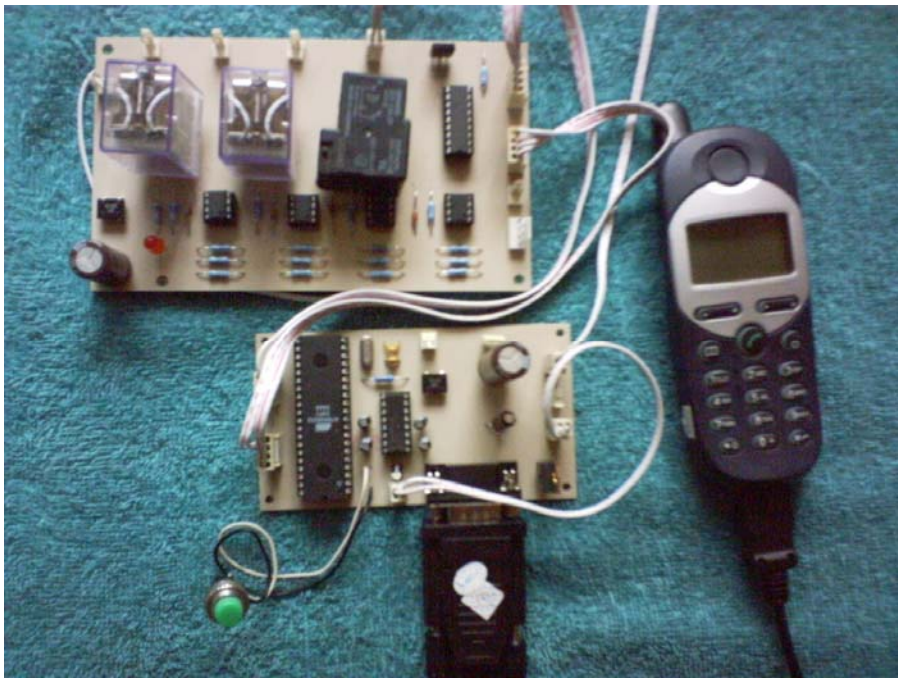
LAMPIRAN A

Tampilan Perangkat Keras

Gambar A.1 Foto Sistem secara keseluruhan



Gambar A.2 Foto Rangkaian

LAMPIRAN B

Source Perangkat Lunak

```
;*********************************************************************
;Tugas Akhir : Penggunaan Layanan SMS Berbasis Mikrokontroler Untuk
;Deteksi Kebocoran Saluran Air Dan Monitor Ketinggian Air
;*********************************************************************


;P1.0 PORT PENUNJUK HUB DGN HP
;P1.1 PORT UTK POMPA1
;P1.2 PORT UTK SV DI BLKNG POMPA2 UTK KEADAAN BOCOR
;P1.3 PORT UTK SV DI DPN POMPA 2 UTK KONTROL ALIRAN


LJMP  START1
NOP
RETI

ORG   0BH
RETI

ORG   13H
RETI

ORG   1BH
RETI

ORG   23H
RETI


COMP:             DB 'A','T','+','C','P','M','S','?',0DH
LIST:             DB 'A','T','+','C','M','G','L','=','4',0DH
READ:             DB 'A','T','+','C','M','G','R','='
DELETE:           DB 'A','T','+','C','M','G','D','='
SEND:             DB 'A','T','+','C','M','G','S','='
SMSC:             DB '0','7','9','1','2','6','5','8','0','5','0','0'
                  DB '0','0','F','0'
SMSC_SENDER:      DB '0','5','9','1','2','6','1','8','1','6','4','2'
NO_SENDER:        DB '0','C','9','1','2','6','1','8','7','5','0','0'
                  DB '6','5','6','4'
DIKRM:            DB '1','B','C','B','3','2','3','D','E','D','3','E'
                  DB '9','F','D','3','6','1','3','7'
                  DB '2','8','9','C','9','6','8','3','E','6','6','4'
                  DB '3','4','8','8','5','E','9','6'
                  DB '8','F','C','3','F','0','7','0','1','A'
LAPORAN:          DB '2','1','D','4','B','2','5','C','1','D','2','6'
                  DB 'A','7','4','1','E','B','B','2'
                  DB 'F','8','3','D','7','E','C','B','C','3','6','E'
                  DB '1','6','B','D','E','E','3','E'
                  DB '9','F','E','B','2','0','7','8','5','9','9','E'
                  DB '7','6','D','3','C','3','6','8'
```

```
ISI_SMS1:         DB '0','9','C','9','7','9','1','A','0','4','2','F'
                  DB 'B','B','E','B','6','8'
ISI_SMS2:         DB '0','7','C','9','7','9','1','A','2','4','7','B'
                  DB 'C','D','0','0'
ISI_SMS3:         DB '0','7','C','9','7','9','1','A','1','4','7','B'
                  DB 'C','9','0','0'
ISI_SMS4:         DB '0','7','C','2','F','A','3','A','0','C','9','A'
                  DB '5','A','0','1'
ISI_SMS5:         DB '0','8','D','4','3','A','B','D','0','E','0','7'
                  DB '4','D','A','D'
ISI_SMS6:         DB '0','B','C','2','F','A','3','A','0','C','0','A'
                  DB 'B','3','D','3','F','2','B','0','1','B'
ISI_SMS7:         DB '0','C','D','4','3','A','B','D','0','E','0','7'
                  DB '8','5','D','9','6','9','7','9','D','8','0','D'
ISI_SMS8:         DB '0','E','5','3','2','B','6','8','4','E','4','6'
                  DB '8','3' 'E','8','6','5','B','9','B','8','B','E'
                  DB '0','E','0','3'
ISI_SMS9:         DB '0','F','5','3','2','B','6','8','4','E','4','6'
                  DB '8','3','E','8','6','5','3','9','B','D','4','E'
                  DB 'A','F','C','3','0','1'
ISI_SMS10:        DB '2','6','D','4','B','0','F','B','B','C','4','E'
                  DB '8','3','D','6','E','F','F','9','D','B','7','D'
                  DB '6','6','8','5','D','9','6','9','7','9','D','8'
                  DB '0','D','0','A','A','7','E','5','A','0','3','9'
                  DB '1','9','0','D','2','2','A','7','D','B','6','1'
                  DB '7','A','7','A','1','D','7','6','0','3'
ISI_SMS11:        DB '0','5','D','2','F','2','B','C','4','C','0','7'


;*********************************************************************
;*                  MAIN PROGRAM
;*********************************************************************

START1:      MOV   P2,#00H
             MOV   P1,#00H
             MOV   A,P2
             MOV   B,A

START:       MOV   SCON,#40H
             MOV   PCON,#80H
             MOV   TMOD,#20H
             MOV   TH1,#0FDH
             MOV   TCON,#40H
             SETB  P2.0
             SETB  P2.1
             SETB  P2.2
             SETB  P2.3
```

```
;*****************************************************************
;*          TDK ADA SMS,CEK KEBOCORAN
;*****************************************************************

CEK_AIR:    LCALL DELAY
            CLR   A
            MOV   A,P2
            ANL   A,#00000001B
            CJNE  A,#00000001B,AIR_KSNG
            CPL   P1.0
            JMP   NO_SMS

AIR_KSNG:   CLR   P1.3
            SETB  P1.1
            LCALL DELAY2
            CLR   P1.1
            CLR   A
            MOV   A,P2
            MOV   B,A
            JMP   CEK_AIR

NO_SMS:     CLR   A
            MOV   A,B
            MOV   R0,#56H
            MOV   @R0,P2
            XRL   A,@R0
            CJNE  A,#00H,BOCOR
            JMP   TUNGGU_PRNT
BOCOR:      JB    P1.3,TUNGGU_PRNT
            JMP   KNDS_BCR


;*****************************************************************
;*          BACA SEMUA SMS
;*****************************************************************

TUNGGU_PRNT:
            CLR   TI
            MOV   R4,#00H
            MOV   DPTR,#LIST
LIST1:      MOV   A,R4
            MOVC  A,@A+DPTR
            MOV   SBUF,A
            JNB   TI,$
            CLR   TI
            INC   R4
            CJNE  A,#0DH,LIST1
            SETB  REN
            MOV   R1,#80H
```

```
;*****************************************************************
;            SMS DI INDEX & SIMPAN INDEX EEPROM
;*****************************************************************

            ORL   WMCON,#EEMEN
            ORL   WMCON,#EEMWE
            MOV   DPTR,#000H
            MOV   R0,#80H

EEWRT:      MOV   A,@R0
            MOVX  @DPTR,A
            LCALL DELAY
            INC   DPTR
            DEC   R1
            INC   R0

            CJNE  R1,#80H,EEWRT
            XRL   WMCON,#EEMWE


            ORL   WMCON,#EEMEN
            ORL   WMCON,#EEMWE
            MOV   DPTR,#000H


INDEX:      MOVX  A,@DPTR
            LCALL DELAY
            INC   DPTR
            MOV   R3,A
            XRL   WMCON,#EEMWE
            XRL   WMCON,#EEMEN

            JZ    CEK_AIR
```

```
;*********************************************************************
;            BACA SMS SATU PERSATU
;*********************************************************************

BANDING1:   CLR   TI
            MOV   R4,#00H
            MOV   DPTR,#READ
READ1:      MOV   A,R4
            MOVC  A,@A+DPTR
            MOV   SBUF,A
            JNB   TI,$
            CLR   TI
            INC   R4
            CJNE  A,#'=',READ1
            MOV   A,R3
            MOV   SBUF,A
            JNB   TI,$
            CLR   TI
            MOV   SBUF,#13
            JNB   TI,$
            CLR   TI

            SETB  REN
            MOV   R0,#02H
            MOV   R1,#5AH
LAGI4:      JNB   RI,$
            MOV   A,SBUF
            CLR   RI
            CJNE  A,#0AH,LAGI4
            DEC   R0
            CJNE  R0,#00H,LAGI4
LAGI5:      JNB   RI,$
            MOV   A,SBUF
            CLR   RI
            MOV   @R1,A
            INC   R1
            CJNE  A,#0DH,LAGI5


;*********************************************************************
;*           BANDINGKAN SMS CENTER PENGIRIM
;*********************************************************************

            MOV   R5,#00H
            MOV   R0,#59H
            MOV   DPTR,#SMSC_SENDER
            MOV   R4,#00H
CSMSC1:     MOV   A,R4
            MOVC  A,@A+DPTR
            INC   R0
            INC   R4
            INC   R5
```

```
            CJNE  R5,#0DH,CSMSC2
            SJMP  NEXT1
CSMSC2:     XRL   A,@R0
            CJNE  A,#00H,LJT
            SJMP  CSMSC1


;*********************************************************************
;*          BANDINGKAN NO PENGIRIM
;*********************************************************************

NEXT1:      MOV   R5,#00H
            MOV   R0,#67H
            MOV   DPTR,#NO_SENDER
            MOV   R4,#00H
CNOS:       MOV   A,R4
            MOVC  A,@A+DPTR
            INC   R0
            INC   R4
            INC   R5
            CJNE  R5,#11H,CNOS2
            SJMP  NEXT2
CNOS2:      XRL   A,@R0
            CJNE  A,#00H,LJT
            SJMP  CNOS

LJT:        LCALL HAPUS
            JMP   CEK_AIR


;*********************************************************************
;*          BANDINGKAN ISI SMS: ISI PENUH
;*********************************************************************

NEXT2:      MOV   R5,#00H
            MOV   R0,#89H
            MOV   DPTR,#ISI_SMS1
            MOV   R4,#00H
CISI:       MOV   A,R4
            MOVC  A,@A+DPTR
            INC   R0
            INC   R4
            INC   R5
            CJNE  R5,#13H,CISI1
            SJMP  ISIPNH
CISI1:      XRL   A,@R0
            CJNE  A,#00H,NEXT3
            SJMP  CISI

ISIPNH:     LCALL HAPUS
            SETB  P1.1
            JB    P2.1,ISIPNH
```

```
            JB    P2.2,ISIPNH
            JB    P2.3,ISIPNH
            LCALL DELAY1
            LCALL DELAY1
            LCALL DELAY1
            CLR   P1.1
            MOV   B,#01H
            LCALL DELAY2
            ;*****************************************************
            ;     LAPORAN KETINGGIAN TERCAPAI
            ;*****************************************************
            LCALL KIRIM
            LCALL SMS_SUM1
            LCALL WAIT
            LCALL SMSC_OP
            LCALL TYPE
            LCALL NOMOR
            LCALL TIME
            MOV   DPTR,#DIKRM
            LCALL DTA1
            MOV   SBUF,#26
            JNB   TI,$
            CLR   TI
            JMP   CEK_AIR


;*********************************************************************
;*          BANDINGKAN ISI SMS: ISI 2/3
;*********************************************************************

NEXT3:      MOV   R5,#00H
            MOV   R0,#89H
            MOV   DPTR,#ISI_SMS2
            MOV   R4,#00H
CISI2:      MOV   A,R4
            MOVC  A,@A+DPTR
            INC   R0
            INC   R4
            INC   R5
            CJNE  R5,#11H,CISI3
            SJMP  ISI2_3
CISI3:      XRL   A,@R0
            CJNE  A,#00H,NEXT4
            SJMP  CISI2

ISI2_3:     LCALL HAPUS
            SETB  P1.1
            JB    P2.1,ISI2_3
            JB    P2.2,ISI2_3
            LCALL DELAY1
            LCALL DELAY1
            LCALL DELAY1
```

```
            CLR   P1.1
            MOV   B,#09H
            LCALL DELAY2
            ;*****************************************************
            ;
            ;     LAPORAN KETINGGIAN TERCAPAI
            ;*****************************************************
            LCALL KIRIM
            LCALL SMS_SUM1
            LCALL WAIT
            LCALL SMSC_OP
            LCALL TYPE
            LCALL NOMOR
            LCALL TIME
            MOV   DPTR,#DIKRM
            LCALL DTA1
            MOV   SBUF,#26
            JNB   TI,$
            CLR   TI
            JMP   CEK_AIR


;*********************************************************************
;*          BANDINGKAN ISI SMS: ISI 1/2
;*********************************************************************

NEXT4:      MOV   R5,#00H
            MOV   R0,#89H
            MOV   DPTR,#ISI_SMS3
            MOV   R4,#00H
CISI4:      MOV   A,R4
            MOVC  A,@A+DPTR
            INC   R0
            INC   R4
            INC   R5
            CJNE  R5,#11H,CISI5
            SJMP  ISI1_2
CISI5:      XRL   A,@R0
            CJNE  A,#00H,NEXT5
            SJMP  CISI4

ISI1_2:     LCALL HAPUS
            SETB  P1.1
            JB    P2.1,ISI1_2
            LCALL DELAY1
            LCALL DELAY1
            LCALL DELAY1
            CLR   P1.1
            MOV   B,#0DH
            LCALL DELAY2
```

```
            ;*****************************************************
            ;     LAPORAN KETINGGIAN TERCAPAI
            ;*****************************************************
            LCALL KIRIM
            LCALL SMS_SUM1
            LCALL WAIT
            LCALL SMSC_OP
            LCALL TYPE
            LCALL NOMOR
            LCALL TIME
            MOV   DPTR,#DIKRM
            LCALL DTA1
            MOV   SBUF,#26
            JNB   TI,$
            CLR   TI
            JMP   CEK_AIR


;*******************************************************************
;*          BANDINGKAN ISI SMS: BUKA ALIRAN
;*******************************************************************

NEXT5:      MOV   R5,#00H
            MOV   R0,#89H
            MOV   DPTR,#ISI_SMS6
            MOV   R4,#00H
CISI6:      MOV   A,R4
            MOVC  A,@A+DPTR
            INC   R0
            INC   R4
            INC   R5
            CJNE  R5,#17H,CISI7
            SJMP  ISI_BKSV
CISI7:      XRL   A,@R0
            CJNE  A,#00H,NEXT6
            SJMP  CISI6

ISI_BKSV:   LCALL HAPUS
            SETB  P1.3
            JMP   CEK_AIR


;*******************************************************************
;*          BANDINGKAN ISI SMS: TUTUP ALIRAN
;*******************************************************************

NEXT6:      MOV   R5,#00H
            MOV   R0,#89H
            MOV   DPTR,#ISI_SMS7
            MOV   R4,#00H
CISI8:      MOV   A,R4
            MOVC  A,@A+DPTR
```

```
            INC   R0
            INC   R4
            INC   R5
            CJNE  R5,#19H,CISI9
            SJMP  ISI_TTPSV
CISI9:      XRL   A,@R0
            CJNE  A,#00H,LJT1
            SJMP  CISI8

ISI_TTPSV:  LCALL HAPUS
            CLR   P1.3
            MOV   A,P2
            MOV   B,A
            JMP   CEK_AIR

LJT1:       LCALL HAPUS
            JMP   CEK_AIR


;*********************************************************************
;                          SEND A SMS
;*********************************************************************

KIRIM:      CLR   RI
            CLR   TI
            MOV   R4,#00H
            MOV   DPTR,#SEND
KRM1:       MOV   A,R4
            MOVC  A,@A+DPTR
            MOV   SBUF,A
            JNB   TI,$
            CLR   TI
            INC   R4
            CJNE  A,#'=',KRM1
            RET

SMS_SUM1:   MOV   SBUF,#'3'
            JNB   TI,$
            CLR   TI
            MOV   SBUF,#'7'
            JNB   TI,$
            CLR   TI
            MOV   SBUF,#0DH
            JNB   TI,$
            CLR   TI
            RET

SMS_SUM2:   MOV   SBUF,#'4'
            JNB   TI,$
            CLR   TI
            MOV   SBUF,#'2'
            JNB   TI,$
```

```
            CLR   TI
            MOV   SBUF,#0DH
            JNB   TI,$
            CLR   TI
            RET

SMS_SUM3:   MOV   SBUF,#'2'
            JNB   TI,$
            CLR   TI
            MOV   SBUF,#'7'
            JNB   TI,$
            CLR   TI
            MOV   SBUF,#0DH
            JNB   TI,$
            CLR   TI
            RET

SMS_SUM4:   MOV   SBUF,#'2'
            JNB   TI,$
            CLR   TI
            MOV   SBUF,#'6'
            JNB   TI,$
            CLR   TI
            MOV   SBUF,#0DH
            JNB   TI,$
            CLR   TI
            RET

SMS_SUM5:   MOV   SBUF,#'4'
            JNB   TI,$
            CLR   TI
            MOV   SBUF,#'7'
            JNB   TI,$
            CLR   TI
            MOV   SBUF,#0DH
            JNB   TI,$
            CLR   TI
            RET

SMS_SUM6:   MOV   SBUF,#'1'
            JNB   TI,$
            CLR   TI
            MOV   SBUF,#'8'
            JNB   TI,$
            CLR   TI
            MOV   SBUF,#0DH
            JNB   TI,$
            CLR   TI
            RET

WAIT:       CLR   RI
            SETB  REN
```

```
WT1:        JNB   RI,$
            MOV   A,SBUF
            CLR   RI
            CJNE  A,#0DH,WT1
            RET

SMSC_OP:    MOV   R5,#00H
            MOV   DPTR,#SMSC
            MOV   R4,#00H
OP1:        MOV   A,R4
            MOVC  A,@A+DPTR
            MOV   SBUF,A
            JNB   TI,$
            CLR   TI
            INC   R4
            INC   R5
            CJNE  R5,#10H,OP1
            RET

TYPE:       MOV   SBUF,#'0'
            JNB   TI,$
            CLR   TI
            MOV   SBUF,#'1'
            JNB   TI,$
            CLR   TI
            MOV   SBUF,#'0'
            JNB   TI,$
            CLR   TI
            MOV   SBUF,#'0'
            JNB   TI,$
            CLR   TI
            RET

NOMOR:      MOV   R5,#00H
            MOV   DPTR,#NO_SENDER
            MOV   R4,#00H
NM1:        MOV   A,R4
            MOVC  A,@A+DPTR
            MOV   SBUF,A
            JNB   TI,$
            CLR   TI
            INC   R4
            INC   R5
            CJNE  R5,#10H,NM1
            RET

TIME:       MOV   SBUF,#'0'
            JNB   TI,$
            CLR   TI
            MOV   SBUF,#'0'
            JNB   TI,$
            CLR   TI
```

```
            MOV   SBUF,#'0'
            JNB   TI,$
            CLR   TI
            MOV   SBUF,#'0'
            JNB   TI,$
            CLR   TI
            RET

DTA1:       MOV   R5,#00H
            MOV   R4,#00H
DT1:        MOV   A,R4
            MOVC  A,@A+DPTR
            MOV   SBUF,A
            JNB   TI,$
            CLR   TI
            INC   R4
            INC   R5
            CJNE  R5,#32H,DT1
            RET

DTA2:       MOV   R5,#00H
            MOV   R4,#00H
DT2:        MOV   A,R4
            MOVC  A,@A+DPTR
            MOV   SBUF,A
            JNB   TI,$
            CLR   TI
            INC   R4
            INC   R5
            CJNE  R5,#3CH,DT2
            RET

DTA3:       MOV   R5,#00H
            MOV   R4,#00H
DT3:        MOV   A,R4
            MOVC  A,@A+DPTR
            MOV   SBUF,A
            JNB   TI,$
            CLR   TI
            INC   R4
            INC   R5
            CJNE  R5,#1EH,DT3
            RET

DTA4:       MOV   R5,#00H
            MOV   R4,#00H
DT4:        MOV   A,R4
            MOVC  A,@A+DPTR
            MOV   SBUF,A
            JNB   TI,$
            CLR   TI
            INC   R4
```

```
            INC   R5
            CJNE  R5,#1CH,DT4
            RET

DTA5:       MOV   R5,#00H
            MOV   R4,#00H
DT5:        MOV   A,R4
            MOVC  A,@A+DPTR
            MOV   SBUF,A
            JNB   TI,$
            CLR   TI
            INC   R4
            INC   R5
            CJNE  R5,#46H,DT5
            RET
DTA6:       MOV   R5,#00H
            MOV   R4,#00H
DT6:        MOV   A,R4
            MOVC  A,@A+DPTR
            MOV   SBUF,A
            JNB   TI,$
            CLR   TI
            INC   R4
            INC   R5
            CJNE  R5,#0CH,DT6
            RET


;*********************************************************************
;*          HAPUS SMS
;*********************************************************************

HAPUS:      CLR   TI
            MOV   R4,#00H
            MOV   DPTR,#DELETE
DEL1:       MOV   A,R4
            MOVC  A,@A+DPTR
            MOV   SBUF,A
            JNB   TI,$
            CLR   TI
            INC   R4
            CJNE  A,#'=',DEL1
            MOV   A,R3
            MOV   SBUF,A
            JNB   TI,$
            CLR   TI
            MOV   SBUF,#13
            JNB   TI,$
            CLR   TI
            LCALL DELAY
            RET
```

```
;*********************************************************************
;*          DELAY
;*********************************************************************

DELAY:      MOV   R7,#0
ULANG2:     MOV   R6,#0
ULANG1:     MOV   R5,#0
ULANG:      INC   R5
            CJNE  R5,#15H,ULANG
            INC   R6
            CJNE  R6,#15H,ULANG1
            INC   R7
            CJNE  R7,#15H,ULANG2
            RET

DELAY1:     MOV   R7,#0
ULANG5:     MOV   R6,#0
ULANG4:     MOV   R5,#0
ULANG3:     INC   R5
            CJNE  R5,#40H,ULANG3
            INC   R6
            CJNE  R6,#40H,ULANG4
            INC   R7
            CJNE  R7,#40H,ULANG5
            RET

DELAY2:     MOV   R7,#0
ULANG8:     MOV   R6,#0
ULANG7:     MOV   R5,#0
ULANG6:     INC   R5
            CJNE  R5,#90H,ULANG6
            INC   R6
            CJNE  R6,#90H,ULANG7
            INC   R7
            CJNE  R7,#90H,ULANG8
            RET


;*********************************************************************
;*          JIKA KEBOCORAN TERJADI
;*********************************************************************

KNDS_BCR:
            LCALL KIRIM
            LCALL SMS_SUM2
            LCALL WAIT
            LCALL SMSC_OP
            LCALL TYPE
            LCALL NOMOR
            LCALL TIME
            MOV   DPTR,#LAPORAN
```

```
            LCALL DTA2
            MOV   SBUF,#26
            JNB   TI,$
            CLR   TI


;*********************************************************************
;*          CEK SMS DATANG
;*********************************************************************

TUNGGU_PRNT2:
            CLR   TI
            MOV   R4,#00H
            MOV   DPTR,#LIST
LIST4:      MOV   A,R4
            MOVC  A,@A+DPTR
            MOV   SBUF,A
            JNB   TI,$
            CLR   TI
            INC   R4
            CJNE  A,#0DH,LIST4
            SETB  REN
            MOV   R1,#80H

LIST5:      JNB   RI,$
            MOV   A,SBUF
            CLR   RI
            CJNE  A,#20H,LIST6
            JNB   RI,$
            MOV   A,SBUF
            CLR   RI
            MOV   @R1,A
            INC   R1
LIST6:      CJNE  A,#4BH,LIST5
            CLR   REN
            ORL   WMCON,#EEMEN
            ORL   WMCON,#EEMWE
            MOV   DPTR,#000H
            MOV   R0,#80H
            MOV   R2,#00H
EEWRT1:     MOV   A,@R0
            MOVX  @DPTR,A
            LCALL DELAY
            INC   DPTR
            DEC   R1
            INC   R0
            INC   R2
            CJNE  R1,#80H,EEWRT1
            XRL   WMCON,#EEMWE
            XRL   WMCON,#EEMEN

            ORL   WMCON,#EEMEN
```

```
            ORL   WMCON,#EEMWE
            MOV   DPTR,#000H
            PUSH  DPL
            PUSH  DPH
INDEX2:     CJNE  R2,#00H,INDEX3
            JMP   TUNGGU_PRNT2
INDEX3:     POP   DPH
            POP   DPL
            MOVX  A,@DPTR
            LCALL DELAY
            INC   DPTR
            PUSH  DPL
            PUSH  DPH
            MOV   R3,A
            DEC   R2
            XRL   WMCON,#EEMWE
            XRL   WMCON,#EEMEN


;*********************************************************************
;           BACA SMS YG DATANG
;*********************************************************************

BANDING2:   CLR   TI
            MOV   R4,#00H
            MOV   DPTR,#READ
READ2:      MOV   A,R4
            MOVC  A,@A+DPTR
            MOV   SBUF,A
            JNB   TI,$
            CLR   TI
            INC   R4
            CJNE  A,#'=',READ2
            MOV   A,R3
            MOV   SBUF,A
            JNB   TI,$
            CLR   TI
            MOV   SBUF,#13
            JNB   TI,$
            CLR   TI

            SETB  REN
            MOV   R0,#02H
            MOV   R1,#5AH
LAGI6:      JNB   RI,$
            MOV   A,SBUF
            CLR   RI
            CJNE  A,#0AH,LAGI6
            DEC   R0
            CJNE  R0,#00H,LAGI6
LAGI7:      JNB   RI,$
            MOV   A,SBUF
```

```
            CLR   RI
            MOV   @R1,A
            INC   R1
            CJNE  A,#0DH,LAGI7


;*********************************************************************
;*          BANDINGKAN SMS CENTER PENGIRIM
;*********************************************************************

            MOV   R5,#00H
            MOV   R0,#59H
            MOV   DPTR,#SMSC_SENDER
            MOV   R4,#00H
CSMSC3:     MOV   A,R4
            MOVC  A,@A+DPTR
            INC   R0
            INC   R4
            INC   R5
            CJNE  R5,#0DH,CSMSC4
            SJMP  NEXT7
CSMSC4:     XRL   A,@R0
            CJNE  A,#00H,LJTA
            SJMP  CSMSC3


;*********************************************************************
;*          BANDINGKAN NO PENGIRIM
;*********************************************************************

NEXT7:      MOV   R5,#00H
            MOV   R0,#67H
            MOV   DPTR,#NO_SENDER
            MOV   R4,#00H
CNOS3:      MOV   A,R4
            MOVC  A,@A+DPTR
            INC   R0
            INC   R4
            INC   R5
            CJNE  R5,#11H,CNOS4
            SJMP  NEXT8
CNOS4:      XRL   A,@R0
            CJNE  A,#00H,LJTA
            SJMP  CNOS3

LJTA:       LCALL HAPUS
            JMP   TUNGGU_PRNT2
```

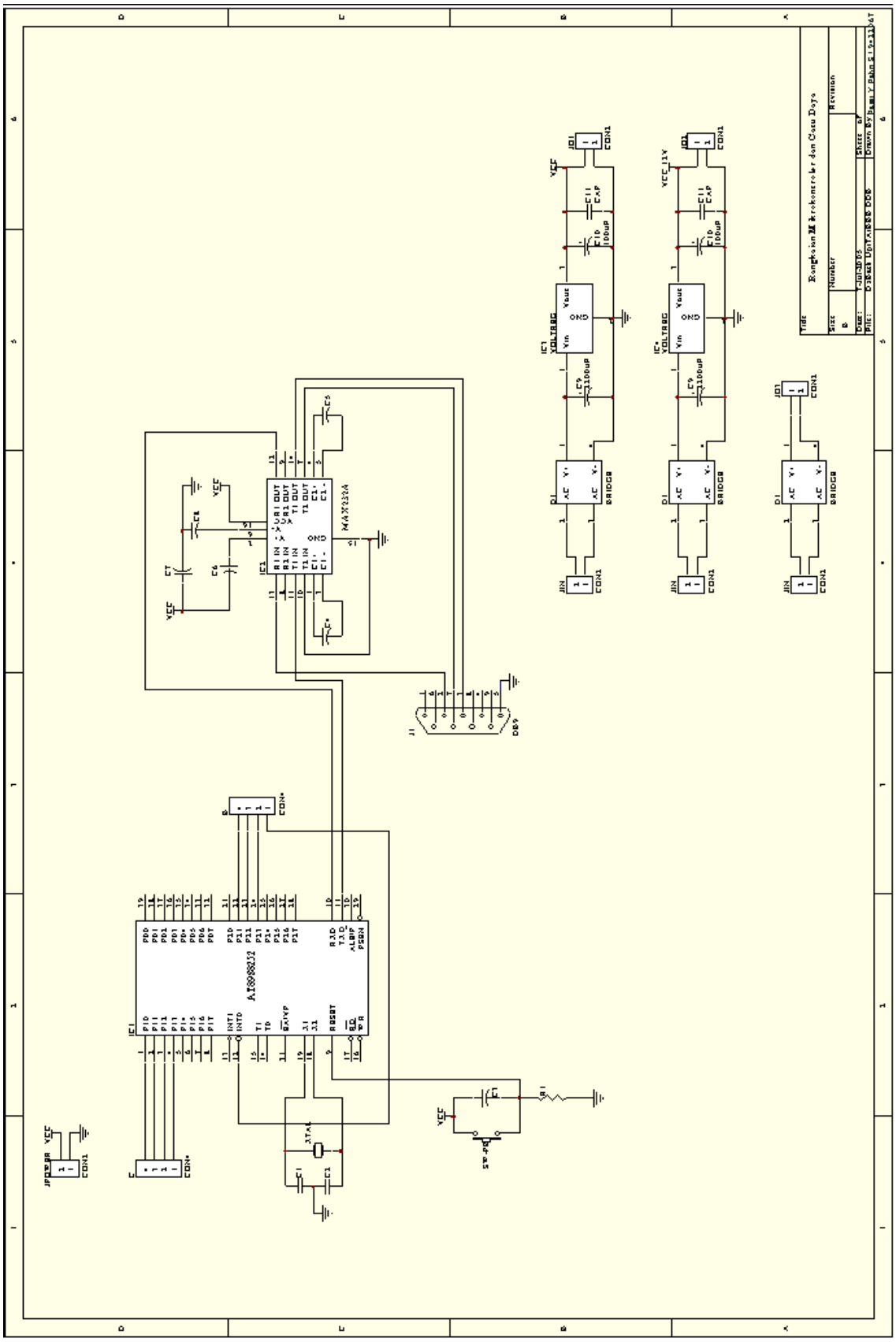
```
;*********************************************************************
;*          BANDINGKAN ISI SMS: BUKA SV
;*********************************************************************

NEXT8:      MOV   R5,#00H
            MOV   R0,#89H
            MOV   DPTR,#ISI_SMS4
            MOV   R4,#00H
CISI10:     MOV   A,R4
            MOVC  A,@A+DPTR
            INC   R0
            INC   R4
            INC   R5
            CJNE  R5,#11H,CISI11
            SJMP  TTPSV
CISI11:     XRL   A,@R0
            CJNE  A,#00H,NEXT9
            SJMP  CISI10


;*********************************************************************
;*          BANDINGKAN ISI SMS: TUTUP SV
;*********************************************************************

NEXT9:      MOV   R5,#00H
            MOV   R0,#89H
            MOV   DPTR,#ISI_SMS5
            MOV   R4,#00H
CISI12:     MOV   A,R4
            MOVC  A,@A+DPTR
            INC   R0
            INC   R4
            INC   R5
            CJNE  R5,#11H,CISI13
            SJMP  BUKASV
CISI13:     XRL   A,@R0
            CJNE  A,#00H,NEXT10
            SJMP  CISI12


;*********************************************************************
;*          BANDINGKAN ISI SMS: RESET
;*********************************************************************

NEXT10:     MOV   R5,#00H
            MOV   R0,#89H
            MOV   DPTR,#ISI_SMS11
            MOV   R4,#00H
CISI14:     MOV   A,R4
```

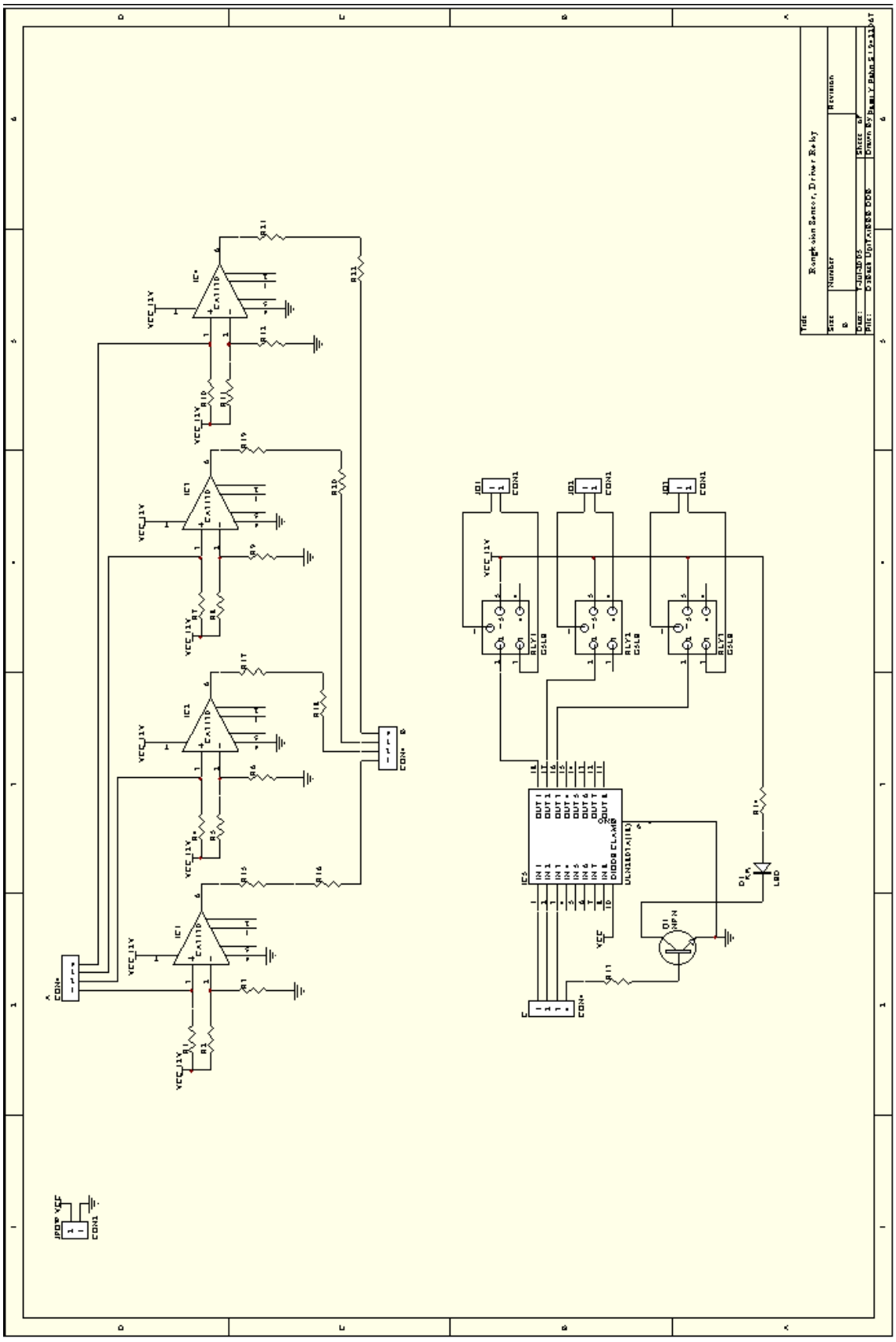
```
            MOVC  A,@A+DPTR
            INC   R0
            INC   R4
            INC   R5
            CJNE  R5,#0DH,CISI15
            SJMP  RST
CISI15:     XRL   A,@R0
            CJNE  A,#00H,LJTB
            SJMP  CISI14

BUKASV:     LCALL DELAY
            LCALL HAPUS
            CLR   P1.2
            ;*****************************************************
            ;     LAPORAN KONDISI SV DITUTUP
            ;*****************************************************
            LCALL DELAY2
            LCALL KIRIM
            LCALL SMS_SUM3
            LCALL WAIT
            LCALL SMSC_OP
            LCALL TYPE
            LCALL NOMOR
            LCALL TIME
            MOV   DPTR,#ISI_SMS9
            LCALL DTA3
            MOV   SBUF,#26
            JNB   TI,$
            CLR   TI
            JMP   TUNGGU_PRNT2

TTPSV:      LCALL DELAY
            LCALL HAPUS
            SETB  P1.2
            CLR   P1.2
            SETB  P1.2
            ;*****************************************************
            ;     LAPORAN KONDISI SV DIBUKA
            ;*****************************************************
            LCALL DELAY2
            LCALL KIRIM
            LCALL SMS_SUM4
            LCALL WAIT
            LCALL SMSC_OP
            LCALL TYPE
            LCALL NOMOR
            LCALL TIME
            MOV   DPTR,#ISI_SMS8
            LCALL DTA4
            MOV   SBUF,#26
            JNB   TI,$
            CLR   TI
```

```
            JMP   TUNGGU_PRNT2

LJTB:       LCALL HAPUS
            LCALL DELAY
            JMP   TUNGGU_PRNT2

RST:        LCALL DELAY
            SETB  P1.2
            MOV   A,P2
            MOV   B,A
            JMP   AWAL


;*********************************************************************
;*          AKHIR PROGRAM
;*********************************************************************

AKH:
            NOP
            SJMP  AKH
            END;
```

LAMPIRAN C

Skema Rangkaian





LAMPIRAN D

Data Komponen

Features

- **Compatible with MCS®51 Products**
- **8K Bytes of In-System Reprogrammable Downloadable Flash Memory**
  - **SPI Serial Interface for Program Downloading**
  - **Endurance: 1,000 Write/Erase Cycles**
- **2K Bytes EEPROM**
  - **Endurance: 100,000 Write/Erase Cycles**
- **4V to 6V Operating Range**
- **Fully Static Operation: 0 Hz to 24 MHz**
- **Three-level Program Memory Lock**
- **256 x 8-bit Internal RAM**
- **32 Programmable I/O Lines**
- **Three 16-bit Timer/Counters**
- **Nine Interrupt Sources**
- **Programmable UART Serial Channel**
- **SPI Serial Interface**
- **Low-power Idle and Power-down Modes**
- **Interrupt Recovery from Power-down**
- **Programmable Watchdog Timer**
- **Dual Data Pointer**
- **Power-off Flag**

Description

The AT89S8252 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of downloadable Flash programmable and erasable read-only memory and 2K bytes of EEPROM. The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard 80C51 instruction set and pinout. The on-chip downloadable Flash allows the program memory to be reprogrammed In-System through an SPI serial interface or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with downloadable Flash on a monolithic chip, the Atmel AT89S8252 is a powerful microcontroller, which provides a highly-flexible and cost-effective solution to many embedded control applications.

The AT89S8252 provides the following standard features: 8K bytes of downloadable Flash, 2K bytes of EEPROM, 256 bytes of RAM, 32 I/O lines, programmable watchdog timer, two data pointers, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry. In addition, the AT89S8252 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port, and interrupt system to continue functioning. The Power-down mode saves the RAM contents but freezes the oscillator, disabling all other chip functions until the next external interrupt or hardware reset.

The downloadable Flash can be changed a single byte at a time and is accessible through the SPI serial interface. Holding RESET active forces the SPI bus into a serial programming interface and allows the program memory to be written to or read from unless lock bits have been activated.

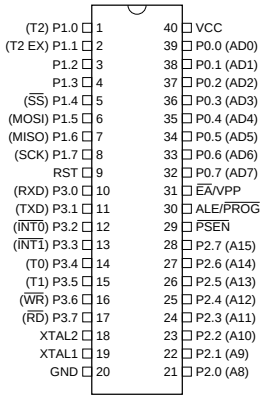
8-bit Microcontroller with 8K Bytes Flash

AT89S8252

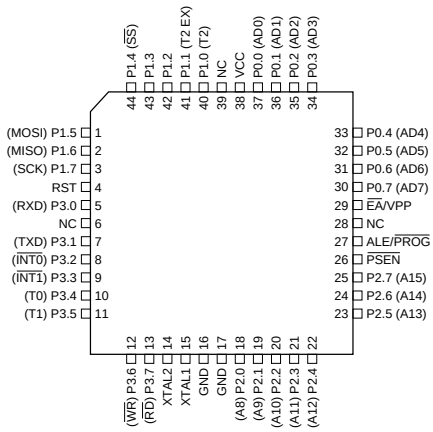
0401F–MICRO–11/03

Pin Configurations

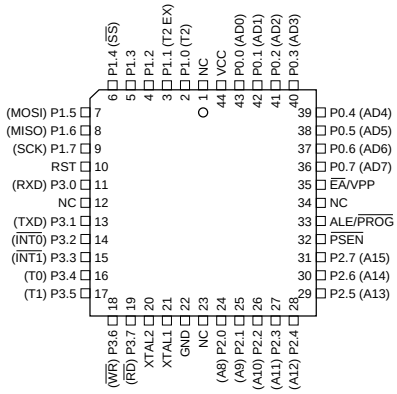
PDIP



TQFP



PLCC



Pin Description

VCC Supply voltage.

GND Ground.

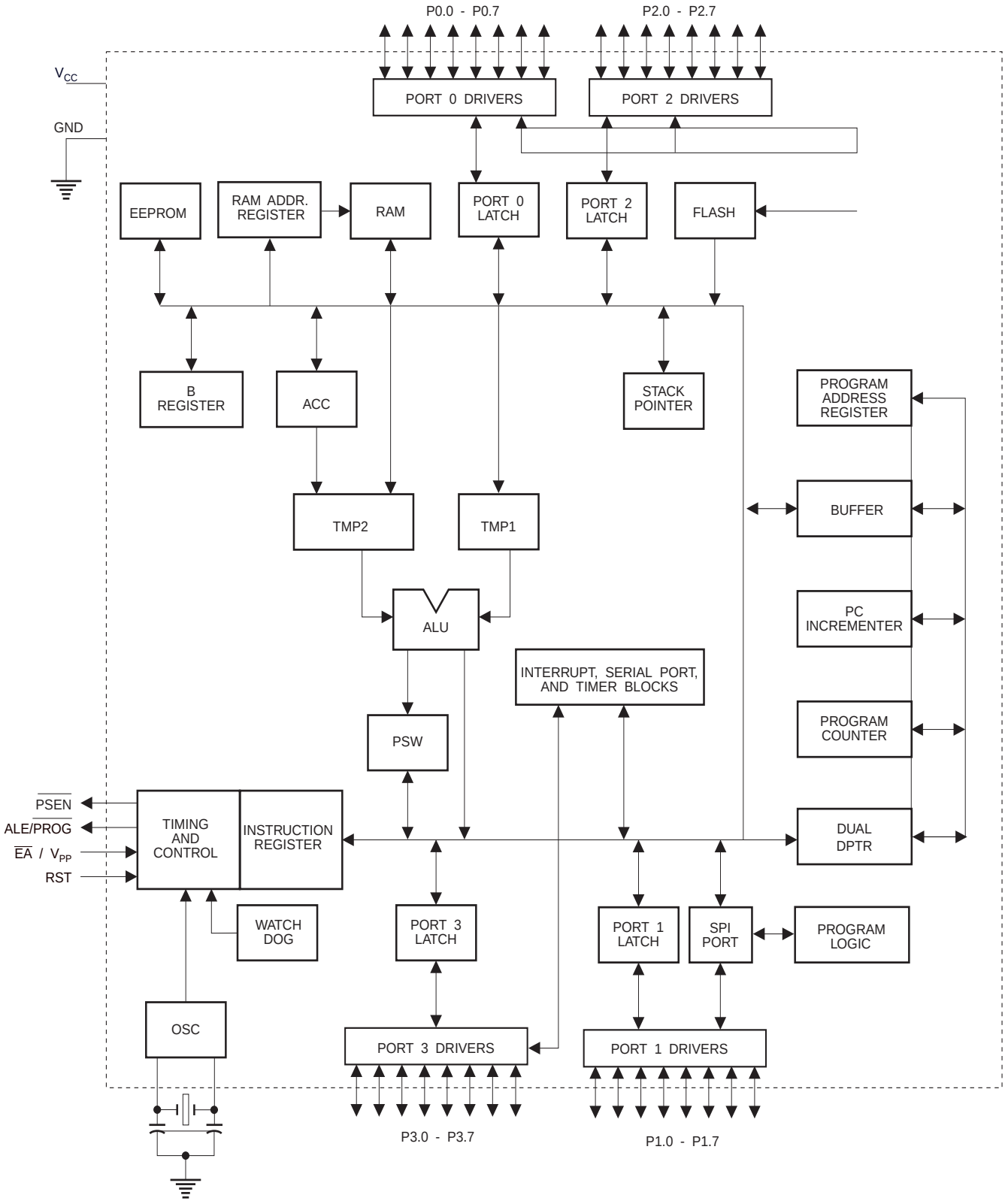
Port 0 Port 0 is an 8-bit open drain bi-didirectional I/O port. As an output port, each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as high-impedance inputs.

Port 0 can also be configured to be the multiplexed low-order address/data bus during accesses to external program and data memory. In this mode, P0 has internal pull-ups.

Port 0 also receives the code bytes during Flash programming and outputs the code bytes during program verification. External pull-ups are required during program verification.

Port 1 Port 1 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 1 output buffers can sink/source four TTL inputs. When 1s are written to Port 1 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 1 pins that are externally being pulled low will source current (I_{IL}) because of the internal pull-ups.

Block Diagram



Some Port 1 pins provide additional functions. P1.0 and P1.1 can be configured to be the timer/counter 2 external count input (P1.0/T2) and the timer/counter 2 trigger input (P1.1/T2EX), respectively.

Furthermore, P1.4, P1.5, P1.6, and P1.7 can be configured as the SPI slave port select, data input/output and shift clock input/output pins as shown in the following table.

Port Pin	Alternate Functions
P1.0	T2 (external count input to Timer/Counter 2), clock-out
P1.1	T2EX (Timer/Counter 2 capture/reload trigger and direction control)
P1.4	$\overline{SS}$ (Slave port select input)
P1.5	MOSI (Master data output, slave data input pin for SPI channel)
P1.6	MISO (Master data input, slave data output pin for SPI channel)
P1.7	SCK (Master clock output, slave clock input pin for SPI channel)

Port 1 also receives the low-order address bytes during Flash programming and verification.

Port 2

Port 2 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 2 pins that are externally being pulled low will source current (I_{IL}) because of the internal pull-ups.

Port 2 emits the high-order address byte during fetches from external program memory and during accesses to external data memory that use 16-bit addresses (MOVX @ DPTR). In this application, Port 2 uses strong internal pull-ups when emitting 1s. During accesses to external data memory that use 8-bit addresses (MOVX @ RI), Port 2 emits the contents of the P2 Special Function Register.

Port 2 also receives the high-order address bits and some control signals during Flash programming and verification.

Port 3

Port 3 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 3 output buffers can sink/source four TTL inputs. When 1s are written to Port 3 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 3 pins that are externally being pulled low will source current (I_{IL}) because of the pull-ups.

Port 3 receives some control signals for Flash programming and verification.

Port 3 also serves the functions of various special features of the AT89S8252, as shown in the following table.

Port Pin	Alternate Functions
P3.0	RXD (serial input port)
P3.1	TXD (serial output port)
P3.2	$\overline{INT0}$ (external interrupt 0)
P3.3	$\overline{INT1}$ (external interrupt 1)
P3.4	T0 (timer 0 external input)
P3.5	T1 (timer 1 external input)
P3.6	$\overline{WR}$ (external data memory write strobe)
P3.7	$\overline{RD}$ (external data memory read strobe)

RST

Reset input. A high on this pin for two machine cycles while the oscillator is running resets the device.

ALE/$\overline{PROG}$

Address Latch Enable is an output pulse for latching the low byte of the address during accesses to external memory. This pin is also the program pulse input ($\overline{PROG}$) during Flash programming.

In normal operation, ALE is emitted at a constant rate of 1/6 the oscillator frequency and may be used for external timing or clocking purposes. Note, however, that one ALE pulse is skipped during each access to external data memory.

If desired, ALE operation can be disabled by setting bit 0 of SFR location 8EH. With the bit set, ALE is active only during a MOVX or MOVC instruction. Otherwise, the pin is weakly pulled high. Setting the ALE-disable bit has no effect if the microcontroller is in external execution mode.

$\overline{PSEN}$

Program Store Enable is the read strobe to external program memory.

When the AT89S8252 is executing code from external program memory, $\overline{PSEN}$ is activated twice each machine cycle, except that two $\overline{PSEN}$ activations are skipped during each access to external data memory.

$\overline{EA}$/VPP

External Access Enable. $\overline{EA}$ must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up to FFFFH. Note, however, that if lock bit 1 is programmed, $\overline{EA}$ will be internally latched on reset.

$\overline{EA}$ should be strapped to V_{CC} for internal program executions. This pin also receives the 12-volt programming enable voltage (V_{PP}) during Flash programming when 12-volt programming is selected.

XTAL1

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

XTAL2

Output from the inverting oscillator amplifier.

19-4323; Rev 14; 8/04

MAXIM

+5V-Powered, Multichannel RS-232 Drivers/Receivers

General Description

The MAX220–MAX249 family of line drivers/receivers is intended for all EIA/TIA-232E and V.28/V.24 communications interfaces, particularly applications where ±12V is not available.

These parts are especially useful in battery-powered systems, since their low-power shutdown mode reduces power dissipation to less than 5µW. The MAX225, MAX233, MAX235, and MAX245/MAX246/MAX247 use no external components and are recommended for applications where printed circuit board space is critical.

Applications

Portable Computers

Low-Power Modems

Interface Translation

Battery-Powered RS-232 Systems

Multidrop RS-232 Networks

AutoShutdown and UCSP are trademarks of Maxim Integrated Products, Inc.

Next-Generation Device Features

- **For Low-Voltage, Integrated ESD Applications MAX3222E/MAX3232E/MAX3237E/MAX3241E/ MAX3246E: +3.0V to +5.5V, Low-Power, Up to 1Mbps, True RS-232 Transceivers Using Four 0.1µF External Capacitors (MAX3246E Available in a UCSP™ Package)**
- **For Low-Cost Applications MAX221E: ±15kV ESD-Protected, +5V, 1µA, Single RS-232 Transceiver with AutoShutdown™**

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX220CPE	0°C to +70°C	16 Plastic DIP
MAX220CSE	0°C to +70°C	16 Narrow SO
MAX220CWE	0°C to +70°C	16 Wide SO
MAX220C/D	0°C to +70°C	Dice*
MAX220EPE	-40°C to +85°C	16 Plastic DIP
MAX220ESE	-40°C to +85°C	16 Narrow SO
MAX220EWE	-40°C to +85°C	16 Wide SO
MAX220EJE	-40°C to +85°C	16 CERDIP
MAX220MJE	-55°C to +125°C	16 CERDIP

Ordering Information continued at end of data sheet.

**Contact factory for dice specifications.*

Selection Table

Part Number	Power Supply (V)	No. of RS-232 Drivers/Rx	No. of Ext. Caps	Nominal Cap. Value (µF)	SHDN & Three-State	Rx Active in SHDN	Data Rate (kbps)	Features
MAX220	+5	2/2	4	0.047/0.33	No	—	120	Ultra-low-power, industry-standard pinout
MAX222	+5	2/2	4	0.1	Yes	—	200	Low-power shutdown
MAX223 (MAX213)	+5	4/5	4	1.0 (0.1)	Yes	✔	120	MAX241 and receivers active in shutdown
MAX225	+5	5/5	0	—	Yes	✔	120	Available in SO
MAX230 (MAX200)	+5	5/0	4	1.0 (0.1)	Yes	—	120	5 drivers with shutdown
MAX231 (MAX201)	+5 and +7.5 to +13.2	2/2	2	1.0 (0.1)	No	—	120	Standard +5/+12V or battery supplies; same functions as MAX232
MAX232 (MAX202)	+5	2/2	4	1.0 (0.1)	No	—	120 (64)	Industry standard
MAX232A	+5	2/2	4	0.1	No	—	200	Higher slew rate, small caps
MAX233 (MAX203)	+5	2/2	0	—	No	—	120	No external caps
MAX233A	+5	2/2	0	—	No	—	200	No external caps, high slew rate
MAX234 (MAX204)	+5	4/0	4	1.0 (0.1)	No	—	120	Replaces 1488
MAX235 (MAX205)	+5	5/5	0	—	Yes	—	120	No external caps
MAX236 (MAX206)	+5	4/3	4	1.0 (0.1)	Yes	—	120	Shutdown, three state
MAX237 (MAX207)	+5	5/3	4	1.0 (0.1)	No	—	120	Complements IBM PC serial port
MAX238 (MAX208)	+5	4/4	4	1.0 (0.1)	No	—	120	Replaces 1488 and 1489
MAX239 (MAX209)	+5 and +7.5 to +13.2	3/5	2	1.0 (0.1)	No	—	120	Standard +5/+12V or battery supplies; single-package solution for IBM PC serial port
MAX240	+5	5/5	4	1.0	Yes	—	120	DIP or flatpack package
MAX241 (MAX211)	+5	4/5	4	1.0 (0.1)	Yes	—	120	Complete IBM PC serial port
MAX242	+5	2/2	4	0.1	Yes	✔	200	Separate shutdown and enable
MAX243	+5	2/2	4	0.1	No	—	200	Open-line detection simplifies cabling
MAX244	+5	8/10	4	1.0	No	—	120	High slew rate
MAX245	+5	8/10	0	—	Yes	✔	120	High slew rate, int. caps, two shutdown modes
MAX246	+5	8/10	0	—	Yes	✔	120	High slew rate, int. caps, three shutdown modes
MAX247	+5	8/9	0	—	Yes	✔	120	High slew rate, int. caps, nine operating modes
MAX248	+5	8/8	4	1.0	Yes	✔	120	High slew rate, selective half-chip enables
MAX249	+5	6/10	4	1.0	Yes	✔	120	Available in quad flatpack package

+5V-Powered, Multichannel RS-232 Drivers/Receivers

ABSOLUTE MAXIMUM RATINGS—MAX220/222/232A/233A/242/243

Supply Voltage (V_{CC}) ....-0.3V to +6V
V+ (Note 1) ....(V_{CC} - 0.3V) to +14V
V- (Note 1) ....+0.3V to +14V
Input Voltages
T_{IN} ....-0.3V to (V_{CC} - 0.3V)
R_{IN} (Except MAX220) ....±30V
R_{IN} (MAX220) ....±25V
T_{OUT} (Except MAX220) (Note 2) ....±15V
T_{OUT} (MAX220) ....±13.2V
Output Voltages
T_{OUT} ....±15V
R_{OUT} ....-0.3V to (V_{CC} + 0.3V)
Driver/Receiver Output Short Circuited to GND ....Continuous
Continuous Power Dissipation (T_A = +70°C)
16-Pin Plastic DIP (derate 10.53mW/°C above +70°C)..842mW
18-Pin Plastic DIP (derate 11.11mW/°C above +70°C)..889mW
20-Pin Plastic DIP (derate 8.00mW/°C above +70°C) ..440mW
16-Pin Narrow SO (derate 8.70mW/°C above +70°C) ...696mW
16-Pin Wide SO (derate 9.52mW/°C above +70°C)....762mW
18-Pin Wide SO (derate 9.52mW/°C above +70°C)....762mW
20-Pin Wide SO (derate 10.00mW/°C above +70°C)....800mW
20-Pin SSOP (derate 8.00mW/°C above +70°C) 640mW
16-Pin CERDIP (derate 10.00mW/°C above +70°C)....800mW
18-Pin CERDIP (derate 10.53mW/°C above +70°C)....842mW
Operating Temperature Ranges
MAX2_ _AC_ _, MAX2_ _C_ _ ....0°C to +70°C
MAX2_ _AE_ _, MAX2_ _E_ _ ....-40°C to +85°C
MAX2_ _AM_ _, MAX2_ _M_ _ ....-55°C to +125°C
Storage Temperature Range ....-65°C to +160°C
Lead Temperature (soldering, 10s) (Note 3) ....+300°C

Note 1: For the MAX220, V+ and V- can have a maximum magnitude of 7V, but their absolute difference cannot exceed 13V.
Note 2: Input voltage measured with T_{OUT} in high-impedance state, $\overline{SHDN}$ or V_{CC} = 0V.
Note 3: Maximum reflow temperature for the MAX225_WI and MAX233A_WP is +220°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—MAX220/222/232A/233A/242/243

(V_{CC} = +5V ±10%, C1–C4 = 0.1µF, MAX220, C1 = 0.047µF, C2–C4 = 0.33µF, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
RS-232 TRANSMITTERS						
Output Voltage Swing	All transmitter outputs loaded with 3kΩ to GND		±5	±8		V
Input Logic Threshold Low				1.4	0.8	V
Input Logic Threshold High	All devices except MAX220		2	1.4		V
	MAX220: V_{CC} = 5.0V		2.4			
Logic Pullup/Input Current	All except MAX220, normal operation			5	40	µA
	$\overline{SHDN}$ = 0V, MAX222/MAX242, shutdown, MAX220			±0.01	±1	
Output Leakage Current	V_{CC} = 5.5V, $\overline{SHDN}$ = 0V, V_{OUT} = ±15V, MAX222/MAX242			±0.01	±10	µA
	V_{CC} = $\overline{SHDN}$ = 0V	V_{OUT} = ±15V		±0.01	±10	
		MAX220, V_{OUT} = ±12V			±25	
Data Rate				200	116	kbps
Transmitter Output Resistance	V_{CC} = V+ = V- = 0V, V_{OUT} = ±2V		300	10M		Ω
Output Short-Circuit Current	V_{OUT} = 0V	V_{OUT} = 0V	±7	±22		mA
		MAX220			±60	
RS-232 RECEIVERS						
RS-232 Input Voltage Operating Range					±30	V
		MAX220			±25	
RS-232 Input Threshold Low	V_{CC} = 5V	All except MAX243 $R2_{IN}$	0.8	1.3		V
		MAX243 $R2_{IN}$ (Note 4)	-3			
RS-232 Input Threshold High	V_{CC} = 5V	All except MAX243 $R2_{IN}$		1.8	2.4	V
		MAX243 $R2_{IN}$ (Note 4)		-0.5	-0.1	

ELECTRICAL CHARACTERISTICS—MAX220/222/232A/233A/242/243 (continued)

(V_{CC} = +5V ±10%, C1–C4 = 0.1µF, MAX220, C1 = 0.047µF, C2–C4 = 0.33µF, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
RS-232 Input Hysteresis	All except MAX220/MAX243, V_{CC} = 5V, no hysteresis in SHDN		0.2	0.5	1	V
	MAX220			0.3		
	MAX243			1		
RS-232 Input Resistance	T_A = +25°C (MAX220)		3	5	7	KΩ
			3	5	7	
TTL/CMOS Output Voltage Low	I_{OUT} = 3.2mA			0.2	0.4	V
	I_{OUT} = 1.6mA (MAX220)				0.4	
TTL/CMOS Output Voltage High	I_{OUT} = -1.0mA		3.5	V_{CC} - 0.2		V
TTL/CMOS Output Short-Circuit Current	Sourcing V_{OUT} = GND		-2	-10		mA
	Shrinking V_{OUT} = V_{CC}		10	30		
TTL/CMOS Output Leakage Current	$\overline{SHDN}$ = V_{CC} or $\overline{EN}$ = V_{CC} ($\overline{SHDN}$ = 0V for MAX222), 0V ≤ V_{OUT} ≤ V_{CC}			±0.05	±10	µA
EN Input Threshold Low	MAX242			1.4	0.8	V
EN Input Threshold High	MAX242		2.0	1.4		V
Operating Supply Voltage			4.5		5.5	V
V_{CC} Supply Current ($\overline{SHDN}$ = V_{CC}), figures 5, 6, 11, 19	No load	MAX220		0.5	2	µA
		MAX222/MAX232A/MAX233A/ MAX242/MAX243		4	10	
	3kΩ load both inputs	MAX220		12		
		MAX222/MAX232A/MAX233A/ MAX242/MAX243		15		
Shutdown Supply Current	MAX222/ MAX242	T_A = +25°C		0.1	10	µA
		T_A = 0°C to +70°C		2	50	
		T_A = -40°C to +85°C		2	50	
		T_A = -55°C to +125°C		35	100	
$\overline{SHDN}$ Input Leakage Current	MAX222/MAX242				±1	µA
$\overline{SHDN}$ Threshold Low	MAX222/MAX242			1.4	0.8	V
$\overline{SHDN}$ Threshold High	MAX222/MAX242		2.0	1.4		V
Transition Slew Rate	C_L = 50pF to 2500pF, R_L = 3kΩ to 7kΩ, V_{CC} = 5V, T_A = +25°C, measured from +3V to -3V or -3V	MAX222/MAX232A/MAX233/ MAX242/MAX243	6	12	30	V/µs
		MAX220	1.5	3	30	
Transmitter Propagation Delay TLL to RS-232 (Normal Operation), Figure 1	t_{PHLT}	MAX222/MAX232A/MAX233/ MAX242/MAX243		1.3	3.5	µs
		MAX220		4	10	
	t_{PLHT}	MAX222/MAX232A/MAX233/ MAX242/MAX243		1.5	3.5	
		MAX220		5	10	

Note 4: MAX243 $R2_{OUT}$ is guaranteed to be low when $R2_{IN}$ is ≥ 0V or is floating.

+5V-Powered, Multichannel RS-232 Drivers/Receivers

ELECTRICAL CHARACTERISTICS—MAX220/222/232A/233A/242/243 (continued)

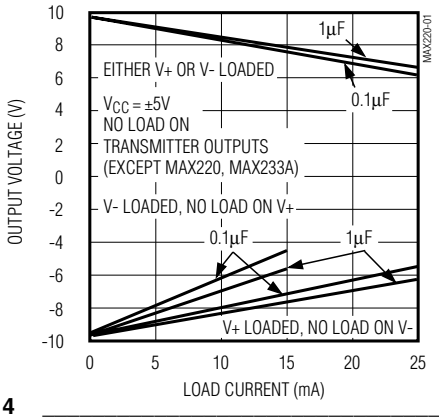
(V_{CC} = +5V ±10%, C1–C4 = 0.1µF, MAX220, C1 = 0.047µF, C2–C4 = 0.33µF, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Receiver Propagation Delay RS-232 to TLL (Normal Operation), Figure 2	t_{PHLR}	MAX222/MAX232A/MAX233/ MAX242/MAX243		0.5	1	µs
		MAX220		0.6	3	
	t_{PLHR}	MAX222/MAX232A/MAX233/ MAX242/MAX243		0.6	1	
		MAX220		0.8	3	
Receiver Propagation Delay RS-232 to TLL (Shutdown), Figure 2	t_{PHLS}	MAX242		0.5	10	µs
	t_{PHLS}	MAX242		2.5	10	
Receiver-Output Enable Time, Figure 3	t_{ER}	MAX242		125	500	ns
Receiver-Output Disable Time, Figure 3	t_{DR}	MAX242		160	500	ns
Transmitter-Output Enable Time ($\overline{SHDN}$ Goes High), Figure 4	tET	MAX222/MAX242, 0.1µF caps (includes charge-pump start-up)		250		µs
Transmitter-Output Disable Time ($\overline{SHDN}$ Goes Low), Figure 4	tDT	MAX222/MAX242, 0.1µF caps		600		ns
Transmitter + to - Propagation Delay Difference (Normal Operation)	tPHLT - tPLHT	MAX222/MAX232A/MAX233/ MAX242/MAX243		300		ns
		MAX220		2000		
Receiver + to - Propagation Delay Difference (Normal Operation)	tPHLR - tPLHR	MAX222/MAX232A/MAX233/ MAX242/MAX243		100		ns
		MAX220		225		

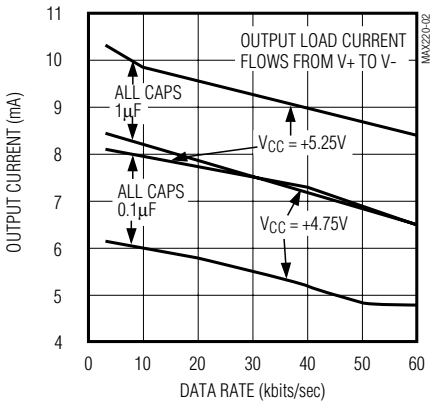
Typical Operating Characteristics

MAX220/MAX222/MAX232A/MAX233A/MAX242/MAX243

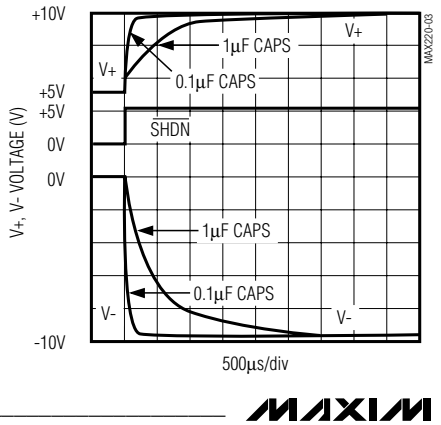
OUTPUT VOLTAGE vs. LOAD CURRENT



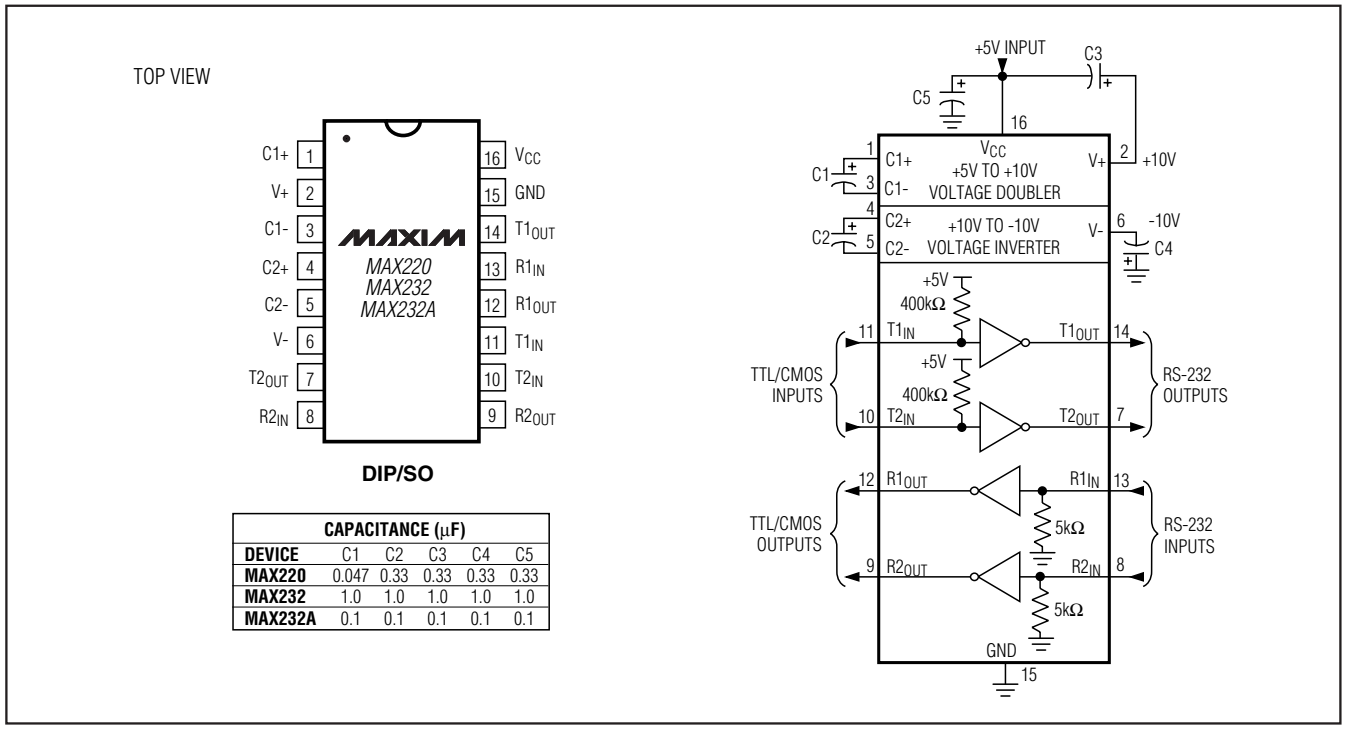
AVAILABLE OUTPUT CURRENT vs. DATA RATE



MAX222/MAX242 ON-TIME EXITING SHUTDOWN



MAXIM



CAPACITANCE (µF)					
DEVICE	C1	C2	C3	C4	C5
MAX220	0.047	0.33	0.33	0.33	0.33
MAX232	1.0	1.0	1.0	1.0	1.0
MAX232A	0.1	0.1	0.1	0.1	0.1

Figure 5. MAX220/MAX232/MAX232A Pin Configuration and Typical Operating Circuit

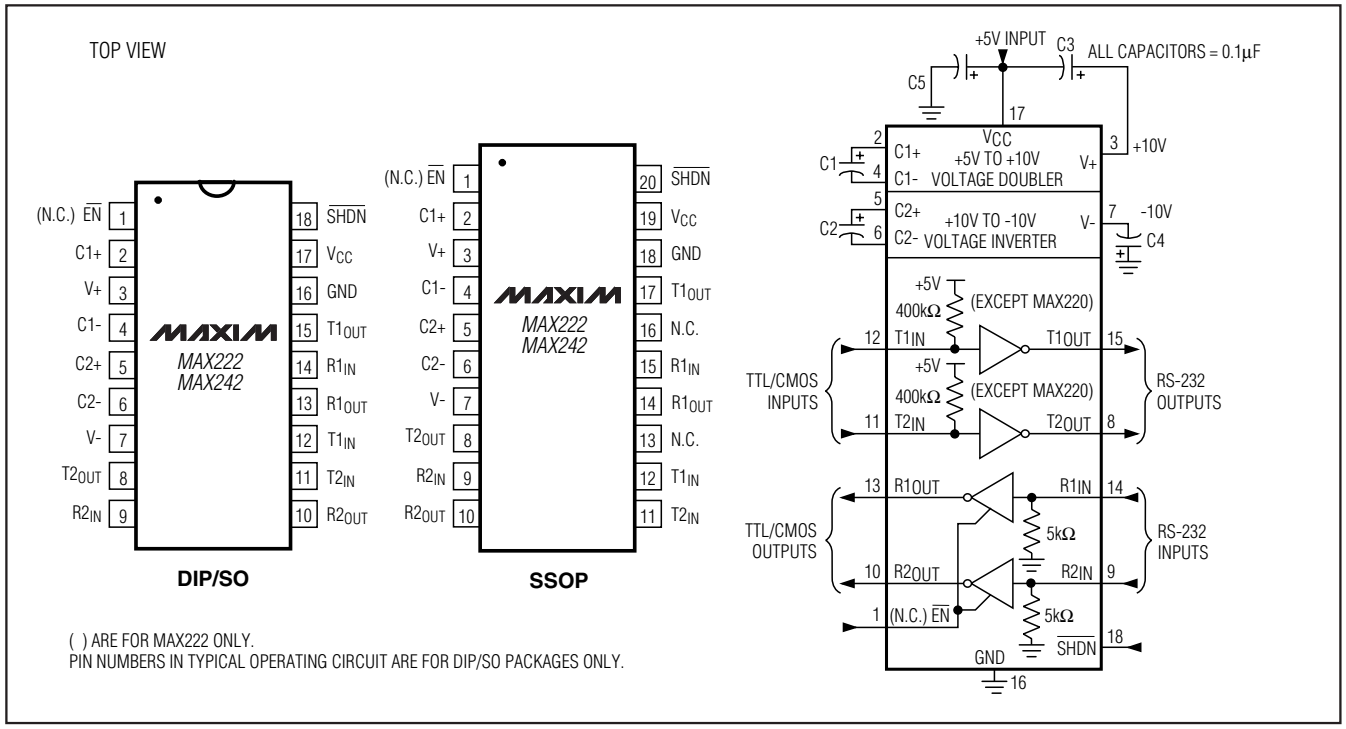


Figure 6. MAX222/MAX242 Pin Configurations and Typical Operating Circuit

Data Sheet | October 2002 | FN817.5

15MHz, BiMOS Operational Amplifier with MOSFET Input/CMOS Output

CA3130A and CA3130 are op amps that combine the advantage of both CMOS and bipolar transistors.

Gate-protected P-Channel MOSFET (PMOS) transistors are used in the input circuit to provide very-high-input impedance, very-low-input current, and exceptional speed performance. The use of PMOS transistors in the input stage results in common-mode input-voltage capability down to 0.5V below the negative-supply terminal, an important attribute in single-supply applications.

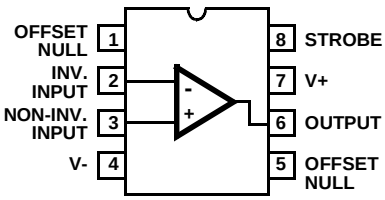
A CMOS transistor-pair, capable of swinging the output voltage to within 10mV of either supply-voltage terminal (at very high values of load impedance), is employed as the output circuit.

The CA3130 Series circuits operate at supply voltages ranging from 5V to 16V, (±2.5V to ±8V). They can be phase compensated with a single external capacitor, and have terminals for adjustment of offset voltage for applications requiring offset-null capability. Terminal provisions are also made to permit strobing of the output stage.

The CA3130A offers superior input characteristics over those of the CA3130.

Pinout

CA3130, CA3130A
(PDIP, SOIC)
TOP VIEW



Features

- MOSFET Input Stage Provides:
  - Very High Z_I = 1.5 TΩ (1.5 x 10^{12}Ω) (Typ)
  - Very Low I_I . . . . . 5pA (Typ) at 15V Operation
    . . . . . = 2pA (Typ) at 5V Operation
- Ideal for Single-Supply Applications
- Common-Mode Input-Voltage Range Includes Negative Supply Rail; Input Terminals can be Swung 0.5V Below Negative Supply Rail
- CMOS Output Stage Permits Signal Swing to Either (or both) Supply Rails

Applications

- Ground-Referenced Single Supply Amplifiers
- Fast Sample-Hold Amplifiers
- Long-Duration Timers/Monostables
- High-Input-Impedance Comparators (Ideal Interface with Digital CMOS)
- High-Input-Impedance Wideband Amplifiers
- Voltage Followers (e.g. Follower for Single-Supply D/A Converter)
- Voltage Regulators (Permits Control of Output Voltage Down to 0V)
- Peak Detectors
- Single-Supply Full-Wave Precision Rectifiers
- Photo-Diode Sensor Amplifiers

Ordering Information

PART NO. (BRAND)	TEMP. RANGE (^oC)	PACKAGE	PKG. NO.
CA3130AE	-55 to 125	8 Ld PDIP	E8.3
CA3130AM (3130A)	-55 to 125	8 Ld SOIC	M8.15
CA3130AM96 (3130A)	-55 to 125	8 Ld SOIC Tape and Reel	M8.15
CA3130E	-55 to 125	8 Ld PDIP	E8.3
CA3130M (3130)	-55 to 125	8 Ld SOIC	M8.15
CA3130M96 (3130)	-55 to 125	8 Ld SOIC Tape and Reel	M8.15

Absolute Maximum Ratings

DC Supply Voltage (Between V+ And V- Terminals). 16V
Differential Input Voltage 8V
DC Input Voltage . . . . . (V+ +8V) to (V- -0.5V)
Input-Terminal Current. 1mA
Output Short-Circuit Duration (Note 1). . . . . Indefinite

Operating Conditions

Temperature Range. . . . . -50^{o}C to 125^{o}C

Thermal Information

Thermal Resistance (Typical, Note 2)	θ_{JA} (^{o}C/W)	θ_{JC} (^{o}C/W)
PDIP Package	115	N/A
SOIC Package	160	N/A

Maximum Junction Temperature (Plastic Package) . . . . . .150^{o}C
Maximum Storage Temperature Range . . . . . -65^{o}C to 150^{o}C
Maximum Lead Temperature (Soldering 10s) . . . . . .300^{o}C
(SOIC - Lead Tips Only)

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTES:

1. Short circuit may be applied to ground or to either supply.
2. θ_{JA} is measured with the component mounted on an evaluation PC board in free air.

Electrical Specifications $T_A = 25^{o}C$, V+ = 15V, V- = 0V, Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	CA3130			CA3130A			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
Input Offset Voltage	$\|V_{IO}\|$	$V_S = \pm 7.5V$	-	8	15	-	2	5	mV
Input Offset Voltage Temperature Drift	$\Delta V_{IO}/\Delta T$		-	10	-	-	10	-	$\mu V/^{o}C$
Input Offset Current	$\|I_{IO}\|$	$V_S = \pm 7.5V$	-	0.5	30	-	0.5	20	pA
Input Current	I_I	$V_S = \pm 7.5V$	-	5	50	-	5	30	pA
Large-Signal Voltage Gain	A_{OL}	$V_O = 10V_{P-P}$, $R_L = 2k\Omega$	50	320	-	50	320	-	kV/V
			94	110	-	94	110	-	dB
Common-Mode Rejection Ratio	CMRR		70	90	-	80	90	-	dB
Common-Mode Input Voltage Range	V_{ICR}		0	-0.5 to 12	10	0	-0.5 to 12	10	V
Power-Supply Rejection Ratio	$\Delta V_{IO}/\Delta V_S$	$V_S = \pm 7.5V$	-	32	320	-	32	150	$\mu V/V$
Maximum Output Voltage	$V_{OM}+$	$R_L = 2k\Omega$	12	13.3	-	12	13.3	-	V
	$V_{OM}-$	$R_L = 2k\Omega$	-	0.002	0.01	-	0.002	0.01	V
	$V_{OM}+$	$R_L = \infty$	14.99	15	-	14.99	15	-	V
	$V_{OM}-$	$R_L = \infty$	-	0	0.01	-	0	0.01	V
Maximum Output Current	$I_{OM}+$ (Source) at $V_O = 0V$		12	22	45	12	22	45	mA
	$I_{OM}-$ (Sink) at $V_O = 15V$		12	20	45	12	20	45	mA
Supply Current	I+	$V_O = 7.5V$, $R_L = \infty$	-	10	15	-	10	15	mA
	I+	$V_O = 0V$, $R_L = \infty$	-	2	3	-	2	3	mA

Electrical Specifications Typical Values Intended Only for Design Guidance, V_{SUPPLY} = ±7.5V, T_A = 25°C Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	CA3130, CA3130A	UNITS
Input Offset Voltage Adjustment Range		10kΩ Across Terminals 4 and 5 or 4 and 1	±22	mV
Input Resistance	R_I		1.5	TΩ
Input Capacitance	C_I	f = 1MHz	4.3	pF
Equivalent Input Noise Voltage	e_N	BW = 0.2MHz, R_S = 1MΩ (Note 3)	23	μV
Open Loop Unity Gain Crossover Frequency (For Unity Gain Stability ≥47pF Required.)	f_T	C_C = 0	15	MHz
		C_C = 47pF	4	MHz
Slew Rate:	SR			
Open Loop		C_C = 0	30	V/μs
Closed Loop		C_C = 56pF	10	V/μs
Transient Response:		C_C = 56pF, C_L = 25pF, R_L = 2kΩ (Voltage Follower)		
Rise Time	t_r		0.09	μs
Overshoot	OS		10	%
Settling Time (To <0.1%, V_{IN} = $4V_{P-P}$)	t_S		1.2	μs

NOTE:

3. Although a 1MΩ source is used for this test, the equivalent input noise remains constant for values of R_S up to 10MΩ.

Electrical Specifications Typical Values Intended Only for Design Guidance, V+ = 5V, V- = 0V, T_A = 25°C Unless Otherwise Specified (Note 4)

PARAMETER	SYMBOL	TEST CONDITIONS	CA3130	CA3130A	UNITS
Input Offset Voltage	V_{IO}		8	2	mV
Input Offset Current	I_{IO}		0.1	0.1	pA
Input Current	I_I		2	2	pA
Common-Mode Rejection Ratio	CMRR		80	90	dB
Large-Signal Voltage Gain	A_{OL}	V_O = $4V_{P-P}$, R_L = 5kΩ	100	100	kV/V
			100	100	dB
Common-Mode Input Voltage Range	V_{ICR}		0 to 2.8	0 to 2.8	V
Supply Current	I+	V_O = 5V, R_L = ∞	300	300	μA
		V_O = 2.5V, R_L = ∞	500	500	μA
Power Supply Rejection Ratio	$\Delta V_{IO}/\Delta V+$		200	200	μV/V

NOTE:

4. Operation at 5V is not recommended for temperatures below 25°C.

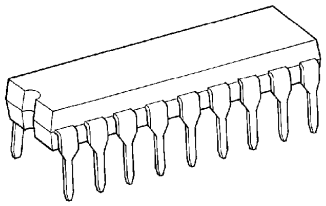
TOSHIBA BIPOLAR DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

ULN2803AP, ULN2803AFW, ULN2804AP, ULN2804AFW

8CH DARLINGTON SINK DRIVER

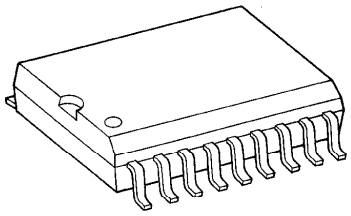
The ULN2803AP / AFW Series are high-voltage, high-current darlington drivers comprised of eight NPN darlington pairs.
All units feature integral clamp diodes for switching inductive loads.
Applications include relay, hammer, lamp and display (LED) drivers.

ULN2803AP
ULN2804AP



DIP18-P-300-2.54F

ULN2803AFW
ULN2804AFW



SOL18-P-300-1.27

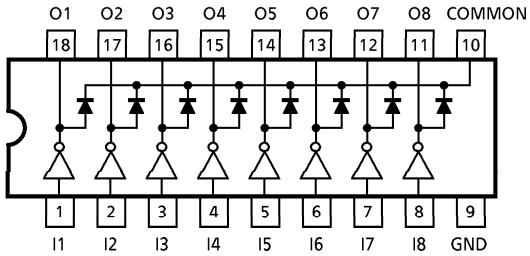
Weight
DIP18-P-300-2.54F : 1.478g (Typ.)
SOL18-P-300-1.27 : 0.48g (Typ.)

FEATURES

- Output current (single output)
  500mA (Max.) (ULN2803AP / AFW series)
- High sustaining voltage output
  50V (Min.) (ULN2803AP / AFW series)
- Output clamp diodes
- Inputs compatible with various types of logic.
- Package type-AP : DIP-18pin
- Package type-AFW : SOL-18pin

TYPE	INPUT BASE RESISTOR	DESIGNATION
ULN2803AP / AFW	2.7kΩ	TTL, 5V CMOS
ULN2804AP / AFW	10.5kΩ	6~15V PMOS, CMOS

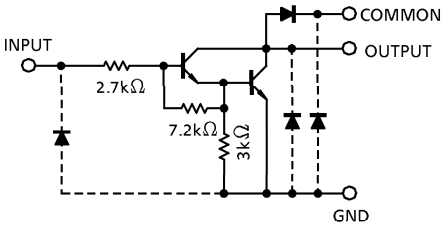
PIN CONNECTION (TOP VIEW)



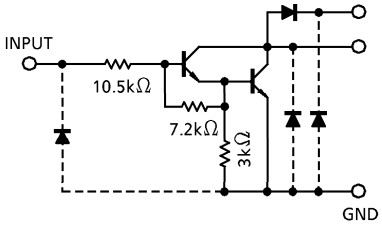
961001EBA1

SCHEMATICS (EACH DRIVER)

ULN2803AP / AFW



ULN2804AP / AFW



(Note) The input and output parasitic diodes cannot be used as clamp diodes.

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Output Sustaining Voltage		$V_{CE\ (SUS)}$	−0.5~50	V
Output Current		I_{OUT}	500	mA / ch
Input Voltage		V_{IN}	−0.5~30	V
Clamp Diode Reverse Voltage		V_R	50	V
Clamp Diode Forward Current		I_F	500	mA
Power Dissipation	AP	P_D	1.47	W
	AFW		0.92 / 1.31 (Note)	
Operating Temperature		T_{opr}	−40~85	°C
Storage Temperature		T_{stg}	−55~150	°C

(Note) On Glass Epoxy PCB (75 × 114 × 1.6mm Cu 20%)

RECOMMENDED OPERATING CONDITIONS (Ta = −40~85°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Sustaining Voltage		$V_{CE\ (SUS)}$		0	—	50	V
Output Current	AP	I_{OUT}	T_{pw} = 25ms, Duty = 10%, 8 Circuits	0	—	347	mA / ch
			T_{pw} = 25ms, Duty = 50%, 8 Circuits	0	—	123	
	AFW		T_{pw} = 25ms, Duty = 10%, 8 Circuits	0	—	268	
			T_{pw} = 25ms, Duty = 50%, 8 Circuits	0	—	90	
Input Voltage		V_{IN}		0	—	30	V
Input Voltage (Output On)	ULN2803AP / AFW	$V_{IN\ (ON)}$		3.5	—	30	V
	ULN2804AP / AFW			8	—	30	
Clamp Diode Reverse Voltage		V_R		—	—	50	V
Clamp Diode Forward Current		I_F		—	—	400	mA
Power Dissipation	AP	P_D	Ta = 85°C	—	—	0.76	W
	AFW		Ta = 85°C (Note)	—	—	0.48	

(Note) On Glass Epoxy PCB (75 × 114 × 1.6mm Cu 20%)

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Leakage Current		I_{CEX}	1	V_{CE} = 50V	Ta = 25°C	—	—	50	μA
				V_{CE} = 50V	Ta = 85°C	—	—	100	
	ULN2804AP / AFW			V_{CE} = 50V	V_{IN} = 1V	—	—	500	
Collector-Emitter Saturation Voltage		$V_{CE\ (sat)}$	2	I_{OUT} = 350mA, I_{IN} = 500μA		—	1.3	1.6	V
				I_{OUT} = 200mA, I_{IN} = 350μA		—	1.1	1.3	
				I_{OUT} = 100mA, I_{IN} = 250μA		—	0.9	1.1	
Input Current	ULN2803AP / AFW	$I_{IN\ (ON)}$	2	V_{IN} = 3.85V		—	0.93	1.35	mA
	ULN2804AP / AFW			V_{IN} = 5V		—	0.35	0.5	
				V_{IN} = 12V		—	1.0	1.45	
		$I_{IN\ (OFF)}$	4	I_{OUT} = 500μA, Ta = 85°C		50	65	—	μA
Input Voltage (Output On)	ULN2803AP / AFW	$V_{IN\ (ON)}$	5	V_{CE} = 2V, I_{OUT} = 200mA		—	—	2.4	V
				V_{CE} = 2V, I_{OUT} = 250mA		—	—	2.7	
				V_{CE} = 2V, I_{OUT} = 300mA		—	—	3.0	
	ULN2804AP / AFW			V_{CE} = 2V, I_{OUT} = 125mA		—	—	5.0	
				V_{CE} = 2V, I_{OUT} = 200mA		—	—	6.0	
				V_{CE} = 2V, I_{OUT} = 275mA		—	—	7.0	
				V_{CE} = 2V, I_{OUT} = 350mA		—	—	8.0	
DC Current Transfer Ratio		h_{FE}	2	V_{CE} = 2V, I_{OUT} = 350mA		1000	—	—	
Clamp Diode Reverse Current		I_R	6	Ta = 25°C (Note)		—	—	50	μA
				Ta = 85°C (Note)		—	—	100	
Clamp Diode Forward Voltage		V_F	7	I_F = 350mA		—	—	2.0	V
Input Capacitance		C_{IN}	—			—	15	—	pF
Turn-On Delay		t_{ON}	8	R_L = 125Ω, V_{OUT} = 50V		—	0.1	—	μs
Turn-Off Delay		t_{OFF}		R_L = 125Ω, V_{OUT} = 50V		—	0.2	—	

(Note) $V_R = V_R$ MAX.