LC SmartGlass™
SPD SmartGlass™

Electronically Switchable Glass Handbook

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We hope that you find this document useful and welcome any feedback.

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COMPANY

FOUNDED: 2003

DIRECTORS: John Browne (Managing), Bob Hudson (Technical), Kevin Root (Commercial), Frank Bagnall (Operations) & Richard Blake (Chairman)

MANAGERS: Alan Saxby (Sales) & Matt Holt (Production)

SELLING AGENT: SCHOTT Glass (Worldwide) www.schott.com

AUDITORS: O’Gorman Brannigan Purthill & Co.

LOCATIONS: Ireland and United Kingdom & Worldwide sales offices.

BUSINESS: Design, manufacture, sale and installation of LC SmartGlass™ & SPD SmartGlass™.

MAJOR PRODUCTS: LC SmartGlass™ - Switchable Privacy Glass
SPD SmartGlass™ - Light control Glass
SLC SmartGlass – Privacy & Light control
Ad Glass
Speciality Glass Laminates

INVESTMENT: In excess of €3 million


AWARDS: RIBA 100% Detail Innovative product of the show award 2008 & 2006. Plan Expo Product Best Innovation of the show award 2004
Welcome to SmartGlass International Ltd, the leading worldwide manufacturer of electronically switchable glass supplied to the commercial, hospitality, healthcare, transport and security, industrial and exclusive residential sectors.

Vision and Values
Our vision is to create, challenge, evolve and respect through excellence, passion, quality, innovation and drive. Our no-compromise attitude to quality and customer focus is the foundation for our commitment to creating products and experiences of real and lasting value.

Intelligent technology, advanced features, innovative solutions and quality are what set us apart.

- LC SmartGlass™ - Privacy on demand – Internal partition screens, windows, security screens & doors
- SPD SmartGlass™ - Solar Control – Windows & Roof-lights

About SmartGlass International
SmartGlass International (SGI) is the dedicated manufacturer of Electronically Switchable Glass. Also known as privacy glass, switchable glass, intelligent glass and electric glass these technologically advanced glass products are fast breaking from being niche to becoming mainstream for use particularly in the commercial, retail, security, transport, healthcare and hospitality sectors. Our main products are LC SmartGlass™ offering Privacy on demand and SPD SmartGlass™ offering Solar-Control.

SmartGlass International has its head quarters, manufacturing, finance and R&D centres in Dublin, Ireland with commercial, sales and technical offices in the UK. With the intention of concentrating our products and markets we only produce electronically switchable glass products and through continued research and development initiatives are expanding our range of products to meet the needs of growing specialist markets in architecture, transport and medical fields. We have invested heavily in plant and machinery and have the capacity to fulfil large orders on short lead times. Each piece of SmartGlass is bespoke made to meet and exceed our client’s needs, always with the client in mind.

We are an award winning company claiming such accolades as the royal institute of British architects sponsored 100% Detail most innovative building product award.

In January 2009, SmartGlass International Ltd and SCHOTT Glass signed an agreement giving SCHOTT the Worldwide sales exclusivity for LC SmartGlass (except UK & Irl). This partnership allows both of our companies to use our particular areas of expertise to grow the Worldwide SmartGlass market.

For 125 years, SCHOTT has been setting the standard in the special glass industry and in 2009 celebrates its 125th birthday. www.schott.com

The use of intelligent smart glass provides added value and increased flexibility in new building design, improves working environments and building ergonomics, saves energy, and increases the well being of occupants. We are dedicated to bringing environmentally friendly building products and unique design capabilities to our customers.

Through continued investment we have expanded to become World leader in the manufacture of electronically controlled smart glass products for the architectural market. We offer unique and bespoke services including technical, consultancy, design, installation, supply only service, control systems, service and maintenance through to complete design & build turnkey solutions.
Employees are part of a community that strives for the highest levels in everything it does. Our no compromise attitude to quality is the foundation for our commitment to creating products and experiences of real and lasting value. The principles of these sentiments are enthusiasm, pride and passion for our company, our products and our roots. This spirit permeates all areas of the SmartGlass International organisation and provides the backing for the full scope of our operations.

LC SmartGlass™ is used for privacy purposes allowing instant privacy at the flick of a switch. Using a minute electrical current, users can immediately switch the LC SmartGlass from clear to private (opaque) and vice versa. LC SmartGlass is easily installed and uses a minute electrical current. Various configurations can be supplied including colour tinted, fire rated, double glazed, curved and shaped.

SPD-SmartGlass™ can be manually or automatically “tuned” to precisely control the amount of light, glare and heat passing through. Glass facades using patented SPD light-control technology reduce the need for air conditioning during the summer months and heating during winter. SPD SmartGlass windows give the ability to instantly switch a window to maximize daylight when it’s really needed and to provide controllable solar shading during peak light conditions is unique.

Our products foster innovative design opportunities never before available while offering unprecedented environmental benefits and protection to building inhabitants and contents.

SmartGlass is currently used in partition screens, windows, roof-lights and doors, projection screens, security & teller screens but as architects and designers explore the boundaries and turn conventional perspectives of glass on their head it is expected that the markets will continue to grow and expand into new and innovative uses. Evidence that the trend for increases in SmartGlass sales is visible in the range and locations of projects recently completed by SmartGlass International including the Guinness Storehouse, Goebach Kirchner, Royal College of Physicians, upmarket private homes, various hospitals, Chevron Texaco HQ, Rolls Royce, Damico tankers, Royal Institution of GB, Emirates Airlines, Saudi Arabian National Guard, European Space Agency, Central Bank of Ireland, Chubb Custodial, SMI, Fairline boats, Zain Bahrain, Zeus Packaging & Pictet Bank. Since 2008, our products have been sold into more than 37 countries throughout the World.
Why SmartGlass International?

We have successfully worked with and supplied to prestigious clients, World renowned architects and landmark projects throughout the World and have built an enviable reputation for:

- **Quality Products.** Our products are designed to be not only aesthetically pleasing but also essentially functional and easy to use. The expectations raised by a strikingly individual appearance must be completely fulfilled in terms of high quality performance in all areas when the SmartGlass system is used. Excellence in providing the consumer with the highest pleasure in both ownership and use rests on the highest quality standards employed through the design and manufacturing processes.

- **Innovation.** Through extensive investment in research and development SmartGlass International continually pushes the boundaries to bring new and innovative products to its customers.

- **Design.** Our design team will work with the client, their architects and design teams in order to guarantee the products supplied are fit for purpose and are optimally designed in terms of quality, regulatory compliance, safety, aesthetics and function.

- **Customer Focus.** We strive to offer our customer a level of service that matches the unprecedented focus on quality and finish of our products. Following design, delivery and installation of your purchase the SmartGlass International product and service guarantee ensures that service and support is always close at hand. Taking care of you and your products is our main ambition. Should you need support for your products, we will do our utmost to help you as quickly and efficiently as possible.

- **Flexibility.** We strive to be as flexible as possible in order to understand and enhance the customer experience. Frequently competitors cannot supply certain configurations which SmartGlass International will supply to exceed the clients requirements.

- **Beware of cheap imitations.** Our SmartGlass products set the standards.

- **Lead time.** Through in house control of the manufacturing and quality processes, lead times generally range from 3 to 6 weeks from receipt of order. Our goal is to deliver a quality product on time.

- **International Sales Network.** Through partnership with SCHOTT glass, we can service the requirements of a worldwide customer base.

- **Environmental Policy.** We work continuously to minimise the effects of greenhouse emissions on the environment. Equal priority is given to finding a balance between the needs of the environment and the consideration given to our products qualities, economic value, aesthetic value and life span. Our products ultimately reduce green house emissions by enabling users to reduce peak electrical demands on lighting and cooling. Our production processes are carried out in a sympathetic manner always with a view to maximising recycling and minimising energy consumption and waste.
LC SmartGlass - Privacy on Demand

OVERVIEW

LC SmartGlass™ offers instant privacy at the flick of a switch. All LC SmartGlass panels are bespoke manufactured using a lamination process which encapsulates a PDLC film between 2 or more glass sheets. Using a minute electrical current, users can immediately switch the LC SmartGlass from clear to private (opaque) and vice versa. LC SmartGlass is easily installed and can be utilised in many applications. Various configurations can be supplied including colour tinted, fire rated, double glazed, curved and shaped.

PRINCIPLE

When the electrical supply is switched on, the liquid crystal molecules align and incident light passes through and the LC SmartGlass panel instantly clears.

When the power is switched off the liquid crystal molecules are randomly oriented scattering light and the LC SmartGlass becomes opaque (private).
APPLICATIONS AND FEATURES

- **Hospitality** – Hotel room privacy screen, bathroom / bedroom privacy screen, external windows, doors, conference centre windows & roof-lights, bar & restaurant screens, toilet cubicles, balustrades and balconies.

- **Commercial** – Office & boardroom partition screens, doors, sliding/folding doors, windows, roof-lights.

- **Healthcare** – Fire rated hospital doors, moveable privacy screens, and X-Ray protection screens.

- **Security** – Cell doors and windows, vision panels, entrance foyer, teller & cash counting screens.

- **Industrial** – Machinery screening, roof-lights, doors, components.

- **Rail** – Driver privacy & security screens.

- **Retail & Showroom** – Projection windows, vanity screens, feature screens.

- **Projection** – Internal or External high resolution rear projection screens.

- **High end Domestic** – Screens, windows, doors, roof-lights, sliding/folding doors.

ADVANTAGES & BENEFITS

- Instant and precise privacy control
- Efficient use of space in the built environment
- Blocks 99.5+% of damaging UV rays
- Eco friendly
- Exceptional optical qualities that reduce glare and eye strain
- High durability, solid-state technology with no moving parts to wear out or break
- Large sizes of many shapes can be produced
- Stable colour characteristics for the life of the unit
- Aesthetically pleasing, hygienic & low maintenance
- Reduce uncomfortable “Gold fish bowl” feeling when working in high-density office buildings
- Reduced fading of carpets, furniture and protects valuable artwork
- High UV stability
- Low working voltage
- High contrast for use as rear projection screen
- Long life - tested to in excess of 1,000,000 cycles
LC SmartGlass is operated by applying 110V AC to the glass from a power transformer supplied. When a current is applied to the glass it immediately turns from opaque to clear allowing vision through. When the current is removed the glass returns to the frosted “private” state. LC SmartGlass can be operated by wall switch, radio remote, PIR switch, Crestron, ABX and more...

CONTROLS

- Wall switch, Remote control, Movement sensor, Timer, Door lock, etc....
## DURABILITY

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Test Item</th>
<th>Test Conditions</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Switching</td>
<td>On(1sec) Off(1sec), 110Vac 60 Hz 1 Million Times</td>
<td>Passed</td>
</tr>
<tr>
<td>2</td>
<td>High Temperature (Boil test)</td>
<td>70°C / 2 Hours</td>
<td>Passed</td>
</tr>
<tr>
<td>3</td>
<td>High Temp. / Humidity</td>
<td>50°C / 95%RH, 14 Days</td>
<td>Passed</td>
</tr>
<tr>
<td>4</td>
<td>Low Temperature</td>
<td>-20°C / 21Days</td>
<td>Passed</td>
</tr>
<tr>
<td>5</td>
<td>Heat Cycle</td>
<td>-20°C to 70°C (1Hrs/Cycle), 5,000Cycles</td>
<td>Passed</td>
</tr>
<tr>
<td>6</td>
<td>Weathering</td>
<td>Standard (For Laminated Glass)</td>
<td>Passed</td>
</tr>
<tr>
<td>7</td>
<td>Heat Resistance</td>
<td>Standard (For Laminated Glass)</td>
<td>Passed</td>
</tr>
<tr>
<td>8</td>
<td>Water submersed</td>
<td>21 Days</td>
<td>Passed</td>
</tr>
</tbody>
</table>

Product samples used: 10.8mm LC SmartGlass - Mfg 16/09/08 Batch 2242A
Check on Chemical resistance acc. DIN EN ISO Task 12543-4
LC SmartGlass CONFIGURATION
(For non-standard configurations please contact us to discuss)

GLASS COLOR:  Clear, bronze, grey, green, blue tint.

GLASS TYPE (All laminated):  Annealed (Standard), Low Iron, heat/chemical strengthened, tempered, Fire rated, curved, bullet resistant, tinted, mirrored.

THICKNESS:  
- Interior  9 mm, 10.8 mm, 13 mm or 15 mm
- Door  11.2 mm or 13 mm tempered
- Exterior Flexible: Ex. 28 mm insulating glass unit (IGU)
  4 mm Low-E outer glass + 13 mm airspace + 10.8 mm LC SmartGlass™ panel

SIZE:  Up to 1,152 mm x 3,000 mm

RATIO:  Maximum Ratio Width: Height approx 4:1
         (Without applying bus bars top and bottom or on 2 opposing sides)

WIRING:  Standard 3 meter, longer wires can be supplied upon request

SHAPE:  Many shapes and curved including drilled holes

ENVIRONMENTAL:  Storage / Operation -20°C to 50°C (-4°F to 122°F)

SIZE TOLERANCE:  ± 3 mm on OA size and ± 0.5 mm on thickness

ELECTRICAL:  
- Driving voltage  65-110 volts A.C.
- Current  less than 200 mA/m²
- Power  approx. 5 watt/m²

SWITCHING TIME:  Approx. 1/100 second at room temperature

OPTICAL:  
- Transmission  approx. 75%
- View angle  approx. 120°
- Scattering effectiveness approx. 100 mm

LIFE:  Greater than 10 years

WARRANTY:  5 years
### LC SmartGlass Sound Control Data*

<table>
<thead>
<tr>
<th>LC SmartGlass Thickness</th>
<th>Configuration</th>
<th>DB Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.2 mm</td>
<td>4 mm / 1.2 / 4 mm</td>
<td>35</td>
</tr>
<tr>
<td>11.2 mm</td>
<td>5 mm / 1.2 / 5 mm</td>
<td>37</td>
</tr>
<tr>
<td>13.2 mm</td>
<td>6 mm / 1.2 / 6 mm</td>
<td>39</td>
</tr>
<tr>
<td>25.2 mm</td>
<td>12 mm / 1.2 / 12 mm</td>
<td>44</td>
</tr>
</tbody>
</table>

*Values are nominal (+/- 5%) and are dependent on glass configuration used. The above figures are recommended for guide purposes only.

### LC SmartGlass Optical performance*

<table>
<thead>
<tr>
<th></th>
<th>LC SmartGlass (10.8mm) Power ON</th>
<th>LC SmartGlass (10.8mm) Power OFF</th>
<th>Clear Float Glass (6mm)</th>
<th>Frosted Glass (6mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visible Light Transmission</td>
<td>75%</td>
<td>67%</td>
<td>86%</td>
<td>76%</td>
</tr>
<tr>
<td>Clarity</td>
<td>76%</td>
<td>4%</td>
<td>83%</td>
<td>18%</td>
</tr>
<tr>
<td>UV Transmission</td>
<td>0.5%</td>
<td>0.5%</td>
<td>55%</td>
<td>55%</td>
</tr>
</tbody>
</table>

*Values are nominal (+/- 5%) and are dependent on glass configuration used. The above figures are recommended for guide purposes only.
**OVERVIEW**

SPD-SmartGlass™ can be manually or automatically “tuned” to control the amount of light and glare passing through a window. While glass is a favored product for use in building facades; glare, solar heat gain and UV exposure are problematic and can often make the use of glass impractical resulting in the need to invest in expensive solar shading devices. Glass facades using patented SPD light-control technology reduce the need for air conditioning during the summer months and heating during winter. The ability to instantly switch the glass to maximize daylight when it’s really needed and to provide controllable solar shading during peak light conditions is valuable and unique. All SPD SmartGlass panels are bespoke manufactured using a lamination process which encapsulates a SPD “Suspended Particle Device” film between 2 or more glass sheets.

**PRINCIPLE**

When the power supply is switched on, the rod shaped suspended particle molecules align, light passes through and the SPD SmartGlass panel clears. SPD SmartGlass protect from damaging UV when on or off. When the power supply is switched off the rod shaped suspended particle molecules are randomly oriented blocking light and the SPD SmartGlass becomes dark blocking up to 99.4% of light.
SPD SmartGlass™ APPLICATIONS & FEATURES

External Glazing

- Fixed or casement windows and doors
- Create comfortable environments in offices, bedrooms, sunrooms and conservatories
- In SPD SmartGlass Curtain walling, the use of a photocell will automatically protect the interior of a building when the sun's rays shine
- Can be single, double or triple-glazed including low E glass and gas filling, resulting in improved thermal performance and reduced solar heat gain and unparalleled U Values

Roof-Lights

- Skylights
- Roof-lights – Fixed or opening
- Commercial and Domestic

Security and Safety

- Protect staff and interiors from the effects of harmful UV rays.
- Reduced harmful solar heat gain.
- Control glare.
- Reduce the effects of noise pollution.
- Added security and safety due to toughened laminated glass construction.
- Low electric consumption.

ADVANTAGES & BENEFITS

In an effort to reduce glare the windows of many commercial buildings are permanently tinted, therefore requiring more lighting inside the building than that which is optimally needed. Natural day lighting, which can be regulated using SPD SmartGlass™ products, has been shown to improve health and well being, and thus its regulation is considered by many to have a strong influence on one’s attitude and productivity.

- Instant and precise control of light
- Energy Savings on cooling & lighting costs
- Eco friendly, reduce building carbon emissions
- Exceptional optical qualities that reduce glare and eye strain
- Elimination of the need for expensive window dressings like electronic louvers; blinds and solar shades used in architectural applications
- High durability, solid-state technology with no moving parts to wear out or break
- Large sizes of any shape can be produced
- Stable colour characteristics for the life of the unit
- Wide working temperature range from -20°C to +70°C - Ideal for exterior applications
- Ambient temperature control
- Aesthetically pleasing
- Hygienic low maintenance material
• Enhanced corporate image
• Wide light transmission ranges
• Reduces uncomfortable “Gold fish bowl” feeling when living or working in high-density buildings such as apartment blocks or office complexes
• Reduced fading of carpets, furniture and protect valuable artwork
• Protecting skin from damaging UV rays
• High UV stability
• Low working voltage
• High contrast at any viewing angle and any illumination level
• Long life - tested to in excess of 100,000 cycles
• Cost competitive.
• Infinite range of light transmission levels without the blocking of ones view.

**SPD SmartGlass - CONFIGURATION**

• Maximum Size:  1,000 * 2,800 mm
• Minimum Size:  200 * 300 mm
• Weight:  35.5 kg/m² (24.0mm SPD SmartGlass DGU)
• Thickness:  Various from 8.8mm for laminates and from 20mm for Double Glazed units
• Colour tints:  Blue
• Glass types:  Gas filled double glazed units (external windows)
• Processing:  Double Glazed, Drilled Holes, Curved, Shaped, Triple Glazed
• Warranty:  5 Years
• Leadtime:  8-12 weeks
• Control:  Wall switch, Remote control, Movement sensor, Light sensor, Timer

**SHAPES**
TRANSMISSION DATA - SPD SmartGlass

<table>
<thead>
<tr>
<th></th>
<th>SPD SmartGlass (10.8mm)</th>
<th>SPD SmartGlass (10.8mm)</th>
<th>Clear Float Glass (6mm)</th>
<th>Frosted Glass (6mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power ON Visible Light</td>
<td>49%</td>
<td>0.24%</td>
<td>86%</td>
<td>76%</td>
</tr>
<tr>
<td>Power OFF Clarity</td>
<td>N/A</td>
<td>2.90%</td>
<td>83%</td>
<td>18%</td>
</tr>
<tr>
<td>UV Transmission</td>
<td>0.5%</td>
<td>0.5%</td>
<td>55%</td>
<td>55%</td>
</tr>
</tbody>
</table>

*Values are nominal (+/-5%) and are dependent on the glass configurations used. SmartGlass International reserves the right to amend information without prior notice.

Sound Control Data - SPD SmartGlass*

<table>
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<td>44</td>
</tr>
</tbody>
</table>

*Results vary according to glass specification and framing system employed. The above figures are recommended for guide purposes only and may change without prior notice.
MANUFACTURING

The production team at SmartGlass International Ltd uses a combination of experience, technology and skill to manufacture each SmartGlass panel to the highest levels of quality. In house proprietary manufacturing processes using an Autoclave lamination process employ heat, vacuum and pressure to produce a multilayer glass sandwich. Each SmartGlass panel is handmade & bespoke for the clients requirements. The production cycle lead time for each panel is 3-5 days depending on configuration.

All of the materials used in the production process are of world class standard and while expensive; these materials ensure premium quality in the finished product.

Each SmartGlass panel is assembled in a climate controlled clean room environment. Production employees are empowered to strive for World class manufacturing standards and individually sign off each bespoke made panel after manufacturing and testing.

After manufacturing, cleaning and wiring each SmartGlass panel is tested by switching approximately 57,000 times in rapid on/off sequence.

SmartGlass can be manufactured into various shapes including holes in the film. (Contact us for detailed explanation) All panels are bespoke manufactured and cannot be cut after manufacture.

SmartGlass™ is real life field tested for in excess of 12 years.

SMARTGLASS PANEL

LC & SPD Smart films are laminated between two pieces of glass.

Liquid crystals - the same technology is used in digital watches, TV’s and computer screens. Liquid crystals are sandwiched between two layers of transparent conductive film to make LC Smart Film. The film is then laminated between two pieces of glass. When electricity is applied to the film the liquid crystals line up and the window is clear (slight haze). When the power is turned off, the liquid crystals return to their normal positions and turn the glass from clear to opaque. 2 wires exit the top of each unit where they are connected to a copper bus bar. **Note:** Framing needs to hide 15 mm where the bus bar is visible, generally at the top of the SmartGlass panel.
The electro active Smart film is sandwiched between two or more glass layers in a similar way to how normal laminated glass is constructed. The outer layers are made up of glass (normally 5 mm or 6 mm thick) each side, then an interlayer is inserted on each side to encapsulate the Smart film and bond the complete laminate.

LC & SPD Smart film’s are manufactured using electrically conductive ITO coatings, polymer matrix, liquid crystals or suspended particles, adhesive films and bus bars.
SPECIFICATION OF LC & SPD SMARTGLASS

Specifications of SmartGlass International
LC SmartGlass and SPD SmartGlass

Wires to power SmartGlass
(2m Long as Standard)

Busbar

Non Active Area
13mm +/- 2mm
at Busbar edge

Mono SmartGlass

LC/SPD Film

Transparent Area
(No LC/SPD Film)
3mm +/- 2mm
Potential Bubbles to be accepted in the transparent area

Bending
3mm per Metre

DGU SmartGlass

13mm DGU Spacer +/- 2mm
from edge of Glass

Note:
In certain circumstances busbars may be applied to both the top and bottom of the panels.

SmartGlass Drawing No. STDC1
SmartGlass - Transmission & Test Data

Energy Transmission Measurements

To provide a better understanding of what these figures are measuring, the brief explanation below discusses the various spectrums of energy created by the sun. These are the same energy spectrums that building products and windows must endure on a daily basis. Some of the characteristics are positive and ones that we want to maximize, while others are detrimental and must be reduced or controlled in some manner. Electromagnetic energy from the sun is broken into a variety of categories or spectrums based on the wavelength of the energy. The three main spectrums that affect the building products industry, people and furnishings in commercial and domestic settings are UV, Visible Light and Infrared energy. Read on to see how SmartGlass can not only achieve immediate privacy on demand but can control, protect and enhance building environments.

ULTRA VIOLET - UV

UV energy is not visible to the human eye and is typically broken into three categories: UVA, UVB, and UVC. UVC energy is mostly rejected by the earth’s atmosphere, never reaching the earth’s surface. UVB and UVA energy pass through the atmosphere and reach the earth’s surface. As it pertains to the window market, most of the UVB energy is blocked by standard float glass. Clear double pane windows will reject almost all of the UVB energy. Therefore the remaining UVA energy is the primary target. UVA energy passes through standard float glass, and can only be blocked by coatings or films that are capable of reflecting or absorbing this spectrum of light such as our SmartGlass technologies. UVA energy is the primary component responsible for fading of furnishings, art work and overall deterioration of fabric quality. The more a window product can reject or absorb the sun’s UV energy, the longer the life and quality of the items being protected. All window products should strive for the lowest UV transmission value possible.

VISIBLE LIGHT

Visible light is the only portion of the sun’s spectrum that human eyes can see including natural daylight and all the colours of the rainbow. Visible light has mostly good attributes associated with it but eye strain associated with glare can cause serious problems for building occupiers. Natural light is often desired to make a home or building feel open or well lit. Large amounts of natural light will also reduce the need for lighting in a given structure, thus reducing utility costs. Windows that are tinted will have lower visible light transmission values. It should be noted that large amounts of natural light can also increase the amount of glare. This unwanted element can be aggravating in rooms with televisions or computer monitors and areas in office buildings where employees have to combat uncomfortable and often dangerous glare levels. SmartGlass allows the user to control visible light transmission and by choosing grey or blue tinted versions for specifically bright areas the user is protected and inhabits a safer and more comfortable environment.

INFRARED – IR

Infrared energy relates to the heat energy that is emitted from the sun and is also referred to as radiant heat. Infrared energy is light that our eyes cannot see, but which our bodies can detect as heat. The radiant heat energy emitted by the sun in the solar spectrum is typically classified as Near Infrared (NIR) energy. This is the energy one feels as heat when standing in the sun. This is the same energy that hits a window surface and transmits through the glass to increase the temperature inside a building. Being able to “control” this near infrared energy
transmission value allows a window to control the amount of heat that is added to a building by the sun. Decreasing the infrared transmission value of a window will decrease the amount of heat energy added to a building, thus reducing over-heating effects that occur in summer months and in hot climates. The use of SmartGlass protects building occupants and significantly reduces carbon emissions and costs associated with air conditioning and cooling. The ability of a window using LC SmartGlass™ to reject infrared energy will be directly related to a window’s Solar Heat Gain Coefficient (SHGC). The lower the Infrared Transmission Value the lower the corresponding Solar Heat Gain Coefficient.

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Evidence of Performance
light transmittance
light reflectance

Test report 410 33071e

Customer
SmartGlass International Ltd.
Unit6 Renmore Business Complex
Kilcoole
County Wicklow
Ireland

Product
Laminated glass
System designation
LC SmartGlass™
Construction
4 float / 1 LC-foil / 6 float

Light transmittance \( \tau \)
Light reflectance \( \rho \)

Opaque state
\( \tau = 0.67 \)
\( \rho = 0.18 \)
Transparent state
\( \tau = 0.75 \)
\( \rho = 0.14 \)

Validating the total solar energy transmittance does not allow any statement to be made on further characteristics of the present structure which could define performance and quality.

Notes on publication
The IFT Guideline “Conditions and Guideline on the Use of IFT Test Reports” applies.
The cover sheet can be used as an abstract.

Contents
The report contains 4 pages in total:
1. Object
2. Procedure
3. Detailed results
1 Object

1.1 Description of test specimen (all dimensions in mm)

<table>
<thead>
<tr>
<th>Product</th>
<th>Laminated glass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>LC SmartGlass™</td>
</tr>
<tr>
<td>Total thickness</td>
<td>11</td>
</tr>
<tr>
<td>construction</td>
<td>4 float / 1 LC-foil / 6 float</td>
</tr>
</tbody>
</table>

For the determination of the spectral data test specimen of single panes were used:
Dimensions (B x H) 80 x 300 mm, 300 x 300 mm
Glass thickness 11

The description is based on the documentation of ift. Numbers and names of material are given by the customer. (Further data from customer are marked with *).

1.2 Representation of test specimen

The illustration was produced by the ift as a schematic representation of the cross section.

Figure 1 Representation of the system LC SmartGlass™
2 Procedure

2.1 Sample

The specimen were selected by the customer.
Quantity 80 x 300 mm, 3 pieces
            300 x 300 mm, 3 pieces
Delivered 16 April 2007 by the customer
Registry No 21783

2.2 Process

Technical basis
EN 410 : 1998-04

Glass in building – Determination of luminous and solar characteristics of glazing

Deviations
There are no deviations from the test procedure or test conditions

2.3 Test equipment

IR-Spectrometer
Type Shimadzu UV-3102PC with LISR-3100, Integration sphere Ø150 mm
Measured range 190 nm to 2500 nm
Resolution variable, 2 nm was selected
Climatic conditions approx 20 °C, 50 % RH
Reflection standard calibrated reflection standard, Fa. Labsphere; aluminium mirror
Averaging average of three samples

2.4 Execution of the test

Date/period 31 May till 2 July 2007
Test engineer F. Böck
3 Detailed results

Table 1  Measured and calculated values according to EN 410 for light at normal incidence for the laminated glass LC SmartGlass™

<table>
<thead>
<tr>
<th></th>
<th>opaque</th>
<th>transparent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultraviolet transmittance $\tau_{UV}$</td>
<td>0.18</td>
<td>0.23</td>
</tr>
<tr>
<td>Light transmittance $\tau_L$</td>
<td>0.67</td>
<td>0.75</td>
</tr>
<tr>
<td>Light reflectance $\rho_L$</td>
<td>0.18</td>
<td>0.14</td>
</tr>
<tr>
<td>Solar direct transmittance $\tau_F$</td>
<td>0.61</td>
<td>0.65</td>
</tr>
<tr>
<td>Solar direct reflectance $\rho_F$</td>
<td>0.15</td>
<td>0.12</td>
</tr>
</tbody>
</table>

ift Rosenheim
4 July 2007
Evidence of Performance

total solar energy transmittance
light transmittance

Test report 410 33071/2e

* Translation of test report n° 410 33071/2 dated 31 October 2007

Client:
SmartGlass International Ltd.
Unit 6 Renmore Business Complex
Kilcoole, County Wicklow
Ireland

Product
Insulating glass unit
System designation
Insulating glass unit with LC-Glass
Construction
6/12/11 mm
Gas filling
90% Argon
Type of coating
IR-Coating on surface 2
Coating designation
arcron N33, arcron sunbelt platin
Uncoated pane
LC-Glass

Total solar energy transmittance g
Light transmittance τ :

\[ g = 0.39 \text{ to } 0.51^* \]
\[ \tau = 0.54 \text{ to } 0.65^* \]

* Exact values see table detailed results

Mike Roska, Dip. Phys.
Head of Testing Department
ift Centre Glass, Building Materials & Building Physics

Florent Dauk, M.Eng., Dipl.-Ing. (FH)
Test engineer
ift Centre Glass, Building Materials & Building Physics

ift Rosenheim

Basis:
EN 410:1998:04
Glass in building – Determination of luminous and solar characteristics of glazing

Representation

Instructions for use
This test report may be used to classify the total solar energy transmittance g as well as the light transmittance τ.

Validity
The data and results given relate solely to the specified, tested object.
Testing the total solar energy transmittance does not allow any statement to be made on further characteristics of the present structure, which could define performance and quality.

Notes on publication
The IFT Guideline "Conditions and Guidelines on the Use of IFT Test Reports" applies.
The cover sheet can be used as an abstract.

Contents
The report contains a total of 4 pages:
1. Object
2. Procedure
3. Detailed results
1 Object

1.1 Description of test specimen (all dimensions in mm)

<table>
<thead>
<tr>
<th>Product</th>
<th>Insulating glass unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Insulating glass unit with LC-Glass</td>
</tr>
<tr>
<td>Total thickness</td>
<td>29</td>
</tr>
<tr>
<td>Construction</td>
<td>5/12/11</td>
</tr>
<tr>
<td>Coating</td>
<td>Thermal protection coating</td>
</tr>
<tr>
<td>Type / Manufacturer</td>
<td>arcon N33 / company Arcon</td>
</tr>
<tr>
<td>Coating on surface</td>
<td>2</td>
</tr>
<tr>
<td>normal emissivity εₚ</td>
<td>0.03</td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>Coating</td>
<td>Solar control coating</td>
</tr>
<tr>
<td>Type / Manufacturer</td>
<td>arcon sunbelt platín / company Arcon</td>
</tr>
<tr>
<td>Coating on surface</td>
<td>2</td>
</tr>
<tr>
<td>normal emissivity εₚ</td>
<td>0.03</td>
</tr>
<tr>
<td>Gas filling in cavity</td>
<td>according to manufacturer</td>
</tr>
<tr>
<td>Gas type</td>
<td>Argon</td>
</tr>
<tr>
<td>Volume in %</td>
<td>90</td>
</tr>
</tbody>
</table>

For the determination of the spectral data test specimen of Insulating glass unit with LC-Glass™ single panes were used:

Dimensions (B x H) 80 x 300 mm, 300 x 300 mm
Glass thickness 11

The description is based on the documentation of ift. Numbers and names of material are given by the customer. (Further data from customer are marked with *).

1.2 Representation of test specimen

The illustration was produced by the ift as a schematic representation of the cross section.

Fig. 1 Representation
2 Procedure

2.1 Sampling

The samples were selected by the client.

Quantity: 3
Delivered: 16 April 2007 by the client
Registration No.: 21783

The spectral data of the coated single pane (coating arcon N33 and arcon sunbelt platin, company Arcon, thickness 4 mm) was taken from the IFT certificate 697 7032482. The coating of the single pane arcon N 33 has been extrapolated from 4 mm to 6 mm substrate according to EN 410, Annex A.

2.2 Process

Technical basis
EN 410 : 1998-04 Glass in building – Determination of luminous and solar characteristics of glazing

Deviations
There are the following deviations from the test procedure and/or test conditions:
Due to the light dispersion (LC-Glass), additional measurements according to DIN 5036 have been made with a 1.25 integration sphere.
Uncoated pane
Laminated glass of the client

2.3 Test equipment

IR-Spectrometer Equipment No 22133
Type Shimadzu UV-3102PC with LISR-3100, Integration sphere Ø150 mm
Measured range 190 nm to 2500 nm
Resolution variable, 2 nm was selected
Climatic conditions approx 20 °C, 50 % RH
Reflection standard calibrated reflection standard, company Labsphere; aluminium mirror
Averaging average of three samples

2.4 Testing

Date/Period 31 May - 31 August 2007
Testing personnel F. Böck
3 Detailed results

<table>
<thead>
<tr>
<th>Coating</th>
<th>arcon N33</th>
<th>arcon sunbelt platin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>opaque</td>
<td>transparent</td>
</tr>
<tr>
<td></td>
<td>opaque</td>
<td>transparent</td>
</tr>
<tr>
<td>$U_L^{\text{1,1}}$ in W/(m²K)</td>
<td>$U_L$</td>
<td>1.3</td>
</tr>
<tr>
<td>Ultraviolet transmittance</td>
<td>$\tau_{\text{UV}}$</td>
<td>0.06</td>
</tr>
<tr>
<td>Light transmittance</td>
<td>$\tau_L$</td>
<td>0.58</td>
</tr>
<tr>
<td>Light reflectance (external)</td>
<td>$\rho_L$</td>
<td>0.21</td>
</tr>
<tr>
<td>Solar transmittance</td>
<td>$\tau_D$</td>
<td>0.38</td>
</tr>
<tr>
<td>Solar reflectance (external)</td>
<td>$\rho_D$</td>
<td>0.29</td>
</tr>
<tr>
<td>Secondary internal heat transfer factor</td>
<td>$q_i$</td>
<td>0.11</td>
</tr>
<tr>
<td>Total solar energy transmittance</td>
<td>$\kappa$</td>
<td>0.49</td>
</tr>
<tr>
<td>(e = $\tau_D + q_i$)</td>
<td>$b$</td>
<td>0.61</td>
</tr>
</tbody>
</table>

1 $U_L$ according to calculation DIN EN 673
2 Shading coefficient (b-Factor) $b = g/0.8$ according to VDI Guideline 2078
3 Coating on surface 2

ift Rosenheim
Test results A02/09

Product/Sample: Laminated Glas – L.C SmartGlass™ ca. 8.8 mm Glass thickness

Task: Check on chemical resistance acc. DIN EN ISO 12543-4

Results/Tests

Glass No 1-3: Humidity test with condensation CH (KK)-Test +/- 50 °C
after 336 hours: OK no attack in the laminate, slight change of colour.
(circular slightly infiltrated humidity)
Spots on the glass surface

Glass No 2

Glass No 1-2: High temperature Test (Boiltest) (2 sample because we needed
1 reference sample
After 2 hours: OK no attack in the laminate, slightly change of colour

Notice: 1 Reference sample

Conclusion: Test results okay. No attack / no failure, only slight change of colour.

See E-Mail Kevin Root 16.02.2009
The samples have passed all the tests. The discolouration is acceptable.
**LC SmartGlass is certified IPX7 rated and** tested in accordance with BS EN 60529:1992.

Please contact us or see [http://www.smartglassinternational.com/downloads/IPX7_Certificate.pdf](http://www.smartglassinternational.com/downloads/IPX7_Certificate.pdf)

**HAZE**

It should be noted that LC SmartGlass is *not* optically as clear as normal float glass. A haze in the form of clouding in the glass is considered normal and is unavoidable due to the nature of the product makeup. It should also be noted that ambient lighting conditions will have an effect on haze levels; direct lighting onto LC SmartGlass should be avoided. Every precaution has been taken to ensure minimum haze. Tinted glass can be used to reduce the visible haze such as blue, green or grey tints. It is essential that the end client understands that *a degree of haze will be present depending on configuration and will not be considered as a reason for exchange or refund.*

**GLASS**

1. Where used, all tempered glass complies with BS6206A.
2. Will be provided in the type and thickness shown on the project drawings or specified to the client.
3. Where glass type is not shown on the drawings or as specified, type and thickness will be supplied as directed by the Architect, main contractor or designer.
4. Where applicable LC SmartGlass™ panel will receive a permanently etched safety certification label unless specifically directed by the Architect.
5. Each SmartGlass panel will contain an identifying label.
6. Float glass-clear: Type 1, Class 1.
7. Fire Rated glass: Borosilicate, BS 476: Part 22 (Subject to conditions).
8. Laminated Safety Glass
9. Specialist glass can be requested for use in specific applications.
GLAZING GUIDELINES

Interior Butt Joint Glazing

SmartGlass™ panels can be butt glazed using a recommended minimum of 9 mm in glass thickness. Long edges will be polished giving an even vertical finish. Panel thickness will vary depending on several conditions including the height and span of the glazed area. We will recommend the ideal glass thickness to protect against bowing and to provide safety, fitness for purpose and adherence with legislative guidelines.

A standard neutral cure structural silicone sealant may be used to close the joint as specified by us. A minimum of a 4 mm separation between panels is recommended. Alternatively a plastic "H" section will be used instead of silicone to dry join panels.

Refer to applicable local building guides for design load requirements regarding interior glazing. Safety and suitability for purpose will be treated as the main driving factors in assessing suitability for butt joint glazing. Note: Not all internal applications will be suitable for butt joint glazing and support framing may be required.

Operable Doors & Windows

Swing door & windows can be glazed with SmartGlass.

Cable connectors will be used to protect wires travelling between the door and frame where the wiring is then connected to the transformer/ power conditioner. Contact switches can also be used.
INSTALLATION

Clients and their installers should inspect each piece of SmartGlass immediately prior to start of installation.

Do not install items which are improperly sized, have damaged edges, or are scratched, abraded, or deficient in any other manner.

Do not remove labels where provided by SmartGlass International until so directed by the Architect, client or site manager.

Adhere to all LC SmartGlass™ installation instructions and installation drawings.

Locate setting blocks of standard width and thickness at quarter points of all glass panels unless otherwise recommended by manufacturer or supplier.

Use setting blocks of proper durometer, size and thickness to support the glass in accordance with the manufacturers’ recommendations.

Glass lap and edge clearances must be provided according to relevant standards of the manufacturers.

If the installer has any questions or concerns, please immediately contact your local SmartGlass representative.

SURFACE CONDITIONS

Examine the areas and conditions under which work of this section will be performed. Correct and make good conditions detrimental to timely and proper completion of this work. Do not proceed until unsatisfactory conditions are corrected. After preparation of the glazing system the glazing channels, stops and gaskets should be cleaned to receive the SmartGlass materials, making free from obstructions and substances which might impair the work at hand. Comply with manufacturers’ instructions for final wiping of surfaces immediately prior to application of primer and glazing compounds or tapes.

USE ONLY RECOMMENDED NEUTRAL CURE SILICONES. DO NOT USE ACETIC SILICONES.

Install glass in a manner which produces the greatest possible degree of uniformity of appearance.

Do not install glass in dynamic frames such as operable windows or sliding doors, without the consent of SmartGlass International Ltd.

Glazing to exterior and wet interior conditions must be wet-sealed and impervious to moisture with provisions to allow for weeping of condensation that may infiltrate of condensation in the system. Electrical connections must exit at the head of any framing system using SmartGlass panels in wet environment applications.

Pressure glazing systems without positive positioning stops are not to be used with SmartGlass.

The glazier should place all electrical connections & wires properly to allow easy access by an electrician.

Cut and seal joints of glazing gaskets in accordance with the manufacturers’ recommendations to provide watertight and airtight seal at corners and other locations where joints are required.
GLAZING METHODS

Wet Glazing: If an elastomeric (non-acetic) sealant is used, it must be compatible with the SmartGlass panel interlayer. Never use putty or glazing compound to glaze SmartGlass.

Exterior Applications - Insulated Glass Units made with SmartGlass can be installed as per normal glazing with the exception of accommodating the unit wiring. SmartGlass is suitable for glazing to steel, timber, aluminium and UPVC framing systems.

Wet Glazing: Pre-shimmed glazing tape and non-acetic sealants are required to create a seal impervious to moisture for all exterior applications.

Butt-Joint Glazing: SmartGlass panels can be butt-joint glazed in interior applications (Long edges polished recommended).

Non-Acetic Sealants
The following sealants are listed as non-acetic by their manufactures. Confirm with these manufactures the compatibility of their respective sealants with regard to butt-joint glazed SmartGlass panels.
GE 1200, Dow Corning 799, Rhodorsi 3B (Rhone-Poulenc), Dow Corning 982, Proglaze (Tremco).

Structural Silicone Glazing: Insulated glass units manufactured with SmartGlass should not be structurally silicone glazed unless agreed in advance by SmartGlass International.

FRAME DESIGN

Frame edge clearance and face clearances may be used, except the edge bite must be 10 mm minimum and framing must include a hole of 6 mm diameter to pass wires through. To maintain a proper seal against the infiltration of water and air adequate bite and sealing is required.

Inadequate clearance for the edges can cause damage due to glass-to-metal contact. Minimum edge clearances should allow for a tolerance of ±1.5mm. This should only be increased if the surrounding materials tolerances are difficult or impossible to control.

The industry standard for framing deflection must be adhered to. The deflection must not exceed either the length of the span divided by 175, or 18 mm, whichever is less. All expansion joints and anchors must be designed so that the glass framing does not incur a load due to structural movement.

Glass larger than .66 square meters should be placed on four EPDM or neoprene setting blocks. These blocks should have a durometer hardness of 85±5. They should be centred at the bottom quarter points (i.e. equal distance). The blocks should be 1.5 mm narrower than the channel width. Lock-strip gasket systems also require setting blocks. Recommendations can be obtained from the gasket manufacturers.

Once the SmartGlass is installed, the architect, general contractor, or building owner should provide for glass protection and cleaning. Weathering steel such as Cor-Ten or alkaline materials may cause surface damage due to staining. Abrasive cleaners should never be used, particularly when the surface to be cleaned has a reflective coating. Windblown objects, welding sparks, plaster, or other material applied to the glass surface during construction may cause irreversible damage.
SmartGlass International Ltd will not be held liable for damage caused by others; the main contractor is responsible for protection of glass on site following delivery & installation.
PLEASE SEE ILLUSTRATIONS BELOW FOR TYPICAL GLAZING SYSTEMS USED

SmartGlass Door System

Not to Scale
SmartGlass Fixed System with Dry Joints

Not to Scale

SmartGlass Fixed System with Dry Joints (No Frame)

Not to Scale
SmartGlass Frame in Wet Area

SmartGlass Single Fixed Panel (No Frame)
SHIPPING AND RECEIVING

SHIPPING

Where applicable we manufacture shipping crates for all individual customer orders. These crates allow for protection of glass in transit but correct handling methods should be observed when off loading. Note: It is the responsibility of the client to off load glass deliveries unless otherwise agreed prior to dispatch.

If no preferred carrier is specified, the SmartGlass panels for domestic customers will be shipped through our ground carriers. For overseas customers, specifying whether the freight should be shipped via Air or Sea is necessary. Where available, it is recommended to have the clients own agent to take care of the shipping and customs clearance issues. We can do so, at additional cost.

Due to the difficulty in estimating the accurate weight and dimensions of the crate at the time of giving a quotation, the panels will be shipped Freight Collect with the full value insured. Alternatively an estimate will be provided and confirmed prior to despatch.
**RECEIVING**

Before signing for and accepting the shipment from the carrier, inspect the crate(s) for the following items:

a. Inspect crate(s) for visible damage.

b. Check Tip 'N Tell indicator where used.

If damage to any of the panel(s) is found, the shipping documents should be so noted and the driver's signature obtained as a witness. You should inform SmartGlass International immediately of any damaged panels. Photographs should be furnished within 24 hours. A freight claim should be filed to the carrier as early as possible. **If you fail to inspect the shipment, the carrier and SmartGlass International Ltd. are not responsible for damage.**

**UNCRATING**

Keep the crate upright at all times until removing the cover. **When removing cover the crate should be tilted, leaning at 5° - 7° from vertical away from the “opening” side.** To avoid possible damage to the panels open the side indicated with “open side” first. The crate will be clearly marked with the side which should be opened. All central and perimeter edge blocking should be carefully loosened and removed so that the SmartGlass panels don't have to be pried out of the crate. **Remove the panels carefully, one at a time, using the appropriate lifting methods.**

**Warning:** Loose connection wires from LC SmartGlass panels are not to be used for lifting, moving or positioning the LC SmartGlass™ panels.

**STORAGE**

Glass edges frequently sustain damage due to careless handling at some point between manufacture and installation, **Handle with care.** If the SmartGlass is to be stored on the job site or in warehouse conditions, proper blocking and protection should be maintained at all times. As with other flat glass products, the SmartGlass panels must be stored where the relative humidity is less than 80% to prevent the SmartGlass from staining. The SmartGlass temperature should be held nearly constant to prevent moisture condensation on the panels. Storage temperature range is -20 +50 °C (-4° +122°F). The crate should be kept in an upright position or tilted at 5° - 7° from vertical at all times using broad, sturdy uprights to support the weight of the crate. Alternatively the SmartGlass should be stored on a glass “A” frame in a position free from obstruction, traffic and danger.

**Note:** SmartGlass panels can be heavy at approximately 27.5 kg/m2. Please be careful and take the weight loads into account when moving and storing.
UNEXPECTED BREAKAGE

"Unexplained" glass breakage may occur after all precautions have been taken. Such breakage is beyond the control of the manufacturer and therefore not warrantable. This includes but is not limited to the following items:

- Thermal stress
- Glazing system pressures
- Damage during glazing by others
- Handling and storage problems
- Excessive wind loads
- Objects and debris striking the glass
- Damage by persons/objects at the construction site

WARRANTIES

SmartGlass International Ltd. warrants that the physically tangible hardware products delivered should be free from defects in materials and workmanship, assuming normal use, for a period of five years from the date of invoice unless otherwise specified. SmartGlass International Ltd's sole obligation and clients sole remedy in the event of breach of warranty is to repair or replace the defective products. The distributor/customer should promptly notify SmartGlass International Ltd of any defect in products delivered there under, and upon obtaining a return authorisation should ship the defective goods to SmartGlass International Ltd for analysis unless otherwise agreed. SmartGlass International Ltd will bear the expense to repair or replace the products supplied but will not accept any costs incurred by others which are associated with, access, removal or replacement / installation of the goods. SmartGlass International Ltd is not responsible for products damaged by external events such as, but not limited to catastrophe, incorrect silicone use, improper use, or maintenance or use of unauthorised parts.

The installer shall warrant for five years the satisfactory performance of the window or partition installation which includes window, framing, glass glazing, anchorage, and electrical work as detailed by the specifications and approved drawings.
ELECTRICAL INSTALLATION

SUPPLIES NEEDED

Installation of SmartGlass panels require the following items:

A 15 AMP (minimum) ground fault interrupter circuit breaker with 230VAC 50/60Hz electricity (Fused Spur).

A wall mounted switch, 230VAC 50/60 Hz (installer/owner supplied). This switch is required to allow the SmartGlass panels to be turned ON/OFF. Alternatively a radio remote control switch can be specified.

SmartGlass power transformer. SmartGlass panels may be connected in parallel up to 15 square meters total area per single power conditioner/transformer. Bespoke electronic controllers can be used including “smart” systems such as Creston and ABX controllers.

POWER TRANSFORMER / CONDITIONER DETAIL

Short circuit proof encapsulated auto wound transformers for step up or step down of mains voltage at 50/60Hz. Transformers tested to EN 61558, VDE 0570.

WARNING: The transformer should be installed by the electrical contractor in an easily accessible area in order to replace fuse in the event of damage.

Specification:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>VA Rating (Continuous)</td>
<td>390</td>
</tr>
<tr>
<td>Input Voltage</td>
<td>220; 230; 240; 115V (ac)</td>
</tr>
<tr>
<td>Output Current</td>
<td>1.6 A</td>
</tr>
<tr>
<td>Dimensions (L<em>W</em>H mm)</td>
<td>166mm * 77mm * 76mm</td>
</tr>
<tr>
<td>Fixing Centres</td>
<td>135 mm * 58 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>2.1 kg</td>
</tr>
</tbody>
</table>

Encapsulated in plastic housing up to 5A
Easy installation-mounting holes provided
Housed in metal enclosures from 10A
Easy connection- screw terminals
Strain relief for connecting leads
Thermal overload protection
Integrated fuse protection
CE Rated
WIRING

SmartGlass International requires all electrical installations be completed by a licensed electrician, and in compliance with all local legislative requirements.

Before installation, inspect bus bars, electrode leads and wires to assure insulation. No exposed bus bars, electrode leads, or wires should contact any metal frames that will damage transformer and SmartGlass.

Multiple SmartGlass panels should be connected in parallel with the transformer. Insure that the transformer "in" connects to 230V AC and "out" connects to SmartGlass panel. The output voltage is approximately 110 V AC.

Before turning on the power, test resistance reading between the metal frame and electrode and make sure that the resistance reading is infinite. Otherwise, check short location and insulate electrodes from metal frames.

SmartGlass uses approximately 5 watts per square meter in the "on" (clear) state. No electricity is consumed in the "off" (opaque) state. SmartGlass can be controlled with either a single or multiple switches or by radio remote controller.

NOTE: It is vital for correct operation that the switch/remote receiver is positioned on the mains voltage before the transformer/power conditioner. Failure to correctly install the switching mechanism may cause irreparable damage to the LC SmartGlass.

Use care when opening the power transformer and allow a few minutes to cool down. Internal electronic parts may be very hot, this is normal. Only open the power transformer in the areas noted safe for opening, never open the sealed body of the power transformer.

Warning: Do not substitute a higher fuse rating! Fuse rating is critical to properly protect SmartGlass panels. A spare fuse is included on the inside cover of the power transformer supplied.
REMOTE CONTROLS - STANDARD

RFS RADIO RECEIVER SWITCH – 86*86*22MM – CAN BE MOUNTED OUT OF SIGHT

H1RF REMOTE SENDER 1 CHANNEL – 100*61*21mm

H2RF REMOTE SENDER 2 CHANNEL – 86*46*16mm

W1RF REMOTE WALL SENDER 1 CHANNEL – 80*80*15mm
MAINTENANCE

Maintenance is generally as simple as keeping the SmartGlass clean. Regular cleaning with neutral materials is recommended for optimum performance. In external windows soapy warm water performs best. Soft coated glass should be cleaned very carefully following the manufacturers own instructions. Use professional glass cleaner or a reputable cleaner.

Annual checks: The client should check that all wiring is in good condition, framing materials are free of any damage and that the transformer and switch are in good visible order. The areas adjoining the SmartGlass including walls, ceilings and floors should be checked for structural integrity, excess humidity and temperature. Should any of these items appear unusual the client should immediately notify the original supplier / installer / contractor or SmartGlass International.

TROUBLE SHOOTING

LC SmartGlass operates at 110 V AC and 50/60 Hz. Higher voltages and frequency may cause permanent damage.

Electrical service must be performed by a qualified electrician who has read and understood this document.

Switch the power ON. Verify that the SmartGlass panel switches. If one or more SmartGlass panels are not operating, check the following

1. Check the circuit breaker to verify power. If there is not power from the circuit breaker, reset or replace the circuit breaker.

2. Visually check the condition of all wiring and that connections have not been broken.

3. Check the switch to verify power. If there is no power from the wall switch check the connection or replace the switch.

4. Check input to the power transformer of affected panels to verify power. If there is not input power to the power transformer, check the wiring between the wall switch and the power transformer for damage and continuous current flow.

5. Check output from the power transformer of affected panels to verify power. If there is no output power from the transformer, the fuse may have blown. Replace fuse with the same size and specifications which is available at electronic supply shops such as RS. Each transformer contains a spare fuse inside the protective cover.

If in any doubt, please contact us to resolve your issue.
## CLIENTS

(Selection)

<table>
<thead>
<tr>
<th>End User</th>
<th>Application</th>
<th>Architected/Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Royal Institution of Great Britain</td>
<td>Unveiling ceremony plaque</td>
<td>RI</td>
</tr>
<tr>
<td>Guinness Storehouse Dublin</td>
<td>Visitors Centre bespoke displays and windows</td>
<td>Event Communications</td>
</tr>
<tr>
<td>European Space Agency</td>
<td>Viewing rooms</td>
<td>ESA</td>
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<tr>
<td>Rolls Royce Marine</td>
<td>Company restaurant screens</td>
<td>Smek</td>
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<tr>
<td>Brinks Global</td>
<td>Security windows</td>
<td>Berrys Design &amp; Build</td>
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<tr>
<td>Blackrock Clinic</td>
<td>Hospital Consultancy Room Screens</td>
<td>RKD</td>
</tr>
<tr>
<td>Central Bank of Ireland</td>
<td>Governors Suite and Meeting Rooms</td>
<td>OPW</td>
</tr>
<tr>
<td>Chevron Texaco UK HQ</td>
<td>Partition Systems board &amp; Meeting rooms</td>
<td>Planet</td>
</tr>
<tr>
<td>Collins Barracks Military Museum</td>
<td>Feature display window</td>
<td>OPW</td>
</tr>
<tr>
<td>Wellington Street Jazz Cafe</td>
<td>Toilet cubicle doors</td>
<td>OPW</td>
</tr>
<tr>
<td>Coughlan House</td>
<td>Wine cellar / Bathroom screens</td>
<td>Scott Tallon Walker</td>
</tr>
<tr>
<td>Crosby Lend Lease</td>
<td>Boardrooms</td>
<td>Synetic Group</td>
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<tr>
<td>Eco House</td>
<td>Solar control external windows</td>
<td>Duncan Stewart</td>
</tr>
<tr>
<td>Emirates Airlines</td>
<td>Chief executive office partition Dubai</td>
<td>Al Reyami</td>
</tr>
<tr>
<td>Galway Clinic</td>
<td>Chapel/prayer room divider</td>
<td>CCH</td>
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<tr>
<td>GJ Maloney Solicitors</td>
<td>Boardroom glass wall</td>
<td>PJ Hegarty</td>
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<tr>
<td>Manor House UK</td>
<td>Solar control roof light</td>
<td>Client</td>
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<tr>
<td>McNamara Building Contractors</td>
<td>Marketing suite glass walls</td>
<td>Skelly</td>
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<td>Montreal Museum of Modern Arts</td>
<td>Feature display window</td>
<td>Client</td>
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<tr>
<td>Nissan UK</td>
<td>Micra CC Launch, 140 panel display</td>
<td>Cunning UK/Nissan</td>
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<tr>
<td>Optica Opticians</td>
<td>Optical testing rooms</td>
<td>Graham</td>
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<tr>
<td>Royal College of Physicians</td>
<td>Privacy Doors</td>
<td>Scott Tallon Walker</td>
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<td>Saudi Arabia National Guard</td>
<td>Communications centre control suites</td>
<td>J&amp;P Intl</td>
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<td>SBS UK</td>
<td>Interview Rooms</td>
<td>Space Glaze UK</td>
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<td>Shapland UK</td>
<td>Hospital Privacy doors</td>
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<tr>
<td>Stonecutter Court London</td>
<td>Conference Rooms</td>
<td>Planet</td>
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<td>Old Jameson Distillery</td>
<td>Feature display / projection screen</td>
<td>AVS</td>
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<td>Pictet</td>
<td>Boardroom partition walls</td>
<td>Spartan Designs</td>
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<td>C&amp;C HQ</td>
<td>Office partition walls</td>
<td>Ardmac</td>
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<td>Zeus</td>
<td>Office partition wall and Door</td>
<td>Client</td>
</tr>
<tr>
<td>Damico Tankers</td>
<td>Offices, meeting rooms and boardroom</td>
<td>BS Ryan</td>
</tr>
<tr>
<td>Topside Group</td>
<td>Home of Manchester United footballer</td>
<td>Client</td>
</tr>
<tr>
<td>AAJ Sankey Set Construction</td>
<td>TV show set</td>
<td>Client</td>
</tr>
<tr>
<td>Ruddy Joinery</td>
<td>Apartment screens</td>
<td>Client</td>
</tr>
<tr>
<td>Four seasons hotel</td>
<td>Room dividers</td>
<td>Client</td>
</tr>
<tr>
<td>Trinity Yachts</td>
<td>Yacht internal screens</td>
<td>Client</td>
</tr>
<tr>
<td>Goldbach Kirchener</td>
<td>Bank boardroom</td>
<td>Schott</td>
</tr>
<tr>
<td>Renfrew Group</td>
<td>NHS Innovation centre screens</td>
<td>NHS</td>
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</tbody>
</table>
TESTIMONIALS (Selection)

“Dear Bob, On behalf of the Royal Institution, I am writing to thank SmartGlass International for supporting our Grand Launch. It was a truly special day, made even more memorable by the unique unveiling ceremony. Many thanks for donating the smart glass plaque and for all your help with the installation and testing that made it possible. I’m sure you’ll agree it was very fitting for the RI – the home of science and technology – to launch our new era using such innovative technology as SmartGlass. As a small token of our appreciation, I enclose a copy of the commemorative book from the launch, which was presented to HM when she officially opened the new RI.”
Baroness Susan Greenfield - Director

“Alan, we are now well and truly settled in our new home, and I would just like to say that the Smartglass you supplied for the panels in our inner porch, are absolutely fantastic. They serve the purpose so well, and are the most talked about gadget in the house. Our Architect has sent numerous clients of his around to look at the house he designed, and some of these have shown particular interest in the Smartglass. Let’s hope you get more business from up here in Cumbria. Thanks once again, for all the help and attention we received from your company. Regards” Hazel Mason

“Dear Frank, I would like to express my gratitude to your team at SmartGlass International for the excellent service that you provided. Our client is delighted with the SmartGlass installation which is the most talked about area of their new offices. I look forward to working with SmartGlass International again in the future.” Deirdre Boland

“Just to let you know we fitted your SmartGlass last week and the MD of xxxxx Services thinks it’s marvellous and now he can’t wait to show it off to the President of xxxxx World Wide” - Tony Berry – Managing Director Berry’s Design & Build

“The SmartGlass is a ‘wow’ factor for visitors and should help us materially improve business this year. It is used in a very prominent area and is a real talking point. To be honest it is also extremely practical. It is great to have it on most of the time to give the view and light and then frost it up for private meetings.” - Gerald Maloney - Managing Partner GJ Maloney Solicitors

“The SmartGlass really is amazing! We will use this room all of the time now that we can do so in private when required.” F O’Callaghan
PROJECT PICTURES

Elm Park Marketing Suite
Manor House, Roof-light
Meeting room, Bank HQ. Courtesy SCHOTT Glass & Golbach Kirchner Germany
1. **Price** - All quotations are subject to confirmation in writing by the Company on receipt of the order and deposit from the Purchaser.

2. **Delivery** - Time of delivery shall not be the essence of the contract, nor shall the Purchaser have the right to make it such. Whilst every endeavour will be made to adhere to any quoted or agreed delivery date or programme, the Company shall in no circumstances be liable for any costs due to delay in delivery, whether due to shortages of material, labour or any other cause whatsoever.

3. **Payments** - Shall be made at the time specified. The amount of the order value to be paid will be that specified in the face of the contract or calculated in accordance with the formula therein. The amount shall not be subject to any discount or set off whatsoever except with prior agreement in writing by the Company. Payments not received within 30 days from date of invoice will be subject to the additional charges as set out in the European Communities “Late payment in commercial actions” regulations 2002.

4. In the case of goods exported, or sent by independent freight carrier whether arranged by the Company, or others, the Purchaser agrees to comply in all respects, with the freight carrier’s conditions of carriage for notification of claims, loss or damage in transit.

5. **Insurance** - It is the responsibility of the Purchaser to insure goods in transit and to pay any costs to the Company for arranging such insurance.

6. **Certificate of Conformity** - The Company shall not supply certificates of conformity unless requested at the time of placing the order. The company reserves the right to charge a fee for any certification supplied.

7. **Retention of Title**

   (1) The goods shall be at the Purchasers risk from the time of delivery or collection.

   (2) In spite of delivery being made, property in the goods shall not pass from the Company to the Purchaser until the full contract value has been paid the full, inclusive of vat where applicable.

   (3) Until property in the goods passes to the Purchaser in accordance with clause (2) the Purchaser shall hold the goods and each of them on a fiduciary basis as bailee for the company.

   (4) Until such time as property in the goods passes from the Company, the Purchaser shall, upon request, deliver up such of the goods as have not ceased to be in existence or resold, to the Company. If the Purchaser fails to do so, the Company may enter upon any premises owned, occupied or controlled by the Purchaser, where the goods are situated, and repossess the goods.

   (5) The purchaser shall promptly deliver the prescribed particulars of this contract to the Registrar in accordance with the companies act. Without prejudice to the other rights of the Company, if the Purchaser fails to do so all sums whatever owing to the Purchaser the Company shall forthwith become due and payable.

8. **Jurisdiction** - The Purchaser accepts that any claim in respect of this or any contract, claim or action with the Company, shall be governed by the jurisdiction of the Irish and English Courts.

9. The Purchaser agrees that these conditions of sale shall bind any subsequent orders and business with the Company unless expressly excluded or varied in writing by the Company.

10. No liability will be accepted by the Company for damage to free issue glass or other materials supplied by the customer for manufacture & lamination by SmartGlass International.

11. SmartGlass will be sold of merchantable quality, fit for purpose and as described. Caveat emptor, the purchaser is responsible for ensuring that the goods they are purchasing are the goods that they expect to receive. It should be noted that there will always be an element of haze within the SmartGlass. This will not be considered or constitute reason for return or refund.

12. If for any reason the materials supplied develop a fault within the warranty period which is considered to be due to bad workmanship or material faults, Smartglass international Limited will repair or replace at their discretion, such items to the original supply specification. Smartglass International will not be held responsible or accept any costs incurred by others which are associated with access, removal or replacement of the goods.

13. The SmartGlass Handbook which is available upon request from our offices or available for viewing and download from our web-site (www.smartglassinternational.com) and should always be reviewed by the customer for specific instructions on the products.