{CR10X}

PROGRAM C7_datalogger_with_autogain
Cyclops 7 (C7) Datalogger with Auto Gain Program example

Program Notes
Use 2:1 voltage divider on Differential Input channel 1 to get full output range from C7

Auto Gain Control Strategy:
CR10X programmed to read 0 to 2500 mv from Cyclops 7
If on Gain X1
If the millivolts drops below 150 mv, change to X10 gain
If on Gain X10
If the millivolts drops below 150 mv, change to X100 gain
If the millivolts rises above 2250 mv, change to X1 gain
If on Gain X100
If the millivolts rises above 2250 mv, change to X10 gain
Program delays calculation of concentration values after a range change (default 3 seconds)

CR10X Panel Wiring
Panel Cyclops 7 wire color

+12 - Red (plus input)
G - black (Input Ground)
1H - Red (plus output) (see note below)
1L - white (minus output)
C1 - Blue (X10 gain)
C2 - Brown (X100 gain)
NOTE: Recommend 2:1 voltage divider terminal input module (CSI part# VDIV2:1)

C7 Gain CR10X control Ports
Gain C1 state C2 state

X1 high high
X10 low high
X100 high low

Subroutines
1 - Initialization subroutine
2 - Increase gain - Set CR10X control ports
3 - Decrease gain - Set CR10X control ports

Input Location Descriptions
Output - C7 output adjusted by gain setting - range from 0 to 2500
C7_output - C7 analog output, raw millivolts (mv) (after voltage divider)
Gain - current gain range setting (1, 10, or 100)
gain_min - C7 millivolt value at which the gain will be increased
gain_max - C7 millivolt value at which the gain will be decreased
gaindelay - how many seconds to wait after range change
delaycntr - the delay timer after a range change

Table 1 Program
01: 1.0000 Execution Interval (seconds)

1: If Flag/Port (P91) ; Call initialization program first time program is run
1: 28 Do if Flag 8 is Low
2: 01 Call Subroutine 1

If we have to change the gain, we need to give the C7 time to settle
When the gain changes, we set a delay counter to count down
If the delay cntr is not equal to zero, then we need to wait until we can take the next valid measurement

2: If (X<=>F) (P89) ; Check if delay counter is zero. If so, we can take a measurement
1: 7 X Loc [delaycntr]
2: 4 <
3: .1 F
4: 30 Then Do

3: Volt (Diff) (P2) ; Read C7 output...NOTE! maximum CR10X input voltage = 2.5 volts (need resistor divider for C7 output)
1: 1 Reps
2: 25 2500 mV 60 Hz Rejection Range
3: 01 DIFF Channel
4: 2 Loc [C7_output]
5: 1.0 Mult
6: 0.0 Offset

4: Z=X/Y (P38) ; We scale the output depending on the gain setting. Maximum output = 2500
1: 2 X Loc [C7_output]
2: 3 Y Loc [Gain]
3: 1 Z Loc [Output]

5: Do (P86)
1: 10 Set Output Flag High (Flag 0)

6: Real Time (P77) ^8270; Store the time
1: 1121 (Same as 1221) Y,D,Hr/Mn,Sec

7: Sample (P70) ^25814; Store the output
1: 1 Reps
2: 1 Loc [Output]

8: If (X<=>Y) (P88) ; Check if the C7 output is small enough that we should increase the gain
1: 2 X Loc [C7_output]
2: 4 <
3: 4 Y Loc [gain_min]
4: 30 Then Do

9: If (X<=>F) (P89) ; If the output is small, only change gain if we are not already at the maximum gain
1: 3 X Loc [Gain]
2: 4 <
3: 99 F
4: 2 Call Subroutine 2

10: End (P95)

11: If (X<=>Y) (P88) ; Check if the C7 output is large enough that we should decrease the gain
1: 2 X Loc [C7_output]
2: 3 >=
3: 5 Y Loc [gain_max]
4: 30 Then Do

12: If (X<=>F) (P89) ; If the output is large, only change gain if we are not already at the minimum gain
1: 3 X Loc [Gain]
2: 3 >=
3: 1.1 F
4: 3 Call Subroutine 3

13: End (P95)

14: Else (P94) ; This is where we come if the gain changed and we need to wait for the C7 to settle

15: Z=X+F (P34) ; We decrement the delay counter
1: 7 X Loc [delaycntr]
2: -1 F
3: 7 Z Loc [delaycntr]

16: End (P95)

*Table 2 Program
02: 0.0000 Execution Interval (seconds)

*Table 3 Subroutines

1: Beginning of Subroutine (P85) ; This is the initialization subroutine to set all variables
1: 01 Subroutine 1

2: Set Port(s) (P20)
1: 9999 C8..C5 = nc/nc/nc/nc
2: 9977 C4..C1 = nc/nc/output/output ; Use I/O C1 and C2 as outputs to control the gain of the C7

3: Z=F x 10^n (P30) ; Start at gain 10 (the middle range)
1: 10 F
2: 00 n, Exponent of 10
3: 3 Z Loc [Gain]

4: Z=F x 10^n (P30) ; Increase gain if C7 output is less than 150 mv
1: 150 F
2: 00 n, Exponent of 10
3: 4 Z Loc [gain_min]

5: Z=F x 10^n (P30) ; Decrease gain if C7 output is more than 2250 mv
1: 2250 F
2: 00 n, Exponent of 10
3: 5 Z Loc [gain_max]

6: Z=F x 10^n (P30) ; Don't measure for 2 cycles after a gain change
1: 2 F
2: 00 n, Exponent of 10
3: 6 Z Loc [gaindelay]

7: Z=F x 10^n (P30) ; Initialize gain delay counter to zero, so we take a measurement right away
1: 0.0 F
2: 00 n, Exponent of 10
3: 7 Z Loc [delaycntr]

8: Do (P86) ; Port 1 low = gain 10
1: 51 Set Port 1 Low
9: Do (P86)
1: 42 Set Port 2 High

10: Do (P86) ; Set flag so we know we initialized and don't need to repeat
1: 18 Set Flag 8 High

11: End (P95)

12: Beginning of Subroutine (P85) ; This is where we increase gain if needed
1: 02 Subroutine 2

13: If (X<=>F) (P89) ; Check to see if we're on gain 10
1: 3 X Loc [Gain]
2: 3 >=
3: 9.9 F
4: 30 Then Do ; We're on gain 10

14: Do (P86) ; Set the gain control ports to the proper gain
1: 41 Set Port 1 High

15: Do (P86)
1: 52 Set Port 2 Low

16: Z=F x 10^n (P30) ; Set the gain to 100
1: 100 F
2: 00 n, Exponent of 10
3: 3 Z Loc [Gain]

17: End (P95)

18: If (X<=>F) (P89) ; Should be on gain 1
1: 3 X Loc [Gain]
2: 4 <

3: 1.1 F
4: 30 Then Do ; If we get here, we're on gain 1, need to increase to gain 10

19: Do (P86) ; Set the gain control ports to the proper gain
1: 51 Set Port 1 Low

20: Do (P86)
1: 42 Set Port 2 High

21: Z=F x 10^n (P30) ; Set the gain to 10
1: 10 F
2: 00 n, Exponent of 10
3: 3 Z Loc [Gain]

22: End (P95)

23: Z=X*F (P37) ; Start the delay counter
1: 6 X Loc [gaindelay]
2: 1 F
3: 7 Z Loc [delaycntr]

24: End (P95)

25: Beginning of Subroutine (P85) ; This is where we decrease gain if needed
1: 03 Subroutine 3

26: If (X<=>F) (P89) ; Check to see if we're on gain 10
1: 3 X Loc [Gain]
2: 4 <
3: 10.1 F
4: 30 Then Do ; We're on gain 10, need to go to gain 1

27: Do (P86) ; Set the gain control ports to the proper gain
1: 41 Set Port 1 High

28: Do (P86)
1: 42 Set Port 2 High

29: Z=F x 10^n (P30) ; Set the gain to 1
1: 1 F
2: 00 n, Exponent of 10
3: 3 Z Loc [Gain]

30: End (P95)

31: If (X<=>F) (P89) ; Should be on gain 100
1: 3 X Loc [Gain]
2: 3 >=
3: 99 F
4: 30 Then Do ; If we get here, we're on gain 100

32: Do (P86) ; Set the gain control ports to the proper gain
1: 42 Set Port 2 High

33: Do (P86)
1: 51 Set Port 1 Low

34: Z=F x 10^n (P30) ; Set the gain to 10
1: 10 F
2: 00 n, Exponent of 10
3: 3 Z Loc [Gain]

35: End (P95)

36: Z=X*F (P37) ; Start the delay counter
1: 6 X Loc [gaindelay]
2: 1 F
3: 7 Z Loc [delaycntr]

37: End (P95)

End Program

-Input Locations-
1 Output 1 1 1
2 C7_output 1 3 1
3 Gain 1 7 5
4 gain_min 1 1 1
5 gain_max 1 1 1
6 gaindelay 1 2 1
7 delaycntr 1 2 4
8 _____ 0 0 0
9 _____ 0 0 0
10 _____ 0 0 0
11 _____ 0 0 0
12 _____ 0 0 0
13 _____ 0 0 0
14 _____ 0 0 0
15 _____ 0 0 0
16 _____ 0 0 0
17 _____ 0 0 0
18 _____ 0 0 0
19 _____ 0 0 0
20 _____ 0 0 0
21 _____ 0 0 0
22 _____ 0 0 0
23 _____ 0 0 0
24 _____ 0 0 0
25 _____ 0 0 0
26 _____ 0 0 0
27 _____ 0 0 0
28 _____ 0 0 0
-Program Security-
0000

0000
0000
-Mode 4-
-Final Storage Area 2-
0
-CR10X ID-
0
-CR10X Power Up-
3
-CR10X Compile Setting-
3
-CR10X RS-232 Setting-
-1
-DLD File Labels-
0
-Final Storage Labels-
0,_RTM,8270
0,_RTM
0,_RTM
0,_RTM
1,Output~1,25814