

X-RAY

Tubes

FTC-200

***X-ray Tube Controller
Users Manual***



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TUB-MAN-2101, Rev B

FTC-200 X-ray Tube Controller

Users Manual

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Introduction

The FTC-200 x-ray tube controller allows users to operate Moxtek high voltage power supplies attached to x-ray tubes. The controller supplies input power to the high voltage power supply and the analog control voltages that set the tube acceleration voltage and emission current. The set points and monitors for the high voltage and emission current control are shown on the LCD display. Set points can be adjusted using the rotary encoder or RS-232 interface.

The following are key features and functions for the controller:

- Programmable power supply for alternate high voltage power supply input requirements
- Front panel controls to adjust high voltage and emission current
- Set point and monitoring read out on the LCD display
- Programmable scaling factors
- Safety interlocks
- RS-232 interface for PC computer control

Manual Set

The manual set for this x-ray tube and power supply controller consists of a *Users Manual* and *Programmers manual* on an included CD ROM. The *Users Manual* contains information on specifications, operation of front panel and setup of the back panel. The *Programmers Manual* contains information on a DLL integration into Microsoft® Visual Studio® development



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platform's Visual Basic and C++. It also contains the RS232 protocol instruction set to operate the controller using a PC computer.

About this Manual

This is the *Users Manual* for the FTC-200 x-ray tube controller (hereafter referred to as the controller). This manual contains information for new users to setup and operate the controller attached to the following high voltage power supplies (Table 1), used to operate a combination of x-ray tubes.

Moxtek Part #	Description of Output Power
ELC00233	10 Watt (-50kV / 200 μ A)
ELC00215	4 Watt (-40kV / 100 μ A)

Table 1 High voltage power supply part numbers

X-Ray Safety Information

Although the controller does not generate x-rays, this controller is used to operate a high voltage power supply attached to an x-ray tube that can generate x-rays.

CAUTION: X-ray tubes produce x-ray radiation. Moxtek x-ray tubes are packaged in a brass housing. This housing provides radiation shielding. Operate x-ray tubes in properly shielded enclosures. It is the responsibility of the operator to ensure all applicable safety precautions are taken.

CAUTION: X-ray tubes operate at high voltage. Safety precautions are required to avoid serious injury or death. Make certain that the x-ray tube is securely grounded before operating.



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General Specifications

Analog Control

Tube voltage control	0-5V 10bit ADC/DAC
Tube current control	0-5V 10bit ADC/DAC

Input Power

External universal power supply brick	
Input voltage	100-240VAC 42W
See appendix A for the controller's input pin diagram detail	

High Voltage and Current Display

High voltage set point	0.1kV increments
Current monitor set point	0.1 μ A increments
High voltage monitor	0.1kV increments \pm 1% full scale
Current monitor	0.1 μ A increments \pm 1% full scale

Environment

Operate temperature range	0-50°C
---------------------------	--------

Display

Liquid Crystal Display, Graphic back LED illuminated

Mechanical

8.1" x 2.2" x 5.2"
See appendix B

Remote Interface

RS-232, 9 pin connector, 9600 baud (See *Programmers Manual* for more detail)

Memory

Space for up to 8 power supply scaling factor presets

Warranty

One Year



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Operation of Front Panel

The front panel allows the user to control all aspects of the high voltage power supply and tube. The user can adjust the tube operating conditions, voltage and current setting, as well as turning on and off the tubes's high voltage power supply. Figure 1 and table 2 describe the operation and function of the controller. The user can monitor the actual high voltage and emission current on the LCD display.



Figure 1 Front panel

Ref.	Feature	Description
A	Power Button	Used to turn on and off the tube controller, high voltage power supply and x-ray tube. Green LED illuminates above button (POWER) when the power is on.
B	X-ray Enable Button	In series with the safety interlock, this button turns on and off the power to the high voltage power supply, controlling the x-ray generation from the tube. Red LED illuminates above the button (X_RAYS) when high voltage power is on generating x-rays.
C	LCD Display	Top row is the set point for the high voltage and emission current. The bottom row is the monitor values returned from the high voltage power supply. If the controller is communicating with a PC computer, the MON and SET text are replaced with REMOTE.
D	Rotary Encoder / Push Button	Pressing the encoder button moves the cursor from one set point location (high voltage/emission current) to the next. Turning the encoder increases or decreases the voltage or current set point.

Table 2 Front panel descriptions



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LCD Display

The LCD has a cursor indicating what value will be changed when the encoder is turned. Turning the encoder clockwise will increase the value and counter-clockwise will decrease the value. Pressing the encoder button will advance the cursor (Figure 2) from kV to 0.1kV then to μ A to 0.1 μ A.



Figure 2 LCD cursor example

When the safety interlock on the back panel is disabled, the LCD display will flash “Check Interlock” as shown in figure 3. With the interlock disabled, no power is applied to the high voltage power supply and x-ray generation is off. Please refer to the “Setup of Back Panel” of this manual for interlock switch setup.



Figure 3 Check interlock example



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Setup of Back Panel

The process to connect a high voltage power supply and x-ray tube to the controller is list below. Refer to Appendix A for back panel connector pin outs and refer to figure 1 for connector locations. Example of the AC power adaptor is shown in figure 5.

1. Attach a 9 pin cable to the ^BTUBE DB-9 receptacle D connector
2. Connect an interlock switch to the ^CTUBE AUX terminal block connector
3. Attach RS232 cable to ^ARS232 connector for PC computer control (not required)
- 4. Make sure all x-ray safety protocols are met**
5. Connect the AC adaptor power supply to the 5 pin ^DPOWER connector
6. Press the POWER button on the front panel to turn on controller
7. Wait until splash screen has passed
8. Press X-RAY button to begin generating x-rays

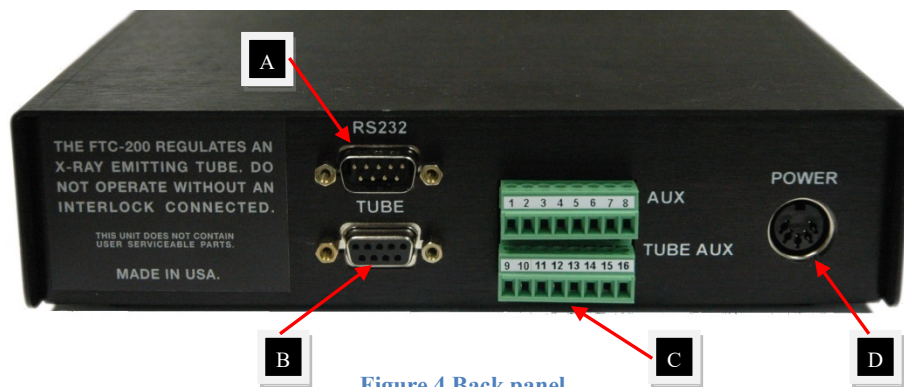


Figure 4 Back panel



Figure 5 AC Adapter



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40kV Cable Setup Example

The 40kV power supply has a DB 9 connector that can be connected directly to the TUBE connector on back panel (Figure 6). An extension cable (included) can be used to extend the distance from the high voltage power supply and controller. Note: RS232 cables are not normally sold with all 9 pins connected and should not be used for an extension cable. The cable should have all 9 pins connected straight through from a DB 9 receptacle to a DB 9 plug.



Figure 6 the 40kV tube setup example

50kV Cable Setup Example

The 50kV power supply is required to have an external power cable (Figure 7) from the high voltage power supply to the TUBE AUX port (pins 9 and 10) on the controller. This is the only difference in setup from a 40kV high voltage power supply.



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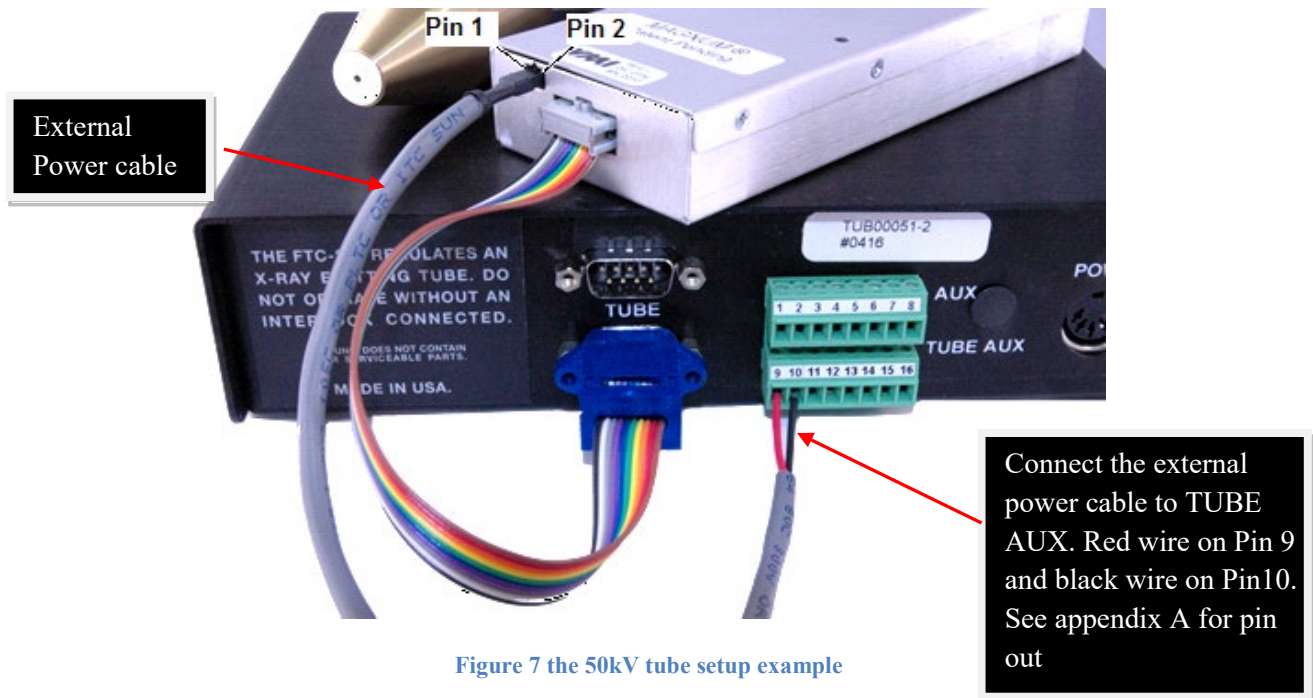


Figure 7 the 50kV tube setup example

Tube Anode Ground Connection

Moxtek x-ray tubes are designed with a grounded anode. It is important to maintain a proper ground to the anode. If the anode is not grounded, it can charge and become a high voltage safety issue. All x-ray tubes are supplied with an external anode ground wire shown in figure 8.

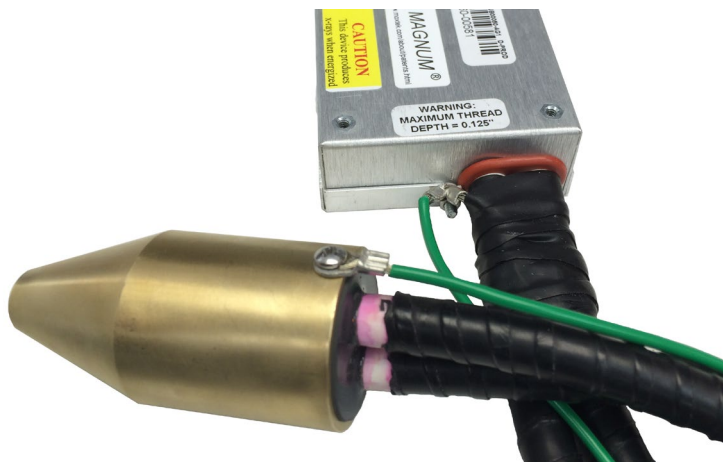


Figure 8 Anode ground connection



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Ordering Information

Please contact MOXTEK for price and delivery information (801) 225-0930.

Moxtek, Inc. Products Warranty

Moxtek, Inc. (“Moxtek”) extends the following limited warranty to each of its customers (each a “Buyer”) (i.e., the persons purchasing Product from Moxtek). For purposes of this limited warranty, the term “Product” shall mean Moxtek’s x-ray components (x-ray tubes, x-ray tube controllers, x-ray windows, x-ray detectors, JFETs, etc.).

MOXTEK warrants that the Product will conform to the Product specifications provided to Customer for a period of 12 months from the date of delivery of the Product (16 months for OEM customers), but only when used in the manner and for the purpose for which the Product is intended. The parties acknowledge and agree that no other affirmation of fact, promise, description, sample or model of or about the Product is a part of the basis of the bargain between them.

The Buyer’s remedy under this warranty and the contract for the sale of Product is expressly and exclusively limited to, per Moxtek’s sole discretion, repairing or replacing defective or nonconforming parts or components of the Product, and covers both parts and labor. Moxtek may, alternatively, in its sole discretion refund the price paid by Customer for the defective or non-conforming Product. Repair or replacement shall take place only at Moxtek’s principal place of business in Orem, Utah. If the Product (or any part or component thereof) has been disassembled, tampered with, or modified by non-Moxtek personnel in any way, or has been lost, damaged, destroyed, or subjected to any abuse or misuse (whether or not intentional) during or following delivery, no warranty coverage will apply. Moxtek assumes no responsibility for products, parts, components, or labor not provided by Moxtek, and has the right to make the final good faith determination concerning the existence and cause of any defect or nonconformity.

To obtain warranty service, Customer must first contact Moxtek to receive a return authorization number, and must then ship the Product pre-paid by Customer to Moxtek in Orem, Utah. Customer shall be solely responsible for risk of loss in connection with the return. A brief statement from the Customer must accompany the Product outlining the alleged nonconformity and stating the name and telephone number of an appropriate Customer representative. Moxtek will use commercially reasonable efforts to replace or repair and return the Product within a reasonable time period, and will keep the Customer representative informed regarding the progress of repair.



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This exclusion and limitation of damages applies regardless of the theory of liability (e.g., contract, warranty, tort, etc.). Customer acknowledges it bargained for this allocation of risk and recognizes that absent the foregoing, the price of the product would be substantially greater.

No claim with respect to the Product or any agreement to purchase or sell the Product may be made by Customer against Moxtek except under this Limited Warranty and as expressly stated herein. All claims for breach of warranty or the contract between the parties relating to the Product must be commenced within one year after the breach occurs



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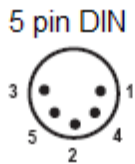
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Appendices

Appendix A: Back Panel Connector pin outs

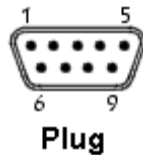
Input Power Connector 5 Pin DIN

Back Panel Power Connector



Pin 1	Common
Pin 2	Common Shell Ground
Pin 3	+ 5VDC / 6A
Pin 4	-15VDC / 3A
Pin 5	+15VDC / 0.8A

RS-232 PC computer interface pin out



Pin 2	Receive
Pin 3	Transmit
Pin 5	Ground
All other pin	Not used

A null modem cable is required to connect controller to PC RS232 port (not included).

Tube HV power supply control connector pin out



Pin 1	Tube Power Supply 9-15VDC	Output
Pin 2	Ground	
Pin 3	HV Set Voltage	Output
Pin 4	Tube enable	Output
Pin 5	Emission Current Monitor Voltage	Input
Pin 6	Signal Reference Ground	
Pin 7	Emission Current Set Voltage	Output
Pin 8	Filament Ready	Input
Pin 9	HV Monitor Voltage	Input



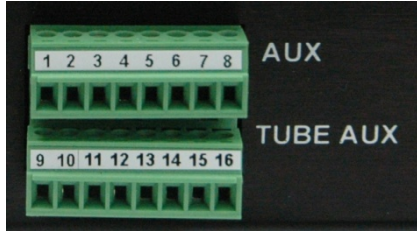
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Tube AUX port pinout



Pin 1	Ground	
Pin 2	NC	
Pin 3	+5VDC	Output
Pin 4	Ground	
Pin 5	-5VDC	Output
Pin 6	NC	
Pin 7	NC	
Pin 8	NC	
Pin 9	Power for high voltage power supply	Output
Pin 10	Ground	
Pin 11	Ground	
Pin 12	Ground	
Pin 13	X-Ray on lamp power	Output
Pin 14	Ground	
Pin 15	Interlock supply	Output
Pin 16	Interlock return	Input



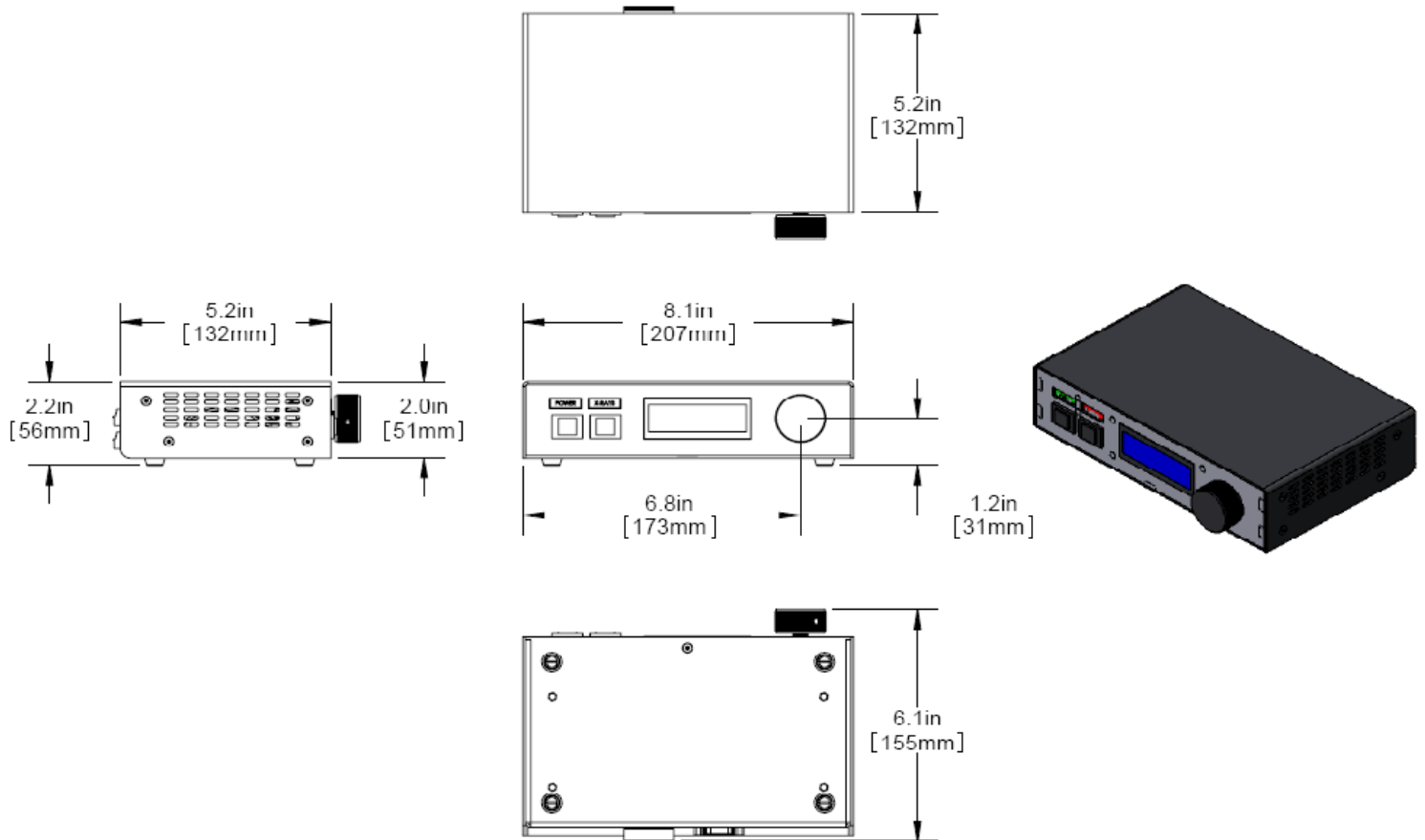
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Appendix B: Mechanical Drawing of Controller Box



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