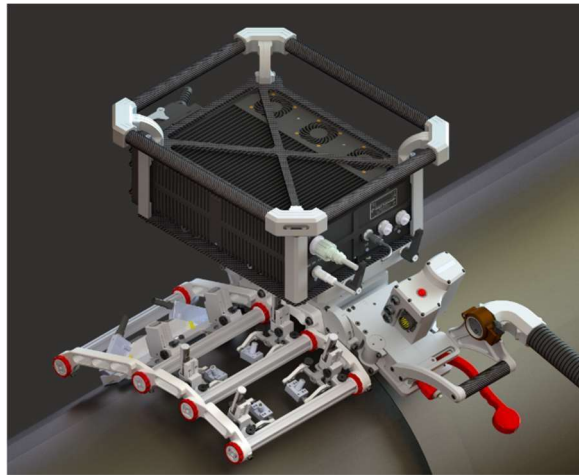


WeldXprt™ - AUT System For Pipeline Girth Weld Inspection

Technical Proposal



Prepared for

Approvals

<i>Date</i>	<i>Prepared by</i>	<i>Approved by</i>	<i>Revision</i>
	PH	FL	A

Table of Content

Approvals	2
1 Subject.....	4
2 Reference Documents.....	4
3 Scope of Supply	4
4 WeldXPRT™ Software	5
4.1 Supported Techniques.....	5
4.2 Advanced Software Tools.....	5
4.2.1 Setup	5
4.2.2 Calibration	7
4.2.3 Motor control.....	9
4.2.4 Analysis.....	9
4.2.5 Reporting.....	11
4.2.6 Free Viewer	11
4.2.7 Multiple Screen Support	12
5 Emerald Advanced Phased Array System	13
6 Scanner	14
6.1 Electrical	14

1 Subject

This budgetary proposal describes the supply of WeldXprt™, a turnkey system for the inspection of Pipeline Girth Welds (PGW). This document details the components that comprise the system, as well as budgetary pricing and is intended to provide an overview of the system, its software and support provided by Eddyfi Technologies in advance of a formal detailed proposal.

2 Reference Documents

- FY24_WeldXprt Solution_10-18.pdf

3 Scope of Supply

Eddyfi's proposal includes the following main components per system:

Included in part number WX-EMERALD-SOLUTION-KIT:

Component	Qty
WeldXPRT™ Software Licence	1
EMERALD Phased Array instrument	1
Scanner including motor controller and probe pan for 4 probes	1
2 x standard 5L60 PAUT probes + flat wedges	1
1 pair standard TOFD probes and flat wedges	1
Irrigation pump	1

Additional requested accessories:

Component	Qty
Pipe Bands 20", 24", 36", 48"	1 each
PA Wedges 20 & 24"	2 each
TOFD Wedges 60° & 70° for 20, 24, 36 & 48"	2 each
Transverse setup for 2 pairs transverse probes including wedges, frame, forks, cables	1

4 WeldXPRT™ Software

WeldXprt is a new dedicated software for PGW inspection based upon the powerful UltraVision® software engine. It includes powerful advanced tools for improving efficiency and data reliability for AUT applications both on-shore and offshore. Supporting multi-methods, independently and simultaneously, with a streamlined user interface gives the operator cutting edge inspection capabilities in a highly reliable platform.

4.1 Supported Techniques

WeldXprt software and the Emerald instrument platform support multiple techniques which can be carried out independently or simultaneously in multi-group configuration:

- Zonal discrimination
- Phased Array UT
- Time of Flight Diffraction (ToFD)
- Conventional UT
- Full Matrix Capture (FMC) – Total Focussing Method (TFM)
- Plane Wave Imaging (PWI) – TFM

4.2 Advanced Software Tools

WeldXPRT contains many advanced software tools developed for high performance AUT. These are summarised below, categorised into their respective application stage.

4.2.1 Setup

4.2.1.1 *Calibration Block Designer*

The calibration block designer tool allows configuration of a suitable calibration block based upon the input pipe and weld configuration. The block may be customised by user-selectable parameters and recommended reflectors generated through use of automatic configuration. Reflectors may also be created and adjusted manually to meet user requirements with live display update for ease of

verification. The resulting calibration block can then be easily exported as engineering drawings for fabrication and the reflectors automatically pulled through for inspection calibration routine setup.

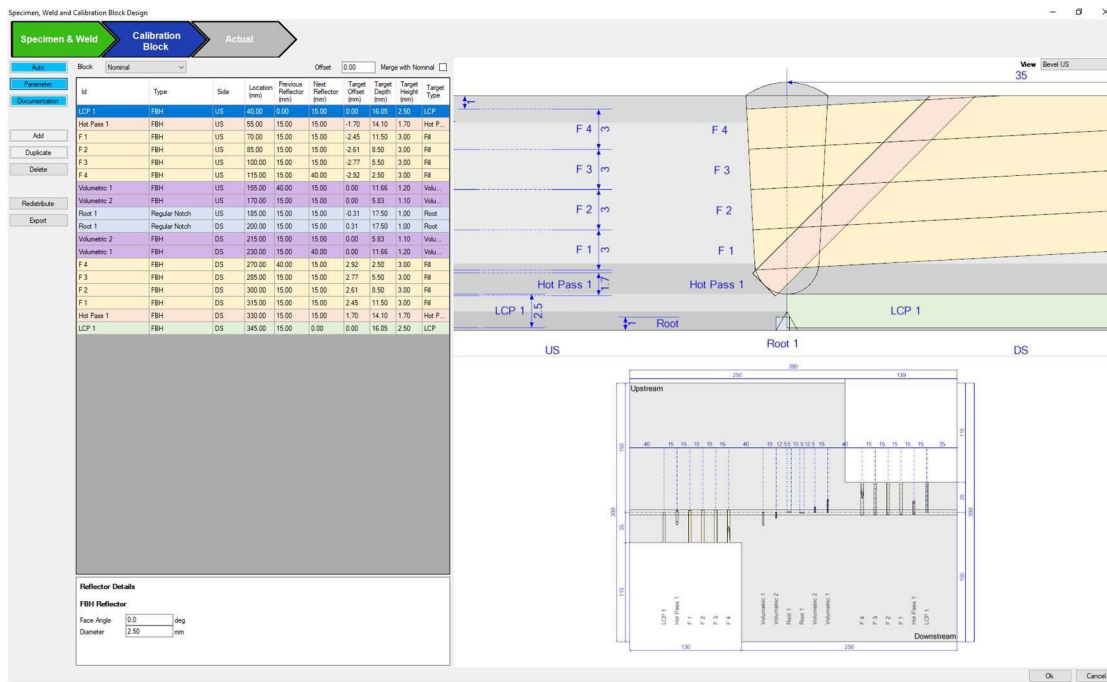


Figure 1 - Calibration Block Designer

4.2.1.2 Auto Zonal Configuration

Once the reflectors are defined the software permits automatic solving of the zonal channels required for each indication. Zones may be manually defined or pulled from the information in the calibration block designer. The Zonal builder table allows quick view, and fine adjustment of essential parameters with options for automatic or manual strip chart display configuration based on user preferences. Fine adjustment to zonal channels can be carried out, with individual beam solving and live display update for rapid configuration.

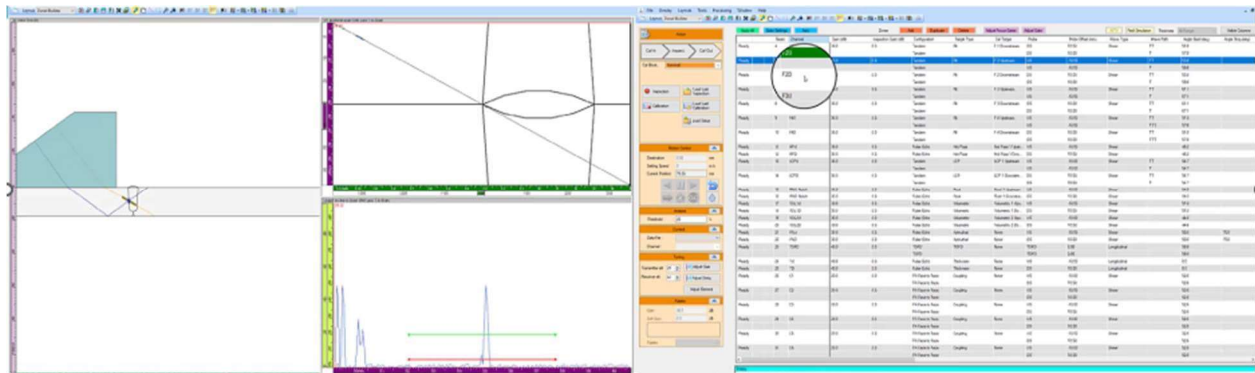


Figure 2 - Autonomic Zonal Builder and Table

4.2.1.3 Beam Simulation

Acoustic beam simulation is available for self-tandem (Zonal), PAUT and UT channels as well as acoustic field simulation for TFM based channels. This helps to verify effective beam parameters during setup up.

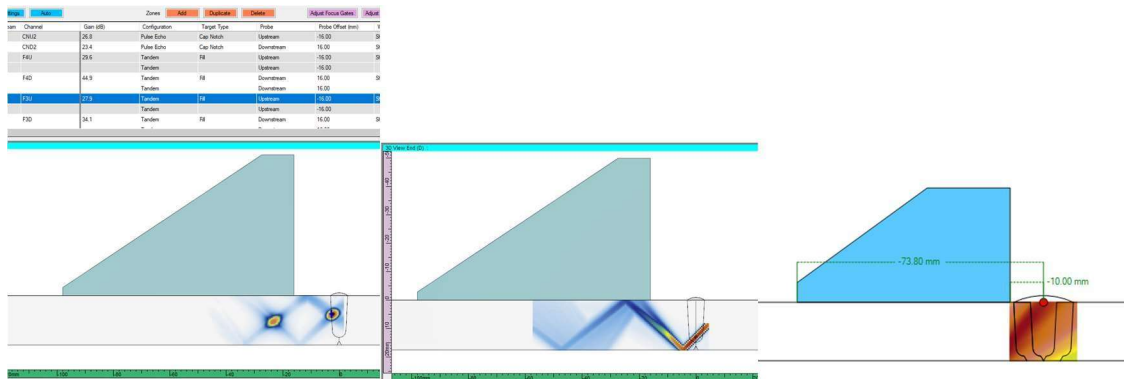


Figure 3 - Beam and acoustic field simulations

4.2.1.4 Assisted Tap-In / Tap-Out

During the Tap-In / Tap-Out optimisation beam optimisation can be carried out for each reflector electronically, greatly speeding up this stage of setup. With direct motor control in the software the scanner can be easily positioned at each reflector position. Once at a reflector, the operator is able to adjust gain and delay in single clicks to optimise the indication response within the detection gate. Fine adjustment of aperture start positioning (element number) for both transmit and receive apertures allows the operator to find the maximum response positioning in a matter of seconds before moving on to the next reflector.

4.2.2 Calibration

4.2.2.1 Auto Calibration Verification

Calibration routine can be commenced with a single click and reflectors are automatically verified for amplitude and position tolerance. 'Calibration Success' and 'Calibration Failure' buttons in green and red give an immediate Go/No Go for calibration compliance. Calibration data files are stored alongside weld inspection data files and recalled automatically during weld file analysis to ease in verification.

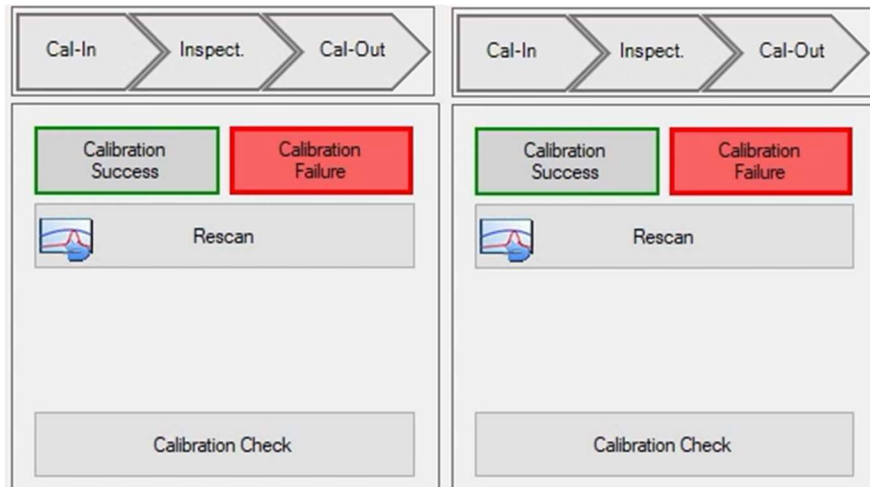


Figure 4 - Calibration condition icons

4.2.2.2 Auto Calibration Adjustment

Following calibration scan routine, any out of tolerance channels are highlighted, with adjustment for gain and delay automatically calculated to bring them back to nominal. The operator is able to select channels for automatic adjustment and apply the adjustment quickly. Overtrace is also calculated and verified for tolerance and managed in the 'Overtrace' tab.

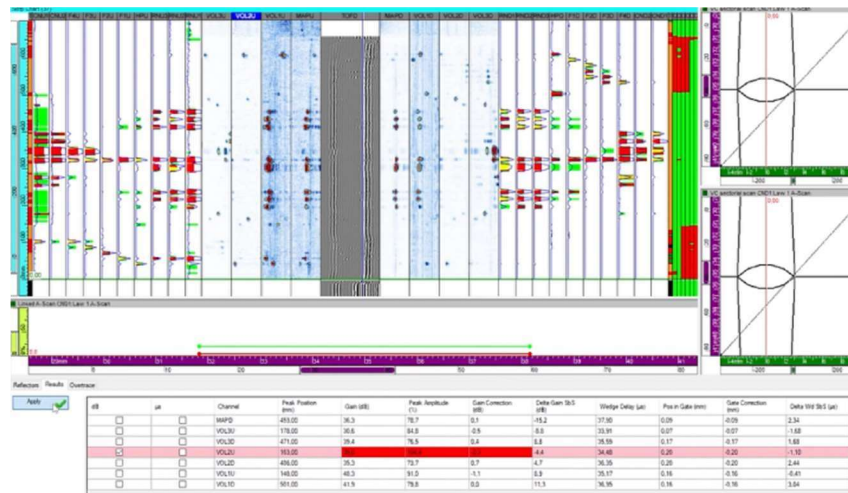


Figure 5 - Auto calibration adjustment

4.2.3 Motor control

The WeldXprt software takes direct control of the Jireh motor controller. Separate sequences may be programmed, for example for calibration and inspection runs which can be initiated through the inspection workflow icons.

4.2.4 Analysis

4.2.4.1 Rule Based Assisted Analysis

During analysis the rule based assisted analysis (RBAA) function can greatly speed up detection and sizing of relevant indications. Rules can be set for indication detection by Zone, weld region and channel with each kernel having unique detection criteria assigned for example:

- Threshold % or SnR
- Position in gate
- Minimum length, height and width
- Grouping with adjacent indications (volumetric data)

Data that meets the rules is boxed, measured and added to the indication table allowing the operator to verify and confirm agreement, delete, or make adjustment to each.

Rule sets can be easily stored for use across multiple jobs. Once configured the indication table is filled in a matter of seconds with a single user action.

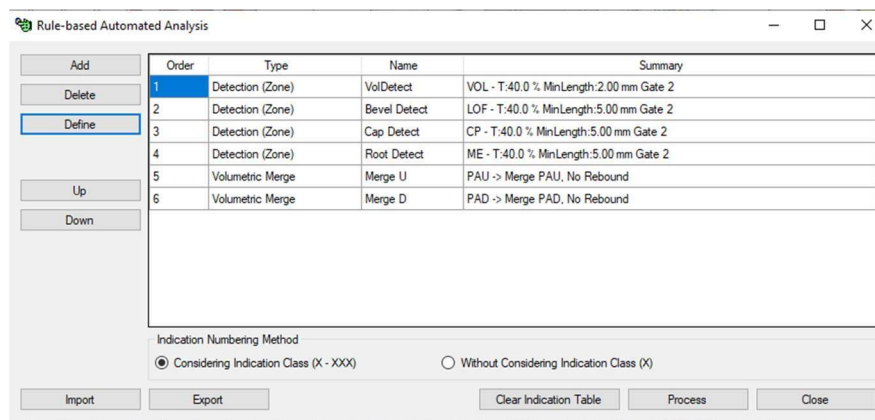


Figure 6 - Example rule based automated analysis kernels

4.2.4.2 Assisted Code Implementation

Once the indication table is filled with the relevant indications, either through manual or RBAA addition. The next step is to interact, accumulate, accept or reject the indication based on the relevant code. Assisted code implementation embedded in WeldXprt greatly speeds up this stage for the Analyst,

automatically applying the code rules to the indications. Indications are accumulated, interacted, accepted or rejected based on the chosen code by a single analyst click. Relevant rules used for the call are detailed in the notes section of each indication. Several codes are already implemented in the software, and it is possible to add additional codes through a custom 'rule' file.

Analysts can review the calls made by the software, overruling them and adjusting where they see fit. The weld status is automatically updated (Accepted / Rejected) based on this outcome, a variable stored with the data file.

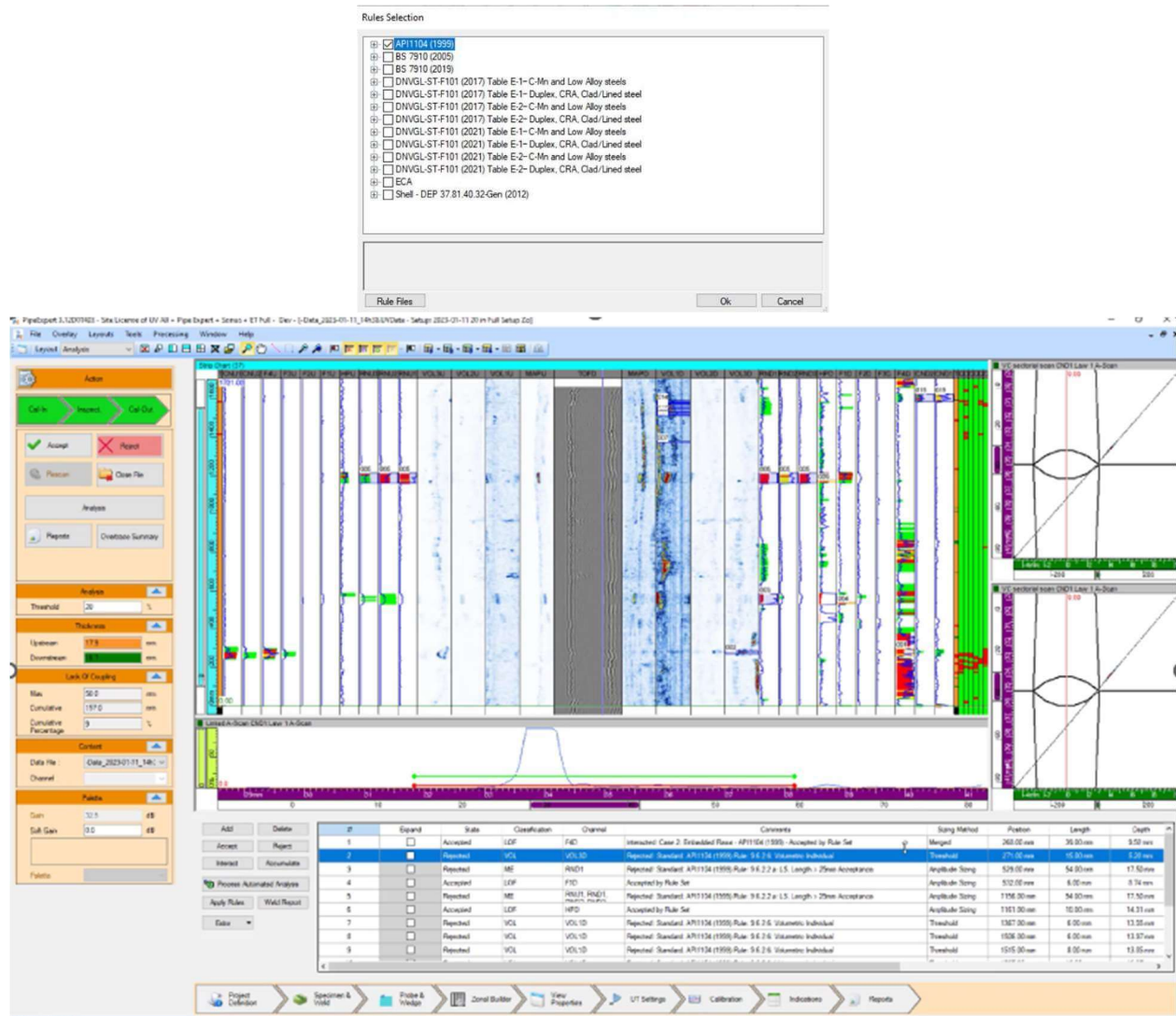


Figure 7 - Assisted code implementation

4.2.5 Reporting

Weld reports are generated easily with a single user action following analysis with a customisable report format. Production reports can also be generated for reporting shift or run reports.



Weld Report

Information

Weld: -Data_2023-01-11_14h38

Weld Status: Rejected

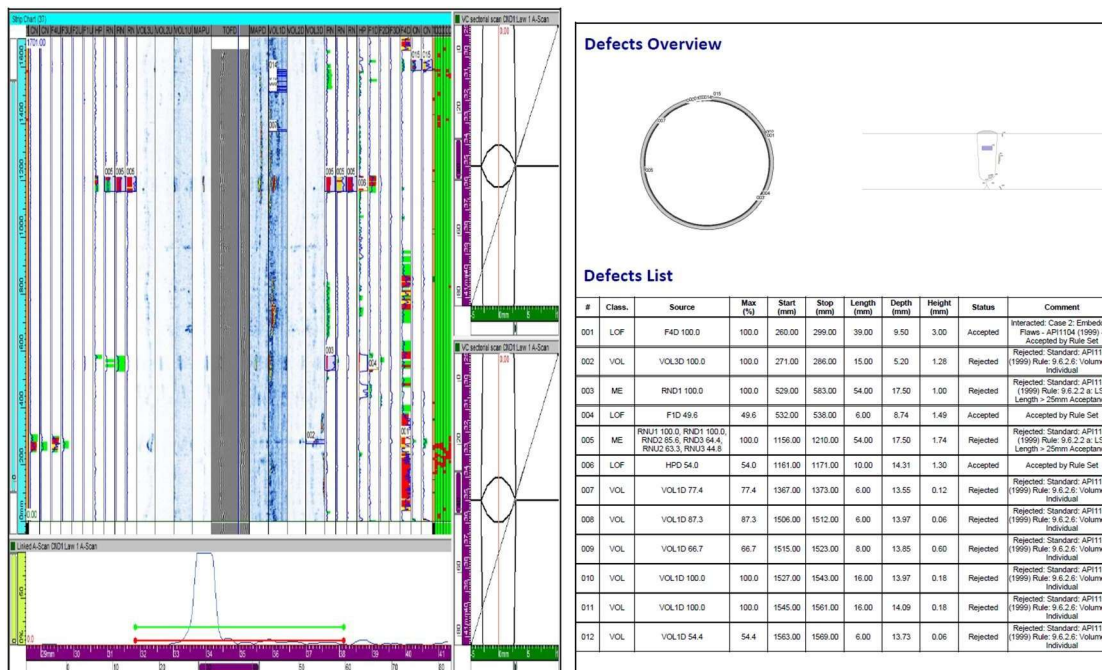


Figure 8 - Typical weld report

4.2.6 Free Viewer

WeldXprt is available as a free viewer, without the need for a software licence to allow operators to share data files with their clients for review without additional cost or licence complication.

4.2.7 Multiple Screen Support

WeldXprt allows the full use of multiple screens, with the creation of live 'child displays' which can be positioned and stored as required across multiple monitors connected to the same PC. With this, all screens may be live and linked, allowing significant increase in useable screen space and improved views and efficiency vs single screen software.



Figure 9 - Multiple screen support

5 Emerald Advanced Phased Array System

The system includes the EMERALD phased array electronics, controlled by the WeldXprt software. The technical specification of this unit makes it particularly suited for multi-mode advanced imaging of pipeline girth welds:

- Fully integrated
- PA UT 64/128PR + 2 UT at 200 V
- Up to 64 active elements, a total of 128 channels
- 16-bit amplitude resolution of phased array signal
- Digitization frequency: up to 100 MHz
- Drives dual matrix array probe assemblies (64T/64R), using the standard splitter box
- Software support of 2D-matrix arrays
- On-line Volumetric Merge
- Bipolar pulse (150Vpp) for more acoustic energy and improved SNR
- Multiple “Live” TFM & PWI with frames up to 1024 x 1024 pixels
- FMC Raw Data Saving in snapshot mode AND in continuous (encoded) mode through UltraVision



Figure 10 - Emerald - Advanced Phased Array Electronics

6 Scanner

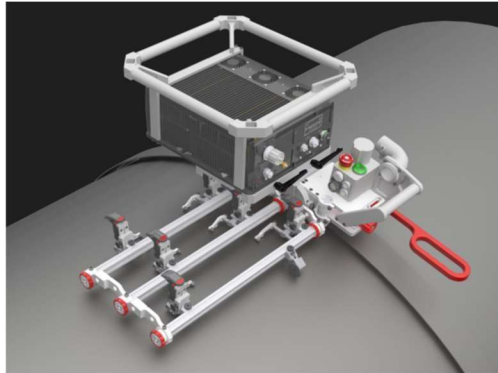


Figure 11 – Scanner

The scanner, from Jireh Industries, is a fully integrated motorised weld band crawler, designed for use with standard 'CRC' profile weld bands. The scanner is supplied configured for Emerald mounting and included umbilical and cable management. The umbilical supplied, carrying the necessary services; power, water, ethernet, motor control lines, is 30m long.

6.1 Electrical

The scanner utilises a Jireh motor controller that is directly connected to the host PC, where control is integrated in the WeldXprt software.



Figure 12 - Jireh motor controller