# Purpose

* 1. The purpose of this procedure is to standardize the electronic design process and promote consistency in file/folder directory organization, documentation, design phases, and peer review expectations.

# Scope

* 1. EE-OP-001 defines the electronic engineering design process for developing electrical and electronic hardware for all use cases.

# Procedure

* 1. Requests requiring hardware or firmware shall conform to this SOP.
  2. Phase: Begin Design
     1. Refer to EE-FC-001, also found in *Figure 1. EE-FC-001 EE Design Process Flow Chart*, for a visual description of the design process, reference documents, and expected design documentation.
     2. Designer engineer shall set up a project directory by following EE-RD-004 to keep folder structure and organization consistent among projects.
     3. Obtain a fresh copy of the EE-DS-001 template document. Fill this document out and keep it updated as new information becomes available.
  3. Phase: Requirements Capture
     1. Determine the complexity of the task or project. Obvious or low complexity designs may not require EE-DS-002. If the design is of medium or higher complexity, include EE-DS-002 document in the design. Design complexity is at the discretion of the engineer.
     2. Obtain a fresh copy of the EE-DS-002 template document. Fill out the template to capture requirements. This could be system level, hardware, cable, firmware, software, documentation requirements, etc. List all the specifications in the design specs tab. Add tabs as needed to describe or document other functionality.
     3. Have the requirements reviewed by stakeholders to ensure the EE-DS-002 meets project expectations.
  4. Phase: Conceptual Design
     1. Create a detailed block diagram including key components.
     2. Demonstrate the ability to meet key requirements via SPICE simulations, datasheet calculations, evaluation board testing, or breadboard testing.
     3. Peer review the conceptual design.
  5. Phase: Detailed Design
     1. Reserve the required part numbers. Each top-level system, PCB, & cable require their own individual part numbers.
     2. For designs requiring schematics or PCBs start a new E-CAD project.
     3. All design source files shall be version controlled. Refer to EE-RD-001 for a version control reference.
     4. Started detailed design of source files such as schematics, software, or firmware.
     5. NPI designs require derating and thermal analysis per EE-RD-005, EE-TD-003, and EE-TL-001.
     6. Obtain a fresh copy of the EE-TD-004 template document. Use this doc to sufficiently describe and defend the design and design choices made.
     7. Perform derating and thermal analysis if the design requires it and it is possible at this stage of the design. Otherwise perform after PCB layout in the design implementation phase.
     8. Peer review design. Bring EE-TD-004, EE-CL-001, and any other relevant information to the review.
  6. Phase: Design Implementation
     1. For PCB projects, begin the board layout and follow IPC-2221 for PCB guidelines.
     2. Check mechanical fit electronic boards or components within the mechanical volume constraint.
     3. Generate relevant output files
     4. Add any additional relevant information to the EE-TD-004. If derating analysis was not possible in the detailed design phase, perform the analysis now.
     5. Peer review the design. Bring EE-TD-004, EE-CL-001, and any other relevant information to the review.
     6. Pending pass/fail results from peer review, place PCBA order.
  7. Phase: Testing
     1. Develop a test plan using the EE-TD-002 template document. Develop a test results worksheet to accompany the test plan using the EE-TD-003 template document.
     2. While waiting for the PCB(A) manufacture, develop software and purchase equipment required to test the hardware.
     3. Test the hardware and record the results in the EE-TD-003.
     4. If issues are found while testing, perform required reworks. If the reworked PCB’s will suffice for the project continue on. If the boards need to be re-spun, go back to the Detailed Design Phase.
     5. Peer review the results with the technical team.
  8. Phase: Project Wrap Up
     1. Ensure all the project docs described in the EE-DS-002 are up to date.
     2. Fill out the EE-TD-001 Lessons Learned document.
     3. Review the EE-TD-001 with the technical team. Technical team should discuss which line items, if any, will be added to the EE-CL-001.
  9. Electronic design is complete

# Records

* 1. Refer to EE-RD-004 for location of documentation with respect to the project’s root directory.
  2. Each task or project will include EE-DS-001 Top Level Description.
  3. Complex projects will include EE-DS-002 Requirements Capture Document.
  4. EE-TD-004 Design Description document shall be generated for each project. Depending on project size, there may be several EE-TD-004 documents describing different aspects of the design.
  5. EE-TL-001 derating worksheet. All NPI or customer facing designs shall be derated.
  6. If the project requires cable designs, EE-CL-002 shall be generated for each cable.The cable shall be documented in the EE-DS-002 as well.
  7. EE-CL-001 shall be generated for each project. The EE-CL-001 applies to schematics, PCB, and PCBA design and documentation.
  8. Electrical and electronic designs shall be tested. EE-TD-002 hardware test plan shall be generated and results shall be recorded in the EE-TD-003.
  9. EE-TD-001 shall be generated upon the completion and wrap of phase of a project. The EE-TD-001 shall be peer reviewed and the EE team shall agree on which line items will be appended to the EE-CL-001 design review checklist.

1. **References**
   1. EE-CL-001 Schematic, PCB, and PCBA Design Review Checklist
   2. EE-CL-002 Cable Drawing Design Review Checklist
   3. EE-DS-001 Top Level Project Description
   4. EE-DS-002 Detailed Project Design Specifications
   5. EE-FC-001 Electronic Engineering Design Process Flow Chart
   6. EE-RD-001 Version Control & EEs Guide to Git
   7. EE-RD-004 Project Directory Setup
   8. EE-RD-005 Component Derating Guide
   9. EE-TD-001 Technical Lessons Learned
   10. EE-TD-002 Hardware Test Plan
   11. EE-TD-003 Hardware Test Results
   12. EE-TD-004 Generic Design Description
   13. EE-TL-001 Component Derating Worksheet

# Figures

A diagram of a company

Description automatically generated

Figure . EE-FC-001 EE Design Process Flow Chart

# Revision

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| --- | --- | --- | --- |
| **Revision** | **Description** | **Author** | **Date** |
| 01 | Initial Release | J. Petrilli | 10/06/2024 |
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