

CHAPTER 4

POWER DISTRIBUTION

4.1 INTRODUCTION

This chapter discusses the power distribution throughout the control and electromechanical interface. Power is traced from its entry point at the Main Disconnect switch, through all of the transformers and power supplies to its end use. Figure 4-1 shows this power distribution in block diagram form. Refer to the diagram when reading the text. The System Wiring Diagram, (3-193-8313) is located at the end of this chapter, followed by duct wiring diagrams for control serial numbers marked thereon.

4.2 SYSTEM OVERVIEW

All incoming power enters at the Main Disconnect switch on the Power Equipment Enclosure. Maximum allowable line voltage is 460 volts AC. The customer has the option of selecting the following incoming line voltages from the available voltage frequency kits offered by Bridgeport.

208 VAC	60 Hz
230 VAC	60 Hz
460 VAC	60 Hz

This is a 4-wire system (three phases and a ground).

After power enters the Power Equipment Enclosure, it passes through a disconnect switch and fuses FU1, FU2 and FU3 before it is applied to the system for power distribution.

The incoming power is distributed into four branches as follows:

- **Line voltage distribution** — Line voltage is wired through a reversing/starting contactor for the spindle motor. When the contactor is activated, voltage is switched to the spindle motor.
- **115 VAC single phase distribution** — Incoming power is fed to transformer T1. T1 steps the line voltage down to 115 volts AC single phase. This voltage is used by the Logic Power Supply and provides primary power to the 24 volt DC power supply located within the Drive Power Supply.
- **90 VAC** — Line voltage is fed to transformer T2. T2 is a single-phase, multiple tap step down transformer. This transformer supplies 90 VAC to the axis drive power supply and 115 VAC to the duplex receptacles, flood and mist coolant, lube motor, three fans and three control relays. The Drive Power Supply provides 128 VDC to the motor drive modules.

The two main power supplies, the Drive Power Supply and the Logic Power supply, deliver DC voltages to the following items:

Logic Power Supply provides:

- +5 VDC to the logic boards
- ±12 VDC to FMDC and EAF boards

Drive Power Supply provides:

- +24 VDC to EAF, Limit Switches, and Pneumatics
- ±128 VDC to Axis Drives

4.3 LINE VOLTAGE DISTRIBUTION BRANCH

This branch connects line voltage directly to the spindle motor. Contactors MF and MR switch incoming power from the line to the spindle motor.

4.3.1 Spindle Motor Protection

The spindle motor is a 3-phase 2 HP AC motor. It operates on 208, 230 or 460 VAC. Through high and low gearing and motor reversal, variable speed operation is available. Reversing contactors MF and MR changes the spindle motor's direction.

Three heaters protect the spindle motor against excessive currents. If the current caused by the load is excessive, the overload heaters will stop current to the spindle motor by opening contactor 1 MOL. After cooling, the heaters must be reset before the spindle motor can be restarted; see Table 4-1.

Table 4-1. Overload Heaters

Line Voltage	Clark No.	Code No.
208V	2441	3-150-4090
230V	2438	3-150-3857
460V	2431	3-150-4240
200V	2441	3-150-4090
220V	2438	3-150-3857
380V	2434	3-150-3388
416V	2433	3-150-3324
575V	2430	3-150-3325

4.4 115 VAC DISTRIBUTION BRANCH

The 115 VAC output from T1 and T2 feed the following :

- Logic Power Supply
- Lube Motor
- Three Fans
- Duplex Receptacles
- Coolant
- EAF Board

4.5 DRIVE POWER SUPPLY

The Drive Power Supply provides +24 VDC power for general purpose switching and control functions. The 24 VDC from the Drive Power Supply is used by the following devices:

1. **Pneumatics** — A pneumatic cylinder clamps a mechanical brake against the spindle whenever the

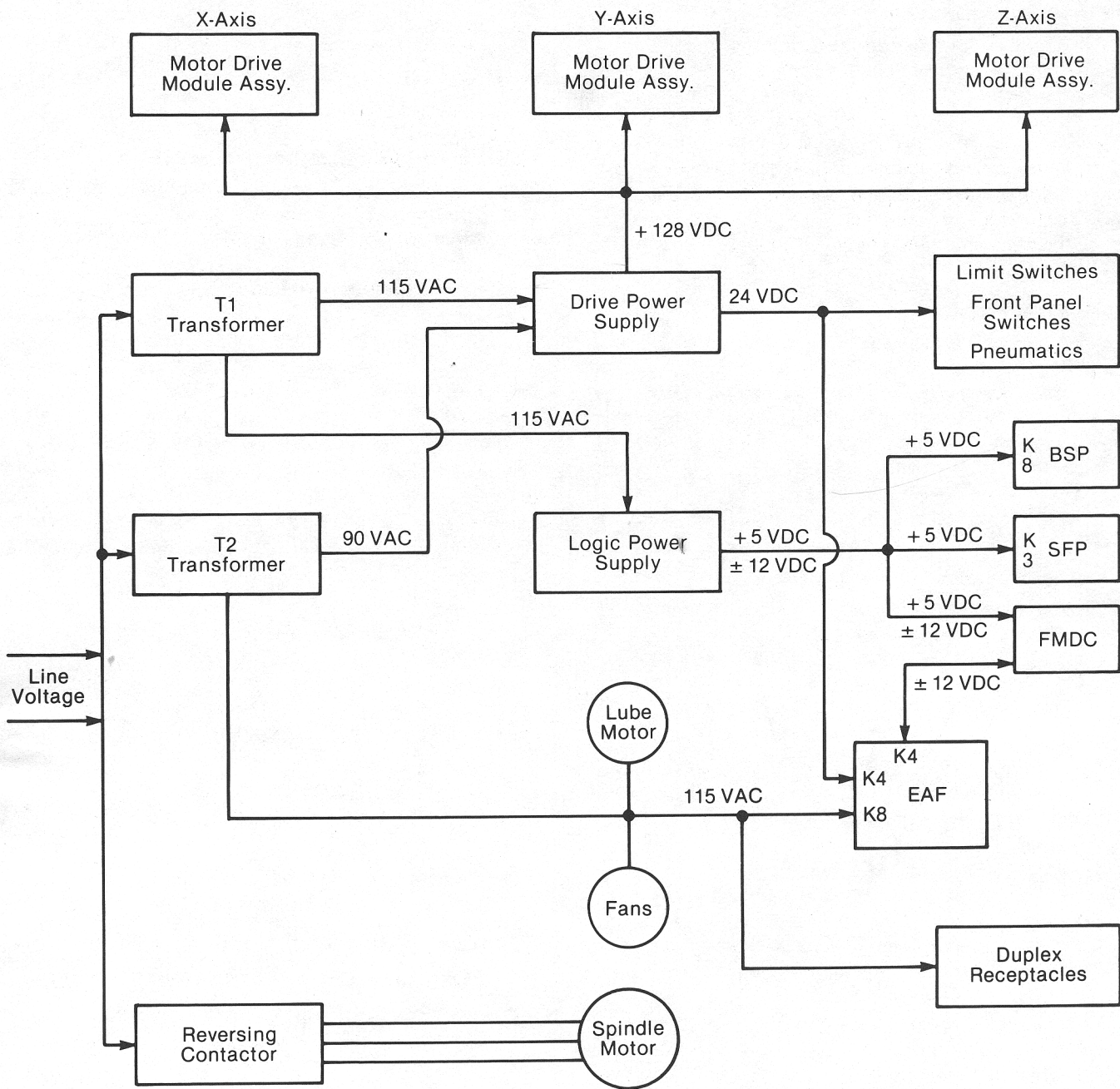


Figure 4-1. Power Distribution — Functional Block Diagram

spindle is disabled. Power to the solenoids is provided when contactors MF or MR are closed and one of the Spindle SPEED Control keys are pressed. Air passing through these solenoids rotates a pneumatic motor clockwise or counterclockwise. This motor moves levers in the head which expand or reduce effective diameters of the drive and spindle motor pulleys, changing the resultant spindle speed.

2. **EAF Board** — The EAF board receives 24 VDC on terminals K4B-3 and K4B-8. The 12 VDC is filtered on the EAF board for use in its logic circuitry. The EAF board also uses the 12 VDC to supply power to the Port A data connector J2, pins 2 and 4.
3. **Front Panel Switches** — The Front Panel switches provide communications between the machine and the operator. Power to the EMERGENCY STOP and the SPINDLE FOR C.W. ROTATION switches is from the 24 VDC supply. The other switches are membrane type; when pressed, they complete a path in the keyboard circuitry which causes the generation of the selected code element. The selected code element is transmitted to the machine controller (BSP) board where the proper firmware is enabled to control the logic circuitry on the EAF and FMDC boards. This logic circuitry is used to control the electromechanical devices in the system.

EMERGENCY STOP Switch — When pressed, this switch will remove power from the reversing/starting contactors, causing the spindle to stop (wire #40 — refer to System Wiring Diagram). When pressed, the EMERGENCY STOP button will also stop the axis drive motors by disabling the logic circuitry controlling them. See Figure 4-2.

SPINDLE FOR C.W. ROTATION — This switch is used in conjunction with the SPINDLE ENABLE button. It determines whether contactor MF or MR operates. This switch is connected to the contactors through wires #48 and #49 (refer to System Wiring Diagram).

4. LIMIT and HOME Switches

LIMIT Switches — The Drive Power Supply provides 24 VDC to all the limit switches in the system over wires #41 through #45 (refer to System Wiring Diagram). The axis limit switches have the same effect on machine operations as the EMERGENCY STOP button. If any one of the four switches open, 24 VDC is removed from the coils of the reversing contactor, turning the spindle motor off. The power is also removed from the logic circuitry controlling the axis drive.

HOME Switches — A switch is located on each axis. When the axes are within one revolution of the Home position, these switches will close, creating a path to ground for the logic circuitry on the EAF and FMDC boards. Refer to System Wiring Diagram, wire #39.

4.6 LOGIC POWER SUPPLY

The Logic Power Supply receives 115 VAC from T1 on wire nos. 12 and 13. The power supply converts the AC voltage to +5 VDC for use in the logic circuitry; and ± 12 VDC for use on the EAF and FMDC boards.

EAF Board — This board uses ± 12 volts DC +12 VDC enters the EAF board on pin K4-1, and the -12 VDC

enters on pin K4-2. Capacitor networks are used to filter some voltages needed by the logic circuitry on the EAF board.

BSP Board — The BSP board uses the +5 VDC and the ± 12 VDC from the Logic Power Supply. The voltages enter the BSP board on the following terminals:

+ 5 VDC	TB1-6
Common	TB1-5
+ 12 VDC	TB1-2
- 12 VDC	TB1-1

These voltages are used by the logic circuitry on the BSP board.

SFP Board — The SFP board uses +5 VDC which enters the SFP board on terminals K3-5 and K3-10. This voltage is conditioned on the board for use in its logic circuitry.

4.7 128 VAC DISTRIBUTION BRANCH

This distribution branch consists of a single phase step down transformer T2, and the drive power supply. Transformer T2 can be supplied to operate on 208 VAC, 230 VAC, or 460 VAC line voltage.

Line voltage is applied to the primary of T2. T2 steps the line voltage down to 90 VAC. This 90 VAC is applied to the drive power supply. The drive power supply converts the 90 VAC to 128 VDC. This 128 VDC is used by the motor drive modules to power the axis drive system.

The +128 VDC enters the controllers on terminal TB1-4 and ground enters the controllers on terminal TB1-1.

4.8 115 VAC DISTRIBUTION BRANCH

The 115 VAC distribution branch originates at transformer T2. T2 steps the line voltage down to 115 VAC single phase. The following devices use 115 VAC single phase.

- Lubrication
- System fans
- EAF board
- The Duplex receptacles

4.8.1 Lubrication Motor and System Fans

A motor located in the Lube and Mist Enclosure runs the pump that pressurizes the Waylube system. This motor turns on when either MF or MR is energized.

Three fans cool the R2E4 power and electronic systems. They receive their power directly from T2.

The two fans in the Drive Card Rack are protected by fuse FU5, wire numbers 5 and 2. The fan in the Logic Card Rack is protected by fuse 9, wires 15 and 2.

4.8.2 EAF Board

The EAF board uses the 115 VAC to power the Mist Coolant solenoid and the Flood Coolant outlet. 115 VAC power enters the EAF board on terminals K8-4 and K8-1. Two triacs Q1 and Q2 control the 115 VAC to the coolant outlet and solenoid. These triacs are gated through two solid state relays, IC1 and IC2, located on the EAF board. Signals from the BSP board activate these relays. When activated, the relays supply the gating pulse for the triacs. Once the triacs are activated, they allow current to

