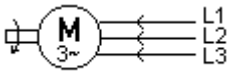
The Squirrel Motor as a Generator

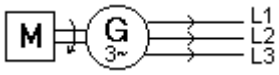
Attention !

The circuits on this page operates at line voltage which is killing dangerous. The connections and experiments of the circuits belong to a professional electrician or a amateur which has experiences enought.
Everyone who practices these circuits make it with his/her own risk. The author of this page take no liability for damages which can happen.

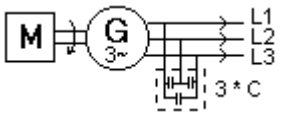
The principle of the operation



To catch the idea of the generator let's think first a squirrel motor in normal motor use. When it is running without mechanical load the speed is a bit above the synchronic speed while it is consuming only the idle current. When the axial load increases the motor takes more current from line while rotation speed decreases a bit (slip).

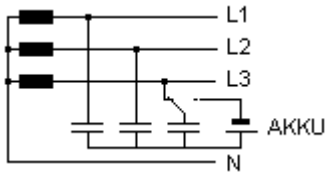


What happens then if we take away axial load and as a opposite of it puts some external rotary power to the axle so that the motor is running equal in synchronic speed. Then the motor needs not even the idle current from the line.
And again, let's put more axial power and try to rotate it faster than the synchronic speed. Then the motor begin to act as a generator and is pushing current to line. The more we try to increase speed the more the motor produces current to line. At same time increases the "negative slip" or the difference to the synchronic speed.



But that's not all. The motor while acting as a generator needs some kind of "power" from line too, namely the idle power or the reactive power. The idle power is what it needs in both uses: as a motor and as a generator.
The effective power is what it produces as a generator while the idle power is "free" from power plant. The effective power meter (kWh-meter) does not register the idle power at all and normal consumers typically need not to pay from the idle power. There is also a way to produce the idle power from "empty" or connecting capacitors parallel to the motor terminals. Now we can talk about a real generator which don't need external line connection to operate.

If we like to use the squirrel motor as a reserve power generator then there is no line power to use and we must use capacitors to produce the idle or reactive power.
For comparing reasons we can think that the idle power is analogous to the magnetization of the direct current generator.



One problem is still left when use the motor as a reserve power generator. How to "wake" the generator or start the exciting. When the generator starts to rotate then there is not any electrical voltage present and the capacitors couldn't produce the idle power. There is some kind of circle around: the voltage cannot arise if there is no voltage. If there is some amount of remanence magnetism in the iron of the motor it can be induced a little voltage which "wakes" the generator. But unfortunately modern motors are made of too "good" iron so there is not remanence

	enought. Usually we need some extra voltage source to start the exciting. But if we push wires from batteries to the terminals of the running generator then we get serious troubles when the generator suddenly wakes and rises voltages high. One way is to use a change-over switch to charge one of the capacitors from battery and then switch it to the generator. There must not be any electrical load connected when waking the generator.

As a result the squirrel motor can act as a generator if these are fulfilled:
- the generator is getting the idle power from line or from capacitors
- there is some way to wake the exciting: remanence magnetism or external current spike

Test with a 1,5 kW motor

When I was a student we made a test to learn the squirrel motor use as a generator with several kind of electric loads. The results have measured in the Technical Institute of Vaasa in Finland at 1974 by the student group: Palomäki E, Palomäki M, Rahkola, Timonen (Those were the days, fellows :-)).

Nominal voltages of the motor must be 220/380V (nowadays 230/400V) which is intended to connect as the star.

The bigger motors are often 380/660V (400/690V), which is intended to connect as the triangle. This is not a good choice as you can find when reading the results. There is no central or neutral point so the monophase 220V load cannot be used.

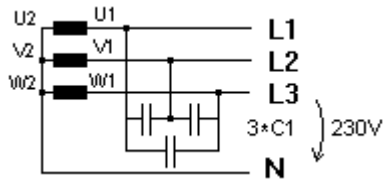
The monophase load the best !

The most shocking finding with these results is that the threephase squirrel motor acts the most best as a generator when the electric load is monophase.
As you know usually it is aim to deliver the electric power as equal as possible to all the three phases. But thinking so is not a good idea here.

If we loads all three phases equally the voltage decreases when we increases the load. So the "magnetization" or the idle power decreases too which affects the voltage decreasing more and there we are in the circle around. As a result the generator stops to produce the electric power alhought the load is comparable low.

As a monophase load there are another two phases which are free from load. The voltages in them are not decreasing when increasing the load in the one phase, contrary the voltages rises in them to the certain point. The situation keeps the idle power (magnetization) high and the voltage in the loaded phase decreases only a very little. As a result form a one phase we got twice the power than threephase loads in all!!

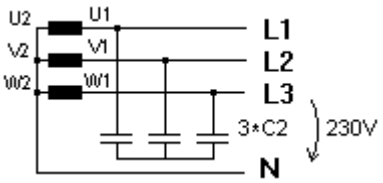
Test circuit



380/220V 3-phase squirrel motor, power 1,5 kW, nominal speed 1415 rpm.

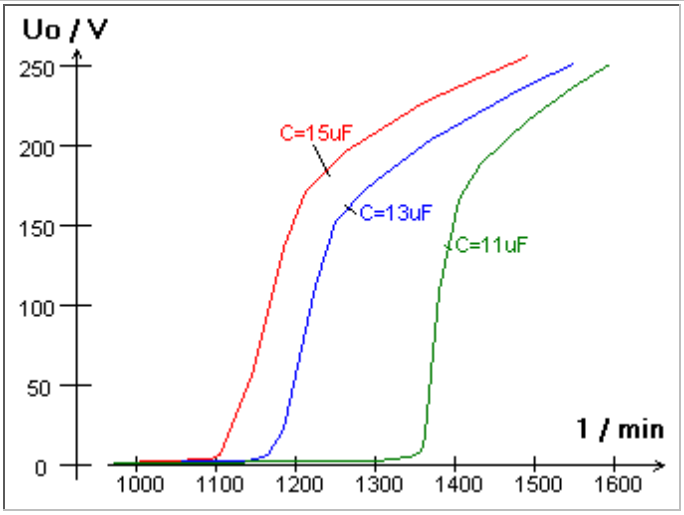
Capacitors connected as a triangle 3 pcs 11-15 uF each, sustain voltage according the main voltage 380VAC added richy reserve. Maybe 450VAC at least (630VDC).

In the drawing you can see how the monophase load is connected. Both other phases are left loadless.



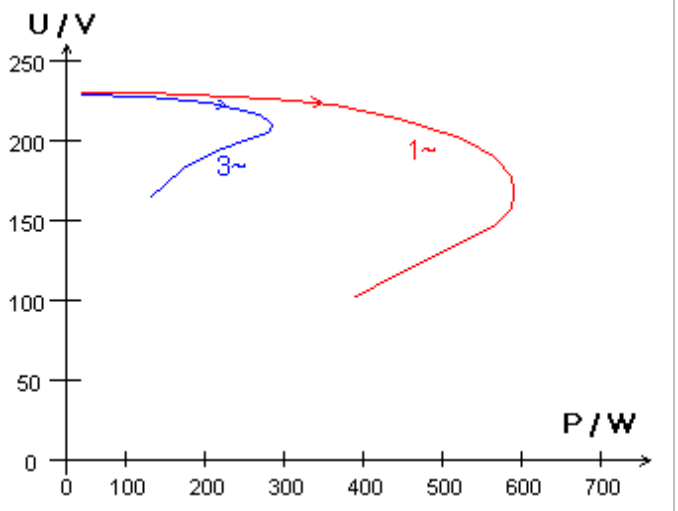
If the capacitors are connected as a star then their capacitances must to be triple as above or 3 pcs 33-45 uF each. Sustain voltage according the phase voltage 220V plus rich reserve. Maybe 300VAC (420VDC).

Voltages at no load as a function of the rotary speed



The idle or loadless voltage voltage of the generator with several capacitive values. The voltage rises when the capacitance increases.

Constant rotary speed, voltages as a function of load



Capacitors 3 pcs 11uF each. Constant speed 1550 rpm.

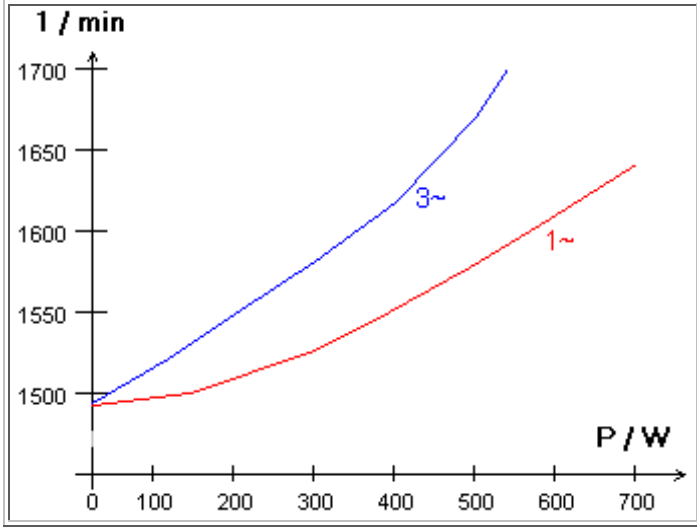
The voltage at no load is 235V.

The load test with monophase and threephase load. The values are total powers

When increasing load there is found a certain maximum limit. The curve turns back because the voltage drops so low that calculated power values decreases.

As a result the monophase load get the highest power amount from the generator.

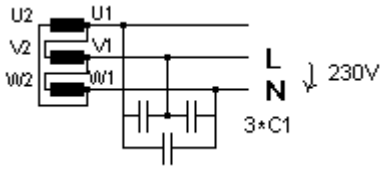
Constant voltage, needed rotary speed as a function of load



Same as above but the rotary speed is increased so that the voltage keeps equal (at the nominal voltage).

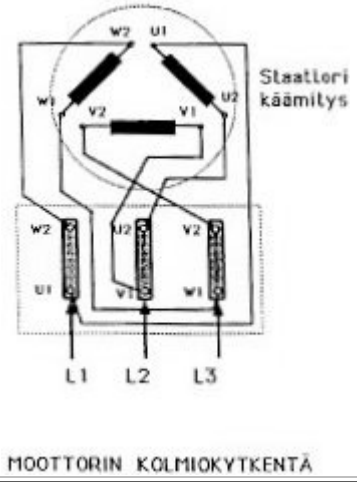
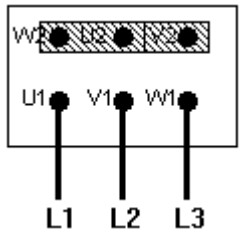
Also here is seen the superiority of the monophase load: the speed is not needed to increase so high than as a threephase load.

Alternative circuit



If motor/generator is connected as a triangle there is a monophase voltage available between two phases. The nominal voltages of the motor must be 220/380V too (nowadays 230/400V).

The connection box of the motor

	The connection box of the squirrel motor. The triangle connection seen here.
	The star connection

Other pages

Wlan-antenna . Do-It-Yourself project
Poor man's frequency convertor to a motor An easy way to divide motor speed with three, five, ans so on

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