Power Supply Concepts

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1. Basics

Using the plug and play lab for experiments with the BASIC-Tiger™, you have no problems with power supply. The power supply delivered with it is strong enough to provide the BASIC-Tiger™, all additional devices and LEDs with energy. An other thing is to build stand alone systems, the main field of microcontrollers like the BASIC-Tiger™. Such devices always need matching power supplies. Especially if you want to provide a system with battery you should choice well tested variants.

2. Power Supply Circuits

2.1. From the AC Net

It is easy to make a power supply with a little plug which has a transformer and a rectifier in it. Such a cheap device should have 9 - 12 Vdc and 100 - 200 mA. A voltage regulator, e.g. any 7805 (it makes constant 5V) without heat sink is enough for the most applications (fig. 1 & 2). Bigger projects should have a heat sink but if there are devices which need much power like motors you have to think about a separate power supply for both the BASIC-Tiger™ with its components and the motor. This may be necessary to, for instance, avoid spikes.

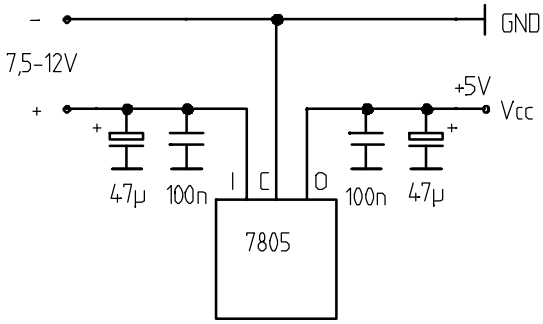

Fig. 1 voltage regulator circuit with 7805

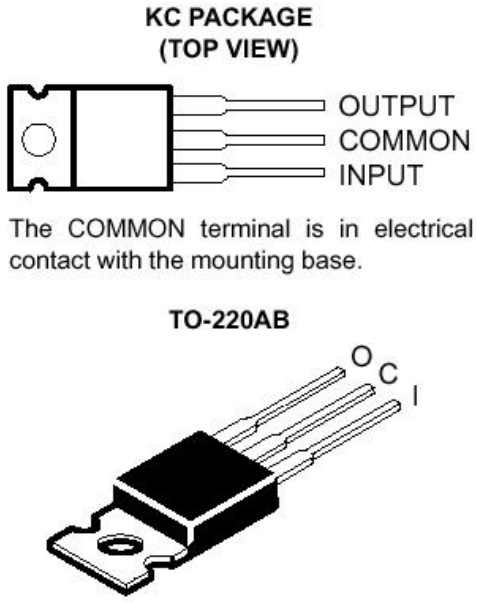

Fig. 2 Pins of typical 7805 (Texas Instr.)

2.2. Battery Operation

Because of the high costs of one way batteries the better choice are accumulators. There are three kinds of usable accumulators:

Nickel cadmium accumulator (NC) 1.2 V operating voltage per cell

Advantages: high capacity (mAh), some kinds are extremely quick rechargeable (<30 minutes), cheap, many cycles of charging / discharging (1000 – 2000 with good charging equipment), high maximal operating current, good constancy of operating voltage over discharging time

Disadvantages: relative high self discharge current, memory effect, can be destroyed by deep discharging or overloading

Nickel metal hydrid accumulator (NiMH) 1.2 V operating voltage per cell

Advantages: higher capacity (mAh) than NC accumulators, no memory effect, many cycles of charging / discharging (1000 with good charging equipment), high maximal operating current (but not so high like NC accumulators), good constancy of operating voltage over discharging time

Disadvantages: relative high self discharge current, not so high discharge current like NC accumulators, can be destroyed by deep discharging or overloading

Rechargeable Alkali Mangan Battery 1.5 V operating voltage per cell

Advantages: high capacity (mAh), no memory effect, good constancy of operating voltage over discharging time, verry small self discharge current (0.2 % per month !), good for standby operations with long cycles without current, not so often rechargeable (some 100 times)

Disadvantages: not so high discharge current like NC or NiMH accumulators, can be destroyed by voltage overload (> 1.7V), a special charging equipment is needed – do not use a normal (cheap) battery charger!

You have the choice - but no battery can deliver exactly 5 V over a long time. The BASIC-Tiger™ and its components need a constant voltage of 5 V (Vcc) without spikes and ripples. In battery operation mode we need a voltage regulator too. Of course you can use the same principle like above with 7805 but this kind of voltage regulation needs typical a 2 – 3 V higher input voltage than the output voltage, this means 2 – 3 cells more without any effect. A second problem is the lower voltage of batteries at the end of capacity, this means you need a "reserve" to hold minimal 7.5 V over all operation conditions and over the hole time. The voltage over 5 V is loss, multiplied with the operating current we have a high loss energy.
A better way is the use of so called step up DC-DC converter which need a voltage source with lower voltage than the output. They work as switching regulators with an inductive element and high switching frequency.
A typical device of this operation mode is the MAX 751 from MAXIM. A data sheet is available:

Datasheet MAX751: http://209.1.238.250/arpdf/1345.pdf

The application circuit of the MAX751 seems to be simple, figure 3 shows on the left side some capacitors, a diode and a coil. But the last two parts are special devices, the best way to get them is to order them together with the MAX751. One distributor is:
Spezial-Electronic GmbH
Kreuzbreite 15
31675 Bückeburg Internet: http://www.spezial.de

(with some luck you get free samples).

The circuit on figure 3 shows not only the MAX751 and its components but a 4 stage switch which is used to change the operation mode of the complete module. So you can:

- Charge the accumulator without endangerment the other parts of the circuit (if you use the battery buffer pin of the BASIC-Tiger™ have a look for limitation the voltage of this pin. You must protect it with serial resistor, zener diode and capacitor or other protection devices from high voltage coming from some modern battery pulse chargers!)
- Switch to PC-mode or run–mode of the BASIC-Tiger™
- Switch off the complete circuit. In this mode only the battery buffer for RTC is on

On the right of figure 3 is shown a +5V to –5V converter with ICL7660 to use a A/D converter or some OPVs (optionally).

Datasheet ICL7660: http://209.1.238.250/arpdf/1017.pdf

To use the MAX751 see the hints of the producer. Some problems come from the high frequency of the switching regulator (170 kHz and harmonics). Have a look at short wires particularly for GND connections and at blocking capacitors near the IC. Pin 1 is now connected via a jumper to battery voltage. If needed you can switch off the regulator with low signal at this pin (sleeping mode). So for instance the BASIC-Tiger™ can switch off its own power supply via a CMOS flip flop. This flip flop gets its Vcc from battery voltage 3.6 V and the output is switching off and on the pin 1 of the MAX 751. The alarm pin of the BASIC-Tiger™ or an other event can switch on and any logic pin can switch off the power supply.

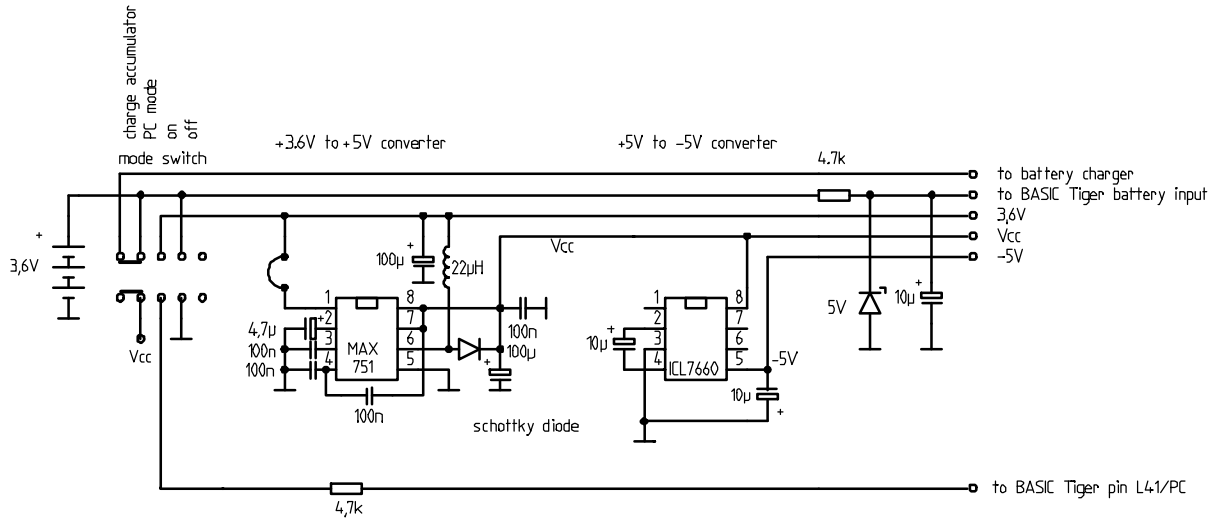

Fig. 3 An universal battery power supply for the BASIC-Tiger™