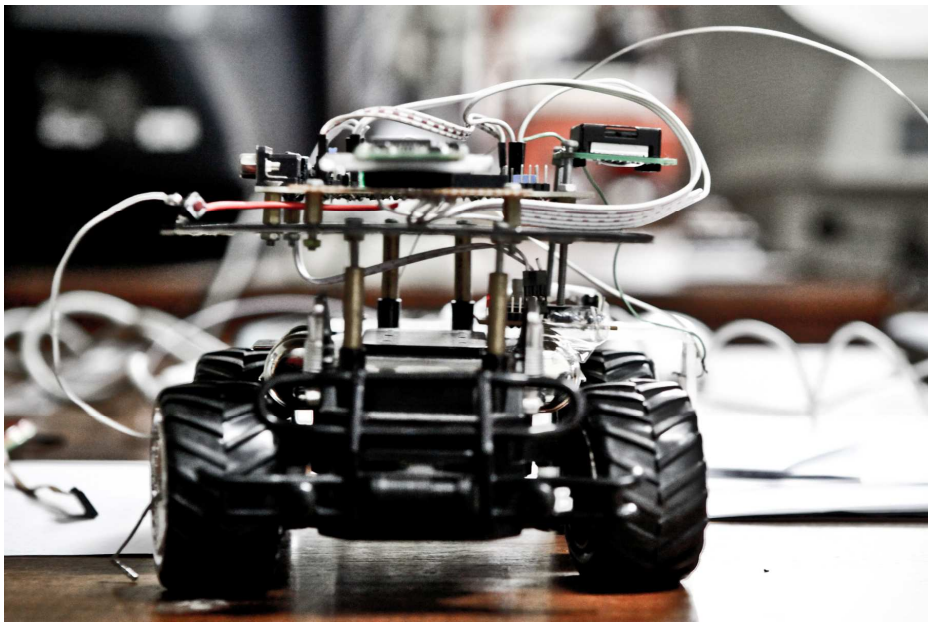
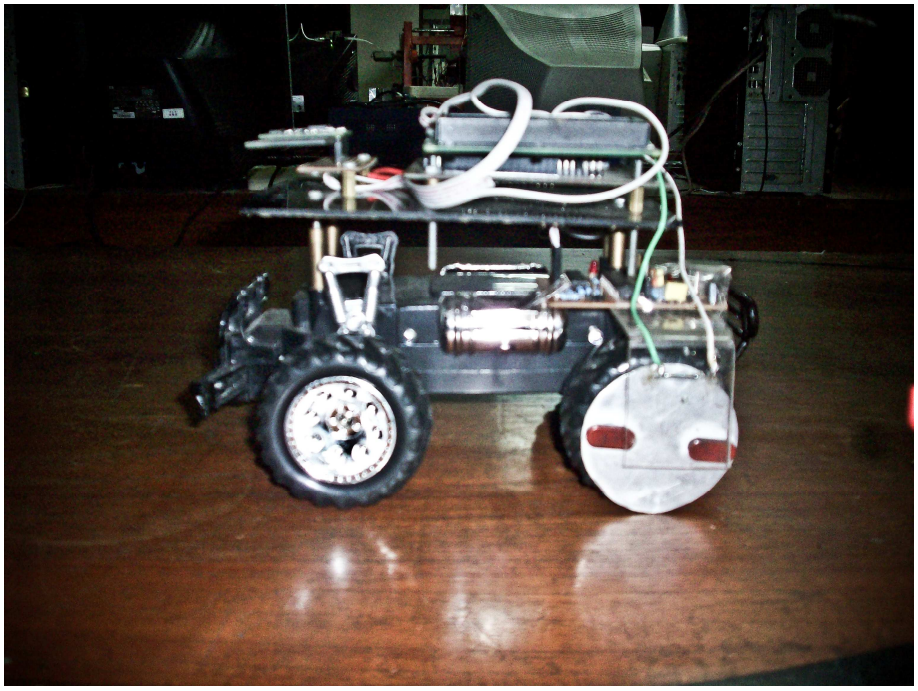
# LAMPIRAN A

Foto Alat

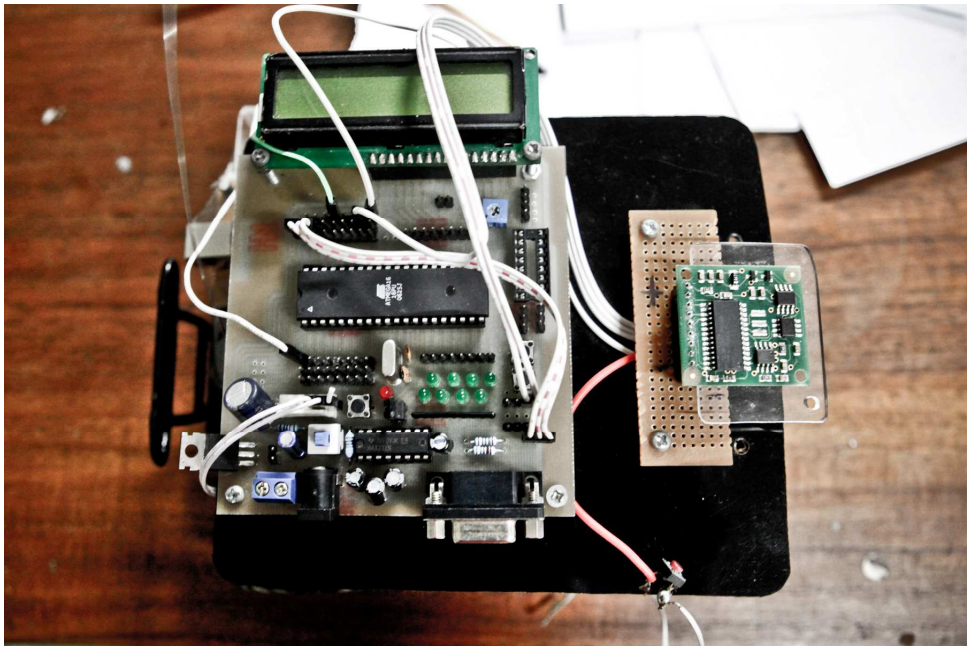
Tampak Depan



Tampak Samping



Tampak Atas



# LAMPIRAN B

**PROGRAM PENGONTROL MIKRO**

**MIKROKONTROLER ATMEGA16**

```
/*****************************************************
This program was produced by the
CodeWizardAVR V1.25.3 Professional
Automatic Program Generator
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http://www.hpinfotech.com

Project :
Version :
Date    : 10/21/2009
Author  : Frederick
Company : UKM
Comments:


Chip type           : ATmega16
Program type        : Application
Clock frequency     : 11.059200 MHz
Memory model        : Small
External SRAM size  : 0
Data Stack size     : 256
*****************************************************/

#include <mega16.h>
#include <delay.h>
eeprom long array[70];
eeprom float array1[70];
eeprom int x,y,akhir,akhirx;
#include <stdio.h>
#include <math.h>
#include <stdlib.h>

// I2C Bus functions
#asm
   .equ __i2c_port=0x1B ;PORTA
   .equ __sda_bit=1
   .equ __scl_bit=0
#endasm
#include <i2c.h>
```

```
// Alphanumeric LCD Module functions
#asm
   .equ __lcd_port=0x15 ;PORTC
#endasm
#include <lcd.h>

// Declare your global variables here

void main(void)
void sensor_kompas(void)
void reed_switch(void)
{
// Declare your local variables here
unsigned int b;
unsigned char text[32];
int data1,data2,konter;
float konterx;
unsigned int kps;
unsigned char text1[16];



// Input/Output Ports initialization
// Port A 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
PORTA=0x00;
DDRA=0x00;

// Port B 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=P State0=P
PORTB=0x03;
DDRB=0x00;

// 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=0x18;
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;

// I2C Bus initialization
i2c_init();

// LCD module initialization
lcd_init(16);

konter=0;
b=PINB.0;
```

```
while (1)
    {
      // Place your code here

  if(PINB.1==0)
    {
        x=0;
        y=0;
        while(x<=akhir-1,y<=akhirx-1)
        {

        printf("%d \n %0.1f \n" ,array[x],array1[y]);
        x++;y++;
        }
        lcd_clear();
        lcd_gotoxy(0,0);
        sprintf(text,"kirim");
        lcd_puts(text);

        delay_ms(1000);
        x=0;
        y=0;
        return;

   }

  if(PINB.1==1)

   {

  if(PINB.0==0)

   {
     while(PINB.0 == 0)
     {}

  {
     reed_switch ()

     sensor_kompas()

  }
```

```
   delay_ms(500);
   lcd_clear();
   lcd_gotoxy(0,0);
   sprintf(text,"kompas=%d  \njarak=%0.1f cm "
  ,kps,konterx);



 lcd_puts(text);
 printf("%d  %0.1f " ,kps,konterx);


     array[x]=kps;
     array1[y]=konterx;
     x++;
     y++;
     akhir=x;
     akhirx=y;

     }
   };
 }

void reed_switch (doid)
}
 konter++;
 b=PINB.0;
 konterx=konter*10.5;
 {

void sensor_kompas (void)
}
 i2c_start();
 i2c_write(0xC0);
 i2c_write(0x02);
 i2c_start();
 i2c_write(0xC1);
 data1=i2c_read(1);
 data2=i2c_read(0);
 i2c_stop();
 kps=((float)data1*256+data2)/10;
{
```

**Program Pengontrol Mikro Ketelitian 0,1°**

**MIKROKONTROLER ATMEGA16**

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

Project :
Version :
Date    : 10/21/2009
Author  : Frederick
Company : UKM
Comments:


Chip type           : ATmega16
Program type        : Application
Clock frequency     : 11.059200 MHz
Memory model        : Small
External SRAM size  : 0
Data Stack size     : 256
*****************************************************/

#include <mega16.h>
#include <delay.h>
eeprom float array[70];
eeprom float array1[70];
eeprom int x,y,akhir,akhirx;
#include <stdio.h>
#include <math.h>
#include <stdlib.h>

// I2C Bus functions
#asm
   .equ __i2c_port=0x1B ;PORTA
   .equ __sda_bit=1
   .equ __scl_bit=0
#endasm
#include <i2c.h>
```

```
// Alphanumeric LCD Module functions
#asm
   .equ __lcd_port=0x15 ;PORTC
#endasm
#include <lcd.h>

// Declare your global variables here

void main(void)
void sensor_kompas(void)
void reed_switch(void)
{
// Declare your local variables here
unsigned int b;
unsigned char text[32];
int data1,data2,konter;
float konterx;
unsigned float kps;
unsigned char text1[16];



// Input/Output Ports initialization
// Port A 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
PORTA=0x00;
DDRA=0x00;

// Port B 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=P State0=P
PORTB=0x03;
DDRB=0x00;

// 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=0x18;
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;

// I2C Bus initialization
i2c_init();

// LCD module initialization
lcd_init(16);

konter=0;
b=PINB.0;
```

```
while (1)
    {
      // Place your code here

  if(PINB.1==0)
    {
        x=0;
        y=0;
        while(x<=akhir-1,y<=akhirx-1)
        {

        printf("%0.1f \n %0.1f \n"
,array[x],array1[y]);
        x++;y++;
        }
        lcd_clear();
        lcd_gotoxy(0,0);
        sprintf(text,"kirim");
        lcd_puts(text);

        delay_ms(1000);
        x=0;
        y=0;
        return;

   }

  if(PINB.1==1)

   {

  if(PINB.0==0)

   {
     while(PINB.0 == 0)
     {}

  {
     reed_switch ()

     sensor_kompas()

  }

   delay_ms(500);
   lcd_clear();
```

```
   lcd_gotoxy(0,0);
   sprintf(text,"kompas=%0.1f \njarak=%0.1f cm "
  ,kps,konterx);



 lcd_puts(text);
 printf("%0.1f %0.1f " ,kps,konterx);


     array[x]=kps;
     array1[y]=konterx;
     x++;
     y++;
     akhir=x;
     akhirx=y;

     }
   };
 }

void reed_switch (doid)
}
 konter++;
 b=PINB.0;
 konterx=konter*10.5;
 {

void sensor_kompas (void)
}
 i2c_start();
 i2c_write(0xC0);
 i2c_write(0x02);
 i2c_start();
 i2c_write(0xC1);
 data1=i2c_read(1);
 data2=i2c_read(0);
 i2c_stop();
 kps=((float)data1*256+data2)/10;
{
```

**LISTING PROGRAM VIUSAL BASIC 6.0**

```
Dim tmp() As String, Max As Long, i As Integer, Skala
As Double
Dim x0 As Double, y0 As Double, TotJ As Double, iDelay
As Integer
Dim onRes As Boolean

Private Sub bRest_Click()
  FG.Rows = 1
  Timer1.Enabled = False
  MSComm1.PortOpen = False
  TotJ = 0
  MsgBox "Please Unplugged Data Cable, Turn Off Your
Hardware" & vbCrLf & _
    "and then Plugged the Cable, Turn It Back On After
Click 'OK'", _
    vbInformation, "Instruction"
  onRes = True
  Unload Me
  FTrack.Show
  End Sub

Private Sub bX_Click()
  If MSComm1.PortOpen = True Then _
  MSComm1.PortOpen = False
  Unload Me
  End Sub

Private Sub Form_Activate()
Dim u As Integer
Picture1.Line (400, 0)-(400, 600), RGB(255, 0, 0)
Picture1.Line (0, 300)-(800, 300), RGB(255, 0, 0)
For u = 1 To 15
  Picture1.Line (790, 50 * u)-(800, 50 * u), RGB(255,
0, 0)
Next u
For u = 1 To 15
  Picture1.Line (50 * u, 590)-(50 * u, 600), RGB(255,
0, 0)
Next u
  Skala = 0.5
  x0 = 400
  y0 = 300
End Sub
```

```
Private Sub Form_Load()
If onRes = False Then
  CurNd = 0
  If MsgBox("Is Data Cable Plugged and The Hardware
Ready?", vbQuestion + vbYesNo + vbDefaultButton2, _
    "Instruction") = vbNo Then
     End
     Exit Sub
  End If
End If
  MSComm1.CommPort = 1
  MSComm1.Settings = "9600,N,8,1"
  MSComm1.InputLen = 0
  MSComm1.PortOpen = True

  FG.Cols = 2
  FG.Rows = 1
  FG.ColWidth(0) = 700
  FG.ColWidth(1) = 700
  FG.TextMatrix(0, 0) = "Sudut (s)"
  FG.TextMatrix(0, 1) = "Jarak (r)"
  onRes = False
End Sub

Private Sub Timer1_Timer()
On Error GoTo ErrHand
Dim uj As Byte, ctr As Long, Tmj As String
Dim y As Integer, kl As String, Sdt() As String
Dim jrk() As String, SumS As Long, SumJ As Long
Dim w As Integer


hasil = MSComm1.Input

For w = 1 To CInt(tDelay.Text)
Next w

If Len(hasil) > 0 Then
  SumS = 0
  SumJ = 0
  tmp = Split(hasil, Chr(10))
  ReDim Sdt((UBound(tmp) \ 2) + 1)
  ReDim jrk((UBound(tmp) \ 2) + 1)
  ctr = 0
  For y = 0 To UBound(tmp) Step 2
     If tmp(y) <> "" And Not IsNull(tmp(y)) Then
       Sdt(ctr) = Trim(tmp(y))
```

```
       ctr = ctr + 1
     End If
  Next y
  SumS = ctr - 1

  ctr = 0
  For y = 1 To UBound(tmp) Step 2
     If tmp(y) <> "" And Not IsNull(tmp(y)) Then
       Tmj = Replace(tmp(y), ".", ",", , ,
vbTextCompare)
       jrk(ctr) = Trim(Tmj)
       ctr = ctr + 1
     End If

Next y
  SumJ = ctr
  Max = 0
  If SumS > SumJ Then
    Max = CLng(SumS)
  Else
    Max = CLng(SumJ)
  End If
  If Max > 32768 Then     '--- batasan data yg diload
ke grid
    Timer1.Enabled = False
    Exit Sub
  End If
  For y = 1 To Max
    If (Sdt(y - 1) <> "" And jrk(y - 1) <> "") And _
         (Sdt(y - 1) <> "0" And jrk(y - 1) <> "0,0")

Then
      If CLng(Sdt(y - 1)) > 0 And CDbl(jrk(y - 1)) > 0
Then
         FG.AddItem Sdt(y - 1) & vbTab & jrk(y - 1)
      Else
         Exit Sub
      End If
    Else

      If CDbl(Sdt(y - 1)) = 0 And CDbl(jrk(y - 1)) = 0
Then
         Timer1.Enabled = False
      End If
      Exit Sub
    End If
  Next y
```

```
  Tjar.Caption = FG.TextMatrix(FG.Rows - 1, 1)
  SNod.Caption = FG.Rows - 1
  Picture1.PSet (x0, y0)
  For i = 1 To FG.Rows - 1


   End If
Exit Sub
ErrHand:
End Sub
```

# LAMPIRAN C

# DATASHEET

### Function Tables

EACH DRIVER

| INPUT TIN | OUTPUT TOUT |
|---|---|
| L | H |
| H | L |

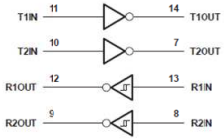
H = high level, L = low level

EACH RECEIVER

| INPUT RIN | OUTPUT ROUT |
|---|---|
| L | H |
| H | L |

H = high level, L = low level

### logic diagram (positive logic)



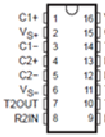



TEXAS INSTRUMENTS
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265



- Meets or Exceeds TIA/EIA-232-F and ITU Recommendation V.28
- Operates From a Single 5-V Power Supply With 1.0-μF Charge-Pump Capacitors
- Operates Up To 120 kbit/s
- Two Drivers and Two Receivers
- ±30-V Input Levels
- Low Supply Current . . . 8 mA Typical
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
- Upgrade With Improved ESD (15-kV HBM) and 0.1-μF Charge-Pump Capacitors is Available With the MAX202
- Applications
  - TIA/EIA-232-F, Battery-Powered Systems, Terminals, Modems, and Computers

MAX232 . . . D, DW, N, OR NS PACKAGE
MAX232I . . . D, DW, OR N PACKAGE
(TOP VIEW)




### description/ordering information

The MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply TIA/EIA-232-F voltage levels from a single 5-V supply. Each receiver converts TIA/EIA-232-F inputs to 5-V TTL/CMOS levels. These receivers have a typical threshold of 1.3 V, a typical hysteresis of 0.5 V, and can accept ±30-V inputs. Each driver converts TTL/CMOS input levels into TIA/EIA-232-F levels. The driver, receiver, and voltage-generator functions are available as cells in the Texas Instruments LinASIC™ library.

ORDERING INFORMATION

| $T_A$ | PACKAGE† | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|---|---|---|---|---|
| 0°C to 70°C | PDIP (N) | Tube of 25 | MAX232N | MAX232N |
| | SOIC (D) | Tube of 40 | MAX232D | MAX232 |
| | | Reel of 2500 | MAX232DR | |
| | SOIC (DW) | Tube of 40 | MAX232DW | MAX232 |
| | | Reel of 2000 | MAX232DWR | |
| | SOP (NS) | Reel of 2000 | MAX232NSR | MAX232 |
| −40°C to 85°C | PDIP (N) | Tube of 25 | MAX232IN | MAX232IN |
| | SOIC (D) | Tube of 40 | MAX232ID | MAX232I |
| | | Reel of 2500 | MAX232IDR | |
| | SOIC (DW) | Tube of 40 | MAX232IDW | MAX232I |
| | | Reel of 2000 | MAX232IDWR | |

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.



TEXAS INSTRUMENTS
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

## DRIVER SECTION

### electrical characteristics over recommended ranges of supply voltage and operating free-air temperature range (see Note 4)

| PARAMETER | | | TEST CONDITIONS | | MIN | TYP† | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $V_{OH}$ | High-level output voltage | T1OUT, T2OUT | $R_L$ = 3 kΩ to GND | | 5 | 7 | | V |
| $V_{OL}$ | Low-level output voltage‡ | T1OUT, T2OUT | $R_L$ = 3 kΩ to GND | | | −7 | −5 | V |
| $r_o$ | Output resistance | T1OUT, T2OUT | $V_{S+}$ = $V_{S-}$ = 0, | $V_O$ = ±2 V | 300 | | | Ω |
| $I_{OS}$§ | Short-circuit output current | T1OUT, T2OUT | $V_{CC}$ = 5.5 V, | $V_O$ = 0 | | ±10 | | mA |
| $I_{IS}$ | Short-circuit input current | T1IN, T2IN | $V_I$ = 0 | | | | 200 | µA |

† All typical values are at $V_{CC}$ = 5 V, $T_A$ = 25°C.
‡ The algebraic convention, in which the least-positive (most negative) value is designated minimum, is used in this data sheet for logic voltage levels only.
§ Not more than one output should be shorted at a time.
NOTE 4: Test conditions are C1–C4 = 1 µF at $V_{CC}$ = 5 V ± 0.5 V.

### switching characteristics, $V_{CC}$ = 5 V, $T_A$ = 25°C (see Note 4)

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| SR | Driver slew rate | $R_L$ = 3 kΩ to 7 kΩ, See Figure 2 | | | 30 | V/µs |
| SR(t) | Driver transition region slew rate | See Figure 3 | | 3 | | V/µs |
| | Data rate | One TOUT switching | | 120 | | kbit/s |

NOTE 4: Test conditions are C1–C4 = 1 µF at $V_{CC}$ = 5 V ± 0.5 V.

## RECEIVER SECTION

### electrical characteristics over recommended ranges of supply voltage and operating free-air temperature range (see Note 4)

| PARAMETER | | | TEST CONDITIONS | | MIN | TYP† | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $V_{OH}$ | High-level output voltage | R1OUT, R2OUT | $I_{OH}$ = −1 mA | | 3.5 | | | V |
| $V_{OL}$ | Low-level output voltage‡ | R1OUT, R2OUT | $I_{OL}$ = 3.2 mA | | | | 0.4 | V |
| $V_{IT+}$ | Receiver positive-going input threshold voltage | R1IN, R2IN | $V_{CC}$ = 5 V, | $T_A$ = 25°C | | 1.7 | 2.4 | V |
| $V_{IT-}$ | Receiver negative-going input threshold voltage | R1IN, R2IN | $V_{CC}$ = 5 V, | $T_A$ = 25°C | 0.8 | 1.2 | | V |
| $V_{hys}$ | Input hysteresis voltage | R1IN, R2IN | $V_{CC}$ = 5 V | | 0.2 | 0.5 | 1 | V |
| $r_i$ | Receiver input resistance | R1IN, R2IN | $V_{CC}$ = 5, | $T_A$ = 25°C | 3 | 5 | 7 | kΩ |

† All typical values are at $V_{CC}$ = 5 V, $T_A$ = 25°C.
‡ The algebraic convention, in which the least-positive (most negative) value is designated minimum, is used in this data sheet for logic voltage levels only.
NOTE 4: Test conditions are C1–C4 = 1 µF at $V_{CC}$ = 5 V ± 0.5 V.

### switching characteristics, $V_{CC}$ = 5 V, $T_A$ = 25°C (see Note 4 and Figure 1)

| PARAMETER | | TYP | UNIT |
|---|---|---|---|
| $t_{PLH(R)}$ | Receiver propagation delay time, low- to high-level output | 500 | ns |
| $t_{PHL(R)}$ | Receiver propagation delay time, high- to low-level output | 500 | ns |

NOTE 4: Test conditions are C1–C4 = 1 µF at $V_{CC}$ = 5 V ± 0.5 V.





### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Input supply voltage range, $V_{CC}$ (see Note 1) . . . . . −0.3 V to 6 V
Positive output supply voltage range, $V_{S+}$ . . . . . $V_{CC}$ − 0.3 V to 15 V
Negative output supply voltage range, $V_{S-}$ . . . . . −0.3 V to −15 V
Input voltage range, $V_I$: Driver . . . . . −0.3 V to $V_{CC}$ + 0.3 V
Receiver . . . . . ±30 V
Output voltage range, $V_O$: T1OUT, T2OUT . . . . . $V_{S-}$ − 0.3 V to $V_{S+}$ + 0.3 V
R1OUT, R2OUT . . . . . −0.3 V to $V_{CC}$ + 0.3 V
Short-circuit duration: T1OUT, T2OUT . . . . . Unlimited
Package thermal impedance, $\theta_{JA}$ (see Notes 2 and 3): D package . . . . . 73°C/W
DW package . . . . . 57°C/W
N package . . . . . 67°C/W
NS package . . . . . 64°C/W
Operating virtual junction temperature, $T_J$ . . . . . 150°C
Storage temperature range, $T_{stg}$ . . . . . −65°C to 150°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 under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
NOTES: 1. All voltages are with respect to network GND.
2. Maximum power dissipation is a function of $T_J$(max), $\theta_{JA}$, and $T_A$. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) - T_A)/\theta_{JA}$. Operating at the absolute maximum $T_J$ of 150°C can affect reliability.
3. The package thermal impedance is calculated in accordance with JESD 51-7.

### recommended operating conditions

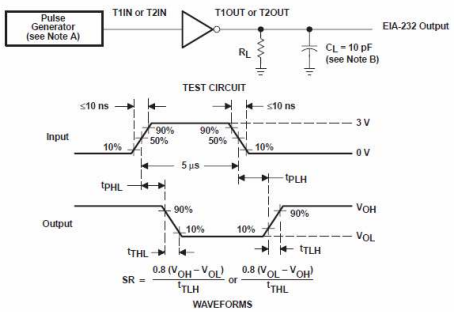
| | | | MIN | NOM | MAX | UNIT |
|---|---|---|---|---|---|---|
| $V_{CC}$ | Supply voltage | | 4.5 | 5 | 5.5 | V |
| $V_{IH}$ | High-level input voltage (T1IN,T2IN) | | 2 | | | V |
| $V_{IL}$ | Low-level input voltage (T1IN, T2IN) | | | | 0.8 | V |
| R1IN, R2IN | Receiver input voltage | | | | ±30 | V |
| $T_A$ | Operating free-air temperature | MAX232 | 0 | | 70 | °C |
| | | MAX232I | −40 | | 85 | |

### electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 4 and Figure 4)

| PARAMETER | | TEST CONDITIONS | | MIN | TYP‡ | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $I_{CC}$ | Supply current | $V_{CC}$ = 5.5 V, $T_A$ = 25°C | All outputs open, | | 8 | 10 | mA |

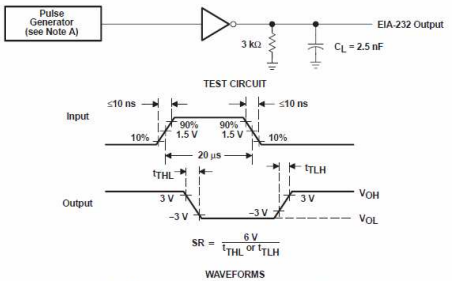
‡ All typical values are at $V_{CC}$ = 5 V and $T_A$ = 25°C.
NOTE 4: Test conditions are C1–C4 = 1 µF at $V_{CC}$ = 5 V ± 0.5 V.

## PARAMETER MEASUREMENT INFORMATION




NOTES: A. The pulse generator has the following characteristics: $Z_O$ = 50 Ω, duty cycle ≤ 50%.
B. $C_L$ includes probe and jig capacitance.

**Figure 2. Driver Test Circuit and Waveforms for $t_{PHL}$ and $t_{PLH}$ Measurements (5-µs Input)**



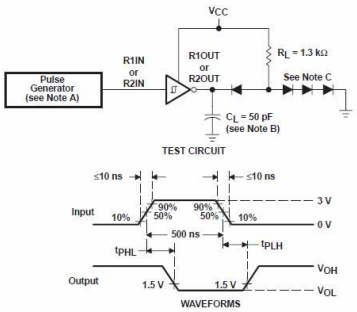

NOTE A: The pulse generator has the following characteristics: $Z_O$ = 50 Ω, duty cycle ≤ 50%.

**Figure 3. Test Circuit and Waveforms for $t_{THL}$ and $t_{TLH}$ Measurements (20-µs Input)**





## PARAMETER MEASUREMENT INFORMATION

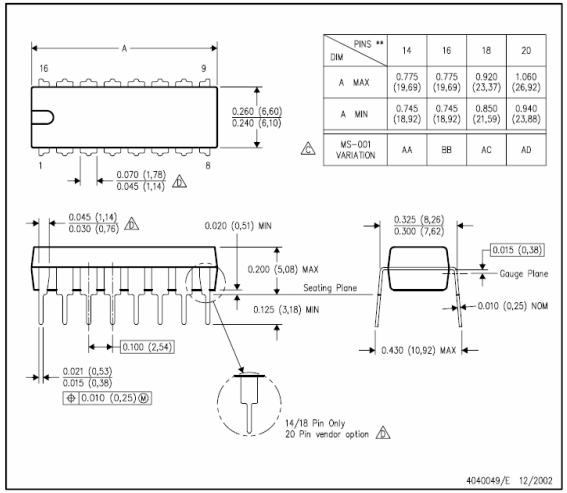



NOTES: A. The pulse generator has the following characteristics: $Z_O$ = 50 Ω, duty cycle ≤ 50%.
B. $C_L$ includes probe and jig capacitance.
C. All diodes are 1N3064 or equivalent.

**Figure 1. Receiver Test Circuit and Waveforms for $t_{PHL}$ and $t_{PLH}$ Measurements**

N (R–PDIP–T**) PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN




| DIM \ PINS ** | 14 | 16 | 18 | 20 |
|---|---|---|---|---|
| A MAX | 0.775 (19,69) | 0.775 (19,69) | 0.920 (23,37) | 1.060 (26,92) |
| A MIN | 0.745 (18,92) | 0.745 (18,92) | 0.850 (21,59) | 0.940 (23,88) |
| MS–001 VARIATION | AA | BB | AC | AD |

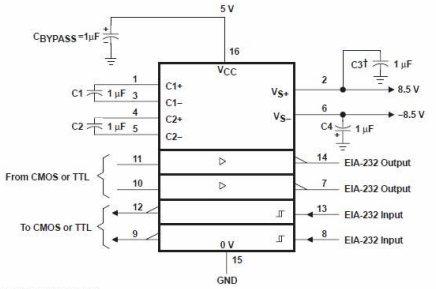
4040049/E 12/2002

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
Falls within JEDEC MS–001, except 18 and 20 pin minimum body length (Dim A).
The 20 pin end lead shoulder width is a vendor option, either half or full width.





APPLICATION INFORMATION




† C3 can be connected to $V_{CC}$ or GND.

NOTES: A. Resistor values shown are nominal.
B. Nonpolarized ceramic capacitors are acceptable. If polarized tantalum or electrolytic capacitors are used, they should be connected as shown. In addition to the 1-µF capacitors shown, the MAX202 can operate with 0.1-µF capacitors.

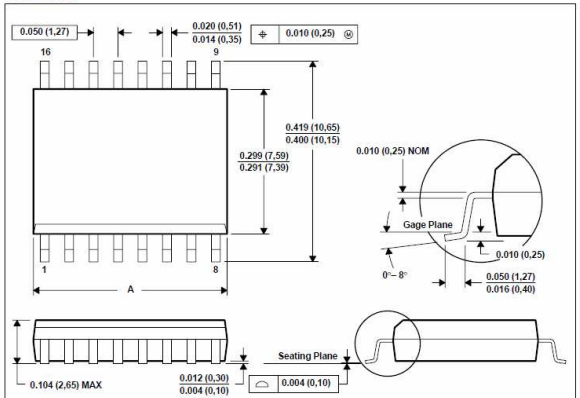
**Figure 4. Typical Operating Circuit**

## MECHANICAL DATA

MSOI003E – JANUARY 1995 – REVISED SEPTEMBER 2001

**DW (R-PDSO-G**)** PLASTIC SMALL-OUTLINE PACKAGE

**16 PINS SHOWN**




| DIM \ PINS ** | 16 | 18 | 20 | 24 | 28 |
|---|---|---|---|---|---|
| A MAX | 0.410 (10,41) | 0.462 (11,73) | 0.510 (12,95) | 0.610 (15,49) | 0.710 (18,03) |
| A MIN | 0.400 (10,16) | 0.453 (11,51) | 0.500 (12,70) | 0.600 (15,24) | 0.700 (17,78) |

4040000/E 08/01

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
D. Falls within JEDEC MS-013

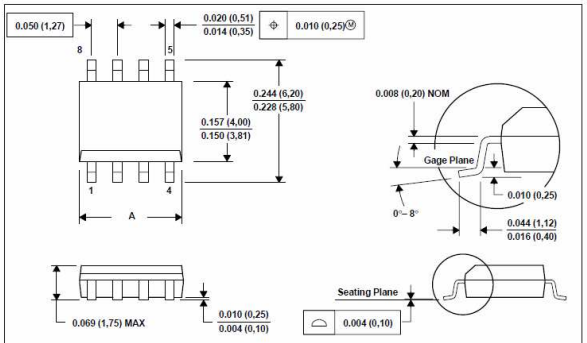


## MECHANICAL DATA

MSOI002B – JANUARY 1995 – REVISED SEPTEMBER 2001

**D (R-PDSO-G**)** PLASTIC SMALL-OUTLINE PACKAGE

**8 PINS SHOWN**




| DIM \ PINS ** | 8 | 14 | 16 |
|---|---|---|---|
| A MAX | 0.197 (5,00) | 0.344 (8,75) | 0.394 (10,00) |
| A MIN | 0.189 (4,80) | 0.337 (8,55) | 0.386 (9,80) |

4040047/E 09/01

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion, not to exceed 0.006 (0,15).
D. Falls within JEDEC MS-012

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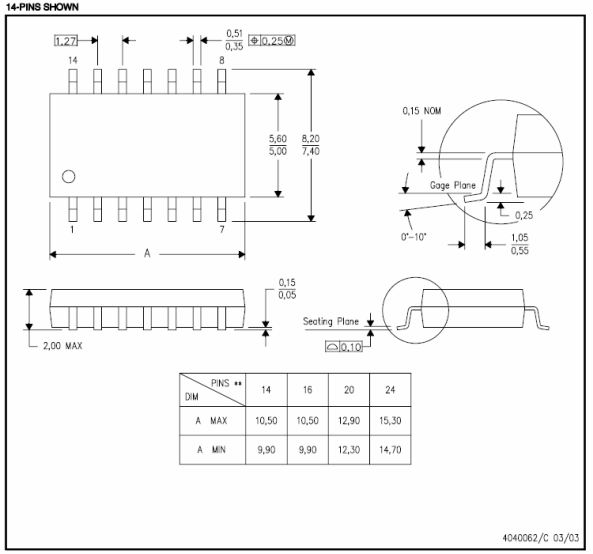
## MECHANICAL DATA

**NS (R-PDSO-G**)** — **PLASTIC SMALL-OUTLINE PACKAGE**

**14-PINS SHOWN**




| DIM \ PINS ** | 14 | 16 | 20 | 24 |
|---|---|---|---|---|
| A MAX | 10,50 | 10,50 | 12,90 | 15,30 |
| A MIN | 9,90 | 9,90 | 12,30 | 14,70 |

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

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