

# Spectrophotometer Health & Safety Document including General Operating Instructions



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Original Instructions

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# 1. HEALTH AND SAFETY

## 1.1. Scope

This booklet covers the following ranges of instruments:

- Ultrospec™ 10 cell density meter
- Novaspec™ III<sup>+</sup> and Novaspec Pro Visible spectrophotometers
- GeneQuant™ 100 & 1300 UV-Visible spectrophotometers
- Ultrospec 2100/7000/8000/9000 UV-Visible spectrophotometers
- SimpliNano™ and NanoVue™ Plus micro volume spectrophotometer

Translations of these instructions are available on the User Manual CD supplied with the instrument

## 1.2. Intended Use

Visible and UV-Visible spectrophotometers shine light through a liquid sample and measure its Absorbance. This sample is typically held in a cuvette but when sample volume is limited, instruments such as the SimpliNano or NanoVue Plus can be used where a 2µl sample can be pipetted directly onto the measurement area. Typical applications of spectrophotometers include DNA/RNA/Oligo concentration and purity measurements as well as protein concentrations. This manual addresses the needs of scientists and technicians who operate UV- Visible spectrophotometers. The level of information presented in this manual assumes the user possesses basic laboratory and technical skills, and has the knowledge and documentation to safely operate. If you need assistance with the instructions in this manual, contact the manufacturer or your supplier for more information.

## 1.3. Safety Notices

These operating instructions contain Warnings and Cautions concerning the products with meanings as defined below:



### **WARNING**

Warning indicates a hazardous situation which, if not avoided, could result in death or serious injury. It is important not to proceed until all stated conditions are met and clearly understood.



### **CAUTION**

CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury. It is important not to proceed until all stated conditions are met and clearly understood.



## WARNING

- There are no bio-hazardous materials within the unit; however this unit could be used with bio-hazardous samples. Before using the instrument, the customer should have in place decontamination procedures designed to protect laboratory workers from occupationally acquired infections. The sample chamber cell holders are removable and may be decontaminated using the appropriate disinfectant for the bio hazard in question, rinsed with distilled water and then allowed to dry. The sample chamber and exterior may be wiped with a suitable disinfectant cleaning wipe. It is the responsibility of the customer to ensure that the user of the equipment is provided with a safe working environment.
- Any chemicals used in Analyses should be used, stored and disposed of in accordance with manufacturer's guidelines and local safety regulations.
- Toxic Fumes. Efficient laboratory ventilation must be provided when working with volatile solvents or toxic substances.
- Waste disposal. Disposal of some solvents and chemicals may be classed as hazardous waste and must be dealt with in accordance with local regulatory practice.
- Personal protective equipment. This is not required to operate the unit but the samples measured may require PPE. A local risk assessment should be carried out.
- Decontamination. Equipment returned for repair should include an appropriate decontamination certificate.

## 1.4. General Safety

This equipment has been designed to conform to the following directives

2006/95/EC	Low voltage directive (LVD)
2004/108/EC	Electromagnetic Compatibility (EMC) directive <sup>2</sup>
2012/19/EU	Waste Electrical and Electronic Equipment directive recast (WEEE Recast) <sup>1</sup>
2011/65/EU	Restriction on the use of certain hazardous substances (ROHS) directive <sup>1</sup>
2006/42/EC	Machinery directive
1999/5/EC	Radio and Telecommunications terminal equipment directive <sup>3</sup>

Standards, to which conformity is declared, are as follows:

EN61010 - 1:2010	Safety requirements for electrical equipment for measurement, control and laboratory use. General requirements
EN61326 - 1:2013	Electrical equipment for measurement, control and laboratory use - EMC Requirements <sup>2</sup>
EN50581:2012	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances.
EN ISO 12100:2010	Safety of machinery-General principles for design, risk assessment and risk reduction
EN 301 489-1/-17	Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements <sup>3</sup>
EN 300 328	Data transmission equipment operating in the 2.4 GHz ISM band and using wide band modulation techniques; essential requirements under article 3.2 of the R&TTE Directive. <sup>3</sup>

<sup>1</sup>Classified as belonging to equipment categories 8 or 9

<sup>2</sup>Classified and tested as class B equipment in accordance with CISPR 11 definition. This equipment has also been tested and found to comply with the limits for a class A digital device, pursuant to CFR Title 47 part 15 of the FCC Rules.

<sup>3</sup>Only applicable to products fitted with a Bluetooth communication device.

## 1.5. General Hazards

There a number of warning labels and symbols that may be present on your instrument. These are to inform you and indicate where a potential danger exists or particular caution is required. Before commencing installation, please take time to familiarise yourself with these symbols and their meaning. This instrument is subject to the following hazards:



### CAUTION

Some of the above instruments contain a UV source which generates a light beam that traverses the sample chamber and is accessible in the lamp chamber. Under normal use the lamp beam is confined within the instrument. The unit should not be operated with the sample chamber lid open or the lamp housing lid removed as prolonged exposure to the beam may cause permanent eye damage. (Not applicable to Ultrospec 10, Novaspec III<sup>+</sup> and Pro)



### WARNING

High voltages exist inside the Ultrospec 2100/7000/8000/9000, GeneQuant 100/1300, SimpliNano and NanoVue Plus instruments. Repair and maintenance should only be carried out by individuals trained specifically to work on these instruments.



### CAUTION

These instruments may be connected to a separate PC. To preserve the integrity of the measuring equipment it is essential that the attached PC itself conforms to basic safety and EMC standards and is set up in accordance with the manufacturers' instructions. If in doubt consult the information that came with your PC. In common with all computer operation the following safety precautions are advised.

- To reduce the chance of eye strain, set up the PC display with the correct viewing position, free from glare and with appropriate brightness and contrast settings.
- To reduce the chance of cross contamination from biological samples, use appropriate personnel protection measures and disinfectant wipes on keyboard and mouse



### CAUTION, HOT SURFACE

- These instruments may be fitted with heated cell holder accessories that depending on operation may become hot to touch. Care should be taken to avoid touching the heated accessory when running at elevated temperatures

## 1.6. Unpacking and installation



NanoVue Plus instrument



External power supply

- Inspect the instrument for any signs of damage caused during transit. If any damage is discovered, do not use the instrument and report the problem to your supplier.
- Ensure your proposed installation site conforms to the environmental conditions for safe operation
  - o Indoor use
  - o 5 to 40°C
  - o Maximum relative humidity 90% up to 31°C decreasing linearly to 50% at 40°C
- Extremes of temperature may require recalibration of the unit for optimum performance
- If the instrument has been stored in a cold environment then it should be allowed to come to thermal equilibrium for 2 to 3 hours before operation so that start up calibration is not compromised by condensation.
- The instrument must be placed on a stable, level bench or table capable of taking its weight with sufficient space around the instrument for ventilation to circulate freely.
- The equipment must be connected to the local supply outlet using the provided power cables, compatible voltages are shown in the table below. Replace power inlet fuses only with the same type and rating as follows

Instrument Type	Power requirements	Replacement Fuse
Ultrospec 10	100–240 V~ 50–60 Hz 2VA	3 A (UK plug only)
Novaspec III <sup>+</sup> and Novaspec Pro	100–240 V~ 50–60 Hz 10VA	3 A (UK plug only)
GeneQuant 100 & 1300	100–240 V~ 50–60 Hz 50VA	3 A (UK plug only)
SimpliNano	100–240 V~ 50–60 Hz 50VA	3 A (UK plug only)
NanoVue Plus	100–240 V~ 50–60 Hz 50VA	3 A (UK plug only)
Ultrospec 2100	100–240 V~, 50–60 Hz 100VA	T 2 A H 250 V AC (Anti-Surge, High breaking capacity)
Ultrospec 7000/8000/9000	100–240 V~, 50–60 Hz 100VA	T 1.6 A H 250 V AC (Anti-Surge, High breaking capacity)

- The instrument should be positioned so that the power cable may be readily removed in the event of a hazard or malfunction occurring.
- Site the instrument in an atmosphere free from dust and corrosive fumes.
- Ultrospec 2100 instruments have the on/off switch on the back of the instrument on the right hand side. Ultrospec 7000/8000/9000 instruments have the on/off switch on the left hand side of the instrument. Ultrospec 10, Novaspec III<sup>+</sup>/Pro, GeneQuant 100/1300, SimpliNano and NanoVue instruments have an on/standby button on the keypad — to disconnect power from these units remove the power lead from the instrument. The instruments will automatically perform some start up self diagnostic checks, please wait for these to finish before attempting to use the equipment.
- The spectrophotometer may be fitted with a range of accessories for specific applications. For the GeneQuant 100/1300 and NanoVue Plus these include a built in printer, Bluetooth or SD card accessory. The SimpliNano has an optional built-in printer. The Ultrospec 2100/7000/8000/9000 have a range of accessories that can be fitted in the sample compartment including a sipper, long path length cell holder and thermostatic cell holder. Full instructions on fitting accessories are within the instrument or accessory user manual.

# 2. OPERATING AND MAINTENANCE

All spectrophotometers are operated in the same generic way by comparing the amount of light Absorbed by a sample when compared to a reference solution:

## 2.1. Preparation before starting

- The instrument is switched on and allowed to initialize, Ultrospec 10, Novaspec III<sup>+</sup>/Pro, GeneQuant 100/1300, SimpliNano and NanoVue Plus units have an on/standby switch on the keypad.



- Ultrospec 2100 units have an on/off switch on the back of the instrument on the right hand side.
- Ultrospec 7000/8000/9000 instruments have the on/off switch on the left hand side of the instrument.
- The relevant software module for the application being carried out is selected from within the instrument software e.g. fixed wavelength measurement, concentration measurement, wavelength scan, kinetics measurement or a dedicated method such as DNA concentration & purity. The options within the application set up the instrument parameters such as wavelength and define any calculations taking place on the measured results.

## 2.2. Performing a run — cuvettes

- On the Ultrospec 10, Novaspec III<sup>+</sup>/Pro, GeneQuant 100/1300 and Ultrospec 2100/7000/8000/9000 units, samples are measured in a cuvette. A suitable cuvette must be used for the application to be carried out – it must be of the correct material to allow the selected wavelength of light to pass through and must be of the correct physical size to fit the relevant instrument and the sample volume available. The cuvette is filled with a solution of reference material which is typically the solution that the sample is dissolved in, the cuvette is placed in the cell holder in the correct orientation as per the diagrams below:

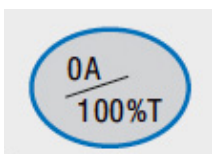
Ultrospec 10, front to back

All other units, right to left

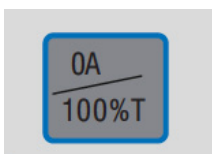


- The instrument is then zeroed by pressing the Zero key on the keypad:

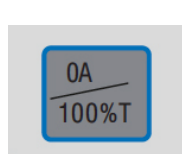
Ultrospec 10



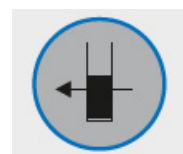
Novaspec III<sup>+</sup>/Pro



GeneQuant 100/1300

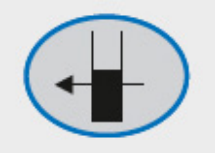


Ultrospec 2100



- The reference solution is then removed, the cuvette filled with the sample and the sample measured by pressing the run Button on the keypad. The measured results will be displayed on the instrument display.

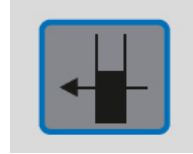
Ultrospec 10



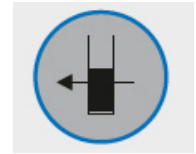
Novaspec III<sup>+</sup>/Pro



GeneQuant 100/1300



Ultrospec 2100



- The Ultrospec 7000/8000/9000 instruments have a colored touchscreen for operation and a double beam optical system. In normal operation a cuvette filled with reference solution is put in the rear cell holder, a cuvette filled with sample in the front cell holder, the relevant application method is loaded and the Run icon pressed. If a single cell is being used e.g. a microcell it should be filled with reference solution, placed in the front cell holder, the Zero icon pressed, the cuvette filled with sample, placed in the front cell holder and the Run icon pressed

Zero



Run



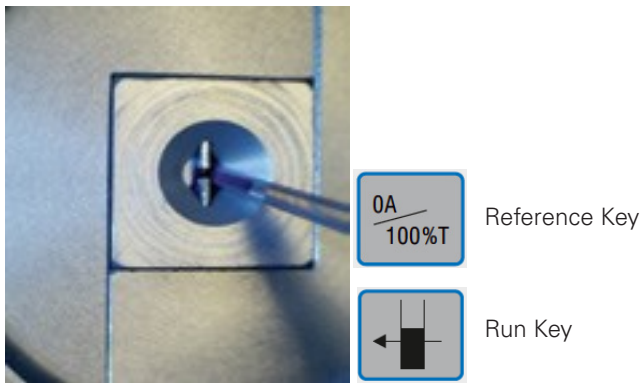
- Typical results screen (DNA application GeneQuant)

DNA	
A230	1.48 A
A260	2.33 A
A280	0.92 A
A320	0.173 A
A260/A280	
2.880	
A260/A230	
1.649	
Sample	
1	
Concentration	
<b>108.0</b>	
Units	
µg/ml	

## 2.3. Performing a run - micro volume instruments

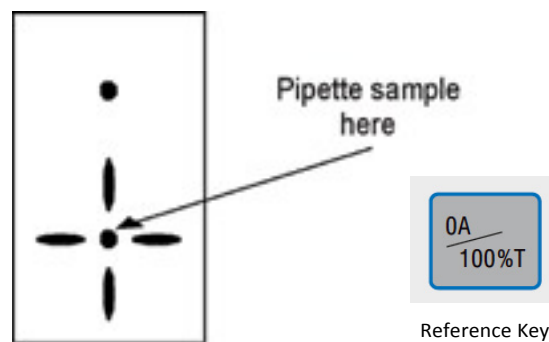
- On the SimpliNano units samples are measured in a sample port. Using a pipette a solution of reference material, which is typically the solution that the sample is dissolved in, is dropped onto the measurement position in the sample port and the instrument zeroed by pressing the Reference key on the keypad.





The reference solution is then wiped away with a tissue; the sample is pipetted into place and measured by pressing the run button on the keypad.

- The measured results will be displayed on the instrument display.
- On the NanoVue Plus units samples are measured on a sample plate. Using a pipette a solution of reference material, which is typically the solution that the sample is dissolved in, is dropped onto the measurement position on the sample plate and the instrument zeroed by pressing the Reference key on the keypad.



- The reference solution is then wiped away with a tissue; the sample is pipetted into place and measured by pressing the run button on the keypad.
- The measured results will be displayed on the instrument display.

## 2.4. Post run procedures

Cuvettes – empty cuvette of sample and rinse with deionised water. Cuvettes may be periodically cleaned by using commercially available cell cleaning solutions or dilute detergent solutions but should always be rinsed in deionised water.

SimpliNano – wipe the sample port with a dry, lint-free tissue between samples and at the end of the run, this is sufficient to remove sample. If more thorough cleaning is desired, the port can also be cleaned with dilute (2%) detergent solution, followed by isopropyl alcohol.

NanoVue Plus – wipe sample with tissue. At end of sample run wipe plates with tissue wetting with deionised water. The plates can also be cleaned with isopropyl alcohol or a dilute detergent solution but the plates should always be rinsed with deionised water after cleaning.

### Sample disposal

- Waste disposal. Disposal of some solvents, chemicals or samples may be classed as hazardous or bio hazardous waste and must be dealt with in accordance with local regulatory practice.

## 2.5. User Maintenance

Instrument Type	User Maintenance
Ultrospec 10	None
Novaspec III <sup>+</sup> and Novaspec Pro	Changing Tungsten lamp, removal of cell holder for cleaning
GeneQuant 100 & 1300 Ultrospec 7000	Removal of cell holder for cleaning
Ultrospec 2100	Removal of cell changer for cleaning
Ultrospec 8000 & 9000	Changing Deuterium/Tungsten lamps, removal of cell holders for cleaning
NanoVue Plus	Cleaning of sample plates, recalibration of path length
SimpliNano	Cleaning of sample port

## 2.6. Novaspec III<sup>+</sup>/Pro Lamp Change

1. Switch off the instrument and disconnect the power supply cord
2. Turn the instrument upside down
3. Disconnect the lamp cable from the main PCB
4. Undo the two thumbscrews from the bottom of the lamp holder
5. Remove the lamp assembly
6. Replace with new lamp assembly using the reverse of these actions – do not touch the glass lamp envelope
7. Dispose of the faulty lamp in accordance with local regulatory practice.

## 2.7. Ultrospec 8000/9000 Lamp Change

1. Switch the instrument off, disconnect the power supply cord and allow lamps to cool.
2. Locate the lamp access cover at the rear of unit and remove the two top screws and slide top cover back and lift off. Never operate the unit with the lamp housing cover removed.



3. Remove the lamp and dispose of in accordance with local regulatory practice.
4. Remove the lamp and dispose of in accordance with local regulatory practice.
5. Follow the handling instructions supplied with the lamp. Do not touch the glass envelopes of the replacement bulbs directly.
6. Replace the lamp cover and screw securely.
7. Attach power cord, switch on and wait at least 30 minutes for the unit to warm up.
8. Perform a new instrument baseline (on all bandwidth settings if variable bandwidth unit) and save this as the permanent baseline (see the online help or user manual).
9. Reset the lamp hours after replacing the lamp (see the online help or user manual).

# 3. TROUBLESHOOTING

Detailed in the table below are the most common faults found while using our spectrophotometers

Instrument	Problem	Possible causes
Ultrospec 10	A flashing Absorbance reading of 2.00 Abs is obtained.	This indicates an Absorbance of more than 1.99 and is therefore out of range. The sample needs to be diluted.
Ultrospec 10	REF is displayed when T is pressed.	The instrument has not been zeroed before a sample measurement has been attempted.
All instruments	A negative reading is obtained.	In normal measurements the test sample has a positive Absorbance compared to that of the Reference. Negative readings will be obtained if the Reference and Test cuvettes are mixed up.
All instruments	Unexpected results are obtained.	Any bubbles in solution will produce considerable error.
All instruments	Absorbance values higher than expected.	Possible issue with optical alignment. Contact service support.
All instruments	Absorbance values lower than expected.	Check sample cuvette filled to 20 mm from base of cuvette. Possible stray light issue. Contact service support.
All cuvette models	Instrument will not zero.	Cuvette placed in wrong orientation, Wrong cuvette material used for wavelength.
GeneQuant 100/1300, Ultrospec 2100, Ultrospec 7000/8000/9000	Poor reproducibility on DNA concentration and purity measurements.	Wrong cuvette being used – not a 15 mm beam height or wrong material – not letting UV light pass through. Background correction mode not switched on. Measured Absorbance too low, should be >0.1 A for accurate results.
Novaspec III <sup>+</sup> /Pro, GeneQuant 100/1300, Ultrospec 2100, Ultrospec 7000/8000/9000	Instrument fails start up calibration check.	Check sample and reference beams are clear when instrument switched on. Novaspec III <sup>+</sup> /Pro, GeneQuant 100/1300, Ultrospec 2100/7000/8000/9000 report failure message to service support.
Ultrospec 10, Novaspec III <sup>+</sup> /Pro, GeneQuant 100/1300, NanoVue Plus, SimpliNano	Instrument switches off after calibration.	You may be keeping your finger on the ON/ standby button too long, so that the instrument receives both ON and OFF signals and switches off after the calibration. Try adjusting the timing of your finger press at switch on.
SimpliNano	Instrument fails to initialise – “cell holder obstructed UV” error message.	Ensure sample port is clean and there is no dried on sample

SimpliNano	Absorbance readings unstable	Ensure Reference QA switched on. Ensure Background correction is switched on. Ensure at least 2 µl sample being used
NanoVue Plus	Instrument fails to initialise – “cell holder obstructed UV” error message.	Ensure sample plates are clean.
NanoVue Plus	Absorbance readings unstable.	Ensure Reference QA switched on. Ensure Background correction is switched on. Ensure at least 2 µl sample being used.
NanoVue Plus	Absorbance readings stable but incorrect.	Check path length calibration.

Detailed instructions on how to carry out the above user maintenance and troubleshooting for the different models may be found in the relevant user manual supplied on a CD with the instrument.

### 3.1. Emergency Procedures

In the event of a malfunction or hazard occurring, the user responsible shall disconnect the unit from power and isolate the instrument for decontamination by an appropriate means if bio hazardous material is spilt on, in or around the instrument.

Ultrospec 2100 instruments have the on/off switch on the back of the instrument on the right hand side. Ultrospec 7000/8000/9000 instruments have the on/off switch on the left hand side of the instrument.

Ultrospec 10, Novaspec III<sup>+</sup>/Pro, GeneQuant 100/1300, SimpliNano and NanoVue instruments have an on/standby button on the keypad – to disconnect power from these units remove the power lead from the instrument.

## 3.2. Recycling Procedures



This equipment should be decontaminated before decommissioning and all local regulations shall be followed with regard to scrapping of the equipment.

## 3.3. Recycling of hazardous substances

Spectrophotometers contain hazardous substances. Detailed information is available from the manufacturer or your local supplier.

## 3.4. Disposal of electrical components

Waste electrical and electronic equipment must not be disposed of as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer for information concerning the decommissioning of your equipment.

## 3.5. Specifications

Specification	SimpliNano	NanoVue Plus	Ultrospec 9000	Ultrospec 8000	Ultrospec 7000	Ultrospec 2100	GeneQuant 1300	GeneQuant 100	Novaspec Pro	Novaspec III*	Ultrospec 10
<b>Wavelength Range nm</b>	190-1100	200-1100	190-1100				190-900		325-1100		600
<b>Light Source</b>	Xenon		Deuterium/Tungsten			Xenon			Pulsed Tungsten Halogen		600nm LED
<b>Bandwidth nm</b>	5.0		0.5, 1.0, 2.0, 4.0	1.0	2.0	<3.0	5.0		<7.0		40.0
<b>Absorbance Range (A)</b>	-0.3 to 50A	0 to 125A (sample plate 10mm path length equivalence)	-4 A to 4A			-3A to 3A		-0.3A to 2.5A			-0.3A to 1.99A
<b>Path length</b>	0.5mm	0.5mm 0.2mm	1mm to 100mm				10mm				
<b>Wavelength Accuracy</b>	± 2 nm across range, ± 1 nm from 240 nm to 330nm	± 2 nm across range, ± 1 nm from 240 nm to 330nm	± 0.3 nm		± 0.5 nm	± 1 nm	± 2 nm		± 2 nm		N/A
<b>Absorbance Accuracy</b>	+/- 1% at 259 nm at 0.7-0.8 A using Uracil	+/- 1% at 259 nm at 0.7-0.8 A using Uracil	± 0.002 A at 0.5 A ± 0.004 A at 1 A ± 0.006 A at 2 A at 440 nm, 465 nm, 546.1 nm, 590 nm, 635 nm ± 0.005 A using 60 mg/l K2Cr2O7			within 0.5% of Absorbance value to 3.000 A at 546 nm	± 0.005 Abs or 1% of the reading, whichever is the greater at 546 nm		± 2.0% or ± 0.010 A to 1.000A at 546nm, whichever is the greater		<± 0.05 A at 1 A using Neutral Density Filters

Full specification and operating instructions are contained within the relevant user manual.

### 3.6. Manufacturing information

Requirement	Content
Name and address of manufacturer	Biochrom US 84 October Hill Road Holliston, Massachusetts 01746-1388 USA
Place and date of declaration NanoVue Plus Family GeneQuant Family Novaspec Family Ultrospec 10, 2100 Family Ultrospec 7000, 8000, 9000 Family SimpliNano Family	Holliston, MA November 2015 Holliston, MA November 2015 Holliston, MA November 2015 Holliston, MA November 2015 Holliston, MA November 2015 Holliston, MA November 2015
Identity of person authorized to sign DoC	Mark Davis Harvard Bioscience Sr. Director of Engineering

Full specification and operating instructions are contained within the relevant user manual.