# Electro Technologies

# Introduction

Electrotehnica has a great experience in performing electrical equipment destined to industrial technologies:
- 8000 Hz hardening swinging generators since 1957
- galvanization rectifiers covering the range of 100…2500 A, 12…24 V since 1969
- 2500 Hz medium frequency static generators since 1986
- electrical equipment for ionic nitration installations since 1987.

Electro-technologies is a specific category of the technological processes, based on the direct utilization of the electrical power. The equipment are placed between the power source and the parts or materials subject to the technological process changing the parameters of the supply source (value, wave form, frequency). The main sizing criterion of the equipment is to obtain a maximum efficiency.

## Electrotehnica can supply:

| | |
|---|---|
| **Rectifiers for galvanization: 12…50V, 100…5000A** | Used in the technological processes such as: zinc coating, nickel plating, tin coating, chrome plating, eloxation, silvering, gold-plating. |
| **Rectifiers for electrolysis: 50…115V, 500…3000A** | Used in the technological processes of: water electrolysis and for the metal electrolytic coatings. |
| **Inductive heating equipment: 60…1250kW, 500…10000Hz** | Up-to-date solution for heating the ferrous and non-ferrous metals. Clean, non-pollution technology with a minimum power consumption. Used in the technological processes of: melting, forging, hardening, releasing or other thermal treatments. |
| **Ionic nitration equipment: 10…170kW** | Meant for the treatments of slight hardening in nitrogen and hydrogen atmosphere (dissociated ammonia) of the steel and cast iron parts. |

Electrotehnica SA ensures research, design, manufacturing, mounting, commissioning, performance tests and the training of the maintenance staff.

# Medium frequency static generators type GSMF

## Operating principle

The generators convert the 50-60 Hz three-phase mains power into medium frequency power (250-10000Hz). A parallel resonant circuit made up of an inductor and a condensers battery is switched in to the output terminals. The generator ensures the power needed by the starting and continuous oscillation of the load resonant circuit. The part (material), which requires to be heated, is introduced inside the inductor, where it gets warmed by joulean effect, under the action of the medium frequency electromagnetic field.

The generators ensure the continuous adjustment of the output power, the operating current limitation and an optimum value for the cos -power factor at the output, without being necessary to change the value of the condensers battery during operation.

The mains supply of the generators is carried out by means of a three-phase transformer which secures the supply voltage required by the generator and also the galvanic separation of the load resonant circuit against the mains.

The basic construction of the generators is made up of the following main parts:

Rectifier - fully controlled thyristors three-phase bridge.

DC mediate circuit fitted with filtration coil.

Fast thyristors one-phase bridge inverter.

Control, adjustment, protection and signalling electrical and electronic circuits.

Closed circuit distilled water cooling equipment type ER, among which water / water heat exchanger. This is connected, outside, to the industrial water network in order to yield the heat taken over from the generator. The low power generators are air cooled.

## Applications

Used for the inductive heating of the ferrous or non-ferrous metals for melting, forging, hardening or other thermal treatments.

The advantages of the inductive heating, compared to the heating standard methods (warm walls or flame furnaces) or the swinging generators, are:

The improvement in controlling the process technological parameters and the increase in quality of the processed parts.

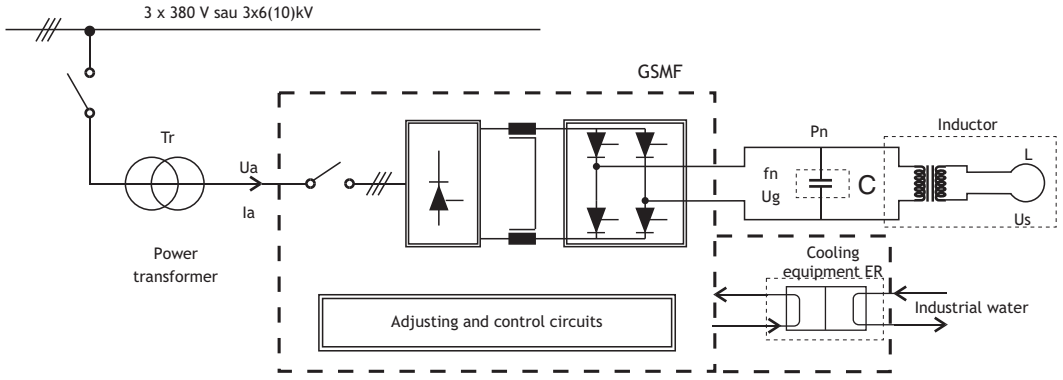
The diminishing of energetical consumptions with an average of 25% per equipment.

Higher reliability and lifetime.

Minimum maintenance and repairing costs.

Small erecting aria.

## Electrical diagram




## Technical parameters

| | |
|---|---|
| Power supply voltage | 3xUa (V) 10%, 50 Hz 4% (according to variant) |
| Control supply voltage | 3 x 380 V 10% |
| Power supply from the mains | Sa (kVA) (according to variant) |
| Output rated power | $P_n$ (kW) (according to variant) |
| Output power adjustment range | (0.1...1) $P_n$ |
| Rated voltage at the generator output | $U_g$ (V) (according to variant) |
| Output power factor cos . | min. 0.8 |
| Generator electrical efficiency | 91 (8000 Hz)...97 (500 Hz) |
| Industrial water flow for ER | $Q_{AR}$ ($m^3$ / h) (according to variant) |
| Protection degree | IP 42 |
| Overall dimensions L x W x H (mm) | (according to variant) |

| Choice / Denomination | Category code |
|---|---|
| GSMF xxxxkW/xxxxxHz/x-zz | 30014301 |

- xxxxkW — Rated output power
- xxxxxHz — Output rated frequency
- x — Constructive variant
- zz — Manufacturer's code

| Trading denomination | Ua | Ug | Sa min | $Q_{AR}$ | Weight L x Wx H |
|---|---|---|---|---|---|
| | V | V | kVA | $m^3/h$ | mm |
| GSMF 60kW / 8000Hz 01 | 380 | 600 | 75 | 2 | 1600x1000x1700 |
| GSMF 110kW / 2500Hz 01 | 510 | 800 | 120 | 3 | 1600x1000x1700 |
| GSMF 125kW / 8000Hz 01 | 380 | 600 | 160 | 3 | 1600x1000x1700 |
| GSMF 125kW / 2500Hz 10 | 510 | 800 | 145 | 3 | 1600x1000x1700 |
| GSMF 175kW / 2500Hz 01 | 510 | 800 | 205 | 3 | 1600x1000x1700 |
| GSMF 200kW / 8000Hz 20 | 440 | 650 | 280 | 4 | 2100x1000x2000 |
| GSMF 250kW / 2500Hz 20 | 510 | 800 | 295 | 3 | 1600x1000x1700 |
| GSMF 300kW / 8000Hz 21 | 440 | 650 | 400 | 6 | 2100x1000x2000 |
| GSMF 400kW / 2500Hz 20 | 510 | 800 | 500 | 8 | 2100x1000x2000 |
| GSMF 400kW / 8000Hz 21 | 440 | 650 | 570 | 10 | 2100x1000x2000 |
| GSMF 500kW / 2500Hz 20 | 510 | 800 | 620 | 8 | 2100x1000x2000 |
| GSMF 600kW / 2500Hz 20 | 510 | 800 | 720 | 10 | 2100x1000x2000 |
| GSMF 750kW / 2500Hz 20 | 525 | 800 | 930 | 10 | 2100x1000x2000 |
| GSMF 750kW / 2500Hz 30 | 525 | 1500 | 930 | 15 | 2400x1000x2000 |
| GSMF 1000kW / 1000Hz 20 | 600 | 850 | 1220 | 10 | 2100x1000x2000 |
| GSMF 1000kW / 1000Hz 30 | 600 | 1500 | 1220 | 15 | 2400x1000x2000 |
| GSMF 1200kW / 1000Hz 40 | 525 | 1500 | 1500 | 15 | 2900x1000x2000 |
| GSMF 1250kW / 2500Hz 40 | 525 | 800 | 1600 | 15 | 3200x1000x2000 |

| Trading denomination | Mains transformers | Transformers overall size mm |
|---|---|---|
| GSMF 60kW/8000Hz 01 | TTA 75kVA 380V/380V | 860x 280x 700 |
| GSMF 110kW/2500Hz 01 | TTA 125kVA 380V/510V | 1130x 480x 800 |
| GSMF 125kW/8000Hz 01 | TTA 160kVA 380V/380V | 1000x 350x 870 |
| GSMF 125kW/2500Hz 10 | TTA 160kVA 380V/380V | 1000x 350x 870 |
| GSMF 175kW/2500Hz 01 | TTA 212kVA 380V/510V | 1100x 550x1015 |
| GSMF 200kW/8000Hz 20 | TTA 280kVA 380V/440V | 1160x 660x 920 |
| GSMF 250kW/2500Hz 20 | TTA 318kVA 380V/510V | 1250x 690x1115 |
| GSMF 300kW/8000Hz 21 | TTA 400kVA 380V/440V | 1215x 820x1150 |
| GSMF 400kW/2500Hz 20 | TTA 500kVA 380V/510V | 1240x 700x1325 |
| GSMF 400kW/8000Hz 21 | TTA 630kVA 380V/440V | 1400x 815x1420 |
| GSMF 500kW/2500Hz 20 | TTA 630kVA 380V/510V | 1400x 815x1420 |
| GSMF 600kW/2500Hz 20 | TTA 720kVA 380V/510V | 1465x 605x1380 |
| GSMF 750kW/2500Hz 20 | TTU 1000kVA 6(10)kV/525V | 2110x1420x2080 |
| GSMF 750kW/2500Hz 30 | TTU 1000kVA 6(10)kV/525V | 2110x1420x2080 |
| GSMF 1000kW/1000Hz 20 | TTU 1300kVA 6(10)kV/600V | 2110x1420x2080 |
| GSMF 1000kW/1000Hz 30 | TTU 1300kVA 6(10)kV/600V | 2110x1420x2080 |
| GSMF 1200kW/1000Hz 40 | TTU 1600kVA 6(10)kV/525V | 2200x1350x2400 |
| GSMF 1250kW/2500Hz 40 | TTU 1600kVA 6(10)kV/525V | 2200x1350x2400 |

Electrotehnica SA can supply, on demand, together with the static generators, three-phase supply transformers and medium frequency workhead transformers and autotransformers.
The other parts of an inductive heating complete equipment can be supplied by Electrotehnica or its partners, depending on the application: inductors, condensers batteries, load circuit water cooling equipment, water cooled medium frequency cables or bars system, automation cabinets, control boards, technological supply and operation mechanism of the parts.

Note: The transformers for the mains supply of the generators are shown in the next table.

# Rectifiers for electro-chemical or electrolysis coatings type RNG, RRG, RNE

## Operating principle

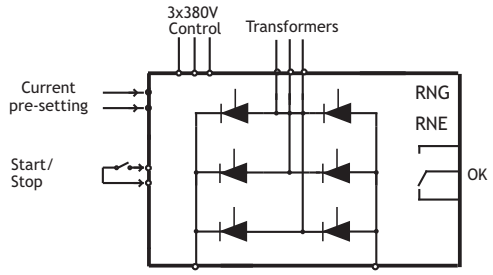
AC/DC three-phase supply converters, achieved in non-reversible variant - type RNG, RNE or reversible (by static reversal of the output voltage polarity) type RRG.
The rectifiers type RNG and RNE contain one or several parallel - working non - reversible three-phase bridges (6thyristors), for the currents higher than 1500 A.

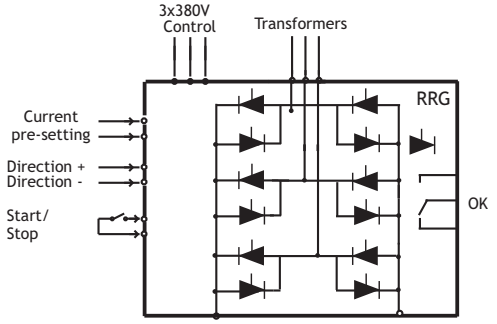
The rectifiers type RRG contain one or several parallel -working reversible bridges (12 thyristors) for the currents higher than 1500 A.
The control unit contains a current regulator with maximum voltage limitation, protection and signalling circuits.

## Applications

The rectifiers type RNG, RRG are utilized for:
electro-chemical coatings type zinc coating, nickel plating, tin coating (15 V variants)
electro-chemical coatings type decorative or hard chrome-plating (15 V or 25 V variants)
electro-chemical coatings type eloxation (anode oxidation - 25 V variants)
special electro-chemical coatings (silvering, gold-plating)
The rectifiers type RNE are used for:
water electrolysis (115 V variants)

## Electrical diagram




## Technical parameters

| | |
|---|---|
| Supply voltage (control circuits) | 3x380V 10%, 50Hz 2% |
| Supply voltage (power circuits) | 3x15V, 25V, 50V, 115V from the supply transformer |
| Maximum output current $I_{dT}$ | 80A, 135A, 250A, 340A, 500A, 1000A, 1500A, 2000A, 3000A, 4500A, 5000A |
| Maximum output voltage | 15VDC, 25VDC, 50VDC, 115VDC |
| Deviation (at maximum variation of supply voltage and temperature) | max. 1% |
| Current specification | 0...+10V or 4...20mA |
| Protections | lack of phase<br>long-time overcurrent<br>heatsinks overtemperature<br>lack of ventilation |
| Signallings | LED or relay contacts |
| Measurement devices | output current and voltage |
| Protection degree according to SR EN 60529:1995 | IP21 |
| Environmental conditions | operating temperature: 0...40°C<br>relative air humidity: 80% at 20°C<br>maximum working altitude: 1000m |

The products are manufactured in compliance with STAS 6692-83.

| Choice / Denominationc | ategory code |
|---|---|
| RXX xxxV/xxxxxA-zz | 30014101 |

RXX xxxV/xxxxxA-zz

- Manufacturer's code
- Output current
- Maximum output voltage
- Variant (E = electrolysis, G = electro-chemistry, x = specific application)
- Variant (N = non-reversible, R = reversible)

| Trading denomination | Overall sizes L x w x H mm | Workhead transformer Type | Included |
|---|---|---|---|
| RNG 15V/500A | 800x800x1800 | TTA 12,3kVA | Yes |
| RNG 15V/1000A | 800x800x2300 | TTA 22,5kVA | Yes |
| RNG 15V/1500A | 800x800x2300 | TTA 35kVA | Yes |
| RNG 15V/2000A | 800x800x2300 | TTA 51kVA | No |
| RNG 15V/3000A | 1600x800x2300 | TTA 63kVA | No |
| RNG 15V/4500A | 2400x800x2300 | TTA 100kVA | No |
| RNG 15V/5000A | 3200x800x2300 | TTA 115kVA | No |
| RRG 15V/500A | 800x800x1800 | TTA 12,3kVA | Yes |
| RRG 15V/1000A | 800x800x2300 | TTA 22,5kVA | Yes |
| RRG 15V/1500A | 800x800x2300 | TTA 35kVA | Yes |
| RRG 15V/2000A | 800x800x2300 | TTA 51kVA | No |
| RRG 15V/3000A | 1600x800x2300 | TTA 63kVA | No |
| RRG 15V/4500A | 2400x800x2300 | TTA 100kVA | No |
| RRG 15V/5000A | 3200x800x2300 | TTA 115kVA | No |
| RNG 25V/500A | 800x800x1800 | TTA 22,5kVA | Yes |
| RNG 25V/1000A | 800x800x2300 | TTA 35kVA | Yes |
| RNG 25V/1500A | 800x800x2300 | TTA 63kVA | No |
| RNG 25V/2000A | 800x800x2300 | TTA 85kVA | No |
| RNG 25V/3000A | 1600x800x2300 | TTA 115kVA | No |
| RNG 25V/4500A | 2400x800x2300 | TTA 160kVA | No |
| RNG 25V/5000A | 3200x800x2300 | TTA 180kVA | No |
| RRG 25V/500A | 800x800x1800 | TTA 22,5kVA | Yes |
| RRG 25V/1000A | 800x800x2300 | TTA 35kVA | Yes |
| RRG 25V/1500A | 800x800x2300 | TTA 63kVA | No |

| Trading denomination | Overall size L x w x H mm | Workhead transformer Type | Included |
|---|---|---|---|
| RRG 25V/2000A | 800x800x2300 | TTA 85kVA | No |
| RRG 25V/3000A | 1600x800x2300 | TTA 115kVA | No |
| RRG 25V/4500A | 2400x800x2300 | TTA 160kVA | No |
| RRG 25V/5000A | 3200x800x2300 | TTA 180kVA | No |
| RNG 50V/500A | 800x800x1800 | TTA 35kVA | Yes |
| RNG 50V/1000A | 800x800x2300 | TTA 85kVA | No |
| RNG 50V/1500A | 800x800x2300 | TTA 115kVA | No |
| RNG 50V/2000A | 800x800x2300 | TTA 160kVA | No |
| RNG 50V/3000A | 1600x800x2300 | TTA 220kVA | No |
| RNG 50V/4500A | 2400x800x2300 | TTA 350kVA | No |
| RNG 50V/5000A | 3200x800x2300 | TTA 350kVA | No |
| RRG 50V/500A | 800x800x2300 | TTA 35kVA | Yes |
| RRG 50V/1000A | 800x800x2300 | TTA 85kVA | No |
| RRG 50V/1500A | 800x800x2300 | TTA 115kVA | No |
| RRG 50V/2000A | 800x800x2300 | TTA 160kVA | No |
| RRG 50V/3000A | 1600x800x2300 | TTA 220kVA | No |
| RRG 50V/4500A | 2400x800x2300 | TTA 350kVA | No |
| RRG 50V/5000A | 3200x800x2300 | TTA 350kVA | No |
| RNE 115V/500A | 800x800x1800 | TTA 85kVA | No |
| RNE 115V/1000A | 800x800x2300 | TTA 180kVA | No |
| RNE 115V/1500A | 800x800x2300 | TTA 280kVA | No |
| RNE 115V/2000A | 800x800x2300 | TTA 350kVA | No |
| RNE 115V/3000A | 1600x800x2300 | TTA 500kVA | No |

**Note**

The workhead transformer must be ordered separately for the manufacturing variants which do not contain this transformer.
On demand, Electrotehnica can also manufacture remote control box, which contains on/off operations, pre-setting and the output current and voltage measurement devices.
The coding of the control boxes is CCD xxxV/xxxxA.
The overall dimensions do not take into consideration the bar outputs and the workhead transformer (for the variants that do not comprise the transformer).

On demand, the voltage and current range, the protection degree and the temperature range can be extended.

# Electrical equipment for ionic nitridation installations type EEINI

## Operating principle

The electrical equipment type EEINI ensure the continuous supply voltage for the tanks of the ionic nitration installations.
The ionic nitration installations are meant for the treatments of slight hardening for steel and cast iron finished articles.
The articles destined to nitration treatment are put inside an air emptied tank and are maintained into a nitrogen and hydrogen atmosphere (dissociated ammonia). The articles are gradually heated up to 500-600$^0$C by delivering an adjustable continuous voltage between 0V and 800-1000V$_{DC}$. The voltage is applied between the parts connected To cathode and anode. The anode has the shape of a screen also connected to the ground terminal.
The ionization of the nitrogen atmosphere takes place as the articles are heated, leading to an abnormal luminescent discharge at the surface of the treated articles. The process of ionic nitration takes place as a result of the slight combinations and the diffusing of the nitrogen atoms, which are rushed towards the cathode during the luminescent discharge.
The nitration represents, on the whole, a sorption process of the nitrogen in the articles that are going to be nitrated, its interstitial linking and shaping of a solid solution which hardens the surface of the treated articles.
During the nitration process, the abnormal discharge can turn into a normal one, under the shape of an electric arc indicated by a short - circuit between the tank electrodes, therefore between the output terminals of the electric equipment.
The equipment type EEINI ensures:

The adjustable continuos voltage within a pre-set range;

The variation of the power pulses space factor between 0 (blocked up conduction) and 100% (continuous conduction), manually (by means of a potentiometer) or automatically (from a programmer) for any value of the converter output voltage;

The fast interlock of the converter in case of a short-circuit at its output (as a result of the arc passing of the abnormal discharge), so that the instantaneous value of the short-circuit current should not exceed the allowed value, without fuses blow-out or articles damages as a consequence of the treatment;

The monitoring and maintenance of a steady temperature for the articles from the nitration tank, subject to the signal received from a temperature regulator;

The choice of the operating regimes:

Degasing - the first phase of the treatment when the degasing and pre-heating of the articles are taking place. The pre-heating of the articles is accomplished by switching the negative output terminal of the converter, from a cathode to an EA auxiliary electrode;

The so-called nitration treatment;

Protections which are specific to the application.

The component parts of the electric equipment:

Three-phase mains supply transformer

Variable power converter made up of:

- fully controlled bridge thyristors rectifier
- diodes circuit for selecting the blow-out path of the tank arcs
- arcs blow-out condensers ($C_s$)
- condensers for the voltage absorption and limitation of the arcs blow-out
- voltage pilot-rectifier
- overvoltages protection circuits

BF filtration coil

Control, adjustment, protection and signalling circuits.

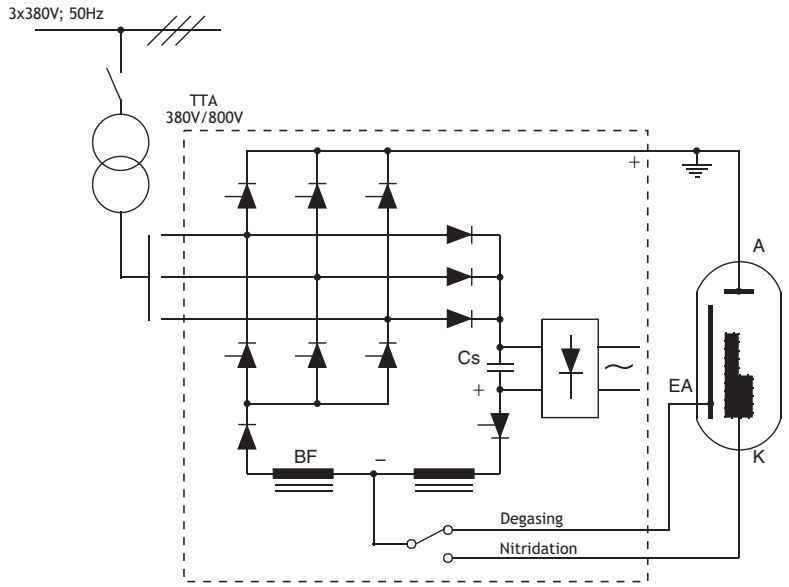
Besides the electric equipment, the ionic nitration installations also contain an ammonia dissociating cabinet, an air emptying unit and one or several tanks.

## Application

For slight hardening treatments of the cast iron and steel parts, in the engineering machine- building industry and the repairing and maintenance workshops.
Advantages of the utilization of the ionic nitration installations fitted with EEINI equipment:

Decreasing of the alloyed / highly alloyed steel consumptions, lowering of the energetical consumptions, repeatability of the treatment technology, environmental protection (lack of the emission of toxic substances), higher reliability and easy maintenance.

## Basic electrical diagram




## Technical parameters

| | |
|---|---|
| Supply voltage | 3x380V ± 10%; 50Hz ± 2Hz (by means of a supply transformer) |
| Rated power | 10kW; 30kW; 70kW; 150kW (according to variant) |
| Maximum output voltage | 800 - 1000 $V_{DC}$ |
| Output rated current | 22A; 60A; 140A; 300A (according to variant) |
| Maximum time period of the electric arc blow-out | 80s |
| Automated resetting time between successively forced blow-outs | max. 0.5s |
| Protection degree | IP 31 |

## Choice / Denomination — Category code

EEINI xxxkW-zz — 30014401

- Manufacturer's code
- Rated output power

| Trading denomination | Supply transformer | EEINI Overall dimensions L x W x H |
|---|---|---|
| EEINI 10kW | TTA 25kVA 380V/700V, 800V | 800x800x2000 |
| EEINI 30kW | TTA 85kVA 380V/700V, 800V | 800x800x2000 |
| EEINI 70kW | TTA 160kVA 380V/700V, 800V | 1600x800x2000 |
| EEINI 150kW | TTA 328kVA 380V/700V, 800V | 1600x800x2000 |

Note:
For EEINI 10kW variant, the supply transformer is included in the equipment.
For EEINI 30kW variant, the transformer is separately delivered in a cabinet with the following overall dimensions: 1200x500x1100 mm.
For EEINI 70kW and EEINI 150kW variants, the transformer is separately delivered in a cabinet with the following overall dimensions: 1250x 700x1700 mm.
At the same time, the filtration coil is separately delivered in a cabinet with the following overall dimensions: 700x650x1000 mm.

The power range, voltage gamma, protection degree, temperature range can be extended, on demand.