LAMPIRAN

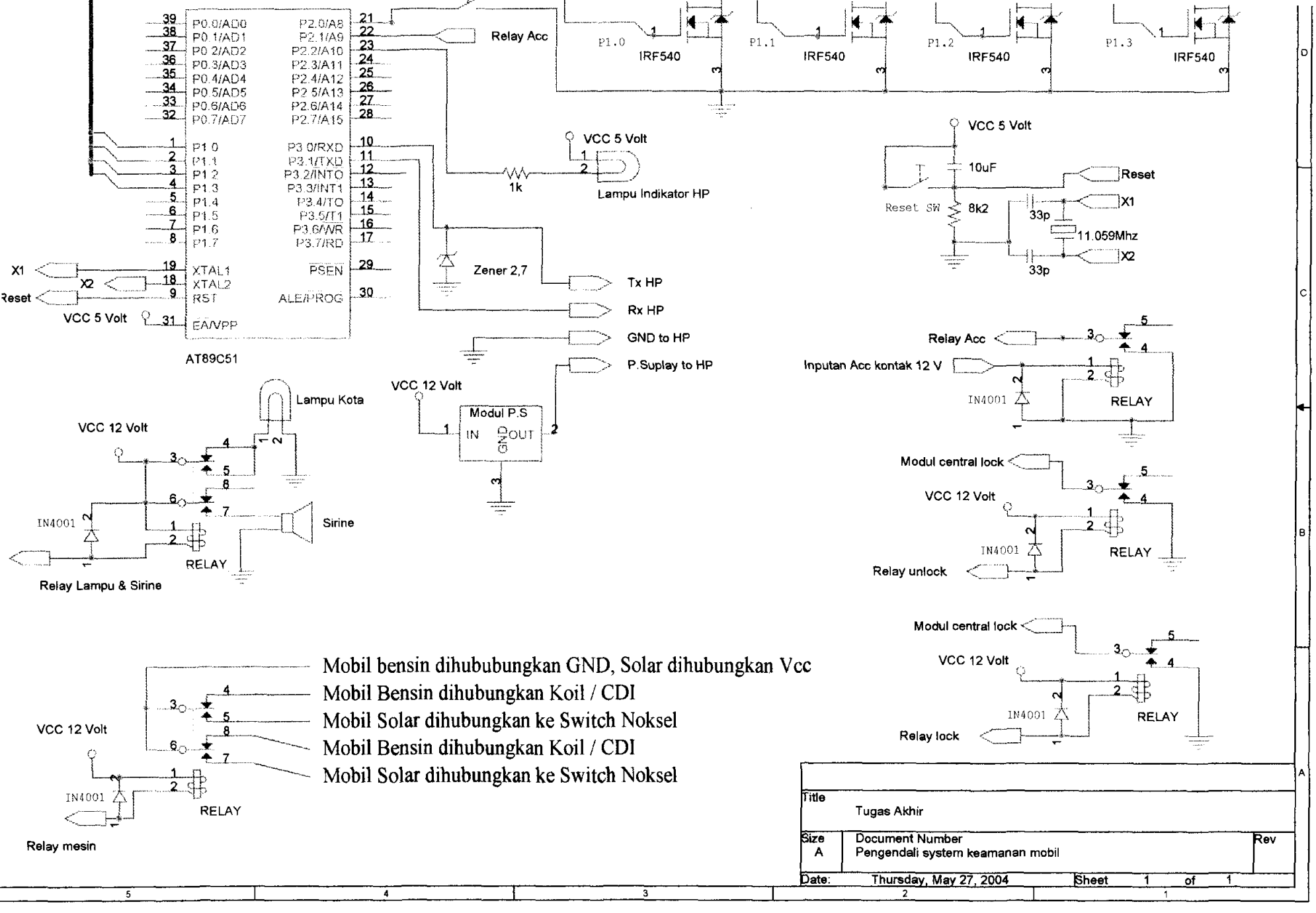
A. Skema rangkaian keseluruhan.

B. Gambar alat.

C. Program keseluruhan.

D. Data sheet.

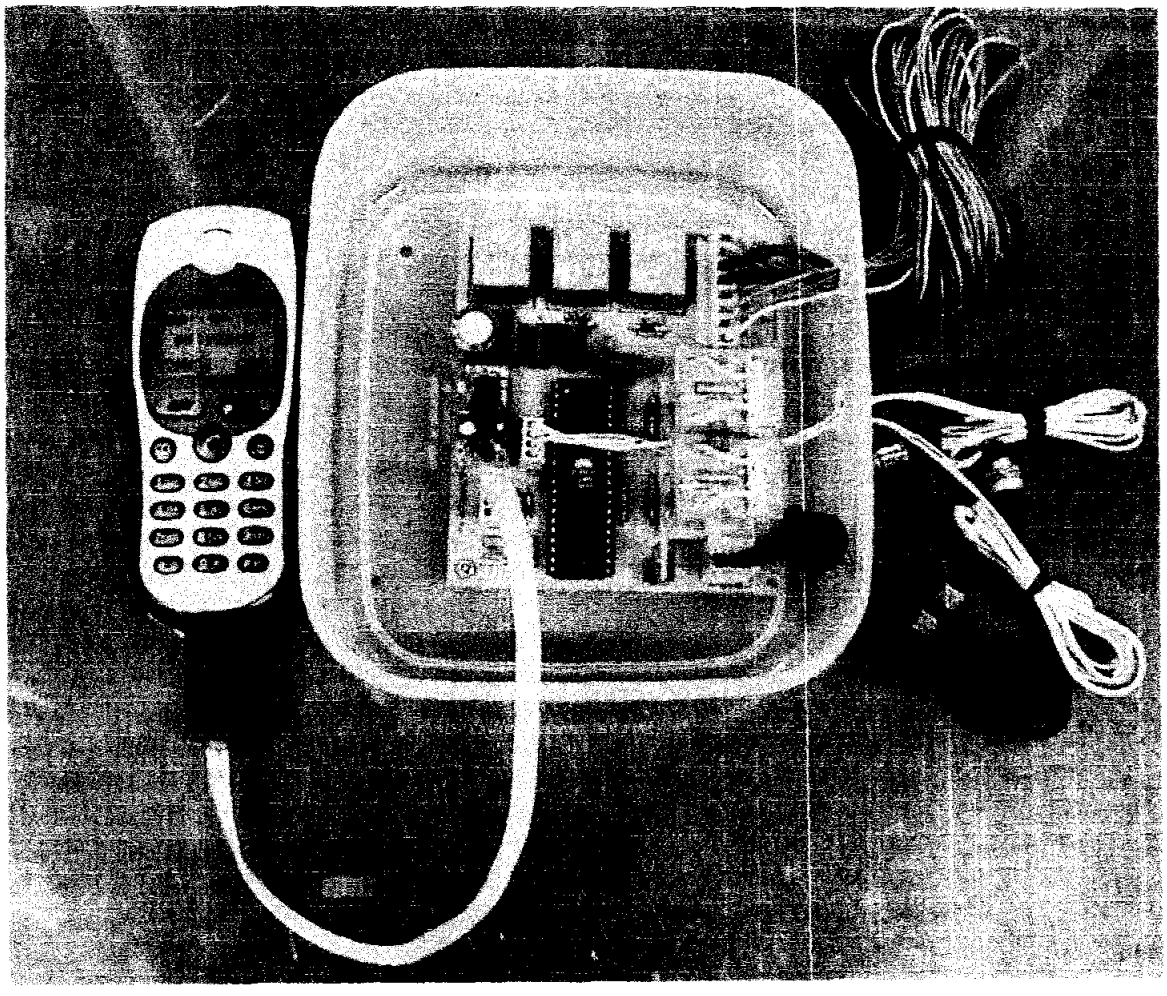
LAMPIRAN A
SKEMA RANGKAIAN



Title	Tugas Akhir	
Size A	Document Number Pengendali system keamanan mobil	Rev
Date:	Thursday, May 27, 2004	Sheet 1 of 1

LAMPIRAN B
FOTO ALAT

foto (920x777x24b jpeg)



LAMPIRAN C
PROGRAM KESELURUHAN

```
Nama     : Hanny Soebjanto
Nrp      : 5103099050
Judul    : Pengendali sistem keamanan mobil menggunakan fasilitas handpohone.
*// -------------------------------------------------------
ROM             EQU     $0000
KonstantaWaktu  EQU     -50000
JumlahCommmand  EQU     5
*****************************************************************
* Output Relay Untuk keperluan :
* - P1.0 Untuk menyalakan Lampu dan Sirine
* - P1.1 Untuk mengaktifkan mesin
* - P1.2 Untuk mengunci pintu mobil
* - P1.3 Untuk membuka pintu mobil
*****************************************************************
Relay_LampuSirine       BIT     P1.0
Relay_Mesin             BIT     P1.1
Relay_Lock              BIT     P1.2
Relay_Unlock            BIT     P1.3
*****************************************************************
* Input Portt Untuk Pintu dan Kontak/Acc
* - P2.0 Untuk mendeteksi pintu terbuka
* - P2.1 Untuk mendeteksi kunci kontak
*****************************************************************
SaklarPintu             BIT     P2.0
KunciKontak             BIT     P2.1

TimerHabis              BIT     0
Sudah05Detik            BIT     1
SudahKirim              BIT     2
ALARM_On                BIT     3

        .Data
        Org     $30
Command         DS      14      ; 30 - 3e
Pencacah5       DS      1       ; 3f berubah setiap 50 mili detik
LetakSMS        DS      1       ; 40
StatusSMS       DS      1       ; 41
LengthSMS       DS      2       ; 42, 43
NomerTujuan     DS      14      ; 44 - ....

Start:
        Acall   InitSerial19200         ; Init Serial Communication
*------ Matikan Semua Relay:
Test_Relay:
        Setb    Relay_LampuSirine       ;
        Acall   Delay
        Clr     Relay_LampuSirine

        Setb    Relay_Mesin
        Acall   Delay
        Clr     Relay_Mesin

        Setb    Relay_Lock
        Acall   Delay
        Clr     Relay_Lock

        Setb    Relay_UnLock
        Acall   Delay
        Clr     Relay_UnLock
        Acall   Delay
```

```
        Setb    Relay_Lock
        Acall   Delay
        Clr     Relay_Lock

        Setb    Relay_Mesin
        Acall   Delay
        Clr     Relay_Mesin

        Setb    Relay_LampuSirine       ;
        Acall   Delay
        Clr     Relay_LampuSirine


; ATZ pasti diterima oleh HP
        Mov     DPTR,#SATZ              ; Command AT Z for any Error
        Acall   KirimString             ; Kirim Command
        Acall   AmbilEnd                ; ATZ,$0D,$0D,$0A
        Acall   AmbilEnd                ; 'OK',$0D,$0A

InitBITAlarm:
        Clr     ALARM_On                ; BIT
;*************************************************************************
* R6= Perintah yang dijalankan:
* '1' = Perintah Untuk Membuka Pintu
* '2' = Perintah Untuk Mengunci Pintu
* '3' = Perintah Untuk Mengaktifkan Alarm
* '4' = Perintah Untuk Mengaktifkan Tanda Bahaya
* Main Program Loop:
;*************************************************************************
P_Mode: Mov     R6,#$03                 ; Command :Aktifkan Alarm
Pilih_Mode:
        Acall   HapusCommand            ; Berpindah Command
        CJNE    R6,#1,Mode2?            ; Apakah Mode 1?
        Acall   Membuka_Pintu           ; Ya, Panggil Routine Membuka Pintu
        Ajmp    Pilih_Mode              ; Sampai Perintah Berikutnya ADA!
Mode2?: CJNE    R6,#2,Mode3?            ; Apakah Mode 2?
        Acall   Mengunci_Pintu          ; Ya, Panggil Routine Mengunci Pintu
        Ajmp    Pilih_Mode              ; Sampai Perintah Berikutnya ADA!
Mode3?: CJNE    R6,#3,Mode4?            ; Apakah Mode 3?
        Acall   Aktifkan_Alarm          ; Ya, Panggil Routine aktifkan ALARM
        Ajmp    Pilih_Mode              ; Sampai Perintah Berikutnya ADA!
Mode4?: CJNE    R6,#4,P_Mode            ; Apakah Mode 4?
        Acall   Aktifkan_Bahaya         ; Ya, Aktifkan Tanda Bahaya
        Ajmp    Pilih_Mode              ; Sampai Perintah Berikutnya ADA!

;*************************************************************************
* Cek Apakah ada SMS yang baru datang pada SIEMEN
* 'AT+CMGL=0,$0D': Ambil SMS yang belum terbaca
* Kemungkinan Jawaban:
*       (*) OK    => Tidak ada SMS Baru
*       (*) '+CMGL= <mem>,<stat>,,<Length>',$0D,$0A,<PDU> => Ada SMS Baru
*       (*) ERROR
;*************************************************************************
CekSMSCommand:
        Mov     DPTR,#SATCMGL           ; AT+CMGL=0, Cari SMS 'Unread'
        Acall   KirimString             ; Kirim  Perintah
        Acall   AmbilEnd                ; $0D,$0A
        Acall   SerialIn                ; 'OK'/'ERROR'/'+'

        CJNE    A,#'O',ERR_SMS          ; Apakah Balasan = 'OK'?
        Acall   AmbilEnd                ; Ambil $0D,$0A
        Acall   Delay
```

```
        Acall   Delay
        CPL     P2.2                    ; Kedipkan LED Merah
        Clr     C                       ; Tidak ada SMS Baru!
        Ret

ERR_SMS:
        CJNE    A,#'E',AmbilCMGL        ; Apakah Balasan = 'ERROR'?
        Acall   AmbilEnd
        Acall   Delay
        Acall   Delay

        Mov     DPTR,#SATCMGD           ; Hapus SMS yang ada!
        Acall   KirimString             ; Tidak ada SMS Baru
        Acall   AmbilEnd                ; Ambil 0D,0A pertama
ERR     Acall   AmbilEnd                ; Ambil 0D,0A Terakhir
        Acall   Delay
        Acall   Delay                   ;
        Acall   Delay
        Clr     C                       ; Tanda 'Masih Belum ADA SMS BARU'
        Ret

AmbilCMGL:                              ; ADA SMS BARU = 'UNREAD'
        CJNE    A,#'+',ERR              ; Tanda '+CMGL: '
Ambil:  Acall   SerialIn                ; Ambil '+CMGL: '
        CJNE    A,#' ',Ambil            ; Sampai ketemu Spasi
        Acall   SerialIn                ; Ambil Nilai 'Index SMS'
        Acall   AmbilEnd                ; Ambil $0D,$0A
        Acall   Ambil_PDU_SMS           ; ............. PDU SMS.........
        Acall   Delay                   ; Tunggu Sebentar
        Acall   Delay
        Acall   Delay
        Acall   Delay                   ; Tunggu Sebentar
        Acall   Delay
        Acall   Delay
        Acall   Delay                   ; Tunggu Sebentar
        Acall   Delay
        Acall   Delay
        Mov     DPTR,#SATCMGD           ; Hapus SMS
        Acall   KirimString             ; Tidak ada SMS Baru
        Acall   AmbilEnd
        Acall   AmbilEnd
        Acall   Delay                   ; Tunggu Sebentar
        Acall   Delay
        Acall   Delay
        Acall   Delay
        Setb    C                       ; ADA PERINTAH BARU
        Ret

;*********************************************************************
KirimNomerTujuan:
        Mov     R0,#NomerTujuan

KirimPanjangNomer:
        Mov     B,#0

        Mov     A,@R0                   ; Diambil Awal
        CJNE    A,#'+',Next1            ; Apakah '+'?
        Inc     R0                      ; Kalau + Lewati
        Ajmp    Next1                   ; Next
LOP_01: Inc     R0
        Inc     B                       ; = Panjang Nomer
Next1:  Mov     A,@R0                   ;
```

```
        JNZ     LOP_01                  ; Apakah Sudah $00?

        Mov     A,B                     ; Ambil Panjang TELPON
        Acall   Out2Hex                 ; Kirim Panjang Nomer Telpon

; Kirim Nomer Tujuan
        Mov     R0,#NomerTujuan         ;
        Mov     A,@R0
        CJNE    A,#'0',Plus?            ; '0'
        Mov     A,#$81                  ; Tipe Nomer National: '81'
        Ajmp    Fin01
Plus?   CJNE    A,#'+',WrongNumber
        Mov     A,#$91                  ; Tipe Nomer International: '91'
        Inc     R0
Fin01   Acall   Out2Hex
LoopUbah:
        Mov     A,@R0
        JZ      FIN             ; APakah $00?, Kalau Ya maka Keluar
        Subb    A,#$30          ;
        Mov     B,A

        Inc     R0
        Mov     A,@R0
        JZ      TambahFF        ; Kalau Nome Ganjil...
        Subb    A,#$30          ;
        Swap    A
        ADD     A,B

        Inc     R0
        Acall   Out2Hex
        Ajmp    LoopUbah

TambahFF:
        Mov     A,#$F0
        ADD     A,B
        Acall   Out2Hex
FIN:    Clr     C
        Ret

WrongNumber
        Setb    C
        Ret

;*************************************************************************
; Ambil Nomer Telpon Tujuan di Phone Book HP Siemens
; Nomer tujuan 1 : pada memory phone book nomer 1 (AT+CPBR=1)
; Nomer tujuan 2 : pada memory phone book nomer 2 (AT+CPBR=2)
;*************************************************************************
AmbilPhoneBook1:
        Mov     DPTR,#SATCPBR1
        Ajmp    PhoneBook

AmbilPhoneBook2:
        Mov     DPTR,#SATCPBR2
PhoneBook:
******* Default Nomer Tujuan = $00
        Clr     A                       ; Nomer Tujuan = NOL
        Mov     R0,#NomerTujuan         ; TANDA KALAU NOMER BELUM DIAMBIL
        Mov     @R0,A                   ;
******* Ambil Nomer Tujuan pada mem phone book no 1
        Acall   KirimString             ; AT+CPBR=1 ,AT+CPBR=2
        Acall   AmbilEnd                ; Ambil 0D,0A,
```

```
                                        Program
        Acall   SerialIn                ; String berikutnya
        CJNE    A,#'+',ErNum1           ; Tanda '+CPBR: '

        Mov     R0,#NomerTujuan
Nomer:  Acall   SerialIn
        CJNE    A,#'"',Nomer
        Ajmp    Am_02

Loo_01  Mov     @R0,A           ; Masukkan Nomer Yang diambil ke Nomer Tujuan
        Inc     R0              ; R0=R0+1
Am_02   Acall   SerialIn
        CJNE    A,#'"',Loo_01   ; Cari tanda "
        Clr     A               ; Tandai  Akhir Nomer dengan 0
        Mov     @R0,A           ; TANDAI....
        Acall   AmbilEnd                ; "Name",$0D,$0A
        Acall   AmbilEnd                ; 0D,0A
        Acall   AmbilEnd                ; 'OK',0D,0A
        Acall   Delay
        Acall   Delay
        Acall   Delay
        Ret

ErNum1: Acall   AmbilEnd
        Acall   Delay
        Acall   Delay
        Acall   Delay
        Acall   Delay
        Acall   Delay
        Acall   Delay
        Acall   Delay
        Acall   Delay
        Acall   Delay
        Ret


;*************************************************************************
; Kirim SMS Bahaya sampai terkirim
;
; Balasan HP:
;       (*) Sukses: -  $0D,$0A,+CMGS: 0,$0D,$0A
;       (*) Gagal : -  $0D,$0A,ERROR,$0D,$0A
;*************************************************************************
KirimSMSBahaya:
        Clr     SudahKirim              ; FLAG KALAU SMS SUDAH DIKIRIM
        Mov     R3,#3                   ; 3 kali kirim SMS Kalau gagal
NomerPertama:                           ; Keluar......
        JB      SudahKirim,NomerKedua
;--->
        Acall   AmbilPhoneBook1         ; Ambil Nomer Telpom Tujuan
        Acall   Delay                   ; Tunggu Sebentar
        Acall   Delay                   ;
        Mov     DPTR,#SATCMGS           ; Siapkan Pointer ke: AT+CMGS=140
        Acall   KirimString             ; Kirim Perintah
        Acall   AmbilEnd                ; Cek balasan
;1.
        Mov     DPTR,#SMSFrame1         ; Kirim PDU Frame dari Code Memori
        Acall   KirimString             ; Kirim PDU
;2.
        Acall   KirimNomerTujuan
;3.
        Mov     DPTR,#SMSFrame2         ; Kirim PDU Frame dari Code Memori
        Acall   KirimString             ; Kirim PDU
```

```
'4.
        Mov     DPTR,#SMSDICURI         ; Siapkan Pointer SMS 'Mobil Dicuri'
        Acall   KirimString             ; Kirim SMS

        Acall   AmbilEnd                ; Tunggu balasan
        Acall   SerialIn
        CJNE    A,#'+',NomerKedua       ; Kalau >< '+' maka Error
' SMS Betul:
        Setb    SudahKirim              ; Berarti Sudah Kirim SMS
        Acall   AmbilEnd                ;
        Acall   AmbilEnd

' Kirim SMS ke Nomer Kedua
' Ada Error Atau Tidak....
NomerKedua:
        Acall   AmbilEnd
        Acall   Delay
        Acall   Delay
        Acall   Delay

        Acall   AmbilPhoneBook2
        Mov     DPTR,#SATCMGS           ; Siapkan Pointer ke: AT+CMGS=140
        Acall   KirimString             ; Kirim Perintah
        Acall   AmbilEnd
'1.
        Mov     DPTR,#SMSFrame1         ; Kirim PDU Frame dari Code Memori
        Acall   KirimString             ; Kirim PDU
'2.
        Acall   KirimNomerTujuan
'3.
        Mov     DPTR,#SMSFrame2         ; Kirim PDU Frame dari Code Memori
        Acall   KirimString             ; Kirim PDU
'4.
        Mov     DPTR,#SMSDICURI         ; Siapkan Pointer SMS 'Mobil Dicuri'
        Acall   KirimString             ; Kirim SMS

        Acall   AmbilEnd
        Acall   SerialIn
        CJNE    A,#'+',KirimLagi        ; Kalau >< '+' maka Error
        Acall   AmbilEnd
        Acall   AmbilEnd
        Acall   AmbilEnd
        Acall   Delay                   ; '+CMGS: 0' Message
        Acall   Delay                   ; Tunggu Balasan Selesai
        Clr     C
        Ret                             ; SMS Berhasil dikirim kedua nomer

KirimLagi:
        Acall   AmbilEnd
        Acall   Delay
        Acall   Delay
        DJNZ    R3,NomerPertama
        Setb    C                       ; Carry SET Ada SALAH
        Ret

;*****************************************************************
' Routine Tanda Bahaya
' - Lampu dan Sirine    = Aktif Terus
' - Mesin               = Tidak Aktif
' - Lock                = Aktif Selama 5 Detik
' - Unlock              = Tidak Aktif
;*****************************************************************
```

```
Aktifkan_Bahaya:
        Clr     Relay_LampuSirine       ; Aktif Terus
        Clr     Relay_UnLock            ; Relay Unlock Off
        Clr     Relay_Mesin             ; Relay Mesin Off
        Clr     Relay_Lock              ; Relay Lock Off

        Setb    Relay_Lock              ; Relay Lock On
        Acall   Delay5Aktif             ; Selama 5 detik
        JNB     TimerHabis,*            ; Tunggu di sini
        Clr     Relay_Lock              ; Matikan Lock

        Mov     Pencacah5,#5
        Setb    ALARM_On
        Acall   Delay025Aktif

C001:   Acall   Delay
        Acall   Delay
        Acall   Delay
        Acall   CekSMSCommand           ; Tidak ada Perubahan Command
        JNC     C001                    ; Ulangi dan Tunggu Command SMS
        Clr     ALARM_On                ; Matikan ALARM
        Clr     TR0                     ; Matikan Timer 0
        Ret

;*****************************************************************
; Routine untuk Mengaktifkan Sistem Keamanan Mobil
; - Lampu dan Sirine    = Aktif Sebanyak 2 kali
;                       = Aktif apabila ada input dari Saklar Pintu
;                         atau Kunci Kontak ( Ada Pengganggu )
; - Mesin               = Tidak Aktif
; - Lock                = Aktif Selama 5 Detik
; - Unlock              = Tidak Aktif
;*****************************************************************
Aktifkan_Alarm:
;*************** Matikan Relay Mesin dan Relay UnLock
        Clr     Relay_LampuSirine       ; Matikan Lampu dan Sirine
        Clr     Relay_Mesin
        Clr     Relay_UnLock
        Clr     Relay_Lock

;-------------- Aktifkan Relay Lock Selama 5 Detik
        Setb    Relay_Lock              ; Lock ON
        Acall   Delay5Aktif             ; Selama 5 detik
        JNB     TimerHabis,*            ; Tunggu di Sini
        Clr     Relay_Lock              ; Matikan Relay Lock

;-------------- Aktifkan Relay Lampu dan Sirine Sebanyak 2 kali
        Setb    Relay_LampuSirine       ; Aktifkan Lampu dan Sirine
        Acall   Delay025Aktif           ; Selama 1 Detik
        JNB     TimerHabis,*            ; Tunggu di Sini
        Clr     Relay_LampuSirine       ; Matikan Lampu dan Sirine
        Acall   Delay025Aktif           ; Selama 1/2 Detik
        JNB     TimerHabis,*            ; Tunggu di Sini
        Setb    Relay_LampuSirine       ; Aktifkan Lampu dan Sirine
        Acall   Delay025Aktif           ; Selama 1 Detik
        JNB     TimerHabis,*            ; Tunggu di Sini
        Clr     Relay_LampuSirine       ; Matikan Lampu dan Sirine

;-------------- Periksa Saklar Pintu dan Kunci Kontak
C002:   JNB     SaklarPintu,AlarmON
        JNB     KunciKontak,AlarmON
        Acall   Delay                   ;
```

```
        Acall   CekSMSCommand
        JNC     C002
        Ret
;-------------- Alarm Sudah Dinyalakan !
AlarmON:
        Setb    Relay_LampuSirine       ; Nyalakan Sirine dan Lampu
        Mov     Pencacah5,#5
        Setb    Alarm_On
        Acall   Delay025Aktif           ; Selama 1/2 Detik

        Acall   KirimSMSBahaya          ; Kirim SMS Bahaya
C003:   Acall   Delay                   ;
        Acall   CekSMSCommand           ; Tidak ada Perubahan Command
        JNC     C003                    ; Ulangi dan Tunggu Command SMS
        Clr     Alarm_On                ; Matikan ALARM
        Clr     TR0                     ; Timer Alarm Dimatikan!!!!
        Ret

;*****************************************************************
; Routine untuk membuka pintu mobil
; - Lampu dan Sirine    = Tidak Aktif
; - Mesin               = Tunggu Input Kunci Kontak
; - Lock                = Tidak Aktif
; - Unlock              = Aktif Selama 5 Detik
;*****************************************************************
Membuka_Pintu:
        Clr     Relay_LampuSirine       ; Matikan relay Lampu dan Sirine
        Clr     Relay_Lock              ; Matikan Relay Lock/kunci pintu
        Clr     Relay_Mesin             ; Matikan relay Mesin

        Setb    Relay_UnLock            ; Kunci dibuka
        Acall   Delay5Aktif             ; Selama 5 detik
Time    JB      TimerHabis,Do_Unlock    ; Tunggu di Sini
Kontak? JNB     KunciKontak,NyalakanRelayMesin
        Clr     Relay_Mesin
        Ajmp    Time
NyalakanRelayMesin:
        Setb    Relay_Mesin
        Ajmp    Time

Do_Unlock:
        Clr     Relay_Unlock            ; Sudah, Matikan relay Unlock

; ------------- Cek Kunci Kontak apakah ON???
        Ajmp    CekKontak

;*****************************************************************
; Routine untuk mengunci pintu mobil
; - Lampu dan Sirine    = Aktif Selama 1 Detik
; - Mesin               = Tunggu Input Kunci Kontak
; - Lock                = Aktif Selama 5 Detik
; - Unlock              = Tidak Aktif
;*****************************************************************
Mengunci_Pintu:
        Clr     Relay_UnLock            ; Matikan Relay UnLock
        Setb    Relay_LampuSirine       ; Aktifkan Relay Lampu Sirine
        Setb    Relay_Lock              ; Aktifkan Kunci Pintu
        Acall   Delay5Aktif             ; Delay selama 5 detik dan cek 1 dtk
Cek3Kondisi:
        JB      KunciKontak,L000        ; Apakah Kunci Kontak aktif??
        Setb    Relay_Mesin             ; Ya, maka Hidupkan Relay Mesin
        Ajmp    L003
```

```
.000:   Clr     Relay_Mesin
.003    JNB     Sudah05Detik,L001       ; Apakah sudah 1 detik?
        Clr     Relay_LampuSirine       ; Ya, Matikan relay Lampu dan Sirine
.001:   JNB     TimerHabis,Cek3Kondisi  ; Apakah Sudah 5 Detik?
        Clr     Relay_Lock              ; Matikan Relay kunci pintu

; ------------- Cek Kunci Kontak apakah ON???
:ekKontak:
        JB      KunciKontak,MesinOFF
        Setb    Relay_Mesin
        Ajmp    M001
1esinOFF:
        Clr     Relay_Mesin
M001:   Acall   Delay
        Acall   CekSMSCommand           ; Output = R6=> COMMAND
        JNC     CekKontak               ; Kalau Carry SET maka ada SMS Baru
        Ret

;*************************************************************
_oopKirimString:
        Lcall   SerialOut
        Inc     DPTR
(irimString:
        Clr     A
        MovC    A,@A+DPTR
        JNZ     LoopKirimString
        Ret

_oopsString:
        Acall   Out2Hex
        Inc     DPTR
(irimString1:
        Clr     A
        MovC    A,@A+DPTR
        JNZ     LoopsString
        Ret
;*************************************************************
Swarning        db      'Awas mobil anda dicuri !',$00
STujuan1        db      '08123168169'$00
STujuan2        db      '081558007998'$00
;*************************************************************
CommandList:
SMSBUKA         db      'C2EA3208',$00                  ;=> BUKA   1
SMSKUNCI        db      'CBAA739804',$00                ;=> KUNCI  2
SMSAKTIF        db      'C125356904',$00                ;=> AKTIF  3
SMSBAHAYA       db      'C22032980D02',$00              ;=> BAHAYA 4

;*****************************************************************************
;*****************************************************************************
* 628123168169  => 0C 261832611896
* 6281558007998 => 0D 261855087099F8
;*****************************************************************************
*----------------        SC    PDU   MR  DA                    DCS  Oktet VP
*                        ^     ^     ^   ^                     ^    ^     ^
*SMSFrame:      db      '00','31','00','0C91261856148146','00','00','A7',$00
*                                      '0C91261832611896'
*                                     ,'0D91261855087099F8'
;*****************************************************************************
;SMSFrame1:     db      '02','81','F1','11','69',$00
SMSFrame1:      db      '00','31','00',$00
SMSFrame2:      db      '00','00','FF',$00
;SMSDICURI      db      'AWAS MOBIL ANDA DICURI',$00
```

```
;MSDICURI       db      '16C16B700A6A3E85492628E8240641C4E4B02A4D02',$1A,$00
                        ;=> AWAS MOBIL ANDA DICURI
;---------------
;*************************************************************************
; -- AT COMMAND SET:
;ATCMGS          db      'AT+CMGS=140',$0D,$00           ; Kirim  SMS Awas...
;ATCMGL          db      'AT+CMGL=0',$0D,$00             ; Ambil  SMS Baru...
;ATCMGD          db      'AT+CMGD=1',$0D,$00             ; Delete SMS ke-1
;ATZ             db      'ATZ',$0D,$00                   ; Reset Param
;ATCPBR1         db      'AT+CPBR=1',$0D,$00             ;
;ATCPBR2         db      'AT+CPBR=2',$0D,$00             ;
;ATCMGR          db      'AT+CMGR=',$00                  ;
;*************************************************************************
Out2Hex:
        Push    0
        Acall   Out2h2
        Pop     0
        Ret

Out2H2: Mov     R0,A
        Swap    A
        Acall   Out1H
        Mov     A,R0
Out1H:  ANL     A,#$0F
        Acall   Htoa
        Acall   SerialOut
        Ret

;*************************************************************************
* Hex To ASCII Conversion
* Input  : hex nibble in accumulator a.0 - a.7
* Output : ASCII code in accumulator
;*************************************************************************
Htoa:   Anl     A,#$0F
        CJNE    A,#$0A,*+3
        JC      Htoa2
        Add     A,#7
Htoa2:  Add     A,#'0'
        Ret

SerialOut:
        JNB     TI,*
        CLR     TI
        Mov     SBUF,A
SerialIn:
        JNB     RI,*
        Clr     RI
        Mov     A,SBUF
        Ret
;*************************************************************
;*************************************************************************
; Input data from Serial
; Dengan menggunakan R0 dan B sebagai tanda
; ada/tidak ada balasan pada jangka waktu tertentu
; ada balasan           : tidak timeout
; tidak ada balasan     ; timeout
;*************************************************************************
SerialTimeout:
        Push    B
        Push    0
        Mov     R0,#$0
```

```
Pol:    JB      RI,AmbilSerial
        DJNZ    B,Pol
        DJNZ    R0,Pol
        Pop     0
        Pop     B
        Setb    C                       ; Tidak Ada Serial dan Timeout
        Ret
;*************************************************************************
; Ada balasan, Ambil data pada serial
;*************************************************************************
AmbilSerial:
        Clr     RI
        Mov     A,Sbuf
        Pop     0
        Pop     B
        Clr     C                       ; Ada Serial dan data ada di A
        Ret

;*************************************************************
InitSerial19200:
        Mov     A,PCON
        Setb    A.7
        Mov     PCON,A
        Mov     SCON,#%01010010         ; Serial Control Activated
        Mov     Tmod,#$20               ;
        Mov     TH1,#-3
        Setb    TR1
        Ret
;*************************************************************
Delay5Aktif:
        Mov     Pencacah5,#100          ; Nilai awalnya 100
        Ajmp    Set
Delay1Aktif:
        Mov     Pencacah5,#20           ; Nilai awalnya 20
        Ajmp    Set

Delay025Aktif:
        Mov     Pencacah5,#5            ; Nilai awalnya 10
Set     Clr     Sudah05Detik
        Mov     A,Tmod                  ; Save Tmod
        Anl     A,#$F0                  ; Ambil 4 bit MSB
        Orl     A,#$01                  ; Timer 0 activated
        Mov     TH0,#KonstantaWaktu/256 ; Interupsi 20 kali/detik
        Mov     TL0,#KonstantaWaktu
        Clr     TimerHabis
        Setb    ET0                     ; Aktipkan interupsi Timer 0
        Setb    EA                      ; Aktipkan Sistem interupsi
        Setb    TR0                     ; Jalankan Timer 0
        Ret

;*************************************************************
InterupsiTimer0:
        Push    PSW
        JB      ALARM_On,ToggleSirine

        Mov     TL0,#KonstantaWaktu             ; Ambil Nilai Timer LSB
        Mov     TH0,#KonstantaWaktu/256         ; Ambil Nilai Timer MSB
        Mov     R7,Pencacah5                    ; Ambil Pencacah 20
        Setb    Sudah05Detik                    ; Ya, Sudah 1 Detik
Not1:   DJNZ    Pencacah5,SelesaiInterupsi      ; Decrement Pencacah
        Setb    TimerHabis                      ; Kalau sudah Nol,Timer Habis
        Clr     ET0                             ; Clear ET0, Matikan Timer
```

```
        Clr     TR0                             ; Timer Stop
;**** Terjadi sekali dalam waktu 1 detik
SelesaiInterupsi:
        Pop     PSW                             ;
        Reti
ToggleSirine
        DJNZ    Pencacah5,SelesaiInterupsi
        Mov     Pencacah5,#5
        CPL     Relay_LampuSirine
        Pop     PSW
        Reti

Delay:
        Mov     B,#0
Pd0:    Push    B
        Mov     B,#0
        DJNZ    B,*
        Pop     B
        DJNZ    B,Pd0
        Ret

Ambil_PDU_SMS:
        Acall   Ambil_NomerSC
        Acall   Ambil2Byte
        Acall   Ambil_NomerHP
        Mov     B,#$09
        Acall   Ambil_BerapaByte        ; Ambil 18 Byte
        Acall   GetByte                 ; Get Panjang Command
        CJNE    A,#$07,*+3              ; Lebih besar/=7 bukan Command
        JNC     NotCommand

        Mov     R0,#Command
        RL      A
        Mov     B,A
        Mov     R0,#Command
L_0089: Lcall   SerialIn
        Mov     @R0,A
        Inc     R0
        DJNZ    B,L_0089
        Acall   AmbilEnd
        Acall   AmbilEnd
        Acall   AmbilEnd
        Acall   CommandKe?              ; Output di R6
        Clr     C                       ; No Error
        Ret
NotCommand:
        Acall   AmbilEnd
        Acall   AmbilEnd
        Acall   AmbilEnd
        Setb    C                       ; With Error
        Ret


Isi     db      '059126181642240C91261856148146000040302032940482O6C22032980D02',$00

;*************************************************************************
Ambil_NomerHP:
        Acall   GetByte
        JNB     A.0,TdkTambah
        Inc     A
TdkTambah:
```

```
                                        Program
        Push    A                       ; Simpan A
        Acall   Ambil2Byte              ; Ambil $81/$91
        Pop     A                       ; Ambil A
        Mov     B,A                     ; Ambil nilai A
;er01   Acall   SerialIn
        DJNZ    B,Ser01
        Ret
;*************************************************************************
Ambil_NomerSC:
        Acall   GetByte
        Mov     B,A
Ambil_BerapaByte:
        Acall   Ambil2Byte
        DJNZ    B,Ambil_BerapaByte
        Ret
;*************************************************************************
HapusCommand:
        Mov     R0,#Command
HapusRAM:
        Push    A               ; Simpan A
        Push    B               ; Simpan B
        Mov     B,#14           ; B = 14
L_0032: Clr     A               ; A=0
        Mov     @R0,A           ; Simpan di Alamat R0
        Inc     R0              ; r0=r0+1
        DJNZ    B,L_0032        ; Loop Sampai B Habis (B=B-1)
        Pop     B               ; Ambil B
        Pop     A               ; Ambil A
        Ret

;*************************************************************************
*// ASCII To Hex Conversion
*// Input  : ASCII code in accumulator
*// Output : hex nibble in accumulator a.0 - a.7
;*************************************************************************
GetByte:
        Push    B
        Acall   SerialIn
        Acall   Atoh
        Swap    A
        Mov     B,A
        Acall   SerialIn
        Acall   Atoh
        ORL     A,B
        Pop     B
        Ret

Atoh:   CLR     A.7
        CJNE    A,#'9'+1,*+3
        JC      Atoh2
        Add     A,#9
Atoh2:  ANL     A,#$0F
        Ret
;*************************************************************************
AmbilEnd:
        Acall   SerialIn
        CJNE    A,#$0D,AmbilEnd
        Acall   SerialIn
        CJNE    A,#$0A,AmbilEnd
        Ret

Ambil0D0A:
```

```
Ambil2Byte:
        Acall   SerialIn
        Acall   SerialIn
        Ret

SerialIn1
        Clr     A
        MovC    A,@A+DPTR
        Inc     DPTR
        Ret

;*****************************************************************
; Ambil String dalam memory 'Command'
; Bandingkan dengan Code yang ada pada Code memory
; Jika Sama  => R6 = Perintah ke berapa?
;               R6 = #1 = BUKA
;               R6 = #2 = KUNCI
;               R6 = #3 = AKTIF
;               R6 = #4 = BAHAYA
; Tidak Sama => R6 = #JumlahCommand/#5
;*****************************************************************
CommandKe?:
        Mov     DPTR,#CommandList-1
        Mov     R6,#0
LoopCom Inc     R6                      ;
        Inc     DPTR
        CJNE    R6,#JumlahCommmand,Cari
        Setb    C
        Ret

Cari:   Acall   BandingkanCommand
        JC      LoopCom
        Ret
```

LAMPIRAN D
DATA SHEET

eatures

- Compatible with MCS-51™ Products
- 4K Bytes of In-System Reprogrammable Flash Memory
  - Endurance: 1,000 Write/Erase Cycles
- Fully Static Operation: 0 Hz to 24 MHz
- Three-Level Program Memory Lock
- 128 x 8-Bit Internal RAM
- 32 Programmable I/O Lines
- Two 16-Bit Timer/Counters
- Six Interrupt Sources
- Programmable Serial Channel
- Low Power Idle and Power Down Modes

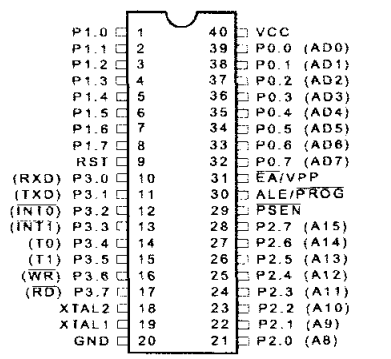
escription

he AT89C51 is a low-power, high-performance CMOS 8-bit microcomputer with 4K ytes of Flash Programmable and Erasable Read Only Memory (PEROM). The evice is manufactured using Atmel's high density nonvolatile memory technology nd is compatible with the industry standard MCS-51™ instruction set and pinout. The n-chip Flash allows the program memory to be reprogrammed in-system or by a con- entional nonvolatile memory programmer. By combining a versatile 8-bit CPU with ash on a monolithic chip, the Atmel AT89C51 is a powerful microcomputer which rovides a highly flexible and cost effective solution to many embedded control appli- ations.

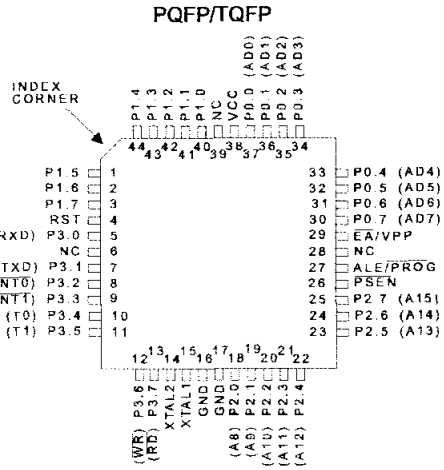
(continued)

in Configurations

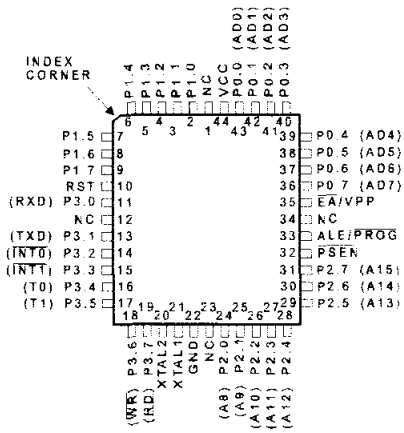
PDIP



PQFP/TQFP



PLCC

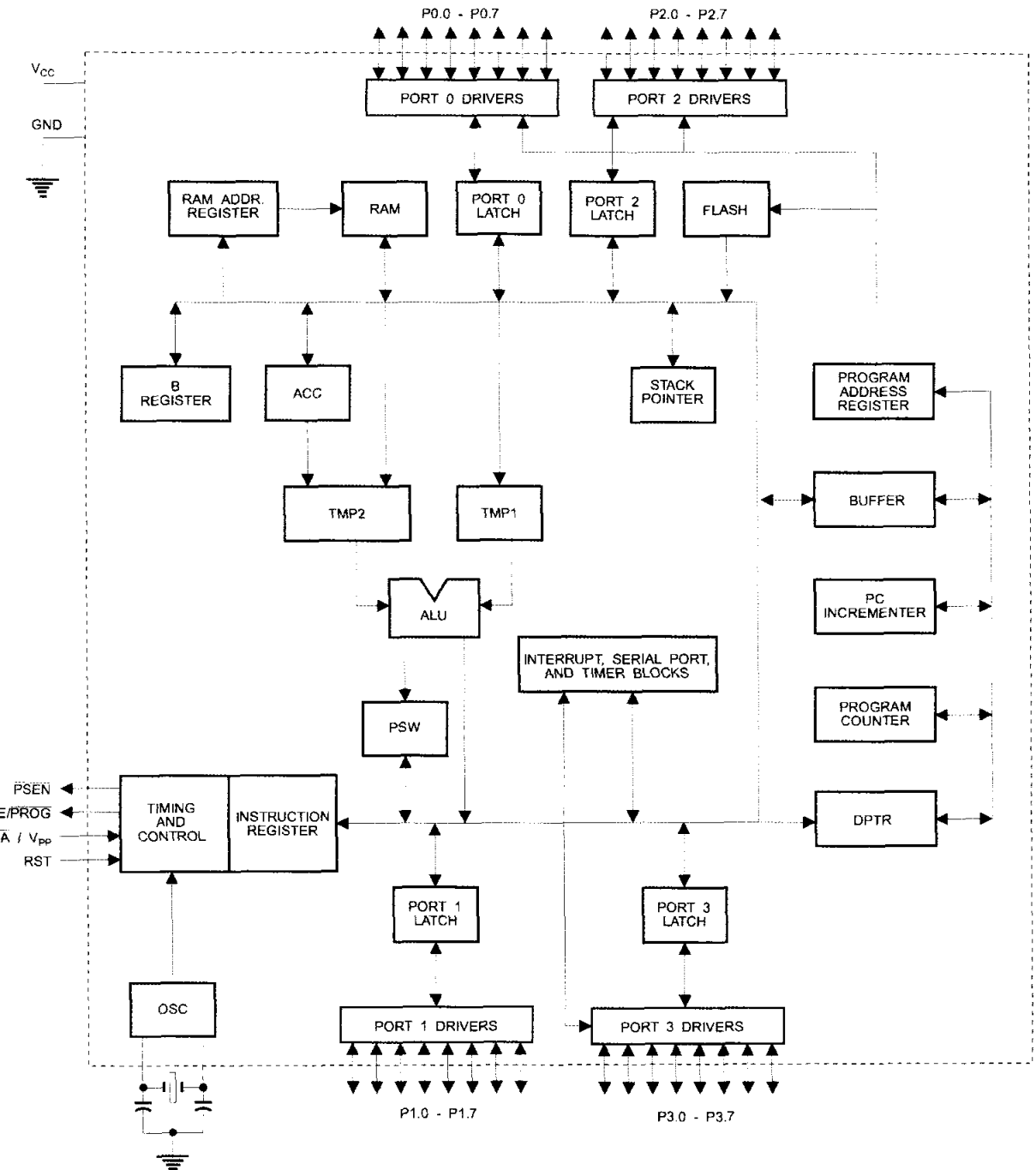


8-Bit Microcontroller with 4K Bytes Flash

AT89C51

0265F-A–12/97

ck Diagram


P0.0 - P0.7
P2.0 - P2.7
VCC
GND
PORT 0 DRIVERS
PORT 2 DRIVERS
RAM ADDR. REGISTER
RAM
PORT 0 LATCH
PORT 2 LATCH
FLASH
B REGISTER
ACC
STACK POINTER
PROGRAM ADDRESS REGISTER
TMP2
TMP1
BUFFER
ALU
PC INCREMENTER
INTERRUPT, SERIAL PORT, AND TIMER BLOCKS
PSW
PROGRAM COUNTER
PSEN
E/PROG
A / VPP
RST
TIMING AND CONTROL
INSTRUCTION REGISTER
DPTR
PORT 1 LATCH
PORT 3 LATCH
OSC
PORT 1 DRIVERS
PORT 3 DRIVERS
P1.0 - P1.7
P3.0 - P3.7

ne AT89C51 provides the following standard features: 4K ytes of Flash, 128 bytes of RAM, 32 I/O lines, two 16-bit ner/counters, a five vector two-level interrupt architecture, full duplex serial port, on-chip oscillator and clock cir- uitry. In addition, the AT89C51 is designed with static logic r operation down to zero frequency and supports two oftware selectable power saving modes. The Idle Mode ops the CPU while allowing the RAM, timer/counters, erial port and interrupt system to continue functioning. The ower Down Mode saves the RAM contents but freezes e oscillator disabling all other chip functions until the next ardware reset.

in Description

cc
upply voltage.

ND
round.

ort 0
ort 0 is an 8-bit open drain bidirectional I/O port. As an utput port each pin can sink eight TTL inputs. When 1s re written to port 0 pins, the pins can be used as high- npedance inputs.

ort 0 may also be configured to be the multiplexed low- rder address/data bus during accesses to external pro- ram and data memory. In this mode P0 has internal pul- ps.

ort 0 also receives the code bytes during Flash program- ing, and outputs the code bytes during program verifica- on. External pullups are required during program verifica- on.

ort 1
ort 1 is an 8-bit bidirectional I/O port with internal pullups. he Port 1 output buffers can sink/source four TTL inputs. /hen 1s are written to Port 1 pins they are pulled high by e internal pullups and can be used as inputs. As inputs, ort 1 pins that are externally being pulled low will source urrent (I_{IL}) because of the internal pullups.

ort 1 also receives the low-order address bytes during lash programming and verification.

ort 2
ort 2 is an 8-bit bidirectional I/O port with internal pullups. he Port 2 output buffers can sink/source four TTL inputs. /hen 1s are written to Port 2 pins they are pulled high by e internal pullups and can be used as inputs. As inputs, ort 2 pins that are externally being pulled low will source urrent (I_{IL}) because of the internal pullups.

ort 2 emits the high-order address byte during fetches rom external program memory and during accesses to xternal data memory that use 16-bit addresses (MOVX @ PTR). In this application it uses strong internal pullups 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 bidirectional I/O port with internal pullups. 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 pullups 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 pullups.

Port 3 also serves the functions of various special features of the AT89C51 as listed below:

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)

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

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 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.

hen the AT89C51 is executing code from external pro-
am memory, PSEN is activated twice each machine
cle, except that two PSEN activations are skipped during
ch access to external data memory.

Ā/V_{PP}

ternal Access Enable. EA must be strapped to GND in
der to enable the device to fetch code from external pro-
am memory locations starting at 0000H up to FFFFH.
te, however, that if lock bit 1 is programmed, EA will be
ernally latched on reset.

Ā should be strapped to V_{CC} for internal program execu-
ns.

is pin also receives the 12-volt programming enable volt-
e (V_{PP}) during Flash programming, for parts that require
-volt V_{PP}.

TAL1

put to the inverting oscillator amplifier and input to the
ternal clock operating circuit.

TAL2

utput from the inverting oscillator amplifier.

Oscillator Characteristics

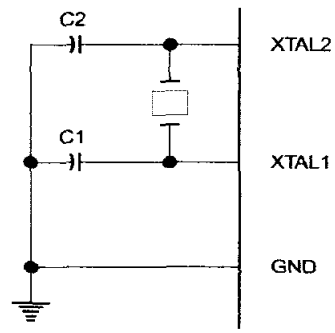
TAL1 and XTAL2 are the input and output, respectively,
an inverting amplifier which can be configured for use as
n on-chip oscillator, as shown in Figure 1. Either a quartz
ystal or ceramic resonator may be used. To drive the
evice from an external clock source, XTAL2 should be left
nconnected while XTAL1 is driven as shown in Figure 2.
here are no requirements on the duty cycle of the external
ock signal, since the input to the internal clocking circuitry
through a divide-by-two flip-flop, but minimum and maxi-
um voltage high and low time specifications must be
bserved.

Idle Mode

idle mode, the CPU puts itself to sleep while all the on-
hip peripherals remain active. The mode is invoked by
ftware. The content of the on-chip RAM and all the spe-
al functions registers remain unchanged during this
ode. The idle mode can be terminated by any enabled
terrupt or by a hardware reset.

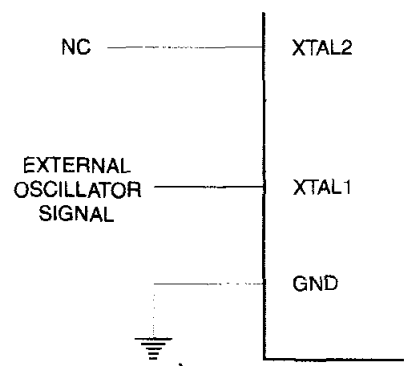
It should be noted that when idle is terminated by a hard ware reset, the device normally resumes program execution, from where it left off, up to two machine cycles before the internal reset algorithm takes control. On-chip hardware inhibits access to internal RAM in this event, but access to the port pins is not inhibited. To eliminate the possibility of an unexpected write to a port pin when Idle is terminated by reset, the instruction following the one that invokes Idle should not be one that writes to a port pin or to external memory.

Figure 1. Oscillator Connections



Note: C1, C2 = 30 pF ± 10 pF for Crystals
= 40 pF ± 10 pF for Ceramic Resonators

Figure 2. External Clock Drive Configuration



Status of External Pins During Idle and Power Down Modes

Mode	Program Memory	ALE	PSEN	PORT0	PORT1	PORT2	PORT3
dle	Internal	1	1	Data	Data	Data	Data
dle	External	1	1	Float	Data	Address	Data
Power Down	Internal	0	0	Data	Data	Data	Data
Power Down	External	0	0	Float	Data	Data	Data

ower Down Mode

the power down mode the oscillator is stopped, and the struction that invokes power down is the last instruction ecuted. The on-chip RAM and Special Function Regis- rs retain their values until the power down mode is termi- ited. The only exit from power down is a hardware reset. eset redefines the SFRs but does not change the on-chip AM. The reset should not be activated before V_{CC} is stored to its normal operating level and must be held tive long enough to allow the oscillator to restart and sta- lize.

Program Memory Lock Bits

On the chip are three lock bits which can be left unprogrammed (U) or can be programmed (P) to obtain the additional features listed in the table below:

When lock bit 1 is programmed, the logic level at the $\overline{EA}$ pin is sampled and latched during reset. If the device is powered up without a reset, the latch initializes to a random value, and holds that value until reset is activated. It is necessary that the latched value of $\overline{EA}$ be in agreement with the current logic level at that pin in order for the device to function properly.

ock Bit Protection Modes

Program Lock Bits				Protection Type
	LB1	LB2	LB3	
1	U	U	U	No program lock features.
2	P	U	U	MOVC instructions executed from external program memory are disabled from fetching code bytes from internal memory, $\overline{EA}$ is sampled and latched on reset, and further programming of the Flash is disabled.
3	P	P	U	Same as mode 2, also verify is disabled.
4	P	P	P	Same as mode 3, also external execution is disabled.

rogramming the Flash

ne AT89C51 is normally shipped with the on-chip Flash emory array in the erased state (that is, contents = FFH) nd ready to be programmed. The programming interface ccepts either a high-voltage (12-volt) or a low-voltage $_{CC}$) program enable signal. The low voltage programming mode provides a convenient way to program the T89C51 inside the user's system, while the high-voltage rogramming mode is compatible with conventional third arty Flash or EPROM programmers.

he AT89C51 is shipped with either the high-voltage or w-voltage programming mode enabled. The respective p-side marking and device signature codes are listed in e following table.

	V_{PP} = 12V	V_{PP} = 5V
Top-Side Mark	AT89C51 xxxx yyww	AT89C51 xxxx-5 yyww
Signature	(030H)=1EH (031H)=51H (032H)=FFH	(030H)=1EH (031H)=51H (032H)=05H

he AT89C51 code memory array is programmed byte-by- yte in either programming mode. *To program any non- lank byte in the on-chip Flash Memory, the entire memory ust be erased using the Chip Erase Mode.*

Programming Algorithm: Before programming the AT89C51, the address, data and control signals should be set up according to the Flash programming mode table and Figures 3 and 4. To program the AT89C51, take the following steps.

1. Input the desired memory location on the address lines.
2. Input the appropriate data byte on the data lines.
3. Activate the correct combination of control signals.
4. Raise $\overline{EA}/V_{PP}$ to 12V for the high-voltage programming mode.
5. Pulse ALE/$\overline{PROG}$ once to program a byte in the Flash array or the lock bits. The byte-write cycle is self-timed and typically takes no more than 1.5 ms. Repeat steps 1 through 5, changing the address and data for the entire array or until the end of the object file is reached.

Data Polling: The AT89C51 features $\overline{Data}$ Polling to indicate the end of a write cycle. During a write cycle, an attempted read of the last byte written will result in the complement of the written datum on PO.7. Once the write cycle has been completed, true data are valid on all outputs, and the next cycle may begin. $\overline{Data}$ Polling may begin any time after a write cycle has been initiated.

Ready/$\overline{Busy}$: The progress of byte programming can also be monitored by the RDY/$\overline{BSY}$ output signal. P3.4 is pulled low after ALE goes high during programming to indicate BUSY. P3.4 is pulled high again when programming is done to indicate READY.

rogram Verify: If lock bits LB1 and LB2 have not been ogrammed, the programmed code data can be read back a the address and data lines for verification. The lock bits nnot be verified directly. Verification of the lock bits is chieved by observing that their features are enabled.

hip Erase: The entire Flash array is erased electrically using the proper combination of control signals and by olding ALE/$\overline{PROG}$ low for 10 ms. The code array is written th all "1"s. The chip erase operation must be executed efore the code memory can be re-programmed.

eading the Signature Bytes: The signature bytes are ad by the same procedure as a normal verification of cations 030H,

31H, and 032H, except that P3.6 and P3.7 must be pulled a logic low. The values returned are as follows.

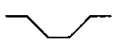
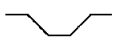
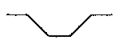
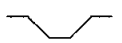
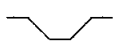
(030H) = 1EH indicates manufactured by Atmel
(031H) = 51H indicates 89C51
(032H) = FFH indicates 12V programming
(032H) = 05H indicates 5V programming

Programming Interface

Every code byte in the Flash array can be written and the entire array can be erased by using the appropriate combination of control signals. The write operation cycle is self-timed and once initiated, will automatically time itself to completion.

All major programming vendors offer worldwide support for the Atmel microcontroller series. Please contact your local programming vendor for the appropriate software revision.

Flash Programming Modes

Mode		RST	$\overline{PSEN}$	ALE/$\overline{PROG}$	$\overline{EA}$/V_{PP}	P2.6	P2.7	P3.6	P3.7
Write Code Data		H	L		H/12V	L	H	H	H
Read Code Data		H	L	H	H	L	L	H	H
Write Lock	Bit - 1	H	L		H/12V	H	H	H	H
	Bit - 2	H	L		H/12V	H	H	L	L
	Bit - 3	H	L		H/12V	H	L	H	L
Chip Erase		H	L	 (1)	H/12V	H	L	L	L
Read Signature Byte		H	L	H	H	L	L	L	L

ote: 1. Chip Erase requires a 10-ms $\overline{PROG}$ pulse.

gure 3. Programming the Flash

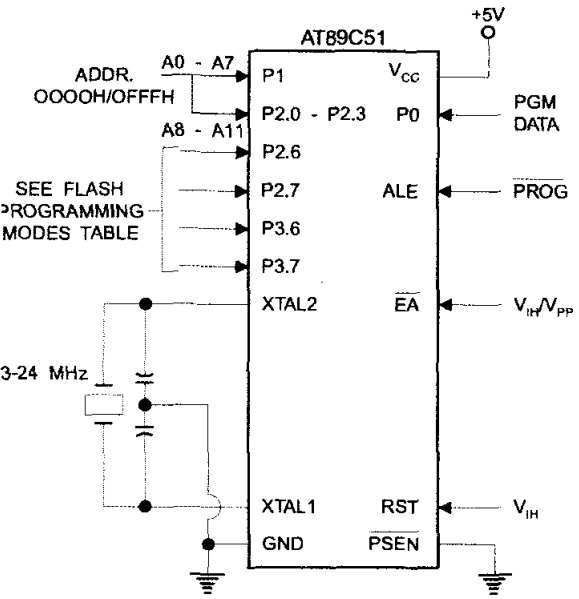
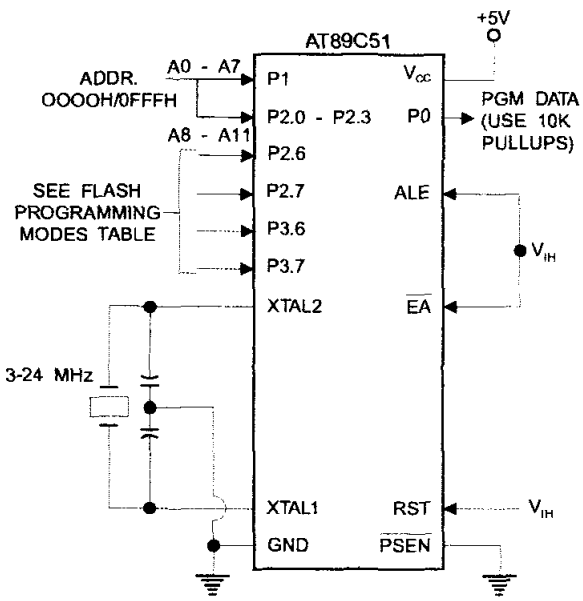


Figure 4. Verifying the Flash



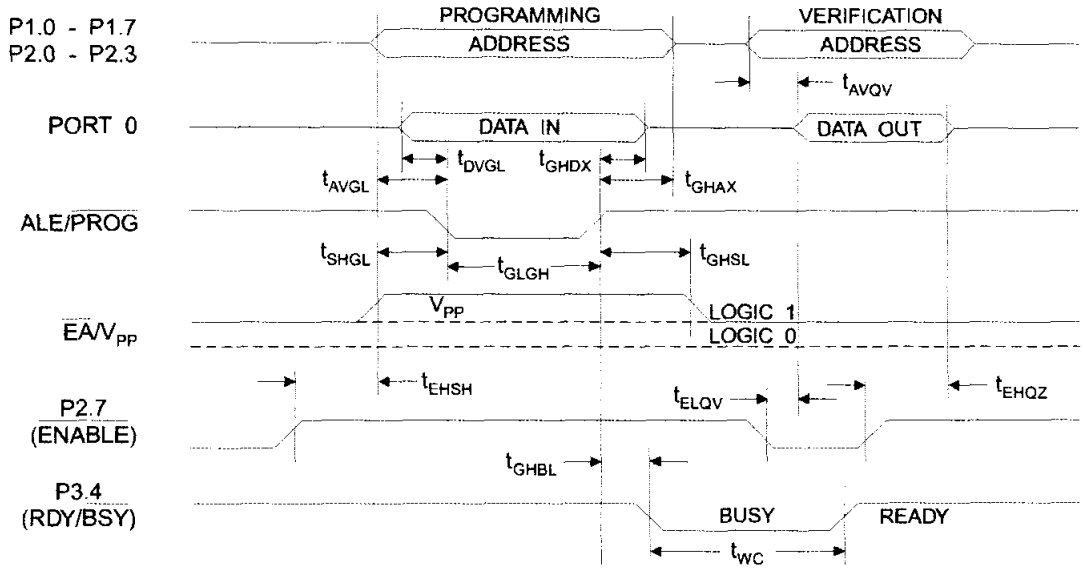
lash Programming and Verification Characteristics

$_A$ = 0°C to 70°C, V_{CC} = 5.0 ± 10%

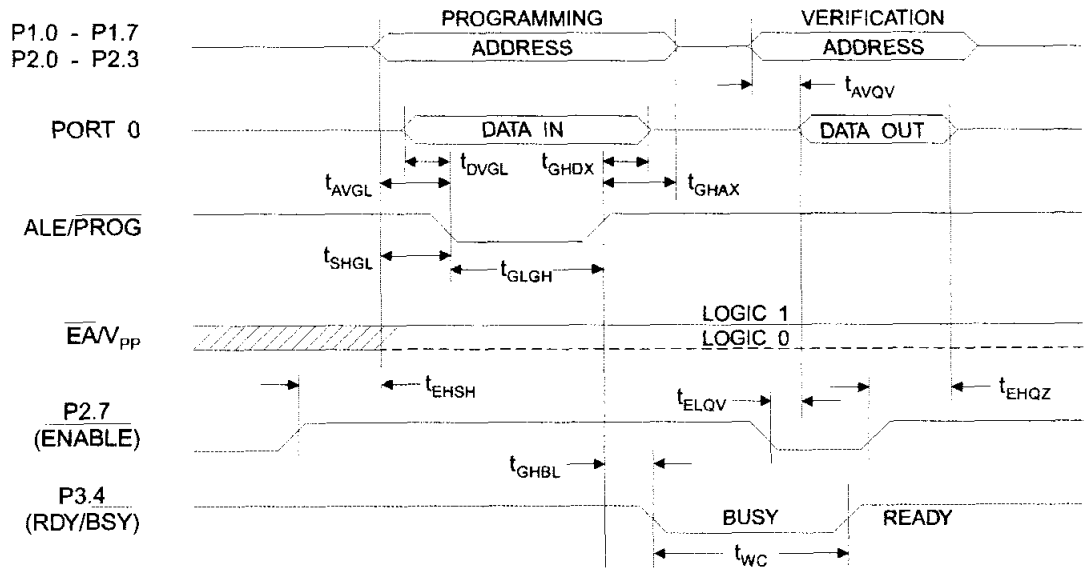
Symbol	Parameter	Min	Max	Units
V_{PP}[1]	Programming Enable Voltage	11.5	12.5	V
$_{PP}$[1]	Programming Enable Current		1.0	mA
$1/t_{CLCL}$	Oscillator Frequency	3	24	MHz
AVGL	Address Setup to $\overline{PROG}$ Low	$48t_{CLCL}$		
GHAX	Address Hold After $\overline{PROG}$	$48t_{CLCL}$		
DVGL	Data Setup to $\overline{PROG}$ Low	$48t_{CLCL}$		
GHDX	Data Hold After $\overline{PROG}$	$48t_{CLCL}$		
EHSH	P2.7 ($\overline{ENABLE}$) High to V_{PP}	$48t_{CLCL}$		
SHGL	V_{PP} Setup to $\overline{PROG}$ Low	10		µs
GHSL[1]	V_{PP} Hold After $\overline{PROG}$	10		µs
GLGH	$\overline{PROG}$ Width	1	110	µs
AVQV	Address to Data Valid		$48t_{CLCL}$	
ELQV	$\overline{ENABLE}$ Low to Data Valid		$48t_{CLCL}$	
EHQZ	Data Float After $\overline{ENABLE}$	0	$48t_{CLCL}$	
GHBL	$\overline{PROG}$ High to $\overline{BUSY}$ Low		1.0	µs
WC	Byte Write Cycle Time		2.0	ms

ote: 1. Only used in 12-volt programming mode.

lash Programming and Verification Waveforms - High Voltage Mode (V_{PP} = 12V)



lash Programming and Verification Waveforms - Low Voltage Mode (V_{PP} = 5V)



Absolute Maximum Ratings*

Operating Temperature	-55°C to +125°C
Storage Temperature	-65°C to +150°C
Voltage on Any Pin with Respect to Ground	-1.0V to +7.0V
Maximum Operating Voltage	6.6V
DC Output Current	15.0 mA

*NOTICE: Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

DC Characteristics

T_A = -40°C to 85°C, V_{CC} = 5.0V ± 20% (unless otherwise noted)

Symbol	Parameter	Condition	Min	Max	Units
V_{IL}	Input Low Voltage	(Except $\overline{EA}$)	-0.5	0.2 V_{CC} - 0.1	V
V_{IL1}	Input Low Voltage ($\overline{EA}$)		-0.5	0.2 V_{CC} - 0.3	V
V_{IH}	Input High Voltage	(Except XTAL1, RST)	0.2 V_{CC} + 0.9	V_{CC} + 0.5	V
V_{IH1}	Input High Voltage	(XTAL1, RST)	0.7 V_{CC}	V_{CC} + 0.5	V
V_{OL}	Output Low Voltage[1] (Ports 1,2,3)	I_{OL} = 1.6 mA		0.45	V
V_{OL1}	Output Low Voltage[1] (Port 0, ALE, $\overline{PSEN}$)	I_{OL} = 3.2 mA		0.45	V
V_{OH}	Output High Voltage (Ports 1,2,3, ALE, $\overline{PSEN}$)	I_{OH} = -60 µA, V_{CC} = 5V ± 10%	2.4		V
		I_{OH} = -25 µA	0.75 V_{CC}		V
		I_{OH} = -10 µA	0.9 V_{CC}		V
V_{OH1}	Output High Voltage (Port 0 in External Bus Mode)	I_{OH} = -800 µA, V_{CC} = 5V ± 10%	2.4		V
		I_{OH} = -300 µA	0.75 V_{CC}		V
		I_{OH} = -80 µA	0.9 V_{CC}		V
I_{IL}	Logical 0 Input Current (Ports 1,2,3)	V_{IN} = 0.45V		-50	µA
I_{TL}	Logical 1 to 0 Transition Current (Ports 1,2,3)	V_{IN} = 2V, VCC = 5V ± 10%		-650	µA
I_{LI}	Input Leakage Current (Port 0, $\overline{EA}$)	0.45 < V_{IN} < V_{CC}		±10	µA
R_{RST}	Reset Pulldown Resistor		50	300	KΩ
C_{IO}	Pin Capacitance	Test Freq. = 1 MHz, T_A = 25°C		10	pF
I_{CC}	Power Supply Current	Active Mode, 12 MHz		20	mA
		Idle Mode, 12 MHz		5	mA
	Power Down Mode[2]	V_{CC} = 6V		100	µA
		V_{CC} = 3V		40	µA

Notes:
1. Under steady state (non-transient) conditions, I_{OL} must be externally limited as follows:
   Maximum I_{OL} per port pin: 10 mA
   Maximum I_{OL} per 8-bit port: Port 0: 26 mA
   Ports 1, 2, 3: 15 mA
   Maximum total I_{OL} for all output pins: 71 mA
   If I_{OL} exceeds the test condition, V_{OL} may exceed the related specification. Pins are not guaranteed to sink current greater than the listed test conditions.
2. Minimum V_{CC} for Power Down is 2V.

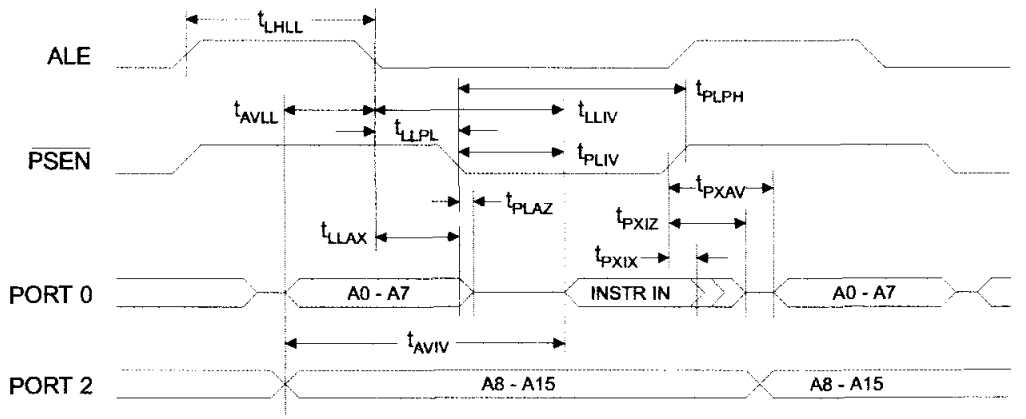
C Characteristics

Under Operating Conditions; Load Capacitance for Port 0, ALE/$\overline{PROG}$, and $\overline{PSEN}$ = 100 pF; Load Capacitance for all other utputs = 80 pF)

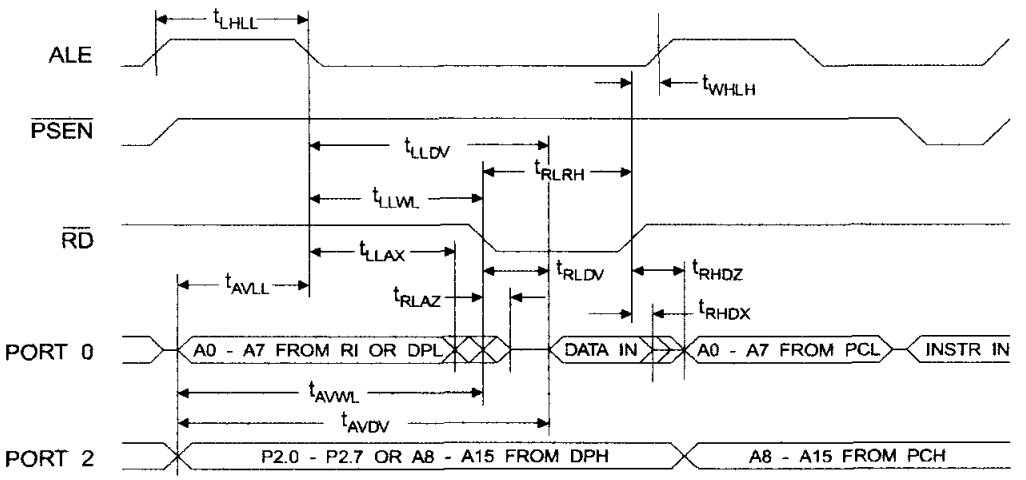
xternal Program and Data Memory Characteristics

Symbol	Parameter	12 MHz Oscillator		16 to 24 MHz Oscillator		Units
		Min	Max	Min	Max	
$1/t_{CLCL}$	Oscillator Frequency			0	24	MHz
t_{LHLL}	ALE Pulse Width	127		$2t_{CLCL}$-40		ns
t_{AVLL}	Address Valid to ALE Low	43		t_{CLCL}-13		ns
t_{LLAX}	Address Hold After ALE Low	48		t_{CLCL}-20		ns
t_{LLIV}	ALE Low to Valid Instruction In		233		$4t_{CLCL}$-65	ns
t_{LLPL}	ALE Low to $\overline{PSEN}$ Low	43		t_{CLCL}-13		ns
t_{PLPH}	$\overline{PSEN}$ Pulse Width	205		$3t_{CLCL}$-20		ns
t_{PLIV}	$\overline{PSEN}$ Low to Valid Instruction In		145		$3t_{CLCL}$-45	ns
t_{PXIX}	Input Instruction Hold After $\overline{PSEN}$	0		0		ns
t_{PXIZ}	Input Instruction Float After $\overline{PSEN}$		59		t_{CLCL}-10	ns
t_{PXAV}	$\overline{PSEN}$ to Address Valid	75		t_{CLCL}-8		ns
t_{AVIV}	Address to Valid Instruction In		312		$5t_{CLCL}$-55	ns
t_{PLAZ}	$\overline{PSEN}$ Low to Address Float		10		10	ns
t_{RLRH}	$\overline{RD}$ Pulse Width	400		$6t_{CLCL}$-100		ns
t_{WLWH}	$\overline{WR}$ Pulse Width	400		$6t_{CLCL}$-100		ns
t_{RLDV}	$\overline{RD}$ Low to Valid Data In		252		$5t_{CLCL}$-90	ns
t_{RHDX}	Data Hold After $\overline{RD}$	0		0		ns
t_{RHDZ}	Data Float After $\overline{RD}$		97		$2t_{CLCL}$-28	ns
t_{LLDV}	ALE Low to Valid Data In		517		$8t_{CLCL}$-150	ns
t_{AVDV}	Address to Valid Data In		585		$9t_{CLCL}$-165	ns
t_{LLWL}	ALE Low to $\overline{RD}$ or $\overline{WR}$ Low	200	300	$3t_{CLCL}$-50	$3t_{CLCL}$+50	ns
t_{AVWL}	Address to $\overline{RD}$ or $\overline{WR}$ Low	203		$4t_{CLCL}$-75		ns
t_{QVWX}	Data Valid to $\overline{WR}$ Transition	23		t_{CLCL}-20		ns
t_{QVWH}	Data Valid to $\overline{WR}$ High	433		$7t_{CLCL}$-120		ns
t_{WHQX}	Data Hold After $\overline{WR}$	33		t_{CLCL}-20		ns
t_{RLAZ}	$\overline{RD}$ Low to Address Float		0		0	ns
t_{WHLH}	$\overline{RD}$ or $\overline{WR}$ High to ALE High	43	123	t_{CLCL}-20	t_{CLCL}+25	ns

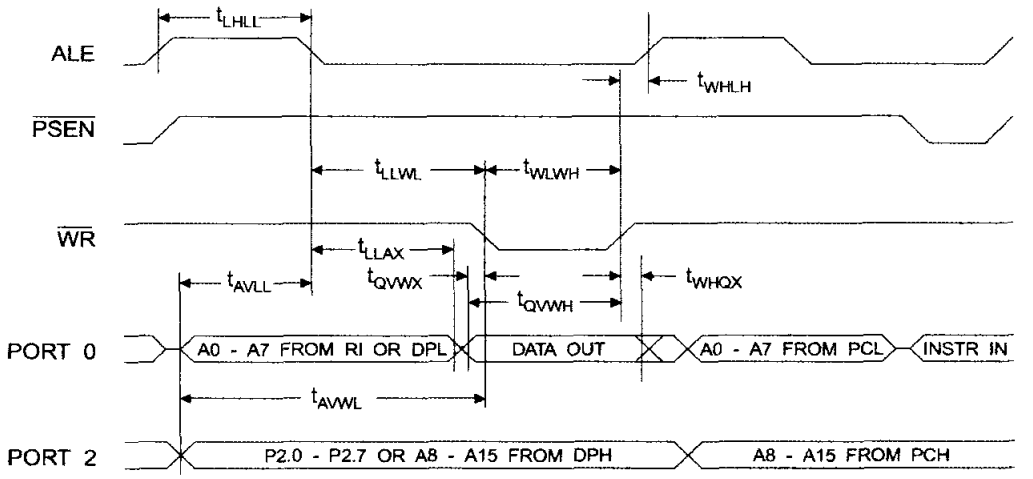
xternal Program Memory Read Cycle



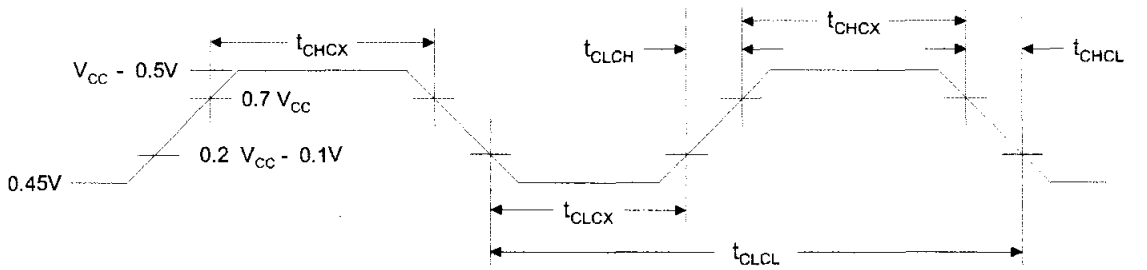
xternal Data Memory Read Cycle



xternal Data Memory Write Cycle



xternal Clock Drive Waveforms



xternal Clock Drive

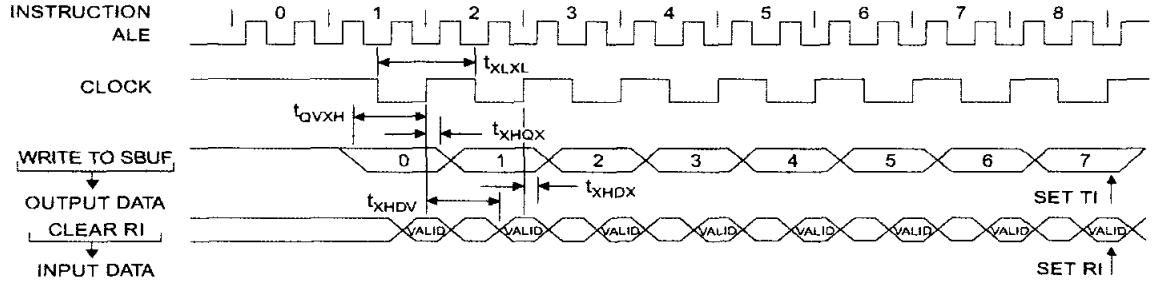
Symbol	Parameter	Min	Max	Units
$1/t_{CLCL}$	Oscillator Frequency	0	24	MHz
t_{CLCL}	Clock Period	41.6		ns
t_{CHCX}	High Time	15		ns
t_{CLCX}	Low Time	15		ns
t_{CLCH}	Rise Time		20	ns
t_{CHCL}	Fall Time		20	ns

erial Port Timing: Shift Register Mode Test Conditions

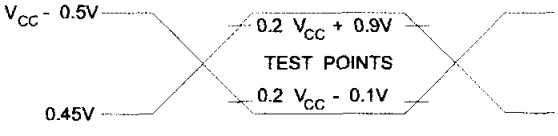
V_{CC} = 5.0 V ± 20%; Load Capacitance = 80 pF)

Symbol	Parameter	12 MHz Osc		Variable Oscillator		Units
		Min	Max	Min	Max	
t_{XLXL}	Serial Port Clock Cycle Time	1.0		$12t_{CLCL}$		µs
t_{QVXH}	Output Data Setup to Clock Rising Edge	700		$10t_{CLCL}$-133		ns
t_{XHQX}	Output Data Hold After Clock Rising Edge	50		$2t_{CLCL}$-117		ns
t_{XHDX}	Input Data Hold After Clock Rising Edge	0		0		ns
t_{XHDV}	Clock Rising Edge to Input Data Valid		700		$10t_{CLCL}$-133	ns

hift Register Mode Timing Waveforms

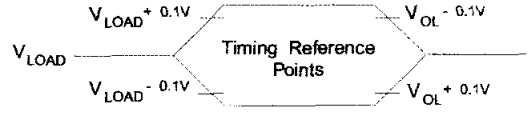


AC Testing Input/Output Waveforms[1]



ote: 1. AC Inputs during testing are driven at V_{CC} - 0.5V for a logic 1 and 0.45V for a logic 0. Timing measurements are made at V_{IH} min. for a logic 1 and V_{IL} max. for a logic 0.

Float Waveforms[1]



Note: 1. For timing purposes, a port pin is no longer floating when a 100 mV change from load voltage occurs. A port pin begins to float when 100 mV change from the loaded V_{OH}/V_{OL} level occurs.

Ordering Information

Speed (MHz)	Power Supply	Ordering Code	Package	Operation Range
12	5V ± 20%	AT89C51-12AC	44A	Commercial
		AT89C51-12JC	44J	(0°C to 70°C)
		AT89C51-12PC	40P6	
		AT89C51-12QC	44Q	
		AT89C51-12AI	44A	Industrial
		AT89C51-12JI	44J	(-40°C to 85°C)
		AT89C51-12PI	40P6	
		AT89C51-12QI	44Q	
		AT89C51-12AA	44A	Automotive
		AT89C51-12JA	44J	(-40°C to 105°C)
		AT89C51-12PA	40P6	
		AT89C51-12QA	44Q	
16	5V ± 20%	AT89C51-16AC	44A	Commercial
		AT89C51-16JC	44J	(0°C to 70°C)
		AT89C51-16PC	40P6	
		AT89C51-16QC	44Q	
		AT89C51-16AI	44A	Industrial
		AT89C51-16JI	44J	(-40°C to 85°C)
		AT89C51-16PI	40P6	
		AT89C51-16QI	44Q	
		AT89C51-16AA	44A	Automotive
		AT89C51-16JA	44J	(-40°C to 105°C)
		AT89C51-16PA	40P6	
		AT89C51-16QA	44Q	
20	5V ± 20%	AT89C51-20AC	44A	Commercial
		AT89C51-20JC	44J	(0°C to 70°C)
		AT89C51-20PC	40P6	
		AT89C51-20QC	44Q	
		AT89C51-20AI	44A	Industrial
		AT89C51-20JI	44J	(-40°C to 85°C)
		AT89C51-20PI	40P6	
		AT89C51-20QI	44Q	

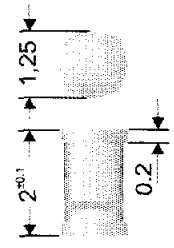
Ordering Information

Speed (MHz)	Power Supply	Ordering Code	Package	Operation Range
24	5V ± 20%	AT89C51-24AC	44A	Commercial (0°C to 70°C)
		AT89C51-24JC	44J	
		AT89C51-24PC	44P6	
		AT89C51-24QC	44Q	
		AT89C51-24AI	44A	Industrial (-40°C to 85°C)
		AT89C51-24JI	44J	
		AT89C51-24PI	44P6	
		AT89C51-24QI	44Q	

	Package Type
44A	44 Lead, Thin Plastic Gull Wing Quad Flatpack (TQFP)
44J	44 Lead, Plastic J-Leaded Chip Carrier (PLCC)
40P6	40 Lead, 0.600" Wide, Plastic Dual Inline Package (PDIP)
44Q	44 Lead, Plastic Gull Wing Quad Flatpack (PQFP)

Surface mount Zener Diodes
Zener-Dioden für die Oberflächenmontage

Version 2004-05-04



Dimensions / Maße in mm

Power dissipation – Verlustleistung	500 mW
Nominal Zener voltage Nominale Zener-Spannung	1...100 V
Glass case Glasgehäuse	Quadro-MicroMELF
Weight approx. – Gewicht ca.	0.01 g
Standard packaging taped and reeled Standard Lieferform gegurtet auf Rolle	

Marking: The ring denotes "cathode"
The type numbers are noted only on the lable on the reel
Kennzeichnung: Der Ring kennzeichnet die "Kathode"
Die Typenbezeichnungen sind nur auf dem Rollenaufkleber vermerkt

Standard Zener voltage tolerance is graded to the international E 24 (~5%) standard.
Other voltage tolerances and higher Zener voltages on request.
Die Toleranz der Zener-Spannung ist in der Standard-Ausführung gestuft nach der internationalen Reihe E 24 (~5%). Andere Toleranzen oder höhere Arbeitsspannungen auf Anfrage.

Maximum ratings and Characteristics — Grenz- und Kennwerte

Power dissipation Verlustleistung	$T_A = 25°C$	P_{tot}	500 mW [1]
Operating junction temperature – Sperrschichttemperatur		T_j	– 50...+175°C
Storage temperature – Lagerungstemperatur		T_S	– 50...+175°C
Thermal resistance junction to ambient air Wärmewiderstand Sperrschicht – umgebende Luft		R_{thA}	< 300 K/W [1]
Thermal resistance junction to terminal Wärmewiderstand Sperrschicht – Kontaktfläche		R_{thT}	< 70 K/W

Zener voltages see table on next page – Zener-Spannungen siehe Tabelle auf der nächsten Seite

[1]) Mounted on P.C. board with 25 mm² copper pads at each terminal
Montage auf Leiterplatte mit 25 mm² Kupferbelag (Lötpad) an jedem Anschluß
[2]) Tested with pulses t_p = 20 ms – Gemessen mit Impulsen t_p = 20 ms
[3]) The ZMC1 is a diode operated in forward. Hence, the index of all parameters should be "F" instead of "Z".
The cathode, indicated by the ring is to be connected to the negative pole.
Die ZMC1 ist eine in Durchlaß betriebene Si-Diode. Daher ist bei allen Kenn- und Grenzwerten der Index "F" anstatt "Z" zu setzten. Die durch den Ring gekennzeichnete Kathode ist mit dem Minuspol zu verbinden.

Maximum ratings — Grenzwerte

Type Typ	Zener voltage [1] Zener-Spanng. [1] I_Z = 5 mA V_{zmin} [V]	V_{zmax}	Dynamic resistance Inhär. diff. Widerstand r_{zj} [Ω] at f = 1 kHz I_Z = 5 mA	I_Z = 1 mA	Temp. Coeffiz. of Z-voltage ...der Z-spanng. $\alpha_{VZ}10^{-4}$ [°C]	Reverse volt. Sperrspanng. I_R = 100 nA V_R [V]	Z-current [2] Z-Strom [2] T_A = 25°C I_{Zmax} [mA]
ZMC1 [3]	0,71	0,82	<8	<50	-26...-23	–	400
ZMC2.4	2,28	2,56	<85	< 600	-9...-6	1 (50µA)	180
ZMC2.7	2,5	2,9	<85	< 600	-9...-6	1 (10µA)	159
ZMC3.0	2,8	3,2	<85	< 600	-8...-5	1 (4µA)	144
ZMC3.3	3,1	3,5	<85	< 600	-8...-5	1 (2µA)	131
ZMC3.6	3,4	3,8	<85	< 600	-8...-5	1 (2µA)	121
ZMC3.9	3,7	4,1	<85	< 600	-8...-5	1 (2µA)	112
ZMC4.3	4,0	4,6	<75	< 600	-6...-3	1 (1µA)	100
ZMC4.7	4,4	5,0	<60	< 600	-5...+2	1 (0,5µA)	92
ZMC5.1	4,8	5,4	<35	< 550	-2...+2	1	85
ZMC5.6	5,2	6,0	<25	< 450	-5...+5	1	77
ZMC6.2	5,8	6,6	<10	< 200	+3...+6	2	70
ZMC6.8	6,4	7,2	<8	< 150	+3...+7	3	64
ZMC7.5	7,0	7,9	<7	< 50	+3...+7	5	58
ZMC8.2	7,7	8,7	<7	< 50	+3...+8	6	53
ZMC9.1	8,5	9,6	<10	< 50	+3...+9	6	48
ZMC10	9,4	10,6	<15	< 70	+3...+10	7	43
ZMC11	10,4	11,6	<20	< 70	+3...+11	8	40
ZMC12	11,4	12,7	<20	< 90	+3...+11	9	36
ZMC13	12,4	14,1	<26	< 110	+3...+11	9	33
ZMC15	13,8	15,6	<30	< 110	+3...+11	10	29
ZMC16	15,3	17,1	<40	< 170	+3...+11	11	27
ZMC18	16,8	19,1	<50	< 170	+3...+11	13	24
ZMC20	18,8	21,2	<55	< 220	+3...+11	14	22
ZMC22	20,8	23,3	<55	< 220	+4...+12	16	20
ZMC24	22,8	25,6	<80	< 220	+4...+12	17	18
ZMC27	25,1	28,9	<80	< 220	+4...+12	19	16
ZMC30	28	32	<80	< 220	+4...+12	21	14
ZMC33	31	35	<80	< 220	+4...+12	23	13
ZMC36	34	38	<80	< 220	+4...+12	26	12
ZMC39	37	41	<90	< 500	+4...+12	28	11
ZMC43	40	46	<90	< 500	+4...+12	30	10
ZMC47	44	50	<110	< 600	+4...+12	33	9
ZMC51	48	54	<125	< 700	+4...+12	36	9
ZMC56	52	60	<135	< 700	+4...+12	39	8
ZMC62	58	66	<150	< 1000	+4...+12	44	7
ZMC68	64	72	<200	< 1000	+4...+12	48	6
ZMC75	70	79	<250	< 1000	+4...+12	53	6
ZMC82	77	88	<300	< 1500	+5...+12	58	5
ZMC91	85	96	<450	< 2000	+5...+12	64	5
ZMC100	94	106	<450	< 5000	+5...+12	71	4

[1] Notes see previous page – Fußnoten siehe vorhergehende Seite

National Semiconductor

February 1995

LM78XX Series Voltage Regulators

General Description

The LM78XX series of three terminal regulators is available with several fixed output voltages making them useful in a wide range of applications. One of these is local on card regulation, eliminating the distribution problems associated with single point regulation. The voltages available allow these regulators to be used in logic systems, instrumentation, HiFi, and other solid state electronic equipment. Although designed primarily as fixed voltage regulators these devices can be used with external components to obtain adjustable voltages and currents.

The LM78XX series is available in an aluminum TO-3 package which will allow over 1.0A load current if adequate heat sinking is provided. Current limiting is included to limit the peak output current to a safe value. Safe area protection for the output transistor is provided to limit internal power dissipation. If internal power dissipation becomes too high for the heat sinking provided, the thermal shutdown circuit takes over preventing the IC from overheating.

Considerable effort was expanded to make the LM78XX series of regulators easy to use and mininize the number of external components. It is not necessary to bypass the output, although this does improve transient response. Input bypassing is needed only if the regulator is located far from the filter capacitor of the power supply.

For output voltage other than 5V, 12V and 15V the LM117 series provides an output voltage range from 1.2V to 57V.

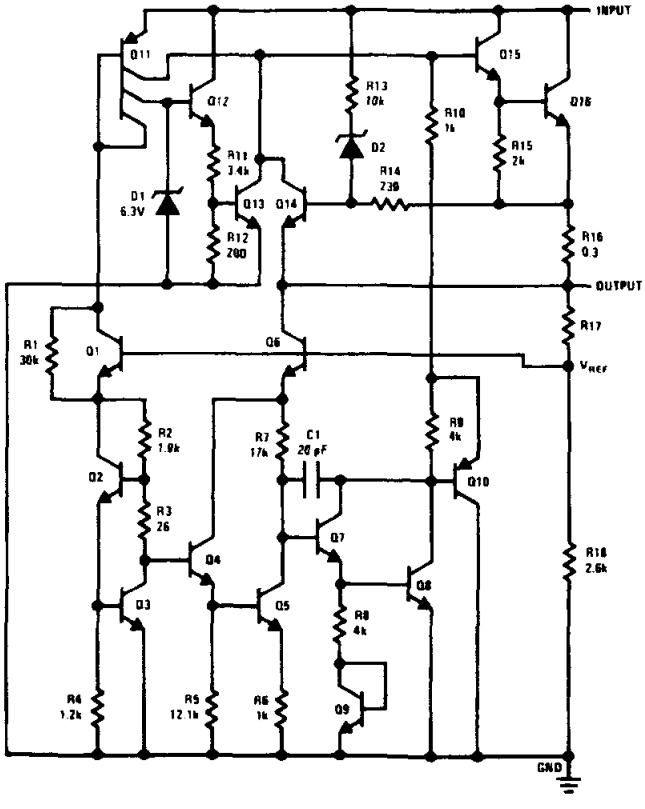
Features

- Output current in excess of 1A
- Internal thermal overload protection
- No external components required
- Output transistor safe area protection
- Internal short circuit current limit
- Available in the aluminum TO-3 package

Voltage Range

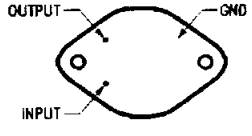
LM7805C	5V
LM7812C	12V
LM7815C	15V

Schematic and Connection Diagrams



TL/H/7746–1

Metal Can Package
TO-3 (K)
Aluminum

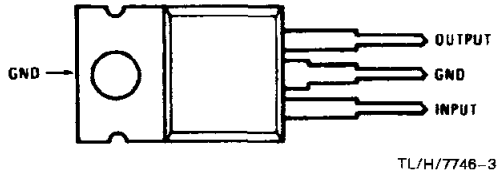


TL/H/7746–2

Bottom View

Order Number LM7805CK,
LM7812CK or LM7815CK
See NS Package Number KC02A

Plastic Package
TO-220 (T)



TL/H/7746–3

Top View

Order Number LM7805CT,
LM7812CT or LM7815CT
See NS Package Number T03B

RRD-B30M115/Printed in U. S. A.

lute Maximum Ratings

y/Aerospace specified devices are required, contact the National Semiconductor Sales istributors for availability and specifications.

age (V_O = 5V, 12V and 15V)	35V
ower Dissipation (Note 1)	Internally Limited
Temperature Range (T_A)	0°C to +70°C
Maximum Junction Temperature	
(K Package)	150°C
(T Package)	150°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	
TO-3 Package K	300°C
TO-220 Package T	230°C

rical Characteristics LM78XXC (Note 2) 0°C ≤ Tj ≤ 125°C unless otherwise noted.

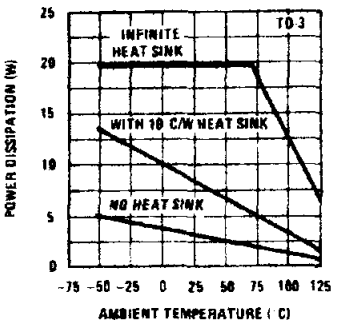
Output Voltage			5V			12V			15V			Units
Input Voltage (unless otherwise noted)			10V			19V			23V			
Parameter	Conditions		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
tput Voltage	Tj = 25°C, 5 mA ≤ I_O ≤ 1A		4.8	5	5.2	11.5	12	12.5	14.4	15	15.6	V
	P_D ≤ 15W, 5 mA ≤ I_O ≤ 1A		4.75		5.25	11.4		12.6	14.25		15.75	V
	V_{MIN} ≤ V_{IN} ≤ V_{MAX}		(7.5 ≤ V_{IN} ≤ 20)			(14.5 ≤ V_{IN} ≤ 27)			(17.5 ≤ V_{IN} ≤ 30)			V
e Regulation	I_O = 500 mA	Tj = 25°C		3	50		4	120		4	150	mV
		ΔV_{IN}	(7 ≤ V_{IN} ≤ 25)			14.5 ≤ V_{IN} ≤ 30)			(17.5 ≤ V_{IN} ≤ 30)			V
		0°C ≤ Tj ≤ +125°C			50			120			150	mV
		ΔV_{IN}	(8 ≤ V_{IN} ≤ 20)			(15 ≤ V_{IN} ≤ 27)			(18.5 ≤ V_{IN} ≤ 30)			V
	I_O ≤ 1A	Tj = 25°C			50			120			150	mV
		ΔV_{IN}	(7.5 ≤ V_{IN} ≤ 20)			(14.6 ≤ V_{IN} ≤ 27)			(17.7 ≤ V_{IN} ≤ 30)			V
		0°C ≤ Tj ≤ +125°C			25			60			75	mV
		ΔV_{IN}	(8 ≤ V_{IN} ≤ 12)			(16 ≤ V_{IN} ≤ 22)			(20 ≤ V_{IN} ≤ 26)			V
ad Regulation	Tj = 25°C	5 mA ≤ I_O ≤ 1.5A		10	50		12	120		12	150	mV
		250 mA ≤ I_O ≤ 750 mA			25			60			75	mV
	5 mA ≤ I_O ≤ 1A, 0°C ≤ Tj ≤ +125°C				50			120			150	mV
iescent Current	I_O ≤ 1A	Tj = 25°C			8			8			8	mA
		0°C ≤ Tj ≤ +125°C			8.5			8.5			8.5	mA
iescent Current ange	5 mA ≤ I_O ≤ 1A				0.5			0.5			0.5	mA
	Tj = 25°C, I_O ≤ 1A				1.0			1.0			1.0	mA
	V_{MIN} ≤ V_{IN} ≤ V_{MAX}		(7.5 ≤ V_{IN} ≤ 20)			(14.8 ≤ V_{IN} ≤ 27)			(17.9 ≤ V_{IN} ≤ 30)			V
	I_O ≤ 500 mA, 0°C ≤ Tj ≤ +125°C				1.0			1.0			1.0	mA
	V_{MIN} ≤ V_{IN} ≤ V_{MAX}		(7 ≤ V_{IN} ≤ 25)			(14.5 ≤ V_{IN} ≤ 30)			(17.5 ≤ V_{IN} ≤ 30)			V
tput Noise Voltage	T_A = 25°C, 10 Hz ≤ f ≤ 100 kHz			40			75			90		μV
ple Rejection	f = 120 Hz; I_O ≤ 1A, Tj = 25°C or		62	80		55	72		54	70		dB
	f = 120 Hz; I_O ≤ 500 mA, 0°C ≤ Tj ≤ +125°C		62			55			54			dB
	V_{MIN} ≤ V_{IN} ≤ V_{MAX}		(8 ≤ V_{IN} ≤ 18)			(15 ≤ V_{IN} ≤ 25)			(18.5 ≤ V_{IN} ≤ 28.5)			V
pout Voltage	Tj = 25°C, I_{OUT} = 1A			2.0			2.0			2.0		V
tput Resistance	f = 1 kHz			8			18			19		mΩ
ort-Circuit Current	Tj = 25°C			2.1			1.5			1.2		A
ak Output Current	Tj = 25°C			2.4			2.4			2.4		A
erage TC of V_{OUT}	0°C ≤ Tj ≤ +125°C, I_O = 5 mA			0.6			1.5			1.8		mV/°C
ut Voltage quired to Maintain e Regulation	Tj = 25°C, I_O ≤ 1A			7.5		14.6			17.7			V

ermal resistance of the TO-3 package (K, KC) is typically 4°C/W junction to case and 35°C/W case to ambient. Thermal resistance of the TO-220) is typically 4°C/W junction to case and 50°C/W case to ambient.

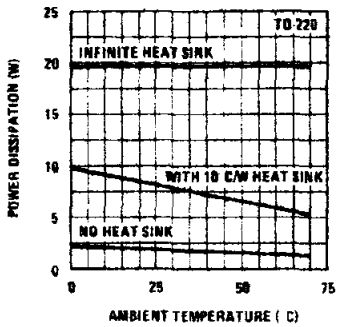
characteristics are measured with capacitor across the input of 0.22 μF, and a capacitor across the output of 0.1μF. All characteristics except noise l ripple rejection ratio are measured using pulse techniques (t_w ≤ 10 ms, duty cycle ≤ 5%). Output voltage changes due to changes in internal) must be taken into account separately.

Typical Performance Characteristics

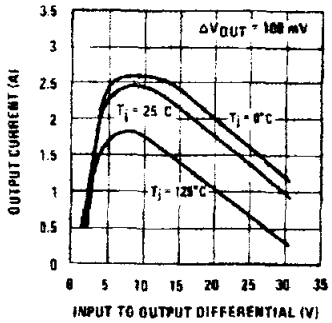
Maximum Average Power Dissipation



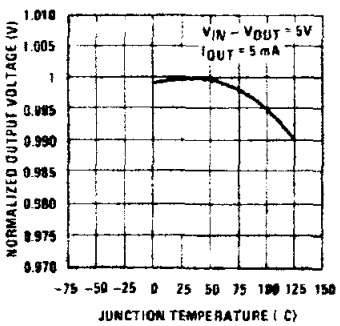
Maximum Average Power Dissipation



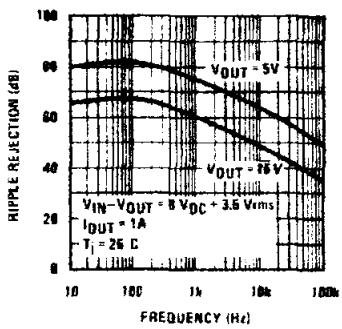
Peak Output Current



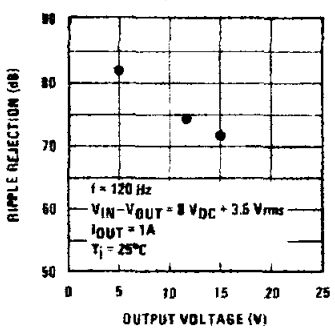
Output Voltage (Normalized to 1V at Tj = 25°C)



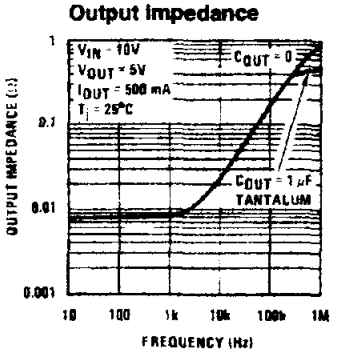
Ripple Rejection



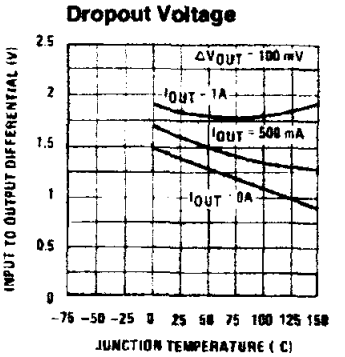
Ripple Rejection



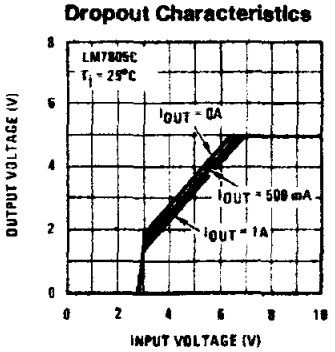
Output Impedance



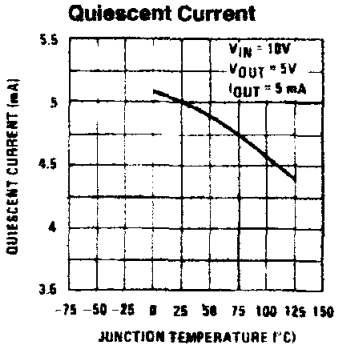
Dropout Voltage



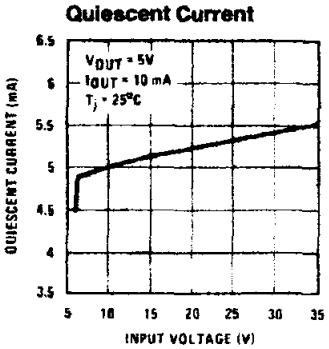
Dropout Characteristics



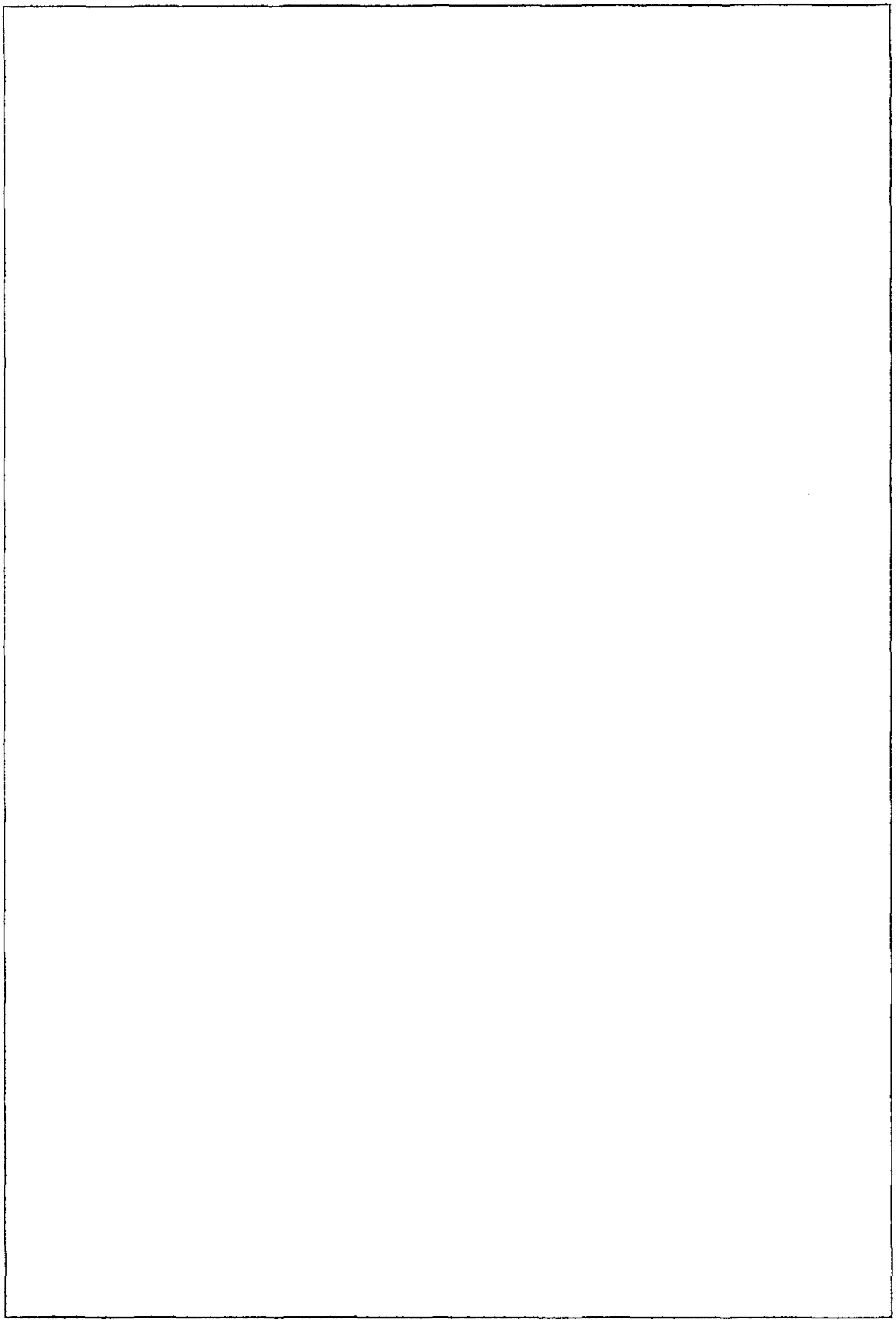
Quiescent Current



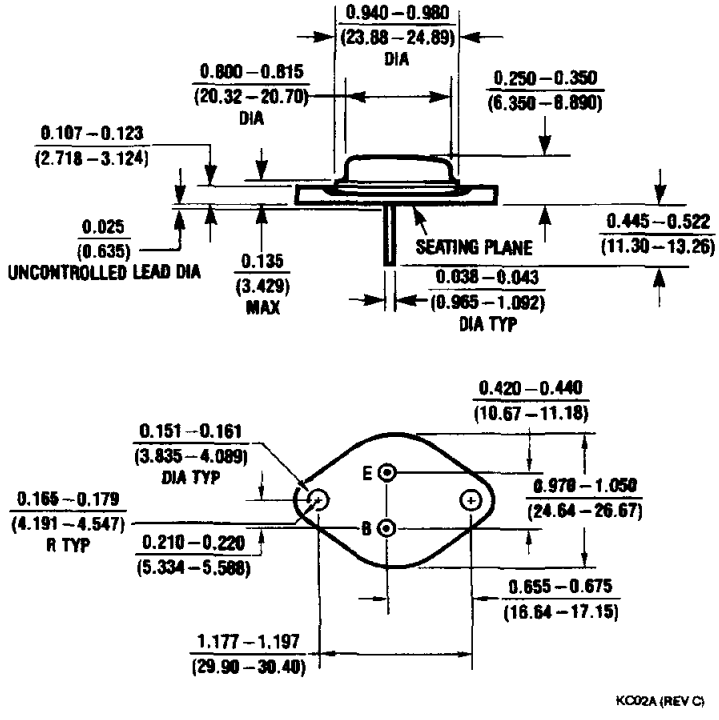
Quiescent Current



TL/H/7746–4

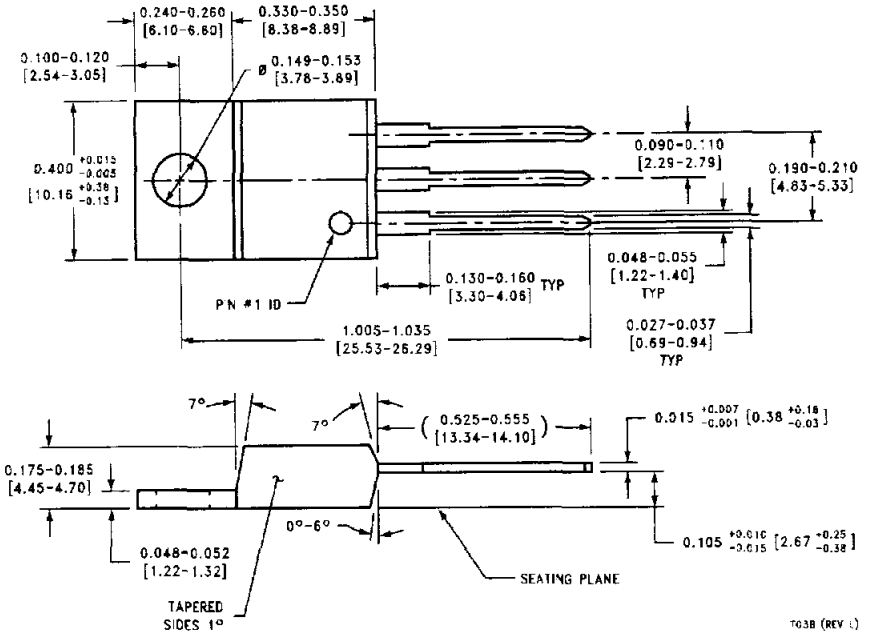


Physical Dimensions inches (millimeters)



Aluminum Metal Can Package (KC)
Order Number LM7805CK, LM7812CK or LM7815CK
NS Package Number KC02A

Physical Dimensions inches (millimeters) (Continued)



TO-220 Package (T)
Order Number LM7805CT, LM7812CT or LM7815CT
NS Package Number T03B

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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HARRIS Semiconductor

IRF540, IRF541, IRF542, IRF543, RF1S540, RF1S540SM

25A and 28A, 80V and 100V, 0.077 and 0.100 Ohm, N-Channel Power MOSFETs

November 1997

Features

- **25A and 28A, 80V and 100V**
- **$r_{DS(ON)}$ = 0.077Ω and 0.100Ω**
- **Single Pulse Avalanche Energy Rated**
- **Nanosecond Switching Speeds**
- **Linear Transfer Characteristics**
- **High Input Impedance**
- **Related Literature**
  - **TB334 "Guidelines for Soldering Surface Mount Components to PC Boards"**

Description

These are N-Channel enhancement mode silicon gate power field effect transistors. They are advanced power MOSFETs designed, tested, and guaranteed to withstand a specified level of energy in the breakdown avalanche mode of operation. All of these power MOSFETs are designed for applications such as switching regulators, switching convertors, motor drivers, relay drivers, and drivers for high power bipolar switching transistors requiring high speed and low gate drive power. These types can be operated directly from integrated circuits.

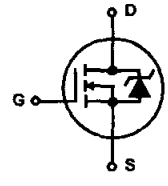
Formerly developmental type TA17421.

Ordering Information

PART NUMBER	PACKAGE	BRAND
IRF540	TO-220AB	IRF540
IRF541	TO-220AB	IRF541
IRF542	TO-220AB	IRF542
IRF543	TO-220AB	IRF543
RF1S540	TO-262AA	RF1S540
RF1S540SM	TO-263AB	RF1S540SM

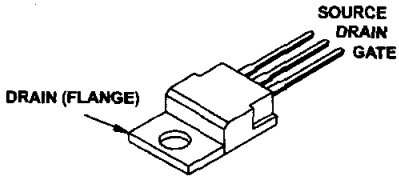
NOTE: When ordering, use the entire part number. Add the suffix 9A to obtain the TO-263AB variant in the tape and reel, i.e., RF1S540SM9A.

Symbol

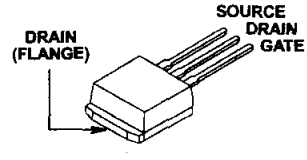


Packaging

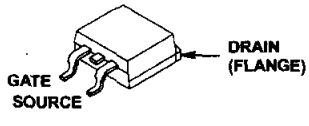
JEDEC TO-220AB



JEDEC TO-262AA



JEDEC TO-263AB



CAUTION: These devices are sensitive to electrostatic discharge. Users should follow proper ESD Handling Procedures.

File Number **2309.3**

Absolute Maximum Ratings $T_C = 25^oC$, Unless Otherwise Specified

	IRF540, RF1S540, RF1S540SM	IRF541	IRF542	IRF543	UNITS
Drain to Source Breakdown Voltage (Note 1) ..... V_{DS}	100	80	100	80	V
Drain to Gate Voltage (R_{GS} = 20kΩ) (Note 1) ..... V_{DGR}	100	80	100	80	V
Continuous Drain Current ..... I_D	28	28	25	25	A
$T_C = 100^oC$ ..... I_D	20	20	17	17	A
Pulsed Drain Current (Note 3) ..... I_{DM}	110	110	100	100	A
Gate to Source Voltage ..... V_{GS}	±20	±20	±20	±20	V
Maximum Power Dissipation ..... P_D	150	150	150	150	W
Dissipation Derating Factor	1	1	1	1	$W/^oC$
Single Pulse Avalanche Energy Rating (Note 4) ..... E_{AS}	230	230	230	230	mJ
Operating and Storage Temperature ..... T_J, T_{STG}	-55 to 175	-55 to 175	-55 to 175	-55 to 175	^oC
Maximum Temperature for Soldering					
Leads at 0.063in (1.6mm) from Case for 10s ..... T_L	300	300	300	300	^oC
Package Body for 10s, See Techbrief 334 ..... T_{pkg}	260	260	260	260	^oC

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.

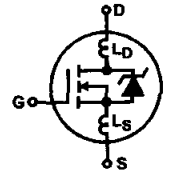
NOTE:

1. $T_J = 25^oC$ to $T_J = 150^oC$.

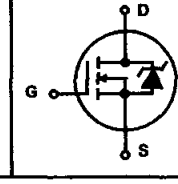
Electrical Specifications $T_C = 25^oC$, Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Drain to Source Breakdown Voltage IRF540, IRF542, RF1S540, RF1S540SM	BV_{DSS}	I_D = 250μA, V_{GS} = 0V (Figure 10)	100	-	-	V
IRF541, IRF543			80	-	-	V
Gate to Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}$, I_D = 250μA	2	-	4	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = Rated BV_{DSS}, V_{GS} = 0V	-	-	25	μA
		V_{DS} = 0.8 x Rated BV_{DSS}, V_{GS} = 0V, $T_J = 150^oC$	-	-	250	μA
On-State Drain Current (Note 2) IRF540, IRF541, RF1S540, RF1S540SM	$I_{D(ON)}$	$V_{DS} > I_{D(ON)} \times r_{DS(ON)\ MAX}$, V_{GS} = 10V (Figure 7)	28	-	-	A
IRF542, IRF543			25	-	-	A
Gate to Source Leakage Current	I_{GSS}	V_{GS} = ±20V	-	-	±100	nA
Drain to Source On Resistance (Note 2) IRF540, IRF541, RF1S540, RF1S540SM	$r_{DS(ON)}$	I_D = 17A, V_{GS} = 10V (Figures 8, 9)	-	0.060	0.077	Ω
IRF542, IRF543			-	0.080	0.100	Ω
Forward Transconductance (Note 2)	g_{fs}	$V_{DS} \geq 50V$, I_D = 17A (Figure 12)	8.7	13	-	S
Turn-On Delay Time	$t_{d(ON)}$	V_{DD} = 50V, $I_D \approx 28A$, $R_G \approx 9.1Ω$, R_L = 1.7Ω (Figures 17, 18) MOSFET Switching Times are Essentially Independent of Operating Temperature	-	15	23	ns
Rise Time	t_r		-	70	110	ns
Turn-Off Delay Time	$t_{d(OFF)}$		-	40	60	ns
Fall Time	t_f		-	50	75	ns
Total Gate Charge (Gate to Source + Gate to Drain)	$Q_{g(TOT)}$	V_{GS} = 10V, I_D = 28A, V_{DS} = 0.8 x Rated BV_{DSS}, $I_{g(REF)}$ = 1.5mA (Figures 14, 19, 20) Gate Charge is Essentially Independent of Operating Temperature	-	38	59	nC
Gate to Source Charge	Q_{gs}		-	8	-	nC
Gate to Drain "Miller" Charge	Q_{gd}		-	21	-	nC

Electrical Specifications $T_C = 25^oC$, Unless Otherwise Specified **(Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNITS
Input Capacitance	C_{ISS}	V_{DS} = 25V, V_{GS} = 0V, f = 1MHz (Figure 11)		-	1450	-	pF
Output Capacitance	C_{OSS}			-	550	-	pF
Reverse Transfer Capacitance	C_{RSS}			-	100	-	pF
Internal Drain Inductance	L_D	Measured From the Contact Screw on Tab To Center of Die	Modified MOSFET Symbol Showing the Internal Devices Inductances 	-	3.5	-	nH
		Measured From the Drain Lead, 6mm (0.25in) from Package to Center of Die		-	4.5	-	nH
Internal Source Inductance	L_S	Measured From the Source Lead, 6mm (0.25in) From Header to Source Bonding Pad		-	7.5	-	nH
Thermal Resistance Junction to Case	$R_{\theta JC}$			-	-	1	$^oC/W$
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	Free Air Operation		-	-	80	$^oC/W$
	$R_{\theta JA}$	RF1S540SM Mounted on FR-4 Board with *Minimum Mounting Pad*		-	-	62	$^oC/W$

Source to Drain Diode Specifications

PARAMETER	SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNITS
Continuous Source to Drain Current	I_{SD}	Modified MOSFET Symbol Showing the Integral Reverse P-N Junction Diode		-	-	28	A
Pulse Source to Drain Current (Note 3)	I_{SDM}			-	-	110	A
Source to Drain Diode Voltage (Note 2)	V_{SD}	$T_J = 25^oC$, I_{SD} = 27A, V_{GS} = 0V (Figure 13)		-	-	2.5	V
Reverse Recovery Time	t_{rr}	$T_J = 25^oC$, I_{SD} = 28A, dI_{SD}/dt = 100A/µs		70	150	300	ns
Reverse Recovery Charge	Q_{RR}	$T_J = 25^oC$, I_{SD} = 28A, dI_{SD}/dt = 100A/µs		0.44	1.0	1.9	µC

NOTES:

2. Pulse test: pulse width ≤ 300µs, duty cycle ≤ 2%.
3. Repetitive rating: pulse width limited by maximum junction temperature. See Transient Thermal Impedance curve (Figure 3).
4. V_{DD} = 25V, *starting* $T_J = 25^oC$, L = 440µH, R_G = 25Ω, peak I_{AS} = 28A. *(Figures 15, 16).*

Typical Performance Curves Unless Otherwise Specified

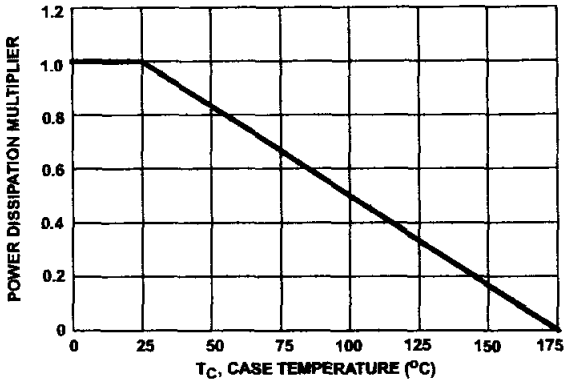


FIGURE 1. NORMALIZED POWER DISSIPATION vs CASE TEMPERATURE

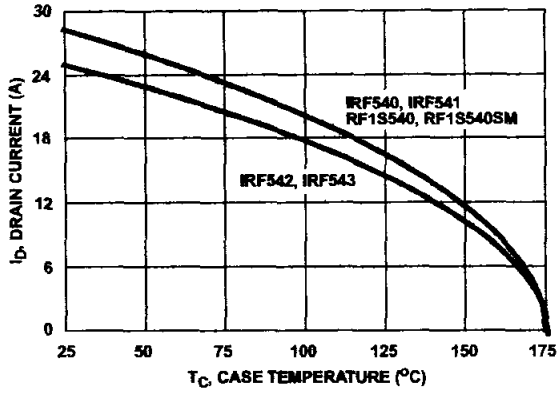


FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE

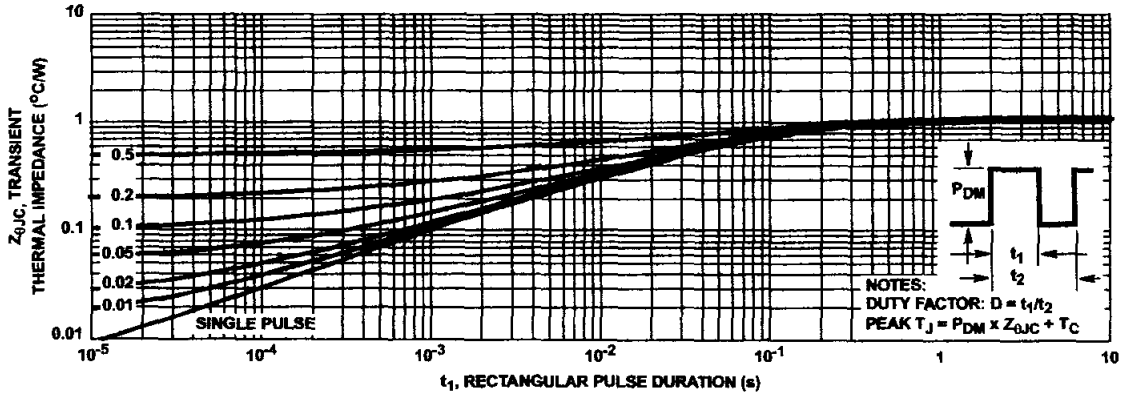


FIGURE 3. MAXIMUM TRANSIENT THERMAL IMPEDANCE

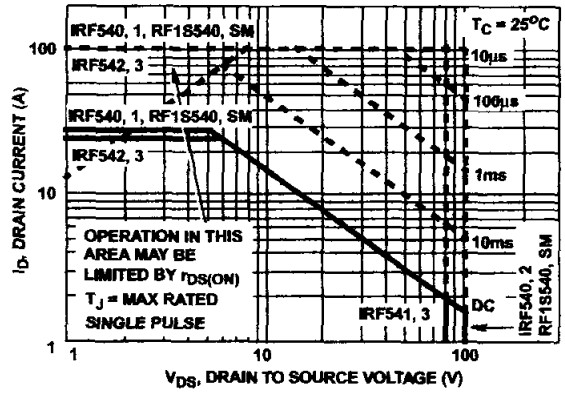


FIGURE 4. FORWARD BIAS SAFE OPERATING AREA

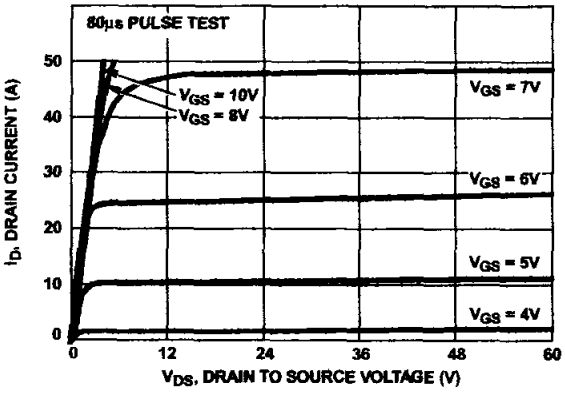


FIGURE 5. OUTPUT CHARACTERISTICS

Typical Performance Curves Unless Otherwise Specified (Continued)

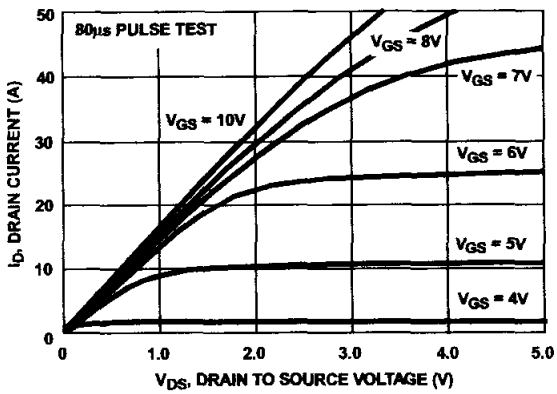


FIGURE 6. SATURATION CHARACTERISTICS

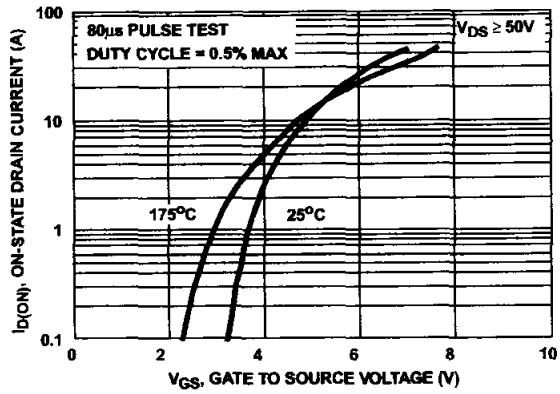


FIGURE 7. TRANSFER CHARACTERISTICS

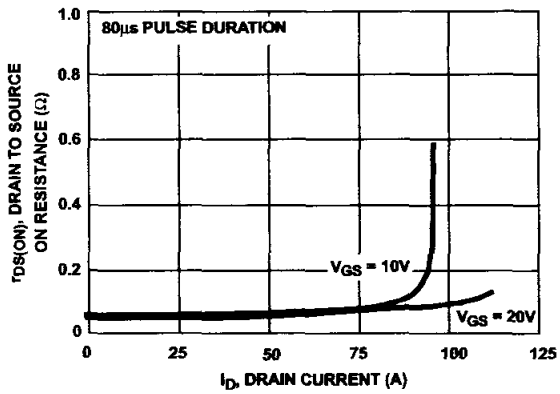


FIGURE 8. DRAIN TO SOURCE ON RESISTANCE vs GATE VOLTAGE AND DRAIN CURRENT

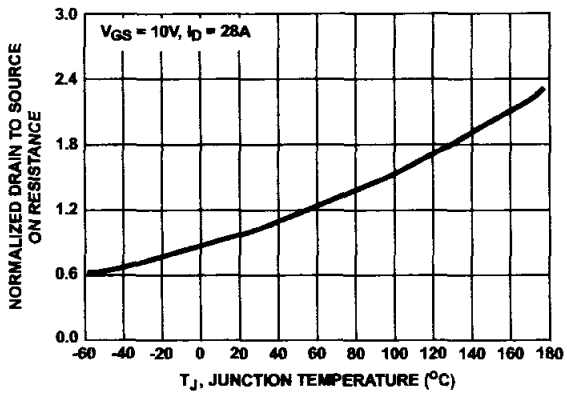


FIGURE 9. NORMALIZED DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE

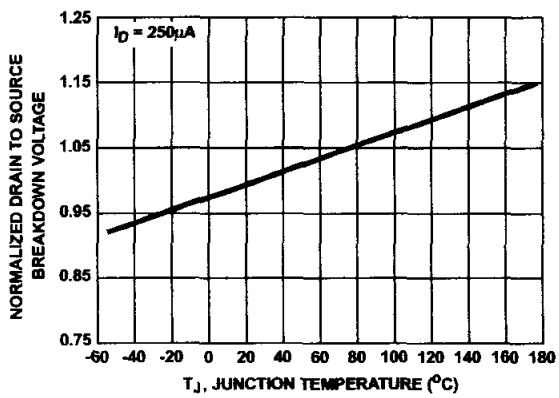


FIGURE 10. NORMALIZED DRAIN TO SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE

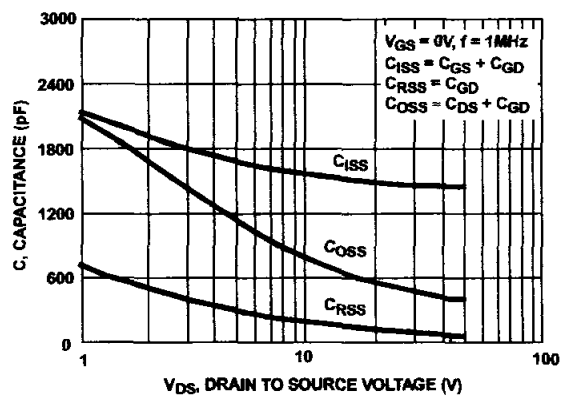


FIGURE 11. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE

Typical Performance Curves Unless Otherwise Specified (Continued)

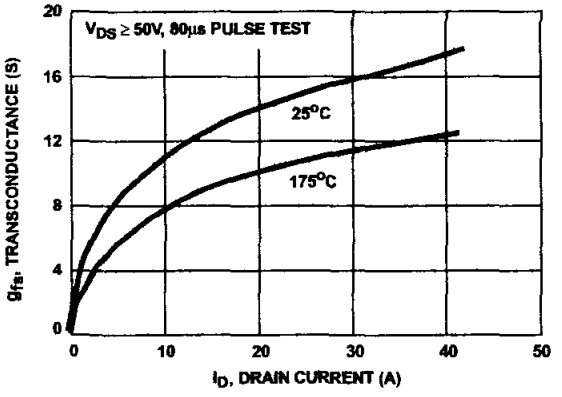


FIGURE 12. TRANSCONDUCTANCE vs DRAIN CURRENT

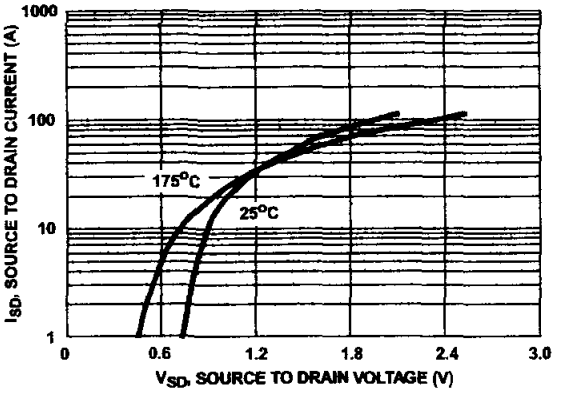


FIGURE 13. SOURCE TO DRAIN DIODE VOLTAGE

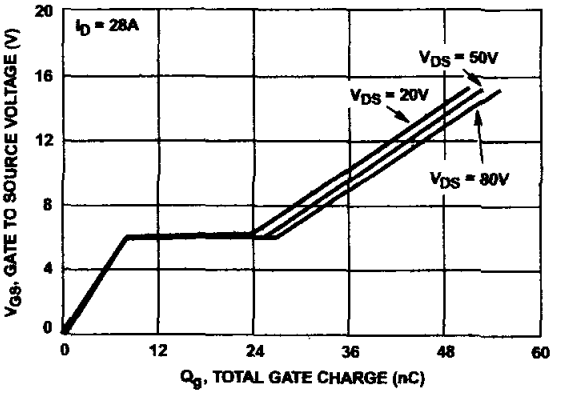


FIGURE 14. GATE TO SOURCE VOLTAGE vs GATE CHARGE

Test Circuits and Waveforms

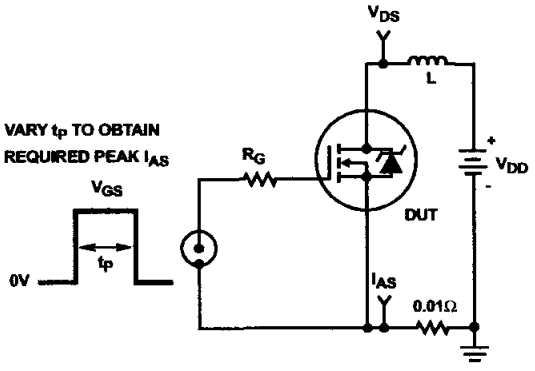


FIGURE 15. UNCLAMPED ENERGY TEST CIRCUIT

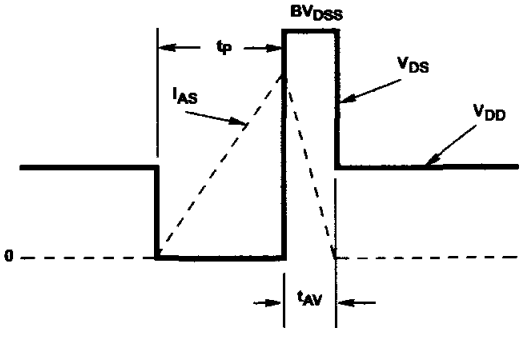


FIGURE 16. UNCLAMPED ENERGY WAVEFORMS

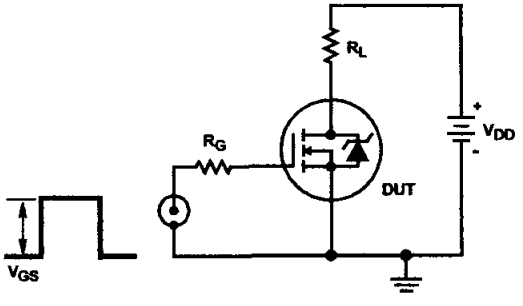


FIGURE 17. SWITCHING TIME TEST CIRCUIT

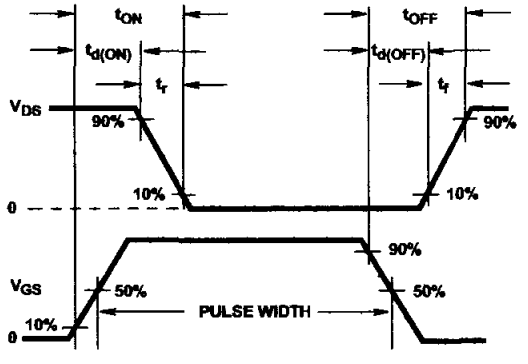


FIGURE 18. RESISTIVE SWITCHING WAVEFORMS

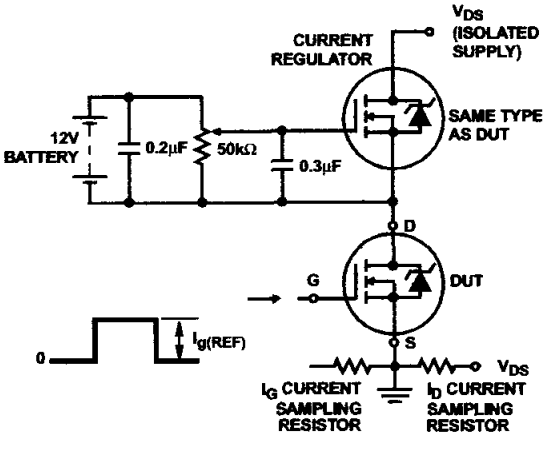


FIGURE 19. GATE CHARGE TEST CIRCUIT

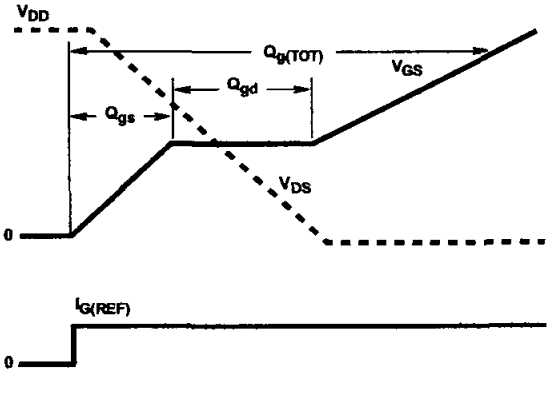


FIGURE 20. GATE CHARGE WAVEFORMS

Manual Reference

AT Command Set

(GSM 07.07, GSM 07.05,
Siemens specific commands)

for the SIEMENS Mobile Phones

S35i,C35i, M35i

The command descriptions or example sequences in this document imply no liability or warranty in any way. The author therefore will take no responsibility and will accept no liability which results of using the content of this document in any way.

Revisions Overview

Date	Version	Name	Description of revision
15-03-2000	1.0	Kel	created

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7	AT+CGMM	Issue model ID code
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8	AT+CGSN	Output the serial number (IMEI)
8	AT+GSN	Output the serial number (IMEI)
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24	AT+CALM	Alert sound mode
24	AT+CRSL	Ringer sound level
24	AT+CLVL	Loudspeaker volume level
24	AT+CMUT	Mute control
25	AT+CVIB	Vibrator mode

1.2. AT Command Set

Remote control operation of the GSM mobile telephone runs via a serial interface (data cable of infrared connection), where AT+C commands according to ETSI GSM 07.07 and GSM 07.05 specification as well as several manufacturer specific AT commands are available. These commands are described in more detail later on.

The modem guideline V.25ter applies to the sequence of the interface commands. According to this guideline, commands should begin with the character string **"AT"** and end with **"<CR>" (= 0x0D).** The input of a command is acknowledged by the display of "OK" or "ERROR". **A command currently in process is interrupted by each additional character entered.** This means that you should not enter the next command until you have received the acknowledgment; otherwise the current command is interrupted.

The commands supported are listed in the following tables:

1.2.1. Hayes-Standard Commands

The Hayes-standard commands correspond to the commands of AT Hayes-compatible modems.

Command	Function
A/	Repeat last command
AT...	Prefix for all other commands
ATA	Accept call
ATD<str>;	Dial the dialing string <str> with the voice utility Valid dial modifiers: "T" (tone dialing), "P" (pulse dialing) is ignored. The character ";" is important, for this tells the phone that the call should be set up with the voice utility. Otherwise an attempt is made to set up a data call, which the phone immediately acknowledges with "ERROR". The dial command responds with OK to the user right after starting a voide call. Other behavior like *# sequences in the dial command and also data calls remain unchanged.
ATD><n>;	Dial the telephone number from the current telephone book location number <n> The telephone book is selected with the command at+cpbs (or at^spbs).
ATD><mem><n>;	Dial the telephone number from the telephone book <mem> location number <n>
ATDL	Dial last telephone number
ATE0	Deactivate command echo
ATE1	Activate command echo
ATH[0]	Separate connection
ATQ0	Display acknowledgments
ATQ1	Suppress acknowledgments
ATV0	Output acknowledgments as numbers
ATV1	Output acknowledgments as text
AT&F[0]	Reset to factory profile
ATZ	Set to default configuration
AT+GCAP	Output the capabilities list

1.2.2. Acknowledgments for Normal Data Communication

Response	Numeric	Meaning
OK	0	Command executed, no errors
RING	2	Ring detected
NO CARRIER	3	Link not established or disconnected
ERROR	4	Invalid command or command line too long
NO DIALTONE	6	No dial tone, dialing impossible, wrong mode
BUSY	7	Remote station busy

1.3. AT Commands and Responses According to GSM 07.07 and GSM 07.05

According to GSM, it is possible to execute an AT command in various forms.

Test command	AT+CXXX=?	The telephone responds by sending the list of parameters and value ranges; these can be set using the affiliated Write command or by means of internal processes.
Read command	AT+CXXX?	This command tells you the current value setting of the parameter(s).
Write command	AT+CXXX=<...>	This command is used to set parameters that can be set.
Execute command	AT+CXXX	The Execute command reads non-settable parameters which are influenced by internal processes in the telephone.

1.3.1. AT Cellular Commands According to GSM 07.07

AT+CGMI	Issue manufacturer ID code
Test command AT+CGMI=?	Response OK
Execute command AT+CGMI	Response <manufacturer> Parameter <manufacturer> Name of manufacturer (SIEMENS) **Important:** There is a leading output prefix +CGMI in models before the S25.

AT+CGMM	Issue model ID code
Test command AT+CGMM=?	Response OK
Execute command AT+CGMM	Response <model> Parameter <model> Name of telephone (MOBILE) **Important:** There is a leading output prefix +CGMM in models before the S25.

AT+CGMR	Output the GSM telephone version
Test command AT+CGMR=?	Response OK
Execute command AT+CGMR	Response <revision> Parameter <revision> Version of the telephone software **Important:** There is a leading output prefix +CGMR in models before the S25.

AT+CGSN	Output the serial number (IMEI)
Test command AT+CGSN=?	Response OK
Execute command AT+CGSN	Response <sn> Parameter <sn> *IMEI of the telephone* **Important:** There is a leading output prefix +CGMI in models before the S25.

AT+GSN	Output the serial number (IMEI)
Test command AT+GSN=?	Response OK
Execute command AT+GSN	Response +GSN: <sn> Parameter <sn> IMEI of the telephone **Important:** The output prefix +GSN may be missing in future versions.

AT+CHUP	Terminate call
Test command AT+CHUP=?	Response OK
Execute command AT+CHUP	Response OK/ERROR
	Description All active calls and all calls on hold are terminated.

AT+CEER	Query the reason for disconnection of last call
Test command AT+CEER=?	Response OK
Execute command AT+CEER	Response +CEER: <report> Parameter <report> Disconnection reason reported as number

AT+CREG	Network registration		
Test command AT+CREG=?	Response +CREG: (list of supported <n>s) OK/ERROR/+CME ERROR		
	Parameter <n>	0	Suppresses the unexpected network-status messages
		1	Displays the unexpected network-status messagesOK/ERROR/+CME ERROR
Read command AT+CREG?	Response +CREG: <n>,<stat>[,<lac>,<ci>] OK/ERROR/+CME ERROR		
	Parameter <n>		See Test command
	<stat>	0	Not checked in, not seeking
		1	Checked in
		2	Not checked in, but seeking a network
		3	Check-in denied by network
		4	Unknown
		5	Registered, roaming
	<lac>		Hexadecimal 2-byte string type of location area code
	<ci>		Hexadecimal 2-byte string type of cell ID
Write command AT+CREG=<n>	Parameter <n> Response OK/ERROR/+CME ERROR		See Test command
	Unexpected message +CREG: <stat>		

AT+COPS	Commands concerning selection of network operator		
Test command AT+COPS=?	Response +COPS: [list of supported (<stat>,long alphanumeric <oper>,,numeric <oper>)s][,,(list of supported <mode>s),(list of supported <format>s)] OK/ERROR/+CME ERROR		
	Parameter <stat>	0	Unknown
		1	Useful network operator
		2	Used network operator
		3	Prohibited network operator
	<oper>		Operator in the format according to <mode>
	<mode>	0	Automatic mode
		1	Manual selection of network operator
		3	Setting of format
		4	Automatic, manual selected
	<format>	0	Long alphanumeric
		2	Numeric <oper>
Read command AT+COPS?	Response +COPS: <mode>[,<format>,<oper] OK/ERROR/+CME ERROR		
	Parameter <mode>		See Test command
	<format>		See Test command
	<oper>		Network operator
Write command AT+COPS=<mode>[,<format>[,<oper>]]	Parameter <mode>		See Test command
	<format>		See Test command If <mode> = 1, <format> can only = 2
	<oper>		In numeric form only
	Response		

	OK/ERROR/+CME ERROR

AT+CLCK	Switch locking on and off **Revision to GSM 07.07 according to CR TDOC ETSI/SMG4 187/96**
Test command AT+CLCK=?	Response +CLCK: (list of supported <fac>s) OK/ERROR/+CME ERROR Parameter <fac> "CS" Keyboard lock "PS" Phone locked to SIM (device code) "SC" SIM card (PIN) "FD" FDN lock "AO" BAOC (bar all outgoing calls) "OI" BOIC (bar outgoing international calls) "OX" BOIC-exHC (bar outgoing international calls except to home country) "AI" BAIC (bar all incoming calls) "IR" BIC-Roam (bar incoming calls when roaming outside the home country) "AB" All Barring services "AG" All outgoing barring services "AC" All incoming barring services
Write command AT+CLCK=<fac>, <mode>[, <passwd> [,<class>]]	Parameter <fac> See Test command <mode> 0 Cancels lock 1 Activates lock 2 Queries lock status <passwd> Password <class> 1 Voice 2 Data 4 Fax 7 All classes (default value) Response If <mode>=2 and command is successful +CLCK: <status>[,<class1>[<CR><LF> +CLCK: <status>, class2....]] Parameter <status> 0 Off 1 On OK/ERROR/+CME ERROR

AT+CPWD	Change password to a lock
Test command AT+CPWD=?	Response +CPWD: list of supported (<fac>, <pwdlength>)s OK/ERROR/+CME ERROR Parameter <fac> "P2" PIN2 otherwise See Test command for AT+CLCK command, without "FD" <pwdlength> Password length
Write command AT+CPWD= <fac>, <oldpwd>, <newpwd>	Parameter <fac> See Test command for AT+CLCK command <oldpwd>, <newpwd> Old and new password Response OK/ERROR/+CME ERROR

AT+CLIP	Display telephone number of calling party		
Test command AT+CLIP=?	Response +CLIP: (list of supported <n>s) OK/ERROR/+CME ERROR Parameter		
	<n>	0	Suppresses the unexpected messages
		1	Displays the unexpected messages
Read command AT+CLIP?	Response +CLIP: <n>, <m> OK/ERROR/+CME ERROR Parameter		
	<n>		See Test command
	<m>	0	CLIP not booked
		1	CLIP booked
		2	Unknown
Write command AT+CLIP=[<n>]	Parameter <n>		See Read command
	Response OK/ERROR/+CME ERROR		
	Unexpected message +CLIP: <num>,<type> Telephone number of caller		

AT+CCFC	Call forwarding		
Test command AT+CCFC=?	Response +CCFC: (list of supported <reas>s) OK/ERROR/+CME ERROR Parameter		
	<reas>	0	Always
		1	If busy
		2	If no answer
		3	If not available
		4	All reasons (0-3)
		5	All conditional reasons (1-3)
Write command AT+CCFC=<reas>, <mode>[, <num> [,<type>[,<class> [,,,<time>]]]]	Parameter <reas>		See Test command
	<mode>	0	Deactivate
		1	Activate
		2	Query
		3	Install
		4	Delete
	<num>		Telephone number
	<type>		Type of telephone number
	<class>	1	Voice
		2	Data
		4	Fax
		7	All classes
	<time>	1-30	Time, rounded to a multiple of five seconds
	Response If <mode>=2 and command is successful +CCFC: <status>, <class1>[, <num>, <type>[,,, <time>]][<CR><LF>+CCFC: ....] OK/ERROR/+CME ERROR Parameter		
	<status>	0	Not active
		1	Active

AT+CHLD	Call hold and multiparty		
Test command AT+CHLD=?	Response +CHLD: (list of supported <n>s) OK/ERROR/+CME ERROR		
Write command AT+CHLD= [<n>]	Parameter <n>	0	Terminates all held calls or sets UDUB (**User Determined User Busy**) for a waiting call
		1	Terminates all active calls (if there are any) and accepts the other call (waiting call or held call)
		1X	Terminates call number X (X= 1-7)
		2	Puts all active calls on hold (if there are any) and accepts the other call (waiting call or held call) as active
		2X	Puts all active calls except call X (X= 1-7) on hold
		3	Connects the call put on hold to the active call
	For terminating		Terminating all calls except waiting calls is done with "AT+CHUP"
	Note:		Command scope depends on the SIM clearing and/or on the network support
	Response OK/ERROR/+CME ERROR		

AT+CPAS	Query the telephone status		
Test command AT+CPAS=?	Response +CPAS: (list of supported <pas>s) OK/ERROR/+CME ERROR		
	Parameter <pas>	0	Ready
		3	Incoming call (phone is ringing)
		4	Call is active
Execute command AT+CPAS	Response +CPAS: <pas> OK/ERROR/+CME ERROR		
	Parameter <pas>		See Test command
	OK/ERROR/+CME ERROR		

AT+CPIN	Enter PIN and query lock
Test command AT+CPIN=?	Response OK
Read command AT+CPIN?	Response +CPIN: <code> OK/ERROR/+CME ERROR Parameter <code> READY — No further input necessary SIM PIN — SIM PIN input necessary SIM PUK — SIM PUK input necessary PH-SIM PIN — Device-code (theft protection) input necessary PH-SIM PUK — Device-code PUK (theft protection) input necessary SIM PIN2 — PIN2, e.g. for editing the FDN book; *only possible if previous command was acknowledged with* +CME ERROR:17 SIM PUK2 — Only possible if previous command was acknowledged with error +CME ERROR:18 The required error message can (must) be provoked by an attempted Write command.
Write command AT+CPIN=<*pin*> [,<new pin>]	Parameter <*pin*> — Password for appropriate lock; if the lock is a PUK, then a <new pin> is necessary. <new pin> — New password for the lock Response OK/ERROR/+CME ERROR

AT+CBC	Battery charge
Test command AT+CBC=?	Response +CBC: (list of supported <bcs>s),(list of supported <bcl>s) OK/ERROR/+CME ERROR Parameter <bcs>: 0 ME is supplied from battery; 1 ME has battery but is not supplied from there; 2 ME has no battery connected; 3 Error <bcl>: 0 Battery is flat, but no more actions possible; 1-100 charge in per cent
Execute command AT+CBC	Response +CBC: <bcs>,<bcl>

AT+CSQ	Output signal quality
Test command AT+CSQ=?	Response +CSQ: (list of supported <rssi>s), list of supported <ber>) OK/ERROR/+CME ERROR Parameter <rssi> *Reception level:* 0 -113 dBm or less 1 -111 dBm 2-30 -109 to -53 dBm 31 -51 dBm or more 99 Unknown <ber> Bit error rate: 0-7 Like RXQUAL values from Table GSM 05.08 in Section 8.2.4 99 Unknown
Execute command AT+CSQ	Response +CSQ: <rssi>, <ber> OK/ERROR/+CME ERROR Parameter <rssi> See Test command <ber> See Test command

AT+CPBS	Select a telephone book
Test command AT+CPBS=?	Response +CPBS: (list of supported <sto>s) OK/ERROR/+CME ERROR Parameter <sto> "FD" SIM fix-dialing phonebook "SM" SIM phonebook "ME" ME phonebook "DC" ME Dialled Calls List "ON" SIM (or ME) own numbers (MSISDNs) list "LD" SIM last-dialling phonebook "MC" ME missed (unanswered received) calls list "RC" ME received calls list ***For description of telephone-book features, see** *Appendix A* **Note:** "DC" and "LD" are never both available.
Read command AT+CPBS?	Response +CPBS: <sto> OK/ERROR/+CME ERROR Parameter <sto> See Test command
Write command AT+CPBS=<sto>	Parameter <sto> See Test command Response OK/ERROR/+CME ERROR

AT+CPBR	Read a telephone-book entry
Test command AT+CPBR=?	Response +CPBR: (list of supported <index>s), <nlength>, <tlength> OK/ERROR/+CME ERROR Parameter <index> Location number <nlength> Max. length of telephone number <tlength> Max. length of text corresponding to the number
Write command AT+CPBR= <index1> [,<index2>]	Response +CPBR: <index1>, <*nummer*>, <typ>, <text>[<CR><LF> +CPBR: ..... +CPBR: <index2>, <nummer>, <typ>, <text>] OK/ERROR/+CME ERROR Parameter <index1> Location number where the read of the entry starts <index2> Location number where the read of the entry ends <nummer> Telephone number <typ> Type of number <text> Text corresponding to the telephone number **NOTE:** In the <text> field, there may appear special characters like **`"` (0x22), `@` (0x00), `ò` (0x08), `Ö` (0x5c).** (See also **+CPBW** and *Appendix A*: **Special hints for using** +CPBR/+CPBW **command)** In models before the S25, empty phonebook records are reported as follows: **+CPBR: <index1>,empty** In S25ff, those empty entries don't produce any output.

AT+CPBW	Write a telephone-book entry
Test command AT+CPBW=?	Response +CPBW: (list of supported <index>s), <nlength>,(list of supported <type>s), <tlength> OK/ERROR/+CME ERROR Parameter <index> Location number <nlength> Max. length of telephone number <tlength> Max. length of text corresponding to the number
Write command AT+CPBW= [<index>] [,<nummer> [,<typ>[,<text>]]]	Parameter <index> Location number at which the entry is written <nummer> Telephone number <typ> Type of number <text> Text corresponding to the telephone number Response OK/ERROR/+CME ERROR Note: The following characters in `<text>` must be entered via the escape sequence (see also *Appendix A*: **Special hints for using** +CPBR/+CPBW **command**)

GSM Char	Hex char.	ASCII	**GSM Esc Seq**	Seq.(hex)	Note
Ö	5C	\	**Ö5C**	5C 35 43	Backslash
"	22	"	**Ö22**	5C 32 32	String delim
ò	08	BSP	**Ö08**	5C 30 38	Backspace
@	00	NULL	**Ö00**	5C 30 30	GSM Null

y cause problems on application level when using the function strlen() and should thus be represented by an escape sequence

AT+CMEE	Expanded error messages according to GSM 07.07
Test command AT+CMEE=?	Response +CMEE: (list of supported <n>s) Parameter <n> 0 Suppresses the expanded error format 1 Expanded error messages as number 2 Expanded error messages as text
Read command AT+CMEE?	Response +CMEE: <n> Parameter <n> See Read command
Write command AT+CMEE=<n>	Parameter <n> See Read command Response OK/ERROR/+CME ERROR
	Description: **The following CME errors are possible:** 0 PHONE FAILURE 1 NO CONNECTION TO PHONE 2 PH-TA LINK RESERVED 3 OPERATION NOT ALLOWED 4 OPERATION NOT SUPPORT 5 PH-SIM PIN REQUIRED 10 SIM NOT INSERTED 11 SIM PIN REQUIRED 12 SIM PUK REQUIRED 13 SIM FAILURE 14 SIM BUSY 15 SIM WRONG 16 INCORRECT PASSWORD 17 SIM PIN2 REQUIRED 18 SIM PUK2 REQUIRED 20 MEMORY FULL 21 INVALID INDEX 22 NOT FOUND 23 MEMORY FAILURE 24 TEXT TOO LONG 25 INV CHAR IN TEXT 26 DIAL STRING TOO LONG 27 INV CHAR IN DIAL 30 NO NETWORK SERVICE 31 NETWORK TIMEOUT 100 UNKNOWN 512 CALL BARRED BY BLACKLIST 513 PHONE LINK RESERVED 514 INVALID DIAL STRING 515 PHONE BUSY 550 PH-SIM PUK REQUIRED 551 NTF-SIM PIN REQUIRED 552 NTF-SIM PUK REQUIRED 553 PH-NET PIN REQUIRED 554 PH-NET PUK REQUIRED 555 PH-SP PIN REQUIRED 556 PH-SP PUK REQUIRED 557 PH-CP PIN REQUIRED 558 PH-CP PUK REQUIRED 559 FEATURE PIN REQUIRED

	560 FEATURE PUK REQUIRED The following CMS errors have been defined for SMS: 300 ME failure 301 SMS service of ME reserved 302 operation not allowed 303 operation not supported 304 invalid PDU parameter 305 invalid TEXT mode 310 SIM not inserted 311 SIM PIN necessary 312 PH-SIM PIN necessary 313 SIM failure 314 SIM busy 315 SIM wrong 320 memory failure 321 invalid memory failure 322 memory full 330 SMSC address unknown 331 no network service 332 network timeout 340 NO +CNMA ACK EXPECTED 500 unknown error

AT+VTS	Send a DTMF tone
Test command AT+VTS=?	Response (list of supported <dtmf>s), (list of supported <duration>s) OK/ERROR/+CME ERROR Parameter <dtmf> 0-9,#,*,A-D, exactly one character <duration> Duration of tone in (duration/10) seconds
Write command AT+VTS= <dtmf> [,<duration>] or AT+VTS= <dtmf-string>	Parameter <dtmf> **One** character from the list, see Test command<duration> See Test command <dtmf-string> max. 29 characters in quotation marks ("..."), then a duration cannot be specified Response OK/ERROR/+CME ERROR **Important**: There is a leading output prefix +VTS in models before the S25.

AT+VTD	Set duration of a DTMF tone
Test command AT+VTD=?	Response +VTD: (list of supported <duration>s) OK/ERROR/+CME ERROR Parameter <duration> 1-255 Duration of tone in (duration/10) seconds
Read command AT+VTD?	Response +VTD: <duration> OK/ERROR/+CME ERROR
Write command AT+VTD= <duration>	Parameter <duration> See Test command Response OK/ERROR **Important**: There is a leading output prefix +VTD in models before the S25.

AT+WS46	Select wireless network
Test command AT+WS46=?	Response (list of supported <n>s) OK
Read command AT+WS46?	Response <n> OK/ERROR/+CME ERROR Parameter <n> Integer; WDS side stack 12 GSM digital cellular
Write command AT+WS46=[<n>]	Response OK/ERROR/+CME ERROR **Important:** There is a leading output prefix +WS46 in models before the S25.

AT+CSCS	Select TE character set
Test command AT+CSCS=?	Response +CSCS: (list of supported <chset>s) OK
Read command AT+CSCS?	Response +CSCS: <chset> OK/ERROR/+CME ERROR Parameter <chset> String; determines which TE character set is used
Write command AT+CSCS= [<chset>]	Response OK/ERROR/+CME ERROR

AT+CAOC	Advice of charge
Test command AT+CAOC=?	Response +CAOC: (list of supported <mode>s) Parameter <mode> 0 query CCM value
Read command AT+CAOC?	Response +CAOC: <mode> Parameter <mode> 0 See Test command
Write command AT+CAOC=<mode>	Response OK Parameter <mode> 0 See Test command
Execute command AT+CAOC	Response +CAOC: <ccm> OK/ERROR/+CME ERROR Parameter <ccm> Updated hexadecimal call meter, measured in home units; coding analogous to ACMmax on the SIM

AT+CSSN	Supplementary service notifications **Revision according to GSM 07.07 Version 5.0.0**
Test command AT+CSSN=?	Response +CSSN: (list of supported <n>s), (list of supported <m>s) Parameter <n> 0 Suppresses the +CSSI messages 1 Activates the +CSSI messages <m> 0 Suppresses the +CSSU messages 1 Activates the +CSSU messages For supported +CSSI/+CSSU messages, see also 1.3.4. **Summary of All UnexpectedMessages**
Read command AT+CSSN?	Response +CSSN: <n>,<m> Parameter <n> See Test command <m> See Test command
Write command AT+CSSN=<n>[,<m>]	Parameter <n> See Read command <m> See Read command
	Unexpected message +CSSI: <code1> +CSSU: <code2> Parameter <code1> Intermediate result code 3 Waiting call is pending <code2> Unsolicited result code 5 Held call was terminated

AT+CRSM	Restricted SIM access
Test command AT+CRSM=?	Response OK
Write command +CRSM=<command> [,<fileid> [,<P1>,<P2>,<P3> [,<data>]]]	Response +CRSM: <sw1>,<sw2>[,<response>] OK/ERROR/+CME ERROR Parameter <command>: 176 READ BINARY 178 READ RECORD 192 GET RESPONSE 214 UPDATE BINARY 220 UPDATE RECORD 242 STATUS <fileid>: Integer, identifier of the data file on the SIM, mandatory for every command except STATUS (see GSM 11.11) <P1>, <P2>, <P3>: Integer, transferal parameter from ME to SIM, mandatory for every command except GET RESPONSE,STATUS (see GSM 11.11) <data>: Hexadecimal string; information that is to be written to the SIM <sw1>, <sw2>: Integer; information from the SIM as to how/whether the command was executed <response>: Hexadecimal string; given when a command was successfully processed **Note**: The write access to CK boxes receives only limited support and differs from device to device.

AT+CIMI	Output of IMSI
Test command AT+CIMI=?	Response OK
Execute command AT+CIMI	Response <imsi> Parameter <imsi> International Mobile Subscriber Identity (IMSI)

AT+CACM	Accumulated call meter
Test command AT+CACM=?	Response OK
Read command AT+CACM?	Response +CACM: <acm> OK/ERROR/+CME ERROR Parameter <acm> Accumulated call meter in hexadecimal format, measured in home units; coding analogous to ACMmax on the SIM
Write command AT+CACM=[<passwd>]	Response OK/ERROR/+CME ERROR Parameter <passwd> String type; usually PIN2

AT+CAMM	Accumulated call meter maximum
Test command AT+CAMM=?	Response OK
Read command AT+CAMM?	Response +CAMM: <acmmax> OK/ERROR/+CME ERROR Parameter <acmmax> Accumulated call meter maximum in hexadecimal format, measured in home units; coding analogous to ACMmax on the SIM
Write command AT+CAMM=[<acmmax>[,<passwd>]]	Response OK/ERROR/+CME ERROR Parameter <acmmax> (see Read command) <passwd> String type; usually PIN2

AT+CLCC	List Current Calls
Test command AT+CLCC=?	Response OK
Execute command AT+CLCC	Response [+CLCC: <id1>,<dir>,<stat>,<mode>,<mpty>, <number>,<type>] [<CR><LF>+CLCC: <id2>,<dir>,<stat>,<mode>,<mpty>, <number>,<type> [...]]] OK/ERROR/+CME ERROR Parameter <idx>: integer type; call identification number as described in GSM 02.30 [19] subclause 4.5.5.1; this number can be used in +CHLD command operations <dir>: 0 mobile originated (MO) call 1 mobile terminated (MT) call <stat> (state of the call): 0 active 1 held 2 dialing (MO call) 3 alerting (MO call) 4 incoming (MT call) 5 waiting (MT call) <mode> (bearer/teleservice): 0 voice 1 data 2 fax 3 voice followed by data, voice mode 4 alternating voice/data, voice mode 5 alternating voice/fax, voice mode 6 voice followed by data, data mode 7 alternating voice/data, data mode 8 alternating voice/fax, fax mode 9 unknown <mpty>: 0 call is not one of multiparty (conference) call parties 1 call is one of multiparty (conference) call parties <number>: string type phone number in format specified by <type> <type>: type of address octet in integer format

AT+CCLK	Clock
Test command AT+CCLK=?	Response OK
Read command AT^SCLK?	Response +CCLK: <time> OK/ERROR/+CME ERROR Parameter: <time>: string type value; format is "yy/MM/dd,hh:mm:ss", where characters indicate year (two last digits), month, day, hour, minutes; E.g. 6th of May 1994, 22:10:00 hours equals to „94/05/06,22:10:00"
Write command AT+CCLK=<time>	Response OK/ERROR/+CME ERROR Parameter: <time> see Test commnd

AT+COPN	Read operator names
Test command AT+COPN=?	Response OK
Execute command AT+COPN	Response +COPN:numeric <oper>,long alphanumeric <oper><CR><LF> +COPN:..... OK/ERROR/+CME ERROR Parameter <oper> Network operator in numeric and alphanumeric notation see AT^SPLM

AT+CPUC	Price per unit and currency table
Test command AT+CPUC=?	Response OK
Read command AT+CPUC?	Response +CPUC: <currency>,<ppu> OK/ERROR/+CME ERROR Parameter <currency> three-character currency code (e.g. "FRA", "DEM") <ppu> price per unit; dot is used as a decimal separator (e.g. "1.33")
Write command AT+CPUC=<currency>,<ppu>[,<passwd>]	Response OK/ERROR/+CME ERROR Parameter <passwd> String type; usually PIN2

AT+CALM	Alert sound mode
Test command AT+CALM=?	Response +CALM: (list of supported <mode>s) OK
Read command AT+CALM?	Response +CALM: <mode> OK/ERROR/+CME ERROR
Write command AT+CALM=<mode>	Response OK/ERROR/+CME ERROR Parameter <mode>: 0 normal mode 1 silent mode (all sounds are prevented) 2 beep (only a short beep indicates an incomming call)

AT+CRSL	Ringer sound level
Test command AT+CRSL=?	Response +CRSL: (list of supported <level>s) OK
Read command AT+CRSL?	Response +CRSL: <level> OK/ERROR/+CME ERROR
Write command AT+CRSL=<level>	Response OK/ERROR/+CME ERROR Parameter <level>: Ringer Sound Level

AT+CLVL	Loudspeaker volume level
Test command AT+CLVL=?	Response +CLVL: (list of supported <level>s) OK
Read command AT+CLVL?	Response +CLVL: <level> OK/ERROR/+CME ERROR
Write command AT+CLVL=<level>	Response OK/ERROR/+CME ERROR Parameter <level>: Loudspeaker Volume Level

AT+CMUT	Mute control
Test command AT+CMUT=?	Response +CMUT: (list of supported <n>s) OK
Read command AT+CMUT?	Response +CMUT: <n> OK/ERROR/+CME ERROR
Write command AT+CMUT=<n>	Response OK/ERROR/+CME ERROR Parameter <n>: 0 mute off 1 mute on

AT+CVIB	Vibrator mode
Test command AT+CVIB=?	Response +CVIB: (list of supported <mode>s) OK
Execute command AT+CVIB	Response +CVIB: <mode> OK/ERROR/+CME ERROR
Write command AT+CVIB=<mode>	Response OK/ERROR/+CME ERROR Parameter <*mode*>: *Vibrator mode* 0 disable 1 enable 16 vibrate then ring (not available in every model)

1.3.2. AT Commands According to GSM 07.05 for SMS

The GSM 07.05 commands are used for operating the SMS functions of the GSM mobile phone. The GSM module MOBILE supports the SMS PDU mode.

AT+CSMS	Selection of message service **Revision according to GSM 07.05 Version 5.0.0**
Test command AT+CSMS=?	Response +CSMS: (list of supported <service>s) Parameter <service> 0 GSM 3.40 and 3.41 1 GSM 3.40 and 3.41 and compatibility of the AT command syntax for phase 2+ **NOTE:** Deactivating the phase 2+ compatibility is only possible if the direct output of short messages +CNMI=1,2 or +CNMI=1,3 is not activated. If necessary, the latter should be deactivated first.
Read command AT+CSMS?	Response +CSMS: <service>,<mt>,<mo>,<bm> Parameter <service> 0 GSM 3.40 and 3.41 <mt> Mobile terminated messages 1 Type supported <mo> Mobile originated messages 1 Type supported <bm> Broadcast type messages 0 Type not supported
Write command AT+CSMS=<service>	Parameter <service> 0 GSM 3.40 and 3.41 Response +CSMS: <mt>,<mo>,<bm> OK/ERROR/+CMS ERROR

AT+CPMS	Selection of SMS memory **Revision according to GSM 07.05 Version 4.7.0**
Test command AT+CPMS=?	Response +CPMS: (list of supported <mem1>s),(list of supported <mem2>s) ,(list of supported <mem3>s) Parameter <mem1> Memory from which messages are read and deleted "SM" SIM-messages memory <mem2> Memory to which messages are written and sent "SM" SIM-messages memory <mem3> Memory in which received messages are stored, if forwarding to the PC is not set ("+CNMI") "SM" SIM-messages memory
Read command AT+CPMS?	Response +CPMS: <mem1>,<used1>,<total1>,<mem2>,<used2>,<total2> ,<mem3>,<used3>,<total3> Parameter <memx> Memory from which messages are read and deleted <usedx> Number of messages currently in <memx> <totalx> Number of storable messages in <memx>
Write command AT+CPMS= <mem1> [,<mem2> [,<mem3>]]	Parameter <mem1> See Test command <mem2> See Test command <mem3> See Test command Response +CPMS: <used1>,<total1>,<used2>,<total3>,<used3>,<total3> OK/ERROR/+CMS ERROR

AT+CMGF	SMS format
Test command AT+CMGF=?	Response +CMGF: (list of supported <mode>s) Parameter <mode>: 0 PDU mode
Read command AT+CMGF?	Response +CMGF: <mode> Parameter <mode>: 0 PDU mode
Write command AT+CMGF=[<mode>]	Parameter <mode>: 0 PDU mode Response OK/ERROR

AT+CSCA	Address of the SMS service center
Test command AT+CSCA=?	Response OK
Read command AT+CSCA?	Response +CSCA: <sca>,<tosca> Parameter <sca> *Service-center address in string format* <tosca> Service-center address format
Write command AT+CSCA= <sca>[,<tosca>]	Parameter <sca> Service-center address in string format <tosca> Service-center address format Response OK/ERROR

AT+CNMI	Display new incoming SMS **Revision according to GSM 07.05 Version 4.7.0**
Test command AT+CNMI=?	Response +CNMI: (list of supported <mode>s),(list of supported <mt>s),(list of supported <bm>s),(list of supported <ds>s),(list of supported <bfr>s) Parameter <mode> 0 Buffers unexpected messages (but is equivalent to rejecting; see <bfr>) 1 Discard indication and reject new received message unsolicited result codes when TA-TE link is reserved. Otherwise forward them directly to the TE. (only with S25ff) 2 Buffers unexpected messages if serial interface is occupied, otherwise they are output (only models before S25) <mt> 0 Suppresses unexpected messages for incoming short messages 1 Unexpected messages of a received short message (SMS-DELIVER) that is stored on a chip card are output in the form +CMTI: <mem>,<index> 2 Unexpected messages of a received short message (SMS-DELIVER) (except class 2 and the message "Waiting Indication Group: store message") are output in the form +CMT: [<alpha>],<length><CR><LF><pdu> (<alpha> is not supported) Class 2 and the message "Waiting Indication Group: store message" are output as <mt>=1 3 Unexpected messages of a received short message (SMS-DELIVER) class 3 are output as <mt>=2. Messages with other data coding schemes are output as <mt>=1. **NOTE:** <mt>=2 and <mt>=3 are not possible unless the Phase 2+ compatibility has been activated by means of +CSMS=1 <bm> 0 *Suppresses unexpected messages for* incoming cell broadcast messages 2 Outputs unexpected messages for cell broadcast messages in the form +CBM: <length><CR><LF><pdu> <ds> 0 Suppresses unexpected messages for incoming SMS status reports 2 Outputs unexpected messages for SMS status reports in the form +CDS: <length><CR><LF><pdu>

	<bfr> 1 Buffered unexpected messages are rejected when switching from <mode> 0 to <mode> 2. <mem> See +CPMS <index> Index of the record on the chip card <alpha> alphanumeric representation of the sender address <length> Length of <pdu> <pdu> See +CMGL
Read command AT+CNMI?	Response +CNMI: <mode>,<mt>,<bm>,<ds>,<bfr> Parameter <mode> See Test command <mt> See Test command <bm> See Test command <ds> See Test command <bfr> See Test command
Write command AT+CNMI= [<mode> [,<mt>[,<bm> [,<ds>[,<bfr>]]]]]	Parameter <mode> See Test command <mt> See Test command <bm> See Test command <ds> See Test command <bfr> See Test command Response OK/ERROR/+CMS ERROR
	Unexpected message +CMTI: <mem>,<index> Indication that new message has arrived +CMT: ,<length><CR><LF><pdu> Direct output of the short message +CDS: <length><CR><LF><pdu> Direct output of the status report *+CBM: <length><CR><LF><pdu>* Direct output of the cell broadcast message

AT+CNMA	**Acknowledgment of a short message directly output (without storing on the chip card)** **Revision according to GSM 07.05 Version 5.0.0** ***(NOTE: This command is not possible unless the Phase 2+ compatibility has been activated by means of +CSMS=1)***
Test command AT+CNMA=?	Response +CNMA: (list of supported <n>s) Parameter <n> 0 Mode of functioning analogous to *GSM 07.05 text mode*
Write command AT+CNMA[=<n>]	Parameter <n> See Test command Response OK/ERROR/+CMS ERROR: <err>

AT+CMGL	List SMS **Revision according to GSM 07.05 Version 4.7.0**
Test command AT+CMGL=?	Response +CMGL: (list of supported <stat>s) Parameter <stat> 0 "REC UNREAD": received unread messages (*default*) 1 "REC READ": received read messages 2 "STO UNSENT": stored unsent messages 3 "STO SENT": stored sent messages 4 "ALL": all messages
Write command AT+CMGL [=<stat>]	Parameter <stat> See Test command Response If PDU mode (+CMGF=0) and command are successful: +CMGL:<index>,<stat>,[<alpha>],<length> <CR><LF><pdu>[<CR><LF> +CMGL: <index>,<stat>,[alpha],<length> <CR><LF><pdu><CR><LF> [...]]
	Parameter <pdu> The PDU begins with the service-center address (according to GSM04.11), followed by the TPDU according to GSM03.40 in *hexadecimal format* otherwise: +CMS ERROR: <err>

AT+CMGR	Read in an SMS **Revision according to GSM 07.05 Version 4.7.0**
Test command AT+CMGR=?	Response OK
Write command AT+CMGR= <index>	Parameter <index> Index of message in selected memory <mem1> Response **If PDU mode (+CMGF=0) and command are successful:** +CMGR: <stat>,[<alpha>],<length><CR><LF><pdu> Parameter <pdu> Siehe "AT+CMGL" otherwise: +CMS ERROR: <err>

AT+CMGS	Send an SMS
Test command AT+CMGS=?	Response OK
Write command **If PDU mode (+CMGF=0)** +CMGS=<*length*><CR>***PDU is given*** <ctrl-Z/ESC>	Parameter <length> Length of PDU <pdu> See "AT+CMGL" <mr> Message reference Response **If sending is successful:** +CMGS: <mr> **If sending is not successful:** +CMS ERROR: <err>

AT+CMSS	Send an SMS from the SMS memory
Test command AT+CMSS=?	Response OK
Write command +CMSS=<index>[,<da>[,<toda>]]	Parameter <index> Index of message in selected memory <mem1> <da> Destination address in string format <toda> Format of destination address <mr> Message reference Response **If sending is successful:** +CMSS: <mr> **If sending is not successful:** +CMS ERROR: <err>

AT+CMGW	Write an SMS to the SMS memory
Test command AT+CMGW=?	Response OK
Write command **If PDU mode (+CMGF=0)** AT+CMGW=<length>[,<stat>]<CR>***PDU is given*** <ctrl-Z/ESC>	Parameter <length> Length of PDU <stat> See command +CMGL <pdu> See "AT+CMGL" <index> Index of message in selected memory <mem1> Response +CMGW: <index> +CMS ERROR: <err>

AT+CMGD	Delete an SMS in the SMS memory
Test command At+CMGD=?	Response OK
Write command AT+CMGD=<index>	Parameter <index> Index of message in the selected memory <mem1> Response OK/ERROR/+CMS ERROR

AT+CSCB	Select cell broadcast messages
Test command AT+CSCB=?	Response +CSCB: (list of supported <mode>s) Parameter <mode> 0 Accepts messages that are defined in <mids> and <dcss> 1 Does not accept messages that are defined in <mids> and <dcss>
Read command AT+CSCB? Write command AT+CSCB=[<mode>[,<mids>[,<dcss>]]]	Response +CSCB: <mode>,<mids>,<dcss> Parameter <mode> See Test command <mids> String type; combinations of CBM message IDs <dcss> String type; combinations of CBM data coding schemes

AT+CMGC	Send an SMS command
Test command AT+CMGC=?	Response OK
Write command **If PDU mode (+CMGF=0)** +CMGC=<length><CR>***PDU is given*** <ctrl-Z/ESC>	Parameter <length> Length of PDU <pdu> See "AT+CMGL" <mr> Message reference Response **If sending is successful:** +CMGC: <mr> **If sending is not successful:** +CMS ERROR: <err>