ENGINEERING VALIDATION

Mini-ITX Engineering Validation Handbook

General methodology for validating Mini-ITX and embedded computing platform configurations

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Status	Public Engineering Reference

SCOPE STATEMENT

This handbook describes a general engineering validation framework. It is not a certification report and does not certify any specific product, platform, configuration, or end system.

Mini ITX Board

Engineering Documentation Series

1. Purpose

This handbook defines the general engineering validation framework used for Mini-ITX and embedded computing platform projects.

Validation is performed against the confirmed project configuration rather than a generic board specification. Test scope, conditions, duration, acceptance criteria, and recorded evidence may therefore vary between projects.

This document describes the validation process and documentation method. It does not represent certification of any specific product or configuration.

2. Validation Scope

Depending on the project requirements, engineering validation may include:

- Hardware configuration verification
- Power input and startup testing
- Thermal and workload testing
- I/O and interface verification
- Storage and memory checks
- Operating system and driver verification
- Burn-in or extended runtime testing
- Mechanical integration checks
- EMC pre-compliance screening
- Project-specific functional testing

Not every project requires every validation activity. The final validation plan should be defined from the confirmed hardware, software, enclosure, environmental, and application requirements.

3. Configuration Identification

Every validation record should identify the configuration being tested. At minimum, the following information should be recorded where applicable:

Item	Required Record
Board / Platform	Model or reference platform
PCB Revision	Hardware revision
Processor	Exact CPU or SoC
Memory	Capacity and configuration
Storage	Device type and capacity
BIOS	BIOS version
Operating System	OS version and build
Drivers	Relevant driver versions
Power Input	Input voltage and power source
Cooling	Passive, active, or enclosure-assisted
Enclosure	Open bench or final enclosure
Expansion	PCIe, M.2, Wi-Fi, LTE, or other modules
Test Date	Date of validation
Test Operator	Engineer or responsible tester

APPLICABILITY

A validation result applies only to the recorded configuration unless otherwise stated.

4. Validation Planning

Before testing begins, project requirements should be converted into measurable validation items. A validation plan normally defines:

VALIDATION CHAIN

Requirement -> Test Method -> Test Condition -> Acceptance Criteria -> Recorded Evidence

Requirement	Validation Method	Acceptance Criteria
Operate from 12 V DC	Input power test	Stable boot and operation
Dual Ethernet required	Interface verification	Both ports link and transfer data
Fanless operation	Thermal workload test	No unacceptable thermal shutdown or instability
Windows deployment	OS verification	Required devices recognized and functional

Acceptance criteria should be agreed before final validation whenever possible.

5. Power Input Validation

Power validation checks whether the platform starts and operates reliably under the required input conditions.

- Cold boot
- Warm reboot
- Repeated power cycling
- Input voltage verification
- Startup behavior
- High-load operation
- Peripheral power loading
- Unexpected shutdown or restart observation

Where a project requires a voltage range rather than a fixed input voltage, appropriate test points should be selected based on the confirmed design.

Evidence to Record

- Input voltage
- Input current
- Test power supply
- Connected peripherals
- System workload
- Boot result
- Restart behavior
- Observed abnormalities

LIMITATION

Testing a reference configuration does not automatically validate every possible power adapter, enclosure, or peripheral combination.

6. Thermal Validation

Thermal validation determines whether the confirmed system configuration can maintain stable operation under the required workload and cooling conditions. Testing should reflect the intended deployment as closely as practical.

Variables may include ambient temperature, processor workload, GPU or accelerator workload, storage activity, network traffic, enclosure design, heatsink configuration, airflow, system orientation, and test duration.

Typical Thermal Procedure

1. Record the complete hardware configuration.
2. Record ambient conditions.
3. Allow the system to reach a stable initial state.
4. Apply the defined workload.
5. Monitor relevant temperatures and system behavior.
6. Record throttling, errors, shutdowns, or instability.
7. Continue for the planned test duration.
8. Review results against project acceptance criteria.

IMPORTANT LIMITATION

A board-level thermal result does not automatically represent performance inside a different enclosure. Changes to enclosure volume, orientation, heatsink contact, airflow, workload, storage devices, expansion cards, or ambient temperature may require revalidation.

7. I/O and Interface Verification

Interface validation confirms that required ports and expansion interfaces operate correctly in the tested configuration.

- Ethernet
- USB
- COM / serial ports
- HDMI and DisplayPort
- LVDS or eDP
- Audio
- SATA and M.2
- PCIe
- GPIO and CAN
- Wi-Fi, Bluetooth, and cellular modules

Testing should include both interface detection and project-relevant functional behavior. For example, an Ethernet port should not be considered fully validated only because the operating system detects the controller.

Where relevant, validation may include link establishment, data transfer, simultaneous interface use, repeated connection, driver loading, peripheral compatibility, and extended operation.

8. Storage and Memory Verification

Memory

- Installed capacity recognition
- Boot stability
- Memory stress testing
- Extended workload operation

Storage

- Device detection
- Boot from target storage
- Read/write operation
- Extended access

- SATA or NVMe interface verification
- Temperature observation where relevant

Specific storage devices should be identified in the validation record when their behavior can affect final system performance.

9. BIOS and Operating System Validation

Software compatibility should be validated against the actual project configuration. Records may include:

- BIOS version and settings
- Operating system, kernel, or build version
- Driver versions
- Device detection status
- Required boot mode
- Watchdog configuration
- Auto power-on behavior
- Serial port configuration
- TPM or security settings where applicable

COMPATIBILITY STATEMENT

A platform supporting an operating system in general does not guarantee compatibility with every OS release, driver revision, peripheral, or project-specific software stack.

10. Burn-In and Extended Runtime Testing

Extended runtime testing may be used to identify intermittent faults that are not visible during short functional checks. Depending on project requirements, the test may combine CPU load, memory activity, storage activity, network traffic, repeated I/O operation, thermal stress, and application workload.

The test record should identify start and end time, configuration, workload, ambient condition, errors or interruptions, and final result.

Burn-in duration should be selected according to project requirements rather than treated as a universal qualification period.

11. Mechanical Verification

Mechanical validation checks whether the board and associated components integrate correctly with the intended mechanical system.

- Board dimensions and mounting-hole positions
- Connector location
- Heatsink and memory clearance
- Storage and expansion card clearance
- Cable routing
- Enclosure fit
- Access to external ports

Where mechanical drawings are used, the applicable drawing revision should be recorded. Final enclosure integration should be verified against the actual mechanical assembly whenever possible.

12. EMC Pre-Compliance Screening

EMC pre-compliance testing may be performed during development to identify potential emissions or immunity issues before formal certification testing. Depending on project scope, screening may include selected checks informed by applicable standards or laboratory practices.

- Radiated emissions screening
- Conducted emissions screening
- ESD screening
- EFT or surge screening

- Grounding review
- Cable and shielding evaluation

> **IMPORTANT STATEMENT**
> EMC pre-compliance screening is not equivalent to formal product certification. Formal compliance depends on the applicable market, final product configuration, enclosure, cables, power supply, accessories, test standard, laboratory, and certification route.

Where formal compliance is required, testing should be performed against the applicable standard and final product configuration.

13. Test Equipment Identification

Where measured data is included in a validation report, relevant test equipment should be identifiable. Records may include equipment type, manufacturer, model, asset or equipment ID, calibration status where applicable, and measurement method.

The required level of equipment traceability depends on the type and purpose of the validation.

14. Deviations and Engineering Changes

Not every first validation cycle will produce a final pass. Where a test identifies an issue, the result should be recorded rather than removed.

> **ENGINEERING CYCLE**
> Test -> Identify Issue -> Engineering Change -> Retest -> Review

Possible changes may involve BIOS settings, component selection, heatsink design, power input design, I/O configuration, cable selection, enclosure ventilation, driver revision, or PCB revision.

The final report should distinguish between the original tested condition and the configuration that passed after corrective action.

15. Result Classification

Status	Meaning
PASS	The tested configuration met the defined acceptance criteria.
REVISE	A design, configuration, or test condition requires adjustment before acceptance.
RETEST	The configuration has changed or the available evidence is not sufficient for a final result.
NOT APPLICABLE	The validation item is outside the confirmed project scope.

> **RESULT SCOPE**
> A PASS result applies only to the tested configuration and defined conditions.

16. Validation Evidence

Depending on the project and confidentiality requirements, validation evidence may include:

- Test checklist
- Measurement table

- Temperature log
- Power measurement
- System screenshot
- BIOS record
- Interface checklist
- Photographs
- Test equipment record
- Error log
- Engineering change record
- Retest record

Customer-confidential information may be removed from publicly released examples.

17. Redacted Public Reports

When a project report is released as a public example, commercially or technically sensitive information may be removed.

Typical redactions may include customer identity, contact information, commercial pricing, project code, serial number, confidential circuit details, proprietary software information, and customer-specific deployment information.

A useful redacted report should still retain sufficient technical context to show what was tested, which configuration was tested, under what conditions, which method was used, what was measured, and what result was obtained.

18. Revalidation Triggers

A previously validated result may require review or revalidation when significant configuration changes occur.

- PCB revision change
- Processor, memory, or storage change
- BIOS or operating system change
- Power supply change
- Heatsink or enclosure change
- Expansion module change
- New ambient requirement
- Workload change

The required revalidation scope should reflect the potential impact of the change.

19. Validation Record Control

Controlled engineering documents should identify their revision and issue status. Recommended document fields include:

- Document ID
- Revision
- Issue Date
- Applicable Platform
- Hardware Revision
- Prepared By
- Reviewed By
- Revision History

Superseded reports should remain distinguishable from current revisions.

20. Example Document Structure

9. Document Control
10. Project Scope
11. Tested Configuration
12. Test Requirements
13. Test Environment
14. Test Equipment
15. Validation Procedures

16. Recorded Results
17. Deviations
18. Corrective Actions
19. Retest Results
20. Final Status
21. Limitations
22. Approval
23. Revision History

21. Limitations

Engineering validation reduces project risk but cannot demonstrate suitability for every possible use condition. Results are dependent on the tested hardware, BIOS, software, enclosure, cooling, peripherals, workload, environment, and test method.

Unless explicitly stated in a project-specific report:

- Validation should not be interpreted as regulatory certification.
- Reference-platform results should not be automatically transferred to modified configurations.
- Pre-compliance testing should not be interpreted as final EMC compliance.
- Component-level specifications should not be interpreted as complete system-level performance guarantees.

Final acceptance criteria remain project-specific.

22. Related Engineering Documents

Document Series	Purpose
MIB-EV-CHK-001	System Validation Requirements Checklist
MIB-EV-RPT Series	Project-Specific or Redacted Validation Reports
MIB-RP Series	Mini-ITX Reference Platform Briefs

Each related document should identify its own revision, scope, and applicable configuration.

Revision History

Revision	Date	Description
Rev 1.0	July 2026	Initial public release

DOCUMENT NOTICE

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