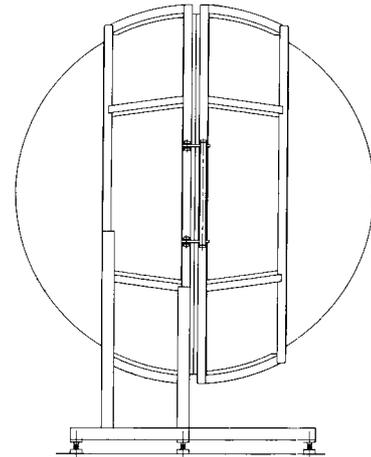


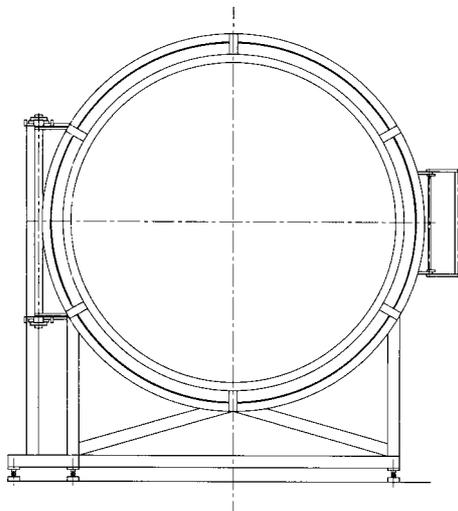
LightLab CIS2000BSi Integrating Sphere.

This system comprises:

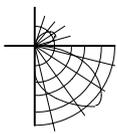
- a) A fully computerised, dual hemisphere 2000mm diameter Integrating Sphere mounted on a steel structure with castor wheels.
- b) Computer automation electronics, including combined spectroradiometer and silicon photodetector system, computer interface, Pentium computer and laser printer.
- c) Computer software covering control, data acquisition and report processing functions.
- d) Optional components for system calibration and laboratory operation.



CIS2000BSi Side View



CIS2000BSi Front View



LightLab CIS2000BSi Integrating Sphere.

A.1 CIS2000BSi Computerised 2000mm Integrating Sphere

The sphere is manufactured from two separate hemispheres that are vertically hinged. One hemisphere is attached to a rigid square section steel support assembly, the other hemisphere forms the door entry for access to inside the sphere. This is a traditional arrangement for this size sphere.

The interior of the CIS2000BSi sphere is coated with Barium Sulphate (BaSO₄) based reflectance paint. This paint forms a nearly perfect diffusing surface as required for accurate measurements. This paint is stable and durable; to clean away dust and other material simply wipe with a lint free cloth or a soft brush. Inside the sphere is a direct light shield and ports for the temperature measurement probe, sample holder, electrical supply and spectroradiometer port. The CIS2000BSi is constructed of corrosion proof materials and is guaranteed light-tight to ensure the life of your investment. A precision laser alignment system is built into the sphere as an option.

LightLab detection systems adhere to world standards, in particular the CIS2000BSi performs measurements and calculations according to CIE publications 15, 69 and 84 and complies with the requirements of CIE 25.

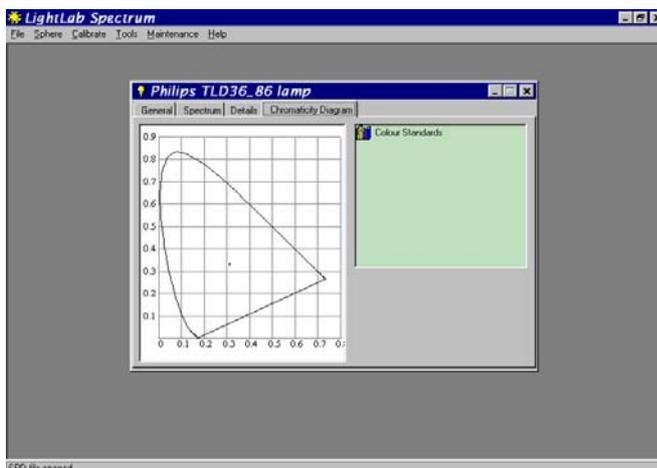
Two optical detection systems are used in the LightLab CIS2000BSi sphere to ensure the most accurate measurement system. A silicon photodetector is used to ensure accurate measurement of luminous flux and a 2048 element silicon spectrometer ensures accurate spectral measurements.

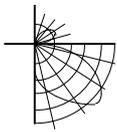
The CIS2000BSi is fitted with temperature stabilized (35°C) Silicon Photodetector (CIE parameters $f_1 < 1.5\%$, $f_2 < 1.5\%$). The photodetector is interfaced to the computer through a GPIB based picoammeter.

The spectroradiometer detector used in the CIS2000BSi uses a revolutionary optical design that includes the world's first miniature spectrometer coupled to the sphere. The CCD has 2048 elements and a very fine grating and contains no moving parts. This gives the spectrometer significant reliability over designs that incorporate motors and rotating gratings.

By using a spectrometer to measure the spectral power density of the light within the integrating sphere, colour corrections for the V_λ response of the photocell are then applied mathematically to

enhance the measurement accuracy of the photodetector. The spectrometer incorporated in the CIS2000BSi is calibrated against the CIE V_λ responsivity across the full spectrum, thus yielding the highest possible degree of accuracy. Furthermore the responsivity of both the spectrometer and the sphere is calibrated simultaneously so that accurate colorimetric and photometric readings for any light source can be computed. The dual detector system in the CIS2000BSi ensures unprecedented accuracy of measurement for your laboratory.



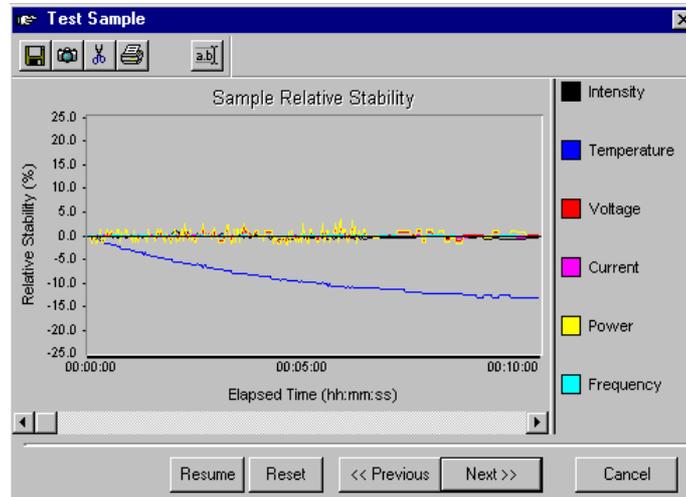


LightLab CIS2000BSi Integrating Sphere.

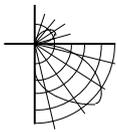
By using the dual spectroradiometer and silicon photodetectors the CIS2000BSi can perform a full range of photometric and colorimetric measurements, including the following :

- Spectral Energy Distribution
- Colour co-ordinates x, y, u, v
- Correlated colour temperature
- Luminous flux in lumens
- General and Special colour rendering indices
- UCS Chromaticity 2nd Field
- CIE Chromaticity 2nd Field
- CIE and UCS Chromaticity diagrams with point representation of the sample
- Luminous efficacy (in conjunction with power measurement instrument)

The functionality of the CIS2000BSi is enhanced with its integrated computer system which includes the computer, monitor, colour printer and operating software "Sphere". All of the common tasks are automated : calibration of the system, performing test measurements and even diagnostic functions are all included as step by step laboratory wizards. This considerably eases the burden of operators. Furthermore all of the test data is electronically logged and can be retrieved at a later date. Reports containing all of the measurement information can be previewed or printed. With our lamp stability tracking module you can view the lamp flux output (along with all of the other parameters such as voltage, current, power, colour coordinates, colour temperature and so on) versus time on the screen so the operator can quickly determine if the test lamp is stable. This saves time in the laboratory and ensures accurate results.



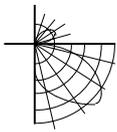
The CIS2000BSi comes complete with an auxiliary lamp for measurement of test lamp self absorption in cases where the test lamp is different from the sphere calibration lamp. The auxiliary lamp is driven from a constant current dc power supply fitted next to the computer. As an option the system can be fitted with a Platinum RTD ambient temperature sensor through the wall of the sphere.



LightLab CIS2000BSi Integrating Sphere.

Specification summary:

Electrical characteristics of supply	Option StVACIS125kV1	1.25 kVA maximum supply Voltage regulation $\leq 0.1\%$ THD $\leq 1\%$
Electrical measurement Accuracy	Option WTCIS	Voltage $< 0.2\%$
	Option WTPCIS	Voltage $< 0.1\%$
Photocell Specifications All options have 35° C temperature stabilisation	Standard photocell	20 nA / lux response
	Option PhotCIS	120 nA / lux response, CIE characteristics as per Photocell Table 1 in the summary section
Software	Sphere	Wizard based procedures, calibration tracking, diagnostics, client formattable test reports
Sample characteristics	Horiz.dimensions	1500mm max luminous length
	Maximum power	Limited only by stabilised supply
System Supply		100 – 120V or 220 – 240V (50/60 Hz)

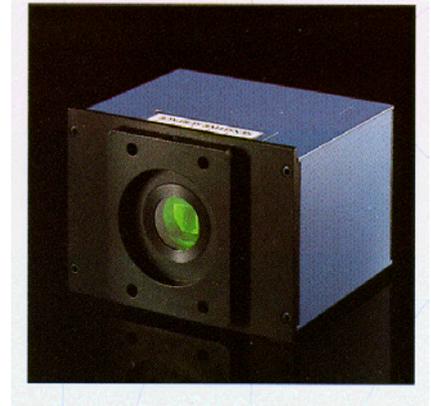


LightLab CIS2000BSi Integrating Sphere.

B.1 Photoelectric Detector

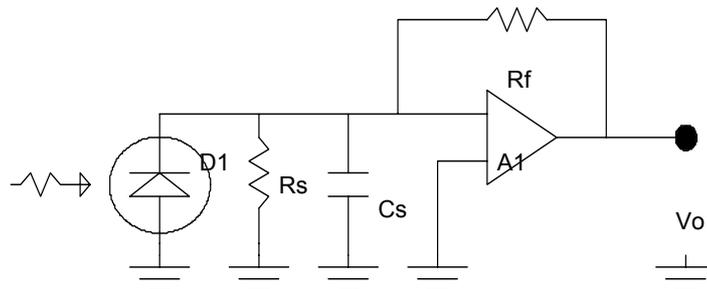
All of the photodetectors supplied meet the following minimum specifications below, specific features of each photocell option are listed in the Specification Summary section.

Thermally stabilised Si-photovoltaic cell (35 degrees Celsius) with high accuracy $V\lambda$ correction using the full filter method ($f_1 < 1.0\%$, $f_1 \leq 2.0\%$, refer CIE Pub No 53). Photodetector comes complete with spectral response calibration certificate and separate power supply for the cell heater.



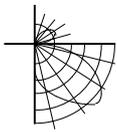
- very high shunt resistance (R_s), giving the system a low overall noise gain.
- low shunt capacitance (C_s), giving fast response to rapidly changing intensities.

Other photocells are available, please refer to the options.



Simplified Photocell Input Circuit.

- Noise gain a to R_f/R_s
- Frequency response a $1/(C_s \times R_f)$



LightLab CIS2000BSi Integrating Sphere.

B.2 Photocell Interface

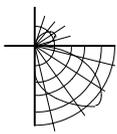
The interface electronics used in the Model R100 Photometer drives the output from the photocell into a virtual earth (refer simplified photocell input circuit) via a low noise, low capacitance 'Triax' cable and will measure over the range 2nA (resolution 10fA) to 2mA (10nA resolution). Precision is 5 & 1/2 digits auto ranging. The unit is fully programmable via an IEEE-488 bus and has selectable 50Hz or 60Hz line integration to reduce noise. The interface electronics has an integral display so it can display the photocell value independently of the computer.

B.3 Computer

The integrating sphere is fully computer controlled and is therefore supplied complete with computer.

Specifications:

- IBM PC compatible, Pentium IV processor.
- 80 GB Hard disk.
- 512 Mb RAM.
- 15" TFT LCD colour screen and interface card.
- IEEE-488 interface card and software.
- Parallel and Serial ports, cd-rom, network interface and all accessories
- An optional printer
- An optional 19" rack mount industrial computer chassis and enclosure.



LightLab CIS2000BSi Integrating Sphere.

C.1 Power meters

The system optionally includes two Yokogawa WT200 wattmeters fitted into the control room instrumentation rack complete with one precision shunt wired onto the photometer. Wattmeters are connected via IEEE instrumentation bus to the computer. One wattmeter is used to measure lamp volts, amps & watts, the other for total circuit (lamp+ballast) volts, amps & watts.

For higher precision measurements and measurement of 3 phase inputs there is the option of using either a Yokogawa WT130 or a Voltech PM3000ACE meter instead of the WT200. Combinations of meters are supported to measure the electrical parameters at more than one point or a single Voltech PM3000ACE can be configured to measure at two points, allowing separate measurements of line and lamp measurements for most parameters.

Measurement system	3 phase
Basic accuracy	0.05%
Bandwidth	DC and 0.1Hz to 1 MHz
Measurements	W, V, A, VA, VAR, power factor, Cos, Vpk, Apk, crest factors, frequency and inrush current, transients
Harmonics	A, V, (incl. Phase) and W to the 99th. THD Integrator for W-hr, VA-hr, A-hr, VA-hr, Average and target PF Crest factors up to 20
Integration	W-hr, VA-hr, A-hr, VA-hr, Average and target PF

System measurement specifications with PM3000ACE option

Additional measurements made by the instrumentation is available for display, logging and reporting by the computer system.

C.2 Stabilised power supply.

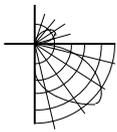
LightLab recommends California Instruments stabilised AC power sources. There are a range of models available to suit your requirements. Model 5000iM will allow operation to 5000VA, single phase output. Model 4500L also operates to 5000VA and has a 3 phase output.

For those supplies that support it, control of the output can be done through the front panel or by the host computer.

C.3 Temperature Indicator.

The system includes one Analog Devices Acquisition Unit configured as a digital thermometer, Sensor is potted inside 6mm diameter stainless steel tube. Resolution is 0.05°C and calibrated accuracy is 0.25°C.

For greater resolution, an optional HP Data Acquisition Unit configured as a digital thermometer is available, connected via IEEE instrumentation bus to the control computer. Calibrated accuracy is 0.1°C. This option replaces the standard instrumentation.



LightLab CIS2000BSi Integrating Sphere.

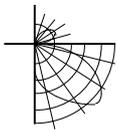
D. CIS2000BSi Integrating Sphere system summary :

The CIS2000BSi comprises:

- D.1 Size : 2000mm nom internal diameter.
 D.2 Material : Glass fibre.
 D.3 External Colour: According to agreement between customer and LightLab, black and blue are typical colours.
 D.4 Construction : Two separate hemispheres vertically hinged. Refer diagram on front page.
 D.5 Door Lock : Bar type handle with over-centre mechanical locking feature.
 D.6 Structure : Mild steel frame support with heavy duty castor type wheels.
 D.7 Interior Coating : Multiple coatings of high reflectance BaSO₄ paint.
 D.8 Direct Light Shield : Fitted about horizontal axis in front of detector port with provision for fitting of various size baffle plates.
 D.9 Detector : Silicon photodetector and spectroradiometer (no moving parts).
 D.10 Auxiliary Lamp : Fitted to inside wall on sphere and driven from a constant current dc power supply.
 D.11 Computer : Laboratory class computer as specified

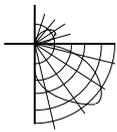
Options

<i>Item</i>	<i>Description</i>	<i>Qty</i>
MaintCIS	Maintenance contract LightLab will maintain and service the integrating sphere upon expiry of the warranty. Maintenance includes annual calibration, software updates, training courses and servicing where required.	1
StVACIS	Power Stabilisers California Instruments range of power stabilisers as detailed below : 800VA – single phase, CI Model 800RP : StVACIS8kV1 1000VA – single phase, CI Model 1000P : StVACIS1kV1 1250VA – single phase, CI Model 1250RP : StVACIS125kV1 2000VA – single phase, CI Model 2001RP : StVACIS2kV1 2000VA – three phase, CI Model 2003RP : StVACIS2kV3 3000VA – single phase, CI Model 3000iM : StVACIS3kV1 5000VA – single phase, CI Model 5000iM : StVACIS5kV1 5000VA – three phase, CI Model 4500L : StVACIS5kV3	1
ATCIS	Ambient temperature measurement & display RTD probe fitted into sphere wall with Agilent rack mount 6 & ½ digit data acquisition unit / thermometer with IEEE-488 interface to display temperature inside sphere. Will also display supply voltage or lamp voltage where the user does not opt for a wattmeter. Unit is integrated with LightLab testing software.	1



LightLab CIS2000BSi Integrating Sphere.

LRSCIS	<p>Lumen & Relative Spectral Irradiance Standard Lamps</p> <p>One set of three lumen standard incandescent lamps with one calibrated for relative spectral irradiance, E27 base, 240V 60W or other wattages on request. Used for spectral calibration of both the sphere and spectrometer simultaneously. Lamps come serialised and with National Measurement Laboratory (NML) calibration certificates.</p>	1 set of 3 lamps
LRSCISL	<p>LightLab Lumen & Relative Spectral Irradiance Standard Lamps</p> <p>One set of three lumen standard incandescent lamps with one calibrated for relative spectral irradiance, E27 base, 240V 60W or other wattages on request. Used for spectral calibration of both the sphere and spectrometer simultaneously. Lamps come serialised and with LightLab calibration certificates.</p>	1 set of 3 lamps
LMFCIS	<p>Lamp Mounting Fixtures</p> <p>Painted brass mounting tubes with 4 wire E27 or E40 bases, bipin incandescent lamp holder</p>	Each
LMFCISDE	<p>Double ended Fluorescent Lamp Mounting Fixtures</p> <p>Painted brass mounting tube with adjustable fluorescent lamp holder between 10 and 40W, to suit T5 or T8 lamps</p>	Each
PTCIS	<p>Printer</p> <p>HP Laserjet 1200 1200 DPI laser configured for LightLab software (PTCISLas) or HP Deskjet Cxi960 colour inkjet printer (PTCISIJ). Other printers available on request.</p>	1
IRCIS	<p>Instrument Rack</p> <p>Rittal very high quality 19" instrumentation rack to fit computer, thermometer, wattmeter with space provided for further expansion.</p>	1
WTCIS	<p>50kHz Wattmeter</p> <p>Yokogawa WT200 50kHz single phase wattmeter with rack mounting kit, IEEE-488 interface and integrated into LightLab testing software. Used to measure lamp operating parameters. Specify WTRLampR80 for wattmeter setup for measurement of lamp parameters and/or WTRSupplyR80 for wattmeter setup for measurement of supply parameters.</p>	1
WTCIS3	<p>3 Phase Wattmeter</p> <p>Yokogawa WT103 three phase wattmeter with rack mounting kit, IEEE-488 interface and integrated into LightLab testing software. Used to measure electrical operating parameters.</p>	1
WTPCIS3	<p>High Precision 3 Phase Wattmeter</p> <p>Voltech PM3000A three phase wattmeter with rack mounting kit, IEEE-488 interface and integrated into LightLab testing software. Used for high precision measurement of electrical operating parameters.</p>	1
TICIS	<p>Training & Installation</p> <p>LightLab will provide training and installation service if required. With this option for one LightLab Engineer to come to the client's premises, install and perform one day training on the operation of the CIS2000BSi. Includes all costs associated with travel and accommodation. Requires two days at client's premises.</p>	1



LightLab CIS2000BSi Integrating Sphere.

FiltCIS	<p>Coloured and Neutral density filters</p> <p>For calibration of the photocell according to the method of CIE Pub 24. This allows field verification of the system performance in terms of spectral response and linearity.</p>	
2yCIS	<p>2 year warranty</p> <p>This option gives a one year extension to usual one year system warranty, total 2 years.</p>	1
LmpCIS	<p>Calibrated Lamps</p> <p>Other lamps can be supplied with the system. Typically the lamps will be supplied in groups of 3 and calibrated for luminous flux and / or spectral output at client request, calibration report will include the CRI and CCT where appropriate. The lamps can be of types : compact fluorescent – LmpCISCFL, high pressure sodium – LmpCISHPS, metal halide LmpCISMH or incandescent LmpCISInc. Specify wattage and type at time of order. Lamps are supplied with hand selected production ballasts or can be combined with option BalCIS below.</p>	Set of 3 lamps
LaserCIS	<p>Laser</p> <p>Laser for lining up the test sample inside the integrating sphere.</p>	1

Characteristic	Symbol for associated error parameter	Maximum Value
V(λ) match	f1	1.5 %
Cosine Response	f2	-
Linearity	f3	0.1%
Error of display unit	f4	0.2 %
Fatigue	f5	0.2%
Evaluation of modulated light	f7	-
Polarization dependence	f8	-
Influence of non-uniform illumination	f9	1.0 %
Range change	f11	0.1%
UV response	U	0.2%
IR response	R	0.2%
Temp. dependence	A	0.2 % / K
Responsivity		30, 60 or 120nA / lux

Photocell Table 1 – for CIE parameters not listed here please contact LightLab for specifications