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Model 5400E Series, Manual X-Y, Motorized Z Axis Wire Bonders

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Overview

Model 5400E brings forward the new advances of the "E" Series, notably the placement of all machine mechanism above the work plane to allow unlimited access, and the setting of axis brakes to lock on target. In this model the tool, rather than the work, is moved, both for alignment and for bonding, with the work pre-rotated. Bond heads are built around a 63 kHz ultrasonic transducer and provide full three-way convertibility.

Application

Machines of this series bond aluminum or gold wires from 0.0007 in. to 0.002 in. diameter to interconnect wire leads to semiconductor, hybrid or microwave devices. Three bond methods are available by tool head conversion; angled-feed wedge bonding, vertical-feed wedge bonding, and Negative EFO ball bonding. Both wedge bond methods require front-to-back wire progress, hence pre-rotation of the work piece. Wherever possible, angled feed wedge bonding is recommended because clamps very near the bond foot can have the best effect to work the wire into arches.

Mechanical

The bonding mechanism is constructed of three axes, straight-line and orthogonal, stacked in an array. Two axes, X and Y, are driven by micromanipulator for positioning, then held by pneumatic brakes for bonding. The Z Axis is driven by its programmed motor to create and arch the connection. Work is aligned by microscope, with the target judged by an angled view of the tool at a search elevation just above the work. Approach to search and then down to contact can be controlled by a separate manual encoder that generates clocks to drive the Z Motor directly, or can be controlled at the keypad or by a push-button on the right-hand control. These different methods can be used interchangeably in any sequence. Microscope alignment allows direct view of and placement of all bonds with minimum movements. The work piece is aligned front-to-back on a large fixed platform. Optional rotating and adjustable height platforms are available.

Ranges, Ratios and Resolutions

X-Y Positioning, by Manipulator	0.625" Total, +/- 0.3125" @ 8/1 Ratio
Z Stroke, by Motor	0.500" Total, 0.460" Up, 0.040" Down
Resolution	0.00333" per half-step, 0.000208" per micro-step
Z Encoder, Manual	0.125" Touchdown from Search @ 8/1 Ratio
Resolution	0.001" per encoder transition
Work Platform, by Thumbscrew	0.625" Total: 0.500" Up, 0.125" Down

Bond Tool Head Assemblies

The new forward-pivot wedge bond tool assemblies of this series are built around K~Sine Transducer, Model No.K~24-EW, operated at 63 KHz. It is driven by K~Sine Part No. 6795 Ultrasonic Power Supply, four Watts, dual channel, with power and time set as program values. This transducer uses a bond tool of 0.750" length dropped 0.65625" below center. Vertical clearance is a full 0.375" everywhere under these tool heads and all other mechanism except for wire presentation at 45° for angled feed. Wire Clamps are air-opened and spring-closed, and have self-contained closure pivots. A separate pivot about an axis located to serve both overhead and angled feed generates the clamp motions along their lines of feed action. To change between angled feed and overhead feed, it is necessary only to exchange the small clamp assemblies and to change the wire drag means. Alignment of clamps to the tool is facilitated by individual adjustments along three axes. Actuation of all clamp motion is by the same spiral cam

of an inboard motor and is transferred through the pivots of the four-bar linkage. Appropriate clamp motion settings for each method are configured in software and are retained in non-volatile memory. Motions toward the tool are spring-driven, while the more powerful motor drives away from the tool – to ease concerns during set-up.

The similar and interchangeable tool assembly for Negative EFO ball bonding is built around K~Sine Model K~27-EC ultrasonic transducer, one half wave in length, operating at a nominal frequency of 63 KHZ. Feed method is vertical and tool recommended is 0.750" length.

Rigid bearing mounts, rather than taper loading, fix the strut bar of these assemblies so that any required bond force can be applied. The standard set of force springs generates 15 to 150 grams, and together with the work-sensing firing switch, is built into the four-bar linkage. A dual force mechanism, operated pneumatically, acts to change between two pre-set force values, and either high or low force may be programmed for any bond. Radiant tool heat with panel mounted, constant current control is included.

Machine Configuration

The mechanism of this series was designed to mount above a customer's work handling system, to be confined entirely above the work plane, and so not to have any base or work platform. In this configuration, a model of this series is designated as "54~~EX". For use as a stand-alone complete bonding machine, the mechanism will be completed with a plain base having a bolted-on work platform, and will be designated as "54~~E".

In either the "E" or the "EX" configurations, optional control arms are included to move both the manipulator control point and the Z axis encoder control point five inches vertically from their normal positions near the machine base to new locations above the work plane. When the high control arrangement is used, the customer must provide suitable operator's forearm rests. This is essential both for the operator's safety and comfort, and to provide a stable platform from which to direct control motions with the accuracy required for wire bonding. The manual Z Encoder method of controlling tool descent is optional.

Mounting points for the "EX" version of this mechanism are provided at two foot locations at the work plane elevation 5.000 in. above table surface, approximately 22.312 in. apart, and 8.734 in. to the rear left, and 13.093 in. rear right, of the work point.

Electrical Software and Hardware

A software program controls operation of motors and other actuators, as configured by setup values, in response to operator's inputs. It is executed by West·Bond Part No 8100 CPU, containing a Motorola 68000 microprocessor and 256 KB of nonvolatile RAM. Thirty separate buffers of bond settings for a wire type can be entered and selected during bonding by keypad. Each wire type can have approximately 21 stitch bonds, each with its own settings of ultrasonic power, time, and ramping, and with high or low force

A keypad is provided for direct entry and editing of both configuration and user data and for selection of operation options. Entry and execution is prompted at the machine panel by a series of "screens" displayed on a 4-line 40-character LCD. All programmed values are displayed during bonding. At "home", various options are enabled including a patented self-threading routine for the angled feed method.

Operating Controls.

1. *Keypad.* Twelve-key pad for entry of program data, setting of Modes, and direct control of machine actions. At left hand.
2. *Z Encoder.* Generates Z-Axis motor step clocks: A home sensor parallels the G Key and the Ball Button. At left hand with both high and low control arms.
3. *X-Y Manipulator.* Moves tool head, TV camera, and motorized slides atop X-Y-Axes with 8/1 mechanical advantage. At right hand with both high and low control arms.
4. *Ball Button.* Push-button switch in the manipulator control ball. Parallels the G Key but also acts to lock only the X-Axis for scanning the bond path along the Y-Axis, front-to-back.
5. *Rotary Work Table.* Rotates about the center of tool motion range to pre-set the alignment of bonds front-to-back.

Definitions of complete stand-alone Models of this Series:

- **Model No. 5456E.** This machine with single wedge bond tool head, Assy No. 9305, with angled clamp Assy No 9048 and overhead clamp Assy No 9049, for bonding by either wedge method.
- **Model No. 545657E.** This machine with two bond tool heads, Assy No 9305 with the two clamp assemblies for wedge bonding as above, and with tool head Assy No 9220 for Negative EFO ball bonding, all convertible.

Definitions of Models of this Series without base or work platform:

- **Model No. 5456EX.** This machine, specified as Model 5456E, except without base.
- **Model No. 545657EX.** This machine, specified as Model 545657E, except without base.

Features available for "E" Models of this Series:

- **Feature No. 70.** Adjustable height workstation with a rotary platform to rotate work about the center of tool X-Y range. Assembly No. 8965. Recommended to pre-align bonds front to back. Not for “EX models.
- **Feature No. 79.** Adjustable height work platform. Assembly No. 8965. Not for “EX” models.

ESD Protection

Protection against Electrostatic Discharge is implemented by finishing exposed tool assemblies and other moving parts by Electro less Nickel plating, which is conductive; and all exposed painted parts with a powder-coated paint that is dissipative.

Accessories

The microscope recommended for this model is either the Olympus SZ51-60E with the “Luxuray” LED illuminator #10265. Neither microscope nor illuminator is included. One recommended bonding tool is included.

All work holders are priced separately, and should be ordered separately. A universal unheated work holder, capable of holding most common substrate devices between a pivoted clamp lever and adjustable backstops, is maintained in stock and is available for delivery in the same time span as the machine. Quite a large number of previously designed special work holders, both heated and unheated, are available but are not stocked, and cannot be promised for delivery with the machine. These should preferably be on an order separate from the machine order, but if not, the machine order must state that partial deliveries are allowed. Work holders for new work pieces requiring custom design and fabrication will be quoted upon receipt of drawings and samples: These must be ordered on separate purchase orders.

Services

Compressed air, regulated to 50 psig, is required. Connection is via 1/4-inch tubing.

Electrical service required is 50-60 Hz, single phase, either 115 VAC or 230 VAC; however, input must be configured at the factory for 230 VAC. A fuse and three-prong power cord connector are provided for 115 VAC: For 230 VAC, these must be changed to conform to local requirements.

Dimensions

"E" Series machine size is 24.218" wide x 22.297" deep x 11.000" high, exclusive of microscope, or 15.000" in height to scope eyepieces. Weight is 75 lb. uncrated, or 140 lb. accessorized and crated.

"EX" Series machine size is 22.312" wide x 16.500" deep x 6.000" high above work plane, exclusive of microscope, or 10.0" high from work plane to scope eyepieces. Weight is 55 lb. uncrated, or 115 lb. accessorized and crated.