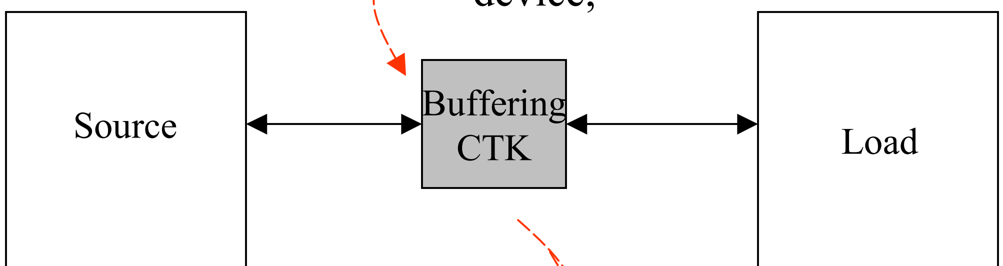
Buffering: Utilization of Isolation Stage

For Both Analog and Digital Circuit

Embedded System deals with I/F which can be the output from sensors or actuators, they can be digital or analog in nature.

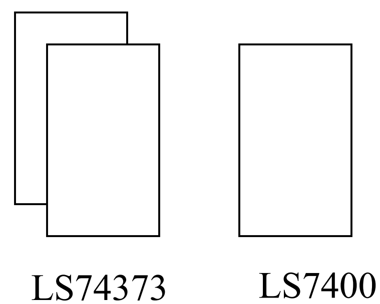
Buffering is used in a more generic term, it applies for both actual buffer and transceiver, as well as OpAmp device;



The need for buffering: To connect the signal from the "source", the previous stage to the "load", the next stage WITHOUT having the effect on the source output signal, or, with the minimum acceptable change to the output signal while maintaining adequate signal input to the load.

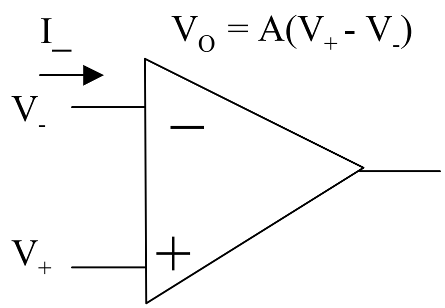
Commonly Used Buffering devices

DIGITAL: Buffers and Transceivers, NAND gates etc.



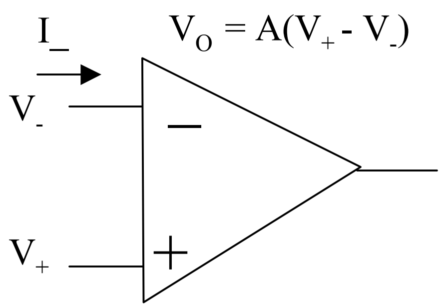
ANALOG: OpAmp, such as 741

$V_O = A(V_+ - V_-)$



OpAmp Device As a Buffering Stage

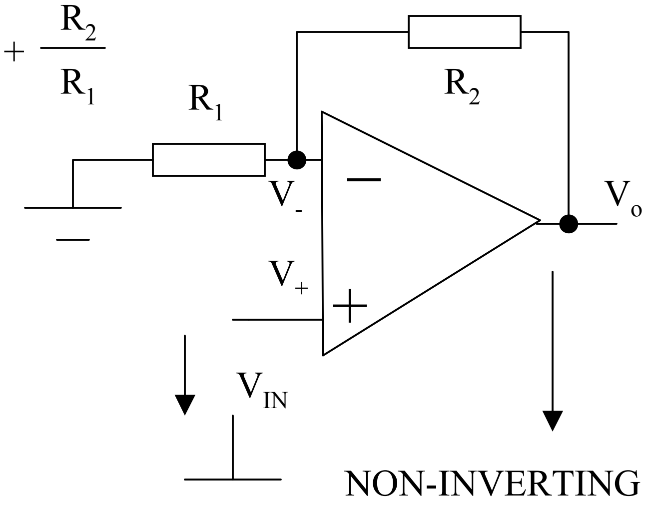
Both Analog and Digital Circuit



(1) To protect the previous stage's output signal, which is the input to the next stage, while sampling/connecting the signal to its next stage logic circuit. (2) Unit gain non-inverting OpAmp configuration is an excellent choice.

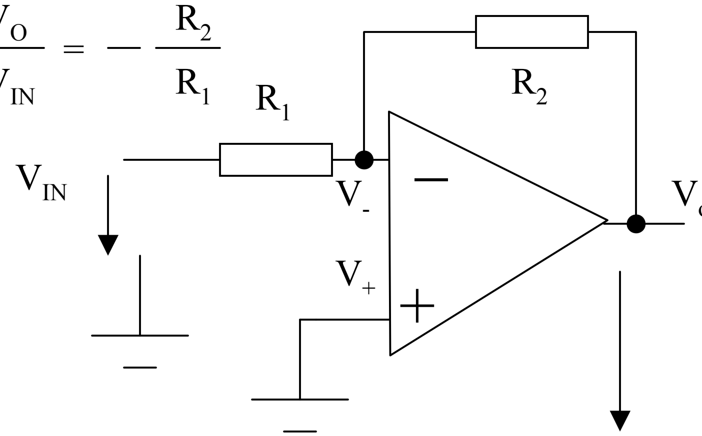
Ideal OpAmp Properties: (1) very large gain, A>>M; (2) draws very little current, $I\_ \sim 0$, e.g., very high impedance; (3) $V_O = A(V_+ - V_-)$ is finite range, which leads to $V_+ = V_-$.

$$\frac{V_O}{V_{IN}} = 1 + \frac{R_2}{R_1}$$



NON-INVERTING

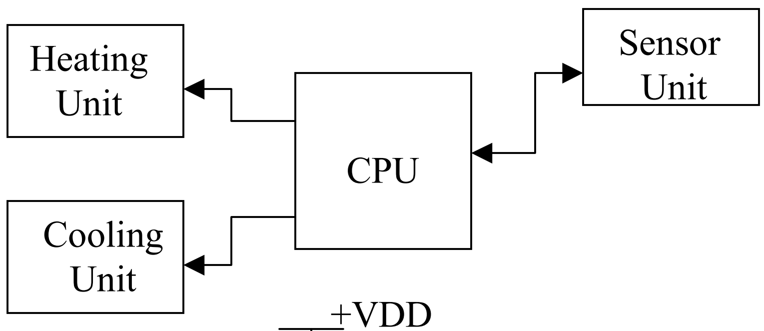
$$\frac{V_O}{V_{IN}} = -\frac{R_2}{R_1}$$

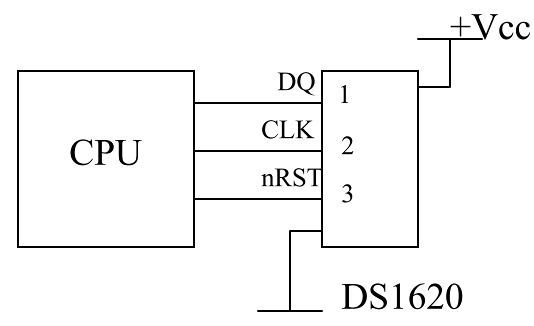


INVERTING

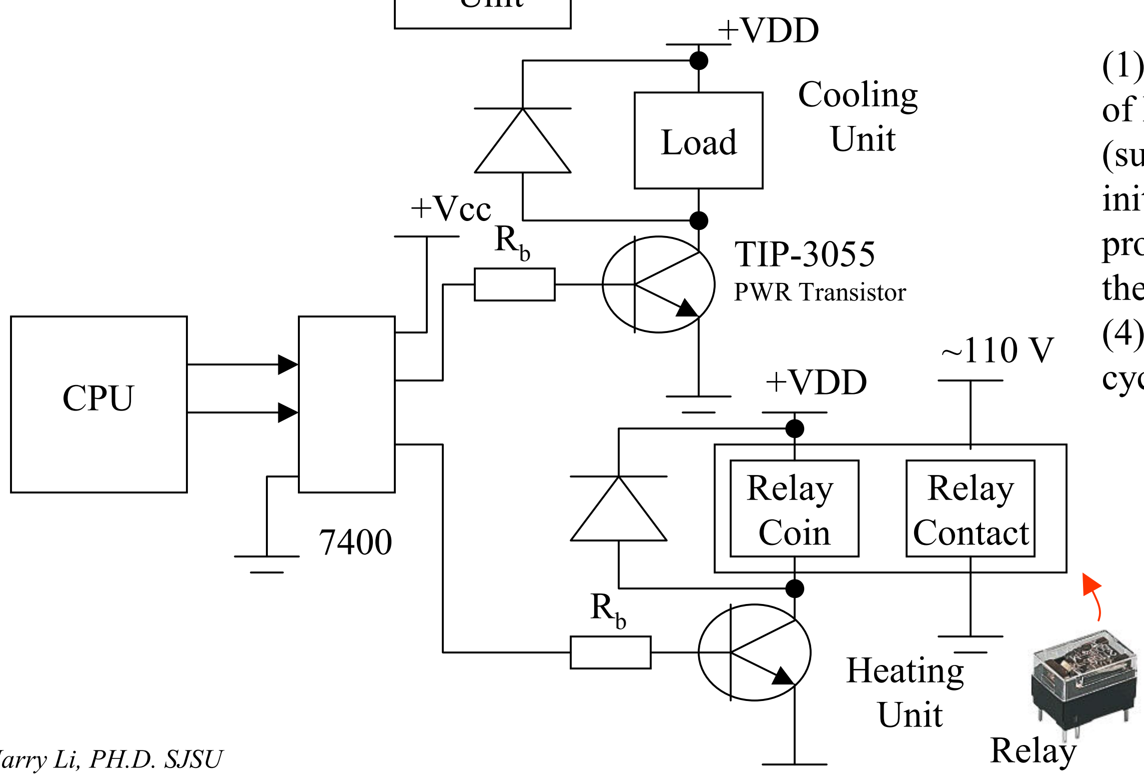
Harry Li, PH.D. SJSU

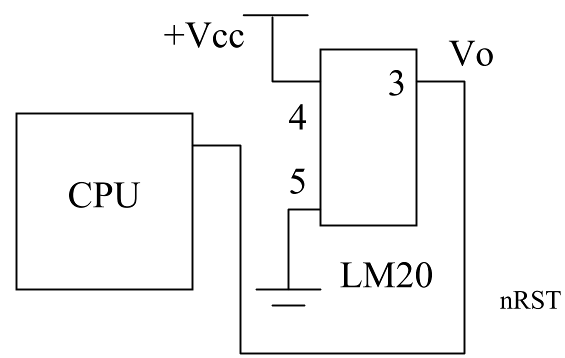
Climate Controlled Outdoor Embedded System Unit





(1) CPU provides timer output to drive CLK of DS1620, (2) CPU to provide control signal (such as through GPP pin to rise nRST to initiate the communication; (3) CPU to send protocol, such as through GPP pin, to define the operation, then CPU to send/receive data; (4) then drive nRST low to terminate the cycle.



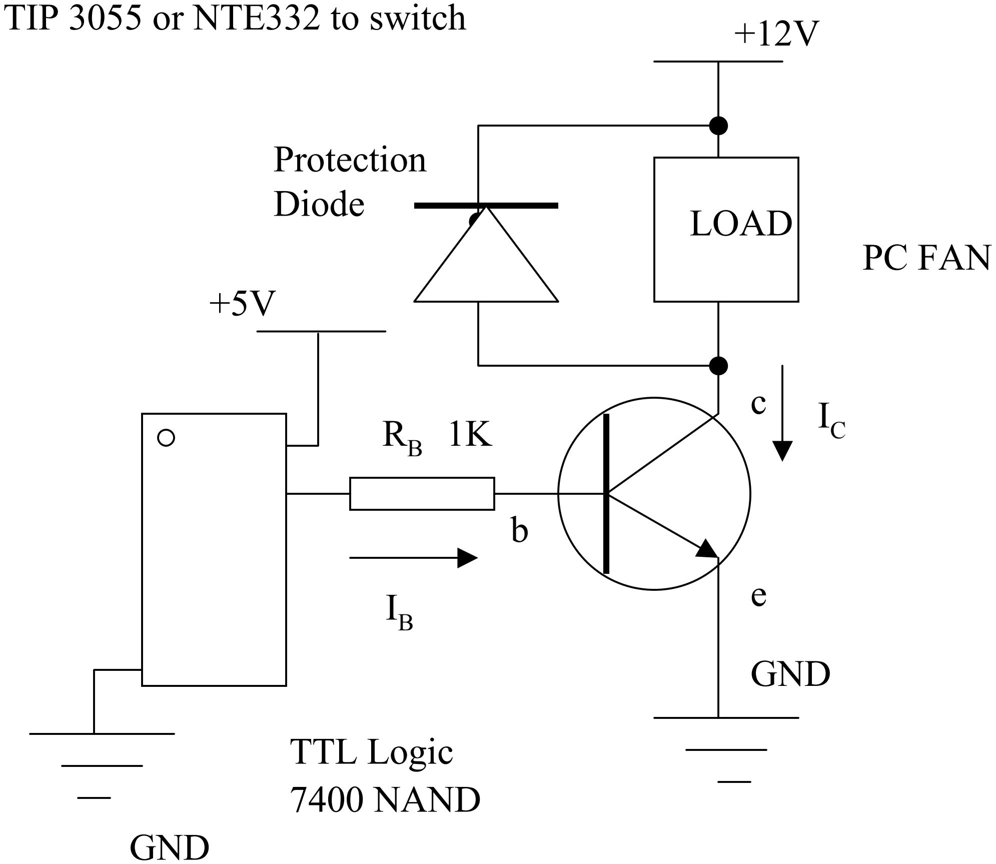


Driver Circuit Design (1/2)

Objective: To use NPN transistor, such as TIP 3055 or NTE332 to switch PC fan on/off per TTL logic's input.

Design Guidelines: The output from a 7400 chip is required to turn on the transistor switch so the cooling or heating unit can operate. The supply voltage is 5V for the chip and 12V for the load. Suppose the chip can supply a maximum safe current of 10mA.

1. Base current = $5/R_b$ = 10mA, so R_L can be 5K. But very often logic high may have noise margin, which make the output logic 1 below ideal 5V, and plus Vbe may be in the range of 0.5V, the actual voltage drop cross R_b can be much smaller, say about 2V, this will allow resistor as small as 2K. (In my design, I use 1K resistor, push too much the margin, but it works.)
2. Design for relay load should have a protection diode.

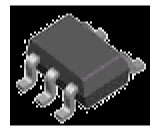


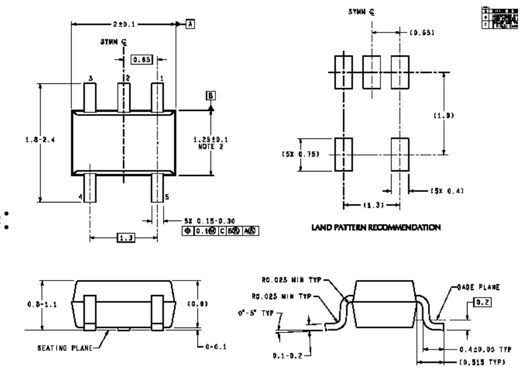
Low Precision Temperature Sensing Design

Low Precision/ Low Cost, No Control Capability, Non Stand Alone

http://www.national.com/pf/LM/LM20.html

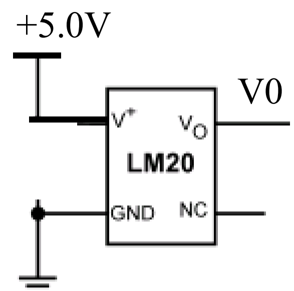
Use National Semi LM20, choose SC-70 package (it comes with 5 pins), cost much less ~$0.30 per 1K quantity.



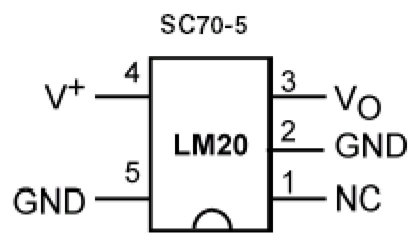


SC-70 Package:
5 PINS

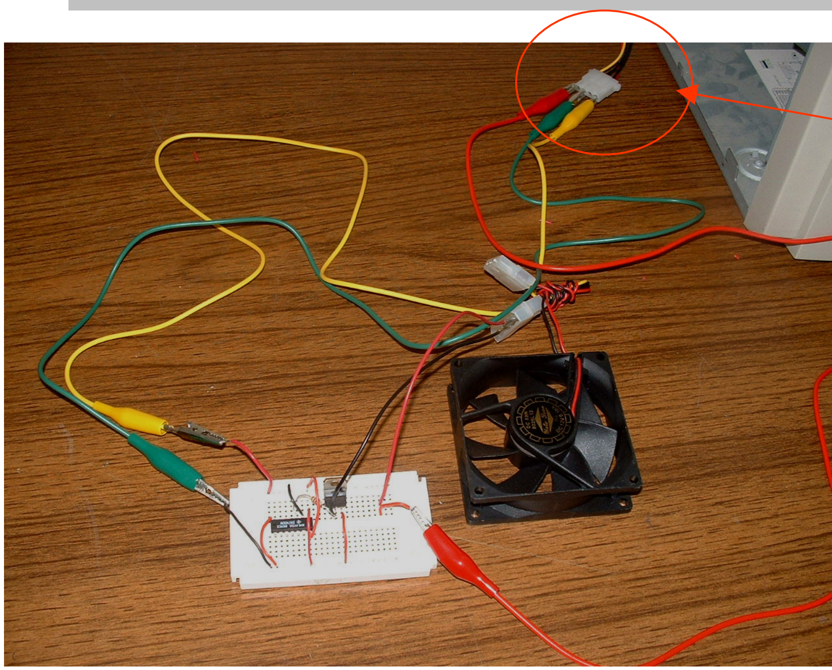
	LM20	DS1620
Temp. Range	-55 to +130 degree C	-55 to +125 degree C
Accuracy	~1.5/2.5 degree C	~0.5 degree C
Intelligent I/F	No	Digital serial I./F
Characteristics of the chip	Analog; can not work alone	Digital; can work alone;
Power supply	+2.5V to +5.5V	+2.7V to +5.5V
Cost	~$0.30 per 1K	~$3.0 per 1 K

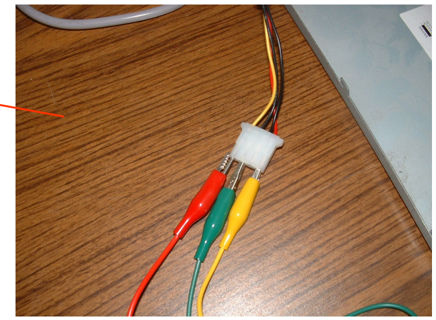


To A/D conversion pin of the ARM CPU



Driving The PC Fan





FAN is powered by +12.0V DC
Transistor is powered by +5.0V DC

PC 4-Wire Connector	
BLACK	GND
RED	+5.0V
YELLOW	+12V

Multimedia Computing On ARM Platform (1/2)

For CMPE 242

$$X(k) = \sum_{n=0}^{N-1} x(n) W_N^{kn}, \qquad 0 \le k \le N-1$$

$$W_N = e^{-j2\pi/N}$$

Example: Given x(n), for n=0,1,2,3
(1) Compute X(m); (2) Find its power spectrum;
(3) estimate the total number of floating points for (1) and (2).

Why? To be able to use RISC Architecture to estimate the computational requirements and to engage and implement computation if needed.

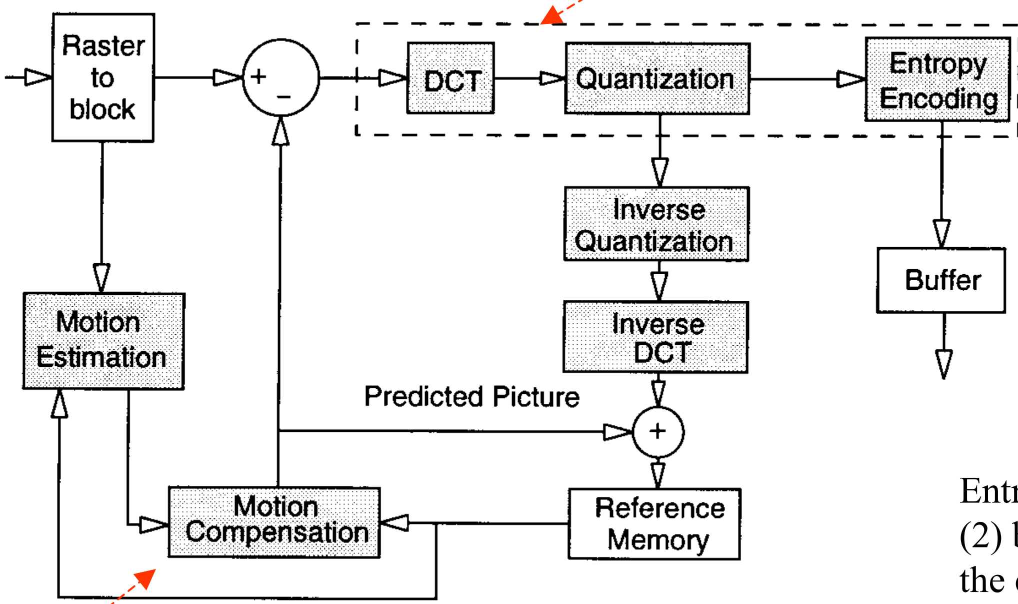
What: (1) To use the mathematical formula to compute 1D DFT; (2) To understand the physical meaning of power spectrum; (3) To be able to compute power spectrum of a given signal; (4) based on the DFT and Power Spectrum definition, to be able to estimate computational complexity.

Image size X bpp X fps: 1024x1024x24x30	Total bits per second: 1 Gbps (= 2^{10} 2^{10} 2^5 2^5)	Estimated floating point computation (for DFT): 2^{20} , ~1 GFLOPS
128x128x24x30	16 Mbps	~16 MFLOPS

Multimedia Computing On ARM Platform (2/2)

For CMPE 242

PART I



PART II

Reference: Image and Video Compression Standard

Two key mathematic computations for MPEG2 Compression: (1) JPEG coding part, e.g., DCT and Entropy encoding; and (2) motion compensation.

Use ARM core for MPEG2 compression.

Entropy encoding: (1) lossless compression; (2) based on Shannon’s information theory; (3) the compression