Dicing Systems

Kulicke & Soffa Ltd.

Your Resource for Advanced Dicing Solutions

K&S 4500 Series

Manual Wire Bonders

Operation and Maintenance Manual

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Customer Support

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RECORD OF CHANGES

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

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SAFETY FIRST

Kulicke & Soffa believes that the safety of personnel working with and around the Model 4500 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 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 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 Series, the following safety precautions are strongly recommended.

1 The Model 4500 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 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 4522 and 4524 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.

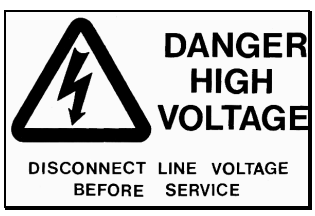
The N.E.F.O. produces high voltage within the N.E.F.O. box, in the electrode and on the high voltage cable.

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 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 Series.

Manual Contents

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

Chapter 2 **Installation**

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

Chapter 3 **Physical Description**

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Chapter 4 **Controls and Indicators**

Description of the K&S 4500 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 Series Manual Wire Bonders for operation.

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

Chapter 8 **Electrical Subassemblies**

Information for maintaining and adjusting the K&S 4500 Series Manual Wire Bonder electrical subassemblies.

Chapter 9 **Mechanical Subassemblies**

Details about maintaining the main mechanical subassemblies of the K&S 4500 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 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 Series Manual Wire Bonders.

Chapter 13 **Troubleshooting**

Procedures for troubleshooting the K&S 4500 Series Manual Wire Bonders.

Chapter 14 **Options and Accessories**

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Part numbers of all components and assemblies of the K&S 4500 Series Manual Wire Bonders.

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1. INTRODUCTION

1.1 Product Description

The K&S 4500 Series Manual Wire Bonders offer complete solutions to the various wire bonding applications and process requirements.

The 4500 Series comprises the following bonding machine models: 4522, 4523, 4524 and 4526.

1.1.1 Model 4522 Multi-Process Ball Bonder

The Model 4522 Multi-Process Ball Bonder for gold wire is ideal for Research & Development and small production lots where unique processes are used.

Single point TAB, ball bumping, and coining, together with standard ball bonding, offer process flexibility and versatile capabilities.

Semi-auto and manual operation modes, individual bond parameter control and a wide range of wire diameters make it ideal for a variety of applications.

The built-in programmable Negative Electronic Flame-Off (N.E.F.O.) system provides consistency and fine control of ball size.

1.1.2 Model 4523 Wedge Bonder

The Model 4523 Wedge Bonder is used with aluminum wire, gold wire and ribbon. It is versatile enough to bond simple discrete devices up to complex hybrid, microwave and deep cavity devices.

The 4523 offers control of individual bond parameters, loop height and force, along with the capability of using a wide range of wire diameters.

The new bonding head, with the deep access option and tail adjust system, makes it ideal for deep cavity microwave applications where tight control over the tail length is required.

1.1.3 Model 4524 Ball Bonder

The Model 4524 Ball Bonder for gold wire provides versatile production capabilities for bonding applications from simple discrete devices to complex hybrid and microwave devices.

Semi-auto and manual operation modes, individual bonding parameter control, and a wide range of wire diameters make the 4524 ideal for a variety of applications.

The built-in programmable Negative Electronic Flame-Off (N.E.F.O.) system provides fine control and consistency of ball size.

1.1.4 Model 4526 Auto-Stepback Wedge Bonder

The Model 4526 Auto-Stepback Wedge Bonder is used with aluminum wire, gold wire and ribbon. It is especially appropriate for your high quality applications requiring tight control of wire length and loop formation.

The 4526 offers control of individual bond parameters and programmable loop formation along with the capability of using a wide variety of wires.

The new bonding head, with the deep access option and tail adjust system, makes it ideal for deep cavity microwave applications where tight control over the tail length is required.

1.2 Features

1.2.1 Common Standard Features

The following standard features are found on all K&S 4500 Series models:

- **DC Servo/LVDT Closed Loop Control** enables the bonding head to move at maximum speed and high precision between set heights, with gradual starts and stops, and minimum jarring or vibration. All sequence and timing functions are controlled electronically.
- **Ultrasonic System** results in maximum efficiency, minimum power requirement and close control of the bonding process.
  - **High-Q Transducer** is sensitive to changes of load during bonding.
  - **Phase-Locked-Loop (PLL) Ultrasonic Generator** enables the bonder to apply power to the bond at the instantaneous frequency of the system.
- **Electronic Dials** control settings of bond forces, ultrasonic power, search and loop heights, and bonding duration.
- **Air-Damped Bonding Head** provides smooth travel without vibration and ensures soft-touch without impact.

- **Bonding Area** - 134 mm x 134 mm (5.3" x 5.3") for wedge bonding. 152 mm x 152 mm (6.0" x 6.0") for ball bonding.
- **Multi Mouse** Single Hand Integrated Control, an ergonomic "all-in-one" control system, provides:
  - Bonding position control
  - Semi/Auto mode operation - semi-automatic bonding
  - Manual Z mode operation - manual movement of the bonding head
  - Stitch mode operation - performance of any number of consecutive stitch bonds.
- **Temperature controller** controls the temperature of the heated workholders.
- **Diagnostic LEDs** allow fast isolation of faults that may occur during machine operation. Any faults detected during the machine's self-test cause a combination of the LEDs to turn on. This helps the technician determine the cause of the fault.
- **Overhead Microscope** provides up to 85° view of the work area, depending on the bonder's microscope and spotlight (optional) adjustments.
- **Motorized Y Table** with programmable steps provides tight control of wire looping and wire length (4526).
- **Manual Z Mode** allows manual control of all bonding operations. This mode is very useful when bonding hybrid packages, or for bonding very fine wire.
- **Lange Coupler Mode** enables semi-automatic bonding of Lange coupler applications. This mode provides exact repetitive table motion and produces consistent low loops (4526).
- **Tail Control System** provides very fine control of the tail length, resulting in tail length consistency throughout the bonding process. The system is driven by a high resolution linear stepper motor. A real-time tail control algorithm allows you to manually control and adjust the tail length during the bonding process.
- **Negative Electronic Flame-Off (N.E.F.O.)** system forms a ball by generating a spark between the N.E.F.O. wand and the wire (4522, 4524).

1.2.2 Optional Features

The following optional features are available for the K&S 4500 Series models:

- **Clamp 90° Wire Feed Kit** allows up to 12.7 mm (500 mil) access for bonding in deep packages and for rework of microwave and hybrid packages.

- **Height Adjustable Rotary Table** provides simple and accurate control over the required wire angle and the bond level height. This table is useful for applications with bond level variation and different wire directions.
- **Spotlight** eases targeting by projecting a bull's-eye pattern onto the bonding pad. The cross hair pattern provides even greater accuracy with narrower gauge wire.
- **Workholders** - various types of stationary or motorized, heated or unheated workholders are available.
- **Fiber Optic Illumination Kit** provides better illumination than the standard lamp and contains a spotlight target.
- **Motorized Y Table Kit** for Model 4524 provides tight loop control by motorized auto-step back and reverse.
- **3rd Channel Kit** provides 10 optional bonding cycles with three different bonding parameters.
- **Deep Access Kit** for Model 4524 allows 12.7 mm (500 mil) deep access capability.

For all optional equipment and accessories, see Chapter 14.

1.3 Specifications

1.3.1 4522

The K&S 4522 Multi-Process Ball Bonder has the following specifications.

Wire

Gold	18 - 76 µm (0.7 - 3.0 mil)
Spool	50.8 mm (2")

Machine Specifications

Bonding Area	152 mm x 152 mm (6" x 6")
Throat Depth	143 mm (5.6")
Gross Table Motion	140 mm (5.5")
Fine Table Motion	14 mm (0.55")
Multi Mouse Ratio	6:1
Z Motion System	DC servo/LVDT control
Z Travel	9.1 mm (360 mil)
Ultrasonic System	High Q 60 kHz transducer PLL ultrasonic generator
Low Ultrasonic Power	1.3 W
High Ultrasonic Power	2.5 W
Bond Time:	
Ball Bonding/Bumping	20 - 200 ms
Single Point TAB	20 - 1000 ms
Bond Force	Force coil 10 - 160 gr
Wire Termination	Clamp tear
Modes of Operation	Semi-Auto, Manual Z, Ball Bonding, Ball Bumping, Single Point TAB, Coining
Ball Formation System	Negative EFO (N.E.F.O.)

Missing Ball Detector	Indication and auto-stop
Temperature Controller	up to 250º ± 0.5ºC

Options

- Microscopes and eyepieces
- Deep access kit for 12.5 mm (500 mil) Z travel
- Spotlight target
- 3rd channel kit
- Motorized Y table for tight loop control
- Fiber optic illumination and spotlight target
- Manually height-adjustable, heated workholders
- Motorized index workholders
- Heated capillary kit
- Height-adjustable rotary table
- ESD kit and shielded wand
- Left-hand operation
- Portable dials kit

Electrical Requirements

Voltage	100 - 120/220 - 240 V ± 10%, 50/60 Hz, 250 VA max.

Physical Dimensions

Height	530 mm (21")
Width	680 mm (27")
Depth	700 mm (27.5")

Weight (basic machine)

Shipping	55 kg (122 lb)
Net	31 kg (69 lb)

Note: These specifications are subject to change without prior notice.

1.3.2 4524

The K&S 4524 Ball Bonder has the following specifications.

Wire

Gold	18 - 76 µm (0.7 - 3.0 mil)
Spool	50.8 mm (2")

Machine Specifications

Bonding Area	152 mm x 152 mm (6" x 6")
Throat Depth	143 mm (5.6")
Gross Table Motion	140 mm (5.5")
Fine Table Motion	14 mm (0.55")
Multi Mouse Ratio	6:1
Z Motion System	DC servo/LVDT control
Z Travel	9.1 mm (360 mil)
Ultrasonic System	High Q 60 kHz transducer PLL ultrasonic generator
Low Ultrasonic Power	1.3 W
High Ultrasonic Power	2.5 W
Bond Time:	10 - 100 ms/10 - 1000 ms
Bond Force	Force coil 10 - 160 gr
Wire Termination	Clamp tear
Modes of Operation	Semi-Auto, Manual Z
Ball Formation System	Negative EFO (N.E.F.O.)
Missing Ball Detector	Indication and auto-stop
Temperature Controller	up to 250º ± 0.5ºC

Options

- Microscopes and eyepieces
- Deep access kit for 500 mil (12.5 mm) Z travel
- Motorized index workholders
- Heated capillary kit

- Spotlight target
- 3rd channel kit
- Motorized Y table for tight loop control
- Fiber optic illumination and spotlight target
- Manually height-adjustable, heated workholders
- Height-adjustable rotary table
- ESD kit and shielded wand
- Left-hand operation
- Portable dials kit

Electrical Requirements

Voltage	100 - 120/220 - 240 V ± 10%, 50/60 Hz, 250 VA max.

Physical Dimensions

Height	530 mm (21")
Width	680 mm (27")
Depth	700 mm (27.5")

Weight (basic machine)

Shipping	55 kg (122 lb)
Net	31 kg (69 lb)

Note: These specifications are subject to change without prior notice.

1.3.3 4523

The K&S 4523 Wedge Bonder has the following specifications.

Wire

Diameter Range	
Gold	12.7 - 76 µm (0.5 - 3.0 mil)
Aluminum	20 - 76 µm (0.7 - 3 mil)
Gold Ribbon (Option)	Up to 25 x 250 µm (1x10 mil)
Spool	12.7 mm (0.5")
Option	50.8 mm (2")

Machine Specifications

Bonding Area	134 mm x 134 mm (5.3" x 5.3")
Throat Depth	143 mm (5.6")
Gross Table Motion	140 mm (5.5")
Fine Table Motion	14 mm (0.55")
Multi Mouse Ratio	6:1
Z Motion System	DC servo/LVDT control
Z Travel	
Low Reset	6.6 mm (260 mil)
High Reset	12.7 mm (500 mil)
Ultrasonic System	High Q 60 kHz transducer PLL ultrasonic generator
Low Ultrasonic Power	1.3 W
High Ultrasonic Power	2.5 W
Bond Time	10 - 100 ms/10 - 1000 ms
Bond Force	Force coil 10 - 160 gr
Wire Termination	Clamp tear

Wire Feed Angle	30/45º
Option	90º (Vertical)
Modes of Operation	Semi-Auto, Manual Z, Stitch
Temperature Controller	up to 250º ± 0.5ºC

Options

- Microscopes and eyepieces
- 90º wire feed angle kit for deep access
- Spotlight target
- 3rd channel kit
- Height-adjustable rotary table
- Fiber optic illumination and spotlight target
- Manually height-adjustable, heated workholders
- Motorized index workholders
- Mini-heater kit
- ESD kit and shielded wand
- Left-hand operation
- Portable dials kit

Electrical Requirements

Voltage	100 - 120/220 - 240 V ± 10%, 50/60 Hz, 250 VA max.

Physical Dimensions

Height	530 mm (21")
Width	680 mm (27")
Depth	700 mm (27.5")

Weight (basic machine)

Shipping	55 kg (122 lb)
Net	31 kg (69 lb)

Note: These specifications are subject to change without prior notice.

1.3.4 4526

The K&S 4526 Auto Stepback Wedge Bonder has the following specifications.

Wire

Diameter Range	
Gold	12.7 - 76 µm (0.5 - 3.0 mil)
Aluminum	20 - 76 µm (0.7 - 3 mil)
Gold Ribbon (Option)	Up to 25 x 250 µm (1x10 mil)
Spool	12.7 mm (0.5")
Option	50.8 mm (2")

Machine Specifications

Bonding Area	134 mm x 134 mm (5.3" x 5.3")
Throat Depth	143 mm (5.6")
Gross Table Motion	140 mm (5.5")
Fine Table Motion	14 mm (0.55")
Multi Mouse Ratio	6:1
Motorized Y	
Stepback	Up to 4 mm (160 mil)
Reverse	Up to 0.25 mm (10 mil)
Kink Height	Up to 0.5 mm (20 mil)
Z Motion System	DC servo/LVDT control
Z Travel	
Low Reset	6.6 mm (260 mil)
High Reset	12.7 mm (500 mil)
Ultrasonic System	High Q 60 kHz transducer PLL ultrasonic generator
Low Ultrasonic Power	1.3 W
High Ultrasonic Power	2.5 W

Bond Time	10 - 100 ms/10 - 1000 ms
Bond Force	Force coil 10 - 160 gr
Wire Termination	Clamp tear
Wire Feed Angle	30/45º
Option	90º (Vertical)
Modes of Operation	Semi-Auto, Manual Z, Stitch, Lange Coupler
Temperature Controller	up to 250º ± 0.5ºC

Options

- Microscopes and eyepieces
- Ribbon clamp
- Manually height-adjustable, heated workholders
- Motorized index workholders
- Mini-heater kit
- Fiber optic illumination and spotlight target
- 90º wire feed angle kit for deep access
- Spotlight target
- 3rd channel kit
- Height-adjustable rotary table
- ESD kit and shielded wand
- Left-hand operation
- Portable dials kit

Electrical Requirements

Voltage	100 - 120/220 - 240 V ± 10%, 50/60 Hz, 250 VA max.

Physical Dimensions

Height	530 mm (21")
Width	680 mm (27")
Depth	700 mm (27.5")

Weight (basic machine)

Shipping	55 kg (122 lb)
Net	31 kg (69 lb)

Note: These specifications are subject to change without prior notice.

2. INSTALLATION

This chapter contains instructions and guidelines for installing your K&S 4500 Series Manual Wire Bonder.

2.1 Pre-installation Requirements

Before installing the K&S 4500 Series Manual Wire Bonder, ensure that the designated work area includes:

- One or two properly grounded AC wall outlets, supplying 100-120/220-240 V ± 10% at 50/60 Hz (250 VA max).
- Stable work table, as shown in Figure 2-1.
- Vacuum for the workholder (if required).

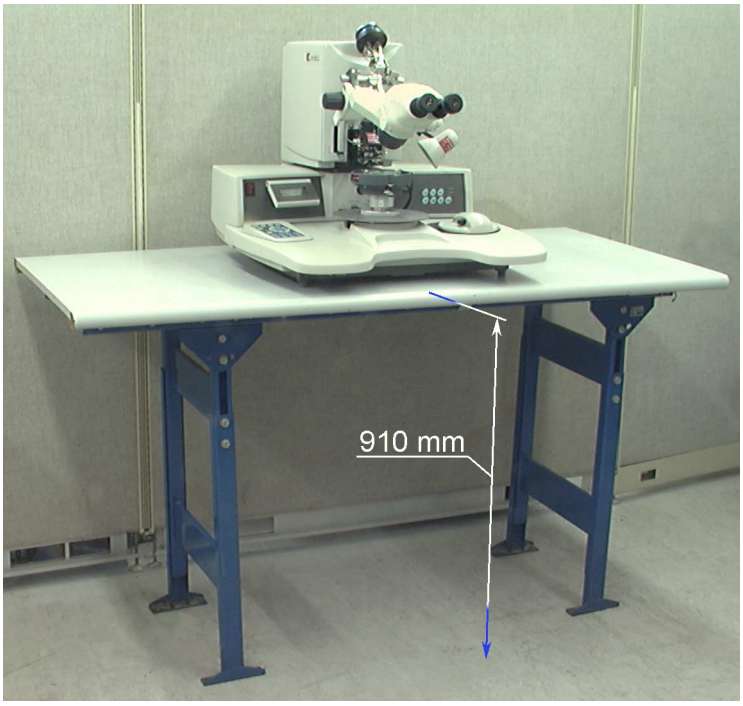


Figure 2-1: Stable Work Table for K&S 4500

2.2 Unpacking and Installation

Your K&S 4500 Series Manual Wire Bonder model was packed in a reinforced container that provides complete protection against damage during shipment.

To remove the bonder from its container:

1 Remove the packing list from the pocket located on the outside of the shipping crate.

2 Cut the plastic bands that bind the wood.

3 Open the wood clamps on the top cover with a long screwdriver and remove the top cover (see Figure 2-2).

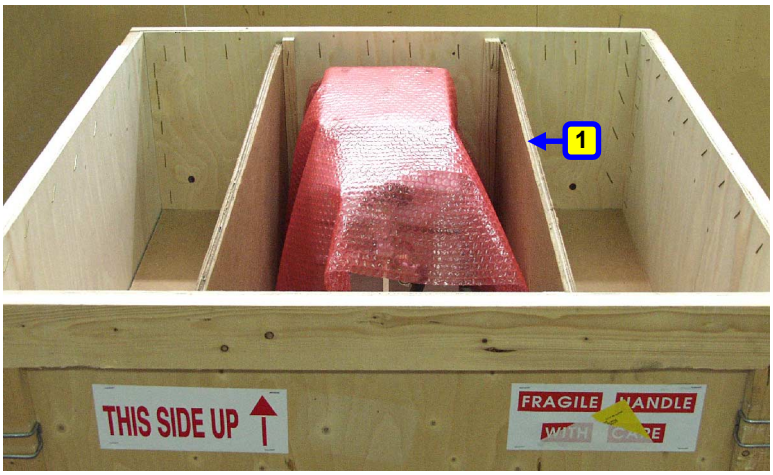
4 Lift the accessories boxes out of their “cages” on the sides of the bonder. From these boxes, remove the box(es) containing the bonder fixtures and accessories (see Figure 2-3).

5 Remove the remaining walls of the shipping crate.

6 Remove the four (4) screws that secure the shipping board to the base of the box using a hex wrench (see Figure 2-4).

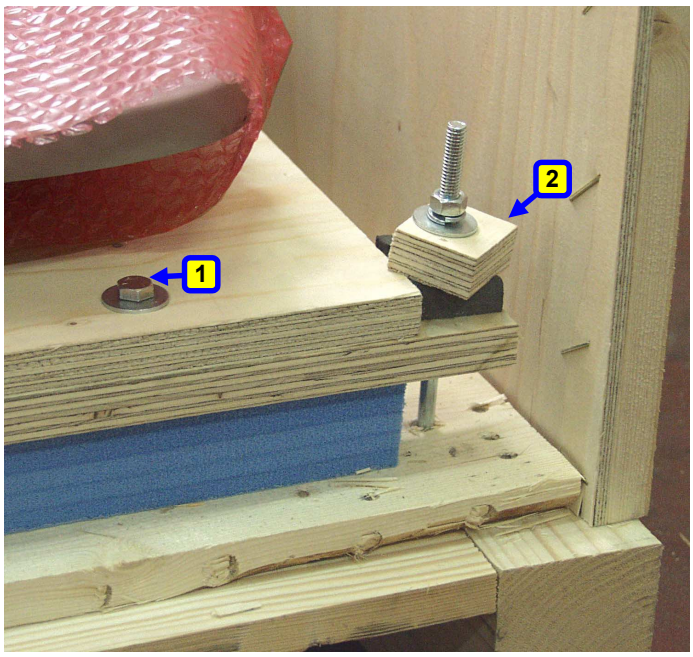
1 Box Accessories

Figure 2-2: K&S 4500 Wire Bonder Packaging



1 Box Holder

Figure 2-3: Removing the K&S 4500 Box Holder



1 Screw attached to base (x4)
2 Square Block

Figure 2-4: Loosening the K&S 4500 Square Blocks

7 Loosen the four (4) nuts holding the four (4) square blocks that tighten the shipping board to the base of the crate. Turn the square blocks to release the shipping board.

8 Lift the bonder with its attached shipping board out of the crate and place it on a cart. This step requires two people (see Figure 2-5).

Caution: Grasp the bonder lower casting. Do not grasp the covers (see Figure 2-5).

9 Remove the protective bubble sheet from the bonder base (see Figure 2-6).

10 Using a flat 9/16" wrench, remove the shipping screws, spacers and shipping board from the base of the bonder (see Figure 2-7).

11 Place the bonder at its designated installation site. Ensure that it rests on a stable platform in a draft-free location. It is not necessary to bolt the bonder to the platform.

12 Remove the protective covering of the area light by cutting the twine at the ends of the woven sponge sleeve and slipping the sleeve off (see Figure 2-6).

13 Remove the masking tape attaching the Multi Mouse.

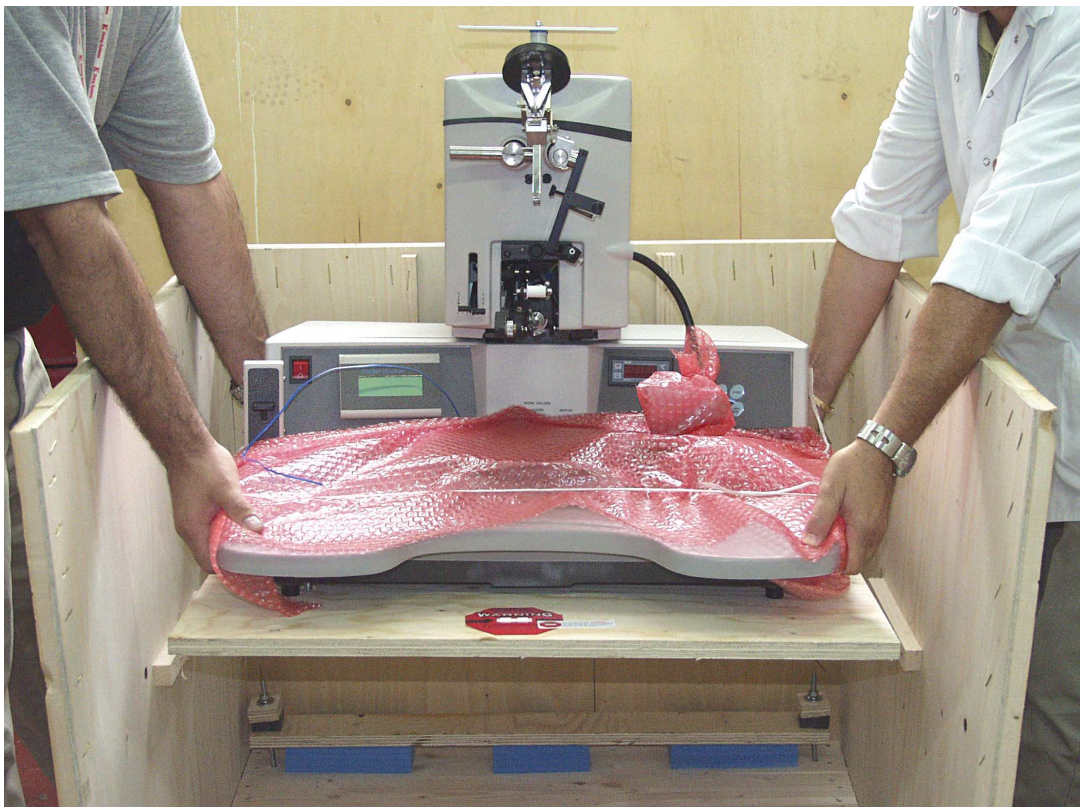


Figure 2-5: Taking the K&S 4500 Wire Bonder Out of the Shipping Crate

14 Open the box(es) containing the bonder fixtures and accessories and verify that the contents are as written in the packing slip.

Note: If any part is missing or damaged, notify your K&S representative and shipper without delay.

15 From the interior right side of the main head, remove the rubber band holding the Height Control Link to the main LVDT holder (see Figure 2-8).

16 Remove the sponge packing located between the cam pulley and the height control link (see Figure 2-8).

17 Remove the protective packaging from the force coil top (see Figure 2-8).

18 Remove the small plastic pads located between the jaws of the wire clamp and the drag clamp (see Figure 2-9).

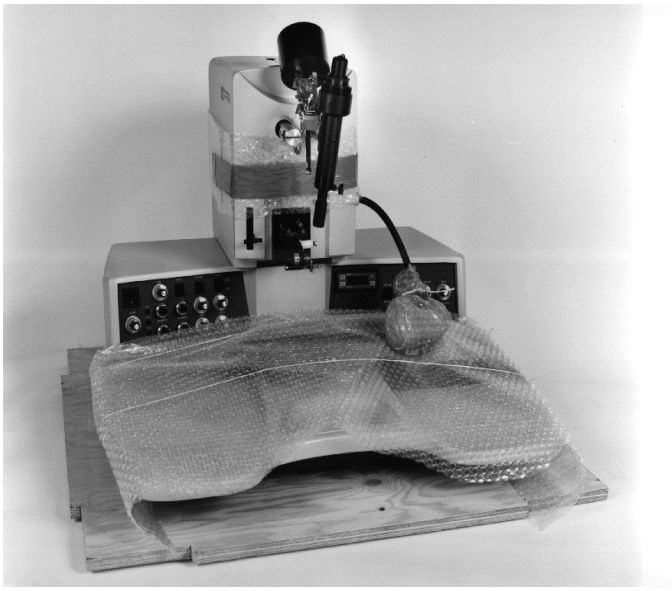


Figure 2-6: K&S 4500 Wire Bonder on Shipping Board

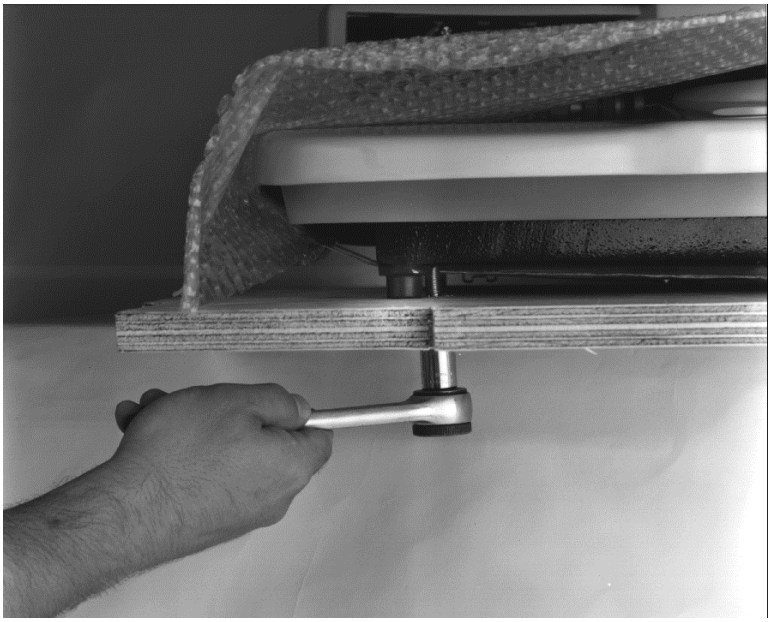


Figure 2-7: Removing the Shipping Screws

19 Remove the sponge padding located between the bonding head and the wand bracket (4522, 4524).

20 Remove the bands holding the bonding head (see Figures 2-8 and 2-9).

Note: The following step requires two people.

Caution: Improper support of the bonder when performing the following step will cause the manipulator to become disassembled and damage the bonder.

21 Free the manipulator assembly as follows (see Figure 2-10):

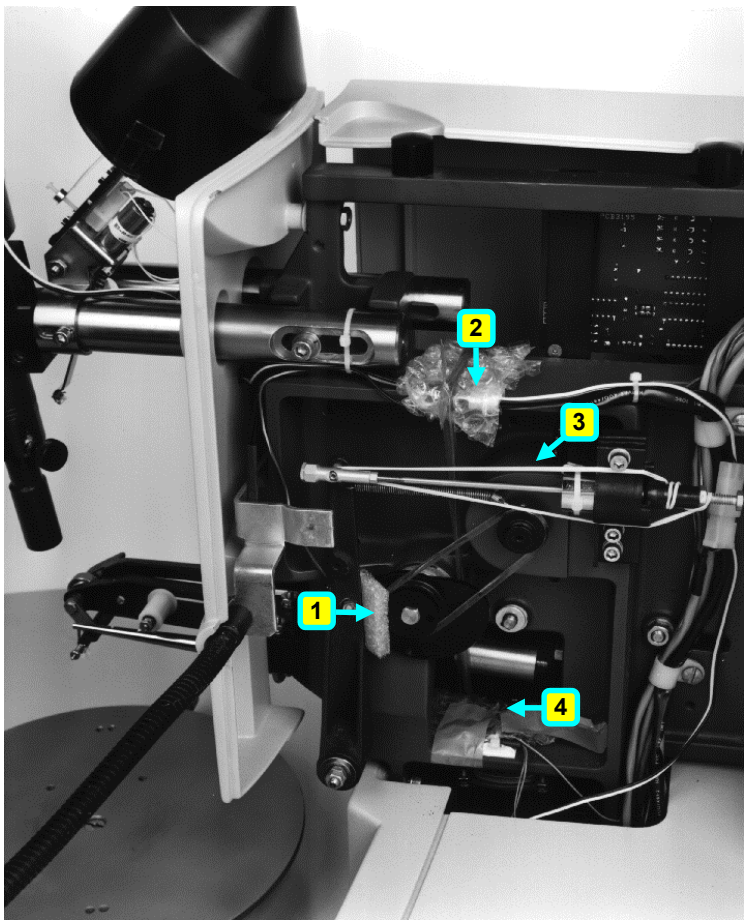
a. Pull the bonder forward so that it projects beyond the table, supporting the chessman and table with one hand. Tilt the bonder backwards to access the bottom of the bonder with the other hand. Take care not to tip the bonder over.

b. Using an Allen wrench, remove the two screws securing the manipulator assembly locking bar. Remove the bar. Retain the bar in case you will have to move the bonder to another location.

c. Slide the bonder back into place on the table.

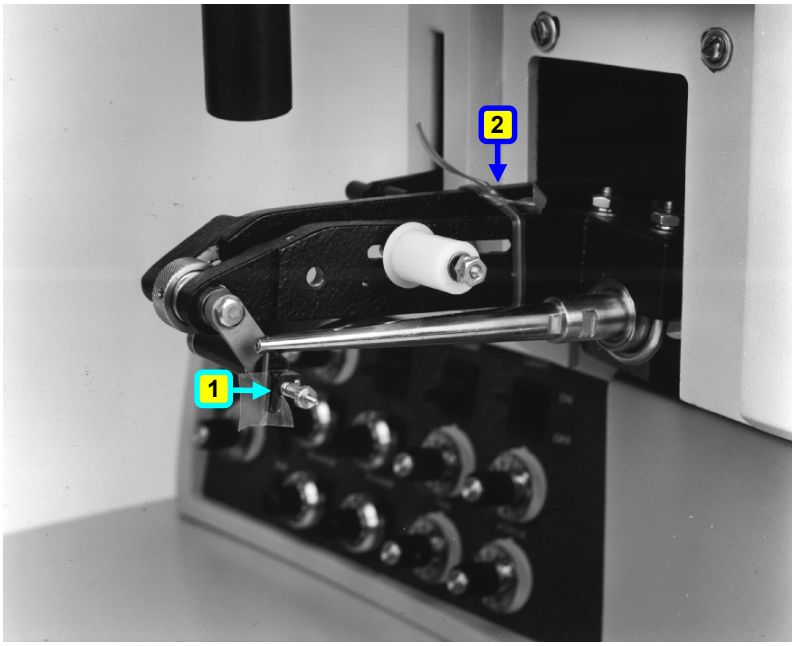
22 Uncoil the power cord. See the bonder nameplate for the operating voltage requirement. Check that your AC wall outlet supplys the correct voltage. If it does not, contact your K&S representative.

Note: If the cord does not have a plug, install a 3-prong plug which fits your AC wall outlet socket. In particular, note the ground connection and remove the GROUND label.



1 Bonding Head Band
2 LVDT Band
3 Cam Band
4 Coil Band

Figure 2-8: Main Head Packaging - Inner Right Side



1 Bonding Head Band
2 Clamp Pad

Figure 2-9: Main Head Packaging - Front Side

Figure 2-10: Support the chessman and manipulator and lift

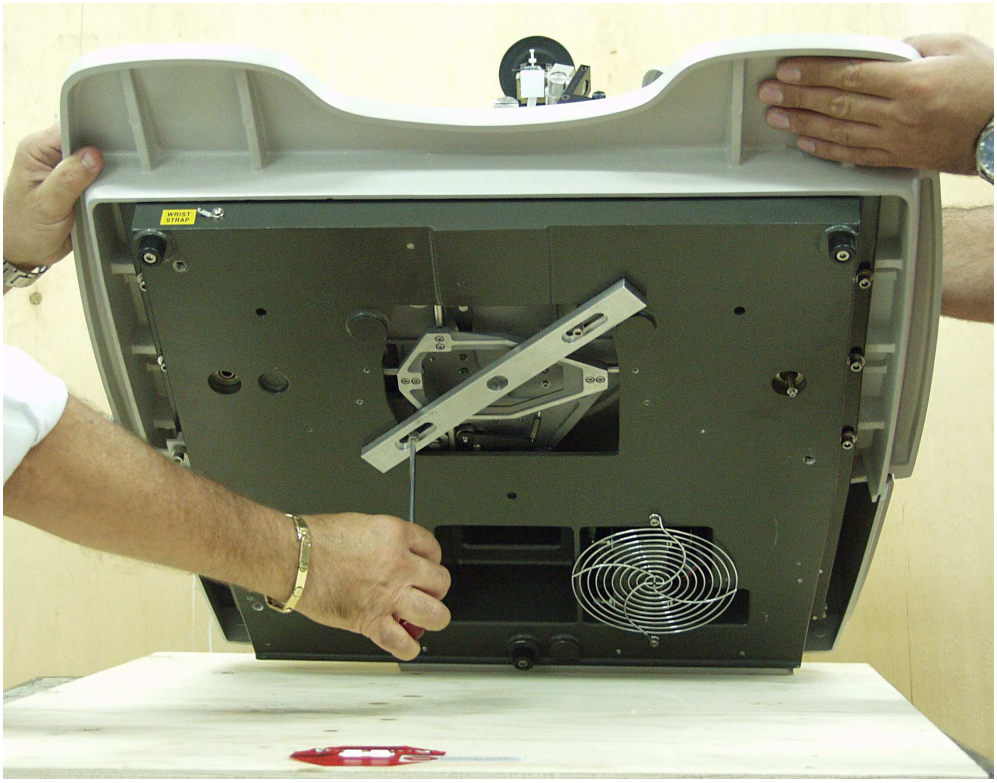


Figure 2-11: Removing the Manipulator Locking Rod

2.3 Microscope Installation

This section describes the installation of the microscope.

2.3.1 Leica S6/MZ-6 Microscope Installation

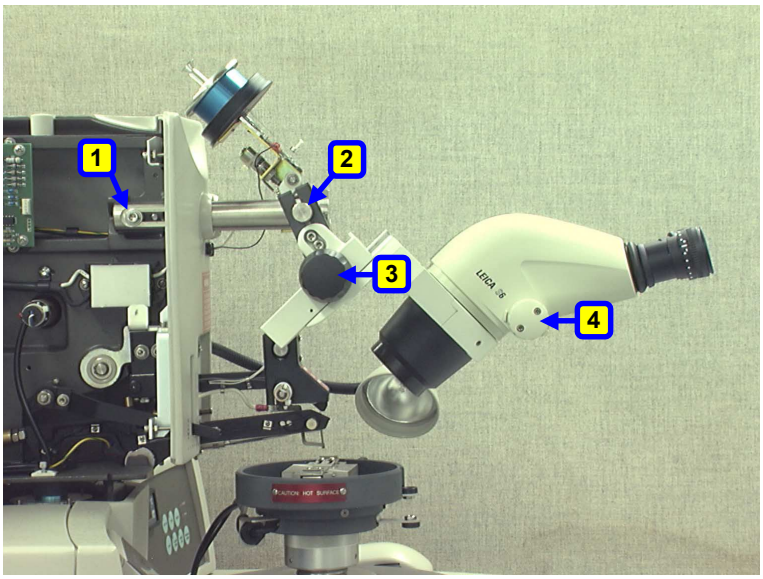
1 Take the microscope holder out of the accessories box. Unwrap and install it on the microscope support

2 Using a millimetric Allen wrench, adjust the pivot locking screw

3 To install the microscope, mount it on the pivot from the left side and secure it in place by tightening the pivot locking screw.

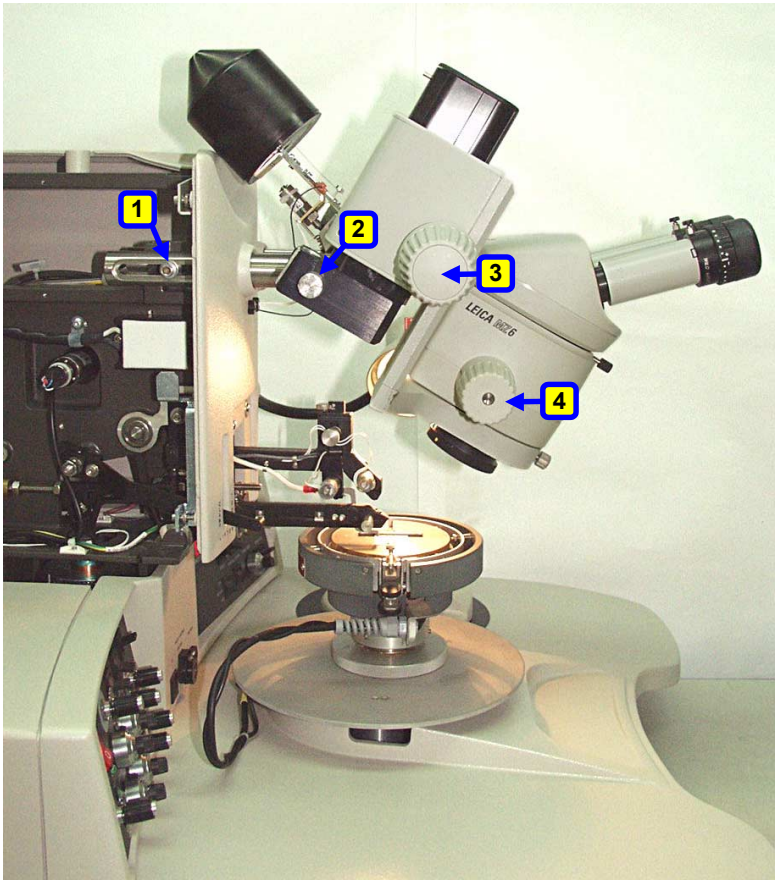
4 Install the eye pieces in the oculars

Note: To adjust the view angle, release the rod locking screw and slide the rod to the required position.



1 Rod Locking Screw
2 Pivot Locking Screw
3 Focus Knob
4 Zoom Knob

Figure 2-12: Leica S6 Microscope Installation



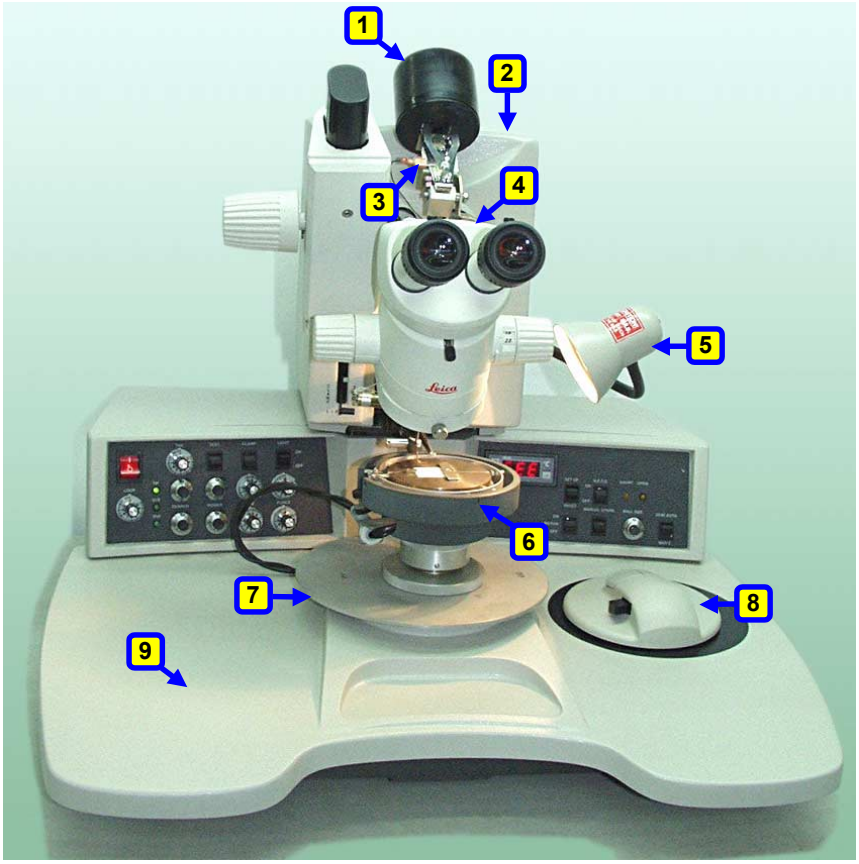
1 Rod Locking Screw
2 Pivot Locking Screw
3 Focus Knob
4 Zoom Knob

Figure 2-13: Leica MZ6 Microscope Installation

3. PHYSICAL DESCRIPTION

This chapter provides a description of the principal parts of the K&S 4500 Series Manual Wire Bonder.

Figure 3-1 shows a general view of the 4500 Manual Wire Bonder.



1 2" Spool Feed System
2 Main Head
3 Kicker
4 Microscope
5 Area Light
6 Workholder
7 Rotary Table
8 Multi Mouse
9 Base Cover

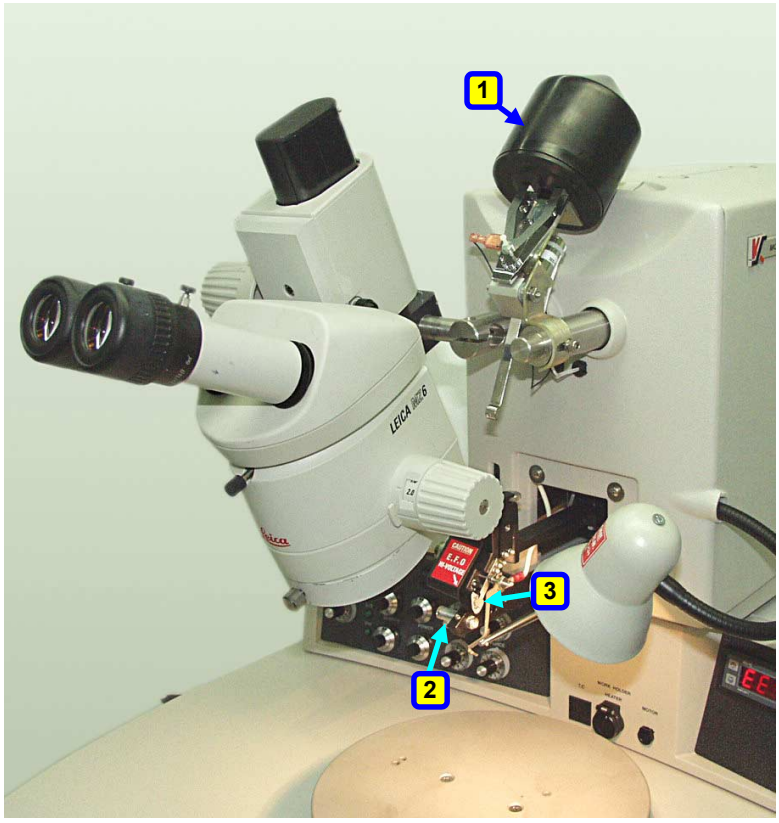
Figure 3-1: K&S 4500 Manual Wire Bonder – Main Parts

3.1 The Main Head

Figure 3-2 shows the main head assembly of Models 4523 and 4526.

Figure 3-2: The Main Head Assembly – 4523, 4526

Figure 3-3 shows the main head assembly of Models 4522 and 4524.



1 2" Spool for Vertical Wire Feed
2 Bonding Head
3 Electrode and Drag Assembly

Figure 3-3: The Main Head Assembly – 4522, 4524

3.1.1 The Wire Feed System

3.1.1.1 Spool for Vertical Wire Feed (4522, 4524, 4523, 4526)

The 2" Spool for Vertical Wire Feed System is mounted on the spotlight support. At the top of the system, a 2" spool stores the wire and is held in place by a spool holder. A glass tube for feeding the wire is attached to the spool cap. Below the glass tube, a fixed tensioner provides wire tension, preventing slack.

The 2" spool includes a kicker, which hangs from the top front of the main head. After the first bond is performed, the kicker releases a sufficient amount of wire for the bonder to complete the loop and the second bond (4522, 4524).

A drag clamp retains tension on the wire at certain stages in the bonding cycle. The force is adjusted by rotating an adjustment nut on the side of the clamp. A wire guide leads the wire across the jaws of the clamp (4522, 4524).

For more details, see Figure 5-5.

3.1.1.2 2" Spool for 30°/45° Wire Feed (4523, 4526)

The 2" Spool for 30°/45° Wire Feed System is mounted by a bracket on the front cover. The spool is located directly above the 0.5" spool axis, which preserves wire tension. Wire is fed through a hole in the transducer to the wire clamp either over the axis (45°) or under the axis (30°).

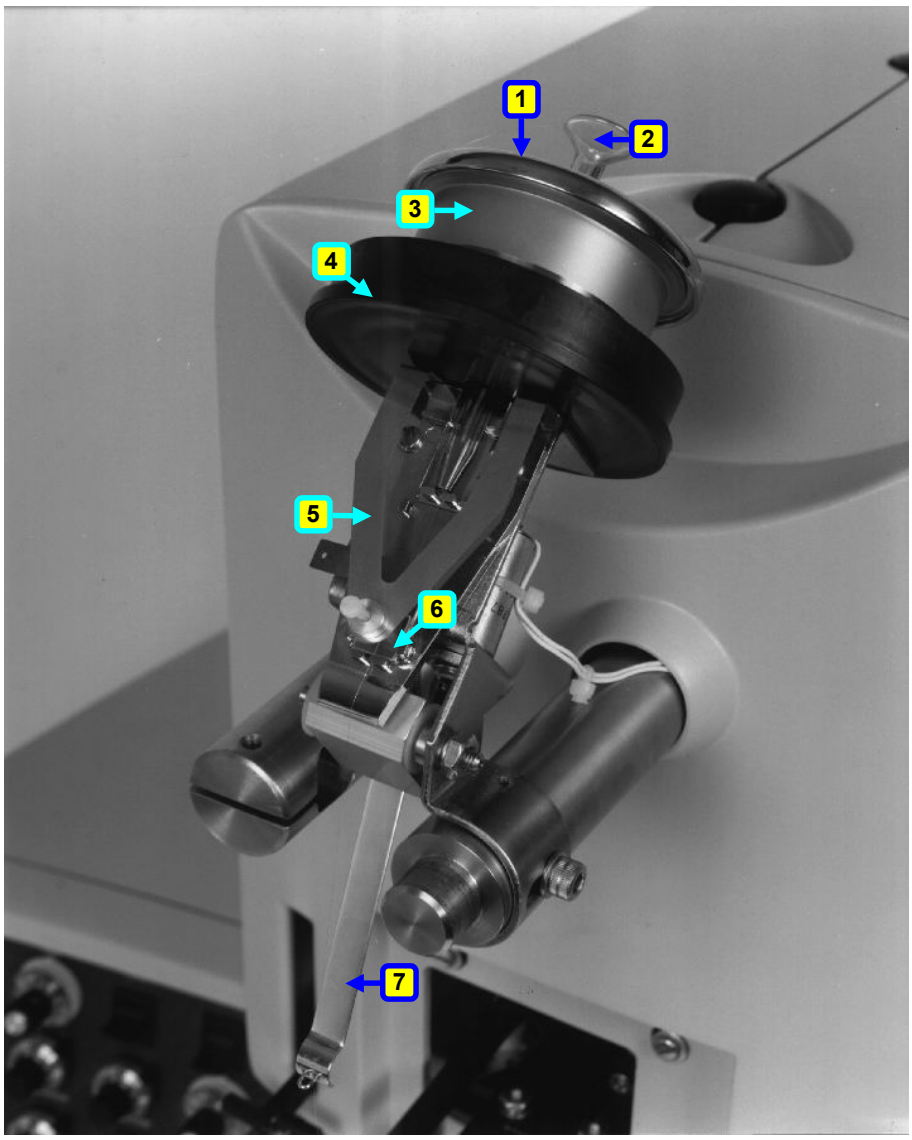
For more details, see Figure 5-7.

3.1.1.3 0.5" Spool for 30°/45° Wire Feed (4523, 4526)

The 0.5" spool is located on the bonding head. The wire is pulled from the spool through the feed holes of the ultrasonic transducer at 30° or 45° angles, depending on the application. The wire is then fed into the wedge.

The spool rotates when the wire is pulled. Wire tension is controlled by turning a nut on the side of the spool.

For more details, see Figure 5-6.



1 Spool Cup
2 Glass Tube
3 Wire Spool
4 Spool Holder
5 Fixed Tensioner
6 Glass Plate
7 Kicker

Figure 3-4: The 2" Spool

3.1.1.4 Spool for Vertical Wire Feed (4523, 4526)

The 2" spool for ribbon bonding is located on the bonding head (Figure 5-11).

The 0.5" spool is located on the bonding head directly above the wire clamp.

The spool rotates as the wire is pulled. Wire tension is controlled by turning a nut on the side of the spool.

For more details, see Figure 5-8.

3.1.2 Microscope

The bonder may be equipped with either a Leica S6, MZ6 or S6D microscope. The microscope has a common focus of both oculars and an adjustable magnification zoom capability.

3.1.3 The Area Light

The area light illuminates the work area so that it may be viewed through the microscope.

The area light is fastened to the front of the main head frame by a flexible gooseneck. The LIGHT on/off switch is located on the left control panel.

3.1.4 The Bonding Head

The bonding head is a horizontal lever with its pivot fixed in the main head frame. The bonding head is driven by a dc servo motor.

The up/down motion of the bonding head is controlled electrically by signals from the logic board and mechanically by the cam pulley and height control link. The air dashpot at the rear of the bonding head assures smooth, vibration-free motion.

Bonding head position feedback to the logic circuits is affected by the main linear variable differential transformer (LVDT). This synchronizes the bonding head motion with the bonding cycle and modulates the bonding head speed.

The front of the bonding head holds the ultrasonic transducer, within which the wedge/capillary is clamped. The wedge/capillary holds the wire above the bonding pad and activates the ultrasonic vibration required to perform the bond.

The bonding head also contains the wire clamp, which performs the tear and tail operations.

3.1.5 The Tool Lifter

The tool lifter enables manual lifting of the front end of the bonding head. This is useful for replacing the wedge/capillary, or for protecting the wedge/capillary when it's not in use. Raising the tool lifter causes its lever to lower the rear part of the bonding head, which raises the bonding head front and the wedge/capillary.

3.1.6 The Clamp Lifter (4523, 4526)

The clamp lifter helps you feed the wire into the wedge wire feed hole. Raising the clamp lifter moves the wire clamp away from the rear of the wedge.

The clamp lifter handle is linked to an arm that raises the rear end of the tear & feed arm, which in turn, pivots the wire clamp to the rear position.

3.1.7 The Negative Electronic Flame Off System (N.E.F.O.) (4522, 4524)

The Negative Electronic Flame Off System (N.E.F.O.) is a standard feature of Models 4522 and 4524. The N.E.F.O. has two assemblies:

A generator box mounted inside the rear of the main head.

A wand located above the bonding head.

The generator box supplies negative voltage to the wand, producing a spark between the wire and the wand. This spark creates the ball on the wire.

3.1.8 The Spotlight (Optional)

The spotlight emits a bull's-eye pattern on the bonding pad under the tip of the wedge/capillary. This shows you the exact location of the bonding.

Using the centering screws in the spotlight housing, you can center the beam on the bonding target area.

3.2 The Base

The base houses the bonder's electronic and mechanical controls. The following subassemblies are found on the base:

- The Manipulator and Multi Mouse (right or left-hand operation)
- Right and Left Control Panels
- Motorized Y Table (4526)
- Workholder Connector Panel

3.2.1 The Manipulator and Multi Mouse

The manipulator supports the workholder table. It glides on three ball-bearing raceways mounted within the base. The manipulator moves in the horizontal plane, without backlash, and is secured against rotation.

The manipulator helps you maneuver a device, so that the bonding pads rest directly under the wedge/capillary. You can also maneuver the device over a larger motion by moving the workholder on the workholder table.

The Multi Mouse, located on either the right or left side of the base, is used primarily to make fine adjustments in the position of the workholder. Through a mechanical linkage system, the motion of the Multi Mouse is translated, at a 6:1 ratio, to the manipulator.

The Multi Mouse includes buttons for switching the bonding head into specific bonding modes. For more details, see section 4.1.

3.2.2 The Motorized Y Table (4526)

The motorized Y table is mounted on the manipulator of Model 4526. This enables programmable motion along the Y-axis which controls loop formation. The table assembly contains the following:

- Stepper motor
- Lead screw
- Anti-backlash nut
- Linear slides

The motorized Y table is also an option for Model 4524.

3.2.3 The Left and Right Control Panels

The left and right control panels are located on the upper face of the base (see Figure 3-1).

The left control panel contains the power on/off switch, the controls for setting the bonding parameters and indicators connected with the bonding process. The left control panel is common for all 4500 Series Bonders.

The right control panel contains controls and indicators for the bonder's electrical operations, such as the temperature controller, motorized Y table motion adjustment (4526) and N.E.F.O. system (4522, 4524). The right control panel is specific for each model.

The controls and their functions are described in Chapter 4.

3.2.4 The Workholders Connectors Panel

The workholders connectors panel is located at the center of the bonder directly behind the workholder table. It contains the following connectors:

T.C.	Connects to the workholder thermocouple, which indicates the workholder temperature.
HEATER	Connects to the workholder heating power supply.
MOTOR	Connects two 19 V ac lines to the motorized index workholder power supply.

4. CONTROLS AND INDICATORS

This chapter describes the K&S 4500 Series Manual Wire Bonders controls and indicators.

4.1 The Multi Mouse

The Multi Mouse is located on the base either to the right or the left of the workholder table. The Multi Mouse has two functions:

- Control of the bonding cycle.
- Fine positioning of the bonding pad under the wedge/capillary.

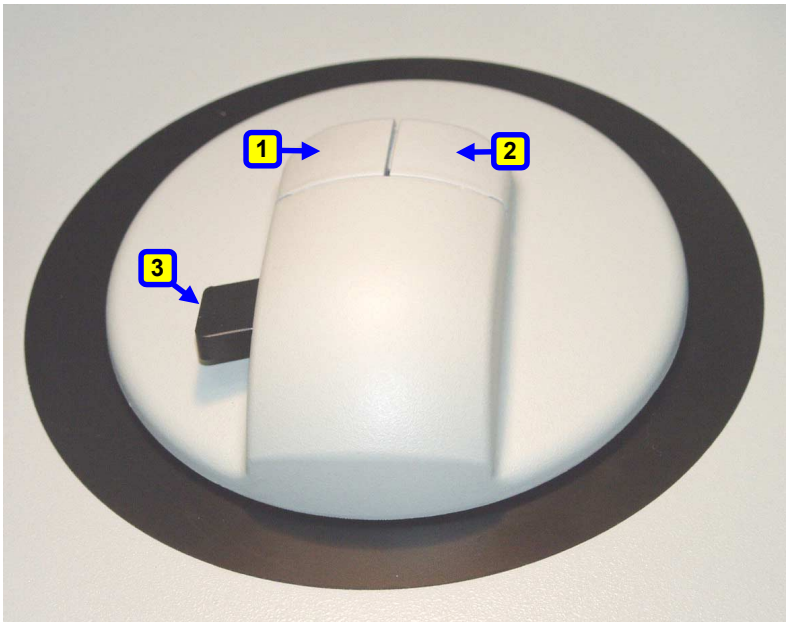
The Multi Mouse has three pushbuttons (see Figure 4-1):

SEMI/AUTO — Left pushbutton on the top side of the Multi Mouse. It operates the semi-automatic bonding cycle.

MANUAL Z — Sidebutton located on the left side of the Multi Mouse. It activates the Manual Z mode, enabling manual control of bonding head movement

STITCH — Right pushbutton on the top side of the Multi Mouse. Pressing and holding this pushbutton after performing the first bond activates the Stitch mode. The bonder continues making stitch bonds until this pushbutton is released (not applicable for ball bonding).

In addition, pressing the Stitch pushbutton when the bonding head is in the Reset position displays the bond cycle mode of the bonder. The bonding mode indications are described in Chapter 6.



1 Semi/Auto Pushbutton
2 Stitch Pushbutton
3 Manual Z Sidebutton

Figure 4-1: The Multi Mouse

4.2 The Left Control Panel

The left control panel, located on the left side of the base, is common for all K&S 4500 Series Bonders. It has the following switches and indicators (see Figure 4-2):

POWER	Switch for powering on the bonder. When the switch is in the up position (ON), power from the AC wall outlet is applied to the bonder.
CLAMP	Switch for opening the wire clamp for wire loading. When the switch is in the up position, the clamp is open. When the switch is in the down position, the clamp is closed.
TEST	Momentary switch. Pressing this switch tests the tuning of the ultrasonic generator.
LIGHT	Switch for turning the area light on and off.

1st indicator	When on, this indicator signals the start of the first bonding cycle. The bonding head is in the Reset position. The indicator remains on until the completion of the first bond.
2nd indicator	When on, this indicator signals that the bonder is operating in the second bonding cycle. The bonding head is at the Loop height. The indicator remains on until the completion of the second bond.
U/S indicator	When on, this indicator signals that the ultrasonic transducer is active. When the TEST switch is pressed up, this indicator turns on, signalling that the ultrasonic circuit is properly tuned.

On the left control panel, the top row dials are used for setting the parameters of the first bond, and the bottom row dials are used for setting the parameters of the second bond.

The dials that set the bonding parameters are:

SEARCH	Controls the Search height of the bonding head.
FORCE	Controls the downward force exerted by the bonding head during bonding.
TIME	Controls duration of the ultrasonic energy and bonding force.
POWER	Controls the electrical power level of the ultrasonic energy. A high power setting increases the mechanical ultrasonic vibration of the tool tip.
LOOP	Sets the height to which the bonding head rises after performing the first bond.
TAIL	Sets the tail length.

Figure 4-2: The Left Control Panel

4.3 The Right Control Panel

The right control panel, located on the right side of the base, is specific for each model of the K&S 4500 Series (see Figures 4-3, 4-4 and 4-5).

4.3.1 Common Right Panel Controls

The following right panel controls are common to all 4500 Series Bonders:

SET UP/RESET — Three-position switch used for measuring bond forces, for normal operations and for resetting the system.

Setting the switch to the SET UP position applies the bond force to the bonding head.

The switch in the mid-position permits normal operation.

Setting the switch to the RESET (momentary) position resets the bonder. In addition, pressing this switch to RESET allows you to change the bond cycle mode.

SEMI AUTO/MAN Z — Switch for selecting the bond cycle mode to Semi/Auto or Manual Z.

Setting the switch in one of the positions enables bonding in the selected mode. However, bonding head movement is only activated when the corresponding Multi Mouse button is pressed (see Section 4.1).

4.3.2 Temperature Controller

The temperature controller, common to all 4500 Series Bonders, has the following controls and indicators:

SET — Pushbutton to enable setting of the workholder temperature.

UP — Pushbutton for increasing the set point 1 value during temperature setting.

DOWN — Pushbutton for decreasing the set point 1 value during temperature setting.

LED I — Status light which blinks when set point 1 is displayed or changed.

LED II — Status light which is not used by the bonder.

TC Display — Three-digit display that shows the temperature (°C) of the workholder.

When the SET pushbutton is pressed, the set-point temperature appears in the TC display.

For more details, see Section 5.3.3 and the supplied EWPC 907/T Series manual.

4.3.3 Right Panel Controls - 4522, 4524

N.E.F.O. — Switch that powers on the N.E.F.O. When the N.E.F.O. switch is set to the ON position, the N.E.F.O. performs its normal operations. If the switch is set to the OFF position, the N.E.F.O. cannot be operated.

OPEN — Indicator that signals that the N.E.F.O. did not produce a spark because of a remaining open circuit.

SHORT Indicator that signals that the N.E.F.O. did not produce a spark because of a short circuit.

MANUAL SPARK Momentary switch enabling you to manually produce a spark between the wire and the wand.

BALL SIZE Dial for setting the size of the ball.

MOTOR Switch for turning the dc servo motor (Z motor) on and off.

When the switch is set to the ON position, the Z motor performs its normal operations. Setting the switch to the OFF position turns the motor off.

Figure 4-3: Right Control Panel - 4522, 4524

4.3.4 Right Panel Controls - 4523

TEAR Dial for setting the length of the tear motion after performance of the second bond.

RESET LEVEL Switch for selecting the height of the Reset position (HIGH or LOW).

Figure 4-4: Right Control Panel - 4523

4.3.5 Right Panel Controls – 4526

TEAR	Dial for setting the length of the tear motion after performance of the second bond.
RESET LEVEL	Switch for selecting the height of the Reset position (HIGH or LOW).
STEP BACK	Dial for setting the motorized Y table's backward motion from the first bonding pad to the second bonding pad.
Y SPEED	Dial for setting the motorized Y table speed.
KINK HEIGHT	Dial for setting the height to which the bonding head rises after performing the first bond. This setting affects loop formation.
REVERSE	Dial for setting the motorized Y table's forward motion. This setting affects loop formation.

Figure 4-5: Right Control Panel - 4526

5. SETUP AND ADJUSTMENTS

This chapter contains the procedures and instructions for setting up and adjusting the K&S 4500 Series Manual Wire Bonders for operation. Unless otherwise specified in your order, your machine was adjusted and tested at the K&S factory according to K&S standard procedure.

- Models 4522/4524 are factory-set for bonding with 25 µm (1 mil) gold wire.
- Models 4523/4526 are factory-set for bonding with 25 µm (1 mil) aluminum wire.

Unpack and install the machine according to the instructions in Chapter 2. Before setting up the machine, familiarize yourself with its control panels (see Chapter 4). Then perform the procedures in this chapter in the order in which they appear (depending on your machine model).

5.1 Tool Installation

5.1.1 Wedge Installation (4523, 4526)

Note: Two setup gauges are supplied with the bonder: one for the 0.750" drop and one for the 0.828" drop. It is recommended to use the 0.750" wedge with either of these gauges. If you use the 0.828" wedge, readjust the wire clamp position.

To install the wedge:

1. Take the plastic tube containing the wedge, Allen wrench and setup gauges out of the machine accessories box.
2. Use the Allen wrench to loosen the wedge set screw located at the front of the transducer. Insert the wedge so that the same amount protrudes out the top of the transducer tip as from the bottom. Tighten the set screw slightly so that the wedge is securely in place.
3. Position the setup gauge under the wedge (see Figures 5-1 and 5-2).
4. Loosen the set screw and gently push the wedge down until its tip just rests on the setup gauge (see Figures 5-1 and 5-2). Tighten the wedge set screw.

Figure 5-1: Wedge Installation Using the Setup Gauge - 4523, 4526 with 30°/45° Wire Feed, 0.75" Drop

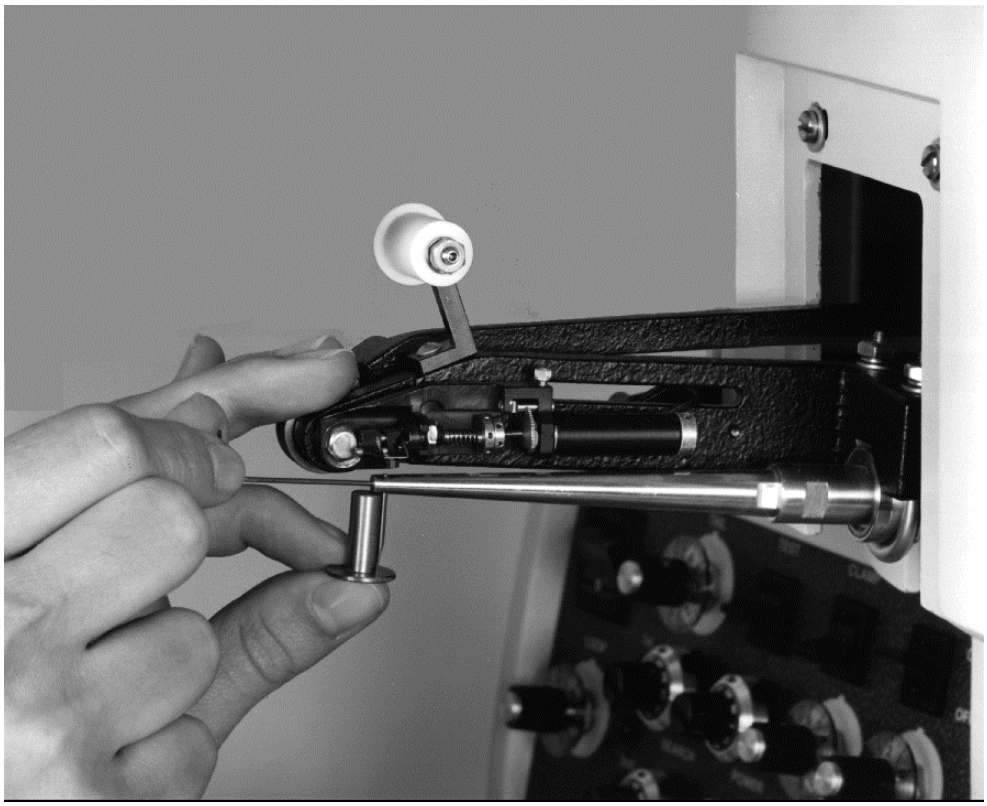


Figure 5-2: Wedge Installation Using the Setup Gauge - 4523, 4526 with Vertical Wire Feed, 0.828" Drop

Caution: Do not tighten the set screw all the way since this may damage the screw socket.

Caution: When the wedge tip rests on the setup gauge, do not move the gauge, since this can rub the wedge, damaging the tip.

5 Power on the machine. Ensure that the 1st and 2nd indicators are on.

6 Wait until the **2nd** indicator goes out. Set and hold the TEST switch in the down position and check that the **U/S** indicator is on. Release the TEST switch.

7 Wait at least 30 minutes until the machine warms up.

8 Ensure that the **1st** indicator only is on. To test for a tuned condition of the ultrasonic circuit, set and hold the TEST switch in the down position and check that the **U/S** indicator is on. Release the TEST switch.

Table 5-1: Recommended Wedges

Model	Description	K&S Part Number	Manufacturer Serial Number
4523/4526 Deep Access	1.0 mil, Gold wire, vertical feed	27795-1003-010	Deweyl TKSVD-1/16-750-45-CG-2025-M-A8D Micro-Swiss 4WDE4-1825-TG5-M21
	0.7 mil, Gold wire, vertical feed	27795-1003-007	Deweyl TKSVD-1/16-750-45-F-1510-M-A8D Micro-Swiss 4WDE4-1315-T5F-M21
	2.0 mil, Gold wire, vertical feed	27795-1003-020	Deweyl TKSVD-1/16-750-45-CG-3035-M-A8D Micro-Swiss 4WDF4-3030-T5G-M21
	1x5 mil, Gold Ribbon, vertical feed	27795-1004-050	Deweyl TKSVD-1/16-750-45-CG-1X5-3-M Micro-Swiss 4WRF4-D230-T5G-M21

Table 5-1: Recommended Wedges			
Model	**Description**	**K&S Part Number**	**Manufacturer Serial Number**
	1x10 mil, Gold Ribbon, vertical feed	27795-1004-100	Deweyl TKSVD-1/16-750-45-CG-1X10-3-M Micro-Swiss 4WRF4-J240-T5G-M21
	1.0 mil, Aluminum wire, vertical feed	27795-1005-010	Deweyl CKSVD-1/16-750-45-C-2025-M-A8D
4523/4526 Standard Access	1 mil, Aluminum wire, 30° feed	40427-0007-152	Micro-Swiss 4WNL0-2025-W5C-M00
	1 mil, Gold wire, 30° feed	40428-0002-251	Micro-Swiss 4WNL0-2025-T5G-M00
	0.7 mil, Gold wire, 30° feed	40430-1310-251	Micro-Swiss 4WAV0-1315-T5F-M00
	1x5 mil, Gold ribbon, 30° feed	44293-0009-251	Micro-Swiss 4WRL0-D230-T5G-M00
	1x10 mil, Gold ribbon, 30° feed	44293-0015-251	Micro-Swiss 4WRL0-J230-T5G-M00

5.1.2 Capillary Installation (4522, 4524)

To install the capillary:

1 Take the plastic tube containing the capillary, Allen wrench and setup gauges out of the machine accessories box.

2 Use the Allen wrench to loosen the capillary set screw located at the front of the transducer. Insert the capillary so that the same amount protrudes out the top of the transducer tip as from the bottom. Tighten the set screw slightly so that the capillary is securely in place.

3 Position the setup gauge under the capillary (see Figure 5-3).

4 Loosen the set screw and gently push the capillary down until its tip just rests on the setup gauge (see Figure 5-3). Tighten the capillary set screw.

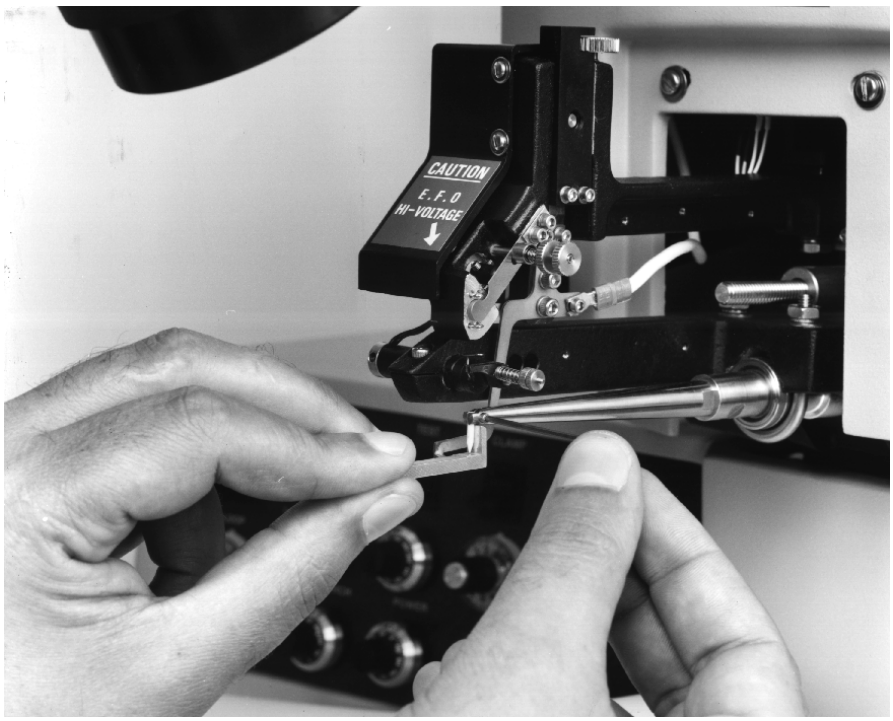


Figure 5-3: Capillary Insertion Using Setup Gauge - 4522, 4524

Caution: Do not tighten the set screw all the way since this may damage the screw socket

Caution: When the capillary tip rests on the setup gauge, do not move the gauge, since this can rub the capillary, damaging the tip.

5 Power on the machine. Ensure that the **1st** and **2nd** indicators are on.

6 Wait until the **2nd** indicator goes out. Set and hold the TEST switch in the down position and check that the **U/S** indicator is on. Release the TEST switch..

7 Wait about 30 minutes until the machine warms up.

8 Ensure that the **1st** indicator only is on. To test for a tuned condition of the ultrasonic circuit, set and hold the TEST switch in the down position and check that the **U/S** indicator is on. Release the TEST switch.

Table 5-2: Recommended Capillaries			
Model	**Description**	**K&S Part Number**	**Manufacturer Serial Number**
4522/4524 Standard Access	1.0 mil, Gold wire	40472-0010-324	Micro-Swiss
	1.3 mil, Gold wire	41464-0013-324	Micro-Swiss
4522/4524 RC	1.0 mil, Gold wire	40472-0010-624	Micro-Swiss
4522/4524 Deep Access	1.0 mil, Gold wire	40472-0012-344	Micro-Swiss
4522 Ball Bumping	1.0 mil, Gold wire	41494-0024-335	Micro-Swiss
	1.5 mil, Gold wire	41494-0015-335	Micro-Swiss
4522 Coining	For coining ball up to 5 mi	41482-0075-330	Micro-Swiss

5.2 Microscope Adjustment

To adjust the microscope:

1 Turn the ZOOM knob to minimum magnification and turn the area light on.

2 Set the LOOP dial to 0. Press and release the SEMI/AUTO pushbutton. The bonding head passes through the first bond cycle, leaving the wedge/capillary at the Loop height.

3 Release the pivot locking screw and swivel the microscope to the left or right. Pivot it up or down so that you see the wedge/capillary in the center of the field of view of the right eyepiece. Turn the focus knob until the wedge/capillary is in sharp focus.

4 Turn the ZOOM knob to maximum magnification. Repeat step 3 until the wedge/capillary tip is sharply focused in the field of view.

5 Tighten the microscope locking screw.

6 Adjust the distance between the eyepieces by pulling or pushing the oculars sideways.

7 To compensate for differences in right and left eye focus requirements, focus the left eyepiece independently using the left ocular focus ring.

5.3 Workholder Installation and Adjustment

Note: This procedure refers to manually height adjustable workholders of type 483, 4142 or 4135. For motorized workholders, see the instructions that are supplied with the workholder.

5.3.1 Workholder Installation

To install the workholder:

1 Take the workholder out of the machine accessories box.

2 Hold the top of the workholder and turn the workholder base counterclockwise until it stops. The workholder is now at its minimum height.

3 Place the workholder on the work station.

4 If using a heated workholder, connect the workholder harness to the HEATER and T.C. connectors on the workholder connectors panel.

5.3.2 Height Adjustment

To adjust the workholder height (see Figure 5-4)**:**

1 Load a device in the workholder. Adjust the workholder clamps to secure the device in place

2 Set the LOOP dial to 1. Press and release the SEMI/AUTO pushbutton. The bonding head drops to its lowest position and remains there. Ensure that the **2nd** indicator is on.

3 Hold the top of the workholder and turn the base of the workholder clockwise to raise the workholder until the wedge/capillary just touches the lowest bonding level.

4 Set the LOOP dial to 10. Press the SEMI/AUTO pushbutton to return the bonding head to the Reset position.

At this position, a device placed on the workholder should just touch the wedge/capillary tip. The machine can now work within the maximum range of bonding heights and the required overtravel.

5.3.3 Setting Workholder Temperature

Note: If "EEE" appears in the temperature controller display, check that the workholder is plugged into the workholder connectors panel properly.

To set the temperature of the workholder:

1 Press the SET pushbutton on the temperature controller. The temperature controller display shows the temperature setting (set point 1) for 3 seconds. LED I blinks.

Note: If the SET pushbutton is pressed again within 3 seconds, set point 2 appears in the display. This value has no function for the 4500 Series.

2 Press the UP and/or DOWN pushbutton until the required temperature setting appears in the display.

Figure 5-4: Adjusting Workholder Height

3 Release the pushbuttons. Within 3 seconds, set point 1 is stored in the temperature controller memory. The temperature controller display shows the actual workholder temperature. Ensure that LED I is on (indicating that the workholder heater is turned on).

Note: The temperature controller is factory-set to the optimum setup. If the actual workholder temperature deviates from set point 1, recalibrate the temperature controller (see section 12.14). If it is necessary to change parameters other than the set temperature, see the supplied EWPC 907/T Series manual.

5.4 Wire Loading

Caution: When loading a wire, always wear protective gloves. Never touch the wedge/capillary, wire or spool holder with your bare fingers. This leaves oil traces that affect normal operation.

Caution: When handling the wedge/capillary, use a good pair of tweezers such as MicroSwiss' Tool Tweezers, model 43003-0010-001. Poor quality tweezers make wire feeding difficult. This may affect the bonding operation of your machine.

5.4.1 Useful Tips

The following tips should help you during wire loading:

- For best results, use the recommended wedges/capillaries (see sections 5.1.1 and 5.1.2).
- When feeding the wire through the wedge/capillary:
  - Hold the wire about 12 mm (1/2") from the end (4522, 4524).
  - Hold the wire about 2-3 mm (1/8") from the end (4523, 4526 - 30°/45° wire feed).
  - For the first feed, hold the wire about 25 mm (1") from the end. For the second feed, hold the wire about 2-3 mm (1/8") from the end (4523, 4526 - vertical wire feed).
- Do not squeeze the wire too tightly with the tweezers. Gold is extremely malleable and squeezing can cause the wire to get stuck inside the wedge/capillary.
- When feeding a new wire into the wedge/capillary, tear off a small piece of the wire lead to create a sharp point at the end of the wire. This makes it much easier to insert the wire into the wedge/capillary hole.
- If the wire does not go through the wedge/capillary hole, set the TEST switch to the up position and release, while feeding the wire. This applies ultrasonic vibrations to the wedge/capillary, easing the wire feeding.

5.4.2 Wire Loading of 2" Spool - Vertical Wire Feed (4522, 4524)

To load the wire:

1 Power on the bonder. Ensure that the bonding head is in the Reset position (**1st** indicator only is on).

2 If the 2" spool is not installed, install the spool holder assembly on the spool holder bracket (see Figure 3-4).

3 Remove the plastic dust cover, spool cap and glass feed tube from the spool holder. Place the gold wire spool in the spool holder (see Figure 3-4).

4 While holding the glass feed tube in your hand, slip one of the rubber O-rings over the tube's pointed end. Slide it up to a location 15-18 mm (5/8-3/4") from the tube's flared end. Insert the pointed end of the tube through the spool cap, from the top.

5 Slip the second O-ring over the tube from below, and slide it up so that the spool cap is held securely between the two O-rings. Place the spool cap with the tube (flared end upward) on the spool holder (see Figure 3-4).

6 Place the spool of wire on the spool holder with the free end of the wire facing upwards. Place the spool cap together with the glass tube over the wire spool.

7 Pull the free end of the wire, with the end pointed upward, over the polished circumference of the spool cap and insert the wire into the flared end of the tube. Feed the wire through the tube so that it protrudes from the lower end.

8 Place the dust cover over the spool holder without pinching the wire.

9 Set the CLAMP switch to the up position to open the wire and drag clamps.

10 Using tweezers, grasp the small glass plate of the fixed tensioner (see Figure 3-4) and gently remove it from its seat. If necessary, lift the white plastic screw slightly over the tensioner to clear the way.

11 Pull the wire tip along the tensioner route and feed it through the wire guide.

12 Ensure that the small glass plate is free of dust, grease or fingerprints, and place it on top of the wire on the fixed tensioner bracket. Ensure that the polished, rounded side of the glass plate faces downward on the wire.

13 Pull the wire further through the wire guides and open jaws of the drag clamp and wire clamp. Using tweezers, feed the wire through the capillary so that it protrudes about 12.5 mm (1/2") from the capillary tip.

14 Set the CLAMP switch to the down position to close the clamp. The bonder will automatically switch to the second bond cycle.

Note: The wire should form a straight line from the kicker down to the capillary. Otherwise, friction may cause looping problems and damage to the wire. If the wire is not straight, reposition the spool holder.

Figure 5-5: Wire Loading of 2″ Spool - Vertical Wire Feed

5.4.3 Wire Loading of 0.5" Spool - 30°/45° Wire Feed (4523, 4526)

To load the wire:

1 Power on the bonder. Ensure that the bonding head is in the Reset position (**1st** indicator only is on).

2 Place the spool of wire on the spool holder on the right side of the bonding head.

- If using a 30° wedge, feed the wire through the 30° wire feed hole of the transducer.
- If using a 45° wedge, feed the wire through the 45° wire feed hole of the transducer.

3 Set the CLAMP switch to the up position to open the wire clamp. Lift the clamp lifter handle up, and feed the wire through the wire clamp above the wire guide and through the wire feed hole in the wedge.

4 Set the CLAMP switch to the down position to close the wire clamp and push the clamp lifter handle down.

Figure 5-6: Wire Loading of 0.5" Spool - 30°/45° Wire Feed

5.4.4 Wire Loading of 2" Spool - 30°/45° Wire Feed (Optional for 4523, 4526)

To load the wire:

1 Power on the bonder. Ensure that the bonding head is in the Reset position (**1st** indicator only is on).

2 If the 2" spool is not installed, install the spool holder assembly on the spool holder bracket.

3 Remove the plastic dust cover, spool cap and glass feed tube from the spool holder. Place the wire spool on the spool holder.

4 While holding the glass feed tube in your hand, slip one of the rubber O-rings over the tube's pointed end. Slide it up to a location 15-18 mm (5/8-3/4") from the tube's flared end. Insert the pointed end of the tube through the spool cap, from the top.

5 Slip the second O-ring over the tube from below, and slide it up until the spool cap is held securely between the two O-rings. Place the spool cap with the tube (flared end upward) on the spool holder.

6 Pull the free end of the wire, with the end pointed upward, over the polished circumference of the spool cap and insert the wire into the flared end of the tube. Feed the wire through the tube so that it protrudes from the lower end.

7 Place the dust cover back on the spool holder without pinching the wire.

8 Place the spool of wire on the spool holder on the right side of the bonding head.

- If using a 30° wedge, feed the wire through the 30° wire feed hole of the transducer.
- If using a 45° wedge, feed the wire through the 45° wire feed hole of the transducer.

9 Set the CLAMP switch to the up position to open the wire clamp. Lift the clamp lifter handle up, and feed the wire through the wire clamp above the wire guide and through the wire feed hole in the wedge.

10 Set the CLAMP switch to the down position to close the wire clamp and push the clamp lifter handle down.

Note: The wire should form a straight line from the transducer to the wedge. Otherwise, friction may cause looping problems and damage to the wire. If the wire is not straight, see section 9.6 for Wire Clamp Adjustment procedures.

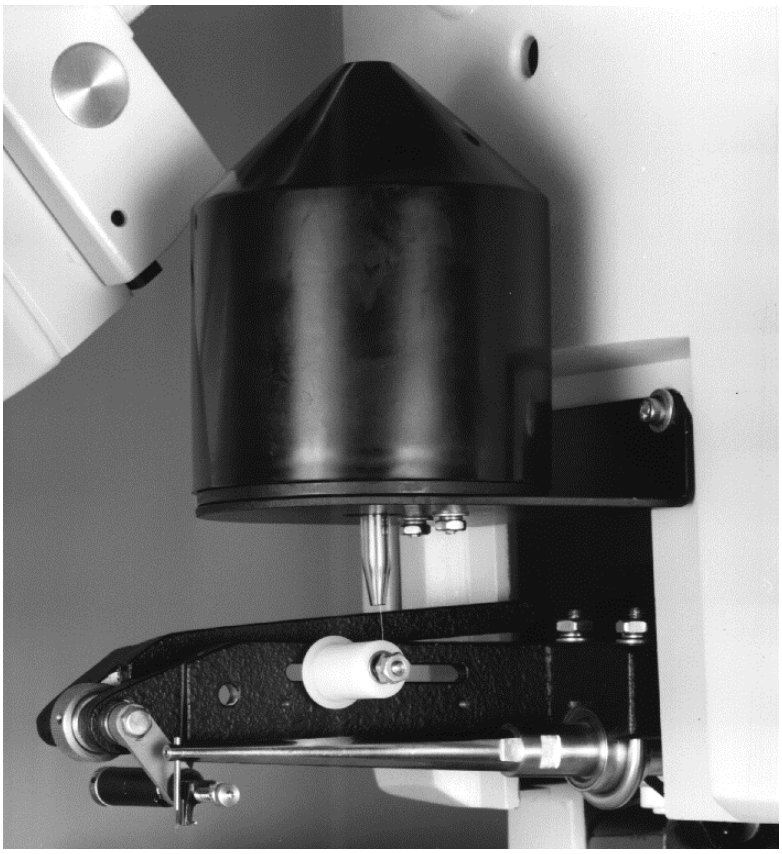


Figure 5-7: Wire Loading of 2" Spool - 30°/45° Wire Feed

5.4.5 Wire Loading of 0.5" Spool - Vertical Wire Feed (Optional for 4523, 4526)

To load the wire:

1 Power on the bonder. Ensure that the bonding head is in the Reset position (**1st** indicator only is on).

2 Assemble the spool support bracket (supplied with the vertical wire clamp kit).

3 Place the spool of wire on the spool holder on the right side of the bonding head.

4 Open the clamp manually by pulling the clamp plunger towards you. Then, rotate the clamp plunger slightly to lock it in the open position.

5 Feed the wire into the vertical hole of the wedge until it protrudes from the hole at the bottom.

6 Ensure that the wire is loaded from the front side of the spool, through the wire guide and the clamp, to the wedge.

7 Release the clamp plunger and close the clamp manually.

8 Set the CLAMP switch to the up position to open the clamp.

9 Pull a small length of wire to ensure that the wire is fed properly, without friction.

10 Set the CLAMP switch to the down position to close the clamp.

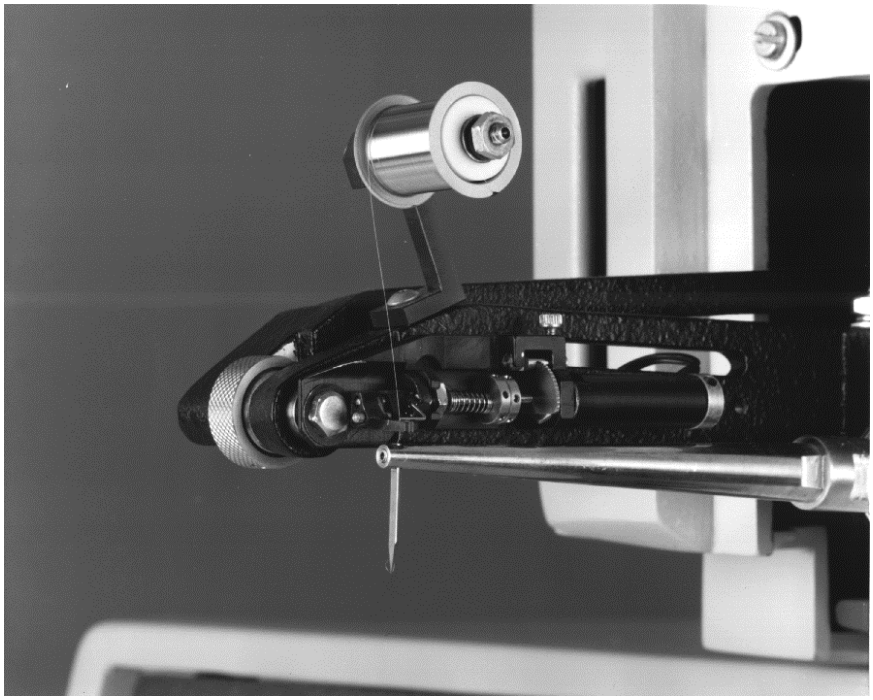


Figure 5-8: Wire Loading of 0.5" Spool - Vertical Wire Feed

5.4.6 Wire Loading of 2" Spool - Vertical Wire Feed (Optional for 4523, 4526)

To load the wire:

1 Power on the bonder. Ensure that the bonding head is in the Reset position (**1st** indicator only is on).

2 If the 2" spool is not installed, install the spool holder assembly on the spool holder bracket (see Figure 3-4).

3 Remove the plastic dust cover, spool cap and glass feed tube from the spool holder. Place the gold wire spool in the spool holder (see Figure 3-4).

4 While holding the glass feed tube in your hand, slip one of the rubber O-rings over the tube's pointed end. Slide it up to a location 15-18 mm (5/8-3/4") from the tube's flared end. Insert the pointed end of the tube through the spool cap, from the top.

5 Slip the second O-ring over the tube from below, and slide it up so that the spool cap is held securely between the two O-rings. Place the spool cap with the tube (flared end upward) on the spool holder (see Figure 3-4).

6 Place the spool of wire on the spool holder with the free end of the wire facing upwards. Place the spool cap together with the glass tube over the wire spool.

7 Pull the free end of the wire, with the end pointed upward, over the polished circumference of the spool cap and insert the wire into the flared end of the tube. Feed the wire through the tube so that it protrudes from the lower end.

8 Place the dust cover over the spool holder without pinching the wire.

9 Open the clamp manually by pulling the clamp plunger towards you. Then, rotate the clamp plunger slightly to lock it in the open position.

10 Using tweezers, grasp the small glass plate of the fixed tensioner (see Figure 3-4) and gently remove it from its seat. If necessary, lift the white plastic screw slightly over the tensioner to clear the way.

11 Pull the wire tip along the tensioner route and feed it through the wire guide.

12 Ensure that the small glass plate is free of dust, grease and fingerprints, and place it on top of the wire on the fixed tensioner bracket. Ensure that the polished, rounded side of the glass plate faces downward on the wire.

13 Feed the wire into the vertical hole of the wedge until it protrudes from the hole at the bottom.

14 Ensure that the wire is fed from the front side of the spool, through the wire guide and the clamp, to the wedge.

15 Release the clamp plunger and close the clamp manually.

16 Set the CLAMP switch to the up position to open the clamp.

17 Pull a small length of wire to ensure that the wire is fed properly, without friction.

18 Set the CLAMP switch to the down position to close the clamp.

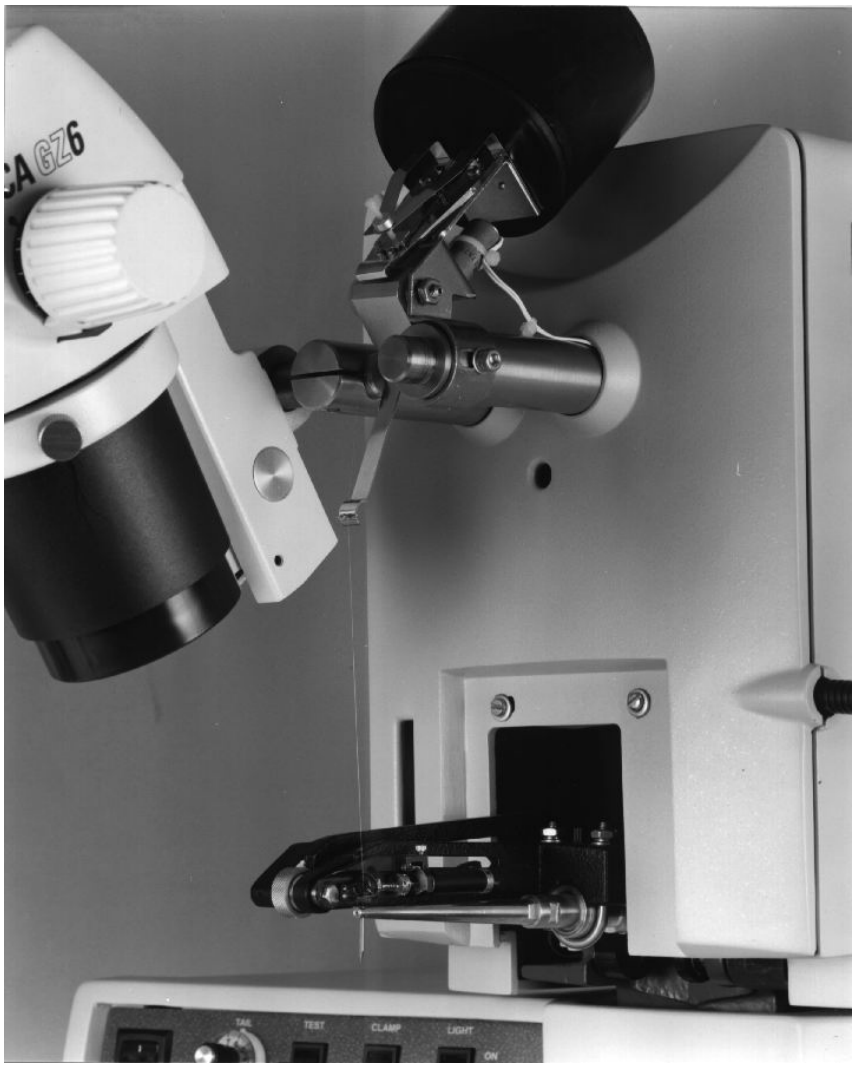


Figure 5-9: Wire Loading of 2" Spool - Vertical Wire Feed

5.5 Spotlight Adjustment

If your bonder is equipped with the optional spotlight, spotlight adjustment is necessary. Spotlight adjustment includes the following tasks:

- Preparing a reference bond to aid spotlight adjustment
- Positioning the spotlight
- Focusing

To prepare a reference bond:

1 Set the LOOP dial to 10.
Set the REVERSE and STEP BACK dials to 0 (4526).

2 Maneuver the reference device directly under the bonding head.

3 Move the Multi Mouse to position the device precisely under the wedge/capillary.

4 Perform the reference bond. Do not move the Multi Mouse after the bond is performed. The bonding head is now at the Loop height and the **2nd** indicator is on.

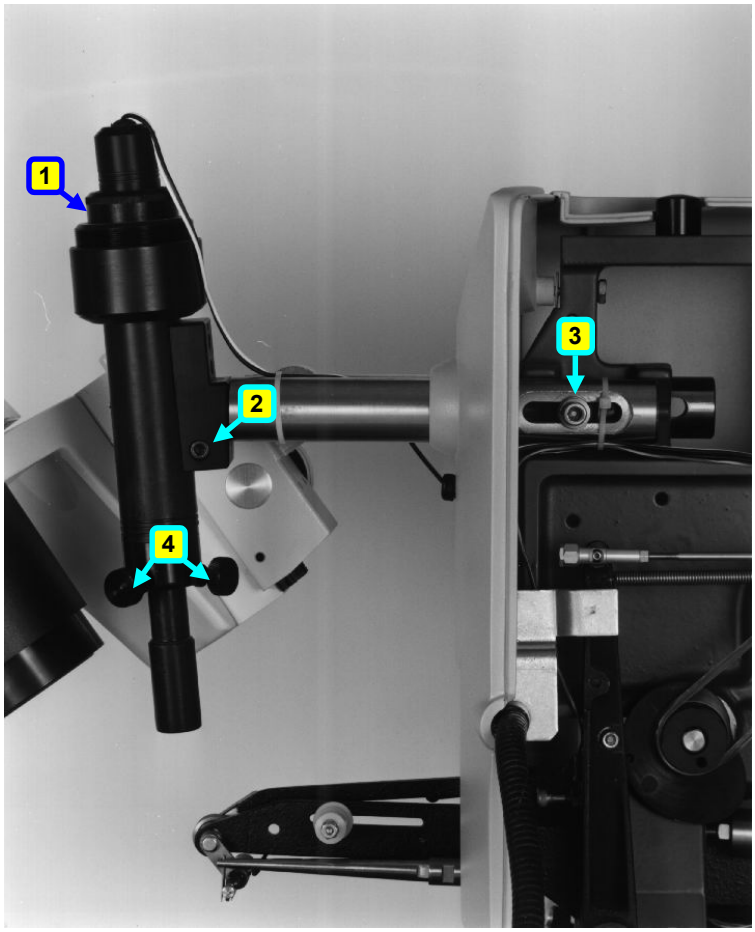
To adjust the spotlight:

1 Loosen the clamping screw on the spotlight housing.

2 Move the spotlight housing so that you see the target spot near the reference bond.

3 Turn the focusing ring at the top of the spotlight so that the target spot appears as a sharp ring.

4 Turn the knurled screws near the bottom of the spotlight housing to make fine adjustments in the target spot position.



1 Focus Knob
2 Spotlight Clamping Screw
3 Rod Locking Screw
4 Fine Adjust

Figure 5-10: Spotlight Adjustment

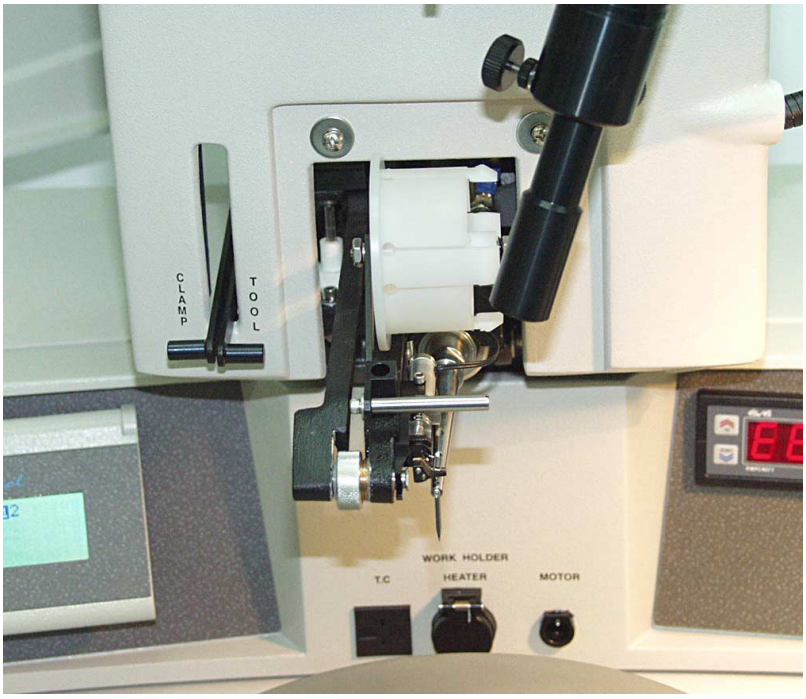


Figure 5-11: 2" Spool for Ribbon Wire Feed

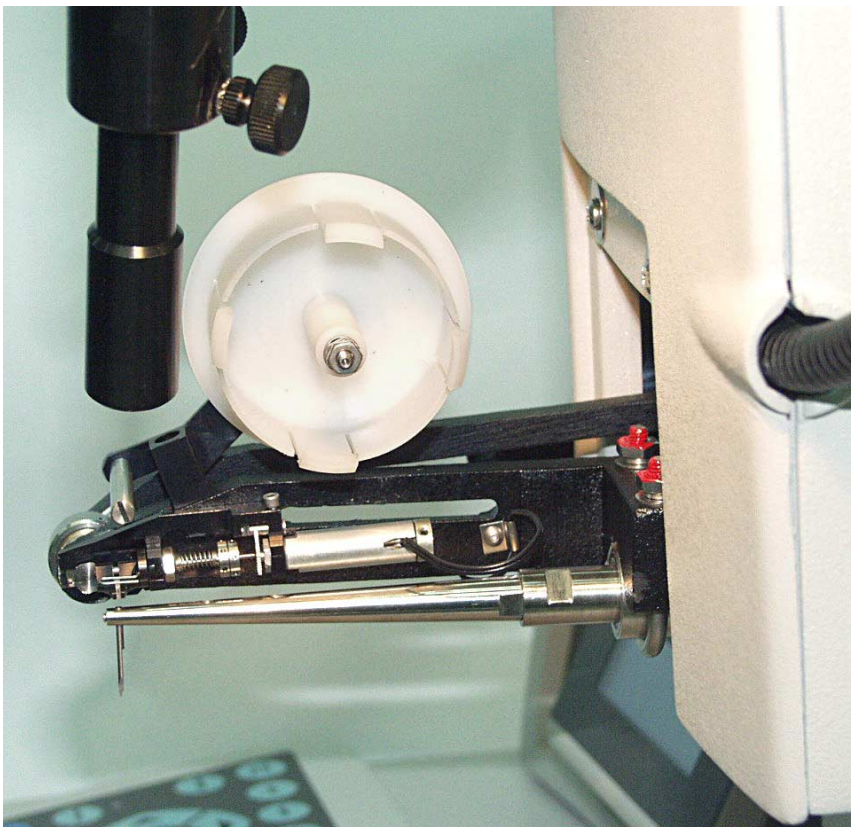


Figure 5-12: Close-up of 2" Spool for Ribbon Wire Vertical Feed

6. OPERATION

This chapter explains how to operate your K&S 4500 Series Manual Wire Bonder. The 4500 Series Bonders have common operation principles and bonding methods. However, each model also has specific process parameters and operation procedures.

6.1 Common Operation - 4500 Series

Common operation principles and bonding methods for the 4500 Series may be classified in the following categories:

- Bonding Parameters
- Process Parameters
- Modes of Operation

6.1.1 Bonding Parameters

Wire bonding is a function of three main bonding parameters:

- Power
- Time
- Force

The left control panel contains the controls for setting these bonding parameters. The upper bank of dials is for setting the parameters of the first bond. The lower bank of dials is for setting the parameters of the second bond.

6.1.1.1 Power

Bonding power is the amount of ultrasonic energy applied to the bond. High POWER dial settings result in high ultrasonic vibration amplitude and lower settings result in low vibration amplitude.

The POWER dial has two scales - LOW and HIGH. The current scale depends on whether the ultrasonic generator has been set to LOW or HIGH. The LOW scale is used for wire thicknesses of up to 50 µm (2 mil). The HIGH scale is used for wire thicknesses ranging from 50 to 75 µm (2 - 3 mil). The position of the HIGH/LOW switch on the logic board sets this scale.

6.1.1.2 Time

Bonding time is the amount of time that the ultrasonic power and force are applied. The TIME dial scale depends if the time has been set to Standard Bonding Time or Long Bonding Time. These settings are further explained in section 6.1.3.1.

6.1.1.3 Force

Bonding force is applied to the wire while the ultrasonic energy is being applied. This force consists of the following:

- Static force, which is set by the position of the counterweights on the bonding head cover.
- Amount of force applied by the electromagnetic coil (set by the FORCE dial).

To set the bonding force:

1 Ensure that the bonding head is in the Reset position (the **1st** indicator only is on).

2 Remove the workholder from the workholder table.

3 Set the SET UP/RESET switch to SET UP.

4 Set both SEARCH dials to 0.

5 Press and hold the SEMI/AUTO pushbutton.

6 Using a gram gauge (see Figure 6-1), lift the bonding head until the gauge reading starts to rise.

7 Read the gram gauge. This is the force required for the first bond. Set the upper FORCE dial accordingly (see the recommended values for each specific wire type).

8 Release the SEMI/AUTO pushbutton.

9 Press and hold the SEMI/AUTO pushbutton. The bonding head moves to the second Search height.

10 Using a gram gauge, lift the bonding head until the gauge reading starts to rise.

11 Read the gram gauge. This is the force required for the second bond. Set the lower FORCE dial accordingly. (see the recommended values for each specific wire type).

12 Release the SEMI/AUTO pushbutton.

13 Set the SET UP switch to the mid-position for normal operation.

Note: If the required bonding force appears to be lower than the minimum force (FORCE = 0) or higher than the maximum force (FORCE = 10), readjust the static force (see section 9.2.3).

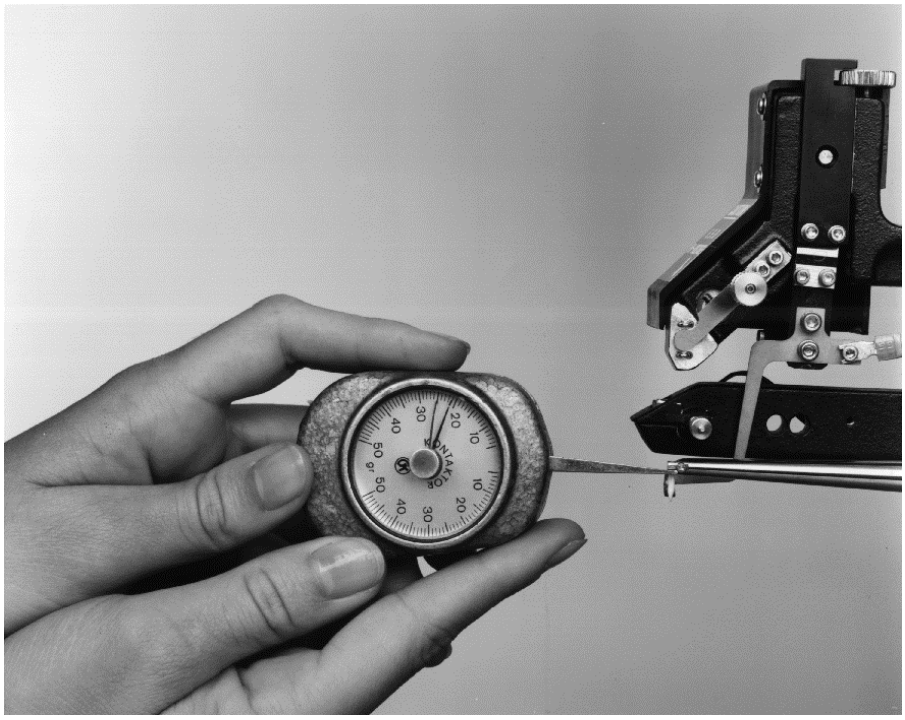


Figure 6-1: Force Adjustment Using a Gram Gauge

6.1.2 Process Parameters

The common process parameters of wire bonding are:

- Loop Height
- Search Height

6.1.2.1 Loop Height

The Loop height is the position of the loop after performing the first bond. The Loop height is determined by the wire diameter and the specific application.

6.1.2.2 Search Height

The Search height is the position at which the bonding head stops above the bond site. At the Search height, you can perform fine positioning (by the Multi Mouse) of the device before bonding the wire. The Search height is set to 75 - 100 µm (3 - 4 mil) above the bond site.

To set the Search height:

1 Power on the bonder. Ensure that the **1st** indicator is on.

2 Move the workholder with the device to the first bond site. Set the upper SEARCH dial to a high value, so that the wedge/capillary does not hit the device's surface. Press and hold the SEMI/AUTO pushbutton. The bonding head descends to the first Search height.

3 Set the upper SEARCH dial to the required Search height, 75-100 µm (3 - 4 mil). Use a feeler gauge to determine the Search height setting.

4 Release the SEMI/AUTO pushbutton. The bonding head descends to the bond site and completes the first bond. It then rises to the Loop height, and the **2nd** indicator turns on.

5 Set the lower SEARCH dial to a high value. Move the workholder with the device to the second bonding site. Press and hold the SEMI/AUTO pushbutton. The bonding head descends to the second Search height

6 Repeat step 3 for the lower SEARCH dial.

7 Release the SEMI/AUTO pushbutton. The bonding head descends to the second bonding site, and then rises to the Reset position.

6.1.3 Modes of Operation

The common modes of bonding operation are:

- Short/Long Bond Time
- High/Low Ultrasonic (U/S) Power

6.1.3.1 Short/Long Bond Time

The K&S 4523, 4524, 4526 are factory-set to a maximum standard bonding time of 120 ms, which is suitable for most applications.

The time scale of the TIME dials can be switched to provide a maximum bonding time of 1000 ms. Longer bonding times may be needed for high temperature bonding, for applications where low ultrasonic energy is required, or for bonding wires other than gold.

To switch the TIME scale between standard and long bonding time:

1 Set the SET UP/RESET switch to the RESET position and then release.

2 Immediately press and hold the STITCH pushbutton and the SEMI/AUTO pushbutton simultaneously until the **2nd** indicator turns off. Release both pushbuttons.

3 To identify the active mode, press the STITCH pushbutton. The **1st** or **2nd** indicator shows the mode as follows:

- Indicator blinks rapidly - Standard Bonding Time Scale.
- Indicator blinks slowly - Long Bonding Time Scale.

Model 4522 is factory-set to the following maximum bonding times:

- 200 ms for standard ball bonding.
- 200 ms for ball bumping.
- 1000 ms for single point TAB.

6.1.3.2 High/Low Ultrasonic (U/S) Power

The high/low U/S power is the ultrasonic vibration required to bond the wire. This power level is determined by the setting of the HIGH/LOW switch on the logic board.

- LOW setting is used for bonding wires of up to 50 µm (2 mil) diameter.
- HIGH setting is used for bonding wires of 50 - 75 µm (2 - 3 mil) diameter.

Caution: The U/S power level is preset in the factory. The HIGH/LOW switch should be set by authorized service personnel only.

For more details, see section 8.1.3.6.

6.2 Operation - Model 4522

This section describes specific process parameters, bond cycle modes and operation principles of the K&S Model 4522 Multi-Process Ball Bonder.

6.2.1 Process Parameters

In addition to the common process parameters (see section 6.1.2), Model 4522 requires the following settings:

- Ball Size
- Tail

6.2.1.1 Ball Size

The BALL SIZE dial on the right control panel is used for setting the ball size. The ball size should be set at 2 - 3 times larger than the diameter of the wire.

If the ball is too small, it can block up the capillary. If the ball is too large, it can cause a short-circuit between the N.E.F.O. wand and the wire.

You can view the ball size in the Reset position (before starting the bonding cycle) by adjusting the microscope magnification.

6.2.1.2 Tail

The tail is the length of wire protruding from the capillary after performance of the second bond.

The tail length is set by turning the TAIL dial on the left control panel. A capillary with a longer bonding foot requires a higher setting, and a capillary with a shorter foot requires a lower setting. The setting must always ensure that sufficient tail length exists to enable the N.E.F.O. wand to charge the wire without causing an OPEN or SHORT fault.

6.2.2 Bond Cycle Modes

The 4522 can operate in the following bonding modes:

- Standard ball bonding using Semi/Auto mode or Manual Z mode.
- Ball bumping using Semi/Auto mode or Manual Z mode.
- Single point TAB and coining using Semi/Auto mode only.

6.2.2.1 Semi/Auto Mode Bonding Cycle

To set the bonder for Semi/Auto Mode Bonding:

1 Press the SET UP/RESET switch to the RESET position and release.

2 Immediately press and hold the SEMI/AUTO pushbutton of the Multi Mouse until the **2nd** indicator turns off.

3 Release the SEMI/AUTO pushbutton.

4 When the bonding head is in the Reset position, press the STITCH pushbutton of the Multi Mouse. The indicators on the left control panel indicate the Semi/Auto Bonding Cycle mode as follows:

1st	Blinks
U/S	Off
2nd	Off

To perform Semi/Auto Mode Bonding:

Note: A graphic representation of the cycle appears in Figure 6-2.

1 Ensure that the bonding head is in the Reset position.

2 Position the workholder so that the bonding pad is under the capillary. Ensure that the ball is ready and that the drag and wire clamps are closed.

3 Press and hold the SEMI/AUTO pushbutton. The wire clamp opens and the kicker pulls out wire slack from the wire spool. The bonding head descends to the first Search height and stops. The drag clamp pulls the wire so that the ball is seated against the capillary tip.

4 While still holding the SEMI/AUTO pushbutton, move the Multi Mouse to position the first bonding pad precisely under the capillary.

5 Release the SEMI/AUTO pushbutton. The bonding head descends to the first bonding pad. The first bonding force and ultrasonic energy (set by the upper FORCE and POWER dials, respectively) are applied for the time set by the upper TIME dial. The first bond is performed, the drag clamp opens and the kicker is released.

After completing the first bond, the bonding head automatically rises to the Loop height and stops.

6 Move the Multi Mouse to position the second bonding pad directly under the capillary.

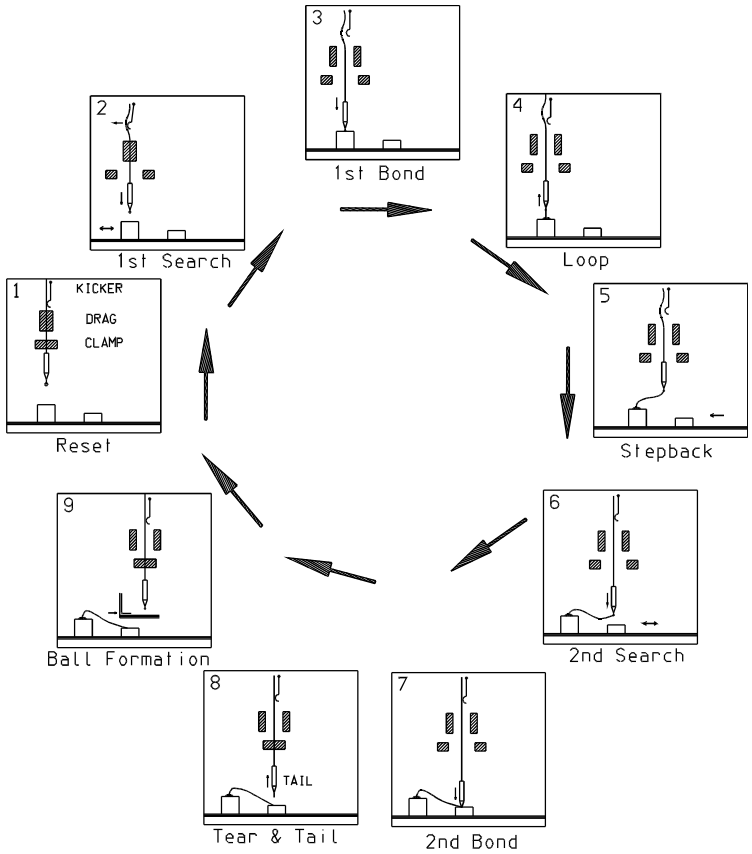


Figure 6-2: Ball Bonding Cycle in Semi/Automatic Mode

7 Press and hold the SEMI/AUTO pushbutton. The bonding head drops to the second Search height and stops.

8 While still pressing the SEMI/AUTO pushbutton, move the Multi Mouse to position the second bonding pad precisely under the capillary.

9 Release the SEMI/AUTO pushbutton. The bonding head descends to the second bond pad. The second bonding force and ultrasonic energy (set by the lower FORCE and POWER dials, respectively) are applied for the time set by the lower TIME dial.

The bonding head rises automatically to the Reset position. The wire clamp closes, after which the wire is snapped, creating a tail for a new ball.

The bonding head remains in the Reset position. The N.E.F.O. wand approaches the tail and fires. A new ball is created for the next bonding cycle.

6.2.2.2 Manual Z Bonding

The Manual Z bonding mode enables you to maneuver the bonding head manually. The MANUAL Z sidebutton of the Multi Mouse provides you with full control of the bonding head motion.

To perform Manual Z bonding:

1 Set the SEMI AUTO/MAN Z switch on the right control panel to the MAN Z position.

2 Press and hold the MANUAL Z sidebutton of the Multi Mouse. Lower the bonding head as close as you want to the bonding pad. Move the Multi Mouse to maneuver the first bonding pad precisely under the capillary.

3 Continue pressing the MANUAL Z sidebutton to drop the bonding head to the bonding pad and perform the bond as in the Semi/Auto mode.

4 Release the MANUAL Z sidebutton slowly to raise the bonding head to the Loop height.

5 Move the Multi Mouse to position the second bonding pad directly under the capillary.

6 To perform the second bond, repeat steps 2 and 3.

7 The bonding head rises to the Reset position automatically. The N.E.F.O. then fires to create a ball for the next bonding cycle. Release the MANUAL Z sidebutton to start the next cycle.

6.2.2.3 Ball Bumping

The ball bumping bond cycle is used to perform the first bond.

To set the bonder for ball bumping:

1 Press the SET UP/RESET switch to the RESET position and release.

2 Immediately press and hold the SEMI/AUTO and STITCH pushbuttons of the Multi Mouse simultaneously until the **2nd** indicator turns off.

3 Release the SEMI/AUTO and STITCH pushbuttons.

4 When the bonding head is in the Reset position, press the STITCH pushbutton. The indicators on the left control panel indicate the Ball Bumping Bonding Cycle mode as follows:

1st	Blinks
U/S	Off
2nd	Blinks

To perform ball bumping:

Note: A graphic representation of the cycle appears in Figure 6-3.

1 Ensure that the bonding head is in the Reset position.

2 Press and hold the SEMI/AUTO pushbutton. The bonding head lowers to the first Search height.

3 While still pressing the SEMI/AUTO pushbutton, move the Multi Mouse to position the second bonding pad precisely under the capillary.

4 Release the SEMI/AUTO pushbutton. The bonding head drops to the bonding pad to perform the first bond.

The bonding head rises from the bonding pad, forming a tail. The wire clamp closes to tear the wire. The bonding head then rises to the Reset position. The N.E.F.O. fires to create a ball for the next bonding cycle.

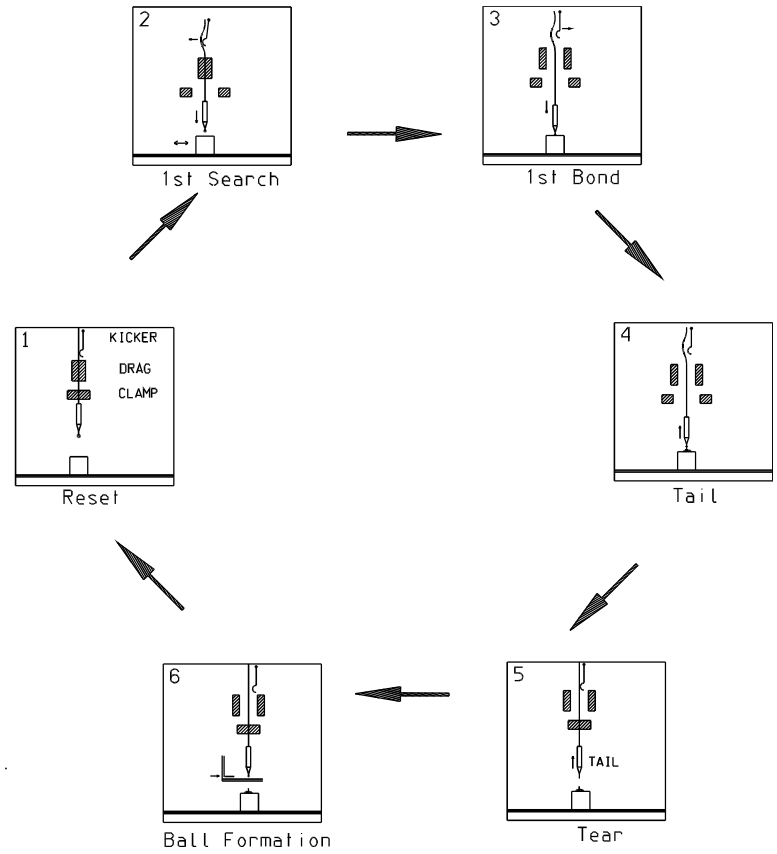


Figure 6-3: Ball Bumping Cycle in Semi/Automatic Mode

6.2.2.4 Single Point TAB and Coining

The single point TAB bond cycle is used to bond single points.

To set the bonder for single point TAB bonding:

1 Press the SET UP/RESET switch to the RESET position and release.

2 Immediately press and hold the STITCH pushbutton of the Multi Mouse until the **2nd** indicator turns off.

3 Release the STITCH pushbutton.

4 When the bonding head is in the Reset position, press the STITCH pushbutton again. The indicators on the left control panel indicate the Single Point TAB Bonding Cycle mode as follows:

1st	Off
U/S	Off
2nd	Blinks

To perform single point TAB bonding:

Note: A graphic representation of the cycle appears in Figure 6-4.

1 Ensure that the bonding head is in the Reset position.

2 Press and hold the SEMI/AUTO pushbutton of the Multi Mouse. The bonding head lowers to the first Search height.

3 While still pressing the SEMI/AUTO pushbutton, move the Multi Mouse to position the lead precisely under the capillary.

4 Release the SEMI/AUTO pushbutton. The bonding head drops to the bonding pad to perform the first bond. The bonding head rises from the bonding pad to the Loop height.

5 Repeat steps 2 - 4 as many times as required.

6 Press and hold the SEMI/AUTO pushbutton. The bonding head drops to the first Search height.

7 Press and release the STITCH pushbutton to return to the Reset position.

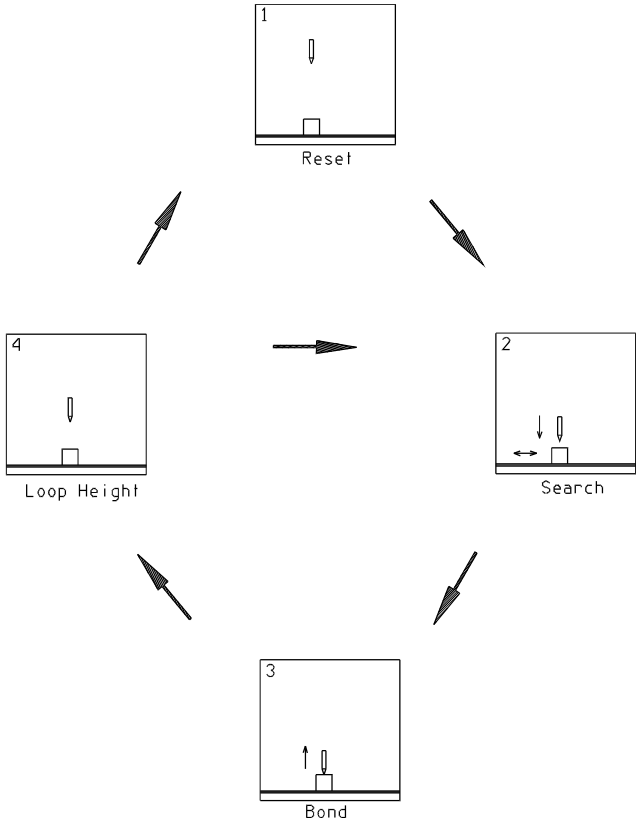


Figure 6-4: Single Point TAB Cycle in Semi-Automatic Mode

6.2.3 Bonding Operation

6.2.3.1 Initial Parameters and Machine Setting

The following adjustments and parameters are recommended for selected wires. Final bonding parameters should be optimized using microscopic analysis and destructive tests.

Table 6-1: Recommended Machine Adjustments

Parameter	Setting		
	25 µm Gold	**30 µm Gold**	**50 µm Gold**
Wire clamp gap (µm)	80	100	120
Wire clamp force (gm)	100	100	120
Drag clamp gap (µm)	250	350	500
Drag clamp force (gm)	6	10	10
N.E.F.O. Wand distance from capillary at Reset (µm)	500	570	625
N.E.F.O. ball size	1.5 - 2.5	2.5 - 4.5	5 - 7
Tail length	4 - 5	5 - 6	6 - 7
Initial Bond Dial Settings			
1st POWER	1 - 2	1.5 - 2.5	2 - 3
1st TIME	5	4 - 10	5*
1st FORCE	1 - 2	2 - 3	4 - 5
1st FORCE (gm)	40	60	80
LOOP	4	5	7
2nd POWER	2 - 3	3 - 4	6 – 8
2nd TIME	5 - 7	10	3 - 5*
2nd FORCE	4 - 6	7	8 - 10
2nd FORCE (gm)	80	100	120

Table 6-1: Recommended Machine Adjustments	
Parameter	**Setting**
Wires	Loop control is better if the elongation is higher.
Ball Bonding	Recommended wire is 99.99% gold with 2 - 6% elongation.
Ball Bumping	Recommended wire is 98% gold, 2% palladium with 2 - 4% elongation.

* Operate the bonder in Long time mode.

Your bonder was factory-set for bonding 25 µm (0.001") gold wire, 2-4% elongation.

Note: For wire diameter 38 μm or larger, use clamps with ceramic jaws.

6.2.3.2 Creating a Ball

After loading the wire and setting the bonding parameters, but before performing bonding, you must create a ball.

To create a ball:

1 Power on the N.E.F.O. unit and set the BALL SIZE dial to the recommended setting (see page 6-12).

2 Set the CLAMP switch to the up position to open the wire clamp.

3 Pull some wire from the capillary tip and bend the wire upwards.

4 Set the CLAMP switch to the down position to close the wire clamp. The bonding head moves to the Loop height.

5 Perform the second bond in semi/auto mode. A ball is created.

Note: If a ball is not created, the missing ball detector automatically stops the bonder. The SHORT or OPEN indicator on the right control panel turns on, depending on the cause of the fault (see section 6.2.3.3).

6.2.3.3 Missing Ball Detector

The missing ball detector is integrated within the N.E.F.O. system. If the N.E.F.O. system fails to create a ball, the missing ball detector stops bonder operation.

- The SHORT indicator turns on if a small gap exists between the tail and the wand.
- The OPEN indicator turns on if a large gap exists between the tail and the wand.

To correct a missing ball condition:

1 Readjust the tail length or the wand gap.

2 Set the CLAMP switch to the up position to open the clamp.

3 Pull more wire through the capillary and bend the wire below the capillary tip.

4 Set the CLAMP switch to the down position to close the clamp. The bonding head moves to the Loop height and is ready to perform the second bond.

5 Perform the second bond. The bonder will then create a ball for the next cycle.

6.2.3.4 Capillaries and Wires

For best results, use MicroSwiss capillaries. For a list of recommended capillaries, see section 5.1.2.

Always use the setup gauge when installing the capillary. After installing a new capillary, reset the bonder.

Be aware that the hole of the capillary applies some friction on the wire during loop creation. If the hole diameter is too small, wire friction results in loop height variations which are difficult to control. A soft wire produces higher loops than a hard wire, which is important when making long loops.

6.2.3.5 Factors Influencing Loop Height (Standard Cycle)

The factors influencing the loop height of a wire bonded on the 4522 at a specific distance with a specific height difference are:

LOOP Dial Setting	For longer distances between the first and the second bond, a higher dial setting is required.
Wire Tension	The higher the tension on the wire as it is pulled out of the spool, the lower the loop will be. Wire tension is controlled by the fixed tensioner glass plate.
Kicker Stroke	The kicker may be used to form loops in long wires by pulling a greater length of wire from the spool and neutralizing the fixed tensioner during wire manipulation.
Wire Elongation Coefficient	A wire with a low elongation coefficient (hard wire) produces lower loops than a wire with a high elongation coefficient (soft wire). Typically, wires with elongation coefficients of 2 - 4% are used for ball bonding.

6.2.3.6 Bond Strength Optimization

Bond strength depends on the following main parameters:

- Metalization - the bondability and the adhesion of the die and the substrate metals
- Wire type, tensile strength and elongation
- Capillary type
- Ball size
- Bonding parameter settings
- Workholder temperature

Using a bond shear tester, perform a series of tests such as wire loop pull testing and microscopic analysis of the squashed wire dimensions. Be aware that loop height and the distance from the first bond to the second bond affect the results of pull test measurements.

Figure 6-5 shows typical bonds and loops performed by Model 4522.

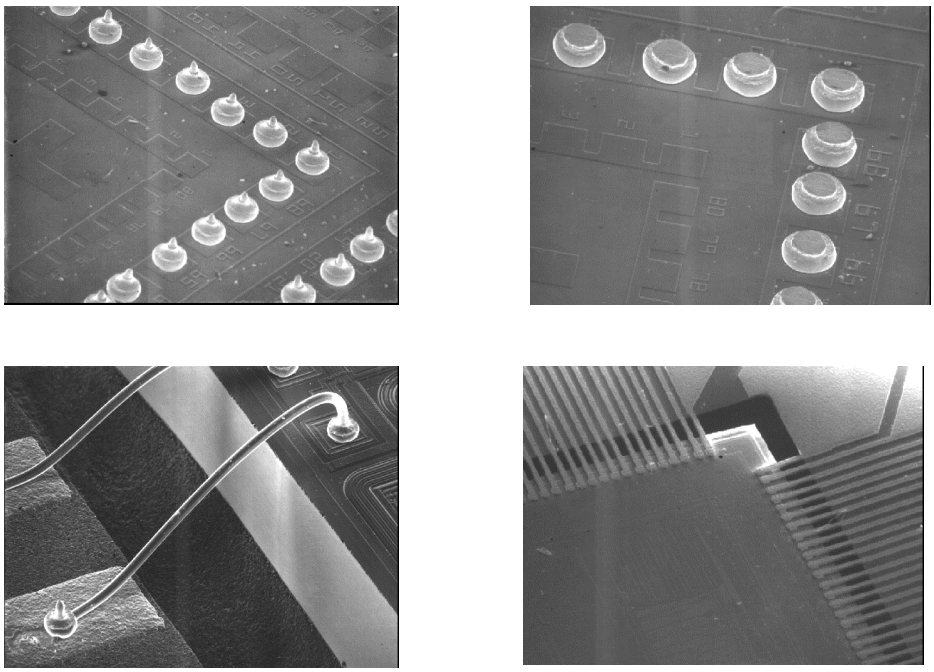


Figure 6-5: Typical Bonds Performed by Model 4522

6.3 Operation - Model 4523

This section describes specific process parameters, bond cycle modes and operation principles of the K&S Model 4523 Wedge Bonder.

6.3.1 Process Parameters

In addition to the common process parameters (see section 6.1.2), Model 4523 requires the following settings:

- Tail
- Tear

6.3.1.1 Tail and Tear Settings

The TAIL dial sets the length of tail produced after tearing. The TEAR dial sets the tear point of the wire.

The tear point motion and tail length motion of the wire clamp are controlled by a linear motor.

6.3.2 Bond Cycle Modes

The 4523 can operate in the following bonding modes:

- Semi-automatic bonding using the SEMI/AUTO pushbutton.
- Manual bonding using the MANUAL Z sidebutton.
- Stitch bonding in the Semi/Auto Cycle or Manual Z mode.
- Long tail length

6.3.2.1 Semi/Auto Mode Bonding Cycle

To perform Semi/Auto Mode Bonding:

Note: Graphic representations of the cycle appear in Figure 6-6 and Figure 6-7.

1 Ensure that the bonding head is in the Reset position.

2 Position the workholder so that the bonding pad is under the wedge. Ensure that the wire clamp is closed.

3 Press and hold the SEMI/AUTO pushbutton of the Multi Mouse. The bonding head descends to the first Search height and stops.

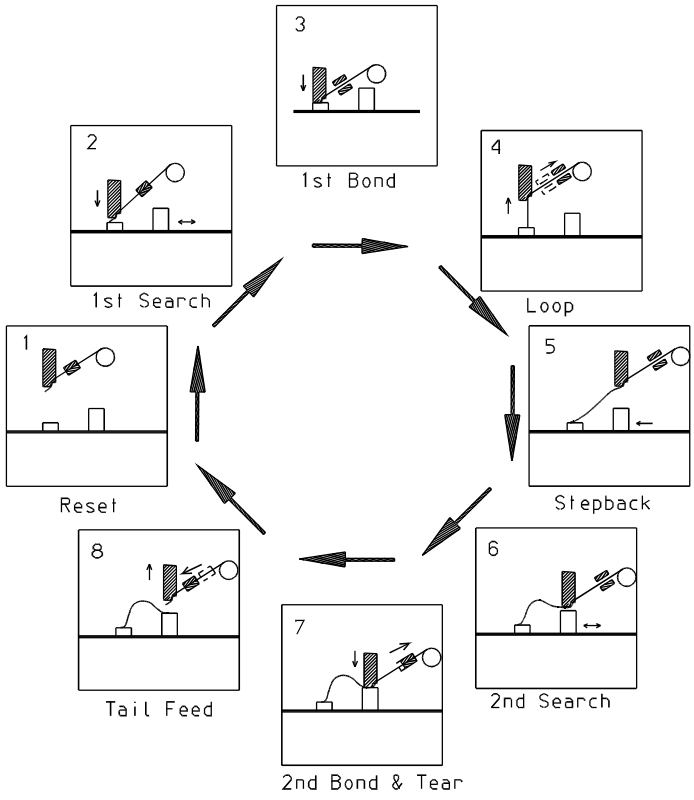


Figure 6-6: Wedge Bonding Cycle in Semi/Automatic Mode - 30°/45° Wire Feed

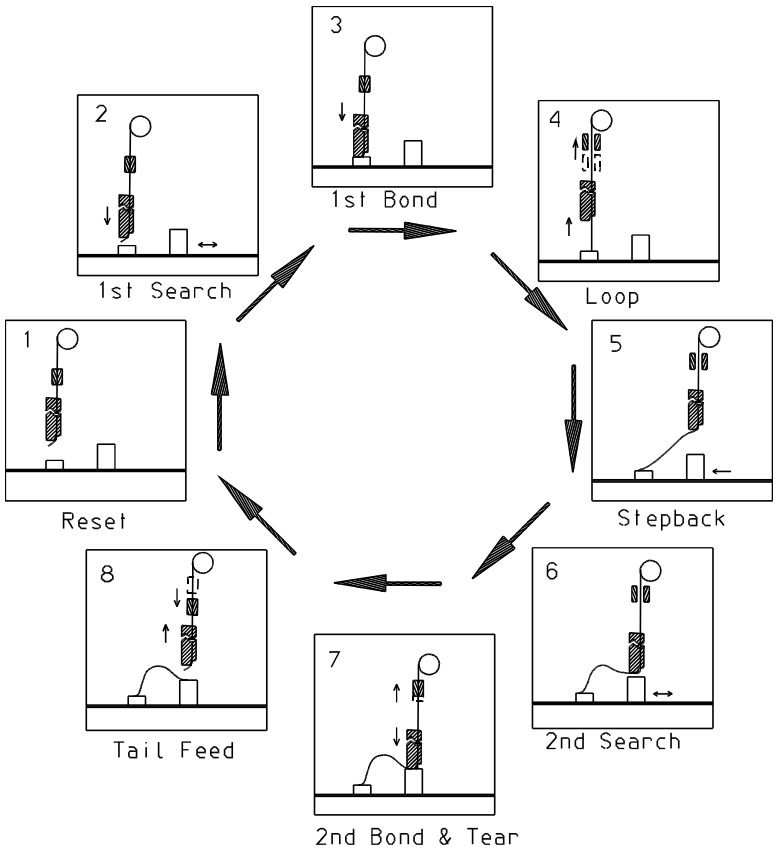


Figure 6-7: Wedge Bonding Cycle in Semi/Automatic Mode - 90° Wire Feed

4 While still holding the SEMI/AUTO pushbutton, move the Multi Mouse to position the first bonding pad precisely under the wedge.

5 Release the SEMI/AUTO pushbutton. The bonding head descends to the first bonding pad. The first bonding force and ultrasonic energy (set by the upper FORCE and POWER dials, respectively) are applied for the time set by the upper TIME dial. The first bond is performed and the wire clamp opens.

The bonding head rises automatically to the Loop height (set by the LOOP dial). As the bonding head reaches the Loop height, the linear motor moves to the feed position.

Note: Perform wedge bonding in the direction of the wire. If necessary, rotate the device so that the first bond and the second bond pads are aligned with the wire feed line.

6 Move the Multi Mouse to position the second bonding pad directly under the wedge.

7 Press and hold the SEMI/AUTO pushbutton. The bonding head drops to the second Search height and stops. As the bonding head starts its descent, the wire clamp closes momentarily to prevent the wire from feeding back into the wedge feed hole (helping to create a stable loop).

8 While still pressing the SEMI/AUTO pushbutton, move the Multi Mouse to position the second bonding pad precisely under the wedge.

9 Release the SEMI/AUTO pushbutton. The bonding head descends to the second bond pad. The second bonding force and ultrasonic energy (set by the lower FORCE and POWER dials, respectively) are applied for the time set in the lower TIME dial. After the bond is performed, the wire clamp closes and rises (as set by the TEAR dial), tearing the wire.

The bonding head rises to the Reset position. The wire clamp drops from the Tear position, feeding a wire tail through the wedge feed hole to prepare for the next bond.

6.3.2.2 Manual Z Bonding

The Manual Z bonding mode enables you to maneuver the bonding head manually. The MANUAL Z sidebutton of the Multi Mouse provides you with full control of the bonding head motion.

To perform Manual Z bonding:

1 Set the SEMI AUTO/MAN Z switch on the right control panel to the MAN Z position.

2 Press and hold the MANUAL Z sidebutton of the Multi Mouse. Lower the bonding head as close as you want to the bonding pad. Move the Multi Mouse to maneuver the first bonding pad precisely under the wedge.

3 Continue pressing the MANUAL Z sidebutton to drop the bonding head to the bonding pad and perform the bond as in the Semi/Auto mode.

4 Release the MANUAL Z sidebutton slowly to raise the bonding head to the Loop height

5 Move the Multi Mouse to position the second bonding pad directly under the capillary.

6 To perform the second bond, repeat steps 2 and 3.

7 Release the MANUAL Z sidebutton to raise the bonding head to the Reset position.

6.3.2.3 Stitch Bonding

The Stitch Bond mode enables the bonder to automatically perform one or more successive bonds without tearing the wire.

To perform stitch bonding:

1 Press and hold the STITCH pushbutton of the Multi Mouse after performing the first bond. The bonder performs the second bond without tearing the wire as in step 9 of the Semi/Auto Cycle Bonding Cycle (see section 6.3.2.1). The bonder then continues making bonds until you release the pushbutton.

2 After making one or more stitch bonds, release the STITCH pushbutton and make one more bond. The bonding head then rises to the Reset position and the wire tail is formed.

6.3.2.4 Long Tail Length Mode

The Long Tail Length mode is used when bonding thick wires with diameters of 76 µm (3 mil) or ribbon wires thicker than 25 x 125 µm (1 x 5 mil).

To set the bonder for the Long Tail Length mode:

1 Set the SET UP/RESET switch to the RESET position and release.

2 Immediately press and hold the SEMI/AUTO pushbutton of the MultiMouse until the **2nd** indicator turns off.

3 Release the SEMI/AUTO pushbutton.

The indicators on the left control panel indicate the Long Tail Length mode as follows:

1st	Blinks
U/S	Off
2nd	On

6.3.3 Bonding Operation

6.3.3.1 Initial Parameters and Machine Setting

The following adjustments and parameters are recommended for selected wires. Final bonding parameters should be optimized using microscopic analysis and destructive tests.

Table 6-2: Recommended Machine Adjustments - 30°/45° Wire Feed

Parameter	Setting			
	18 µm Gold	**25 µm Gold**	**25 µm Alum**	**25 x 125 µm Ribbon**
Static bond force (gm)	7 - 10	15	15	15
Wire clamp gap (µm)	70	100	100	100
Wire clamp force (gm)	80 - 100	80 - 100	80 - 100	100 - 120
Workholder temperature (°C)	150	150		150

Table 6-2: Recommended Machine Adjustments - 30°/45° Wire Feed				
Parameter	**Setting**			
Initial Bond Dial Settings				
1st POWER	0 - 1	1 - 2	1 - 2	2 - 4
1st TIME	3*	5*	4	5*
1st FORCE	0 - 1	1 - 2	1 - 2	4 - 5
1st FORCE (gm)	12 - 14	25 - 30	25 - 30	60 - 80
LOOP	3	4	4	4
2nd POWER	1 - 2	1.5 - 2.5	1.5 - 2.5	2.5 - 4.5
2nd TIME	3*	5*	5	5*
2nd FORCE	0 - 1	1 - 2	1 - 2	5
2nd FORCE (gm)	14 - 16	25 - 30	25 - 30	60 - 80
TAIL	3	5	5	7
TEAR	4	5	5	5
Wires				
Gold	The smaller the wire diameter, the harder the wire should be. The recommended elongation is: 0.5 - 2% for18 μm wire 6 - 8% for 76 μm wire.			
Aluminum	1% Silicon wire with elongation of 1 - 3%.			

* Operate the bonder in Long time mode.

Table 6-3: Recommended Machine Adjustments - 90° Wire Feed Deep Access				
Parameter	**Setting**			
	18 μm Gold	**25 μm Gold**	**25 μm Alum**	**25 x 125 μm Ribbon**
Static bond force (gm)	7 – 10	15	15	15
Wire clamp gap (μm)	70	100	100	100
Wire clamp force (gm)	80 – 100	80 – 100	80 – 100	100 – 120

Table 6-3: Recommended Machine Adjustments - 90° Wire Feed Deep Access				
Parameter	**Setting**			
Workholder temperature (°C)	150	150		150
Initial Bond Dial Settings				
1st POWER	0 – 1	1 – 2	1 – 2	2 – 4
1st TIME	3*	5*	4	5*
1st FORCE	0 – 1	1 – 2	1 – 2	4 – 5
1st FORCE (gm)	15 – 20	25 – 30	25 – 30	60 – 80
LOOP	3	4	4	5
2nd POWER	0 –1	1 – 2	1 – 2	2 – 4
2nd TIME	3*	4*	5	5*
2nd FORCE	0 – 1	1 – 2	1 – 2	4 – 5
2nd FORCE (gm)	15 – 20	25 – 30	25 – 30	60 – 80
TAIL	3	5	5	3**
	18 µm Gold	**25 µm Gold**	**25 µm Alum**	**25 x 125 µm Ribbon**
TEAR	4	5	5	6
Wires				
Gold	The smaller the wire diameter, the harder the wire should be. The recommended elongation is: 0.5 – 2% for18 µm wire 6 – 8% for 76 µm wire.			
Aluminum	1% Silicon wire with elongation of 1 – 3%.			

* Operate the bonder in Long time mode.
** Operate the bonder in Long Tail Length mode.

6.3.3.2 Bond Strength Optimization

Bond strength depends on the following main parameters:

- Metalization – the bondability and the adhesion of the die and the substrate metals
- Wire type, tensile strength and elongation
- Wedge type
- Bonding parameter settings
- Workholder temperature (for gold wire)

Using a bond shear tester, perform a series of tests such as wire loop pull testing and microscopic analysis of the squashed wire dimensions. Be aware that loop height and the distance from the first bond to the second bond affect the results of pull test measurements.

Figure 6-8 shows typical bonds and loops performed by Model 4523.

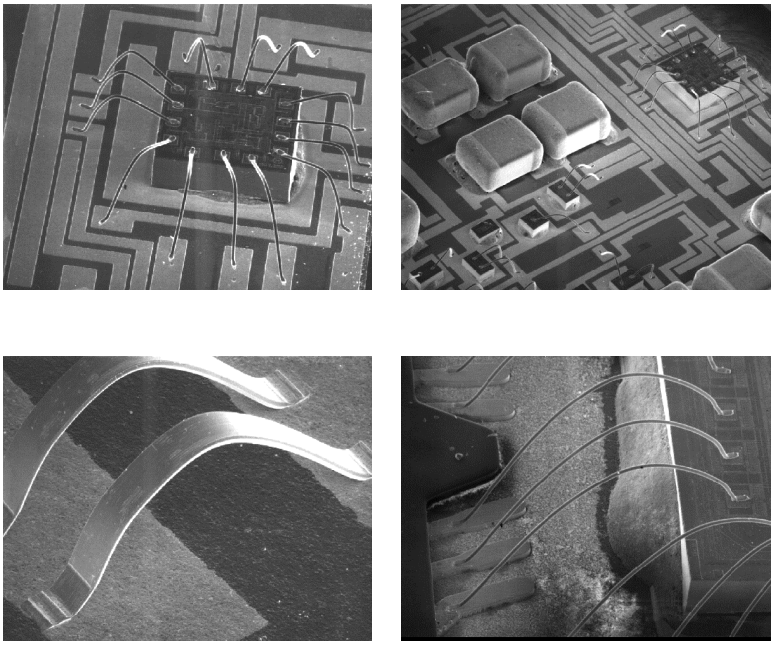


Figure 6-8: Typical Bonds Performed by Model 4523

6.4 Operation – Model 4524 Operation - Model 4524

This section describes specific process parameters, bond cycle modes and operation principles of the K&S Model 4524 Ball Bonder.

6.4.1 Process Parameters

In addition to the common process parameters (see section 6.1.2), Model 4524 requires the following settings:

- Ball Size
- Tail

6.4.1.1 Ball Size

The BALL SIZE dial on the right control panel is used for setting the ball size. The ball size should be set at 2 – 3 times larger than the diameter of the wire.

If the ball is too small, it can block up the capillary. If the ball is too large, it can cause a short-circuit between the N.E.F.O. wand and the wire.

You can view the ball size in the Reset position (before starting the bonding cycle) by adjusting the microscope magnification.

6.4.1.2 Tail

The tail is the length of wire protruding from the capillary after performance of the second bond.

The tail length is set by turning the TAIL dial on the left control panel. A capillary with a longer bonding foot requires a higher setting, and a capillary with a shorter foot requires a lower setting. The setting must always ensure that sufficient tail length exists to enable the N.E.F.O. wand to charge the wire without causing an OPEN or SHORT fault.

6.4.2 Bond Cycle Modes

The 4524 can operate in the following bonding modes:

- Semi-automatic bonding using the SEMI/AUTO pushbutton.
- Manual bonding using the MANUAL Z sidebutton.

6.4.2.1 Semi/Auto Mode Bonding Cycle

To perform Semi/Auto Mode Bonding:

Note: A graphic representation of the cycle appears in Figure 6-9.

1 Ensure that the bonding head is in the Reset position.

2 Position the workholder so that the bonding pad is under the capillary. Ensure that the ball is ready and that the drag and wire clamps are closed.

3 Press and hold the SEMI/AUTO pushbutton. The wire clamp opens and the kicker pulls out wire slack from the wire spool. The bonding head descends to the first Search height and stops. The drag clamp pulls the wire so that the ball is seated against the capillary tip.

4 While still holding the SEMI/AUTO pushbutton, move the Multi Mouse to position the first bonding pad precisely under the capillary.

5 Release the SEMI/AUTO pushbutton. The bonding head descends to the first bonding pad. The first bonding force and ultrasonic energy (set by the upper FORCE and POWER dials, respectively) are applied for the time set by the upper TIME dial. The first bond is performed, the drag clamp opens and the kicker is released.

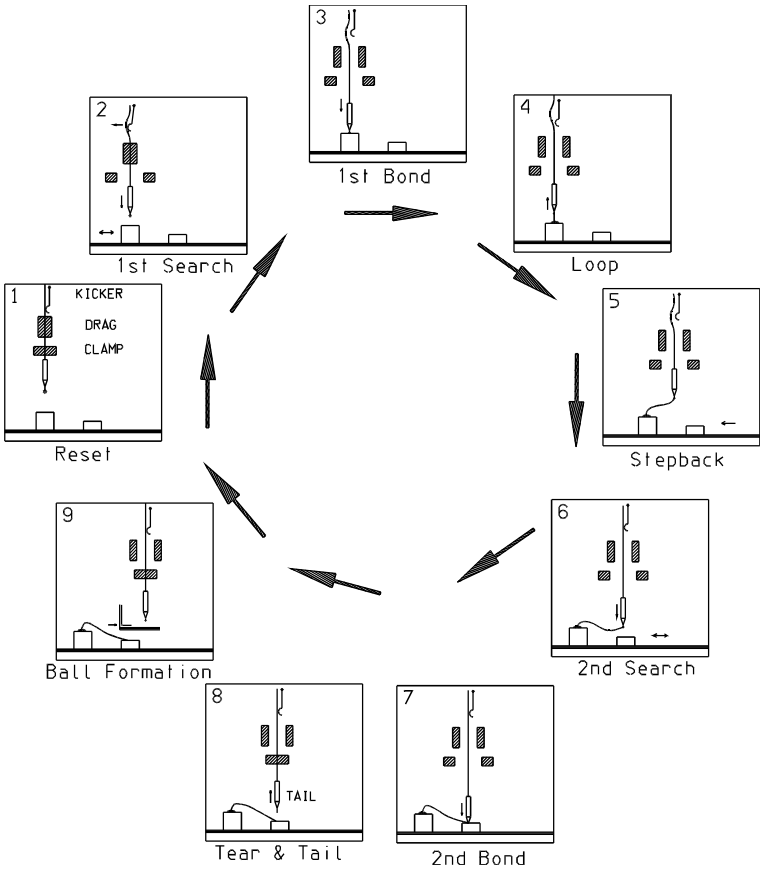


Figure 6-9: Ball Bonding in Semi/Automatic Mode

After completing the first bond, the bonding head automatically rises to the Loop height and stops.

6 Move the Multi Mouse to position the second bonding pad directly under the capillary.

7 Press and hold the SEMI/AUTO pushbutton. The bonding head drops to the second Search height and stops.

8 While still pressing the SEMI/AUTO pushbutton, move the Multi Mouse to position the second bonding pad precisely under the capillary.

9 Release the SEMI/AUTO pushbutton. The bonding head descends to the second bond pad. The second bonding force and ultrasonic energy (set by the lower FORCE and POWER dials, respectively) are applied for the time set by the lower TIME dial.

The bonding head rises automatically to the Reset position. The wire clamp closes, after which the wire is snapped, creating a tail for a new ball.

The bonding head remains in the Reset position. The N.E.F.O. wand approaches the tail and fires. A new ball is created for the next bonding cycle.

6.4.2.2 Manual Z Bonding

The Manual Z bonding mode enables you to maneuver the bonding head manually. The MANUAL Z sidebutton of the Multi Mouse provides you with full control of the bonding head motion.

To perform manual Z bonding:

1 Set the SEMI AUTO/MAN Z switch on the right control panel to the MAN Z position.

2 Press and hold the MANUAL Z sidebutton of the Multi Mouse. Lower the bonding head as close as you want to the bonding pad. Move the Multi Mouse to maneuver the first bonding pad precisely under the capillary.

3 Continue pressing the MANUAL Z sidebutton to drop the bonding head to the bonding pad and perform the bond as in the Semi/Auto mode.

4 Release the MANUAL Z sidebutton slowly to raise the bonding head to the Loop height.

5 Move the Multi Mouse to position the second bonding pad directly under the capillary.

6 To perform the second bond, repeat steps 2 and 3.

7 The bonding head rises to the Reset position automatically. The N.E.F.O. then fires to create a ball for the next bonding cycle. Release the MANUAL Z sidebutton to start the next cycle.

6.4.3 Bonding Operation

6.4.3.1 Initial Parameters and Machine Setting

The following adjustments and parameters are recommended for selected wires. Final bonding parameters should be optimized using microscopic analysis and destructive tests.

Table 6-4: Recommended Machine Adjustments

Parameter	Setting		
	25 µm Gold	**30 µm Gold**	**50 µm Gold**
Wire clamp gap (µm)	80	100	120
Wire clamp force (gm)	100	100	120
Drag clamp gap (µm)	250	350	500
Drag clamp force (gm)	6	10	10
N.E.F.O. Wand distance from capillary at Reset (µm)	500	570	625
N.E.F.O. ball size	1.5 - 2.5	2.5 - 4.5	5 - 7
Tail length	4 - 5	5 - 6	6 - 7
Initial Bond Dial Settings			
1st POWER	1 - 2	1.5 - 2.5	2 - 3
1st TIME	5	4 - 10	5*
1st FORCE	1 - 2	2 - 3	4 - 5
1st FORCE (gm)	40	60	80
LOOP	4	5	7
2nd POWER	2 - 3	3 - 4	6 – 8
2nd TIME	5 - 7	10	3 - 5*
2nd FORCE	4 - 6	7	8 - 10
2nd FORCE (gm)	80	100	120

Table 6-4: Recommended Machine Adjustments	
Parameter	**Setting**
Wires	Loop control is better if the elongation is higher.
Ball Bonding	Recommended wire is 99.99% gold with 2 - 6% elongation.

* Operate the bonder in Long time mode.

Your bonder was factory-set for bonding 25 µm (0.001") gold wire, 2-4% elongation.

Note: For wire diameter 38 μm or more, use clamps with ceramic jaws.

6.4.3.2 Creating a Ball

After loading the wire and setting the bonding parameters, but before performing bonding, you must create a ball.

To create a ball:

1 Power on the N.E.F.O. unit and set the BALL SIZE dial to the recommended setting (see page 6-27).

2 Set the CLAMP switch to the up position to open the wire clamp.

3 Pull some wire from the capillary tip and bend the wire upwards.

4 Set the CLAMP switch to the down position to close the wire clamp. The bonding head moves to the Loop height.

5 Perform the second bond in semi/auto mode. A ball is created.

Note: If a ball is not created, the missing ball detector automatically stops the bonder. The SHORT or OPEN indicator on the right control panel turns on, depending on the length of the tail (see section 6.4.3.3).

6.4.3.3 Missing Ball Detector

The missing ball detector is integrated within the N.E.F.O. system. If the N.E.F.O. system fails to create a ball, the missing ball detector stops bonder operation.

- The SHORT indicator turns on if a small gap exists between the tail and the wand.
- The OPEN indicator turns on if a large gap exists between the tail and the wand.

To correct a missing ball condition:

1 Readjust the tail length or the wand gap.

2 Set the CLAMP switch to the up position to open the clamp.

3 Pull more wire through the capillary and bend the wire below the capillary tip.

4 Set the CLAMP switch to the down position to close the clamp. The bonding head moves to the Loop height and is ready to perform the second bond.

5 Perform the second bond. The bonder will then create a ball for the next cycle.

6.4.3.4 Capillaries and Wires

For best results, use MicroSwiss capillaries. For a list of recommended capillaries, see section 5.1.2.

Always use the setup gauge when installing the capillary. After installing a new capillary, reset the bonder to calibrate the ultrasonic generator.

Be aware that the hole of the capillary applies some friction on the wire during loop creation. If the hole diameter is too small, wire friction results in loop height variations which are difficult to control. A soft wire produces higher loops than a hard wire, which is important when making long loops.

6.4.3.5 Factors Influencing Loop Height (Standard Cycle)

The factors influencing the loop height of a wire bonded on the 4524 at a specific distance with a specific height difference are:

LOOP Dial Setting	For longer distances between the first and the second bond, a higher dial setting is required.
Wire Tension	The higher the tension on the wire as it is pulled out of the spool, the lower the loop will be. Wire tension is controlled by the fixed tensioner glass plate.
Kicker Stroke	The kicker may be used to form loops in long wires by pulling a greater length of wire from the spool and neutralizing the fixed tensioner during wire manipulation.
Wire Elongation Coefficient	A wire with a low elongation coefficient (hard wire) produces lower loops than a wire with a high elongation coefficient (soft wire). Typically, wires with elongation coefficients of 2 - 4% are used for ball bonding.

Capillary Bore Diameter The smaller the bore diameter of the capillary, the lower the loop is (see the MicroSwiss catalog).

6.4.3.6 Bond Strength Optimization

Bond strength depends on the following main parameters:

- Metalization - the bondability and the adhesion of the die and the substrate metals
- Wire type, tensile strength and elongation
- Capillary type
- Ball size
- Bonding parameter settings
- Workholder temperature

Using a bond shear tester, perform a series of tests such as wire loop pull testing and microscopic analysis of the squashed wire dimensions. Be aware that loop height and the distance from the first bond to the second bond affect the results of pull test measurements.

Figure 6-10 shows typical bonds and loops performed by Model 4524.

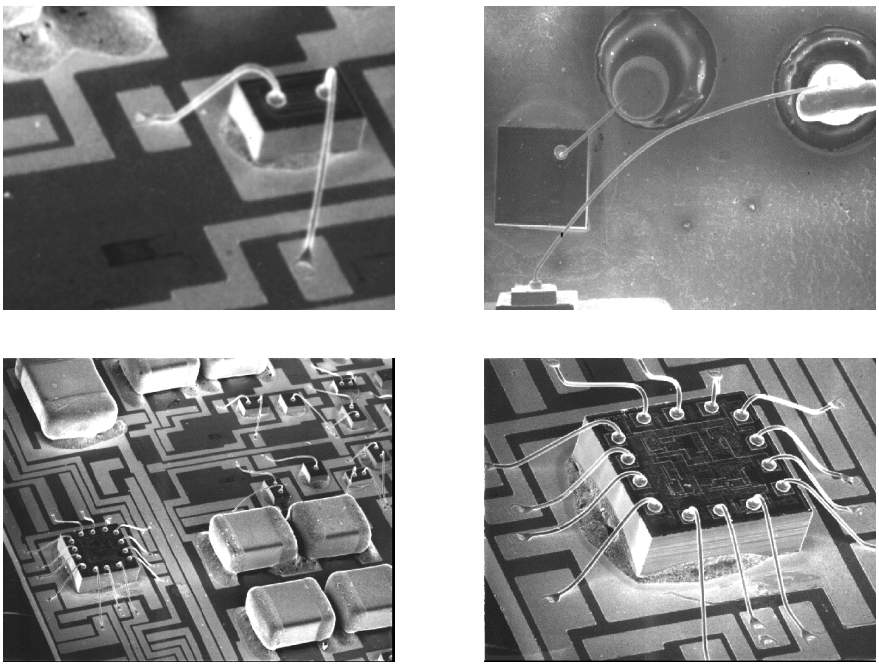


Figure 6-10: Typical Bonds Performed by Model 4524

6.5 Operation - Model 4526

This section describes specific process parameters, bond cycle modes and operation principles of the K&S Model 4526 Auto Stepback Wedge Bonder.

6.5.1 Process Parameters

In addition to the common process parameters (see section 6.1.2), Model 4526 requires the following settings:

- Tail
- Tear
- Kink Height
- Reverse
- Stepback
- Y Speed

6.5.1.1 Tail and Tear Settings

The TAIL dial sets the length of tail produced after tearing. The TEAR dial sets the tear point of the wire.

The tear point motion and tail length motion of the wire clamp are controlled by a linear motor.

6.5.1.2 Kink Height

The Kink height is the length of wire protruding from the wedge after the bonding head rises following performance of the first bond. This length is set by the KINK HEIGHT dial on the right control panel.

6.5.1.3 Reverse

In standard bonding modes, the Reverse parameter is the amount of reverse motion of the motorized Y table following the first bond (which influences looping). This value is set **before** bonding by the REVERSE dial on the right control panel.

After the bonding head rises to the Kink height, the Y table moves backwards according to the REVERSE setting. The bonding head then rises to the Loop height.

In Lange Coupler mode, the Reverse motion is used to create low loops. After making the first bond, the bonding head rises to the Loop height and the motorized Y table returns. At the second Search height, the motorized Y table performs the reverse motion. This reverse motion presses the wire backward, creating a low loop.

6.5.1.4 Stepback

The stepback is the distance of the motorized Y table motion between the first and the second bond pads. This distance is set by the STEP BACK dial on the right control panel.

The stepback travel saves manipulation time. It is useful for applications requiring a series of parallel wires having equal distances between the first and second bonds.

- In the Semi/Automatic Bonding Cycle mode, the maximum stepback setting is 6.4 µm (160 mil).
- In the Lange Coupler mode, the recommended stepback setting is 0.8 µm (20 mil).

6.5.1.5 Y Speed

The Y speed parameter is the speed of the motorized Y table. This value is used in very fine bonding applications.

6.5.2 Bond Cycle Modes

The 4526 can operate in the following bonding modes:

- Semi-automatic bonding using the SEMI/AUTO pushbutton.
- Manual bonding using the MANUAL Z sidebutton.
- Stitch bonding in the Semi/Auto Cycle or Manual Z mode.
- Lange coupler bonding.
- Long tail length.

6.5.2.1 Semi/Auto Mode Bonding Cycle

To set the bonder for Semi/Auto Mode Bonding:

1 Press the SET UP/RESET switch to the RESET position and release.

2 Immediately press and hold the SEMI/AUTO pushbutton of the Multi Mouse until the **2nd** indicator turns off.

3 Release the SEMI/AUTO pushbutton

4 When the bonding head is in the Reset position, press the STITCH pushbutton of the Multi Mouse. The indicators on the left control panel indicate the Semi/Auto Bonding Cycle mode as follows:

1st	Blinks
U/S	Off
2nd	Off

To perform Semi/Auto Mode Bonding:

Note: Graphic representations of the cycle appear in Figure 6-11 and Figure 6-12.

1 Ensure that the bonding head is in the Reset position.

2 Position the workholder so that the bonding pad is under the wedge. Ensure that the wire clamp are closed.

3 Press and hold the SEMI/AUTO pushbutton of the Multi Mouse. The bonding head descends to the first Search height and stops.

4 While still holding the SEMI/AUTO pushbutton, move the Multi Mouse to position the first bonding pad precisely under the wedge.

5 Release the SEMI/AUTO pushbutton. The bonding head descends to the first bonding pad. The first bonding force and ultrasonic energy (set by the upper FORCE and POWER dials, respectively) are applied for the time set by the upper TIME dial. The first bond is performed and the wire clamp opens.

The bonding head rises automatically to the Kink height position, and travels in a reverse motion to form the loop. The bonding head then automatically performs loop height again and stepback to the second bond position.

Note: Perform wedge bonding in the direction of the wire. If necessary, rotate the device so that the first bond and the second bond pads are aligned with the wire feed line.

6 Press and hold the SEMI/AUTO pushbutton. The bonding head drops to the second Search height and stops. As the bonding head starts its descent, the wire clamp closes momentarily to prevent the wire from feeding back into the wedge feed hole (helping to create a stable loop).

7 While still pressing the SEMI/AUTO pushbutton, move the Multi Mouse to position the second bonding pad precisely under the wedge.

8 Release the SEMI/AUTO pushbutton. The bonding head descends to the second bond site. The second bonding force and ultrasonic energy (set by the lower FORCE and POWER dials, respectively) are applied for the time set in the lower TIME dial. After the bond is performed, the wire clamp closes and rises (as set by the TEAR dial), tearing the wire.

The bonding head rises to the Reset position. The wire clamp drops from the Tear position, feeding a wire tail through the wedge feed hole to prepare for the next bond.

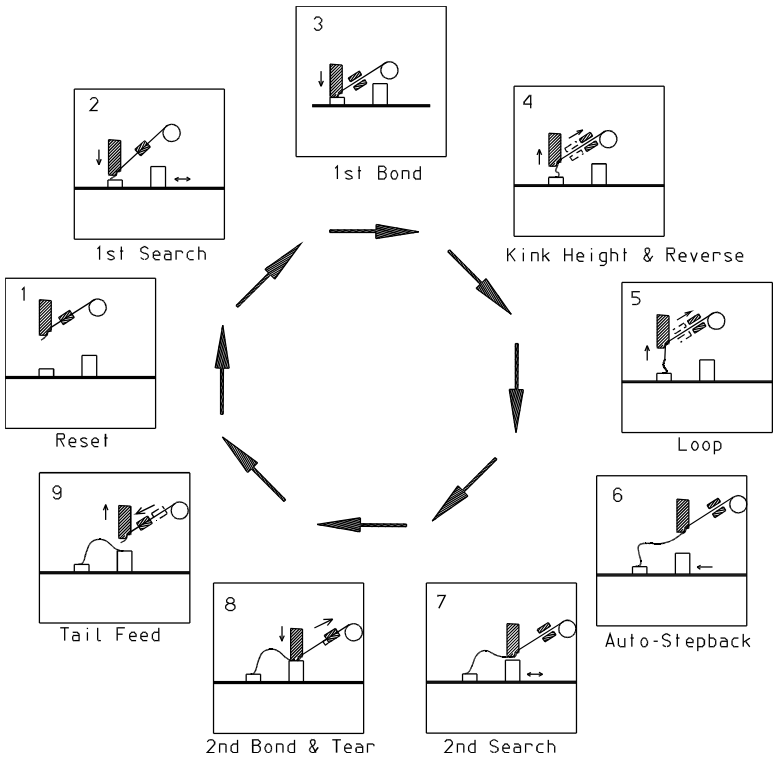


Figure 6-11: Wedge Bonding Cycle in Semi/Auto Mode - 30°/45° Wire Feed

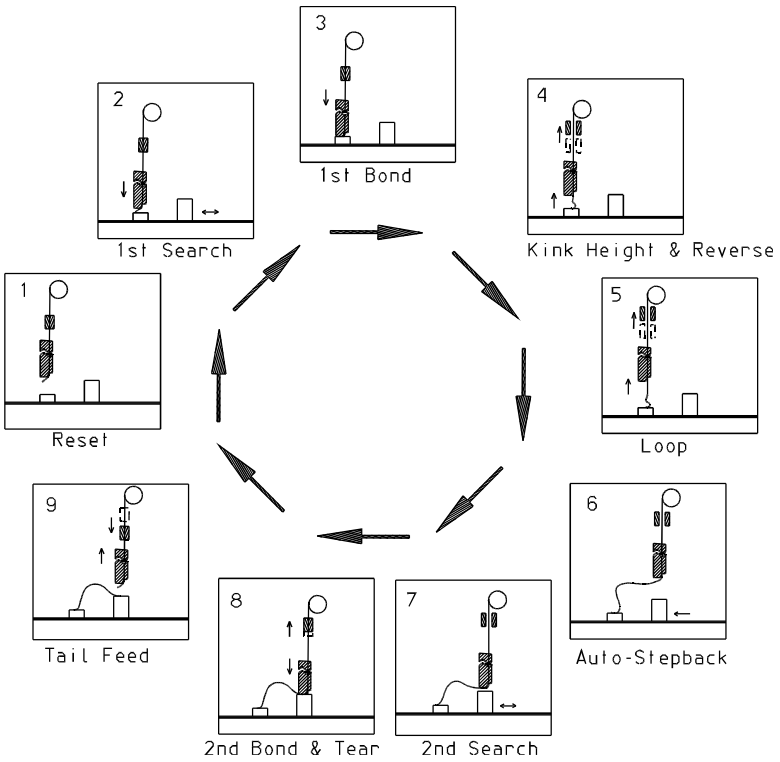


Figure 6-12: Wedge Bonding Cycle in Semi/Auto Mode - 90° Wire Feed

6.5.2.2 Manual Z Bonding

The Manual Z bonding mode enables you to maneuver the bonding head manually. The MANUAL Z sidebutton of the Multi Mouse provides you with full control of the bonding head motion.

To perform Manual Z bonding:

1. Set the SEMI AUTO/MAN Z switch on the right control panel to the MAN Z position.
2. Press and hold the MANUAL Z sidebutton of the Multi Mouse. Lower the bonding head as close as you want to the bonding pad. Move the Multi Mouse to maneuver the first bonding pad precisely under the wedge.
3. Continue pressing the MANUAL Z sidebutton to drop the bonding head to the bonding pad and perform the bond as in the Semi/Auto mode. The bonding head rises automatically to the Kink height, and then travels in a reverse motion to the Loop height.
4. Release the MANUAL Z sidebutton slowly to raise the bonding head to the Loop height.
5. Move the Multi Mouse to position the second bonding pad directly under the wedge.
6. To perform the second bond, repeat steps 2 and 3.
7. Release the MANUAL Z sidebutton to raise the bonding head to the Reset position.

6.5.2.3 Stitch Bonding

The Stitch Bond mode enables the bonder to automatically perform one or more successive bonds without tearing the wire.

To perform stitch bonding:

1. Press and hold the STITCH pushbutton of the Multi Mouse after performing the first bond. The bonder performs the second bond without tearing the wire as in step 8 of the Semi/Auto Cycle Bonding Cycle (see section 6.5.2.1). The bonder then continues making bonds until you release the pushbutton.
2. After making one or more stitch bonds, release the STITCH pushbutton and make one more bond. The bonding head then rises to the Reset position and the wire tail is formed.

6.5.2.4 Lange Coupler Mode

Lange couplers may be present in some high frequency microwave amplifiers. A typical Lange coupler requires a series of extremely short and low wire loops connecting thin film leads. Regular wedge bonding cannot achieve loop heights that are low enough. Therefore, the 4526 has a special Lange coupler bonding capability. In Lange Coupler mode, bonding may be performed semi-automatically as in regular wedge bonding. For very small Lange couplers, however, Manual Z bonding is recommended.

To set the bonder for Lange Coupler mode:

1 Press the SET UP/RESET switch to the RESET position and release.

2 Immediately press and hold the STITCH pushbutton of the Multi Mouse until the **1st** indicator is on and the **2nd** indicator turns off.

3 Release the STITCH pushbutton.

4 Press the STITCH pushbutton. The indicators on the left control panel indicate the Lange Coupler bonding mode as follows:

1st	Off
U/S	Off
2nd	Blinks

5 To return to the Semi/Auto Bond Cycle mode, repeat steps 2 and 3.

To perform Lange Coupler mode bonding:

Note: Graphic representations of the cycle appear in Figure 6-13 and Figure 6-14.

1 Ensure that the bonding head is in the Reset position.

2 Position the workholder so that the bonding pad is under the wedge. Ensure that the wire clamp is closed, and that a wire tail protrudes from the wedge foot.

3 Press and hold the SEMI/AUTO pushbutton of the Multi Mouse. The bonding head descends to the first Search height and stops.

4 While still holding the SEMI/AUTO pushbutton, move the Multi Mouse to position the first bonding pad precisely under the wedge.

5 Release the SEMI/AUTO pushbutton. The bonding head descends to the first bonding pad. The first bonding force and ultrasonic energy (set by the upper FORCE and POWER dials, respectively) are applied for the time set by the upper TIME dial. The first bond is performed and the wire clamp opens.

The bonding head rises to the Loop height, which should be a low setting (set by the LOOP dial). The Y table overshoots the second bond site by about half the lead width (set by the STEP BACK dial).

Note: To achieve higher resolution in Lange Coupler mode, the maximum travel range of the stepback motion is reduced from 4.0 mm (0.160") to 0.5 mm (0.020").

6 Press and hold the SEMI/AUTO pushbutton. The bonding head drops to the second Search height and stops.

Note: The second Search setting should be such that the wire touches the substrate. Otherwise, the loop will be flattened and may cause shorts in the leads.

7 Release the SEMI/AUTO pushbutton. The Y table moves forward (as set by the REVERSE dial), bringing the bonding head back to the second bond site, and compensating for the overshoot of the stepback motion. The low setting of the SEARCH dial causes the flat loop to bend during the reverse movement. The second bond is performed and the clamp closes.

The Y table returns to its reset position. The bonding head rises to its Reset position and stops. The tail arm moves and feeds the wire for the next bond. The bonder is now ready for the next bond cycle.

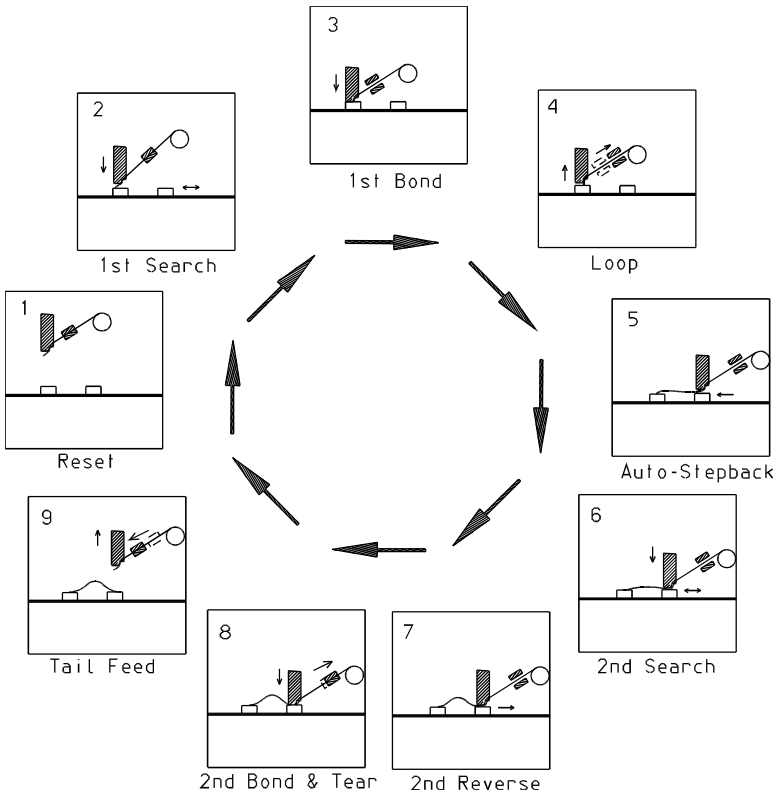


Figure 6-13: Wedge Bonding Cycle in Lange Coupler Mode - 30°/45° Wire Feed

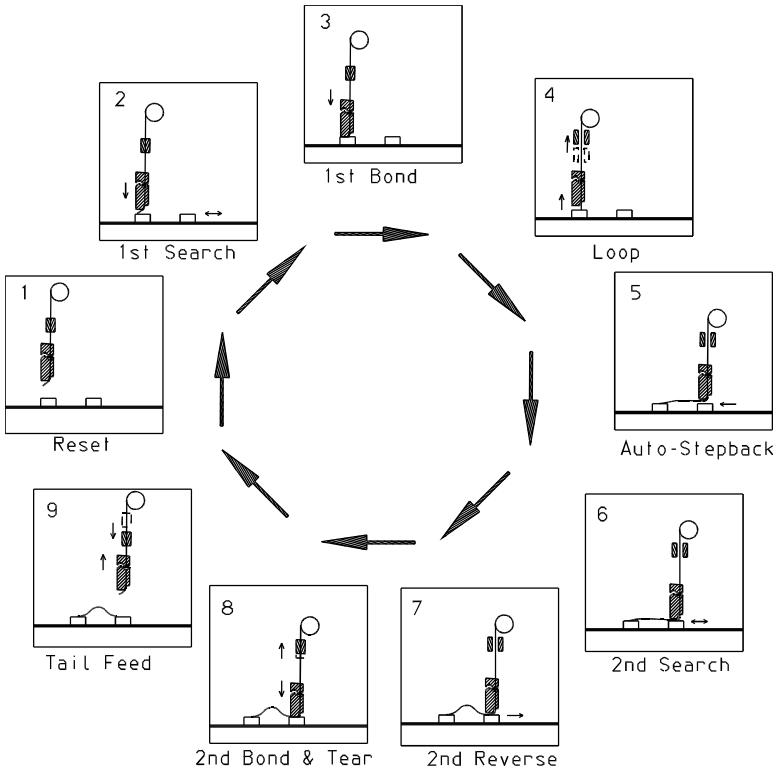


Figure 6-14: Wedge Bonding Cycle in Lange Coupler Mode - 90° Wire Feed

6.5.2.5 Long Tail Length

The Long Tail Length mode is used when bonding thick wires with diameters of 76 µm (3 mil) or ribbon wires thicker than 25 x 125 µm (1 x 5 mil).

To set the bonder for the Long Tail Length mode:

1 Press the SET UP/RESET switch to the RESET position and release.

2 Immediately press and hold the SEMI/AUTO pushbutton of the Multi Mouse until the **2nd** indicator turns off.

3 Release the SEMI/AUTO pushbutton.

The indicators on the left control panel indicate the Long Tail Length mode as follows:

1st Blinks

U/S Off

2nd On

In Lange Coupler mode, the indicators on the left control panel indicate the Long Tail Length mode as follows:

1st On

U/S Off

2nd Blinks

6.5.3 Bonding Operation

6.5.3.1 Initial Parameters and Machine Setting

The following adjustments and parameters are recommended for selected wires. Final bonding parameters should be optimized using microscopic analysis and destructive tests.

Table 6-5: Recommended Machine Adjustments – 30°/45° Wire Feed				
Parameter	**Setting**			
	18 µm Gold	**25 µm Gold**	**25 µm Alum**	**25 x 125 µm Ribbon**
Static bond force (gm)	7 – 10	15	15	15
Wire clamp gap (µm)	70	100	100	100
Wire clamp force (gm)	80 – 100	80 – 100	80 – 100	100 – 120
Workholder temperature (°C)	150	150		150
Initial Bond Dial Settings				
1st POWER	0 – 1	1 – 2	1 – 2	2 – 4
1st TIME	3*	5*	4	5*
1st FORCE	0 – 1	1 – 2	1 – 2	4 – 5
1st FORCE (gm)	12 – 14	25 – 30	25 – 30	60 – 80
LOOP	3	4	4	4
2nd POWER	1 –2	1.5 – 2.5	1.5 – 2.5	2.5 – 4.5
2nd TIME	3*	5*	5	5*
2nd FORCE	0 – 1	1 – 2	1 – 2	5
2nd FORCE (gm)	14 – 16	25 – 30	25 – 30	60 – 80
TAIL	3	5	5	7
TEAR	4	5	5	5
STEP BACK	1 - 2	2 - 3	2 - 3	4 - 6
REVERSE	2 - 3	3	3	3
KINK HEIGHT	2	2	2	3
Y SPEED	2	2	2	2

Table 6-5: Recommended Machine Adjustments – 30°/45° Wire Feed	
Parameter	**Setting**
Wires	
Gold	The smaller the wire diameter, the harder the wire should be. The recommended elongation is: 0.5 – 2% for18 μm wire 6 – 8% for 76 μm wire.
Aluminum	1% Silicon wire with elongation of 1 – 3%.

* Operate the bonder in Long time mode.

Table 6-6: Recommended Machine Adjustments – 90° Wire Feed Deep Access				
Parameter	**Setting**			
	18 μm Gold	**25 μm Gold**	**25 μm Alum**	**25 x 125 μm Ribbon**
Static bond force (gm)	7 – 10	15	15	15
Wire clamp gap (μm)	70	100	100	100
Wire clamp force (gm)	80 – 100	80 – 100	80 – 100	100 – 120
Workholder temperature (°C)	150	150		150
Initial Bond Dial Settings				
1st POWER	0 – 1	1 – 2	1 – 2	2 – 4
1st TIME	3*	4*	5	5*
1st FORCE	0 – 1	1 – 2	1 – 2	4 – 5
1st FORCE (gm)	15 – 20	25 – 30	25 – 30	60 – 80
LOOP	3	4	4	5
2nd POWER	0 – 1	1 – 2	1 – 2	2 – 4
2nd TIME	3*	4*	5	5*
2nd FORCE	0 – 1	1 – 2	1 – 2	4 - 5
2nd FORCE (gm)	15 – 20	25 – 30	25 – 30	60 – 80
TAIL	3	5	5	3**
TEAR	4	5	5	6

Table 6-6: Recommended Machine Adjustments – 90° Wire Feed Deep Access				
Parameter	**Setting**			
STEP BACK	1 - 2	1.5 –2.5	1.5 –2.5	2 - 3
REVERSE	2 - 3	2 – 3	2 – 3	3 - 4
KINK HEIGHT	2	2	2	2 - 3
Y SPEED	0	2	2	3
Wires				
Gold	The smaller the wire diameter, the harder the wire should be. The recommended elongation is: 0.5 – 2% for18 μm wire 6 – 8% for 76 μm wire.			
Aluminum	1% Silicon wire with elongation of 1 – 3%.			

* Operate the bonder in Long time mode.
** Operate the bonder in Long Tail Length mode.

6.5.3.2 Bond Strength Optimization

Bond strength depends on the following main parameters:

- Metalization - the bondability and the adhesion of the die and the substrate metals
- Wire type, tensile strength and elongation
- Wedge type
- Bonding parameter settings
- Workholder temperature (for gold wire)

Using a pull tester, perform a series of tests such as wire loop pull testing and microscopic analysis of the squashed wire dimensions. Be aware that loop height and the distance from the first bond to the second bond affect the results of pull test measurements.

Figure 6-15 shows typical bonds and loops performed by Model 4526.

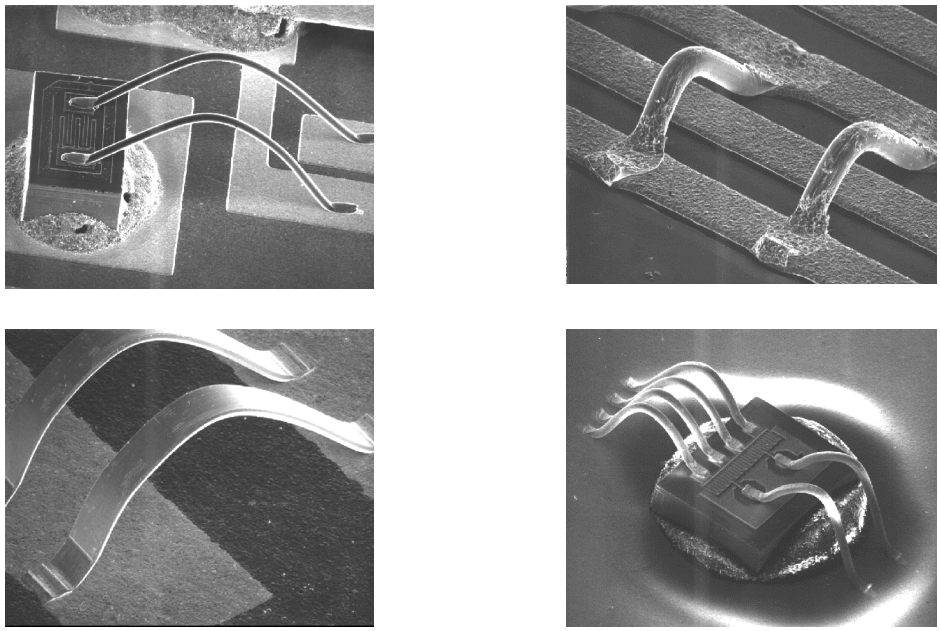


Figure 6-15: Typical Bonds Performed by Model 4526

7. MAINTENANCE OVERVIEW

The K&S 4500 Series Manual Wire Bonder is a rugged, durable machine, designed to operate trouble-free for many years. However, like any machine, the bonder requires servicing, adjustments, and occasional repairs. Chapters 8-15 provide necessary information to the technician for making repairs and adjustments.

It is assumed that the technician knows how to operate the K&S 4500 Series Manual Wire Bonder.

7.1 General Guidelines

When performing maintenance on the K&S 4500 Series Manual Wire Bonder, adhere to the following general guidelines:

1 Always use the proper tools and equipment, as instructed in the procedures.

2 Never use other than K&S approved spare parts (a complete parts list appears in Chapter 15).

3 If a problem persists after you perform a procedure provided by this manual, refer the problem to your K&S representative. Do not attempt repairs beyond the scope of this manual.

4 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.

5 Except for adjustments that require bonder operation, perform all maintenance work with the bonder's power off.

7.2 Machine Adjustments Checklist

Because of the interdependence of the electrical and mechanical assemblies for proper bonder operation, the following adjustments appear in the order of their priority. If you perform a specific adjustment, then you must perform the adjustments that follow it in the list. For example, if you perform 18 Vp-p adjustment, then you must also perform Reset Height Adjustment, Verticality Adjustment, and so on down the list.

7.2.1 4522, 4524

1 18 Vp-p Adjustment (section 8.3.2)

2 Reset Height (LVDT) Adjustment (section 9.4)

3 Verticality (Transducer) Adjustment (section 9.5)

4 Force Actuator Adjustment (section 9.3.4)

5 Static Bonding Force Adjustment (section 9.2.3)

6 Wire Path from Kicker to Capillary Alignment (section 5.4)

7 Ultrasonic Free Running Frequency Adjustment (section 8.3.3.1)

8 Ultrasonic Power Adjustment (section 8.3.3.2)

9 Clamp Solenoid Adjustments (section 9.6.2)

10 Drag Clamp Gap and Force Adjustments (sections 9.8.1 and 9.8.2)

11 Kicker Stroke Adjustment (section 9.10.4)

12 N.E.F.O. Wand and Ball Size Adjustment (section 8.2)

13 Bonding Parameters Setup (sections 6.2.3.1 and 6.4.3.1)

7.2.2 4523, 4526

1 18 Vp-p Adjustment (section 8.3.2)

2 Reset Height (LVDT) Adjustment (section 9.4)

3 Transducer Insertion Depth - should be performed according to the wedge type and together with the Clamp Position Adjustment (section 9.5)

4 Verticality (Transducer) Adjustment (section 9.5)

5 Force Actuator Adjustment (section 9.3.4)

6 Static Bonding Force Adjustment (section 9.2.3)

7 Clamp Gap and Force Adjustment (section 9.6.2)

8 Clamp Lateral Position Adjustment (section 9.6.3)

9 Ultrasonic Free Running Frequency Adjustment (section 8.3.3.1)

10 Ultrasonic Power Adjustment (section 8.3.3.2)

11 Bonding Parameters Setup (sections 6.3.3.1 and 6.5.3.1)

8. ELECTRICAL SUBASSEMBLIES

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

Figures 8-1, 8-2 and 8-3 show the electrical subassemblies and their interconnections of Models 4522/4524, 4523 and 4526, respectively.

8.1 Description of Electrical System

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

- Power supply
- Motherboard
- Logic board
- Z Motor Relay Board (4526)
- Stepper drivers board (4526)

8.1.1 The Power Supply

The 4500 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

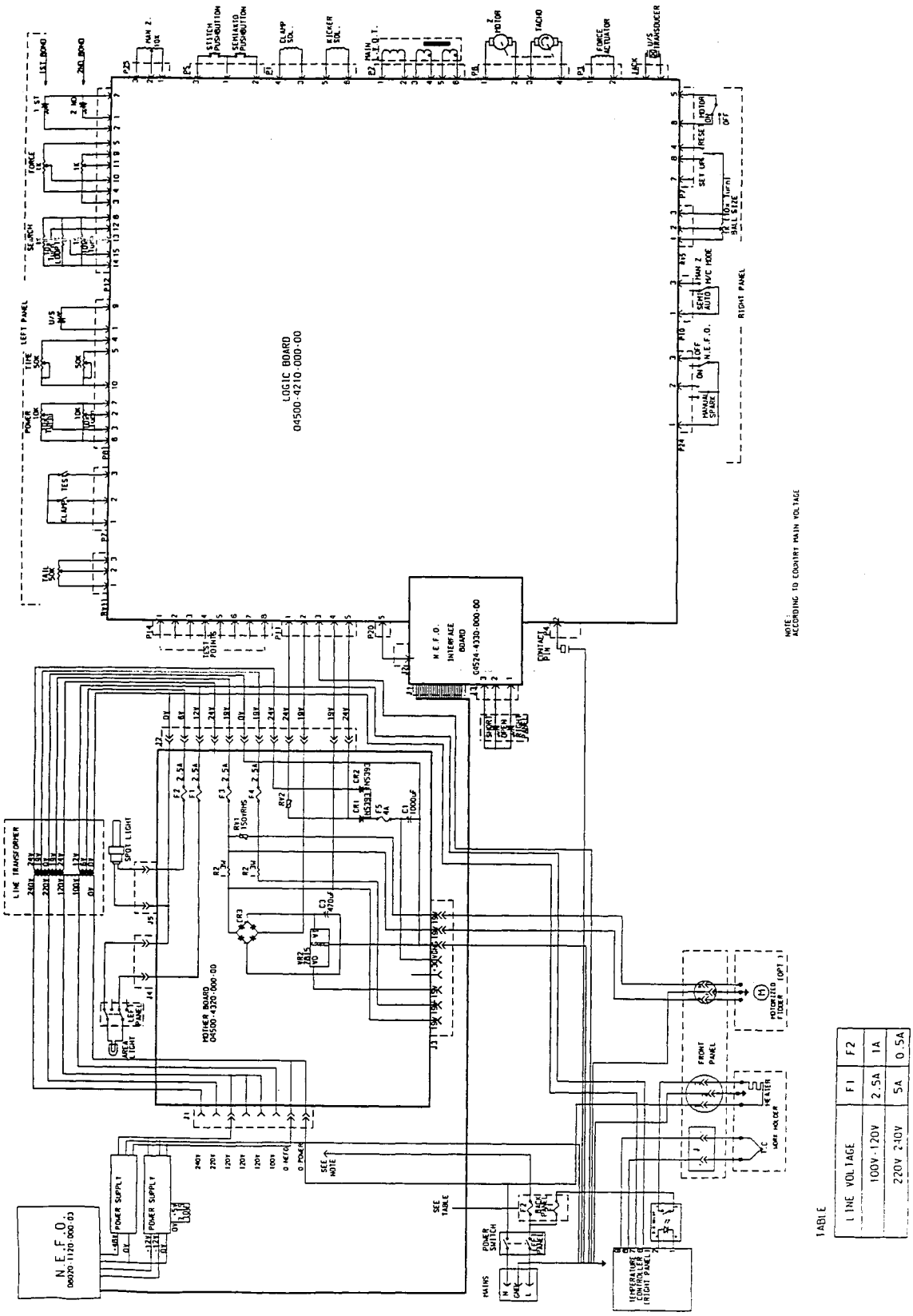


Figure 8-1: Interconnections Schematic Diagram - Models 4522/4524

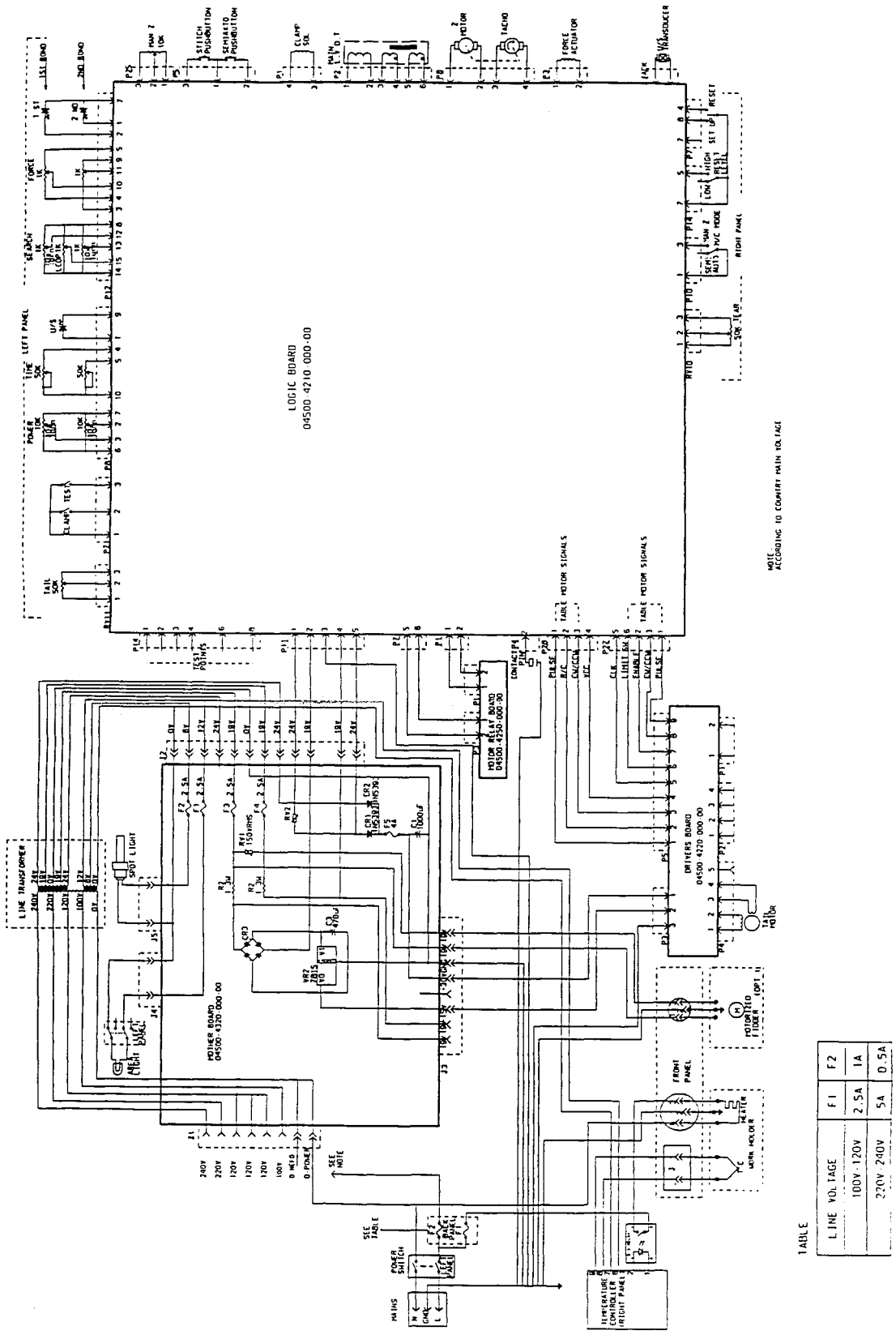


Figure 8-2: Interconnections Schematic Diagram - Model 4523

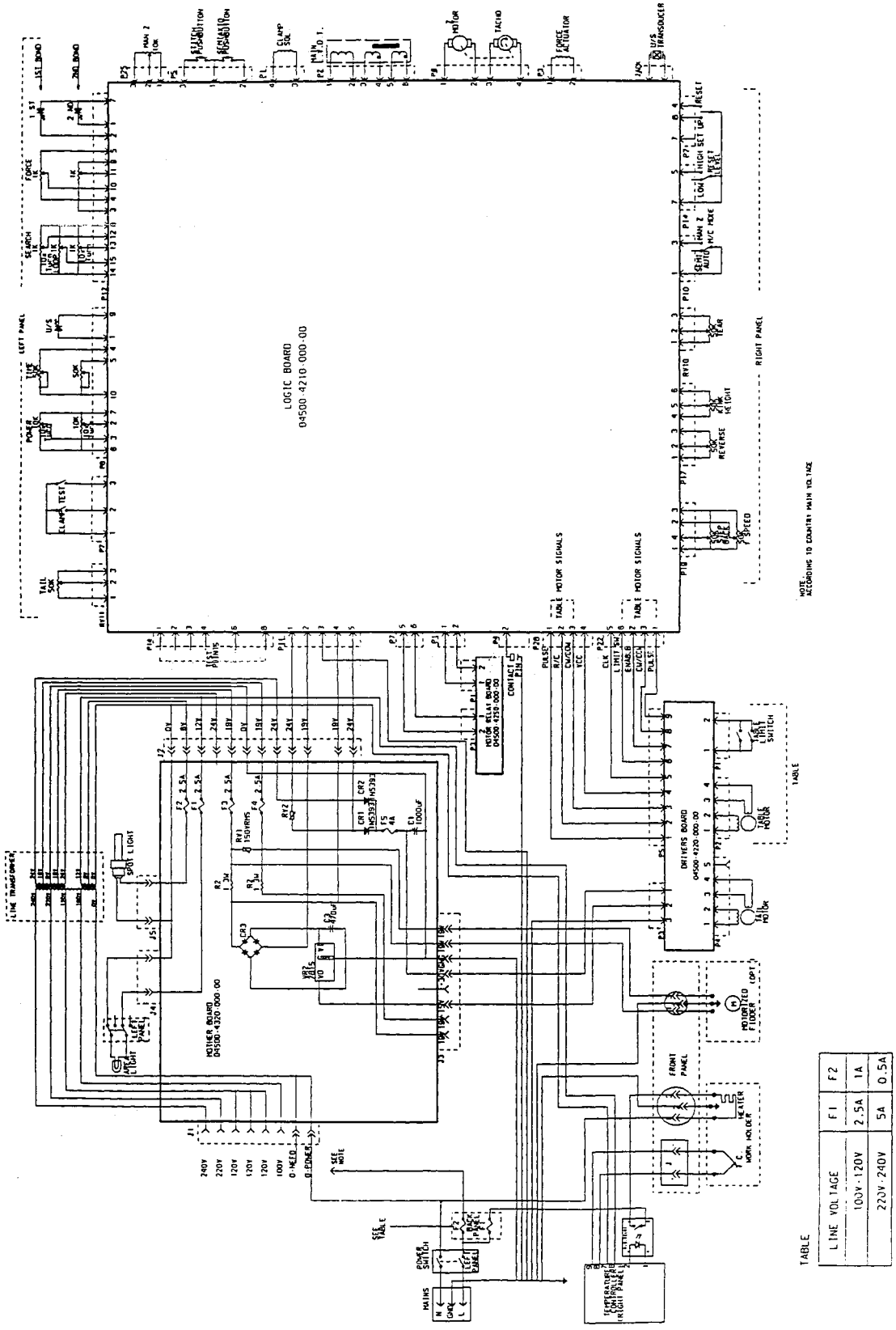


Figure 8-3: Interconnections Schematic Diagram - Model 4526

8.1.2 The Motherboard

The motherboard receives all power input to the 4500 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 8-4 shows the layout of the motherboard.

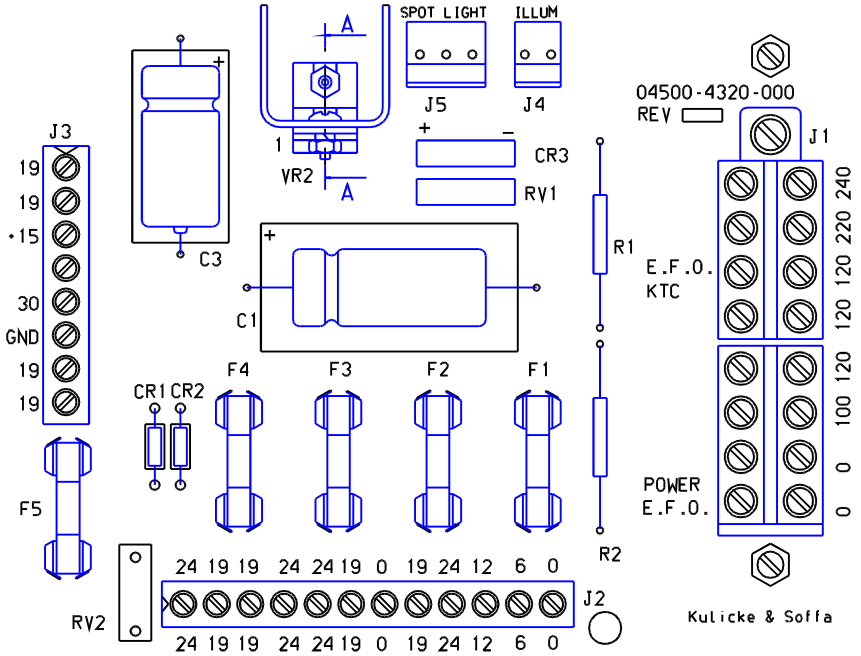


Figure 8-4: Motherboard Layout

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 your bonder's Interconnections Schematic Diagram (Figure 8-1, 8-2 or 8-3).

8.1.2.1.3 Connector J3

J3 connects two 19 V ac lines to the motorized workholder connector on the workholder connectors panel. Two additional 19 V ac lines are 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 (4523, 4526).

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 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 W/H motor.
- F5 protects the 30 V dc line to the stepper drivers board (4523, 4526).

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 Series bonder. The circuitry uses the switch and dial 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 8-5. The detailed schematic of the board is shown in Figure 8-6.

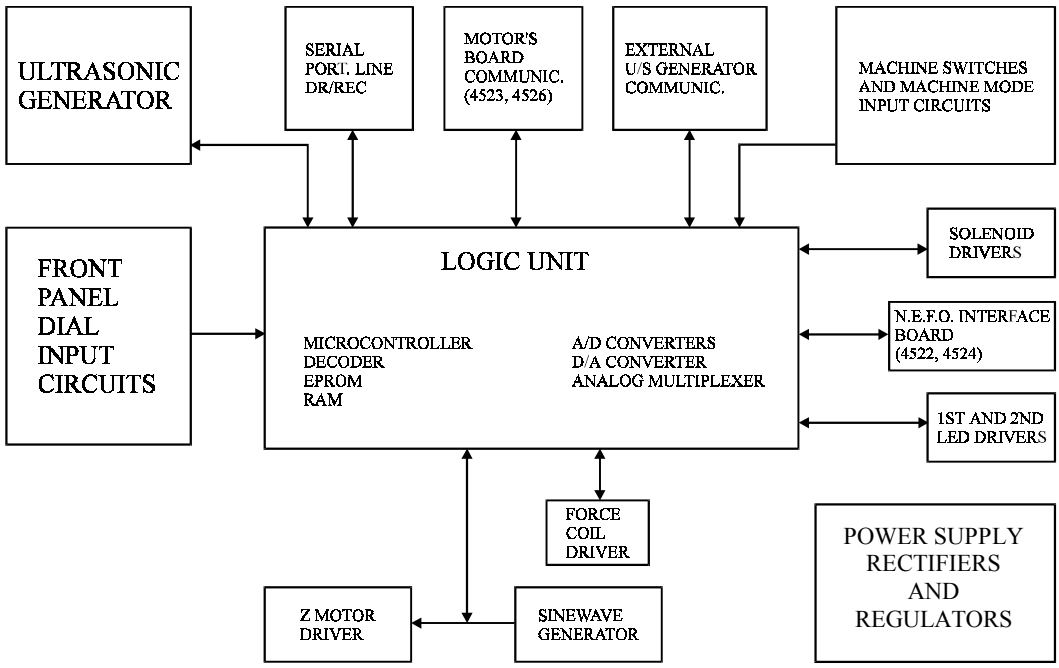


Figure 8-5: Logic Board Block Diagram

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 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 68HC11E microcontroller. Two memory components, a RAM and an EPROM, support the microcontroller.

8.1.3.4 Sine Wave Generator

The Sine Wave 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 optimal speed by turning RV2. This is done at the factory (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 UP/RESET switch is set to the SET UP position, the force circuit drives the force coil, applying a force that is proportional to the supplied current.

When the bonding head is in the Reset position, the force circuit applies the force set by the upper FORCE dial. When the bonding head is at the Loop height, the circuit applies the force set by the lower FORCE dial.

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 8-6.

Table 8-2: Connectors

Connector	Function
P1 (4522, 4524)	Connects the kicker and clamp solenoids.
P1 (4523, 4526)	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 (4522, 4524)	Connects the SET UP/RESET, MOTOR, CLAMP and TEST switches on the left and right control panels.
P7 (4523, 4526)	Connects the SET UP/RESET, CLAMP, TEST switches and the Z motor relay board on the left and right control panels.
P8	Connects the POWER and TIME dials and the U/S indicator.
P9	Not used.
P10	Connects the SEMI AUTO/MAN Z switch.
P11	Connects the power supply.
P12	Connects the SEARCH, FORCE and LOOP dials and the **1st** and **2nd** indicators on the left control panel.
P14 (4522, 4524)	Not used.

Table 8-2: Connectors	
Connector	**Function**
P14 (4523, 4526)	Optional 3rd channel kit, connects the HIGH/LOW (Z motor reset level) switch.
P15 (4522, 4524)	Connects the EFO solenoid.
P17 (4526)	Connects the REVERSE and KINK HEIGHT dials on the right control panel.
P19 (4526)	Connects the STEP BACK snd Y SPEED dials on the right control panel.
P20(4522, 4524)	Connects the missing ball detector.
P22 + **P28** (4523, 4526)	Connects the Tail/Tear and Y table motors.
P23	Serial communication port.
P24 (4522, 4524)	Connects the MANUAL SPARK and N.E.F.O. switches on the right control panel.
P25	Connects Manual Z potentiometer.
J1	Ultrasonic plug.
RV10 (4523, 4526)	Connects the TEAR dial on the right control panel.
RV11	Connects the TAIL dial on the left control panel.
RV5 (4524)	Connects the BALL SIZE dial on the right control panel.

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 8-6.

Table 8-3: 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 8-6.

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.

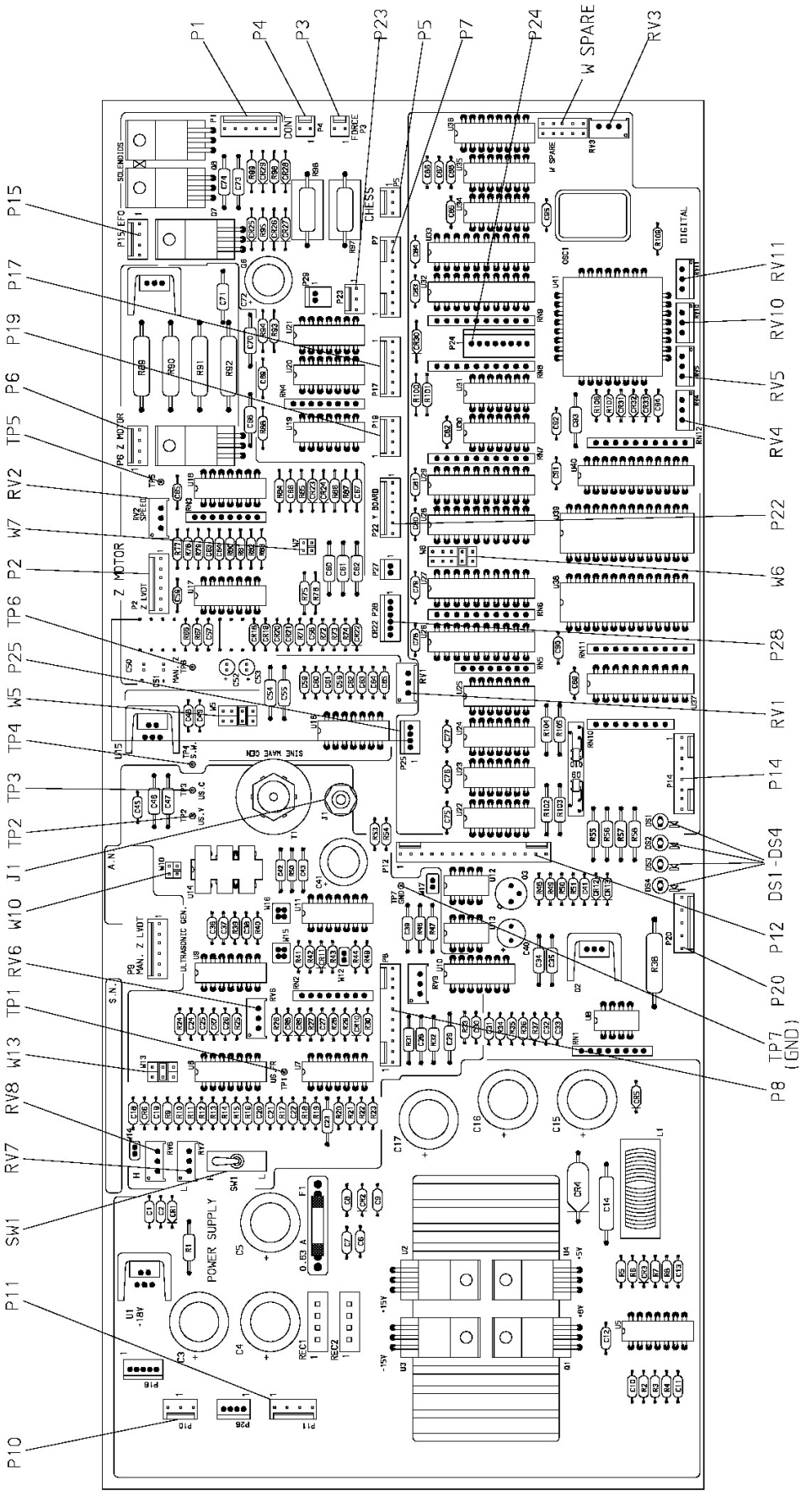


Figure 8-6: Logic Board Layout

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 is determined by the bonder model. Figure 8-7 shows the required jumper configurations for Models 4522, 4523, 4524 and 4526, respectively.

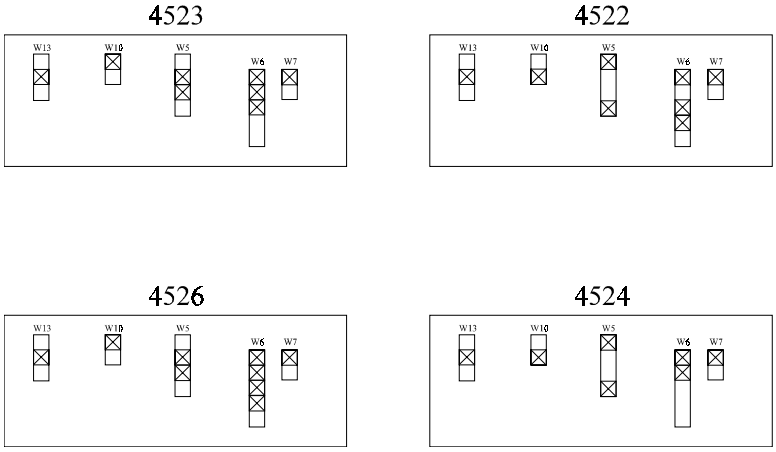


Figure 8-7: Jumper Configurations for Model 4522, 4523, 4524 and 4526

8.1.4 The Z Motor Relay Board (4523, 4526)

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 LEVEL switch on the right control panel.

When the switch is set to the LOW position, the bonding head reset position is 6.6 mm (260 mil) and the Z motor relay is constantly energized.

When the switch is set to the HIGH position, the Z motor relay is de-energized 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 8-8 shows a schematic drawing of the Z motor relay board.

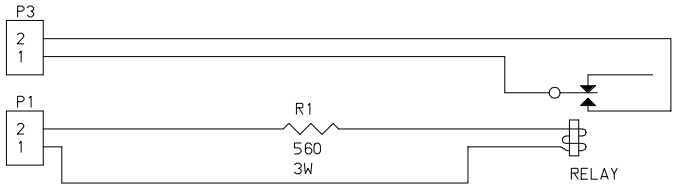


Figure 8-8: The Z Motor Relay Board - Schematic Drawing

8.1.5 The Stepper Drivers Board (4526)

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 dc and +19 V ac 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 BACK dial settings.

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 11.1).

Figure 8-9 shows the electronic layout of the stepper drivers board.

8.2 The N.E.F.O. (4522, 4524)

The N.E.F.O. supplies high voltage pulses to the N.E.F.O. wand. It is connected to the N.E.F.O. interface board, which is connected to the logic board at P20.

The N.E.F.O. interface board includes the N.E.F.O. memory and the decoder memory address. The 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 SIZE dial).

The 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. Figure 8-10 shows the electronic layouts of the N.E.F.O. interface board and the N.E.F.O. control panel.

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
- +5 V dc from the N.E.F.O. interface board

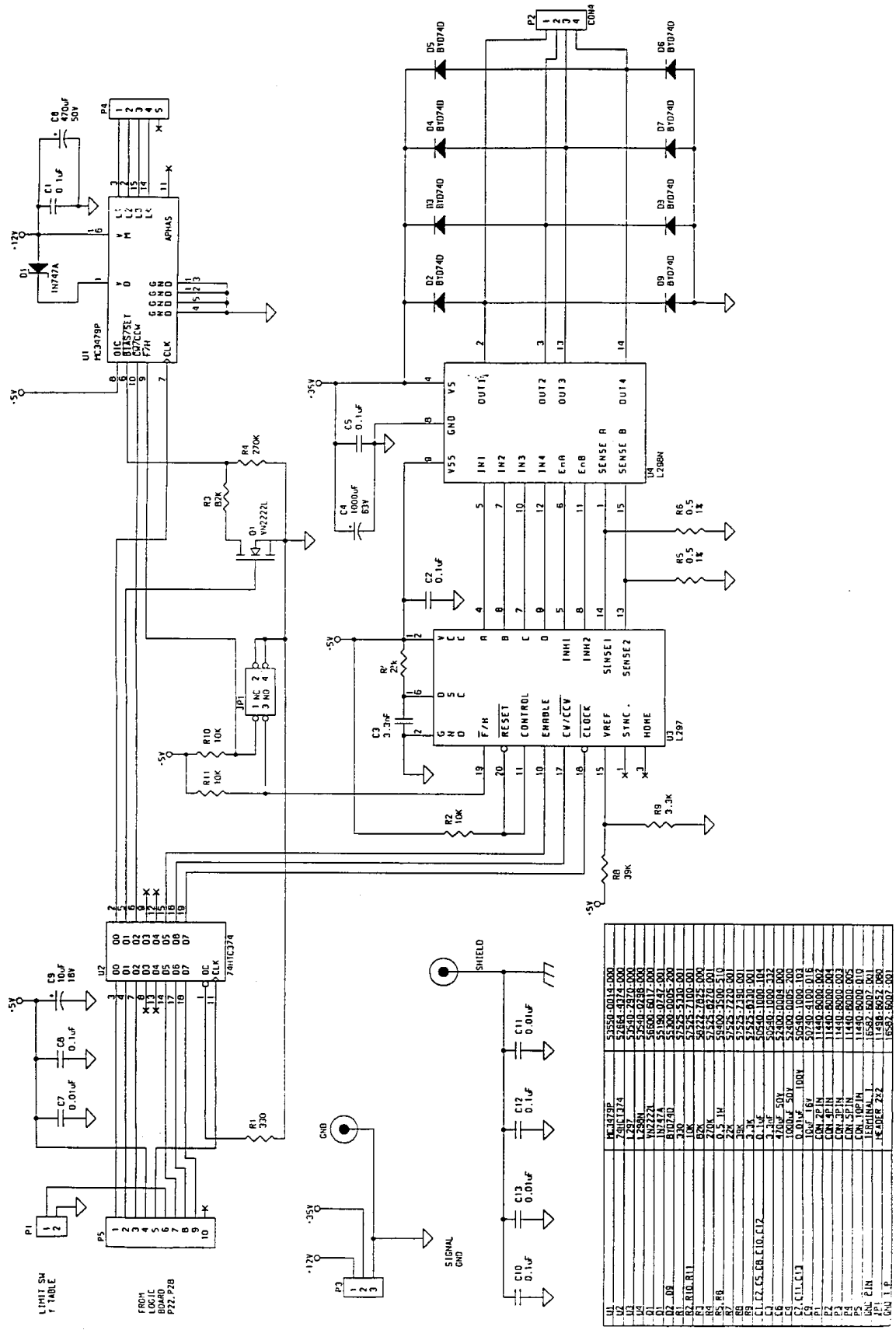


Figure 8-9: Stepper Drivers Board - Schematic Drawing

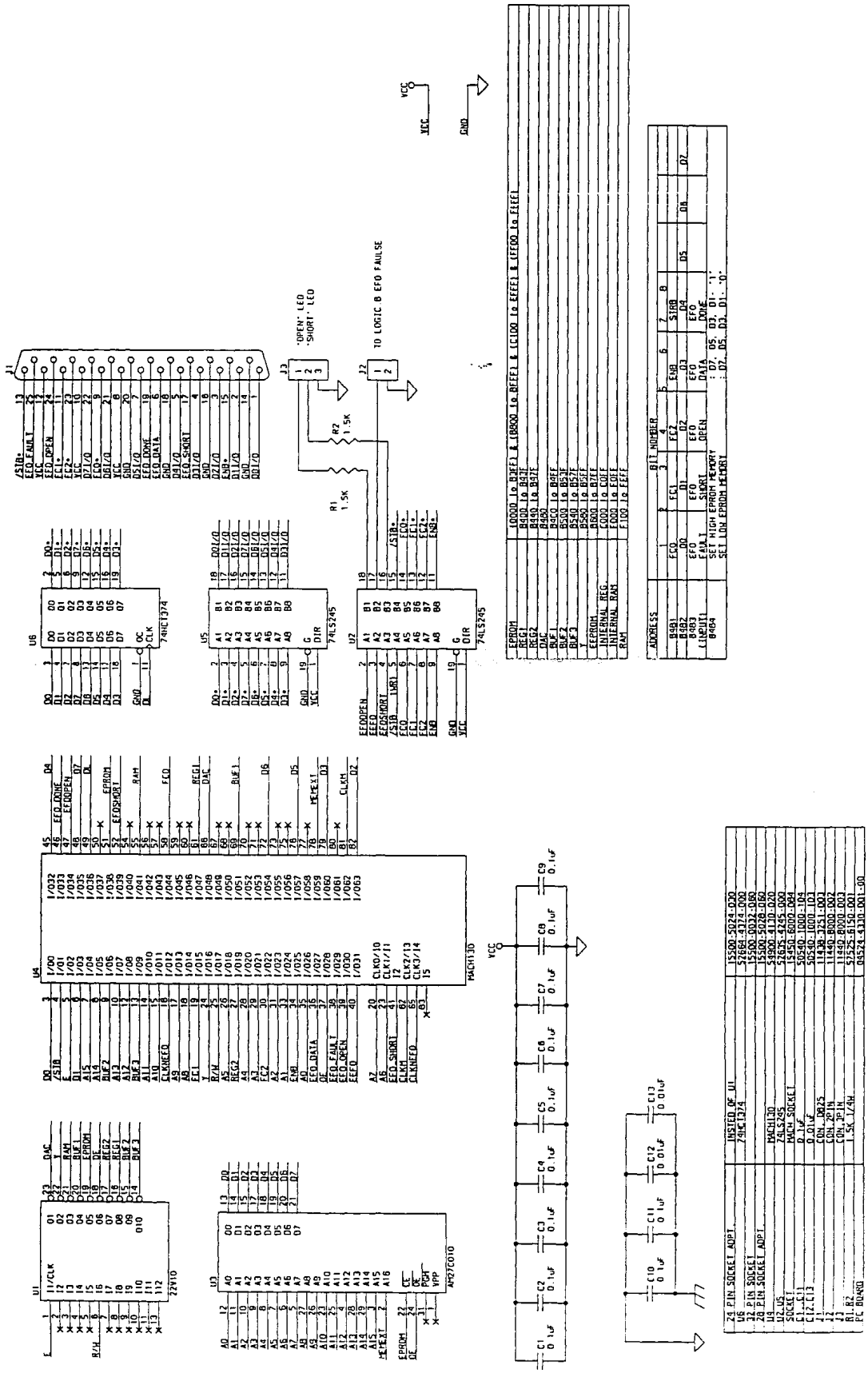


Figure 8-10: N.E.F.O. Interface Board - Schematic Drawing

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 your bonder model (see Figure 8-7).

To replace the logic board:

1 Set the POWER switch to the OFF position. Verify again that the jumper configuration is the right one for the bonder model.

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 form 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 new 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 8-6 to verify that the connections are correct.

5 Leave the back cover off to permit further adjustments, and turn the machine on. The 1st and 2nd LED indicators illuminate simultaneously (indicating that the machine is performing self-test routines). Wait until only the 1st LED indicator is illuminated.

Note: K&S recommends waiting 20 minutes after turning on the machine before working.

6 Perform the following adjustments, as necessary:

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

8.3.2 Adjusting the Sine Wave Generator

The logic board uses a Sine Wave Generator 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 sine wave generator:

1 Ensure that the bonding head is in the Reset position and that the 1st indicator on the right control panel is on. Allow a warm-up period of 20 minutes.

2 Connect the oscilloscope (or multimeter) probe to TP4 (S.W.) and the ground to TP7 (GND) (see Figure 8-6). 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, adjust the voltage to this value using the RV1 trimmer. (see Figure 8-6).

8.3.3 Ultrasonic Generator Adjustment

Required tools: Digital frequency counter
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 8-6).

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 8-6).

4 Check that the value displayed by the counter matches the value appropriate for your bonding machine, according to Table 8-5 below. If it does not, use the small screwdriver to adjust trimmer potentiometer RV6 until you get the proper value.

Table 8-5: Free Running Frequency Adjustment Values

M/C / FREQ	4522	4523	4524	4525	4526
58.5 KHz		X		X	X
59.5 KHz	X		X		

5 Turn the bonding machine off. Insert the transducer plug into its place (J1).

6 Disconnect the digital frequency counter.

8.3.3.2 Ultrasonic Power Adjustment

This procedure requires the oscilloscope and small flathead screwdriver.

To adjust the ultrasonic power:

1 Set switch SW1 (see Figure 8-6) to the LOW position.

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

3 Set the range of the potentiometer of 1st and 2nd POWER on dial to 5.

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 (only the 1st LED indicator is illuminated).

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

7 Adjust trimmer RV7 on the logic board until the voltage is appropriate for the specific machine, according to Table 8-6 below. At the same time, adjust the oscilloscope time base and voltage scale until the waveform shown in Figure 8-11 appears.

Table 8-6: Low Power Adjustment

Machine type	4522	4523	4524	4525	4526
Voltage (p-p)	13.6	7.5	13.6	13.6	7.5

8 Set switch SW1 to HIGH.

9 Adjust trimmer RV8 on the logic board until the voltage is appropriate for the specific machine, according to Table 8-7 below. At the same time, adjust the oscilloscope time base and voltage scale until a waveform like the one shown in Figure 8-11 appears.

Table 8-7: High Power Adjustment

Machine type	4522	4523	4524	4525	4526
Voltage (p-p)	23	15	23	23	15

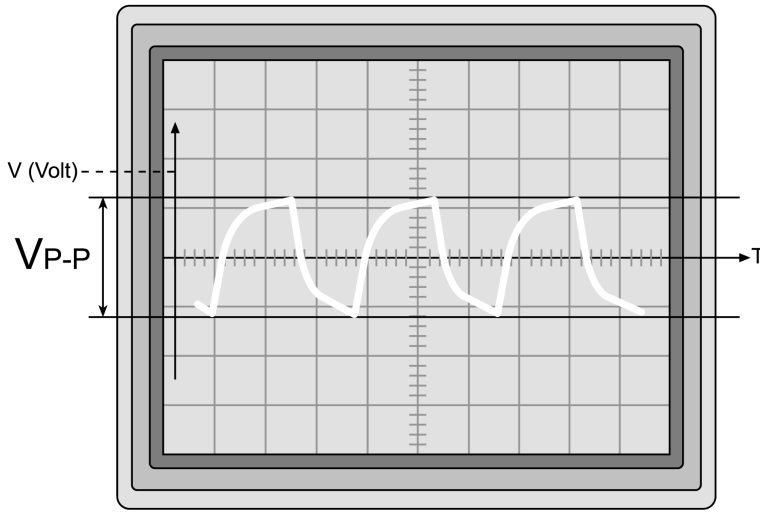


Figure 8-11: The Waveform

10 Set switch SW1 to LOW.

11 Disconnect the oscilloscope probes.

12 Check that no diagnostic LEDs are illuminated.

If there is a malfunction and the Diagnostic LEDs are illuminated, turn to Chapter 6 of this manual and process the fault. Verify that the Ultrasonic Generator is operating properly by pressing down the TEST switch and checking whether the U/S LED indicator illuminates.

13 Return the bonder machine base covers 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.

If it is necessary to change the factory-set speed, insert a screwdriver in trimmer RV2 (see Figure 8-6):

- Turn clockwise to increase the Z motor speed
- Turn counter clockwise to decrease the Z motor speed

Required tools: Digital frequency counter and probe (x10)

Small screwdriver

8.3.4.1 Adjustments for Models 4523/4526 Only

If it is necessary to adjust the factory-set speed, insert a screwdriver in trimmer RV2 (see Figure 8-6) and turn counter clockwise to decrease the Z motor speed.

8.3.4.2 Adjustments for Models 4522/4524/4525 Only

If it is necessary to adjust the Z motor speed, perform the procedure described below.

To adjust the Z motor speed:

1 Set the range of the potentiometer for 1st and 2nd TIME on the dial to 0.

2 Set the range of the potentiometer for LOOP on the dial to 0.

3 Set the range of the potentiometer for 1st and 2nd SEARCH on the dial to 0.

4 Connect the Frequency Counter probe to P14/2 (see Figure 8-6) and the ground to TP7 (GND).

5 Adjust the frequency counter time base to 0.1 hz.

6 Run the machine in AUTO CYCLE mode. Verify that the machine is working properly (see section 11.4). If the machine is not working properly, see Chapter 11.

7 Every ten seconds, take a reading of the test frequency from the counter tool.

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

Table 8-8: Frequency of Z Motor Speed Adjustment

4522/4/5 TYPE	FREQUENCY (Hz)
Not deep access	14
Deep access	12

9 Press down the SET-UP/RESET switch on the front right panel to the Reset position, and then release.

10 Disconnect the digital frequency counter.

9. MECHANICAL SUBASSEMBLIES

This chapter describes the main mechanical subassemblies of the K&S 4500 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

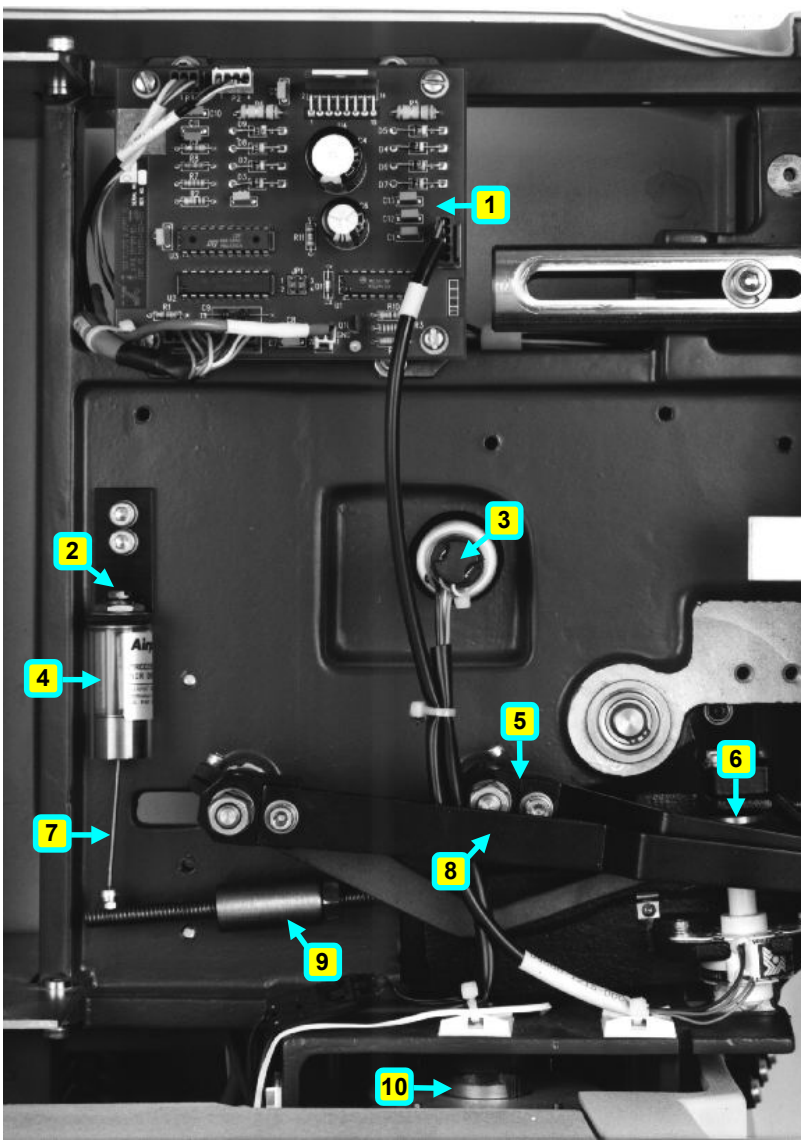
The DC motor drives the up/down movement of the bonding head. The DC motor receives signals from the logic board which determine the direction of the movement.

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.

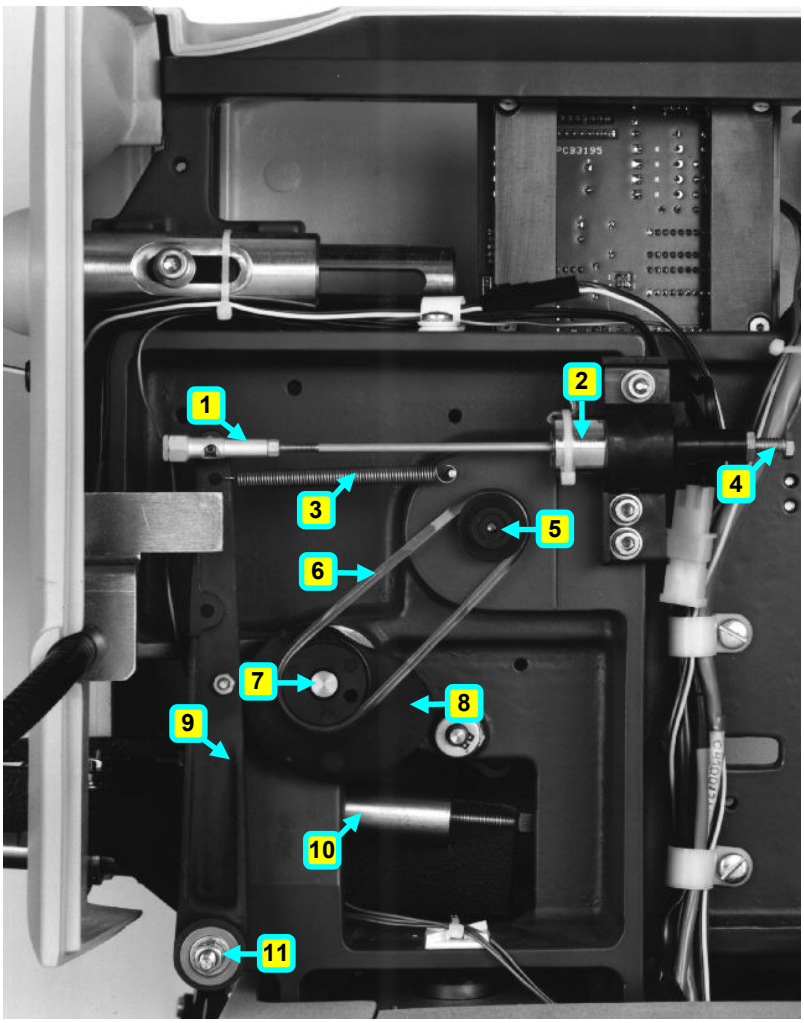
The signals are based on the settings of:

- The TAIL dial (4523).
- The REVERSE, TAIL, TEAR, Y SPEED and STEP BACK dials (4526).



1 Stepper Drivers Board
2 Dashpot Nut
3 DC Motor
4 Air Dashpot
5 Tool Lifter
6 Tear & Feed Arm
7 Dashpot Rod
8 Clamp Lifter
9 Rear Counter weight
10 Force Actuator

Figure 9-1: Main Head - Left View



1 Rod End Nut
2 Main LVDT
3 Return Spring
4 Stop Screw
5 Pulley
6 Drive Belt
7 Height Control Cam
8 Cam
9 Height control Link
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 (4523, 4526)

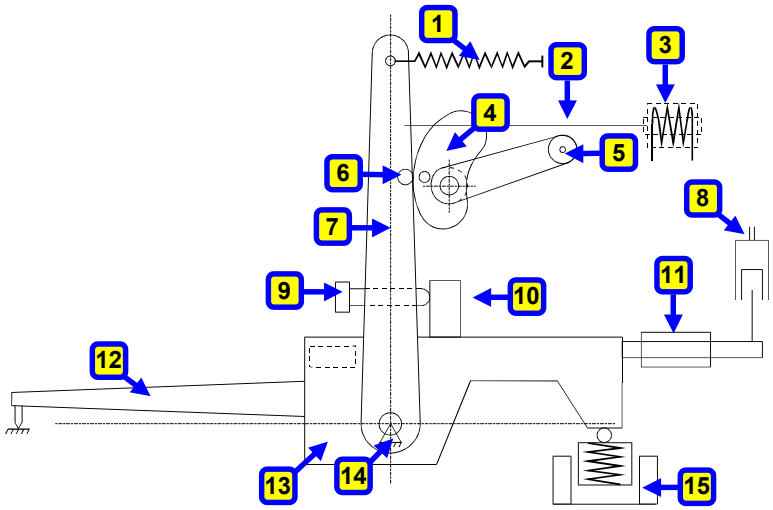
The clamp lifter allows you to create enough space between the wedge and the clamp to feed the wire into the wedge wire feed hole. The clamp lifter handle is linked to an arm which raises the rear of the tear & feed arm.

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 dials. 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.



1 Return Spring
2 Push Rod
3 Main LVDT
4 Cam
5 Pulley
6 Bearing
7 Height Control Link
8 Dashpot
9 Levelling Screw
10 Contact Pin
11 Counterweight
12 Transducer
13 Bonding Head
14 Bonding Pivot
15 Force Actuator

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 dials, 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.

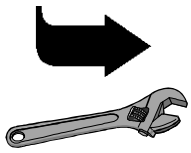
9.1.2.2.2 LVDT (Linear Variable Differential Transformer)

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 (4523, 4526)
- 23 gr - 25 gr on the bonding head (4522, 4524)

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.

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.

4 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.

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

6 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 Reset position (for Models 4523 and 4526, set the RESET LEVEL switch to the HIGH position).

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 8-6).

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

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

6 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.

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

9.3.3 Force Actuator Replacement

Note: For Model 4526, 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 4523 and 4526
- 2 mm (0.08") for Models 4522 and 4524

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 8-6).

5 Verify free movement, without friction or obstruction, of the new actuator within 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 **1st** indicator is on (for Models 4523 and 4526, set the RESET LEVEL switch to the HIGH position).

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

3 Move the force actuator up or down to create a play of 0.5-1 mm (0.02" to 0.04") 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 4526, create a play of 0.5-1 mm (0.02" to 0.04").

4 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 Turn the bonder off.

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 (4523, 4526).

Push the LVDT to the edge of the housing. Secure the LVDT by tightening the screw in its housing (4522, 4524).

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

4 Power on the bonder and set the MOTOR switch to the ON position (4522, 4524).

Power on the bonder and set the RESET LEVEL switch to the LOW position (4523, 4526).

5 Wait for the bonder to complete its initialization routines (the **1st** indicator only is on) and is in the Reset position.

6 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.

7 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 **1st** indicator is on and that the Z motor is in the Reset position.

Set the RESET LEVEL switch to the HIGH position (4523, 4526).

8 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.

9 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 from 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 8-6).

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

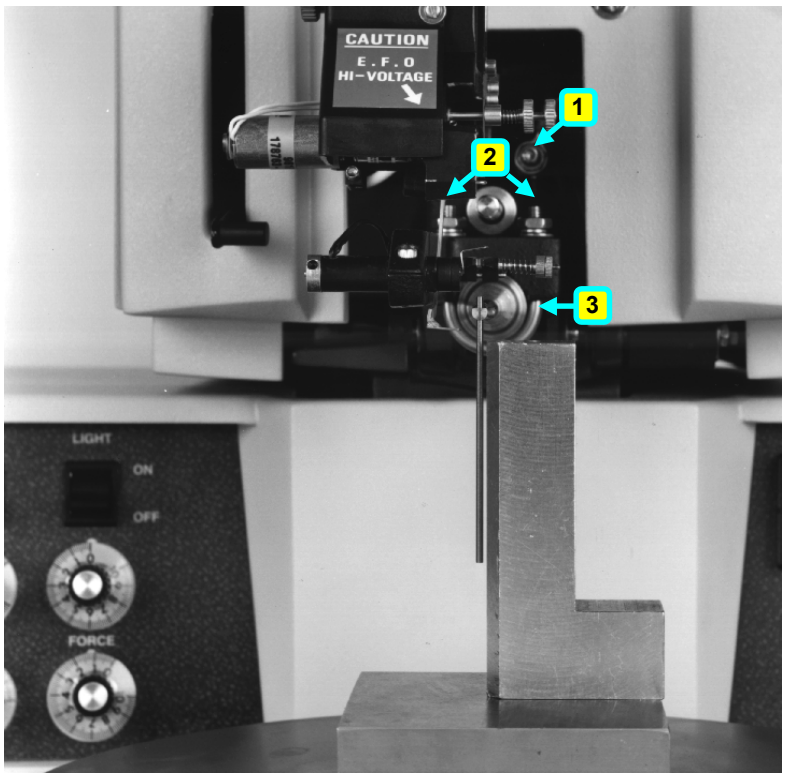
To level the transducer:

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.

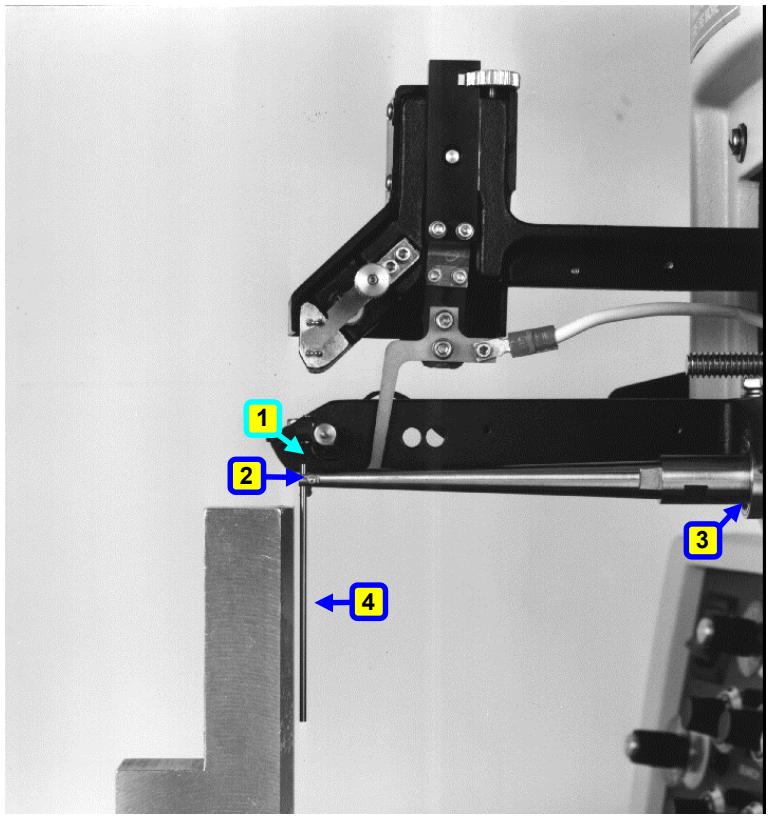
3 Loosen the wedge/capillary set screw and remove the verticality pin from the transducer. Ensure that the ground connection is held tight by the nut on the levelling screw.

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 in Chapter 7.

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

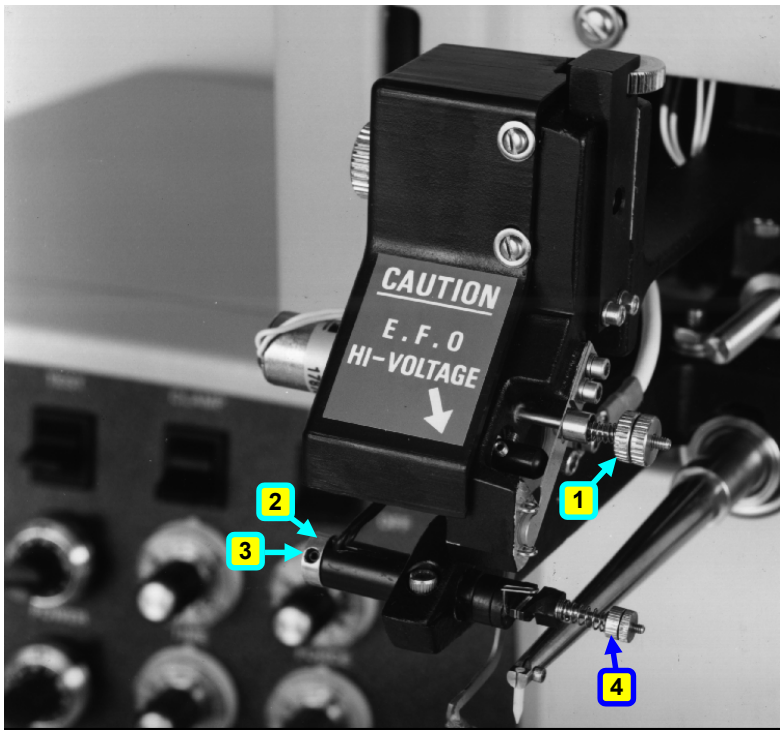
Before replacing the solenoid, check if the clamp solenoid is firmly connected to the logic board and is receiving voltage. If the connection is good, check that the resistance of the clamp solenoid is 60 Ω ±5%. If you detect an open or short circuit, replace the clamp solenoid.

9.6.1.1 Clamp Solenoid Replacement (4522, 4524)

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 - 4522, 4524

9.6.1.2 Clamp Solenoid Replacement (4523, 4526 Standard Access)

To replace the clamp solenoid:

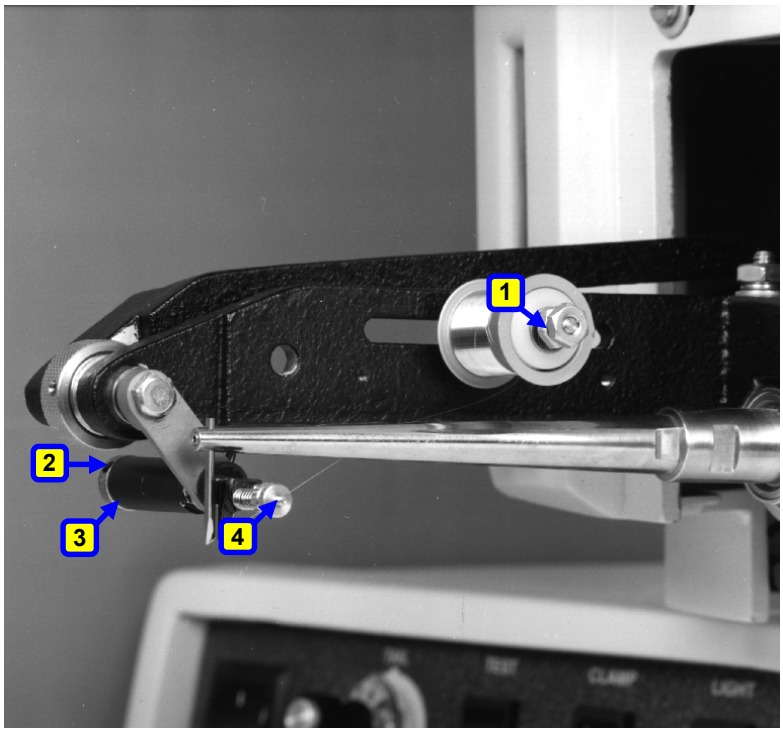
1 Disconnect the clamp solenoid harness from P1 on the logic board Remove the harness from all clamps holding it to the bonding head.

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 - 4523, 4526 Standard Access

9.6.1.3 Clamp Solenoid Replacement (4523, 4526 Deep Access)

To replace the clamp solenoid:

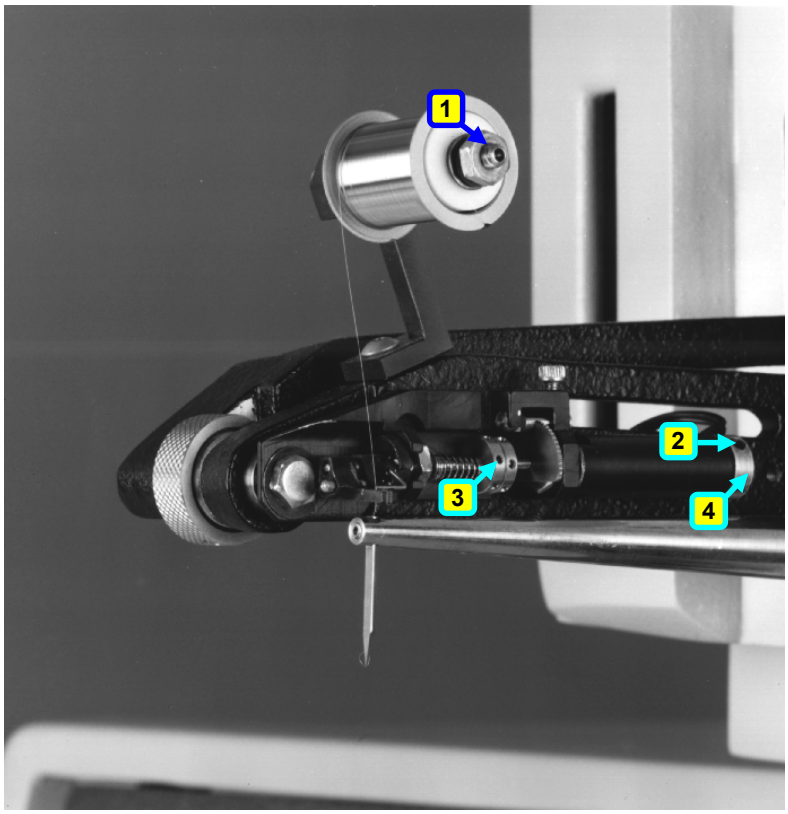
1 Disconnect the clamp solenoid harness from P1 on the logic board. Remove the harness from all clamps holding it to the bonding head.

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 Adjustment

Figure 9-8: Clamp Solenoid and Wire Clamp - 4523, 4526 Deep Access

9.6.2 Clamp Solenoid Gap Adjustment

To adjust the clamp solenoid gap:

1 Power on the bonder and ensure that the **1st** indicator is on.

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 Recommended Machine Adjustments for your bonder in Chapter 7).

4 Set the CLAMP switch to the up position to activate 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 Set the CLAMP switch to the down position to deactivate 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 Figures 9-6 and 9-7). Set the clamping force to the recommended value (see Recommended Machine Adjustments for your bonder in Chapter 7).

8 Test that the clamp opens and closes properly by pressing the CLAMP switch up and down 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 (4523, 4526)

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.

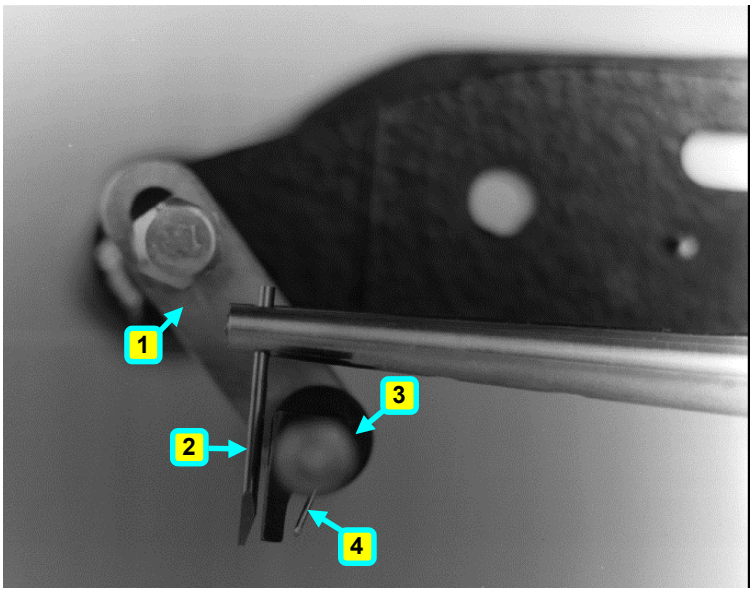
To adjust the clamp lateral position:

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 (4523, 4526)

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 (4522, 4524)

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 (4522, 4524)

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 Recommended Machine Adjustments for your bonder in Chapter 7). 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 (4522, 4524)

To adjust the drag clamp force:

1. 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 (4522, 4524)

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 (4522, 4524)

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.

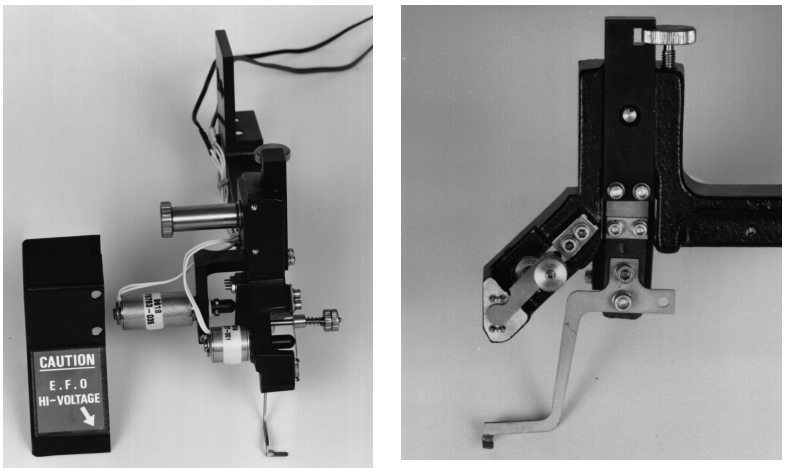


Figure 9-10: Electrode and Drag Assembly

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 (**1st** indicator is on).

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 Recommended Machine Adjustments for your bonder in Chapter 7).

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 approx. 4.4 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 90° 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 (4526)
  - 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 (4522, 4523, 4524).
- The manipulator assembly supports the motorized Y table (4526).

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 (4526)

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 (4526)
- 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 (4526)

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 (4526)

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.

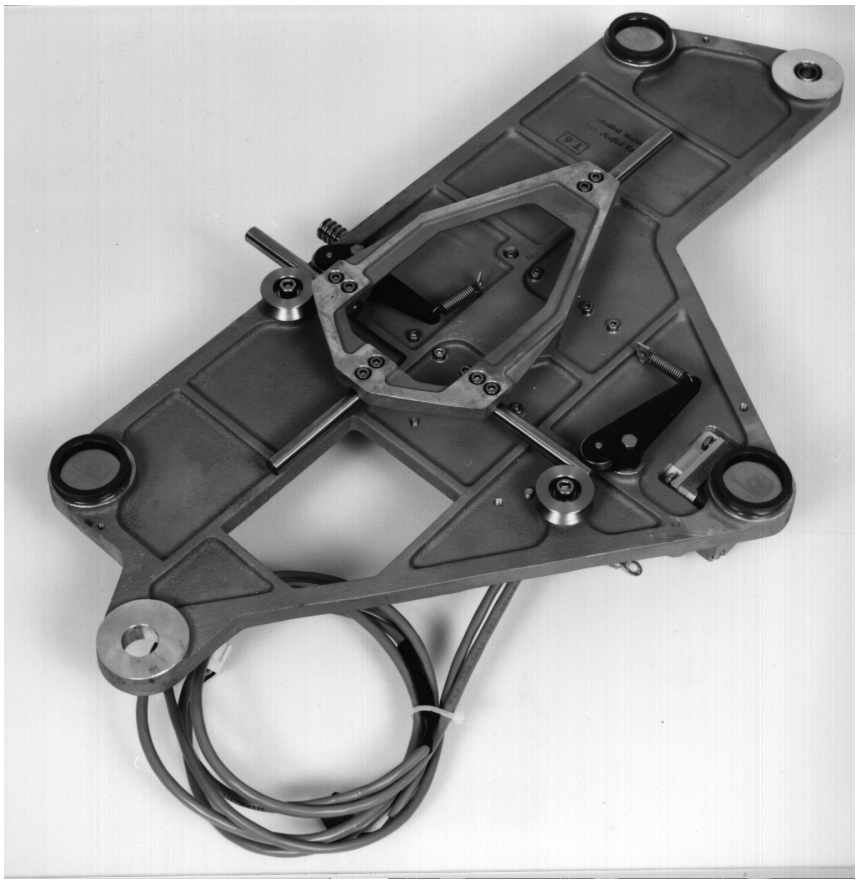


Figure 9-11: The Manipulator

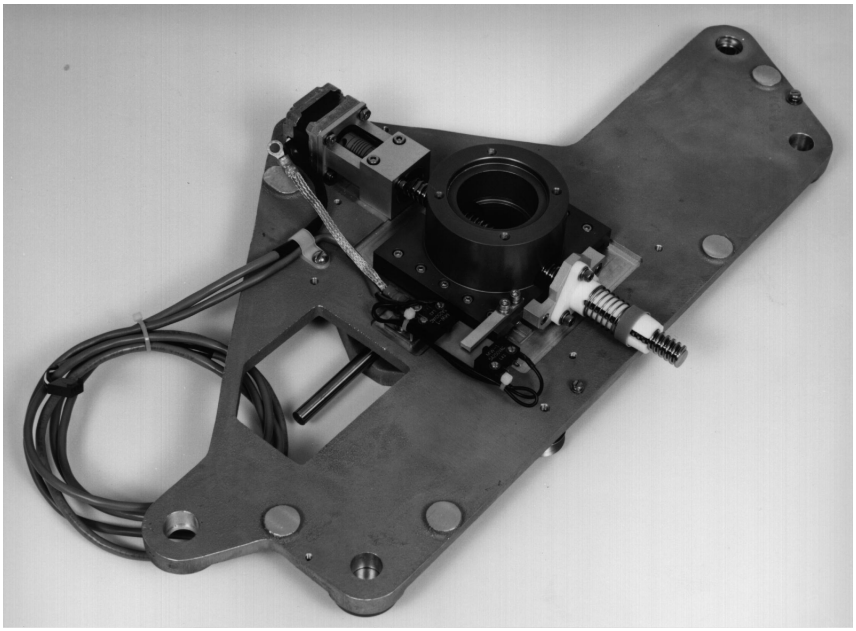


Figure 9-12: The Motorized Y Table

10. TIMING DIAGRAMS

To aid the technician in tracking the motion and operation of the K&S 4500 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:

- Models 4522/4524 Semi/Auto Bonding Cycle, section 10.1
- Models 4522/4524 Manual Bonding Cycle, section 10.2
- Model 4522 Ball Bumping Cycle, section 10.3
- Model 4522 Single Point TAB Cycle, section 10.4
- Model 4523 Semi/Auto Bonding Cycle, section 10.5
- Model 4523 Manual Bonding Cycle, section 10.6
- Model 4526 Semi/Auto Bonding Cycle, section 10.7
- Model 4526 Manual Bonding Cycle, section 10.8

10.1 Models 4522/4524 Semi/Auto Bonding Cycle

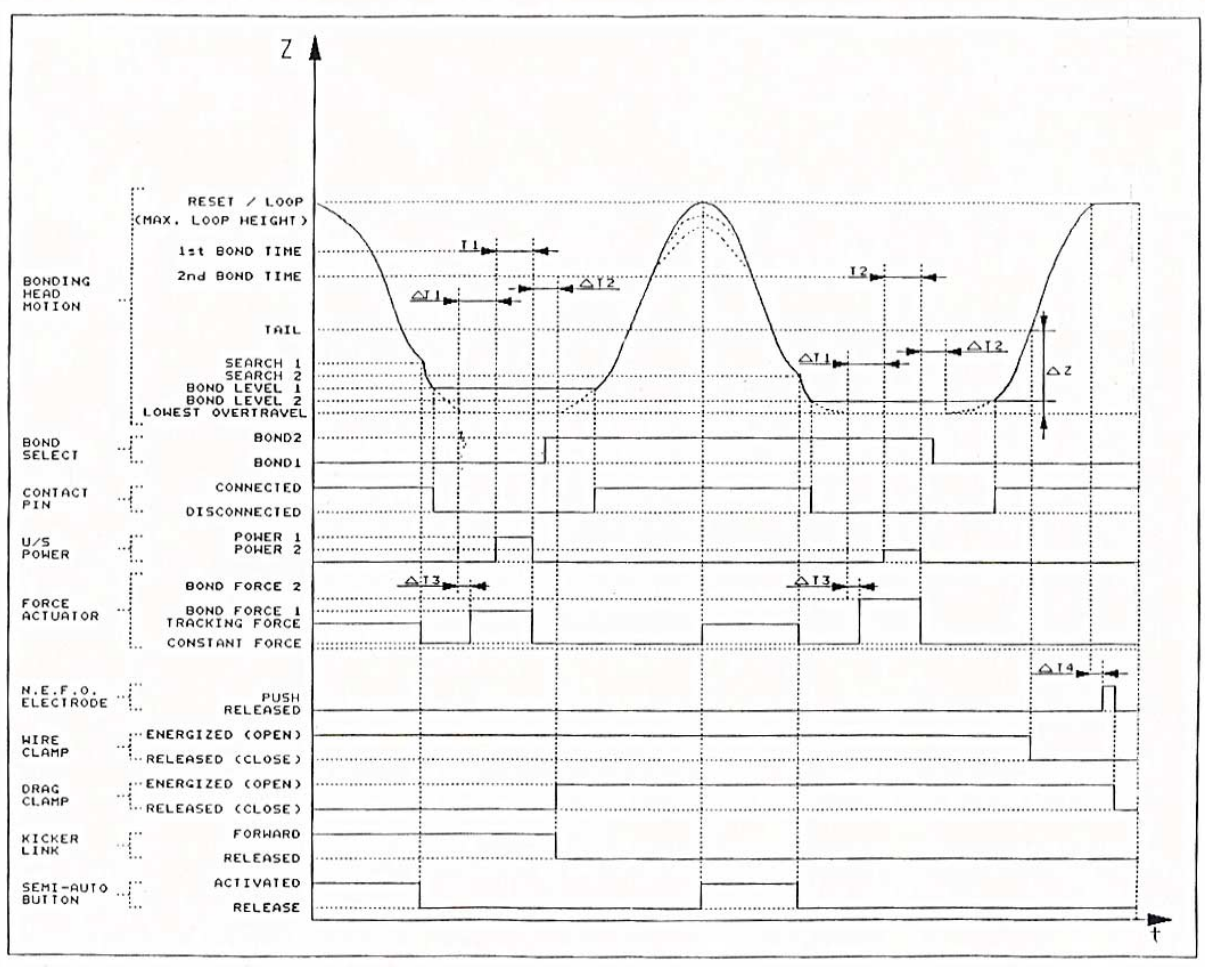


Figure 10-1: Models 4522/4524 Semi/Auto Bonding Cycle

10.2 Models 4522/4524 Manual Bonding Cycle

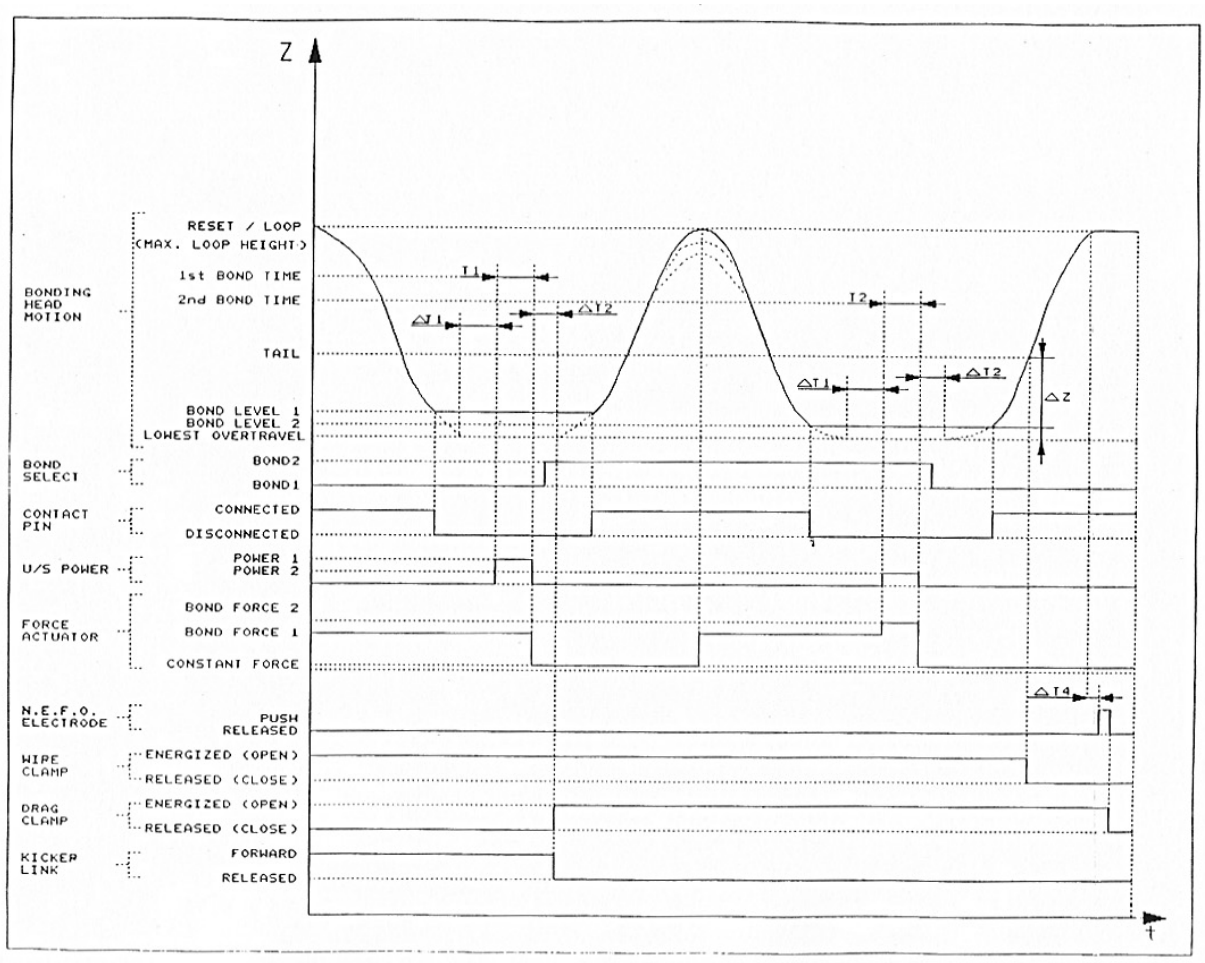


Figure 10-2: Models 4522/4524 Manual Bonding Cycle

10.3 Model 4522 Ball Bumping Cycle

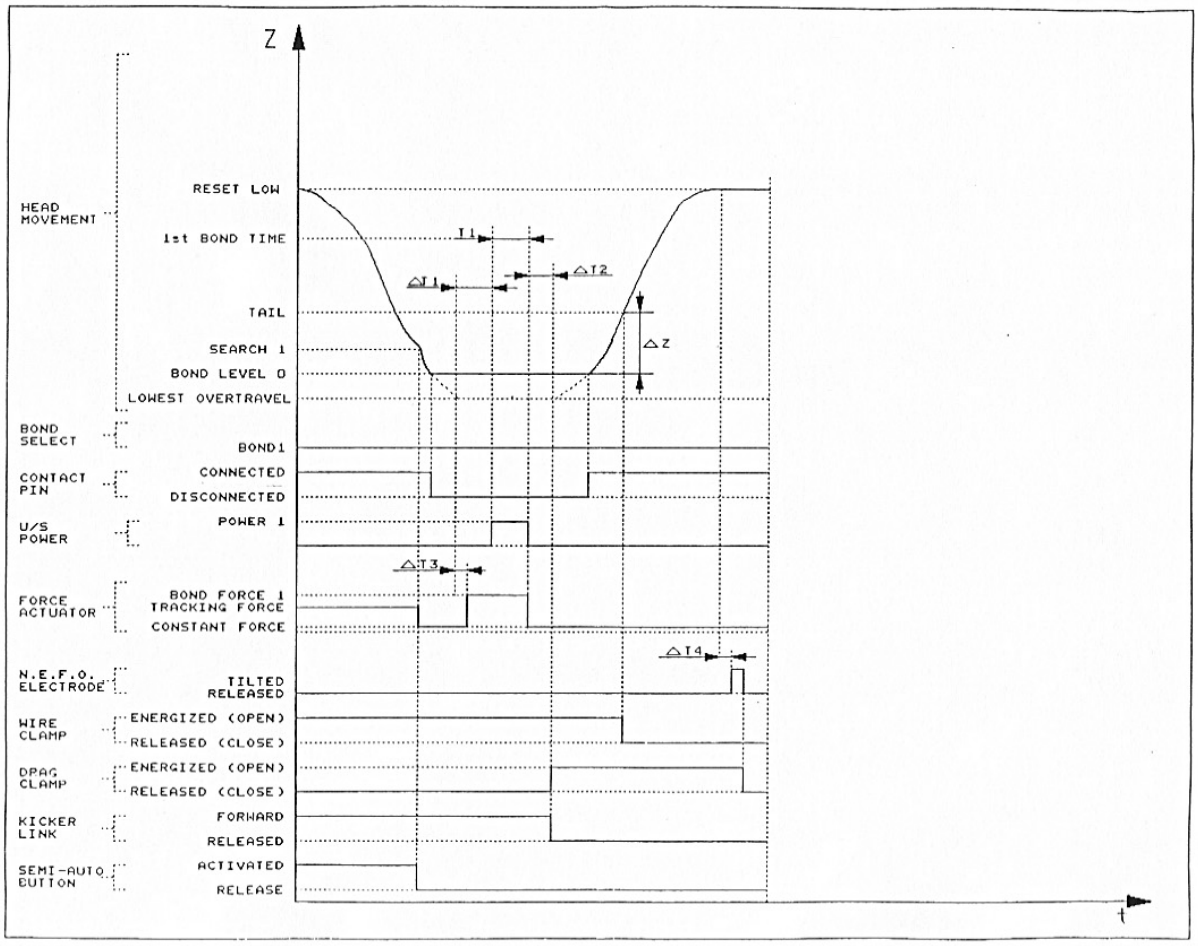


Figure 10-3: Model 4522 Ball Bumping Cycle

10.4 Model 4522 Single Point TAB Cycle

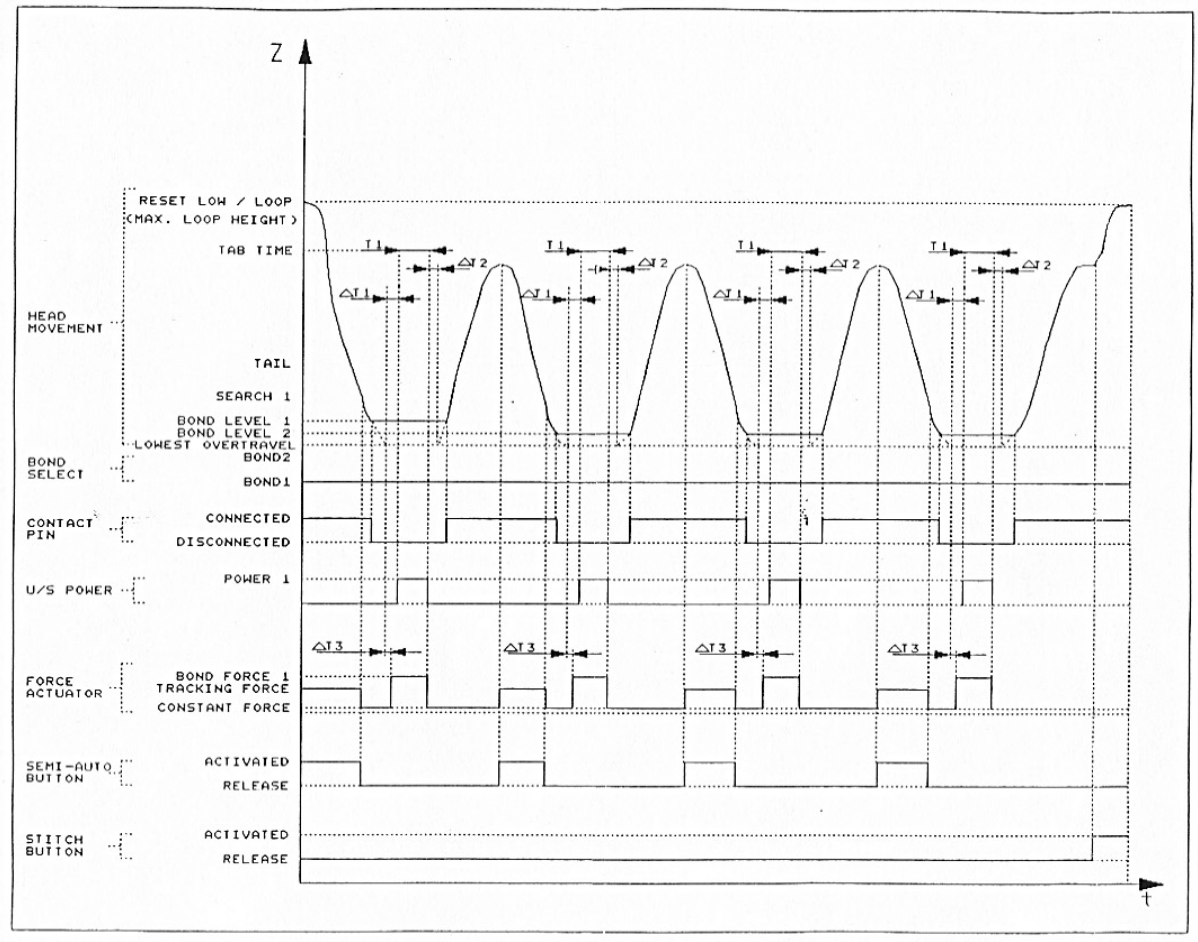


Figure 10-4: Model 4522 Single Point TAB Cycle

10.5 Model 4523 Semi/Auto Bonding Cycle

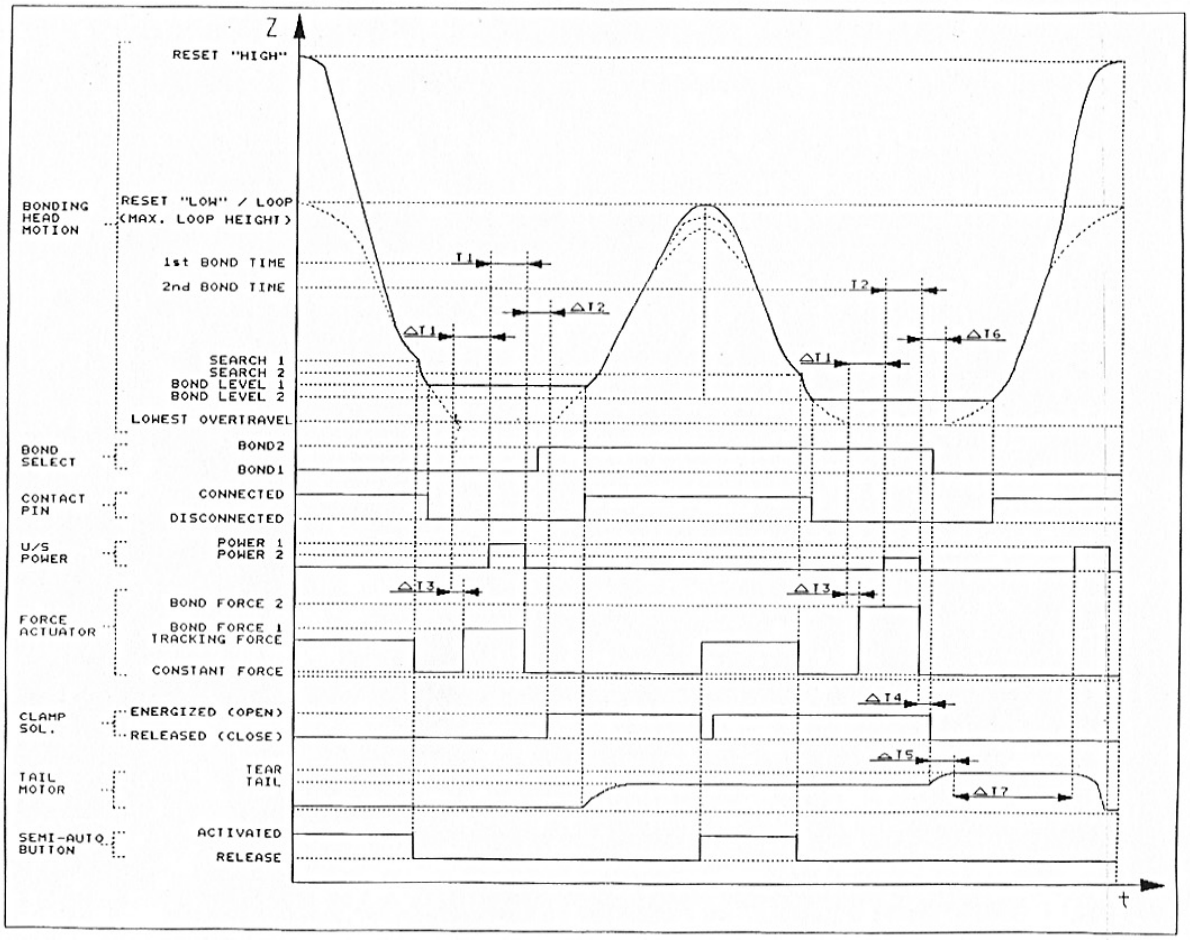


Figure 10-5: Model 4523 Semi/Auto Bonding Cycle

10.6 Model 4523 Manual Bonding Cycle

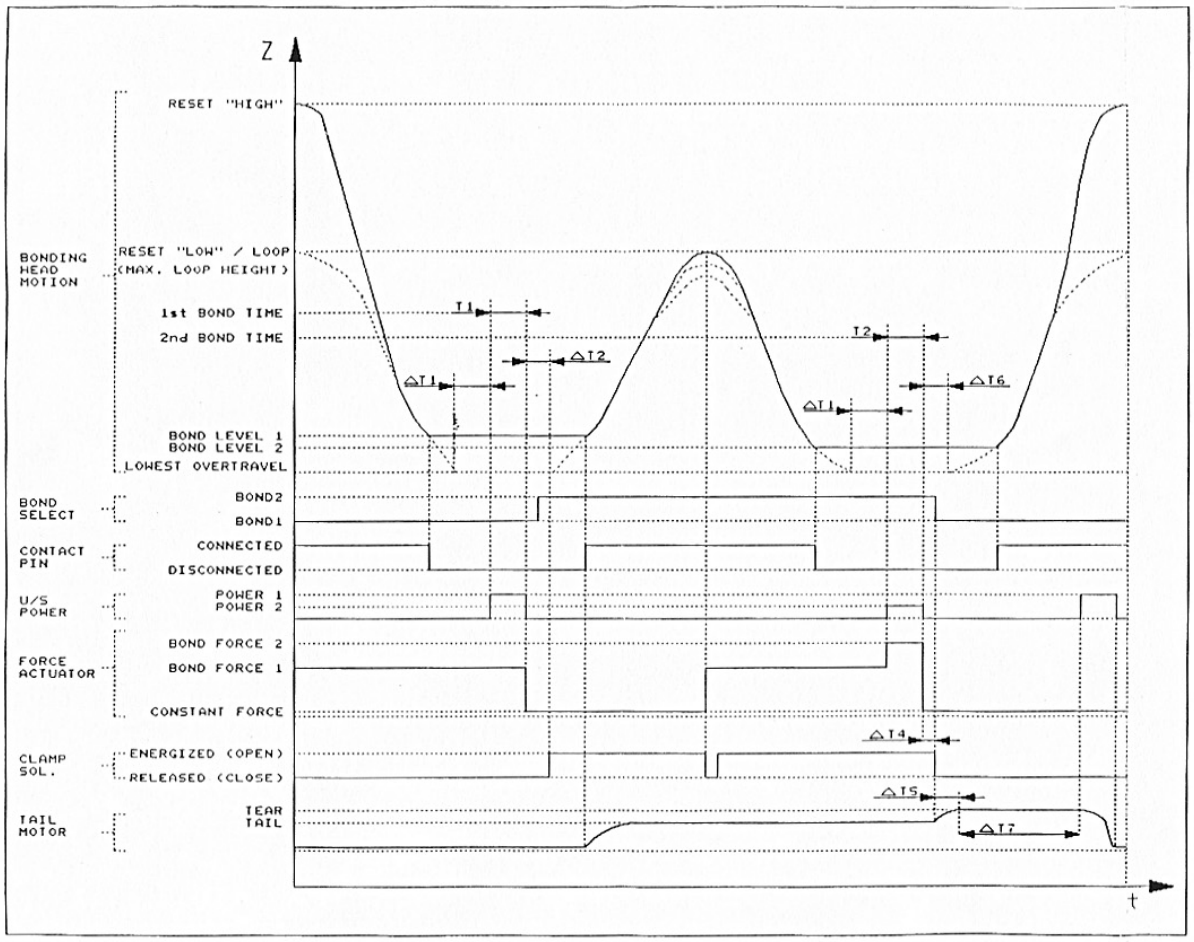


Figure 10-6: Model 4523 Manual Bonding Cycle

10.7 Model 4526 Semi/Auto Bonding Cycle

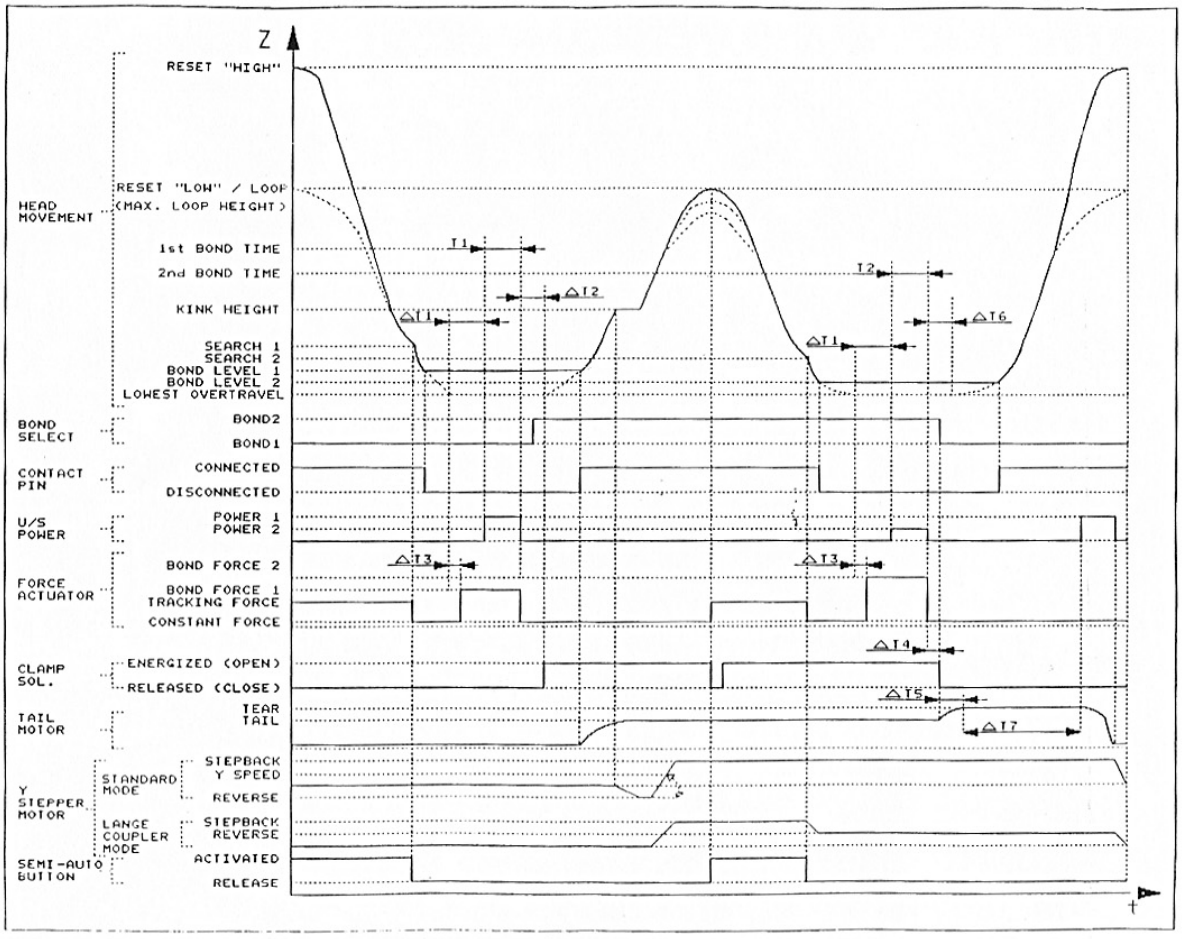


Figure 10-7: Model 4526 Semi/Auto Bonding Cycle

10.8 Model 4526 Manual Bonding Cycle

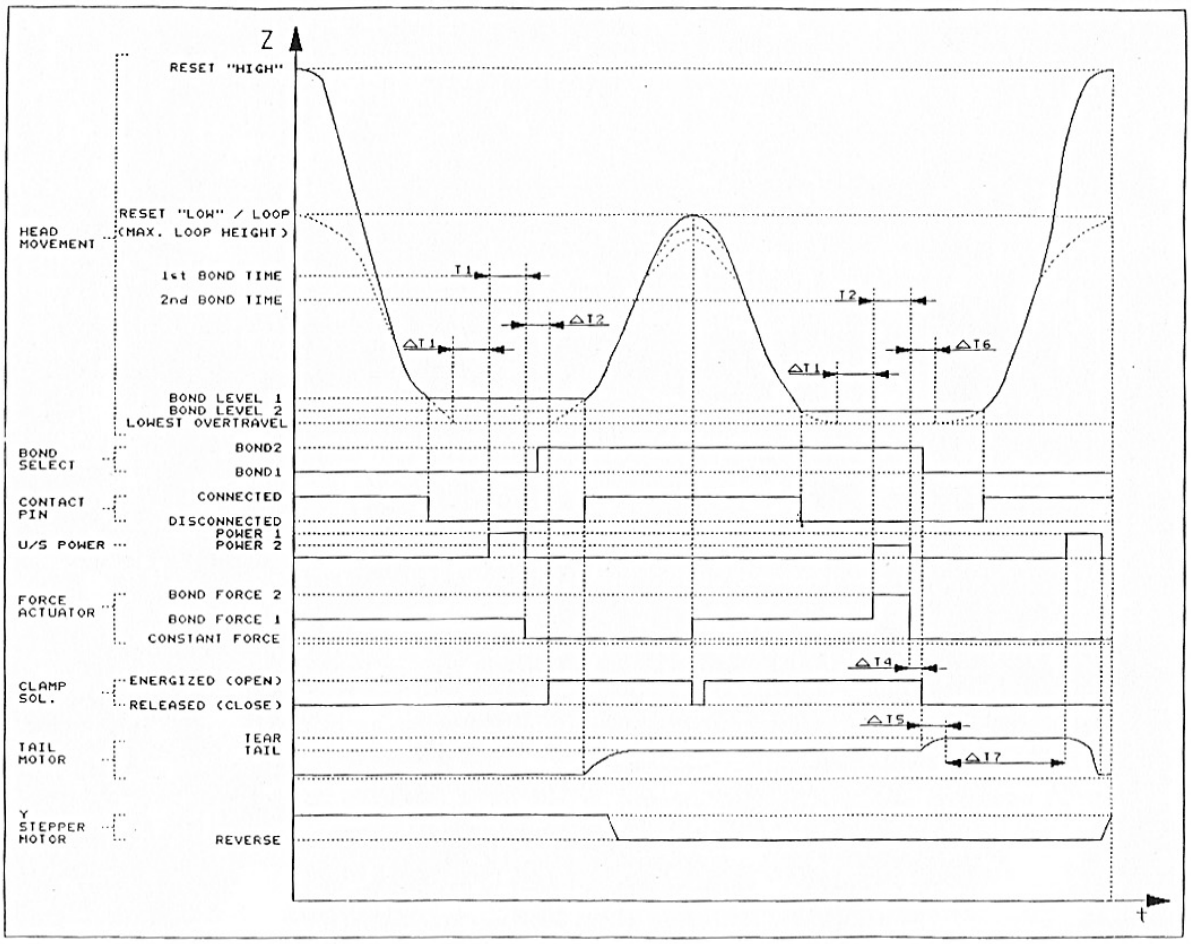


Figure 10-8: Model 4526 Manual Bonding Cycle

11. DIAGNOSTICS

11.1 Diagnostic LEDs

When the K&S 4500 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 both the **1st** and **2nd** indicators are on. If the self-test is successful, the **2nd** indicator turns off and only the **1st** indicator remains on, 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 1st indicator 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 switch is left on, the **2nd** indicator blinks and the appropriate diagnostic LEDs turn on.

After correcting the fault, resume normal bonder operations by setting the SET UP/RESET switch to the mid-position.

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 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 (4522, 4524)	x	0	0	0	Open drag clamp circuit.
09 (4526)	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 switch.
02	0	0	x	0	Check whether Force Coil is disconnected.
04	0	x	0	0	Check tool or replace Transducer.
06	0	x	x	0	Check Contact Pin and adjust as required.
07	0	x	x	x	Check Clamp Solenoid assembly.
08	x	0	0	0	Check Drag (Zero/Tail) Solenoid assembly.
09	x	0	0	x	Move Y Table limit switch, or check limit switch harness.
10	x	0	x	0	Check External U/S Generator connections.
11	x	0	x	x	Lower KINK potentiometer setting, or increase LOOP dial setting.
12	x	x	0	0	Check Z Motor pulley belt. Replace it if necessary.
14	x	x	x	0	Check External U/S 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 4523/4526/4525

1 Press down the SET-UP/RESET switch on the right panel to Reset and then release. Immediately afterwards, press down the TEST switch on the left panel and, at the same time, hold the STITCH pushbutton until only the 1st LED indicator is illuminated.

2 Release the STITCH pushbutton and TEST switch together. The machine is now on Auto Cycle.

11.4.2 For Models 4522/4524

1 Set the N.E.F.O. switch down on the right panel.

2 Press down the SET-UP/RESET switch on the right panel to Reset and then release. Immediately afterwards, press down the TEST switch on the left panel and, at the same time, hold the STITCH pushbutton until only the 1st LED indicator is illuminated.

3 Release the STITCH pushbutton and TEST switch together. The machine is now on Auto Cycle.

12. PREVENTIVE MAINTENANCE

This chapter provides preventive maintenance procedures for various subassemblies of the K&S 4500 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 (4522, 4524)	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 (4522, 4524)

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
Sticky tape

To check the force actuator coil motion:

1 Power on the machine and set the HIGH/LOW switch to the LOW position.

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.

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.

6 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).

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.

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 you adjusted or released the LVDT, push the rod and readjust the Reset position and verticality (see section 9.5).

12.12 Adjust 18 Vp-p

To adjust the 18 Vp-p, use this procedure. For details, see section 8.3.2.

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, use this procedure. For details, see section 8.3.3.

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 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 you perform the remedy, please contact your 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 motherboard (J4). If faulty, correct it. 3. Check fuse F1 on the motherboard. Replace it if necessary.
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.

Table 13-1: General Troubleshooting	
Symptom	**Remedy**
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 POWER switch is in the up (ON) position. 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 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.
Z motor does not operate properly through the bonding cycle, or does not operate at all.	1. Check that the MOTOR switch is in the ON position (4522, 4524). 2. Check if the CLAMP switch was left in the ON position (**2nd** indicator blinking - 4523, 4526 **1st** indicator blinking - 4522, 4524) If it was, set it to the OFF position and press the SET UP/RESET switch to RESET. 3. Check the drive belt of the motor. If defective or slipping, replace it. 4. Check the Semi/Auto Cycle pushbutton. If defective, replace it. 5. Check if jumpers W5, W6 and W7 on the logic board are set properly. If not, correct the jumper configuration.

Table 13-1: General Troubleshooting	
Symptom	**Remedy**
Z motor does not operate properly through the bonding cycle, or does not operate at all (cont.).	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 (4526).	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 Cycle pushbutton is stuck. If it is, unstick it. 2. Replace the Semi/Auto Cycle 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.
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 if the drive belt is not slipping. If it is, replace it.

Table 13-1: General Troubleshooting	
Symptom	**Remedy**
Z motor rotates uncontrollably (cont.).	6. Check if the height control link is not stuck. If it is, release it. 7. Check if the bonding head is not obstructed. • Check if the height control link correctly tracks the cam movement. • Check if the LVDT is not damaged. • Check if the LVDT wiring is intact and in good condition. If not, replace it. • Measure the gap between the wire guide of the clamp and the drag assembly and ensure it is 3 to 4 mm.

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 is not on when TEST switch is set to the up position.	Faulty transducer.	Check diagnostic LEDs for error code 04. If this code appears, replace the transducer.

Table 13-2: Bonding Process Diagnostics		
Symptom	**Possible Cause**	**Remedy**
	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 is not on when TEST switch is set to the up position (cont.).	Capillary is clamped too loose or tight in the transducer (4522, 4524).	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 8.3.3.1.
	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.
	The CLAMP switch is set to the ON position.	Set the CLAMP switch to the OFF position.
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.

Table 13-2: Bonding Process Diagnostics

Symptom	Possible Cause	Remedy
Bonds do not hold or are not consistent (cont.).	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 (4523, 4526).	Try using another device.
	Wedge is clogged or broken.	Check wedge. Clean if clogged. Replace if broken.
	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 switch. Check diagnostic LEDs for error code 04 (see Table 11-1). If code appears, replace transducer.

Table 13-2: Bonding Process Diagnostics		
Symptom	**Possible Cause**	**Remedy**
Bonds do not hold or are not consistent (cont.).	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).
	Dashpot is set for too much damping, or is faulty.	Check that the dashpot is not overtight. Loosen the dashpot by turning the valve counter-clockwise.
	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.

Table 13-2: Bonding Process Diagnostics

Symptom	Possible Cause	Remedy
Bonds do not hold or are not consistent (cont.).	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 (4526).	Check motion of the motorized Y table (see section 9.11.2).
Ball is too large (4522, 4524).		Reduce BALL SIZE dial setting.
Tail length is too long or short (4522, 4524).		Adjust the TAIL dial on the left control panel.
Ball size varies (4522, 4524).		1. If ball is too small, increase setting of BALL SIZE dial. 2. If the tail length varies, tighten wire clamp clamping force.
No ball created (4522, 4524)		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).

Table 13-2: Bonding Process Diagnostics		
Symptom	**Possible Cause**	**Remedy**
Wire breaks just above the first bond (4522, 4524).		1. Lower the setting of the upper POWER dial. 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 (4523, 4526).	Overly squashed bond.	Reduce the bonding parameter settings.
	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.

Table 13-2: Bonding Process Diagnostics

Symptom	Possible Cause	Remedy
Wire breaks just above the first bond (4526).		1. Lower the setting of the upper POWER dial. 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 (4522, 4524).		1. Tighten drag clamp. 2. Replace capillary.
Loop height varies (4522, 4524).		Replace capillary.
Loop is too flat.		1. Reduce fixed tensioner force. 2. Replace capillary with one having a larger feed hole (4522, 4524).

Table 13-2: Bonding Process Diagnostics		
Symptom	**Possible Cause**	**Remedy**
Loop is too high or sagging (4522, 4524).		1. Tighten fixed tensioner force. 2. Replace capillary.
Loop is too high (4526).		1. Decrease LOOP dial setting. 2. Decrease REVERSE dial setting.
Loop height varies or tangles sideways (4523, 4526).	Improper LOOP dial 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 (4523, 4526).	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.
	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.

Table 13-2: Bonding Process Diagnostics		
Symptom	**Possible Cause**	**Remedy**
Inconsistent tail length (4523, 4526) (cont.).	Improper 2nd bond settings.	Change 2nd bond settings.
	Improper workholder height.	Lower workholder height.
No tail remains in wedge after 2nd bond (4523, 4526).	Tail length not adjusted properly.	Readjust tail length.
	2nd bond is squashed too much.	Lower 2nd bond settings.
Pig tail attached to bond after 2nd bond (gold wire only) (4523, 4526).	Wire is too soft.	Use harder wire.
	Tear motion is improperly adjusted.	Adjust TEAR dial setting.
	Wire slipped out of the wedge.	Feed the wire again between the clamp jaws and through the wire guide.
Stitch bonds cannot be performed (4523, 4526).	2nd bond parameters are set too high.	Lower 2nd bond parameter settings.
	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 Series Manual Wire Bonders. For more details, contact your 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

K&S Part No.	Description
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 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

K&S Part No.	Description
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, you need to order, in addition, the Height Adjustable Base for Cold Workholders (P/N 04123-0360-000).

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)

K&S Part No.	Description
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 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 4523/4526
- Bonding Head of Models 4522/4524
- Manipulator and Motorized Y Table
- Base Assembly
- 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 your purchase order.

15.1 Front Panel Assembly

Table 15-1: FRONT PANEL ASSEMBLY 04500-0670-000-00		
Item Number	**Description**	**K&S Catalog Number**
1	KNOB	04320-0005-007
2	TEMPERATURE CONTROLLER	11795-2001-000
3	SWITCH RKR. SPDT ON-NONE-ON	16200-0010-000
4	SWITCH RKR. SPDT ON-OFF-MON	16200-0010-001
5	POTENTIOMETER 50KΩ 2W 10% CERMET PA	56117-7500-008
6	POTENTIOMETER DIAL	28595-1001-000
7	DIODE, LED RED HIGH INTENSITY	55120-6005-000
8	CLIP, MOUNTING LED T-1-3/	18521-5496-000
9	SWITCH RKR. SPDT ON-OFF-ON	16200-0010-003
10	SWITCH RKR. DPDT ON-NONE-ON	16200-0010-020
11	POTENTIOMETER 1KΩ 2W 1 TURN	56066-6100-108
12	POTENTIOMETER 10KΩ 2W 10 TURNS	56094-6000-001
13	POTENTIOMETER 1KΩ 2W 10 TURNS	56094-6000-000
14	POWER SWITCH 15A 250V	16200-3001-1

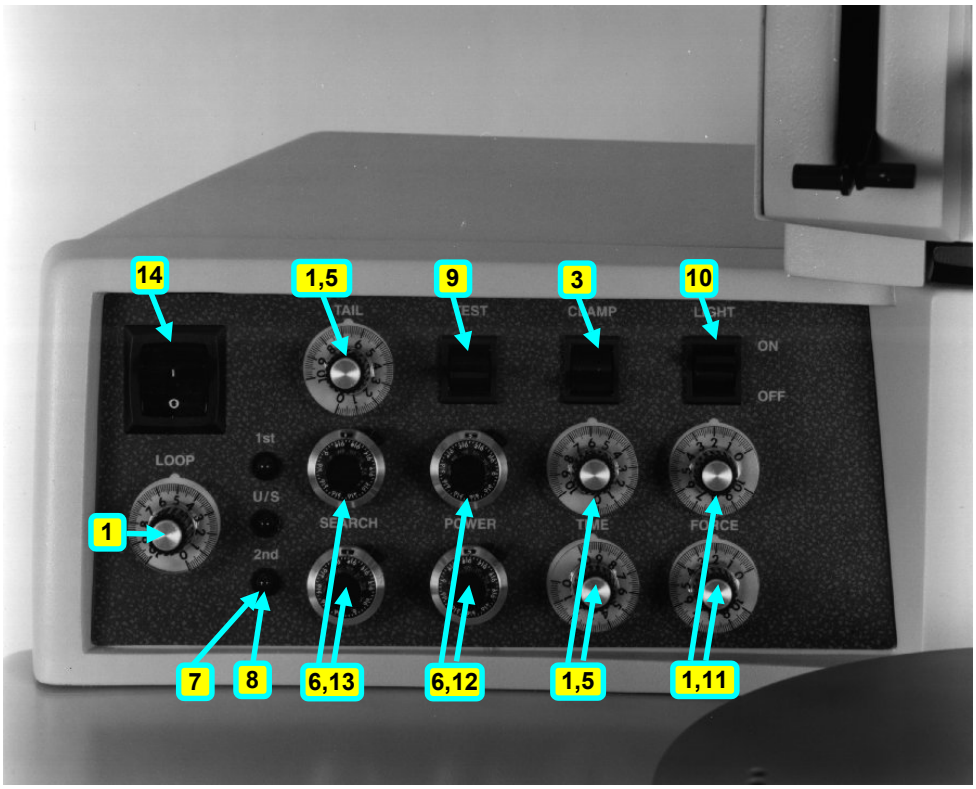


Figure 15-1: Left Control Panel

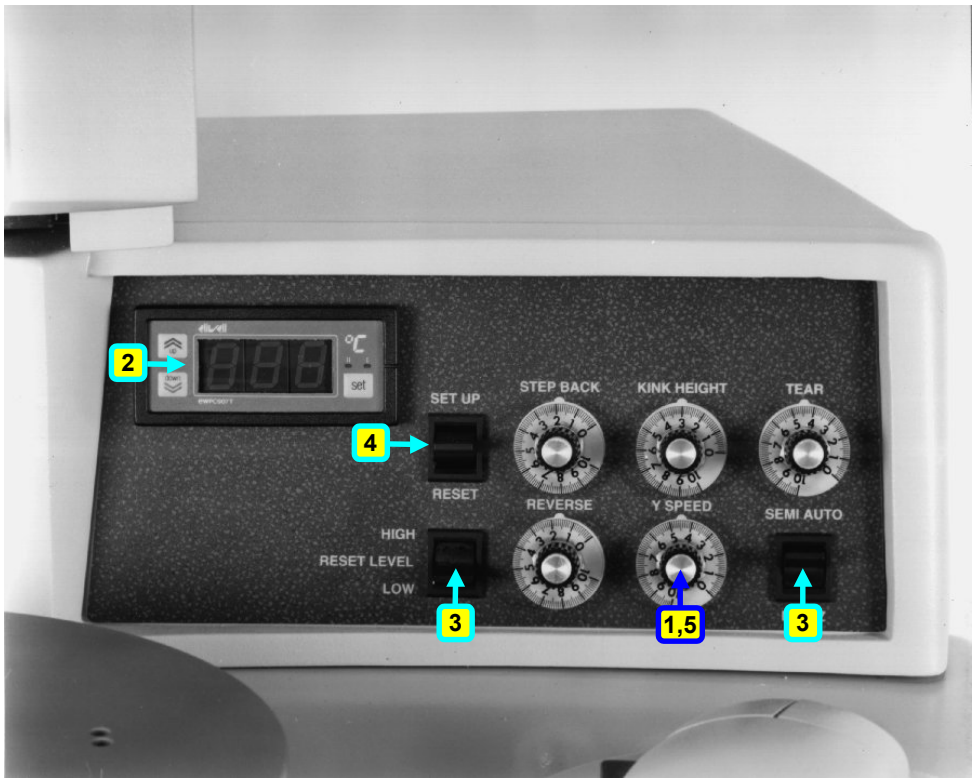


Figure 15-2: Right Control Panel – Model 4526

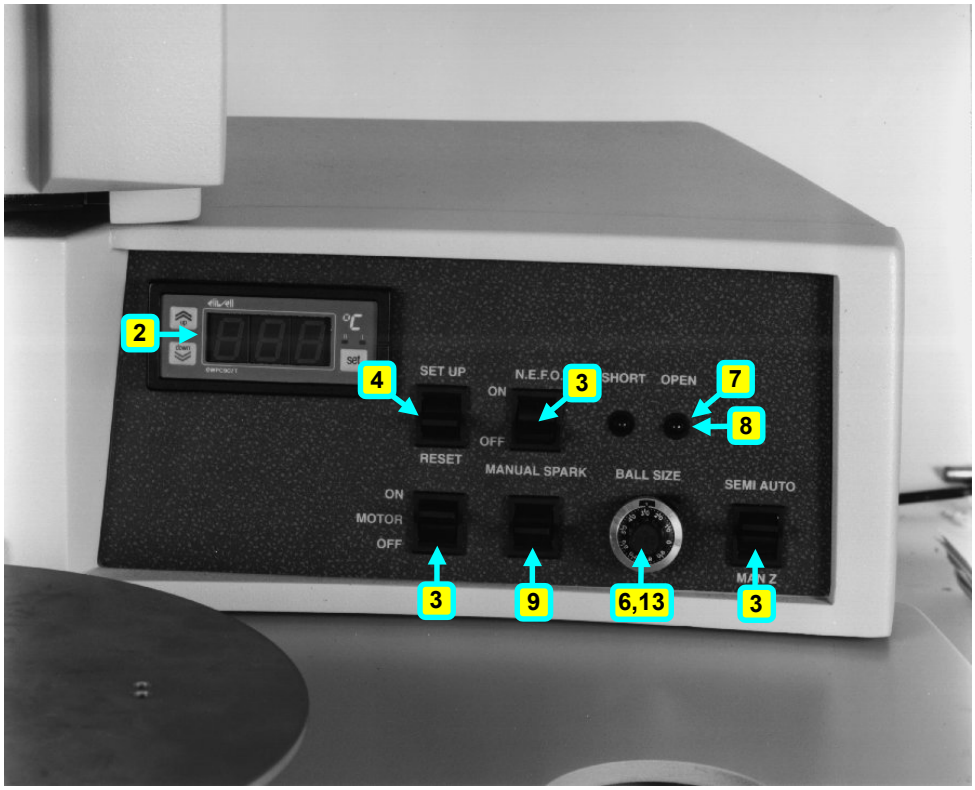


Figure 15-3: Right Control Panel - Model 4524

15.2 Main Head

Table 15-2: 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 (4523, 4526)	04123-0455-000

Table 15-2: MAIN HEAD 04500-0405-000-00		
Item Number	**Description**	**K&S Catalog Number**
10	HEIGHT CONTROL LINK (4522, 4524)	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

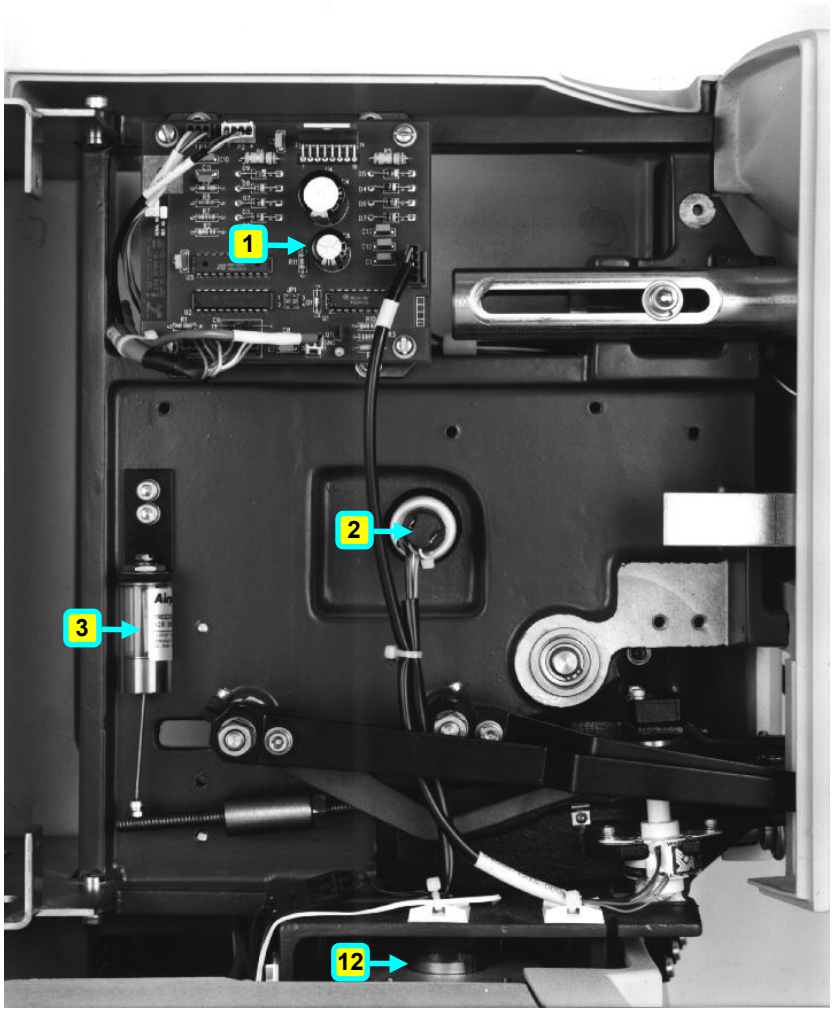


Figure 15-4: Main Head - Left View

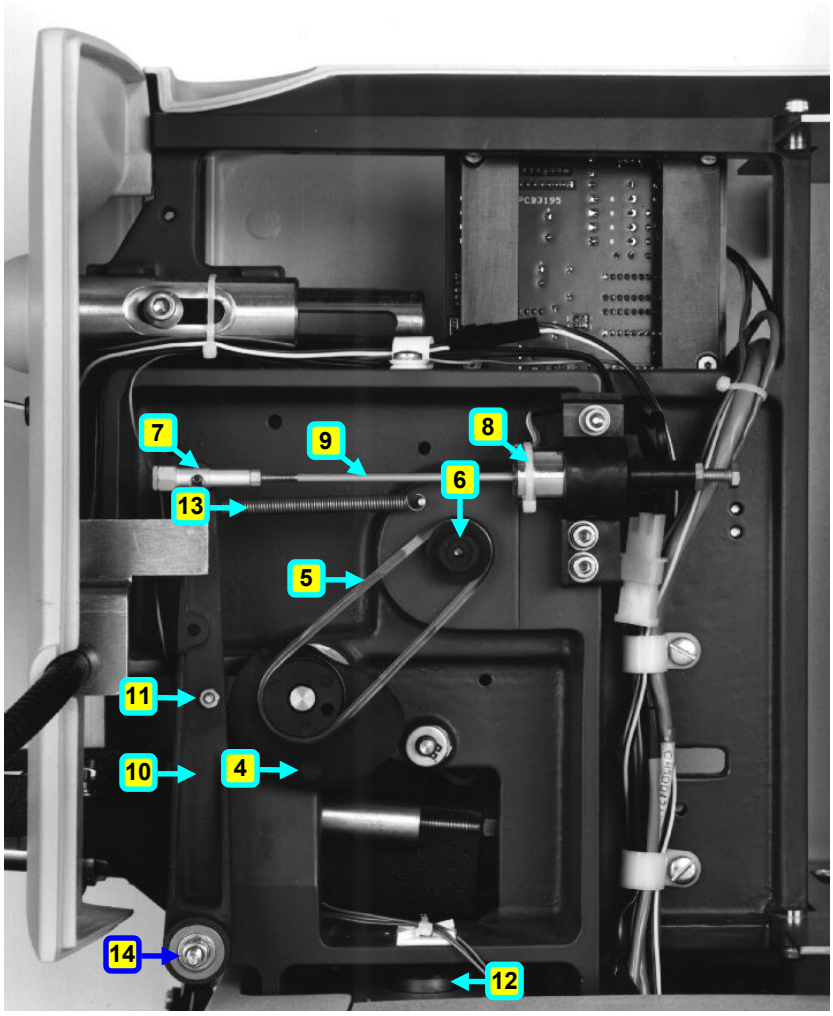


Figure 15-5: Main Head - Right View

15.3 Bonding Head - Models 4522 and 4524

Table 15-3: 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

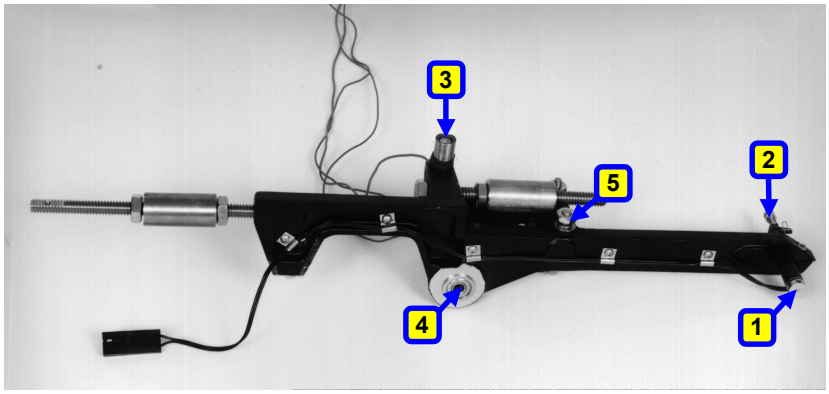


Figure 15-6: Bonding Head - Models 4522, 4524

15.4 Bonding Head - Models 4523 and 4526

Table 15-4: BONDING HEAD 04523-0450-000-00		
Item Number	**Description**	**K&S Catalog Number**
1	0.5" SPOOL ASSEMBLY	04123-0426-000
2	MOTOR TAIL 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

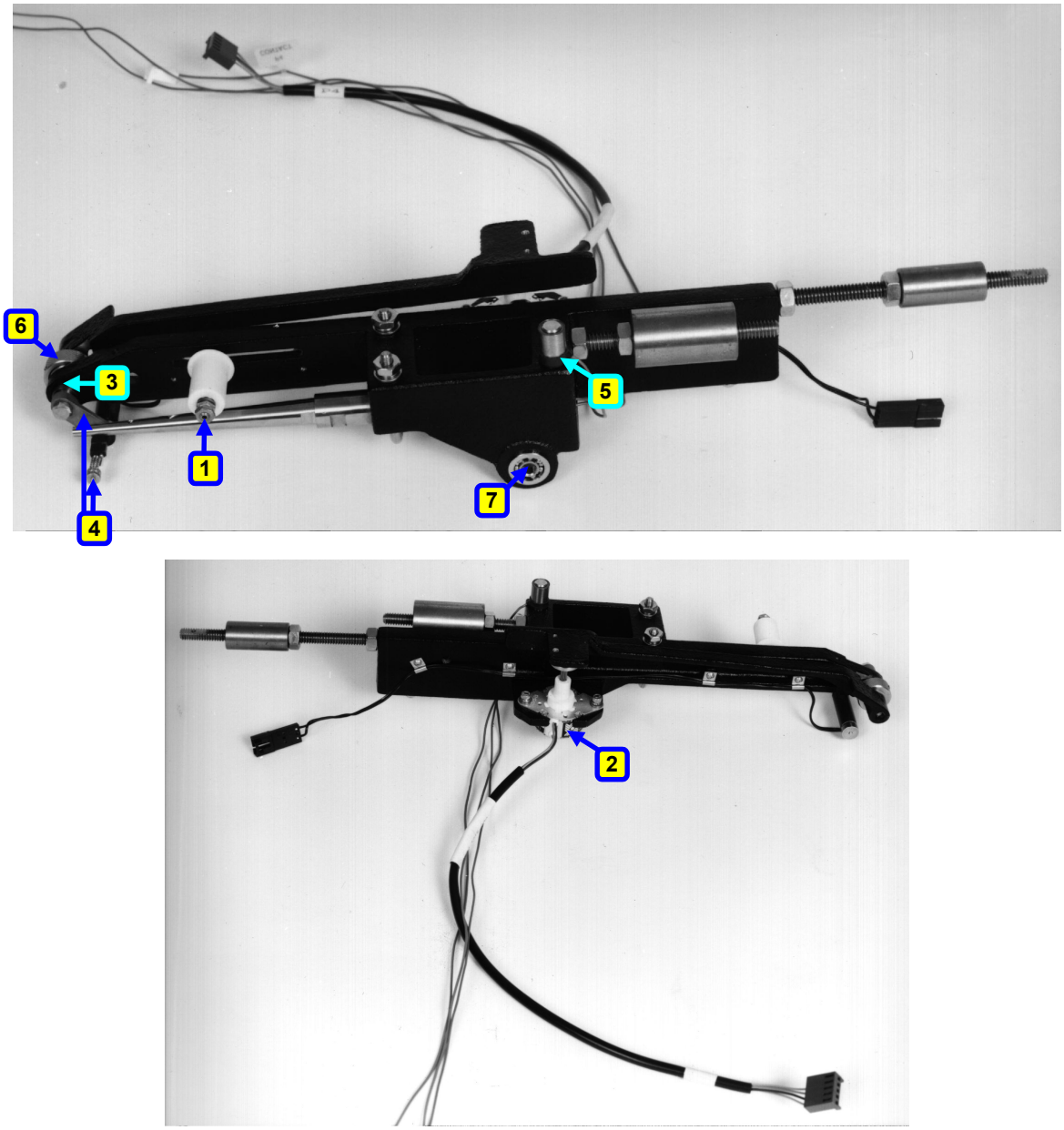


Figure 15-7: Bonding Head - Models 4523, 4526

15.5 Manipulator and Motorized Y Table

Table 15-5: 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

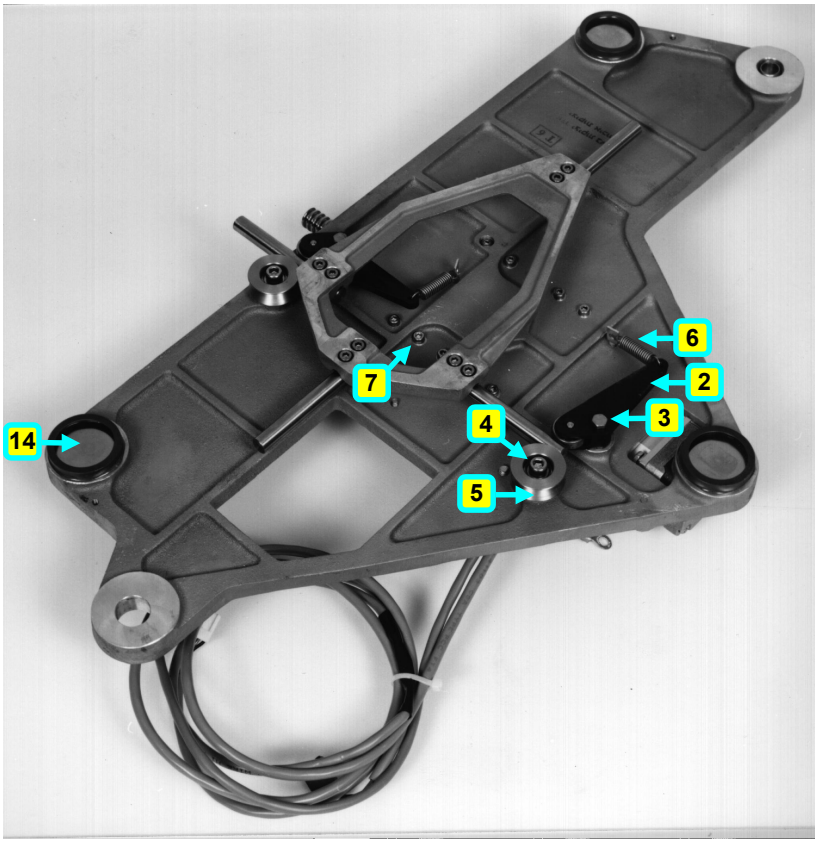


Figure 15-8: Manipulator

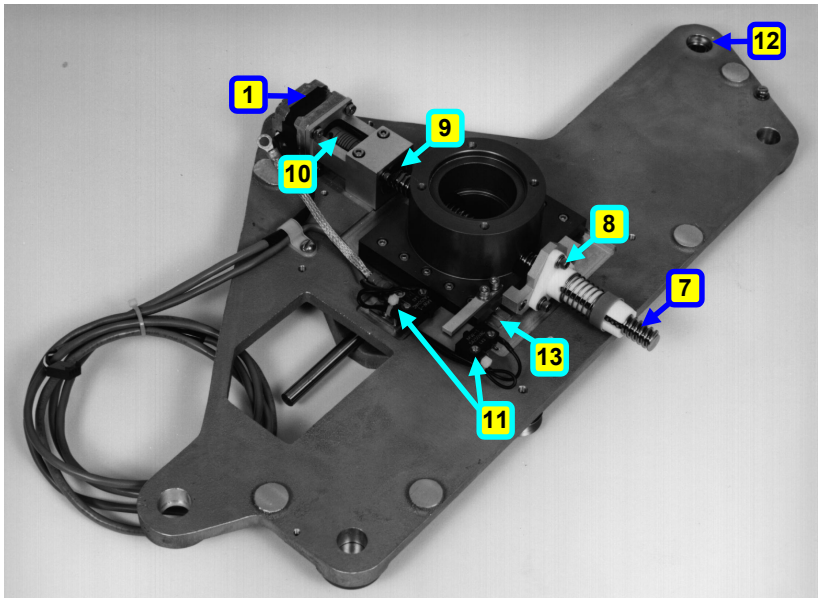


Figure 15-9: Motorized Y Table

15.6 Base Assembly

Table 15-6: 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	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	18539-6008-000
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

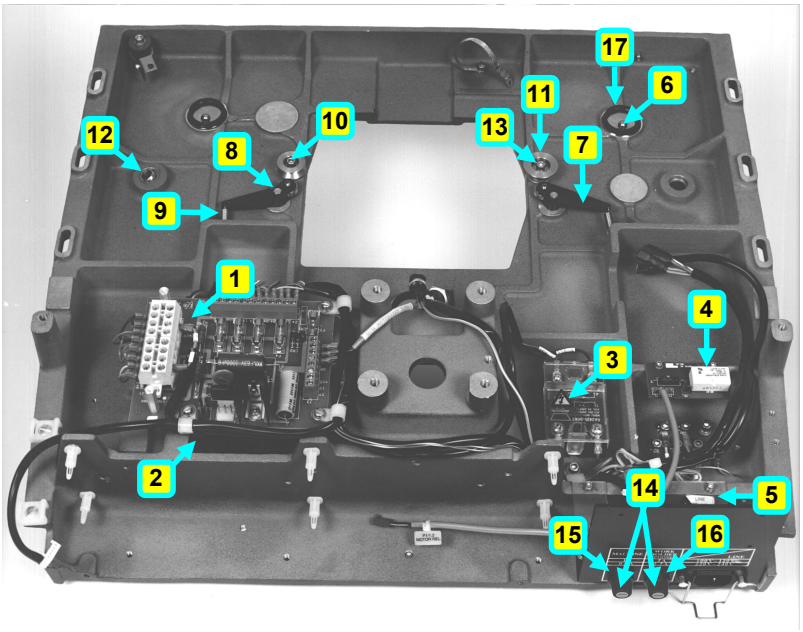


Figure 15-10: Base Assembly

15.7 Drag and Electrode Assembly

Table 15-7: 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
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

Table 15-7: DRAG AND ELECTRODE ASSEMBLY 04124-0452-000		
Item Number	**Description**	**K&S Catalog Number**
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

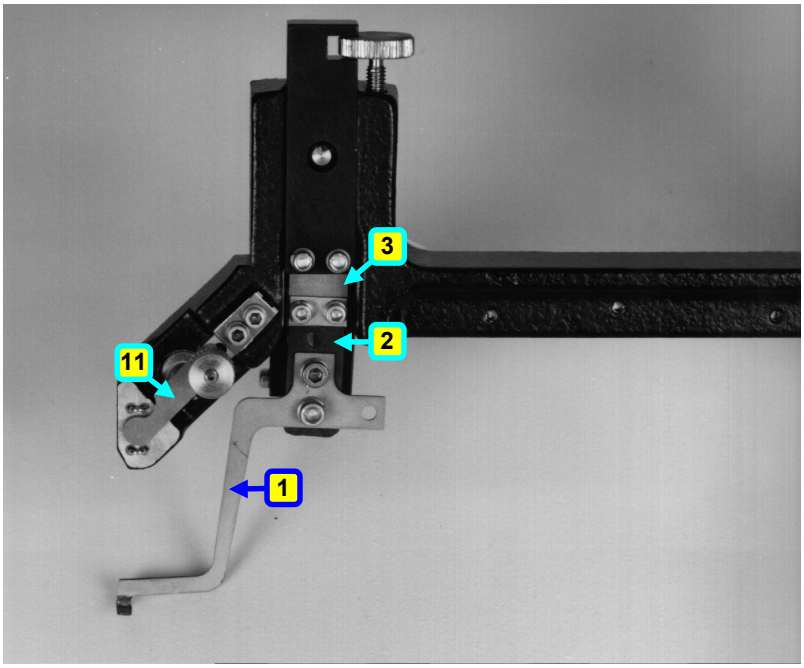


Figure 15-11: Drag Assembly

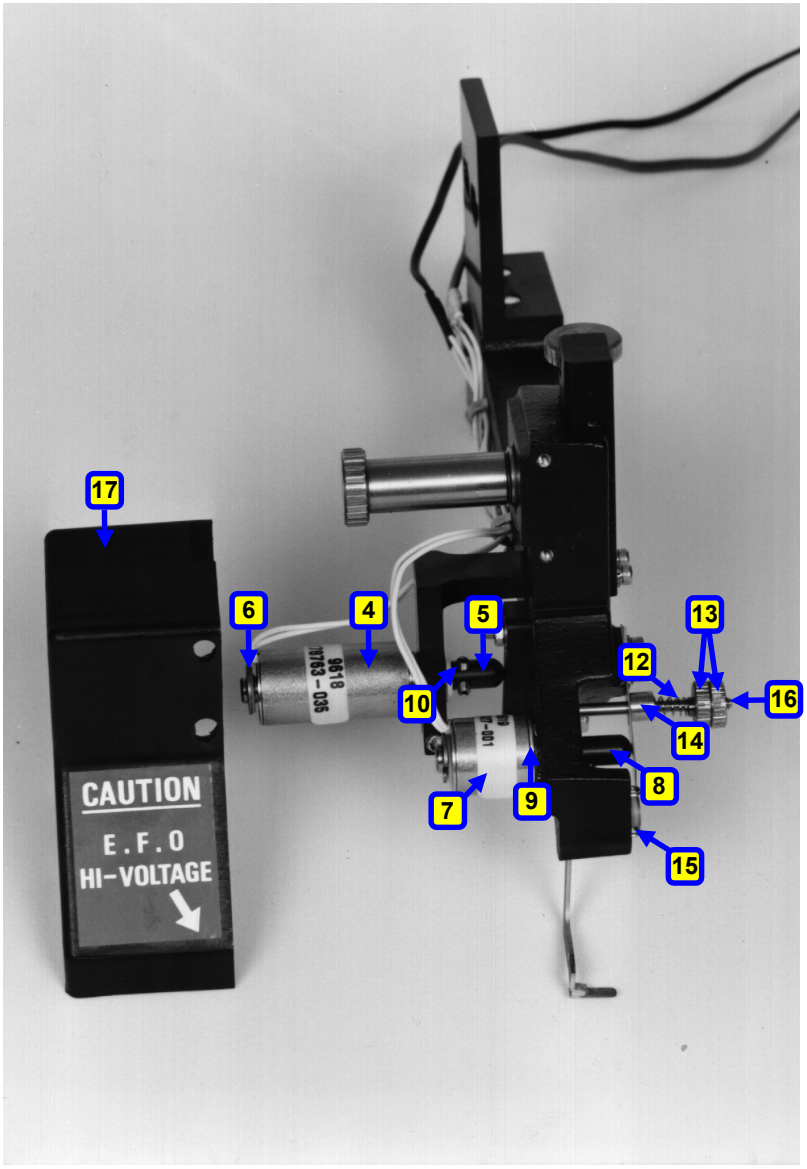


Figure 15-12: Electrode Assembly

15.8 2" Spool Assembly

Table 15-8: 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

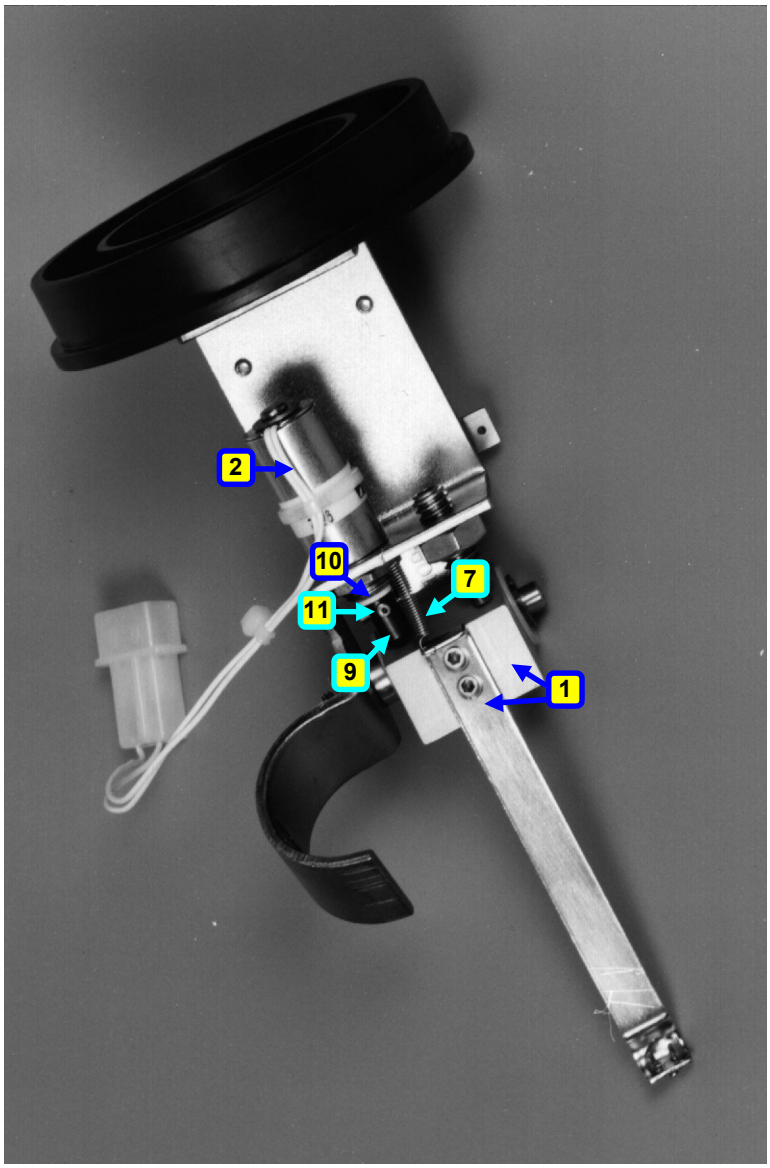


Figure 15-13: 2" Spool Assembly

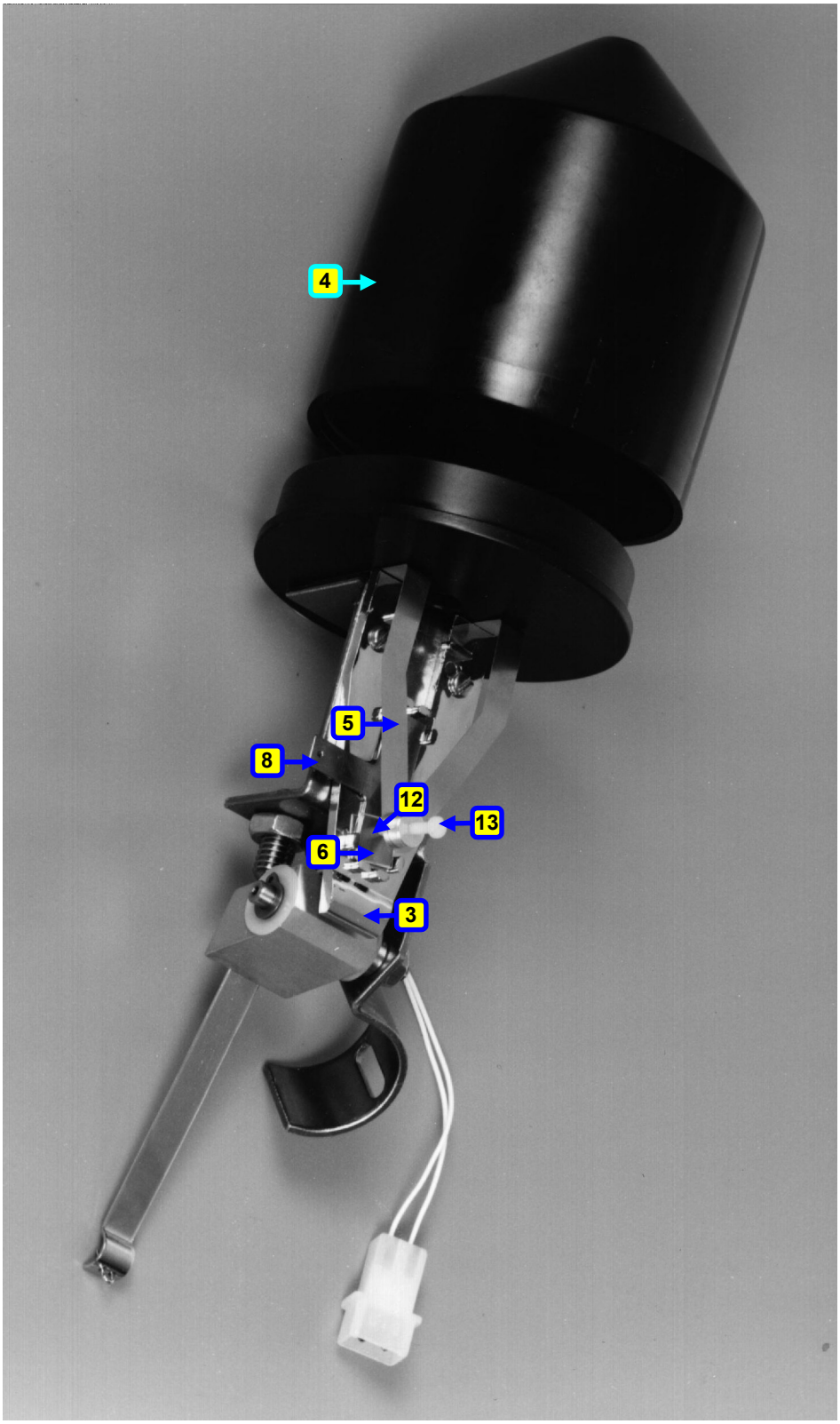


Figure 15-14: 2" Spool Assembly

15.9 Multi Mouse Assembly

Table 15-9: 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

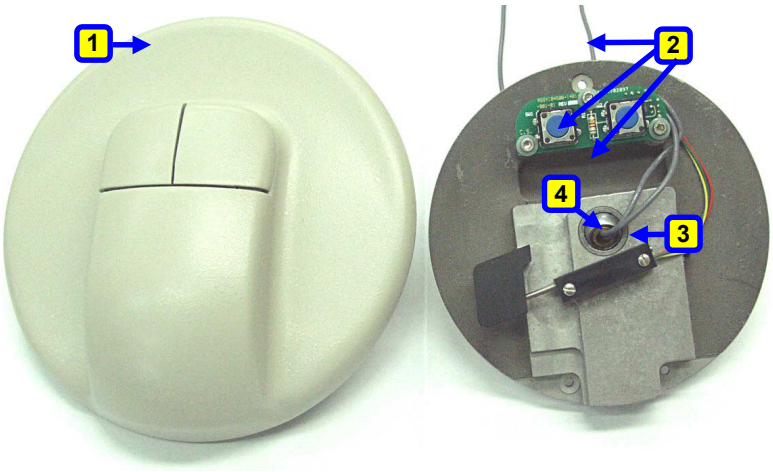


Figure 15-15: Multi Mouse Assembly

15.10 Clamp Assembly for 90° Wire Feed

Table 15-10: 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

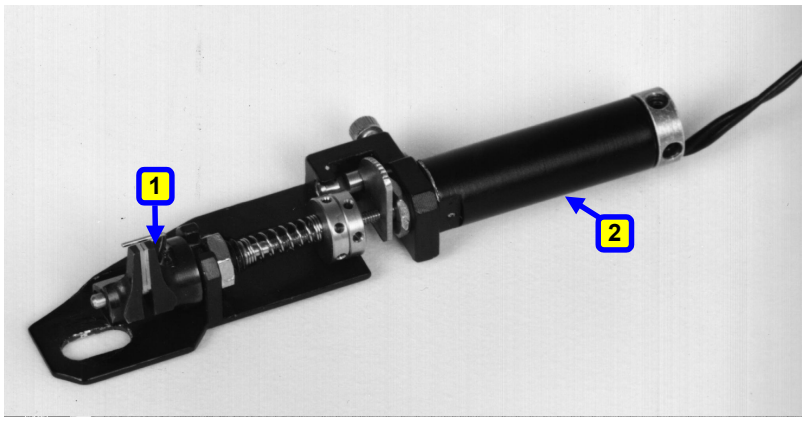


Figure 15-16: Clamp Assembly for 90° Wire Feed

15.11 N.E.F.O. System

Table 15-11: N.E.F.O. SYSTEM 04524-1001-000-01		
Item Number	**Description**	**K&S Catalog Number**
1	N.E.F.O. BOX ASSEMBLY	08020-1120-000-10
2	N.E.F.O. INTERFACE BOARD	04524-4330-000-00
3	SWITCHING POWER SUPPLY 5V/5A, 12V/12A	19074-0012-000
4	SWITCHING POWER SUPPLY 48V/1A	19074-0013-000
5	N.E.F.O. CABLE ASSEMBLY	08001-1091-000-00
6	POWER RESISTOR 7.15Ω 1%	59400-4715-130

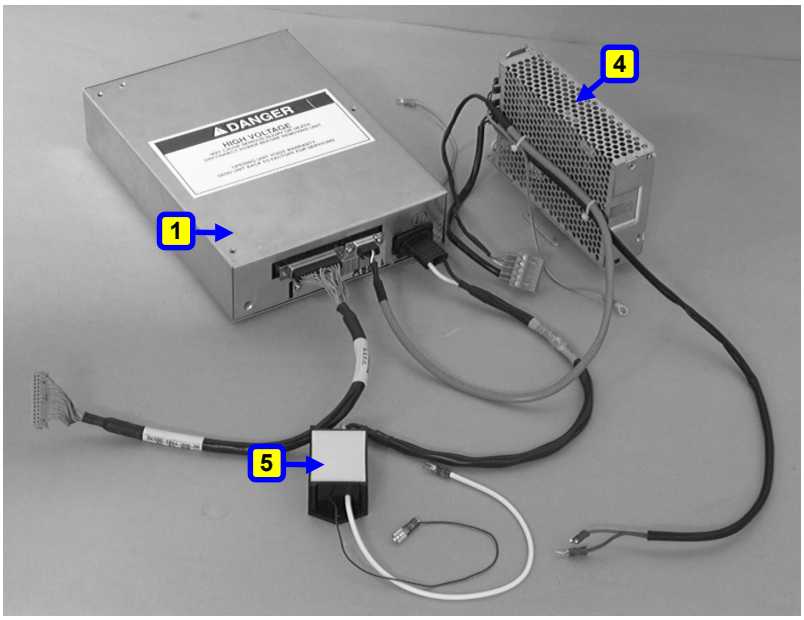


Figure 15-17: N.E.F.O. System

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