Display Definition and Overview

Display: An electrical component used to convert electrical signals into visual imagery for direct interpretation by humans. A visual interface between humans and machines.

McGraw-Hill Science and Technology

Mobile Phones, Televisions, Displays, E-books, Games, Laptops, GPS, etc….

LCD (CCFL, LED), OLED, Plasma, E-Ink, Touch-screen (Capacitive, Resistive), Flexible……
Typical Application_LCD Panel requirements

**Requirements**

- Resolution
- Gamut
- **Response time (motion blur)**
- Brightness
- **Contrast ratio**
- Viewing angle
- Electric power consumption
- Thin
- Crash proof
- Water proof
- Graffiti
- Anti glare

**Technical trend**

- Full HD
- Hi-color CCFL/RGB LED
- **Over drive 60=>120=>180Hz**
- Diffuser/luminous efficiency
- **Local dimming with LED**
- Vertical alignment/In-plane switching
- **Local dimming with LED**
- Backlight design/high density package
- **Gap filling**
- Sealing
- Top coat

**Silicone Application**

- TIM for driver
- TIM for light module
- Binder gel for TIM
- Optical bonding
- Electrode Coating
- FIPG
- Assembly adhesive
- Hard coat
- Tospearl
Typical Application_construction of LCD module

- Black matrix Ink
- Optically bonding
- Electrode coat
- Seal TIM
- Reinforce adhesive
- FIPG
- IC
- Top panel
- Glass
- Retardation film (TAC)
- BEF
- Prism sheet
- Polarizing film
- Reflector
- Diffuser sheet
- Light guide
- CCFL
- ACF
- Electrode coat
- Sealant
- TIM
- End seal
- Spacer
- ITO
- Alignment layer
- Overcoat

Copyright 2012 Momentive Performance Materials Inc. All rights reserved. CONFIDENTIAL
Silicone material solution for Display applications

Momentive silicone offers high performance materials solutions for current and future display technology. The material portfolio for display industry includes electrode coating, optical bonding/potting/coatings, formed in place gasket(FIPG) sealants, adhesives, potting compounds and thermal interface materials.

Typical Applications:
- ITO/silver electrode coatings
- Optical bonding
- OLED Potting
- Formed in place gasket(FIPG)
- Thermal interface materials
- Assembly adhesives
- Black Matrix Ink
- Overcoat for TFT-LCD

Material Solutions:
- Room temperature cure or UV cure encapsulants
- UV cure or Snap cure optical clear adhesives
- High purity silicone potting
- TI controlled room temperature cure adhesives
- Thermal conductive adhesive/gel/grease
- Fast cure/high purity adhesives
- High adhesion with good printing uniformity
- Fast UV cure with good leveling
The New Momentive – Transformational Combination Forges An Industry Leader

MOMENTIVE performance materials + HEXION Specialty Chemicals

The science behind the solutions.

MOMENTIVE

Pro forma Revenue $7.5 Billion
Pro forma Adjusted EBITDA $1.2 Billion
Serving More Than…

- 20,000 customers
- 117 production facilities around the world
- With 10,000 Momentive associates

- Balanced geographic portfolio
- With sales of over $7 billion
- Ability to serve global customers in all major regions worldwide
- New Product Development opportunities across a range of technologies in shared end use markets
  - Automotive, construction, electronics, energy among others
## Combined Technology Platform Brings Growth Opportunities

<table>
<thead>
<tr>
<th>Complementary Technology Portfolio</th>
<th>Fluids</th>
<th>Silanes</th>
<th>Elastomers</th>
<th>Engineered Materials</th>
<th>Urethane Additives</th>
<th>Sealants</th>
<th>Quartz</th>
<th>Epoxy</th>
<th>Versatics</th>
<th>Phenolics</th>
<th>Amino Resins</th>
<th>Vinyl &amp; Acrylic Lattices</th>
<th>Formaldehyde</th>
<th>Acrylic Monomers</th>
<th>Polyester Resins</th>
<th>UPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial/Marine</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumer/Durable Goods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Home Construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automotive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graphic Arts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repair/Remodel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electronics/Electrical</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil Field E&amp;P</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Architectural</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind Energy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthcare/Personal Care</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Furniture</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# New Customer Opportunities From Expanded Product Attribute Grid

## Attribute Grid

<table>
<thead>
<tr>
<th>Fluids</th>
<th>Silanes</th>
<th>Elastomers</th>
<th>RTV</th>
<th>Hardcoats</th>
<th>PSA/RLC</th>
<th>Urethane Additives</th>
<th>Sealants</th>
<th>Quartz</th>
<th>Epoxy</th>
<th>Versatics</th>
<th>Phenolics</th>
<th>Proppants</th>
<th>Amino Resins</th>
<th>Vinyl &amp; Acrylic Lattices</th>
<th>Formaldehyde</th>
<th>Acrylic Monomers</th>
<th>Polyester Resins</th>
<th>UPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength &amp; Damage Tolerance</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Foam Control</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Emmision Reduction</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Safety &amp; Personnel Protection</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Adhesion</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Controlled Wetting</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Enhanced Electronics</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Surface Protection &amp; Modification</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Softening &amp; Conditioning</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Enhanced Energy Production</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Durable Commercial Construction</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Insulation &amp; Energy Conservation</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Sustainable Home Construction</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Polymer Reinforcement</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
</tbody>
</table>

- Momentive Heritage
- Hexion Heritage
Creating Value For Our Customers

- **Unique Product Portfolio:** Providing customers a broadened and unique range of products
- **Product Innovation:** An ability to solve our customer’s technical challenges with new innovative solutions that span our broad array of technologies
- **Global Capability:** 117 plants with a capability to serve in all regions of the globe
- **Best Practices:** Leveraging best practices of each company, such as technology/R&D and supply chain expertise

- **World-Class Management Team:** Drawing from both companies to develop the leadership team for the new Momentive
Momentive Business Overview

**Epoxy, Phenolic & Coating Resins**
- Adhesive & Structural Applications
  - Epoxy Resins and Intermediates
  - Phenolic Encapsulated Substrates
  - Composite Resins
  - Phenolic Specialty Resins
- Coating Applications
  - Epoxy Coating Resins
  - Versatic Acids & Derivatives
  - Polyester Resin
  - Alkyd Resins
  - Acrylic Resins

**Forest Products**
- Adhesive & Structural Application Products
  - Forest Product Resins
  - Formaldehyde & Derivatives
  - Specialty Waxes & Emulsions
  - Adhesives

**Silicones & Quartz**
- Silicones
  - Elastomers
  - Engineered Materials
  - Specialty Fluids
  - Silanes
  - Urethane Additives
- Sealants
  - Silicone and Acrylic Sealants
- Quartz & Ceramics
  - High-Purity Fused Quartz
  - Ceramic Materials

Copyright 2012 Momentive Performance Materials Inc. All rights reserved. CONFIDENTIAL
Electronics

Fabrication
- Quartz crucibles & ingots

Semiconductor Packaging
- Greases & curable compounds
- Adhesives
- Thermally conductive gels
- Boron nitride
- Resin molding compounds
- Epoxy resins

Modules
- Potting compounds
- Encapsulants
- Optical inspection resins
- Conformal coatings

Circuit Boards
- Potting compounds
- Encapsulants
- Optical inspection resins
- Conformal coatings
- Copper clad laminates

Consumer Products
- Smartphones & telecommunications
- Computers
- LCD, OLED & PDP displays
- Game devices
- Appliances
- LED lighting
+ much more

Momentive Heritage  Hexion Heritage

Copyright 2012 Momentive Performance Materials Inc. All rights reserved. CONFIDENTIAL
Why Silicone is needed?

- Great intermolecular distances
- Low intermolecular forces
- Excellent cold resistance
- High compressibility
- High gas permeability
- Small mechanical strength

- Stable Si-O bond
- Stable aC-H bond
- Excellent thermal stability
- Excellent UV stability
- Excellent weatherability
- Excellent Ozone Resistance

Flexible Bonding
Small Rotation Barrier

Large Bonding Energy
- 444kJ/mol
- (C-C: 356kJ)
- (C-O; 339kJ)

Large Ionic Character

\[ \text{Si} \rightarrow \text{O} \rightarrow \text{Si} \rightarrow \text{O} \]

\[ \text{d} 3.5 \quad \text{d} 1.8 \]

\[ \text{Si} \quad 1.61 \text{Å} \quad \text{O} \]
Transparency of silicone polymers

UV-Vis-IR spectra of dimethylsilicone and methylphenylsilicone

- Transparent in visible region
- Transparent to around 340nm

Wavelength (nm)
Transmittance (a.b.u)

- dimethylsilicone
- methylphenylsilicone
Typical trend of silicone

Volume Resistivity by Temperature

Water Absorption

Stable Modulus

Stable C.T.E
Good wettability

Young’s formula

\[ \cos \theta = \frac{(\gamma_s - \gamma_{sl})}{\gamma_l} \]

- \( \gamma_l \): surface energy (liquid)
- \( \gamma_s \): surface energy (substrate)
- \( \gamma_{sl} \): surface energy (substrate/liquid)

Lower contact angle will be larger \( \cos \theta \)
- Larger surface energy of substrate
- Lower surface energy of liquid

Over flow
Good wettability_Surface tension

Low surface energy → good wettability
Optical bonding
Optical Clear Silicone

Momentive’s family of Optical clear silicone series feature outstanding optical bonding process and makes displays more readable in direct sunlight or in bright ambient lighting conditions. Our silicones deliver high light transmittance and display component protection to effectively reduce surface reflection and increase display reliability.
Function of Optical Clear Silicone

- Less transmittance loss
- Preventing glaring
- Better mechanical design
- Improve shock resistance
- Extending display life

Copyright 2012 Momentive Performance Materials Inc. All rights reserved. CONFIDENTIAL
General display module structure

**Touch-less screen**
- Cover glass
- Adhesive (PF, CF glass, LC, TFT glass)

**Touch screen**
- Cover glass
- Adhesive
- Touch module
- Adhesive
- PF
- CF glass
- LC
- TFT glass

**New Touch system**
- Cover glass
- Adhesive
- PF
- CF glass
- LC
- TFT glass

Copyright 2012 Momentive Performance Materials Inc. All rights reserved. CONFIDENTIAL
Various applications with touch screen structure

<table>
<thead>
<tr>
<th>GFF</th>
<th>GG</th>
<th>G1F/GF2</th>
<th>G2/G1</th>
<th>In-cell/On-cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cover Window (Glass/PMMA)</td>
<td>Cover Window (Glass/PMMA)</td>
<td>Cover Window (Glass/PMMA)</td>
<td>Cover Window (Glass/PMMA)</td>
<td>Cover Window (Glass/PMMA)</td>
</tr>
<tr>
<td>OCA/LOCA</td>
<td>OCA/LOCA</td>
<td>OCA/LOCA</td>
<td>OCA/LOCA</td>
<td>OCA/LOCA</td>
</tr>
<tr>
<td>ITO Film</td>
<td>ITO Glass</td>
<td>ITO Film</td>
<td>ITO Film</td>
<td>Display</td>
</tr>
<tr>
<td>OCA/LOCA</td>
<td>OCA/LOCA</td>
<td>OCA/LOCA</td>
<td>OCA/LOCA</td>
<td>Display</td>
</tr>
<tr>
<td>Display</td>
<td>Display</td>
<td>Display</td>
<td>Display</td>
<td>Display</td>
</tr>
</tbody>
</table>

*Note) GFF: Glass Film Film, GG: Glass Glass, G1F/GF2:Glass 1way sensor Film/Glass Film 2way sensor, G2/G1:Glass 2way sensor/Glass 1way sensor

With air gap case:
- GFF
- GG
- G1F/GF2
- G2/G1
- In-cell/On-cell: No air gap case

<Source: IHS Displaybank, Touch Trend & Perspective>
Trend of Touch structure by application

- **High-end**
  - Smartphone: On-cell, In-cell, GG, G2 (Cell), GFF, G1F, GF2
  - Tablet PC: G2 (sheet), G1F, GF2
  - Notebook PC: GG, G2
  - AIO PC: GG, G2

- **Mid-end**
  - Smartphone: GG, GFF, G2 (sheet), GFF, GG, G1F, GF2
  - Tablet PC: G2 (sheet), G1F, GF2
  - Notebook PC: GG, G2
  - AIO PC: GG, G2

- **Low-end**
  - Smartphone: G1, P1
  - Tablet PC: PFF, P1
  - Notebook PC: GF2, GFF
  - AIO PC: GG, G2

*Source: IHS Displaybank, Touch Trend & Perspective*

Copyright 2012 Momentive Performance Materials Inc. All rights reserved. CONFIDENTIAL
<table>
<thead>
<tr>
<th>Market Categories</th>
<th>Smart phone</th>
<th>Tablet/Note PC</th>
<th>e-Book</th>
<th>Vehicle display</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product</strong></td>
<td>Acrylic(OPA Series)</td>
<td>OP2131SD/Snap Cure</td>
<td>OP2131SD/Snap Cure</td>
<td>OP2131S/OP2012S</td>
</tr>
<tr>
<td><strong>Legacy</strong></td>
<td>Glass Touch module Screen/TP---OCA Touch/LCM---LOCA</td>
<td>Glass touch module Screen/TP---OCA Touch/LCM---Air gap or OCA</td>
<td>No lens structure</td>
<td>Glass touch module or No lens structure</td>
</tr>
<tr>
<td><strong>New trend</strong></td>
<td>Touch integration (On-cell, In-cell) Screen/LCM --- LOCA</td>
<td>Touch-P integration (Film sensor or OGS) Screen/LCM --- LOCA</td>
<td>Front light guide (PMMA Screen) PMMA/EPD --- LOCA</td>
<td>In-console display PC or PMMA/Touch --- LOCA</td>
</tr>
<tr>
<td><strong>Concern</strong></td>
<td>Tack time Accuracy Adhesion</td>
<td>Tact time BM Cure Low shrinkage UVA resistance</td>
<td>UVA resistance Low shrinkage Curing method Less UV transmittance</td>
<td>Thermal shock Curve design</td>
</tr>
</tbody>
</table>
### Why improved visibility is valuable to end users?

<table>
<thead>
<tr>
<th>Category</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle</td>
<td>• No loss of time looking at unclear picture, decrease of change accidents when looking on navigation screen</td>
</tr>
<tr>
<td>Mobile communication devices</td>
<td>• Better details in environment with high ambient light levels</td>
</tr>
<tr>
<td>3D Display</td>
<td>• Better viewing angle in 3 dimensional way</td>
</tr>
<tr>
<td>Ship Navigation</td>
<td>• Details on sea maps better visible with improved visibility</td>
</tr>
<tr>
<td>Outdoor</td>
<td>• Better detail of tracks visible</td>
</tr>
<tr>
<td>Aviation</td>
<td>• Clear picture on screens giving information on system status</td>
</tr>
</tbody>
</table>
Key techniques to improve visibility

**External reflective surface**

| Anti Reflective | • Protective coating on the top of surface, touch screen  
|                 | • Cancels reflections  
|                 | • Best not used in screen often touched, touch screens.  
|                 |   easily smudges, difficult to clean and multiple  
|                 |   cleaning session destroy the coating. |

| Anti Glare | • Etching of the surface of protective surface  
|           | • Light is scattered in many directions. Perception of the  
|           |   eye is less glare and picture enhancement  
|           | • Better to clean and more durable than AR |

**Internal reflective surface**

| Optical bonding | • Close air gap between TFT LCD and protective cover  
|                | • Reduce reflections due to reduction of internal reflective  
|                |   surfaces |
Liquid optical bonding process

2P Thermal cure type

- Dispense
- Alignment
- Bonding
- Curing
- Inspection
- Full curing

UV cure type

- Syringe
- Flip bonding
The kind of method for liquid optical bonding

1. Triaxial Robot dispenser & Flip bonder
   - For small size
   - Drawing by robot
   - Possible to bond under atmosphere pressure

2. Screen print & Vacuum bonder
   - For large size
   - Coating whole area

3. Slot die coater & Vacuum bonder
   - For ultra large size
   - Coating whole area
   - Variable coating thickness
   - High accuracy
Transparency trend, 60 °C, 90%RH 168hrs

UV-Vis spectra of Silicone vs Acrylic

- Glass/Air/Glass
- Acrylic resin_Initial
- Acrylic resin_60C/90%RH_168hrs
- Silicone_initial
- Silicone_60C/90%RH_168hrs

Transmittance(%) vs Wavelength(nm)

<table>
<thead>
<tr>
<th>Material</th>
<th>Initial</th>
<th>60C/90%RH_168hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soda-lime Glass</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adhesive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soda-lime glass</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Copyright 2012 Momentive Performance Materials Inc. All rights reserved. CONFIDENTIAL
Transparency trend, 85 °C 500hrs

UV-Vis spectra of Silicone vs Acrylic
Impact resistance_Drop ball test

<table>
<thead>
<tr>
<th>Drop ball test(23°C)</th>
<th>OP1012</th>
<th>OP2012</th>
<th>OP2131</th>
<th>Acrylic</th>
<th>Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>50cm</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
</tr>
<tr>
<td>60cm</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td>Broken</td>
</tr>
<tr>
<td>100cm</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>120cm</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>130cm</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td>Broken</td>
<td></td>
</tr>
<tr>
<td>150cm</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td>Broken</td>
<td></td>
</tr>
<tr>
<td>180cm</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drop ball test(-40°C)</th>
<th>OP1012</th>
<th>OP2012</th>
<th>OP2131</th>
<th>Acrylic</th>
<th>Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>100cm</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
</tr>
<tr>
<td>110cm</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td>Broken</td>
</tr>
<tr>
<td>120cm</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>130cm</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td>Broken</td>
<td></td>
</tr>
<tr>
<td>150cm</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td></td>
<td></td>
</tr>
<tr>
<td>180cm</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Vacuum Resistance

Silicone

1000Pa
500Pa
50Pa
30Pa
10Pa

Acrylic

1000Pa
500Pa
50Pa
30Pa
10Pa

Main components will be boiling

*Rotary pump : 360L/ min, Chamber φ 500mmx300mm
Provided by Piezo Parts Co., Ltd
Cure Shrinkage

Low shrinkage
Yellowing trend@85degC*85%RH

![Graph showing yellowing trend over hours for OP2131 and Acrylic. The graph indicates that Acrylic has a higher yellowing index than OP2131.]

- **Yellowing Index** vs **Hours (Hr)**
- **OP2131** vs **Acrylic**
- **Low Yellowing**

Copyright 2012 Momentive Performance Materials Inc. All rights reserved. CONFIDENTIAL
Haze trend@85degC*85%RH

- **Haze**: Y-axis represents the haze level.
- **Hr**: X-axis represents hours.
- **Less Haze**: Indicates a lower haze trend.
- **OP2131** and **Acrylic**: Two different materials compared in the graph.

The graph shows a linear increase in haze for both OP2131 and Acrylic with an increase in hours, with Acrylic showing a steeper increase compared to OP2131.
Silicone is the stable modulus in various temperatures.
Concept of InviSil OP series

- Clarity (High transmittance >95%, Colorless)
- Refractive index (>1.4)
- Good reliability (non yellowing after aging test)
- Non solvent low surface energy solution
- Non bubble generation
- Mild cure condition
- Low shrinkage during curing
- No corrosive (No acid, Low ionic agent)
- Electric insulating (Volume resistivity $10^{13}$ Ω·m)
- Good shock absorption (Stable of dynamic modulus)
## Requirements and material properties

<table>
<thead>
<tr>
<th>Process</th>
<th>Customer requirements</th>
<th>Competitors (UV)</th>
<th>Momentive Silicone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Acrylic</td>
<td>OPXX1X Series</td>
</tr>
<tr>
<td>Product</td>
<td></td>
<td>Thermal</td>
<td>UV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dispensing</td>
<td>Stable Viscosity on Various temp.</td>
<td>Fair</td>
<td>Excellent</td>
</tr>
<tr>
<td></td>
<td>Pot life</td>
<td>Good</td>
<td>Fair</td>
</tr>
<tr>
<td></td>
<td>Component</td>
<td>1P</td>
<td>2P</td>
</tr>
<tr>
<td></td>
<td>Bubble less</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Bonding</td>
<td>Wet ability</td>
<td>Good</td>
<td>Excellent</td>
</tr>
<tr>
<td></td>
<td>Bubble less</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Curing</td>
<td>Fast cure</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Property</td>
<td>Adhesion</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Glass</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td></td>
<td>Plastics</td>
<td>Fair</td>
<td>Good</td>
</tr>
<tr>
<td></td>
<td>Non Shrinkage</td>
<td>Fair</td>
<td>Excellent</td>
</tr>
<tr>
<td>Product</td>
<td>Type</td>
<td>System</td>
<td>Ratio(^1)</td>
</tr>
<tr>
<td>----------</td>
<td>-------</td>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>OP2131</td>
<td>Rubber</td>
<td>UV, 1P</td>
<td>n.a</td>
</tr>
<tr>
<td>OP2131D</td>
<td>Rubber</td>
<td>UV, 1P</td>
<td>n.a</td>
</tr>
<tr>
<td>OP2131S</td>
<td>Rubber</td>
<td>UV, 1P</td>
<td>n.a</td>
</tr>
<tr>
<td>OP2131SD</td>
<td>Rubber</td>
<td>UV, 1P</td>
<td>n.a</td>
</tr>
<tr>
<td>OP2831D</td>
<td>Rubber</td>
<td>UV, 1P</td>
<td>n.a</td>
</tr>
<tr>
<td>OP1012</td>
<td>Gel</td>
<td>AC, 2P</td>
<td>1:1</td>
</tr>
<tr>
<td>OP2012</td>
<td>Rubber</td>
<td>AC, 2P</td>
<td>1:1</td>
</tr>
<tr>
<td>OP2012S</td>
<td>Rubber</td>
<td>AC, 2P</td>
<td>1:1</td>
</tr>
<tr>
<td>OP2012L</td>
<td>Rubber</td>
<td>AC, 2P</td>
<td>1:1</td>
</tr>
</tbody>
</table>

\(^1\) UV = UV cure, AC = Addition Cure
## InviSil OPA series

(selected grades only, please contact us for material selection support)

<table>
<thead>
<tr>
<th>Product</th>
<th>Type</th>
<th>System¹</th>
<th>Ratio (w/w)</th>
<th>Cure Condition</th>
<th>Viscosity (Pa.s)</th>
<th>Adhesion strength (Mpa)</th>
<th>Yellow index</th>
<th>Shrinkage (%)</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCS-100</td>
<td>Rubber</td>
<td>UV, 1P</td>
<td>n.a</td>
<td>2000mJ@365nm</td>
<td>3.2</td>
<td>0.40</td>
<td>0.90</td>
<td>1.20</td>
<td>Standard</td>
</tr>
<tr>
<td>OCS-200</td>
<td>Rubber</td>
<td>UV, 1P</td>
<td>n.a</td>
<td>2000mJ@365nm</td>
<td>1.0</td>
<td>0.40</td>
<td>0.80</td>
<td>1.30</td>
<td>Lower viscosity</td>
</tr>
<tr>
<td>OCS-300</td>
<td>Rubber</td>
<td>UV, 1P</td>
<td>n.a</td>
<td>2000mJ@365nm</td>
<td>3.3</td>
<td>0.40</td>
<td>0.80</td>
<td>1.30</td>
<td>High elongation</td>
</tr>
<tr>
<td>OCS-400L</td>
<td>Rubber</td>
<td>UV, 1P</td>
<td>n.a</td>
<td>2500mJ@365nm</td>
<td>25.0</td>
<td>0.43</td>
<td>0.92</td>
<td>1.20</td>
<td>High Viscosity (Dam)</td>
</tr>
<tr>
<td>OCS-400H</td>
<td>Rubber</td>
<td>UV, 1P</td>
<td>n.a</td>
<td>2500mJ@365nm</td>
<td>50.0</td>
<td>0.45</td>
<td>0.96</td>
<td>1.10</td>
<td>High viscosity (Dam)</td>
</tr>
<tr>
<td>OCS-500</td>
<td>Rubber</td>
<td>UV, 1P</td>
<td>n.a</td>
<td>2000mJ@&gt;365nm</td>
<td>3.5</td>
<td>0.40</td>
<td>1.05</td>
<td>1.40</td>
<td>longer wave length cure</td>
</tr>
</tbody>
</table>

¹ UV = UV cure
OP2131S

System: 1-P UV cure

Silicone features
- High Transparent
- Fast cure
- Viscosity 3.0 Pa.s
- Low Shrinkage
- Cohesive adhesion

Application benefits
- Functions in general display temperature range
- Good plastic and film adhesion
- Process flexibility
- Absorbs shock and protects display module from external stress
- Less bubble generation
OP2131SD

System: 1-P UV cure

Silicone features
• High Transparent
• Longer wavelength curable (>365nm)
• viscosity 3.0 Pa.s
• Soft
• Low Shrinkage
• Cohesive adhesion

Application benefits
> Functions in general display temperature range
> Good plastic and film adhesion
> Design flexibility
> Absorbs shock and protects display module from external stress
> Less bubble generation

UV absorbance on PMMA

Stress/Strain Curve by Temperature

Copyright 2012 Momentive Performance Materials Inc. All rights reserved. CONFIDENTIAL
Representative Product

OP2012S

System: 2-P addition cure

Silicone features
- High Transparent
- Low temp. cure
- Viscosity 0.8 Pa.s
- Low Shrinkage
- Cohesive adhesion

Application benefits
- Functions in general display temperature range
- Good plastic and film adhesion
- Excellent optical properties
- Shadow portion curable
- Absorbs shock and protects display module from external stress
- Design flexibility

Curing curve by Temperature

85degC*85%RH, Yellow Index

Copyright 2012 Momentive Performance Materials Inc. All rights reserved. CONFIDENTIAL
Road Map of UV Curable

**Current**

- **UVA2500**
  - *UV activated addition cure*
  - Two part 10:1 mixing
  - Vis : 0.25Pa.s
  - Hardness : 25(Type 00)
  - Ad.strength : Gel type

- **OP2131**
  - Vis : 3.0Pa.s
  - Hardness : 21(Type E)
  - Ad.Strength : 0.5MPa

- **OP2131D**
  - *365nm curable*
  - Vis : 3.0Pa.s
  - Hardness : 21(Type E)
  - Ad.Strength : 0.5MPa

**Next Generation**

- **OP2131S**
  - Cohesive adhesion
  - Vis : 3.0Pa.s
  - Hardness : 5(Type E)
  - Ad.Strength : 0.2MPa
  - Onto plastic

- **OP2131SD**
  - 365nm curable
  - Adhesion to plastic
  - Vis : 3.0Pa.s
  - Hardness : 5(Type E)
  - Ad.Strength : 0.2MPa

- **OP2831D**
  - 365nm curable
  - Adhesion to plastic
  - Vis : 30Pa.s
  - Hardness : 10(Type E)
  - Ad.Strength : 0.5MPa

**Platform technology**

- Adhesion promoter to pol.film/glass
- Polymer / resin design
- Photo initiator system

- Anti Yellowish and Haze(<0.5%)
- Curable under BM
- Good plastic/film adhesion
- Hybrid Cure(UV/Low temp) and adhesive

- New products with good cure profile to shadow BM by new photo initiator or UV chemistries
- New adhesion promoter for high plastic and pol.film adhesion
- Hybrid polymer for UV/ low temperature hybrid cure
OP1012
Two part
30min @70degC
Vis : 0.8Pa.s
Hardness : Gel

OP2012
Two part
30min @70degC
Vis : 0.8Pa.s
Hardness : 25(Type E)
Ad.Strength : 0.1MPa

OP2012L
Two part
30min @70degC, Vis : 0.1Pa.s
Hardness : 5(Type E)
Ad.Strength : 0.3MPa (t=0.1mm)

OP2012S
Two part
30min @70degC, Vis : 0.8Pa.s
Hardness : 25(Type E)
Ad.Strength : 0.1MPa

OP2012FC
Two part
10min @70degC, Vis : 0.8Pa.s
Hardness : 25(Type E)
Ad.Strength : 0.1MPa

* Not commercialized

Anti Yellowish and Haze
Good plastic/film adhesion
Fast cure within 5min @23degC

-One part preferable
-Fast cure with longer pot life
-Excellent adhesion to plastic/film
-Hybrid curable(UV+Thermal)
-High R.I

New adhesion promoter
for high plastic and pol.film

New polymer and resin design

Platform technology
- Adhesion promoter to pol.film/glass
- Polymer / resin design
- Pt/Inhibitor system
Product In Development

**ALOC**

("Advanced Liquid Optical Bonding system")

1. **coating**

2. **Flip**

3. **Bonding**

Snap curable by addition cure system ~1min.

Finish cure process

Available Q4.2012
ITO/silver electrode coatings
ITO/silver electrode coatings

The protection and longevity of sensitive circuits and components is important in display panel. Momentive’s silicone offers short tack free times to drive productivity, primerless adhesion to many substrates and are available in standard and repairable grades. These silicones help to protect delicate display electrodes against moisture and corrosion, adding to system reliability.

- Insulation protective coatings provided protection to fine pitch patterns of FPD /Touch panel electrodes and Driver ICs
- Conformal coatings to moisture proof electrodes parts
- Provide reliability and durability to the end products
# ECS series (selected grades only, please contact us for material selection support)

<table>
<thead>
<tr>
<th>Product</th>
<th>System</th>
<th>Viscosity (Pa.s)</th>
<th>Tack Free Time (min)</th>
<th>Hardness (Type A)</th>
<th>Tensile Strength (MPa)</th>
<th>Elongation (%)</th>
<th>Adhesive Strength (MPa)</th>
<th>Volatile Siloxane (D3-D10) (Wt%)</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECS0600</td>
<td>CC, 1P</td>
<td>5</td>
<td>7</td>
<td>20</td>
<td>1.2</td>
<td>300</td>
<td></td>
<td>0.01</td>
<td>Fast tack free, Repairability, Low ionic impurities</td>
</tr>
<tr>
<td>ECS0601</td>
<td>CC, 1P</td>
<td>1.4</td>
<td>7</td>
<td>24</td>
<td>0.8</td>
<td>150</td>
<td></td>
<td>0.3</td>
<td>Fast tack free, Low ionic impurities</td>
</tr>
<tr>
<td>XE11-C0602</td>
<td>CC, 1P</td>
<td>1.3</td>
<td>7</td>
<td>27</td>
<td>1.1</td>
<td>180</td>
<td></td>
<td>0.3</td>
<td>Fast tack free, Repairability, Low ionic impurities</td>
</tr>
<tr>
<td>ECS0605-WL</td>
<td>CC, 1P</td>
<td>5</td>
<td>18</td>
<td>20</td>
<td>0.8</td>
<td>220</td>
<td></td>
<td>0.3</td>
<td>Slow tack free, Good for Repair process, Low ionic impurities</td>
</tr>
<tr>
<td>ECS0609FR</td>
<td>CC, 1P</td>
<td>18</td>
<td>7</td>
<td>28</td>
<td>2.4</td>
<td>250</td>
<td></td>
<td>1.2</td>
<td>UL94V-0, Low volatile, Low ionic impurities</td>
</tr>
<tr>
<td>ECS0560-B</td>
<td>CC, 1P</td>
<td>0.66</td>
<td>6</td>
<td>23</td>
<td>0.6</td>
<td>110</td>
<td></td>
<td>0.5</td>
<td>Low viscosity, Fast tack free, Low ionic impurities</td>
</tr>
</tbody>
</table>

1 CC = Condensation cure
Representative Product

ECS0601

System: 1-P Condensation cure

Silicone features
• Low Viscosity (Solventless)
• Fast Tack-free time
• Excellent adhesion to many substrates
• Low Volatility
• Non corrosive to metals
• Low odor cure; release alcohol vapor during test

Application benefits
> Functions in insulating protective coatings for fine pitch patterns for FPD/Touch panel electrode and Driver ICs
> Moisture proof coating of electrical and electronic parts
> Thin section section potting of electrical and electronic parts

Curing Speed by Moisture and Temperature

Insulation resistance test

Product: ECS0601-W
Thickness(Average): 183 μm
Test condition:
JIS 2
(Pattern: 0.316mm, BT resin, Cu )
85℃/85%RH, 1000Hr
DC20V, Test piece: n=10
Test condition: Continuous measurement
Change in resistance
Determination: Lower 1 × 10^{13} Ω: NG
Silicone Electrode Coating Materials

**Current**

- **TSE3995**
  - Vis: 2.5 Pa.s
  - TS: 1.3 MPa / LV
  - TFT: 10min at RT Adhesion

- **TSE3996**
  - Vis: 1.7 Pa.s
  - TS: 1.2 MPa / LV
  - TFT: 10min at RT Adhesion

**New!**

- **ECS0600**
  - Vis: 5.8 Pa.s
  - TS: 1.3 MPa / LV
  - TFT: 7min at RT Repairable

- **ECS0601**
  - Vis: 1.4 Pa.s
  - TS: 0.8 MPa / LV
  - TFT: 7min at RT Adhesion

- **ECS0609FR**
  - Vis: 18 Pa.s
  - TS: 2.2 MPa / LV
  - TFT: 7min at RT UL, Adhesion

**Next Generation**

- **ECS0605**
  - Vis: 5 Pa.s
  - TS: 0.8 MPa / LV
  - TFT: 7min at RT Adhesion

**Next. Gen.**

- ✦ UL
- ✦ Low Volatile <50 ppm
- ✦ UV
- ✦ Repairable
- ✦ Sulfuric gas res.
- ✦ Electro-Conductive

**Conformal Coating (No-Solvent)**

- **XE11-C2845**
  - Vis: 0.1 Pa.s
  - HS: 35
  - TFT: 3min at RT
  - Cure Time: 2min at 60℃/15% RH

- **XE11-C2846**
  - Vis: 0.5 Pa.s
  - HS: 22 / LV
  - TFT: 5min at RT
  - Cure Time: 2min at 60℃/15% RH

Copyright 2012 Momentive Performance Materials Inc. All rights reserved. CONFIDENTIAL
OLED Potting
The major concern at OLED industry is the limited lifetime of organic illuminant materials which are damaged by moisture, some chemical agent attack. Momentive’s potting silicone provides excellent protection to organic illuminant materials and device against circumstance.

- Protecting illuminants from the damages of moisture, ionic agent, and physical impact.
- Reducing structure stress from OLED modules
- Better reliability under harsh environments to sustain high quality performance
<table>
<thead>
<tr>
<th>Product</th>
<th>System¹</th>
<th>Viscosity (Pa.s)</th>
<th>Cure condition</th>
<th>Hardness (Type A)</th>
<th>Impurity</th>
<th>Adhesive Strength (MPa)</th>
<th>Volatile Siloxane (D3-D10) (Wt%)</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM2211</td>
<td>AC, 1P</td>
<td>6</td>
<td>100degC*1hr</td>
<td>18</td>
<td>&lt;1ppm</td>
<td>0.3</td>
<td>0.33</td>
<td>High purity, mild cure</td>
</tr>
<tr>
<td>AM4911</td>
<td>AC, 1P</td>
<td>282</td>
<td>100degC*1.5hr</td>
<td>44</td>
<td>&lt;1ppm</td>
<td>2.7</td>
<td>0.22</td>
<td>High Viscosity</td>
</tr>
</tbody>
</table>

¹ AC = Addition Cure
Formed in place gasket (FIPG)
FPD backlight units used to apply tape on the bezel to support display panel with heavy manpower consumption. Momentive’s FIPG silicones is ideally designed for display panel support and light shielding with huge cost saving and reliability.

- Better reliability than conventional tape process
- Huge cost saving and productivity by automatic dispensing system
- Better repairability than conventional tape

<table>
<thead>
<tr>
<th>Methods</th>
<th>Material Cost($/unit)</th>
<th>Labor Cost($/unit)</th>
<th>Total($/unit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tape</td>
<td>0.3</td>
<td>0.1</td>
<td>0.4</td>
</tr>
<tr>
<td>FIPG</td>
<td>0.1</td>
<td>0.02</td>
<td>0.12</td>
</tr>
</tbody>
</table>

If 200K unit/M produce
Total Cost ($MM/yr)
0.96
0.24
0.05
# Product Selector Guide

## XE11 series

<table>
<thead>
<tr>
<th>Product</th>
<th>System</th>
<th>Appearance</th>
<th>Viscosity (Pa.s)</th>
<th>Tack Free Time (min)</th>
<th>Hardness (Type A)</th>
<th>Tensile Strength (MPa)</th>
<th>Elongation (%)</th>
<th>Adhesion (MPa)</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>XE11-C1331</td>
<td>CC, 1P</td>
<td>Translucent</td>
<td>48</td>
<td>5</td>
<td>24</td>
<td>1.0</td>
<td>220</td>
<td>1.0</td>
<td>Fast tack free, 1part RT Cure, excellent adhesion</td>
</tr>
<tr>
<td>XE11-C3452</td>
<td>CC, 1P</td>
<td>Translucent</td>
<td>41</td>
<td>5</td>
<td>23</td>
<td>1.7</td>
<td>310</td>
<td>1.1</td>
<td>Fast tack free, strong adhesion, good repairability</td>
</tr>
<tr>
<td>XE11-C1106</td>
<td>CC, 1P</td>
<td>Translucent</td>
<td>81</td>
<td>5</td>
<td>39</td>
<td>2.0</td>
<td>160</td>
<td>1.5</td>
<td>Fast tack free, excellent adhesion, good heat resistance</td>
</tr>
</tbody>
</table>

1 CC = Condensation cure
Thermal interface materials
TIM for TCP & COF in Display

Thermal Management for backlight units will reduce junction temperature of backlight units. Junction temperature increases may lead to reduced brightness and shortness of light source. Momentive TIMs help solve heat dissipation issues.

- Better reliability than conventional fabricated thermal pad process
- Liquid-dispersed alternative provide process, performance, and cost benefits.
- Increased processing capacity of BLU creating heat dissipation issues.

Copyright 2012 Momentive Performance Materials Inc. All rights reserved. CONFIDENTIAL
**Thermal Interface Materials (TIM)**

**TIM1:**
- “Inside the Package”
- Thermal path between die (CPU) and heat spreader (=lid)
- Requires structural adhesion
- Ability to withstand thermal stress
- Silicone-based Thermal Products:
  - Adhesives
  - Tacky gels

**TIM2, TIM1.5:**
- “Outside the Package”
- Thermal path between heat-spreader or die to Heat Sink
- Reparability commonly required
- Silicone-based Thermal Products:
  - Grease
  - Gels
What prevents heat from getting out?
Answer: Thermal Resistance (TR)

Thermal Resistance is expressed in mm$^2$·K/W units.

Lower mm$^2$·K/W values = better heat transfer

Contributing Variables:

1) Thermal Conductivity (TC)
2) Bond Line Thickness (BLT)
3) Contact Resistance

TC and BLT Effect on Overall TR
# Product Selector Guide_TIM Grease

<table>
<thead>
<tr>
<th>Product</th>
<th>TIG830SP</th>
<th>TIG210BX</th>
<th>TIG300BX</th>
<th>TIG400BX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key feature</td>
<td>Low TR</td>
<td>Low oil-bleed</td>
<td>Low oil-bleed</td>
<td>Low oil-bleed</td>
</tr>
<tr>
<td>Viscosity (23C, Pa.s)</td>
<td>300</td>
<td>250</td>
<td>200</td>
<td>350</td>
</tr>
<tr>
<td>Penetration (23C)</td>
<td>360</td>
<td>345</td>
<td>350</td>
<td>260</td>
</tr>
<tr>
<td>TC (W/mK)</td>
<td>4.1</td>
<td>2.1</td>
<td>3.0</td>
<td>4.0</td>
</tr>
<tr>
<td>TR (mm2K/W)</td>
<td>8</td>
<td>26</td>
<td>20</td>
<td>17</td>
</tr>
<tr>
<td>BLT (μm)</td>
<td>20</td>
<td>50</td>
<td>45</td>
<td>55</td>
</tr>
</tbody>
</table>

Penetration; JIS K 2220 3 (23C)

TC: Thermal conductivity by hot wire method.

TR: Thermal resistance by Laser flash analysis on a Si-Si sandwitch material
<table>
<thead>
<tr>
<th>Product</th>
<th>TIA216G</th>
<th>TIA223G</th>
<th>TIA260R</th>
<th>TIA320R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key feature</td>
<td>2P, fast cure</td>
<td>2P, fast cure</td>
<td>1P</td>
<td>1P</td>
</tr>
<tr>
<td>Viscosity (23C, Pa.s)</td>
<td>8</td>
<td>40</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>Cure condition (°C/hr)</td>
<td>70/0.5</td>
<td>70/0.5</td>
<td>120/0.5</td>
<td>150/1</td>
</tr>
<tr>
<td>Specific gravity (23C)</td>
<td>2.7</td>
<td>2.8</td>
<td>2.9</td>
<td>4.0</td>
</tr>
<tr>
<td>TC (W/mK)</td>
<td>1.6</td>
<td>2.1</td>
<td>2.6</td>
<td>3.2</td>
</tr>
<tr>
<td>BLT (μm)</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>30</td>
</tr>
<tr>
<td>Hardness type E</td>
<td>45</td>
<td>45</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Hardness type A</td>
<td>-</td>
<td>-</td>
<td>55</td>
<td>93</td>
</tr>
<tr>
<td>CTE (ppm/K)</td>
<td>150</td>
<td>140</td>
<td>130</td>
<td>140</td>
</tr>
</tbody>
</table>
Assembly adhesives
# Fast cure SnapSil TN-Series adhesives

<table>
<thead>
<tr>
<th>Product type</th>
<th>SnapSil</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flowable</td>
<td>TN3705</td>
<td>C, W, B</td>
</tr>
<tr>
<td>High viscosity</td>
<td>TN3305</td>
<td>C, W, B</td>
</tr>
<tr>
<td>No-flowable</td>
<td>TN3005</td>
<td>C, W, B</td>
</tr>
<tr>
<td>No-flowable flame retardant</td>
<td>TN3085</td>
<td>W, G</td>
</tr>
</tbody>
</table>

C: Clear, W: White, B: Black, G: Gray

<table>
<thead>
<tr>
<th>SnapSil</th>
<th>TN3705</th>
<th>TN3305</th>
<th>TN3005</th>
<th>TN3085</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity (Pas)</td>
<td>1.5</td>
<td>47</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TFT (min.)</td>
<td>7</td>
<td>9</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Hardness A</td>
<td>13</td>
<td>14</td>
<td>22</td>
<td>46</td>
</tr>
<tr>
<td>S.G.</td>
<td>1.01</td>
<td>1.04</td>
<td>1.03</td>
<td>1.63</td>
</tr>
<tr>
<td>Elongation (%)</td>
<td>130</td>
<td>400</td>
<td>330</td>
<td>150</td>
</tr>
<tr>
<td>Tensile strength (MPa)</td>
<td>0.4</td>
<td>1.5</td>
<td>1.8</td>
<td>2.3</td>
</tr>
<tr>
<td>Adhesive strength (MPa)</td>
<td>0.2</td>
<td>1.0</td>
<td>1.2</td>
<td>1.3</td>
</tr>
</tbody>
</table>
Non-Yellowing Performance of SnapSil TN-series

Aging test at 150°C for 1,000hrs

<table>
<thead>
<tr>
<th>TN3005C</th>
<th>TN3305C</th>
<th>TN3705C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

After aging

Initial

Legacy

Competitor’s grade

After aging

Initial
Black Matrix Ink & Overcoat
Momentive HRB-100 Black Ink is environmental friendly products with non solvent solution. It is applied to cover lenses, touch screens and displays as a black matrix area. It provides excellent heat resistance, chemical resistance and wetting properties of glass and plastics.

**Material Features**
- High heat resistance black ink, at 300 °C
- Excellent adhesion
- Good uniformity
- Good leveling & wetting properties
- Low temp curable

**Product Information**

<table>
<thead>
<tr>
<th>Product name</th>
<th>HRB-100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Black</td>
</tr>
<tr>
<td>Form</td>
<td>1-Component</td>
</tr>
<tr>
<td>Heat resistance temperature</td>
<td>300 °C</td>
</tr>
<tr>
<td>Optical Density</td>
<td>&gt; 2.0</td>
</tr>
<tr>
<td>Surface resistance (Ω/□)</td>
<td>1x10^{13}</td>
</tr>
<tr>
<td>Solid content (%)</td>
<td>70 (Controllable)</td>
</tr>
<tr>
<td>Viscosity (at 25°C)</td>
<td>20,000 ± 5,000</td>
</tr>
<tr>
<td>Density</td>
<td>1.1 ± 0.1</td>
</tr>
<tr>
<td>Storage condition (at 25°C)</td>
<td>0 ~ 15°C</td>
</tr>
<tr>
<td>Shelf life</td>
<td>6month</td>
</tr>
</tbody>
</table>

Copyright 2012 Momentive Performance Materials Inc. All rights reserved. CONFIDENTIAL
Overcoat Solution for TFT-LCD

Momentive ALOC 100series one component protective coating material of TFT-LCD it provide excellent adhesion with leveling properties. And also optically clear properties

**Material Features**
- Organic-Inorganic hybrid(Single liquid type)
- Excellent adhesion
- Good uniformity & flattening
- Good leveling & wetting properties
- Halogen free type

**Product Information**

<table>
<thead>
<tr>
<th>Properties</th>
<th>OCS-100U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Clear</td>
</tr>
<tr>
<td>Chemical base</td>
<td>Organic-Inorganic hybrid</td>
</tr>
<tr>
<td>Solid content(%)</td>
<td>30±5%</td>
</tr>
<tr>
<td>Solvent base</td>
<td>PGMEA/NMP</td>
</tr>
<tr>
<td>Viscosity</td>
<td>10~20 mPa.s (Controllable)</td>
</tr>
<tr>
<td>Transmittance</td>
<td>&gt; 98%</td>
</tr>
<tr>
<td>Haze</td>
<td>&lt; 1.0%</td>
</tr>
<tr>
<td>Cure condition</td>
<td>100~200mJ/cm² (G, H, I-Line broadband)</td>
</tr>
<tr>
<td>Thermal stability</td>
<td>&gt; 300°C</td>
</tr>
<tr>
<td>Adhesion</td>
<td>100/100 (cross cut)</td>
</tr>
<tr>
<td>Storage condition (at 25°C)</td>
<td>5 ~ 15°C</td>
</tr>
<tr>
<td>Shelf life</td>
<td>3month</td>
</tr>
</tbody>
</table>
DISCLAIMER: THE MATERIALS, PRODUCTS AND SERVICES OF MOMENTIVE PERFORMANCE MATERIALS INC., MOMENTIVE PERFORMANCE MATERIALS USA INC., MOMENTIVE PERFORMANCE MATERIALS ASIA PACIFIC PTE. LTD., MOMENTIVE PERFORMANCE MATERIALS WORLDWIDE INC., MOMENTIVE PERFORMANCE MATERIALS GmbH, THEIR SUBSIDIARIES AND AFFILIATES DOING BUSINESS IN LOCAL JURISDICTIONS (collectively "SUPPLIERS"), ARE SOLD BY THE RESPECTIVE LEGAL ENTITY OF THE SUPPLIER SUBJECT TO SUPPLIERS’ STANDARD CONDITIONS OF SALE, WHICH ARE INCLUDED IN THE APPLICABLE DISTRIBUTOR OR OTHER SALES AGREEMENT, PRINTED ON THE BACK OF ORDER ACKNOWLEDGMENTS AND INVOICES, AND AVAILABLE UPON REQUEST. ALTHOUGH ANY INFORMATION, RECOMMENDATIONS, OR ADVICE CONTAINED HEREIN IS GIVEN IN GOOD FAITH, SUPPLIERS MAKE NO WARRANTY OR GUARANTEE, EXPRESS OR IMPLIED, (i) THAT THE RESULTS DESCRIBED HEREIN WILL BE OBTAINED UNDER END-USE CONDITIONS, OR (ii) AS TO THE EFFECTIVENESS OR SAFETY OF ANY DESIGN INCORPORATING SUPPLIERS’ PRODUCTS, MATERIALS, SERVICES, RECOMMENDATIONS OR ADVICE. AFOREMENTIONED EXCLUSIONS OR LIMITATION OF LIABILITY ARE NOT APPLICABLE TO THE EXTENT THAT THE END-USE CONDITIONS AND/OR INCORPORATION CONDITIONS CORRESPOND TO THE RECOMMENDED CONDITIONS OF USE AND/OR OF INCORPORATION AS DESCRIBED BY SUPPLIER IN ITS PRODUCT DATA SHEET AND/OR PRODUCT SPECIFICATIONS. EXCEPT AS PROVIDED IN SUPPLIERS' STANDARD CONDITIONS OF SALE, SUPPLIERS AND THEIR REPRESENTATIVES SHALL IN NO EVENT BE RESPONSIBLE FOR ANY LOSS RESULTING FROM ANY USE OF ITS MATERIALS, PRODUCTS OR SERVICES DESCRIBED HEREIN. Each user bears full responsibility for making its own determination as to the suitability of Suppliers’ materials, services, recommendations, or advice for its own particular use. Each user must identify and perform all tests and analyses necessary to assure that its finished parts incorporating Suppliers’ products, materials, or services will be safe and suitable for use under end-use conditions. Nothing in this or any other document, nor any oral recommendation or advice, shall be deemed to alter, vary, supersede, or waive any provision of Suppliers’ Standard Conditions of Sale or this Disclaimer, unless any such modification is specifically agreed to in a writing signed by Suppliers. No statement contained herein concerning a possible or suggested use of any material, product, service or design is intended, or should be construed, to grant any license under any patent or other intellectual property right of Suppliers or any of its subsidiaries or affiliates covering such use or design, or as a recommendation for the use of such material, product, service or design in the infringement of any patent or other intellectual property right.

Momentive, the M-design logo and ‘the science behind the solutions’ are trademarks of Momentive Performance Materials Inc.