

MODELS:

7520-40	Unified Masterflex Drive, 600 RPM, 115 V
7520-47	Unified Masterflex Drive, 600 RPM, 230 V ce
7520-50	Unified Masterflex Drive, 100 RPM, 115 V
7520-57	Unified Masterflex Drive, 100 RPM, 230 V ce
7520-60	Unified Masterflex Drive, 300 RPM, 115 V
7520-67	Unified Masterflex Drive, 300 RPM, 230 V ce
77521-40	Unified Masterflex Drive, w/4-20 mA, 600 RPM, 115 V
77521-47	Unified Masterflex Drive, w/4-20 mA, 600 RPM, 230 V ce
77521-50	Unified Masterflex Drive, w/4-20 mA, 100 RPM, 115 V
77521-57	Unified Masterflex Drive, w/4-20 mA, 100 RPM, 230 V ce
900-1076	OEM Drive MILLIPORE, 600 RPM, 115 V
900-1077	OEM Drive MILLIPORE, 600 RPM, 230 V ce
900-1268	OEM Drive Drive Tech 300 RPM, 115 V
900-1273	OEM Drive Spectrum Pump System, 600 RPM, 115 V
900-1274	OEM Drive Spectrum Pump System, 600 RPM, 230 V ce



PROPRIETARY

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A-1299-0934
Edition 02

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APPENDIX:

OLD SERVICE MANUAL (A-1299-0442) for 7520-xx drives manufactured before the date code outlined on the next page.

INTRODUCTION

This service manual is written to cover the **Re-Designed** 7520-xx series drives. The new drives can be identified by the manufactures use of a “gold colored chassis”. The previous products had black chassis. The 7520-xx have similar electronics hardware. Service techniques used on one system will carry over to the other family. This also holds true for the OEM model numbers.

The 7520-xx and 900-xx series drives that were manufactured prior to H00005767 (excluding #'s H00001068 thru H00001114) as listed on the drives serial number code are covered under the old service manual part number A-1299-0442 (**see appendix**).

Service for this product is performed at three levels: the customer, distributor/COLE-PARMER and factory/depot repair. This manual describes distributor/COLE-PARMER service procedures.

Customer service procedures are described in the operator's manual. Customers are encouraged to perform service as described in the operators manual as well as in special circumstances where special skills and safety are not considerations.

To use this manual, begin with the troubleshooting section to isolate the fault to a replaceable part. The functional description and checkout procedure sections are also helpful in determining the faulty part. Distributor/COLE-PARMER repair is limited to replacement of modules as detailed in the replacement parts list section. The repair procedure section details disassembly and assembly procedures. After repair, the product should be calibrated and checked for proper performance.

Please refer to the operators' manual (PT: #A-1299-0860) for:

- A.) APPLICATIONS DATA
- B.) PRODUCT DESCRIPTION
- C.) INSTALLATION
- D.) SETUP
- E.) OPERATION
- F.) USER CALIBRATION
- G.) USER TROUBLESHOOTING & MAINTENANCE
- H.) ACCESSORIES
- I.) SPECIFICATIONS

SAFETY CONSIDERATIONS

Servicing must be performed only by personnel trained and skilled in the methods of troubleshooting and repair of electro-mechanical products. Use of procedures other than those described in this manual may result in a safety hazard to service personnel and/or customers.

When servicing any component of this unit be absolutely certain that all power to circuitry is removed. If any functional checks are to be performed while power is applied and chassis is disassembled, care must be exercised for the following:



WARNING!

- A.) THIS IS A LINE OPERATED DEVICE AND IS NOT ISOLATED FROM GROUND. USE OF AN ISOLATION TRANSFORMER IS STRONGLY RECOMMENDED.
- B.) DO NOT INADVERTENTLY SHORT ANY PART OF THE PRINTED CIRCUIT CARD TO GROUND, AS SEVERE DAMAGE WILL RESULT.
- C.) MAKE ABSOLUTELY SURE THAT ANY TEST EQUIPMENT USED FOR REPAIR IS NOT REFERENCED TO EARTH GROUND.

THEORY OF OPERATION

The variable speed controller employs a phase-controlled rectifier bridge to vary the power applied to a permanent magnet DC motor. The bridge will conduct current only when the power line voltage exceeds the voltage across the motor terminals. Varying the point at which the bridge starts to conduct relative to the phase of the line voltage can therefore control the power to the motor. An inner torque, outer speed regulator loop, controls the phase angle at which the bridge starts conducting. The speed of the motor is directly proportional to the back EMF generated by the motor. Comparing the voltage across the motor terminals against the speed reference signal at the center tap of the front panel speed control pot, an op amp generates a torque reference signal. The torque supplied by the motor is directly proportional to the current supplied to the motor. The op amp amplifies the voltage drop across a sense resistor, providing a signal proportional to the average current supplied to the motor. The peak value of the signal is subtracted from the torque reference signal by a transistor. The resulting torque error signal charges a capacitor, firing the power bridge SCR's for a given line cycle.

Transient voltage suppression for the line is provided by "line to line" MOV's. Motor brush commutation noise is suppressed using a RC network.

600 volt SCR's and 1000 volt diodes make up the power bridge and primary power supply. Supply regulation is through a zener diode network. SCR switching at zero cross is actually centered on a 10-volt window creating a secondary supply, allowing a complete shut-off of each SCR. This voltage is also used to synchronize the SCR firing circuit to the line.

A simple RC network provides for a soft-start circuit, which provides a gentle acceleration of the motor.

The 77521-xx series drives have an identical motor controller front end, with the addition of linear speed control inputs. These two inputs take either 2 – 10 volt dc or 4 – 20 ma and operate the drive over its full rated speed range.

The linear inputs generate a 1 – 5 volt span that is OP amp buffered for common mode up to 15 vdc. This voltage is then fed through an offset OP amp to subtract 1 volt from the signal, leaving 0 – 4 volt control signal for speed reference. MOS switches select either the front panel control reference voltage or the linear input speed reference to control drive speed. This stage also incorporates an additional MOS switch that allows contact closure (start/stop) control of the drive motor. Additional circuitry allows the user to remotely select the front panel or linear input speed references using a contact closure.

The output of the commanded 4-20 mA and 2-10 VDC inputs are optically isolated from the ac line, minimum 1250 Vac for 115Vac units, 1900 Vdc for 230Vac units.

DETAILED CIRCUIT OPERATION

7520-XX SERIES CONTROLLERS

GENERAL OVER-VIEW

A.) The 7520 series controller board employs modular SMT technology (see figure #1) to provide a single board solution, employing an SCR based power amplifier to drive permanent magnet motors up to .1 HP.

Power Supply

- A.) AC line is brought in at (J-3 and J-4) and routed through ("FWD: OFF: REV") switch contacts to power bridge consisting of (CR1-CR4).
- B.) 100 VDC at (TP #8), is dropped by series resistor (R-26) and regulated to approximately 22.7 VDC at (TP #6) by (CR-7).
- C.) LED (DS-1) indicates power "ON" to circuitry.
- D.) Varistor VR1 and RC network R1 & C1 suppress line noise generated externally and internally by motor and power bridge.

Output Drive

- A.) Motor power bridge consists of (CR-3, CR-4, Q-1, Q-2). Diode (CR-5) bypasses the inductive current surges of the motor when the Power Bridge shuts off. The output bridge is routed through ("FWD: OFF: REV") switch contacts to allow motor reversal and is brought out at (J-1 and J-2) of the PCB.
- B.) Resistor capacitor combination consisting of (R-5 and C-2) forms a snubber network for commutation noise suppression.

Control Section

- A.) Motor speed is set by front panel pot connected to J6.
- B.) A +VREF is obtained by regulating the +22VDC supply with (R-13 and CR-11) to approximately +12VDC. This is routed through network (R-33 and R-30) to DC ground. Adjustment pot. (R-33) sets maximum motor speed approx. +10VDC at (TP-1).
- C.) Components (R-13, CR-9, and C-6) control acceleration, deceleration of motor RPM.

- D.) Set-speed is controlled and regulated by differential amp (U1) and related components (R-15, C-7, R-17, and R-2, R-37, R-3). All scaling is done at 5volts full-scale for all op amp circuits. As motor load increases, back EMF, picked off drive output resistor network (R-2, R-37 and R-3), (TP-3) decreases from 5 volts. This is fed through (R-17) to pin 2 of (U1-A) causing (TP-2) to charge integrator capacitor (C-10) via (R-18) to advance the SCR firing angle, until the op amp equalizes its input voltages.
- E.) Current limit of circuit is accomplished by monitoring the voltage drop of current sense resistor (R-4), feeding it through (R-19 and R-11) to level amp (U1-B) and related components. As current through (R-4) approaches [2.0 amps for 120 volt units]; [1.0 amps for 240 volt units] voltage to (TP-4) rises to approximately +5.0VDC. This is fed through resistor network (R-22 and R-23) at a [2 to 1] ratio, into the peak detector (CR-10 & C-9). The output of the peak detector is buffered (R-21 & Q-4) by an emitter follower (Q-4 & R-25) amplifier which discharges integrator (C-10), retarding the SCR firing angle. The resultant firing angle will be proportional to the difference between the torque reference charging current (R-18) and the torque feedback discharging current (R-25).
- F.) The SCR will fire when the integrator (C-10) voltage is equal to the "PUT" (Q-9) reference voltage (VR-3: R-11; & R-12). Line synchronization is achieved by allowing the reference voltage to drop to zero (10-volt window) with each line cross, thereby discharging (C-10) through (Q-9). (C-10 & Q-9) form a relaxation oscillator whose period is proportional to the rate of charge of (C-10). When the voltage across (C-10) is equal to the reference voltage, the "PUT"(Q-5) is forward biased and will conduct, discharging (C-10) through the base-emitter junction of buffer (Q-6). (R-9) bypasses any leakage current, while (C-11) filters out noise pulses.
- G.) The pulse output of the relaxation oscillator (C-10 & Q-9) is buffered and amplified by (Q-6) and level shifted by a Darlington pair (Q-3 & Q-8) on 115-volt units or (Q-8 & Q-7) on 220-volt units' fire the Power Bridge SCR (Q-1 & Q-2). (R-7 & R-29) limits the gate current, while (CR-6 & CR-12) blocks back conduction of the Darlington pair.
- H.) For a detailed view of these signals see figure #3 waveform and related descriptions.

DETAILED CIRCUIT OPERATION

77521-XX SERIES CONTROLLERS

GENERAL OVER-VIEW

A.) The 77521 series controller board employs modular SMT technology (see figure #2) to provide a single board solution, employing an SCR based power amplifier to drive permanent magnet motors up to .1 HP. This board also incorporates circuitry to allow remote speed control through voltage or current as well as control through contact closures. All of the board features of the 7520 are used in this design, therefore the detailed descriptions of circuitry that follow will only outline the major differences between the two.

Power Supply

- A.) The +22 volt non-isolated supply is derived by 100 VDC at (TP #8), dropped by resistor network (R117, R132, R133, R134, R135, R136) these are multiple smt style resistors and regulated to approximately 22 VDC at (TP #6) by (VR4). The voltage will charge (C5) through CR8) to filter the ripple and produce a regulated supply.
- B.) The +15 volt non-isolated supply is derived by tapping off (C5) through (R33) and regulated by (VR2). Capacitor (C16) filters any ripple.
- C.) A separate +15 volt supply used to drive the circuitry on the isolated side of the circuits is derived for transformer (T1), rectified by (D1-D4), filtered and bypassed by (C23-C24), then fed into regulator (U8). The 15 volts is set by (R106-R107) and filtered by (C20). This voltage is available at (J16 pin#1).

Control Section

In this controller all user adjustable controls e.g. speed pot and remote features are isolated from the ac line. The final output from the opto coupler isolator drives the input of the aforementioned controller.

- A.) Motor speed is set by front panel pot connected to J8.
- B.) Front panel speed reference voltage is generated by divider network (R65, R56, and R53) to DC ground. Adjustment pot (R-65) sets maximum motor speed approx. +4.0VDC at (J16 pin3).
- C.) The 4 volt signal that is set above is routed through analog switch network (SW1-A & SW1C) which is the selection network for front panel speed or remote speed select and the foot switch control. Switch (SW1-A) works opposite of (SW1-B) when local remote switch is in the LOCAL position a low is placed at pin5 (SW1-B) turning it off. The low prevents conduction of (D8) allowing pull-up (R75) to enable (SW1-A) selecting the front panel speed reference. When local remote switch is in the REMOTE position a high is placed at pin5 (SW1-B) turning it on selecting the remote speed inputs. The high causes conduction of (D8), transistor (Q11) conducts, pulling pin13 (SW1-B) low deselecting the front panel speed reference. In this mode the user can select either front panel or remote speed references by grounding (J6 pin4 interface connector).
- D.) The foot switch control works in a similar manner as above. When local remote switch is in the REMOTE position a low is placed at pin6 (SW1-B) turning it off. The low is generated by (Q10) conduction through (D7) pull-up (R70) this prevents the speed reference voltage (regardless of front panel or remote selection) from driving the opto coupler isolation drive.

By grounding (J6 pin7 interface connector) the low prevents conduction of (D7), transistor (Q10) turns off, allowing pull up (R73) to enable (SW1-C) allowing the speed reference voltage selected to drive the opto coupler isolation drive.

- E.) The opto coupler isolation drive consists of (OPT1) and U4-B) this circuit works by taking a voltage at pin5 (U4-B) and having the output of the op amp drive the input ird led of (OPT1) until the op amp equalizes its input voltages at pin6. Because there is are two detectors within opt1 one is within the feedback path, another in a separate op amplifier (U5-B). A linear drive voltage will give a linear output of the same voltage, pin7 (U5-B). This control voltage typically 0 – 10 volts will drive the SCR amplifier input. This circuit also serves to provide isolation barrier of approx. 3500 volts between the grounded and hot referenced control circuits.
- F.) The linear inputs consist of (U3-A) dual op amp. This is split one for voltage one for current. The +voltage input enters pin1 (J6) and ground pin3 (J6) through (R78). The voltage across R78 is divided by 2 and buffered by (U3-A), to generate a 1 – 5 volt output. The +current input enters pin2 (J6) and ground pin3 (J6) through (R47). The voltage across R47 is buffered by (U3-B), to generate a 1 – 5 volt output.
- G.) Because the scaling of the electronics the outputs of the above circuits have to start at “zero” and then span. This is accomplished by setting (U4-A) for an offset of 1 volt. The result is a 0 – 4 volt control signal.
- H.) (D13) is configured as an adjustable zener diode. This will conduct at 6 volts to clamp off (U3-A) outputs of greater than 5 volts, preventing excessive drive speed.

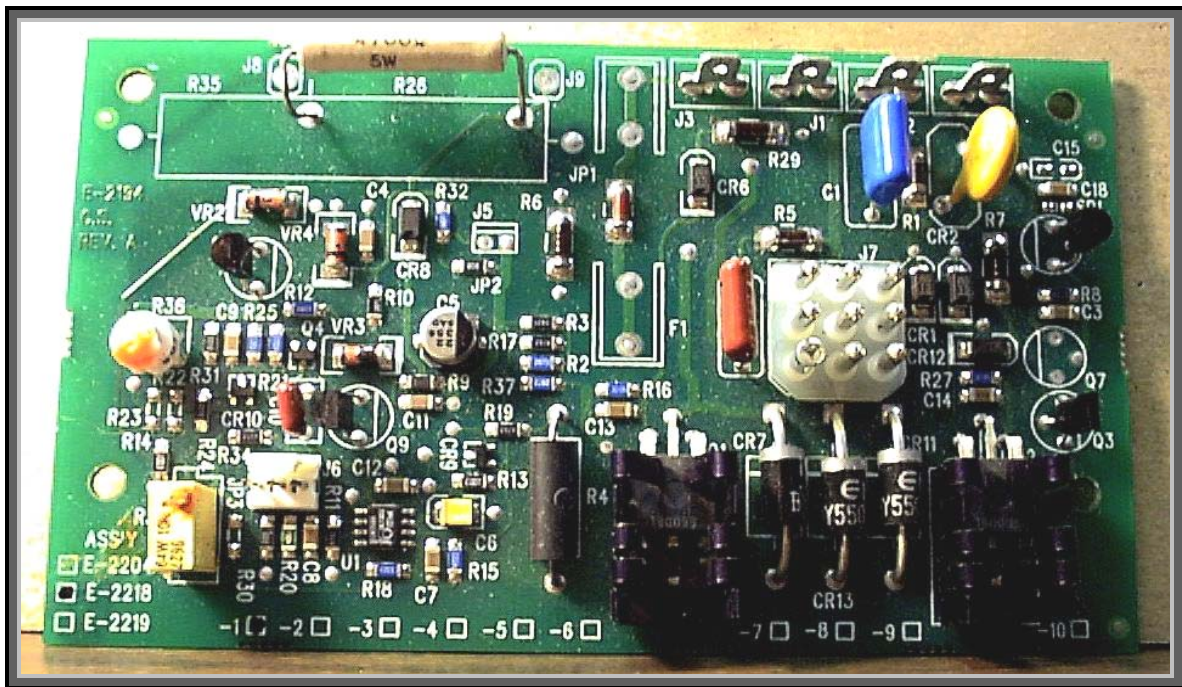


Figure 1 Typical controller board employed in the 7520 series drives.

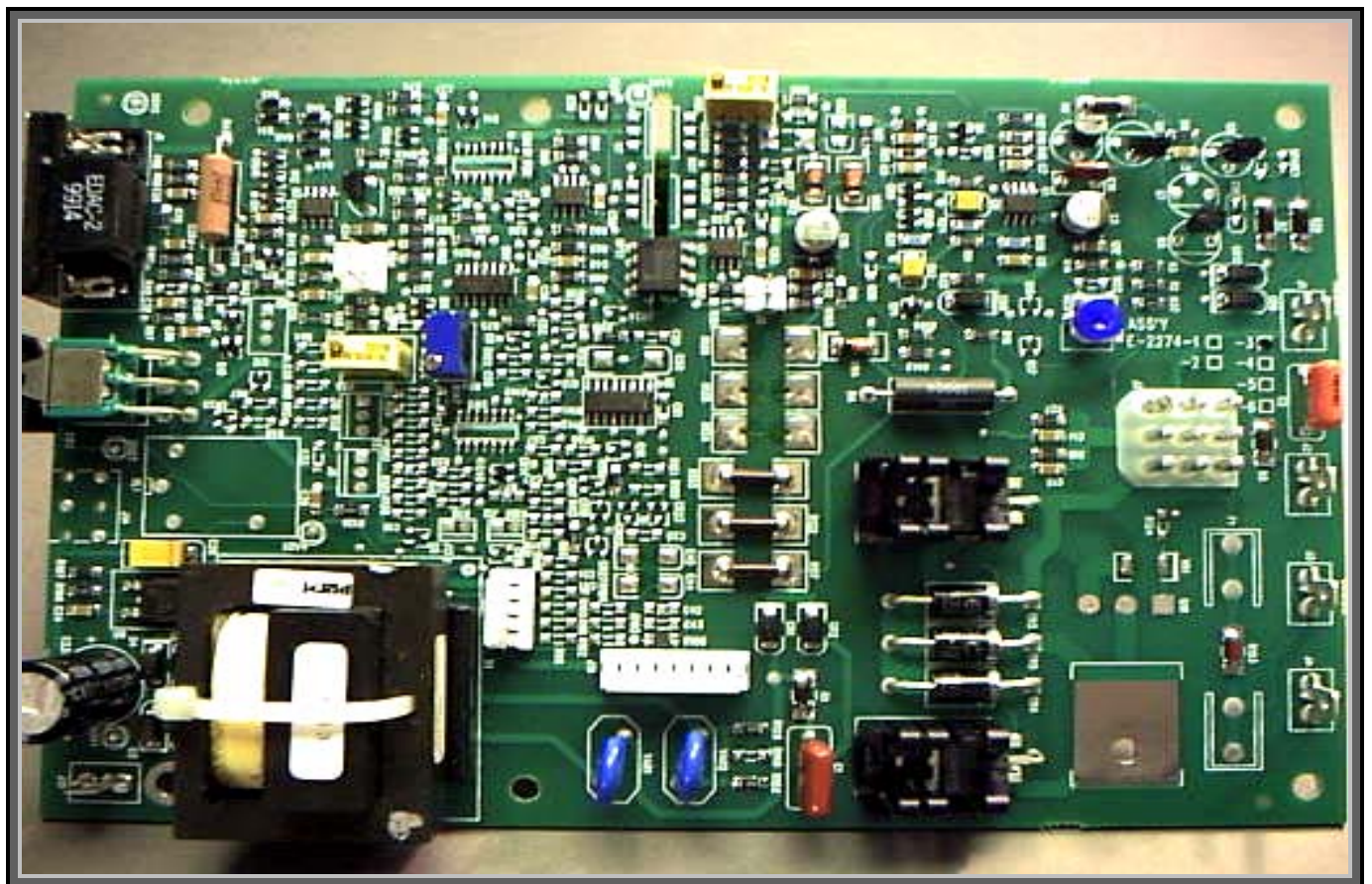


Figure 2 Typical controller board employed in the 77521 series drives.

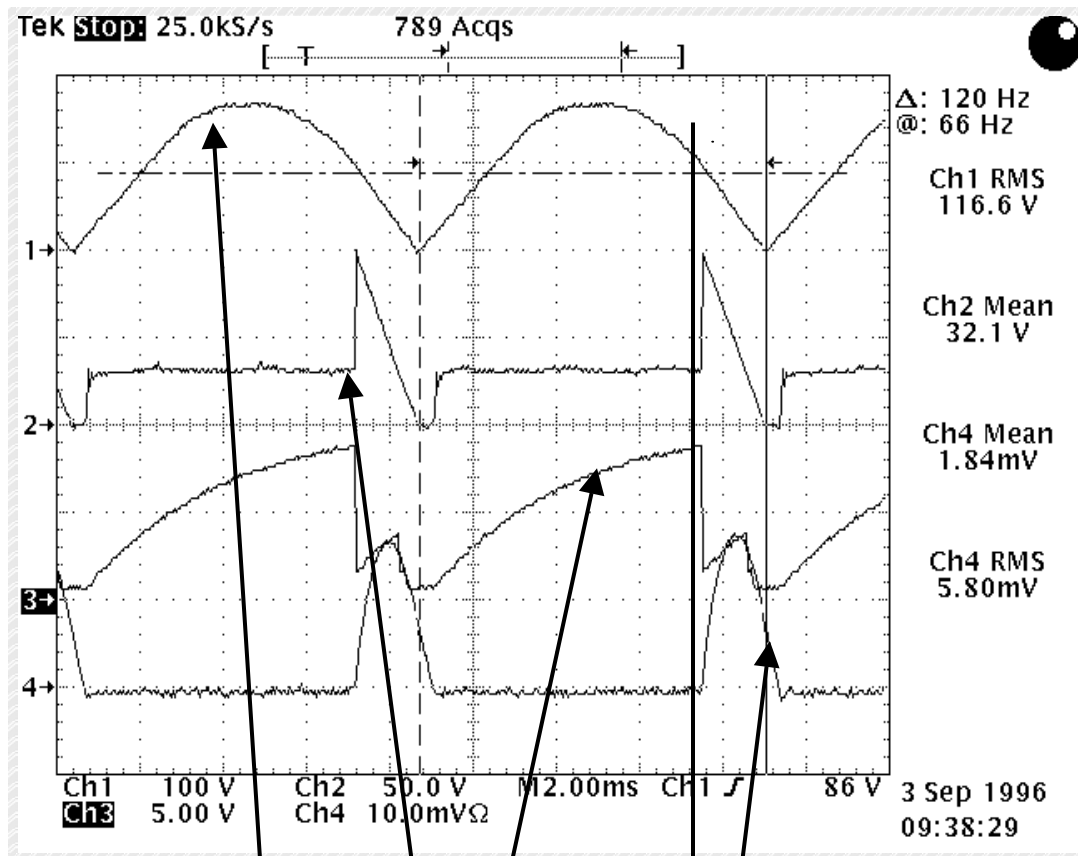


Figure 3

1. Waveform #1 Test point #6
 2. Waveform #2 Output of scr bridge across motor
 3. Waveform #3 PUT charging ramp test point #5
 4. Waveform #4 Motor current measured using TEK #TPC-202 current probe
- Follow for operation

TROUBLESHOOTING

Repairs on this unit are basically confined to either the unit's control PCB and/or the drive motor assembly.

Where possible, swap "known good" parts to localize and isolate the problem. The following is a list of possible problems and remedies:

UNIT DOES NOT TURN ON; NO POWER LIGHT:

- | | |
|--------------------------------------|------------------------------|
| 1. Fuse blown | -replace fuse |
| 2. Power cord not connected properly | -check & replace |
| 3. FWD-OFF-REV switch failure | -replace main controller PCB |
| 4. Unit connected to dead outlet | -verify supply is HOT |

UNIT BLOWS FUSES:

- | | |
|-----------------------------|-------------------------------|
| 1. Motor drive failure | -check using known good motor |
| 2. Defective controller PCB | -replace/return to factory |
| 3. Wrong fuse installed | -check fuse rating |

MOTOR WILL NOT REVERSE:

- | | |
|---------------------------------|-----------------------|
| 1. Defective FWD-OFF-REV switch | -replace switch assy. |
|---------------------------------|-----------------------|

MOTOR WILL NOT RUN: (assumed functional motor)

- | | |
|-----------------------------------|------------------------------------|
| 1. Defective FWD-OFF-REV switch | -replace switch assy. |
| 2. Defective controller PCB ASSY. | -Replace main controller PCB ASSY. |

LOSS OF SPEED CONTROL OR IMPROPER SPEEDS:

- | | |
|-----------------------------------|------------------------------------|
| 1. Defective controller PCB ASSY. | -Replace main controller PCB ASSY. |
| 2. Unit out of calibration | -recalibrate controller |

MOTOR IMMEDIATELY RUNS WHEN POWER IS APPLIED:

- | | |
|--------------------------------|------------------------------------|
| 1. Power output triacs shorted | -replace main controller PCB ASSY. |
|--------------------------------|------------------------------------|

For additional information regarding the unit, please refer to the following:

A-1299-0860 operators manual

REPAIR PROCEDURES

TO DISASSEMBLE UNIT, PROCEED AS FOLLOWS:

As pictured, remove the six Phillips screws (three from each side) from the cover assembly

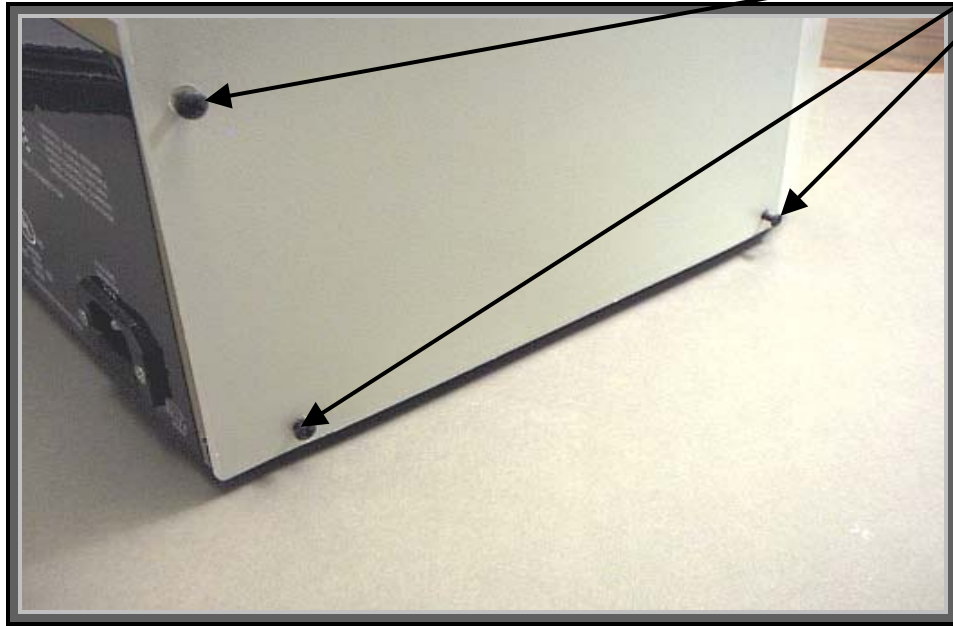
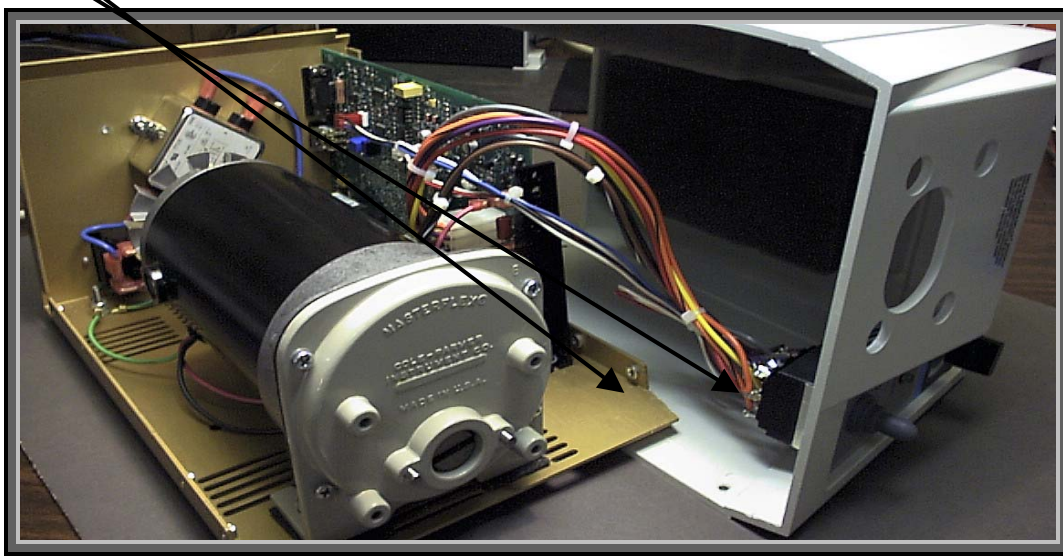


Figure 4

Position cover and chassis as shown. Be very care full not to let any switch terminals ground out to chassis.

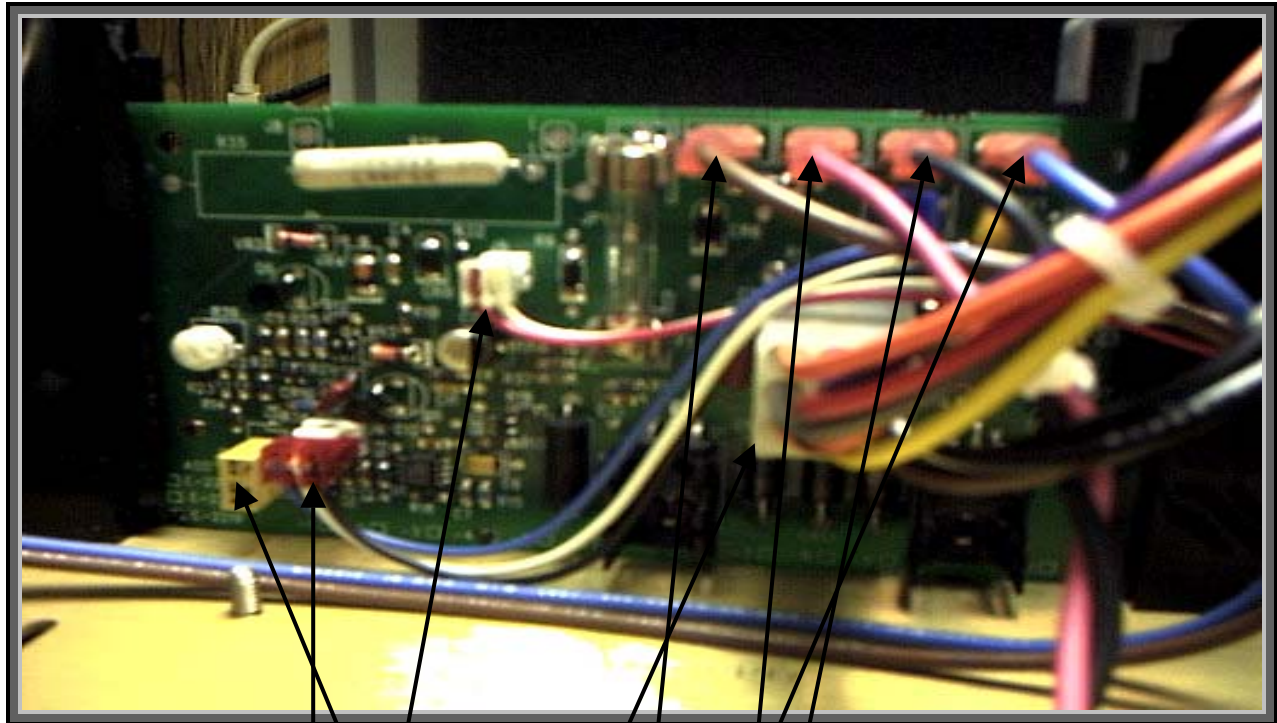


TO REASSEMBLE UNIT, PROCEED AS FOLLOWS:

A.) Reverse the above steps insuring that no wiring is pinched. The wiring harnesses should be formed as an upside down "P TRAP" position inside the enclosure.

TO REPLACE MAIN CONTROL PCB ASSEMBLY (7520):

- A) Follow the steps outlined in "DISASSEMBLE UNIT".
- B.) Disconnect the wiring and hardware as shown in picture.



Potentiometer to front panel

Led indicator to front panel

FWD/REV switch

AC line

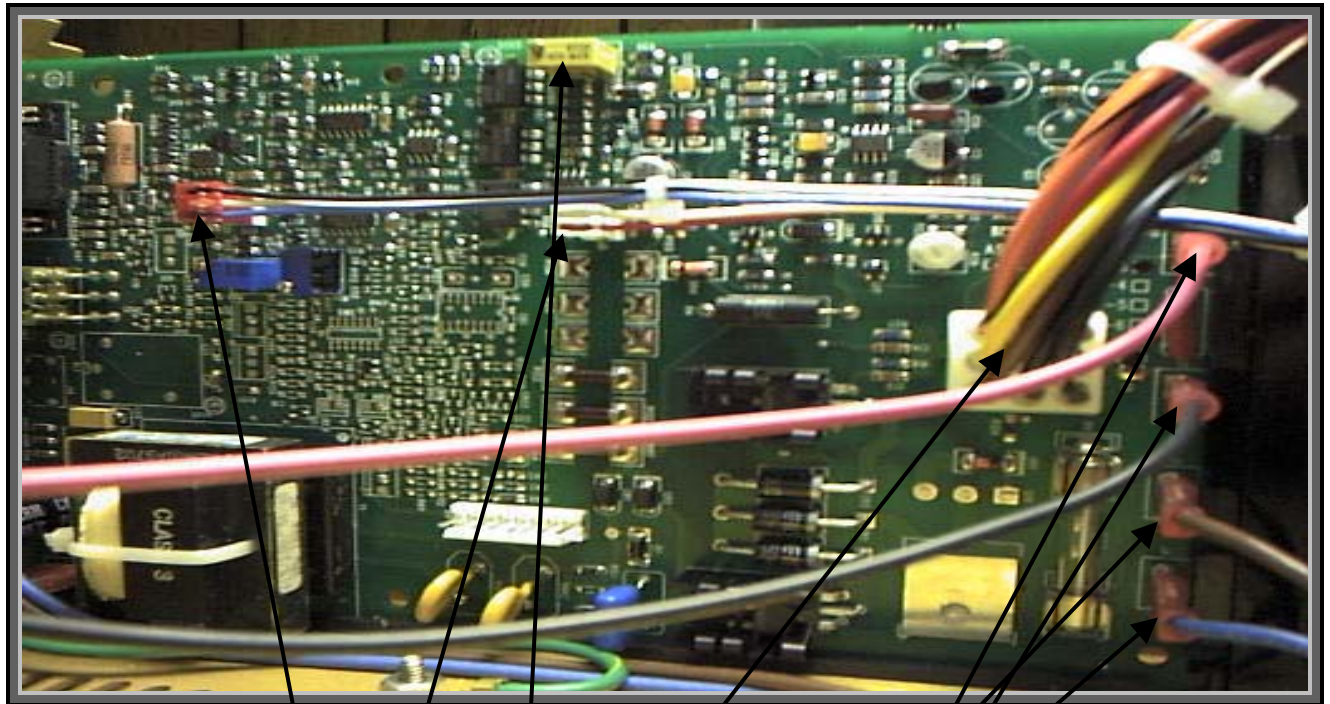
Motor connections

Max speed ADJ. (R33)

- C.) Replace control board noting wiring.
- D.) Check calibration as per applicable CAL. specifications.
- E.) Follow the steps outlined in "ASSEMBLE UNIT".

TO REPLACE MAIN CONTROL PCB ASSEMBLY (77521):

- A.) Follow the steps outlined in "DISASSEMBLE UNIT".
B.) Disconnect the wiring and hardware as shown in picture.



Potentiometer to front panel

Led indicator to front panel

FWD/REV switch

AC line

Motor connections

Max speed ADJ. (R90)

- C.) Replace control board noting wiring.
D.) Check calibration as per applicable CAL. specifications.
E.) Follow the steps outlined in "ASSEMBLE UNIT"

T0 REPLACE MOTOR

- A.) Follow the steps outlined in "DISASSEMBLE UNIT".
- B.) Remove groundnut and wires from PCB noting wiring.
- C.) Loosen motor mounting bolts.
- D.) Slide motor forward and remove from chassis.
- E.) Install new motor. Reattach ground and motor leads. Slide motor back and tighten bolts.

TO REPLACE SPEED POTENTIOMETER:

- A.) Remove knob and mounting hardware.
- B.) Slide pot. Assembly out of enclosure.
- C.) Install new pot. Assembly in reverse sequence.
- D.) Verify that when the knob is turned fully counter-clockwise, the indicator line is at 7:00

TO REPLACE FWD-OFF-REV SWITCH:

- A.) Remove switch sealing boot, using care to prevent damage to it.
- B.) Slide switch assembly out of control panel, noting which side keyway slot on bushing is facing.
- C.) Insert switch assembly into control panel with keyway slot in proper direction, reinstall boot and tighten until switch will not rotate.

TO REASSEMBLE UNIT, PROCEED AS FOLLOWS:

- A.) Carefully plug all connectors into PCB observing proper orientation of plugs.

REPLACEMENT PARTS LISTING

The following is a list of stockable, motor assemblies, main control PCB assemblies, and their reference schematic diagrams for all indicated models:

-MODELS-				
MODEL #	MAX. RPM	Motor Assembly #	PCB#	REFERENCE SCHEMATIC
7520-40	600RPM; 115V	5870-0021-CR	E-2219-0006-CR	E-2193
7520-50	100RPM; 115V	5871-0007-CR	E-2219-0006-CR	E-2193
7520-60	300RPM; 115V	5870-0021-CR	E-2219-0008-CR	E-2193
7520-47	600RPM; 230V	5870-0012-CR	E-2219-0007-CR	E-2193
7520-57	100RPM; 230V	5871-0008-CR	E-2219-0007-CR	E-2193
7520-67	300RPM; 230V	5870-0012-CR	E-2219-0009-CR	E-2193
900-1076	600RPM; 115V	5870-0021-CR	E-2219-0006-CR	E-2193
900-1077	600RPM; 230V	5870-0012-CR	E-2219-0009-CR	E-2193
900-1268	600RPM; 115V	5870-0013-CR	E-2219-0008-CR	E-2193
900-1273	600RPM; 115V	5870-0021-CR	E-2219-0006-CR	E-2193
900-1274	600RPM; 230V	5870-0012-CR	E-2219-0007-CR	E-2193
77521-40	600RPM; 115V	5870-0021-CR	E-2274-0003-CR	E-2268
77521-50	100RPM; 115V	5871-0007-CR	E-2274-0003-CR	E-2268
77521-47	600RPM; 230V	5870-0012-CR	E-2274-0004-CR	E-2268
77521-57	100RPM; 230V	5871-0008-CR	E-2274-0004-CR	E-2268

The following is a list of commonly used parts applicable to the above model LISTINGS:

DESCRIPTION	BARNANT Part#
Speed adjustment knob (7520) (900-1273, 900-1274)	B-1083-0056
Speed adjustment knob (77521) (900-1076/1077/1268)	A-2583
FWD-OFF-REV switch assembly (115 volt Non-CE models)	5632
FWD-OFF-REV switch assembly (230 volt CE models)	5775
Switch sealing boot (all models)	A-2984
Speed pot. Assembly single turn (7520) (900-1273, 900-1274)	5655-0001
Speed pot. Assembly ten turn (77521) (900-1076/1077/1268)	5633-0001
T3.15 5 x 20 MM fuse (115V systems)	B-1115-0057
T1.16 5 x 20 MM fuse (230 V systems)	B-1115-0042
Rubber foot on chassis	B-1390-0002

----- C A L I B R A T I O N -----

After repairs are made, the unit must be tested to assure proper performance to specifications. In many cases servicing personnel to accomplish this can use factory/QC checkout procedures.

For calibration procedures please refer to the following (CAL-SPECIFICATION) listings table appropriate to the model that is being serviced.

MODEL#	CAL-SPECIFICATION #		MODEL#	CAL-SPECIFICATION#	
7520-40	CAL #1834		900-1076	CAL #1834	
7520-47			900-1077		
7520-50			900-1268		
7520-57			900-1273		
7520-60			9001274	▼	
7520-67	▼				
77521-40	CAL #1836				
77521-47					
77521-50					
77521-57	▼				

Additional technical specifications are available in the unit's OPERATOR MANUAL.

Because this manual is covering approximately 15 different models, exact calibration procedures will differ between each unit. However the following procedure may be used to roughly tweek an out-of-spec. unit.



BEFORE PROCEEDING FURTHER PLEASE NOTE ALL WARNINGS AS LISTED IN THE
"SAFETY CONSIDERATIONS SECTION"!!!

TOOLS REQUIRED

- A.) #1 Phillips screwdriver
- B.) Non-metallic pot-tweaker
- C.) Hand-held tachometer

Proceed as follows:

- 1.) Follow procedure for unit dissassembly.
- 2.) Plug unit into the appropriate line voltage. If this can be done through an adjustable variac, to e.g. 115 vac (115 volt units) or 230 vac (230 volt units).
- 3.) Turn unit on, set speed control for maximum.
- 4.) Measure & turn pot (R-90) E-2274-0003 & -0004 series PC Boards; (R-33) E-2219-xxxx series both pots are (multi-turn) to obtain proper motor terminal voltage as follows:

100.0 vdc +/- .5 vdc (for 115 vac units)

200.0 vdc +/- 1.0 vdc (for 230 vac units)

- 5.) All other pots are factory adjusted and should not be field adjusted.
- 6.) Seal pot adjustments and reassemble unit.

FUNCTIONAL TESTS

- A.) Mate drive motor to specified controller.
- B.) Power up controller at specified line voltage.
- C.) Verify that controller drives motor properly.
- D.) Refer to the "CALIBRATION" Section for additional information regarding the controller.

SPECIFICATIONS

Power

Supply Voltage (per DSM 8806): 90-130 Vrms or 190-260 Vrms, 50/60 Hz, Single Phase

IEC 664 Installation Category II (Appliances and portable equipment powered from local branches)

All drives use modular line cords with IEC 320/CEE 22-connector coupler. Female line cord/male socket. Alternative Line cords is available as Model numbers:

50001-68 (USA-115V, Japanese), 50001-70 (European),
50001-60 (Australia), 50001-62 (Denmark), 50001-64 (India), 50001-66 (Israel),
50001-72 (British), 50001-74 (Swiss), 50001-76 (Italian), 50001-78 (USA-230V)

Motor Power: 0.10 hp
(Maximum at output shaft)

Drive Current, Max.

115 Vrms:	2.3 A
230 Vrms:	1.2 A

Control Circuit Power: 6 watts, maximum dissipation.

4.3.2 Remote Start/Stop & Remote/Local

The remote control inputs work with current sinking outputs (open-collector NPN transistor outputs with or without passive pull-up resistors) or contact closures to DC common (earth ground). A continuous active low to the Remote Start/Stop input causes the drive to run, while a continuous active low to the Remote/Local input switches speed control to the front panel speed control.

	<u>Input Voltage</u>	<u>Input Current</u>
High State:	15 VDC Typ.	100 μ A Max. leakage
Low State:	0.8 VDC Max.	1.5 mA Max.

All inputs will be electrically isolated from the ac line, minimum 1250 Vac for 115Vac units, 1900 Vdc for 230Vac units.

4.3.3 Remote Analog Input (Ref.: ISA-S50.1)

4-20 mA Input:	250 ohms typical input impedance referenced to signal ground. 4 mA, Stop; 20 mA, Full Speed Accuracy: 3% F.S., Linear Resolution Overload Capability: 10 V or 40 mA max.
2-10 V Input:	10 K ohms typical input impedance referenced to signal ground. 2 V, Stop; 10 V, Full Speed Accuracy: 3% F.S., Linear Resolution Overload Capability: 15 V max.

Only one of the analog inputs may be used at any one time. The front end of the circuit is a differential op amp to allow for multiple units (max 3) to be cascaded in series (Current Input) or parallel (Voltage Input) for control. Both 4-20 mA and 2-10 VDC inputs are optically isolated from the ac line, minimum 1250 Vac for 115Vac units, 1900 Vdc for 230Vac units.

4.4 ENVIRONMENTAL INPUTS (ref.: DSM 8806)

Indoor Use - Nonmobile, laboratory or office environment readily accessible to maintenance. Normally only non-conductive pollution occurs, but a temporary conductivity caused by condensation must occasionally be expected (IEC 664 Pollution Degree 2).

	<u>Minimum</u>	<u>Maximum</u>
4.4.1 Operating Temperature:	0 °C	40 °C
Storage Temperature:	-45 °C	65 °C
Humidity: (non-cond.)	10 %	90 %
Altitude:	-	2000 m

4.4.2 Chemical resistance. All materials withstand standard cleaning solvents. Materials used in the construction are:
ABS plastic case with a polyester label, gold, irridite-coated aluminum chassis, and zinc-plated screws.

4.4.3 Vibration: Withstands standard freight shipment (Rail, Air, Sea, and Paved Roads) when packed in specified shipping container (Secured Cargo).

Electromagnetic Compatibility (EMC): Meets immunity requirements of EN 61326-1/A1: 1998 for residential, commercial and light industry applications to comply with EC EMC Directive for the European Union "CE" mark.

APPENDIX:

*******SERVICE MANUAL*******

MODELS:

7520-40 Unified Drive System, 600 rpm, 115v [single turn]
7520-45 Unified Drive System, 600 rpm, 230v [single turn]
7520-47 Unified Drive System, 600 rpm, 230v [single turn] "CE" mark
7520-50 Unified Drive System, 100 rpm, 115v [single turn]
7520-55 Unified Drive System, 100 rpm, 230v [single turn]
7520-57 Unified Drive System, 100 rpm, 230v [single turn] "CE" mark
7520-60 Unified Drive System, 300 rpm, 115v [single turn]
7520-65 Unified Drive System, 300 rpm, 230v [single turn]

PROPRIETARY

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A-1299-0442
Edition 04

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INTRODUCTION

Service for this product is performed at three levels: the customer, distributor/COLE-PARMER and factory/depot repair. This manual describes distributor/COLE-PARMER service procedures.

Customer service procedures are described in the operators manual. Customers are encouraged to perform service as described in the operators manual as well as in special circumstances where special skills and safety are not considerations.

To use this manual begin with the troubleshooting section to isolate the fault to a replaceable part. The functional description and check-out procedure sections are also helpful in determining the faulty part. Distributor/COLE-PARMER repair is limited to replacement of modules as detailed in the replacement parts list section. The repair procedures section details disassembly and assembly procedures. After repair, the product should be calibrated and checked for proper performance.

Please refer to the operators manual (pt# A-1299-0110) for:

- A) APPLICATIONS DATA
- B) PRODUCT DESCRIPTION
- C) INSTALLATION
- D) SETUP
- E) OPERATION
- F) USER CALIBRATION
- G) USER TROUBLESHOOTING & MAINTENANCE
- H) ACCESSORIES
- I) SPECIFICATIONS

SAFETY CONSIDERATIONS

Servicing must be performed only by personnel trained and skilled in the methods of troubleshooting and repair of electro-mechanical products. Use of procedures other than those described in this manual may result in a safety hazard to service personnel and/or customers.

When servicing any component of this unit make absolutely sure that all power to circuitry is removed. If any functional checks are to be performed while power is applied and chassis is disassembled, care must be exercised for the following:

- A) THIS IS A LINE OPERATED DEVICE AND IS NOT ISOLATED FROM GROUND. USE OF A ISOLATION TRANSFORMER IS STRONGLY RECOMMENDED.**
- B) DO NOT INADVERTENTLY SHORT ANY PART OF THE PRINTED CIRCUIT CARD TO GROUND, AS SEVERE DAMAGE WILL RESULT.**
- C) MAKE ABSOLUTELY SURE THAT ANY TEST EQUIPMENT THAT IS USED FOR REPAIR IS NOT REFERENCED TO EARTH GROUND.**

THEORY OF OPERATION

The variable speed controller employs a phase-controlled rectifier bridge to vary the power applied to a permanent magnet DC motor. The bridge will conduct current only when the power line voltage exceeds the voltage across the motor terminals. The power to the motor can therefore be controlled by varying the point at which the bridge starts to conduct, relative to the phase of the line voltage. The phase angle at which the bridge starts conducting is controlled by an inner torque, outer speed regulator loop. The speed of the motor is directly proportional to the back EMF generated by the motor. Comparing the voltage across the motor terminals against the speed reference signal at the center tap of the front panel speed control pot R-29, U-1 generates a torque reference signal. The torque supplied by the motor is directly proportional to the current supplied to the motor. U1 amplifies the voltage drop across a load resistor, providing a signal proportional to the current supplied to the motor. The peak value of the signal is subtracted from the torque reference signal by Q4. The resulting torque error signal charges C10, firing Q6 and the power bridge SCR's.

VR1, R1, and C1 provide transient voltage protection from power line surges caused by other power conversion equipment and lightning strikes. R5 and C2 provide transient protection from surges created by motor brush noise and FWD/REV switching.

CR3, CR4, Q1, and Q2 form the main power bridge for the motor. CR5 provides a current path to allow shut-off of SCR's Q1 and Q2. R2 and R3 provide voltage feedback and R4 provides current feedback to the regulator circuits. CR1 and CR2 with CR3 and CR4 form the secondary power bridge for the power to the regulator circuits. R26 is a voltage dropping resistor from line voltage to the +22V used by the regulators. CR7 limits the voltage to +22V. CR6 decouples the pulsating DC, used to synchronize the SCR firing circuit to the line, from the steady DC, filtered by C5, used to power the regulator circuits. R3 and CR1 stabilize the speed reference signal. R11 and R12 provide the voltage reference and line synchronization for the PUT Q5, used to fire the power bridge SCR's. R14, CR9, and C6 form the soft-start circuit which provides a gentle acceleration of the motor. R31 and R16 compensate for the voltage drop introduced by the motor armature resistance, thereby improving load regulation of the drive. CR10 and C09 form a current peak detector which is buffered by R24 and Q04. Q6 and Q3 form a pulse amplifier and level shifter to fire the power bridge SCR's. The SCR used for Q3 in the 220 vac units is configured to act like a high voltage PNP transistor.

DETAILED CIRCUIT OPERATION

Power Supply

- A. AC line is brought in at (J-3 and J-4) and routed through ("FWD:OFF:REV") switch contacts, to power bridge consisting of (CR1-CR4).
- B. 100 VDC at (TP #8), is dropped by series resistor (R-26) and regulated to Approx. 22.7 VDC at (TP #6) by (CR-7).
- C. Green LED indicates power "ON" to circuitry.
- D. Varistor VR1 and RC network R1 & C1 suppress line noise generated externally and internally by motor and power bridge.

Output Drive

- A. Motor power bridge consists of (CR-3, CR-4, Q-1, Q-2). Diode (CR-5) bypasses the inductive current surges of the motor when the power bridge shuts off. The output bridge is routed through ("FWD:OFF:REV") by (J-9, J-10, J-11, J-12, J-17, J-18) connecting switch contacts to allow motor reversal and is brought out at (J-1 and J-2) of the pcb.
- B. Resistor capacitor combination consisting of (R-5 and C-2) which forms a snubber network for commutator noise suppression.

Control Section

- A. Motor speed is set by panel mounted pot (R-29).
- B. A +VREF is obtained by regulating the +22VDC supply with (R-13 and CR-11) to approximately +12VDC. This is routed through network (R-28 and R-29) to DC ground. Adjustment pot. (R-28) sets maximum motor speed approx. +10VDC at (TP-1).
- C. Components (R-14, CR-9, C-6) control acceleration and deceleration of motor RPM.
- D. Set speed is controlled and regulated by differential amp (U7-A) and related components (R-15, C-7, R-17, R-2, R-3). As motor load increases back EMF picked off drive output resistor network (R-2 and R-3), (TP-3) drops off. This is fed through (R-17) to pin 2 of (U1-A) causing (TP-2) to charge integrator capacitor (C-10) via (R-18) to advance the SCR firing angle.
- E. Current limit of circuit is accomplished by monitoring the voltage drop of current sense resistor (R-4) feeding it through R-19 and R-20) to level amp (U1-B) and related components. As current through (R-4) approaches [2.0 amps for 120 voltunits]; [1.0 amps for 240 volt units] voltage to (TP-4) rises to approximately +4.0VDC. This is fed through resistor network (R-22 and R-23) at a [2 to 1] ratio, into the peak detector (CR-10 & C-9). The output of the peak detector is buffered (R-24 & Q-4) by an emitter follower (Q-4 & R-24) amplifier which discharges integrator (C-10), retarding the SCR firing angle. The resultant firing angle will be proportional to the difference between the torque reference charging current (R-18) and the torque feedback discharging current (R-25).

F. The SCR will fire when the integrator (C-10) voltage is equal to the "PUT" (Q-5) reference voltage (CR-7, R-11, & R-12). Line synchronization is achieved by allowing the reference voltage to drop to zero with each line cross, thereby discharging (C-10) through (Q-5). (C-10 & Q-5) form a relaxation oscillator whose period is proportional to the rate of charge of (C-10). When the voltage across (C-10) is equal to the reference voltage, the "PUT" (Q-5) is forward biased and will conduct, discharging (C-10) through the base-emitter junction of buffer (Q-6). (R-9) bypasses any leakage current, while (C-11) filters out noise pulses.

G. The pulse output of the relaxation oscillator (C-10 & Q-5) is buffered and amplified by (Q-6) and level shifted by (Q-3) on 115 volt units or SCR (Q-8) on 220 volt units to fire the power bridge SCR (Q-1 & Q-2). (R-7) limits the gate current, while (CR-6) blocks back conduction of (Q-3 or Q-8).

TROUBLESHOOTING

Repairs on this unit are basically confined to either the units control PCB and/or drive motor assembly.

Where possible, swap in known good parts to localize and isolate the problem. The following is a list of possible problems and remedies:

UNIT DOES NOT TURN ON;NO POWER LIGHT:

1. fuse blown -replace fuse
2. power cord not connected properly -check & replace
3. FWD-OFF-REV switch failure -replace switch ASSY.
4. unit connected to dead outlet -verify supply is HOT

UNIT BLOWS FUSES:

1. motor drive failure -check using known good motor
2. defective controller pcb -return/replace to factory
3. wrong fuse installed -check fuse rating

MOTOR WILL NOT REVERSE:

1. defective FWD-OFF-REV switch -replace switch ASSY.

MOTOR WILL NOT RUN: (assumed functional motor)

1. defective FWD-OFF-REV switch -replace switch ASSY.
2. defective controller PCB ASSY. -replace main controller PCB ASSY.

LOSS OF SPEED CONTROL, OR IMPROPER SPEEDS:

1. defective controller PCB ASSY. -replace main controller PCB ASSY.
2. unit out of calibration -recalibrate controller

MOTOR IMMEDIATELY RUNS WHEN POWER IS APPLIED:

1. power output triacs shorted -replace main controller PCB ASSY.

FOR ADDITIONAL INFORMATION REGARDING THE UNIT PLEASE REFER TO THE FOLLOWING: (A-1299-0110) operators manual

REPAIR PROCEDURES

TO DISASSEMBLE UNIT, PROCEED AS FOLLOWS:

- A) Remove the three pan head screws on each side of the unit's cover.
- B) Lift off molded housing.

TO REASSEMBLE UNIT, PROCEED AS FOLLOWS:

- A) Slide on molded housing.
- B) Install the three pan head screws on each side of the unit's cover.

TO REPLACE MAIN CONTROL PCB ASSEMBLY:

- A) Follow the steps outlined in "DISASSEMBLE UNIT".
- B) Replace main pcb assembly.
- C) Note wiring of chassis as follows:
 - 1) BROWN of corcom line filter to: J#3
 - 2) BLUE of corcom line filter to: J#4
 - 3) RED of drive motor to: J#1
 - 4) BLACK of drive motor to: J#2
 - 5) Follow steps in "TO REPLACE FWD-OFF-REV SWITCH"
[Note-switch does not have to be removed from housing.]
- D) Check calibration per applicable CAL. specifications.
- E) Follow the steps outlined in "ASSEMBLE UNIT".

TO REPLACE FWD-OFF-REV SWITCH:

- A) Follow the steps outlined in "DISASSEMBLE UNIT".
- B) Pull handle off switch ASSY.
- C) Remove retaining hardware from switch.
- D) Note wiring of chassis as follows:
 - 1) ORANGE-----J#9
 - 2) ORANGE\BLACK-----J#10
 - 3) YELLOW-----J#11
 - 4) RED-----J#12
 - 5) BROWN-----J#13
 - 6) BLACK-----J#14
 - 7) GRAY-----J#17
 - 8) VIOLET-----J#18
 - 9) BLACK\WHITE-----J#19

REPAIR PROCEDURES

The following is a list of stockable main control pcb assemblies, and their reference schematic diagrams for all indicated models:

115Volt Models

<u>MODEL#</u>	<u>PCB#</u>	<u>REFERENCE SCHEMATIC</u>
7520-40	D-2763-0001	D-2761
7520-50	D-2763-0001	D-2761
7520-60	D-2763-0005	D-2761

230Volt Models

<u>MODEL#</u>	<u>PCB#</u>	<u>REFERENCE SCHEMATIC</u>
7520-45	D-2763-0002	D-2761
7520-47	D-2763-0008	D-2761
7520-55	D-2763-0002	D-2761
7520-57	D-2763-0008	D-2761
7520-65	D-2763-0006	D-2761

The following is a list of commonly used parts applicable to all the above model LISTINGS:

<u>DESCRIPTION</u>	<u>BARNANT part#</u>
Speed Adjustment Knob [single turn]	B-1083-0056
Rubber Foot-large	B-1390-0002

FRONT PANEL OVERLAYS

<u>MODEL#</u>	<u>BARNANT part#</u>
7520-40	D-2553
7520-45	D-2553
7520-47	D-2553
7520-50	D-2553
7520-55	D-2553
7520-57	D-2553
7520-60	D-2553
7520-65	D-2553

CALIBRATION

After repairs are made, the unit must be tested to assure proper performance to specifications. In many cases factory/QC check-out procedures can be used by servicing personnel to accomplish this.

For calibration procedures please refer to the following (CAL-SPECIFICATION) listings table appropriate to the model that is being calibrated.

<u>MODEL#</u>	<u>CAL-SPECIFICATION#</u>
---------------	---------------------------

7520-40	CAL-1352
---------	----------

7520-45	CAL-1352
---------	----------

7520-47	CAL-1352
---------	----------

7520-50	CAL-1352
---------	----------

7520-55	CAL-1352
---------	----------

7520-57	CAL-1352
---------	----------

7520-60	CAL-1612
---------	----------

7520-65	CAL-1612
---------	----------

Additional technical specifications are available in the units OPERATOR MANUAL.

Because this manual is covering approximately four different models, exact calibration procedures will differ between each unit. However the following procedure may be used to roughly calibrate an out-of-spec. unit.

**BEFORE PROCEEDING ANY FARTHER PLEASE NOTE ALL WARNINGS
AS LISTED IN THE "SAFETY CONSIDERATIONS SECTION"!!!**

TOOLS REQUIRED

- A) #1 Phillips screw driver
- B) non-metallic pot tweaker
- C) hand held tachometer

Proceed as follows:

- 1) Remove the three pan head screws on each side of the unit's cover.
- 2) Position top half of cover so that adjustment pots are accessible.
- 3) Plug unit into the appropriate line voltage. If this can be done through an adjustable variac, set to nominal value, eg 120 for 115 volt units or 240 for 230 volt units.
- 4) Turn unit on; set speed control for maximum.
- 5) Measure shaft RPM of driven device; turn pot R-28 (multi-turn) to obtain proper RPM:
 - 600 RPM - 605 RPM for (600 RPM units)
 - 100 RPM - 105 RPM for (100 RPM units)
 - 300 RPM - 305 RPM for (300 RPM units)
- 6) Pot R-31 is used to set the unit's no-load to full-load response and therefore should not be field adjusted.
- 7) Seal pot adjustments and reassemble unit.

FUNCTIONAL TESTS

- A) Power Up controller at specified line voltage.
- B) Verify that controller drives motor properly.
- C) Refer to the "CALIBRATION" Section for additional information regarding the unit.

SPECIFICATIONS

LINE VOLTAGES:

<u>MODEL#</u>	<u>NOMINAL</u>	<u>MINIMUM</u>	<u>MAXIMUM</u>
7520-40	115 volts	90 volts	130 volts
7520-50	115 volts	90 volts	130 volts
7520-60	115 volts	90 volts	130 volts
7520-45	230 volts	200 volts	260 volts
7520-47	230 volts	200 volts	260 volts
7520-55	230 volts	200 volts	260 volts
7520-57	230 volts	200 volts	260 volts
7520-65	230 volts	200 volts	260 volts

LINE FREQUENCY: All models SINGLE PHASE 50/60 hertz

TEMPERATURE & HUMIDITY:

	<u>MINIMUM</u>	<u>MAXIMUM</u>
OPERATING TEMPERATURE:	0 degrees c	40 degrees c
STORAGE TEMPERATURE:	-45 degrees c	65 degrees c
HUMIDITY (NON-COND.):	0%	90%

CODE RATINGS:

All controller housings meet INTERNATIONAL ELECTRIC CODE 34-5
(IP-CODE) 53 RATING
Note: (SIMILAR TO NEMA 5 AND 12 RATINGS)