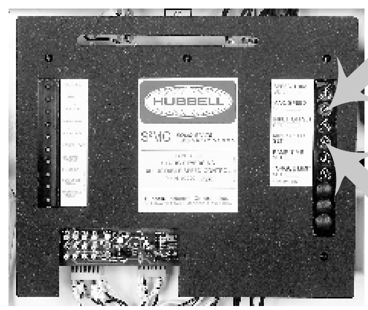
34. Back off on the handle of the Master Switch or the Pendant button from the lower position until the full speed contact just opens up. It is very important to move the handle or the button until the full speed contact just breaks open. The “Full Speed” LED on the ASC should be out.



35. Adjust the “Max Speed” potentiometer on the ASC until a reading of –4.5V ±0.05V is obtained on the DVM.

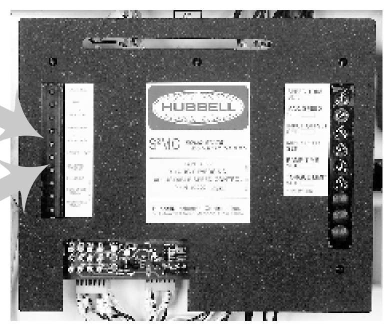
36. Repeat steps 31–35 until no further adjustments are necessary. Typically, three or four iterations are required to obtain a 0V ±0.05V reading at first speed point, and a –4.5V ±0.05V setting at the maximum stepless position.

37. Move the Master Switch handle or depress the Lower Pendant button until first point Lower is obtained. Rotate the “Min Speed” potentiometer clockwise until a –0.5V ±0.05V reading is obtained on the DVM.



38. Move the Master Switch handle or depress the Lower Pendant button to the maximum position. The DVM should read –5.0V ±0.05V.

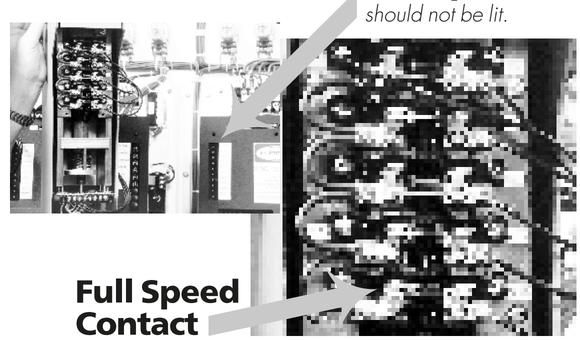
39. Check the minimum speed and maximum speed points in the Hoist direction. Move the Master Switch or the Pendant through the various speed points in the Hoist direction. The “Lower” LED on the ASC should go off and the “Hoist” LED should come on.



40. At the first speed point for Hoist direction the DVM should read +0.5V ±0.05V.

41. At full speed hoist (handle fully in the Hoist position) the “Full Speed” LED on the ASC should be lit.

42. Back off on the handle of the Master Switch from the hoist position until the full speed contact on the Master Switch or Pendant just opens up. The “Full Speed” LED should go out. The DVM should read +5.0V ±0.05V.

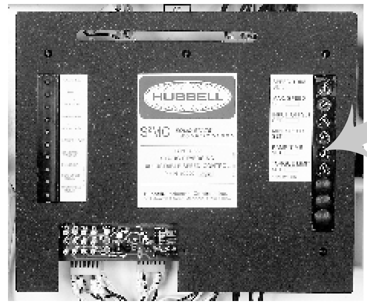


43. Return the Master Switch or the Pendant button to the Off position. The DVM should read 0.0V.

Controller Ramp and Tachometer Signal Adjustments

44. Turn off the power by turning off the Circuit Breaker and Control Knife Switch.

45. Determine the required system accelerated ramp time required for the application. The "Ramp Time" potentiometer on the ASC can provide times from 0.5 seconds (set at 0) to 10 seconds (set at 100). Rotate the "Ramp Time" potentiometer to the desired time setting. Hoist applications typically use short acceleration times of 0.5 to 2.0 seconds for good response.



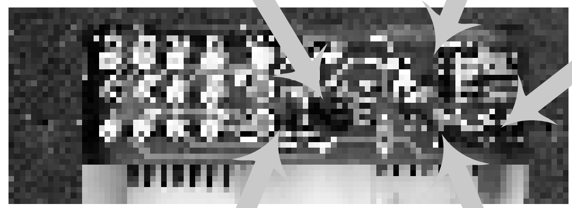
46. Determine the relative synchronous speed of the system tachometer. Move the "RPM Select" jumper on the ASC to the RPM position corresponding to the tachometer synchronous speed value.

Note: When a Hubbell Tachometer/Overspeed Switch Assembly is used, the "1200 RPM" position must be selected.

47. Set the "T/L Select" jumper on the ASC to "HI".

48. Move the "Permissive" jumper on the ASC from the "SETUP" position to the "RUN" position. Restore operation to the holding brake circuit by reinstalling the brake circuit fuses.

49. Set the "Plug/Counter Torque" jumper on the ASC to "CNTR" position.



Initial Motor Direction Verification and Gain Adjustment

50. Close the Circuit Breaker and then the Control Knife Switch. The motor control system will now be able to operate the motor.

Remember: The following steps are done with the crane motor energized. Please follow all safety precautions applicable for operating the crane system.

51. Check the phase of the power by bumping the motor with the Master Switch or pendant in the Lower direction. If the motors turns in the Hoist direction change the wiring between the motor and the controller. Bump the motor again and check the rotation. Important — don't change the Circuit Breaker wiring in the controller to correct phase problems.

52. Assuming that the hook is in the UP position, attempt to operate the motor at first point Lower by moving the Master Switch or by depressing the pendant Lower button. The hook should descend at minimum speed. If the motor appears to be running at full speed, stop the control and reverse the Tachometer leads.

53. Turn the "Gain" potentiometer on the ASC to the fully counterclockwise minimum gain position.

54. When the ASC is set at minimum "Gain", the controller will be sluggish to changes in direction. With too much "Gain", the controller will be quick at speed changes but could be unstable; bouncing back and forth between directions.

55. Move the Master Switch or Pendant button between minimum and mid-speed positions. Observe the operation of the motor to changes in speed reference. The "Lower" and "Hoist" LEDs should change as the handle is moved and the incandescent lights on the ASC circuit boards will change intensity.

56. Adjust the "Gain" potentiometer on the ASC so that when the Master Switch or Pendant button is moved from Hoist to Lower or vice-versa the controller changes directions with minimal bouncing between the "Hoist" and "Lower" LEDs on the ASC. When the "Gain" is correctly adjusted, the incandescent lights on the ASC circuit boards will glow evenly and change smoothly when the handle is moved on the Master Switch. They will not flicker back and forth. Additionally, the crane motor will produce a smooth, even running sound when the direction is changed and will not be sluggish in changing directions.

LSR and HSR Setup/Adjustment

57. Place the black common DVM probe tip into TP8. Place the red meter probe tip into TP4.

58. Set both the "HSR" and "LSR" potentiometers on the ASC fully clockwise.

59. Move the handle on the Master Switch or the Pendant button in the Hoist position until the DVM reads +1.2V ±0.05V. Hold the handle at this position throughout the next adjustment.

60. Adjust the "LSR" potentiometer counterclockwise until the "Low Speed" LED on the ASC turns on.

61. Move the handle on the Master Switch or the Pendant button in the Hoist direction until the DVM reads +4.8V ±0.05V. Hold the handle at this position throughout the next adjustment.

62. Adjust the "HSR" potentiometer counterclockwise until the "High Speed" LED on the ASC turns on.

Final Load Test and Off-Point Timer Adjustment

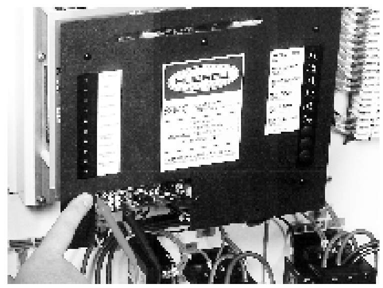
63. Now load the hook with a safe working load and prepare the crane for operation utilizing full safety operating rules and standards for this facility.

64. Raise and Lower the load using various speed conditions. The motor should continue to operate smoothly through the speed and direction changes. Final "Gain" adjustment can be made at this time for smooth acceleration and direction changes.

65. Determine the time required for the control to slow a descending load from full speed to minimum speed. This time will be the "Ramp Time" setting. Set the Off-Point Timer for this slow down time period.

66. Open the Circuit Breaker and then the Control Knife Switch. Replace the cover on the Master Switch or Pendant. Replace the access cover on the ASC. This completes the set up of the motor control system.

Incandescent Lights

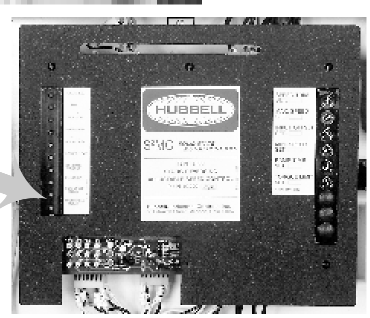


TP Locations

LSR Potentiometer

HSR Potentiometer

Low Speed & High Speed LEDs



Circuit Description

Power Circuit

The incoming three phase power, L1, L2, L3 is connected to the main circuit breaker, MCB, and then to the main contactor, M. Power is supplied to the SCR bridges through the overload relays, 1OL, 2OL, and 3OL, when the power contacts of M are closed. Current limit resistors are connected in series with the power inputs of the Lowering SCR bridges. The current limit resistors control SCR fault currents should they occur. The SCR bridge outputs provide adjustable voltage power to the motor primary windings, T1, T2, T3, through the Power Limit Switch, LS. The limit switch transformer, LSXFMR, monitors one of the limit switch power contacts, and removes power from the brake panel should the monitored power contact open. See Fig. 4 (pg. 13) and Fig. 5 (pg. 14).

Control Circuit

The three phase power from the main circuit breaker, MCB, is also connected to the control circuit breaker, CCB. The control circuit breaker supplies power to the synchronizing transformer, XFMR2, and the control power transformer, XFMR1. See Fig. 4 and Fig 5. Transformer XFMR2 supplies power and SCR synchronizing information to the Static Control Assembly, SCA, and the control power transformer XFMR1 supplies 120V power to the remaining control circuit.

The 120V control circuit power from the control transformer is controlled by the UV relay located on the tachometer continuity assembly, TCA. The function of the TCA is to verify continuity in the Tachometer/ Overspeed Switch circuit. The UV relay will pickup when continuity is established through the tachometer circuit and the control circuit continuity loop composed of the normally closed overload contacts, 1OL, 2OL, and 3OL. The SCR bridge over temperature switch, mounted on the central common SCR bridge, is also included in the control circuit continuity loop along with 1CR and 2CR contacts which are present when the Float option is supplied.

The master switch or pendant station controls the Hoist and Lower Relays, HR and LR, the Off-Point Timing Relay, TR, and the Full Speed Contactor, FS. The brake relay, BR, supplies power to the brake panel and is controlled by HR, LR and the Limit Switch Transformer. HR and LR also operate the Main Contactor, M, through the controlling Master Switch or Pendant contacts. The M Contactor and the initiating directional relay will remain energized when the Master Switch or Pendant is returned to Off-Point to allow the motor to slow the load before removing power and setting the holding brake. The Off-Point Timing Relay, TR, and the Low Speed Relay, LSR, perform this function. Normally, LSR will open at minimum speed to set the brake and remove power. However, should a system problem prevent normal slowdown, the TR contact acts as a backup and removes power and sets the brake after a preset minimum time. See Fig. 4.

The Master Switch or Pendant also provides a bipolar adjustable voltage DC speed reference signal from an internal potentiometer. A positive signal represents the hoisting direction, and a negative signal represents the lowering direction. In this way, the Master Switch handle or Pendant button determines the direction of motion and establishes a voltage reference level by which motor speed will be controlled.

Figure 5 shows the addition of the SC contactor which is used when the extended slow speed option is required. During normal speed hoisting operations, the Low Speed Relay, LSR, will be picked up, and the Counter-Torque Relay, CTR, will remain de-energized. This causes the SC contactor to close and supply normal 0.1 $^{E}/_{I}$ motor secondary impedance in the rotor circuit. During slow, minimum speed operations, when LSR is dropped out, or during counter-torque operations, when CTR is picked up, the SC contactor will remain open, and the extended 0.3 $^{E}/_{I}$ secondary impedance will be in the rotor circuit to reduce slow speed and counter-torque motor currents.

Figure 5 also shows the addition of the Float option components which are, 1FR, 1CR, 2CR, FTR, and the Float Relay Assembly. The Float option is used when very slow or zero speed load position control is required. The Float mode is entered by depressing and holding the Master Switch thumb button while the Master Switch is in the Off position. This mode limits the full travel Master Switch speed value to ±10% with smooth load control through zero speed.

Control Circuit, Static Control Assembly

The Static Control Assembly, SCA, contains all of the control system responsible for the speed regulation function of the Static Reversing Controller. The system also determines the motor's operating mode by controlling which set of SCR bridges is supplying the power. The Static Control Assembly receives its three phase power from the synchronizing transformer, XFMR2. See Figs. 4 and 5 (page 13 &14). This transformer provides low voltage AC power for the electronic power supply section and synchronizing information for the firing circuits. See Fig. 3 (page 12).

The permissive circuit monitors the Permissive command input from the M contactor coil at the 120V AC control power level and converts this signal to an isolated low level signal compatible with the electronic system. The permissive circuit also monitors a tachometer continuity signal originating on the Tachometer Continuity Assembly. In order for the Static Control Assembly system to operate, the tachometer continuity signal must be present along with the control permissive signal from the M contactor circuit. The permissive circuit also monitors the Full Speed command input. This input will enable full speed regenerative lower operation.

The ramp circuit receives the speed reference signal from the Master Switch or Pendant potentiometer and conditions the signal such that it is allowed to change only at a preset rate. This function provides for controlled acceleration and deceleration.

The speed regulator circuit receives the tachometer signal and compares it to the system speed reference signal from the ramp circuit. If the system speed is below the speed reference level, the output of the speed regulator circuit increases to provide more phase reference signal via the directional command circuit. This increased signal provides more voltage to the motor via the firing circuits and consequently more motor torque to increase system speed. If the system speed is above the speed reference level, the speed regulator output reverses polarity. This action causes the directional command circuit to issue a counter torque command to slow the motor. The resulting counter torque command signal causes the speed regulator circuit to provide a clamped or limited phase reference voltage to the firing circuits to control motor current and torque during the slow down interval.

The directional command circuit receives the bipolar speed error signal and a bipolar tachometer signal from the speed regulator circuit and compares these signals to determine the operational mode of the system motor. The directional command circuit issues a Hoist command signal to activate the Hoist and Common SCR bridges via the delayed directional permissive circuit, or a Lower command signal to activate the Lower and Common SCR bridges in a similar fashion.

The delayed directional permissive circuit receives the directional command signals from the directional command circuit and generates firing circuit permissive signals that are delayed by 4 ½ cycles of the 60 hz line. The delay is inserted in the permissive signals to prevent firing circuits that control the previously OFF SCR bridges from turning ON before the SCR bridges which are currently ON have stopped conducting. Shoot through faults are prevented by this delay.

The firing circuits receive the phase reference signal and, along with the synchronizing signals from the three phase synchronizing transformer and the delayed permissive signals from the delayed directional permissive circuit, produce the firing or gating signals required by the SCR bridges.

Specifications

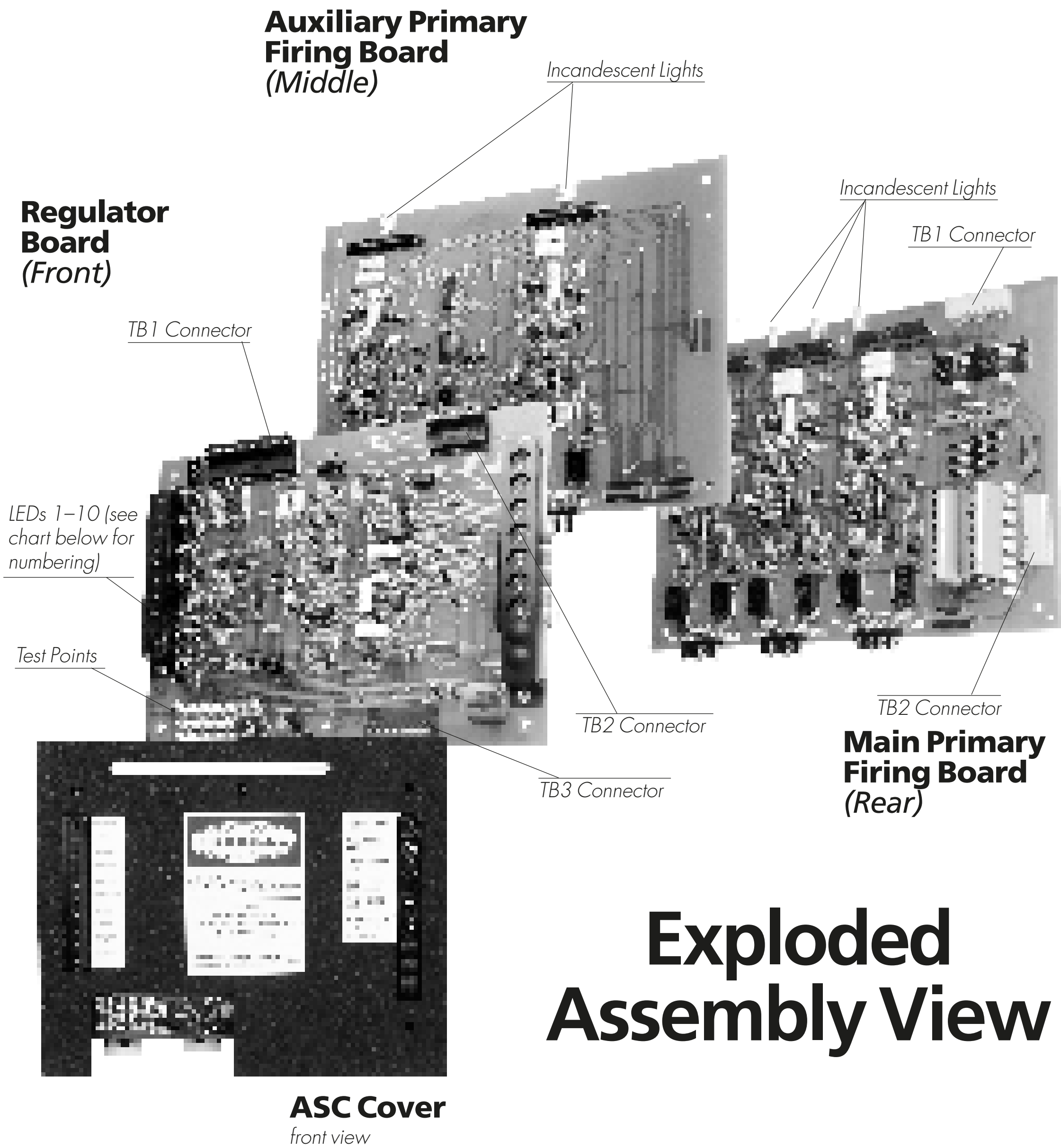
Input Power	230V or 460V, 3 phase, 60 hz
Horsepower Range (at 460V)	5–40 hp (compact construction); 50–250 hp with external SCRs
Speed Range	Typical 10 to 1 with full speed 80% sync.
Speed Regulation	Better than 1%
Control Configuration	Static Reversing
Temperature Range	-40°F (-40°C) to 131°F (55°C) (typical) -40°F(-40°C) to 158°F (70°C) (electronics)

Figure 3 — Static Control Assembly System Block Diagram

Figure 4 — Schematic Diagram of Compact Primary Static Reversing Hoist Control Speed Regulated with Full Speed Contactor and Off-Point Counter Torque

Figure 5 — Schematic Diagram of Compact Primary Static Reversing Hoist Control Speed Regulated with Full Speed Contactor, Extended Slow Speed, and Off-Point Counter Torque and Float

ASC Diagrams & Call-Outs



Exploded Assembly View

LED/Potentiometer Numbers and Function

The Adjustable Speed Control module is made up of three circuit boards — Regulator Board, Auxiliary Firing Board and the Main Primary Firing Board. They are stacked from front to back in this same order. If access to any of these boards is required during troubleshooting, be careful when removing and reinstalling the ribbon cable assemblies, paying particular attention not to bend the dual in-line connector plug pins.

To the left is exploded view of the ASC module for board location and clarity. On the following two pages are graphic representations of the logic diagram for the ASC module. The logic diagrams expands on the system block diagram presented earlier, and identifies system circuit function and signal levels by test points.

Troubleshooting

The following section is a trouble shooting section that should locate most common problems. When the instructions require a voltage measurement, a hand held DVM set to the appropriate AC or DC scale should be used.

When the instructions involve a common referenced DC voltage, insert the black common test lead of the digital voltmeter into test point 8, 0V, and measure the indicated test point voltage with the red meter test lead.

When the instructions involve PC board replacement, the adjustment potentiometers, if any, on the replacement board should be set to the approximate positions indicated on the old board.

Control does not operate, will not respond to command inputs.

➥ **No power to controller.**
Restore power.

➥ **Main circuit breaker or control circuit breaker**
Close circuit breakers. (See Major Components, page 4, for location.)

The UV Relay on the Tach Continuity Assembly (TCA) is not energized. There is power to the control.

➥ **There is no control power present from Terminal 3 to Terminal 4** (see figure right) **on the TCA.**
Check the control circuit fuses. Replace if open. (See Major Components, page 4, for location.)
Investigate the control circuit for the cause of the fault.

➥ **Continuity loop Terminal 1 to Terminal 2 is open.**
Measure the voltage from Terminal 1 to Terminal 2. The normal voltage should be 0VAC.
A 120VAC reading indicates an open condition. Check the following:
a. Normally closed overload relay contacts.
b. The thermostat located on the center SCR bridge.

➥ **Open tachometer, overspeed switch or tachometer signal wiring**
Measure the voltage from Terminal 5 to Terminal 6 on the TCA. A normal reading will be 5V to 10VAC. A 120VAC reading indicates an open circuit. Check the Tachometer/Overspeed switch wiring.

A reading of 0V from Terminal 5 to Terminal 6 of the TCA indicates one of the following:
a. No power to the TCA, and/or
b. Shorted tachometer or tachometer wiring, and/or
c. Faulty TCA.

Control will not respond to command inputs. The UV relay on the TCA is operative.

➥ **Defective command input control wiring.**
Check wiring continuity. Correct Problem. (See Major Components, page 4, for location.)

➥ **M contactor not operating**
Check M power contacts. (See Major Components, page 4, for location.) Replace if necessary.

Open contactor coil. Replace coil or complete contactor.

➥ **Defective Static Control Assembly.**
The adjustable speed control unit is not responding to the command inputs. See Troubleshooting, page 19, "The ASC module is not functioning."

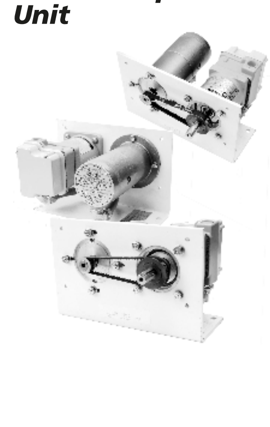
Motor operates but runs at full speed in either direction. No speed control.

➥ **Loss of tachometer feedback signal.**
Monitor the tachometer voltage. If the motor is operating and the voltage is zero:
a. Check the tachometer/overspeed unit. The driving belt may be loose or broken.
b. The tachometer/overspeed unit driving coupling may be loose.
c. The tachometer may be defective. Replace the tachometer or the tach/overspeed unit.

TCA Terminals and Major Components

TCA Terminals and Relay Location. (Outline above, photograph below)

Tach/Overspeed Unit



The Adjustable Speed Control (ASC) module is not functioning.

➥ No control power to the ASC.

Carefully check for the presence of 3 phase 460V or 230V on the primary leads of transformer XFMR2. If the proper voltages are not present, restore power.

➥ No tachometer continuity signal from the Tachometer Continuity Assembly (TCA).

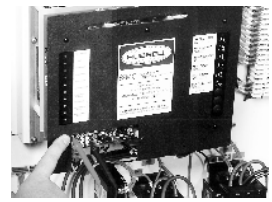
Set the digital voltmeter to a 20VDC scale. Measure the voltage on TB2–9 on the ASC. The voltage should read 0V.

a. If the voltage reads +8.5V, the tachometer continuity signal is absent. If the UV relay on the TCA is energized with this condition, the TCA is defective. Replace the TCA.
b. If the voltage reads +8.5V and the UV relay on the TCA is de-energized see Troubleshooting, page 18, "The UV relay on the TCA is not energized…".
c. If the voltage reads 0V the ASC power supply may be defective. Set the digital voltmeter to read 20VDC. Measure the following test points on the ASC and verify the voltages:

TP8 to TP9	−12VDC to −18VDC
TP8 to TP10	−8.5VDC ±0.5V
TP8 to TP11	+8.5VDC ±0.5V
TP8 to TP12	+12VDC to +18VDC

Look here for info on TP Locations

ASC TP Locations



If any of the voltage readings are incorrect, replace the Main Firing Board.

➥ Control circuit permissive signal is not present.

Set the digital voltmeter to read 120VAC. Measure the following AC voltages on the regulator board on the ASC *(for location see ASC Diagrams page 15)*:

ASC terminals	*Raise*	*Off*	*Lower*
TB1–1 to TB1–2	120V	0V	120V

a. If the above readings are not observed, check the control wiring and correct the problem.
b. Check command input control wiring. Correct any problems.
c. If the UV relay on the TCA is de-energized see Troubleshooting, page 18, "The UV relay on the TCA is not energized…".

➥ Speed reference signal is not present.

Read the voltage at TB2–1 to TP8 with the digital voltmeter. The voltage should be positive when the Hoist direction is chosen. The output should be approximately 1.0–7.0V for the stepless range, and 8.0V for full speed. The voltage should be negative when the Lower direction is chosen. The voltage should be approx. −1.0V to –7.0V for the stepless range, and –8.0V for full speed.

Internal problem with the Static Control Assembly.

➥ Defective 3 phase power transformer XFMR2.

Set the digital voltmeter to read 20VAC. Measure the AC voltages from TB1–4 on the Main Firing Board of the ASC to each of the secondary leads of the Transformer XFMR2. *(For location see ASC Diagrams page 15)*

a. TB1–4 to TB1–6	(YEL)	10VAC ±15%
b. TB1–4 to TB1–2	(BLU)	10VAC ±15%
c. TB1–4 to TB1–3	(RED/WHT)	10VAC ±15%
d. TB1–4 to TB1–7	(BLK)	10VAC ±15%
e. TB1–4 to TB1–1	(WHT/BLU)	10VAC ±15%
f. TB1–4 to TB1–6	(GRA)	10VAC ±15%

If any of the voltage readings are incorrect, replace transformer XFMR2.

➥ Defective Power Supply

Set the digital voltmeter to read 20VDC. Measure the indicated test points on the ASC Regulator Board and verify the following voltages:

TP8 to TP9	−12VDC to −18VDC
TP8 to TP10	−8.5VDC ±0.5V
TP8 to TP11	+8.5VDC ±0.5V
TP8 to TP12	+12VDC to +18VDC

If any of the voltage readings are incorrect, replace the Main Firing Board.

For specific locations of various LEDs, Test Points and/or Connections in reference to the Adjustable Speed Control (ASC) module see page 15, ASC Diagrams & Call Outs.

Defective Permissive Circuit

Observe LED1–LED4 on the Regulator Board of the ASC.

a. LED1 Full Speed Permissive. On only when full speed hoist or regenerative lower is used.
b. LED2 should be on with 120VAC from TB1–1 to TB1–2 of the Regulator Board of the ASC. M contactor should be closed. If this is not true see Troubleshooting, page 19, "Control circuit permissive signal is missing."
c. LED3 should be on with the Tach Continuity signal present from the TCA and 0V from TB2–9 to TB2–14 of the Regulator Board of the ASC. If this is not true see Troubleshooting, page 18, "No tachometer continuity signal from the TCA."
d. LED4 should be on when LED2 and LED3 are on. With LED4 on, measure the voltage from TB3–1 to TP8. Both of these connecitons are on the Regulator Board of the ASC. The voltage should read +12VDC to +18VDC. The permissive jumper must be in the "RUN" position.

If any of the above conditions are not observed, replace the ASC Regulator Board.

Defective Ramp Circuit

Measure the DC voltage between TP1, Ramp, and TP8, 0V, of the Regulator Board on the ASC. The following voltages should be read:

LEDNumbers and Function

a. Min. Speed Hoist	+0.5V	d. Min. Speed Lower	–0.5V
b. Max. Stepless Hoist	+5.0V	e. Max. Stepless Lower	–5.0V
c. Max. Speed Hoist	+6.5V	f. Max. Speed Lower	–6.5V

The voltage readings will rise and fall slowly. If the above conditions are not observed, check the setup of the Ramp Circuit. If the circuit fails to setup properly as described earlier in steps 31-38 on page 8, the circuit is defective. Replace the Regulator Board on the ASC.

Defective Speed Regulator

Measure the voltage between TP3, ±Tach, and TP8, 0V, of the Regulator Board on the ASC. The following voltages should be read:

a. –0.5V to –5.0V for a stepless Hoist operation.
b. +0.6V to +5.0V for a stepless Lower operation

This is the scaled tachometer signal.

Measure the voltage at TP7, ±Err, and TP8, 0V, of the Regulator Board on the ASC. This signal is the Speed Error signal, and will vary from ±0.5V to ±5.0V depending upon motor load. If the motor is not operational and there is no tachometer feedback signal, any speed reference signal will cause this error signal to quickly saturate to ±6.0V.

If the output does not vary or remains saturated when the system should be regulating, the speed regulator circuit is probably defective. Replace the ASC Regulator Board.

Defective Directional Command Circuit

Observe LED5, LED6, and LED7 on the ASC Regulator Board. LED5 should be on during hoist operations. LED6 should be on during driving lower operations. LED7 should be on during slowdown or counter torque lowering operations. If LED7 is on continuously during Raise operations or fails to come on during slowdown or counter torque lowering operations, replace the ASC Regulator Board. *Note:* If the polarity of the tachometer signal is not consistent with the Raise operation, LED7 will be on in both directions. Check tach wiring and reverse if necessary.

Defective Firing Circuits

Observe the incandescent lights on each of the Firing Circuit boards. The lights should vary in brilliance as the drive operates. Three lights at a time should be illuminated, equal in brilliance.

a. 3 lights on the rear Main Firing board will illuminate during Hoist and Counter Torque Lower operations.
b. The 2 lights on the central Aux. Firing board and the central light on the Main Firing board will illuminate during Driving Lower operations.

If the above conditions are not observed, correct the problem or replace the affected board.

Silicon Controlled Rectifier

Silicon Controlled Rectifiers

The primary SCR bridge is an SCR/Heat Sink assembly with the power SCRs connected in inverse parallel. The function of the SCR bridge is to control the amount of voltage applied to the motor. The SCR, silicon controlled rectifier, is similar to standard rectifiers in that it will allow current to flow in one direction while blocking current in the reverse direction. However, SCRs will conduct current only when turned ON. When two SCRs are connected as shown a controllable AC switch or contact is formed that will carry current in either direction but only when GATED ON. SCRs can react very quickly to gating signals, quickly enough to be able to control portions of half cycles of standard AC power. When the gating or firing signal is presented to the SCR very late in the half cycle, the SCR will block all of the cycle up to the time of firing. At the time the gating signal is applied, the SCR will turn ON and conduct the remaining portions of the half cycle to the load.

As the firing signal is presented earlier in the half cycle, the SCR will conduct more and more of the cycle on to the load. The extremes will be maximum firing when the SCR bridge passes all of the AC power on to the motor, and lock out, zero firing, when the SCR bridge blocks all of the AC power.

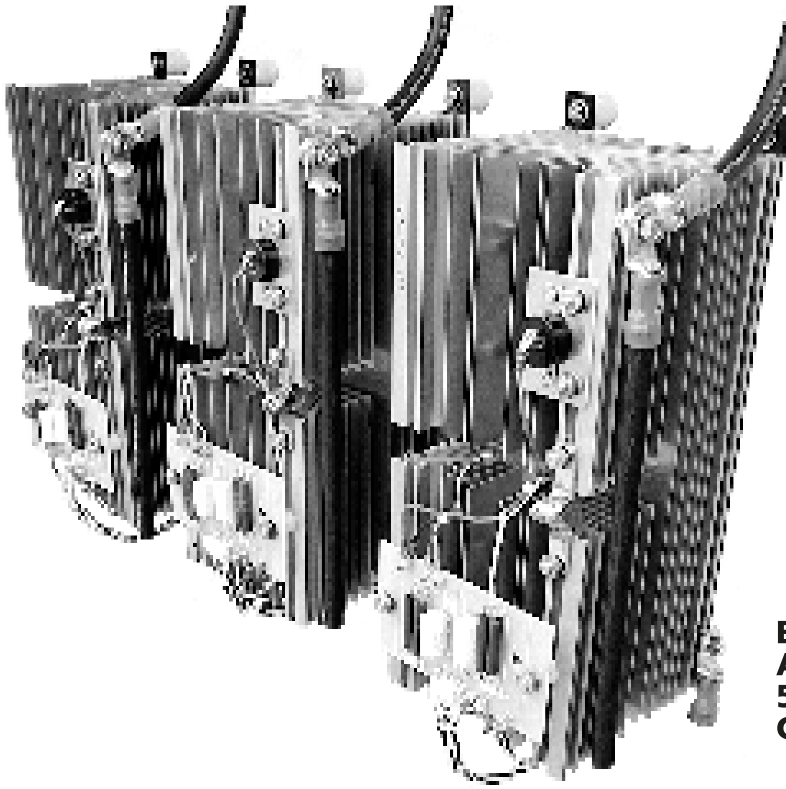
In static reversing controllers, the SCR bridges also perform a directional control function as well. As can be seen in Figures 4 & 5 (on pages 13 & 14), there are five SCR bridges, two Hoist bridges, two Lower bridges, and one Common bridge. When a Hoist operation is required, adjustable voltage three phase power is supplied to the motor via the two Hoist bridges and the Common bridge. The three phase relationship of the applied motor power determines the direction of developed motor torque and rotation.

A Lower operation will be performed in one of two ways depending upon mechanical losses and the weight of the suspended load. First, adjustable voltage power is supplied to the motor via the two Lower bridges and the Common bridge to produce a driving lower operation. If the loading is such as to continue to require a driving lower torque, system will supply lowering adjustable voltage power to meet the commanded speed condition. If an overhauling condition exists, a counter-torque lowering operation will occur where the Hoist SCR bridges and the Common bridge provide motor power. True motor and power system regeneration can be used, if desired, to lower overhauling loads at full speed. For this condition, the system turns the Lower SCR bridges and the Common SCR bridge fully on to supply full lowering voltage to the motor.

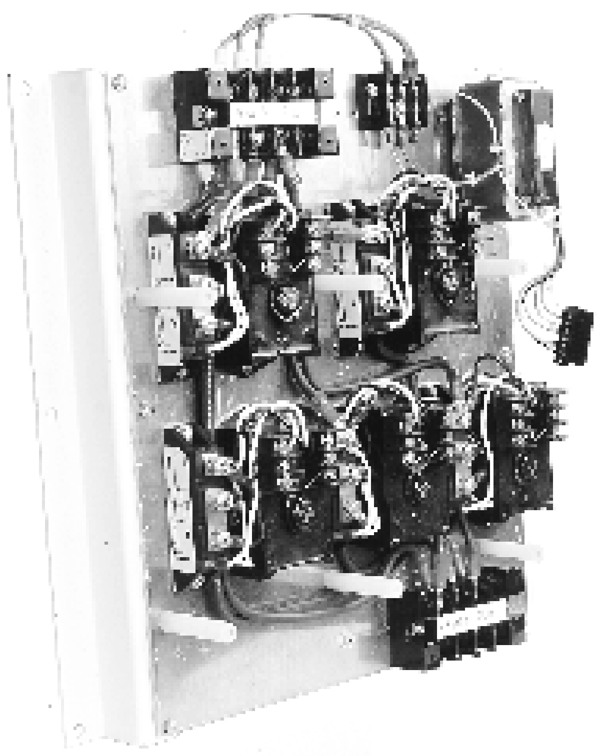
The transition from driving lower to counter-torque lower is automatic and is determined by the mechanical loading presented to the motor. Full voltage regenerative lowering will produce lowering speeds 10% to 15% greater than full load hoisting speeds.

Section Contents

Major Components



External SCR Bridge Assemblies for 50hp (460V) or Greater



Compact SCR Bridge Assembly for 40hp (460V) or Less

Thryistor Power Module Protection

Thyristor Power Module Protection

Thyristor power modules (TPM's) are SCR/SCR, full wave assemblies available in several horsepower ratings from 10–500 hp in ambients up to 140°F (60°C). Each assembly is configured as an inverse parallel bridge with snubbing circuit and voltage transient protection as shown in the illustration. The TPM's are the units that control the applied motor voltage on primary thyristor controls.

The snubbing circuit, comprised of a capacitor and a resistor, is connected in parallel with the SCR's across the bridge. The function of the snubbing circuit is to limit the rate of rise of applied voltage. Transient voltage protection is provided by a metal oxide varistor, MOV, which is also connected in parallel across the bridge. The MOV is a non-linear resistive device that will limit or clamp the transient voltage to a safe level. The snubbing circuit in conjunction with the MOV provides complete transient voltage protection for the TPM's.

Troubleshooting

Inverse parallel SCR bridges control AC power by providing a method of adjusting applied voltage as in the case of Primary Motor Control. The AC Power is handled on a half cycle basis by one of two SCR's. Refer to the Primary SCR Bridge figure provided. SCR1 can conduct power on the first half of the cycle and SCR2 can conduct during the remaining half of the cycle thereby providing balanced currents. Ammeter readings of motor primary currents at low motor speeds should produce balanced readings.

If one of the SCR's fails to conduct, the controlled power becomes unbalanced with a DC component which can saturate common motor loads and lead to higher than normal operating currents. If one of the SCR's becomes shorted, the SCR Bridge supplies full conduction for that phase resulting in unbalanced phase voltages and currents in Primary Control.

The operating condition of an inverse parallel SCR Bridge can be determined easily with a digital DVM. A simple continuity test can be performed with the power removed from the motor circuit. In most Primary Control systems, when the power is removed and the directional or main contactor is open, the SCR Bridge is isolated and continuity measurements can be made directly at the bridge. A shorted SCR will result in a very low or "Zero" ohmmeter reading. A good SCR Bridge will result in a ohmmeter reading of 200K to 300K ohms.

An open or non-conducting SCR as well as a shorted SCR can also be located by taking a set of AC and DC readings across each SCR Bridge and comparing the values. Again, normal readings will be balanced from phase to phase with the "odd" reading indicating a problem. By looking at the SCR Bridge waveforms on the figures supplied, normal operation is indicated by equal periods of positive and negative voltage. With the motor operating at minimum speed, approximately 50% voltage will be supported across each SCR Bridge, and an AC measurement across each bridge should yield balanced voltages. A "Zero" or very low AC voltage reading indicates a shorted SCR. With the DVM set to read DC, voltage measurements across each bridge should yield a low DC value indicating equal periods of positive and negative voltage. A typical DC voltage encountered in this measurement will be less than 10 volts. A reading substantially higher than 10 volts indicates unbalanced firing. The unbalanced condition will affect the readings on the remaining two phases, therefore, the highest unbalanced voltage when compared to the remaining readings, indicates the problem phase.

SCR Readings

Connecting a DVM as shown above, test an SCR for the two conditions listed below. If either of the test conditions fail the SCR will need to be replaced.

1. Power Off Condition

Set the DVM to Ohms and measure the resistance across the SCR. It should read 200k–300k . If it reads 0 , then the SCR is shor ted. It needs to be replaced.

2. Power On Condition

(Motor Running at minimum speed)

Set the DVM to read 600VAC. If the DVM reads between 200–300V AC for a 460V system configuration, the SCR is acting normal with all phases balanced. If the DVM reads 0V, the SCR is shorted. It needs to be replaced.

Now set the DVM to 600VDC. If the DVM read ±5 to ±10VDC, the SCR is runing normally with all phases balanced. If the DVM reads >±20VDC, the SCR is conducting current as a diode or is not firing. It needs to be replaced.

Step Reference Board

Step Reference Board

General Description

The 48978-101 and -102 Step Reference Board assemblies provide a means of supplying a stepped adjustable speed reference signal for adjustable speed drives from input control devices such as relay output programmable controllers, or pushbuttons and master switches without signal potentiometers. Input relays operating from the 120VAC control power are activated by the control device contacts and provide signal isolation. Each selected speed point is independently adjustable by one of five potentiometers. The -101 assembly is used for systems requiring a positive speed reference signal for both directions, and the -102 assembly is used for systems requiring a bi-polar speed signal.

Application Information

The 48978-101 & -102 Step Reference Board is used to provide individually adjustable speed reference points for adjustable speed drives from controlling devices not possessing adjustable voltage output capabilities. Devices such as programmable controllers with relay only outputs, and master switches and pendants without signal potentiometers can control the Step Reference Board. The control inputs consist of 120VAC relays.

A standard progressive maintained control sequence is required for proper operation of the Step Reference board. The first speed point level signal from P1 is available at the Step Reference Board Reference output terminal as soon as the FWD or REV directional relay is closed. The second speed point level signal from P2 is available when the 2nd speed relay is closed. The standard progressive sequence proceeds in this manner through the fifth speed point and P5.

The test points on the Step Reference Board can be used to set and monitor the individual speed point levels, or the output of the adjustable speed drive ramp circuit can be monitored as in standard set-up procedures. In either case, to simplify the system adjustments, it is recommended to set the adjustable speed drive Minimum Speed Potentiometer to a fully counterclockwise position, and the Maximum Speed Potentiometer to a fully clockwise position. These adjustments permit the Step Reference Board signals to directly determine system speed level without offset or scaling.

A typical Step Reference Board application will use the first four speed points as stepless points, and the fifth point as a full speed point. The above right table shows speed levels recommended by speed step.

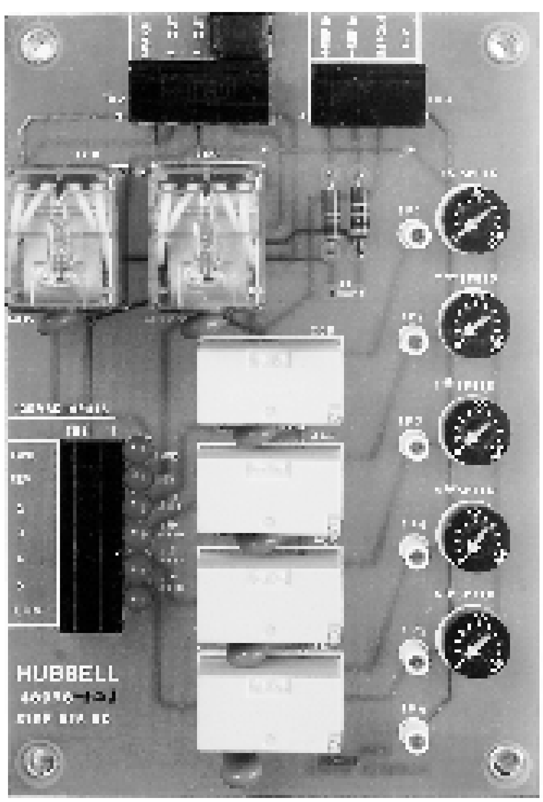
To insure that the adjustable speed drive input circuit loading on the Step Reference Board potentiometers is accounted for, make the above settings with the individual speed points selected with the control device. The signal levels listed above can also be monitored at the adjustable speed drive ramp output. An alternate method is to set the speed point potentiometers to the approximate dial positions listed above, then custom adjust the individual signal levels if necessary with the drive system operational.

Recommend Speed Levels

Speed Point	Test Point†	Signal Level§	Dial Setting
1st	TP1	0.5VDC	10
2nd	TP2	2.0VDC	30
3rd	TP3	3.5VDC	55
4th	TP4	5.0VDC	80
5th	TP5	6.3VDC	100

† The black, common, lead of the digital voltmeter is attached to TP6, 0V and the red, power, lead is attached to the appropriate test point.

§ Signal level is either (+) or (–) voltages depending on whether the speed point being measured is in the Hoist or Lower direction.



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Circuit Description

The Step Reference Board assembly is comprised of six isolating control relays and indicating LED's, and five speed point adjustment potentiometers. See Figures R1 and R2. There are two directional relays, FCR and RCR that connect the adjustable speed drive power supply voltages to the speed point potentiometers. For systems requiring only a positive speed reference signal, the -101 assembly is used, and jumper J1 is in place. This jumper causes a common polarity supply voltage to be connected to the speed point potentiometers when either directional relay is closed. The -102 assembly is used for systems requiring a bi-polar speed reference signal, and jumper J1 is removed. This version causes a positive supply voltage to be connected to the speed point potentiometers when directional relay RCR is closed, and a negative supply voltage to be connected to these potentiometers when directional relay FCR is closed.

Resistors R1 and R2 provide current limit protection for the adjustable speed drive power supply. The resistive elements of the speed point potentiometers are all connected in parallel. When a directional relay is closed, the voltage on the wiper of the first point potentiometer, P1, is connected to the reference output terminal through a normally closed 2nd point relay contact. The setting of this potentiometer thus determines the first point speed reference signal. When the 2nd speed point relay is energized by a programmable controller, pendant or master switch contact closure, the first speed point potentiometer, P1, is disconnected, and the 2nd speed point potentiometer, P2, is connected to the reference output through a normally closed 3rd point relay contact and a normally open 2nd point relay contact. A standard progressive maintained input sequence is required for the stepped operation to continue through the fifth speed point.

The voltage setting of each potentiometer can be measured on the Step Reference board by means of test points. A common test point, TP6 is provided for 0V power supply connection. TP1 through TP5 provide the respective speed point voltages. The voltages at these points should be measured and adjusted only when the respective speed point is selected, as the external circuit of the adjustable speed drive will load the individual potentiometers and change the level somewhat when selected.

Additional directional relay contacts are provided for auxiliary control functions if needed. Two normally closed contacts, one from each directional relay, are connected in series thus providing an Off-Point LV initialization circuit. Two normally open contacts, one from each directional relay are connected in parallel and provide a brake relay or main relay control circuit. An additional normally open contact from each directional relay is also provided for auxiliary control functions.

Figure R1 – Step Reference Board Outline

Specifcations

Input Power and Signals

Input relay control voltage	120VAC @ 1.3 VA Max.
Reference supply voltage	±24VDC Max.
Loading to Reference supply	1.3 K

Reference signal output capabilities

Output step reference voltage	0 to 75% of Reference
Output impedance per step	2.5 K Max.

Output relay contact capabilities

Max resistive switching voltage	
AC current	250VAC
DC current	30VDC
Max resistive switching current	
AC current	2 amps
DC current	3 amps
Temperature range	–40°F (–40°C) to 122°F (50°C)

Indicators/Diagnostics

LED's	FWD and REV direction for 2nd, 3rd, 4th, and 5th speed points
Test Points	TP1, TP2, TP3, TP4, and TP5 individual speed points with TP6 for 0V reference

Figure R2 – Step Reference Schematic

Tachometer Signal Loss Assembly

Tach Signal Loss Assy.

General Discription

The 49232-101 & -102 Tachometer Signal Loss Assembly monitors a speed regulated system's DC tachometer signal and compares this signal with the system's commanding speed reference. A speed difference error signal is produced and compared to an adjustable differential window. If the speed difference signal falls outside the differential window for longer than an adjustable time limit, the unit's Low Voltage relay will deenergize. The Low Voltage relay will deener-gize immediately if the absolute value of the monitored tachometer signal exceeds 125% of the selected synchronous speed, thus providing a fixed overspeed sensing function.

The Tachometer Signal Loss Assembly can monitor 50V or 100VDC tachometers, can be set for standard 60 hz synchronous motor speeds from 600–1800 rpm, can be set to accept bipolar or positive only speed reference signals of up to 50V in magnitude, and provides adjustments for Differential Error, Error Time, and Speed Reference Signal Attenuation.

There are two signal level Lockout Command inputs and one 120VAC control circuit Isolated Lockout Command input. These inputs are used to override the unit's comparison function during periods of nonspeed regulated operation such as Full Speed regenerative lowering or torque/current limiting reversing plugging. The lockout inputs do not disable the overspeed sensing function.

Application Information

The 49232-101 & -102 Tachometer Signal Loss Assembly can be used to monitor and verify the speed feedback signal of speed regulated control systems. The -101 assembly will monitor 50V tachometers and the -102 assembly will monitor 100V tachometers. The assemblies can be set for any of five standard 60 hz synchronous tachometer speed ranges, and to accept either bipolar, ±Ref, or positive only, +Ref, system speed reference signals. The assemblies also provide immediate detection of overspeed conditions. This function will respond to tachometer signal levels exceeding 125% of the selected speed range.

The assemblies have three adjustment potentiometers:

1. The Reference Attenuation potentiometer allows the system speed reference signal to be adjusted and scaled to match the speed feedback signal requirements.
2. The Differential Potentiometer sets the speed reference error window and determines how precise the speed must follow the system reference.
3. The Time Potentiometer sets the time period that a sensed speed tracking error must exist before the output LV relay is deenergized. The time delay function is bypassed when an overspeed condition is sensed, causing the LV relay to disengage immediately.

The assemblies have two signal level Lockout inputs, and one control circuit Isolated Lockout input. These inputs can be used to inhibit the speed tracking function. When any of these inputs are activated, the output LV relay will remain energized regardless

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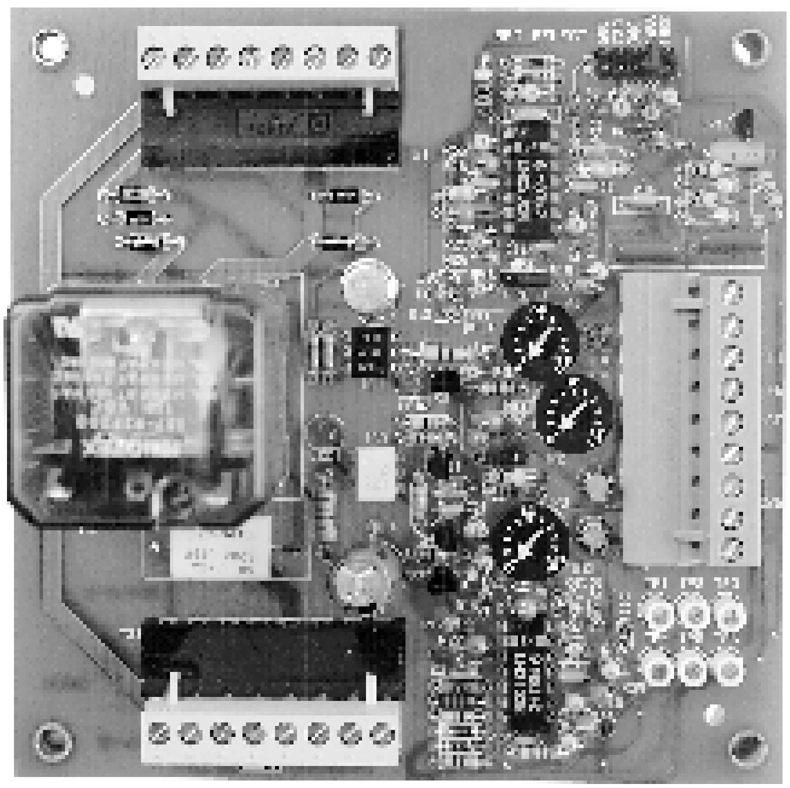


49232-101 Tachometer Signal Loss Assembly of the speed to reference error. Overspeed detection is not inhibited by the activation of any of the lockout inputs.

The assemblies have a Tach Loss Output signal. This current sinking output can be connected to 0V referenced circuits and used to confirm to the speed controlling system that the motor and tachometer are tracking the system speed reference signal within the set differential limits. This output can also be used to control an external relay. Note: a free-wheeling diode must be placed in parallel with the coil of the external relay. This output can sink 200 mA to 0V at 70°C.

Figures T2 (on the next page) shows a typical hoist control application of the Tachometer Signal Loss Assembly. The LV relay on the assembly is used as the system low voltage relay. The 120V control voltage is connected to TB1-1,2 and to TB1-3,4. Any LV circuit permissive contacts such as overload or thermostat contacts are connected in series between TB1-5,6 and TB1-7,8. For standard Off-Point reset operation, the Off-Point setup circuit needs to be in place.

This is done by jumpering TB2-5,6 and TB2-3,4, and connecting the Off-Point initiating contacts between TB1-1,2 and TB2-5,6. This completes the 120V control circuit connections for the LV relay.

The motor control system that the Tachometer Signal Loss Assembly is monitoring, supplies the regulated DC power for the unit's electronics. The 0V connection is made to TB3-1. The +8.0 to +12.0VDC power is connected to TB3-4, and the –8.0 to –12.0V power is connected to TB3-3.

The Tachometer Loss output, TB3-2, can be connected to the Tachometer Continuity input on the Speed Regulating system. This signal provides a direct input to the Speed Regulating system's Permissive circuit. Should this connection not be desired, the Tach Loss output can be left open, but the tachometer continuity input on the speed regulating control should be jumpered to 0V to enable the permissive circuit. The latter is the typical connection.

The speed regulating control's Ramp signal is used as the comparison reference for the monitored tachometer signal. The Ramp signal from the speed control is connected to TB3-5.

The system tachometer is connected to TB3-8 and TB3-9. The polarity of the tachometer signal is important when the speed control Ramp signal is bipolar. For typical applications, the positive tachometer line is connected to TB3-9 for the Raise or Hoist motion when a positive speed reference Ramp signal is present at TB3-5.

The Isolated Lockout input is used to disable the speed tracking function of the Tachometer Signal Loss Assembly. The tracking function should be disabled at any time that the speed control system is not actively providing speed control operation, such as full speed, full voltage Raise or Hoist, full voltage regenerative lower, or prolonged current limit operation during a stalled float sequence. The Isolated Lockout is activated by supplying 120VAC from TB2-1,2 to TB1-3, 4

Figure T1 – Ouline drawing of TSLA

Specifications

Input Power and Signals

LV Control Circuit	120V AC
Signal Circuit Power Supply	30 mA. loading; ±8.0VDC to ±12.0VDC
Tachometer Signal	
–101 assembly	50V/1000 rpm
–102 assembly.	100V/1000 rpm
System Speed Reference	up to 50VDC
Lockouts #1 and #2	connect to + Supply 10K ohm load to 0V
Isolated Lockout	10 mA loading @ 120VAC

Output

Tach Loss Out	200 mA sink to 0V from +Supply @ 70°C
LV Relay	2 – N.O. @ 10 amps, 120VAC @ 70°C

Adjustments

RPM Select (rpm) (JP1)	600, 720, 900, 1200, 1800
Reference Select (JP2)	±Ref, +Ref
Reference Atten (P1)	input reference signal scaling
Differential (P2)	5% – 100%
Time Delay (P3)	0.25–5.0 seconds

Indicators / Diagnostics

LED1	Isolated Lockout active
LED2	LV Relay engaged
Test Point 1 (TP1)	Scaled speed ref. ±5.0V System Sync Speed
Test Point 2 (TP2)	Scaled ±Tach; ±5.0V for System Sync Speed; ±6.25V for Overspeed level
Test Point 3 (TP3)	–lTachl; –5.0V for System Sync Speed; –6.25V for Overspeed level
Test Point 4 (TP4)	±Error; ±5.0V for trip @ set differential
Test Point 5 (TP5)	–lErrorl; –5.0V for trip @ set differential
Test Point 6 (TP6)	0V
Temperature Range	–4°F (–20°C) to 158°F (70°C)

Figure T2 – a typical TSLA installation for a hoist controller

Adjusting TSLA

The jumpers and potentiometers on the Tachometer Signal Loss Assembly must be setup correctly for proper operation of the unit. Below are the major adjustments and each of their respective functions. Adjust them or select them in the following order:

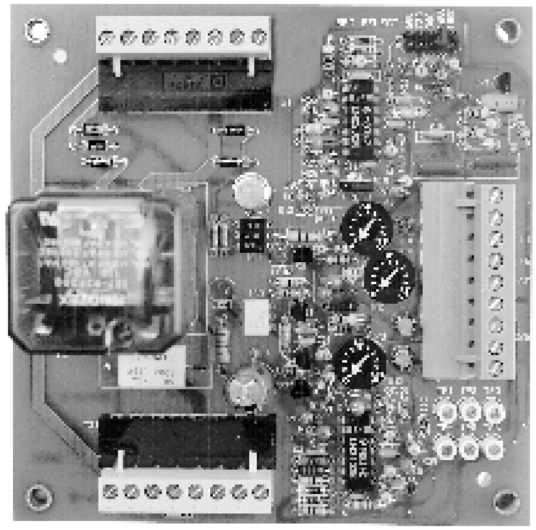
1. RPM Select
2. Ref Select
3. Reference Attenuation Potentiometer
4. Differential Potentiometer
5. Time Potentiometer

RPM Select

This jumper should be set to the rpm value that the system tachometer turns when the controlled motor is running at it's synchronous speed. In direct tachometer to motor connection, this setting will be the motor's synchronous speed. In applications involving a Hubbell Tachometer/Overspeed switch assembly, verify the tachometer speed increase/reduction. Most Tachometer/Overspeed assemblies drive the tachometer at 1200 rpm when the system motor is running at synchronous speed. In these cases, set the jumper to the 1200 rpm position.

Ref. Select

This jumper determines whether a bipolar or positive only system Ramp signal will be used as the speed reference. For speed regulating systems having a bipolar Ramp signal, such as 4922C and 4929C, this jumper must be set in the ±Ref position. For speed regulating systems with positive only Ramp signals, such as 4924C and 4925C, set the jumper to the +Ref position.



Reference Attenuation Potentiometer

This potentiometer is used to scale the speed regulating system's speed reference Ramp signal to match the scaled Tachometer signal. The attenuated speed reference signal can be measured from TP1 to TP6. A value of ±5.0V at this point represents system synchronous speed. During drive setup, when a system Ramp signal which represents synchronous speed is present, adjust the Reference Attenuation potentiometer for 5.0V at TP1. With standard Hubbell SCR adjustable speed drives, this potentiometer can be preset to "80". When the speed control system is operational, operate the motor at a reduced speed point while monitoring the speed error voltage at TP4. When the motor is operating at a constant reduced speed under control of the adjustable speed control, adjust the Reference Attenuation potentiometer for a near 0V reading at TP4.

Time Potentiometer

This potentiometer sets the Tachometer Signal Loss Assembly response time to an error condition. The adjustment range is 0.25 seconds when the Time potentiometer is set fully counterclockwise to approximately 5.0 seconds for a fully clockwise adjustment. A typical setting would be "10" or "20" for a 0.5 second to 1.0 second response time. The time delay function is used to prevent nuisance trips due to normal system speed overshoots or undershoots. This setting can also be adjusted to meet the speed tracking requirements of the system.

Differential Potentiometer

This potentiometer sets the speed error comparison window. The adjustment range is 5% at the fully counter-clockwise position to 100% at the fully clockwise position. A typical setting would be "15" or "20" for a 20% to 25% differential range. This setting can be adjusted to meet the speed tracking requirements of the system.

Troubleshooting

The function of the Tachometer Signal Loss Assembly is to compare the speed regulated system's tachometer speed feedback signal to the system speed reference signal. In normal speed regulated operation, these two signals should track due to the controlling action of the speed regulator. If a problem should develop with the tachometer feed back system, such as a broken or loose coupling, broken drive belt, or open tachometer signal circuit, the Tachometer Signal Loss Assembly will deenergize the LV relay on the assembly. A problem with the speed regulating control system that would cause the system speed not to track the speed reference signal will also cause the unit to deenergize the LV relay.

Verify the Setup

Verify the setup of the Tachometer Signal Loss Assembly by following the set-up procedure outlined in the Adjusting Tachometer Signal Loss Assembly section.

Unit Power

For proper operation of the unit, 120VAC must be present. This is indicated by having

1. 120VAC at terminals TB1-1,2 to TB1-3,4
2. DC control power in the range of +8.0 to +12.0V must be present at TB3-4 to TB3-1, and –8.0 to –12.0V must be present at TB3-3 to TB 3-1.

LV Relay Doesn't Energize

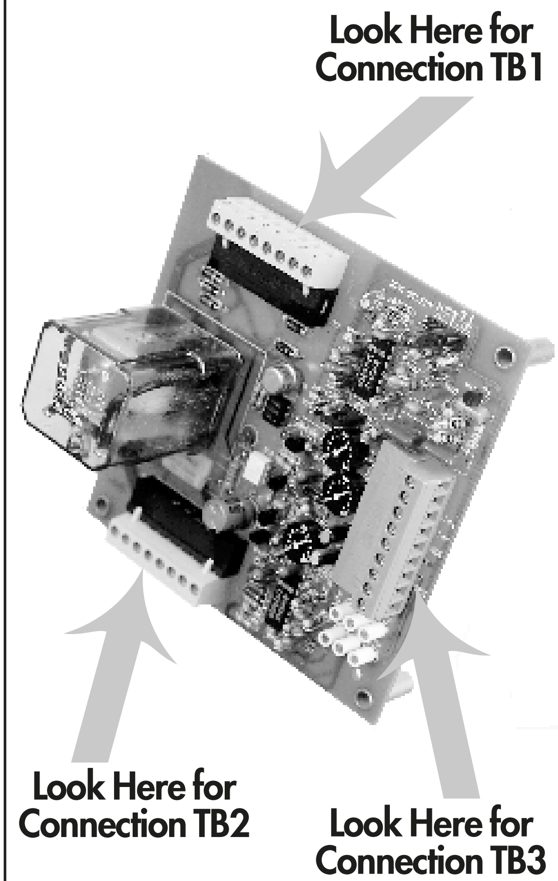
In order for the LV relay to pick-up, the unit must be powered as described above, the Off-Point reset circuit must be in place, and the overload/thermostat circuit must be complete. The Off-Point reset circuit connects TB1-1,2 to TB2-5,6. TB2-5,6 must be jumpered to TB2-3,4 for proper Off-Point reset operation. The overload/thermostat circuit connects TB1-5,6 to TB1-7,8. Verify the operation and function of these controlling circuits.

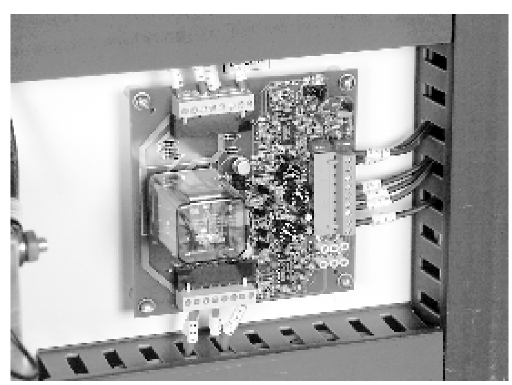
LV Relay is Energized at Off-Point but Drops Out

If the LV relay is energized at Off-Point but drops out when presence of the controlled motion is started, verify the tachometer signal at TB3-8 to TB3-9. For hoisting applications with a positive hoisting speed reference signal, the tachometer signal should be positive on TB3-9. Also verify the presence of valid speed reference signal from the speed regulating system. This signal should be present on TB3-5 to TB3-1 (0V).

Check the position of the RPM Select jumper.

This jumper must be set to a speed value corresponding to the tachometer's driven speed at the motor's synchronous speed. This adjustment allows for discrete gearing or belt reduction ratios. Check the position of the Reference Select Jumper. This jumper must be set to correspond with the type of system speed reference supplied from the speed regulator. Systems such as the 4922C and 4929C use a bipolar speed reference signal. For these systems the Reference Select Jumper must be set to the ±Ref. position. For systems with a positive only speed reference, such as the 4925C, the Reference Select Jumper must be set to the +Ref position.





Shown installed inside a panel.