Gravipull-3 Micropipette Puller

User Guide

A new way of pulling standard or long-tapered multi-barrel micropipettes

by

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2013

Version: 1.1

Serial no.:

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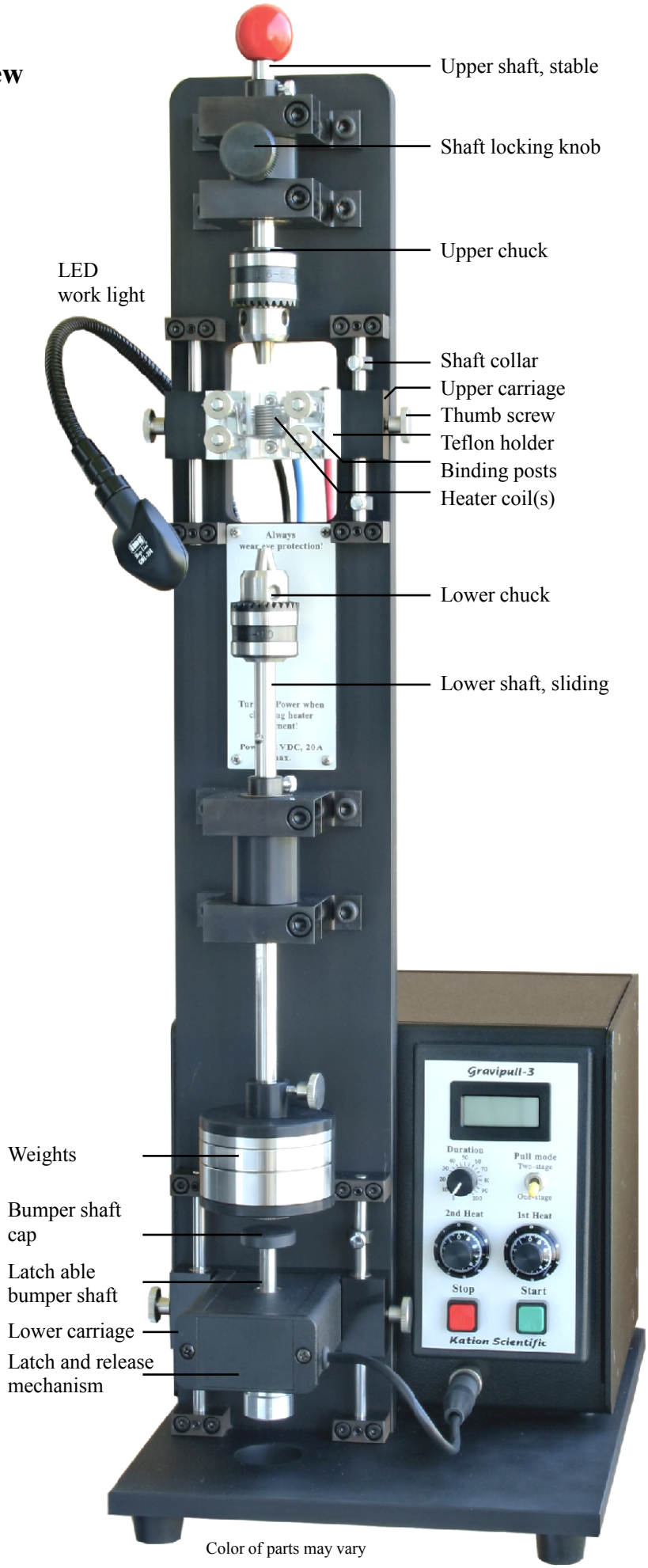
Pictorial overview



Color of parts may vary

General description

The Gravipull-3 is designed to pull multi-barrel glass micropipette assemblies but it also is capable of pulling single-barrel glass micropipettes. It is intended to soften and pull borosilicate or aluminosilicate glass capillary tubing assemblies (‘blanks’) up to 0.25" (6.4 mm) in diameter and 6" (152 mm) long. The blank is fixed in the upper and lower chucks of the puller while the upper one is held in place by a locking screw. The ‘Start’ button on the front panel begins the pulling cycle. The pull is fed by gravity using a 7-stage weight system. The lower chuck can be rotated once the glass begins to soften. The rotation and pulling cause the lengths of tubing to fuse together. The combination of current supplies to the heating coil and the degree and timing of pull may be varied to produce pipettes of different lengths and diameters. A bumper in the bottom of the puller arrests the lower glass holder gently so as not to damage the lower piece of glass. The heater automatically switches off at the end of each cycle.

A truly unique feature of the Gravipull-3 is the capability of pulling micropipettes in two stages using two separate heater coils and an exceptional latch mechanism. For greater flexibility, the heater coils and the latch system are mounted on two carriages allowing vertical adjustments. Altogether, this system permits producing taper lengths up to about 100 mm.

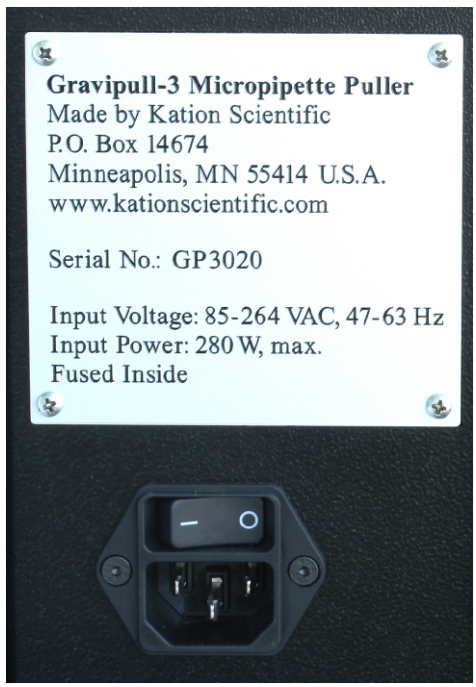
Setting up the puller

Unpack your puller with great care. Set up your pulling station in a room with still air having a temperature of about 25 °C. Keep in mind that room temperature, humidity and air convection can greatly influence the quality of pulling. Place the puller on a horizontal surface. This puller is equipped with a universal, world-wide power supply with automatic self-adjustment.

AC power input and rearview controls

The AC power input is located in the back with an integrated main switch that turns the unit on or off. It directly accepts world-wide AC voltages ranging from 85 to 264 V with frequencies between 47 and 63 Hz. The internal switching power supply galvanically isolates the low voltage (12 VDC) internal circuitry as well as the heater coils from the AC line power. Switch of the LED work light is located in the rear of the column.

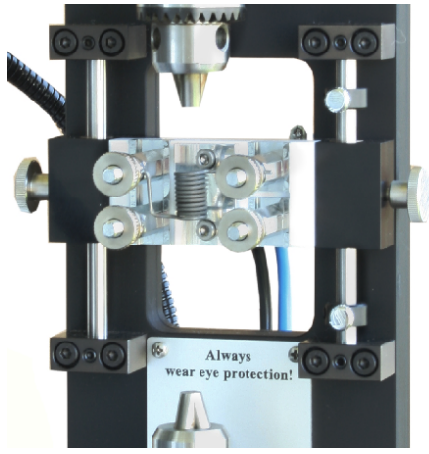
Do not obstruct the rear panel cooling fan outlet.



Front panel controls

Four-digit LCD (top)
Shows the actual current flowing through either 'Heater coil 1 or 2'.
Pull mode toggle switch
One-stage or two-stage pulls can be selected here.
Start push button
Begins the pulling cycle provided that the sliding shaft is in its upper position and the end switch is deactivated.
1st Heat
Sets current for 'Heater coil 1' up to 20A.
2nd Heat
Sets current for 'Heater coil 2' up to 20A.
Duration
Sets the On time for 'Heater coil 2' during the second pull between 3s and 45s. The second pull is performed at the end of this period.
Stop
Works as an emergency stop. Interrupts pulling cycles at any point of time.

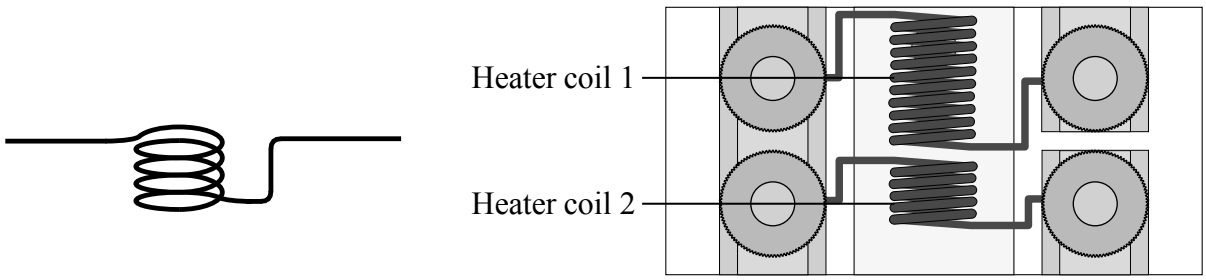
Mechanical controls



By means of the provided shaft collars, the position or movement of the shafts and carriages can easily be located and re-located. This helps to set the length of taper during the second pull and to manufacture micropipettes of the same size. The upper (stable) shaft is held in position by a locking thumb screw. Blanks to be pulled are held in the two chucks. Adjust the chucks' grip to securely holding blank without cracking it. Tightening chucks by hand does the job in most cases. Weight discs can be changed after removing the bottom knurled knob and the black weight holder. The black upper lid of the weight assembly should be re-adjusted accordingly using its thumb screw.

Making heater coils

Turn Kanthal AF, (from AWG 17 to AWG 21 or 1.1 mm to 0.7 mm diam. recommended) or similar heater wire around a 0.25" diam. (6.4 mm or so) cylindrical object (*e.g. shank of a drill bit)* for several times as needed. Form horizontal ends of the wire that are to be mounted in the binding posts of the teflon holder. Position the coil in the posts so that it is coaxial with the pulling shafts. More loops in the heater coil will result in longer taper of the pipettes.
Note that heater wires can easily be shaped when they are hot. So, heat up the coil, press 'Stop' button and then shape the coil as needed. Also, a metal rod fixed in the lower chuck movable up and down comes handy when coils are adjusted. Use a knife or scalpel blade if loops form a short circuit.



Caution!
Heater coils can get extremely hot. Only qualified personnel should do this job.

Always were eye protection when the coils are heated! A pair of dark sunglasses will do.

Pulling multi-barrel micropipettes

Mounting blanks for pulling
Mount your blank in the chucks with the heater coil in the middle. Make sure that the glass is positioned in the center of the coil. Adjust the chucks' grip to securely holding blank without cracking it. Tightening chucks by hand does the job in most cases. It is often useful to place an unsymmetrical blank upside (working end) down in the chucks and use the multi-barrel pipette remained in the lower chuck.

General procedures
The pulling cycle is initiated by pressing the green 'Start' push button provided that the sliding shaft is in its upper position and the end switch is deactivated. The pulling cycle can be interrupted any time by pressing the red 'Stop' push button switch. The actual heater current is shown by the 4-digit reflective display on top. Pull mode can be selected by the corresponding toggle switch.
When the glass begins to soften, gently rotate the lower chuck to about 2/3 of the full turn. Allow the sliding shaft to descend about 1 inch (2.5 cm) and rotate the shaft back by about 1/3 turn. The rotation and pulling will cause the lengths of tubing to fuse together. **This may take a great deal of practice!**
In case of one-stage pull, release the shaft when the back rotation is complete and let the weight system finishes the pull by freely falling on the non-latched bumper shaft. It is important to set the suitable sliding distance using the upper and lower carriages not to cause unnecessary shocks in the system.
When two-stage pull is performed, however, use your thumb and index finger to slow down falling of the sliding shaft ("finger brake") so that it descends slowly and at an even pace then lands gently on, and without any bouncing back from, the disc of the latched bumper shaft.

One-stage pulls
Toggle the 'Pull mode' switch to this position. Glass is softened by heater coil no. 1 in this case. Set current for 'Heater coil 1' using the 10-turn '1st Heat' dial. Finding the adequate current requires **trial pulls**. Pulling cycle is activated by pressing the 'Start' button and it is ended when the non-latched bumper shaft is hit and pushed all the way down by the falling lower (sliding) shaft. Set the suitable sliding distance using the upper and lower carriages not to cause unnecessary shocks in the system. **For further protection of the bumper/latch system, place a piece of 1" (2.5 cm or so) thick urethane foam on the cap of the bumper shaft.**

Two-stage pulls
Toggle the 'Pull mode' switch to 'two-stage' position. The first pull is mostly to be accomplished as one-stage pulls. However, instead of letting the sliding shaft falling freely onto the latched bumper shaft, use your thumb and index finger to slow down falling of the sliding shaft ("finger brake") so that it descends slowly and at an even pace then lands gently on, and without any back bouncing from, the disc of the bumper shaft. Also, set the suitable sliding distance using the upper and lower carriages to define the length of the first pull. **This takes practice!**

The first pull is now finished and the second pull begins when the latched bumper shaft is pushed down by about 5 mm and it stays there for about 20s holding the entire sliding shaft system including the drawn glass. This period of time allows cooling off the glass and provides an opportunity to reposition 'Heater coil 2' for the second pull. Then 'Heater coil 2' is activated by current selected by the '2nd Heat' 10-turn dial. Again, finding the adequate current requires trial pulls.
The extent of the second heating and pulling period is determined by the 'Duration' dial which can be set between about 3 and 45 seconds. When the selected period of time elapse the latch mechanism releases and the bumper shaft falls about an additional 15 mm completing the second pull. Finding the suitable 'Duration' requires trial pulls.

Pulling single-barrel micropipettes

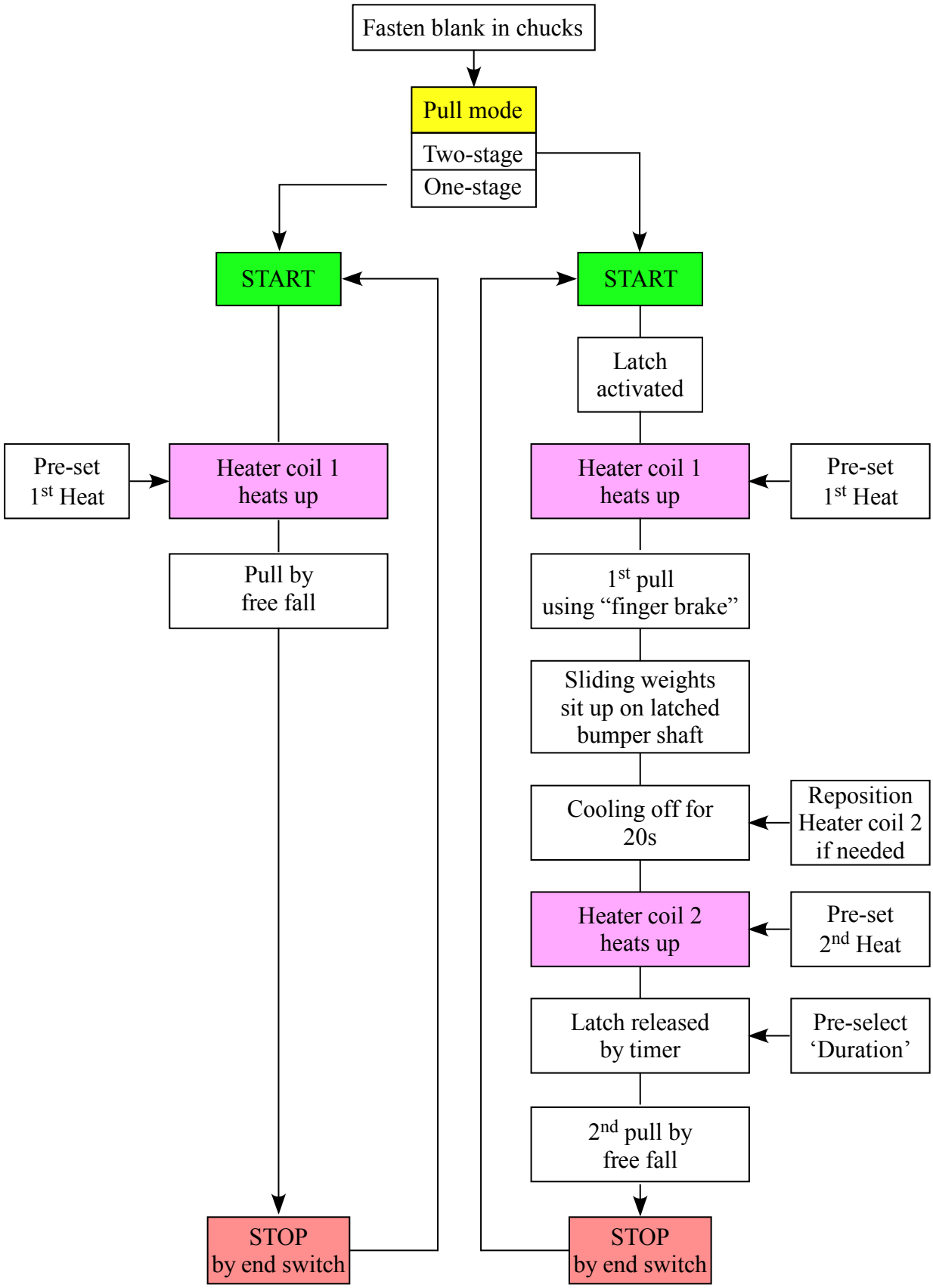
Single-barrel micropipettes can also be pulled through applying one- or two-stage pull modes. Their pull is quite similar to the procedures described above. The only difference as compared to multi-barrels is the omission of turning the sliding shaft when pulling is being performed.
Extra care should be taken when fine-walled glass tubing is posted in the chucks. It is often a good idea to apply sections of heat-shrinkable plastic tubing at both ends of the glass to be pulled to prevent cracking.

Factors affecting the length and width of micropipette tapers

For any pulls:
Temperature, humidity and convection of air in the room.
Length and diameter of the heater coils.
Current applied to the heater coil.
Pulling force set by weight discs.
Wall thickness of the glass capillary tubings.

For two-stage pulls:
Speed of the descending sliding shaft. Practice "finger braking." The taper length is defined by the distance between the weight system and the bumper shaft.
The length of the second taper is greatly influenced by the length of the second heater coil and by the applied current as well as the duration of the current application. Usually, short coils (3 to 4 loops) produce the best results. **Caution, a small change in the heater current may lead to great change in the tip shape formed by the second pull!** So, practice and perseverance are highly worthwhile.

Flow-chart of the two pull modes



Safety features

The internal low voltage circuitry as wells as the supply for the heater coils are galvanically isolated from the AC input power using switch mode power supply that is certified as follows:
NRTL* * * Recognition to UL60950-1
CSA C22.2 No. 609501-03
BAUART Certification to EN60950-1
CB Test Report in Accordance with IEC60950-1
CE Declaration to Low Voltage Directive 72/23/EEC

For your safety, always wear eye protection when pulling micropipettes! A pair of dark sunglasses will do.

Care and maintenance

Clean your Gravipull-3 using mild detergent only. *Never apply any aggressive organic solvent such as acetone.* The stationary and sliding shafts can only be lubricated with powdered graphite lubricant. Apply graphite lubricant before every major pulling session using a soft cloth. *Never apply any fluid lubricant such as oil or grease*. Keep your instrument in dry conditions away from any moisture or corrosive fumes.

Specifications

Blank dimension:	0.25" diam. x 6" length, max. (6.4 mm x 152 mm)
Slider's travel:	4.4" (112 mm), vertical
Taper length:	100 mm, max.
Pulling force:	Gravity-fed set by weight discs
Discs weight:	1, 2 and 3-unit masses
Heater power:	12 VDC, 20 A, max., by pulse width modulation
Heater wire:	Kanthal AF, from 17 AWG to 20 AWG (1.1 mm to 0.7 mm diam.) recommended
Display:	LCD to show heater currents in Amperes
Work light:	12 V LED lamp
Mains power input:	World-wide automatic, self-adjusting: from 85 to 265 VAC, 280 W, max.
Mains frequency:	From 47 Hz to 63 Hz
Dimensions:	8.3" x 12.2" x 25.6" (W x D x H) (21 cm x 31 cm x 65 cm)
Net weight:	22 lbs (10.0 kg)
Shipping weight:	35 lbs (16.0 kg)

Certification:
Kation Scientific certifies that this instrument has been tested and inspected thoroughly and was found to meet all published specifications before shipment from the factory.
Warranty:
This product is warranted against defects in materials and workmanship for one full year from the date of shipment as long as it has been exposed to normal and proper use. Products which prove to be defective during the warranty period will be repaired or replaced without charge provided they are returned to the factory. Kation Scientific will provide for servicing and calibration after the warranty period for a reasonable service charge. The instrument should be shipped to the factory postage prepaid.