PROlineUSB Ultrasonic Testing Instrument and Systems

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Abstract

VOGT Ultrasonics GmbH, in Burgwedel near Hanover, Germany is a developer and manufacturer for ultrasonic testing systems and instruments. As a distribution partner of established manufacturers such as ScanMaster and Phoenix, and on the basis of our wide experience in ultrasonic applications, as well as technical interfaces, we have developed our own ultrasonic instrument and systems „PROline“.

PROline systems are used for the inspection of components in the aerospace, aviation, automotive, steel and plastics industry. Universities and research institutions also use the wide range of PROline family applications.

The PC-based PROlineUSB ultrasonic testing instrument is characterized by a high class manufacturing quality, excellent ultrasonic properties and extremely user-friendly software. It is designed to be integrated into product lines within robust conditions. PROlineUSB is extremely compact, splash proof and well constructed. Suitable for laboratory and for field inspections, this ultrasonic testing instrument is a must have.

In association with mechanized and automated ultrasonic testing applications, the PROlineUSB ultrasonic testing instrument shows its strength due to its flexibility, diversity and its open interfaces. The PROlineUSB ultrasonic testing instrument provides ideal testing conditions for the inspection of weld seams, cracks and internal defects, solder and coating connections and their adhesion quality, wall thicknesses as well as inspecting shafts, bars, tubes and flat plates, plastics and many more.

Keywords: PROline USB; ultrasonic instrument, ultrasonic systems, aerospace, aviation, automotive, steel and plastics industry, ultrasonic testing instrument, mechanized and automated ultrasonic testing applications, cracks in weld seams, internal defects, wall thickness, inspection of shafts, bars, tubes, plates, plastics, inline testing, online testing, user-friendly software, fully integrating.

1. PROline Series

The ultrasonic inspection device PROlineUSB in combination with the inspection software PROlinePLUS represents an extremely flexible, PC-supported inspection system (Figure 1) based on MS Windows. The system is designed for the mechanised and automated ultrasonic inspection and can be operated within production lines as well as a stand-alone solution for various applications in laboratories.
As a PC based multi-channel ultrasonic inspection device, the PROline series is designed to extend the scope of compact ultrasonic devices. The PROline series can be used for education and training purposes in the field of material testing and physics of ultrasound as well as cost efficient, in-line and offline inspection (with multi-channels) 100% inspection during the production process. Figure 2 shows schematically a typical assembly of a 4-channel configuration of the PROline series.

In addition to the USB 2.0 connection between the PROlineUSB box and the inspection software PROlinePLUS, the open hardware and software related interfaces offer a great deal of possible applications and make the PROlineUSB ultrasonic testing instrument compact, powerful and flexible in component testing.
2. **PROline**\(^{\text{USB}}\) Box

Designed as a cost efficient but all-purpose ultrasonic device, the PROline\(^{\text{USB}}\) box can be considered as the core of the PROline series. In addition to its excellent ultrasound characteristics, it provides all hardware components that are needed to realise inspection systems from lean single-channel solutions up to eight-channel stand-alone systems with axis control and integrated PLC-based applications. Figure 3 shows the front and back panel of the 2-channel and 8-channel version with various connections.

![Figure 3: PROline\(^{\text{USB}}\) Box](image)

3. **PROline**\(^{\text{PLUS}}\) Software

The PROline\(^{\text{PLUS}}\) Software (Figure 4) works with Windows Platform PCs and has two main functions. First of all it provides all the functionality one would need to set up and carry out the inspection. Secondly it is the graphic user interface (GUI) of the PROline\(^{\text{USB}}\) ultrasonic hardware and all connected peripheral devices. All communication between the ultrasonic device and the PC runs via USB 2.0, which offers plenty of opportunities in terms of the PC’s configuration. Data transfer rates up to 35 MByte/s are achieved.
Besides the A-Scan view (ultrasonic RF view) the multifunctional display provides combined test procedures and inspection results such as „start“, „stop“, „pass/fail-signals“, statistics, graphical views of ultrasonic signals (amplitudes, time of flight) or combinations from those, as well as conventional colour-coded and location dependent C-scan and D-scan views.

The user-friendly software and software GUI requires little training for the user to operate the system safely.

The basic setup for the inspection is carried out within the ultrasonic part. It contains the UT setting according to the application, e.g. TOF, PRF, gain or gate information. All gates can be used for more complex solutions; these can be defined in the inspection plan. The inspection plan administration is used to adjust the system to the inspection requirements through integration of scan mechanics, axis movement and automatic evaluation procedures as well as I/Os. Predefined functions support the user by defining even more complex inspections. Predefined functions are scan paths and evaluation options e.g. notch-detection and cluster evaluation. Control scripts for automated and integrated applications can also be predefined.

4. Application

Open interfaces and fast connections allow installation of PROline series in many different applications. Some of these are shown below. A common application is the in-line or offline inspection of laser-welded joints on power train components such as gear wheels (Figure 5) and ring gears on differentials.
Depending on the coupling technology and the weld orientation, the covering of the weld seam is achieved by the accordant arrangement of the probe in axial or radial direction and by rotation of the probe or part with optional Z-movement. This testing principal supports manual and automatic loading. In case of 100% in-line inspection, the automatic evaluation by parameter provides an ok/nok result, which is transmitted via I/O, PLC, network or other interfaces.

Depending on the customer’s needs the appropriate application may be more comprehensive. As an example the application for the inspection of welded or soldered sliding shoes is shown in Figure 6. The PROline series is used to control the 3-axis of the scan mechanics to provide a C-Scan for the cluster evaluation.

The evaluation results are stored in a data file, which is analyzed automatically by the customers QC system.
Figure 7 shows the automated inspection and evaluation of high pressure tubes using immersion technique with spiral scan and cluster evaluation.

In this immersion scanning system, the tube is scanned with a barcode reader and loaded manually into the system. The setup is loaded and the tube is lowered into the immersion tank automatically. The newly developed ultrasonic probe (length of 500 mm) is positioned inside the tube with the transducer on the axis of rotation. The spiral scan of the tube is evaluated automatically ok/nok by cluster evaluation. The probe with its diameter of 6.5 mm dives into a hole of about 7.6 mm into the part for testing the soldering by rotation.