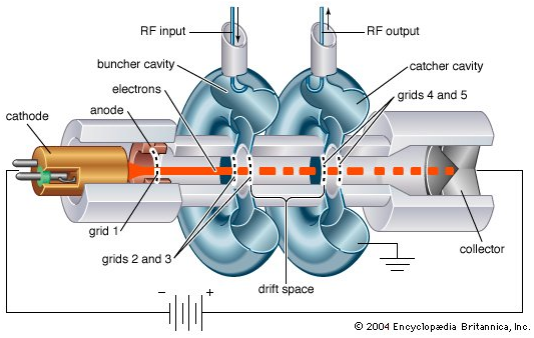
NASDAQ: RELL
PRICE: $13.32
DATE: May 23, 2011

Analysis of Microwave Tube Market

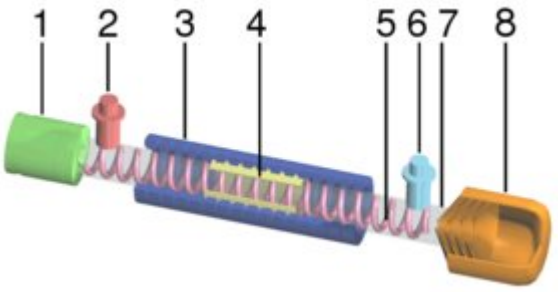
On recent conference calls Richardson has announced its intention to expand further into the microwave tube market under its EDG (Electron Device Group) division including the possibility of bolt-on acquisitions. At present time, microwave-related products represent approximately 18% of its EDG sales, or $20 million. Microwaves are electromagnetic waves with wavelengths as long as 1 meter and as short as 1 millimeter. Consequently, the frequencies are much higher than radio waves, ranging from .3Ghz-300Ghz. The size of conventional electron device tubes must match the size of the electromagnetic wave being produced, so microwaves with short wavelengths and high frequencies would require extremely small electron device tubes which are not feasible. Whereas conventional electron device tubes slow the RF to one-tenth the speed of light, VEDs (Vacuum Electron Devices) allow wave propagation based on different principles without reducing the speed of light. Ultimately these devices are able to generate high frequencies at high power without having the size of the device reduced. VEDs have been in existence since the early 1900's but their use proliferated during World War II due to new demands for radar and communication systems.

The $1 billion microwave market[1] is arguably not well understood and is under-researched. In 1999 the microwave market was $488 million, representing a CAGR of approximately 6-7% through 2010. Surprisingly, this supposed anachronistic technology has proven highly resilient to the threats of its modern day competitor, the semiconductor or solid-state. Even the most advanced semiconductor, Gallium nitride (GaN), is not expected to meaningfully capture market share from VEDs. As the modern electronics world places increasing demands on power, bandwidth, and frequency, the VED has proven superior to semiconductors. The RF (radio frequency) power generated by VEDs within a small space would require tens of thousands of transistors.

Typical VEDs include klystrons, TWTs (Traveling-wave tubes), gyrotons, and magnetrons. Each of the devices has unique advantages based on power and frequency capabilities as well as cost.



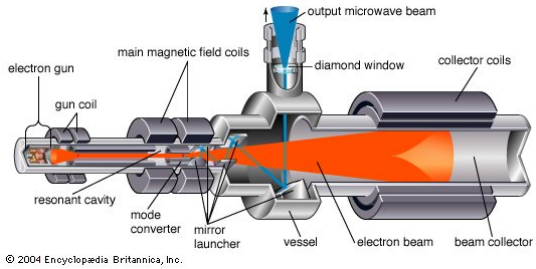
Klystron



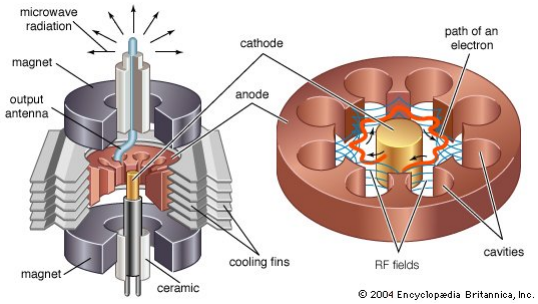
TWT (Traveling-Wave Tube)
1) Electron gun; (2) RF input; (3) Magnets; (4) Attenuator; (5) Helix coil; (6)

[1] ABI Research

RF output; (7) Vacuum tube; (8) Collector.

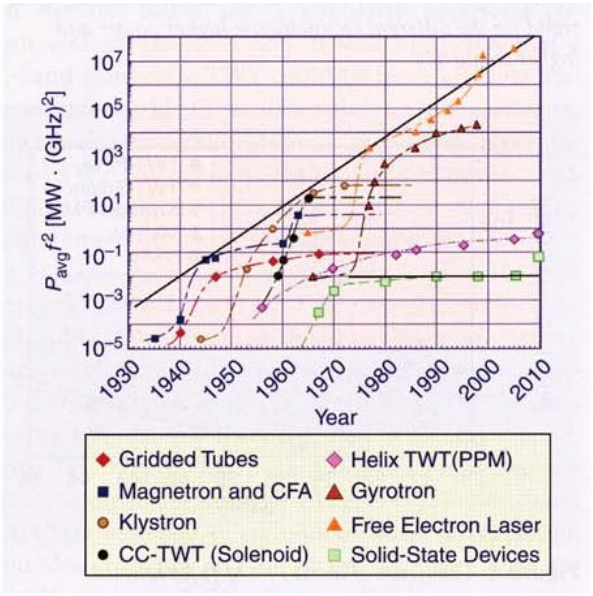


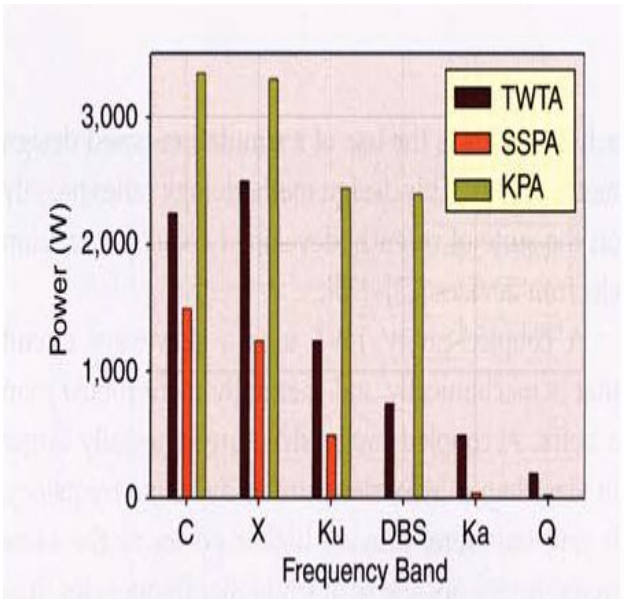
Gyrotron



Magnetron

The graphs below compare the evolution of power and frequency for VEDs vs. semi-conductors through the years in addition to comparing the respective performance for satellite applications.





Typical power of commercial satellite communication high-power amplifiers including traveling-wave tube amplifier (TWTA), klystron power amplifier (KPA), and Solid State power amplifier (SSPA)

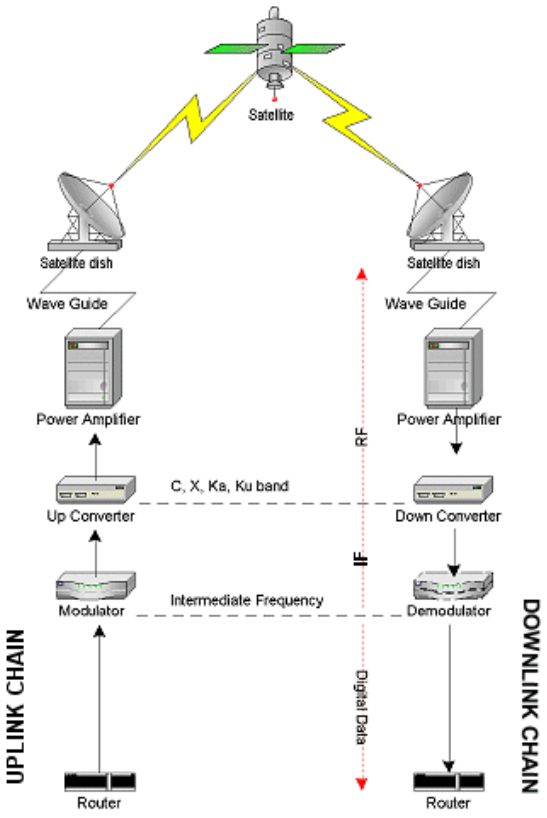
Source: IEEE Microwave Magazine, December 2009

Whereas the company's traditional EDG products are typically sold into such markets as broadcasting and semiconductor wafer fabrication, VEDs are sold into the following markets: radar and electronic warfare, communications, medical, industrial, and scientific. The medical applications are typically for imaging systems such as X-ray, MRI, PET (positron emission tomography), and cancer treatment. The industrial applications include industrial heating, LCD display manufacturing, and semiconductor manufacturing. The scientific uses are primarily related to fusion research. VEDs typically have product life cycles of 3-7 years which creates a stable recurring revenue stream due to replacements, spares

and repairs, and upgraded replacements. The price per unit can range from $2,000-$200,000. Major manufacturers within the industry include CPI International, Ebeam Inc., Northrop Grumman, L-3 Communications, Teledyne Technologies, Thales Components and Subsystems, and Triton. Richardson presently has distribution agreements with some of these suppliers.

Generally speaking, commercial satellites and military electronic applications are the two most significant users of VED microwave technology. The customers for military applications are typically foreign governments and defense departments. In addition to the power and frequency advantages, VEDs are also favored by the military as they are not affected by electromagnetic impulses from nuclear explosions as well as being less noisy which prevents detection.

Satellites require large-signal bandwidth with higher operating frequencies due to the increasing volume of data. VED amplifiers are utilized both in space-based transponders and ground terminals. The schematic below depicts the amplifiers both in the uplink and downlink process. VEDs are also employed in SNG (satellite news gathering) mobile systems, network hubs, and small lightweight flyaway pack systems.



Source: *www.inetdaemon.com*

Within the satellite equipment industry it is common for companies to operate service centers to accommodate the equipment needs of customers. This is consistent with Richardson's announcement

to invest $2-3 million in the opening of 6-8 technical centers. The outlook for capital expenditure spending by commercial satellite operators remains somewhat unclear due to speculation about possible over-capacity from previous years of satellite launches. Regardless, the industry itself remains relatively strong with the continued growth of HD (high definition) and DTH (Direct to Home) satellite television especially in emerging markets and the growth of satellite internet. For the satellite industry, NSR (Northern Sky Research) is forecasting an average annual revenue growth rate of 5.4% for the leasing of satellite capacity through 2019. Specifically, weather satellites are growing significantly within the industry. The estimated $1 billion industry is expected to grow at a CAGR of 19%[2] through 2018 to $4 billion.

As mentioned previously, VEDs have a long history with the military for radar, electronic warfare, and satellite communication. It is estimated that there at least 300,000[3] TWT and other VEDs employed in nearly 300 US defense systems. The military satellite communications electronics market is pegged to grow at a CAGR of 12%[4] from $800 million in 2009 to $2.6 billion in 2020. Most notably, TWT amplifiers are responsible for the quality images submitted by radar systems on the UAV (unmanned aerial vehicles) Predator drones which have proven highly effective in the wars in Iraq and Afghanistan. The radar system can transmit real-time images with a resolution of four inches from 16 miles above the ground despite clouds, rain, and darkness. Despite cuts in defense spending, the worldwide UAV market is projected to double from $5.9 billion to $11.3[5] billion over the next 10 years. Lastly, worldwide military spending increased 5.9% YOY in 2009 despite the global recession.

The table below reflects five-year sales for CPI International, Inc., a major manufacturer of VEDs. The company reports that approximately half of its FY10 sales were for the U.S. or foreign governments for military use. On average 56% of the radar and electronic warfare revenue is recurring vs. 36% for overall sales.

CPI International, Inc.

	FY06	FY07	FY08	FY09	FY10
Sales (in thousands)	$339,717	$351,090	$370,014	$332,876	$360,434
YOY % growth		3.3%	5.4%	-10.0%	8.3%
Radar and Electronic Warfare	$146,700	$144,200	$151,800	$135,900	$131,600
% of Sales	43.2%	41.1%	41.0%	40.8%	36.5%
Communications	$106,700	$112,300	$117,800	$106,400	$124,000
% of Sales	31.4%	32.0%	31.8%	32.0%	34.4%
Medical	$57,600	$67,600	$65,800	$61,200	$70,200
% of Sales	17.0%	19.3%	17.8%	18.4%	19.5%
Industrial	$22,100	$20,500	$25,100	$20,200	$23,600
% of Sales	6.5%	5.8%	6.8%	6.1%	6.5%
Scientific	$6,600	$6,500	$9,500	$9,200	$11,000
% of Sales	1.9%	1.9%	2.6%	2.8%	3.1%
	100.0%	100.0%	100.0%	100.0%	100.0%

Lastly, it should be noted that India has emerged as a progenitor within the microwave tube industry. Several academic institutes have been formed for the specific study of microwave technology. Additionally, Bharat Electronics is the only manufacturer of microwave tubes in South Asia and has announced aggressive expansion plans positron emission tomography for product applications within missile and radar systems.

[2] Biztechreport.com, October 2010
[3] The Journal of Electronic Defense, July 2009
[4] Strategic Analyst
[5] Teal Group

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