

Program: Control Program_All Trials Running_2018.CR6

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1  'SPIRODELA POLYRHIZA POND CONTROL PROGRAM
2  'Version: Full system operation for Trials 2 and 3
3  'The objectives of this program include:
4      'Monitor PAR solar irradiance
5      'Monitor PAR solar irradiance + lighting contribution
6      'Monitor ambient temperature
7      'Monitor temperature at the bottom of 18 ponds; six at ambient temp and 1
8      'Control heated ponds to 2 degrees C above ambient ponds and 5 degrees C
9      'Heaters controlled by bottom temperature probes
10
11 'Series Datalogger
12 'Date: June 4, 2018
13 'Program author: Riley Moris, Simons Lab
14
15 'Pond Schedule
16     '      1      2      3      4
17     'A | BK | E1 | E3 | BK | A
18     'B | E2 | E1 | E1 | E2 | B
19     'C | E3 | E2 | E3 | E3 | C
20     'D | E3 | E1 | E2 | E1 | D
21     'E | E1 | E3 | E2 | E2 | E
22     '      1      2      3      4
23 'Trial 2: ACTIVE
24     'Pond A3: Environment 3 (Ambient + 5 deg C) - SDM Channel 1
25     'Pond B1: Environment 2 (Ambient + 2 deg C) - SDM Channel 2
26     'Pond B2: Environment 1 (Ambient)
27     'Pond B4: Environment 2 (Ambient + 2 deg C) - SDM Channel 3
28     'Pond C3: Environment 3 (Ambient + 5 deg C) - SDM Channel 4
29     'Pond D1: Environment 3 (Ambient + 5 deg C) - SDM Channel 5
30     'Pond D2: Environment 1 (Ambient)
31     'Pond D4: Environment 1 (Ambient)
32     'Pond E3: Environment 2 (Ambient + 2 deg C) - SDM Channel 6
33 'Trial 3: ACTIVE
34     'Pond A2: Environment 1 (Ambient)
35     'Pond B3: Environment 1 (Ambient)
36     'Pond C1: Environment 3 (Ambient + 5 deg C) - SDM Channel 7
37     'Pond C2: Environment 2 (Ambient + 2 deg C) - SDM Channel 8
38     'Pond C4: Environment 3 (Ambient + 5 deg C) - SDM Channel 9
39     'Pond D3: Environment 2 (Ambient + 2 deg C) - SDM Channel 10
40     'Pond E1: Environment 1 (Ambient)
41     'Pond E2: Environment 3 (Ambient + 5 deg C) - SDM Channel 11
42     'Pond E4: Environment 2 (Ambient + 2 deg C) - SDM Channel 12
43
44 'Multiplexer Wiring Schedule
45     'Channel Mode: 2x32
46     'Channel 1: PAR Quantum Sensor
47     'Channel 2: Therm109_Atmospheric Temperature Probe
48     'Channel 3: Therm107(1)_Pond Probe (Pond A3)
49     'Channel 4: Therm107(2)_Pond Probe (Pond B1)
50     'Channel 5: Therm107(3)_Pond Probe (Pond B2)
51     'Channel 6: Therm107(4)_Pond Probe (Pond B4)
52     'Channel 7: Therm107(5)_Pond Probe (Pond C3)
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53      'Channel 8: Therm107(6)_Pond Probe (Pond D1)
54      'Channel 9: Therm107(7)_Pond Probe (Pond D2)
55      'Channel 10: Therm107(8)_Pond Probe (Pond D4)
56      'Channel 11: Therm107(9)_Pond Probe (Pond E3)
57      'Channel 12: Therm107(10)_Pond Probe (Pond A2)
58      'Channel 13: Therm107(11)_Pond Probe (Pond B3)
59      'Channel 14: Therm107(12)_Pond Probe (Pond C1)
60      'Channel 15: Therm107(13)_Pond Probe (Pond C2)
61      'Channel 16: Therm107(14)_Pond Probe (Pond C4)
62      'Channel 17: Therm107(15)_Pond Probe (Pond D3)
63      'Channel 18: Therm107(16)_Pond Probe (Pond E1)
64      'Channel 19: Therm107(17)_Pond Probe (Pond E2)
65      'Channel 20: Therm107(18)_Pond Probe (Pond E4)
66
67      'Declare Constants
68      Const Rad_Sensitivity = 5.35 'As per Calibration Certificate
69      Const HeaterE2 = 2 'Temperature above ambient that Environment 2 ponds ar
70      Const HeaterE3 = 5 'Temperature above ambient that Environment 3 ponds ar
71
72      'Declare Variables
73      'CR6 parameters
74      Public BattV
75      Public PTemp
76      'Radiometer parameters
77      Public Rad_OutputVoltage
78      Public Rad_Irradiance
79      Public DayNight As Boolean 'True Daylight - Day = True, Night = False
80      'T107/T109 temperature probes
81      Public Temp_Amb
82      Public Temp_Pond(18)
83      Public Temp_PondAmb
84      Public Temp_PondHeat
85
86      'Functional parameters
87      Dim ChannelCount
88      Public SDMControl(16)=0
89
90      'Declare Units
91      Units BattV = Volts
92      Units PTemp = Deg C
93      Units Rad_OutputVoltage = microV
94      Units Rad_Irradiance = micromol/sm2
95      Units Temp_Amb = Deg C
96      Units Temp_Pond = Deg C
97      Units Temp_PondAmb = Deg C
98      Units Temp_PondHeat = Deg C
99
100     'Define output data tables
101     DataTable(EnviroData2018,1,-1)
102     DataInterval(0,30,min,10)
103     CardOut(0,-1)
104     Average(1,BattV,FP2,False)
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105 Average(1, PTemp, FP2, False)
106 Average(1, Rad_Irradiance, FP2, False)
107 Sample(1, DayNight, Boolean, False)
108 Average(1, Temp_Amb, FP2, False)
109 EndTable
110 DataTable(PondData2018, 1, -1)
111 DataInterval(0, 30, min, 10)
112 CardOut(0, -1)
113 Sample(1, DayNight, Boolean, False)
114 Average(1, Temp_Amb, FP2, False)
115 Average(1, Temp_PondAmb, FP2, False)
116 Average(1, Temp_Pond(1), FP2, False)
117 Average(1, Temp_Pond(2), FP2, False)
118 Average(1, Temp_Pond(3), FP2, False)
119 Average(1, Temp_Pond(4), FP2, False)
120 Average(1, Temp_Pond(5), FP2, False)
121 Average(1, Temp_Pond(6), FP2, False)
122 Average(1, Temp_Pond(7), FP2, False)
123 Average(1, Temp_Pond(8), FP2, False)
124 Average(1, Temp_Pond(9), FP2, False)
125 Average(1, Temp_Pond(10), FP2, False)
126 Average(1, Temp_Pond(11), FP2, False)
127 Average(1, Temp_Pond(12), FP2, False)
128 Average(1, Temp_Pond(13), FP2, False)
129 Average(1, Temp_Pond(14), FP2, False)
130 Average(1, Temp_Pond(15), FP2, False)
131 Average(1, Temp_Pond(16), FP2, False)
132 Average(1, Temp_Pond(17), FP2, False)
133 Average(1, Temp_Pond(18), FP2, False)
134 EndTable
135
136 'Main Program
137 BeginProg
138 'A scan is done every 60 seconds, but recordings are averaged over a 30
139 Scan(60, sec, 1, 0)
140 Battery(BattV)
141 PanelTemp(PTemp, 60)
142 'Turn on AM16-32B Multiplexer using PortSet Function - RES port connec
143 PortSet(U2, 1)
144 Delay(0, 150, mSec)
145 SubScan(1, Sec, 1)
146 PulsePort(U1, 10000) 'Clock to first multiplexer channel
147 'Channel 1
148 VoltDiff(Rad_OutputVoltage, 1, mV5000, U3, 0, 0, 60, 1, 0) 'Rad PAR Quantum
149 Rad_Irradiance = 1000*(Rad_OutputVoltage/Rad_Sensitivity)
150 If Rad_Irradiance >= 10 Then
151 DayNight = True
152 ElseIf Rad_Irradiance < 10 Then
153 DayNight = False
154 EndIf
155 NextSubScan
156 SubScan(1, Sec, 1)
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157     PulsePort(U1,10000)  'Clock to second multiplexer channel
158     'Channel 2
159     Therm109(Temp_Amb,1,U4,U3,0,60,1,0)
160 NextSubScan
161 ChannelCount = 1
162 SubScan(1,Sec,18)
163     PulsePort(U1,10000)
164     'Clock thorough channels 3 through 20
165     Therm107(Temp_Pond(ChannelCount),1,U4,U3,0,60,1,0)
166     ChannelCount = ChannelCount + 1
167 NextSubScan
168 PortSet(U2,0)  'Turn Multiplexer off
169 'Set average ambient pond temperature - AVERAGE(A2,B2,B3,D2,D4,E1)
170     Temp_PondAmb = (Temp_Pond(10)+Temp_Pond(3)+Temp_Pond(11)+Temp_Pond(
171 'TRIAL 2 PONDS
172 'Heated Pond A3: Trial 2, Environment 3 (Ambient + 5 degC)
173     Temp_PondHeat = Temp_Pond(1)
174     If Temp_PondHeat <= Temp_PondAmb + HeaterE3
175         SDMControl(1) = 1
176     ElseIf Temp_PondHeat > Temp_PondAmb + HeaterE3
177         SDMControl(1) = 0
178     EndIf
179 'Heated Pond B1: Trial 2, Environment 2 (Ambient + 2 degC)
180     Temp_PondHeat = Temp_Pond(2)
181     If Temp_PondHeat <= Temp_PondAmb + HeaterE2
182         SDMControl(2) = 1
183     ElseIf Temp_PondHeat > Temp_PondAmb + HeaterE2
184         SDMControl(2) = 0
185     EndIf
186 'Heated Pond B4: Trial 2, Environment 2 (Ambient + 2 degC)
187     Temp_PondHeat = Temp_Pond(4)
188     If Temp_PondHeat <= Temp_PondAmb + HeaterE2
189         SDMControl(3) = 1
190     ElseIf Temp_PondHeat > Temp_PondAmb + HeaterE2
191         SDMControl(3) = 0
192     EndIf
193 'Heated Pond C3: Trial 2, Environment 3 (Ambient + 5 degC)
194     Temp_PondHeat = Temp_Pond(5)
195     If Temp_PondHeat <= Temp_PondAmb + HeaterE3
196         SDMControl(4) = 1
197     ElseIf Temp_PondHeat > Temp_PondAmb + HeaterE3
198         SDMControl(4) = 0
199     EndIf
200 'Heated Pond D1: Trial 2, Environment 3 (Ambient + 5 degC)
201     Temp_PondHeat = Temp_Pond(6)
202     If Temp_PondHeat <= Temp_PondAmb + HeaterE3
203         SDMControl(5) = 1
204     ElseIf Temp_PondHeat > Temp_PondAmb + HeaterE3
205         SDMControl(5) = 0
206     EndIf
207 'Heated Pond E3: Trial 2, Environment 2 (Ambient + 2 degC)
208     Temp_PondHeat = Temp_Pond(9)
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209     If Temp_PondHeat <= Temp_PondAmb + HeaterE2
210         SDMControl(6) = 1
211     ElseIf Temp_PondHeat > Temp_PondAmb + HeaterE2
212         SDMControl(6) = 0
213     EndIf
214 'TRIAL 3 PONDS
215 'Heated Pond C1: Trial 3, Environment 3 (Ambient + 5 degC)
216     Temp_PondHeat = Temp_Pond(12)
217     If Temp_PondHeat <= Temp_PondAmb + HeaterE3
218         SDMControl(7) = 1
219     ElseIf Temp_PondHeat > Temp_PondAmb + HeaterE3
220         SDMControl(7) = 0
221     EndIf
222 'Heated Pond C2: Trial 3, Environment 2 (Ambient + 2 degC)
223     Temp_PondHeat = Temp_Pond(13)
224     If Temp_PondHeat <= Temp_PondAmb + HeaterE2
225         SDMControl(8) = 1
226     ElseIf Temp_PondHeat > Temp_PondAmb + HeaterE2
227         SDMControl(8) = 0
228     EndIf
229 'Heated Pond C4: Trial 3, Environment 3 (Ambient + 5 degC)
230     Temp_PondHeat = Temp_Pond(14)
231     If Temp_PondHeat <= Temp_PondAmb + HeaterE3
232         SDMControl(9) = 1
233     ElseIf Temp_PondHeat > Temp_PondAmb + HeaterE3
234         SDMControl(9) = 0
235     EndIf
236 'Heated Pond D3: Trial 3, Environment 2 (Ambient + 2 degC)
237     Temp_PondHeat = Temp_Pond(15)
238     If Temp_PondHeat <= Temp_PondAmb + HeaterE2
239         SDMControl(10) = 1
240     ElseIf Temp_PondHeat > Temp_PondAmb + HeaterE2
241         SDMControl(10) = 0
242     EndIf
243 'Heated Pond E2: Trial 3, Environment 3 (Ambient + 5 degC)
244     Temp_PondHeat = Temp_Pond(17)
245     If Temp_PondHeat <= Temp_PondAmb + HeaterE3
246         SDMControl(11) = 1
247     ElseIf Temp_PondHeat > Temp_PondAmb + HeaterE3
248         SDMControl(11) = 0
249     EndIf
250 'Heated Pond E4: Trial 3, Environment 2 (Ambient + 2 degC)
251     Temp_PondHeat = Temp_Pond(18)
252     If Temp_PondHeat <= Temp_PondAmb + HeaterE2
253         SDMControl(12) = 1
254     ElseIf Temp_PondHeat > Temp_PondAmb + HeaterE2
255         SDMControl(12) = 0
256     EndIf
257 SDMCD16AC(SDMControl(),1,0)
258 CallTable(EnviroData2018)
259 CallTable(PondData2018)
260 NextScan
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261 [EndProg](#)

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