ULTEM® FR Film

ULTEM film is manufactured from ULTEM polyetherimide resins. It is GE’s highest performance film, offering enhanced heat and chemical resistance. Low moisture absorption and excellent dielectric properties make ULTEM film the superior choice for a broad range of applications including high-voltage internal insulation, high-temperature PSA tapes and speaker cones.

ULTEM film was specified for shielding these PCBs used in personal TV systems for passenger aircraft. It was chosen for its excellent electrical properties, flame retardance and proven performance in avionics applications.

UL Listings

<table>
<thead>
<tr>
<th>Product</th>
<th>Thickness inches / mm</th>
<th>UL 94 Flame Class Rating</th>
<th>Tensile Heat Distortion Temp°C</th>
<th>Thermal Index Electrical°C</th>
<th>UL PERFORMANCE LEVEL Categories</th>
<th>Moisture Absorption (%)</th>
<th>Shrinkage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ULTEM 3000 Film</td>
<td>.002/.007 / .050/.175</td>
<td>VTM-0</td>
<td>210</td>
<td>-</td>
<td>-</td>
<td>0.25</td>
<td>0.135@200°C</td>
</tr>
</tbody>
</table>
LEXAN®, VALOX® and ULTEM® films from GE Structured Products provide cost-effective solutions in applications ranging from simple, flat barrier insulation to highly complex, three-dimensional EMI/RFI shielding.

**Excellent electrical and mechanical properties**
Films, in conjunction with our fabrication partners, provide a low-cost, lightweight solution to both primary and secondary shielding problems.

Flame retardant insulating film laminated to a conductive foil, such as copper or aluminium, allows creatively designed shields to be placed in close proximity to the emitting source, without fear of internal arcing. Typical applications are ground planes, gaskets, box designs, trays or spacers.

**UL Listings**
The range offers a strong complement of flame retardant, electrical and thermal properties. For a complete list of the most recent UL Listings contact GE Structured Products. GE films are listed under UL File #E61257 (R).

**Easy, cost-effective fabrication**
All grades are easily die-cut with steel rule dies or tools and can be match metal thermoformed or cold embossed. Gauge control across the web is excellent, ensuring uniform cutting or creasing and preventing the risk of damage to the die from uneven film thickness.

All films can be cut cleanly without burring or edge cracking and when bent or folded, they remain in position. They are also compatible with a broad range of fastening and laminating adhesives, including silicone rubbers, epoxies and acrylics.

**Excellent printability**
Unlike some other insulating materials, films from GE Structured Products are easily printed with part I.D. numbers or standard safety warnings (usually before die-cutting), often eliminating the need for secondary labelling required with other materials.

**VALOX® FR Film**

VALOX FR1 film is a flame retardant polybutylene terephthalate material offering good temperature resistance and chemical resistance, in addition to excellent dielectric strength. This makes it suitable for a wide range of applications in the electronics industry, such as disc drive insulation, and other business machine barrier insulation applications. Low moisture absorption and high chemical resistance make it suitable for laminated EMI/RFI shields.

For a display screen shield, VALOX FR1 film provides high performance in a thin gauge. VALOX is laminated to aluminium foil resulting in a ‘seamless box’.

0.010” VALOX FR1 film provides a flame retardant barrier insulation in this motor application. The film’s combination of chemical resistance, dielectric strength and thermoformability make it ideal to produce a custom shape.

<table>
<thead>
<tr>
<th>Thickness</th>
<th>UL 94 Flame Class Rating</th>
<th>UL 1990 Qualified</th>
<th>Tensile Heat Distortion Temp °C</th>
<th>Thermal Index Electrical °C</th>
<th>UL PERFORMANCE LEVEL CATEGORIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.003-0.004 / .08-10</td>
<td>VTM-2</td>
<td>-</td>
<td>167</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>0.005-0.008 / .127-23</td>
<td>VTM-0</td>
<td>✔</td>
<td>167</td>
<td>125</td>
<td>-</td>
</tr>
<tr>
<td>0.010-0.024 / .25-60</td>
<td>VTM-0</td>
<td>✔</td>
<td>167</td>
<td>125</td>
<td>4</td>
</tr>
<tr>
<td>0.125 / 3.175</td>
<td>V-0</td>
<td>-</td>
<td>167</td>
<td>120</td>
<td>3</td>
</tr>
</tbody>
</table>
LEXAN®, VALOX® and ULTEM® films from GE Structured Products provide cost-effective solutions in applications ranging from simple, flat barrier insulation to highly complex, three-dimensional EMI/RFI shielding.

- **Excellent electrical and mechanical properties**
  Films, in conjunction with our fabrication partners, provide a low cost, lightweight solution to both primary and secondary shielding problems.
  Flame retardant insulating film laminated to a conductive foil, such as copper or aluminium, allows creatively designed shields to be placed in close proximity to the emitting source, without fear of internal arcing. Typical applications are ground planes, gaskets, box designs, trays or spacers.

- **UL Listings**
  The range offers a strong complement of flame retardant, electrical and thermal properties. For a complete list of the most recent UL Listings contact GE Structured Products. GE films are listed under UL File #E61257 (R).

- **Easy, cost-effective fabrication**
  All grades are easily die-cut with steel rule dies or tools and can be match metal thermoformed or cold embossed. Gauge control across the web is excellent, ensuring uniform cutting or creasing and preventing the risk of damage to the die from uneven film thickness.
  All films can be cut cleanly without burring or edge cracking and when bent or folded, they remain in position. They are also compatible with a broad range of fastening and laminating adhesives, including silicone rubbers, epoxies and acrylics.

- **Excellent printability**
  Unlike some other insulating materials, films from GE Structured Products are easily printed with part I.D. numbers or standard safety warnings (usually before die-cutting), often eliminating the need for secondary labelling required with other materials.

---

**VALOX® FR Film**

VALOX® FR1 film is a flame retardant polybutylene terephthalate material offering good temperature resistance and chemical resistance, in addition to excellent dielectric strength. This makes it suitable for a wide range of applications in the electronics industry, such as disc drive insulation, and other business machine barrier insulation applications. Low moisture absorption and high chemical resistance make it suitable for laminated EMI/RFI shields.

- **0.010” VALOX FR1 film** provides a flame retardant barrier insulation in this motor application. The film's combination of chemical resistance, dielectric strength and thermoformability make it ideal to produce a custom shape.

<table>
<thead>
<tr>
<th>UL Listings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
</tr>
<tr>
<td>VALOX FR1 Film</td>
</tr>
<tr>
<td>VALOX FR1 Film</td>
</tr>
<tr>
<td>VALOX FR1 Film</td>
</tr>
<tr>
<td>VALOX FR1 Film</td>
</tr>
</tbody>
</table>
ULTEM® FR Film

ULTEM film is the substrate for this high-performance screen-printed circuit board. With 10 circuit surfaces, the board replaces 15 parts, achieving a 30% cost saving over conventional technology.

ULTEM film is manufactured from ULTEM polyetherimide resins. It is GE’s highest performance film, offering enhanced heat and chemical resistance. Low moisture absorption and excellent dielectric properties make ULTEM film the superior choice for a broad range of applications including high-voltage internal insulation, high-temperature PSA tapes and speaker cones.

ULTEM film was specified for shielding these PCBs used in personal TV systems for passenger aircraft. It was chosen for its excellent electrical properties, flame retardance and proven performance in avionics applications.

UL Listings

<table>
<thead>
<tr>
<th>Product</th>
<th>Thickness inches / mm</th>
<th>UL94 Flame Class Rating</th>
<th>Tensile Heat Distortion Temp°C</th>
<th>Thermal Index Electrical°C</th>
<th>UL PERFORMANCE LEVEL CATEGORIES</th>
<th>Moisture Absorption (%)</th>
<th>Shrinkage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ULTEM 1000 Film</td>
<td>.0002 / .007</td>
<td>VTM-o</td>
<td>210</td>
<td>-</td>
<td>-</td>
<td>0.25</td>
<td>0.135 @ 200°C</td>
</tr>
</tbody>
</table>
LEXAN FR Film

Clear or opaque LEXAN FR Film is a flame retardant polycarbonate material available with a variety of surface textures and offering an excellent complement of properties. It is highly puncture resistant and maintains its performance at extremes of temperature. LEXAN FR film’s, excellent dielectric strength and UL 94 V-0 rating make it ideal for foil based EMI/RFI shields.

LEXAN FR700 Film was selected for use as the insulation in this power supply application due to its total dielectric strength of 17,000 volts at 0.10"; a UL 94 V-0 rating and lowcost.

LEXAN FR700 film and copper foil provide a high-end solution to an extremely demanding digital shielding problem. Precise control of shield location was critical, making a die-cut part the winner over conductive paint.

Film Technology Backed by Hands-On Support

The growing family of GE thin-gauge extruded film products represents diverse technologies from the industry’s broadest and most comprehensive engineering plastics line. The superior properties, durability and performance of these materials are your assurance of quality results.

To optimize your use of GE film products, GE Structured Products offers a range of technical assistance throughout every phase of your project – from initial concept through design, fabrication and end-use.

For further information, please call: (800) 451-3147 or (413) 448-5400.

For Customer Service assistance, please call: (800) 323-3783

GE Structured Products

UNITED STATES
GE Plastics
1 Plastics Avenue
Pittsfield, MA 01201
(413) 448-5400

AMERICAS
GE Plastics
1 Plastics Avenue
Pittsfield, MA 01201
(413) 448-5400

Brazil
GE Plastics - Coplen S.A.
Rua Samso Alves dos Santos 20
Brooklin, 48471
São Paulo, Brazil
(55) 11-543-5800 ext. 202

EUROPE
The Netherlands
GE Plastics B.V.
Structured Products Europe
Plasticstalk 3
4612 PX, Bergen op Zoom
The Netherlands
(31) 1640-32911
(31) 1640-36828 (Fax)

Austalia
GE Plastics (Australia) Pty. Ltd.
175 Hammond Road
Dandenong, Victoria
3175 Australia
(61) 39-794-4204
(61) 39-794-8563 (Fax)

PACIFIC
Guangzhou
GE Plastics (Guangzhou)
Room 1212, Yi An Plaza
12 Prince Edward Road
Guangzhou, China 510405
(86) 10-6500-6538
(86) 10-6500-6476 (Fax)

Hong Kong
GE Plastics Hong Kong
Room 2308, Tower 1, The Gateway
25 Canton Road
Kowloon, Hong Kong
(852) 26-29-0800
(852) 26-29-0001 (Fax)

Singapore
GE Pacific Pte. Ltd.
23-03, 12 Prince Edward Road
Podium A, Bestway Building
Singapore 079212
(65) 323-8817 x22
(65) 222-5882 (Fax)

Taiwan
GE Plastics
12 Floor, 458
Tun Hua North Road
Taipei, Taiwan
(886) 2-514-9842
(886) 2-514-9881 (Fax)

Thailand
GE Plastics Thailand
15th Floor, Thanee Plaza Building
25 Silom Road, Bangkok 10500
Thailand
(66) 223-2298
(66) 223-2232 (Fax)

GE Struced Products

© Registered Trademarks of General Electric Company
SPL®-3057C, 1209B SH CC

For further information, please call: (800) 451-3147 or (413) 448-5400.

For Customer Service assistance, please call: (800) 323-3783

General Electric Company
One Plastics Avenue
Pittsfield, MA 01201

For questions regarding: GE Plastic products, please call: (800) 323-3783

GE Plastics Shanghai
10th Floor, Shanghai Building
4521-8, Nonhyun-Dong
Kangnam-Ku
Seoul 135-010
Korea
(82) 510-6290
(82) 510-6606 (Fax)

Shanghai
GE Plastics Shanghai
10th Floor, Shanghai Center
12 Zunyi Road(s)
Shanghai 200206
China
(86) 21-6270-6769
(86) 21-6270-9973 (Fax)
(86) 21-6270-9974 (Fax)

Singapore
GE Pacific Pte. Ltd.
2 Prince Edward Road
Podium A, Bestway Building
Singapore 079212
(65) 323-8817 x22
(65) 222-5882 (Fax)

Taiwan
GE Plastics
12 Floor, 458
Tun Hua North Road
Taipei, Taiwan
(886) 2-514-9842
(886) 2-514-9881 (Fax)

Thailand
GE Plastics Thailand
15th Floor, Thanee Plaza Building
25 Silom Road, Bangkok 10500
Thailand
(66) 223-2298
(66) 223-2232 (Fax)
LEXAN® FR Film

Clear or opaque LEXAN FR Film is a flame retardant polycarbonate material available with a variety of surface textures and offering an excellent complement of properties. It is highly puncture resistant and maintains its performance at extremes of temperature.

LEXAN FR film’s, excellent dielectric strength and UL 94 V-0 rating make it an ideal choice for barrier insulation applications. These include insulation for high voltage power supplies, printed circuit boards and monitors. It also acts as a good retardant polycarbonate material available with a variety of surface textures and a UL94 V-0 rating and lowcost.

LEXAN FR700 film and copper foil provide a high-end solution to an extremely demanding digital shielding problem. Precise control of shield location was critical, making a die-cut part the winner over conductive paint.

LEXAN FR700 film was selected for use as the insulation in this power supply application due to its total dielectric strength of 17,000 volts at 0.010”, a UL94 V-0 rating and lowcost.

For further information, please call: (800) 451-3147 or (413) 448-5400.

For Customer Service assistance, please call: (800) 323-3783

Film Technology Backed by Hands-On Support

The growing family of GE thin-gauge extruded film products represents diverse technologies from the industry’s broadest and most comprehensive engineering plastics line. The superior properties, durability and performance of these materials are your assurance of quality results.

To optimize your use of GE film products, GE Structured Products offers a range of technical assistance throughout every phase of your project—from initial concept through design, fabrication and end-use.

For further information, please call: (800) 451-3147 or (413) 448-5400.

UL Listings

<table>
<thead>
<tr>
<th>Thickness</th>
<th>Flame Class Rating</th>
<th>UL 94</th>
<th>Tensile H</th>
<th>Tensile Modulus</th>
<th>Thermal Index</th>
<th>Moisture Absorption</th>
<th>Shrinkage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F3100 Film</td>
<td>0.010 / .25</td>
<td>V0 ✓</td>
<td>150</td>
<td>130</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>F3100 Film</td>
<td>0.015 / .38</td>
<td>V0 ✓</td>
<td>150</td>
<td>130</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>F3100 Film</td>
<td>0.020 / .40</td>
<td>V0 ✓</td>
<td>150</td>
<td>130</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>F3100 Film</td>
<td>0.025 / .45</td>
<td>V0 ✓</td>
<td>150</td>
<td>130</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

Inasmuch as General Electric Company has no control over the use to which others may put this material, it does not assume responsibility for the result obtained. Nor does General Electric Company guarantee the completeness or accuracy of any representation or statement made herein. Each user of the material or design described herein, and any user making any suggested use of the material or design described herein, is hereby advised to make his own tests to determine the suitability of the material or any material for the use intended. Statements concerning possible or suggested designs for articles of manufacture as well as limitations of liability are not to be construed as constituting a license under any General Electric patent covering such use or as recommendations for use of such materials or designs in the infringement of any patent.

LEXAN® FR700 Film

GE Structured Products

UNITED STATES

GE Plastics
1 plastics Avenue
Pittsfield, MA 01201
(413) 448-5400

AMERICAS

Brazil
GE plastics - Coplen S.A.
Rua Samao Alves dos Santos 20
Brooklin, 04871
Sao Paulo, Brazil
(55) 11-543-5080 ext. 202

EUROPE

The Netherlands
GE Plastics B.V.
Structured Products Europe
Plasticscan 1
4632 P.X., Bergen op Zoom
The Netherlands
(31) 1640-2921
(31) 1640-36228 (Fax)

AUSTRALIA

Australia
GE Plastics (Australia) Pty. Ltd.
175 hammond road
Dandenong, Victoria
3175 Australia
(61) 3-794-4424
(61) 3-794-8563 (Fax)

PACIFIC

China
GE Plastics China
No. 19) 19 Guo M en Wai Avenue
Beijing 100004 China
(86) 10-6500-6538
(86) 10-6500-6476 (Fax)

Guangzhou
GE Plastics Guangzhou
Room 1212, Yi An Plaza
No. 38, j i an She 6 Road
Guangzhou, China 51060
(86) 20-8307-2818
(86) 20-3228 or 3118 (Fax)

Hong Kong
GE Plastics Hong Kong Ltd.
Rm 1208, Tower 1, The Gateway
25 Canton Road
Kowloon, Hong Kong
(852) 26-29-0800
(852) 26-29-0801 (Fax)

GE Plastics Indonesia
Lipar Plastics, 9th Floor
J l. J end Sudiman Kav, 25
Jakarta 12903, Indonesia
(62) 21-530-3503
(62) 21-530-3510 (Fax)

Japan
SP Pacific Ltd.
Nihonbash Hamako Park Bldg. 5th Floor
2-3-4, Nihonbash Hamacho Chuo ku, Tokyo 103, Japan
(81) 3-590-6290
(81) 3-356-6306 (Fax)

Korea
GE Plastics Korea Co. Ltd.
421-6 Nonhyn-Dong Kangnam-Ku
Seoul 135-010, Korea
(82) 510-6200
(82) 510-6606 (Fax)

Shanghai
GE Plastics Shanghai
10th Floor, Shartses Center
22 J umi Road(s)
Shanghai 200020, China
(86) 21-6707-6789
(86) 21-6707-9973 (Fax)
9974 (Fax)

Singapore
GE Pacific Pte. Ltd.
12 Prince Edward Road
Podium A, Bestway Building
Singapore 079212
(65) 222-8017 x22
(65) 222-5882 (Fax)

Taiwan
GE Plastics
12th Floor, 468
Tun Hua North Road
Taipei, Taiwan
(886) 2-514-9942
(886) 2-514-9921 (Fax)

Thailand
GE Plastics Thailand
15th Floor, Thanin Plaza Building
52 Silom Road, Bangkok 10500 Thailand
(66) 231-2328
(66) 231-2322 (Fax)

GE Plastics Indonesia
Lipar Plastics, 9th Floor
J. J end Sudiman Kav, 25
Jakarta 12903, Indonesia
(62) 21-530-3503
(62) 21-530-3510 (Fax)

Japan
SP Pacific Ltd.
Nihonbash Hamako Park Bldg. 5th Floor
2-3-4 Nihonbash Hamacho
Chuo ku, Tokyo 103, Japan
(81) 3-590-6290
(81) 3-356-6306 (Fax)

Korea
GE Plastics Korea Co. Ltd.
421-6 Nonhyn-Dong Kangnam-Ku
Seoul 135-010, Korea
(82) 510-6200
(82) 510-6606 (Fax)

Shanghai
GE Plastics Shanghai
10th Floor, Shartses Center
22 J umi Road(s)
Shanghai 200020, China
(86) 21-6707-6789
(86) 21-6707-9973 (Fax)
9974 (Fax)

Singapore
GE Pacific Pte. Ltd.
12 Prince Edward Road
Podium A, Bestway Building
Singapore 079212
(65) 222-8017 x22
(65) 222-5882 (Fax)

Taiwan
GE Plastics
12th Floor, 468
Tun Hua North Road
Taipei, Taiwan
(886) 2-514-9942
(886) 2-514-9921 (Fax)

Thailand
GE Plastics Thailand
15th Floor, Thanin Plaza Building
52 Silom Road, Bangkok 10500 Thailand
(66) 231-2328
(66) 231-2322 (Fax)