

14.5GHZ – 2.2KW CW GENERATOR

GKP 22KP 14.5GHz WR62 3x400V

UTILIZATION OF GKP 22KP GENERATOR

With its characteristics of **power stability** whatever the load, very fast **response time** at a pulse, low **ripple**, **spectral quality**, **degree of protection** and **reliability**, it is a high-performance appliance designed for high-performance applications and particularly for the ions sources.



I GENERAL CHARACTERISTICS

The GKP 22 KP generators comprise in a single cabinet housing the power supply and the RF circuits. The cabinet can be easily transported by a pallet or fork-lift truck.

All the generator circuits are readily accessible through doors on all 4 sides. The front face features the HMI (Human Machine Interface) touch screen, 8" colored PRO-FACE. They can be mounted on high-voltage platforms for ion sources. All these generators are fully remotely controllable (Ethernet, RS232 RS485..).

Generator is equipped with a klystron tube mounted in an amplifier arrangement, driven by low-level circuit referenced to a dielectric resonator oscillator (DRO). Solid state circuit is filtered with inter stages isolators to maintain **frequency stability**.

Stability of forward power over time is ensured by:

- The principle of measurement of forward power, which is reliable whatever the phase or amplitude of the load VSWR.
- Regulation of forward power by a high-speed electronic circuit from an accurate internal reference of exact 10 V, and the static gain of the open-loop comparator.

Power level is set through the electronic circuitry by means of a PIN diode attenuator in the low-level circuit. This electronic circuitry guarantees:

- A very low ripple factor
- An very short response providing high performance pulse
- Minimum rise and fall times without overshoots (μs)
- A dynamic power adjustment range of more than 30 dB.

The most critical **generator systems** are also controlled by a specific electronic circuitry:

- The klystron is protected against reflected power by an isolator and through an electronic circuit which acts when reflected power reaches 500W (adjustable level from 0 to 500W). The electronic circuit then reduces the forward power level to the necessary level in a few microseconds. There is no power cutoff. The reflected power measurement system therefore gives reliable values, whatever the VSWR level and its phase.
- A second reflected power security circuit after klystron switch off power (in case of fault in 1st system)
- The generator microwave components are protected by the electronic speed cutoff if arcs are detected in the waveguide.
- The electronic circuitry also controls anode and klystron body current limiting, as well as all the standard safety mechanisms (cooling, temperature, filament, etc.).

The **high-voltage power supply** is a resonant switch mode circuit. The switching frequency is from 80 KHz to 35 KHz depending on output voltage and current. The ripple is very low.

High voltage is adjustable and maintained constant, whatever the mains power fluctuations, by the controller. This system ensures a very gradual rise to high voltage, which helps increase the service life of the klystron. Furthermore, when the klystron is first started, the successive phases in the rise to high voltage to form it will be easily obtained from the HMI. HV value is displayed.

The high-voltage power supply module is protected against short circuits and opened circuit.

The **DC filament supply** is voltage and current controlled with a “squared” function. The control electronics (linear) ensures a total absence of ripple.

As the cathode is at the potential of the high voltage, this assembly is integrated in an isolated high-voltage unit on which the filament current / voltage values can be read (display control visible when

door is opened). This filament information isn't coming to HMI

II TECHNICAL CHARACTERISTICS

- Klystron : type VKU-7820A12 (CPI)
- Frequency : de 14 GHz to 14.5 GHz, 14.5 GHz usually
As this generator is an amplifier driven by DRO (dielectric resonator oscillator) the exact transmission frequency must be specified with your order. The *frequency stability reaches ± 1 MHz for a temperature variation of $\pm 10^{\circ}\text{C}$.*
- Output power : 2.4 KW typical means 2.2 KW at the generator's output (reduced of 5% by isolator losses). The power value is given for a matching load in continue (CW).
- Ripple factor : < 0.2% RMS at nominal power.
- Power stability : better than 10^{-3} (whatever the time base).
- Rise and fall time : rise time < 3 μs and fall time < 1 μs at full power; overshooting < 5%.
- Generator control : all parameters (analog and logic) and set points (analog and logic) are displayed on a 8" touch screen display. Moreover, all functions are available on RS232, RS485 Ethernet, and analog connector.
- Power control : From 0 to 100%, dynamic range >30dB. To drive in pulse mode, choose a level power, and apply a TTL modulation (0 to 5V) to a BNC off/on socket (input impedance of 50 Ω). This input "chops" the analog level.
- Reflected power protection : by isolator and electronics: over 500 W reflected power, forward power is automatically reduced or shut off (500W can be adjusted and reduced or stopped mode). A extra independent system protection uses a specific coupler and a detector situated close to the klystron and switch off (i.e. the isolator is out of order).
- Analog power parameters : True unfiltered parameters; analog outputs on remote control connector; FP by 0 to 10V voltage for 0 to 100%; RP by 0 to 10V voltage for 0 to 50%.
- Microwave output : on waveguide WR62.
- H.V. power supply : Switch mode technology, 80KHz to 35KHz, efficiency > 94%, 10 KV, adjustable from 2000V to 10000V (preset 8600V on generator control), I_a nom 1.05A.
- Filament power supply : DC, linear, isolated HV, adjustable from 0 to 8 V and from 0 to 4 A (preset at 6.5V and 4.2A); 5mn preheating timer.

Air cooling	: power supply and klystron; klystron flow rate: 600 m ³ /h, air input and output by flange Ø 125 mm above cabinet. Internal control phase order.
Noise	: 75 DBA at 1 meter, without chimney.
Line voltage	: 400 V three-phase + earth 50Hz / 60Hz.
Line consumption	: 11 KVA approx.
Operating temperature	: from 10°C to 35°C ambient
Dimensions / Weight	: Width = 610 mm, Depth = 825 mm, Height = 1770 mm +/-35mm (see drawing next page) Weight= 295 Kg

III. CONTROL DESCRIPTION

For safety, the stop push button stops directly high voltage and microwave.

Display is realized on a color 8 inches touch screen, PRO-FACE system. All the operating and control reports, as well as every possible failure are displayed in clear on this screen. In addition to forward and reflected powers (digital display and bar graph), the power set point is pre-displayed before starting. HV and anodic current and body current are also displayed.

The main control functions on the display panel are the following:

- Starting mode :
 - o Standard mode ON/OFF
 - o Low RF power mode to save klystron time life
 - o Tube forming
 - o Slope mode (0 to 30 s)
- Control mode :
 - o Local, ON OFF & Analog and pulses
 - o Com RS 232 (baud rate, parity adjustable...)
 - o Com RS485 (address, baud rate, parity adjustable...)
 - o Com Ethernet (with Pro-Server EX from Pro-face)
- Reflected power control
 - o Adjustable from 0 to 500W
 - o Disjunction mode or forward power limitation mode (sound signal)
- Various
 - o Fault list, historic
 - o Filament hour counter
 - o PIN code (for restricted access)
- Configuration
 - o Preset and load configuration
 - o Language (English and French, 10 more are possible)

