

ULTRACAPACITOR SAFETY DATA SHEET (SDS)

This document is prepared as a courtesy to provide persons using this product with additional safety and regulatory information. Users are also encouraged to access the applicable SDS for the internal components referenced in Section 3 (Composition and Ingredients).

Prepared using U.S. OSHA, CMA, ANSI, Canadian WHMIS, Australian NOHSC, Japanese, Chinese, and European Union Standards as a guide.

NOTE: This product is an "article" under the U.S. Federal Occupational Safety and Health Administration (OSHA) Hazard Communication Standard (29 CFR 1910.1200), European Union (EU) Directives, Japanese, Chinese and Korean regulations and the Canadian Workplace Hazardous Materials Standard. Refer to Section XV (Regulatory Information) for specific regulatory citations. As an article, this product presents negligible health and physical hazards under reasonably anticipated conditions of use. Accordingly, a Safety Data Sheet (SDS) is not required for this product under the standards cited above.

SECTION 1 - PRODUCT IDENTIFICATION



Product Identifier:	Ultracapacitor
Synonyms, Other Means of Identification:	Supercapacitor, electric double layer capacitor
Description:	Commercial Product
Manufacturer:	Maxwell Technologies, Inc. 3888 Calle Fortunada San Diego, CA 92123 +1 (858) 503-3300
Emergency Phone Number:	CHEMTREC +1 (800) 424-9300

SECTION 2 - HAZARDS IDENTIFICATION

This ultracapacitor is a manufactured electronic product that contains primarily non-hazardous materials, including metal and plastic. Ultracapacitors are sealed, metal containers (steel or aluminum), which enclose layers of activated carbon that is saturated with an electrolyte solution. The electrolyte solution contains a quaternary salt compound (tetraethylammonium tetrafluoroborate) dissolved in the solvent acetonitrile. The assembled layers of activated carbon are inserted into an outer metal container and are saturated with the above electrolyte solution and then are sealed and stored in an electrically uncharged state. If the contents of these ultracapacitors remain sealed in the outer shell and they are kept uncharged, persons handling these products will avoid most of the risks associated with hazardous components of the electrolyte. As such, precautions should be taken to avoid rupture or overheating the sealed metal containers.

EMERGENCY OVERVIEW: *Product Description:* This product is a solid article consisting of an opaque plastic and metal sealed case, which is filled with an electrolyte solution that has been almost completely adsorbed and or absorbed by the activated carbon layers. **HEALTH HAZARDS:** This product is considered a manufactured article and presents negligible health hazards under typical use conditions. Misuse of this product, such as deliberate destruction, overcharging or heating, may release internal components contained within the sealed case. Skin contact with the carbon may cause mild irritation. **FLAMMABILITY HAZARDS:** The internal components of this product are combustible and may be ignited if a particular failure mode occurs and they are exposed to an ignition source or if subjected to direct flame. If the article is involved in a fire, the chemicals contained in the case may decompose and produce toxic gases (e.g. nitrogen oxides, carbon oxides, hydrogen cyanide, hydrogen fluoride and other miscellaneous fluoride and boron compounds). During a fire involving this product, care should be taken to avoid inhalation of fumes. Misuse of this product, such as overcharging, may cause the article to vent which could then cause the release of these toxic fumes as well. **REACTIVITY HAZARDS:** Negligible. **ENVIRONMENTAL HAZARDS:** Negligible. **EMERGENCY CONSIDERATIONS:** Emergency responders must wear the proper personal protective equipment (and have appropriate fire-suppression equipment) suitable for the situation to which they are responding. Appropriate precautions should be taken in the event of a container rupture under emergency conditions including fire.

SECTION 3 - COMPOSITION AND INGREDIENTS

This product is a solid article consisting of an opaque plastic and metal casing filled with activated carbon saturated with an electrolyte solution. The following information is for the components of the electrolyte solution and the activated carbon. As manufactured, exposure to individual electrolyte components is not expected. If this product is heated, cut or otherwise manipulated in such a way that will release the internal components or produce fumes, exposure to these components is possible.

CHEMICAL NAME	CAS #	EUROPEAN EINECS #	JAPANESE MITI #	KOREAN ECL #	CHINESE IECSC 2007 INVENTORY	NEW ZEALAND NZIoC	% w/w	EU CLASSIFICATION FOR COMPONENTS
Acetonitrile	75-05-8	200-835-2	2-1508	KE-00067	Listed	HSR001071	10-20%	HAZARD CLASSIFICATION: F+, Xn RISK PHRASES: R:11, R:20/21/22, R:67
Activated Carbon	7440-44-0	231-153-3	Mineral Excepted	KE04671	Listed	HSR001271	10-20%	HAZARD CLASSIFICATION: Not applicable RISK PHRASES: Not applicable
Tetraethylammonium tetrafluoroborate	429-06-1	207-055-1	Unlisted	KE-05-1249	Listed	HSR004712	5-15%	HAZARD CLASSIFICATION: Not applicable RISK PHRASES: Not applicable
Other components that comprise the balance of the capacitor (e.g. metal can, plastic, foil, etc.)							Balance	HAZARD CLASSIFICATION: Not applicable RISK PHRASES: Not applicable

See Section XV for full EU classification information on products and components

SECTION 4 - FIRST AID INFORMATION

Damaged ultracapacitors may release electrolyte containing acetonitrile and TEABF4. Acetonitrile is moderately toxic by inhalation and/or skin absorption. If necessary, physicians should refer to Section XI (Toxicological Information) in the event there is a severe inhalation, skin contact or ingestion exposure to the electrolyte solution. Under these circumstances, take a copy of this SDS to the physician or health care professional with the exposed individual. First-aid measures applicable to contamination with the electrolyte solution are as follows:

RECOMMENDATIONS TO PHYSICIANS: Eliminate exposure and treat symptoms.

SKIN EXPOSURE: If skin exposure to electrolyte occurs, flush contaminated area liberally with water. Seek medical attention if any adverse effects occur after flushing.

EYE EXPOSURE: If liquid, vapors or fumes from the electrolyte contained in this product contaminate the eyes, rinse eyes under gently running water. Use sufficient force to open eyelids and then "roll" eyes while flushing. Minimum flushing is for 20 minutes. Seek medical attention.

INHALATION: If vapors or fumes from the electrolyte contained in this product are inhaled, remove exposed person to fresh air. If necessary, use artificial respiration to support vital functions and seek medical attention.

INGESTION: In the unlikely event that the electrolyte contained in this product is swallowed, CALL PHYSICIAN OR POISON CONTROL CENTER FOR MOST CURRENT INFORMATION. If professional advice is not available, DO NOT INDUCE VOMITING. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having convulsions, or unable to swallow. If victim is convulsing, maintain an open airway and obtain immediate medical attention.

SECTION 4 - FIRST AID INFORMATION (CONTINUED)

ELECTRIC SHOCK: Victim should not be touched if a connection to the product still exists. Once the victim is no longer in contact with the device and if electric shock from the device has resulted in cessation of breathing, immediately begin cardiopulmonary resuscitation (CPR). If no person that is trained in CPR is available, obtain immediate medical advice on how to perform CPR. If the heart has stopped, a qualified person should begin CPR. Immediate medical attention should be sought while attempts to revive the victim are ongoing. If an automatic external defibrillator (AED) is available, immediately begin treatment with AED.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: No medical conditions are known to be aggravated by exposure to this product.

SECTION 5 - FIRE-FIGHTING MEASURES

SUITABLE FIRE EXTINGUISHING MATERIALS: The following fire extinguishing materials are suitable for fires involving this product:

Water Spray: OK (cooling only and only if products are uncharged)	Dry Chemical: OK	Carbon Dioxide: OK
Foam: OK	Halon: OK	Other ABC Type: OK

UNSUITABLE FIRE EXTINGUISHING MATERIALS: None known.

FIRE AND EXPLOSION HAZARDS: This product is not flammable under normal operational and non-operational conditions; however if this product is operated improperly, punctured or exposed to high temperatures, as may be encountered in a fire situation, the adsorbed electrolyte may escape and ignite. Due to the small amount of electrolyte solution in each device and the presence of activated carbon, these articles contain little or no freestanding liquid and are not anticipated to pose a significant fire hazard under normal conditions of storage, use and shipment. Sealed devices involved in a fire may rupture explosively if heated for a sufficiently long period of time. If involved in a fire, the materials contained in these articles may thermally decompose and produce toxic gases (e.g. nitrogen oxides, carbon oxides, hydrogen cyanide, hydrogen fluoride and other fluoride and boron compounds).

Explosion Sensitivity to Mechanical Impact: Not sensitive.

Explosion Sensitivity to Static Discharge: Not sensitive.

SPECIAL FIRE-FIGHTING PROCEDURES: Incipient fire responders should wear eye protection. Structural firefighters must wear Self-Contained Air Breathing Apparatus (SCABA) and full protective equipment. Chemical resistant clothing may be necessary. Move the articles from fire area if it can be done without risk to personnel. Water spray or fog may be used by trained firefighters to disperse vapors, protect personnel and to cool fire-exposed containers in areas where dangerous electrical voltages are not present. If possible, prevent runoff water from entering storm drains, bodies of water, or other environmentally sensitive areas.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Because the hazardous constituents are adsorbed on carbon media and very little free liquid is available for release to the environment, this product does not normally represent a spill hazard. If failures occur or misuse of the product results in a release or spill of the electrolyte solution, releases should be cleaned up by trained personnel using appropriate cleaning tools and techniques. Proper personal protective equipment (PPE) should be used. Eliminate all sources of ignition before cleanup begins. Secure cleanup residue in closed containers and manage residuals properly (see Section XIII, Disposal Considerations). Call CHEMTREC (1-800-424-9300) for emergency assistance, or if in Canada, call CANUTEC (613-996-6666).

SECTION 7 - HANDLING AND STORAGE

GENERAL SAFE WORK PRACTICES AND GOOD HYGIENE PRACTICES: Do not eat, drink, smoke, or apply cosmetics while handling this article. Wash hands thoroughly after handling this article or containers for this article. Avoid breathing gases generated by this article. Use in a well-ventilated location. Follow SPECIFIC USE INSTRUCTIONS supplied by the manufacturer.

STORAGE AND HANDLING PRACTICES: Employees must be trained to properly use this article. These articles are capable of accepting, storing, or releasing an electric charge. Although these articles are shipped uncharged and operate singly at low voltages, when charged and shorted, arcing may occur and result in molten metal splattering and arc-flash hazards. Remove hand jewelry before handling these articles. Keep away from heat, sparks, and other sources of ignition. Do not charge in unventilated areas. When stacking the articles upon one another, place insulating and cushioning layers between each unit, to avoid damage and short-circuiting. Do not use organic solvents other than recommended chemical cleaners. Store in a cool, dry, well-ventilated place away from combustible materials and away from material with which it is incompatible (see Section X, Stability and Reactivity). Post warning and "NO SMOKING" signs in storage and use areas as appropriate. Have appropriate fire extinguishing and spill response equipment in the storage area (i.e., sprinkler system, portable fire extinguishers, sorbents, etc.). Inspect all incoming packages before storage to ensure that ultracapacitors are properly labeled and not damaged.

SECTION 8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

NORMAL USE: NOT APPLICABLE. Finished commercial product.

FOR OPENED UNITS: As an intact, sealed, manufactured article, exposure to individual components is not possible. If this product leaks, fails, is cut or is otherwise manipulated in such a way that the contents are released, exposure to the internal components is possible. The only internal component that is dispersible is the electrolyte; therefore, the following information applies to the electrolyte solution only.

Chemical Name	CAS #	Applicable Exposure Limits							
		OSHA-PELs		ACGIH-TLVs		ACGIH-RELS			Other
		TWA ppm	STEL ppm	TWA ppm	STEL ppm	TWA ppm	Skin Note	IDLH ppm	
Acetonitrile	75-05-8	40	60 (15 min.)	20	NE	20	Skin	500	DFG MAKs (skin) (vacated TWA = 20 ppm (skin) 1989 PEAK = 2.ppm MAX 15 min, average value, 1-hr interval, 4 PEL) per shift DFG MAK Pregnancy Risk Classification: C Carcinogen: EPA-CBD, EPA-D, TLV-A4
Tetraethylammonium tetrafluoroborate	429-06-1	NE	NE	NE	NE	NE	NE	NE	

NE = Not Established

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE (COLOR, PHYSICAL FORM, SHAPE): Finished commercial product. Various sizes and shapes.

VOLATILE ORGANIC COMPOUND (VOC) CONTENT: Not applicable. Product not regulated for VOC content at state or federal level.

SECTION 10 - STABILITY AND REACTIVITY

STABILITY: Stable under condition of normal temperature.

DECOMPOSITION PRODUCTS:

Combustion: Products of thermal decomposition can include toxic gases (e.g. nitrogen oxides, carbon oxides, hydrogen cyanide, hydrogen fluoride and other miscellaneous fluoride and boron compounds).

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE:

Electrolyte Solution: Strong reducing agents, strong oxidizers, strong acids, diphenyl sulfoxide, trichlorosilane, n-fluoro compounds, nitrating agents.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Avoid exposure to or contact with sparks, flames, or other sources of ignition, extreme temperatures, and incompatible chemicals.

SECTION 11 - TOXICOLOGICAL INFORMATION

This product is a finished commercial product. It is classified as an "article" and exempt under the federal OSHA Hazard Communication standard.

CHRONIC EFFECTS: No chronic health effects reported.

TARGET ORGANS: No target organ effects reported.

CARCINOGENICITY: This finished consumer product is not carcinogenic.

SECTION 12 - ECOLOGICAL TOXICITY ENVIRONMENTAL FATE AND TRANSPORT

ENVIRONMENTAL STABILITY: This product is not expected to decompose in the environment. The following environmental data are available for components of the electrolyte solution.

MOBILITY: This product has not been tested for mobility in soil. The following information is available for the acetonitrile component. Acetonitrile is expected to have high mobility in soil and to adsorb weakly to soils as predicted by its KOC value. Removal occurs primarily by volatilization and leaching into groundwater (HSDB 1994). Volatilization from moist soil surfaces is expected to be an important fate process. Acetonitrile has a vapor pressure of 88.8 mm Hg and would be expected to volatilize from dry soil surfaces. Volatilization from surface waters is slow due to the high water solubility, moderate vapor pressure, and low Henry's law constant (HSDB 1994). The water solubility of acetonitrile suggests that dissolution into clouds and raindrops may occur leading to possible removal in rainfall (U.S. EPA 1985).

SECTION 12 - ECOLOGICAL TOXICITY ENVIRONMENTAL FATE AND TRANSPORT (CONTINUED)

PERSISTENCE AND BIODEGRADABILITY: The metal and plastic case of this product will persist in the environment for extended periods of time. The following information is available for the acetonitrile component of the electrolyte solution.

- **Air:** If released to air, acetonitrile will exist solely as a vapor in the ambient atmosphere. Vapor-phase acetonitrile will be degraded in the atmosphere by reaction with photochemically produced hydroxyl radicals and ozone. The half-life for the reaction with hydroxyl radicals ranges from 0.6 to 20 days. The half-life for the reaction with ozone is somewhat slower and ranges from 54 to 76.4 days. Acetonitrile is not expected to be susceptible to direct photolysis by sunlight as it absorbs light only in the far UV region.
- **Soil:** Acetonitrile is removed from soil by microbial degradation (U.S. EPA 1985). *Nocardia rhodochrus* LL100-21 and *Aeromonas* sp. BN 7013 isolated from soils are capable of utilizing acetonitrile as a sole carbon and nitrogen source (CHEMFATE 1994; U.S. EPA 1985). The chemical is enzymatically hydrolyzed by a strain of the fungus *Fusarium solani* (U.S. EPA 1985). Evaporation and leaching are also important in removing acetonitrile from soils (U.S. EPA 1985). Biodegradation studies of acetonitrile with mixed cultures of microorganisms from activated sludge and sewage show that degradation proceeds slowly without acclimatization of microorganisms.
- **Water:** If released into water, acetonitrile is not expected to adsorb to suspended solids and sediment based upon its KOC value. Acetonitrile is removed from water by biodegradation, with decomposition occurring about five times faster following acclimation of the microorganisms (U.S. EPA 1985; CHEMFATE 1994). Decomposition of the chemical in the Ohio River (0.1 to 25 mg/L) was 20% in 5 days and 40% in 12 days (HSDB 1994). Degradation occurs by *Corynebacterium nitrilophilus* isolated from activated sludge (U.S. EPA 1985; CHEMFATE 1994). Enzymatic hydrolysis is accomplished by *Pseudomonas* sp. capable of utilizing acetonitrile as a sole carbon source (U.S. EPA 1985). Calculated volatilization half-lives from a typical pond and river are 11 days and 6 days, respectively (U.S. EPA 1985). Although slow, loss by volatilization may become more important in shallow waters (HSDB 1994). Volatilization from water surfaces is expected to be an important fate process based upon this compound's Henry's Law constant. Hydrolysis is not expected to be an important environmental fate process since this compound lacks functional groups that hydrolyze under environmental conditions.

BIOACCUMULATION POTENTIAL: The metal and plastic case of this product will not bioaccumulate. An estimated BCF of 3 was calculated for acetonitrile, using a log KOW of -0.34 and a regression-derived equation. According to a classification scheme, this BCF suggests that the potential for bioconcentration in aquatic organisms is low.

AQUATIC TOXICITY: The release of a significant amount of electrolyte solution to an aquatic environment is unlikely. Acetonitrile has low acute toxicity to aquatic organisms; toxicity values are greater than 1,000 mg/L. The 96-hour Median Tolerance Limit (TLm) values for *Pimephales promelas* (fathead minnow) in hard and soft water are 1,020 mg/L and 1,000 mg/L, respectively (Verschuere 1983). For *Lepomis macrochirus* (bluegill) and *Lebistes reticulatus* (guppy), the TLm values in soft water are 1,850 mg/L and 1,650 mg/L, respectively (Verschuere 1983). Tetraethylammonium tetrafluoroborate (TEABF₄) may be toxic to aquatic organisms. Although data is lacking, available data suggests that TEABF₄ is toxic to aquatic ecosystems. Additionally, quaternary ammonium compounds generally are aquatic toxins, and boron compounds tend to be toxic to aquatic organisms, particularly invertebrates. Do not allow TEABF₄ residues to enter storm drains or waterways.

SECTION 13 - DISPOSAL CONSIDERATIONS

These articles are not exempt from government solid and hazardous waste regulations. As solid, intact articles, they are not specifically listed as, nor do they exhibit any characteristics of a hazardous waste; however, they do contain materials that may become an environmental concern if disposed improperly. The primary material of potential concern is the electrolyte, which contains acetonitrile and tetraethylammonium tetrafluoroborate. These articles should be disposed only in facilities suitable for accepting industrial waste that do not allow ultracapacitor components to be released into the environment, and not into municipal solid waste landfills. Check state and local regulations for any additional requirements, as these may be more restrictive than federal laws and regulations.

USEPA (RCRA) HAZARDOUS WASTE NUMBER: None.

EUROPEAN WASTE CODES: 16 02 Waste Electrical and Electronic Equipment; 16 02 13: Discarded equipment containing hazardous components other than those mentioned in 16 02 09 to 16 02 12.

SECTION 14 - TRANSPORTATION INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION: This product is NOT classified as dangerous goods, per U.S. DOT regulations (see §173.176). Ultracapacitors as articles are not specifically listed nor exempted from hazardous materials regulations (HMR). The materials comprising the ultracapacitors are "...in a quantity and form that does not pose a hazard in transportation." Therefore, the ultracapacitors are not subject to the HMR.

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: This product is NOT classified as dangerous goods, per regulations of Transport Canada.

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA): This product is NOT classified as dangerous goods under rules of IATA (see A186, SP361).

INTERNATIONAL MARITIME ORGANIZATION (IMO) DESIGNATION: This product is NOT classified as dangerous goods by the International Maritime Organization (see 36-12).

EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR):
This product is NOT classified by the United Nations Economic Commission for Europe to be dangerous goods (see SP 361).

AUSTRALIAN FEDERAL OFFICE OF ROAD SAFETY CODE FOR THE TRANSPORTATION OF DANGEROUS GOODS BY ROAD OR RAIL: This product is NOT classified as dangerous goods, per regulations of the Australian Federal Office of Road Safety.

SECTION 15 - REGULATORY INFORMATION

UNITED STATES REGULATIONS:

SARA REPORTING REQUIREMENTS: The components of these products are subject to reporting requirements under Sections 302, 304, 311, 312 and 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA), as indicated below:

- SARA Section 302: None of the components of Maxwell ultracapacitors has a Threshold Planning Quantity listed in the implementing regulations for SARA Section 302 contained in Appendix A to 40 CFR Part 355.
- SARA Section 304: The CERCLA release reporting threshold for acetonitrile is 5,000 pounds.
- SARA Sections 311/312: The default Federal Material Safety Data Sheet submission and inventory requirement filing threshold of 10,000 lbs. (4,540 kgs) applies to acetonitrile, per 40 CFR §370.20. For Product As Manufactured: ACUTE: No; CHRONIC: No; FIRE: No; REACTIVE: No; SUDDEN RELEASE: No. For Electrolyte Solution: ACUTE: Yes; CHRONIC: No; FIRE: Yes; REACTIVE: No; SUDDEN RELEASE: No
- SARA Section 313: Acetonitrile is listed in 40 CFR §372.65. Persons who "otherwise use" acetonitrile in quantities greater than 10,000 pounds per year are required to report releases to the environment on EPA Form R.

CERCLA REPORTABLE QUANTITY (RQ): Acetonitrile = 5,000 lbs. (2,270 kg)

TOXIC SUBSTANCE CONTROL ACT (TSCA) INVENTORY STATUS: All components of these articles are listed on the TSCA inventory.

OTHER U.S. FEDERAL REGULATIONS: This product meets the definition of an "article" under the Federal OSHA Hazard Communication Standard and is exempt from MSDS/SDS requirements pursuant to §1910.1200(b)(6)(v). Specifically, the §1910.1200(c) defines an "article" as follows: article means a manufactured item other than a fluid or particle: (i) which is formed to a specific shape or design during manufacture; (ii) which has end use function(s) dependent in whole or in part upon its shape or design during end use; and (iii) which under normal conditions of use does not release more than very small quantities, e.g., minute or trace amounts of a hazardous chemical, and does not pose a physical hazard or health risk to employees. Acetonitrile has requirements under the following U.S. Federal regulations.

CLEAN AIR ACT: Acetonitrile is listed as a Hazardous Air Pollutant (HAP).

CLEAN WATER ACT REQUIREMENTS: Acetonitrile is designated as a toxic pollutant pursuant to Section 307(a)(1) of the Federal Water Pollution Control Act and is subject to effluent limitations.

CERCLA: Persons in charge of vessels or facilities are required to notify the National Response Center (NRC) immediately, when there is a release of a designated hazardous substance, in an amount equal to or greater than its reportable quantity. Acetonitrile has a RQ of 5,000 lbs. or 2,270 kgs. The toll free number of the NRC is (800) 424-8802. Notification requirements are set forth in 40 CFR §302.6.

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): No component of this product is on the CA Proposition 65 lists.

ANSI LABELING (ZI29.1): This is a manufactured article; no label information is required under OSHA 29 CFR 1910.1200 or ANSI Z400.1 to address the chemical hazards.

SECTION 16 - DOCUMENT INFORMATION

Document Name: Safety Data Sheet (SDS) for Maxwell Ultracapacitors	Document Control Number: 3000389-EN
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