

STARLOG

Net Radiometer

Model 7201A

This data sheet describes the operation of a Net Radiometer in a STARLOG Data Logging System.

The Net Radiometer (Model 7201A) measures net radiation (incoming total hemispherical radiation minus outgoing total hemispherical radiation) between 0.25 to 60 μ m wavelengths. It is used in evapotranspiration research and is designed and calibrated to minimize errors caused by windshield temperatures. This instrument generates a millivolt signal proportional to the net radiation level.

1. Choosing A Logger

The Model 7000 MACRO Data Logger is the best choice when using a Net Radiometer because the MACRO can readily measure:

- low voltages output by the Radiometer
- negative and positive voltages output by the Radiometer

The Model 6004 STARLOGGER or Model 6003 Portable Data Logger can be used with a Net Radiometer providing:

- a Model 6142A Universal Amplifier is installed on the Logger's Field Termination Strip,
- you calibrate the Amplifier, and
- you calculate and enter a formula for scaling using STARLOG Software.

The Amplifier boosts the Radiometer's output signal so that it can be measured by the STARLOGGER or PDL. When the Amplifier is calibrated properly, negative voltages from the Radiometer can be measured by the STARLOGGER or PDL (which normally only accept positive inputs). The scaling formula ensures that these amplified and offset signals are converted to negative and positive data for use in a Scheme.

2. Using a Model 7000 MACRO Data Logger

1. Install the instrument. (See section 2.1)
In higher ranges (above 395 W/m^2), you may require a voltage divider (see section 2.1.1).
2. Add a special formula to the PDLOUT.FOR file in STARLOG Software to scale the instrument's output. (See section 2.2).
3. If you are using Version 2 Software there is an additional step required: Configure the input channel. (See section 2.3.)
4. Create a Scheme. (See section 2.4.)

2.1. Installation

See the REBs manual included with the Radiometer for more details.

Connect the instrument to the Logger as shown below:

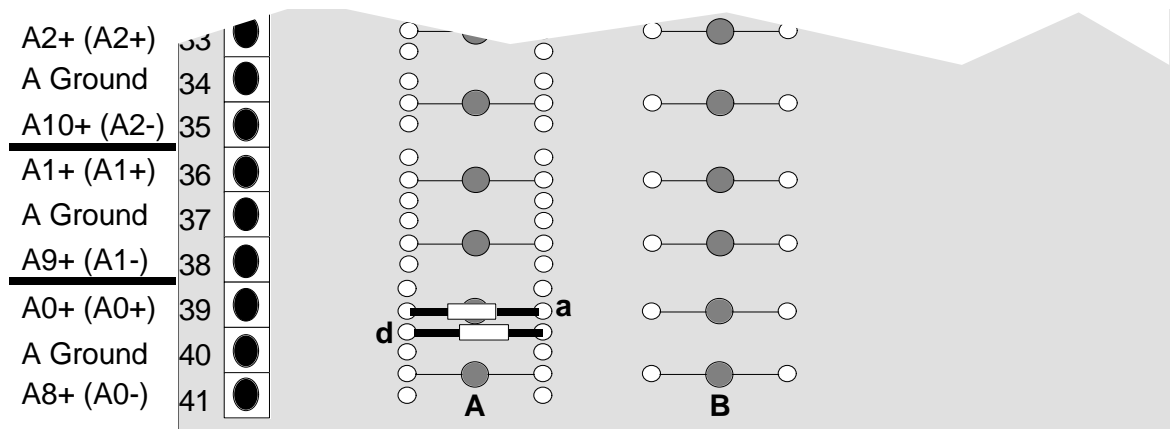
Net Radiometer		Macro Data Logger	
Colour	Function	Pin	Terminal
Red	A0 +ve	20	39
Black	Analog ground	1	40
Shield	Earth Ground	Connect to good earth ground.	

* When using a STARLOGGER or Portable Data Logger, you must use a Field Termination Strip.

2.1.1. Installing a Voltage Divider 2:1 on MACRO FTS

If you are using MACRO Data Logger and measuring net radiation in higher ranges (above 395 W/m^2) you must reduce the instrument input signal by installing a voltage divider (Model 6104A Voltage Divider 2:1) on the Macro Field Termination Strip for the Analog Channel used.

1. Install the voltage divider to the Analog Channel's **Link a** on the Macro Field Termination Strip.
2. Install the voltage divider to the Analog Channel's **Link d** on the Macro Field Termination Strip.



Installing Voltage Divider on MACRO Field Termination Strip

2.2. The NetRad Formula

When using a MACRO Data Logger, a new formula must be defined before generating a scheme. This is because the instrument has different scaling factors for positive and negative radiation. The following formula should be added to the PDLOUT.FOR file. (See the STARLOG Software Users Manual 6203 or, for Version 3, see 6245.)

```

:netrad
pushv
dup
7
bge
(11.9)          (Negative Calibration Factor)
mul
50
mul
4095
div
end
(9.6)          (Positive Calibration Factor)
mul
50
mul
4095
div
end

```

Replace these numbers with the factors for your instrument found on the front page of the REBS manual

The Calibration Factors (11.9 and 9.6) used in this formula are nominal values used here as defaults only. Ensure that your formula uses the factors written on the front page of the manual included with each instrument. Because these factors differ from instrument to instrument, you require a separate formula (with a different name) for each instrument.

2.3. MACRO Logger Configuration (for Version 2 Software)

MACRO Logger channels are usually set to the 0 to 5000 mV range. However, in this case, because the instrument is of the order of 50mV full scale, the –50 to 50 mV scale of the MACRO Logger must be used. To configure the MACRO to use this input channel range, create a MACRO Configuration by using the **Maintain Macro Loggers** menu. The channel being used must be configured as follows:

channel 0	-50 to 50	single ended	X	X	8	2.55
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This is equivalent to a range of approximately –595 to 395 W/m². If the range is greater than this, a voltage divider must be used to reduce the level of the instrument output. If the instrument output range is reduced, you must also change the calibration factors in the formula.

E.g. change 11.9 to 23.8
 change 9.6 to 19.2

Once the MACRO Configuration has been created, you can create a Scheme which uses this configuration. (Enter the name of the configuration in the **Hardware Details – Data logger** menu.)

2.4. Creating a Net Radiation Scheme for the MACRO Logger

This instrument may be added to the instrument list before creating your scheme by using the **Instrument Editor** (Version 3) or the **Maintain Instruments** menu (Version 2). Transducer details are defined as follows:

- » Note: In the following examples, the input signal should be connected to terminals 39 (+ve) and 40 (-ve) on the Model 7000B Macro Field Termination Strip.

Using Version 2 Software and a MACRO Data Logger

transducer description	net radiation	
input channel	h0	
input channel range mV	-50 to 50	
transducer range mV	-50 to 50	
transducer scaling/formula	netrad	
title for reports		netR
units of result	W/m2	
using string	###	

Using Version 3 Software and a Macro Data Logger

Transducer 1

Description: Net Radiometer - MACRO

Output: Analog Voltage (mV) Channel: A0

Min: -50

Max: 50

Scale: Formula

a: 1

b: 0

Formula: netrad

Title: netR

Units: W/m2

Using: ###

OK Cancel

*Using Version 3 to define the Net Radiometer for use with a
MACRO Data Logger*

3. Using A Model 6004 STARLOGGER or Model 6003 PDL

1. Install and calibrate a Model 6142A Universal Amplifier on the Field Termination Strip. (See section 3.1)
2. Install the instrument. (See section 3.1)
3. Create a Scheme.

Ensure that you calculate the correct scaling formula using information from the front of the REBs manual.

3.1. Installation

See the REBs manual included with the Radiometer for more details.

Connect the instrument to the Logger as shown below:

Net Radiometer		STARLOGGER & PDL FTS*
Colour	Function	Terminal
Red	A0 +ve	39
Black	Analog ground	41
Shield	Earth Ground	Connect to good earth ground.

* When using this instrument with a STARLOGGER or Portable Data Logger, you must use a Field Termination Strip.

The Amplifier's Offset Adjust Trimmer must be set to read zero volts for the most negative input signal to be used. To calibrate the Amplifier Module:

1. Select a Gain factor of 10 by setting Switch #3 ON. All other switches remain OFF. *
2. Apply the most -ve input signal and adjust the Offset Trimmer anti-clockwise until you have a reading on that channel (use Test Mode to view the reading.)
3. Carefully adjust (clockwise) until reading just changes to zero.
4. Lock trimmer into position.

* **Setting the Gain** – The Net Radiometer output is bipolar with a range of 200mV. From the table in the FTS manual, 6208, you can determine that the Gain should be set at 10.

See supplement 6208 for more details of how to calibrate the Model 6142A Universal Amplifier.

3.1.3. Creating a Net Radiation Scheme for the STARLOGGER

This instrument may be added to the instrument list before creating your scheme by using the **Instrument Editor** (Version 3) or the **Maintain Instruments** menu (Version 2). Transducer details are defined as follows:

- » Note: In the following examples, the input signal should be connected to terminals 39 and 41 on the PDL or STARLOGGER Field Termination Strip.

Using Version 2 Software and a STARLOGGER

transducer description	net radiation
input channel	h0
input channel range mV	0 to 2550
transducer range mV	0 to 2000
transducer scaling/formula	a to b (see section 3.2)
title for reports	netR
units of result	W/m2
using string	###

Using Version 3 Software and a STARLOGGER

```

[ ] Transducer 1
Description: Net Radiometer
Output: Analog Voltage (mV)
Min: 0
Max: 2000
Channel: A0 (a0 for PDL)
Scale: FullScale a to b
a:
b:
Formula: Use the instrument's
         calibration factor to
         determine scaling.
Title: netR
Units: W/m2
Using: #####
OK Cancel

```

Using Version 3 to define the Net Radiometer for use with a STARLOGGER or Portable Data Logger

3.2. Calculating the Scaling Formula: FullScale a to b

1. Locate the Positive Calibration Factor (found on the front page of the REBS manual supplied with the instrument). For example, let's assume the factor is 9.6.
2. Multiply the Positive Calibration Factor by the transducer's minimum output (-25) to get **a**.
Eg. $9.6 \times -25 = -230$ Therefore, **a** would be -230.
3. Multiply the Positive Calibration Factor by the transducer's maximum output (175) to get **b**.
Eg. $9.6 \times 175 = 1612$ Therefore, **b** would be 1612.
4. Enter these values into the transducer definition as shown above.