FLUKE®
Biomedical

MODEL 07-453

X-RAY PULSE COUNTER/EXPOSURE TIME METER

Instruction Manual

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Fluke Biomedical
Radiation Management Services

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Section 1

Description

1.1 Product Description

The Fluke Biomedical Model 07-453 X-ray Timer/Counter is used to measure the duration of radiation output produced by X-ray generators. The Model 07-453 is a solid-state, digital instrument designed specifically for service personnel in assessing the performance of radiation generator timing controls. The instrument is a noninvasive instrument, which samples the radiation beam of x-rays.

The Model 07-453 can be used as follows:

1) To count the number of x-ray pulses produced by half-wave and full-wave rectified machines. It will count the output pulses typically 60 pulses per second for half-wave rectified machines or 120 pulses per second for full-wave. Dental x-ray machines are usually half-wave rectified.

2) To measure the length of radiation output when the x-ray output is steady state such that "pulsing" does not exist. X-rays that generate steady outputs include 3-phase AC medical x-ray machines; capacitor discharge x-ray machines and DC operated x-rays.

3) To measure the "on time" or relay contact closure time by counting the number of pulses of AC line voltage (90 to 130 VAC) via the front panel input jacks and test leads.

The Model 07-453 replaces not only mechanical impulse counters, but also other electronic counters. The small hand held size conveniently fits in a small toolbox, jacket pocket or handbag.

There is no "Reset" button. The Model 07-453 automatically resets at the beginning of each exposure, holding the reading until the next exposure.

The most convenient way of using the 07-453 is to place it directly under the x-ray head. Step back, take the exposure and then read the exposure time in pulses or milliseconds. An optional remote sensor is also available to allow use of the 07-453 at distances of up to 10 feet away from the x-ray.

It is important that the user be thoroughly familiar with the contents of this manual before performing any tests on radiation generating equipment. It is also imperative that the user be thoroughly qualified, and familiar with safety precautions and other practices relating to radiation generators.

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Section 2

General Instructions

2.1 General Instructions

Switch Settings
The front panel selector toggle switch on the Model 07-453 has 3 positions, 'OFF', 'PULSES", and "MILLISECONDS'. The switch is OFF in the center position.

PULSES
When the switch is moved to the 'PULSES' position, the instrument will be used for measuring output pulses from half-wave or full-wave rectified machines as well as AC line voltage pulses. Normally, each full second of exposure will produce 60 pulses. An exposure of 2/10 second will read 12 for example. Refer to the chart on page 5 for further illustration.

MILLISECONDS
With the switch in the 'MILLISECONDS' position, the instrument will measure the length of time that a DC or 3-phase AC x-ray is on. The display reading will be in milliseconds i.e. an exposure of 1 second will read 1000, an exposure of 2/10 second will read 200.

OFF
All power to the instrument is disconnected in the 'OFF' position. Set the switch to 'OFF' when not in use to conserve battery life. The center position is OFF.

Connections
When reading directly from an x-ray head, no connections are made to the instrument. Point the x-ray head at the "target" area of the Model 07-453 (near the lower left side of the instrument). Take an exposure and read the time on the display in pulses or milliseconds.

Remote Sensor
To use the optional remote sensor, connect the plug at the end of the remote sensor cable in to the jack on left side of the 07-453 case. Point the x-ray head at the target on the Remote Sensor. Stretch the cable out and use as described above.

AC Input
Connect the two test leads to the two input jacks on the front of the instrument. Since the instrument counts AC pulses, the AC line must be switched by the relay that is in the timer under test. A typical wiring configuration is shown in schematic form in Figure 1. A typical wiring configuration for testing an Electronic Control Concepts Model 8200A Timer is shown in Figure 2.

The circuit for AC inputs is completely isolated from the rest of the instrument. No damage to the instrument will occur if the probes are reversed. However, to obtain the best accuracy, the '+' (Red) should be connected to the high side of the line, and the black or '-' probe should be connected to the low side of the line.

Oscilloscope Output

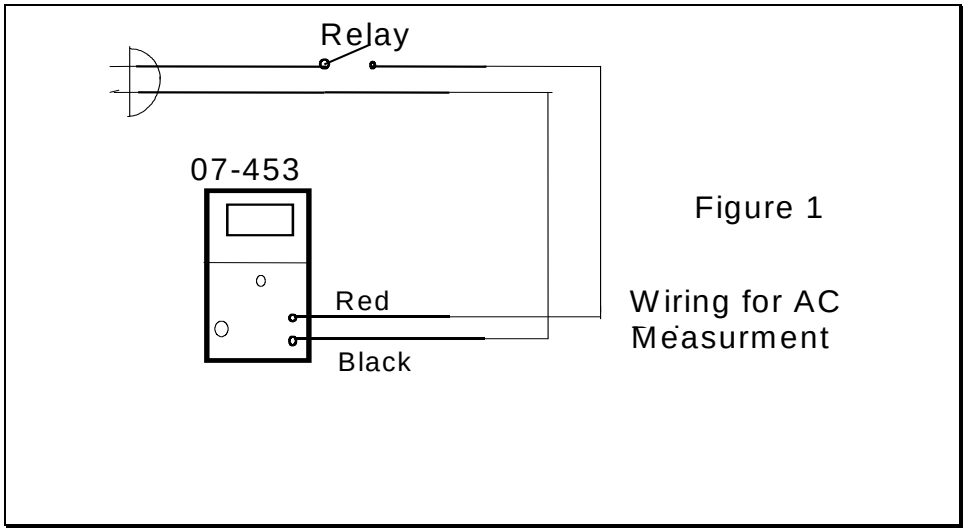
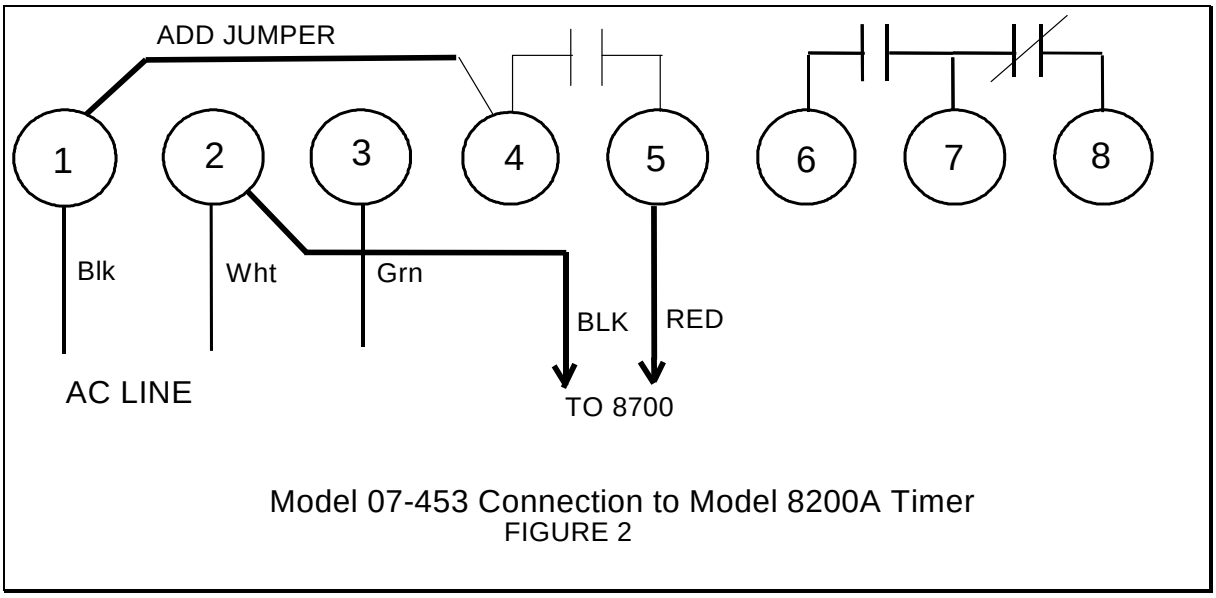


Figure 1

Wiring for AC Measurment

A jack is available at the left side of the instrument to observe x-ray waveforms. When looking at the Model 07-453 from the left, the connector labeled 'SCOPE' the Oscilloscope output. This connector takes a standard 2.5mm mono phone plug.



Model 07-453 Connection to Model 8200A Timer
FIGURE 2

Section 3

Battery Replacement Oscilloscope Output

BATTERY REPLACEMENT

The Model 07-453 is supplied with one 9 Volt Alkaline battery. Replace the battery when the "Lo Bat" indicator shows in the display. Any standard 9 Volt Alkaline battery can be used in the 07-453. To meet the battery life specification, please use a Duracell MN1604 Battery. This is the familiar “gold top” battery. To prolong battery life, turn the instrument off when not in use.

To replace the battery, slide the battery compartment open on the bottom of the case. Remove the old battery, and install the new battery.

OSCILLOSCOPE OUTPUT

The 07-453 can be and usually is used without an oscilloscope, but the scope output feature enables technical analysis of the x-ray output.

X-ray generators often have characteristics such as gradual rise times, variations in amplitude, noise, capacitive filtering, and extended decay times. Problems with x-rays can often be diagnosed by observing the output waveform of an x-ray with an oscilloscope. A jack is provided on the left side of the 07-453 case to enable a user to observe the x-ray wave form on an oscilloscope. Plug in a standard 2.5mm mono phone plug into the jack and attach the leads of the scope probe to the phone plug terminals. Set the vertical sensitivity of the scope to about 0.2 Volt per cm. The scope waveform will be an amplified version of the actual output of the x-ray detector.

A cable with a phone plug and a BNC connector for a scope is available from Fluke Biomedical. Order Fluke Biomedical Part Number 07-453SC. Alternatively, a 2.5mm mono phone plug is available from many vendors including Mouser Electronics, Part No. 177PP095. An oscilloscope probe can be clipped to this part.

The Remote Sensor available from Fluke Biomedical is particularly useful when observing the x-ray output using an oscilloscope. Order Fluke Biomedical Part Number 07-453RS.

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Section 4

Calibration and Exposure Time Conversion Chart

CALIBRATION

The circuitry in the Model 07-453 (above serial number 1001) is completely digital and microprocessor controlled and will not need periodic calibration. As a service Fluke Biomedical will continue to test, verify and issue a calibration certificate for all instruments upon customer request.

EXPOSURE TIME CONVERSION CHART

Impulses	Time in Seconds	Time in Seconds	Time in Seconds
1	0.02	0.02	0.01
2	0.03	0.04	0.02
3	0.05	0.06	0.03
4	0.07	0.08	0.03
5	0.08	0.1	0.04
6	0.1	0.12	0.05
7	0.12	0.14	0.06
8	0.13	0.16	0.07
9	0.15	0.18	0.08
10	0.17	0.2	0.08
15	0.25	0.3	0.13
20	0.33	0.4	0.17
25	0.42	0.5	0.21
30	0.5	0.6	0.25
35	0.58	0.7	0.29
40	0.67	0.8	0.33
45	0.75	0.9	0.38
50	0.83	1	0.42
60	1	1.2	0.5
70	1.17	1.4	0.58
80	1.33	1.6	0.67
90	1.5	1.8	0.75
100	1.67	2	0.83
120	2	2.4	1
150	2.5	3	1.25
180	3	3.6	1.5
200	3.33	4	1.67
240	4	4.8	2
	60 Hz Line	50 Hz Line	Full Wave

	USA, Canada	Europe	@ 60 Hz

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Section 5

Warranty and Service Information

WARRANTY

Fluke Biomedical warrants the Model 07-453 X-ray Timer/Counter from defects in materials and workmanship for a period of one year. There is no warranty on the battery. Fluke Biomedical will replace or repair any Model 07-453 during the first two years after shipment that does not show obvious signs of abuse. Contact the factory as described below.

SERVICE INFORMATION

If a unit should need calibration or service, please contact the factory by phone or fax to obtain a Service Return Authorization (SRA).

(800)850-4608 Phone Ext. 2564 globalcal@flukebiomedical.com
(440)542-3682 Fax

After obtaining an SRA number
ship the unit to:

Fluke Biomedical
6045 Cochran Road
Cleveland, OH 44139

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Section 6

Specifications

Model 07-453 SPECIFICATIONS

Accuracy
- AC Input / X-ray Pulse - +/- 1 Count
- DC Input - 2% +/- 1 Count
    - Measures at 70% of peak value

Sensitivity
- AC Input - 90 VAC minimum
- X-ray input - 50kVp, 5mA at 2.0 inches from top surface of case, pointed to target on case.

Range
- 9999 Pulses
- 9999 Milliseconds

Display
- 0.3" Liquid Crystal

Power
- 9 Volt Battery

Low Battery Indicator
- "Lo Batt" Appears in display when battery voltage reaches 5.3 Volts +/- 0.3 Volt.

Size
- 80 X 147 X 40 mm
- 3.15 X 5.8 X 1.6 inches

Battery Life
- 48 Hours minimum
    - With Duracell MN1604 Alkaline or equivalent

AC Input Jacks
- 130 Volts AC maximum
- 90 Volts AC minimum
- Input circuit not affected by reversed polarity

Optional Accessories
- Remote x-ray sensor
- Carrying case
- AC test leads with tip plugs

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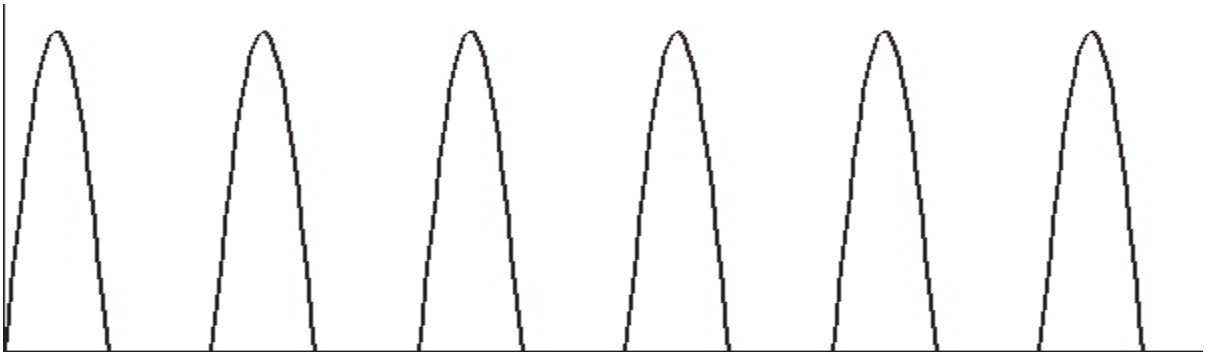
Section 7

APPENDIX

X-RAY WAVEFORMS

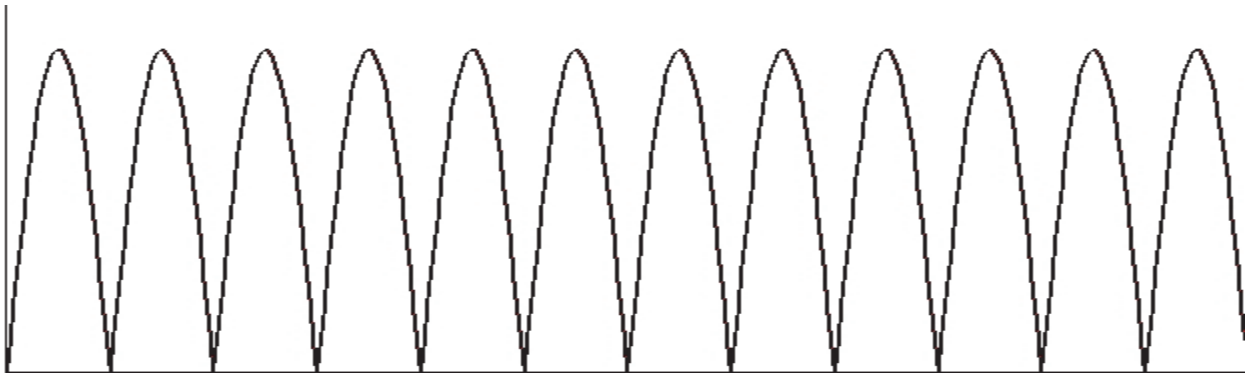
This section has been added to the manual to assist users of the Fluke Biomedical Model 07-453 Pulse Counter / Exposure Time Meter. Understanding the material in this section will enable the user to obtain the correct exposure time for any x-ray.

HALF-WAVE – This is typical of practically all dental x-rays and most podiatry x-rays.



Switch the Model 07-453 to PULSE. The instrument will count and display the number of pulses. To convert to time (in seconds), refer to the Exposure Time Conversion Chart or use the formula Time = pulses / 60 (in countries with 60 Hz power). As shown, the 07-453 would count 6 pulses, and the exposure time would be 6/60 = 0.1 second.

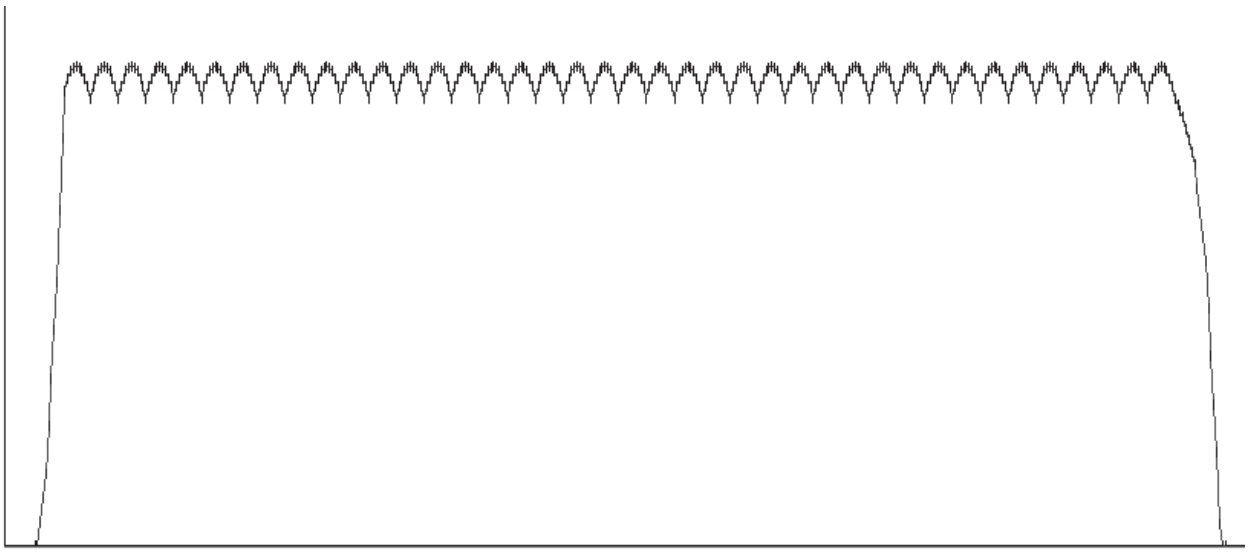
FULL-WAVE – This is typical of some older hospital x-rays.



Switch the Model 07-453 to PULSE. The instrument will count and display the number of pulses. To convert to time (in seconds), refer to the Exposure Time Conversion Chart or use the formula Time = pulses / 120 (in countries with 60 Hz power). As shown, the 07-453 would count 12 pulses, and the exposure time would be 12/120 = 0.1 second.

DC X-RAYS

This type of x-ray is typical of the larger x-rays and is multi-phase or 3 phase. A drawing of a typical waveform is shown below. A very similar waveform is also produced by capacitor discharge x-rays. These are portable, battery operated x-rays.



Switch the Model 07-453 to MILLISEC. Take the x-ray exposure. The instrument will count and display the exposure time in milliseconds. For example if the x-ray is set for 2/10 second, the actual exposure time should be around 200 milliseconds.

It is important to note that the 07-453 will end the count at the end of the x-ray when the intensity drops below about 70% of the peak value. This is done to ensure an accurate count when there is a ”tail” at the end of the x-ray i.e. the x-ray intensity drops slowly.

If the Model 07-453 is in PULSE mode, and a measurement of a DC or multiphase x-ray is taken the instrument will count and display 1. This is because the 07-453 detects what is basically one pulse. Switch the instrument to MILLISEC and take another exposure.


137
PULSE
MILLISEC
OFF
+
AC INPUT
X-RAY
DETECTOR
FLUKE
NUCLEAR ASSOCIATES


30
PULSE
MILLISEC
OFF
+
AC INPUT
−
X-RAY
DETECTOR
FLUKE
NUCLEAR ASSOCIATES
DIGITAL X-RAY PULSE
COUNTER/TIMER

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