

DEK STANDARD ENGINEERING INSTRUCTION

Title

REQUIREMENTS FOR PCB'S FOR PRODUCTION

DSEI-PCB

This Standard is divided into sections; these sections define DEKs PCB requirements in the areas of design, build, test, materials and data. Each section is stand-alone and hence the document can be invoked in sections or as a whole.

SECTION 1 - DESIGN REQUIREMENTS

Overview

This standard engineering instruction defines the design requirement that must be applied for all circuit boards designed at or commissioned by DEK printing.

General Rules

All design to be performed in line with requirements of IPC standards with in the 2200 series, key standards being –

- IPC 2221 Generic Standard on Printed Circuit Board Design

Specific design standards exist for certain board structures, type these are defined within IPC 2221, typically -

- IPC 2222 Sectional Design Standard for Rigid Organic Printed Boards.
- IPC-SM-782 Surface Mount design and Land Pattern Standard

Where Assembly or board layout drawings are produced then they should conform to the requirements of –

- IPC-2615 Printed Circuit Board Dimensions and Tolerance.

Contractual documents can over ride the requirements of this standard, but any such exceptions must be documented and justified within the contract documents.

Design Requirements, Clarifications and Exceptions

Clarification or variation to numbered sections of standard IPC 2221

1.6.3 Producibility level

There is no outline requirement for the production and supply of GA drawings for product. GA drawings are a requirement only where complex or unusual assembly or board characteristics are required. Boards need to be manufactured to workmanship standard defined in BUILD AND ASSEMBLY REQUIREMENTS section of this DSEI

3.2 Design layout

Design review should be conducted at least once pre and once post design, layout; personnel from the following areas should be included.

- DEK
 - Design
 - Production Engineering.
 - Purchasing.
- Design Consultants
- Board Assembly Manufacturer

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3.5.6.1 Bare Board Testing

Bare Board Testing and inspection to be performed on 100% of volume production product (volume = more than 25 pieces). Physical parameters to also be checked. Preferred test method - Intelligent test carried out against board net listing
Non preferred method – Comparative test against golden board.

4.1 Board Material

Board material to match bare board's requirement as defined in Bare Board section of this DSEI.

4.6 Legend and marking

To be screened onto all boards, Items requiring indenting –

- DEK assembly number.
- Bare Board Issue status
- Description. (typically – 'Breakout Board A')
- Component ID's
- Component foot prints
- Component polarising and key pin idents.
- Board base material approvals, UL, etc.

5.2.4 Bow and Twist

Defined in Build and Assembly section of this DSEI

6.3 Electrical Clearance

All designs to match or exceed the requirements of UL standards, clearance distances shall be specified as the larger clearance selected from the relevant IPC design standard or the requirements of BS EN 60950 Section 2.9. Which ever offers the highest distances.

10.1.2 Electrical Creepage

All designs to match or exceed the requirements of UL standards, creepage distances shall be specified as the larger distance selected from the relevant IPC design standard or the requirements of BS EN 60950 Section 2.9. Which ever offers the highest distances.

Documents for DEK to Issue Pre Layout.

- Contract
- Purchase Order
- Relevant DSEI documents.
- Board requirement documents
- Physical constraints, size, component area, etc
- Critical Components Lists (data on key components, including manufacturer part no.)
- Circuits
- Node list / tracks list detailing,
- Voltage current and signal requirements per line.
- Special assembly requirements.
- Change process definition
- Product marking
- Test Requirements.

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General Notes

Units of measure

- SI units
- mm for length measure
- Celsius temperature

Marking and Identification of Development Product, all boards to be marked with the following as a minimum –

- DEK assembly number.
- Issue status
- Serial number
- Description.
- Label clearly defining development product, source and manufacture date.

Documents Required by DEK Post Design.

All document should be electronic file format, issued on CD ROM as a design package on a per product basis.

- Design Source File.
- Gerber Files
- SMA ASCII text files containing circuit ref. X, Y, & Theta co-ordinates + side panel
- Drilling Data
- Routing Data
- Special Test Requirements.
- Special Tooling Requirements.
- Full Parts List.
- Special Assembly notes.
- Node list / tracks list detailing, voltage current and signal requirement.
- Step and repeat data

SECTION 2 - BARE BOARD MATERIAL SPECIFICATION

Overview

This standard engineering instruction defines the requirement for base materials, (material bare board are manufactured from) and bare board construction criteria.

Aim

The aim of this document is to define reference standards and specific construction requirements to be applied in build of DEK bare boards

Base Materials

General

Base material to be as the requirement defined in IPC standards –

IPC-4101 Material for Base Materials for Rigid and Multi layer Printed Circuit Boards.

Where conflicts occur the requirement of this document or any other DEK standard or procedure take precedence over the above IPC document.

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The particular materials required will be dependent upon board style, performance and application. Details of the material selected (in consultation with supplier) to be defined with in particular boards inception document / design file.

Contractual documents can over ride the requirements of this standard, but any such exceptions must be documented and justified within the contract documents.

Clarification of and Exceptions to IPC-4101

Flammability

Laminates and finished boards must meet the requirements of UL95 and must have ratings of UL95V-0 for flammability.

The DEK requirement is for V-0 Class materials as specified in section 1.2.13 of BS EN 60950 Safety of Information Technology Equipment Including Electrical Business Equipment.

Surface Finish

Standard surface finish requirements

- Hot air levelled solder, of a 60/40 Tin/Lead mix
 - Alpha Level silver.
 - Special finished to be defined as required.
- Finish's to be specified in the board 'Requirement Specification'.

Legends and Marking

To be printed using white inks on both sides of the board as required.

- DEK assembly number.
- Bare Board Issue status
- Description. (typically – 'Breakout Board A')
- Component ID's
- Component foot prints
- Component polarising and key pin idents.
- Board base material approvals, UL, etc.

Bare Board Testing

Bare Board Testing to be an intelligent test carried out against net listing on 100% of product. Physical parameters to also be checked.

Physical Constraints

- Bow and Twist, should be to a maximum of 1% of boards longest edge,
- Typically 1mm on a 100mm board.
- Meaning on a 1.6mm thick board, laid flat on a surface table the maximum deviation above the surface of the table would be 2.6mm
- Test methods as defined in IPC-TM-650

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SECTION 3 - DATA FOR MANUFACTURE

Overview

This standard engineering instruction defines the data to be issued to current and prospective board assembly manufacturers.

Aim

The aim of this document is to ensure that all necessary and relevant data is supplied to the manufacturer. And that all requirement are clearly defined.

General Rules.

Data to be issued in line with requirement defined in IPC standards –

IPC-D-326 Information Requirements for Manufacturing printed Circuit Board Assemblies.

Where conflicts occur the requirement of this document or any other DEK standard or procedure, DEK documents take precedence over the above IPC document.

The suite of data issued will be dependent upon board style, performance and application. A standard documents listing sheet to be completed as per sheet 2 of this document.

Contractual documents can over ride the requirements of this standard, but any such exceptions must be documented and justified within the contract documents.

Clarification of and Exceptions to IPC-D-326

Section 4.1

All materials to be supplied by assembler, unless otherwise specified in contractual documentation.

Section 4.8

A full quality and manufacturing audit should be performed on any supplier pre order placement, any specific quality issue for correction to be documented, issues to be resolved pre order placement or product supply.

Section 4.10

Requirement is to define any standard engineering requirements as well as any specific product related items.

Section 6.1

Assembly drawings are only required for complex or non standard assembly requirements, when available they should be provided as part of the documentation package.

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Section 6.3

See comments on section 6.1 above

Document List – Listing of documents to be issued with every board enquiry placed. Template available, showing typical listing as below.

PCB Assembly Number –			
Document ID.	Description	Date of Issue	Issue Status
	BOM (including parts specifications)		
	Assembly Identification Requirements		
	Document Listing		
	Test Requirements		
	PIC Data (if applicable)		
	Packaging Requirements		
	Gerber Files		
	Quality System Evaluation (including upgrades required)		
	ESS Requirements (ESS – Environmental Stress Screening)		
	Workmanship Standards (DSEI documents + board specific listing)		
	Models and Assembly Drawings		
	Delivery Requirements		
	Contractual Documents (including copy exactly)		
	ASCII Text File (for SMA's)		

SECTION 4 - BUILD AND ASSEMBLY REQUIREMENTS

Overview

This standard engineering instruction defines the documentation requirements and assembly standards that must be achieved in production of all DEK circuit board assemblies.

General Rules

All manufacturing to be performed in line with requirements of IPC standards –

- IPC / ELA J-STD-001C Requirements for Soldered Electrical and Electronic Assemblies
- IPC – A – 610 Acceptability of Electronic Assemblies

Documentation to be supplied in line with the requirements outlined in Data for Manufacture section of this DSEI.

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General Requirements

DEK will supply documentation generally in line with IPC – D – 326, with the clarification of –

BOM's

- The vendor will supply all materials required.
- All materials / components used will be from the manufacturers specified.

Control Documents

DEK will issue the following documents as required, to detail build and requirement.

- Parts Lists
- Gerber Files
- SMA ASCII text files containing circuit ref. X, Y, & Theta co-ordinates + side panel
- Circuits
- GA (for special or complex assemblies or assembly operations)
- PIC code.

Testing and Test Equipment

- Test requirement and test equipment to be defined in board test document.
- Test equipment to be supplied by vendor. Method of supply and allocated costs to be defined at the initiation of any new board contract.

Quality System

- Supplier shall operate an approved quality system in line with ISO 9001 2000

Workmanship Standards

Suppliers are required to supply to the following standards these are listed in order of precedence –

- Special instruction in GA's or other DEK specific data.
 - IPC / ELA J-STD-001C Requirements for Soldered Electrical and Electronic Assemblies
 - IPC – A – 610 Acceptability of Electronic Assemblies.

Workmanship of assemblies to be to Class 2 levels as defined in IPC / ELA J-STD-001C section 1

Exceptions and variation to the build class to be assessed and defined on a per board basis at the time of introduction, with in the 'Board requirement document'

Quantity and Delivery Requirements

To be defined by purchasing, items to cover include –

- Contractual and purchase order requirements.
- Delivery requirements, line side and JIT as applicable.

Design Change Process

No change to be made in the areas listed below with out approval of DEK and change approval via the DEK DCR process.

- Components
- PCB layout, component arrangement and clearance and creepage distances.

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Marking and Identification

All boards to be marked with the following as a minimum –

- DEK assembly number.
- Issue status
- Serial number
- Description

Build Clarifications and Exceptions

PCB build will be to the standards defined in - IPC / ELA J-STD-001C Requirements for Soldered Electrical and Electronic Assemblies

Inspection and workmanship quality shall be reviewed in line with - IPC – A – 610 Acceptability of Electronic Assemblies.

Units of measure

SI units

- mm for length measure
- Celsius temperature

Process control measurement

Process should be monitored and evaluated with various measures –

- Monitoring of process indicators
- In process reject analysis
 - 1st time pass rates
 - 2nd time pass rates
- Customer returns reject analysis
- Process changes to be documented and validated.
- Statistical process control systems are to be evident and functional within the standard process control envelope
- SPC Analysis should be performed in line with the methodology presented in the IPC manufacturing standard

Solder

Shall be in accordance with J-STD-006 'Requirements for Electronic Grade Solder'.

Flux

Shall be in accordance with J-STD-004 'Requirements for Soldering Fluxes'

No clean fluxes may be used; when used the detail should be listed within the 'Board requirement document'.

Cleaning

All boards to be cleaned unless assembled using 'No Clean' fluxes, method and testing requirements to be defined on a per product basis and by discussion with supplier. Item for consideration.

- Sides of board to be cleaned.
- Solder used.
- Testing of effectiveness of cleaning process. (batch test)
- No cleaning required for 'No Clean' fluxes.

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Inspection

100% inspection required on all new boards.

- This to be performed to a defined requirement.
- Relaxation of inspection requirement only to be undertaken after documented review of defect analysis data and proving of suitability of change.

Physical Constraints

Bow and Twist, should be to a maximum of 1% of boards longest edge,

- Typically 1mm on a 100mm board.
 - Meaning on a 1.6mm thick board, laid flat on a surface table the maximum deviation above the surface of the table would be 2.6mm
 - Test methods as defined in IPC-TM-650

Coatings and Encapsulates

- All boards to be supplied un-coated, unless such is required with the specific product build data.
- When specified coating and encapsulate shall be used in line with both the defined IPC standard and the material manufacturer, or DEK's product specification documentation.
 - Hierarchy of documents is –
 - DEK specific work / instruction procedures
 - Material manufacturers instructions. (usage, not coverage)
 - IPC procedures.

Repairs

- No repair of any DEK product is permissible with out written approval.
- When repair is approved then it is to be carried out in line with the requirements specified in IPC-7721 Repair and Modification of Printed Circuit Board and Electronic Assemblies.

Rework

- Rework of DEK product is permissible but defect must be documented and process corrections made to ensure problems do not re-occur.
- Any rework undertaken to be reviewed within the product return process and review with DEK.

Rework to be carried out in line with the requirements specified in IPC-7721 Repair and Modification of Printed Circuit Board and Electronic Assemblies.

General Requirements.

Items of clarification or requirement not defined elsewhere.

- All component placement, soldering, wire laying etc, should be done such that no reduction in the designed in clearance / crepage distance is introduced at the assembly / build process.

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SECTION 5 - TEST REQUIREMENTS

Overview

This standard engineering instruction defines standard test and inspection requirement that can be applied to PCB assemblies. Due to the large diversity of assembly types used, varying from simple point to point connection boards, to active power switching control boards, hence there are various test profile defined below. The specific test requirement for each board is to be defined and expanded with in the 'REQUIREMENT SPECIFICATION' for the individual product.

General

All testing and all fixtures, fittings and instructions associated must be controlled update and maintained within a functional traceable environment, all run under the control of the prevailing quality system.

All processes should be monitored and evaluated using SPC tools

Test Equipment

Programming of automated test equipment and design and control of all equipment must be through quality control systems.

- All testing will be done with either
- Automated test equipment
- Custom functionally operational test equipment.
- Test equipment must be controlled and calibrated.
- Test software must be tamper protected.

Test logs

- All tests should be logged.
- Each board tested should be traceable to a test date, serial number and operative.
- A structured review of failure modes and corrective action should be undertaken periodically.

Test 'PCB T1' - Visual Inspection.

Bare Boards tested and inspected to 'Bare Board Section' of this document.

Assembled Board Inspection

- 100% inspection required on all new boards.
 - This to be performed to a defined requirement.
- Relaxation of inspection requirement only to be undertaken after documented review of defect analysis data and proving of suitability of change.

This test requires the test / inspection operative to perform a visual inspection of the PCB presented for test. Typical items to be tested checked are –

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- General check for abrasions or any signs of damage or contamination.
- All relevant legends, number and labelling are fitted and legible.
- Board matches the criteria of standard IPC-A-610 C in respect to build requirements.
- All screws, covers, heat sinks, fitted correctly and secure.
- Any adjustable on board items, can be adjusted.
- Check manufacturers part reference to ensure correct parts supplied and used.
- Any specific inspection criteria defined within the board test requirement document are correct.

Test 'PCB T2' – In Circuit Testing.

A method of probing a board and determining that the correctly profiled components are fitted.

- Method and requirement to be defined with supplier.

Test 'PCB T3' – ATE Node Testing.

Automated test of node point connection and isolation, can also in some cases be used to detect simple component on board when configured to provide non complex / active circuits, typically detect diode, resistors capacitors both in and across the node point connection.

- Typical test parameters to be applied.
 - Short circuit node to node track test resistance less than 1ohm within board assembly
 - Open circuit resistance between nodes and track to be greater than 1 M ohm within board assembly.
 - For diodes, resistors, capacitors, inductors etc, value will be dependent on component and set to detect the required value +/- the manufacturer + 1%
 - ATE node testing to be performed by plugging directly into the board's external mounting connectors.

Test 'PCB T4' – Functional Testing.

This may be performed either by the use of interactive ATE equipment that has the capability to drive the product in the manner it which it would be use with in the machine environment, or by the construction of suitable custom test jigs and fixtures. The key requirement is that the testing perform a representative test of the true and final operating environment.

- Supply voltage matches those in final use.
- Monitor signal input and output speed and level are consistent with the final operating environment.
- Results are parameter based and not straight pass or fail.
- Status changes for outputs and inputs are applied and monitored.
- Operation is checked at extremes of window of operation.
- Operation of on board test points is correct.
- Correct operation of any onboard indicators or LED's

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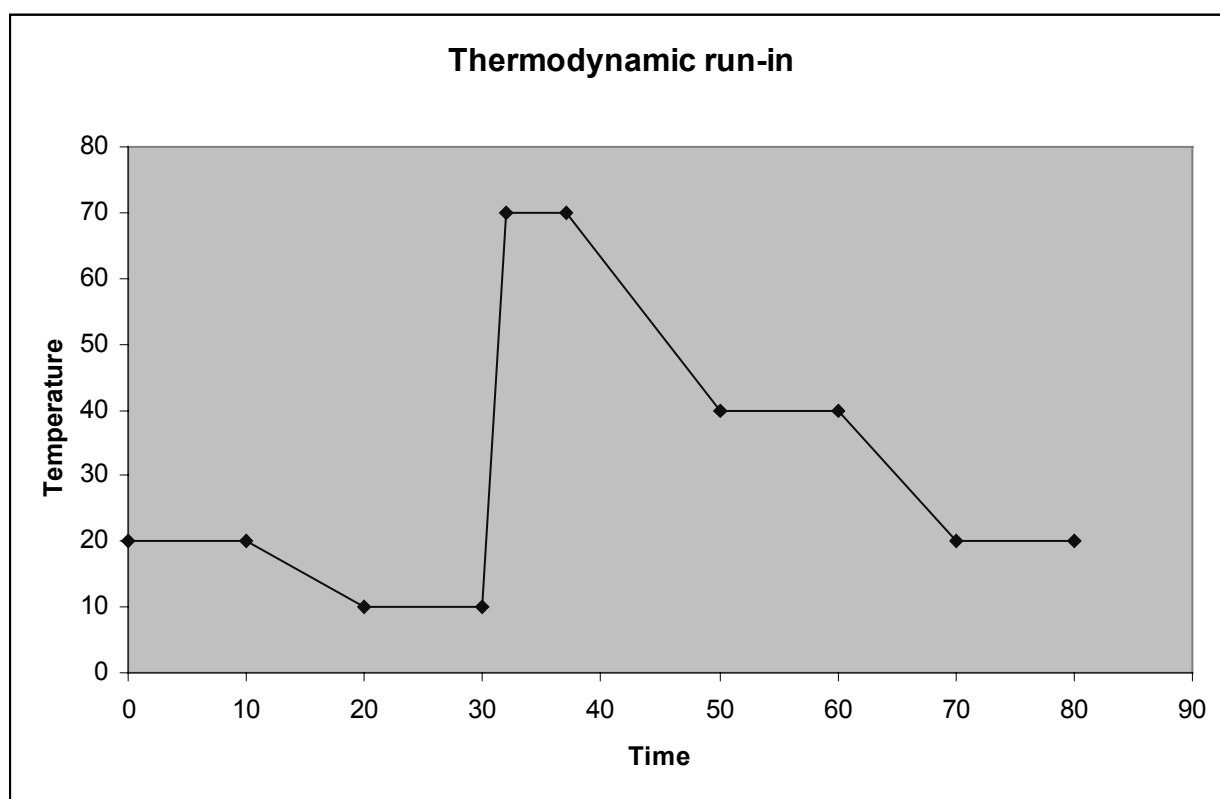
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Test 'PCB T5' – Environmental Stress Screening.

Below is defined an ESS or Thermodynamic run-in process for burn in of PCB's. General notes –

- These tests to be performed at Vendors premises as part of full test and inspections program.
- Functional, ICT or ATE testing to be specified as the active element of the test.
- Components on assemblies under test must not exceed their maximum permitted temperature. (In special cases if required test parameter to be redefined on per unit basis to accommodate)



Clarification of Graph

- 20C used as a demonstration of typical Room temperature, use prevailing room temperature in place of 20C specified.
- All areas of board and components must be stable and soaked at 10C before the rise to 70C is initiated.
- Time elements are non-critical with the exception of the 10 to 70 degree rise time period which must be achieved with a rise rate of circa 30C per minute.
- All areas of board and components must be stable and soaked at 70C before the fall to 40C is initiated.
- Selected method of test to be initiated when the unit is stable at 40C, and continue as the temperature falls to room ambient.

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Post Test Requirements

- Failing units to be positively marked and segregated for evaluation of the failure mode, marking to include failure mode and temperature at which failure occurred.
- Failing units cannot be used or reworked with out approval of DEK.
- Passing unit to be marked 'T5'

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