Chapter 9: The Power Supply of the robot

9.1 Introduction

Essential points:

- Overview
  - Why we need to have a stable power system?
  - How to make stable power system?
  - Use of 7805
  - What is the use of optical couplers?
- Use of 3 stages of de-coupling capacitors
- Theory and calculations

9.2 Overview of the system

As we have discussed earlier than when the motors start to move the current requirement is great, it can draw up to 1A for each motor. Such a surge of current would affect the other components of the digital circuit if they share the same power supply. Therefore a separate power supply for each system is necessary.

Two methods can be used to reduce the adverse effect caused by the noise generated by the DC motors.

- Use of a fixed regular e.g. 7805: A fixed voltage power supply device such as the 7805 is a power electronic device which gives a stable voltage output as long the input is above a certain voltage level

![Diagram of 7805 regulator](image)

- Use of optical isolation: If two systems share the same power supply, small voltage noise can creep into one system from another. If we want to have a very clean and stable system, we can design two totally isolated power supply systems, one for the digital circuits and micro-
controller etc., and the other for the motors. To enable the systems to communicate, one can use an optical coupler device, (e.g. TLP521) which sends binary information through light from one system to the other. For example for the control of motors we need four control bits from the digital circuit to the DC motor power drive system. We can use four optical couplers with their inputs on the digital system side (light current side) and output to the H-bridge power electronic side (large current side). This technique is also used in many power electronic systems where total electrical isolation is required. However, such a setup would require two different batteries for our robot, which increase the weight and cost significantly. Therefore we modify it to combine the two power sources together and use only the 7805 regular to make stable power supply for each sub-systems – the computer/digital system, and the motor drive system.

![Figure 9-1 Overview of a stable power supply system with optical isolation](image)

**Use of 7805 power stabilizer and power isolation**

- 7.2V or above Power supply
- Electrically Isolated
- Optical isolators
- 7.2 Volts battery
- Current driver circuit
- Left/Right motors
- 8031
- Xilinx
- Low power
- High power

9.3 Voltage regulators: The 7805 [1] and the use of TIP3055

![Figure 9-2 pictures of 7805 devices for fixed voltage regulation](image)
Figure 9-3: TIP3055, TIP2955 from http://www.st.com/stonline/books/pdf/docs/4136.pdf

Use of established power supply system
E.g. 7805 for supper isolation to reduce interference

7V or above
200μF

Fixed at 5V, current limit 500mA

Variable power supply design and usage,
e.g. step down 5V --> 3V.

Input power \( V_1 \)

\[
\begin{align*}
\text{TIP3055} \\
\text{R1} \\
\text{R2} \\
\end{align*}
\]

Output = \( V_1 \left[ \frac{R2}{(R1+R2)} \right] \)

Figure 9-4 The use of 7805 and TIP3055 to stabilize power

Figure 9-5 The power supply system of our robot
Exercise 9. 1 What are R1 and R2 if V1 is 9V and output is 5V?

Exercise 9. 2 Why do we need to have SW3 and VR1 in the power supply system of our robot?

9.4 Opto-coupler

For example the 522 series from Meder electronics [2]

![Opto-coupler Diagram](image)

Figure 9-6 Solid state relay

The input and output circuits are electrically isolated, but information can flow from the input to the output by the on/off of the light. The whole circuit including the light transmitter and receiver are enclosed inside the housing package.

Exercise 9. 3 Give two more examples of the use of optical isolators.

9.5 Power supply handling in the board level

Please refer to robot9.ppt and [3].

9.6 Conclusion

The reason for having a stable power supply for the robot has been explained. Also the design and use of de-coupling capacitor are discussed in this chapter.

9.7 References