

# OPTICAL FILTERS

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## Our Company

Founded in 1987, Futura is located south of Milan, Italy, and can supply a wide range of optical filters for applications in electronic field. Futura can offer a high level know-how in display light, filtering of light and shielded windows for electronic instruments. Our optical filters are recognized for their outstanding optical and mechanical properties that have proven its value in a wide range of applications.

## Products and service

Futura can offer an extensive range of ColourMatching services meeting almost any customer specified colour or chromatic target.

We can offer:

- Contrast filters that are useful to provide the greatest possible degree of readability of visible light coming from display and monitors. A wide range of colour conversion and contrast enhancement filters for the choice of infinite solutions when using display colours.
- LCD filters are special filters which have a light transmittance of 100% in comparison to standard acrylic.
- Infrared filters are used in remote control units, security systems, sensors, scanners, IR cameras and other areas where there is a need to exclude visible light.
- EMC filters that are a complete range of optical filters with an embedded metal mesh for the attenuation of electromagnetic fields.
- Diffusion filters in three degrees of diffusion. The standard filters diffuse in white light, but they can also be tinted in other colours.
- Polycarbonate filters. The properties of polycarbonate make the material suitable for use in display and information boards which are extensively used in trains and aeroplanes.

On our optical filters we can apply coatings to eliminate disturbing reflections. In particular we have four different coatings:

- Standard non glare coating, a surface treatment which effectively reduces surface gloss on plastic products and at the same time eliminates disturbing reflections.
- Hard-finish coating, a UV-cured, non glare hard coating developed to protect and enhance acrylics and polycarbonates to provide effective abrasion and chemical resistance for display windows.
- AR-coating which is a multi layer metal oxide, carefully designed to allow up to 99 % of light to be transmitted through the material.
- Clartech MAT that combines protective dual-sided abrasion resistance with a non glare coating for improved daylight readability.

## Casting process

The sheets are made in float glass casts.

This casting process results in a perfect optical surface, without any distortion of the display signal. This technique enables tolerances down to +/- 0.1 mm.

## Our customers

Our everyday philosophy is to establish with our customers long relationship to allow a constant technical support during the design and the production of the final product. In this way the customer has the possibility to build up a product with the lowest cost.

Our staff can satisfy any kind of request from the sampling to mass production with efficiency and cost saving. Customer service in line with innovation and responsibility is the key to consider our customers as partners. The key components of our success are the strong long term partnership with customers world wide.

### **Quality commitment**

The constant growth of the company was also possible with a high attention to the quality of the service by the introduction of a quality system in all the company sectors, according to Vision 2000 standard. Our goal is to maintain a high quality level leading to optimizing our processes and eliminating any defects.

## CONTRAST FILTERS

Futura can supply contrast filters in many variants in two main areas:

- Selective filters for monochrome displays.
- Broad-band filters for colour display.

The contrast filters are used to improve the degree of readability of visible light from displays and monitors. This is done by adapting the contrast filter's transmittance to the wavelength of the light emitted from the display, so that secondary light is blocked. The narrower the transmittance curve in the desired wavelength region, the greater the contrast.

The filtering process also means that the amount of reflected light from the surface of the display is so limited that the mechanical components and electronics which lie behind the filter are partly or fully hidden.

It is possible to create a high degree of contrast by either a filter with narrow transmittance curve or a dark tinted filter. The latter will make information from the display stand out clearly against a dark background. This may increase readability and provides an elegant design function. An important distinction is made between broad-band and selective filters.

### Broad band filters

Broad band filters provide increased contrast and improved readability of the information in electronic equipments with colour displays. These filters are typically used in industrial PC, colour LCD, diodes. Broad-band filters are basically grey-shaded filters which allow for the transmittance of all the colours. They are therefore often used in applications in which contrast enhancement is required without loss of the full colour spectrum.

### Selective filters

Selective filters are used when the light emitted from the display is monochromatic. Selective contrast filters are typically used for LED modules, monochrome VFD, diodes.

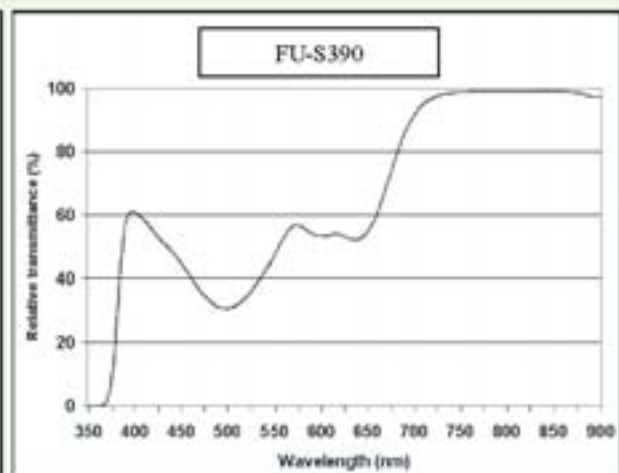
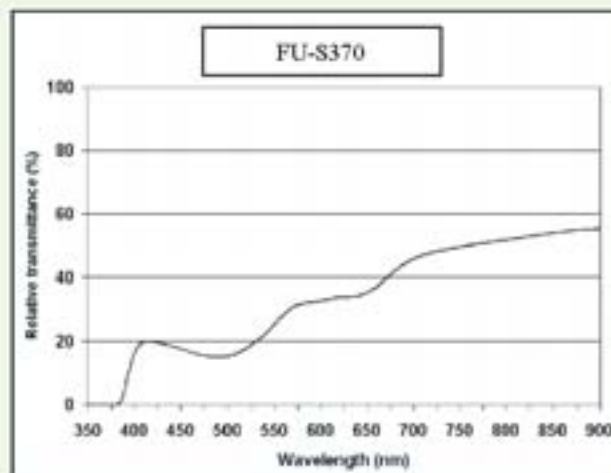
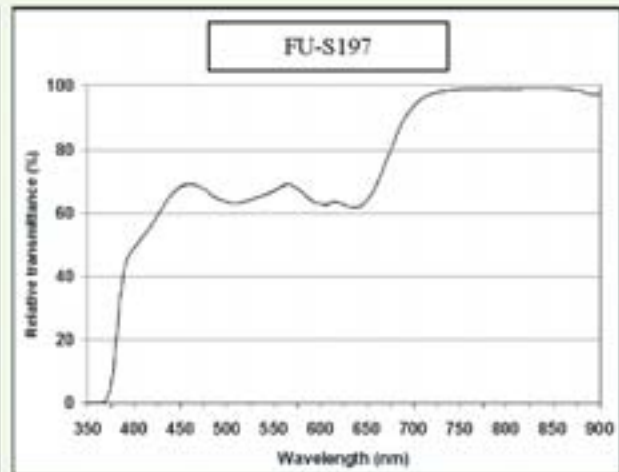
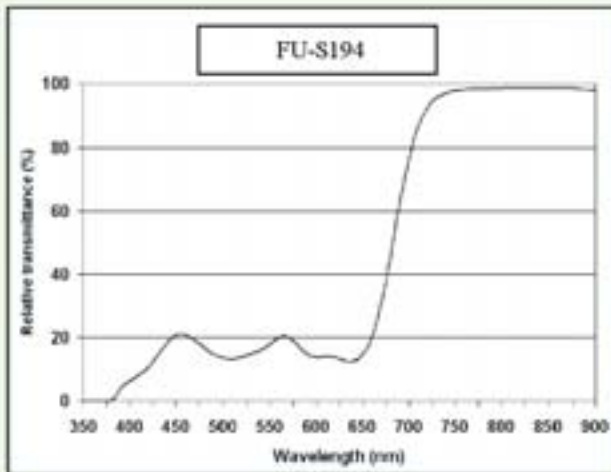
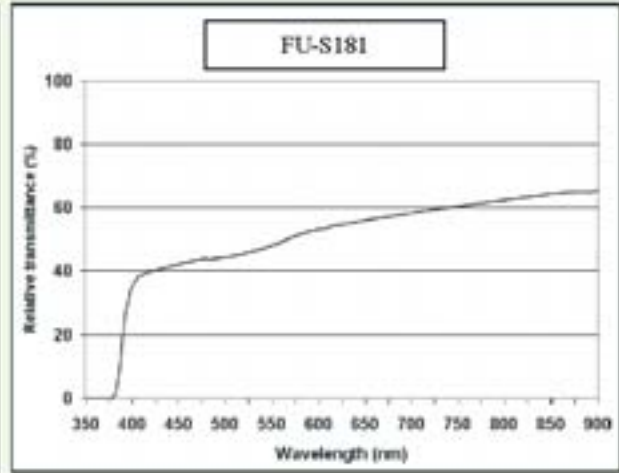
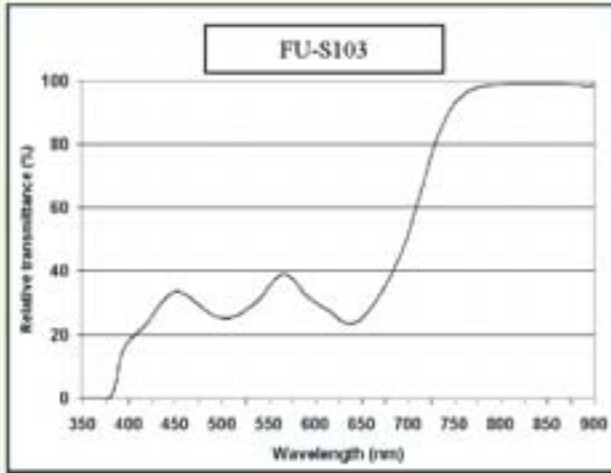
In case where a monochrome display is sufficiently bright, it is possible to use a dark, grey, or smoked broad-band filter. This results in the information from the display appearing clearly on dark, almost black, background.

The contrast filters can be supplied with non glare treatment which prevents distracting reflections from the surroundings without reducing the quality of the signal. The filters can also be supplied with silk screen printing. It is possible to have the filters machined using laser cutting and milling techniques.

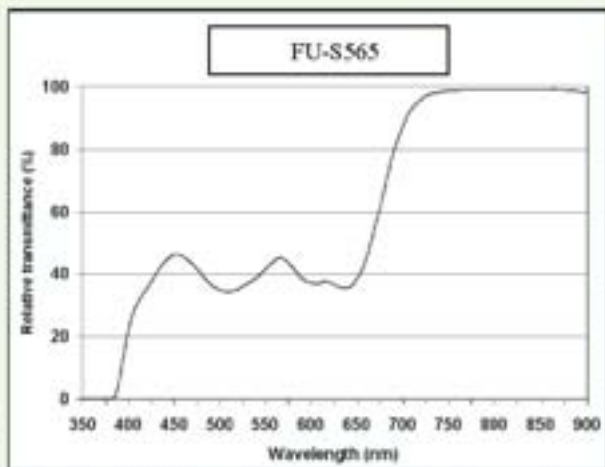
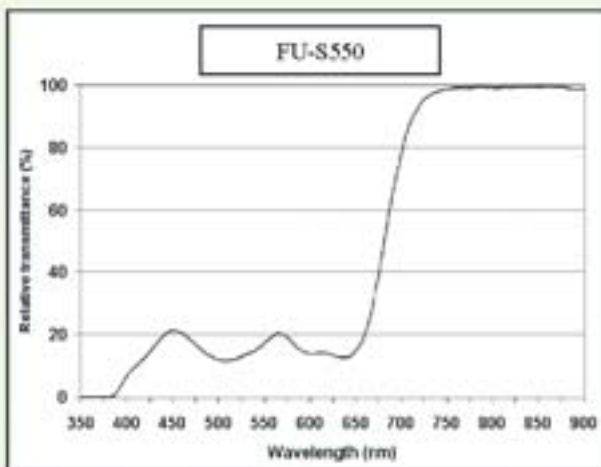
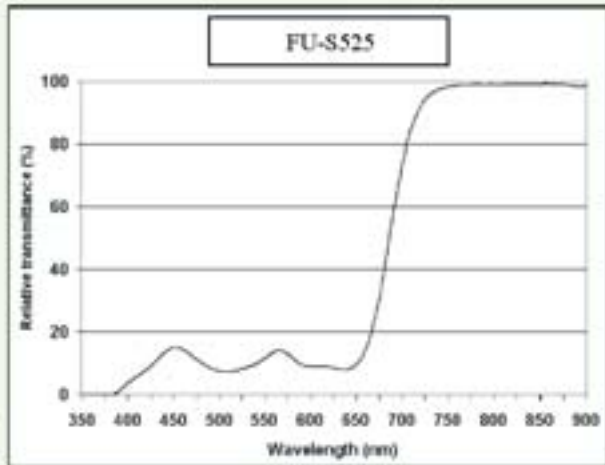
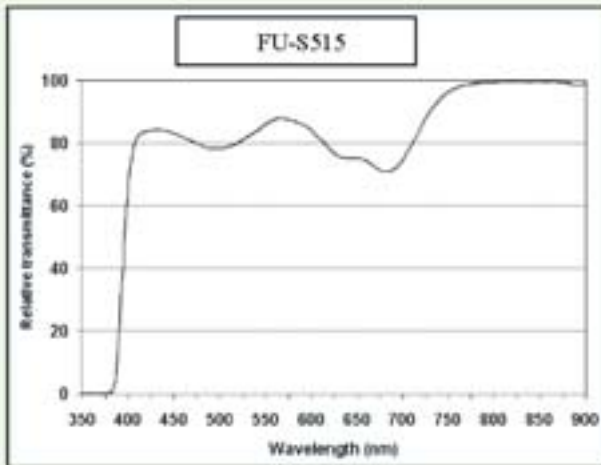
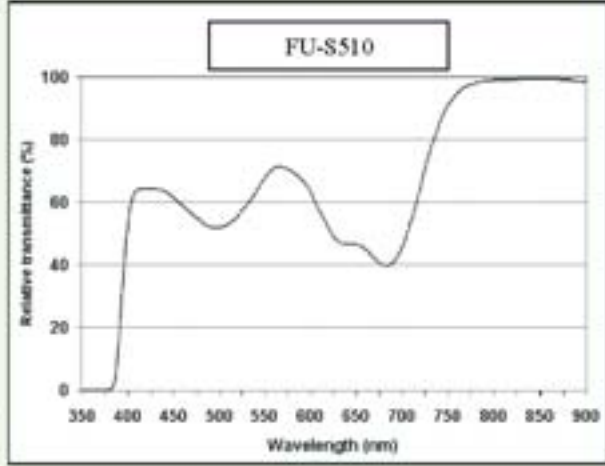
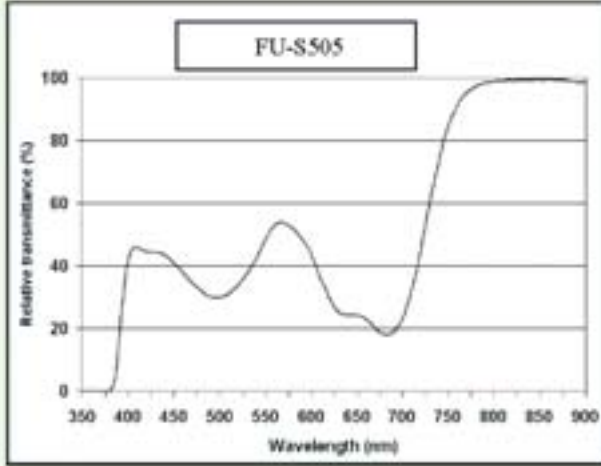
### Technical Data

- Light transmittance up to 100% compared to transparent acrylic.
- Thickness from 0.5 mm.
- Tolerances down to +/- 0.1 mm
- Dimensions up to 2000 x 3000 mm.
- More than 60 standard colours optimised for various types of displays.
- UV block up to 400 nm.

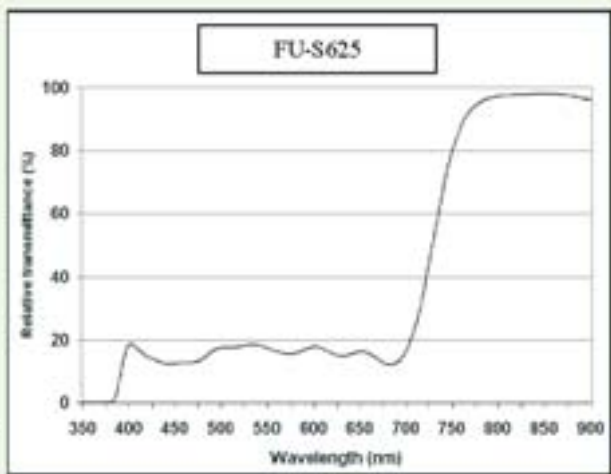
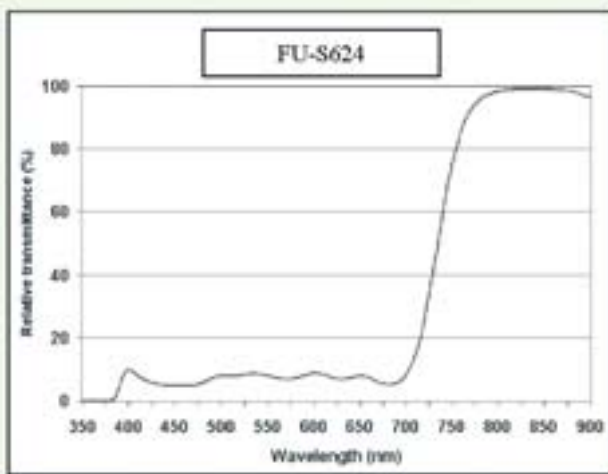
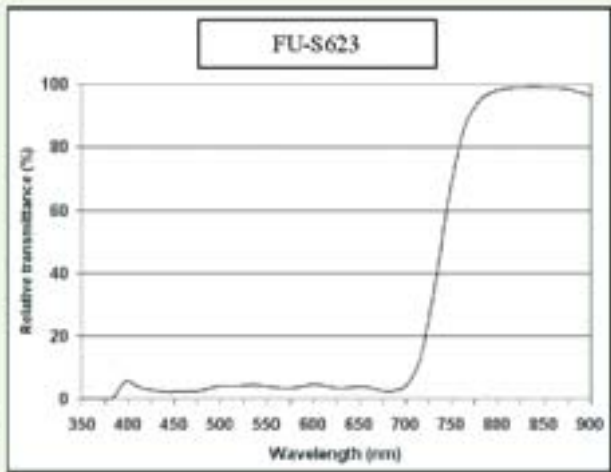
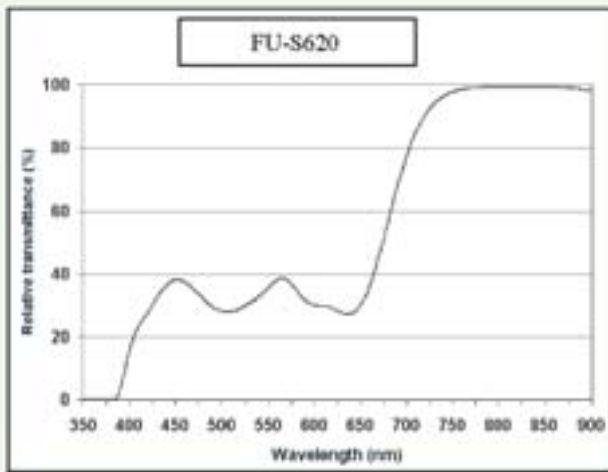
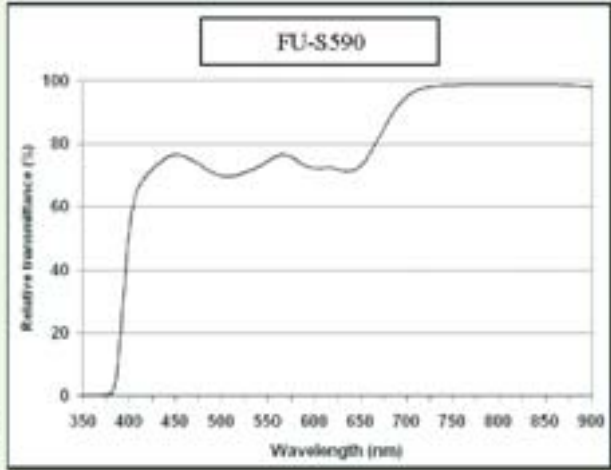
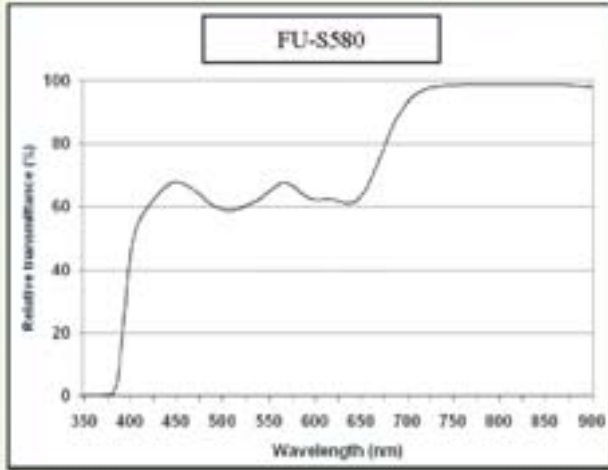
## BROADBAND FILTERS



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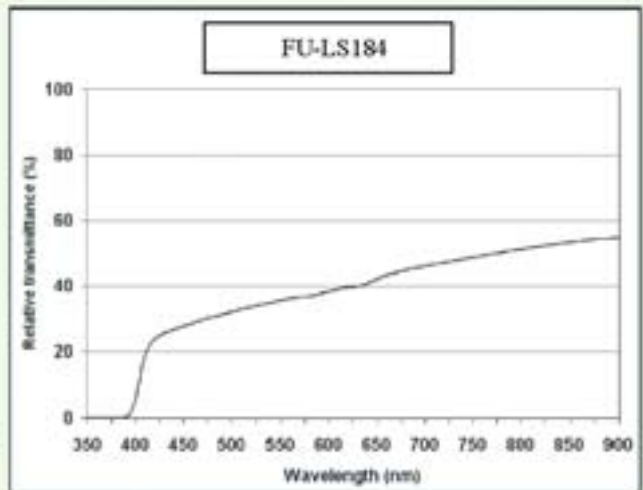
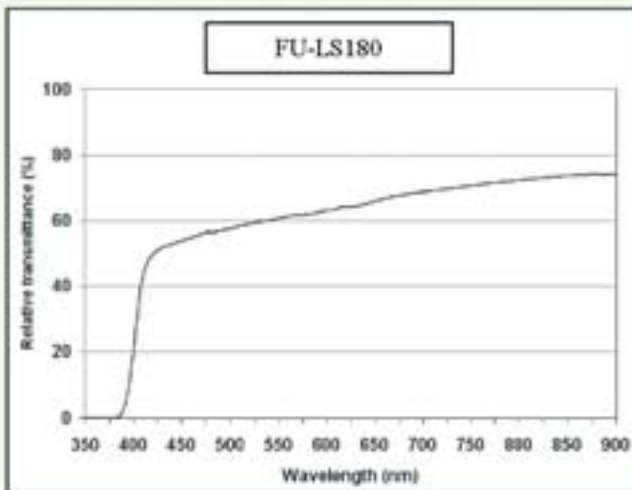
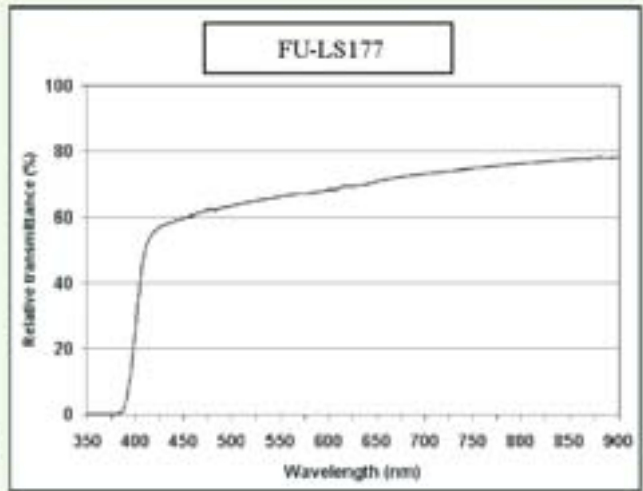
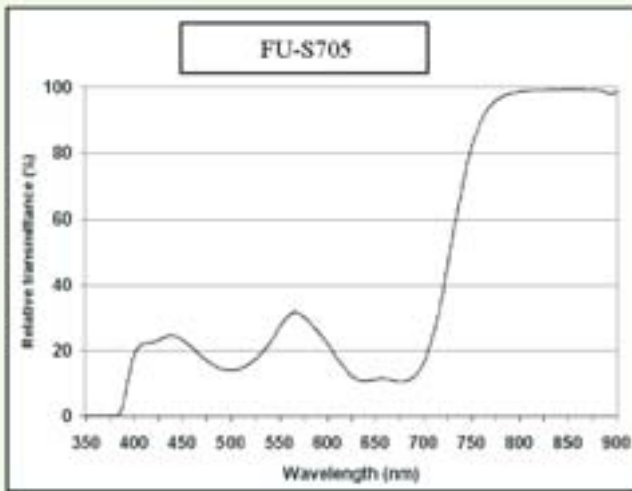


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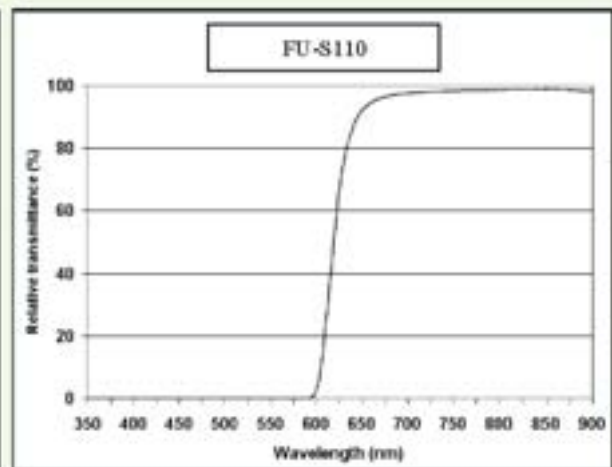
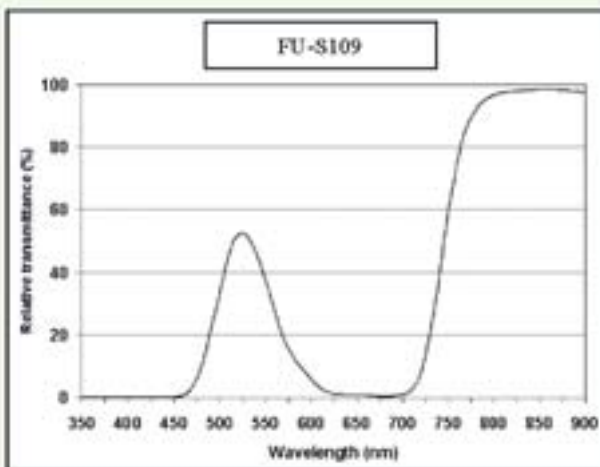
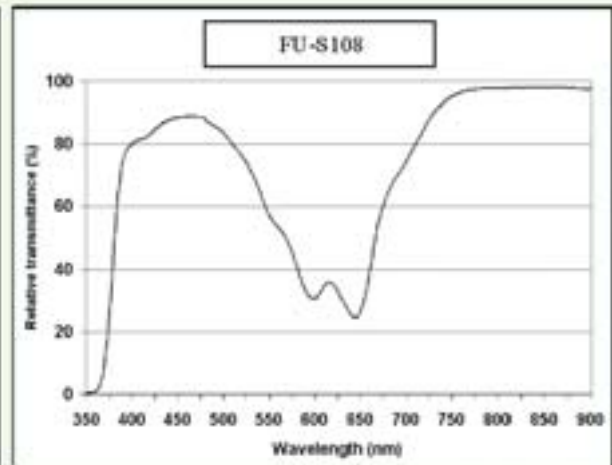
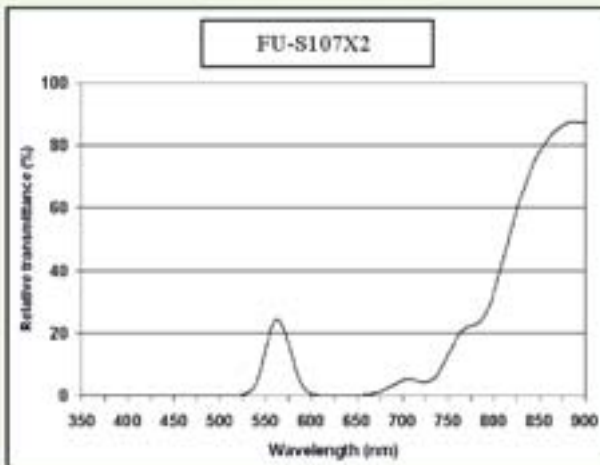
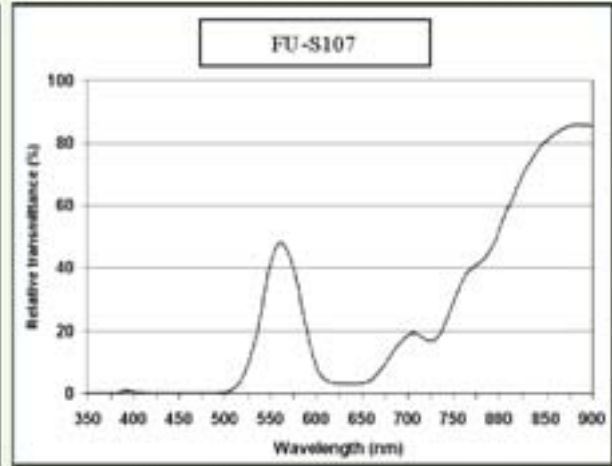
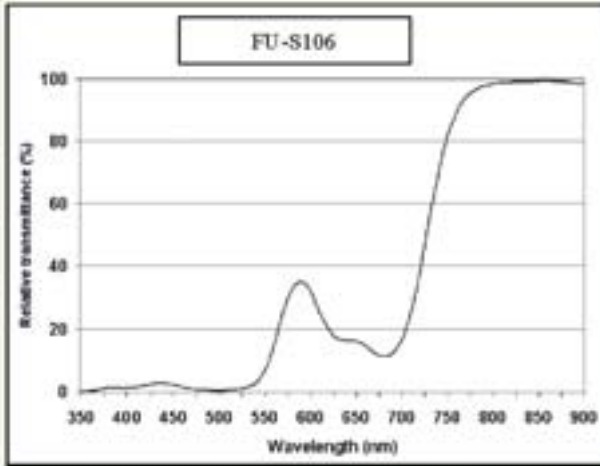




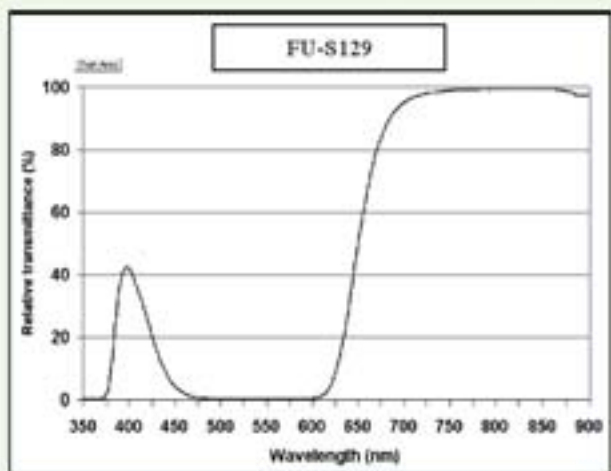
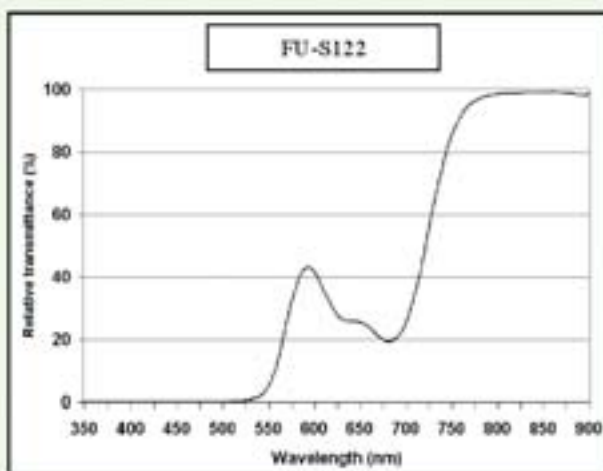
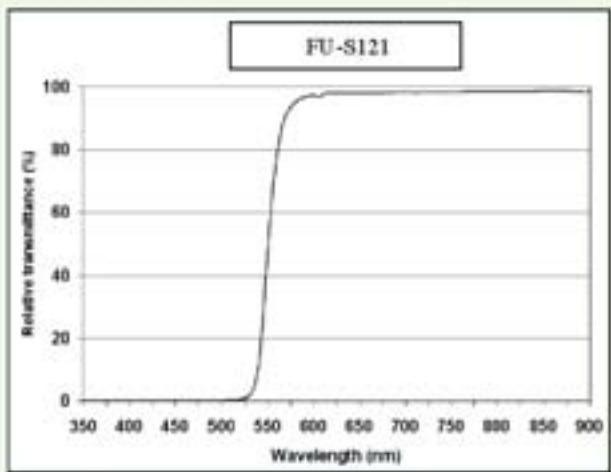
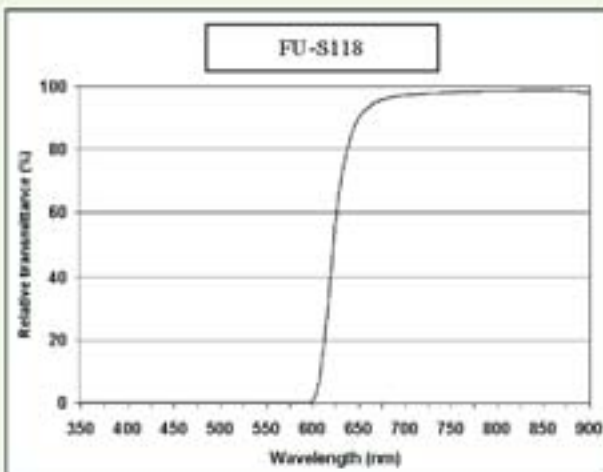
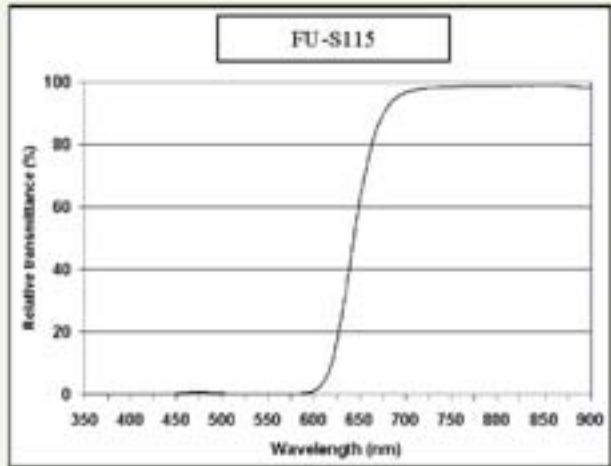
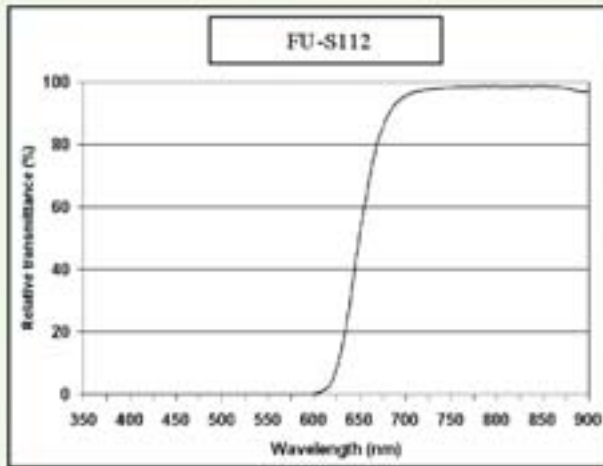
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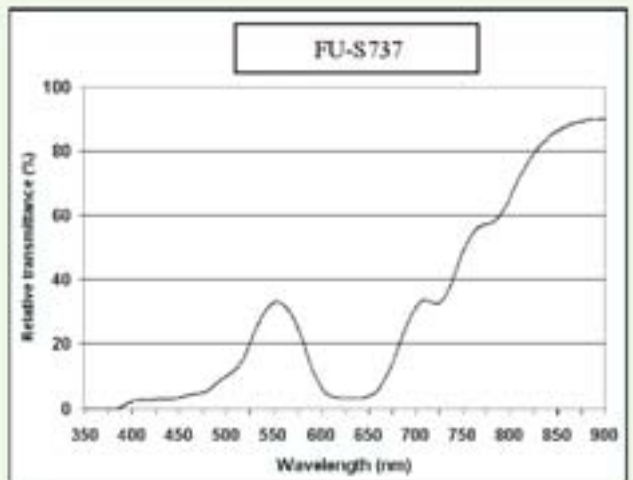
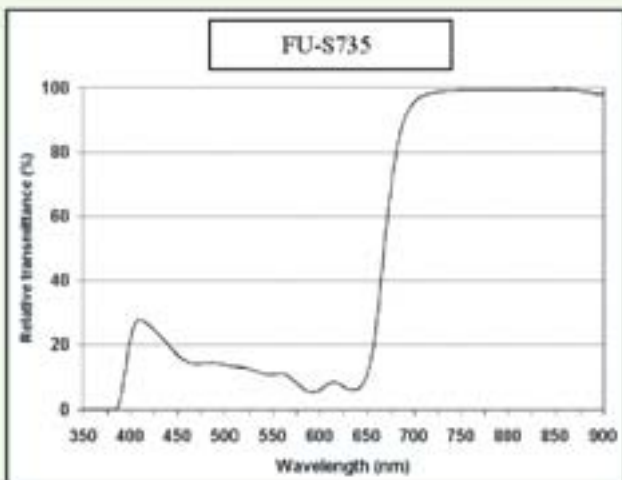
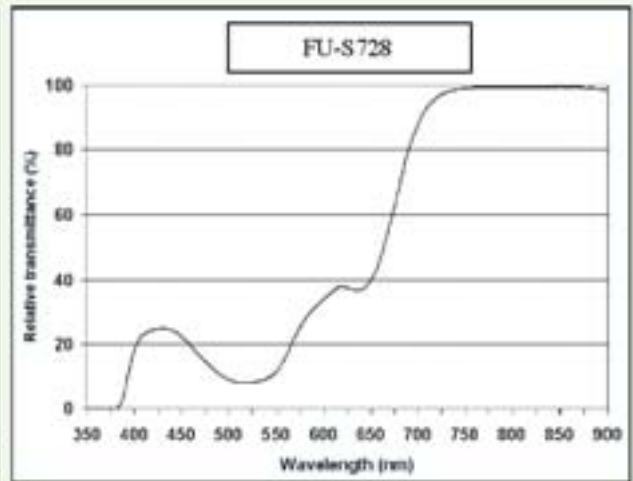
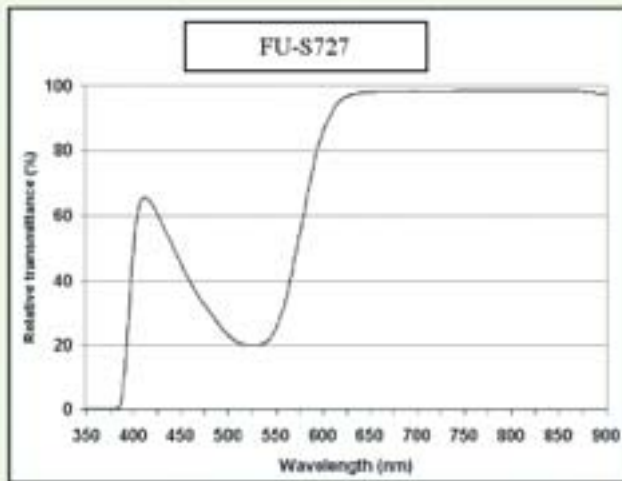
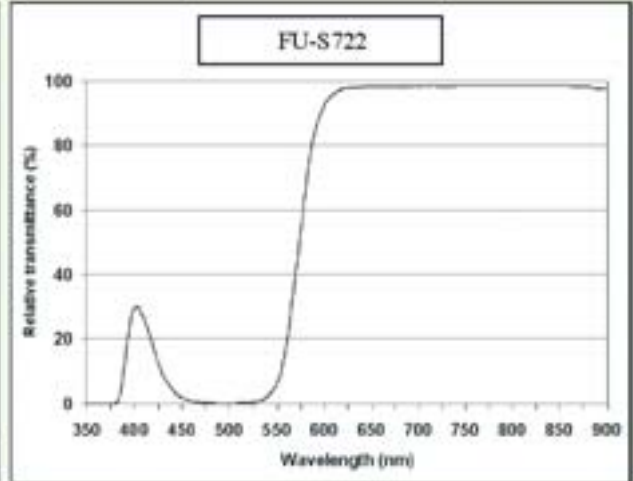
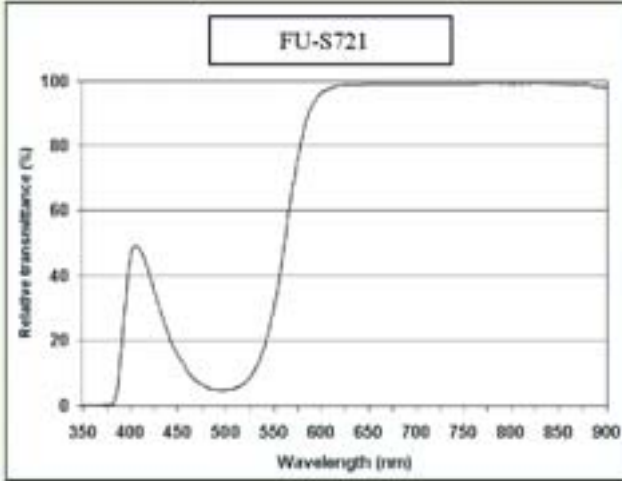
## SELECTIVE FILTERS



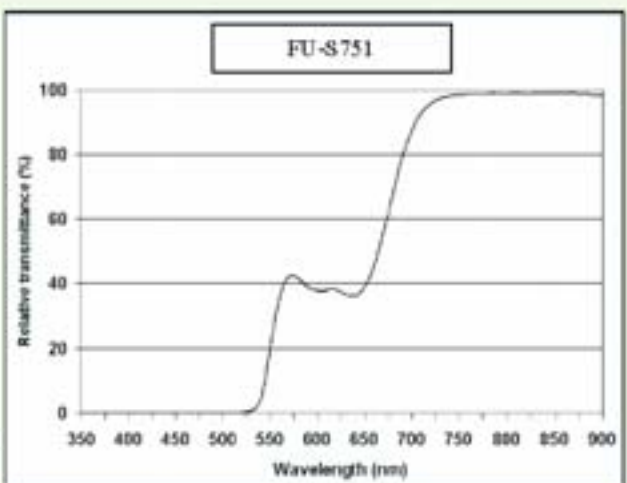
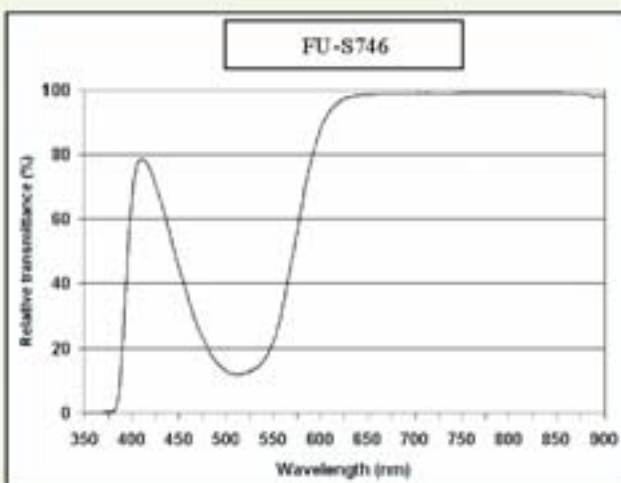
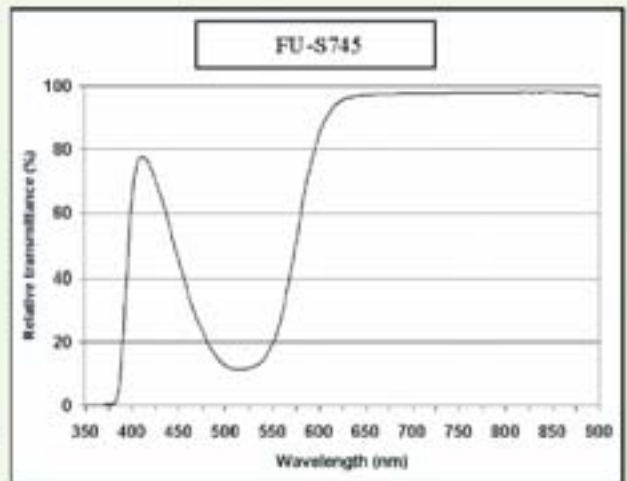
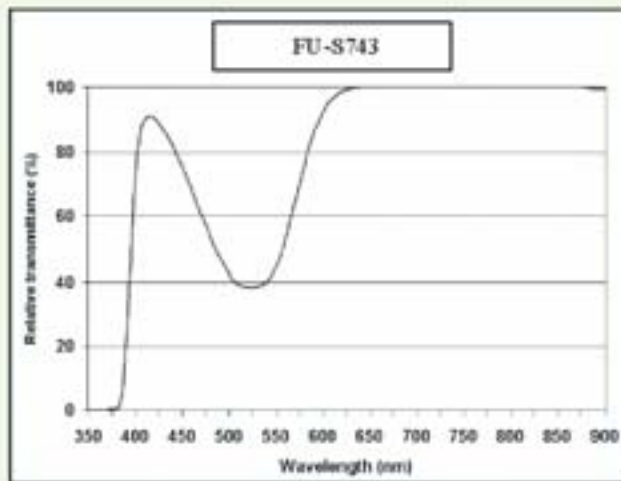
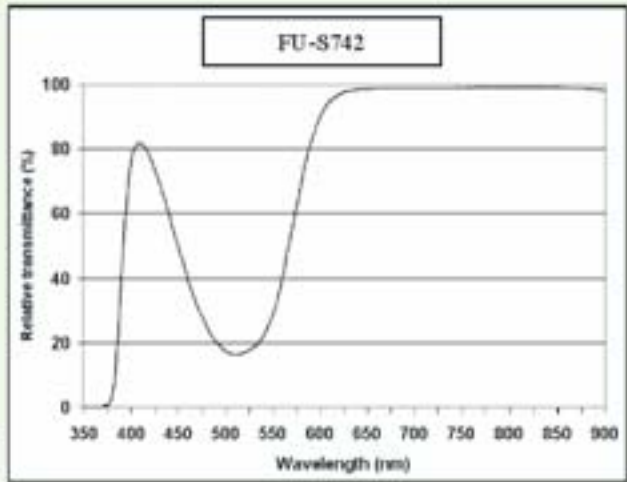
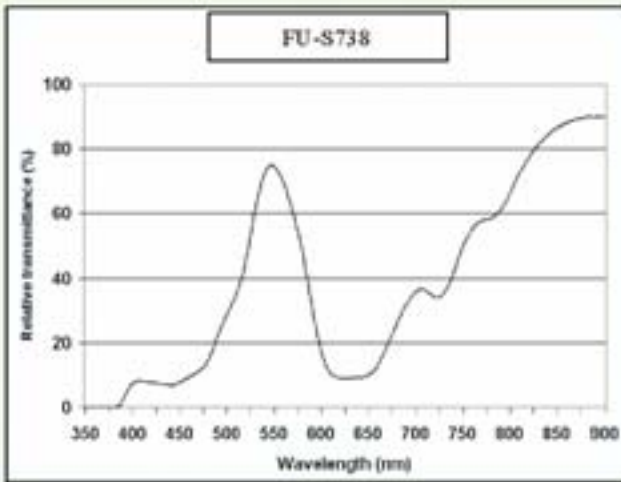
## SELECTIVE FILTERS



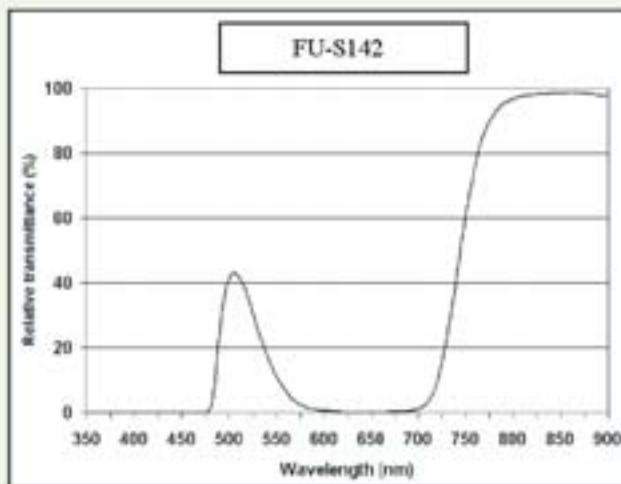
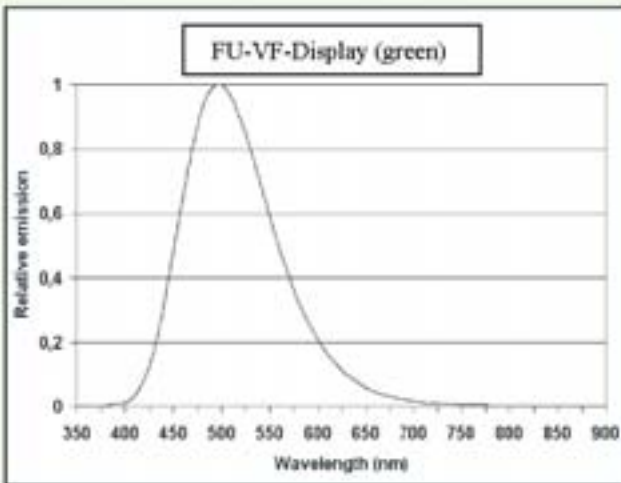
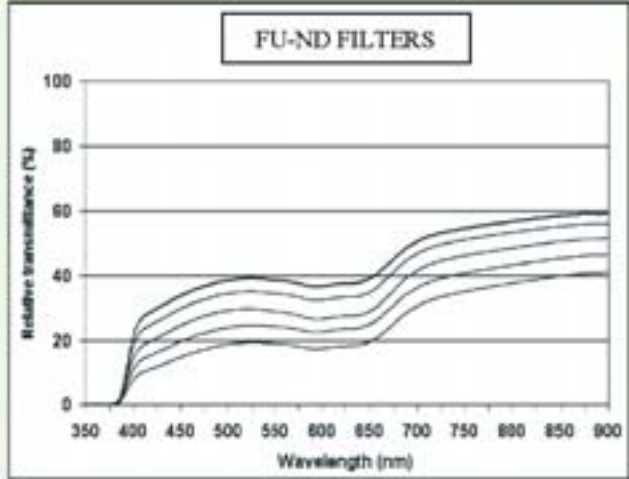
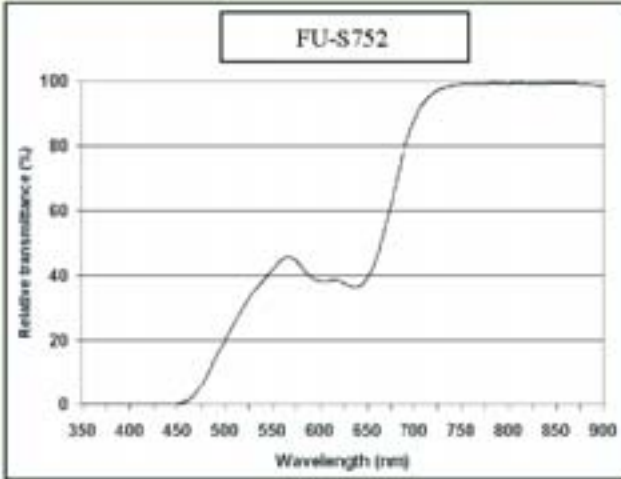
## SELECTIVE FILTERS



## SELECTIVE FILTERS



## SELECTIVE FILTERS



## LCD FILTERS

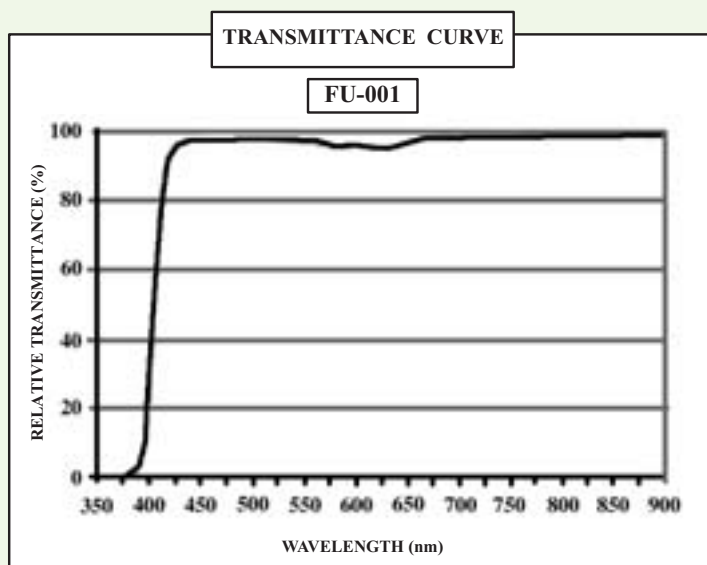
Futura can supply a special filter, FU-001, which has a light transmittance of 100% compared to transparent acrylic. This allows to satisfy some LCD's requirements that need the amount of external light to be as high as possible.

FU-001 is produced in transparent acrylic but with an integrated light guiding material. In this way, it is possible to obtain the same high transmittance as transparent acrylic with high contrast and thus greater readability.

FU-001 filter also absorbs the sun's harmful UV rays below 400 nm.

The high degree of light transmittance through the filter results from the fact that the acrylic monomer (MMA) which is used as the raw material is, as standard, filtered down to 7 microns before moulding.

The LCD filter can be supplied with standard non glare treatment, which prevents distracting reflections from the surrounding without reducing the quality of the signal. The filter can be produced with an embedded metal mesh to prevent electromagnetic noise (EMC filters) and can be supplied with silk screen printing.



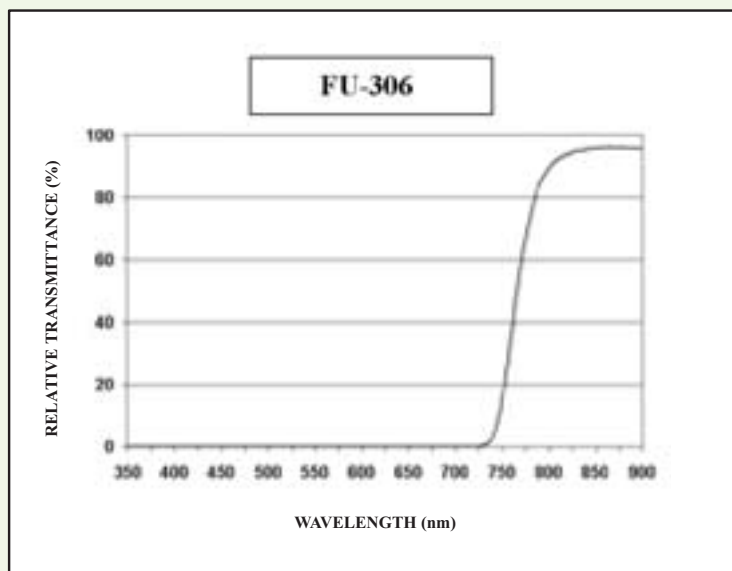


## INFRARED FILTERS

Infrared filters are used in sensors, security systems, scanners, IR camera and in all the applications where it is necessary to exclude visible light. Acrylic is the most suitable base material for the transmission of light in the near-infrared region.

The infrared filter is a broad-band filter in the range 800-2000 nm, absorbs the entire visible spectrum and ultraviolet rays and provides the maximum transmittance for display with near-infrared light.

In fact the filter prevents the penetration of light with wavelength below 750 nm. The filter can be supplied with standard non glare surface treatment, which prevents distracting reflections from the surrounding without reducing the quality of the signal. The filter can be produced with an embedded metal mesh to prevent electromagnetic noise (EMC filters) and can also be supplied with silk screen printing.



### Technical Data

Light transmittance up to 96% from 800 - 2000 nm compared to transparent acrylic

Thickness from 0.5 mm

Tolerances down to +/- 0.1 mm

Steep cut-on

Dimensions up to 2000 x 3000 mm



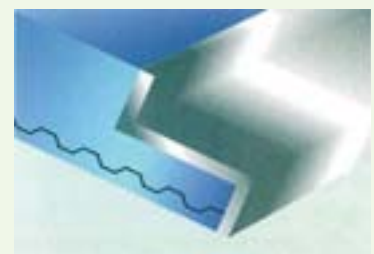
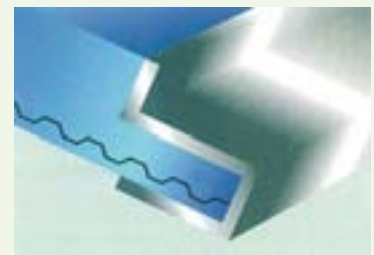
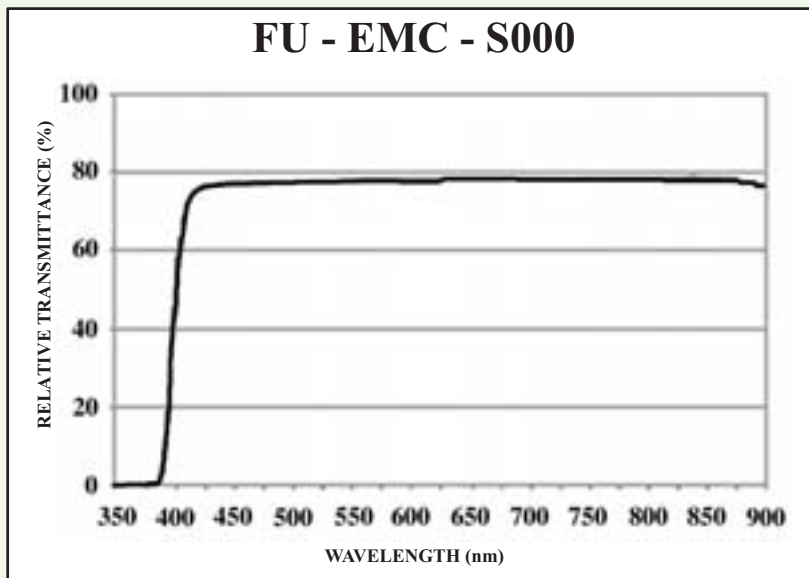
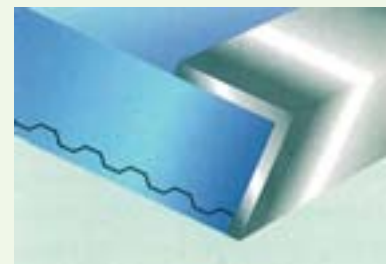
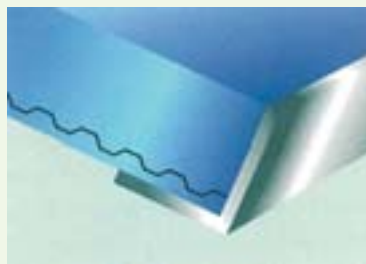
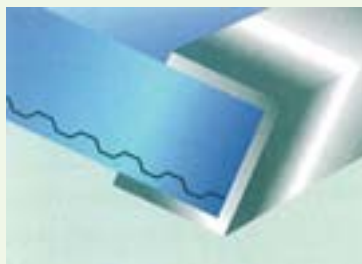
## EMC filters

We are specialized in offering EMI display solutions. In this field our optical filters are supplied with an embedded metal mesh for the reduction of electromagnetic interference. EMC filters can be supplied in wide range of transparent colours.

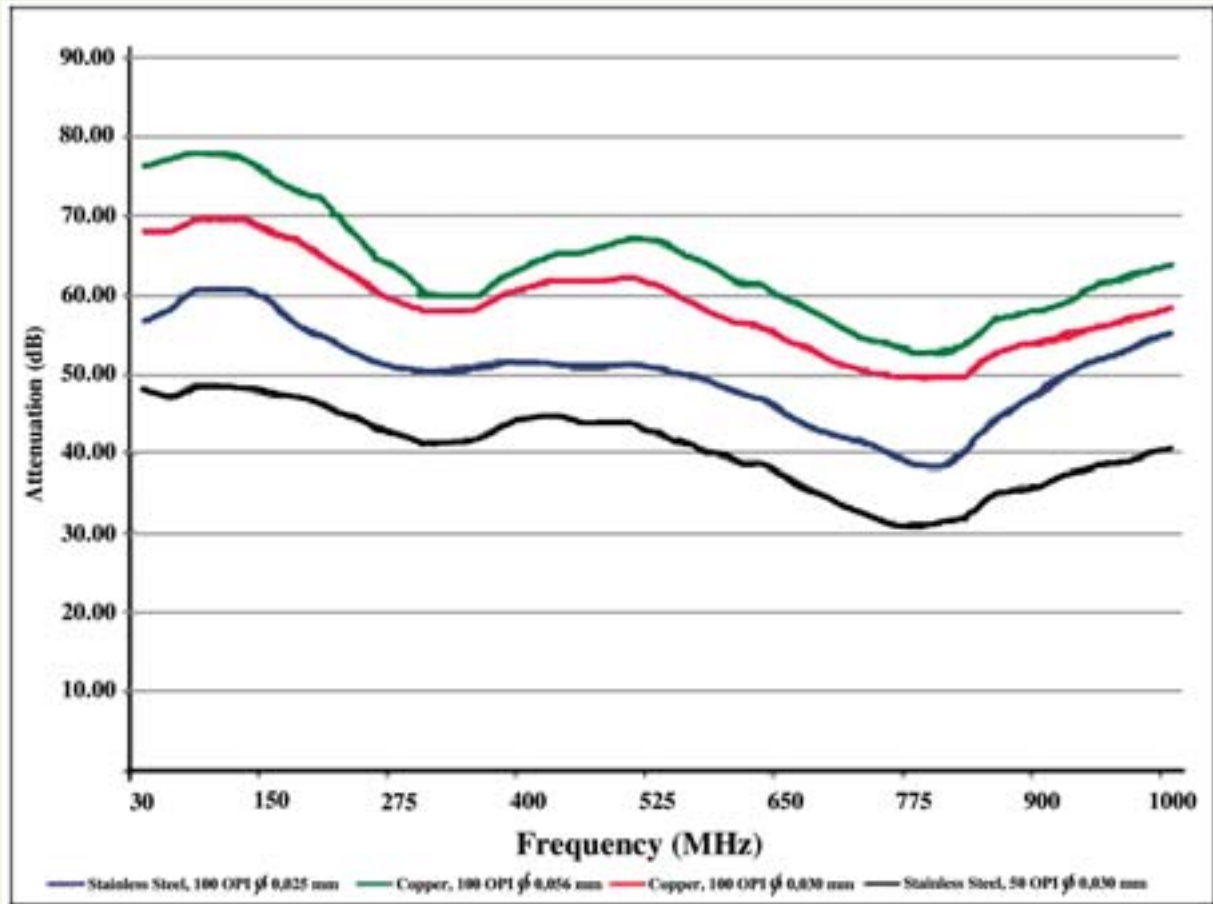
We supply EMC filters by using a method that makes it possible to embed the metal mesh as an integral part of the acrylic filter so that we have no refraction surfaces. The embedded mesh can be stainless steel or copper.

Sometimes if we apply the mesh directly on the dots in the display, some interferences can occur. This disturbing effect can be avoided by rotating the mesh. EMC filters we supply can be mounted at any angle between 0° and 45°. We can supply acrylic sheets with EMC embedded mesh in dimensions of up to 1000 x 1500 mm.

All EMC shielding is a compromise between the shielding effect and readability. Our EMC filters can allow a light transmittance of 78% for the EMC filter compared to transparent acrylic.



## Electromagnetic Shielding performance for EMC-Filters with embedded blackened mesh



In order for the filter to be able to meet the specified data, it is vital that electrical contact is made between the entire perimeter of the mesh and the cabinet of the apparatus. We establish this contact by applying conductive silver or nickel paint to the edge of the filter. The EMC filter should then be mounted in the panel with a conducting gasket or conducting glue. The EMC filters can be supplied with non glare treatment, which prevents distracting reflections from the surroundings without reducing the quality of the signal. It is possible to have the filters machined, for instance, using laser cutting and milling techniques. The filters can also be supplied with silk screen printing.

## Technical Data

- Light transmittance approx. 78% compared to transparent acrylic
- Thickness: 1.5, 2, 2.5, 3, and 4 mm
- Supplied in approx. 40 different colours
- Mesh: Bright (Non-standard) or blackened
- Wire diameter: 0.025 mm, 100 OPI.
- The mesh can be angled between 0°- 45°
- Flexible, conductive silver or nickel edge
- Standard operation temperatures between -40°C to 70°C
- Dimensions up to 1500 x 1000 mm

Non-standard mesh types can be embedded upon request. Normally copper or stainless steel mesh is used depending on the application and the requirements for attenuation. The mesh is blackened in order to minimize reflections and at the same time increase the contrast from the display. The blackening process does not change the shielding characteristics of the mesh.

Here we present the characteristics of the mesh we can supply.

Mesh	Surface	OPI	Wire diam. (mm)	Dimens. (mm)	Light transmit.
Steel	Bright	100	0,025	width max. 1220 length upon request	79%
Steel	Blackened	100	0,025	1570x1070	79%
Steel	Blackened	50	0,030	NA	88%
Steel	Bright	100	0,030	width max. 1220 length upon request	76%
Steel	Blackened	100	0,030	1570x1070	76%
Copper	Blackened	100	0,056	1220x1000	61%
Copper	Blackened	100	0,030	1220x1000	75%

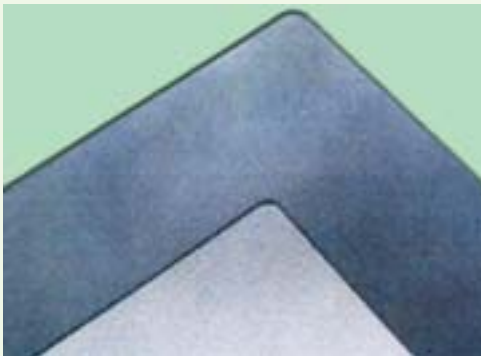
## COMBI-SHIELD

Combi-Shield is an EMI-shielding solution which can be combined with almost any type of front display window. It is especially suitable for touch-screen applications.

Due to its high level shielding performance, this product is indicated in TEMPEST applications. It is a blackened "flying mesh" which is stretched and mounted on a thin, rigid conductive and corrosion resistant metal frame.

The solution can be integrated in a current application needing EMI shielding without changing anything else. Combi-Shield is very thin and only takes up 1-1.5 mm space. Frame geometry can be optimized according to customer specifications. It can be applied independently on the chosen front window solution.

Depending on the application, other metals than aluminium, can be used if needed according to specific requirements.



## DIFFUSION FILTERS

This kind of filters are typically used for back-lighted LCD modules such as Passenger Information Systems at airports and train stations, but also instruments in which a combination of the greatest possible light transmittance and a controlled dispersion of light, diffusion, is required. The readability of back-lighted LCD is often negatively affected by sunlight, surrounding sources of light and reflections, since the LCD itself is rather faint. However, our diffusion filters give the LCD light source the maximum effect whilst at the same time creating a contrast background which makes the information clear.

### The properties of diffusion filter.

The diffuser's special properties occur by mixing raw materials with different refractive indices. The filter therefore contains no pigments which can hinder light transmission. An ideal diffusion of light is thus achieved.

The diffusion filter is placed close to the light source so that diffusion occurs before the light hits the LCD modules. With a diffusion filter, a maximum amount of light is distributed to the LCD, and only a minimal amount of parallel light leaves the filter.

### Technical data

- Almost no parallel light leaves the filter
- Thickness from 0.6 mm
- Tolerances down to +/- 0.1 mm
- 3 standard degrees of diffusion

Approx. 40 colours available (Non-standard)





## TECHNICAL DATA FOR ACRYLIC

	Test	Unit	Values
<b>Mechanical properties:</b>			
Tensile strength	DIN 53455	N/mm <sup>2</sup>	65-68
Compressive strength	DIN 53454	N/mm <sup>2</sup>	125
Flexural strength	DIN 53452	N/mm <sup>2</sup>	120
Impact strength	DIN 53453	N/mm <sup>2</sup>	12
Modulus of elasticity	DIN 53457	N/mm <sup>2</sup>	3.000
Elongation at break	DIN 53455	%	3-4
Hardness	DIN 53456	N/mm <sup>2</sup>	175
<b>Thermal properties:</b>			
Heat stability - Vicat, clear 3 mm	DIN 53460	°C	115
Forming temperature		°C	150-170
Coefficient of linear thermal expansion	VDE 0304	mm/m°C	0.08
Specific heat		kJ/kg K	1.46
Thermal conductivity		W/m K	0.186
<b>Electric properties:</b>			
Dielectric strength	DIN 53481	kV/mm	40
Volume resistivity	DIN 53482	ohm cm	10 <sup>13</sup>
Dielectric constant	DIN 53483		3.4
Dissipation factor	DIN 53483		0,06
<b>Other properties:</b>			
Specific gravity	DIN 53479	g/cm <sup>3</sup>	1.18-1.19
Water absorption	at 20° C in 24 h	%	0.17
Light transmission (clear)	450 nm	%	92
Flame class rating clear 3 mm	UL94		HB
Refractive index			1.49

## POLYCARBONATE FILTERS

The polycarbonate is particularly indicated for use in displays, information boards and Passengers information systems, which are mainly used in places as mass transportation vehicles, bus and train stations, airports.

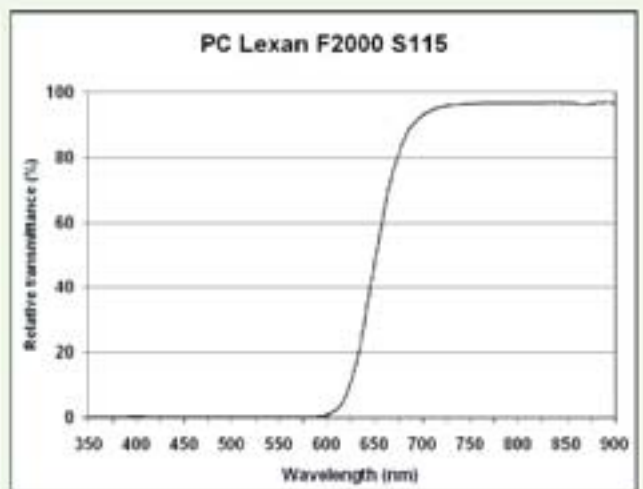
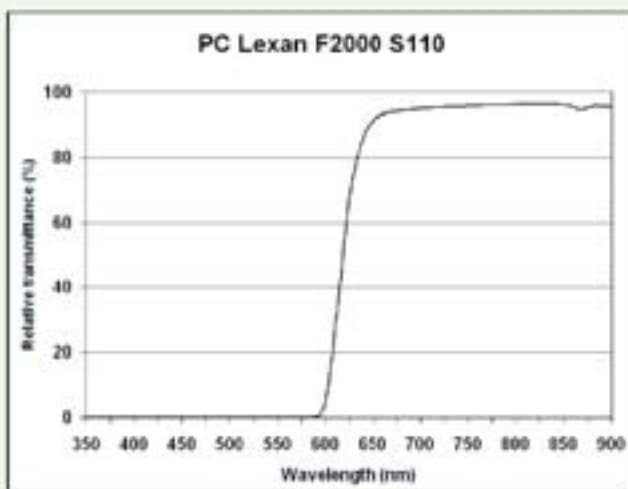
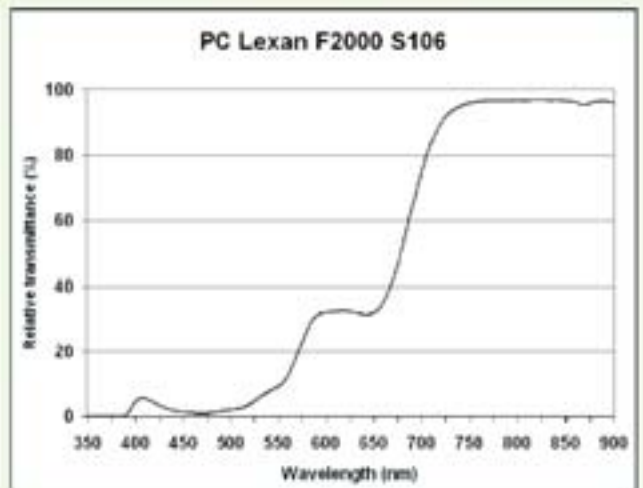
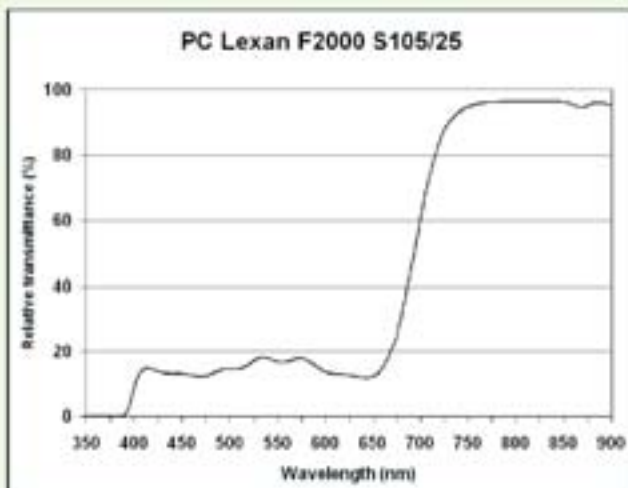
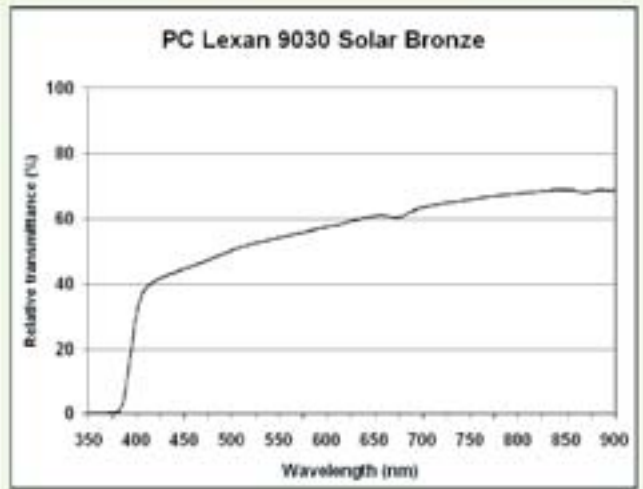
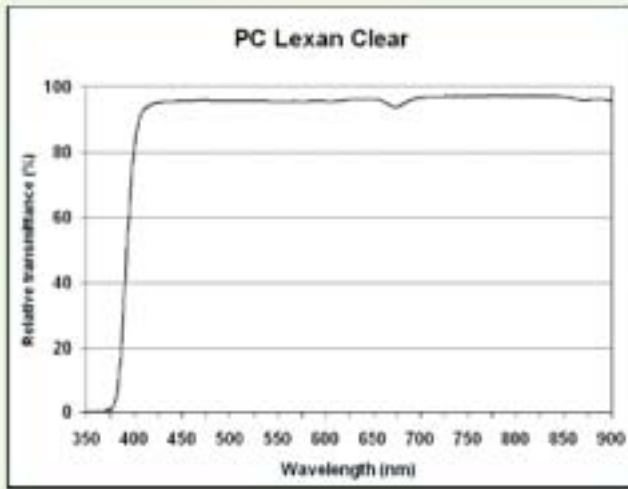
Polycarbonate is highly resistant to shock and impact. Polycarbonate as a transparent material has a transmittance of transparent light of 85%. UV radiation is almost completely absorbed. Polycarbonate has good fire behaviour performances. It does not contribute to the spread of fire or to generation of toxic gasses.

Filters in polycarbonate can be supplied with non glare treatment.

Polycarbonate filters can also be produced as EMC filters with a welded metal mesh. In addition, it is possible to have the filters machined using laser cutting and milling techniques. The filters can also be supplied with silk screen printing.

We can supply polycarbonate filters with the following colours.







## TECHNICAL DATA

<b>Polycarbonate</b>			
<b>Extruded Polycarbonate sheets - standard quality:</b>			
	Test	Unit	Values
<b>Mechanical properties at 23°C:</b>			
Tensile strength, yield	DIN 53455	N/mm <sup>2</sup>	60
Tensile strength, break	DIN 53455	N/mm <sup>2</sup>	70
Tensile elongation, yield	DIN 53455	%	7
Tensile elongation, break	DIN 53455	%	120
Flexural modulus	DIN 53457	N/mm <sup>2</sup>	2500
Flexural strength, yield	DIN 53452	N/mm <sup>2</sup>	100
Impact strength	GE method	Nm	>200
Charpy impact, notched	DIN 53453	kJm <sup>2</sup>	>40
Hardness	DIN 53456	N/mm <sup>2</sup>	95
<b>Thermal properties:</b>			
Coefficient of linear thermal	VDE 0304/1	mm/m°C	0.07
Thermal conductivity	DIN 52612	W/mK	0.21
Vicat softening temp. rate B	ASTM D 1525	°C	153
HDT, 1,82 MPa	DIN 53461	°C	138
Forming temperature		°C	175-205
<b>Other properties:</b>			
Specific gravity	DIN 53479	g/cm <sup>3</sup>	1.20
Water absorption, 24h	DIN 53495	mg	10
Light transmission, clear 3 mm	ASTM D-1003	%	85
Flame class rating, clear 3 mm	UL94		V2 to V0*
* Performance depends on thickness and material			

**Standard thickness:**  
from 0.5 mm  
up to 12.0 mm

**Standard colours:**  
Clear, Opal,  
Solar Bronze.  
Special colours  
available upon  
request.  
Minimum  
quantity has to  
be expected.

## SURFACES TREATMENTS

On our filters we can supply four different non-glare coatings:

- Standard non glare coating
- Hard-coating
- Cleartech Mat
- AR-coating

### Standard non glare coating

To be used when significant reduction of disturbing reflections with no loss or distortion of light is your priority.

#### Properties

It is especially developed to produce a mat, exclusive looking surface for elimination of reflections and perfect optical performance. The degree of matness can be adjusted to fit the specific requirements of the application. The coating process creates a unique surface structure consisting of lens-shaped micro-particles. These micro-particles block most of the ambient light from reaching the display without influencing the signal transmitted from the display. Hence the disturbing reflections are reduced with no loss of display readability.

When two plane surfaces are placed against each other, an undesirable phenomenon (Newton rings) can occur. However, this coating acts as a spacer, creating sufficient distance between the surfaces to prevent this occurrence. It can be applied to extruded, injection-moulded and laminated plastic materials. The only requirement is that the sheet has not already been surface treated. The application of this coating surface treatment does not affect the potential for later silk screen printing, thermoforming, cold bending or other forms of processing.

### Hard-coating

Whenever there is a need to protect and enhance acrylics and polycarbonates to provide effective abrasion and chemical resistance for display windows, Hard coating surface treatment does the job. Hard coating is designed for applications where abrasion resistance and optical quality are important – with abrasion resistance as first priority, for instance in industrial equipment in which cleaning agents and organic solvents are frequently used.

#### Properties of Hard coating

The Hard coating adds a layer of lacquer containing almost invisible particles, which are referred to as a matting agent. The varnish is clear and the amount of particles is a dominant factor of how non-glare the surface treatment becomes.

The Hard coating surface treatment is a UV-cured, non-glare hard coating characterised by extremely good physical and chemical properties. Futura offers Hard coating surface treatments, which are suitable for either interior or exterior use.

The application of the Hard coating surface treatment does not affect the possibility for laser cutting and milling. However, laser thermoforming and cold bending as well as gluing and silk screen printing on the coated side are not possible.

### Cleartech Mat

Cleartech Mat combines protective dual-sided abrasion resistance with a non-glare coating for improved daylight readability. Both sides of the display window are treated with a clear and very hard coating resulting in a surface hardness among the best ever seen in plastics. In addition, the front side is given a standard non glare treatment, which significantly reduces disturbing reflections with a minimum loss of light transmittance. The dual-sided abrasion resistance reduces the risk of damaging the window during mounting and assembly processes.

## Properties

The clear hard coating on the rear side of the window is virtually invisible and without any optical defects to disturb the display images.

Clartech Mat can be applied to clear acrylic in thicknesses including 0.8-1.0-1.5-2.0 and 3.0 mm.

Clartech Mat surfaces can be silk screen printed.

For application requiring maximum abrasion resistance and no interference with display signal from the surface the dual-sided clear clartech surface can be applied.

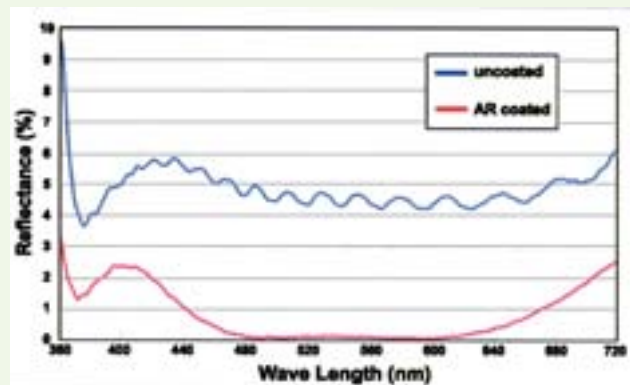
## AR-coating

Often safety considerations make it extremely important that displays are easy to read from all angles and under all external light conditions, for instance on medical equipment or navigation computers.

For these applications Futura can supply a range of very effective AR (anti reflective) surface treatments, reducing reflections to an absolute minimum and increasing undisturbed light transmission.

## Properties of AR Finish

The AR coating works by applying series of very thin layers of metal oxides. By careful design of these layers, light hitting the surface will not be reflected but transmitted through the material, resulting in an improvement of clarity and light transmissions, and total reduction of unwanted reflections. surface treatment is a high quality coating offering the very best optical characteristics due to an advanced vacuum deposition process. The AR coating provides you with the best preservation of the original colours, and combined with Anti Finger Print (AFP) coating, the AR coating is close to optical perfection. Moreover, it offers exceptional abrasion, impact and smudge resistance.



## WET AR

The WET AR surface treatment is a cost effective alternative to the exclusive AR-Finish, consisting of fewer layers.

## Marine AR

The Marine AR is an AR coating specially developed for the harsh environment which is found on ships, since it has exceptional UV and saltwater resistance

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