A Geno Technology, Inc. (USA) brand name

# Ultra-micro UV-visible Spectrophotometer with Cuvette and Fluorescence detection

## Cat. No. BT3903

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# Table of Contents


Important Safety information ..... 5
Instrument Care and Maintenance ..... 5
Introduction ..... 6
Features ..... 6
Technical Specifications ..... 7
Normal Operating Conditions ..... 7
Basic Parameters ..... 7
Cuvette Measurement Specifications ..... 7
Fluorescence Detection Specifications ..... 8
Structure ..... 8
Quick Guide ..... 9
Micro-Volume Measurement Instructions ..... 9
Cuvette Measurement Instructions ..... 9
Automatic Blank Detection ..... 9
Automatic Sample Detection ..... 9
Blank Measurement and Absorbance Calculation ..... 10
Software Applications ..... 10
Common Functions of the Measurement Software ..... 11
Blank Measurement Procedure ..... 11
Nucleic Acid Measurement ..... 12
Measurement Parameters ..... 12
Microarray Nucleic Acid Measurement ..... 13
Measurement Parameters ..... 13
Pure Protein Measurement (ProteinA280) ..... 14
Measurement Parameters ..... 14
Labeled Protein Measurement ..... 15
Measurement Parameters ..... 15
Quantitative Protein Measurement ..... 16
Measurement Methods ..... 16
BCA Method ..... 16
Lowry Method ..... 16
Bradford Method ..... 16

Software Functions ..... 17
Standard Measurement Table ..... 17
Measurement Parameters ..... 17
Standard Curve Viewing ..... 18
Unknown Protein Concentration Measurement ..... 18
Measurement Parameters ..... 18
Cuvette Mode Measurement ..... 19
NucleicAcid, ProteinA280, and Cell Cultures Measurement Interface ..... 19
Measurement Parameters ..... 19
Kinetics Measurement Interface ..... 20
Microbial Cell Culture Measurement ..... 22
Measurement Parameters ..... 22
UV-Visible Absorbance Measurement ..... 22
Fluorescence Detection ..... 23
Fluorescence Measurement Procedure ..... 23
Fluorescence Detection Interface ..... 24
dsDNA Detection Interface ..... 25
Standard Curve Display (Left Panel) ..... 25
Sample Measurement Display (Right Panel) ..... 25
Data Table ..... 26
Standard Curve Creation Interface ..... 26
Fluorescence Intensity Measurement ..... 27
Fluorescence Kinetics Measurement ..... 28
Measurement Procedure ..... 28
Data Export ..... 29
Graphical Data Export ..... 29
Tabular Data Export ..... 29
Screenshot Export ..... 29
Dye Parameters ..... 30
Viewing and Exporting Historical Data ..... 30
Accessing Historical Data ..... 30
Historical Data Parameters ..... 31
Viewing and Managing Historical Files ..... 31
Setting the Historical Data Date Range ..... 31

User Management....32
Accessing User Management....32
Managing User Accounts....32
User Account Limitations....32
Software Update....33
Dye Editing....34
Managing Dye Profiles....34
Selecting Dyes for Measurement....35
Audit Trail....36
User Permissions....37
Administrator....37
Regular User....37
Guest....37
Printer operation....38
Printer Specifications....38
Troubleshooting....39
WARRANTY....39
RETURNS AND SERVICE....39
Wiring Diagram....40

Thanks for choosing BT Lab Systems' Ultra-micro UV-visible Spectrophotometer with Cuvette and Fluorescence detection. This operation manual describes the function and operation of the instrument. For proper use and to avoid any serious injuries, please read this manual carefully before operating the instrument. Follow all safety instructions during operation, maintenance, and servicing. Failure to do so may damage the instrument, shorten its service life, or compromise its protective features.

## IMPORTANT SAFETY INFORMATION

- This product is an indoor instrument which conforms to Standard B style- I type- GB9706.1
- These units are designed for laboratory use by people knowledgeable in safe laboratory practices.
- The operator should never open or repair the instrument. Opening or repairing the instrument will void the warranty and can cause accidents.
- Before powering the instrument, ensure the supply voltage matches the instrument's requirements, and the electrical outlet has sufficient capacity. Replace damaged power cords with the same type. Keep the power cord free of obstructions and away from walkways to prevent damage or tripping hazards. When disconnecting the power cord, grasp the plug rather than pulling on the cord.
- Turn off the instrument after use. If the instrument will not be used for an extended period, unplug the power cord and cover it with a cloth or plastic cover to prevent dust accumulation.
- In case of the following, unplug the instrument at once and contact BT Lab Systems.
    - The instrument encounters liquid.
    - The instrument gets soaked or burned.
    - The instrument emits an abnormal sound or smell.
    - The instrument is dropped or the outer shell damaged.
    - The instrument functions abnormally.

## INSTRUMENT CARE AND MAINTENANCE

- Temperature and humidity can affect measurement accuracy and accelerate corrosion or deterioration of instrument components.
- Operate the instrument in a dry environment at a recommended temperature of 15–35 °C and relative humidity of 70% or less.
- Place the instrument on a stable, level workbench away from vibration.
- Avoid intense room lighting and direct sunlight.
- Do not direct fans or strong air currents toward the instrument during measurement.
- Keep the instrument away from strong magnetic or electric fields and high-frequency electrical equipment.
- Do not operate the instrument in areas containing corrosive gases, such as hydrogen sulfide.

## INTRODUCTION

The Ultra-Micro UV-Visible Spectrophotometer is a versatile analytical instrument supporting micro-volume, cuvette, and fluorescence measurements. Micro-volume mode enables nucleic acid and protein quantification, microarray analysis, microbial cell density measurement, and full-spectrum UV-Visible scanning. Cuvette mode supports nucleic acid and protein analysis, microbial cell density measurement, and kinetic testing.

The fluorescence detection module provides highly sensitive nucleic acid quantification using fluorescent dyes that bind to target molecules. It is particularly suitable for detecting extremely low concentrations that cannot be reliably measured using conventional absorbance methods.

## FEATURES

- Requires as little as 0.5 µL per measurement using liquid column technology, conserving valuable samples.
- Measures a broad range of sample concentrations without dilution.
- No warm-up required, with results in approximately 5 seconds.
- Equipped with integrated software that provides intuitive operation with fast, stable performance.
- Portable and suitable for laboratory and field applications.
- Stores over 10,000 measurement records with screenshot, export, and deletion functions.
- Supports convenient software upgrades via USB flash drive.
- Allows independent measurements and data management for multiple users.
- High-resolution 7-inch touchscreen capacitive display supports operation with laboratory gloves.
- Checks for potential contamination on the measurement pedestal during startup.
- Sample measurement platform is constructed from corrosion-resistant stainless steel and quartz optical fiber.
- Supports integrated heating and stirring in cuvette mode for expanded analytical applications
- Monitors absorbance changes over time at user-defined wavelengths, with storage for up to 100 kinetic programs.
- Supports OD600 measurements in both micro-volume and cuvette modes.
- Equipped with a dust-protected cuvette compartment to minimize dust accumulation to maintain measurement accuracy.
- Supports direct printing of measurement results using a compatible printer.
- Fluorescence Quantification enables quantitative analysis of DNA and RNA using fluorescent dyes.
- Detects ultra-low sample concentrations beyond the sensitivity of conventional absorbance measurements.

## TECHNICAL SPECIFICATIONS

### *Normal Operating Conditions*

- Ambient temperature: 4 – 45 °C
- Recommended Ambient temperature: 15 – 35 °C
- Relative Humidity: ≤70%

### *Basic Parameters*

| Model | BT3903 |
|---|---|
| **Sample Volume** | 0.5–2 μL |
| **Light Source** | Xenon lamp |
| **Detector** | 2048-element linear CCD array |
| **Optical Path Length** | ≤0.7 mm |
| **Wavelength Range** | 200–850 nm |
| **Wavelength Accuracy** | 1 nm |
| **Wavelength Resolution** | ≤2 nm |
| **Absorbance Range** | 0.04–300 Abs (10 mm equivalent) |
| **Absorbance Precision** | 0.002 Abs (1 mm) |
| **Absorbance Accuracy** | 1% (at 0.76 Abs, 256 nm) |
| **Nucleic Acid Concentration Range** | 2–15,000 ng/μL (dsDNA) |
| **Protein Concentration Range** | 0.06–450 mg/mL (BSA) |
| **Sample Platform Material** | 304 stainless steel and quartz optical fiber |
| **Measurement Time** | Approximately 5 seconds |
| **Power Consumption** | 20 W |
| **Power Adapter** | DC 12V, 5A |
| **Dimensions (W × D × H)** | 197 x 327 x 181 mm |
| **Net Weight** | 3.1 kg |

### *Cuvette Measurement Specifications*

| Parameter | Specification |
|---|---|
| **Cuvette Dimensions (L x W x H)** | 12.5 x 12.5 x 45 mm |
| **Cuvette Optical Path Length** | 1, 2, 5, or 10 mm |
| **Cuvette Optical Beam Height** | 8 mm |
| **Cuvette Heating Temperature** | 37 ±0.5°C |
| **Measurement Time** | Approximately 2 seconds |
| **Cuvette Stirring Speed** | High and Low modes |
| **Cuvette Detection Concentration Range** | 0.2–75 ng/μL (dsDNA) |
| **Cuvette Protein Concentration Range** | 0.012–22.5 mg/mL (BSA) |
| **Cuvette Absorbance Range** | 0.004–25 Abs (10 mm path length) |

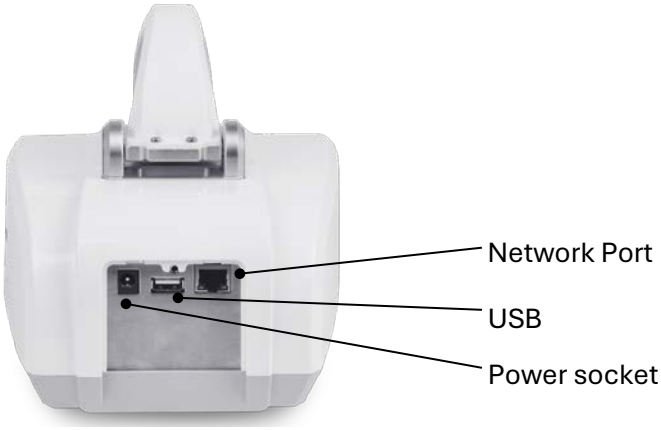
### *Fluorescence Detection Specifications*

| Parameter | Specification |
|---|---|
| **Sample Volume** | 1–20 µL |
| **Light Source** | Monochromatic LEDs |
| **Dynamic Range** | 5 orders of magnitude |
| **Linearity** | $R^2 > 0.995$ |
| **Detector** | Photodiode |
| **Detection Concentration Range** | 1 pg/µL–100 ng/µL (dsDNA) |
| **Excitation Wavelength Range** | Blue light: 430–495 nm |
| **Emission Wavelength Range** | Green light: 510–580 nm |
| **Repeatability** | ≤1.5% |
| **Stability** | ≤1.5% |
| **Sensitivity** | 0.5 pg/µL (dsDNA) |
| **Measurement Time** | Approximately 3s per measurement |

## STRUCTURE

This chapter identifies the instrument components and explains the basic steps required before measurement. Review these instructions before first use.



## QUICK GUIDE

### *Micro-Volume Measurement Instructions*

1. Lift the measurement arm and pipette 0.5–2 μL of sample onto the sample measuring platform. A sample volume of 2 μL is recommended.
2. Lower the measurement arm and follow the on-screen instructions to measure the sample.
3. After measurement, gently wipe the measurement surfaces with a clean, lint-free wipe to remove any sample residue.

### *Cuvette Measurement Instructions*

1. Raise the measurement arm and insert the sample-filled cuvette into the cuvette compartment.
2. Lower the measurement arm and follow the on-screen instructions to perform the measurement.
3. After completing the measurement, remove the cuvette, close the cuvette compartment's dust cover, and lower the measurement arm.

### *Automatic Blank Detection*

1. When entering the measurement interface for the first time, the Measure button is disabled (grayed out), indicating that a blank measurement is required before sample analysis.
2. If more than 30 minutes have elapsed since the last blank measurement, the software displays a reminder recommending that a new blank measurement be performed.

### *Automatic Sample Detection*

1. Select Automatic Detection on the measurement interface.
2. Apply the sample to the sample measurement platform
3. Lower the measurement arm. The instrument automatically initiates measurement and displays the sample concentration on the screen.

# Operation Guide

## BLANK MEASUREMENT AND ABSORBANCE CALCULATION

The instrument automatically selects the appropriate optical path length based on the sample's light intensity. During blank measurement, the system records the transmitted light intensity at multiple optical path lengths to establish a reference.

When measuring a sample, the instrument selects the optimal optical path and records the transmitted light intensity. Absorbance at a specific wavelength is then calculated using the following equation:

$$A = -\log_{10}\left(\frac{I_{\text{sample}}}{I_{\text{blank}}}\right)$$

Where:

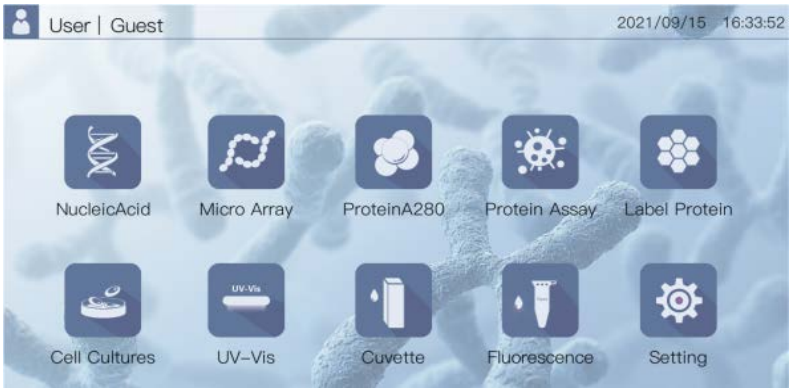
- A: Absorbance
- $I_{sample}$: Light intensity transmitted through the sample
- $I_{blank}$: Reference light intensity measured during blank calibration at the corresponding optical path length.

By comparing the transmitted light intensity of the sample with the blank reference, the instrument calculates the sample's absorbance at the selected wavelength.

## SOFTWARE APPLICATIONS

The instrument features 9 software functions for sample analysis, instrument monitoring, and system configuration.

1. Nucleic Acid
2. Microarray
3. Protein A280
4. Protein Assay
5. Labeled Protein
6. Cell Cultures
7. UV-Visible
8. Cuvette measurement
9. Fluorescence measurement
10. System Settings

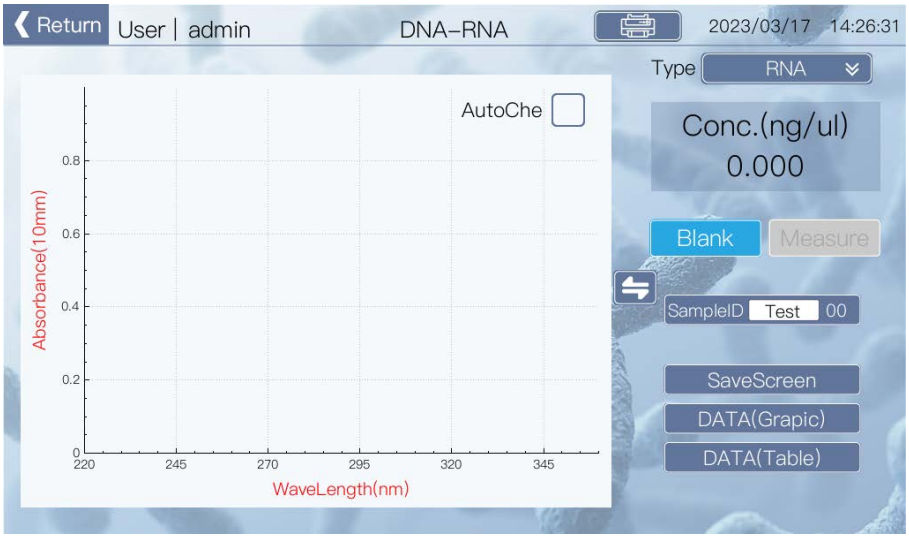


## COMMON FUNCTIONS OF THE MEASUREMENT SOFTWARE

1. **Blank**: Measures and saves the light intensity of the blank solution to establish a reference for subsequent sample measurements.
2. **Measure**: Initiates sample measurement and calculates the sample concentration.
3. **Sample ID**: Allows users to customize the sample identification number or name. The default sample name is "Test."
4. **Save Screen**: Captures a screenshot of the current display, which can be saved to a USB flash drive.
5. **DATA (Graphic)**: Displays measurement results as a spectral curve or graph. Graphical data can be exported to a USB flash drive.
6. **DATA (Table)**: Displays measurement results in a table format. Tabulated data can be exported to a USB flash drive.
7. **Sidebar** : Tap the sidebar toggle icon on the left side of the screen to display detailed information about the current sample, including the extinction coefficient (Ext. Coeff), baseline, selected wavelength (SW nm), absorbance at the selected wavelength (SW Abs), A260/A280 ratio, A260/A230 ratio, and other relevant measurement parameters.

## BLANK MEASUREMENT PROCEDURE

After powering on the instrument, navigate to the appropriate sample measurement interface.



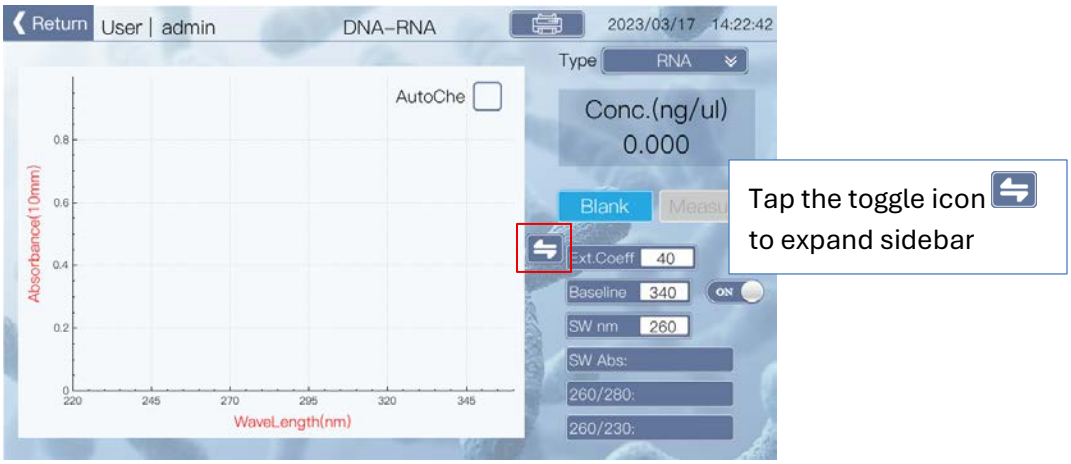

1. Lift the measurement arm and apply the blank solution to the sample measuring platform.
2. Lower the measurement arm and tap "Blank" to measure and record the blank reference light intensity.
3. Clean the measuring platform with a lint-free wipe, apply a fresh aliquot of the blank solution, and tap "Measure" to measure its absorbance.

   The resulting absorbance spectrum should appear as a nearly flat horizontal line, with absorbance variation not exceeding 0.04 A (10 mm equivalent path length).

**Note**: Minor fluctuations in blank measurement readings are normal when the absorbance is ≤0.04 Abs.

## NUCLEIC ACID MEASUREMENT

The NucleicAcid application measures nucleic acid concentration and evaluates sample purity using UV absorbance measurements.




### *Measurement Parameters*

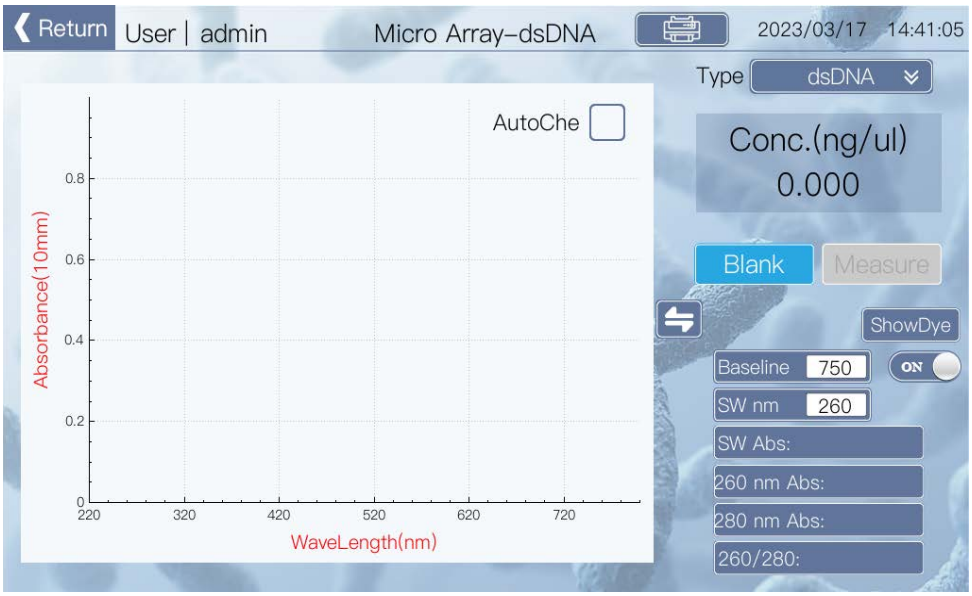
- **Type**: Select the nucleic acid type from dsDNA (double-stranded DNA), ssDNA (single-stranded DNA), RNA, or Other. The Other option allows users to define a custom nucleic acid type and extinction coefficient.
- **Ext. Coeff (Extinction Coefficient)**: Specifies the conversion factor used to calculate nucleic acid concentration from absorbance at 260 nm.

| Nucleic Acid Type | Extinction Coefficient |
|---|---|
| **dsDNA** | 50 |
| **ssDNA** | 33 |
| **RNA** | 40 |

- **Baseline:** Sets the wavelength used for baseline correction. The default wavelength is 340 nm, with baseline correction enabled. Users can customize the wavelength or enable and disable baseline correction as needed.
- **SW nm (Selected Wavelength)**: Specifies the wavelength used for measurement. The default wavelength for nucleic acid analysis is 260 nm, but users can select a different wavelength.
- **260/280**: The ratio of absorbance at 260 nm to absorbance at 280 nm (A260/A280) is used to assess nucleic acid purity.
    - Pure DNA typically has an A260/A280 ratio of approximately 1.8.
    - Pure RNA typically has an A260/A280 ratio of approximately 2.0.
    - Lower ratios may indicate contamination from proteins, phenol, or other substances that absorb light near 280 nm.
- **260/230**: The ratio of absorbance at 260 nm to absorbance at 230 nm (A260/A230) provides an additional indicator of nucleic acid purity.
    - Pure nucleic acid samples generally have an A260/A230 ratio between 1.8 and 2.2.
    - Lower ratios may indicate the presence of contaminants that absorb light near 230 nm.

## MICROARRAY NUCLEIC ACID MEASUREMENT

The Micro Array application simultaneously measures nucleic acid concentration and fluorescent dye concentration at specified wavelengths.

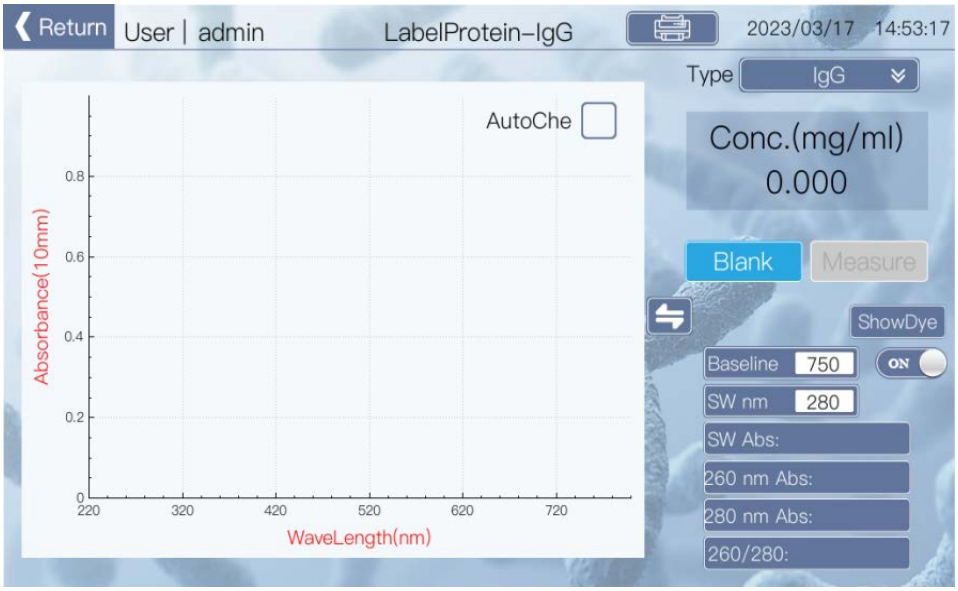



### *Measurement Parameters*

- **Type:** Select the nucleic acid type from dsDNA (double-stranded DNA), ssDNA (single-stranded DNA), or RNA
- **ShowDye / HideDye**: Tap "ShowDye" in the sidebar to display the dye concentration settings and measurement results. Users can select the dye type and view its concentration. Tap "HideDye" to hide the dye concentration panel.
- **Baseline**: Sets the wavelength used for baseline correction. The default wavelength is 750 nm. Users can customize the wavelength or enable and disable baseline correction as needed.
- **SW nm (Selected Wavelength)**: Specifies the wavelength used for nucleic acid measurement. The default wavelength is 260 nm, but users can select a different wavelength.
- **SW Abs (Selected Wavelength Absorbance)**: Displays the absorbance value at the selected measurement wavelength.
- **260 nm Abs**: Displays the absorbance value at 260 nm.
- **280 nm Abs**: Displays the absorbance value at 280 nm.
- **260/280**: Displays the ratio of absorbance at 260 nm to absorbance at 280 nm (A260/A280), which is used to assess nucleic acid purity.

## PURE PROTEIN MEASUREMENT (PROTEINA280)

The ProteinA280 application measures the concentration of purified protein samples based on their absorbance at 280 nm. Users can select from predefined protein types, each with a corresponding extinction coefficient for concentration calculations.




### *Measurement Parameters*

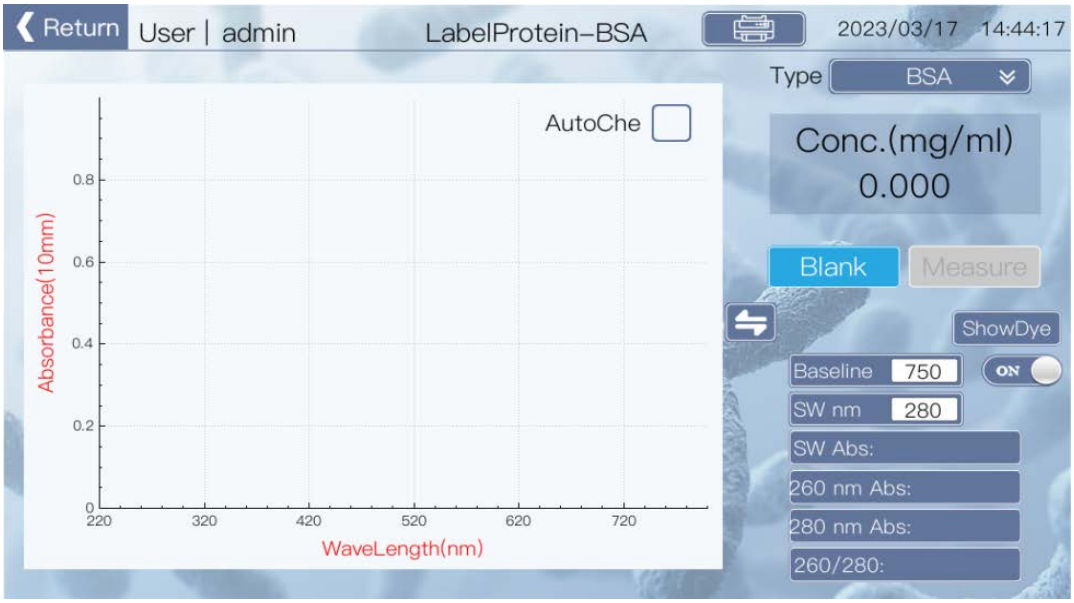
- **Type**: Select the protein type from BSA (Bovine Serum Albumin), 1 Abs = 1 mg/mL, IgG (Immunoglobulin G), or Lysozyme.

| Protein Type | Extinction Coefficient/ Reference |
|---|---|
| **BSA** | Uses a reference absorbance of 6.7 A at 280 nm for a 10 mg/mL BSA solution (1 cm path length). |
| **1 Abs = 1 mg/mL** | Assumes a protein concentration of 1 mg/mL corresponds to an absorbance of 1.0 A at 280 nm (1 cm path length). |
| **IgG** | Uses a reference absorbance of 13.7 A at 280 nm for a 10 mg/mL IgG solution (1 cm path length). |
| **Lysozyme** | Uses a reference absorbance of 26.4 A at 280 nm for a 10 mg/mL lysozyme solution (1 cm path length). |

- **Baseline**: Sets the wavelength used for baseline correction. The default wavelength is 340 nm, with baseline correction enabled. Users can customize the wavelength or enable and disable baseline correction as needed.
- **SW nm (Selected Wavelength)**: Specifies the wavelength used for protein measurement. The default wavelength is 280 nm, but users can select a different wavelength.
- **SW Abs (Selected Wavelength Absorbance)**: Displays the absorbance value at the selected measurement wavelength.
- **260 nm Abs**: Displays the absorbance value at 260 nm.
- **280 nm Abs**: Displays the absorbance value at 280 nm.
- **260/280**: Displays the ratio of absorbance at 260 nm to absorbance at 280 nm (A260/A280), which can help assess potential nucleic acid contamination in protein samples.

## LABELED PROTEIN MEASUREMENT

The Label Protein application measures protein concentration and dye concentration in labeled protein samples. Users can select the appropriate protein type and dye to obtain measurement results.

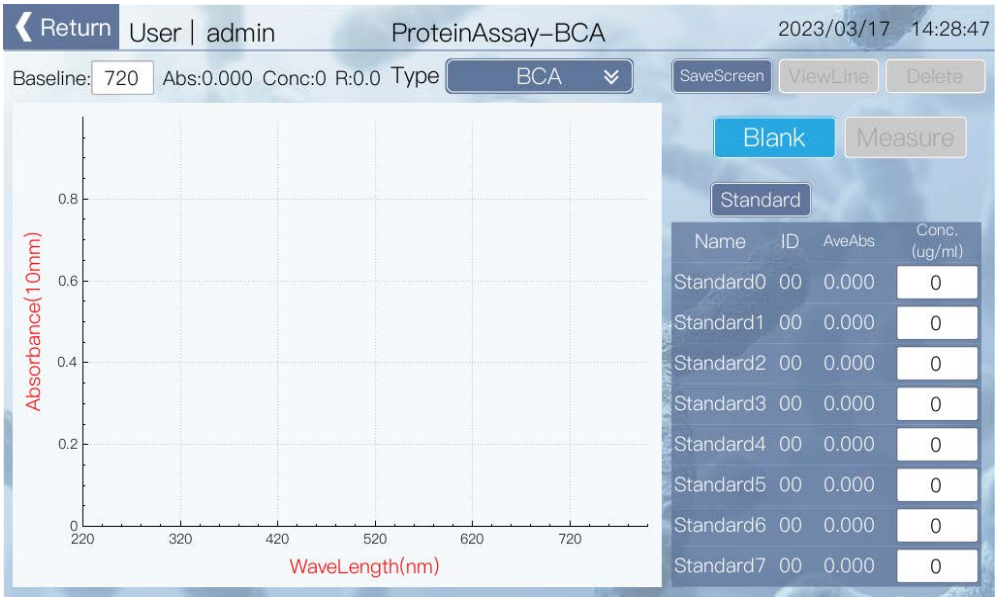



### *Measurement Parameters*

- **Type**: Select the protein type from BSA (Bovine Serum Albumin), 1 Abs = 1 mg/mL, IgG (Immunoglobulin G), or Lysozyme.
- **Baseline**: Sets the wavelength used for baseline correction. The default wavelength is 750 nm, with baseline correction enabled. Users can customize the wavelength or enable and disable baseline correction as needed.
- **SW nm (Selected Wavelength)**: Specifies the wavelength used for protein measurement. The default wavelength is 280 nm, but users can select a different wavelength.
- **SW Abs (Selected Wavelength Absorbance)**: Displays the absorbance value at the selected measurement wavelength.
- **260 nm Abs**: Displays the absorbance value at 260 nm.
- **280 nm Abs**: Displays the absorbance value at 280 nm.
- **260/280**: Displays the ratio of absorbance at 260 nm to absorbance at 280 nm (A260/A280), which can help assess potential nucleic acid contamination in protein samples.
- **ShowDye / HideDye**: Tap "ShowDye" in the sidebar to display the dye concentration settings and measurement results. Users can select the dye type and view its concentration. Tap "HideDye" to hide the dye concentration panel.

## QUANTITATIVE PROTEIN MEASUREMENT

The ProteinAssay application determines protein concentration using colorimetric assays. Protein concentrations are calculated by comparing sample absorbance values against a standard curve generated from known protein concentrations.




### *Measurement Methods*

- **Type**: Select the appropriate protein quantification method from BCA, Lowry, or Bradford.

### BCA Method

The BCA assay is based on the reduction of copper ions ($Cu^{2+}$) to cuprous ions ($Cu^{+}$) by proteins under alkaline conditions. The resulting $Cu^{+}$ ions react with bicinchoninic acid (BCA) to form a purple-colored complex with a strong absorbance at 562 nm. The absorbance intensity is proportional to protein concentration.

### Lowry Method

The Lowry assay involves the reduction of copper ions ($Cu^{2+}$) to cuprous ions ($Cu^{+}$) under alkaline conditions, followed by a reaction with the Folin–Ciocalteu reagent. This produces a blue-colored complex with absorbance measured at approximately 750 nm. The absorbance intensity is used to determine protein concentration.

### Bradford Method

The Bradford assay is based on the binding of Coomassie Brilliant Blue G-250 dye to proteins, causing a shift in the dye's absorbance maximum. The resulting, blue-colored complex is measured at 595 nm. Protein concentration is determined by comparing the sample absorbance against a standard curve.

### *Software Functions*

- **ViewLine**: Displays the standard curve generated from measured protein standards. This button remains disabled until at least two standard measurements are available to generate the curve.
- **Delete**: Removes the selected protein standard from the standard curve calculation. The button is disabled by default and becomes available when a standard is selected in the standard measurement table. Once deleted, the selected standard is excluded from the standard curve calculation.
- **Standard**: Opens the standard measurement interface, where users can measure protein standards of known concentrations to generate a calibration curve.
- **Sample**: Opens the sample measurement interface for determining the concentration of unknown protein samples using the established standard curve.

  ***Important***: Once the user enters the unknown sample measurement interface and begins measuring samples, the software does not allow a return to the Standard measurement interface. This restriction helps prevent accidental modification of the standard measurements used to calculate protein concentrations.

### *Standard Measurement Table*

The Standard Measurement Table supports up to eight protein standards for generating a calibration curve. A minimum of two standards is required to establish the standard curve used for protein concentration calculations.

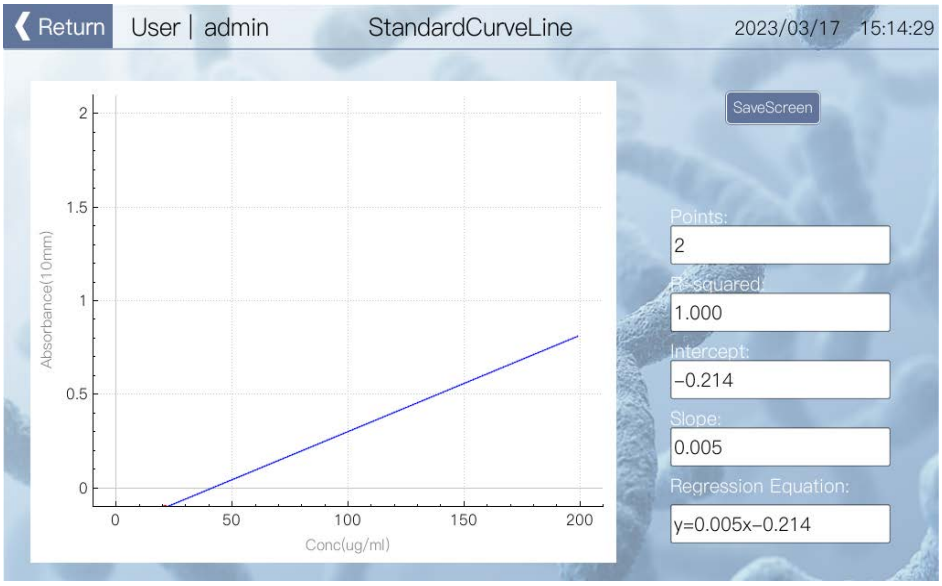
#### Measurement Parameters

- **Name**: Displays the standard sample name, automatically assigned from Standard 0 through Standard 7. These names are predefined and cannot be modified.
- **ID**: Displays the measurement identification number assigned to each standard sample.
- **AveAbs (Average Absorbance)**: Displays the average absorbance value obtained from multiple measurements of the same standard. The software automatically calculates the average and uses it to generate the standard curve, helping improve measurement accuracy and reliability.
- **Conc (Concentration)**: Specifies the known concentration of each protein standard. Users must manually enter the concentration before measurement. Only Standard 0 can have a concentration of zero. Standards 1–7 must have concentrations greater than zero; otherwise, the software will not allow measurement.

  ***Note****:* Ensure that the correct concentrations are entered for all standards before generating the calibration curve, as inaccurate values will affect the calculated concentrations of unknown protein samples.

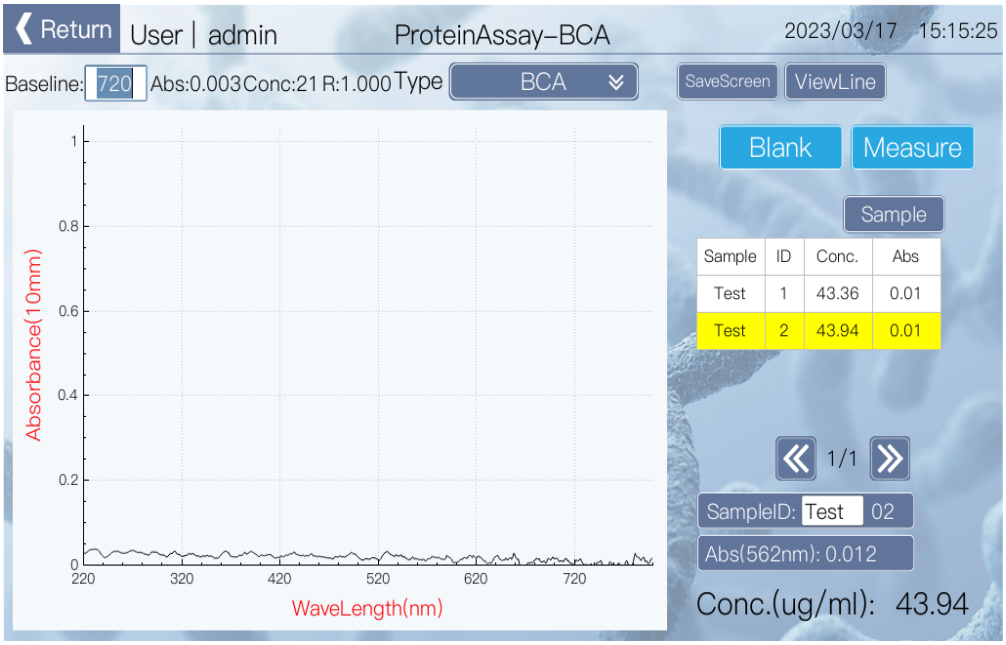
### *Standard Curve Viewing*

The instrument automatically generates a standard calibration curve based on the measured absorbance values of the protein standards. At least two standards must be measured to generate the curve, which is then used to calculate the concentrations of unknown protein samples.




### *Unknown Protein Concentration Measurement*

The Sample Measurement interface displays the absorbance and calculated concentration of unknown protein samples based on the established standard curve.



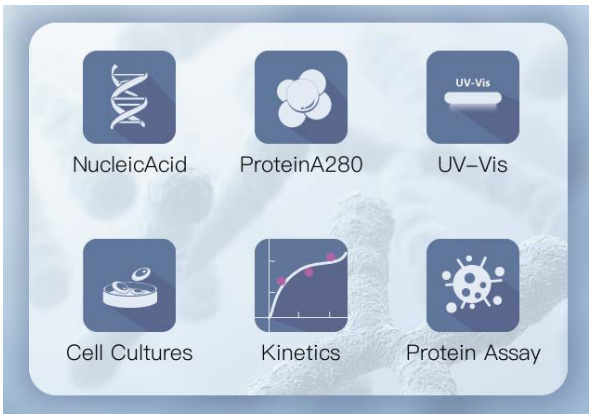

### Measurement Parameters

- **Abs (562 nm)**: Displays the sample absorbance at 562 nm for the BCA method. Other protein quantification methods display absorbance at their respective measurement wavelengths.
- **Conc. (µg/mL)**: Displays the calculated protein concentration of the sample, determined by comparing its absorbance at 562 nm with the established standard curve.

## CUVETTE MODE MEASUREMENT

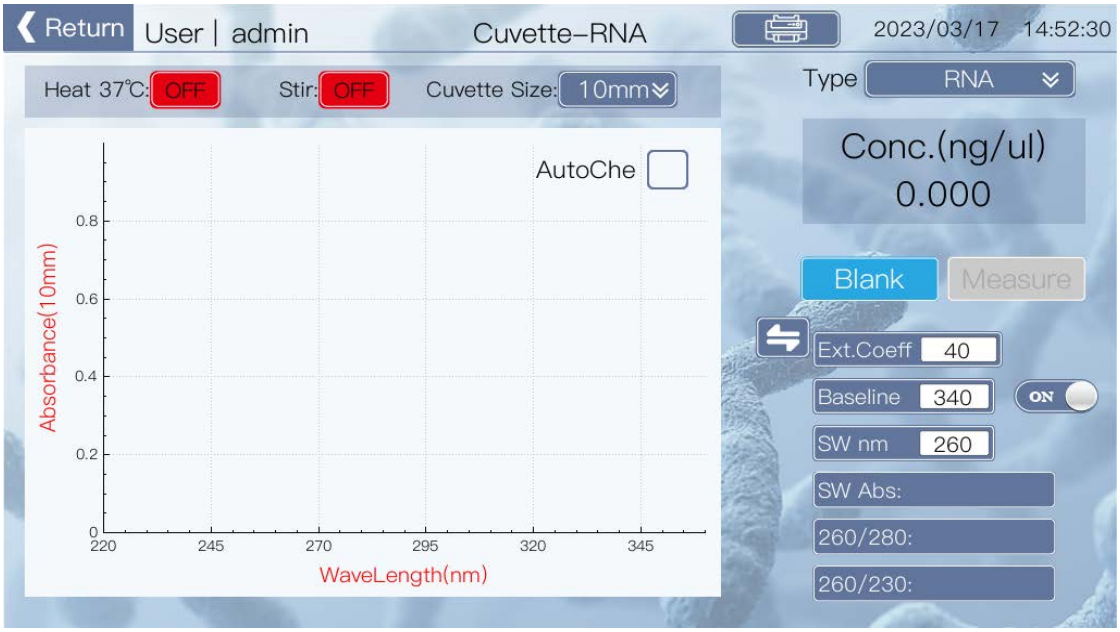
The Cuvette measurement mode allows users to perform nucleic acid quantification, protein analysis, microbial cell density measurements, and kinetic assays using standard cuvettes.

From the main menu, click Cuvette to access the cuvette measurement application selection interface. Five measurement applications are available: NucleicAcid, ProteinA280, UV-Vis, Cell Cultures, and Kinetics.




### *NucleicAcid, ProteinA280, and Cell Cultures Measurement Interface*

The NucleicAcid, ProteinA280, and Cell Cultures applications provide the following cuvette-specific measurement settings.




### Measurement Parameters

- **Heat 37°C**: Enables or disables the cuvette heating function. When activated, the instrument maintains the cuvette temperature at a constant 37°C.
- **Stir**: Controls the cuvette stirring function. A magnetic stir bar must be placed inside the cuvette before enabling stirring. Two stirring speeds are available: Low and High.
- **Cuvette Size**: Specifies the optical path length of the cuvette used for measurement. Supported optical path lengths are 1, 2, 5, and 10 mm.

### *Kinetics Measurement Interface*

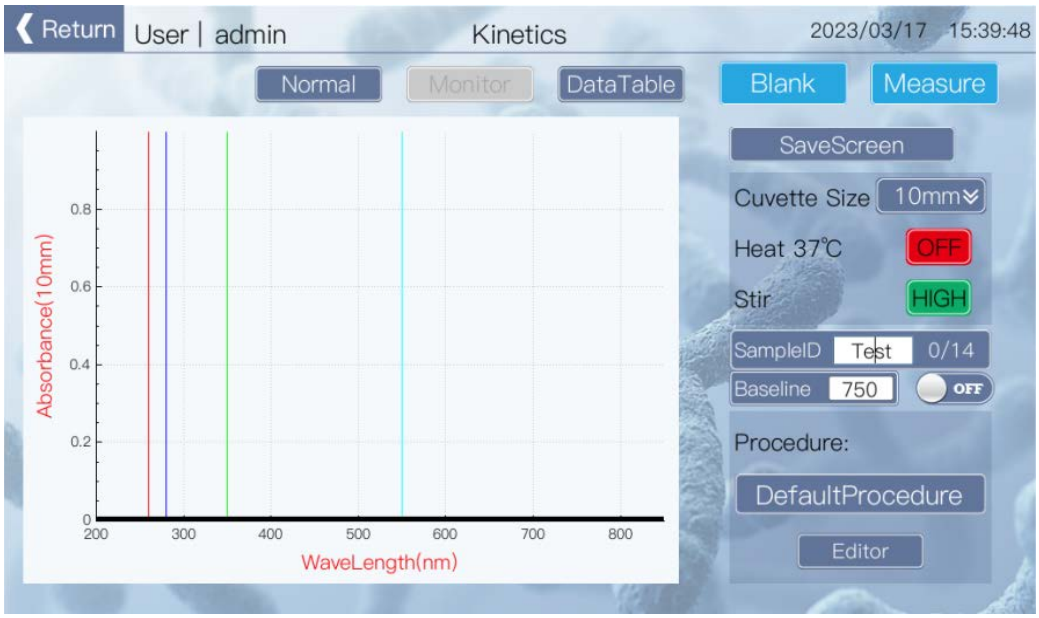
The Kinetics application monitors changes in sample absorbance over time, allowing users to analyze reaction kinetics and other time-dependent processes.

The interface provides the following functions:

- **Normal**: Displays the absorbance spectrum as a function of wavelength. Cursors indicate the wavelengths selected for kinetic monitoring. Users can customize up to six monitoring wavelengths.
- **SaveScreen**: Captures a screenshot of the current measurement interface for documentation and export.



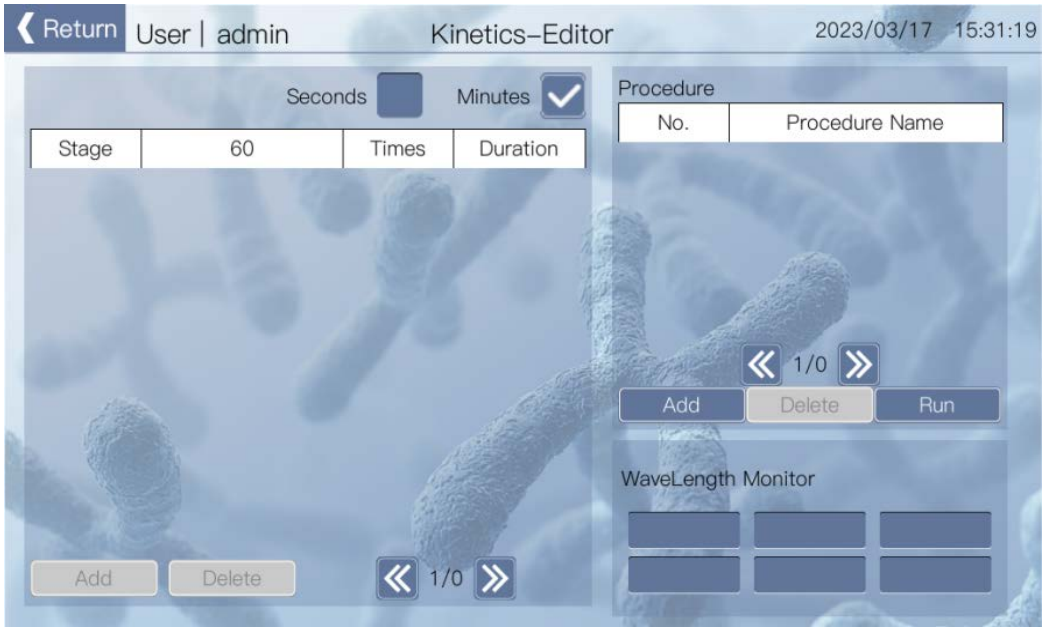

- **Monitor**: Displays absorbance-versus-time curves for the selected monitoring wavelengths. Each curve represents the absorbance changes recorded at a specific wavelength during the kinetic measurement.



- **DataTable**: Opens the kinetic measurement data table, allowing users to review and export recorded measurement results.




- **Editor**: Opens the kinetic program editing interface, where users can create new programs, modify existing programs, and execute kinetic measurements.



## MICROBIAL CELL CULTURE MEASUREMENT

The Cell-Cultures application measures the optical density of cell or microbial suspensions by detecting absorbance at 600 nm (OD600). This measurement provides an indication of cell density in the sample.




### *Measurement Parameters*

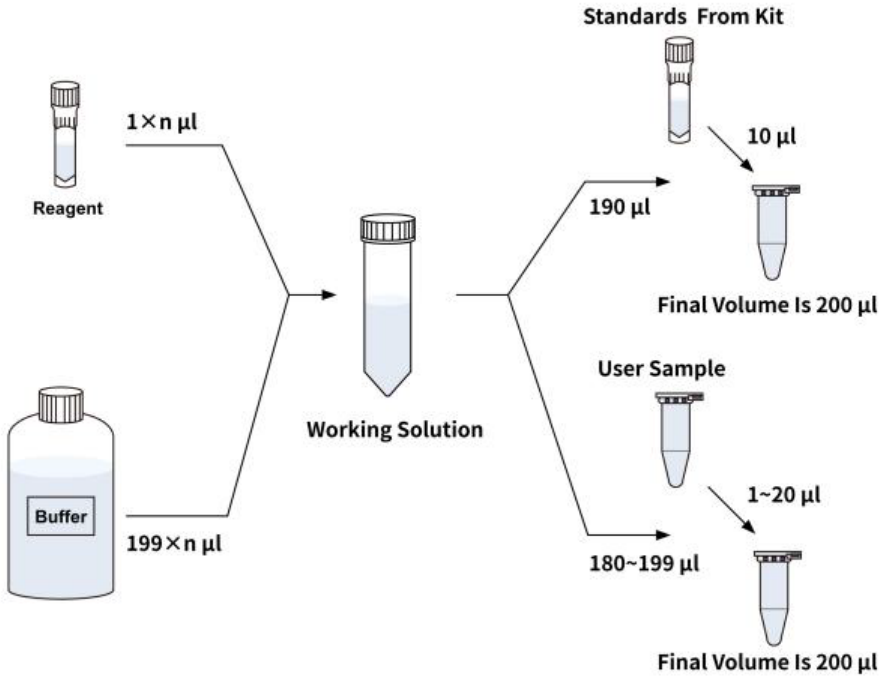
- **SW nm (Selected Wavelength)**: Displays the wavelength selected for measurement. The corresponding absorbance value is displayed under SW Abs.
- **SW Abs (Selected Wavelength Absorbance)**: Displays the absorbance value at the selected measurement wavelength.
- **600 nm Abs**: Displays the absorbance value at 600 nm (OD600), normalized to an equivalent optical path length of 10 mm (1 cm).

## UV-VISIBLE ABSORBANCE MEASUREMENT

The UV-Vis application measures sample absorbance across the ultraviolet and visible wavelength spectrum. Users can select specific measurement wavelengths and configure the corresponding baseline correction wavelength to obtain accurate absorbance readings.



## FLUORESCENCE DETECTION




### *Fluorescence Measurement Procedure*

Fluorescence measurements are performed using 0.5 mL PCR tubes. The instrument uses a fixed fluorescence excitation wavelength of 460 nm.

1. Place the PCR tube containing the prepared fluorescent sample into the fluorescence measurement chamber.
2. Lower the measurement arm to cover the sample chamber.
3. Tap Measure on the measurement interface to initiate fluorescence detection.

**Note**: For optimal measurement performance, use a sample volume of 0.2 mL (200 µL) in the 0.5 mL PCR tube. The sample volume used during measurement must be consistent with the volume used to establish the standard curve.

### *Fluorescence Detection Interface*

The fluorescence detection menu provides six measurement applications.



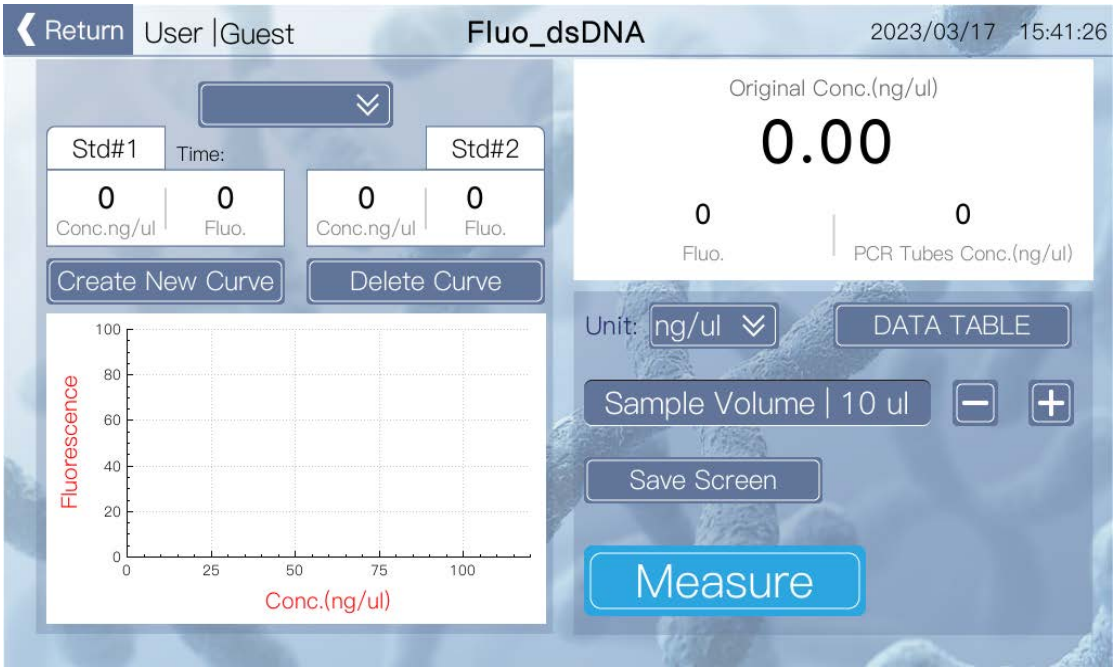

- **dsDNA**: Quantitative detection of double-stranded DNA
- **RNA**: Quantitative detection of RNA
- **Protein**: Quantitative detection of proteins
- **Oligo**: Quantitative detection of oligonucleotides
- **Fluorescence**: Measurement of fluorescence intensity without concentration calculations
- **Fluorescence Kinetics**: Continuous fluorescence monitoring over time

The Fluorescence and Fluorescence Kinetics applications measure fluorescence intensity only. They do not support standard curve generation or sample concentration calculations.

The dsDNA, RNA, Protein, and Oligo applications support standard curve generation and quantitative sample analysis. These four applications share the same software functions and are provided separately to simplify the organization of different sample types and fluorescent reagents.

### *dsDNA Detection Interface*

**Note**: The dsDNA, RNA, Protein, and Oligo applications use identical software functions. The following instructions describe the dsDNA application and apply to the other three applications.




### Standard Curve Display (Left Panel)

Displays the selected standard curve, including its creation date, fluorescence values, and corresponding concentrations for Standard 1 and Standard 2.

- **Select Standard Curve**: Select an existing standard curve for sample measurement.
- **Create New Curve**: Create a standard curve using prepared standard solutions.
- **Delete Curve**: Update the current standard curve by remeasuring the standard solutions.

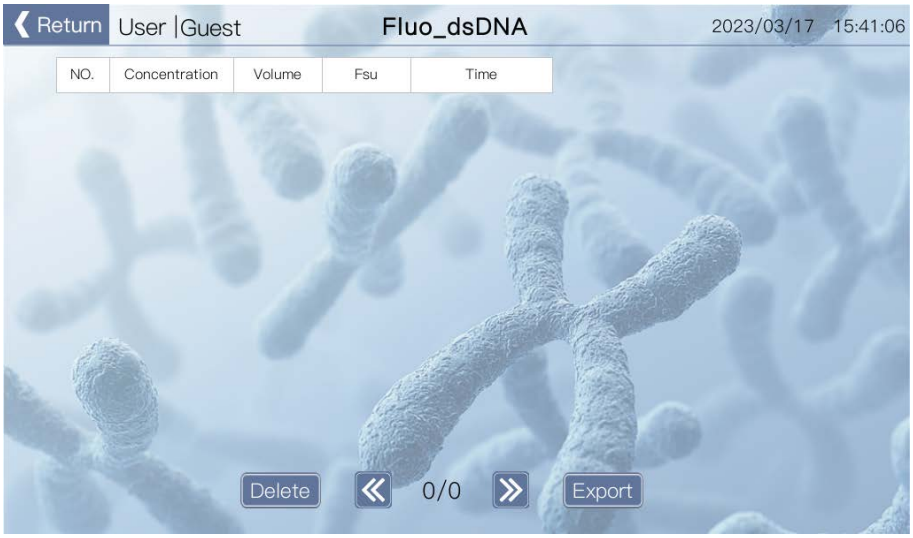
### Sample Measurement Display (Right Panel)

Displays the sample measurement results and includes additional functions.

- **Original Sample Concentration**: The calculated concentration of the original sample, adjusted according to the sample volume entered by the user.
- **Fluorescence Value**: The measured fluorescence intensity of the sample
- **PCR Tube Concentration**: The concentration calculated directly from the standard curve.
- **Unit**: Select the display unit for the original sample concentration.
- **Data Table**: View previously recorded measurement data.
- **Sample Volume (+/−)**: Adjust the sample volume used for concentration calculations.
- **Save Screen**: Export a screenshot of the current measurement interface to a USB flash drive.
- **Measure**: Initiate sample measurement.
  **Note**: A valid standard curve must be selected or created before quantitative sample measurement can begin.

### Data Table

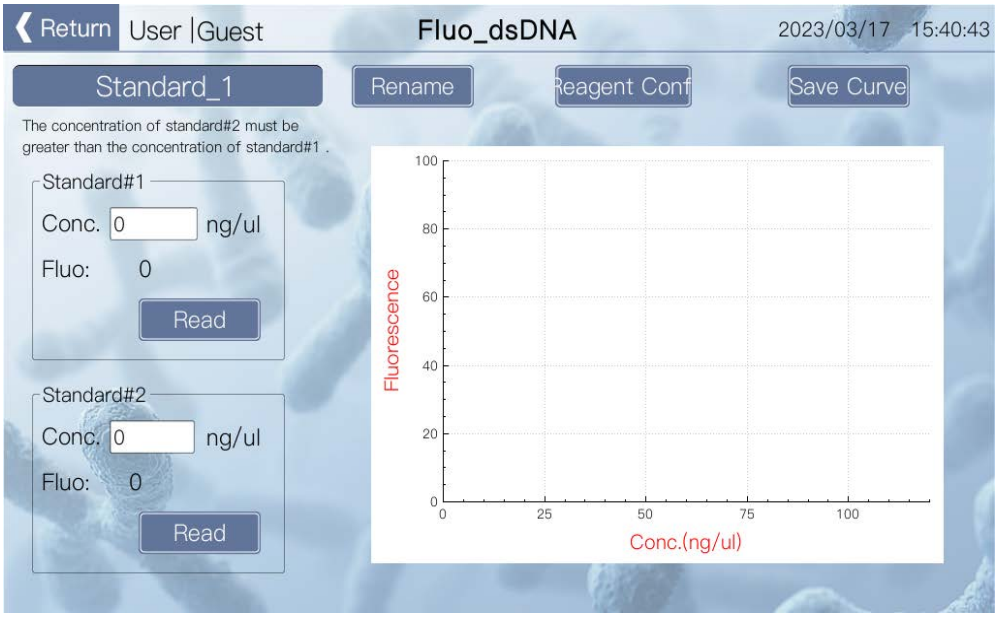
The data table displays recorded sample measurement results.




- **Delete**: Delete all measurement records displayed in the table.
- **Export**: Export all measurement data to a USB flash drive.

### Standard Curve Creation Interface

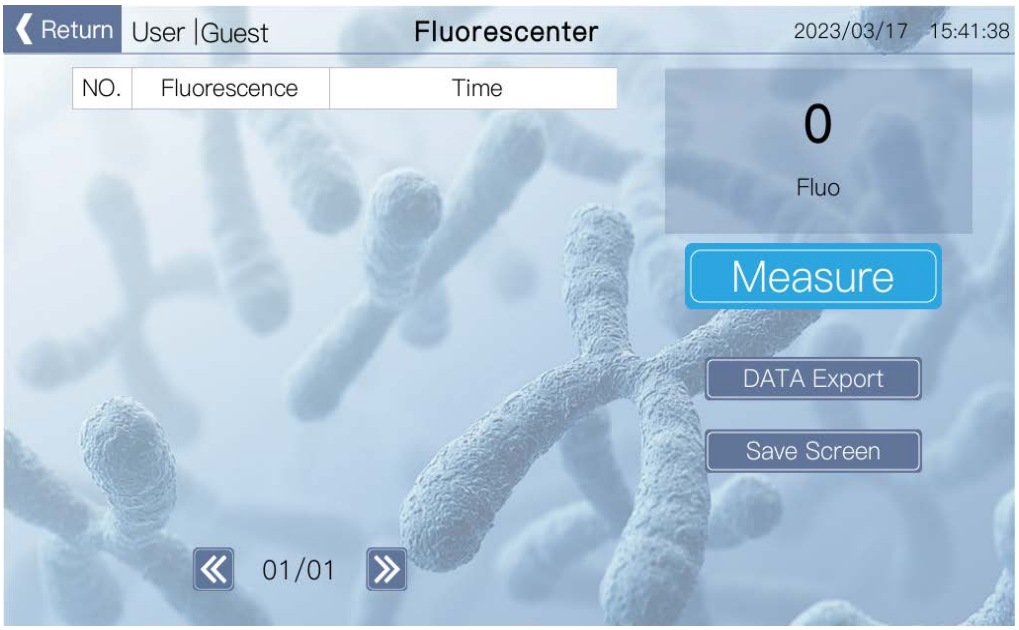
The standard curve creation interface allows users to generate and save calibration curves using standard solutions of known concentrations.




- **Rename**: Change the name of the current standard curve.
- **Read**: Measure and record the fluorescence intensity of a standard solution.
- **Standard Concentration**: Enter the known concentration of each standard solution.
- **Reagent Configuration**: Display the reagent preparation instructions.
- **Save Curve**: Save the completed standard curve.
  **Note**: A standard curve cannot be saved if required measurement data are missing or the curve does not meet the software's validation requirements.

## FLUORESCENCE INTENSITY MEASUREMENT

The Fluorescence application measures sample fluorescence intensity without generating a standard curve or calculating sample concentration.

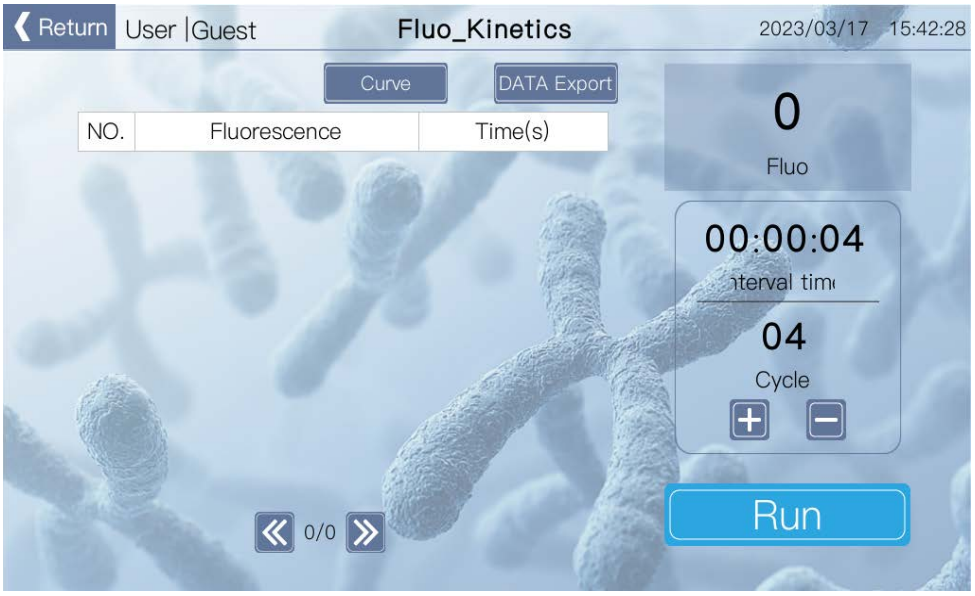



- **Measure:** After placing the sample in the fluorescence measurement chamber, tap Measure to record its fluorescence intensity. Results are displayed in the data table on the left.
- **Export:** Export the recorded fluorescence measurement data to a USB flash drive.
- **Save Screen:** Save a screenshot of the current measurement interface to a USB flash drive.

## FLUORESCENCE KINETICS MEASUREMENT

The Fluorescence Kinetics application continuously monitors changes in sample fluorescence intensity over time.

Users can configure the measurement interval and number of measurement cycles to perform automated, repeated fluorescence measurements.




- **View Curve / View Data**: Switch between the fluorescence kinetics graph and the measurement data table. The button label changes according to the current display.
- **Data Export**: Export recorded fluorescence measurement data to a USB flash drive.
- **+ / -**: Set the time interval and total number of measurement cycles.
- **Run / Stop**: Start or stop continuous fluorescence measurements.

### *Measurement Procedure*

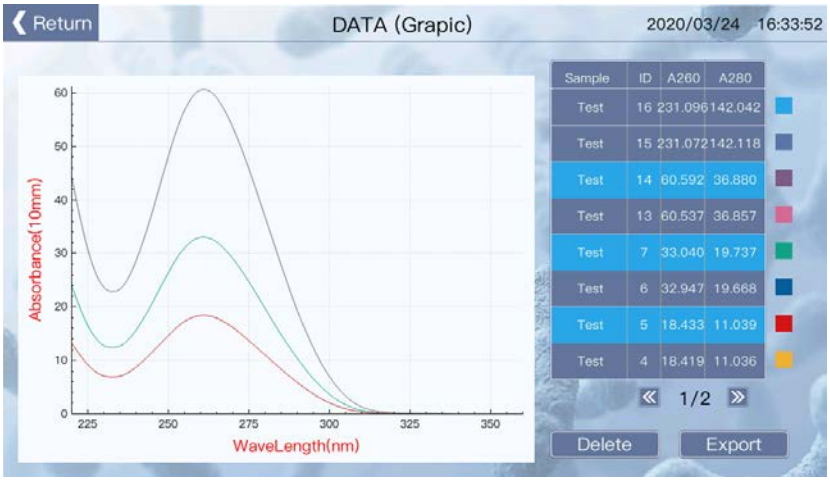
1. Place the prepared fluorescent sample into the fluorescence measurement chamber.
2. Lower the measurement arm to cover the chamber.
3. Use the **+** and **–** buttons to adjust the value of measurement interval and number of cycles.
4. Tap Run to begin continuous fluorescence measurement. The button changes to Stop while measurement is in progress.
5. Tap Stop to interrupt the measurement sequence if necessary.
6. Use View Curve or View Data to switch between graphical and tabular results.
7. Tap Data Export to save the measurement results to a USB flash drive.

## DATA EXPORT

The instrument supports exporting measurement graphs, data tables, and screenshots to a USB flash drive for data storage and analysis.

### *Graphical Data Export*

Click DATA (Graphic) on the measurement screen to open the graphical data viewing interface.




- **Export**: Insert a USB flash drive and click Export to open the file export interface and save the selected graphical data.
- **Delete**: Deletes the selected graphical data.

### *Tabular Data Export*

Click DATA (Table) on the measurement screen to open the tabular data viewing interface.




| # | Sample | ID | Type | ExtCoeff | Conc(ng/ul) | 260/280 | 260/230 | SW(nm) | SWAbs | A260(10mm) | A280(10mm) | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Test | 9 | dsDNA | 50 | 74.635 | 1.716 | 2.331 | 260 | 1.493 | 1.493 | 0.870 | 14:49:15 |
| 1 | Test | 8 | dsDNA | 50 | 74.585 | 1.703 | 2.333 | 260 | 1.492 | 1.492 | 0.876 | 14:49:06 |
| 2 | Test | 7 | dsDNA | 50 | 74.685 | 1.703 | 2.349 | 260 | 1.494 | 1.494 | 0.877 | 14:48:56 |
| 3 | Test | 6 | dsDNA | 50 | 74.655 | 1.694 | 2.346 | 260 | 1.493 | 1.493 | 0.881 | 14:48:51 |
| 4 | Test | 5 | dsDNA | 50 | 74.790 | 1.688 | 2.357 | 260 | 1.496 | 1.496 | 0.886 | 14:48:46 |
| 5 | Test | 4 | dsDNA | 50 | 74.750 | 1.683 | 2.344 | 260 | 1.495 | 1.495 | 0.888 | 14:48:40 |
| 6 | Test | 3 | dsDNA | 50 | 74.865 | 1.668 | 2.330 | 260 | 1.497 | 1.497 | 0.898 | 14:48:34 |
| 7 | Test | 2 | dsDNA | 50 | 74.910 | 1.662 | 2.199 | 260 | 1.498 | 1.498 | 0.901 | 14:48:08 |
| 8 | Test | 1 | dsDNA | 50 | 841.055 | 1.629 | 2.396 | 260 | 16.821 | 16.821 | 10.327 | 14:47:41 |

- **Export**: Insert a USB flash drive and click Export to open the file export interface and save the selected graphical data.
- **Delete**: Deletes the selected measurement data.

### *Screenshot Export*

Click SaveScreen on the measurement screen to open the screenshot export interface.

Insert a USB flash drive before exporting screenshots.

## DYE PARAMETERS

The Micro Array and Label Protein applications use the Beer–Lambert law to calculate fluorescent dye concentrations based on their absorbance values and molar extinction coefficients.

The following table lists the fluorescent dye parameters stored in the instrument software for use in the Micro Array and Label Protein applications.

| *Dye* | **Unit** | **Extinction Coefficient ($M^{-1}\cdot cm^{-1}$)** | **Analysis Wavelength (nm)** | **260 nm Correction** | **280 nm Correction** |
|---|---|---|---|---|---|
| **Cy3** | μM | 1.5E+5 | 550 | 0.04 | 0.05 |
| **Cy5** | μM | 2.5E+5 | 650 | 0.00 | 0.05 |
| **Alexa Fluor 488** | μM | 7.1E+4 | 495 | 0.30 | 0.11 |
| **Alexa Fluor 546** | μM | 1.04E+5 | 556 | 0.21 | 0.12 |
| **Alexa Fluor 555** | μM | 1.5E+5 | 555 | 0.04 | 0.08 |
| **Alexa Fluor 594** | μM | 7.3E+4 | 590 | 0.43 | 0.56 |
| **Alexa Fluor 647** | μM | 2.39E+5 | 650 | 0.00 | 0.03 |
| **Alexa Fluor 660** | μM | 1.32E+5 | 663 | 0.00 | 0.10 |
| **Cy3.5** | μM | 1.5E+5 | 581 | 0.08 | 0.24 |
| **Cy5.5** | μM | 2.5E+5 | 675 | 0.05 | 0.18 |

## VIEWING AND EXPORTING HISTORICAL DATA

The instrument automatically stores measurement records, allowing users to review, manage, and export previously collected data.

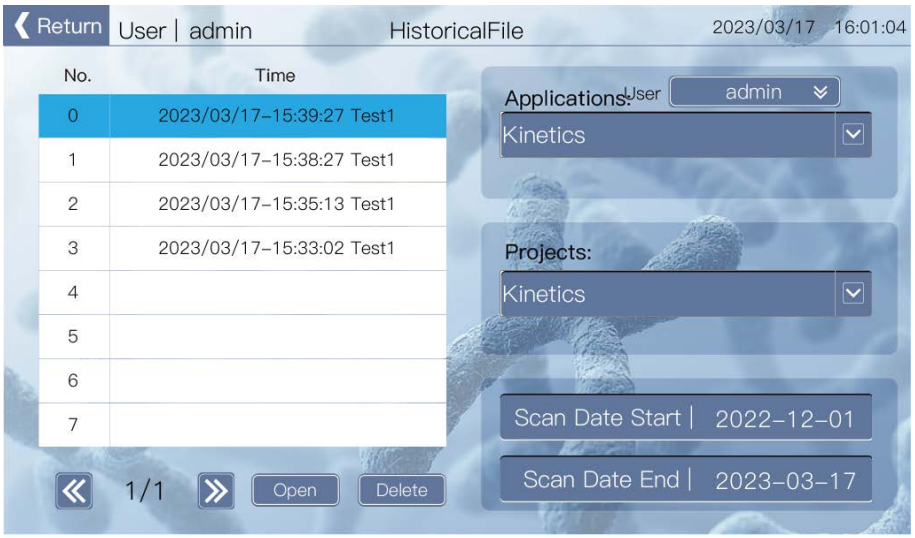
### *Accessing Historical Data*

1. From the main menu, click Setting to open the settings interface.
2. Click Historical File to access the historical data viewing interface.
3. Select the desired measurement application and project to locate previously saved measurement records.



### Historical Data Parameters

- **Applications**: Displays the available measurement applications, including NucleicAcid, Micro Array, ProteinA280, Label Protein, ProteinAssay, Cell Cultures, and UV-Vis. Applications without recorded measurements will not appear in the list.
- **Projects**: Displays the measurement categories associated with the selected application. For example, selecting NucleicAcid displays the available categories: dsDNA, ssDNA, RNA, and Other. Categories without recorded measurements will not appear.
- **File List**: Displays the saved measurement records for the selected application and project. Each file is named using the measurement time, Sample ID, and measurement count.




### Viewing and Managing Historical Files

- **Open**: Select a measurement record and click Open to view its data. Historical data can be exported using the procedure described in Data Export section.
- **Delete**: Select a measurement record and click Delete to remove the selected file.

### Setting the Historical Data Date Range

The date range control is in the lower-right corner of the historical data interface.

By default, the instrument displays measurement records from the previous three months.

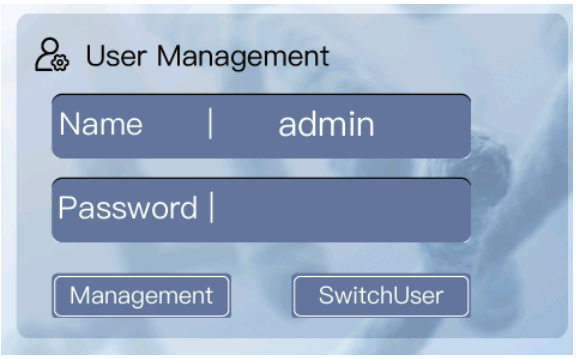
To view older records, adjust the date range to the desired period. The file list will display measurement records corresponding to the selected date range.

## USER MANAGEMENT

The User Management function allows administrators to manage user accounts and switch between registered users.

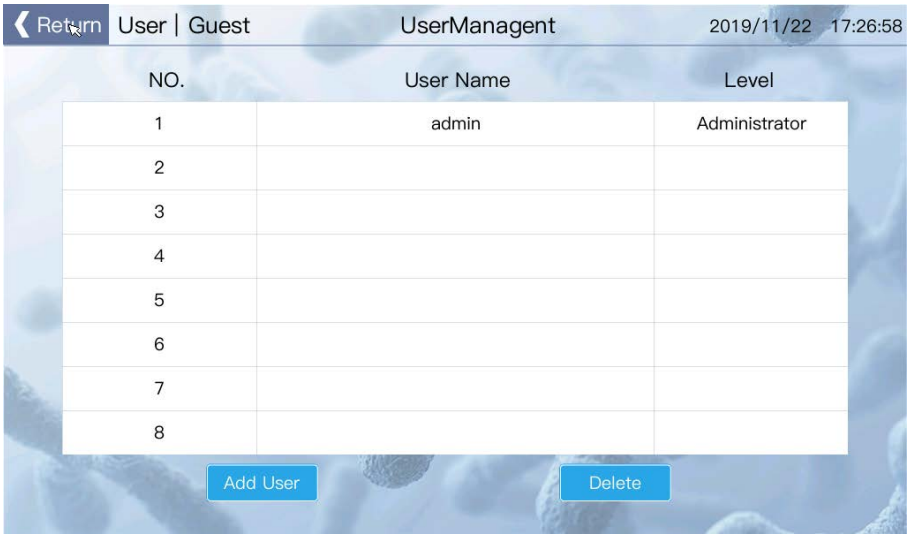
### *Accessing User Management*

1. From the main menu, click Setting to open the settings interface.
2. The following user management options are available:
    - SwitchUser: Switches between existing user accounts.
    - Management: Opens the user management interface.
3. To access Management, enter the admin password.
    - Default Administrator Password: 123456




### *Managing User Accounts*

The user management interface allows administrators to add and delete user accounts.




- **Add User**: Creates a new user account.
- **Delete**: Removes an existing user account. The default administrator (admin) account cannot be deleted.

### *User Account Limitations*

The instrument supports a maximum of 8 user accounts, including:

- 1 administrator account (admin)
- Up to 7 additional user accounts

## SOFTWARE UPDATE

The Software Update function allows users to upgrade the instrument software using a USB flash drive containing the appropriate update files.

1. From the main menu, click Setting to open the settings interface.
2. Insert a USB flash drive containing the software update files into the instrument's USB port.
3. Click Update to access the software update interface.



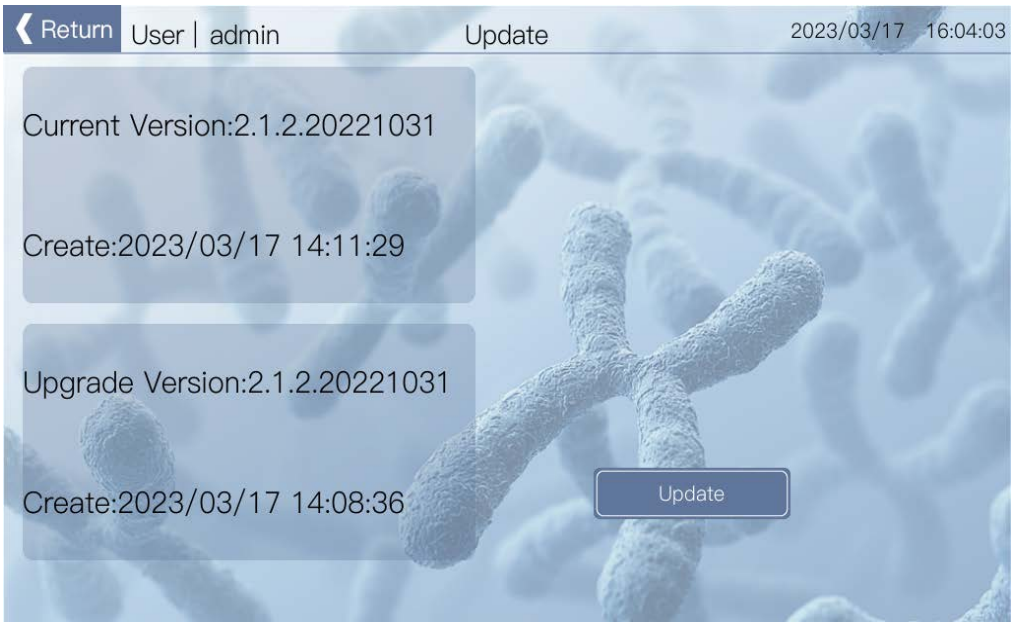

The instrument automatically checks for a connected USB flash drive and valid software update files.

The following messages may appear:

- "No USB device found!" — No USB flash drive has been detected. Insert a USB flash drive and try again.
- "U disk no upgrade file available!" — No compatible software update files were found on the USB flash drive. Verify that the correct update files are present.

If a valid update file is detected, the software update interface will open.

4. Review the current and available software version information.
5. Click Update to begin the installation.

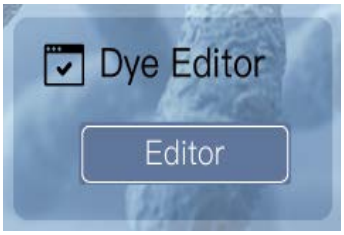



6. Once the update is complete, the instrument will automatically restart and launch the updated software.

## DYE EDITING

The Dye Editor function allows users to view predefined fluorescent dye parameters, create custom dye profiles, and manage saved dyes for use in measurements.

1. From the main menu, click Setting to open the settings interface.
2. Select Editor to access the dye management interface.

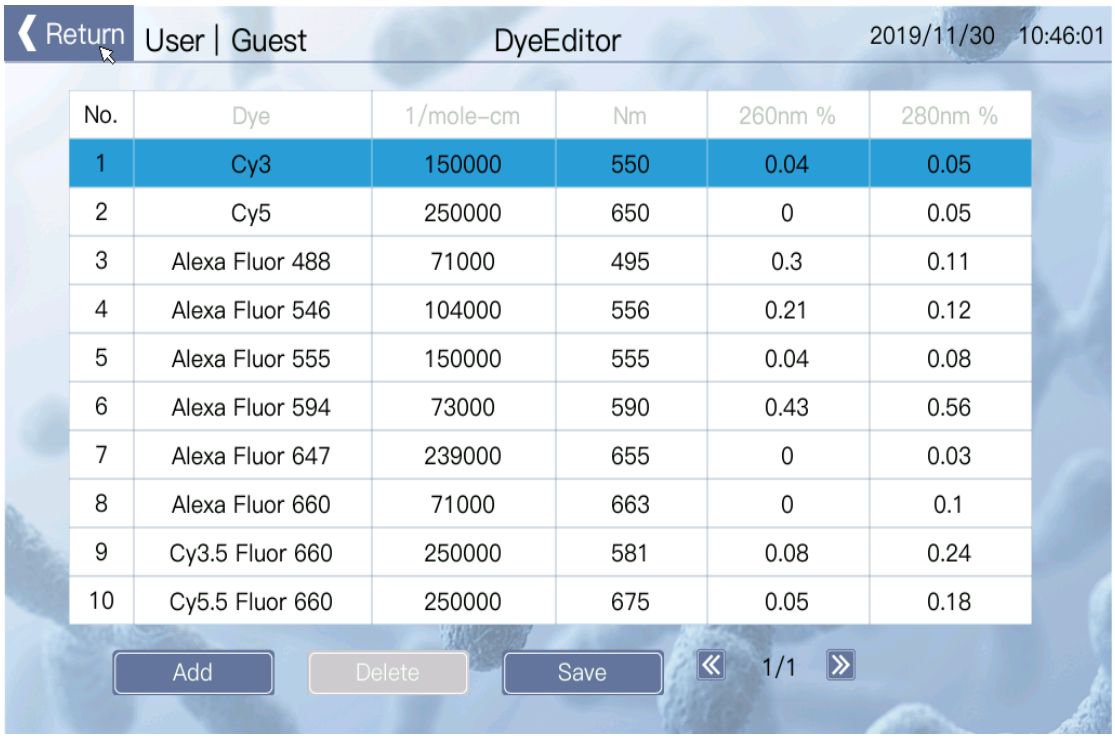



3. View the parameters of existing dyes or add custom dyes as needed.

### *Managing Dye Profiles*

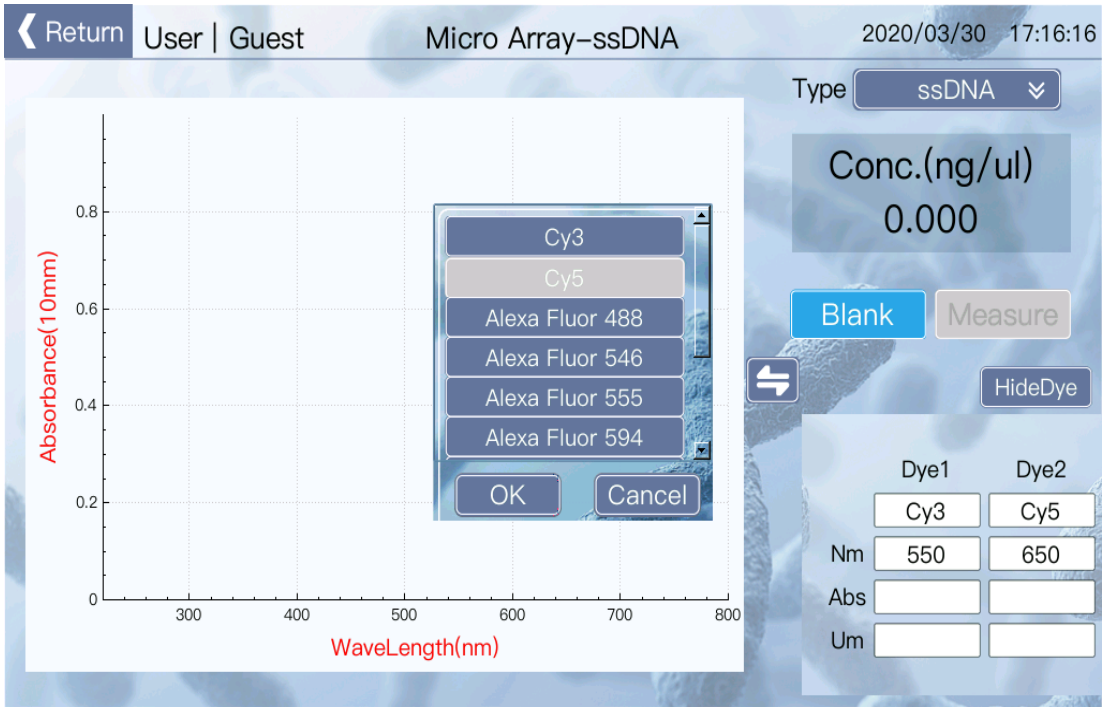
The Dye Editor provides the following functions:

- **View Dye Parameters**: Displays the measurement parameters associated with predefined and custom fluorescent dyes.
- **Add Custom Dye**: Allows users to enter and save parameters for additional fluorescent dyes.
- **Delete Custom Dye**: Removes previously saved custom dye profiles. The system's predefined dyes cannot be deleted.



### *Selecting Dyes for Measurement*

1. Open the Micro Array or Label Protein measurement application.
2. Click ShowDye to enable fluorescent dye measurement.
3. Click the dye selection field to open the dye selection interface.
4. Select a predefined dye or a previously saved custom dye.



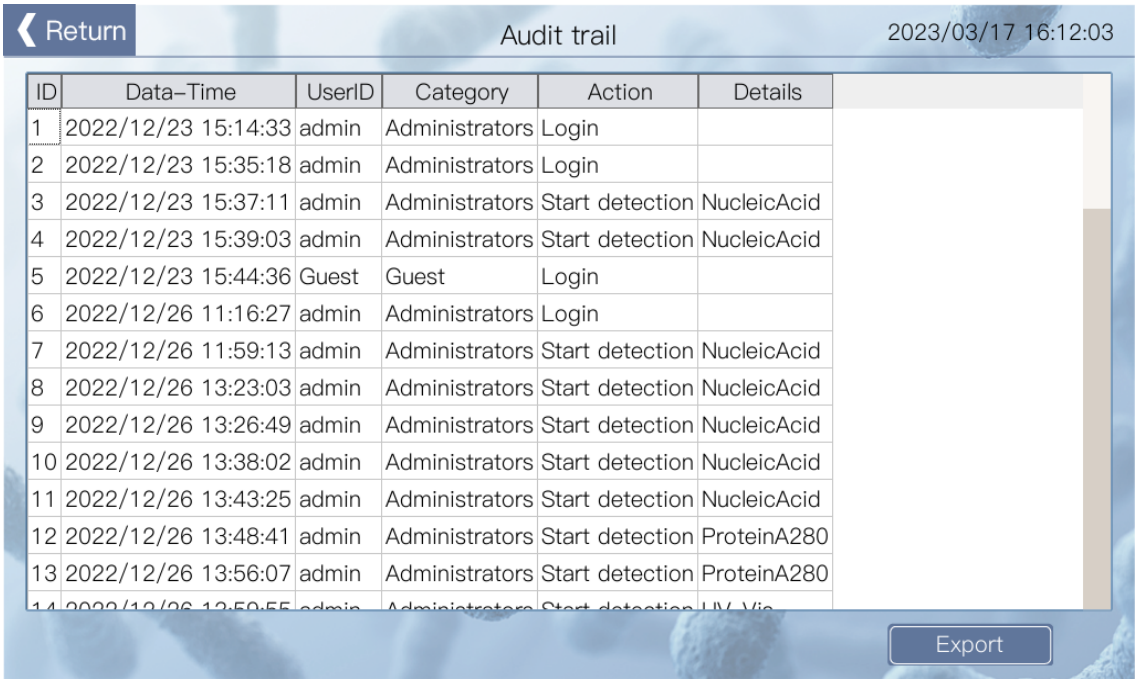
## AUDIT TRAIL

The Audit Trail function automatically records instrument operations, system events, and changes to instrument settings.

1. From the main menu, click Setting to open the settings interface.
2. Select Audit Trail to access the audit trail interface.




Each audit log entry contains the following information:




| ID | Data–Time | UserID | Category | Action | Details |
|---|---|---|---|---|---|
| 1 | 2022/12/23 15:14:33 | admin | Administrators | Login | |
| 2 | 2022/12/23 15:35:18 | admin | Administrators | Login | |
| 3 | 2022/12/23 15:37:11 | admin | Administrators | Start detection | NucleicAcid |
| 4 | 2022/12/23 15:39:03 | admin | Administrators | Start detection | NucleicAcid |
| 5 | 2022/12/23 15:44:36 | Guest | Guest | Login | |
| 6 | 2022/12/26 11:16:27 | admin | Administrators | Login | |
| 7 | 2022/12/26 11:59:13 | admin | Administrators | Start detection | NucleicAcid |
| 8 | 2022/12/26 13:23:03 | admin | Administrators | Start detection | NucleicAcid |
| 9 | 2022/12/26 13:26:49 | admin | Administrators | Start detection | NucleicAcid |
| 10 | 2022/12/26 13:38:02 | admin | Administrators | Start detection | NucleicAcid |
| 11 | 2022/12/26 13:43:25 | admin | Administrators | Start detection | NucleicAcid |
| 12 | 2022/12/26 13:48:41 | admin | Administrators | Start detection | ProteinA280 |
| 13 | 2022/12/26 13:56:07 | admin | Administrators | Start detection | ProteinA280 |

- **Log ID:** Unique identification number assigned to each recorded event.
- **Timestamp:** Date and time the event occurred.
- **User ID:** Identification of the user who performed the operation.
- **User Classification:** Indicates the category of the user.
- **Operation Action Details:** Description of the action performed.

The audit trail records events such as instrument errors, user logins, sample measurements, and file deletions.

## USER PERMISSIONS

The instrument provides three levels of user access: Administrator, Regular User, and Guest. Each level has different permissions for accessing measurement records, managing files, and modifying instrument settings. Administrators have the highest level of access.

**Note:** Administrator privileges are required to delete measurement records and access historical files belonging to other users.

### *Administrator*

Administrators have full access to instrument functions and data management.

- **View Historical Records:** Access measurement reports and historical files for all users, including Regular Users and Guests. Navigate to **Settings > Historical File** and select the desired user from the drop-down menu.
- **Manage Data:** Delete and export measurement records and save screenshots.
- **Access Settings:** Enter the Settings interface to configure and manage instrument functions.

### *Regular User*

Regular Users can perform measurements and access their own measurement records, with limited file management permissions.

- **View Historical Records:** Access previously saved measurement reports and historical files.
- **Manage Data:** Export measurement data and save screenshots. Deleting generated files is not permitted.
- **Access Settings:** Enter the Settings interface to configure available instrument functions.

### *Guest*

Guests have restricted access to measurement results and instrument functions.

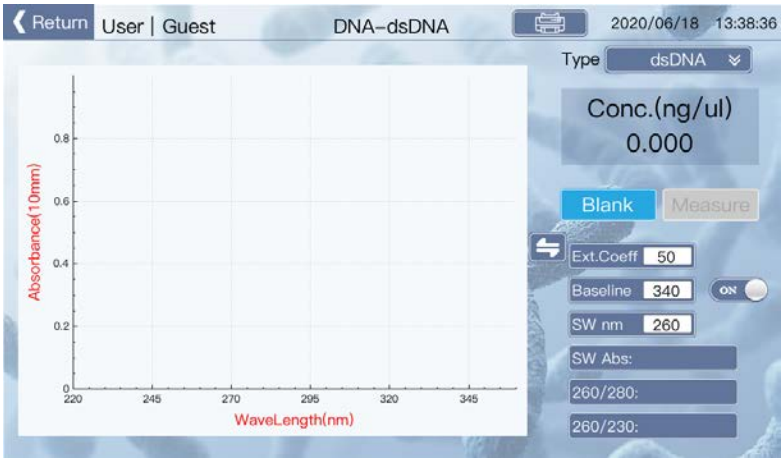
- **View Measurement Results:** View reports generated during the current measurement session. Access to historical files is not permitted.
- **Manage Data:** Cannot delete or export measurement records or save screenshots.
- **Access Settings:** Cannot access the Settings interface.

## PRINTER OPERATION

The instrument supports an optional USB thermal printer for printing measurement results directly from the software interface.

The software provides two printing functions, click the Printer button  to print results.

- **Current Measurement**: Print the current measurement results.




- **Selected Measurement**: Print selected data from measurement record.




| # | Sample | ID | Type | ExtCoeff | Conc(ng/ul) | 260/280 | 260/230 | SW(nm) | SWAbs | A260(10mm) | A280(10mm) | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Test | 9 | dsDNA | 50 | 74.635 | 1.716 | 2.331 | 260 | 1.493 | 1.493 | 0.870 | 14:49:15 |
| 1 | Test | 8 | dsDNA | 50 | 74.585 | 1.703 | 2.333 | 260 | 1.492 | 1.492 | 0.876 | 14:49:06 |
| 2 | Test | 7 | dsDNA | 50 | 74.685 | 1.703 | 2.349 | 260 | 1.494 | 1.494 | 0.877 | 14:48:56 |
| 3 | Test | 6 | dsDNA | 50 | 74.655 | 1.694 | 2.346 | 260 | 1.493 | 1.493 | 0.881 | 14:48:51 |
| 4 | Test | 5 | dsDNA | 50 | 74.790 | 1.688 | 2.357 | 260 | 1.496 | 1.496 | 0.886 | 14:48:46 |
| 5 | Test | 4 | dsDNA | 50 | 74.750 | 1.683 | 2.344 | 260 | 1.495 | 1.495 | 0.888 | 14:48:40 |
| 6 | Test | 3 | dsDNA | 50 | 74.865 | 1.668 | 2.330 | 260 | 1.497 | 1.497 | 0.898 | 14:48:34 |
| 7 | Test | 2 | dsDNA | 50 | 74.910 | 1.662 | 2.199 | 260 | 1.498 | 1.498 | 0.901 | 14:48:08 |
| 8 | Test | 1 | dsDNA | 50 | 841.055 | 1.629 | 2.396 | 260 | 16.821 | 16.821 | 10.327 | 14:47:41 |

**Note**: The printer is an optional accessory and is not included. Users may purchase the printer separately.

### *Printer Specifications*

| Parameter | Specification |
|---|---|
| Printer Model | BT3901-A |
| Printing Method | Direct thermal line printing |
| Print Width | 48 mm |
| Print Resolution | 384 dots per line |
| Printing Speed | 90 mm/s |
| Interface | USB |
| Paper Width | 57.5 ±0.5 mm |
| Max. Paper Roll Diameter | ϕ83 mm |
| Power Adapter Input | AC 110/220V, 50-60 Hz |
| Power Adapter Output | DC 12V, 3A |
| Printhead Service Life | 50 km of printing |

## TROUBLESHOOTING

The following table outlines common operating issues, their possible causes, and recommended corrective actions.

| Fault/Problem | Possible Causes | Recommended Action |
|---|---|---|
| Low Light Intensity Alarm at Startup | The measuring arm may not be fully lowered, or the measurement sample platform may be contaminated. | Lower the measuring arm completely and clean the measurement sample platform with a lint-free wipe. |
| Abnormal Motor Noise | The motor wiring may be partially damaged, or the photoelectric sensor may be malfunctioning, causing the motor to reach its mechanical limit. | Contact BT Lab Systems |
| Display Does Not Turn On | The internal circuitry may be damaged | Contact BT Lab Systems |
| Touchscreen Is Unresponsive | The internal circuitry may be damaged | Contact BT Lab Systems |
| USB Flash Drive Not Recognized | The internal circuitry may be damaged | Contact BT Lab Systems |
| Xenon Lamp Does Not Flash During Measurement | The internal USB cable may be loose, or the internal circuitry may be damaged | Contact BT Lab Systems |

## WARRANTY

Our company warrants this product against defects in materials and workmanship for a period of one year from the date of shipment. During the warranty period, we will repair or replace defective equipment at no charge, provided that the equipment has been operated under normal laboratory conditions and in accordance with the instructions provided in this manual.

The warranty does **not** cover damage or defects resulting from:

- Accident, misuse, or abuse.
- Natural disasters or other events beyond reasonable control.
- Unauthorized repair, modification, or alteration of the equipment.
- Corrosion or damage caused by using incompatible solvents, samples, or chemicals.
- Improper installation, operation, or maintenance.
- Use of fittings, replacement parts, or accessories supplied by other manufacturers.

**Platinum wire, accessories, and consumable components are excluded from this warranty.**

## RETURNS AND SERVICE

A Return Authorization must be obtained from our company before returning any product for repair. For technical support, warranty assistance, or repair service, please contact:

Email: info@BTLabSystems.com

## WIRING DIAGRAM

The wiring diagram is for reference only. Product specifications and design are subject to change without prior notice.

