temate® PowerBox H
Operations Manual
Rev. TPBH-OM-J12

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1. General Description

The **temate® PowerBox H** is a hand-held, battery operated ultrasonic instrument capable of generating spikes and tone bursts up to 1200V or 8kW of peak power in frequencies ranging from 100kHz to 6MHz. The equipment can be used in pulse-echo (same transmitter and receiver) and pitch-catch (different transmitter and receiver) operation. For pulse-echo operation, a built-in transmitter/receiver switch permits connecting sensors directly to the instrument with no additional hardware. A built-in thermocouple port permits taking temperature readings to correct Time-Of-Flight measurements, and a one-axis encoder input can be used for integration with an automated or manual scanner. The instrument can be used with sensors from Innerspec Technologies or other manufacturers to generate bulk waves (normal and angle beam) and guided waves. A setting of 600Vpp (approx. 3kW) is also available to maximize battery life if the application does not require full power.

Embedded software **PowerUT® H** permits the user to modify the triggering and receiving patterns, use advanced filters to enhance signal-to-noise and present the information on A, B, C and Line Scan formats. Screen captures, device settings and data can be downloaded to a PC using additional software provided with the instrument.

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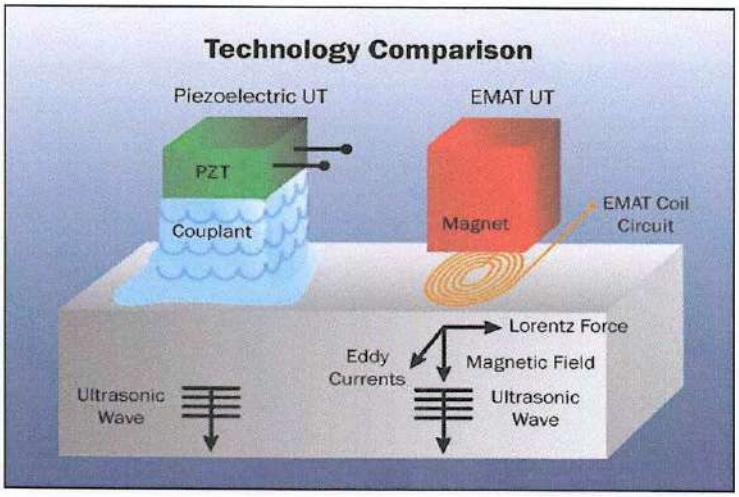
2. Applications

The **temate® PowerBox H** is designed to drive sensors that require a very high-power instrument with tone-burst capabilities such as EMAT, air coupled, and other high-performance piezoelectric transducers.

2.1. Advantages of EMAT

EMAT or Electro Magnetic Acoustic Transducer is an Ultrasonic Testing (UT) technique that generates the sound in the part inspected instead of the transducer.

An EMAT induces ultrasonic waves into a test object with two interacting magnetic fields. A relatively high frequency (RF) field generated by electrical coils interacts with a low frequency or static field generated by magnets to generate a Lorentz force in a manner similar to an electric motor. This disturbance is transferred to the lattice of the material, producing an elastic wave. In a reciprocal process, the interaction of elastic waves in the presence of a magnetic field induces currents in the receiving EMAT coil circuit. For ferromagnetic conductors, magnetostriction produces additional stresses that enhance the signals to much higher levels than could be obtained by the Lorentz force alone. Various types of waves can be generated using different combinations of RF Coils and Magnets.



Because the sound is generated in the part inspected instead of the transducer, EMATs have the following advantages over more conventional piezoelectric transducers:

- Dry inspection. EMATs do not require couplant for transmitting sound, which makes them very well suited for inspection of hot parts, and integration in automated environments.
- Impervious to surface conditions. EMATs can inspect through coatings and are not affected by pollutants, oxidation or roughness.
- Easier probe deployment. Not having wedges or couplant, Snell's law of refraction does not apply, and the angle of the probe does not affect the direction of propagation. This makes them easier to control and deploy, especially in automated environments.
- Ability to generate unique wave modes. EMATs are the only practical means for generating shear waves with horizontal polarization (SH waves), which do not travel through low-density couplants. The ability to easily produce Guided SH waves and lamb waves make EMAT ideal for generation of guided waves, used in the inspection of plates, tubes and rounds.

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2.2. Wave Modes

EMAT is capable of generating all wave modes used in ultrasonic testing, including some modes that are very difficult or impractical with conventional piezoelectric transducers.

The table below provides a summary guide of the type of wave and technique available for different applications.

Bulk/Guided	Beam Orientation	Wave Mode	Technique	Main Applications
Bulk	Normal	Longitudinal	Piezo EMAT	- Thickness and Velocity Measurements - Flaw Detection - Properties Measurement
		Shear Horizontal	EMAT[1]	
	Angled	Shear Vertical	Piezo EMAT	- Flaw Detection
		Shear Horizontal	EMAT[1]	- Flaw Detection, including austenitic materials
Guided	Surface	Rayleigh	Piezo EMAT[2]	- Flaw Detection (surface)
	Volumetric	Lamb	Piezo EMAT[2]	- Flaw (including Corrosion) Detection - Velocity and Properties Measurements
		Shear Horizontal	EMAT[1]	- Flaw (including Corrosion) Detection - Velocity and Properties Measurements

[1] Generation restricted to EMAT for practical purposes
[2] Especially well-suited for generation with EMAT

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2.3. Standard Applications

For EMAT applications, Innerspec Technologies offers sensors that can generate nearly any type of wave mode and used for hundreds of applications. The available wave modes include:

- Normal Beam (0°); Shear Horizontal and Longitudinal.
- Angled Beam (0° to 90°); Shear Horizontal and Shear Vertical.
- Guided waves (90°); Rayleigh (surface), Shear Horizontal and Lamb.

The most common EMAT applications are:

- Normal Beam, including:
  - Measurement of thickness and flaw detection at very high and very low temperatures. Innerspec offers normal beam (0°) sensors capable of inspecting parts at up to 1000°C and -50°C. Check Application Sheet AS-NB-A11 for details.
  - Scanning of plates, tanks, pipes and vessels for corrosion monitoring.
- Flaw and Corrosion Detection, including:
  - Shear Horizontal Angled Waves. Permit inspection of austenitic materials.
  - Guided Waves (Shear Horizontal, Surface and Lamb Waves)
- Thin Weld Inspection using Lamb Waves. Permits inspection of welds from 0.5mm to 3mm with extremely high levels of detection and repeatability.
- Corrosion Monitoring, including:
  - Multi-channel **temate® BAND**.
- Material Properties Measurement, including:
  - Measurement of residual stress with linearly polarized Shear Horizontal Normal Beam waves.
  - Measurement of Bolt-Load using dual mode Shear and Longitudinal waves.
  - Measurement of Nodularity using dual mode Shear and Longitudinal waves.

The tables below shows the equipment required for each application.

Application Sheets are available from Innerspec Technologies, and new ones are created often. Check www.innerspec.com for the latest information and news.

2.3.1. EMAT Applications

1. Normal Beam EMAT	Thickness Measurement		Flaw Detection		Corrosion Monitoring
	High Temp Spot	Scanning	Thin (<100mm)	Thick (>100mm)	BAND (Fixed Sensor)
ternate PowerBox H Kit (US/EU)	800A0165/6	800A0165/6	800A0165/6	800A0165/6	800A0165/6
Signal Conditioning/Mux	279A0010 (for 190 only)	NA	NA	NA	279A0009 (mux)
Sensors/Magnets (S/M)	S - 274A0165/190	M - 274A0107/144	M - 274A0107/144	M - 274A0107/144	274A0194/195
Roller Kit/ Sensor Fixture	NA	187A0003	187A0003	187A0003	NA
Handle	187A0007	NA	NA	NA	NA
Cable EMAT	232A0123	232A0123	232A0123	232A0123	NA
Thermocouple	281A0001	NA	NA	NA	Included with sensor
Encoder	NA	281A0002	281A0002	281A0002	NA
RF Coils	NA	PE-L-S-0.730-0.250	PE-L-B-0.726-0.492	PE-L-B-1.208-0.942	NA
Tuning Module	NA	NA	NA	NA	NA
Wear Surface	NA	510V0005	510V0005	510V0005	NA
Software	NA	NA	NA	NA	400S0014
Comments	Up to 650°C	Scanning up to 200°C with 274A0144 (80°C with 107)			8-Channels Multiplexed

2. Angled Beam EMAT	SH Wave	SV Wave
	Austenitic Welds	Non-Austenitic Materials
ternate PowerBox H Kit (US/EU)	800A0165/6	800A0165/6
Signal Conditioning	279A0009	279A0009
Sensors/Magnets (S/M)	S - 274A0201	S - 274A0107/144
Roller Kit/ Sensor Fixture	Included	160A0071
Handle	NA	NA
Cable EMAT	232A0123 x2	232A0123 x2
Thermocouple	NA	281A0001
Encoder	NA	281A0001
RF Coils	Included	R-L-M-0.060x12-1.000, R-L-M-0.070x10-1.000, R-L-M-0.080x8-1.000, R-L-M-0.100x7-1.000, R-L-M-0.120x5-1.000, R-L-M-0.140x6-1.000, R-L-M-0160x5x1.000,
Tuning Module	SP-R2-0.250-500 kHz	L/SE-PE-M-0.060-3500, L/SE-PE-M-0.070-3000, L/SE-PE-M-0.080-2600, L/SE-PE-M-0.100-2000L/SE-PE-M-0.120-2000, L/SE-PE-M-0.140-1500, L/SE-PE-M-0.160-1250
Wear Surface	510V0005	510V0005
Software	400S0006 (BEAM)	400S0006 (BEAM)
Comments	0-90°	30-50°

3. Guided Waves	MRUT Application (Perm. Magnet)		Other Lamb Type Waves		
	Shear Horizontal	Lamb	Volumetric (0.5mm-12mm)	Surface Waves	0-3mm Weld Inspection
ternate PowerBox H Kit (US/EU)	800A0165/6	800A0165/6	800A0165/6		800A0165/6
Signal Conditioning/Mux	279A0010	279A0010	279A0010		279A0009 (mux)
Sensors/Magnets (S/M)	Transmit: S 274A0169 Receive:S 274A0170	274A0093-M00 x2	M - 274A0107 x2 (x1 for Pulse Echo)		M - 274A0107
Roller Kit/ Sensor Fixture	NA	NA	187A0003 (x2 for Pitch Catch)		187A0003
MRUT Scanner	800A0163	800A0163	NA		NA
Cable EMAT	232A0123 x2	232A0580 x2	232A0123 (x2 for Pitch Catch)		232A0169
Encoder	Included in Scanner	Included in Scanner	281A0002		281A0002
RF Coils	Included	See App. Sheet	See App. Sheet		280A0199
Tuning Module P/C	XLP-R-250 kHz	See App. Sheet	See App. Sheet		NA
Tuning Module P/E	NA	See App. Sheet	See App. Sheet		L-PE-MF-280A0199
Wear Surface	510V0005/6	510V0005/6	510V0005/6		510V0006
Software	400S0002 (GWAT)	400S0002 (GWAT)	400S0002 (GWAT)		400S0013
Comments	Non-Leaky Wave Mode	Highly Sensitive Mode	Leaky, Highly Sensitive Mode	Surface & Near Surface	Focused Angled for Point Defects
	Corrosion & Flaw in Plates, Tubes	Corrosion & Flaw in Plates, Tubes	Corrosion & Flaw in Plates, Tubes		Straight for Planar Defects

4. Properties Measurement & Corrosion Monitoring	Normal Beam (0°)		
	Stress	Bolt Load	Nodularity
ternate PowerBox H Kit (US/EU)	800A0165/6	800A0165/6	800A0165/6
Multiplexer	279A0009	279A0009	279A0009
Sensors	274A0157	274A0158	274A0158
Handle	187A0007	187A0007	187A0007
Cable EMAT	232A0169	232A0169	232A0169
Thermocouple	NA	281A0001	281A0001
Tuning Module	NA	NA	NA
Wear Surface	NA	035A0020	035A0020
Add. Software Required	400S0008	400S0009	400S0010
Comments	Dual Coil	Shear & Long. Modes	Shear & Long. Modes

2.3.2. Piezoelectric Applications

UNDER DEVELOPMENT

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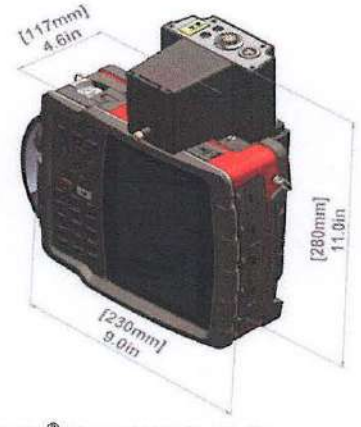
3. Technical Specifications and Pulser Performance

3.1. Technical Specifications

Specifications - temate® PowerBox H		
 temate® Powerbox H	Part Number	245A0183
	Ultrasonic Channels	1
	Bandwidth	100kHz to 6MHz
	Pulse Repetition Rate	Up to 300 Hz
	RF Pulser	Spike, Toneburst Waveforms 8 kW Power Output 1200Vpp @ 25App into 50 Ohms 0.1% Maximum Duty
	Receiver	**Pulse-Echo Mode** 1 kΩ Input Impedance 30 dB to 70 dB Gain <0.05 dB Gain Resolution **Pitch-Catch Mode** 50 Ω Input Impedance -20 dB to 60 dB Gain <0.1 dB Gain Resolution
	P/R Modes	Pulse-Echo, Pitch-Catch
	A/D Converters	12-bit, 100MHz
	Filtering	FIR Digital Filters
	Rectification	Full-wave, +/- half-wave, and RF mode
	Evaluation Gates	Interface plus 2 Gates Amplitude and Time Measurements
 temate® Powerbox H with Snap-on Module	Encoder Interface	A/B Quadrature
	PC Communication	USB MiniAB Drag-n-drop
	Software	**PowerUT® H** with A, B, C and Line Scans plus PC Interface Software
	Connectors	Lemo EGG.0B.302.CLL Lemo EGG.2B.319.CLL
	Operating Temperature	0°C (32°F) to 40°C (105°F)
	AC Power Input	100-240VAC, 50-60Hz
	Other I/O	Magnet Pulser Trigger Thermocouple Input (Type K) General Purpose I/O (5V TTL) Encoder/Signal Cond. Power VGA output Ethernet 10/100 SD Card
	Dimensions	8"W x 9"H x 4"T
		203mm x 229mm x 100mm
	Weight	2.71Kgs (6lbs)
	Battery Life	4-8 Hours

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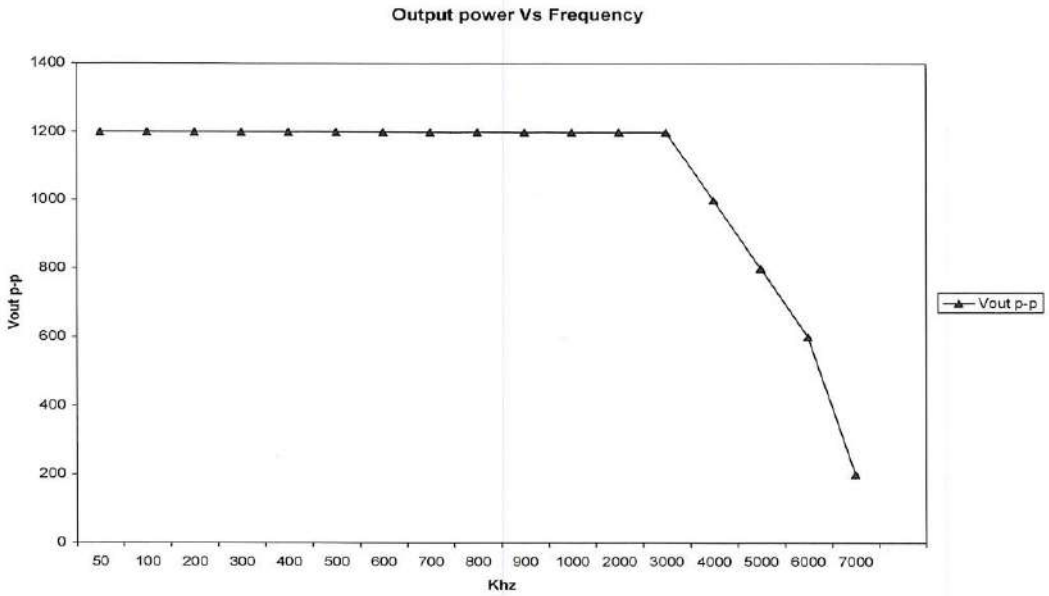
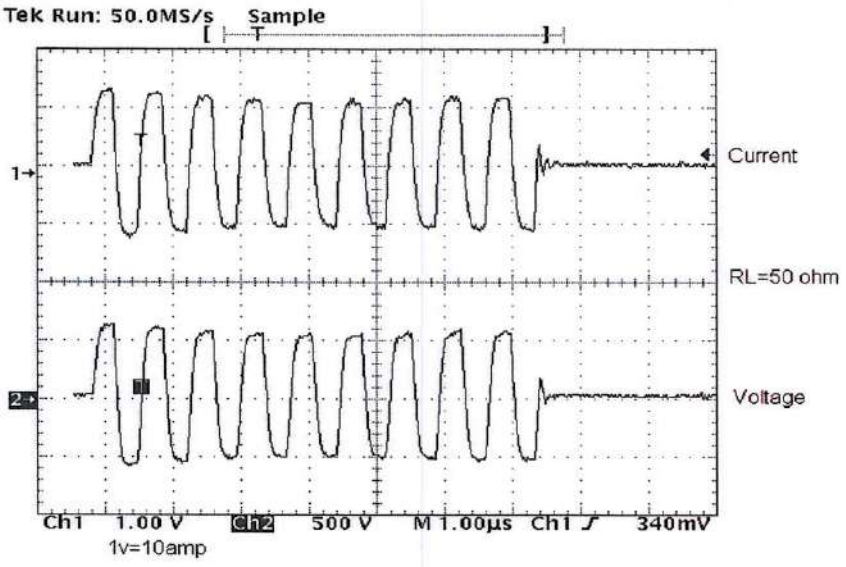
3.2. Pulser Performance

The chart below provides the pulser performance at a wide range of frequencies, and typical output at 1.5MHz.



Typical output currents and voltages 8Kw RF pulser at 1.5Mhz



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4. Equipment at a Glance

4.1. What is in the Box

1. Instrument
2. AC Power Supply
3. Hard Shell Carrying Case
4. Verification Block (Not Shown)
5. 14.4 V DC Battery (Not Shown)
6. USB Adapter (Not Shown)
7. SDHC Card (Not Shown)
8. USB Memory Stick (Not Shown)

4.2. Instrument Overview

The **temate® PowerBox H** consists of two main parts:

- Basic Platform. Includes the PC with the Graphical User Interface software, LCD screen, data entry keyboard, and input/outputs for ancillary devices.
- Cartridge. Attaches to the back of the Basic Platform, and includes the high-power pulser/receiver, the fast speed DSP board with D/A and A/D converters, and the signal input/ ports.

- **Front View**

1. Screen
2. Data entry keyboard
3. Scroll wheel
4. Harness anchor points
5. Hand band

- **Side View**

1. SD Card Port
2. MiniUSBPort
3. VideoPort
4. NetworkPort
5. AC PowerPort

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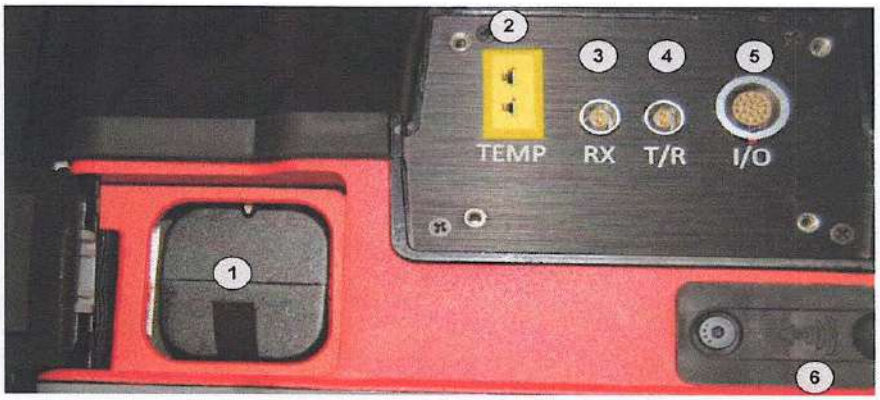
- **Top View**



1. Battery access.
2. TEMP. Thermocouple port.
3. RX. Receive connector for pitch-catch operation (requires separate Signal Conditioning Box Module PN 279A0010).
4. T/R. Transmit/Receive connector for pulse-echo operation, or Transmit connector for pitch-catch operation.
5. I/O. Input/Output connector for encoders and other devices.
6. Sound port (Not Used).

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5. Power and Battery

5.1. Power ON/OFF and Power Save

The instrument can operate from the battery, and/or when connected directly to the grid with the included power supply. To operate from the grid, connect the instrument's AC/DC power pack to the DC power jack. When DC power is connected, the green DC LCD will turn and stay on.

Power ON

- Press Power button until the red POWER LED turns on (approximately 2 seconds).
- The instrument will first display a splash screen for 10 seconds, then the update/failsafe window for another 20 seconds. The software application should appear within 45 seconds after pressing power button.
- The red MEMORY BUS ACTIVITY LED will blink during the boot-up process. It shows that the operating system is loading.

Power OFF with Automatic Saving of Setup Files

- Press and hold the power button for two seconds. A beep will be heard prior to the shutdown. Release button immediately after the beep.
- The system will save all the current setups to the default configuration file. During next Power On all the setups done prior to shut down will be available. It is still recommended to use the SAVE function to save setups. The SAVE function will save and permit assigning new names to configuration files.
- If a file was saved in the Ram drive, it will prompt to save on the hard drive.

Power Save

- Pressing the power button once will shut down the LCD. The software is still running but if an acquisition was running it will stop.
- Pressing the power button once again will cancel Power Save mode and LCD will illuminate again.
- On the System tab, when TIMERS control is enabled:
    - The "Efficiency Mode Time" is the countdown to dime out the LCD to 15 % of its maximum brightness.
    - "Auto-shutdown" is the countdown to automatically shut-down the device.
    - The "Efficiency Mode" and "Auto-Shutdown" countdown is reset as soon as a key is pressed.

5.2. System Reset

Soft Reset

- Press the X button 3 times in a row within 1 second. This will close the software and user will lose all the existing configuration setups which are not saved to a configuration file. The software will re-start after reset. In some outstanding circumstances the application might need to be re-installed. To do so, do the following:
    - Turn OFF the device, and re-start. Keep left arrow pressed to enter update menu.
    - Select the "Uninstall Application" menu option. This opens up another file menu with a single entry – "PowerBox® H". Press SEL in the keypad to navigate to the "Uninstall" button in the GUI. Press OK after selecting "Uninstall".
    - Go back to the Main Update menu using the "MENU" button in the GUI.
    - Select "Install Cartridge" menu option and press OK. This step installs the software application for the cartridge. At the end of this step, a 'Done' message appears along with a "Start Application" button.
    - The software is fully updated. You may start the application or turn OFF the device.

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Hard Reset

- If the software has crashed and screen is frozen, reboot the device as follows:
  - Press and hold the power button for 5-6 seconds.
  - When the red power LED goes off, release the power button.
  - Press the power button again to boot the device.

Software Re-Installation

  - If a soft or hard reset do not work, proceed with a full re-installation of the software (see 8. **Software Upgrades** for detailed instructions).

5.3. System Restore

If resetting the equipment or trying to install new software fails, a system restore might be needed. To restore the equipment, proceed as follows:

- Shutdown the device. Wait until the red LED power goes off.
- Prepare the restore file on an USB drive. Contact support at Innerspec Technologies for "restore" file if not available.
- The file must be located in the root directory of the USB drive (not into a subfolder).
- Press and hold the Power button for at least 10 seconds. The system must go through TWO complete full power cycles (the red power LED will turn on, then after 5 seconds it will turn off, 5 seconds later it will turn on again). After two power cycles, release power button.
- Follow the step on the screen. The system restore will erase all the data on the hard drive and reinstall the OS.
- After completion reboot the device and install the latest PBH software again.

If the problem persists, contact Innerspec Technologies for additional support.

5.4. Charging the Battery

- Charging starts immediately as soon as the DC power pack is connected, whether the application is running or not. If the application is not running, the battery will charge completely within 2 hours.
- During charging, the orange CHARGE LED stays on.

6. Navigation and File Management

6.1. Navigation

Navigation is normally performed using the keypad and scroll wheel. An external USB keyboard and mouse can also be used for this purpose.

Activating Menu and Views

- To show or hide the menu, press MENU.
- If menu is visible, the SEL key will cycle through VIEW 1 (top), VIEW 2 (bottom view, if available) and MENU.
- The item selected will have a purple outline. If enabled, the RULERS of a selected view will also switch to a white background.

Navigating Tabs and Parameters inside Tabs

- Press MENU, or navigate to the menu bar using SEL key.
- Use LEFT and RIGHT arrows to move from tab to tab.
- Use scroll wheel to move up and down inside a tab and highlight parameters.
- Use OK key, to select a parameter inside the tab.
- Once a parameter has been selected, use scroll wheel or keyboard inputs to change values and/or move up and down to cycle through the various parameters.
- Some parameters will modify results in real time, and others will not. Press OK key to confirm the new value and move to other items. Pressing OK on check boxes will also toggle the state of the check box (active or not).

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Editing Values – Alpha-Numeric Field

- All editable fields once selected for editing, their background color will change to blue. After making changes the user presses OK and the background color reverts back to its original color.
- Any character can be selected using Alpha-Numeric keypad. For example "F2" key pressed once will input "2', but when pressed twice will input value "A". Similarly user can input values "B" and "C" by pressing the same key three or four times in quick succession.
- All special characters can be selected by repeatedly pressing "F1" key.
- The decimal value or dot can be selected by pressing "F1" key three times in quick successions.
- The "space" can be selected by pressing "ZERO" key twice.

Editing Values – Numeric Field Only

- Some editable fields will only accept numeric values.
- User can select any value from 0 to 9 from the keypad. However decimal value cannot be selected from the keypad directly.
- The decimal value can be selected by pressing "F1" or "1" key twice in quick succession.
- Another way to enter decimal values can be :
- First enter the whole numbers.
- To enter decimal point, rotate scroll wheel. The field will change with a decimal point and one, two or three default digits after the decimal point.
- To amend the value after decimal point, press right key which will move the cursor to the end of the field.
- You can then delete digits after the decimal point by pressing left key once twice or thrice.
- Now enter new numbers which you want after the decimal point and press OK.

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6.2. Shortcut Keys

The instrument includes shortcut keys to directly navigate to a specific parameter in the menu.

Key	Full Name	Action
F1	Function 1	Shortcut to Display tab Views box
F2	Function 2	Shortcut to Display tab Distance box
F3	Function 3	Shortcut to DSP/GATES strip chart box
ZOOM	Zoom	On a selected view, the instrument will zoom in between the cursors. Pressing again will zoom out.
SPAN	Span	Short cut to DAQ Range value
CAL	Calibration	Short cut to velocity calibration mode
GAIN	Gain	Short cut to Gain value
COLOR	Color Palette	Short cut to color palette gradient.
SNAP	Snapshot	Screen capture of the entire screen and record it to selected media. Record media can be selected from system TAB
RULER	Ruler	Cycle through the various ruler display options.
ZERO	Zero	Short cut to DAQ Delay value
GATE	Gate	Short cut to Gate values
SAVE	Save	Save the configuration file.
RPT	Report	System will generate a report with view, cursor, and gate settings and it will be saved to selected media.
OPEN	Open	Open File (Configuration, data, report, File Management, etc.).

6.3. Saving and Recalling Files

The **temate® PowerBox H** can record and store four different types of files:

- Configuration Files.cfg. Store all the setup parameters for easy access to saved configurations.
- Data Files .datStore the entire inspection along with the configuration used for that inspection.
- Report Files .rpt. Provide snap shots of Scan Views with cursor readouts in a tabulated format. It also includes TX/RX parameters, DAQ parameters and System Hardware Information.
- Screen captures .png. Screen captures in png form.

All data files can be viewed in the PC viewer software provided with the instrument. In addition to this, Data Files can also be exported to an ASCII or CSV file for view with other programs.

All files can be stored in four different drives:

- SD Card.
- USB.
- Internal Flash Memory.
- RAM (Temporary Storage Only - Data will be lost at Power Down).

Some SD cards and USB drives may not be compatible with the unit. Known compatible brands include SanDisk, Kingston, Dane-Elec, Transcend, Lexar, Staples, and Verbatim.

To select the media to save files, go to System Tab and select Record Media. This becomes the default save location to save data, report and screen snapshots. The configuration files are saved using SAVE.

General File Operations

- OPEN and SAVE keys will enter the File browser.
- ESCAPE/CANCEL keys will exit the File browser.
- SAVE key permits saving a file or data at any point during the operation of the equipment.
- Pressing OPEN twice will enter into File Management mode. This mode permits copying, moving, deleting and renaming files within and among drives.

Configuration Files

- OPEN or SAVE key to enter File menu.
- Scroll to select Configuration files only (*.cfg) or All and press SEL or OK.
- Select an existing file name or type a name to create a new one
- SAVE Key to record a configuration file.
- Configuration files can be saved at any point during the operation of the equipment.

Data Files

- To record and save data on the selected drive, press START (Red Dot) for three seconds or more, the display on top left hand corner will change to REC.
- Release START (Red Dot) button and data recording will begin.
- After pressing stop, the data will automatically be transferred to the drive.
- OPEN key to enter File menu.
- Scroll to select *.dat files only or All and press SEL or OK.
- Select a file name by pressing OK.
- The user interface will load with the data from the file. All parameters except some from the DISPLAY menu tab will be read only.
- The view(s) will be loaded with the data from the file.
- Use cursors to make measurements.
- To generate Reports, remove measurements from screen.

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Report Files

- To save a report file for analysis, press the RPT key.
- A report will be generated in "report" folder.
- The report file name will be named as the selected "Record File Name items" in GENERAL Tab.
- To open a report file for viewing, press the OPEN key.
- OPEN menu will be displayed. Press ESCAPE/CANCEL to exit
- On top-left corner, select REPORT (*.rpt)" filter or ANY file (.*) filter.
- Navigate to the report folder and select the file to open. Each report file is saved in a separate folder along with other files depending upon the display selected
- Select the file with ".rpt" extension to open.
- The report will show in full screen. Use scroll wheel or USB mouse to browse.

6.4. File Management

File Management mode is activated by pressing twice the OPEN key.

This mode permits deleting and renaming files as well as copying and moving between the different drives (medias).

To operate, select the source and destination medias. Press OK to browse files within a media and press SEL to select the file. The cursor will move to the options menu (Copy, Move, Delete, Rename or Close).

For example, to copy a file from the internal flash drive to an SD card, select source media ia as "Internal Flash Media" and destination media as "SD Card". Scroll to the file in "Internal Flash Media" and press SEL followed by COPY. The file is now copied to SD Card at the selected location.

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7. PowerUT® H Software

7.1. Quick Reference

The **temate® PowerBox H** includes **PowerUT® H** software application. This application provides most of the generic controls used in advanced UT flaw detectors, plus a number of proprietary features especially designed for EMAT applications.

Standard Features:

- A, B, C Scans and Strip Chart Views.
- PRF and Gain selections.
- Flaw and Back-wall Gates.
- Manual, External Input, and Encoder median triggers.
- Distance Amplitude Correction Graphs.
- Time-Of-Flight (TOF) measurement algorithms (zero crossing and autocorrelation).
- Calibration.

Unique EMAT features:

- Frequency and number of cycles (from 0.5 to 5 complete cycles).
- Transmitting and receiving delay options.
- Timing for external magnet pulsers.
- Advanced software filters and algorithms to enhance signal-to-noise.
- Normalization gate (provides self-calibration for guided wave applications).

The main screen is organized in 5 sections:

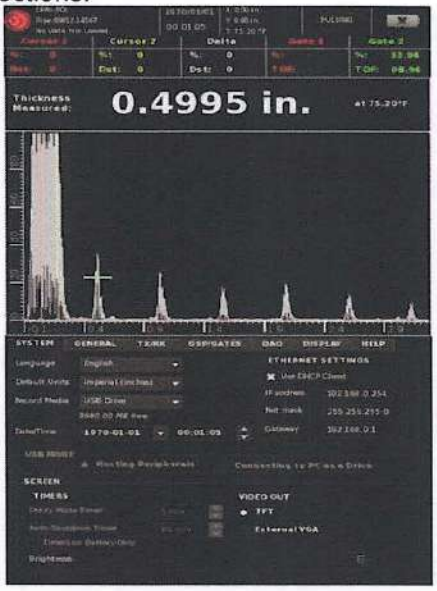
STATUS Bar

MEASUREMENT Bar

THICKNESS MEASUREMENT Bar

VIEW Area

MENU Area



* STATUS bar shows information about the instrument status. The bar is always displayed.
* MEASUREMENT bar shows the value of various cursors and gates in a view, and any important messages.
* THICKNESS bar shows the value of Thickness derived from Gate 2 TOF in large characters for improved readability.
* VIEW area will feature one or many views, depending on the screen layout selected.
* MENU area displays the menu when open. It is organized in seven tabs accessible using the right and left arrows.

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7.1.1. Measurement Bar Options

Four different Measurement Bar display options are accessible on the DISPLAY menu. The options include A-Scan, Strip Chart, B and C-scan and Alarm as shown below.

Measurement Bar for A-scan

Measurement Bar for Strip Chart

Measurement Bar for B-scan and C-scan

Measurement Bar for Alarms

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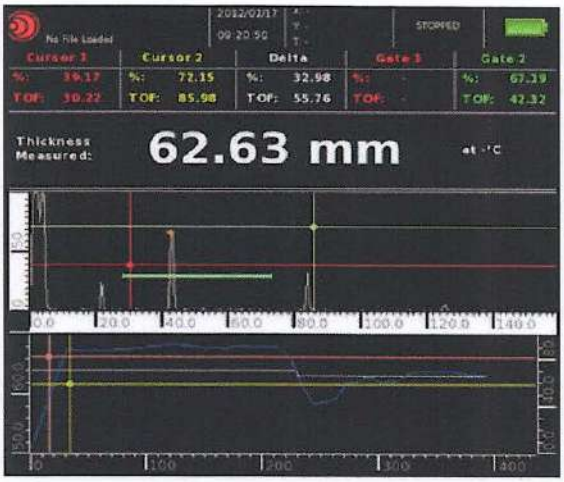
7.1.2. Measurement Cursors – View Area

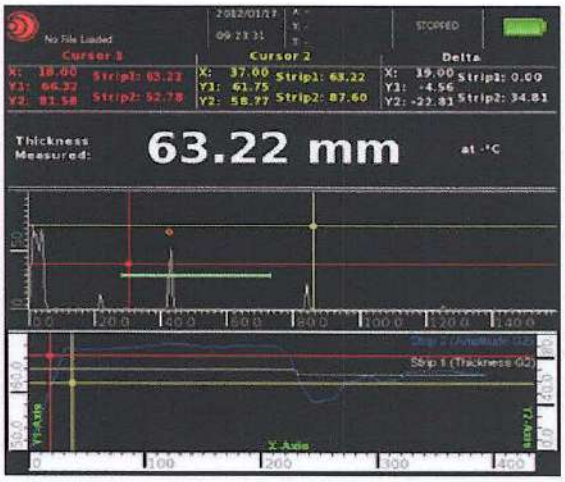
All views (A-scan, Strip Chart, B-scan and C-scan) include two cursor bars (red and yellow) that can be used to measure absolute Amplitude or TOF at a given location of the cursor or provide differential measurements. The measurement values are displayed in the Measurement Bars.

To select and move the cursors, first press SEL to highlight the View and then repeatedly press CUR to toggle between red or yellow cursor in the view. In case of A-scan view the CUR will also toggle between Gate bars. Use arrow keys (Up, Down, Left, Right) to move cursor on the screen. In A-scan View the cursors can "Snap to A" (in Display Tab) where cursor's vertical position will snap to each sample point on A-scan. In case of "A-scan + B-scan" view the cursor can also "LINK A/B" (in Display Tab) which causes simultaneous movement of cursors in A-scan and B-scan displaying the same point or area on the screen.

Once the cursors are placed on the view screen, the measurements can be read on the Measurement Bar. The measurement value will only update in Measurement Bar when the View screen is selected by pressing SEL button and one or both cursors are selected (CUR button). To create a permanent record of the measurements, reports can be generated by pressing "RPT" button (keypad) for each measurement.



Cursors and Measurements – A-scan View



Cursors and Measurements – Strip View

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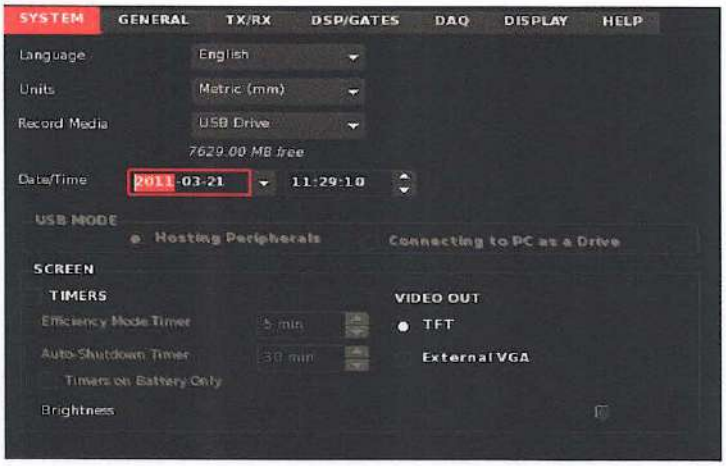
7.1.3. SYSTEM Menu Tab

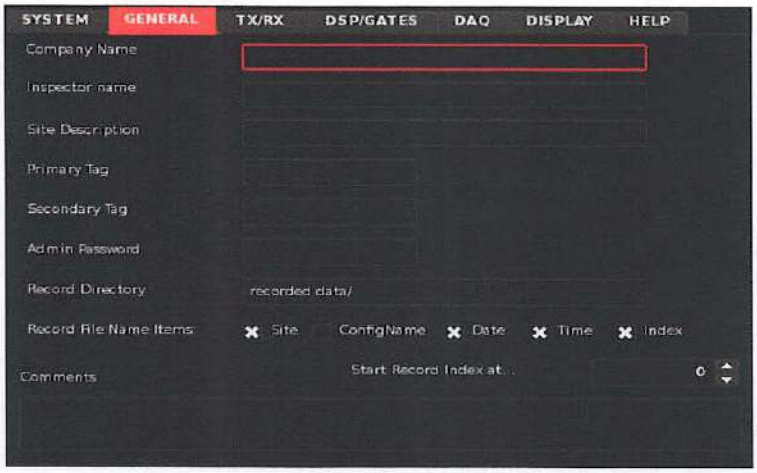
The SYSTEM Menu Tab is used for general system settings.



Parameter Name	Action
Language	Changes operating language.
Default Units	Switches between Metric and Imperial units.
Record Media	Selects media for saving and retrieving files.
Date/Time	Date and time adjustment.
Screen Timers	Enable/disable timers.
Efficiency Mode Timer	Specifies the period of inactivity before the system goes into efficiency mode. The system will continue to collect data but the screen will be dimmed to preserve power
Auto-Shutdown Timer	Specifies the period of inactivity before the system is shut down.
Timers on Battery Only	Enables timers only when the system is running on battery.
Brightness	Controls TFT screen brightness.
Video Out	Permits switching between instrument and external monitor.
Ethernet Settings	Use DHCP Client to connect Gateway for Internet Browsing if Network Cable is connected. Can also be used for Remote Access in future software upgrade.

7.1.4. GENERAL Menu Tab

The General Menu Tab used to enter inspection specific information



Parameter Name	Action
Company Name	Company Name.
Inspector Name	Inspector Name.
Site Description	Site Description.
Primary Tag	Primary identification Tag for the inspection.
Secondary Tag	Secondary identification Tag for the inspection
Admin Password	NA (pending)
Record Directory	Directory folder for storing data.
Record File Name Items	Information to be written to the file name
Start Record Index	Starting number for the data file.
Comments	General comments.

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7.1.5. TX/RX Menu Tab

The TX/RX Menu Tab permits setting timing and signal parameters.

Parameter Name	Action
Magnet	Enable trigger function for external electromagnet.
Duration	Control the length of time that the magnet is on.
Voltage	Sets transmit voltage to full power (1200Vpp) or half power (600Vpp)
Burst Frequency	Sets frequency of transmitted signal.
Number of Cycle(s)	Number of cycles per burst in 0.5 cycle increments from 0.5 to xx
Set PRF	Desired Pulse Repetition Frequency. Actual achievable PRF depends on various settings.
Obtained PRF	Effective PRF based on current settings.
Initial Mag Delay	Preliminary time to enable the electro-magnet, to ramp-up the magnetic field.
Data Window	Length of the DAQ range
RX Delay	Length of time for DAQ delay.
RX Gain	Receive signal gain.
External Signal Conditioning Box*	Type of inspection Pulse-Echo or Pitch-Catch. To be selected when you connect external signal conditioning box.
Display Timing Graph	Displays transmit, receive and magnet timings graphically to improve understanding.

* The device includes hardware tuned to provide pulse-echo measurements at 1.5-4MHz using our standard normal beam sensors and coils. The external Signal Conditioning Box attachment permits inspections using any coils from our standard catalog in pulse-echo or pitch-catch.

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7.1.6. DSP/Gates Menu Tab

The DSP/Gates Menu Tab provides access to filters and algorithms used in Digital Signal Processing and the Gates.

Parameter Name	Action
Coincidence	Can be used to eliminate noise caused by other electric devices such as electric motors
Average	Determines how many consecutive signals should be averaged to provide a resulting signal.
Enable Filtering	Apply Digital Filter
Design Filter	Can be used to select different band-pass filters, adjust lower and upper cut-off frequencies and plot filter response.
Gate Enable	Enable/Disable Gate
Gate Start	Adjust the start of the Gate
Gate Range	Adjust the duration of the Gate.
Gate Threshold	Adjust the threshold for Gate
Gate Menu	Change the Gate options
Strip Chart Content	Displays Amplitude, TOF, Thickness or Temperature. Two output values can be simultaneously displayed.

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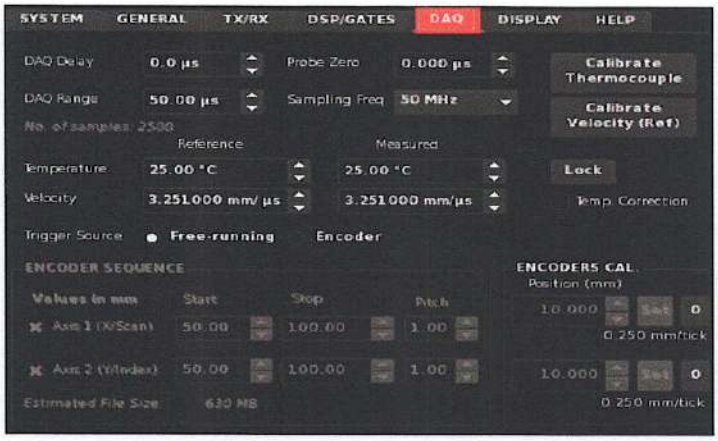
7.1.7. DAQ Menu Tab

The DAQ Menu Tab provides access to Digital Acquisition parameters such as acquisition start time, probe offsets, ultrasound velocity, type of trigger and encoder settings.



Parameter Name	Action
DAQ Delay	Adjusts when in time the A-scan acquisition should start.
Probe Zero	Adjusts probe time offset due to electronic delays.
DAQ Range	Adjusts how long in time the A-scan acquisition will last.
Sampling Frequency	Adjusts the sampling frequency of the received signal.
Calibrate Thermocouple	Opens up menu to calibrate external thermocouple probe.
Calibrate Velocity (Ref)	Opens up velocity calibration panel.
Temp Reference	Displays temperature at which the last velocity calibration was done.
Temp Measured	Current temperature of the part under inspection.
Velocity Reference	Displays calibrated sound velocity of the inspected material.
Velocity Measured	Corrected velocity at the measured temperature value
Lock	Locks the temperature readout to calculate velocity correction.
Temp Correction	Used for High Temperature Measurements. Enables measured temperature and velocity fields.
Trigger Source	Toggles between different Trigger Sources
Axis Enable	Enable/Disable Axis
Axis Start	Adjusts the start position for Axis for data recording.
Axis Stop	Adjusts the stop position for Axis
Axis Pitch	Adjusts the position interval to trigger and acquire new data.
Axis Zero	Forces the current Axis position to zero and enables Axis Position field for calibration.
Axis Position	Adjusts the encoder travel distance to calibrate mm/tick.
Axis Set	Calibrates encoder by calculating mm/tick, based on the encoder travel distance

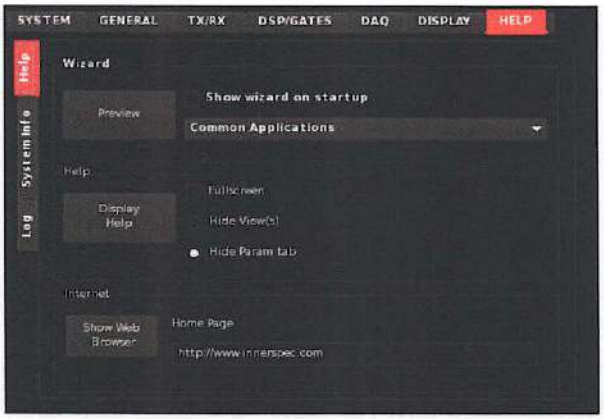
7.1.8. DISPLAY Menu Tab

The DISPLAY Menu Tab provides access to how the user views the data collected.

Parameter Name	Action
Pattern	Selects color gradient for B and C Scan representation.
Minimum Threshold	Adjust the minimum amplitude for a particular shade in the gradient.
Saturate Threshold	Adjust the maximum amplitude for a particular shade in the gradient.
Views	Selects the type of scan/s(A, B, C or Strip Chart) and its size to be displayed on the screen.
A-scan Skip	Display Settings for A-scan to increase effective PRF
Thickness Measurement	Displays or hides thickness measurement bar.
A-scan H Ruler	Displays or hides horizontal ruler in A-scan.
A-scan V Ruler	Displays or hides vertical ruler in A-scan.
A-scan Distance in us	Shows distance/depth values in microseconds.
A-scan Rectification	Turns on/off rectification for A-scan signal.
A-scan Keep max	Keeps maximum values on A-Scan if pixel compression occurs.
A-scan Keep Min	Keeps minimum values on A-Scan if pixel compression occurs
Signal Fill (Options)	Display option for No Fill, Signal Fill, Max Fill and Min Fill
A-scan DAC	Superimposes a DAC curve on top of the A-scan.
A-scan DAC Edit	Opens the DAC curve menu.
B/C/Strip H Ruler	Displays the horizontal ruler in B/C-scan and Strip chart.
B/C/Strip V Ruler	Displays the vertical ruler in B/C-scan and Strip chart.
Compress B	Keeps maximum values when compressing an A-scan into a B-scan.
Vertical Strip Chart	Rotates the strip chart 90° on screen.
Cursors Link A/B	Links cursors in A-scan and B-scan, for synchronized movement.
Cursors Snap to A	Forces the A-scan cursor to snap to an actual sample value.
Big Cursors	Increases Cursors width for better visibility
C-Vertical Strip	Display strip chart vertically along C-scan
C-scan Content	Selects peak amplitude or TOF to be shown on C-Scan.
Measurement Bar	Changes content of measurement bar.
Strip Min	Sets the lower limit for Strip Chart-1. Used to view small changes in TOF or Thickness Measurements.
Strip Max	Sets the lower limit for Strip Chart-1. Used to view small changes in TOF or Thickness Measurements.

7.1.9. HELP Menu Tab

The HELP Menu Tab provides options for built-in and on-line help.



Parameter Name	Action
Application Wizard	Will be available in later software versions
Display Help	Display help files.
Fullscreen	Display help in full screen.
Hide Views	Displays help on top of the views.
Hide Param tab	Displays help on top of the menu.
Show Web Browser	Displays web browser. Only standard HTM can be displayed
Home Page	URL of the home page.

The System Info Tab provides information about the platform, cartridge and status of storage devices.

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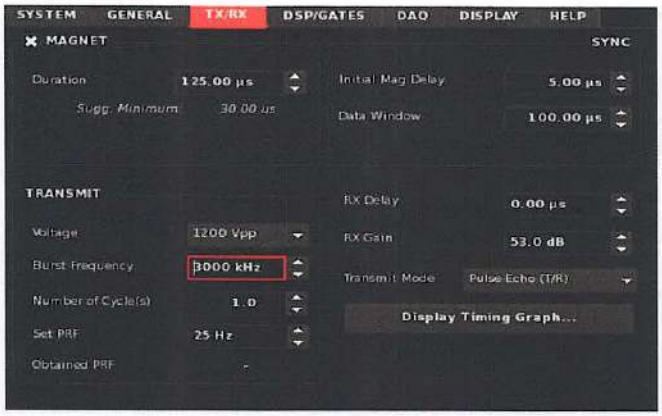
7.2. Basic Operation

This manual provides a basic operation guide for the **temate® PowerBox H unit** but it is not designed to substitute formal training. It is highly recommended that new users take an EMAT training course to learn to set experiments, and use the full capabilities of the equipment. Contact Innerspec Technologies for training courses in your area.

The systems include built-in setups for the most common applications. However, the user has complete flexibility to change or modify the settings as desired. **It is recommended to back up all the setup files provided with the system for quick restore**. This section explains some common operations needed to setup any application or inspection.

7.2.1. Technique Set Up (TX/RX)



This panel permits changing the frequency of excitation for the transducer by selecting the "Burst Frequency"and the number of cycles in the burst. More cycles can increase signal to noise (up to a point) but could reduce resolution and battery life.

"PRF" (Pulse Repetition Frequency) selection permits setting the pulsing velocity. However, real PRF might be different than set PRF depending on resources used during the inspection. The resources will vary depending on the time/data windows, gate widths and the algorithms and filters selected. Low PRF will require slow scanning to avoid leaving areas uninspected.

"Rx Delay" is used to delay the start of Receiver. The DAQ will wait for the specified time as per Rx Delay before collecting samples. The display window will also shift left as per the Delay value. The Receiver gain can also be adjusted from 20dB to 100dB in Pulse-Echo (T/R) mode and from -20dB to 60dB in Pitch-Catch (T/R->R) mode.

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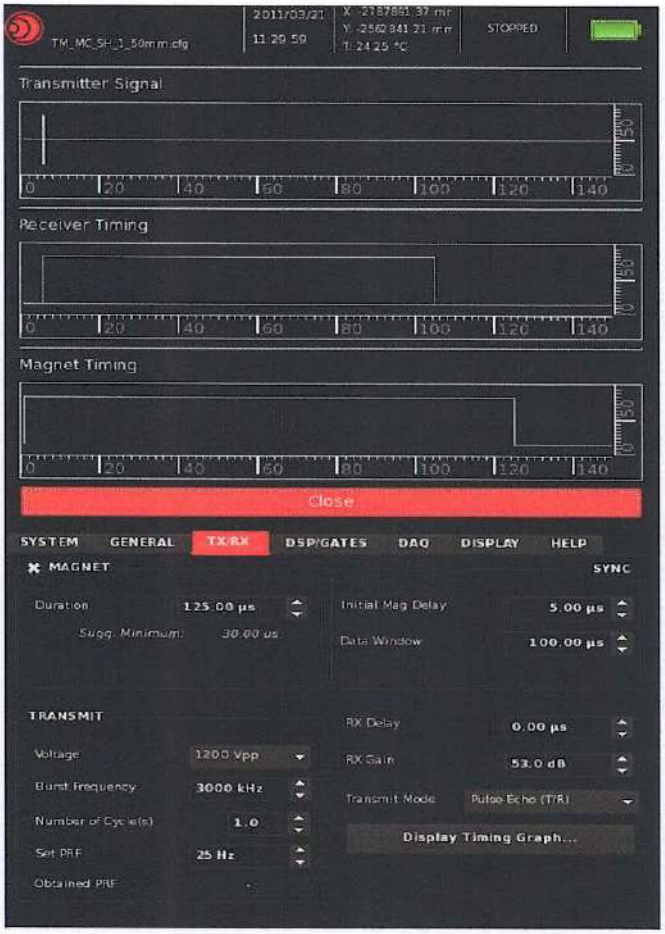
7.2.2. Magnet Setup



Magnet setup is used to control pulsed electromagnets used for some EMAT applications. This feature is only available to trained users, and requires **temate® PowerBox MP** magnet-pulsers, and electromagnet probes. Contact Innerspec Technologies for details.

The magnet "Duration" is the total time magnet will remain on. This duration should be equal to at least the DAQ Range plus the Data Window. The magnet delay is needed to give sufficient time for the magnet to reach its maximum flux density before transmitting the RF pulse. The magnet should stay on until data collection is finished for each sample.

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7.2.3. Filters and Gates (DSP/GATES)

The received signal can be processed using various filters. The "Coincidence" filter is used to remove un-synchronous RF frequency interferences, which sometimes appears like spikes or "running waves" (aka running rabbits) on the A-scan window. The "Average" increases signal-to-noise ratio.

The user can also design and apply a digital band-pass filter as shown above. The lower cut-off and upper cut-off frequencies can be adjusted using the keypad or thumb wheel. The filter quality is determined by the number of taps (64, 128 or 256). Higher tap weights (filter coefficients) increase the quality of the filter, but consume more system resources, and affect maximum PRF.

The Gates can be adjusted using the menu controls or dynamically adjusted directly on the A-Scan view panel. To adjust the gates directly on the A-Scan, press "SEL" to shift to the A-scan. Press CUR as needed until the desired gate is highlighted. Use "up/down", or "left/right" navigation keys to adjust the position of the gate. To adjust the gate width, highlight the gate using CUR key. Press OK (Check Mark) to select the left or right edge of the gate (use OK to toggle from one edge to the other). Once the edge is selected, use the right or left arrow to reduce or increase the gate width. Press SEL when done to exit the A-Scan.

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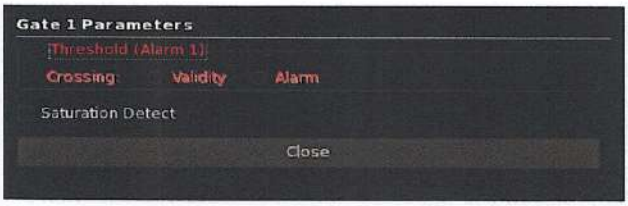
7.2.4. Measurements and Alarms

The gates Menu provides advanced gate control parameters. All Gates can be used for "Amplitude" or "TOF" measurements, and include automatic threshold setting for Alarms. A total of four Alarms (G1-Amp, G2 Amp, G3 Amp and G2 TOF) are available. Gate1 is normally used as CAL (calibration) gate (normally used for guided wave applications. Refer to the appropriate Application Sheets). Gate-2 as Flaw gate and Gate-3 as a back-wall gate for normal beam inspections.**Gate-2 is the only gate used for thickness measurements**, and provides three optional algorithms for calculating "TOF":

- Peak in the gate
- Zero-Crossing
- Auto-Correlation
- Zero-Crossing on First Peak After Threshold

Select DISPLAY tab and set Measurement Bar on Alarms. All Alarm conditions can be displayed in the Measurement Bar for G1, G2 and G3. DIO (Digital Input Output) connector can also be used to media other devices in case of Alarms. The system has the provision to provide 6 digital inputs and 6 digital outputs if needed.

7.2.4.1. Gate 1 Parameters



"Alarm-1" can be enabled by selecting "Threshold (Alarm1)" with options to set "Validity" or "Alarm". If "Validity" is selected than as soon as Peak signal level within Gate-1 drops below threshold, the inspection data will become invalid indicated with YELLOW color in Measurement Bar. The B-scan data will also be painted YELLOW. If user selects option to "Alarm", then as soon as the Peak amplitude crosses the Gate-1 threshold level the system will display Alarm in RED on the measurement bar". In case of B-scan this condition is indicated with RED color. The "Alarm" set the Alarm-1 bit high on the digital input/output connector which can be configured to media any other device.

If "Saturation Detection" is enabled, the Alarm will display peak amplitude "Saturated" within the gate when amplitude value exceeds 100% in the gate. This will also be indicated on the Measurement Bar for Alarms.

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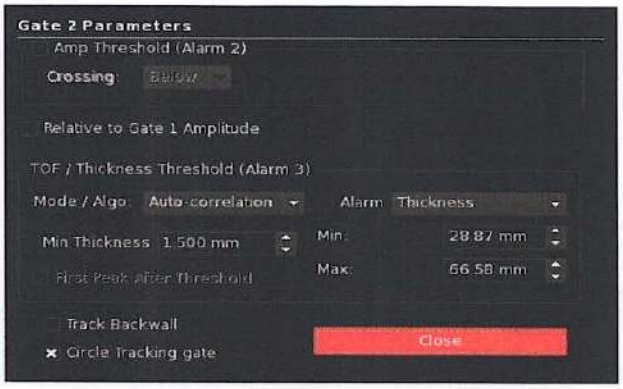
7.2.4.2. Gate 2 Parameters



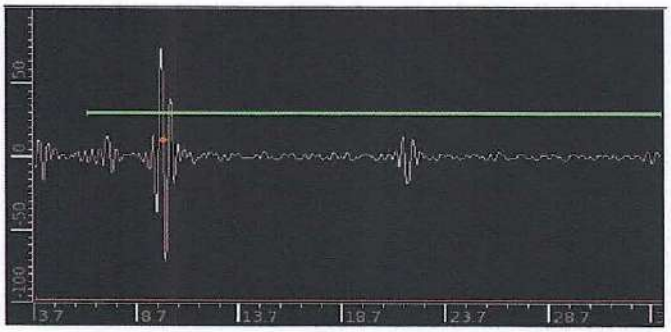
"Alarm 2" can be set on Gate-2 amplitude for Crossing "Above" the threshold or Crossing "Below" the threshold for G2 amplitude Alarm condition.

Relative to Gate 1 Amplitude (Signal Normalization) once checked divides G2 amplitude with G1 amplitude to perform point-by-point self calibration. This feature is recommended for flaw detection with guided waves (reflection technique with separate transmitter and receiver).

"Alarm 3" is used for TOF or Thickness threshold using Gate-2. Alarm-3 is enabled by selecting "TOF/Thickness Threshold (Alarm 3)". If the TOF algorithm is "Peak" or "Zero-Crossing" the Alarm can be set between minimum TOF (G2 Start) to maximum TOF (G2 End). These thresholds can be adjusted in µs for TOF or in mm for Thickness. In case TOF algorithm is selected to be "Auto-Correlation", the minimum and maximum thresholds can range from 0 µs to the width of G2. The minimum thickness value needs to be adjusted for auto-correlation algorithm. This value can change due to the transducers frequency of excitation, and number of cycles in a burst. Using 3000 kHz excitation and 1 cycle, the minimum measurable thickness is approximately 1.5mm.

Track Back Wall enables adjusting the width of G2 with reference to G3. Normally G3 is in this application is set on the back-wall and G2 is set to detect flaws very close to the back-wall surface. Using this feature the user can lock G2 to move according to changes in TOF measured on G3.

Circle Tracking Gate will display a circle on the TOF reference point in A-scan using Zero-Crossing and Peak algorithm only. This feature is helpful in knowing the exact peak in the reflected signal which is being used as reference to measure TOF.



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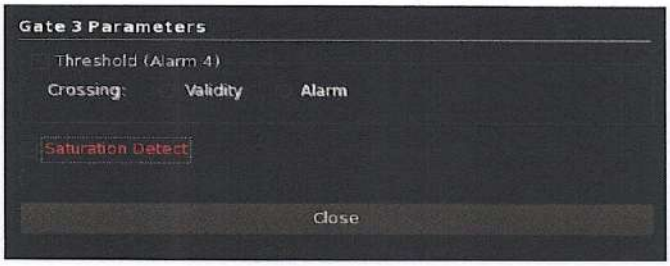
7.2.4.3. Gate 3 Parameters



"Alarm-4" can be enabled by selecting "Threshold (Alarm4)" with options for "Validity" or "Alarm". "Validity" will alarm in yellow when the peak signal level within G3 drops below the selected threshold (invalid data). The B-scan data will also be painted yellow. "Alarm" will display the Alarm caption in red in the measurement bar, and change the color of the B-scan if the maximum value on G3 reaches the threshold level. "Saturation Detection" will display Saturated caption in the measurement bar when when the amplitude value exceeds 100% in the gate.

7.2.5. Strip Chart Options

DSP GATES panel also provides setups for Strip Chart view. The system's Strip Chart view can display two outputs from any of the gates along with ability to display temperature. The right side ruler of strip chart will display the Y-axis values for strip-1 and left side ruler will display Y-axis values for strip-2. The X-axis values can be encoded by changing Trigger Source (DAQ panel) from Free-running to Encoder mode. The various options which can be displayed in a strip chart are:

- G1 Amp
- G1 TOF
- G2 Amp
- G2 TOF
- G3 Amp
- G3 TOF
- Thick
- Temp

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7.2.6. Calibration and Running Modes (DAQ)

"DAQ Delay" sets where the zero or starting point of the display. It is used to eliminate from view a portion of the display that is not interesting for the user.

"Probe-zero" is used to offset any delays due to hardware/processing. It can also be adjusted manually in case of piezoelectric transducers to offset delays due to wedge.

The "Calibration" button is used for velocity calibration, and "Calibration Temperature" is used to calibrate the device to measure correct temperature. The system is also capable of providing sampling frequencies of 10MHz, 25MHz, 50MHz and 100MHz. Please note that for good signal reconstruction in digital domain the sampling frequency should be at least 10 times the RF frequency. The "Data Window" size, also referred to as "DAQ Range" is also dependent on the selected sampling frequency. When a large data window size is desired, it is recommended to use the lowest possible sampling frequency to optimize maximum PRF possible.

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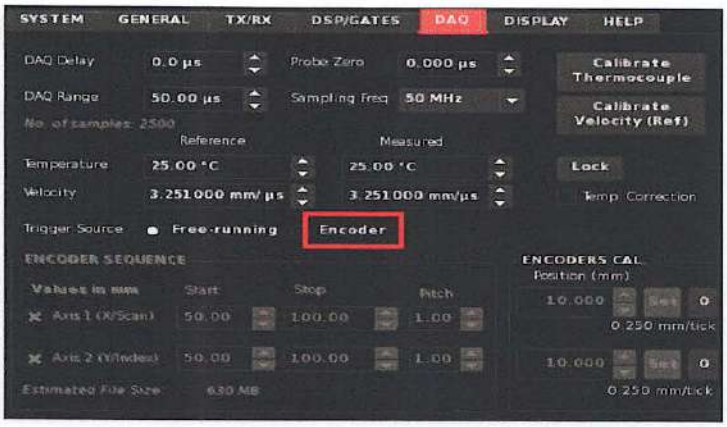
7.2.7. Encoder Setup (DAQ)



Setting Trigger Source to "Encoder" enables the Encoders Calibration and Sequence setups. To calibrate encoder, press "0" and edit the distance to be used for calibration. In the above figure it is shown a distance of 200mm. To calibrate, press START and the system will start pulsing when the encoder moves. Move the encoder the distance selected, and press SET, to calculate mm/tick distance.

The "Encoder Sequence" is setup by editing the values for start and stop. The pitch can be adjusted based on the distance (mm/tick) calculated during calibration. Encoder PN 281A0002 from Innerspec Technologies is set from the factory to 0.25 mm/tick. To setup an encoded in-line scan sampling every 3mm, the pitch in the scan setup can be adjusted to "12" (0.25 mm/tick x 12 = 3mm).

The forward encoder motion will paint forward and reverse motion will paint in reverse direction. The maximum scan can be from -10m to +10m.

The system provides complete flexibility to integrate two encoders (Axis-1 and Axis-2) of any make and type with the system.

For maximum PRF/speed during scanning, change VIEW to Strip Only or B-scan only. For optimum performance, use A-scan VIEW only when setting the experiment

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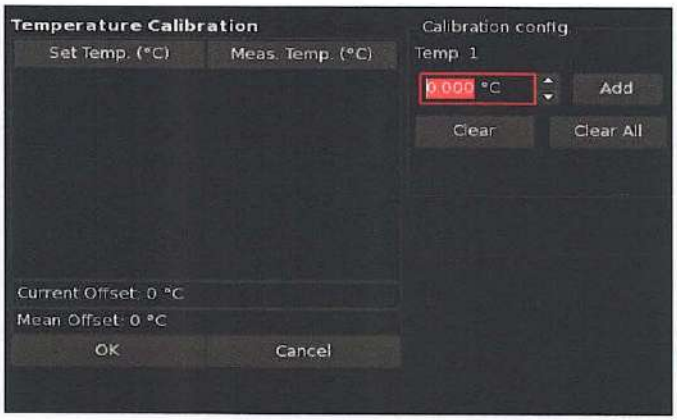
7.2.8. Calibrate Thermocouple



A thermocouple probe such as PN 281A0001 provided by Innerspec Technologeis can be calibrated by using the Calibrate Thermocouple menu on the DAQ panel.

To calibrate, edit the "Temp-1" field with the known temperature value of a reference part. Now place the thermocouple to be calibrated on the same partand press"Add". Press "OK" to exit from this panel. To increase accuracy, add points as needed.

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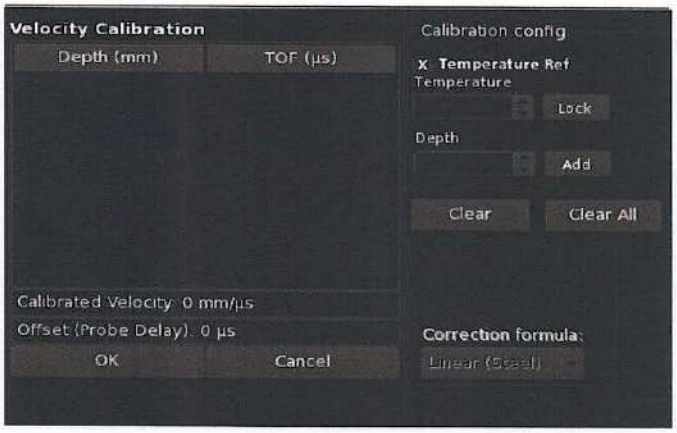
7.2.9. Calibrate Velocity, and Temperature Correction



Velocity calibration is necessary for accurate thickness measurements. The **temate® PowerBox H** provides different TOF calculation algorithms. For "zero-crossing", the system requires two known depth values to calculate "Offset (Probe Delay)" and "Calibrated Velocity". When using the "Auto-Correlation" algorithm, only one known depth value is required to determine "Calibrated Velocity". "Offset (Probe Delay)" calculation is not necessary using this algorithm.

For maximum accuracy or when the calibration part is known to be at a different temperature than the material to be inspected, it is necessary to use a Reference Temperature in the calibration process. To use this feature, enable "Temperature Ref".When using a thermocouple attached to the equipment, press pulse to start reading the temperature (the sensor can be in the air or on a part).Once the temperature reading is appropriate, press "Lock" to fix the temperature value. Pressing "Lock" also permits manual editing of the temperature value. Enter the depth value for velocity calibration. Press "Add" to calculate TOF values for velocity calibration and probe offset.

During the inspection, the "Temperature correction" can be performed on DAQ tab by enabling "Temp Correction". When using a thermocouple attached to the instrument, it needs to be pulsing (the sensor can be in the air or on any part) to read the temperature of the part. Press "Lock" to fix the temperature value.The velocity will be automatically correctedusing the algorithm (Correction Formula) previously selected in the calibration process. The new velocity will be displayed in the "Measured Velocity" field. Apply transducer to the part and perform inspection. The values of the measurements will be calculated using the temperature-corrected velocity.

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7.2.10. Display (DISPLAY)

The color palette can be adjusted for minimum and maximum thresholds to enhance the contrast for small variation.

A-scan skip provides ability to pulse at higher PRF using A-scan in VIEW mode. The A-scan mode takes considerable resources from the instrument to render the complete data window, and may not be able to achieve more than 25 PRF. Higher PRF can be achieved by skipping one or more alternate A-scans.

"Compress B" is used to display B-scan data in real-time, in a compressed format (low resolution) to increase PRF and speed of inspection. The actual B-scan data will be saved in full resolution and can be displayed later after the scanning has completed.

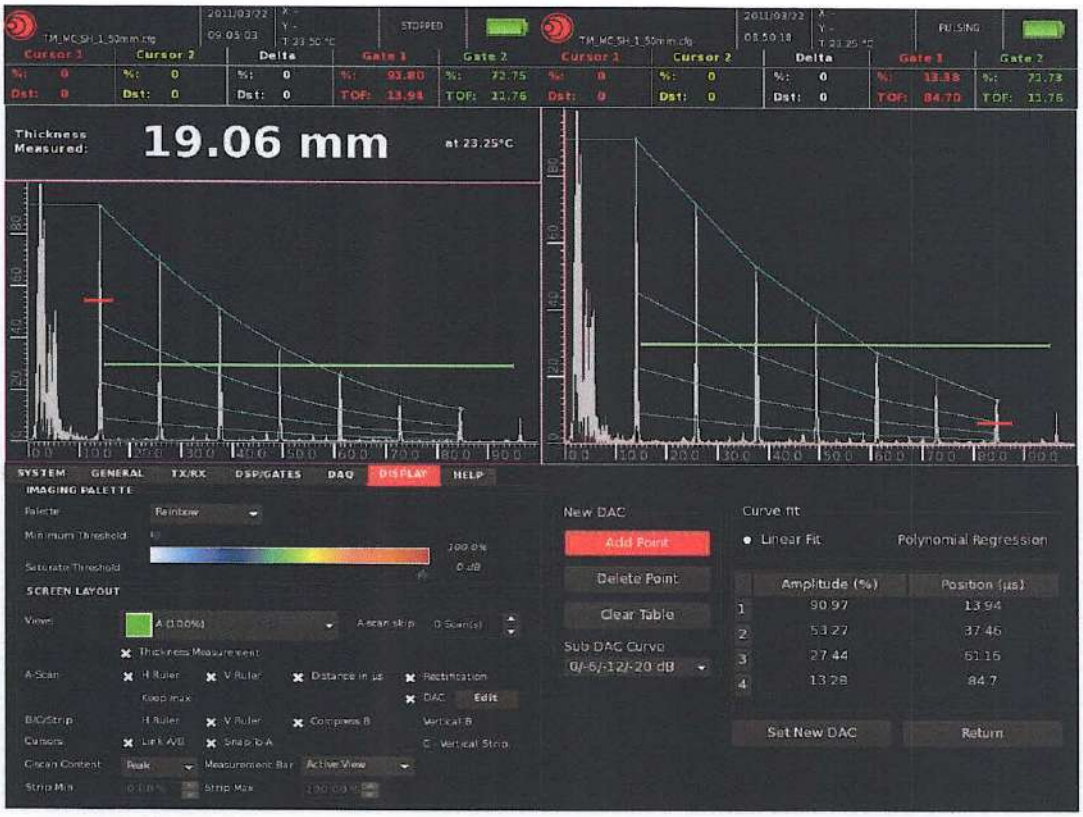
"Link A/B" when enabled causes cursors in A-scan view and B-scan view be linked together.

"Snap to A" causes the cursors in A-scan to snap to the sample's amplitude value. It provides ability to readout the true amplitude at a certain location in A-scan view.

Measurement Bar shifts to the cursors position readouts based on the active view. The focus can be shifted to any view using "SEL" button on keypad.

Strip "Min" and "Max" permits setting the Y-axis range for Strip-1 when measuring TOF or Thickness. Y-axis scaling options are only available for Strip-1, so it should always be selected for TOF and thickness measurements. The "Zoom" button should only be used to zoom horizontally between two cursor locations.

7.2.11. Overlaying DAC Curves on A-Scan (DAQ)



DAC Curves can be editted and overlayed on A-scan view using DISPLAY tab. Gate1 should be enabled before editing the DAC curves (shown above in Red) as Gate1 is used for recording the points.

The system permits recording any four points on A-scan view, and set the DAC curve using a "Linear Fit" or "Polynomial Regression".

Enable DAC and press EDIT. Start pulsing, and press SEL to shift to the A-scan view. Press CUR to select Gate1, and using navigation arrow keys, position the gate on the peak to be recorded as point-1 in the DAC curve. Press SEL again to toggle to the DAC edit menu, and press "Add Point". Up to four points can be added by repeating the same process. Select the Curve Fit algorithm (Linear or Polynomial fit), and press "Set New DAC". Four different DAC curves will be overlayed at 0dB, -6dB, -12dB and -20dB.

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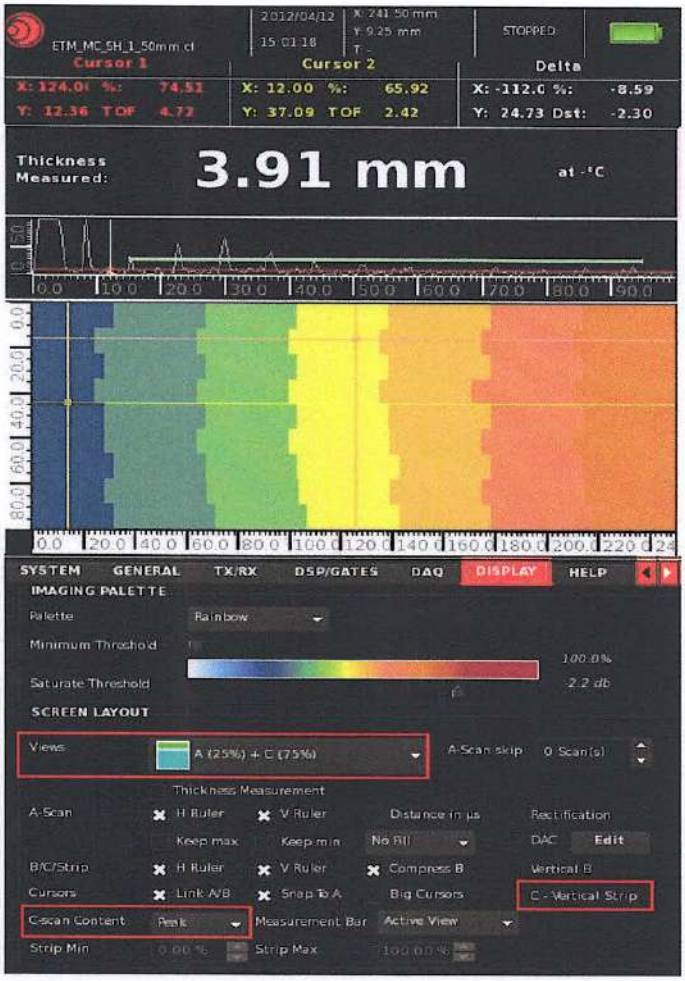
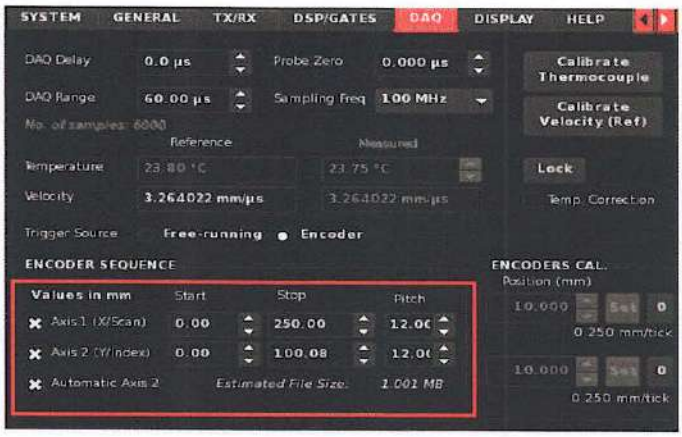
7.2.12. Generating C-Scan



From Views in Display panel, C-scan can be displayed alone or can be displayed with A-scan or strip chart options. In "C-scan + A-scan" option the A-scan data will also be displayed while acquiring C-scan data for each sample point. In case of "C-scan + Strip" option, the Strip-Chart is only used to review C-scan data after data acquisition has completed. In C-scan review mode, the strip chart will display the data along the horizontal position of the cursor or along the vertical position of the cursor. To display the data along the vertical position of the cursor the user must enable "C-Vertical Strip" in Display Tab. The C-scan is a 2-dimentional data where the information from gate-2 (G2) can be plotted using shades of color provided by the selected palette. The C-scan can be plotted for the amplitude value in G2 or can be plotted for TOF data using "C-scan Contents" in Display Tab. In case of TOF as C-scan Contents, the thickness information can also be displayed by selecting thickness measurement bar.



To record a C-scan both X and Y encoders (Axis-1 and Axis-2) are needed. If Y-encoder (Axis-2) is not available users can still generate C-scan by generating Y-encoder trigger manually or automatically based on the Axis-2 (Y/Index) parameters. User selects the horizontal and vertical area of scan by providing Axis-1 and Axis-2 "Start" and "Stop" values. To increment Y-index manually, ensure "Automatic Axis-2" is disabled. Start pulsing and move probe in the X-axis, when probe reaches the end or when you want to do Y-increment, select C-scan view area by pressing SELECT and press DOWN arrow key and start moving the probe in reverse direction. The C-scan will start painting second line in reverse direction. Again reaching back to the X-axis start position, press DOWN arrow key again and start moving probe in the forward direction. In case "Automatic Axis-2" is enabled the Y-index would be incremented automatically when probe reaches the either end of X-axis scan range as specified by Start and Stop values.

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8. Software Upgrades

The instrument's software is designed to be easily updated by the user. After receiving the new .upd file from Innerspec Technologies, follow these instructions carefully:

- Copy the firmware update (.UPD file) into the root (main) directory of the USB drive provided with the unit, or on a USB drive from an approved vendor. See section 6.3 for details.
- Connect AC Power Supply to instrument. Only perform updates when the instrument is connected with the external power supply.
- Plug the USB drive (use micro USB adapter included with the equipment if needed), and turn the instrument ON.
- When the **temate®** logo splash screen shows up, hold down the left arrow button in the keypad to bring up the Main Update menu.
- In the Main Update menu, navigate to the "Install Update" option using the scroll wheel, and select it by pressing the OK button.
- A file menu opens up with all the available files in the different storage media. Select USB media, and highlight the correct software update file. Press SEL in the keypad to navigate to the "Install" button in the GUI. Start installation by selecting "Install Update".
- Each update file may also contain some important messages about the update file.
- The installation takes a few minutes, and should end with a message reporting success. Turn OFF the device by pressing the power button once.
- Turn ON the device again and enter the update menu by keeping the left arrow button pressed.
- Select the "Uninstall Application" menu option. This opens up another file menu with a single entry – "PowerBox® H". Press SEL in the keypad to navigate to the "Uninstall" button in the GUI. Press OK after selecting "Uninstall".
- Go back to the Main Update menu using the "MENU" button in the GUI.
- Select "Install Cartridge" menu option and press OK. This step installs the software application for the cartridge. At the end of this step, a 'Done' message appears along with a "Start Application" button.
- The software is fully updated. You may start the application or turn OFF the device.

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9. PC Viewer Software

The instrument comes with an easy to use desktop application to view and save settings, generate reports etc. The GUI of the software is similar to the instrument.

To use the application unzip the file to a folder and run PowerBoxH.exe.

Keyboard Shortcut	Function
Ctrl+ O	Open File
Ctrl+ S	Save File
Ctrl+ P	Generate Report
Ctrl+ +	Zoom in
Ctrl+ -	Zoom out

- "Open File" is used to load a Data file or Report File to review.
- "Save File" exports the data into a ".csv" file and saves it back in the same directory with the name provided by the user. This file can be opened in Excel and data from each sample point can be further processed in any other software as needed.
- "Generate Report" will generate a report, which will be saved in "Report" folder. The generated report can be opened using "Open File" and can be converted into PDF for distribution and print out.

NOTE:

1. PC Viewer Software provides complete "DATA EXPORT" functionality using "Ctrl+ S" option as explained above.

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10. Troubleshooting

- USB Not Recognized.
  - Try using another USB from the recommended manufacturers (see section 6.3. of this manual)
- SD Card Not Recognized.
  - The system cannot recognize the SD card if it is started with the card inside the slot. Remove the SD card from the slot and restart the system. Insert SD card.
  - If the SD card is removed while the system is running, it will not be recognized if inserted again, unless the system is restarted.
- System Locked-up
  - Press CANCEL or X three times in succession for soft-reset.
  - If problem still persists, press power button for approximately 7 seconds for a hard-reset. The screen will turn green or black, wait for system shut down, and restart again all files will be lost.
- Noisy A-scan
  - Check that all cables are properly inserted in the connectors.
  - Increase Coincidence Filter taps.
  - Increase averaging.
  - Use a better quality filter Q3(256) with a narrow band-pass filter around the excited transducer frequency.
  - Ground the part with a metallic strap from the part to the connector of the receiver.

For any problems with this unit, contact Innerspec Technologies Technical Support. Details in section 12.

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11. Maintenance

Maintenance of this unit is restricted to charging the battery, and occasional cleaning of the equipment.

- Battery will begin charging when the AC power is connected and will continue until fully charged. The Battery is removed by sliding tab on lid on top of the unit. Re-insert by aligning the keyed slot with the bottom of the casing.
- The display screen may be cleaned using slightly damp (water) cloth and wiping with light pressure.The case may be cleaned with mild household detergent.

****WARNING****

The temate® PowerBox H is designed to resist occasional splashing of liquids on the surface of the unit.

Do not immerse or expose to direct water streams.
Keep water and other liquids away from the connectors, ports, and battery.

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12. Accessories

Innerspec Technologies offers hundreds of EMAT sensors (contact Innerspec for catalog), and many accessories for the **temate® PowerBox H**, including:

12.1. Signal Conditioning and Multiplexing Attachments

These snap-on modules connect directly to the **temate® PowerBox H** to provide pulse-echo multiplexing, and pitch-catch signal conditioning for guided wave and angle beam applications.

Part Number	Type & Frequency	Probes & Sensors	Minimum Cables Required*	Connector Instrument	Connector Probe	Dimensions
279A0009	**1:8Multiplexer** Pulse-Echo	All Normal Beam except 160A0046	1-232A0123	Not Applicable (snap-on Module)	6 Pin Lemo 1B 19 Pin Lemo 2B Type K Mini	 4.16"W x 4.48"D x 3.63"H 105mm x 114mm x 92mm
279A0010	**Signal Conditioning 1 Channel** Pitch-Catch **Angled Beam & Guided Waves** (includes 1 slot for Tuning Module)	274A0106 274A0107 274A0120 274A0144 274A0108 160A0062 160A0049 160A0076 160A0119	2-232A0123	Not Applicable (snap-on Module)	2-2 Pin Lemo 0B 19 PinLemo 2B Type K Mini	

12.2. Encoders, Thermocouple, Batteries and Other Accessories

Part Number	Description	Connector	Probes	Instrument	Picture
281A0002	Encoder Cable Length: 120cm Resolution: 4p/mm -100ppi	Lemo FGG.2B.319.CLAD62Z	274A0107 274A0144 274A0120 274A0121	temate® PowerBox H	
281A0001	Thermocouple	Type K Mini	NA	temate® PowerBox H	
210V0002	Spare Battery	NA	NA	temate® PowerBox H	
210V0003	Battery charger (dual slot)	NA	NA	temate® PowerBox H	
211V0053	AC/DC power pack with AC cord	NA	NA	temate® PowerBox H	
232V0477	Body Harness	NA	NA	temate® PowerBox H	

13. Limited Warranty

The **temate® PowerBox H** has passed strict controls under ISO 9001:2008 quality guidelines, and is designed to use in industrial environments.

Innerspec Technologies warrants its products to be free of defects in Material and Workmanship for a period of **one year** from date of purchase by end user. **Innerspec Technologies** will, at its choice, replace or repair parts found defective and return equipment or parts to the purchaser.

The above stated warranty does not apply to expendable or consumable parts, and to products which have failed due to misuse, alteration, unauthorized repair or modification. The purchaser is responsible for transportation costs of the equipment to and from the factory for warranty replacement or repair. The above warranty does not include incidental or consequential damages.

Innerspec Technologies is not responsible for damage to or loss of any programs, data, or removable storage media and for the restoration or reinstallation of any programs or data other than software installed by **Innerspec Technologies** when the product is manufactured.

Contact Information

For any questions or comments concerning operation, spares, and sensors and attachments for this unit, please contact Innerspec Technologies by regular mail, phone or e-mail.

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For Additional Equipment: sales@innerspec.com

Check www.innerspec.com for the Latest Product Releases and News