

<b>MODULE TITLE</b>	<b>PRINTED CIRCUIT BOARD FABRICATION</b>
<b>Nominal Duration</b>	One Module
<b>Module Code or Number</b>	EA 151
<b>Module Purpose</b>	To enable students to construct a working prototype P.C.B., given pre-production drawings, and perform relevant calculations and wiring and testing of equipment in accordance with SAA wiring rules.
<b>Relationship to Competency Standards</b>	<p>This module will be modified in line with the requirements of the national metals and Engineering Standards when they become available.</p> <p>The module contains the knowledge and skills identified and agreed by all state/territories. It has been developed on the assumption that these will be reflected in the Standards.</p>
<b>Prerequisites</b>	EA 150 Printed Circuit Board Design NE 29 Electronic Soldering Techniques
<b>Summary of Content</b>	<ol style="list-style-type: none"><li><u>Board Preparation</u><ul style="list-style-type: none"><li>Pre-coated materials</li><li>Board preparation by abrasives and acid dipping</li><li>Positive &amp; negative resist properties</li><li>Solder mask &amp; component overlay coatings</li><li>Environmental coatings</li><li>Application method</li></ul></li></ol>

2. Exposure

Application of inverse square law  
Test strips  
Cleanliness  
Safety  
Incandescent and discharge light sources  
Peak wavelength  
Polymerisation faults  
Coating sensitivity  
Lamp preheat requirements  
Image reversal materials  
Vacuum frames  
Undercut compensation  
Scaling  
Registration methods

3. Development

Prebake and postbake  
Agitation  
Concentration

4. Etching

Ferric Chloride  
Acid  
Ammonium  
Persulphate and peroxide etchants  
Gaseous burst agitation  
Spray agitation  
Etchant rates  
Calculation of undercut  
Concentration measurement  
Replenishment

5. Plating

Electro and electroless methods  
Throw  
Time-current thickness and current density relationships  
Simple plating both fabrication

6. Drilling

PCB bit sizing  
Hole clearances  
Drill speeds  
Drill bit types  
Hole punching

7. Heatsinks

Calculation of temperature rise for  
flat metal plates  
Interpretation of thermal graphs

8. Soft soldering

Electrical solder composition  
Construction  
Properties  
Types  
Wetting and alloying  
Flux types  
    Action  
    Properties  
    Applications  
    Selection  
Reflow methods  
    Hand  
    Wave  
    Dip  
    Vapour phase  
Accessories  
Joint failure mechanism  
    Identification  
Desoldering tools and methods  
Component thermal sensitivity  
Heat shunts

9. Harness Fabrication, termination & fusing

- Cable materials
- Insulation
- Temperature range
- Abrasion resistance
- Flexibility
- Configurations
- Voltage breakdown
- Application and selection
- Ribbon cable mass termination
- Cable stripping
- Cable identification methods
- Solder and crimp lug selection and fitting
- Harness jigs and drawings
- Application of cable accessories
  - Spaghetti tubing
  - Marking methods
  - Termination methods
  - Snakes
  - Lubricants
  - Ducting
  - Conduits

10. Labelling

- Panel labelling methods of engraving
- Decals
- Dry transfers (Letraset)
- Silk screening
- Etching (aluminium)
- Adhesive metal and plastic photosensitive materials (Scotchcal)
- Layout of a front of a panel

11. Appliance Wiring and Testing

- Cords and plugs
  - Selection
  - Fitting
  - Testing
- Cable clamping

**Delivery**

<b>Learning outcomes</b>	On completion of this module the learner will be able to:
<b><i>Learning Outcome 1</i></b>	<b>Describe the steps, procedures and requirements to manufacture a bare PCB.</b>
Assessment criteria	Review production sequences. Identification of materials and equipment. Standard unit sizes. Use of cutting and piercing tools and the multilayer method.
Conditions	
Assessment method	Short answer and multiple choice test
<b><i>Learning Outcome 2</i></b>	<b>Calculate current densities for plating, exposure time versus distance, track and cable current carrying capacity, heatsink area.</b>
Assessment criteria	Examine gold, solder and tin materials and solutions for plating. Basic material preparations. Thermal resistance of material as a function of shape, surface, colour, orientation. Calculate heatsink size given device data and $\theta$ or power.
Conditions	
Assessment method	Short answer test of problems
<b><i>Learning Outcome 3</i></b>	<b>Manufacture of a simple bare PCB with cutouts, an electroplated edge connector, and electroless plated conductors.</b>
Assessment criteria	Produce a prototype and one-off finished PCB for special industrial tasks. Produce finished boards with plating, coatings, and mechanical reliability. Construct a prototype for testing and for use as a model for the manufacture of multiple PCBs.
Conditions	
Assessment method	Test PCB for accuracy and conformance to specifications

**Learning Outcome 4**

**Wire and test cords, plugs and equipment safely in accordance with SAA wiring rules.**

Assessment criteria

Identify the range, scope and application of SAA wiring rules with respect to flexible cords and plugs.  
Know the relevant safety requirements, safety precautions and licence requirements.  
Describe a domestic MEN system.

Conditions

Assessment method

Separate practical test of prototype

**Learning Outcome 5**

**Identify common components, polarities and types, and given pre-production drawings, construct a working prototype PCB.**

Assessment criteria

Examine solder and friction terminations, current density of terminations, mechanical and electrical reliability, corrosion resistance, serviceability and other relevant manufacturing techniques.  
Use wire wrap tools, techniques and standards.

Conditions

Assessment method

Create a prototype

**Suggested Learning Resources**

**Physical resources**

VCR (VHS)  
Monitor/TV receiver - colour  
Dual trace oscilloscope and probes  
Colour test pattern generator  
Test tapes including factory alignment tape  
Torque or tension gauge  
VCR Bed and Leight gauge  
VCR tools - for tape guides, CTL head  
Alignment tools  
VCR manuals - Service and Training  
Hand tools for assembly/disassembly  
Patch leads

**Texts/references**