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CEG2400 - Microcomputer Systems

Lecture 4: Driving Loads

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On teaching/learning

- Students of ancient times all had their teachers. For a teacher is a man who transmits the way, imparts learning, and dispels doubts. No man is born with knowledge, and then, how can a man be free from doubts? If a man has doubts and does not learn from a teacher, his doubts can never be solved. -Han yu (Tang Dynasty)

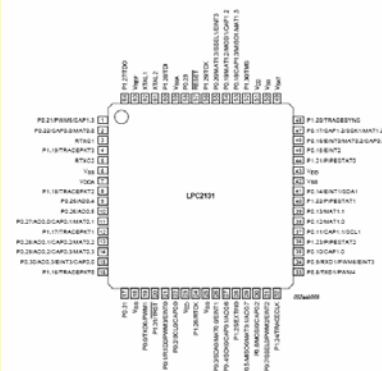
古之学者必有师。师者所以传道授业解惑也。人非生而知之者，孰能无惑？惑者不从师。其为惑也终不解矣。 -韩愈

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General Purpose I/O

- Remember, refer to http://www.nxp.com/acrobat_download/usermanuals/UM10120_1.pdf for LPC213x specific info




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Pin description

Symbol	Pin	Type	Description
P0.0 to P0.31		I/O	Port 0: Port 0 is a 32-bit I/O port with individual direction controls for each bit. Total of 30 pins of the Port 0 can be used as a general purpose bi-directional digital I/Os while P0.21 is output only pin. The operation of port 0 pins depends upon the pin function selected via the pin connect block. Pin P0.24 is not available.
P0.0/TXD0/PWM1	19U	I/O O	P0.0 — General purpose digital input/output pin TXD0 — Transmitter output for UART0 PWM1 — Pulse Width Modulator output 1
P0.1/RxD0/PWM3/EINT0	21U	I/O I O	P0.1 — General purpose digital input/output pin RxD0 — Receiver input for UART0 PWM3 — Pulse Width Modulator output 3 EINT0 — External interrupt 0 input
P0.2/SCL0/CAPO.0	22U	I/O I/O I	P0.2 — General purpose digital input/output pin SCL0 — I ² C clock input/output. Open drain output (for PC compliance) CAPO.0 — Capture input for Timer 0, channel 0
P0.3/SDA0/MAT0.0/EINT1	28U	I/O I/O	P0.3 — General purpose digital input/output pin SDA0 — I ² C data input/output. Open drain output (for PC compliance)

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Pin connect block


- Configures pins to their individual function

7.4.1 Pin Function Select Register 0 (PINSEL0 - 0xE002 C000)

The PINSEL0 register controls the functions of the pins as per the settings listed in Table 61. The direction control bit in the IODIR register is effective only when the GPIO function is selected for a pin. For other functions, direction is controlled automatically.

Bit	Symbol	Value	Function	Reset value
1:0	P0.0	00	GPIO Port 0.0	0
		01	TXD (UART0)	
		10	PWM1	
		11	Reserved	
3:2	P0.1	00	GPIO Port 0.1	0
		01	RxD (UART0)	
		10	PWM3	
		11	EINT0	
5:4	P0.2	00	GPIO Port 0.2	0
		01	SCL0 (I ² C)	
		10	Capture 0.0 (Timer 0)	
		11	Reserved	
7:6	P0.3	00	GPIO Port 0.3	0
		01	SDA0 (I ² C)	
		10	Match 0.0 (Timer 0)	

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Pin/Register Desc

8.3 Pin description

Pin	Type	Description
P0.0-P0.31	Input/	General purpose input/output. The number of GPIOs actually available depends on the use of alternate functions.
P1.16-P1.31	Output	

8.4 Register description

LPC2131/2/4/6/8 has two 32-bit General Purpose I/O ports. Total of 30 input/output and a single output only pin out of 32 pins are available on PORT0. PORT1 has up to 16 pins available for GPIO functions. PORT0 and PORT1 are controlled via two groups of 4 registers as shown in Table 63.

Generic Name	Description	Access	Reset value	PORT0 Address & Name	PORT1 Address & Name
IOPIN	GPIO Port Pin value register. The current state of the GPIO configured port pins can always be read from this register, regardless of pin direction.	R/W	NA	0xE002 6000 IOPIN	0xE002 8010 IO1PIN

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Driving Large Loads

- In fig 3, the BJT amplifies the current, a Darlington transistor can be used for higher current gain (note V_{unreg} doesn't have to be 3.3V)
- For fig 4, the FET does not require a continuous current output from the uC. However, the gate capacitance is high
- Having a buffer between the large load and the uC is a good idea as well

FIGURE 3: OPEN COLLECTOR DRIVER SCHEMATIC

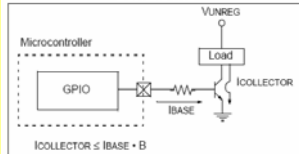
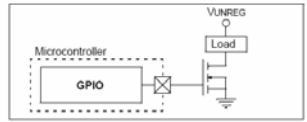


FIGURE 4: OPEN DRAIN DRIVER SCHEMATIC



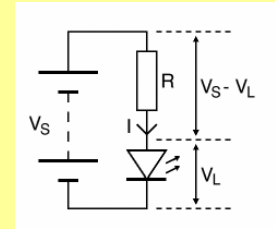
Source: <http://ww1.microchip.com/downloads/en/AppNotes/01035A.pdf>

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Example: LED

- Suppose for a red LED the voltage $V_L=2V$ and $I=24mA$
 - $V_S=3.3V$ what should R be?
- How would we drive a 4V white LED?
- How do we drive it from an LPC213x?



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Stepper Motors

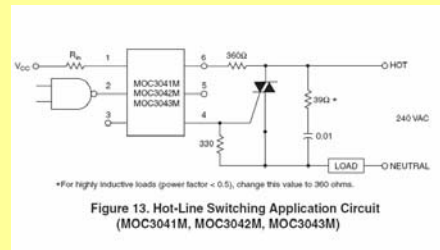
- There are many choices from discrete implementations to ICs (e.g. Motorola SAA1042)
- See <http://www.cs.uiowa.edu/~jones/step/index.html>

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AC loads

- Easiest way is to use a zero-crossing optoisolated triac driver + triac



<http://www.fairchildsemi.com/ds/MO/MOC3033-M.pdf>

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Last week's tut

```

__main                U0DLL = 15 (57600) or 90
                        (9600)
    bl    iuart0
loop  adr    r1,HSTR
    l1    ldrb r0,[r1],#1
        cmp r0,#0
        beq loop
        bl  writec
        b  l1
HSTR = "Hello world\n\r", 0
align

```