INSTRUCTION SET

Arithmetic Operations

			bytes	OSC periods
ADD	A,source	add source to A	1,2	12
ADD	A,#data		2	12
ADDC	A,source	add with carry	1,2	12
ADDC	A,#data		2	12
SUBB	A,source	subtract from A with borrow	1,2	12
SUBB	A,#data		2	12
INC	A	increment	1	12
INC	source		1,2	12
INC	DPTR *		1	24
DEC	A	decrement	1	12
DEC	source		1,2	12
MUL	AB	multiply A by B	1	48
DIV	AB	divide A by B	1	48
DA	A	decimal adjust	1	12

Legend

Rn	register addressing using R0-R7
direct	8bit internal address (00h-FFh)
@Ri	indirect addressing using R0 or R1
source	any of [Rn, direct, @Ri]
dest	any of [Rn, direct, @Ri]
#data	8bit constant included in instruction
#data16	16bit constant included in instruction
bit	8bit direct address of bit
rel	signed 8bit offset
addr11	11bit address in current 2K page
addr16	16bit address

* INC DPTR increments the 24bit value DPP/DPH/DPL

Data Transfer Operations

			bytes	OSC periods
MOV	A,source	move source to destination	1,2	12
MOV	A,#data		2	12
MOV	dest,A		1,2	12
MOV	dest,source		1,2,3	24
MOV	dest,#data		2,3	12,24
MOV	DPTR,#data16		3	24
MOVC	A,@A+DPTR	move from code memory	1	24
MOVC	A,@A+PC		1	24
MOVX	A,@Ri	move to/from data memory	1	24
MOVX	A,@DPTR		1	24
MOVX	@Ri,A		1	24
MOVX	@DPTR,A		1	24
PUSH	direct	push onto stack	2	24
POP	direct	pop from stack	2	24
XCH	A,source	exchange bytes	1,2	12
XCHD	A,@Ri	exchg low digits	1	12

Logical Operations

			bytes	OSC periods
ANL	A,source	logical AND	1,2	12
ANL	A,#data		2	12
ANL	direct,A		2	12
ANL	direct,#data		3	24
ORL	A,source	logical OR	1,2	12
ORL	A,#data		2	12
ORL	direct,A		2	12
ORL	direct,#data		3	24
XRL	A,source	logical XOR	1,2	12
XRL	A,#data		2	12
XRL	direct,A		2	12
XRL	direct,#data		3	24
CLR	A	clear A to zero	1	12
CPL	A	complement A	1	12
RL	A	rotate A left	1	12
RLC	A	...through C	1	12
RR	A	rotate A right	1	12
RRC	A	...through C	1	12
SWAP	A	swap nibbles	1	12

Program Branching

			bytes	OSC periods
ACALL	addr11	call subroutine	2	24
LCALL	addr16		3	24
RET		return from sub.	1	24
RETI		return from int.	1	24
AJMP	addr11	jump	2	24
LJMP	addr16		3	24
SJMP	rel		2	24
JMP	@A+DPTR		1	24
JZ	rel	jump if A = 0	2	24
JNZ	rel	jump if A not 0	2	24
CJNE	A,direct,rel	compare and jump if not equal	3	24
CJNE	A,#data,rel		3	24
CJNE	Rn,#data,rel		3	24
CJNE	@Ri,#data,rel		2	24
DJNZ	Rn,rel	decrement and jump if not zero	2	24
DJNZ	direct, rel		3	24
NOP		no operation	1	12

Boolean Variable Manipulation

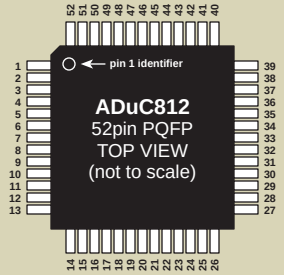
			bytes	OSC periods
CLR	C	clear bit to zero	1	12
CLR	bit		2	12
SETB	C	set bit to one	1	12
SETB	bit		2	12
CPL	C	complement bit	1	12
CPL	bit		2	12
ANL	C,bit	AND bit with C	2	24
ANL	C,/bit	...NOTbit with C	2	24
ORL	C,bit	OR bit with C	2	24
ORL	C,/bit	...NOTbit with C	2	24
MOV	C,bit	move bit to bit	2	12
MOV	bit,C		2	24
JC	rel	jump if C set	2	24
JNC	rel	jmp if C not set	2	24
JB	bit,rel	jump if bit set	3	24
JNB	bit,rel	jmp if bit not set	3	24
JBC	bit, rel	jmp&clear if set	3	24

ASSEMBLER DIRECTIVES

EQU	define symbol
DATA	define internal memory symbol
IDATA	define indirect addressing symbol
XDATA	define external memory symbol
BIT	define internal bit memory symbol
CODE	define program memory symbol
DS	reserve bytes of data memory
DBIT	reserve bits of bit memory
DB	store byte values in program memory
DW	store word values in program memory
ORG	set segment location counter
END	end of assembly source file
CSEG	select program memory space
XSEG	select external data memory space
DSEG	select internal data memory space
ISEG	select indirectly addressed internal data memory space
BSEG	select bit addressable memory space

PIN FUNCTIONS

1	P1.0 / ADC0 / T2	27	SDATA / MOSI	40	$\overline{EA}$
2	P1.1 / ADC1 / T2EX	28	P2.0 / A8 / A16	41	$\overline{PSEN}$
3	P1.2 / ADC2	29	P2.1 / A9 / A17	42	ALE
4	P1.3 / ADC3	30	P2.2 / A10 / A18	43	P0.0 / AD0
5	AV_{DD}	31	P2.3 / A11 / A19	44	P0.1 / AD1
6	AGND	32	XTAL1 (in)	45	P0.2 / AD2
7	C_{REF}	33	XTAL2 (out)	46	P0.3 / AD3
8	V_{REF}	34	DV_{DD}	47	DGND
9	DAC0	35	DGND	48	DV_{DD}
10	DAC1	36	P2.4 / A12 / A20	49	P0.4 / AD4
11	P1.4 / ADC4	37	P2.5 / A13 / A21	50	P0.5 / AD5
12	P1.5 / ADC5 / $\overline{SS}$	38	P2.6 / A14 / A22	51	P0.6 / AD6
13	P1.6 / ADC6	39	P2.7 / A15 / A23	52	P0.7 / AD7
14	P1.7 / ADC7				
15	RESET				
16	P3.0 / RxD				
17	P3.1 / TxD				
18	P3.2 / $\overline{INT0}$				
19	P3.3 / $\overline{INT1}$ / MISO				
20	DV_{DD}				
21	DGND				
22	P3.4 / T0				
23	P3.5 / T1 / $\overline{CONVST}$				
24	P3.6 / $\overline{WR}$				
25	P3.7 / $\overline{RD}$				
26	SCLOCK				



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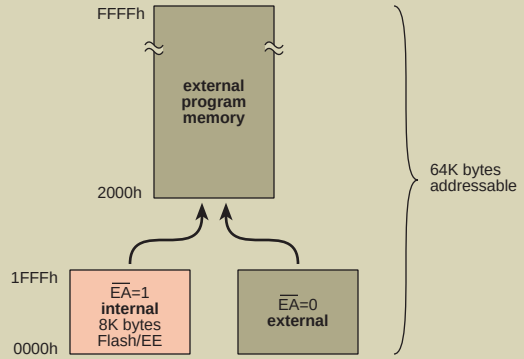
PROGRAM MEMORY SPACE (read only)



INTERRUPT VECTOR ADDRESSES

Interrupt Bit	Interrupt Name	Vector Address	Priority within Level
PSMCON.5	Power Supply Monitor Interrupt	43h	1
IE0	External Interrupt 0	03h	2
ADCI	End of ADC Conversion Interrupt	33h	3
TF0	Timer0 Overflow Interrupt	0Bh	4
IE1	External Interrupt 1	13h	5
TF1	Timer1 Overflow Interrupt	1Bh	6
ISPI/I2CI	SPI/I2C Interrupt	3Bh	7
RI/TI	UART Interrupt	23h	8
TF2/EXF2	Timer2 Interrupt	2Bh	9

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ANALOG DEVICES

ADuC812

MicroConverter® Quick Reference Guide

a "Data Acquisition System on a Chip"

the ADuC812 is:

ADC: 12bit, 5µs, 8channel, self calibrating
0.5LSB INL & 70dB SNR

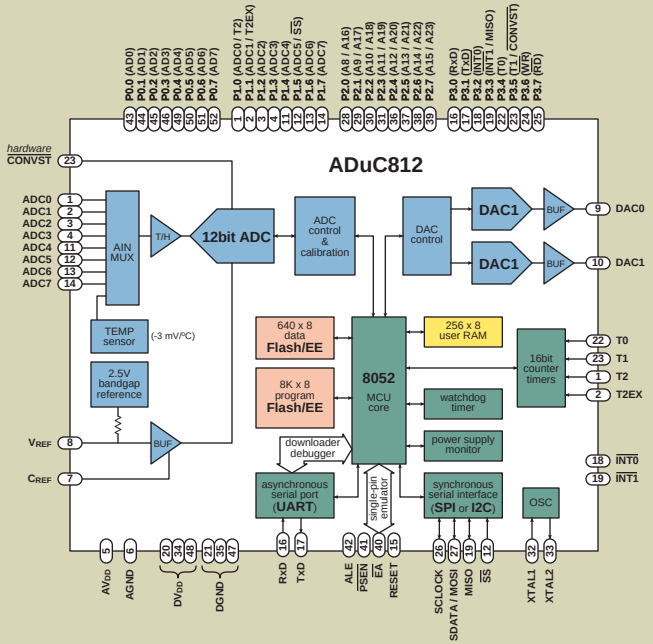
DAC: dual, 12bit, 15µs, voltage output
1LSB DNL

Flash/EEPROM: 8K bytes Flash/EE program memory
640 bytes Flash/EE data memory

microcontroller: industry standard 8052
DC to 16MHz, up to 1.3MIPS, 32 I/O lines

other on-chip features: temperature sensor, power supply monitor, watchdog timer, flexible serial interface ports, precision voltage reference

FUNCTIONAL BLOCK DIAGRAM



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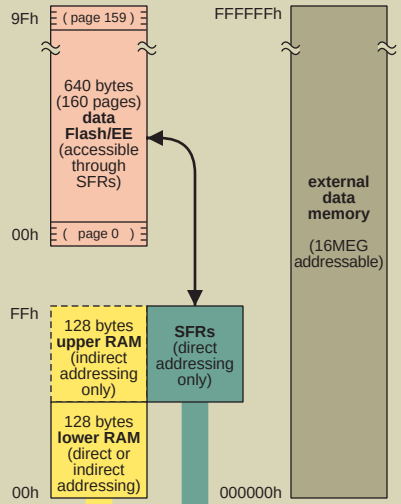
REV. B

DATA MEMORY: RAM, SFRs, user Flash/EE (all read/write)

LOWER RAM

decimal address	HEX address		MSB address (bit addresses) LSB address							
127	7Fh	General Purpose Area								
...	...									
48	30h									
47	2Fh	Bit Addressable Area	7Fh	7Eh	7Dh	7Ch	7Bh	7Ah	79h	78h
46	2Eh		77h	76h	75h	74h	73h	72h	71h	70h
45	2Dh		6Fh	6Eh	6Dh	6Ch	6Bh	6Ah	69h	68h
44	2Ch		67h	66h	65h	64h	63h	62h	61h	60h
43	2Bh		5Fh	5Eh	5Dh	5Ch	5Bh	5Ah	59h	58h
42	2Ah		57h	56h	55h	54h	53h	52h	51h	50h
41	29h		4Fh	4Eh	4Dh	4Ch	4Bh	4Ah	49h	48h
40	28h		47h	46h	45h	44h	43h	42h	41h	40h
39	27h		3Fh	3Eh	3Dh	3Ch	3Bh	3Ah	39h	38h
38	26h		37h	36h	35h	34h	33h	32h	31h	30h
37	25h		2Fh	2Eh	2Dh	2Ch	2Bh	2Ah	29h	28h
36	24h		27h	26h	25h	24h	23h	22g	21h	20h
35	23h		1Fh	1Eh	1Dh	1Ch	1Bh	1Ah	19h	18h
34	22h		17h	16h	15h	14h	13h	12h	11g	10h
33	21h		0Fh	0Eh	0Dh	0Ch	0Bh	0Ah	09h	08h
32	20h		07h	06h	05h	04h	03h	02h	01h	00h
31	1Fh	R7	Register Bank 3							
30	1Eh	R6								
29	1Dh	R5								
28	1Ch	R4								
27	1Bh	R3								
26	1Ah	R2								
25	19h	R1								
24	18h	R0								
23	17h	R7	Register Bank 2							
22	16h	R6								
21	15h	R5								
20	14h	R4								
19	13h	R3								
18	12h	R2								
17	11h	R1								
16	10h	R0								
15	0Fh	R7	Register Bank 1							
14	0Eh	R6								
13	0Dh	R5								
12	0Ch	R4								
11	0Bh	R3								
10	0Ah	R2								
9	09h	R1								
8	08h	R0								
7	07h	R7	Register Bank 0							
6	06h	R6								
5	05h	R5								
4	04h	R4								
3	03h	R3								
2	02h	R2								
1	01h	R1								
0	00h	R0								

DATA MEMORY SPACE (read/write area)



lower RAM details

SFR details

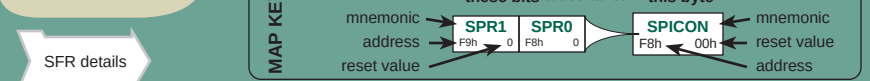
SFR MAP & RESET VALUES

(not used)	SPIDAT 00h F7h	ADCCON1 20h EFh	(reserved)	PSMCON DFh	(reserved)	(reserved)	(reserved)	EDATA4 00h BFh	(not used)	(not used)	(not used)	(not used)	(not used)	(not used)	(not used)	PCON 00h 87h
(reserved)	(reserved)	(reserved)	(reserved)	(reserved)	(reserved)	(reserved)	EADRL 00h C6h	EDATA3 00h BEh	(not used)	(not used)	(not used)	(not used)	(not used)	(not used)	(not used)	(reserved)
DACCON 04h FDh	ADCCON3 00h F5h	(reserved)	(reserved)	(reserved)	(reserved)	TH2 00h CDh	(reserved)	EDATA2 00h BDh	(not used)	(not used)	(not used)	(not used)	(not used)	(not used)	TH1 00h 8Dh	(reserved)
DAC1H 00h FCh	ADCGAINH 00h* F4h	(reserved)	(reserved)	(reserved)	DMAP 00h D4h	TL2 00h CCh	ETIM3 C9h	EDATA1 00h BCh	(not used)	(not used)	(not used)	(not used)	(not used)	(not used)	TH0 00h 8Ch	DPP 00h 84h
DAC1L 00h FBh	ADCGAINL 00h* F3h	(reserved)	(reserved)	(reserved)	DMAH 00h D3h	RCAP2H 00h CBh	(not used)	ETIM2 04h BBh	(not used)	(not used)	(not used)	(not used)	(not used)	I2CADD 55h 9Bh	TL1 00h 8Bh	DPH 00h 83h
DAC0H 00h FAh	ADCOFSH 20h* F2h	(reserved)	(reserved)	ADCDATAH 00h DAh	DMAL 00h D2h	RCAP2L 00h CAh	(not used)	ETIM1 52h BAh	(not used)	(not used)	(not used)	(not used)	(not used)	I2CDAT 00h 9Ah	TL0 00h 8Ah	DPL 00h 82h
DAC0L 00h F9h	ADCOFSL 00h* F1h	(reserved)	(reserved)	ADCDATAL 00h D9h	(reserved)	(reserved)	(not used)	ECON 00h B9h	(not used)	IE2 00h A9h	(not used)	SBUF 00h 99h	SCON 00h 98h	P1 90h FFh	TMOD 00h 89h	SP 07h 81h
SPICON 00h F8h	B 00h F0h	I2CCON 00h E8h	ACC 00h E0h	ADCCON2 00h D8h	PSW 00h D0h	T2CON 00h C8h	WDCON 00h C0h	IP 00h B8h	P3 FFh B0h	IE 00h A8h	P2 FFh A0h	SCON 98h	P1 90h FFh	TCON 00h 88h	P0 FFh 80h	

SPR0 0 F8h	0 F0h	I2CI 0 E8h	0 E0h	CS0 0 D8h	P 0 D0h	CAP2 0 C8h	WDE 0 C0h	PX0 0 B8h	RXD 1 B0h	EX0 0 A8h	1 A0h	RI 0 98h	T2 1 90h	IT0 0 88h	1 80h
SPR1 0 F9h	0 F1h	I2CTX 0 E9h	0 E1h	CS1 0 D9h	F1 0 D1h	CNT2 0 C9h	WDS 0 C1h	PT0 0 B9h	TXD 1 B1h	ET0 0 A9h	1 A1h	TI 0 99h	T2EX 1 91h	IE0 0 89h	1 81h
CPHA 0 FAh	0 F2h	I2CRS 0 EAh	0 E2h	CS2 0 DAh	OV 0 D2h	TR2 0 CAh	WDR2 0 C2h	PX1 0 BAh	TXD 1 B1h	ET1 0 AAh	1 A2h	RB8 0 9Ah	1 92h	IT1 0 8Ah	1 82h
CPOL 0 FBh	0 F3h	I2CM 0 EBh	0 E3h	CS3 0 DBh	RS0 0 D3h	EXEN2 0 CBh	WDR1 0 C3h	PT1 0 BBh	INT1 1 B3h	ET1 0 ABh	1 A3h	TB8 0 9Bh	1 93h	IE1 0 8Bh	1 83h
SPIM 0 FCh	0 F4h	MDI 0 ECh	0 E4h	CCONV 0 DCh	RS1 0 D4h	TCLK 0 CCh	PRE0 0 C4h	PS 0 BCh	T1 1 B4h	ES 0 ACh	1 A4h	REN 0 9Ch	1 94h	TR0 0 8Ch	1 84h
SPE 0 FDh	0 F5h	MCO 0 EDh	0 E5h	DMA 0 DDh	F0 0 D5h	RCLK 0 CDh	PRE1 0 C5h	PT2 0 BDh	T1 1 B5h	ET2 0 ADh	1 A5h	SM2 0 9Dh	1 95h	TF0 0 8Dh	1 85h
WCOL 0 FEh	0 F6h	MDE 0 EEh	0 E6h	ADCI 0 DEh	AC 0 D6h	EXF2 0 CEh	PRE2 0 C6h	PADC 0 BEh	WR 1 B6h	EADC 0 AEh	1 A6h	SM1 0 9Eh	1 96h	TR1 0 8Eh	1 86h
ISPI 0 FFh	0 F7h	MDO 0 EFh	0 E7h	CY 0 D7h	TF2 0 CFh	PRE2 0 C7h	PSI 0 BFh	RD 1 B7h	EA 0 AFh	1 A7h	SM0 0 9Fh	1 97h	TF1 0 8Fh	1 87h	

MAP KEY

these bits are contained in this byte



* calibration coefficients are preconfigured at power-up to factory calibrated values

SFR DESCRIPTIONS

ADCCON1 ADC Control register #1

ADCCON1.7 ADC power control bits
ADCCON1.6 [shtdn, norm, autoshtdn, autostby]
ADCCON1.5 conversion time = 15.5 / ADCclk
ADCCON1.4 ADCclk = Mclk / [1,2,4,8]
ADCCON1.3 acquisition time select bits
ADCCON1.2 acq time = [1,2,3,4] / ADCclk
ADCCON1.1 Timer2 convert enable
ADCCON1.0 external CONVST enable

ADCCON2 ADC Control register #2

ADCI ADC interrupt flag
DMA DMA mode enable
CCONV continuous conversion enable bit
SCONV single conversion start bit
CS3 input channel select bits
CS2 0000 - 0111 = ADC0 - ADC7
CS1 1000 = temperature sensor
CS0 1111 = "HALT" command (DMA mode only)

ADCCON3 ADC Control register #3

ADCCON3.7 busy indicator flag (0=ADC not active)
ADCCON3.6 (this bit must contain zero)
ADCCON3.5 (this bit must contain zero)
ADCCON3.4 (this bit must contain zero)
ADCCON3.3 (this bit must contain zero)
ADCCON3.2 (this bit must contain zero)
ADCCON3.1 (this bit must contain zero)
ADCCON3.0 (this bit must contain zero)

ADCDATAH
ADCDATAL ADC Data registers

DMAP,DMAH,DMAL DMA address pointer

ADCGAINH
ADCGAINL ADC Gain calibration coefficients

ADCOFSH
ADCOFSL ADC Offset calibration coefficients

DACCON DAC Control register

DACCON.7 ModeSelect (0=12bit, 1=8bit)
DACCON.6 DAC1 RangeSelect (0=VREF, 1=VDD)
DACCON.5 DAC0 RangeSelect (0=VREF, 1=VDD)
DACCON.4 Clear DAC1 (0=0V, 1=normal operation)
DACCON.3 Clear DAC0 (0=0V, 1=normal operation)
DACCON.2 SynchronousUpdate (1=asynchronous)
DACCON.1 PowerDown DAC1 (0=off, 1=on)
DACCON.0 PowerDown DAC0 (0=off, 1=on)

DAC1H,DAC1L DAC1 data registers

DAC0H,DAC0L DAC0 data registers

ECON data EE/FLASH comand register

01h READ 04h VERIFY
02h WRITE 05h ERASE
03h (reserved) 06h ERASE ALL

EADRL data EE/FLASH address register

EDATA1,EDATA2,EDATA3,EDATA4 data EE/FLASH Data registers

ETIM1,ETIM2,ETIM3 EE/FLASH timing regs

SPICON SPI Control register

ISPI SPI interrupt (set at end of SPI transfer)
WCOL write collision error flag
SPE SPI enable (0=disable SPI & enable I2C)
SPIM master mode select (0=slave)
CPOL clock polarity select (0=SCLK idles low)
CPHA clock phase select (0=leading edge latch)
SPR1 SPI bitrate select bits
SPR0 bitrate = Fosc / [4, 8, 32, 64]

SPIDAT SPI Data register

I2CCON I2C Control register

MDO master mode SDATA output bit
MDE master mode SDATA output enable
MCO master mode SCLK bit
MDI master mode SDATA input bit
I2CM master mode select
I2CRS serial port reset
I2CTX transmission direction status
I2CI serial interface interrupt

I2CADD I2C Address register

I2CDAT I2C Data register

WDCON Watchdog Timer control register

PRE2 watchdog timeout selection bits
PRE1 timeout=[16,32,64,128,256,512,1024,2048]ms
PRE0
WDR1 watchdog timer refresh bits
WDR2 set sequentialy to refresh watchdog
WDS watchdog stag flag
WDE watchdog enable

PSMCON Power Supply Monitor control register

PSMCON.7 (not used)
PSMCON.6 PSM status bit (1=normal / 0=fault)
PSMCON.5 PSM interrupt bit
PSMCON.4 trip point select bits
PSMCON.3 [4.63V, 4.37V, 3.08V, 2.93V, 2.63V]
PSMCON.2
PSMCON.1 AVDD/DVDD fault indicator (1=AVDD / 0=DVDD)
PSMCON.0 PSM powerdown control (1=on / 0=off)

SP Stack Pointer

IE Interrupt Enable register #1

EA enable interrupts (0=all interrupts disabled)
EADC enable ADCI (ADC interrupt)
ET2 enable TF2/EXF2 (Timer2 overflow interrupt)
ES enable RI/TI (serial port interrupt)
ET1 enable TF1 (Timer1 overflow interrupt)
EX1 enable IE1 (external interrupt 1)
ET0 enable TF0 (Timer0 overflow interrupt)
EX0 enable IE0 (external interrupt 0)

IE2 Interrupt Enable register #2

IE2.1 enable PSMI (power supply monitor interrupt)
IE2.0 enable ISPI/I2CI (serial interface interrupt)

IP Interrupt Priority register

PSI priority of ISPI/I2CI (serial interface interrupt)
PADC priority of ADCI (ADC interrupt)
PT2 priority of TF2/EXF2 (Timer2 overflow interrupt)
PS priority of RI/TI (serial port interrupt)
PT1 priority of TF1 (Timer1 overflow interrupt)
PX1 priority of IE1 (external INT1)
PT0 priority of TF0 (Timer0 overflow interrupt)
PX0 priority of IE0 (external INT0)

TMOD Timer Mode register

TMOD.3/.7 gate control bit (0=ignore INTx)
TMOD.2/.6 counter/timer select bit (0=timer)
TMOD.1/.5 timer mode selecton bits
TMOD.0/.4 [13bitT, 16bitT/C, 8bitT/Creload, 2x8bitT]
(upper nibble = Timer1, lower nibble = Timer0)

TCON Timer Control register

TF1 Timer1 overflow flag (auto cleared on vector to ISR)
TR1 Timer1 run control (0=off, 1=run)
TF0 Timer0 overflow flag (auto cleared on vector to ISR)
TR0 Timer0 run control (0=off, 1=run)
IE1 external INT1 flag (auto cleared on vector to ISR)
IT1 IE1 type (0=level trig, 1=edge trig)
IE0 external INT0 flag (auto cleared on vector to ISR)
IT0 IE0 type (0=level trig, 1=edge trig)

TH0,TL0 Timer0 registers

TH1,TL1 Timer1 registers

T2CON Timer2 Control register

TF2 overflow flag
EXF2 external flag
RCLK receive clock enable (0=Timer1 used for RxD clk)
TCLK transmit clock enable (0=Timer1 used for TxD clk)
EXEN2 external enable (0=ignore T2EX, 1=cap/rld on T2EX)
TR2 run control (0=stop, 1=run)
CNT2 timer/counter select (0=timer, 1=counter)
CAP2 capture/reload select (0=reload, 1=capture)

TH2,TL2 Timer2 register

RCAP2H,RCAP2L Timer2 Reload/Capture

P0 Port0 register (also A0-A7 & D0-D7)

P1 Port1 register (analog & digital inputs)

T2EX timer/counter 2 capture/reload trigger
T2 timer/counter 2 external input

P2 Port2 register (also A8-A15 & A16-A23)

P3 Port3 register

RD external data memory read strobe
WR external data memory write strobe
T1 timer/counter 1 external input
T0 timer/counter 0 external input
INT1 external interrupt 1
INT0 external interrupt 0
TxD serial port transmit data line
RxD serial port receive data line

SCON Serial communications Control register

SM0 UART mode control bits baud rate:
SM1 00 - 8bit shift register - FOSC/12
01 - 8bit UART - TimerOverflowRate/32(x2)
10 - 9bit UART - FOSC/64(x2)
11 - 9bit UART - TimerOverflowRate/32(x2)
SM2 in modes 2&3, enables multiprocessor communication
REN receive enable control bit
TB8 in modes 2&3, 9th bit transmitted
RB8 in modes 2&3, 9th bit received
TI transmit interrupt flag
RI receive interrupt flag

SBUF Serial port Buffer register

PCON Power Control register

PCON.7 double baud rate control
PCON.4 ALE disable (0=normal, 1=forces ALE high)
PCON.3 general purpose flag
PCON.2 general purpose flag
PCON.1 power-down control bit (recoverable with hard reset)
PCON.0 idle-mode control (recoverable with enabled interrupt)

PSW Program Status Word

CY carry flag
AC auxiliary carry flag
F0 general purpose flag 0
RS1 register bank select control bits
RS0 active register bank = [0,1,2,3]
OV overflow flag
F1 general purpose flag 1
P parity of ACC

DPP Data Pointer Page

DPH,DPL (DPTR) Data Pointer

ACC Accumulator

B auxiliary math register