

Microwave Power Generators

Velocity Modulated Oscillators

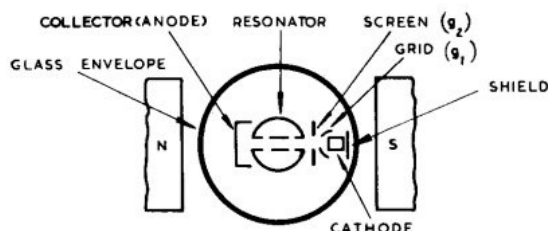
Since 1939, a comprehensive range of single transit coaxial line oscillators (Heil tubes) has been built up covering the frequency range 0.9–6 Gc/s. Types are available having wide mechanical or electronic tuning, wave guide or coaxial mounting, or any combination of these features.

The principle of operation is best explained by reference to the diagram below which shows a cross-section of the tube structure. An electron stream is accelerated from the cathode by the screen and is focused by the grid and magnet into a beam. The beam traverses the two interaction gaps in the resonator and is collected by the anode. The resonator is, effectively, a section of coaxial line with a hollow centre conductor. Interaction occurs between the beam and the field between the centre and outer conductors. The frequency is determined by the cavity to which the structure is coupled and by the potential difference between resonator and cathode. Variation of this potential difference affords a means of frequency modulation.

Application of the screen grid voltage in pulses provides the facility for square wave amplitude modulation. Constant output may be achieved by providing a means of adjusting the screen voltage to keep the cathode current constant.

STC microwave oscillator tubes are designed for long life which is an important requirement in microwave links in which many of these tubes are used.

The letter A immediately in front of the oblique stroke in the Commercial Code indicates a tube designed primarily for wide mechanical tuning range, and similarly the letter C indicates a tube designed for electronic tuning.



Cross-section of tube assembly

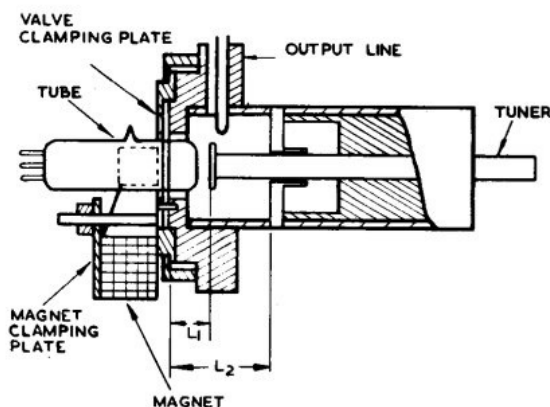
Commercial Code	CV Number	Suitable Cavity	Frequency Range Mc/s	Minimum Power Output W	Resonator Voltage Range V	Cathode Current mA	Minimum Electronic Tuning Range Mc/s
V190C/1M	—	{ 495-LVA-202	500–925	0.25	180	40	±1
V218A/1K	—	{ 495-LVA-203	800–1000	2	180–270	80	±2
V231C/1K	—	—	1700–2000	0.5	200–300	50	—
V233A/1K	2190	495-LVA-252	3060–3180	0.05	180–240	45	±8
V235A/1K	2221	495-LVA-201	2700–4200	0.3	190–380	50–65	±1
V237C/1K	—	495-LVA-226	2700–4000	0.5	190–350	50–65	±1
V238A/1K	5292	{ 495-LVA-251	3560–3820	0.35	225–285	45	±4
V239C/1K	5048		3500–4300	0.55	260–400	50	±1
V241C/1K	5049		3780–4040	0.35	225–285	45	±4
V243A/2FS	5463		4000–4240	0.35	225–285	45	±4
V245C/1K	—		4100–4600	0.75	235–275	65	—
V246A/2K	485		4400–4630	0.2	230–265	50	±8.5
V246C/4K	2422		4580–4860	0.25	200–250	40	±3
V247C/1K	—		4400–4850	0.3	280–360	50	±3
V249C/1K	—		4570–4750	0.2	230–265	50	±8.5
			4760–5000	0.2	240–290	50	±8

* For waveguide output the cavity is type 439-LTA-32A.

The collector voltage is preferably set 10–20 volts above resonator potential. The resonator is usually connected directly to a grounded cavity and the cathode operated at a negative potential. When frequency modulation is required, the resonator may be insulated from the cavity by a mica washer.

"A" TYPES

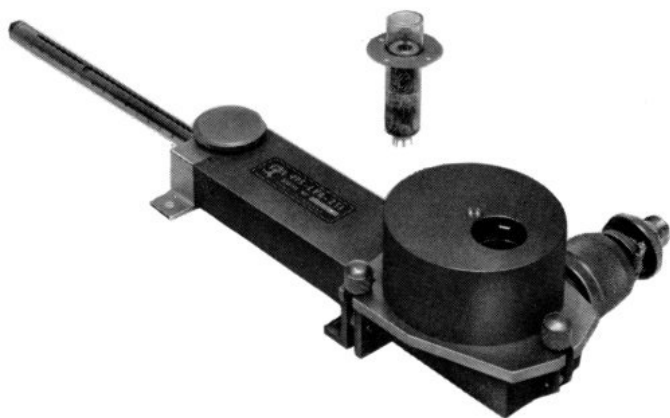
V235A/1K (CV2221)



When operated in the simple recommended coaxial cavity, this oscillator provides a typical power output of more than 0.7 watts and tunes mechanically over the frequency range 2.6–4.1 Gc/s. Its freedom from spurious moding, and ease of tuning, have made it a very widely used and popular tube for laboratory bench work and the many other applications where wide tuning range is required. Power requirements are 175–400 volts at 15 watts. Output is via 50 Ω or 70 Ω coaxial line loop-coupled to the cavity.

The illustration shows the cross section of a typical coaxial line cavity and indicates the dimensions L_1 and L_2 which are critical in determining the resonant frequency.

V238A/1K (CV5292)



A versatile cavity 495-LVA-251 for Coaxial Line Oscillators

This tube is characterized by high power output (typical 1 W), excellent frequency stability in the range 3 560–4 240 Mc/s. For laboratory work it may be used in waveguide cavity 495-LVA-251 which is fitted with coaxial output socket, as illustrated.

The high frequency stability required for Wide Band Systems is achieved by operating the tube, in its tuning circuit, in a temperature controlled oven with carefully regulated power supplies. Under these conditions a long-term frequency stability can be obtained which is better than ± 250 kc/s in the frequency range 3 550–4 250 Mc/s.

V238A/1K is extensively used in radio links operating in many parts of the world.

V243A/2FS (CV5463)



This oscillator tube was introduced primarily for use in the STC Miniature Radio Altimeter in which the tube operates, with a minimum power output of 750 mW, in a waveguide cavity designed for mechanical frequency modulation of ± 50 Mc/s in the band 4 200 to 4 400 Mc/s. If, however, the V243A/2FS is mounted in the waveguide cavity 495-LVA-251 illustrated above the frequency range can be increased to cover 4 100 to 4 600 Mc/s.

The tube is designed to withstand mechanical shock and vibration and to operate in ambient temperatures up to 100°C.

This tube is now fitted with a heat dissipating shield as a standard attachment.

"C" TYPES

V190C/1M

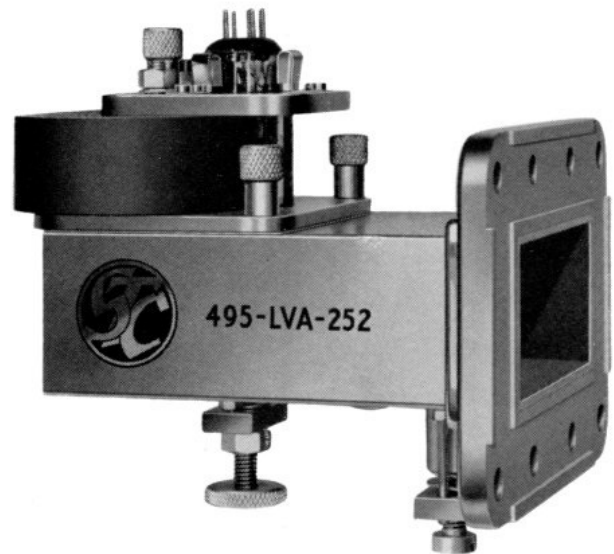
This oscillator tube is unique in having its coaxial line terminated by an open instead of short circuit. Frequency modulation or A.F.C. can therefore be effected by modulating the drift tube potential. The power output over the frequency range 800 to 1 000 Mc/s is over 2 watts and a useful performance at reduced power output is obtainable at lower frequencies down to 470 Mc/s; hence this tube can cover U.H.F. bands IV (470 to 585 Mc/s) and V (610 to 960 Mc/s).

When used in cavity 495-LVA-203, the tube resonator voltage and d.c. drift tube potential is set for the centre frequency required but in the more compact cavity 495-LVA-202 for the lower frequencies the tube is operated at constant resonator potential and electronic tuning achieved by variation of the drift tube voltage alone.



V231C/1K

This tube was developed for local oscillator use in S-band radar and provides a minimum output of 40 mW in the frequency range 3 040 to 3 120 Mc/s and may be electronically tuned over a range of ± 10 Mc/s. The inexpensive cavity with which it is used is compact in design and both mechanical tuning and power output control are achieved by simple screw adjustments.



V245C/1K, V247C/1K

V249C/1K

This family comprising three tubes covers an overall frequency range of 4 400 to 5 000 Mc/s. Their comparatively wide electronic tuning range makes them eminently suitable for local oscillator operation or in applications such as frequency modulation at radio frequency, as in multichannel links. This latter

A Simple Waveguide Cavity 495-LVA-252 for V231C/1K

application has been well proven in the field in STC links. These tubes are intended for operation in waveguide cavities feeding directly into systems via matching slugs, and will deliver approximately $\frac{1}{4}$ watt. A cross section of a typical circuit is shown below. If a coaxial output socket is preferred cavity 495-LVA-251 (illustrated on the opposite page) may be used.

