

Digital Servo Wire Splicer

US-3020WS2

U.S. Patent Pending

*The World's First Servo
Ultrasonic Wire Splicer*



Dynamic Force and Amplitude Control™ with Multi-Step Welding

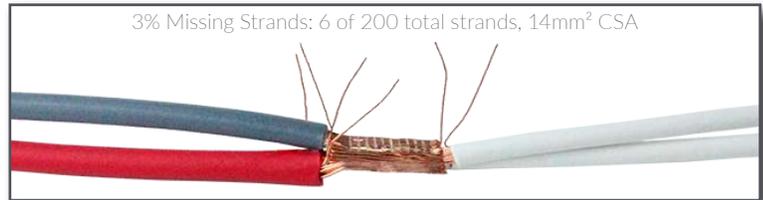
- Ability to adjust force and amplitude during the weld cycle to optimize parameters for each specific wire application
- Capability of over 20 weld steps with unique force and amplitude parameters while energy and frequency remain constant

Industry Leading Missing Strand Detection Under 3% CSA

- Can detect single missing strands from 0.13mm² wires
- Detects partially retracted wires, missing wires, and added insulation within 3% of total cross section area

Specifications

Frequency	20 kHz nominal
Ultrasonic Power Output	3.0 kW max Power Supply 220-240 VAC single phase; 20 Amp max; Nema 6-20r outlet
Pneumatic Pressure	5 bars / 72.5 psi; Air Filter built-in; requires 6mm OD Hose
Weld Force	~1,200 Newton maximum
Weldhead	23 kg / 20.3 x 50.8 x 18.5 cm 50 lb / 8 x 20 x 7.3 inches
Controller Cabinet	33 kg / 50.8 x 70 x 22.9 cm 71 lb / 20 x 24 x 9 inches
Visual Display	17 inch LCD display and mouse
Additional Options	Wire Cutter Barcode Scanner



Welding Capabilities

Cross Section Area	0.26mm ² - 42mm ²
Heavy Duty Upgrade	0.26mm ² - 60mm ²
Wire Type	Copper (Cu) Aluminum (Al) Enamel Coated Magnet

Load Cell Force Feedback

- Single micron resolution
- Consistent measurement and ultrasonic output produce high cPk values
- Measurement of pre-weld and post-weld height and width
- Cross section area measurement and calculation for additional quality control

Network Compatible

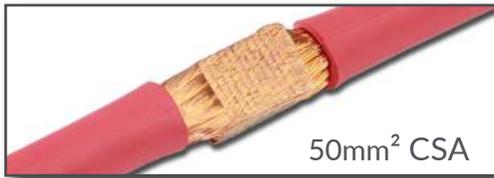
- Logs weld height, weld energy, & weld time
- Saves last 20,000 welds; export via USB or TCP/IP

TECH-SONIC

ULTRASONIC METAL WELDING

Proven Solution in the Automotive Wire Harness Industry

TECH-SONIC has been providing industry support on a Multi-National level for over two decades



Weld Program Settings

Program: (555)

Section	Welding	Taught	Tolerances	Tooling	Customer
Force [N]	Duration [mSec]	Amp [µm]			
300	100	0.0			
700	200	20.0			
800	300	23.0			
200	700	21.0			
300	100	0.0			

Weld Mode: Energy

Weld Energy: 900 J

Weld Width: 3.79 mm

H/W Ratio: 60 %

Buttons: Add, Edit, Delete, Back, Save, Teach

Multi-Step Welding: this teach screen displays the ability to utilize multi-step welding with variable force and amplitude control. The first-step is a compression stage without ultrasonic energy, followed by the changing of parameters over the next three steps, and a final compression stage to measure height.

TECH-SONIC offers comprehensive multi-national support and service!

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TECH-SONIC US-3020WS2 Digital Servo Wire Splicer Video Links

YouTube

[US-3020WS2 Servo Wire Splicer Demo](#)

[US-3020WS2 Missing Strand Detection Demo](#)

[US-3020WS2 0.39mm² Missing Strand Detection](#)

[US-3020WS2 50mm² Splice Capability](#)

Vzaar (International Safe Link)

[US-3020WS2 Servo Wire Splicer Demo](#)

[US-3020WS2 Missing Strand Detection Demo](#)

[US-3020WS2 0.39mm² Missing Strand Detection](#)

[US-3020WS2 50mm² Splice Capability](#)

TECH-SONIC Introduces World's First Digital Servo Ultrasonic Wire Splicer

The new line of TECH-SONIC digital servo ultrasonic metal welders combines the precision of servo control with the proven strength of ultrasonic welding to produce the most significant advance in ultrasonic welding technology in the last 20 years. Ultrasonic metal welding technology uses a welding horn to direct high frequency ultrasonic vibratory energy to the material surfaces between the metals being welded. The vibratory energy disperses the contamination and oxidation from the work pieces, creating a strong metallurgical bond. No materials are melted, no flux or fillers are introduced, and no substrate degradation occurs, making the welding process not only very strong, but also energy efficient and environmentally friendly.

TECH-SONIC's patent-pending digital servo ultrasonic wire splicer, model US-3020WS2, one in a new line of TECH-SONIC digital servo metal welders, goes far beyond conventional pneumatic ultrasonic wire splicers to combine an ultrasonic power generator and embedded high-speed digital microprocessor control with a servo-controlled weld head utilizing force feedback sensors for precise control. This unique combination provides a stress-free weld joint with CPK values which were previously impossible using conventional, pneumatic wire splicers. Its unique capabilities are also revolutionizing the wire splicing industry with its small wire splicing capability and industry leading missing strand detection.

Using ultra-high-speed digital control based on load cell and motion sensors, the US-3020WS2 provides Dynamic Force and Amplitude Control™ with multi-step welding through real-time force monitoring during welding to adjust both the ultrasonic amplitude and the applied force. This produces optimum welding conditions by adjusting both power and force so it can weld wires of many different sizes to provide better quality welds while improving yields, all without the need to change tooling.

Employing force feedback via precise servo control, the US-3020WS2 can also detect missing strands more accurately and consistently than a pneumatic wire splicer, below 3% of the total cross section (Figure 2). A typical pneumatic wire splicer can only detect missing strands if they are greater than 5% of the total cross section of wires. Many automobile manufacturers require the wire harness producers to detect less than 3% of missing strands, and have determined that the limitations of the pneumatic process prevent them from providing consistently acceptable part quality.

The US-3020WS2 also provides precise, reliable, and repeatable splicing for many wires ranging from combinations 0.26mm² to 38mm² without need for tooling change. Conventional pneumatic wire splicers require the application of higher pressure and ultrasonic power (typically exceeding 3 kW) to overcome energy losses and expand their splicing capabilities beyond this approximate range. They also cause additional stress on the tooling by using excessive force, diminishing the life of the horn and anvils, and often resulting in wire breakage due to excess stress on strands. However, by utilizing servo welders with Dynamic Force and Amplitude Control™, TECH-SONIC has simply expanded the size of tooling to accommodate wire combinations up to 60mm² without having to increase power or force. The application of ideal welding parameters preserves the integrity of the wires and prevents over welding. In many cases, the US-3020WS2 tooling can last over one million cycles due to the precise application of pressure and energy.

The US-3020WS2 also provides ample storage for user-defined wire splicing combinations, each having its own set of weld parameters, available by screen selection or barcode scanner input. It is based on the reliable Windows CE operating system and includes a TCP/IP interface for transfer of production information to a host system, where it can be saved and analyzed.

Advantages of Digital Servo-Controlled Ultrasonic Metal Welders to Traditional Pneumatic Ultrasonic Welders

Overview

Ultrasonic metal welding is one of many processes used for bonding metals including resistance welding, soldering, and laser welding. Although ultrasonic metal welding can be utilized to join many different materials, it is best suited for the welding of nonferrous metals. Ultrasonic metal welding technology is prominent in key manufacturing sectors such as electric vehicles, lithium batteries, automotive wire harness, solar cells, power electronics, and many others. Weld applications in these industries could benefit considerably from innovative servo-controlled ultrasonic welding technology, which offers much greater precision during welding than the pneumatic driven systems.

TECH-SONIC's innovative servo controlled ultrasonic metal welder, patent pending, is the first and only one of its kind on the market today. TECH-SONIC has pioneered the development of servo controlled ultrasonic metal welders to meet market expectations for critical applications that require extreme precision and quality control. TECH-SONIC's servo-controlled ultrasonic metal welders provide more consistent and repeatable welding than current pneumatic welding systems and boast the ability to set extremely tight quality windows for monitoring important weld parameters such as energy, time, weld height, weld width, and weld force. TECH-SONIC has engineered novel ultrasonic, servo, and load cell feedback processes that provide ultimate digital control throughout the welding process.

Additionally, TECH-SONIC's servo welders include user friendly ergonomic features, advanced graphical user interface, more accurate process control capabilities, and advanced quality control monitoring capabilities compared with pneumatic welders. Due to the enhanced features, servo driven precision control, and innovative feedback processes, TECH-SONIC's new servo ultrasonic metal welders are well positioned to satisfy the growing demand for smarter ultrasonic metal welding technologies.

Ultrasonic Metal Welding Design and Process

Ultrasonic welding has been widely used in joining plastics for many years and is therefore a well characterized process. Conversely, ultrasonic metal welding has not been as widely adopted and hence, is not as largely understood in the industry. With the growing need for welding nonferrous metals such as copper, aluminum, nickel, and others, ultrasonic metal welding has been recognized for its unique capability by the industry.

Ultrasonic metal welders are compact, easy to incorporate into automation, and economical. They produce high quality welds with short cycle times. Ultrasonic metal welder's hardware consists of an ultrasonic generator, a transducer, a booster, and a welding horn. The process of ultrasonic metal welding depends on controlling the transfer of ultrasonic energy into the weld and two welding parameters that must be controlled to achieve a good result: power (amplitude) and force (pressure).

The power is precisely controlled by the generator and determines the horn's vibration amplitude. The force applied to the weld determines how well the power is transferred into the weld. The generator converts standard line power into a high-frequency, high-voltage sine wave, which is sent to the transducer. The transducer converts the electrical energy into a high frequency compression wave, which is then modified by the booster and passed through the horn into the part(s) to be welded.

The horn has a knurled or waved surface to grip the parts to be welded. In combination with the horn, there is a stationary anvil. The material to be welded is positioned between the horn and anvil while the force presses the horn into the materials. The ultrasonic motion of the horn and the friction coefficient of the material causes a

scrubbing action between the various members to be welded. This friction softens the materials under contact. There is a metallurgical diffusion between the parts being welded and a bond is formed. There is no melting of the materials. The welding occurs in a solid state which allows welding of different nonferrous metals.

Advancement of Servo Technology

In the early 1980s, ultrasonic plastic welding showed a significant effect on the weld strength when optimum welding forces were applied. Research has suggested that dynamic force can produce greater weld strength when properly applied for both plastic and metal welding purposes. Force profiling, or adjusting the weld pressure during the weld cycle, has been shown to maximize weld strength while simultaneously decreasing weld cycle time. The development and implementation of servo-controlled ultrasonic metal welding technology is an important step in precisely controlling all welding parameters and providing superior digital process control, the greatest advantage of servo-controlled ultrasonic metal welders.

Force (pressure) in pneumatic ultrasonic metal welders cannot be controlled with the precision and speed achieved by servo force control, which causes excessive deviation in terms of welding quality. With servo-controlled ultrasonic metal welders, the force (pressure) is measured, monitored, and controlled by using a combination of servo motor and load cell feedback. Multi-step welding, where force is applied before the weld energy is introduced in a compression stage, before automatically moving into the welding stage makes it capable of Dynamic Force Control™. Ultrasonic amplitude (power) can also be varied during the weld process, providing additional energy according to the parameters. Servo control also provides for rapid part placement and withdrawal, resulting in shorter cycle times than conventional pneumatic ultrasonic metal welding can achieve.

Advantages of Servo Technology

While the greatest advantage of servo-controlled ultrasonic metal welding is Dynamic Force Control™ and the ability to precisely control all welding parameters throughout the weld process with multi-step welding, there are several other advantages which cannot be achieved using traditional pneumatic ultrasonic welders.

One such advantage is the increased life cycle of the replaceable tooling parts. Whereas pneumatic ultrasonic welders will often introduce more force and power than needed, thus overworking the tooling, servo-controlled ultrasonic welders only introduce as much force and power that is needed for each weld. This leads to much longer tooling life cycles as the horn and anvil are not transferring more energy than needed. They also boast the ability to weld wider ranges of material sizes, which is crucial in eliminating downtime in a production setting and allows the user to quickly change back and forth between wire sizes.

Being 100% digital, servo-controlled ultrasonic welders also simplify the calibration process by removing pneumatic components. Validating the ultrasonic metal welding process becomes easier and more reliable than ever through the automatic process which requires no manual adjustment. The removal of pneumatic components also saves money that would normally be spent on compressed air.

Additionally, servo-controlled ultrasonic metal welders have a feature with the capability to change the way several industries set their production standards: missing strand and missing leaf detection.

Missing Strand/Foil Detection

TECH-SONIC's servo-controlled ultrasonic metal welders have one micron resolution of linear encoder built into the servo. Due to height measurement compensated by the force measurement, the precise servo control using force feedback provides an improved capability to detect missing wire strands and copper foils. The new US-3020WS2 ultrasonic wire splicer and US-3020SRT ring termination machine can detect single missing wire strands, even on wires with cross sections as small as 0.13mm², and below three percent (3%) of the total weld cross section.

Conversely, pneumatic ultrasonic wire splicers and ring termination machines can only detect missing strands if they are greater than five percent (5%) of the total cross section.

Currently, many automobile manufacturers require wire harness producers to detect missing strands within three percent (3%) of the total cross section. The importance of this lies in the fact that during the stripping of wire insulation, strands will sometimes be cut unintentionally by the stripping machines without the user's awareness. Fewer strands in the wire lowers the conductivity of the wire, which at a certain point can become problematic for automobile manufacturers. The ability to detect below three percent (3%) of the total cross section of wires will give automobile manufacturers increased confidence in their electrical wiring and their overall production process.

Additionally, the new US-3020S servo-controlled spot welder, using the same force feedback, has the capability to detect single missing copper or aluminum foils which are base materials as anode and cathode in lithium battery designs. With individual thicknesses of ten microns, the US-3020S has been tested to detect one missing or one additional foil in a stack of sixty (60). Typical pneumatic welders do not have this missing foil technology, so the introduction of the servo technology can improve confidence in the production process for battery manufacturers.

TECH-SONIC servo-controlled ultrasonic metal welders are programmable to hold thousands of weld recipes. The user can set their desired parameters and if the servo force feedback detects materials outside those parameters in the compression stage of multi-step welding, it will signal the error to the user and stop the operation before the welding process occurs.

Conclusion

With the integration of servo technology in the ultrasonic metal welding process, TECH-SONIC has proven the ability to achieve significant improvements in many key areas of wire splicing, ring termination and spot welding. Dynamic Force Control™ and multi-step welding not only allow for the digital monitoring and adjustment of all weld parameters during the weld process, but also boast the industry's best three percent (3%) missing strand, wire, and foil detection. Servo technology allows for the welding of a wider range of material sizes than are currently possible with pneumatic ultrasonic welders and helps to reduce costs and production downtime. These factors will help to provide reliable solutions across many industries that surpass the standards currently being met by the previous generation of ultrasonic metal welders.

TECH-SONIC, Inc. is headquartered in Columbus, Ohio, USA with subsidiaries in China, and sales and service offices in Mexico, Germany, India, Thailand and the Philippines. It has been designing and manufacturing high-tech ultrasonic metal welders since 1996. In recent years, the company has devoted its research and development to servo controlled ultrasonic metal welding – the “Holy Grail” of ultrasonic metal welding. As a pioneer in servo ultrasonic metal welding technology, it integrates the latest electronics, hardware, location and force sensors, and control software in new and unique ways.

TECH-SONIC has been serving global companies in electrical, automotive, EV, battery, wire harness, appliance, HVAC, solar, and military industries throughout the world, and its engineers have many years of experience in custom welding systems. The company specializes in designing its automated systems for the customers who seek high productivity, precision welding, and improved yields. To demonstrate that TECH-SONIC equipment can meet your welding needs and assembly specifications, the company provides free welding sample testing. For more information and to apply for free sample testing, please visit our website www.tech-sonic.us. For immediate assistance, call Frank Myers in marketing and sales at +1-614-792-3117 or email frank.m@techsonicultrasonic.com.