PIC
PWM MOTOR

DISCUSS HOW LAB WENT

- POT COMMAND NOT ~~BEST~~ SIMPLEST WAY TO READ KEYPAD (SEE & BOOK) — BUT REQUIRE ONLY 1 PIN
- TROUBLE-SHOOTING SECTION (pg. 163) VERY IMPORTANT & USEFUL

1 uF CAP ON PIC SOLVES PROBLEM

- PART OF DIFFICULTY IS LOW LAB CURRENT (+ CURRENT SURGE) CAPACITY OF POWER SUPPLIES (NOT MEANT FOR LARGE CURRENT SWITCHING)
  ~~(9V BATTERY W/ VR DEMO'D BY TA JUST AS GOOD FOR THIS PURPOSE)~~
- USING SEPARATE PS FOR MOTOR WOULD HELP
- PUTTING CAP. ACROSS MOTOR ~~TABS~~ TO FILTER COMMUTATION NOISE WOULD HELP
- OR USING HIGHER-CURRENT SUPPLY (w/ bigger output CAPS & VR) WOULD WORK

- LOW DUTY-CYCLE PWM MIGHT ~~NOT~~ BE ENOUGH TO START MOTOR FROM STAND STILL (~~DUE TO~~ STARTING TORQUE REQUIREMENT)

POSSIBLE SOLUTION: SET HIGH (100%) DUTY CYCLE FOR 1/10 sec before PWM

MECH307 - Useful Project Advice

[redacted] Add: Use project resource page + good places start to find info you need

- If you haven't done so yet, carefully read:
  - Chapter 7 in the course textbook (especially the Threaded Design Examples with full hardware and software examples, with video demonstrations).
  - Labs 9-11 in the course Lab Book.
  - "Lab" 15 in the course Lab Book (contains lots of useful project-related advice).
- [redacted] all of the project [redacted] + look @ components used by past students
- Use devices on the Useful PIC I/O Devices page instead of trying to design and build them yourself (especially H-bridges and stepper motor controllers).

- Research and order [redacted] via these links:
  - [redacted]
    - [redacted]der:
      - [redacted]
      - pa[redacted] (plastic dual inline package), not SOIC (small outline surface-mount IC)!!!
    - Make sure the selected model is supported ~~in~~ by the Lab software before ordering. Make sure it is listed in the software, and make sure a test program compiles before placing an order.
    - [redacted] :-)
      - most familiar from Lab work.
      - can use multiple PICs in design if necessary (and to subdivide tasks and I/O demands).
    - I[redacted]88:
      - [redacted] (e.g., see the PIC16F88 datasheet) for:
        - pinout diagram and the special features summary (and print and insert this in your design notebook).
        - "Oscillator Configurations" for "OSCCON" settings.
        - "I/O Ports" for pin functions (e.g., open-drain or not, Schmitt Trigger, weak pull-ups, analog/digital, etc.) and important "Special Function Registers" (e.g., ANSEL, with details later in datasheet in "Analog-To-Digital Converter (A/D) Module").

SEE "ELECTRICAL CHARACTERISTICS" (ITEM ADDED)

  - [redacted]
- [redacted]
  - [redacted] on the Lab Book resources page [redacted] (from Lab 9).
  - [redacted] (implement and test only one thing at a time).
  - When [redacted] (finding errors), remove all nonessential + non-related code.

- Implement an [redacted] early in your design (even if it isn't required in the final solution) so you can display messages and values while developing and debugging.
- When having trouble, carefully read the command descriptions in the PicBasic Pro manual (printed copies available in the Lab) and study the examples in the textbook and in the PIC section on the project resources page.
- [redacted] every time you compile a program onto a PIC (e.g., if the Code Protect bit is ON, you will never be able to program that PIC ever again. Also, if the I/O pin functions are not set correctly, the I/O won't work properly). See the PIC16F88 code template and the PIC programming procedure for information on how to automate this.

See examples on proj resources page under PIC-programming examples

- **Be very careful when applying power** to circuits and sub systems (e.g., actuators).
  - If using a variable-voltage power supply, [redacted]
  - If using more than one power supply (or battery or AC adaptor), with different voltage levels, be very careful to not switch them by mistake.
    - Applying a high voltage to a PIC or other digital IC will damage them instantaneously and permanently.
    - Consider [redacted] for the different supplies to prevent a possible mistake (which can be very costly and time-consuming to fix).

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see

LAB 15.1

dc Power Supply Options for PIC Projects

(1) a 6 V, 9 V, or 12 V wall transformer with a 5 V regulator

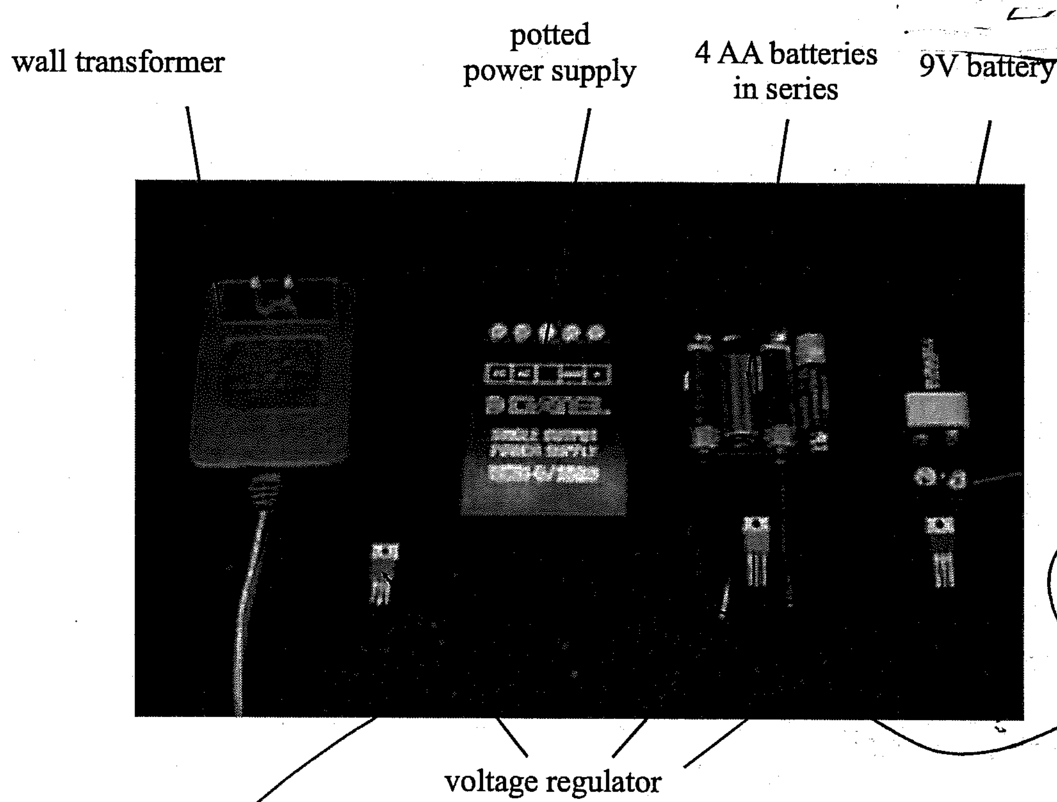
(2) a potted power supply with ac input and 5 V regulated output

(3) four AA batteries (6 V) in series with a 5 V regulator

(4) a 9 V battery with a 5 V regulator

(5) a rechargeable battery (or batteries in series) with a 5V regulator

(6) a full featured instrumentation power supply



NOT REQ'D (6V OK) + 7805 NOT APPROP

Figure 15.1 Low Cost Power Supply Options

ex: CAR 12V or MOTORCYCLE

OR LARGER FRAME POWER SUPPLIES (e.g., FROM computer)

OR BATTERIES FOR DEVICES REQUIRING LOTS OF CURRENT

VISIT "BATTERIES PLUS" FOR BATTERY OPTIONS

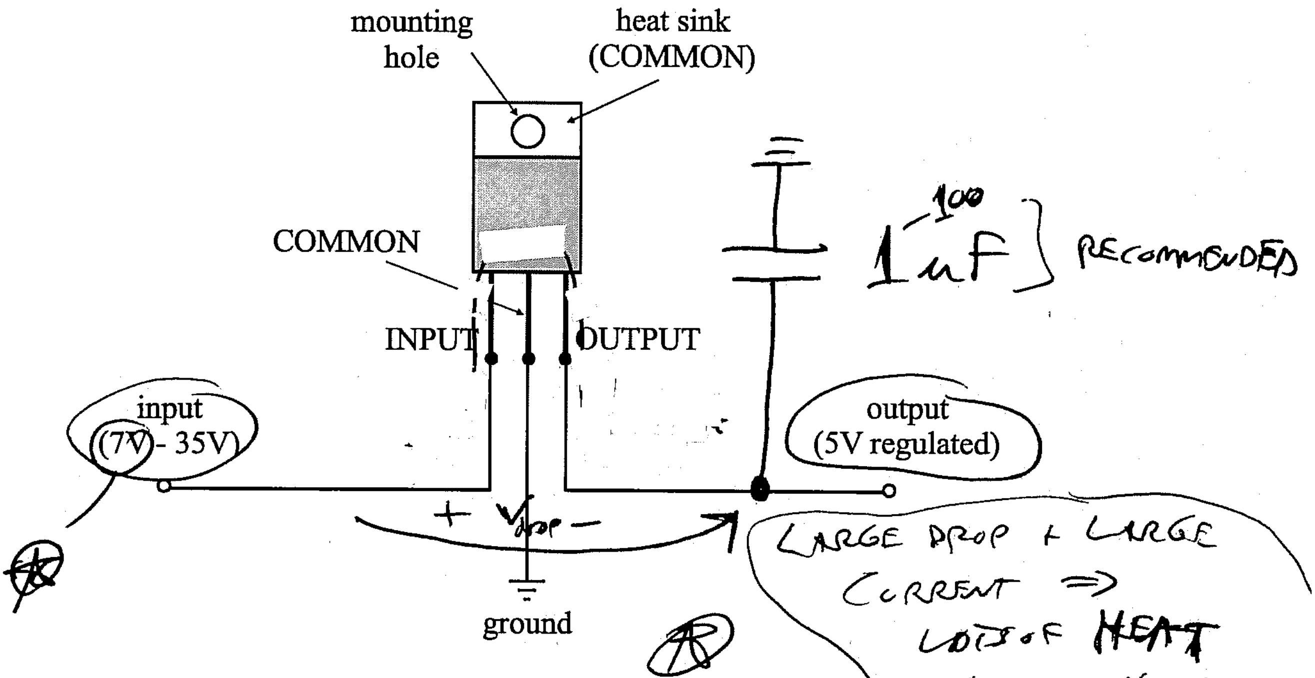


Figure 15.3 7805 Voltage Regulator Connections

LARGE DROP + LARGE CURRENT ⇒ LOTS OF HEAT (UNLESS HIGH EFFICIENCY REGULATOR OR dc-to-dc converter USED INSTEAD)

Table 15.1 **5V Power Supply Options Summary**

Device	Typical current	Relative size	Relative cost
instrumentation power supply	1 A – 5 A	large	very expensive (~$1000)
small potted, open frame, or enclosed power supply	1 A – 10 A	medium	moderately expensive (~$20-$100)
wall transformer	1 A	small	cheap
9V battery	100 mA	small	cheap
4 AA batteries	100 mA	small	cheap
rechargeable battery	See Section 15.11	small	moderate

~~15.11~~ 15.2 **Battery Characteristics**

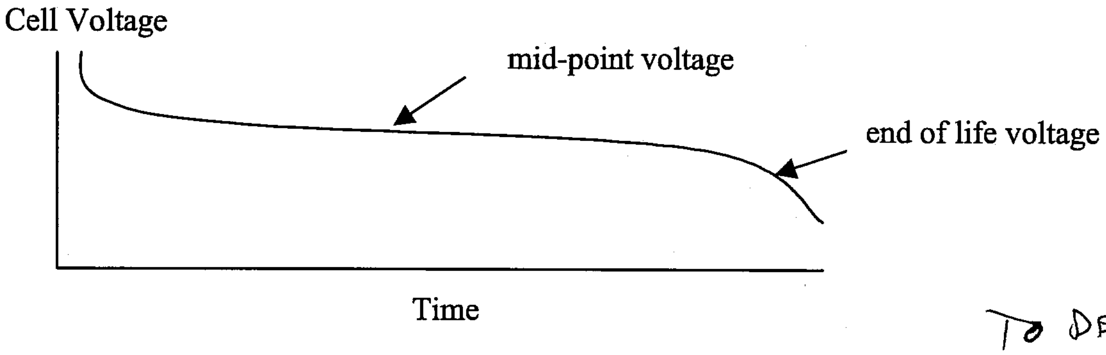


Figure 15.5 Example Battery Discharge Curve

TYPICAL OPERATING CURRENT

TO DECIDE IF BATTERY CAN PROVIDE ENOUGH CURRENT OVER ~~ENOUGH~~ ~~TIME~~ DESIRED LIFETIME

Table 15.2 Characteristics for Various Types of Batteries

Type	Voltage (OC)	Type	Typical Ah Capacity	R internal (Ω)
9V alkaline	9 V	primary	0.60 @ 25 mA	2
9V lithium	9 V	primary	1.0 @ 25 mA 0.95 @ 80 mA	18
alkaline D	1.5 V	primary	17.1 @ 25 mA	0.1
alkaline C	1.5 V	primary	7.9 @ 25 mA	0.2
alkaline AA	1.5 V	primary	2.7 @ 25 mA	0.4
alkaline AAA	1.5 V	primary	1.2 @ 25 mA	0.6
Ni-Cd D	1.3 V	secondary	4.0 @ 800 mA 3.5 @ 4 A	0.009
Ni-MH AAA	1.2 V	secondary	0.55 @ 200 mA	?
Ni-MH AA	1.2 V	secondary	1.3 @ 200 mA	?
Ni-MH C	1.2 V	secondary	3.5 @ 200 mA	?
Ni-MH D	1.2 V	secondary	7.0 @ 200 mA	?
Ni-MH 9V	8.4 V	secondary	0.13 @ 200 mA	?
Lithium Ion	3.7 V	secondary	0.76 @ 200 mA	?

WORST FOR ROUGH GUESS

EXTRAPOLATING

.6 Ah

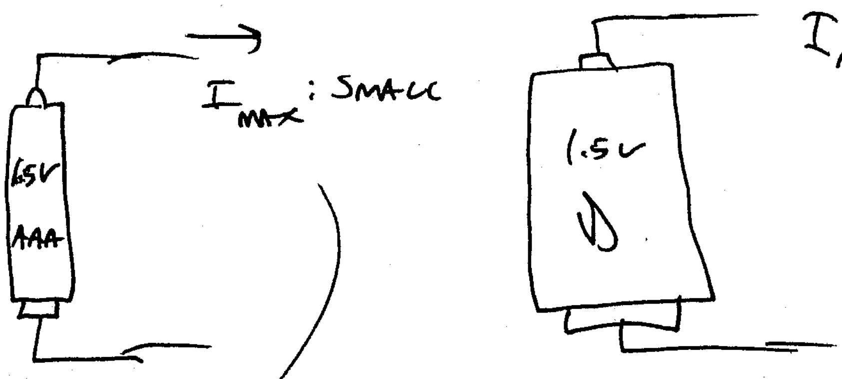
=> @

.5 A (500mA not 25)

$\Delta t = \frac{Ah}{A}$ = lifetime

LIFE

V + I CAPACITY

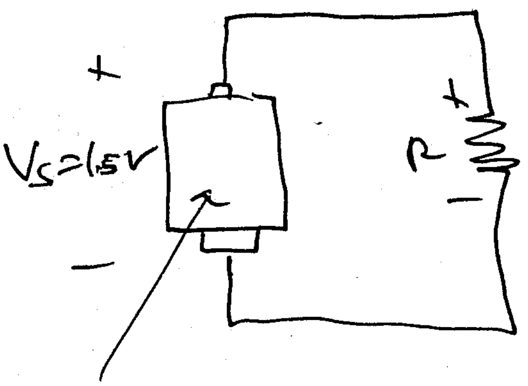


I_{MAX}: SMALL

I_{MAX}: LARGE

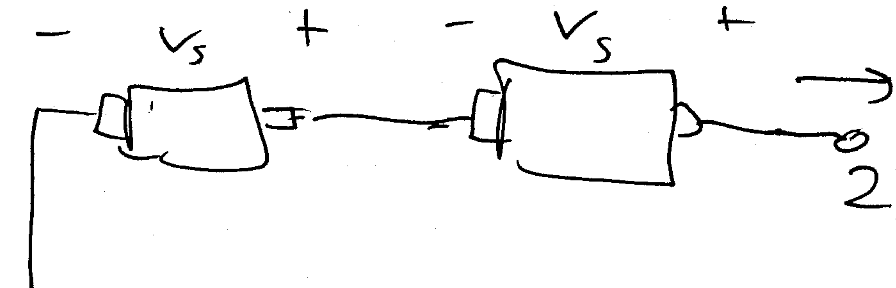
- LONGER LIFE (MORE ENERGY AVAIL)
- LARGER CURRENT CAPACITY

BUT:

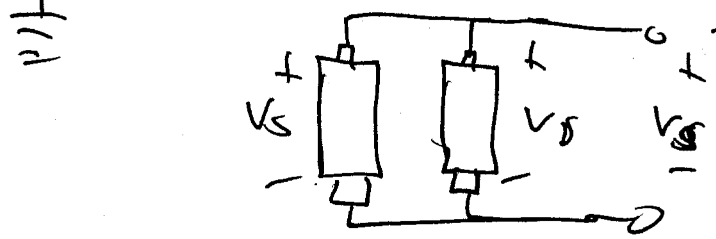


$I = \frac{V_S}{R}$ IFF $I < \underbrace{I_{MAX}}_{\text{CURRENT CAPACITY}}$

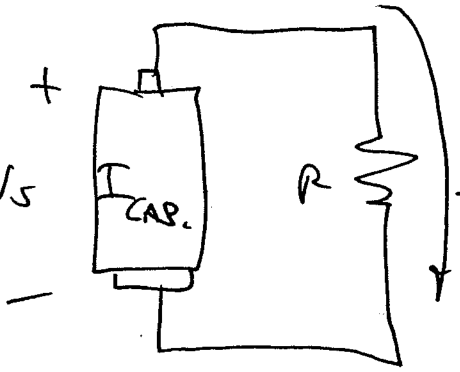
AAA OR D



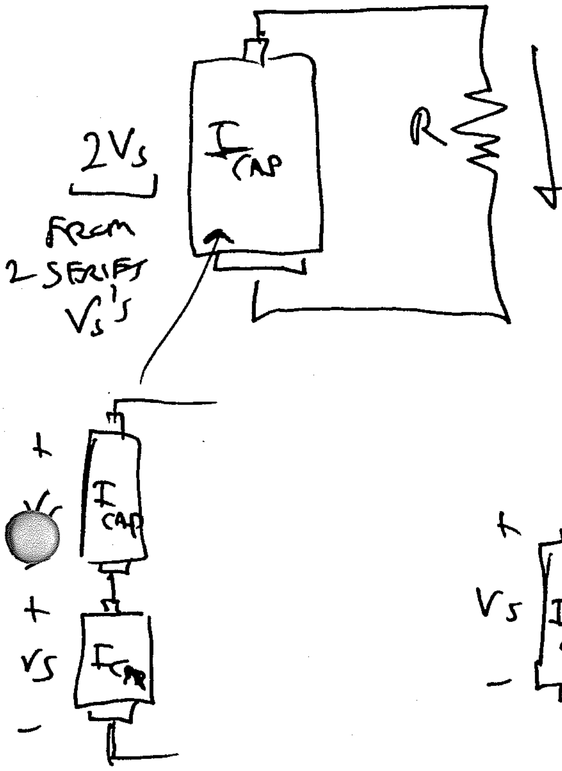
$\longrightarrow I_{CAPACITY}$ SAME AS INDIVIDUAL CAP



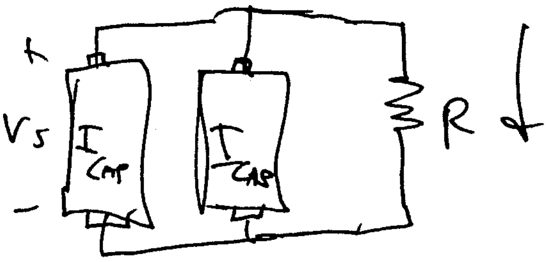
$\longrightarrow 2 \cdot I_{CAPACITY}$



$I = \frac{V_S}{R}$ IFF $I < I_{CAP}$

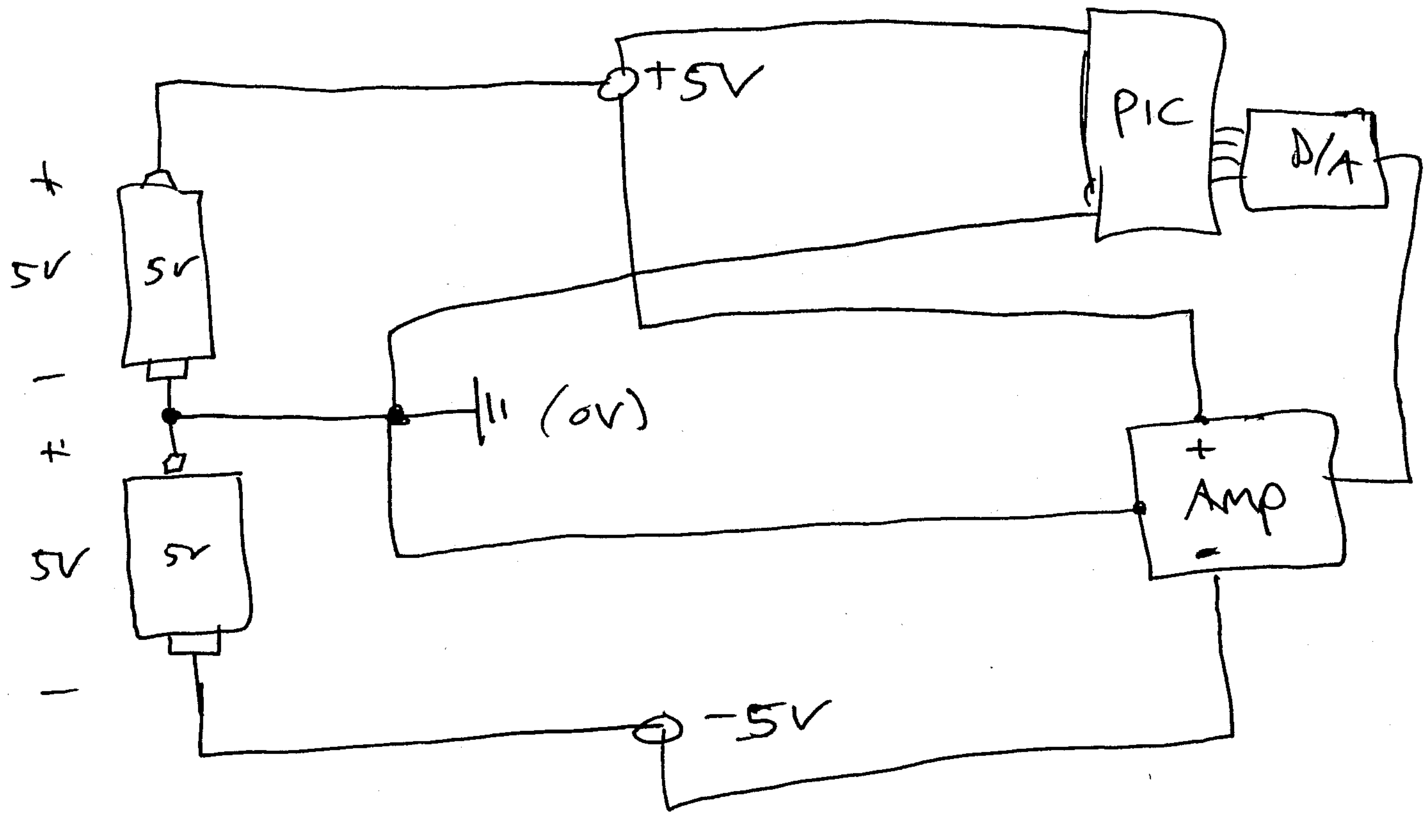


$I = \frac{2V_S}{R}$ IFF $I < I_{CAP}$

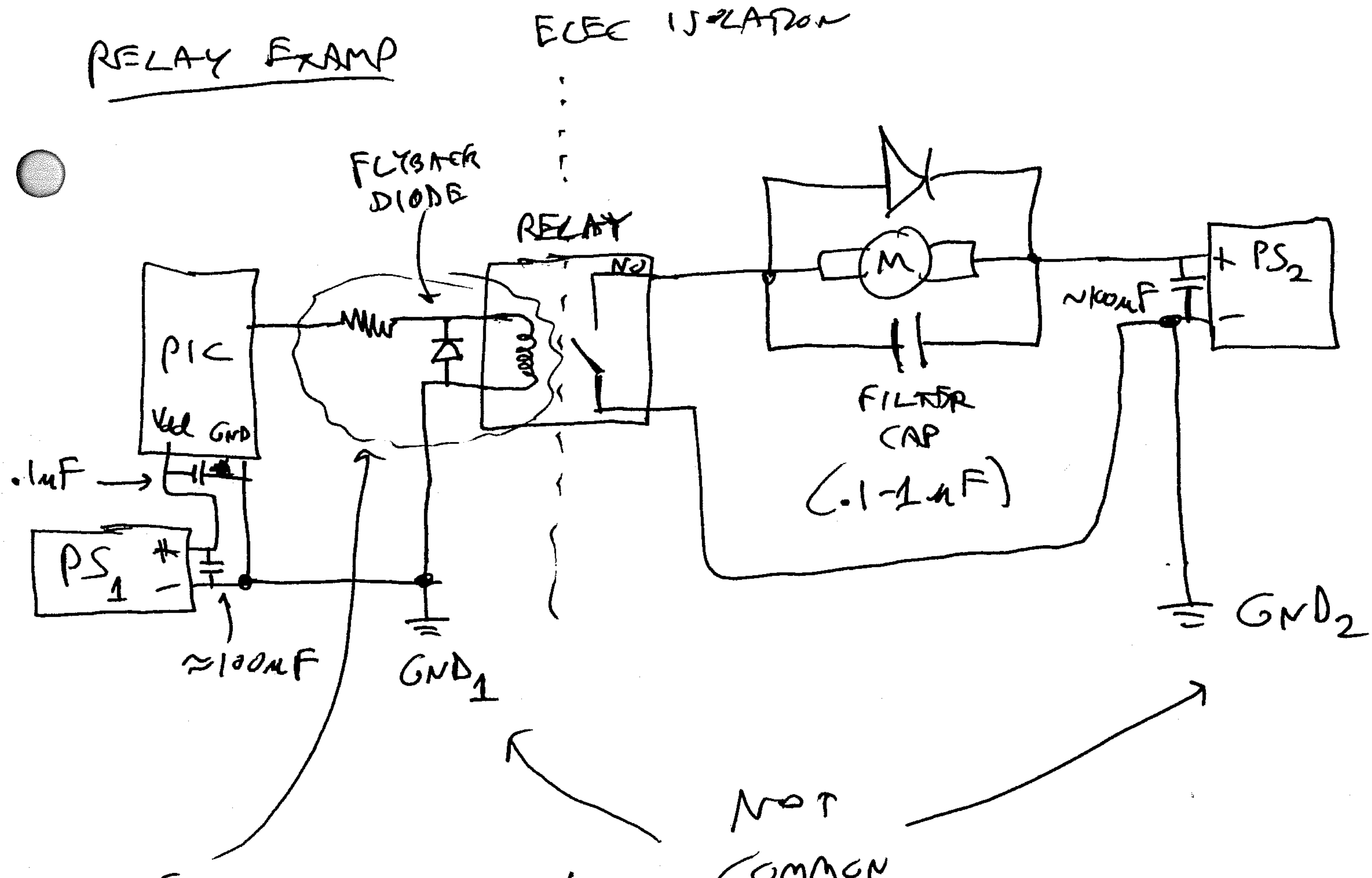


$I = \frac{V_S}{R}$ IFF $I < 2I_{CAP}$

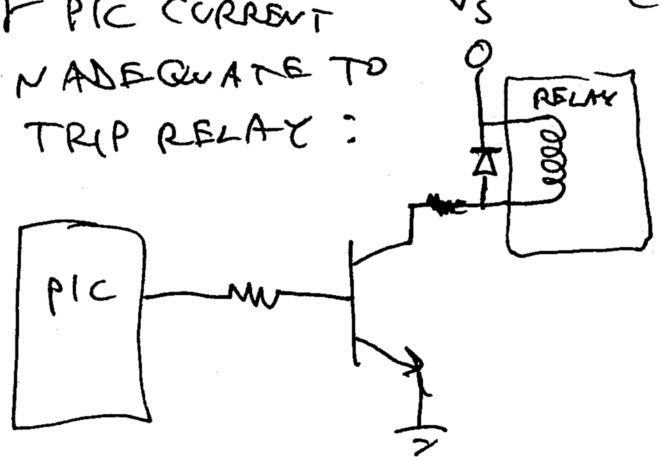
TO CREATE NEGATIVE VOLTAGE



RELAY EXAMP



IF PIC CURRENT INADEQUATE TO TRIP RELAY:



SHOW

LAB 15.3 RELAY VS. TRANSISTOR

ADV / DISADV. STRESSING

FIRST

SEE LINK ON LECTURE PAGE

⇒ USE RELAY UNLESS NEED PWM

TO CONTROL POSITION

OF DC MOTOR (NOT SERVO OR STEPPER),

EASY POSITION CONTROL

CAN USE INDEX OR LIMIT SWITCHES

OR PROX SENSOR(S) TO CONTROL STOP POINTS

DON'T ~~TRY~~ TO ~~USE~~ "ON TIME"

TO ATTEMPT TO CONTROL DISPLACEMENT AMOUNT.

DOESN'T WORK SINCE SPEED VARIES

W/ CONDITIONS (FRICTION, ALIGNMENT, WEAR, ETC.)

BATTERY CHARGE, TEMPERATURE, HUMIDITY,

SIMILAR FOR SPEED CONTROL

(NEED TO SENSE SPEED

& MAKE CORRECTIONS)

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