Experiments with a three-phase revolving-armature generator (P 3.5.4.1)

P 3.5.4

Three-phase machines

P 3.5.4.1 Experiments with a three-phase revolving-armature generator

P 3.5.4.2 Experiments with a three-phase revolving-field generator

P 3.5.4.3 Comparing star and delta connections on a three-phase generator

P 3.5.4.4 Assembling synchronous and asynchronous three-phase motors

Cat. No.	Description	P 3.5.4.1 (a)	P 3.5.4.1 (b)	P 3.5.4.2 (a)	P 3.5.4.2 (b)	P 3.5.4.3 (a)	P 3.5.4.3 (b)	P 3.5.4.4 (a)	P 3.5.4.4 (b)
563 480	Electric motor and generator models, basic set	1	1	1	1	1	1	1	1
563 481	Electric motor and generator models, supplementary set	1	1	1	1	1	1	1	1
563 12	Short-circuit rotor							1	1
727 81	Basic machine unit	1	1	1	1	1	1	1	1
563 303	Hand cranked gear	1	1	1	1	1	1		
726 50	Plug-in board 297 x 300 mm					1	1		
579 06	STE lamp holder, E10, top					3	3		
505 14	Set of 10 lamps E 10; 6.0 V/3.0 W					3	3		
501 48	Set of 10 bridging plugs					1	1		
521 485	AC/DC-power supply 0....12 V, 230 V/50 Hz			1	1	1	1		
521 29	3-phase extra-low voltage transformer							1	1
531 120	Multimeter, AC/DC, e.g. Multimeter LDanalog 20	3	3	3	3	2	2	1	1
575 211	Two-channel oscilloscope 303	1*	1*	1*	1*				
575 24	Screened cable BNC/4 mm	2*	2*	2*	2*				
313 07	Stopclock I, 30s/15min	1*	1*	1*	1*				
726 19	Panel frame, SL 85	1		1		1		1	
301 300	Demonstration-experiment frame		1		1		1		1
500 414	Connecting lead, black, 25 cm					3	3	3	3
501 451	Pair of cables, 50 cm, black	3	3	4	4	6	6	2	2

* additionally recommended

In the real world, power is supplied mainly through the generation of three-phase AC, usually referred to simply as “three-phase current”. Consequently, three-phase generators and motors are extremely significant in actual practice. In principle, their function is analogous to that of AC machines. As with AC machines, we differentiate between revolving-armature and revolving-field generators, and between asynchronous and synchronous motors.

The simplest configuration for generating three-phase current, a revolving-armature generator which rotates in a permanent magnetic field, is assembled in the first experiment using a three-pole rotor. The second experiment examines the more common revolving-field generator, in which the magnetic field of the rotor in the stator coils is induced by phase-shifted AC voltages. In both cases, instruments for measuring current and voltage, and for observing the phase shift for a slowly turning rotor, are connected between two taps. For faster rotor speeds, the phase shift is measured using an oscilloscope.

In the third experiment, loads are connected to the three-phase generator in star and delta configuration. In the star configuration, the relationship

$$\frac{U_{aa}}{U_{a0}} = \sqrt{3}$$

is verified for the voltages U_{aa} between any two outer conductors as well as U_{a0} between the outer and neutral conductors. For the currents I_1 flowing to the loads and the currents I_2 flowing through the generator coils in delta configuration, the result is

$$\frac{I_1}{I_2} = \sqrt{3}.$$

The final experiment examines the behavior of asynchronous and synchronous machines when the direction of rotation is reversed.