CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

RM Young Service
Model 05108HD

RMA: 29807-1 **Technician:** Brady Mikesell

Serial Number: 146182 **Checkout Date:** 03/21/19

Accessories Received: Cable ☒ Vane ☒ Propeller ☒ Propeller Nut ☒ Mount Clamp ☒

Condition as received:	Very good condition.

Repairs				Additional Repair Notes
Replaced Prop Bearings...	☐	Replaced Propeller Nut....	☐	
Replaced Vertical Bearings	☐	Replaced Prop Shaft w/Hub	☐	
Replaced Coil.....	☐	Replaced Nose Cone.....	☐	
Replaced Potentiometer...	☐	Replaced Lower Housing.	☐	
Aligned Potentiometer.....	☐	Replaced Circuit Board....	☐	
Replaced Vane.....	☐	Repaired Cable.....	☐	
Replaced Propeller.....	☐	Replaced Cable.....	☐	
No Repairs Needed.....	☒			

Wind Direction Linearity Test						Wind Speed Output Test	
***Reference Point**	**30**	**90**	**180**	**270**	**350**	**300** ☒ **1500** ☒ **1800** ☒	**Pass** ☒
Measured Before	30	90	180	269	350		
Measured After	30	90	180	269	350		

* Reference is not traceable to a standard. It is used for checkout purposes only.

*Wind Vane Torque Test		**Propeller Torque Test	
Vane Torque:	**Pass** ☒	**Propeller Torque:**	**Pass** ☒

*Measured with RM Young Torque Gauge and fixture in CW&CWW at four locations.

**Measured with RM Young Torque Disk.

CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

RM Young Service
Model 05103

RMA: 29807-1 **Technician:** Brady Mikesell

Serial Number: 105732 **Checkout Date:** 03/26/19

Accessories Received: Cable ☒ Vane ☒ Propeller ☒ Propeller Nut ☒ Mount Clamp ☒

Condition as received:	Very good condition.

Repairs				Additional Repair Notes
Replaced Prop Bearings...	☒	Replaced Propeller Nut....	☐	
Replaced Vertical Bearings	☒	Replaced Prop Shaft w/Hub	☐	
Replaced Coil.....	☐	Replaced Nose Cone.....	☐	
Replaced Potentiometer...	☐	Replaced Lower Housing.	☐	
Aligned Potentiometer.....	☒	Replaced Circuit Board....	☐	
Replaced Vane.....	☐	Repaired Cable.....	☐	
Replaced Propeller.....	☐	Replaced Cable.....	☐	
No Repairs Needed.....	☐			

Wind Direction Linearity Test						Wind Speed Output Test	
***Reference Point**	**30**	**90**	**180**	**270**	**350**	**300** ☒ **1500** ☒ **1800** ☒	**Pass** ☒
Measured Before	29	89	180	268	349		
Measured After	30	90	180	270	350		

* Reference is not traceable to a standard. It is used for checkout purposes only.

***Wind Vane Torque Test**		****Propeller Torque Test**	
Vane Torque:	**Pass** ☒	**Propeller Torque:**	**Pass** ☒

*Measured with RM Young Torque Gauge and fixture in CW&CWW at four locations.

**Measured with RM Young Torque Disk.

CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

RM Young Service
Model 05103

RMA: 29807-1 **Technician:** Brady Mikesell

Serial Number: 132719 **Checkout Date:** 03/26/19

Accessories Received: Cable ☒ Vane ☒ Propeller ☒ Propeller Nut ☒ Mount Clamp ☒

Condition as received:	Good condition.

Repairs				Additional Repair Notes
Replaced Prop Bearings...	☒	Replaced Propeller Nut....	☐	
Replaced Vertical Bearings	☒	Replaced Prop Shaft w/Hub	☐	
Replaced Coil.....	☐	Replaced Nose Cone.....	☐	
Replaced Potentiometer...	☐	Replaced Lower Housing.	☐	
Aligned Potentiometer.....	☒	Replaced Circuit Board....	☐	
Replaced Vane.....	☐	Repaired Cable.....	☐	
Replaced Propeller.....	☐	Replaced Cable.....	☐	
No Repairs Needed.....	☐			

Wind Direction Linearity Test						Wind Speed Output Test	
*Reference Point	30	90	180	270	350	300 ☒ 1500 ☒ 1800 ☒	Pass ☒
Measured Before	31	91	180	271	352		
Measured After	31	91	180	270	351		

* Reference is not traceable to a standard. It is used for checkout purposes only.

*Wind Vane Torque Test		**Propeller Torque Test	
Vane Torque:	Pass ☒	Propeller Torque:	Pass ☒

*Measured with RM Young Torque Gauge and fixture in CW&CWW at four locations.

**Measured with RM Young Torque Disk.

CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

RM Young Service
Model 05103

RMA: 29807-1 **Technician:** Brady Mikesell

Serial Number: 95225 **Checkout Date:** 03/26/19

Accessories Received: Cable ☒ Vane ☒ Propeller ☒ Propeller Nut ☒ Mount Clamp ☒

Condition as received:	Good condition.

Repairs				Additional Repair Notes
Replaced Prop Bearings...	☒	Replaced Propeller Nut....	☐	
Replaced Vertical Bearings	☒	Replaced Prop Shaft w/Hub	☐	
Replaced Coil.....	☐	Replaced Nose Cone.....	☐	
Replaced Potentiometer...	☐	Replaced Lower Housing.	☐	
Aligned Potentiometer.....	☒	Replaced Circuit Board....	☐	
Replaced Vane.....	☐	Repaired Cable.....	☐	
Replaced Propeller.....	☐	Replaced Cable.....	☐	
No Repairs Needed.....	☐			

Wind Direction Linearity Test						Wind Speed Output Test	
***Reference Point**	**30**	**90**	**180**	**270**	**350**	**300** ☒ **1500** ☒ **1800** ☒	**Pass** ☒
Measured Before	31	90	180	271	351		
Measured After	31	90	180	271	351		

* Reference is not traceable to a standard. It is used for checkout purposes only.

*Wind Vane Torque Test		**Propeller Torque Test	
Vane Torque:	**Pass** ☒	**Propeller Torque:**	**Pass** ☒

*Measured with RM Young Torque Gauge and fixture in CW&CWW at four locations.

**Measured with RM Young Torque Disk.

CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

RM Young Service
Model 05103

RMA: 29807 **Technician:** T. Worley

Serial Number: 105730 **Checkout Date:** 03/26/2019

Accessories Received: Cable ☒ Vane ☒ Propeller ☒ Propeller Nut ☒ Mount Clamp ☒

Condition as received:	Good condition.

Repairs				Additional Repair Notes
Replaced Prop Bearings...	☒	Replaced Propeller Nut....	☐	
Replaced Vertical Bearings	☒	Replaced Prop Shaft w/Hub	☐	
Replaced Coil.....	☐	Replaced Nose Cone.....	☐	
Replaced Potentiometer...	☐	Replaced Lower Housing.	☐	
Aligned Potentiometer.....	☐	Replaced Circuit Board....	☐	
Replaced Vane.....	☐	Repaired Cable.....	☐	
Replaced Propeller.....	☐	Replaced Cable.....	☐	
No Repairs Needed.....	☐			

Wind Direction Linearity Test						Wind Speed Output Test	
*Reference Point	30	90	180	270	350	300 ☒ 1500 ☒ 1800 ☒	Pass ☒
Measured	32	92	180	269	349		

* Reference is not traceable to a standard. It is used for checkout purposes only.

*Wind Vane Torque Test		**Propeller Torque Test	
Vane Torque:	Pass ☒	Propeller Torque:	Pass ☒

*Measured with RM Young Torque Gauge and fixture in CW&CWW at four locations.

**Measured with RM Young Torque Disk.

CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

RM Young Service
Model 05103

RMA: 29807 **Technician:** T. Worley

Serial Number: 58427 **Checkout Date:** 03/26/2019

Accessories Received: Cable ☒ Vane ☒ Propeller ☒ Propeller Nut ☒ Mount Clamp ☒

Condition as received:	Good condition.

Repairs				Additional Repair Notes
Replaced Prop Bearings...	☒	Replaced Propeller Nut....	☐	
Replaced Vertical Bearings	☒	Replaced Prop Shaft w/Hub	☐	
Replaced Coil.....	☐	Replaced Nose Cone.....	☐	
Replaced Potentiometer...	☐	Replaced Lower Housing.	☐	
Aligned Potentiometer.....	☐	Replaced Circuit Board....	☐	
Replaced Vane.....	☐	Repaired Cable.....	☐	
Replaced Propeller.....	☐	Replaced Cable.....	☐	
No Repairs Needed.....	☐			

Wind Direction Linearity Test						Wind Speed Output Test	
*Reference Point	30	90	180	270	350	300 ☒ 1500 ☒ 1800 ☒	Pass ☒
Measured	30	90	180	268	348		

* Reference is not traceable to a standard. It is used for checkout purposes only.

*Wind Vane Torque Test		**Propeller Torque Test	
Vane Torque:	Pass ☒	Propeller Torque:	Pass ☒

*Measured with RM Young Torque Gauge and fixture in CW&CWW at four locations.

**Measured with RM Young Torque Disk.

apogee INSTRUMENTS
721 West 1800 North
Logan, UT 84321

Certificate of Calibration
LI-COR Pyranometer
Model LI-200X

Customer Name	:	Kenneth Hall
Serial Number	:	PY43093
Calibration Date	:	29-Mar-2019
Previous Calibration Date	:	17-May-2017
Recommended Recalibration Date	:	28-Mar-2021
Calibration Factor	:	200.52 **W m^{-2} per mV**
Output	:	86.4 **µA per 1000 W m^{-2}**
Calibration Factor as Received	:	198.52 **W m^{-2} per mV**
Output as Received	:	87.3 **µA per 1000 W m^{-2}**
Resistance (Measured)	:	57.7 **Ω**
Change in Output	:	-1.0 **%**
Change in Output per Year	:	-0.5 **%**

Calibration Procedure

Calibration is based on a side-by-side comparison under high intensity discharge metal halide lamps using the mean of (4) LI-COR transfer standard pyranometers. LI-COR transfer standards are calibrated to the mean of at least (2) ISO-classified reference pyranometers under sunlight (clear sky conditions) in Logan, Utah. Each of the four ISO-classified reference pyranometers are recalibrated on an alternating year schedule (two instruments per year) at the National Renewable Energy Laboratory (NREL) in Golden, Colorado. NREL reference standards are calibrated to the World Radiometric Reference (WRR) in Davos, Switzerland.

Traceability

Reference Instrument	Serial Number	ISO 9060 Classification
EKO Instruments MS80*	S16088044	Spectrally Flat Class A
Kipp & Zonen CM11	060089	Spectrally Flat Class A
Kipp & Zonen CMP11	101625	Spectrally Flat Class A
Hukseflux SR20	2497	Spectrally Flat Class A
Li-Cor LI-200	PY68846	Fast Response Class C
Li-Cor LI-200	PY68847	Fast Response Class C
Li-Cor LI-200	PY68895	Fast Response Class C
Li-Cor LI-200	PY68896	Fast Response Class C

*MS80 purchased new in 2017. Initial calibration conducted by EKO Instruments with traceability to the World Radiometric Reference.

Technical Manager : Jacob Bingham

Date : 29-Mar-2019

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721 West 1800 North
Logan, UT 84321

Certificate of Calibration
LI-COR Pyranometer
Model LI-200X

Customer Name	:	Kenneth Hall
Serial Number	:	PY60145
Calibration Date	:	29-Mar-2019
Previous Calibration Date	:	28-May-2016
Recommended Recalibration Date	:	28-Mar-2021
Calibration Factor	:	195.02 **W m^{-2} per mV**
Output	:	99.2 **µA per 1000 W m^{-2}**
Calibration Factor as Received	:	199.41 **W m^{-2} per mV**
Output as Received	:	97.0 **µA per 1000 W m^{-2}**
Resistance (Measured)	:	51.7 **Ω**
Change in Output	:	2.2 **%**
Change in Output per Year	:	0.8 **%**

Calibration Procedure

Calibration is based on a side-by-side comparison under high intensity discharge metal halide lamps using the mean of (4) LI-COR transfer standard pyranometers. LI-COR transfer standards are calibrated to the mean of at least (2) ISO-classified reference pyranometers under sunlight (clear sky conditions) in Logan, Utah. Each of the four ISO-classified reference pyranometers are recalibrated on an alternating year schedule (two instruments per year) at the National Renewable Energy Laboratory (NREL) in Golden, Colorado. NREL reference standards are calibrated to the World Radiometric Reference (WRR) in Davos, Switzerland.

Traceability

Reference Instrument	Serial Number	ISO 9060 Classification
EKO Instruments MS80*	S16088044	Spectrally Flat Class A
Kipp & Zonen CM11	060089	Spectrally Flat Class A
Kipp & Zonen CMP11	101625	Spectrally Flat Class A
Hukseflux SR20	2497	Spectrally Flat Class A
Li-Cor LI-200	PY68846	Fast Response Class C
Li-Cor LI-200	PY68847	Fast Response Class C
Li-Cor LI-200	PY68895	Fast Response Class C
Li-Cor LI-200	PY68896	Fast Response Class C

*MS80 purchased new in 2017. Initial calibration conducted by EKO Instruments with traceability to the World Radiometric Reference.

Technical Manager : Jacob Bingham Date : 29-Mar-2019

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Logan, UT 84321

Certificate of Calibration
LI-COR Pyranometer
Model LI-200X

Customer Name	:	Kenneth Hall
Serial Number	:	PY60172
Calibration Date	:	29-Mar-2019
Previous Calibration Date	:	28-May-2016
Recommended Recalibration Date	:	28-Mar-2021
Calibration Factor	:	196.46 **W m^{-2} per mV**
Output	:	99.6 **µA per 1000 W m^{-2}**
Calibration Factor as Received	:	199.69 **W m^{-2} per mV**
Output as Received	:	98.0 **µA per 1000 W m^{-2}**
Resistance (Measured)	:	51.1 **Ω**
Change in Output	:	1.6 **%**
Change in Output per Year	:	0.6 **%**

Calibration Procedure

Calibration is based on a side-by-side comparison under high intensity discharge metal halide lamps using the mean of (4) LI-COR transfer standard pyranometers. LI-COR transfer standards are calibrated to the mean of at least (2) ISO-classified reference pyranometers under sunlight (clear sky conditions) in Logan, Utah. Each of the four ISO-classified reference pyranometers are recalibrated on an alternating year schedule (two instruments per year) at the National Renewable Energy Laboratory (NREL) in Golden, Colorado. NREL reference standards are calibrated to the World Radiometric Reference (WRR) in Davos, Switzerland.

Traceability

Reference Instrument	Serial Number	ISO 9060 Classification
EKO Instruments MS80*	S16088044	Spectrally Flat Class A
Kipp & Zonen CM11	060089	Spectrally Flat Class A
Kipp & Zonen CMP11	101625	Spectrally Flat Class A
Hukseflux SR20	2497	Spectrally Flat Class A
Li-Cor LI-200	PY68846	Fast Response Class C
Li-Cor LI-200	PY68847	Fast Response Class C
Li-Cor LI-200	PY68895	Fast Response Class C
Li-Cor LI-200	PY68896	Fast Response Class C

*MS80 purchased new in 2017. Initial calibration conducted by EKO Instruments with traceability to the World Radiometric Reference.

Technical Manager : Jacob Bingham

Date : 29-Mar-2019

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721 West 1800 North
Logan, UT 84321

Certificate of Calibration
LI-COR Pyranometer
Model LI-200X

Customer Name	:	Kenneth Hall
Serial Number	:	PY60144
Calibration Date	:	29-Mar-2019
Previous Calibration Date	:	28-Apr-2016
Recommended Recalibration Date	:	28-Mar-2021
Calibration Factor	:	194.97 **W m^{-2} per mV**
Output	:	91.9 **µA per 1000 W m^{-2}**
Calibration Factor as Received	:	198.46 **W m^{-2} per mV**
Output as Received	:	90.3 **µA per 1000 W m^{-2}**
Resistance (Measured)	:	55.8 **Ω**
Change in Output	:	1.8 **%**
Change in Output per Year	:	0.6 **%**

Calibration Procedure

Calibration is based on a side-by-side comparison under high intensity discharge metal halide lamps using the mean of (4) LI-COR transfer standard pyranometers. LI-COR transfer standards are calibrated to the mean of at least (2) ISO-classified reference pyranometers under sunlight (clear sky conditions) in Logan, Utah. Each of the four ISO-classified reference pyranometers are recalibrated on an alternating year schedule (two instruments per year) at the National Renewable Energy Laboratory (NREL) in Golden, Colorado. NREL reference standards are calibrated to the World Radiometric Reference (WRR) in Davos, Switzerland.

Traceability

Reference Instrument	Serial Number	ISO 9060 Classification
EKO Instruments MS80*	S16088044	Spectrally Flat Class A
Kipp & Zonen CM11	060089	Spectrally Flat Class A
Kipp & Zonen CMP11	101625	Spectrally Flat Class A
Hukseflux SR20	2497	Spectrally Flat Class A
Li-Cor LI-200	PY68846	Fast Response Class C
Li-Cor LI-200	PY68847	Fast Response Class C
Li-Cor LI-200	PY68895	Fast Response Class C
Li-Cor LI-200	PY68896	Fast Response Class C

*MS80 purchased new in 2017. Initial calibration conducted by EKO Instruments with traceability to the World Radiometric Reference.

Technical Manager : Jacob Bingham

Date : 29-Mar-2019

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721 West 1800 North
Logan, UT 84321

Certificate of Calibration
LI-COR Pyranometer
Model LI-200X

Customer Name	:	Kenneth Hall
Serial Number	:	PY90552
Calibration Date	:	29-Mar-2019
Previous Calibration Date	:	14-Sep-2015
Recommended Recalibration Date	:	28-Mar-2021
Calibration Factor	:	192.41 **W m^{-2} per mV**
Output	:	90.7 **µA per 1000 W m^{-2}**
Calibration Factor as Received	:	198.70 **W m^{-2} per mV**
Output as Received	:	87.8 **µA per 1000 W m^{-2}**
Resistance (Measured)	:	57.3 **Ω**
Change in Output	:	3.3 **%**
Change in Output per Year	:	0.9 **%**

Calibration Procedure
Calibration is based on a side-by-side comparison under high intensity discharge metal halide lamps using the mean of (4) LI-COR transfer standard pyranometers. LI-COR transfer standards are calibrated to the mean of at least (2) ISO-classified reference pyranometers under sunlight (clear sky conditions) in Logan, Utah. Each of the four ISO-classified reference pyranometers are recalibrated on an alternating year schedule (two instruments per year) at the National Renewable Energy Laboratory (NREL) in Golden, Colorado. NREL reference standards are calibrated to the World Radiometric Reference (WRR) in Davos, Switzerland.

Traceability

Reference Instrument	Serial Number	ISO 9060 Classification
EKO Instruments MS80*	S16088044	Spectrally Flat Class A
Kipp & Zonen CM11	060089	Spectrally Flat Class A
Kipp & Zonen CMP11	101625	Spectrally Flat Class A
Hukseflux SR20	2497	Spectrally Flat Class A
Li-Cor LI-200	PY68846	Fast Response Class C
Li-Cor LI-200	PY68847	Fast Response Class C
Li-Cor LI-200	PY68895	Fast Response Class C
Li-Cor LI-200	PY68896	Fast Response Class C

*MS80 purchased new in 2017. Initial calibration conducted by EKO Instruments with traceability to the World Radiometric Reference.

Technical Manager : Jacob Bingham

Date : 29-Mar-2019

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Certificate of Calibration
LI-COR Pyranometer
Model LI-200X

Customer Name	:	Kenneth Hall
Serial Number	:	PY52878
Calibration Date	:	29-Mar-2019
Previous Calibration Date	:	28-May-2016
Recommended Recalibration Date	:	28-Mar-2021
Calibration Factor	:	195.79 **W m^{-2} per mV**
Output	:	95.3 **µA per 1000 W m^{-2}**
Calibration Factor as Received	:	199.96 **W m^{-2} per mV**
Output as Received	:	93.3 **µA per 1000 W m^{-2}**
Resistance (Measured)	:	53.6 **Ω**
Change in Output	:	2.1 **%**
Change in Output per Year	:	0.8 **%**

Calibration Procedure

Calibration is based on a side-by-side comparison under high intensity discharge metal halide lamps using the mean of (4) LI-COR transfer standard pyranometers. LI-COR transfer standards are calibrated to the mean of at least (2) ISO-classified reference pyranometers under sunlight (clear sky conditions) in Logan, Utah. Each of the four ISO-classified reference pyranometers are recalibrated on an alternating year schedule (two instruments per year) at the National Renewable Energy Laboratory (NREL) in Golden, Colorado. NREL reference standards are calibrated to the World Radiometric Reference (WRR) in Davos, Switzerland.

Traceability

Reference Instrument	Serial Number	ISO 9060 Classification
EKO Instruments MS80*	S16088044	Spectrally Flat Class A
Kipp & Zonen CM11	060089	Spectrally Flat Class A
Kipp & Zonen CMP11	101625	Spectrally Flat Class A
Hukseflux SR20	2497	Spectrally Flat Class A
Li-Cor LI-200	PY68846	Fast Response Class C
Li-Cor LI-200	PY68847	Fast Response Class C
Li-Cor LI-200	PY68895	Fast Response Class C
Li-Cor LI-200	PY68896	Fast Response Class C

*MS80 purchased new in 2017. Initial calibration conducted by EKO Instruments with traceability to the World Radiometric Reference.

Technical Manager : Jacob Bingham

Date : 29-Mar-2019

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Logan, UT 84321

Certificate of Calibration
LI-COR Pyranometer
Model LI-200X

Customer Name	:	Kenneth Hall
Serial Number	:	PY63699
Calibration Date	:	29-Mar-2019
Previous Calibration Date	:	28-May-2016
Recommended Recalibration Date	:	28-Mar-2021
Calibration Factor	:	196.24 **W m^{-2} per mV**
Output	:	89.6 **µA per 1000 W m^{-2}**
Calibration Factor as Received	:	199.49 **W m^{-2} per mV**
Output as Received	:	88.1 **µA per 1000 W m^{-2}**
Resistance (Measured)	:	56.9 **Ω**
Change in Output	:	1.7 **%**
Change in Output per Year	:	0.6 **%**

Calibration Procedure

Calibration is based on a side-by-side comparison under high intensity discharge metal halide lamps using the mean of (4) LI-COR transfer standard pyranometers. LI-COR transfer standards are calibrated to the mean of at least (2) ISO-classified reference pyranometers under sunlight (clear sky conditions) in Logan, Utah. Each of the four ISO-classified reference pyranometers are recalibrated on an alternating year schedule (two instruments per year) at the National Renewable Energy Laboratory (NREL) in Golden, Colorado. NREL reference standards are calibrated to the World Radiometric Reference (WRR) in Davos, Switzerland.

Traceability

Reference Instrument	Serial Number	ISO 9060 Classification
EKO Instruments MS80*	S16088044	Spectrally Flat Class A
Kipp & Zonen CM11	060089	Spectrally Flat Class A
Kipp & Zonen CMP11	101625	Spectrally Flat Class A
Hukseflux SR20	2497	Spectrally Flat Class A
Li-Cor LI-200	PY68846	Fast Response Class C
Li-Cor LI-200	PY68847	Fast Response Class C
Li-Cor LI-200	PY68895	Fast Response Class C
Li-Cor LI-200	PY68896	Fast Response Class C

*MS80 purchased new in 2017. Initial calibration conducted by EKO Instruments with traceability to the World Radiometric Reference.

Technical Manager : Jacob Bingham

Date : 29-Mar-2019

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721 West 1800 North
Logan, UT 84321

Certificate of Calibration
LI-COR Pyranometer
Model LI-200X

Customer Name	:	Kenneth Hall
Serial Number	:	PY60189
Calibration Date	:	29-Mar-2019
Previous Calibration Date	:	28-May-2016
Recommended Recalibration Date	:	28-Mar-2021
Calibration Factor	:	198.50 **W m^{-2} per mV**
Output	:	93.5 **µA per 1000 W m^{-2}**
Calibration Factor as Received	:	199.92 **W m^{-2} per mV**
Output as Received	:	92.8 **µA per 1000 W m^{-2}**
Resistance (Measured)	:	53.9 **Ω**
Change in Output	:	0.7 **%**
Change in Output per Year	:	0.3 **%**

Calibration Procedure
Calibration is based on a side-by-side comparison under high intensity discharge metal halide lamps using the mean of (4) LI-COR transfer standard pyranometers. LI-COR transfer standards are calibrated to the mean of at least (2) ISO-classified reference pyranometers under sunlight (clear sky conditions) in Logan, Utah. Each of the four ISO-classified reference pyranometers are recalibrated on an alternating year schedule (two instruments per year) at the National Renewable Energy Laboratory (NREL) in Golden, Colorado. NREL reference standards are calibrated to the World Radiometric Reference (WRR) in Davos, Switzerland.

Traceability

Reference Instrument	Serial Number	ISO 9060 Classification
EKO Instruments MS80*	S16088044	Spectrally Flat Class A
Kipp & Zonen CM11	060089	Spectrally Flat Class A
Kipp & Zonen CMP11	101625	Spectrally Flat Class A
Hukseflux SR20	2497	Spectrally Flat Class A
Li-Cor LI-200	PY68846	Fast Response Class C
Li-Cor LI-200	PY68847	Fast Response Class C
Li-Cor LI-200	PY68895	Fast Response Class C
Li-Cor LI-200	PY68896	Fast Response Class C

*MS80 purchased new in 2017. Initial calibration conducted by EKO Instruments with traceability to the World Radiometric Reference.

Technical Manager : Jacob Bingham

Date : 29-Mar-2019

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721 West 1800 North
Logan, UT 84321

Certificate of Calibration
LI-COR Pyranometer
Model LI-200X

Customer Name	:	Kenneth Hall
Serial Number	:	PY90553
Calibration Date	:	29-Mar-2019
Previous Calibration Date	:	14-Sep-2015
Recommended Recalibration Date	:	28-Mar-2021
Calibration Factor	:	192.60 **W m^{-2} per mV**
Output	:	87.7 **µA per 1000 W m^{-2}**
Calibration Factor as Received	:	198.96 **W m^{-2} per mV**
Output as Received	:	84.9 **µA per 1000 W m^{-2}**
Resistance (Measured)	:	59.2 **Ω**
Change in Output	:	3.3 **%**
Change in Output per Year	:	0.9 **%**

Calibration Procedure
Calibration is based on a side-by-side comparison under high intensity discharge metal halide lamps using the mean of (4) LI-COR transfer standard pyranometers. LI-COR transfer standards are calibrated to the mean of at least (2) ISO-classified reference pyranometers under sunlight (clear sky conditions) in Logan, Utah. Each of the four ISO-classified reference pyranometers are recalibrated on an alternating year schedule (two instruments per year) at the National Renewable Energy Laboratory (NREL) in Golden, Colorado. NREL reference standards are calibrated to the World Radiometric Reference (WRR) in Davos, Switzerland.

Traceability

Reference Instrument	Serial Number	ISO 9060 Classification
EKO Instruments MS80*	S16088044	Spectrally Flat Class A
Kipp & Zonen CM11	060089	Spectrally Flat Class A
Kipp & Zonen CMP11	101625	Spectrally Flat Class A
Hukseflux SR20	2497	Spectrally Flat Class A
Li-Cor LI-200	PY68846	Fast Response Class C
Li-Cor LI-200	PY68847	Fast Response Class C
Li-Cor LI-200	PY68895	Fast Response Class C
Li-Cor LI-200	PY68896	Fast Response Class C

*MS80 purchased new in 2017. Initial calibration conducted by EKO Instruments with traceability to the World Radiometric Reference.

Technical Manager : Jacob Bingham Date : 29-Mar-2019

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apogee INSTRUMENTS
721 West 1800 North
Logan, UT 84321

Certificate of Calibration
LI-COR Pyranometer
Model LI-200X

Customer Name	:	Kenneth Hall
Serial Number	:	PY90559
Calibration Date	:	29-Mar-2019
Previous Calibration Date	:	14-Sep-2015
Recommended Recalibration Date	:	28-Mar-2021
Calibration Factor	:	191.20 **W m^{-2} per mV**
Output	:	84.6 **µA per 1000 W m^{-2}**
Calibration Factor as Received	:	198.64 **W m^{-2} per mV**
Output as Received	:	81.5 **µA per 1000 W m^{-2}**
Resistance (Measured)	:	61.8 **Ω**
Change in Output	:	3.9 **%**
Change in Output per Year	:	1.1 **%**

Calibration Procedure
Calibration is based on a side-by-side comparison under high intensity discharge metal halide lamps using the mean of (4) LI-COR transfer standard pyranometers. LI-COR transfer standards are calibrated to the mean of at least (2) ISO-classified reference pyranometers under sunlight (clear sky conditions) in Logan, Utah. Each of the four ISO-classified reference pyranometers are recalibrated on an alternating year schedule (two instruments per year) at the National Renewable Energy Laboratory (NREL) in Golden, Colorado. NREL reference standards are calibrated to the World Radiometric Reference (WRR) in Davos, Switzerland.

Traceability

Reference Instrument	Serial Number	ISO 9060 Classification
EKO Instruments MS80*	S16088044	Spectrally Flat Class A
Kipp & Zonen CM11	060089	Spectrally Flat Class A
Kipp & Zonen CMP11	101625	Spectrally Flat Class A
Hukseflux SR20	2497	Spectrally Flat Class A
Li-Cor LI-200	PY68846	Fast Response Class C
Li-Cor LI-200	PY68847	Fast Response Class C
Li-Cor LI-200	PY68895	Fast Response Class C
Li-Cor LI-200	PY68896	Fast Response Class C

*MS80 purchased new in 2017. Initial calibration conducted by EKO Instruments with traceability to the World Radiometric Reference.

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Certificate of Calibration
LI-COR Pyranometer
Model LI-200X

Customer Name	:	Kenneth Hall
Serial Number	:	PY43036
Calibration Date	:	29-Mar-2019
Previous Calibration Date	:	28-May-2016
Recommended Recalibration Date	:	28-Mar-2021
Calibration Factor	:	191.85 **W m^{-2} per mV**
Output	:	103.0 **µA per 1000 W m^{-2}**
Calibration Factor as Received	:	199.62 **W m^{-2} per mV**
Output as Received	:	99.0 **µA per 1000 W m^{-2}**
Resistance (Measured)	:	50.6 **Ω**
Change in Output	:	4.1 **%**
Change in Output per Year	:	1.4 **%**

Calibration Procedure
Calibration is based on a side-by-side comparison under high intensity discharge metal halide lamps using the mean of (4) LI-COR transfer standard pyranometers. LI-COR transfer standards are calibrated to the mean of at least (2) ISO-classified reference pyranometers under sunlight (clear sky conditions) in Logan, Utah. Each of the four ISO-classified reference pyranometers are recalibrated on an alternating year schedule (two instruments per year) at the National Renewable Energy Laboratory (NREL) in Golden, Colorado. NREL reference standards are calibrated to the World Radiometric Reference (WRR) in Davos, Switzerland.

Traceability

Reference Instrument	Serial Number	ISO 9060 Classification
EKO Instruments MS80*	S16088044	Spectrally Flat Class A
Kipp & Zonen CM11	060089	Spectrally Flat Class A
Kipp & Zonen CMP11	101625	Spectrally Flat Class A
Hukseflux SR20	2497	Spectrally Flat Class A
Li-Cor LI-200	PY68846	Fast Response Class C
Li-Cor LI-200	PY68847	Fast Response Class C
Li-Cor LI-200	PY68895	Fast Response Class C
Li-Cor LI-200	PY68896	Fast Response Class C

*MS80 purchased new in 2017. Initial calibration conducted by EKO Instruments with traceability to the World Radiometric Reference.

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Logan, UT 84321

Certificate of Calibration
LI-COR Pyranometer
Model LI-200X

Customer Name	:	Kenneth Hall
Serial Number	:	PY63673
Calibration Date	:	29-Mar-2019
Previous Calibration Date	:	28-May-2016
Recommended Recalibration Date	:	28-Mar-2021
Calibration Factor	:	194.79 **W m^{-2} per mV**
Output	:	92.2 **µA per 1000 W m^{-2}**
Calibration Factor as Received	:	199.48 **W m^{-2} per mV**
Output as Received	:	90.0 **µA per 1000 W m^{-2}**
Resistance (Measured)	:	55.7 **Ω**
Change in Output	:	2.4 **%**
Change in Output per Year	:	0.8 **%**

Calibration Procedure

Calibration is based on a side-by-side comparison under high intensity discharge metal halide lamps using the mean of (4) LI-COR transfer standard pyranometers. LI-COR transfer standards are calibrated to the mean of at least (2) ISO-classified reference pyranometers under sunlight (clear sky conditions) in Logan, Utah. Each of the four ISO-classified reference pyranometers are recalibrated on an alternating year schedule (two instruments per year) at the National Renewable Energy Laboratory (NREL) in Golden, Colorado. NREL reference standards are calibrated to the World Radiometric Reference (WRR) in Davos, Switzerland.

Traceability

Reference Instrument	Serial Number	ISO 9060 Classification
EKO Instruments MS80*	S16088044	Spectrally Flat Class A
Kipp & Zonen CM11	060089	Spectrally Flat Class A
Kipp & Zonen CMP11	101625	Spectrally Flat Class A
Hukseflux SR20	2497	Spectrally Flat Class A
Li-Cor LI-200	PY68846	Fast Response Class C
Li-Cor LI-200	PY68847	Fast Response Class C
Li-Cor LI-200	PY68895	Fast Response Class C
Li-Cor LI-200	PY68896	Fast Response Class C

*MS80 purchased new in 2017. Initial calibration conducted by EKO Instruments with traceability to the World Radiometric Reference.

Technical Manager : Jacob Bingham

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INSTRUMENTS
721 West 1800 North
Logan, UT 84321

Certificate of Calibration
LI-COR Pyranometer
Model LI-200X

Customer Name	:	Kenneth Hall
Serial Number	:	PY60149
Calibration Date	:	29-Mar-2019
Previous Calibration Date	:	28-May-2016
Recommended Recalibration Date	:	28-Mar-2021
Calibration Factor	:	195.75 **W m^{-2} per mV**
Output	:	98.2 **µA per 1000 W m^{-2}**
Calibration Factor as Received	:	199.90 **W m^{-2} per mV**
Output as Received	:	96.2 **µA per 1000 W m^{-2}**
Resistance (Measured)	:	52 **Ω**
Change in Output	:	2.1 **%**
Change in Output per Year	:	0.7 **%**

Calibration Procedure
Calibration is based on a side-by-side comparison under high intensity discharge metal halide lamps using the mean of (4) LI-COR transfer standard pyranometers. LI-COR transfer standards are calibrated to the mean of at least (2) ISO-classified reference pyranometers under sunlight (clear sky conditions) in Logan, Utah. Each of the four ISO-classified reference pyranometers are recalibrated on an alternating year schedule (two instruments per year) at the National Renewable Energy Laboratory (NREL) in Golden, Colorado. NREL reference standards are calibrated to the World Radiometric Reference (WRR) in Davos, Switzerland.

Traceability

Reference Instrument	Serial Number	ISO 9060 Classification
EKO Instruments MS80*	S16088044	Spectrally Flat Class A
Kipp & Zonen CM11	060089	Spectrally Flat Class A
Kipp & Zonen CMP11	101625	Spectrally Flat Class A
Hukseflux SR20	2497	Spectrally Flat Class A
Li-Cor LI-200	PY68846	Fast Response Class C
Li-Cor LI-200	PY68847	Fast Response Class C
Li-Cor LI-200	PY68895	Fast Response Class C
Li-Cor LI-200	PY68896	Fast Response Class C

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