

General Description

- ▶ Shielded windows consist of one or more window layers with a conductive intermediate layer. Applicable for all visual display systems, e.g. in meters and monitors.
- ▶ Due to the various possibilities our standard is custom-made production. The window should be selected according to following criteria:
 1. window material
 2. color of material
 3. dimensions
 4. anti-reflectivity
 5. intermediate layers
 6. construction
 7. gasket type
 8. frame finish
- ▶ Shielded windows are generally used for all kind of electric displays, e.g. LCD, LED, plasma and EL displays, etc.

Orientation

- ▶ 90° - 45° - 30° - 15°

Tolerances

1. Outer dimensions

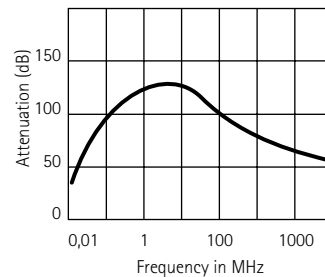
- | | | | |
|---|--------------|--------------|----------------|
| ▶ | | Glass | Acrylic |
| | up to 600 mm | ± 0,5 | ± 0,2 |
| | > 600 mm | ± 2,0 | - |

2. Material thickness (per material sheet)

- | | | | |
|---|------------|--------------|----------------|
| ▶ | | Glass | Acrylic |
| | up to 4 mm | ± 0,2 | ± 0,3 |
| | > 4 mm | ± 0,4 | ± 0,5 |

Shielding Test Data

- ▶ Measured on shielded window 300 x 300 mm.
- ▶ Mesh: Blackened silver plated stainless steel 100 opi.



Window Material

- ▶ Glass, plexiglass (acryl), makrolon (polycarbonate) and PVC can be selected.
- ▶ Besides the use of two layers of the same material, following combinations are possible:
 - glass - PVC
 - glass - polycarbonate
 - glass - acryl
- ▶ For further details see also construction table

Color

- ▶ Base color of all materials is transparent/clear. However, for some applications it may be more advantageous to color the material yellow, green, red or amber.
- ▶ The base material for acrylic windows is colored whereas for glass windows the adhesive foil between the panes is colored.
- ▶ Please consider that with colored materials the light transmission will be affected.

Dimensions

- ▶ Outer dimensions: There is no standard outer dimension, all windows are custom-made.
- ▶ Material thickness: The material thickness for glass starts from 0,8 - 1,2 mm, for acrylic from 0,8 mm and for polycarbonate from 1,5 mm. The variety of available material thicknesses helps to meet almost all customer requirements. For a final glass-glass window the shielding mesh and the adhesive add 0,8 mm when laminated together.
- ▶ For further details see also construction table.

Anti Reflectivity

- ▶ All materials can be supplied with anti reflective surface to avoid glaring and to enhance contrast. Different proceedings can be used.

Anti reflectivity for glass:

- ▶ Multi layer coating per MIL SPEC 675 B (less than 0,6 % remaining reflection)
- ▶ Single layer coating per DIN 58197 (less than 1,5 % remaining reflection)
- ▶ Chemical etching:

5 % reflection	(R11G or GW 80)
9 % reflection	(R19G or GW 100)
13 % reflection	(R27G or GW 120)

Anti reflectivity for plastics

- ▶ Chemical etching is the standard procedure for a good anti reflectivity with plastics which comes out very strong.
- ▶ A special coating, giving a scratch resistance in addition to anti reflectivity, can influence the intensity of reflectivity.

Intermediate Layers

- ▶ The intermediate layer for EMI/RFI shielding is a woven microstructure mesh. Mesh materials are copper, stainless steel or silver plated stainless steel.
- ▶ The mesh can be blackened so as to enhance contrast on the display. This does not affect the shielding performance. To avoid interferences between mesh grid pattern and monitor or display ("Moiré fringes") simply change the orientation of the mesh by turning it a little. The number of openings per inch (opi) determine the shielding effectiveness, but also the light transmission.
- ▶ In applications with a very high resolution display which does not allow the use of a mesh, a highly conductive, transparent foil can be laminated onto the glass or it can be equipped with a conductive ITO coating.
- ▶ Note: The mesh is also available as individual part for other applications.

Selection of mesh and its shielding performance

Mesh	Surface	Open. per inch	Wire ø	E-field				P-field		Max. size available	Open area %
				1 MHz	10 MHz	100 MHz	400 MHz	1 GHz	10 GHz		
Copper	blackened	70	0,07	110	111	98	68	64	38	1200 x 1000 mm	65
Copper	blackened	100	0,05	107	111	85	70	58	-	1200 x 1000 mm	64
Stainless steel	bright	100	0,025	110	105	88	76	62	-	1200 x 1000 mm	81
Silver plated stainless steel	blackened	100	0,025	128	112	92	86	80	74	700 x 700 mm	81
Silver plated stainless steel	blackened	165	0,05	130	124	106	100	81	61	700 x 700 mm	46
Silver plated stainless steel	blackened	200	0,025	128	108	98	88	86	68	700 x 700 mm	64

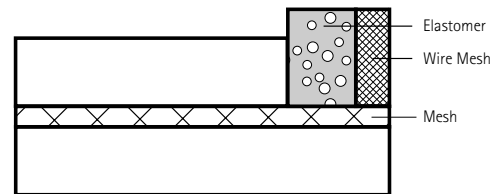
Selection of Conductive Coatings

- ▶ ITO coating (Indium-Tin-Oxide) from 100 Ω to 5 Ω/square. Substrate size on request.
- ▶ Gold coating down to 5 Ω/square
- ▶ It is recommended to have an additional protective coating over the conductive coating when glass is used. This gives a protection for the metalized surface and at the same time provides anti reflectivity.

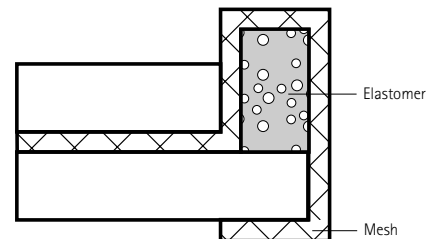
Construction

- ▶ Depending on the application the window consists of a carrier with a laminated mesh on the rear or the mesh is laminated between two carriers (the window).
- ▶ The mesh overlaps the carrier to serve as contact area for the gasket or installation.
- ▶ Plastic will be laminated either with adhesives or with high temperatures.
- ▶ Glass will be laminated in vacuum with double sided adhesive foils. Please note that a fully laminated glass window using a PVB interlayer (PVB = Polyvinyl Butyral) as adhesive cannot be cleaned with solvents, because the solvent will damage the PVB interlayer.

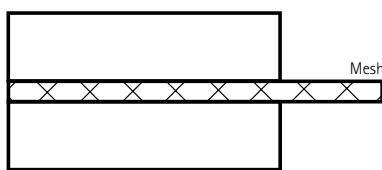
Schematic illustration



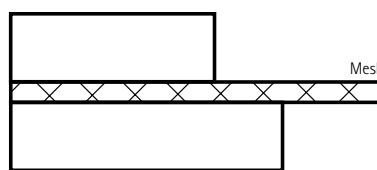
Step construction with RF-gasket



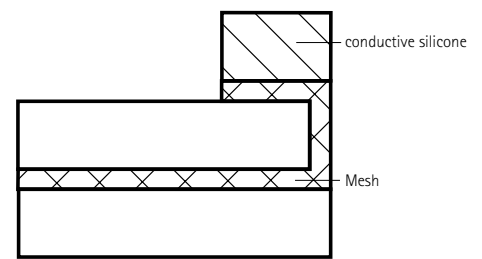
Step construction with mesh over elastomer core



plain ending



Step construction



Plain end with conductive silicone gasket

Table construction

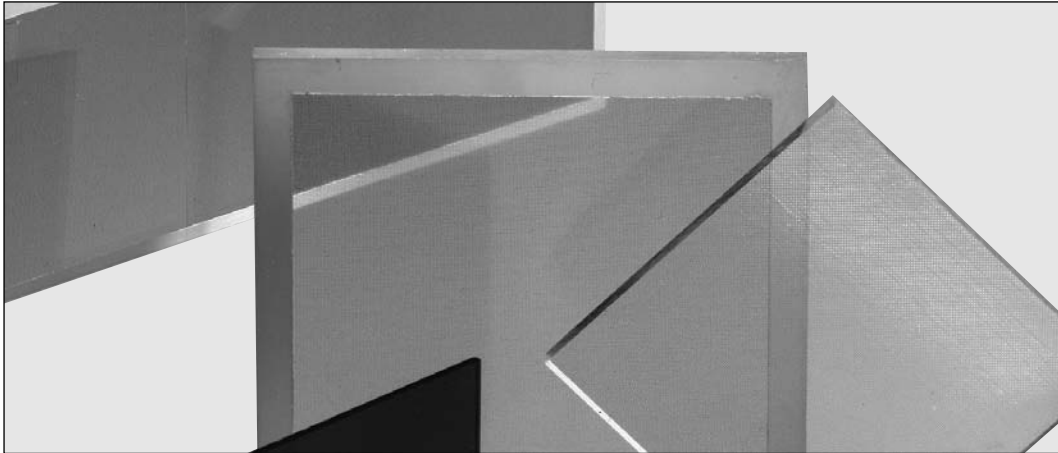
Laminate	Total material thickness		Temp. range °C	Construction	Form	Conductive medium		Filter	Anti-reflectivity	
	min.	max.				Mesh	Conductive coating		Refraction of light	Anti-reflection
Glass/ glass	2,4	on request	- 55 + 75	plain end. stepconstr.	flat, curved	see mesh selection	> 4 Ω /square	grey, green, red, orange	chem. etching	Multi layer
Glass/ poly- carbonate	3,0	on request	- 55 + 60	plain end. stepconstr.	flat, curved in 1 direction	see mesh selection	> 4 Ω /square	grey, different colours	chem. etching	Multi layer
Glass/ acrylic	2,2	on request	- 55 + 60	plain end. stepconstr.	flat, curved	see mesh selection	> 4 Ω /square	grey, green, red, orange	chem. etching	Multi layer
Glass/ polyester	1,7	on request	- 40 + 70	plain end.	flat, curved in 1 direction	see mesh selection	> 4 Ω /square	grey, green, red, orange	chem. etching	Multi layer
Poly- carbonate/ polycarbonate	3,8	on request	- 55 + 60	plain end. stepconstr.	flat, curved in 1 direction	see mesh selection	> 10 Ω /square	grey	chem. etching	-
Acrylic/ acrylic	1,3	on request	- 50 + 60	plain end. stepconstr.	flat, curved	see mesh selection	> 1000 Ω /square	different colours of acrylicglass	chem. etching	-
Polyester/ polyester	1,3	on request	- 40 + 70	plain end.	flat	see mesh selection	> 10 Ω /square	grey, green, red, orange	chem. etching	-

Gasket Type

- ▶ To achieve shielding effectiveness, a good contact between mesh and enclosure is required. The contact can either be established in a direct way or by means of a conductive gasket. When selecting the gasket you should consider the characteristics that have to be met by the finished product with regards to environmental seal (IP-protection etc.).
- ▶ For a choice of gasket and contact methods please contact our sales department.

Frame Finish

- ▶ Windows can be supplied from the factory as complete units. The finish is made according to customer specification and facilitates the assembly. The appropriate gasket is integrated in the frame to provide a good contact between mesh and enclosure.



General Description

- ▶ A micro-structure wire mesh is stretched in a mould and then cast into acrylic. Due to a special moulding technique, the wire mesh is smoothly embedded in the sheet and will therefore only cause a minimum of optical disturbances. If the shielded window is placed in front of a data display, there might occur interference phenomena followed by varying light intensities on the screen (Moiré fringes). A turn of the mesh by a few degrees may reduce these disturbances.
- ▶ Custom-made shielded windows with specific dimensions will be cut out of this sheet. Afterwards a groove will be milled all the way round the edge of the sheet in a step construction. This groove will be plated with silver (silver busbar) and provides the contact to the wire mesh. The window can then be mounted on the chassis by means of a conductive gasket or by using a conductive adhesive. Shielded windows used in front of a display should be mounted in a way that the mesh side of the window is placed as close to the LED/LCD as possible.
- ▶ New: UV-block with 390 nm excellent protection of LCDs.

Material

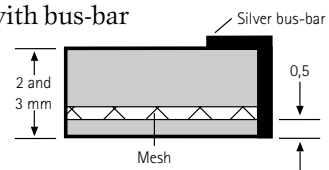
- ▶ **Type of plastic:** Cast acrylic
Max. size: 1150 x 850 mm
Thickness: 2 mm, 3 mm
Tolerances: +/- 0,2 mm
- ▶ **Mesh**
Stainless steel, 100 OPI
Surface: bright or blackened
Wire diameter: 0,025 mm
Light transmission: 81 %
- ▶ **Silver paint:** Electrodag 1415

Filter

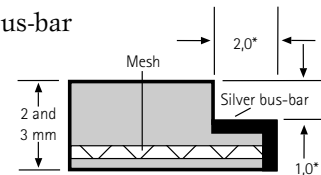
- ▶ In addition to the EMI shielding requirements, the shielded window can be used as contrast filter. More than 55 different transparent colours are available making it possible to choose a contrast filter adapted to the wave length (colour) of the signal source (display). This allows for the greatest possible light transmission while simultaneously excluding secondary light to achieve a clear and easily read signal.

Construction

- ▶ Butt edge with bus-bar



- ▶ Step with bus-bar



*Standard (other dimensions and step versions are possible)

Reflection

- ▶ Reflections from shielded windows can be eliminated by using a uniquely developed surface treatment, consisting of optical micro-particles. The surface density can be applied in 5 standard types to suit the individual product, eliminating possible glare from surroundings without luminous loss or distortion of the visual signal. This surface treatment can be applied to the complete shielded window or to selected parts of it only.

with mat.-finish	Reflection in %
A 1	64 – 65
A 2	61 – 62
A 3	58 – 59
A 4	55 – 56
A 5	49 – 50

Mechanical Properties

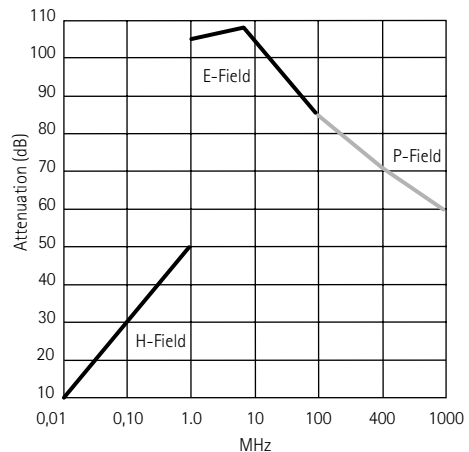
	Test	Unit	Values
Tensile strength	DIN 53455	N/mm ²	65 – 68
Compressive strength	DIN 53454	–	125
Flexural strength	DIN 53452	–	120
Impact strength	DIN 53453	kJ/m ²	12
Modulus of elasticity	DIN 53457	N/mm ²	3000
Elongation at break	DIN 53455	%	3 – 4
Hardness	DIN 53456	N/mm ²	175

Other Properties

	Test	Unit	Values
Specific gravity	DIN 53479	g/cm ³	1,18 – 1,19
Water absorption	at 20° C / 24 h	%	0,17

Shielding Performance

- ▶ Test Window:
250 x 250 mm according to modified MIL-STD 285



Thermal Properties

	Test	Unit	Val.
Heat stability – Vicat	DIN 53460	°C	110
Forming temperature	–	°C	150 – 170
Coefficient of linear thermal expansion	VDE 0304	mm/m °C	0,08
Specific heat	–	kJ/kg K	1,46

Ordering Code

- ▶ The ordering code consists of the material code, followed by a new assigned P/N (including all necessary dimensions, tolerances and process steps):

BOM-DCA-xxxx

└─ New P/N will be assigned after order is placed
└─ Material code