4. Circuit Description

This chapter explains how the **Enigma-E** circuitry works. Each part of the hardware is described below and you may want to fold out the circuit diagram that came with the kit (one of the separate A3 sheets).

4.1 Power Supply

All electronic parts inside the **Enigma-E** are powered at 5V. This has to be a rather stable power source. There are two possible ways to provide this power:

Using a battery

If you want to use your **Enigma-E** in a portable environment, you may want to connect a battery to the unit. A battery can be connected directly to the PCB at terminals **TWP1** and **TWP2**. Please ensure that power is 8V or higher. Although it's possible to use a standard 9V battery, a small dry rechargable 12V battery is preferred as it will last longer and can be recharged too.

Using a power adapter

If you're using the **Enigma-E** at home, an external power supply is recommended. This is probably the only thing that is not contained in the DIY kit. The reason for this is that safetly regulations and mains voltage are different for each country. Please source a power adapter locally or use one of the power adapters you are likely to have at home. The voltage of the adapter is not critical; any **DC** adapter between 8V DC and 16V DC can be used. If you want to use an **AC** adapter, please note that the voltage needs to be between 8V AC and 12V AC. The power consumption of the **Enigma-E** is about 20mA, so even the smallest adapter will do.

Power from the adapter is fed to diode **D1**, which acts as a simple rectifier. It also protects the **Enigma-E** in case the adapter is connected the wrong way around. The rectified current goes through the slide switch and is stored in **C14**. A **78L05** power stabiliser is used to create a stable 5V level to which all circuitry of the **Enigma-E** is connected. An extra diode, **D28**, has been added to protect your **Enigma-E** against reverse power connection, in which case the diode will conduct and cause the MultiFuse (FUSE1) to 'blow'.

Some users may want to use rechargable batteries for their **Enigma-E**. For the more technically advanced users, the circuit diagram of a suitable battery charger is available on the **Enigma-E** website.

4.2 Micro controller

At the heart of the **Enigma-E** is a small RISC micro controller. This little beast controls just about everything that your **Enigma-E** is capable of. The micro controller we've used for this design is a **PIC16F873A**; a well known member of the famous Microchip PIC family. From now on, we'll refer to this chip as the '**PIC**'. For it's operation, the PIC needs a 4MHz high frequency signal, which is provided by the ceramic resonator **RES1**. The PIC can execute instructions at a quarter of this speed, which means it can do 1 million instructions per second! All software is held in the non-volatile memory inside the PIC. It contains the mathematical algorithms for the encryption, the permutation tables for all wheels, the wheel wiring, setup procedure, selection of wheels, etc. But that's not all. The PIC also scans the keyboard, the Stecker board and the alpha-numerical displays.

4.3 Serial port

You may connect your **Enigma-E** to the outside world by using the on-board serial port. This is a standard RS232 interface, build around two transistors **T5** and **T7**. When a PC or laptop is connected, a negative voltage will be present at the **RxD** line (**TWP23**). As soon as information is sent by the PC, positive pulses will be received on this line. Transistor **T7**, converts these positive pulses into negative ones. These pulses are then fed to pin 18 of the PIC. The **Enigma-E** can also send data to the PC. In this case, the serial port will 'steal' the required negative voltage, from **TWP23** through diode **D29**. Resistor **R12** is used to charge capacitor **C29**. This way we have buffered the negative voltage in order to send data from the **Enigma-E**.