SECTION VI

MAINTENANCE

WARNING

- **SERIES 3120 CONTROLLERS CONTAIN HIGH VOLTAGE WHICH CAN CAUSE ELECTRIC SHOCK RESULTING IN PERSONAL INJURY OR LOSS OF LIFE.**
- **BE SURE ALL AC SUPPLY VOLTAGE IS DISCONNECTED FROM THE CONTROLLER BEFORE WORKING ON THE CONTROLLER.**
- **NEVER CLEAN THE CONTROLLER OR MOTOR, MAKE VISUAL INSPECTIONS, OR PERFORM MAINTENANCE WITH THE AC SUPPLY VOLTAGE TURNED-ON.**
- **WHEN THE AC LINE SUPPLY IS TURNED-OFF, VOLTAGE FROM SELECTED OPTIONS AND/OR AUXILIARY EQUIPMENT MAY BE IN THE CONTROLLER.**

RECOMMENDED MAINTENANCE SCHEDULE

CONTROLLER

The following is a suggested routine maintenance schedule for the controller when it is installed in a relatively clean environment. The actual environment may necessitate more frequent maintenance. In addition, controllers that operate continuously need more frequent attention than controllers that operate less frequently. Therefore, perform the following maintenance schedule at the recommended time period or as conditions require.

Weekly

Run the controller and drive motor for at least 30 minutes. If the environment is damp, run the controller drive motor for 30 minutes twice a week to ensure dryness.

Monthly

1. Clean or replace the controller enclosure filters (where used). The controller filters must be kept clean.

2. If needed, clean the front of the controller with a mild cleaning solution.

   Note: Some cleaning solutions may damage meter faces and covers.

Quarterly

Clean inside the controller with a vacuum cleaner. Never use compressed air in the controller. Dirt blown beneath and into components can cause grounds and shorts which can damage the controller.

Semiannually

1. Check all terminals and power connections in the controller for tightness.

2. Inspect all components in the controller for damage due to overheating or breakage. All damaged components must be replaced.

3. Check all DC contactors for excessive wear or contact pitting. Replace parts as needed.

4. Exchange spare circuit boards with the one(s) in the controller to ensure the readiness of all circuit boards.

   Note: All new circuit boards should always be checked in the controller to ensure freedom from shipping damage.

MOTOR

Maintain the motor according to maintenance instructions supplied by the motor manufacturer.

ADJUSTMENT INSTRUCTIONS

Series 3120 Controllers are factory tested and adjusted under simulated operating conditions. No adjustments should be needed for normal operation. However, if necessary, the following adjustments can be made. All adjustments must be made in strict conformance to the following instructions.

Note: The standard controller input and feedback boards are Linear Accel/ Decel 60224 and Feedback 60212, respectively. If optional input and/or feedback boards are used, refer to the instruction sheet supplied with the optional board(s), or to Section VII in this manual for adjustment instructions to the optional board(s).

An isolated oscilloscope or digital voltmeter (DVM) is required for controller adjustment if standard armature feedback is used. If optional tachometer feedback is used, only a multimeter (VOM) is required.

CAUTION

CONTACT BETWEEN A GROUNDED TEST INSTRUMENT AND CONTROLLER CAN DAMAGE THE INSTRUMENT AND CONTROLLER.

Reference: Figure 10-11 (Page 10-13)

1. Preset the potentiometers on the standard circuit boards in the 3120M Module as follows:

   a. Adjustment Board

      (1) IR COMP R111 - fully counterclockwise

      (2) MAX SPEED R131 - fully counterclockwise

      (3) CUR LIMIT R113 - fully clockwise

   b. Linear Accel/Decel Board

      (1) ACCEL R11 - mid-position

      (2) DECEL R10 - mid-position

      (3) MIN SPD R17 - fully counterclockwise

   c. Control Board

      All potentiometers on the control board are factory adjusted and, with the exception of the CUR LIMIT TEST potentiometer, are also sealed. The CUR LIMIT TEST potentiometer may be preset to any position. The remaining potentiometers should not be readjusted. If a seal is broken, return the potentiometer to the factory setting.

2. Be sure the input speed reference signal is zero (turn the speed control potentiometer fully counterclockwise, if used).

3. Turn-on the AC supply voltage and the input line circuit breaker.

4. Check the output of the power supplies on the control board with the test meter. First turn the test switch to Positions +24V and -24V. The PERCENT meter should read between 90 and 130% at each position. Then turn the switch to Positions +12V and -12V. The meter should read in the green zone at each position. An incorrect reading indicates a faulty control board or a short circuit connected to the control board.

5. Turn the test meter switch to AMPS position.

6. Push and hold the CUR LIMIT TEST button on the control board and adjust the CUR LIM TEST potentiometer until the PERCENT meter reads the percentage of desired maximum allowable motor armature current (normally 150%).

   Note: If optional tachometer feedback is used and an external torque (current) limit potentiometer is connected to the tachometer feedback board, turn this potentiometer fully clockwise so that Terminals 8 and 9 are shorted on the tachometer feedback board before performing step 7.

7. With the CUR LIMIT TEST button depressed, turn CUR LIMIT Potentiometer R113 counterclockwise on the adjustment board until the CUR LIMIT LED (D23) lights on the control board. Then turn Potentiometer R113 clockwise until D23 turns-off. Release the CUR LIMIT TEST button. Steps 6 and 7 set the current limit to limit motor armature current at the percentage set in step 6.

CAUTION

DO NOT EXCEED 150% OF RATED ARMATURE CURRENT. Excessive armature current can damage the controller and motor.

8. If the controller has both the Field Regulator Option (1029) and optional tachometer feedback, skip to the “Adjustment Instructions” on page 8-7 or page 8-10, as applicable. Do not continue with the following procedure.

9. If the controller has optional tachometer feedback, but does not have Field Regulator Option 1029, disconnect the tachometer generator from the controller.

10. Connect an isolated oscilloscope or multimeter to the output (motor armature) terminals of the controller.

11. Initiate a Start or Run command, increase the input speed reference signal to maximum (turn the speed control potentiometer fully clockwise, if used), and then turn MAX SPEED Potentiometer R131 clockwise slowly until rated armature voltage is attained. If optional tachometer feedback is used, set R131 for 110% of rated armature voltage.

12. Reduce the speed reference signal to minimum (turn the speed control potentiometer fully counterclockwise, if used) and initiate a Stop command.

13. Perform this step only if standard armature feedback is used. If optional tachometer feedback is used, skip to step 14.

    a. Connect the isolated oscilloscope or digital voltmeter to Resistor R110 on the control board (the lead that connects to IR COMP Potentiometer R111) and to common. See IR Test Point in Figure 10-11.

    b. Initiate a Start or Run command and increase the speed reference signal to maximum (turn the speed control potentiometer fully clockwise, if used).

    c. With the test switch turned to AMPS position, record the meter reading, and then turn IR COMP Potentiometer R111 clockwise slowly until the oscilloscope or digital voltmeter measures the following potential:

TEST METER PERCENT	POTENTIAL (VDC)
100	2.0
50	1.0
25	0.5

    The measured potential and armature current (PERCENT meter reading) are directly proportional.

    Note: If motor speed oscillates (hunts) or is unstable, turn Potentiometer R111 counterclockwise until stability is attained.

14. Perform this step only if optional tachometer feedback is used and Field Regulator Option 1029 is not used. Otherwise, skip to step 15.

    a. Turn-off the AC supply voltage and reconnect the tachometer generator leads to the controller.

    b. Turn the MAX SPEED TACH potentiometer fully counterclockwise on the tachometer feedback board.

    c. Turn-on the AC supply voltage, initiate a Start or Run command, and run the motor at maximum speed.

d. Turn the MAX SPEED TACH potentiometer clockwise slowly until rated armature voltage is attained.

Note: If the MAX SPEED TACH potentiometer is set for a speed greater than that set by MAX SPEED Potentiometer R131, motor speed will decrease.

15. Reduce the input speed reference signal to minimum (turn the speed control potentiometer fully counterclockwise, if used) and adjust MIN SPD Potentiometer R17 for the desired minimum speed. If zero minimum speed is desired, turn R17 fully counterclockwise.

16. Initiate a Stop command.

17. If necessary, readjust acceleration and deceleration as described in step 11 on page 3-4.

TROUBLESHOOTING

Most electrical failures are caused by incorrect connections, overload, or the accumulation of dirt, dust, or moisture. Dirt and dust deposits limit the transfer of heat from the solid-state components. Moisture, usually caused by either “wash-down” or condensation, can cause insulation failures and short circuits. Be sure the controller remains clean and dry.

WARNING

1. **BE SURE ALL AC SUPPLY VOLTAGE IS TURNED-OFF TO THE CONTROLLER BEFORE WORKING ON THE CONTROLLER.**

2. **WHEN MAKING VOLTAGE MEASUREMENTS, DO NOT TOUCH ANY TERMINAL OR ELECTRICAL CONNECTION. HIGH VOLTAGE IN THE CONTROLLER CAN CAUSE ELECTRIC SHOCK RESULTING IN PERSONAL INJURY OF LOSS OF LIFE.**

If repeated fuse blowing, circuit breaker tripping, and/or SCR failures occur, check the AC line voltage for transients (high level spikes) or rapid power fluctuations.

Use standard troubleshooting procedures, e.g., continuity checks, to detect faults in the magnetic control logic and operator controls.

TROUBLESHOOTING TABLE

The following table (Table 6-1) is a general guide in locating and correcting faults. It is not intended to cover every contingency. The corrective actions are presented in a logical order. When a corrective action

is completed and the malfunction still occurs, proceed to the next possible cause.

Table 6-7: TROUBLESHOOTING

INDICATION	POSSIBLE CAUSE	CORRECTIVE ACTION
1. Input line circuit breaker trips when turned-on	Wiring faulty or incorrect	Check all external wiring terminating in the controller. Correct accordingly.
	Circuit, component, or wiring grounded in the magnetic control logic or operator controls	Remove ground.
	Input line Varistor RV1, RV2 or RV3 shorted	Replace shorted varistors.
	SCR shorted in the SCR bridge	Replace all shorted SCR's.
	Control board failure causing SCR's to turn-on	Replace control board.
2. Input line circuit breaker trips when a Start command is initiated	SCR shorted in the SCR bridge	Replace all shorted SCR's.
	Motor shorted or grounded	Repair motor.
	Control board failure causing the SCR's to turn-on fully	Replace control board.
3. Input line circuit breaker trips while the motor is running	Motor overloaded	Check the motor shunt field current. Low shunt field current causes excessive armature current. If field current is adequate, check for a mechanical overload. If the unloaded motor does not rotate freely, check motor bearings. Also check for a shorted motor armature. Correct accordingly.
	Loose or corroded connection	Check circuit breaker terminals and all terminals and connections between the line, controller, and motor.
	SCR breaking down in the SCR bridge	Replace all faulty SCR's.
	Control board failure causing SCR false firing or misfiring	Replace control board.
4. Fuse F1, F2 or F3 blown on the standard field supply board	Motor shunt field shorted or grounded	Disconnect the shunt field wiring at the motor connection box and check the shunt field resistance. Compare the resistance with the motor rating. Also check the shunt field wiring for shorts and grounds. Repair accordingly.
	Field supply shorted	Replace field supply.
5. Control Fuse F4 or F5 blown (Model 3120S)	Short or ground in the magnetic control logic or operator controls	Repair accordingly.
	Control transformer shorted	Replace control transformer.
(Continued on next page)		

Table 6-7: TROUBLESHOOTING

INDICATION	POSSIBLE CAUSE	CORRECTIVE ACTION
6. Ø LOSS LED turned-on	Phase loss	Check for three-phase rated line voltage, ±10%, on the controller line terminals.
7. Armature contactor pulls in, but motor won't run	Speed control device failure	Check for a faulty speed control device (e.g., potentiometer, transducer) and speed control circuit. Repair accordingly.
	Contact faulty on the armature contactor	Clean or replace faulty contact.
	Control board failure	Replace control board.
8. Minimum speed excessive	VOLTAGE SELECT switches in wrong position on the control board	Reposition for the applicable line voltage - UP for 208/230 VAC line, DOWN for 380/460 VAC line.
	MIN SPEED Potentiometer R17 misadjusted	Readjust R17 for desired minimum speed. For zero minimum speed, turn R17 to 0.
	Control board failure	Replace control board.
	Tachometer feedback signal loss (if used)	Check tachometer generator connections and the tachometer feedback board in the controller. Repair accordingly.
9. Motor won't reach top speed	Low line voltage	Check for three-phase rated line voltage, ±10%, on the controller line terminals.
	Motor overloaded	Check the motor shunt field current. Low shunt field current causes excessive armature current. If field current is adequate, check for a mechanical overload. If the unloaded motor does not rotate freely, check motor bearings. Also check for a shorted motor armature. Correct accordingly.
	Input speed reference signal too low	Check for +10 VDC speed reference signal. Repair accordingly.
	MAX SPD Potentiometer R131 misadjusted	Readjust per "Adjustment Instructions," page 6-3.
	VOLTAGE SELECT switches in wrong position on the control board	Reposition for the applicable line voltage - UP for 208/230 VAC line, DOWN for 380/460 VAC line.
	Control board failure	Replace control board.
	Linear accel/decel board failure	Replace linear accel/decel board.
	SCR failure in the SCR bridge	Replace all faulty SCR's.
10. Motor only runs at fast speed	Control board failure	Replace control board.
	Linear accel/decel board failure	Replace linear accel/decel board.
	Feedback circuit open or feedback board failure	Repair accordingly.

(Continued on next page)

Table 6-7: TROUBLESHOOTING

INDICATION	POSSIBLE CAUSE	CORRECTIVE ACTION
11. Unstable speed	AC supply voltage oscillating	Observe line voltage with voltmeter or oscilloscope. If oscillations occur, correct accordingly.
	Oscillating load connected to the motor	Correct accordingly. Turning IR COMP Potentiometer R111 counterclockwise may minimize condition. See "Adjustment Instructions," page 6-3.
	Motor series field connected incorrectly	Interchange Series Field Leads S1 and S2. Lead S1 must have the same polarity as Shunt Field Lead F1.
	IR compensator misadjusted	Turn IR COMP Potentiometer R111 counterclockwise until oscillations cease. See "Adjustment Instructions," page 6-3.
	Speed reference signal oscillating	Check the speed control device (e.g., potentiometer, transducer). Also check for a faulty linear accel/decel board. Correct accordingly.
	Motor brushes faulty	Replace brushes.
	SCR misfiring or false firing	Replace all faulty SCR's.
	Control board failure	Replace control board.
12. High unstable motor speed, low torque	Motor series field connected incorrectly	Interchange Series Field Leads S1 and S2. Lead S1 must have the same polarity as Shunt Field Lead F1.
	Field supply failure	Replace field supply.
13. Top speed only about 50% of motor base speed, and the motor is noisy	Control board failure	Replace control board.
14. Motor surges when started	SCR's breaking down in the SCR bridge	Replace all faulty SCR's
	Control board failure	Replace control board.
15. Line current and motor armature current excessive	Motor overloaded	Check the motor shunt field current. Low shunt field current causes excessive armature current. If field current is adequate, check for a mechanical overload. If the unloaded motor does not rotate freely, check motor bearings. Also check for a shorted motor armature. Correct accordingly.
16. Line currents unbalanced	SCR's faulty in the SCR bridge	Replace all faulty SCR's.
	Control board failure	Replace control board.

(Continued on next page)

Table 6-7: TROUBLESHOOTING

INDICATION	POSSIBLE CAUSE	CORRECTIVE ACTION
17. Motor shunt field current insufficient	Open motor shunt field winding or wiring to the shunt field	Check the shunt field circuitry and motor shunt field for a loose connection or a broken wire. Repair accordingly.
	Field supply failure	Replace field supply.
18. Motor shunt field current excessive	Motor shunt field connected incorrectly	Check motor connection diagram for correct connections.
	Motor shunt field windings shorted	Measure the shunt field resistance and compare with the motor rating. Repair motor.
19. Motor thermal switch open (if used)	Ventilation insufficient	Remove dirt, dust, and debris from the motor intake and exhaust screens.
	Line current and motor armature current excessive	See Indication 15.
	Line currents unbalanced	See Indication 16.
	Motor overheating from friction	Check for misalignment. Realign motor.
	Shorted motor windings or faulty bearings	Repair motor.

TESTING CONTROLLER COMPONENTS

WARNING

BEFORE PERFORMING CONTINUITY CHECKS, COMPONENT TESTS, OR REPAIRING OR REPLACING COMPONENTS, BE SURE ALL AC SUPPLY VOLTAGE IS TURNED-OFF TO THE CONTROLLER. HIGH VOLTAGE IN THE CONTROLLER CAN CAUSE ELECTRIC SHOCK RESULTING IN PERSONAL INJURY OR LOSS OF LIFE.

TEST INSTRUMENTS

WARNING

WHEN MAKING VOLTAGE MEASUREMENTS, DO NOT TOUCH ANY TERMINAL OR ELECTRICAL CONNECTION. HIGH VOLTAGE IN THE CONTROLLER CAN CAUSE ELECTRICAL SHOCK RESULTING IN PERSONAL INJURY OR LOSS OF LIFE.

For the majority of continuity checks and component tests, use a multimeter with minimum input impedances of 5000 ohms-per-volt AC and 20,000 ohms-per-volt DC.

Use an AC clamp-on ammeter for measuring line current and also for checking three-phase current balance. An AC/DC clamp-on ammeter can also be used to measure motor armature current.

Use an isolated oscilloscope or digital voltmeter (DVM) for measuring circuit board potentials. The firing pulses and SCR waveforms can be monitored simultaneously with a dual-trace oscilloscope.

CAUTION

CONTACT BETWEEN A GROUNDED INSTRUMENT AND THE CONTROLLER CAN DAMAGE THE INSTRUMENT AND CONTROLLER.

TEST METER

The 3120 test meter is a useful aid for startup, adjustments, and troubleshooting the 3120M Module. Major potentials can be checked and monitored while the module is in operation.

The meter is selectable by a switch to various test points in the module. It is accessible from the outside of the module cover. This meter records the percentage of the potential it measures. When the meter is selected to measure a variable potential, the reading will be proportional to the potential.

A polarity indicator on the test meter glows red for positive potentials, green for negative potentials, and red and green (which appears yellow) for AC potentials.

The following table (Table 6-2, page 6-12) shows the relationship between the positions of the selector switch, meter readings, actual potentials, and potential polarity. All potentials in Table 6-2 are listed with respect to common.

Table 6-8: TEST METER READINGS

SWITCH POSITION	METER READING	POTENTIAL	POLARITY INDICATOR
+24V	90% - 130%	+24 VDC. Output of power supply.	Red
-24V	90% - 130%	-24 VDC. Output of power supply.	Green
+12V	Green Zone	+12 VDC. Output of power supply	Red
-12V	Green Zone	-12 VDC. Output of power supply.	Green
AMPS	0 - 150%	0 to 150% rated motor armature current. Proportional to motor armature current. When the motor is running at base speed and driving rated load, the meter should read in the green zone. During acceleration, the meter may read 150%, maximum.	Green
ERROR	0 - Green Zone	0 to +10 VDC. Output of the speed regulator. Proportional to the speed reference signal.	Red
FDBK	0 - Green Zone	0 to -5.0 VDC. Proportional to motor speed.	Green
REF	0 - Green Zone	0 to +10 VDC. Proportional to the speed reference signal. When the motor is running at base speed and driving rated load, the meter should read in the green zone.	Red
FIELD	Green Zone (Motor Running)	Rated motor shunt field voltage	Green
	60% - 75%[a] (Motor Stopped)	Field economy voltage	Green
Ø1 Ø2 Ø3	Green Zone	Line Voltage	Yellow

a. Meter reading will be about 50% with optional field supply.

SCR TESTING

Disconnect the SCR from extraneous circuitry to ensure an accurate test. An SCR should be operative if its resistance equals that shown in Figure 6-2, page 6-13.

Use the circuit shown in Figure 6-3 (page 6-13) to test for an open SCR and its ability to fire.

When the switch is closed, the ohmmeter reading should change from infinity to between 1000 and 10,000 ohms. When the switch is opened and the holding current (ohmmeter batteries) is removed, the ohmmeter should again read infinity. A faulty SCR will not switch, but remains in either a conducting state or open circuit.

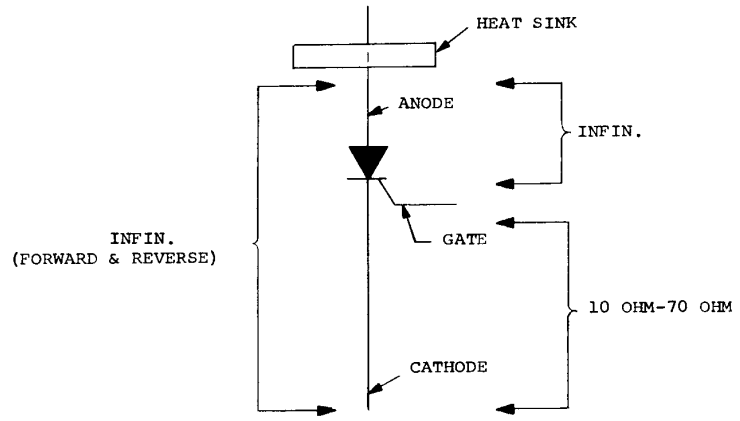

FIGURE 6-1. RESISTANCE OF AN SCR

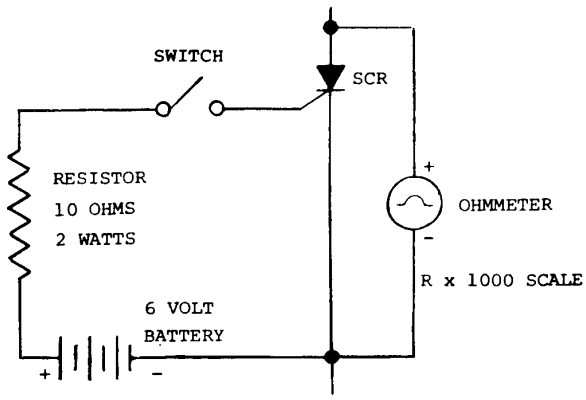

FIGURE 6-2. SCR TEST CIRCUIT

DYNAMIC TESTING OF SCR's

Check for SCR misfiring and false firing by monitoring the output of the SCR bridge (motor armature voltage) with an isolated oscilloscope under operating conditions, as follows:

1. Synchronize the oscilloscope to the AC line.

2. Place the scope probes on the output (motor armature) terminals of the controller.

3. Run the motor at 1/3 speed. One of the peaks will be out of proportion with the others if an SCR shorts, opens, misfires, false fires, or breaks down. An open or misfiring SCR is also apparent by a missing peak at higher speeds.

A shorted SCR or one that breaks down can also be detected by disconnecting the gate wiring from all the SCR's. Then, turn-on the AC line voltage to the SCR bridge and measure the voltage dropped across the anode and cathode of each SCR. An SCR with a low voltage drop must be replaced.

VARISTOR TESTING

A Varistor (RV1, RV2, RV3) is connected across each phase of the AC input. To test a varistor, remove the wire(s) from one of the varistor's terminals and check its resistance with an ohmmeter. If the ohmmeter reads less than infinity in either direction, replace the varistor.

CIRCUIT BOARDS

Circuit board repairs in the field are not recommended due to the complexity of the circuitry. The circuit boards are designed for easy replacement. Therefore, if defective, a circuit board should be replaced and the faulty board returned to Fincor for repair.

BLOWN FUSE

If a fuse blows, turn-off all AC supply voltage to the controller and check the controller with an ohmmeter for short circuits and grounds.

GROUNDS

Controller

To check for grounds, turn-off all AC supply voltage to the controller, disconnect all ground leads from the secondaries of all applicable transformers, and check with an ohmmeter from a clean, bare metal surface in the controller to all terminal strip terminals. The ohmmeter should read near infinity on every terminal. A low reading indicates a ground which must be removed.

CAUTION

- **NEVER USE HIGH POTENTIAL TEST INSTRUMENTS (E.G., A MEGGER) IN THE CONTROLLER. This can damage the solid-state components.**

- **RECONNECT THE GROUND LEAD(S) BEFORE OPERATING THE MOTOR.**

Motor

Disconnect the motor wiring in the motor connection box or at the controller terminal board. Check for grounds by meggering from each motor lead to the motor frame. Check for a rotating ground by manually turning the motor shaft while meggering the motor leads.