

Klein K-Series Colorimeter K-1 K-10 User's Manual



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Klein K-Series User's Manual

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Foreword

This is just another title page
placed between table of contents
and topics

1 Introduction

1.1 Welcome

Klein K Colorimeter Manual v 3.0.145

Congratulations for purchasing the Klein K Colorimeter. The Klein K Colorimeter is a highly accurate serial port colorimeter and flicker meter with included PC program. Its optical filters are carefully constructed to conform to the CIE 1931 Photopic xyY color measurement system. The electronics of the colorimeter take 256 simultaneous XY and Z readings per second, and communicate these to a controlling PC program via the PC RS-232 comm port.

1.2 Unpacking the K Colorimeter

Hardware

K-1 Colorimeter

The Klein Instruments K-1 Colorimeter includes:

Klein K-1 Colorimeter body

Black Rubber slip-on boot

Attached Cable; Comm with Power

RS-232 9 DIN comm plug

5v connector (USB male style plug)

5v Power Supply (USB female style plug)

CD including Klein K Colorimeter PC program and Manual

K-10 Colorimeter

The Klein Instruments K-10 Colorimeter includes:

Klein K-10 Colorimeter body with lens

Black Rubber boot with 52mm threads

Attached Cable; Comm with Power

RS-232 9 DIN comm plug

5v connector (USB male style plug)

5v Power Supply (USB female style plug)

CD including Klein K Colorimeter PC program and Manual

The K series Colorimeter is a serial port device, intended to be used with the Klein K Colorimeter PC program. It draws power from an attached 5v cable (USB style connector). The 5v power may also be taken from a standard USB port.

1.3 Product Overview

Hardware Requirements

To use the K Colorimeter, you must have a

- K Colorimeter
- 5v Power Source (supplied, or plug into a USB port for power)
- Windows based PC with a RS-232 comm port (win 95 or greater)
- Klein K Colorimeter PC program (requires 20M of hard drive space)

K-1 Colorimeter

The K-1 is designed for measuring luminance and color from a diffuse source, such as a CRT. The K-1 is also useful for taking Lux measurements from a front projector.

K-10 Colorimeter

The K-10 has a +/- 5 degree angular input aperture, and is used for measuring luminance and color from a directional but partially diffuse source, such as an LCD display or a rear projector display.

Flicker Meter Function Included

Both the K-1 and the K-10 are also fully functional flicker meters. They feed real time data to the pc program which performs a Fast Fourier Transform and graphs the data as frequency versus amplitude.

Optical Filters

Inside the Klein K Colorimeter are three optical filter sets, one each for CIE X, Y, and Z, and three silicon detectors.

Electronic Filters, A/D and Microprocessor

Each Optical Filter and silicon detector has its own electronic channel consisting of a 6 step auto-ranging amplifier and access to a 12 bit A/D with 4 dither steps. The A/D is read 256 times per second by a microprocessor.

Each electronic channel amplifier has a 3 pole 28 Hz analog filter, which, along with digital the averaging function, filters out unwanted 60 Hz and faster noise. For flicker measurements, the data is sent as raw unaveraged 256 measurements per second.

On-board Flash Memory in the Colorimeter

The K Colorimeter will store up to 96 custom calibrations in Flash memory. These are easily accessible via the Klein Colorimeter PC program. The calibration files can be named by monitor type for ease of remembering which calibration file is which.

2 Chapter 1: Installing the PC Program

2.1 Installing the PC Program

The Klein K Colorimeter PC Program is intended to be run on pc's with windows 95 and later. The PC program uses a comm port for communication to the colorimeter, and it uses database functions for data logging.

To Install the Klein K Colorimeter PC Program

On the CD included, find and open the file: "Setup.exe".
Install the Klein PC program in the locations suggested.

The installation of the Klein K Colorimeter PC Program will add folders and files to the newly created folder:

C: \ Program Files \ KLEIN

In addition, the program makes use of microsoft .dll files. If these are missing from your computer, the setup program installs them. If they already exist on your pc, the setup program will allow you to keep the old files or install new ones.

If you log data, the log files will be found in the folder:

C: \ Program Files \ KLEIN \ DataBase

To Uninstall the Klein K Colorimeter PC Program

If you wish to uninstall the program, Klein recommends that you simply delete the KLEIN folder. This has shown to be effective and safe.

If you wish to remove all the Microsoft .dll files that the Klein Setup may have included, you may use the Microsoft START / Settings / Control Panel / Add_Remove Programs.

3 Chapter 2: Taking a Color Measurement

3.1 Taking a Color Measurement

Attaching the Colorimeter to the PC

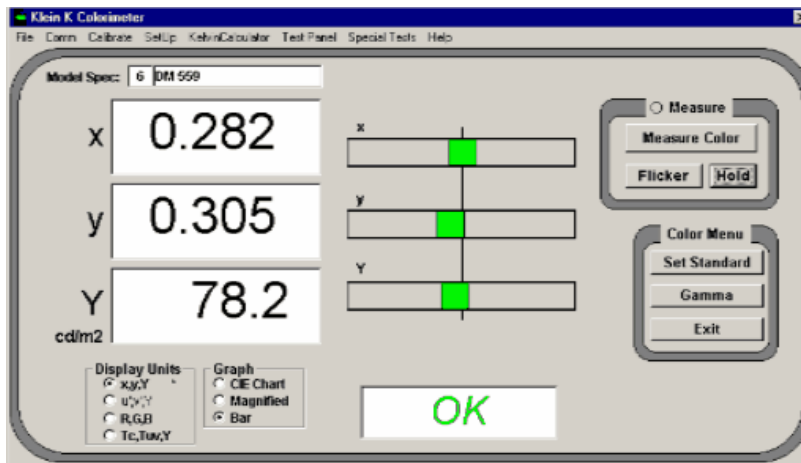
To attach the Colorimeter to a PC, plug the 9 pin Comm connector into the PC's comm port. Also attach the USB style connector to the (supplied) 5v source. For the 5v source, you may instead use one of your PC's USB ports as a power source. If you know which comm port you have attached to, you may enter it into the PC program (below).

Run the Klein PC Program

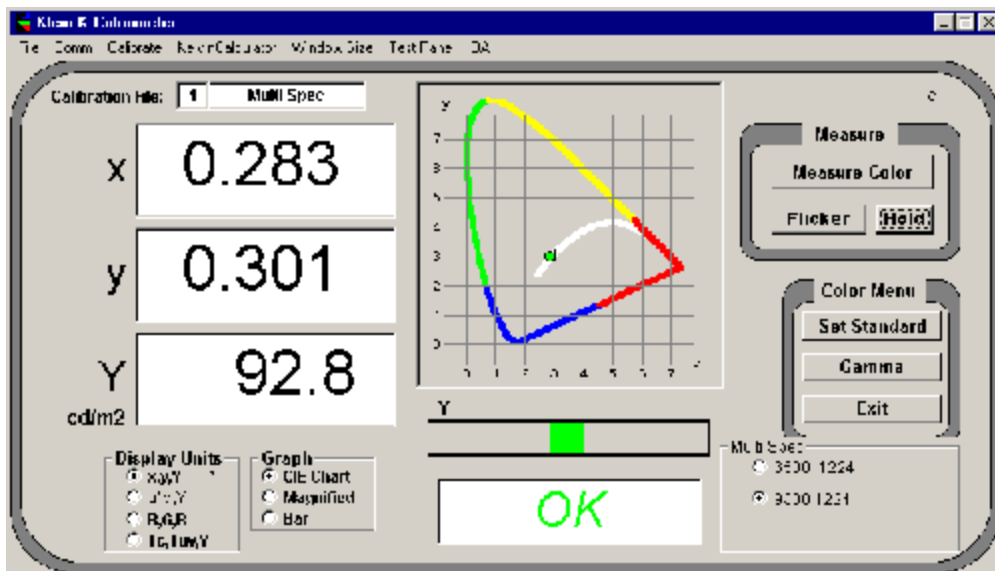
The Klein K Colorimeter program is accessible from the "Start" button, then "Programs", then "Klein".

The Klein K Colorimeter program can also be found in C:\ Program Files \ Klein.

The program interface::



With the CIE Chart Graph Mode chosen, the display may look like this:



On first hookup, there may be an error message telling you that the colorimeter is not responding.

In the menu item "Comm", choose the comm port to which the colorimeter is attached. Press "Measure Color" to test the comm connection.

Also on first hookup, the program will load use the "Factory Default" Color Correction file.

Press the "Measure Color" button.

The Measure Indicator above the "Measure Color" button will begin to flash, and u'v'Y values will begin to show in the measurement windows, and also the graph area.

You may switch color measurement from xyY or u'v'Y by pressing the Display Units buttons. This will also change the graphic units.

You may view the graphic of the color data by choosing the Graph to be CIE (shown above), Magnified (for a closer look at the center of the CIE graph), or Bar (startup default. Sliders, for making adjustments.

There will also be an "OK/NoPass" shown below the Y slider. This can be turned on or off from the menu item "Setup".

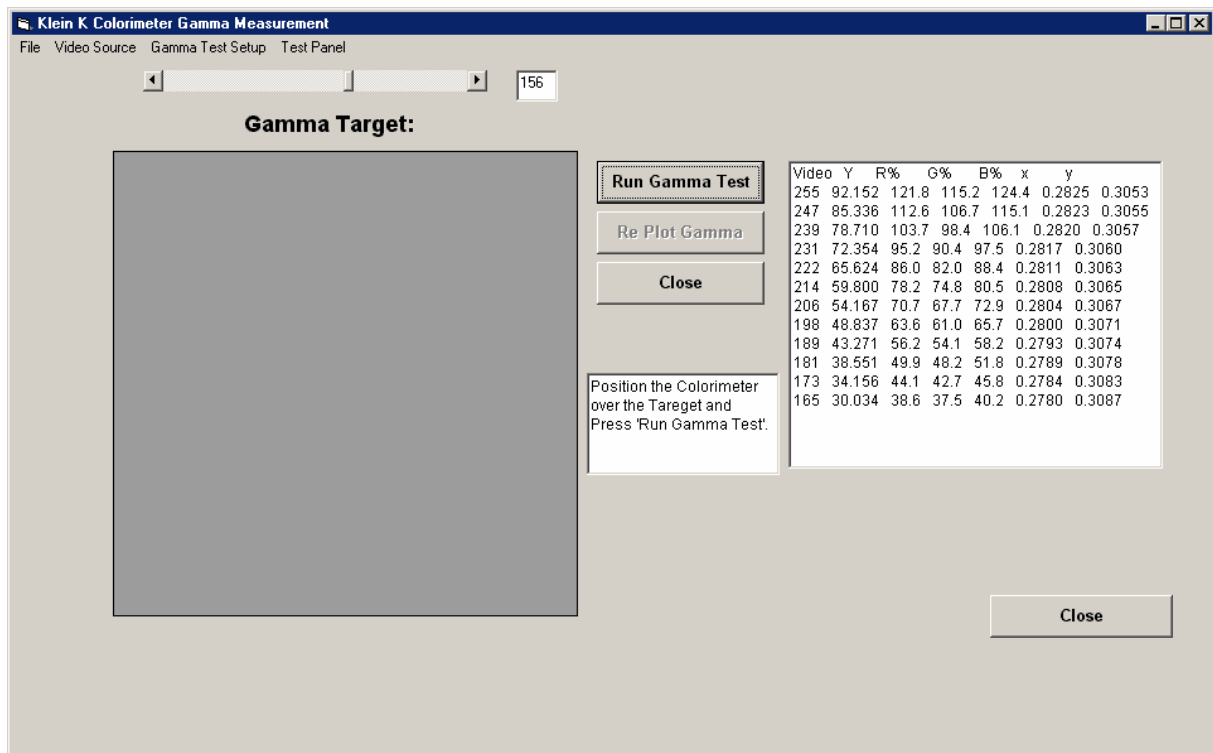
4 Chapter 3: Gamma Measurements

4.1 Gamma Measurement

The Gamma Measurement function is accessed from the "Gamma" button on the main window.

By aiming the colorimeter at a display which is running the Klein K Colorimeter PC program, the user can run a test which will calculate the gamma of the display and display driver.

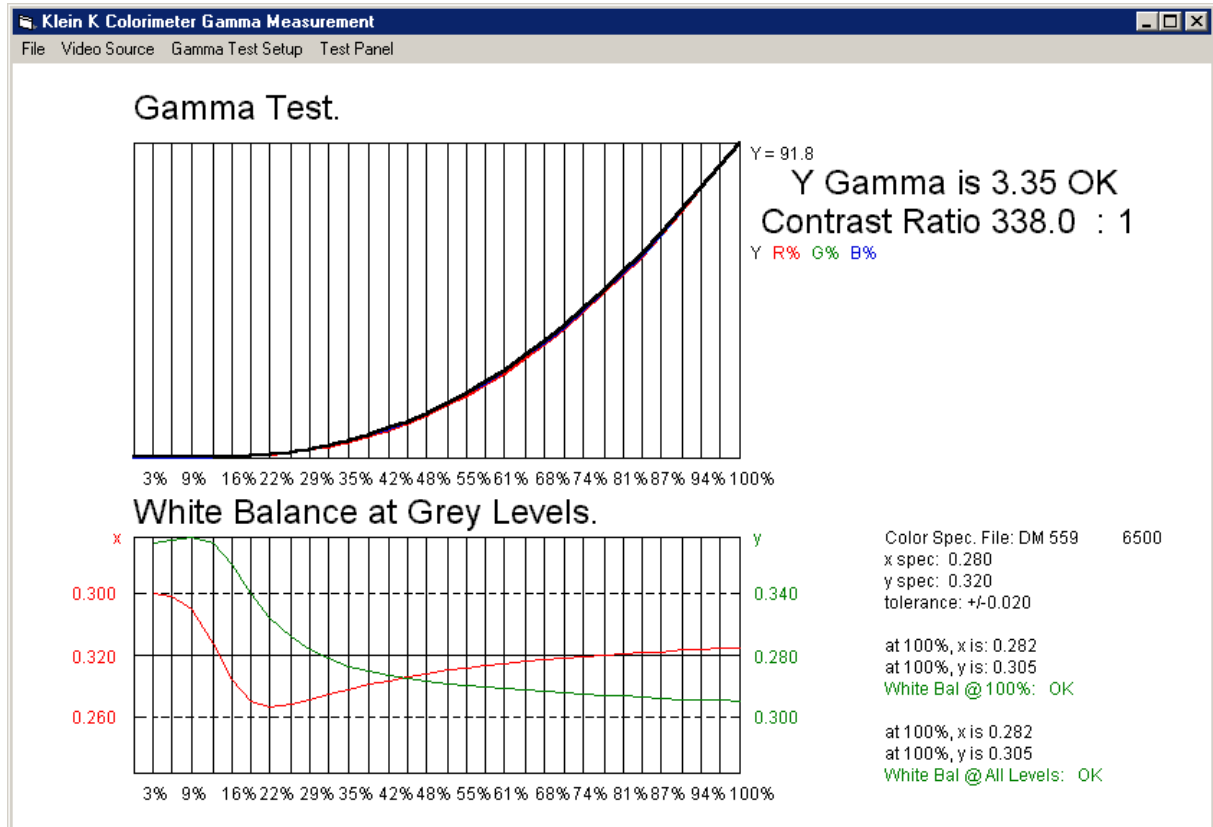
The number of video intensity steps is programmable in the menu item "Gamma Test Setup".



When the colorimeter has taken the number of readings required by the Gamma Test Setup, a graph is

created, showing Gamma, Contrast Ratio, and White Balance at Grey Levels. The OK / NoPass criteria for gamma is set in the menu "Gamma Test Setup".

The gamma report includes a graph of R, G, B, and Y (white Intensity) gamma, and the determined Gamma value for white.



5 Chapter 4: Flicker Measurements

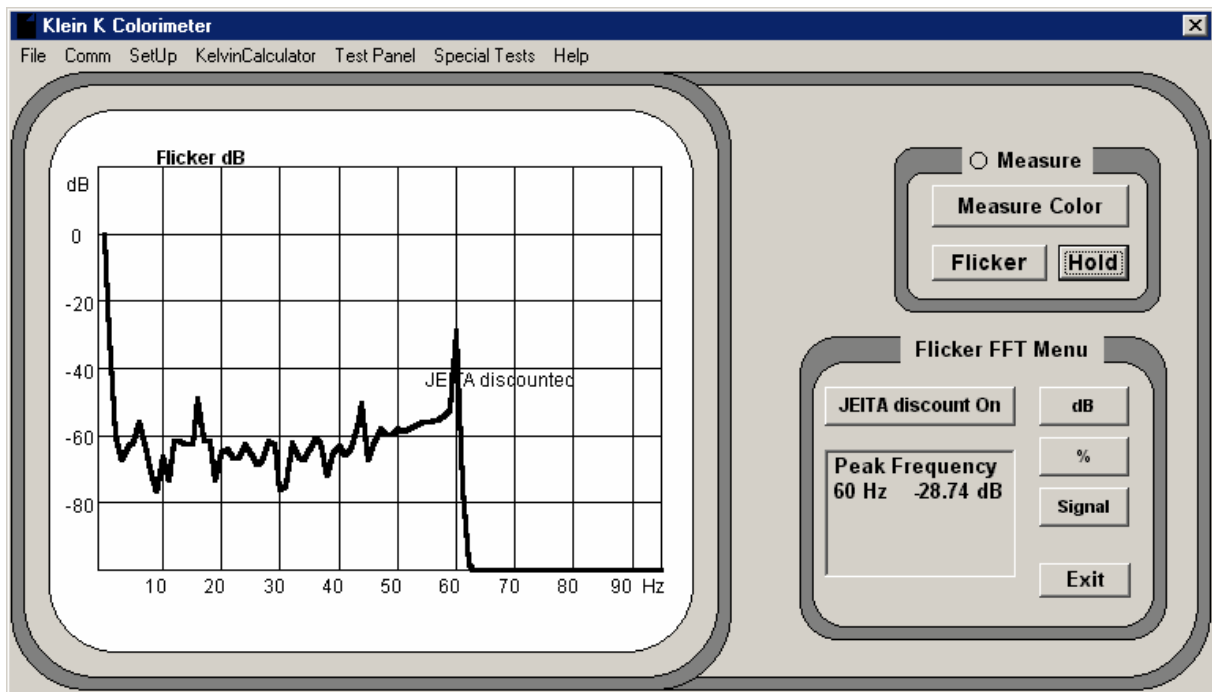
5.1 Flicker Measurements

The flicker feature of the Klein K Colorimeter PC program is accessed by pressing the "Gamma" button on the Main window.

The colorimeter provides raw Y data at 256/second. The pc program has downloaded a conversion file for frequency sensitivity, and uses it to scale the FFT transform of the received data. The data is updated 8 times per second.

The flicker shown is for Y of a display, and it is graphed in true intensity versus frequency. It is displayed in percent, or dB.

There is a button which will apply a JEITA discount to the flicker FFT data. Highest flicker intensity, and frequency is displayed, along with the entire intensity versus frequency curve.



Because frequencies are shown with precision, and all frequencies are shown, contributions to flicker from various components can be easily measured.

The updating of data at 8 times per second is rapid enough for real-time adjustments to be made to TFT panel bias balance.

6 Chapter 5: Data Logging

The Klein K Colorimeter Program allows for data logging of single or multiple points, single or multiple spec's.

Each logging entry includes 50 items, including:

- Time/Date
- Work Order Number
- Model + Ext (Spec file name)
- Serial Number
- Operator
- Shift
- xy or u'v' spec mode
- x spec
- y spec
- Y spec

Measurement data (for one to 9 data points)

- x (or u') value
- y (or v') value

Y value

The logged data can be graphed on a histogram and measured value graph for each model and spec, with average, Cpk given for each "Model + Ext (Spec file name)".

The logging feature is best understood by stepping through the logging process.

See Sub-Chapters:

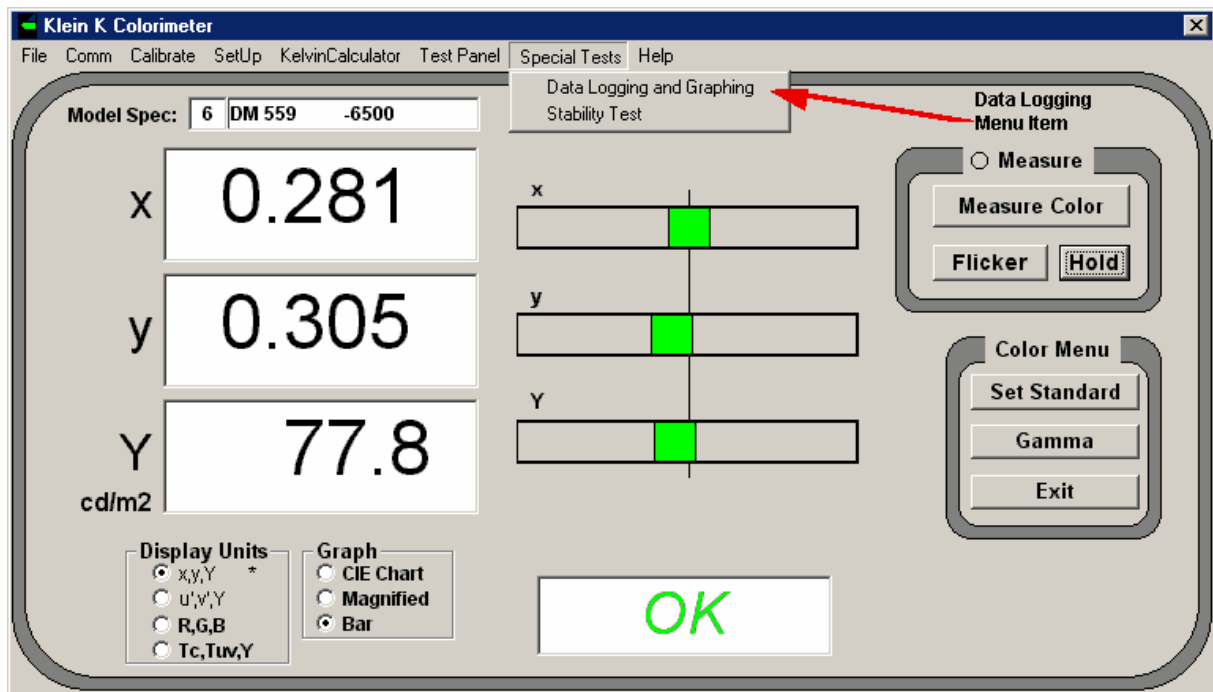
Data Logging Single White Point Spec

Data Logging Multiple White Point Specs

Making and Printing Reports

6.1 Data Logging, Single White Point Spec

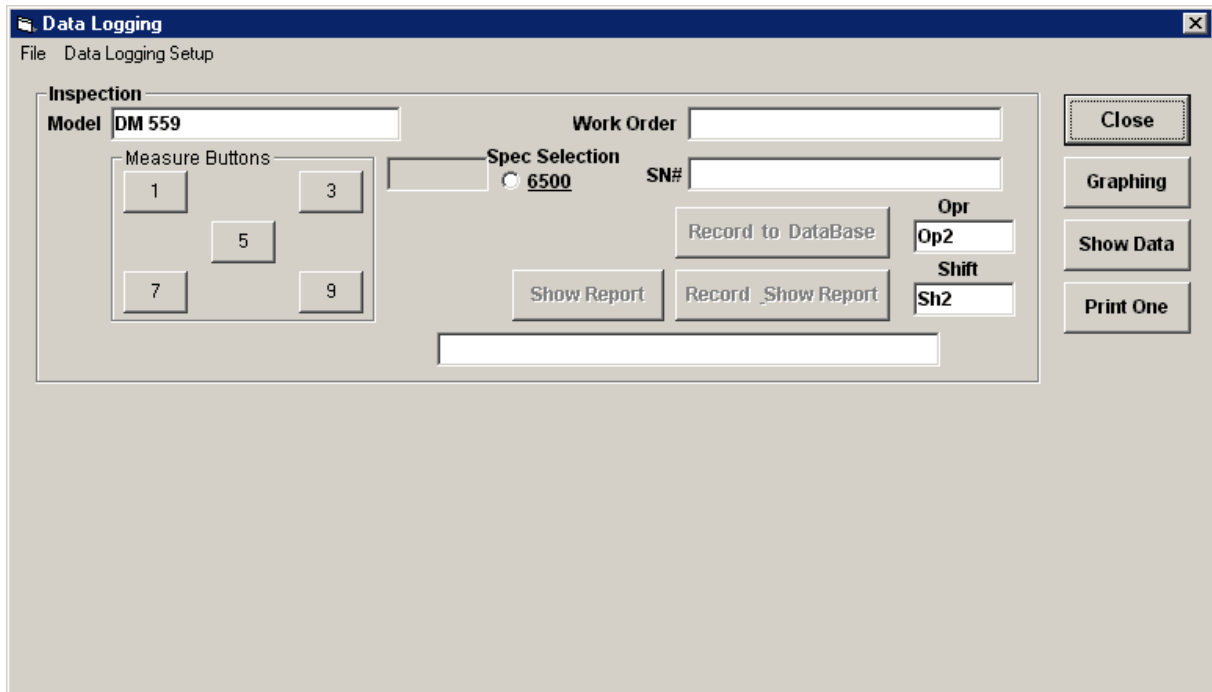
Attach the colorimeter, choose the comm port, press the Measure Color button to verify operation.. Choose the Model Spec (Color Calibration and Spec File) desired from the Model Spec window.



Select the menu item "Special Tests / Data Logging and Graphing" and the "Data Logging" window will appear.

The Klein program keeps a running log of all measurements taken, stored in the KLEIN / Database folder.

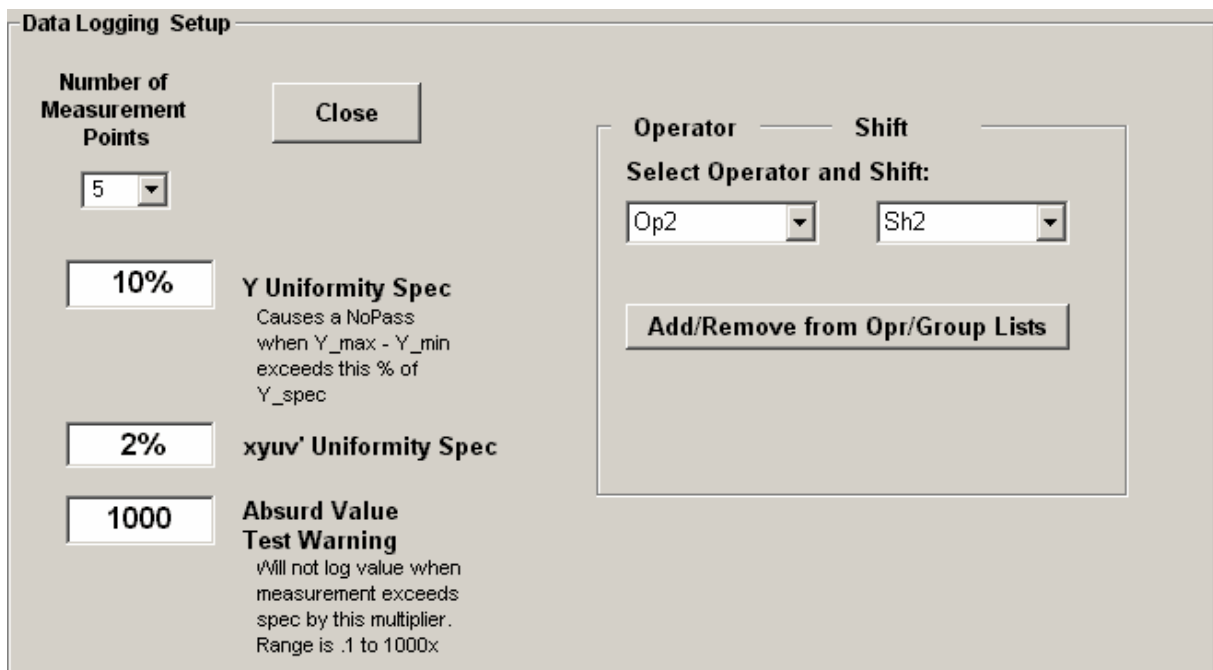
When the Data Logging window is opened for the first time in a new month, the program will save the current database and offer to begin a new one. We suggest that you choose "yes" if this happens. Your previous month's database will be stored in the KLEIN / Database / Archive folder, named with the current year and month.



Data Logging (continued)

The "Model" name appears in the upper left part of the screen. This Model was selected from the Main window Setup, and when readings are logged, the spec values (stored in the "Model" file) are written to the database along with the readings. The saved spec values will be compared to the saved measured values when QC graphs are made from the data.

There is some setup that may need to be done. Press the menu item "Data Logging Setup"



The "Operator" and "Shift" are stored with data, for the purpose of sorting data by a certain operator or shift. They can be chosen or edited now. (or use the default values).

The "Number of Measurement Points" can be chosen now. You may choose up to 9 points to be measured and stored in a single data record.

The "Y Uniformity Spec" can be chosen now. If more than one measurement points are taken, the "OK / NoPass" criteria for the record will in part depend on how uniform the measurements are, and the limit for the criteria is set here. This spec is stored with each record for later data analysis.

The "xyuv' Uniformity Spec" is stored with the record. It is not currently used as part of the "OK / NoPass" criteria.

The "Absurd Value Test Warning" can be set to a large number (1000) so that it does not interfere with storing data. If you wish to lock out measurements which are obvious mistakes, you may set this to a value of 0.5 so that readings which are less than 50%, or more than 150% of the spec will not be recorded. Other values can be chosen for this as well.

The Data Logging Setup values are stored on the pc.

Close the Data Logging Setup, and the Data Logging window will be as shown:

You are now ready to begin logging data.

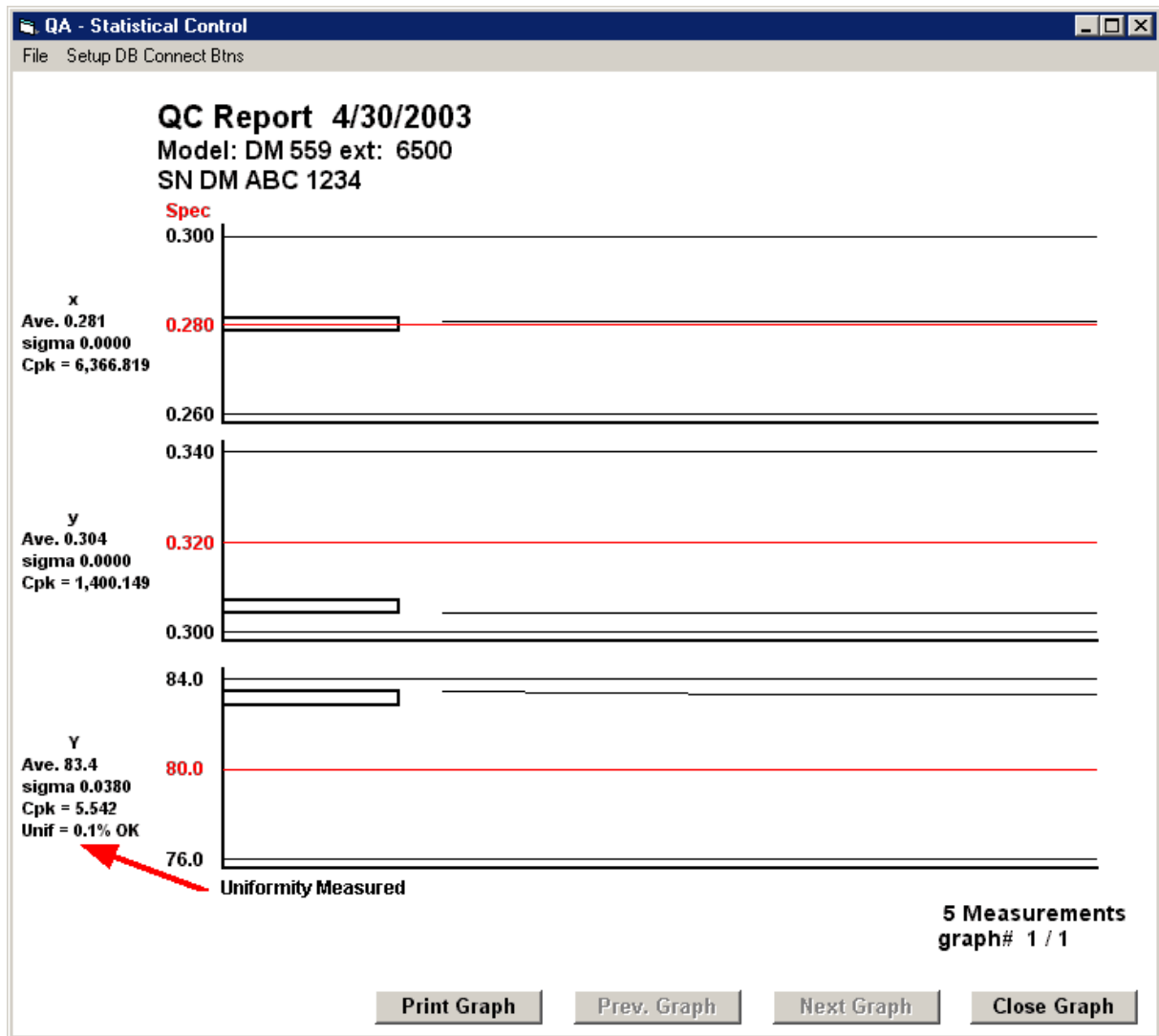
You must enter something in the SN# field. You may enter any keyboard characters you wish. You may enter a "Work Order" number if you wish. This SN# and Work Order number will be stored with each data record.

In the example above, the Model is "DM 559 - 6500". The last 4 characters of the model are what we call a "file extension" or a "Spec Selection", and this is used to select one of possibly several specs for the same model. In this case, there is only one Spec Selection, here "6500".

To take a reading, point the colorimeter at the area to be measured, and press one of the measure buttons. The number on the button should change to "ok" or "np" meaning OK or NoPass for that reading. When all Measure Buttons for the Spec have been pressed, the window next to the Spec Selection will show "OK" or "NoPass" and the "Record to DataBase" button is enabled.

You may press the "Record to DataBase" button, and the measurements and current specs will be written to a record in the database. You may press "Show Data" and the details of all records will show at the bottom of the window. Scroll down to the last entry to see the data you have recorded.

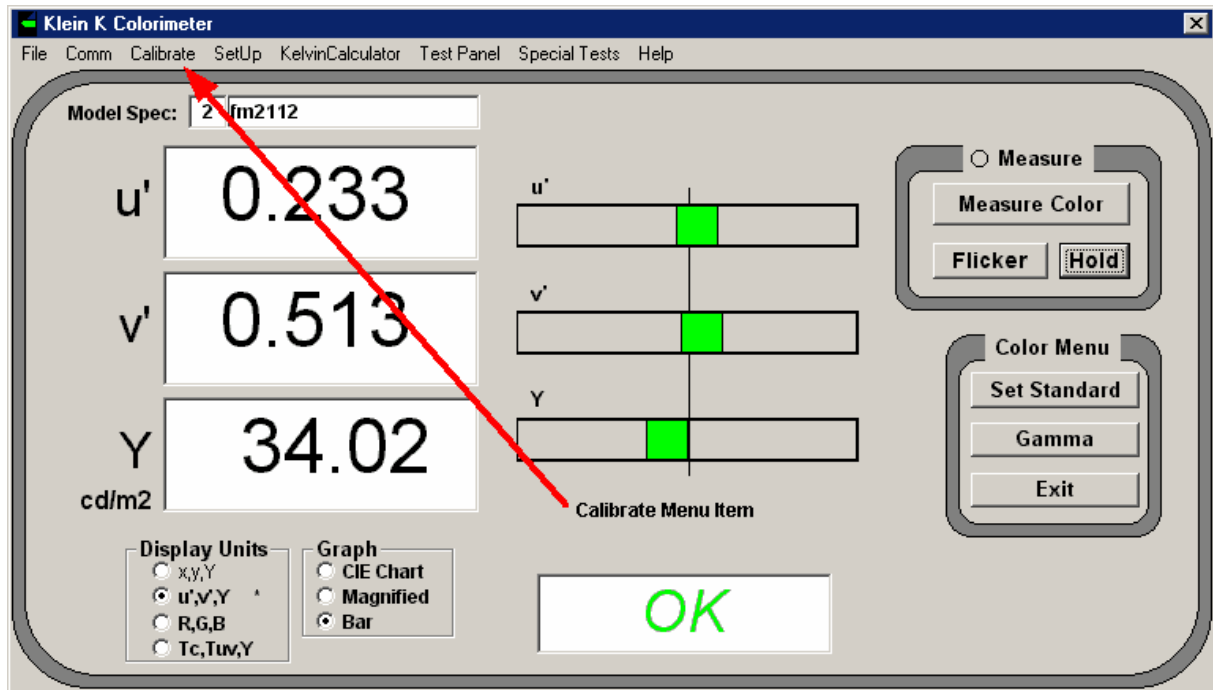
The "Show Report" button will show a graph of the data you have just taken, including an OK / NoPass indicator for the uniformity of the Y reading, (depending on the value set in the Data Logging Setup). You may save the record to an Excel file from the graph window (shown below).



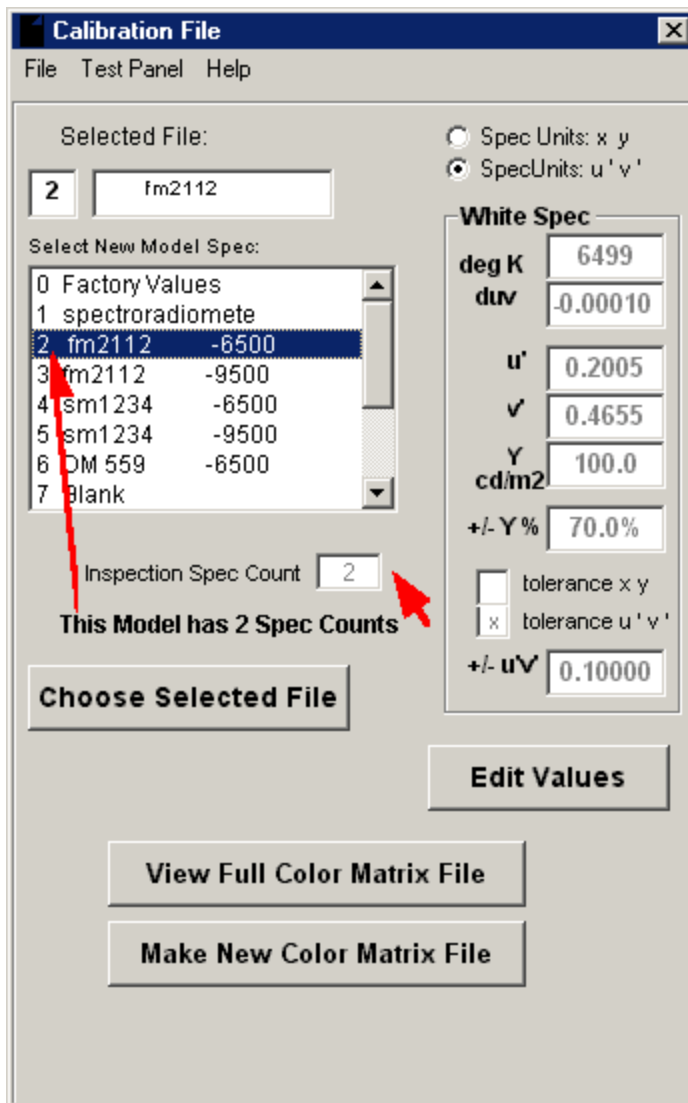
The graph may be printed and used as a Report.

6.2 Data Logging Multiple White Specs

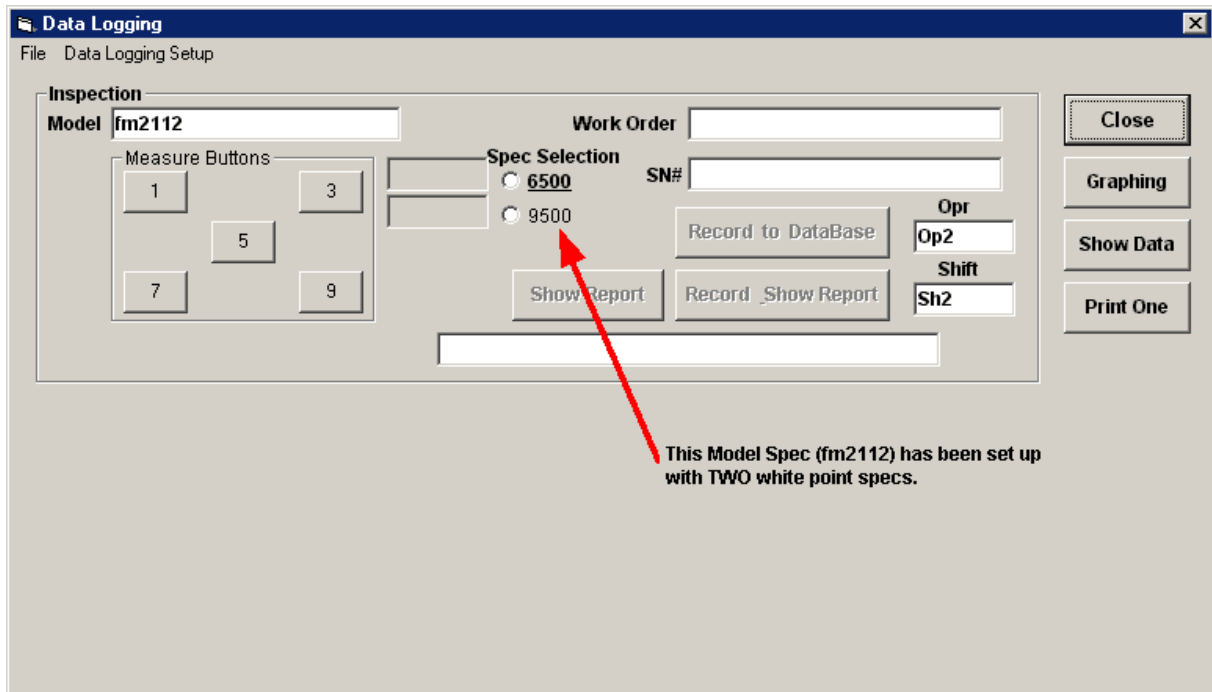
The Data Logging for Multiple Specs is similar to the Data Logging for a single Spec. However, in the Data Logging window, two (or three) separate white point spec files can be used for the OK/NoPass criteria. The picture below shows two White Point Specs being used, "9300" and "6500".



To set up the Logging function to log one display for two white point settings, open the Calibrate menu item, select a Model Spec file that has 2 or more Inspection Specs (see the section Custom Calibration to see how to create a set of two or more Model Specs for one Model).



Then, when the Special Tests / Data Logging window is opened, there will be TWO (or three) specs showing under "Spec Selection".

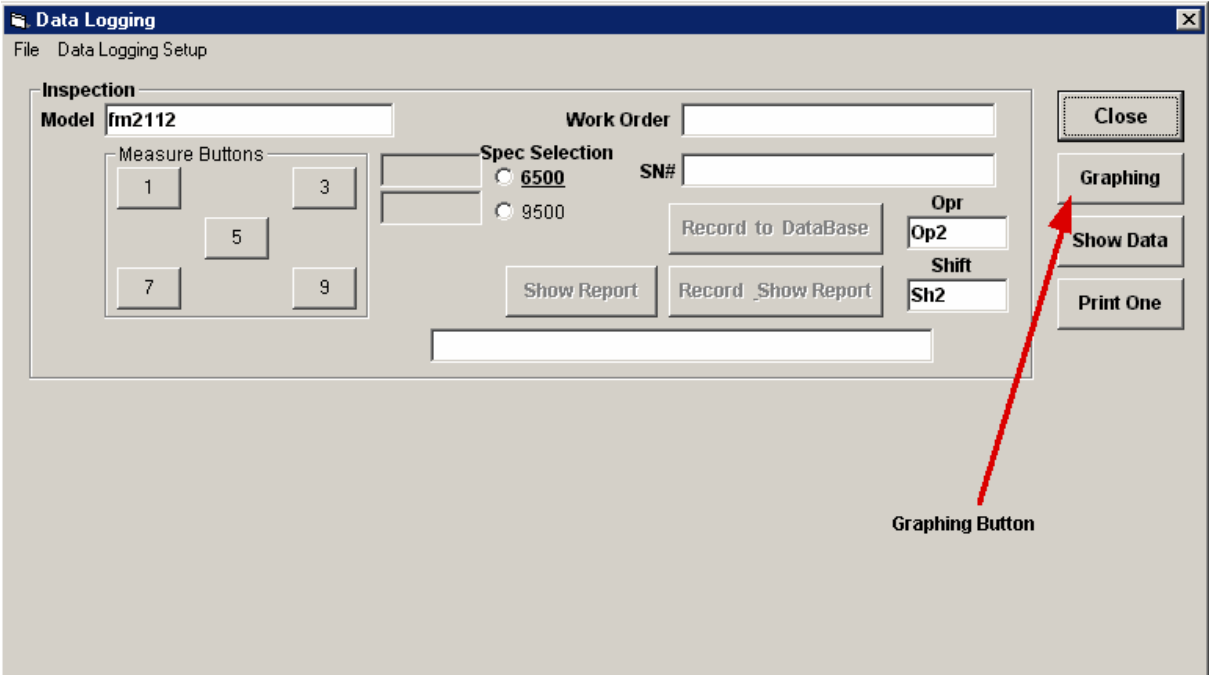


To record data, as in Single White Point Spec, enter a serial number and measure the required points by aiming the colorimeter appropriately and clicking the corresponding "Measure Buttons". Then select the second white point inspection button, change the display to the new white point, and measure the required points by aiming the colorimeter appropriately and clicking the corresponding "Measure Buttons". After all buttons have been pressed for all Spec Selections, the "Record to DataBase" button becomes enabled, and the data may be stored to the database (and optionally graphed with the Show Report button).

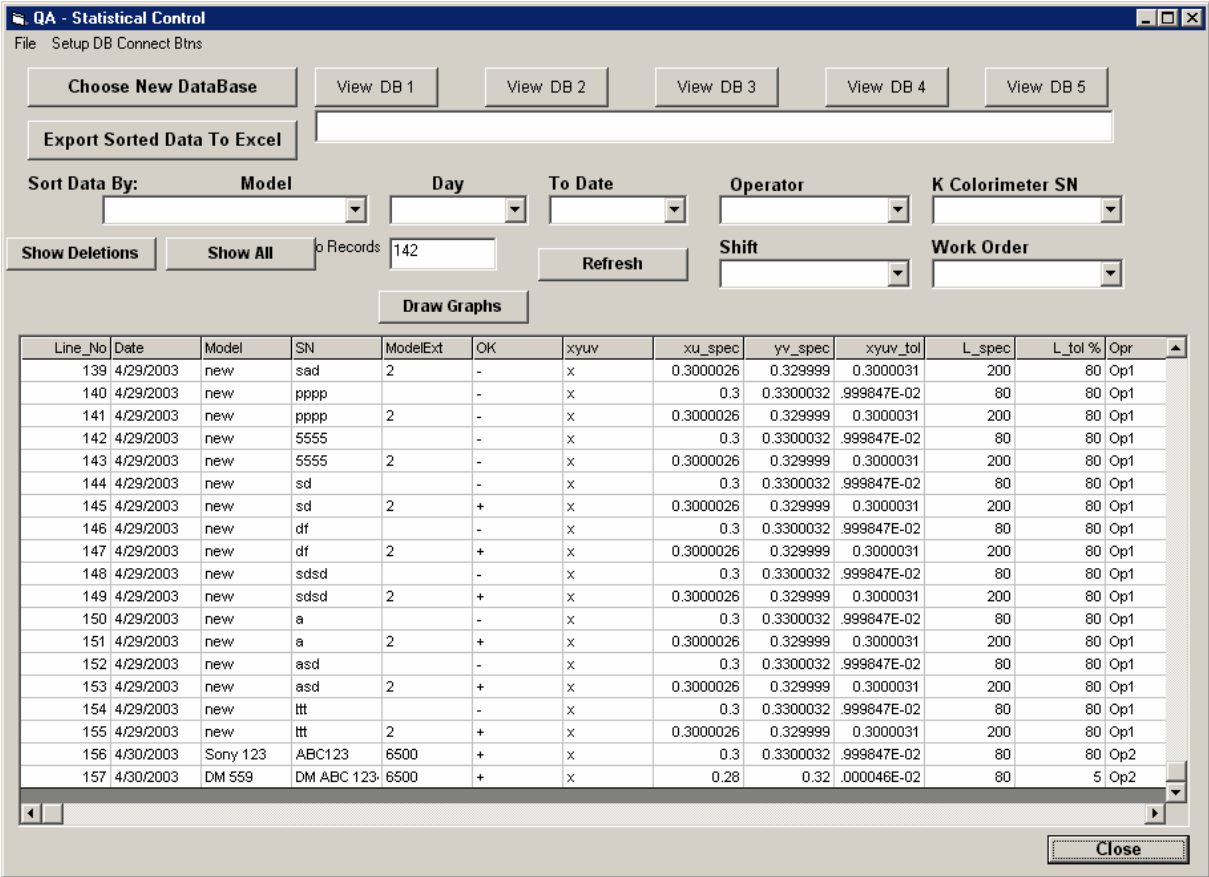
When the Report for a dual spec display is made, it appears as two pages of graphs, one page for each spec of the display.

6.3 Making and Printing Reports

It was shown in "Data Logging, Single White Point Spec" section how to log a reading. Once several loggings have occurred, the data can be accessed in the DataGraph window. To do this, press the "Graphing" button in the "Data Logging" window.



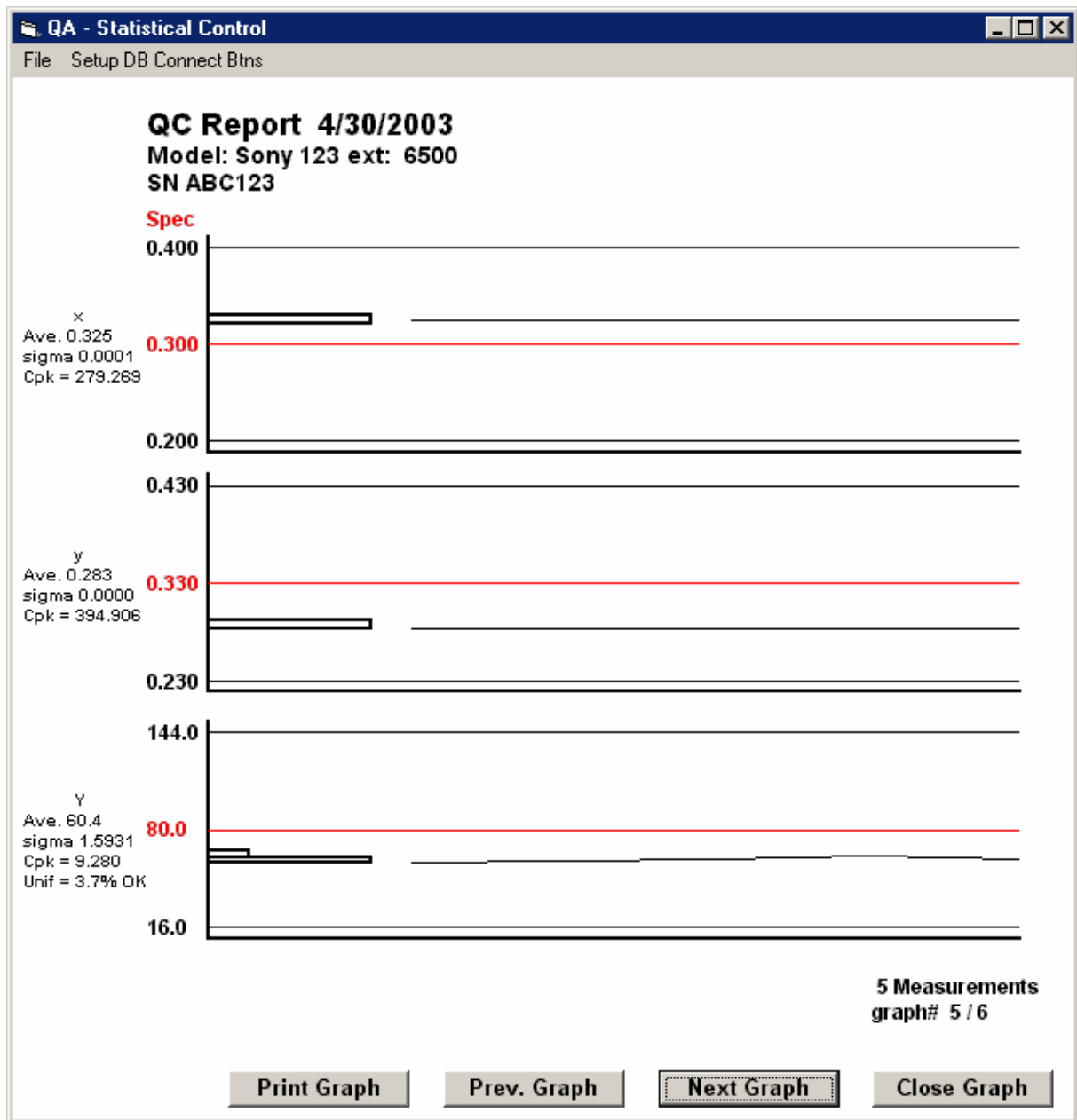
The QA - Statistical Control window will open, showing the default (current) database.



You may also choose to examine other databases, from the Archive folder for example, by pressing the "Choose New DataBase" button.

The data shown is ALL the data in the database, and there may be many Models, Dates shown. To see only a subset of the data, in the "Sort Data By" pull down lists, select only the data you wish to see, whether it be from a single Model, or Work Order Number, etc.

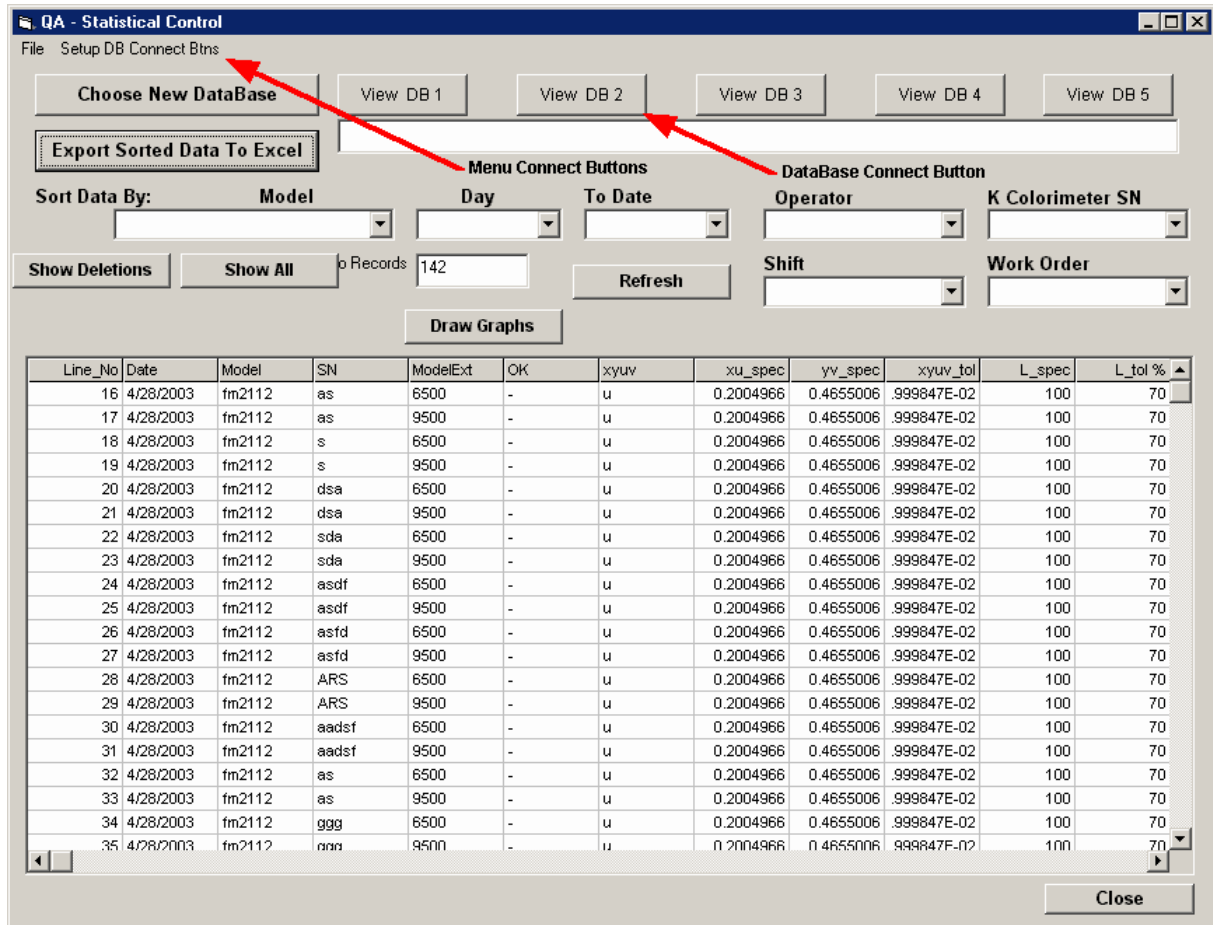
When the "Draw Graphs" button is pressed, a QC graph is drawn for the xyY (or u'v'Y) data of each different Model, each different White Point Spec file extension. The graphs will show how many units are within spec, how close to the spec edge they are, and in which direction. Each graph will include Cpk data to keep track of process control.



You may print each graph as a report.

Gathering DataBase Data by Networking to PC's on the Production Floor

If your PC is connected to a network, and you wish to draw a Cpk graph for data which is in the default database or archive of another pc, there is a Setup DB Connect Btms menu item which will connect up to 5 Data Connect Buttons to databases on you PC, or on other networked PC's. In this way, you may easily get a Cpk graph for current manufacturing processes in near real time.



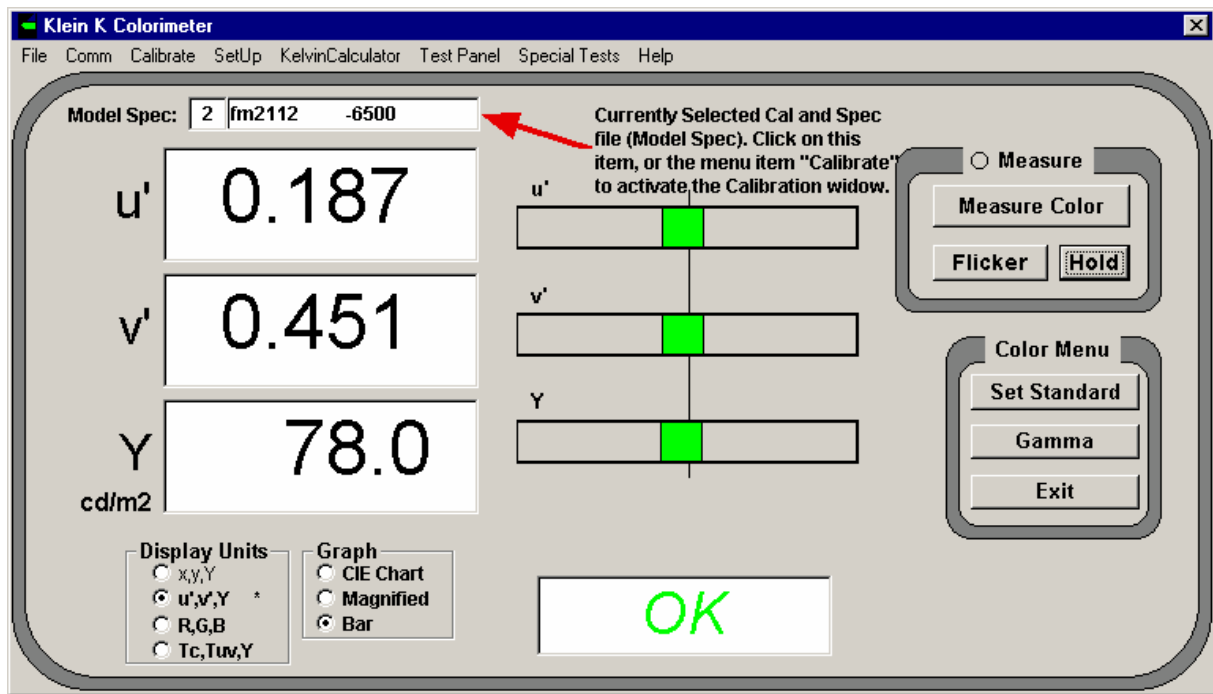
7 Chapter 6: Custom Calibration

7.1 Custom Calibration

There are up to 96 Custom Calibration files stored in the colorimeter.

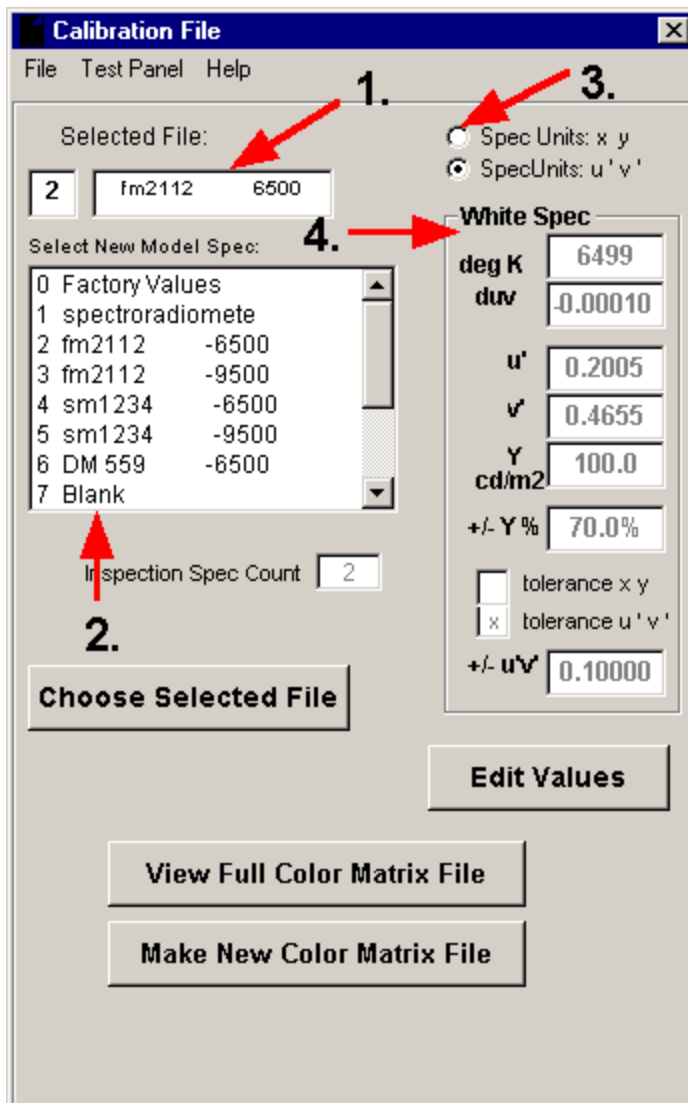
Each Calibration file contains a White Point Spec, and a color conversion matrix.

To access the White Point Spec, attach the colorimeter to the comm port, run the Klein K Colorimeter PC Program, and observe:



Entering or Changing a White Spec Value in a Calibration File

Click the "Model Spec" window, or click the "Calibrate" menu item to call up the Calibration File window:



Observe the items in the above Calibration File window:

1. The currently chosen Model Name of the cal file (fm2112) and its extension (6500). The names and the cal values are stored in the colorimeter head, and downloaded to the pc program on startup of the pc program.
2. The list of cal files in the colorimeter head from which to choose.
3. A button to choose to observe the spec values in u'v' units, or in xy units.
4. The White Spec Values for this particular calibration file. These values will be used to judge whether measurements (of a white field) are within spec or out of spec.

To Choose a file, click on it. To return to the main window, click "Choose Selected File".

The 'White Spec' dialog box contains the following fields and options:

- deg K: 6499 (indicated by arrow 1)
- duv: -0.00010
- u': 0.2005 (indicated by arrow 2)
- v': 0.4655
- Y: 100.0
- cd/m2: 100.0
- +/- Y %: 70.0% (indicated by arrow 3)
- tolerance x y
- tolerance u' v' (indicated by arrow 4)
- +/- u'v': 0.10000 (indicated by arrow 5)

Observe in the White Spec portion of the window:

1. deg K and duv. These are read only values calculated from xy (or u'v') below. Use the Main window "Kelvin Calculator" to see the degree Kelvin values for xy or u'v' values.
2. u'v'Y' (or xyY). These are the target (spec) values for white for this cal file.
3. Y tolerance in %. For the OK / NoPass indicator, this is the amount Y can vary and still be in spec.
4. xy tolerance mode, u'v' tolerance mode. This determines what the native mode of the colorimeter will be when this cal file is chosen. If xy is chosen, the colorimeter will prefer to show color in xy values when first opened, and will make QC graphs with axis labeled as x and y. If u'v' is chosen, the colorimeter will prefer to run in the u'v' mode.
5. u'v' (or xy) tolerance value for OK / NoPass tests.

The white point spec values may be edited by clicking on the Calibration File window "Edit Values" button. Before making any other changes, choose xy or u'v' spec by clicking on the "Spec Units xy" or "Spec Units u'v'" radio button. Then also choose the "tolerance xy" or "tolerance u'v'" to match this choice. The remaining xyY and tolerance values may be edited. Notice that the degK value is non-editable, and follows the value of xy (u'v') entered. When you have edited the white spec values to your liking, press the button "Save As" (which appeared in the Calibration File window when edit mode was entered). A new small window appears:

The dialog box contains the following text and fields:

You have been editing file listed below.
Press 'Store Now' to overwrite that file, or
enter a new file number and matrix
name, then press 'Store Now'.

No.	File Name	Mult Ext
2	fm2112 6500	6500

Buttons: Store Now, Cancel

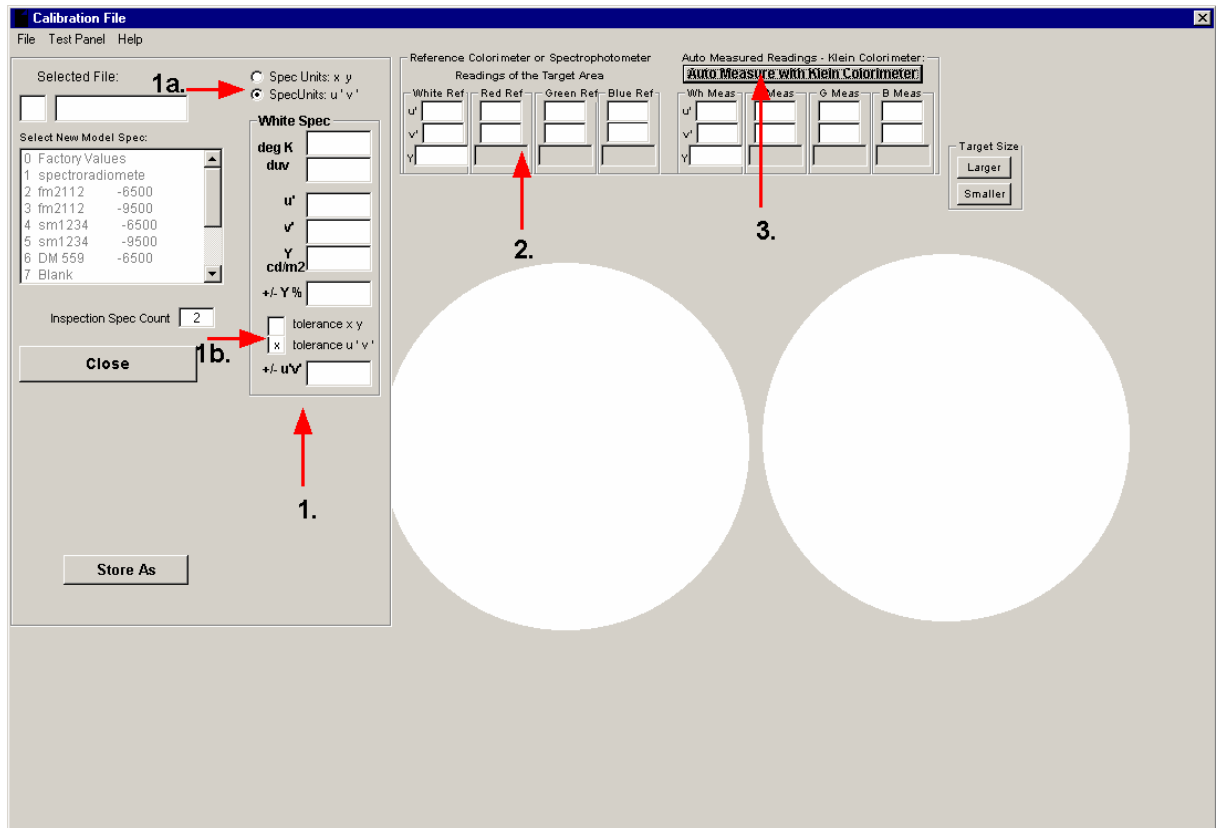
Choose a new File Number (1-96) and a new File Name (1-16 letters) and Extension (4 letters). The file name should match the name of a model of display for which it is to be used. The Extension value should match the name of one of the white point specs for tat monitor (9400 or 6500 would be good names).

Press "Store Now" and a message should appear telling you that the spec file has been stored to flash in the colorimeter.

Creating a Calibration Full Color Correction File

For this calibration procedure, you will need a display which will be used as a calibration match transfer. It does not need to be precisely calibrated, although it should be nearly so. You will also need a reference colorimeter or spectro-radiometer. You will enter values in the pc program which will cause the Klein K colorimeter to match the readings of the reference colorimeter for red, green, blue, and white.

Run the klein pc program with the colorimeter attached, press the "Calibrate" Menu item, press "Make New Color Matrix File". Before you enter any values, choose "Spec Units xy" or "Spec Units u'v'". Choose the same units for "Tolerance units xy" or "Tolerance units u'v'"



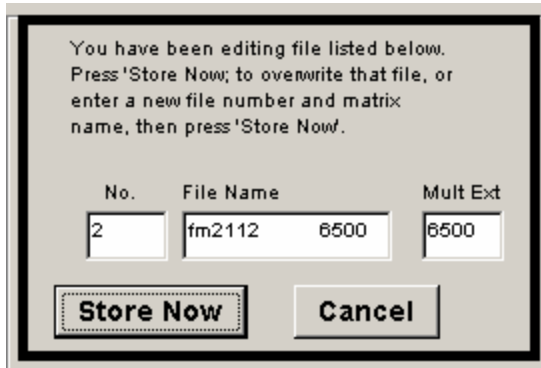
After you press "Make New Color Matrix File", the window opens to show entry boxes, and color targets.

1. Choose the Spec Units to be xy or u'v'. This must be done first, as the Spec Units fields cannot be edited once other values are entered. Also choose the tolerance mode to be xy or u'v'. Enter a new white point spec xyY or u'v'Y values. Enter a new Y tolerance (%) and xy (or u'v') tolerance value.

2. With a reference colorimeter (which you are trying to match precisely) or a spectro-radiometer, take and enter readings of a chosen target area of xy (u'v') Y for a white, red, green, and blue field. To change the color of a target area, move the mouse cursor over a data entry point.

3. Aim the Klein colorimeter at the precise same target area, and press the "Auto Measure" button. The target areas will flash different colors, and in several seconds a color correction file will be created which should cause the Klein colorimeter to precisely match the reference colorimeter for THIS display and similar displays.

4. Press the "Store As" button to save the new Color Correction file to the colorimeter head.



The dialog box contains the following text and fields:

You have been editing file listed below.
Press 'Store Now' to overwrite that file, or
enter a new file number and matrix
name, then press 'Store Now'.

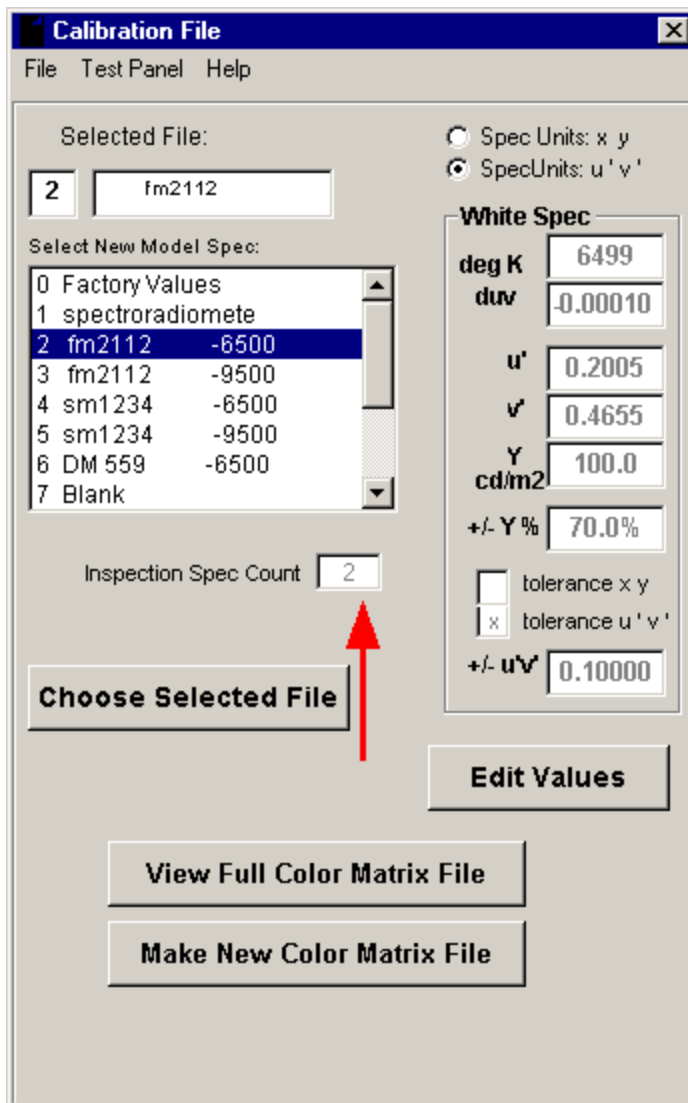
No.	File Name	Mult	Ext
2	fm2112	6500	6500

Buttons: Store Now, Cancel

Choose a new file number, File Name, and File Extension, and press "Store Now".

Making a dual (or tripple) white point spec:

If there is to be a second (or third) white point spec for this same monitor, you may recall the first spec, put a number (2 or 3) in the box for "Inspection Spec Count", and store it again. Then recall it once more, modify the xyY (or u'v'Y) spec and tolerance values, then Store it. Give it the file number of the next consecutive number following the first spec file for that monitor. Give it a file extension that makes sense (9500 for 9400 degrees kelvin white or whatever). Do a "Store Now". This will give you a second spec file for the monitor.



The second spec file for a monitor may be used in the data logging window (main menu / Special Tests / Data Logging) in order to quickly switch between calibration specs while testing a single monitor.

TO PLAY WITH THE CALIBRATION, IF YOU DO NOT HAVE A REFERENCE COLORIMETER, THEN YOU CAN

PRETEND THE FOLLOWING VALUES ARE "TRUE" VALUES FROM A REFERENCE COLORIMETER, AND

PROCEED TO CALIBRATE THE K-10 TO MATCH THEM:

x y Y

white .280 .300 60

red .620 .320 2 (r,g,b Y cal taken from white)

green .280 .600 2

blue .140 .075 2

Store the cal file as "Trial Number 1" or something similar. Then whenever the colorimeter is run and the "Trial Number 1"

file is chosen, and the same monitor is measured, the values for a white, red, green, blue field should match

the entered values above, (except for the Y values of red, green, blue, which are taken as ratios of the white value for cal purposes).

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