

FLUKE®

Biomedical

Victoreen® 843-22

Beta Detector

Users Manual

**Fluke Biomedical
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Section 1

Introduction

1.1 General Description

Beta Scintillation Detector 843-22 consists of a beta sensitive plastic crystal optically coupled to a photomultiplier tube. This assembly is mounted inside a protective housing and coupled to a voltage divider network that establishes a range of dynode voltages.

1.2 Compatibility

In back of the crystal-photomultiplier tube assembly is a preamplifier integrated circuit that plugs into a socket mounted on a disk-shaped printed circuit board. This preamplifier conditions the output pulse from the photomultiplier tube to match the input requirements of Victoreen Ratemeters 842-11 and 842-21 or Ratemeter/ Spectrometers 842-31 and 842-41, as well as Victoreen Programmable Radiation Digital Processor (PRDP) 862. The detector can also be used with any other readout device that has equivalent power supply and input characteristics.

1.3 Specifications

Housing	Carbon steel
Dimensions	9.5 (L) x 2.5 in O.D. (241.3 x 63.5 mm)
Weight	3 lb (1.4 kg)
Operating Voltages	500 to 1400 V @ 0.14 mA
Pulse Polarity	Negative
Signal Connector	Circular P/N 31-62
Preamplifier Input Supply Voltage	16 ± 1.5 VDC
Preamplifier Input Supply Current	Less than 25 mA
Preamplifier Input Impedance	Greater than 100 kilohms
Preamplifier Input Pulse Polarity	Negative
Preamplifier Output Pulse Polarity	Negative
Preamplifier Output Pulse Width	Approximately 1.5 microseconds
Output Pulse Height (Maximum)	5.0 V p-p
Output Impedance	50 ohms
Pre amplifier Gain	1.0
Beta Crystal	NE 102
Operating Temperature Range	32° to 140°F (0° to 60°C)

NOTE

When the detector has been supplied as part of a system, it has been factory calibrated to be operated with a specific readout unit. Compare the serial numbers of the channel components with those listed on the calibration data sheets to be sure the components are properly matched. On no account should the high voltage listed for that channel ever be exceeded. The instructions located in Section 2 apply if the detector is ever replaced.

1.4 Procedures, Warnings, and Cautions

The equipment described in this manual is intended to be used for the detection and measurement of ionizing radiation. It should be used only by persons who have been trained in the proper interpretation of its readings and the appropriate safety procedures to be followed in the presence of radiation.

Although the equipment described in this manual is designed and manufactured in compliance with all applicable safety standards, certain hazards are inherent in the use of electronic and radiometric equipment.

WARNINGS and **CAUTIONS** are presented throughout this document to alert the user to potentially hazardous situations. A **WARNING** is a precautionary message preceding an operation that has the potential to cause personal injury or death. A **CAUTION** is a precautionary message preceding an operation that has the potential to cause permanent damage to the equipment and/or loss of data. Failure to comply with **WARNINGS** and **CAUTIONS** is at the user's own risk and is sufficient cause to terminate the warranty agreement between Fluke Biomedical and the customer.

Adequate warnings are included in this manual and on the product itself to cover hazards that may be encountered in normal use and servicing of this equipment. No other procedures are warranted by Fluke Biomedical. It shall be the owner's or user's responsibility to see to it that the procedures described here are meticulously followed, and especially that **WARNINGS** and **CAUTIONS** are heeded. Failure on the part of the owner or user in any way to follow the prescribed procedures shall absolve Fluke Biomedical and its agents from any resulting liability.

Indicated battery and other operational tests must be performed prior to each use to assure that the instrument is functioning properly. If applicable, failure to conduct periodic performance tests in accordance with ANSI N323-1978 (R1983) Radiation Protection Instrumentation Test and Calibration, paragraphs 4.6 and 5.4, and to keep records thereof in accordance with paragraph 4.5 of the same standard, could result in erroneous readings or potential danger. ANSI N323-1978 becomes, by this reference, a part of this operating procedure.

Section 2 Operation

2.1 Preparation for Use

Gently unpack the detector; the crystal end is fragile. Examine the detector for shipping damage. Take particular note of the plastic crystal and its covering to be sure it is intact.

CAUTION

Do not put voltage into the detector if the aluminized cover is not on the crystal, or if it has been damaged. Even slight pinpricks in the cover could admit enough light to seriously damage the detector. The only occasion when the detector might be used without the cover is when beta emissions of very low energy are being monitored, and the crystal cover cannot be used. In this case, it is the responsibility of the user to be sure the crystal end of the detector is in a light tight enclosure before applying high voltage. Failure to observe this precaution may destroy instrument calibration, or may even cause destruction of the instrument itself.

Install the detector in its receptacle with the crystal end as near the source of radiation as practical (1/8 to 1/4 inch preferred).

2.2 Operation

Before connecting the detector to its readout, be sure channel power is turned off, and the high voltage potentiometer is turned all the way to its lowest setting.

NOTE

On digital systems the power should have been turned off before the detector was removed to avoid a surge that might destroy some digital components. This is good practice with all systems, digital and analog.

Connect the detector; turn on the channel power, and slowly turn the high-voltage potentiometer up until the channel begins to count pulses.

CAUTION

Do not exceed 1400 V under any circumstances.

Set the high voltage to the value indicated on the Factory Calibration Sheet supplied by Fluke Biomedical.

The detector is now in normal operation.

2.3 Functional Description

2.3.1 Scintillator and Photomultiplier Tube

When beta particles enter the plastic crystal, pulses of light are emitted. The light pulses striking the photocathode of the photomultiplier tube excite the electrons in the cathode to a high-energy state causing them to escape from the surface of the cathode. The freed electrons are attracted by a voltage potential to the first dynode of the photomultiplier tube. This starts a cascading effect where a charge is passed from dynode to dynode, increasing in size at each stage until a shower of electrons is received at the anode to produce a small current pulse that is passed on to the preamplifier. This scintillator-photomultiplier tube assembly is shown in Figure 1-1.

2.3.2 Preamplifier

The signal pulses from the photomultiplier tube are capacitance coupled to the input of the preamplifier by capacitor C5 (See Figure 1-2).

The output of the preamplifier is essentially the same shape as the input. Impedance is adjusted to match the impedance of the anticipated readout devices. The output impedance of the preamplifier is 50 ohms.

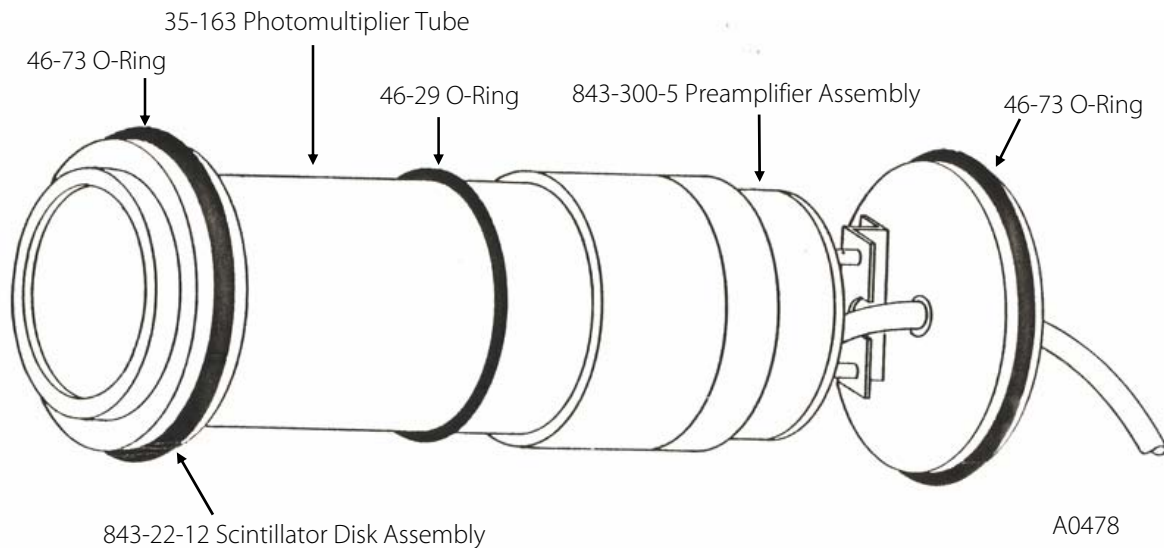


Figure 1-1 Crystal-PM Tube Assembly for Beta Detector 843-22

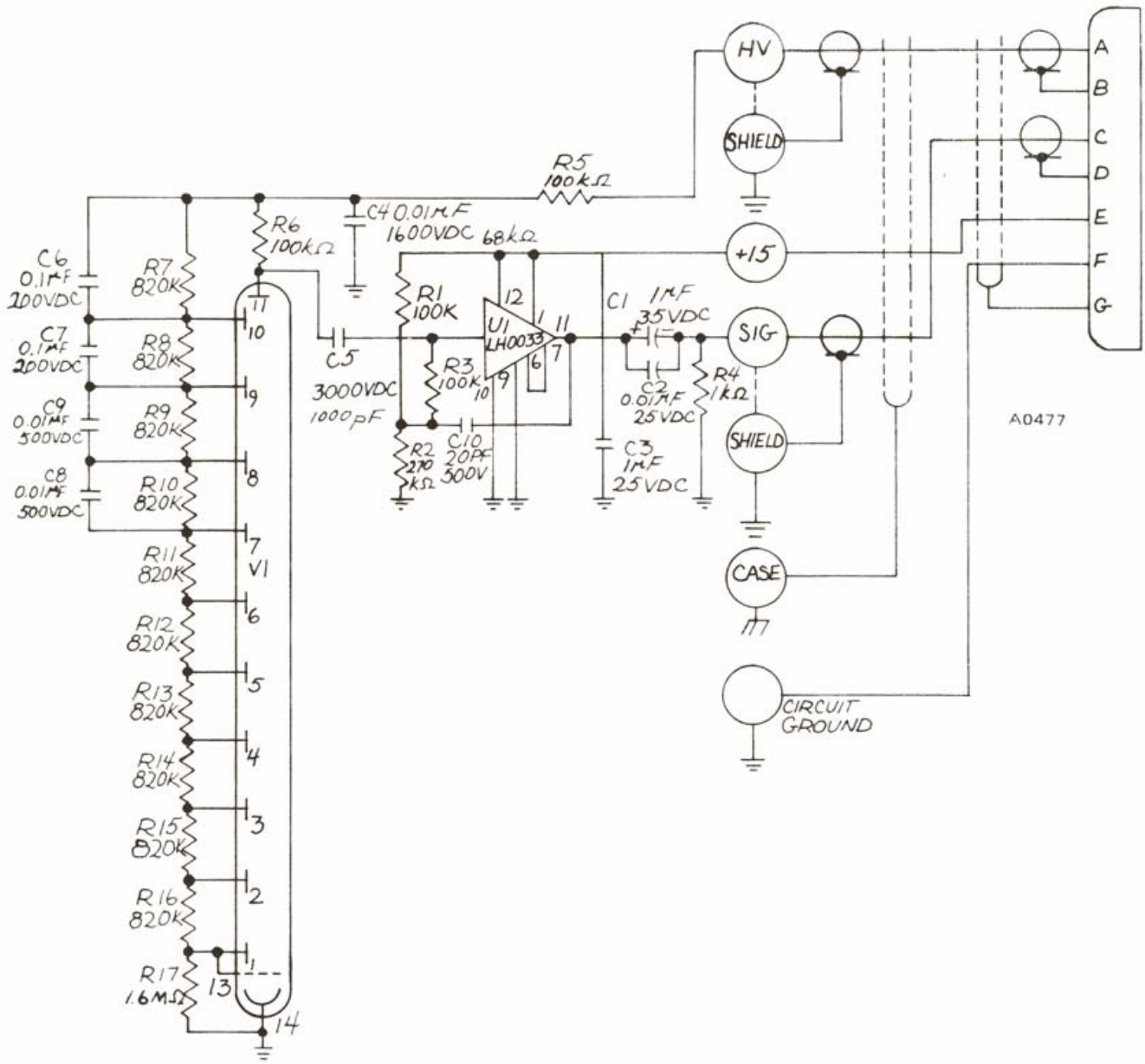


Figure 1-2 Schematic of Preamplifier and PMT for Scintillation Detector 843-22

2.4 Replacement Parts

<u>Part Number</u>	<u>Description</u>	<u>QTY</u>
31-62	Plug, Straight	1
843-300-5	Preamplifier Assembly; Preamplifier Photo multiplier Tube signal	1
MSM-1501	Dutch Leaf; Light Barrier	2
MSG-8398	Metallized Film; Light Barrier	1
35-163 (V1)	Tube; SRC #150B1 Photomultiplier Tube	1
38-25	Retaining Ring; Positions scintillator assembly	1
46-29	O- Ring; Centers Photomultiplier Tube in sleeve	1
46-73	O- Ring; Seals disc assembly and rear cover in detector sleeve	2
843-2-12	Scint. Disc Assembly; 843-20 Beta Particle Detector	1
843-2-12A	Scinto Disc Assembly; 843-20A Reduced sensitivity beta particle detector (10:1) optional	1
843-2-12B	Scinto Disc Assembly; 843-20B Reduced sensitivity beta particle detector (100:1) optional	1
843-21-11	Snap Ring; Retains disc assembly and detector sleeve	2
843-3-11	Clamp Assembly; Retains detector assembly in sampler	1

Appendix A

Applicable Drawings and Bill of Materials

A.1 Applicable Drawings

<u>Drawings</u>	<u>Description</u>
843-22-5	Main Assembly
843-300-5	Preamp Assembly

A.2 Applicable Bill of Materials

<u>Document Number</u>	<u>Description</u>
843-22-5	Main Assembly
843-300-5	Preamp Assembly

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