Dicing Systems

Kulicke & Soffa Ltd.

Your Resource for Advanced Dicing Solutions

K&S 4500 Series

Digital Series Manual
Wire Bonders

Operations and Maintenance Manual

P/N 94500-000D-000-01 *March 2002*

Customer Support

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RECORD OF CHANGES

Item	New Part Number	New Page Number(s)	Revision Date	Comments

RECORD OF CHANGES				
Item	**New Part Number**	**New Page Number(s)**	**Revision Date**	**Comments**

SAFETY FIRST

Kulicke & Soffa believes that the safety of personnel working with and around the Model 4500 Digital Series is the most important consideration. Please read the following information before attempting to operate the system or perform any maintenance function.

Important Safety Features

The Model 4500 Digital Series is equipped with a number of features which are meant to help ensure your safety as well as the safety of the system. Get to know each of them.

Protection Circuitry

The Model 4500 Digital Series is equipped with two fuses, one for the general machine and one for workholders, which blows when overcurrent is detected.

Safety Precautions

When working with or near the Model 4500 Digital Series, the following safety precautions are strongly recommended.

1 The Model 4500 Digital Series must be connected to the Main Power source through a Earth Leakage Circuit Breaker.

2 Always keep your hands out of the Working Area while the Bonding Head is in operation.

3 Never touch the Heated Workholders with your hands or any material having a low melting point.

The maximum temperature of the Heated Workholders is limited to 250°C. Wait 30 minutes before replacing the Heated Workholders, illumination lamps or any other hot machine part to allow the parts to cool down.

4 Beware of touching tools, as they may have sharp edges.

5 All maintenance tasks should be performed by trained, authorized personnel. When indicated by the instructions in the Maintenance Manual, contact K&S Customer Support before making the attempt.

6 Never perform any maintenance function while the Model 4500 Digital Series is in operation. Always, power down the system first. Remove the AC plug from the wall outlet as well.

Caution: If available at the site, perform the Lockout Procedure to eliminate any chance of the AC plug being returned to the wall outlet before the end of the maintenance procedure.

7 Read carefully all warnings given in the Maintenance Manual before beginning any maintenance task.

8 No matter what the procedure, read carefully all instructions and study the schematics and drawings provided before beginning to work.

9 Personnel who handle or remove printed circuit boards (PCBs) must be grounded to avoid electrostatic discharge (ESD) damage. Banana Grounding Sockets are located directly below the Base cover.

10 Obey all standard precautions for working with mechanical and electrical equipment.

11 Left and Right Head doors may be opened for adjustment only while the machine is in the RESET position.

12 The Back Cover should be opened only after powering down the machine and removing the power cord from the wall outlet.

Specific Precautions for Models 4524D and 4524AD with N.E.F.O.

Do not touch the electrode or wire during bonding or when manually firing the Negative Electric Flame Off (N.E.F.O.). The system produces a spark between the N.E.F.O. electrode and the wire, which can cause an electric shock if contacted during N.E.F.O. firing. The potential shock hazard is not usually considered life threatening (IEC publication no. 479). However, K&S recommends that those persons with abnormal heart conditions or artificial heart stimulation devices (e.g. pacemakers) should not be permitted to operate or service this equipment.

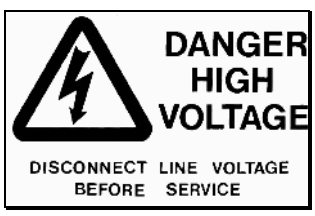
The N.E.F.O. produces high voltage within the N.E.F.O. box, in the electrode and on the high voltage cable.

1 Do not open the N.E.F.O. box. If it becomes necessary to handle the high-voltage cable or remove the N.E.F.O. box, unplug the machine power cable and wait at least five minutes.

2 Use high voltage techniques at all times when handling the N.E.F.O. box.

3 K&S recommends that during bonding operators use insulated gloves and insulated tweezers.

Electrical Safety Labels



About this Manual

This manual describes installation, operation and maintenance of the K&S 4500 Digital Series Manual Wire Bonders. It is assumed that you are knowledgeable about the wire bonding process. All procedures described in this manual should be performed by qualified personnel only.

Note: Unless noted otherwise, the photographs in this manual show views/items that are common for all models of the 4500 Digital Series.

Manual Contents

Chapter 1 **Introduction**

A general description of the K&S 4500 Digital Series Manual Wire Bonders.

Chapter 2 **Installation**

Instructions and guidelines for installing your K&S 4500 Digital Series Manual Wire Bonder.

Chapter 3 **Physical Description**

Description of the principal parts of the K&S 4500 Digital Series Manual Wire Bonder.

Chapter 4 **Controls and Indicators**

Description of the K&S 4500 Digital Series Manual Wire Bonders switches, dials and displays.

Chapter 5 **Setup and Adjustments**

Procedures and instructions for setting up and adjusting the K&S 4500 Digital Series Manual Wire Bonders for operation.

Chapter 6 **Operation**

Descriptions of bonding parameters and procedures for setting bonding modes and performing bonds.

Chapter 7 **Maintenance Overview**

General guidelines and adjustments checklist for maintaining the K&S 4500 Digital Series Manual Wire Bonders.

Chapter 8	**Electrical Subassemblies** Information for maintaining and adjusting the K&S 4500 Digital Series Manual Wire Bonder electrical subassemblies.
Chapter 9	**Mechanical Subassemblies** Details about maintaining the main mechanical subassemblies of the K&S 4500 Digital Series Manual Wire Bonders, including procedures for adjusting and replacing mechanical parts of the machine.
Chapter 10	**Timing Diagrams** Diagrams of each machine's bonding cycle time and motion.
Chapter 11	**Diagnostics** Description of the K&S 4500 Digital Series Manual Wire Bonders' diagnostics functions, such as fault detection in the machine's parts or in the bonding cycle.
Chapter 12	**Preventive Maintenance** Preventive maintenance procedures for various subassemblies of the K&S 4500 Digital Series Manual Wire Bonders.
Chapter 13	**Troubleshooting** Procedures for troubleshooting the K&S 4500 Digital Series Manual Wire Bonders.
Chapter 14	**Options and Accessories** Part numbers of optional items that are available for the K&S 4500 Digital Series Manual Wire Bonders.
Chapter 15	**Parts List** Part numbers of all components and assemblies of the K&S 4500 Digital Series Manual Wire Bonders.

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8. ELECTRICAL SUBASSEMBLIES

This chapter contains information for maintaining and adjusting the K&S 4500 Digital Series Manual Wire Bonder electrical subassemblies.

Figures 8-1, 8-2, 8-3 and 8-4 show the electrical subassemblies and their interconnections of Models 4523D, 4523AD, 4524D and 4524AD respectively.

8.1 Description of Electrical System

This section describes the electrical system of the 4500 Series bonders.

- Power supply
- Motherboard
- Logic board
- Ball/Wedge interface board
- Controller assembly
- Z Motor Relay Board (4523D, 4523AD)
- Stepper drivers board (4523AD, 4524AD)
- The N.E.F.O. (4524D, 4524AD)

8.1.1 The Power Supply

The 4500 Digital Series Manual Wire Bonder operates on 100-120 V or 220-240 V (50 Hz or 60 Hz). The bonder is connected to the AC wall outlet by a 3-wire (active, neutral and ground) power cable. The bonder is grounded by attaching the grounding lead of the power cable to the base of the chassis. The two main power leads (active and neutral) are connected to the POWER switch.

Fuse F1 protects the workholder heater power supply and fuse F2 protects the bonder's operating power supply. F1 and F2 are located on the bonder's rear panel. Table 8-1 shows the ratings for these fuses (ratings depend on the AC wall outlet voltage).

Table 8-1: Main Power Fuse Ratings

TYPE	FUSE	100-120 V ac	220-240 V ac
Workholder	F1	5 A	2.5 A
Machine	F2	1 A	0.5 A

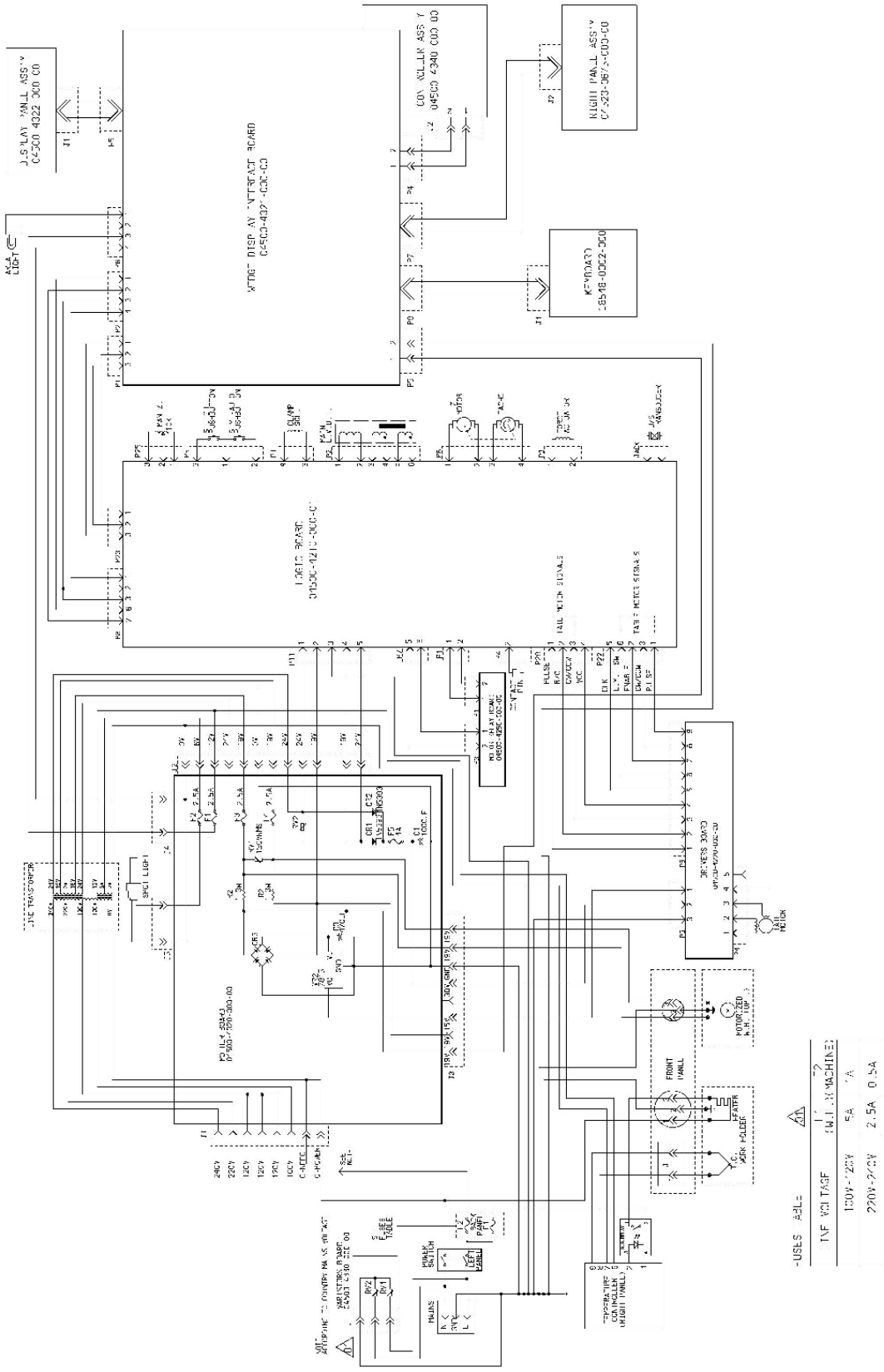


Figure 8-1: Interconnections Schematic Diagram - Models 4523D

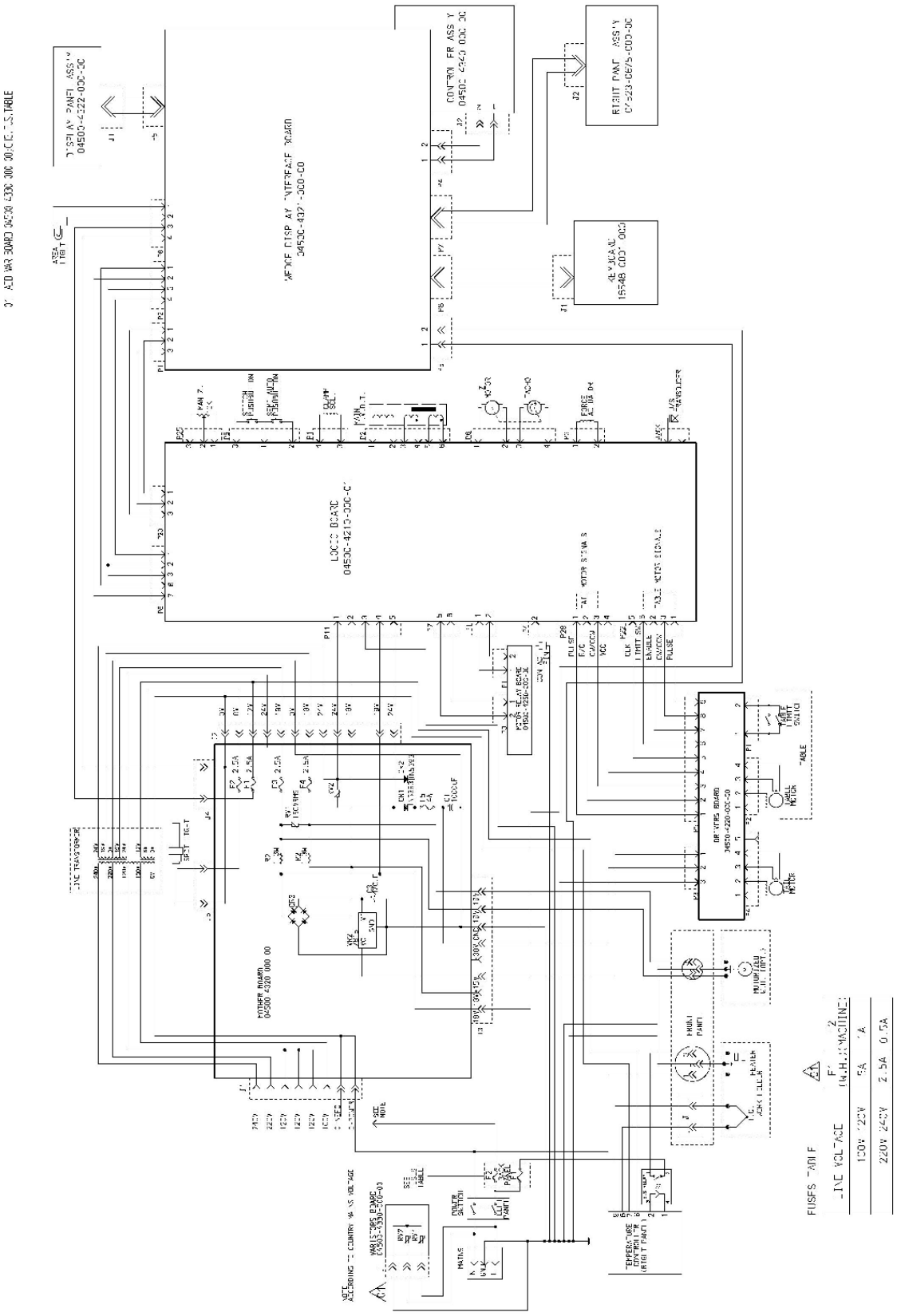


Figure 8-2: Interconnections Schematic Diagram - Model 4523AD

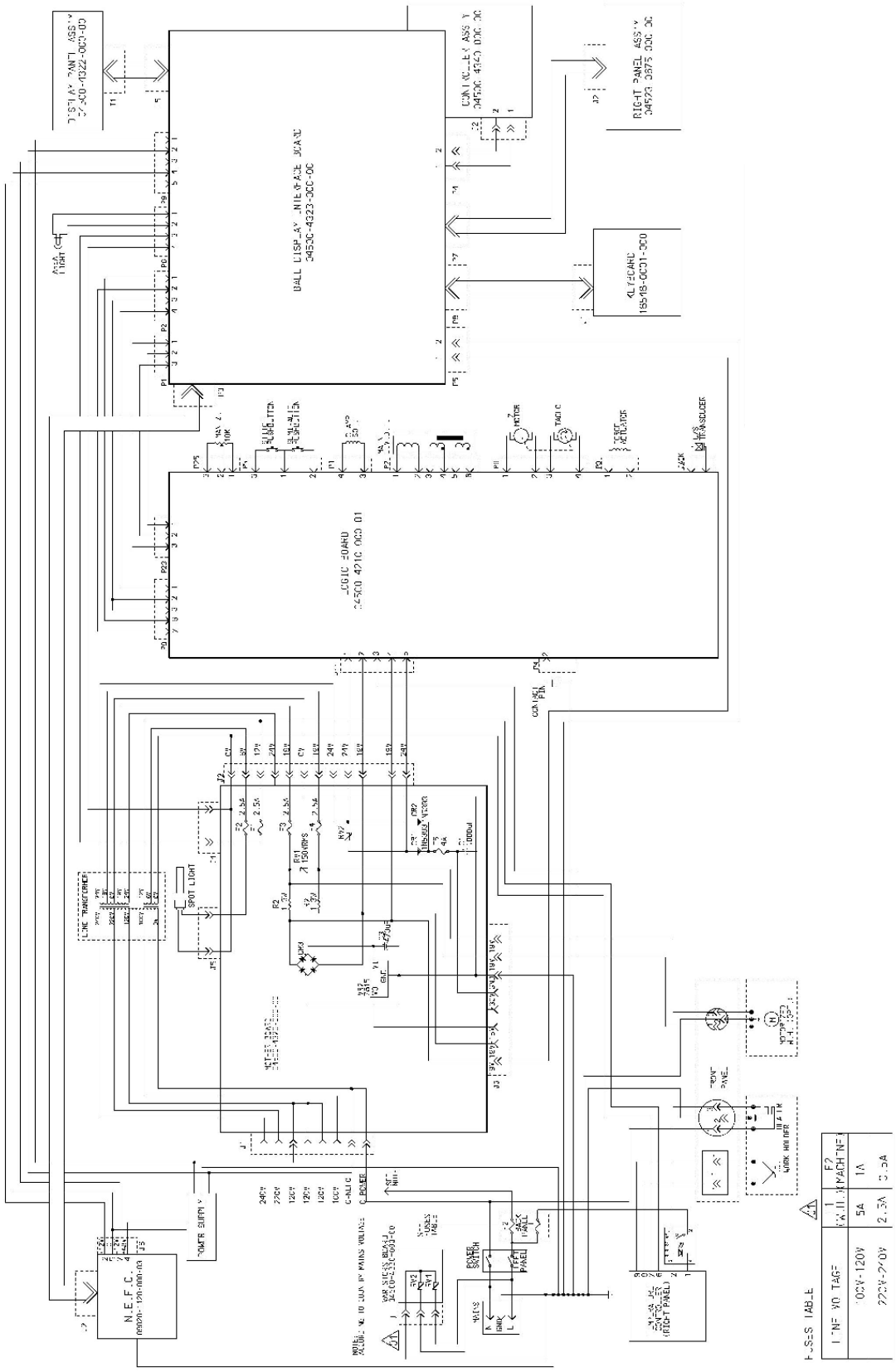


Figure 8-3: Interconnections Schematic Diagram - Model 4524D

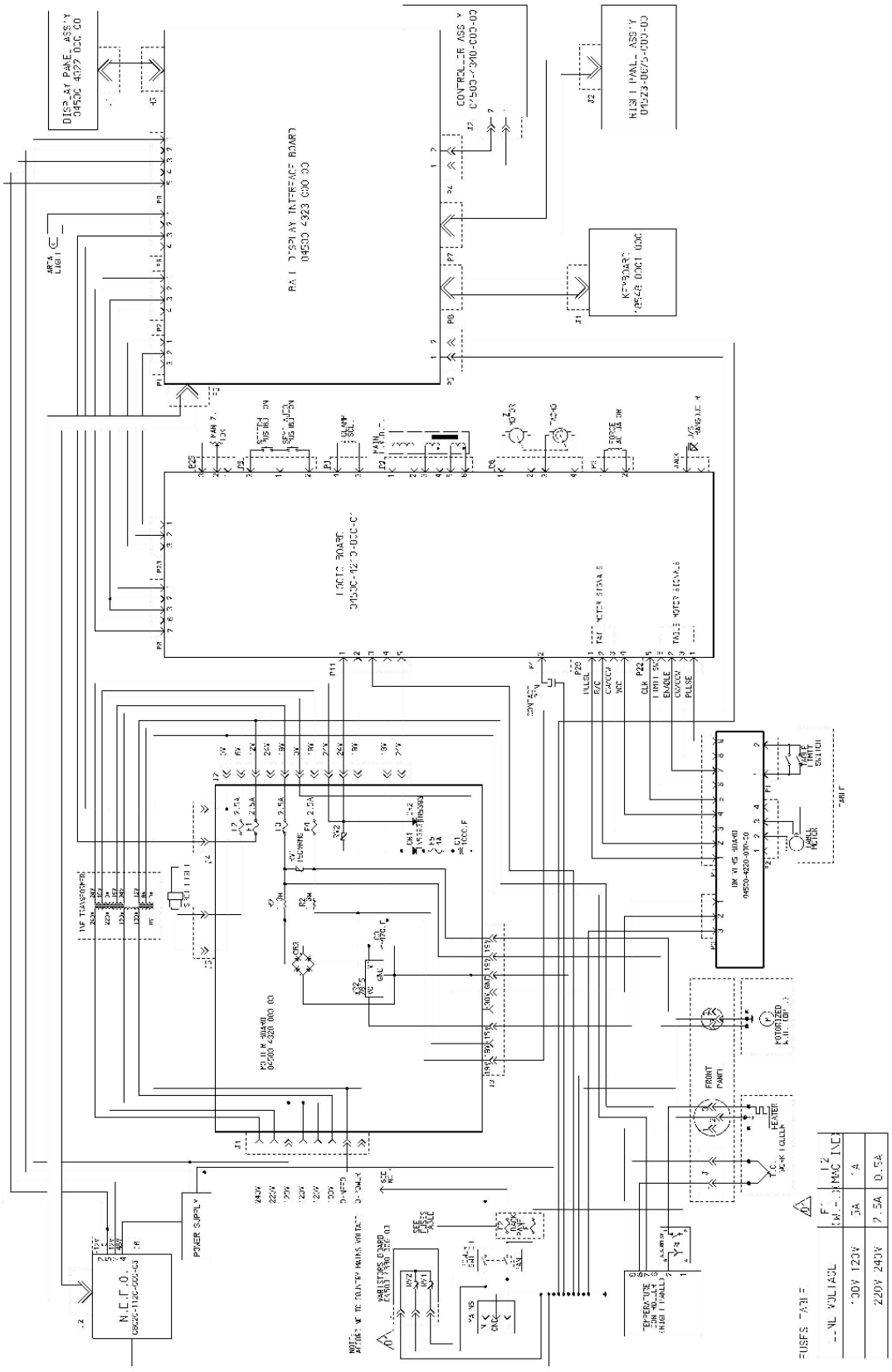


Figure 8-4: Interconnections Schematic Diagram - Model 4524AD

8.1.2 The Motherboard

The motherboard receives all power input to the 4500 Digital Bonder. It has five connectors (J1 - J5) connecting power to various subassemblies.

The motherboard is located inside the base on the left side (as seen from the rear). Figure 8-5 shows the layout of the motherboard.

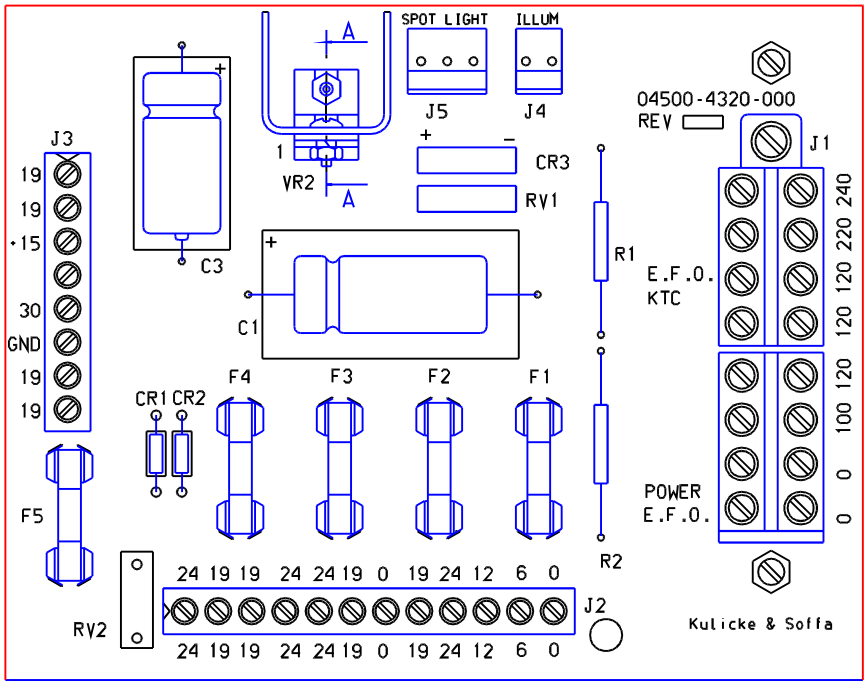


Figure 8-5: Motherboard Layout

8.1.2.1 Connectors J1 - J5 and Fuses

8.1.2.1.1 Connector J1

J1 connects the AC wall outlet power to a transformer. The primary output of the transformer is tapped so that all input voltages are converted to 120 V ac.

8.1.2.1.2 Connector J2

The transformer's secondary output is connected to J2. The secondary output supplies operating voltages of 0, 6, 12, 19 and 24 V ac to various components, such as the spotlight (if present), area light, temperature controller and logic board. To see which voltages are supplied to specific components, see the Interconnections Schematic Diagram for the appropriate bonder. (Figure 8-1, 8-2, 8-3, or 8-4).

8.1.2.1.3 Connector J3

J3 connects two 19 V ac lines to the motorized workholder connector on the workholder connectors panel. One 19 V ac line is connected to the ball/wedge interface board. One additional 19 V ac line is spare. The GND line is connected to the base of the bonder chassis. The 15 and 30 V dc lines are connected to the stepper drivers board (4523D, 4523AD, 4524AD).

8.1.2.1.4 Connector J4

J4 connects 12 V ac to the area light.

8.1.2.1.5 Connector J5

J5 connects 6 V ac to the spotlight (if present).

8.1.2.1.6 Fuses

The motherboard contains the following five fuses:

- F1 protects the 12 V ac line to the area light.
- F2 protects the 6 V ac line to the spotlight (if present).
- F3 and F4 protect the two 19 V ac lines to the logic board and the workholder motor.
- F5 protects the 30 V dc line to the stepper drivers board (4523D, 4523AD, 4524AD).

All of the fuses are 250 V slow-blow fuses rated for 2.5 A.

8.1.3 The Logic Board

The logic board contains the electronic circuitry that controls the operation of the 4500 Digital Series bonder. The circuitry uses the control button settings of the control panels to generate the electronic signals that operate the bonder. The output sequence of these signals is timed to match the bonder operating cycle.

The block diagram of the logic board is shown in Figure 8-6. The logic board layout is shown in Figure 8-7.

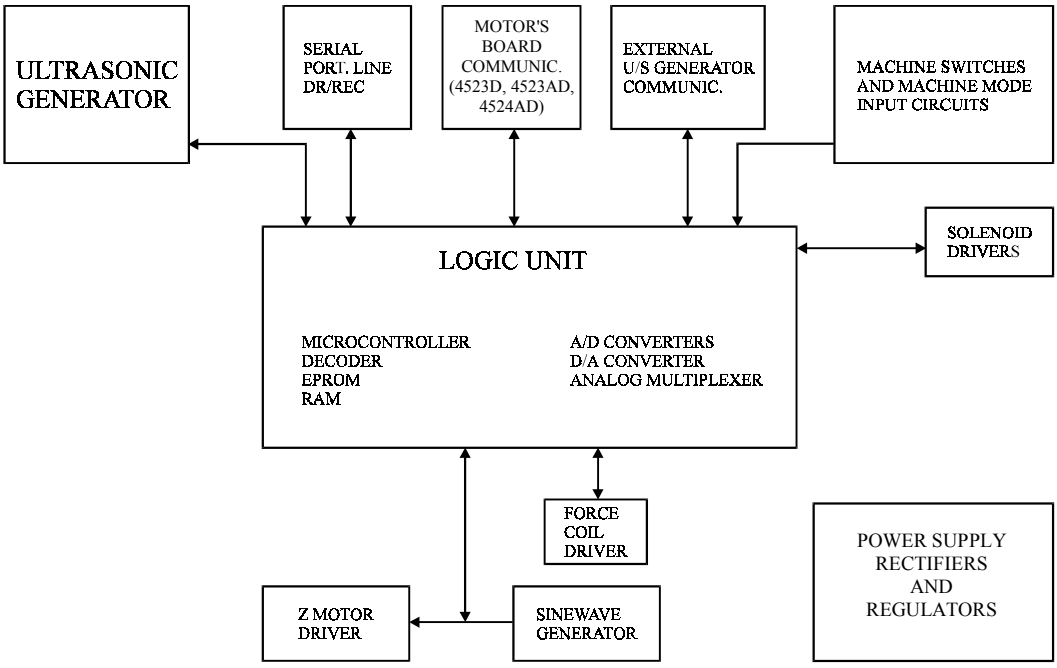
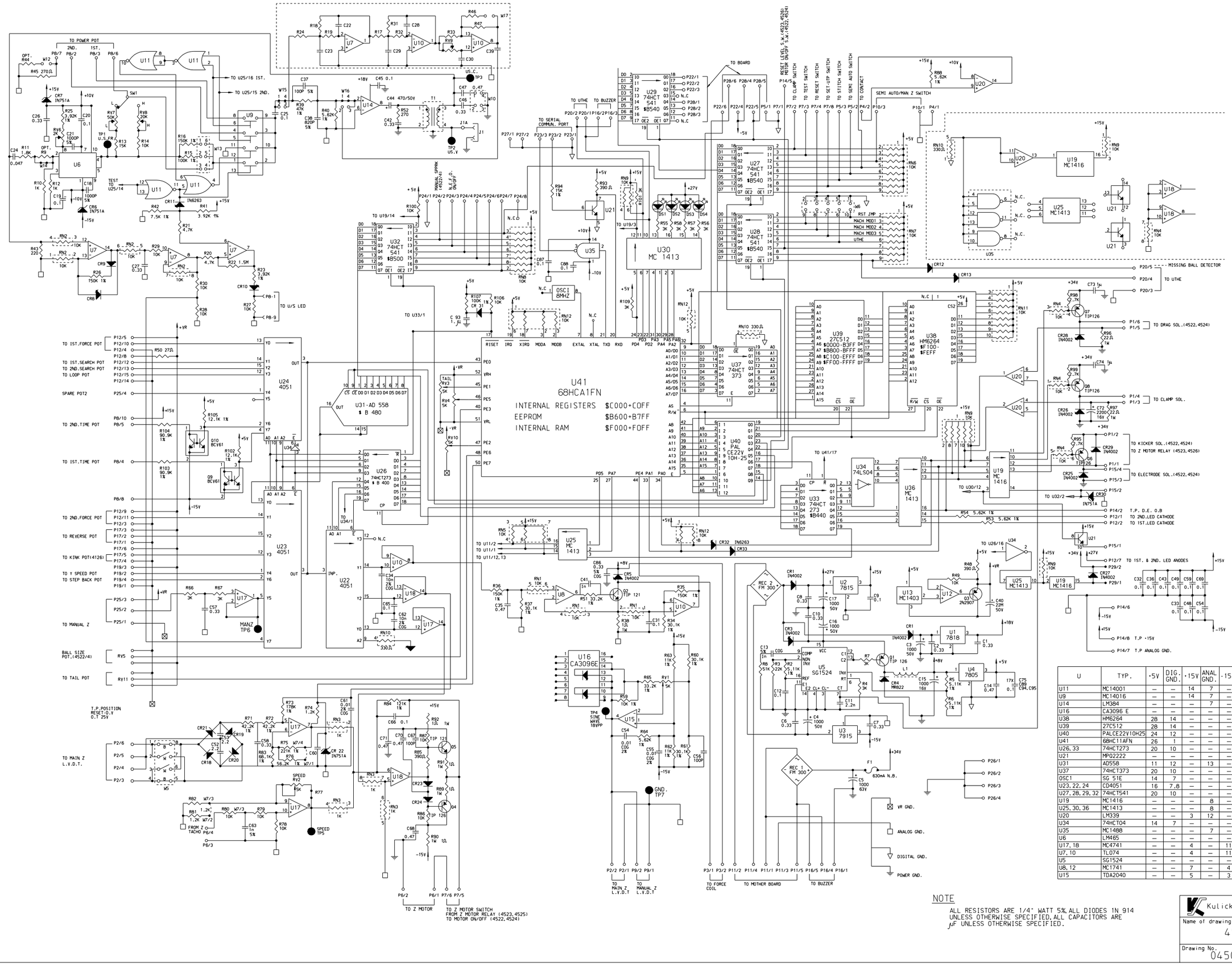


Figure 8-6: Logic Board Block Diagram



U	TYP.	+5V	DIG. GND.	-15V	ANAL. GND.	-15V	POW. GND.
U11	MC14001	—	—	14	7	—	—
U9	MC14016	—	—	14	7	—	—
U14	LM384	—	—	—	7	—	—
U16	CA3096 E	—	—	—	—	—	3,4,5, 10,11,12
U38	HM6264	28	14	—	—	—	—
U39	27C512	28	14	—	—	—	—
U40	PALCE22V10H25	24	12	—	—	—	—
U41	68HC11AFN	26	1	—	—	—	—
U26, 33	74HCT273	20	10	—	—	—	—
U21	MP02222	—	—	—	—	—	—
U31	AD558	11	12	—	13	—	—
U37	74HCT373	20	10	—	—	—	—
OSC1	SG 51E	14	7	—	—	—	—
U23, 22, 24	CD4051	16	7,8	—	—	—	—
U27, 28, 29, 32	74HCT541	20	10	—	—	—	—
U19	MC1416	—	—	—	8	—	—
U25, 30, 36	MC1413	—	—	—	8	—	—
U20	LM339	—	—	3	12	—	—
U34	74HCT04	14	7	—	—	—	—
U35	MC1488	—	—	—	7	—	—
U6	LM465	—	—	—	—	—	—
U17, 18	MC4741	—	—	4	—	11	—
U7, 10	TL074	—	—	4	—	11	—
U5	SG1524	—	—	—	—	—	8
U8, 12	MC1741	—	—	7	—	4	—
U15	TDA2040	—	—	5	—	3	—

NOTE

ALL RESISTORS ARE 1/4" WATT 5% ALL DIODES IN 914 UNLESS OTHERWISE SPECIFIED. ALL CAPACITORS ARE µF UNLESS OTHERWISE SPECIFIED.

Kulicke and Soffa Industries, Inc.

Name of drawing

452X LOGIC BOARD

Drawing No. 04500-4200-000-05 Rev.

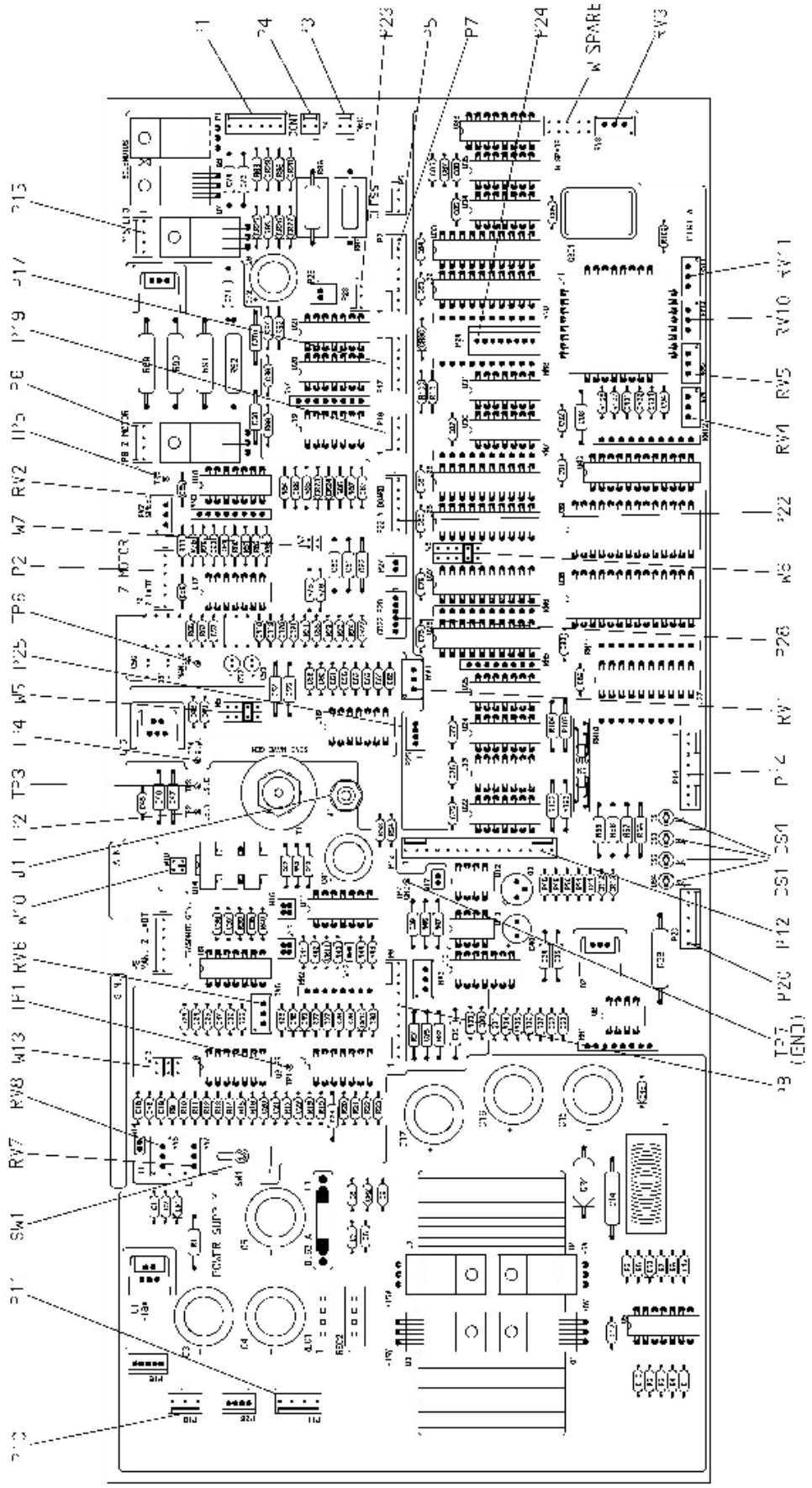


Figure 8-7: Logic Board Layout

8.1.3.1 The Logic Board Power Supply

The logic board receives two input voltages, 19 V ac and 24 V ac, from the motherboard through P11.

8.1.3.2 Fuse F1

F1 is a 250 V/0.630 A normal blow fuse that protects the +34 V dc voltage line used internally by the logic board to activate the solenoids.

8.1.3.3 The Logic Unit

The logic unit provides control and sends commands for the K&S 4500 Digital Series Bonder operation. The unit receives communication through an RS232 serial port.

The logic unit reads dial and switch settings from the control panel. Based on those settings, the logic unit sends commands to activate solenoids, run motors and turn on indicators.

The main component is a Motorola G8HC11 microcontroller. Two memory components, a RAM and an EPROM, support the microcontroller.

8.1.3.4 Sinewave Generator

The sinewave generator drives the main Z LVDT. The generator is an oscillator with a fixed frequency of 2.7 kHz. Its amplitude must be 18 Vp-p. The amplitude is measured at TP4 (S.W.) and adjusted by turning RV1 (see section 8.3.2).

8.1.3.5 Z Motor Circuit

The Z motor circuit activates the Z motor. Together with signals from the Z motor relay board, the Z motor circuit controls the bonding head up/down (Z-axis) movement.

The Z motor is set to an optimum speed by turning RV2. It is done at the factory site (see section 8.3.4).

The Z motor circuit operates in both Semi/Auto Cycle mode and Manual Z mode.

8.1.3.6 The Ultrasonic Generator Circuit

The ultrasonic circuit drives PZT crystals to produce the ultrasonic vibration required for bonding.

The generator's main part is a Phase Lock Loop (PLL) integrated circuit. The free running frequency of the PLL is measured at TP1 (US.FR) and adjusted by turning RV6 (see section 8.3.3.1).

The circuit contains a two-position switch, SW1, for setting the ultrasonic power level - LOW or HIGH. At the LOW setting, the circuit voltage output can be adjusted by turning RV7. At the HIGH setting, the circuit voltage output can be adjusted by turning RV8. The test point for measuring this voltage is TP2 (see section 8.3.3.2).

During its diagnostic self-test (after the bonder is powered on or reset), the logic unit checks that the transducer and ultrasonic circuit form a closed circuit. If the self-test detects a fault in the circuit, the appropriate diagnostic LEDs turn on (see section 11.2).

8.1.3.7 The Force Driver Circuit

When the SET control button is pressed and the LED lights, the force circuit drives the force coil, applying a force that is proportional to the supplied current. The force circuit applies the force set by the actual FORCE parameter.

8.1.3.8 Connectors

The logic board's connection points and their functions are listed below. The physical location of each connector is shown in Figure 8-7.

Table 8-2: Logic Board Connectors	
Connector	**Function**
P1 (4524D, 4524AD)	Connects the kicker and clamp solenoids.
P1 (4523D, 4523AD)	Connects the clamp solenoid and relay PC board.
P2	Connects the main Z LVDT.
P3	Connects the force actuator.
P4	Connects the contact pin.
P5	Connects the Semi/Auto Cycle and STITCH pushbuttons.
P6	Connects the Z motor
P7/5, P7/6 (4524D, 4524AD)	Connects the short of Z motor.
P7/5, P7/6 (4523D, 4523AD)	Connects the Z motor relay board.
P8	Connects the POWER and the U/S indicator circuit to the Ball/Wedge interface board.
P9	Not used.
P10	Not used.
P11	Connects the power supply.
P12	Not used.
P14	Not used.

Table 8-2: Logic Board Connectors	
Connector	**Function**
P15 (4524D, 4524AD)	Connects the EFO solenoid.
P17	Not used.
P19	Not used.
P20	Not used.
P22 + **P28** (4523D, 4523AD, 4524AD)	Connects the Tail/Tear and Y table motors.
P23	Serial communication port. Connects the Ball/Wedge interface board.
P24	Not used.
P25	Connects Manual Z potentiometer.
J1	Ultrasonic plug.
RV10	Not used.
RV11	Not used.
RV5	Not used.

8.1.3.9 Diagnostic LEDs

The diagnostic LEDs indicate if a failure was detected during the bonder's self-test. Each specific type of failure causes a combination of the LEDs to turn on. The diagnostic LEDs are located on the bottom left area of the logic board.

For more details about the diagnostic LEDs, see section 11.1.

8.1.3.10 Adjustment Controls

The logic board contains a number of adjustment controls. These controls are listed below. Their locations are shown in Figure 8-7.

Table 8-3: Logic Board Adjustment Controls

Connector	Function
SW1	Switch for changing the power level of the ultrasonic generator (HIGH/LOW).
RV1	Trimmer for adjusting the sine wave amplitude of the 18 Vp-p.
RV2	Trimmer for adjusting the Z motor speed.
RV6	Trimmer for adjusting the ultrasonic free running frequency.
RV7	Trimmer for adjusting the ultrasonic low level voltage amplitude.
RV8	Trimmer for adjusting the ultrasonic high level voltage amplitude.

8.1.3.11 Logic Board Test Points

The logic board provides test points for measuring various signals. These test points are described below. Their locations are shown in Figure 8-7.

Table 8-4: Logic Board Test Points

Test Point	Name	Function
TP1	**US.FR**	Ultrasonic free running frequency.
TP2	**US.V**	Ultrasonic generator output voltage.
TP3	**US.C**	Ultrasonic generator current sensing.
TP4	**S.W**	Sinewave generator output.
TP5	**SPEED**	Z motor tacho amplifier output.
TP6	**MAN. Z**	Manual Z LVDT amplifier output.
TP7	**GND.**	Electrical ground.

8.1.3.12 Jumper Configuration

The logic board is common for all K&S 4500 Series Manual Wire Bonders. However, the configuration of the logic board's jumpers are determined by the bonder model. Figure 8-8 shows the required jumper configurations for Models 4523D, 4523AD, 4524D and 4524AD, respectively.

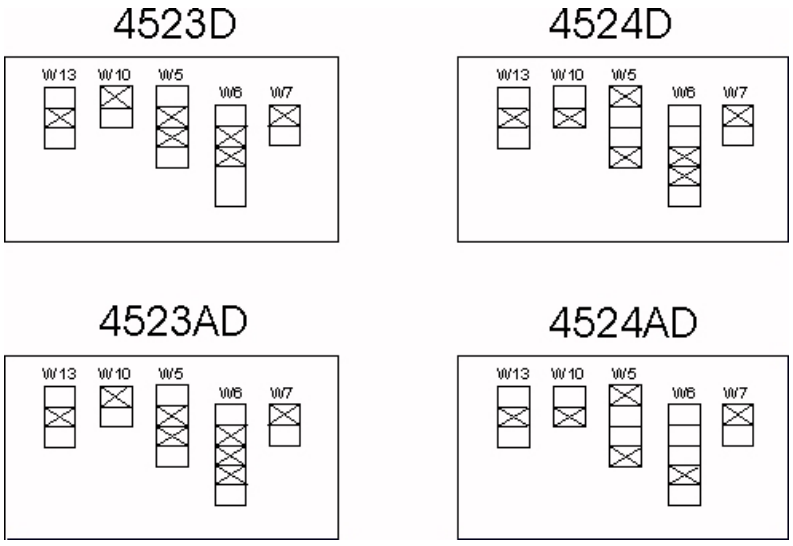


Figure 8-8: Jumper Configurations for Model 4523D, 4523AD, 4524D, 4524AD

8.1.4 The Z Motor Relay Board (4523D, 4523AD)

The Z motor relay board is located in the right side of the base (as seen from the rear). It controls the Reset position of the bonding head. This height is set by the RESET HEIGHT control button on the right control panel.

When the LED is OFF, the bonding head reset position is 6.6 mm (260 mil) and the Z motor relay is constantly energized.

When the LED is ON the Z motor relay is deenergized when the bonding head reaches 6.6 mm (260 mil). A spring mechanism then "pulls" the bonding head up to a maximum Reset position of 12.7 mm (500 mil). Figure 8-9 shows a schematic drawing of the Z motor relay board.

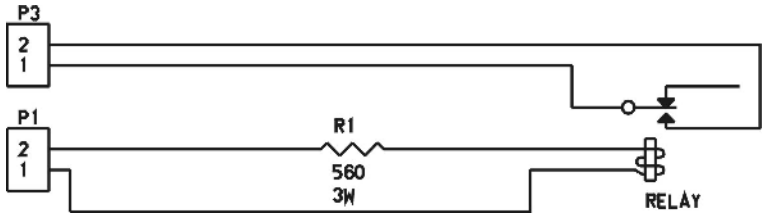


Figure 8-9: The Z Motor Relay Board - Schematic Drawing

8.1.5 The Stepper Drivers Board (4523D, 4523AD, 4524AD)

The stepper drivers board is located in the inner right side of the main head (as seen from the rear). It drives the linear motor of the clamp arm (tail/tear) and the Y table motor.

The board receives power from two sources. It receives +5 V dc from the logic board, +15 V dc, +30 V from the motherboard.

The motors' motions are driven by step motors controlled by the logic board. The logic board generates signals representing the motors' displacements, directions and speeds. These signals are generated on command from the logic board. The logic board determines the timing and content of these commands in accordance with the REVERSE, TAIL, TEAR, Y SPEED and STEP parameters.

During the logic board's self-test, the stepper drivers board receives a signal to move the Y table from one limit switch to the second. If the Y table does not reach the limit switches (or moves from one of the limit switches), the appropriate diagnostic LEDs combination turns on (see section 11.2).

Figure 8-10 shows the electronic layout of the stepper drivers board.

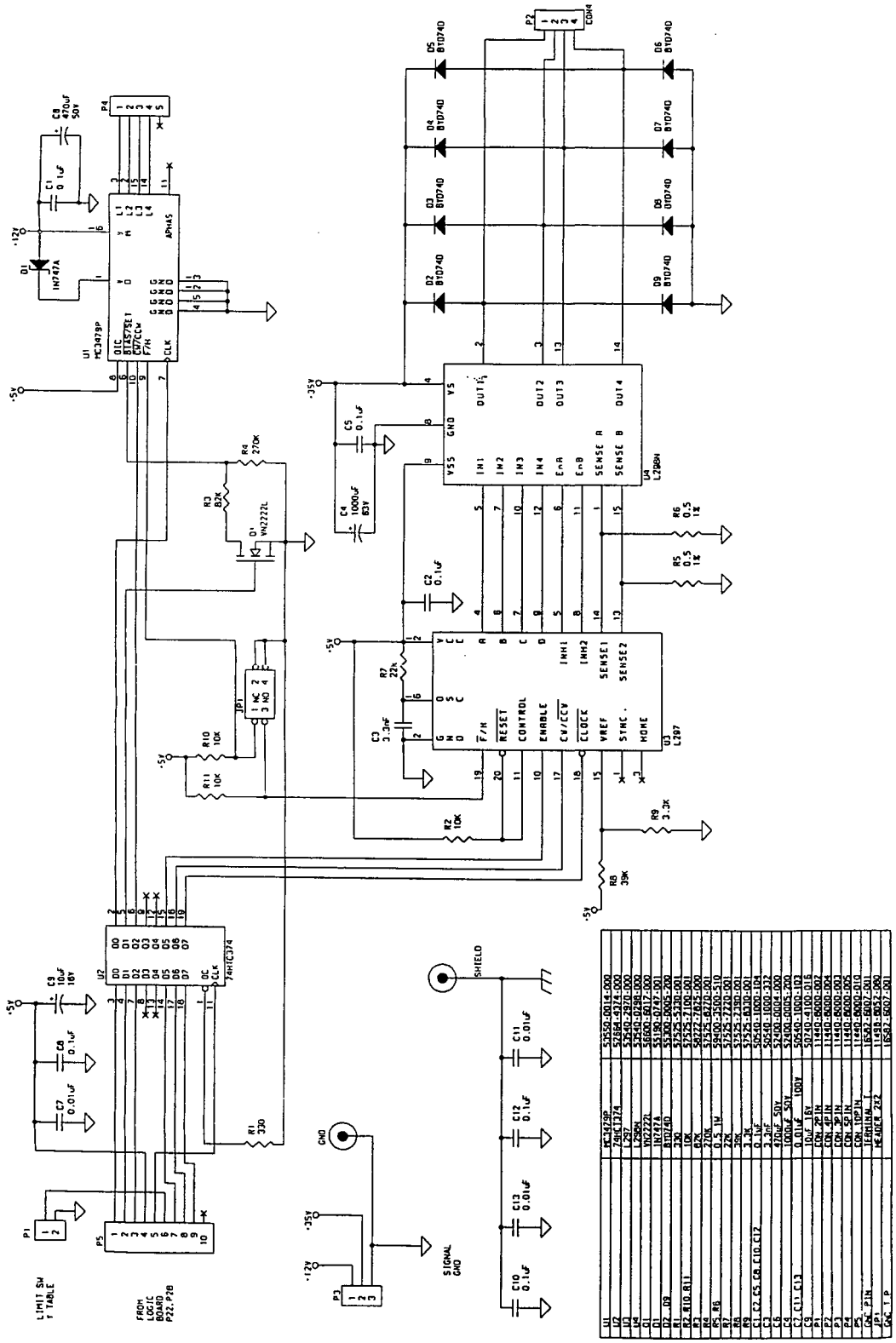


Figure 8-10: Stepper Drivers Board - Schematic Drawing

8.2 The N.E.F.O. (4524D, 4524AD)

The N.E.F.O. supplies high voltage pulses to the N.E.F.O. wand. It is connected to the Ball Interface Board, which is connected to the logic board at P23 (data transmission and reception).

The Ball Interface Board sends digital signals to the N.E.F.O. for producing a spark that creates a ball of a specific size (set by the BALL parameter).

The Ball Interface Board also receives OPEN, SHORT and data error signals from the N.E.F.O. In response, the interface board sends signals to turn on the OPEN or SHORT indicator.

8.2.1 N.E.F.O. Power Supply

Voltage is supplied to the N.E.F.O. as follows:

- +48 V dc single power supply
- +12 V dc, -12 V dc second power supply (located on the Ball Interface Board P9)
- +5 V dc from the Ball Interface Board through P3

8.2.2 Ball/Wedge Interface Board

The Ball/Wedge Interface Board is located on the right side of the base, behind the Left Control Panel (as seen from the rear). The Ball Interface board is used on Model 4524D and 4524AD and the Wedge Interface Board is used on Models 4523D and 4523AD.

Figure 8-11 shows the Ball/Wedge Interface Board layout, Figure 8-12 shows the Ball Interface Board schematic diagram, Figure 8-13 shows the Wedge Interface Board layout and Figure 8-14 shows the Wedge Interface Board schematic diagram.

The Ball/Wedge Interface Board performs the following functions:

- It connects the controller serial port H3 through P1 to the logic board P23. Through this RS232 port the logic board receives and transmits data (parameter values and status) from the controller assembly.
- It connects the controller's input and output ports to the right control panel through P7 and to the keypad through P8. This connection allows the controller to sense the keys and set/reset the LED indicators.
- It connects to the U/S circuit through P2 using the U/S reference signal from the logic board (P8). Using a digital to analog converter (U3) and an analog multiplier (U4), it sends the power signal (set by the POWER parameter) to the power stage of the U/S circuit.

- It connects the controller's data/address buses through H5 to the LCD display.
- It connects a solid-state relay (U9) to the area light through P6 of the machine, turning the light ON and OFF.
- It provides +12 Vdc through P4 to the controller assembly (converted from +19 V ac from the motherboard).
- It converts 120 Vac to +12 Vdc, -12Vdc to the N.E.F.O. (valid only in the Ball Interface Board).

8.2.2.1 Connectors

The Ball/Wedge Interface Board's connection points and their functions are listed below. The physical location of each connection is shown in Figure 8-11.

Table 8-5: Ball/Wedge Interface Board Connectors

Connector	Function
P1	Serial interface. Connects the logic board (P23).
P2	Connects the ultrasonic circuit of the logic board (P8).
P3	Connects the N.E.F.O. box (4524D, 4524AD).
P4	+12 Vdc power out connection to the controller.
P5	Power in connection from the motherboard. (19 Vac)
P6	Area light connection.
P7	Right panel connection.
P8	Keypad connection.
P9	N.E.F.O. box power connection (4524D, 4524AD - Ball Interface Board only).
H5	Display connection.

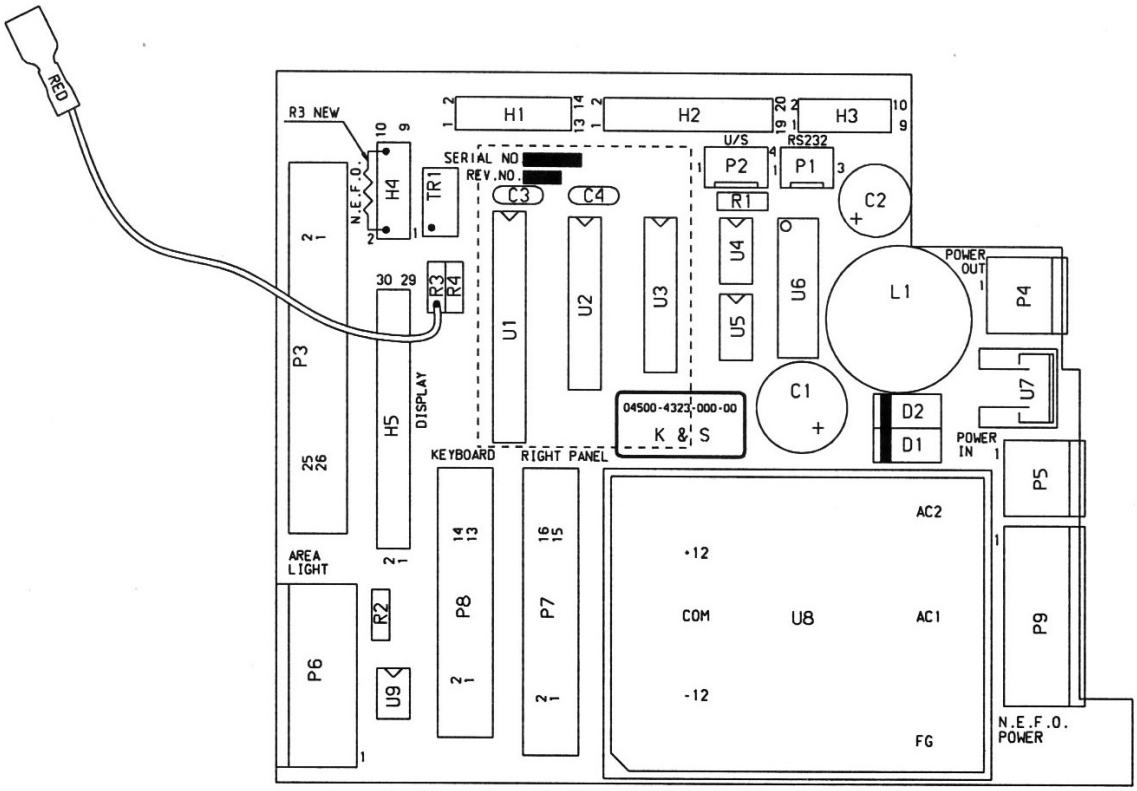


Figure 8-11: Ball/Wedge Interface Board Layout

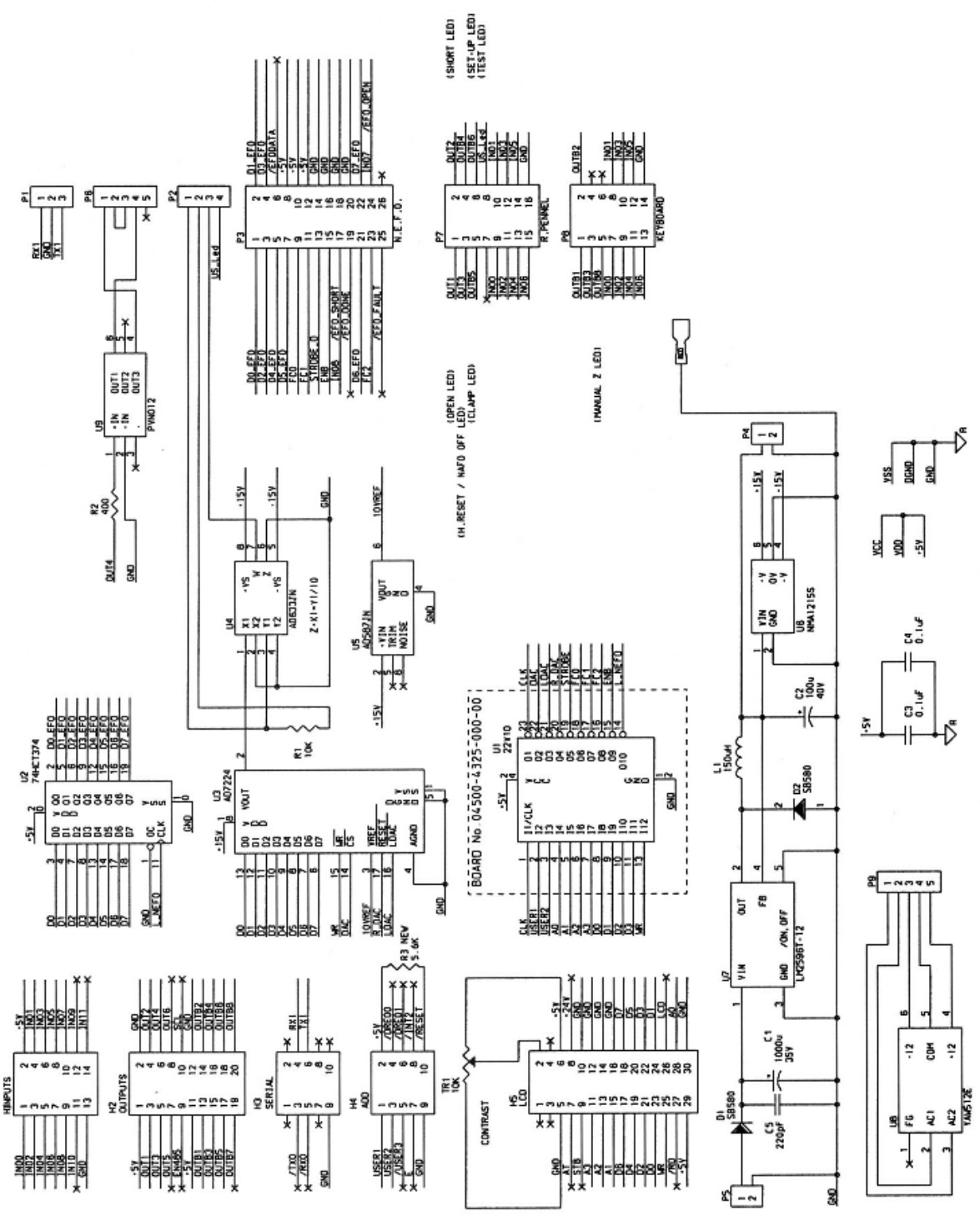


Figure 8-12: Ball Interface Board Schematic Diagram

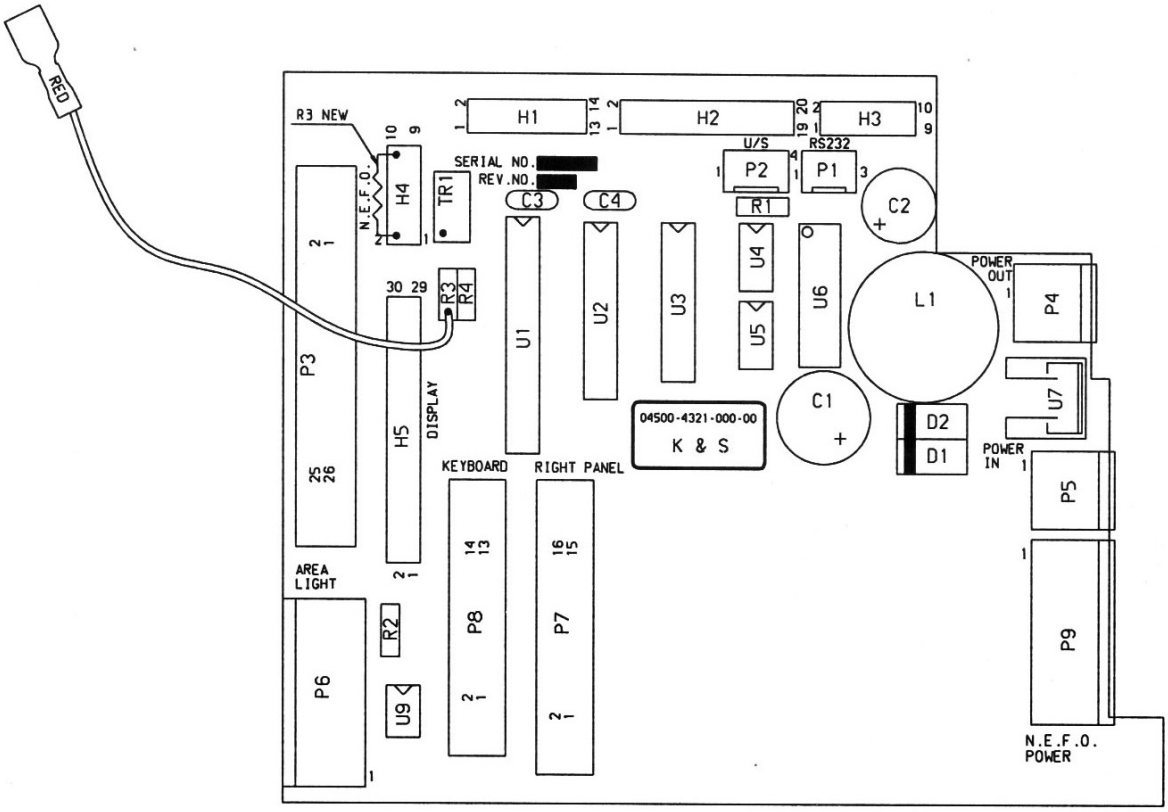


Figure 8-13: Wedge Interface Board Layout

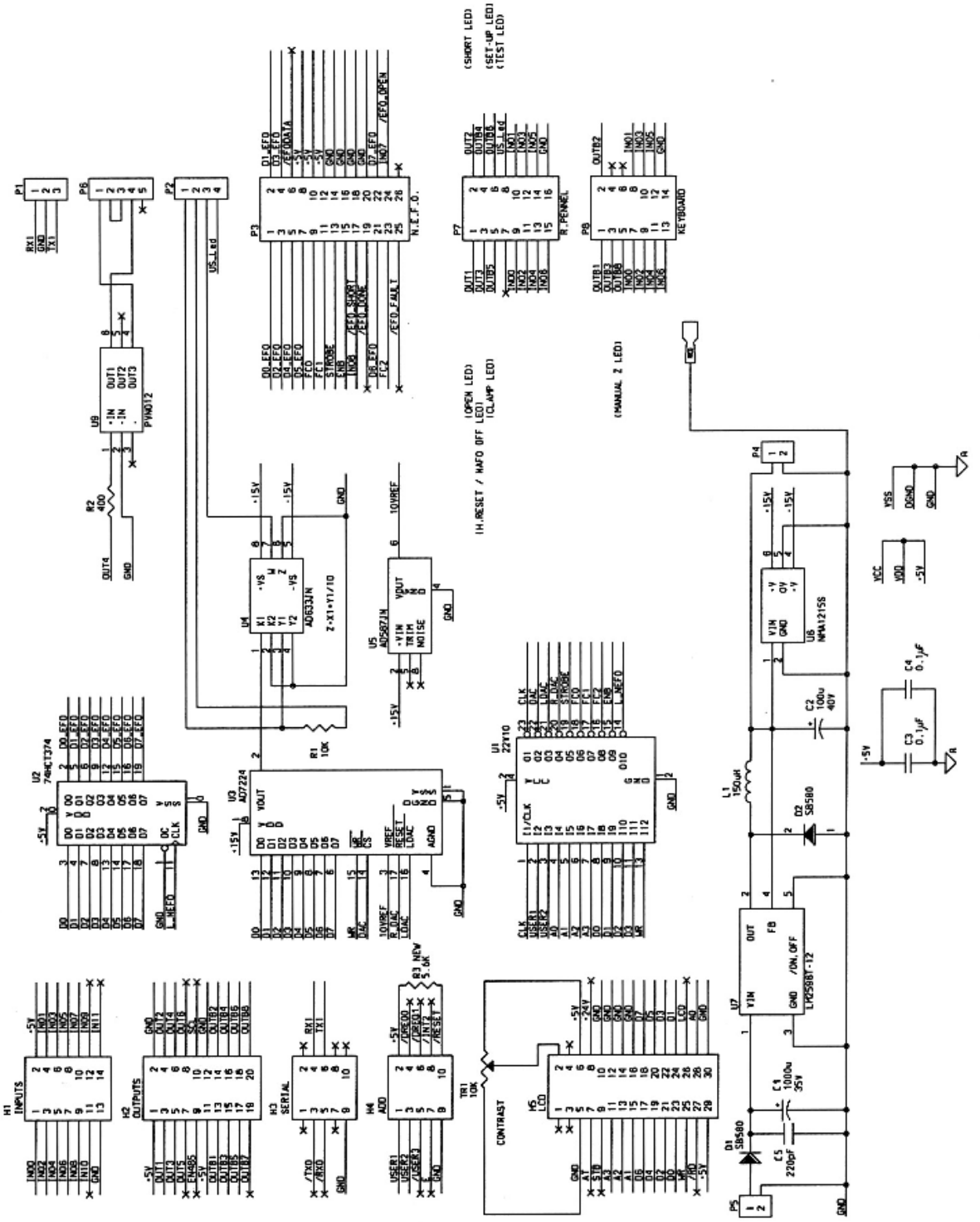


Figure 8-14: Wedge Interface Board Schematic Diagram

8.2.3 Controller Assembly

The controller board is located on the right side of the base behind the left control panel (as seen from the rear) and is mounted on a bracket connected to the Ball/Wedge Interface Board.

The controller functions as a man-machine interface:

- It controls the LCD display.
- It transmits and receives data to and from the logic board.
- It connects to the right control panel and the keypad, sensing the key and control signals.
- It has a battery backed up memory used for storage of programs.
- It loads digital values to the N.E.F.O. and to the U/S circuit which are set by the actual parameter value.
- All connections are made through the Ball/Wedge Interface Board.

8.2.3.1 Jumper Configuration

The controller board is common to all K&S 4500 Digital Series Manual Wire Bonders. Figure 8-15 shows the required jumper configuration.

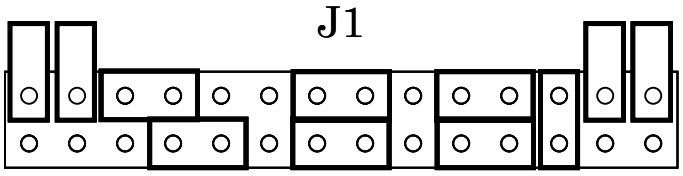


Figure 8-15: Controller Jumper Configuration

8.3 Electrical Assemblies Replacement and Adjustment

8.3.1 Logic Board Replacement

Before replacing the logic board, ensure that the jumper configuration is correct for the relevant bonder model (see Figure 8-8).

To replace the logic board:

1 Set the POWER switch to the OFF position. Verify again that the jumpers are set correctly on the board for the relevant machine.

2 Remove the screws securing the covers for the machine base and push the top covers aside. Remove the back cover.

3 Unplug all connectors from the logic board that is in your machine (carefully note which plug goes to which connector). Then unsnap the old board from the six nylatch fasteners.

4 Align the logic board supplied in the kit with the nylatch fasteners and gently snap it into place. Reconnect all harnesses to their proper connectors on the new logic board. See section 8.1.3.8 and Figure 8-7 to verify that the connections are correct.

5 Leave the back cover off so that you will be able to make further adjustments, and turn the machine on.

6 Wait until initialization is completed on the display. Locations are shown in the 1st Bond Screen.

Note: After turning on the machine, it is recommended to wait 30 minutes until it warms up before working.

7 Perform the following checks and adjustments:

- Sine Wave Generator Adjustment (RV1)
- Ultrasonic Generator Adjustments (RV6, RV7, RV8)
- Z Motor Speed Adjustment (RV2)

8.3.2 Sine Wave Generator Adjustment

The logic board uses a Sine Wave Generator (18 Vp-p) to set the bonding head's travel distance between the Reset position and the Overtravel position.

Required Tools: Oscilloscope (or digital multimeter)
Small screwdriver
Regular screwdriver

To adjust the sinewave generator:

1 Make sure that the bonding head is in the Reset position and that the 1st Bond schedule number is highlighted (1st Bond Screen). Allow a warm-up period of 30 minutes.

2 Connect the oscilloscope (or multimeter) probe to TP4 (S.W.) and the ground to TP7 (GND) (see Figure 8-7). Check that a sharp, non-distorted, 18 Vp-p sine wave appears in the oscilloscope display (or that a 6.37 Vac (Vrms) reading appears on a multimeter).

3 If the voltage does not equal 18 Vp-p, turn the voltage to this value with trimmer RV1 on the logic board to attain 18 Vp-p (see Figure 8-7).

8.3.3 Ultrasonic Generator Adjustments

Required tools: Digital frequency counter and probe (x10)

Oscilloscope

Small flathead screwdriver

8.3.3.1 Free Running Frequency Adjustment

Free Running Frequency Adjustment requires the digital frequency counter and small flathead screwdriver.

To adjust the free running frequency:

1 Disconnect the transducer from J1 on the logic board (see Figure 8-7)

2 Set switch SW1 to the LOW position on the logic board.

3 Connect the counter leads to TP1 (US.FR) and TP7 (GND) (see Figure 8-7).

4 Check that the value displayed by the counter matches the appropriate value for the relevant bonding machine, according to Table 8-6. If it does not, use the small screwdriver to adjust trimmer potentiometer RV6 until the proper value is attained.

Table 8-6: Free Running Frequent Adjustment Values

M/C FREQ	4523D	4523AD	4524D	4524AD
58.5 KHz	X	X		
59.5 KHz			X	X

5 Turn off the bonder. Insert the transducer plug in its place (J1).

6 Disconnect the digital frequency counter.

8.3.3.2 Ultrasonic Power Adjustment

This procedure requires the oscilloscope and a small flathead screwdriver.

To adjust the ultrasonic power:

1 Set switch SW1 (see Figure 8-7) to the LOW position.

2 Connect the oscilloscope probe to TP2 (US. V) and the ground to TP7 (GND).

3 Set the cursor of the POWER Parameters in the 1st and 2nd Bond Screens to **4.9**.

4 Adjust the oscilloscope time base to 5 msec., the voltage scale to 5 v/d and the trigger to Normal mode.

5 Turn the bonding machine on and wait for it to complete its initialization routines (as shown in the 1st Bond Screen).

6 Press and release the **Semi Auto pushbutton**, and then perform the bond "in the air". Repeat this a number of times during all its cycles. At the same time, a square wave should appear in the oscilloscope display. If there is a problem, go to Chapter 11.

7 Adjust trimmer RV7 on the logic board until the voltage for the relevant machine is attained, according to Table 8-7 below. At the same time, adjust the oscilloscope time base and voltage scale until the waveform shown in Figure 8-16 appears.

Table 8-7: Low Power Adjustment

Machine type	4523D	4523AD	4524D	4524AD
Voltage (p-p)	9 max.	9 max.	13.6	13.6

8 Set switch SW1 to HIGH.

9 Adjust trimmer RV8 on the logic board until the voltage appropriate for the relevant machine is attained, according to Table 8-8 below. At the same time, adjust the oscilloscope time base and voltage scale until a waveform like the one shown in Figure 8-16 appears.

Table 8-8: HIgh Power Adjustment

Machine type	4523D	4523AD	4524D	4524AD
Voltage (p-p)	18 max.	18 max.	23	23

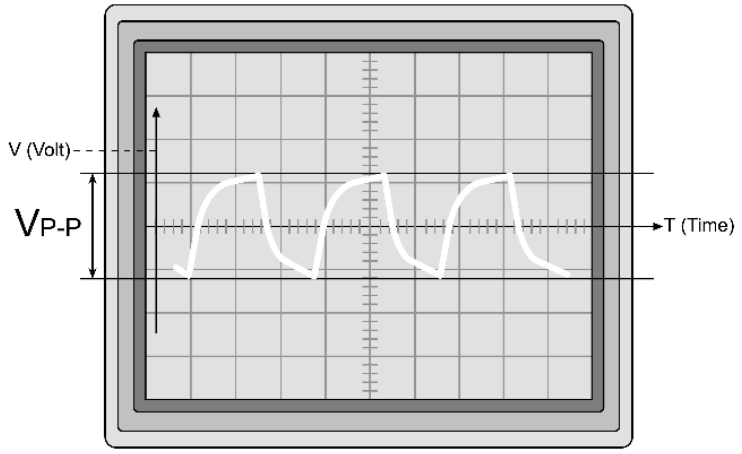


Figure 8-16: The Waveform

10 Set switch SW1 to LOW.

Note: When bonding wires thinner than 25mm (1 mil), turn RV7 counterclockwise to the minimum setting.

11 Disconnect the oscilloscope probes.

12 Verify that no diagnostic LEDs are illuminated.

If there is a malfunction and the Diagnostic LEDs are illuminated, refer to Chapter 11 of this manual to process the fault. Verify that the Ultrasonic Generator is operating properly by pressing and holding down the TEST control button and checking whether the LED indicator illuminates.

13 Return the bonder machine base cover and rear cover to their places. Secure the covers to ensure that they do not fall off.

8.3.4 Z Motor Speed Adjustment

The bonding head movement of each bonder (Z-axis) is factory-set to its optimum speed.

The sections that follow detail the steps necessary to change the factory-set speed for each Model, if required.

Required tools: Digital frequency counter and probe (x10)

Small screwdriver

8.3.4.1 Adjusting the Z Motor Speed for Models 4523D/4523AD

If it is necessary to adjust the factory-set Z motor speed in Models 4523D or 4523AD, insert a screwdriver in trimmer RV2 (see Figure 8-7) and turn counterclockwise to decrease the speed.

8.3.4.2 Adjustments for Model 4524D Only

If it is necessary to adjust the factory-set Z motor speed in the Model 4524D, perform the procedure described below.

To adjust the Z motor speed (Model 4524D):

1 In the 1ST and 2ND BOND screens, set the cursor of the TIME, LOOP and SEARCH parameters to **0.0**.

2 Connect the Frequency Counter probe to P14/2 (see Figure 8-7) and the ground to TP7 (GND).

3 Adjust the frequency counter time base to 0.1 Hz.

4 Run the bonder in Auto Cycle mode. Verify that the machine is working properly. If the machine is not working properly, see Chapter 11.

5 Every 10 seconds, take a reading of the test frequency from the counter tool.

6 Adjust trimmer RV2 on the logic board by turning it clockwise until the appropriate frequency is obtained, as shown in Table 8-9.

Table 8-9: Frequency of Z Motor Speed Adjustment – Model 4524D

4524D/AD TYPE	FREQUENCY (Hz)
Standard access	14 max.
Deep access	10

7 Press and release the RESET control button on the right panel.

8 Disconnect the digital frequency counter.

8.3.4.3 Adjustments for Model 4524AD Only

If it is necessary to adjust the factory-set Z motor speed in the Model 4524AD, perform the procedure described below.

To adjust the Z motor speed (Model 4524AD):

1 Turn the bonder off.

2 Set jumper W6 to the configuration used for the **Model 4524D** (not with the Motorized Y Table), as shown in Figure 8-8.

3 Turn the bonder on. Allow it to warm up for at least 30 minutes (until the 1ST BOND screen is displayed).

4 In the 1ST and 2ND BOND screens, set the cursor of the TIME, LOOP and SEARCH parameters to **0.0**.

5 Connect the Frequency Counter probe to P14/2 (see Figure 8-7) and the ground to TP7 (GND).

6 Adjust the frequency counter time base to 0.1 Hz.

7 Run the bonder in Auto Cycle mode. Verify that the machine is working properly. If the machine is not working properly, see Chapter 11.

8 Every 10 seconds, take a reading of the test frequency from the counter tool.

9 Adjust trimmer RV2 on the logic board by turning it clockwise until the appropriate frequency is obtained, as shown in Table 8-9.

10 Press and release the RESET control button on the right panel.

11 Turn the bonder off.

12 Return jumper W6 to its original configuration (with the Motorized Y Table), as shown in Figure 8-8.

13 Disconnect the digital frequency counter.

8.3.5 Display Contrast Adjustment

If it is necessary to change the factory-set, turn the voltage with the trimmer TR1 on the Ball/Wedge Interface Board.

9. MECHANICAL SUBASSEMBLIES

This chapter describes the main mechanical subassemblies of the K&S 4500 Digital Series Manual Wire Bonders. The chapter also provides procedures for adjusting and replacing mechanical parts of the bonder.

The bonder consists of two major mechanical assemblies:

- Main Head Assembly
- Base Assembly

9.1 The Main Head Assembly

The main head assembly contains the mechanisms for lowering the wire to the bonding pad, performing the bonding and tearing the wire after bonding. In addition, the main head is the platform for attaching the microscope, area light and optional spotlight.

Figures 9-1 and 9-2, respectively, show left and right views (from the front) of the main head assembly.

9.1.1 Left Side View (Internal)

9.1.1.1 The DC Motor

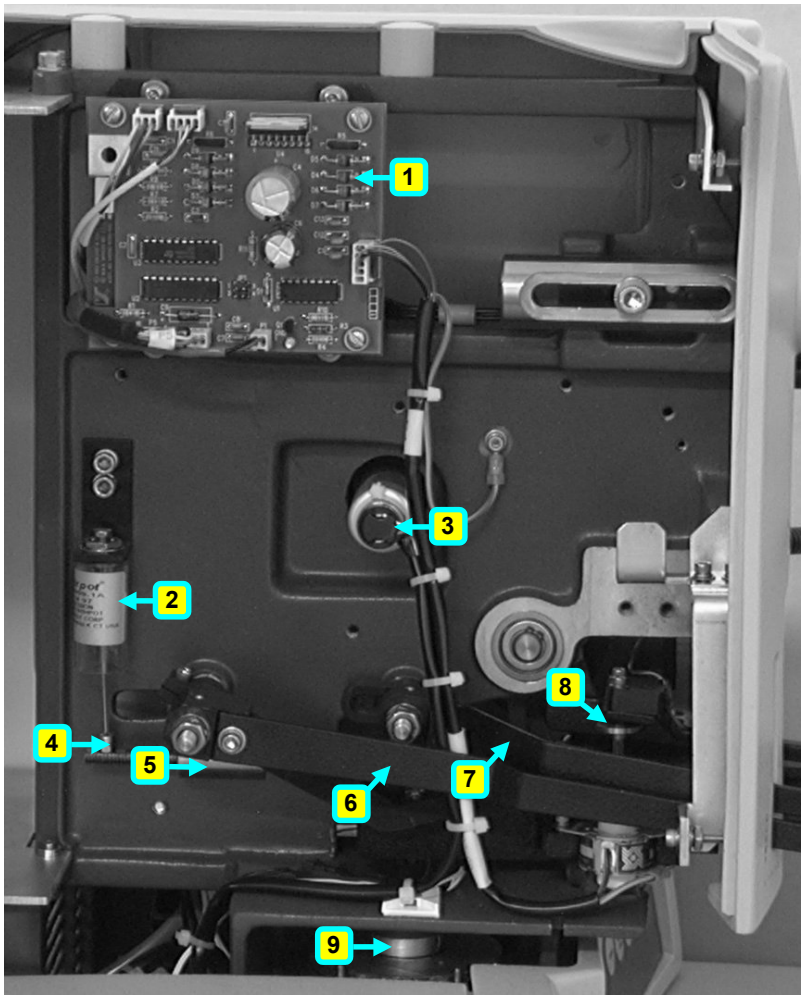
The DC motor drives the up/down movement of the bonding head. The DC motor receives signals from the logic board which determine the direction of the movement.

9.1.1.2 The Stepper Drivers Board

The stepper drivers board controls Y-motion, tail and tear movement. Signals from the logic board command the stepper drivers board to drive the motors.

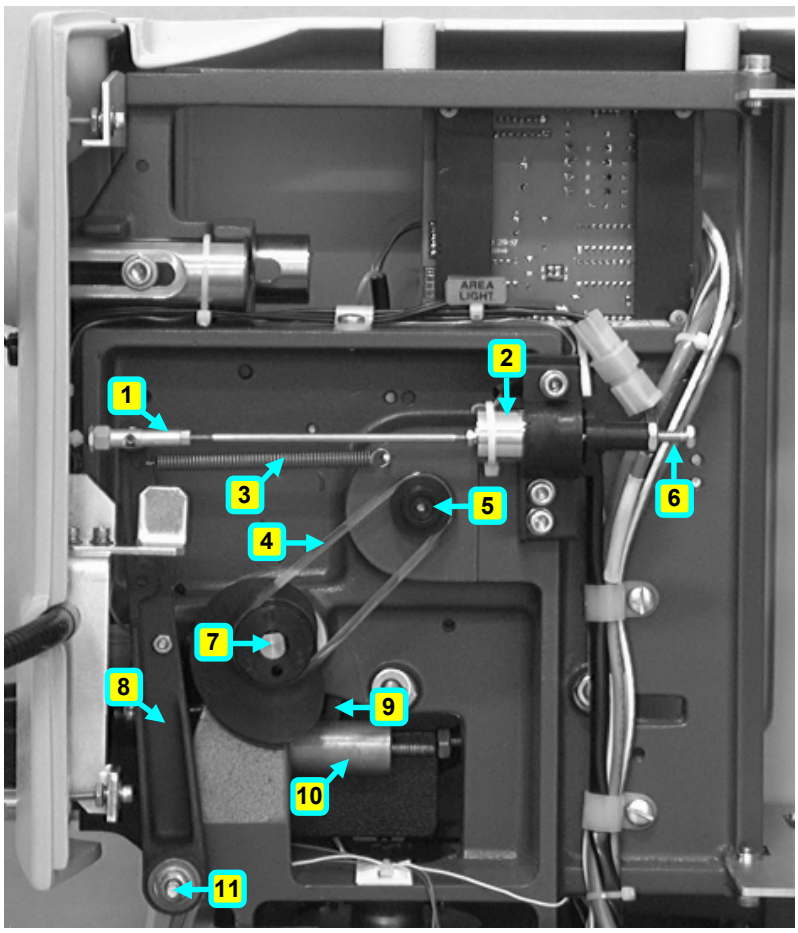
The signals are based on the settings of:

- The Tail parameter (4523D, 4523AD).
- The Reverse, Tail, Tear, Y Speed and Step parameters (4523AD, 4524AD).



1 Stepper Driver Board
2 Air Dashpot
3 DC Motor
4 Dashpot Rod
5 Rear Counterweight
6 Clamp Lifter
7 Tool Lifter
8 Tear & Feed Arm
9 Force Actuator

Figure 9-1: Main Head - Left View



1 Rod End Nut
2 Main LVDT
3 Return Spring
4 Drive Belt
5 Pulley
6 Stop Screw
7 Height Control Cam
8 Height control Link
9 Cam
10 Front Counterweight
11 Bonding Head Pivot

Figure 9-2: Main Head - Right View

9.1.1.3 The Air Dashpot

The air dashpot is an adjustable pneumatic shock absorber that dampens vertical vibrations in the bonding head. It absorbs most of the impact of the wedge/capillary's contact with the bonding pad.

The amount of vibration damping is adjusted by turning the needle valve screw at the top of the dashpot.

9.1.1.4 The Tool Lifter

The tool lifter allows you to manually raise the bonding head front to protect the wedge/capillary when not in use, or to replace the wedge/capillary. Raising the tool lifter handle engages its cam and lowers the rear of the bonding head lever, thereby raising the bonding head. The bonding head remains raised until the tool lifter handle is lowered.

9.1.1.5 The Clamp Lifter (4523D, 4523AD)

The clamp lifter allows you to create enough space between the wedge and the clamp to feed the wire into the wedge wire feed hole. The clamp lifter handle is linked to an arm which raises the rear of the tear & feed arm.

9.1.1.6 The Bonding Head Mechanism

The bonding head mechanism (see Figure 9-3) moves the wedge/capillary tip to positions set by the LOOP and SEARCH parameters. The mechanism also applies mechanical forces in response to electronic signals from the logic board. The pivot of the bonding head produces its up/down motion.

The bonding head pivot is secured to the main head casting. The ultrasonic transducer holding the wedge/capillary is clamped to the front of the bonding head cover.

The applied bond force is a combination of the static balance and the electronically controlled force. Static balance is adjusted by changing the position of the counterweights that are threaded on rods connected to the bonding head.

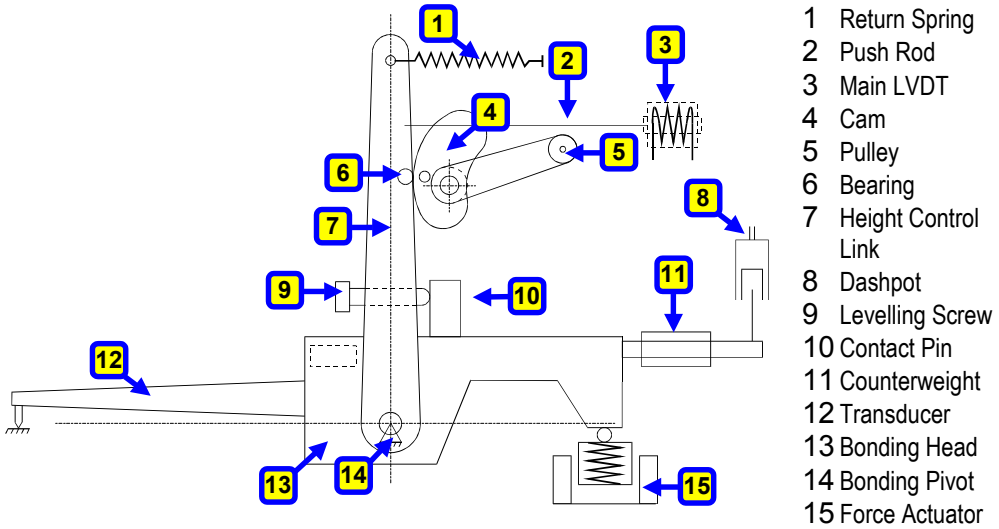


Figure 9-3: Bonding Head Mechanism

9.1.1.7 The Force Actuator

The force actuator is an electrical moving coil mounted vertically between the poles of a permanent magnet. When the actuator is energized, it rises, pushing up the rear (heel ball) of the bonding head cover. This lowers the bonding head, applying a controlled force.

The actuator rises at four force levels: first bond force, second bond force, tracking force and constant force. All forces are applied at a particular time in the bonding cycle.

The first bond and second bond forces are applied when the wedge/capillary is in contact with the bonding pad. The top and bottom FORCE parameters, respectively, set these force values.

Tracking force and constant force are factory-set. The tracking force overcomes the air dashpot incidental braking action when the bonding head drops to the Search position and keeps the levelling screw in contact with the contact pin.

The constant force keeps the actuator in continuous contact with the heel ball. This force is weak enough to be overcome by the link return spring. When the POWER switch is set to OFF, the actuator loses contact with the heel ball.

9.1.2 Right Side View (Internal)

9.1.2.1 The Height Control Cam

The height control cam translates the operation of the DC motor into bonding head movement. The DC motor drives the cam by transferring power through the pulley and the drive belt, located on the right side of the main head.

During bonder operation, the cam remains in contact with the height control link. This enables the logic board to send movement signals to the bonding head that are relative to its position.

9.1.2.2 The Height Control Link and Contact Mechanism

The height control link is located on the bonding head pivot. Before and after bonding, the height control link is held against the height control cam by the link return spring. After each bond, the constant force enables the link return spring to pull the height control link against the height control cam.

The height control link works in conjunction with two electro-mechanical components that send bonding head position data to the logic board. These components are:

- Contact Pin
- LVDT - (Linear Variable Differential Transformer)

9.1.2.2.1 The Contact Pin

The contact pin maintains electrical contact between the bonding head and the height control link until the wedge/capillary touches the bonding pad. The height control cam continues revolving to the Overtravel position, tilting the height control link forward independently of the bonding head.

After the first bond is performed, the logic board switches from actuator force to the constant force to raise the bonding head. The link return spring tilts the height control link back and brings the levelling screw in contact again with the contact pin. This contact point is the reference point for the next operation in the bonding cycle.

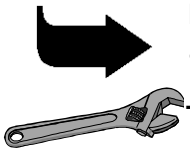
9.1.2.2.2 LVDT (Linear Variable Differential Transformer)

The LVDT sends height control link position signals to the logic board. The logic board uses these signals to synchronize and modulate the bonding cycle and the bonding speed.

9.2 Bonding Head Maintenance

One of the most important actions of the machine is the movement of the bonding head. The maintenance procedures in this section ensure smooth bonding head motion with no jerking or friction.

9.2.1 Bonding Head Free Motion



Note: This procedure should always be performed after making adjustments to the static force.

To check that bonding head free motion is correct:

1 Turn the bonder off. Push the height control link to lower the bonding head to the bonding pad.

2 Continue pushing the height control link and raise the bonding head.

3 Let the bonding head fall freely. It should drop with a steady, smooth motion down to the bonding pad.

4 Grasp the bonding head cover and try to move it to the side. If you feel any backlash, the bearings must be adjusted.

Improper bonding head movement (such as jumpiness or no movement at all) may be caused by one or more of the following:

- The bearing retaining screw is too tight.
- The dashpot needs adjustment or replacement.
- The angular contact flange bearing is faulty (contact your K&S representative).

9.2.2 Bonding Head Bearings Adjustment

To adjust the bonding head bearings:

1 Ensure that the bonder is turned off.

2 Using a 5/32" wrench, tighten the retaining screw slightly. Raise the bonding head and let it drop two or three times. Check that it moves up and down freely with no sideways backlash. If you detect sideways backlash, continue tightening the retaining screw.

3 Secure the retaining screw by tightening its nut, so that the screw does not rotate. Ensure that the bonding head still moves up and down freely with no sideways backlash.

4 Return the two nuts which the hold the bonding head pivot screws. Tighten the first nut and check that the height control link tilts freely with no side play. Secure the first nut with the second nut. Ensure that the contact leveling screw is centered at the contact pin.

5 Connect the dashpot rod to the threaded rod at the rear of the bonding head.

9.2.3 Static Bonding Force and Dashpot Adjustment

The static bonding force and dashpot adjustment is required only if you switch to a bonding wire of a different diameter. Thicker wires require greater static bonding force.

The bonding force is applied by two adjustable counterweights on the bonding head (the air dashpot damping effect is only incidental). If high bonding force is required, one or both counterweights may be removed.

To adjust the static bonding force and the dashpot damping effect:

1 Turn the bonder off.

2 Raise the bonding head to the bonding level height by pulling the height control link away from the cam.

3 Place the force gauge under the wedge/capillary. Turn the front and rear counterweights, respectively, to obtain an undamped static force of:

- 11 gr – 15 gr (14 gr recommended) on the bonding head (4523D, 4523AD)
- 23 gr – 25 gr on the bonding head (4524D, 4524AD)

Note: These forces are suitable for 25 μm (1 mil) wire.

4 Lock the counterweight nuts.

5 Raise the front of the bonding head and let it drop. Check that the bonding head falls smoothly.

6 If necessary, adjust the air dashpot nut (see Figure 9-1) to obtain the required damping effect. Raise the front of the bonding head and let it drop. Ensure that the bonding head falls smoothly, but not too slowly.

9.2.4 Dashpot Replacement

Generally, the dashpot must be replaced if the bonding head does not descend or if its downward movement is seriously impeded.

Note: Before replacing the dashpot, ensure that the problem is not caused by erroneous dashpot adjustment, excess pressure on the pivot, or a faulty bearing.

To replace the dashpot:

1 Using a 7/32" wrench, release the dashpot rod (see Figure 9-1) from the dashpot connection rod. Take care that the dashpot piston does not fall out.

2 Using a 1/2" wrench, remove the nut holding the dashpot to its support. Remove the dashpot.

3 Invert the dashpot and hold it at a 45° angle to check the dashpot linkage.

4 Check that the rod falls inside the dashpot by its own weight. Also, check that the dashpot's lower ball joint moves freely. If one of these does not occur, severe friction exists in the linkage or within the dashpot. The dashpot assembly must be replaced.

5 While holding the piston inside the dashpot, slip the new dashpot assembly onto the dashpot support. Using a 1/2" wrench, tighten the nut to secure the dashpot in place.

6 Connect the lower end of the piston to the dashpot connecting rod.

7 Operate the bonder through a bonding cycle and ensure that the bonding head moves normally.

9.3 Force Actuator Assembly

The force actuator requires maintenance in the following cases:

- Dust and/or debris has accumulated in the magnet groove, resulting in friction or causing the force actuator to stick. The force actuator must be cleaned and adjusted.
- A break in the coil windings. The force actuator must be replaced.

Required tools: Allen wrench

9.3.1 Force Actuator Test

To test for a force actuator problem:

1 Turn the bonder off. Open the door on the right side of the main head.

2 Push the height control link forward and lift, then release, the force actuator. Ensure that the actuator rises smoothly and falls by itself when released.

3 Power on the bonder and leave it in the Height Reset position (for Models 4523D and 4523AD, press the RESET control button. The LED turns On indicating that the Reset Level is HIGH).

4 Press the force actuator and release. Ensure that the actuator goes down easily and, when released, rises by itself so that it touches the heel ball of the bonding head cover.

5 Check the diagnostic LEDs to ensure that the force actuator circuit is not open (see Table 11-1). If the LEDs indicate an open circuit, disconnect the force actuator from the logic board and check if the coil resistance is approx. 7.5 Ω. If not, replace the coil.

9.3.2 Force Actuator Disassembly

To disassemble the force actuator:

1 Turn the bonder off.

2 Open the SnapTite tie holding the force actuator to the main head.

3 Remove the rear cover.

4 Disconnect the actuator plug from P3 on the logic board (see Figure 8-7).

5 Unscrew the two screws from the main head casting and remove the whole force actuator assembly.

6 After removing the force actuator, you can check that the coil moves freely, and remove the coil if the magnet groove needs cleaning.

7 To remove debris from the magnet groove, insert sticky tape into the groove and pull it out. Use an air gun or vacuum to remove dust.

8 If required, replace the actuator (see section 9.3.3).

9.3.3 Force Actuator Replacement

Note: For Models 4523D and 4523AD, power on the bonder and set the RESET LEVEL switch to the HIGH position before performing this procedure.

To replace the force actuator:

1 Move the force actuator backward or forward so that the heel ball is at the center of the coil. Adjust the force actuator height so that in the Reset position, the distance between the ball bearing and the coil is:

- 1 mm (0.04") for Models 4523D and 4523AD
- 2 mm (0.08") for Models 4524D and 4524AD

2 Tighten the screws in the main head casting.

3 Attach the coil wires to the main head casting by closing the SnapTite cable tie. Ensure that the wires are not too tense, and that the actuator can move freely.

4 Connect the force actuator connector to P3 on the logic board (see Figure 8-7).

5 Verify free movement, without friction or obstruction, of the new actuator in the magnet. If the magnet is defective or weak, replace it.

6 Perform force actuator assembly adjustment (see section 9.3.4).

9.3.4 Adjusting the Force Actuator

Note: Throughout this procedure, ensure that the heel ball remains at the center of the coil.

To adjust the force actuator:

1 Power on the bonder. Ensure that the bonder is in the Reset position and the first bond channel is highlighted on the Digital Display (for Models 4523D and 4523AD).

2 Press the RESET HEIGHT control button. The LED turns On indicating that the Reset Level is HIGH).

3 Loosen the two screws holding the force actuator to the main head casting.

4 Move the force actuator up or down to create a play of 1-3 mm (0.04" to 0.12") between the coil and the heel ball when the actuator is pressed downward. Ensure that the actuator returns to its original position after it is released.

Note: For Model 4523AD, create a play of 1-1.5 mm (0.04" to 0.06").

5 Tighten the two screws holding the force actuator to the main head casting.

9.4 Main LVDT Reset Position

The linear variable differential transformer (LVDT) is located in the right side of the main head (see Figure 9-2). The LVDT establishes the starting position of the cam relative to the height control link. From this position, the bonder accurately tracks all bonding head positions (Reset, Search, Overtravel, etc.) during the bonding cycle. If the LVDT sends incorrect position readings to the logic board, it should be adjusted or replaced.

This procedure is always performed after adjusting the 18 Vp-p on the logic board (see section 8.3.2).

Required tools: Allen and open wrenches, 3/16" and 5/16"

To adjust the LVDT:

1 Power off the bonder.

2 Push the LVDT so that it protrudes from its housing by approximately 15 mm (5/8"). Secure the LVDT by tightening the screw in its housing (4523D, 4523AD).

3 Push the LVDT to the edge of the housing. Secure the LVDT by tightening the screw in its housing (4524D, 4524AD).

4 Release the locking nut on the rod end (see Figure 9-2).

5 Power on the bonder and set the MOTOR switch to the ON position (4524D, 4524AD).

6 Power on the bonder. (For Models 4523D and 4523AD, make sure the LED next to the RESET HEIGHT control button is Off indicating that the Reset Level is LOW).

7 Wait for the bonder to complete its initialization and is in the Reset position.

8 Using the two wrenches, loosen the locking nut on the rod end. Turn the rod until the indentation on the cam is in line with the ball bearing follower of the height control link. Tighten the locking nut to secure the rod in place.

9 Press and release the Semi/Auto Cycle pushbutton twice to operate the bonder through a single bonding cycle. At the end of the cycle, ensure that the first bond channel is highlighted on the Digital Display and that the Z motor is in the Reset position.

Note: For Models 4523D and 4523AD, press the RESET height control button. The LED turns On indicating that the Reset Level is HIGH.

10 Loosen the locking nut of the LVDT stop screw (at the rear of the LVDT housing). Turn the stop screw so that the wedge/capillary tip is 12.7 mm (0.500") above the "0" Loop height. Tighten the locking nut to secure the LVDT stop screw in place.

11 Check and adjust bonding head verticality by performing the transducer levelling procedure (see section 9.5), and perform drag and wire clamp adjustments (see section 9.8).

Note: Always perform this step after adjusting the Main LVDT Reset position.

9.5 Transducer Replacement and Levelling

The ultrasonic transducer converts electrical signals from the logic board to mechanical vibrations at a frequency of approximately 60 kHz by using two piezo electric crystals.

Caution: The ultrasonic transducer is a very sensitive electromechanical device. Do not attempt to disassemble the transducer, as this requires special calibration equipment.

The transducer requires replacement in the following cases:

- The diagnostic LEDs indicate a faulty transducer.
- The bonding quality is inconsistent or poor.

Required tools: Square block
3" verticality pin 0.0625" diameter
90° angle bar with a leg length of at least 3"
Open and Allen wrenches
Torque meter

Note: The square block, verticality pin and angle bar are available in the K&S Maintenance Kit, P/N 4500-910-0-0.

To replace the transducer:

1 Turn the bonder off.

2 Remove the present transducer as follows:

a. Disconnect the transducer cable from J1 on the logic board (see Figure 8-7).

b. Cut the plastic strips that bind the transducer cable to other cables.

c. Loosen the two lock nuts of the transducer clamp's U-bolt and remove the transducer (see Figures 9-4 and 9-5).

3 Insert the cylindrical end of the replacement transducer into the U-bolt and partially tighten the lock nuts. Attach the transducer cable to the U/S connector on the logic board. Using plastic strips, secure the cable with the rest of the bonder wiring (leave enough spare wire to allow the bonding head to move freely).

4 Insert the verticality pin into the tool hole of the new transducer and clamp it in place by using the set screw at the transducer tip (see Figure 9-5).

5 Adjust the depth of the transducer insertion so that the verticality pin is aligned with the center of the wire clamp jaws. As a general rule (if the clamp is not assembled), the cylindrical end of the transducer should be flush against the front of the bonding head casting (see Figure 9-5).

6 Turn the transducer to adjust its angular orientation (see Figure 9-4). Using a 90° angle bar on a square block, ensure that the verticality pin is aligned properly. Tighten the two U-bolt lock nuts at a 7 kg/cm torque.

7 Set the POWER and MOTOR switches to the ON position. Move the bonding head to the Loop height by pressing and releasing the **Semi/Auto Cycle** pushbutton of the Multi Mouse. Ensure that the **2nd** indicator is on.

8 Set the LOOP parameter to 0. Ensure that the height control link is vertical when the bonding head is at the LOOP=0 height.

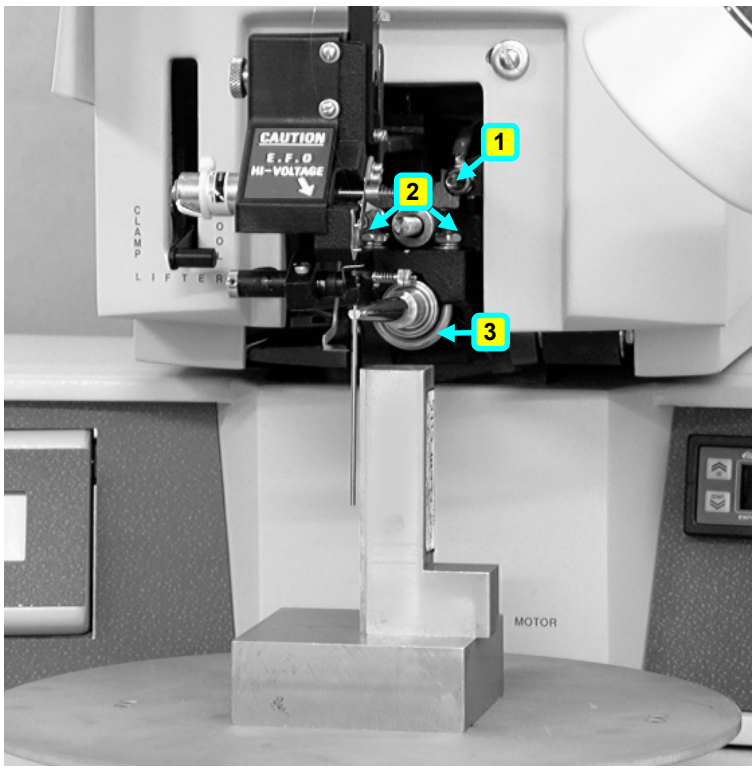
To level the transducer:

1 Using an angle bar on square block, view the alignment of the transducer from the side (see Figure 9-4).

2 Loosen the lock nut on the levelling screw of the height control link. Turn the levelling screw so that when it touches the contact pin of the bonding head, the verticality pin aligns with the angle bar.

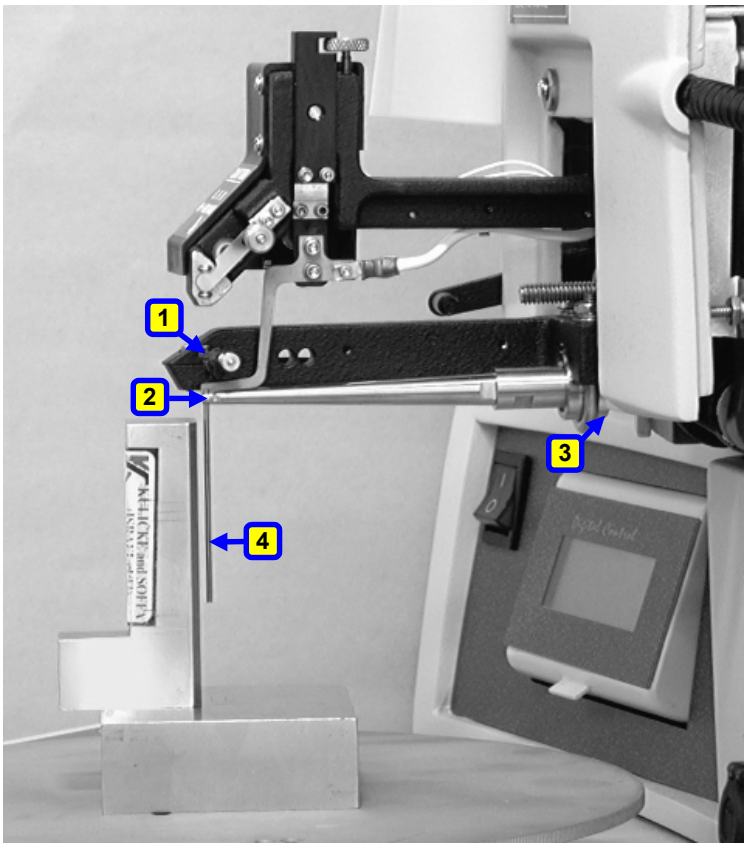
3 Loosen the wedge/capillary set screw and remove the verticality pin from the transducer. Ensure that the ground connection is held tight by the nut on the levelling screw.

4 Insert the wedge/capillary into the transducer (see section 5.1.1 or 5.1.2). Test the transducer by setting the TEST switch to the UP position. Ensure that the **U/S** indicator turns on.



1 Levelling Screw
2 Lock Nuts
3 U-Bolt

Figure 9-4: Verticality Adjustment - Front View



1 Wire Clamp
2 Set Screw
3 Cylindrical End
4 Verticality Pin

Figure 9-5: Verticality Adjustment - Side View

9.6 Clamp Solenoid/Wire Clamp Replacement and Adjustment

The clamp solenoid opens the wire clamp against the opposing force of a compressed spring.

The wire clamp subassembly normally requires few adjustments. If the wire clamp does not open at the proper times in the bonding cycle, the clamp and/or solenoid may require cleaning, adjustment or replacement.

For information about cleaning the clamp solenoid, see section 12.15.

For recommended clamp adjustments, see the Recommended Machine Adjustments tables in Chapter 6.

9.6.1 Clamp Solenoid Replacement

The clamp solenoid is located on the bonding head casting near the wedge/ capillary. The clamp gap must be readjusted after replacing a solenoid or after clamp malfunction. The clamping force must be adjusted if you switch to a wire of different diameter.

When a clamp solenoid fault indication appears on the diagnostic LEDs (see Table 11-1), replace the clamp solenoid.

Required tools: Force Gauge 0-100 grams
Feeler Gauge
Open and Allen wrenches

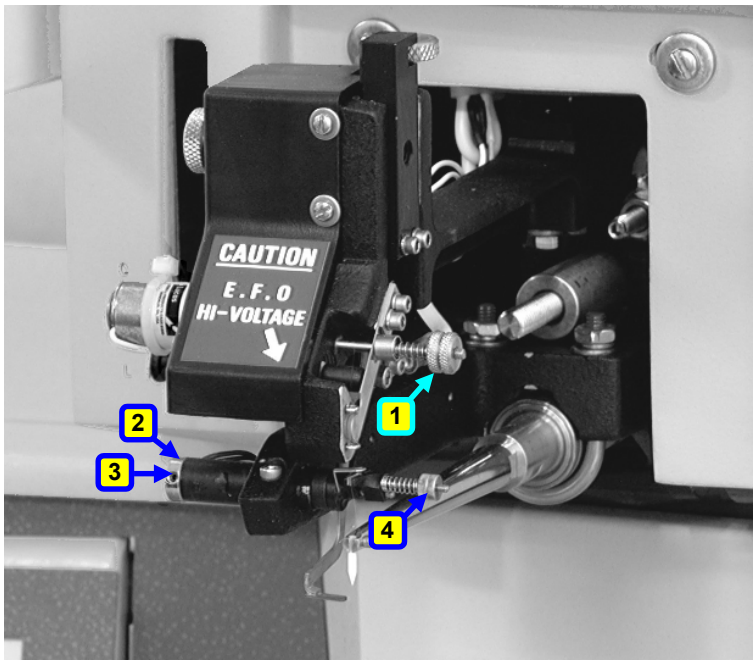
Before replacing the solenoid, check if the clamp solenoid is firmly connected to the logic board and is receiving voltage. If the connection is good, check that the resistance of the clamp solenoid is 60 Ω ±5%. If you detect an open or short circuit, replace the clamp solenoid.

9.6.1.1 Clamp Solenoid Replacement (4524D, 4524AD)

To replace the clamp solenoid:

1. Disconnect the clamp solenoid harness from P1 on the logic board Remove the harness from all clamps holding it to the bonding head.
2. Using a 3/32" Allen wrench, loosen the solenoid lock nut. Push the solenoid to the right (viewed from the front).
3. Using a 7/32" Allen wrench, unscrew the clamp assembly and remove it from the solenoid. Remove the solenoid.
4. To install a new solenoid, perform the opposite actions in steps 3 and 2, respectively.

5 Reconnect the clamp solenoid harness.



1 Drag Force Adjustment
2 Force Measurement
3 Gap Adjustment
4 Force Adjustment

Figure 9-6: Clamp Solenoid and Wire Clamp - 4524D, 4524AD

9.6.1.2 Clamp Solenoid Replacement (4523D, 4524AD Standard Access)

To replace the clamp solenoid:

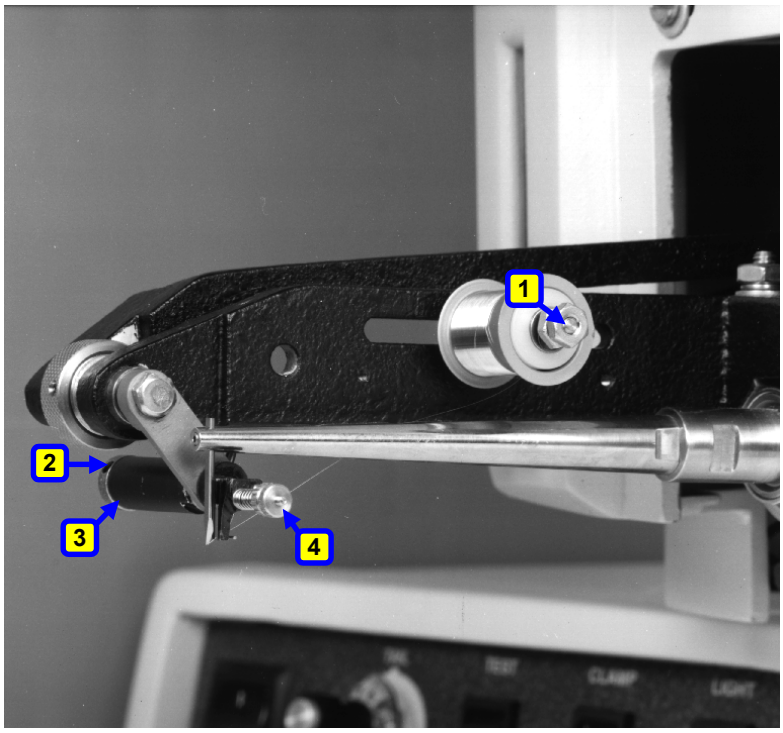
1 Disconnect the clamp solenoid harness from P1 on the logic board Remove the harness from all clamps holding it to the bonding head.

2 Using a 1/4" open wrench, unscrew the solenoid nut. Remove the clamp assembly.

3 Using 1/4" and 7/32" open wrenches, unscrew the solenoid from the clamp.

4 To install a new solenoid, perform the opposite actions in steps 3 and 2, respectively.

5 Reconnect the clamp solenoid harness.



1 Tension Adjustment
2 Gap Adjustment
3 Force Measurement
4 Force Adjustment

Figure 9-7: Clamp Solenoid and Wire Clamp - 4523D, 4523AD Standard Access

9.6.1.3 Clamp Solenoid Replacement (4523D, 4523AD Deep Access)

To replace the clamp solenoid:

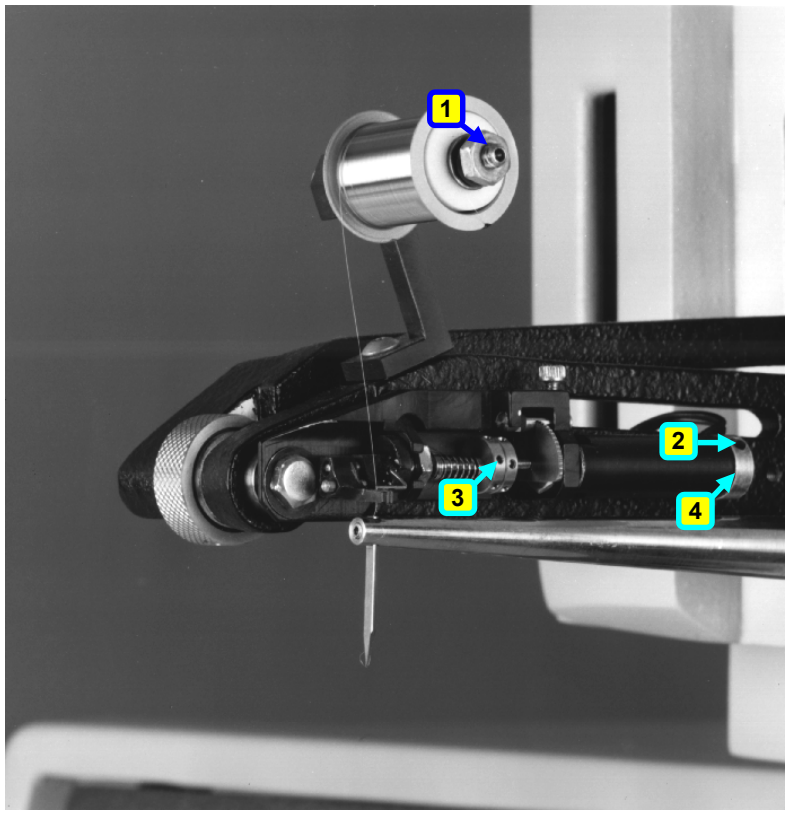
1 Disconnect the clamp solenoid harness from P1 on the logic board. Remove the harness from all clamps holding it to the bonding head.

2 Using a 1/4" open wrench, unscrew the solenoid nut. Remove the clamp assembly.

3 Using two 1/4" open wrenches, unscrew the solenoid from the clamp.

4 To install a new solenoid, perform the opposite actions in steps 3 and 2, respectively.

5 Reconnect the clamp solenoid harness.



1 Tension Adjustment
2 Gap Adjustment
3 Force Adjustment
4 Force Measurement

Figure 9-8: Clamp Solenoid and Wire Clamp - 4523D, 4523AD Deep Access

9.6.2 Clamp Solenoid Gap Adjustment

To adjust the clamp solenoid gap:

1 Power on the bonder and ensure that the first bond schedule number on the Display is highlighted.

2 Loosen the two set screws securing the solenoid plunger to the pin.

3 Press the right pin and insert a feeler gauge between the clamp jaws. Set the clamp gap to the recommended value (see the Recommended Machine Adjustments tables for each model bonder in Chapter 6).

4 Press the CLAMP control button. The green LED next to the button turns On, activating the clamp solenoid. Ensure that the solenoid plunger is pulled towards the solenoid body. Press the solenoid pin lightly so that it touches the clamp pin. Tighten the two set screws on the plunger. Remove the feeler gauge.

5 Press the CLAMP control button again. The green LED next to the button turns Off, deactivating the clamp solenoid.

6 Press the force gauge against the left end of the clamp solenoid pin and read the force required to open the clamp.

7 Turn the two clamp force adjustment nuts to adjust the clamping force (see Figure 9-6 and Figure 9-7). Set the clamping force to the recommended value (see the Recommended Machine Adjustments table for each model bonder in Chapter 6).

8 Test that the clamp opens and closes properly by pressing the CLAMP control button On and Off several times.

9 Turn the solenoid plunger at increments of 90° and check that the clamp opens at each position. If it does not, the plunger may not be parallel to the clamp solenoid face.

9.6.3 Clamp Lateral Position Adjustment (4523D, 4523AD)

The wire path must be a straight line from the transducer hole to the wedge feed hole. The wire clamp leads the wire from the wedge feed hole to the wedge foot. If the clamp and the wedge feed hole are not aligned along the same axis, the wire will not be centered under the foot of wedge. This results in bonding inconsistencies.

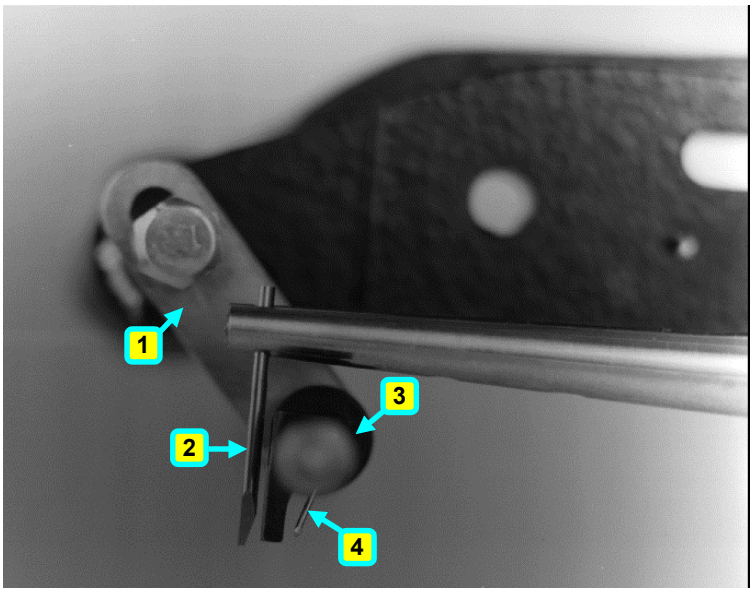
To adjust the clamp lateral position:

1 Feed the wire through the clamp jaws and the wedge feed hole. Focus the microscope on the tip of the wedge and check if the wire is in the center of the wedge. If it is, exit the procedure at this point.

2 Loosen the set screw that faces you (see Figure 9-9). Adjust the clamp's lateral position by turning the knurled adjusting nut so that the wire is centered under the wedge foot.

3 Perform a few bonds and check that the wire is still centered. If necessary, adjust the clamp's lateral position more.

4 Secure the knurled adjusting nut by tightening the set screw. Do not tighten too much as this may strip the set screw threads.



1 Link
2 Wedge
3 Clamp
4 Wire Guide

Figure 9-9: Wire Clamp Position Adjustment

9.7 Wire Tension Adjustment - 0.5" Spool Holder (4523D, 4523AD)

The wire tension depends directly on the friction of the spool holder bearings.

To increase the friction and the wire tension, tighten the two nuts against the spring washers. To decrease the friction and the wire tension, loosen the two nuts (see Figures 9-7 and 9-8).

9.8 Drag Clamp and Drag Solenoid Adjustment and Replacement (4524D, 4524AD)

The drag clamp places the ball against the capillary tip before the first bond, slightly stretching the wire just above the ball. If bonding devices have a considerable height difference between the two bonds (mainly in hybrid types), the resulting wire tension hardens the section just above the ball, improving the stability of the long loops.

9.8.1 Drag Clamp Gap Adjustment (4524, 4524AD)

To adjust the drag clamp gap:

1. Loosen the two set screws on the drag clamp solenoid tip.
2. Press the solenoid pin to the right until it is stopped by the solenoid body.
3. Place the solenoid jaws at the recommended drag clamp gap (see the Recommended Machine Adjustments tables for each model bonder in Chapter 6). Continue pressing the solenoid pin.
4. Shift the solenoid tip to the right until it is stopped by the right jaw leaf spring.
5. Tighten the set screws (see Figure 9-10).

9.8.2 Drag Clamp Force Adjustment (4524D, 4524AD)

To adjust the drag clamp force:

- Turn the drag clamp adjusting nut. Ensure that the force is sufficient (about 6 gm) to place the ball against the capillary tip.

Caution: Higher loops require greater force, but excessive force may break the wire just above the ball.

9.8.3 Drag Solenoid Replacement (4524D, 4524AD)

Replace the drag solenoid when it is shorted or disconnected. This condition is indicated by the diagnostic LEDs (see Table 11-1).

The resistance of the solenoid should be 209-215 Ω.

To replace the drag solenoid:

1 Disconnect the drag solenoid connector from P1 on the logic board. Remove the harness from all clamps holding it to the bonding head.

2 Unscrew the solenoid and remove it from its socket.

3 Unscrew the two screws securing the solenoid tip to the solenoid shaft. Remove the solenoid tip.

4 Mount the Teflon washer on the new solenoid shaft.

5 Insert the solenoid tip onto the shaft of the solenoid piston and tighten the two screws.

6 Insert the solenoid in its socket and screw it until the solenoid wall is stopped by the main head casting.

7 Insert the solenoid harness into the harness clamp. Tighten the screws to secure the harness clamp to the main head casting.

8 Connect the drag solenoid connector to the logic board.

9 Adjust the solenoid tip so that when the solenoid piston moves forward, the solenoid tip pushes the leaf spring. Ensure that the distance between the stationary plate and the mobile plate on the leaf spring is approx. 0.3 mm (0.012"). Tighten the screws.

9.9 Wand Adjustments and Replacement (4524D, 4524AD)

The N.E.F.O. consists of a power supply circuit board and a moveable wand actuated by a solenoid. The N.E.F.O. circuit charges the wand to high DC voltage. A signal from the logic board activates the N.E.F.O. solenoid, which pushes the wand towards the capillary. A spark passes between the wand and the wire, melting the end of the wire and forming a ball. The logic board then turns the N.E.F.O. solenoid off, and a return spring retracts the wand.

The wand can be adjusted for gap, Reset position and overtravel.

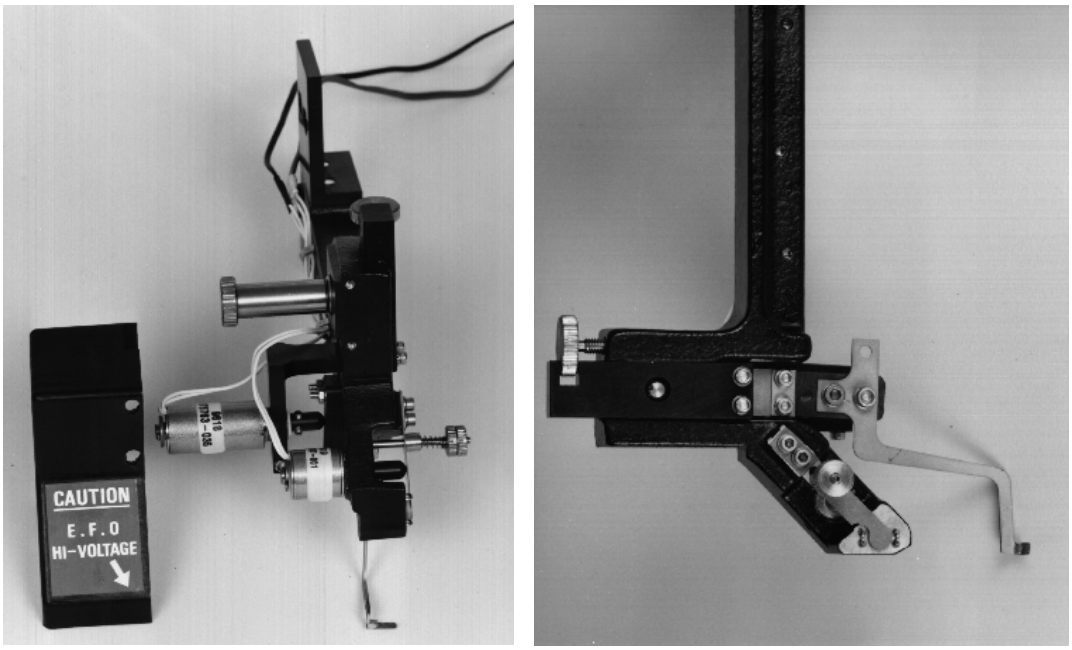


Figure 9-10: Electrode and Drag Assembly

9.9.1 Wand Gap Adjustment

To adjust the gap between the wand and the wire:

1. Power on the bonder and ensure that it is in the Reset position (first bond channel number highlighted on Digital Display).
2. Loosen the wand lock screw on the left of the wand slide.
3. Turn the top height adjustment screw so that the wand is located at the recommended distance under the capillary tip (see the Recommended Machine Adjustments tables for each model bonder in Chapter 6).
4. Tighten the lock screw.

Note: In general, the greater the wand gap, the smaller the ball. However, an oversized wand gap may cause inconsistencies in ball formation.

9.9.2 Wand Reset Position Adjustment

To adjust the wand reset position:

1. Loosen the N.E.F.O. solenoid clamping screw.
2. Turn the solenoid so that the wand tip is close to but does not touch the capillary during bonder operation.
3. Tighten the clamping screw.

9.9.3 Wand Overtravel Adjustment

To adjust the wand overtravel:

1. Loosen the N.E.F.O. solenoid tip two set screws.
2. Press the solenoid pin to the right until it is stopped by the solenoid body.
3. Continue pressing the solenoid pin. Tilt the wand manually to the right so that its tip reaches 1-1.5 mm (0.04"-0.06") beyond the capillary tip. Hold the wand in this position.
4. Move the plunger to the right until it is stopped by the wand insulator.
5. Tighten the tip set screws.

9.9.4 Wand Replacement

During operation, the wand gets coated with carbon deposits from sparking. Periodic cleaning (see section 12.5) helps prolong the life of the wand, but eventually, the wand erodes until it must be replaced.

To replace the wand:

1. Turn the bonder off.
2. Disconnect the high voltage cable by removing its securing screw.
3. Unscrew the two retaining screws and remove the old wand.
4. Insert the new wand. Adjust its position so that when the wand is under the capillary, the center of the capillary tip is aligned with the center of the wand.
5. Screw in the two retaining screws. Reconnect the high voltage cable and screw in its securing screw.

9.9.5 Solenoid Replacement

Replace the solenoid when it is shorted or disconnected. For normal operation, the resistance of the solenoid is approximately 44 Ω at 20°C.

To replace the solenoid:

1. Turn the bonder off.
2. Disconnect the N.E.F.O. solenoid assembly connector from P2 on the logic board.
3. Unscrew the harness clamp screws and remove the N.E.F.O. solenoid cable from the harness clamp.
4. Unscrew the solenoid clamping screw to enable rotation of the N.E.F.O. solenoid.

5 Turn the solenoid counter-clockwise and remove it from its bracket.

6 Unscrew the two retaining screws holding the solenoid tip and then remove the solenoid tip.

7 Install a Teflon washer on the piston shaft of the new solenoid. Position the solenoid tip so that when the piston moves forward, the distance between the internal end of the solenoid tip and the solenoid wall is approx. 1.5 mm (0.06"). Screw in the two retaining screws.

8 Turn the new N.E.F.O. solenoid clockwise in its bracket so that the solenoid tip touches the novotex insulator. The leaf spring functions as the backward movement agent of the solenoid piston.

9 Tighten the two retaining screws to secure the solenoid in place.

10 Insert the N.E.F.O. solenoid harness in the harness clamp. Tighten the harness clamp screws to attach the harness to the main head casting.

11 Connect the N.E.F.O. solenoid connector to P2 on the logic board.

9.10 Spool 90º Wire Feed System

9.10.1 Wire Spool Holder

The wire spool holder is mounted on a bracket on the microscope support. It has highly polished, closely-fitting interior surfaces that keep dust out and prevent the spool or wire from binding. The spool cover must always cover the spool, except during spool replacement. The wire is fed from the top of the spool, over the spool cap and down through a polished glass tube.

9.10.2 Fixed Tensioner

The fixed tensioner is mounted below the spool holder. It clamps the wire between a bottom metal grounding plate and an upper glass plate. Pressure on the glass is maintained by a white plastic clamping screw at the tip of a sensitive leaf spring. The curved edges of the glass plate face downward applying pressure on the wire, pulling it down from the spool.

Turning the clamping screw affects the pressure on the wire, and therefore, the height of the bonding loop. The metal plate functions as the ground between the wire and the bonder frame, completing the N.E.F.O. circuit.

9.10.3 Kicker

The kicker is a strip (tongue) hanging down from the main head top front. The kicker action is controlled by the kicker solenoid behind the top of the kicker arm.

The resistance of a normal kicker solenoid is approximately 160 Ω. Replace the kicker solenoid if it is disconnected internally or shorted.

Note: When replacing wire, clean all surfaces touching the wire thoroughly with lens cleaning paper.

9.10.4 Kicker Stroke Adjustment

The kicker supplies sufficient wire slack to make one loop. When the bonding head is at the second Search height, no slack wire remains.

The kicker action is crucial when the distance between the first and second bonds is medium to long. If your loops are too low, adjusting the kicker is usually the solution.

To adjust the kicker stroke:

1. Loosen the two set screws at the kicker solenoid tip.
2. Place the upper stop washer of the solenoid pin about 0.1 mm (0.004") from the solenoid body. Hold the stop washer in this position.
3. Ensure that the kicker pivot is in the released (rear) position. Drop the solenoid tip on the pin so that it is stopped by the kicker pivot base.
4. Tighten the set screws.
5. The kicker is now set for a maximum stroke. To decrease the stroke, release the nut and turn the screw clockwise.
6. Perform a few bonds and adjust the kicker stroke according to the loop height.

9.11 Base Assembly

The base assembly includes:

- The mechanism for maneuvering the workholder table. This assembly has the following interconnected subassemblies:
  - Manipulator assembly
  - Motorized Y table (4523AD)
  - Multi Mouse
- The control panels (see Chapter 4)
- Electronic circuit boards controlling the operation of the bonder (see Chapter 8)

9.11.1 The Manipulator Assembly

The manipulator assembly supports the workholder table on the manipulator body. The manipulator assembly supports the motorized Y table (4523AD, 4524AD).

The manipulator body is a four-sided plate which glides along three ball-bearing raceways (pads) in the base assembly. Four guide rods, passing between spring-loaded pairs of rollers, guide the manipulator in the X and Y axes. These rods form a cross under the manipulator body, extending from the edges of the X-Y boundaries.

9.11.2 The Motorized Y Table (4523AD, 4524AD)

The motorized Y table slides on two cross-roller ways which are preloaded to assure smooth motion. It is driven by a step motor and an anti-backlash lead screw mechanism.

The Y table has two limit switches (front and back) that reverse the direction of the table motion when the Y table reaches them. This is a safety precaution to prevent the Y table motor from burning out trying to drive the table beyond the table limit. During bonder initialization, a self-test checks the table contact with these two limit switches. Failure of a limit switch to cause motor reversal generates a Fault Code 09 indication on the diagnostic LEDs (see Table 11-1).

9.11.3 The Multi Mouse

The Multi Mouse, located on the right of the base, is the fine manipulation control. The Multi Mouse is linked to the manipulator assembly by the Multi Mouse rod through three spherical bearings: one each in the base, the manipulator body and the Multi Mouse case. Manual motion of the Multi Mouse is translated to the manipulator assembly by a 6:1 ratio.

The Multi Mouse also contains the **Semi/Auto Cycle** pushbutton for controlling the semi-automatic bonding cycle, the **MANUAL Z** sidebutton and the **STITCH** pushbutton.

9.11.4 Multi Mouse Assembly Removal

You have to remove the Multi Mouse assembly to access the inside of the base.

To remove the Multi Mouse assembly:

1. Slide the bonder forward (take care that it does not fall from the bench) to access its underside. From under the bonder, while holding the Multi Mouse rod with pliers, remove the Multi Mouse retaining screw.
2. Slide the bonder back on the bench and pull the Multi Mouse assembly out of the base bearing well.

3 When reinstalling the Multi Mouse, align the spherical bearing of the manipulator with the spherical bearing of the base from above. Insert the Multi Mouse rod into the base until the Multi Mouse rests on the surface of the base cover. Then slide the bonder forward and screw in the retaining screw from the bottom of the bonder.

9.11.5 Multi Mouse Disassembly

To service the internal parts of the Multi Mouse or to replace the Multi Mouse switches, you may have to disassemble the Multi Mouse.

To disassemble the Multi Mouse:

1 Remove the Multi Mouse cover by removing the two retaining screws.

2 Separate the cover from the Multi Mouse housing.

9.12 Manipulator and Motorized Y Table Maintenance

Maintenance of the manipulator and the motorized Y table generally includes:

- Cleaning the manipulator raceways
- Cleaning the motorized Y table (4523AD, 4524AD)
- Checking the ball bearings upon which the manipulator glides

9.12.1 Manipulator Maintenance

You may have to disassemble the manipulator before servicing or cleaning the bearings, or if the ball bearings upon which the manipulator glides have shifted from the pads.

To disassemble the manipulator:

1 Remove the Multi Mouse by removing the retaining screw holding the Multi Mouse rod to the lower spherical bearing.

2 Remove the workholder table by unscrewing the two retaining screws.

3 Remove the base cover by unscrewing the four retaining screws.

4 Disconnect the negator spring and ground cable from the manipulator. Remove the manipulator from its well in the base by pressing on the base levers and pulling up on the manipulator.

To clean the manipulator and visually inspect it:

1 Using a vacuum cleaner, remove all dust and bonding wire residues from the base interior.

2 Check for free rotation of all bearings and replace if faulty. Check the condition of the three ball bearings and clean the raceways with alcohol.

3 Remove the X-Y frame from the manipulator by pressing the manipulator levers against the spring. Check the condition of the manipulator bearings, the ball raceways and the X-Y frame rods.

To reassemble the manipulator:

1 Install the X-Y frame to the manipulator body in the Y-direction. Place the three ball bearings in the ball raceway and mount the X-direction rods of the X-Y frame between the spring loaded bearings and grooved rollers.

2 Press on top of the manipulator and check that it glides freely on all three ball bearings.

9.12.2 Disassembling the Y Drive Subassembly (4523AD, 4524AD)

The Y drive subassembly can be removed from the manipulator as a complete unit.

To disassemble the Y drive subassembly:

1 Turn the bonder off and remove the Multi Mouse and base cover.

2 Disconnect the Y motor harness from the stepper drive board. Release the harness from the cable clamp.

3 Remove the lead screw nut holder by unscrewing the screws. Manually move the motorized Y table until the two screws are seen through the two holes located on the top of the table holder. Unscrew the two screws and pull out the drive assembly.

When reassembling the Y drive, make sure that the lead screw is parallel to the slide. To do this, loosely screw in the screws and. Then, manually turn the lead screw until the table stops at the rear limit switch. Tighten the screws.

Caution: Do not lubricate the lead screw and the nut because this may increase the friction of the nut.

9.12.3 Preload Adjustment of the Motorized Y Table (4523AD, 4524AD)

To adjust the preload of the motorized Y table:

1 Disassemble the Y drive. Check the motion of the Y table. It should move freely without any side play. If the motion is normal, exit at this point.

2 From the left side of the top of the table holder, loosen, but do not remove the five screws.

3 Recheck the motion of the Y table. As you do this, tighten or loosen the five preload set screws until the table motion is correct. Then, tighten the five retaining screws. Reassemble the Y drive.

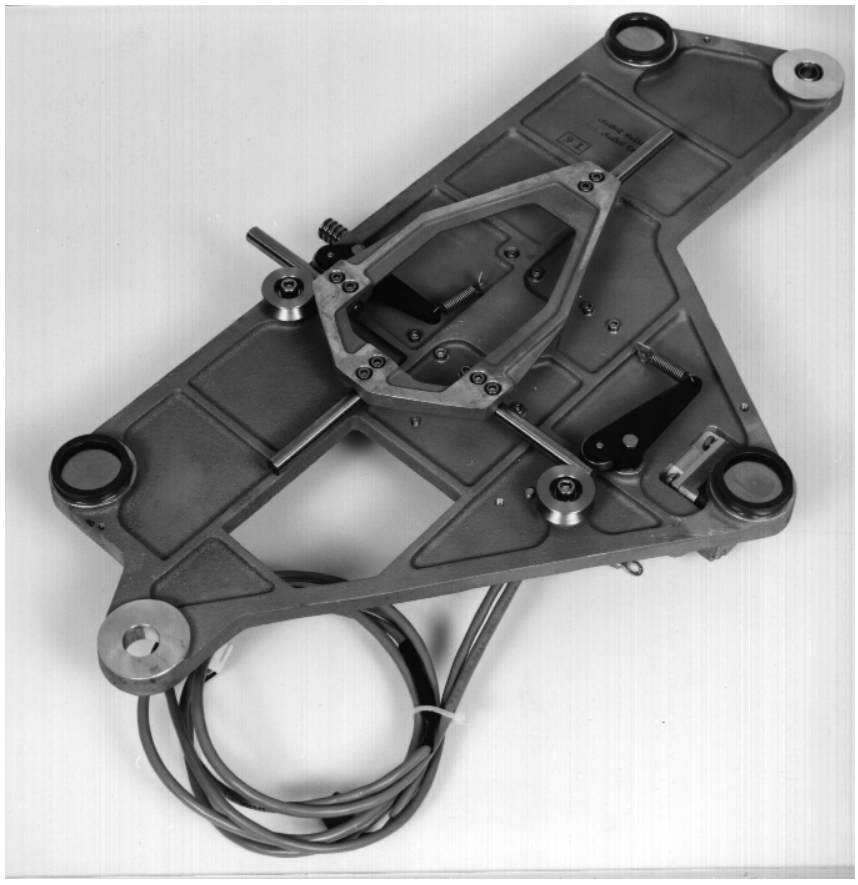


Figure 9-11: The Manipulator

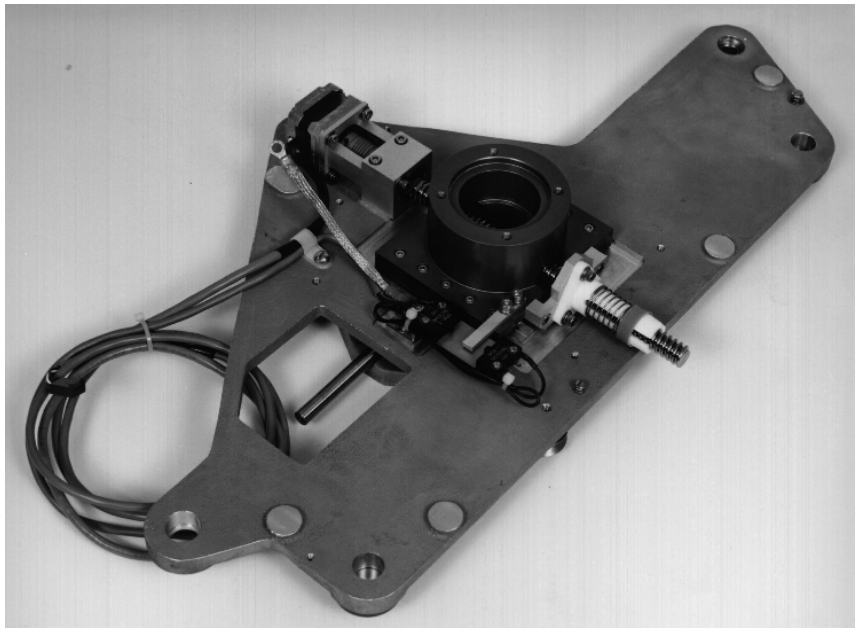


Figure 9-12: The Motorized Y Table

10. TIMING DIAGRAMS

To aid the technician in tracking the motion and operation of the K&S 4500 Digital Series Manual Wire Bonders, this chapter presents each machine's bonding cycle time and motion in graphical form.

This chapter includes the following timing diagrams:

- Model 4523D Semi Auto Bonding Cycle, section 10.1
- Model 4523D Manual Bonding Cycle, section 10.2
- Model 4523AD Semi Auto Bonding Cycle, section 10.3
- Model 4523AD Manual Bonding Cycle, section 10.4
- Model 4523AD Table Tear Bonding Cycle, section 10.5
- Model 4523AD Lange Coupler Bonding Cycle, section 10.6
- Model 4524D Semi Auto Bonding Cycle, section 10.7
- Model 4524D Manual Bonding Cycle, section 10.8
- Model 4524D Ball Bumping Cycle, section 10.9
- Model 4524D Single Point TAB Cycle, section 10.10
- Model 4524AD Semi Auto Bonding Cycle, section 10.11
- Model 4524AD Manual Bonding Cycle, section 10.12

10.1 Models 4523D Semi/Auto Bonding Cycle

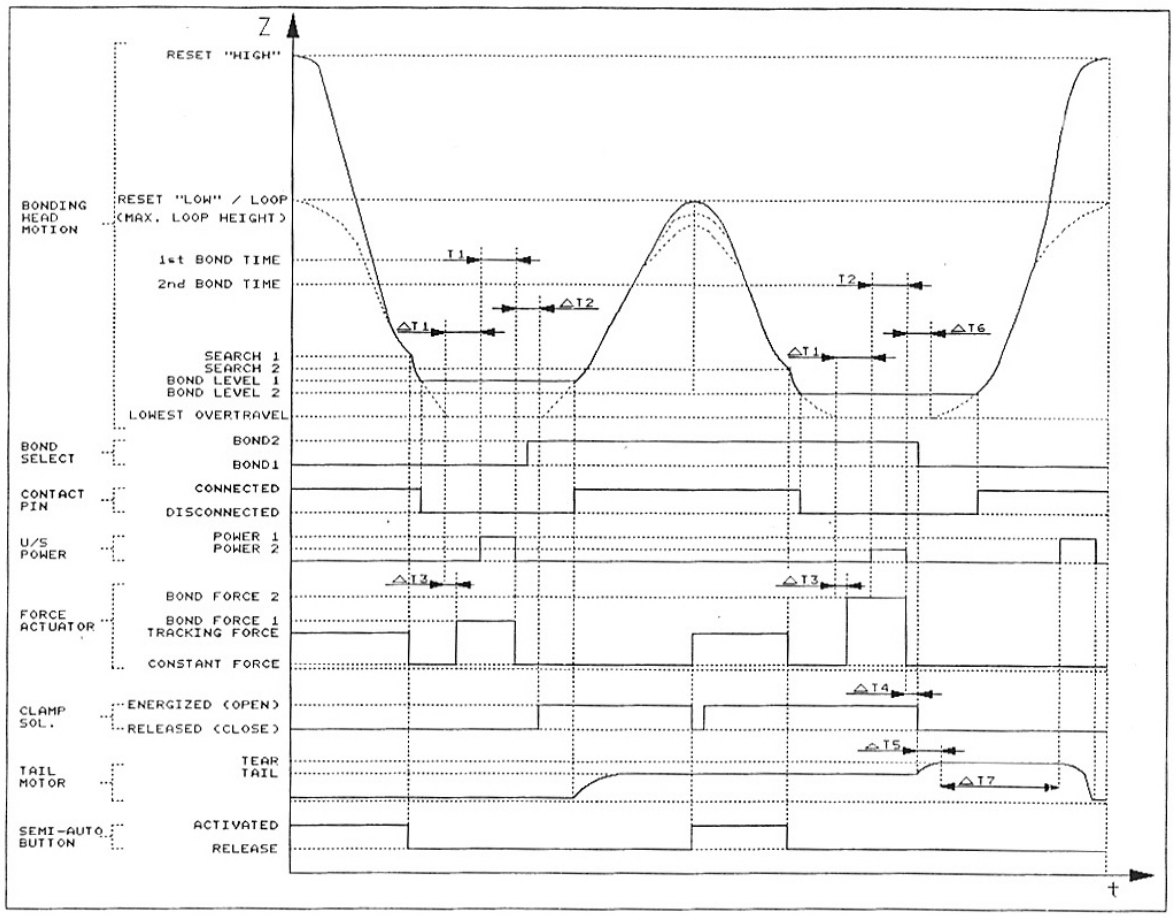


Figure 10-1: Models 4523D Semi/Auto Bonding Cycle

10.2 Models 4523D Manual Bonding Cycle

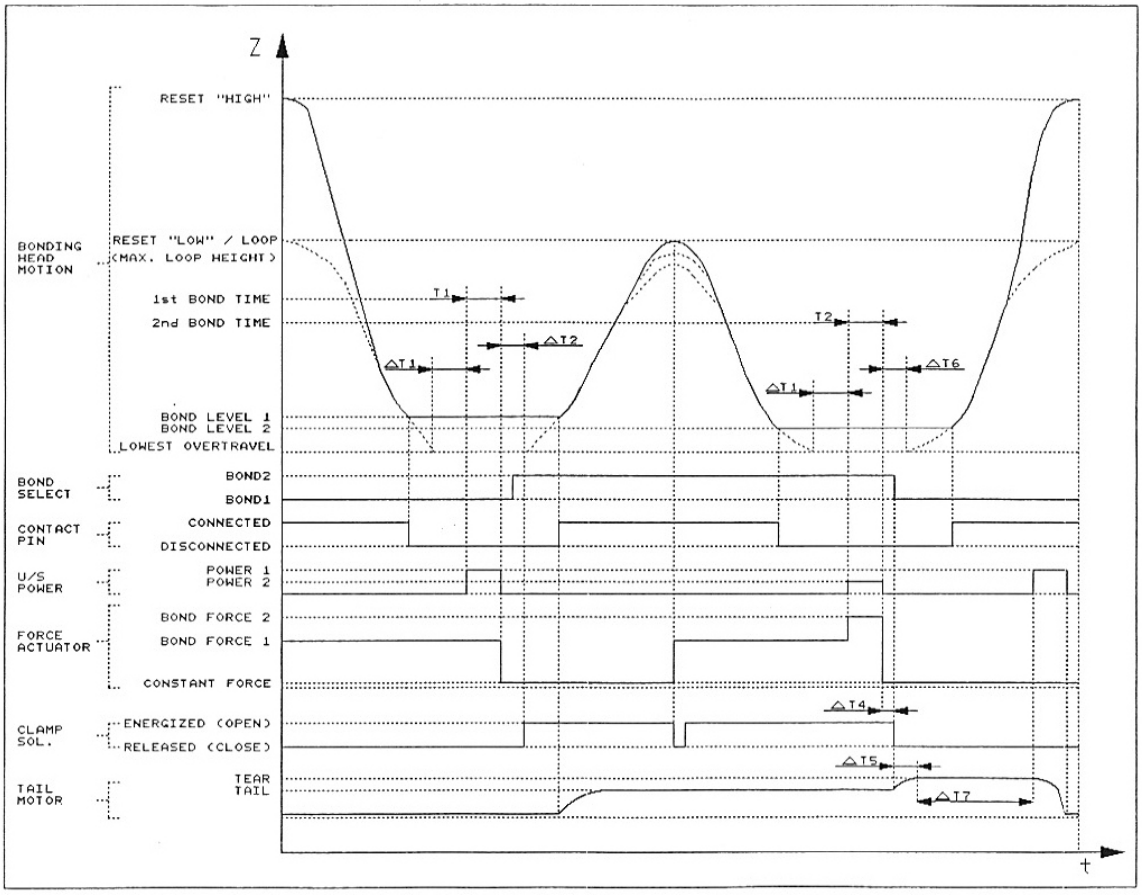


Figure 10-2: Models 4523D Manual Bonding Cycle

10.3 Model 4523AD Semi/Auto Bonding Cycle

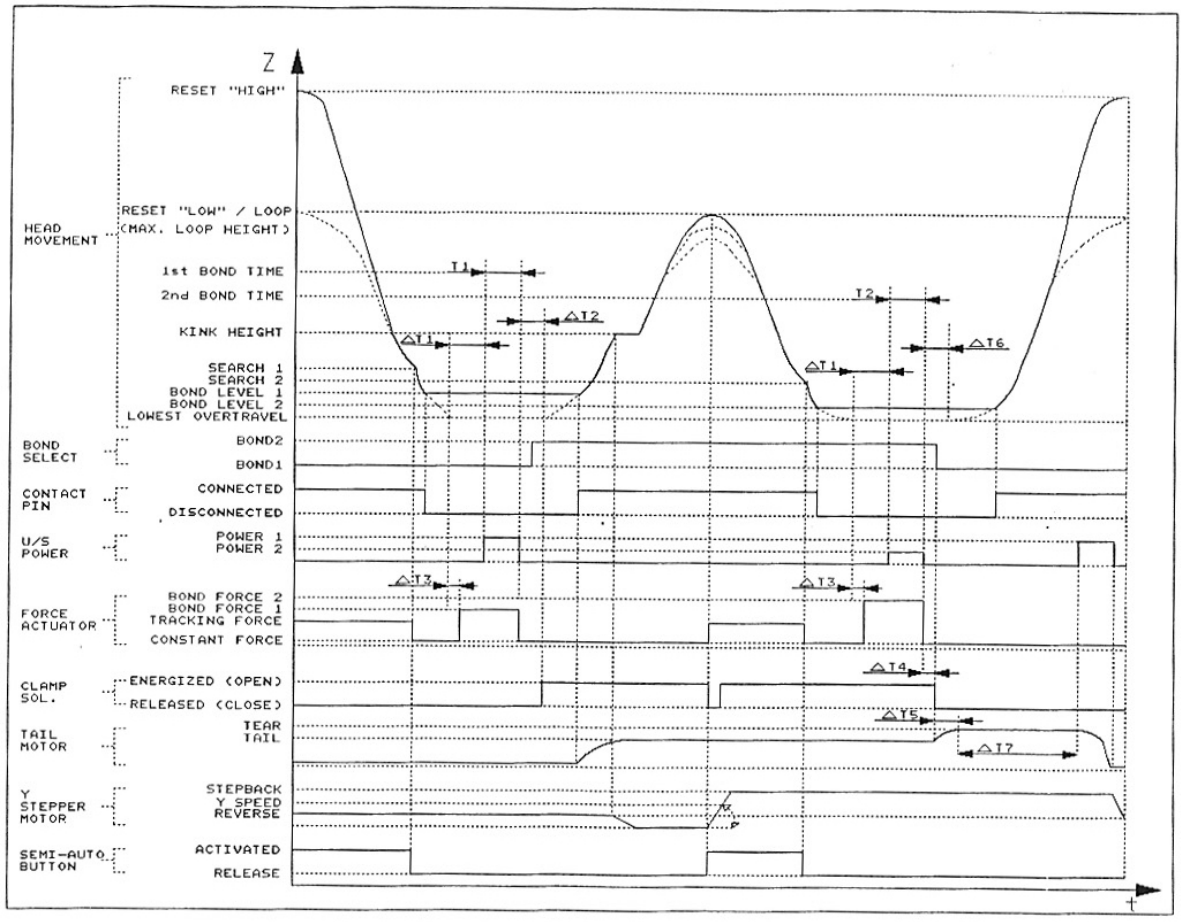


Figure 10-3: Model 4523AD Semi/Auto Bonding Cycle

10.4 Model 4523AD Manual Bonding Cycle

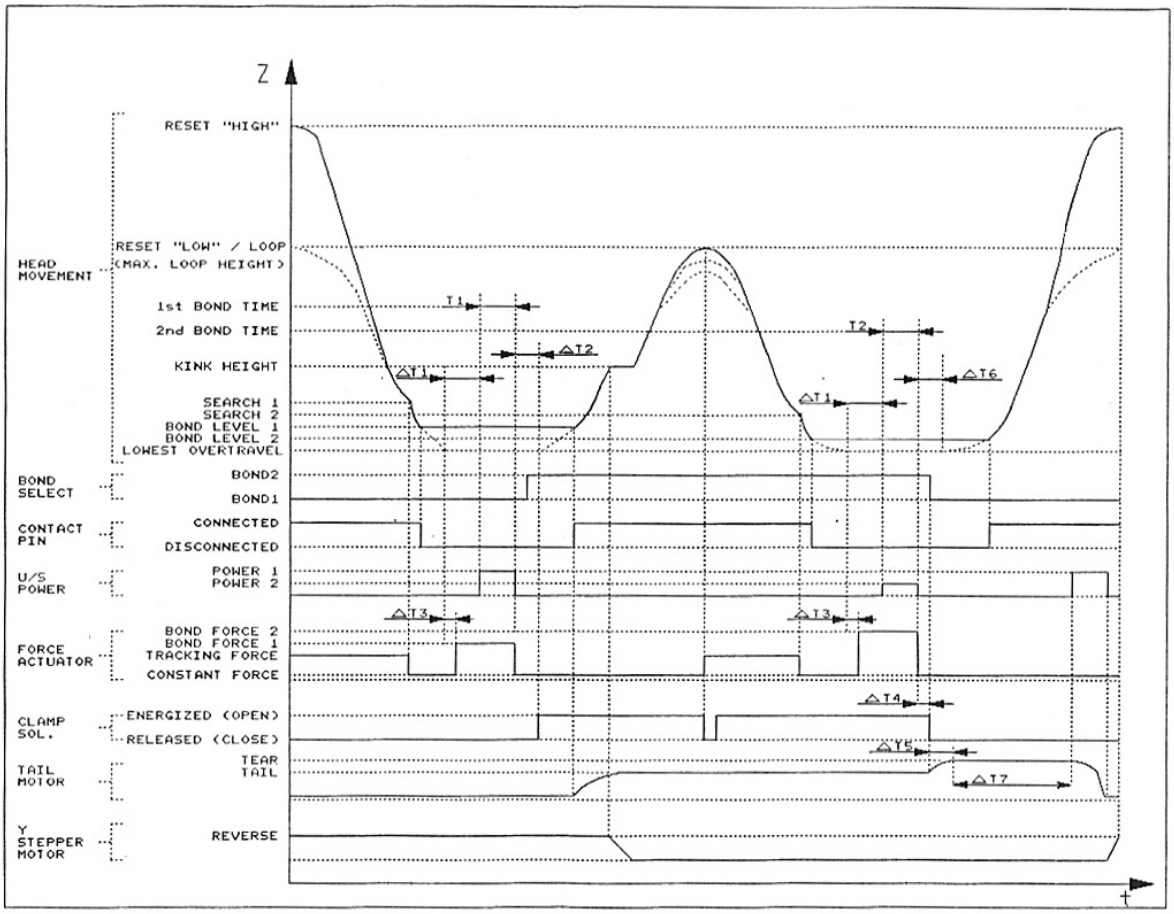


Figure 10-4: Model 4523AD Manual Bonding Cycle

10.5 Model 4523AD Table Tear Bonding Cycle

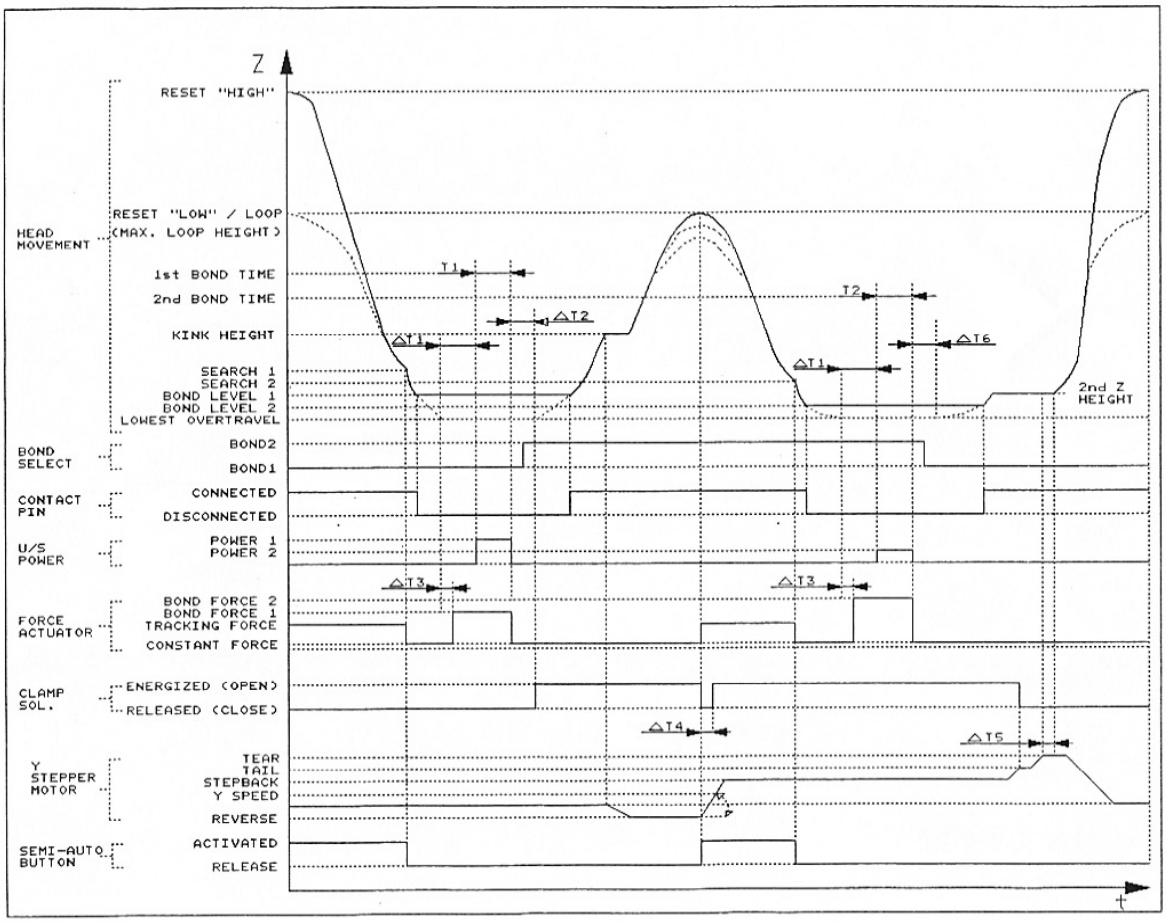


Figure 10-5: 4523AD Table Tear Bonding Cycle

10.6 Model 4523AD Lange Coupler Bonding Cycle

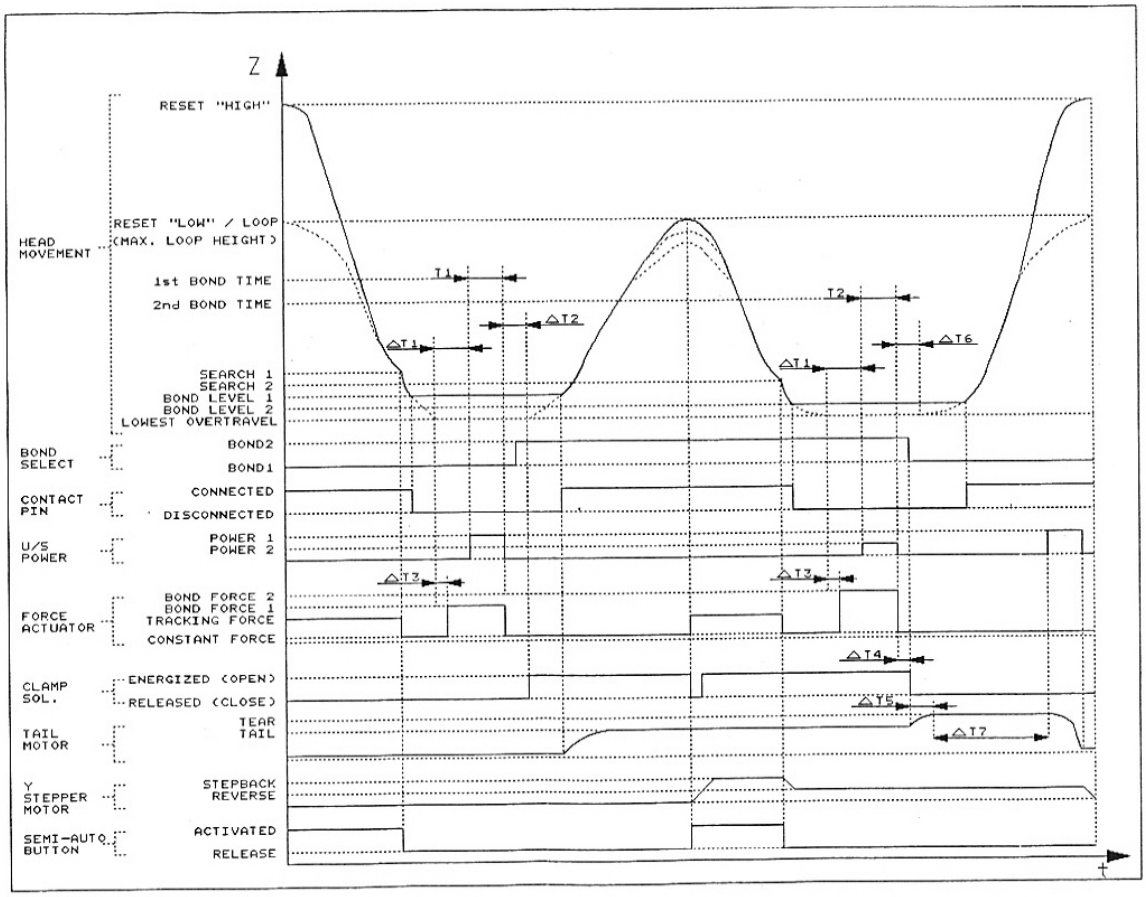


Figure 10-6: Model 4523AD Lang Coupler Bonding Cycle

10.7 Model 4524D Semi/Auto Bonding Cycle

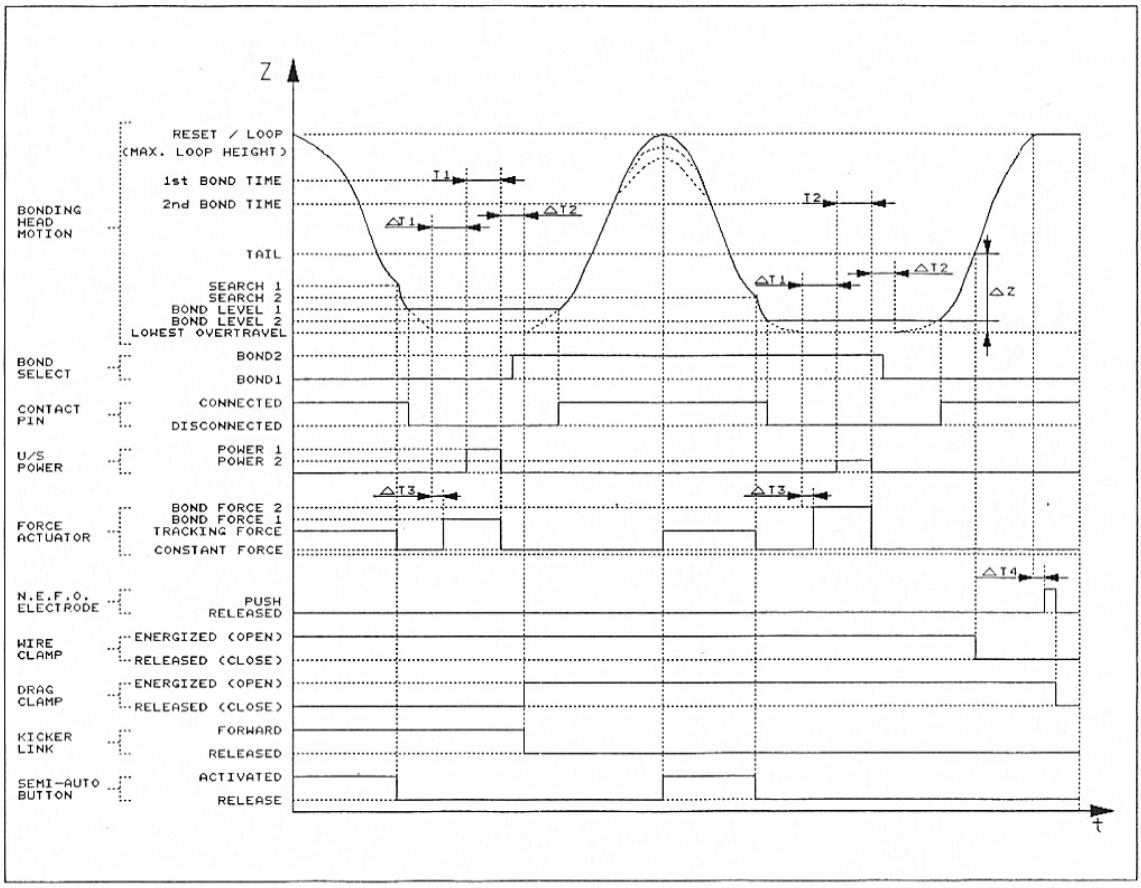


Figure 10-7: Model 4524D Semi/Auto Bonding Cycle

10.8 Model 4524D Manual Bonding Cycle

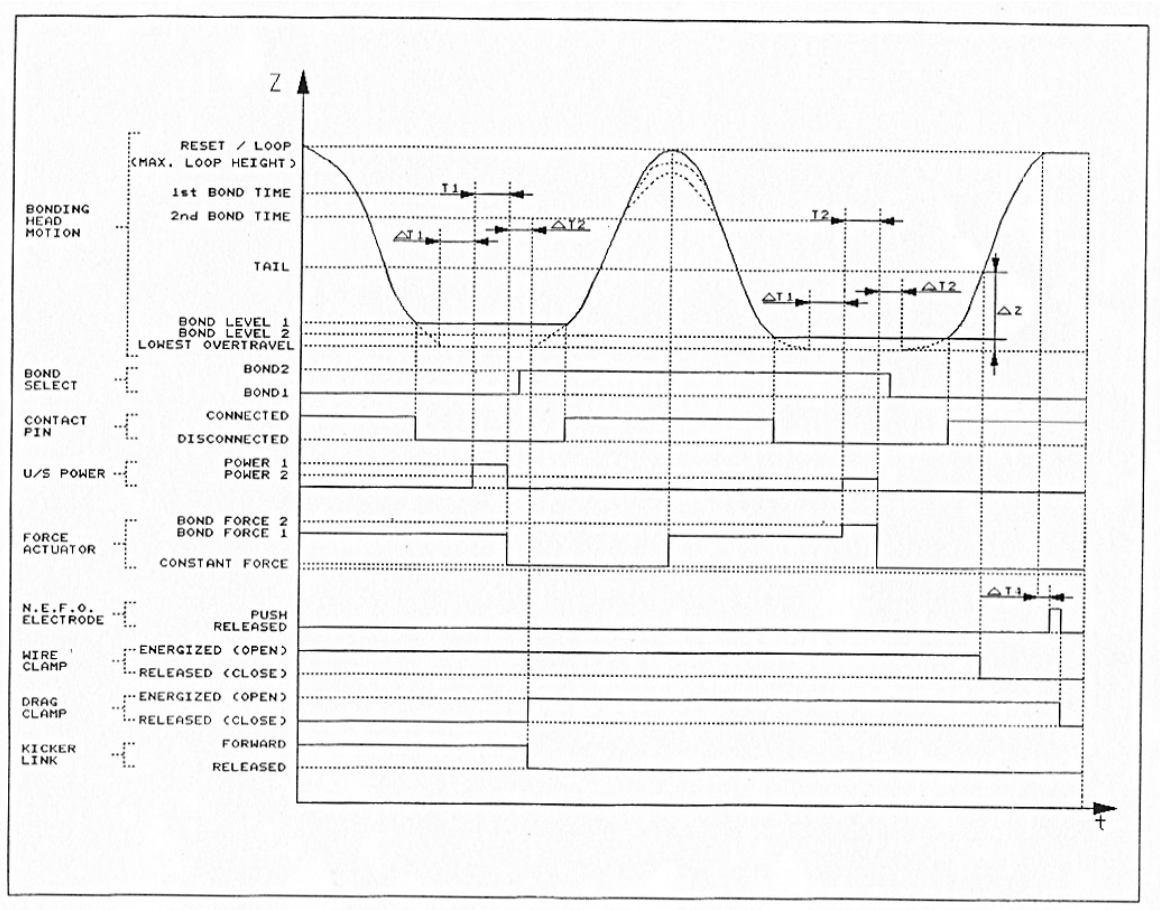


Figure 10-8: Model 4524D Manual Bonding Cycle

10.9 Model 4524D Ball Bumping Cycle

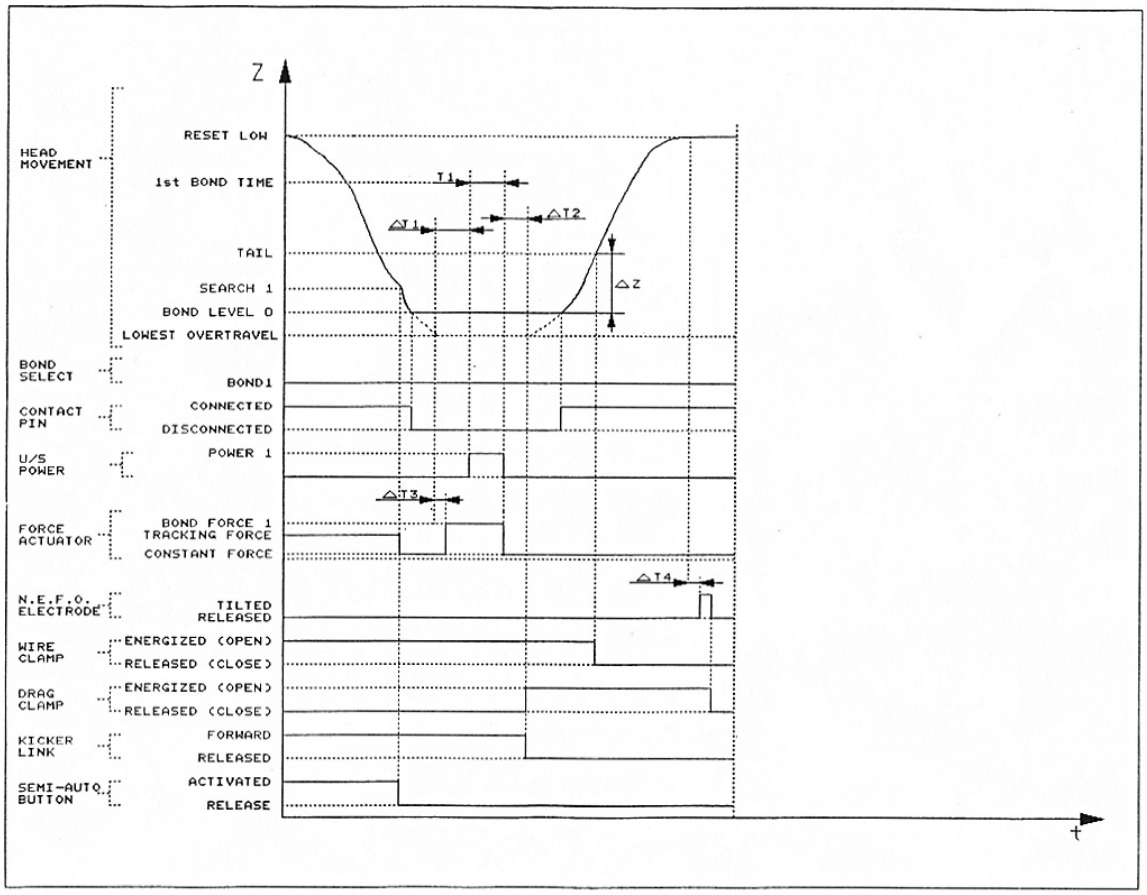


Figure 10-9: Model 4524D Ball Bumping Cycle

10.10 Model 4524D Single Point TAB Cycle

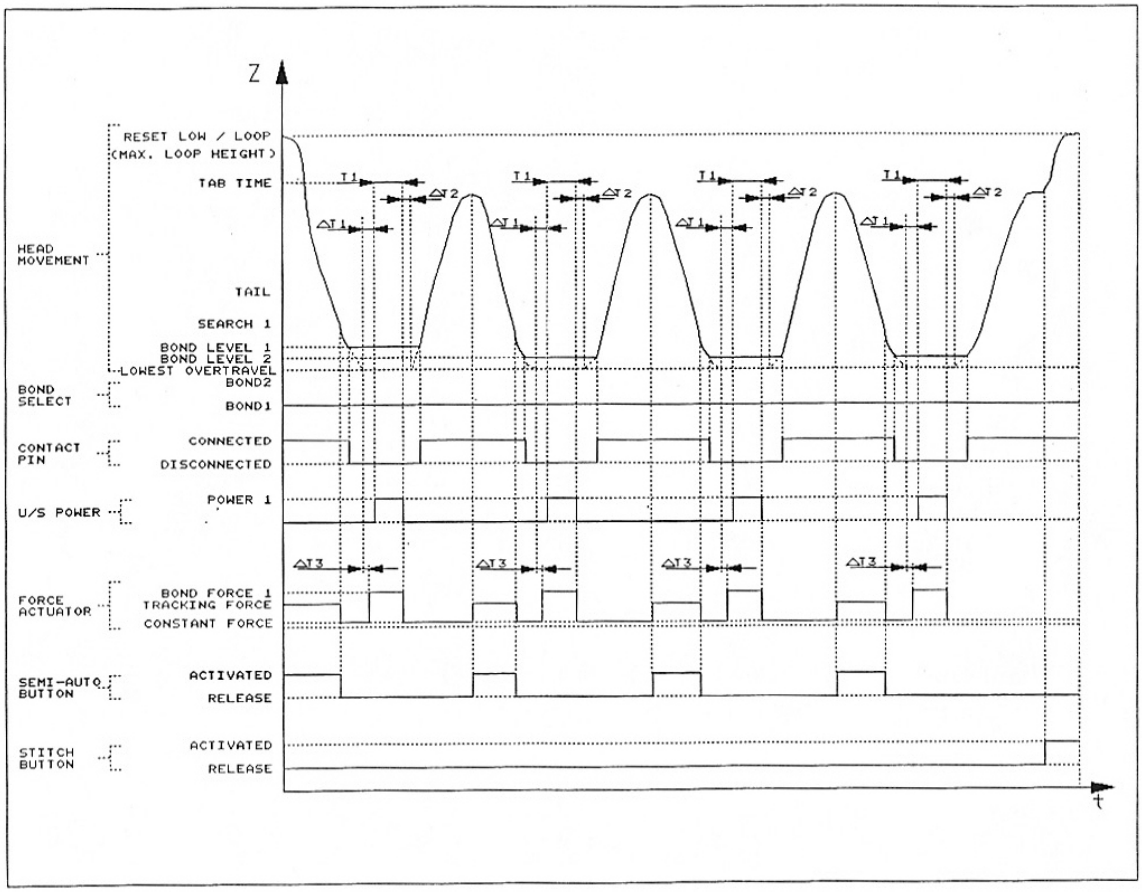


Figure 10-10: Model 4524D Single Point TAB Cycle

10.11 Model 4524AD Semi/Auto Bonding Cycle

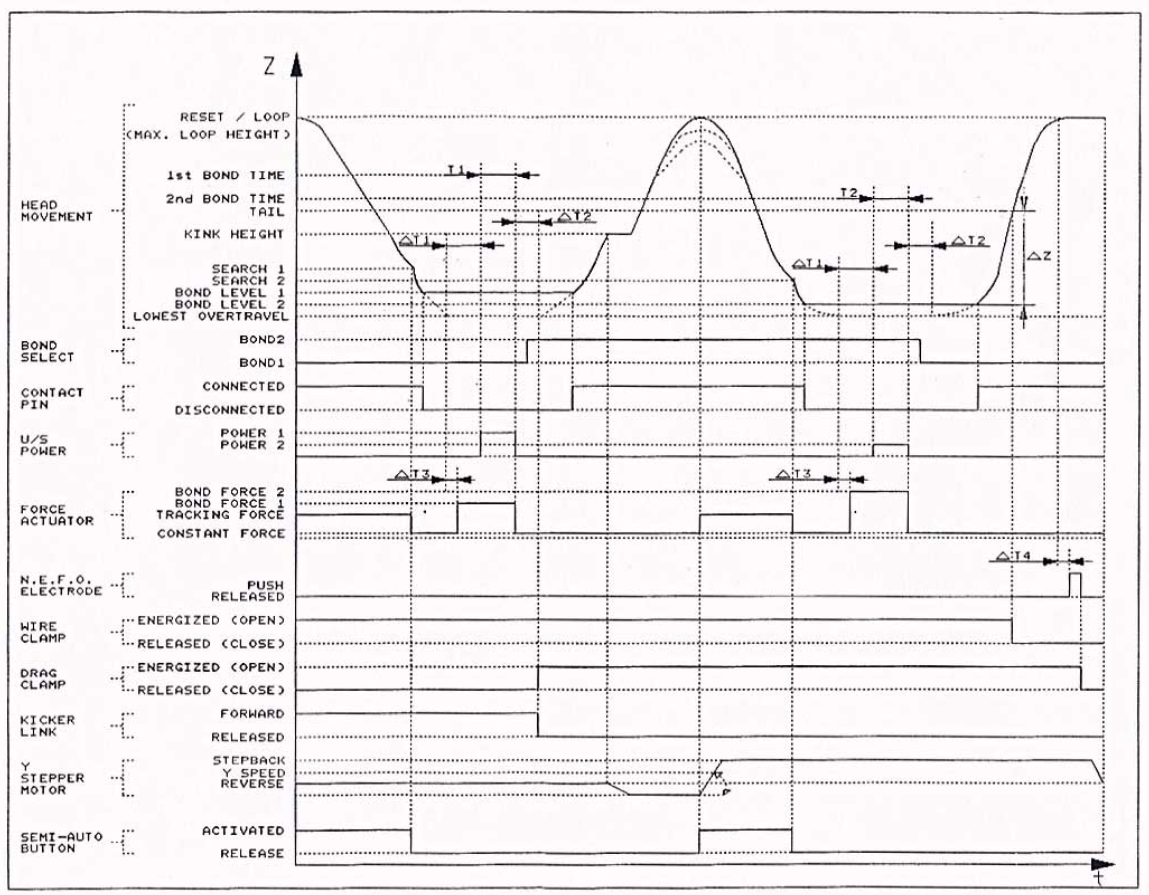


Figure 10-11: Model 4524AD Semi/Auto Bonding Cycle

10.12 Model 4524AD Manual Bonding Cycle

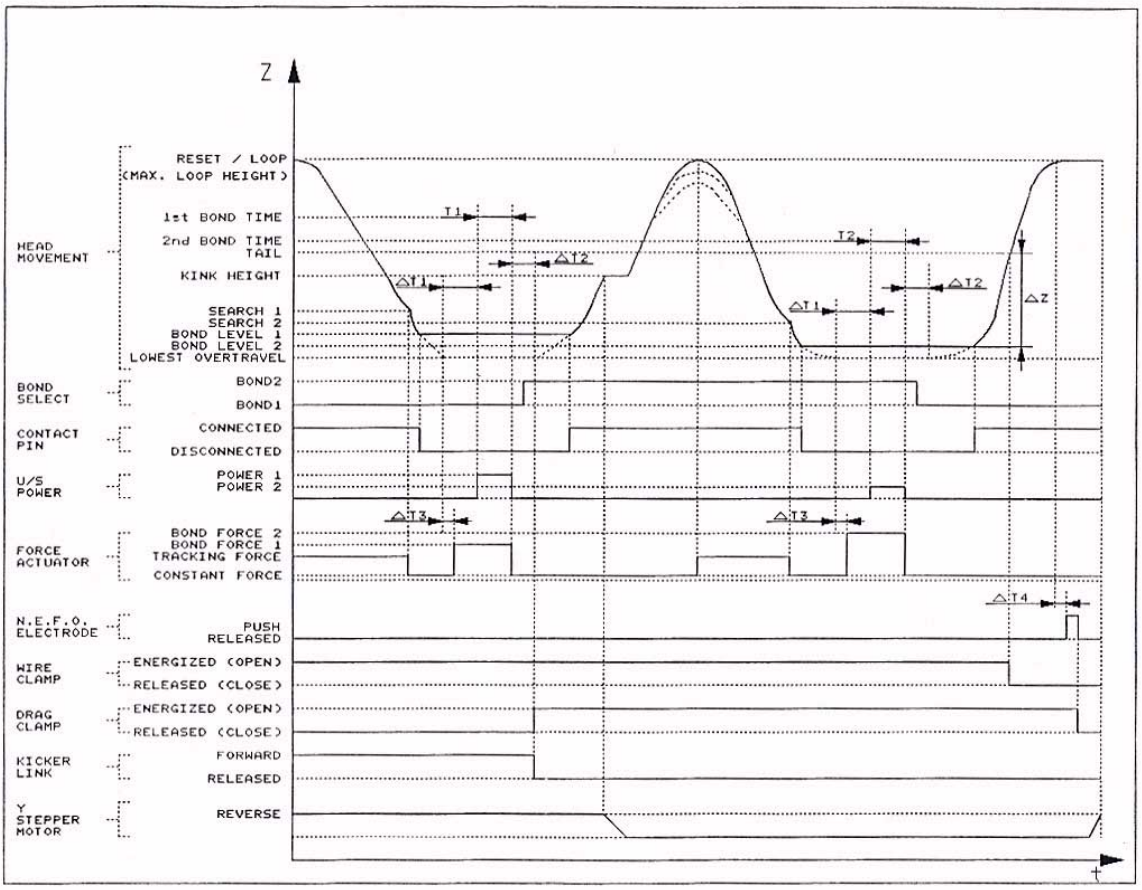


Figure 10-12: Model 4524AD Manual Bonding Cycle

11. DIAGNOSTICS

11.1 Diagnostic LEDs

When the K&S 4500 Digital Series Manual Wire Bonder is powered on, or reset, the bonder performs an automatic self-test. During this test, the bonder checks the ultrasonic transducer, force coil, motorized Y table limit switches, drag solenoid (only during the power-up routine), and the contact pin. The bonder indicates that the test is being run when the second bond channel number is highlighted on the Display. If the self-test is successful, the second bond channel number turns off and the first bond channel numbers is highlighted, indicating that the bonder is ready for operation.

If the bonder detects a fault, it turns on indicators DS1-DS4 (diagnostic LEDs) on the logic board. The diagnostic LEDs are visible through the rear cover of the base. Each fault has its own code which is represented by a combination of illuminated LEDs. If more than one fault is detected, the fault having the highest code number is displayed.

The diagnostic LEDs also indicate certain faults in the bonding cycle:

- If the bonding head fails to reach a Search height (i.e., Z motor fault), the first bond channel number blinks and the diagnostic LEDs indicate the fault code.
- If the bonding head hangs up at the Loop height for more than 3 minutes, or if the CLAMP control button is left on, the appropriate diagnostic LEDs turn on. A message will be displayed and a reset will be required.

After correcting the fault, resume normal bonder operations by pressing the RESET control button.

11.2 Diagnostic Codes

Table 11-1 lists the fault codes, the diagnostic LED combinations and the fault associated with the code.

Table 11-1: 4500 Digital Series Fault Codes

Code	DS4	DS3	DS2	DS1	Fault
01	0	0	0	x	Timeout at Loop height, or clamp left open for more than 3 minutes.
02	0	0	x	0	Open circuit in force actuator.
04	0	x	0	0	High impedance in the transducer, or disconnected transducer.
06	0	x	x	0	Contact signal not received, or fault in contact mechanism.
07	0	x	x	x	Open clamp solenoid circuit.
08 (4524D, 4524AD)	x	0	0	0	Open drag clamp circuit.
09 (4523AD)	x	0	0	x	Y table stuck at one of the limit switches.
10	x	0	x	0	No performance of 2nd bond received from external ultrasonic generator, if installed.
12	x	x	0	0	Z motor did not drive bonding head to Search height.
14	x	x	x	0	No starting Busy signal received from the external ultrasonic generator, if installed.

Legend:

x - LED blinks

0 - LED off

11.3 Corrective Action

Table 11-2 presents corrective action to be performed in response to the LEDs.

Table 11-2: Corrective Action

Code	DS4	DS3	DS2	DS1	Corrective Action
01	0	0	0	x	Press RESET control button.
02	0	0	x	0	Check if Force Coil is disconnected.
04	0	x	0	0	Check tool or replace Transducer.
06	0	x	x	0	Check Contact Pin, adjust as required.
07	0	x	x	x	Check Clamp Solenoid assembly.
08	x	0	0	0	Check Drag Solenoid assembly.
09	x	0	0	x	Move Y Table limit switch, or check limit switch harness.
10	x	0	x	0	Check External Generator connections.
12	x	x	0	0	Check Z Motor pulley belt, replace as necessary.
14	x	x	x	0	Check External Generator connections.

Note: The code number is for use by K&S technicians using the machine's diagnostic VT–100/2 terminal via the RS-232 communication port.

11.4 Auto Cycle Operation

The operating mode for Auto Cycle on each machine is described below.

11.4.1 For Models 4523D/4523AD

1 Press the RESET control button on the right panel and then release. Immediately afterwards, press the TEST control button on the right panel, the LED turns on and at the same time hold the STITCH pushbutton on the MultiMouse, until the locations are shown in the 1st BOND screen.

2 Release the STITCH pushbutton and TEST switch together. The LED turns off together.

This bonder machine is now on auto cycle.

11.4.2 For Models 4524/4524AD

1 Press and release the N.E.F.O. control button. The LED on the right panel turns on.

3 Press the RESET control button on the right panel and then release. Immediately afterwards, press the TEST control button on the right panel, the LED turns on and at the same time hold the STITCH pushbutton on the MultiMouse, until the locations are shown in 1st BOND Screen.

4 Release the STITCH pushbutton and TEST switch together. The LED turns off together.

The bonder machine is now on auto cycle.

12. PREVENTIVE MAINTENANCE

This chapter provides preventive maintenance procedures for various subassemblies of the K&S 4500 Digital Series Manual Wire Bonder.

Caution: Unless otherwise instructed, do not apply oil on any of the parts of the bonder. Oil attracts dust that can interfere with the proper functioning of the parts.

12.1 Preventive Maintenance Schedule

Table 12-1 provides the maintenance schedule for various subassemblies of the bonder. Adhering to this schedule maximizes the useful life of the machine and ensures trouble-free operation.

Table 12-1: Preventive Maintenance Schedule

Activity	Monthly	Quarterly	Annually
Clean bonding head contact pin and screw	x		
Clean wire and drag clamps	x		
Clean 2" spool holder and kicker	x		
Clean N.E.F.O. wand (4524D, 4524AD)	x		
Check force actuator coil		x	
Check Z motor drive belt tension		x	
Check bonding head movement and dashpot			x
Clean manipulator, base, and motorized Y table			x
Check cam follower bearing			x
Check height control link motion			x
Adjust 18 Vp-p			x
Adjust ultrasonic generator			x
Adjust temperature controller zero offset			x
Clean solenoids			x

12.2 Clean the Bonding Head Contact Pin and Screw

A dirty contact pin can cause serious deviations in the 2nd Z height.

Frequency: Monthly

Required tools and materials: Cotton swabs
Acetone

To clean the bonding head contact pin and screw:

1 Turn the machine off.

2 Using a cotton swab dipped in Acetone, thoroughly clean the contact pin.

3 Clean the height control screw thoroughly.

12.3 Clean the Wire Clamp and the Drag Clamp

The wire clamp and drag clamp assemblies must be clean because they are in constant contact with the wire.

Frequency: Monthly

Required tools and materials: Lens cleaning paper

To clean the wire clamp and the drag clamp:

1 Turn the machine off.

2 Pass the lens paper through the wire and drag clamps several times.

3 Feed a length of wire through the clamps and check that no residue or dirt remains.

12.4 Clean the Spool Holder and Kicker

All surfaces that touch the gold wire must be clean, especially the inside of the spool holder and the kicker.

Frequency: Monthly

Required tools and materials: Lens cleaning paper

To clean the spool holder and kicker:

1 Turn the machine off.

2 Using the lens paper, remove dust and oil from all surfaces touching the wire.

Note: Do not use a brush since hairs from the brush may remain on the surfaces.

12.5 Clean the N.E.F.O. Wand (4524D, 4524AD)

As a result of the sparking, carbon deposits and flecks of gold from the wire settle on the N.E.F.O. wand. After a time, this seriously reduces the ability of the wand to spark.

Frequency: Monthly

Required tools and materials: 320 mesh emery paper

To clean the N.E.F.O. wand:

1 Turn the machine off.

2 Gently wipe the tip of the N.E.F.O. wand with the emery paper.

3 Blow away any remaining particles.

12.6 Check the Force Actuator Coil Motion

Frequency: Quarterly

Required tools and materials: Air gun
Adhesive tape

To check the force actuator coil motion:

1 Power on the machine and verify that the LED next to the RESET HEIGHT control button is Off.

2 Set the SET UP/RESET switch to the SET UP position and set the FORCE dials to minimum force.

3 Push the coil downward and release it. If it returns to its original position, stop this procedure.

If the coil does not return to its original position, an impediment exists. Continue with Step 4 below.

4 Turn the machine off.

5 To verify that the coil is not stuck, remove the force actuator (see section 9.3.2) from the machine and check if the coil falls freely through the magnet's groove. Check this several times by turning the coil slightly each time and then dropping it through the magnet's groove.

If the coil does not fall through the magnet's groove, check for magnetic flakes in the groove. If flakes exist, remove them by passing a strip of sticky tape through the groove. If the material clogging the groove is non-magnetic dirt, clean it by blasting air from the air gun.

If the coil is bent, replace the coil (see section 9.3.3).

12.7 Check the Z Motor Drive Belt Tension

Frequency: Quarterly

To check the Z motor drive belt tension:

1 Power on the machine.

2 Run the machine through a few bonding cycles (by repeatedly pressing the Semi/Auto Cycle pushbutton). Check that the diagnostic LEDs do not indicate error code 12 (see Table 11-1).

3 If error code 12 appears, replace the Z motor drive belt.

12.8 Check the Bonding Head Movement and Dashpot

Frequency: Annually

To check the bonding head movement and the dashpot:

1 Turn the machine off and move the height control link towards you.

2 Lift the bonding head up to its maximum height and let it fall freely. Check that the movement is smooth.

If the bonding head descends smoothly, stop this procedure. Otherwise, continue with step 3 below.

3 Check the bonding head pivot bearings. If the bearing screw support is too tight, loosen it and recheck the movement of the bonding head. If the bearing is defective, contact a K&S representative.

If the bonding head pivot bearing is good, check the air dashpot, particularly the joint of the dashpot rod. Deflect the dashpot and verify that the dashpot rod drops off the frame. If it does not, replace the dashpot.

12.9 Clean the Manipulator, Base and Motorized Y Table

Frequency: Annually

Required tools and materials:
Vacuum cleaner
Lint-free cloth
Cotton swabs
Alcohol
Silicon grease
Thin lubrication oil

To clean the manipulator and the base:

1 Turn the machine off and unplug it from the AC wall outlet.

2 Remove the Multi Mouse from the base (see section 9.11.5).

3 Remove the workholder table from the base.

4 Remove the base cover and the manipulator.

5 Using the vacuum cleaner, clean out all dust particles and wire residue from the base, the manipulator and the Y table slide.

6 Using cotton swabs soaked in alcohol, clean all ball raceway pads thoroughly (three in the base and three on the manipulator). Clean the three ball bearings.

7 Using lint-free cloth and alcohol, clean the manipulator X-Y guide rods and all bearings. Check that the bearings move freely. If any bearings are defective, replace **all** bearings (so that they wear evenly).

8 Lubricate the cross roller slides of the motorized Y table with the thin lubrication oil.

9 Using a cotton swab, smear a thin layer of silicon grease on the Multi Mouse rod.

10 Reassemble the base. Ensure that the manipulator rests on all three ball bearings.

12.10 Check the Cam Follower Bearing

Frequency: Annually

Required tools and materials: Allen and open wrenches
Loctite 222

To check the cam follower bearing:

1 Turn the machine off.

2 Release the rear edge of the height control link return spring from the pin.

3 Rotate the cam follower bearing with your finger. The bearing should rotate freely.

4 Readjust the mounting screw of the bearing if rotation is not free. Tightening the screw increases the friction on the bearing. Using Loctite 222, secure the screw, ensuring that no Loctite gets into the bearing.

12.11 Check the Height Control Link Motion

Frequency: Annually

To check the height control link motion:

1 Turn the machine off.

2 Disconnect the height control link return spring and check that the link pivots are free.

3 If the link pivots are not free, check for friction in the motion of the LVDT core pin. Using the push rod, adjust alignment of the LVDT core pin and the LVDT housing so that a smooth motion is obtained.

4 Check the height control link bearings for smooth motion. If the motion is not smooth, adjust the spring loading of the bearings by tightening or releasing the nuts, or replace the bearings.

5 Push the height control link to the left and check that it pushes the spring wave washers in. If it does not, loosen the nuts of the height control link.

6 If the LVDT was adjusted or released, push the rod and readjust the Reset position and verticality (see section 9.4).

12.12 Adjust 18 Vp-p

To adjust the 18 Vp-p, see section 8.3.2.1.

Frequency: Annually

Required tools and materials: Oscilloscope (or DVM)
Small screwdriver
Regular screwdriver

12.13 Adjust Ultrasonic Generator

To check ultrasonic free running frequency and power, see section 8.3.3.2.

Frequency: Annually

Required tools and materials: Digital frequency counter
Oscilloscope
Small flathead screwdriver

12.14 Adjust Temperature Controller Zero Offset

Use this procedure to check the accuracy of the temperature controller.

Frequency: Annually

Required tools and materials: Digital thermometer
Small flathead screwdriver

To adjust the temperature controller zero offset:

1 Power on the temperature controller and ensure that the workholder is plugged into the workholder connectors panel.

2 Set the temperature controller to the working temperature. Wait 20 minutes for the workholder temperature to stabilize.

3 Using an external thermometer, measure the actual workholder surface temperature. If there is a deviation from the set temperature (set point 1), proceed to the next step. Otherwise, stop this procedure.

4 Press the SET pushbutton of the temperature controller for more than 4 seconds and release.

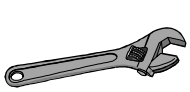
5 Immediately press the UP or DOWN pushbutton until the CAL parameter appears in the display. Press the SET pushbutton and the UP (or DOWN) pushbutton simultaneously to reduce the difference between the external thermometer reading and the T.C. display reading.

12.15 Clean Solenoids

Over a period of time, grime forms on the solenoid pistons and within the solenoids. This can weaken the magnetic power.

Frequency: Annually

Required tools and materials: Lint-free cloth
Cotton swab
Gentle cleaning solvent



To clean the solenoids:

1 Remove each solenoid (see section 9.6).

2 Remove the pistons from the solenoids. Using a cloth dipped in the cleaning solvent, wipe the pistons and the outside of each solenoid.

3 Using a cotton swab dipped in the cleaning solvent, clean the inside of each solenoid.

4 Reinstall the solenoids (see section 9.6).

13. TROUBLESHOOTING

This chapter contains the procedures for troubleshooting the K&S 4500 Digital Series Manual Wire Bonders.

Caution: When you troubleshoot the bonder, do not attempt any repair work beyond the scope of this chapter and in Chapters 8 and 9. If conditions not described in this manual arise or the problem persists after performing the remedy, please contact a K&S representative.

Performing unauthorized maintenance may cause serious damage to the bonder.

Caution: Never disconnect any connector from the logic board while power is applied to the bonder. This can damage the internal circuits of the logic board.

The troubleshooting steps are arranged in a sequence that begins with the simpler remedy leading to more complex remedies. If a remedy solves the problem, stop the procedure.

13.1 General Operational Troubleshooting

Table 13-1: General Troubleshooting

Symptom	Remedy
Bonder does not receive power.	1. Check if the power cable is connected to the AC wall outlet and that AC power is available. 2. Check fuse F2 on the rear of the base. Replace it if necessary.
Workholder does not heat up (if using heated workholder).	1. Check fuse F1 on the rear of the bonder. Replace it if necessary. 2. Check if "EEE" appears in the temperature controller display. If it does, replace the workholder harness. 3. Unplug the power connector from the workholder connectors panel, and leave the temperature controller plug connected. While LED1 blinks, check if power is present in the power connector of the workholder connectors panel. If power is present, replace the workholder harness. 4. Check if the control signal is supplied to the solid state relay. If it is, replace the solid state relay. If the control signal is not supplied, replace the temperature controller.
Area light does not light.	1. Check bulb. If burned out, replace it. 2. Check connection of light to Ball/Wedge Interface Board (P6). If faulty, correct it. 3. Check connection between Ball/Wedge Interface Board (P6) and motherboard (J4). 4. Check fuse F1 on the motherboard. Replace it if necessary.

Table 13-1: General Troubleshooting	
Symptom	**Remedy**
Spotlight does not light.	1. Check bulb. If burned out, replace it. 2. Check connection of light to motherboard (J5). If faulty, correct it. 3. Check fuse F2 on the motherboard. Replace it if necessary.
The bonder does not proceed properly through the bonding cycle, or performs improper bonding.	Check fuses F3 and F4 on the motherboard. Replace it if necessary.
	**Note:** Although the bonder still operates if only one of the fuses is burnt, replace the fuse. Otherwise, problems may occur with the software and ultrasonic energy.
N.E.F.O. wand does not fire.	1. Check if the N.E.F.O. Off LED is On. 2. Check if the power supply voltage is correct (48 V, ±12 V). 3. Check the wiring of signal, power supplies and high voltage.
Self-test is not performed at startup or reset (1st and 2nd indicators do not turn on after startup or reset).	1. Check fuses F3 and F4 on the motherboard. Replace them if necessary. 2. Check if jumper W6 is set correctly. If not, connect it correctly (see section 8.1.3.12). 3. Check for 5 Vdc at P4 on the Ball/Wedge Interface Board. If it is not present, replace the board. 4. Check for +5 V dc at U4/3 and +27 V dc at P12/7 on the logic board. If these voltages are not present, replace the logic board.

Table 13-1: General Troubleshooting	
Symptom	**Remedy**
Z motor does not operate properly through the bonding cycle, or does not operate at all.	1. Check if the CLAMP OPEN LED is ON by pressing and releasing the clamp OPEN control button. 2. Check the drive belt of the motor. If defective or slipping, replace it. 3. Check the **Semi Auto Pushbutton**. If defective, replace it. 4. Check if jumpers W5, W6 and W7 on the logic board are set properly. If not, correct the jumper configuration.
Z motor does not operate properly through the bonding cycle, or does not operate at all (cont.).	5. Check for ±15 V dc on the logic board (+15 V dc at U2/3 and -15 V dc at U3/3). If not present, replace the logic board.
Y table does not move (4523AD, 4524AD).	1. Check fuses F3, F4 and F5 on the motherboard. 2. Check if +15 V and +30 V are present in the motherboard. 3. Check connections to the stepper drive board.
No response when Semi Auto Cycle Pushbutton is pressed.	1. Check if the **Semi Auto Pushbutton** is stuck. If it is, unstick it. 2. Replace the **Semi Auto Pushbutton** (see section 9.11.4).
Manual Z mode is faulty (bonding head does not respond properly).	Disconnect the Manual Z potentiometer harness from the logic board (P25). Push the Manual Z button and check for a change in resistance between pins 1 and 2 on the cable connector by using an ohmmeter. If there is no change, replace the Multi Mouse.

Table 13-1: General Troubleshooting	
Symptom	**Remedy**
Z motor rotates uncontrollably.	1. Turn the bonder off and then power on. 2. Check for +15 V dc at U2/3 and -15 V dc at U3/3 on the logic board. If these voltages are not present, replace the logic board. 3. Check for 18 Vp-p (or 6.37 Vrms) at TP4 on the logic board. If 18 Vp-p is not correct, adjust RV1. If it is not present, replace the logic board. 4. Check for 0 V dc (if bonding head is in the Reset position) or +2.5 V dc (if bonding head is in the Overtravel position) at U17/7 on the logic board. If these voltages are not present, replace the logic board. 5. Check whether the drive belt is slipping. If it is, replace it. 6. Check whether the height control link is stuck. If it is, release it. 7. Check whether the bonding head is obstructed. • Check if the height control link correctly tracks the cam movement. • Check if the LVDT is damaged. • Check if the LVDT wiring is intact and in good condition. If not, replace it. • Check that the gap between the wire guide of the clamp and the drag assignment is 3-4mm.

13.2 Bonding Process

Faults that appear during bonder operation may be complicated by several factors during each stage of the bonding process. To help you troubleshoot bonding process faults, the following table is arranged not only by fault, but by suggested possible causes within the fault. To use the table effectively, visually inspect the bonder to determine the most likely cause. Then, perform the remedies for that cause.

In all cases, first check the diagnostic LEDs for an error code.

Table 13-2: Bonding Process Diagnostics

Symptom	Possible Cause	Remedy
U/S indicator does not turn on when TEST control button is pressed.	Faulty transducer.	Check diagnostic LEDs for error code 04. If this code appears, replace the transducer.
	Wedge/capillary is improperly installed.	Check if the wedge/capillary is installed according to the setup gauge. If not, adjust the wedge/capillary properly (see sections 5.1.1 and 5.1.2).
U/S indicator does not turn on when TEST control button is pressed.	Capillary is clamped too loose or tight in the transducer (4524D, 4524AD).	1. Tighten (or loosen) the clamping torque. 2. Replace capillary lock screw if it is worn out.
	Wedge/capillary is damaged or broken.	Replace wedge/capillary (see sections 5.1.1 and 5.1.2).
	Transducer does not receive enough power.	Check the ultrasonic free running frequency and power. Adjust as described in section 8.3.2.1.
	Transducer is not properly clamped in the bonding head.	Check that the clamping torque of the transducer U-bolt nuts is 7 kg/cm. If not, adjust the torque.

Table 13-2: Bonding Process Diagnostics

Symptom	Possible Cause	Remedy
U/S indicator does not turn on when TEST control button is pressed (cont.).	The CLAMP OPEN LED is ON.	Set the CLAMP OPEN LED to OFF by pressing and releasing the CLAMP OPEN control button.
Bonds do not hold or are not consistent.	Bonding parameters are incorrect.	Change the bonding parameters one at a time to obtain the proper settings.
	Search height is too high.	Check if the Search height is 0.127 mm (0.005") above the bonding surface. If not, reset the Search height or the workholder height.
	Bonding surface is dirty, the device is not installed correctly, or the wire is faulty.	1. Check if the surface of the device is dirty. If it is, clean the surface. 2. Check if the device lies flat on the workholder and is properly clamped. If not, adjust the device.
	Wedge/capillary is not set correctly, or is defective.	1. Check if the wedge/capillary has been installed properly. If not, reinstall the wedge/capillary using the setup gauge (see sections 5.1.1 or 5.1.2). 2. Replace the wedge/capillary.
	Poor metalization (4523D, 4523AD).	Try using another device.
	Wedge is clogged or broken.	Check wedge. Clean if clogged. Replace if broken.

Table 13-2: Bonding Process Diagnostics		
Symptom	**Possible Cause**	**Remedy**
Bonds do not hold or are not consistent (cont.).	Force actuator coil is stuck.	Check if the force actuator coil does not stick. If it does, clean or replace it, as needed.
	Wire is too old.	If the wire is over 6 months old, replace it.
	U/S transducer is out of order.	Press RESET control button. Check diagnostic LEDs for error code 04 (see Table 11.1). If the code appears, replace the transducer.
	Wire clamp does not open, so wire cannot be pulled from the spool.	1. Reduce the clamping force (see section 9.6). 2. Check clamp solenoid. Replace if faulty.
	Bonding head movement is improper.	1. Check that no cables interfere with the movement. 2. Check that the counterweights provide the proper static force (see section 9.2.3). 3. Check that the force actuator coil does not stick. If it does, clean or replace it (see section 9.3.3).
	Workholder does not heat properly.	1. Check that the workholder temperature is set correctly, and that it matches the set temperature. 2. Adjust temperature controller offset (see section 12.14).

Table 13-2: Bonding Process Diagnostics

Symptom	Possible Cause	Remedy
Bonds do not hold or are not consistent (cont.).	Dashpot is set for too much damping, or is faulty.	Check that the dashpot is not overtight. Loosen the dashpot by turning the valve counterclockwise.
	Manipulator movement is faulty.	Check condition of the ball bearings in the base and on the manipulator. Replace if needed. Check that the raceways are clean.
	Backlash in the manipulator or missing ball bearing.	Check condition of the ball bearings in the base and on the manipulator. Replace if need. Check that the raceways are clean.
	The Multi Mouse moves during bonding.	Check if you hold the Multi Mouse steady when bonding.
	Free play in the motorized Y table (4523AD, 4524AD).	Check motion of the motorized Y table (see section 9.11.2).
Ball is too large (4524D, 4524AD).		Reduce BALL parameter setting.
Tail length is too long or short (4524D, 524AD).		Adjust the TAIL parameter on the Display.
Ball size varies (4524D, 4524AD).		1. If ball is too small, increase setting of BALL parameter. 2. If the tail length varies, tighten wire clamp clamping force.

Table 13-2: Bonding Process Diagnostics		
Symptom	**Possible Cause**	**Remedy**
No ball created (4524D, 4524AD)		1. Check N.E.F.O. wand alignment. Adjust and clean the wand, if necessary. 2. Perform manual sparking by pressing down the MANUAL SPARK switch. If no spark is produced, check the wiring. 3. Check voltage to the N.E.F.O. (see section 8.2).
Wire breaks just above the first bond (4522D, 4524AD).		1. Decrease the setting of the first POWER parameter. 2. Check if the fixed tensioner is not too tight. Loosen if necessary. 3. Check if the drag clamp is not too tight. Loosen if necessary. 4. Check if the wire does not bind in the wire spool holder. 5. Check if the wire clamp opens. If not: • Adjust wire clamp solenoid gap. • Adjust wire clamp force. • Replace wire clamp solenoid. 6. Check if the capillary is blocked.
Wire breaks just above the first bond (4523D, 4523AD).	Overly squashed bond.	Reduce the bonding parameter settings.

Table 13-2: Bonding Process Diagnostics

Symptom	Possible Cause	Remedy
Wire breaks just above the first bond (4523D, 4523AD)	Heel cracks because of a sharp back radius.	Replace the wedge with one that has a larger back radius.
	Excessive drag on the wire.	Reduce wire drag by loosening spool holder nuts.
	Wire clamp does not open.	Reduce clamping force and check the clamp solenoid.
		1. Decrease the setting of the first POWER parameter. 2. Check that the fixed tensioner is not too tight. Loosen if necessary. 3. Check that the wire does not bind in the wire spool holder. 4. Check that the feed hole of the wedge is not too small, or clogged. Clean or replace, if necessary. 5. Decrease REVERSE dial setting (especially for aluminum wires). 6. Check if the wire clamp opens. If not: • Adjust wire clamp solenoid gap. • Adjust wire clamp force. • Replace wire clamp/wire clamp solenoid. See Chapter 9.
Ball is bonded off center (4524D, 4524AD).		1. Tighten drag clamp. 2. Replace capillary.

Table 13-2: Bonding Process Diagnostics		
Symptom	**Possible Cause**	**Remedy**
Loop height varies (4524D, 4524AD).		Replace capillary.
Loop is too flat.		1. Reduce fixed tensioner force. 2. Replace capillary with one having a larger feed hole (4524D, 4524AD).
Loop is too high or sagging (4524D, 4524AD).		1. Tighten fixed tensioner force. 2. Replace capillary.
Loop is too high (4523AD, 4524AD).		1. Decrease LOOP parameter setting. 2. Decrease REVERSE parameter setting.
Loop height varies or tangles sideways (4523D, 4523AD).	Improper LOOP parameter setting.	Change dial setting.
	Wedge hole is too large.	Change wedge.
	Wire fed improperly through clamp wire guide.	Feed wire through clamp again.
	Excessive drag on wire.	Loosen wire tension by loosening nuts of the spool holder.
	Clamp is improperly aligned with the wedge.	Adjust clamp sideways position.
Inconsistent tail length (4523D, 4523AD).	Clamp is too far away from the wedge.	Readjust the clamp position (see section 9.6.3).
	Clamp is improperly aligned with the wedge.	Adjust clamp sideways position.
	Wire is slipping in the clamp.	1. Check wire clamp force. 2. Tighten clamp force spring.

Table 13-2: Bonding Process Diagnostics

Symptom	Possible Cause	Remedy
Inconsistent tail length (4523D, 4523AD) (cont.).	Wire is too soft (gold wire only).	Use harder wire.
	Wedge has too large a back radius.	Replace wedge with one that has a smaller back radius.
	Wedge is clogged or broken.	Clean or replace wedge, as required.
	Improper 2nd bond settings.	Change 2nd bond settings.
	Improper workholder height.	Lower workholder height.
No tail remains in wedge after last bond (4523D, 4523AD).	TAIL parameter is not proper.	Increase TAIL parameter.
	2nd bond is squashed too much.	Lower 2nd bond settings.
Pig tail attached to bond after 2nd bond (gold wire only) (4523D, 4523AD).	Wire is too soft.	Use harder wire.
	Tear motion is improperly adjusted.	Set TEAR parameter.
	Wire slipped out of the wedge.	Feed the wire again between the clamp jaws and through the wire guide.
Stitch bonds cannot be performed (4523D, 4523AD).	2nd bond parameters are set too high.	Decrease stitch bond parameter settomgs.
	Wedge foot is too small for the wire diameter.	Use a wedge with a larger foot, or use wire with a smaller diameter.

14. OPTIONS AND ACCESSORIES

The following list helps you to identify part numbers of optional items that are available for the K&S 4500 Digital Series Manual Wire Bonders. For more details, contact a K&S representative or service center.

14.1 Optical Accessories

K&S Part No.	Description
0450-0370-000-00	Leica S6 Microscope with focus arm
Optional eyepieces for Leica S6: Mag. X10, X16, X20	
04500-0362-000-00	Leica MZ6 Microscope with focus arm
Optional eyepieces for Leica MZ6: Mag. X16, X25	
04500-7300-000-00	Spotlight Target (Red Cross)
04500-7320-000-00	Spotlight Target (Green Cross)
04500-735x-000-00	Fiber Optic Illumination and Spotlight Target 115/230v
34005-0200-000	Spot pointer for fiber optic illumination

14.2 Stationary Heated Workholders

K&S Part No.	Description
04142-0X01-000-01	Adjustable Height Stationary Heated Workholder for Substrates and Flat Packages up to 2" x 2", 115/230v
04142-0X02-000-01	Adjustable Height Stationary Heated Workholder for 24, 28, 40 leads DIL and Side-Braze Packages, 115/230v
04142-0X03-000-01	Adjustable Height Stationary Heated Workholder for 14-40 leads 0.3" and 0.6" Centerline, 115/230v
04142-0X04-000-01	Adjustable Height Stationary Heated Workholder with 0.1" slots, 0.25" deep for 2" x 2" Packages, 115/230v

K&S Part No.	Description
04142-0X05-000-01	Adjustable Height Stationary Heated Workholder with Vacuum Hold Down for Packages and Substrates up to 2" x 2", 115/230v
04142-0X09-000-01	Adjustable Height Stationary Heated Workholder for TO-3 Single Station, 115/230v
04142-0X11-000-01	Adjustable Height Stationary Heated Workholder with Vacuum and Mechanical Hold Down for Packages and Substrates up to 2" x 2", 115/230v
04142-0X13-000-01	Adjustable Height Stationary Heated Workholder for TO-5 Dual Station, 115/230v
04142-0X14-000-01	Adjustable Height Stationary Heated Workholder for TO-18 Dual Station, 115/230v
04142-0X15-000-01	Adjustable Height Stationary Heated Workholder for TO-8 (0.5") Dual Station, 115/230v
04142-0X16-000-01	Adjustable Height Stationary Heated Workholder for TO-8 (0.6") Dual Station, 115/230v
04142-0X17-000-01	Adjustable Height Stationary Heated Workholder for Substrates and Flat Packages up to 4" x 4", 115/230v
04142-0X26-000-01	Adjustable Height Stationary Heated Workholder with Vacuum and Mechanical Hold Down for Packages and Substrates up to 4" x 4", 115/230v

14.3 Rotary Heated Workholders

K&S Part No.	Description
04135-0X01-000-01	Height Adjustable Rotary Heated Workholder for Substrate and Flat Packages up to 2.5" x 2.5", 115/230v
04135-0X05-000-01	Height Adjustable Rotary Heated Workholder with Vacuum Hold Down for Packages and Substrates up to 2.5" x 2.5", 115/230v
04135-0X06-000-01	Height Adjustable Rotary Heated Universal Workholder with 0.1" Centerline Slots, 0.25" Deep, 115/230v

14.4 Cold Workholders

K&S Part No.	Description
00483-0051-000	Workholder and Top Plate Assembly for Substrates, adjustable from 1/4 " x 1/4" to 1" x 1" x 0.02" to 0.06" thickness
00483-0054-000	Workholder and Top Plate Assembly for TO-5 and TO-18
00483-0058-000	Workholder and Top Plate Assembly for TO-8 Devices with 0.5" diameter
00483-0095-000	Workholder and Top Plate Assembly for TO-8 Devices with 0.6" diameter
00483-0059-000	Workholder and Top Plate Assembly for Substrate, adjustable from 1" x 1" to 2" x 2" x 0.02" to 0.06" thickness
00483-0148-000	Universal Workholder for Flat Ceramic Packages 3/8" to 2" x 2", Chip Carrier, 0.3", 0.4", 0.6", 0.8" and 0.9″ Centerline Bent Lead Packages and Side Braze
00483-0158-000	Universal Workholder for Cerdip and Side Braze Devices Lead Centerline 0.3", 0.6" and 0.9"
04142-0027-000-01	Adjustable Height Stationary Cold Workholder with vacuum and mechanical hold down for packages and substrates up

K&S Part No.	Description
	to 4" x 4"
04142-0028-000-01	Adjustable Height Stationary Cold Workholder for substrates and flat packages up to 4" x 4"
00483-5005-000	Universal Workholder for PGA (pin down) and substrates
04123-0360-000	Adjustable Height Base Adapter for cold workholders
04137-0000-000	Magnetic Base for Workholders (cold or hot)

Note: The Magnetic Base for Workholders requires a ferromagnetic base plate.

Note: When ordering a cold workholder, the Height Adjustable Base for Cold Workholders (P/N 04123-0360-000) must be ordered as well.

K&S can supply custom made workholders on request.

14.5 Manual Index Workholders

K&S Part No.	Description
04261-0101-000-01	Manual Workholder for Leadframe Strips with adjustable index and width. Index range up to 1.5", width range 0.75" - 2.312" (for 110 V)
04261-0201-000-01	Manual Workholder for Leadframe Strips with adjustable index and width. Index range up to 1.5", width range 0.75" - 2.312" (for 220 V)
04262-0101-000-01	Pneumatic Workholder for Vertical Lead Strips (for 110 V)
04262-0201-000-01	Pneumatic Workholder for Vertical Lead Strips (for 220 V)

14.6 Motorized Index Workholders

K&S Part No.	Description
04268-0101-000-01	Motorized Index Workholder for Leadframe Strips with adjustable index and width. Index range up to 1.5", width range 0.875"-2.5" (for 110 V)
04268-0201-000-01	Motorized Index Workholder for Leadframe Strips with adjustable index and width. Index range up to 1.5", width range 0.875"-2. 5" (for 220 V)
04268-0102-000-01	Motorized Index Workholder for Leadframe Strips with adjustable index and width. Index range up to 1.5", width range 0.875"-2.5". For TO-92 leadframes only (for 110 V)
04268-0202-000-01	Motorized Index Workholder for Leadframe Strips with adjustable index and width. Index range up to 1.5", width range 0.875"-2.5". For TO-92 leadframes only (for 220 V)

14.7 Motorized Heated Workholders

K&S Part No.	Description
04280-0101-000-01	Motorized Heated Workholder for TO-5/18, less tapes and carriers (for 110 V)
04280-0201-000-01	Motorized Heated Workholder for TO-5/18, less tapes and carriers (for 220 V)
04280-0102-000-01	Motorized Heated Workholder for TO-5/18, single tape (for 110 V)
04280-0202-000-01	Motorized Heated Workholder for TO-5/18, single tape (for 220 V)

14.8 Workholders Harness Adapters

K&S Part No.	Description
04123-1014-000	Interface harness (4100 Workholder to 4500 machine)
04123-1015-000	Interface harness (4500 Workholder to 4100 machine)
04123-1012-000	Interface harness (VDE Workholder to 4500 machine)
04123-1013-000	Interface harness (4500 Workholder to VDE machine)
04123-1020-000	Interface harness (4100 Motorized Workholder to 4500 machine)
04123-1019-000	Interface harness (4500 Motorized Workholder to 4100 machine)

14.9 General Accessories

K&S Part No.	Description
04526-0221-000-00	Height Adjustable Rotary Table
04525-7700-000-00	3rd Channel Kit
04524-0212-000-00	Motorized Table for 4522/4524
04523-7550-000-00	2" Spool, 30°/45° wire feed for 4523/4526
04523-7560-000-00	2" Spool, 90° wire feed for 4523/4526 (only with clamp 90° wire feed)
04524-0920-000-00	Deep Access Kit for 4522/4524
40304-0001-002	Mini Heater 2 coils
40304-0001-004	Mini Heater 4 coils
40304-0001-006	Mini Heater 6 coils
40304-0001-008	Mini Heater 8 coils
40304-0008-002	0.08" Dia. Mini-heater 2 coils
04561-1000-000-00	Mini-heater support bracket (for deep access)
01470-1063-000-00	Mini Heater Power Supply 100/115 V
04561-1230-000-01	Mini Heater Power Supply 230 V
04500-5005-000-00	2" Ribbon spool holder with vertical feed for 4523/6 and 4523D/AD
40509-0100-000	Heated Capillary Kit
04500-0900-000-00	Spare Part Kit
04500-0910-000-00	Maintenance Tool Kit
04500-6100-000-00	Dust Cover
04500-2101-000-00	Monitor Kit for 115 Volt
04500-2201-000-00	Monitor Kit for 230 Volt
04500-4000-000-00	Cross Hair Generator Kit for 115 Volt (with Monitor Kit P/N: 04500-2101-000-00)

K&S Part No.	Description
04500-4001-000-00	Cross Hair Generator Kit for 230 Volt (with Monitor Kit P/N: 04500-2201-000-00)
04525-0203-000-00	ESD Protection Kit for Analog machines
04525-0200-000-00	ESD Protection Kit for Digital machines
04500-0250-000-00	Positioning Control Kit for Digital Bonders (Left-hand chessman machine)
04500-0230-000-00	Positioning Control Kit for Analog Bonders (Left-hand chessman machine)
04500-0240-000-00	Positioning Control Kit for Analog Bonder (Retrofit – left-hand chessman machine)
04500-0260-000-00	Positioning Control Kit for Digital Bonder (Retrofit – left-hand chessman machine)
04500-0270-000-00	Portable Cials Kit (for Analog machines with Positional Control kit only)
04500-0232-000-00	Manual Z Lever Kit
04525-0232-000-00	Manual Z Lever Kit (ESD protected)

14.10 Clamps

K&S Part No.	Description
04526-0770-000-00	Clamp 90° wire feed, deep access for 4523/4526
04526-0780-000-00	Ribbon Clamp 90° wire feed, deep access for 4523/4526
04523-0780-000-00	Ribbon Clamp 30°/45° wire feed for 4523/4526
04524-0780-000-00	Clamp with Ceramic Jaws for 4524

15. PARTS LISTS

This chapter contains a list of assemblies and parts of the K&S Digital 4500 Series Wire Bonders. Each section includes a picture of an assembly and a table listing the assembly's parts, item number in picture, K&S catalog number and description.

Parts lists for the following assemblies are provided:

- Front Panel Assembly
- Main Head
- Bonding Head of Models 4523D/4523AD
- Bonding Head of Models 4524/4524AD
- Manipulator and Motorized Y Table
- Base Assembly
- Keypad
- Drag and Electrode Assembly
- 2" Spool Assembly
- Multi Mouse Assembly
- Clamp Assembly for 90° Wire Feed
- N.E.F.O. System

When ordering spare parts, write the corresponding K&S catalog numbers on the purchase order.

15.1 Front Panel Assembly

15.1.1 The Left Panel

Figure 15-1: Left Panel

Table 15-1: FRONT PANEL ASSEMBLY 04500-0213-000-00		
Item Number	**Description**	**K&S Catalog Number**
THE LEFT PANEL		
1	WEDGE LEFT PANEL BALL LEFT PANEL	04500-0790-000-00 04500-0791-000-00
2	DISPLAY HOUSING	04500-0790-004-00
3	DISPLAY PANEL	04500-4322-004-00
4	POWER SWITCH ISA-250V	16200-0010-001
5	KEYPAD 4523D, 4524D/ KEYPAD 4523AD, 4524AD	18548-0002-000-00 18548-0001-000-00

15.1.2 Wedge Right Panel (Models 4523D, 4523AD)

Figure 15-2: Right Panel (Models 4523D, 4523AD)

15.1.3 Ball Right Panel (Models 4524D, 4524AD)

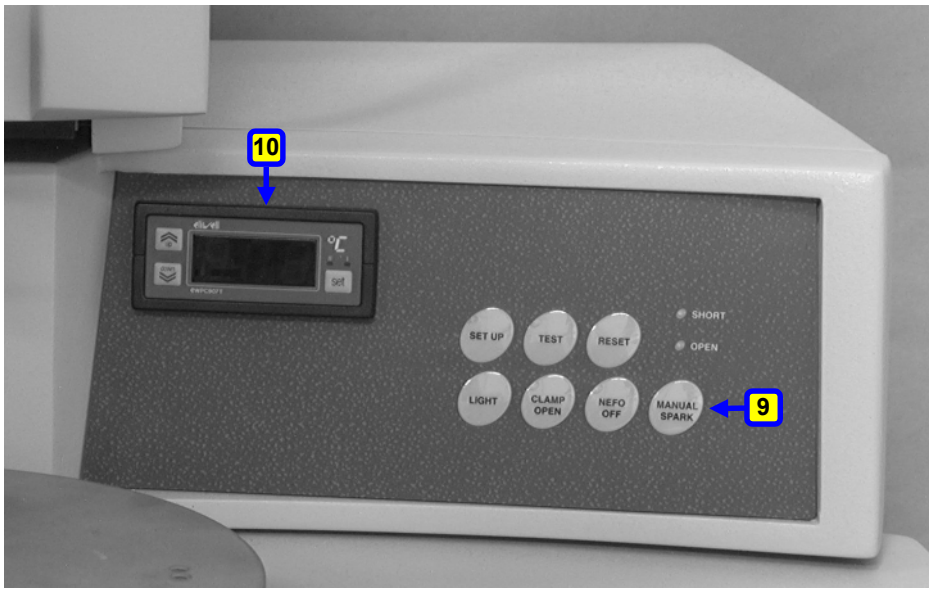


Figure 15-3: Right Panel (Models 4523D, 4523AD)

Table 15-2: FRONT PANEL ASSEMBLY 04500-0213-000-00		
Item Number	**Description**	**K&S Catalog Number**
THE RIGHT PANEL		
8	WEDGE RIGHT PANEL	04523-0675-000-00
9	BALL RIGHT PANEL	04524-0675-000-00
10	TEMPERATURE CONTROLLER	11795-2001-000

15.2 Main Head

Table 15-3: MAIN HEAD 04500-0405-000-00		
Item Number	**Description**	**K&S Catalog Number**
1	STEP DRIVER	04500-4220-000-00
2	MOTOR TACHO ASSEMBLY	04500-1600-000-00
3	DASHPOT 160A 1.5F 2.25L	25815-6001-000
4	DOUBLE PULLEY MOTOR DRIVER	04123-0440-006
5	STEPPER DRIVE BELT	04123-0410-021
6	DOUBLE PULLEY MOTOR DRIVER	04123-0440-001
7	ROD END ASSEMBLY	00428-0555-000
8	LVDT ASSEMBLY	04123-0414-000
9	PUSH ROD	04123-0400-001
10	HEIGHT CONTROL LINK (4523D, 4523AD)	04123-0455-000
10	HEIGHT CONTROL LINK (4524D, 4524AD)	04124-0455-000
11	BALL BEARING	20647-1053-000
12	FORCE ACTUATOR ASSEMBLY	04500-0417-000-00
13	EXTENSION SPRING	04123-0400-003
14	BALL BEARING	20647-1152-001

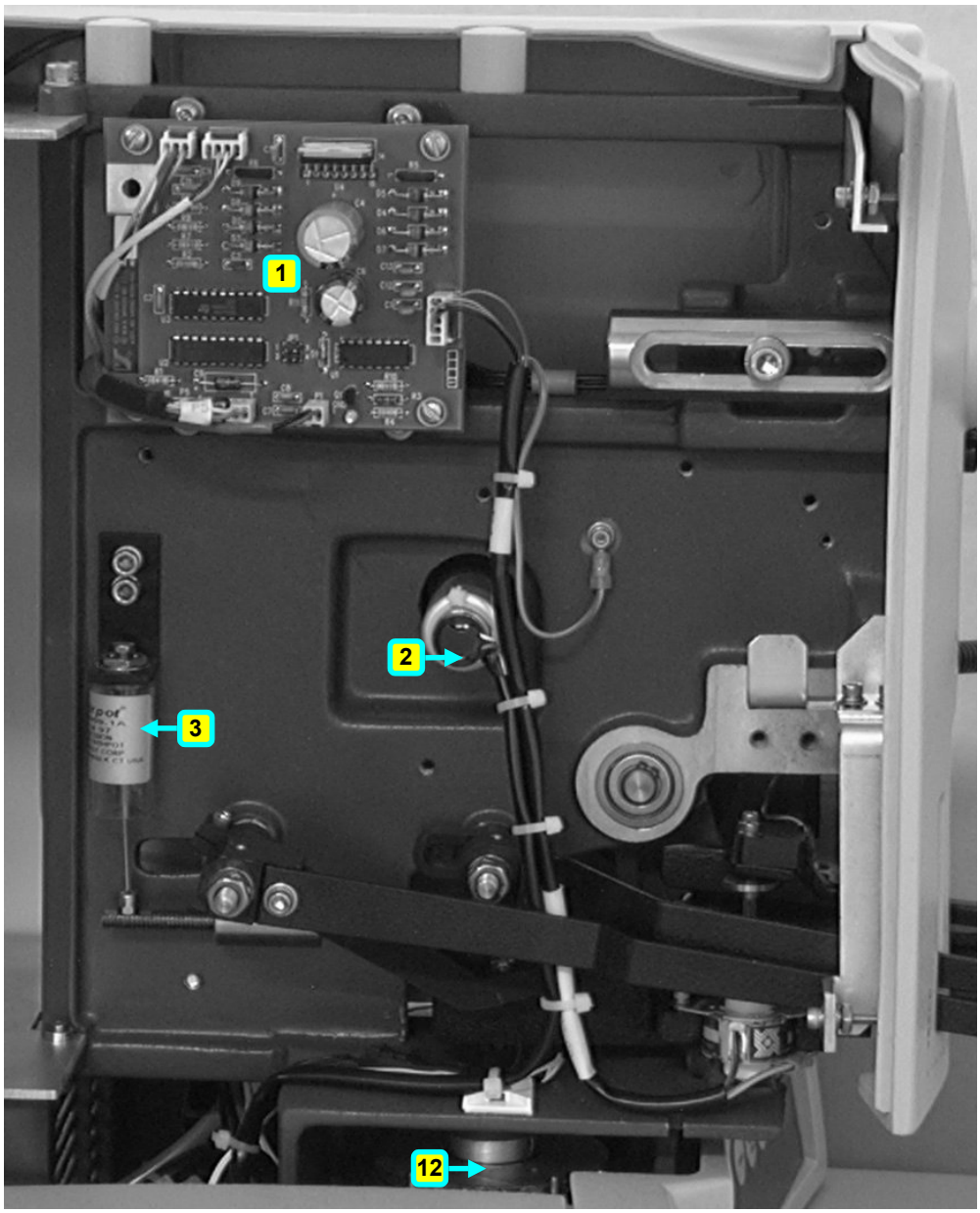


Figure 15-4: Main Head - Left View

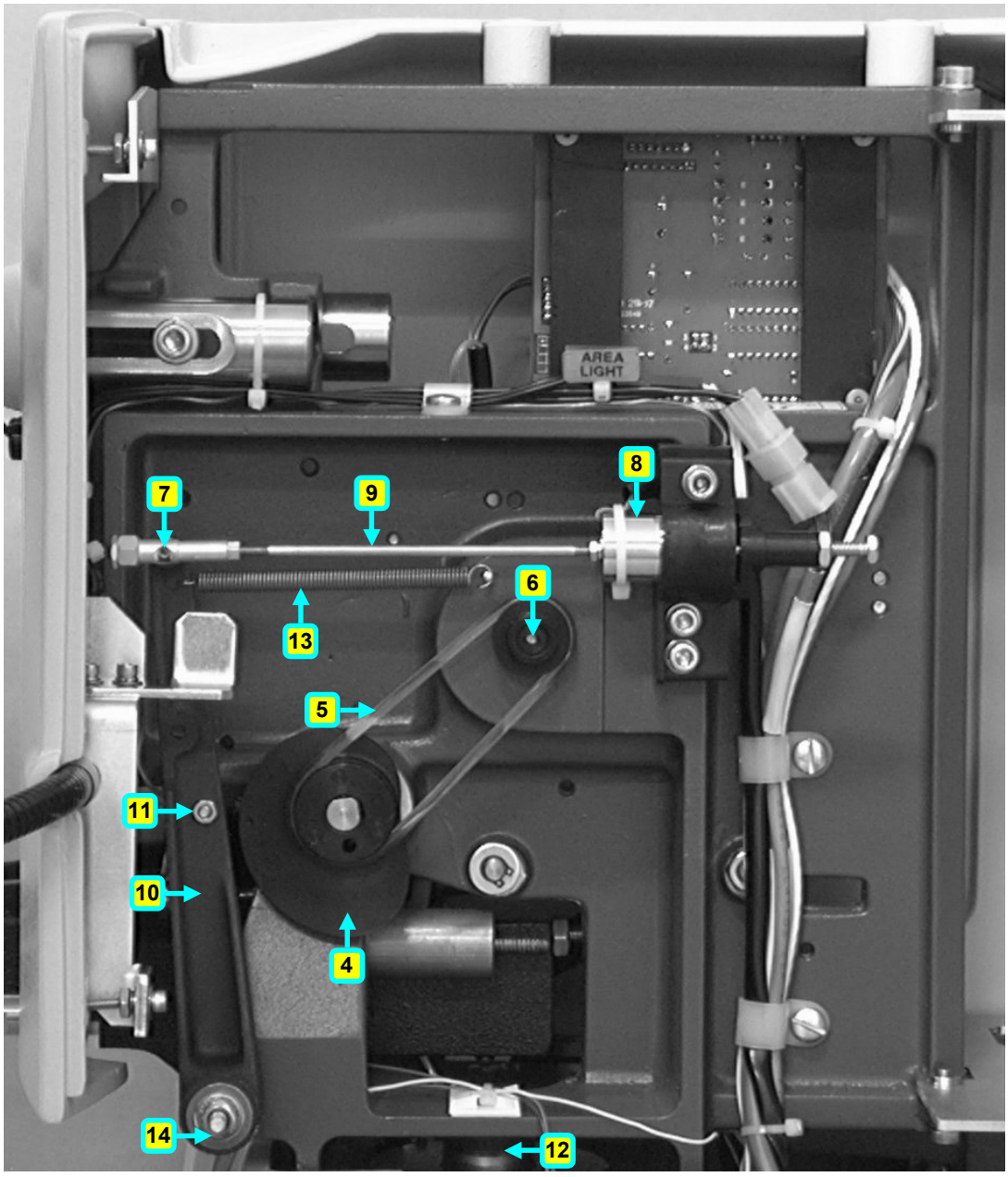


Figure 15-5: Main Head - Right View

15.3 Bonding Head - Models 4524D and 4524AD

Table 15-4: BONDING HEAD 04524-0450-000-00		
Item Number	**Description**	**K&S Catalog Number**
1	CLAMP SOLENOID HARNESS	04500-1102-000-01
2	WIRE CLAMP ASSEMBLY	04124-0770-000
3	CONTACT ASSEMBLY	04500-0427-000-00
4	BALL BEARING 0.188B 0.500D 0	20647-7255-000
5	U-BOLT	04124-0420-002

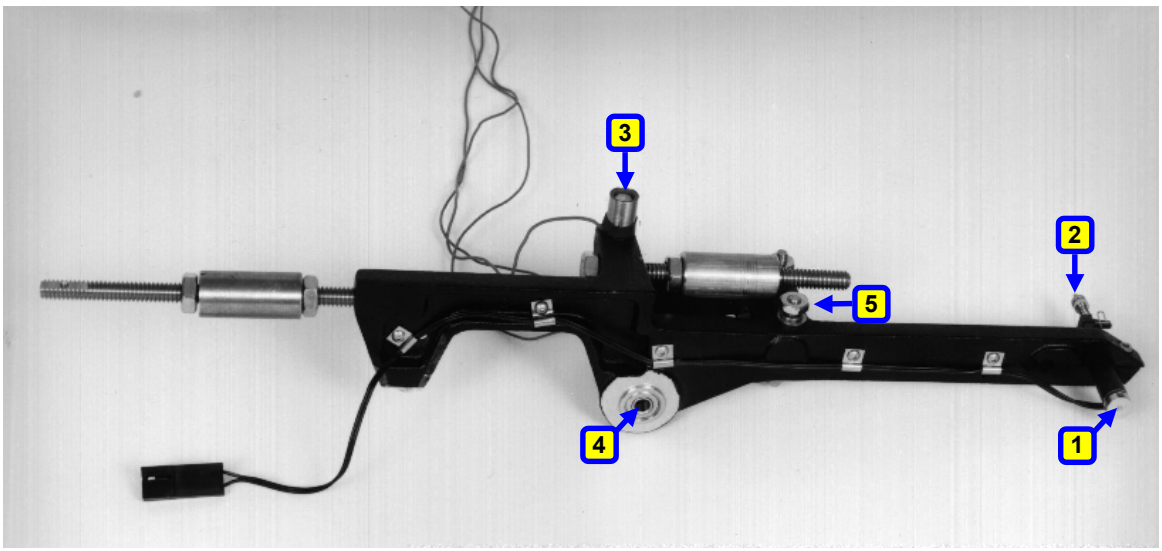


Figure 15-6: Bonding Head - Models 4524D, 4524AD

15.4 Bonding Head - Models 4523D and 4523AD

Table 15-5: BONDING HEAD 04523-0450-000-00		
Item Number	**Description**	**K&S Catalog Number**
1	0.5" SPOOL ASSEMBLY	04123-0426-000
2	TAIL MOTOR ASSEMBLY	04500-1215-000-00
3	BRONZE BEARING	04500-0450-002-00
4	CLAMP WITH BRACKET ASSEMBLY	04523-0770-000-00
5	CONTACT ASSEMBLY	04500-0427-000-00
6	NYLON PAD	04123-0450-002
7	BALL BEARING	20647-7255-000

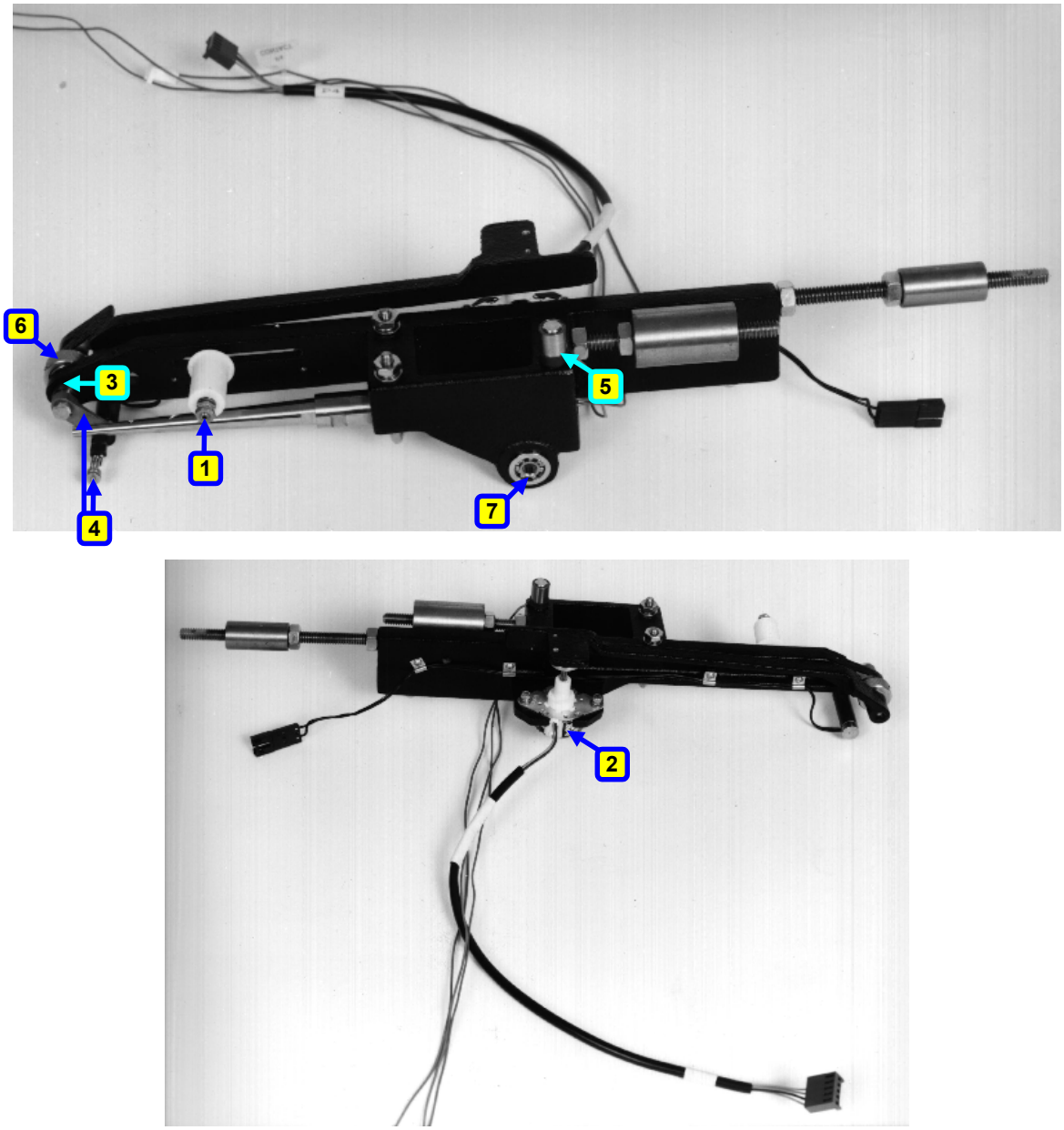


Figure 15-7: Bonding Head - Models 4523D, 4523AD

15.5 Manipulator and Motorized Y Table

Table 15-6: MANIPULATOR AND MOTORIZED Y TABLE 04526-0212-000-00		
Item Number	**Description**	**K&S Catalog Number**
1	Y TABLE STEPPER MOTOR	04129-1004-000
2	LEVER ASSEMBLY	04123-0214-000
3	SHOULDER SCREW	04123-0210-005
4	BALL BEARING 0.188B 0.500D 0	20647-6015-000
5	GROOVED ROLLER	04123-0211-002
6	SPRING	04123-0212-003
7	LEAD SCREW	04526-0223-001-00
8	LEAD SCREW NUT	73900-0016-000
9	BALL BEARING 8MM B 22MM D	20604-6002-000
10	COUPLING	22195-0002-000
11	LIMIT SWITCH HARNESS	04526-1003-000-00
12	SPHERICAL BEARING	20750-0150-108
13	LINEAR BEARING CRS RLR WAY 16 R	20678-6017-000
14	BALL RETAINER	00478-5001-10

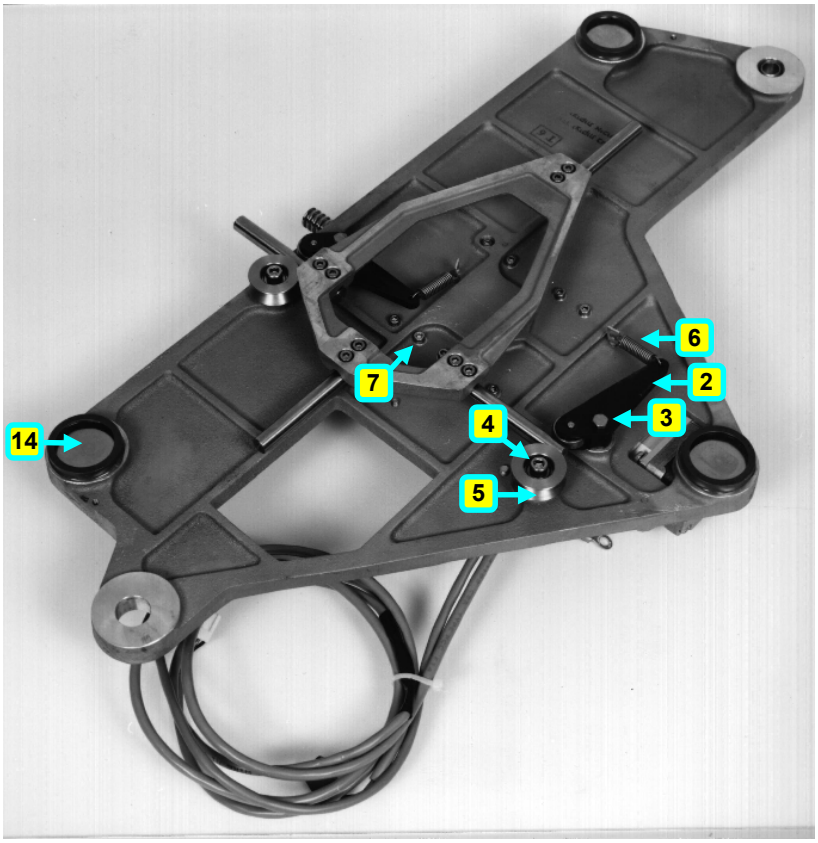


Figure 15-8: Manipulator

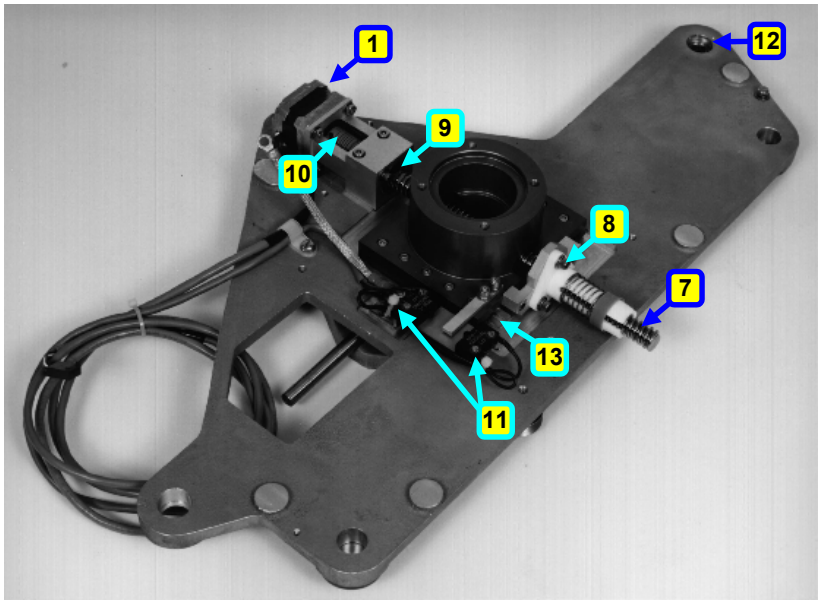


Figure 15-9: Motorized Y Table

15.6 Base Assembly

Table 15-7: BASE ASSEMBLY 04500-0201-000-00		
Item Number	**Description**	**K&S Catalog Number**
1	MOTHERBOARD	04500-4320-000-00
2	TRANSFORMER ASSEMBLY	04500-1009-000-00
3	TEMPERATURE CONTROLLER RELAY	15000-0007-032
4	MOTOR RELAY BOARD (4523D, 4523AD)	04500-4250-000-00
5	HIGH VOLTAGE COVER	04123-0201-001-01
6	PRECISION BALL 8MM DIAMETER, GRADE 3	29010-6031-000
7	LEVER ASSEMBLY	04123-0214-000
8	SHOULDER SCREW	04123-0210-005
9	SPRING	04123-0212-003
10	GROOVED ROLLER	04123-0211-002
11	ROLLER	04123-0211-005
12	SPHERICAL BEARING	20750-0150-108
13	BALL BEARING	20647-6015-000
14	FUSE HOLDER	18543-0001-002
15	FUSE 1/4 X 1-1/4 1A 250V	18538-6041-000
15	FUSE 1/4 X 1-1/4 0.5A 250V	18538-6049-000
16	FUSE 1/4 X 1-1/4 2.5A 250V	18538-6085-000
16	FUSE 1/4 X 1-1/4 5A 250V	18538-6091-000
17	BALL RETAINER	00478-5001-010

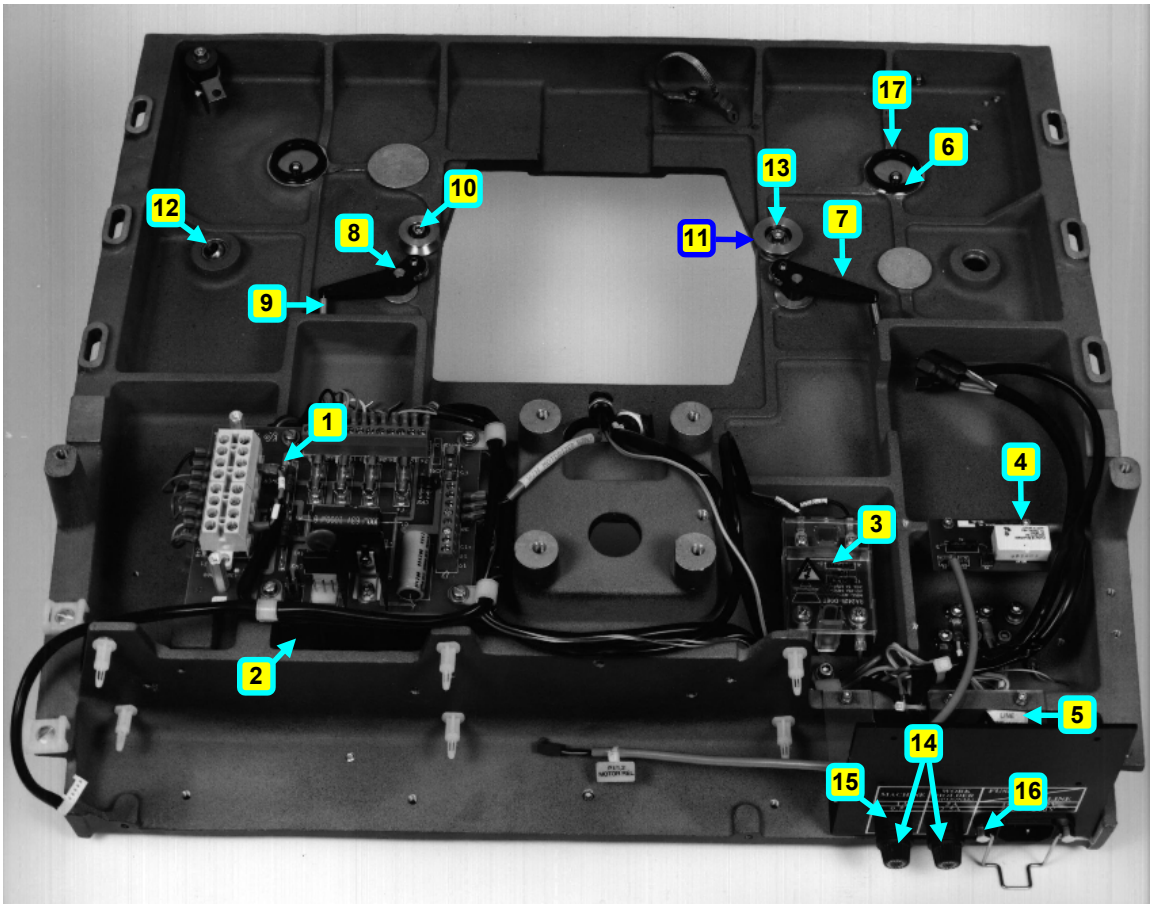


Figure 15-10: Base Assembly

15.7 Drag and Electrode Assembly

Table 15-8: DRAG AND ELECTRODE ASSEMBLY 04124-0452-000		
Item Number	**Description**	**K&S Catalog Number**
1	FLAME-OFF WAND	04124-0780-000
2	INSULATOR	04124-0452-004
3	LEAF SPRING	04124-0452-002
4	N.E.F.O. SOLENOID ASSEMBLY	04124-1710-000-01
5	SOLENOID TIP	04124-0450-005
6	WASHER	00478-5013-007
7	DRAG SOLENOID ASSEMBLY	04124-1720-000-01
8	SOLENOID TIP	04124-0450-005

Table 15-8: DRAG AND ELECTRODE ASSEMBLY 04124-0452-000		
Item Number	**Description**	**K&S Catalog Number**
9	WASHER LOCK	67153-2432-022
10	SET SCREW 2-56 X 1/8"L	72770-0256-008
11	LEAF SPRING FOR DRAG ASSEMBLY	04124-0751-001
12	FORCE SPRING	04124-0750-007
13	DRAG FORCE ADJUSTING NUT	04124-0750-004
14	SPRING SHOE FOR DRAG ASSEMBLY	04124-0750-005
15	SAPPHIRE JEWEL	29042-2440-000
16	SCREW	04124-0750-008
17		04124-0000-002

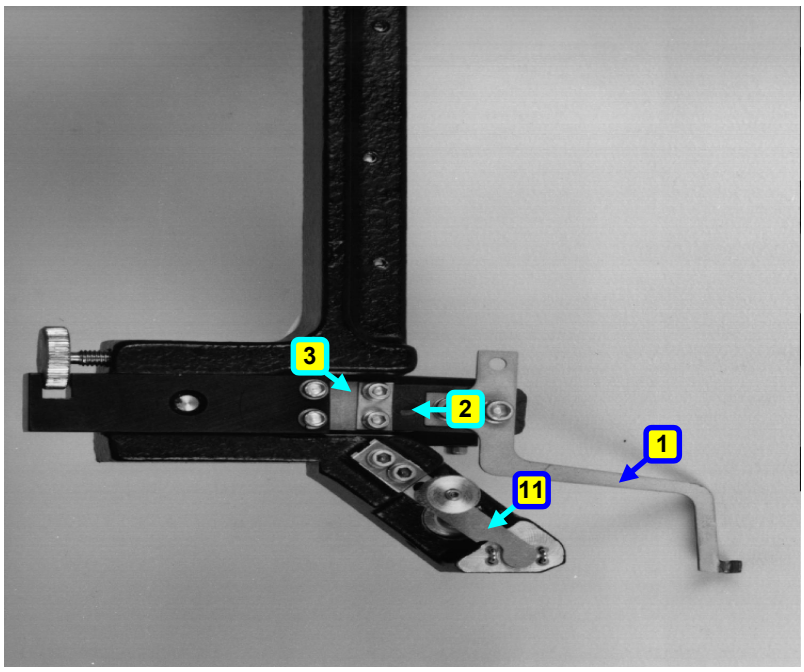


Figure 15-11: Drag Assembly

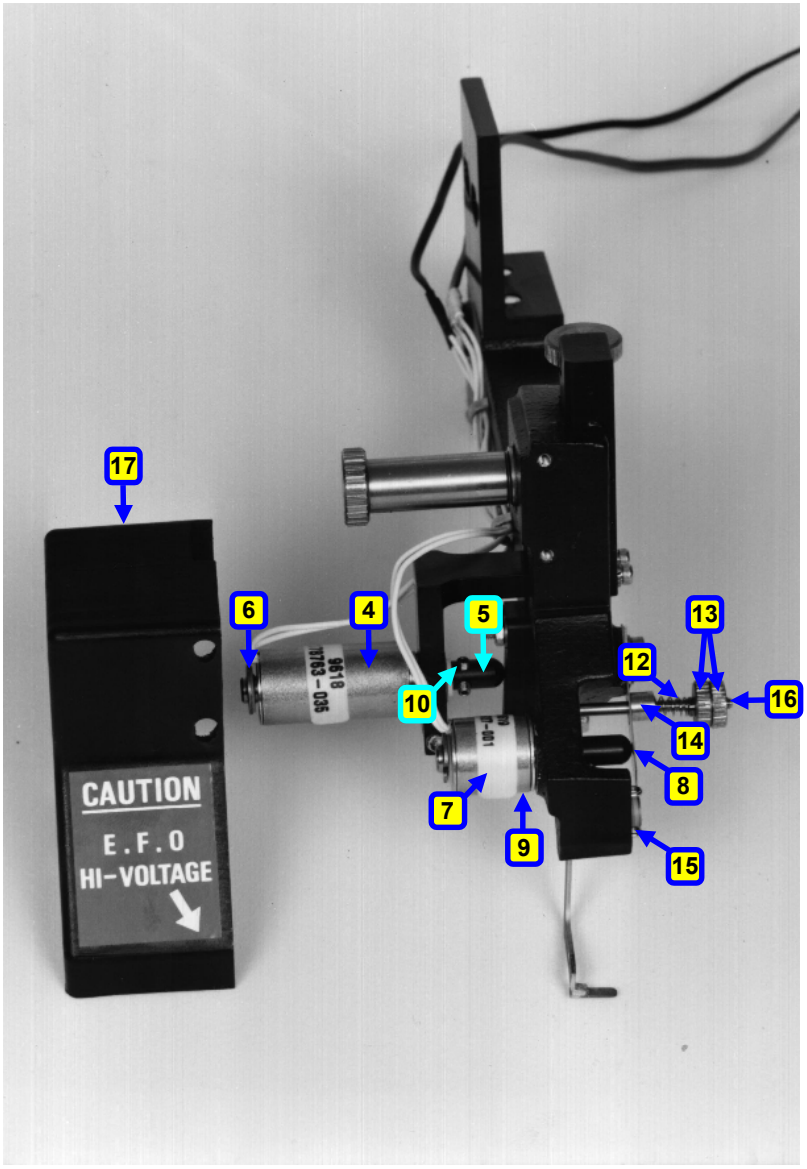


Figure 15-12: Electrode Assembly

15.8 2" Spool Assembly

Table 15-9: 2" SPOOL ASSEMBLY 04524-0460-000-00		
Item Number	**Description**	**K&S Catalog Number**
1	KICKER ASSEMBLY	04124-0461-000
2	KICKER SOLENOID ASSEMBLY	04524-1730-000-00
3	TENSIONER BRACKET	01419-0510-001
4	SPOOL COVER	01418-0902-001
5	TENSIONER SPRING	00478-0564-003
6	THREADED BUSHING	00478-0564-002
7	KICKER SPRING	04124-0460-003
8	GROUND PLATE	00478-0910-023
9	SOLENOID TIP	04124-0450-005
10	FLAT WASHER OD=0.250" ID=0.09"	69500-0250-025
11	S.S.S. 2-56 X 1/8"L	72770-0256-008
12	GLASS PLATE	01418-0010-006
13	NYLON SCREW 2-56 X 5/8"	71580-0256-040

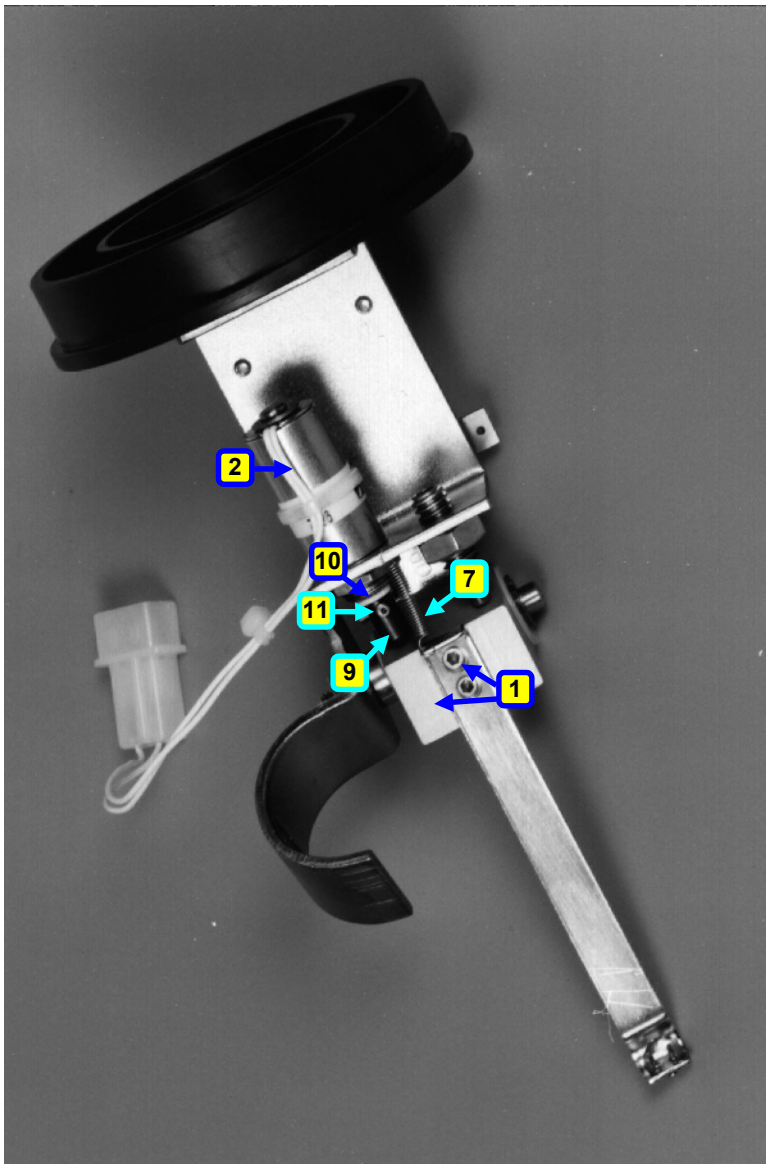


Figure 15-13: 2" Spool Assembly

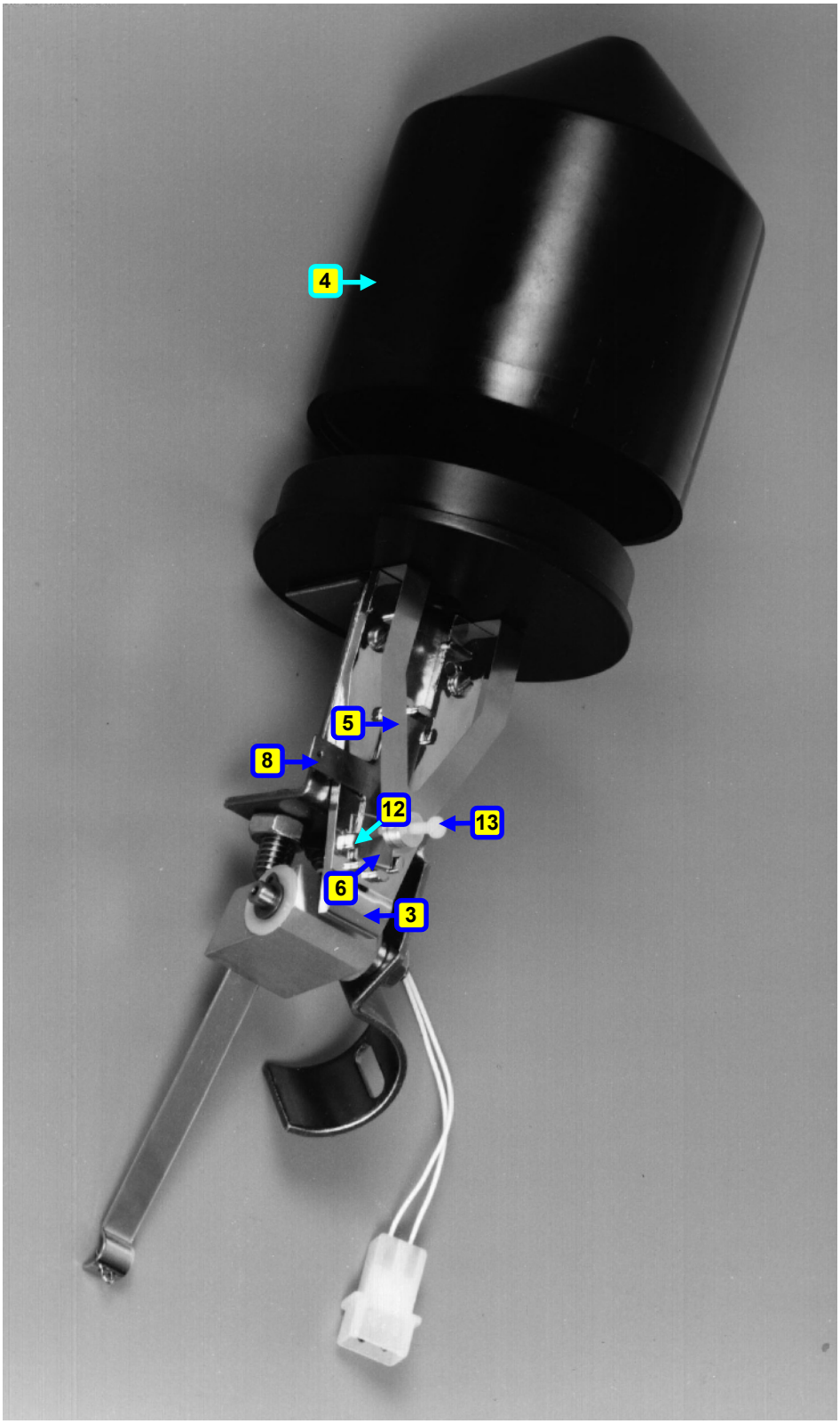


Figure 15-14: 2" Spool Assembly

15.9 Multi Mouse Assembly

Table 15-10: MULTI MOUSE ASSEMBLY 04500-0220-000-01		
Item Number	**Description**	**K&S Catalog Number**
1	MOUSE COVER	04500-0541-001-01
2	MOUSE HARNESS	04500-1401-000-00
3	SPHERICAL BEARING	20750-0150-108
4	MOUSE ROD	04500-0220-002-00

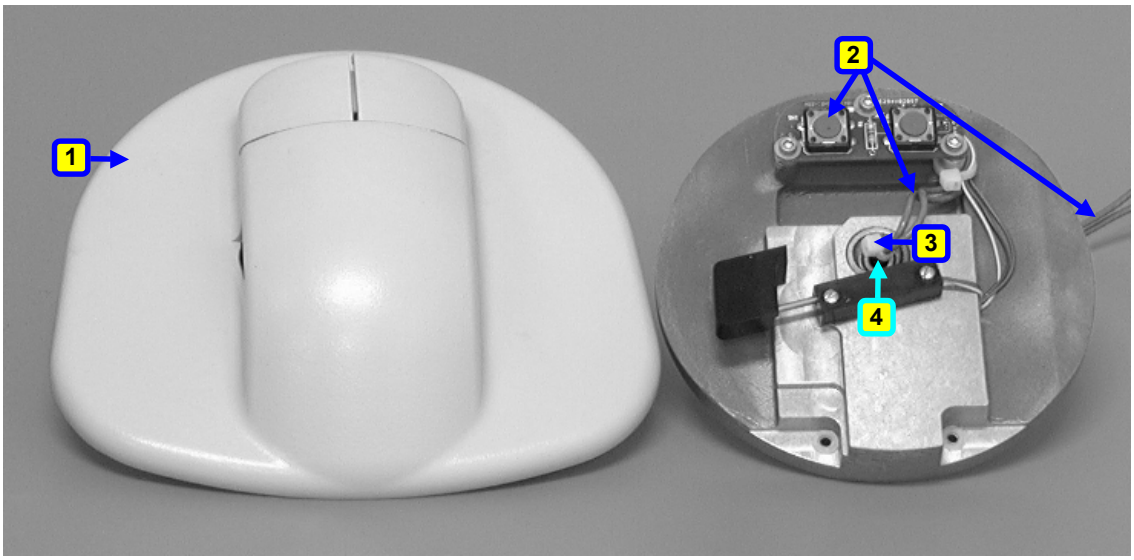


Figure 15-15: Multi Mouse Assembly

15.10 Clamp Assembly for 90° Wire Feed

Table 15-11: CLAMP ASSEMBLY FOR 90° WIRE FEED 04526-0770-000-00		
Item Number	**Description**	**K&S Catalog Number**
1	WIRE CLAMP ASSEMBLY	04129-0770-000
2	CLAMP SOLENOID HARNESS ASSEMBLY	04500-1102-000-01

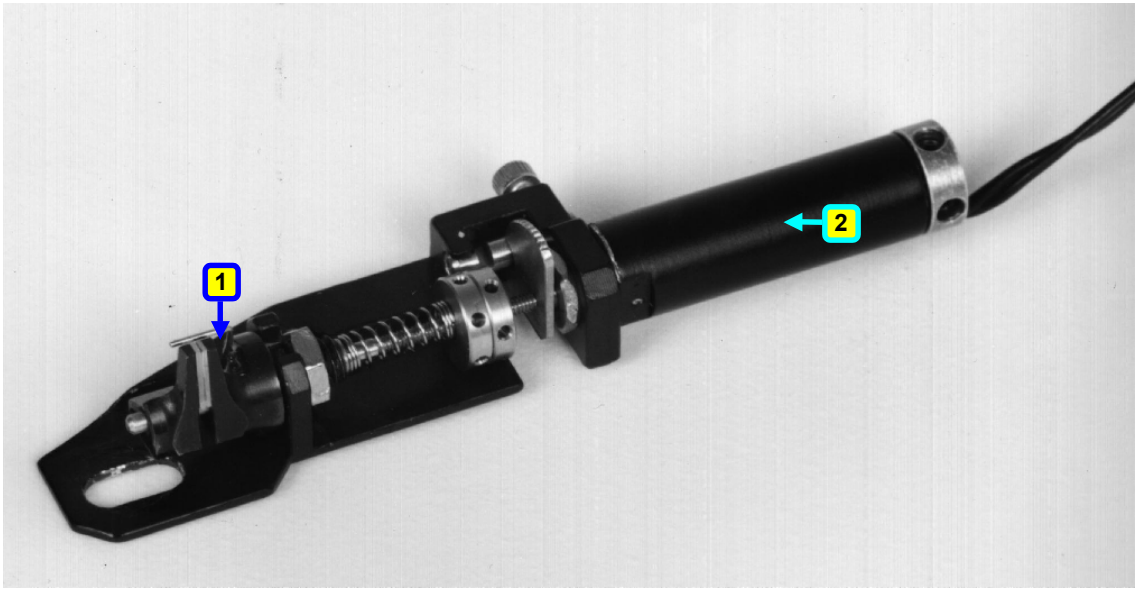


Figure 15-16: Clamp Assembly for 90° Wire Feed

15.11 N.E.F.O. System

Table 15-12: N.E.F.O. SYSTEM 04524-1000-000-00		
Item Number	**Description**	**K&S Catalog Number**
1	N.E.F.O. BOX ASSEMBLY	04524-1001-000-00
2	SWITCHING POWER SUPPLY 48V/1A	19074-0013-000
3	N.E.F.O. CABLE ASSEMBLY	08001-1091-000-00

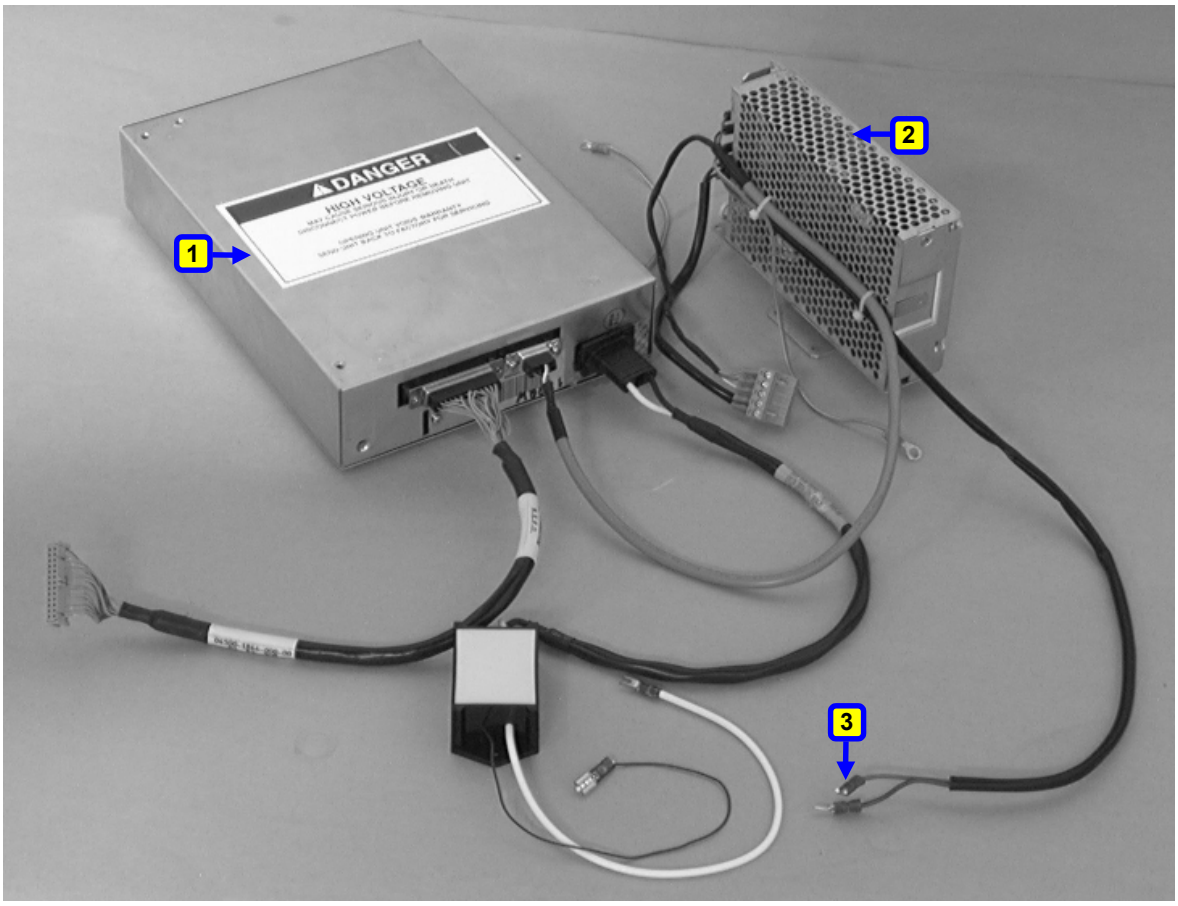


Figure 15-17: N.E.F.O. System

15.12 Ball/Wedge Interface Board

Table 15-13: BALL/WEDGE INTERFACE BOARD 04500-4323-000-00 & 04500-4321-000-00		
Item Number	**Description**	**K&S Catalog Number**
1	BALL INTERFACE BOARD/ WEDGE INTERFACE BOARD	04500-4323-000-00 04500-4321-000-00
2	CONTROLLER ASSEMBLY	04500-4340-000-00
3	DISPLAY PANEL	04500-4322-000-00
4	PIGGYBACK	04500-4325-000-00

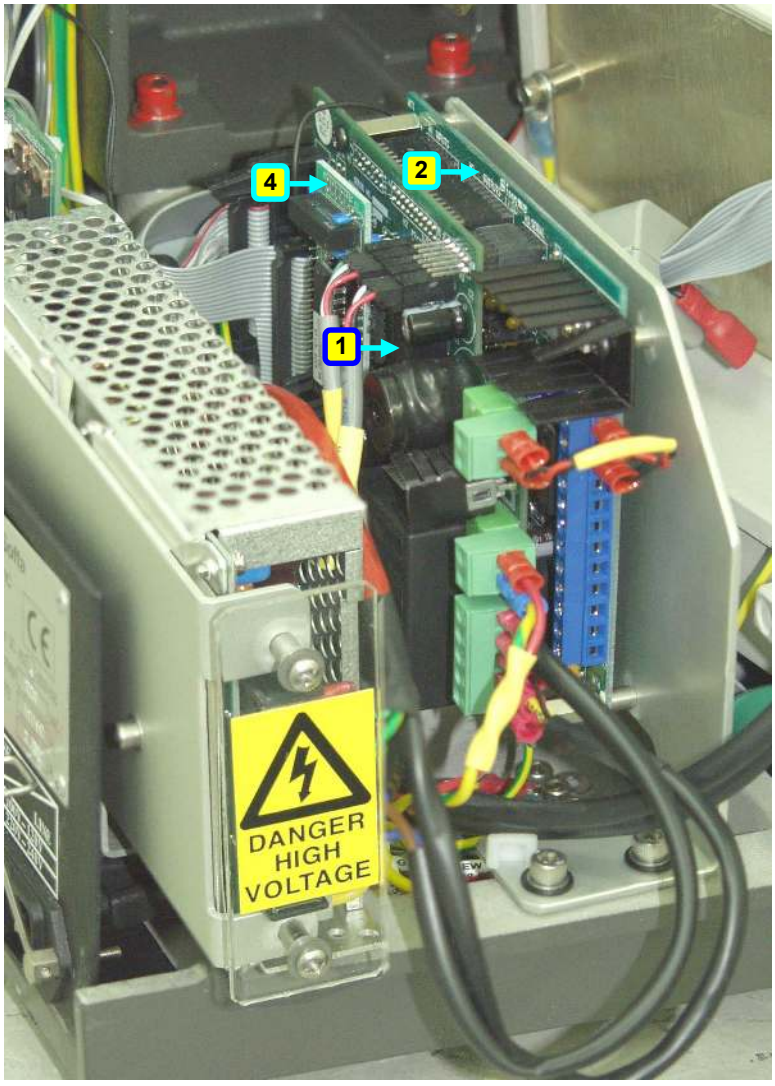


Figure 15-18: Ball/Wedge Interface Board

16. INDEX

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