```
'DDS-Generator - AD9851 - AD8321
'-----------------------------------------------

' es fehlt noch: Sweep-Modus, Offsets für S/E, Bands, Menü, RIT, LSB/USB


'MCUSR = &H80 besser für M32: JTAG über Fusebit deaktivieren
'MCUSR = &H80

$regfile = "m32def.dat"
$crystal = 4000000
$baud = 9600

Config Lcdpin = Pin , Db4 = Portc.0 , Db5 = Portc.1 , Db6 = Portc.2 , Db7 = Portc.3 , E = Portc.5 , Rs =
Portc.4
Config Lcd = 20 * 4


'für Tastaturroutinen--------------------

Ddra = &H0F                                                 '00001111 Ein- u. Ausgänge
Porta = &HF0                                                'Eing. mit PullUp, Ausg. auf 0

Ddrd.6 = 0
Portd.6 = 1                                                 '5. Scan-Leitung für 4 ext. Taster

Ddrd.3 = 0                                                  '=INT1
Portd.3 = 1                                                 'Eing. + PullUp

On Int1 Onint1
Mcucr.isc10 = 1                                             'INT1 bei FALLING + RISING
Mcucr.isc11 = 0                                             '=beim Drücken u. Loslassen einer Taste
Gimsk.int1 = 1

Dim Key As String * 1 : Key = ""
Dim Tastenarr As String * 20 : Tastenarr = "123CU456RV789FW-0+EX"


'für Drehgeber---------------------------

Ddrd.2 = 0                                                  'Eingänge mit Pullup für Drehgeber
Portd.2 = 1

Ddrd.4 = 0
Portd.4 = 1

On Int0 Onint0
Mcucr.isc00 = 1                                             'INT0 bei FALLING + RISING
Mcucr.isc01 = 0
Gimsk.int0 = 1

Dim Drehgeber As Long                                       'wird von ISR (INT0) verändert
Dim Drehgeber_alt As Long


'für RS232-------------------------------

On Urxc Onrxd                                               'Interrupt-Routine setzen
Enable Urxc

Dim At_command As String * 16                               'AT FRQ=123456789
                                        'AT LEV=-127

'für Anschlüsse AD9851-------------------

Ddrb = &B11111011                                           'bis auf PB2 alles Ausgänge: AD8951+AD8321

9851_data Alias Portb.0
9851_clk Alias Portb.1
9851_fqud Alias Portb.3
9851_reset Alias Portb.4


'für Anschlüsse AD8321-------------------

8321_data Alias Portb.5
8321_clk Alias Portb.6
8321_ena Alias Portb.7

Ddrc = &B11111111                                           'Ausgänge: AD8321 + Display

Att32 Alias Portc.6
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```
Att64 Alias Portc.7

Att32 = 0                                                   'zunächst ohne Dämpfung
Att64 = 0


'für 1000Hz-Ausgang---------------------

Ddrd.5 = 1                                                  'OC1A-Ausgang-Buffer einschalten
Tccr1a.com1a0 = 1                                           'Toogle OC1A
Tccr1b.ctc1 = 1                                             'CTC-Modus (CLEAR TIMER ON COMPARE)
Ocr1ah = &H07                                               'zuerst HighByte
Ocr1al = &HD0


'---------------------------------------

Declare Sub Init
Declare Sub Show_frequ_anz(byval X As Integer , Byval Y As Integer)
Declare Sub Show_frequ_offset(byval X As Integer , Byval Y As Integer)
Declare Sub Show_entermode
Declare Sub Show_step(byval X As Integer , Byval Y As Integer)
Declare Sub Show_pegel_anz(byval X As Integer , Byval Y As Integer)
Declare Sub Calc_frequ_gen
Declare Sub Reset_ad9851
Declare Sub To_ad9851
Declare Sub To_ad8321(pegel As Integer)                     'Dämpfung; -130..+10, Step: 0.7526 dB
Declare Sub Check_pegel_gen

Dim Frequ_anz As Long : Frequ_anz = 1000000                 'als Defaultwerte
Dim Frequ_offset As Long : Frequ_offset = 0
Dim Frequ_gen As Long : Frequ_gen = Frequ_anz
Dim Frequ_step As Long : Frequ_step = 1000
Dim Ext_multi As Byte : Ext_multi = 1

Dim Pegel_anz As Integer : Pegel_anz = 0                    '-130... + 10dbm
Dim Pegel_gen_akt As Integer                                ' (pseudo-) aktueller Pegel-Value

Dim Frequ_anz_ee As Eram Long                               'fürs EEPROM
Dim Frequ_offset_ee As Eram Long
Dim Frequ_step_ee As Eram Long
Dim Pegel_anz_ee As Eram Integer

Dim Am As Byte : Am = 0                                     'AM-Modulation 1000Hz ein/aus
Dim Entermode As Byte : Entermode = 0                       '0: Frequ, 1: Offset, 2: Pegel
Dim Eingabe As String * 16

Dim L As Long

Sreg.7 = 1                                                  'Interrupts freigeben
Cursor Off
Cursor Noblink

Cls
Lcd "DDS-Generator"
Locate 2 , 1
Lcd "50 Hz - 70 (75) MHz"
Locate 3 , 1
Lcd "Vers. 1.0 22.06.2005";
Locate 4 , 1
Lcd "(c) by DiLi-Soft"

Waitms 2000
Reset_ad9851
Init

Drehgeber = Frequ_anz
Drehgeber_alt = Drehgeber
Do
   If Drehgeber <> Drehgeber_alt Then

      If Entermode = 0 Then
         L = Drehgeber - Drehgeber_alt
         L = L * Frequ_step
         Frequ_anz = Frequ_anz + L
         If Frequ_anz < 0 Then
            Frequ_anz = 0
         End If
         Drehgeber = Frequ_anz
         Drehgeber_alt = Drehgeber
         Call Show_frequ_anz(7 , 1)
         Calc_frequ_gen
```

```
      To_ad9851
      Eingabe = ""
   End If

   If Entermode = 1 Then
      L = Drehgeber - Drehgeber_alt
      L = L * Frequ_step
      Frequ_offset = Frequ_offset + L
      Drehgeber = Frequ_offset
      Drehgeber_alt = Drehgeber
      Call Show_frequ_offset(7 , 2)
      Calc_frequ_gen
      To_ad9851
      Eingabe = ""
   End If

   If Entermode = 2 Then
      L = Drehgeber - Drehgeber_alt
      Pegel_anz = Pegel_anz + L
      If Pegel_anz > 10 Then
         Pegel_anz = 10
      End If
      If Pegel_anz < -130 Then
         Pegel_anz = -130
      End If
      Drehgeber = Pegel_anz
      Drehgeber_alt = Drehgeber
      Call Show_pegel_anz(7 , 4)
      Call To_ad8321(pegel_anz)
      Eingabe = ""
   End If

   Waitms 50
End If


If At_command <> "" Then
   If Left(at_command , 3) = "AT " Then

      If Mid(at_command , 4 , 4) = "FRQ=" Then
         Eingabe = Mid(at_command , 8 , 9)
         Frequ_anz = Val(eingabe)
         Eingabe = ""
         Call Show_frequ_anz(7 , 1)
         Calc_frequ_gen
         To_ad9851
         Print " ok"
         Goto Atende
      End If

      If Mid(at_command , 4 , 4) = "OFF=" Then
         Eingabe = Mid(at_command , 8 , 9)
         Frequ_offset = Val(eingabe)
         Eingabe = ""
         Call Show_frequ_offset(7 , 2)
         Calc_frequ_gen
         To_ad9851
         Print " ok"
         Goto Atende
      End If

      If Mid(at_command , 4 , 4) = "LEV=" Then
         Eingabe = Mid(at_command , 8 , 9)
         Pegel_anz = Val(eingabe)
         Eingabe = ""
         Call Show_pegel_anz(7 , 4)
         Call To_ad8321(pegel_anz)
         Print " ok"
         Goto Atende
      End If

      If Mid(at_command , 4 , 4) = "EXT=" Then
         Eingabe = Mid(at_command , 8 , 9)
         Ext_multi = Val(eingabe)
         Calc_frequ_gen
         To_ad9851
         Eingabe = ""
         Print " ok"
         Goto Atende
      End If

      Print " unknown command"
```

```
   Else
      Print " unknown command"
   End If
   Atende:
   At_command = ""
End If


If Key <> "" Then
   Select Case Key

      Case "U" : If Eingabe = "" Then                    'Taste 1: entermode toogeln
                    Incr Entermode
                    If Entermode = 3 Then
                       Entermode = 0
                    End If
                    Show_entermode
                 End If

      Case "V" : If Am = 0 Then                          'Taste 2: AM ein/aus
                    Timer1 = 0
                    Tccr1b.cs10 = 1                      'OnCompare einschalten; 1000Hz ein
                    Am = 1
                    Locate 3 , 19
                    Lcd "AM";
                 Else
                    Tccr1b.cs10 = 0                      '1000Hz ausschalten
                    Am = 0
                    Locate 3 , 19
                    Lcd "  ";
                 End If

      Case "W" : If Eingabe = "" Then                    'Taste 3: speichern
                    Cls
                    Locate 2 , 1
                    Lcd "Saving? (CE / E)"
                    Key = ""
                    While Key = ""
                    Wend
                    If Key = "E" Then
                       Locate 3 , 1
                       Lcd "saving...";
                       Sreg.7 = 0                        'Interrupts aus
                       Frequ_anz_ee = Frequ_anz
                       Frequ_offset_ee = Frequ_offset
                       Frequ_step_ee = Frequ_step
                       Pegel_anz_ee = Pegel_anz
                       Sreg.7 = 1                        'Ints wieder an
                       Waitms 100
                       Lcd " ok"
                       Waitms 500
                    End If
                    Init
                 End If

      Case "X" : If Eingabe = "" Then                    'Taste 4: Speicherabruf
                    If Frequ_step_ee <> &HFFFFFFFF Then  'programmiert?
                       Cls
                       Locate 2 , 1
                       Lcd "Restore? (CE / E)"
                       Key = ""
                       While Key = ""
                       Wend
                       If Key = "E" Then
                          Sreg.7 = 0
                          Frequ_anz = Frequ_anz_ee
                          Frequ_offset = Frequ_offset_ee
                          Frequ_step = Frequ_step_ee
                          Pegel_anz = Pegel_anz_ee
                          Sreg.7 = 1
                          Entermode = 0
                       End If
                       Init
                    End If
                 End If

      Case "C" : Eingabe = ""                            'CE-Taste
                  Select Case Entermode
                     Case 0 : Call Show_frequ_anz(7 , 1)

                     Case 1 : Call Show_frequ_offset(7 , 2)
```

```
                Case 2 : Call Show_pegel_anz(7 , 4)
             End Select

Case "R" : L = Frequ_anz \ Frequ_step              'genau aufs Raster setzen
           Frequ_anz = L * Frequ_step
           Call Show_frequ_anz(7 , 1)
           Calc_frequ_gen
           To_ad9851

Case "F" : Print "F-Key"                           'noch unbelegt

Case "E" : If Eingabe <> "" Then                   'Eingabe abschließen
               Select Case Entermode
                  Case 0 : Frequ_anz = Val(eingabe)
                           Frequ_anz = Frequ_anz * 1000
                           Eingabe = ""
                           Call Show_frequ_anz(7 , 1)
                           Calc_frequ_gen
                           To_ad9851

                  Case 1 : Frequ_offset = Val(eingabe)
                           Eingabe = ""
                           Call Show_frequ_offset(7 , 2)
                           Calc_frequ_gen
                           To_ad9851

                  Case 2 : Pegel_anz = Val(eingabe)
                           If Pegel_anz > 10 Then
                              Pegel_anz = 10
                           End If
                           If Pegel_anz < -130 Then
                              Pegel_anz = -130
                           End If
                           Eingabe = ""
                           Call Show_pegel_anz(7 , 4)
                           Call To_ad8321(pegel_anz)

               End Select
               Show_entermode
           End If

Case "0" To "9" : Select Case Entermode
                      Case 0 : If Len(eingabe) < 6 Then
                                   Eingabe = Eingabe + Key
                                   Locate 1 , 7
                                   Lcd Spc(11) ; "k";
                                   Locate 1 , 7
                                   Lcd Eingabe;
                               End If

                      Case 1 : If Len(eingabe) < 8 Then
                                   Eingabe = Eingabe + Key
                                   Locate 2 , 7
                                   Lcd Spc(11);
                                   Locate 2 , 7
                                   Lcd Eingabe;
                               Else
                                   If Len(eingabe) < 9 Then
                                      If Left(eingabe , 1) = "-" Then
                                         Eingabe = Eingabe + Key
                                         Locate 2 , 7
                                         Lcd Spc(11);
                                         Locate 2 , 7
                                         Lcd Eingabe;
                                      End If
                                   End If
                               End If

                      Case 2 : If Len(eingabe) < 3 Then
                                   Eingabe = Eingabe + Key
                                   Locate 4 , 7
                                   Lcd Spc(14);
                                   Locate 4 , 7
                                   Lcd Eingabe;
                               Else
                                   If Len(eingabe) < 4 Then
                                      If Left(eingabe , 1) = "-" Then
                                         Eingabe = Eingabe + Key
                                         Locate 4 , 7
                                         Lcd Spc(14);
                                         Locate 4 , 7
```

```
                                        Lcd Eingabe;
                                    End If
                                End If
                            End If
                        End Select

        Case "+" : If Entermode = 0 Then
                     Select Case Frequ_step
                       Case 1 : Frequ_step = 10
                       Case 10 : Frequ_step = 100
                       Case 100 : Frequ_step = 1000
                       Case 1000 : Frequ_step = 5000
                       Case 5000 : Frequ_step = 9000
                       Case 9000 : Frequ_step = 10000
                       Case 10000 : Frequ_step = 12500
                       Case 12500 : Frequ_step = 25000
                       Case 25000 : Frequ_step = 50000
                       Case 50000 : Frequ_step = 100000
                       Case 100000 : Frequ_step = 1000000
                       Case 1000000 : Frequ_step = 10000000
                       Case 10000000 : Frequ_step = 1
                     End Select
                     Call Show_step(7 , 3)
                   End If

        Case "-" : Select Case Entermode
                      Case 0 : Select Case Frequ_step
                                  Case 1 : Frequ_step = 10000000
                                  Case 10 : Frequ_step = 1
                                  Case 100 : Frequ_step = 10
                                  Case 1000 : Frequ_step = 100
                                  Case 5000 : Frequ_step = 1000
                                  Case 9000 : Frequ_step = 5000
                                  Case 10000 : Frequ_step = 9000
                                  Case 12500 : Frequ_step = 10000
                                  Case 25000 : Frequ_step = 12500
                                  Case 50000 : Frequ_step = 25000
                                  Case 100000 : Frequ_step = 50000
                                  Case 1000000 : Frequ_step = 100000
                                  Case 10000000 : Frequ_step = 1000000
                               End Select
                               Call Show_step(7 , 3)

                      Case 1 : If Len(eingabe) = 0 Then    ' - am Anfang v. Offset
                                  Eingabe = Key
                                  Locate 2 , 7
                                  Lcd Spc(11);
                                  Locate 2 , 7
                                  Lcd Eingabe;
                               End If

                      Case 2 : If Len(eingabe) = 0 Then    ' - am Anfang v. Offset
                                  Eingabe = Key
                                  Locate 4 , 7
                                  Lcd Spc(14);
                                  Locate 4 , 7
                                  Lcd Eingabe;
                               End If
                   End Select
      End Select

      Key = ""                                              'damit ist Taste abgeholt
   End If                                                   'if key <> ""
Loop

End


'---------------------------------------

Sub Init
   Cls

   Lcd "Frqu:";
   Call Show_frequ_anz(7 , 1)
   Calc_frequ_gen
   To_ad9851

   Locate 2 , 1
   Lcd "Offs:";
   Call Show_frequ_offset(7 , 2)
```

```
   Locate 3 , 1
   Lcd "Step:";
   Call Show_step(7 , 3)

   Locate 3 , 19
   If Am = 1 Then
      Lcd "AM";
   Else
      Lcd "  ";
   End If

   Locate 4 , 1
   Lcd "Pout:" ;
   Call Show_pegel_anz(7 , 4)
   Call To_ad8321(pegel_anz)

   Show_entermode
End Sub


'Anzeige-Routinen-------------------------

Sub Show_frequ_anz(byval X As Integer , Byval Y As Integer)
   Local S2 As String * 11
   Local S As String * 9

   Locate Y , X
   S = Str(frequ_anz)
   S = Format(s , "000000000")
   S2 = Left(s , 3) + "." + Mid(s , 4 , 3) + "." + Right(s , 3)
   Lcd S2 ; " Hz";
End Sub


Sub Show_frequ_offset(byval X As Integer , Byval Y As Integer)
   Local S2 As String * 11
   Local S As String * 9

   Locate Y , X
   S = Str(frequ_offset)
   S = Format(s , "+00000000")
   S2 = Left(s , 3) + "." + Mid(s , 4 , 3) + "." + Right(s , 3)
   Lcd S2 ; " Hz";
End Sub


Sub Show_entermode
   Select Case Entermode
      Case 0 : Locate 2 , 6
               Lcd " ";
               Locate 4 , 6
               Lcd " ";

      Case 1 : Locate 2 , 6
               Lcd "*";
               Locate 4 , 6
               Lcd " ";

      Case 2 : Locate 2 , 6
               Lcd " ";
               Locate 4 , 6
               Lcd "*";
   End Select
End Sub


Sub Show_step(byval X As Integer , Byval Y As Integer)
   Locate Y , X
   Select Case Frequ_step
      Case 1 : Lcd "   1  ";
      Case 10 : Lcd "  10  ";
      Case 100 : Lcd " 100  ";
      Case 1000 : Lcd "   1 k";
      Case 5000 : Lcd "   5 k";
      Case 9000 : Lcd "   9 k";
      Case 10000 : Lcd "  10 k";
      Case 12500 : Lcd "12,5 k";
      Case 25000 : Lcd "  25 k";
      Case 50000 : Lcd "  50 k";
      Case 100000 : Lcd " 100 k";
      Case 1000000 : Lcd "   1 M";
      Case 10000000 : Lcd "  10 M";
```

```
   End Select
   Lcd "Hz";
End Sub


Sub Show_pegel_anz(byval X As Integer , Byval Y As Integer)
   Local S As String * 4
   Local I As Integer
   Local Si As Single
   Local Einh As String * 2

   Locate Y , X
   Lcd Spc(14);
   Locate Y , X

   I = Pegel_anz
   S = Str(i)
   Lcd S ; "dBm =" ;

   I = I + 107                                          'dBm -> dBuV
   Si = I
   Si = Si / 20
   Si = 10 ^ Si                                         'dBuV-> uV

   If Si < 1000 Then
      Einh = "uV"
   Else
      Einh = "mV"
      Si = Si / 1000
   End If

   If Si < 10 Then
      S = Fusing(si , "#.#")
   Else
      Si = Round(si)
      I = Si
      S = Str(i)
   End If

   Lcd S ; Einh;
End Sub


Sub Calc_frequ_gen
   Frequ_gen = Frequ_anz + Frequ_offset
   Frequ_gen = Frequ_gen / Ext_multi
End Sub


'Generator-Routinen----------------------

Sub Reset_ad9851
   9851_reset = 0                                       'Ausgangslage
   9851_clk = 0
   9851_fqud = 0
   Waitus 1

   9851_reset = 1                                       'RESET
   Waitus 1
   9851_reset = 0
   Waitms 1

   9851_clk = 1                                         'Clock übernimmt parallele Daten
   Waitus 1                                             'dort muss xxxxx011 anliegen !!!
   9851_clk = 0
   Waitus 1

   9851_fqud = 1                                        'Umschaltung auf Seriell-Mode
   Waitus 1
   9851_fqud = 0
   Waitus 1
End Sub


Sub To_ad9851
   Local S As Single
   Local Fred As Long
   Local Korr As Long
   Local W As Long
   Local Lauf As Byte

   Select Case Frequ_gen                                'nötig wg. Ungenauigkeiten des single-Types
```

```
                                        'bzw. fehlenden int64-Types
      Case 0 To 9999999 : Fred = Frequ_gen
                          Korr = 0
      Case 10000000 To 19999999 : Fred = Frequ_gen - 10000000
                                  Korr = 238609294
      Case 20000000 To 29999999 : Fred = Frequ_gen - 20000000
                                  Korr = 477218588
      Case 30000000 To 39999999 : Fred = Frequ_gen - 30000000
                                  Korr = 715827883
      Case 40000000 To 49999999 : Fred = Frequ_gen - 40000000
                                  Korr = 954437177
      Case 50000000 To 59999999 : Fred = Frequ_gen - 50000000
                                  Korr = 1193046471
      Case 60000000 To 69999999 : Fred = Frequ_gen - 60000000
                                  Korr = 1431655765
      Case Is >= 70000000 : Fred = Frequ_gen - 70000000
                            Korr = 1670265060
   End Select

   S = Fred
   S = S * 23.86092942                                  '= 2 ^ 32 / 180MHz; = delta phi pro Hz
   W = Round(s)
   W = W + Korr

   For Lauf = 1 To 32
      9851_data = W.0
      Waitus 1

      9851_clk = 1                                      'Clock
      Waitus 1
      9851_clk = 0
      Waitus 1

      Shift W , Right , 1                               'von LSB nach MSB (W0 bis W31)
   Next Lauf

   W = &B00000001                                       'W32 bis W39; hier wird nur 6x REFCLOCK
gesetzt
   For Lauf = 1 To 8
      9851_data = W.0
      Waitus 1

      9851_clk = 1                                      'Clock
      Waitus 1
      9851_clk = 0
      Waitus 1

      Shift W , Right , 1
   Next Lauf

   9851_fqud = 1                                        'FQ_UD übernimmt die 40 Bit
   Waitus 1
   9851_fqud = 0

   Check_pegel_gen                                      'ggf. Pegel anpassen
End Sub


Sub To_ad8321(pegel As Integer)                         'att(enuator) von -130...+10dBm
   Local Att_byte As Byte
   Local Lauf As Byte
   Local S As Single

   S = Pegel / 0.7526
   S = 51 + S

   Select Case Frequ_gen
     'case is < 36000000:
      Case 36000001 To 57000000 : S = S + 1             'sin(x)/x + Filter ausgleichen
      Case 57000001 To 66500000 : S = S + 2
      Case 66500001 To 70500000 : S = S + 3
      Case 70500001 To 73500000 : S = S + 4
      Case 73500001 To 75000000 : S = S + 5
      Case Is > 75000000 : S = -121                     '=-130dBm
   End Select

   Pegel_gen_akt = Round(s)                             'zum Vergleich, wenn Frequ.-Änderung
   Lauf = 0
   While S < 5.82                                       '=-34dBm; das schafft der AD8321 allein
      S = S + 42.5193                                   '= +32dB
      Incr Lauf
   Wend
```

```
   Select Case Lauf
      Case 0 : Att32 = 0                                  'Dämpfungsglieder entspr. einstellen
               Att64 = 0

      Case 1 : Att32 = 1
               Att64 = 0

      Case 2 : Att32 = 0
               Att64 = 1

      Case 3 : Att32 = 1
               Att64 = 1
   End Select

   S = Round(s)
   Att_byte = Int(s)

   8321_ena = 0                                           'zunächst auf 0
   8321_clk = 0
   Waitus 1

   For Lauf = 1 To 8
      8321_data = Att_byte.7                              'hier von MSB nach LSB !!
      Waitus 1
      8321_clk = 1
      Waitus 1
      8321_clk = 0

      Shift Att_byte , Left , 1
   Next Lauf

   Waitus 1
   8321_ena = 1                                           'damit wird übernommen
End Sub


Sub Check_pegel_gen
   Local S As Single
   Local I As Integer

   S = Pegel_anz / 0.7526
   S = 51 + S
   Select Case Frequ_gen
     'case is < 36000000:
      Case 36000001 To 57000000 : S = S + 1               'sin(x)/x + Filter ausgleichen
      Case 57000001 To 66500000 : S = S + 2
      Case 66500001 To 70500000 : S = S + 3
      Case 70500001 To 73500000 : S = S + 4
      Case 73500001 To 75000000 : S = S + 5
      Case Is > 75000000 : S = -121
   End Select
   I = Round(s)
   If I <> Pegel_gen_akt Then
      Call To_ad8321(pegel_anz)
      Pegel_gen_akt = I
   End If

End Sub


'Tastaturroutine-------------------------
'Rückgaben:
'var key = letztes Zeichen

Dim Zeile As Byte
Dim Spalte As Byte
Dim Scancode As Byte

Onint1:
   If Key <> "" Then                                      'Taste noch nicht ausgewertet
      Goto Keyende
   End If

   Waitms 10                                              'Tastenpreller abwarten
   If Pind.3 = 0 Then                                     '=INT1; Taste gedrückt
      Porta = Pina Or &H0F                                'zunächst alle Zeilen auf 1
      For Zeile = 0 To 3
         Porta.zeile = 0                                  'dann Zeilen 0..3 einzeln auf 0

         For Spalte = 4 To 7                              'damit die Spalten durchsuchen
            If Pina.spalte = 0 Then                       'Taste gefunden
```

```
               Scancode = Zeile * 5
               Scancode = Scancode + Spalte
               Scancode = Scancode - 3
               Goto Keyende                              'Taste merken; wird beim Loslassen aktiv
            End If
         Next Spalte

         If Pind.6 = 0 Then                              'externe Tasten (Spalte 5)
            Scancode = Zeile * 5
            Scancode = Scancode + 5
            Goto Keyende
         End If

         Porta.zeile = 1                                 'akt. Zeile auf 1 zurück
      Next Zeile
   Else                                                  'Taste los gelassen
      If Scancode > 0 Then
         Key = Mid(tastenarr , Scancode , 1)
         Scancode = 0
      End If
   End If

   Keyende:
   Porta = &HF0                                          'Start-Scannzustand wiederherstellen
   Gifr.intf1 = 1                                        'ggf. Tastenpreller entfernen
Return


'Drehgeber-Routine-----------------------
'verändert var drehgeber (=long)

Drehimpuls1 Alias Pind.2
Drehimpuls2 Alias Pind.4
Onint0:
   If Drehimpuls1 = 1 Then                             'steigende Flanke
      If Drehimpuls2 = 1 Then
         Decr Drehgeber
      Else
         Incr Drehgeber
      End If
   Else                                                'fallende Flanke
      If Drehimpuls2 = 0 Then
         Decr Drehgeber
      Else
         Incr Drehgeber
      End If
   End If
   Waitus 50
   Gifr.intf0 = 1                                      'evtl. Preller entfernen
Return


'RS232-Empfangsroutine------------------

Dim Ser_buf As String * 16
Dim Udr_buf As Byte

Onrxd:
   Udr_buf = Udr                                       'Byte aus der UART auslesen
   If Udr_buf <> 13 Then
      If Udr_buf <> 8 Then
         If Len(ser_buf) < 16 Then
            Ser_buf = Ser_buf + Chr(udr_buf)
            Udr = Udr_buf                              'Echo auf Konsole
         End If
      End If
   Else
      At_command = Ser_buf                             'erst nach CR übergeben
      Ser_buf = ""
   End If
Return
```