LAMPIRAN A

Listing Program

Listing Program pada Mikrokontroler

```
/*****************************************************
Chip type           : ATmega8535
Clock frequency     : 11.059200 MHz
*****************************************************/

#include <mega8535.h>
#include <delay.h>
#include <stdio.h>

int hijau1;
int hijau2;
int hijau3;
int hijau4;
char pilihan;


#define RXB8 1
#define TXB8 0
#define UPE 2
#define OVR 3
#define FE 4
#define UDRE 5
#define RXC 7

#define FRAMING_ERROR (1<<FE)
#define PARITY_ERROR (1<<UPE)
#define DATA_OVERRUN (1<<OVR)
#define DATA_REGISTER_EMPTY (1<<UDRE)
#define RX_COMPLETE (1<<RXC)

// USART Receiver buffer
#define RX_BUFFER_SIZE 8
char rx_buffer[RX_BUFFER_SIZE];

#if RX_BUFFER_SIZE<256
unsigned char rx_wr_index,rx_rd_index,rx_counter;
#else
unsigned int rx_wr_index,rx_rd_index,rx_counter;
#endif

// This flag is set on USART Receiver buffer overflow
bit rx_buffer_overflow;

// USART Receiver interrupt service routine
```

```
interrupt [USART_RXC] void usart_rx_isr(void)
{
char status,data;
status=UCSRA;
data=UDR;
if ((status & (FRAMING_ERROR | PARITY_ERROR |
DATA_OVERRUN))==0)
   {
   rx_buffer[rx_wr_index]=data;
   if (++rx_wr_index == RX_BUFFER_SIZE) rx_wr_index=0;
   if (++rx_counter == RX_BUFFER_SIZE)
      {
      rx_counter=0;
      rx_buffer_overflow=1;
      };
   };
   if(data=='Z')
 {
 pilihan=1;
 putsf("mode 1");


 }
  if(data=='z')
 {
 pilihan=0;
 putsf("mode 0");
 }

 switch (data)
{
    case 'A':
    hijau1=3000;
    putsf("HIJAU1 3 DETIK");
    break;


    case 'B':
    hijau1=6000;
    putsf("HIJAU1 6 DETIK");
    break;


        case 'C':
    hijau1=9000;
    putsf("HIJAU1 9 DETIK");
    break;
```

```
case 'D':
hijau2=3000;
putsf("HIJAU2 3 DETIK");
break;


case 'E':
hijau2=6000;
putsf("HIJAU2 6 DETIK");
break;


case 'F':
hijau2=9000;
putsf("HIJAU2 9 DETIK");
break;

case 'G':
hijau3=3000;
putsf("HIJAU3 3 DETIK");
break;


case 'H':
hijau3=6000;
putsf("HIJAU3 6 DETIK");
break;


case 'I':
hijau3=9000;
putsf("HIJAU3 9 DETIK");
break;

case 'J':
hijau4=3000;
putsf("HIJAU4 3 DETIK");
break;
```

```
   case 'K':
   hijau4=6000;
   putsf("HIJAU4 6 DETIK");
   break;


   case 'L':
   hijau4=9000;
   putsf("HIJAU4 9 DETIK");
   break;


   case 'O':
   hijau4=9000;
   putsf("MENYALA SEMUA");
   PORTA = 0xFF;
   PORTB = 0xFF;
   break;

   case 'P':
   hijau4=9000;
   putsf("PADAM SEMUA");
   PORTA = 0x00;
   PORTB = 0x00;
   break;

   }
}

#ifndef _DEBUG_TERMINAL_IO_
// Get a character from the USART Receiver buffer
#define _ALTERNATE_GETCHAR_
#pragma used+
char getchar(void)
{
char data;
while (rx_counter==0);
data=rx_buffer[rx_rd_index];
if (++rx_rd_index == RX_BUFFER_SIZE) rx_rd_index=0;
#asm("cli")
--rx_counter;
#asm("sei")
return data;
}
#pragma used-
#endif
```

```
// USART Transmitter buffer
#define TX_BUFFER_SIZE 8
char tx_buffer[TX_BUFFER_SIZE];

#if TX_BUFFER_SIZE<256
unsigned char tx_wr_index,tx_rd_index,tx_counter;
#else
unsigned int tx_wr_index,tx_rd_index,tx_counter;
#endif

// USART Transmitter interrupt service routine
interrupt [USART_TXC] void usart_tx_isr(void)
{
if (tx_counter)
   {
   --tx_counter;
   UDR=tx_buffer[tx_rd_index];
   if (++tx_rd_index == TX_BUFFER_SIZE) tx_rd_index=0;
   };
}

#ifndef _DEBUG_TERMINAL_IO_
// Write a character to the USART Transmitter buffer
#define _ALTERNATE_PUTCHAR_
#pragma used+
void putchar(char c)
{
while (tx_counter == TX_BUFFER_SIZE);
#asm("cli")
if (tx_counter || ((UCSRA & DATA_REGISTER_EMPTY)==0))
   {
   tx_buffer[tx_wr_index]=c;
   if (++tx_wr_index == TX_BUFFER_SIZE) tx_wr_index=0;
   ++tx_counter;
   }
else
   UDR=c;
#asm("sei")
}
#pragma used-
#endif

// Standard Input/Output functions
#include <stdio.h>
```

```
// Declare your global variables here

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

// Input/Output Ports initialization
// Port A initialization
// Func7=In Func6=In Func5=Out Func4=Out Func3=Out Func2=Out Func1=Out
Func0=Out
// State7=T State6=T State5=0 State4=0 State3=0 State2=0 State1=0 State0=0
PORTA=0x00;
DDRA=0xFF;

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

// Port C initialization
// Func7=In Func6=In Func5=In Func4=In Func3=In Func2=In Func1=In
Func0=In
// State7=T State6=T State5=T State4=T State3=T State2=T State1=T State0=T
PORTC=0x00;
DDRC=0x00;

// Port D initialization
// Func7=In Func6=In Func5=In Func4=In Func3=In Func2=In Func1=In
Func0=In
// State7=T 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
// OC0 output: Disconnected
TCCR0=0x00;
TCNT0=0x00;
OCR0=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;

// Timer/Counter 2 initialization
// Clock source: System Clock
// Clock value: Timer 2 Stopped
// Mode: Normal top=FFh
// OC2 output: Disconnected
ASSR=0x00;
TCCR2=0x00;
TCNT2=0x00;
OCR2=0x00;

// External Interrupt(s) initialization
// INT0: Off
// INT1: Off
// INT2: Off
MCUCR=0x00;
MCUCSR=0x00;

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

// USART initialization
// Communication Parameters: 8 Data, 1 Stop, No Parity
// USART Receiver: On
// USART Transmitter: On
// USART Mode: Asynchronous
// USART Baud rate: 9600
UCSRA=0x00;
```

```
UCSRB=0xD8;
UCSRC=0x86;
UBRRH=0x00;
UBRRL=0x47;

// Analog Comparator initialization
// Analog Comparator: Off
// Analog Comparator Input Capture by Timer/Counter 1: Off
ACSR=0x80;
SFIOR=0x00;

// Global enable interrupts
#asm("sei")

while (1)
     {
     while(pilihan == 0)
     {
       PORTA = 0x0C;
       PORTB = 0x09 ;
       delay_ms(6000);
       PORTA= 0x0A;
       delay_ms(1000);
       PORTA= 0x09;
       delay_ms(4000);
       PORTA=0x21;
       delay_ms(6000);
       PORTA=0x11;
       delay_ms(1000);
       PORTA=0x09;
       delay_ms(4000);
       PORTB=0x0C;
       delay_ms(6000);
       PORTB=0x0A;
       delay_ms(1000);
       PORTB=0x09;
       delay_ms(4000);
       PORTB=0x21;
       delay_ms(6000);
       PORTB=0x11;
       delay_ms(1000);
       PORTB=0x09;
       delay_ms(4000);

       };
```

```
 while (pilihan == 1)
     {
       PORTA = 0x0C;
       PORTB = 0x09 ;
       delay_ms(hijau1);
       PORTA= 0x0A;
       delay_ms(1000);
       PORTA= 0x09;
       delay_ms(4000);
       PORTA=0x21;
       delay_ms(hijau2);
       PORTA=0x11;
       delay_ms(1000);
       PORTA=0x09;
       delay_ms(4000);
       PORTB=0x0C;
       delay_ms(hijau3);
       PORTB=0x0A;
       delay_ms(1000);
       PORTB=0x09;
       delay_ms(4000);
       PORTB=0x21;
       delay_ms(hijau4);
       PORTB=0x11;
       delay_ms(1000);
       PORTB=0x09;
       delay_ms(4000);

}

     }

}
```

Listing Program pada Mikrosoft Visual Basic 6.0

```
Option Explicit

Dim P1, P2, P3, P4 As Integer
Dim i, j, warna, r, G, b, X, luas, lebar As Integer
Dim buffx, buffy As Integer
Dim ZZ As Long
Dim x1, x2, x3, x4, x5, x6, x7, x8, x9, x10, x11, x12, x13, x14, x15, x16, y1, y2,
y3, y4, y5, y6, y7, y8, y9, y10, y11, y12, y13, y14, y15, y16 As Integer


Private Sub cmdjlr1_Click()
If cmdjlr1.Tag = "0" Then
  cmdjlr1.Tag = "1"
  cmdjlr1.Caption = "RST Jalur1"
Else
  cmdjlr1.Tag = "0"
  cmdjlr1.Caption = "Set Jalur1"
End If

End Sub

Private Sub cmdjlr2_Click()
If cmdjlr2.Tag = "0" Then
  cmdjlr2.Tag = "1"
  cmdjlr2.Caption = "RST Jalur2"
Else
  cmdjlr2.Tag = "0"
  cmdjlr2.Caption = "Set Jalur2"
End If
End Sub

Private Sub cmdjlr3_Click()
If cmdjlr3.Tag = "0" Then
  cmdjlr3.Tag = "1"
  cmdjlr3.Caption = "RST Jalur3"
Else
  cmdjlr3.Tag = "0"
  cmdjlr3.Caption = "Set Jalur3"
End If
End Sub

Private Sub cmdjlr4_Click()
If cmdjlr4.Tag = "0" Then
  cmdjlr4.Tag = "1"
  cmdjlr4.Caption = "RST Jalur4"
```

```
Else
  cmdjlr4.Tag = "0"
  cmdjlr4.Caption = "Set Jalur4"
End If
End Sub

Private Sub Command1_Click()

'================== JALUR 1 ==================
Dot(1).X = Text1.Text
Dot(1).Y = Text2.Text
Dot(2).X = Text3.Text
Dot(2).Y = Text4.Text

Dim panjang As Integer
Dim lebar As Integer
Dim hitam, putih As Integer

hitam = 0
putih = 0
Text17.Text = ""
panjang = Abs(Dot(1).X - Dot(2).X)
lebar = Abs(Dot(1).Y - Dot(2).Y)

For i = Dot(1).X To Dot(2).X
   For j = Dot(1).Y To Dot(2).Y
      warna = Picture1.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)
      X = (r + G + b) / 3

      If X < 128 Then
         X = 0
         hitam = hitam + 1
      End If


      If X >= 128 Then
         X = 255
         putih = putih + 1
      End If

      Picture1.PSet (i, j), RGB(X, X, X)
   Next j
Next i
```

```
Text17.Text = (putih / (hitam + putih)) * 100
If Val(Text17.Text) < 30 Then
Text22.Text = "3 Detik"
ElseIf Val(Text17.Text) >= 30 And Val(Text17.Text) < 60 Then
Text22.Text = "6 detik"
ElseIf Val(Text17.Text) >= 60 Then
Text22.Text = "9 detik"
End If

'================== JALUR 2 ==================
Dot(1).X = Text5.Text
Dot(1).Y = Text6.Text
Dot(2).X = Text7.Text
Dot(2).Y = Text8.Text


hitam = 0
putih = 0
Text18.Text = ""
panjang = Abs(Dot(1).X - Dot(2).X)
lebar = Abs(Dot(1).Y - Dot(2).Y)

For i = Dot(1).X To Dot(2).X
   For j = Dot(1).Y To Dot(2).Y
      warna = Picture1.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)
      X = (r + G + b) / 3

      If X < 128 Then
         X = 0
         hitam = hitam + 1
      End If


      If X >= 128 Then
         X = 255
         putih = putih + 1
      End If

      Picture1.PSet (i, j), RGB(X, X, X)
   Next j
Next i

Text18.Text = (putih / (hitam + putih)) * 100
If Val(Text18.Text) < 30 Then
```

```
Text23.Text = "3 Detik"
ElseIf Val(Text18.Text) >= 30 And Val(Text18.Text) < 60 Then
Text23.Text = "6 detik"
ElseIf Val(Text18.Text) >= 60 Then
Text23.Text = "9 detik"
End If

'================== JALUR 3 ==================
Dot(1).X = Text9.Text
Dot(1).Y = Text10.Text
Dot(2).X = Text11.Text
Dot(2).Y = Text12.Text


hitam = 0
putih = 0
Text19.Text = ""
panjang = Abs(Dot(1).X - Dot(2).X)
lebar = Abs(Dot(1).Y - Dot(2).Y)

For i = Dot(1).X To Dot(2).X
   For j = Dot(1).Y To Dot(2).Y
      warna = Picture1.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)
      X = (r + G + b) / 3

      If X < 128 Then
         X = 0
         hitam = hitam + 1
      End If


      If X >= 128 Then
         X = 255
         putih = putih + 1
      End If

      Picture1.PSet (i, j), RGB(X, X, X)
   Next j
Next i

Text19.Text = (putih / (hitam + putih)) * 100
If Val(Text19.Text) < 30 Then
Text24.Text = "3 Detik"
ElseIf Val(Text19.Text) >= 30 And Val(Text19.Text) < 60 Then
```

```
Text24.Text = "6 detik"
ElseIf Val(Text19.Text) >= 60 Then
Text24.Text = "9 detik"
End If

'================== JALUR 4 ==================
Dot(1).X = Text13.Text
Dot(1).Y = Text14.Text
Dot(2).X = Text15.Text
Dot(2).Y = Text16.Text


hitam = 0
putih = 0
Text20.Text = ""
panjang = Abs(Dot(1).X - Dot(2).X)
lebar = Abs(Dot(1).Y - Dot(2).Y)

For i = Dot(1).X To Dot(2).X
   For j = Dot(1).Y To Dot(2).Y
      warna = Picture1.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)
      X = (r + G + b) / 3

      If X < 128 Then
         X = 0
         hitam = hitam + 1
      End If


      If X >= 128 Then
         X = 255
         putih = putih + 1
      End If

      Picture1.PSet (i, j), RGB(X, X, X)
   Next j
Next i

Text20.Text = (putih / (hitam + putih)) * 100
If Val(Text20.Text) < 30 Then
Text25.Text = "3 Detik"
ElseIf Val(Text20.Text) >= 30 And Val(Text20.Text) < 60 Then
Text25.Text = "6 detik"
ElseIf Val(Text20.Text) >= 60 Then
```

```
Text25.Text = "9 detik"
End If
End Sub

Private Sub Command2_Click()
   Call TWAIN_LogFile(1)
   Call TWAIN_SetHideUI(1)
   Call TWAIN_SetIndicators(0)
   If TWAIN_OpenSource("USB PC Camera (SN9C102P)") <> 0 Then
      Call TWAIN_SetPixelType(2)
      Call TWAIN_SetXferCount(1)
      Call TWAIN_SetAutoScan(0)
      ' If you can't use Me.hwnd, pass 0:
      Call TWAIN_AcquireToFilename(Me.hwnd, "C:\image.bmp")
   End If
   If TWAIN_LastErrorCode() <> 0 Then
      Call TWAIN_ReportLastError("Unable to scan.")
   End If
Image1.Picture = LoadPicture("c:\image.bmp")
Picture1.Picture = Image1.Picture
End Sub

Private Sub Command5_Click()
'JALUR 1
P1 = Val(Text17.Text)

If P1 < 30 Then
MSComm1.Output = "Z"  'AKTIFKAN PILIHAN MODE 1
While MSComm1.InBufferCount = 0
 Text21.Text = " "
Wend
Text21.Text = MSComm1.Input
For ZZ = 1 To 1000000: Next ZZ
MSComm1.Output = "A"
While MSComm1.InBufferCount = 0
 Text21.Text = " "
Wend
Text21.Text = MSComm1.Input
For ZZ = 1 To 1000000: Next ZZ

ElseIf (P1 > 30) And (P1 < 60) Then
MSComm1.Output = "B"
While MSComm1.InBufferCount = 0
 Text21.Text = " "
Wend
Text21.Text = MSComm1.Input
For ZZ = 1 To 1000000: Next ZZ
```

```
ElseIf P1 > 60 Then
MSComm1.Output = "C"
While MSComm1.InBufferCount = 0
 Text21.Text = " "
Wend
Text21.Text = MSComm1.Input
For ZZ = 1 To 1000000: Next ZZ
End If

'JALUR 2
P2 = Val(Text18.Text)

If P2 < 30 Then
MSComm1.Output = "Z"  'AKTIFKAN PILIHAN MODE 1
While MSComm1.InBufferCount = 0
 Text21.Text = " "
Wend
Text21.Text = MSComm1.Input
For ZZ = 1 To 1000000: Next ZZ
MSComm1.Output = "D"
While MSComm1.InBufferCount = 0
 Text21.Text = " "
Wend
Text21.Text = MSComm1.Input
For ZZ = 1 To 1000000: Next ZZ

ElseIf (P2 > 30) And (P2 < 60) Then
MSComm1.Output = "E"
While MSComm1.InBufferCount = 0
 Text21.Text = " "
Wend
Text21.Text = MSComm1.Input
For ZZ = 1 To 1000000: Next ZZ

ElseIf P2 > 60 Then
MSComm1.Output = "F"
While MSComm1.InBufferCount = 0
 Text21.Text = " "
Wend
Text21.Text = MSComm1.Input
For ZZ = 1 To 1000000: Next ZZ
End If

'JALUR 3
P3 = Val(Text19.Text)
If P3 < 30 Then
```

```
MSComm1.Output = "Z"  'AKTIFKAN PILIHAN MODE 1
While MSComm1.InBufferCount = 0
 Text21.Text = " "
Wend
Text21.Text = MSComm1.Input
For ZZ = 1 To 1000000: Next ZZ
MSComm1.Output = "G"
While MSComm1.InBufferCount = 0
 Text21.Text = " "
Wend
Text21.Text = MSComm1.Input
For ZZ = 1 To 1000000: Next ZZ

ElseIf (P3 > 30) And (P3 < 60) Then
MSComm1.Output = "H"
While MSComm1.InBufferCount = 0
 Text21.Text = " "
Wend
Text21.Text = MSComm1.Input
For ZZ = 1 To 1000000: Next ZZ

ElseIf P3 > 60 Then
MSComm1.Output = "I"
While MSComm1.InBufferCount = 0
 Text21.Text = " "
Wend
Text21.Text = MSComm1.Input
For ZZ = 1 To 1000000: Next ZZ
End If

'JALUR 4
P4 = Val(Text20.Text)

If P4 < 30 Then
MSComm1.Output = "J"
While MSComm1.InBufferCount = 0
 Text21.Text = " "
Wend
Text21.Text = MSComm1.Input
For ZZ = 1 To 1000000: Next ZZ

ElseIf (P4 > 30) And (P4 < 60) Then
MSComm1.Output = "Z"  'AKTIFKAN PILIHAN MODE 1
While MSComm1.InBufferCount = 0
 Text21.Text = " "
Wend
Text21.Text = MSComm1.Input
```

```
For ZZ = 1 To 1000000: Next ZZ

MSComm1.Output = "K"
While MSComm1.InBufferCount = 0
 Text21.Text = " "
Wend
Text21.Text = MSComm1.Input
For ZZ = 1 To 1000000: Next ZZ


ElseIf P4 > 60 Then
MSComm1.Output = "Z"  'AKTIFKAN PILIHAN MODE 1
While MSComm1.InBufferCount = 0
 Text21.Text = " "
Wend
Text21.Text = MSComm1.Input
For ZZ = 1 To 1000000: Next ZZ
MSComm1.Output = "L"
While MSComm1.InBufferCount = 0
 Text21.Text = " "
Wend
Text21.Text = MSComm1.Input
For ZZ = 1 To 1000000: Next ZZ
End If
End Sub

Private Sub Form_Load()
MSComm1.CommPort = 1
MSComm1.Settings = "9600,N,8,1"
MSComm1.InputLen = 0
MSComm1.PortOpen = True
End Sub

Private Sub Picture1_MouseDown(Button As Integer, Shift As Integer, X As
Single, Y As Single)
Call MouseDown
   buffx = X
   buffy = Y
Picture1.CurrentX = buffx
Picture1.CurrentY = buffy

'jalur satu
If cmdjlr1.Tag = "2" Then
   x2 = buffx
   y2 = buffy
   cmdjlr1.Tag = "0"
   Text3.Text = x2
```

```
    Text4.Text = y2
    cmdjlr1.Caption = "Set Jalur1"
    x3 = x2
    y3 = y1
    x4 = x1
    y4 = y2
End If

If cmdjlr1.Tag = "1" Then
    x1 = buffx
    y1 = buffy
    cmdjlr1.Tag = "2"
    Text1.Text = x1
    Text2.Text = y1
End If

'jalur dua
If cmdjlr2.Tag = "2" Then
    x6 = buffx
    y6 = buffy
    cmdjlr2.Tag = "0"
    Text7.Text = x6
    Text8.Text = y6
    cmdjlr2.Caption = "Set Jalur2"
    x7 = x6
    y7 = y5
    x8 = x5
    y8 = y6
End If

If cmdjlr2.Tag = "1" Then
    x5 = buffx
    y5 = buffy
    cmdjlr2.Tag = "2"
    Text5.Text = x5
    Text6.Text = y5
End If

'jalur tiga
If cmdjlr3.Tag = "2" Then
    x10 = buffx
    y10 = buffy
    cmdjlr3.Tag = "0"
    Text11.Text = x10
    Text12.Text = y10
    cmdjlr3.Caption = "Set Jalur3"
    x11 = x10
```

```
    y11 = y9
    x12 = x9
    y12 = y10
End If

If cmdjlr3.Tag = "1" Then
    x9 = buffx
    y9 = buffy
    cmdjlr3.Tag = "2"
    Text9.Text = x9
    Text10.Text = y9
End If

'jalur empat
If cmdjlr4.Tag = "2" Then
    x14 = buffx
    y14 = buffy
    cmdjlr4.Tag = "0"
    Text15.Text = x14
    Text16.Text = y14
    cmdjlr4.Caption = "Set Jalur4"
    x15 = x14
    y15 = y13
    x16 = x13
    y16 = y14
End If

If cmdjlr4.Tag = "1" Then
    x13 = buffx
    y13 = buffy
    cmdjlr4.Tag = "2"
    Text13.Text = x13
    Text14.Text = y13
End If

End Sub

Private Sub Picture1_MouseMove(Button As Integer, Shift As Integer, X As
Single, Y As Single)

Dim buffx As Integer, buffy As Integer

If writelet = True Then

    buffx = X
    buffy = Y
```

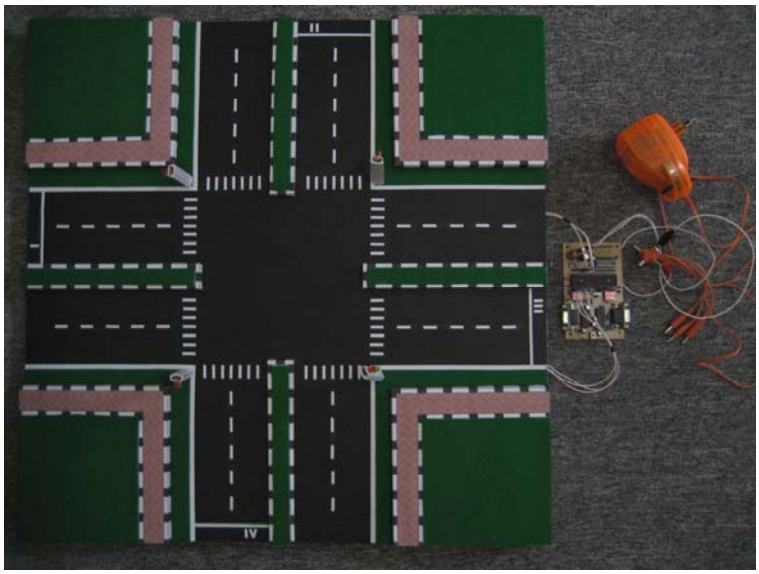
```
    Label1.Caption = buffx
    Label2.Caption = buffy

End If

End Sub

Private Sub Picture1_MouseUp(Button As Integer, Shift As Integer, X As Single,
Y As Single)
writelet = False
End Sub

Private Sub Command3_Click()
End
End Sub

Private Sub Timer1_Timer()
Call Command2_Click
End Sub

Private Sub Timer2_Timer()
Call Command1_Click
End Sub

Private Sub Timer3_Timer()
Call Command5_Click
End Sub
```

Modules :

1. **EZTwain.bas**
2. **Module.bas**

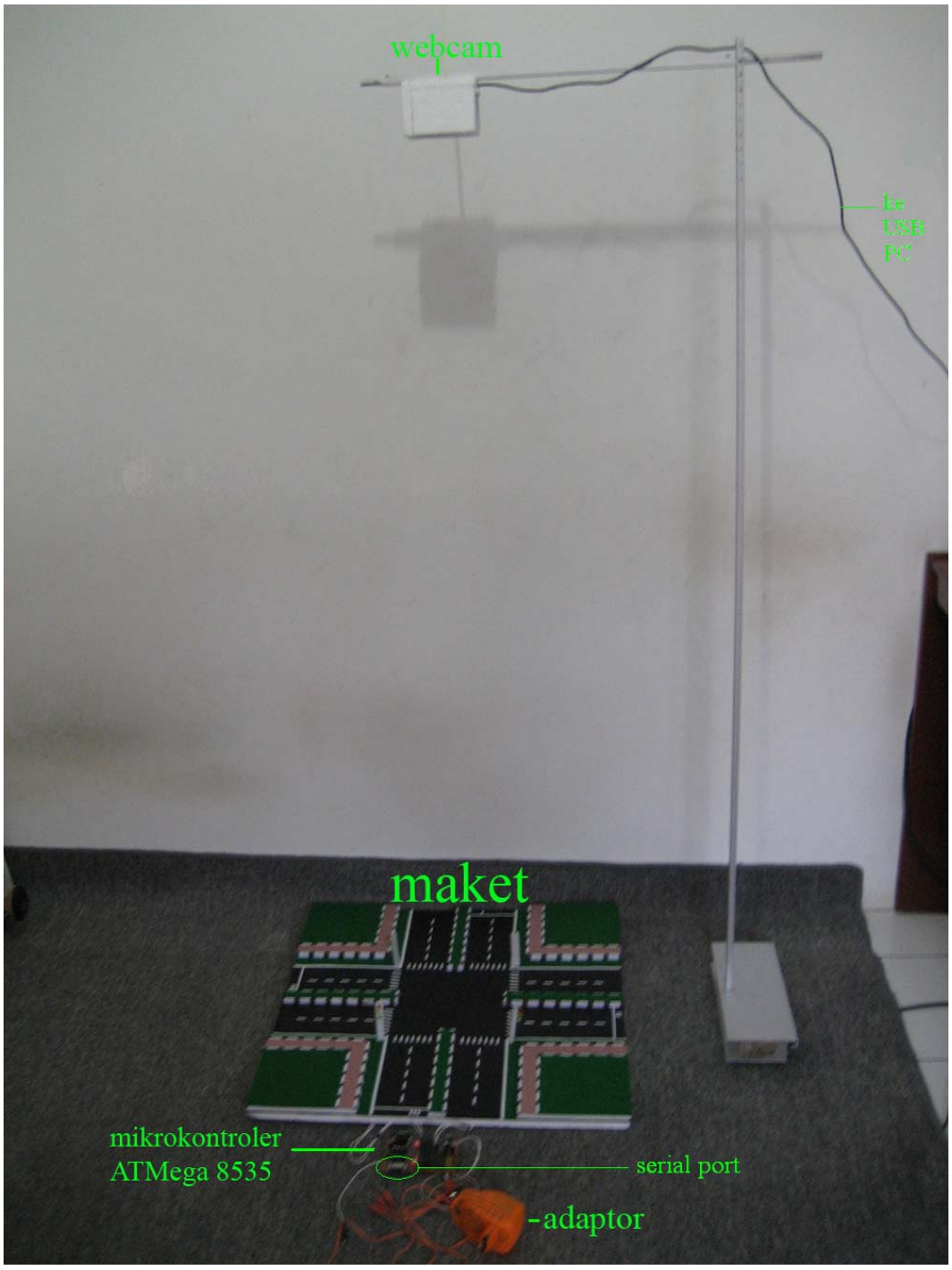
```
Public Type Node
   X As Integer
   Y As Integer
End Type

Public Dot(1 To 2) As Node

Public writelet As Boolean
Public Sub MouseDown()

writelet = True
HoldX = X
HoldY = Y
End Sub
```

LAMPIRAN B



Gambar B.1 Maket Tampak Atas

Gambar B.2 Maket Tampak Samping



Gambar B.3 Gambar Keseluruhan

LAMPIRAN C

Features

- High-performance, Low-power AVR® 8-bit Microcontroller
- Advanced RISC Architecture
  - 130 Powerful Instructions – Most Single Clock Cycle Execution
  - 32 x 8 General Purpose Working Registers
  - Fully Static Operation
  - Up to 16 MIPS Throughput at 16 MHz
  - On-chip 2-cycle Multiplier
- Nonvolatile Program and Data Memories
  - 8K Bytes of In-System Self-Programmable Flash
    Endurance: 10,000 Write/Erase Cycles
  - Optional Boot Code Section with Independent Lock Bits
    In-System Programming by On-chip Boot Program
    True Read-While-Write Operation
  - 512 Bytes EEPROM
    Endurance: 100,000 Write/Erase Cycles
  - 512 Bytes Internal SRAM
  - Programming Lock for Software Security
- Peripheral Features
  - Two 8-bit Timer/Counters with Separate Prescalers and Compare Modes
  - One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
  - Real Time Counter with Separate Oscillator
  - Four PWM Channels
  - 8-channel, 10-bit ADC
    8 Single-ended Channels
    7 Differential Channels for TQFP Package Only
    2 Differential Channels with Programmable Gain at 1x, 10x, or 200x for TQFP Package Only
  - Byte-oriented Two-wire Serial Interface
  - Programmable Serial USART
  - Master/Slave SPI Serial Interface
  - Programmable Watchdog Timer with Separate On-chip Oscillator
  - On-chip Analog Comparator
- Special Microcontroller Features
  - Power-on Reset and Programmable Brown-out Detection
  - Internal Calibrated RC Oscillator
  - External and Internal Interrupt Sources
  - Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby and Extended Standby
- I/O and Packages
  - 32 Programmable I/O Lines
  - 40-pin PDIP, 44-lead TQFP, 44-lead PLCC, and 44-pad QFN/MLF
- Operating Voltages
  - 2.7 - 5.5V for ATmega8535L
  - 4.5 - 5.5V for ATmega8535
- Speed Grades
  - 0 - 8 MHz for ATmega8535L
  - 0 - 16 MHz for ATmega8535

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

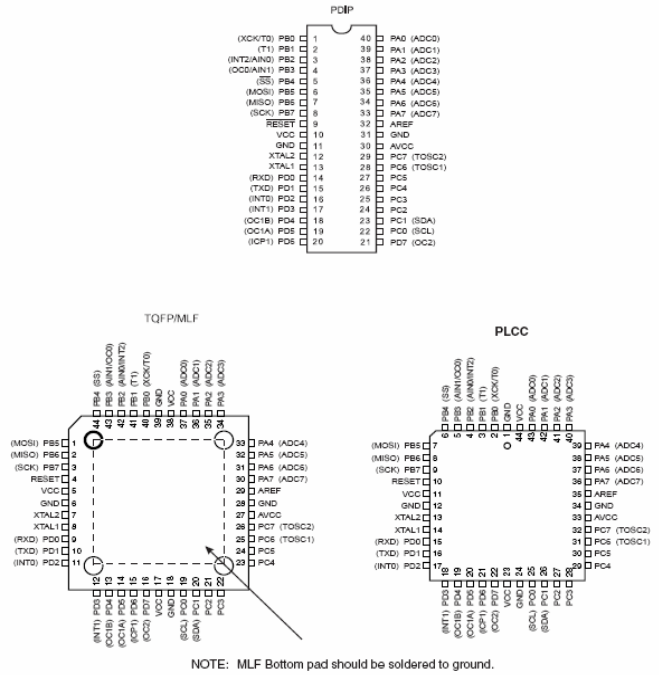
ATmega8535
ATmega8535L

Summary

2502KS–AVR–10/06

Pin Configurations

Figure 1. Pinout ATmega8535



NOTE: MLF Bottom pad should be soldered to ground.

Disclaimer

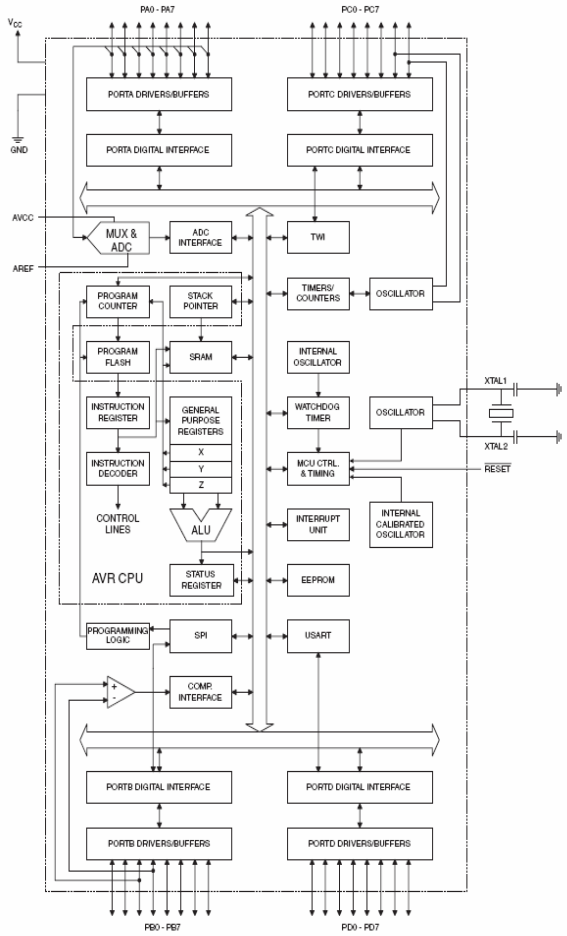
Typical values contained in this data sheet are based on simulations and characterization of other AVR microcontrollers manufactured on the same process technology. Min and Max values will be available after the device is characterized.

Overview

The ATmega8535 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing instructions in a single clock cycle, the ATmega8535 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 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 ATmega8535 provides the following features: 8K bytes of In-System Programmable Flash with Read-While-Write capabilities, 512 bytes EEPROM, 512 bytes SRAM, 32 general purpose I/O lines, 32 general purpose working registers, three flexible Timer/Counters with compare modes, internal and external interrupts, a serial programmable USART, a byte oriented Two-wire Serial Interface, an 8-channel, 10-bit ADC with optional differential input stage with programmable gain in TQFP package, a programmable Watchdog Timer with Internal Oscillator, an SPI serial port, and six software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, SPI port, 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 Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC, to minimize switching noise during ADC conversions. 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. In Extended Standby mode, both the main Oscillator and the asynchronous timer continue to run.

The device is manufactured using Atmel's high density nonvolatile memory technology. The On-chip ISP Flash allows the program memory to be reprogrammed In-System through an SPI serial interface, by a conventional nonvolatile memory programmer, or by an On-chip Boot program running on the AVR core. The boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation. By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega8535 is a powerful microcontroller that provides a highly flexible and cost effective solution to many embedded control applications.

The ATmega8535 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.

AT90S8535 Compatibility

The ATmega8535 provides all the features of the AT90S8535. In addition, several new features are added. The ATmega8535 is backward compatible with AT90S8535 in most cases. However, some incompatibilities between the two microcontrollers exist. To solve this problem, an AT90S8535 compatibility mode can be selected by programming the S8535C fuse. ATmega8535 is pin compatible with AT90S8535, and can replace the AT90S8535 on current Printed Circuit Boards. However, the location of fuse bits and the electrical characteristics differs between the two devices.

AT90S8535 Compatibility Mode

Programming the S8535C fuse will change the following functionality:

- The timed sequence for changing the Watchdog Time-out period is disabled. See "Timed Sequences for Changing the Configuration of the Watchdog Timer" on page 45 for details.
- The double buffering of the USART Receive Register is disabled. See "AVR USART vs. AVR UART – Compatibility" on page 146 for details.

Pin Descriptions

V_{CC} Digital supply voltage.

GND Ground.

Port A (PA7..PA0) Port A serves as the analog inputs to the A/D Converter.

Port A also serves as an 8-bit bi-directional I/O port, if the A/D Converter is not used. Port pins can provide internal pull-up resistors (selected for each bit). The Port A output buffers have symmetrical drive characteristics with both high sink and source capability. When pins PA0 to PA7 are used as inputs and are externally pulled low, they will source current if the internal 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 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 ATmega8535 as listed on page 60.

Port C (PC7..PC0) Port C is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port C output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Port D (PD7..PD0) Port D is an 8-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 ATmega8535 as listed on page 64.

$\overline{\text{RESET}}$ 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 37. Shorter pulses are not guaranteed to generate a reset.

XTAL1 Input to the inverting Oscillator amplifier and input to the internal clock operating circuit.

XTAL2 Output from the inverting Oscillator amplifier.

AVCC AVCC is the supply voltage pin for Port A and the A/D Converter. It should be externally connected to V_{CC}, even if the ADC is not used. If the ADC is used, it should be connected to V_{CC} through a low-pass filter.

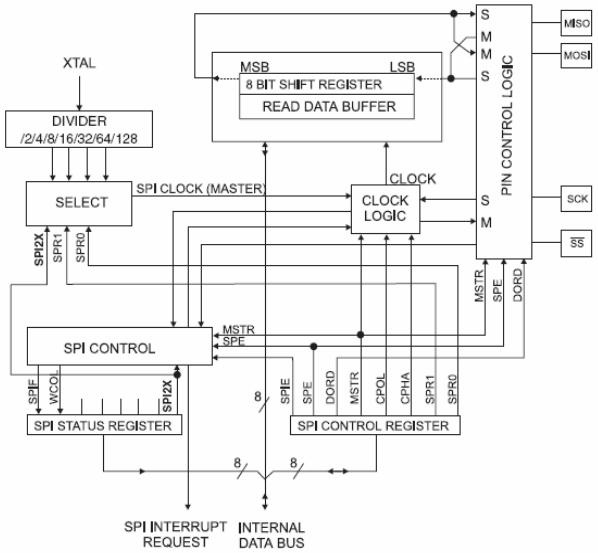
AREF AREF is the analog reference pin for the A/D Converter.

Serial Peripheral Interface – SPI

The Serial Peripheral Interface (SPI) allows high-speed synchronous data transfer between the ATmega8535 and peripheral devices or between several AVR devices. The ATmega8535 SPI includes the following features:

- **Full Duplex, Three-wire Synchronous Data Transfer**
- **Master or Slave Operation**
- **LSB First or MSB First Data Transfer**
- **Seven Programmable Bit Rates**
- **End of Transmission Interrupt Flag**
- **Write Collision Flag Protection**
- **Wake-up from Idle Mode**
- **Double Speed (CK/2) Master SPI Mode**

Figure 65. SPI Block Diagram[1]



Note: 1. Refer to Figure 1 on page 2, and Table 26 on page 60 for SPI pin placement.

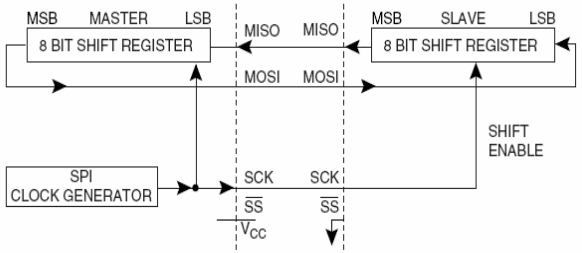
The interconnection between Master and Slave CPUs with SPI is shown in Figure 66. The system consists of two Shift Registers, and a Master clock generator. The SPI Master initiates the communication cycle when pulling low the Slave Select $\overline{SS}$ pin of the desired Slave. Master and Slave prepare the data to be sent in their respective Shift Registers, and the Master generates the required clock pulses on the SCK line to interchange data. Data is always shifted from Master to Slave on the Master Out – Slave In, MOSI, line, and from Slave to Master on the Master In – Slave Out, MISO, line. After each data packet, the Master will synchronize the Slave by pulling high the Slave Select, $\overline{SS}$, line.

When configured as a Master, the SPI interface has no automatic control of the $\overline{SS}$ line. This must be handled by user software before communication can start. When this is

done, writing a byte to the SPI Data Register starts the SPI Clock Generator, and the hardware shifts the eight bits into the Slave. After shifting one byte, the SPI clock generator stops, setting the end of Transmission Flag (SPIF). If the SPI Interrupt Enable bit (SPIE) in the SPCR Register is set, an interrupt is requested. The Master may continue to shift the next byte by writing it into SPDR, or signal the end of packet by pulling high the Slave Select, $\overline{SS}$ line. The last incoming byte will be kept in the buffer register for later use.

When configured as a Slave, the SPI interface will remain sleeping with MISO tri-stated as long as the $\overline{SS}$ pin is driven high. In this state, software may update the contents of the SPI Data Register, SPDR, but the data will not be shifted out by incoming clock pulses on the SCK pin until the $\overline{SS}$ pin is driven low. As one byte has been completely shifted, the end of Transmission Flag, SPIF is set. If the SPI Interrupt Enable bit, SPIE, in the SPCR Register is set, an interrupt is requested. The Slave may continue to place new data to be sent into SPDR before reading the incoming data. The last incoming byte will be kept in the buffer register for later use.

Figure 66. SPI Master-Slave Interconnection



The system is single buffered in the transmit direction and double buffered in the receive direction. This means that bytes to be transmitted cannot be written to the SPI Data Register before the entire shift cycle is completed. When receiving data, however, a received character must be read from the SPI Data Register before the next character has been completely shifted in. Otherwise, the first byte is lost.

In SPI Slave mode, the control logic will sample the incoming signal of the SCK pin. To ensure correct sampling of the clock signal, the minimum low and high periods should be:

Low periods: Longer than 2 CPU clock cycles.

High periods: Longer than 2 CPU clock cycles.

When the SPI is enabled, the data direction of the MOSI, MISO, SCK, and $\overline{SS}$ pins is overridden according to Table 56 on page 138. For more details on automatic port overrides, refer to “Alternate Port Functions” on page 57.

Table 56. SPI Pin Overrides[1]

Pin	Direction, Master SPI	Direction, Slave SPI
MOSI	User Defined	Input
MISO	Input	User Defined
SCK	User Defined	Input
$\overline{SS}$	User Defined	Input

Note: 1. See “Alternate Functions Of Port B” on page 60 for a detailed description of how to define the direction of the user defined SPI pins.

The following code examples show how to initialize the SPI as a Master and how to perform a simple transmission. DDR_SPI in the examples must be replaced by the actual Data Direction Register controlling the SPI pins. DD_MOSI, DD_MISO and DD_SCK must be replaced by the actual data direction bits for these pins. For example, if MOSI is placed on pin PB5, replace DD_MOSI with DDB5, and DDR_SPI with DDRB.

Assembly Code Example[1]

```
SPI_MasterInit:
  ; Set MOSI and SCK output, all others input
  ldi   r17,(1<<DD_MOSI)|(1<<DD_SCK)
  out   DDR_SPI,r17
  ; Enable SPI, Master, set clock rate fck/16
  ldi   r17,(1<<SPE)|(1<<MSTR)|(1<<SPR0)
  out   SPCR,r17
  ret

SPI_MasterTransmit:
  ; Start transmission of data (r16)
  out   SPDR,r16
Wait_Transmit:
  ; Wait for transmission complete
  sbis  SPSR,SPIF
  rjmp  Wait_Transmit
  ret
```

C Code Example[1]

```
void SPI_MasterInit(void)
{
  /* Set MOSI and SCK output, all others input */
  DDR_SPI = (1<<DD_MOSI)|(1<<DD_SCK);
  /* Enable SPI, Master, set clock rate fck/16 */
  SPCR = (1<<SPE)|(1<<MSTR)|(1<<SPR0);
}

void SPI_MasterTransmit(char cData)
{
  /* Start transmission */
  SPDR = cData;
  /* Wait for transmission complete */
  while(!(SPSR & (1<<SPIF)))
    ;
}
```

Note: 1. See “About Code Examples” on page 7.

The following code examples show how to initialize the SPI as a Slave and how to perform a simple reception.

Assembly Code Example[1]

```
SPI_SlaveInit:
  ; Set MISO output, all others input
  ldi   r17,(1<<DD_MISO)
  out   DDR_SPI,r17
  ; Enable SPI
  ldi   r17,(1<<SPE)
  out   SPCR,r17
  ret

SPI_SlaveReceive:
  ; Wait for reception complete
  sbis  SPSR,SPIF
  rjmp  SPI_SlaveReceive
  ; Read received data and return
  in    r16,SPDR
  ret
```

C Code Example[1]

```
void SPI_SlaveInit(void)
{
  /* Set MISO output, all others input */
  DDR_SPI = (1<<DD_MISO);
  /* Enable SPI */
  SPCR = (1<<SPE);
}

char SPI_SlaveReceive(void)
{
  /* Wait for reception complete */
  while(!(SPSR & (1<<SPIF)))
    ;
  /* Return Data Register */
  return SPDR;
}
```

Note: 1. See “About Code Examples” on page 7.

$\overline{SS}$ Pin Functionality

Slave Mode

When the SPI is configured as a Slave, the Slave Select ($\overline{SS}$) pin is always input. When $\overline{SS}$ is held low, the SPI is activated, and MISO becomes an output if configured so by the user. All other pins are inputs. When $\overline{SS}$ is driven high, all pins are inputs, and the SPI is passive, which means that it will not receive incoming data. Note that the SPI logic will be reset once the $\overline{SS}$ pin is driven high.

The $\overline{SS}$ pin is useful for packet/byte synchronization to keep the Slave bit counter synchronous with the Master clock generator. When the $\overline{SS}$ pin is driven high, the SPI Slave will immediately reset the send and receive logic, and drop any partially received data in the Shift Register.

Master Mode

When the SPI is configured as a Master (MSTR in SPCR is set), the user can determine the direction of the $\overline{SS}$ pin.

If $\overline{SS}$ is configured as an output, the pin is a general output pin which does not affect the SPI system. Typically, the pin will be driving the $\overline{SS}$ pin of the SPI Slave.

If $\overline{SS}$ is configured as an input, it must be held high to ensure Master SPI operation. If the $\overline{SS}$ pin is driven low by peripheral circuitry when the SPI is configured as a Master with the $\overline{SS}$ pin defined as an input, the SPI system interprets this as another Master selecting the SPI as a Slave and starting to send data to it. To avoid bus contention, the SPI system takes the following actions:

1. The MSTR bit in SPCR is cleared and the SPI system becomes a Slave. As a result of the SPI becoming a Slave, the MOSI and SCK pins become inputs.
2. The SPIF Flag in SPSR is set, and if the SPI interrupt is enabled, and the I-bit in SREG is set, the interrupt routine will be executed.

Thus, when interrupt-driven SPI transmission is used in Master mode, and there exists a possibility that $\overline{SS}$ is driven low, the interrupt should always check that the MSTR bit is still set. If the MSTR bit has been cleared by a Slave Select, it must be set by the user to re-enable SPI Master mode.

SPI Control Register – SPCR

Bit	7	6	5	4	3	2	1	0	
	SPIE	SPE	DORD	MSTR	CPOL	CPHA	SPR1	SPR0	SPCR
Read/Write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
Initial Value	0	0	0	0	0	0	0	0	

- **Bit 7 – SPIE: SPI Interrupt Enable**

This bit causes the SPI interrupt to be executed if SPIF bit in the SPSR Register is set and the if the Global Interrupt Enable bit in SREG is set.

- **Bit 6 – SPE: SPI Enable**

When the SPE bit is written to one, the SPI is enabled. This bit must be set to enable any SPI operations.

- **Bit 5 – DORD: Data Order**

When the DORD bit is written to one, the LSB of the data word is transmitted first.

When the DORD bit is written to zero, the MSB of the data word is transmitted first.

- **Bit 4 – MSTR: Master/Slave Select**

This bit selects Master SPI mode when written to one, and Slave SPI mode when written logic zero. If $\overline{SS}$ is configured as an input and is driven low while MSTR is set, MSTR will

be cleared, and SPIF in SPSR will become set. The user will then have to set MSTR to re-enable SPI Master mode.

- **Bit 3 – CPOL: Clock Polarity**

When this bit is written to one, SCK is high when idle. When CPOL is written to zero, SCK is low when idle. Refer to Figure 67 and Figure 68 for an example. The CPOL functionality is summarized below:

Table 57. CPOL Functionality

CPOL	Leading Edge	Trailing Edge
0	Rising	Falling
1	Falling	Rising

- **Bit 2 – CPHA: Clock Phase**

The settings of the Clock Phase bit (CPHA) determine if data is sampled on the leading (first) or trailing (last) edge of SCK. Refer to Figure 67 and Figure 68 for an example. The CPOL functionality is summarized below:

Table 58. CPHA Functionality

CPHA	Leading Edge	Trailing Edge
0	Sample	Setup
1	Setup	Sample

- **Bits 1, 0 – SPR1, SPR0: SPI Clock Rate Select 1 and 0**

These two bits control the SCK rate of the device configured as a Master. SPR1 and SPR0 have no effect on the Slave. The relationship between SCK and the Oscillator Clock frequency f_{osc} is shown in the following table:

Table 59. Relationship between SCK and the Oscillator Frequency

SPI2X	SPR1	SPR0	SCK Frequency
0	0	0	$f_{osc}/4$
0	0	1	$f_{osc}/16$
0	1	0	$f_{osc}/64$
0	1	1	$f_{osc}/128$
1	0	0	$f_{osc}/2$
1	0	1	$f_{osc}/8$
1	1	0	$f_{osc}/32$
1	1	1	$f_{osc}/64$

SPI Status Register – SPSR

Bit	7	6	5	4	3	2	1	0	
	SPIF	WCOL	–	–	–	–	–	SPI2X	SPSR
Read/Write	R	R	R	R	R	R	R	R/W	
Initial Value	0	0	0	0	0	0	0	0	

- **Bit 7 – SPIF: SPI Interrupt Flag**

When a serial transfer is complete, the SPIF Flag is set. An interrupt is generated if SPIE in SPCR is set and global interrupts are enabled. If $\overline{SS}$ is an input and is driven low when the SPI is in Master mode, this will also set the SPIF Flag. SPIF is cleared by hardware when executing the corresponding interrupt handling vector. Alternatively, the SPIF bit is cleared by first reading the SPI Status Register with SPIF set, then accessing the SPI Data Register (SPDR).

- **Bit 6 – WCOL: Write COLlision flag**

The WCOL bit is set if the SPI Data Register (SPDR) is written during a data transfer. The WCOL bit (and the SPIF bit) are cleared by first reading the SPI Status Register with WCOL set, and then accessing the SPI Data Register.

- **Bit 5..1 – Res: Reserved Bits**

These bits are reserved bits in the ATmega8535 and will always read as zero.

- **Bit 0 – SPI2X: Double SPI Speed Bit**

When this bit is written logic one the SPI speed (SCK Frequency) will be doubled when the SPI is in Master mode (see Table 59). This means that the minimum SCK period will be two CPU clock periods. When the SPI is configured as Slave, the SPI is only guaranteed to work at $f_{osc}/4$ or lower.

The SPI interface on the ATmega8535 is also used for program memory and EEPROM downloading or uploading. See page 251 for Serial Programming and verification.

SPI Data Register – SPDR

Bit	7	6	5	4	3	2	1	0	
	MSB							LSB	SPDR
Read/Write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
Initial Value	X	X	X	X	X	X	X	X	Undefined

The SPI Data Register is a read/write register used for data transfer between the Register File and the SPI Shift Register. Writing to the register initiates data transmission. Reading the register causes the Shift Register receive buffer to be read.

Data Modes

There are four combinations of SCK phase and polarity with respect to serial data, which are determined by control bits CPHA and CPOL. The SPI data transfer formats are shown in Figure 67 and Figure 68. Data bits are shifted out and latched in on opposite edges of the SCK signal, ensuring sufficient time for data signals to stabilize. This is clearly seen by summarizing Table 57 and Table 58, as done below:

Table 60. CPOL Functionality

	Leading Edge	Trailing Edge	SPI Mode
CPOL=0, CPHA=0	Sample (Rising)	Setup (Falling)	0
CPOL=0, CPHA=1	Setup (Rising)	Sample (Falling)	1
CPOL=1, CPHA=0	Sample (Falling)	Setup (Rising)	2
CPOL=1, CPHA=1	Setup (Falling)	Sample (Rising)	3

Figure 67. SPI Transfer Format with CPHA = 0

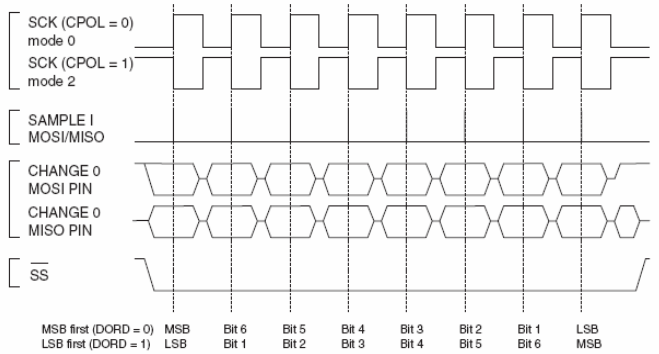
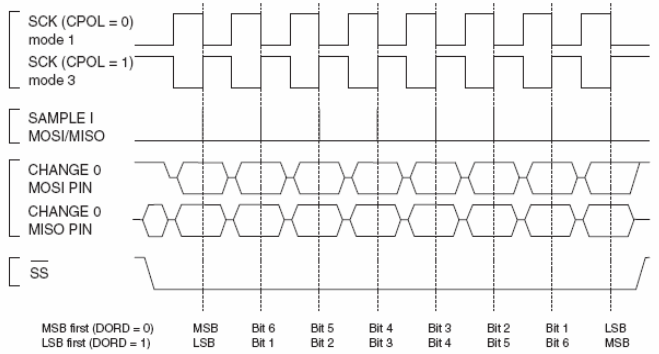


Figure 68. SPI Transfer Format with CPHA = 1



19-0175; Rev 4; 11/00

MAXIM

±15kV ESD-Protected, +5V RS-232 Transceivers

General Description

The MAX202E–MAX213E, MAX232E/MAX241E line drivers/receivers are designed for RS-232 and V.28 communications in harsh environments. Each transmitter output and receiver input is protected against ±15kV electrostatic discharge (ESD) shocks, without latchup. The various combinations of features are outlined in the *Selector Guide*. The drivers and receivers for all ten devices meet all EIA/TIA-232E and CCITT V.28 specifications at data rates up to 120kbps, when loaded in accordance with the EIA/TIA-232E specification.

The MAX211E/MAX213E/MAX241E are available in 28-pin SO packages, as well as a 28-pin SSOP that uses 60% less board space. The MAX202E/MAX232E come in 16-pin TSSOP, narrow SO, wide SO, and DIP packages. The MAX203E comes in a 20-pin DIP/SO package, and needs no external charge-pump capacitors. The MAX205E comes in a 24-pin wide DIP package, and also eliminates external charge-pump capacitors. The MAX206E/MAX207E/MAX208E come in 24-pin SO, SSOP, and narrow DIP packages. The MAX232E/MAX241E operate with four 1µF capacitors, while the MAX202E/MAX206E/MAX207E/MAX208E/MAX211E/MAX213E operate with four 0.1µF capacitors, further reducing cost and board space.

Applications

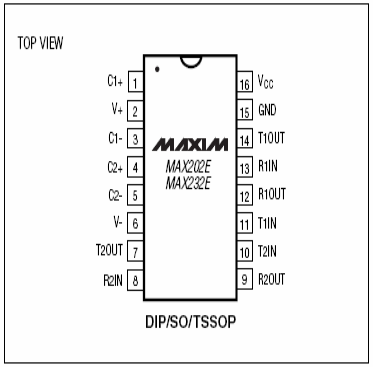
Notebook, Subnotebook, and Palmtop Computers
Battery-Powered Equipment
Hand-Held Equipment

Ordering Information and Typical Operating Circuits appear at end of data sheet.
Pin Configurations continued at end of data sheet.

Features

- ESD Protection for RS-232 I/O Pins:
  ±15kV—Human Body Model
  ±8kV—IEC1000-4-2, Contact Discharge
  ±15kV—IEC1000-4-2, Air-Gap Discharge
- Latchup Free (unlike bipolar equivalents)
- Guaranteed 120kbps Data Rate—LapLink™ Compatible
- Guaranteed 3V/µs Min Slew Rate
- Operate from a Single +5V Power Supply

Pin Configurations



Selector Guide

PART	No. of RS-232 DRIVERS	No. of RS-232 RECEIVERS	RECEIVERS ACTIVE IN SHUTDOWN	No. of EXTERNAL CAPACITORS	LOW-POWER SHUTDOWN	TTL THREE-STATE
MAX202E	2	2	0	4 (0.1µF)	No	No
MAX203E	2	2	0	None	No	No
MAX205E	5	5	0	None	Yes	Yes
MAX206E	4	3	0	4 (0.1µF)	Yes	Yes
MAX207E	5	3	0	4 (0.1µF)	No	No
MAX208E	4	4	0	4 (0.1µF)	No	No
MAX211E	4	5	0	4 (0.1µF)	Yes	Yes
MAX213E	4	5	2	4 (0.1µF)	Yes	Yes
MAX232E	2	2	0	4 (1µF)	No	No
MAX241E	4	5	0	4 (1µF)	Yes	Yes

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For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at 1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.

±15kV ESD-Protected, +5V RS-232 Transceivers

MAX202E–MAX213E, MAX232E/MAX241E

ABSOLUTE MAXIMUM RATINGS

VCC ..... -0.3V to +6V
V+ ..... (VCC - 0.3V) to +14V
V- ..... -14V to +0.3V
Input Voltages
T_IN ..... -0.3V to (V+ + 0.3V)
R_IN ..... ±30V
Output Voltages
T_OUT ..... (V- - 0.3V) to (V+ + 0.3V)
R_OUT ..... -0.3V to (VCC + 0.3V)
Short-Circuit Duration, T_OUT ..... Continuous
Continuous Power Dissipation (TA = +70°C)
16-Pin Plastic DIP (derate 10.53mW/°C above +70°C) 842mW
16-Pin Narrow SO (derate 8.70mW/°C above +70°C) 696mW
16-Pin Wide SO (derate 9.52mW/°C above +70°C) 762mW
16-Pin TSSOP (derate 9.4mW/°C above +70°C) 755mW
20-Pin Plastic DIP (derate 11.11mW/°C above +70°C) 889mW
20-Pin SO (derate 10.00mW/°C above +70°C) 800mW
24-Pin Narrow Plastic DIP
(derate 13.33mW/°C above +70°C) 1.07W
24-Pin Wide Plastic DIP
(derate 14.29mW/°C above +70°C) 1.14W
24-Pin SO (derate 11.76mW/°C above +70°C) 941mW
24-Pin SSOP (derate 8.00mW/°C above +70°C) 640mW
28-Pin SO (derate 12.50mW/°C above +70°C) 1W
28-Pin SSOP (derate 9.52mW/°C above +70°C) 762mW
Operating Temperature Ranges
MAX2_ _EC_ _ ..... 0°C to +70°C
MAX2_ _EE_ _ ..... -40°C to +85°C
Storage Temperature Range ..... -65°C to +165°C
Lead Temperature (soldering, 10sec) ..... +300°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(VCC = +5V ±10% for MAX202E/206E/208E/211E/213E/232E/241E; VCC = +5V ±5% for MAX203E/205E/207E; C1–C4 = 0.1µF for MAX202E/206E/207E/208E/211E/213E; C1–C4 = 1µF for MAX232E/241E; TA = TMIN to TMAX; unless otherwise noted. Typical values are at TA = +25°C.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
DC CHARACTERISTICS							
VCC Supply Current	ICC	No load, TA = +25°C	MAX202E/203E		8	15	mA
			MAX205E–208E		11	20	
			MAX211E/213E		14	20	
			MAX232E		5	10	
			MAX241E		7	15	
Shutdown Supply Current		TA = +25°C, Figure 1	MAX205E/206E		1	10	µA
			MAX211E/241E		1	10	
			MAX213E		15	50	
LOGIC							
Input Pull-Up Current		T_IN = 0V (MAX205E–208E/211E/213E/241E)			15	200	µA
Input Leakage Current		T_IN = 0V to VCC (MAX202E/203E/232E)				±10	µA
Input Threshold Low	VIL	T_IN; EN, $\overline{SHDN}$ (MAX213E) or $\overline{EN}$, SHDN (MAX205E–208E/211E/241E)				0.8	V
Input Threshold High	VIH	T_IN		2.0			V
		EN, $\overline{SHDN}$ (MAX213E) or $\overline{EN}$, SHDN (MAX205E–208E/211E/241E)		2.4			
Output Voltage Low	VOL	R_OUT; IOUT = 3.2mA (MAX202E/203E/232E) or IOUT = 1.6mA (MAX205E/208E/211E/213E/241E)				0.4	V
Output Voltage High	VOH	R_OUT; IOUT = -1.0mA		3.5	VCC - 0.4		V
Output Leakage Current		$\overline{EN}$ = VCC, EN = 0V, 0V ≤ ROUT ≤ VCC, MAX205E–208E/211E/213E/241E outputs disabled			±0.05	±10	µA

ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = +5V ±10% for MAX202E/206E/208E/211E/213E/232E/241E; V_{CC} = +5V ±5% for MAX203E/205E/207E; C1–C4 = 0.1µF for MAX202E/206E/207E/208E/211E/213E; C1–C4 = 1µF for MAX232E/241E; T_A = T_{MIN} to T_{MAX}; unless otherwise noted. Typical values are at T_A = +25°C.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
EIA/TIA-232E RECEIVER INPUTS							
Input Voltage Range				-30		30	V
Input Threshold Low		T_A = +25°C, V_{CC} = 5V	All parts, normal operation	0.8	1.2		V
			MAX213E, $\overline{SHDN}$ = 0V, EN = V_{CC}	0.6	1.5		
Input Threshold High		T_A = +25°C, V_{CC} = 5V	All parts, normal operation		1.7	2.4	V
			MAX213E (R4, R5), $\overline{SHDN}$ = 0V, EN = V_{CC}		1.5	2.4	
Input Hysteresis		V_{CC} = 5V, no hysteresis in shutdown		0.2	0.5	1.0	V
Input Resistance		T_A = +25°C, V_{CC} = 5V		3	5	7	kΩ
EIA/TIA-232E TRANSMITTER OUTPUTS							
Output Voltage Swing		All drivers loaded with 3kΩ to ground (Note 1)		±5	±9		V
Output Resistance		V_{CC} = V+ = V- = 0V, V_{OUT} = ±2V		300			Ω
Output Short-Circuit Current					±10	±60	mA
TIMING CHARACTERISTICS							
Maximum Data Rate		R_L = 3kΩ to 7kΩ, C_L = 50pF to 1000pF, one transmitter switching		120			kbps
Receiver Propagation Delay	t_{PLHR}, t_{PHLR}	C_L = 150pF	All parts, normal operation		0.5	10	µs
			MAX213E (R4, R5), $\overline{SHDN}$ = 0V, EN = V_{CC}		4	40	
Receiver Output Enable Time		MAX205E/206E/211E/213E/241E normal operation, Figure 2			600		ns
Receiver Output Disable Time		MAX205E/206E/211E/213E/241E normal operation, Figure 2			200		ns
Transmitter Propagation Delay	t_{PLHT}, t_{PHLT}	R_L = 3kΩ, C_L = 2500pF, all transmitters loaded			2		µs
Transition-Region Slew Rate		T_A = +25°C, V_{CC} = 5V, R_L = 3kΩ to 7kΩ, C_L = 50pF to 1000pF, measured from -3V to +3V or +3V to -3V, Figure 3		3	6	30	V/µs
ESD PERFORMANCE: TRANSMITTER OUTPUTS, RECEIVER INPUTS							
ESD-Protection Voltage		Human Body Model			±15		kV
		IEC1000-4-2, Contact Discharge			±8		
		IEC1000-4-2, Air-Gap Discharge			±15		

Note 1: MAX211EE_ _ tested with V_{CC} = +5V ±5%.

Applications Information

Capacitor Selection

The capacitor type used for C1–C4 is not critical for proper operation. The MAX202E, MAX206–MAX208E, MAX211E, and MAX213E require 0.1µF capacitors, and the MAX232E and MAX241E require 1µF capacitors, although in all cases capacitors up to 10µF can be used without harm. Ceramic, aluminum-electrolytic, or tantalum capacitors are suggested for the 1µF capacitors, and ceramic dielectrics are suggested for the 0.1µF capacitors. When using the minimum recommended capacitor values, make sure the capacitance value does not degrade excessively as the operating temperature varies. If in doubt, use capacitors with a larger (e.g., 2x) nominal value. The capacitors' effective series resistance (ESR), which usually rises at low temperatures, influences the amount of ripple on V+ and V-.

Use larger capacitors (up to 10µF) to reduce the output impedance at V+ and V-. This can be useful when "stealing" power from V+ or from V-. The MAX203E and MAX205E have internal charge-pump capacitors.

Bypass V_{CC} to ground with at least 0.1µF. In applications sensitive to power-supply noise generated by the charge pumps, decouple V_{CC} to ground with a capacitor the same size as (or larger than) the charge-pump capacitors (C1–C4).

V+ and V- as Power Supplies

A small amount of power can be drawn from V+ and V-, although this will reduce both driver output swing and noise margins. Increasing the value of the charge-pump capacitors (up to 10µF) helps maintain performance when power is drawn from V+ or V-.

Driving Multiple Receivers

Each transmitter is designed to drive a single receiver. Transmitters can be paralleled to drive multiple receivers.

Driver Outputs when Exiting Shutdown

The driver outputs display no ringing or undesirable transients as they come out of shutdown.

High Data Rates

These transceivers maintain the RS-232 ±5.0V minimum driver output voltages at data rates of over 120kbps. For data rates above 120kbps, refer to the Transmitter Output Voltage vs. Load Capacitance graphs in the *Typical Operating Characteristics*. Communication at these high rates is easier if the capacitive loads on the transmitters are small; i.e., short cables are best.

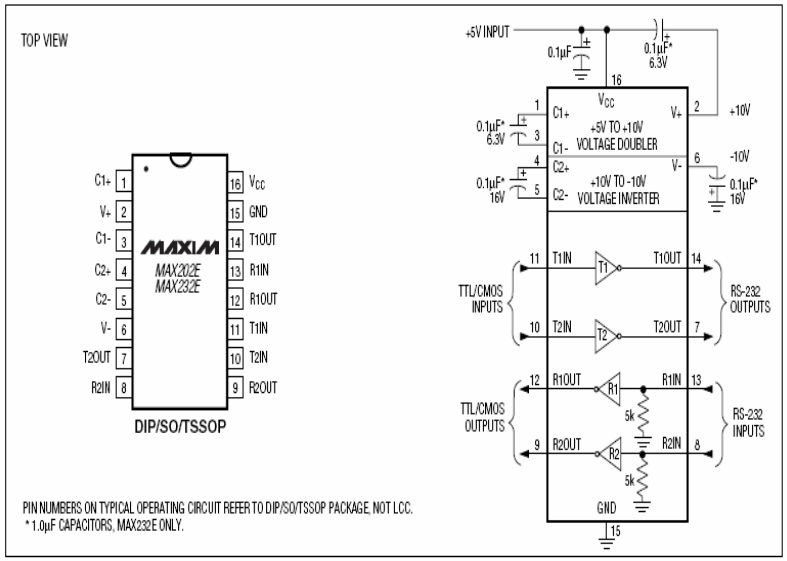
Table 2. Summary of EIA/TIA-232E, V.28 Specifications

PARAMETER		CONDITIONS	EIA/TIA-232E, V.28 SPECIFICATIONS
Driver Output Voltage	0 Level	3kΩ to 7kΩ load	+5V to +15V
	1 Level	3kΩ to 7kΩ load	-5V to -15V
Driver Output Level, Max		No load	±25V
Data Rate		3kΩ ≤ R_L ≤ 7kΩ, C_L ≤ 2500pF	Up to 20kbps
Receiver Input Voltage	0 Level		+3V to +15V
	1 Level		-3V to -15V
Receiver Input Level			±25V
Instantaneous Slew Rate, Max		3kΩ ≤ R_L ≤ 7kΩ, C_L ≤ 2500pF	30V/µs
Driver Output Short-Circuit Current, Max			100mA
Transition Rate on Driver Output		V.28	1ms or 3% of the period
		EIA/TIA-232E	4% of the period
Driver Output Resistance		-2V < V_{OUT} < +2V	300Ω

Table 3. DB9 Cable Connections Commonly Used for EIA/TIAE-232E and V.24 Asynchronous Interfaces

PIN	CONNECTION	
1	Received Line Signal Detector (sometimes called Carrier Detect, DCD)	Handshake from DCE
2	Receive Data (RD)	Data from DCE
3	Transmit Data (TD)	Data from DTE
4	Data Terminal Ready	Handshake from DTE
5	Signal Ground	Reference point for signals
6	Data Set Ready (DSR)	Handshake from DCE
7	Request to Send (RTS)	Handshake from DTE
8	Clear to Send (CTS)	Handshake from DCE
9	Ring Indicator	Handshake from DCE

_____Pin Configurations and Typical Operating Circuits (continued)



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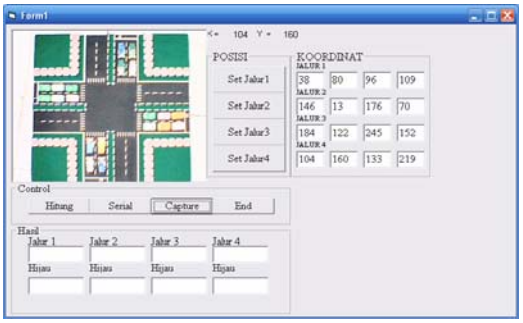

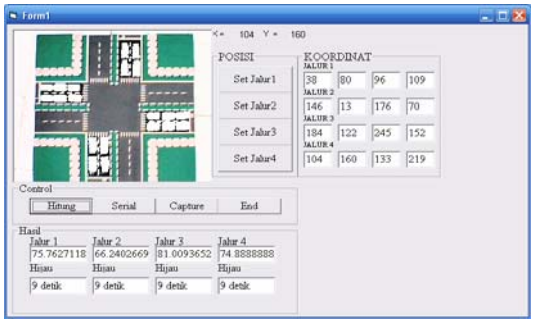

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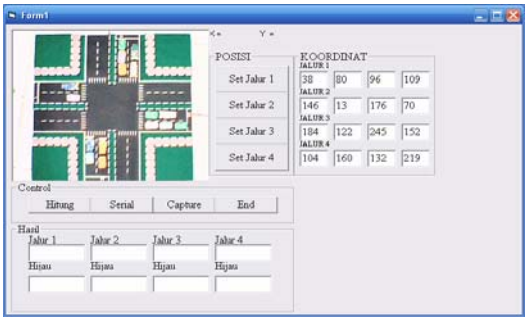

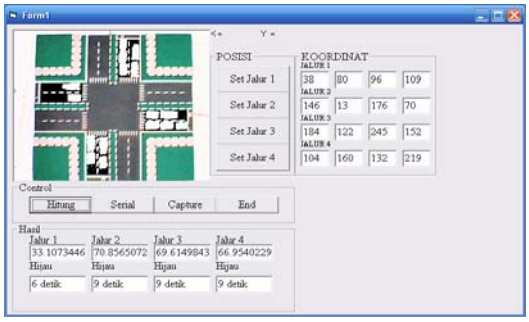

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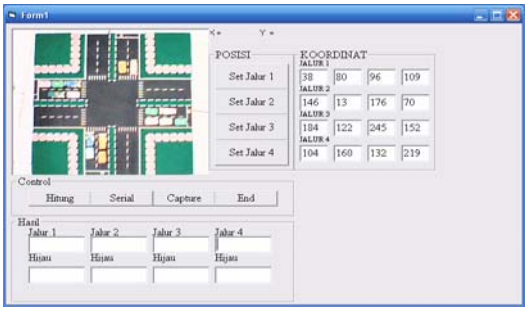

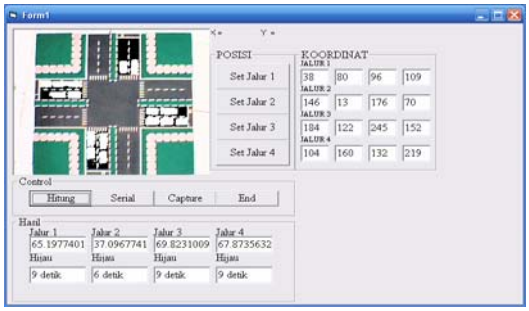

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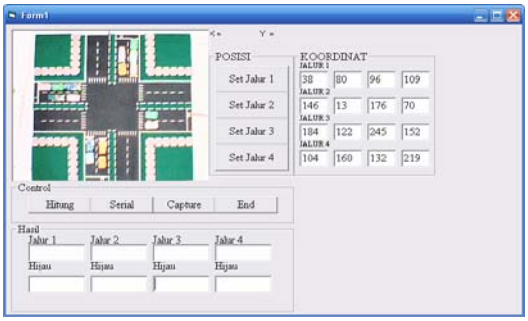

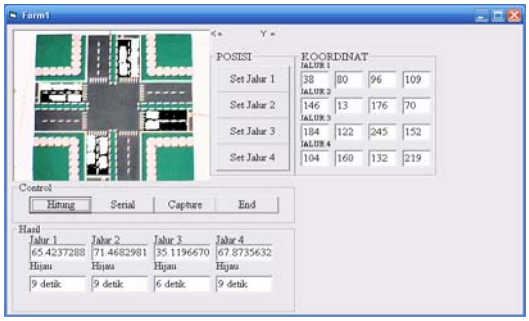

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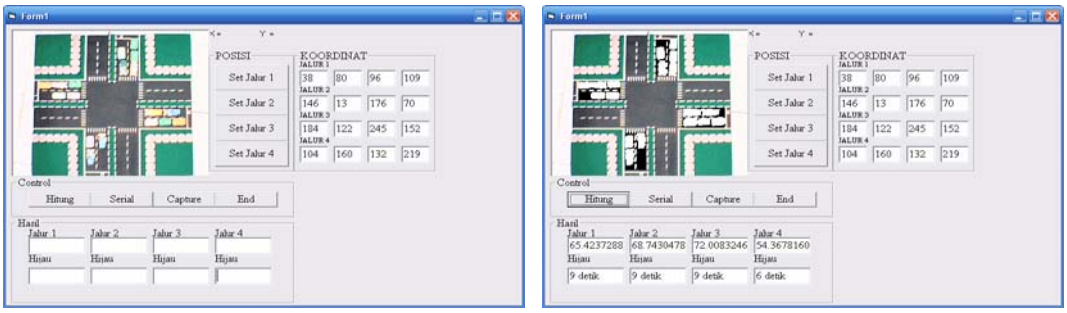

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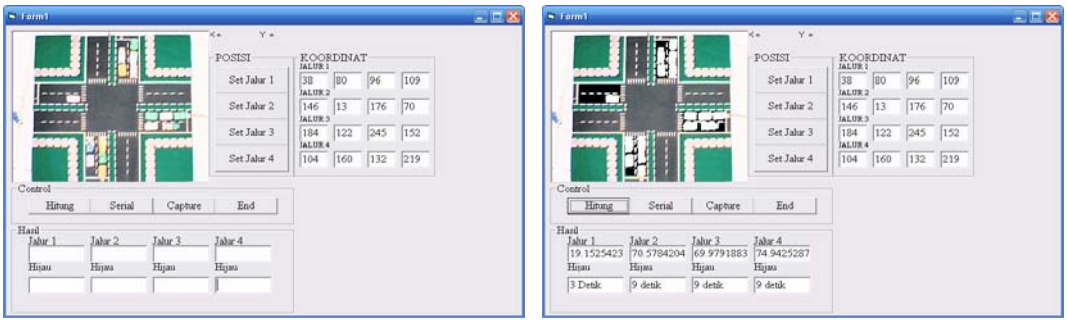

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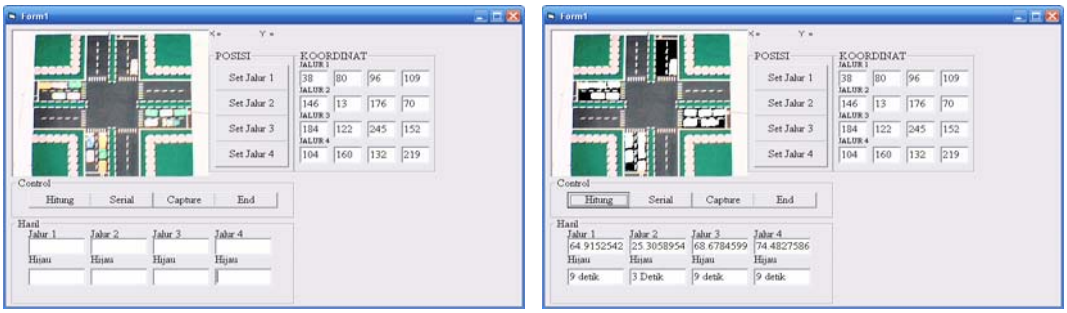

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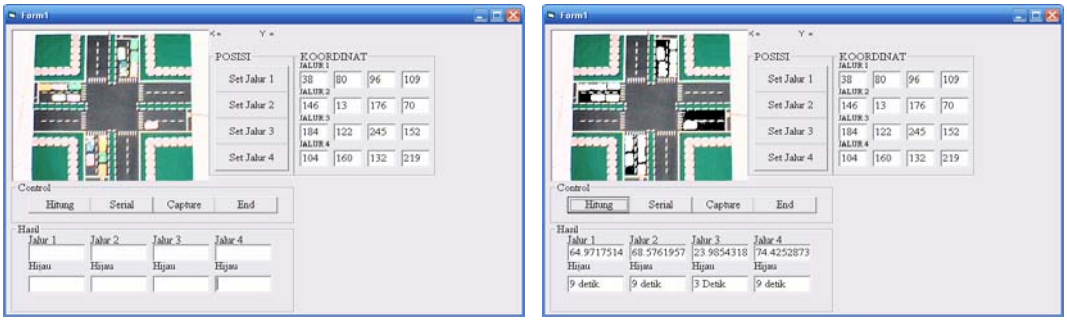

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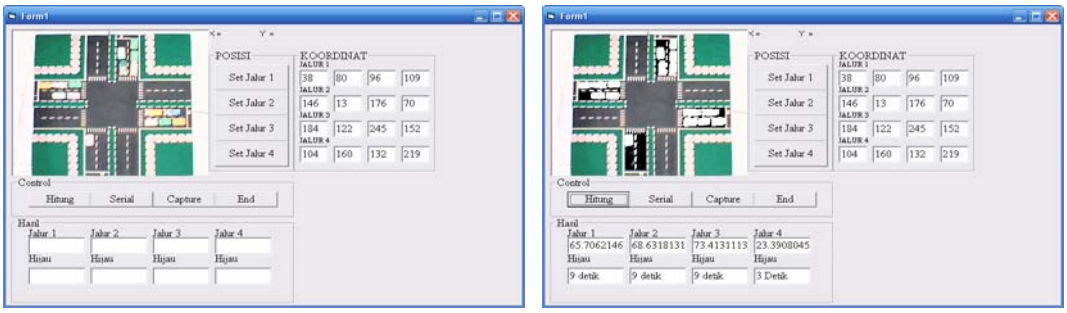

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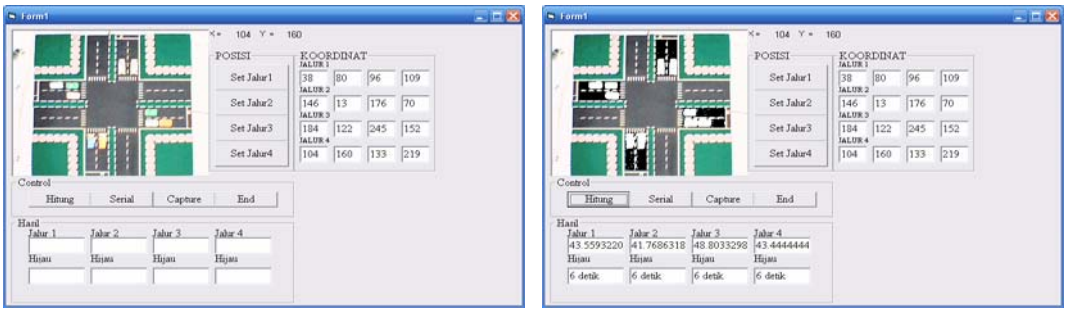

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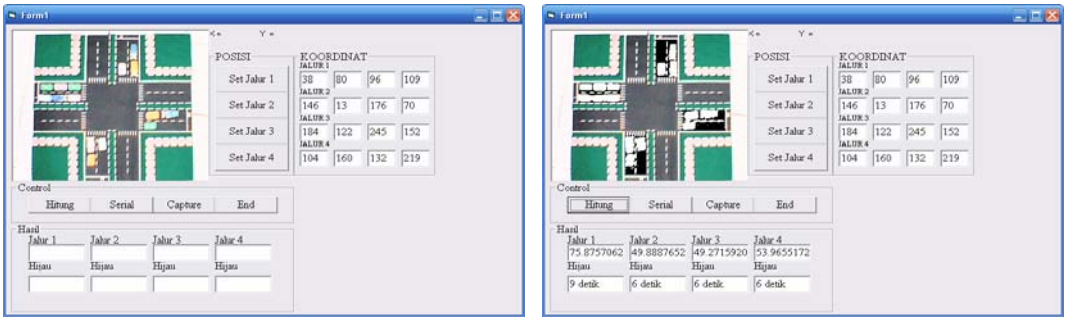

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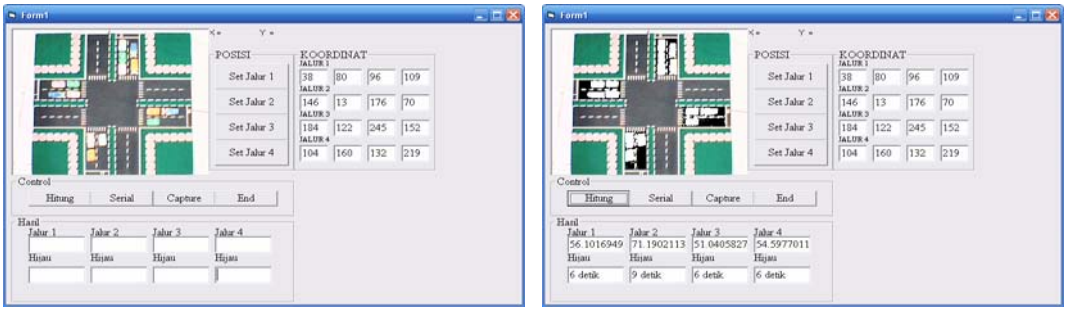

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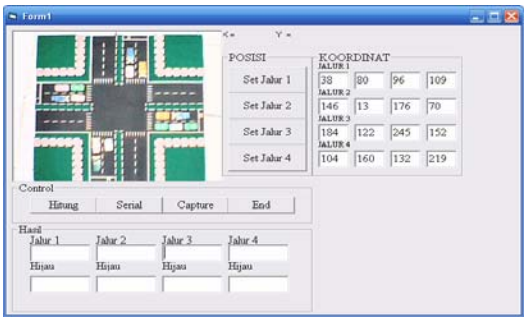

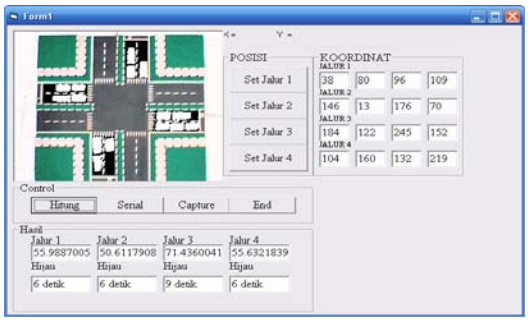

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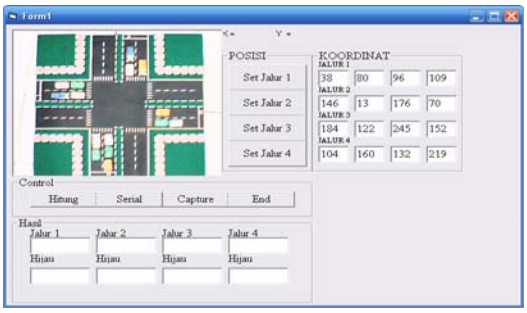

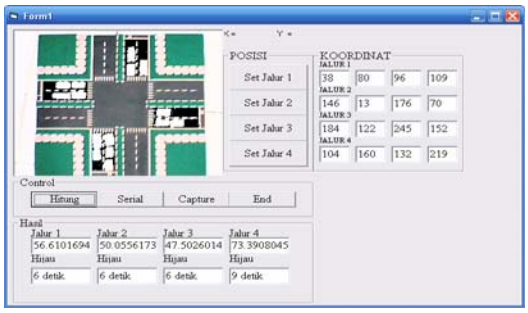

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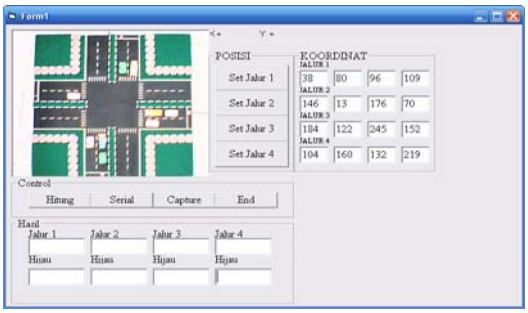

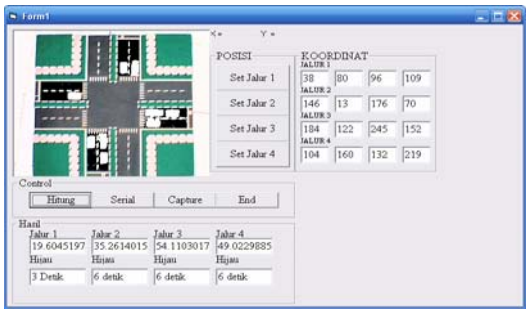

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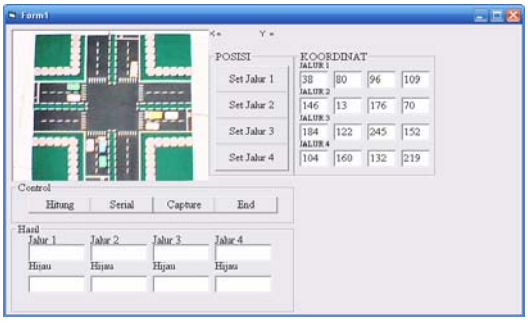

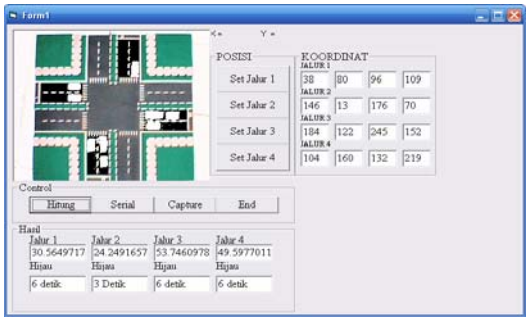

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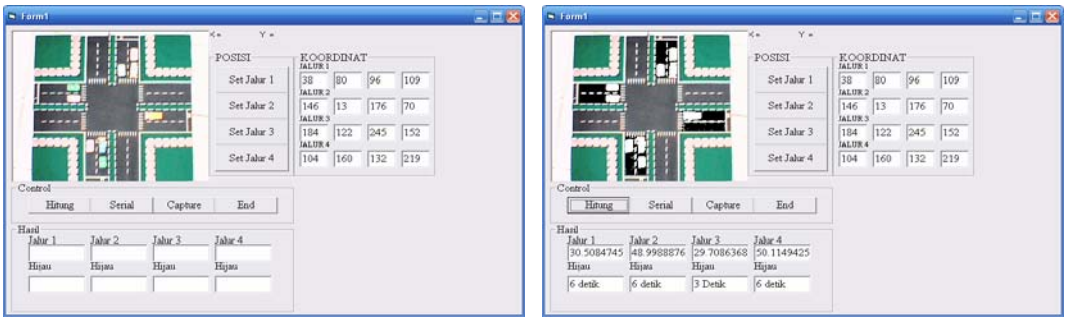

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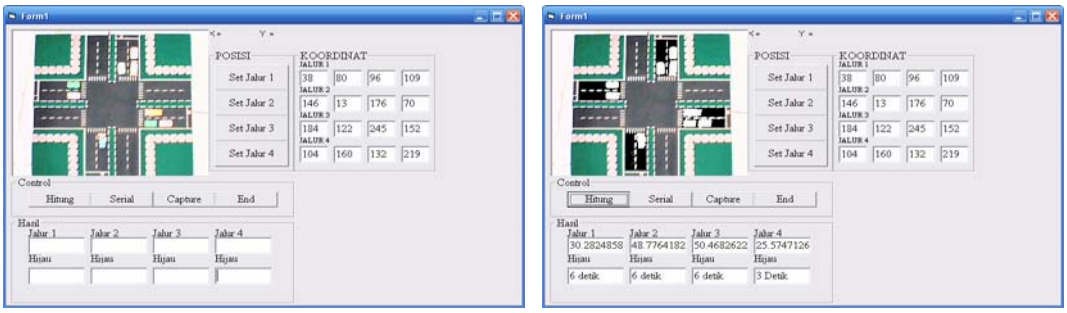

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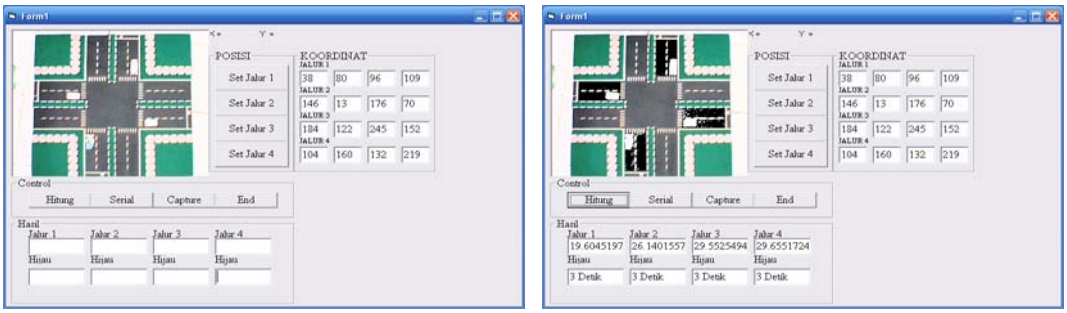

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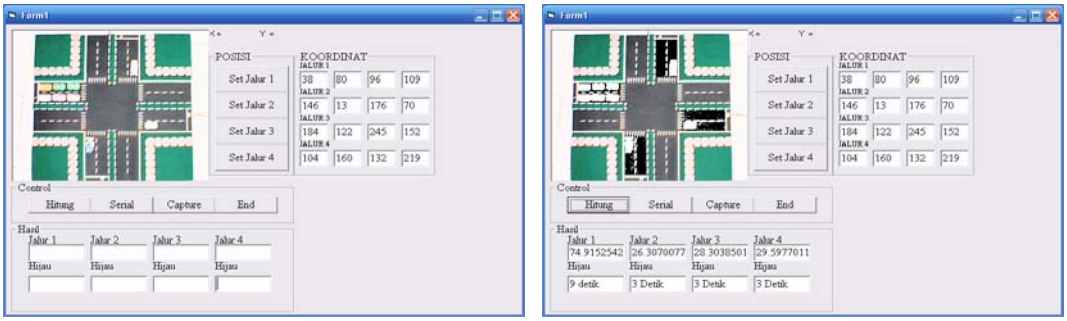

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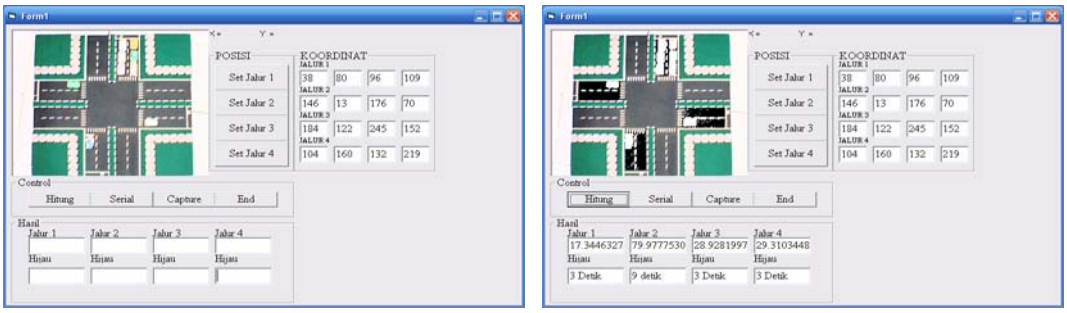

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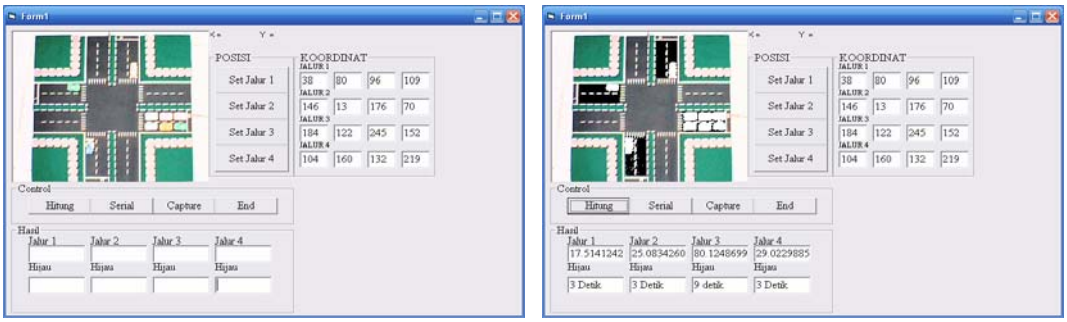

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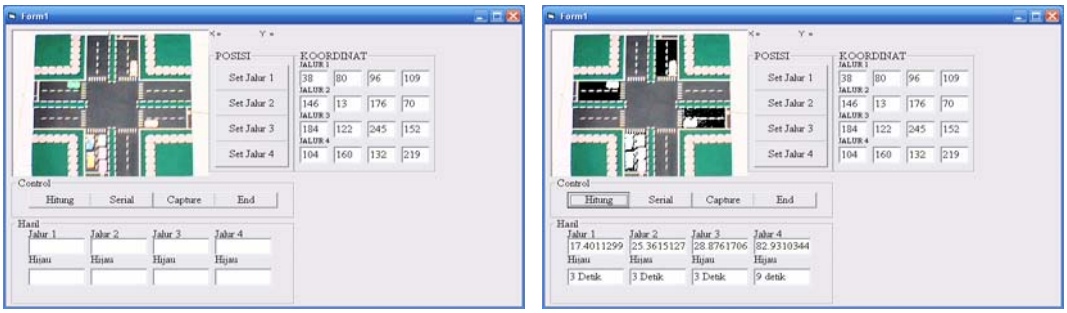

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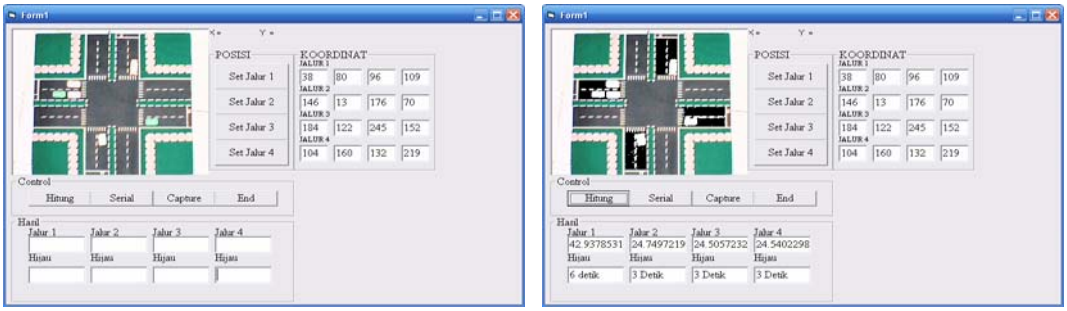

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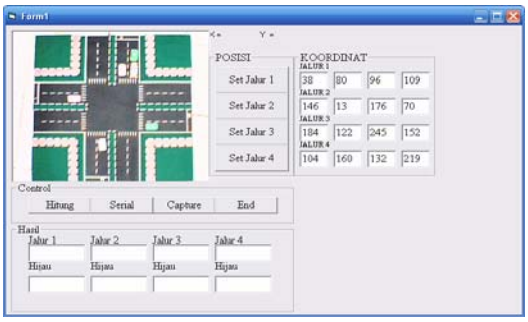

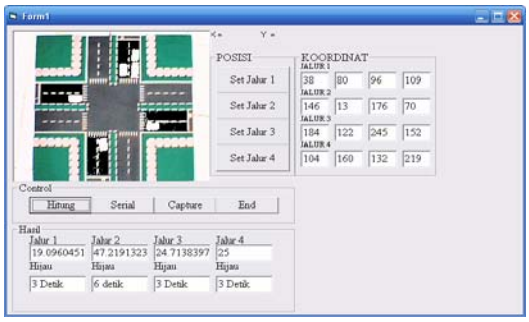

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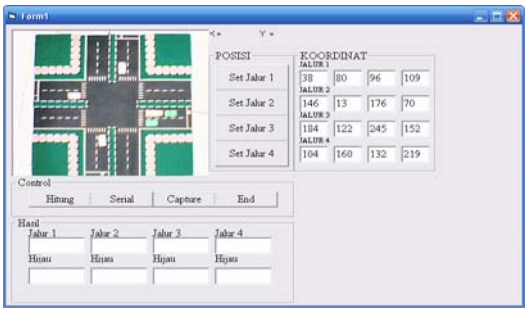

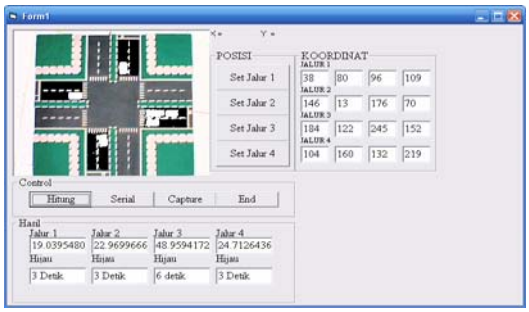

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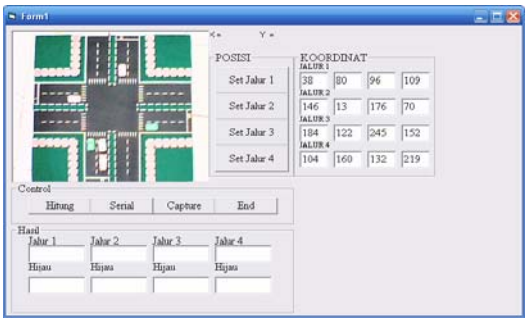

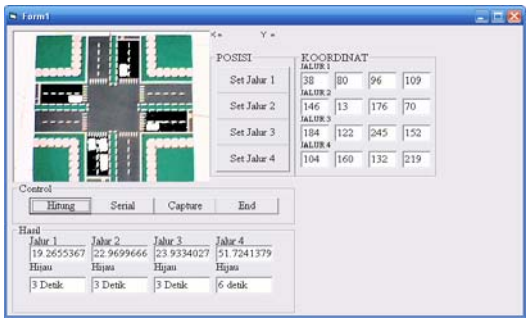

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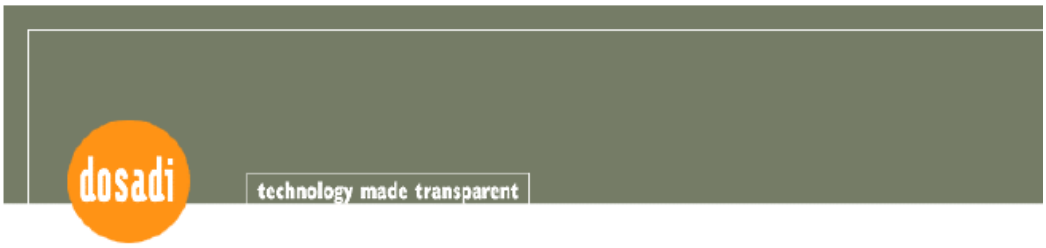

EZTwain Pro User Guide

A guide to the EZTwain library for developers.

Version 3.09

By Spike McLarty for Dosadi. Revised 1/27/2006 12:44 PM

TWAIN_LogFile

```
void TWAIN_LogFile(int fLog);
```

EZTwain can write a quite detailed log of its activity, including every TWAIN call it makes and the result. Log output goes to **c:\eztwain.log**. You can use TWAIN_SetLogFolder to direct the log file to another directory.
TWAIN_LogFile(0) close log file and turn off logging
TWAIN_LogFile(1) open log file (if not already) and start logging.
If logging is already turned on, TWAIN_LogFile(1) flushes the logfile to disk so prior output won't be lost in a subsequent crash.

TWAIN_SetHideUI / TWAIN_GetHideUI

```
void TWAIN_SetHideUI(int fHide);
int TWAIN_GetHideUI(void);
```

These functions control the 'hide source user interface' flag. This flag is initially FALSE(0), but if you set it non-zero, then when a source is enabled it will be asked to hide its user interface. Note this is a request - some sources will ignore it.
See: How To: Hide the Datasource User Interface.
If the user interface is hidden, you will probably want to set at least some of the basic acquisition parameters yourself – see Negotiating Scanning Parameters . See also: HasControllableUI

TWAIN_SetIndicators

```
int TWAIN_SetIndicators(BOOL bVisible)
```

Tell the source to show (hide) progress indicators during acquisition.

TWAIN_OpenSource

```
int TWAIN_OpenSource(LPCSTR pzName);
```

Opens the Source with the given name.
If that source is already open, does nothing and returns TRUE. If another source is open, closes it and attempts to open the specified source. Will load and open the Source Manager if needed.
If this call returns TRUE, TWAIN is in State 4 (TWAIN_SOURCE_OPEN)

TWAIN_SetPixelType

```
int TWAIN_SetPixelType(int nPixType);
```

Try to set the current pixel type for acquisition.
The source may select this pixel type, but don't assume it will.
This function should be used in place of the older TWAIN_SetCurrentPixelType.

Pixel Type Codes (TWPT_*)

Code	TWAIN Name	Description
0	TWPT_BW	1-bit per pixel, black and white
1	TWPT_GRAY	grayscale, 8 or 4-bit
2	TWPT_RGB	RGB color, 24-bit (rarely, 15,16,32-bit)
3	TWPT_PALETTE	indexed color (image has a color table) 8 or 4-bit.
4	TWPT_CMY	CMY color, 24-bit
5	TWPT_CMYK	CMYK color, 32-bit

TWAIN_SetXferCount

```
int TWAIN_SetXferCount(int nXfers);
```

Tell the Source the number of images the application will accept.
nXfers = -1 means any number (the default, when a device is opened.)
Returns: 1 for success, 0 for failure.

TWAIN_SetAutoScan

```
int TWAIN_SetAutoScan(int fYes);
```

(Try to) turn on/off scan-ahead (CAP_AUTOSCAN). Returns TRUE(1) if successful, FALSE(0) otherwise.
This is an optional feature supported by some ADF scanners. When enabled, the scanner will scan pages before they are requested, buffering them in the scanner or host PC. When disabled, the scanner will not feed and scan a page until the application asks for it. Used to achieve maximum throughput on ADF scanners. **Note:** A few high-speed scanners (e.g. Kodak i200) have this capability permanently on – such scanners always scan all pages in the feeder once they start.

TWAIN_AcquireToFilename

```
int TWAIN_AcquireToFilename(HWND hwndApp, LPCSTR pszFile);
```

Acquire an image and save it to a file. If the filename contains a standard extension (.bmp, .jpg, .jpeg, .tif, .tiff, .png, .pdf, .gif, .dcx) then the file is saved in the implied format. Otherwise the file is saved in the default save format– see TWAIN_SetSaveFormat.
If pszFile is NULL or an empty string, the user is prompted for the file name and format with a standard Save File dialog. Only available and appropriate formats are presented in the Save File dialog. If you use this feature, you can call TWAIN_LastOutputFile to obtain the filename.
See also TWAIN_Acquire below.
Return values:
0 success.
-1 the Acquire failed.
-2 file open error (invalid path or name, or access denied)
-3 invalid DIB, or image incompatible with file format, or...
-4 writing failed, possibly output device is full.
-10 user cancelled File Save dialog
The minimal use of EZTwain is to call this function with null arguments:

```
ErrCode = TWAIN_AcquireToFilename(0, "");
```

TWAIN_LastErrorCode

```
int TWAIN_LastErrorCode(void);
```

Return the most recent EZTwain error code, one of the EZTEC_ codes – See the EZTwain declaration file for your programming language, or refer to eztwain.h.

TWAIN_ReportLastError

```
void TWAIN_ReportLastError(LPCSTR pzMsg);
```

Like TWAIN_ErrorBox, but if some details are available from TWAIN about the last failure, they are included in the message box. This function uses TWAIN_LastErrorText to find out about the last error – see below.