

balance.f

```
1      { =====
2      Main MICROBALANCE Application Load file
3
4      Copyright (c) 2000, LucidTek
5
6      This file initializes the ports for the Microbalance Application
7      PORT D is used to drive and sense the opto-interupter
8      the PWM output PD5(OC1A) is used to drive the galvometer.
9      The galvo is mirror driven by PD5 with ext. current limiting.
10     PD0      RXD          \ UART Receive data
11     PD1      TXD          \ UART Transmit data
12     PD2      SENSOR E    \ Sensor phototransistor Emitter lead
13     PD3      SENSOR C    \ Sensor phototransistor Collector lead
14     PD4      Coil-
15     PD5      Coil+
16     PD6      EMITTER K
17     PD7      EMITTER A
18
19     ===== }
20
21     INCLUDE EEMAP          \ EEPROM data
22     INCLUDE LCDdrv        \ LCD drivers
23     INCLUDE DISPLAY       \ MODIFIED LCD DRIVER SETUP
24
25
26     { ===== }
27     \ Configure STK200 board for GALVO based Microbalance 4/29/00
28     : INIT-PORTS ( -- )
29         $FF DDRA C!      \ PORTA Output to drive LCD
30         $CC DDRB C!      \ PORTB KEYPAD Scan/Read bits, SPI
31         $F7 DDRC C!      \ PORTC Ext brd select, LCD-RS,EN,SPKR
32         $FA DDRD C!
33
34         $00 PORTA C!      \ Set LCD data to 0's
35         $FF PORTB C!      \ PULL UP PB5..PB0 MOSI, MISO, Keypad
36         $00 PORTC C!      \ LCD, SPKR, Camera brds
37         $37 PORTD C!      \
38
39         $A3 TCCR1A C!
40         $01 TCCR1B C!
41         ;
42
43     $08 EQU TARE-SW      \ Tare Switch bit position
44     500 EQU T-GALVO
45
46     VARIABLE GALVO
47     VARIABLE SPEED
48     VARIABLE TARE \ must be followed by ERROR for proper init
49     VARIABLE ERROR
50     CVARIABLE EXIT-CNT
51
52     INCLUDE SYS-CONFIG   \ SYSTEM CONFIGURATION SETUP
53
54
55     : PRINT-GALVO ( -- )
56         0 0 AT-XY GALVO @ . \ "." Displays result fetched from GALVO at LCD position 0,0
57         6 0 AT-XY ." micrograms" \ position LCD and show message
58         ;
59
60     : ?TARE ( -- f ) \ TRUE if TARE button (PD3) down, momentarily reconfig PORT
61         PORTD C@ DDRD C@ OVER OVER $F7 AND DDRD C! \ OPEN OPTO Sensor Emitter
62         TARE-SW OR PORTD C! \ TURN ON PULL UP RESISTOR AT INPUT
63         PIND C@ TARE-SW AND NOT \ IF FALSE ELSE TRUE THEN
64         SWAP DDRD C! SWAP PORTD C! ; \ Put the PORT connections back where they were
65
66
67     : TARE-GALVO ( -- )
68         ?TARE IF DUP GALVO @ TARE ! ( SAR ) THEN \ Test Tare Switch, Update& SAR Tare IF ?
69         GALVO @ TARE @ - \ Prepare Tared Difference
70         0 1 AT-XY 6 SPACES 0 1 AT-XY . \ CLEAN UP DISPLAY AND PRINT TARE Value
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10:51 am,21 Sep 2000

balance.f

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71         6 1 AT-XY ." Tare --PD3"
72         ;
73
74 : SERIAL-DATA-OUT
75     SERIAL-IO          \ select the serial IO for printing etc.
76     GALVO @ .         \ Print the GALVO result to the serial IO
77     <CR> (S-EMIT)      \ with <CR> to end data value for EXCEL column data entry
78     ?TARE IF          \ CHECK if TARE down repeatedly, means send <ESC> to stop data acq
79         1 EXIT-CNT C+! \ TARE is down this time
80         EXIT-CNT C@ 2 > IF 0 EXIT-CNT C! <ESC> (S-EMIT) THEN \ it was down enough
81         ELSE 0 EXIT-CNT C!
82     THEN
83     LCD-TERMINAL ;    \ back to using the LCD for printing data & messages
84
85
86 : >PWM ( n -- )      \ n is the value to store in PWM register
87     1023 MIN 0 MAX   \ Hard Limit VALUE before PWM Update
88     DUP $FF AND SWAP 8 RSHIFT \ position n's bits for PWM Hi Lo
89     OCR1AH C! OCR1AL C! ; \ transfer data to PWM registers
90
91 : ?BEAM ( -- f )     \ Test if light beam can pass TRUE means beam on
92     PORTD C@ $3F AND $80 OR PORTD C! 75 MS \ Turn ON OPTO LED only and wait
93     PIND C@ 4 AND NOT ; \ then test SENSOR bit, it's neg logic
94
95 : SHOW-BEAM ( -- )  \ SHOW THE RESULT OF ?BEAM TEST
96     ?BEAM IF PORTB C@ $7F AND PORTB C! \ TURN ON LED=BEAM, DO NOT DISTURB OTHERS
97     ELSE PORTB C@ $80 OR PORTB C! \ TURN LED OFF
98     THEN ;
99
100 : SAR ( -- )        \ 10 BIT Successive approximation using stack recursion algo
101     0 GALVO !       \ Initialize to all bits OFF
102     10 0 DO GALVO @ \ Using the current approximation, turn on
103     1 9 I - LSHIFT OR DUP \ successively lower bit positions, starting at MSB
104     >PWM 50 MS      \ and try the new value on the galvo motor, see if lifts the n
105     ?BEAM IF DROP   \ If the beam is ON, still too high, drop this trial value
106     ELSE GALVO !    \ otherwise beam is blocked, save this trial value
107     THEN            \ continue this way using smaller and smaller trails
108     LOOP ;          \ Iterate for each bit position
109
110
111 : UPDATE-GALVO      \ simple PID loop update ... I only for example
112     ?BEAM IF 1 ERROR +! -1
113     ELSE -1 ERROR +! 1
114     THEN
115     GALVO @ 20 * 10 + ERROR @ - 20 / +
116     DUP 0 MAX 1023 MIN GALVO ! >PWM ;
117
118
119 |U| |S| |R| BACKGROUND electroBAL
120
121 \ This is the microbalance background task
122
123 : /BALANCE          \ Bring up the electro balance application
124     INIT-SYS        \ Initialize the system and variables
125     electroBAL BUILD \ Build and Activate this task
126     electroBAL ACTIVATE \ which runs forever in the background
127     INIT-TASK       \ final initializations
128     PAGE            \ Clear LCD page
129     ." Power-On Test OK" \ If you can read this Power-up Message, system is OK
130     1000 MS         \ pause so the message can be read
131     PAGE            \ clear the LCD page ( 2 lines in this case)
132     0 MODE C!       \ clear the engineering mode flag
133
134     SAR GALVO @ >PWM \ Quickly acquire using successive approximation
135
136     BEGIN           \ This is the BEGINning of the Infinite measurement loop
137     MODE C@ NOT IF \ IF engr mode non-zero, disable the Loop for debug, otherwise
138
139     UPDATE-GALVO    \ update using your favorite algorithm, results in GALVO
140
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10:51 am,21 Sep 2000

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```
141          PRINT-GALVO          \ Print the value in GALVO at the right place, with "~units"
142
143          TARE-GALVO
144 \      ?TARE IF DUP GALVO @ TARE ! SAR THEN \ Test Tare Switch, Update& SAR Tare IF ?TARE
145 \      GALVO @ TARE @ - \ Prepare Tared Difference
146 \      0 1 AT-XY 6 SPACES 0 1 AT-XY . \ CLEAN UP DISPLAY AND PRINT TARE Value
147 \      6 1 AT-XY ." Tare --PD3"
148
149          SERIAL-DATA-OUT
150
151          THEN
152          SHOW-BEAM          \ Show ?BEAM test results on the LEDs at PORTB.7
153          SPEED @ MS          \ idle here so speed of loop is not too fast
154          AGAIN ;          \ where the infinite loop returns to the BEGINING
155
```