

RTI MAS-1

Invasive Tube Current Probe Adapter

User's Manual - English - Version 2019.12A



INDEPENDENT X-RAY
QUALITY ASSURANCE

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Intended Use of the RTI MAS-1

Together with instruments from RTI Group AB it is to be used for independent service and quality control, as well as measurements of kerma, kerma rate, kVp, tube current, exposure time, luminance, and illuminance within limitations stated below.

If installed according to accompanying documents, the product is intended to be used together with all diagnostic X-ray equipment except for:

- therapeutical X-ray sources.
- X-ray equipment with tube potential below 20 kV.
- X-ray equipment on which the instrument cannot be mounted properly, e.g. equipment where the beam field size is narrower than the active part of the detector.
- specific types of X-ray equipment listed in the instructions for use or in additional information from the manufacturer.

With the X-ray installation in stand-by conditions without patients present, the product is intended to be used:

- to provide the operator with information on radiation beam parameters that might influence further steps in an examination but not an ongoing exposure.
- for assessing the performance of the X-ray equipment.
- for evaluation of examination techniques and procedures.
- for service and maintenance measurements.
- for quality control measurements.
- for educational purposes, authority supervision etc.

The product is intended to be used by hospital physicists, X-ray engineers, manufacturer's service teams, and other professionals with similar tasks and competencies. The operator needs a short training to be able to use the product as intended. This training can be achieved either by careful study of the manual, studies of the built-in help function in measurement software or, on request, in a course provided by the manufacturer.

The product is intended to be used inside X-ray rooms ready for clinical use and can safely be left switched on and in any measuring mode in the vicinity of patients.

The product is NOT intended to be used:

- for direct control of diagnostic X-ray equipment performance during irradiation of a patient.
- so that patients or other unqualified persons can change settings of operating parameters during and immediately before and after measurements.

Table of Contents

1.....INTRODUCTION.....	4
1.1 A Presentation of the MAS-1	4
2.....FUNCTION AND CONNECTION.....	5
2.1 Connection of the RTI MAS-1	5
2.2 Battery and Charging	6
3.....MEASUREMENTS.....	7
3.1 Measurements of the mAs and mA Value	7
3.2 Hints and Trouble-shooting	7
4.....SAFETY PRECAUTIONS.....	9
4.1 General Rules	9
5.....SPECIFICATIONS.....	10
5.1 General Specifications for RTI MAS-1	10
.....Index	11

Note!

For a full description of the Piranha or Cobia, see the Piranha or Cobia Reference Manual.

That Manual can be found on the Product USB or be downloaded from RTI's website (www.rti.se).

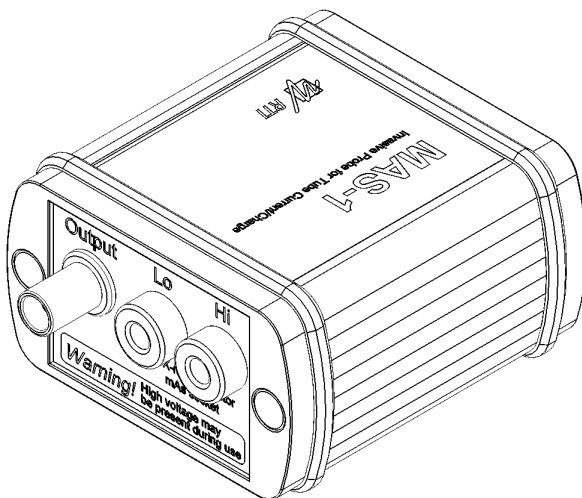
1 INTRODUCTION

1.1 A Presentation of the MAS-1

The RTI MAS-1 probe provides an invasive way to measure mA and mAs on X-ray equipment. The current probe should be connected to the X-ray mAs socket. It is connected in series with the tube current ground return line of the high voltage transformer.

The tube current feeds a 2.2 ohm resistor and the voltage drop is measured and converted to a signal suitable for the Piranha or Cobia. RTI MAS-1 should be used only on those generators providing open and short circuit protection of the measuring circuit and where the circuit operates not more than 90 V above or below ground potential.

The probe has a built in second order low pass filter with a bandwidth of 500 Hz. The probe accept floating current input of 90 V relative to the ground level which makes it accept most manufacturers' current signals.



The RTI MAS-1 can measure from 0,1 mA to 3000 mA, when used together with the Piranha or Cobia. By using Free-run or Timed update modes the RTI MAS-1 is able to measure even lower.

**CAUTION:**

Users of mAs meters must be aware of the potential damage to generators and electrical human hazards in the case of improper connection or failure of any part of the meter circuit. The MAS-1 is intended for use only by those

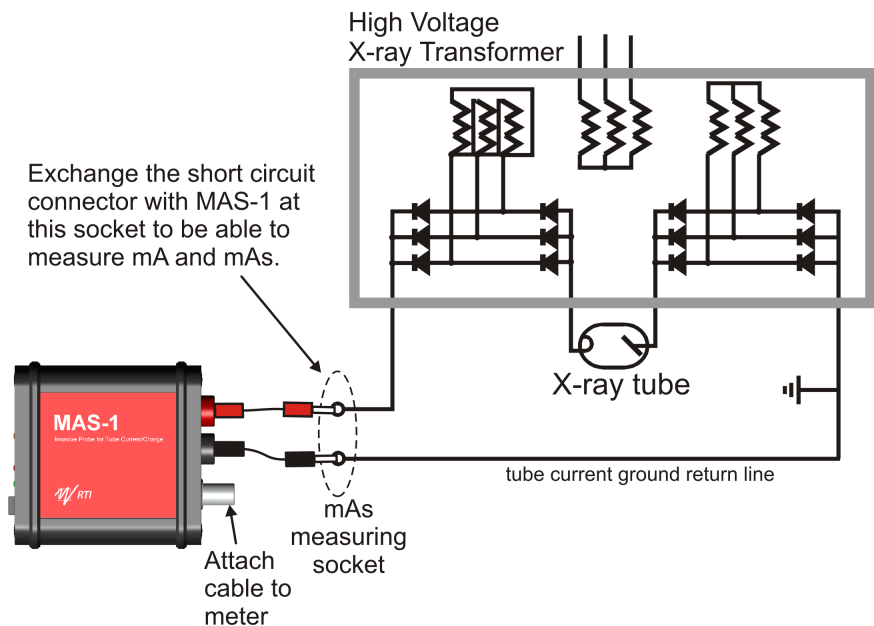
skilled in the calibration and repair of X-ray machines. Please read the section [SAFETY PRECAUTIONS](#)^[9] for more safety rules.

2 FUNCTION AND CONNECTION

2.1 Connection of the RTI MAS-1

Please be aware that high voltage may exist if the mA probe connection is not properly made. Read the [SAFETY PRECAUTIONS](#)^[9] chapter before you start measuring!

- Power down the X-ray unit and turn OFF the RTI MAS-1.
- Connect the RTI MAS-1 to the mAs measuring socket using the included safety cables. Please observe the polarity (see picture below).



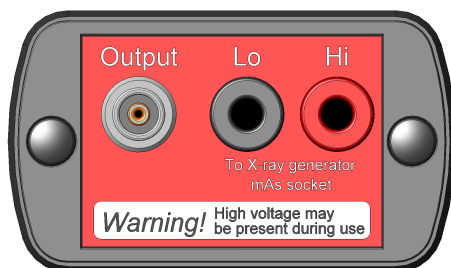
Caution!



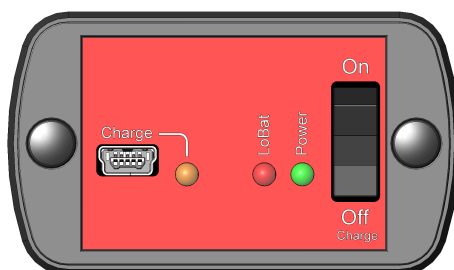
Users of mAs meters must be aware of the potential damage to generators and electrical human hazards in the case of improper connection or failure of any part of the meter circuit. The MAS-1 is intended for use only by those skilled in the calibration and repair of X-ray machines. Please read [SAFETY PRECAUTIONS](#)^[9] for more safety rules.

- Now connect the RTI MAS-1 to the detector input of the Piranha or Cobia using the included cable. Attach the round Lemo female connector to the connector that is

marked *Output* on the probe, and the other end to the electrometer input on your meter.



- Turn ON the RTI MAS-1 using the grey rocker switch on the back panel, by pushing the top part of the switch.



The green LED will now indicate that the RTI MAS-1 is powered ON. If the red “LoBat” LED lights up, it indicates that the battery voltage is low. Please recharge the RTI MAS-1 before measuring. See [Battery and charging](#) ⁶⁴.

2.2 Battery and Charging

The RTI MAS-1 uses a built in rechargeable battery which you charge using the standard mini-USB connector at the back of the probe. You can use either:

- a USB cable and charge it from your computer
- the charger that came with your Piranha
- or a standard USB charger with an output of +5 V.

Finally you need to flip the power switch to Off/Charge.

Note that you cannot use the RTI MAS-1 while it is charging. If the yellow LED at the back is lit it indicates that the battery is charging. When the yellow LED switches off the RTI MAS-1 battery is fully charged. Normally only a few minutes of charge is needed to be able to measure for an hour or two.

The battery cannot be over-charged, since the RTI MAS-1 contains a charging controller.

3 MEASUREMENTS

3.1 Measurements of the mAs and mA Value

Setup the RTI MAS-1 according to the section [Connection of the RTI MAS-1](#) ⁵. Power on the RTI MAS-1 and then the Piranha or Cobia.

Start the QABrowser, as described in the QABrowser manual. and then select the appropriate Real-time Meter display, e.g. tap **Measure, Radiography, Tube Current**, (for the Barracuda you must also choose the EMM module) to be able to read the current. It is typically shown in the unit "mA".

Tap **Reset**, then "0" should be displayed.

The offset adjustment procedure for Piranha or Cobia is finished and the RTI MAS-1 is ready for measurements.

Now just perform an exposure and the QABrowser will show you readings of tube current (mA) and tube charge (mAs). You may also study the tube current waveform by tapping the **Wave** button. The Piranha or Cobia starts to measure when the mA signal is greater than approximately 0.1 mA when using the RTI MAS-1. For long exposure times, you may want to switch to the Continuous update mode. The QABrowser will then update the display continuously during the exposure. (See Settings in the Piranha or Cobia manual).

Note!

Note that when using a PC connected to mains and and at the same time a cable to the Piranha or Cobia, ground loops may arise that generates ground currents that affects the measurements. It is recommended to either connect wirelessly between the PC and meter, or run a laptop PC on battery.

3.2 Hints and Trouble-shooting

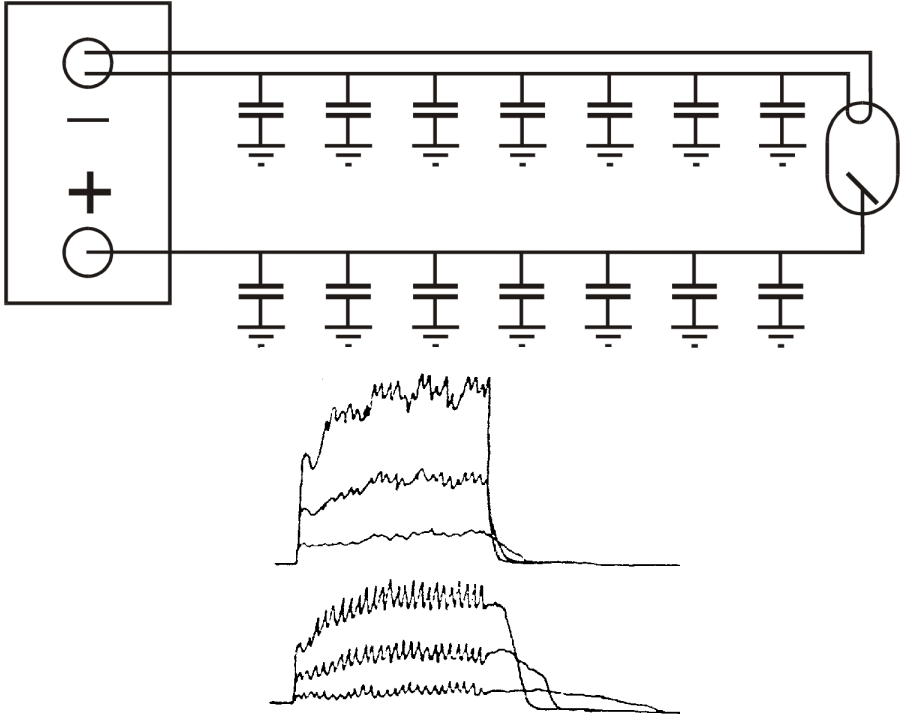
- If no current can be measured, please check the direction of current, Piranha or Cobia CANNOT measure negative current.
- The most common cause of failure to measure correctly is incorrect connection to the X-ray generator, usually to the tube filament circuit.
- Please use "All" and put the Piranha or Cobia in the X-ray field to "gate" the measurements if it is a problem to hold the mAs value when using the single tube current mode. This may happen because of current noise from the rotating anode engine.
- An 8 meter extension cable EXT-1 is available if needed, to further extend the cable.

- A good rule is that the mA waveform should be studied whenever checking the mA station.

Large inaccuracy can arise when small values are measured if the mA waveform information is not available.

If the value is lower than 10 mAs, special attention must be drawn to how the charge supplied to the capacitance in the high voltage cable will influence the measuring result. See picture below.

The easiest way to do this is to use the oRTigo/Ocean waveform analyser.



Selected values: 100 kV, 80 ms and 10, 25, and 50 mA. The upper part of the right picture shows the radiation intensity response from the detector. The lower part of the figure shows the tube current measured with MAS-1B. Note especially the last part of the exposure. Large mAs errors can be made if this part cannot be avoided. The left picture shows that the high voltage cables act as capacitors and can influence the mAs measuring result.

- Note that when using a PC connected to mains and at the same time a cable to the Piranha or Cobia, ground loops may arise that generates ground currents that affects the measurements. It is recommended to connect wirelessly between the PC and meter, or run a laptop PC on battery.

4 SAFETY PRECAUTIONS

4.1 General Rules

Only use the RTI MAS-1 if you are authorised to make invasive measurements using the X-ray generator mAs measuring socket.

- Please be aware that high voltage may exist on the RTI MAS-1 if the cable connection between RTI MAS-1 and the X-ray generator mAs socket is broken.
- Always switch off the X-ray generator and wait approximately one minute before you make any connection or disconnection of the cables between RTI MAS-1 and the mAs measuring socket.
- Always check that the short circuit path normally connected to the mAs measuring socket is connected after the use of the RTI MAS-1 and before the X-ray unit is switched on again.
- Do **NOT** connect the RTI MAS-1 to the filament current circuitry. The RTI MAS-1 is only intended to measure the tube mA and mAs.
- Do **NOT** use the RTI MAS-1 in contact with a patient.
- Do **NOT** use RTI MAS-1 on a circuit with voltage higher than 90 V DC.
- Do **NOT** expose the instrument to direct sunlight, extremes of temperature and humidity, or dew fall.
- Do **NOT** exceed maximum tube current input.
- Do **NOT** forget to turn the power switch off after use.
- Do **NOT** use the RTI MAS-1 on a circuit with a voltage of higher than 600 V AC.

**Note!**

The RTI MAS-1 is intended for service and quality control of diagnostic X-ray equipment. It is not intended for use during or together with diagnostic examinations of patients.

RTI Electronics AB takes no responsibility for misuse of the RTI MAS-1 or use together with products that the RTI MAS-1 is not intended for.

RTI Electronics AB assumes no responsibility for customers not following these safety precautions.

5 SPECIFICATIONS

5.1 General Specifications for RTI MAS-1

Specifications are valid after a warm-up time of one minute and presuming reference conditions.

Reference conditions

Temperature	20 °C
Relative humidity	50 %

Specifications

Current range	0.1 - 3000 mA
Charge range	0.001 - (at least) 9999 mAs
Inaccuracy	±1 % or ±0.01 mA
Frequency range, bandwidth	DC - 500 Hz (-3 dB)
Random error	1 %
Voltage over-protection limit	90 V nominal
Impedance / Load to generator socket	2.2 ohm
Scale/calibration factor	0.45 nA/mA (version 3)
Operating temperature and relative humidity:	15 - 30 °C at <80 % relative humidity
Storage temperature	-10 °C to +50 °C
Accepted maximum floating input range: (Max common mode voltage)	90 V relative to X-ray generator ground
Battery type	Li-Ion, 1100 mAh
Weight	125 g
Dimensions	60×35×72 mm
Battery life	Around 2 years of typical use or 100 hours

Index

Note!

Page references in this Index points to the first page of the section it is mentioned, not the exact page.

- A -

Accuracy 10

- B -

Bandwidth 10
Battery 6, 10
Battery life 10
Battery type 10

- C -

Calibration factor 10
Capacitance in the HV cable 7
Charging 6
Connection of the RTI MAS-1 5

- D -

Dimensions 10

- E -

Extension cable 7

- F -

Frequency range 10

- G -

General Rules 9
Green LED 5
Ground loops 7

- H -

Hints and Trouble-shooting 7
HV cable capacitance 7

- I -

Inaccuracy 10
Introduction 4

- M -

Measurements 7
Measuring Range 10

- N -

Negative current 7
Noise 7

- O -

Operating temperature 10
Output 5

- P -

Piranha power supply 6
Polarity 5
Power ON 5

- R -

Range 10
Rechargeable 6
Red LED 5

- S -

Safety 9
Specifications 10
Storage temperature 10

- T -

Trouble-shooting 7

- U -

USB charger 6

- W -

Weight 10
Work flow 7

- Y -

Yellow LED 5, 6

Notes
