ISONIC 3510

Smart Phased Array Ultrasonic Flaw Detector and Recorder with 2 Additional Channels for Conventional UT / TOFD

Designed and built under the drive for improved detection, productivity, and reducing of inspection cost **ISONIC 3510** resolves the well-known nowadays challenges faced by NDT and QA management such as increasing of nomenclature and complexity of inspections combined with more demanding codes, standards, and norms along with significant loss of domain expertise

ISONIC 3510 instrument carries the application based smart platform for the regular and advanced ultrasonic testing delivering

- 5 inspection modalities – PA, TOFD, CHIME, SRUT GW, conventional UT and a combination of them
- outstanding ultrasonic performance and probability of detection
- simplicity and intuitiveness of operation and data interpretation
- rapidness in the creation of the new inspection solutions and procedures
- easily expandable on-board solutions base
- reduced training time and cost
- comprehensiveness of automatically created inspection reports

The optimal suitability of **ISONIC 3510** for resolving of the huge variety of inspection tasks for all industries and processes involving ultrasonic NDT are strongly backed by the above listed features and technical particulars and specs below

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- Flaw Detection and Thickness / Corrosion Mapping
- True-To-Geometry Volume Overlay and 3D Coverage and Imaging for:
  - Butt Welds (Planar and Circumferential) with
    - Symmetrical or Asymmetrical Bevel or Unbeveled
    - Equivalent or Different Thickness of Jointed Parts
  - Longitudinal Welds
  - Fillet, Tee-, and TKY- Welds - Flat and Curved Parts
  - Corner and Nozzle Welds
  - Lap Joints
  - Elbow and Transit Welds
  - Simple and Complex Geometry Solid and Hollow Shafts and Axles
  - Drill Rods, Bridge Hanger Pins, Bolts
  - Turbine Blades
  - Flat and Curved Carbon Fiber, Glass Fiber, Honeycombs Parts Including Corners and Radius Areas
  - etc
- TOFD
- CHIME and SRUT GW - Short Range Guided Wave
- Operating 1 or 2 PA Probes Simultaneously: No External Splitter Required
- Fully Parallel Architecture 32:32 expandable to 64:64 / 128:128
- Freely Adjustable Emitting and Receiving Aperture
- EquPAS – the Equalized Phased Array Ultrasonic Testing (PAUT) Sensitivity
- FMC/TFM
- VAUT - Video Aided UT
- GPS and RFID data embedding
- Intuitive User Interface
- UT over IP: Remote Control, Observation of the Indications, Data Acquisition through LAN, Internet, Intranet, etc
- and much more...

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Phased Array (PA) Modality:

- Fully parallel 32:32 PA electronics expandable to 64:64 / 128:128 functionality
- 2 PA probe terminals: 1 X 32:32 / 2 X 16:16 - switchable: *there is no external splitter required for operating 2 PA probes simultaneously*
- Ability of work with PA probes carrying up to 64 and 128 elements
- Independently adjustable emitting and receiving aperture with parallel firing, A/D conversion, and on-the-fly real time digital phasing
- Phased array pulser receiver with image guided ray tracing / scan plan designer for the numerous types of simple and complex geometry welds, shafts, bolts, spindles, composite profiles, and the like
- 8192 independently adjustable focal laws
- Bi-polar square wave initial pulse: up to 300 Vpp / 100 dB analogue gain / 0.2...25 MHz bandpass / 16 bit 100 MHz ADC / 32 taps smoothly tunable digital filter
- Regular and volume overlay B-Scan / Sector Scan (S-Scan) / Horizontal Plane S-Scan (CB-Scan) coverage accompanied with all-codes-compliant A-Scan based evaluation
- Multigroup coverage composed of several cross-sectional B- and S-Scans
- Strip Chart
- Single group and multigroup Top (C-Scan), Side, End View imaging formed through encoded / time-based line scanning, 3D-Viewer
- Single side / both sides weld coverage with use of one PA probe / pair of PA probes
- TOFD Map out of a pair of PA probes
- Top (C-Scan), Side, End View imaging formed through encoded XY- scanning, 3D-Viewer
- Built-in automatic coupling monitor and lamination checker for wedged probes
- Equalized cross sectional coverage sensitivity: TCG-independent gain per focal law adjustment providing pure angle gain compensation for S-Scan, etc
- DAC, TCG
- Dynamic Focusing
- FMC, TFM, Back Diffraction Technique with / without and Mode Conversion
- Processing of diffracted and mode converted signals for defects sizing and pattern recognition
- Linear Array (LA), Ring Array (RA), Matrix Array (MA), Dual Matrix Array (DMA), Dual Linear Array (DLA), and other PA probes
- FFT signal analysis
- 100% raw data capturing
- Automatic alarming defects / generating of editable defects list upon scanning completed
- Advanced defects sizing and pattern recognition utilities

Conventional UT and TOFD:

- 2 channels
- Single / dual modes of pulsing/receiving for every channel
- Bi-polar square wave initial pulse: up to 300 Vpp / 100 dB analogue gain / 0.2...25 MHz bandpass / 16 bit 100 MHz ADC / 32 taps smoothly tunable digital filter
- Regular A-Scan
- Thickness B-Scan
- True-to-Geometry flaw detection B-Scan – straight / angle beam probes
- CB-Scan
- TOFD
- Strip Chart and Stripped C-Scan
- Parallel or sequential pulsing/receiving and A/D conversion
- DAC, DGS, TCG
- FFT signal analysis
- 100% raw data capturing

ISONIC 3510

General:

- *Dual Core 1.6 GHz clock 2 GB RAM 120 GB SSD W'7PRO on-board control computer*
- *Intuitive User Interface*
- *Single and multi-axis encoder connection*
- *Comprehensive postprocessing and data reporting toolkit*
- *Remote control and data capturing with use of a regular PC with no need in special software*
- *No intake air / no cooling IP 65 light rugged case*
- *Sealed all-functional keyboard and mouse*
- *8.5" bright touch screen*
- *Ethernet, USB, sVGA terminals*

ISONIC 3510 uniquely combines PA, single- and multi-channel conventional UT, and TOFD modalities providing 100% raw data recording and imaging. Along with the intuitive user interface, portability, lightweight, and battery operation this makes it suitable for all kinds of every-day ultrasonic inspections

The PA modality is carried by the **fully parallel non-multiplexed 32:32 electronics** with independently adjustable emitting and receiving aperture, each may consist of 1...32 elements when operating one PA probe or 1...16 elements per probe in case of operating two PA probes simultaneously: *there is no external splitter required for the simultaneous use of 2 PA probes*. The 64- and 128-elements PA probes may be used with the **ISONIC 3510** as well upon they are connected to the corresponding instrument's terminals through the various miniature extenders expanding the functionality to the *fully parallel 1 X 64:64, 2 X 32:32, 1 X 128:128, and 2 X 64:64 modes with no multiplexing involved (depending on the type and quantity of the extenders)*. The groups of phased array probe elements composing the emitting and receiving aperture may be fully or partially matching or totally separated allowing flexible managing of the incidence angles, focal distances, types of radiated and received waves including directly reflected and diffracted signals either mode converted or not

Each channel is equipped with the own pulser-receiver and A/D converter. Parallel firing, A/D conversion, and "on-the-fly" digital phasing are performed for every possible composition and size of the emitting and receiving aperture so the implementing of each focal law is completed within a single pulsing/receiving cycle providing the **maximal possible speed of material coverage**

ISONIC 3510 allows using of the various types PA probes: Linear Array (LA), Ring Array (RA), Matrix Array (MA), Dual Matrix Array (DMA), Dual Linear Array (DLA), etc

In addition to the PA electronics **ISONIC 3510** carries 2 independent conventional channels for implementing of the regular UT and TOFD inspection; each channel is capable for both single and dual modes of use

The **top level ultrasonic performance** is achieved through firing PA, TOFD, and conventional probes with the bipolar square wave initial pulse with wide-range-tunable duration and amplitude (up to 300 Vpp). The high stability of the initial pulse amplitude within entire duration of the positive and negative half-waves, the extremely short boosted rising and falling edges and the automatic adaptive damping improve the signal to noise ratio and resolution allowing controlling of the analogue gain over the 0…100 dB range for each modality

ISONIC 3510 is a very powerful platform for the huge number of the practical PA UT applications available for the activation at any moment. Thanks to the unique ***True-To-Geometry Volume Overlap Coverage and Real Time Imaging*** the **ISONIC 3510** is suitable for the high performance inspection of the simple and complex geometry welds (butt, longitudinal, fillet, lap, corner, elbow, etc) with scanning from one or both sides simultaneously (if applicable), bolts, bridge hanger pins, wind turbine and other shafts, annular rings, flanges, rails and railway axles and wheels, CRFP and GRFP composite panels and profiled stuff, and the like. The precise and easy reproducible automatic ***Equalizing of the Sensitivity within Entire Cross-Section / Volume of the Material*** is provided by the unique TCG-independent angle gain / gain per focal law compensation solution along with the DAC / TCG image normalization

Thanks to the above noted ***True-To-Geometry Volume Overlap Coverage and Imaging*** and ***Equalizing of the Sensitivity within Entire Cross-Section / Volume of the Material*** the inspection results produced by the **ISONIC 3510** are ***easy interpretable and well acceptable by the UT Pros and non-Pros as well***

ISONIC 3510 is packed into the IP 65 reinforced plastic case with no intake air or any other cooling means. The large 800X600 8.5" bright screen provides fine resolution and visibility for all types of inspection data presentation at strong ambient light along with the optimized power consumption rate for the outdoor operation

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ISONIC 3510 is fully compliant with the following codes

- *ASME Code Case 2541 – Use of Manual Phased Array Ultrasonic Examination Section V*
- *ASME Code Case 2557 – Use of Manual Phased Array S-Scan Ultrasonic Examination Section V per Article 4 Section V*
- *ASME Code Case 2558 – Use of Manual Phased Array E-Scan Ultrasonic Examination Section V per Article 4 Section V*
- *ASTM 1961– 06 – Standard Practice for Mechanized Ultrasonic Testing of Girth Welds Using Zonal Discrimination with Focused Search Units*
- *ASME Section I – Rules for Construction of Power Boilers*
- *ASME Section VIII, Division 1 – Rules for Construction of Pressure Vessels*
- *ASME Section VIII, Division 2 – Rules for Construction of Pressure Vessels. Alternative Rules*
- *ASME Section VIII Article KE-3 – Examination of Welds and Acceptance Criteria*
- *ASME Code Case 2235 – Use of Ultrasonic Examination in Lieu of Radiography*
- *Non-destructive testing of welds – Ultrasonic testing – Use of automated phased array technology. - International Standard EN ISO 13588:2012*
- *Non-Destructive Examination of Welded Joints – Ultrasonic Examination of Welded Joints. – British and European Standard BS EN 1714:1998*
- *Non-Destructive Examination of Welds – Ultrasonic Examination – Characterization of Indications in Welds. – British and European Standard BS EN 1713:1998*
- *Calibration and Setting-Up of the Ultrasonic Time of Flight Diffraction (TOFD) Technique for the Detection, Location and Sizing of Flaws. – British Standard BS 7706:1993*
- *WI 00121377, Welding – Use Of Time-Of-Flight Diffraction Technique (TOFD) For Testing Of Welds. – European Committee for Standardization – Document # CEN/TC 121/SC 5/WG 2 N 146, issued Feb, 12, 2003*
- *ASTM E 2373 – 04 – Standard Practice for Use of the Ultrasonic Time of Flight Diffraction (TOFD) Technique*
- *Non-Destructive Testing – Ultrasonic Examination – Part 5: Characterization and Sizing of Discontinuities. – British and European Standard BS EN 583-5:2001*
- *Non-Destructive Testing – Ultrasonic Examination – Part 2: Sensitivity and Range Setting. – British and European Standard BS EN 583-2:2001*
- *Manufacture and Testing of Pressure Vessels. Non-Destructive Testing of Welded Joints. Minimum Requirement for Non-Destructive Testing Methods – Appendix 1 to AD-Merkblatt HP5/3 (Germany).– Edition July 1989*

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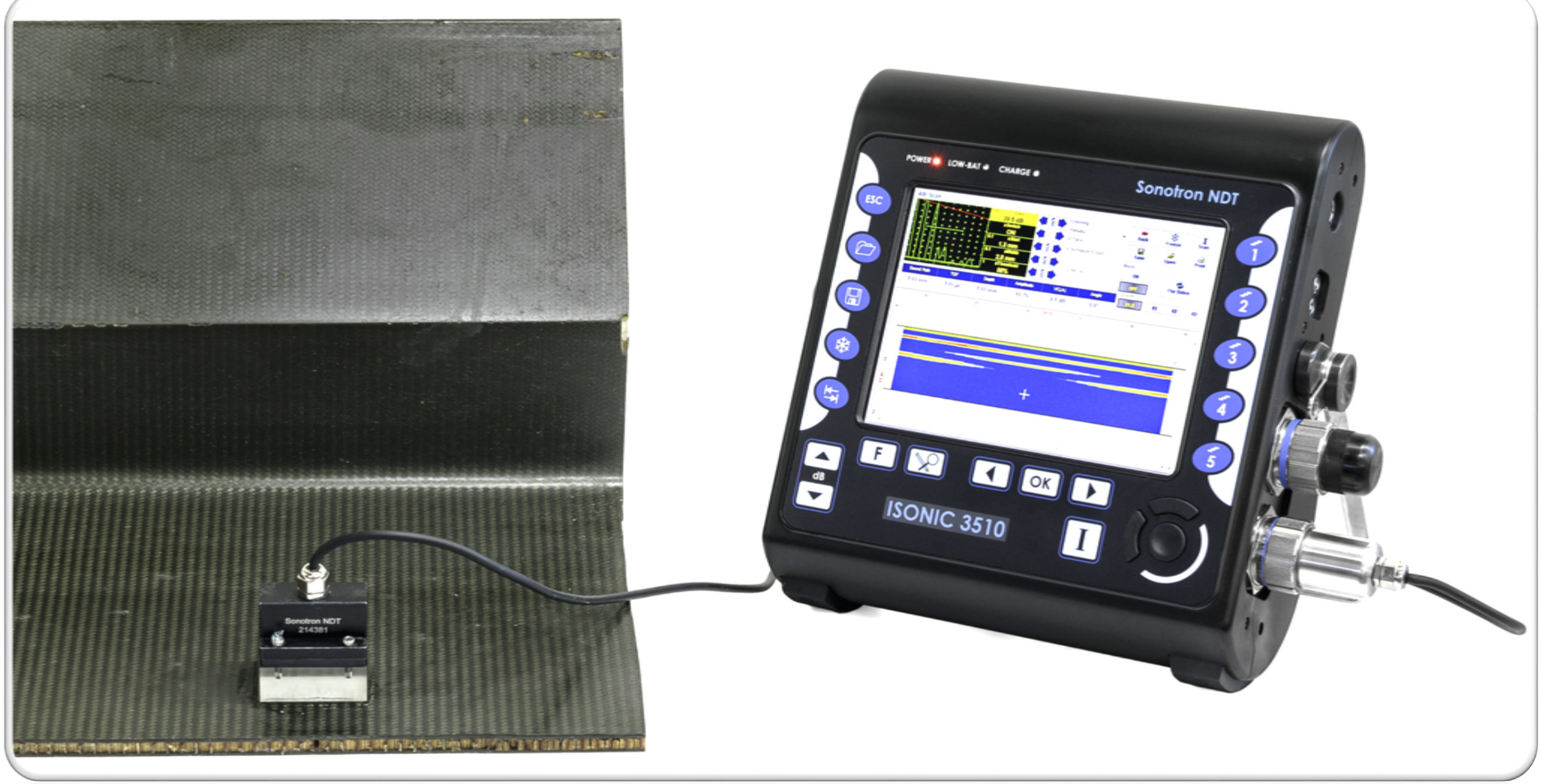

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AGI – Power, Oil, Gas, Transportation, etc

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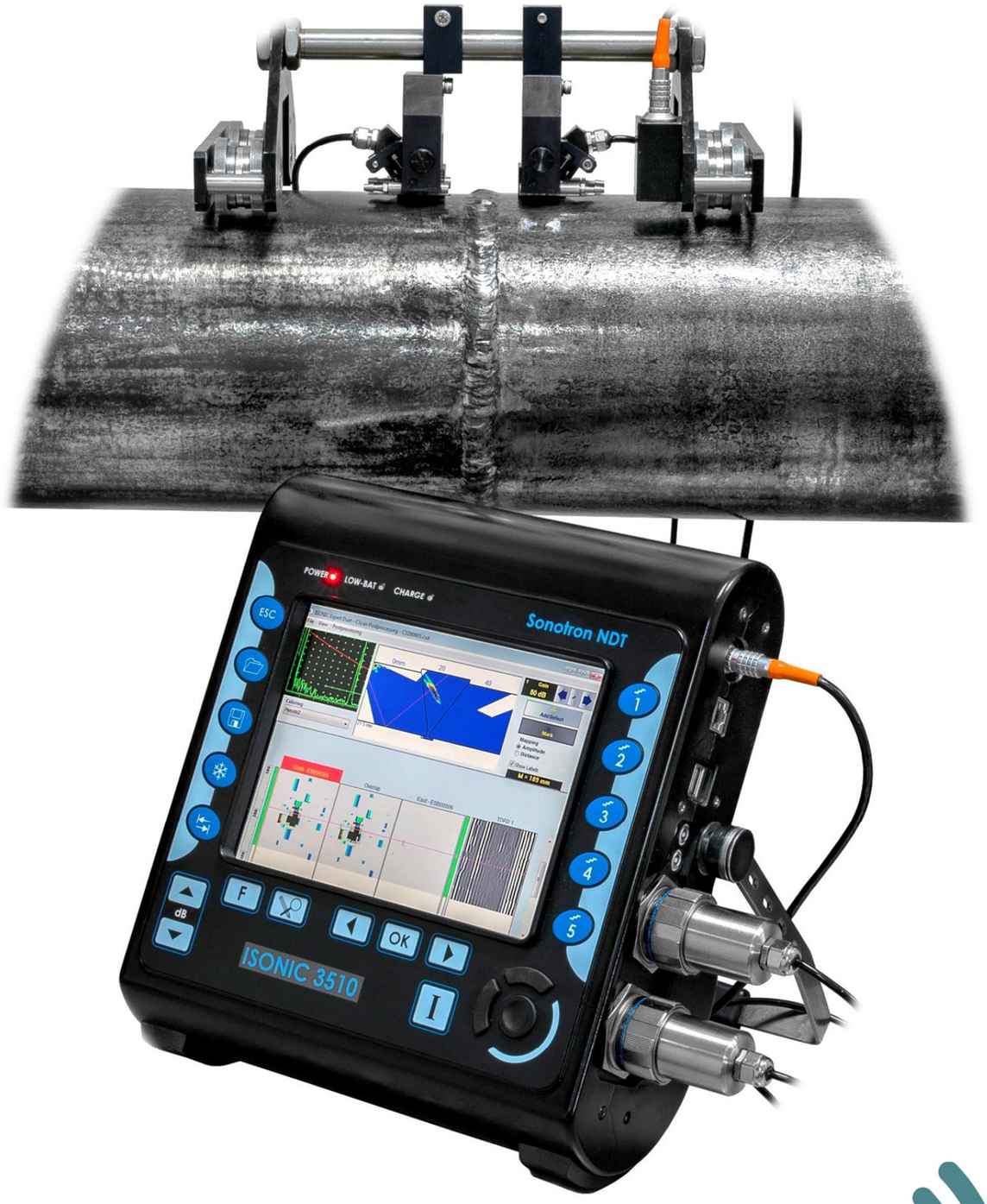

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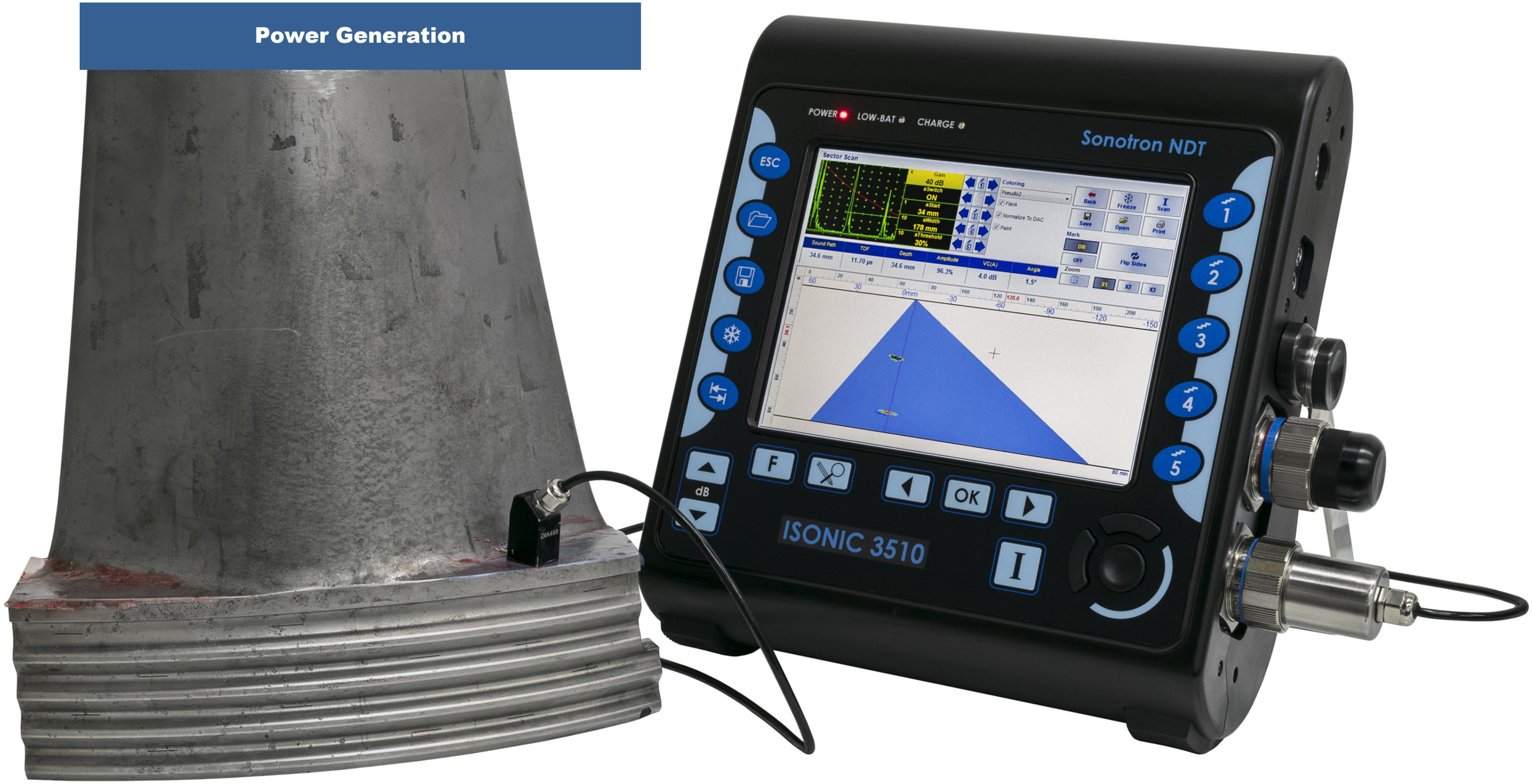
Power Generation



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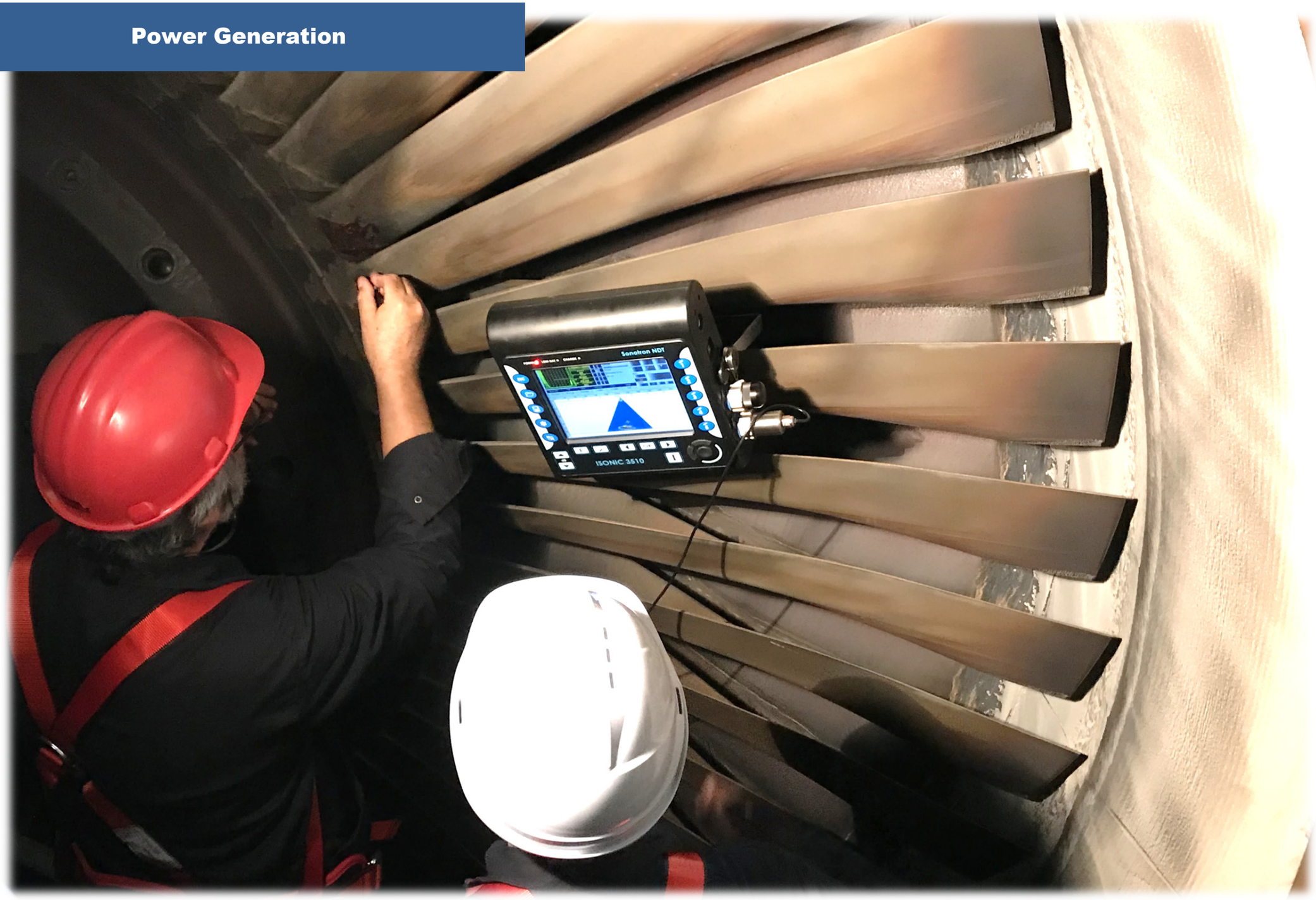
Power Generation



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Multi-use: CRA / Duplex / Super Duplex Welds

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Multi-use: CRA / Duplex / Super Duplex Welds

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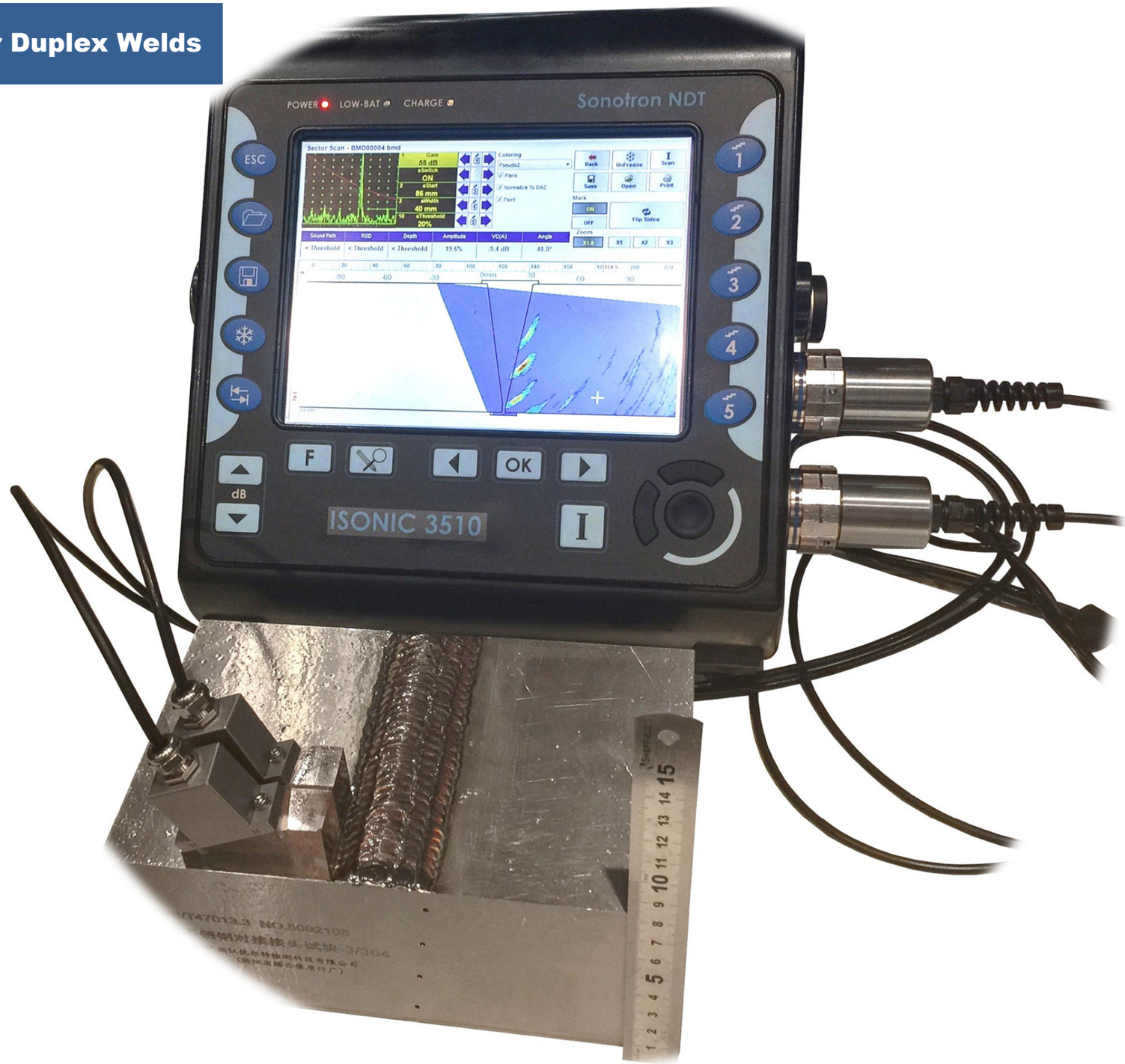

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Multi-use: CRA / Duplex / Super Duplex Welds

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Trucks, buggers, cranes etc

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Trucks, buggers, cranes etc

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Bridges

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Railways

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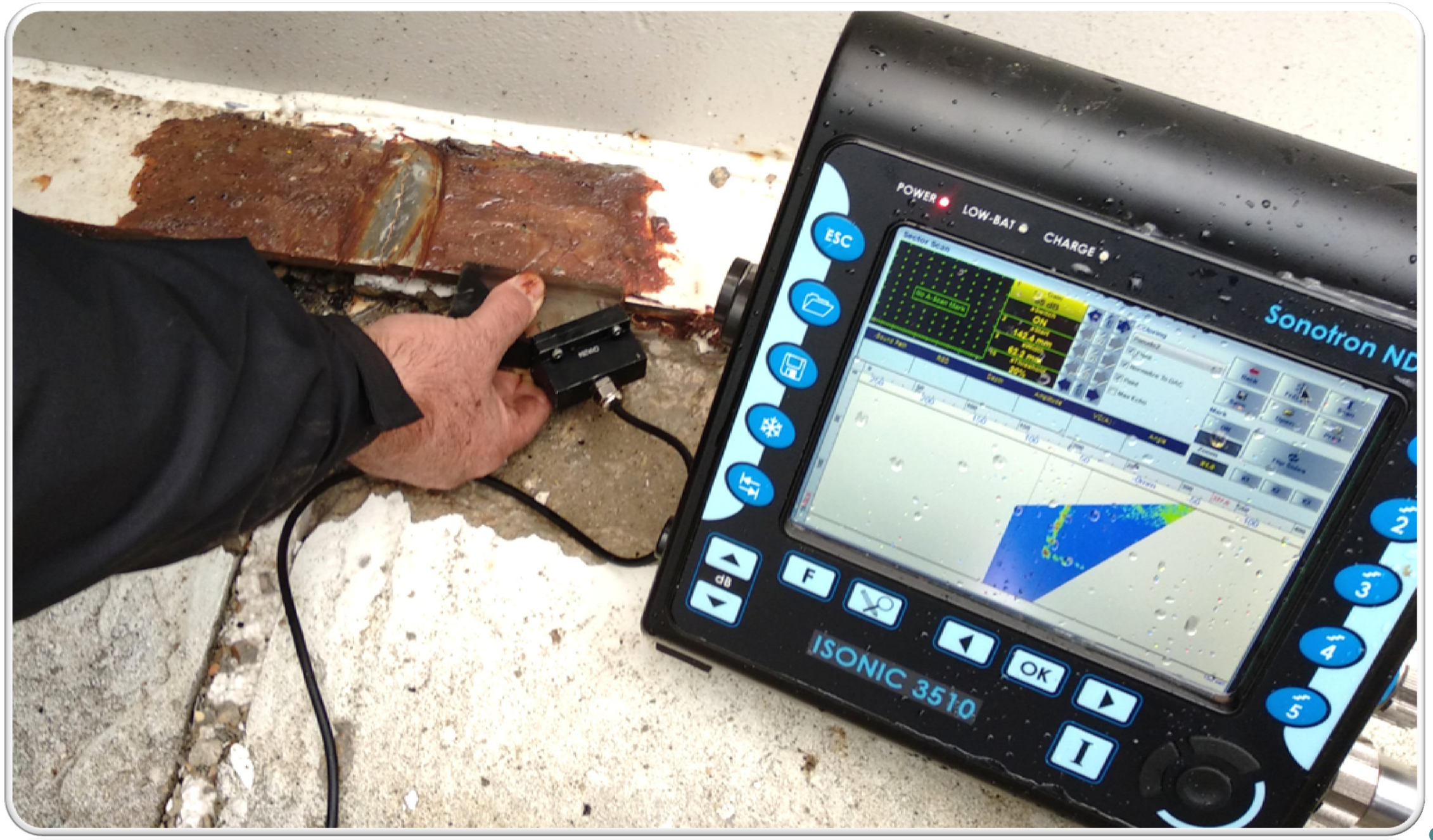
Preventive Maintenance: Annular Rings



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Preventive Maintenance: Annular Rings

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Preventive Maintenance: Annular Rings

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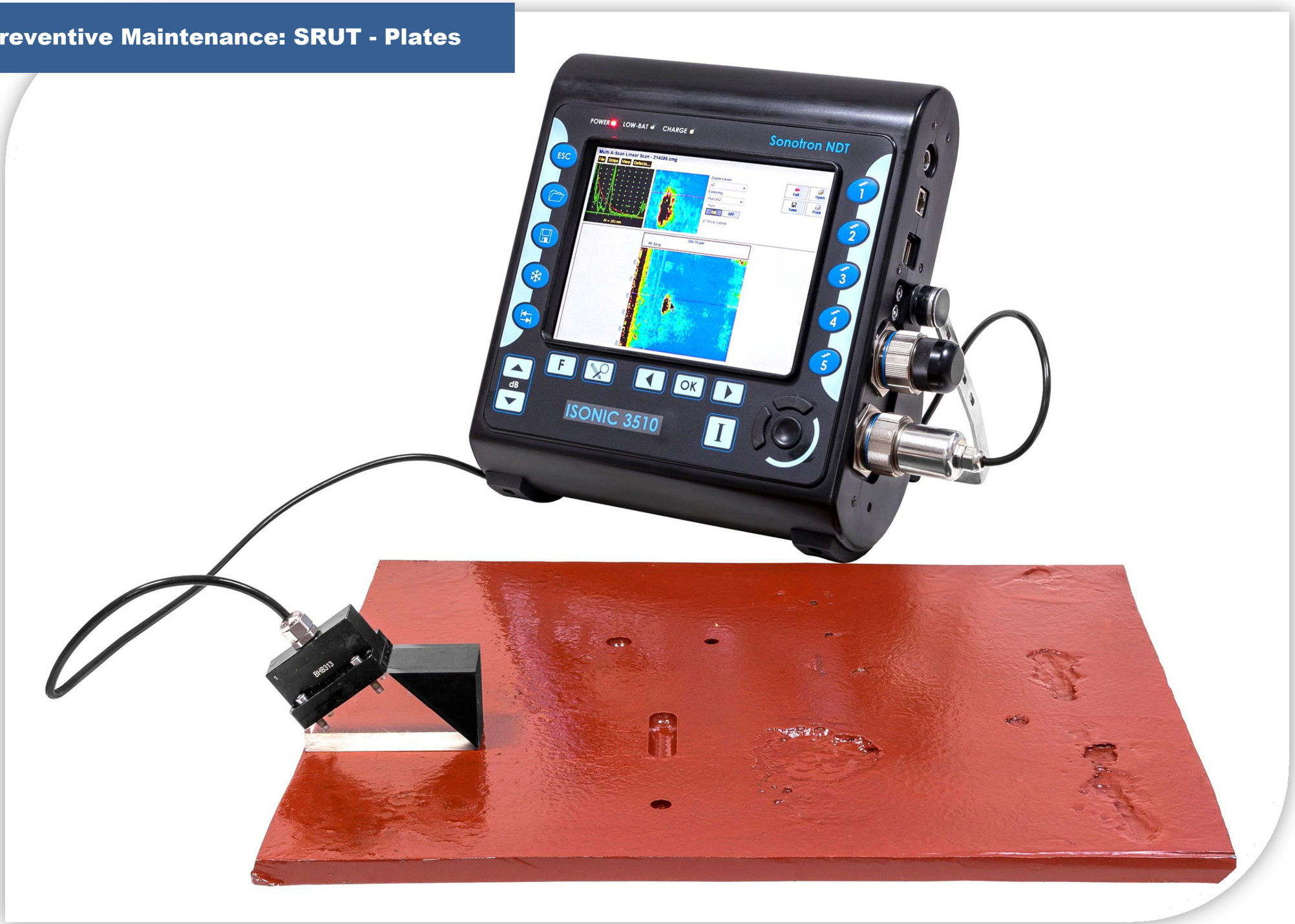
Preventive Maintenance: SRUT - Plates



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Preventive Maintenance: SRUT – Pipe Walls

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Preventive Maintenance: FFC

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Preventive Maintenance: FAC

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Preventive Maintenance: FAC

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Wind Energy: Glass Fiber

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Yachts, Boats, Other Ships: Glass Fiber

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Drilling and Exploration

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Casting, forging, other raw materials

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VAUT: Video Aided UT

VAUT (**V**ideo **A**ided **UT**) technology is the standard feature of **ISONIC 3510** that provides displaying of the live image of the probe manipulated over the material and the corresponding UT data simultaneously: this concentrates most of the operator's attention on the instrument screen whilst scanning manually. Every single A-Scan or cross-sectional view such as S-Scan, etc obtained in the corresponding static probe position may be stored into a file comprising the UT data along with the embedded photo representing the test piece and the probe placement. Every record comprising a sequence of A-Scans and cross-sectional views composing the C-Scan or / and strip chart may be stored into a file comprising the UT data and video of the scanning process

The embedded photo or video is assigned to the UT data in the file only and it is not openable / reproducible separately. On opening the file the recorded photo / video will be played along with ultrasonic data recoverable for each probe position

If the video camera is fitted into the scanner or encoder frame and focused onto material surface the inspection results file will carry the synchronized **UT** and **VT (Visual Testing)** data providing the **dual modality inspection results obtained in one pass** and comprised together; this increases the global productivity of NDE

VAUT technology also allows **embedding of the GPS- or GLONASS- coordinate and the RFID data of the part under test into the inspection files** provided the appropriate standard gadgets are connected to the instrument at the time of inspection. Along with the photo and / or video the global position and RFID data embedded into the same UT inspection files will improve the operation and reliability of the RBIM (Risk-Based Inspection and Maintenance) databases avoiding the mistaken assigning of the NDT results to the wrongly designated objects

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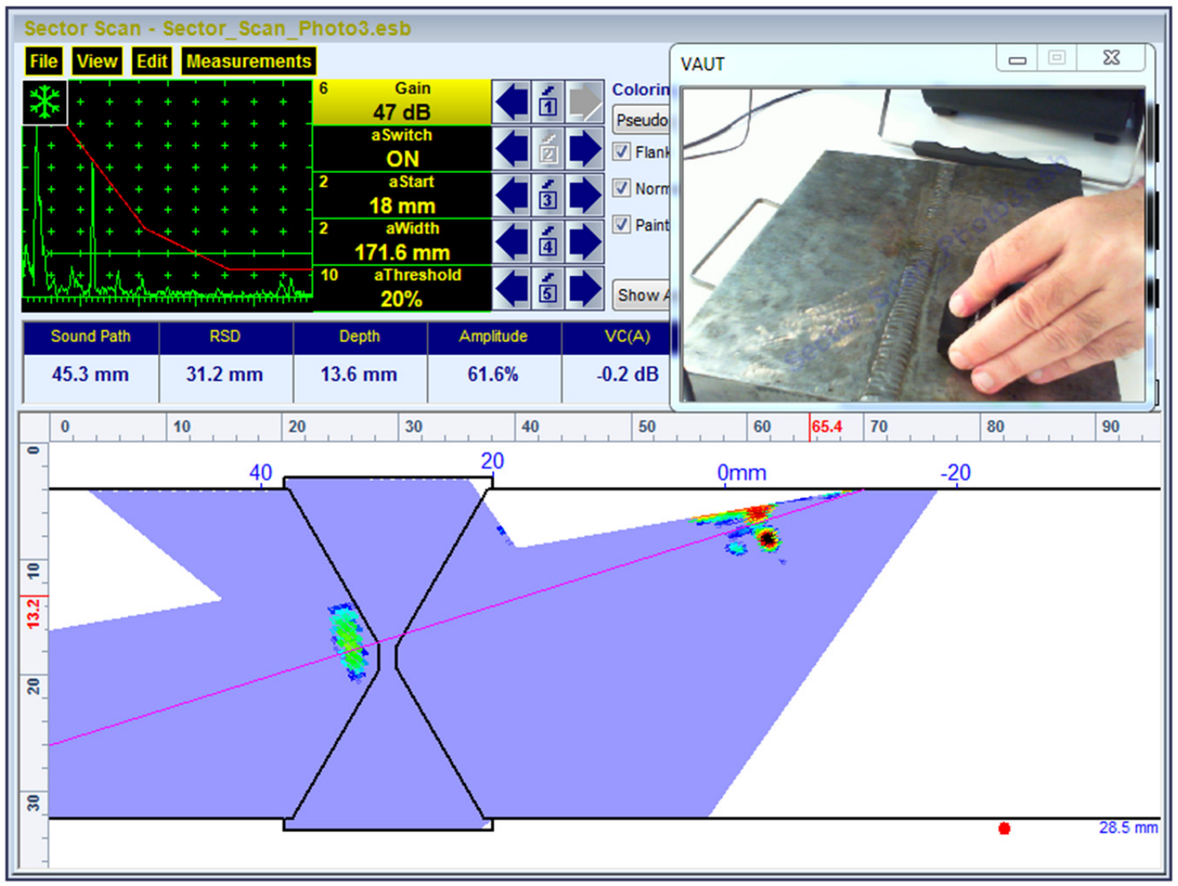
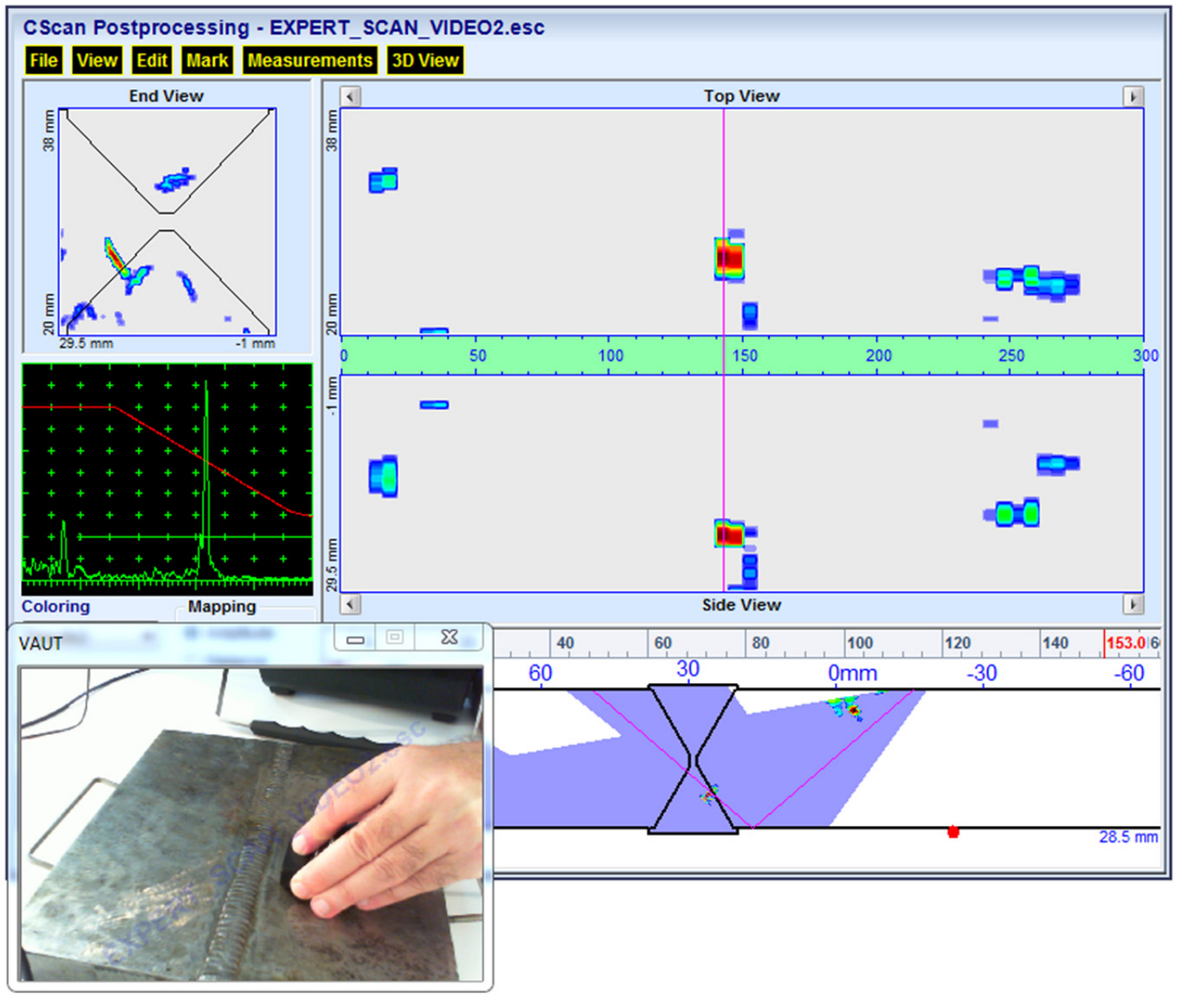
VAUT: Video Aided UT

A number of cameras may be connected to **ISONIC 3510** having the ability of processing of several video streams simultaneously. This opens the opportunity of the video-encoded scanning similarly to the famous Hawkeye® tennis ball tracing technology without add-on devices such as encoders, probe holders, etc





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UT over IP

ISONIC 3510 may be controlled remotely from a regular computer running under Win'XP, 7, 8, 10. There is no need in the special software for that purpose, just the same software that runs in the instrument. The instrument and the PC should be connected to the LAN or to the router distributing IPs automatically. Since the connection is established **ISONIC 3510** enters into the slave mode driving the probes and capturing the A-Scans, the hardware measurements, and the encoder data supplying them to the computer, which provides full control of the instrument along with data acquisition, processing, displaying and storage on the local drives

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ISONIC 3510 - Technical Data

PA Modality

Structure:	1 X 32:32 switchable to / from 2 X 16:16 1 X 64:64* switchable to / from 2 X 32:32* 1 X 128:128* switchable to / from 2 X 64:64* * - with use of the corresponding extension terminals **Important:** there is no external splitter required in case of using 2 PA probes simultaneously
Initial Pulse:	Bipolar Square Wave with Boosted Rising and Falling Edges, Guaranteed Shell Stability, and Active Damping
Transition:	≤7.5 ns (10-90% for rising edges / 90-10% for falling edges)
Amplitude:	Smoothly tunable (12 levels) 50 … 300 Vpp into 50 Ω
Half Wave Duration:	50…600 ns controllable in 10 ns step
Emitting aperture:	1...32/64*/128* adjustable as fully or partially matching OR mismatching with the receiving aperture * - with use of the corresponding extension terminals
Receiving Aperture:	1...32/64*/128* adjustable as fully or partially matching OR mismatching with the emitting aperture * - with use of the corresponding extension terminals
Phasing - emitting and receiving:	0…100 µs with 5 ns resolution independently controllable
Analogue Gain:	0...100 dB controllable in 0.5 dB resolution
Advanced Low Noise Design:	85 µV peak to peak input referred to 80 dB gain / 25 MHz bandwidth
Frequency Band:	0.2 … 25 MHz
A/D Conversion:	100 MHz 16 bit
Digital Filter:	32-Taps FIR band pass with controllable lower and upper frequency limits; non-linear acoustics technique supported
Superimposing of receiving aperture signals:	On-the-fly, no multiplexing involved
Phasing (receiving aperture):	On-the-fly 0…100 µs with 5 ns resolution
Dynamic Focusing:	Supported
FMC, TFM, Back Diffraction Technique with / without and Mode Conversion:	Supported
A-Scan:	• RF • Rectified (Full Wave / Negative or Positive Half Wave) • Signal's Spectrum (FFT Graph)
Reject:	0...99 % of screen height controllable in 1% resolution
Material Ultrasound Velocity:	300...20000 m/s (11.81…787.4 "/ms) controllable in 1 m/s (0.1 "/ms) resolution

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Time Base - Range:	0.5...7000 µs - controllable in 0.01 µs resolution
Time Base - Display Delay:	0...400 µs - controllable in 0.01 µs resolution
Probe Delay:	Automatically settled depending on the PA probe / wedge / delay line in use according to the desired: • Aperture(s) • Incidence angle • Focal point position • etc
DAC / TCG:	• One Per Focal Law • Multi-curve • Slope ≤ 20 dB/µs • Available for the rectified and RF A-Scans • Theoretical – through entering dB/mm (dB/") factor • Experimental – through recording echoes from several reflectors; capacity - up to 40 points
Gates:	2 Independent gates per focal law controllable over entire time base in 0.1 mm /// 0.001" resolution
Threshold:	5…95 % of A-Scan height controllable in 1 % resolution
Phased Array Probes:	• 1D Array – linear (LA), rings (RA), and the like • Dual Linear Array (DLA) • Matrix Array (MA) • Dual Matrix Array (DMA)
Number of focal laws:	8192 independently adjustable gain / time base per focal law
Scanning and Imaging:	• Cross-Sectional B-Scan (E-Scan) – regular and/or Volume Overlay True-To-Geometry • Cross-Sectional Sector Scan (S-Scan) – regular and/or Volume Overlay and True-To-Geometry • Multi-group image composed of several cross-sectional B- and S-Scans • Horizontal Plane S-Scan • FMC/TFM synthetic aperture images • Back-diffraction image • Strip Chart • TOFD Map out of a pair of PA probes • Top (C-Scan), Side, End View imaging formed through encoded / time-based line scanning, 3D-Viewer • Top (C-Scan), Side, End View imaging formed through encoded XY- scanning, 3D-Viewer
GPS Coordinate:	Obtained and Displayed Automatically Along with UT Data with Use of the External GPS Receiver Connected to Instrument's USB Port

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VAUT:	Video Data from One or Two External Cameras Connected to Instrument's USB Port(s) is Displayed Automatically Along with UT Data
Data Storage:	• 100% Raw Data Capturing • GPS Coordinate Embedded Into the Data File in Case of GPS Receiver Connected • Photo Embedded Into the Single A-Scan / Cross-sectional Image Data File in Case of USB Camera Connected • Video Embedded Into the Scanning Results Data File in Case of USB Camera Connected
Postrpocessing:	• Built-in means for the comprehensive postprocessing in the instrument • ISONIC PA Office - freely distributable postprocessing package for the computer running under W'XP, W'7, W'8, W'10

Conventional UT and TOFD

Number of Channels:	2
Pulsing/Receiving (dual channel operation):	• Parallel - both channels do fire, receive, digitize, and record signals simultaneously • Sequential – cycles of firing, receiving, digitizing, and recording signals by each channel are separated in time in a sequence loop
Initial Pulse:	Bipolar Square Wave with Boosted Rising and Falling Edges, Guaranteed Shell Stability, and Active Damping
Transition:	≤7.5 ns (10-90% for rising edges / 90-10% for falling edges)
Amplitude:	Smoothly tunable (12 levels) 50 … 300 Vpp into 50 Ω
Half Wave Duration:	50…600 ns controllable in 10 ns step
Modes:	Single / Dual
Analogue Gain:	0...100 dB controllable in 0.5 dB resolution
Advanced Low Noise Design:	85 µV peak to peak input referred to 80 dB gain / 25 MHz bandwidth
Frequency Band:	0.2 … 25 MHz Wide Band
A/D Conversion:	100 MHz 16 bit
Digital Filter:	32-Taps FIR band pass with controllable lower and upper frequency limits
A-Scan:	• RF • Rectified (Full Wave / Negative or Positive Half Wave) • Signal's Spectrum (FFT Graph)
Reject:	0...99 % of screen height controllable in 1% resolution
Material Ultrasound Velocity:	300...20000 m/s (11.81…787.4 "/ms) controllable in 1 m/s (0.1 "/ms) resolution
Time Base - Range:	0.5...7000 µs - controllable in 0.01 µs resolution
Time Base - Display Delay:	0...400 µs - controllable in 0.01 µs resolution
Probe Angle:	0…90° controllable in 1° resolution

ISONIC 3510

Probe Delay:	0...70 µs controllable in 0.01µs resolution
DAC / TCG:	• Multi-curve • Slope ≤ 20 dB/µs • Available for the rectified and RF A-Scans • Theoretical – through entering dB/mm (dB/") factor • Experimental – through recording echoes from several reflectors; capacity - up to 40 points
DGS:	Standard Library for 18 probes / unlimitedly expandable
Gates:	2 Independent Gates controllable over entire time base in 0.1 mm /// 0.001" resolution
Threshold:	5…95 % of A-Scan height controllable in 1 % resolution
HW Gates:	Standard Option
Interface Echo:	Standard Option
Digital Readout:	• 27 automatic functions • Dual Ultrasound Velocity Measurement Mode for Multi-Layer Structures • Curved Surface / Thickness / Skip correction for angle beam probes • Ultrasound velocity and Probe Delay Auto-Calibration for all types of probes
Freeze A-Scan:	• Freeze All • Freeze Peak Note: signal evaluation, manipulating Gates and Gain is possible for the frozen A-Scans as for live
Scanning and Imaging - Single Channel:	• Thickness Profile B-Scan • True-To-Geometry Angle / Skip Corrected Cross-sectional B-Scan • High Resolution B-Scan • Horizontal Plane View CB-Scan • TOFD
Scanning and Imaging - Dual Channel:	• Strip Chart - strips of 4 types, namely P/E Amplitude/TOF; Map; TOFD; Coupling • Stripped C-Scan
Standard length of one line scanning record:	50…20000 mm (2"…800"), automatic scrolling
Data storage:	100% raw data capturing
Postprocessing:	• Built-in means for the comprehensive postprocessing in the instrument • ISONIC Office L - freely distributable postprocessing package for the computer running under W'XP, W'7, W'8, W'10

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General

PRF:	10...5000 Hz controllable in 1 Hz resolution
On-Board Computer CPU:	Dual Core Intel Atom N2600 CPU 1.6 GHz
RAM:	2 GB
Quasi HDD:	SSD Hard Drive 120 GB
Screen:	Sun readable 8.5” touch screen 800 x 600
Controls:	• Touch screen • Front Panel Sealed Keyboard and Mouse
Standard Ports:	• 2 x USB (optionally expandable up to 8) • Ethernet • sVGA
Operating System:	W'7PRO
Encoder:	• Single Axis Incremental TTL encoder - Built-In • Multi-Axis (>=2) Incremental TTL Encoder - Optional
Remote Control:	• From an external computer running under W'XP, W'7, W'8, W'10 through Ethernet • No special software required • All calibration and inspection data is stored in the control computer
Ambient Temperature:	• -30°C ... +60°C (operation) • -50°C ... +60°C (storage)
Housing:	• Rugged reinforced plastic case with the stainless steel carrying handle • IP 65 • No air intake • The cooling is not required
Dimensions:	292x295x115 mm (11.50"x11.61"x4.53") - with / without battery inside
Weight:	4,850 kg (10.70 lbs) – with battery 4.200 kg (9.26 lbs) – without battery