SABIC offers thermoplastic polymers for optical interconnections and lenses for applications like IR sensors and optical transceivers. Micro molders around the globe may produce free form optics with SABIC resins, enabling device manufacturers to collimate light between fiber, VCSEL and detectors.

**Optical Performance with Reflow Capability**
SABIC offers a broad resin portfolio with supporting data around Light Transmission, Refractive Index as a function (wavelength, temperature) and heat resistance for Reflow Soldering Assembly / Surface Mounting. Our thermo-optical resin portfolio is listed in the ZEMAX OpticStudio® materials database.

**Economy of Scale**
Micro-injection molding of thermoplastics allows for high precision mass production of complex parts.

**Design Freedom and Part Integration**
Thermoplastics may allow for complex part designs and the integration of mechanical (such as fixtures) and optical features for simplified assembly.
KEY PRODUCT FEATURES

**Infrared transparent ULTEM™ resin**

- Offers an unique balance of:
  - High heat resistance (glass transition temperature up to 220°C)
  - Micro-injection moldable for optical elements (lenses, diffractive optical elements)
  - High transmission in IR regions, lower transmission in VIS regions
  - High dimensional stability
  - High refractive index

**Infrared transparent EXTEM™ resin**

- Offers an unique balance of:
  - Higher heat resistance (glass transition temperature up to 267°C)
  - Reflow soldering capable
  - Micro-injection moldable for optical elements (lenses, diffractive optical elements)
  - High transmission in IR regions, low transmission in VIS regions
  - High dimensional stability
  - High refractive index

**TYPICAL APPLICATIONS MAY BE:**

![Fiber Optical Connector](image1)

**FIBER OPTICAL CONNECTOR**
- High IR transmission
- High refractive index
- Low CTE 25°C-200°C

![On Board Lens* (Array)](image2)

**ON BOARD LENS* (ARRAY)**
- Potential to withstand reflow
- High IR transmission
- Low CTE 25°C-250°C

![Sensor Lens](image3)

**SENSOR LENS**
- High temperature, lead free soldering
- High IR transmission
- High flow for complex tooling

* Optical interconnect lens provided by Nalux Co., LTD.
SABIC’S THERMO OPTICAL PORTFOLIO

SABIC has several decades of history in supplying thermoplastic polymers in the opto-electronics industry. SABIC offers a broad portfolio of optical thermoplastics, so that customers have the option to select a grade with either highest heat resistance in combination with infrared transparency, or select a grade with lower heat resistance, but higher transparency in the UV-VIS spectrum.

TYPICAL OPTICAL PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Standard</th>
<th>Unit</th>
<th>ULTEM™ DT1810EV resin</th>
<th>ULTEM™ 1010 resin</th>
<th>EXTEM™ XH1015 resin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexural Modulus</td>
<td>ISO 178</td>
<td>MPa</td>
<td>3100</td>
<td>3300</td>
<td>2870</td>
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<tr>
<td>Flexural Strength</td>
<td>ISO 178</td>
<td>MPa</td>
<td>120</td>
<td>160</td>
<td>120</td>
</tr>
<tr>
<td>HDT, 0.45 Mpa</td>
<td>ISO 75</td>
<td>°C</td>
<td>190</td>
<td>207</td>
<td>250</td>
</tr>
<tr>
<td>Vicat B120</td>
<td>ISO 306</td>
<td>°C</td>
<td>195</td>
<td>212</td>
<td>260</td>
</tr>
<tr>
<td>Density</td>
<td>ISO 1183</td>
<td>g/cm³</td>
<td>1.28</td>
<td>1.27</td>
<td>1.31</td>
</tr>
<tr>
<td>CTE (-40 to 150°C)</td>
<td>ISO 11359</td>
<td>10-5/°C</td>
<td>6</td>
<td>5.5</td>
<td>5</td>
</tr>
<tr>
<td>Transmission at 1mm at 850nm</td>
<td>ASTM D1002</td>
<td>%</td>
<td>&gt;88.5</td>
<td>&gt;88.0</td>
<td>&gt;84.5</td>
</tr>
<tr>
<td>Transmission at 1mm at 1310nm</td>
<td>ASTM D1003</td>
<td>%</td>
<td>&gt;89</td>
<td>&gt;88.5</td>
<td>&gt;87.5</td>
</tr>
<tr>
<td>Refractive index 589 nm (nD)</td>
<td>ISO 489</td>
<td>-</td>
<td>1.655</td>
<td>1.662</td>
<td>1.657</td>
</tr>
<tr>
<td>Refractive index 850 nm</td>
<td>ISO 489</td>
<td>-</td>
<td>1.633</td>
<td>1.639</td>
<td>1.634</td>
</tr>
<tr>
<td>Refractive index 1310 nm</td>
<td>ISO 489</td>
<td>-</td>
<td>1.620</td>
<td>1.626</td>
<td>1.622</td>
</tr>
<tr>
<td>Abbe number</td>
<td>ISO 489</td>
<td>-</td>
<td>21</td>
<td>21</td>
<td>18</td>
</tr>
<tr>
<td>dn/dT (+23°C-140°C)</td>
<td>ISO 489</td>
<td>10-5/°C</td>
<td>-11</td>
<td>-11</td>
<td>-11</td>
</tr>
</tbody>
</table>
OPTICAL DATA SHEET
ULTEM™ 1010 RESIN

Refractive Index
\[ n_d = 1.662 \]
\[ n_{580 \text{ nm}} = 1.638 \]
\[ n_{370 \text{ nm}} = 1.626 \]
\[ n_{550 \text{ nm}} = 1.623 \]

Abbe Number
\[ v_d = 20.8 \]

Density
1.27 g/cm³

Coefficient of Thermal Expansion
5.5E-05 1/°C (-30 to 70 °C)

The information contained herein is given in good faith. See full Disclaimer on page 8.

OPTICAL PARAMETERS FOR ULTEM™ 1010 RESIN
(Also available in Zemax OpticStudio)

Sellmeier Dispersion Equation for Refractive Index
\[ n^2 - 1 = \frac{B_1 \lambda^2}{\lambda^2 - C_1} + \frac{B_2 \lambda^2}{\lambda^2 - C_2} + \frac{B_3 \lambda^2}{\lambda^2 - C_3} \]

### Constants of Sellmeier Dispersion

<table>
<thead>
<tr>
<th>( B_1 )</th>
<th>( C_1 )</th>
<th>( B_2 )</th>
<th>( C_2 )</th>
<th>( B_3 )</th>
<th>( C_3 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.77291</td>
<td>0.029205</td>
<td>0.87094</td>
<td>0.02908</td>
<td>-0.028123</td>
<td>0.072528</td>
</tr>
</tbody>
</table>

Temperature Dependence of Refractive Index
\[ \Delta n_{\text{abs}} = \frac{n^2 - 1}{2n} \left[ D_0 \Delta T + D_1 \Delta T^2 + D_2 \Delta T^3 + \frac{E_0 \Delta T + E_1 \Delta T^2}{\lambda^2 - \lambda_{ik}^2} \right] \]

### Constants of Dispersion \( dn/dT \)

<table>
<thead>
<tr>
<th>( D_0 )</th>
<th>( E_0 )</th>
<th>( D_1 )</th>
<th>( E_1 )</th>
<th>( D_2 )</th>
<th>( \lambda_{ik} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.7457×10⁻⁴</td>
<td>-5.5635×10⁻⁸</td>
<td>2.4583×10⁻⁷</td>
<td>6.6215×10⁻⁷</td>
<td>-3.3513×10⁻⁹</td>
<td>0.000</td>
</tr>
</tbody>
</table>

*These constants are valid for a temperature range from 30 °C to 120 °C and from 0.5 to 1.7 µm.

Dispersion formula returns a valid refractive index between 0.4 and 1.7 µm.

Internal Transmittance

<table>
<thead>
<tr>
<th>( \lambda ) (nm)</th>
<th>( t = 1 \text{ mm} )</th>
<th>( \lambda ) (nm)</th>
<th>( t = 1 \text{ mm} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 0.00</td>
<td>900 0.992</td>
<td>340 0.00</td>
<td>920 0.998</td>
</tr>
<tr>
<td>380 0.00</td>
<td>940 1.000</td>
<td>420 0.002</td>
<td>960 0.996</td>
</tr>
<tr>
<td>460 0.051</td>
<td>980 0.995</td>
<td>500 0.624</td>
<td>1000 0.996</td>
</tr>
<tr>
<td>540 0.826</td>
<td>1050 0.995</td>
<td>580 0.897</td>
<td>1100 0.995</td>
</tr>
<tr>
<td>620 0.937</td>
<td>1150 0.993</td>
<td>660 0.959</td>
<td>1200 0.971</td>
</tr>
<tr>
<td>700 0.972</td>
<td>1250 0.989</td>
<td>740 0.980</td>
<td>1300 0.996</td>
</tr>
<tr>
<td>780 0.984</td>
<td>1350 0.993</td>
<td>800 0.986</td>
<td>1400 0.971</td>
</tr>
<tr>
<td>820 0.988</td>
<td>1450 0.949</td>
<td>840 0.989</td>
<td>1500 0.971</td>
</tr>
<tr>
<td>860 0.990</td>
<td>1550 0.981</td>
<td>880 0.990</td>
<td>1600 0.985</td>
</tr>
</tbody>
</table>
OPTICAL DATA SHEET
EXTEM™ XH1015 RESIN

Refractive Index

\[ n_d = 1.657 \]
\[ n_{850\,nm} = 1.633 \]
\[ n_{1310\,nm} = 1.621 \]
\[ n_{1550\,nm} = 1.618 \]

Abbe Number

\[ \nu_d = 20.4 \]

Density

1.316 g/cm³

\[ \Delta P_{\rho F} = -0.0306 \]

Coefficient of Thermal Expansion

5.5E-05 1/°C (-30 to 70 °C)

OPTICAL PARAMETERS FOR EXTEM™ XH1015 RESIN
(Also available in Zemax OpticStudio)

Sellmeier Dispersion Equation for Refractive Index

\[ n^2 - 1 = \frac{B_1\lambda^2}{\lambda^2 - C_1} + \frac{B_2\lambda^2}{\lambda^2 - C_2} + \frac{B_3\lambda^2}{\lambda^2 - C_3} \]

<table>
<thead>
<tr>
<th>Constants of Sellmeier Dispersion® Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>( B_1 ) 0.62956</td>
</tr>
<tr>
<td>( B_2 ) -0.028644</td>
</tr>
<tr>
<td>( B_3 ) 0.99923</td>
</tr>
</tbody>
</table>

Temperature Dependence of Refractive Index

\[ \frac{\Delta n_{\text{abs}}}{n^2 - 1} \frac{1}{2n} = b_0\Delta T + b_1\Delta T^2 + b_2\Delta T^3 + \frac{E_0\Delta T + E_1\Delta T^2}{\lambda^2 - \lambda_{ik}^2} \]

<table>
<thead>
<tr>
<th>Constants* of Dispersion dn/dT</th>
</tr>
</thead>
<tbody>
<tr>
<td>( D_0 ) (-2.7233 \times 10^{-4})</td>
</tr>
<tr>
<td>( D_1 ) (1.5604 \times 10^{-6})</td>
</tr>
<tr>
<td>( D_2 ) (-8.2040 \times 10^{-9})</td>
</tr>
</tbody>
</table>

*These constants are valid for a temperature range from 30 °C to 120 °C and from 0.5 to 1.7 μm.

Dispersion formula returns a valid refractive index between 0.4 and 1.7 μm.

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