System Overview



 Image: CR-PVS1

PV Soiling Loss Index RTU

QUICK DEPLOY GUIDE



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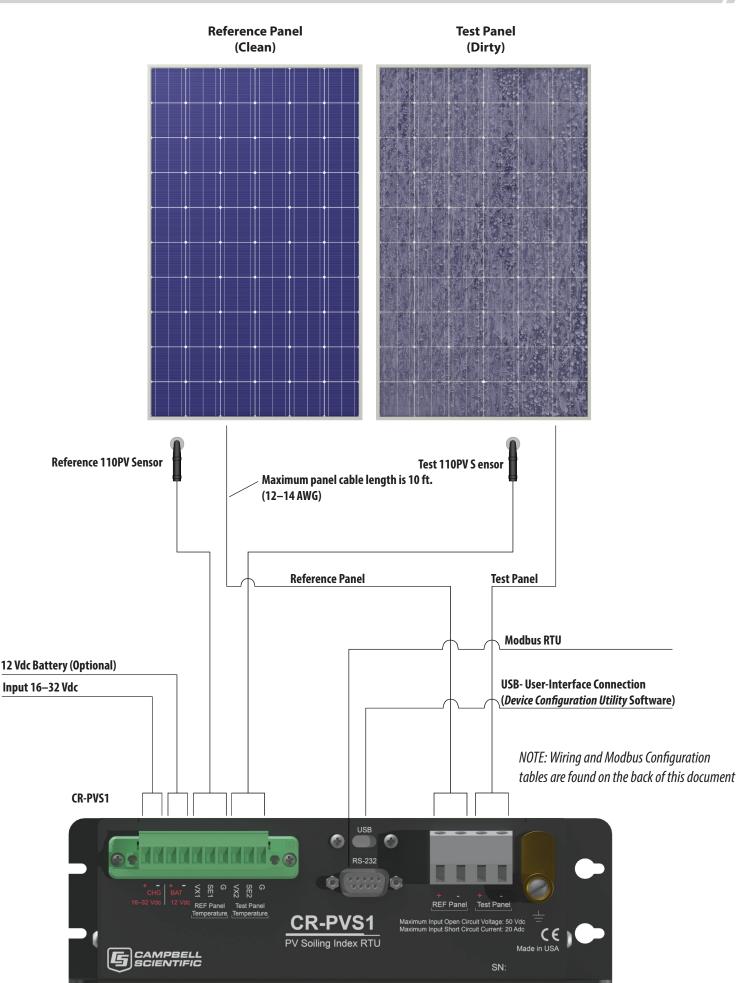
IMPORTANT NOTE: This Quick Deploy Guide is a general installation reference. Refer to the Owner's Manual for detailed installation instructions and information.

Caution!

To prevent injury, completely cover the panels during installation to limit output current and voltage. Do not short the solar panel (+) and (-) leads together.

2 **Item List** Ships With CR-PVS1 x 1 UV resistant cable ties x 2 Kapton tape x 1 110PV-L15-PT surface mount thermistor x 2 Flathead screwdriver x 1 Grommet x 4 Screw x 4 USB 2.0 Cable Type A Male to Micro B Male **CR300** Calibration Documentation **Quick Deploy Guide** Labels for Reference and Test Modules USB flash drive with Device Configuration Utility software (DevConfig) **Other required items** Rubbing alcohol or non-residue cleaner

16–32 Vdc power supply

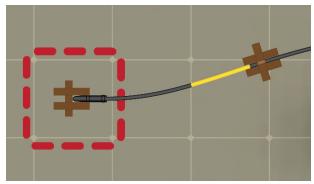


Physical Deployment

- 3.1 Install the CR-PVS1 near the Test and Reference panels. The length of the solar panel wires should not exceed 10 feet. Connect the ground lug to earth ground.
- 3.2 Using the stickers supplied with the CR-PVS1, identify one panel as Test and the other as Reference. Do the same with the two temperature sensor cables by writing on the white band near the cable end.
- 3.3 Route the Test panel sensor cable to the enclosure. Use cable ties to attach the cable to the panel framework, but do not tighten them yet. Repeat with the sensor cable for the Reference panel.
- 3.4 On the back of the Test panel, choose a solar cell as close to the center as possible. Clean the surface of the cell with rubbing alcohol or non-residue cleaner. Clean the cell in the same reference position on the Reference panel in the same manner.
- 3.5 IMPORTANT: Before mounting, wash your hands and then clean the back of the PV module or other device with ethyl alcohol.
 Use Kapton tape for cable strain relief; a yellow label on the cable indicates where the cable must be secured. If the temperature might exceed 70 °C, Kapton tape is also required to better secure the sensor to the measurement surface.
 To ensure that the sensor disk and cable are adequately fastened to the mea-

To ensure that the sensor disk and cable are adequately fastened to the measurement surface, use three strips of Kapton tape in two places each:

- a. For strain relief, place the first strip of tape across the cable just below the yellow heat shrink and rub the tape surface to remove bubbles.
- b. Place the other strips of tape on the ends of the first strip of tape and rub the tape surface to remove bubbles. These strips of tape should be perpendicular to the first strip of tape—forming an "H". They hold the first strip of tape down against the weight of the cable.
- c. To secure the sensor to the module surface, remove the paper from the bottom of the disk and adhere the disk to the center of the module most center cell.
- d. Place a strip of tape across the sensor head, perpendicular to the cable and rub the tape surface to remove bubbles. Rub as close as possible to the sensor's disk. Do not go over the sensor molding with the tape; only put tape over the metal disk portion of the sensor.



- e. Place the two other strips of tape on the ends of the sensor disk, perpendicular to the first piece of tape and parallel to the cable then rub the tape surface into the module surface.
- 3.6 Tighten the cable ties securing the sensor wires to the solar panel frame.
- 3.7 Wire the Test and Reference panels and sensors to the CR-PVS1 terminals shown in the wiring tables in Section 4.
- 3.8 Supply an input voltage of 16-32 Vdc through the CHG + and terminals. If backup power is needed, connect a 12 V battery to the Bat + and terminals.

Note: Cover the panels while wiring to reduce the voltage on the lead wires. Do not allow the wires to touch each other.



Wiring Tables

Panel Connections

Panel	Wire	Function	CR-PVS1 Terminal
DEE	RED	+	REF Panel +
REF	BLACK	-	REF Panel —
TECT	RED	+	Test Panel +
TEST	BLACK	-	Test Panel –

110PV Temperature Sensor Connections

Panel	Wire	Function	CR-PVS1 Terminal
	BLACK	Power	REF Panel Temperature VX1
DEE	RED	Signal	REF Panel Temperature SE1
REF	VIOLET	Ground	REF Panel Temperature G
	CLEAR	Shield	REF Panel Temperature G
	BLACK	Power	Test Panel Temperature VX2
TECT	RED	Signal	Test Panel Temperature SE2
TEST	VIOLET	Ground	Test Panel Temperature G
	CLEAR	Shield	Test Panel Temperature G



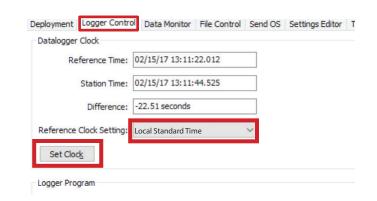
Device Configuration Utility (DevConfig)

To complete the following steps, connect to the CR-PVS1 using Device Configuration Utility (DevConfig). A copy of DevConfig is provided on the USB flash drive included with the CR-PVS1. DevConfig is also available as a free download from Campbell Scientific. www.campbellsci.com/devconfia

In the Device Type panel, select CR300 Series. Follow the steps shown in the right panel of the window to connect.

5.1 Set Time

In the Logger Control tab, select Local Standard Time. Click Set Clock.



- 5.2 Set Location and Solar Panel Coefficients
- In the Data Monitor tab, select the Public table from the list on the left. a.
- Double-click on the value in the UTC Offset UserEntered field. Enter the h correct Coordinated Universal Time (UTC) offset value for the location and press Enter.
- Double-click on the value in the Latitude_UserEntered field. Enter the C. latitude for your location and press Enter. Do the same for the longitude in

Longitude UserEntered.

- Double-click on the value in the AlphaTest_UserEntered field. Enter the d. correct value and press **Enter**. Do the same for the **AlphaRef UserEntered**, IscTeststc_UserEntered, and IscRefstc_UserEntered values.
- Double-click on the value in the HrSolNoonOffset UserEntered field. Enter ρ the correct value and press Enter. Do the same for GeffThreshold_UserEntered.

Definitions:

UTC Offset UserEntered: User-entered UTC offset of site location, hours Latitude_UserEntered: User-entered latitude of site location

Longitude_UserEntered: User-entered longitude of site location

- AlphaTest UserEntered: Published panel short circuit current (lsc) temperature coeffecient of the test panel (if published in units of %/deq_C then enter published value/100)
- AlphaRef_UserEntered: Published panel short circuit current (lsc) temperature coeffecient of the reference panel (if published in units of %/deq_C then enter published value/100)
- IscTeststc_UserEntered: Published panel short circuit current (Isc) of the test panel at STC
- IscRefstc_UserEntered: Published panel short circuit current (Isc) of the reference panel at STC
- HrSolNoonOffset_UserEntered: User-entered field that defines that

number of hours before and after solar noon to include measurements for calculating soiling index.

GeffThreshold UserEntered: User-entered field that defines that minimum effective irradiance value for calculating soiling index.

Deployment Logger Contro Data Monitor Data Collection File Control Send OS Settings Editor Terminal

Constants	UserEntered_Data		Г
DailyAvg	UTC_Offset_UserEntered	-7	T
DataTableInfo Offset	Latitude_UserEntered	40	t
Public RawMeasurementData Status TempTestDiagnostics	Longitude_UserEntered	-112	E
	AlphaTest_UserEntered	0.00105	
	AlphaRef_UserEntered	0.00105	
	IscTeststc_UserEntered	1.16	L
	IscRefstc_UserEntered	1.16	
	HrSolNoonOffset_UserEntered	2	
	GeffThreshold UserEntered	500	
View Data	Modbus Register Map		

DailyAv DataTal Offret Public

Status

TempTe

Live data is shown in the **Public** table. To verify that the system is working as expected, review the Raw_Measurement_Data and the Modbus_Register_Map values.

Data Monitor Deployme

ent	Logger Contro	Data Monitor	ata Collection	File Control	Send OS	Settings Editor	Termina	
ants		Record No			55	,188		
vg		Time Stamp				3/19/2018 9:14:07 AM		
ableI	nto	RTU_H	ealth_Data					
		RTU_Internal	_Temp		28	.04255		
edsu	rementData	RTU_Voltage			13	.36283		
estD	iagnostics	Soiling	Loss_Index					
		Soiling_Loss_	Index_Isc		0.	1502828		
		Soiling_Loss_	Index_Geff		0.3	1308178		
		Measur	ement_Status					
		Stable_Data_	Check		0			
		Time_Status			Ba	d Time of Day		
		Geff_Status			Ge	Geff is Stable		
		GeffThreshol	d_Status		Ge	Geff > Minimum Threshold		
		Isc_Status Temp. Status			Isc	Isc is Stable		
					Te	Temp is Stable		
		Raw_M	leasurement_Da	ta				
		IscTest			1.1	195894		
		IscRef			1.3	203829		
		TempTest	TempTest			24.40967		
		TempRef	TempRef			24.05655		
		GeffTest GeffRef			1,0	1,031.582		
					1,0	1,038.812		
		Stable_Data_	Count		0			
		Initiate	_Offset_Correc	tion				
		Update_Offs	et		0	0		
		Offset_Isc	Offset_Isc			1.005465		
		Offset_Geff	Offset_Geff			1.006048		
		UserEn	tered_Data					
		UTC_Offset_	UserEntered		-7	-7		
		Latitude_Use			40	40		
		Longitude Lie	erEntered		_11	10		

Deployment	Logger Contro	Data Monitor	Data Collection	File Control	Send OS	Settings Editor	Termina

		a oo becango cartor	
	Modbus_Register_Map		
	_40001_40002_Minutebeat	14	
	_40003_40004_Soiling_Loss_Index_Isc	0.1502828	
a	_40005_40006_Soiling_Loss_Index_Geff	0.1308178	
	_40007_40008_IscTest	1.192105	
	_40009_40010_IscRef	1.199821	
	_40011_40012_TempTest	24.33829	
	_40013_40014_TempRef	23.97034	
	_40015_40016_GeffTest	1,028.391	
	_40017_40018_GeffRef	1,035.447	
	_40019_40020_Offset_Isc	1.005465	
	_40021_40022_Offset_Geff	1.006048	
	_40023_40024_Update_Offset	0	
	_40025_40026_UTC_Offset_UserEntered	-7	
	_40027_40028_Latitude_UserEntered	40	
	_40029_40030_Longitude_UserEntered	-112	
	_40031_40032_TempCoefIscTest_UserEnter	0.00105	
	_40033_40034_TempCoefIscRef_UserEnter	0.00105	
	_40035_40036_IscTeststc_UserEntered	1.16	
	_40037_40038_IscRefstc_UserEntered	1.16	
	_40039_40040_SolNoonOffset_UserEntered	2	
	_40041_40042_GeffThreshold_UserEntered	500	
	_40043_40044_RTU_Voltage	13.36528	
	_40045_40046_RTU_Internal_Temp	28.042	
	_40047_40048_LocalSolarNoon	12.60767	
	Solar_Noon_Check		
	LocalSolarNoon	12.60767	
	Tstart	28	
	Tstop	32	
	Tnow	33,291	

This table shows the default Modbus serial settings for the CR-PVS1. Any device connected to the the CR-PVS1 must have the same configuration for successful communication.

Modbus Configuration			
ComPort	Com RS-232		
Baud Rate	19200, 8-bit		
Parity	Even		
Address	11		
Data	32-bit Float		
Data Format	CDAB		

5.4

Constants

DailyAvg

Status empTestDia

Constants

Status

DailyAvg DataTableInfo

empTestDiagnostic

The soiling loss index based on short circuit current only and effective irradiance (including temperature correction) will show the previous day's average soiling loss index assuming the minimum number of stable data points are recorded. If zero stable data are recorded for the day, the SLI will show NAN. If the minimum number of stable data points are recorded, the soiling loss indices will update at midnight.

Deployment Logger Control Data Monitor Data Collection File Control Send OS Settings Editor Termi

	Record No	55,772
	Time Stamp	3/19/2018 9:43:20 AM
	RTU_Health_Data	
	RTU_Internal_Temp	27.8655
entData	RTU Voltage	13.36724
ostics	Soiling_Loss_Index	
	Soiling_Loss_Index_Isc	0.1502828
	Soiling_Loss_Index_Geff	0.1308178
	Medsdrement_status	
	Stable_Data_Check	0
	Time_Status	Bad Time of Day
	Geff_Status	Geff is Stable
	GeffThreshold_Status	Geff > Minimum Thresho
	Isc_Status	Isc is Stable
	Temp_Status	Temp is Stable
	Raw_Measurement_Data	
	IscTest	1.187845
	IscRef	1.194092
	TempTest	24.36032
	TempRef	24.03696
	CeffTest	1 024 692



A difference in power output of the two modules under identical conditions, including cleanliness, weather, and position of the sun is expected. This difference is called the "offset" and can significantly vary between solar modules, even of the same model and batch.

The "offset" should be determined at the beginning of the soiling measurement campaign and should be updated periodically.

The procedure below causes the program to automatically determine the offset, and then implements a correction factor into the measurement sequence to remove any effects that may be caused by the offset.

NOTE: The procedure is only followed to remove the "offset" when both modules are clean. It is not used as an indicator of when the reference module only is cleaned.

NOTE: The offset correction procedure is normally initiated in the morning, immediately after both modules are cleaned. In this case, the offset will be updated at midnight if the minimum number of good data points is met. If the offset correction is applied in the afternoon, then the offset will be updated at the end of the following day assuming the minimum number of data points has been met.

- 1. Double-click on the value in the Update_Offset field. Enter -1 and press Enter.
- 2. Results will be available when the minimum number of data points has been met for calculating a good offset value. This is typically at midnight if the offset was initiated in the morning or midnight of the following day if the offset was initiated in the afternoon.

Inital Value

Deployment Logger Contro	Data Monitor Data Collection File Control	Send OS Settings Editor Terr
Constants DailyAvg DataTableInfo Offoat Public RawMeasurementData Status TempTestDiagnostics	Childe Date Count Initiate_Offset_Correction Update_Offset Offset_Isc Offset_Geff	0 0 1.005465 1.006048
	UTC_Offset_UserEntered Latitude_UserEntered Latitude_UserEntered Lonaitude UserEntered	-7 40 -112

Entered Value

Deployment Logger Contro	Data Monitor Data Collection F	File Control	Send OS	Settings Editor	Term
Constants DailyAvg DataTableInfo Offeet Public RammeasurementData Status TempTestDiagnostics	Genter Initiate_Offset_Correction Jpdate_Offset Dffset_Isc Dffset_Geff	Initiate_Offset_Correction Initiate_Offset Jpdate_Offset Dffset_Isc		-1 1.005465 1.006048	
	UTC_Offset_UserEntered Latitude_UserEntered		-7 40		
	Longitude_UserEntered		-112		