Spectrafy
solar spectral sensors

Application Note:

Interfacing the SolarSIM-GPV+iSG with a Campbell Scientific Datalogger

1. Introduction

This application note describes how to interface the iSG Integration Spectrum Generatorwith a Campbell Scientific CR6 series datalogger.

The provided instructions and programs can be easily adapted to other Campbell Scientific dataloggers.

2. Mechanical installation

The iSG can either be deployed in open air, or within a data logger enclosure via standard DIN rail. The iSG enclosure contains mounting slots as detailed in Figure 1 below:

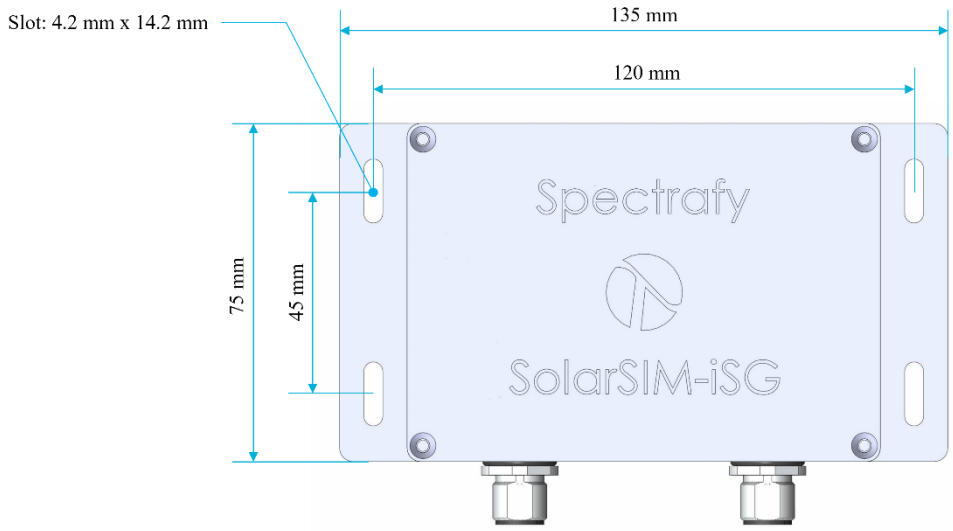

Figure 1. Main dimensions of the iSG

3. SolarSIM-iSG connections

The SolarSIM-iSG has two ports: "MAIN" and "SSIM", as pictured in Figure 1. The SolarSIM-GPV connects to the "SSIM" port via a double-ended connector cable, while the "MAIN" port interfaces via a single-ended connector cable to the data logger.

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Figure 2. SolarSIM-iSG ports: "MAIN" connects to the datalogger and "SSIM" connects to the SolarSIM-GPV.

iSG port	Connects to
MAIN	Datalogger
SSIM	SolarSIM-GPV

Table 1. Ports on the SolarSIM-iSG

4. Wiring to a datalogger

The SolarSIM-iSG uses the MODBUS RTU communication protocol over a RS-485 half-duplex line. The CR6 series datalogger has two half-duplex MODBUS-capable RS-485 serial ports (COMC1 and COMC3). In this application note the serial port COMC3 is used, as shown in Figure 2.

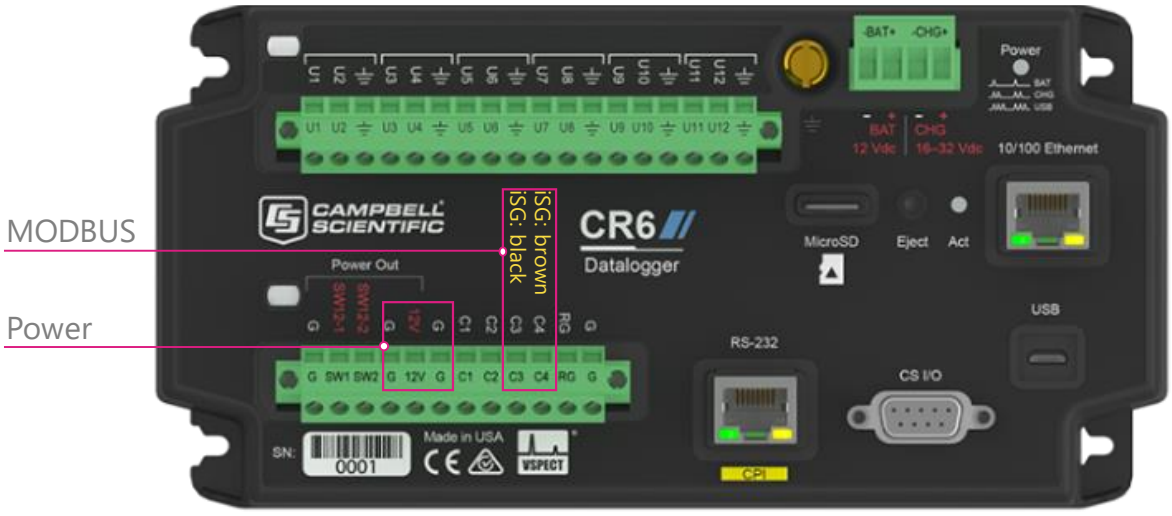

Figure 3. Interfacing with a Campbell Scientific's CR6 series datalogger

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Colour	Label	Function
Blue	V_{in}	Input voltage (+12 VDC)
White	GND	Common ground
Black	A-	Negative RS-485 input
Brown	B+	Positive RS-485 input

Table 2. The wire colour guide for the SolarSIM-iSG's "Main' port cable

Wiring the SolarSIM-iSG to CR6

SolarSIM-iSG Wire	CR6 Connection	Function
Blue	12V	12V supply
White	G	Common ground
Black	C3	Negative RS-485 input
Brown	C4	Positive RS-485 input

Table 3. The wiring guide for wiring the SolarSIM-iSG's 'Main' port cable to the CR6 datalogger

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5. Datalogger programming

The CRBasic program for interfacing the CR6 datalogger with the SolarSIM-iSG is presented in the Appendix. The user **must** change the geographic settings to match the local settings. Four parameters must be defined by the user as shown in the table below:

Parameter	Units	Range
Timezone	hours	-12 to 14 (can be fractional)
Latitude	degrees	-90° to 90° ("+" for Northern hemisphere)
Longitude	degrees	-180° to 180° ("+" for Eastern hemisphere)
Altitude	meters	0 to 9999

Table 4. The geographic parameters, with appropriate units and ranges to be adjusted in the CRBasic code

Note: DO NOT modify any other parameters in the code.

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6. Datalogger output

Figure 3 shows the SolarSIM-iSG outputs as displayed through the PC400 software.

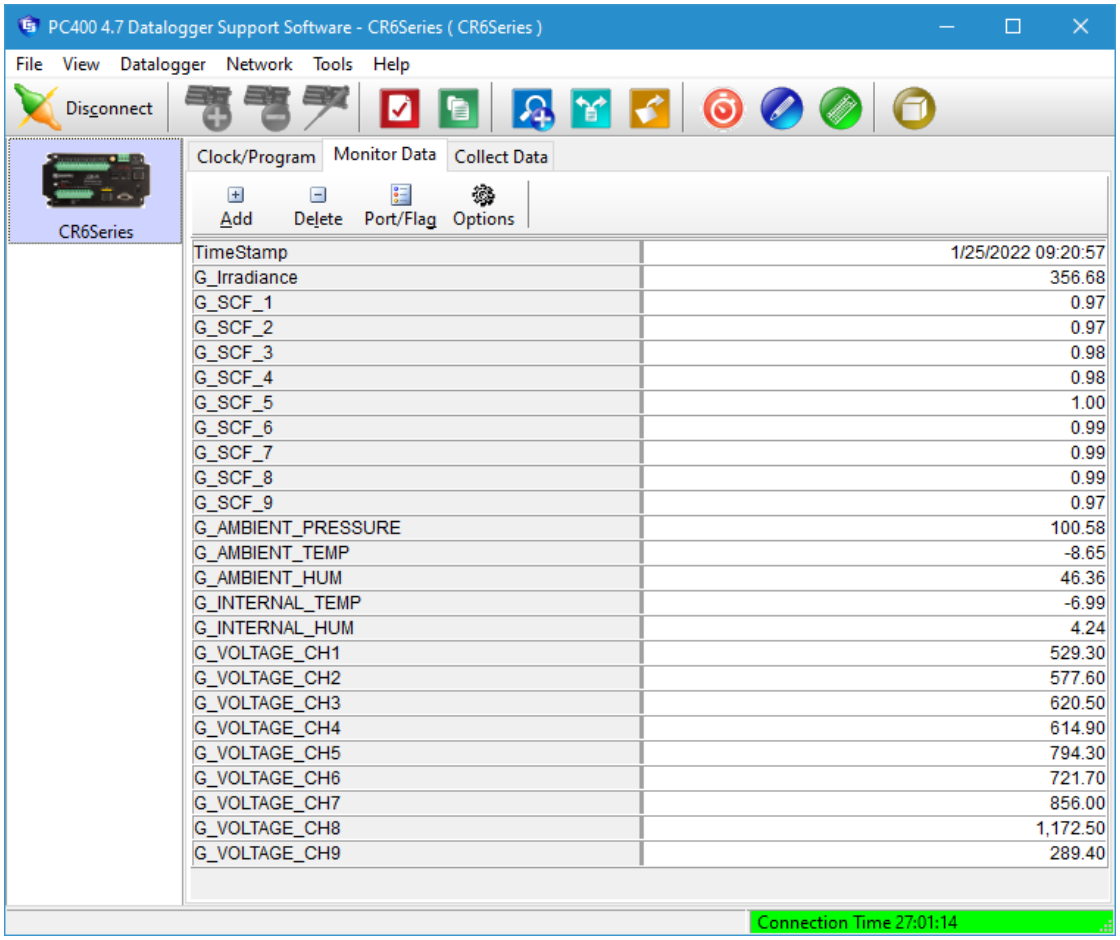

Figure 4. Datalogger output from the SolarSIM-iSG

Table 5. Datalogger outputs from the SolarSIM-iSG.

Parameter	Name	Units	Notes
TimeStamp	Local timestamp	N/A	N/A
G_Irradiance	Global irradiance	W/m^2	GHI/GTI (Class A)
G_SCF_1	Spectral correction factor 1	N/A	First Solar S3+ panel
G_SCF_2	Spectral correction factor 2	N/A	First Solar S4v1 panel
G_SCF_3	Spectral correction factor 3	N/A	First Solar S4v2 panel
G_SCF_4	Spectral correction factor 4	N/A	First Solar S6 panel
G_SCF_5	Spectral correction factor 5	N/A	PERC Mono Si panel
G_SCF_6	Spectral correction factor 6	N/A	PERC Poly Si panel
G_SCF_7	Spectral correction factor 7	N/A	Poly Si panel
G_SCF_8	Spectral correction factor 8	N/A	CIGS panel

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G_SCF_9	Spectral correction factor 9	N/A	a-Si panel
G_AMBIENT_PRESSURE	Ambient pressure	kPa	N/A
G_AMBIENT_TEMPERATURE	Ambient temperature	C	N/A
G_AMBIENT_HUMIDITY	Ambient humidity	%	N/A
G_INTERNAL_TEMPERATURE	Internal temperature	C	N/A
G_INTERNAL_HUMIDITY	Internal humidity	%	N/A
G_VOLTAGE_CH1	Voltage channel 1	mV	N/A
G_VOLTAGE_CH2	Voltage channel 2	mV	N/A
G_VOLTAGE_CH3	Voltage channel 3	mV	N/A
G_VOLTAGE_CH4	Voltage channel 4	mV	N/A
G_VOLTAGE_CH5	Voltage channel 5	mV	N/A
G_VOLTAGE_CH6	Voltage channel 6	mV	N/A
G_VOLTAGE_CH7	Voltage channel 7	mV	N/A
G_VOLTAGE_CH8	Voltage channel 8	mV	N/A
G_VOLTAGE_CH9	Voltage channel 9	mV	N/A

Table 6. Datalogger outputs from the SolarSIM-iSG.

7. User-defined spectral response curve

The SolarSIM-iSG comes with nine default spectral response (SR) curves as detailed in Table 5. The SolarSIM-iSG can also be used with alternative SR curves. If you would like to use alternative SR curves, please contact us at info@spectrafy.com before your Solar-iSG unit is shipped, so that your SR curves can be incorporated into the iSG software. User-defined SR curves need to be formatted to 1nm resolution and span the wavelength range from 280-4000nm.

8. Support

If you have any questions regarding your specific application, don't hesitate to contact Spectrafy at info@spectrafy.com.

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Appendix: CRBasic Code

```
'Description:     Acquires processed G data from SolarSIM-iSG
'Datalogger:      CR6 from Campbell Scientific
'Author:          Spectrafy Inc.
'Version:         1.3
'Last modified:   October 12, 2021


'Defines user constants
Public Timezone     = -5 'hrs ‘To be modified by user
Public Latitude     = 45.46 'To be modified by user. Positive for Northern
hemisphere (range -90 to 90)
Public Longitude    = -75.68 'To be modified by user. Negative for Western
hemisphere (west of Greenwich) (range -180 to 180)
Public Altitude     = 70 'To be modified by user. In meters

'Modbus parameters
Const ModbusAddress   = 55 'must be 55
Const ModbusTimeout   = 450 ' * 0.01 s = 2000 ms
Const ModbusBaudRate  = 19200 ' must be 19200

'CR6 parameters
Const Sampling_Frequency = 5 ' in seconds (min 5 seconds)
Const DAQ_Rate           = 10 ' in seconds (min 5 seconds)

'Declares public variables
Public iSG_OutputData(26) As Long
Public iSG_Output(24) As Float
Public iSG_ModbusErrorCode As Long
Public iSG_Input(11) As Long
Public Datalogger_Time(9)
Public G_SERIAL_NUMBER As Long
Public iSG_Comm_Err As Long

Alias Datalogger_Time(1) = Year         'assign the alias Year to
Datalogger_Time(1)
Alias Datalogger_Time(2) = Month        'assign the alias Month to
Datalogger_Time(2)
Alias Datalogger_Time(3) = DOM          'assign the alias DOM to
Datalogger_Time(3)
Alias Datalogger_Time(4) = Hour         'assign the alias Hour to
Datalogger_Time(4)
Alias Datalogger_Time(5) = Minute       'assign the alias Minute to
Datalogger_Time(5)
Alias Datalogger_Time(6) = Second       'assign the alias Second to
Datalogger_Time(6)
Alias Datalogger_Time(7) = uSecond      'assign the alias uSecond to
Datalogger_Time(7)
```


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```
Alias Datalogger_Time(8) = WeekDay      'assign the alias WeekDay to
Datalogger_Time(8)
Alias Datalogger_Time(9) = Day_of_Year  'assign the alias Day_of_Year to
Datalogger_Time(9)

Alias iSG_Input(1)  = iSG_DAQ_Request
Alias iSG_Input(2)  = iSG_Year
Alias iSG_Input(3)  = iSG_Month
Alias iSG_Input(4)  = iSG_Day
Alias iSG_Input(5)  = iSG_Hour
Alias iSG_Input(6)  = iSG_Minute
Alias iSG_Input(7)  = iSG_Second
Alias iSG_Input(8)  = iSG_Timezone
Alias iSG_Input(9)  = iSG_Latitude
Alias iSG_Input(10) = iSG_Longitude
Alias iSG_Input(11) = iSG_Altitude


Alias iSG_Output(1) = G_Irradiance 'global irradiance as measured by the
SolarSIM-G
Alias iSG_Output(2) = G_SCF_1
Alias iSG_Output(3) = G_SCF_2
Alias iSG_Output(4) = G_SCF_3
Alias iSG_Output(5) = G_SCF_4
Alias iSG_Output(6) = G_SCF_5
Alias iSG_Output(7) = G_SCF_6
Alias iSG_Output(8) = G_SCF_7
Alias iSG_Output(9) = G_SCF_8
Alias iSG_Output(10) = G_SCF_9
Alias iSG_Output(11) = G_AMBIENT_PRESSURE
Alias iSG_Output(12) = G_AMBIENT_TEMP
Alias iSG_Output(13) = G_AMBIENT_HUM
Alias iSG_Output(14) = G_INTERNAL_TEMP
Alias iSG_Output(15) = G_INTERNAL_HUM
Alias iSG_Output(16) = G_VOLTAGE_CH1
Alias iSG_Output(17) = G_VOLTAGE_CH2
Alias iSG_Output(18) = G_VOLTAGE_CH3
Alias iSG_Output(19) = G_VOLTAGE_CH4
Alias iSG_Output(20) = G_VOLTAGE_CH5
Alias iSG_Output(21) = G_VOLTAGE_CH6
Alias iSG_Output(22) = G_VOLTAGE_CH7
Alias iSG_Output(23) = G_VOLTAGE_CH8
Alias iSG_Output(24) = G_VOLTAGE_CH9


'Defines data table for SolarSIM-G
DataTable (Spectrafy_G,1,-1)       ' Autoallocates table size
  DataInterval (0,DAQ_Rate,Sec,10) ' Sets the DAQ rate
  Sample (1,Timezone,FP2)      ' Stores timezone variable
  Average (24,iSG_Output,IEEE4,iSG_Comm_Err) ' Stores iSG data
EndTable
```


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```
'Executes main program
BeginProg

  SerialOpen (ComC3,19200,0,0,256,3) 'RS-485 communication on port "ComC3"
                                     'Black wire (A-) to C3 terminal
                                     'Brown wire (B+) to C4 terminal
                                     'Baud rate: 19200 bps
                                     'Buffer size: 256 bytes
                                     'Mode: Half-duplex RS-485 (option "3")

  iSG_Timezone = INT((Timezone + 12.0) * 8.0)
  iSG_Latitude = INT((Latitude + 91.0) * 100.0)
  iSG_Longitude = INT((Longitude + 181.0) * 100.0)
  iSG_Altitude = INT(Altitude)

  Scan (Sampling_Frequency,Sec,0,0)

    RealTime(Datalogger_Time)

    iSG_Comm_Err = 0

    iSG_DAQ_Request = 1
    iSG_Year = Year
    iSG_Month = Month
    iSG_Day = DOM 'day
    iSG_Hour = Hour
    iSG_Minute = Minute
    iSG_Second = Second
    iSG_Input(8) = iSG_Timezone
    iSG_Input(9) = iSG_Latitude
    iSG_Input(10) = iSG_Longitude
    iSG_Input(11) = iSG_Altitude

    'Sends measurement request to iSG along with geolocation parameters
    ModbusMaster
(iSG_ModbusErrorCode,COMC3,ModbusBaudRate,ModbusAddress,16,iSG_Input(),1,11,2
,100,3)

    'Delays 2500 ms to allow iSG to make the measurement
    Delay(0,2500,mSec)

    'Receives the data from iSG
    ModbusMaster
(iSG_ModbusErrorCode,COMC3,ModbusBaudRate,ModbusAddress,3,iSG_OutputData(),12
,26,2,ModbusTimeout,3)

    G_SERIAL_NUMBER = iSG_OutputData(1)

    'Checks to see if the data is correct
    If G_SERIAL_NUMBER < 1000 Then
```


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```
  iSG_Comm_Err = 1
  G_AMBIENT_PRESSURE = -1
  G_AMBIENT_TEMP     = -1
  G_AMBIENT_HUM      = -1
  G_INTERNAL_TEMP    = -1
  G_INTERNAL_HUM     = -1
  G_VOLTAGE_CH1      = -1
  G_VOLTAGE_CH2      = -1
  G_VOLTAGE_CH3      = -1
  G_VOLTAGE_CH4      = -1
  G_VOLTAGE_CH5      = -1
  G_VOLTAGE_CH6      = -1
  G_VOLTAGE_CH7      = -1
  G_VOLTAGE_CH8      = -1
  G_VOLTAGE_CH9      = -1
Else
  G_AMBIENT_PRESSURE = iSG_OutputData(2) / 50.0 / 10.0
  G_AMBIENT_TEMP     = iSG_OutputData(3) / 8.0 / 75.0 - 50.0
  G_AMBIENT_HUM      = iSG_OutputData(4) / 6.0 / 100.0
  G_INTERNAL_TEMP    = iSG_OutputData(5) / 8.0 / 75.0 - 50.0
  G_INTERNAL_HUM     = iSG_OutputData(6) / 6.0 / 100.0
  G_VOLTAGE_CH1      = iSG_OutputData(7) / 10.0
  G_VOLTAGE_CH2      = iSG_OutputData(8) / 10.0
  G_VOLTAGE_CH3      = iSG_OutputData(9) / 10.0
  G_VOLTAGE_CH4      = iSG_OutputData(10) / 10.0
  G_VOLTAGE_CH5      = iSG_OutputData(11) / 10.0
  G_VOLTAGE_CH6      = iSG_OutputData(12) / 10.0
  G_VOLTAGE_CH7      = iSG_OutputData(13) / 10.0
  G_VOLTAGE_CH8      = iSG_OutputData(14) / 10.0
  G_VOLTAGE_CH9      = iSG_OutputData(15)  / 10.0
EndIf

'Postprocesses the received data
If iSG_OutputData(16) = 9999 or iSG_Comm_Err > 0 Then
  G_Irradiance = -1.0
  G_SCF_1 = -1.0
  G_SCF_2 = -1.0
  G_SCF_3 = -1.0
  G_SCF_4 = -1.0
  G_SCF_5 = -1.0
  G_SCF_6 = -1.0
  G_SCF_7 = -1.0
  G_SCF_8 = -1.0
  G_SCF_9 = -1.0

Else
  G_Irradiance = iSG_OutputData(16) + iSG_OutputData(17) / 1000.0
  G_SCF_1 = (iSG_OutputData(18) / 1000.0) - 1.0
  G_SCF_2 = (iSG_OutputData(19) / 1000.0) - 1.0
  G_SCF_3 = (iSG_OutputData(20) / 1000.0) - 1.0
  G_SCF_4 = (iSG_OutputData(21) / 1000.0) - 1.0
```


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```
      G_SCF_5 = (iSG_OutputData(22) / 1000.0) - 1.0
      G_SCF_6 = (iSG_OutputData(23) / 1000.0) - 1.0
      G_SCF_7 = (iSG_OutputData(24) / 1000.0) - 1.0
      G_SCF_8 = (iSG_OutputData(25) / 1000.0) - 1.0
      G_SCF_9 = (iSG_OutputData(26) / 1000.0) - 1.0

    EndIf

    CallTable Spectrafy_G

  NextScan


EndProg
```


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