Multi-Channel Eddy Current Testing System

(ECT System 2506)

Operation & Installation Manual

Revision 1.1

Abbreviations and Acronyms

Abbreviation	Full Form
AC	Alternating Current
CH	Channel
DC	Direct Current
DHCP	Dynamic Host Configuration Protocol
ECT	Eddy Current Testing
EIB	EIB Solutions
EMI	Electromagnetic Interference
ESD	Electrostatic Discharge
HDMI	High-Definition Multimedia Interface
I/O	Input / Output
IEC	International Electrotechnical Commission
IP	Input (I/O)
LED	Light-Emitting Diode
NO GO	No Go (reject)
GO	Good / pass
OP	Output
PC	Personal Computer
PLC	Programmable Logic Controller
PWD	Password

Abbreviation	Full Form
RPM	Revolutions Per Minute
SUB-D-25	D-subminiature 25-pin connector
UDP	User Datagram Protocol
USB	Universal Serial Bus
VAC	Volts Alternating Current
VGA	Video Graphics Array
Z1 / Z2	Acceptance zones

Foreword

The ECT System 2506 is a six-channel eddy-current testing controller for automatic inspection of bearing races, rings, rollers and other precision metal components. It delivers reliable GO / NO GO decisions in real time and is designed for integration into automatic bearing and metal-surface testing systems. The system combines high-performance ECT_R2 acquisition boards with a Windows based application operator interface and a rugged 4U rack-mount chassis.

This manual is intended to serve as both the operation manual and the installation manual for the ECT System 2506. It covers unpacking, mounting, wiring, configuration, software operation, calibration, maintenance, and troubleshooting. Please read the entire document before installing or operating the system. Keep this manual accessible to all qualified operators and maintenance personnel.

The system detects the relative signal profile of each workpiece and compares it with validated master and known-defect samples.

Document conventions

WARNING — Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION — Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or equipment damage.

NOTICE — Indicates practices or information essential to proper operation or product protection.

Contents

1. Safety Information

1.1 General Precautions

WARNING — Moving machinery Eddy-current probes and I/O terminals are usually connected to high-speed production machinery. Always stop the associated conveyor, sorter, or spindle before connecting or disconnecting probe cables or I/O wiring.

CAUTION — Heat and ventilation Do not obstruct the rear cooling fan or chassis ventilation slots. Allow at least 100 mm clearance around the rear and sides of the chassis.

NOTICE — ESD sensitivity The acquisition boards contain electrostatic-sensitive components. Use an ESD wrist strap and an ESD-safe mat when handling boards or modules outside the chassis.

1.2 Intended Use

The ECT System 2506 is intended for:

- Non-destructive eddy-current inspection of bearing races, rings, rollers, and other metallic components.
- Surface and near-surface flaw detection such as cracks, pits, internal cracks and material discontinuities.
- Automatic GO / NO GO sorting when integrated with a part-handling or reject mechanism.

Use the system only within its specified environmental and electrical conditions. Any other use is considered improper.

2. Brief Technical Specifications

System level technical specifications are listed below. Further details can be found in subsequent chapters.

Parameter	Value
Number of channels	1, 2, 4, or 6 (user-configurable expansion in the same 6-channel chassis)
Excitation frequency	1 kHz – 1000 kHz
Gain control	1% to 100%
Measurement length	1 to 30 seconds
Digital I/O per channel	3 inputs, 2 outputs
Power supply	230 VAC, 50 Hz, single-phase
Chassis dimensions	19.0 in × 11.9 in × 4U high (482.6 mm × 302.6 mm × approximately 177 mm)
Operating temperature	0 °C to +50 °C
Storage temperature	-10 °C to +60 °C
Relative humidity	Up to 85 % non-condensing

NOTE — The chassis dimensions, front panel image, and Mini PC specifications are for reference only. Any brand of Mini PC may be used; the actual front panel and layout may differ from the values shown.

3. Product Configurations and Ordering

The ECT System 2506 is supplied in a standard 19 × 11.9 inch, 4U-high rack-mountable chassis. The same chassis can be populated with one, two, four, or six acquisition boards and the corresponding number of probe and I/O connections.

Model	Channels	I/O Connector Groups	Typical Application
ECT System 2506-1	1	CH 1-3 I/O (partial)	Single-station or R&D test bench
ECT System 2506-2	2	CH 1-3 I/O (partial)	Two-up fixture or dual-head machine
ECT System 2506-4	4	CH 1-3 I/O (full) + CH 4-6 I/O (partial)	Four-head rotary or linear machine
ECT System 2506-6	6	CH 1-3 I/O (full) + CH 4-6 I/O (full)	Full six-head production line

NOTICE — The 1-, 2-, and 4-channel variants use the same six-channel chassis, with unused positions reserved for later expansion. Additional acquisition boards and the corresponding probe and I/O connections can be installed on request.

4. General Description

4.1 Detection Principle

An eddy-current probe is energized by a precise, frequency-tunable AC signal. The resulting electromagnetic field induces eddy currents in the conductive test piece. Cracks, pits, and other material discontinuities disturb these currents and change the measured signal. The acquisition board captures the response, and the EIB ECT App evaluates it within the configured Z1 and Z2 inspection windows against the Th-1 threshold. The system then reports a GO or NO GO result and updates the configured digital outputs.

4.2 Main Components

The ECT System 2506 consists of the following major assemblies:

1. Rack-mount controller chassis containing the Mini PC and acquisition boards.
2. ECT_R2 acquisition boards — excitation, signal acquisition, and measurement electronics.
3. EIB ECT App — Windows WPF operator interface for configuration, acquisition, analysis, and reporting.
4. Rear-panel CH1–CH6 probe connectors and CH 1-3 / CH 4-6 SUB-D-25 I/O connectors.
5. VGA/HDMI monitor connector and 230 VAC / 50 Hz power inlet on the rear panel.
6. Eddy-current probes and application-specific mechanical fixtures.

5. Mechanical Chassis Description

5.1 Chassis Mechanical Data

Parameter	Value
Width	19.0 in (482.6 mm)
Depth	11.9 in (302.6 mm)
Height	4U (7.0 in; approximately 177 mm)
Mounting hole spacing	Standard EIA-310 19-inch rack pattern on the front ears (fit M6 or 10-32 cage nuts)
Weight	Approximately 12 to 15 kg, depending on channel count and options

All chassis dimensions are in millimetres (mm).

Chassis dimensions

Figure 1 — ECT System 2506 chassis dimensional drawing (all dimensions in mm).

5.2 Front Panel

The front panel is 19 inches wide and 4U high (approximately 177 mm). It carries:

- The EIB Solutions logo and product name ECT SYSTEM 2506.
- The Mini PC with front-access 2x USB ports and power button.
- Mounting holes on the left and right sides for rack installation.

ECT System 2506 front panel

Figure 2 — Front panel showing EIB Solutions branding and Mini PC.

NOTE — The chassis front image is for reference only. Any brand of Mini PC may be used; the actual front panel may look different from the one shown.

5.3 Rear Panel

The rear panel provides all field wiring and power interfaces. From left to right (as shown in Figure 3):

- Cooling fan with protective grille and ventilation slots.
- 230 VAC / 50 Hz power inlet.
- VGA / HDMI monitor connector.
- CH 4-6 I/O SUB-D-25 connector for channels 4, 5, and 6 digital inputs and outputs.
- CH6, CH5, CH4, CH3, CH2, CH1 circular probe aviation connectors.
- CH 1-3 I/O SUB-D-25 connector for channels 1, 2, and 3 digital inputs and outputs.

Rear panel layout

Figure 3 — Rear panel with fan, power inlet, display connection, CH1–CH6 probe connectors, and SUB-D-25 I/O connectors.

NOTICE — The exact pin assignments for IP1, IP2, IP3, OP1, OP2, +24 V, 0 V, and common returns are silkscreened on the rear panel next to each SUB-D-25 connector.

5.4 Unpacking and Inspection

5.4.1 Delivery Check

Inspect the shipping crate / box and the chassis for visible damage. Verify that the following items are present:

- ECT System 2506 controller chassis.
- Mains power cord.
- Mini PC (pre-installed in the chassis) visible on the front panel.
- ECT_R2 acquisition boards installed as ordered (can be counted by inspecting the back panel 4 pin aviation connectors).
- Type and number of probe cables (quantity as ordered).

- User manual.

If any item is missing or damaged, contact OEM before energizing the system.

5.4.2 Environmental Requirements

- Indoor use only.
- Flat, level mounting surface or standard 19-inch / custom equipment rack.
- Ambient temperature: 0 °C to +50 °C.
- Relative humidity: 85 %, non-condensing.
- Free from dust, corrosive gases, and strong electromagnetic interference.
- Minimum 100 mm clearance around the rear cooling fan and side vents.

5.5 Installation and Mounting

5.5.1 Rack-Mount Installation

The ECT System 2506 chassis uses a standard 19-inch rack-mount configuration with front mounting ears. The chassis body is 19 inches (482.6 mm) wide, 11.9 inches (302.6 mm) deep, and 7 inch (4 Unit) (177 mm) high, with the front ears providing a 465 mm mounting-hole spacing to fit standard EIA-310 19-inch racks.

Rack-mount dimensions

Figure 4 — Rack-mount front and side views with key dimensions.

1. Select a suitable location in a 19-inch or custom equipment rack. The 19-inch width of the chassis fits a standard 19-inch rack; use the supplied front mounting ears or adapter brackets.
2. Install cage nuts or clip nuts (M6 or 10-32) in the rack rails at the desired 4U position.
3. Two qualified persons should lift the chassis and align the front mounting holes with the rack rails.
4. Insert and finger-tighten the four mounting screws (two per side).
5. Check that the chassis is horizontal and the rear is supported by the rack rails or a shelf.
6. Tighten the screws to approximately 3 N·m (26 lb-in). Do not overtighten.
7. Route the power cord, VGA/HDMI, probe, and I/O cables through the rear or side cable management.
8. Ensure the rear cooling fan is not blocked by cables or the rack door.

5.5.2 Bench / Table-Top Mounting

If the chassis is not mounted in a rack:

1. Place the chassis on a flat, rigid, and level bench or machine cabinet.
2. Install the four rubber feet under the chassis corners if not preinstalled.
3. Allow at least 100 mm clearance on all sides for ventilation.
4. Secure the chassis with mechanical brackets or retaining straps if the machine generates vibration.

6. Eddy-Current Probes

The ECT System 2506 uses two probe styles, both fitted with the same 4-pin aviation connector used on the CH1–CH6 rear panel probe connectors. The correct probe style depends on the part feature being inspected.

6.1 Straight Probe

The straight probe is intended for flat, end-face, or straight-profile surfaces. It is typically used to inspect the face (axial surface) of a bearing race or ring, as well as straight O.D. or I.D. sections where the probe can be presented perpendicular to the surface.

Straight probe

Figure 5 — Straight eddy-current probe with 4-pin aviation connector.

6.2 Angled Probe

The angled probe is intended for inner and outer curved profiles where the probe head must be presented at an angle or where side clearance is limited. The 90° head allows access to curved raceways and peripheral surfaces that are difficult to reach with a straight probe.

Angled probe

Figure 6 — Angled eddy-current probe with 4-pin aviation connector.

6.3 Probe Dimensions

All probe dimensions are in millimetres (mm).

Straight and angled probe dimensions

Figure 7 — Straight and angled probe dimensional drawings (all dimensions in mm).

6.4 General Probe Specifications

Parameter	Specification
Connector	4-pin aviation connector, mates with CH1–CH6 rear panel connectors
Standard cable length	1.0 m or 2.0 m (custom lengths available on request)
Probe body	Stainless steel, M7 diameter
Probe tip	White plastic (Delrin)
Operating frequency	1 kHz – 1 MHz (set by channel recipe)
Operating temperature	0 °C to +50 °C
Minimum bend radius	50 mm
Storage	Coiled, dry, away from moisture and solvents

CAUTION — Do not kink or crush the probe cable. Excessive bending below the minimum bend radius may alter the coil characteristics and affect measurement repeatability. Ensure the probe is clean and dry before each shift.

CAUTION — Ensure that the probes do not rub against or collide with the workpiece during installation or normal operation. Damage caused by mechanical contact is not covered under warranty. Probes are not field-repairable.

7. Bearing Information

The ECT System 2506 can inspect different bearing-ring forms. The two most common test pieces are the external (outer) ring and the internal (inner) ring.

External bearing ring

Figure 8 — External bearing ring.

The external ring shown above is a plain cylindrical race. Its flat face and peripheral O.D. can be inspected with the straight probe for end-face quality or with the angled probe for curved profiles.

Internal bearing ring

Figure 9 — Internal bearing ring.

The internal ring may include flanges, shoulders, or raceway steps. Use the angled probe to reach inside diameters and curved raceways that the straight probe cannot access.

7.1 Bearing Probe Mounting

The photographs below show a typical production mounting arrangement for an eddy-current bearing inspection. A bearing race or ring is seated on a locating fixture, and one or more eddy-current probes are mounted in fixed holders above the part.

Bearing mount isometric view

Figure 10 — Bearing and probe assembly, isometric view.

The isometric view shows the probe holders, the locating base, and the part orientation. This arrangement keeps the probe tip at a constant stand-off from the bearing surface so that lift-off and sensitivity are repeatable from part to part.

Bearing mount front view

Figure 11 — Bearing and probe assembly, front view.

The front view shows the straight and angled probe tips presented to the bearing at the correct inspection points. Mount the probes so that:

- The probe tip is perpendicular to the surface being inspected (use the straight probe for flat/axial faces and the angled probe for curved raceways).
- The working gap between the probe tip and the bearing surface is consistent with the recipe setup value.
- The probe holder does not flex or vibrate during indexing.
- The part seating fixture locates the bearing axially and radially so the inspection track is in the same position for every part.

CAUTION — Do not allow the probe tip to contact the bearing during loading or rotation. Contact will damage the plastic probe face and produce false readings. This could also damage the probe electronics permanently and render it unusable.

8. Cables and Wiring

8.1 Power and Grounding

8.1.1 Mains Power

The ECT System 2506 operates from a single-phase 230 VAC, 50 Hz supply. The chassis uses an IEC 320 C14 inlet with an integral fuse and switch.

Parameter	Value
Nominal voltage	230 VAC
Frequency	50 Hz
Maximum current	3 A (fuse rating may vary; see chassis label)
Earth connection	Mandatory via the IEC inlet earth pin

NOTE — A reliable protective-earth connection is required for safe and stable operation. Poor grounding can increase signal noise and cause false NO GO results.

DANGER — Ensure the facility mains supply is properly earthed. Do not use cheater plugs or remove the earth pin. Failure to earth the chassis can result in electric shock.

8.1.2 Isolation of Internal Supplies

The chassis contains an internal AC/DC switch-mode power supply that provides the low-voltage rails for the ECT_R2 boards and the cooling fan. The Mini PC is powered independently through its supplied external power adapter, which is also fed from the chassis mains distribution.

CAUTION — Do not connect external power supplies to the ECT_R2 boards. Board-level voltages are generated and monitored internally.

8.1.3 Power-On and Power-Off Sequence

Power on:

1. Verify all probe and I/O cables are connected.
2. Turn on the chassis mains switch.
3. The Mini PC should turn on automatically. If it does not, press the front-panel power button.
4. Wait for the Windows host PC to boot.
5. After Windows starts, the EIB ECT App should open automatically. If it does not, double-click the desktop icon.

Power off:

1. Press STOP in the EIB ECT App.
2. Close the EIB ECT application.
3. Shut down Windows using the Start menu.
4. After the PC has shut down, turn off the chassis mains switch.

8.2 Digital I/O

8.2.1 On-Board Digital I/O Mapping

The STM32H5 firmware defines the following digital I/O for each ECT_R2 board. These signals are routed through the printed circuit board and the chassis harness to the rear SUB-D-25 I/O connectors.

Signal	Type	Function
IP1	Input	Starts acquisition on the rising edge; measurement remains active while asserted
IP2	Input	Self-calibration input, active high; production counters are not incremented
IP3	Input	Auxiliary digital input
OP1	Output	GO / NO GO result pulse; active-low by default

Signal	Type	Function
OP2	Output	Auxiliary output; not used in the standard configuration

NOTICE — The output stage is active-low: writing a logic 0 to OP1 or OP2 asserts the output. Use the Output Invert setting in the EIB ECT App if the machine PLC requires positive logic.

I/O Signal Usage

- IP1 — Start / continuous measurement input. While this input is active, the channel remains in measurement mode and keeps collecting samples.
- IP2 — Calibration input. When this input is active, the channel can perform calibration. During calibration the fail, pass and total part counters are not incremented.
- OP1 — GO / NO GO output. This output reports the inspection result. The minimum output pulse width is 0.5 s. The output is active-low by default; use the Output Invert setting if the PLC needs positive logic.
- IP3 and OP2 are auxiliary I/O for future expansion or custom machine functions.

8.2.2 Board Address

Each ECT_R2 board is assigned a unique address automatically. No action is needed in this case.

8.2.3 Probe and I/O Connector Details

The CH1–CH6 circular connectors accept the eddy-current probe cables. The center contact(s) carry the conditioned analog signal to the board's ADC inputs (MESCH1, MESCH2). Shield and ground are referenced to the chassis common.

The two SUB-D-25 I/O connectors group the digital I/O for channels 1–3 and 4–6. Each connector carries:

- Three channels of inputs (IP1, IP2, IP3) and outputs (OP1, OP2).
- Isolated or common-return pairs for each input and output (marked with P and N on the silkscreen).
- A common 0 V / common pin for the digital I/O section.

- A +24 V auxiliary supply pin for powering external sensors or indicators where required.

CAUTION — Do not apply voltages greater than the rated +24 V logic level to the digital I/O pins. Overvoltage will damage the acquisition board.

I/O Electrical Characteristics

The SUB-D-25 digital I/O is designed for standard industrial 24 V DC logic. All inputs and outputs are optically (galvanically) isolated from the acquisition board and the Mini PC.

Parameter	Specification
Input voltage range	12 V DC to 24 V DC (absolute maximum 30 V DC)
Input threshold (active high)	High: >= 9 V DC Low: <= 3 V DC
Input current	Approx. 5 mA to 15 mA
Output type	Optically isolated, active-low (default), current-sinking
Output load current	Up to 100 mA per output
Output pulse width (GO / NO GO)	Minimum 0.5 s
Isolation	Approx. 5 kV RMS between field I/O and controller logic

NOTE — Output polarity and active level can be configured with the Output Invert option in the EIB ECT App.

8.2.4 Cable Connections

1. Connect the 230 VAC / 50 Hz mains inlet through a suitably rated circuit breaker and ensure reliable earth continuity.
2. Connect the VGA monitor to the rear panel.
3. Connect the Mini PC to the internal Ethernet switch or directly to the chassis network.

4. Connect the CH1–CH6 eddy-current probe cables to the rear circular connectors.
5. Connect the SUB-D-25 I/O cables to the CH 1-3 and CH 4-6 connectors for the machine PLC or reject mechanism.

9. Mini PC Configuration

NOTE — The Mini PC brand, model, and I/O layout shown are for reference only. Any equivalent Mini PC that meets the interface requirements may be used.

The ECT System 2506 includes a Mini PC mounted on the front panel. The PC is pre-installed with the EIB ECT App. The customer must supply the following peripherals:

- One HDMI or VGA monitor (the rear panel provides VGA; use the PC's HDMI output if a second or alternate display is required).
- One USB keyboard.
- One USB mouse.

The Mini PC front and rear I/O typically include:

- Front: dual USB ports for keyboard and mouse, power button.
- Rear: VGA / HDMI (depending on the exact Mini PC model), additional USB 3.0 / USB 2.0 ports, and a barrel-type power connector.

10. Network Setup

The ECT System 2506 uses a private 192.168.1.x Ethernet network between the host PC and the ECT_R2 acquisition boards.

The ECT system is supplied with a preconfigured private network. If reconfiguration is required, apply the following settings to the dedicated LAN adapter.

1. Close the EIB ECT application.
2. Go to Network settings. Open LAN adapter properties.
3. Disable DHCP as the system needs static IP configuration.
4. Set the host PC IPv4 address to 192.168.1.50 and subnet mask 255.255.255.0.
5. Leave the default gateway blank.
6. Apply the changes, then restart the EIB ECT App.

11. System Commissioning

11.1 Pre-Start Checks

Before starting the EIB ECT App, verify the protective-earth connection, ventilation clearance, probe and I/O cable connections, private-network settings, and mechanical probe clearance.

11.2 Communication and Signal Check

Turn on the controller and host PC, confirm that COM is green for every enabled channel, and use TEST mode to verify a stable waveform response from each probe before enabling production triggers.

12. Software Operation

12.1 Main Window

The main window is divided into six identical channel panes. Each pane displays the live waveform, current parameter set, digital I/O status, and the last test result.

Main application window

Figure 12 — EIB ECT App main window.

Each channel pane contains:

- Graph area — live eddy-current signal trace.
- I/O indicators — IP1, IP2, IP3, OP1, OP2, COM.
- Status bar — State, Test Result, and Length.
- Parameter block — Freq, Gain, Filter, Th-1, Total, Pass, Fail, Name, Z1, Z2.

12.2 Main Window Controls

Button	Function
START	Arms the selected channels for production testing. Acquisition is triggered by the IP1 rising edge.
TEST	Forces continuous acquisition for setup and waveform verification.
STOP	Stops acquisition on all channels immediately.
UNLOCK	Enables parameter editing after password entry.

Button	Function
CHANGE PWD	Opens the password-change dialog to update the operator password.
SYS CONFIG	Opens the system configuration dialog (OEM access level only).
STATUS	Displays current board and communication status.
REPORT	Opens the production report export window. See Section 15.
ABOUT	Shows software version and company information.
EXIT	Closes the application.

12.2.1 Password Change

Click CHANGE PWD on the main screen to open the Password Change dialog.

Password Change dialog

Figure 13 — Password Change dialog.

Enter the current operator password and the new six-digit numeric password, then click OK.

12.3 Channel Parameter Block

After unlocking with the customer/operator password, all per-channel parameter fields are enabled for editing:

Parameter Name	Description
Freq	Excitation frequency in kHz (1–1000 kHz).

Parameter Name	Description
Gain	Signal gain in percent (1% to 100%).
Filter	Application-specific digital filter setting (0 to 7). Select the value by comparing defect response, repeatability, and noise.
Th-1	Signal threshold used for GO / NO GO evaluation within the configured Z1 and Z2 inspection windows.
Total	Total parts tested (read-only). Press **RESET** to clear.
Pass	Number of GO parts (read-only).
Fail	Number of NO GO parts (read-only).
Name	Recipe or component ID.
Z1	First inspection window, defined by start and end waveform sample positions.
Z2	Second inspection window, defined by start and end waveform sample positions.

Channel parameter window

Figure 14 — Channel parameter window.

12.4 Lock or Unlock Parameter

Parameter editing is password-protected to prevent accidental changes. Click UNLOCK to open the password dialog, then enter one of the following:

- Customer / Operator password — unlocks all channel parameter fields for editing. The default is 111111.

- OEM / Configuration password — unlocks the channel parameters and additionally reveals the SYS CONFIG button for the system configuration dialog.

Click OK to confirm the selected access level.

Password dialog

Figure 15 — Unlock/password dialog.

12.5 Running Modes

12.5.1 Test Mode

In Test mode the system runs continuously for waveform verification and commissioning checks.

- Press the TEST button on the main window.
- The raw data are populated on the live waveform plot for each enabled channel.
- When the display duration configured in System Configuration is reached, the plot scrolls: the oldest samples move off-screen and the newest samples are appended.
- Move a metal object close to the probe tip; spikes should appear on the plot if the probe, cable and acquisition board are functioning.
- This mode is used to verify that the system is functional after commissioning and to check probes without rejecting parts.

12.5.2 Start Mode (Production Operation)

In Start mode the system operates as a triggered production tester.

- Press the START button to arm the selected channels.
- The system waits for a trigger signal on digital input IP1 of each ECT_R2 card.
- When the trigger arrives, acquisition begins and the status text on each plot changes from Waiting to the active measurement state.
- While the part is inside the Z1 and Z2 index windows, if the signal exceeds the Th-1 threshold, the system generates a digital output pulse of at least 0.5 seconds on output OP1 of the card.
- The result is then reported as GO or NO GO in the channel pane.

12.5.3 Self-Calibration Mode

The self-calibration mode is a periodic check that ensures the probes, wiring and signal path are still producing the correct reject response.

- At the configured interval (for example, every 1000 or 2000 measurement cycles), the machine PLC places a master bearing piece that contains known scratch marks through the test station.
- During this check, digital input IP2 on the ECT_R2 card is activated.
- The reference-defect master must generate a NO GO result on OP1.
- This result confirms to the PLC that the probe, signal path, evaluation, and output path are functioning.
- If the master piece does not produce the expected fail signal, the probe may have shifted, a cable may be loose, or the signal levels may have drifted. In this case:
    - Inspect probe positioning and tighten or reposition as needed.
    - Check cable connections between the probe and the ECT_R2 card.
    - Repeat the channel parameter tuning procedure described in Section 13.2 before resuming production.

13. Initial Setup for Production

13.1 Preparation

Before starting production, prepare:

- A set of known-good (master) samples representative of the production part.
- Known-defect samples covering the minimum rejectable flaw size for the application.
- A clean, correctly positioned probe.

13.2 Channel Parameter Tuning Procedure

This section explains how to tune the parameters shown in Figure 14 so that the ECT System 2506 reliably separates good (GO) bearing parts from defective (NO GO) parts. The parameters should be adjusted in the sequence below because each setting affects the next one.

13.2.1 Mechanical Inspection Setup

Before tuning the electrical parameters, set up the mechanical inspection:

1. Probe lift-off: Set the distance from the probe tip to the bearing surface to 0.5 mm–1.0 mm (typically 0.8 mm). Use a feeler gauge or a dial indicator. Smaller lift-off gives higher sensitivity, but too small a gap risks probe contact with vibration.

2. Part rotation: Rotate the bearing at 300 RPM during inspection. The surface speed depends on the bearing diameter:

- Surface speed (mm/s) = π × diameter (mm) × RPM / 60

3. Probe traverse: Move the probe across the surface at a constant rate — typically 0.5 mm/s to 2 mm/s — so the same type of defect produces a repeatable response.

4. Fixturing: Use a rigid probe holder, keep the cable away from moving parts, and make sure the chassis and machine are connected to the same earth point.

13.2.2 Tuning Sequence

Use a known-good master sample and at least one known-defect sample of the same material and geometry. Click UNLOCK, enter the authorized password, and place the system in TEST mode so the waveform remains visible while parameters are adjusted.

1. Select start values

- Enter the Name for the part.
- Set an initial Freq and Gain. For steel bearing races, rollers, and rings, start with 10–300 kHz and 40–60 % gain.
- Set Filter to 0 as the initial setting.
- Set Th-1 to a temporary value such as 25%, and set the Z1 and Z2 start/end positions to cover the relevant waveform range (for example, 2 to 200). Finalize these values after frequency, gain, and filter tuning.
- Press TEST to view the live waveform and verify the COM indicator is green.

2. Tune Freq (excitation frequency)

The frequency determines how deep the eddy currents penetrate and how large the defect signal is.

- Higher frequencies give better sensitivity to open surface cracks and pits but penetrate less.
- Lower frequencies detect subsurface or deeper defects better, but the surface-defect signal is smaller.
- For steel bearing surfaces, a practical starting range is 100 kHz–600 kHz.
- Fine-tune by scanning a reference defect and increasing the frequency in steps until the signal amplitude reaches a maximum and then begins to collapse. The maximum point — the knee of the response — gives the best signal-to-noise ratio.

3. Tune Gain

After selecting the frequency, adjust Gain so the normal master-part response is approximately 40% to 60% of full scale and the reference-defect response remains clearly separated without clipping.

- If the waveform is too small and noisy, increase Gain.
- If the waveform is clipped or saturates, reduce Gain.

- Gain is displayed as a percentage from 1% to 100% and controls the signal amplification applied by the acquisition channel.

4. Tune Filter

Filter is an application-specific digital filter setting from 0 to 7. Begin at 0, then compare the repeatability of the normal waveform, reference-defect amplitude, and background noise at each setting.

The right setting depends on the defect frequency, which is a function of the RPM, the bearing diameter, and the defect size:

defect frequency (Hz) ≈ surface speed (mm/s) / defect width (mm)

For example, a 0.5 mm wide crack on a 50 mm diameter bearing at 300 RPM:

surface speed = π × 50 × 300 / 60 ≈ 785 mm/s

Use the estimated defect frequency as a guide only. Increase Filter one step at a time and retain the setting that gives the most repeatable separation between good and defective samples without suppressing the defect peak.

Select the filter setting by comparative testing with validated good and defective samples.

If the trace remains noisy, test the next filter setting. If small defect peaks become attenuated or disappear, return to the previous setting. Validate the selected value over multiple rotations and parts.

5. Set Z1 and Z2 Inspection Windows

With the part rotating and the probe traversing, identify the waveform sample positions corresponding to the inspection track. Set the Z1 start and end positions to bound the first inspection window. Use Z2 when a second inspection window is required.

- The Th-1 threshold is evaluated only within the enabled Z1 and Z2 inspection windows.
- If only one inspection window is required, configure Z2 according to the approved recipe or disable it where supported.

6. Set Th-1 threshold

Th-1 is the signal threshold used to determine GO or NO GO within the configured inspection windows.

- Place the known-defect sample in the test position and note the peak response.
- Set Th-1 below the repeatable reference-defect peak while maintaining adequate separation from normal master-part noise. Known defects must consistently produce NO GO.
- Test the master sample and confirm a consistent GO result. If good parts are rejected, raise Th-1 cautiously; if validated defects are missed, lower Th-1 and repeat validation.
- The threshold should be far enough above the normal master-part noise to avoid false rejects.

7. Validate and start production

1. Press RESET to clear Total / Pass / Fail counters.
2. Run at least 10–20 master parts and confirm a consistent GO result.
3. Run the known-defect sample several times and confirm a consistent NO GO result.
4. If pass/fail decisions are not reliable, repeat the tuning sequence from Freq and Gain, then adjust Filter, Z1/Z2, and Th-1 again.
5. When the recipe is stable, save it and press START for production.

NOTICE — Do not release the machine to production until a statistically significant number of good and bad samples have been tested successfully.

14. Production Operation

14.1 Test Modes

- Run Mode (START) — Acquisition is triggered by the IP1 rising edge for each part.
- Test Mode (TEST) — Continuous acquisition for setup and waveform verification.

14.2 Normal Production Cycle

1. Load the correct recipe for the part.
2. Confirm that the COM indicator is green for all active channels.
3. Press START.
4. The machine presents the part and asserts IP1.
5. The ECT_R2 board captures the waveform and sends it to the PC.
6. The EIB ECT App evaluates the waveform and drives the digital outputs.
7. The host machine sorts or rejects based on the outputs.
8. Counters update automatically.

14.3 Stopping and Shutting Down

- Press STOP to halt acquisition.
- Close the EIB ECT App.
- Shut down Windows.
- Turn off the chassis mains switch.

15. Reports and Data Management

15.1 Production Reports

The report utility exports shift, day, or lot data as a tabular text file. The report includes:

- Date and time of export.
- Channel number.
- Total, Pass, and Fail counts.
- Pass-rate and Fail-rate percentages.
- Work-time and Wait-time per channel.

Report export

Figure 16 — Example production report.

15.2 Data Storage

- Reports are saved in a user-selected folder and may be opened in Microsoft Excel or any text editor.
- Store reports on a network drive or removable media for backup.

16. Maintenance and Care

16.1 Daily

- Verify that the cooling fan is running and the rear vents are clear.
- Confirm the COM status for all active channels.
- Wipe down the chassis with a dry, lint-free cloth.

16.2 Weekly

- Inspect probe and I/O cables for wear or damage.
- Verify pass/fail outputs respond correctly to a reference sample.

16.3 Periodic

- Recalibrate each channel every 6 months, or sooner if the probe or material changes.
- Back up the report archive to external storage.
- Check mains power cord and earth connection integrity.

17. Troubleshooting

Symptom	Possible Cause	Action
COM LED gray / red	Network fault, board not powered, or wrong IP	Verify Ethernet, board jumpers, and subnet.
No waveform	Probe disconnected, broken cable, or Gain too low	Check probe and cable; increase **Gain** in TEST mode.
Waveform noisy	Wrong frequency, poor probe contact, or EMI	Change **Freq** and **Filter**; check grounding.
All parts fail	Threshold too tight or probe displaced	Relax **Th-1** and recalibrate.
All parts pass	Threshold too loose or no excitation	Verify **Freq** and **Gain**; test with a known defect.
Outputs not recognized by PLC	Output logic inverted or wiring error	Check **Output Invert** setting and wiring.
STATUS shows Idle	No IP1 trigger signal	Verify input wiring and PLC timing.
Password not accepted	Caps Lock on or wrong password	Contact the system administrator.

18. Service and Support

For spare parts, service, or application support, contact:

EIB Solutions

D82, Shaktipark Society, Old Sama Road, Sama

Vadodara – 390 008, Gujarat, India

Phone: +91 95 5880 7442

Email: contact@eib-solutions.com

Web: www.eib-solutions.com

Product: ECT System 2506

Do not attempt internal repairs. Contact EIB Solutions for authorized service. Unauthorized repair may void the warranty.

Appendix A Default Network Settings

- Host PC IP: 192.168.1.50
- Subnet mask: 255.255.255.0
- Default gateway: (not required for this isolated network)

Ensure that no other device on the private network uses the same IP address as the host PC or an acquisition board.

Appendix B I/O Connector Reference

The two rear SUB-D-25 I/O connectors carry the digital inputs and outputs for the corresponding channel groups. Each I/O line is provided as a P (positive / signal) and N (negative / common) pair. The exact pin positions are silkscreened on the rear panel. The common application connections are:

- IP1 — external trigger / part-present (rising edge).
- IP2, IP3 — auxiliary inputs.
- OP1, OP2 — pass / fail or reject outputs (active-low; use Output Invert if positive logic is required).
- COM — common return for the digital I/O section.
- +24 V — auxiliary supply for approved external interfaces where provided; observe the rating shown on the chassis label.

Appendix C Parameter Limits

The values below summarize the operator-adjustable ranges described in this manual. Approved production settings must be established using validated master and known-defect samples.

Parameter	Range or Purpose
Freq	1 kHz to 1000 kHz
Gain	1% to 100%
Filter	0 to 7; application-specific setting
Th-1	GO / NO GO signal threshold
Z1	First inspection-window start and end positions
Z2	Second inspection-window start and end positions
Measurement length	1 to 30 seconds