KONICA MINOLTA

Spectroradiometer
CS-2000/2000A

The world's top-level capability spectroradiometers make further advances with addition of second model to lineup.

Giving Shape to Ideas

World's top level capability to detect extremely low luminance

* As a polychromator type spectroradiometer (As of March 2009)

1,000,000:1 contrast measurement is now possible!

* When the peak luminance is 500 cd/m²

CS-2000A

Opening the curtain on a new age in which people can experience theater ambiance with their home televisions.
The Spectroradiometer CS-2000A enables high-accuracy mega-contrast measurements of the extremes from delicate shadows to glittering wavefronts which are key to image reproduction performance.
This newest addition to the Konica Minolta Optics lineup will contribute greatly to research and development as well as quality control of the most advanced FPDs.

0.0005 cd/m² opens new worlds

With an additional decimal place of performance in measuring low luminosity even compared to our CS-2000, which was awarded the ADY 2008 grand prize, the CS-2000A helps open up a new stage of display development by enabling the measurement of contrast ratios up to 1 million to 1*1 which is being targeted by the latest FPD technology.

*1 Maximum luminance 500 cd/m²

Measurement example:
Measurement of an organic EL illumination panel during development

Instruments that push the extreme boundaries of practical application and cost performance to support design and development work.

CS-2000

Highly accurate measurement of luminances as low as 0.003 cd/m²

Konica Minolta's original optical design and signal-processing technologies provide accurate measurement of luminance/chromaticity down to extremely low luminances of 0.003 cd/m².

Low-luminance measurements: From 0.003 cd/m²
Measurement accuracy: ±2% (Luminance)

Quick measurements even at low luminance

Designed to thoroughly eliminate mechanical and electrical noise factors, the CS-2000 makes quick measurements with good repeatability possible even at low luminance levels.

Measurement time for 1 cd/m²:
Approx. 5 sec. (FAST mode)

* Konica Minolta's previous model CS-1000: Approx. 123 sec.

Low polarization error

The polarization error generated when using a reflection-type diffraction grating has been minimized to 2% (measuring angle: 1°). This ensures more stable measurements of display devices that use polarization, such as LCDs.

Half bandwidth of 5 nm

A half bandwidth of 5 nm, which is required for colorimetry (JIS Z 8724-1997, CIE122-1996), is ensured for the entire wavelength range, allowing accurate chromaticity measurements.

Selectable measuring angle for measurement of tiny areas

The CS-2000 enables you to select the optimum measuring angle according to the application.

Measuring angle selection: 1°, 0.2°, 0.1°

Minimum measuring area: ø0.1 mm (when the optional close-up lens is attached)

Practical design

- The operating temperature range of 5 to 35°C ensures reliable operation at temperatures in actual work environments.
- Measurement can be started after a warm-up time of only 30 seconds. (Measuring angle: 1°; Target luminance: 5 cd/m² or more; 23°C)

Stable measurement even of periodic light sources

1. Internal synchronization measurement

   Measurement at numerically-input frequency

2. External synchronization measurement

   Measurement with line input of vertical synchronization signal to instrument

3. Multi-integration mode measurement

   Measurement for reducing variations due to unsynchronized measurements or synchronized measurements of sources having irregular light-emission cycles

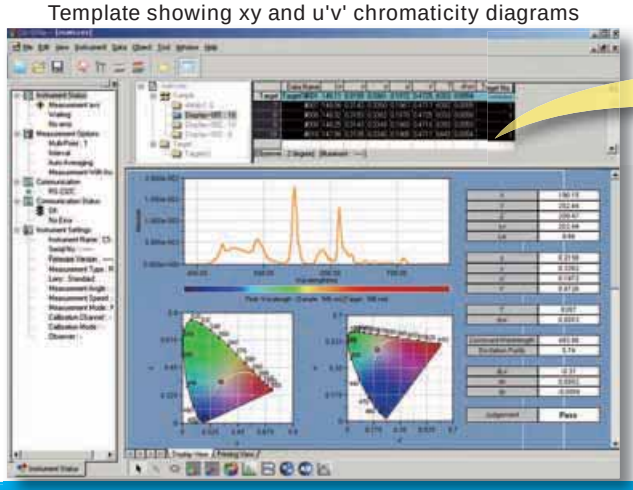
Easy operation with color LCD screen and simple operation panel

The color LCD screen and operation panel are located at the rear of the instrument The simply arranged operation panel enables intuiti e selection of necessary functions

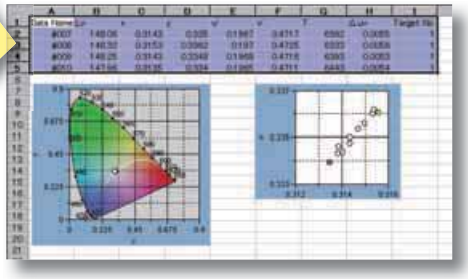
Data Management Software CS-S10w Professional (Standard accessory)

With this software the CS-2 and CS-2 A can be controlled from a personal computer to display measured data in arious graphs or lists to transfer data to spreadsheet software or to copy-and-paste data CS-S w offers arious data management analysis and e aluation options to assist in research and de elopment or uality control

Template showing xy and u'v' chromaticity diagrams



Multiple data objects can be copied and pasted to spreadsheet software.



- Windows is a trademark or registered trademark of Microsoft Corporation in the USA and other countries
- Pentium is a trademark of ntel Corporation in the USA and other countries

Display	Spectral graph spectral data list chromaticity diagram
Color space mode	L y L u L T u dominant wa elength e citation purity scotopic luminosity
Calculation	our basic arithmetic operations and function processing of spectral data
Mode selection	Normal mode contrast mode B mode B contrast mode ob ect color mode
Instrument control	A eraging measurement inter al measurement user calibration
Data management	eading sa ing les managing data by using folders creating sa ing and reading templates with arious graphs designed and laid-out by users displaying data with graphs
Data evaluation	Obser er illuminant setting color rendering property e aluation statistic alue display for each folder bo tolerance setting multiple point setting for display e aluation non-uniformity (mura) display contrast display polygonal tolerance setting

System requirements

OS	Windows P Professional 32-bit SP3 -bit SP2
	Windows ista Business 32-bit -bit
	Windows Professional 32-bit -bit
CPU	Pentium MH e ui alent or faster
Memory	2 MB or more (2 MB or more recommended)
Hard disk	MB or more of free space for installation
Display	2 2 colors minimum
Other	CD- OM dri e for installation USB port for instrument connection

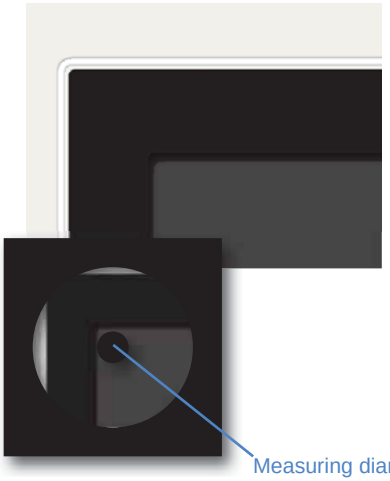
Measurement Examples

Measurements of various objects are possible by selecting the best-suited measuring angle.

1° is suitable for

Typical targets such as middle- and large-size display units

- LCD, PDP, or EL display panels
- LCD panels of cellular phones and digital cameras
- Radar and other instrument panels used in airplane cockpits
- Large outdoor display screens



Measuring diameter viewed through viewfinder

0.2° is suitable for

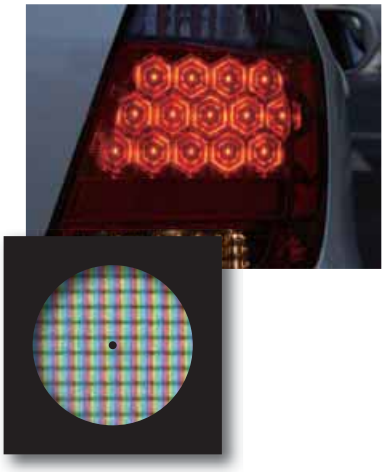
Small light sources such as LEDs

- Car audio systems
- Instrument panels for automobiles
- Lamps, fluorescent tube backlights, and other light sources

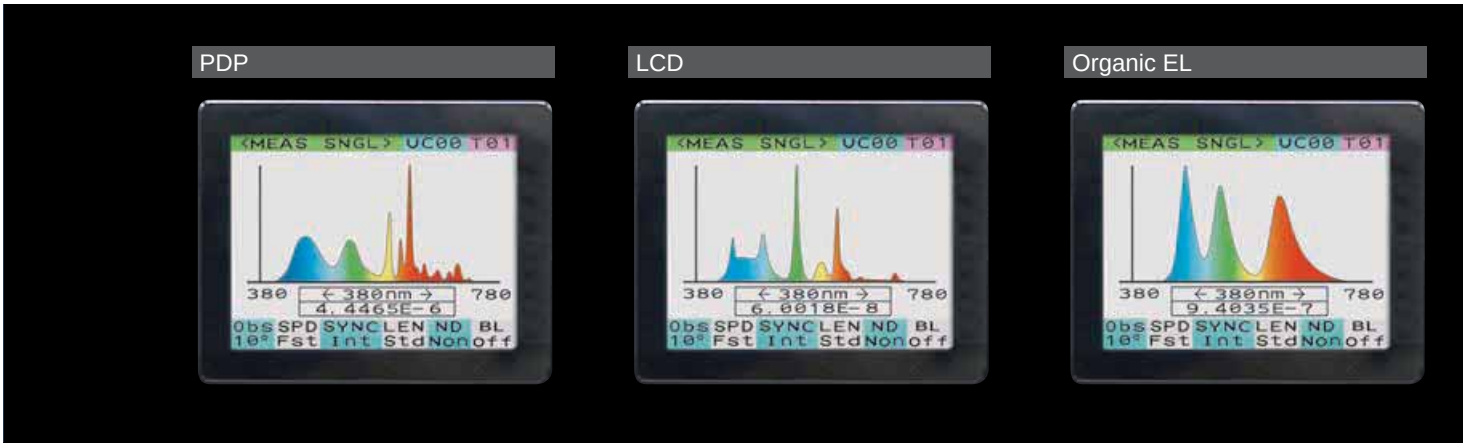
0.1° is suitable for

Extremely small light sources or distant lights

- PDP or LCD pixels
- Cold-cathode tubes
- Brake lamps of automobiles
- Traffic signals



LCD pixels



Close-up lens for measurement of even tinier areas

(Optional accessory)

Optional close-up lens allows measurements of areas as tiny as ø0.1 mm. Not only general display units but also small targets can be measured.

■ Measuring distance vs. measuring area

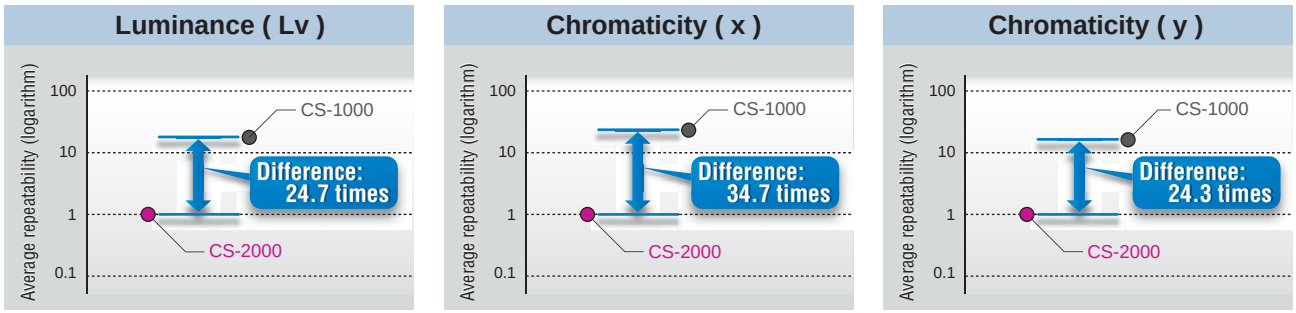
(Units: mm)

Measuring distance		Measuring angle		
		1°	0.2°	0.1°
When a close-up lens is attached	55.0	ø1.00	ø0.20	ø0.10
	70.9	ø1.39	ø0.28	ø0.14
350		ø5.00	ø1.00	ø0.50
500		ø7.78	ø1.56	ø0.78
1,000		ø16.66	ø3.33	ø1.67
2,000		ø34.18	ø6.84	ø3.42

* The measuring distance is the distance from the objective lens or the end of the metal frame of the close-up lens.

Comparison of repeatability

* Comparison with Konica Minolta's previous model CS-1000 for target luminance of 0.1 cd/m^2
* The y-axis indicates the logarithm when the average of the CS-2000 measured values is assumed to be 1.



High repeatability achieved by an instrument design which thoroughly eliminated mechanical and electrical noise factors.

Measured luminance vs. Measurement times

(Units: sec.)

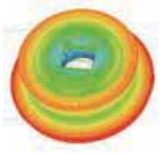
Luminance (cd/m^2)	NORMAL mode	FAST mode
0.003	243	35
0.01	243	35
0.1	155	27
1	19	5
10	4	4
300	3.7	3.7

Measurement subject: Standard light source A

* All time indications are approximate values.

Technology

The optical sensor, which is the heart of the CS-2000, was designed through precise analysis in order to eliminate the influence of thermal distortion of its components on the measurement values.



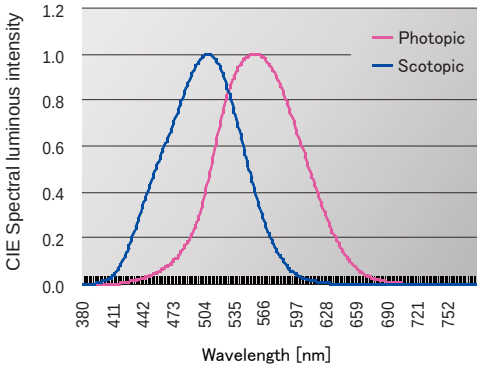
Thermal analysis diagram of the sensor block

Scotopic vision measurement

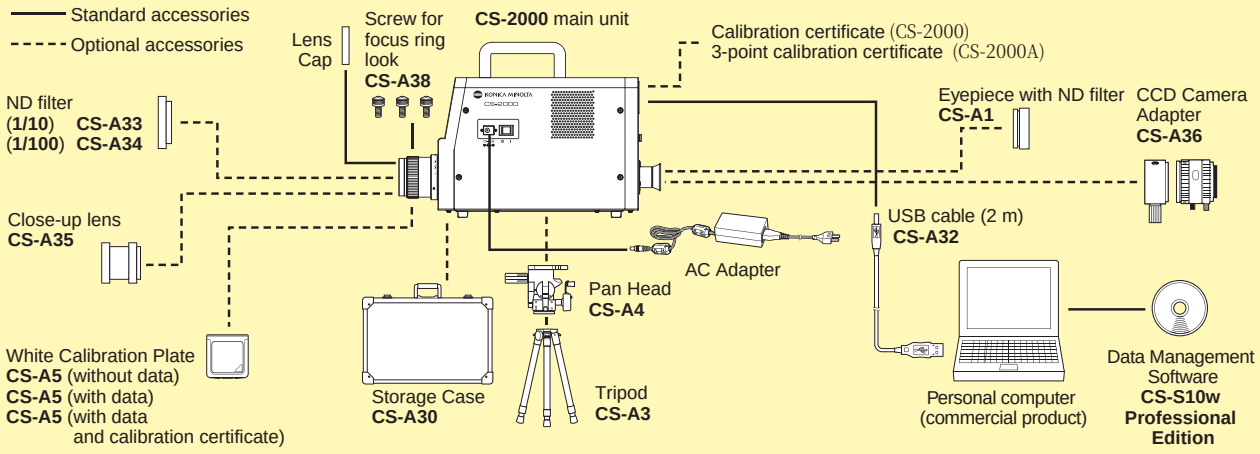
It is known that the sensitivity of human vision shifts to blue region in dark environments, but past instruments did not have scotopic measurement function. CS-2000A achieves sufficient capability to make it possible with CS-S10w Professional (standard accessory).

Scotopic vision

In the human eye, there are 2 types of photoreceptor cells, which are cone cells and rod cells. Cone cells are sensitive to color and rod cells are sensitive to only brightness. As brightness decreases, the activity of rod cells becomes stronger, and the condition in which only rod cells are working is called scotopic vision. The peak of spectral luminous efficiency of scotopic vision is shifted toward blue from the green peak of photopic vision (vision under brighter conditions) and thus blue objects are perceived to be brighter.



■ System Configuration



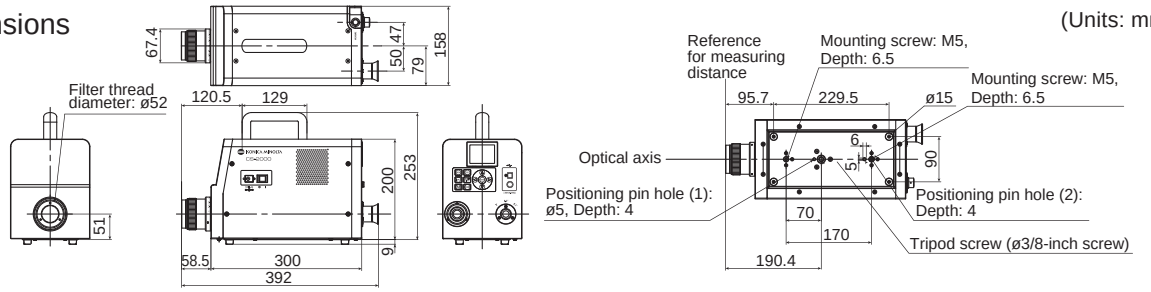
Major specifications of CS-2000/2000A

Model		CS-2000/2000A		
Wavelength range		380 to 780 nm		
Wavelength resolution		0.9 nm/pixel		
Display wavelength bandwidth		1.0 nm		
Wavelength precision		±0.3 nm (Median wavelength: 435.8 nm, 546.1 nm, 643.8 nm; Hg-Cd lamp)		
Spectral bandwidth		5 nm or less (half bandwidth)		
Measuring angle (selectable)		1°	0.2°	0.1°
Measurement luminance range (Standard light source A)	CS-2000	0.003 to 5,000 cd/m²	0.075 to 125,000 cd/m²	0.3 to 500,000 cd/m²
	CS-2000A	0.0005 to 5,000 cd/m²	0.0125 to 125,000 cd/m²	0.05 to 500,000 cd/m²
Minimum measuring area		ø5 mm (ø1 mm when using close-up lens)	ø1 mm (ø0.2 mm when using close-up lens)	ø0.5 mm (ø0.1 mm when using close-up lens)
Minimum measuring distance		350 mm (55 mm when using close-up lens)		
Minimum spectral radiance display		1.0x10⁻⁹ W/sr, m², nm		
Accuracy: Luminance (Standard light source A)*1		±2%		
CS-2000	Accuracy: Chromaticity (Standard light source A)*1	x,y : ±0.003 (0.003 to 0.005 cd/m²) x,y : ±0.002 (0.005 to 0.05 cd/m²) x : ±0.0015 y : ±0.001 (0.05 cd/m² or more)	x,y : ±0.003 (0.075 to 0.125 cd/m²) x,y : ±0.002 (0.125 to 1.25 cd/m²) x : ±0.0015 y : ±0.001 (1.25 cd/m² or more)	x,y : ±0.003 (0.3 to 0.5 cd/m²) x,y : ±0.002 (0.5 to 5 cd/m²) x : ±0.0015 y : ±0.001 (5 cd/m² or more)
	Repeatability: Luminance (2σ) (Standard light source A)*2	0.4% (0.003 to 0.05 cd/m²) 0.3% (0.05 to 0.1 cd/m²) 0.15% (0.1 to 5,000 cd/m²)	0.4% (0.075 to 1.25 cd/m²) 0.3% (1.25 to 2.5 cd/m²) 0.15% (2.5 to 125,000 cd/m²)	0.4% (0.3 to 5 cd/m²) 0.3% (5 to 10 cd/m²) 0.15% (10 to 500,000 cd/m²)
	Repeatability: Chromaticity (2σ) (Standard light source A)*2	x,y : 0.002 (0.003 to 0.005 cd/m²) x,y : 0.001 (0.005 to 0.1 cd/m²) x,y : 0.0006 (0.1 to 0.2 cd/m²) x,y : 0.0004 (0.2 to 5,000 cd/m²)	x,y : 0.002 (0.075 to 0.125 cd/m²) x,y : 0.001 (0.125 to 2.5 cd/m²) x,y : 0.0006 (2.5 to 5 cd/m²) x,y : 0.0004 (5 to 125,000 cd/m²)	x,y : 0.002 (0.3 to 0.5 cd/m²) x,y : 0.001 (0.5 to 10 cd/m²) x,y : 0.0006 (10 to 20 cd/m²) x,y : 0.0004 (20 to 500,000 cd/m²)
CS-2000A	Accuracy: Chromaticity (Standard light source A)*1	x,y :±0.002 (0.001 to 0.05 cd/m²) x : ±0.0015 y : ±0.001 (0.05 cd/m² or more)	x,y : ±0.002 (0.025 to 1.25 cd/m²) x : ±0.0015 y : ±0.001 (1.25 cd/m² or more)	x,y : ±0.002 (0.1 to 5 cd/m²) x : ±0.0015 y : ±0.001 (5 cd/m² or more)
	Repeatability: Luminance (2σ) (Standard light source A)*2	1.5% (0.0005 to 0.001 cd/m²) 0.7% (0.001 to 0.003 cd/m²) 0.25% (0.003 to 0.05 cd/m²) 0.15% (0.05 to 5,000 cd/m²)	1.5% (0.0125 to 0.025 cd/m²) 0.7% (0.025 to 0.075 cd/m²) 0.25% (0.075 to 1.25 cd/m²) 0.15% (1.25 to 125,000 cd/m²)	1.5% (0.05 to 0.1 cd/m²) 0.7% (0.1 to 0.3 cd/m²) 0.25% (0.3 to 5 cd/m²) 0.15% (5 to 500,000 cd/m²)
	Repeatability: Chromaticity (2σ) (Standard light source A)*2	x: 0.003 y:0.0035 (0.001 to 0.003 cd/m²) x: 0.001 y:0.0015 (0.003 to 0.1 cd/m²) x,y: 0.0006 (0.1 to 0.2 cd/m²) x,y: 0.0004 (0.2 to 5,000 cd/m²)	x: 0.003 y: 0.0035 (0.025 to 0.075 cd/m²) x: 0.001 y: 0.0015 (0.075 to 2.5 cd/m²) x,y: 0.0006 (2.5 to 5 cd/m²) x,y: 0.0004 (5 to 125,000 cd/m²)	x: 0.003 y: 0.0035 (0.1 to 0.3 cd/m²) x: 0.001 y: 0.0015 (0.3 to 10 cd/m²) x,y : 0.0006 (10 to 20 cd/m²) x,y : 0.0004 (20 to 500,000 cd/m²)
Polarization error		1°: 2% or less (400 to 780 nm); 0.1° and 0.2°: 3% or less (400 to 780 nm)		
Integration time		Fast: 0.005 to 16 sec.; Normal: 0.005 to 120 sec.		
Measurement time		CS-2000 : Approx. 2 sec. minimum (Manual mode) to 243 sec. maximum (Normal mode)	CS-2000A : Approx. 2 sec. minimum (Manual mode) to 247 sec. maximum (Normal mode)	
Color space mode		L_vxy, $L_vu'v'$, $L_vT\Delta uv$, XYZ, spectral graph, dominant wavelength, excitation purity, scotopic luminosity (with CS-S10w Professional)		
Interface		USB 1.1		
Operating temperature/ humidity range		CS-2000 : 5 to 35°C, relative humidity 80% or less with no condensation	CS-2000A : 5 to 30°C, relative humidity 80% or less with no condensation	
Storage temperature/humidity range		0 to 35°C, relative humidity 80% or less with no condensation		
Power		AC adapter (100 - 240 V∿, 50/60 Hz)		
Current consumption		Approx. 20 W		
Size		158 (W) x 200 (H) x 300 (D) mm (Main unit), ø70 × 95mm (Lens)		
Weight		6.2 kg		

*1: Average of 10 measurements in Normal mode at a temperature of 23±2°C and a relative humidity of 65% or less.
*2: 10 measurements in Normal mode at a temperature of 23±2°C and a relative humidity of 65% or less.

■ Outer dimensions

(Units: mm)



SAFETY PRECAUTIONS

For correct use and for your safety, be sure to read the instruction manual before using the instrument.

- Always connect the instrument to the specified power supply voltage. Improper connection may cause a fire or electric shock.

The specifications and drawings given here are subject to change without prior notice.
- If you have any questions about specifications, please contact your Konica Minolta representative.

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Registration Date : March 3, 1995

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Registration Date : March 12, 1997

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