WorldSkills Singapore 2025 Technical Description – Electronics

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Name and Description of Skills Category

The name of the skills category is Electronics.

Scope of Competition

The Electronics competition covers the following areas:

- Theoretical knowledge of analog and digital electronics with emphasis on application of electronics devices in modules/systems.
- Circuit design skills for small electronic circuits.
- Translate theoretical design to final design through printed circuit board (PCBA) ready for manufacturing.
- Product prototyping skills ranging from PCB assembly (PCBA), wire harness, test & measurement of electronic circuits and light mechanical assembly.
- Embedded Software design using the C programming language.

References

- WorldSkills Standards and Assessment Guide from the last international WorldSkills.

Test Project

The Test Project is a series of three (3) standalone or integrated modules. They are:

Module name	Duration and schedule
Hardware Prototype Design	8.5 h, Day 1 and Day 3 (PM)
Embedded Systems Programming	4.0, Day 2
Fault Finding & Repair	3.5, Day 3 (AM)

Hardware Prototype Design module

This module is split into 3 phases. They are:

Phase name	Duration (h)	Day of competition
Circuit design (A1)	2.5	1 (AM)
PCB layout design (A2)	3.0	1 (PM)
Assembly and measurement (A3)	3.0	3 (PM)

Phase A1

Competitors are required to design up to 4 circuits that meet given specifications. The circuits are usually a part of a larger circuit that performs a certain function. Analog and / or digital components will be used. LTSpice will be used to capture the competitor's design and run simulations. Marking criteria will include the simulation results and the aesthetic appearance of the schematic. Judgment criteria (0-3 marks) will follow the current WorldSkills Standards and Assessment Guide. LTSpice models will be managed thus:

- LTSpice version (currently 24.xx) will be fixed 1 month before competition.
- All models not found in LTSpice will be provided at the competition.

Submission standards:

- All answers, calculations, schematics, and simulation results to be submitted in soft copy Word document.
- Screenshot and paste schematic and simulation results into the Word document. Annotations must be done to explain the measurements clearly.

Phase A2

Competitors will use Autodesk Fusion 360 Electronic Design software for this task.

Competitors will be given a partially-completed schematic (soft copy) and a component library that contains the schematic symbols and footprints needed to complete the PCB except for one component. They will create the schematic symbol and footprint for this one component, then finish the schematic according to provided hard copy reference schematic, followed by laying out the components on a double-sided PCB using PCB layout software. The layout and the generated PCB output files must be suitable for fabrication by a PCB milling machine. Competitors must prepare manufacturing documents: Gerbers, drills files, printed layout, printed schematics, Bills of Material (BOM), etc.

PCB specifications:

- Maximum number of components: 30.

- Maximum board size: 90mm x 90mm. Board dimensions and any pre-defined component positions will be specified clearly in the question paper.
- Double-layer board. Competitors to make vias using wire instead of using jumper wires.
- Through-hole and SMD components may be placed on either top or bottom layer. The TWG will mill the PCB as submitted.
- Copper pour is a must, as specified by the WorldSkills Standards and Assessment Guide (they use the word "Polygon"). Unused copper areas will not be rubbed out (cost and time constraints).

Design rules:

Name	Specification
Minimum via size	0.7 mm ID 1.4 mm OD
Minimum clearance between traces and copper pour / rubout copper	0.2 mm
Minimum clearance between component pads and copper pour / rubout copper	0.3 mm
Minimum track width	0.2 mm

The PCB designed will be used in phase A3 of the competition. At the end of this task, competitors must decide on their own whether they wish to use their own design or the "reference design" provided by the TWG in phase A3. If they choose to use the reference design, they will lose all copper-related marks in phase A2 (worth about 50% of the marks in phase A2).

The TWG will produce the competitor-designed PCBs during Day 2.

Phase A3

Competitors will assemble the PCBA on Day 3. The PCBA may be integrated into a mechanical assembly for completeness. If problems/errors in design are recognised at this stage they may be repaired. The board will primarily use Surface Mount Technology (SMT) components with some Through-Hole Technology (THT) components.
- ICs shall have ≥0.65 mm pin pitch.
- Surface mounted passive devices shall have 0805 footprint or bigger.

A properly completed project should function according to given specifications. Competitors must make the specified measurements and document them in the Word document. There will be an app in the laptop to view the oscilloscope screen, for competitors to do screen captures. Time will be allocated during familiarisation for competitors to practise this task.

Embedded Systems Programming module

Competitors will write C code for an embedded system. The embedded MCU will be an ARM Cortex M0+: STM32L052K6Tx. Details on the MCU platform and development tools to be used are as follows:
- Microcontroller: STM32L052K6Tx.
- Development Board: WorldSkills CPU board.
- Software Development Suite: STM32CubeIDE, currently v1.15.1. Version will be finalised and communicated by 31 December 2024.
- In-circuit Debugger and Programmer: Standalone ST-LINK/V2.

The competition will use most, if not all, of the following STM32L0 features and peripherals.
- System peripherals and features
  - GPIOs
  - NVIC and EXTI

- o Reset and clock control (RCC)
- o DMA
- o Low power modes
- Communication
  - o USART/LPUART
  - o SPI
- Analog
  - o ADC
  - o COMP
  - o DAC
- Timers
  - o TIM/LPTIM and PWM

Preconfigured firmware "skeleton" project generated by STM32CubeMX (either standalone or integrated into STM32CubeIDE) will be used and will include STM32CubeL0 library and possibly middleware libraries as well. Interrupts and Interrupt Service Routines (ISRs) may be used. The firmware programming will be in embedded C. In-line assembly is not allowed.

TWG will do their best to ensure all hardware has no faults, and also guide competitors to test the hardware during briefing. This module does not test hardware skills, but competitors must understand that embedded programming is inherently hardware-related and must consider hardware effects on their code. If they suspect hardware fault, please flag out to experts.

Fault Finding and Repair module

Competitors must find, document, and repair the faults in the provided PCBA. Some of the required modifications or repairs may be specified in the question paper. Measurements must be done and recorded before and after the modifications or repairs are done. Oscilloscope screenshots must be captured using the provided app.

Final task will only be published during the competition. No datasheets will be provided before the competition; only block diagram of task will be provided 1 month before the competition.
The component specifications are the same as phase A3.

No fault on software and microcontroller.

A functioning project will be demonstrated to experts and competitors at the competition.

Replacement components for every component in the project will be available during the competition. They will be delivered by industry experts only. A "set meal" will be prepared for competitors who give up; however, they will still be credited with any faults they have found before giving up. But in any case, no replacement boards will be provided.

All boards will be pre-built before the Competition. Each board will have a minimum of 5 faults.

Note: In future WorldSkills, the direction may shift towards focusing more on the circuit modification and measurement and competitors may be told exactly what are the "faults" to be rectified.

Equipment List

To be provided by organiser: (Equipment models will be announced when they are confirmed).

S/N	Equipment
1	Oscilloscope

2	Function generator
3	Triple output DC power supply (Instek GPS-3303)
4	Digital Multimeter
5	Notebook and Monitor
6	PCB milling machine

Tools and Equipment the candidates can bring:

S/N	Equipment
1	Component tray
2	General hand tools (pliers, cutter, wire-stripper, screw drivers)
3	PCB work piece holder
4	De-soldering pump (manually operated)
5	Pocket calculator (non-programmable)
6	Workbench vice
7	Standard keyboard and mouse
8	PCB soldering and rework station

Marking Criteria

We refer to the most current WorldSkills Standards and Assessment Guide from the last international WorldSkills for marking. However, here are the main focus areas:

Circuit Design

- Functionality.
- Schematic and simulation presentation quality.
- Correctly-designed components value.

PCB Layout Design

- Component placement.
- Copper trace design.
- Ground pour ("polygon") design.
- Following design rules and specifications.

Assembly and Measurement

- Assembly workmanship.
- Circuit functionality.
- Measurement presentation quality.

Embedded Systems Programming

- Functionality.

Fault Finding and Repair

- Correct fault identification.
- Repair / modification workmanship.
- Measurement presentation quality.