IEEE MICROMOUSE COMPETITION
Region 6 – Central Area
BEST PACKAGING PRIZE
Selection Criteria and Competition Guidelines
IEEE-CPMT-SCV

1. **OBJECTIVE**
   - 1.1. The IEEE Components, Packaging, and Manufacturing Technology (CPMT) Society's "Micromouse Best Packaging Prize" will be awarded to the R6 Central Area Student Micromouse Contestant which best meets the Selection Criteria contained herein. This Prize is in addition to – and fully independent of – the Primary Micromouse Prize for Best Performance in the Micromouse Maze.
   - 1.2. The Competition for the Best Packaging Prize does not depend on Contestant performance in the Maze Competition. Selection is based on the Contestant's Design with respect to the Selection Criteria enumerated below.
   - 1.3. Award of the Best Packaging Prize is not intended to replace or otherwise substitute for the Maze Competition – See Prize Eligibility in the next section.
2. **PRIZE ELIGIBILITY**
   - 2.1. All Contestant Eligibility Requirements as set forth in the IEEE Region 6 Micromouse Contest Rules also hold for the Micromouse Best Packaging Prize.
   - 2.2. This Prize is available only during the Region 6 – Central Area Competition, and is not available at the Region 6, or other Competitions.
   - 2.3. Contestants may NOT enter the Best Packaging Prize Competition without also meeting Eligibility Requirements for the Micromouse Maze Competition.
     - 2.3.1. The Best Packaging Prize does NOT require Successful Completion of the Maze Competition. The Best Packaging Prize MAY be awarded to a contestant that was not able to complete the Maze Competition due to operational problems, time limit failure, or functional breakdown.
     - 2.3.2. However, the Best Packaging Prize Contestant must be able to attempt the Maze Competition. A Contestant cannot enter the competition for Best Packaging Prize without entering the Maze Competition.
     - 2.3.3. Any Contestant entered for the Best Packaging Prize MUST compete in the Maze Competition and achieve a minimum of the following:
       - 2.3.3.1. Successfully operate in the Maze for 3 minutes or more;
       - 2.3.3.2. Successfully navigate at least two (2) turns in the Maze.
       - 2.3.3.3. Failure to achieve the above minimum qualifications will result in DISQUALIFICATION from the Best Packaging Award Competition.
     - 2.3.4. Any Contestant disqualified from the Maze Competition for failure to meet the Micromouse Design Rules – such as exceeding Micromouse physical dimensions, implementation of remote-control, damage to the Maze, or excessive Micromouse materials cost – also will be DISQUALIFIED from the Best Packaging Prize Competition.
     - 2.3.5. Entry into the Maze Competition does NOT require competition for the Best Packaging Prize. Any Contestant wishing to be considered for the

Best Packaging Prize MUST submit an Entry Form at the time of the Maze Competition event.

3. PRIZE SELECTION CRITERIA

3.1. Further Information on specific topics, Key Word, and Literature Searches.

3.1.1. Throughout this and subsequent sections, certain words and word phrases appear in a different font-style and underlined. These Key Words can be used by the student contestant teams for Internet and Technical Literature Searches (e.g., ieeeexplore.ieee.org) for additional information on various principles used in the Selection Criteria.

3.2. Power Consumption:

3.2.1. The Micromouse contestants, like all Portable Electronic Devices, use batteries as the primary power source. And like all portable electronic devices, the operational Battery Life is an important performance specification. The operation battery life depends on the Charge Storage Capacity of the Power Cell and the Charge Depletion Rate caused by operation of the electronic device, also called power consumption. At the end of the operational battery life, the power cells (batteries) must either be replaced, or recharged. Typically, Rechargeable Batteries offer a shorter operational battery life than non-rechargeable batteries. However, the use of non-rechargeable batteries adds to the Operational Cost of the electronic device, requiring an occasional Replacement Cost expenditure for new batteries. The Life Cycle Cost recognizes this trade-off. Reducing the electronic device power consumption extends operational battery life and reduces the operation cost of the device. Therefore, it is advantageous for the electronic device to consume less power during normal operation and stand-by mode.

3.2.1.1. The Micromouse contestants will be scored on Power Consumption. Power Consumption of the Micromouse contestants will be based on the size/type of battery used in the Micromouse, the number batteries used, and the power cell connection configuration – series/parallel. Typical Alkaline batteries, for example, are specified by "size" and are rated of capacity in ampere-hours. See the Table below. So, a single "D" battery can provide approximately 2X current as a single "C" battery for same length of time or, conversely, provide the same amount of current for 2X length of time. Configuring the batteries in parallel provides more current capability at the same voltage, while in series provide more voltage at the same current. The Micromouse power unit will be scored based on the power capacity (in Volt-Amperes), depending on the battery size, number of batteries used, and wiring configuration. The lower the power capacity, the lower the expected power consumption and, hence, a better score.

PRODUCT NUMBER	SIZE	NOMINAL VOLTAGE (volts)	RATED CAPACITY (ampere-hours)
MN1300	D	1.5	15.000
MN1400	C	1.5	7.800
MN1500	AA	1.5	2.850
MN2400	AAA	1.5	1.150
Typical Alkaline Manganese Dioxide Battery Performance Characteristics			

3.2.1.2. Rechargeable Batteries: The Micromouse Contestants will score additional points for the use of rechargeable batteries in their design. Lead-acid and alkaline batteries contain non-negligible amounts of hazardous compounds and must be disposed of according to hazardous chemical guidelines. The use of rechargeable batteries greatly reduces the waste from battery compounds and is highly recommended in portable electronic devices. (Note: NiCd rechargeables have non-negligible amounts of heavy metal contaminants and require special disposal, and will be rated lower than Lithium-Ion, Nickel-Metal-Hydride, Fuel-Cell, etc.)

3.3. Thermal Dissipation:

3.3.1. Heat dissipation and Thermal Management are critical concerns for any portable electronic device. Excessive heating can significantly shorten the useful lifetime of any electronic component. Therefore, adequate heatsinking must be provided for any heat-generating component. Also, excess heat often indicates resistive electrical losses in the device that consume battery power. Hot surfaces caused by excessive heat generation can make the device difficult to use for certain applications – such as hand-held devices. The Micromouse contestants will be scored on the Thermal Dissipation and Thermal Management design elements of the Micromouse device.

3.3.1.1. Quiescent/Full Operation: A temperature probe will be attached to the main PCB (wherever accessible) of the Micromouse and the Micromouse will be operated in quiescent (standby) mode for 5 minutes. The chassis temperature will be recorded. After the 5 minute quiescent operation, the Micromouse will be operated in normal "run" mode for 3 minutes with wheels-off-the-ground (on blocks) and another temperature reading will be recorded. Finally, the case of the Micromouse will be touched by the Packaging Judge to determine if the Micromouse case is a) cool, b) warm, or c) hot to the touch. In all cases, cooler is better and the lowest temperatures will earn the contestant the highest score.

3.4. Size and Weight:

3.4.1. The Micromouse Contest Rules include the Requirement that Micromouse cannot exceed 25 cm in length or width. The height of the Micromouse is not limited, nor is the weight. However, almost every portable electronic device has severe size and weight constraints based on the specific

application. Therefore, the Micromouse contestants will be scored on the total size and weight of the Micromouse.

3.4.1.1. The 25 cm length and width restrictions continue to apply. Additionally, the Micromouse with the lowest overall volume will score highest. Overall Volume will be determined by simple Maximum Length, Maximum Width, Maximum Height measurements – yielding a Maximum Package Envelope. Any protruding sensor arms will not be included in the Package Envelope as long as they are not formed by substantial framing. To restate: large, structured sensor supports will be included in the Package Envelope while small sensor arms (antennae) will not.

3.4.1.2. The Micromouse will be weighed on a simple scale. The overall device weight will be recorded. The Micromouse exhibiting the lowest overall weight will score highest.

3.5. Audible Noise:

3.5.1. Audible Noise is a concern for most consumer and business electronic devices. For example, for any personal computer, desktop projector, or printer that is intended to operate in an Office Environment, the Audible Noise (typically due to noise generated by cooling fans) shall not exceed 45 dBA (decibels, weighted for human ear response). Typically, audible noise is measured using a Sound Meter. If a sound meter is available, the Packaging Judge will use the sound meter to measure the audible noise generated by the Micromouse Contestants. In this case the sound meter will be held directly above the center of the Micromouse at approximately 6 inches distance during the Full-Operation temperature measurement and the sound level (in dBA) will be recorded. If a sound meter is not available, then the Packaging Judge will use a portable microcassette recorder to record the sound of the Micromouse during the quiescent temperature measurement. After all Micromouse contestants have been recorded, the Judge will playback the recordings and note any Micromouse that generates excessive noise as determined by the Judge. The Micromouse contestants that do not generate excessive noise will receive a nominal score, while any that are determined to exhibit excessive audible noise will receive zero score.

3.6. EMC/RFI:

3.6.1. Electromagnetic Compatibility is an important factor when portable devices must operate correctly in proximity to other emitters and receivers, while Radio Frequency Interference can disrupt nearby equipment. Sources can include intended radiators and also unintended radiators (such as digital logic and clock signals). All portable electronic devices are subject to EMC/RFI limitations set by regulatory agencies so that the device does not interfere with other nearby electronic devices. The Micromouse Contestants will be scored on RF emanations as measured by an oscilloscope with a simple loop antenna. Although, RF

Interference (RFI) is typically measured with an RF Spectrum Analyzer, simple measurements also can be accomplished using a standard portable oscilloscope. Measurements will be made during the quiescent temperature measurements.

3.6.1.1. RFI Measurements: While the Micromouse is being measured for thermal dissipation in quiescent operation, the Packaging Judge will hold a simple loop antenna (which in turn is connected to the input of a portable oscilloscope) approximately 6 inches away from the Micromouse. The oscilloscope time-base will be adjusted from 10.0usec/div to 1.0nsec/div in single steps and any detectable signal will be noted. Any Micromouse that exhibits excessive signal in the 10kHz – 100MHz bandwidth (as determined by the Packaging Judge) will receive a zero score. All Micromouse contestants that do not exhibit excessive RF signal will receive a nominal score.

3.7. Reliability/Quality:

3.7.1. All electronic devices are expected to perform within specification and meet reliability requirements based on the specified application. Typically Reliability Standards are established for an electronic device based on the area of application – such as Consumer, Commercial, Industrial, Telecommunications, Automotive, Military, and Aerospace. For each of these areas there are published reliability standards. Reliability and Quality are closely related. Device reliability may be largely determined by the device quality. Product Quality consists of the quality/reliability of components used in the Product, the quality of the assembly of the product, and the number of components used in the assembly. A fewer number of components reduces the Failure Probability of the overall device.

3.7.1.1. The Micromouse contestants will be scored on the Quality of Workmanship, or Assembly of the Micromouse – as determined by the Packaging Judge. The Packaging Judge will inspect the assembly workmanship of each contestant. Those Micromouse devices that exhibit a high degree of quality workmanship will receive a nominal score. The Micromouse devices that appear to be poorly assembled will receive a zero score.

3.8. Industrial Design, Aesthetics, Product Appearance:

3.8.1. Modern electronic product design is strongly influenced by Industrial Design Concepts, also known as Aesthetics, or Product Appearance. Often, an appealing, or uniquely functional product design will enhance the marketability of the product. The Industrial Designer is an artist who designs the product case and the functional controls for the product. The designer tries to make the design appealing to the potential customer base and tries to make the controls meet general Human Factors and Usability Guidelines. Human Factors is a science that studies the ability of average humans to interface with electronic devices – with particular attention to

viewing (reading) a display, audible feedback (sounds made in response to an action), control accessibility (such as the size of control buttons on the device relative to human finger size).

3.8.1.1. The Micromouse contestants will be scored on the Design/Appearance of the Micromouse. This is a fully subjective assessment by the Packaging Judge, based on his/her experience in the Product Design field. The Micromouse with the most appealing design or the best application of Human Factors will receive the highest score. This score effectively is the Beauty Contest of the Packaging Award and counts no more than any of the other competition areas described above.

4. EQUIPMENT USED BY THE PACKAGING JUDGE IN THE BEST PACKAGING PRIZE EVALUATION:

4.1. The following equipment will be used by the Packaging Judge in the Evaluation of the Micromouse contestants for the CPMT Best Packaging Prize:

4.1.1. Handheld Thermometer with Temperature Probe – such as Fluke Model 51 digital thermometer with 80PK-1 thermocouple temperature probe, or equivalent.

4.1.2. Standard English or Metric tape measure.

4.1.3. Small standard English or Metric scale (pounds/kilograms).

4.1.4. Sound Level Meter such as the Mannix DSM325, or equivalent, or

4.1.4.1. Portable microcassette recorder.

4.1.5. Portable Oscilloscope such as Tektronix TDS2022B, or equivalent with

4.1.5.1. Simple Loop Antenna such as UHF television antenna.

5. MICROMOUSE PACKAGING EVALUATION FORM:

5.1. A Sample Micromouse Best Packaging Prize Evaluation Form is attached at the end of this document.

6. MICROMOUSE PACKAGING SCORING:

6.1. The Micromouse Best Packaging Prize Contestants will be scored according to the following:

6.1.1. Power Consumption:

Contestant Power Consumption Evaluation	Score
Lowest Power Consumption	5 Points
2nd Lowest Power Consumption	3 Points
3rd Lowest Power Consumption	1 Point
All Others	Zero Points

6.1.1.1. Rechargeable batteries:

Contestant Power Source Evaluation	Score
Fuel Cell	5 Points
Rechargeable and safely disposable	3 Points
Rechargeable but not disposable	1 Point
All Others	Zero Points

6.1.2. Thermal Dissipation:

Contestant Thermal Dissipation Evaluation	Score
Lowest Temperature Measurements	5 Points
2nd Lowest Temperature Measurements	3 Points
3rd Lowest Temperature Measurements	1 Point
All Others	Zero Points

6.1.3. Size/Weight:

Contestant Size Evaluation	Score
Smallest Package Envelop	3 Points
2nd Smallest Package Envelop	2 Points
3rd Smallest Package Envelop	1 Point
All Others	Zero Points

Contestant Weight Evaluation	Score
Lowest Device Weight	3 Points
2nd Lowest Device Weight	2 Points
3rd Lowest Device Weight	1 Point
All Others	Zero Points

6.1.4. Audible Noise:

Contestant Audible Noise Evaluation	Score
Acceptable Noise Level	3 Points
Excessive Noise Level	Zero Points

6.1.5. EMC/RFI:

Contestant RFI Evaluation	Score
Acceptable RFI Level	3 Points
Excessive RFI Level	Zero Points

6.1.6. Reliability/Quality:

Contestant Workmanship Quality Evaluation	Score
Acceptable Workmanship Quality	3 Points
Poor Workmanship Quality	Zero Points

6.1.7. Product Design:

Contestant Product Design Evaluation	Score
Best Product Appearance/Design	5 Points
2nd Best Product Appearance/Design	3 Points
3rd Best Product Appearance/Design	1 Point
All Others	Zero Points

6.1.8. Total Score:

Maximum Achievable Score:	**30 Points**