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;-----
; Title      : 4WIRE_DOGM162_5_0V
;
; Functions  : SPI with 256 kHz
;              : 64 kHz at PB1 (Pin 15)
;              : Display of 64 different Contrast Settings
;              : For temporary Stop: PC0 (Pin 23) = Low
;-----

; CPU        : ATMEGA8A-PU
; Frequency   : 4.096 MHz
; Language    : Assembler Studio 4
; Date        : 06.06.2015
; Version     : 1.0
; Author      : Klaus
;-----

.include "m8def.inc"
;-----

; Reset and Interrupt Vector          Description

Begin: rjmp    Main                  ; 1 POWER ON RESET
      reti     ; 2 Int0-Interrupt
      reti     ; 3 Int1-Interrupt
      reti     ; 4 TC2 Compare Match
      reti     ; 5 TC2 Overflow
      reti     ; 6 TC1 Capture
      reti     ; 7 TC1 Compare Match A
      reti     ; 8 TC1 Compare Match B
      reti     ; 9 TC1 Overflow
      reti     ; 10 TC0 Overflow
      reti     ; 11 SPI, STC Serial Transfer Complete
      reti     ; 12 UART Rx complete
      reti     ; 13 UART Data Register Empty
      reti     ; 14 UART Tx complete
      reti     ; 15 ADC Conversion Complete
      reti     ; 16 EEPROM Ready
      reti     ; 17 Analog Comparator
      reti     ; 18 TWI (I2C) Serial Interface
      reti     ; 19 Store Program Memory Redy

;-----

; Start, Power ON, Reset, Stackpointer, Ports, Power Up Waiting Time

Main:
      ldi      R16, LOW (RAMEND)      ; Stackpointer Initialization
      out      SPL, R16
      ldi      R16, HIGH(RAMEND)
      out      SPH, R16

      ldi      R16, 0b00111111       ; PORTB Bits 1 until 5 = Output
      out      DDRB, R16
      ldi      R16, 0b00000000       ; PORTB Bits 6 and 7 = Quartz
      out      PORTB, R16

      ldi      R16, 0b00000000       ; PORTC Bits 0 until 7 = Input
      out      DDRC, R16
      ldi      R16, 0b00111111       ; PORTC Bits 0 until 5 = 1 (Pullup)
      out      PORTC, R16

      ldi      R16, 0b11111111       ; PORTD Bits 0 until 7 = Output
      out      DDRD, R16
      ldi      R16, 0b00000000       ; PORTD Bits 0 until 7 = 0
      out      PORTD, R16

      ldi      R16, 5                 ; 50 ms Power Up Waiting Time
      rcall    Wait

;-----

; Timer/Counter1: 64 kHz at PB1 Pin 15

      ldi      R18, (1<<COM1A0)
      out      TCCR1A, R18            ; COM1A0 = Toggle PB1 (Pin15)

      ldi      R18, (0<<CS10) | (1<<CS11) | (1<<WGM12)
      out      TCCR1B, R18            ; CS10 = 0 Prescaling 8

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; CS11 = 1
; WGM12 = CTC (Clear Timer on Compare Match)

ldi R19 , 0b00000000
ldi R18 , 0b00000011 ; 3 + 1 = 4
out OCR1AH , R19
out OCR1AL , R18 ; 4096 / (8 * 4) = 128 kHz (PB0 = 64 kHz)

ldi R18 , (1<<OCIE1A) ; OCIE1A = Output Compare A Match Interrupt
out TIMSK , R18 ; Enable

sei ; Global Interrupts Enabled

;-----
; CGRAM Initialization

ldi R20 , 112
ldi R21 , 83
rcall LCD_init
rcall CGRAM_Init
rcall Start
rjmp Loop1

;-----
; Initialization of the LCD DOGM162W-A 5V with 64 different Settings of the Contrast

Start:
rcall LCD_line1
ldi R16 , 1 ; 10 ms
rcall Wait
ldi R16 , 'A'
rcall LCD_data
ldi R16 , 'f'
rcall LCD_data
ldi R16 , 't'
rcall LCD_data
ldi R16 , 'e'
rcall LCD_data
ldi R16 , 'r'
rcall LCD_data
ldi R16 , ' '
rcall LCD_data
ldi R16 , 't'
rcall LCD_data
ldi R16 , 'h'
rcall LCD_data
ldi R16 , 'i'
rcall LCD_data
ldi R16 , 's'
rcall LCD_data
ldi R16 , ':'
rcall LCD_data
ldi R16 , ' '
rcall LCD_data
ldi R16 , 'p'
rcall LCD_data
ldi R16 , 'l'
rcall LCD_data
ldi R16 , 's'
rcall LCD_data
ldi R16 , '.'
rcall LCD_data

rcall LCD_line2
ldi R16 , 1 ; 10 ms
rcall Wait
ldi R16 , ' '
rcall LCD_data
ldi R16 , 'w'
rcall LCD_data
ldi R16 , 'a'
rcall LCD_data
ldi R16 , 'i'
rcall LCD_data

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ldi    R16    , 't'
rcall  LCD_data
ldi    R16    , ' '
rcall  LCD_data
ldi    R16    , 'p'
rcall  LCD_data
ldi    R16    , 'a'
rcall  LCD_data
ldi    R16    , 't'
rcall  LCD_data
ldi    R16    , 'i'
rcall  LCD_data
ldi    R16    , 'e'
rcall  LCD_data
ldi    R16    , 'n'
rcall  LCD_data
ldi    R16    , 't'
rcall  LCD_data
ldi    R16    , 'l'
rcall  LCD_data
ldi    R16    , 'y'
rcall  LCD_data
ldi    R16    , ' '
rcall  LCD_data

ldi    R16    , 250          ; 2500 ms
rcall  Wait

ret

;-----
; Counting up the Contrast Values C5 C4 C3 C2 C1 C0

Loop1:
ldi    R20    , 112          ;      C3 C2 C1 C0 | R20 = 112...127
;                                     | R20 = 0b01110000...0b01111111
ldi    R21    , 80           ; C5 C4      | R21 = 80... 83
;                                     | R21 = 0b01010000...0b01010011
;                                     | Ion: Icon Display Off
;                                     | Bon: Booster Circuit Off
;                                     | Bon: Charge Pump (3.3V -> 5V)

Loop2:
sbis   PINC    , 0           ; Stop Button
rjmp   Loop2
rcall  LCD_Init
ldi    R16    , 1            ; 10 ms
rcall  Wait
rcall  LCD_Text
ldi    R16    , 50           ; 500 ms
rcall  Wait
inc    R20      ; R20 = R20 + 1
cpi    R20     , 128          ; R20 = 128 ?
breq   Loop3     ; if R20 = 128
rjmp   Loop2     ; if R20 <= 127

Loop3:
inc    R21      ; R21 = R21 + 1
cpi    R21     , 84           ; R21 = 84 ? (possible only if R20 = 128
;                                     and R21 = 88
breq   Loop1     ; if R20 = 128 and R21 = 84
ldi    R20     , 112          ; R20 = 112
rjmp   Loop2     ; if R21 <= 83

;-----
; Subroutine for the creation of Text

LCD_Text:
ldi    ZL      , LOW(Text00*2) ; " CONTRAST 543210"
ldi    ZH      , HIGH(Text00*2)
rcall  TextOut10
ldi    ZL      , LOW(Text10*2) ; "SETTING C "
ldi    ZH      , HIGH(Text10*2)
rcall  TextOut20

cpi    R21     , 80

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    breq    T11
    cpi     R21    ,    81
    breq    T12
    cpi     R21    ,    82
    breq    T13
    cpi     R21    ,    83
    breq    T14

T11:
    ldi     ZL     ,    LOW(Text11*2) ; "00    "
    ldi     ZH     ,    HIGH(Text11*2)
    rcall   TextOut30
    rjmp    LCD_Text01

T12:
    ldi     ZL     ,    LOW(Text12*2) ; "01    "
    ldi     ZH     ,    HIGH(Text12*2)
    rcall   TextOut30
    rjmp    LCD_Text01

T13:
    ldi     ZL     ,    LOW(Text13*2) ; "10    "
    ldi     ZH     ,    HIGH(Text13*2)
    rcall   TextOut30
    rjmp    LCD_Text01

T14:
    ldi     ZL     ,    LOW(Text14*2) ; "11    "
    ldi     ZH     ,    HIGH(Text14*2)
    rcall   TextOut30
    rjmp    LCD_Text01

LCD_Text01:
    cpi     R20    ,    112
    breq    T21
    cpi     R20    ,    113
    breq    T22
    cpi     R20    ,    114
    breq    T23
    cpi     R20    ,    115
    breq    T24
    cpi     R20    ,    116
    breq    T25
    cpi     R20    ,    117
    breq    T26
    cpi     R20    ,    118
    breq    T27
    cpi     R20    ,    119
    breq    T28
    cpi     R20    ,    120
    breq    T29
    cpi     R20    ,    121
    breq    T30
    cpi     R20    ,    122
    breq    T31
    cpi     R20    ,    123
    breq    T32
    cpi     R20    ,    124
    breq    T33
    cpi     R20    ,    125
    breq    T34
    cpi     R20    ,    126
    breq    T35
    cpi     R20    ,    127
    breq    T36

T21:    rjmp    LCD_Text21
T22:    rjmp    LCD_Text22
T23:    rjmp    LCD_Text23
T24:    rjmp    LCD_Text24
T25:    rjmp    LCD_Text25
T26:    rjmp    LCD_Text26
T27:    rjmp    LCD_Text27
T28:    rjmp    LCD_Text28
T29:    rjmp    LCD_Text29
T30:    rjmp    LCD_Text30
T31:    rjmp    LCD_Text31
T32:    rjmp    LCD_Text32

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T33: rjmp LCD_Text33
T34: rjmp LCD_Text34
T35: rjmp LCD_Text35
T36: rjmp LCD_Text36

LCD_Text21:
 ldi ZL , LOW(Text21*2) ; "0000"
 ldi ZH , HIGH(Text21*2)
 rcall TextOut40
 ldi R22 , 1
 rcall LCD_Text50
 rjmp LCD_Text40

LCD_Text22:
 ldi ZL , LOW(Text22*2) ; "0001"
 ldi ZH , HIGH(Text22*2)
 rcall TextOut40
 ldi R22 , 2
 rcall LCD_Text50
 rjmp LCD_Text40

LCD_Text23:
 ldi ZL , LOW(Text23*2) ; "0010"
 ldi ZH , HIGH(Text23*2)
 rcall TextOut40
 ldi R22 , 3
 rcall LCD_Text50
 rjmp LCD_Text40

LCD_Text24:
 ldi ZL , LOW(Text24*2) ; "0011"
 ldi ZH , HIGH(Text24*2)
 rcall TextOut40
 ldi R22 , 4
 rcall LCD_Text50
 rjmp LCD_Text40

LCD_Text25:
 ldi ZL , LOW(Text25*2) ; "0100"
 ldi ZH , HIGH(Text25*2)
 rcall TextOut40
 ldi R22 , 5
 rcall LCD_Text50
 rjmp LCD_Text40

LCD_Text26:
 ldi ZL , LOW(Text26*2) ; "0101"
 ldi ZH , HIGH(Text26*2)
 rcall TextOut40
 ldi R22 , 6
 rcall LCD_Text50
 rjmp LCD_Text40

LCD_Text27:
 ldi ZL , LOW(Text27*2) ; "0110"
 ldi ZH , HIGH(Text27*2)
 rcall TextOut40
 ldi R22 , 7
 rcall LCD_Text50
 rjmp LCD_Text40

LCD_Text28:
 ldi ZL , LOW(Text28*2) ; "0111"
 ldi ZH , HIGH(Text28*2)
 rcall TextOut40
 ldi R22 , 8
 rcall LCD_Text50
 rjmp LCD_Text40

LCD_Text29:
 ldi ZL , LOW(Text29*2) ; "1000"
 ldi ZH , HIGH(Text29*2)
 rcall TextOut40
 ldi R22 , 9
 rcall LCD_Text50
 rjmp LCD_Text40

LCD_Text30:
 ldi ZL , LOW(Text30*2) ; "1001"
 ldi ZH , HIGH(Text30*2)
 rcall TextOut40
 ldi R22 , 10
 rcall LCD_Text50

```

        rjmp     LCD_Text40
LCD_Text31:
        ldi      ZL      ,    LOW(Text31*2)  ; "1010"
        ldi      ZH      ,    HIGH(Text31*2)
        rcall    TextOut40
        ldi      R22     ,    11
        rcall    LCD_Text50
        rjmp     LCD_Text40
LCD_Text32:
        ldi      ZL      ,    LOW(Text32*2)  ; "1011"
        ldi      ZH      ,    HIGH(Text32*2)
        rcall    TextOut40
        ldi      R22     ,    12
        rcall    LCD_Text50
        rjmp     LCD_Text40
LCD_Text33:
        ldi      ZL      ,    LOW(Text33*2)  ; "1100"
        ldi      ZH      ,    HIGH(Text33*2)
        rcall    TextOut40
        ldi      R22     ,    13
        rcall    LCD_Text50
        rjmp     LCD_Text40
LCD_Text34:
        ldi      ZL      ,    LOW(Text34*2)  ; "1101"
        ldi      ZH      ,    HIGH(Text34*2)
        rcall    TextOut40
        ldi      R22     ,    14
        rcall    LCD_Text50
        rjmp     LCD_Text40
LCD_Text35:
        ldi      ZL      ,    LOW(Text35*2)  ; "1110"
        ldi      ZH      ,    HIGH(Text35*2)
        rcall    TextOut40
        ldi      R22     ,    15
        rcall    LCD_Text50
        rjmp     LCD_Text40
LCD_Text36:
        ldi      ZL      ,    LOW(Text36*2)  ; "1111"
        ldi      ZH      ,    HIGH(Text36*2)
        rcall    TextOut40
        ldi      R22     ,    16
        rcall    LCD_Text50
        rjmp     LCD_Text40
LCD_Text40:
        ret

LCD_Text50:                                ; Bar Graph in LCD_line3
;      push     R17
;      ldi      R17     ,    16
;      ldi      R16     ,    32
;      rcall    LCD_goto
;LCD_Text51:
;      ldi      R16     ,    32
;      rcall    LCD_data
;      dec     R17
;      cpi     R17     ,    0
;      breq    LCD_Text52
;      rjmp    LCD_Text51
;LCD_Text52:
;      ldi      R16     ,    32
;      rcall    LCD_goto
;LCD_Text53:
;      ldi      R16     ,    5
;      rcall    LCD_data
;      dec     R22
;      cpi     R22     ,    0
;      breq    LCD_Text54
;      rjmp    LCD_Text53
;LCD_Text54:
;      pop     R17
        ret
;-----
; Subroutines for the Output of Text to the LCD

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```

TextOut10:
    push    R16
    rcall   LCD_line1
TextOut11:
    lpm     R16, Z+
    cpi     R16, 255
    breq    TextOut12
    rcall   LCD_data
    rjmp    TextOut11
TextOut12:
    pop     R16
    ret

TextOut20:
    push    R16
    rcall   LCD_line2
TextOut21:
    lpm     R16, Z+
    cpi     R16, 255
    breq    TextOut22
    rcall   LCD_data
    rjmp    TextOut21
TextOut22:
    pop     R16
    ret

TextOut30:
    push    R16
    ldi     R16, 74
    rcall   LCD_goto
TextOut31:
    lpm     R16, Z+
    cpi     R16, 255
    breq    TextOut32
    rcall   LCD_data
    rjmp    TextOut31
TextOut32:
    pop     R16
    ret

TextOut40:
    push    R16
    ldi     R16, 76
    rcall   LCD_goto
TextOut41:
    lpm     R16, Z+
    cpi     R16, 255
    breq    TextOut42
    rcall   LCD_data
    rjmp    TextOut41
TextOut42:
    pop     R16
    ret

; *****
; Begin Initializaton of LCD DOGM162W-A / 5.0 V
; *****
LCD_init:

;-----
; Function Set 01: 3 Mal den 8-Bit Mode ausgeben

    ldi     R16, 0b00110000    ; 8 Bit Mode
    swap    R16                ; 0b00000011 wegen 4 Bit Verdrahtung
                                ; RS = Low = Command
                                ; R/W = Low = Read
    out     PORTD, R16         ; must be set 3 times, why?
;-----
; Function Set 01: Das 1. Mal

    rcall   LCD_enable        ; Impuls von E = MPU D.6 Pin 12

    ldi     R16, 1

```

```

        rcall    Wait

;-----
; Function Set 02: Das 2. Mal

        rcall    LCD_enable                ; Impuls von E = MPU D.6 Pin 12

        ldi      R16      ,    1
        rcall    Wait

;-----
; Function Set 03: Das 3. Mal

        rcall    LCD_enable                ; Impuls von E = MPU D.6 Pin 12

        ldi      R16      ,    1
        rcall    Wait

;-----
; Function Set 04: Den 4-Bit Mode einschalten

        ldi      R16      ,    0b00100000    ; 4 Bit Mode, D.4 = Low = Command
        swap     R16                        ; 0b00000010 wegen 4 Bit Verdrahtung
        out      PORTD    ,    R16
        rcall    LCD_enable                ; Impuls von E = MPU D.6 Pin 12

        ldi      R16      ,    1
        rcall    Wait

;-----
; Function Set 05: 4-Bit Mode, 2 Lines, 5x8 Dots, Instruction table 1, CGRam not available

        ldi      R16      ,    0b00101001
        rcall    LCD_cmd

;-----
; Function Set 06: Bias, 2 Lines

        ldi      R16      ,    0b00011100    ; BS: 1/4, 2 Lines
        rcall    LCD_cmd

;-----
; Function Set 07: Contrast Set (Low Byte)

;        ldi      R16      ,    0b01111000    ; Contrast Set
;        rcall    LCD_cmd

; Contrast Setting by Program
        mov      R16      ,    R20                ; Contrast: Content of R20
        rcall    LCD_cmd

;-----
; Function Set 08: ICON/Power/Contrast (High Byte)

;        ldi      R16      ,    0b01010010    ; Ion: ICON Off
;        rcall    LCD_cmd                ; Bon: Charge Pump Off
;                                        ; C5: Contrast Value On
;                                        ; C4: Contrast Value Off

; Contrast Setting by Program
        mov      R16      ,    R21                ; Contrast: Content of R21
        rcall    LCD_cmd

;-----
; Function Set 09: Follower Control

        ldi      R16      ,    0b01101010    ; Follower CCircuit On
        rcall    LCD_cmd                ; Follower Amplified Ratio:
;                                        ; Rab2=0 Rab1=1 Rab0=0

; Remarks: Fon=0: No Contrast, Fon must be set to 1
;          Rab2=0 Rab1=0 Rab0=0 Contrast: None
;          Rab2=1 Rab1=1 Rab0=1 Contrast: Very High

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;-----
; Function Set 10: 4-Bit Mode, 2 Lines, 5x8 Dots, Normal Instructions, CGRam available

    ldi    R16    ,    0b00101000
    rcall  LCD_cmd

;-----
; Function Set 11: Display On

    ldi    R16    ,    0b00001100    ; Display On
    rcall  LCD_cmd    ;

;-----
; Function Set 12: Clear Display

    ldi    R16    ,    0b00001101    ; Clear Display
    rcall  LCD_cmd    ;

;-----
; Functin Set 13: Entry Mode Set

    ldi    R16    ,    0b00001100    ; Entry Mode Set
    rcall  LCD_cmd

;-----
; The End

    ret

; *****
; End Initialization of LCD DOGM162W-A / 5.0 V
; *****

;-----
; CGRAM Initialisation

CGRAM_Init:
    ldi    R16    ,    0b01000000    ; Set CGRAM address in DDRAM
    rcall  LCD_cmd    ; Instruction Table 1
CGRAM_Init1:
    ldi    ZL     ,    LOW(Symbols*2)
    ldi    ZH     ,    HIGH(Symbols*2)
CGRAM_Init2:
    lpm    R16    ,    Z+
    cpi    R16    ,    255
    breq   CGRAM_Init3
    rcall  LCD_data
    rjmp   CGRAM_Init2
CGRAM_Init3:
    ret

;-----
; Ausgabe von Daten zur Anzeige im LCD, sendet ein Datenbyte

LCD_data:
    push   R17
    mov    R17    ,    R16            ; "Sicherungskopie" für das 2. Nibble
    swap   R16
    ; Nibbles vertauschen
    andi   R16    ,    0b00001111    ; oberes Nibble auf Null setzen
    sbr    R16    ,    0b00010000    ; RS auf 1
    out    PORTD   ,    R16            ; 1. Nibble plus RS ausgeben
    rcall  LCD_enable    ; 1. Nibble plus RS übernehmen
    ; 2. Nibble kein swap, da es in R17 schon an
    ; der richtigen Stelle steht
    andi   R17    ,    0b00001111    ; oberes Nibble auf Null setzen
    sbr    R17    ,    0b00010000    ; RS auf 1
    out    PORTD   ,    R17            ; 2. Nibble plus RS ausgeben
    rcall  LCD_enable    ; 2. Nibble plus RS übernehmen
    rcall  LCD_busy    ; Busy Flag prüfen
    pop    R17
    ret

;-----
; Ausgabe von Kommandos ans LCD, wie LCD_data aber RS = 0

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```

LCD_cmd:
    push    R17
    mov     R17, R16 ; "Sicherungskopie" für das 2. Nibble
    swap    R16      ; Nibbles vertauschen
    andi    R16, 0b00001111 ; oberes Nibble auf Null setzen
    sbr     R16, 0b00000000 ; RS auf 0 (bzw. nicht auf 1)
    out     PORTD, R16 ; 1. Nibble ausgeben
    rcall   LCD_enable ; 1. Nibble übernehmen
    ; 2. Nibble kein swap, da es in R17 schon an
    ; der richtigen Stelle steht
    andi    R17, 0b00001111 ; oberes Nibble auf Null setzen
    sbr     R17, 0b00000000 ; RS auf 0 (bzw. nicht auf 1)
    out     PORTD, R17 ; 2. Nibble ausgeben
    rcall   LCD_enable ; 2. Nibble übernehmen
    rcall   LCD_busy   ; Busy Flag prüfen
    pop     R17
    ret

;-----
LCD_enable:
    sbi     PORTD, 6 ; Enable High
    nop
    nop
    nop
    cbi     PORTD, 6 ; Enable Low
    ret

;-----
; Busy Flag prüfen

LCD_busy:
    push    R16
    ldi     R16, 0b11110000 ; Disable Data Bit Outputs
    out     DDRD, R16
    ldi     R16, 0b00000000 ; Clear all outputs
    out     PORTD, R16

LCD_busy1:
    ldi     R16, 0b00100000 ; Enable only read bit
    out     PORTD, R16
    sbi     PORTD, 6 ; Raise the Enable signal
    nop
    nop
    in      R16, PIND ; Read the current values
    cbi     PORTD, 6 ; Disable the Enable signal
    rcall   LCD_enable ; Puls the Enable (the second nibble is discarded)
    swap    R16      ; Busy flag von R16.3 nach R16.7
    sbrc    R16, 7 ; Check busy flag
    rjmp    LCD_busy1 ;
    ldi     R16, 0b11111111 ; Enable all outputs
    out     DDRD, R16
    pop     R16
    ret

;-----
LCD_clear:
    push    R16
    ldi     R16, 0b00000001 ; Display Clear
    rcall   LCD_cmd
    pop     R16
    ret

;-----
LCD_home:
    push    R16
    ldi     R16, 0b00000010 ; Display Cursor HOME
    rcall   LCD_cmd
    pop     R16
    ret

;-----
LCD_off:
    push    R16
    ldi     R16, 0b00001000 ; LCD OFF

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```

        rcall    LCD_cmd
        pop      R16
        ret

;-----
LCD_on:
        push    R16
        ldi     R16,    0b00001100    ; LCD On, Cursor Off, Blink Off
        rcall   LCD_cmd
        pop      R16
        ret

;-----
LCD_CurOn:
        push    R16
        ldi     R16,    0b00001110    ; LCD On, Cursor On, Blink Off
        rcall   LCD_cmd
        pop      R16
        ret

;-----
LCD_BlkJOn:
        push    R16
        ldi     R16,    0b00001101    ; LCD On, Cursor Off, Blink On
        rcall   LCD_cmd
        pop      R16
        ret

;-----
LCD_CurBlkJOn:
        push    R16
        ldi     R16,    0b00001111    ; LCD On, Cursor On, Blink On
        rcall   LCD_cmd
        pop      R16
        ret

;-----
; LCD_line1:  0
; LCD_line2: 64
; LCD_line3: 2 Lines only

LCD_line1:
        push    R16
        ldi     R16,    0b10000000    ; DDRAM Address 0x00 = 0
        rcall   LCD_cmd
        pop      R16
        ret

;-----
LCD_line2:
        push    R16
        ldi     R16,    0b11000000    ; DDRAM Address 0x40 = 64
        rcall   LCD_cmd
        pop      R16
        ret

;-----
LCD_line3:                                ; 2 Lines only
;        push    R16
;        ldi     R16,    0b10100000    ; DDRAM Address 0x20
;        rcall   LCD_cmd
;        pop      R16
;        ret

;-----
; Goto R16 = Addresses in LCD_line1: 0 ... 15
;                               LCD_line2: 64 ... 79
;                               LCD_line3: 2 Lines only

LCD_goto:
        push    R16
        ori     R16,    0b10000000    ; Goto DDRAM Address R16
        rcall   LCD_cmd
        pop      R16

```

```

        ret

;-----
LCD_CUL:
    push    R16
    ldi     R16,    0b00010000    ; Cursor one position left
    rcall   LCD_cmd
    pop     R16
    ret

;-----
LCD_CUR:
    push    R16
    ldi     R16,    0b00010100    ; Cursor one position right
    rcall   LCD_cmd
    pop     R16
    ret

;-----
; Waiting Time: R16 = 1 ==> 0.01 s, R16 = 255 ==> 2.55 s at 3.686 MHz

Wait:
    push    R16
    push    R17
    push    R18

    cpi     R16,    0
    breq    WLoop0
WLoop1:
    ldi     R17,    0b01101110
WLoop2:
    ldi     R18,    0b01101110
WLoop3:
    dec     R18
    brne    WLoop3
    nop
    nop
    dec     R17
    brne    WLoop2
    dec     R16
    brne    WLoop1
WLoop0:
    pop     R18
    pop     R17
    pop     R16
    ret

;-----
; Text

Text00: .db    " CONTRAST 543210",255,0

Text10: .db    "Setting C ",255,0

Text11: .db    "00    ",255,0
Text12: .db    "01    ",255,0
Text13: .db    "10    ",255,0
Text14: .db    "11    ",255,0

Text21: .db    "0000",255,0
Text22: .db    "0001",255,0
Text23: .db    "0010",255,0
Text24: .db    "0011",255,0
Text25: .db    "0100",255,0
Text26: .db    "0101",255,0
Text27: .db    "0110",255,0
Text28: .db    "0111",255,0
Text29: .db    "1000",255,0
Text30: .db    "1001",255,0
Text31: .db    "1010",255,0
Text32: .db    "1011",255,0
Text33: .db    "1100",255,0
Text34: .db    "1101",255,0
Text35: .db    "1110",255,0

```

Text36: .db "1111",255,0

```
;-
; Symbols for the CGRAM

Symbols:
.db 0,0,0,0,0,0,0,0
.db 0,0,0,16,16,16,0,0
.db 0,0,0,16,16,16,0,0
.db 0,0,0,20,20,20,0,0
.db 0,0,0,20,20,20,0,0
.db 0,0,0,21,21,21,0,0,255,0
;-
```