ELECTRICAL POWER ENGINEERING

POWER GENERATION
DL GTU101-S

Introduction:

The three-phase power is the most commonly used for generation, transmission, distribution and use in the public energy sector. Three-phase systems are more economical than single phase systems due to the reduced amount of conductor material needed to transmit the same amount of power making them suitable for high voltage transmission over long distances. Furthermore, it is ideal for consumers use in three-phase (motors, heavy loads) or single-phase applications.

The generation of electrical energy is performed almost exclusively by means of high power synchronous machines, or alternators, whose construction design depends on the type of drive, which can normally be steam, gas or water. One major limitation of the electrical power is that it cannot be stored in large quantities and, therefore, it has to be generated as the consumer needs it. The synchronous generator can be operated in isolated mode, providing power to a single consumer, or it can be connected in parallel with a constant-voltage constant-frequency grid system.

In this laboratory the main characteristics of a synchronous generator are studied as well its synchronization to the main network and its behaviour under different load conditions.

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Experiments

Generator analysis

- Winding resistance measurement
- Generator no-load test
- Generator short-circuit test
- Conventional efficiency

Load characteristics

- Active power generation.
- Inductive reactive power generation.
- Capacitive reactive power generation.
- Regulation performance analysis.

Network synchronization

- Manual synchronization: Dark lamp synchronization method, Two Bright one dark synchronization method and parallel operation using a synchronoscope.
- Automatic synchronization using a synchronization relay.

Generator network operation

- Alternator and synchronous motor operation.
- Dynamic power factor control of the grid.

Expansion:

Adding optional modules to the GTU 101-S configuration, the available list of experiments and system capabilities are expanded.

DL GTU 101-P Generation protection

- *Paramenter configuration, fault simulation, relay response measurement and oscillograph recording for the following protections:*
  - Overcurrent protection
  - Over-voltage and under-voltage protection
  - Over-frequency and under-frequency protection
  - Unbalanced load protection
  - Stator-earth fault protection
  - Reverse power protection
  - Generator differential protection

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List of modules

DL GTU101-S

DL 2102AL	Three-phase supply unit	1
DL 10065N	Electric power measuring module	1
DL 2109T29	Three-phase power meter	1
DL 2108T02	Power circuit breaker	1
DL 2108T02A	Power circuit breaker	1
DL 2109T1T	Synchronization indicator	1
DL 2109T32	Synchronoscope	1
DL 2108T25	Generator synchronising relay	1
DL 1017R	Resistive load	1
DL 1017L	Inductive load	1
DL 1017C	Capacitive load	1
DL 1067S	Automatic voltage regulator	1
DL 2108T26	Brushless motor with controller	1
DL 2108T26BR	Braking resistor	1
DL 1026P4	Three Phase Synchronous Machine 4 poles	1
DL 1013A	Universal base	1
DL HUBRS485F	Communication MODBUS	1
DL 2600TTI	Three-phase isolation transformer	1
DL SCADA-WEB	SCADA Software	1
DL PCGRID	All-in-One Computer	1
TLGTU101	Cables	1
DL 1196	Holder for leads	1
DL T12090_SK	120x90 working bench	1
DL T06090	60x90 working bench	1
DL A120-3M-LED	Three-level work frame with LED light	1

Expansion modules

DL GTU 101-P

DL 2108T23	Feeder manager relay	1
DL 2108T24	Percentage biased generator differential relay	1
DL 2109T21	Single-phase current transformer	1
DL 2109T22	Three-phase current transformer	2
DL 2108T10	CT Load	1
DL T06090	60x90 working bench	1