# LAMPIRAN A

## LIST PROGRAM APLIKASI DAN AVR

# KETERANGAN OBJEK KONTROL CAPTURE

| OBJEK | PROPERTY | SETTING |
|---|---|---|
| Command1 | Caption | Device |
| Command2 | Caption | Init |
| Command3 | Caption | Execute |
| Command4 | Caption | Start |
| Command5 | Caption | Stop |
| Command6 | Caption | Proses |
| Command7 | Caption | Sensor |
| CheckBox | Caption | Show Map |
| | Picture | (None) |
| | Value | 0-Unchecked |
| | Visible | TRUE |
| CheckBox | Caption | UnLock Object |
| | Picture | (None) |
| | Value | 0-Unchecked |
| | Visible | FALSE |
| CheckBox | Caption | Lock Object |
| | Picture | (None) |
| | Value | 0-Unchecked |
| | Visible | FALSE |
| Text1 | Name | Text1 |
| | TabIndex | 57 |
| | Text | Text1 |
| Text | Name | ThresholdEdit |
| | TabIndex | 15 |
| | Text | |
| Text3 | Name | Text3 |
| | TabIndex | 25 |
| | Text | (Text) |
| | ScrollBars | 2-Vertical |

| | | |
|---|---|---|
| Text | Name | txExp |
| | TabIndex | 46 |
| | Text | |
| Form | Name | Form1 |
| | Caption | Aplikasi Pengenalan Citra |
| Frame1 | Name | Frame1 |
| | Caption | Sensor |
| | BackColor | Abu-abu |
| Frame3 | Name | Frame3 |
| | Caption | Control |
| | BackColor | Abu-abu |
| Frame4 | Name | Frame4 |
| | Caption | Image Processing |
| | BackColor | Abu-abu |
| Frame6 | Name | Frame6 |
| | Caption | Capture Format |
| | BackColor | Abu-abu |
| Label1 | Name | Label |
| | Caption | |
| Label2 | Name | Label2 |
| | Caption | |
| Label3 | Name | Label3 |
| | Caption | |
| Label4 | Name | Label4 |
| | Caption | Video |
| Label5 | Name | Label5 |
| | Caption | Capture Image |

| | | |
|---|---|---|
| Label6 | Name | Label6 |
| | Caption | |
| Label7 | Name | Label7 |
| | Caption | |
| Label8 | Name | Label8 |
| | Caption | Pictured Map : Lingkaran |
| Label9 | Name | Label9 |
| | Caption | Sensor Threshold |
| Label11 | Name | Label11 |
| | Caption | Direction1 |
| Label12 | Name | Label12 |
| | Caption | Direction2 |
| Label13 | Name | Label13 |
| | Caption | |
| Label14 | Name | Label14 |
| | Caption | Indikator : |
| Label15 | Name | Label15 |
| | Caption | Jumlah Pixel Acuan : |
| Label16 | Name | Label16 |
| | Caption | Jumlah Pixel Aktual : |
| Label17 | Name | Label17 |
| | Caption | Klik 'Lock Object, jika Indikator Menunjukan 'POSITIF' |
| Label18 | Name | Label18 |
| | Caption | Koordinat Aktual Objek (nilai x) : |
| Label19 | Name | Label19 |
| | Caption | M RIFKI M |
| Label20 | Name | Label20 |
| | Caption | Proses… |

| | | |
|---|---|---|
| Label21 | Name | Label21 |
| | Caption | Sensor Baris : |
| Label22 | Name | Label22 |
| | Caption | Sensor Koordinat : |
| Label | Name | Move Label |
| | Caption | Move Label |
| Label | Name | IbTriplet |
| | Caption | |
| Label | Name | Indi |
| | Caption | |
| Listbox | Name | List1 |
| | BackColor | Putih |
| | TabIndex | 51 |
| Listbox | Name | IsLib |
| | BackColor | Putih |
| | TabIndex | 48 |
| OptionButton | Name | FormatColour |
| | Caption | Colour |
| | Value | FALSE |
| | Visible | TRUE |
| OptionButton | Name | FormatGrayScale |
| | Caption | GrayScale |
| | Value | FALSE |
| | Visible | TRUE |
| OptionButton | Name | IPNone |
| | Caption | None |
| | Value | FALSE |
| | Visible | TRUE |
| OptionButton | Name | IPEdges |
| | Caption | Edges |
| | Value | FALSE |
| | Visible | TRUE |
| OptionButton | Name | IPThreshold |
| | Caption | Threshold |
| | Value | FALSE |
| | Visible | TRUE |

| | | |
|---|---|---|
| PictureBox | Name | CaptureImage |
| | Align | 0-None |
| | BackColor | Abu-abu |
| | DataFormat | Picture |
| PictureBox | Name | Picap |
| | Align | 0-None |
| | BackColor | Abu-abu |
| | DataFormat | Picture |
| Timer | Name | Writer |
| | Interval | 250 |
| | Enabled | FALSE |
| Timer | Name | Texp |
| | Interval | 0 |
| | Enabled | FALSE |
| Timer | Name | TCK |
| | Interval | 10000 |
| | Enabled | FALSE |
| Timer | Name | iSensor |
| | Interval | 150 |
| | Enabled | FALSE |
| Timer | Name | Tproses |
| | Interval | 100 |
| | Enabled | FALSE |
| Timer | Name | Tbanding |
| | Interval | 500 |
| | Enabled | TRUE |
| Timer | Name | CaptureThread |
| | Interval | 1000 |
| | Enabled | TRUE |
| Timer | Name | TRecoq2 |
| | Interval | 50 |
| | Enabled | FALSE |
| Timer | Name | Trecoq |
| | Interval | 100 |
| | Enabled | TRUE |
| CommonDialog | Name | DLG |
| | Color | Hitam |
| | MaxFileSize | 260 |

# LISTING PROGRAM CAPTURE

```
Private Aray() As String, hsl As String, WrPath As String
Private nTp As Long
Private onHz As Byte

Private Sub bProses2_Click()
Dim tmpH As String, KoordX As String
List1.Clear

For i = 1 To Picap.ScaleWidth 'Step 15          '  proses grayscale & pembentukan matrix
koordinat image
   For j = 1 To Picap.ScaleHeight 'Step 15
      warna = Picap.Point(i, j)
      R = warna And RGB(255, 0, 0)
      g = Int((warna And RGB(0, 255, 0)) \ 256)
      b = Int(Int((warna And RGB(0, 0, 255)) \ 256) \ 256)
      r1 = (R + g + b) / 3
      susun = susun & CStr(r1) & ","
      If r1 = 2 Then
      KoordX = KoordX & CStr(i) & "," & CStr(j) & " | "
      End If
   Next j
Next i
Dim Fh As String, HK() As String, u As Long, mf() As String, e As Long, Tj(2, 1) As String, q
As Long
Dim simC As Long, blk As String
HK = Split(KoordX, " | ")
e = 0
simC = 0
blk = ""
For u = 0 To UBound(HK) - 1                     ' pembentukan matrix pola koordinat image
  mf = Split(HK(u), ",")
  If e = 0 Then
   Tj(e, 0) = mf(0)
   Tj(e, 1) = mf(1)
   e = e + 1
  Else
   If e > 2 Then
      For q = 0 To UBound(Tj)
        Fh = Fh & Tj(q, 0) & "," & Tj(q, 1) & " | "
        blk = blk & Tj(q, 0) & "," & Tj(q, 1) & " | "
      Next
      List1.AddItem blk
      blk = ""
      simC = simC + 1
      Erase Tj
      e = 0
    Else
     If Abs(CLng(Tj(e - 1, 1)) - CLng(mf(1))) = 1 Then
       Tj(e, 0) = mf(0)
       Tj(e, 1) = mf(1)
       e = e + 1
     Else
       Erase Tj
       e = 0
     End If
```

```
    End If
  End If
Next u
nTp = simC
lbTriplet.Caption = "PreProsesor #3 : " & CStr(simC)   '   indikator jumlah matrix pola yg
terbentuk
Dim w As Long, Bts As Integer, v As Long
q = 0
v = 0
Bts = 10
Do While q < lsLib.ListCount - 1
  For e = 0 To List1.ListCount - 1
    If Trim(List1.List(e)) = Trim(lsLib.List(q)) Then
      w = w + 1
    End If
  Next e
  q = q + 1
Loop
Indi.Caption = CStr(w)

End Sub

Private Sub CaptureThreadTimer_Timer()
Dim todisplay, num As Long
' Sampai tombol Stop ditekan
If XVideoOCX.XIsStarted Then
' Coba untuk menangkap gambar
  If (XVideoOCX.XCapture(GV_Image) = True) Then
    todisplay = GV_Image
    End If
' metoda grayscale image processing
    If GV_Color = False Then
    If GV_Edges = True Then
' Sobel edge detection
          XVideoOCX.XSobel GV_Image, GV_TmpImage
' Thresh old image. Nilai threshold value di-set di edit box
          XVideoOCX.XThreshold GV_Image, GV_ThresholdValue, GV_TmpImage
          todisplay = GV_TmpImage
       End If

    If GV_Save = True Then
       XVideoOCX.XSave GV_OutputHandle, todisplay
       If GV_MovieOut = False Then
         GV_Save = False
       End If
    End If
    XVideoOCX.XShowInWindow todisplay, CaptureImage.hdc, 0, 0
    XVideoOCX.XShowInWindow todisplay, Picap.hdc, 50, 50
   CaptureImage.ScaleHeight = 50
   CaptureImage.ScaleWidth = 50
  End If
End If

End Sub

Private Sub CKExp_Click()                    ' seting interval untuk Unlock objek
  If CKExp.Value = 1 Then
    txExp.Visible = True
```

```
    txExp.SetFocus
  Else
    txExp.Visible = False
  End If
End Sub

Private Sub CkLock_Click()                ' me Lock  objek (proses pengenalan objek berhenti)
  If CkLock.Value = 1 Then
     IPThreshold.Value = True
     TBanding.Enabled = True
     Trecoq.Enabled = False
     TRecoq2.Enabled = True
     If TRecoq2.Enabled Then Writer.Enabled = True
     CKExp.Visible = True
     onHz = 0
  Else
     IPEdges.Value = True
     Trecoq.Enabled = True
     Writer.Enabled = False
     Label1.Caption = ""
     Label13.Caption = ""
  End If
End Sub

Private Sub CMap_Click()                  ' untuk menampilkan peta pola biner image
  If CMap.Value = 1 Then
    Text3.Visible = True
  Else
    Text3.Visible = False
  End If
End Sub

Private Sub cmdproses_Click()

' proses pembentukan pola biner image untuk proses sensor arah objek

Dim u As Long, susun As String, pch() As String
Dim pck As String
Text1.Text = ""
Dim r1 As Integer, g1 As Integer, b1 As Integer, f As Long
Dim hsl As String
f = 0
Dim tmpH As String

For i = 1 To Picap.ScaleWidth ' Step 15
   For j = 1 To Picap.ScaleHeight ' Step 15
      warna = Picap.Point(i, j)
      R = warna And RGB(255, 0, 0)
      g = Int((warna And RGB(0, 255, 0)) \ 256)
      b = Int(Int((warna And RGB(0, 0, 255)) \ 256) \ 256)
      r1 = (R + g + b) / 3

      If r1 >= 192 Then tmpH = tmpH & "1" Else tmpH = tmpH & "0"
   Next j
Next i
Dim lk As Long, ctb As Long

ctb = 0
```

```
For lk = 1 To Len(tmpH)
  If Mid(tmpH, lk, 1) = "0" Then
    ctb = ctb + 1
  End If
Next lk

Text1.Text = tmpH
Text1.Refresh

     For u = 1 To Len(Text1.Text)
       If Mid(Text1.Text, u, 1) = "0" Then
          susun = susun & CStr(u) & ","
       End If
     Next u
     Label2.Caption = susun
     Label2.Refresh


' tracing arah berdasarkan koordinat matrix pola sensor arah

     pch = Split(susun, ",")
   If CkLock.Value = 1 Then
     If pch(0) < 19 Then
       Label13.Caption = "LEFT"
       onHz = 1
     ElseIf pch(0) > 700 Then
       Label13.Caption = "RIGHT"
       onHz = 1
     Else
       Label13.Caption = "C"
       onHz = 0
     End If
   End If
Label6.Caption = ctb
End Sub

Private Sub DeviceDlg_Click()                    ' Memilih video device yang digunakan
XVideoOCX.XShowVideoDevicesDlg

End Sub

Private Sub Form_Load()
On Error GoTo ErrLoad

 ' proses inisialisasi parameter komponen capture XVideoOCX
IPNone.Value = 1
GV_InputChannel = 0
GV_Color = True
GV_Format = False
GV_Edges = False
GV_Threshold = False
GV_ThresholdValue = 180
GV_ImageOut = False
GV_ClipboardOut = False
GV_Save = False
XVideoOCX.XSetScaledDisplay (True)
Videomode.Value = True
FormatColor.Value = True
```

```
ThresholdEdit.Text = "100"
GV_Image = 0
GV_TmpImage = 0
GV_OutputHandle = 0

Text4.Text = "20"                                    ' inisialisasi batas jarak pengenalan objek

Dim lk As Long, ctb As Long

Open App.Path & "\map105.txt" For Input As #1   ' loading peta pola biner image
Do While Not EOF(1)
   Line Input #1, q
   hsl = hsl & q
Loop
Close #1
ctb = 0
For lk = 1 To Len(hsl)
  If Mid(hsl, lk, 1) = "0" Then
    ctb = ctb + 1
  End If
Next lk
Text3.Text = hsl

Label3.Caption = ctb
WrPath = App.Path & "\settings"

Dim Uk As String, fle As Integer

'  proses loading Library sensor pengenalan objek untuk proses training

  Close #1
  Open App.Path & "\sensor\libsensor.cfg" For Input As #1
  lsLib.Clear
  Do Until EOF(1)
    Line Input #1, Uk
    lsLib.AddItem Uk
  Loop
  Close #1
IPEdges.Value = True
Exit Sub
ErrLoad:
  MsgBox Err.Description
End Sub

Private Sub FormatColor_Click()                    ' Format RGb
GV_Color = True
GV_Format = True

End Sub

Private Sub FormatGrayScale_Click()                ' Format Grayscale
GV_Color = False
GV_Format = True

End Sub

Private Sub Frame4_DragDrop(Source As Control, X As Single, Y As Single)
```

```
End Sub

Private Sub Initbutton_Click()                          ' koneksi ke Capture Device
XVideoOCX.XInit
ResolutionLabel = "(" & XVideoOCX.XGetWidth & "," & XVideoOCX.XGetHeight & ")"
Initbutton.Enabled = False
End Sub
Private Sub IPEdges_Click()                             ' Untuk proses deteksi tepi
GV_Edges = True
GV_Threshold = False
GV_Invert = False
GV_Motion = False

End Sub
Private Sub IPNone_Click()                              ' image proses tidak dilakukan
GV_Invert = False
GV_Threshold = False
GV_Edges = False
GV_Motion = False
GV_MirrorImage = False

End Sub

Private Sub IPThreshold_Click()                         ' proses Threshold dilakukan
ThresholdEdit_Change
GV_Threshold = True
GV_Edges = False
GV_Invert = False
GV_Motion = False

End Sub

Private Sub iSensor_Timer()                     ' timer untuk training sensor pengenalan image
  bProses2_Click
End Sub

Private Sub StartButton_Click()
Dim bitdepth As Long
If GV_Color = True Then
bitdepth = 24
Else
bitdepth = 8
End If
' image yang akan di capture
GV_Image = XVideoOCX.XGetImageHandle(bitdepth)
' image sememtara
GV_TmpImage = XVideoOCX.XGetImageHandle(bitdepth)
' Start capture
XVideoOCX.XStart
' Memulai Capture timer
CaptureThreadTimer.Enabled = True
CaptureThreadTimer.Interval = 40

Dim R As Long

Tproses.Enabled = True
For R = 1 To 10000
Next R
```

```
iSensor.Enabled = True
Text5.Text = "30"
Text6.Text = "2"
TCK.Enabled = True
Label20.Visible = True
End Sub

Private Sub StopButton_Click()
' Stop internal capture loop
XVideoOCX.XStop
' Release the image memory
XVideoOCX.XReleaseImageHandle (GV_Image)
GV_Image = 0
CaptureThreadTimer.Enabled = False
End Sub

Private Sub TBanding_Timer()   ' proses pembandingan pola image aktual dg pola image pada
Library
Dim u As Long, susun As String, pch() As String
susun = ""
If Text1.Text <> "" Then
    For u = 1 To Len(Text1.Text)
      If Mid(Text1.Text, u, 1) = "0" Then
        susun = susun & CStr(u) & ","
      End If
    Next u
    Label2.Caption = susun
    Label2.Refresh
    pch = Split(susun, ",")
  If CkLock.Value = 1 Then
    If pch(0) < 17 Then
      Label13.Caption = "LEFT"
    ElseIf pch(0) > 1170 Then
      Label13.Caption = "RIGHT"
    Else
      Label13.Caption = "C"
    End If
  End If
End If
End Sub


Private Sub TExp_Timer()
  CkLock.Value = 0
  TExp.Enabled = False
  txExp.Visible = False
  CKExp.Value = 0
  CKExp.Visible = False
End Sub
Private Sub Text4_Change()                          ' Nilai sensor threshold jika kosong = 1
If Text4.Text = "" Then Text4.Text = "1"
End Sub

Private Sub ThresholdEdit_Change()                   'Mengubah nilai threshold
If ThresholdEdit.Text <> "" Then
GV_ThresholdValue = CInt(ThresholdEdit.Text)
Else
GV_ThresholdValue = 0
```

```
End If

End Sub
Private Sub Tproses_Timer()                                    ' Timer untuk proses
  cmdproses_Click
End Sub

Private Sub Trecoq_Timer()                                     ' proses pengenalan objek..

If Indi.Caption = "" Then Exit Sub

If CInt(Indi.Caption) = 0 Then
   Label7.Caption = "Bukan POSITIF"
Else
  If CInt(Indi.Caption) > CInt(Text6.Text) Then
     If nTp > CInt(Text5.Text) Then Label7.Caption = "POSITIF"
  End If
End If

If Trim(Label7.Caption) = "POSITIF" Then
   CkLock.Visible = True
   Label20.Visible = False
   Trecoq.Enabled = False
Else
   CkLock.Visible = False
End If
End Sub

Private Sub TRecoq2_Timer()                                    ' timer proses deteksi arah objek

Dim q As String, Ptg() As String
Dim w As String, j As Long

w = "Bukan"
If Text1.Text = "" Then Exit Sub
If CInt(Label6.Caption) <> CInt(Label3.Caption) Then
  If Abs(CInt(Label6.Caption) - CInt(Label3.Caption)) <= CInt(Text4.Text) Then
    w = ""
  End If
End If
Ptg = Split(Label2.Caption, ",")
Label10.Caption = w & " POSITIF"
Label10.Refresh

For j = 0 To 9

   If CDbl(Label6.Caption) < CDbl(Label3.Caption) + CDbl(Text4.Text) Then
     If onHz = 0 Then
       Label1.Caption = "FWD"
     End If
     Label1.Refresh
   ElseIf CDbl(Label6.Caption) > CDbl(Label3.Caption) + CDbl(Text4.Text) Then
     If onHz = 0 Then
       Label1.Caption = "BKD"
     End If
     Label1.Refresh
   End If
Next j
```

```
If Trim(Label10.Caption) = "POSITIF" Then
  DVert = 0
  Label1.Caption = "N"
End If

End Sub

Private Sub txExp_Change()                                          ' timer untuk unlock
 If Not IsNumeric(txExp.Text) Then Exit Sub
 TExp.Interval = CLng(txExp.Text) * 1000
 TExp.Enabled = True
End Sub



Private Sub Writer_Timer()                  ' proses penulisan perintah yg akan dikirim ke modul
AVRInterface.exe
Dim Isi As String
Isi = Label1.Caption & "#" & Label13.Caption
Close #1
Open WrPath & "\OUTPUT.CFG" For Output As #1
Print #1, Isi
Close #1
End Sub
```

# KETERANGAN OBJEK KONTROL RS232 (VB.6)

| OBJEK | PROPERTY | SETTING |
|---|---|---|
| Command | Name | bConnect |
| | Caption | Connect |
| Command2 | Caption | Send |
| Command | Name | cmExec |
| | Caption | Execute |
| Command6 | Caption | Exit |
| Text1 | Name | txCom |
| | TabIndex | 13 |
| | Text | |
| Text2 | Name | txIP |
| | TabIndex | 4 |
| | Text | 192.168.1.254 |
| Text3 | Name | TxPrt |
| | TabIndex | 5 |
| | Text | 6565 |
| Text4 | Name | Text4 |
| | TabIndex | 2 |
| | Text | |
| Text6 | Name | Text6 |
| | TabIndex | 17 |
| | Text | 1000 |
| Form | Name | Form1 |
| | Caption | AVR RS232 interface |
| Frame4 | Name | Frame4 |
| | Caption | Executed Tracks |
| | BackColor | Abu-abu |
| Frame5 | Name | Frame5 |
| | Caption | Settings |
| | BackColor | Abu-abu |
| Label5 | Name | Label5 |
| | Alignment | 0-LeftJustify |
| | Caption | Camera Sensor |
| | Font | MS Sans Serif |
| | Forecolor | Hitam |
| | TabIndex | 10 |
| Label9 | Name | Label9 |
| | Alignment | 0-LeftJustify |
| | Caption | Command Transfer Interval (ms) |
| | Font | MS Sans Serif |
| | Forecolor | Hitam |
| | TabIndex | 16 |
| Label2 | Name | Label2 |
| | Alignment | 0-LeftJustify |
| | Font | MS Sans Serif |
| | Forecolor | Hitam |
| | TabIndex | 9 |
| Listbox | Name | List1 |
| | BackColor | Putih |
| | TabIndex | 12 |

| | | |
|---|---|---|
| Timer1 | Name | Timer1 |
| | Interval | 0 |
| | Enabled | FALSE |
| Timer2 | Name | Timer1 |
| | Interval | 1000 |
| | Enabled | FALSE |
| Timer3 | Name | Texec |
| | Interval | 1000 |
| | Enabled | FALSE |
| Timer4 | Name | ComLoader |
| | Interval | 1000 |
| | Enabled | FALSE |
| Winsock1 | Name | Sock1 |
| | Protocol | 0-sckTCPProtocol |

# LISTING PROGRAM AVR INTERFACE

```
Option Explicit
Dim LEDs As Integer
Dim Switches() As Byte
Dim sData As String
Dim temp As String
Dim Button As Integer
Dim PB0 As Integer
Dim PB1 As Integer
Dim PB2 As Integer
Dim PB3 As Integer
Dim PB4 As Integer
Dim PB5 As Integer
Dim PB6 As Integer
Dim PB7 As Integer

Private Sub About_Click()
      frmAbout.Show
End Sub


Private Sub bConnect_Click()
On Error GoTo t
Dim t As Long

Sock1.Close                                          'menutup winsock
Sock1.RemoteHost = txIP                              'set host IP
Sock1.RemotePort = TxPrt                             'set port
Sock1.Connect                                        'mencoba koneksi

Exit Sub
t:
MsgBox "Error : " & Err.Description, vbCritical

End Sub

Sub MajuLurus(aktif As Integer)                  ' kontrol otomatis dari textbox command
If aktif = 1 Then
  PB0 = 220
Else
  PB0 = 0
End If
Call Command2_Click
End Sub

Sub MundurLurus(aktif As Integer)                ' kontrol otomatis dari textbox command
If aktif = 1 Then
  PB1 = 225
Else
  PB1 = 0
End If
Call Command2_Click

End Sub
```

```
Sub Majukiri(aktif As Integer)                    '  kontrol otomatis dari textbox command
If aktif = 1 Then
  PB2 = 80
Else
  PB2 = 0
End If
Call Command2_Click

End Sub

Sub Majukanan(aktif As Integer)                   '  kontrol otomatis dari textbox command
If aktif = 1 Then
  PB3 = 145
Else
  PB3 = 0
End If
Call Command2_Click

End Sub

Sub MundurKiri(aktif As Integer)                  '  kontrol otomatis dari textbox command

If aktif = 1 Then
  PB4 = 97
Else
  PB4 = 0
End If
Call Command2_Click

End Sub

Sub MundurKanan(aktif As Integer)                 '  kontrol otomatis dari textbox command

If aktif = 1 Then
  PB5 = 170
Else
  PB5 = 0
End If
Call Command2_Click

End Sub


Private Sub cmExec_Click()                        ' eksekusi otomatis perintah dari sensor kamera
Dim Dcut() As String

Dcut = Split(txCom.Text, "#")

  Call MajuLurus(0)
  Call MundurLurus(0)
  Call Majukiri(0)
  Call Majukanan(0)
  Call MundurKiri(0)
  Call MundurKanan(0)
```

```
' proses interpretasi perintah ke prosedur arah gerak

If Dcut(1) = "C" Then
  If Dcut(0) = "FWD" Then
     Call MajuLurus(1)
  ElseIf Dcut(0) = "BKD" Then
     Call MundurLurus(1)
  End If
ElseIf Dcut(1) = "LEFT" Then
  If Dcut(0) = "FWD" Then
     Call Majukiri(1)
  ElseIf Dcut(0) = "BKD" Then
     Call MundurKiri(1)
  End If
ElseIf Dcut(1) = "RIGHT" Then
  If Dcut(0) = "FWD" Then
     Call Majukanan(1)
  ElseIf Dcut(0) = "BKD" Then
     Call MundurKanan(1)
  End If
End If
List1.AddItem txCom.Text
End Sub


Private Sub cmStop_Click()                              '  memutus koneksi secara manual
TExec.Enabled = False
List1.Clear
  Call MajuLurus(0)
  Call MundurLurus(0)
  Call Majukiri(0)
  Call Majukanan(0)
  Call MundurKiri(0)
  Call MundurKanan(0)
End Sub

Private Sub ComLoader_Timer()                  ' download perintah dari program sensor kamera
Dim data As String
  Close #1
  Open App.Path & "\settings\output.cfg" For Input As #1
  Line Input #1, data
  txCom.Text = data
  Close #1
End Sub

Private Sub Command2_Click()                    '  konversi ASCII dan transmisi data ke wifi
    Dim bytInput() As Byte
    Dim bytElement As Byte
    Dim iX As Long
    Dim iY As Long
    Dim iL As Long
    Dim sResult As String
    Dim sData As String
    Dim i As String

LEDs = PB0 + PB1 + PB2 + PB3 + PB4 + PB5 + PB6 + PB7
Text4.Text = IIf(LEDs = "0", "0", Chr$(LEDs))
Sock1.SendData IIf(LEDs = "0", "0", Chr$(LEDs))
```

```
End Sub

Private Sub Sock1_Connect()                                    ' cek status koneksi wifi
  Label2.Caption = "Connected"
  ComLoader.Interval = CInt(Text6.Text)
  TExec.Interval = CInt(Text6.Text)
  ComLoader.Enabled = True
  TExec.Enabled = True

End Sub

Private Sub Sock1_Error(ByVal Number As Integer, Description As String, ByVal Scode As
Long, ByVal Source As String, ByVal HelpFile As String, ByVal HelpContext As Long,
CancelDisplay As Boolean)
  Label2.Caption = "Connection Failed"                  ' cek status kegagalan koneksi ke wifi
  ComLoader.Enabled = False
  TExec.Enabled = False
  Sock1.Close

End Sub

Private Sub TExec_Timer()      ' eksekusi perintah otomatis setelah didownload dari program
sensor kamera
 If txCom.Text = "" Then Exit Sub
 cmExec_Click
End Sub

Private Sub Timer1_Timer()
       Call Command1_Click
End Sub

Private Sub Form_Load()
LEDs = Hex(0)
On Error GoTo Errorhandler
    Timer1.Interval = 100                                      ' Set Timer interval
    Text3.Text = "00011111"

List1.Clear
  Close #1
  Open App.Path & "\settings\output.cfg" For Output As #1
  Print #1, "N#C"
  Close #1

Exit Sub

Errorhandler:

End Sub
Private Sub Command6_Click()
       Unload Me
       Unload frmAbout
End Sub
```

**LISTING PROGRAM PADA CODEVISION AVR**

```
/*****************************************************
This program was produced by the
CodeWizardAVR V1.25.3 Standard
Automatic Program Generator
© Copyright 1998-2007 Pavel Haiduc, HP InfoTech s.r.l.
http://www.hpinfotech.com

Project :
Version :
Date    : 6/30/2010
Author  : F4CG
Company : F4CG
Comments:


Chip type           : ATtiny2313
Clock frequency     : 11.095200 MHz
Memory model        : Tiny
External SRAM size  : 0
Data Stack size     : 32
*****************************************************/

#include <tiny2313.h>
#include <delay.h>

unsigned char a;
// Standard Input/Output functions
#include <stdio.h>

// Declare your global variables here

void main(void)
{
// Declare your local variables here

// Crystal Oscillator division factor: 1
#pragma optsize-
CLKPR=0x80;
CLKPR=0x00;
#ifdef _OPTIMIZE_SIZE_
#pragma optsize+
#endif

// Input/Output Ports initialization
// Port A initialization
// Func2=In Func1=In Func0=In
// State2=T State1=T State0=T
```

```
PORTA=0x00;
DDRA=0x00;

// Port B initialization
// Func7=Out Func6=Out Func5=Out Func4=Out Func3=In Func2=In
Func1=In Func0=In
// State7=0 State6=0 State5=0 State4=0 State3=T State2=T State1=T State0=T
PORTB=0x00;
DDRB=0xF0;

// Port D initialization
// Func6=In Func5=In Func4=In Func3=In Func2=In Func1=In Func0=In
// State6=T State5=T State4=T State3=T State2=T State1=T State0=T
PORTD=0x00;
DDRD=0x00;

// Timer/Counter 0 initialization
// Clock source: System Clock
// Clock value: Timer 0 Stopped
// Mode: Normal top=FFh
// OC0A output: Disconnected
// OC0B output: Disconnected
TCCR0A=0x00;
TCCR0B=0x00;
TCNT0=0x00;
OCR0A=0x00;
OCR0B=0x00;

// Timer/Counter 1 initialization
// Clock source: System Clock
// Clock value: Timer 1 Stopped
// Mode: Normal top=FFFFh
// OC1A output: Discon.
// OC1B output: Discon.
// Noise Canceler: Off
// Input Capture on Falling Edge
// Timer 1 Overflow Interrupt: Off
// Input Capture Interrupt: Off
// Compare A Match Interrupt: Off
// Compare B Match Interrupt: Off
TCCR1A=0x00;
TCCR1B=0x00;
TCNT1H=0x00;
TCNT1L=0x00;
ICR1H=0x00;
ICR1L=0x00;
OCR1AH=0x00;
OCR1AL=0x00;
```

```
OCR1BH=0x00;
OCR1BL=0x00;

// External Interrupt(s) initialization
// INT0: Off
// INT1: Off
// Interrupt on any change on pins PCINT0-7: Off
GIMSK=0x00;
MCUCR=0x00;

// Timer(s)/Counter(s) Interrupt(s) initialization
TIMSK=0x00;

// Universal Serial Interface initialization
// Mode: Disabled
// Clock source: Register & Counter=no clk.
// USI Counter Overflow Interrupt: Off
USICR=0x00;

// USART initialization
// Communication Parameters: 8 Data, 1 Stop, No Parity
// USART Receiver: On
// USART Transmitter: Off
// USART Mode: Asynchronous
// USART Baud rate: 9600
UCSRA=0x00;
UCSRB=0x10;
UCSRC=0x06;
UBRRH=0x00;
UBRRL=0x47;

// Analog Comparator initialization
// Analog Comparator: Off
// Analog Comparator Input Capture by Timer/Counter 1: Off
ACSR=0x80;

while (1)
    {
    // Place your code here
    a=getchar();
    if(a==220)
    {
    PORTB.4=1;
    PORTB.5=0;
    delay_ms(1000);
    }
    else if(a==225)
    {
```

```
    PORTB.4=0;
    PORTB.5=1;
    delay_ms(1000);
    }
    else if(a==80)
    {
    PORTB.4=1;
    PORTB.5=0;
    PORTB.6=1;
    PORTB.7=0;
    delay_ms(1000);
    }
    else if(a==145)
    {
    PORTB.4=1;
    PORTB.5=0;
    PORTB.6=0;
    PORTB.7=1;
    delay_ms(1000);
    }
    else if(a==97)
    {
    PORTB.4=0;
    PORTB.5=1;
    PORTB.6=0;
    PORTB.7=1;
    delay_ms(1000);
    }
    else if(a==170)
    {
    PORTB.4=0;
    PORTB.5=1;
    PORTB.6=1;
    PORTB.7=0;
    delay_ms(1000);
    }
    };
}
```

# LAMPIRAN B

## SPESIFIKASI MODUL WIFI WIZ600-WI

## 1.2. Specification

**< SOFTWARE >**

| Item | Specification |
|---|---|
| Operation mode | IEEE802.11b/g Access Point, Repeater, Client-bridge mode supported |
| Wireless | Radio Enable/Disable, SSID Hidden, Multi SSID, Auto Channel Select,<br>Rate Control (Include Auto mode), TX Power Control, Fragment Length,<br>RTS/CTS Length, Short & Long Preamble, Super A/g Adaptive Radio,<br>Beacon Interval, DTIM Period |
| Security | WPA, WPA2.0(with Radius Server or Pre-Shared Key), AES and/or TKIP,<br>Unicast Encryption: 802.1x Authentication, WEP Encryption, Packet Filtering,<br>MAC Address Filtering/Limiting, (NetBIOS/NetBEUI Filtering, DHCP Filtering) |
| Network | Port Forwarding (UDP, TCP or Both Protocol Support), DHCP Client/Server/Relay,<br>WDS(Wireless Distribution System) Supported, NAT, DNS Server Setting<br>LAN: IP, Subnet, Gateway, WAN: IP, Subnet, Gateway, VLAN |
| Management | Administrator ID/PWD, Device Name, Station & AP Assoc Information,<br>System Information, SNMP v1/v2 (MIB-II, ieee802dot11), Telnet Server Support<br>Web-based Configuration, Upgrade through HTTP/TFTP,<br>Event Log (WEB Interface), RS232 Console Support |

**< HARDWARE >**

| Item | Specification |
|---|---|
| Standard | IEEE 802.11b/g, IEEE802.3 10/100Mbps Ethernet |
| Modulation | DBPSK, DQPSK, CCK, OFDM |
| Frequency | 2.400~2.483 GHz |
| Available Spectrum | 83.5 MHz |
| Channels | 13ch (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13) |
| Data Rate (Mbps) | 1,2,5.5,11, 6,9,12,18,24,36,48,54 |
| Out Power | 18 dBm |

| | |
|---|---|
| Sensitivity | 1M: -94dBm, 54M: -68dBm |
| Operating Range | Indoor: 100 m, Outdoor: 400m |
| Interface | Ethernet 10/100 1 Port, UART, Factory Reset , Wireless Link/Activity LED, Ethernet Link LED, Two Antenna Port (Rx Diversity) |
| Power | DC3.3V (Pin header Type) |
| Power (Internal) | 3.3V, 2.85V, 1.8V |
| Temperature Range | Storage: -20°C ~ +65°C<br>Operating: -0°C ~ +55°C |
| Humidity | 10% ~ 90% (Non-Condensing) |

**Table 1. Specification**

### 3.1.2. Electrical Characteristics

| | |
|---|---|
| **1. Power consumption** | Typical 500mA(Max 700mA) at 3.3V |
| **2. Operating Voltage** | 3.3V ± 0.2V |

**Table 4. Electrical Characteristics**

## 3.2. Dimension

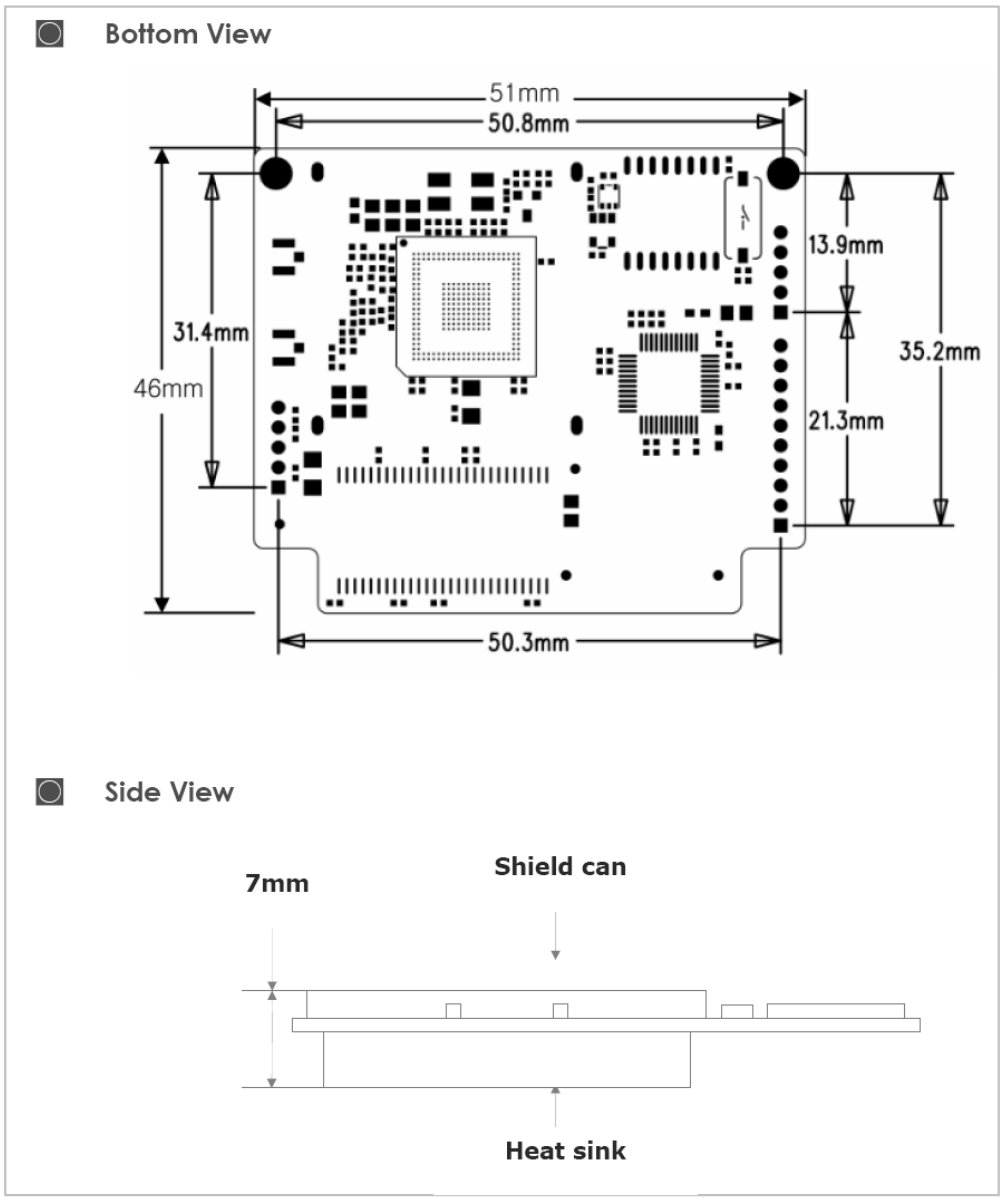



Figure 17. WIZ600Wi Module Dimension

## 3.3. Connector

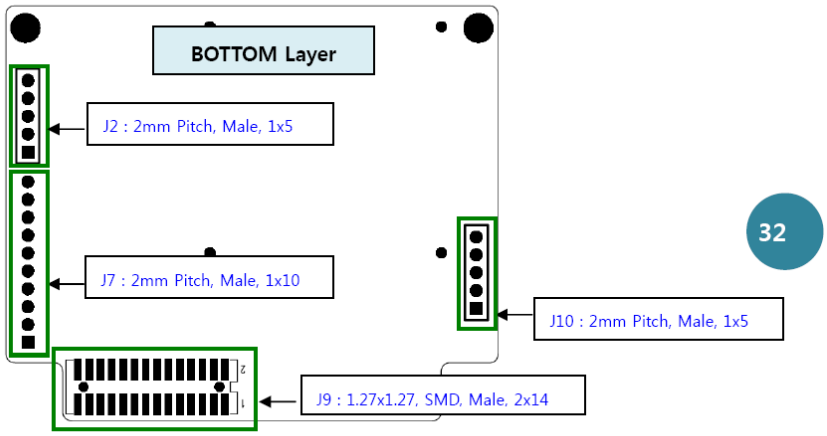



Figure 18. WIZ600Wi Connector Description

| No. | Signal | No. | Signal | No. | Signal |
|---|---|---|---|---|---|
| 1 | 3.3V | 2 | 3.3V | 3 | RXC |
| 4 | /RESET | 5 | TXD2 | 6 | TXC |
| 7 | RXD1 | 8 | TXD0 | 9 | RXD0 |
| 10 | TXD1 | 11 | RXDV | 12 | TXD2 |
| 13 | CRS | 14 | TXD3 | 15 | RXERR |
| 16 | TXEN | 17 | MDC | 18 | COL |
| 19 | MDIO | 20 | GND | 21 | GND |
| 22 | PWFBOUT | 23 | RX+ | 24 | TX+ |
| 25 | RX- | 26 | TX- | 27 | GND |
| 28 | GND | | | | |

Table 5. J9 Pin Description : MII Interface & Ethernet PHY Analog

| No. | Signal | No | Signal | No. | Signal |
|---|---|---|---|---|---|
| 1 | GPIO2 | 2 | GPIO4 | 3 | GPIO3 |
| 4 | GPIO1 | 5 | GND | | |

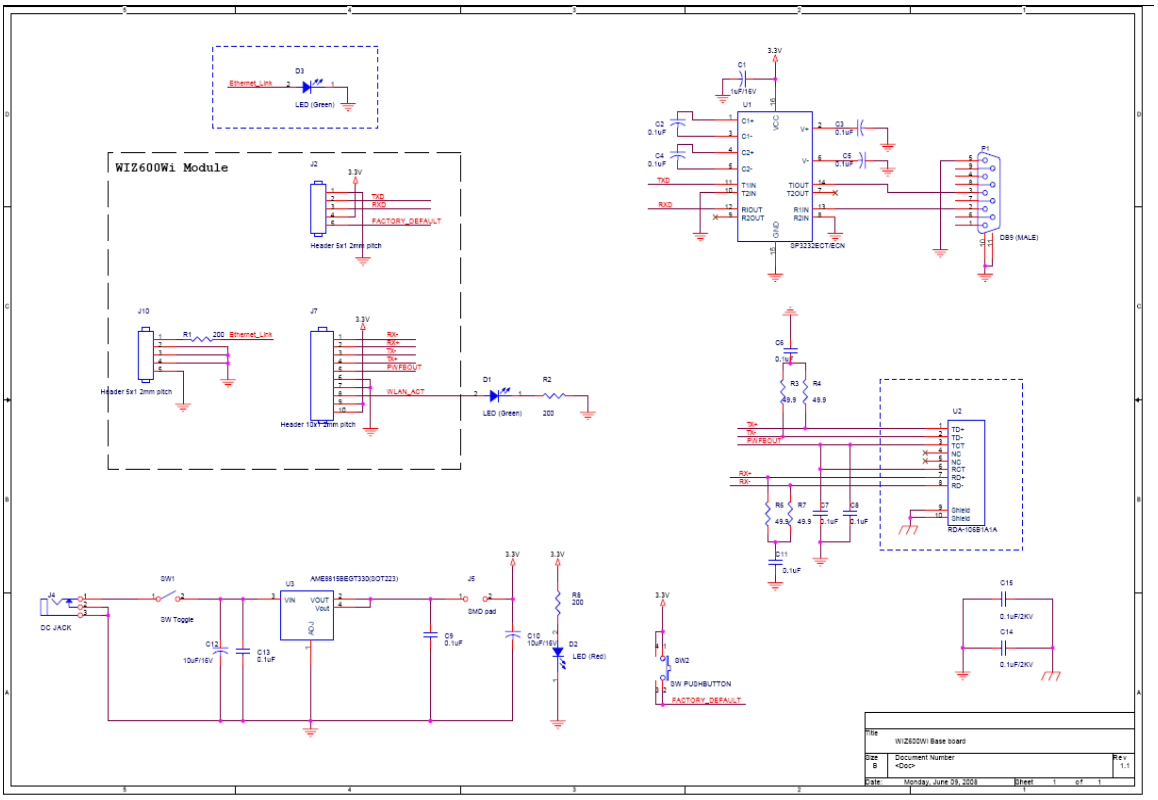
Table 6. J10 Pin Description : GPIO

| No. | Signal | No | Signal | No. | Signal |
|---|---|---|---|---|---|
| 1 | GND | 2 | SOUT (CMOS Level) | 3 | SIN (CMOS Level) |
| 4 | 3.3V | 5 | GPIO6 | | |

Table 7. J2 Pin Description : UART & Factory Defalut>

| No. | Signal | No | Signal | No. | Signal |
|---|---|---|---|---|---|

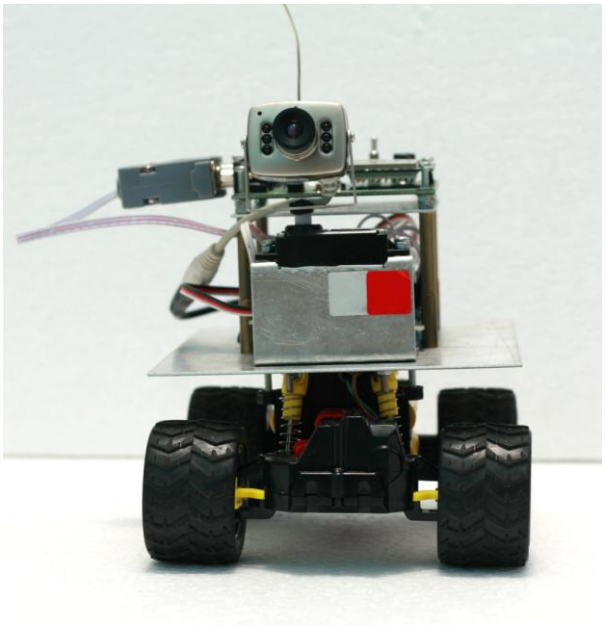
## REFERENCE SCHEMATIC



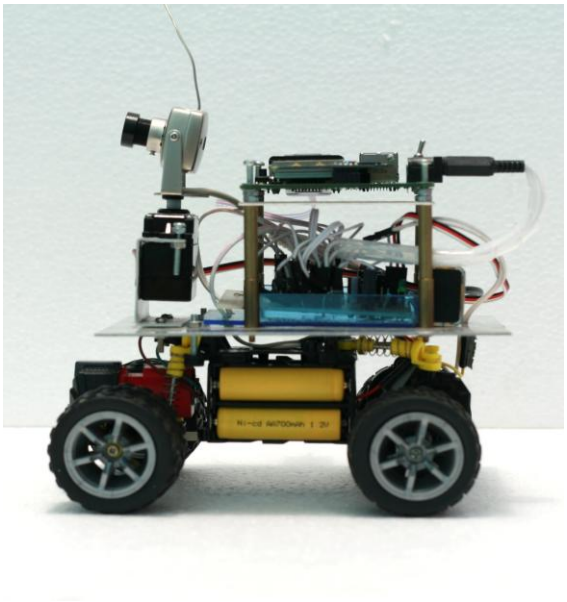
# LAMPIRAN C

## FOTO ROBOT

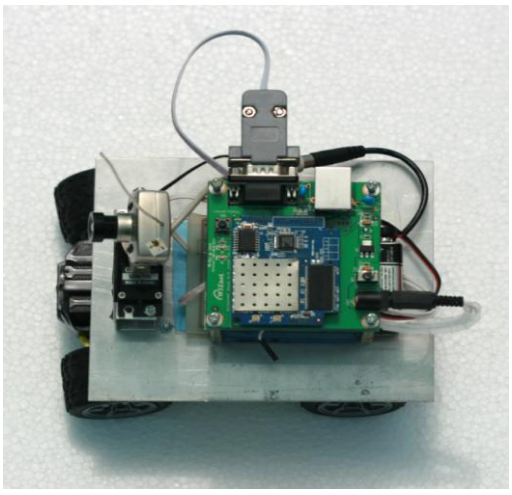
## TAMPAK DEPAN



## TAMPAK SAMPING



## TAMPAK ATAS



# LAMPIRAN D

## DATA SHEET AT TINY 2313 dan IC L293D

## Features

- Utilizes the AVR® RISC Architecture
- AVR – High-performance and Low-power RISC Architecture
  - 120 Powerful Instructions – Most Single Clock Cycle Execution
  - 32 x 8 General Purpose Working Registers
  - Fully Static Operation
  - Up to 20 MIPS Throughput at 20 MHz
- Data and Non-volatile Program and Data Memories
  - 2K Bytes of In-System Self Programmable Flash
    Endurance 10,000 Write/Erase Cycles
  - 128 Bytes In-System Programmable EEPROM
    Endurance: 100,000 Write/Erase Cycles
  - 128 Bytes Internal SRAM
  - Programming Lock for Flash Program and EEPROM Data Security
- Peripheral Features
  - One 8-bit Timer/Counter with Separate Prescaler and Compare Mode
  - One 16-bit Timer/Counter with Separate Prescaler, Compare and Capture Modes
  - Four PWM Channels
  - On-chip Analog Comparator
  - Programmable Watchdog Timer with On-chip Oscillator
  - USI – Universal Serial Interface
  - Full Duplex USART
- Special Microcontroller Features
  - debugWIRE On-chip Debugging
  - In-System Programmable via SPI Port
  - External and Internal Interrupt Sources
  - Low-power Idle, Power-down, and Standby Modes
  - Enhanced Power-on Reset Circuit
  - Programmable Brown-out Detection Circuit
  - Internal Calibrated Oscillator
- I/O and Packages
  - 18 Programmable I/O Lines
  - 20-pin PDIP, 20-pin SOIC, 20-pad QFN/MLF
- Operating Voltages
  - 1.8 - 5.5V (ATtiny2313V)
  - 2.7 - 5.5V (ATtiny2313)
- Speed Grades
  - ATtiny2313V: 0 - 4 MHz @ 1.8 - 5.5V, 0 - 10 MHz @ 2.7 - 5.5V
  - ATtiny2313: 0 - 10 MHz @ 2.7 - 5.5V, 0 - 20 MHz @ 4.5 - 5.5V
- Typical Power Consumption
  - Active Mode
    1 MHz, 1.8V: 230 µA
    32 kHz, 1.8V: 20 µA (including oscillator)
  - Power-down Mode
    < 0.1 µA at 1.8V

# 8-bit AVR® Microcontroller with 2K Bytes In-System Programmable Flash

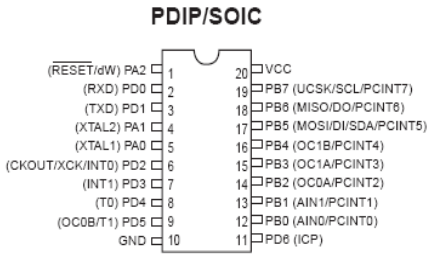
## ATtiny2313/V

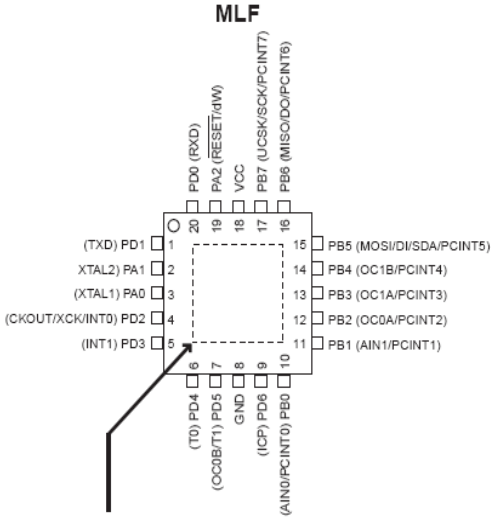
## Preliminary Summary

Rev. 2543IS–AVR–04/06

## Pin Configurations

**Figure 1.** Pinout ATtiny2313



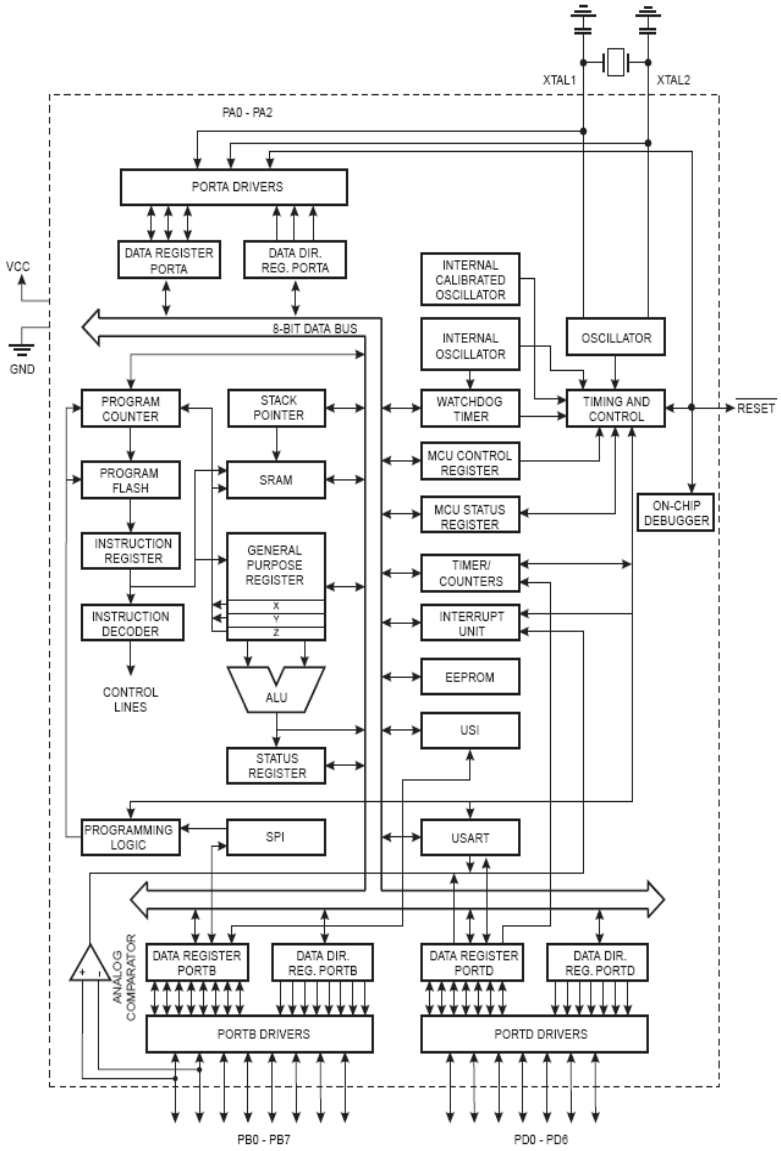

NOTE: Bottom pad should be soldered to ground.

## Overview

The ATtiny2313 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATtiny2313 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.

## Block Diagram

**Figure 2.** Block Diagram



The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

The ATtiny2313 provides the following features: 2K bytes of In-System Programmable Flash, 128 bytes EEPROM, 128 bytes SRAM, 18 general purpose I/O lines, 32 general purpose working registers, a single-wire Interface for On-chip Debugging, two flexible Timer/Counters with compare modes, internal and external interrupts, a serial programmable USART, Universal Serial Interface with Start Condition Detector, a programmable Watchdog Timer with internal Oscillator, and three software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupt or hardware reset. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low-power consumption.

The device is manufactured using Atmel's high density non-volatile memory technology. The On-chip ISP Flash allows the program memory to be reprogrammed In-System through an SPI serial interface, or by a conventional non-volatile memory programmer. By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATtiny2313 is a powerful microcontroller that provides a highly flexible and cost effective solution to many embedded control applications.

The ATtiny2313 AVR is supported with a full suite of program and system development tools including: C Compilers, Macro Assemblers, Program Debugger/Simulators, In-Circuit Emulators, and Evaluation kits.

## Pin Descriptions

**VCC** — Digital supply voltage.

**GND** — Ground.

**Port A (PA2..PA0)** — Port A is a 3-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port A output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port A pins that are externally pulled low will source current if the pull-up resistors are activated. The Port A pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Port A also serves the functions of various special features of the ATtiny2313 as listed on page 53.

**Port B (PB7..PB0)** — Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Port B also serves the functions of various special features of the ATtiny2313 as listed on page 53.

**Port D (PD6..PD0)** — Port D is a 7-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Port D also serves the functions of various special features of the ATtiny2313 as listed on page 56.

**$\overline{\text{RESET}}$** — Reset input. A low level on this pin for longer than the minimum pulse length will generate a reset, even if the clock is not running. The minimum pulse length is given in Table 15 on page 34. Shorter pulses are not guaranteed to generate a reset. The Reset Input is an alternate function for PA2 and dW.

**XTAL1** — Input to the inverting Oscillator amplifier and input to the internal clock operating circuit. XTAL1 is an alternate function for PA0.

**XTAL2** — Output from the inverting Oscillator amplifier. XTAL2 is an alternate function for PA1.

## Resources

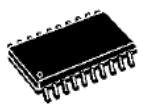
A comprehensive set of development tools, application notes and datasheets are available for downloadon http://www.atmel.com/avr.

SGS-THOMSON MICROELECTRONICS

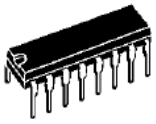
# L293D
# L293DD

## PUSH-PULL FOUR CHANNEL DRIVER WITH DIODES

- 600mA OUTPUT CURRENT CAPABILITY PER CHANNEL
- 1.2A PEAK OUTPUT CURRENT (non repetitive) PER CHANNEL
- ENABLE FACILITY
- OVERTEMPERATURE PROTECTION
- LOGICAL "0" INPUT VOLTAGE UP TO 1.5 V (HIGH NOISE IMMUNITY)
- INTERNAL CLAMP DIODES



SO(12+4+4)



Powerdip (12+2+2)

**ORDERING NUMBERS:**

L293DD L293D

### DESCRIPTION

The Device is a monolithic integrated high voltage, high current four channel driver designed to accept standard DTL or TTL logic levels and drive inductive loads (such as relays solenoides, DC and stepping motors) and switching power transistors.

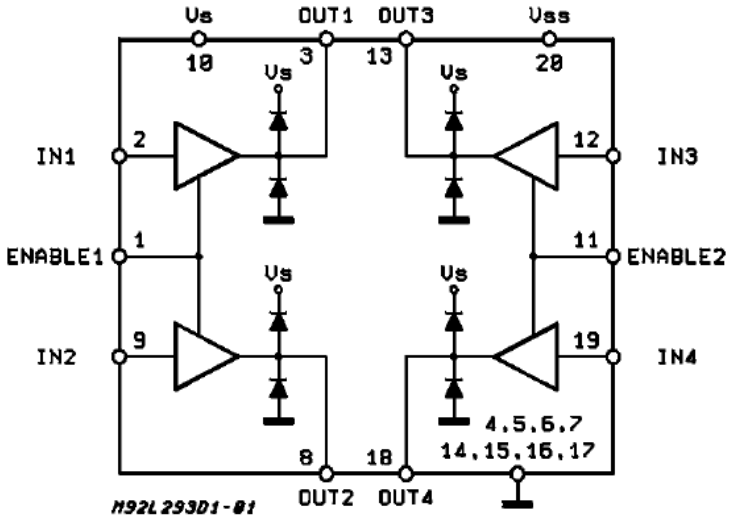
To simplify use as two bridges each pair of channels is equipped with an enable input. A separate supply input is provided for the logic, allowing operation at a lower voltage and internal clamp diodes are included.

This device is suitable for use in switching applications at frequencies up to 5 kHz.

The L293D is assembled in a 16 lead plastic packaage which has 4 center pins connected together and used for heatsinking

The L293DD is assembled in a 20 lead surface mount which has 8 center pins connected together and used for heatsinking.

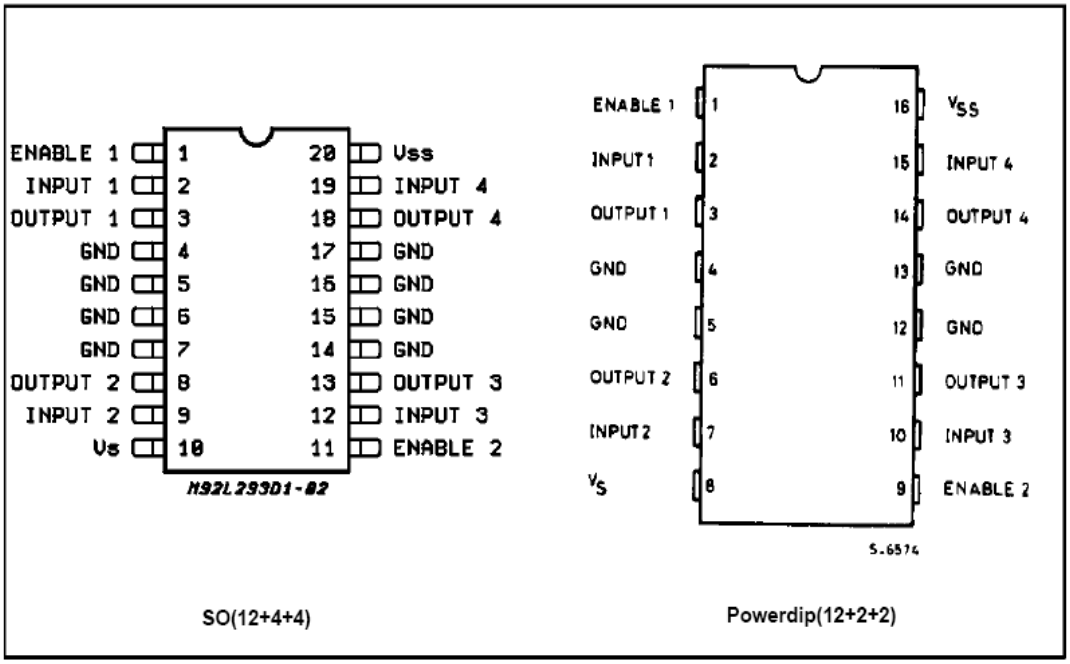
### BLOCK DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_S$ | Supply Voltage | 36 | V |
| $V_{SS}$ | Logic Supply Voltage | 36 | V |
| $V_i$ | Input Voltage | 7 | V |
| $V_{en}$ | Enable Voltage | 7 | V |
| $I_o$ | Peak Output Current (100 µs non repetitive) | 1.2 | A |
| $P_{tot}$ | Total Power Dissipation at $T_{pins}$ = 90 °C | 4 | W |
| $T_{stg}$, $T_j$ | Storage and Junction Temperature | – 40 to 150 | °C |

## PIN CONNECTIONS (Top view)




SO(12+4+4) Powerdip(12+2+2)

## THERMAL DATA

| Symbol | Decription | | DIP | SO | Unit |
|---|---|---|---|---|---|
| $R_{th\ j\text{-}pins}$ | Thermal Resistance Junction-pins | max. | – | 14 | °C/W |
| $R_{th\ j\text{-}amb}$ | Thermal Resistance junction-ambient | max. | 80 | 50 (*) | °C/W |
| $R_{th\ j\text{-}case}$ | Thermal Resistance Junction-case | max. | 14 | – | |

(*) With 6sq. cm on board heatsink.

**ELECTRICAL CHARACTERISTICS** (for each channel, $V_S$ = 24 V, $V_{SS}$ = 5 V, $T_{amb}$ = 25 °C, unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_S$ | Supply Voltage (pin 10) | | $V_{SS}$ | | 36 | V |
| $V_{SS}$ | Logic Supply Voltage (pin 20) | | 4.5 | | 36 | V |
| $I_S$ | Total Quiescent Supply Current (pin 10) | $V_i$ = L ; $I_O$ = 0 ; $V_{en}$ = H | | 2 | 6 | mA |
| | | $V_i$ = H ; $I_O$ = 0 ; $V_{en}$ = H | | 16 | 24 | mA |
| | | $V_{en}$ = L | | | 4 | mA |
| $I_{SS}$ | Total Quiescent Logic Supply Current (pin 20) | $V_i$ = L ; $I_O$ = 0 ; $V_{en}$ = H | | 44 | 60 | mA |
| | | $V_i$ = H ; $I_O$ = 0 ; $V_{en}$ = H | | 16 | 22 | mA |
| | | $V_{en}$ = L | | 16 | 24 | mA |
| $V_{IL}$ | Input Low Voltage (pin 2, 9, 12, 19) | | – 0.3 | | 1.5 | V |
| $V_{IH}$ | Input High Voltage (pin 2, 9, 12, 19) | $V_{SS} \leq 7$ V | 2.3 | | $V_{SS}$ | V |
| | | $V_{SS} > 7$ V | 2.3 | | 7 | V |
| $I_{IL}$ | Low Voltage Input Current (pin 2, 9, 12, 19) | $V_{IL}$ = 1.5 V | | | – 10 | µA |
| $I_{IH}$ | High Voltage Input Current (pin 2, 9, 12, 19) | $2.3\ V \leq V_{IH} \leq V_{SS} - 0.6$ V | | 30 | 100 | µA |
| $V_{en\,L}$ | Enable Low Voltage (pin 1, 11) | | – 0.3 | | 1.5 | V |
| $V_{en\,H}$ | Enable High Voltage (pin 1, 11) | $V_{SS} \leq 7$ V | 2.3 | | $V_{SS}$ | V |
| | | $V_{SS} > 7$ V | 2.3 | | 7 | V |
| $I_{en\,L}$ | Low Voltage Enable Current (pin 1, 11) | $V_{en\,L}$ = 1.5 V | | – 30 | – 100 | µA |
| $I_{en\,H}$ | High Voltage Enable Current (pin 1, 11) | $2.3\ V \leq V_{en\,H} \leq V_{SS} - 0.6$ V | | | ± 10 | µA |
| $V_{CE(sat)H}$ | Source Output Saturation Voltage (pins 3, 8, 13, 18) | $I_O$ = – 0.6 A | | 1.4 | 1.8 | V |
| $V_{CE(sat)L}$ | Sink Output Saturation Voltage (pins 3, 8, 13, 18) | $I_O$ = + 0.6 A | | 1.2 | 1.8 | V |
| $V_F$ | Clamp Diode Forward Voltage | $I_O$ = 600nA | | 1.3 | | V |
| $t_r$ | Rise Time (*) | 0.1 to 0.9 $V_O$ | | 250 | | ns |
| $t_f$ | Fall Time (*) | 0.9 to 0.1 $V_O$ | | 250 | | ns |
| $t_{on}$ | Turn-on Delay (*) | 0.5 $V_i$ to 0.5 $V_O$ | | 750 | | ns |
| $t_{off}$ | Turn-off Delay (*) | 0.5 $V_i$ to 0.5 $V_O$ | | 200 | | ns |

(*) See fig. 1.