WARSAW UNIVERSITY OF TECHNOLOGY
INSTITUTE OF ELECTRICAL MACHINES
**ELECTRICAL MACHINES LABORATORY**

# SYNCHRONOUS GENERATOR TESTS (SYN2)

RATINGS OF GENERATOR AND DRIVING MOTOR

| Generator | | Motor | |
|---|---|---|---|
| $S_N$ = ... | $U_N$ = ... | $P_N$ = ... | $U_N$ = ... |
| $I_N$ = ... | $\cos\varphi_N$ = ... | $I_N$ = ... | $I_{fN}$ = ... |
| $U_{fN}$ = ... | $I_{fN}$ = ... | $n_N$ = ... | |
| $n_N$ = ... | | | |

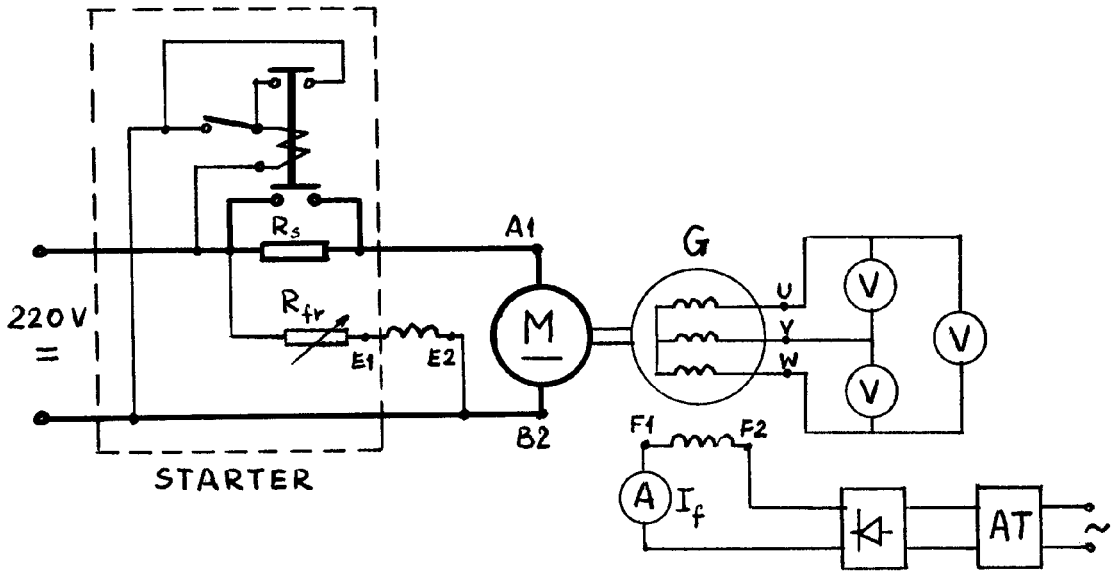
Resistances of generator windings:

- armature winding resistance $R_1$ = ...
- field winding resistance $R_f$ = ...

*Scheme of windings and terminals' symbols (diagram):*

## 1. NO-LOAD CHARACTERISTIC (open-circuit characteristic)

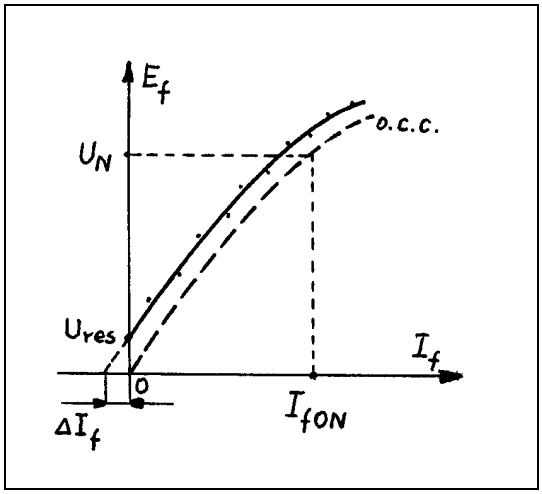
*Supply circuit of driving motor (applicable for all tests) and measuring circuit of generator for no-load test:*



During the measurements of open-circuit curve points coordinates (o.c.c.) the speed of the tested machine should be kept constant: $n=n_N$. The test should be performed in such a way that the field current $I_f$ is being changed (being decreased) from its value corresponding to $E_f \approx 1.2U_N$ to $I_f=0$. Local hysteresis loops cannot be made during measurements. The value of residual emf $E_{res}$ should be exactly measured.

| No of read. | READINGS | | | | | CALC |
|---|---|---|---|---|---|---|
| | $I_f$ | $E_{U-V}$ | $E_{U-W}$ | $E_{V-W}$ | $n$ | $E_f$ |
| | A | V | V | V | rev/min | V |
| 1 | | | | | | |
| 2 | | | | | | |
| ... | | | | | | $E_f=\Sigma E/3$ |
| ... | 0 | | | | | $E_{res}$ |

Notice: If during measurements some readings have been made for $n \neq n_N$, the emf values should be recalculated into their nominal speed values (proportional relation).




Draw the characteristic $E_f=f(I_f)$. If $E_{res}$ is of noticeable value determine the increment $\Delta I_f$ by extrapolation of the linear part of characteristic obtained from the measurements and shift right the curve by this value to get final open-circuit curve of the synchronous generator.
On the basis of o.c.c determine the value of the rated field current at no-load $I_{f0N}$.

$I_{f0N}$=....A

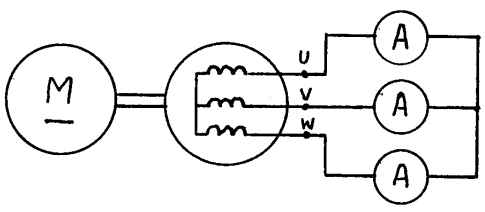
$I_{f0Nr}$= 1 (!)

No-load characteristic (o.c.c.) drawn at the figure convert into per unit values and present it in the form of table:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $E_{fr}$ | p.u. | 0 | | | | 1 | |
| $I_{fr}$ | p.u. | 0 | | | | 1 | |

## 2. SHORT-CIRCUIT CHARACTERISTIC (symmetrical short-circuit)

*Measuring circuit:*



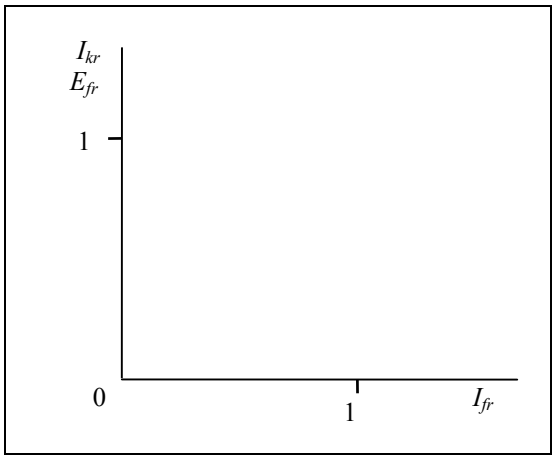
Exciting circuit of generator is connected as in p.1. The measurements of short-circuit curve (s.c.c.) should be made with $n \approx n_N$, within the range of armature current $(0; I_N)$.

| **No.of red.** | $I_f$ A | $I_U$ A | $I_V$ A | $I_W$ A | $I_k$ A | $I_{fr}$ p.u. | $I_{kr}$ p.u. |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| ... | | | | | | | |

$I_k = \Sigma I/3$

$I_{fr} = I_f / I_{f0N}$

$I_{kr} = I_k / I_N$




If for zero field current the residual emf is of such a value that short-circuit current has any noticeable level, the extrapolation of $I_{kr}$ characteristic should be made and appropriate $\Delta I_f$ increment determined (in the same manner as it has been done with o.c.c.)

In common coordinates draw o.c.c. and s.c.c.

$E_{fr} = f(I_{fr})$ and $I_{kr} = f(I_{fr})$.

Determine the following parameters of synchronous generator:

- rated field current at short-circuit in A and in p.u. ($I_{fkN}$ and $I_{fkNr}$),
- short-circuit ratio

$$K_k = \frac{I_{f0N}}{I_{fkN}} = \frac{I_{f0Nr}}{I_{fkNr}}$$

## BIBLIOGRAPHY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