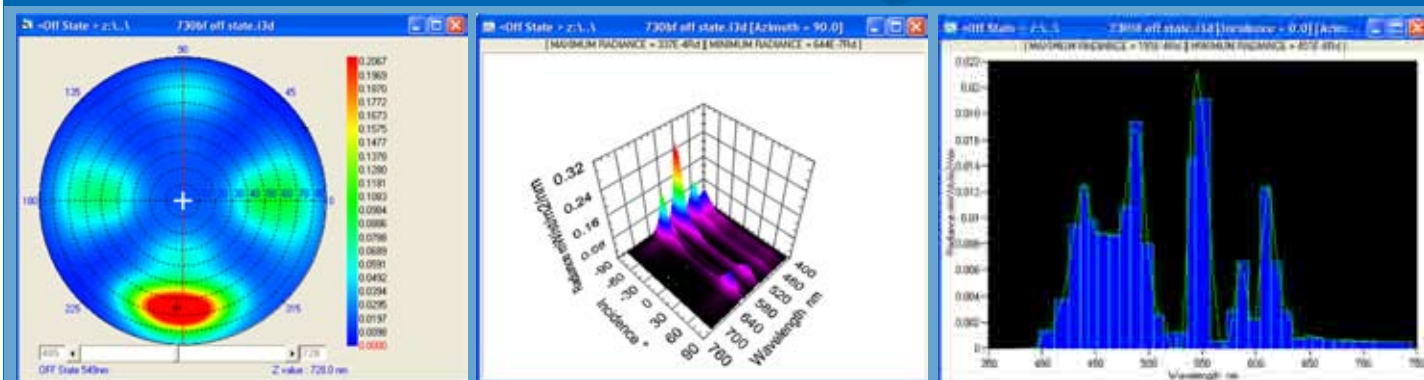# MULTISPECTRAL
VIEWING ANGLE ANALYSER

REVOLUTIONARY SYSTEM FOR FULL SPECTRAL AND POLARIZATION MEASUREMENT IN THE ENTIRE VIEWING ANGLE

EZContrastMS80 & EZContrastMS88

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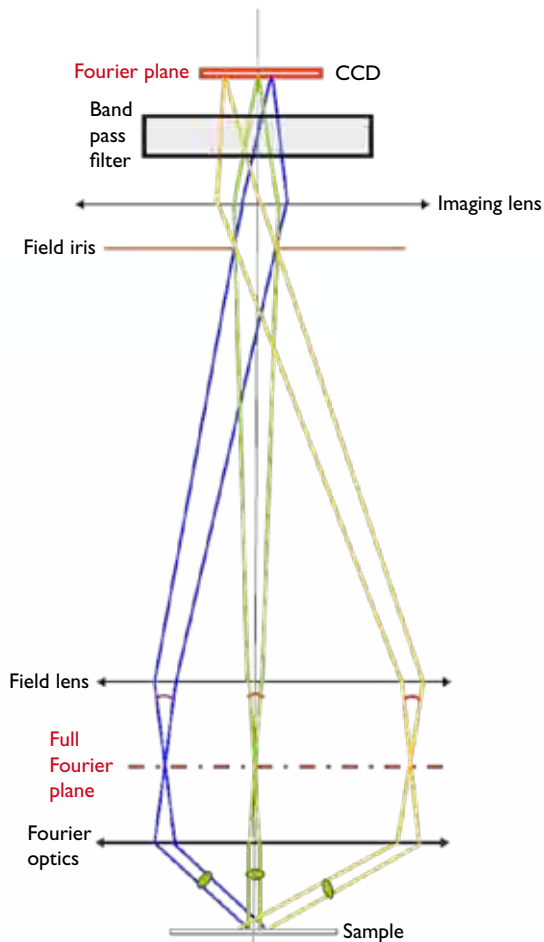新竹：新竹縣竹北市台元 26 號 4 樓之 10
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ADVANCED LIGHT ANALYSIS by ELDIM

Schematic diagram of the Fourier optics design used for viewing angle measurements

First hemispheric lens during QA by stitching interferometry

Optic alignment in clean room environment

High performance Fourier Optics viewing angle instrument

ELDIM manufactures viewing angle instruments based on Fourier optics for more than 10 years. Over the years the system capacities have been increased both for very grazing angles and large spot size. Multispectral series uses the most advanced optical design with incidence up to 88°.

High Efficiency

One of their key features is the patented optical configuration which allows controlling the angular aperture of the system independently of the measurement spot size. The very high light collection efficiency allows measurement up to very extreme grazing angles (88°) with an excellent accuracy. This is a key advantage compared to solution based on standard Fourier optics as shown below
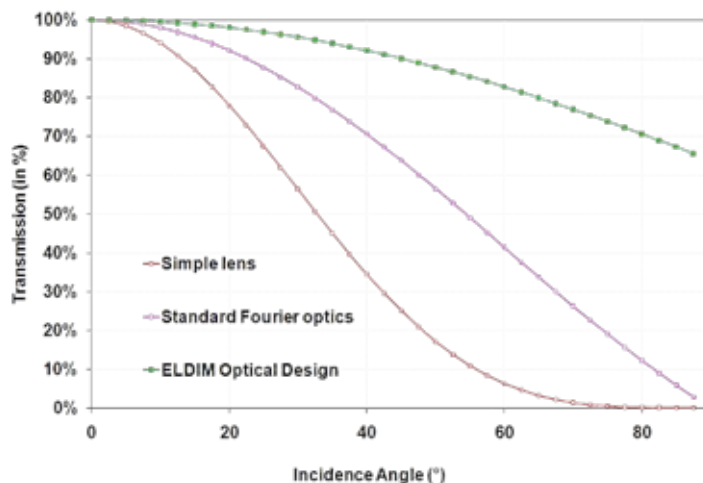
High Speed

The full viewing cone is measured with high incidence and azimuth angular resolution within seconds for luminance and minutes for radiance. Full characterization of films and components can be made in several minutes when several days would be necessary using goniometric solutions.

High accuracy

All ELDIM systems follow a strict manufacturing, quality controls and calibration procedures. Spectral response of each CCD camera is characterized and each filter is controlled by spectrophotometrical processes. Dedicated tools and procedures have been developed to calibrate the systems up to very grazing angles.

High reliability

ELDIM is manufacturing itself all the key components of its systems. The quality of the optics is optimum thanks to advance technologies such as magneto-rheological polishing or stitching interferometry. Antireflective coatings and optical alignments are realized in-house to reduce straight light and parasitic polarization. Optical alignment and mounting is made inside clean rooms. All the system are tested intensively during several days before delivery.

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Up to 33 band-pass filters for multispectral

Fourier optics

Motorized iris, densities, polarizers, wave-plates
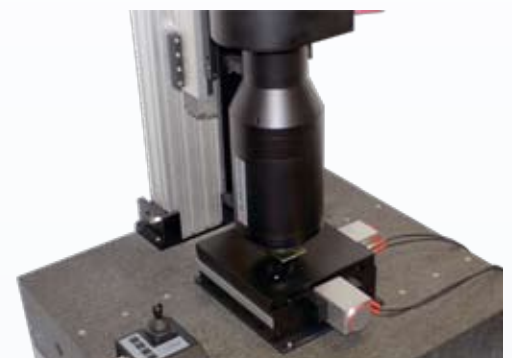

Laboratory bench with motorized Z axis
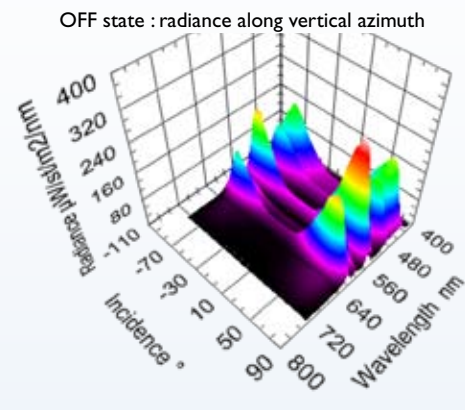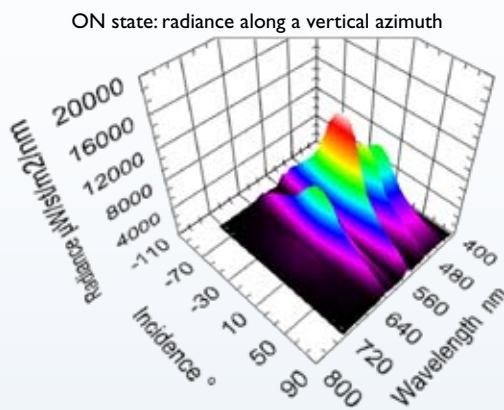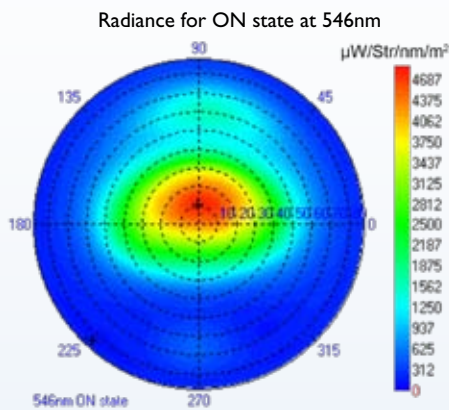

Laboratory bench with motorized Z axis

Inside EZContrastMS, different automated wheels allow selection of the light beam using 31 band pass filters regularly distributed in the visible range. Specific configurations can be done as option on customer requests. The system makes automatically a quasi spectral image of the full Fourier plane at each filter wavelength and the sequence is repeated for all the filters. The system is calibrated in an absolute way to reconstruct the spectral radiance of the object at each incidence and azimuth angle. Measurement spot size can be adjusted automatically. System response can be adapted to very bright sources with neutral densities. Polarizers and wave-plates allow full polarization analysis of the light.

Feature	Standard	Optional		
Spot size	2mm	1mm	500µm	300µm
Filters	31 filters from 400 to 700nm	2 additional band pass filters in NIR		
Densities		0.5	1.0	2.0
Polarizers		3 polarizers (0, 45, 90°) & 2 wave-plates		

EZContrastMS can be provided with dedicated optical bench for easier alignment and positioning. XY manual or automated tables are also available for homogeneity studies within the display surface. Completely automated systems with XYZ tables are also available up to 100inches size displays.

Motorized XY table for small displays

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Radance for ON state at 546nm

ON state: radiance along a vertical azimuth

OFF state : radiance along vertical azimuth

Ultimate LCD light emission study

Multispectral measurement of display emission is extremely powerful to analyze in details the performances. All the key components of LCD displays exhibit strong dependence versus wavelength (polarizer efficiency, transmittance of diffusive films and the polarization modulation of the liquid crystal itself among other). Full angular and radiance analysis allow better understanding of the LCD performances.

Radiance contrast

In addition to standard luminance contrast, the radiance contrast can be evaluated at each wavelength and angle. Lack of performance in the blue and red region can be detected and understood easier by LCD's development teams.

Color emission

From multispectral measurements of R, G and B states it is possible to calculate the radiance contrast for R, G and B pixels separately at any angle and wavelength. Color behavior can be better understood and improved.

Grey level analysis

Isocontrast curves are usually used to evaluate the viewing angle characteristics of LCDs. For grey level scales images, this is not sufficient. Viewing angle grey level analysis of luminance and lightness measured using Fourier optics instrument is generally used. The same type of analysis can be made by EZContrastMS using radiance instead of luminance or lightness. Complete grey level analysis of the LCD emission at each wavelength becomes possible. Fine dependence versus wavelength and incidence can be detected.
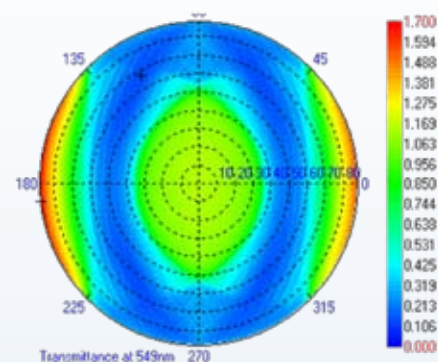

Contrast for R, G and B pixels

Radiance at 549nm versus grey level and incidence angle
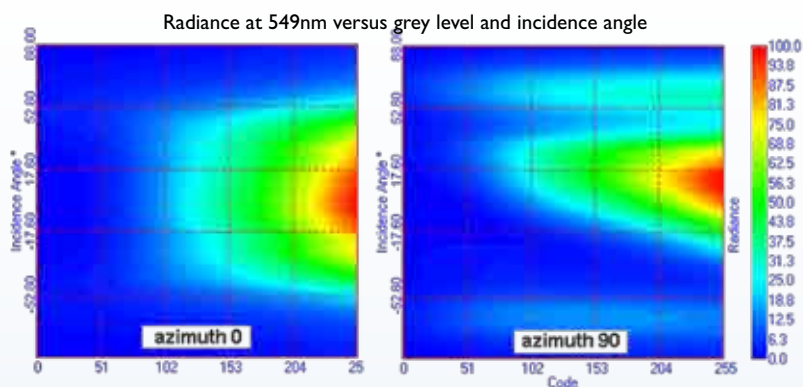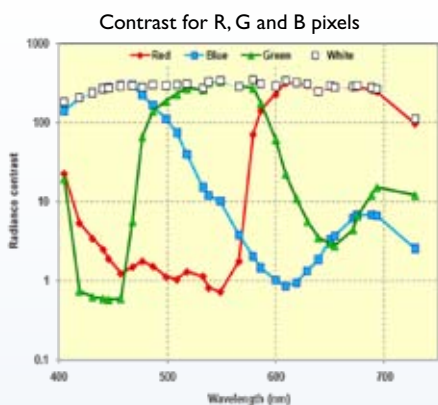
Reference white LED source

Angular emission of reference White source
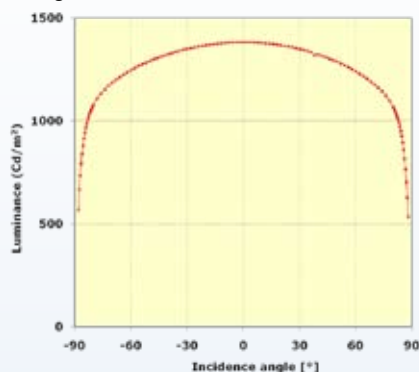
BEF film

LCD component characterization

Accurate simulation of LCDs require a good knowledge of the optical properties of any component includes in their structure. Characterization must be made versus angle and wavelength to be able to predict emission on the full cone. EZContrastMS is the tool of choice for this task. The full pattern of transmittance is obtained within minutes when days are needed using standard measurement solutions
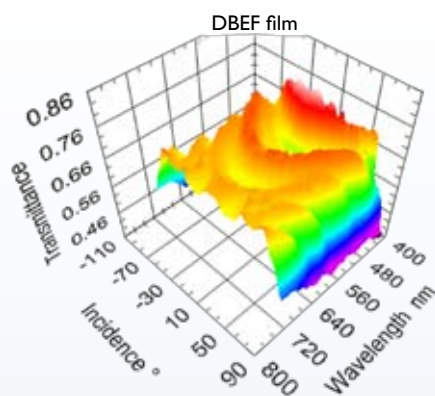
Speed and accuracy

ELDIM can provide a reference near Lambertian white source to make transmittance measurements. Stabilized light emission is ensure between 400 and 700nm with an excellent homogeneity and no residual polarization. Each film is fully characterized within minutes instead of hours or days with goniometric solutions.
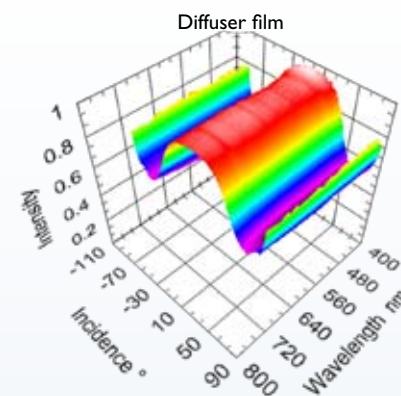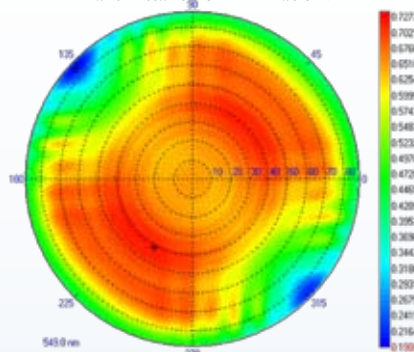
White LEDSource Specifications

Feature		Specifications
Stability	From 5% to 100%	±0.3%
Linearity	From 5% to 100%	±0.5%
Luminance	Min	70Cd/m²
	Max	1400Cd/m²
Uniformity	90% of diffusive surface	±4%
	70% of diffusive surface	±2%
Angular response	Intensity at 10° incidence	99.7%
	Intensity at 30° incidence	97.6%
Non polarized state	Polarization degree	<2%
Diffuser size	Working area	135 x 135mm
Housing size	L x W x H	295 x 280 x 50mm
Weight	Kg	2.5

Specular and diffused components

Components are always measured in conditions representative of their use inside displays. Specular and diffused contributions are measured simultaneously with EZContrastMS. This is extremely important because in many situations the diffused contribution is comparable to the specular one. In addition polarization effects can be quantified.

DBEF film

Transmittance of DBEF at 549nm

Diffuser film

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Polarization of LCD without top polarizer at 693nm

Z value : 693.0 nm
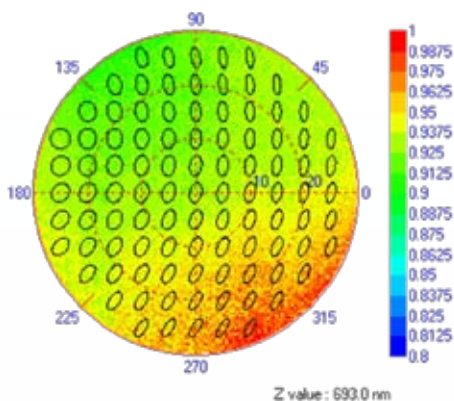
Ellipticity and polarization degree versus grey level and incidence angle

Stokes vector versus grey level at 549nm

Polarization analysis

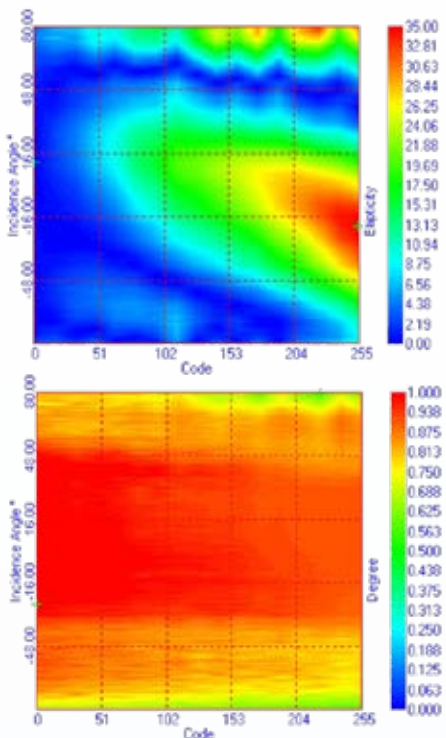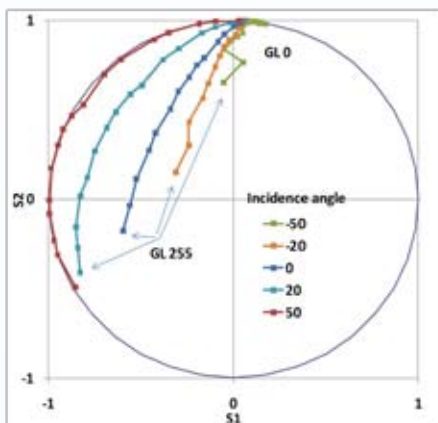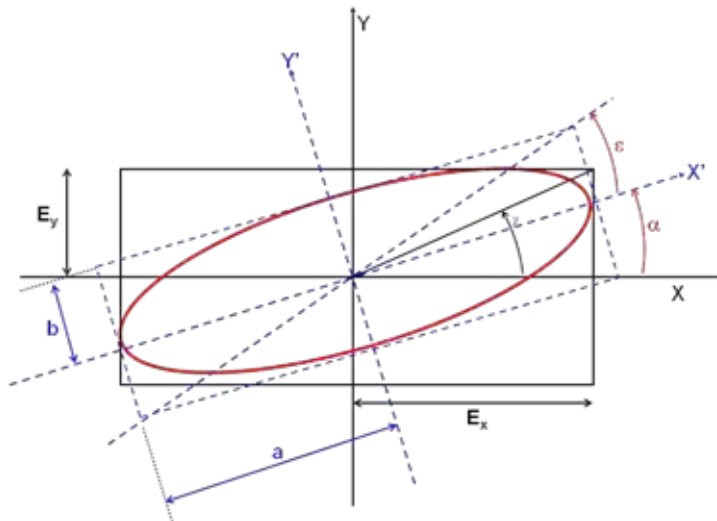EZContrastMS also includes different polarizers and wave-plates to allow full polarization analysis at each filter wavelength. Polarization ellipticity ε, polarization direction and polarization degree are then available in the full viewing angle for each filter wavelength.

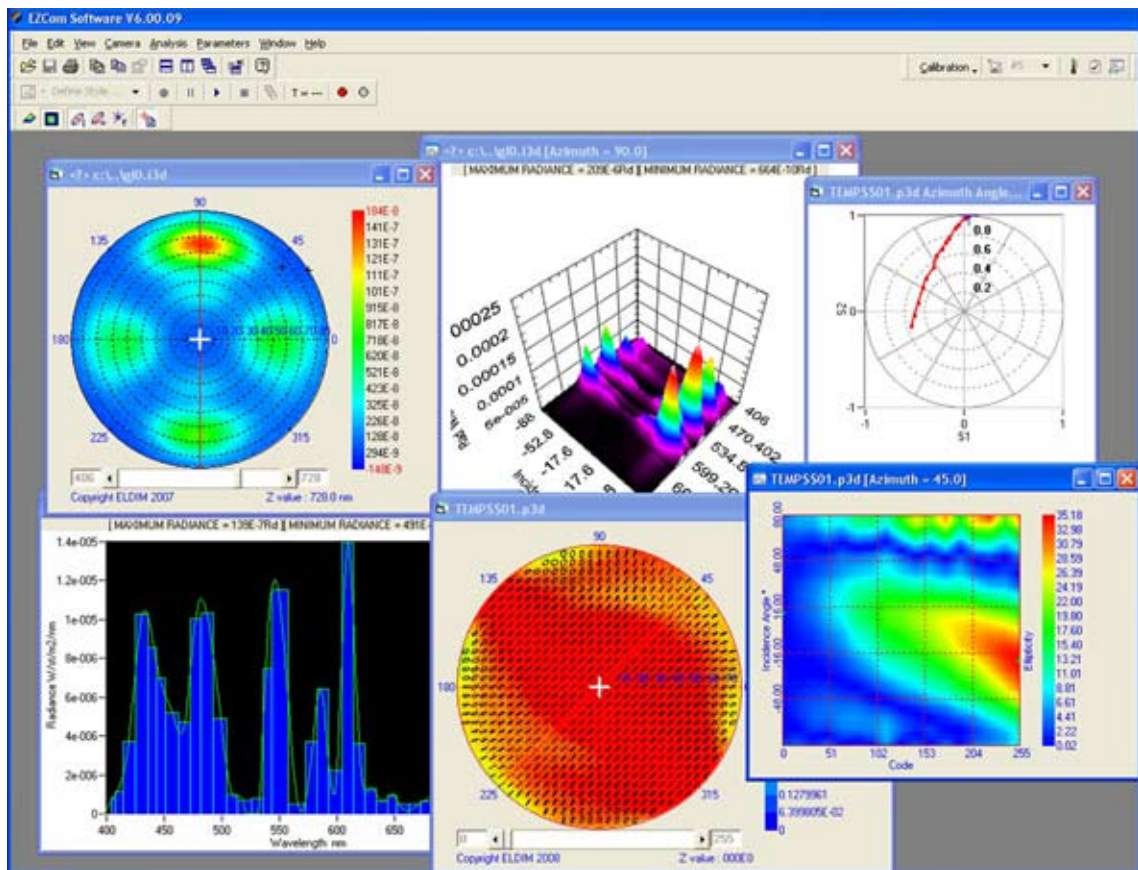## LCD performances and polarization

Polarization analysis of the light emitted by LCDs is very informative on the efficiency of the liquid crystal cell as polarization modulator. Unpolarized light detected in OFF state is, for example, directly related to the quality of the black level of the display and to the contrast in radiance or luminance.

Liquid crystal cell modulation

A powerful way to follow in details the crystal cell switching is to remove the last polarizer of the LCD and to measure the polarization state modulated by the cell versus grey level. The liquid crystal cell rotation acts as a wave-plate and the light becomes nearly circular polarized for ON state. The polarized light can be followed in all its details versus angle and wavelength. Stokes vector can be computed at any angle and wavelength for each grey level. It is possible then to evaluate the best top waveplate and polarizer to optimize the performances of the display.

Component characterization

Polarization efficiency of the polarizers must be analyzed in details for correct prediction of LCD performances. Also many films and components can have an impact of the polarization of the light and so some influence on the performances. EZContrastMS with ELDIM reference white source makes this characterization easy and fast.

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EZContrastMS comes with a complete open software solution for automated measurement and data analysis. All the features can be addressed by others softwares using Microsoft ActiveX technology. Programming examples are provided with the software.

Features	Details	ActiveX	Version
Measurement capacities	Styles for radiance measurement with independent parameters for each filter	Yes	Standard
	Single Filter measurement possible	Yes	Standard
	Polarization measurement with 7 configurations	Yes	Option
Multispectral radiance data	Component to manage and display 3D radiance data	Yes	Standard
	Cross sections versus incidence , azimuth or wavelength	Yes	Standard
	Data export to excel or any other software	Yes	Standard
	Calculation of color and luminance	Yes	Standard
	Grey level analysis of radiance data	Yes	Standard
Multispectral polarization data	Component to manage and display 3D polarization data	Yes	Option
	Cross sections versus incidence , azimuth or wavelength	Yes	Option
	Data export to excel or any other software	Yes	Option
	Stokes vector computation ,display and export	Yes	Option
Color data	Component to manage and display color data	Yes	Standard
	Data export to excel or any other software	Yes	Standard
	Color systems: XYZ, Lxy, Lu'v', Lu*v*,Lab, Color temperature, Dominant wavelength	Yes	Standard
Luminance data	Component to manage and display luminance data	Yes	Standard
	Data export to excel or any other software	Yes	Standard
	Grey level analysis of luminance data	Yes	Option

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Major specifications of EZContrastMS

		EZContrastMS88	EZContrastMS80
Field	Incidence angle Azimuth angle	±88° 0-360°	±80° 0-360°
Measuring area	Maximum diameter Other diameter (optional)	2mm 1mm, 500µm or 300µm*	2mm 1mm, 500µm or 300µm*
Optimum distance	Ensure light coming from same spot at any angle	1mm	3.7mm
Spectral specs	Standard Optional Spectral data extraction	31 band pass filters on the visible range 400-700nm 2 additional band pass filter (between 700 and 900nm) Interpolation with step between 1 and 5nm	
Measurement time	Radiance with full resolution Radiance with half resolution Polarization with full resolution	<6mn** <3mn** <15mn***	
Accuracy	Wavelength resolution (nm) Wavelength accuracy (nm) Angular resolution (deg) Radiance (W/Str/m²/nm) Chromaticity Ellipticity & polarization direction Polarization degree	10 1**** 0.15 ±3% 0.002 (for any stimulus) ±2° up to 60° ±2° up to 60°	10 1**** 0.15 ±3% 0.002 (for any stimulus) ±2° up to 50° ±2° up to 50°
Interface		USB 2.0	
Power		AC adapter (100-240V 50/60Hz)	
Current consumption		70W	
Weight		65Kg	55Kg

* Driven by software
** For A type illuminant with 100Cd/m²
*** For A type illuminant without polarization and 100Cd/m²
**** For all sources found generally inside displays
(it works in particular for monochromatic LED shape sources)

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Outer dimension (unit mm)

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