BETACOLOR 2000 Spectrodensitometer

Preliminary Instruction Manual

1. Introduction

1.1 Starting Operations
To unlock the aperture from its closed position, pull the locking knob straight out.

1.2 Automatic Switch-off
The display switches off after about 20 seconds of to extend battery life. To restore the last reading, briefly tap any key.

1.3 Symbols
Explanation of the abbreviations used on the LCD:

C	Cyan
M	Magenta
Y	Yellow
K	Black
O	Orange
G	Green
B	Blue
%	Dot Area or Trap Efficiency
Δ	Dot gain or Difference
abs.	Absolute
ADJ.	Adjust (Slope)

2. Measuring Functions

2.1 Choosing the Mode
By pressing key **C**, the following six modes can be selected. The list can be scrolled in reverse order by keeping key **A** pressed down and at the same time pressing key **C**.

2.2 Automatic Mode
Automatic zeroing, automatic color recognition, automatic recognition of solid tone, 3 dot area

references, trapping, automatic density, dot gain, automatic recognition of trapping basic colors and printing sequence, as well as automatic determination of the PERL factor.

Adjustment possibilities for dot gain reference percentages for three-quarter tone, half tone and quarter tone patches.

2.3 Density Mode

Automatic zeroing, automatic color recognition, the dominant density is shown.
Lockable measured color to show the secondary colors.
The Betacolor 2000 allows up to 7 Reference colors to be stored; one Reference color for each color tone. After initial display density differences to stored values can be shown.

2.4 Balance Mode

Measurement of the gray balance, gray balance difference, simultaneous measurement of the density of all 7 colors (cyan, magenta, yellow, black, orange, green and blue). Density difference in 7 colors, maximum balance deviation.

2.5 Dot area Mode

In this mode the Dot area (in percentage) can be shown.
Relative Print Contrast can be measured directly.
Hue-error measures the solid tone and the purity.
The Grayness indicates the grayness value of the solid tones.

2.6 Colorimetry Mode

In this mode the unit operates as a Spectrophotometer, which gives values in Lab, LCh and xyY according to the CIE standards. It is possible to store up to 9 Reference colors and to view the difference in CIELab, CIELCh, CIExyY and ΔE. The nearest Reference color is chosen automatically by the device.

2.9 Configuration Mode

Sets the slope factor to adjust to other instruments as well as calibration to absolute zero.
Configuration of the language and of the Baud rate. Should the desired language not appear in the display, please enter in the Configuration Mode and follow the instructions as described above.

3. Explanation of the Measurement Functions

3.1 Automatic Mode

Most of the measuring functions can be carried out in this mode.
Please switch in the polarizing filter by turning the switch on the backside of your unit to "P" (if your device is equipped with Polarization Filter).

3.1.1 Calling Up the Automatic Mode

Press key **C** down until

```
AUTOMATIC MODE
Zero to paper!
Density, Dot Gain
Trapping
```

appears on the LCD

3.1.2 Zeroing in Automatic Mode

Position the aperture over your white reference and push the device downwards until

```
Zeroed!
```

appears on the LCD.

Automatic zeroing is incremental, that is, a white reference that is lower than the previous zero and density of 0.14 actuates an automatic zeroing.

In order to zero on a white reference with a density which is greater than the previous zero and density of 0.14, press key **A**, and the device itself downward at the same time, until the word "zeroed" appears in the LCD.
The primary area of use of zero-methods is in measuring news print or similar substrates which are darker than regular white paper, for example recycled paper.

Measuring a lighter paper automatically zeros to light white.

3.1.3 Density Determination

Position the aperture on a density target, for example cyan, and press the device downwards until you see the density reading on the LCD.

```
C Density 1.455
```

3.1.4 Dot Gain Determination

Measure a solid-tone target, then a dot area (a half tone area, for instance) of the same hue. The basic color, the reference and the dot gain will appear on the LCD:

```
C  Δ40 %  13
```

3 dot area references are stored for all 7 basic colors.

For example:

1/4 tone	25%
1/2 tone	40%
3/4 tone	80%

3.1.5 Dot Gain Reference Setting

The dot gain reference mode is called up by pressing keys **A** and **B** simultaneously. In this mode, percentile references in the 7 basic colors can be set independently of one another, so that you can take color variations on your test sheet into consideration.

```
DOT GAIN REF:1/2
C 40 M 40 Y 40
O 40 G 40 B 40 K 40      =>
```

The relevant reference group is shown in the upper right-hand corner. The reading for the relevant color blinks. To increase this reference reading, press key **A**, to decrease, press key **B**. The readings for the reference groups can be set within the following tolerances:

Reference Group	Area in %
1/4 tone	20...38
1/2 tone	39...50
3/4 tone	70...80

By pressing key **C**, you move on to the next color; if the last color was black, to the next reference group.

By pressing keys **A** and **B** simultaneously, the readings are stored, and you move out of dot gain adjustment mode.

3.1.6 Trapping Measurement (according to Preucil)

Measure a red, green, or blue trapping color field while simultaneously pressing button **B**. The command to measure the solid-tone fields of the two colors which are printed over one another in the trapping field, appears in the LCD:

```
Trapping
Measure Y or M
```

Follow the directions on the LCD and complete the measurement of the solid-tone patches of the 2 colors in whichever order you wish. The percentile readings of the trapping (trapping efficiency) and the order of the colors as they are printed over one another appear on the LCD

```
Trapping
Y on M : 96 %
Perlfactor: 97 %
```

In the above example, magenta has been printed first, and the color absorption of the second color, yellow, has reached 96%, the Perl Factor according to Prof. Axel Ritz indicates 97%.

3.2 Density Mode

This mode is used to analyze substrates and color compositions.
Please switch in the Polarizing filter by turning the switch on the backside of your unit to "P" (if your device is equipped with Polarization Filter).

3.2.1 Calling Up the Manual Mode

Press key **C** down until

```
DENSITY MODE
Zero to Paper!
A Set Solid Ref.
A + B Fix Color
```

appears on the LCD.

3.2.2 Zeroing in Density Mode

Position the aperture over the field of reference (for instance, paper). By pressing the device itself downward, you get the following reading on the LCD:

```
Zeroed!
```

Automatic zeroing is incremental, that is, a white reference of a lower density than the previous reference actuates an automatic zeroing as will any density below 0.14.

In order to manually zero on a white reference with a density which is greater than the previous

zero and density of 0.14, press key **A**, and the device itself downward at the same time, until the word "zeroed" appears in the LCD.
The primary use of manual zero is in measuring news print, recycled paper, or similar substrates which are darker than regular white paper.

Measuring a lighter paper then automatically zeros to light white.

3.2.3 Density Measurement

Measure a density field. The density setting then appears on the LCD next to the blinking density symbol:

```
M Density 1.345
```

3.2.4 Fix color

To deactivate the automatic color recognition, to measure also secondary colors and not only the primary color on various patches, measure on a solid tone patch of the color that you would like to fix. Then press button **A** and **B** simultaneously; on the LCD the following message will appear:

```
M color fixed!
Zero to release
```

For the following measurements the Magenta value of the measured patch will be shown.
To reactivate the automatic color recognition measure on a white field.

3.2.5 Storage of Reference colors

With the Betacolor 2000 you can also store up to 7 Reference colors, one for each ink: Cyan, Magenta, Yellow, Black, Green, Orange and Blue.
These colors will be stored be measuring the respective solid patch and pushing simultaneously the button **B**.
On the Display the following message appears:

```
M Density  0.000
```

The 7 Reference colors will be stores in the memory of the unit until the densitometer will be zeroed to paper or a new value is stores.
By taking a measurement on a patch the color is recognized automatically and the difference between the stored value and the measured patch is shown on the display.

3.3 Balance Mode

Please switch in the Polarizing filter by turning the switch on the backside of your unit to "P" (if your device is equipped with Polarization Filter).

3.3.1 Calling Up the Balance Mode

Press key **C** until

```
BALANCE MODE
A Reference
A+B abs. Density
```

appears on the LCD.

3.3.2 Balance Reference Determination

White paper, a gray balance field, a color field, a special color field, etc. can all serve as a balance reference, according to whether you wish to determine gray balance, gray balance difference or density difference. Position the aperture over the field of reference, press key **A** and the device itself downward until

```
BALANCE-REF. SET
Measure Patch!
B Max. difference
```

appears on the LCD.

3.3.3 Gray Balance Determination

Measure the balance reference on white paper as described above. Then position the aperture next to a gray balance field composed of the colors cyan, magenta and yellow (or of 7 colors).

Press the device downward to complete the measurement.
You obtain the density of the 7 colors, but consider only the printed colors:

(BALANCE)	O 0.604
C 0.490	G 0.501
M 0.575	B 0.510
Y 0.605	K 0.588

The color which then blinks is the predominant one.

3.3.4 Balance Difference

Choose a balance field as reference field on your test sheet and measure the balance reference as described. Then measure a balance field on your test sheet. The balance difference of the 3 basic (7 colors) colors will appear on the LCD, as well as that of black, when the device is released.

3.3.5 Density in 7 colors and special colors

Measure the white paper as your balance reference and then the relevant color field. The 7 densities will be shown simultaneously and the special colors clearly characterized. For densitometric control of the special colors, the predominant density and the predominant densities should be determined in this manner.

3.3.6 Density Difference in 7 Colors and special colors

Measure the relevant color field on your test sheet as a balance reference. Then measure on fields of the same colors on your process sheet. The density variation appears in all four colors on the LCD.

3.3.7 Maximum Balance Difference

Press key **B**, and the maximum balance difference in the basic colors appears on the LCD.

```
MAX: DIFF: 0.115
C->Y
```

3.3.8 Absolute Density (in Balance Mode)

After having called the Balance Mode, push the keys **A** and **B** simultaneously to get into the Absolute Density Mode. On the LCD Display the following message appears:

```
      A+B ABS.BAL    O
      C              G
      M              B
      Y              K
```

Note: Always check that the unit is calibrated on the absolute white Reference (see Configuration Mode)

3.3.9 Measure the absolute Density

Put the aperture of the instrument on the patch that has to be measured and take a measurement; on the LCD will following display appears:

```
      ABS. BAL. O 0.810
      C 0.111   G 0.656
      M 0.254   B 0.124
      Y 1.245   K 0.223
```

3.4 Dot-Area Mode

3.4.1 Calling Up the Dot-Area Mode

Press key **C** until

```
DOT AREA MODE
A Zero to Paper
B Set Solid Ref.
```

```
A+B Set Dot Bal.
```

appears on the LCD.

3.4.2 Zeroing in Dot-Area Mode

Position the aperture over your white reference field, press key **A** and the device itself downward until the information

```
B Set Solid Ref.
```

appears.

3.4.3 Solid-Tone Reference Measurement

Position the aperture next to the relevant solid-tone field of the color to be measured (for instance cyan 100%), press key **B** and the device itself downward until

```
Measure % area C
```

appears on the LCD.

The range 0...100% is stored by the device automatically.

3.4.4 Dot Value Measurement

Position the aperture on any dot patch of the above-mentioned colors and press the device downward. The reading for the Dot appears on the LCD in percentage:

```
C DOT AREA %47
```

3.4.5 Grayness and Hue Error

The Grayness and Hue Error can be displayed by pushing the button **B**, after having taken a measurement on a solid patch.
On the LCD Display appears:

```
Grayness   4 %
Hue Error  33%
```

3.4.6 Relative Print Contrast

After a dot area measurement by pushing the button **B** (and keeping it pressed) on the LCD you will read:

```
C Contrast 13 %
```

3.4.7 Dot Balance

This function gives the possibility to read simultaneously on the display for all 7 colors the dot area value.
After you have zeroed in the Dot area Mode the keys **A** and **B** simultaneously; on the LCD display will appear:

```
DOT REF.    O
C           G
M           B
Y           K
```

Enter the solid tone reference as described before by pushing button **B** and taking at the same time the measurement.
On the display next to the measured color you will read its density value.
Do this storage for all color that have been used in the print.
Then take a measurement on a patch (for ex.: Balance field) and read for every printed color the dot area value on the display:

```
DOT BAL.    O
C 83%       G
M 85%       B
Y 70%       K 90%
```

3.5 Colorimetry Mode (Spectral Analysis)

The spectral Analysis is used mainly for analysis of the appearance of the proof and print, and color management.

The Betacolor 2000 complies with DIN/ISO 13655, where the light source is D50 (5000K) and the observer is 2 degree.

Press key **C** until the following message appears in the LCD:

```
COLORIMETRY
   D50 2°
A Reference
B Lab/LCh/xyY
```

Note: The device must be calibrated at least twice a day to absolute zero (see configuration mode).

3.5.1 Absolute values in CIELab, CIELCh and CIExyY

Choose by pushing button **B** the color system from the 3 different possibilities:: CIELab, CIELCh and CIExyY.
Measure on a color patch or in the picture and on the display will appear the absolute values in CIELab, CIELCh or CIExyY:

```
L* 82.5
a* -5.6
b* 12.9
abs
```

By pushing the key **B** you can switch from one color system to another and read the measured values.

3.5.2 Set Reference values

Press key **A** until on the display you will read in the left button corner R1(Reference number 1). To store a value as R1 put the aperture on the patch to store and simultaneously push button **A** and take a measurement. The measured sample is stored in position R1 and in the display you will read its values:

```
L* 42.5
a* 15.6
b* 11.9
R1
```

By pushing briefly button **A**, R2 will appear in the display.
Store in R2 another Reference color by following the same procedure as described above.
There is the possibility to store up to 9 Reference colors.
By pushing button **B** the Reference-values in the 3 different color systems can be seen (Lab, LCh and xyY).

3.5.3 ΔE (Delta E) values

Please choose by pushing key **A** the Reference color with which you would like to compare the following measurement.
Take a measurement without pushing any button. On the display appears the value ΔE, the distance between the reference color and the measured color in a three dimensional color space system (CIELab).
You can also see the differences in L* (lightness) Δ(L*), in a* (red-green axis) (Δa*) and in b* (blue-yellow axis)(Δb*) to the reference color (for ex.:R3).

```
L* 72.5     ΔL* 0.3
a* 15.6     Δa*-1.0
b* 13.9     Δb* 0.8
R3          ΔE 1.4
```

On the left side of the display the Lab, LCh or xyY values of the measured color are shown.

Push key **B** to see also the differences in the other color systems CIELCh and CIExyY.

∆E corresponds to a visual difference between two colors and is expressed as a number, which can be compared as follows:

∆E	Difference
<1	Excellent Quality (just noticeable difference to an expert viewer)
1-3	Good Quality (just noticeable difference to an average viewer)
3-6	Medium Quality (typical commercial color match)
>6	Poor Quality

∆E in CIELab and CIELCh corresponds to the same value.

3.5.4 Automatic Recognition of the Reference color

This function automatically finds the nearest reference color to the measured color.
The difference between the two colors is shown as ∆E, ∆L*, ∆a*, ∆b*, ∆C*, ∆H, ∆x, ∆y, ∆Y.
After you have stored your Reference colors push button **A** until „auto" appears in the left corner of the display.
Without pushing any key, measure the color that has to be compared and the unit automatically finds the nearest Reference color, shows its number in the Display and gives the differences:

```
L* 72.5     ΔL* 0.3
a* 15.6     Δa* -1.0
b* 13.9     Δb* 0.8
auto-R3     ΔE  1.4
```

By pushing button **B** you can see the differences in the 3 color systems (CIELab, CIELCh, CIExyY).
On the left side of the display the values of the measured color are shown as Lab, LCh or xyY values.

Note: If there is not a comparable color, the device shows in the display only the values Lab, LCh or xyY.

```
L* 82.5
a* -5.6
b* 23.9
auto
```

3.6 Configuration Mode

3.6.1 Calling Up the Configuration Mode

Press the red RESET key on the underside of the instrument until the following appears on the LCD:

```
        VD 2000P v01.05
        A+B D BAUD19200
        B Absolute Zero
        C Slope
```

The type of device (VD 2000) will appear on the screen, followed by a "P" for devices with polarization filter, as well as the version number of the microprocessor program (v 01.05) (which you should quote to us if any questions arise) and the transmission rate (BAUD RATE) of the serial interface between BETACOLOR and your PC.

3.6.2 Adjusting to Absolute Zero

This function can only be carried out with the BETACOLOR 2000. Press key **A** until you see

```
Measure
Absolute White!
A+B EXIT
```

appears on the LCD.

Position the aperture over a white test sheet whose density is already known, for instance, a white field of the included VIPREF check-plaque

or a Status-T reference. Push the device downward until "zeroed!" appears.

Press keys **A** and **B** simultaneously to store your absolute white reference and to change to automatic mode.

3.6.3 Slope Setting

The slope factor can be set to adapt the device to other devices, to internal standards or to any other norm. The gradient can be directly adjusted if the slope factor is already known, or indirectly by measuring a solid-tone patch of known density.

3.6.3.1 Adaptation Requirements

Adaptation must be done separately for each filter. Both devices must function in the same way, that is, with or without polarization filter, for example, or narrow-band or broad-band filters must correspond to one another. Both devices must be zeroed, using the same white test sheet. The color test used for color adjustment must have a middle density of 1.25.

3.6.3.2 Zeroing to Slope Setting

Press key **B** until "1000 Zero" for every color channel appears on the LCD

3.6.3.3 Direct Setting of the Slope Factor

Press key **A** to decrease any key **B** to increase the Slope factor. To move to the next color channel, press key **C**.

3.6.3.4 Setting by Means of Comparison Device

Zero the device which is to be adapted to the BETACOLOR 2000 on a white test sheet. Position the aperture of the BETACOLOR 2000 device over the same sheet and press the densitometer downward to zero it. Measure a field of a basic color with a density of, for instance, 1.35 with the other densitometer. Now

measure the same field with the BETACOLOR densitometer, and on the LCD will appear the measured density, for instance, 1.390.
Adjust this density to that of the other densitometer (1.35) with the help of key **A** (to decrease) and key **B** (to increase). The corresponding slope factor will be determined automatically by the device and displayed.
Repeat each of the above steps for each color.
Press keys **A** and **B** simultaneously to leave the slope mode

4.Troubleshooting and Error Messages

```
WARNING!
Double Measure
on same  % patch
```

If you measure a dot patch with the same reference percentage twice in automatic mode (for instance, twice on a full-tone field), the device will inform you of this with the indication above. The dot gain will nevertheless be calculated and shown.

```
Missing Solid!
```

If you measure a color field in Dot-value mode without having measured the corresponding Solid-tone field by pressing key **B**, the dot value cannot be calculated and the device responds with the indication above.

```
Invalid Patch!
```

In Grayness Mode and in hue error mode, only measurements of the basic-color patches cyan, magenta and yellow are allowed. If you have measured another field, the indication above will appear.

```
TRAPPING ERROR!
Invalid Solid!
```

You have measured a trapping field and the device asks you to measure the two basic colors of the field. If you measure on a field of another color, the indication above will appear. Measure on a field of one of the specified colors.

```
ERROR!
Missing!
Reference Patch
```

If you measure in balance mode without having measured the balance reference beforehand by pressing key **A**, the error indication above will appear. Measure the balance reference by pressing key **A** before you measure a balance field.

5. Replacing the Batteries

The indication

```
LOW BATTERY!
```

shows, that the batteries must be replaced. The user can complete work in progress, but replacement with fresh alkaline AA batteries should take place as soon as possible.

Remove the lid on the underside of the device after loosening the screw. Replace the batteries, paying close attention to polarities. Replace the lid, tighten the screw and press the reset button. The device must be zeroed before any new measurements are made.

6.Technical Data

6.1 RS 232-Interface

RS 232 Standard Format
Data Transmission Rate: 19200 baud
Data Frame: 8 Bit, no parity,
1 stop bit or 7 Bit, even parity, 1 stop bit

6.2 Device Function:

Densitometric Functions
- Automatic zero setting
- Automatic color recognition (for 7 colors: C,M,Y,K,O,B,G)
- Density and density difference
- Absolute Density
- Grayness
- Hue Error
- Relative print contrast
- Perlfactor
- Gray balance and Color balance
- Automatic recognition of function
- Dot area % (Murray Davies)
- Dot gain for 2 and 3 patches
- Dot balance
- Trapping and first printed color recognition
- Slope
- Reference colors 7

Colorimetric Functions according to ISO 13655: daylight D50 and 2° standard observer
CIE L*a*b* (ΔL*, a*, b*, DL*, Δa*, Δb*, ΔE*ab)

CIE L*C*h° (L*, C*, h*, ΔL*, ΔC*, Δh, ΔE*ab)
CIE xyY (x, y, Y, Δx, Δy, ΔY)
- Reference colors 9

Technical Specifications

Aperture (mm)	3.3mm standard (1.8mm optional)
Measuring range	Density 0.00 - 2.50
Percent	0 - 100
Measuring time	0.4 sec.
Digital display	
	LCD display4 lines with 16 characters symbol height (4.75x3.00mm)
Repeatability density	+/- 0.003
Linear accuracy percent	+/- 1
Serial interface	RS232
Measurements per battery-set	over 300,000
Batteries	4 x 1.5V (size AA) Alkaline

Filters	StatusI, T
	(DIN 16536optional polarizing filter
Detector	Photodiode
Weight	Approx. 390 g
Dimensions (mm)	145x83x48
Base plate	Fiberglas reinforced Polycarbonate

Beta measuring devices are constantly being developed further and brought up to latest technical standards. Beta reserves the right to up-date its technical data and design without prior announcement.

8.Accessories

8.1 Basic Equipment

Betacolor 2000
VIPREF Check Plate
Instructions
Shock-resistant packaging

8.2 Optional Equipment

RS 232 cable