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PM 5639 Color Analyzer

Operating Manual

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Contents

1 Safety

Read this chapter carefully before using the instrument.

1.1 Introduction

The instrument described in this manual is designed to be used by properly trained personnel only. Adjustment, maintenance and repair of the exposed equipment must only be made by qualified personnel.

1.2 Safety Precautions

A CRT is a high-voltage device, and the screen may at time carry an electrostatic charge. When the color sensor is placed on the CRT and the display unit is placed on an insulated surface, the instrument may be carrying an electrostatic charge as well. If the instrument is then handled, there may be an electrostatic discharge. This is of a non-destructive type and not dangerous.

The battery pack includes a 500mAh rechargeable nickel-cadmium battery unit with output short-circuit protection. The output terminals of the battery pack are designed to reduce the risk of short-circuiting, as this would reduce the lifetime and reliability of the battery pack.

The only maintenance required for the battery pack is to keep the battery charged and the contacts clean.

The battery pack may explode if disposed of by incineration. A nickel-cadmium battery may exhibit a reduced charge capacity, typically caused by repetitive partial discharge/recharge cycles. To avoid this reduction of charge capacity, please operate your instrument until the pack is fully discharged and then fully recharge it.

1.3 Electrostatically Sensitive Devices

All ICs and many other semi-conductors are susceptible to electrostatic discharges (ESD). Careless handling during repair can reduce lifetime drastically. When repairing, make sure that you are connected to the same potential as the body of the instrument via a wrist wrap with resistance. Keep also components and tools at this potential.

2 Introduction and Applications

2.1 General

Ensuring a high standard of picture quality has become even more important with the increasing interchange of program material from different sources such as TV studios and production houses. The PTV TV Color Analyzer PM 5639 assists in this process by meeting the demand for easy control and adjustment of the color "white" and the brightness on any color monitor.

The PM 5639 consists of a color sensor, which is put onto the CRT and a display unit which can be operated with one hand, leaving the other hand free to adjust the monitor. A built-in rechargeable battery pack allows the instrument to be operated anywhere.

The Color Analyzer uses an adaptive system to establish the correct measurement independent of the field rate. The instrument works with all field rates, HDTV systems, progressive and interlaced systems.

The Color Analyzer operates with all types of phosphors. This is made possible through the use of a new concept, which relies on optical filters that parallel the color response of the human eye as defined by the CIE 1931 standard observer. This, together with a traceable calibration, assures a correct white reference on any monitor.

The Color Analyzer has a 64 x 128 dot matrix LCD display with a back-light in order to make measurements possible even in dim light. Two different graphical display modes have been incorporated:

- An xy Y mode and
- A RGB mode.

2.2 Areas of Application

The main application of the PM 5639 is to align the color of "white" and brightness of color monitors in studios, OB vans, post production, etc.
The monitors can be of the following sorts:

- Measuring monitors ("Grade 1")
- Surveillance monitors ("Grade 2")
- RGB computer monitors
- Consumer color TVs

The monitor should be adjusted in accordance with the manufacturer's instructions, which usually include an adjustment procedure carried out in one of the following ways:

- From the front plate of the monitor with or without tools (screwdriver)
- From the back of the monitor with or without tools (screwdriver)
- From the inside of the monitor with or without tools (screwdriver).

2.3 xy Y Measuring Mode

In this mode the color coordinates are plotted in a CIE 1931 chromaticity diagram, and the x and y values, the luminance value (Y) and the color error (CIELUV) are shown in a numerical display. The user can select a preferred measuring unit for luminance:

- Candela/m^2
- NIT or
- foot-Lambert

The display will show the x,y measurement graphically in a coordinate system, where the pre-programmed color reference is shown as a small box. The monitor is adjusted correctly when the dot is in the box. Using the zoom function this adjustment can be done very accurately. An indication of the resolution is always given. A line corresponding to 0.05 in the x or y direction is shown below the graph. This display mode proved to be very useful when adjusting to a selected color "white" reference (e.g. D6500 or 9300 K) is necessary.

The display is made possible by a new concept which relies on optical interference filters that parallel the color response of the human eye as defined by the CIE 1931 standard observer curves This, together with a traceable calibration, assures a correct white reference on any monitor.

2.4 RGB Measuring Mode

The red, green, and the blue values are shown here as bars in an analog display. This is a relative display mode. The display shows the color balance between the three primaries referenced to a selected phosphor type. When the three bars are in line the color balance corresponds to the selected white reference. One of three values may be selected as a reference for the inequality:

- Two of the primary colors related to the third
- All three primary colors related to the common luminance level
- All three primary colors related to the color balance of the one of the measurements store in the memory of the color analyzer

In all cases the absolute luminance value will be displayed in the unit selected by the user: either Candela/m^2, NIT or foot-Lambert. When all three bars are equally long, reaching the middle of the display, the color balance corresponds to the reference as selected by the user. The color reference may be either a white reference or a memory location. Please remember that the value of the luminance is never used as a reference: this means that the RGB mode is independent of the luminance level.

In the RGB display mode, the adjustment is made by bringing the amplitude of the three bars to the same level, at the center of the display. It is also possible in this mode to use a zoom function to increase the resolution and make a more accurate adjustment.

The display mode is dependent on the phosphor type used, but in order to have minimum of interference between the red, green, and blue phosphors in the displayed bar graphs, it is possible to adapt the instrument to the phosphors by a simple operation in the Learn mode. The phosphors can be named and stored in the memory for later use.

2.5 Operation

The instrument is extremely simple to operate: to enter the two display modes, press either the **xy Y** or the **RGB** button. The rest of the operations are performed by menu control.

The Function button (**FUNCT.**) offers the possibility of selecting between a variety of different measuring facilities: Status, CRT/Phosphor, White Reference, and Measuring Unit.

The status display will show the parameters of the active display mode.

The following parameters have been factory-programmed, but the user can program more himself. Two different standard phosphors have been pre-programmed and are protected from deletion: EBU and SMPTE "C". A maximum of 30 different phosphors can be store using the Learn facility.

The three most-used white references are D6500, 3200 K, and 9300 K. A total of five different white references can be programmed into the PM 5639, either as a measurement on a CRT, as a memorized measurement on a CRT, or the reference can be entered directly as x and y values.

There are three different measuring units. The user can select from Candela/m^2, NIT or foot-Lambert.

Pressing the **RESET** button is a quick way to enter the measuring mode you have selected as the one most frequently used.

The **ZOOM** button instantaneously selects the highest display resolution with all the results still inside the scale.

The ▲ and ▼ buttons manually change the scaling. As for each measuring set-ups, it is possible for several different users to store their preferred measuring set-ups for later use in one of five locations.

The **STORE** button can also be used to store a measurement, which can be recalled later or used as a reference for RGB measurements or as a White Reference.

2.6 The Learn Mode

The Learn mode is intended for "not-every-day" programming of the instrument. It is activated by pressing **ON/OFF** and **ENTER** simultaneously, with the instrument turned on. In this mode it is possible for the operator to program different phosphors, white references and the standard set-up.

Programming a new phosphor is done in a few seconds by turning on the red, green and blue phosphors of the CRT one by one.
A new White Reference can be programmed into the Color Analyzer by directly entering the correct x and y values of the reference, or it is possible to use a measurement of a CRT. The measurement is the one last displayed, which can be either a measurement or a memory location.

The Learn mode is also used to program the preferred measuring set-up.

2.7 Application

Initial Monitor Set-Up

Calibration can be done in two different ways, by using either the xy mode or the RGB mode. The difference is the display and that it is possible to use the xy mode independent of the phosphor. In the RGB mode the instrument needs to know what phosphor you are using. The phosphors can either have been stored previously or you can enter a new one.

Before calibrating a monitor, turn the monitor on and allow it to warm up for at least half an hour

Video input should be either a test pattern of color black or some other low luminance level video signal or constantly changing video information, such as program material. When testing, it is not advisable to leave a high intensity video signal (e.g. color bars) on a monitor for a long time.

After establishing purity, convergence, vertical and horizontal linearity, then select a white reference, and use this for the adjustment (most television systems have standardized on D6500 as the white reference).

Case 1 – Use of xy mode

- Select a 15 percent Window or Color Black with the brightness turned up slightly (LUM value of about 1-3 cd/m^2 (or 1-3 NIT or 0.3-1 ftL). Adjust the screen (Low Light, Black Level R, G, & B controls) to make the dot enter the reference box in the xy Y mode
- Select a 100 percent Window Pattern. Using the contrast control to adjust the luminance to about 80 cd/m^2 (80 NITs, 25 ftL). Adjust the CRT gain (High Light, White Gain R, G & B controls) so that the dot coincides with the reference box in the xy Y display. Return to the 15 percent Window Pattern and check the Black Level adjustments. Depending on how interactive the controls are on the monitor under adjustment, it may be necessary to go back and forth between 15 and 100 percent several times to establish a good grey scale. For best results use the highest resolution on the Color Analyzer
- Select a PLUGE signal to set that Black Level on the monitor. The monitor should be placed in normal viewing conditions and the brightness control adjusted in such a way that the blacker-than-black part of the signal disappears in the black, while the whiter-than black is still visible
- Select a 100 percent Window Pattern to set the white level. The luminance of the white window should be adjusted to 80 cd/m^2 (80 NITs. Note: SMPTE recommends 35 ftL or approx. 120 cd/m^2) by using of the contrast control

A colorbar is needed to adjust the chroma gain

- On a PAL monitor use the split-field EBU colorbar with 75% white for this adjustment. With only the red gun switched on the intensity of the red bar is set to the same intensity as the "white" area in the bottom part of the screen. Alternatively with only the green gun switched on instead, the intensity of the green bar, yellow bar, cyan bar, and the bottom white area should be identical
- On a NTSC monitor use the SMPTE colorbar with the reversed bar and the red and green guns switched off. Adjust the all blue-colored fields to the same intensity using the hue and saturation controls

- To check the results of the adjustment use a 5- or 10-step grey scale test pattern and a good video source of program material

Case 2 – Use of RGB mode

If the phosphor is unknown and not in the phosphor list it is necessary needed to "teach" the instrument the phosphor. This is possible by using the LEARN facility. The teaching process will remove the cross interaction between the three guns in the RGB display. After use of the LEARN facility it is possible to adjust one of the guns and only the corresponding bar will respond. This is very convenient when calibrating several monitors with the same phosphors using the RGB display.

The following procedure should be followed once the instrument has adapted the phosphors.

- Select the phosphor corresponding to the monitor and the white reference desired
- Select a 15 percent Window or Color Black with the brightness turned up slightly (LUM value of about 1-3 cd/m^2 (or 1-3 NIT or 0.3-1 ftL). Adjust the screen (Low Light, Black Level R, G, & B controls) to center the three bars, all three at the same level. It may be necessary to readjust the brightness to keep a convenient luminance level. If it is not possible to adjust all three guns on the monitor, one of the guns may be used as a reference in the display; otherwise use the luminance as a reference
- Select a 100 percent Window Pattern. Use the contrast control to adjust the luminance to about 80 cd/m^2 (80 NITs, 25 ftL). Adjust the CRT gain (High Light, White Gain R, G & B controls), to center the three bars at the same level. It may be needed to adjust the contrast control to keep the luminance level. Return to the 15 percent Window Pattern and check the Black Level adjustments
- Depending on how interactive the controls are on the monitor being adjusted, it may be necessary to go back and forth between 15 and 100 percent several times to establish a good grey scale. For the best result use the highest resolution on the color analyzer
- Select a PLUGE signal to set the Black Level of the monitor. The monitor should be placed in normal viewing conditions and the brightness control adjusted in such a way that the blacker-than black part of the signal disappears in the black, while the whiter-than-black is still visible

- Select a 100 percent Window Pattern to set the white level. The luminance of the white window should be adjusted to 80 cd/m^2 (80 NITs, note: SMPTE recommends 35 ftL, approx. 120 cd/m^2) by means of the contrast control

A colorbar is needed to adjust the chroma gain

- On a PAL monitor use the split-field EBU colorbar with 75% white for this adjustment. With only the red gun switched on the intensity of the red bar is set to the same intensity as the "white" area in the bottom part of the screen. Alternatively with only the green gun switched on instead, the intensity of the green bar, yellow bar, cyan bar, and the bottom white areas should be identical
- On a NTSC monitor use the SMPTE colorbar with the reversed bar, and the red and green guns switched off. Adjust all the blue-colored fields to the same intensity using the hue and saturation controls
- To check the result of the adjustment use a 5- or 10- step grey scale test pattern and a good video source of program material

2.8 Problem Areas

Monitors should always be adjusted in the mode that they are most often used i.e. adjust the black to white grey scale with the monitor in color mode. The monochrome mode may give you a slightly different color of white because it bypasses the decoder used in the color mode.

Test patterns should also have a color burst on them to make sure the color decoder is not being bypassed. If the monitor is a combination composite and component monitor, set its grey scale in the mode most often used.

The 80 cd/m^2 peak white setting used in the procedure is for a low ambient light environment. If room lighting around the monitor is bright, higher black and white levels will be necessary.

If the purity of a monitor is less than perfect, the grey scale may not appear to be consistent over the entire screen. Grey scale tracking, in absolute terms, should be measured at one point on the screen, preferable the center. It is measured by changing the intensity of the Window pattern and watching the cross-moving in the xy Y display on the PM 5639. The three channels should always equal each other; i.e. the dot does not move when Window Pattern levels are changed.

If hum is present on the screen, the beating between the field frequency and the line frequency will result in a vertical moving intensified "bar" in the picture. The bar moves at a speed corresponding to the difference between the two frequencies. The bar can be either moving up, moving down, or standing still. A very slow-moving bar will result in a jitter display. A bar may result in an adjustment, which is not correct. If the interference is of an order which is disturbing it is usually possible to see the bar in a flat-field picture.

A TV color monitor consists of a screen with three phosphors. These three phosphors are made of different materials, which emit light when hit by high-energy electrons. According to the theory of color perception by the human eye three light sources of different color are enough to generate "all" (!) colors.

However, this theory is based on practical experiments made with three monochrome light sources, and the three phosphors in a color monitor do not generate monochrome light. The blue and the green phosphors have relatively wide spectra, in contrast to the red phosphor which has a narrower line spectrum usually dominated by 2-4 lines. The specifications of the phosphors used in color monitors are based on xy coordinates. The xy coordinates do not specify the spectrum of the phosphors, only weighted "mean" value. According to the theory of human color perception it is sufficient to specify the xy values, as long as the spectra do not differ too much. Different manufacturers of CRTs use different materials for the phosphors. This gives rise to different light spectra which, however, have equal xy values. The human eye is very sensitive to small spectrum differences in the red domain, and because the red phosphor is the phosphor witch is most difficult to produce, different manufacturers use different material for the red phosphors. With an instrument relying on filters, even high-grade interference filters like those in the PM 5639, it is difficult to compare the light from two different phosphors with deviating spectra as exactly as the human eye can. This can give rise to some small color differences, which may be noticeable when directly comparing two monitors with different phosphors. To adjust monitors with different phosphors to the exact same color white, the use of some white comparator may be needed.

This only has be to done once because of the learn facility in the PM 5639. This facility makes it possible for the instrument to make corrections for minor phosphor differences.

Color Temperature and Correlated Color Temperature

The color temperature of a light is defined as the temperature of the black body emitting light equal to that light. The black body is sometimes called a Planckian radiator. The chromaticities of the black body are much like the cromaticities for various phases of daylight or the light from a tungsten lamp. If, for example, a lamp has chromaticity point coinciding with the chromaticity of a Planckian radiator at temperature T = 6000 K, the lamp is said to have a "color temperature of 6000K". If the chromaticity point of the lamp does not coincide with the Planckian radiator at any temperature, the temperature which gives the chromaticity point closest to the lamp is chosen to specify the "correlated color temperature". The nearest chromaticity point is the point perceived to give the light, which best approximate to the light from the lamp. This means that two different lamps may have the same correlated color temperature, but they look different! It is therefore safer to specify the chromaticity coordinates than the color temperature.

The white D references are defined as the xy coordinates of the light, which best approximates the various phases of daylight as defined by CIE. The xy values of the different Daylight references are not coincident with the black body curve. This means that 6500 K must most often be understood as a correlated color temperature; a better expression would be D6500 or D65.

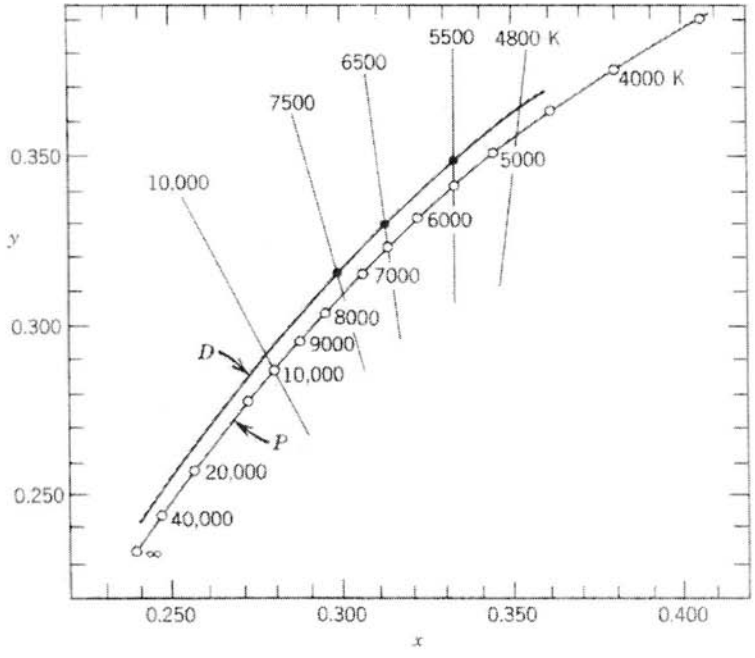

Fig. 2-1 Portion of the CIE 1931 (x,y)-chromaticity diagram showing daylight locus (D) and Planckian locus (P) with a few isotemperature lines.

3 Technical Data

3.1 Safety Characteristics

This apparatus has been designed and tested in accordance with Safety Class I requirements of IEC publication 348 (Safety Requirements for Electronic Measuring Apparatus), and was delivered in a safe condition. This manual contains information and warnings, which must be followed to ensure safe operation and to keep the apparatus in a safe condition.

3.2 Performance Characteristics

Properties expressed in numerical values with stated tolerances are guaranteed by the PTV organization in your country. Specified non-tolerance numerical values indicate those that could be nominally expected as the mean of a range of identical instruments.

3.3 Versions

One version only:
The PM 5639 automatically adjusts itself to the field-scanning rate: 0 Hz or any field rate between 40 and 120 Hz.

3.4 Display

Type:
64 x 128 dot matrix LCD display with switchable backlighting (auto shut-off function is provided).

3.5 Display Modes

3.5.1 xy Y Mode

The x and y coordinates are plotted in a CIE 1931 diagram and the x, y, Y (luminance value) and the color error CIELUV are shown numerically. The color error is calculated as the difference between the selected color reference and the actual color according to the definition CIE 1976 L*u*v* (CIELUV) color space.

3.5.2 RGB Mode

Red, green, and the blue values are shown as bar graphs. The color balance is displayed relative to a selected parameter. The display reference may either be one of the bars the luminance or a previous measurement (memory location).

3.6 Measurement Range

Luminance: 0.1 to 1000 cd/m^2 (0.03 to 300 ftL)

x and y values: 0.000 to 0.800

3.7 Accuracy

The following specifications apply to a measurement with an illuminant D6500 standard monitor*, luminance 80cd/m^2 (23.3 ftL), 15° to 30°C (59° to 86°F).

xy coordinates: Better than +/-0.002

Repeatability: Better than +/-0.002

Luminance (Y): Better than +/-2%, +/-1 digit

Repeatability: Better than +/-0.3%, +/-1 digit

RGB bars: Better than +/-1%

Repeatability: Better than +/-1%

Luminance (Y): Better than +/- digit

* Calibration of the standard monitor is traceable to a primary standard at Physikalisch Technische Bundesanstalt in Braunschweig, Germany

3.8 Memory

Reference:
5 memories for color white references.
Operating parameters for x and y: 0.2 to 0.6

CRT/Phosphors:
30 memories for different phosphors (only used in RGB mode)

Set-Ups:
5 memories for different measuring set-ups (Display mode, CRT/Phosphor type, white reference, and measuring unit).

Measurements:
5 memories for measurements (can be displayed later, used as reference for RGB measurements, or used as white references).

3.9 Factory Programming

3.9.1 CRT/Phosphors:

xy CIE 1931 chromaticity coordinates:

Standard EBU phosphor:

Red	x = 0.64	y = 0.33
Green	x = 0.29	y = 0.60
Blue	x = 0.15	y = 0.06

Standard SMPTE "C" phosphor:

Red	x = 0.635	y = 0.340
Green	x = 0.305	y = 0.595
Blue	x = 0.155	y = 0.070

It is possible to program other phosphors by using the "Learn Phosphor" function.

3.9.2 White References:

xy CIE 1931 chromaticity coordinates:

D6500	x = 0.313	y = 0.329
3200 K**	x = 0.423	y = 0.399
9300 K*	x = 0.281	y = 0.311

It is possible to program other white reference by using the "Learn White Reference" function.

3.9.3 Measuring Unit:

cd/m2

(Other possibilities are ftL and NIT, which can be selected by the user).

3.10 Power

Battery operated. Interchangeable NiCd rechargeable 7.2 V battery pack. The instrument can also be operated when connected to the battery charger.

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* Correlated color temperature

Power consumption:
85 mA (illumination off)
115 mA (illumination on)

Operating time:
>5 h (fully charged batteries)

Battery charging time:
<14 h (instrument off)

Mains voltage:
85- 140 V AC or 187 – 255 V AC.

Power consumption (charger):
< 6 VA

Frequency:
48 – 65 Hz

3.11 Environmental conditions

Operating temperature:
10° to + 40°C (+50° to +104°F) (non-condensing)

Storage temperature:
-30° to +70°C (-22° to 158°F)

3.12 Mechanical Data

3.12.1 Dimensions:

Color Sensor:

Diameter of house:	108 mm (4.25")
Diameter of suction pad:	120 mm (4.75")
Height:	13 mm (5.25")

Display Unit:

Height:	34 mm (1.3")
Width:	75 mm (3.0")
Length:	200 mm (7.9")

Battery Charger:

Height:	86 mm (3.4")
Width:	50 mm (2.0")
Depth: (except mains connector)	45 mm (1.8")

Carrying Case:

Height:	150 mm (5.9")
Width:	460 mm (18.1")
Depth:	310 mm (12.2")

3.12.2 Weight:

Color Sensor (incl. cable):
250 g (0.55 lbs)

Display Unit (incl. Battery pack):
412 g (0.91 lbs)

Battery Charger:
275 g (0.61 lbs)

Total (fully packed carrying case):
4.5 kg (10 lbs)

4 Accessories

4.1 PM 5639 Package

The PM 5639 Package consists of:

1	Color sensor	
1	Display unit	
1	Interface cable between sensor and display unit	(5322 321 61433)
1	Rechargeable battery pack	(5322 256 60305)
1	110 V AC or 230 V AC battery charger with corresponding mains connector	
-	European type	(5322 263 50203)
-	American type	(5322 263 50202)
-	British type	(5322 263 50201)
1	Display unit pocket clip	(5322 492 71019)
1	Operating manual	(9499 491 00711)
1	Carrying case	(5322 600 79653)

4.2 Options

The following options are available:

Item	Ordering number
Service manual *(delivered free of charge when the request card is returned to PTV)*	9499 495 01011
Interface cable *(6 meter – 19.7 ft.)*	9449 900 20351
Interface cable *(10 meter – 32.8 ft.)*	9449 900 20361
PM 8550 *(Calibration software)*	9449 085 50001

5 Installation

5.1 Initial Inspection

Please check the contents of the shipment immediately upon receipt. If the contents are incomplete or damaged, a claim should be filed with the carrier immediately, and please also contact PTV Help Desk in order to facilitate the repair or replacement of the instrument.

Before inserting the charger into the main socket, make sure that it is the correct voltage. If this is not the case, please contact the PTV Help Desk.

5.2 Installing/Changing the Battery

To change the battery pack:

- Press and lift slightly with your thumb on the bottom of the battery pack and the battery pack can be lifted out
- Insert a new battery pack

The data memory is non-volatile, and it is possible to change the battery without loss of data.

When you receive your color analyzer (or a new battery pack) the battery is new and uncharged. Care should be taken to charge the battery completely the first time; this means charging for at least 14 hours.

6 Operating Instructions

6.1 General

Measuring modes

The PM 5639 has two different measuring modes:

1) RGB, where the red, green and blue values are shown as bars in an analog display. The display is relative and shows the balance of the primary colors where either:
   a) Two of the primary colors are related to the third
   b) All three primary colors are related to the actual luminance
   c) All three primary colors are related to a memory location

   In case a) and b) the absolute white reference is the one selected.
   In case c) the absolute white reference is the content of the memory location.
   In all cases, the luminance value is shown beneath the bar display in either Candela/m^2, NIT or foot-Lambert, but is not used as reference.

2) xy Y where the color coordinates are plotted in a CIE chromatically diagram. The x and y values; the luminance value (Y) in Candela/m^2, NIT or foot-Lambert; and the color error in CIELUV are shown numerically beneath the chromaticity xy diagram.

6.2 Menus

The menus can be divided into two categories:
- main menus
- sub-menus

The major difference is that a main menu is chosen by pressing one of the buttons: **RGB** (only from an RGB measuring display – see later), **FUNCT.**, **RECALL** or **STORE**, while the sub-menus can only be accessed via another menu.

All the menus are headed with a descriptive title of the menu. One of the menu items will be highlighted when you start in a menu. Depending on the kind of menu in question, these will either be the previous selection or the one most frequently used.

When scrolling in menus, the arrow button (▲ or ▼) can be used to move up and down. The menus are "cyclic stacks". This means that when the cursor is in the uppermost position pressing ▲ once will move the cursor to the bottom of the menu, and when the cursor is at the bottom, pressing ▼ once will move the cursor to the top of the menu.

Another way of navigating in main menus is to use a related button. If for instance the Function menu is called up by pressing the **FUNCT.** pressing this button again will cause the highlighted cursor to move downwards in the menu – just like using the ▼ button.

Leaving menus can be done by selecting **EXIT**, an option present in all menus. This will result in a step upwards in the menu hierarchy (to a higher-level menu or to the measuring display). To return directly to the measuring display press **RGB** or **xy Y** button. This will return you to the previously selected RGB or xy Y measuring display.

In order to activate a highlighted selection in a menu, press the **ENTER** button.

Time out
If a menu is displayed and no button has been pressed for 1 min., the display will automatically return to the previous measuring mode.

If no bottom has been pressed for 10 minutes, the instrument will switch itself off.

Low voltage
If the battery voltage is low, a warning sign will appear in the display. Approximately 5 minutes after the battery-low sign appears, the instrument will switch itself off. The memory is non-volatile: it is possible to change battery without loss of data.

Non-active buttons
If a button is pressed that is not "allowed" in the mode or menu you are in, nothing will happen

6.3 Normal Operation Mode

6.3.1 "ON/OFF" Button

If the instrument is off pressing the **ON/OFF** button will switch it on. The instrument will start up in the same mode, as it was in when it was turned off. This does not, however, apply to the Learn modes, which always have to be reselected in order to avoid unintended changes to the programming.

If the instrument is on, pressing the **ON/OFF** button will turn it off. The set-up and measuring modes are memorized, so pressing the **ON/OFF** button once more will allow the measurements or menus (except the Learn Mode) to continue as if the instrument had not been turned off.

The auto-switch-off function switches the instrument off automatically if no button has been pressed for 10 minutes.

6.3.2 "Reset" Button

The reset button resets the instruments to a standard measuring mode (factory-or user-programmed in Learn Mode).

6.3.3 " ▲ " and " ▼ " Buttons

In menu displays:
Moves the cursor up or down on the screen. The buttons work as cyclic selectors, which means that pressing the down button when the cursor is at the bottom of the menu display moves the cursor to the top and visa versa, except in the CRT/Phosphor modes, where pressing these buttons has a scroll effect.

In analog measuring modes:
Manual zoom in or zoom out (cyclic function).

6.3.4 "ENTER" Button

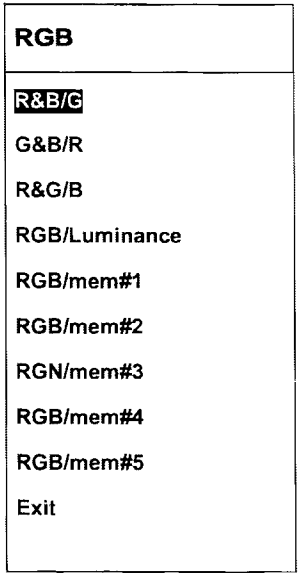
Selects the highlighted parameter in menu operation. In measuring mode this button is inactive.

6.3.5 "RGB" Button

When pressed, the instrument will switch to RGB measuring mode (the button can thus be used as a quick exit from any menu).

If the instrument is in RGB measuring mode when the RGB button is pressed, it will show the RGB menu. The mode you just left is highlighted.

Use the ▲ , ▼ or RGB button to select the desired mode of operation and press ENTER. The instrument will then go into the desired RGB measuring mode.



If "Exit" is selected, the instrument returns to the measuring display, without making any changes.

6.3.6 "xy Y" Button

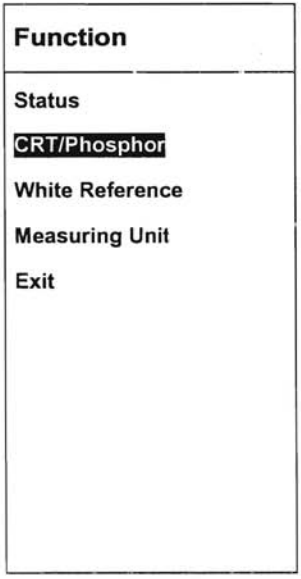
When this button is pressed, the instrument will go into xy Y measuring mode, and the display will show a graphic x-y coordinate display and values for x, y, Y, and the color error dE (CIELUV). This button can also be used as a quick exit from any menu.

6.3.7 "ZOOM" Button

Only active in the RGB analog measurement mode and xy Y measuring mode. The display adjusts to show the maximum possible resolution in the present or measurement situation. Stepwise zooming can be done with the ▲ or ▼ button.

6.3.8 "FUNCT." Button

When this button is pressed, the Function main menu is displayed. The "CRT/Phosphor" is highlighted.



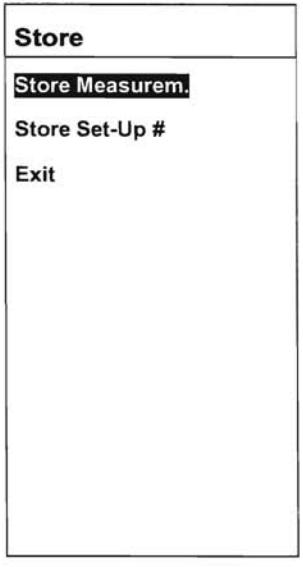
Use the ▲ , ▼ or FUNCT. button to select the desired parameter and then press ENTER. The sub-menu selected will then be displayed. If "Exit" is selected, the instrument will return to the previous measuring display.

6.3.9 "STORE" Button

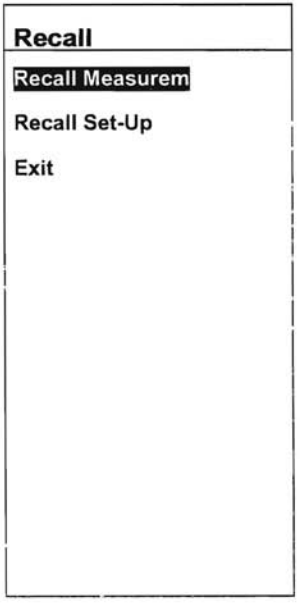
When this button is pressed, the measurement on the screen is "frozen" and the Store main menu is displayed. "Store Measurem." or "Store Set-Up" will be highlighted, depending on which one was in use last.

Use the ▲ , ▼ or **STORE** button to indicate your selection if it is the measurement or the setup you need to store and then press **ENTER**. The sub-menu you chose will then appear.

If "Exit" is selected, the instrument returns to the measuring display without storing anything.



6.3.10 "RECALL" Button



Pressing this button calls the Recall menu onto the display. "Recall Measurem." or "Recal Set-Up" will be highlighted, whichever was in use last.

Use ▲, ▼ or **RECALL** button to find your selection if it is a measurement or a set-up you want to recall and then press **ENTER**. The sub-menu you chose will then appear.

If "Exit" is selected, the instrument returns to the previous measuring display.

6.3.11 "ILLUM." Button

Switches the backlight on/off. The backlight automatically turns off 1 min. after the last time a button was pressed.

Display contrast can be adjusted by holding the **ILLUM.** button down and pressing the ▲ or ▼ buttons.

6.4 Menu Description, Normal Operation

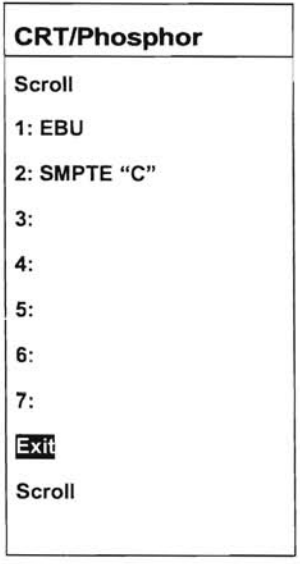
6.4.1 "CRT/Phosphor"

(a "Function" sub-menu)

If "CRT/Phosphor" is selected from the Function main menu, the CRT/Phosphor sub-menu will be shown. The phosphor in use is highlighted.

It is possible to choose between a maximum of thirty phosphors. Use the ▲ or ▼ button to select the phosphor you wish. When "Scroll" is highlighted, the display will scroll upwards or downwards to show more phosphors. Place the bar on the desired phosphor and select this by pressing **ENTER**. The display returns to measuring mode; the CRT/Phosphor you just selected will remain valid until it is changed again.

If "Exit" is selected, the instrument returns to the Function menu without making any changes.



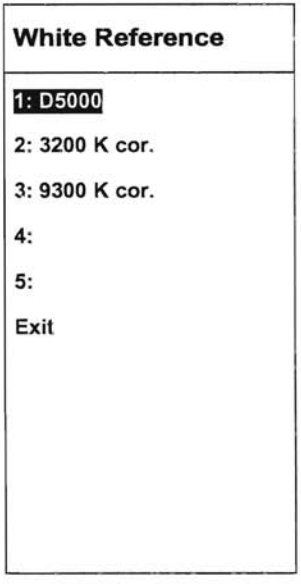
6.4.2 "White Reference"

(a "Function" sub-menu)

If "White Reference" is selected from the Function menu, the White Reference sub-menu will appear. The White Reference in use is highlighted.

Use the ▲ or ▼ buttons to find your selection and then press **ENTER**. The White Reference is now set to the selected value, and the display will return to measuring mode.

If "Exit" is selected, the instrument returns to the Function menu without making any changes.



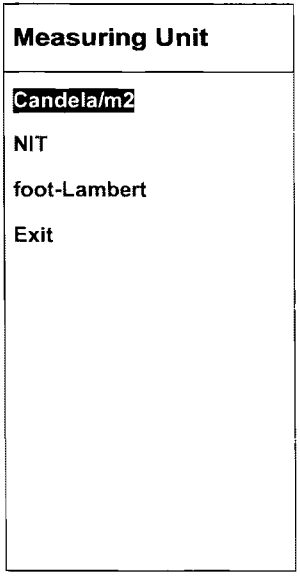
6.4.3 "Measuring Unit"

(a "Function" sub-menu)

If "Measuring Unit" is selected from the Function menu, the Measuring Unit submenu will appear. The measuring unit in use is highlighted.

Use the ▲ or ▼ buttons to find your selection and then press **ENTER**. The measurements will now be shown in the selected unit, and the display returns to measuring mode.

If "Exit" is selected, the instrument returns to the Function menu without making any changes.



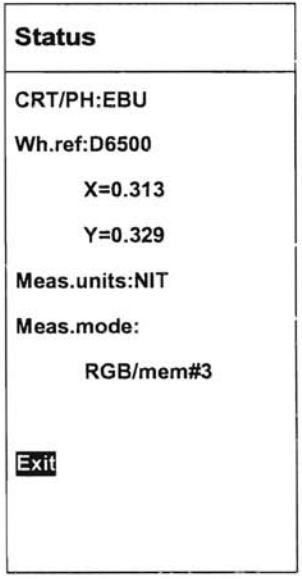
6.4.4 "Status"

(a "Function" sub-menu)

If "Status" is selected from the Function menu, a survey of the parameters chosen will appear on the display (an example is shown).

"Exit" is the only item that can be selected and is thus highlighted.

Pressing **ENTER** will return you to the Function menu.



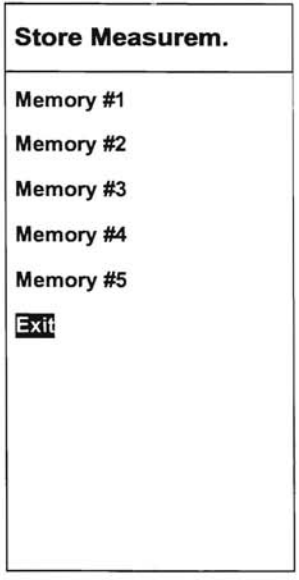
6.4.5 "Store Measurement"

(a "Store" sub-menu)

If "Store Measurem." is selected in the Store menu, the Store Measurement sub-menu is shown. The "Exit" selection is highlighted in order to prevent accidental erasure of stored information.

Use the ▲ or ▼ buttons to find your selection and then press **ENTER**. The measurements valid at the time the **STORE** button was pressed the first time will now be put into the selected memory, and the instrument then returns to measuring mode.

If "Exit" is selected, the instrument returns to the Store menu without making any changes.



6.4.6 "Store Set-Up"

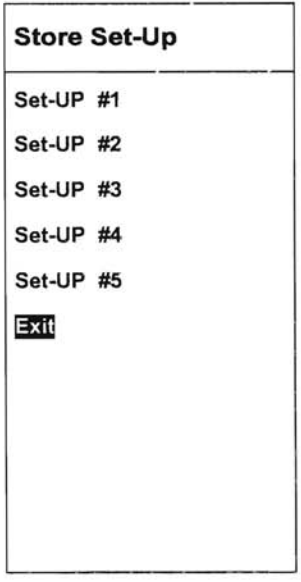
(a "Store sub-menu)

If "Store Set-Up" is selected from the Store menu, the Store Set-Up sub-menu is shown.

The "Exit" selection is highlighted in order to prevent accidental erasure of stored information.

Use the ▲ or ▼ buttons to find your selection and then press **ENTER**. The present setup (functions and measuring mode) is then stored in the selected memory and the instrument returns to measuring mode.

Select "Exit" to return to the Store main menu without making any changes.



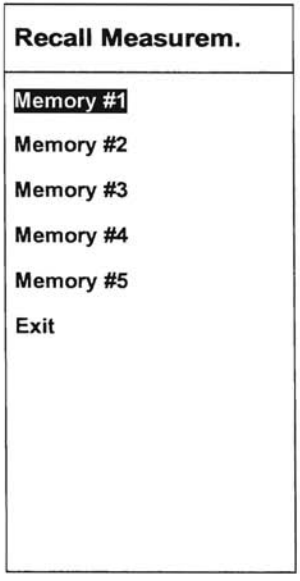
6.4.7 "Recall Measurem"

(a "Recall sub-menu)

If "Recall Measurem." is selected from the Recall menu, the Recall Measurement sub-menu appears.

Use the ▲ or ▼ buttons to find your selection and then press **ENTER**. The previously stored measurement is then shown in the measuring format it was stored in together with the text "Memory #x".

Select "Exit" to return to the Recall menu.



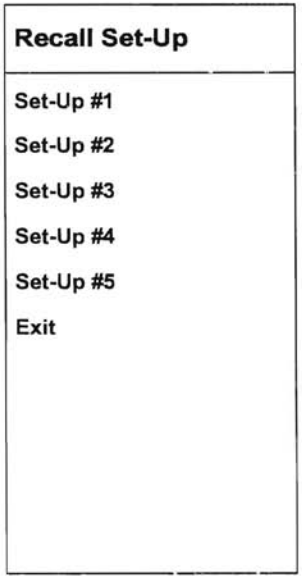
6.4.8 "Recall Set-Up"

(a "Recall" sub-menu)

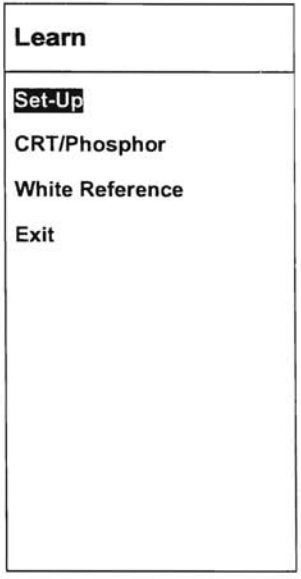
If "Set-Up" is selected from the Recall menu the Recall Set-Up sub-menu appears.

Use the ▲ or ▼ buttons to select the set-up memory you want and then press **ENTER**. The instrument will then go into the previously stored measuring mode with the stored functions.

Select "Exit" to return to the Recall menu without changing anything.



6.5 The Learn Mode, menu description



When the instrument is on, press ENTER ON/OFF simultaneously to enter the Learn menu.

If "Set-Up" is selected from the Learn menu, the present Set-Up (selection of CRT/Phosphor, White Reference, Measuring Unit, and Measuring Mode) is stored, and can be recalled at any time by pressing the Reset button when in operating mode. After performing "Learn: Set-Up" the instrument returns to the Learn menu.

If "CRT/Phosphor" is selected from the Learn menu, the procedure described below in the sections on Learn-Store-Name CRT/Phosphor is started.

If "White Reference" is selected from the Learn menu, the procedure described in the sections on Store-Name White Reference is started.

Select "Exit" in the Learn menu to go to the measuring mode used last.

6.5.1 "Learn CRT/Phosphor"

(a "Learn" sub-menu)

Turn on only the red gun on the reference CRT, then select "Red gun only" and press **ENTER**. The display will show an "ok" to confirm that the measurement has been made.

Proceed with the green gun only, then the blue gun only.

When all three guns of the reference CRT have been measured, select "Enter" to proceed with the Store CRT/Phosphor sub-menu.

If you select "Exit" from the Learn Phosphor sub-menu you will go to the Learn menu without making any changes.

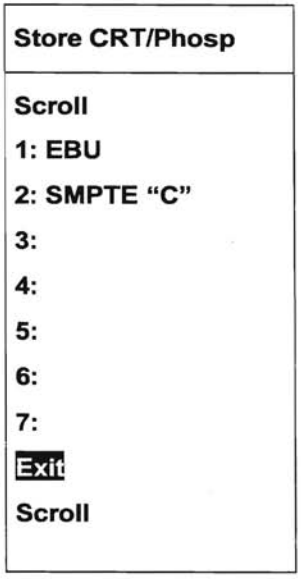
6.5.2 "Store CRT/Phosphor"

(a "Learn CRT/Phosphor" sub-menu)

It is possible to choose between a maximum of 28 phosphors. Use the ▲ or ▼ buttons to select the memory position desired. When "Scroll" is highlighted the display will scroll upwards or downwards to show more phosphors. Highlight the memory position you want and select this by pressing **ENTER**. It is now possible to add a name to the CRT/Phosphor memory using the "Name CRT/Phosphor" sub-menu.

The standard EBU and C phosphors are factory-programmed into memory positions 1 and 2 and cannot be changed.

Select "Exit" to return to the Learn menu without making any changes.



6.5.3 "Name CRT/Phosphor"

(a "Store CRT/Phosphor" sub-menu)

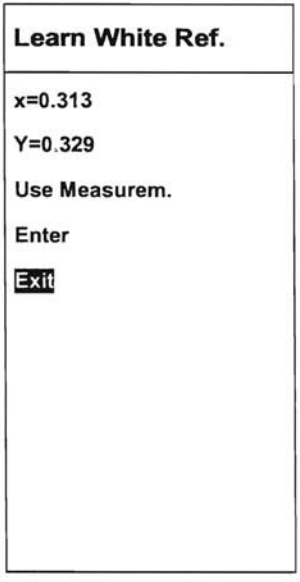
Select one of the rows of letters in the menu, and a sub-menu containing these letters (and an "Exit") will be shown. CRT/Phosphor can be named, by selecting the individual letters.

When selecting "Enter" in the Name CRT/Phosphor sub-menu, you will return to the Store CRT/Phosphor sub-menu, which will show the new updated list of CRT/Phosphors.

Select "Exit" in one of the lowest alphabet menus to return to Name CRT/Phosphor menu without making any changes.

6.5.4 "Learn White Reference"

(a "Learn" sub-menu)



To alter x or y value, highlight "x=0.313" or "y=0.329" and press ▲ or ▼ while holding down the **xy Y** button (The operated parameters for these values are 0.2 – 0.6).

The value you chose to alter will begin to increase or decrease, depending on which arrow button you press, slowly at first but then a little faster. When you reach the correct values, for x and y select "Enter " and press **ENTER** to store these values.

It is also possible to use the last-displayed measurement as the White Reference: if you do so, the x and y values are changed accordingly. Once the new values are in place, select "Enter" to continue. It is now possible to add the new White Reference to the List of White References in the "Store White Reference" sub-men.

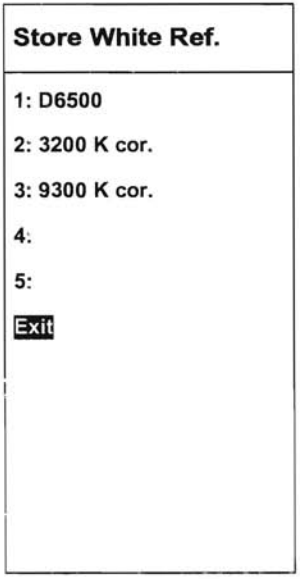
Select "Exit" to return to the learn menu without changing anything.

6.5.5 "Store White reference"

(a "Learn White Reference" sub-menu)

Use the ▲ or ▼ buttons to select the set-up memory you want and then press **ENTER**. It will now be possible to name the White Reference using the "Name White Reference" sub-menu.

Select "Exit" to return to the Learn menu without making any changes.



6.5.6 "Name White Reference"

(a "Store White Reference" sub-menu)

Select one of the rows of letters in the menu, and a sub-menu containing these letters (and an "Exit") will be shown. White Reference can be named, by selecting the individual letters.

When selecting "Enter" in the Name White Reference sub-menu, you will return to the Store White Reference sub-menu, which will show the new updated list of White References.

Select "Exit" to return to the Learn menu without making any changes.

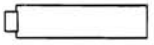
6.6 Error and Warning Messages

6.6.1 "Low Light"

Some of the Learning modes are inhibited when the light level is very low. This is done to ensure the highest degree of calculation accuracy when generating reference data.

6.6.2 "Overload"

A warning that the light intensity is too high. The luminance may not be too high, as the warning only indicated that the signal in at least one of the color channels is too high, i.e. the luminance in clean blue light is very low.

6.6.3 "  " flashing (low battery)

A warning that the battery needs to be recharged, and that the instrument will soon turn itself off down in order to save its memories. It is possible to change the battery without losing the memory contents.

6.6.4 "WARNING"

"C. Sensor changed"
"Select phosphor"

Indicating that the display unit now communicates with a color sensor different from the one connected last time the instrument was in use.

The phosphor data in the color sensor may be different from the data in the old color sensor. You have to make a selection of phosphor data from the phosphors data bank in the new color sensor to get the instrument to perform correctly.

6.6.5 "No C. Sensor Wait.."

There is no communication between the display unit and the color sensor. Check the connectors and the wire between the color sensor and the display unit.

6.6.6 "C. Sens. err. Wait.."

The communication between the color sensor and the display unit is faulty and the display unit is correcting the error. This condition may occur in the case of very fast luminance fluctuations.

6.6.7 "Wait.."

The display unit is initializing the measuring system.

6.6.8 "Wrong C. Sensor"

The display unit has been connected to a color sensor made for a different purpose.

6.7 Master reset

If the instrument seems to be performing very strangely or there seems to be no response to the keyboard it is possible to perform a factory master reset.

This reset may destroy any additional data, which is user-generated.

To perform the master reset the instrument must be OFF.

To master reset, press **FUNC.**, **Xy Y** and **ENTER** simultaneously while turning the instrument ON.