SCIENCE

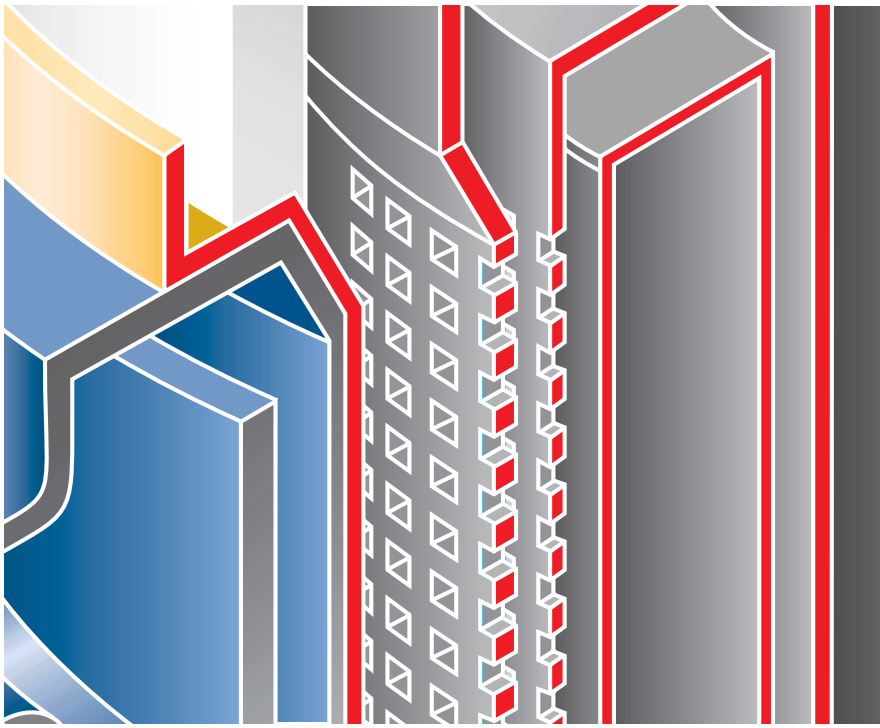
Diacrode®: fundamentals and performance

Diacrode® technology is based on an original development from Thales Electron Devices.

Its fundamentals and performance impact directly on:

- ***power and frequency levels,***
- ***the design of RF amplifiers,***
- ***simplified operating conditions.***

This new generation of power grid tubes offer multiple advantages are summarized in this document.



THALES

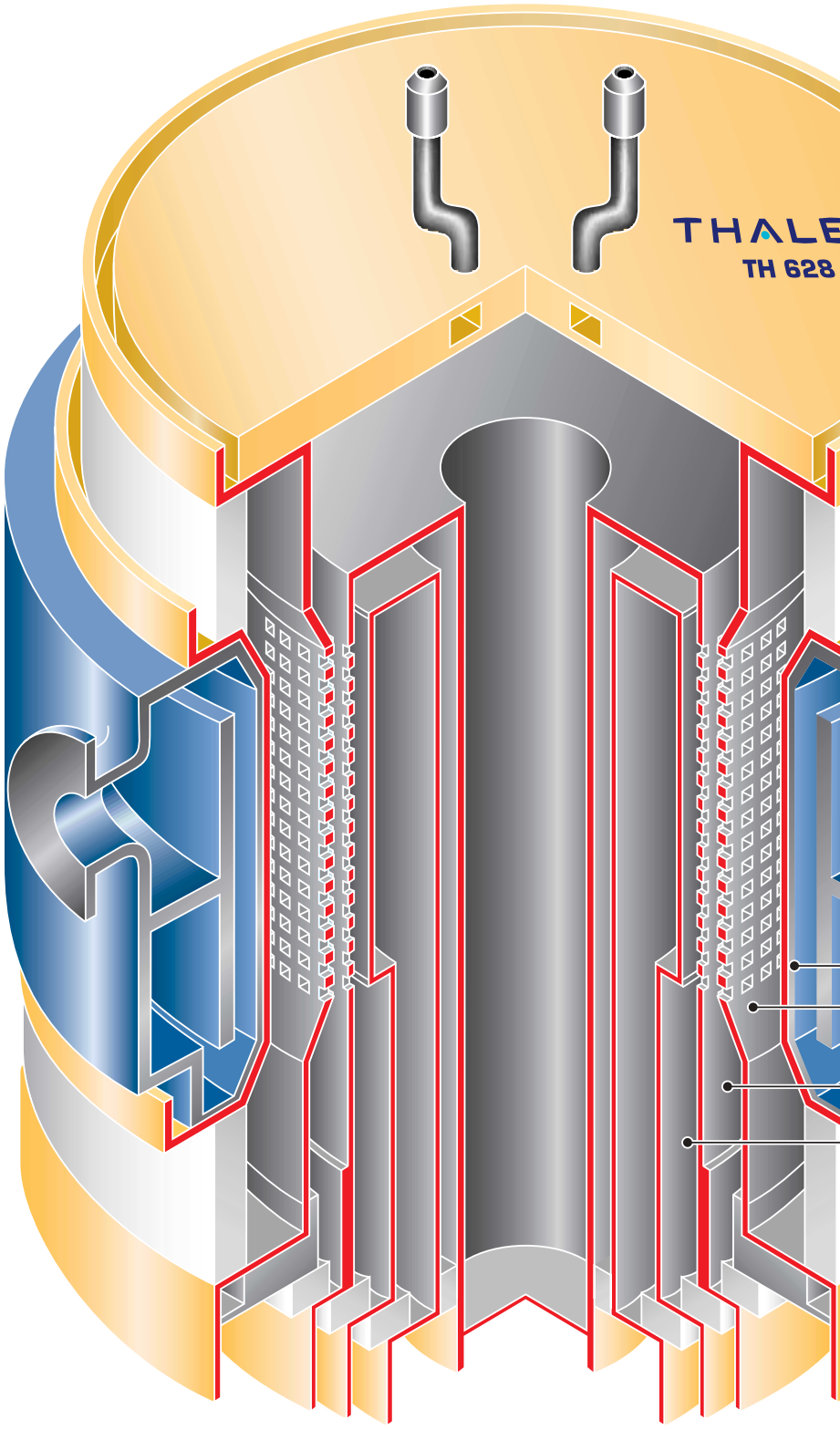
Diacrode®: Fundamentals and Performance

Principle

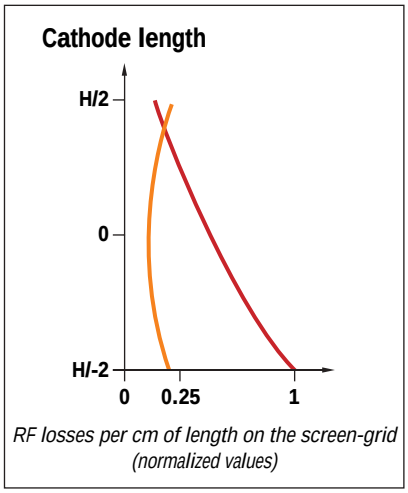
The operating principle of the diacrode is basically the same as that of a Tetrode. The anode current is modulated by an RF drive voltage applied between the cathode and the power grid.

The main difference is in the position of the active zones of the tubes in the resonant coaxial circuits, resulting in improved reactive current distributin in the tube's electrodes.

Water-cooled Diacrode cross-section



Exemple of calculated RF losses on the screen grid.



RF losses per cm of length on the screen-grid (normalized values)

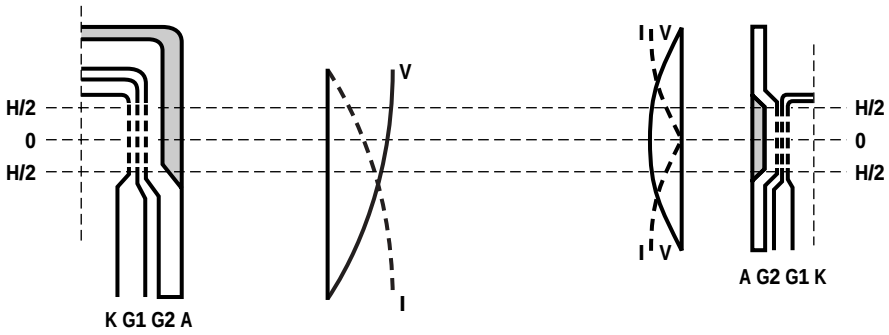
DIACRODE

TETRODE

Same cathode length
Output power: 1.4 MW cw
Frequency: 120 MHz

The Tetrode is located at the end of a quater wavelength, theoretically at the current node side. As soon as one tries to increase power and frequency, many effects come into play which limit the power output. In particular, design constraints raise the tube inner-end capacitances. Because of these and the short wavelengths, the active zones of the tetrode are no longer at the current node side.

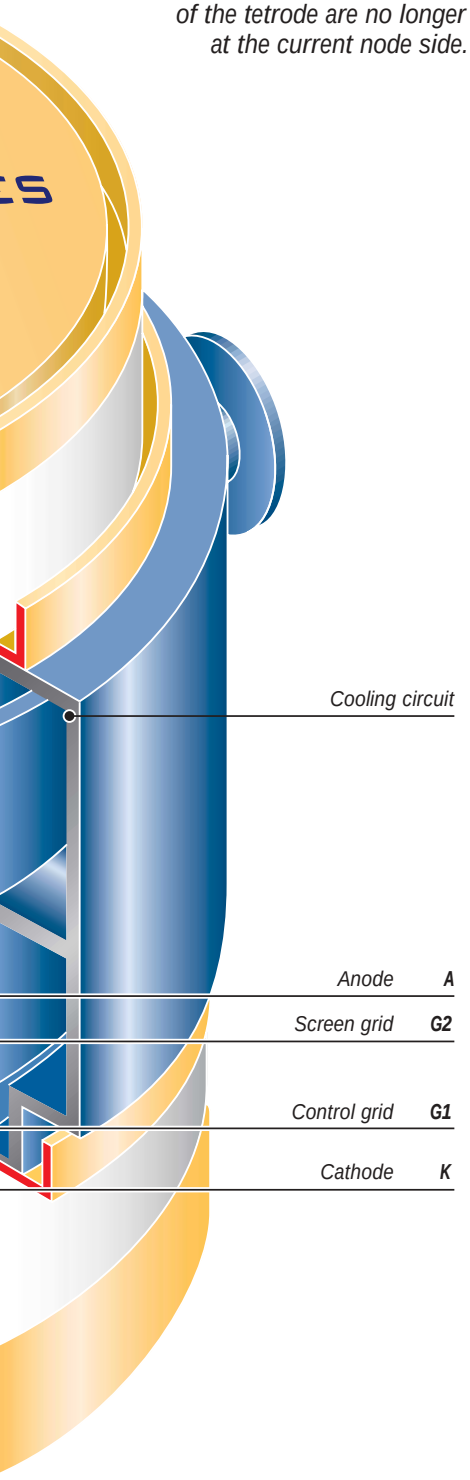
Tetrode to Diacrode evolution



Tetrode 1 MW - 100 MHz

Diacrode 1 MW - 200 MHz

The Diacrode is located at the middle of a half wavelength and thus the current node and the voltage anti-node are situated at the center of the cathode/control grid and screen grid/anode space.



The Diacrode®: higher performance for easier transmitter design

The basic Diacrode design limits electrical losses and electrodes heating by minimizing the reactive curents in the catode and grids meshes. This means tha compared with conventional tetrodes, Diacrodes can either double the output power at a given operatiing frequency or double the frequency for a given power output. Diacrodes provide the same gain and efficiency as conventional tetrodes - but at frequencies wich are out of reach for tetrodes at an equivalent output power.

The TH 628 testing facility

The result is a single tube able to deliver the high average or CW power required, without the need for a comining device.

Thales Electron Devices can also supply fully-matched cavities, ensuring that transmitters realize full performance potential.

TH 628

The TH 628 is a high power RF water cooled Diacrode design for an RF amplifier.

TH 680

The TH 680 is a 50 kW CW water cooled Diacrode for UHF amplification.

The Diacrode® will help you meet the scientific challenges of the 21st century

Diacrodes, while maintaining the high efficiency an gain of conventional tetrodes, operate at higher frequency and power levels (power by frequency product attainable).
This means a single tube is able to deliver the high average or CW power required to upgrade existing pulsed accelerators, or cope with the CW RF requirements of the next generation of high-current hadrons accelerators, as well as auxiliary heating in thermonuclear fusion projects. Diacrodes also featrue easy adjustment an increase stability, thanks to the specially designed RF cavities sus as the TH 18628 and the TH 18680.

At a given level of performance, a single tube makes the entire RF system much simpler, since it reduces the requirements for power supplies, connectins, safety devices and recombining.
This mean the system is less expensive to acquire and operate while also providing higher reliability for greater machine availability. Diacrodes join Thales Electron Devices's comprehensive family of power tubes, including tetrodes, IOTs, klysrons and gyrotrons. Covering an extremely wide range of technologies and performance levels, Thales Electron Devices provides the frequency and power solutions needed for all types of scientific applications.

For further information, please contact:

THALES ELECTRON DEVICES

2 bis, rue Latécoère - 78941 Vélizy Cedex - France
Tel: + 33 1 30 70 35 00 - Fax: + 33 1 30 70 35 35 - www.thales-electrondevices.com

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