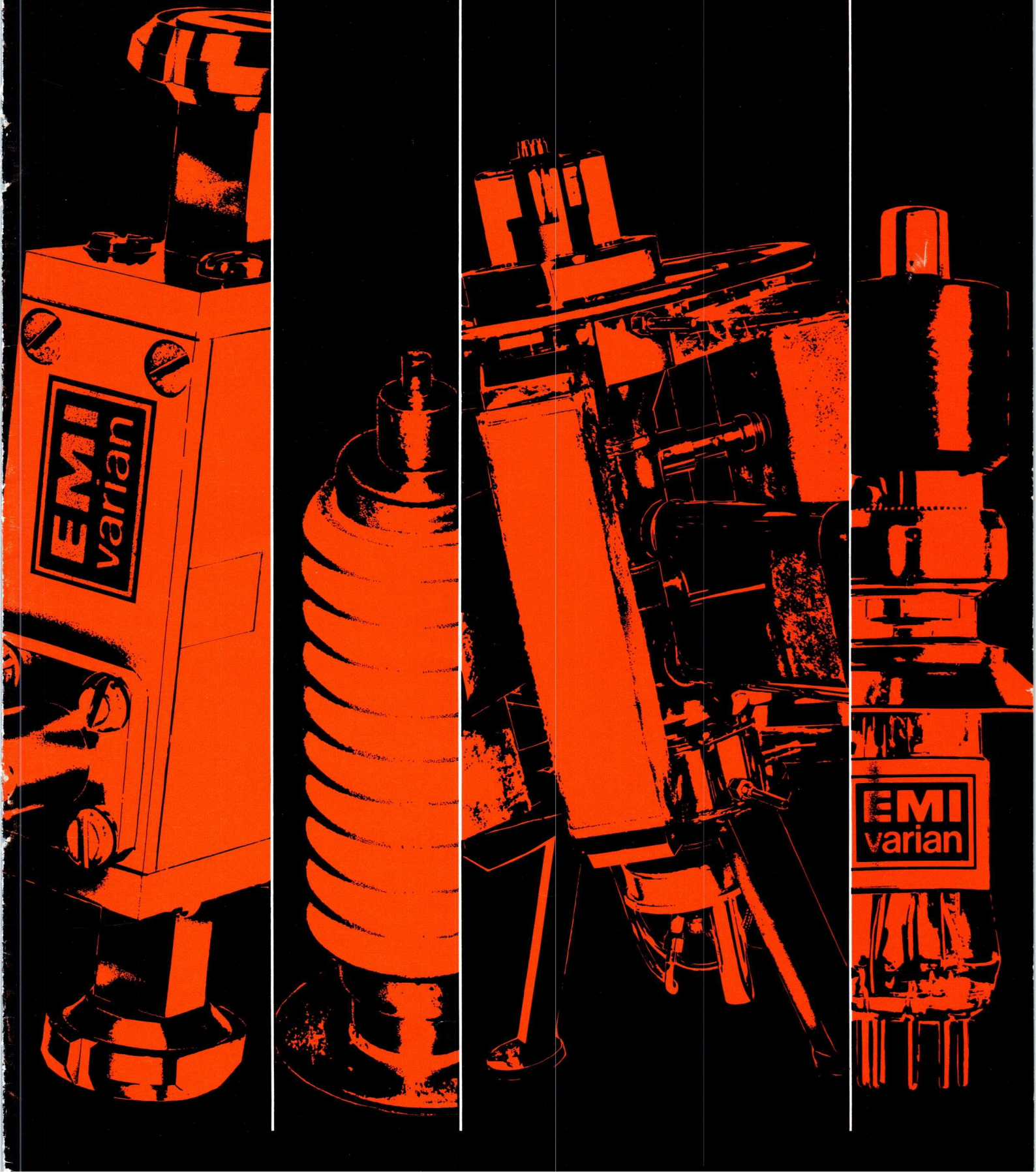
MICROWAVE PRODUCTS and CERAMIC COMPONENTS

EMI varian



EMI-Varian Ltd

EMI-Varian Ltd. was formed as a result of an agreement between EMI Ltd. of U.K. and Varian Associates of U.S.A. to pool their research, technology and manufacturing resources, with respect to microwave tubes and associated devices.

Both companies have vast experience in micro-wave and power tubes and associated components and together can offer a wide range of products backed by unrivalled technical know-how.

EMI-Varian Ltd., markets in the U.K. the products of the following Divisions of Varian Associates:

Bomac Division, Beverly, Massachusetts.
Eimac Division, San Carlos, California.
LEL Division, Copiague L.I., New York.
Palo Alto Tube Division, Palo Alto, California.
TWT Division, Palo Alto, California.
S-F-D Laboratories, Inc., Union, New Jersey.
Solid State Microwave Division, Beverly, Massachusetts.
National Electronics Inc., Geneva, Illinois.
Varian of Canada Ltd.

Varian Associates products available through EMI-Varian:

Reflex klystrons
2-Cavity klystron oscillators
Backward wave oscillators
Magnetron oscillators
Crossed-field amplifiers
Klystron amplifiers
Travelling wave tubes
Solid-state products
Microwave components
Microwave mixer-preamplifiers
R.F. amplifiers, converters and components
I.F. amplifiers and components
Strip transmission line components
Pulse modulation receivers

This short form catalogue describes some of the product lines manufactured by EMI-Varian Ltd.

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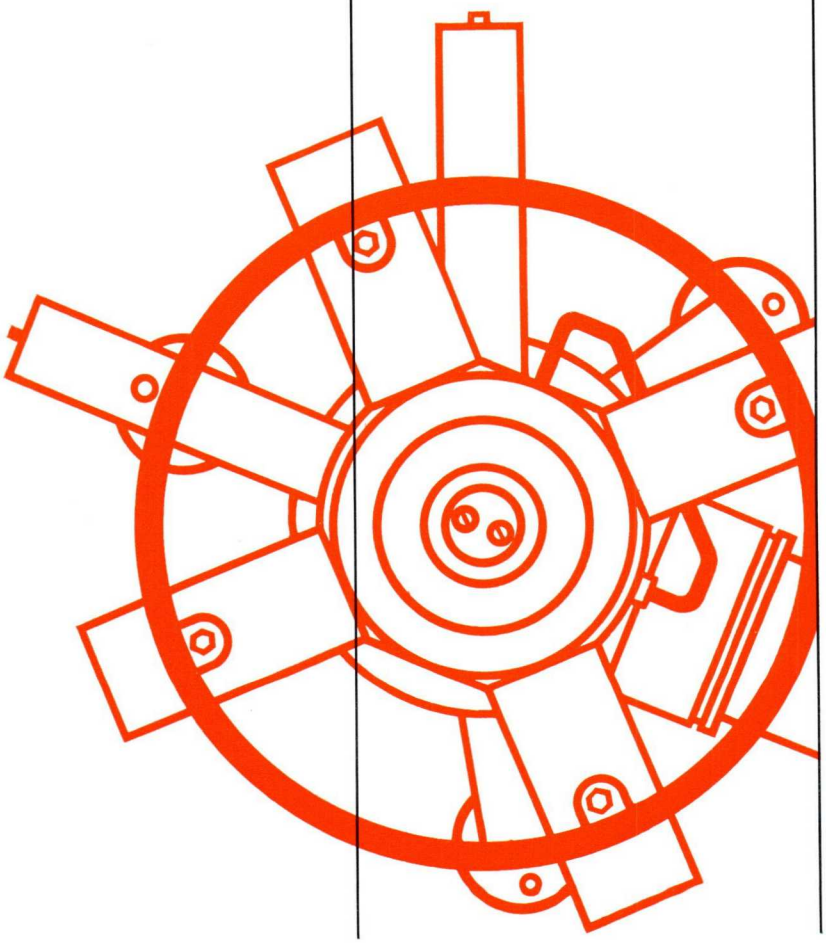
HIGH POWER KLYSTRONS AND TRAVELLING WAVE TUBES

With its integrated resources for research into microwave power devices and its enlarged production facilities EMI-Varian Ltd. can not only meet the currently increasing demand for this type of equipment but also cope with the rapidly developing requirements in design.

By utilising new design techniques evolved in its research departments the company can manufacture a wide range of high power microwave amplifiers such as klystrons and travelling wave tubes together with their associated devices.

The range of tubes includes particularly lightweight, electrostatically focused, ruggedised klystrons for mobile use as well as electromagnetically focused power amplifiers up to the multi-megawatt level.



PT 1001

The PT 1001 is an 'S' band, water cooled, pulsed, 6 cavity klystron amplifier with electromagnetic focusing. Peak pulse powers of between 4 and 10 MW can be obtained with this tube which was designed for use in high power surveillance and air traffic control radar systems.

The tube microperveance is 1.5, its frequency range 2.7 to 3.3 GHz with an output flat to within ± 1 dB over a 100 MHz bandwidth.

Quantity production has assured a high reliability, but in any case tube repairs can be undertaken at a fraction of the cost of a new tube.

The klystron is supported in a frame carrying panels containing connections for water, air and electrical services.

The klystron is fitted with a built-in getter ion pump for use after movement or during periods of storage.

The gun assembly is immersed in an oil tank and lead shielding is provided around collector and output cavity to reduce X-ray radiation. The maximum radiation permitted with the shielding in position is 0.5 roentgen/hour and extra lead cladding of the tube cubicle could be provided by the user to reduce this still further to an acceptable local level.

The weight of the klystron including coils is 1160 Kgs.

PT 1006

The PT 1006 is a long established, highly reliable 'S' band, water cooled amplifier originally designed as a driver for megawatt amplifiers.

It is currently supplied to several universities and atomic energy research establishments in the U.K. and overseas. Use of the tube is also being made in the assessment of the efficiency of experimental radars.

This klystron has a large degree of versatility as it can provide pulse power outputs of between 20 and 200 kW peak, with an efficiency of at least 25% in narrow band operation.

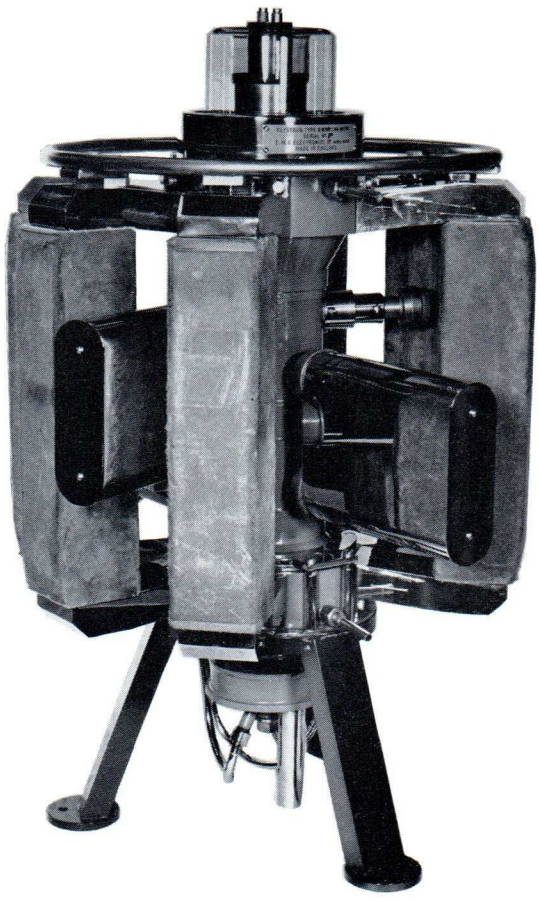
The tunable frequency range is 2.7 to 3.05 GHz.

A tube life in excess of 6000 hours has been obtained in several applications. Long shelf life is also obtainable provided the klystron is run up for a short period every 3 months.

Although normally a 4 cavity tube, 5 cavity versions could be made available to special order giving an increased gain for broad bandwidth applications.

The input RF is applied via a 50 ohm co-axial connection, the output is a WG 10 waveguide with a circular plain flange.

The weight of the tube is 57 Kgs including permanent magnets.



PT 1010

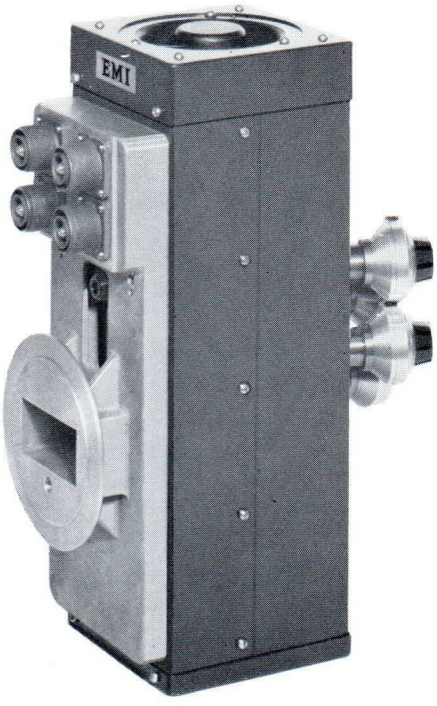
This electrostatically focused klystron, basically designed for mobile applications, is a compact, ruggedised, microwave amplifier, operating in 'S' band. 4 or 5 cavity versions are available, anode or cathode modulated, air or water cooled, without the normal weight and size penalty of the electromagnetic or permanent magnet focused equivalent.

The PT 1010 series have pulse power outputs of up to 2.5 kW when anode modulated, and up to 10 kW when cathode modulated.

The tunable frequency range is 3.1 to 3.4 GHz with a maximum of 200 MHz for any one tube.

Additional benefits are the lack of magnetic interference and absence of any coil supply requirements.

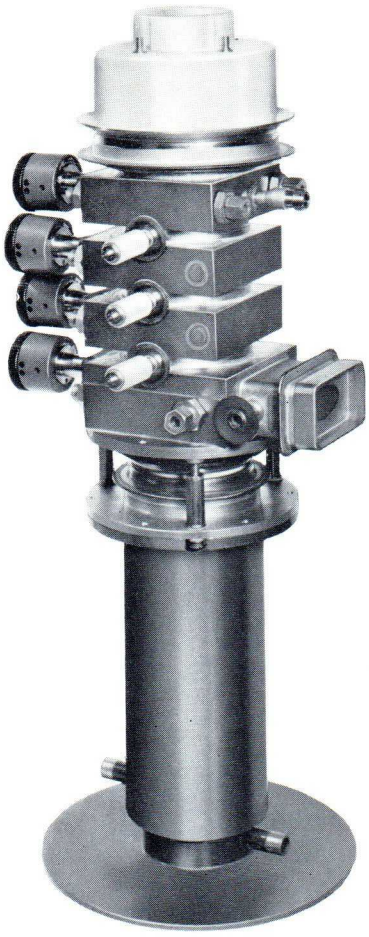
The basic weight varies slightly dependent upon the particular requirement but is of the order of 5 Kgs.



PT 1016

The PT 1016 is basically designed for lightweight operations. It is an 'S' band, water cooled, pulsed, 4 cavity klystron amplifier with electrostatic focusing. It has a peak power of 20 kW with an anode voltage of 30 kV and peak current of 2.5 A. The gain is 45 dB and duty cycle 0.5. Tunable over 200 MHz within frequency limits 3000—3500 MHz.

The weight of this tube is approximately 45 Kgs dependent upon mounting arrangements.



PT 1020

The PT 1020 is a C band, water cooled travelling wave tube with electromagnetic focusing. It was originally designed for use with high power, pulse compression or pulse coded radar systems.

The tube consists of a clover leaf type of coupled cavity slow wave structure. Input and output couplings are by waveguide.

The tube is severed to prevent instability but instead of internal loads at the severed ends of the slow wave structure the terminations are coupled to two more waveguides which are connected to external waveguide water loads.

The system ensures that the tube will withstand large mismatches in the output line and the resultant backward wave in the slow wave structure will not burn out the load.

A maximum of 4 MW output can be obtained and the frequency range is 5.35 to 5.85 GHz

The total weight of this tube is 204 Kgs including coils and lead shielding.

PT 1024

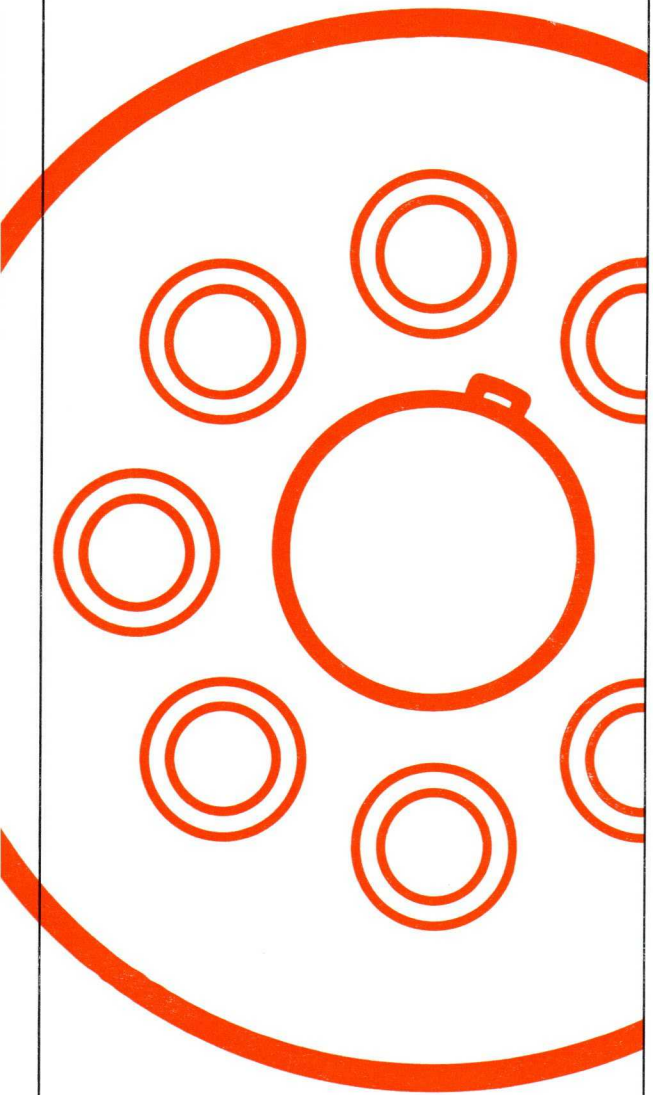
The PT 1024 is an L band, water cooled, pulsed, 4 cavity klystron amplifier with electrostatic focusing. Its peak power is 100 kW with an anode voltage of 45 kV and peak current 9 A. The bandwidth is approximately 0.5% and the duty cycle .05. This model is tunable between 1200 and 1400 MHz.

The weight of this tube, dependant upon mounting arrangements is approximately 60 Kgs.

REFLEX KLYSTRONS AND CAVITIES

The EMI-Varian range of reflex klystron oscillators offers the user virtually complete low-power frequency coverage from 1 GHz to 40 GHz. Higher power tubes are available in the 4 mm and 7 mm communication bands. Applications include radar, communications, education and research.

EMI-Varian research and production experience has ensured a high degree of reliability for these products, all of which are fully guaranteed.



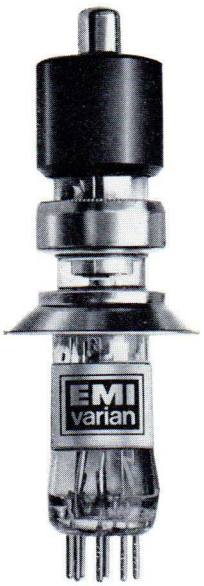
MILLIMETRE KLYSTRONS

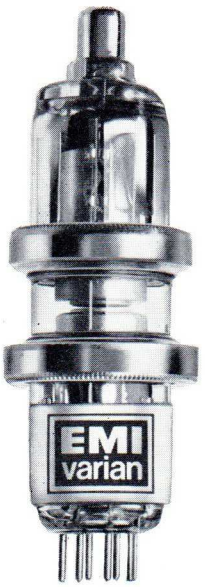
A series of 2 kV tubes covers the frequency range 12.4 to 40 GHz. They are all of metal construction with integral cavities and indirectly heated cathodes. The tuner is of unique design and gives excellent frequency stability and freedom from microphony.

Developed from the 2 kV tubes is a series of 2½ kV tubes. Operation at 2½ kV has been made possible by improved manufacturing techniques and better internal insulation. They typically give about ¼ watt and are tunable over 5% in their respective bands.

PLUG-IN KLYSTRONS

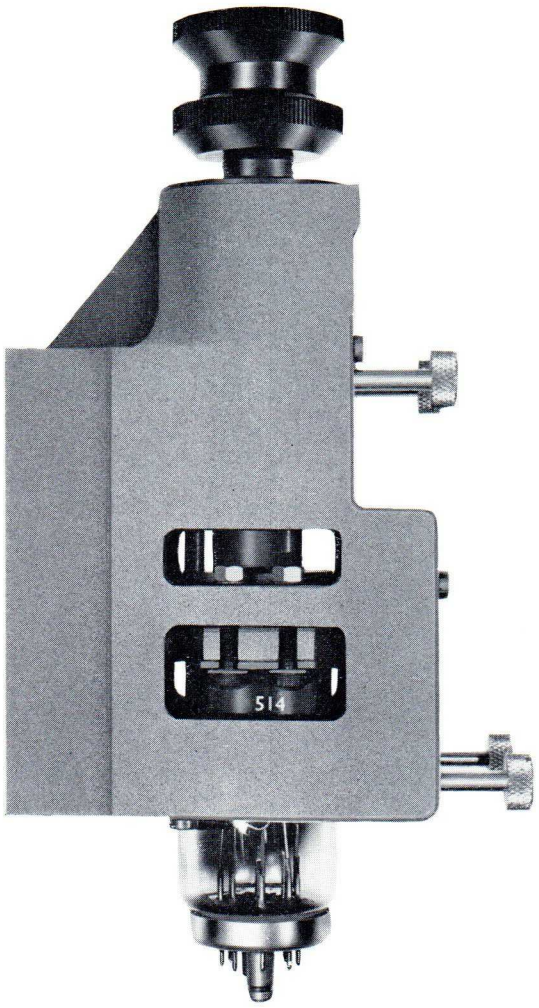
The EMI-Varian range of plug-in klystrons covers the frequency range 1.0 to 11.7 GHz. Included in the range are both commercial and military types. The plug-in klystron enables manufacturers to design their own cavities to fit systems or to give emphasis to one or more parameters which may be of importance in a particular application.





KLYSTRONS FOR MICROWAVE LINKS

A series of five 2-watt transmitter klystrons cover the frequency band 6875 to 7800 MHz each with a tuning range of 250 MHz. These tubes have a waveguide output system which connects to WG 14 waveguide. In the 7 cm band a transmitter tube gives 3½ watts over the range 4400 to 4800 MHz. A similar local oscillator gives 150 mW over a similar range. All of the tubes have integral cavity resonators and are ideally suited for television links where reliability and long life are of paramount importance.



KLYSTRON CAVITIES

This range of wide band cavities covers the frequency range 2.6 to 11.7 GHz. The valves used are the R9559, R9696 and R9701. The latter two are developments of the R9689 having spring contacts attached to the reflector copper.

The cavities are all of the capacity screen type and are tuned using a micrometer head. A high degree of resetting accuracy is obtainable and once the cavity has been calibrated a wavemeter is rendered unnecessary for many applications.

METAL CERAMIC SEALS

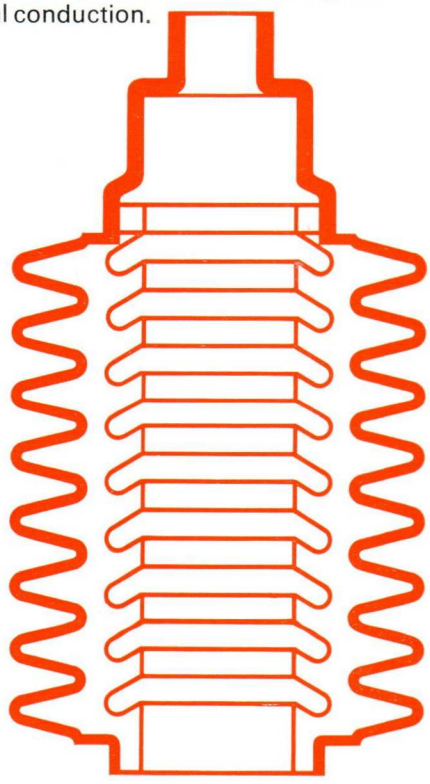
Where leak-tight, high-vacuum components are required to withstand high temperatures, the glass parts of vacuum enclosures are the first to fail and the temperature must be kept below 470 °C, the softening point of the most commonly used sealing glasses. For many modern tubes higher temperature baking is desirable and this has led to the use of ceramic components.

The use of ceramics in place of the conventional glass assemblies allows more accurate construction, better mechanical strength, higher power densities, improved compactness, better thermal and mechanical shock properties apart from improved assembly techniques.

A variety of metallising methods have been developed to produce a satisfactory bond to the required metal for almost any type of ceramic, at the same time matching the thermal expansion of the materials in order to avoid residual strains. Another important factor is the need for consistency of composition in the ceramic and components to ensure reliable seals.

The principal use of metal ceramic seals is in insulators for various parts of microwave tubes, such as target seals, co-axial input loops, gun terminals and getter ion pump terminal insulators. These metal ceramic components can be readily joined to other parts of the tube by argon arc welding or brazing.

High power output windows are also produced in various shapes and sizes including cones and flat discs. For these alumina ceramic is generally used but beryllia can also be used particularly where special power handling conditions require a material with higher thermal conduction.



TERMINALS

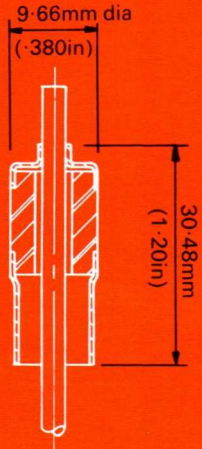
With the exception of some special types terminals are classified in four groups according to the potential they are designed to withstand, i.e. up to 2, 20, 50 or 100 kV.

The terminal parts are in most cases interchangeable and various sizes of caps and support flanges are available. In this way a specific terminal may be selected for specialised applications and supplied by EMI-Varian with minimum delay.

Due to the widely differing coefficients of expansion of alumina ceramic and stainless steel at high brazing temperatures, the stainless steel is not brazed directly to the alumina. A buffer material of nickel-iron such as vacon, which has a similar coefficient of expansion to alumina is used and stainless steel parts are then brazed or welded to the vacon if required.

Small ceramic terminals up to 2 kV
PTC 1040 series.

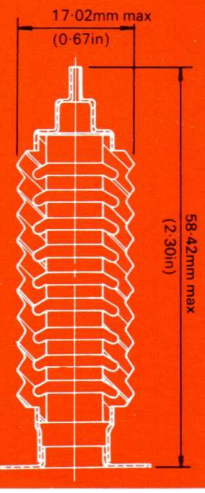
No. PTC 1042, a typical example from the PTC 1040 series of 2 kV terminals. Both plain and corrugated ceramics are available in this group.



Medium ceramic terminals up to 20 kV
PTC 1060 series.

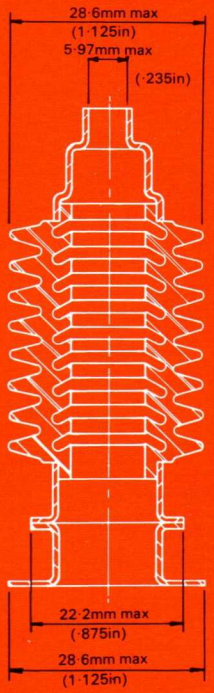
No. PTC 1063

An example from the PTC 1060 series of 20 kV terminals. Both plain and corrugated ceramics are available in this group.



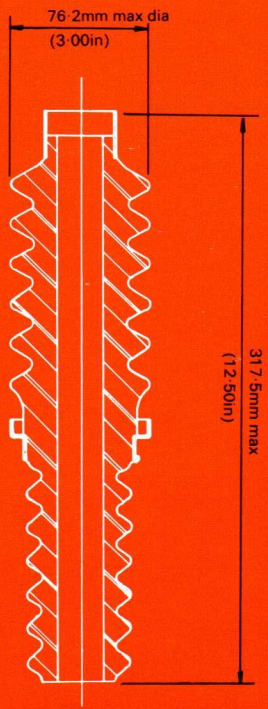
Medium ceramic terminals up to 50 kV
PTC 1070 series.

No. PTC 1071, with stainless steel pedestal brazed to Vacon 70, one of the PTC 1070 series of 50 kV terminals.



Large ceramic terminals up to 100 kV **PTC 1080 series.**

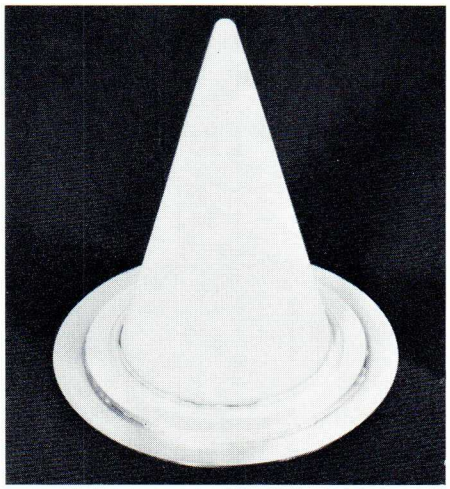
Typical 100 kV terminal in the PTC 1080 series with alumina ceramic corrugated for increased dielectric path.



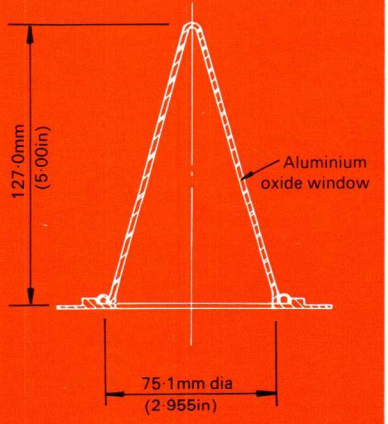
MICROWAVE WINDOWS

A particular application for ceramics is high-power microwave windows which allow power to pass from the vacuum of a tube to the external transmission line.

Because of the high r.f. voltages existing in the region of such a window, electron and occasionally ion bombardment of the window can occur, thus allowing a build-up of charge on the surface in addition to possible direct damage from the bombardment. Both the high dielectric strength and thermal shock resistance properties of ceramics are required in this application.



PTC 1100, one of the range of EMI-Varian high power microwave windows. The material is Al_2O_3 (98.5%). Sealed via Vacon 70 to Nilo-k.

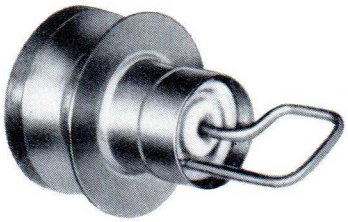


CO-AXIAL LOOPS

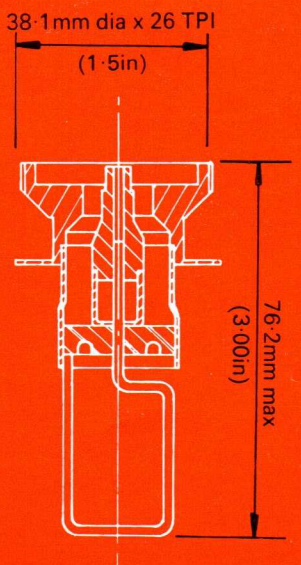
A standard range of vacuum sealed coupling loops for microwave applications is available. These are bakeable up to a temperature of 600 °C.

The insulator is aluminium oxide which is brazed to a stainless steel welding flange via Vacon 70 with a silver copper eutectic.

Although listed as standard sizes the loop wire dimensions of EMI-Varian co-axial loops may be altered to suit particular applications.



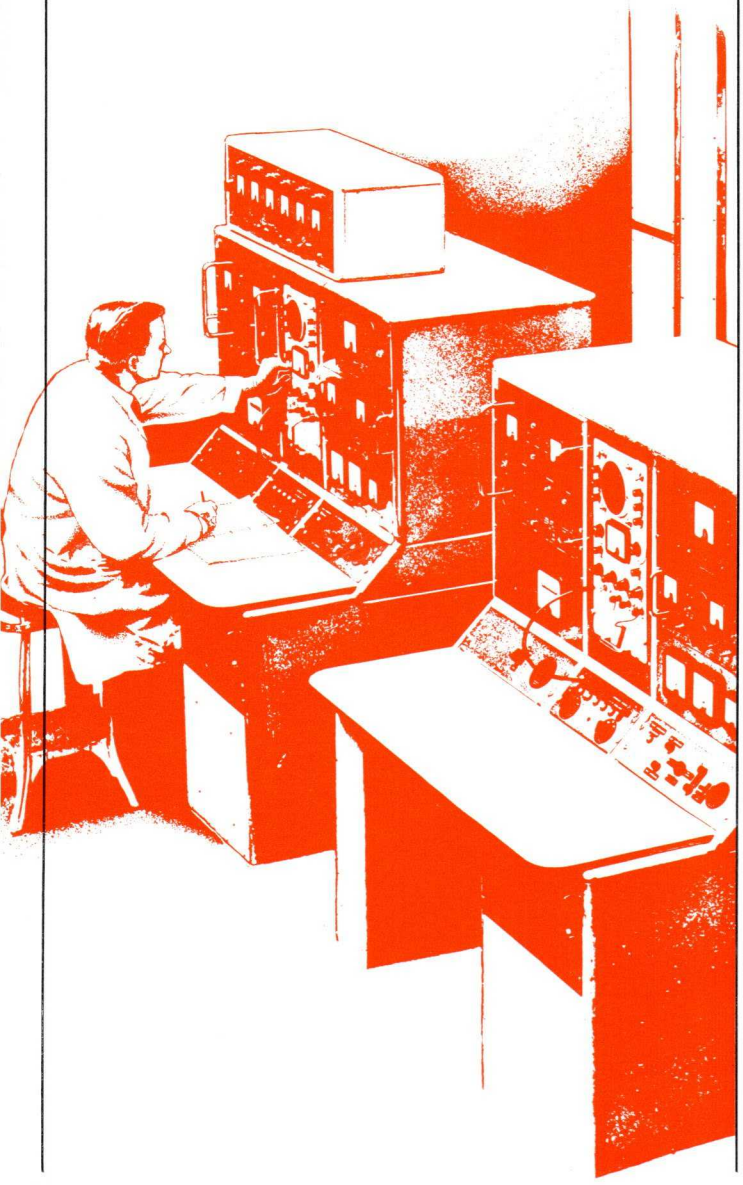
One of the co-axial loops in the EMI-Varian PTC 1090 series standard range.



POWER SUPPLIES AND MODULATORS

EMI-Varian Ltd. are able to design and manufacture a range of power supply and modulator units to customers' requirements for particular application in the high power field.

A typical power supply and modulator with control console is shown in operation below.



SOLID STATE DEVICES

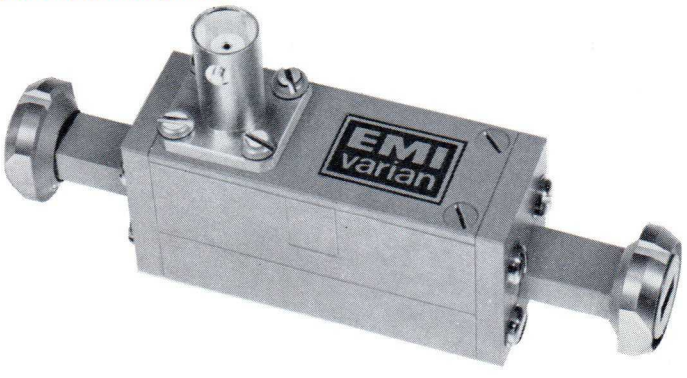
EMI-Varian Ltd. offer a range of solid state sources and frequency multipliers in the frequency range 600 MHz to 12 GHz.

The devices described in this section are those manufactured for particular applications, but with its widely based technological resources EMI-Varian can produce variations and special designs to meet most engineering needs.

P·I·N Diode Attenuator TYPE 2640

A p-i-n diode attenuator comprises an array of diodes mounted as shunt elements in a transmission line. At microwave frequencies a p-i-n diode behaves as a resistor whose value is determined by its d.c. bias current. By incorporation in an appropriate microwave circuit a broad-band electronically controlled attenuator can be produced having a modest control power requirement.

In the designs in this series the frequency of operation of p-i-n diode attenuators has been extended to 40 GHz and a unique range of wide-band components for J, K, and Q bands has been developed. A typical application is the control of wide-band pump power for a low noise parametric amplifier.



S-Band Crystal Controlled Oscillator TYPE S 30,000

This solid state source of high frequency stability and rugged construction consists of a crystal controlled oscillator operating in the 100—150 MHz range, followed by stages of amplification and frequency multiplication. A step-recovery diode is used to give a typical power output of 500 mW at discrete frequencies in the S-band. Variants type S30,000A can be made for the range 3.0 to 3.5 GHz giving very low f.m. noise.

X-Band Solid State Source TYPE S 30,003

This voltage-tuned solid state source of rugged construction consists of a varactor-tuned transistor oscillator operating at U.H.F. coupled to a step-recovery diode harmonic generator and waveguide filter.

Three frequency variants are available in the range 8.5 GHz to 9.6 GHz, each electronically tunable over 400 MHz.

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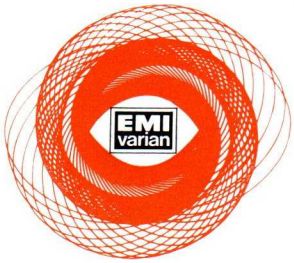

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