HYBOND™

HYBOND, INC.

MODEL 572A

DEEP ACCESS THERMOSONIC WIRE

AND RIBBON WEDGE BONDER

USER'S MANUAL

330 State Place, Escondido, CA 92029 • Phone (760) 746-7105 • Fax (760) 746-1408

HYBOND™

Soft Touch™ DEEP ACCESS THERMOSONIC WIRE AND RIBBON WEDGE BONDER

MODEL 572A

0.5 mil to 3.0 mil Dia. Wire

up to 1.0 mil by 20.0 mil Ribbon

FEATURES

- HYBOND *Soft Touch*™ energy system.
- Front panel ultrasonic test button.
- Deep vertical access of 0.59 inch.
- Horizontal reach of 3.5 inches.
- 0.5 and 2 inch spool mounts standard.
- Loop height control adjustment.
- Motorized vertical wire feed.
- 1-2-2 stitch capability standard.
- Wire-in-tool bonds within 0.04 inch from backwall.
- Swing away clamp assembly standard.
- Infinite angle mounting for microscope.
- Audio and visual bond sequence fault indicators.
- Independent control of first and second bond parameters.
- Tail length is adjustable in .003 inch increments by a front panel control.
- 6 x 8.5 inch work plate supports various heated work stages.
- LED readout for setting and monitoring work stage temperature.
- Independent Z lever for control of bonding tool.
- Wire and ribbon bonding with only a bonding tool change.

HYBOND's exclusive *Soft Touch*™ force ramping system bonds effectively with less trauma for sensitive devices. Superior wire control is provided by a motorized feed and clamping system which features front panel operator adjustment of tail length in .003 inch increments. The amount of "pull-back" required to break the wire at final bond may also be varied in relation to wire elasticity.

Model 572A sets the industry standard for ease of operation and maintenance. Front panel operator controls include force, ultrasonic time, ultrasonic energy, tail length, and stage heat. The 4:1 X-Y manipulator stage movement and Z axis bond motion are conveniently located to reduce operator fatigue. Precision machined mechanical components with sealed ball bearings at major points are durable and trouble free. Modular electronics facilitate quick and cost effective maintenance.

MODEL 572A SPECIFICATIONS

OPTICS AND ILLUMINATION
6:1 Zoom Stereo-microscope with 15X eyepieces (magnification range: 10X - 60X).
Infinite angle mounting for microscope.
Dual Fiber Optic Illuminator.

WORK PLATFORM
Dimensions 6 x 8.5 in. (15.2 x 21.6 cm).

WORK STAGE
Assorted stages available with vacuum or mechanical clamps.
Heated stage temperature range ambient to 300°C.

BOND PARAMETERS
Ultrasonic: Standard 1 watt output (2 watt output with OP-44).
Time: 10 mSec - 400 mSec.
Force: 15 grams - 150 grams standard (higher force available).

POWER
120VAC (±10%) 50-60Hz @ 10 A (maximum).

DIMENSIONS
Bench space required 20.0 x 20.0 in. (50.8 x 50.8 cm).
Unit weight 55 lbs. (24.9 kg).
Approximate crated shipping weight is 135 lbs. (61.4 kg).

OPTIONS

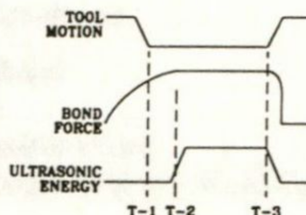
OP-06GZ/20	6:1 Zoom Stereo-Microscope with 20X Eyepieces (mag. range: 13.4X - 80X)
OP-07S	7:1 Zoom Stereo-Microscope with 30X Eyepieces (mag. range: 30X - 210X)
OP-08R	Ring Illumination System - Fiber Optic
OP-12	240VAC (±5%) 50-60Hz @ 5 A (maximum)
OP-17	Motorized Wire Spool Mount & Automatic Tension Control
OP-20	1-2-2, 1-2-1, 1-1-2 Stitching Capability
OP-30	8:1 Ratio X-Y Manipulator
OP-31	Tool Heater and Temperature Controller (6 turn only)
OP-35	Multiple Parameter Setting Module
OP-44	High/Low Ultrasonic Power Selector (2/1 watt)
OP-83	Heated Transducer plus OP-31 Temperature Controller
OP-400A	External Temperature Controller for work stage
WT-X.X	0.750 in. length Wedge Tool to match individual application
RT-X.X	0.750 in. length Ribbon Tool to match individual application

Soft Touch ™ Bonding Sequence

T-1 Tool makes contact with surface.

T-2 Tool is ramped up to desired force level and Ultrasonic Power applied.

T-3 Ultrasonic Power removed, bond force removed. Tool returns to rest position.



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SECTION 1.0

INTRODUCTION

The HYBOND Model 572A is an ultrasonic wire and ribbon wedge bonder. This precision bonder is characterized by vertical feed of wire or ribbon, manual "X-Y" control of the workpiece, and independent manual control of the "Z" Axis or bond tool. The 572A has the HYBOND exclusive "Soft Touch" feature for low trauma bonding in the entire range of applications including those on sensitive devices such as gallium arsenide LEDs, and FETs.

This manual is designed to provide the operator with an understanding of the equipment operation, characteristic features of the bonder, adjustments available to insure the best results in wire bonding, and troubleshooting procedures for fault isolation and correction of malfunctions.

The manual is composed of five sections:

Section 1.0 is a brief introduction.

Section 2.0 contains a detailed description of the mechanical and electrical features of the bonder and its assemblies. Section 2.0 also describes the operation of the mechanical and electronic assemblies; the electromechanical bonding operation sequence; the operation of front panel controls; and significant operation features of the Model 572A bonder.

Section 3.0 provides a detailed description of the Model 572A installation, set up and adjustments. Included in this section are procedures for initial set up and adjustment of the bonder, mechanical and electrical adjustments on the bonder that may affect bonding quality, and electronic printed wiring assembly test and calibration procedures.

Section 4.0 contains information about troubleshooting bonding problems. The information focuses primarily on operational problems that relate to the equipment features and operation technique. Since the Model 572A is such a highly reliable piece of equipment, few failure modes have been identified.

Section 5.0 contains detailed information about the operation and adjustments for the optional features on the Model 572A. Section 5.0 also includes the various service bulletins that have been issued on the equipment. Packing and unpacking procedures are provided at the back of the manual for easy reference in the event that the bonder must be moved or transported.

It is strongly recommended that all operations and maintenance people read this manual thoroughly, and obtain hands-on operating experience with the bonder. The precision and ease of operation of the equipment, and quality of the bonding will be better appreciated by using the bonder. Familiarity will also facilitate expeditious introduction of the equipment in production and enhance productivity.

SECTION 2.0

OPERATION

2.1 General

HYBOND's Model 572A is a relatively simple manual thermosonic wire or ribbon wedge bonder. This bonder was designed to make 0.5 to 3.0 mil gold or aluminum wire or up to 1.0 x 20.0 mil gold or aluminum ribbon electrical interconnections on a wide range of microwave or hybrid microelectronic packages. The Model 572A is characterized by precision mechanism for manual X-Y control of the work platform and workpiece, a manual Z control of the bonding wedge tool, and electronic control of the bonding variables (Force, Ultrasonics, Temperature, and Time). Standard features designed to be used with the Model 572A include: Leica 6:1 Zoom Stereo-microscope with bonder arm and 15X eyepieces; dual fiber optic area illuminator; work stage with mechanical and/or vacuum clamping provisions; tail length control, loop height control, Soft Touch[tm] energy system, and front panel bond parameter controls. A variety of options are available to enhance operability in special applications.

The design considerations were operator comfort and ease of operation, reliability of the bonding system, low inertial impact of the bonding tool, and operator safety. The mechanical assembly of the bonder consists of close tolerance bonder parts for precision operation and control. The electrical assembly is composed of highly reliable electronic components integrated into a modular assembly to facilitate ease of adjustment and troubleshooting.

2.2 Mechanical Description

The Model 572A has the following mechanical components: manual X-Y work position control, manual Z control, ultrasonic transducer mount assembly, force assembly mount, clamping mechanism, wire or ribbon feed mechanism, and static force mechanism.

The "X-Y" control is placed to allow the left hand to grip controls between the thumb and index finger with the heel of the hand resting on the bench top. This is the same natural position as holding a writing pen.

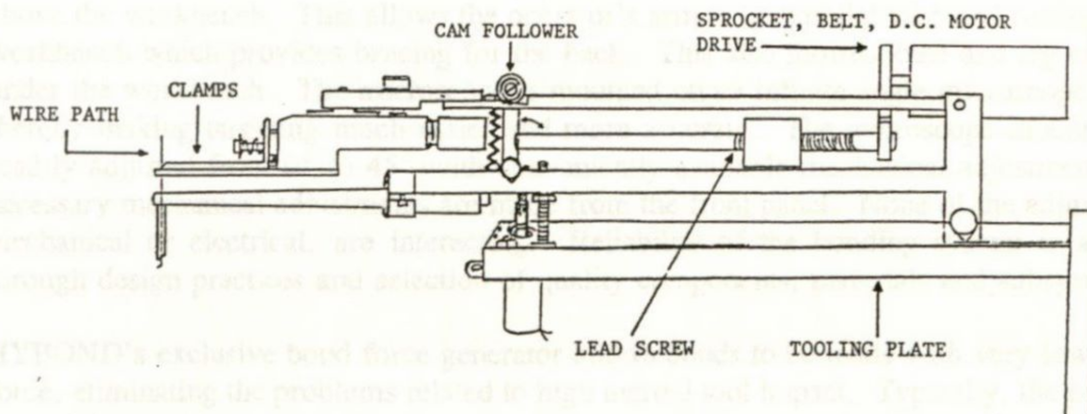
The X-Y travel of the bonding platform is limited to 0.90 inches square by a nylon jacketed pin which protrudes into a cavity of the Y-frame member. Motion is achieved by a pantograph mechanism which is coupled to the work plate. The manipulator ratio is approximately 4:1; i.e., 4.0 inches pantograph travel equals 0.90 inch workpiece travel. The positioning system has a built-in magnetic drag to eliminate overtravel due to the mass of the system. All pivot points with axial loads have sealed ball bearings; other pivots have bronze bearings. All wear points have been provided with hardened steel pads.

The work plate upon which the stage rests is supported on two hardened steel balls in the front and uniball bearing in the rear allowing freedom of movement in "X-Y" axis.

The "Z" control is a pivot mounted lever linked to the bonding platform giving a 2.5:1 mechanical reduction in tool motion. This lever also has a built-in "Z" motion override that is used for actuating the "Go" switch in the down position, and the "Up" switch when in the up position after the second bond. The "Go" switch actuates the bonding parameters through the Logic Control boards. The "Up" switch causes the wire to feed after second bond and prepares the bonder for the next bond cycle.

The Tooling Plate is a platform on which the tool assembly is pivot mounted and counterbalanced against, and is the main "Z" motion component of the mechanism. The tooling plate is rigidly mounted on dowel pins which are pressed into pivot bearings and is spring loaded against the Up-Stop when pressure is removed from the "Z" lever. The "factory only adjusted switch actuators" ("GO" switch and "UP" switch) are also carried on this plate.

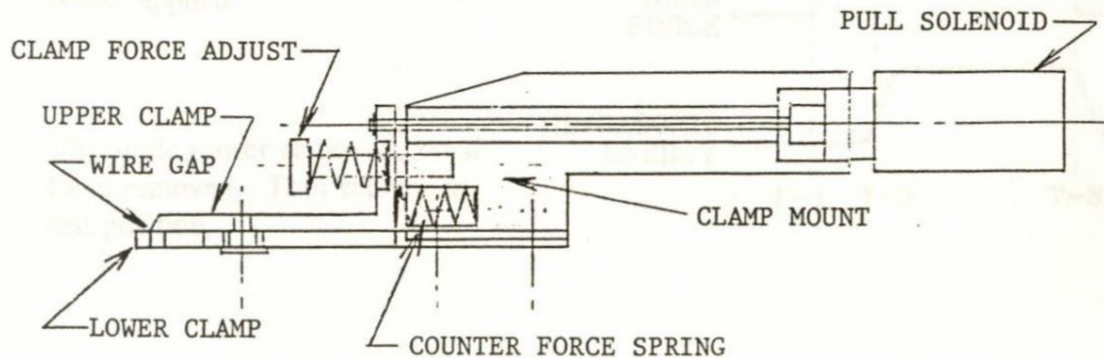
The unique characteristic of the Model 572A is the vertical feed of the wire or ribbon in a wedge bonding tool. The vertical feed is accomplished by the forward and backward movement of a cam follower on the clamp mount assembly which results in vertical motion of the wire clamps. The cam follower is positioned by an 80 pitch lead screw mounted in a fixed nut and belt driven by a geared D.C. motor. When the motor turns counterclockwise (ccw), the lead screw is driven forward causing the cam follower to produce a downward motion in the clamps. When the motor turns clockwise (cw), the lead screw retracts allowing the clamps to move in an upward motion. Motor actuation and the resultant upward and downward movement of the clamp assembly is controlled by the bonder's electronic logic and is sequenced with the clamping operation (opening and closing). Figure 2-1 is a functional sketch that shows the geometry and operation of the wire clamp and feed assembly.



Wire Clamp and Feed Assembly Functional Sketch

Figure 2-1

A set of clamps is provided for clamping the wire during wire pull and tail feed operation. The clamps are closed in the home or starting position, having closed after the second bond and after the bonding head ascends to the preset tail length level. The clamps are opened by a "pull" solenoid after first bond to allow the wire to feed to the second bond position. The clamps are spring loaded to the closed position. Clamping force is adjustable up to 50 grams. Figure 2-2 is a functional sketch of the Model 572A clamp assembly.



Clamp Mechanism Functional Sketch

Figure 2-2

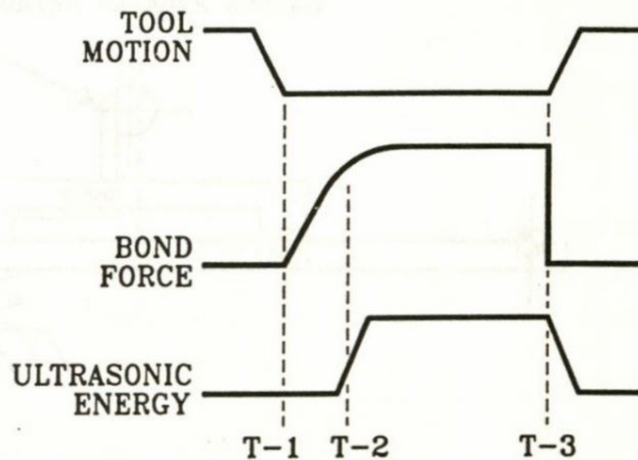
For ease of operation, "X-Y", and "Z" control ratios were carefully selected. The first and second bond indicators and temperature display are placed to be visible during operation without head movement. The microscope is placed so the operator's eyes are 16.25 inches above the workbench. This allows the operator's arm to be parallel with and resting on the workbench which provides bracing for the back. This also insures knee and leg clearance under the workbench. The microscope is mounted on an infinite angle microscope mount, thereby making targeting much easier and more accurate. The microscope mount can be readily adjusted from 0° to 45° with conveniently available mechanical adjustments. All necessary mechanical adjustments are made from the front panel. None of the adjustments, mechanical or electrical, are interacting. Reliability of the bonding system is achieved through design practices and selection of quality components, materials and subsystems.

HYBOND's exclusive bond force generator allows bonds to be made with very low impact force, eliminating the problems related to high inertial tool impact. Typically, the problems were chip cratering or metalization damage, and tool bounce causing uncoupling of tool and wire during bond times. HYBOND force generator provides the control that pulls the loaded transducer into the work and applies force to the preset level over a time set period. Only after force is established, is the ultrasonic energy applied for the specified time. Figure 2-3 illustrates HYBOND's "Soft Touch" energy system.

T-1 Tool makes contact with surface.

T-2 Tool force is ramped up to desired level and ultrasonic power applied.

T-3 Ultrasonic power removed, bond force removed. Tool returns to rest position.



"Soft Touch" Energy Sketch

Figure 2-3

Figure 2-4 on Page 2-5 illustrates the HYBOND Model 572A force system. The "Soft Touch" ramping force system has the following components:

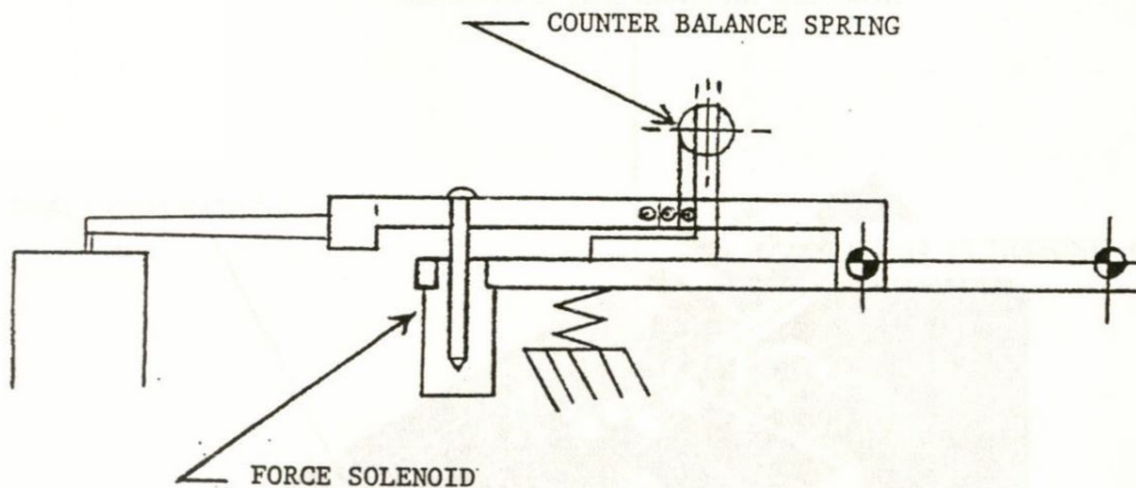
- Front panel control to select force.

- Force generator to integrate current over time, and a sample and hold circuit to hold force and bond time at the front panel settings.

- A force solenoid to which current is metered to create the ramping effect, and thus apply force in a ramped manner.

- A mass dampening circuit which applies low-level voltage to the force solenoid and gives the bond arm magnetic hysteresis dampening (static force).

- A simple mechanical counterbalance system uses a spring with a spring rate complementary to the solenoid rate. The design duty cycle of the force solenoid is 10%.



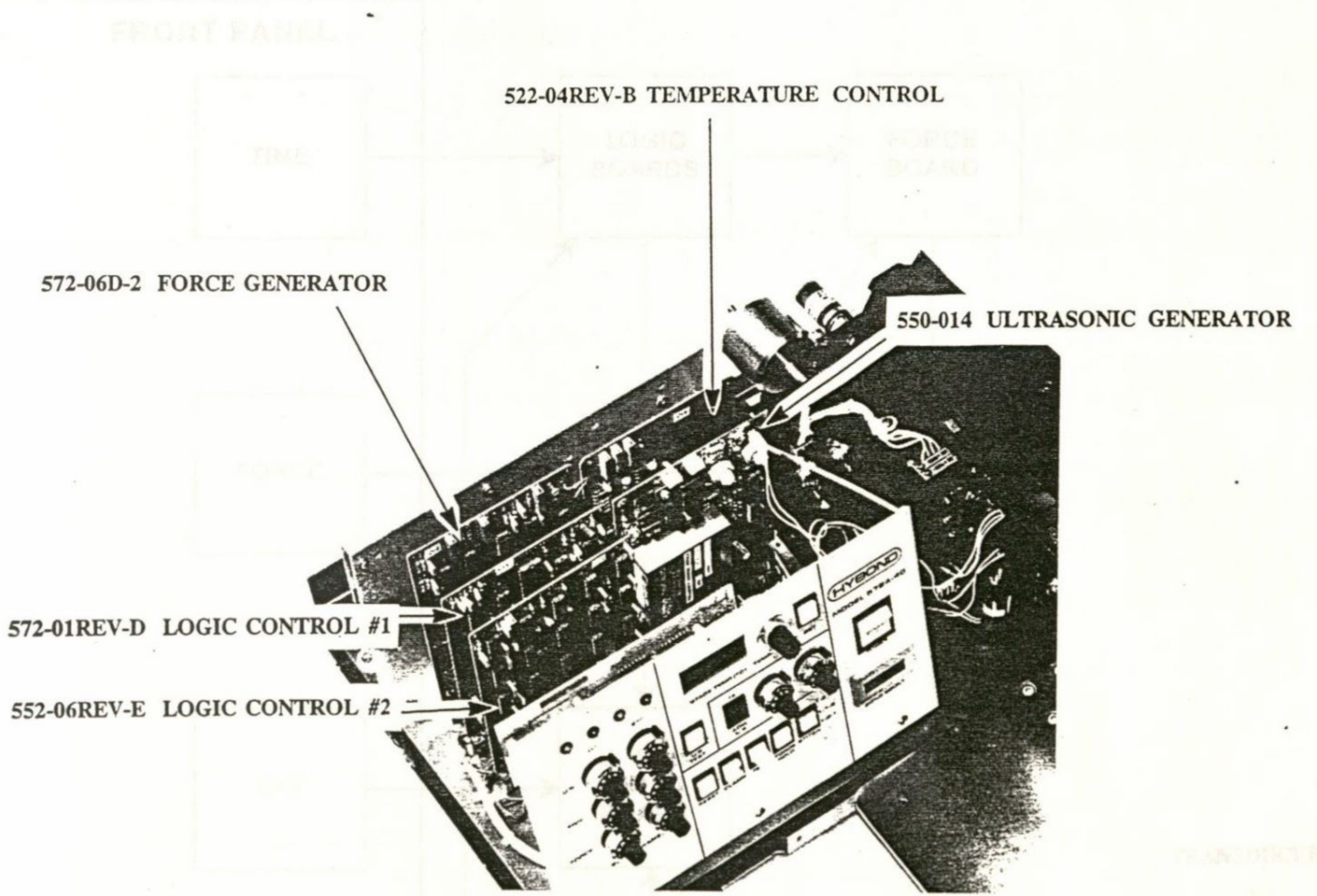
"Soft Touch" Force System

Figure 2-4

2.3 Electrical/Electronic System Description

The major components of the electrical system are the AC power distribution, the DC power supply, the bonder logic printed wiring assemblies, front panel controls and switches, front panel display, and the sequence switches. The Model 572A wiring diagram is included in the back of the manual. Printed wiring assemblies include the: Wedge Logic Controls, Force Generator, Temperature Control, and Ultrasonic Generator. Figure 2-5 shows the Printed Wiring Assembly installation.

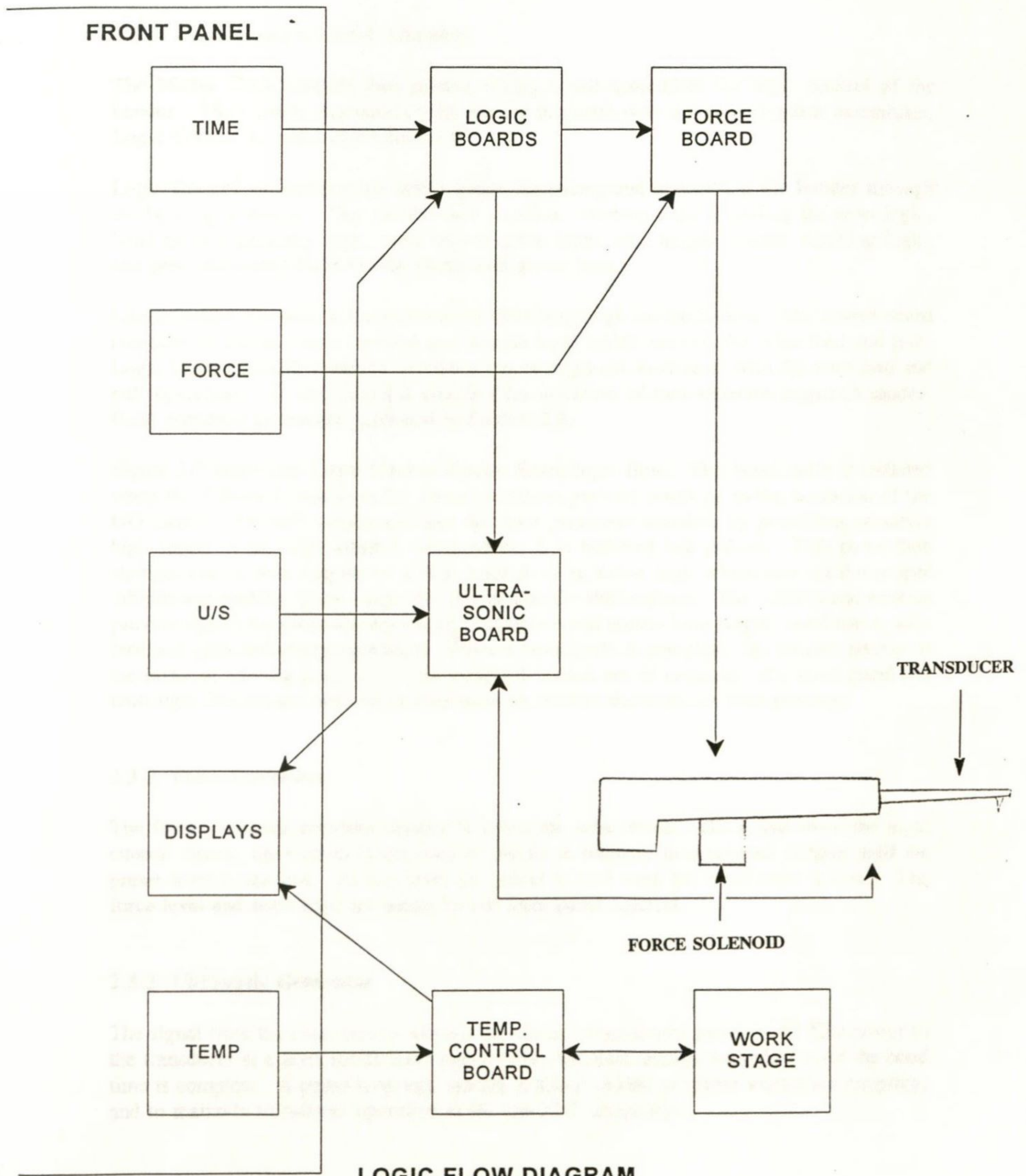
The AC power is brought to the bonder by the rear bulkhead mounted line cord routed to the front panel power switch and back to the fuse holder on the rear bulkhead. There are two fuses in series; a 10 amp and a 1.5 amp. The 10 amp provides AC protection. The 1.5 amp fuse protects the DC power supply and logic control circuits. The DC power supply provides regulated +12 VDC, -12 VDC and unregulated +24 VDC to each printed wiring board connector on commonly numbered pins.



Printed Wiring Assembly Installation

Figure 2-5

Figure 2-6 on Page 2-7 is a simple logic flow diagram associated with the printed wiring assemblies for the Model 572A. The Model 572A wiring diagram at the back of this manual shows the connections of the various printed wiring assemblies.



LOGIC FLOW DIAGRAM

Figure 2-6

2.3.1 Logic Control Board Assembly

The Model 572A contains two printed wiring board assemblies for logic control of the bonder. The control functions of the bonder originate with the logic control assemblies, Logic Control #1 and Logic Control #2.

Logic Control #1 contains the shift register for pacing and controlling the bonder through the bonding sequence. The circuit board contains: start-up logic including the reset logic, bond cycle sequencing logic, bond time duration logic, loop height control, stitching logic, and preconditioning logic for the clamp and motor logic.

Logic Control #2 controls the motor drive and clamp logic on the bonder. The circuit board contains the clamp motor forward and reverse logic which controls the wire feed and pull. Logic Control #2 also contains the clamp sequencing logic associated with the wire feed and pull operations. It also contains switches for selection of two separate sequence modes. Bond sequence modes are explained in Section 2.8.

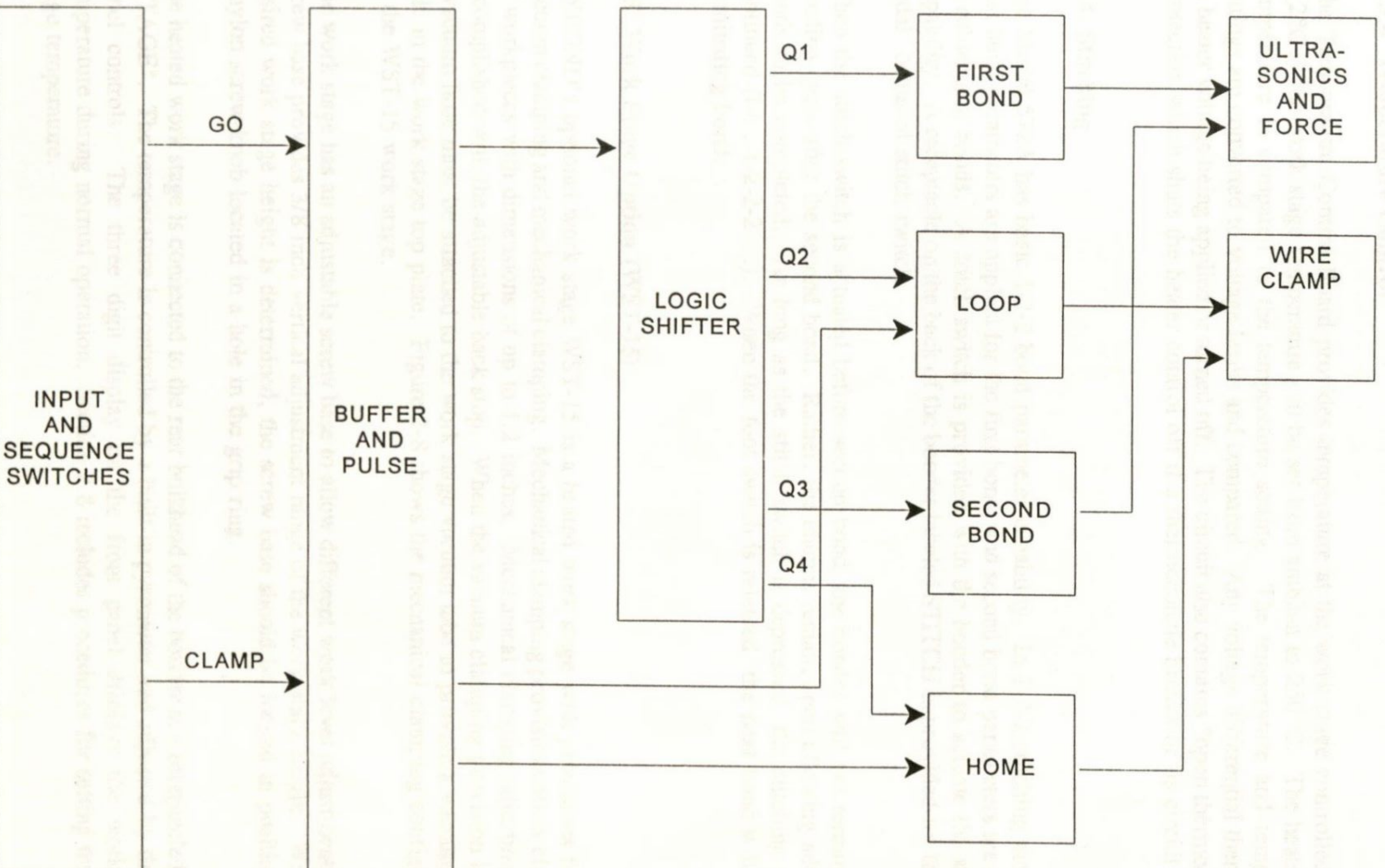
Figure 2-7 shows the Logic Control Circuit Board logic flow. The bond cycle is initiated when the Z-lever is placed in the down (override) position resulting in the actuation of the **GO** switch. The **GO** switch activates the bond parameter schedule by providing an active high signal to the logic control circuit where it is buffered and pulsed. This pulse then changes one of four outputs of a shift register to an active high which sets up the proper inhibits and enables for the respective position on the shift register. The inhibits and enables provide signals for properly sequencing first and second bonds, loop height, bond force, wire feed and pull, and clamp operation. When a bond cycle is complete, the bonder returns to the home or starting position. If the bonder becomes out of sequence, the front panel red fault light illuminates, and the bonder must be reset to the home or start position.

2.3.2 Force Generator

The force generator provides current to effect the bond force. On signal from the logic control circuit, the current is provided to the force solenoid in a ramped fashion until the preset level is reached. At this level the power is held until the bond time is over. The force level and bond time are preset by the front panel controls.

2.3.3 Ultrasonic Generator

The signal from the logic control circuit, the ultrasonic generator provides 62 Khz power to the transducer at a level set on front panel. The ultrasonic energy is applied until the bond time is complete. A phase loop lock system is also provided to insure workpiece coupling, and to maintain transducer operation at the specified frequency.



LOGIC FLOW DIAGRAM
Figure 2-7

2.3.4 Temperature Control

The Temperature Control Board provides temperature at the work stage controlled within ±2°C. The work stage temperature can be set from ambient to 250°C. The heated stage temperature is compared to the temperature setting. The temperature and temperature settings are converted to voltage levels and compared. Any voltage differential then results in heater voltage being applied or turned off. The circuit also contains "open thermocouple" protection which shuts the heater control off if a thermocouple breaks or its circuit opens.

2.4 Stitching

The Model 572A has basic 1-2-2 bond parameter capability. In 1-2-2 stitching mode, the first bond parameters are applied for the first bond, and second bond parameters are applied at subsequent bonds. A stitch switch is provided with the bonder to actuate the stitching capability. A receptacle on the back of the bonder labeled STITCH is provided for the "foot pedal" actuated stitch switch.

When the stitch switch is actuated before second bond, the bonder will not terminate the bonding cycle after the second bond. Rather, the clamps remain open allowing additional bonds to be completed. As long as the stitch switch is depressed, the stitching will be continued (i.e., 1-2-2-2....). When the foot switch is released, the next bond will be the terminating bond.

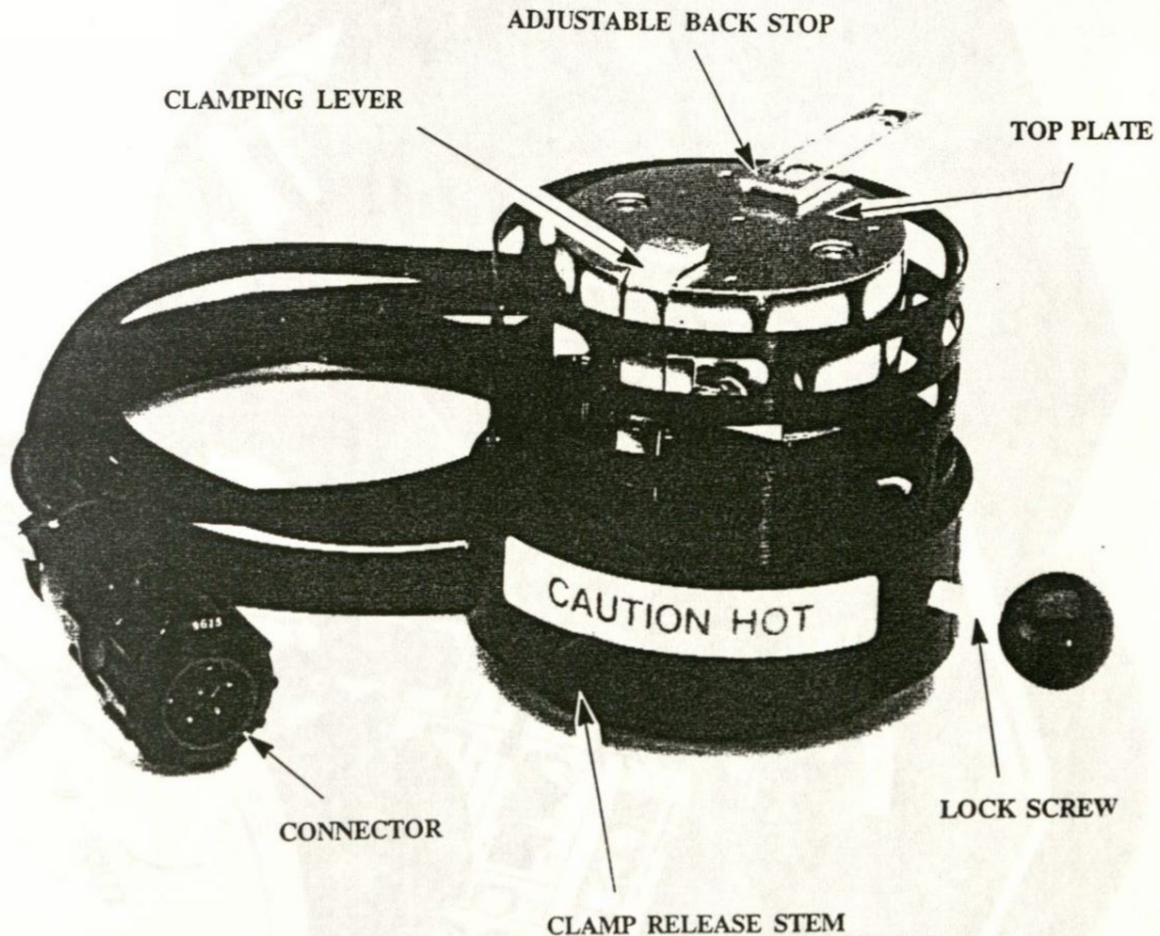
2.5 Work Stage Option (WST-15)

HYBOND's optional work stage WST-15 is a heated work stage with provisions for both vacuum clamping and mechanical clamping. Mechanical clamping provisions allow clamping of workpieces with dimensions of up to 1.2 inches. Mechanical clamping adjustments are accomplished with the adjustable back stop. When the vacuum clamping provision is used, a vacuum hose must be attached to the work stage vacuum tube to provide a vacuum in the hole in the work stage top plate. Figure 2-8 shows the mechanical clamping configuration of the WST-15 work stage.

The work stage has an adjustable screw base to allow different work level adjustments. The screw base provides 3/8 inch vertical adjustment range of the work stage height. When the desired work stage height is determined, the screw base should be locked in position with a nylon screw-knob located in a hole in the grip ring.

The heated work stage is connected to the rear bulkhead of the bonder at a receptacle labeled "STAGE". The temperature is controlled by a built-in pyrometer and adjusted by the front panel controls. The three digit display on the front panel displays the work stage temperature during normal operation. Section 2.8 includes procedures for setting the work stage temperature.

The bonder temperature control circuit contains open thermocouple protection for safety and to avoid "run away" temperature on the work stage. If the thermocouple on the work stage breaks to form an open circuit, the temperature control circuit automatically shuts off power to the work stage, and the front panel display shows "EEE".

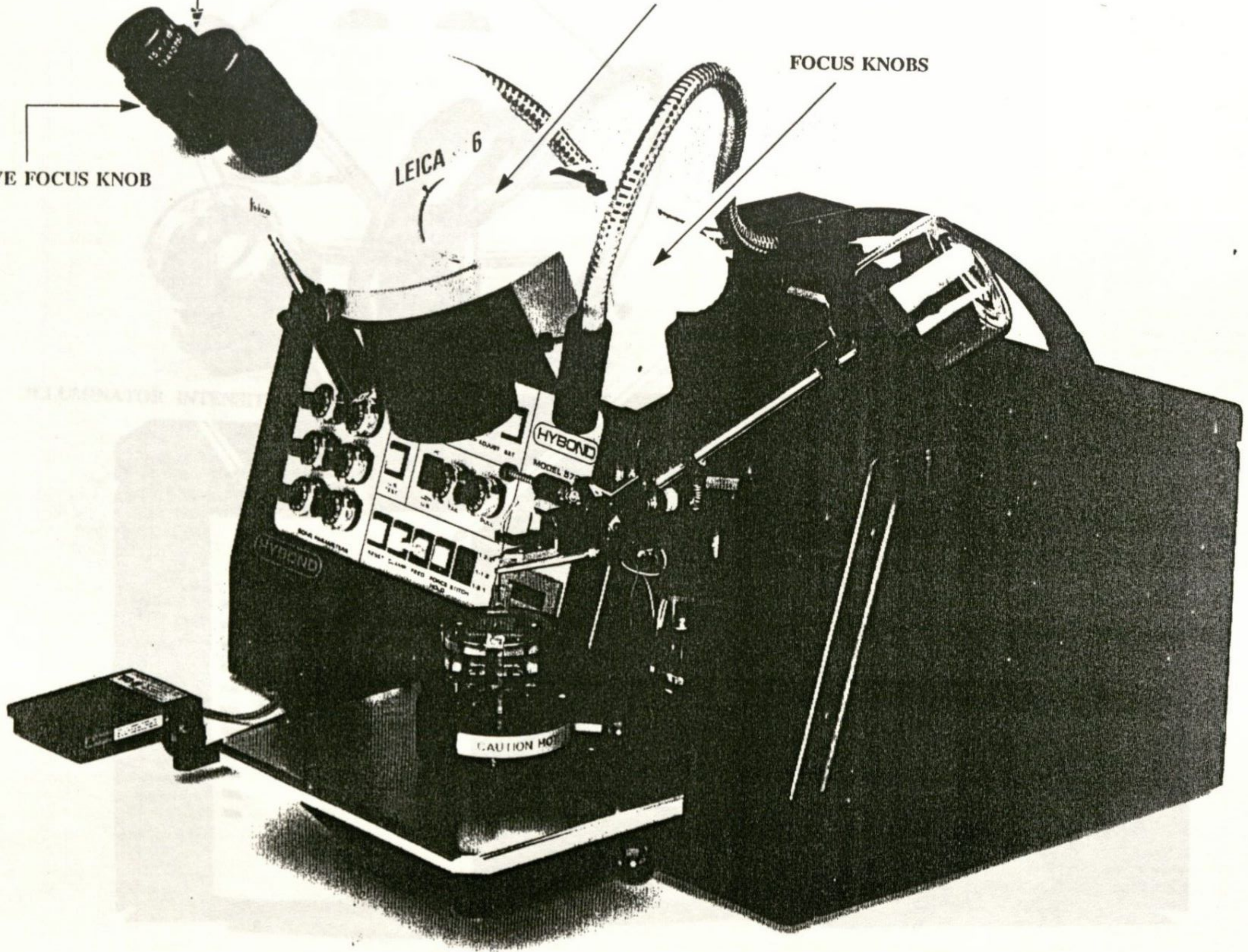


WST-15 Mechanical Clamping Configuration

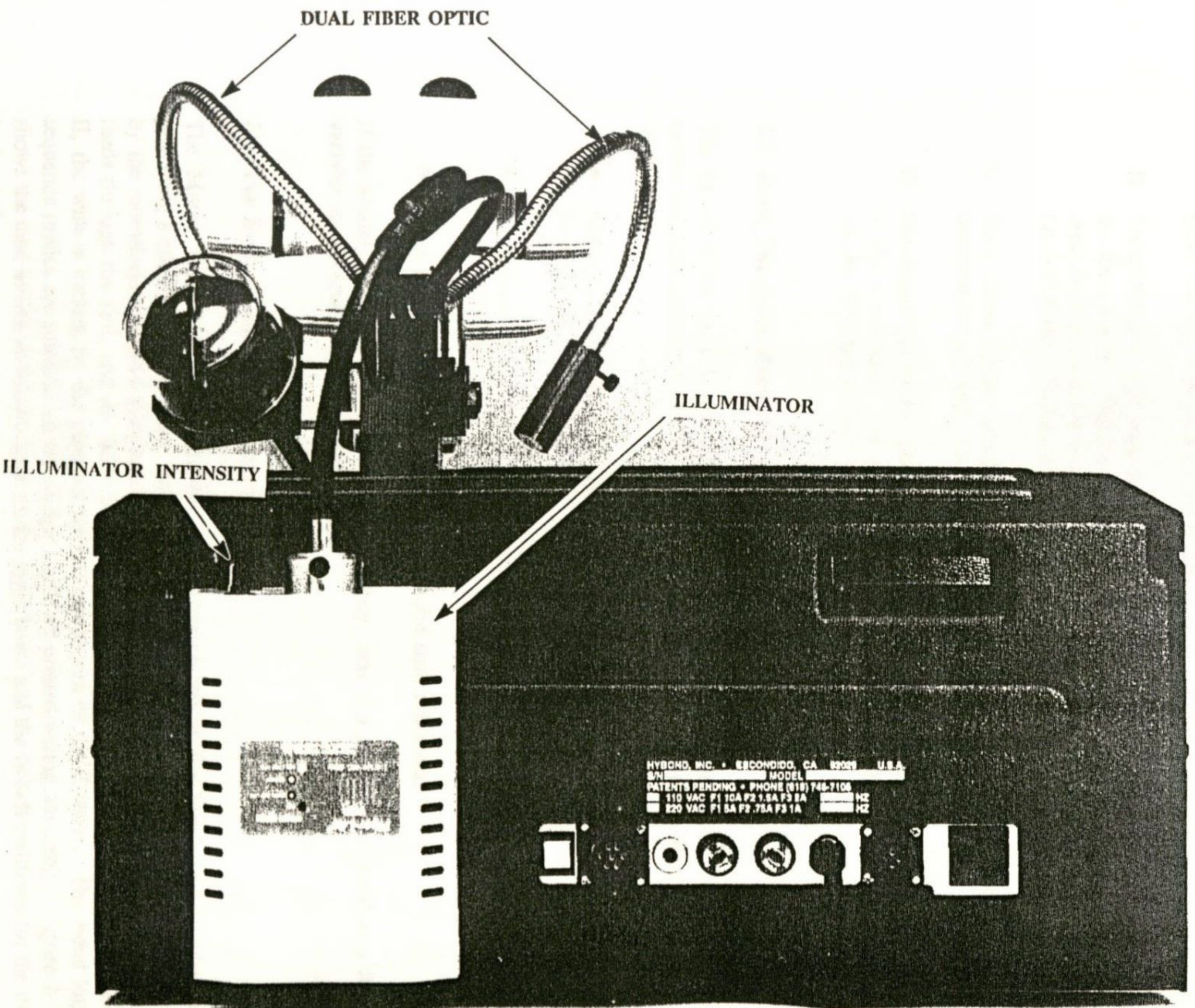
Figure 2-8

2.6 Microscope

The Model 572A is equipped with an infinite angle microscope mount. Figure 2-9 shows HYBOND's Model 572A with a Leica 6:1 Zoom Stereo-microscope with 15X eyepieces. This microscope (Option Number: OP-06GZ/15) has a magnification range of 10X - 60X. This microscope is also available with 20X eyepieces with a magnification range of 13.4X - 80X (Option Number: OP-06GZ/20). The Dual Fiber Optic Illumination System (Option Number: OP-08) is shown in Figure 2-10 on Page 2-13.



Leica 6:1 Zoom Stereo-microscope



Dual Fiber Optic Illumination System

Figure 2-10

A. Zooming Knob: To adjust the magnification of an object rotate to the desired power setting indicated on the knob.

B. Focus Knobs: The main body of the microscope is adjusted vertically by rotating the focus knobs. Tightness of rotation of the knobs can be increased by turning the right and left hand knobs in opposite directions. A knob TENSION arrow is shown on each knob. Tightness is decreased by releasing each knob at the same time.

C. Dual Fiber Optic Illuminator: The adjustable dual fiber optic illuminator incorporates a 6 volt, 10 watt halogen lamp.

D. Illuminator Intensity: The four-position switch on the transformer sets the intensity of the illuminator. To increase bulb life, it is recommended that the transformer **not be** operated at full intensity unless necessary.

2.7 Basic Ultrasonic Bonding

The Model 572A employs the basic ultrasonic wedge bonding method. Bonding of two metals using the ultrasonic method results from three variables: force, ultrasonic energy and time.

- Force is introduced to promote plastic flow (deformation) and intimate coupling between the bonding tool, the wire and the substrate.

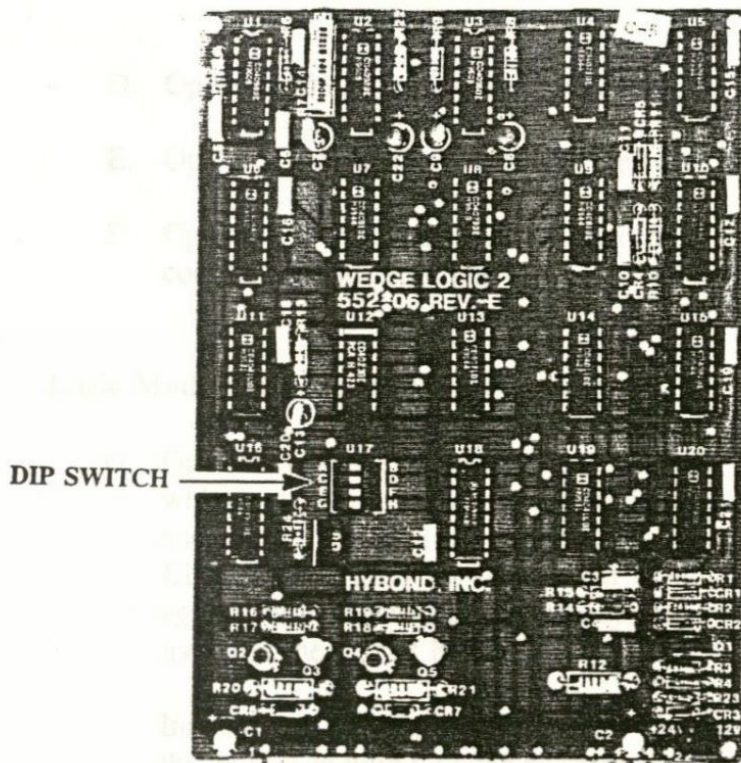
- Ultrasonic (62 KHz) scrubbing displaces surface contaminants and insures metal to metal coupling.

- Time is set sufficiently long to cause solid state diffusion.

If the Model 572A is used for gold wire bonding, heat at a low level is used as a fourth variable to eliminate surface contaminants.

2.8 The Basic Bonding Operation Sequence

The Model 572A has two selectable logic sequence modes for breaking the wire and providing a tail for the next bond. In logic Mode I, the clamps close and the wire is pulled by the motorized wire feed system to break the wire. When the Z-lever is raised, the wire feeds through the tool, and the tail is formed. This is the standard setting. In logic Mode II, the wire is broken by the physical upward movement of the Z-lever. The bond logic sequence modes are selected on the wedge Logic #2 printed wiring assembly. Figure 2-11 shows the dual in-line switch package on the logic board and the switch positions for the two logic modes.



WEDGE LOGIC #2

MODE I	MODE II
ON	OFF
ON	ON
OFF	OFF
OFF	ON

DIP SWITCH SETTINGS

Dual In-Line Switch Package and Logic Modes

Figure 2-11

A. Bonding mechanism is at the home position against the upstop. Wire or ribbon protrudes from the bond wedge slightly (0.0000.003 inches) and the clamps are closed.

B. The operator lowers the bonding mechanism to a level above the work where the final targeting is performed.

C. Operator continues lowering the "Z" lever until bonding wedge makes contact with workpiece. Continuing to lower the "Z" lever activates the "Go" switch and force is ramped up to the preset level. All preset bonding variables (Force, Ultrasonics, Time) for the first bond are applied and the clamps open. Engaging of the "Go" switch causes an audible sound (beep) indicating touchdown. A second signal (beep) indicates end of bond time.

NOTE: The first beep is caused by engaging the "Go" switch and the second occurs when the front panel controlled bond time is complete. If the operator raises the tool before the bond time is complete, (bond time complete), the bond mode/fault red L.E.D. indicator will stay on, indicating operational fault. If this occurs, press the reset switch and restart the bonding cycle.

D. Operator moves tool upward with the "Z" lever to form the loop height.

E. Operator simultaneously moves the work stage in direction of second bond site.

F. Operator lowers bonding mechanism from loop to second targeting level and completes final targeting.

Logic Mode I Operation (Standard Setting)

G. Operator continues lowering the "Z" lever until the bonding wedge makes contact with the workpiece. Again, continuing to lower "Z" lever activates the "Go" switch and force is ramped up to the preset level. All preset bonding variables (Force, Ultrasonics, Time) for the second bond are applied. Engaging the "Go" switch again causes an audible sound (beep) indicating touchdown. A second signal (beep) indicates the end of bond time.

Immediately after bond, the clamps close and pull the wire to break at the heal of the tool. The wire pull can be recognized by observing the clamp assembly moving upwards for a very short time.

H. After the second beep, the operator starts the tool ascent with the "Z" lever. Note the short wire protruding from the wedge tool after the wire breaks.

I. The operator returns the bond mechanism to the home position with the "Z" lever and the clamps remain closed. As the operator continues upward movement of the "Z" lever, the "Up" sequence switch is actuated, and the tail feed mechanism will feed wire back into the tool to form a new tail. The tail feed sequence can be recognized by the forward movement of the clamp assembly. The bonder is now ready for the next bond sequence.

Logic Mode II Operation

Immediately after bond, the clamps close, and descend slightly to form a small loop of wire above the tool. When the Z-lever is raised, the excess wire is pulled through the tool since it is still attached at the second bond. As the Z-lever movement continues upward, the wire breaks at second bond by the pulling effect.

The tail for the next bond cycle is in place having been pulled through the wedge.

Figure 2-12a illustrates bonding sequence Mode I, and Figure 2-12b illustrates bonding sequence Mode II. The two modes differ only in the method by which the wire is broken after second bond. The letters across the center of the two figures correspond to the significant bonding sequence events.

572 BONDING SEQUENCE (NON-STITCH MODE)

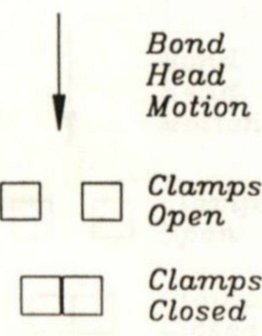
FILENAME: 572SQNC1
DATE: 12/2/96

HOME | TARGETING HEIGHT | 1st BOND | LOOP HEIGHT | TARGETING HEIGHT | 2nd BOND | HOME OR TARGETING HEIGHT

GO switch activates:
Force
U/S
Time
Clamps Open

GO switch activates:
Force
U/S
Time
Clamps Close
Motor Runs
Pullback Occurs
Wire Breaks

Motor Runs
Wire Feeds



Bond Head Motion

Clamps Open

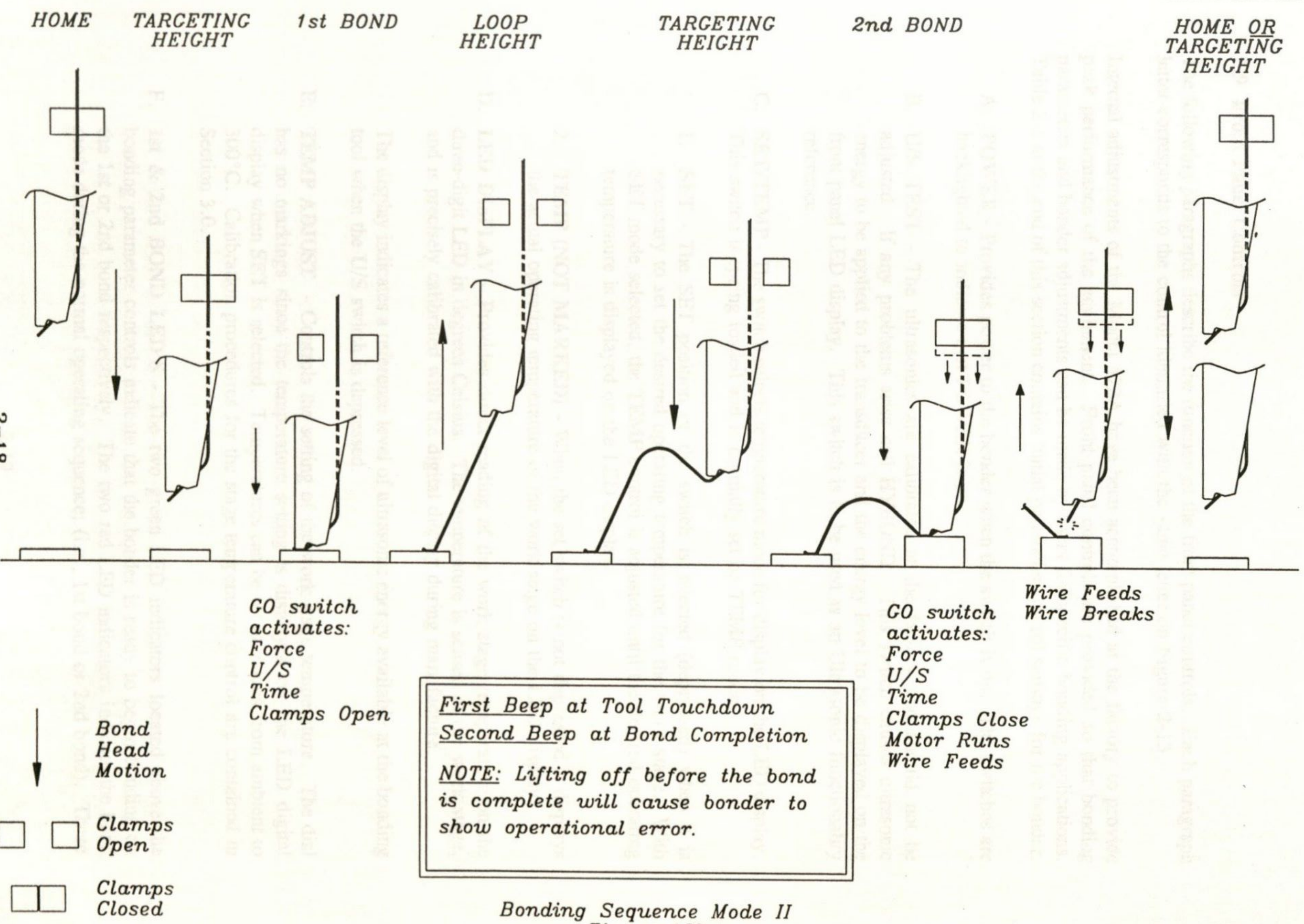
Clamps Closed

First Beep at Tool Touchdown

Second Beep at Bond Completion

NOTE: Lifting off before the bond is complete will cause bonder to show operational error.

Bonding Sequence Mode I
Figure 12a



Bonding Sequence Mode II
Figure 12b

2.9 Front Panel Controls

The following paragraphs describe the function of the front panel controls. Each paragraph letter corresponds to the control identified with the same letter on Figure 2-13.

Internal adjustments of the Model 572A have been accomplished at the factory to provide peak performance of the equipment. Front panel controls are provided so that bonding parameters and bonder adjustments can be made by users for specific bonding applications. Table 2-1 at the end of this section contains initial parameter control settings for the bonder.

A. **POWER** - Provides power to the bonder when the switch is on. The switches are backlighted to indicate that POWER is on.

B. **U/S TEST** - The ultrasonics are calibrated at the factory and should not be adjusted. If any problems arise call HYBOND. This switch causes ultrasonic energy to be applied to the transducer and the energy level to be displayed on the front panel LED display. This switch is to be used as an Ultrasonic functionality reference.

C. **SET/TEMP** - The switch selects temperature mode for display on the LED display. This switch is spring loaded and is normally set on TEMP mode.

   1. **SET** - The SET position of the switch is selected (depressed) when it is necessary to set the desired operating temperature for the work stage. With **SET** mode selected, the **TEMP** control is adjusted until the desired operating temperature is displayed on the LED display.

   2. **TEMP (NOT MARKED)** - When the set switch is not depressed it displays the actual operating temperature of the work stage on the LED display.

D. **LED DISPLAY** - Provides direct reading of the work stage temperature on the three-digit LED in degrees Celsius. The temperature is sensed at the work stage, and is precisely calibrated with the digital display during manufacture.

   The display indicates a reference level of ultrasonic energy available at the bonding tool when the **U/S** switch is depressed.

E. **TEMP ADJUST** - Controls the setting of the work stage temperature. The dial has no markings since the temperature setting is displayed on the LED digital display when **SET** is selected. Temperatures can be set at values from ambient to 300°C. Calibration procedures for the stage temperature control are contained in Section 3.0.

F. **1st & 2nd BOND LED'S** - The two green LED indicators located above the bonding parameter controls indicate that the bonder is ready to begin bonding on the 1st or 2nd bond respectively. The two red LED indicators indicate the bond mode during the normal operating sequence; (i.e., 1st bond or 2nd bond). These

LED's also illuminate and indicate a fault when there is a bonder problem or operator error (e.g., raising the Z-lever prior to second "beep" in the bonding cycle). When he red LED illuminates because of a fault, the light remains on, and no further bonding can be accomplished until the **RESET** switch is pressed.

G. **BONDING PARAMETERS** (1st and 2nd BOND) - The potentiometers provide a means for setting and controlling bonding variables.

1. **U/S** - The **ULTRASONIC (U/S)** potentiometer is used to adjust the relative strength of the U/S signal to the tool. The U/S potentiometers may be adjusted from 0 to 1.0 milliamps.

2. **TIME** - The **TIME** control potentiometer is used to set the time period for application of force and ultrasonic energy during the bond cycle. Bond time is available from 20 milliseconds to 400 milliseconds.

3. **FORCE** - The **FORCE** control is used to set the amount of force that will be applied to the bonding tool during the bonding cycle. The first and second bond forces are adjustable from 15 grams to 200 grams.

H. **RESET** - The **RESET** switch is used to reestablish the bond cycle at the home or beginning position. Pressing the **RESET** button returns the bond cycle to the ready-for-first-bond position, and interrupts any further action in a given bond cycle. It is used to reset the logic control when either the 1st or 2nd bond red mode/fault indicator is on.

I. **1-2-2/1-2-1/1-1-2** - This switch selects the stitching parameters on those bonders where stitching capability is incorporated. The 1-2-2 position selects second bond parameters for the second bond and third bond. The 1-2-1 position selects second bond parameters for the second bond and first bond parameters for the third bond. After the third bond, the bond cycle returns to home ready for first bond. The switch is spring loaded to the neutral position and must be actuated each time the stitch capability is needed.

J. **U/S HI-LO** - Enables the operator to choose between up to 2 watts of ultrasonic power on high position or up to 1 watt of power on low.

K. **FORCE HOLD** - The purpose of this switch is to hold the bond cycle in order to enable the user to determine the force being applied by the bond head by using a gram gauge. When the switch is in the up position 1st bond will be held. When the switch is in the down position 2nd bond will be held. Center position is for normal cycle.

L. **CLAMP** - When the **CLAMP** switch is on, the clamp solenoid is actuated and the clamps are held open. A small red LED illuminates when the switch is on and the clamps are open. This switch should not be left on for extended periods since it puts continuous voltage on the solenoid.

M. **FEED** - The **FEED** toggle switch is used to increase or decrease the tail length. Pushing the toggle switch **down** increases the tail length; pushing it **up** decreases the tail length.

N. **TAIL** - The **TAIL** potentiometer controls the amount of wire fed forward for the new tail after termination of the last bond.

O. **PULL** - The **PULL** potentiometer adjusts the distance the wire is pulled back to break the wire after second bond.

P. **OPERATOR CONTROLS**

1. "X-Y" Axis Controls - 4:1 ratio manipulator that provides 0.9 x 0.9 inch work stage travel.

2. "Z" Axis Controls - 2.5:1 ratio lever system that provides up to 1.12 inches of "Z" tool travel.

Q. **BOND COUNT** - The bond count counter keeps a record of each time the bonder is cycled. It can be restarted by pressing the white switch in the back panel.

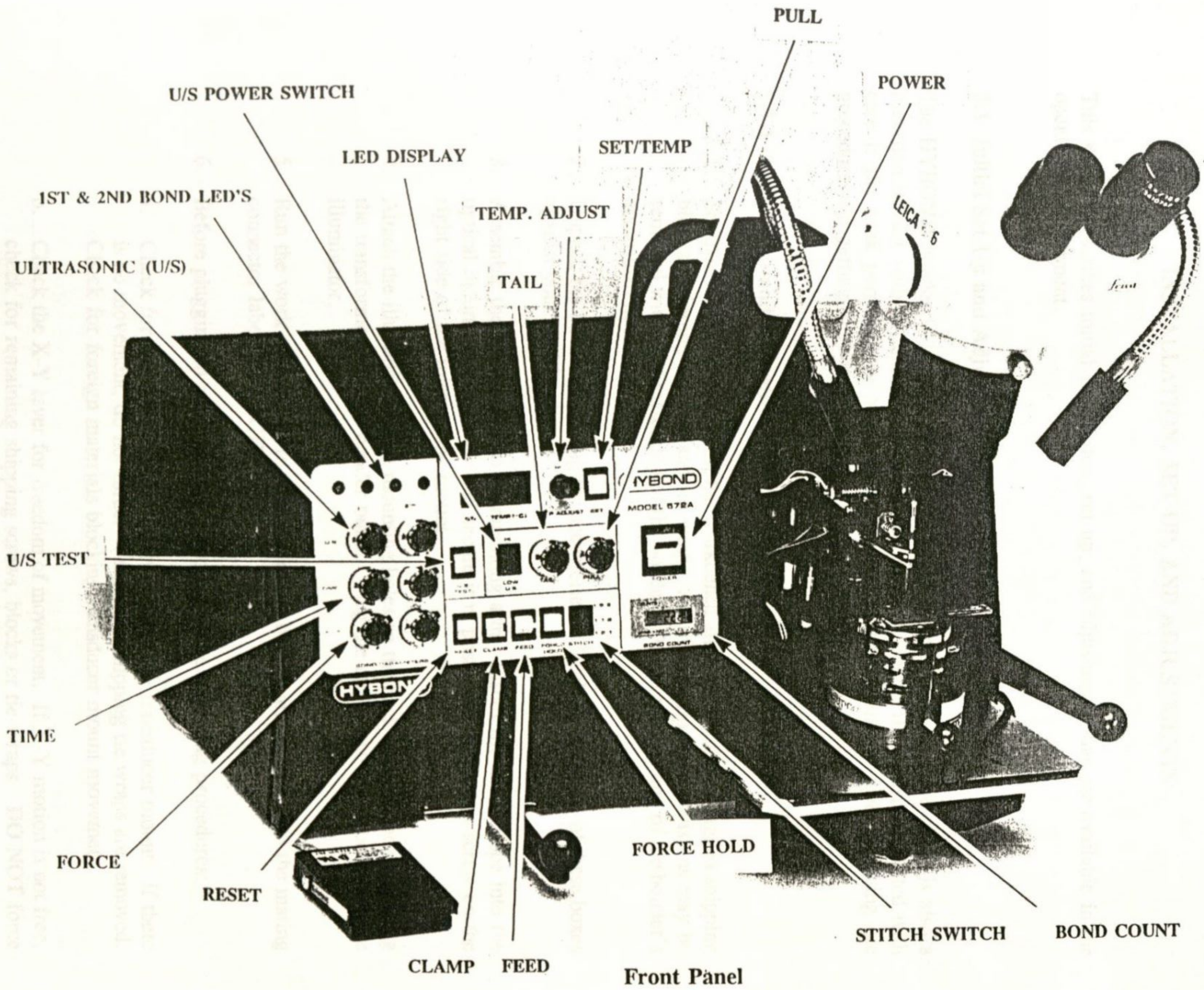
2.10 Starting Parameters

Table 2-1 below shows initial set-up parameters only. Actual parameter values will vary depending on process, materials and specific applications.

	Bond Wire Size:	.7 Mil	1.0 Mil	1.3 Mil
Ultrasonic (Decadial)	1st	1.7	2.5	3.5
	2nd	1.7	3.0	4.5
Time (Decadial)	1st	1.7	2.5	3.5
	2nd	1.7	3.0	4.5
Force (Decadial)	1st	3.0	3.3	3.7
	2nd	3.5	3.7	4.2
Temperature		120°C	120°C	120°C
Wedge Tool: .750 Long Wire Hole Diameter		1.5 Mil	2 Mil	3 Mil

Starting Parameters

Table 2-1



Front Panel

Figure 2-13

SECTION 3.0

INSTALLATION, SET UP, AND ADJUSTMENTS

This section describes initial installation, set up, and adjustments that are available in the operating environment.

3.1 Initial Set Up and Adjustment

The HYBOND bonder is in general a rugged piece of equipment. However, it is also a precision bonder with components, assemblies, and adjustments that must be treated with care if the peak performance of the equipment is to be obtained. The following are procedures for getting the bonder in operation.

3.1.1 Installation and Assembly

1. Set the HYBOND bonder on the workbench and remove all red tagged shipping blocks, shipping screws, and tie wrap. All of the shipping provisions may be removed without disassembly of the bonder. Do not remove any of the bonder's enclosures at this time.

2. Unpack the boxes containing the accessories. Check the contents of these boxes against your packing list.

3. Assemble the microscope to its mounting arm. Install the microscope into the optical mount of the bonder and secure it in position with the set screw on the right side of the microscope mount.

4. Attach the illuminator on its mounting holes on the back of the bonder and plug the transformer into the bonder outlet. Plug the dual fiber optics cord into the illuminator.

5. Run the work stage cable to the back of the bonder and plug it into the mating connector labeled **STAGE**.

6. Before plugging in any power cord, complete the following procedures:

   a. Check for freedom of vertical movement in the transducer mount. If there is no movement, do not force. Verify that shipping tie wraps are removed. Check for foreign materials blocking transducer mount movement.

   b. Check the X-Y lever for freedom of movement. If X-Y motion is not free, check for remaining shipping screws, blocks or tie wraps. **DO NOT** force X-Y lever.

c. Check microscope position. The desired position is such that the tool (in bond position) is in the center of the field of view. Front to back adjustment is achieved by adjusting the sliding bracket, which is located on the left side of the bonder's post. The X axis adjustment is made by swinging the microscope right to left and locking it in place with the set screw on the right side of the microscope mount.

3.1.2 A.C. Power-Up Procedure

1. Before plugging the power cord into the A.C. power source, check the label located above bulkhead on the rear panel. If the label does not agree with the available A.C. power, **DO NOT** plug in the power cord. Check the A.C. power socket for correct wiring. Do not plug in if any of the following conditions exist:

   a. Open Ground

   b. Open Neutral

   c. Open Hot

   d. Hot/Ground Reverse

   e. Hot/Neutral Reverse

   If any of the above conditions exist, have discrepancies corrected before plugging in the bonder power cord.

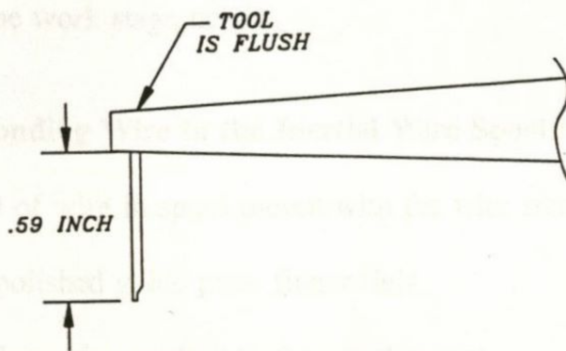
2. Push the power switch to turn the bonder on. The power switch will be back lighted in the **ON** position.

3.1.3 Tool Installation and Work Stage Height Adjustment

3.1.3.1 Tool Installation

1. A 1/16" dia. x 0.750 long bonding wedge with a °45 wire or ribbon feed angle is recommended. Refer to your tool supplier catalog for the tool suitable for the specific application.

2. The bonding tool is fitted into the 1/16 inch diameter hole in the ultrasonic transducer and the top of the wedge tool must be flush with the top of the transducer. Secure by tightening the 2 - 56 x 1/16 set screw with the hex key furnished.

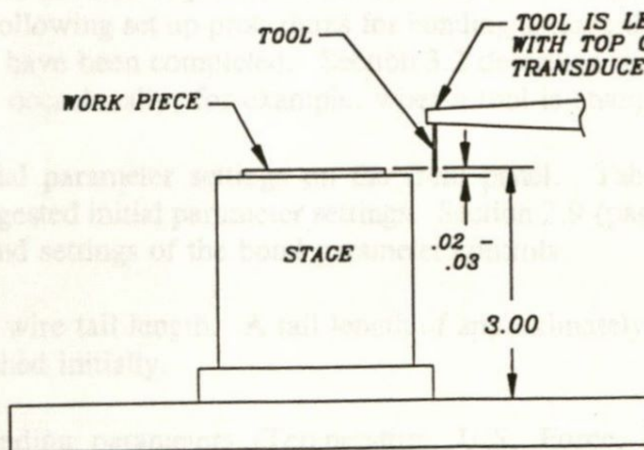


Tool Installation

Figure 3-1

3.1.3.2 Work Stage Height Adjustment

1. Position the work stage holding a workpiece on the work platform, but not under the bonding tool.
2. Lower the tool to its lowest position with the "Z" lever.
3. The bonder is factory adjusted so that the tool tip is .02 to .03 inches below the work stage surface when the work stage is adjusted to the 3" level. Figure 3-2 illustrates the desired tool level relative to the workpiecc.



Tool Level

Figure 3-2

4. If tool level adjustment is required, obtain the required tool tip position by adjusting the work stage height.

3.1.4 Loading the Bonding Wire in the Inertial Wire Spool Mount

1. Place spool of wire in spool mount with the wire starting end up.

2. Screw the polished guide plate finger tight.

3. Place the glass wire guide into the spool mount.

4. Using a length of small gage wire with a hook on the end, pull the bonding wire through both the wire guide and wire tension tubes.

5. Using tweezers, feed the wire through the final wire guide and through the bonding tool.

6. Hook the tension arm loop under the bonding wire.

7. Place the protective cover on the spool mount and secure it in position with the Wire Cover Retainer.

8. The drag is correct, if, when pulling wire through the capillary, the spring tension arm deflects approximately 3/16 inch.

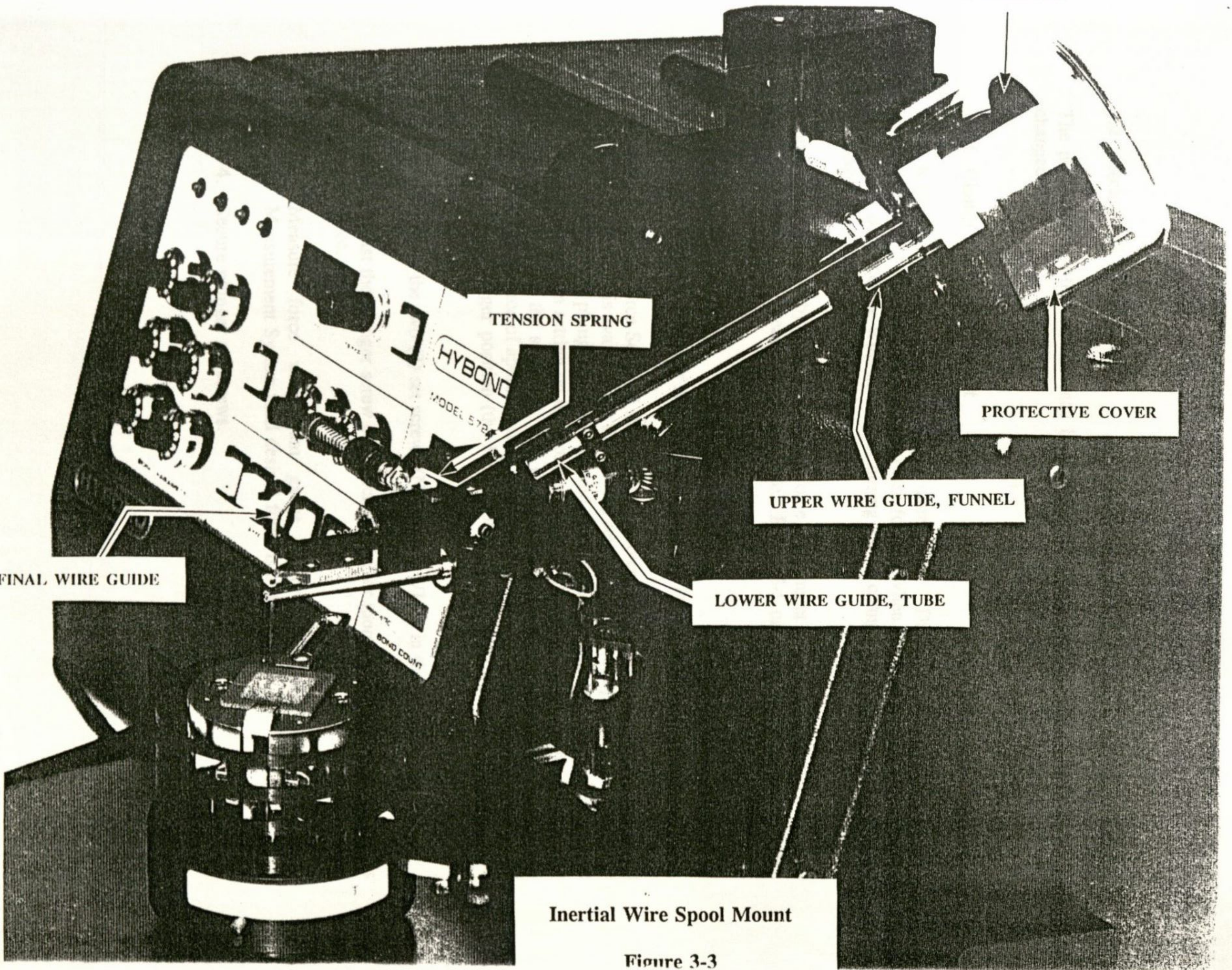
3.1.5 Set Up for Bonding

The HYBOND bonders have all adjustments for the tool and clamps accomplished during manufacturing. The following set up procedures for bonding assume that all mechanical and electrical adjustments have been completed. Section 3.2 describes mechanical adjustments that will be necessary occasionally; for example, when a tool is changed.

1. Make initial parameter settings on the front panel. Table 2-1 on page 2-20 shows suggested initial parameter settings. Section 2.9 (page 2-18) describes the function and settings of the bond parameter controls.

2. Check the wire tail length. A tail length of approximately 0.050 inches should be established initially.

3. Adjust bonding parameters (Temperature, U/S, Force, Time) to obtain the desired bonding results.



Inertial Wire Spool Mount

Figure 3-3

3.2 Mechanical Adjustments

The procedures in this section may be necessary if failed assemblies or components are changed.

3.2.1 Clamp Force Adjustment

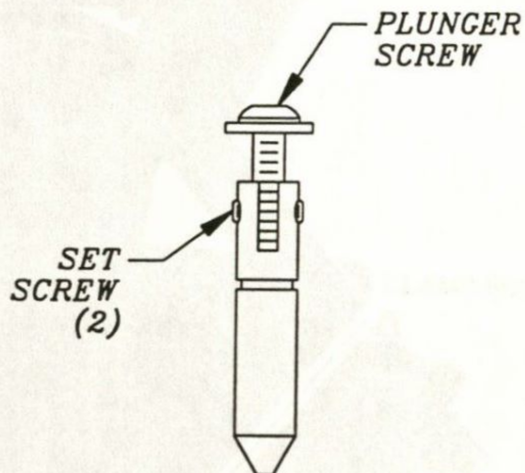
There is no convenient way to measure the clamp force. The user must therefore be alert to deformation of the wire to identify excess force. When force is inadequate, the wire clamps will not hold the wire in the tool during closed clamp conditions or will not break the wire after second bond.

Adjust clamp force by turning clamp force adjustment clockwise to decrease and counterclockwise to increase the clamp force. Figure 3-5 on Page 3-8 shows the location of the clamp force adjust.

3.2.2 Force Solenoid Plunger Adjustment (Dynamic Force Adjustment)

The position of the Force Solenoid Plunger in the Solenoid determines the amount or limits of dynamic force that is available for the various settings on the front panel. The deeper the static position of the plunger in the solenoid, the greater the amount of dynamic force available for any given setting on the front panel. The front panel potentiometer is used to set the voltage across the solenoid. The plunger position is set during manufacture for a maximum dynamic force of approximately 150 to 175 grams. The following are procedures for adjusting the plunger position (the Force Solenoid Plunger is shown in Figure 3-4 on page 3-7):

1. Loosen the two (2) set screws (No. 4-40 x 1/16") in the plunger.
2. Adjust the plunger screw counterclockwise for more force or clockwise for less force.
3. Measure force with gram gauge and/or HYBOND's Dynamic Force Measurement System until desired force is obtained.
4. Secure plunger set screws.



Force Solenoid Plunger Adjustment

Figure 3-4

3.2.3 Static Force Adjustment

Use a gram gauge to measure the static bond head force. Place the point or arm of the gram gauge at the end of the transducer. Slowly raise the gauge until the transducer lifts and a gauge reading is set. Static forc should be 15 grams.

3.2.4 Sequence Switch Adjustments

The Model 572A has two switches that initiate bonding cycle functions during the bond cycle. The two switches are referred to as the "**Go**" switch and the "**Up**" switch. Figure 3-5 shows the two sequence switches which are located on the right side of the Main Post. The inside switch is the "**Up**" switch and the outside switch is the "**Go**" switch. These switches are adjusted during manufacture and normally should **not need** adjusting unless components require replacement.

Clamp Assembly

Figure 3-5

3.2.5 "Go" Switch Adjustment

The "**Go**" switch is adjusted for manual initiation of the bonding parameters. The switch is actuated by the "Z" lever override after the tool contacts the workpiece. The switch is wired in the "normally open" configuration. The "**Go**" switch adjustment is accomplished as follows. See Figure 3-6 below.

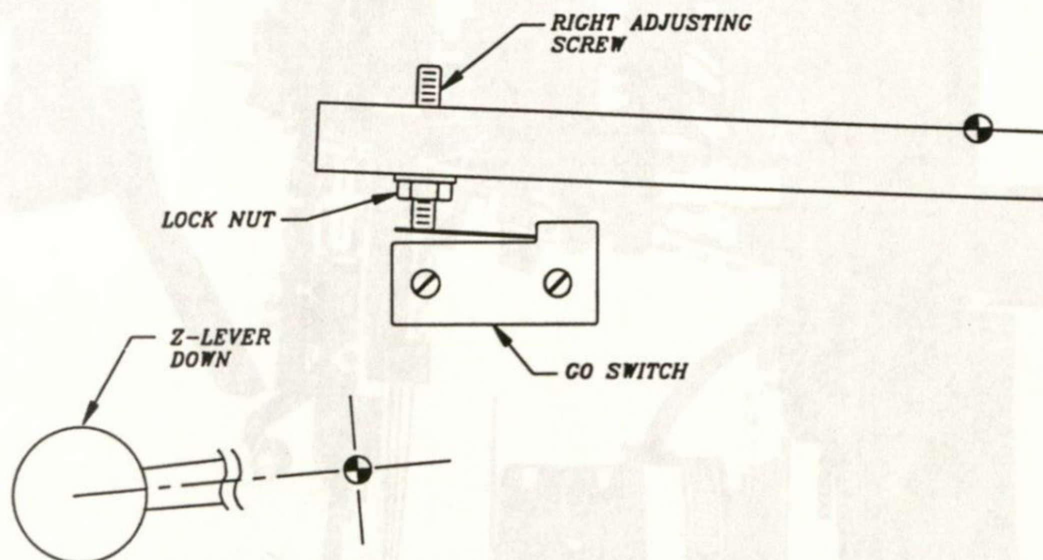
1. Turn adjustment screw counterclockwise several turns.

2. Hold "Z" lever in maximum down position.

3. Turn adjustment screw clockwise until first or second bond indicators turn on.

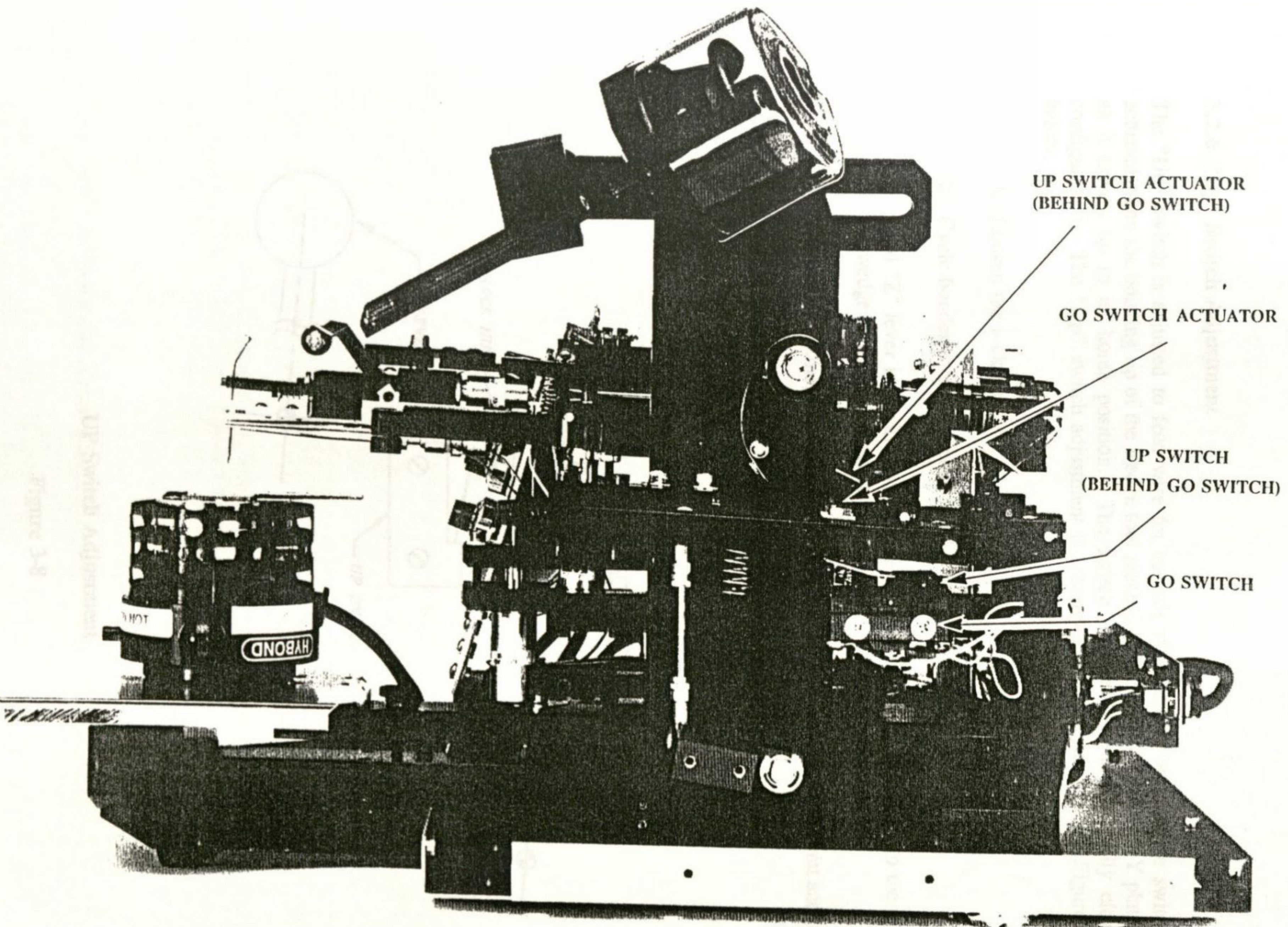
4. Turn adjustment screw counterclockwise one quarter turn and lock into place.

5. Repeat above steps as necessary. Switch should actuate after the tool contacts the workpiece, but before the "Z" lever is at the maximum down position.



GO Switch Adjustment

Figure 3-6



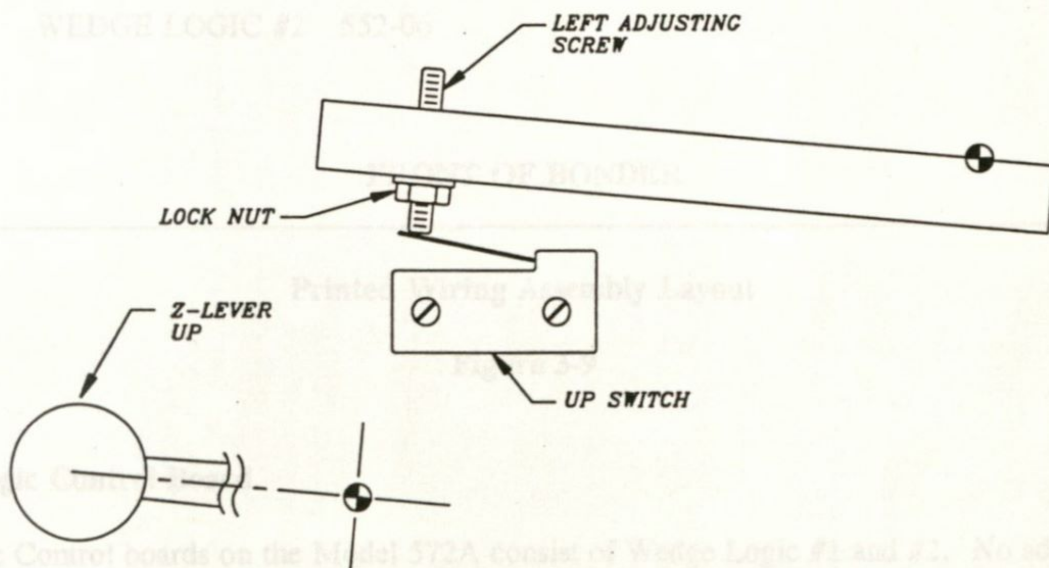
Sequence Switches

Figure 3-7

3.2.6 "Up" Switch Adjustment

The "**Up**" switch is adjusted to feed wire for the tail after second bond. The switch is actuated when the bonding tip of the wedge tool reaches 3.15 inches from the X-Y platform as it travels up to its home position. The switch is wired in the "normally closed" configuration. The "**Up**" switch adjustment is accomplished as follows. See Figure 3-9 below.

1. Loosen the lock nut.
2. Cycle bonder through second bond.
3. Hold "Z" lever in position so that the distance from the X-Y plate to the tip of the wedge tool is 3.15 inches.
4. Turn the adjustment screw until the feed motor runs, then turn lock nut and lock in place.



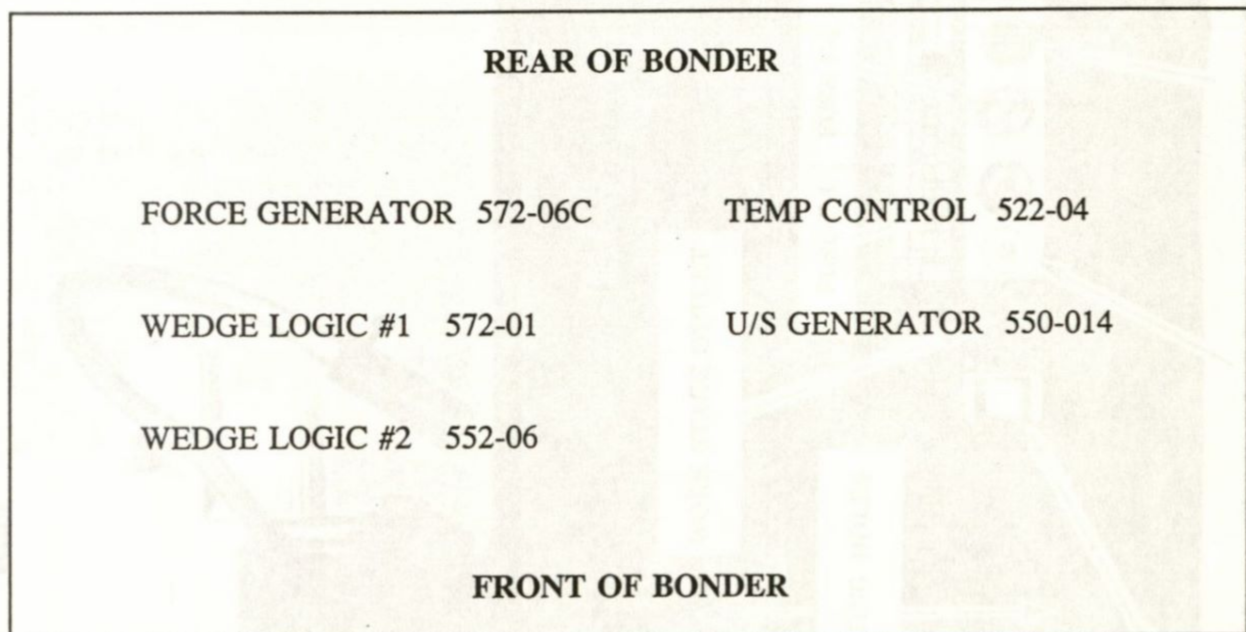
UP Switch Adjustment

Figure 3-8

3.3 Electrical/Electronic Adjustments

Figure 3-6 below illustrates the Printed Wiring Assembly (PWA) installation/mounting configuration. The Model 572A wiring diagram is included at the back of this manual. The following procedures should only be performed by a HYBOND Factory Service Representative or a Factory Trained Service Technician.

PRINTED WIRING ASSEMBLY INSTALLATION



Printed Wiring Assembly Layout

Figure 3-9

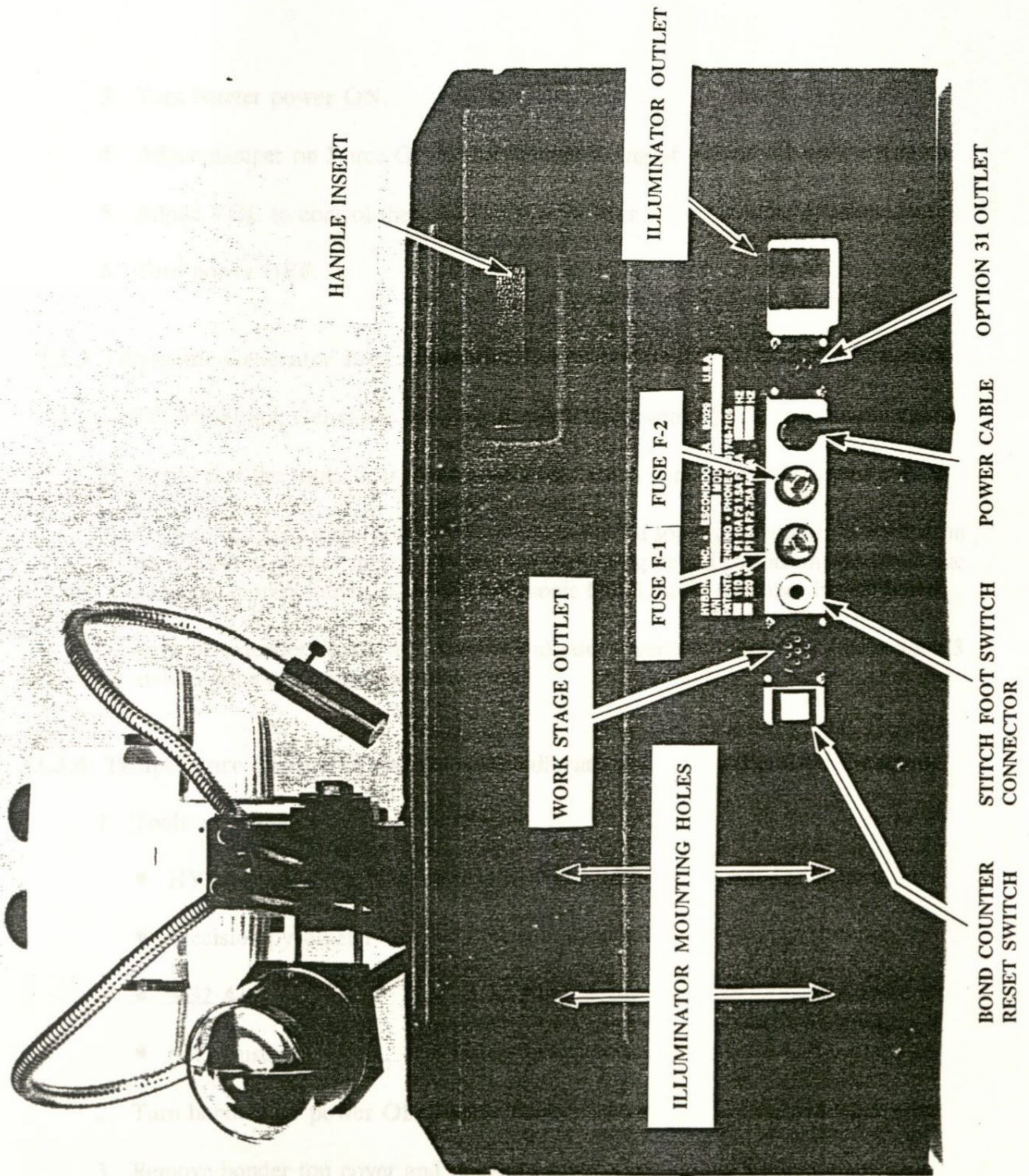
3.3.1 Logic Control Board

The Logic Control boards on the Model 572A consist of Wedge Logic #1 and #2. No adjustments on the Model 572A Logic Control boards are necessary.

3.3.2 Force Generator

1. Insert the Force Generator board (Part. No.: 522-08) into C2.

2. Put voltmeter leads on TS1 pins 2 and 4. Pin 2 is +24VDC, and pin 4 is the force solenoid (see Figure 3-10 on Page 3-13).



Bonder Back Panel

Figure 3-10

3. Turn bonder power **ON**.

4. Adjust damper on Force Generator until a reading of +2.5 volts is achieved.

5. Adjust **VOL** to control the volume of the **beeper**.

6. Turn power **OFF**.

3.3.3 Ultrasonic Generator Board

1. The Ultrasonic Generator board is located in connector C3.

2. Verify that the transducer is plugged into the U/S generator board.

3. Press to test ultrasonic power, this should result in some movement or reading on the ultrasonic power meter. If there is no reading or indication on the ultrasonic generator power meter, place the ultrasonic board on an extender board.

5. Remove extender board, and insert the ultrasonic generator board in connector C3 and plug the transducer plug in.

3.3.4 Temperature Control (Factory/Field Calibration)

1. Tools and equipment required:

   - HYBOND calibration thermocouple assembly
   - Precision pyrometer
   - 3/32 Allen wrench
   - Pot adjustment tool

2. Turn bonder AC power **OFF**.

3. Remove bonder top cover and PWA Retainer.

4. Unplug the heated work stage from the rear bulkhead and replace with the calibration thermocouple.

5. Turn bonder AC power **ON**, wait one minute before proceeding.

6. Adjust "S.C. LO" pot so that the front panel display reads "000".

7. Turn bonder AC power **OFF**.

8. Disconnect calibration thermocouple and plug in heated work stage.

9. Turn bonder AC power **ON** and adjust "Temperature Set-Point" to 150°C. Allow 3-5 minutes for the temperature to stabilize.

10. Using the precision pyrometer, measure work surface temperature and adjust S.C. Hi pot so that the front panel display has the same 150°C reading as the precision pyrometer.

11. Turn bonder AC power **OFF**, return bonder to operating configuration.

SECTION 4.0

TROUBLESHOOTING BONDING PROBLEMS

After reading the manual and setting up the bonder for bonding, it is recommended that the operator become familiar with the equipment. Install a dummy workpiece and practice with the bonder until proficiency and comfort with the bonder is achieved. During the familiarization, the operator should become familiar with the effects of the various parameters that influence the bond quality.

The following is a list of bonding problems that may be encountered by the operator. Also described are corrective measures that can be taken to correct the problems.

1. Possible Start-Up Problems

   a. First or second bond mode/fault indicator lighted.

      HYBOND bonders are equipped with an operator pace and bond fault system. If the operator lifts off the bond before the bond time is complete, the bond mode/fault indicator will light.

      This condition indicates potentially incomplete bonds. If the bond force is removed before the bond time is complete, then it is possible that the bond is not complete.

      Rough or erratic operation of the "Z" lever will also cause the mode/fault indicator to light.

   b. Determine and use minimum first and second bond times.

   c. Install a dummy workpiece and have the operator practice bonder operation until proficient, remembering a smooth "Z" lever operation is required.

   d. The bonding process is possible because of three variables: heat, force, and time. Lifting of the bond early terminates the force and will cause an inherent problem.

2. Bonds Not Sticking

   a. Contaminated workpiece.

   b. Defective, worn or dirty bonding tool.

   c. Skidding workpiece due to loose or inadequate clamping.

d. Bonding to downwards slope of substrate metalization such that the tool touches work but wire does not.

e. One or any combination of the following:

- Force too low
- Time too short
- Ultrasonics too low or high
- Temperature too high or low

f. Poor quality bond pads and metalization is lifting off chip or substrate.

g. Tool not square to workpiece.

h. Wire pull back not enough to break wire after second bond, causing the second bond to be pulled up by tool-up motion.

3. No Tail After Second Bond (Wire Stuck in Wire Hole of Bond Tool)

a. Overbonding at second bond due to one or any combination of the following:

- Force too high
- Time too long
- Ultrasonics too high
- Too much wire pull

b. Dirty bonding tool.

c. Bonding on downwards slope of substrate metalization such that only wire touches the work, applying excessive force.

d. Loose workpiece.

e. Tail length system friction adjustment incorrect.

4. Not Pulling Tail After Second Bond (Wire Still Attached to Work-piece)

a. Clamps not closing, tail length adjustment incorrect.

b. Clamps closing but wire slipping through clamps, clamp force adjustment incorrect.

c. Clamp surfaces contaminated.

d. Clamp surfaces not parallel due to damaged clamp assembly.

5. Pulling Up Second Bond, or Not Breaking Wire After Second Bond

   a. Pull set too low

   b. Force too low

   c. Time too short

   d. Ultrasonics too low

SECTION 5.0

UNPACKING AND PACKING INSTRUCTIONS

A. Unpacking Instructions

1. Remove the top layer of protective foam.
2. Review the contents of the manila envelope located on the inner side of the crate. The envelope contains a tool kit, instruction manuals, and any special instructions.
3. Carefully remove all the boxes and bubble wrapped items containing the bonder accessories from the crate.
4. Before removing the HYBOND bonder from the crate, note if an X-Y manipulator handle is present. **Do not lift the bonder by that handle**, or bump it while lifting the bonder free of the crate. Applying pressure to the handle or its' mounting shelf may damage the unit. To remove the bonder from the crate lift only by the **hand hold cutouts** located on both sides of the cardboard/foam insert that surrounds the bonder. When removing the bonder from the insert, lift only by microscope mount and handle insert located on the back of the bonder.
5. Transfer the bonder to its final work area. **Do not remove** the shipping screws, nylon tie wraps, or foam shipping blocks until the bonder is ready to go into the final work area. See section 3.0 of the manual for set-up procedures.

B. Packing Instructions

1. Remove any options (i.e., work stage, microscope, illuminator, eyepieces, etc.) and the Z-handle from the bonder.
2. Secure the work plate (if applicable) by inserting the 1 1/4" work plate locking screw through the hole provided slightly to the rear of the work plate, and into the threaded hole provided in the Y-frame member of the bonder. Tighten the screw to secure the work plate and X-Y manipulator arm.
3. Use nylon tie wraps and padding **only** to secure the bonding arm in the down position. The tie wraps should be placed over the transducer mounting arm and around the force solenoid mount to hold the transducer mounting arm down and secure with padding placed between moving parts to prevent damage.
4. Carefully move the bonder onto the cardboard/foam insert and lower into crate using the two **hand hold cutouts** provided for proper leverage.
5. Pack accessories (i.e., work stage, microscope, illuminator, eyepieces, Z-handle, etc.) in bubble wrap in separate boxes. Position these items at suitable locations around the sides of the bonder so that they are secure from movement and so the top foam cover can be installed.
6. Place the foam cover over the bonder and close to the top flaps of the box.
7. Position and bolt the wooden cover onto the crate.

HYBOND™

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Escondido, CA 92029

VENDORS FOR BONDERS

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COMPANY	TYPE	TECHNICAL CONTACT
Deweyl Tool Company 959 Transport Way Petaluma, CA 94954	Wedge Peg No Capillaries	Phone: (800) 821-8665 Fax: (707) 765-0327
Gaiser Tool Company 4544 McGrath Ventura, CA 93003	Wedge Capillaries Die Collets	Phone: (805) 644-5583 Fax: (805) 644-2013
Microminiature Tool Company P.O. Box 5030 Napa, CA 94581	Wedge	Phone: (707) 643-2146 Fax: (707) 643-7942
Pine Valley Precision 5075 Central Highway Pennsauken, NJ 08109	Wedge Die Collets	Phone: (609) 663-1855 Fax: (609) 663-8472
Small Precision Tool 1330 Clegg Street Petaluma, CA 94954	Wedge Capillaries Die Collets	Phone: (707) 765-4545 Fax: (707) 778-2271

WIRE & RIBBON

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Williams Advanced Materials (Formerly Hydrostatics) 2005 Industrial Drive Bethlehem, PA 18017	Gold Wire & Ribbon	Phone: (716) 837-1000 Fax: (716) 833-2926
California Fine Wire P.O. Box 446 Grover Beach, CA 93483		Phone: (805) 489-5144 Fax: (805) 489-5352
Sigmond Cohn 121 South Columbus Avenue Mount Vernon, NY 10553		Phone: (914) 664-5300 Fax: (914) 664-5377
American Fine Wire Corporation 907 Ravenwood Drive Selma, AL 37601	Aluminum Ribbon	Phone: (205) 875-4040 Fax: (205) 874-7119