

INSTRUCTION MANUAL

MODEL 168-20

AUTORANGING DMM/mA_s METER

SPECIFICATIONS

As a DMM: Identical to Model 168

As a mAs Meter:

Range: 0 to 1999 milliamp-seconds (other ranges selectable with external shunt resistor)

Accuracy: $\pm 1\%$ of reading ± 1 digit

Drift: 1 digit in ten seconds

Input Limit: mAs range not to exceed 1999 mAs

Maximum Current: (mAs range) 3000 ma not to exceed .66 seconds duration

Tracking Rate: Greater than 3000 ma per microsecond for rated accuracy

SECTION 1. GENERAL INFORMATION

The Model 168-20 mAs meter is a Model 168 modified by the addition of integrating capability on voltage and current ranges. The Model 168-20 is specifically designed to measure mAs on x-ray machines but has application wherever integrated current or voltage measurements are required.

SECTION 2. INITIAL PREPARATION

Same as 168, however check zero and adjust if necessary.

The 168-20 mAs meter should be used for making mAs measurements on x-ray machines only by people who are fully familiar with the machine involved and the hazards associated with mAs measurements. An error in measurement technique could result in lethal shock hazards.

SECTION 3. OPERATING INSTRUCTIONS

As a DMM: Place mAs-NORM switch to NORM position, then refer to Model 168 manual for DMM operation.

As a mAs Meter: Refer to Model 168 manual for power selection details. Place mAs-NORM switch to mAs. For the 0-1999 mAs range, depress (DC) and (A). Depress the erase button to reset the unit to 0 mAs and use the erase button whenever a reset is desired.

Connection to X-Ray Machines: The 168-20 mAs meter is specifically designed for use with x-ray machines in the 0-1999 mAs range. The mAs meter must be connected in series with the x-ray machine's high voltage secondary, between the secondary winding and ground, as shown in Figure 1. Most x-ray machines have labeled ma or mAs test points for this purpose.

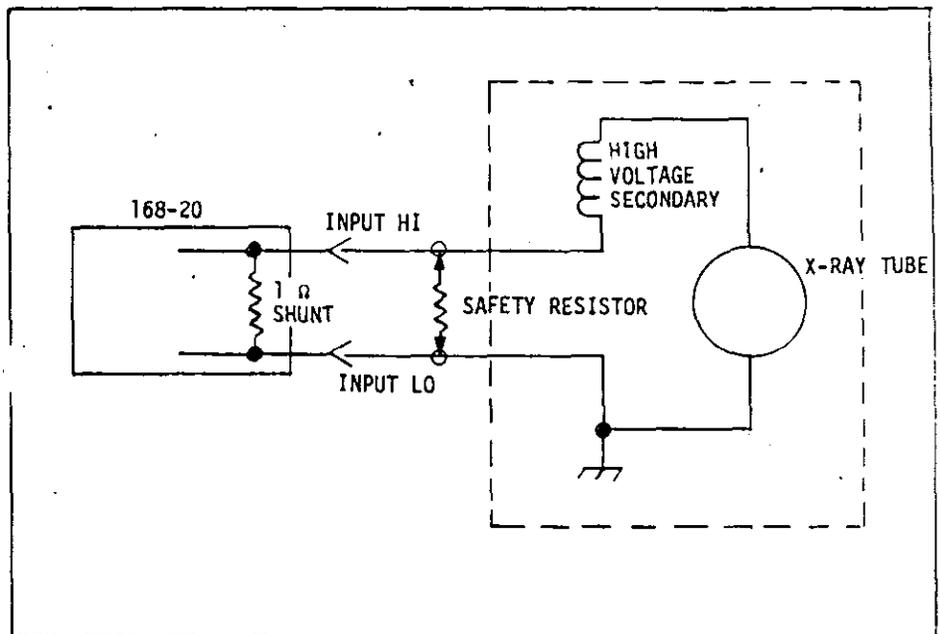


FIGURE 1. Connection to X-Ray High Voltage Secondary

WARNING

Consult x-ray machine service manual for proper hook up, since improper connections can result in lethal voltages present on the 168-20 and damage to the meter. NEVER connect 168-20 to "high" side of the secondary. This will result in destruction of the meter and a dangerous shock hazard. Never touch any part of the measurement circuit with the high voltage on.

An over voltage protection device should be securely fastened across the ma or mAs test points externally or internally to protect both machines and the operator in the event of an open circuit to the mAs meter (i.e., test lead falling off, blown fuse, etc.). Suitable protection devices include power resistors, spark gaps, etc. Specific information concerning protection devices should be obtained from the manufacturer of the x-ray machine in question.

Figure 2 shows an alternate measurement technique for measuring mAs. A shunt resistor is securely installed across the ma or mAs test points and the 168-20 is used in the integrating voltage mode. Integrating voltage mode is selected by placing the mAs-NORM switch in the mAs position and depressing (DC).

The shunt resistor should be wire wound, with a power rating adequate for the machine's maximum current.

<u>Range</u>	<u>Shunt Resistor</u>
0 + 199.9 mAs	10 Ω
0 + 1999 mAs	1 Ω
0 + 19990 mAs	.1 Ω

This technique provides greater safety, multiple ranges, and greater input overload protection on the 168-20.

Other Uses: The 168-20 has 3 usable integrating ranges, as follows:

Function	Setting (mAs/NORM in mAs)	Range
mAs	(DC) (A)	0 - 1999 mAs
mAs	(DC) (mA)	0 - 1.999 mAs
Vs	(DC)	0 - 1.999 Vs

NOTE

The low mAs range has 1000 ohm series resistance, and should not be used for x-ray mAs measurements. The volt-second range can be transformed into an mAs range by use of a shunt resistor.

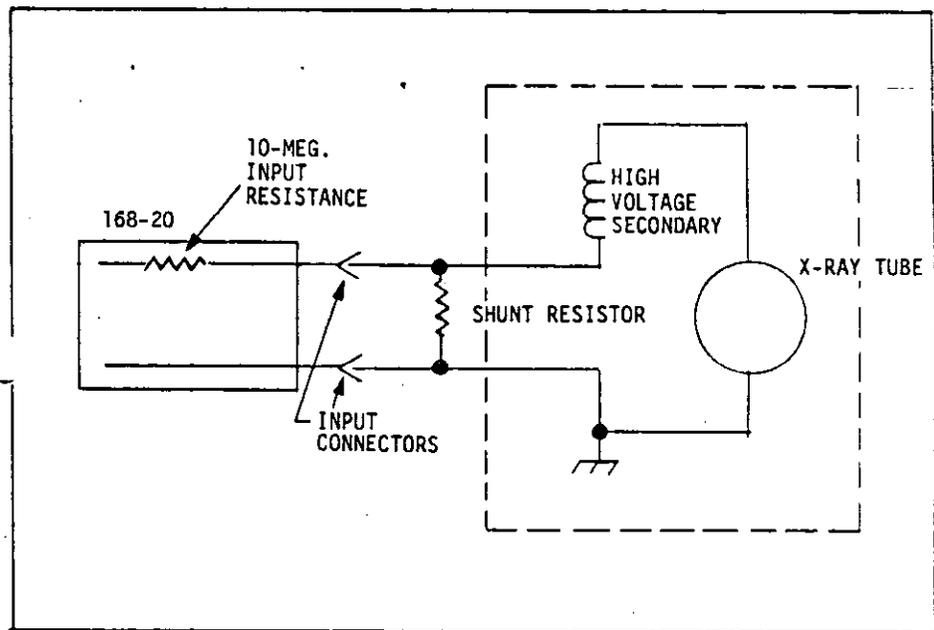


FIGURE 2. Integrating Voltage Mode

SECTION 4. MAINTENANCE

For All DMM Functions: Refer to Model 168 manual.

mAs Meter Leakage Test: Perform DC voltage zero check and zero adjustment if necessary as outlined in Model 168 manual. Place meter in mAs mode with input open, reset with erase button. Release button and time drift with a stop watch. Drift should be less than 1 digit per ten seconds. If drift is greater than this, repeat zero adjustment.

mAs Meter Accuracy Test: Connect mAs meter in mAs mode to a Keithley 227 or other current source adjusted for a 10.0 ma output. Reset the mAs meter and, with a stop watch, measure the time interval for the mAs reading to increase from 100 mAs to 1100 mAs. The elapsed time should be 100 sec. \pm 1 sec.

Calibration and Repair: Return instrument to factory as specified in 168 manual.