



**Vikuiti™ Reflective Display Film—Black (RDF-B)**  
**Vikuiti™ Reflective Display Film—Clear (RDF-C)**  
**Vikuiti™ Transflective Display Film (TDF)**

Transflective and reflective mode LCDs can now be enhanced to improve readability and style. These films are based on Vikuiti’s proprietary reflective polarizer and diffuse adhesive technologies, and allow direct replacement of the bottom polarizer assembly used in conventional displays.

Feature	Advantage	Benefit
Reflective Polarizer	<ol style="list-style-type: none"> <li>1. Replaces standard bottom polarizer</li> <li>2. Nearly doubles reflected brightness across the complete viewing range</li> <li>3. Illuminated images in backlit mode</li> <li>4. Enables colored characters</li> </ol>	<ul style="list-style-type: none"> <li>• No additional film cost</li> <li>• Low light readability eliminates and/or reduces backlight need and extends battery charge and backlight life</li> <li>• Unique display appearance reduces the size of the required electroluminescent backlight</li> <li>• Allows unique styling of the characters when used with metallic reflectors or colored electroluminescent backlights</li> </ul>
Diffuse Adhesive	<ol style="list-style-type: none"> <li>1. Small particle size</li> </ol>	<ul style="list-style-type: none"> <li>• Provides a “smooth” or “creamy” appearance</li> </ul>
No Transflector	<ol style="list-style-type: none"> <li>1. Single film construction</li> </ol>	<ul style="list-style-type: none"> <li>• Reduces total LCD module thickness and weight</li> </ul>



The following three products can meet your specific display needs:

LCD Mode	Vikuiti Product Type	Product Application	Unique Feature
Reflective	RDF- B	Calculators, instrumentation, appliances	High contrast
Transflective or Reflective	RDF-C	Palmtop PC, cellular phones, pagers, watches/clocks	Enables colored characters, illuminated backlit image*
Transflective	TDF	Palmtop PC, cellular phones, pagers, watches/clocks	Illuminated backlit image*

\*Example

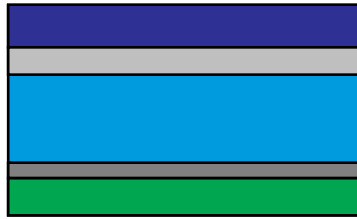


The following drawings detail each product construction:

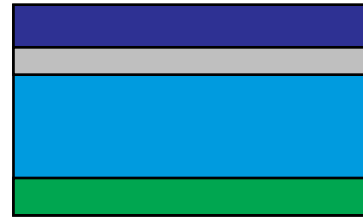
**Vikuiti™ RDF-B**







**Vikuiti™ TDF**





**Vikuiti™ RDF-C**

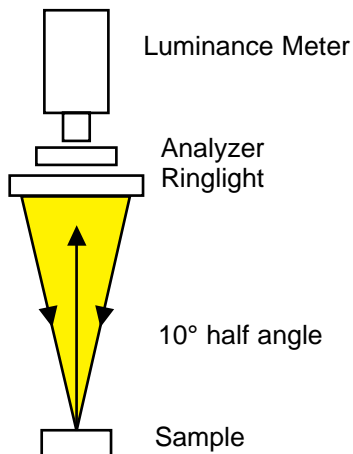


 Release Liner  
 Diffuse Adhesive

 Reflective Polarizer  
 Black Coating

 Neutral Density Coating  
 Protective Liner

	Vikuiti™ RDF-B	Vikuiti™ TDF	Vikuiti™ RDF-C
Color of the adhesive side	Bright Diffuse Silver		
Color of the backside	Black	Gray (50% Neutral Density)	Clear
10° Contrast Ratio*	40:1	40:1	40:1
180° Peel Force (adhesive to LCD glass)	720 g/in.		
Reflectance	45%	45%	45%
Transmittance	0%	21.5%	43%
Normalized white state brightness**	5:1		
Product format	330 x 550mm Sheets Transmission Axis Along 550mm Dimension		
Thickness with liners	273 micrometers		260 micrometers
Thickness without liners	171 micrometers		158 micrometers



**\*3M 10° Contrast Ratio Test Method.**

Vikuiti film sample is painted black (3M™ Scotchcal™ 3905 black screen printing ink, #75-5239-0502-6) on the backside and oriented in the test fixture (see drawing on left) for sequential maximum and minimum on-axis reflected luminance with 10° incident illumination. The ratio of the maximum and minimum values gives the 10° contrast ratio.

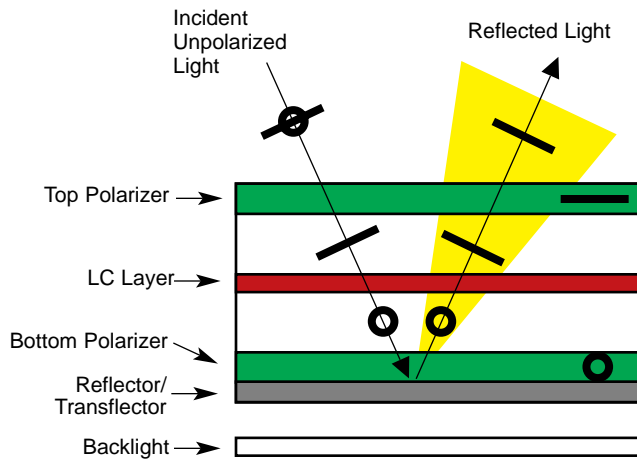
**\*\*3M Normalized White State Brightness Test Method.**

Vikuiti film sample is oriented in test fixture (see drawing on left) for maximum on-axis reflected luminance with 10° incident illumination. This means the two polarizers are oriented 90° with respect to each other.

Conventional reflective/transflective displays use absorbing polarizers along with visibly textured surfaces to manage both polarization and light scattering. This mode of operation is illustrated below for both the ambient and backlit illumination conditions for a normally white cell.

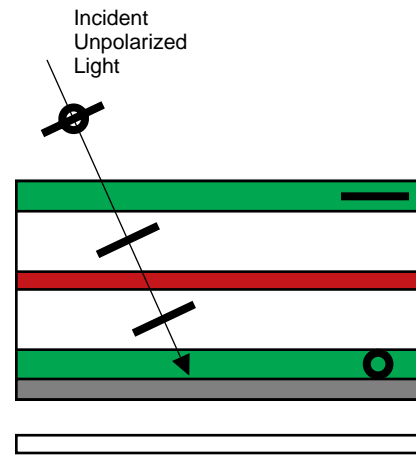
### Ambient Illumination Conventional Display

#### Voltage OFF/Bright State



1. Top polarizer transmits linearly polarized light by absorption of orthogonal polarization.
2. LC layer rotates polarization 90°.
3. Bottom polarizer transmits this light to the reflector/transflector.
4. Reflector/transflector reflects and scatters light back through entire stack for white state.

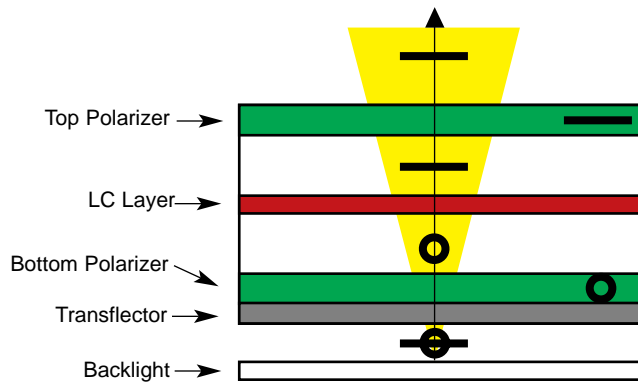
#### Voltage ON/Dark State



1. Top polarizer transmits linearly polarized light by absorption of orthogonal polarization.
2. LC layer does not rotate light.
3. Light is absorbed by bottom polarizer giving dark state.

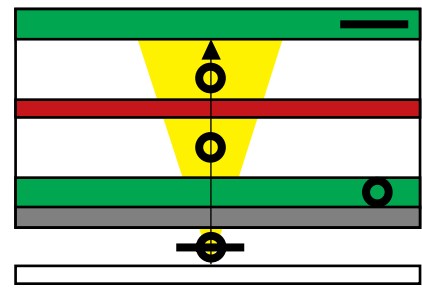
### Backlit Illumination Conventional Display (Transflector only)

#### Voltage OFF/Bright State



1. Backlight illumination passes through transflector layer and is scattered.
2. Bottom polarizer transmits linearly polarized light by absorption of orthogonal polarization.
3. LC layer rotates incident polarization 90°.
4. Light transmits through top polarizer giving white state.

#### Voltage ON/Dark State



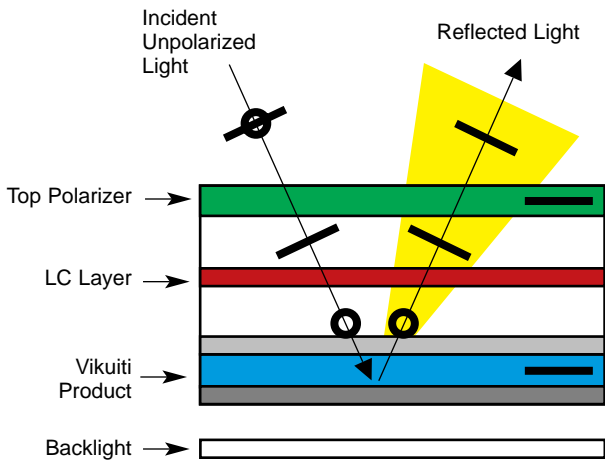
1. Backlight illumination passes through transflector layer and is scattered.
2. Bottom polarizer transmits linearly polarized light by absorption of orthogonal polarization.
3. LC layer transmits light with no rotation.
4. Light is absorbed by top polarizer giving dark state.

In either ambient or backlit mode, multiple passes through the absorbing polarizer decrease brightness and impart a greenish tint to the display. In addition, the textured reflector/transflector, used for light scattering, gives the entire display a grainy appearance.

Based on the Vikuiti product construction, absorption is minimized using a reflective polarizer rather than a dichroic polarizer. The following illustrations highlight both ambient and backlit illumination for a normally white cell with the Vikuiti product.

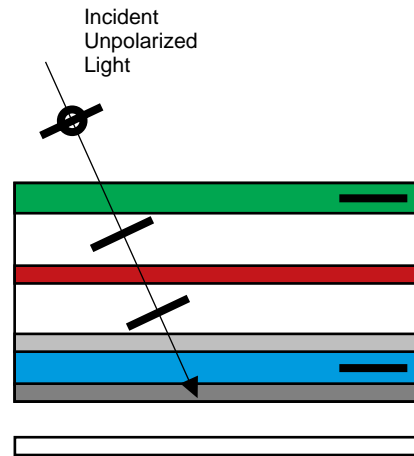
### Ambient Illumination Vikuiti RDF-B, Vikuiti RDF-C, Vikuiti TDF

#### Voltage OFF/Bright State



1. Top polarizer transmits linearly polarized light by absorption of orthogonal polarization.
2. LC layer rotates polarization 90°.
3. Vikuiti product reflects and diffuses light for passage back through stack for white state.

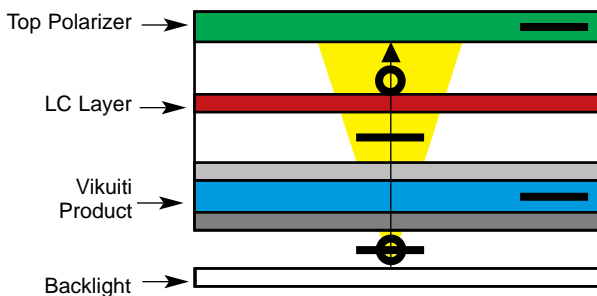
#### Voltage ON/Dark State



1. Top polarizer transmits linearly polarized light by absorption of orthogonal polarization.
2. LC layer does not rotate light.
3. Light is diffused and transmitted by Vikuiti product where absorption by opaque/neutral density coating or reflection by colored layer gives dark or colored state.

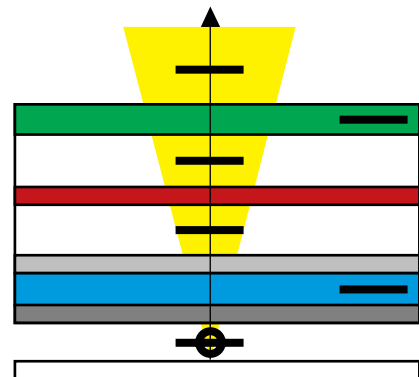
### Backlit Illumination Vikuiti RDF-C, Vikuiti TDF

#### Voltage OFF/Dark State



1. Backlight illumination passes through opaque/colored layer.
2. Vikuiti reflective polarizer transmits linearly polarized light by reflection of orthogonal polarization.
3. Light is diffused by adhesive layer.
4. LC layer rotates incident polarization 90°.
5. Light is absorbed by top polarizer giving dark state.

#### Voltage ON/White State



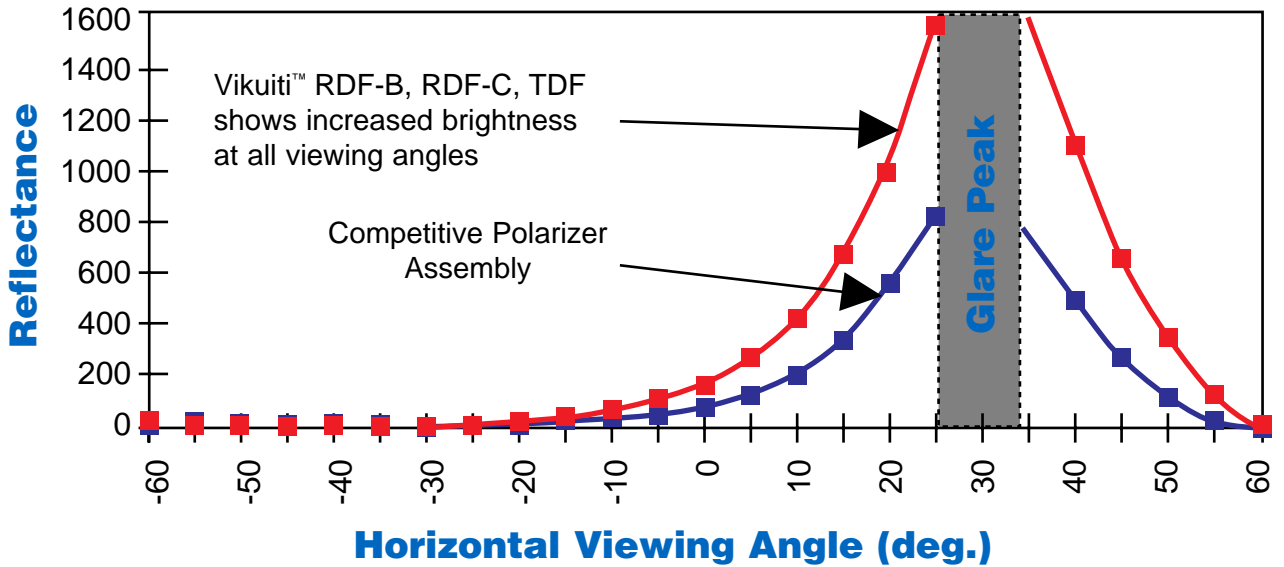
1. Backlight illumination passes through opaque/colored layer.
2. Vikuiti reflective polarizer transmits linearly polarized light by reflection of orthogonal polarization.
3. Light is diffused by adhesive layer.
4. LC layer does not rotate polarization.
5. Light is transmitted by top polarizer giving white state.

Note: The above drawings illustrate that Vikuiti RDF-B, Vikuiti RDF-C and Vikuiti TDF are *aligned* with the transmission axis of the display top polarizer, as opposed to a conventional display where the polarizers are orthogonal.

Illuminated images can now be created when Vikuiti TDF and Vikuiti RDF-C are backlit. Additional styling can be achieved when Vikuiti RDF-C is used in conjunction with colored films or electroluminescent backlights.

## Ambient Mode Optical Performance

(Note: -30° Incident Light)



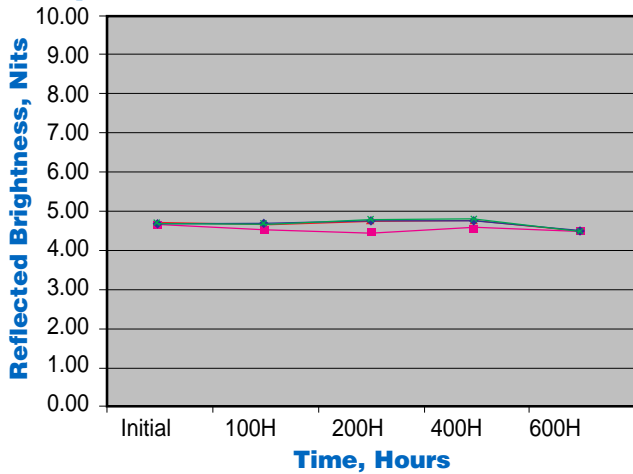
Vikuiti TDF and Vikuiti RDF films nearly double the reflected light. The above graph illustrates the image-enhancing characteristics of Vikuiti RDF/TDF films. Their unique reflective polarizer film and high performance diffusing adhesive dramatically improves brightness levels at nearly all viewing angles and ambient lighting conditions.

## Optical Performance to Environmental Conditions

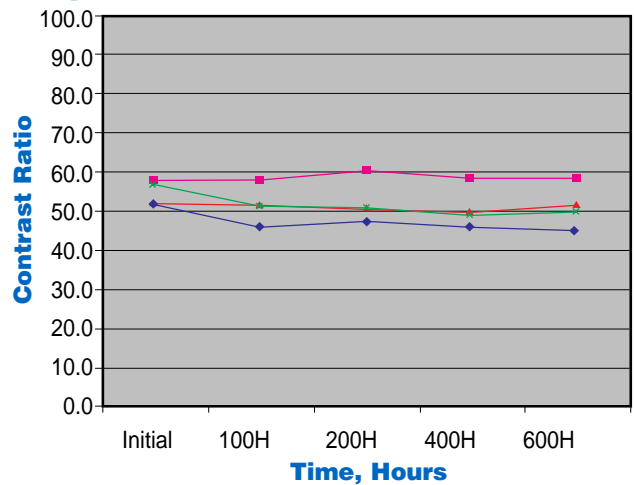
Film samples have withstood the following environmental tests without any appreciable deterioration in visible appearance, physical integrity or optical performance. Over the entire test duration all optical properties maintained specified performance criteria. All samples were roller laminated to conventional Fisher Scientific microscope slides precleaned with isopropyl alcohol.

Description	Condition	Duration
High Temperature	+85°C	600 hours
Low Temperature	-35°C	600 hours
High Temp/Humidity	+65°C at 95% R.H.	600 hours
Thermal Shock	One hour at -35°C followed by one hour at +85°C	200 cycles

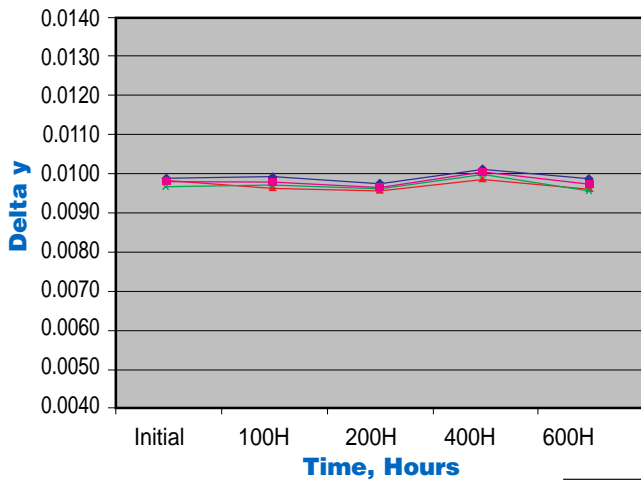
**Reflected Brightness Over Time  
Exposed to Environmental Conditions**



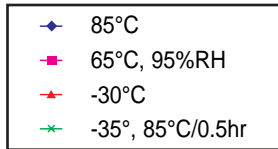
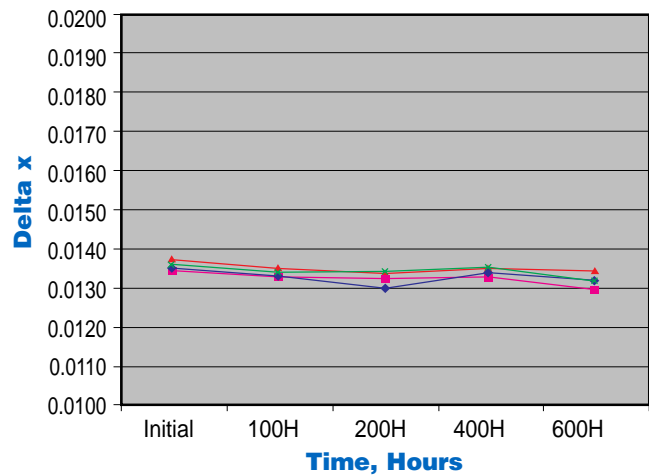
**Contrast Over Time  
Exposed to Environmental Conditions**



**Color Shift Over Time  
Exposed to Environmental Conditions**



**Color Shift Over Time  
Exposed to Environmental Conditions**



For ordering information on Vikuiti™ Display Enhancement Films from 3M, please call:  
**1-800-553-9215**

For technical information please send an e-mail to: [ostechserv@mmm.com](mailto:ostechserv@mmm.com)

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Optical Systems Division**

3M Center, Building 260-5N-10  
St. Paul, MN 55144-1000



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