REGULATION
Digital Controler for Synchronous Machines

Applications

The digital Automatic Voltage Regulator (AVR) RG750 was specially designed to control the excitation of large synchronous machines (alternators & motors).

Thanks to its regulation principles & high performances, it allows the machines that are equipped with to ensure dynamic stability of the feeded networks.

The AVR RG750 belongs to the RG700 series grouping Technirel's digital regulators. They are dedicated to the control of synchronous machines.

Regulation purposes:

The digital A.V.R. RG750 acts on the rectifier bridge to control the excitation current of the alternator in order to:

- Maintain the voltage value at the stator terminals on the fixed point regardless of the load conditions of the network.
- Maintain the power factor value of the machine according to the conditions requested for production or absorption of reactive power.
- The RG750 AVR is a digital controller with override regulation facilities (open loop control operation, see figure N° 60135/1 pages 1 & 2).

Limitation purposes:

The digital AVR RG750 takes into account 3 kinds of limitation that supersede the regulation purposes.

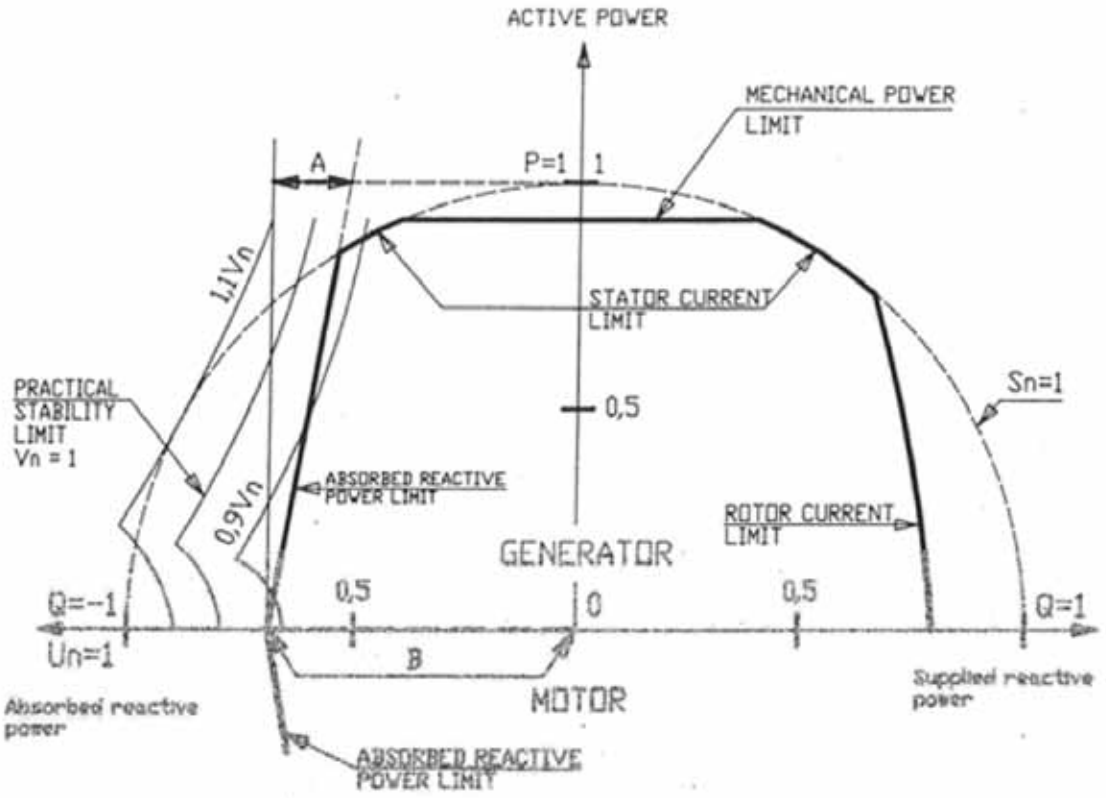
- These limitations make the alternator operating inside its proper boundary defined by the PQ diagram. See figure on next page.
- However, the limits of this boundary can be trespassed in case of extreme operational conditions that require exceptional & short field forcing.
  - Rotor & stator current limitations.
    They correspond to rotor & stator coils over heating conditions.
  - Reactive power absorption limitation.
    It corresponds to the practical static stability limits of the machine (internal angle limitation).

Over excitation purposes:

The digital AVR RG750 allows to set the field excitation current at several levels of over excitation.

- Thus, when the grid network suffers from important disturbances (short circuits), the RG750 AVR can cancel the permanent excitation ceiling that goes up from 1.2 Ifn normal value to 1.6 Ifn exceptional value for a 10 s maximum duration.

Active power



$$\frac{Q}{Sn} = A\frac{|P|}{Sn} + B\left[\frac{V}{Vn}\right]^2$$

ALTERNATOR P-Q DIAGRAM

P : (active power)
Q : (réactive power)

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Functions:

Basically, the digital AVR RG750 ensures the following functions:

- **Regulation functions**:
  - Field flashing up to 0.6 Un stator voltage.
  - Excitation current regulation.
  - Progressive stator voltage establishment when starting up (soft start).
  - Stator voltage regulation.
  - Stator voltage & grid voltage matching before coupling.
  - Machine powerfactor control.
  - Under frequency operation control of U/F = Constant ratio.
  - Bumpless transfer from auto mode to manual mode (and inversely).
  - Adjustable droop.
- **Limitations**:
  - Stator current limitation.
  - Rotor current rotor limitation.
  - Reactive power absorption limitation.
- **Regulation & limitation functions activation**:

Regulation & limitations modes are activated by switching on external contacts or logic arrangement of these contacts.

- **Manual mode**:

The digital AVR RG750 offers the possibility of manually controlling the excitation current by allowing the stator voltage adjustment over a span covering from 0 to 125 % of nominal voltage.

The RG750 AVR performs bumpless transfer from manual to auto mode & vice versa.

Manual mode is activated through external contacts selection & stator voltage is set by action on voltage rise or down contacts.

- **Preset mode**:

This facility allows to start up the excitation of the system using a predetermined value.

The preset mode is activated by switching on an external contact. The preset value is adjusted from the PC terminal.

Displays:

Regulation & limitation modes selections are displayed by LEDs illumination on the front face of the RG750 (see Fig 66001 /1).

- Yellow LEDs indicating regulation modes involved.
- Red LEDs indicating limitation modes involved, microprocessors alarms and communication port activation.
- Green LEDs indicating stabilized regulation condition.

Settings:

The settings of the internal set points, the scalling of the measurements, the selection of the PID parameters are performed through the communication port located on the front face by using the PC terminal.

Measurements:

All measurements are filtered.

- 5 voltage measurments through PTs with 100 / 110 V:
  - 3 stator voltage measurements (V1, V2, V3 / U12 - U23 - U31)
  - 1 grid voltage measurement.
  - 1 voltage measurement for thyristors synchronisation.
- 1 voltage measurement through a Hall effect probes
  1 voltage measurement (Uf rotor / U excitation)
- 3 current measurements through CTs with 5 A secondary. 3 stator current measurements (I1, I2, I3)
- 1 excitation current measurement through an Hall effect probe (If rotor / Iex).

Remote settings:

The RG7SO Digital AVR allows remote adjustment of the following regulation set points:

- Stator voltage regulation set point.
- Power factor regulation set point.
- If rotor excitation current set point.

These remote settings are retrieved in form of analog signals:

- Current :

± 5 mA	0 to 5 mA	1 to 5 mA
± 10 mA	0 to 5 mA	2 to 10 mA
± 20 mA	0 to 5 mA	4 to 20 mA

- Voltage:

± 5 V	0 to 5 V	1 à 5 V
± 10 V	0 to 10 V	2 à 10 V

- Potentiometer: 0 to 10 kΩ on 0 to 5 V

Logic control input signals:

To activate regulation or limitation automatic functions the RG750 digital AVR retrieves 16 logic control signals galvanically insulated by the means of optocouplers.

Logic control output signals:

Independently from the serial communication links, the RG750 digital AVR has the capacity of 5 logic signals output to deliver the following status informations:

- Current stator limitation function activated.
- Current rotor limitation function activated.
- Reactive power absorption.
- AVR CPU Faulty (Watchdog).
- Field flashing sequence over.

Description:

The digital AVR RG750 uses 2 microprocessors 16 bits type 80C196KB-12 MHZ.

One microprocessor is in charge of:

- Communication management: serial ports 1 & 2
- Binary data input & output management.

The other one is in charge of regulations & limitations functions as well as the control of the triggers

The RG750 hardware is made of 7 PCBs fitted in a 19" wide rack 3 units high suitable for flush or projection mounting.

Safety:

Each microprocessor has its own watchdog equipped with an alarm signalling contact hardwired on terminal.

All parameters used by the regulation are saved in EEPROM with a backup lifetime of 10 years.

Communication:

The RG 750 digital AVR is basically devoted to control & communication.

Communication function uses 2 serial dedicated ports:

- Port n°1 is dedicated to the man/machine dialogue needed by comissionning operation.
- Port n°2 is dedicated to communication with supervisory system.
- Port n°1 characteristics:
  Link type: RS232
  Speed: 9600 Bauds
  Protocol: private TECHNIREL ICE property.
  Plug in connexion: on the front panel, DB9 plug in type.

Terminal suitable: PC / Windows XP.

- Port n°2 characteristics
  Link type:
  - RS232
  - Current loop 0 - 20 mA

Speed: 300 to 19200 Bauds

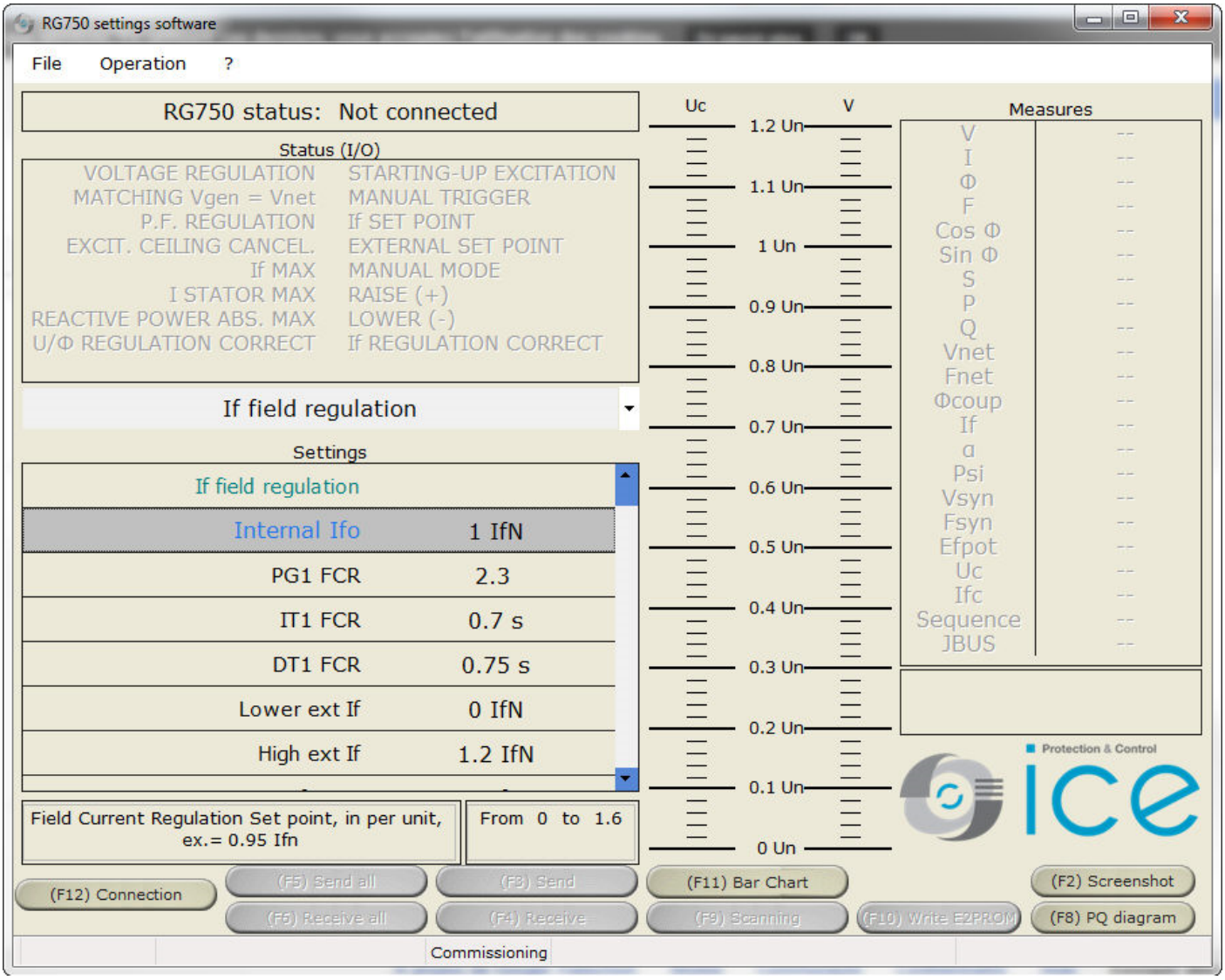
Protocol: Modbus / Jbus slave

Connexion: on rear terminal (screw connexion)

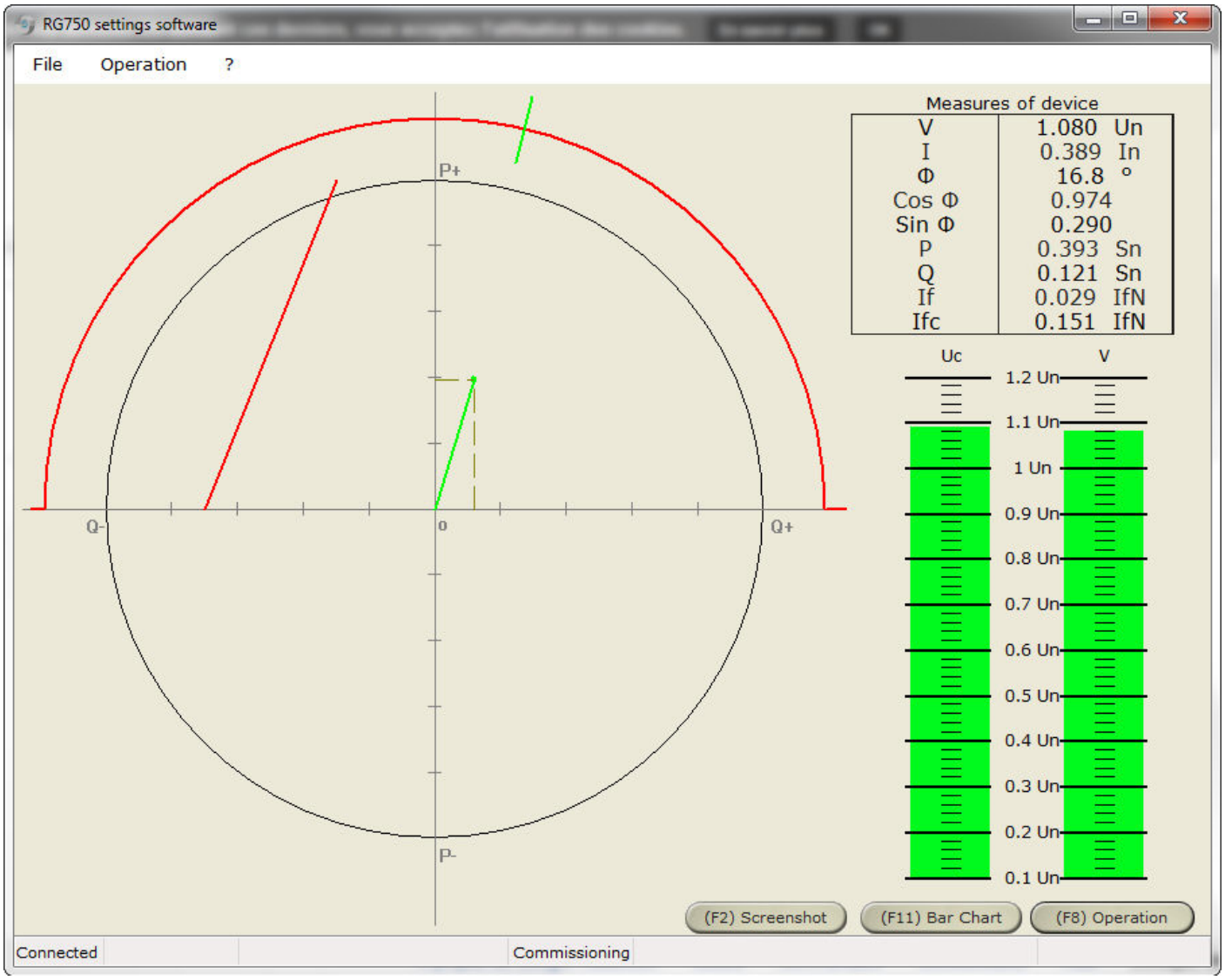
Man-machine interface of ICE's configuration software:

- Introduction of the operation software RG7x0:
  - Measurements display
  - Set points & PID parameters generation or modification.
  - Alarms & signals display
  - Set points & parameters are protected by passwords
  - PQ diagram situation display

RG7x0 software: Operation window



RG7x0 software: PQ representation window



Electrical characteristics:

- Auxiliary supply:
  - Galvanically isolated.
  - 48 - 110 - 127 Vdc
  - Power consumption: 30 W maxi.
- Measurement input characteristics:
  - Input current: 5 A - 50 / 60 Hz
    - Consumption per input: 10 VA
    - Isolated.
  - Voltage input: 100 / 110 V - 50 / 60 Hz
    - Consumption : 10 VA
    - Isolated.
  - Set point input:
    - 3 ranges available: current (mA), voltage (mV), potentiometer (kΩ).
- Control input characteristics:
  - Dry contacts free of voltage, galvanically insulated.

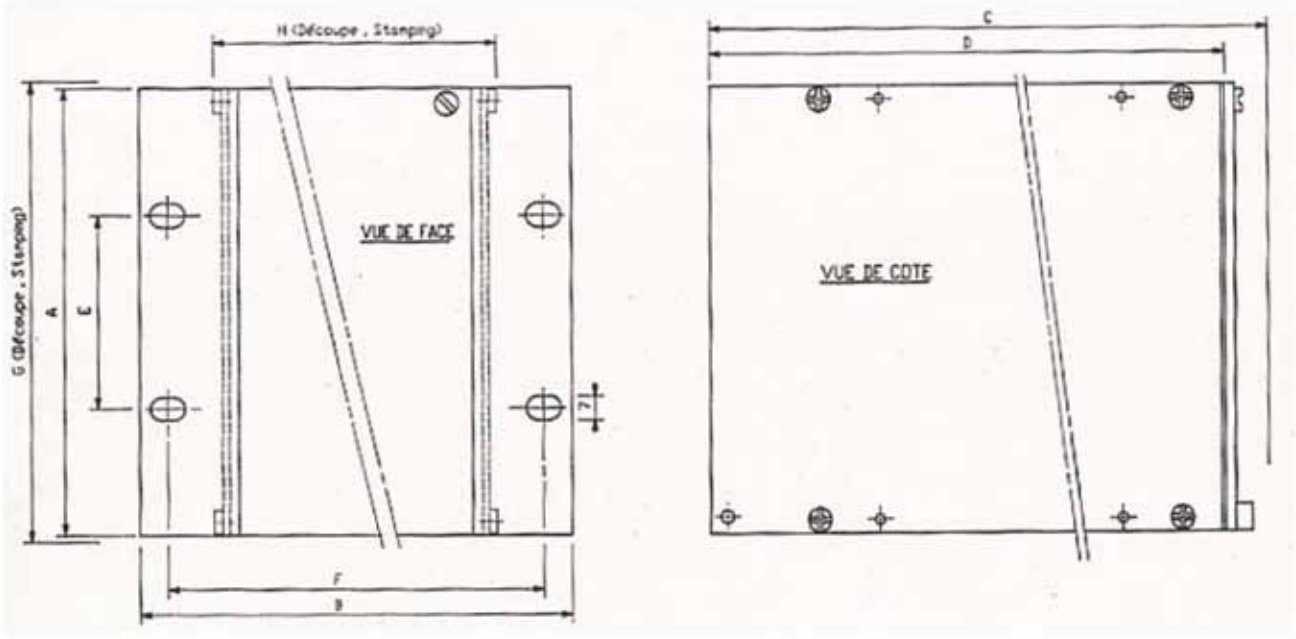
Contacts output characteristics: dry contacts free of voltage.

- Breaking rate dc current:
  30 V / 8 A - 100 V / 0.5 A - 30 V / 0.3 A.
- Breaking rate ac current:
  2000 VA / 220 V.

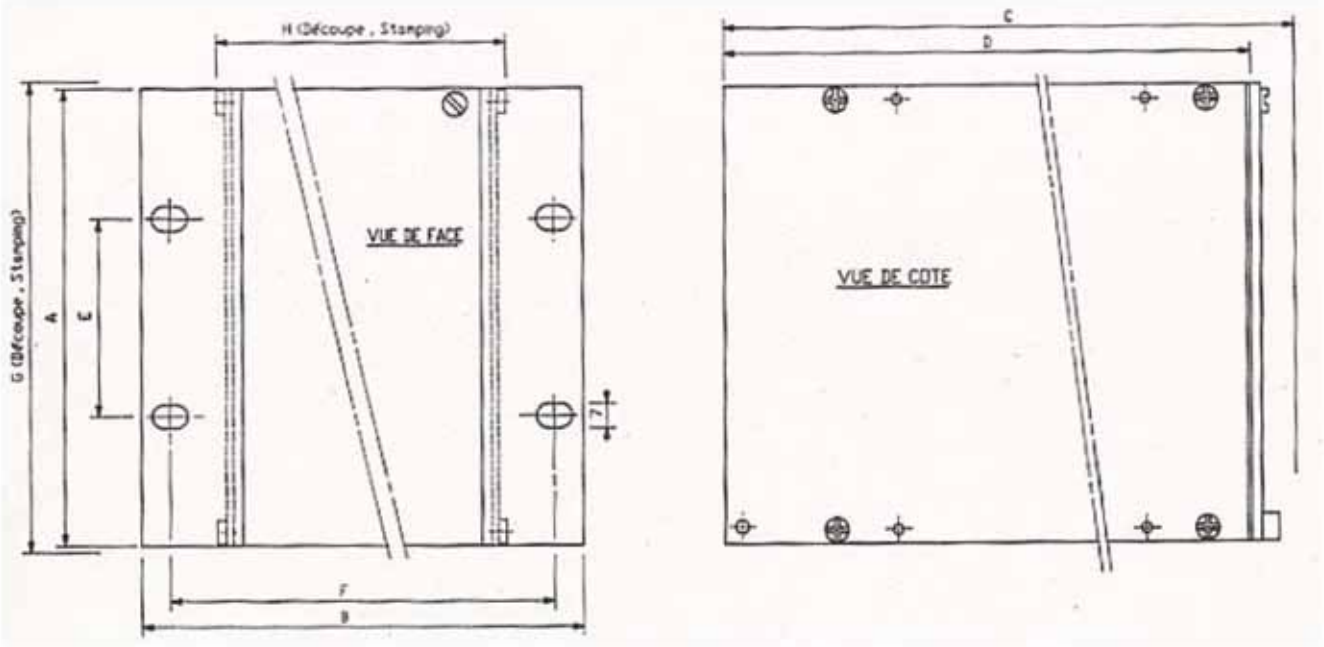
- Performances :
  Regulation accuracy: ± 1 %.
- Environmental conditions:
  - Operating temperature: 0°C to + 50°C.
  - Storage temperature: - 20°C to + 70°C.
  - Relative humidity: 0 to 92% non condensing.
- Compliance and standards :
  - The RG750 was developed to comply to EDF CPC June 1972 & revision D421 PR / AG & DF 312 April 1981
- Cases

Dimensions (mm)	Projecting mounting	Flush mounting
A	190	132,5
B	493	483,0
C	238	255,0
D	178	225,5
E	14	57,1
F	465	466,0
G	-	133,0
H	7	443,5

- Flush mounting:



- Projecting mounting:



- Weight: 10 kg
- Wiring: by 107 positions screw terminal.

The specifications and drawings given are subject to change and are not binding unless confirmed by our specialists.

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