LAMPIRAN A

PROGRAM PADA *VISUAL BASIC*

VARIABEL GLOBAL

```
Dim i, x, z, k, panjang As Integer
Dim s, si As String
```

FORM

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

EXIT

```
Private Sub Command3_Click()
Unload Me
End Sub
```

RESET 1

```
Private Sub reset_Click()
z = 1
i = FreeFile
Open "D:\UDR.txt" For Input As #i
Do Until EOF(i)
Input #i, s
s1 = s1 & s & IIf(EOF(i), "", vbCrLf)
Loop
Close #i

If Len(s1) > 0 Then
    MSComm1.Output = Space(63 - Len(s1))
    Text1.SetFocus
End If

End Sub
```

RESET 2

```
Private Sub Command2_Click()
    z = 1
    i = FreeFile
    Open "D:\UDR.txt" For Output As #i
    Print #i, ""
    Close #i
End Sub
```

SEND

```
Private Sub send_Click()
```

```
Dim a As String
Dim c, d, e As Integer
c = Len(Text1.Text)
d = Len(Text2.Text)
e = Len(Text4.Text)
If z = 0 Then
'message box
Dim Msg3, Style3, Title3, Help3, Ctxt3, Response3, Mystring3
Msg3 = "Silahkan reset dahulu!"
Style3 = vbOKOnly + vbInformation + vbDefaultButton2
Title3 = "Info"
Help3 = "DEMO.HLP"
Ctxt3 = 1000

Response3 = MsgBox(Msg3, Style3, Title3, Help3, Ctxt3)
If Response3 = vbOK Then
reset.SetFocus
End If
End If

If c = 0 And d = 0 And e = 0 Then
'message box
Dim Msg, Style, Title, Help, Ctxt, Response, Mystring
Msg = "Silahkan Masukkan Teks!!"
Style = vbOKOnly + vbInformation + vbDefaultButton2
Title = "Info"
Help = "DEMO.HLP"
   Ctxt = 1000

Response = MsgBox(Msg, Style, Title, Help, Ctxt)
If Response = vbOK Then
Text1.SetFocus
End If
End If

If c > 25 Or d > 25 Or e > 6 Then
'message box
Dim Msg1, Style1, Title1, Help1, Ctxt1, Response1, Mystring1
Msg1 = "Teks kelebihan!!"
Style1 = vbOKOnly + vbInformation + vbDefaultButton2
Title1 = "Info"
Help1 = "DEMO.HLP"
   Ctxt1 = 1000

Response1 = MsgBox(Msg1, Style1, Title1, Help1, Ctxt1)
If Response1 = vbOK Then
```

```
End If
End If


If ((c > 0 And c <= 25) And (d > 0 And d <= 25) And (e > 0 And e <= 6)) And z =
1 Then
MSComm1.Output = Text1.Text + "~%" + Text2.Text + "|%" + Text4.Text + "||"

'save frame
i = FreeFile
Open "D:\UDR.txt" For Output As #i
Print #i, Text1.Text + "~%" + Text2.Text + "|%" + Text4.Text + "||"
Close #i

Text1.Text = ""
Text2.Text = ""
Text4.Text = ""
z = 0

End If

End Sub
```

MASUK ATCOMMAND

```
Private Sub Command5_Click()
Timer2.Enabled = True
MSComm1.Output = "+++"
End Sub
```

SETTING LAMA

```
Private Sub Command7_Click()
If Option1.Value Then
MSComm1.Output = "ATID" + Chr(13)
Timer2.Enabled = False
End If
If Option2.Value Then
MSComm1.Output = "ATMY" + Chr(13)
Timer2.Enabled = False
End If
If Option3.Value Then
MSComm1.Output = "ATDL" + Chr(13)
Timer2.Enabled = False
End If
If Option4.Value Then
MSComm1.Output = "ATBD" + Chr(13)
Timer2.Enabled = False
```

```
End If
End Sub
```

SETTING BARU

```
Private Sub Command6_Click()
If Option1.Value Then
MSComm1.Output = "ATID" + Text8.Text + ",wr,cn" + Chr(13)
End If
If Option2.Value Then
MSComm1.Output = "ATMY" + Text9.Text + ",wr,cn" + Chr(13)
End If
If Option3.Value Then
MSComm1.Output = "ATDL" + Text7.Text + ",wr,cn" + Chr(13)
End If
If Option4.Value Then
MSComm1.Output = "ATBD" + Text10.Text + ",wr,cn" + Chr(13)
End If
End Sub
```

TIMER 1

```
Private Sub Timer1_Timer()
If Option1.Value Then
Text11.Text = MSComm1.Input
Timer2.Enabled = False
End If
If Option2.Value Then
Text12.Text = MSComm1.Input
Timer2.Enabled = False
End If
If Option3.Value Then
Text13.Text = MSComm1.Input
Timer2.Enabled = False
End If
If Option4.Value Then
Text14.Text = MSComm1.Input
Timer2.Enabled = False
End If
End Sub
```

TIMER 2

```
Private Sub Timer2_Timer()
Text5.Text = MSComm1.Input
End Sub
```

TULISAN TERAKHIR

```
Private Sub Command1_Click()
i = FreeFile
Open "D:\UDR.txt" For Input As #i
Do Until EOF(i)
Input #i, s 'tiap baris d tampung d variabel "s"
s1 = s1 & s & IIf(EOF(i), "", vbCrLf)
Loop
Close #i
Text3.Text = s1
End Sub
```

LAMPIRAN B

PROGRAM PADA MIKROKONTROLER ATMEGA32

```
/*****************************************************
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    : 10/8/2011
Author  : Adrian
Company : Maranatha
Comments:


Chip type           : ATmega32
Program type        : Application
Clock frequency     : 11.059200 MHz
Memory model        : Small
External SRAM size  : 0
Data Stack size     : 512
*****************************************************/

#include <mega32.h>
#include <delay.h>

#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 63
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;
unsigned int k,z;
```

```
// USART Receiver interrupt service routine
interrupt [USART_RXC] void usart_rx_isr(void)
{
 char status,data;
 status=UCSRA;
 data=UDR;
 k=rx_counter;

 if (UCSRA.7==0)
   {
        rx_buffer[rx_counter]=data;

        if (++rx_counter == RX_BUFFER_SIZE)
        {
                rx_counter=0;
                rx_buffer_overflow=1;
                UCSRB.5=1;
        }

        if (++rx_wr_index == RX_BUFFER_SIZE)
        {
                rx_wr_index=0;
        }
   z=1;
   }
}

#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

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

// Declare your global variables here
unsigned char karakter;
unsigned char spasi = 0x00;
unsigned char data[191];
unsigned char data1[191];
unsigned char data2[77];
unsigned char frame[63][5];
unsigned int a,b,c,d,e,f,g,i,j,l,m,p,q,u,w,x,y,r,s,h;
```

```
unsigned char hexa [95][5] =
   {
        {0x00, 0x00, 0x00, 0x00, 0x00}, //spasi
        {0x04, 0x2a, 0x2a, 0x2a, 0x1e}, //a
        {0x7e, 0x0a, 0x0a, 0x0a, 0x04}, //b
        {0x1c, 0x22, 0x22, 0x22, 0x24}, //c
        {0x04, 0x0a, 0x0a, 0x0a, 0x7e}, //d
        {0x1c, 0x2a, 0x2a, 0x2a, 0x12}, //e
        {0x10, 0x3e, 0x50, 0x40, 0x20}, //f
        {0x10, 0x2a, 0x2a, 0x2a, 0x3c}, //g
        {0x7e, 0x08, 0x08, 0x08, 0x06}, //h
        {0x02, 0x0a, 0x5e, 0x02, 0x02}, //i
        {0x04, 0x02, 0x02, 0x12, 0x5c}, //j
      {0x7e, 0x10, 0x18, 0x24, 0x02}, //k
      {0x42, 0x42, 0x7e, 0x02, 0x02}, //l
      {0x1e, 0x20, 0x18, 0x20, 0x1e}, //m
      {0x3e, 0x10, 0x20, 0x20, 0x1e}, //n
      {0x1c, 0x22, 0x22, 0x22, 0x1c}, //o
      {0x3f, 0x28, 0x28, 0x28, 0x10}, //p
      {0x10, 0x28, 0x28, 0x28, 0x3f}, //q
      {0x3e, 0x10, 0x20, 0x20, 0x10}, //r
      {0x12, 0x2a, 0x2a, 0x2a, 0x24}, //s
      {0x10, 0x7c, 0x12, 0x02, 0x04}, //t
      {0x3c, 0x02, 0x02, 0x04, 0x3e}, //u
      {0x38, 0x04, 0x02, 0x04, 0x38}, //v
      {0x3c, 0x02, 0x0c, 0x02, 0x3c}, //w
      {0x22, 0x14, 0x08, 0x14, 0x22}, //x
      {0x30, 0x0a, 0x0a, 0x0a, 0x3c}, //y
      {0x22, 0x26, 0x2a, 0x32, 0x22}, //z

      {0x3e, 0x48, 0x48, 0x48, 0x3e}, //A
      {0x7e, 0x52, 0x52, 0x5a, 0x24}, //B
      {0x3c, 0x42, 0x42, 0x42, 0x24}, //C
      {0x7e, 0x42, 0x42, 0x42, 0x3c}, //D
      {0x7e, 0x52, 0x52, 0x52, 0x42}, //E
      {0x7e, 0x50, 0x50, 0x50, 0x40}, //F
      {0x3c, 0x42, 0x52, 0x52, 0x5c}, //G
      {0x7e, 0x10, 0x10, 0x10, 0x7e}, //H
      {0x42, 0x42, 0x7e, 0x42, 0x42}, //I
      {0x04, 0x02, 0x02, 0x02, 0x7c}, //J
      {0x7e, 0x10, 0x18, 0x24, 0x42}, //K
      {0x7e, 0x02, 0x02, 0x02, 0x02}, //L
      {0x7e, 0x40, 0x30, 0x40, 0x7e}, //M
      {0x7e, 0x30, 0x18, 0x0c, 0x7e}, //N
      {0x3c, 0x42, 0x42, 0x42, 0x3c}, //O
      {0x7e, 0x48, 0x48, 0x48, 0x30}, //P
      {0x3c, 0x62, 0x5a, 0x44, 0x3a}, //Q
      {0x7e, 0x48, 0x48, 0x4c, 0x32}, //R
      {0x32, 0x5a, 0x5a, 0x5a, 0x4c}, //S
      {0x40, 0x40, 0x7e, 0x40, 0x40}, //T
      {0x7c, 0x02, 0x02, 0x02, 0x7c}, //U
      {0x78, 0x04, 0x02, 0x04, 0x78}, //V
      {0x7c, 0x02, 0x0e, 0x02, 0x7c}, //W
      {0x42, 0x24, 0x18, 0x24, 0x42}, //X
      {0x60, 0x10, 0x0e, 0x10, 0x60}, //Y
      {0x46, 0x4a, 0x5a, 0x52, 0x62}, //Z
```

```
        {0x02, 0x22, 0x7e, 0x02, 0x02}, //1
        {0x22, 0x46, 0x4a, 0x52, 0x22}, //2
        {0x24, 0x42, 0x52, 0x52, 0x3c}, //3
        {0x70, 0x10, 0x10, 0x10, 0x7e}, //4
        {0x74, 0x52, 0x52, 0x52, 0x5c}, //5
        {0x1c, 0x2a, 0x4a, 0x4a, 0x04}, //6
        {0x42, 0x44, 0x48, 0x50, 0x60}, //7
        {0x24, 0x5a, 0x5a, 0x5a, 0x24}, //8
        {0x20, 0x52, 0x52, 0x54, 0x38}, //9
        {0x3c, 0x72, 0x5a, 0x4e, 0x3c}, //0

        {0x00, 0x78, 0xfd, 0x78, 0x00}, //!
        {0x4e, 0xd9, 0x9f, 0xc1, 0x7e}, //@
        {0x2c, 0x38, 0x6c, 0x38, 0x68}, //#
        {0x24, 0x52, 0xff, 0x52, 0x4c}, //$
        {0xc6, 0xcc, 0x18, 0x33, 0x63}, //%
        {0x20, 0x40, 0x80, 0x40, 0x20}, //^
          {0x76, 0x89, 0x95, 0x62, 0x05}, //&
          {0x54, 0x38, 0xfe, 0x38, 0x54}, //*
          {0x3c, 0x7e, 0xc3, 0x00, 0x00}, //(
          {0x00, 0x00, 0xc3, 0x7e, 0x3c}, //)

          {0xc0, 0xe0, 0x60, 0x10, 0x00}, //`
          {0x18, 0x18, 0x18, 0x18, 0x18}, //-
          {0x6c, 0x6c, 0x6c, 0x6c, 0x6c}, //=
          {0x7f, 0x7f, 0x41, 0x00, 0x00}, //[
          {0x00, 0x00, 0x41, 0x7f, 0x7f}, //]
          {0x00, 0xed, 0xef, 0xee, 0x00}, //;
          {0x05, 0x06, 0x00, 0x00, 0x00}, //,
          {0x06, 0x06, 0x00, 0x00, 0x00}, //.
          {0x03, 0x0e, 0x3c, 0x70, 0xc0}, ///
          {0xe0, 0xe0, 0x00, 0xe0, 0xe0}, //"

          {0x20, 0x40, 0x20, 0x10, 0x20}, //~
          {0x01, 0x01, 0x01, 0x01, 0x01}, //_
          {0x18, 0x18, 0x7e, 0x18, 0x18}, //+
          {0x08, 0x76, 0x81, 0x81, 0x00}, //{
          {0x00, 0x81, 0x81, 0x76, 0x08}, //}
          {0x00, 0xe7, 0xe7, 0xe7, 0x00}, //:
          {0x08, 0x14, 0x22, 0x41, 0x00}, //<
          {0x00, 0x41, 0x22, 0x14, 0x08}, //>
          {0x60, 0xc0, 0x8d, 0xd0, 0x60}, //?
          {0x7f, 0x7f, 0x00, 0x00, 0x00}, //|

          {0xc0, 0x70, 0x3c, 0x0e, 0x03}, //\
          {0x00, 0x00, 0xe0, 0x00, 0x00}  //'

 };

unsigned char simbol [95] =
{' ','a','b','c','d','e','f','g','h','i','j','k','l','m','n','o',
'p','q','r','s','t','u','v','w','x','y','z','A','B','C','D','E','F
','G','H','I','J','K','L','M','N','O','P','Q','R','S','T','U','V',
'W','X','Y','Z','1','2','3','4','5','6','7','8','9','0','!','@','#
','$','%','^','&','*','(',')','`','-
```

```
','=','[',']',';',',','.','/','"','~','_','+','{','}',':','<','>',
'?','|','\\','\''
};

void konversi()
{
    for(d=0;d<93;d++)
    {
        if (karakter==simbol[d])
        {
        y=d;
        }
    }
}

void framing()
{
        for(j=0;j<5;j++)
        {
        frame[u][j]=hexa[y][j];
        }
}

void clear_frame()
{
        for(j=0;j<5;j++)
        {
        frame[u][j]=0x00;
        }
}


void data_isi1()
 {

           a=40;

           for(b=0; b<x; b++)
           {

                   for(c=0; c<6; c++)
                   {
                          if (c==5)
                          {
                          data[a]=spasi;
                          }
                          else
                          {
                          data[a]=frame[b][c];
                          }
                          a++;
                   }
           }
 }
```

```
void data_isi2()
{

          a=40;

          for(b=x+2; b<w; b++)
          {

                  for(c=0; c<6; c++)
                  {
                         if (c==5)
                         {
                         data1[a]=spasi;
                         }
                         else
                         {
                         data1[a]=frame[b][c];
                         }
                         a++;
                  }
          }
}

void data_isi3()
{

          a=40;

          for(b=w+2; b<q; b++)
          {

                  for(c=0; c<6; c++)
                  {
                         if (c==5)
                         {
                         data2[a]=spasi;
                         }
                         else
                         {
                         data2[a]=frame[b][c];
                         }
                         a++;
                  }
          }
}


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

// Input/Output Ports initialization
// Port A initialization
// Func7=Out Func6=Out Func5=Out Func4=Out Func3=Out Func2=Out
Func1=Out Func0=Out
```

```
// State7=0 State6=0 State5=0 State4=0 State3=0 State2=0 State1=0
State0=0
PORTA=0x00;
DDRA=0xFF;

// 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=T
State0=T
PORTB=0x00;
DDRB=0x00;

// Port C initialization
// Func7=Out Func6=Out Func5=In Func4=In Func3=In Func2=In
Func1=In Func0=In
// State7=0 State6=0 State5=T State4=T State3=T State2=T State1=T
State0=T
PORTC=0x00;
DDRC=0xC0;

// 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;

// USART initialization
// Communication Parameters: 8 Data, 1 Stop, No Parity
// USART Receiver: On
// USART Transmitter: Off
// USART Mode: Asynchronous
// USART Baud rate: 9600
UCSRA=0x00;
UCSRB=0x90;
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)
      {
      // Place your code here

if(z==1)
{
          for(i=0;i<k+1;i++)
          {
                if(rx_buffer[i]=='~' && rx_buffer[i+1]=='%')
                {x=i;
                }
                if(rx_buffer[i]=='|' && rx_buffer[i+1]=='%')
                {w=i;
                }
                if(rx_buffer[i]=='|' && rx_buffer[i+1]=='|')
                {q=i;
                }


                for(u=0;u<x;u++)
                {
                        karakter=rx_buffer[u];
                        konversi();
                        framing();
                };
                data_isi1();

                for(u=0;u<62;u++)
                {clear_frame();}

                m=(w-x-2)*6+40;
                for(u=x+2;u<w;u++)
                {
                        karakter=rx_buffer[u];
                        konversi();
                        framing();
                };
                data_isi2();

                for(u=0;u<62;u++)
                {clear_frame();}

                for(u=w+2;u<q;u++)
                {
                        karakter=rx_buffer[u];
                        konversi();
                        framing();
                };
                data_isi3();

                for(u=0;u<62;u++)
                {clear_frame();}
          };
          z=0;
          g=1;
}
```

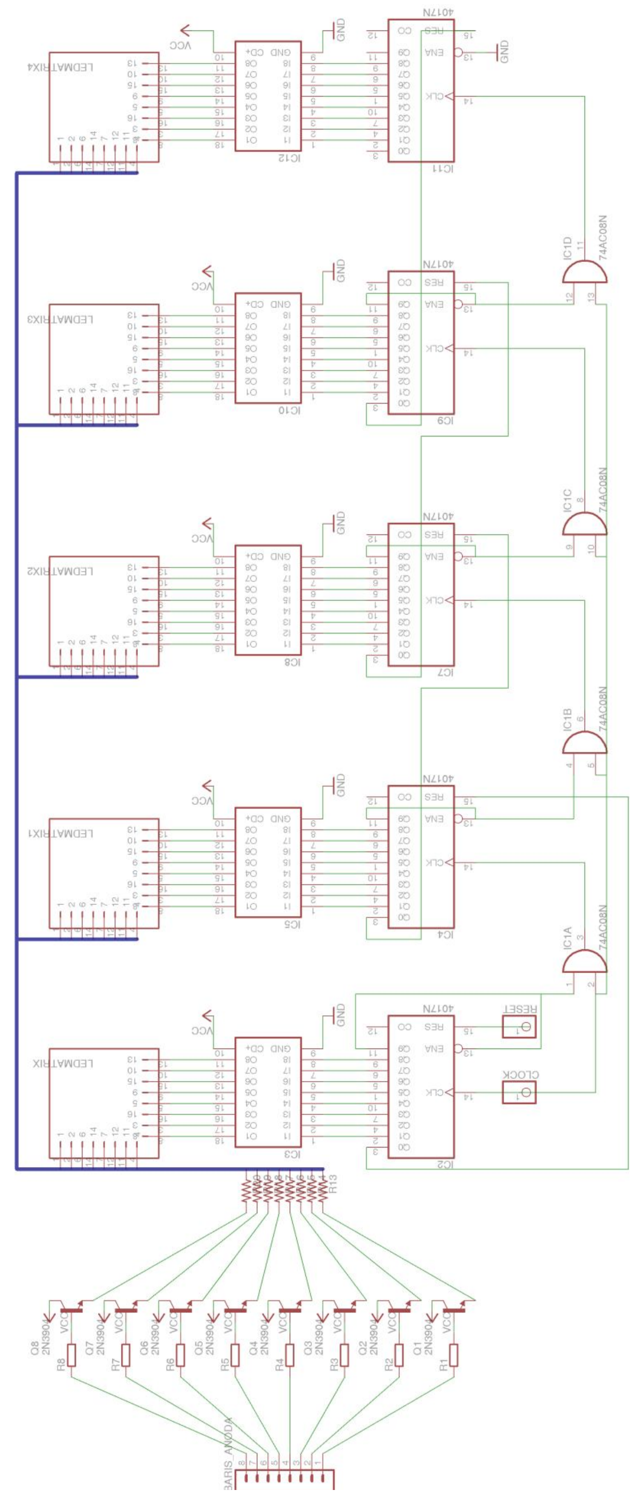
```
if(g==1)
  {
         PORTA=data[e+f];
         e++;
         PORTC.7=1;
         delay_us(1500);
         PORTC.7=0;


         if(e==40)
         {
                PORTC.6=1;
                PORTC.6=0;
                e=0;
                f++;
         }
         p=6*(x)+40;

         if(f==p)
         {
                f=0;g=2;
          }
  }

 if(g==2)
  {
         PORTA=data1[m+l];
         l++;
         PORTC.7=1;
         delay_us(1500);
         PORTC.7=0;


         if(l==40)
         {
                PORTC.6=1;
                PORTC.6=0;
                l=0;
                m--;
         }
         if(m==0)
         {
                m=(w-x-2)*6+40;g=3;
         }

 }

if(g==3)
 {      for(p=0;p<5;p++)
        {
            for(h=0;h<1000;h++)
            {
                PORTA=data2[r+37];
                PORTC.7=1;
                delay_us(500);
                PORTC.7=0;
```

```
                r++;

                if(r==40)
                {
                        PORTC.6=1;
                        PORTC.6=0;
                        r=0;

                }
             }
             delay_ms(200);
         }

         g=1;
 }

      };
}
```

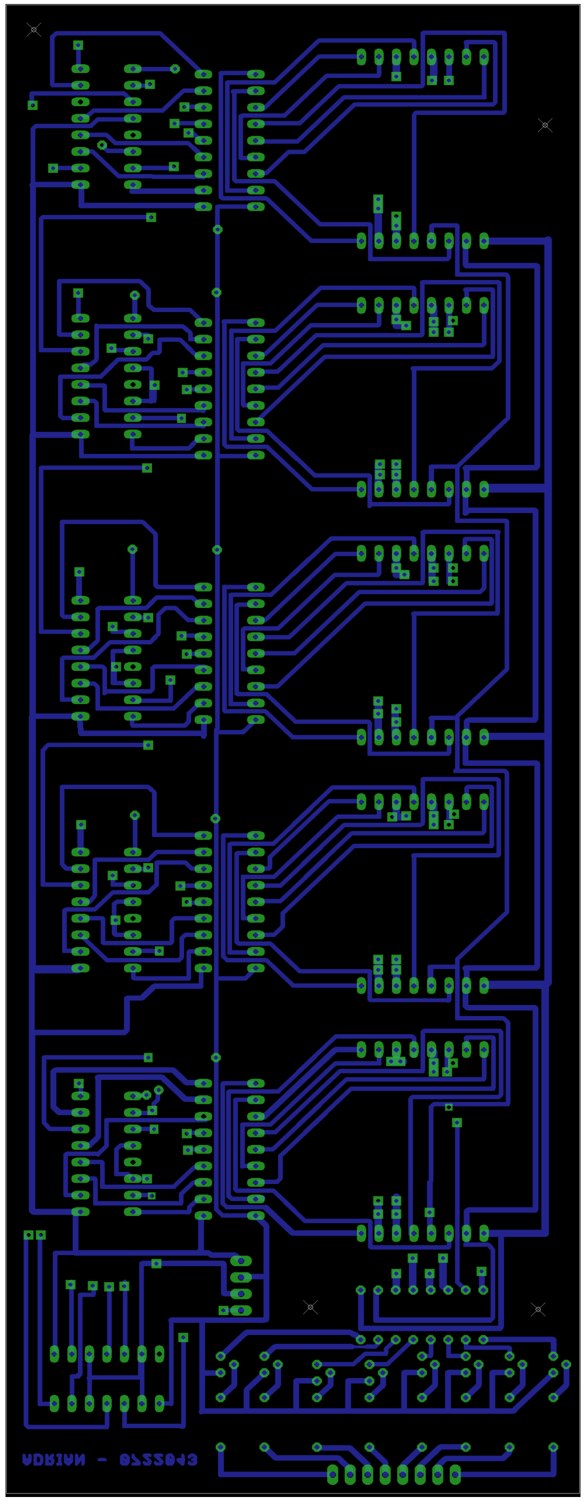
LAMPIRAN C

RANGKAIAN SKEMATIK DAN FOTO ALAT

SKEMATIK SCROLLING TEXT DISPLAY



BOARD SCROLLING TEXT DISPLAY



SKEMATIK MIKROKONTROLER DAN XBEE-PRO

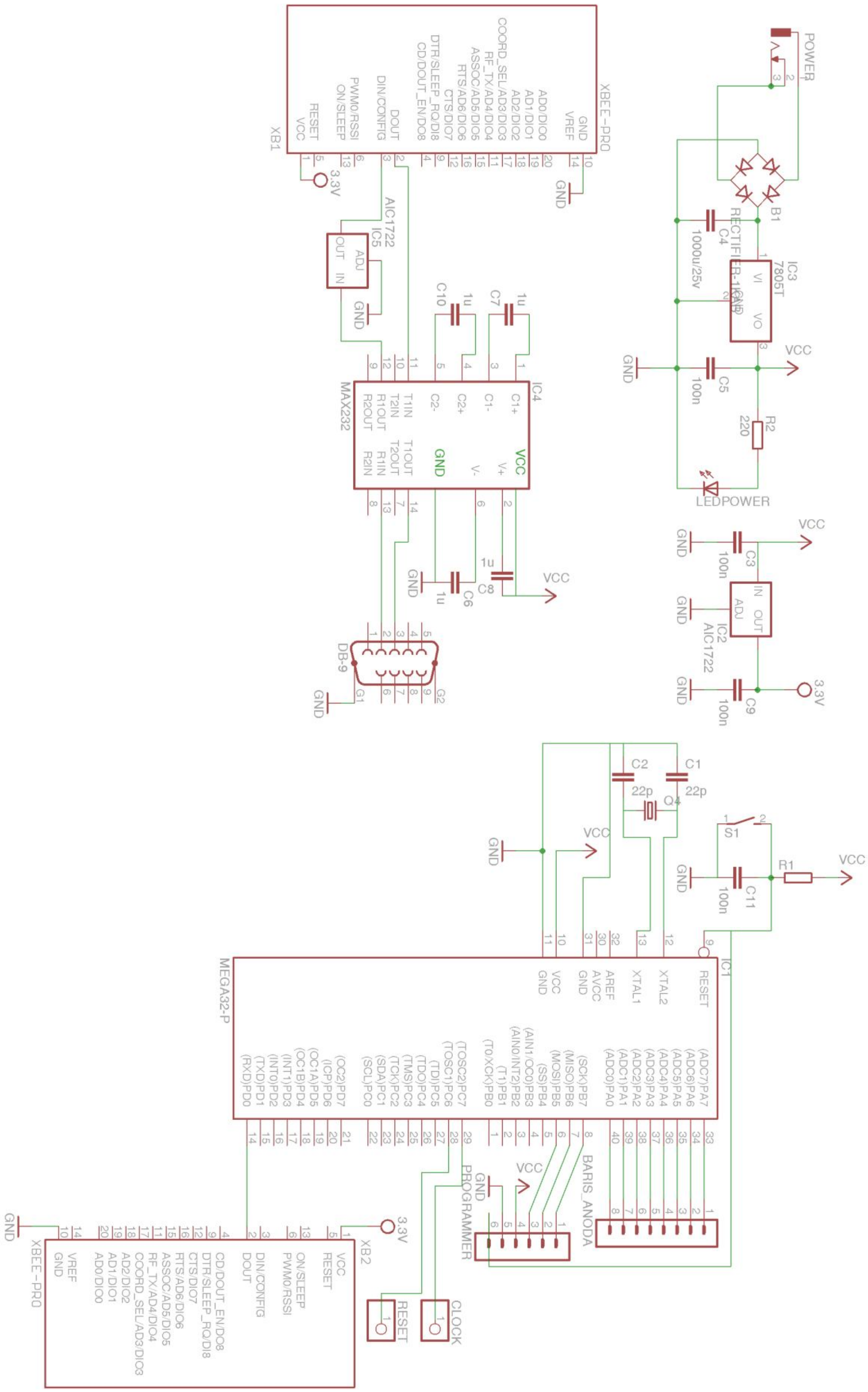
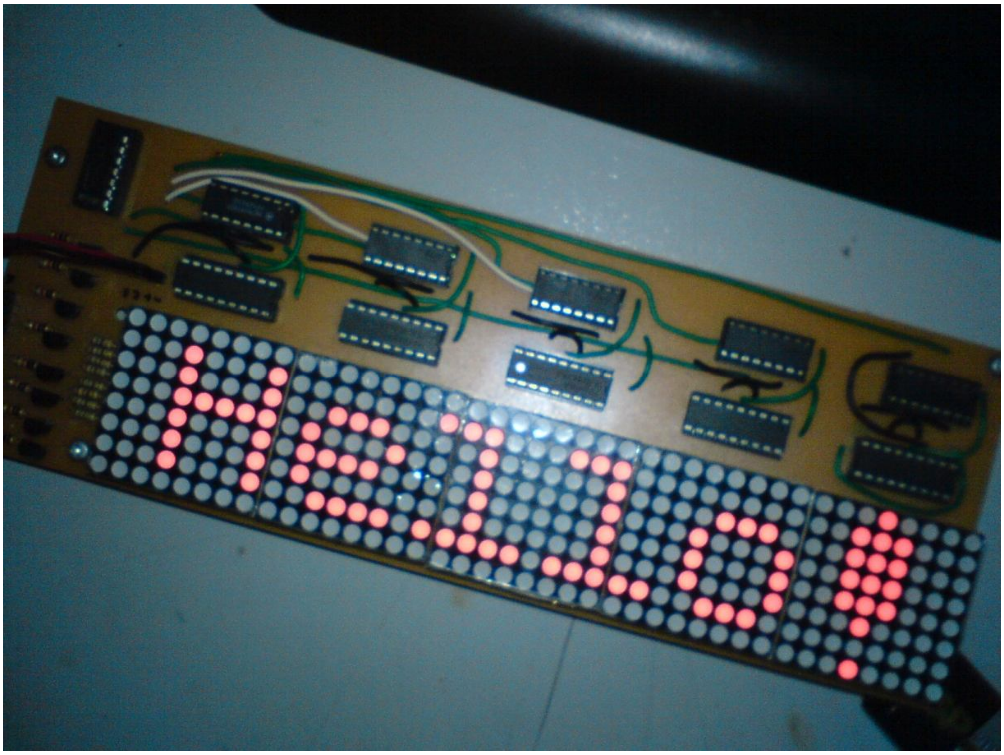
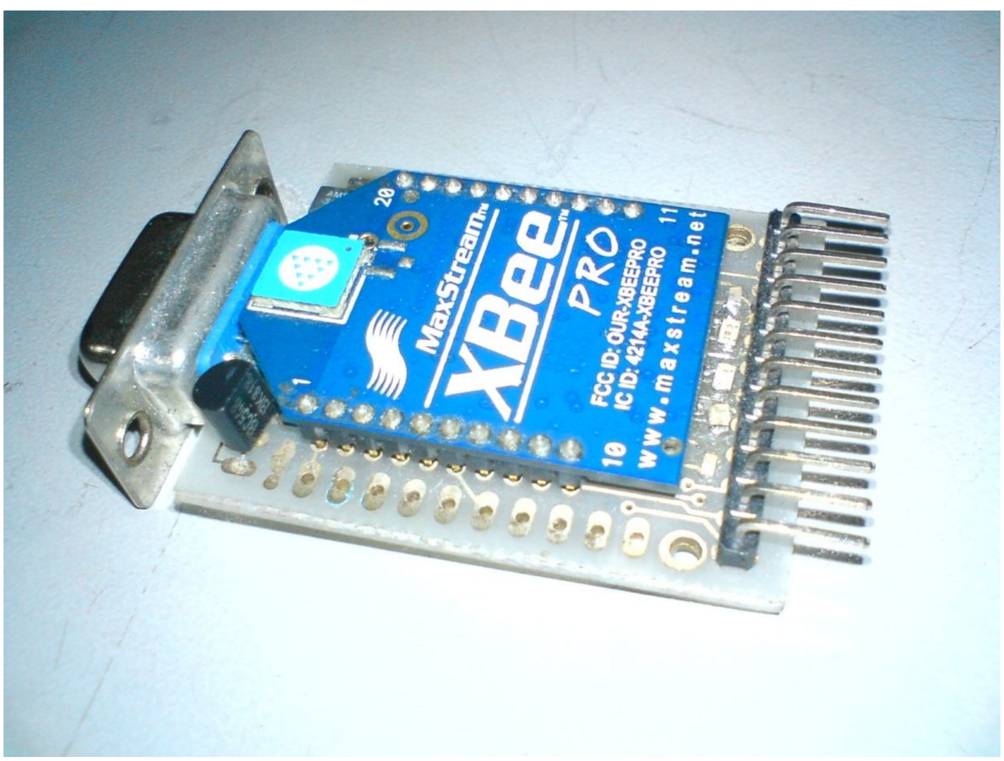


FOTO ALAT



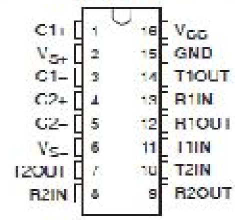

MaxStream
XBee
PRO
FCC ID: OUR-XBEEPRO
IC ID: 4214A-XBEEPRO
www.maxstream.net

LAMPIRAN D

DATASHEET

- 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.

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

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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, θ_{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), θ_{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, All outputs open, T_A = 25°C		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.

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

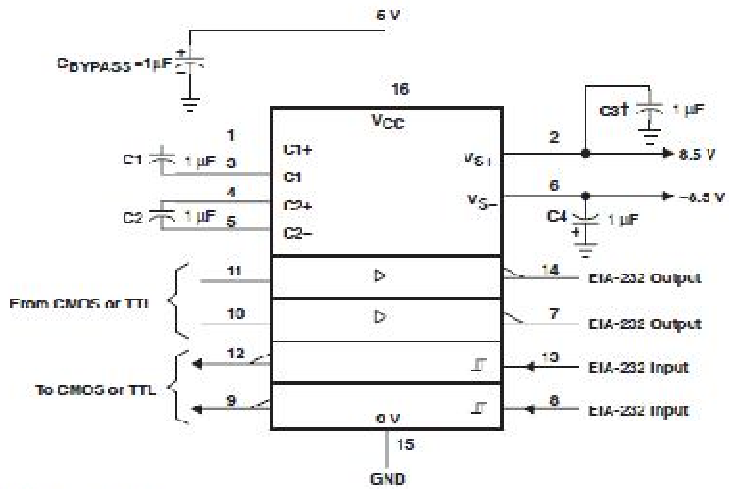
† All typical values are at V_{CC} = 5 V, T_A = 25°C.
‡ The algebraic convention, in which the least-positive (most negative) value is designated minimum, is used in this data sheet for logic voltage levels only.
NOTE 4: Test conditions are C1–C4 = 1 µF at V_{CC} = 5 V ± 0.5 V.

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.

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

1. XBee/XBee-PRO OEM RF Modules

XBee and XBee-PRO Modules were engineered to meet ZigBee/IEEE 802.15.4 standards and support the unique needs of low-cost, low-power wireless sensor networks. The modules require minimal power and provide reliable delivery of critical data between devices.

The modules operate within the ISM 2.4 GHz frequency band and are pin-for-pin compatible with each other.

1.1. Key Features

High Performance, Low Cost

XBee

- Indoor/Urban: up to 100' (30 m)
- Outdoor line-of-sight: up to 300' (100 m)
- Transmit Power: 1 mW (0 dBm)
- Receiver Sensitivity: -92 dBm

XBee-PRO

- Indoor/Urban: up to 300' (100 m)
- Outdoor line-of-sight: up to 1 mile (1500 m)
- Transmit Power: 100 mW (20 dBm) EIRP
- Receiver Sensitivity: -100 dBm

RF Data Rate: 250,000 bps

Advanced Networking & Security

Retries and Acknowledgements

DSSS (Direct Sequence Spread Spectrum)

Each direct sequence channels has over 65,000 unique network addresses available

Point-to-point, point-to-multipoint and peer-to-peer topologies supported

128-bit Encryption (downloadable firmware version coming soon)

Self-routing/Self-healing mesh networking (downloadable firmware version coming soon)

Low Power

XBee

- TX Current: 45 mA (@3.3 V)
- RX Current: 50 mA (@3.3 V)
- Power-down Current: < 10 µA

XBee-PRO

- TX Current: 270 mA (@3.3 V)
- RX Current: 55 mA (@3.3 V)
- Power-down Current: < 10 µA

Easy-to-Use

No configuration necessary for out-of box RF communications

Free X-CTU Software (Testing and configuration software)

AT Command Mode for simple configuration of module parameters

Small form factor

Network compatible with other ZigBee/802.15.4 devices

Free & Unlimited Technical Support

1.1.1. Worldwide Acceptance

FCC Approval (USA) Refer to Appendix A [p23] for FCC Requirements. Systems that include XBee/XBee-PRO Modules inherit MaxStream's Certifications.

ISM (Industrial, Scientific & Medical) 2.4 GHz frequency band

Manufactured under **ISO 9001:2000** registered standards

XBee/XBee-PRO RF Modules are optimized for use in **US, Canada, Australia, Israel and Europe** (contact MaxStream for complete list of approvals).

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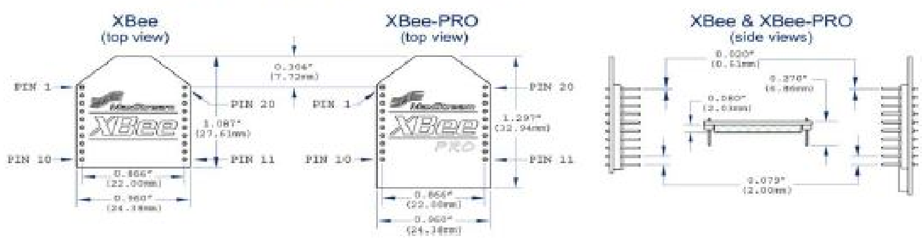
1.2. Specifications

Table 1-01. Specifications of the XBee/XBee-PRO OEM RF Modules

Specification	XBee	XBee-PRO
Performance		
Indoor/Urban Range	up to 100 ft. (30 m)	Up to 300' (100 m)
Outdoor RF line-of-sight Range	up to 300 ft. (100 m)	Up to 1 mile (1500 m)
Transmit Power Output	1mW (0 dBm)	60 mW (18 dBm) conducted, 100 mW (20 dBm) EIRP
RF Data Rate	250,000 bps	250,000 bps
Interface Data Rate (software selectable)	1200 - 115200 bps (non-standard baud rates also supported)	1200 - 115200 bps (non-standard baud rates also supported)
Receiver Sensitivity	-92 dBm (1% packet error rate)	-100 dBm (1% packet error rate)
Power Requirements		
Supply Voltage	2.8 – 3.4 V	2.8 – 3.4 V
Transmit Current (typical)	45 mA (@ 3.3 V)	270 mA (@ 3.3 V)
Receive Current (typical)	50 mA (@ 3.3 V)	55 mA (@ 3.3 V)
Power-down Current	< 10 µA	< 10 µA
General		
Operating Frequency	ISM 2.4 GHz	ISM 2.4 GHz
Dimensions	0.960" x 1.087" (2.438cm x 2.761cm)	0.960" x 1.297" (2.438cm x 3.294cm)
Operating Temperature	-40 to 85° C (industrial)	-40 to 85° C (industrial)
Antenna Options	U.FL Connector, Chip Antenna or Whip Antenna	U.FL Connector, Chip Antenna or Whip Antenna
Networking & Security		
Supported Network Topologies	Point-to-Point, Point-to-Multipoint, Peer-to-Peer and Mesh (coming soon)	Point-to-Point, Point-to-Multipoint, Peer-to-Peer and Mesh (coming soon)
Number of Channels (software selectable)	16 Direct Sequence Channels	13 Direct Sequence Channels
Filtration Options	PAN ID, Channel and Source/Destination Addresses	PAN ID, Channel and Source/Destination Addresses
Agency Approvals		
FCC Part 15.247	OUR-XBEE	pending
Industry Canada (IC)	pending	pending
Europe	pending	pending

1.3. Mechanical Drawings

Figure 1-01. Mechanical drawings of the XBee/XBee-PRO OEM RF Modules (antenna options not shown)
XBee and XBee-PRO RF Modules are pin-for-pin compatible.



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1.4. Pin Signals

Figure 1-02. XBee/XBee-PRO RF Module Pin Number
(top sides shown - shields on bottom)

Table 1-02. Pin Assignments for the XBee and XBee-PRO Modules
(Low-asserted signals are distinguished with a horizontal line above signal name.)

Pin #	Name	Direction	Description
1	VCC	-	Power supply
2	DOUT	Output	UART Data Out
3	DIN / CONFIG	Input	UART Data In
4	CD* / DOUT_EN* / DO8*	Output	Carrier Detect, TX_enable or Digital Output 8
5	RESET	Input	Module Reset
6	PWM0 / RSSI	Output	PWM Output 0 or RX Signal Strength Indicator
7	[reserved]		Do not connect
8	[reserved]		Do not connect
9	DTR / SLEEP_RQ / DI8	Input	Pin Sleep Control Line or Digital Input 8
10	GND	-	Ground
11	RF_TX* / AD4* / DIO4*	Either	Transmission Indicator, Analog Input 4 or Digital I/O 4
12	CTS* / DIO7*	Either	Clear-to-Send Flow Control or Digital I/O 7
13	ON / SLEEP	Output	Module Status Indicator
14	VREF*	Input	Voltage Reference for A/D Inputs
15	Associate / AD5* / DIO5*	Either	Associated Indicator, Analog Input 5 or Digital I/O 5
16	RTS* / AD6* / DIO6*	Either	Request to Send Flow Control, Analog Input 6 or Digital I/O 6
17	COORD_SEL* / AD3* / DIO3*	Either	Analog Input 3, Digital I/O 3 or Coordinator Select
18	AD2* / DIO2*	Either	Analog Input 2 or Digital I/O 2
19	AD1* / DIO1*	Either	Analog Input 1 or Digital I/O 1
20	AD0* / DIO0*	Either	Analog Input 0 or Digital I/O 0

* Functions not supported at the time of this release.

Design Notes:

- Minimum connections are: VCC, GND, DOUT and DIN
- Signal Direction is specified with respect to the module
- Module includes a 50k pull-up resistor attached to RESET
- Unused pins should be left disconnected.

1.5. Electrical Characteristics

Table 1-03. DC Characteristics of the XBee & XBee-PRO (VCC = 2.8 - 3.4 VDC)

Symbol	Parameter	Condition	Min	Typical	Max	Units
V_{IL}	Input Low Voltage	All Digital Inputs	-	-	0.35 * VCC	V
V_{IH}	Input High Voltage	All Digital Inputs	0.7 * VCC	-	-	V
V_{OL}	Output Low Voltage	I_{OL} = 2 mA, VCC >= 2.7 V	-	-	0.5	V
V_{OH}	Output High Voltage	I_{OH} = -2 mA, VCC >= 2.7 V	VCC - 0.5	-	-	V
I_{IIN}	Input Leakage Current	V_{IN} = VCC or GND, all inputs, per pin	-	0.025	1	uA
I_{IOZ}	High Impedance Leakage Current	V_{IN} = VCC or GND, all I/O High-Z, per pin	-	0.025	1	uA
TX	Transmit Current	VCC = 3.3 V	-	45 (XBee) / 270 (PRO)	-	mA
RX	Receive Current	VCC = 3.3 V	-	50 (XBee) / 55 (PRO)	-	mA
PWR-DWN	Power-down Current	SM parameter = 1	-	< 10	-	uA

2.2.4. Command Mode

To modify or read RF Module parameters, the module must first enter into Command Mode - a state in which incoming characters are interpreted as commands. Two command modes are supported: AT Command Mode and ATI Command Mode.

A robust set of AT Commands is available for programming and customizing the module.

AT Command Mode

To Enter AT Command Mode:

Send the 3-character command sequence "+++" and observe guard times before and after the command characters. [Refer to the "Default AT Command Mode Sequence" below.]

Default AT Command Mode Sequence (for transition to Command Mode):

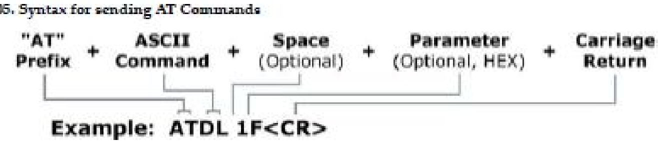
- No characters sent for one second [GT (Guard Times) parameter = 0x3E8]
- Input three plus characters ("+++") within one second [CC (Command Sequence Character) parameter = 0x2B.]
- No characters sent for one second [GT (Guard Times) parameter = 0x3E8]

All of the parameter values in the sequence can be modified to reflect user preferences.

To Send AT Commands:

Send AT commands and parameters using the syntax shown below.

Figure 2-05. Syntax for sending AT Commands



To read a parameter value stored in the RF module's register, leave the parameter field blank.

The preceding example would change the RF module Destination Address (Low) to "0x1F". To store the new value to non-volatile (long term) memory, subsequently send the WR (Write) command.

For modified parameter values to persist in the module's registry, changes must be saved to non-volatile memory using the WR (Write) Command. Otherwise, parameters are restored to previously saved values after the module is powered off and then on again (or re-booted).

System Response. When a command is sent to the RF module, the module will parse and execute the command. Upon successful execution of a command, the module returns an "OK" message. If execution of a command results in an error, the module returns an "ERROR" message.

To Exit AT Command Mode:

1. Send ATCN (Exit Command Mode) Command.

   [OR]

2. If no valid AT Commands are received within the time specified by CT (Command Mode Timeout) Command, the RF module automatically returns to Idle Mode.

For an example of programming the RF module using AT Commands and descriptions of each configurable parameter, refer to the "RF Module Configuration" chapter [p14].

3. RF Module Configuration

3.1. Programming the RF Module

Refer to the "Command Mode" section [p13] for more information about entering Command Mode, sending AT commands and exiting Command Mode.

3.1.1. Programming Examples

Setup

The programming examples in this section require the installation of MaxStream's X-CTU Software and a serial connection to a PC. (MaxStream stocks RS-232 and USB boards to facilitate interfacing to a PC.)

1. Install MaxStream's X-CTU Software to a PC by double-clicking the "setup_X-CTU.exe" file. (The file is located on the MaxStream CD and under the 'Software' section of the following web page: www.maxstream.net/helpdesk/download.php)
2. Mount the RF module to an interface board, then connect the module assembly to a PC.
3. Launch the X-CTU Software and select the 'PC Settings' tab. Verify the baud and parity settings of the Com Port match those of the RF module.

NOTE: Failure to enter AT Command Mode is most commonly due to baud rate mismatch. Ensure the 'Baud' setting on the 'PC Settings' tab matches the interface data rate of the RF module (by default, BD parameter = 3 (which corresponds to 9600 bps)).

Sample Configuration: Modify RF Module Destination Address

Example: Utilize the 'Terminal' tab of the X-CTU Software to change the RF module's DL (Destination Address Low) parameter and save the new address to non-volatile memory.

After establishing a serial connection between the RF module and a PC [refer to the 'Setup' section above], select the 'Terminal' tab of the X-CTU Software and enter the following command lines ('CR' stands for carriage return):

Method 1 (One line per command)

Send AT Command	**System Response**
+++	OK <CR> (Enter into Command Mode)
ATDL <Enter>	{current value} <CR> (Read Destination Address Low)
ATDL1A0D <Enter>	OK <CR> (Modify Destination Address Low)
ATWR <Enter>	OK <CR> (Write to non-volatile memory)
ATCN <Enter>	OK <CR> (Exit Command Mode)

Method 2 (Multiple commands on one line)

Send AT Command	**System Response**
+++	OK <CR> (Enter into Command Mode)
ATDL <Enter>	{current value} <CR> (Read Destination Address Low)
ATDL1A0D,WR,CN <Enter>	OK <CR> (Execute commands)

Sample Configuration: Restore RF Module Defaults

Example: Utilize the 'Modem Configuration' tab of the X-CTU Software to restore default parameter values of the RF module.

After establishing a connection between the RF module and a PC [refer to the 'Setup' section above], select the 'Modem Configuration' tab of the X-CTU Software.

1. Select the 'Read' button.
2. Select the 'Restore' button.

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3.1.2. Command Reference Tables

Table 3-01. **XBee/XBee-PRO Commands** (RF modules expect numerical values in hexadecimal. Hexadecimal values are designated by the "0x" prefix. Decimal equivalents are designated by the "d" suffix.)

AT Command	Command Category	Name and Description	Parameter Range	Default
BD	Serial Interfacing	**Interface Data Rate.** Set/Read the serial interface data rate for communications between the RF module serial port and host.	0 - 7 (custom rates also supported)	3
CC	AT Command Mode Options	**Command Sequence Character.** Set/Read the ASCII character value to be used between Guard Times of the AT Command Mode Sequence (GT+CC+GT). The AT Command Mode Sequence enters the RF module to AT Command Mode.	0 - 0xFF	0x2B ('+' ASCII)
CH	Networking & Security	**Channel.** Set/Read the channel number used for transmitting and receiving between RF modules. Uses 802.15.4 protocol channel numbers.	0x0B - 0x1A (XBee) 0x0C - 0x17 (XBee-PRO)	0x0C (12d)
CN	AT Command Mode Options	**Exit Command Mode.** Explicitly exit AT Command Mode.	-	-
CT	AT Command Mode Options	**Command Mode Timeout.** Set/Read the period of inactivity (no valid commands received) after which the RF module automatically exits AT Command Mode and returns to Idle Mode.	2 - 0xFFFF [x 100 ms]	0x64 (100d)
DB	Diagnostics	**Received Signal Strength.** Read signal level [in dB] of last good packet received (RSSI). Absolute value is reported. (For example: 0x58 = -88 dBm) Reported value is accurate between -40 dBm and RX sensitivity.	0 - 0x64 [read-only]	-
DH	Networking & Security	**Destination Address High.** Set/Read the upper 32 bits of the 64-bit destination address. When combined with DL, it defines the destination address used for transmission. To transmit using a 16-bit address, set DH parameter to zero and DL less than 0xFFFF. 0x000000000000FFFF is the broadcast address for the PAN.	0 - 0xFFFFFFFF	0
DL	Networking & Security	**Destination Address Low.** Set/Read the lower 32 bits of the 64-bit destination address. When combined with DH, DL defines the destination address used for transmission. To transmit using a 16-bit address, set DH parameter to zero and DL less than 0xFFFF. 0x000000000000FFFF is the broadcast address for the PAN.	0 - 0xFFFFFFFF	0
GT	AT Command Mode Options	**Guard Times.** Set required period of silence before and after the Command Sequence Characters of the AT Command Mode Sequence (GT+ CC + GT). The period of silence is used to prevent inadvertent entrance into AT Command Mode.	0x02 - 0xFFFF [x 1 ms]	0x3E8 (1000d)
ID	Networking & Security	**PAN ID.** Set/Read the PAN (Personal Area Network) ID. 0xFFFF indicates a message for all PANs.	0xFFFF	0x3332 (13106d)
MY	Networking & Security	**16-bit Source Address.** Set/Read the RF module 16-bit source address. Set MY = 0xFFFF to disable reception of packets with 16-bit addresses. 64-bit source address (serial number) and broadcast address (0x000000000000FFFF) is always enabled	0 - 0xFFFF	0
PC	Diagnostics	**PWM0 Configurations.** Select/Read function for PWM0.	0 - 1	1
PL	RF Interfacing	**Power Level.** Select/Read power level at which the RF module transmits.	0 - 4	4
RE	(Special)	**Restore Defaults.** Restore RF module parameters to factory defaults. Follow with WR command to save values to non-volatile memory	-	-
RN	Networking & Security	**Random Delay Slots.** Set/Read the minimum value of the back-off exponent in the CSMA-CA algorithm that is used for collision avoidance. If RN = 0, collision avoidance is disabled during the first iteration of the algorithm (802.15.4 - macMinBE).	0 - 3	0
RO	Serial Interfacing	**Packetization Timeout.** Set/Read number of character times of inter-character delay required before transmission. Set to zero to transmit characters as they arrive instead of buffering them into one RF packet.	0 - 0xFF [x character times]	3
RP	Diagnostics	**RSSI PWM Timer.** Enable a PWM (pulse width modulation) output (on pin 6 of the RF modules) which shows RX signal strength.	0 - 0xFF [x 100 ms]	0x28 (40d)
SH	Diagnostics	**Serial Number High.** Read high 32 bits of the RF module's unique IEEE 64-bit address. 64-bit source address is always enabled.	0 - 0xFFFFFFFF [read-only]	Factory-set
SL	Diagnostics	**Serial Number Low.** Read low 32 bits of the RF module's unique IEEE 64-bit address. 64-bit source address is always enabled.	0 - 0xFFFFFFFF [read-only]	Factory-set
SM	Sleep (Low Power)	**Sleep Mode.** Set/Read Sleep Mode configurations.	0 - 6	0
SP	Sleep (Low Power)	**Cyclic Sleep Period.** Set/Read sleep period for cyclic sleeping remotes. Maximum sleep period is 268 seconds (0x68B0).	0x01 - 0x68B0 [x 10 ms]	0x64 (100d)
ST	Sleep (Low Power)	**Time before Sleep.** Set/Read time period of inactivity (no serial or RF data is sent or received) before activating Sleep Mode. The ST parameter is only valid with Cyclic Sleep settings (SM = 4 - 6). Set ST on Cyclic Sleep Coordinator to match Cyclic Sleep Remotes.	0x01 - 0xFFFF [x 1 ms]	0x1388 (5000d)
VR	Diagnostics	**Firmware Version.** Read firmware version of the RF module.	0 - 0xFFFF [read-only]	Factory-set
WR	(Special)	**Write.** Write parameter values to RF module's non-volatile memory so that modifications persist through subsequent power-up or reset.	-	-

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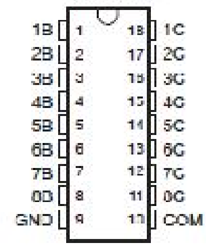
- 500-mA Rated Collector Current (Single Output)
- High-Voltage Outputs . . . 50 V
- Output Clamp Diodes
- Inputs Compatible With Various Types of Logic
- Relay Driver Applications
- Compatible with ULN2800A Series

DW OR N PACKAGE
(TOP VIEW)



description/ordering information

The ULN2803A is a high-voltage, high-current Darlington transistor array. The device consists of eight npn Darlington pairs that feature high-voltage outputs with common-cathode clamp diodes for switching inductive loads. The collector-current rating of each Darlington pair is 500 mA. The Darlington pairs may be connected in parallel for higher current capability.

Applications include relay drivers, hammer drivers, lamp drivers, display drivers (LED and gas discharge), line drivers, and logic buffers. The ULN2803A has a 2.7-kΩ series base resistor for each Darlington pair for operation directly with TTL or 5-V CMOS devices.

ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
−40°C to 85°C	PDIP (N)	Tube of 20	ULN2803AN	ULN2803AN
	SOIC (DW)	Tube of 40	ULN2803ADW	ULN2803A
		Reel of 2000	ULN2803ADWR	

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

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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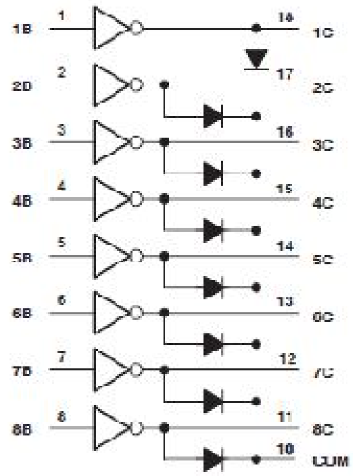
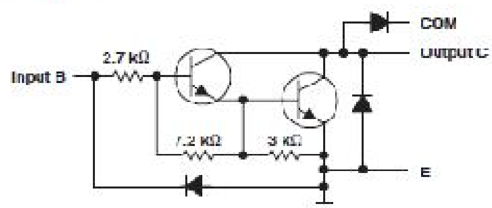
logic diagram



schematic (each Darlington pair)



absolute maximum ratings at 25°C free-air temperature (unless otherwise noted)†

Collector-emitter voltage	50 V
Input voltage (see Note 1)	30 V
Continuous collector current	500 mA
Output clamp diode current	500 mA
Total substrate-terminal current	−2.5 A
Package thermal impedance, θ_{JA} (see Notes 2 and 3): DW package	73.14°C/W
N package	62.66°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 voltage values, unless otherwise noted, are with respect to the emitter/substrate terminal GND.
2. Maximum power dissipation is a function of $T_J(max)$, θ_{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.

electrical characteristics at 25°C free-air temperature (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
I_{CEX}	Collector cutoff current	V_{CE} = 50 V, See Figure 1	I_I = 0,			50	µA
$I_{I(off)}$	Off-state input current	V_{CE} = 50 V, T_A = 70°C,	I_C = 500 µA, See Figure 2	50	65		µA
$I_{I(on)}$	Input current	V_I = 3.85 V,	See Figure 3		0.93	1.35	mA
$V_{I(on)}$	On-state input voltage	V_{CE} = 2 V, See Figure 4	I_C = 200 mA			2.4	V
			I_C = 250 mA			2.7	
			I_C = 300 mA			3	
$V_{CE(sat)}$	Collector-emitter saturation voltage	I_I = 250 µA, See Figure 5	I_C = 100 mA,		0.9	1.1	V
		I_I = 350 µA, See Figure 5	I_C = 200 mA,		1	1.3	
		I_I = 500 µA, See Figure 5	I_C = 350 mA,		1.3	1.6	
I_R	Clamp diode reverse current	V_R = 50 V,	See Figure 6			50	µA
V_F	Clamp diode forward voltage	I_F = 350 mA,	See Figure 7		1.7	2	V
C_i	Input capacitance	V_I = 0 V,	f = 1 MHz		15	25	pF

switching characteristics at 25°C free-air temperature

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
t_{PLH}	Propagation delay time, low- to high-level output	V_S = 50 V, C_L = 15 pF,	R_L = 163 Ω, See Figure 8		130		ns
t_{PHL}	Propagation delay time, high- to low-level output				20		
V_{OH}	High-level output voltage after switching	V_S = 50 V, See Figure 9	I_O ≈ 300 mA,	V_S − 20			mV

HEF4017B

5-stage Johnson decade counter

Rev. 04 — 9 December 2008 Product data sheet

1. General description

The HEF4017B is a 5-stage Johnson decade counter with ten spike-free decoded active HIGH outputs (Q0 to Q9), an active LOW carry output from the most significant flip-flop ($\overline{Q}$5-9), active HIGH and active LOW clock inputs (CP0, $\overline{CP}$1) and an overriding asynchronous master reset input (MR).

The counter is advanced by either a LOW-to-HIGH transition at CP0 while $\overline{CP}$1 is LOW or a HIGH-to-LOW transition at $\overline{CP}$1 while CP0 is HIGH (see Table 3).

When cascading counters, the $\overline{Q}$5-9 output, which is LOW while the counter is in states 5, 6, 7, 8, and 9, can be used to drive the CP0 input of the next counter. A HIGH on MR resets the counter to zero (Q0 = $\overline{Q}$5-9 = HIGH; Q1 to Q9 = LOW) independent of the clock inputs (CP0, $\overline{CP}$1).

Automatic counter code correction is provided by an internal circuit: following any illegal code the counter returns to a proper counting mode within 11 clock pulses.

Schmitt trigger action makes the clock inputs highly tolerant of slower rise and fall times.

It operates over a recommended V_{DD} power supply range of 3 V to 15 V referenced to V_{SS} (usually ground). Unused inputs must be connected to V_{DD}, V_{SS}, or another input. It is also suitable for use over both the industrial (–40 °C to +85 °C) and automotive (–40 °C to +125 °C) temperature ranges.

2. Features

- Automatic counter correction
- Tolerant of slow clock rise and fall times
- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- Operates across the automotive temperature range –40 °C to +125 °C
- Complies with JEDEC standard JESD 13-B
- ESD protection:
  - HBM JESD22-A114E exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V

3. Applications

- Industrial and automotive

founded by Philips

4. Ordering information

Table 1. Ordering information
All types operate from −40 °C to +125 °C

Type number	Package		
	Name	**Description**	**Version**
HEF4017BP	DIP16	plastic dual in-line package; 16-leads (300 mil)	SOT38-4
HEF4017BT	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1

5. Functional diagram

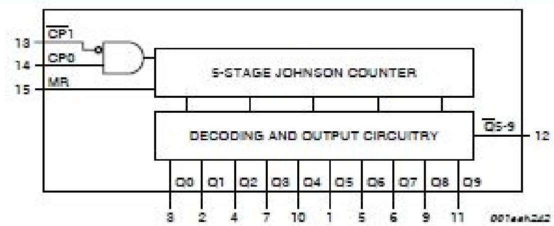


Fig 1. Functional diagram

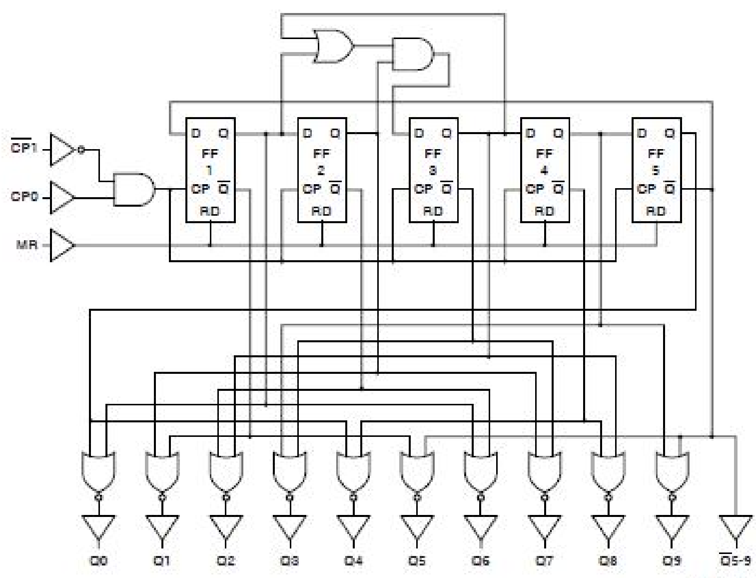


Fig 2. Logic diagram

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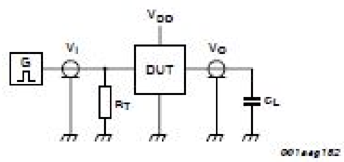


Test data is given in Table 10.

Definitions for test circuit:

DUT = Device Under Test;

C_L = load capacitance including jig and probe capacitance;

R_T = termination resistance should be equal to the output impedance Z_o of the pulse generator.

Fig 10. Test circuit

Table 10. Test data

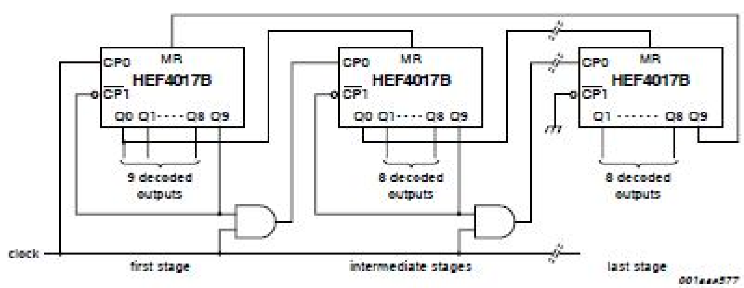
Supply voltage	Input		Load
V_{DD}	V_I	t_r, t_f	C_L
5 V to 15 V	V_{SS} or V_{DD}	≤ 20 ns	50 pF

13. Application information

Some examples of applications for the HEF4017B are:

- Decade counter with decimal decoding
- 1 out of n decoding counter (when cascaded)
- Sequential controller
- Timer

Figure 11 shows a technique for extending the number of decoded output states for the HEF4017B. Decoded outputs are sequential within each stage and from stage to stage, with no dead time (except propagation delay).



Enabling the counter on $\overline{CP1}$ when CP0 is HIGH, or on CP0 when $\overline{CP1}$ is LOW, causes an extra count.

Fig 11. Counter expansion

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