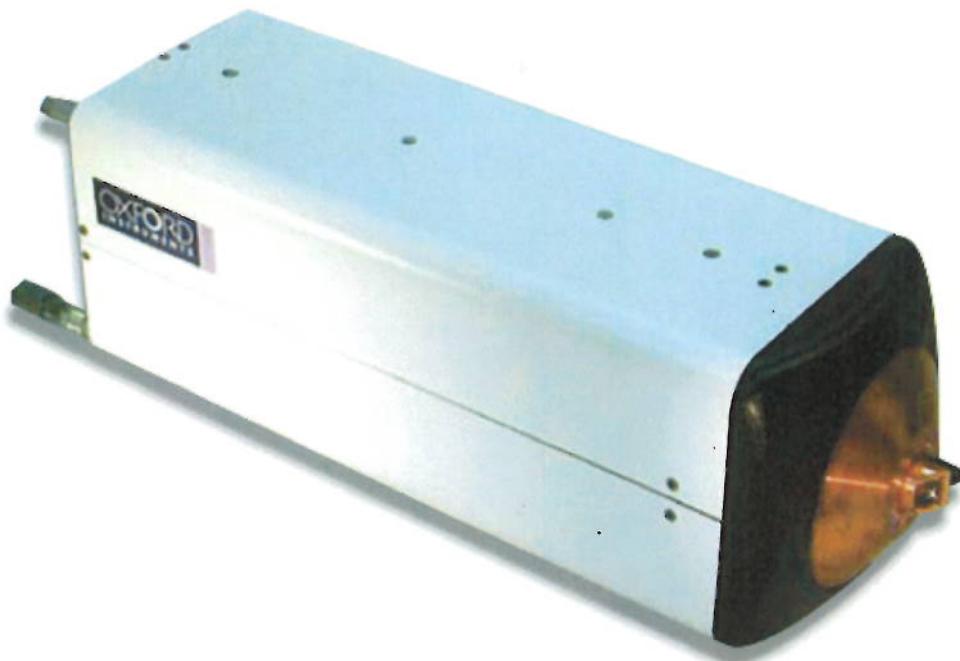


User Manual

# Oxford Instruments X-Ray Technology

Nova 96000 Series Microfocus Source

Nova User Manual



[www.oxford-instruments.com](http://www.oxford-instruments.com)



*The Business of Science\**

## Nova 90kV, 80W Microfocus X-ray Source

### IMPORTANT UNPACKING INFORMATION

Inspect the outside of the shipping package for damage before opening the box and make sure that the "ShockWatch" Warning indicator label is not red.

If the indicator label is red, do not open the package.  
Call our Customer Service team at +1 831-439-9729.



### IMPORTANT SAFETY PRECAUTIONS

#### GENERAL SAFETY PRECAUTIONS

This integrated X-ray source generates voltages that are dangerous and may be fatal.  
Please observe extreme caution when working with this equipment.

- X-ray sources must always be grounded.
- Wait at least five minutes for the internal capacitance of the power supply to discharge.
- Do not ground yourself or work under wet or damp conditions.
- Nova has a Safety Interlock Circuit which must be closed before X-rays can be generated. During operation the interlock is closed before any kV can be generated across the X-ray tube.

#### SERVICE SAFETY PRECAUTIONS

There are no user serviceable parts in the power supply.

Service should be performed by a trained Oxford Instruments technician.

**DANGER:** the product manual identifies hazards in the operation of this unit that could possibly lead to injury or death.

**CAUTION:** the product manual identifies procedures to be followed to avoid possible damage to the equipment.

**NOTE:** If Nova is dropped during use, it should not be turned back on again.

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## Nova 90kV, 80W Microfocus X-ray Source

### Introduction

Please read this manual before attempting to operate the unit. Although every care has been taken to ensure your safety, it is essential that you understand the operation of the unit before doing so. Pay particular attention to radiation shielding, as this unit is not shielded against radiation exposure.

Nova is a complete water-cooled X-ray source unit, controller and optional chiller.

The X-ray source unit is composed of an X-ray tube, high voltage power supply and water-cooled package.

The controller unit is used to control the voltage and power settings. It may be operated manually with the front panel controls or remotely from a computer through its RS-232c port. The software used to communicate with the controller may be that supplied with this source or may be provided by the end user.

The optional chiller unit is capable of removing all the heat generated by the X-ray source unit. The water temperature is maintained at 20.0+/- .1° C at all times. While the chiller primarily removes heat from the source unit, it also helps maintain a stable operating temperature.

The Oxford Instruments supplied software CD contains software that allows remote operation of the controller unit.

### Safety Instructions

Please read and follow all the safety and operating instructions before operating the source. Misuse of this product can result in serious injury or death.

### X-ray Radiation Safety

Nova is a source of X-ray radiation when energized. It is incapable of generating X-rays if it is not connected to a source of electrical energy. It is **not** radioactive nor can it cause other materials to become radioactive when exposed to the X-rays generated by this source.

Do not under any circumstances operate this equipment without proper radiation safeguards in place. These include but are not limited to:

- Radiation shielding such as lead plate placed between the source and personnel.
- Properly interlocked access panels or doors. Nova is equipped with two separate door interlock circuits which when wired properly, automatically shut down the source. See the section on Controller Set-Up for instructions on how to connect the interlocks.
- Barriers which will prevent the operator from placing any part of their person in the direct path of the X-rays.

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- Radiation warning lights that will energize when the X-ray source is energized. Nova is equipped with a TTL status output, which is enabled when the X-ray Source Unit is enabled. See the section on Controller Set-up for instructions on how to use this feature.
- Radiation film badges to help warn the user of cumulative exposure to radiation.

### Beryllium (Be)

Nova contains a thin Beryllium window on the X-ray tube. Beryllium (silver/gray and metallic in appearance) and beryllium oxide (normally a whitish powder in appearance) dust are harmful if inhaled or ingested.



### Contents Under Pressure

Nova is pressurized to 60 psi with Sulfur Hexafluoride. Sixteen 8-32 socket head cap screws hold back the pressure of the gas. Each screw holds back 120 lbs of force! Do not remove the socket head cap screws (located on the end of the Source Unit and under the metal cover) under any circumstances. If the screws were removed without de-pressurizing the unit, the force generated could cause serious injury or death.



## Nova 90kV, 80W Microfocus X-ray Source

### **Heat Hazard**

The Anode gets hot. Do not touch the anode immediately after it has been operated. Wait 3 minutes before touching the anode if the chiller is left operating. Wait 10 minutes before touching the anode if the chiller has been shut down. As a precautionary procedure, the chiller should always be left running for 5 minutes after the source has shut down.

### **Fire Hazard**

Under no circumstances should the main cable between the controller unit and the Source Unit be replaced with a substitute. Should it be necessary to replace the cable, contact customer support for a replacement. This cable has the appropriate wire gauge size and insulation thickness necessary to operate Nova safely—any substitution may lead to overheating and fire.

### **High Voltage**

The Source Unit contains a high voltage power supply. High voltage is not exposed, as the supply is completely contained with a conductive barrier and cannot operate if it is removed from the Source Unit package. However, the Source Unit should still be grounded to earth ground as a precaution. The 25-pin low voltage cable includes a grounding wire but large surge current associated with internal arcing may generate substantial voltages between the Source Unit and the controller. As a safeguard, the Source Unit should be mounted to a metal fixture, and that fixture should be grounded with a large braided cable. The controller has a large ground lug and should also be grounded to earth.

The high voltage power supply has been thoroughly tested and should not ever arc to its own case. However, immediately discontinue use of the source if at any time any high voltage arcing or popping is heard. High voltage arcing has a distinctive sharp cracking sound. Lock the controller with the supplied key to prevent further operation and call customer support if you suspect that the power supply is arcing.

### **AC Line Voltage**

Nova operates off of normal AC line voltages. Under normal operating conditions, these voltages are not exposed. However, if the controller cover is removed and the AC cord is plugged into an electrical source, line voltages are exposed and present even if the controller is turned off.

### **Weight Hazard**

Nova Source Unit, controller, and chiller are heavy. Use proper lifting techniques to prevent back injury. Do not drop any of the components, not only will they likely be damaged to the point will they will not be safe to operate, but the impact on any part of the body will likely cause serious injury.



## Nova 90kV, 80W Microfocus X-ray Source

### Sulfur Hexafluoride (SF<sub>6</sub>)

Sulfur Hexafluoride (SF<sub>6</sub>) is used as a high voltage insulating gas in Nova. It is pressurized to 60 psi and is sealed in the source unit with several rubber-like seals. See the warning on pressure, above. Each source unit is checked for leaks before being filled with SF<sub>6</sub>. SF<sub>6</sub> is a colorless, odorless, nontoxic, nonflammable gas that is used as an insulating gas in electrical equipment. At atmospheric pressures it sublimes directly from a solid to a gas. SF<sub>6</sub> is chemically inert and is completely stable in the presence of most materials to temperatures of about +400°F at 392 psig (+204°C at 28 bar) SF<sub>6</sub> is however a very powerful greenhouse gas. It is 23,900 times more efficient at trapping heat radiation than is CO<sub>2</sub>. Therefore, do not release the contents of the source unit.

### Unpacking the Unit

Unpack the boxes and check that you have the following items:

- This Manual
- Software CD
- Nova Source Unit
- Controller
- On Switch Keys (2 each)
- Controller Power Cord
- DB-25 Cable
- RS-232 Null Modem Cable
- Interlock Cable with connectors attached
- Molex Pins (6 each)
- Water Quick Connects (2 each, attached to tubing if optional chiller has been purchased)

If Optional Chiller has been purchased these items should also be included:

- Chiller
- Chiller Power Cord
- Chiller Tubing with plastic fittings and quick connects attached on one end (2 each)
- Additional Plastic NPT fittings (2 each)
- Algaecide / Antifreeze

### Required Tools and Materials

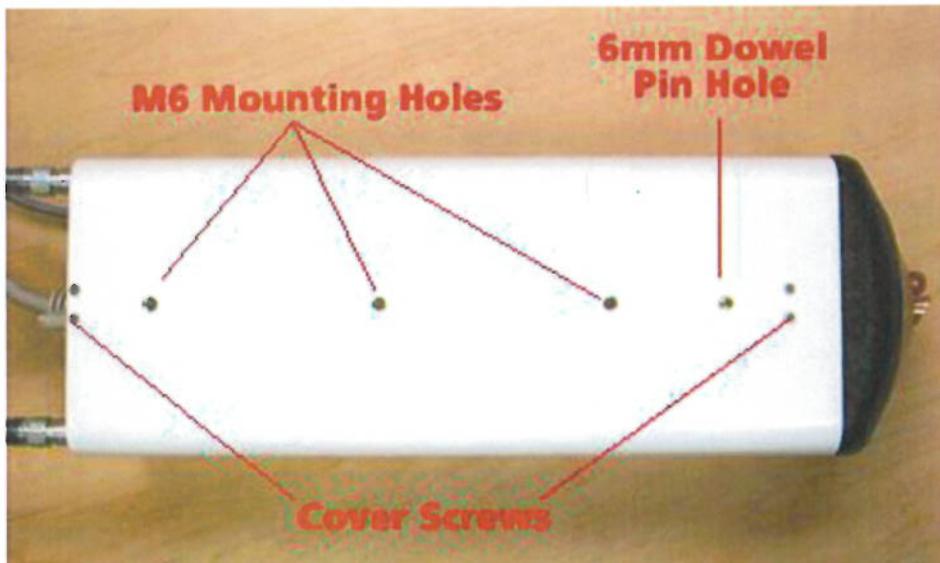
- Crescent Wrench
- Phillips Screw Driver
- Water Bucket
- Distilled Water

## Nova 90kV, 80W Microfocus X-ray Source

### Source Unit Set-up

#### Mounting Source Unit

The Source Unit may be mounted with M6 screws located on two sides of the Source Unit. The Source Unit also has two holes that will accept two 6 mm dowel pins. See the Outline Drawing on page 34. Be sure the unit is firmly secured before operation.



#### Changing Source Orientation

If required, the cover may be removed and rotated by 90 degrees to expose mounting holes 90 degrees from those in the normal position.

To remove the cover, remove the 16 Philips #4 screws holding the cover in place. Slide the cover pieces apart and remove the plastic end cover. See the photo above.

Do not remove the #8 Socket head cap screws; the contents are under pressure. See pressure warning under Safely Instruction.

To reinstall the cover, first install the metal covers with 8 of the screws on the rear of the Source Unit. Then snap the plastic cover onto the end of the source. Next install the remaining 8 screws toward the front of the source.

## Nova 90kV, 80W Microfocus X-ray Source

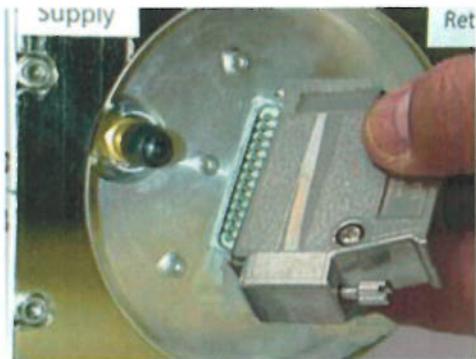
### Mounting to Anode

The anode has four #2-56 threaded inserts. Any small device may be mounted to these holes. However, caution must be used with these threaded holes. Use screws of the proper length; do not use screws that will bottom out—the thread depth is 0.10 inches. Also, the anode is a soft annealed copper material; it may be easily bent. If the anode is bent the source will be permanently damaged and not operate to specifications.



### Electrical Connections

Insert the female end of the large DB-25 cable into the mating connector on the Source Unit endplate and tighten using the attached jackscrews. This cable connects the Source Unit to the controller to provide power and control.



## Nova 90kV, 80W Microfocus X-ray Source

Insert the round temperature interlock cable connector into the round connector on the Source Unit. This cable connects the flow and thermal switches in the unit to the interlock interface on the controller.



### Water Connections

The water hose quick connectors are included with Nova and mate to the connectors on the back of the Source Unit. These fittings are of the No-Drip type and once they are fitted to water hoses and the appropriate chiller, they may be connected and removed without the worry of water spillage. Mount the mating connectors to the hose. The user's side of the quick connects are of the 1/8" NPT female type. If the optional chiller has been purchased, these have already been fitted to the hoses. To insert the connectors, first pull back on the locking collar and then insert the mating connector. Make sure the water is flowing in the proper direction as indicated.

If the water flow drops below 0.10 liters per minute, or if the temperature at the anode exceeds 70 °C, the interlocks will open and the controller will display an over-temperature condition. Should the flow be too low, increase the flow in the system to bring it back up above 0.15 liters per minute to reset the flow switch. If the anode gets too hot, the Source Unit needs to be cooled to 20 °C or the thermal switch will not reset.



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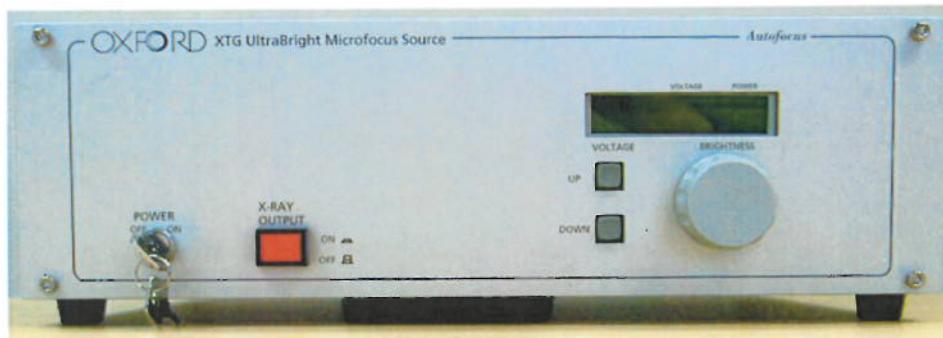
### Grounding

There is no special grounding lug on the Source Unit, but it should still be grounded through the normal M6 mounting screws. The fixture to which the Source Unit is attached should be made of metal and should be grounded via a ground strap to earth ground.

### Radiation Shielding and Interlocks

The Source Unit is shielded for radiation and so should need no additional radiation shielding. However, X-ray radiation is emitted from the window on the front of the tube. Appropriate radiation shielding should be provided and interlocked so that it is not possible to expose any part of any personnel to the X-ray beam. Interlock connections are provided on the back of the controller. See the section on setting up the controller.

### Controller Set-up



### Location and Orientation

Locate the controller in an area with normal room temperatures. If the environment is comfortable for the operator, it will be appropriate for the controller. Do not block the sides, back or top of the controller, as it requires proper ventilation to prevent overheating.

## Nova 90kV, 80W Microfocus X-ray Source

### Controller Rear Panel



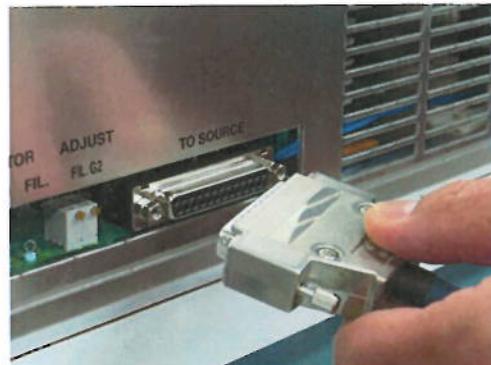
- 1) AC OUTPUT connector
- 2) Fuse 3A
- 3) AC INPUT connector
- 4) Ground terminal (WARNING: Never turn on unit without proper grounding)
- 5) Cable clamp
- 6) TO SOURCE connector
- 7) G3 SPAN adjust potentiometer \*\*
- 8) G3 ZERO adjust potentiometer \*\*
- 9) G2 adjust potentiometer \*\*
- 10) Interlock connector
- 11) MODE switch
- 12) ENTER switch
- 13) Air duct
- 14) RS-232C connector
- 15) LOCAL/REMOTE toggle switch

\*\*Do not adjust. Modification of these settings will degrade performance and may cause permanent damage.

## Nova 90kV, 80W Microfocus X-ray Source

### Controller Connection to Source

Connect the male side of the large DB-25 cable to the mating connector on the back of the controller. The connector is labeled "To Source". Do not plug this cable into the connector labeled "RS-232C".



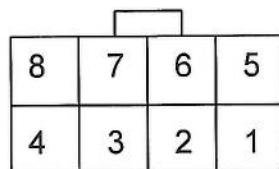
## Nova 90kV, 80W Microfocus X-ray Source

### Temperature Interlock Connections

One end of the thermal interlock cable has a white Molex-style connector. The thermal interlock wires use pins 5 and 6, and are pre-wired.



INT.Lock Connector

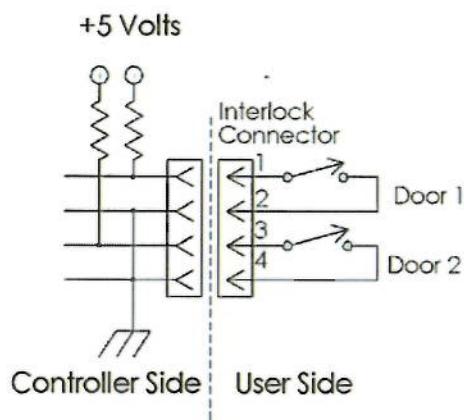


1	Interlock 1
2	Common
3	Interlock 2
4	Common
5	Tube over temp
6	Common
7	Status
8	Common

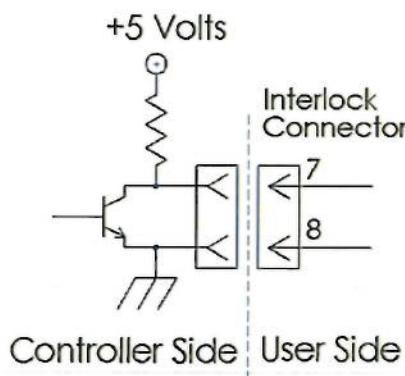
## Nova 90kV, 80W Microfocus X-ray Source

### Door Interlock Connections

Several male pins have been provided that will insert into the interlock connector shell. These will first have to be wired to customer supplied interlock switches. Pin 1 should be wired through a switch to Pin 2. Pin 3 should be wired through a switch to pin 4. If only one interlock is desired, you may jumper the pins. The interlock switches need to be in the closed state for Nova to operate. That is, when any interlocked doors are in the open position, the interlock switch needs to be an open circuit.



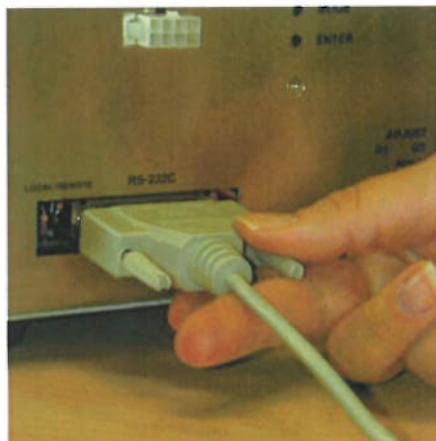
Pins 7 and 8 of the interlock connector are a TTL output used to indicate that the unit is outputting X-rays. Pin 7 is an open collector and pin 8 is common ground. You may use this output to drive a solid state relay for controlling a warning light or other device which needs to be active when X-rays are being emitted from the unit. Do not use this output to drive a mechanical relay without proper diode protection. The maximum voltage is 5 volts. The maximum current is 20 mA.



## Nova 90kV, 80W Microfocus X-ray Source

### RS-232C Connection

If it is desired to run Nova from a computer, use the Null Modem cable provided. Connect one side to the connector labeled "RS-232C". Connect the other side to your computer's serial port. You may need to use an adapter (not provided) to connect to your computer.



### AC Auxiliary Power Connection

This AC plug is activated when the unit is switched on. You may use it with a warning light, cooling fan, or other device which would like to have power when the unit is switched on. The unit is powered even when the X-rays are switched off at the front panel.



## Nova 90kV, 80W Microfocus X-ray Source

### AC Input Power Connection

Finally, connect the power cord to the AC Line connector. The voltage may be from 92 to 230 VAC.



### Chiller Requirements

In order for Nova to operate, it must be water-cooled. If the optional chiller unit was not purchased, then the user must supply the chiller. The following specifications must be met for Nova unit to operate stably, safely and within specification.

Water Temperature	20.0 $\pm$ 2 °C (68 $\pm$ 4 °F)
Temperature Stability	$\pm$ .5 °C ( $\pm$ 1 °F)
Minimum Water Flow Rate	0.15 l/min (0.03 g/min)
Maximum Water Flow Rate	0.30 l/min.(0.06 g/min)
Minimum Water Pressure	83 kpa (12 psi)
Maximum Water Pressure	277 kpa (40 psi)
Maximum Hose Size	6mm (0.25") OD

The combination of high pressure and low flow rate will generally mean that the water chiller should have a bypass valve.

Should the water flow rate drop below 0.1 l/min, the temperature interlock will open. Before resetting the interlock, the flow rate must be brought back up to 0.15 l/min.

With the proper cooling the anode temperature should never exceed 70 °C even under maximum power. Should excessive temperature be encountered an internal thermal switch will cause the temperature interlock to open. Should the temperature interlock open, the anode temperature must be brought back to 20 °C for the thermal switch to reset.

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### Algaecide

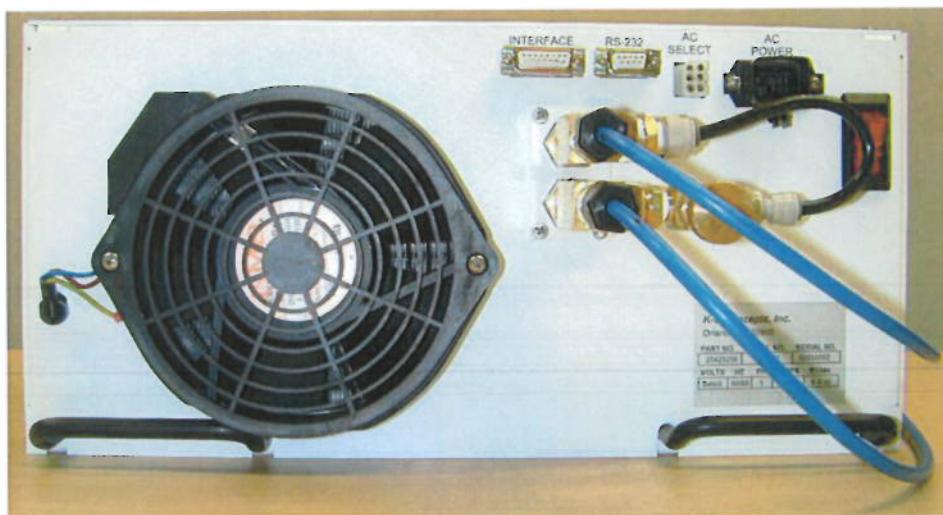
The Source Unit has very small openings within the water lines. To prevent them from becoming clogged it is recommended that the water lines be opaque. It is also recommended that an algaecide be added to the chiller water.

A line filter may also be added but it is not required so long as the water is kept clean. A filter may further increase the back pressure at the chiller pump.

### Front Panel



### Rear Panel



## Nova 90kV, 80W Microfocus X-ray Source

### Transformer Set-up

The chiller comes with several transformer jumpers. Select the proper jumper for your electrical service and plug it into the AC select connector.



### Power Connections

Insert the power cord into the AC power connector as shown. Be sure to tighten the strain relief screw in order to prevent the power cord from slipping out accidentally.



## Nova 90kV, 80W Microfocus X-ray Source

### Chiller Set-up

Water hoses and connectors are included with Nova. One end of each hose is fitted with a quick connect and the other end will be fitted with a plastic NPT fitting (included). The quick connect end of the hose fits into the mating connections on the Source Unit endplate. See Source Unit Set-up. These fittings are of the No-Drip type and may be connected and removed without the worry of water spillage.

1. Screw both of the plastic fittings into the chiller's inlet and outlet ports and tighten with a crescent wrench.
2. Insert one of the tubes into this fitting as far as it will go. Tighten the plastic nut with a crescent wrench. (Do this for only one tube)
3. Make sure both of the tube's quick connects are inserted into the Source Unit.
4. Place the tube associated with the outlet side of the Source Unit into a water bucket. This will be used to ensure that you have proper flow and that air has been removed from the lines before making the final attachment to the chiller.
5. Add about 64 oz. (1.89 liters) of distilled water to the chiller's reservoir. There is no need to fill completely at this time, as an algaecide/antifreeze will be added later.
6. Turn on the main power to the Chiller Unit.
7. Make sure that water is flowing out of the hose into the water bucket. You should see both water and air bubbles flowing from the hose. After a short time (less than a minute), most of the air bubbles should cease. It is not necessary to remove all of the air from the lines at this time.
8. Turn off the power switch on the chiller.
9. Insert the return hose into the plastic fitting on the inlet side of the chiller and tighten with a crescent wrench.
10. Turn the chiller on again.
11. Check for water leaks at the chiller's inlet and outlet and at the source's inlet and outlet. Also check for leaks in the tubing along its entire length.
12. Open the container of algaecide and add it to the reservoir. Add additional distilled water until the proper fill level has been reached.

### Set Chiller Temperature

It is not required to set the temperature of the chiller. It is preset to 20.0 °C and should remain at this temperature. This temperature was chosen to prevent condensation inside the Source Unit, yet still provide enough headroom to prevent an over temperature condition.



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### Nova Operation

#### Optional Chiller Unit Operation

The Chiller Unit must be on and running before the Controller Unit will function properly. The temperature, flow rate and pressure on the optional Chiller Unit have been preset at the factory. No adjustment should be necessary. For a user supplied chiller, water temperature should be kept at 20.0°C and the flow rate kept above .15 liters per minute. If the temperature were to be set below 20°C, there is the possibility of condensation forming on the Source Unit and hoses. This should be avoided. If the flow rate drops below .10 liters per minute, the internal flow sensor will cause the Controller Unit to stop functioning and show a fault condition "FAULT TUBE OT". This is why the Chiller Unit must be on and functioning before proceeding.

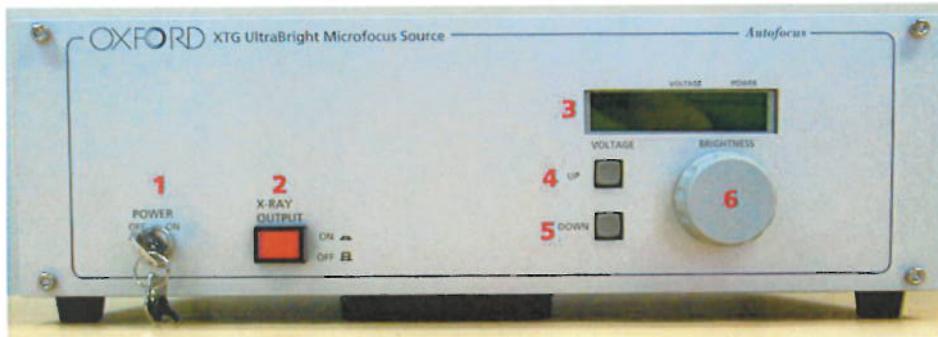
#### Pressure and Flow Setting

The flow rate has been pre-set at the factory. Should there be a need to adjust the flow rate, adjust the bypass valve on the back of the chiller unit. Turning the knob clockwise decreases the bypass, which increases the pressure and flow rate in the Source Unit.



## Nova 90kV, 80W Microfocus X-ray Source

### Controller Unit Operation



#### Front Panel

- 1) POWER ON/OFF switch
- 2) X-ray OUTPUT ON/OFF switch with red LED
- 3) LCD
- 4) High Voltage UP switch
- 5) High Voltage DOWN switch
- 6) Brightness/Spot size knob

### Power On/Warm-up

You must use the keys provided to turn on the Controller with the key switch.

After the Controller Unit is turned on, the display will show Warm-up for approximately 2 minutes.

PRESET -20kV 20W  
WARM UP

### Standby

After warm-up the controller will display stand-by. This indicates the controller is ready to accept commands.

PRESET -20kV 20W  
STAND-BY

## Nova 90kV, 80W Microfocus X-ray Source

### Local / Remote Mode

The controller may be operated in either local or remote mode. In local mode the buttons and knobs on the front panel control the operation of the unit. In remote mode, the unit is controlled through a serial port on the back of the controller.

As shipped, the Controller Unit should be in the local mode. If it is in Remote Mode, the front LCD panel will show the letter R in the lower right corner of the display, and the front panel controls will be disabled. Locate the **LOCAL/REMOTE** switch on the rear of the controller unit next to the RS-232C connector. Use a plastic pen or pencil to set the desired switch position.



### Operating in Local Mode

#### X-ray On Switch

When depressed, the **X-RAY ON** switch enables the controller to apply power to the Source Unit. If it is not depressed, the Source Unit cannot emit X-Rays. However, if the **X-RAY ON** switch is depressed, the source may or may not be enabled. The **X-RAY ON** switch is also an indicator. When lit, the **X-RAY ON** switch indicates that power is being supplied to the Source Unit. When it is not lit, power is not being supplied to the Source Unit and no X-Rays are being generated.

When the **X-RAY ON** switch is first depressed, the Source Unit front panel will display the lowest voltage and power settings that were set by the factory. The unit may not be set lower than these setting values.

OUTPUT -20kV 20W

## Nova 90kV, 80W Microfocus X-ray Source

### Interlock and Fault Reset Using the X-ray On Button

Should an interlock go open or a fault condition occur, the **X-RAY ON** switch light will go out, and the source unit will be shut off. The front panel display will show which fault has occurred or which interlock has opened.

For example:

FAULT INTER LOCK

To reset the interlock open condition, attend to the interlock or fault and then press the **X-RAY ON** switch twice. This will reset the fault condition on the controller, unless there is another interlock or fault condition, which has not been corrected. The first fault that occurs is the one that appears on the display. Deal with each fault as it occurs until the unit will successfully turn on.

Display	Description
FAULT FIL.OC	Filament over current (Up to 1.2A)
FAULT FIL.SHUTDOWN	Filament over current (Up to 2A)
FAULT INTER LOCK	Interlock (Rear panel INT.Lock connector)
FAULT ANODE OC	Anode over current
FAULT ANODE OV	Anode over voltage
FAULT ANODE UC	Anode under current
FAULT ANODE UV	Anode under voltage
FAULT TUBE OT	Tube over temp (Rear panel INT.Lock connector)
FAULT HV OT	High voltage unit over temp (> E.P. 80°C)
FAULT HV PRESS DOWN	High voltage unit pressure down (< 45 psi)
FAULT PS PROBLEM	Power supply problem

#### Notes:

- When the unit detects a fault, the output voltage is cut off
- In order to reset the fault mode, remove the cause of the fault. After doing this, turn the X-ray OUTPUT ON/OFF SWITCH to the OFF position
- When LCD shows "FAULT FIL.SHUTDOWN", turn the POWER ON/OFF SWITCH to the OFF position

## Nova 90kV, 80W Microfocus X-ray Source

### Using Voltage Control Buttons

Depressing the Voltage Control buttons briefly will cause the X-ray tube voltage to increase or decrease in 1000 Volt increments. Pressing and holding the buttons will cause the voltage to scroll quickly up or down. To improve reliability of the product, the Controller Unit has been preset to limit both the minimum and maximum voltages that may be set.

### Using the Brightness Control Knob

The BRIGHTNESS CONTROL knob is used to control the total power output of the Source Unit. The power input to the Source Unit and Controller Unit will be greater than this value due to normal overhead and efficiencies. The minimum and maximum power levels are preset at the factory to assure high reliability.

### Delays and Settling Times

The actual voltage and power presented at the X-ray tube will be delayed slightly; be sure to wait a few seconds before taking any X-ray images and measurements. Because of the inherent thermal affects on the X-ray tube, there will be small shifts in both the X-ray Spot size and location for two hours after making changes to the settings. For extremely delicate measurements, you may have to wait up to two hours before proceeding.

### Spot Size and Focusing

The user may have noticed the conspicuous absence of a focusing knob on the controller. All focusing of Nova is done automatically. Each voltage and brightness setting has a preset optimal focus to ensure maximum X-ray spot intensity. While the user may feel this is limiting, the manufacturer has found no application that requires less than optimal focusing. In addition, allowing over focusing can damage the source. We hope this helps to explain the absence of a focus control knob.



## Nova 90kV, 80W Microfocus X-ray Source

### Operating in Remote Mode

Remote mode allows the user to operate the controller from another computer. While in remote mode, the front panel controls will not operate with the exception of the **POWER** switch and the off and reset functions of the **X-RAY ON/OFF** switch.

### Preliminaries

Before operating the unit in remote mode, you should first be sure that the unit works in local mode. (See Operating In Local Mode above.) The RS-232C connector on the back of the Controller Unit needs to be connected to a computer's serial port COM1 with the null model cable provided. Also, be sure the **REMOTE/LOCAL** switch is in the remote position. Verify that the switch is in the proper position by looking on the front display. There should be a small letter R in the lower right corner. If there is not, try the other position.

### RS-232C Remote Operation

Baud Rate:	9600 ASYNC
Data Bits:	8
Stop Bits:	1
Parity:	None
Flow control:	None

Use a 25-pin D-connector cross (null modem) cable for the RS-232C.

**Both the POWER ON/OFF switch and the X-ray OUTPUT ON/OFF switch on the controller front panel must be manually turned ON and the LOCAL/REMOTE toggle switch on the back panel must be in REMOTE position before X-rays can be output by remote command.**

## Nova 90kV, 80W Microfocus X-ray Source

### Codes Used in Commands

1. Do not used codes in the shaded area
2. Use CR(OD<sub>H</sub>) only as a delimiter.
3. Either upper case or lower case characters can be used.
4. In command lines, use a space (20H) as a separator between commands and parameters.

ASCII Code Table

	0 <sub>H</sub>	1 <sub>H</sub>	2 <sub>H</sub>	3 <sub>H</sub>	4 <sub>H</sub>	5 <sub>H</sub>	6 <sub>H</sub>	7 <sub>H</sub>
0 <sub>H</sub>	NUL	DLE	SP	0	@	P	`	p
1 <sub>H</sub>	SOH	DC1	!	1	A	Q	a	q
2 <sub>H</sub>	STX	DC2	"	2	B	R	b	r
3 <sub>H</sub>	ETX	DC3	#	3	C	S	c	s
4 <sub>H</sub>	EOT	DC4	\$	4	D	T	d	t
5 <sub>H</sub>	ENQ	NAK	%	5	E	U	e	u
6 <sub>H</sub>	ACK	SYN	&	6	F	V	f	v
7 <sub>H</sub>	BEL	ETB	'	7	G	W	g	w
8 <sub>H</sub>	BS	CAN	(	8	H	X	h	x
9 <sub>H</sub>	HT	EM	)	9	I	Y	i	y
A <sub>H</sub>	LF	SUB	*	:	J	Z	j	z
B <sub>H</sub>	VT	ESC	+	;	K	[	k	{
C <sub>H</sub>	FF	FS	.	<	L	\	l	
D <sub>H</sub>	CR	GS	,	=	M	]	m	}
E <sub>H</sub>	SO	RS	-	>	N	^	n	~
F <sub>H</sub>	SI	US	/	?	O	_	o	

# Nova 90kV, 80W Microfocus X-ray Source

## Command List

Classification		Command	Function
Setting	Output	VCN WCN	Sets High Voltage Sets power
	Output on/off	XON/XOFF	Turns X-ray Output on/off.
	Parameter	VMIN VMAX WMIN WMAX	Sets minimum High Voltage Sets maximum High Voltage Sets minimum power Sets maximum power
Readout	Output measurement	VM WM GM	Measures High Voltage Measures power Measures G3 voltage
	Mode check	STS FLT	Checks power supply status Checks Fault status
	Version check	VER	Checks ROM version

## Command Details

### VCN Command

Sets high voltage between VMIN and VMAX. **See the source data sheet for high voltage maximum and minimum allowable settings.**

Examples: 1. VCN 90      ← High voltage = -90kV  
           "     2. VCN 20      ← High voltage = -20kV  
           "     3. VCN 123      ← High voltage will not change

Note: Settings exceeding 2 figures are not valid and will be ignored (Example 3).  
       Settings either below the minimum voltage value or above the maximum voltage value will be ignored.



## Nova 90kV, 80W Microfocus X-ray Source

### WCN Command

Sets power between WMIN and WMAX. See the source data sheet for power maximum and minimum allowable settings.

Examples: 1. WCN 80      ← Power = 80W  
"      2. WCN 10      ← Power = 10W  
"      3. WCN 123      ← Power will not change.

Note: Settings exceeding 2 figures are not valid and will be ignored (Example3).  
Settings either above maximum power value or below minimum power value will be ignored.

### XON/XOFF Commands

Turns X-ray output on/off.

Command: 1. XON      ← Output ON  
          2. XOFF      ← Output OFF

Note: Both the POWER ON/OFF switch and the X-ray OUTPUT ON/OFF switch on the controller front panel must be manually turned ON and the LOCAL/REMOTE toggle switch on the back panel must be in REMOTE position. The source must complete the 2 minute WARM-UP and be in STAND-BY mode before X-rays can be output and controlled by remote commands.

### VM Command

High voltage monitor value will be displayed from VMIN to VMAX.

Command: VM

Response: 1 VM = 90      ← High voltage = -90kV  
          2 VM = 20      ← High voltage = -20kV

## Nova 90kV, 80W Microfocus X-ray Source

### WM Command

Displays power from WMIN to WMAX.

Command: WM

Response: 1 WM = 80 ← Power = 80W  
2 WM = 10 ← Power = 10W

### GM Command

Displays G3 voltage from 200 - 5500.

Command: GM

Response: 1) GM = 5500 ← G3 voltage = 5500V  
2) GM = 200 ← G3 voltage = 200V

### STS Command

Power supply mode displayed in ASCII format.

Command: STS

Response: STS = ASCII (see below)

WARM UP	Warm-up mode
STANDBY	Stand-by mode
OUTPUT	X-ray output mode
FAULT	Fault mode



## Nova 90kV, 80W Microfocus X-ray Source

### FLT Command

Fault status is displayed in ASCII format.

Command: **FLT**

Response: **FLT = ASCII (see below)**

NONE	No fault
FIL.OC	Filament over current (Up to 1.2A)
FIL.SHUTDOWN	Filament over current (Up to 2A)
INTER LOCK	Interlock (Rear panel INT.Lock connector)
ANODE OC	Anode over current
ANODE OV	Anode over voltage
ANODE UC	Anode under current
ANODE UV	Anode under voltage
TUBE OT	Tube over temp (Rear panel INT.Lock connector)
HV OT	High voltage unit over temp (> E.P. 80°C)
HV PRESS DOWN	High voltage unit pressure down (< 45 psi)
PS PROBLEM	Power supply problem

### VER Command

ROM version is displayed.

Command: **VER**

Response: **1 VER = 2.0.0**



## Nova 90kV, 80W Microfocus X-ray Source

### LabVIEW Controller Software Instructions

- 1) Install software. Must have Windows operating system installed on the computer. Use the software CD and run setup.exe. Follow the installation instructions. A program group containing the LabVIEW executable program will be created.
- 2) Connect the RS232C cable between the COM1 serial port on the computer and the RS232C port on the back panel of the Nova controller.
- 3) Launch the controller program. The virtual instrument front panel in **Figure 1** will appear on the monitor. When the status reaches STAND-BY, the green START button may be pressed to start X-ray output. The virtual instrument front panel shown in **Figure 2** will pop-up on the monitor.
- 4) The High Voltage (kV) and Brightness (W) can each be adjusted in three independent ways:
  - a. Dragging the slider bar up or down,
  - b. Entering or scrolling a numeric value in the list box, or
  - c. Picking the arrows on the top and bottom of each slider bar.
- 5) Stop X-ray output by pushing the red OFF button. Close the virtual instrument by toggling the Stop Monitor button.



## Nova 90kV, 80W Microfocus X-ray Source

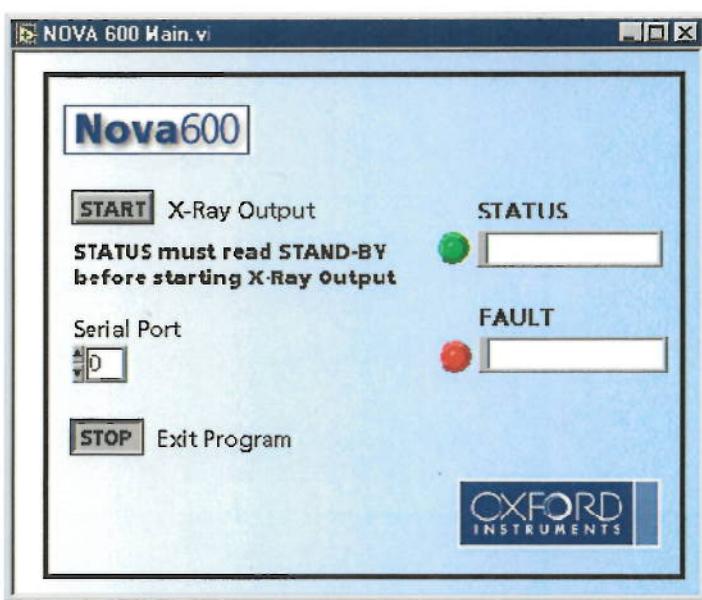


Figure 1

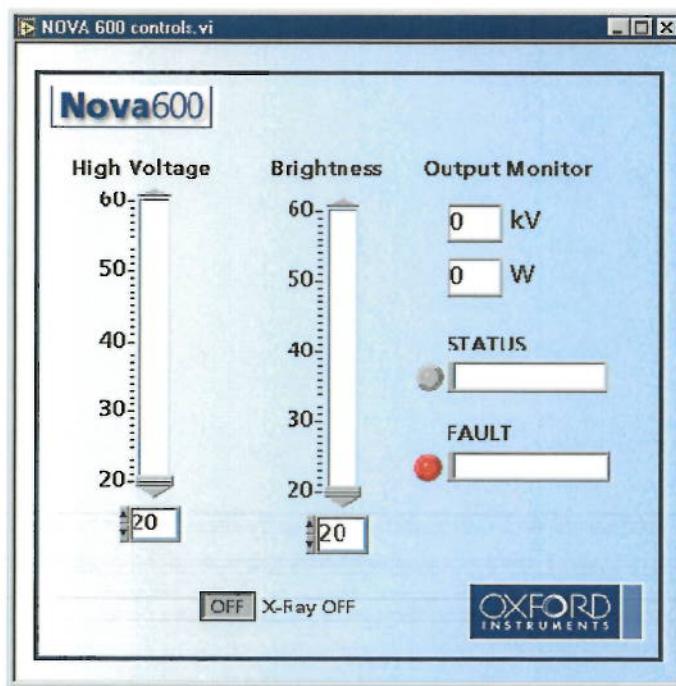
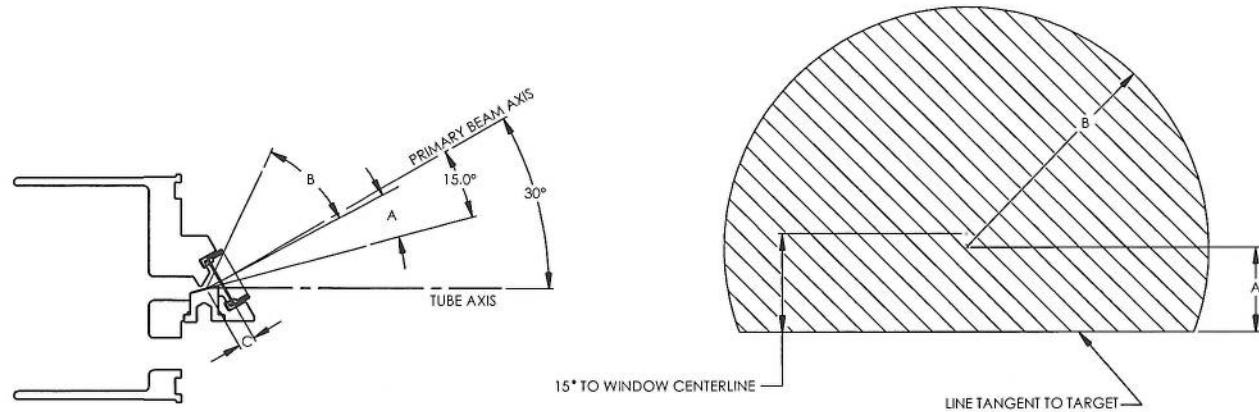
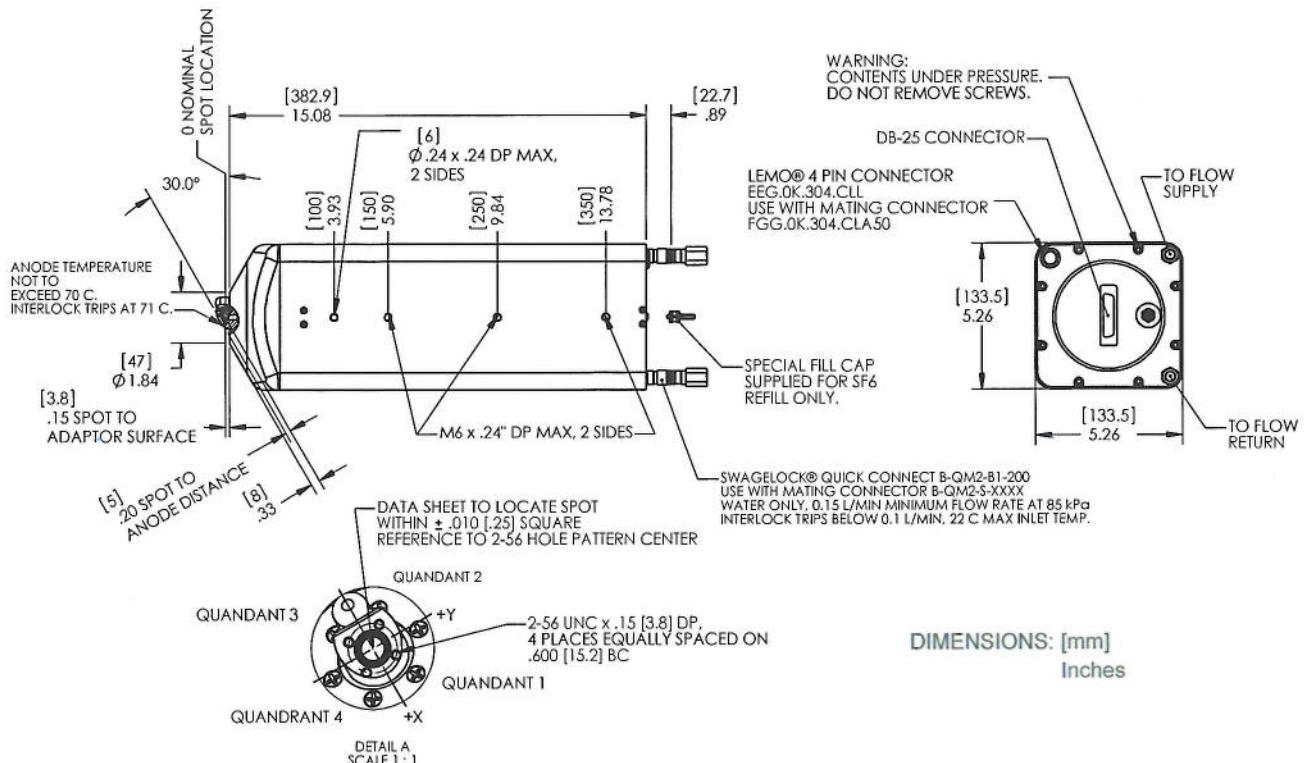


Figure 2

## Nova 90kV, 80W Microfocus X-ray Source

## Outline Drawing



RADIATION PATTERN AS SEEN NORMAL TO WINDOW

Dimension	Description	Units	Emitted Cone and Spot Position		
			Farthest	Nominal	Nearest
A	Location of radiation cone center	Degrees	10.6	12.9	16.4
B	Radius of cone	Degrees	32.2	36.8	42
C	Window to spot distance	mm	4.47	3.14	1.82

## Nova 90kV, 80W Microfocus X-ray Source



*The Business of Science®*

X-Ray Technology  
360 El Pueblo Road, Suite 104  
Scotts Valley, CA 95066, USA  
Phone: +1 (831) 439-9729  
Fax: +1 (831) 439-6050  
Email: [xray-sales@oxinst.com](mailto:xray-sales@oxinst.com)  
[www.oxford-instruments.com/xt](http://www.oxford-instruments.com/xt)