How To Kill A Drone: Since Drones Can Kill Americans, Americans Can Kill Drones, Here’s How

Tuesday, February 5, 2013 16:02

(Before It's News)

Since Barack Obama recently took it upon himself to label himself 'dictator' with free will to kill Americans with drones, isn't it time that Americans learn how to fight back and kill drones? Where there is a will, there is a way! This excellent article informs Americans who are completely disgusted with the 'Police State' our once free nation has become on how to kill UAV's. If UAV's are going to be used to kill Americans, Americans need to learn how to fight back. Our GOD given right to defend our own lives is a much higher power than either Barack Obama or the 2nd Amendment of the US Constitution or the US Pentagon and their killing machines. These monsters DESERVE to be grounded. Here's how to do it!

The UAVs have two alternative systems for communication.

Line of sight radio :
In the military C-Band 500 - 1000 MHz that can be jammed with simple spark-gap radio

Satellite communication :
In the Ku-Band between 10.95 - 14.5 GHz, and the satellite can be jammed.
The Uplink-Band to the satellite is 13.75 - 14.5 GHz
The Downlink-Band from the satellite is 10.95 - 12.75 GHz
And you should jam the Uplink frequencies with a jammer directed at the satellite.

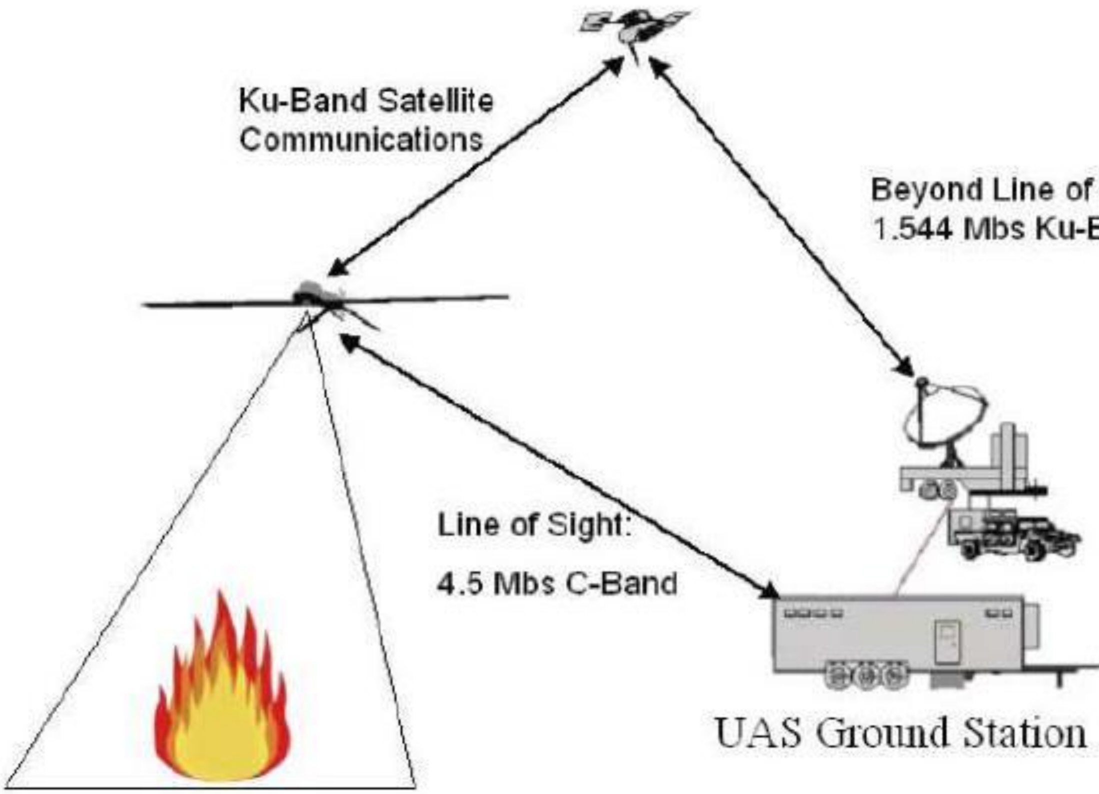

Figure: C-Band and Ku-Band Communication

The satellite link system is from L-3 Communications.
Specifications.pdf

Surprisingly, the resistance can tap off the military's video feeds

As you can see in the specifications, the satellite link system uses the same civilian commercial technology as television broadcasting

companies. And the surprise is that the resistance and others have tapped off the videos from the battlefield with simple commercial equipment.

But now the communication is perhaps encrypted. Read more about SkyGrabber.pdf

If you jam the communication, then the operator becomes blind and the UAV will fly around until it crashes or the fuel is gone. But you must kill both links of communication to kill any rescue.

There are a limited number of satellite channels available which means that the satellite link becomes a bottleneck. The satellite is therefore used as a backup and jammer-rescue channel and for single special operations from far away from the target, while C-band radio is used for multiple simultaneous operations from near the targets. Every military base have their own UAVs that must be operated through the C-band radio. C-band radio is also reported to be used for take off and landing. Which means that the C-band radio is your primary target. The C-band radio is also easier to jam.

Read much more on how to destroy Americans latest and greatest enemy here.

http://beforeitsnews.com/alternative/2013/02/how-to-kill-a-drone-since-drones-can-kill-americans-americans-can-kill-drones-heres-how-2556926.html

How to kill UAVs

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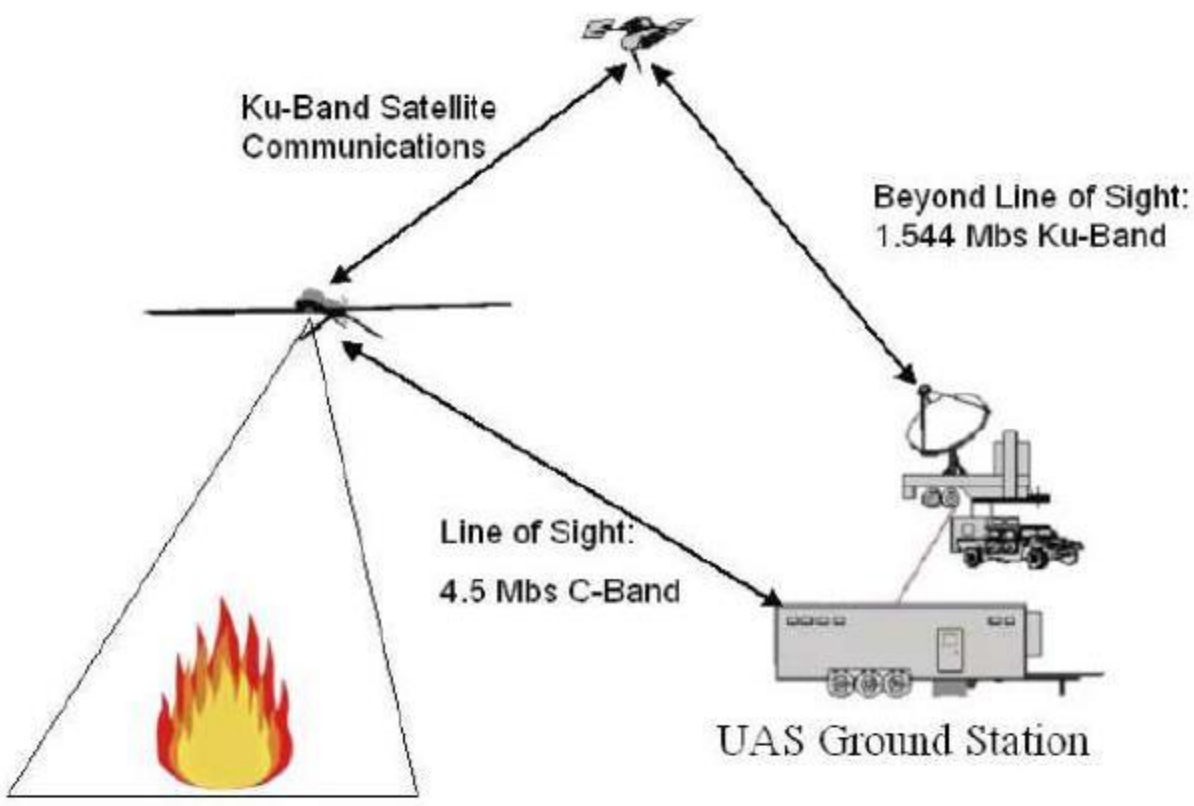

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First some clips from the web

http://www.lexingtoninstitute.org
Lack of protected satellite communications could mean defeat for joint force in future war. Defense experts have repeatedly warned that the availability of space-based communications could be compromised in future conflicts by the fact that **80-90% of all military traffic is transmitted on vulnerable commercial satcom channels.** However, there is a related problem that far fewer military observers have noticed: only about 1% of defense communications today are protected against even the most modest jamming threats.

http://www.abc.net.au/science/news/space/SpaceRepublish_120537.htm
According to the US Air Force, information from the internet is being used to sabotage satellite signals critical to military operations.

This week's New Scientist reports that instructions on how to build satellite jammers, using cheap equipment from home improvement stores and electronics fairs, are to be found on the internet.

The US Air Force team, dubbed the Space Aggressor Squadron, was set up to look for weak spots in satellite communications and navigation systems by playing the part of a potential enemy.

"We ran a search on the Net and found there's quite a lot of information out there on how to build and operate satellites but also, unfortunately, on how to jam them," says Tim Marceau, head of the squadron. "Just type in 'satellite communications jamming' and you'll be surprised how many hits you get."

Two rookie engineers from the US Air Force Research Laboratory were ordered to build a jamming system using only a Net connection and whatever they could buy for cash.

For $7500, the engineers lashed together a mobile ultrahigh-frequency (UHF) high-power noise source that they could use to jam satellite antennas or military UHF receivers. "It's just like turning your radio up louder than someone else's," Marceau says.

The engineers built their home-made jammer using a petrol-driven electricity generator, wood, plastic piping and copper tubing. The amplification and noise-generation electronics were obtained at an electronics enthusiasts "swap meet".

"For very little money and very little sophistication, we found you could muck up communications," says Marceau. Different components could be used to jam other frequencies, such as that of the Global Positioning System.

http://www.theregister.co.uk/2005/09/23/us_deploys_sat_jamming_squads/
The US has created electronic-warfare squads capable of jamming enemy satellite transmissions. Fearful of losing its advantage of superior technology resources over its potential enemies

http://en.wikipedia.org/wiki/Satellite#Jamming
Due to the low received signal strength of satellite transmissions they are prone to jamming by land-based transmitters. Such jamming is limited to the geographical area within the transmitter's range. GPS satellites are potential targets for jamming, but satellite phone and television signals have also been subjected to jamming. It is trivial to transmit a carrier to a geostationary satellite and thus interfere with any other users of the transponder. It is common on commercial satellite space for earth stations to transmit at the wrong time or on the wrong frequency and dual illuminate the transponder rendering the frequency unusable. Satellite operators now have sophisticated monitoring that enables them to pin point the source of any carrier and manage the transponder space effectively.

http://www.wnd.com/?pageId=118345
The U.S. Army is moving forward with a plan to order thousands of radio-frequency-jammer devices to foil improvised explosive devices, even though terrorists' latest attacks in the Afghanistan war have used mechanical, rather than radio, detonators, according to a report from Joseph Farah's G2 Bulletin.

The jammers likely will cause problems with remotely operated aerial drones, ...

According to experts, U.S. troops experienced jamming **in Iraq in 2006 when the Warlock RF jamming system had a detrimental effect on their communications systems and UAVs.**

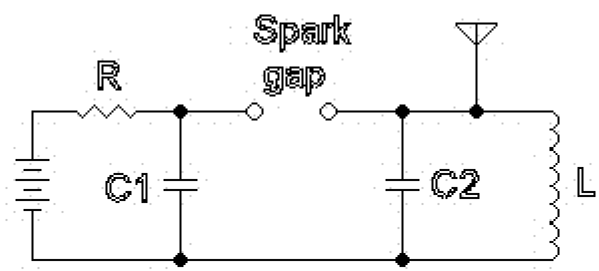
http://www.military.com/features/0,15240,108934,00.html
Warlock radio frequency jammers in use in Iraq interfere with Army radio communications and block controls needed to operate unmanned aerial vehicles, according to a study of the service's initial effort to transform divisions into “modular” brigades.

Spark gap transmitter

The radio pioneers in the old days had no semiconductors or vacuum tubes.
And that's the type of transmitter you are looking for if you want to build a jammer at home in your garage.

Every resonant device, a bell or an electronic circuit works in the same manner.
Hit the bell with hammer and it will ring for a while. If you repeat the hammering periodically then the bell will ring continuously.
For an electric circuit we should use an electric spark instead of a hammer to do the job.

http://en.wikipedia.org/wiki/Spark-gap_transmitter



The coil L and the capacitor C2 is the resonant circuit.
The energy from a high voltage source is stored in the capacitor C1, and is released on every spark. And that makes the resonant circuit ring.
This circuit will then wait for the capacitor C1 to charge up again through the resistor R, and then release another spark. And the spark frequency is about 1 / R*C1

For UHF frequencies the antenna itself is the resonant circuit, tuned to a frequency.

The spark gap transmitter has an output power of wide bandwidth, but centered around the resonant frequency. And in case you want to spread out the power more uniformly then try a motorized or electro-mechanical modulation at C2 or the antenna itself. Or multiple transmitters tuned to different frequencies.

A radio jammer can also be used to deny the enemy to call in air support when you attack. Send out a team to jam the airbase radio before you attack any of those spread out tiny outposts or patrols.

This is probably what you are looking for

US patent 4491842
http://www.freepatentsonline.com/4491842.html
US military radio jammer that can be used in the military C-Band 500 - 1000 MHz

It's not necessary to transmit 100 kWatts of power to jam an UAV which means that the construction can be simplified. And you can use a simplified spark-gap.

High voltage

The high voltage can be generated from a 12 volt car battery in the same way that high voltage is generated to the car's spark plugs. You need a coil and an oscillator circuit that turn on and off a transistor switch. Connect a high voltage diode from the coil to a high voltage reservoir capacitor.
You can also use a motorized electro-mechanical switch.
The only trouble is that you must keep in mind that the capacitors and the coil can be destroyed from overvoltage. Which means that you must somehow turn off the switch if the voltage becomes too high.
But very often the circuit (spark gap) will control the voltage balance itself if it is correctly dimensioned.

Groundplane reflection

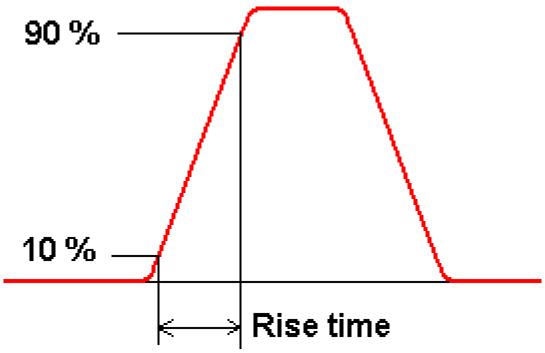
As you perhaps know, you can reach and jam receivers at longer distance away if you put your C-Band transmitter antenna as high up as possible. (don't care with paraboles)
This is caused by the fact that the radiowaves travel two separate ways from your transmitter.
A direct way through air.
And a damped and **phase inverted** **reflected way, bouncing from the ground.** Which cancels out most of the power from your transmitter.
This damping of your transmitters power can be avoided if you put the transmitter antenna high up.
And also try get as good electric ground connection as possible for your transmitter.

If you connect the antennas through a shielded coaxial cable from a bunker at a safe distance then it becomes almost impossible to destroy the jammer with homing missiles, and too easy to repair a piece of cheap bent metal antenna.

Spark gap jammer at 14 Giga Hertz frequency ?

This is more complicated but possible and under evaluation by the scientists for use as UWB radar.
And you must improve the spark's rise time in order to make it generate more power at higher frequencies.

Definition of rise time



There is a simple thumb rule for the relationship between **rise time** and **bandwidth** for spark-gaps and single stage RC filters and oscilloscopes. http://en.wikipedia/wiki/Rise_time

Bandwidth * Rise Time = 0.35

50 pS rise time will give a bandwidth of 7GHz
25 pS rise time will give a bandwidth of 14 GHz

But you must keep in mind that the upper Bandwidth limit is defined as the frequency at which the power is damped -3dB. **But still there is power emitted at higher frequencies**, but damped. As you can read in the links below power is generated and measured at 5 GHz for a switch with 200 pS rise time. But the thumb rule above says that the Bandwidth is only 1.75 GHz.

These spark gaps can generate GigaWatt pulses which means that you can tolerate the bad efficiency at 14 GHz in your home built jammer.
But since you are building a jammer, not an UWB radar, do you have to change the construction to emit 10-100 times more pulses of (1/1000) less power, with a mean value power consumption of perhaps 100W-10kW.
No guarantee for that the satellite jammer will work in the Ku-Band, but it's simple and worth some testing.

Fast Rise Time Switch

Two different techniques can be used in your homebuilt jammer.
Electro-mechanical, for example a mercury filled reed relay that can switch with a rise time below 70 pS as you can read in the links below. Or perhaps try a motorized switch ?
High pressure cascaded hydrogen spark gaps that can switch with a rise time below 50 pS.

A spark gap has a static arcing voltage that is lower than the dynamic arcing voltage.
Which means that if you feed a spark gap with a very fast rising voltage then it will take some time before the spark gap reacts. And you can make it arc at voltages that are about 25 times higher than the static arcing voltage. This overvoltage have the effect that the rise time becomes shorter.

And you can improve the rise time by **cascading multiple spark-gaps**.
But keep in mind to optically shield the spark-gaps from each other because the UV light from a spark can turn on the other spark gaps.

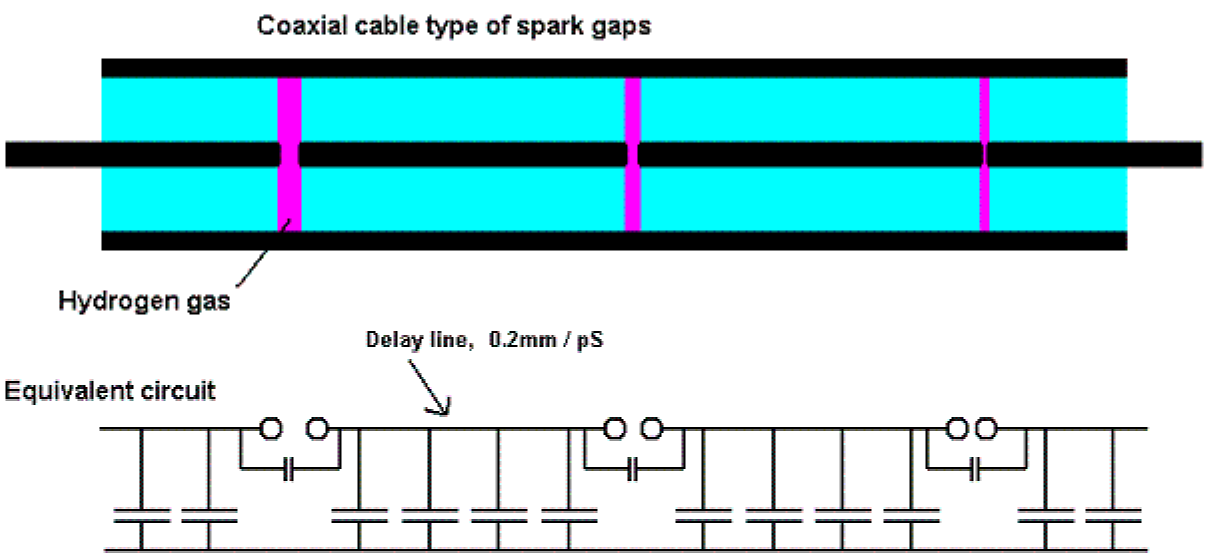
If the spark gap is in an extremely high pressure hydrogen atmosphere then it becomes faster.
Up to 125 atmospheres over pressure have been tested by the scientists as you can read, and it looks like the rise time is near an inverse cubic root function of the pressure.
t = K / CubicRoot(pressure)

And the electrodes should have no sharp edges.

This has perhaps never been tested ?
Aluminum can emit electrons if illuminated with UV light
And how that affects the rise time is worth some experimenting, if it's possible to create an improved chain reaction with two aluminum mirror electrodes.
But the life time of the switch is also affected if you use aluminum instead of a heavy metal like copper or tungsten/wolfram. And perhaps aluminum is too soft and will kill the switch with aluminum dust between the electrodes. It may work or not.

Coaxial cable type of spark-gap

At GigaHertz frequency it becomes hard to keep the radiation under control because every tiny part of the circuit is like an antenna and the radiowaves behaves like light bouncing on everything. You also want to keep the "cable" impedance constant in order to minimize power lost through reflections.
A simple solution is to design the spark-gaps to look like a coaxial cable. Maybe some holes to help the hydrogen gas circulate and be exchanged from an external container. And try build the spark-gaps and the microwave feed-horn together in the same unit.



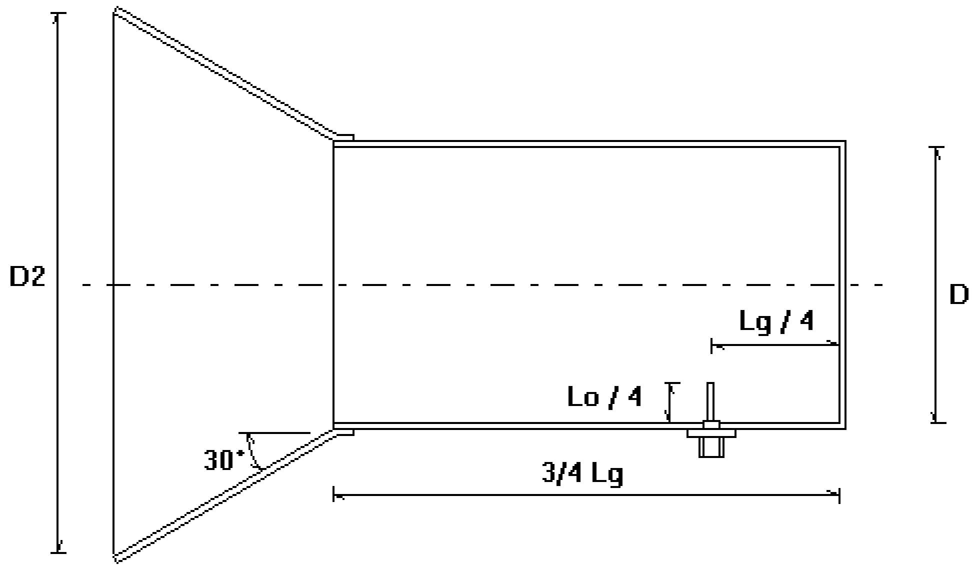
It's hard to analyze, but I think that the cable capacitanses and the delay lines help fire the spark-gaps in the right order, from the left to the right. The capacitanse in the spark-gap itself is small compared to the cable capacitanse. Try speculate about how a shorter or longer cable between each spark-gap will change the firing of the spark-gaps. And if any resistors are necessary for discharging of insulated capacitanses ?
The impedance of a coaxial cable is a function of relative dimensions and the dielectricum (insulator) used. Very easy to calculate. It's almost only mechanical work to build the jammer.
The right side pin is the antenna pin in the feed-horn. But the question is how to connect it in order to discharge all the reservoir capacitanses. It can't be hanging in the air. It must be connected to ground somewhere inside the feed horn.
And you must also try analyze how the length of each coaxial section affects the output through reflections and standing waves. Especially the last section.

Evaluation of your homebuilt jammer

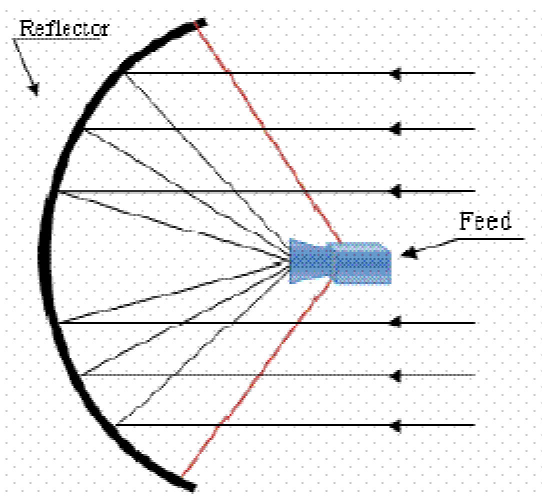
Use your Ku-Band satellite TV system to test your jammer.
Aim the jammer against the satellite.
If the TV picture becomes jammed then your jammer works perfectly and is ready to kill the UAV communication.
Also try turn the jammer 90 degrees because the satellite channel can have different vertical or horizontal polarization.

You can also use your satellite TV receiver to low power test your mechanical switch jammers if you put them on a stick and in front of your satellite dish which is aimed at your TV satellite. If you can see any disturbance on your TV screen then it's OK to go to next step, highpower aimed at the satellite.

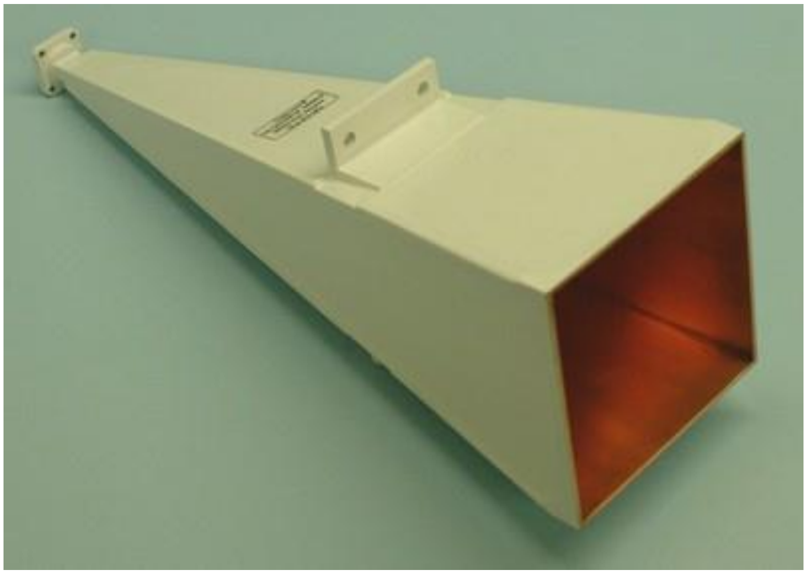
Feed horn



The construction above is from a homebuilt "CanTenna" for 2.4GHz, that can be used as a feed horn to a parabolic antenna.
And you can use the same construction for your jammer at 14 GHz if you change the size.
Note the tiny antenna pin mounted on top of the coaxial cable connector.



Take the parabole from a satellite TV system.



Horn antennas have been used for long time to send and receive microwaves.
It's a simple construction, but the parabole is more effective if you want higher gain. And want to focus the output power in a narrower beam.

Some more clips

...Ultrafast gas breakdown under the extreme overvoltages which occur when a high pressure switch is pulse charged to hundreds of KV in 1 ns or less. The highly overvolted peaking gaps produce powerful electromagnetic pulses with risetimes < 100 pS which can be used for ultrawideband radar systems. . . We have produced and accurately measured pulses with 50 to 100 pS risetimes to peak levels of 75 to 160 kV at pulse repetition frequencies (PRF) to 1 kHz.

Typically the highest pressure with the shortest gap spacing produces the fastest output rise time and minimum switch loss.

Hydrogen gas is used in e.g radar thyratrons where a current pulse with very steep flanks is desired, since in hydrogen the build-up and the recovery time are much shorter than in other gases.

http://en.wikipedia.org/wiki/Gas-filled_tube
Hydrogen is used in tubes used for very fast switching, e.g. some thyratrons, dekatrons, and krytrons, where very steep edges are required. The build-up and recovery times of hydrogen are much shorter than in other gases.

Collected documents from the web :

10353.pdf
Compact high-voltage picosecond generator used as pulsar transient radar source

1650709.pdf
Ultrafast gas switching experiments

slac_pub_4858.pdf
High speed switching in gases.

ssn480.pdf
A highly directive, very intensive, impulse like radiator. UWB Ultra Wide Band

539554.pdf
Picosecond high pressure gas switch experiment.

31295012202627.pdf
High voltage subnasosecond dielectric breakdown

Ljp49105.pdf
Radiation of ultra-wideband electromagnetic pulses by pulsed excitation of rectangular antenna.

Links :

Homebuilt CanTennas for 2.4 GHz
http://www.turnpoint.net/wireless/cantennahowto.html
http://www.saunalahti.fi/elepal/antenna2.html
http://www.wlan.org.uk/antenna-page.html

70 pS rise time pulse generator that uses a mercury filled reed relay
http://www.fkh.ch/pdf_files/Pulsgen.pdf alternative Pulsgen.pdf
100 pS
http://www.dtic.mil/cgi-bin/. . . .GetTRDoc.pdf alternative GetTRDoc.pdf

Horn antennas
http://www.ramayes.com/Horn_Antennas.htm
http://www.w1ghz.org/antbook/chap2.pdf alternative chap2.pdf
http://www.ets-lindgren.com/page/?i=RFAntennas
http://www.ijetch.org/papers/013.pdf alternative 013.pdf

http://www.q-par.com/products/horn-antennas
http://www.qsl.net/n1bwt/contents.htm

Satellite information
http://www.lyngsat.com/launches/ku.html

Jam the satellite with commercial equipment

Any television station with an uplink can jam a satellite. All it takes is two uplinks trying to broadcast at the same time

As you can see in the specifications the military use the same technique as the commercial TV channels. And the UAVs output power is only 50 Watts.
All you have to do is to jam the satellite with your own transmitter.

Satellite communication systems use a device named TRAVELING WAVE TUBE TWT to amplify microwave frequencies. http://en.wikipedia.org/wiki/Traveling-wave_tube
Even if simple in construction, these are usually nothing that you will build in your garage at home because it is a vacuum tube.
The major manufacturers of TWTS are EMI-Varian, Ferranti, EEV, Hughes, STC, Litton, Raytheon, Siemens, Watkins-Johnson and Thomson-CSF and also some russian and japanese companies.

The TWTs are usually sold and assembled together in a box with all necessary high voltage and control electronics. See picture below.
But you can buy the TWT tube itself as a spare part because it has a limited life time, like a lamp.

The TWT is an amplifier (not an oscillator) and doesn't generate any output frequencies if it has no input signal. And you need more equipment.

You need this equipment :

1 Jammer video signal from perhaps a simple PC video card.
2 UHF modulator to convert it to a carrier TV frequency that the UP-converter can accept.
3 UP-converter to an adjustable Ku band frequency, or to a block of frequencies.
4 TWT equipment for power amplification
5 Parabolic antenna

The UP-converter 3 can be of two types, with a single input UHF (TV) channel or a block of UHF input channels, (a block converter.) And if you use a block converter then perhaps can you try connect a home built UHF jammer instead of the video 1 and modulator 2 to the UP converter. That will also kill every channel on the satellite instead of a single channel.

If you can't build or buy this equipment then try steal it from a TV broadcasting company.
(In war time noone cares about the law. Steal, kill destroy.)

Rack mounted traveling wave tube equipment.

Block converter

Some examples of manufacturers :
http://www.miteq.com
http://www.ar-worldwide.com/html/12210_twt_amplifier_twta.asp
http://www.ifi.com/web/html/intro/TWTamplifiers.htm

Google
http://www.google.se/search?q=traveling+wave+tube+twt

Happy experimenting, and killing of UAVs

HOME

Spark-gap transmitter

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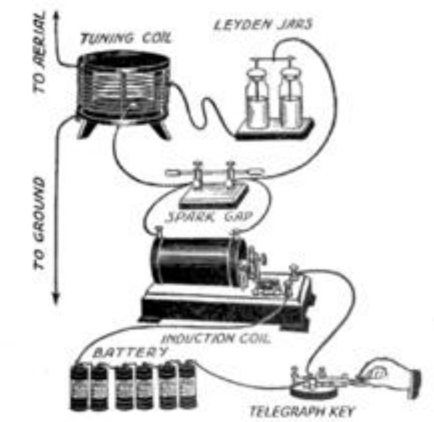
This article includes a list of references, but **its sources remain unclear because it has insufficient inline citations**. Please help to improve this article by introducing more precise citations. *(June 2012)*

This article **needs additional citations for verification**. Please help improve this article by adding citations to reliable sources. Unsourced material may be challenged and removed. *(May 2012)*

A **spark-gap transmitter** is a device for generating radio frequency electromagnetic waves using a spark gap.

These devices served as the transmitters for most wireless telegraphy systems for the first three decades of radio (1887–1916) and the first demonstrations of practical radio were carried out using them. In later years somewhat more efficient transmitters were developed based on rotary machines like the high-speed Alexanderson alternators and the static Poulsen Arc generators, but spark transmitters were still preferred by most operators. This was because of their uncomplicated design and because the carrier stopped when the telegraph key was released, which allowed the operator to "listen through" for a reply. With other types of transmitter, the carrier could not be controlled so easily, and they required elaborate measures to modulate the carrier and to prevent transmitter leakage from de-sensitizing the receiver. After WWI, greatly improved transmitters based on vacuum tubes became available, which overcame these problems, and by the late 1920s the only spark transmitters still in regular operation were "legacy" installations on naval vessels. Even when vacuum tube based transmitters had been installed, many vessels retained their crude but reliable spark transmitters as an emergency backup. However, by 1940, the technology was no longer used for communication. Use of the spark-gap transmitter led to many radio operators being nicknamed "Sparks" long after spark transmitters ceased to be used. Even today, the German verb "funken", literally, "to spark", also means "to send a radio message/signal".



Pictorial diagram of a simple spark-gap transmitter showing examples of the early electronic components used. From a 1917 boy's book, it is typical of the low power transmitters homebuilt by thousands of amateurs to explore the exciting new technology of radio.

Contents

[hide]

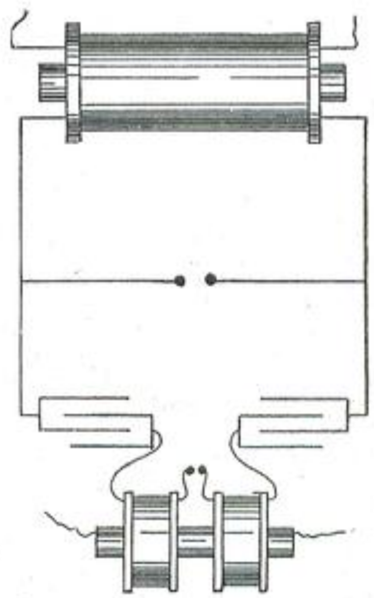
[edit] History

The history of radio shows that the spark gap transmitter was the product of many people, often working in competition. In 1862 James Clerk Maxwell predicted the propagation of electromagnetic waves through a vacuum.

In 1878, David E. Hughes used a spark gap to generate radio signals, achieving a detectable range of approximately 500 metres.

In 1888 physicist Heinrich Hertz set out to scientifically verify Maxwell's predictions. Hertz used a tuned spark gap transmitter and a tuned spark gap detector (consisting of a loop of wire connected to a small spark gap) located a few meters away. In a series of UHF experiments, Hertz verified that electromagnetic waves were being produced by the transmitter. When the transmitter sparked, small sparks also appeared across the receiver's spark gap, which could be seen under a microscope.

Nikola Tesla introduced his radio system in 1893 and later developed the so-called "loose coupler" system which was a major technological breakthrough. It produced a far more coherent carrier wave, generated far less interference, worked with much greater efficiency, required much lower operating voltages and could be operated in any weather conditions.



One form of Nikola Tesla's Spark-gap transmitter

Source: H. S. Norrie, "Induction coils: how to make, use, and repair them". Norman H. Schneider, 1907, 4th edition, New York.

Tesla pursued the application of his high voltage high frequency technology to radio. By tuning a receiving coil to the specific frequency used in the transmitting coil, he showed that the radio receiver's output could be greatly magnified through resonant action. Tesla was one of the first to patent a means to reliably produce radio frequencies (e.g., U.S. Patent 447,920, "Method of Operating Arc-Lamps" (March 10, 1891). Tesla also invented a variety of rotary, cooled, and quenched spark gaps capable of handling high power.

Marconi began experimenting with wireless telegraphy in the early 1890s. In 1895 he succeeded in transmitting over a distance of 1 1/4 miles. His first transmitter consisted of an induction coil connected between a wire antenna and ground, with a spark gap across it. Every time the induction coil pulsed, the antenna would be momentarily charged up to tens (sometimes hundreds) of thousands of volts until the spark gap started to arc over. This acted as a switch, essentially connecting the charged antenna to ground, producing a very brief burst of electromagnetic radiation.

While the various early systems of spark transmitters worked well enough to prove the concept of wireless telegraphy, the primitive spark gap assemblies used had some severe shortcomings. The biggest problem was that the maximum power that could be transmitted was directly determined by how much electrical charge the antenna could hold. Because the capacitance of practical antennas is quite small, the only way to get a reasonable power output was to charge it up to very high voltages. However, this made transmission impossible in rainy or even damp conditions. Also, it necessitated a quite wide spark gap, with a very high electrical resistance, with the result that most of the electrical energy was used simply to heat up the air in the spark gap.[1]

Another problem with the spark transmitter was a result of the shape of the waveform produced by each burst of electromagnetic radiation. These transmitters radiated an extremely "dirty" wide band signal which could greatly interfere with the reception of other transmissions on nearby frequencies. Receiving sets located relatively close to such a transmitter would have entire sections of a band masked by this wide band noise.

Despite these flaws, Marconi was able to generate sufficient interest from the British Admiralty in these originally crude systems to eventually finance the development of a commercial wireless telegraph service between United States and Europe using vastly improved equipment.

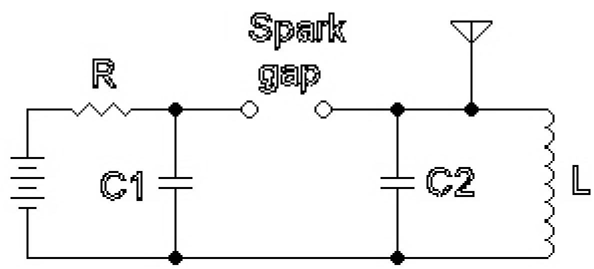
Reginald Fessenden's first attempts to transmit voice employed a spark transmitter operating at approximately 10,000 sparks/second. To modulate this transmitter he inserted a carbon microphone in series with the supply lead. He experienced great difficulty in achieving intelligible sound. At least one high-powered audio transmitter used water cooling for the microphone.

In 1905 a "state of the art" spark gap transmitter generated a signal having a wavelength between 250 meters (1.2 MHz) and 550 meters (545 kHz). 600 meters (500 kHz) became the International distress frequency. The receivers were simple unamplified magnetic detectors or electrolytic detectors. This later gave way to the famous and more sensitive galena crystal sets. Tuners were primitive or nonexistent. Early amateur radio operators built low power spark gap transmitters using the spark coil from Ford Model T automobiles. But a typical commercial station in 1916 might include a 1/2 kW transformer that supplied 14,000 volts, an eight section capacitor, and a rotary gap capable of handling a peak current of several hundred amperes.[*citation needed*]

Shipboard installations usually used a DC motor (usually run off the ship's DC lighting supply) to drive an alternator whose AC output was then stepped up to 10,000–14,000 volts by a transformer. This was a very convenient arrangement, since the signal could be easily modulated by simply connecting a relay between the relatively low voltage alternator output and the transformer's primary winding, and activating it with the morse key key. (Lower-powered units sometimes used the morse key to directly switch the AC, but this required a heavier key making it more difficult to operate).

Spark gap transmitters generate fairly broad-band signals. As the more efficient transmission mode of continuous waves (CW) became easier to produce and band crowding and interference worsened, spark-gap transmitters and damped waves were legislated off the new shorter wavelengths by international treaty, and replaced by Poulsen arc converters and high frequency alternators which developed a sharply defined transmitter frequency. These approaches later yielded to vacuum tube technology and the 'electric age' of radio would end. Long after they stopped being used for communications, spark gap transmitters were employed for radio jamming. As late as 1955, a Japanese radio-controlled toy bus used a spark transmitter and coherer receiver; the spark was visible behind a sheet of blue transparent plastic. Spark gap oscillators are still used to generate high frequency high voltage to initiate welding arcs in gas tungsten arc welding[1]. Powerful spark gap pulse generators are still used to simulate EMPs. Most high power gas-discharge street lamps (mercury and sodium vapor) still use modified spark transmitters as switch-on ignitors.[citation needed]

[edit] Operation



A typical spark transmitter circuit.

Legend:

capacitor - C_1 and C_2;

resistor - R;

inductor - L.

The function of the spark gap is to present a high resistance to the circuit initially to allow the C1 capacitor to charge. When the breakdown voltage of the gap is reached, it then presents a low resistance to the circuit causing the C1 capacitor to discharge. The discharge through the conducting spark takes the form of a damped oscillation, at a frequency determined by the resonant frequency of the C2 and L tank LC circuit.

The spark transmitter is very simple in operation, but it presented significant technical problems mostly due to very large induced EMF when the spark struck, which caused breakdown of the insulation in the primary transformer. To overcome this the construction of even low-power sets was very solid. The damped wave output was very wasteful of bandwidth, and this limited the number of stations that could communicate effectively without interfering with each other.

[edit] Spark gaps

Main article: Spark gap

A simple **spark gap** consists of two conducting electrodes separated by a gap immersed within a gas (typically air). When a sufficiently high voltage is applied, a spark will bridge the gap, ionizing the gas and drastically reducing its electrical resistance. An electric current then flows until the path of ionized gas is broken or the current is reduced below a minimum value called the 'holding current'. This usually occurs when the voltage across the gap drops sufficiently, but the process may also be assisted by cooling the spark channel or by physically separating the electrodes. This breaks the conductive filament of ionized gas, allowing the capacitor to recharge, and permitting the recharging/discharging cycle to repeat. The action of ionizing the gas is quite sudden and violent (*disruptive*), and it creates a sharp sound (ranging from a *snap* for a spark plug, to a loud *bang* for a wider gap). The spark gap also liberates light and heat.

[edit] Quenching the arc

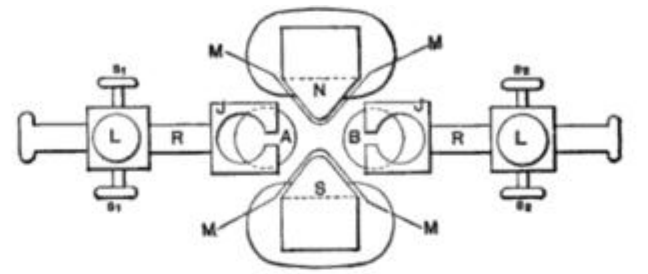
Quenching refers to the act of extinguishing the previously established arc within the spark gap. This is considerably more difficult than initiating spark breakdown in the gap. As transmitter power was increased, the problem of quenching arose.

A cold, non-firing spark gap contains no ionized gases. Once the voltage across the gap reaches its breakdown voltage, gas molecules in the gap are very quickly ionized along a path, creating a hot electric arc, or plasma, that consists of large numbers of ions and free electrons between the electrodes. The arc also heats part of the electrodes to incandescence. The incandescent regions contribute free electrons via thermionic emission, and (easily ionized) metal vapor. The mixture of ions and free electrons in the plasma is highly conductive, resulting in a sharp drop in the gap's electrical resistance. This highly conductive arc supports efficient tank circuit oscillations. However, the oscillating current also sustains the arc and, until it can be extinguished, the tank capacitor cannot be recharged for the next pulse.

Several methods were applied to quench the arc.

- Jets of air that cool, stretch, and literally 'blow out' the plasma,
- multi-plate discharger of Max Wien to cool the arcs in medium power spark sets, known as the "whistling spark" for its distinctive signal,
- using a different gas, such as hydrogen, that quenches more efficiently by providing more effective electrode cooling,
- a magnetic field (from a pair of permanent magnets or poles of an electromagnets) oriented at right angles to the gap to stretch and cool the arc.

[edit] Magnetic



Arrangement of Improved Discharger and Magnet.

A magnetic blowout

Spark gaps used in early radio transmitters varied in construction, depending on the power to be handled. Some were fairly simple, consisting of one or more fixed (*static*) gaps connected in series, while others were significantly more complex. Because sparks were quite hot and erosive, electrode wear and cooling were constant problems.

[edit] Rotary gaps

The need to extinguish arcs in increasingly higher power transmitters led to the development of the rotating spark gap. These devices were used with an alternating current power supply, produced a more regular spark, and could handle more power than conventional static spark gaps. The inner rotating metal disc typically had a number of studs on its outer edge. A discharge would take place when two of the studs lined up with the two outer contacts which carried the high voltage. The resulting arcs were rapidly stretched, cooled, and broken as the disk rotated.

Rotary gaps were operated in two modes, synchronous and asynchronous. A synchronous gap was driven by a synchronous AC motor so that it ran at a fixed speed, and the gap fired in direct relation to the waveform of the A.C. supply that recharged the tank capacitor. The point in the waveform where the gaps were closest was changed by adjusting the rotor position on the motor shaft relative to the stator's studs. By properly adjusting the synchronous gap, it was possible to have the gap fire only at the voltage peaks of the input current. This technique allowed the tank circuit to fire only at successive voltage peaks, thereby delivering maximum energy from the fully charged tank capacitor each time the gap fired. The *break rate* was thus fixed at twice the incoming power frequency (typically, 100 or 120 breaks/second, corresponding to 50 Hz or 60 Hz supply). When properly engineered and adjusted, synchronous spark gap systems delivered the largest amount of power to the antenna. However, electrode wear would progressively change the gap's *firing point*, so synchronous gaps were somewhat temperamental and difficult to maintain.

Asynchronous gaps were considerably more common. In an asynchronous gap, the rotation of the motor had no fixed relationship relative to the incoming AC waveform. Asynchronous gaps worked quite well and were much easier to maintain. By using a larger number of rotating studs or a higher rotational speed, many asynchronous gaps operated at break rates in excess of 400 breaks/second. Since the gap could be fired more often than the input waveform switched polarity, the tank capacitor was charged and discharged more rapidly than a synchronous gap. However, each discharge would occur at a varying voltage that was almost always lower than the consistent peak voltage obtained from a synchronous gap.

Rotary gaps also served to alter the tone of the transmitter, since changing either the number of studs or the rotational speed changed the spark discharge frequency which was audible in receivers with detectors that could detect the modulation on the spark signal. This enabled listeners to distinguish between different transmitters that were nominally tuned to the same frequency. A typical high-power multiple spark system (as it was also called) used a 9-to-24-inch-diameter (230 to 610 mm) rotating commutator with six to twelve studs per wheel, typically switching several thousand volts.

The output of a rotary spark gap transmitter was turned on and off by the operator using a special kind of telegraph key that switched power going to the high voltage power supply. The key was designed with large contacts to carry the heavy current that flowed into the low voltage (primary) side of the high voltage transformer (often in excess of 20 amps). Alternatively a relay was used to do the actual switching.

[edit] See also

- Coherer
- Crystal Radio
- Radio receiver
- Antique radio
- Television interference (electrical interference)

[edit] References

1. ^ A. B. Rolfe-Martin (1914). "IX Spark Gaps and Dischargers". *wireless Telegraphy*. London: Adam and Charles Black. p. 103. efficiency is 25%

[edit] External links

Wikimedia Commons has media related to: ***Spark-gap transmitters***

- Alternator, Arc and Spark
- Fessenden and the Early History of Radio Science
- Brief history of spark
- Massie Spark Transmitter The new England Wireless and Steam Museum
- "The Sounds of a Spark Transmitter with audio". Archived from the original on July 18, 2011. http://web.archive.org/web/20110718231452/http://www.physics.otago.ac.nz/ursi/belrose/spark.html.
- The Sparks Telegraph Key Review

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Telecommunications in South America

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Categories:

- History of radio
- Radio electronics
- Electric arcs
- Electrical power conversion
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Lack Of Protected Satellite Communications Could Mean Defeat For Joint Force In Future War

Author:

Loren B. Thompson, Ph.D.

Date:

Wednesday, April 14, 2010

Tags

In the years since the Cold War ended, the U.S. military has become heavily dependent upon satellite communications to maintain its global connectivity. Without such links, it would be difficult for the military to operate in a coordinated fashion or exchange information critical to situational awareness. Defense experts have repeatedly warned that the availability of space-based communications could be compromised in future conflicts by the fact that 80-90% of all military traffic is transmitted on vulnerable commercial satcom channels. However, there is a related problem that far fewer military observers have noticed: only about 1% of defense communications today are protected against even the most modest jamming threats.

Jamming means overloading key frequencies with so much electronic "noise" that communications cannot get through to intended destinations. It's a simple process in the case of unprotected satellite links, because signals are relatively weak after traveling 22,000 miles from transponders in geosynchronous orbit -- the orbit that communications satellites must maintain in order to serve as "stationary" links above particular points on the Earth's surface (they aren't really stationary, but they appear to be because their rotation matches that of the Earth). If the satellites were any closer to Earth they would zoom across the surface at a speed of several miles per second, making them unavailable as communications nodes most of the time. So they must sit 22,000 miles above sea level, which makes their signals easy to overwhelm with modest amounts of electromagnetic interference, especially if the jammer is near communications receivers.

The only satellite constellation the military is currently building that can provide protection against the full array of potential communications threats is the Advanced Extremely High Frequency (AEHF) system. AEHF is designed to cope with everything from jammers to hackers to scintillation from thermonuclear explosions. However, although it will provide ten times as much capacity as the legacy MilStar constellation, it can only carry a small portion of the military communications traffic passing through space portals. As a result, the amount of that traffic that is well protected against jamming will peak at 6-7% in fiscal year 2012, leaving over 90% of joint-force transmissions vulnerable to degradation. That's not a serious problem if the biggest threats we face are rag-tag adversaries such as the Taliban, but in a war with China there's a high likelihood that America's military would lose the use of most of its satcom links in places like the Western Pacific.

The Bush Administration had an initiative for addressing this problem called the Transformational Communications Satellite program, or TSAT. TSAT would have provided internet-like access to U.S. warfighters all over the world, including troops on the move, from a constellation of five very capable satellites. However, TSAT was canceled last year due to astronomical (no pun intended) costs, and now the military space community has no real plan for assuring that a reasonable portion of joint-force communications traffic will be protected against jamming in the future. The feasible, affordable answer is not to begin a new program, but to start incrementally evolving AEHF towards a more robust capability. I argued in *Space News* several years ago that such an approach was more likely to work out than trying to implement the complex TSAT initiative, but at the time everybody in the business was still chasing the TSAT opportunity. Now that it's gone, military planners need to start thinking about how the government can leverage its investment in AEHF through incremental improvements to each new satellite. If that move is not made soon, our warfighters may one day face an adversary who knows how to isolate them from the rest of the joint force and then kill them.

Loren B. Thompson, Ph.D.

http://www.lexingtoninstitute.org/lack-of-protected-satellite-communications-could-mean-defeat-for-joint-force-in-future-war?a=1&c=1171

Backyard satellite jammers concern US Air Force

Tuesday, 25 April 2000

Typing the words 'satellite' 'communications' and 'jamming' into a search engine delivered nearly 3,000 hits.

According to the US Air Force, information from the internet is being used to sabotage satellite signals critical to military operations.

This week's *New Scientist* reports that instructions on how to build satellite jammers, using cheap equipment from home improvement stores and electronics fairs, are to be found on the internet.

The US Air Force team, dubbed the Space Aggressor Squadron, was set up to look for weak spots in satellite communications and navigation systems by playing the part of a potential enemy.

"We ran a search on the Net and found there's quite a lot of information out there on how to build and operate satellites but also, unfortunately, on how to jam them," says Tim Marceau, head of the squadron. "Just type in 'satellite communications jamming' and you'll be surprised how many hits you get."

Two rookie engineers from the US Air Force Research Laboratory were ordered to build a jamming system using only a Net connection and whatever they could buy for cash.

For $7500, the engineers lashed together a mobile ultrahigh-frequency (UHF) high-power noise source that they could use to jam satellite antennas or military UHF receivers. "It's just like turning your radio up louder than someone else's," Marceau says.

The engineers built their home-made jammer using a petrol-driven electricity generator, wood, plastic piping and copper tubing. The amplification and noise-generation electronics were obtained at an electronics enthusiasts "swap meet".

"For very little money and very little sophistication, we found you could muck up communications," says Marceau. Different components could be used to jam other frequencies, such as that of the Global Positioning System.

The Lab

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US deploys satellite jamming tech

Son of Star Wars tracks phantom menace

By **John Leyden** • **Get more from this author**

Posted in Science, 23rd September 2005 14:45 GMT

The US has created electronic-warfare squads capable of jamming enemy satellite transmissions. Fearful of losing its advantage of superior technology resources over its potential enemies, the US has established mobile teams equipped with electronic jamming gear capable of disrupting attempts to interfere with its satellite resources, The *Washington Times* reports.

"You can't go to war and win without space," Gen. Lance Lord, the four-star general in charge of the Colorado-based Air Force Space Command, told the paper. Air Force Space Command is tasked with both protecting Us satellites from attack or disruption and maintaining an offensive capability against "enemy" space hardware. Just who the enemy might be in this context isn't entirely clear but may include China and Russia.

Talk of jamming capabilities in space, together with earlier reports of space cannons, brings to mind former US president Ronald Reagan's ill-fated Star Wars program of the 1980s not to mention James Bond flicks such as *You Only Live Twice*. Gen Lord is keen to downplay suggestions that the US was intent in turning space into a battlefield.

"We're not talking about weaponizing* space. We're not talking about massive satellite attacks coming over the horizon or anything like that. This is really a way to understand space situational awareness, who's out there, who's operating. We understand that," he said.

Russia reportedly developed anti-satellite weapons at the height of the Cold War and China is judged to pose a threat to the US's strategic superiority in space. Unnamed officials told *Washingtom Times* that China has carried tested electronic signal jamming against satellites. If China has this capability then the US needs to develop countermeasures, the thinking goes. "China's had 45 successful launches since 1996. They will be a very robust and potent competitor in the future, and we want to make sure we understand who they are and how they're emerging in this business. They look at us; we look at them," the official said.

The US Space Command has a responsibility to accessing military threats. "We understand that jamming has gone on and other things have occurred, and we watch that very closely," Gen. Lord said. "If somebody is trying to use space against us, we could interrupt, in a reversible kind of way, those kind of capabilities as needed and as directed by US policy."

Anti-satellite weapons are currently limited to jamming signals sent from the ground to satellites that try to disrupt US military or civilian spacecraft, Gen. Lord concluded. ®

Bootnote

*No, it's not in our dictionary either, but we know what he means.

- America to send space radar to Australia (14 November 2012)
- DARPA seeks 'Precision Electronic Warfare' (25 August 2009)
- **Column** Commuters shouting into their mobiles? Just jam 'em (26 November 2007)
- Israeli sky-hack switched off Syrian radars countrywide (22 November 2007)
- Mystery Israeli satellite telly disruption blamed on UN (11 October 2007)
- Mobile blocking helicopter to trail Bush in Sydney (18 May 2007)
- US Navy seeks help in developing e-warfare systems (16 January 2007)
- Germany to jam prisoners' mobile phones (25 May 2006)
- Greece rocked by mobile phone tapping scandal (6 February 2006)
- China to launch two-man space-pod (11 October 2005)
- **Updated** US gov seeks space billboard ban (20 May 2005)
- USAF seeks space weapon mandate (18 May 2005)
- NASA hacker jailed for six months (20 December 2004)

http://www.theregister.co.uk/2005/09/23/us_deploys_sat_jamming_squads/

Satellite

From Wikipedia, the free encyclopedia

Jump to: navigation, search

This article is about artificial satellites. For natural satellites, also known as moons, see Natural satellite.

For other uses, see Satellite (disambiguation).

Menu

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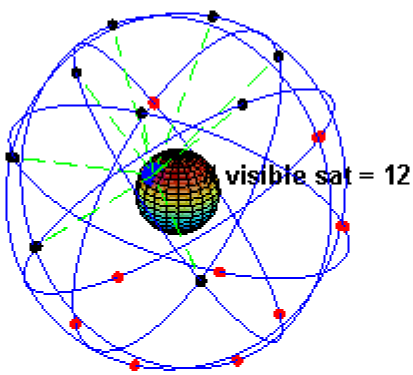
NASA's Earth-observing fleet as of June 2012.



An animation depicting the orbits of GPS satellites in medium Earth orbit.

A full-size model of the Earth observation satellite ERS 2

In the context of spaceflight, a **satellite** is an object which has been placed into orbit by human endeavour. Such objects are sometimes called **artificial satellites** to distinguish them from natural satellites such as the Moon.

The world's first artificial satellite, the Sputnik 1, was launched by the Soviet Union in 1957. Since then, thousands of satellites have been launched into orbit around the Earth. Some satellites, notably space stations, have been launched in parts and assembled in orbit. Artificial satellites originate from more than 50 countries and have used the satellite launching capabilities of ten nations. A few hundred satellites are currently operational, whereas thousands of unused satellites and satellite fragments orbit the Earth as space debris. A few space probes have been placed into orbit around other bodies and become artificial satellites to the Moon, Mercury, Venus, Mars, Jupiter, Saturn, and the Sun.

Satellites are used for a large number of purposes. Common types include military and civilian Earth observation satellites, communications satellites, navigation satellites, weather satellites, and research satellites. Space stations and human spacecraft in orbit are also satellites. Satellite orbits vary greatly, depending on the purpose of the satellite, and are classified in a number of ways. Well-known (overlapping) classes include low Earth orbit, polar orbit, and geostationary orbit.

Satellites are usually semi-independent computer-controlled systems. Satellite subsystems attend many tasks, such as power generation, thermal control, telemetry, attitude control and orbit control.

Contents

[hide]

[edit] History

[edit] Early conceptions

"Newton's cannonball", presented as a "thought experiment" in *A Treatise of the System of the World*, was the first published mathematical study of the possibility of an artificial satellite.

The first fictional depiction of a satellite being launched into orbit is a short story by Edward Everett Hale, *The Brick Moon*. The story is serialized in *The Atlantic Monthly*, starting in 1869.[1][2] The idea surfaces again in Jules Verne's *The Begum's Fortune* (1879).

Konstantin Tsiolkovsky

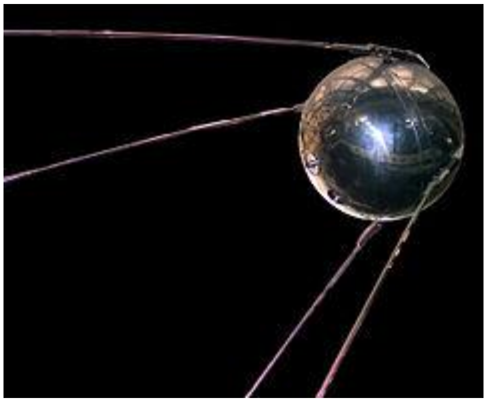
In 1903, Konstantin Tsiolkovsky (1857–1935) published *Means of Reaction Devices* (in Russian: *Исследование мировых пространств реактивными приборами*), which is the first academic treatise on the use of rocketry to launch spacecraft. He calculated the orbital speed required for a minimal orbit around the Earth at 8 km/s, and that a multi-stage rocket fueled by liquid propellants could be used to achieve this. He proposed the use of liquid hydrogen and liquid oxygen, though other combinations can be used.

In 1928 Slovenian Herman Potočnik (1892–1929) published his sole book, *The Problem of Space Travel — The Rocket Motor* (German: *Das Problem der Befahrung des Weltraums — der Raketen-Motor*), a plan for a breakthrough into space and a permanent human presence there. He conceived of a space station in detail and calculated its geostationary orbit. He described the use of orbiting spacecraft for detailed peaceful and military observation of the ground and described how the special conditions of space could be useful for scientific experiments. The book described geostationary satellites (first put forward by Tsiolkovsky) and discussed communication between them and the ground using radio, but fell short of the idea of using satellites for mass broadcasting and as telecommunications relays.

In a 1945 *Wireless World* article the English science fiction writer Arthur C. Clarke (1917–2008) described in detail the possible use of communications satellites for mass communications.[3] Clarke examined the logistics of satellite launch, possible orbits and other aspects of the creation of a network of world-circling satellites, pointing to the benefits of high-speed global communications. He also suggested that three geostationary satellites would provide coverage over the entire planet.

The US military studied the idea of what was referred to as the *earth satellite vehicle* when Secretary of Defense, James Forrestal, made a public announcement on December 29, 1948 that his office was coordinating that project between the various services.[4]

[edit] History of artificial satellites



Sputnik 1: The first artificial satellite to orbit Earth.

The first artificial satellite was Sputnik 1, launched by the Soviet Union on October 4, 1957, and initiating the Soviet Sputnik program, with Sergei Korolev as chief designer (there is a crater on the lunar far side which bears his name). This in turn triggered the Space Race between the Soviet Union and the United States.

Sputnik 1 helped to identify the density of high atmospheric layers through measurement of its orbital change and provided data on radio-signal distribution in the ionosphere. The unanticipated announcement of *Sputnik 1*'s success precipitated the Sputnik crisis in the United States and ignited the so-called Space Race within the Cold War.

Sputnik 2 was launched on November 3, 1957 and carried the first living passenger into orbit, a dog named Laika.[5]

In May, 1946, Project RAND had released the Preliminary Design of an Experimental World-Circling Spaceship, which stated, "A satellite vehicle with appropriate instrumentation can be expected to be one of the most potent scientific tools of the Twentieth Century."[6] The United States had been considering launching orbital satellites since 1945 under the Bureau of Aeronautics of the United States Navy. The United States Air Force's Project RAND eventually released the above report, but did not believe that the satellite was a potential military weapon; rather, they considered it to be a tool for science, politics, and propaganda. In 1954, the Secretary of Defense stated, "I know of no American satellite program."[7]

On July 29, 1955, the White House announced that the U.S. intended to launch satellites by the spring of 1958. This became known as Project Vanguard. On July 31, the Soviets announced that they intended to launch a satellite by the fall of 1957.

Following pressure by the American Rocket Society, the National Science Foundation, and the International Geophysical Year, military interest picked up and in early 1955 the Army and Navy were working on Project Orbiter, two competing programs: the army's which involved using a Jupiter C rocket, and the civilian/Navy Vanguard Rocket, to launch a satellite. At first, they failed: initial preference was given to the Vanguard program, whose first attempt at orbiting a satellite resulted in the explosion of the launch vehicle on national television. But finally, three months after Sputnik 2, the project succeeded; Explorer 1 became the United States' first artificial satellite on January 31, 1958.[8]

In June 1961, three-and-a-half years after the launch of Sputnik 1, the Air Force used resources of the United States Space Surveillance Network to catalog 115 Earth-orbiting satellites.[9]

Early satellites were each constructed as a unique "one-off" designs. With growth in the economic sphere of geosynchronous (GEO) satellite communication, multiple instances of a single satellite design began to be built on a single model platform; these are called satellite buses. The first standardized satellite bus design was the HS-333 GEO commsat, launched in 1972.

The largest artificial satellite currently orbiting the Earth is the International Space Station.

ESTCube-1: the first electric sail driven satellite

[edit] Space Surveillance Network

Main article: United States Space Surveillance Network

The United States Space Surveillance Network (SSN), a division of The United States Strategic Command, has been tracking objects in Earth's orbit since 1957 when the Soviets opened the space age with the launch of Sputnik I. Since then, the SSN has tracked more than 26,000 objects. The SSN currently tracks more than 8,000 man-made orbiting objects. The rest have re-entered Earth's atmosphere and disintegrated, or survived re-entry and impacted the Earth. The SSN tracks objects that are 10 centimeters in diameter or larger; those now orbiting Earth range from satellites weighing several tons to pieces of spent rocket bodies weighing only 10 pounds. About seven percent are operational satellites (i.e. ~560 satellites), the rest are space debris.[10] The United States Strategic Command is primarily interested in the active satellites, but also tracks space debris which upon reentry might otherwise be mistaken for incoming missiles.

A search of the NSSDC Master Catalog at the end of October 2010 listed 6,578 satellites launched into orbit since 1957, the latest being Chang'e 2, on 1 October 2010.[11]

[edit] Non-military satellite services

There are three basic categories of non-military satellite services:[12]

[edit] Fixed satellite services

Fixed satellite services handle hundreds of billions of voice, data, and video transmission tasks across all countries and continents between certain points on the Earth's surface.

[edit] Mobile satellite systems

Mobile satellite systems help connect remote regions, vehicles, ships, people and aircraft to other parts of the world and/or other mobile or stationary communications units, in addition to serving as navigation systems.

[edit] Scientific research satellites (commercial and noncommercial)

Scientific research satellites provide us with meteorological information, land survey data (e.g., remote sensing), Amateur (HAM) Radio, and other different scientific research applications such as earth science, marine science, and atmospheric research.

[edit] Types

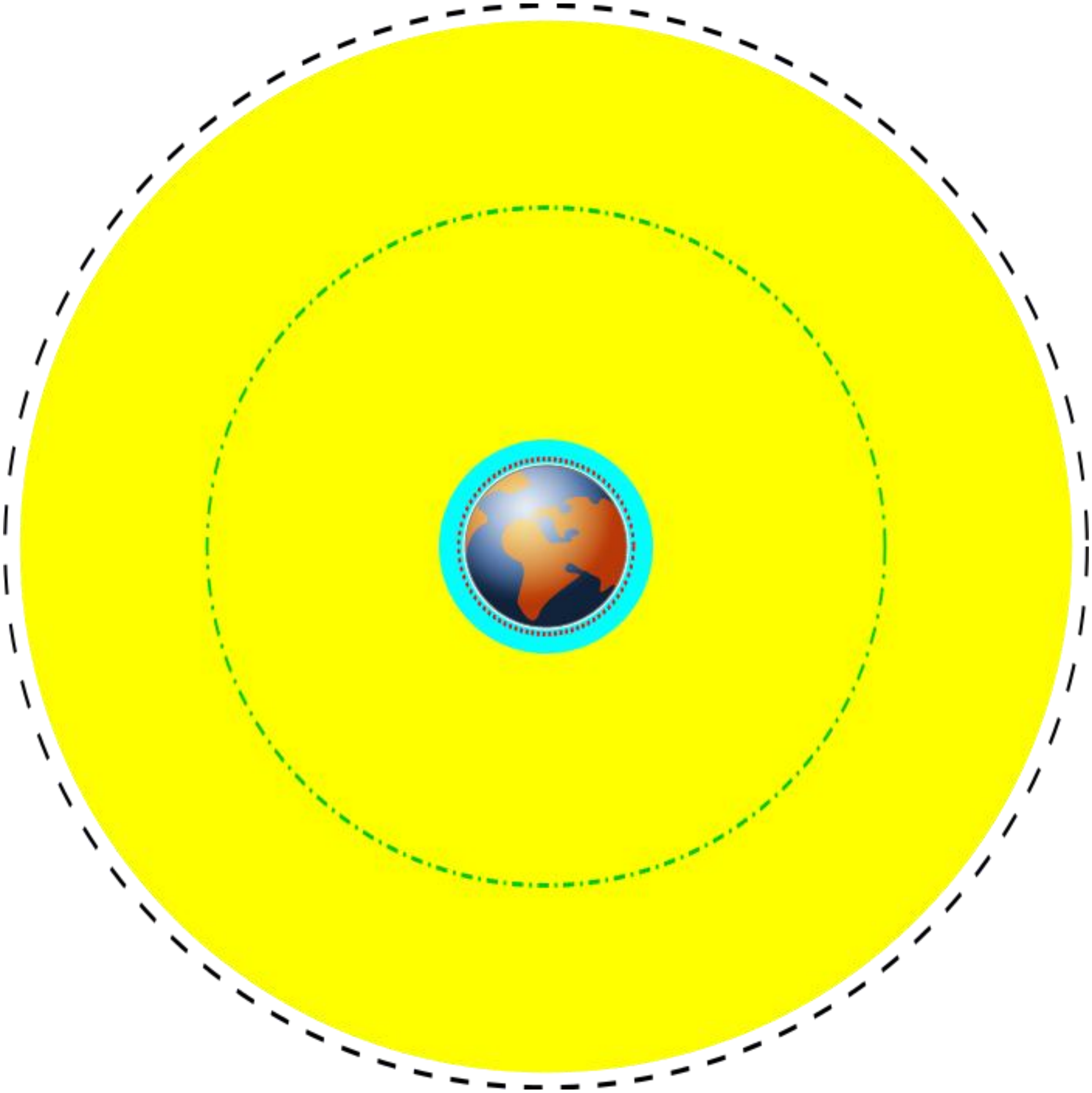
MILSTAR: A communication satellite

- **Anti-Satellite weapons/"Killer Satellites"** are satellites that are designed to destroy enemy warheads, satellites, and other space assets.
- **Astronomical satellites** are satellites used for observation of distant planets, galaxies, and other outer space objects.
- **Biosatellites** are satellites designed to carry living organisms, generally for scientific experimentation.
- **Communications satellites** are satellites stationed in space for the purpose of telecommunications. Modern communications satellites typically use geosynchronous orbits, Molniya orbits or Low Earth orbits.

- **Miniaturized satellites** are satellites of unusually low masses and small sizes.[13] New classifications are used to categorize these satellites: minisatellite (500–100 kg), microsatellite (below 100 kg), nanosatellite (below 10 kg).[citation needed]
- **Navigational satellites** are satellites which use radio time signals transmitted to enable mobile receivers on the ground to determine their exact location. The relatively clear line of sight between the satellites and receivers on the ground, combined with ever-improving electronics, allows satellite navigation systems to measure location to accuracies on the order of a few meters in real time.
- **Reconnaissance satellites** are Earth observation satellite or communications satellite deployed for military or intelligence applications. Very little is known about the full power of these satellites, as governments who operate them usually keep information pertaining to their reconnaissance satellites classified.
- **Earth observation satellites** are satellites intended for non-military uses such as environmental monitoring, meteorology, map making etc. (See especially Earth Observing System.)
- **Tether satellites** are satellites which are connected to another satellite by a thin cable called a tether.
- **Weather satellites** are primarily used to monitor Earth's weather and climate.[14]
- **Recovery satellites** are satellites that provide a recovery of reconnaissance, biological, space-production and other payloads from orbit to Earth.
- **Manned spacecraft (spaceships)** are large satellites able for put human into (and beyond) an orbit, being on it and recovery back to Earth. Spacecrafts, and orbital parts-spaceplanes of reusable systems also, has a major propulsion or landing facilities, and often uses as transport to and from the orbital stations.
- **Space stations** are man-made orbital structures that are designed for human beings to live on in outer space. A space station is distinguished from other manned spacecraft by its lack of major propulsion or landing facilities. Space stations are designed for medium-term living in orbit, for periods of weeks, months, or even years.

[edit] Orbit types

Main article: List of orbits



The first satellite, Sputnik 1, was put into orbit around Earth and was therefore in geocentric orbit. By far this is the most common type of orbit with approximately 2456 artificial satellites orbiting the Earth. Geocentric orbits may be further classified by their altitude, inclination and eccentricity.

The commonly used altitude classifications are Low Earth orbit (LEO), Medium Earth orbit (MEO) and High Earth orbit (HEO). Low Earth orbit is any orbit below 2000 km, and Medium Earth orbit is any orbit higher than that but still below the altitude for geosynchronous orbit at 35786 km. High Earth orbit is any orbit higher than the altitude for geosynchronous orbit.

[edit] Centric classifications

- **Geocentric orbit**: An orbit around the planet Earth, such as the Moon or artificial satellites. Currently there are approximately 2465 artificial satellites orbiting the Earth.
- **Heliocentric orbit**: An orbit around the Sun. In our Solar System, all planets, comets, and asteroids are in such orbits, as are many artificial satellites and pieces of space debris. Moons by contrast are not in a heliocentric orbit but rather orbit their parent planet.
- **Areocentric orbit**: An orbit around the planet Mars, such as by moons or artificial satellites.

The general structure of a satellite is that it is connected to the earth stations that are present on the ground and connected through terrestrial links.

[edit] Altitude classifications

- **Low Earth orbit (LEO)**: Geocentric orbits ranging in altitude from 0–2000 km (0–1240 miles)
- **Medium Earth orbit (MEO)**: Geocentric orbits ranging in altitude from 2,000 km (1,200 mi) to just below geosynchronous orbit at 35,786 km (22,236 mi). Also known as an intermediate circular orbit.
- **High Earth orbit (HEO)**: Geocentric orbits above the altitude of geosynchronous orbit 35,786 km (22,236 mi).

Orbital Altitudes of several significant satellites of earth.

[edit] Inclination classifications

- **Inclined orbit**: An orbit whose inclination in reference to the equatorial plane is not zero degrees.
  - **Polar orbit**: An orbit that passes above or nearly above both poles of the planet on each revolution. Therefore it has an inclination of (or very close to) 90 degrees.
  - **Polar sun synchronous orbit**: A nearly polar orbit that passes the equator at the same local time on every pass. Useful for image taking satellites because shadows will be nearly the same on every pass.

[edit] Eccentricity classifications

- **Circular orbit**: An orbit that has an eccentricity of 0 and whose path traces a circle.
  - **Hohmann transfer orbit**: An orbital maneuver that moves a spacecraft from one circular orbit to another using two engine impulses. This maneuver was named after Walter Hohmann.
- **Elliptic orbit**: An orbit with an eccentricity greater than 0 and less than 1 whose orbit traces the path of an ellipse.

    - **Geosynchronous transfer orbit**: An elliptic orbit where the perigee is at the altitude of a Low Earth orbit (LEO) and the apogee at the altitude of a geosynchronous orbit.
    - **Geostationary transfer orbit**: An elliptic orbit where the perigee is at the altitude of a Low Earth orbit (LEO) and the apogee at the altitude of a geostationary orbit.
    - **Molniya orbit**: A highly elliptic orbit with inclination of 63.4° and orbital period of half of a sidereal day (roughly 12 hours). Such a satellite spends most of its time over two designated areas of the planet (specifically Russia and the United States).
    - **Tundra orbit**: A highly elliptic orbit with inclination of 63.4° and orbital period of one sidereal day (roughly 24 hours). Such a satellite spends most of its time over a single designated area of the planet.

[edit] Synchronous classifications

- **Synchronous orbit**: An orbit where the satellite has an orbital period equal to the average rotational period (earth's is: 23 hours, 56 minutes, 4.091 seconds) of the body being orbited and in the same direction of rotation as that body. To a ground observer such a satellite would trace an analemma (figure 8) in the sky.
- **Semi-synchronous orbit (SSO)**: An orbit with an altitude of approximately 20,200 km (12,600 mi) and an orbital period equal to one-half of the average rotational period (earth's is approximately 12 hours) of the body being orbited
- **Geosynchronous orbit (GSO)**: Orbits with an altitude of approximately 35,786 km (22,236 mi). Such a satellite would trace an analemma (figure 8) in the sky.
    - **Geostationary orbit (GEO)**: A geosynchronous orbit with an inclination of zero. To an observer on the ground this satellite would appear as a fixed point in the sky.[15]
        - **Clarke orbit**: Another name for a geostationary orbit. Named after scientist and writer Arthur C. Clarke.
    - **Supersynchronous orbit**: A disposal / storage orbit above GSO/GEO. Satellites will drift west. Also a synonym for Disposal orbit.
    - **Subsynchronous orbit**: A drift orbit close to but below GSO/GEO. Satellites will drift east.
    - **Graveyard orbit**: An orbit a few hundred kilometers above geosynchronous that satellites are moved into at the end of their operation.
        - **Disposal orbit**: A synonym for graveyard orbit.
        - **Junk orbit**: A synonym for graveyard orbit.
- **Areosynchronous orbit**: A synchronous orbit around the planet Mars with an orbital period equal in length to Mars' sidereal day, 24.6229 hours.
- **Areostationary orbit (ASO)**: A circular areosynchronous orbit on the equatorial plane and about 17000 km(10557 miles) above the surface. To an observer on the ground this satellite would appear as a fixed point in the sky.
- **Heliosynchronous orbit**: A heliocentric orbit about the Sun where the satellite's orbital period matches the Sun's period of rotation. These orbits occur at a radius of 24,360 Gm (0.1628 AU) around the Sun, a little less than half of the orbital radius of Mercury.

[edit] Special classifications

- **Sun-synchronous orbit**: An orbit which combines altitude and inclination in such a way that the satellite passes over any given point of the planets's surface at the same local solar time. Such an orbit can place a satellite in constant sunlight and is useful for imaging, spy, and weather satellites.

- **Moon orbit**: The orbital characteristics of Earth's Moon. Average altitude of 384,403 kilometres (238,857 mi), elliptical–inclined orbit.

[edit] Pseudo-orbit classifications

- **Horseshoe orbit**: An orbit that appears to a ground observer to be orbiting a certain planet but is actually in co-orbit with the planet. See asteroids 3753 (Cruithne) and 2002 AA_{29}.
- **Exo-orbit**: A maneuver where a spacecraft approaches the height of orbit but lacks the velocity to sustain it.
    - **Suborbital spaceflight**: A synonym for exo-orbit.
- **Lunar transfer orbit (LTO)**
- **Prograde orbit**: An orbit with an inclination of less than 90°. Or rather, an orbit that is in the same direction as the rotation of the primary.
- **Retrograde orbit**: An orbit with an inclination of more than 90°. Or rather, an orbit counter to the direction of rotation of the planet. Apart from those in sun-synchronous orbit, few satellites are launched into retrograde orbit because the quantity of fuel required to launch them is much greater than for a prograde orbit. This is because when the rocket starts out on the ground, it already has an eastward component of velocity equal to the rotational velocity of the planet at its launch latitude.
- **Halo orbit** and **Lissajous orbit**: Orbits "around" Lagrangian points.

[edit] Satellite subsystems

The satellite's functional versatility is imbedded within its technical components and its operations characteristics. Looking at the "anatomy" of a typical satellite, one discovers two modules.[12] Note that some novel architectural concepts such as Fractionated Spacecraft somewhat upset this taxonomy.

[edit] Spacecraft bus or service module

This bus module consist of the following subsystems:

- **The Structural Subsystems**

The structural subsystem provides the mechanical base structure, shields the satellite from extreme temperature changes and micro-meteorite damage, and controls the satellite's spin functions.

- **The Telemetry Subsystems** (aka Command and Data Handling, C&DH)

The telemetry subsystem monitors the on-board equipment operations, transmits equipment operation data to the earth control station, and receives the earth control station's commands to perform equipment operation adjustments.

- **The Power Subsystems**

The power subsystem consists of solar panels and backup batteries that generate power when the satellite passes into the Earth's shadow. Nuclear power sources (Radioisotope thermoelectric generators) have been used in several successful satellite programs including the Nimbus program (1964–1978).[16]

- **The Thermal Control Subsystems**

The thermal control subsystem helps protect electronic equipment from extreme temperatures due to intense sunlight or the lack of sun exposure on different sides of the satellite's body (e.g. Optical Solar Reflector)

- **The Attitude and Orbit Control Subsystems**

Main article: Attitude control

The attitude and orbit control subsystem consists of small rocket thrusters that keep the satellite in the correct orbital position and keep antennas positioning in the right directions.

[edit] Communication payload

The second major module is the communication payload, which is made up of transponders. A transponder is capable of :

- Receiving uplinked radio signals from earth satellite transmission stations (antennas).
- Amplifying received radio signals
- Sorting the input signals and directing the output signals through input/output signal multiplexers to the proper downlink antennas for retransmission to earth satellite receiving stations (antennas).

[edit] End of life

When satellites reach the end of their mission, satellite operators have the option of de-orbiting the satellite, leaving the satellite in its current orbit or moving the satellite to a graveyard orbit. Historically, due to budgetary constraints at the beginning of satellite missions, satellites were rarely designed to be de-orbited. One example of this practice is the satellite Vanguard 1. Launched in 1958, Vanguard 1, the 4th manmade satellite put in Geocentric orbit, was still in orbit as of August 2009.[17]

Instead of being de-orbited, most satellites are either left in their current orbit or moved to a graveyard orbit.[18] As of 2002, the FCC now requires all geostationary satellites to commit to moving to a graveyard orbit at the end of their operational life prior to launch.[19]

[edit] Launch-capable countries

Main article: Timeline of first orbital launches by nationality

Launch of the KSLV-1, the first Korean Orbital Launch System.

This list includes countries with an independent capability to place satellites in orbit, including production of the necessary launch vehicle. Note: many more countries have the capability to design and build satellites but are unable to launch them, instead relying on foreign launch services. This list does not consider those numerous countries, but only lists those capable of launching satellites indigenously, and the date this capability was first demonstrated. Does not include consortium satellites or multi-national satellites.

First launch by country

Order	Country	Year of first launch	Rocket	Satellite
1	Soviet Union	1957	Sputnik-PS	*Sputnik 1*
2	United States	1958	Juno I	*Explorer 1*
3	France	1965	Diamant	*Astérix*
4	Japan	1970	Lambda-4S	*Ōsumi*
5	China	1970	Long March 1	*Dong Fang Hong I*
6	United Kingdom	1971	Black Arrow	*Prospero X-3*

First launch by country				
Order	**Country**	**Year of first launch**	**Rocket**	**Satellite**
7	India	1980	SLV	*Rohini*
8	Israel	1988	Shavit	*Ofeq 1*
—	Russia[1]	1992	Soyuz-U	*Kosmos 2175*
—	Ukraine[1]	1992	Tsyklon-3	*Strela*
9	Iran	2009	Safir-2	*Omid*
10	North Korea	2012	Unha	*Kwangmyŏngsŏng-3*
11	Azerbaijan	2013	Azerspace	*Azerspace*
—	South Korea [20]	2013	KSLV-1	*Naro-3*

[edit] Attempted first launches

This section requires expansion. *(May 2012)*

- United States tried in 1957 to launch the first satellite by own launcher before successfully completing a launch in 1958.
- China tried in 1969 to launch the first satellite by own launcher before successfully completing a launch in 1970.
- India, after launching the first national satellite by foreign launcher in 1975, tried in 1979 to launch the first satellite by own launcher before succeeding in 1980.
- Iraq have claimed orbital launch of warhead in 1989, but this claim was later disproved.[24]
- Brazil, after launch of first national satellite by foreign launcher in 1985, tried to launched the satellites by own VLS 1 launcher three times in 1997, 1999, 2003 but all were unsuccessful.
- North Korea claimed a launch of Kwangmyŏngsŏng-1 and Kwangmyŏngsŏng-2 satellites in 1998 and 2009, but U.S., Russian and other officials and weapons experts later reported that the rockets failed to send a satellites into orbit, if that was the goal. The United States, Japan and South Korea believe this was actually a ballistic missile test, which is a claim also made after North Korea's 1998 satellite launch, and later rejected. The first (April 2012) launch of Kwangmyŏngsŏng-3 was unsuccessful, a fact publicly recognized by the DPRK. However, the December 2012 launch of the "second version" of Kwangmyŏngsŏng-3 was successful, putting the DPRK's first satellite into orbit.

- South Korea (Korea Aerospace Research Institute), after launching their first national satellite by foreign launcher in 1992, tried to launch a first KSLV own launcher (created with assistance of Russia) in 2009, 2011 and 2012, but all were unsuccessful.

[edit] Other notes

- ^ Russia and Ukraine were parts of the Soviet Union and thus inherited their launch capability without the need to develop it indigenously. Through Soviet Union they also are on the number one position in this list of accomplishments.
- France, United Kingdom, Ukraine launched their first satellites by own launchers from foreign spaceports.
- Some countries such as South Africa, Spain, Italy,[citation needed] Germany, Canada, Australia, Argentina, Egypt and private companies such as OTRAG, have developed their own launchers, but have not had a successful launch.
- Only eight countries from the list above (Russia and Ukraine instead of USSR, also USA, Japan, China, India, Israel and Iran) and one regional organization (the European Space Agency, ESA) have independently launched satellites on their own indigenously developed launch vehicles. (The launch capabilities of the United Kingdom and France now fall under the ESA.)
- Several other countries, including South Korea, Brazil, Pakistan, Romania, Kazakhstan, Taiwan, Indonesia, Sri Lanka,[citation needed] Australia, New Zealand, Malaysia[citation needed] and Turkey, are at various stages of development of their own small-scale launcher capabilities.

[edit] Launch capable private entities

- Orbital Sciences Corporation is conducting launches using its Taurus I rocket.
- On September 28, 2008, the private aerospace firm SpaceX successfully launched its Falcon 1 rocket in to orbit. This marked the first time that a privately built liquid-fueled booster was able to reach orbit.[25] The rocket carried a prism shaped 1.5 m (5 ft) long payload mass simulator that was set into orbit. The dummy satellite, known as Ratsat, will remain in orbit for between five and ten years before burning up in the atmosphere.[25]

A few other private companies are capable of sub-orbital launches.

[edit] First satellites of countries

First satellites of countries including launched indigenously or by help of other[26]

Country	Year of first launch	First satellite	Payloads in orbit as on Jan 2013[27]
Soviet Union (Russia)	1957 (1992)	*Sputnik 1* (*Cosmos 2175*)	1457
United States	1958	*Explorer 1*	1110
United Kingdom	1962	*Ariel 1*	30

First satellites of countries including launched indigenously or by help of other[26]			
Country	Year of first launch	First satellite	Payloads in orbit as on Jan 2013[27]
Canada	1962	*Alouette 1*	34
Italy	1964	*San Marco 1*	22
France	1965	*Astérix*	57
Australia	1967	*WRESAT*	12
Germany	1969	*Azur*	42
Japan	1970	*Ōsumi*	134
China	1970	*Dong Fang Hong I*	140
Netherlands	1974	*ANS*	4
Spain	1974	*Intasat*	9
India	1975	*Aryabhata*	50
Indonesia	1976	*Palapa A1*	12
Czechoslovakia	1978	*Magion 1*	4
Bulgaria	1981	*Intercosmos Bulgaria 1300*	1
Brazil	1985	*Brasilsat A1*	13
Mexico	1985	*Morelos 1*	7
Sweden	1986	*Viking*	11
Israel	1988	*Ofeq 1*	11
Luxembourg	1988	*Astra 1A*	5
Argentina	1990	*Lusat*	9

First satellites of countries including launched indigenously or by help of other[26]			
Country	**Year of first launch**	**First satellite**	**Payloads in orbit as on Jan 2013[27]**
Pakistan	1990	*Badr-1*	3
South Korea	1992	*Kitsat A*	11
Portugal	1993	*PoSAT-1*	1
Thailand	1993	*Thaicom 1*	7
Turkey	1994	*Turksat 1B*	8
Ukraine	1995	*Sich-1*	6
Malaysia	1996	*MEASAT*	6
Norway	1997	*Thor 2*	3
Philippines	1997	*Mabuhay 1*	2
Egypt	1998	*Nilesat 101*	4
Chile	1998	*FASat-Bravo*	2
Singapore	1998	*ST-1*	3
Taiwan	1999	*ROCSAT-1*	8
Denmark	1999	*Ørsted*	4
South Africa	1999	*SUNSAT*	2
Saudi Arabia	2000	*Saudisat 1A*	12
United Arab Emirates	2000	*Thuraya 1*	6
Morocco	2001	*Maroc-Tubsat*	1

First satellites of countries including launched indigenously or by help of other[26]			
Country	**Year of first launch**	**First satellite**	**Payloads in orbit as on Jan 2013[27]**
Algeria	2002	*Alsat 1*	1
Greece	2003	*Hellas Sat 2*	2
Cyprus	2003	*Hellas Sat 2*	2
Nigeria	2003	*Nigeriasat 1*	4
Iran	2005	*Sina-1*	1
Kazakhstan	2006	*KazSat 1*	2
Colombia	2007	*Libertad 1*	1
Mauritius	2007	*Rascom-QAF 1*	2
Vietnam	2008	*Vinasat-1*	3
Venezuela	2008	*Venesat-1*	2
Switzerland	2009	*SwissCube-1*[28]	2
Poland	2012	*PW-Sat-1*	1
Hungary	2012	*MaSat-1* [29]	1[*citation needed*]
Romania	2012	*Goliat* [30]	1
Belarus	2012	BelKA-2	N/A
North Korea	2012	Kwangmyŏngsŏng-3 Unit 2	1

orbital launch and satellite operation

satellite operation, launched by foreign supplier

satellite in development

orbital launch project at advanced stage or indigenous ballistic missiles deployed

While Canada was the third country to build a satellite which was launched into space,[31] it was launched aboard a U.S. rocket from a U.S. spaceport. The same goes for Australia, who launched on board a donated Redstone rocket. The first Italian-launched was San Marco 1, launched on 15 December 1964 on a U.S. Scout rocket from Wallops Island (VA,USA) with an Italian Launch Team trained by NASA.[32] Australia's launch project (WRESAT) involved a donated U.S. missile and U. S. support staff as well as a joint launch facility with the United Kingdom.[33] The first satellite built by Singapore, X-SAT, was launched aboard a PSLV rocket on April 20, 2011.[34]

[edit] Attempted first satellite

This section requires expansion. *(May 2012)*

- USA tried unsuccessfully to launch its first satellite in 1957; they were successful in 1958.
- China tried unsuccessfully to launch its first satellite in 1969; they were successful in 1970.
- Chile tried unsuccessfully in 1995 to launch its first satellite *FASat-Alfa*; in 1998 they were successful.†
- North Korea has tried in 1998, 2009, 2012 to launch satellites, first successful launch on 12 December 2012.[35]
- Belarus tried unsuccessfully in 2006 to launch its first satellite *BelKA*.†

†-note: Both Chile and Belarus used Russian companies as principal contractors to build their satellites, they used Russian-Ukrainian manufactured rockets and launched either from Russia or Kazakhstan.

[edit] Planned first satellites

This section requires expansion. *(June 2011)*

- Afghanistan announced in April 2012 that it is planning to launch its first communications satellite to the orbital slot it has been awarded. The satellite is expected to be launched by a commercial company.[36]
- Austria The microsatellite BRITE-AUSTRIA (TUG-SAT-1) plans to start in early 2012.[37]
- Azerbaijan is developing its space satellite Azerspace. According to the approved plan, the Azerspace satellite will be launched into orbit in 2013.[38]
- Bangladesh announced in 2009 that it intends to launch its first satellite into space by 2011.[39]
- Belgium Its nano-satellite OUFTI-1 within European University program CubeSat for test radio protocol in space are under construction in University of Liege.[40]
- Bolivia New Bolivian Space Agency plans a first satellite to 2012 by Chinese help [41]
- Cambodia Royal Group plans to purchase for $250–350 million and launch in the beginning of 2013 the telecommunication satellite [4]
- Croatia has a goal to construct a satellite by 2013–2014. Launch into Earth orbit would be done by a foreign provider.[42]
- Ecuador presented its first satellite in April 4, 2011, the NEE-01 Pegasus designed and built by the Ecuadorian Space Agency. The pico-satellite will be launched into orbit by Q1/2013, and will have an expected 1-year lifespan. it has 16 missions and 3 payloads, it is the first known CubeSat to be able to send real-time video from orbit, both visible and infrared. It also carries a thermal and radiation shield.
- Estonia The nano-satellite ESTCube-1 plans by University of Tartu within student CubeSat projects [5]
- Finland Aalto-1 with solar panels is a funded by EU student nano-satellite project of Aalto University, Finland and Finnish Meteorological Institute [6]. When launched (plan to 2013), it would be the first Finnish satellite.
- Laos First satellite will be telecommunication and will be built and launched in 2013 for $250 million by China Asia-Pacific Mobile Communications Company (China-APMT) [7] [8]
- Latvia The 5 kg nano-satellite Venta-1 is built in Latvia in cooperation with the German engineers. The data received from satellite will be received and processed in Irbene radioastronomical centre (Latvia); satellite will have software defined radio capabilities. "Venta-1" will serve mainly as a means for education in Ventspils University College with additional functions, including an automatic system of identification of the ships of a sailing charter developed by *OHB-System AG*. The launch of the satellite was planned for the end of 2009 using the Indian carrier rocket. Due to the financial crisis the launch has been postponed until late 2011.[43] Started preparations to produce the next satellite "Venta-2".
- Lithuania New national Space Science and Technology Institute [44] plans nano-satellite "Lituanica-1" [45] with space capsules by Russian help [46]
- Moldova The remote sensing satellite plans to start in 2013 by Space centre at national Technical University.[47]
- Myanmar plans to purchase for $200 million the own telecommunication satellite [9]
- New Zealand Private New Zealand Satellite Opportunities company since 2005 plans to launch in 2010 or later a commercial satellite NZLSAT for $200 million. [10] [11] Radio enthusiasts federation at Massey University [12] since 2003 hopes for $400,000 to launch a

nano-satellite KiwiSAT to relay a voice and data signals [13] Also another RocketLab company works under suborbital space launcher and may use a further version of one to launch into low polar orbit a nano-satellite [14] [15]

- North Korea will launch several more satellites according to national space program of Korean Committee of Space Technology [48][49]
- Peru developed its space satellite with the National Engineering University, called Chasqui 1. The nano-satellite planning to launch into orbit in 2012 with an expected 60-day lifespan. Payload includes two small VGA cameras with NIR filter(s).
- Serbia Nongovermental organisations designed, developed and assembled the first Serbian satellite Tesla-1 in 2009 but it still remains unlaunched.
- Sri Lanka has a goal to construct two satellites. Sri Lankan Telecommunications Regulatory Commission has signed an agreement with Surrey Satellite Technology Ltd to get relevant help and resources. Launch into Earth orbit would be done by a foreign provider.[50][51]
- Tunisia is developing its first satellite, ERPSat01. Consisting of a CubeSat of 1 kg mass, it will be developed by the Sfax School of Engineering. ERPSat satellite is planned to be launched into orbit in 2013.[52]
- Turkmenistan New National Space Agency plans a first satellite by help of SpaceX to 2014 [53]
- Uzbekistan Uzbek State Space Research Agency (UzbekCosmos) announced in 2001 about intention of launch in 2002 first remote sensing satellite [16] Later in 2004 was stated that two satellites (remote sensing and telecommunication) will be built by Russia for $60–70 million each [17]

[edit] Attacks on satellites

For more details on this topic, see Anti-satellite weapon.

In recent times[timeframe?] satellites have been hacked by militant organizations to broadcast propaganda and to pilfer classified information from military communication networks.[54][55]

For testing purposes, satellites in low earth orbit have been destroyed by ballistic missiles launched from earth. Russia, the United States and China have demonstrated the ability to eliminate satellites.[56] In 2007 the Chinese military shot down an aging weather satellite,[56] followed by the US Navy shooting down a defunct spy satellite in February 2008.[57]

[edit] Jamming

See also: Satellite Jamming in Iran

Due to the low received signal strength of satellite transmissions, they are prone to jamming by land-based transmitters. Such jamming is limited to the geographical area within the transmitter's range. GPS satellites are potential targets for jamming,[58][59] but satellite phone and television signals have also been subjected to jamming.[60][61]

Also, it is trivial to transmit a carrier radio signal to a geostationary satellite and thus interfere with the legitimate uses of the satellite's transponder. It is common for Earth stations to transmit at the wrong time or on the wrong frequency in commercial satellite space, and dual-illuminate the transponder, rendering the frequency unusable. Satellite operators now have sophisticated monitoring that enables them to pinpoint the source of any carrier and manage the transponder space effectively.[citation needed]

[edit] Satellite services

- Satellite Internet access
- Satellite phone
- Satellite radio
- Satellite television
- Satellite navigation

[edit] See also

Spaceflight portal

- 2009 satellite collision
- Footprint (satellite)
- Fractionated Spacecraft
- International Designator
- IMINT
- Space exploration
- List of Earth observation satellites
- List of communications satellite firsts
- Satellite Catalog Number
- Satellite formation flying
- USA 193 (2008 American anti-satellite missile test)
- Spaceport (including list of spaceports with achieved satellite launches)
- Echo 1
- Pioneer 10
- Mariner 10
- Viking I
- Viking II
- Satellites on stamps
- List of passive satellites

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Orbital meteorological and remote sensing systems

Concepts	Defense Weather Satellite System Earth observation satellite Geographic information system (GIS) Weather satellite	
Current projects	**Earth Observing System (EOS)**	TRMM Landsat 7 QuikSCAT Terra ACRIMSAT NMP/EO-1 Jason-1 OSTM/Jason 2 Meteor 3M-1/Sage III GRACE Aqua SORCE

		- Aura - CloudSat - CALIPSO - NPOESS - ESSP - Aquarius - LDCM - SMAP
	A-train satellites	- Aqua - Aura - CALIPSO - CloudSat - GCOM-W1 (Shizuku)
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		• IKONOS • Landsat • MetOp • Meteor • NOAA-N' • QuickBird • RADARSAT-1 • RADARSAT-2 • SMOS • SPOT • TerraSAR-X • THEOS
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	Failed	• OCO • Glory
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FROM JOSEPH FARAH'S G2 BULLETINWORLDNETDAILY EXCLUSIVE

ARMY TO ATTACK IEDS WITH RADIO JAMMING

Even though latest attacks have switched to mechanical triggering
Published: 12/09/2009 at 12:12 AM

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Editor's Note: The following report is excerpted from Joseph Farah's G2 Bulletin, the premium online newsletter published by the founder of WND. Subscriptions are $99 a year or, for monthly trials, just $9.95 per month for credit card users, and provide instant access for the complete reports.

The U.S. Army is moving forward with a plan to order thousands of radio-frequency-jammer devices to foil improvised explosive devices, even though terrorists' latest attacks in the Afghanistan war have used mechanical, rather than radio, detonators, according to a report from Joseph Farah's G2 Bulletin.

IED explosion in Afghanistan

The jammers likely will cause problems with remotely operated aerial drones, communications systems and other radio-based functions. They also have a limited potential, since they must be set to operate within the right frequency, experts say.

Nevertheless, the decision has been made to go ahead and increase the number and use of RF jammers against radio-controlled explosive detonators from remote locations. The detonators include mobile phones, satellite phones and long-range cordless phones.

As G2B reported last month, the Pentagon has become concerned over the inability to detect IEDs blamed for increasing American fatalities in Afghanistan. Sources say it is the primary concern of U.S. Defense Secretary Robert Gates.

The RF jammers operate by transmitting a high-power signal on the same frequency as the targeted device. The signal collides with signals sent to and from the targeted device, rendering it useless.

RF jammers can cover considerable distances and a wide range of signal frequencies. Not only are the jammers effective against various phones but also other potential electronic detonators, including receivers for car alarms, garage-door openers and doorbells.

A recent Pentagon report, however, recognized that the Afghan Taliban is beginning to use IEDs that can avoid detection which are detonated by long cords rather than by electronic means.

Yet, the Army is proceeding to increase significantly the number of electronic jammers.

The decision outlines a dilemma: Either increase jammers and minimize electronically detonated IEDs, interfering with unmanned aerial vehicles and long-range communications at the same time. Or, run greater risks against such IEDs but minimize jamming of UAVs and long-range communications.

The RF jammers can affect a wide range of frequencies, thereby jamming various unintended signals from electronic devices and creating what defense experts call "signal pollution."

In addition, long-range-communications systems generally operate on similar frequencies as the devices being jammed. This would include not only communications systems used by the U.S. and its allies but also the Taliban and other insurgent groups.

According to experts, U.S. troops experienced jamming in Iraq in 2006 when the Warlock RF jamming system had a detrimental effect on their communications systems and UAVs. The Warlock RF jammer also is being used in Afghanistan.

http://www.wnd.com/2009/12/118345/

Jammers Causing Interference in Iraq

InsideDefense.com NewsStand | Jen DiMascio | August 08, 2006

SHARE

Warlock radio frequency jammers in use in Iraq interfere with Army radio communications and block controls needed to operate unmanned aerial vehicles, according to a study of the service's initial effort to transform divisions into “modular” brigades.

The commanding general of the Combined Arms Center asked the Center for Army Lessons Learned to take on the study, “Modular Force Insights Memorandum,” which was completed in March but not publicly released. The results were culled from post-deployment interviews of members of the 3rd Infantry Division after their return from Iraq.

The 3rd ID was the first division to undertake the modular redesign. It was the first to partially transform and then see combat, according to the executive summary of the report, stamped “for official use only.”

The report brought in at least 36 suggestions for doctrine, organization, training, material, leadership, personnel, and facilities, as well as 11 “emerging insights,” according to the executive summary.

Among the key recommendations of the report is the suggestion that the Army address problems with Warlock jammers, which are supposed to thwart the electronic signals used to trigger improvised explosive devices.

During convoy operations, soldiers had to stop using the jammers if they wanted to use their Single Channel Ground and Airborne Radio Systems. “Likewise, distant stations were not able to communicate with convoys utilizing Warlock,” the report says. “This situation was a common and significant problem for 3ID.”

In addition to interfering with radio transmissions, the Warlock also blocked the control link between the Raven unmanned aerial system and aviation systems.

“With the loss of the Raven control link, the ground controller would lose control and the aircraft would re-acquire the satellite and return to its launch point,” the study says.

Helicopters that were operating in the same footprint as Warlock also were affected.

While pilots were able to continue to use SINCGARS radios to communicate with ground stations and other Army aircraft, communications with the Air Force broke down until helicopters moved away from the Warlock transmission area.

As a result, the study recommends that the Army Signal School at Ft. Gordon, GA, revise doctrine, tactics, techniques and procedures for using jammers. The program manager for

Warlock should look at ways to change the jammers themselves, and look at other ways to use frequencies so the jammers do not conflict with other command and control systems, the study says. In addition to Raven's difficulties with jammers, the 3rd ID experienced problems in the air. The risk of a mid-air collision with a Raven aircraft was the chief concern for the division's aviators, the study says.

The concern was attributed to many factors. Because it is so small and light, the Raven is “extremely susceptible to altitude variations in flight due to wind gusts, up-drafts, etc., despite the best efforts of the controller,” the report says. Also, Ravens are so small that soldiers in manned aircraft can't easily see them. Plus, because there is no way to electronically confirm a Raven's location from an Army cockpit, “Army aviation assets are reluctant to share airspace with the Raven,” the report states.

The division also raises issues concerning Raven training.

“Based upon experience in [Operation Iraqi Freedom], Army Aviation assets remain concerned that Raven operators are not always clearing airspace requests through the brigade” before a Raven is launched, the report says. That helps drive a perception among aviators that procedures are not always heeded before a Raven is launched.

As a result, the study recommends that the Army Aviation Center and Army Air Defense Artillery Center conduct an “end-to-end” review of small UAS operations. Also, the study calls for procedures covering small unmanned aerial systems to be added to current doctrine and recommends wide dissemination of revised tactics.

Another key issue outlined in the report is the training for the brigade combat team's fire support system. Commanders of the division's fires battalions said that units were not receiving the required technical training and certification standards, according to the report.

“This seems to be a symptom of either of two causes: lack of time to fully train soldiers and system processes during a full [Army Force Generation] cycle; or that maneuver battalion commanders and staffs do not possess the expertise, background, or time to accomplish training required to maintain training standards,” the study says.

Accordingly, the lessons-learned report recommends further study of the underlying causes of the training gap. It also says the service should close observe a number of brigade combat teams throughout a full ARFORGEN cycle to evaluate battalion commanders' ability to provide the right kind of training, the study says.

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http://www.military.com/features/0,15240,108934,00.html

Frozen wave generator jammer

United States Patent 4491842

A high peak power, broad band, radio frequency pulse generator generates are wave pulses at a high pulse repetition frequency for use in jamming of radar, data links, voice communication, or other radio frequency signals. The generator is constructed with one or more pairs of coaxial cable formed into opposite half loops. The cable is provided with an inner conductor and outer conductors with the outer conductor of each opposed loop attached to a spark gap switch while the inner conductor is continuous throughout the loops from one side of a matched impedance load, such as an antenna, to the other side of the load. The spark gap switch is provided with a pair of electrodes separated by a gap. The gap contains a dielectric medium having fast spark quenching characteristics and a high standoff voltage. Peak power for the generator is 10 to 100 kilowatts with a pulse repetition frequency of 1 to 100 kilohertz.

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G01S7/38; **G01S7/38**; (IPC1-7): G01S7/38

Field of Search:

307/106, 307/108, 328/59, 328/67, 343/18E, 455/1

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US Patent References:

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4193032	**High speed transmitter pulser**	March, 1980	Milberger et al.	343/18E
4063109	**Clock pulse system**	December, 1977	van der Mark	307/106
3909828	**Airborne repeater decoy**	September, 1975	Israel et al.	343/18E
3668416	**DEVICE FOR PRODUCING RECTANGULAR VOLTAGE PULSES OF VERY SMALL WIDTH BETWEEN TWO OUTPUTS**	June, 1972	Marilleau	307/106

3333203	Pulse generator with standing wave energy storage	July, 1967	Baker	328/67
3225223	Pulse generator	December, 1965	Martin	307/108
3071710	Coaxial transmission line with spaced capacitance control of pulse generation	January, 1963	Fischer	328/67
2792508	Pulse generator	May, 1957	Samsel	307/106

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Claims:

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. An improved high frequency square wave pulse generator for generation of pulses of energy in a predetermined frequency range for use in the jamming of radar, data links, voice communications, or other radio frequency signals, said improved high frequency square wave pulse generator being of the type having at least one dipole configured transmission line including inner and outer conductors separated by an insulator and being formed into oppositely disposed first and second half loops so as to form a dipole and configuration for storage of the pulses of energy, wherein the improvement comprises:

a single spark gap switch device operatively connected to said dipole configured transmission line such that said inner conductor thereof is continuous throughout said oppositely disposed first and second half loops from one side of a predetermined load device through said first half loop via said single spark gap switch and through said second half loop via said single spark gap switch to the other side of the predetermined load; such that one half of said outer conductor corresponding to said first half loop farthest from the predetermined load device is electrically connected to a first electrode of said single spark gap switch device and the other half of said outer conductor corresponding to said second half loop farthest from the predetermined load device is electrically connected to a second electrode of said single spark gap switch device; and such that the one half of said outer conductor corresponding to said first half loop nearest to the predetermined load device is connected to a first predetermined voltage potential and the other half of said outer conductor corresponding to said second half loop nearest to the predetermined load device is connected to a second predetermined voltage potential.

2. The improved high frequency square wave pulse generator of claim 1 wherein said single spark gap switch device further comprises, a housing having first and second interfaces operatively affixed to said first and second electrodes, respectively, so as to form a chamber, said first and second electrodes being disposed so as to create a spark gap therebetween, and said chamber being formed so as to enclosed said first and second electrodes and the spark gap created thereby.

3. The improved high frequency square wave pulse generator of claim 2 wherein said first and second electrodes of said single spark gap switch have diameters substantial larger than the spacing of the spark gap therebetween so as to aid in the rapid deionization thereof.

4. The improved high frequency square wave pulse generator of claim 3 wherein said first and second electrodes of said single spark gap switch are configured to have a smooth finish and a predetermined radius so as to suppress arcing to inner walls of said chamber.

5. The improved high frequency square wave pulse generator of claim 4 wherein said single spark gap switch device further comprises, first and second sealing rings disposed circumferentially around said first and second electrodes, respectively, in respective ones of said first and second interfaces of said housing to form a seal therebetween.

6. The improved high frequency square wave pulse generator of claim 5 wherein said single spark gap switch device further comprises, means configured therein for connection to a source of dielectric medium.

7. The improved high frequency square wave pulse generator of claim 6 wherein said means for connection of said single spark gap switch device is configured in said first electrode.

8. The improved high frequency square wave pulse generator of claim 7 wherein said dielectric medium is a gas having a fast spark quenching characteristic and a high voltage standoff.

9. The improved high frequency square wave pulse generator of claim 8 wherein said gas is 95-percent argon and 5-percent hydrogen.

Description:

BACKGROUND OF THE INVENTION

The present invention relates to a frozen wave generator jammer and more particularly to a radio frequency pulse generator for generating pulses having a high peak power and a high pulse repetition frequency.

Prior art radio frequency oscillators have included the pulse generator disclosed in U.S. Pat. No. 2,792,508, to R. W. Samsel. The oscillator of Samsel provides high intensity pules of predetermined character as to frequency of oscillation, intensity and duration without the use of electron discharge devices, transistors, or other translation or other timing devices. The Samsel generator is inefficient and complicated, and it can not generate the high pulse repetition frequenices necessary for its use as a jammer.

The frozen wave generator jammer of the present invention generates radio frequency pulses having a high peak power and a high pulse repetition frequency.

SUMMARY OF THE INVENTION

The present invention is a frozen wave generator for use in the jamming of radar, data links, voice communication, or other radio frequency signals.

The high frequency, square wave pulse generator of the present invention is constructed with one or more pairs of transmission line, such as coaxial cable, for storing pulses of energy. The pairs of coaxial cable are formed into opposite half loops. The coaxial cable is provided with an inner conductor and an outer conductor with the outer conductor of each loop electrically connected to a spark gap switch. The inner conductor of the cable is continuous throughout the loops from one side of the load, through the loops and back to the other side of the load.

The spark gap switch is provided with a pair of opposite electrodes separated by a spark gap. The electrodes are provided with a large diameter to gap ratio to aid in deionization of the spark gap. The switch is positioned in a housing which encloses the electrodes and gap. A dielectric medium such as a gas having a fast spark quenching character and a high voltage standoff is positioned in the gap between the electrodes. The gas may be a composition of 95% argon and 5% hydrogen. Peak power of the generator is 10 to 100 kilowatts with a pulse repetition frequency of 1 to 100 kilohertz.

OBJECTS OF THE INVENTION

Accordingly, it is an object of the present invention to provide a frozen wave generator jammer which produces a square wave pulse.

Another object of the present invention is to provide a radio frequency pulse generator which generates square wave pulses with high peak power.

A further object of the present invention is to provide a frozen wave generator which generates a square wave pulse having high peak power and a high pulse repetition frequency.

A still further object of the present invention is to provide a frozen wave generator for jamming radio frequency signals with high voltage and high pulse repetition frequency.

Yet another object of the present invention is to provide a frozen wave generator jammer that can produce broader frequency spectrums simultaneously than can conventional jammers.

Another object of the present invention is to provide a radio frequency jammer that is of simple and inexpensive construction.

Other objects, advantages, and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily understood by reference to the following detailed description when considered with the accompanying drawings in which like reference numerals designate like parts throughout the figures and wherein:

FIG. 1 shows a schematic illustration of the frozen wave generator jammer of the present invention in partial section;

FIG. 2 shows a schematic illustration of the spark gap switch of FIG. 1 in partial section;

FIG. 3 shows a schematic illustration of an alternative embodiment of the invention of FIG. 1;

FIG. 4 shows a schematic illustration of a single cycle frozen wave generator;

FIG. 5 illustrates a graph of potential difference versus distance along the frozen wave generator cable of FIG. 4 at Time=0;

FIG. 6 illustrates a graph of potential difference versus distance along the frozen wave generator cable of FIG. 4 at Time=0+;

FIG. 7 illustrates a graph of potential difference versus distance along the frozen wave generator cable of FIG. 4 at Time=0+;

FIG. 8 illustrates a graph of potential difference versus distance along the frozen wave generator gap of FIG. 4 at Time=d+/2v;

FIG. 9 illustrates a graph of potential differences versus distance along the frozen wave generator cable of FIG. 4 at Time=d/v;

FIG. 10 illustrates a graph of potential difference versus distance along the frozen wave generator cable of FIG. 4 at Time=d+/v;

FIG. 11 illustrates a graph of potential difference versus distance along the frozen wave generator cable of FIG. 4 at Time=2d/v;

FIG. 12 illustrates a graph of potential with respect to virtual ground versus time at point r of the frozen wave generator of FIG. 4; and

FIG. 13 shows a schematic illustration of a two cycle frozen wave generator of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, there is illustrated a schematic of the frozen wave generator 10 of the present invention. Generator 10 is constructed with one or more pairs of opposed loops of transmission line, such as coaxial cable, illustrated in FIG. 1 as 11 and 12, with each loop of coaxial cable being half of a wavelength in electrical length.

A spark gap switch 14 is positioned between the opposed loops of the cable. As illustrated in FIG. 1, the coaxial cable is constructed with a continuous inner conductor 21 surrounded by outer conductors 22 and 25. The inner conductor 21 and the outer conductors 22 and 25 are separated by an insulator 27. The inner conductor 21 is continuous throughout the one or more pairs of opposite loops from one side of a matched impedance load to the other side of the load, while the outer conductors 22 and 25 are electrically connected to electrodes 15 and 16, respectively, by means of bands 23 and 24, respectively. Although FIGS. 1, 3 and 4 illustrate the transmission line as being coaxial cable, it is to be understood that balanced line or stripline may also be used for cable loops 11 and 12 in the generator 10.

As shown in FIG. 1, and better illustrated in FIG. 2, spark gap switch 14 is constructed with the pair of opposite electrodes 15 and 16, separated by a gap 28. The electrodes and spark gap are positioned in housing 17 so as to create a chamber 19 enclosing both the electrodes 15 and 16 and the gap 28. A dielectric medium is positioned in chamber 19 so as to be between electrodes 15 and 16. As shown in FIG. 2, the dielectric medium is furnished to chamber 19 by means of a connection 20 which is positioned in electrode 15.

The dielectric medium may be a gas such as a mixture of 95% argon and 5% hydrogen, which exhibits fast spark quenching characteristics and a high voltage standoff. The dielectric medium acts as a switching mechanism that functions as an insulator until the voltage buildup in the switch reaches a predetermined point causing self-breakdown of the gas. When the gas breaks down, the dielectric medium functions as a conductor until the voltage dropoff reaches another predetermined point at which time the gas recovers and again functions as an insulator. The characteristics of the dielectric medium along with the electrode geometry enable the switch, and thus the generator, to have a high pulse repetition frequency.

Chamber 19 is provided with sealing rings 18 which are positioned circumferentially between the housing 17 and the electrodes 15 and 16 so as to seal the dielectric medium on the chamber 19.

Electrodes 15 and 16 are positioned relative to one another so as to create gap 28 and are constructed with a large electrode diameter to gap ratio which aids in deionization of the gap after firing of the switch.

The pairs of opposite coaxial cable loops 11 and 12 are constructed with each cable loop electrical length equal to half of a wavelength. More of the cable loops may be added as desired to produce a given number of cycles for the generator 10. The additional loops are also half an electrical wavelength and function to statically store square wave pulses in each loop of the cable. A two cycle generator having two pairs of opposite loops is illustrated in FIG. 13. When the spark gap switch fires, a series of traveling waves is initiated which allows the previously frozen energy in the coaxial cable loops to move through the load. The more pairs of cable loops present in the generator, the more cycles generated and the narrower the energy spectrum of the generator's output. The jammer may thus be turned to cover a wide or narrow band of frequencies by adjusting the number of radio frequency cycles in the output.

FIG. 3 illustrates an alternative embodiment for the frozen wave generator 10 illustrated in FIG. 1. As illustrated in FIG. 3, the outer conductor 22 of the coaxial cable loops is attached electrically to the electrodes with solder 26. The inner conductor of the coaxial cable is continuous throughout the loops from one side of the load to the other side of the load. The load may be any type of balanced antenna having two elements.

To clarify the waveforming process in the cable sections of a frozen wave generator, the following is a detailed description of the wave interactions for a single-cycle frozen wave generator as shown in FIG. 4. As shown, the outer conductor of the left-hand cable is charged to a potential difference, $-V_o$, with respect to the inner conductor, and the outer conductor of the right-hand cable is charged to $+V_o$. If we clockwise traverse the cable of the left-hand loop from point "t" to point "r" and jump across the load and continue along the right-hand cable from "s" to "u," a plot of the potential difference between the cable conductors as a function of the distance traveled would appear as illustrated in FIG. 5. Since this distribution remains unchanged until the switch closes, FIG. 5 is a graphical depiction of a wave which is frozen in the device.

When the switch closes, the $+V_o$ and $-V_o$ potentials on the cables cause a virtual ground at the switching point. This causes two waves to be launched at each of the points "r," "s," "t," and "u" (one in each direction). These waves will travel with a velocity, v, in the cables. The distance they travel along the cables is given by $d=v\Delta t$, where Δt is the time after switching. The amplitude and position of these waves a short time after switching is shown in FIG. 6. The closed circles represent the initial frozen wave. The ∇, Δ, and .quadrature. lines depict the traveling waves. The amplitude of all of the traveling waves is $V_o /2$, since in every case the cable is discharging into an impedance equal to its characteristic impedance (either another cable section or a matched load). The solid line is the resultant wave in the frozen wave generator at the instant of time depicted in the particular figure. The voltage across the load for this instant of time is equal to the voltage discontinuity at the points "r" and "s" in FIG. 4.

At the switching time, t=0, at point "r" a wave (1, FIG. 6) of amplitude $+V_o/2$ will be launched in a counterclockwise direction toward point "t." The other wave from point "r" will be launched clockwise into the load where it will be completely absorbed (since it is a matched load). Likewise, at point "s" a wave (2, FIG. 6) of amplitude $-V_o/2$ will be launched clockwise toward point "u," and a wave will be launched into and absorbed by the load. The two waves launched from "r" and "s" into the load are not shown because they are completely absorbed.

At point "t" a $+V_o/2$ wave (3, FIG. 6) will be launched clockwise toward "r." A $-V_o/2$ wave (4, FIG. 6) will also be launched counterclockwise toward "s." Likewise, at "u" a $-V_o/2$ wave (5, FIG. 6) drawn above 4 merely for display purposes, will be launched counterclockwise toward "s" and and a $+V_o/2$ wave (6, FIG. 6) will be launched toward "r." Since the points "t" and "u" are very close together and ideally coincident, the two $+V_o/2$ waves traveling clockwise can be combined into one V_o wave (7, FIG. 7). This is also true for the counterclockwise traveling waves, (8, in FIG. 7). This facilitates keeping track of these waves. FIG. 6 can then be redrawn as in FIG. 7.

FIG. 8 shows the conditions in the frozen wage generator at t=d+/2v shortly after the waves have traveled d/2v along the cable sections. The leading edges of the waves have passed each other.

At t=d/v (FIG. 9) waves 7 and 8 are absorbed in the load, which is matched to the impedance of the cable. At this time voltage across the load discontinuously reverses (i.e., the "r" side of the load is now positive rather than negative with respect to the virtual ground).

FIG. 10 illustrates t=d+/v. Waves 1 and 2 travel past the t-u switch intersection with no reflection (ideally there is no discontinuity). The resultant wave gives rise to the potential difference across the load as shown.

Finally, in FIG. 11 the traveling waves 1 and 2 are absorbed in the load and the initial frozen wave is completely canceled.

By combining the position-voltage graphs into a time-voltage graph, the time-varying voltage at the "r" side of the load is obtained (FIG. 11). The "s" side has an equal and opposite voltage so that the total voltage across the load is V_o until the time t=d/v. The voltage then discontinuously reverses polarity and is again V_o in amplitude. At the time t=2d/v the voltage across the load drops to zero and stays there.

As shown in FIG. 12, the output from the generator is a single square wave cycle. Note that FIG. 12 has the same form as FIG. 5. In FIG. 5 the abscissa is distance, while in FIG. 12 it is time. The output of the frozen wave generator is a time replica of the initial "frozen" wave.

FIG. 13 illustrates a two cycle frozen wave generator with a voltage source V and charging resistors R_c as a means of charging the generator. The charging means illustrated in FIG. 13 is also applicable to the generators illustrated in FIGS. 1, 3 and 4. It is to be understood that the generators illustrated in FIGS. 1, 3 and 4 may be charged through a transformer or inductors without the charging resistors, so as to increase the efficiency of the charging process. The high peak power of the jammer is obtained by Hertz boosting during the charging process. Energy is stored in the generator at a slow rate and low power over a long period of time. The energy is released at high power over a short period of time. Peak power for the generator is 10 to 100 kilowatts with a pulse repetition frequency of 1 to 100 kilohertz.

It is thus apparent that the disclosed radio frequency, square wave pulse generator provides a means for producing high peak power pulses with a high pulse repetition frequency for use in jamming radar, data links, voice communication, or other radio frequency signals. The jammer is simple and inexpensive to construct and can produce broader frequency spectrums simultaneously than can conventional jammers.

Many obvious modifications and embodiments of the specific invention other than those set forth above will readily come to mind to one skilled in the art having the benefit of the teachings presented in the foregoing description and the accompanying drawings of the subject invention, and hence it is to be understood that such modifications are included within the scope of the appended claims.

http://www.freepatentsonline.com/4491842.html

Gas-filled tube

From Wikipedia, the free encyclopedia

Jump to: navigation, search

See also: Gas-discharge lamp

A **gas-filled tube**, also known as a **discharge tube**, is an arrangement of electrodes in a gas within an insulating, temperature-resistant envelope. Gas-filled tubes exploit phenomena related to electric discharge in gases, and operate by ionizing the gas with an applied voltage sufficient to cause electrical conduction by the underlying phenomena of the Townsend discharge.

The voltage required to initiate and sustain discharge is dependent on the pressure and composition of the fill gas and geometry of the tube. Although the envelope is typically glass, power tubes often use ceramics, and military tubes often use glass-lined metal. Both hot cathode and cold cathode type devices are encountered.

This article deals with tubes producing visible discharges or used for switching purposes. For the use of gas filled tubes for radiation detection see gaseous ionisation detectors.

Contents

[hide]

[edit] Gases in use

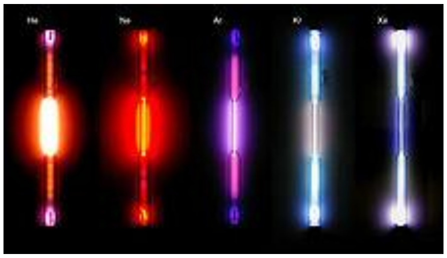
[edit] Hydrogen

Hydrogen is used in tubes used for very fast switching, e.g. some thyratrons, dekatrons, and krytrons, where very steep edges are required. The build-up and recovery times of hydrogen are much shorter than in other gases.[1] Hydrogen thyratrons are usually hot-cathode. Hydrogen (and deuterium) can be stored in the tube in the form of a metal hydride, heated with an auxiliary filament; releasing hydrogen by heating such storage element can be used to replenish cleaned-up gas, and even to adjust the pressure as needed for a thyratron operation at a given voltage.[2]

[edit] Deuterium

Deuterium is used in ultraviolet lamps for ultraviolet spectroscopy, in neutron generator tubes, and in special tubes (e.g. crossatron). It has higher breakdown voltage than hydrogen. In fast switching tubes it is used instead of hydrogen where high voltage operation is required.[3] For a comparison, the hydrogen-filled CX1140 thyratron has anode voltage rating of 25 kV, while the deuterium-filled and otherwise identical CX1159 has 33 kV. Also, at the same voltage the pressure of deuterium can be higher than of hydrogen, allowing higher rise rates of rise of current before it causes excessive anode dissipation. Significantly higher peak powers are achievable. Its recovery time is however about 40% slower than for hydrogen.[2]

[edit] Noble gases



Noble gas discharge tubes; from left to right: helium, neon, argon, krypton, xenon

Noble gases are frequently used in tubes for many purposes, from lighting to switching. Pure noble gases are employed in switching tubes. Noble gas filled thyratrons have better electrical parameters than mercury-based ones.[3] The electrodes undergo damage by high-velocity ions. The neutral atoms of the gas slow the ions down by collisions, and reduce the energy transferred to the electrodes by the ion impact. Gases with high molecular weight, e.g. xenon, protect the electrodes better than lighter ones, e.g. neon.[4]

- Helium is used in helium-neon lasers and in some thyratrons rated for high currents and high voltages. Helium provides about as short deionization time as hydrogen, but can withstand lower voltage, so it is used much less often.[5]
- Neon has low ignition voltage and is frequently used in low-voltage tubes. Discharge in neon emits relatively bright red light; neon-filled switching tubes therefore also act as indicators, shining red when switched on. This is exploited in the decatron tubes, which act as both counters and displays. Its red light is exploited in neon signage. Used in fluorescent tubes with high power and short length, e.g. industrial lighting tubes. Has higher voltage drop in comparison with argon and krypton. Its low atomic mass provides only a little protection to the electrodes against accelerated ions; additional screening wires or plates can be used for prolonging the anode lifetime. In fluorescent tubes it is used in combination with mercury.[4]
- Argon was the first gas used in fluorescent tubes and is still frequently used due to its low cost, high efficiency, and very low striking voltage. In fluorescent tubes it is used in combination with mercury.[4] It was also used in early rectifier tubes; first thyratrons were derived from such argon-filled tubes.
- Krypton can be used in fluorescent lamps instead of argon; in that application it reduces the total energy losses on electrodes from about 15% to 7%. The voltage drop per lamp length is however lower than with argon, which can be compensated by smaller tube diameter. Krypton-filled lamps also require higher starting voltage; this can be alleviated by using e.g. 25%–75% argon-krypton mixture. In fluorescent tubes it is used in combination with mercury.[4]
- Xenon in pure state has high breakdown voltage, making it useful in higher-voltage switching tubes. Xenon is also used as a component of gas mixtures when production of ultraviolet radiation is required, e.g. in plasma displays, usually to excite a phosphor. The wavelength produced is longer than with argon and krypton and penetrates the phosphors better. To lower the ionization voltage, neon-xenon or helium-xenon are used; above 350 torr, helium has lower breakdown voltage than neon and vice versa. At concentrations of 1% and less of xenon, the Penning effect becomes significant in such mixtures, as most of xenon ionization occurs by collision with excited atoms of the other noble gas; at more than few percents of xenon, the

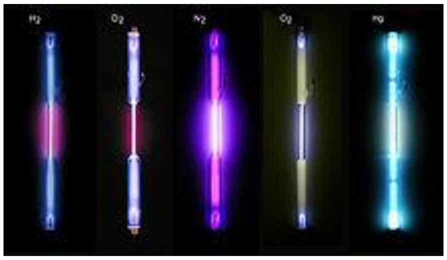
discharge ionizes xenon directly due to most energy of the electrons being spent on direct ionization of xenon.[6]

- Penning mixtures are used where lower ionization voltage is required, e.g., in the neon lamps, Geiger-Muller tubes and other gas-filled particle detectors. A classical combination is about 98–99.5% of neon with 0.5–2% of argon, used in, e.g., neon bulbs and in monochrome plasma displays.

[edit] Elemental vapors (metals and nonmetals)

- Mercury vapors are used for applications with high current, e.g. lights, mercury arc valves, ignitrons. Mercury is used because of its high vapor pressure and low ionization potential. Mercury mixed with an inert gas is used where the energy losses in the tube have to be low and the tube lifetime should be long. In mercury-inert gas mixtures, the discharge is initially carried primarily by the inert gas; the released heat then serves to evaporate enough mercury to reach the desired vapor pressure. Low-voltage (hundreds volts) rectifiers use saturated mercury vapor in combination with a small amount of inert gas, allowing cold start of the tubes. High-voltage (kilovolts and more) rectifiers use pure mercury vapor at low pressure, requiring maintenance of maximum temperature of the tube. The liquid mercury serves as a reservoir of mercury, replenishing the vapors that are used up during the discharge. Unsaturated mercury vapor can be used, but as it can not be replenished, the lifetime of such tubes is lower.[1] The strong dependence of vapor pressure on mercury temperature limits the environments the mercury-based tubes can operate in. In low-pressure mercury lamps, there is an optimum mercury pressure for the highest efficiency. Photons emitted by ionized mercury atoms can be absorbed by nearby nonionized atoms and either reradiated or the atom is deexcited nonradiatively, too high mercury pressure therefore causes losses of light. Too low mercury pressure leads to too few atoms present to get ionized and radiate photons. The optimum temperature for low-pressure mercury lamps is at about 42 °C, when the saturated vapor pressure of mercury (present as a drop of about 1 mg of liquid mercury in the tube, as a reservoir compensating for losses by clean-up) reaches this optimum. In lamps intended for operation at higher ambient temperatures, and at a wider temperature range, mercury is present in the form of an amalgam with e.g. bismuth and indium; the vapor pressure above amalgam is lower than above liquid mercury.[7] Mercury is used in fluorescent tubes as a source of visible and ultraviolet light for exciting the phosphor; in that application it is usually used together with argon, or in some cases with krypton or neon. Mercury ions deionize slowly, limiting the switching speed of mercury-filled thyratrons. Ion bombardment with mercury ions of even relatively low energies also gradually destroys oxide-coated cathodes.[2]
- Sodium vapors are used in sodium-vapor lamps.
- Sulfur vapors are used in sulfur lamps.
- Vapors of many metals, alone or together with a noble gas, are used in many lasers.

[edit] Other gases



Other gases in discharge tubes; from left to right: hydrogen, deuterium, nitrogen, oxygen, mercury

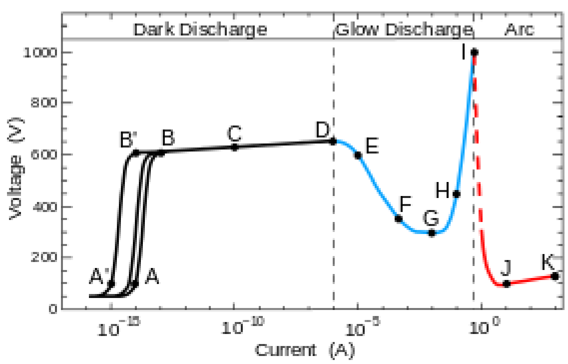
- Air can be used in some low-demanding applications.
- Nitrogen at relatively high pressure tends to be used in surge arresters, due to its short build-up time, giving the tubes fast response time to voltage surges.[1]
- Halogens and alcohol vapors absorb ultraviolet radiation and have high electron affinity. When added to inert gases, they quench the discharge; this is exploited in e.g. Geiger-Muller tubes.[1]

[edit] Insulating gases

Main article: Dielectric gas

In special cases (e.g., high-voltage switches), gases with good dielectric properties and very high breakdown voltages are needed. Highly electronegative elements, e.g., halogens, are favored as they rapidly recombine with the ions present in the discharge channel. One of the most popular choices is sulfur hexafluoride, used in special high-voltage applications. Other common options are dry pressurized nitrogen and halocarbons.

[edit] Gas-tube physics and technology



Voltage-current characteristics of electrical discharge in neon at 1 torr, with two planar electrodes separated by 50 cm.

A: random pulses by cosmic radiation

B: saturation current

C: avalanche Townsend discharge
D: self-sustained Townsend discharge
E: unstable region: corona discharge
F: sub-normal glow discharge
G: normal glow discharge
H: abnormal glow discharge
I: unstable region: glow-arc transition
J: electric arc
K: electric arc
The A-D region is called a dark discharge; there is some ionization, but the current is below 10 microamperes and there is no significant amount of radiation produced.
The F-H region is a region of glow discharge; the plasma emits a faint glow that occupies almost all the volume of the tube; most of the light is emitted by excited neutral atoms.
The I-K region is a region of arc discharge; the plasma is concentrated in a narrow channel along the center of the tube; a great amount of radiation is produced.

The fundamental mechanism is the Townsend discharge, which is the sustained multiplication of electron flow by ion impact when a critical value of electric field strength for the density of the gas is reached. As the electric field is increased various phases of discharge are encountered as shown in the accompanying plot. The gas used dramatically influences the parameters of the tube. The breakdown voltage depends on the gas composition and electrode distance; the dependencies are described by Paschen's law.

[edit] Gas Pressure

The gas pressure may range between 0.001 and 1000 torr; most commonly, pressures between 1–10 torr are used.[1] The gas pressure influences the following factors:[1]

- breakdown voltage (also called ignition voltage)
- current density
- operating voltage
- backfire voltage
- tube lifetime (lower pressure tubes tend to have shorter lifetimes due to using up of the gas)
- cathode sputtering, reduced at higher pressures

Above a certain value, the higher the gas pressure, the higher the ignition voltage. High-pressure lighting tubes can require a few kilovolts impulse for ignition when cold, when the gas pressure is low. After warming up, when the volatile compound used for light emission is vaporized and the pressure increases, reignition of the discharge requires either significantly higher voltage or reducing the internal pressure by cooling down the lamp.[7] For example, many sodium vapor lamps cannot be re-lit immediately after being shut off; they must cool down before they can be lit up again.

The gas tends to be used up during the tube operation, by several phenomena collectively called **clean-up**. The gas atoms or molecules are adsorbed on the surfaces of the electrodes. In high voltage tubes, the accelerated ions can penetrate into the electrode materials. New surfaces, formed by sputtering of the electrodes and deposited on e.g. the inner surfaces of the tube, also readily adsorb gases. Non-inert gases can also chemically react with the tube components. Hydrogen may diffuse through some metals.[1]

For removal of gas in vacuum tubes, getters are used. For resupplying gas for gas-filled tubes, **replenishers** are employed. Most commonly, replenishers are used with hydrogen; a filament made from a hydrogen-absorbing metal (e.g. zirconium or titanium) is present in the tube, and by controlling its temperature the ratio of absorbed and desorbed hydrogen is adjusted, resulting in controlling of the hydrogen pressure in the tube. The metal filament acts as a hydrogen storage. This approach is used in e.g. hydrogen thyratrons or neutron tubes. Usage of saturated mercury vapor allows using a pool of liquid mercury as a large storage of material; the atoms lost by clean-up are automatically replenished by evaporation of more mercury. The pressure in the tube is however strongly dependent on the mercury temperature, which has to be controlled carefully.[1]

Large rectifiers use saturated mercury vapor with a small amount of an inert gas. The inert gas supports the discharge when the tube is cold.

The mercury arc valve current-voltage characteristics are highly dependent on the temperature of the liquid mercury. The voltage drop in forward bias decreases from about 60 volts at 0 °C to somewhat above 10 volts at 50 °C and then stays constant; the reverse bias breakdown ("arc-back") voltage drops dramatically with temperature, from 36 kV at 60 °C to 12 kV at 80 °C to even less at higher temperatures. The operating range is therefore usually between 18–65 °C.[8]

[edit] Gas purity

The gas in the tube has to be kept pure to maintain the desired properties; even small amount of impurities can dramatically change the tube values; presence of non-inert gases generally increases the breakdown and burning voltages. The presence of impurities can be observed by changes in the glow color of the gas. Air leaking into the tube introduces oxygen, which is highly electronegative and inhibits the production of electron avalanches. This makes the discharge look pale, milky, or reddish. Traces of mercury vapors glow bluish, obscuring the original gas color. Magnesium vapor colors the discharge green. To prevent outgassing of the tube components during operation, a bake-out is required before filling with gas and sealing. Thorough degassing is required for high-quality tubes; even as little as 10^{-8} torr of oxygen is sufficient for covering the electrodes with monomolecular oxide layer in few hours. Non-inert gases can be removed by suitable getters. for mercury-containing tubes, getters that do not form amalgams with mercury (e.g. zirconium, but not barium) have to be used. Cathode sputtering may be used intentionally for gettering non-inert gases; some reference tubes use molybdenum cathodes for this purpose.[1]

Pure inert gases are used where the difference between the ignition voltage and the burning voltage has to be high, e.g. in switching tubes. Tubes for indication and stabilization, where the difference has to be lower, tend to be filled with Penning mixtures; the lower difference between ignition and burning voltages allows using lower power supply voltages and smaller series resistances.[1]

[edit] Lighting and display gas-filled tubes

Fluorescent lighting, CFL lamps, mercury and sodium discharge lamps and HID lamps are all gas-filled tubes used for lighting.

Neon lamps and neon signage (most of which is not neon based these days) are also low-pressure gas-filled tubes.

Specialized historic low-pressure gas-filled tube devices include the Nixie tube (used to display numerals) and the Decatron (used to count or divide pulses, with display as a secondary function).

Xenon flash lamps are gas-filled tubes used in cameras and strobe lights to produce bright flashes of light.

The recently developed sulfur lamps are also gas-filled tubes when hot.

[edit] Gas-filled tubes in electronics

Some important examples include the thyratron, krytron, and ignitron tubes, which are used to switch high-voltage currents. A specialized type of gas-filled tube called a Gas Discharge Tube (GDT) is fabricated for use in surge protectors, to limit voltage surges in electrical and electronic circuits.

[edit] List of -tron tubes

[9]

- Mercury pool tubes
  - Excitron, a mercury pool tube
  - Gusetron or gausitron, a mercury arc pool tube
  - Ignitron, a mercury pool tube
  - Sendytron, a mercury pool tube
- Trignitron, a trade name for a mercury pool tube used in electric welders
- Capacitron, a mercury pool tube
- Corotron, a trade name for a gas-filled shunt regulator, usually contains small quantities of radioactive materials to set the regulated voltage
- Crossatron, a modulator tube
- Kathetron or cathetron, a hot cathode gas filled triode with grid outside of the tube
- Neotron, a pulse generator
- Permatron, a hot cathode rectifier with anode current controlled by magnetic field
- Phanotron, a rectifier
- Plomatron, a grid-controlled mercury-arc rectifier
- Pulsatron, a gas-filled triode with two cathodes
- Strobotron, a cold cathode tube designed for high current narrow pulses, used in high-speed photography
- Takktron, a cold cathode rectifier for low currents at high voltages

- Thyratron, a hot cathode switching tube
- Trigatron, a high-current switch similar to a spark gap
- Alphatron, a form of ionization tube for measuring vacuum
- Dekatron, a counting tube (see also nixie tube and neon light)
- Plasmatron, a hot cathode tube with controlled anode current
- Tacitron, a low-noise thyratron with interruptible current flow
- Krytron, a fast cold-cathode switching tube

[edit] See also

- List of plasma (physics) articles
- Townsend discharge - The fundamental mechanism of electron multiplication in an electric field

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[edit] External links

Wikimedia Commons has media related to: ***Gas discharge lamps***

- Pulse Power Switching Devices – An Overview (both vacuum and gas filled switching tubes)
- Measurement of Radiation, Gas Filled Detector
- Gas discharge tubes

http://en.wikipedia.org/wiki/Gas-filled_tube

How To Build A Tin Can Waveguide WiFi Antenna

for 802.11(b or g) Wireless Networks or other 2.4GHz Applications

click on image to enlarge

Got no dough for a commercial WiFi antenna? Looking for an inexpensive way to increase the range of your wireless network? A tin can waveguide antenna, or Cantenna, may be just the ticket. This design can be built for under $5 U.S. and reuses a food, juice, or other tin can.

I am not an electrical engineer, nor do I have access to any fancy test equipment. I've built some antennas that worked for me and thought I would share what I learned. I have no idea if this is safe for your radio or wireless network equipment. The risk to you and your equipment is yours.

Building your Cantenna is easy, just follow these steps.

1. **Collect the parts**
2. **Drill or punch holes in your can to mount the probe**
3. **Assemble the probe and mount in can**

Collect the parts:

You'll need:

- A N-Female chassis mount connector.
- Four small nuts and bolts
- A bit of thick wire
- A can

These vendors can supply the parts (the wire and can you provide yourself).

The Connector
A N type Female Chassis-mount connector. One side is N-female for connecting the cable from your wireless equipment, and the other side has a small brass stub for soldering on wire. These can be found at electronics stores internet suppliers (see the list below under "Connect your antenna..." If you shop around, you should be able to find these for $3-$5.

Nuts & Bolts
You'll need them just long enough to go through the connector and the can. I've used #6x1/4" stainless. If your N-connector is a screw on type, then you won't need the nuts and bolts.

Wire
You'll need about 1.25" of 12 guage copper wire. This wire will stick into the brass stub in the N-connector.

A Can
This is the fun part. You're looking for a can between about 3" and 3 2/3" in diameter. The size doesn't have to be exact. I made a good antenna with a Nalley's "Big Chunk" Beef Stew can that was 3.87" in diameter. Others have reported good results with big 39oz. coffee cans that are 6" in diameter. The pringles can is really too small for good performance, however. Try to get as long a can as possible. The old fashioned fruit juice cans should work well.

Click on image to enlarge

Drill or punch holes in your can to mount the probe

The N-connector assembly will mount in the side of your can. You need to put holes in the right place to mount the connector. The placement of the hole and connect is very important. It's location is derived from formulas that use the frequency that the antenna will operate at and the can diameter. To make life easy on you, here's a calculator to figure it out for you.

Click on image to enlarge

3.25 **Can Diameter**

Cuttoff Frequency in MHz for TE11 mode	MHz
Cuttoff Frequency in Mhz for TM01 mode	MHz
Guide Wavelength in Inches	inches

1/4 Guide Wavelength	inches
3/4 Guide Wavelength	inches

Enter the diameter of your can above and click on the calculate button. 802.11b and 802.11g WiFi networking equipment operates at a range of frequencies from 2.412 GHz to 2.462 GHz. Ideally, with your can size, the TE11 cut-off frequency should be lower than 2.412 and the TM01 cut-off should be higher than 2.462. It would be good, also, if your can is longer than the 3/4 Guide Wavelength. If your can is a little off in length or diameter, don't despair, experimentation is fun!

You want to mark the location on the can where you will put the hole for the connector. The 1/4 Guide Wavelength number tells you how far up from the bottom metal end of the can to put the center of the hole. Open only one end of your can, eat the contents, and give it a good washing. You'll probably want to remove the label too. Use a ruler to measure up from the closed end 1/4 Guide Wavelength and mark the can with a dot.

If you've got a drill, select a bit that matches the size of the center of your connector. You may want to start with a small bit and work the hole larger and larger. You could even start with a hammer and nail, then use drill bits. If you don't have a drill, start with a nail hole and use a file to get the hole to the required size. If you're using a bolt on connector, make four more holes for the bolts - you can use the connector as a drilling guide.

Assemble the probe and mount in can

Now you'll need that bit of wire. You'll need a soldering iron or a friend with one as well. Cut the wire so that when it is stuck in the connector as shown, the total length of both the brass tube and wire sticking out past the connector is 1.21". Get as close to this length as you can.

When you've got your wire correctly sized, solder it into the connector keeping it as straight and upright as you can. When it's cooled, bolt or screw the assembly into your can. Put the heads of the bolts inside the can and the nuts on the outside to minimize the obstructions in your antenna. Your Done!

Connect your antenna to your wireless card or access point

To use your cantenna, you'll need a special cable commonly called a "Pig Tail". The pig tail connects your wireless card or access point to you antenna. One end of the cable will have a "N" Male connector (just right for connecting your your cantenna), while the other end will have a connector appropriate to your card or access point. For a good picture of a pig tail, take a look at: http://www.seattlewireless.net/index.cgi?PigTail

You'll want to have a wireless NIC or access point with an external antenna connector. Otherwise, you may have to hack into the one you have to hook up the cable. I wouldn't recommend this unless you're good with a soldering iron and electronics. For this reason, I like the Agere Orinoco cards which have a nice antenna connector. Pig Tails can be hand made if you have the right tools, but it's probably easier to get a pre-made one. Try:

- Fleeman Anderson & Bird
  Fleeman Anderson & Bird has a "cantenna kit" for sale that includes the connector and pigtail. Choose one of the "cables" links from the menu and look towards the bottom of the list.
- Hyperlinktech
- Antenna Systems

Hook up your cable, point the antenna at a friend's, and see how far you can stretch you network. Be sure to let me know (greg@turnpoint.net) how it works.

This antenna has linear polarization. That means that how you rotate the antenna will affect the strength of your signal. Usually, you will want to put the connection straight down, but experiment with rotating the can while watching the signal strength on your PC to get the best performance.

For more information, check out these resources:

- The ARRL Antenna Handbook
- A Tin Can Design with good theory information.
- A free on-line book on microwave antennas
- "Juice Up" your Tin Cantenna with a surplus satellite dish.

- Spreadsheet for optimum can size calculation

Go to the Homebrew WiFi Antenna Shootout

Go to the Wireless Home

http://www.turnpoint.net/wireless/cantennahowto.html

community wireless

wlan.org.uk

internet access

HOME

Antennas, Amplifiers and Propagation Topics

(for Microwave WLANs)

LAST UPDATED: Monday 9th August 2010

KA3SDP (USA) installs Alford Slot antenna

Click on the headings below

ANTENNAS
AMPLIFIERS
PROPAGATION Topics

Sponsors Links

****

****

****

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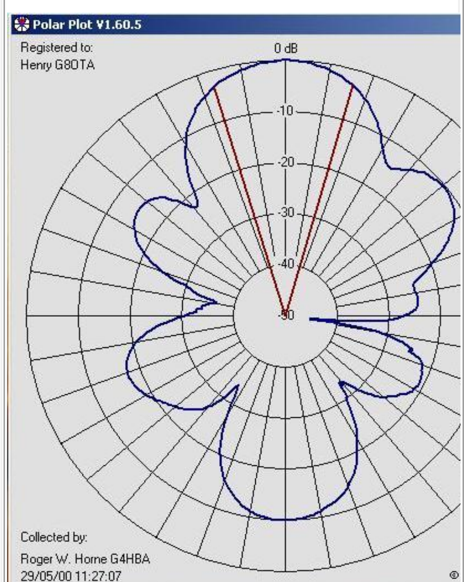
PROPAGATION:

RAIN ATTENUATION

NOTES on 802.11 rain attenuation

propagation thru rain.htm

from John Waters



G4HFQ POLAR PLOTTING PROGRAM

PolarPlot is a program that lets you see what the polar diagram of your rotatable beam antenna

actually looks like where it is operating. It has been written for the ham radio community interested

in knowing more about their beam antennas.

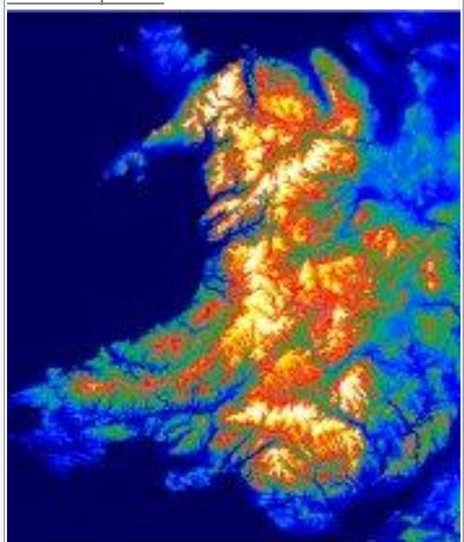
You can **download** and try out PolarPlot to see if you like the look of it. The program will operate fully for 30 runs during a 15 day period. You can check that it works on your equipment and take take a look at some sample antenna plots. All that is needed (apart from your rig of course!) to measure your own or someone else's antenna is a standard PC with a sound card. For more information look at this **copy of the user guide** PolarPlot runs on Windows 95/98, Windows/NT4 and Windows 2000, desktop machines and even laptops!

With PolarPlot you can measure the polar diagram of the antenna and check for abnormalities - compare plots taken before and after changes to the design or location - check the -3dB beamwidth - look at the front to back ratio - see the size and position of the sidelobes - compare the design pattern to the actual -

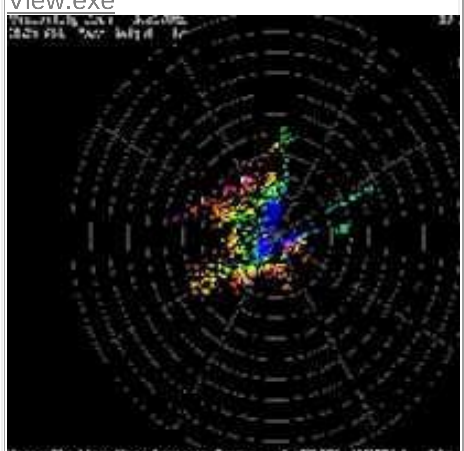
gain a better understanding of the antenna. You can view the plot on a circular or rectangular grid, with either log or linear scales. The screenshot on the right is a 2m beam before and after a re-build - the blue is the before, and the red is the after!. Take a look at some more **screenshots** of PolarPlot in action.

http://www.g4hfq.co.uk/index.html

localmap.exe



View.exe



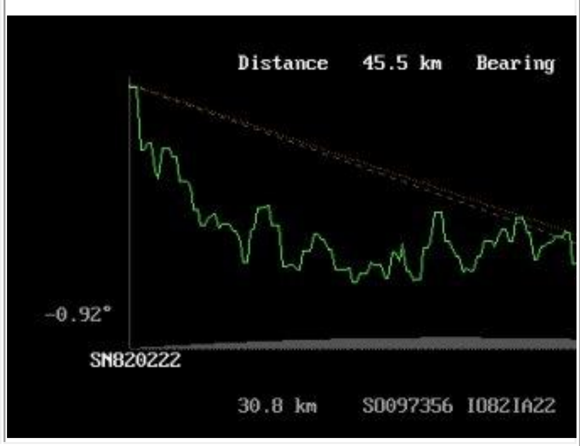
G4JNT Microwave Broadband (ATV) path prediction program for PCs

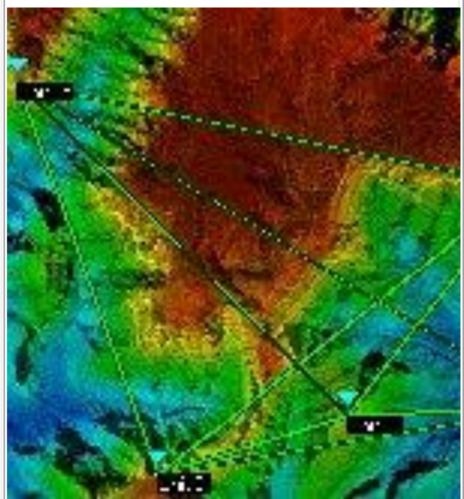
A set of Public Domain programs for plotting microwave (broadband amateur television) line of sight radio pathways,using NGR/Locator Grid. Draws Localmaps around a given point. Point-to-point Terrain paths and optical horizon Views.

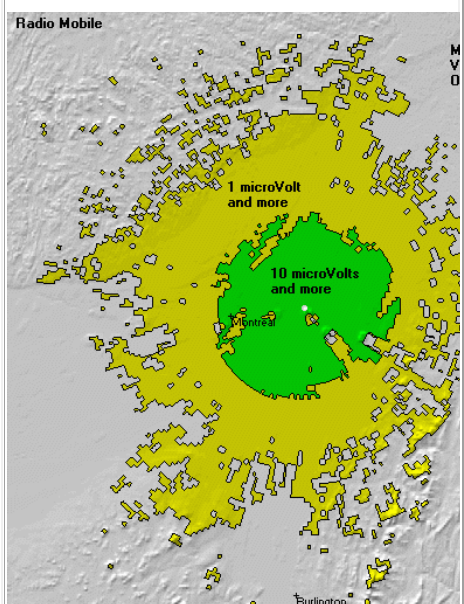
Mainland Britain only. MicroSoft DOS or Windows.

http://www.wlan.org.uk/downloads/g4jnt-atv.zip

Terrain.exe







VE2DBE "RADIO MOBILE" path prediction program for PCs

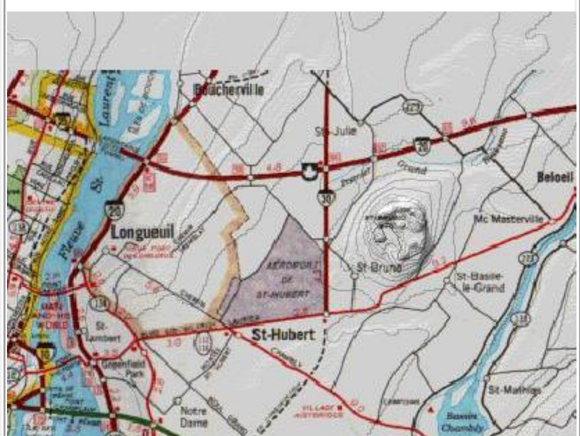
Radio Mobile Version 3.5.4 Radio Propagation and Virtual Mapping Freeware by VE2DBE.

An up-to-date Windows program useable world-wide requiring additional mapping and topographical data obtainable from other external sources.....

Elevation data For most of the world is available

The software also provides 3D views, stereoscopic views, and animation.

Freeware by VE2DBE



http://www.cplus.org/rmw/english1.html

Getting started in "Radio Mobile"

G8GTZ (20/3/2002)

Getting started in "Radio Mobile"

Radio Mobile is a fantastic program for predicting links and radio coverage. However, it does take some time to get to know and the user documentation is not the best! So here is the G8GTZ how to get started guide.

Download in original Word format

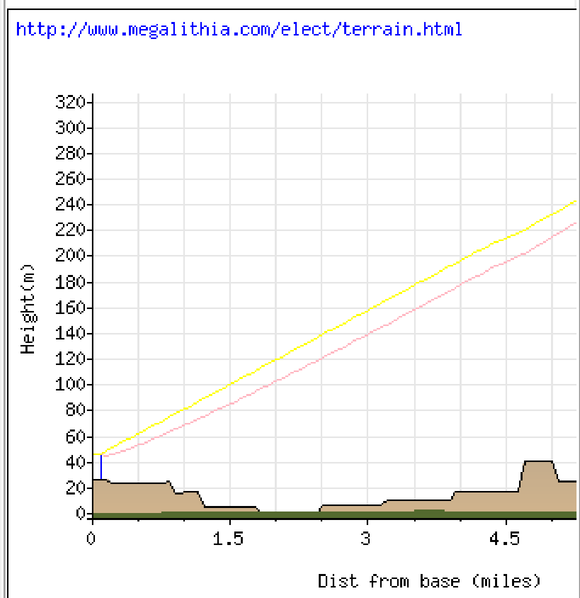
Noel - G8GTZ

http://www.cplus.org/rmw/getting_started.html

ONLINE Terrain Plot

(United Kingdom Only)

Online Terrain Plot U.K.



This page is an online implementation of a program used by UK radio amateurs since 1993. Credit is due for the original Power Basic design, logic and implementation Andy Talbot G4JNT

http://www.megalithia.com/elect/terrain.html

KISMET

Features

Multiple packet capture sources
Runtime network sorting by AP MAC address (bssid)
IP block detection via ARP and DHCP packet dissection
Cisco product detection via CDP
Ethereal and tcpdump compatable file logging

Kismet 802.11b Wireless Network Sniffer (Linux Based)

What is it?

Kismet is a 802.11b wireless network sniffer. It is capable of sniffing using almost any wireless card supported in Linux, including Prism2 based cards supported by the Wlan-NG project (Linksys, Dlink, Rangelan, etc), cards which support standard packet capture via libpcap

Airsnort-compatable "interesting" (cryptographically weak) logging Secure SUID behavior Cloaked network detection Grouping and custom naming of SSIDs Multiple clients viewing a single capture stream Graphical mapping of data Cross-platform support (handheld linux and BSD)	(Cisco), and limited support for cards without RF Monitor support. top Author: Mike Kershaw (*dragorn@kismetwireless.net*) http://www.kismetwireless.net/index.shtml 5/2002	
	Net Stumbler *NetStumbler.com is a website dedicated to wireless networking technology and security of all kinds. We do our best to keep our website up to date with the latest wireless news - we really appreciate user submitted stories. NetStumbler.com is also the official home of the NetStumbler software.* *NetStumbler is a Windows utility for 802.11b based wireless network auditing written by Marius Milner.* http://www.netstumbler.com/ March 2004	
	SMART ID - WFS-1 WI-FI Detector *It is becoming increasingly difficult not to be caught up in WiFi traffic since so many homes and businesses are taking advantage of this technology. Unfortunately, the ever-decreasing prices and ever-improving ease-of-use has also caused wireless networks to be real security problems within businesses and institutions. At a personal level, it would be useful to have a way to know where these public "hotspots" are without having to carry around equipment that makes you look like an extra from a Star Trek set. At a corporate level, it would be extremely advantageous to have a means to detect rogue WiFi equipment at all company sites without having to spend many thousands of dollars on*	

an enterprise-level WLAN detection system.

A solution may be at hand with the appearance of two "pocket-sized" 802.11 detectors on the market: the Smart ID WFS-1 and the Kensington WiFi Finder. Both devices claim to detect 802.11b and 802.11b/g traffic and report the strength of the signals. They each cost in the area of $30 USD. The question is: how well do they work and how can you use them for both personal information gathering and corporate protection?

Bob Rudis
September 2, 2003

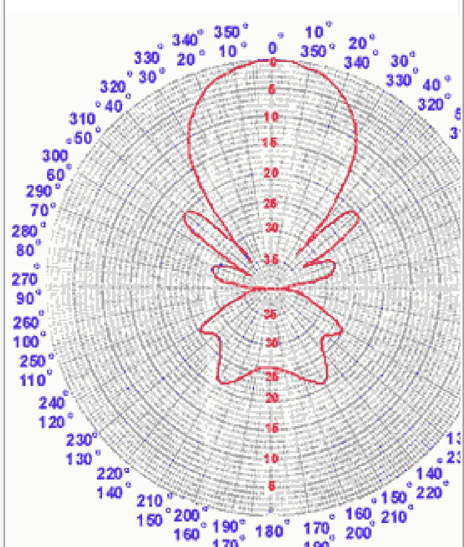
http://www.smartid.com.sg/

March 2004

Understanding Antenna Radiation Patterns

Technical Library

Astron Wireless Technologies, Inc.



Understanding and Using Antenna Radiation Patterns
By Joseph H. Reisert

Each antenna supplier/user has different standards as well as plotting formats. Each format has its own pluses and minuses. Hopefully this technical note will shed some light on understanding and using antenna radiation patterns.

All antennas have directional qualities. They do not radiate power equally in all directions. Therefore, antenna radiation patterns or plots are a very important tool to both the antenna designer and the end user. These plots show a quick picture of the overall antenna response. However, radiation patterns can be confusing.

http://www.astronantennas.com/radiation_patterns.html

March 2004

HOME

Click on the headings below

ANTENNAS

AMPLIFIERS

PROPAGATION Topics

ANTENNA:

Aironet Wireless Communications

11 Mbps Wireless LAN Solution For Small Businesses About Wireless/ Evolution of Wireless Advantages Glossary Future of WLAN What is Wireless Local Area Networking? In the simplest of terms, WLAN is local area networking without wires, providing all the features and benefits of traditional LAN technologies like...

5/27/2000

http://www.aironet.com/wireless

CanTenna

CanTenna - WB8ERJ

I have come up with my own version of the classic "cantenna" using 4 inch diameter aluminum dryer vent pipe, and a 4 to 6 inch pipe adapter. Although the basic design is the same as other cantenna type antennas, the materials I ended up using are a bit different. Preliminary results show a gain of 15 DBi. Not bad for less than $10 worth of materials!

Mike Thompson WB8ERJ

Check out Mike's Web pages:
http://wb8erj.home.att.net

My Ham Radio page:

	http://www.qsl.net/wb8erj http://www.qsl.net/wb8erj/wirelessCantenna.html March 2004	
CIRCULAR WAVEGUIDE ANTENNA 	**CIRCULAR WAVEGUIDE ANTENNA** We have been experimenting with waveguide antenna, made from old food cans, to massively extend the range of 802.11b wireless networks. All that was required was fitting, in the correct place, a driven element consisting of a short piece of copper wire soldered into the centre of an N-type connector. One of the antennas made from a J&B whiskey tin. This was evolved primarily since the Pringle's can antenna. The Pringle's can, being cardboard, does not last long in a storm, and it is very hard to affix connectors securely. The dipole-less "yagi" bit inside is fiddly to make, and initial tests show the waveguide cans to work better. Author: spacepleb@psand.net http://flakey.info/antenna/waveguide/ Dec 2004	
Cisco Aironet Antennas	CISCO AIRONET Every wireless Local Area Network (LAN) deployment is different. When engineering an in-building solution, varying facility sizes, construction materials, and interior divisions raise a host of transmission and multipath considerations. When implementing a building-to-building solution, distance, physical obstructions between facilities, and a number of transmission points involved must be accounted	

and Accessories

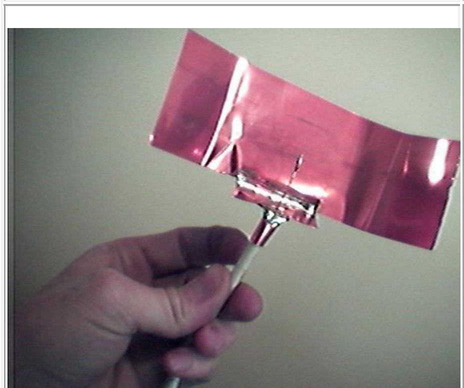
for.

Cisco is committed to providing not only the best access points, client adapters, and bridges in the industry — it is also committed to providing a complete solution for any wireless LAN deployment. That`s why Cisco has the widest range of antennas, cable, and accessories available from any wireless manufacturer.

With the Cisco FCC-approved directional1 and omnidirectional2 antennas, low-loss cable, mounting hardware, and other accessories, installers can customize a wireless solution that meets the requirements of even the most challenging applications.

http://www.cisco.com/univercd/cc/td/doc/pcat/ao____o1.htm#xtocid0

Jan 2003

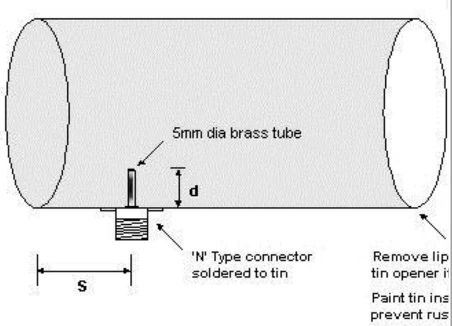


Amateur Antenna #1

This "15 minute antenna" is a quarter-wave ground-plane antenna with trough reflector formed on the end of 50 ohm coaxial cable with a light sheet metal trough type of reflector.

(Photo only) Estimated gain >8 dBi

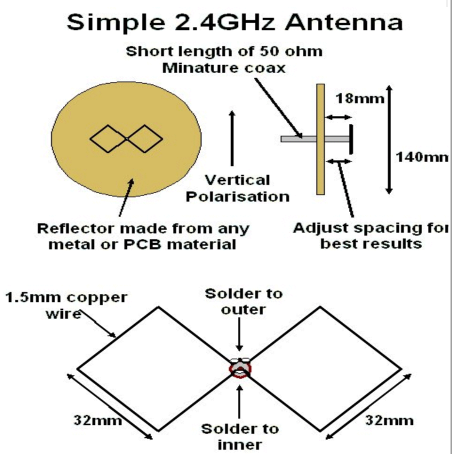
http://www.wlan.org.uk/cheapo.gif



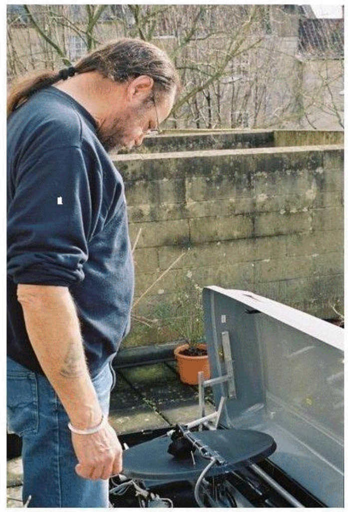
Amateur Antenna #2

A simple concept, the "circular waveguide antenna" is repeatable & easy to make with simple tools and without instruments.

These are often calculated and built as efficient amateur dish feeds. The dimensions given in the example offers 13.5dBi gain... with a beam-width approximately that required to efficiently

	illuminate a standard British satellite dish of f/D ratio = .72) **Radproject 2000** http://www.wlan.org.uk/tincan.gif	
	Amateur Antenna #3 The simple 2.4GHz Double Quad Antenna is a compact and easy to make high performance antenna offering some 14.4dBi gain. As with the "circular waveguide antenna" type also on this page it offers a beam-width (in the vertical plane) not far off that required to efficiently illuminate a standard British satellite dish of f/D ratio = .72) The optimum reflector to element spacing requires a VSWR measurement system for a precise impedance match...... http://www.wlan.org.uk/simple_double_quad.gif	
	Amateur Antenna #4 The European "ASTRA" Direct Broadcasting Satellite (DBS) pole mounted parabolic dish of 60cms dia. with an efficient ("double-quad") feed is capable of over 25dBi forward gain. Double Quad Feed In this example the top stub mast is mounted on a standard Amateur Radio rotator made by Kenwood which motorises through 360 degrees rotation and the whole mast folds down into a "Rooftop Ski Box" on top of Amateur Radio vehicle G8OTA/M (mobile RV). (Pictures) http://www.wlan.org.uk/g8ota double-quad.gif	

Roof-top folding antennna for long-range WLA



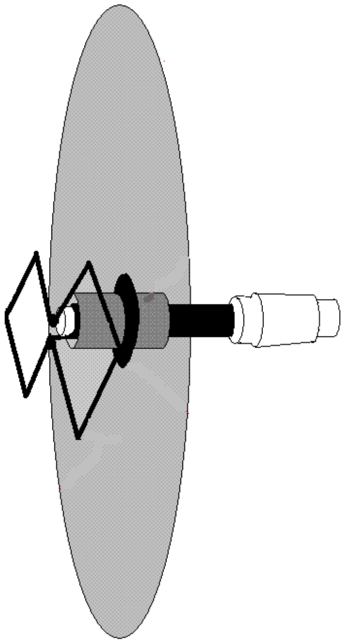
Alun (G0TJP) inspects the "ski-box" folding dish antenna

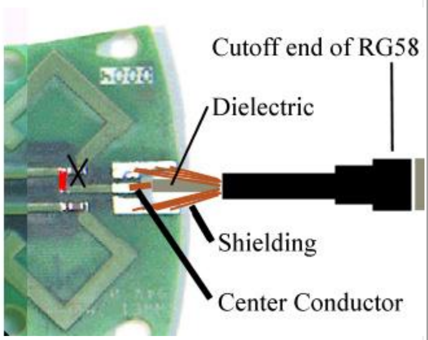
The folding lid
limit switch ass

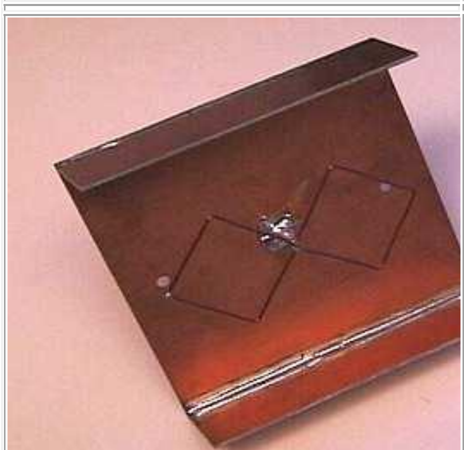
Double Quad (Bow Tie)

Double Quad

* A compact directional antenna useful for workshop and hand-held operation
* Fair gain (14 dBi)
* Wide bandwidth (full 802.11b/g spectrum)
* More compact than Yagi or circular waveguide types of equivalent gain

	* Fits a wide range of microwave cooking food containers * Ideal as a feed to a standard domestic satellite dish * Liberal mechanical tolerances * useful as reference antenna * Easy to replicate (- but do use correct gauge wire and thickest & best microwave coax you can afford !) * Can use a 120mm CD as a reflector with slightly diminished performance at 2.4GHz * Can omit the "Sleeve Balun" for ordinary Wi-Fi use * Scalable for many frequencies * See equally practical other variants on this page.. *Originally from a German Amateur Radio Microwave Compendium design concept of the 1980's this antenna concept has proven popular for broadband Amateur TV and I have made examples of these from 600MHz to 6GHz.* *It exploits the 6dB gain from solid plane reflector (not everyone knows that !)* *Henry - G8OTA* http://www.wlan.org.uk/g8ota double-quad.gif March 2008	
	Antcaptenna A printed circuit 12 dBi version of the Double Quad, house in an ABS plastic case. *The AntCaptenna (ACA) was born from a desire to make an antenna that could be used as a 'client' antenna (i.e. used to connect to an AP) - had a reasonable gain (12-14 dBi) - was waterproof - was rugged - could be pole-mounted. The result was the AntCaptenna - which gets its name from the Ant-Cap used as the back reflector.*	

	[Ant Caps are used on wooden stumps in Western Australia, to prevent white ants (termites) from coming up from the ground into the house. **Rob Clark** http://www.erlang-software.com/FreeNet http://members.iinet.net.au/~clark/FreeNet/AntCaptenna/ May 2003
DWL-650  	Adding an Antenna for DWL-650 PCMCIA card a short guide to voiding your warranty by: Will Rachelson < will at c0rtex dot com > The DWL-650 I purchased this card because it was the cheapest (<$100 @ CompUSA). I knew that I was going to build an antenna, but wanted to do so very cheaply. The connectors for the Lucent cards are costly and hard to find. There were some nice pictures at seattlewireless that convinced me it would be easy to add an antenna. http://kevlar.burdell.org/~will/antenna/

	Use a Surplus Primestar Dish as an IEEE 802.11 Wireless Networking Antenna High gain from a simple DIY project. Uses a circular waveguide feed for illuminating a surplus Direct Broadcast Satellite (DBS) dish made here from a juice can and co-axial connector.....The author notes that the optimum length should be between 14 and 21 inches with the (can) opening at the focus of the dish. **see** Amateur Antenna #2 above  http://www.wwc.edu/~frohro/Airport/Primestar/Primestar.html	
	Bi Quad Feed for Primestar Satellite Dish	

Author: Trevor Marshall

"That's all there is to it, folks -- you now have a dish with 27-31 dBi of gain and negligable sidelobe radiation (<40dB). The beamwidth is about 4 degrees."

http://trevormarshall.com/biquad.htm

see below: WLAN Slotted Waveguide Antennas by the same authorTrevAuor

Central States VHF Society

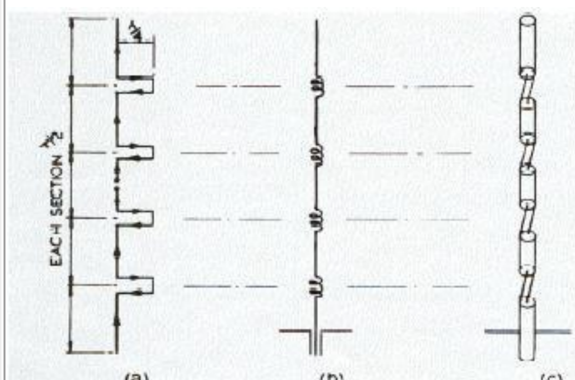
Antenna Test Reports

Central States VHF Society - USA

The Central States VHF Society has conducted Antenna Gain Measurements since its inception in 1967.

The published results can be used to make comparisons between commercial and homebrew antennas, between different homebrew designs, and between different commercial designs.

Comparisons can be made between antennas measured in different years on the 50 MHz through 432 MHz bands because the same reference antennas have been in use for over 10 years!

	http://www.csvhfs.org/CSVHFANT.HTML **Nov 2004**	
OMNI DIRECTIONAL ANTENNA **DESIGN**	Design of a Planar Omnidirectional Antenna  **Randy Bancroft and Blaine Bateman** http://www.centurion.com/pdf/wp_omni_wireless.pdf March 2004	
EASY HOMEBREW CO-LINEAR OMNI for 2.4GHz	EASY HOMEBREW CO-LINEAR OMNI for 2.4GHz   **A 6dBi Vertical Polarised Omnidirectional Antenna** An easy step-by-step guide go making a homemade wireless antenna, for a fraction of the cost of commercial antenna. Uses readily available parts, and requires no specialist tools or knowledge.Or in geek speak - an omnidirectional colinear dipole design suitable for wifi compatible	

	hardware with external antenna connector. http://www.amsterdamwireless.net/workshop-15-12/3.html Oct 2003	
	## Satenna Double Quad type satellite dish feed design... *The Satenna is a complete unit: 65cm satellite TV dish, plus SatCap. The combined gain is 29 dBi.* *You can make your own Satenna by simply buying or building a SatCap, and combining with a locally purchased satellite TV dish. Search your local 'Yellow Pages' for satellite TV installers for good prices on dishes and roof mounts.* **Rob Clark** http://www.erlang-software.com/FreeNet http://members.iinet.net.au/~clark/FreeNet/index.htm May 2003	

"HOT SPOT 16"

WLAN-MAX - BRISTOL U.K.

"HOT SPOT 16"

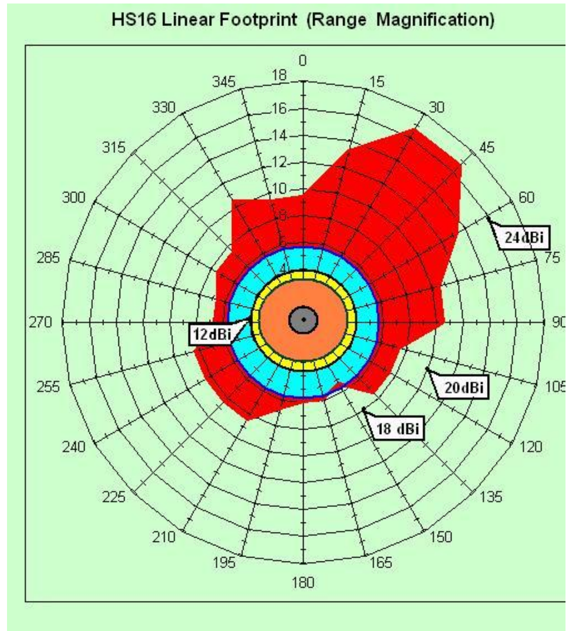
Highest Performance Community WLAN Service Antenna for 2.4GHz

For best long range performance, horizontal polarization is a more effective polarization method. At 16dBi this antenna claims to be "the best omnidirectional horizontal polarisation service antenna available anywhere in the world"

*Using new patented technology the "HS16" example offers a nominal all round 16dBi omnidirectional gain for general **"point to multi-point service".***

*Using a pair of dual antenna access points these antenna each exhibit a **sector gain** of more than 20dBI (x 10 range) over a 90 degree sector, so that 4 of these antenna back-to-back at 90 degs (a Quad Block) more than cover a square service footprint with sides 20n x 20n where "n" is the normal isotropic antenna range...*

*It additionally features **a directional peak** 24 dBi (x16 range) in one 15 degree sector for long range interlinking, obviating the need for an additional point-to-point dish up to 60cm dia.....see **Field Plot***



R.F. Termination = Silver plated "N Type" line socket Length = 1.8 metres. Weight = 7 Kg Mounting = 48mm dia.x 6mm thick walled aluminium stub. Casing White UPVC. Wind Loading Tested for 200 Km/h
Best VSWR = 1.04:1 (2445MHz)

This antenna is not yet commercially manufactured and distributed but can be supplied as "designer samples" individually hand made and tested at: **$799** each.

Further details: A-Antenna Limited....

Vertically Polarised Omnidirectional Co-linear Array Antenna

Vertical Co-axial Sleeve Co-linear Array

A vertically polarised omnidirectional co-linear sleeve dipole array consisting of a number of stacked omni-directional elements.

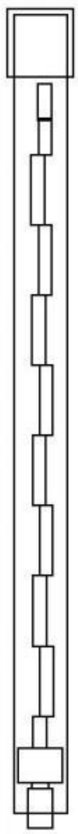
with about 9dBi gain as shown.....

Radproject 2000

http://www.wlan.org.uk/co-linear.gif

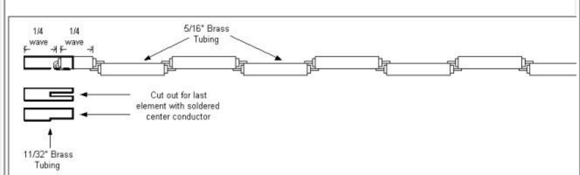
Vertically Polarised 6dBi Co-Linear

www.guerrilla.net

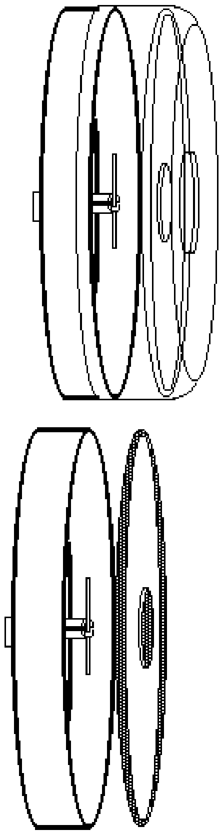


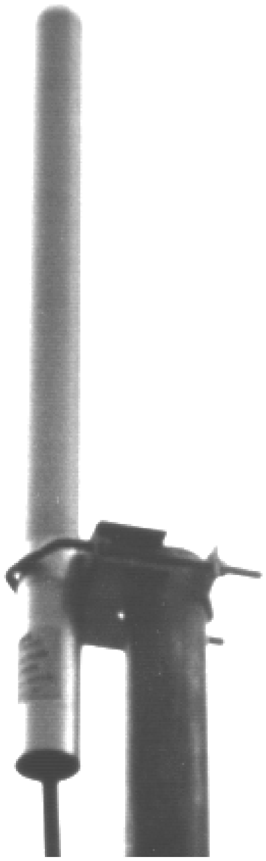
You have seen them in catalogs for $150 to $250. Now you can build one for a fraction of the cost at the expense of some time. Construction time can take as little as a few days up to a few weeks, depending on your drive and resourcefulness. Proper acquisition of materials and the tools at your disposal will speed up the construction time. We will go over some theory, tools and materials required, construction steps for the feeble minded, installation tips, and our actual measured results. Construction of an assembly jig will also be covered for those that wish to mass produce a few of these for your community users. Everyone will need at lease one of these units for the multipoint location. Also for those who desire to provide access to a geographic location outside of their immediate locality.

The collinear antenna was historically used by repeater sites, stacking various 1/2 wave dipole elements on top of each other for increased gain connected by some equipment to correct for phase error between the elements of the array. The higher in frequency the better in gain you can achieve in a relatively small assembly. The eight (8) element array we build here will yield 6dBi gain in a radome of less than a meter.



http://www.guerrilla.net/reference/antennas/2ghz_collinear_omni/

	Wlan antenna 2.4 GHz Do-It-Yourself "My antenna has found been about 2 dB better gain than the Freedom antenna, which is specificated as 12 dBi antenna." (This >14dBi measured gain should make a good dish feed for an Ex-Astra European Satellite Dish.) 11 July 2001 **Martti Palomaki** http://www.saunalahti.fi/~elepal/antenna1.html	
Circular Polarised Helical Directional Antenna	Circular Polarised Helical Directional Antenna A high performance circularly polarised directional antenna with a calculated gain of 18.2 dBi. Similar in concept to the Jason Hecker design also on this page.. **W0OQC Feb 1998** http://www.wlan.org.uk/helix.gif	



BLR-6GCC 2.4-2.5 GHz Ground Plane Antenna

BLR-6GCC is 4x5/8 vertical omnidirectional Ground Plane Antenna. The antenna's body is made of silver plated copper wire placed in the PVC radome. The feedpoint is a standard N female conector that is protected from the weather within the lower aluminum tube. A galvanized steel bracket provides easy side or top mounting to a 20-60mm dia. mast.

Horizontal radiation pattern is circular with 8.2dBi gain. Vertical radiation pattern is with downtilted lobes for good short and far distance coverage.

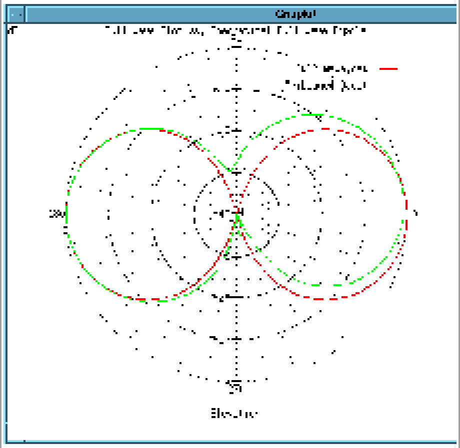
* Real 8.2 dBi gain .
* Downtilt mainlobe and sidelobe .
* Easy mouting .
* Excelent price/performance ratio .

Price US $150

Naugarduko 41 LT 2600 Vilnius Lithuania

Tel : +370 2 263068 Fax: +370 2 263668

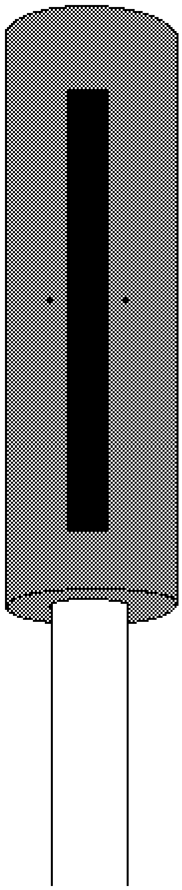
http://www.vigintos.com/elmika/



The "Truth" About Horizontally Polarized Omni-Directional Antennas

There are about 5,000 different antenna designs in existence. Of those 5,000 designs, horizontal omnis seem to be the one design most shrouded in mystery in the amateur radio world. UHF applications requiring horizontally polarized omni-directional antennas usually use an Alford Slot, its cousin the Rib-Cage Slot, or a loop antenna. Unfortunately, technical references containing slot antenna information rarely contain practical design information required to build such antennas reliably, and few experimenters have access to the resources needed to fully analyze the radiation properties of their antennas over wide bandwidths. A low VSWR is often mistaken as meaning an antenna is functioning well. However, VSWR means nothing when it comes to radiation patterns and antenna gain.

http://www.qsl.net/kd2bd/superturnstile.html

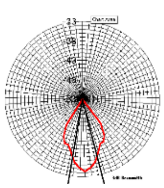


Measured Performance Of The WB0QCD Alford-Slot Antenna

You've seen the ads. "5.6dBd gain...flat VSWR and good gain bandwidth performance over the entire 420-440 MHz band"... But just how well does the WB0QCD antenna perform in real life? We put ours to the test on a professional antenna range and the results we found were less than impressive!

First, the good news. The WB0QCD Alford-Slot antenna is a mechanically solid antenna that does exhibit a horizontally polarized, omni-directional radiation pattern. The E-plane pattern is consistant with that of a single axially slotted cylindrical antenna with a small diameter/wavelength ratio (see G. Sinclair, "Patterns of Slotted-Cylinder Antennas" Proceedings of the IRE, vol. 36, pp.1487-1492; December, 1948). The antenna is about 3 dB more responsive in the direction of the slot than it is off the rear of the antenna. This feature is consistant across the entire 420 MHz to 450 MHz band.

http://www.qsl.net/kd2bd/slot.html



How to Make a Simple 2.425GHz Helical Aerial for Wireless ISM Band Devices

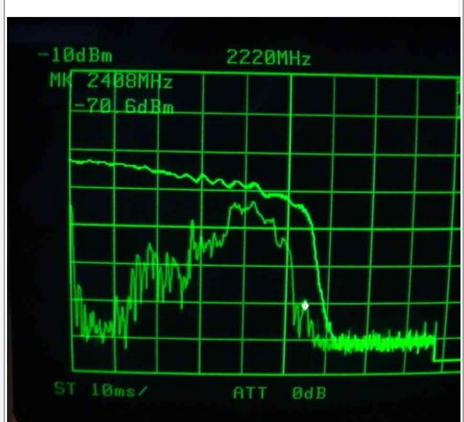
A comprehensive and well written DIY constructional article from Australia on making a 2.4GHz antenna with about a x 8 range magnification factor.......

(excellent case study example)

Jason Hecker

http://home.iprimus.com.au/jhecker/

http://www.wlan.org.uk/jhecker.html



Improved Helical Antenna Design for 802.11b WLAN - by *PA0HOO*

The Disappointment

It was very disappointing to find out that 'the thingy' we made wasn't performing at all. Even the relatively small distance of 200 m could not be bridged. What was it that we did wrong??.

The dimension were OK, all sizes were according to the known formulas. The proven calculating programs such as helix_20 from Holger Granholm and 'HelixCalc' from Jason Hecker gave similar dimensions.

The Experiment

We tried to find out the real 'over the ether' behavior of the antennas over a wide spectrum. We could use a cable TV spectrum analyzer up to 4 GHz and tracking generator up to 2450 MHz. Test area: our living room...
We were astonished to discover that the antennas were radiating very well around 1650 MHz. 2450 was just outside the band pass. See the 'test set up' and the graph below.

Detailed examination of the antenna design

Looking into detail, there IS a difference between de ordinary Helix antenna and the PVC-one: The classical helix is al 'on air' spiral, our spiral is 'on PVC'. Kraus' formulas, calculate air spirals. As our spiral is on PVC, it COULD be that the traveling velocity of the radio waves inside the antenna is being influenced because of the high e_r of PVC. (similar to the cause of shortening factor of coax cables). In that case Klaus' formulas will give erroneous results.

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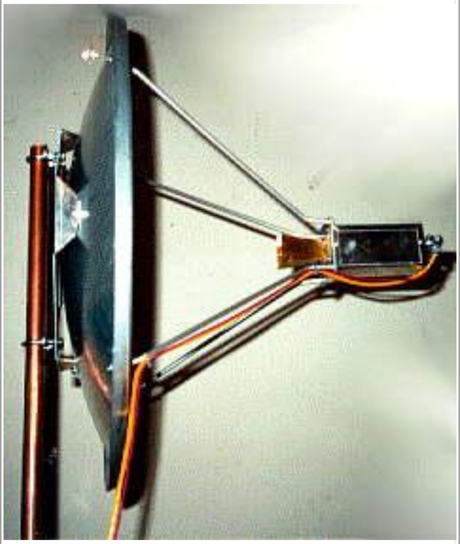
The main question is, could our PVC plumber tube actually cause the working frequency being decreased? If the answer is 'yes', it must be possible to improve the design.

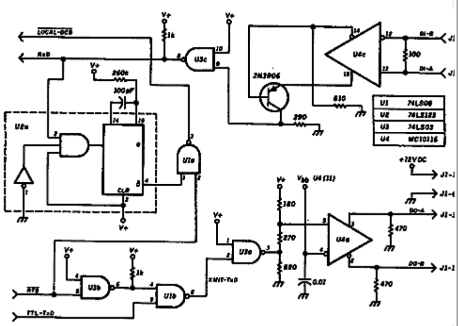
Study books say that the traveling velocity is reversed proportional with the square root of the dielectric constant.

It appears that PVC has a fairly high dielectric constant.

http://www.pa0hoo.tk/

Jan 2003





INEXPENSIVE MULTI-MEGABAUD MICROWAVE DATA LINK

.....some inexpensive antenna, radio, and computer interface hardware which allows communication of digital data at rates up to 2 megabaud (1 megabaud = 1 million bits per second) on an Amateur Radio band. The link operates in the 10-GHz Amateur band and uses an inexpensive commercial parabolic antenna along with a Doppler radar transceiver module to provide medium range communications at low cost. We'll discuss modifications to surplus networking interface cards that let you use this high speed data in Amateur Radio service with IBM-style personal computers. AX.25 packet radio has suggested the need for faster systems to improve current performance and has spawned some fundamentally new ideas for Amateur Radio. A whole spectrum of new user applications and the possibility of a nationwide or even worldwide digital Amateur network are two major areas made possible by faster hardware.

Originally published in Ham Radio Magazine December 1989

(A great case study - applicable to current 100Mb and 1Gb DIY link development)

http://www.qsl.net/k3pgp/Notebook/Gunnplexers/N6gn/10ghzdata.htm

MARS Antennas and RF Systems

Electrical	
Frequency range	2400-2500 MHz

MARS Antennas & RF Systems Ltd. (Israel)

:

Gain:	14-17 dBi min
VSWR	1:1.5 (Referred to 50 ohm)
Beamwidth	30, 60°
Crosspolarization	22 dB
Polarization	Linear Vertical Dual Linear(+45,-45 deg)
Connectors	SMA - standard. Other are optional
Fixed Tilt	0 - 10 ° (optional)
Front to Back Ratio	20 dB
Power Handling	50 W per port
Mounting	Pole mount/wall mount (please specify at order)

MARS's 2.4 GHz PCS Antenna is designed for outdoor and indoor installations. The antenna is perfectly suited for all PCS wireless 2.4 GHz applications. In particular the antenna is exceptionally proficient in harsh outdoor applications. The combination of its aesthetic appeareance and high efficiency makes it ideal for installations where the antenna is installed at low heights.

www.mars-antennas.com

 	Pacific Wireless Pacific Wireless manufactures high quality and low cost wireless communications solutions for the 1.7 to 2.7 GHz Frequency Bands, including MMDS, ISM (2.4GHz), DECT and S-Bands. We offer parabolic grid directional antenna products and GaAs MMIC RFIC downconverter and mixer products targeted at the following applications: Wireless Internet, Point to Point and Point to Multipoint.. http://www.pacwireless.com/	
	Parabolic AB Welcome to Parabolic AB New! 2.4 GHz WLAN Antennas Parabolic has been into the cable- and satellite business since 1982 manufacturing satellite receivers, modulators, signal processors, antennas up to 8 meters and all kinds of accessories to...11/29/1999 http://www.parabolic.se/	
Purdue University Group Project **2.45 GHz Yagi Antenna**	**Purdue University - 2.45 GHz Yagi Antenna - Lafayette Indiana USA** Useful project to design a directional disc Yagi of17.5dB gain for point to point WLAN applications.....	

2.45GHz Yagi Antenna
Spring 2002

Figure 5: Completely Assembled Antenn

April 2002

Has anyone a current link to this excellent project? ed.

Purdue University: http://www.purdue.edu/

November 2004

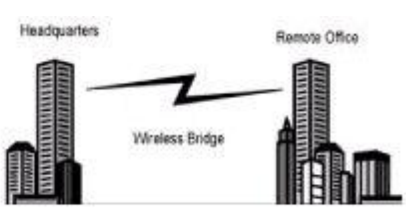
SBISMSO5V - Vertically

Signull Technologies

We manufacture antennas and equipment for the 2.4ghz ism band used by 802.11b WiFi devices at competitive prices. You can check us out online.

Mike Spenard

mounted suction cup 5dBi omni antenna for mobile and temporary non metallic mounting applications.	 www.signull.com.	
TELE Wireless Products Gr Bringing Innovation to the Wireless Worl 	Model 2426AA WLAN 5 dBi Omni This WLAN antenna is broadband and designed to operate from 2400 to 2483 MHz. The antenna features an omni directional pattern with a gain of 5 dBi. It is enclosed in a weatherproof radome for outdoor or indoor use. The antenna provides for mounting to a mast, or an optional ceiling mount is available. Standard coax connectors, as well as connectors to meet Part 15 of FCC regulations, can be supplied. http://www.telexwireless.com/wlanantennas.htm	
Wireless Internet Access in Latvia  **Guntis Barzdins** ***Institute of mathematics and Computer***	WIRELESS INTERNET ACCESS IN LATVIA The Latvian Research Network LATNET was established in 1992, shortly after breaking of the USSR. The limited resources and poor communications infrastructure in the country (only analogue lines available) have forced LATNET to search for alternative ways to establish high speed data links for Internet access to the numerous University of Latvia departments scattered around the capital city Riga. The liberal radio frequency licensing policy and newly appeared	

Science, University of Latvia **Rainis blvd.29, Riga LV1459, LATVIA Phone +371 9206943, Fax +371 7 820153, E-mail guntis@mii.lu.lv**	inexpensive and easy to use wireless LAN products, made it possible to develop a high speed spread spectrum wireless Internet access network. There are currently over 30 academic, research, government, and other sites - spread all over the city - using these high-speed wireless links for Internet connection as an alternative to lower speed leased telephone lines. Guntis Barzdins http://www.wlan.org.uk/wia-latvia.html	
 	YDI: Licence free U-N11 **100Mbps links** at 5.5GHz. Providing Wireless Lan Equipment Solutions for Businesses. ISPs, WIPOPs, 2.4GHz, 5.4GHz, Amplifiers, YDI: Wireless data solutions, Wireless LAN equipment, WANs, LANs, MANs, Broadband connectivity, wireless internet, Direct and Frequency Hopping Spread Specturm Equipment, amplifiers, antennas, modems, radio, ISA, PCMCIA, 2.4 GHz, 900 MHz, IEEE 802.11 4/29/2000 (GOOD TECHNICAL INFO HERE. ed.) http://bandwidthhog.com/	

HyperGain™ Model HG2415U

High Performance 15 dBi Omnidirectional Antenna

The HyperGain™ HG2415U High-Performance Omnidirectional Antenna features an impressive 15 dBi gain for long-range multipoint applications in the 2.4 GHz ISM band.

This antenna's construction features a lightweight fiberglass radome for durability and aesthetics. It's mounting system features two heavy duty extruded aluminum brackets and stainless steel U-Bolts for superior strength in all-weather conditions.

http://www.hyperlinktech.com/hg2415u.htm

H4x90°

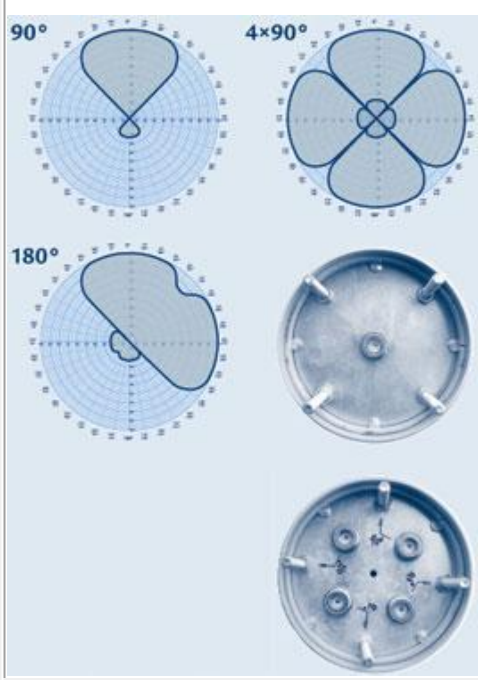
FERIMEX - Slovakia

Antenna Sector H4x90°

12dBi Gain at 360 degrees with Horizontal Polarisation in four 90 degree sectors.

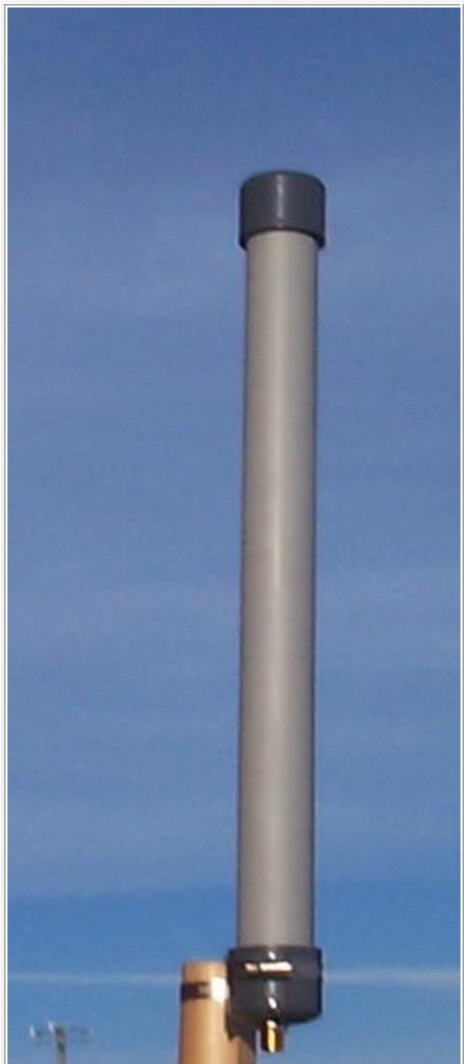
The H Range comprise 5 different Sector Antennas with horizontal polarization with different beam angles. For use as access point antennas. More expensive than vertical polarization antennas, use only when you need horizontal polarization.

The Antenna H4x90 has 4 connectors, one for each 90-degree sector, and requires 4 devices to be attached. In this way you can handle 4 times as many customers at one access point. Antenna H2x90 and Antenna H2x180 have 2 connectors and require 2 devices to be attached. Antenna H90 and Antenna H180 have one connector.



http://www.ferimex.com/en/product.php?Antenna_Sector

Oct 2007

	SuperPass Antennas Inc. SuperPass Company Inc. was founded in 1996 by several world-leading electrical and electronic scholars and engineers who have a strong desire to develop innovative, high performance, and low cost antennas for the booming wireless communication industry. http://www.superpass.com/	
	TIL-TEK Antennas Inc. ....provides a complete line of base station and remote antennas in frequencies from 800 MHz to 5.8 GHz, with selected products from 300 MHz to 28 Ghz. Applications include cellular, GSM, PCS, DECT, WLL/WLAN and rural point-to-multipoint systems as well as special applications such as radar test targets and Digital Audio Broadcast antennas. http://www.tiltek.com	

WINNCOM TECHNOLOGIES

WINNCOM TECHNOLOGIES 13.5 dBi Horizontal Omni

13.5 dBi Omnidirectional Antenna, Horizontally Polarized, 2.4 GHz
Product Code WRO2400-135H

Antenna Performance	
Frequency	2.400 - 2.48
Gain (dBi)	13.5
VSWR	>1.5:1
Polarization	Horizontal
-3 dB Beamwidth	9°
Impedence (ohms)	50
Maximum Power Rating	100 W
Physical Characteristic	
Height	29.2 in. (73
Weight (Including Clamps)	2.5 lb. (1.46
Wind Load	125 mph (2
RF Connector	N type fem
Mounting	Stainless st Mast or Pole mou 30 - 62 mm)

$699.00

http://www.winncom.com/cgi-bin/moreinfo.pl?ITCODE=WRO2400-135H

	WinProp Prediction of wave propagation in indoor, urban and terrain scenarios. Wireless mobile communication networks incl. Radio network planning for macrocells, microcells, WLAN, indoor, Picocells. http://www.winprop.de	
	WLAN Slotted Waveguide Antennas Unlike wideband antennas like the BiQuad, slotted waveguides are resonant antennas, and have a narrow operating frequency range. It is possible to increase the bandwidth, but at the expense of gain and radiation pattern. Highest gains are only achieved over a few channels of the 802.11b spectrum. This should not be a limitation in a fixed installation, as multiple antennas are typically deployed, each covering a few channels.The antenna can be "tuned" with adjusting screws, or by adjusting its length. (if you need wide bandwidth then the BiQuad is the better choice)  Author: Trevor Marshall http://www.trevormarshall.com/waveguides.htm see above: Bi Quad Feed for Primestar Satellite Dish by the same author	

Downpipe Antenna

Slotted Waveguide type for 11 -14dBi horizontal polarisation...

The downpipe antenna was born after seeing the success of the Trevor Marshall Waveguide (WG) design, but after frustration at trying to buy 'small' lengths of the required ALU tubing, at realistic prices. In Australia, the minimum quantity is 6 m - you normally need less than 1 m. A 6m length will not fit in a car, and costs AU$160.

However, 95 x 45 x 0.4 mm ZincAlum downpipe is readily available in any Australian hardware store, and a 1.8m length costs less than AU$ 9. While this material is much more 'flimsy', it turned out sufficiently strong enough that it did not distort when the slots were machined (my main concern), and was plenty robust enough to mount solidly with V-Clamps. The material itself is designed to be used outside - so corrosion is expected to be minimal.

Rob Clark http://www.erlang-software.com/FreeNet

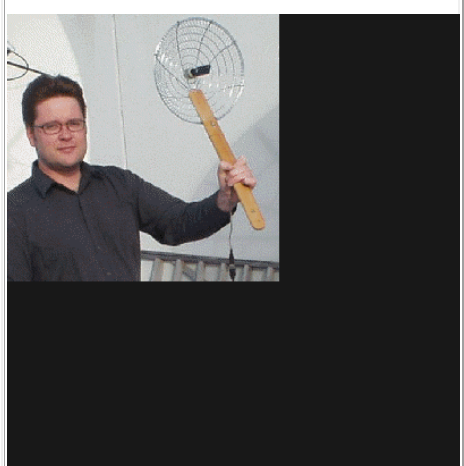
http://members.iinet.net.au/~clark/FreeNet/Waveguide/#Downpipe

May 2003

Horizontal Polarized - Wide-sector directional antenna.

A typical amateur constructed high performance wide sector directional antenna based on a slotted waveguide design by DL4EBJ

USB adaptors & DIY antennae



"Poor Man's WiFi" ?

USB adaptors & DIY antennae "Poor Man's WiFi" ?

Harbour 10Km Link

A popular site with lots of imaginative and interesting low cost antenna ideas for DIY antenna from Massey University New Zealand.... Frying pans, Cooking Woks, foil and mesh lined Umbrellas.

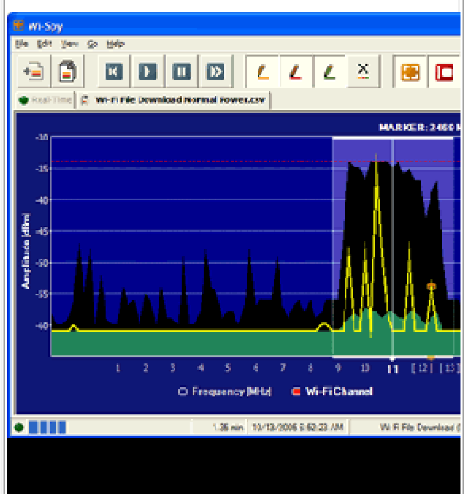
"Gains typically ~12-15db with LOS ranges ~3-5km, AND great cost benefits from

using cheap RF loss free USB cable" (repeater cables every 5metres length)

Stan Swan
Wellington, New Zealand

http://www.usbwifi.orcon.net.nz/

Oct 2005



What is Wi-Spy™?

Wi-Spy™ is the world's smallest 2.4 GHz spectrum analyzer*. Wi-Spy is perfect for troubleshooting interference from the following devices:

- Wi-Fi (802.11 b/g/n)
- Microwave Ovens
- Cordless Phones
- Baby Monitors
- Bluetooth

Wi-Spy is a fraction of the cost of traditional spectrum analyzers!
*Wi-Spy's frequency range is 2.400 - 2.483 GHz

http://www.wi-spy.co.uk/

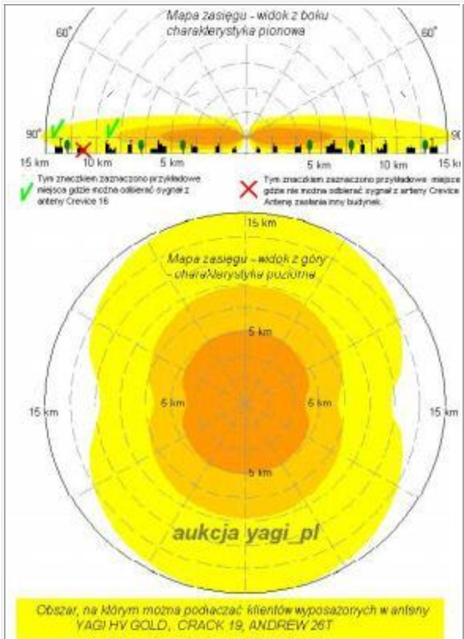
YAGI.PL

YAGI PL - POLAND

CREVICE Z-17 Super High Gain

16.5 dBi

Omnidirectional High



Gain Antenna

Outdoor design
gold elements.

Electrical Specifications:

Gain (at work with other antenna working in horizontal polarization)	16,5 dBi
Frequency	2400 - 2500 Mhz
VSWR	1,3
Polarization	horizontal
Vertical beamwidth E vector	8°
Horizontal beamwidth horizontal H vector	360° (dokladnie 2x160° -3dB)
Termination / connector	N-type / female
Impedance	50 Ohm
Weight	2 kg
Dimension	length 860 mm, section 100x50 mm
Clamp (Mounting bracket)	30-60mm

e-mail:
ebay@yagi.pl
iapt@yagi.pl
www.yagi.pl

Dec 2007

HOME

Click on the headings below

AMPLIFIERS:

BreezeCOM

The AMP-500, 500 mW amplifier (*after-burner*) is used to increase the range of outdoor links. Its built-in 3.5dB Noise Figure Receiving Amplifier can also be used to compensate for cable losses to an antenna at the top of a building or mast.

http://www.breezecom.com/Products/Antennas/amp_500.htm

LINKSYS WIRELESS BOOSTER

Linksys Wireless Booster

The Linksys Wireless Signal Booster piggybacks onto your Linksys Wireless Access Point (or Wireless Access Point Router) to increase the effective range and coverage area of the 802.11b network.

- Increase the effective range of your Linksys 802.11b Access Point or Wireless Access Point Router
- Stronger signal improves throughput by reducing retransmissions
- Save on wiring costs -- increase your Access Point's coverage into hard-to-reach areas
- Simple installation -- stack, connect, and go

http://www.linksys.com/products/product.asp?grid=33&scid=38&prid=478

RENASIS ILB30-24

RENASIS ILB30-24

The ILB30-24 is an industrial quality outdoor RF Power Amplifier. From the Middle East to Anchorage, Alaska, its rugged, weatherproof design allows the ILB30 to survive in extreme outdoor environments.

Each unit is tested 3 times before being shipped. An assembly line ON/OFF Test is followed by an RF Power Output Test, and then finally with an RF Power Consistency Test. There is no better performing, or higher quality Outdoor RF Power Amplifier than the ILB30-24.

The amplifier comes complete with the DC power injector module (INJ24) as well as the 12V AC Power Adapter.

Features:

- Dual Band b & g Compatible
- Rugged Outdoor Housing
- Low Heat Generation
- Clean Signal Gain
- Low Noise Floor
- Plug-n-Play Ready
- Complete with Power Supply

Details

SKU RNS-ILB30 Weight 3.05 lbs
Price:
$240.00

http://www.fab-corp.com/product.php?productid=2915&cat=269&page=1

DB6NT LINEAR POWER AMPLIFIERS FOR 2304 - 2450MHz

We are pleased to offer four power amplifiers for the 2304 - 2450MHz. amateur radio bands.

Three 5 watt models are offered with various gain configurations as well as a 10 watt 10dB gain model. Commerical wide

	band versions as well as custom frequencies are available. Call us with your requirements. FEATURES: Small mechanical dimensions. Commercial construction in a milled aluminum case Built in detector for monitoring power output. SMA - Female connectors 10 or **27dB Gain** (Depending on model). 13.8VDC operation Small size 80 x 60 x 20mm ..... 130 x 60 x 20 mm Built-in protection for the Power GaAs FET http://www.ssbusa.com/m13amp.html	
	Model WL-2400A .5 Watt IEEE 802.11 Mast-mounted 2.4GHz. Wireless LAN/WAN Amplifier Ultra Low Noise Preamplifier, automatic RF carrier detection, plus a CDMA rated linear amplifier operating at less than .3dB compression all add up to solid links over extended distances. The WL-2400 A is the highest performance LAN amplifier available today! **FEATURES:** **.5 watt RF output** — **10dB Transmit Gain** **Preamplifier NF <1.5dB** — **Preamplifier Gain 14.0dB typical** **Seamless interface to all LAN cards** — **Suitable for land, mobile, aircraft and shipboard use**	

	IEEE 802.11 compatible — Rugged mast-mounted 100% weatherproof construction Heavy Duty "N" type connectors — 120V / 220V AC or 13.8VDC operation http://www.ssbusa.com/wireless.html	
 	Hyper Amp II Model 2401 1 Watt IEEE 802.11 compatible 2.4 GHz Wireless LAN Amplifiers HyperAmp™ II is the latest evolution in HyperLink's family of pole-top amplifiers for spread spectrum wireless LANs. This unit's high power, high gain and ultra-low 2.5 dB noise figure make it the highest performance wireless LAN amplifier available today. The HyperAmp™ II significantly improves operating range and link reliability by placing maximum transmit power and up to 20dB of receive gain directly at the antenna where is most effective. The unit can be configured to deliver over 1 Watt of transmit power with as little as 1mW of input power. This feature permits cable runs of several hundred feet with no degradation http://www.hyperlinktech.com/ha2401.htm	
40 Watt 2.4GHz Amplifier	**OPHIR RF**	

OPHIR RF

5300 Beethoven Street, Los Angeles, C
TEL: (310)306-5556 • FAX: (310)57
WEB: www.ophirrf.com • E-MAIL: sales@o

http://www.ramayes.com/Data%20Files/Ophir%20RF/5302016.pdf

http://www.ramayes.com/

Dec 2004

MODEL 5302016

2.3 - 2.4 GHz
40 WATTS
LINEAR POWER RF AMPLI

HOME

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ANTENNAS
AMPLIFIERS
PROPAGATION Topics

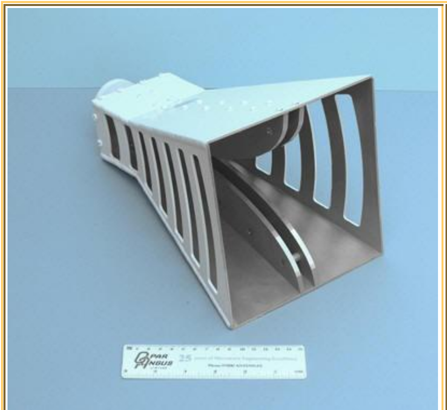
GO BACK TO TOP OF PAGE

http://www.wlan.org.uk/antenna-page.html

Microwave Horn Antennas Index
Double-Ridge Horns (0.5 - 5 GHz, 1 - 18 GHz & 18 - 40 GHz)
Optimum Gain Microwave Horns
Wide Band Microwave Horns

Wide Band Horn Antennas

Picture	Model	Features
	Q-par Angus Ltd IDEAS ENGINEERED	**Wideband Horn**



Frequency 1 - 8 GHz

Wideband Horn Antennas

These multi-Octave range wideband horns offer an unrivalled facility for measurements, evaluation and electronic surveillance. The band of 0.5 GHz to 18 GHz
can be covered with only 2 to 4 wideband horn antennas.

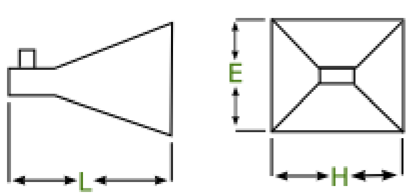
Horn Antenna Catalog

Wideband Horn Selection

Features

- Connector - SMA or N type (others available, please contact us for details)
- A full wideband horn antenna test report including gain against frequency is provided with each horn
- Ideal for spectrum monitoring and surveillance, and EMC applications
- Wideband horns are normally fitted with an integrated coaxial to waveguide adaptor, but can also be supplied with just a waveguide flange - including WRD ridged waveguide.
- Broadband Ridged Horns that are compatible with WRD ridged waveguide can also be supplied with a waveguide flange
- All wideband horns are fitted with a convenient mounting plate and optionally with an aperture window to prevent ingress of moisture

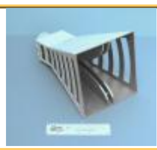
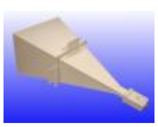
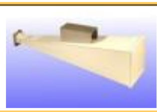
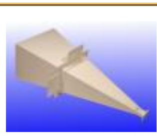
Dimensions



All dimensions are nominal and measured in mm.

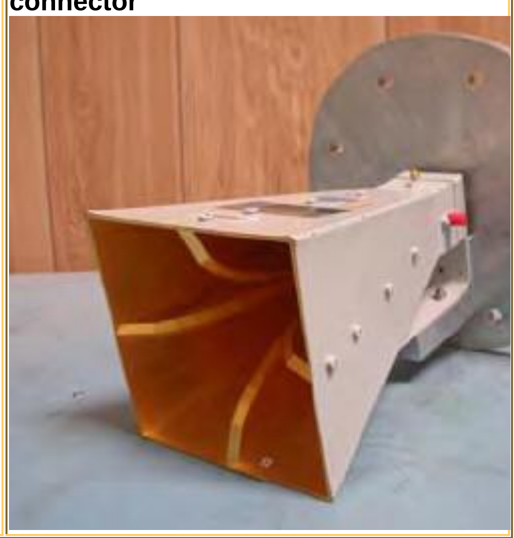
Many other standard wide band horns are available, or we can design a horn to your specification. Please include required gain/beamwidth, frequency range, size etc with your enquiry.

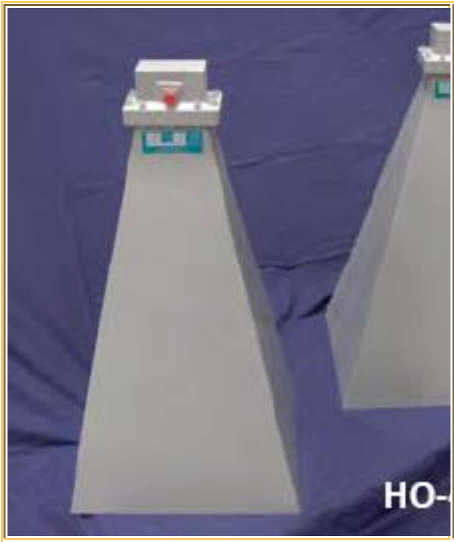
The 3 dB beamwidths are always specified so that the the first figure refers to the lowest frequency in the operating band.

Picture	Model	Frequency GHz	Power (CW)	Connector	Gain dBi
	WBH0.5-2N	0.5 - 2.0	250 W	N-type	8 - 13.5
	WBH0.5-2N13	0.5 - 2.5	250 W	N-type	7.4 - 14.5
	WBH1-2#10	1.0 - 2.0	300 W	N-type, SMA	8.2 - 12.1
	WBH1-8#10HP	1.0 - 8.0	1.5 kW	7/8" IEC female, others available	5.5 - 16.8
	WBH2-4#17	2.0 - 4.0	10 kW peak 750 W mean	WRD200 Flange	16.4 - 18.1
	WBH2-8#13	2.0 - 8.0	100 W (N-type) 800 W (7/16)	N-type, SMA, 7/16 (High Power)	11 - 15
	WBH2-18#	2.0 - 18.0	50 W	N-type, SMA	7 - 13
	WBH2-18#HG	2.0 - 18.0	80 W	N-type, SMA	10 - 20
	WBH4-8#20	4.0 - 8.0	2 kW	WRD350 Flange, N-type, SMA	17 - 20.9

	**WBH6.5-18#17**	**6.5 - 18.0**	**50 W**	**WRD650 Flange or SMA transition**	**8.8 - 17**
	**WBH8-18#20**	**8.0 - 18.0**	**2 kW**	**WRD750 Flange, N-type, SMA**	**20.2 - 21.4**
	**WBH18-40**	**18.0 - 40.0**	**40 W (K-type) 200 W (Flanged version)**	**K-type transition or WRD180 Flange**	**12 - 14**

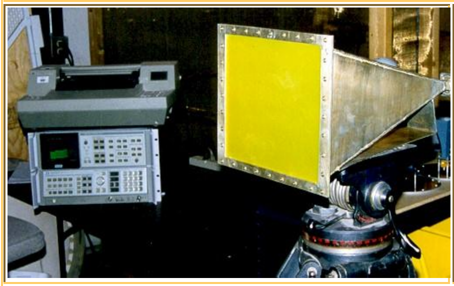
Optimum Gain Horn Antennas

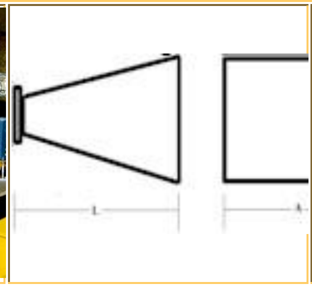
Picture	Model	Features
	TMC Design Corporation **HO Series** **Optimum Gain Horn Antennas** **Wide & Narrow Bandwidth** **Rugged Construction** **Gain to 24 dB** **Linear Polarization** **VSWR 2:1**	TMC Design Corporation offers optimum gain horn antennas covering the frequency spectrum from 1.12 GHz to 18 GHz in wave guide bandwidths. These antennas offer high gain in a very durable horn antenna. Many are available with the optional tripod mounts and the lower frequency horns as highly portable (HP) designs with removable side panels. **Power Handling:** **500 watts CW with N-Type connector (standard)** **1500 watts CW with waveguide connector** 



Model	Frequency - GHz	Gain - dB	Beamwidth (degrees)
HO-650-S	1.12-1.70	10	30x90
HO-650-18	1.12-1.70	18	20x20
HO-650-20	1.12-1.70	20	15x15
HO-650-24	1.12-1.70	24	10x10
HO-430-S	1.70-2.60	10	30x90
HO-430-18	1.70-2.60	18	20x20
HO-430-20	1.70-2.60	20	15x15
HO-430-24	1.70-2.60	24	10x10
HO-284-S	2.60-3.95	10	30x90
HO-284-18	2.60-3.95	18	20x20
HO-284-20	2.60-3.95	20	15x15
HO-284-24	2.60-3.95	24	10x10
HO-187-S	3.95-5.85	10	30x90
HO-187-20	3.95-5.85	20	15x15
HO-187-24	3.95-5.85	24	10x10
HO-137-RH	5.85-8.20	8	30x120
HO-137-S	5.85-8.20	10	30x90
HO-137-20	5.85-8.20	20	15x15
HO-137-24	5.85-8.20	24	10x10
HO-112-RH	7.05-10.0	8	30x120
HO-112-S	7.05-10.0	10	30x90
HO-112-18	7.05-10.0	18	20x20
HO-112-20	7.05-10.0	20	15x15
HO-112-24	7.05-10.0	24	10x10
HO-90-RH	8.20-12.40	8	30x120
HO-90-S	8.20-12.40	10	30x90

HO-90-18	8.20-12.40	18	20x20
HO-90-20	8.20-12.40	20	15x15
HO-90-24	8.20-12.40	24	10x10
HO-75-24	10.0-15.0	24	10x10
HO-62-24	12.40-18.00	24	10x10





Model	Dimension A (inches)	Dimension B (inches)	Dimension L (inches)	Weight (Pounds)
HO-650-18	28	24	46	37.7
HO-650-20	38	33	64	67.6
HO-650-24	60	52	105	166 (HP-108)
HO-430-18	18	16	30	15.8
HO-430-20	25	22	42	28.2
HO-430-24	40	34	72	72.3
HO-284-18	12	10	20	7.0
HO-284-24	16	14	28	11.9
HO-284-24	26	22	47	32.3
HO-187-20	11	10	19	5.8
HO-187-24	18	15	32	15.1
HO-137-20	8	7	13	2.89
HO-137-24	12	11	22	6.7
HO-112-24	10	8.5	18	4.5
HO-90-20	5	4	9	1.2
HO-90-24	8	7	15	3.0
HO-75-24	7	6	12	2.1
HO-62-24	6	5	10	1.5

Double-Ridge Waveguide Horns

Picture	Model	Features

TDK RF Solutions Inc

Double-Ridge Horn Antenna

HRN-5005

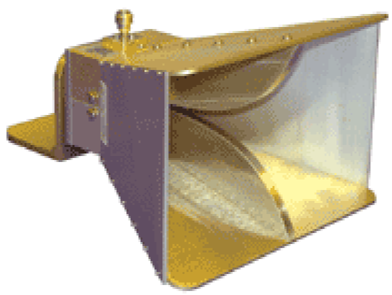
500 MHz to 5 GHz

500 Watts

DATA

TDK RF Solutions' HRN-5005 Horn Antenna is designed specifically for radiated emissions and immunity measurements in EMC test environments. The HRN-5005 provides optimal performance over the frequency range of 500 MHz to 5 GHz.

- VSWR: <1.5:1 average
- Polarization: Linear
- Power handling: 500 W
- Feed point Impedance: 50 ohm (nominal)



Swivel Mount Bracket

TDK RF Solutions Inc

Double-Ridge Horn Antenna

HRN-0118

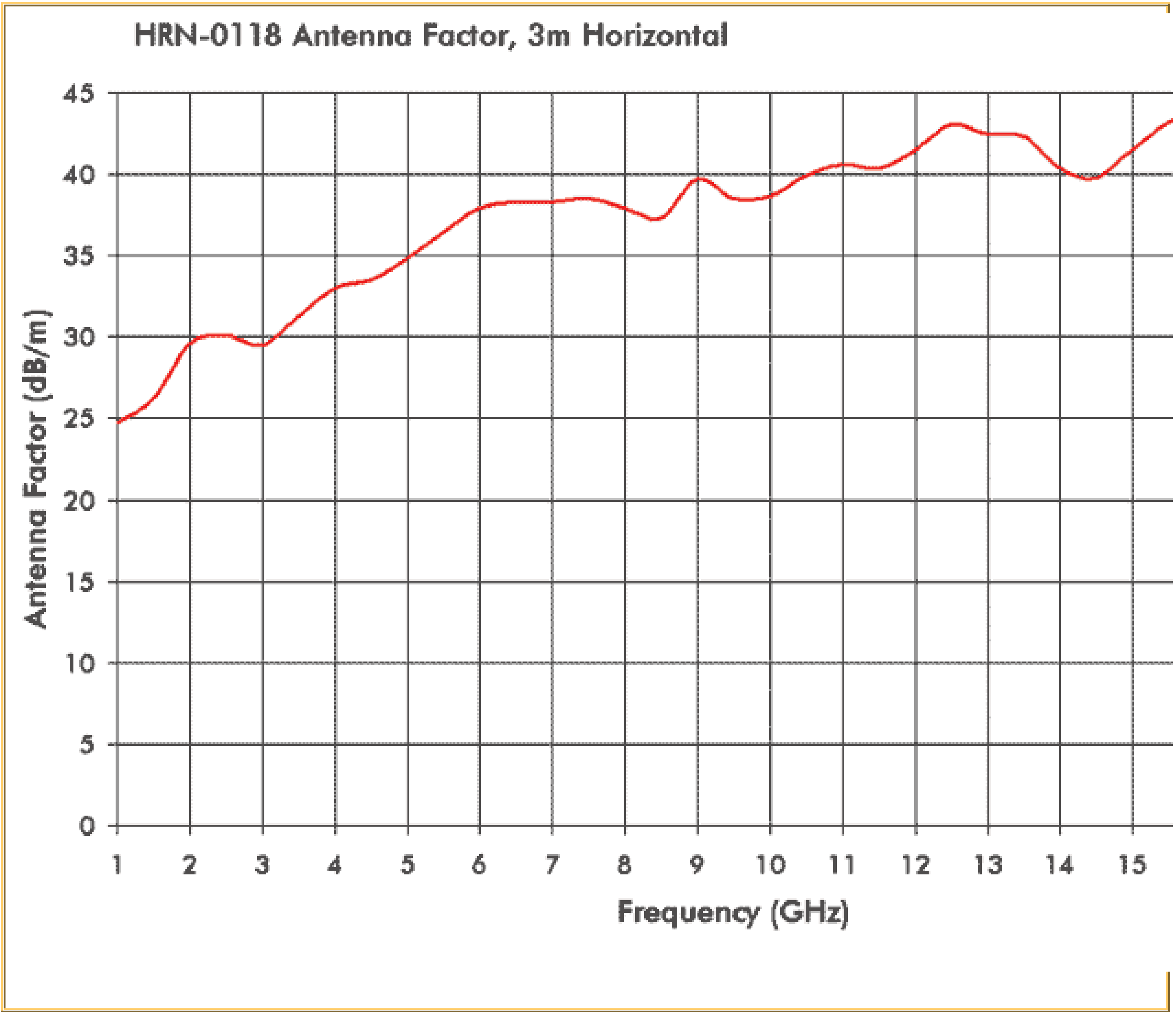
1 GHz to 18 GHz

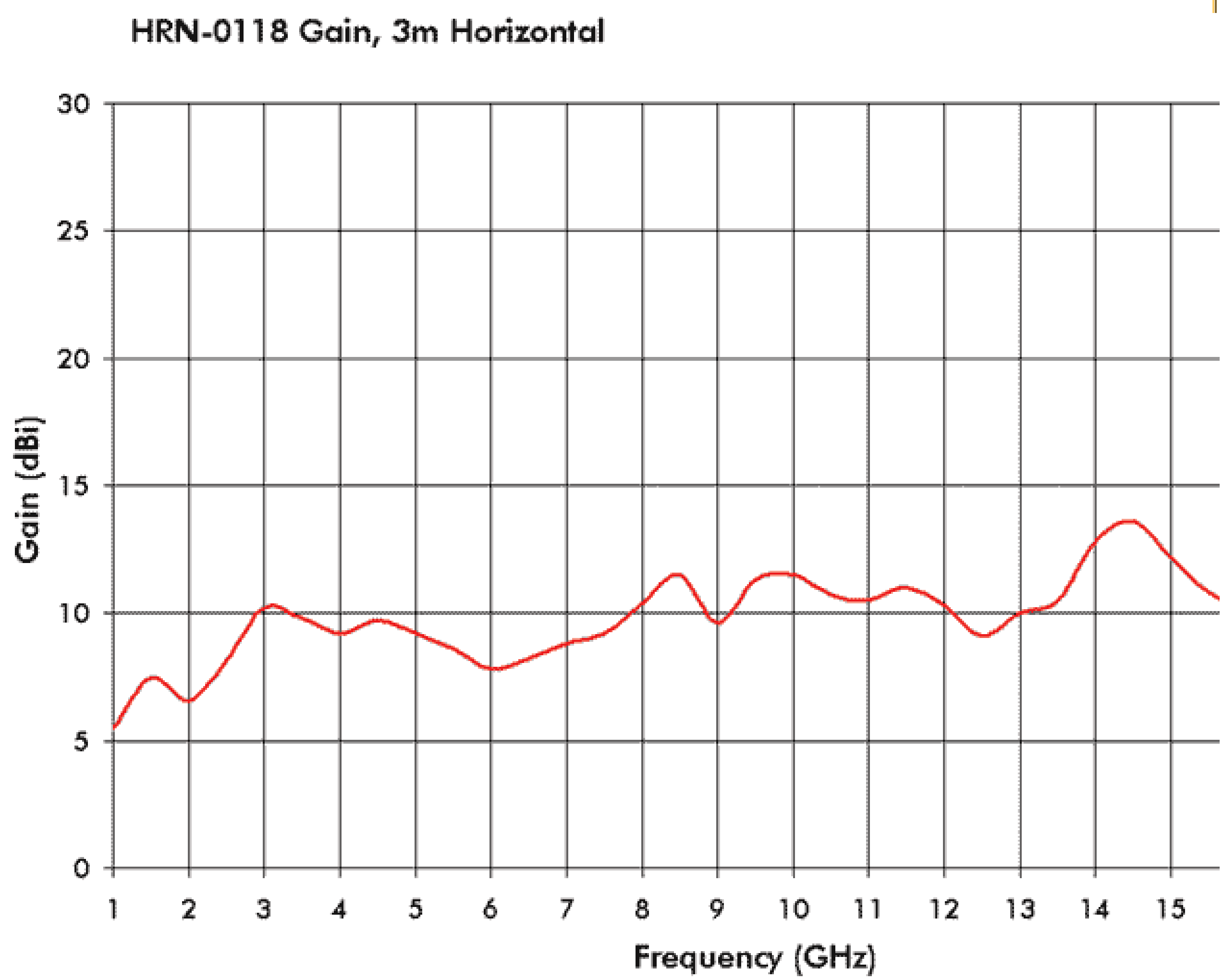
300 Watts

DATA

TDK RF Solutions' HRN-0118 Horn Antenna is designed specifically for radiated emissions and immunity measurements in EMC test environments. The HRN-0118 provides optimal performance over the frequency range of 1 GHz to 18 GHz.

- VSWR: <1.5:1 average
- Polarization: Linear
- Power handling: 300 W
- Feed point Impedance: 50 ohm (nominal)
- Width: 25 cm (9.8 in.)
- Depth: 30 cm with mounting bracket (11.8 in.); 21 cm without bracket
- Height: 15 cm (5.9 in)
- Weight: 1.8 kg (4 lbs.)
- Construction: Aluminum with a gold chromate finish
- RF Connector: Type N female
- Warranty: 1 year


HRN-0118 Antenna Factor, 3m Horizontal
Antenna Factor (dB/m)
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Frequency (GHz)



Sunol Sciences Corp

Manufacturers of Turntables and Antenna Towers for

Double-Ridge Horn Antenna

Model: DRH-118

1 GHz to 18 GHz

300 Watts

Available

Calibrated (Horn Specific Data)

or

Uncalibrated (Typical Horn Data)

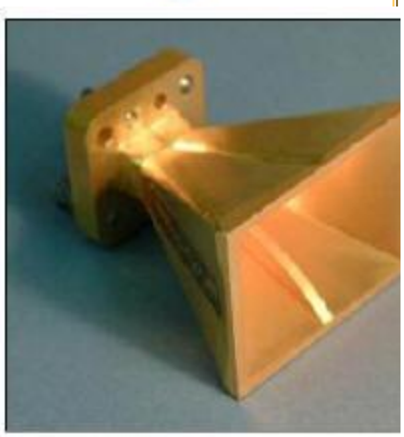
DATA

Sunol Sciences DRH-118 is designed for emissions and immunity testing for the EMC test market. The DRH-118 provides optimal performance over the frequency range of 1 GHz to 18 GHz.

- "L" Bracket included for Vertical & Horizontal Polarization
- Construction: Aluminum
- RF Connector: Type N female
- Warranty: 2 year

Model	**DRH-118**
Frequency:	1 - 18 GHz
Impedance:	50 Ω nominal
VSWR:	< 1.5:1

	average
Connector:	Type N female
Polarization:	Linear
Max. Power:	300 watts
Length:	9 in. (23 cm)
Width:	9.5 in. (24 cm)
Height:	6 in. (15 cm)
Weight:	4 lbs. (1.8 kg)
Mount:	¼-20 tripod mount



DRH-1840 (with K Adapter Ren

NEW

Sunol Sciences Corp

Manufacturers of Turntables and Antenna Towers for

Double-Ridge Horn
Model: DRH-1840

18 GHz to 40 GHz

20 Watts CW (with K adapter)

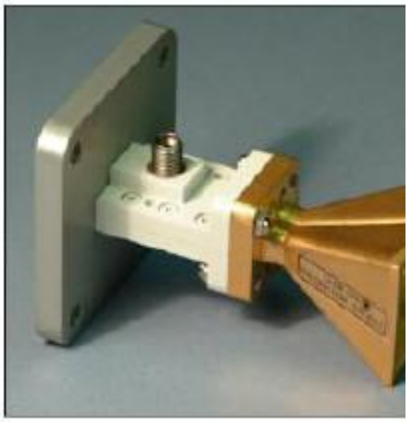
200 Watts (K adapter removed)

DATA

DRH-1840 is designed for emissions and immunity testing for the EMC test market. The DRH-1840 provides optimal performance over the frequency range of 18 GHz to 40 GHz.

- Frequency Range of 18 GHz to 40 GHz
- Receive and Transmit
- Individually Calibrated or Typical Calibration Data
- FCC, MIL-STD, VDE and TEMPEST Testing

Model	**DRH-1840**
Frequency:	18-40 GHz
Impedance:	50 Ω
VSWR:	< 1.3 : 1, (< 1.8 : 1 with K adapter)
Connector:	Type K female and WRD-180 Flange
Polarization:	Linear
Max. Power:	200 watts (without K adapter) 20 watts (with K adapter)

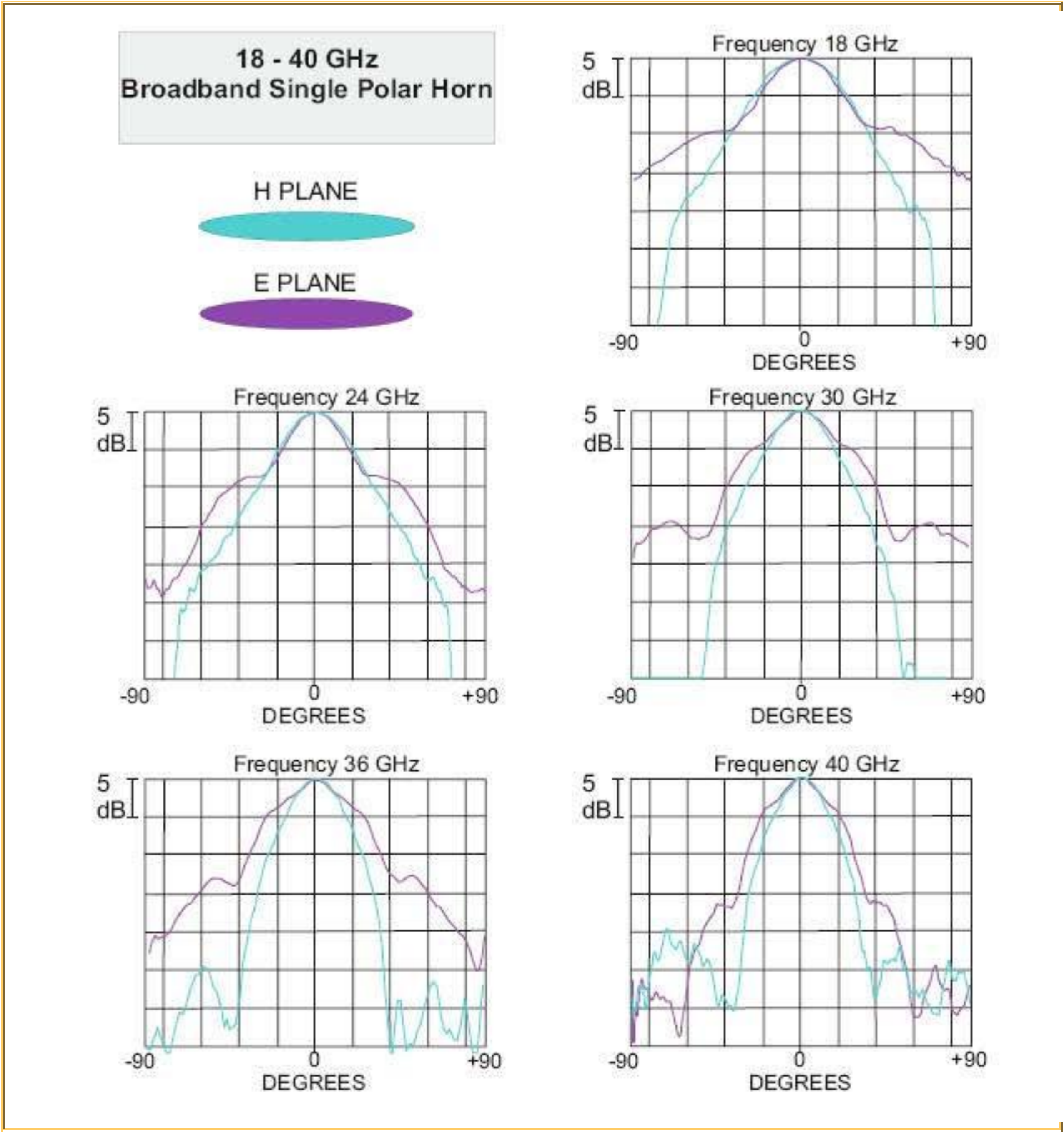


DRH-1840

Length:	1.4 in. (35 mm)
Width:	1.1 in. (28 mm)
Height:	1.5 in (38 mm) 2.87 in. (73 mm) with K adapter
Weight:	0.18 lb. (80g) 0.31 lb. (140 g)
Mount:	WRD-180 or Mounting Plate

GAIN TABLE

Frequency (GHz)	Gai
18	
24	
30	
36	
40	



TDK RF Website | TMC Website | Sunol Website

http://www.ramayes.com/Horn_Antennas.htm

Rise time

From Wikipedia, the free encyclopedia

Jump to: navigation, search

In electronics, when describing a voltage or current step function, **rise time** is the time taken by a signal to change from a specified low value to a specified high value. Typically, in analog electronics, these values are 10% and 90% of the step height: in control theory applications, according to Levine (1996, p. 158), rise time is defined as "the time required for the response to rise from x% to y% of its final value", with 0%-100% rise time common for underdamped second order systems, 5%-95% for critically damped and 10%-90% for overdamped.[1] The output signal of a system is characterized also by fall time: both parameters depend on rise and fall times of input signal and on the characteristics of the system.

Contents

[hide]

[edit] Overview

Rise time is an analog parameter of fundamental importance in high speed electronics, since it is a measure of the ability of a circuit to respond to fast input signals. Many efforts over the years have been made to reduce the rise times of generators, analog and digital circuits, measuring and data transmission equipment, focused on the research of faster electron devices and on techniques of reduction of stray circuit parameters (mainly capacitances and inductances). For applications outside the realm of high speed electronics, long (compared to the attainable state of the art) rise times are sometimes desirable: examples are the dimming of a light, where a longer rise-time results, amongst other things, in a longer life for the bulb, or digital signals apt to the control of analog ones, where a longer rise time means lower capacitive feedthrough, and thus lower coupling noise.

[edit] Simple examples of calculation of rise time

The aim of this section is the calculation of rise time of step response for some simple systems: all notations and assumptions required for the following analysis are listed here.

- t_r is the **rise time** of the analyzed system, measured in seconds.
- f_L is the *low frequency cutoff* (-3 dB point) of the analyzed system, measured in hertz.
- f_H is *high frequency cutoff* (-3 dB point) of the analyzed system, measured in hertz.
- $h(t)$ is the *impulse response* of the analyzed system in the time domain.
- $H(\omega)$ is the *frequency response* of the analyzed system in the frequency domain.
- The bandwidth is defined as

  $$BW = f_H - f_L$$

  and since the low frequency cutoff f_L is usually several decades lower than the high frequency cutoff f_H,

  $$BW \cong f_H$$

- All systems analyzed here have a frequency response which extends to 0 (low-pass systems), thus

  $$f_L = 0 \Leftrightarrow f_H = BW$$ exactly.

- All systems analyzed are thought as electrical networks and all the signals are thought as voltages for the sake of simplicity: the input is a step function of V_0 volts.

[edit] Gaussian response system

A system is said to have a Gaussian response if it is characterized by the following frequency response

$$H(\omega) = e^{-\frac{\omega^2}{\sigma^2}}$$

where $\sigma > 0$ is a constant, related to the high frequency cutoff by the following relation:

$$f_H = \frac{\sigma}{2\pi}\sqrt{\frac{3}{20\log e}} \cong 0.0935\sigma$$

The corresponding impulse response can be calculated using the inverse Fourier transform of the shown frequency response

$$\mathcal{F}^{-1}\{H\}(t) = h(t) = \frac{1}{2\pi}\int_{-\infty}^{+\infty} e^{-\frac{\omega^2}{\sigma^2}} e^{i\omega t} d\omega = \frac{\sigma}{2\sqrt{\pi}} e^{-\frac{1}{4}\sigma^2 t^2}$$

Applying directly the definition of step response

$$V(t) = V_0 H * h(t) = \frac{V_0}{\sqrt{\pi}} \int_{-\infty}^{\frac{\sigma t}{2}} e^{-\tau^2} d\tau = \frac{V_0}{2}\left[1 + \operatorname{erf}\left(\frac{\sigma t}{2}\right)\right] \Leftrightarrow \frac{V(t)}{V_0} = \frac{1}{2}\left[1 + \operatorname{erf}\left(\frac{\sigma t}{2}\right)\right]$$

Solving for *t*'s the two following equations by using known properties of the error function

$$0.1 = \frac{1}{2}\left[1 + \operatorname{erf}\left(\frac{\sigma t_1}{2}\right)\right] \qquad 0.9 = \frac{1}{2}\left[1 + \operatorname{erf}\left(\frac{\sigma t_2}{2}\right)\right]$$

the value $t = -t_1 = t_2$ is then known and since $t_r = t_2 - t_1 = 2t$

$$t_r = \frac{4}{\sigma}\operatorname{erf}^{-1}(0.8) \cong \frac{0.3394}{f_H}$$

and then

$$t_r \cong \frac{0.34}{BW} \quad \Longleftrightarrow \quad BW \cdot t_r \cong 0.34$$

[edit] One stage low pass RC network

For a simple one stage low pass RC network, rise time is proportional to the network time constant $\tau = RC$:

$$t_r \cong 2.197\tau$$

The proportionality constant can be derived by using the output response of the network to a step function input signal of V_0 amplitude, aka its step response:

$$V(t) = V_0(1 - e^{-\frac{t}{\tau}}) \quad \Longleftrightarrow \quad \frac{V(t)}{V_0} = (1 - e^{-\frac{t}{\tau}})$$

Solving for *t*'s the two equations

$$0.1 = (1 - e^{-\frac{t_1}{\tau}}) \qquad 0.9 = (1 - e^{-\frac{t_2}{\tau}})$$

the times $t_1$and $t_2$to 10% and 90% of steady-state value thus known

$$t_1 = \tau(\ln 10 - \ln 9) \qquad t_2 = \tau \ln 10$$

Subtracting $t_1$from t_2

$$t_2 - t_1 = \tau \cdot \ln 9$$

which is the rise time. Therefore rise time is proportional to the time constant:

$$t_r = \tau \cdot \ln 9 \cong \tau \cdot 2.197$$

Now, noting that

$$\tau = RC = \frac{1}{2\pi f_H}$$

then

$$t_r \cong \frac{2.197}{2\pi f_H} \cong \frac{0.349}{f_H}$$

and since the high frequency cutoff is equal to the bandwidth

$$t_r \cong \frac{0.35}{BW} \quad \Longleftrightarrow \quad BW \cdot t_r \cong 0.35$$

This formula implies that if the bandwidth of an oscilloscope is 350 MHz, its 10% to 90% risetime is 1 nanosecond.

[edit] Rise time of cascaded blocks

Consider a system composed by $n$cascaded non interacting blocks, each having a rise time t_{r_i} and no overshoot in their step response: suppose also that the input signal of the first block has a rise time whose value is t_{r_S}. Then its output signal has a rise time t_{r_O}equal to

$$t_{rO} = \sqrt{t_{rS}^2 + t_{r1}^2 + \ldots + t_{rn}^2}$$

This result is a consequence of the central limit theorem, as reported in Valley & Wallman 1948, pp. 77–78 and proved by Henry Wallman in Wallman 1950.[2]

[edit] Factors affecting rise time

Rise time values in a resistive circuit are primarily due to stray capacitance and inductance in the circuit. Because every circuit has not only resistance, but also capacitance and inductance, a delay in voltage and/or current at the load is apparent until the steady state is reached. In a pure RC circuit, the output risetime (10% to 90%), as shown above, is approximately equal to $2.2RC$.

[edit] Rise time in control applications

In control theory, for overdamped systems, rise time is commonly defined as the time for a waveform to go from 10% to 90% of its final value.[1]

The quadratic approximation for normalized **rise time** for a 2nd-order system, step response, no zeros is:

$$t_r \cdot \omega_0 = 2.230\zeta^2 - 0.078\zeta + 1.12$$

where ζ is the damping ratio and ω_0 is the natural frequency of the network.

However, the proper calculation for rise time from 0 to 100% of an under-damped 2nd-order system is:

$$t_r \cdot \omega_0 = \frac{1}{\sqrt{1-\zeta^2}} \left(\pi - \tan^{-1} \left(\frac{\sqrt{1-\zeta^2}}{\zeta} \right) \right)$$

where ζ is the damping ratio and ω_0 is the natural frequency of the network.

[edit] See also

- Fall time
- Frequency response
- Impulse response
- Step response
- Transition time
- Settling time

[edit] Notes

1. ^ [a] [b] Precisely, Levine (1996, p. 158) states: "*The rise time is the time required for the response to rise from x% to y% of its final value. For overdamped second order systems, the 0% to 100% rise time is normally used, and for underdamped systems...the 10% to 90% rise time is commonly used*". See also the textbook Nise 2008.
2. ^ This beautiful one-page paper does not contain any calculation. Henry Wallman simply sets up a table he calls dictionary paralleling concepts from electronics engineering and probability theory: the key of the process is the use of Laplace transform. Then he notes that, following the correspondence of concepts established by the dictionary, that the step response of a cascade of blocks corresponds to the central limit theorem and states that: "*This has important practical consequences, among them the fact that if a network is free of overshoot its time-of-response inevitably increases rapidly upon cascading, namely as the square-root of the number of cascaded network*".(Wallman 1950, p. 91)

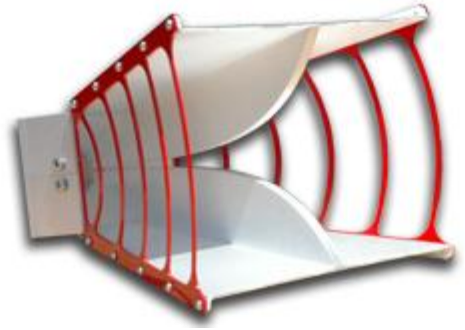
[edit] References

- Levine, William S. (1996), *The control handbook*, Boca Raton, FL: CRC Press, pp. 1548, ISBN 0-8493-8570-9.
- Nise, Norman S. (2008), *Control Systems Engineering* (Fifth ed.), John Wiley & Sons, pp. xvii+880, ISBN 978-0-471-79475-2
- United States Federal Standard 1037C: Glossary of Telecommunications Terms
- Valley, George E., Jr.; Wallman, Henry (1948), *Vacuum Tube Amplifiers*, MIT Radiation Laboratory Series, **18**, New York: McGraw-Hill., pp. xvii+743 Paragraph 2 of chapter 2 and paragraphs 1 to 7 of chapter 7 .
- Wallman, Henry (1950), "Transient response and the central limit theorem of probability", *Proceedings of Symposia in Applied Mathematics* (Providence: AMS.) **2**: 91, MR 0034250, Zbl 0035.08102.

http://en.wikipedia.org/wiki/Rise_time

RF Microwave Antennas

Double-Ridged Guide



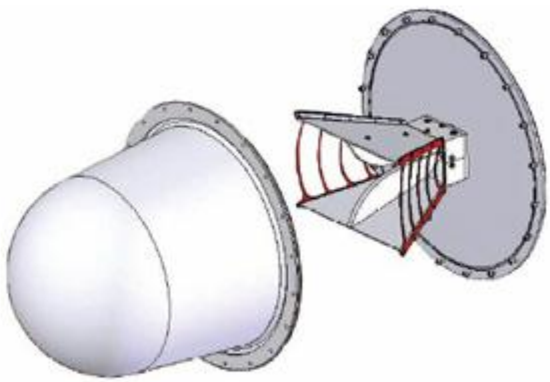
- 3115 Double-Ridged Guide Antenna | Datasheet | Manual
  Frequency Range: 750 MHz - 18 GHz. The Model 3115 Double-Ridged Guide Antenna has excellent gain and VSWR characteristics. This antenna is small and portable with a length of 24.4 cm (9.6 in).
- 3116C Double-Ridged Waveguide Horn | Datasheet | Manual
  Frequency Range: 10 GHz to 40 GHz. The Model 3116C Double-Ridged Waveguide Horn is the latest addition to a family of double-ridge guide horns for EMC measurement from ETS-Lindgren.
  Available for Antennas-2-Go in September 2012.
- 3117 Double-Ridged Guide Antenna | Datasheet | Manual
  Frequency Range: 1 GHz - 18 GHz. The Model 3117 Double-Ridged Waveguide Horn is the latest addition to a family of double-ridged waveguide for microwave and EMC measurement from ETS-Lindgren.
- 3119 Double-Ridged Waveguide Horn | Datasheet | Manual
  The Model 3119 Double Ridged Waveguide is a the latest addition to a family of double ridge waveguides for wireless and EMC measurement from ETS-Lindgren. Users of this antenna benefit from uniform illumination of target surfaces and accurate gain measurement.

Open Boundary Quad-Ridged Horn

- 3164-01 Open Boundary Quad-Ridged Horn | Datasheet
  Frequency Range: 100 MHz - 1 GHz. ETS-Lindgren's Model 3164-01 Open Boundary Quad-Ridged Horn Antenna takes the open boundary concept to its extreme by providing a totally open horn, including an open boundary feed cavity.
- 3164-05 Open Boundary Quad-Ridged Horn | Datasheet | Manual
  Frequency Range: 2 GHz - 18 GHz. The Model 3164-05 Open Boundary Quad-Ridged Horn is the newest in a series of Quad-Ridged horns from ETS-Lindgren. The "open boundary" design with its absence of side plates makes this antenna unique in both appearance and performance.
- 3164-06 Open Boundary Quad-Ridged Horn | Datasheet | Manual
  Frequency Range: 300 MHz - 6 GHz. The Model 3164-06 Open Boundary Quad-Ridged Horn is the newest in a series of quad-ridged horns from ETS-Lindgren. The "open boundary" design with its absence of side plates makes this antenna unique in both appearance and performance.

- 3164-08 Open Boundary Quad-Ridged Horn | Datasheet | Manual
  Frequency Range: 700 MHz - 10 GHz. The 3164-08 Open Boundary Quad-Ridged Horn “open boundary” design makes this antenna unique in both appearance and performance. Because of excellent gain and improved VSWR, the 3164-08 replaces former models 3164-04 and 3164-07.
  Available for Antennas-2-Go in September 2012.
- 3164-10 Open Boundary Quad-Ridged Horn | Datasheet | Manual
  Frequency Range: 400 MHz - 10 GHz. The Model 3164-10 Open Boundary Quad-Ridged Horn design makes this antenna unique in both appearance and performance. Designed to measure wireless devices for Over-The-Air (OTA) performance, this unit features excellent gain, with low VSWR.

Custom Antenna Radome Enclosure



- Custom Antenna Radome Enclosure | Datasheet
  ETS-Lindgren's Custom Antenna Radome Enclosure offers a weatherproof environment for our most popular horn antennas.

High Gain Conical Horn Antennas

- 3163 High Gain Conical Horn Antennas | Datasheet | Manual
  Series Frequency Range: 4 GHz to 26.5 GHz. The ETS-Lindgren Model 3163 Series Conical Horns are high gain (Over 16 dBi) antennas, designed for use as feeds in tapered anechoic chambers, as well as in applications requiring high gain and linear polarization.

Conical Log Spiral

- 3102 Conical Log Spiral Antenna | Manual
  Frequency Range: 1 GHz - 10 GHz. The Model 3102 Conical Log Spiral is made with spiral windings of wire attached to the outside of a fiberglass cone.

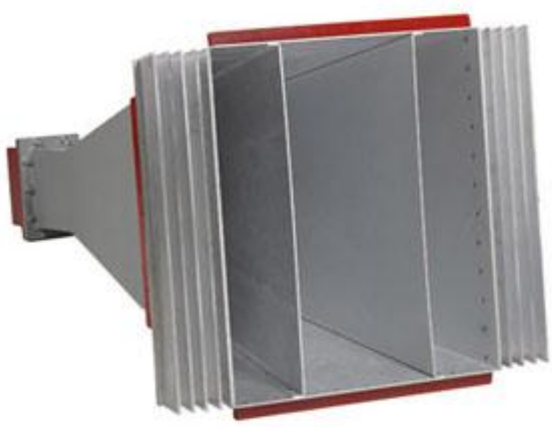
Biconicals

- 3159 Biconical Antenna | Datasheet | Manual
  Frequency Range: 30 MHz - 100 MHz. ETS-Lindgren's Model 3159 Biconical Antenna is a broadband, linearly-polarized biconical antenna.

Dipoles

- 3126 Precision Sleeve Dipole | Datasheet | Manual
  Frequency Range: 450 MHz - 5000 MHz. The Model 3126 Sleeve Dipoles are designed as precision gain references for antenna range calibration and to meet the Cellular Telecommunication and Internet Association's (CTIA) +/- 0.1 dB symmetry requirement for ripple test measurements.
- 3127 Magnetic Dipole Antenna | Datasheet | Manual
  Frequency Range: 440 MHz 2665 MHz. ETS-Lindgren's Model 3127 Resonant Loops are designed to meet the Cellular Telecommunication and Internet Association's (CTIA) ± 0.1 dB symmetry requirement for ripple test measurements at the labeled center frequency.

Field Generating



- 3162-01 Field Generating Antenna | Datasheet | Manual
  Frequency Range: 1.2 GHz - 1.4 GHz. ETS-Lindgren's Model 3162-01 Pyramidal Type High Gain Horn was specifically developed for the GMW 3097 and ES-XW7T-1A278-AC specifications for automotive EMC components testing.
- 3162-02 Field Generating Antenna | Datasheet | Manual
  Frequency Range: 2.7 Ghz - 3.1 GHz. ETS-Lindgren's Model 3162-02 Pyramidal Type High Gain Horn was specifically developed for the ES-XW7T-1A278- AC specification for automotive EMC components testing.

Octave Horn

- 3161 Octave Horn Antenna | Manual
  Frequency Range: 1 GHz - 8 GHz. Model 3161 Octave Horn Antennas cover a bandwidth of 1 to 8 GHz. All models in the series are linearly polarized, have medium gain, optimum half power beam width (equal in both horizontal and vertical planes), and low VSWR.

Pyramidal Standard Gain

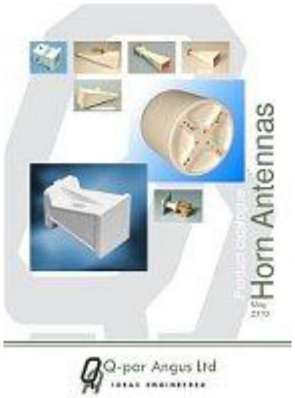
- 3160 Pyramidal Standard Gain Antenna | Manual
  Frequency Range: 960 MHz - 40 GHz. Model 3160 Standard Gain Horns cover a multi-octave bandwidth. All models in the series are linearly polarized, have medium gain, optimum half power beamwidth (equal in both horizontal and vertical planes), and low VSWR.

http://www.ets-lindgren.com/RFAntennas

Horn Antennas

Our company specialises in waveguide horn antennas (standard gain horns) and wideband horn antennas. Here we show our standard range including precision standard gain horns, millimeter wave horns, wideband octave and multi-octave horns. We supply horn antennas from 100 MHz to 140 GHz in many styles including rectangular / pyramidal, conical, multimode, sectoral, double ridged, quadruple ridged, corrugated, light-weight plastic and diagonal horns.

New Horn Antenna Catalogue Cover



Latest Horn Catalogue

Latest Horn Catalogue

Our Horn Antennas catalogue is available for download

Introduction

Introduction

- Every Q-par Angus product is built to last. Manufacturing processes to ISO9001 refined over more than 30 years, ensure the highest quality products.
- All horn antennas come with an integral Type N, SMA or K type connector. Alternatively, they can be provided with standard waveguide flange inputs, usually at no extra cost.
- Each of our antennas is supplied with a test report which can include typical Gain, 3 dB and 10 dB Beamwidth plots, and specific VSWR or Return Loss figures. A sample test report can be found here.

QSH18S10S Thumbnail

Standard Gain Horns

Our standard gain horns are made to the highest standards. These standard gain horn antennas are ideal for gain reference, test & measurement, microwave lab use, field use, & for applications such as GSM, 3G, WiMAX, 802.11 systems.

HIRF thumb

Ultra High Gain Horns

These Ultra High Gain horns are a complement to our Standard Gain (10, 15 & 20 dBi) horns. They feature gains of over 20 dBi and are ideal for projects that require that little bit more.

Wideband Horn Antenna 2_18GHz

Wideband Horn Antennas

These multi-Octave range wideband horns offer an unrivalled facility for measurements, evaluation and electronic surveillance. The band of 0.5 GHz to 18 GHz can be covered with only 2 to 4 wideband horn antennas.

Ultra Wideband Horn Antenna 1-18GHz

Ultra Wideband Horn Antennas

These multi-octave Ultra-wideband horns provide outstanding coverage of their frequency band without compromising VSWR. Our best selling 1 - 18 GHz Ultra-wideband horn is probably the smallest available on the market.

WBH1-8#10HP Thumbnail

EMC Horn Antennas

These Octave range EMC horn antennas offer an unrivalled facility for EMI/RFI testing, evaluation and electronic surveillance. The band of 0.5 GHz to 18 GHz can be covered with only 2 to 4 EMC antennas.

WBH1840DPK_thumb.jpg

Dual Polarised Horns

Q-par Angus designs & manufactures a wide range of Dual Polarised Horn Antennas. Shown here are our standard range, please also see examples of our bespoke designs in the Capabilities area of this website.

QSH thumb

Specialist Horn Antennas

Including Dielectric Filled Horns, Sectoral Horns, Low Sidelobe Diagonal Horns, Hog Horns, and our *brand-new* capability to manufacture lightweight Horn Antennas using rapid prototyping techniques.

WBH1-18S with Lens thumb

Lenses and Lensed Horn Antennas

Lensed horns can produce a much improved gain figure, ideal for materials testing, and can be an alternative to a more bulky reflector antenna. A Lens can be retrofitted to existing horns and are very useful for EMC / HiRF measurement systems.

WRD180 Horn Antenna Thumb

Millimetric Horns

Q-par Angus offers a full range of Millimetric Horn Antennas including wide band horns, both single polarised and dual polarised. Increasingly, higher and higher frequency ranges are being used worldwide.

http://www.q-par.com/products/horn-antennas

The W1GHZ Online Microwave Antenna Book

Paul Wade W1GHZ (ex N1BWT) ©
1994,1995,1996,1997,1998,1999,2000,2001,2002,2003

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8. Periscope Antenna Systems - *17 May 2000*

Part 2 — Antenna Measurement

9. Antenna Range Measurements - *April 1998*
10. Antenna Measurements using Sun Noise - *April 1998*

Part 3 —Computer Analysis of Antennas

11. Parabolic Dish Feeds - Performance Analysis - *March 1998*
12. Pattern Calculation and Phase Analysis - *October 1999*
13.

Software Page

Downloads:

HDL_ANT.exe *version 3b4* and Source code 3b4 *March 2003 - Minor corrections*
FEEDPATT.exe
PHASEPAT.exe
Periscopegain.xls
Slotantenna.xls *30 May 2002* ******Updated******

http://www.qsl.net/n1bwt/contents.htm

Date (UTC)	Satellite	Rocket	Site	Position	Comments	Source Updated
121127 10:13	**ChinaSat 12**	Long March 3B	Xichang	87.5°E	23 Ku tps and 28 C tps will replace ChinaSat 5A	Satelit TV Video D Shimoni Erwinn Sat-ND 121127
121203 20:44	**Eutelsat 70B**	Zenit 3	Sea Launch	70.5°E	48 Ku tps has replaced Eutelsat 70A	D Shimoni William-1 Sat-ND 121203
121208 13:14	**Yamal 402**	Proton	Baikonur	55.0°E	46 Ku tps	D Shimoni Satelit TV Video 121208
121219 21:49	**Mexsat Bicentenario**	Ariane 5 - VA211	Kourou	114.9°W	12 Ku and 12 C tps	D Shimoni Sat-ND 121219
130131 01:48	**TDRS K**	Atlas 5 - V401	Cape Canaveral			Sat-ND 130131
130201 06:56	**Intelsat 27**	Zenit 3	Sea Launch	55.5°W	Ku tps and C tps should have replaced Intelsat 805 and Galaxy 11	D Shimoni R Hable Intelsat BBC Monitoring Satelit TV Video Sat-ND 130201
130207 21:36-22:20	**AzerSpace 1/Africasat 1a**	Ariane 5 - VA212	Kourou	46.0°E	12 Ku and 24 C tps	Satelit TV Video 130203

130207 21:36-22:20	**Amazonas 3**	Ariane 5 - VA212	Kourou	61.0°W	9 Ka tps and 33 Ku tps and 19 C tps will replace Amazonas 1	Satelit TV Video 130203
1301-03	**Express AM5**	Proton	Baikonur	140.0°E	12 Ka tps and 40 Ku tps and 30 C tps and 2 L tps	Satelit TV Video 121015
130315 19:15	**SatMex 8**	Proton	Baikonur	116.8°W	40 Ku tps and 24 C tps will replace SatMex 5	Satelit TV Video 130203
1301-06	**G-Sat 11**	GSLV	Sriharikota	74.0°E	12 Ku tps and 36 C tps will replace Insat 3C	Satelit TV Video 101225
130405 19:01	**Anik G1**	Proton	Baikonur	107.3°W	28 Ku tps and 24 C tps	Satelit TV Video 130203
1304	**SES 6**	Proton	Baikonur	40.5°W	36 Ku tps and 38 C tps will replace NSS 806	Satelit TV Video 121103
130426 19:30	**Eutelsat 3D**	Proton	Baikonur	3.0°E	56 Ku tps	Satelit TV Video 130203
130521	**Astra 2E**	Proton	Baikonur	28.2°E	Ka tps and Ku tps	Satelit TV Video 130203
1306	**SES 8**	Falcon 9 or Ariane 5	Cape Canaveral or Kourou	95.0°E	33 Ku tps	Satelit TV Video 121225
1306	**G-Sat 7**	Ariane 5	Kourou		Ku tps and C tps and S tps	Satelit TV Video 121030
13 mid	**ABS 2**	Ariane 5	Kourou	75.0°E	78 tps co-located with ABS 1	Satelit TV Video 121115
13 mid	**Eshail 1**	Ariane 5	Kourou	25.5°E	14 Ka tps and 24 Ku tps will replace Eutelsat 25A	Satelit TV Video 121030
13	**ChinaSat 9A**	Long March 3B	Xichang	92.2°E	22 Ku tps	Satelit TV Video 120501
13	**Express AT2**	Proton	Baikonur	140.0°E	16 Ku tps	Eutelsat BBC Monitoring 121101

13	**Yamal 401**	Proton	Baikonur	90.0°E	36 Ku tps and 17 C tps	Sat-ND 121229
1307-09	**Express AM6**	Proton	Baikonur	53.0°E	12 Ka tps and 44 Ku tps and 14 C tps and 2 L tps	Satelit TV Video 120927
1307-09	**Astra 5B**	Ariane 5	Kourou	31.5°E		Satelit TV Video 120914
1309	**Arsat 1**	Ariane 5 or Soyuz	Kourou	71.8°W	24 Ku tps	Satelit TV Video 120914
1307-12	**Thaicom 6**	Falcon 9	Cape Canaveral	78.5°E	8 Ku tps and 18 C tps	Satelit TV Video 121225
1307-12	**Arsat 2**	Ariane 5 or Soyuz	Kourou	81.0°W	16 Ku tps and 4 C tps	Satelit TV Video 101220
1311	**Türksat 4A**	Proton	Baikonur	42.0°E	2 Ka tps and 28 Ku tps will replace Türksat 2A	S Günes 120510
1310-12	**Lybid**	Zenit 3	Baikonur	48.0°E	20 Ku tps	C A Scarlaken 120202
1310-12	**Measat 3b**	Ariane 5	Kourou	91.5°E	48 Ku tps will be co-located with Measat 3/3a	Satelit TV Video 111214
1310-12	**Thor 7**	Ariane 5	Kourou	0.8°W	Ka tps and 11 Ku tps	Satelit TV Video 110705
1311-12	**Amos 4**	Zenit 3	Baikonur	65.0°E	4 Ka tps and 8 Ku tps will be located at 65-70 East	Satelit TV Video 121229
13 end-14 early	**KazSat 3**			58.5°E	28 Ku tps	Satelit TV Video 110730
140101	**TDRS L**	Atlas 5	Cape Canaveral			Satelit TV Video 121225
1402	**Türksat 4B**	Proton	Baikonur	50.0°E	12 Ka tps and 18 Ku tps and C tps	S Günes 120510
1401-03	**Astra 2G**			28.2°E		S Günes 100220
1401-03	**Mexsat 1**	Proton	Baikonur	113.0°W	will replace SatMex 6	C A Scarlaken

						120320
14 early	**Express AM8**	Proton	Baikonur	14.0°W	2 Ka tps? and 16 Ku tps and 24 C tps and 2 L tps	Satelit TV Video 121015
14 early	**Express AT1**	Proton	Baikonur	56.0°E	2 Ka tps? and 32 Ku tps will replace Bonum 1	Satelit TV Video 121015
14 early	**Eutelsat 3B**			3.0°E	9 Ka tps and 30 Ku tps and 12 C tps	Eutelsat 110728
14 early	**Amazonas 4A**	Ariane 5 or Soyuz	Kourou	61.0°W	24 Ku tps	Hispasat Satelit TV Video 120910
1404-06	**AsiaSat 8**	Falcon 9	Cape Canaveral		24 Ku tps	Satelit TV Video 120629
1404-06	**Express AM4R**	Proton	Baikonur	80.0°E	2 Ka tps and 28 Ku tps and 30 C tps and 3 L tps	BBC Monitoring 120515
1406	**Star One C4**			70.0°E	48 Ku tps	C A Scarlaken 120330
14	**Africasat 2a**			5.7°E	12 Ku and 24 C tps footprint maps: Ku and C	Satelit TV Video 121025
14	**G-Sat 15**	GSLV	Sriharikota	93.5°E	36 Ku tps and 12 C tps	S Günes 090307
14	**Hispasat 1F**			30.0°W	58 Ku tps will replace Hispasat 1C and Hispasat 1D	S Günes 100809
14	**Intelsat 30**	Ariane 5	Kourou	95.0°W	82 tps co-located with Galaxy 3C	D Shimoni 110914
14	**TurkmenSat**	Long March	Xichang	52.0°E	25-30 Ku tps	Alex Sosa 111127
14 autumn	**Express AM7**	Proton	Baikonur	40.0°E	36 Ku tps and 24 C tps and 2 L tps	BBC Monitoring 120515
14 late	**Hispasat AG1**	Ariane 5	Kourou		3 Ka tps and 20 Ku tps	Hispasat Satelit TV Video 120910
14 end	**Eutelsat 9B**			9.0°E	66 tps	Eutelsat 111004

14 late-15 eary	**SatMex 7**					Sat-ND 120314
15 summer	**Belarus Sat 1**	Long March 3B	Xichang		40 C and Ku tps	Satelit TV Video 121115
15	**G-Sat 9**			83.0°E	12 Ku tps	D Shimoni 120423
15	**G-Sat 13**	GSLV	Sriharikota	93.5°E	6 Ku tps and 18 C tps will replace Insat 3A	Satelit TV Video 110831
15	**Intelsat 31**	Ariane 5	Kourou	95.0°W	82 tps co-located with Galaxy 3C	D Shimoni 110914
15	**Eutelsat 8 West B**			8.0°W	10 C tps and 40 Ku tps	Sat-ND 121011
15	**Express AMU1**	Proton	Baikonur	36.0°E	70 Ku tps and Ka tps	Eutelsat BBC Monitoring 121101
1508	**Amos 6**	Falcon 9	Cape Canaveral	4.0°W	24 Ka tps and 39 Ku tps and 2 S tps will replace Amos 2	Satelit TV Video 121225
1507-12	**Badr 7**	Ariane 5	Kourou	26.0°E	36 Ku tps	Satelit TV Video 130123
1507-12	**Türksat 5A**			31.0°E	16 Ku tps and 4 C tps	S Günes 120510
	SES 9			108.2°E	57 Ku tps co-located with SES 7 and NSS 11	Satelit TV Video Sat-ND 121010

http://www.lyngsat.com/launches/ku.html

Traveling-wave tube

From Wikipedia, the free encyclopedia

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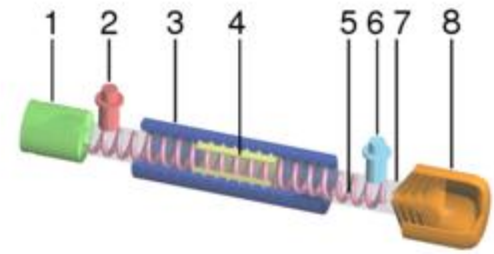

Cutaway view of a helix TWT. (1) Electron gun; (2) RF input; (3) Magnets; (4) Attenuator; (5) Helix coil; (6) RF output; (7) Vacuum tube; (8) Collector.

A **traveling-wave tube (TWT)** is a specialised vacuum tube that is used in electronics to amplify radio frequency (RF) signals to high power, usually as part of an electronic assembly known as a **traveling-wave tube amplifier** (TWTA).

The bandwidth of a broadband TWT can be as high as one octave, although tuned (narrowband) versions exist, and operating frequencies range from 300 MHz to 50 GHz. The voltage gain of the tube is on the order of 70 decibels.

Contents

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[edit] Description

The device is an elongated vacuum tube with an electron gun (a heated cathode that emits electrons) at one end. A magnetic containment field around the tube focuses the electrons into a beam, which then passes down the middle of an RF circuit (wire helix or coupled cavity) that stretches from the RF input to the RF output, the electron beam finally striking a collector at the other end. A directional coupler, usually a waveguide or an electromagnetic coil, fed with the low-powered radio signal that is to be amplified, is positioned near the emitter, and induces a current into the helix.

The RF circuit acts as a delay line, in which the RF signal travels at near the same speed along the tube as the electron beam. The electromagnetic field due to the RF signal in the RF circuit interacts with the electron beam, causing bunching of the electrons (an effect called *velocity modulation*), and the electromagnetic field due to the beam current then induces more current back into the RF circuit (i.e. the current builds up and thus is amplified as it passes down).

A second directional coupler, positioned near the collector, receives an amplified version of the input signal from the far end of the RF circuit. Attenuators placed along the RF circuit prevent the reflected wave from traveling back to the cathode.

Higher powered Helix TWTs usually contain beryllium oxide ceramic as both a helix support rod and in some cases, as an electron collector for the TWT because of its special electrical, mechanical, and thermal properties.[1][2]

[edit] Invention, development and early use

The invention of the TWT is widely attributed to Rudolf Kompfner in 1942–1943, although Nils Lindenblad, working at RCA (Radio Corporation of America) in the USA did patent a device in May 1940[3] that was remarkably similar to Kompfner's TWT.[4]:2 Kompfner independently invented the TWT, and built the first working TWT, in a British Admiralty radar lab during World War II.[5] His first sketch of his TWT is dated November 12, 1942, and he built his first TWT in early 1943.[4]:3[6] The TWT was refined by Kompfner,[6] John Pierce,[7] and Lester M. Field at Bell Labs.

By the 1950s, after further development at the Electron Tube Laboratory at Hughes Aircraft Company in Culver City, California, TWTs went into production there, and by the 1960s TWTs were also produced by such companies as the English Electric Valve Company, followed by Ferranti in the seventies.[8][9][10]

On July 10, 1962, the first communications satellite, Telstar 1, was launched with a 2 W, 4 GHz RCA-designed TWT transponder used for transmitting RF signals to Earth stations. Syncom 2, the first synchronous satellite (Syncom 1 did not reach its final orbit), launched on July 26, 1963 with two 2 W, 1850 MHz Hughes-designed TWT transponders (one active and one spare).[11][12]

[edit] Coupled-cavity TWT

Helix TWTs are limited in peak RF power by the current handling (and therefore thickness) of the helix wire. As power level increases, the wire can overheat and cause the helix geometry to warp. Wire thickness can be increased to improve matters, but if the wire is too thick it becomes impossible to obtain the required helix pitch for proper operation. Typically helix TWTs achieve less than 2.5 kW output power.

The **coupled-cavity TWT** overcomes this limit by replacing the helix with a series of coupled cavities arranged axially along the beam. This structure provides a helical waveguide, and hence amplification can occur via velocity modulation. Helical waveguides have very nonlinear dispersion and thus are only narrowband (but wider than klystron). A coupled-cavity TWT can achieve 60 kW output power.

Operation is similar to that of a klystron, except that coupled-cavity TWTs are designed with attenuation between the slow-wave structure instead of a drift tube. The slow-wave structure gives the TWT its wide bandwidth. A free electron laser allows higher frequencies.

[edit] Traveling-wave-tube amplifier

A TWT integrated with a regulated power supply and protection circuits is referred to as a traveling-wave-tube amplifier[13] (abbreviated **TWTA** and often pronounced "TWEET-uh"). It is used to produce high-power radio frequency signals. The bandwidth of a broadband TWTA can be as high as one octave,[*citation needed*] although tuned (narrowband) versions exist; operating frequencies range from 300 MHz to 50 GHz.

A TWTA consists of a traveling-wave tube coupled with its protection circuits (as in klystron) and regulated power supply Electronic Power Conditioner (EPC), which may be supplied and integrated by a different manufacturer. The main difference between most power supplies and those for vacuum tubes is that efficient vacuum tubes have depressed collectors to recycle kinetic energy of the electrons, so the secondary winding of the power supply needs up to 6 taps of which the helix voltage needs precise regulation. The subsequent addition of a linearizer (as for inductive output tube) can, by complementary compensation, improve the gain compression and other characteristics of the TWTA; this combination is called a linearized TWTA (LTWTA, "EL-tweet-uh").

Broadband TWTAs generally use a helix TWT, and achieve less than 2.5 kW output power. TWTAs using a coupled cavity TWT can achieve 15 kW output power, but at the expense of bandwidth.

[edit] Uses

TWTAs are commonly used as amplifiers in satellite transponders, where the input signal is very weak and the output needs to be high power.[14]

A TWTA whose output drives an antenna is a type of transmitter. TWTA transmitters are used extensively in radar, particularly in airborne fire-control radar systems, and in electronic warfare and self-protection systems.[15] In such applications, a control grid is typically introduced between the TWT's electron gun and slow-wave structure to allow pulsed operation. The circuit that drives the control grid is usually referred to as a grid modulator.

Another major use of TWTAs is for the electromagnetic compatibility (EMC) testing industry for immunity testing of electronic devices.[*citation needed*]

TWTAs can often be found in older (pre-1995) aviation SSR microwave transponders.[*citation needed*]

[edit] Historical notes

A TWT has sometimes been referred to as a "traveling-wave amplifier tube" (TWAT),[16] although this term was never widely adopted. "TWT" has been pronounced by engineers as "twit",[17] and "TWTA" as "tweeta".[18]

[edit] See also

- Distributed amplifier

Other types of microwave power tubes include:

- Magnetron
- Klystron tube
- Crossed-field amplifier
- Backward wave oscillator
- Inductive output tube

[edit] References

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[edit] External links

- Memorial page, with photo of John Pierce holding a TWT
- Nyquist page, with photo of Pierce, Kompfner, and Nyquist in front of TWT calculations on blackboard
- TMD Travelling Wave Tubes, Information & PDF data sheets.
- Flash animation showing the operation of a traveling wave tube (TWT) and its internal construction

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Electronic components

Semiconductor devices	• Avalanche diode • Barretter • Bipolar junction transistor (BJT) • Darlington transistor • DIAC • Diode • Field-effect transistor (FET)

	• Insulated gate bipolar transistor (IGBT) • Integrated circuit (IC) • JFET • Light-emitting diode (LED) • Memistor • Memristor • MOSFET • Photodetector • PIN diode • Silicon-controlled rectifier (SCR) • Thyristor • Transistor • TRIAC • Unijunction transistor (UJT) • Zener diode
Vacuum tubes	• Diode • Audion tube • Triode • Nuvistor • Tetrode • Beam tetrode • Pentode • Pentagrid • Hexode • Heptode • Octode • Nonode • Cathode ray tube

	• Beam deflection tube • Charactron • Monoscope • Storage tube • Video camera tube • Williams tube • Cold cathode • Compactron • Fleming valve
Vacuum tubes (RF)	• Backward wave oscillator (BWO) • Cavity magnetron • Crossed-field amplifier (CFA) • Gyrotron • Inductive output tube (IOT) • Klystron • Maser • **Traveling-wave tube** (TWT)
Adjustable	• Potentiometer • Thermostat • Variable capacitor • Varicap • Varistor • Humidistat

Passive	• Connector
	  ○ Electrical power
	  ○ Audio and video

	◦ RF • Ferrite • Fuse (Resettable fuse) • Resistor • Thermistor • Transformer
Reactive	• Capacitor (Types of capacitor) • Ceramic resonator • Crystal oscillator • Inductor

http://en.wikipedia.org/wiki/Traveling-wave_tube

Traveling Wave Tube Amplifiers (TWTA, TWT Amplifiers) for High-Power Microwave Test Applications.The "T" Series.

- RF Amplifiers
- Microwave Amplifiers
- TWT Amplifiers
- Full Listing
- Price List

0.8 to 45 GHz. 10 to 10,000 watts.

When test needs call for higher power and higher frequency, consider our "T" Series microwave amplifier line– 0.8 to 45 GHz, 10 to 10,000 watts CW and Pulse. These amplifiers provide coverage for a wider range of high-power microwave test applications than any other brand of microwave amplifier on the market and are incredibly feature-rich.

They also offer an advanced design and highest quality construction of any TWT amplifier on the market.

Just How Rich Are They?

Front panel displays give you digital data on everything the amplifier's internal component monitoring system does–including forward and reflected power, gain, event recognition, and complete TWT monitoring. A well-thought-out help screen for simple navigation keeps information clear and your test accurate. Modular switching power supplies keep amplifiers maintainable, transportable and serviceable. Built-in IEEE interface, forced-air cooling, 0 dBm input, RF sample port, hardware and software VSWR protection are all standard.

Clean designs with well-engineered, well-thought-out interiors. Under the hood of these amplifiers, you'll see quality of construction immediately. Modular components and conservative engineering mean they're very reliable and ready for your toughest applications.

model	description	price
40T18G40	40 Watt, 18-40GHz	login
10ST1G18A	10 Watt CW, 0.8 - 18 GHz (w/harmonic filters, meets Telcordia spec)	login
20ST1G18A	20 Watt CW, 0.8 - 18 GHz (includes DCP & IEEE interfaces)	login
35ST1G18	35 Watt CW, 0.8 - 18 GHz (w/ harmonic filters, meets Telcordia spec)	login
50ST1G18	50 Watt CW, 0.8 - 18 GHz	login
250T1G3	250 Watt CW, 1 - 2.5 GHz - Full features unit	login
250TR1G2z5	250 Watt CW, 1 - 2.5 GHz	login
500T1G2	500 Watt CW, 1 - 2.5 GHz	login
1000T1G2z5	1000 Watt CW, 1 - 2.5 GHz	login
1700T1G2z5	1700 Watt CW, 1 - 2.5 GHz	login
2000T1G3	2000 Watt CW, 1 - 2.5 GHz	login
200T2G8A	200 Watt CW, 200 Watt Pulse, 2.5 - 7.5 GHz	login
300T2G8	300 Watt CW, 2.5 - 7.5 GHz - Full features unit	login
300TR2z5G7z5	300 Watt CW, 2.5 - 7.5 GHz	login
500T2z5G7z5	500 Watt CW, 2.5 - 7.5 GHz	login
1000T2G8B	1000 Watt CW, 2.5 - 7.5 GHz	login
1500T2G8A	1500 Watt CW, 2.5 - 7.5 GHz	login
200T4G8	200 Watt CW, 4 - 8 GHz - Full features unit	login

200TR4G8	200 Watt CW, 4 - 8 GHz	login
15T4G18A	15 Watt CW, 4.2 - 18 GHz (w/harmonic filters, meets Telcordia spec)	login
20T4G18A	20 Watt CW, 4.2 - 18 GHz	login
40T4G18	40 Watt CW, 4.2 - 18 GHz (w/harmonic filters, meets Telcordia spec)	login
50T4G18	50 Watt CW, 4.2 - 18 GHz **BARGAIN CORNER UNIT AVAILABLE**	login
250T8G18	250 Watt CW, 7.5 - 18 GHz - Full features unit	login
250TR7z5G18	250 Watt CW, 7.5 - 18 GHz	login
300T7z5G18	300 Watt CW, 7.5 - 18 GHz - Full features unit	login
500T7z5G18	500 Watt CW, 7.5 - 18 GHz	login
1000T8G18B	1000 Watt CW, 7.5 - 18 GHz	login
1500T8G18	1500 Watt CW, 7.5 - 18 GHz	login
2000T8G18	2000 Watt CW, 7.5 - 18 GHz	login
40T18G26A	40 Watt CW, 18 - 26.5 GHz	login
130T18G26z5B	130 Watt CW, 18 - 26.5 GHz	login
200T18G26z5A	200 Watt CW, 18 - 26.5 GHz	login
40T26G40A	40 Watt CW, 26.5 - 40 GHz	login
130T26z5G40B	130 Watt CW, 26.5 - 40 GHz	login
200T26z5G40A	200 Watt CW, 26.5 - 40 GHz	login
70T40G45	70 Watt CW, 40 - 45 GHz	login
120T40G45	120 Watt CW, 40 - 45 GHz	login

1000TP1G2z5	1000 Watt Pulse only, 1 - 2.5 GHz	login
1900TP1G2z5	1900 Watt Pulse only, 1 - 2.5 GHz	login
6500TP1z5G2	6500 Watt Pulse only, 1.5 - 2 GHz	login
8000TP1G1z5	8000 Watt Pulse only, 1 - 1.5 GHz	login
3800TP1G2	3800 Watt Pulse only, 1 - 2 GHz	login
4000TP2G4	4000 Watt Pulse only, 2 - 4 GHz	login
6900TP2G4	6900 Watt Pulse only, 2 - 4 GHz	login
1000TP2G8	1000 Watt Pulse only, 2.5 - 7.5 GHz	login
2000TP2G8B	2000 Watt Pulse only, 2.5 - 7.5 GHz	login
8000TP2z7G3z1	8000 Watt Pulse Only, 2.7 - 3.1 GHz	login
4000TP4G8	4000 Watt Pulse only, 4 - 8 GHz	login
7400TP4G8	7400 Watt Pulse only, 4 - 8 GHz	login
1000TP8G18	1000 Watt Pulse only, 7.5 - 18 GHz	login
2000TP8G18	2000 Watt Pulse only, 7.5 - 18 GHz	login
4000TP8G12	4000 Watt Pulse only, 8 - 12 GHz	login
8300TP8G12	8300 Watt Pulse only, 8 - 12 GHz	login
10000TP8G10	10,000 Watt Pulse only, 8 - 10 GHz	login
8000TP10G12	8000 Watt Pulse only, 10 - 12 GHz	login
3000TP12G18	3000 Watt Pulse only, 12 - 18 GHz	login
5700TP12G18	5700 Watt Pulse only, 12 - 18 GHz	login

http://www.ar-worldwide.com/html/12210_twt_amplifier_twta.asp

1. *traveling wave tube* (*TWT*) - Wikipedia
   *en.wikipedia.org/wiki/**Traveling**-**wave_tube*** - Översätt den här sidan

   A **traveling**-**wave tube** (**TWT**) is a specialised vacuum tube that is used in electronics to amplify radio frequency (RF) signals to high power, usually as part of an **...**

   Description - Invention, development and ... - Coupled-cavity TWT

2. Radar Basics - *Traveling Wave Tube*
   www.radartutorial.eu/08.../tx13.en.html - Översätt den här sidan

   Traveling Wave Tube. **Traveling wave tubes** (**twt**) are wideband amplifiers. They take therefore a special position under the velocity-modulated tubes. On reason **...**

3. What is *traveling*-*wave tube* (*TWT*)? - Definition from WhatIs.com
   *whatis.techtarget.com/.../**traveling**-**wa**...* - Översätt den här sidan

   av Margaret Rouse - i 282 cirklar i Google+

   A '**traveling**-**wave tube** (**TWT**)' is a specialized vacuum tube used in wireless communications, especially in satellite systems.

4. *TWTs* - *Traveling Wave Tubes*: Electron Devices
   *www2.l-3com.com/.../products_**traveling_wav**...* - Översätt den här sidan

   Typical Mini-**TWT**. < 1 lb. Go Back. Pause. Play. The **TWT** is a vacuum RF microelectronic device that functions as a power booster. A preamplified signal source **...**

5. *Traveling Wave Tube*, *TWT* :: Radio-Electronics.Com
   *www.radio-electronics.com/.../**twt**/**travelling**-**tra**...* - Översätt den här sidan

   Overview, tutorial information and theory about the basics of the **travelling wave tube**, **TWT**, and the traveling wave tube amplifier, TWTA, used for very high **...**

6. Welcome to Teledyne MEC & *TWT's*
   www.teledyne-mec.com/ - Översätt den här sidan

   The Teledyne MEC Business Unit is a world leader in the design, development and manufacture of broadband high power helix **Traveling Wave Tubes** (**TWTs**), **...**

7. Triton Electron Technology Division - Mini *Traveling Wave Tubes*
   www.tritonetd.com/web/guest/products - Översätt den här sidan

   Traveling Wave Tubes (mini **TWTs**). Mini-**TWT**, Triton ETD began manufacturing miniature **TWTs** in 1972 and in the early 1980s developed the first micro **TWT**.

8. *TWT* Amplifiers, *Traveling Wave Tube* Amplifiers, Microwave **...**
   *www.quarter**wave**.com/* - Översätt den här sidan

Traveling Wave Tube Amplifier and High Voltage Power Supply Manufacturer.

9. **[PDF]**

The *Traveling Wave Tube* Lives On… and On - Manz Communications
*www.manzcomm.com/.../JED%20**TWTs**%207...* - Översätt den här sidan

Filtyp: PDF/Adobe Acrobat - Snabbtitt
(VED) and, in particular, a **traveling wave tube** (**TWT**). As a result, while the markets for VEDs (vacuum **tubes** in the vernacular) are flat according to most reports **...**

10. TWTA (*Traveling Wave Tube* Amplifiers), *TWT* Amplifiers
*www.arww-rfmicro.com/.../12210_**twt**_amplifi...* - Översätt den här sidan

50+ objekt – AR RF/Microwave Instrumentation manufactures and **...**

model	description
10ST1G18A	10 Watt CW, 0.8 - 18 GHz (w/harmonic filters, meets Telcordia **...**
20ST1G18A	20 Watt CW, 0.8 - 18 GHz (includes DCP & IEEE interfaces)

Sökningar relaterade till *traveling wave tube twt*

traveling wave tube twt **oscillation prevention device**

development a traveling wave tube

linearized traveling wave

twt **code**

design of a linear twt

linear twt **development digital communication**

linear twt **development hargreaves**

http://www.google.se/search?q=traveling+wave+tube+twt

SATCOM Products

SATCOM Installations All Over The World.
Since 1969, and thousands of installations worldwide, MITEQ is a proven and recognized leader in the Telecommunications Industry. Serving both the Military and Commercial

Markets, MITEQ designs and manufactures standard and customized satellite communication equipment. MITEQ's SATCOM product line includes Frequency Converters, Translators, Redundant Switchover Units, Amplifier Systems, Video Products, INMARSAT Products, Equalizer Products, Uplink Power Control Products, Power Amplifiers and Custom Communication Equipment.

- Frequency Converter Systems
- Frequency Translator Systems
- SATCOM Amplifiers
- Redundant Switchover Units
- Equalizer Products
- Uplink Power Control Units
- Beacon Receivers
- Fiber Optic Products
- Video Products
- INMARSAT Products
- SATCOM Custom Products

Brochure:

SATCOM Products Overview (D-359.PDF)

NEW Space Saving, patented, 1/3 rack 1RU high SATCOM Products
Unique, full function space saving 1/3 products are available with the same performance and options as our full rack units but require 1/3 the rack space of a traditional unit. The 1/3 product line is patented #7,510,090 and only available from MITEQ. These 1/3 rack 1RU high solutions are available in the following products: Amplifiers, Frequency Converters, Translators, Equalizer Products, Fiber Optic Transmitters and Receivers, as well as in our Broadband and Ultra Broadband Products (contact MITEQ for additional information on our Broadband and Ultra-Broadband product line).

The Space Savings feature of the 1/3 products is unbelievable and allow you to create Redundancy, Three-Channel Amplifiers, FO Transmit and Receive, Equalizer and Switchover or even Test Translator Block Configurations in 1 RU. Think of a 1:12 Redundant Equalizer Configuration in 300% less Rack space. Now that's a savings and the combinations are endless!

SATCOM Product Discontinuation Notification - March 6,2009:
MITEQ announces it will discontinue production of Amplifier Power Supply Unit (model APS4-96-1). The production life of model APS4-96-1 will cease as of May 1, 2009. All orders must be received by MITEQ, prior to May 1,2009. For additional information please contact satcomsales@miteq.com

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Support
Technical Notes (requires an account)
Firmware (requires an account)

Related Products
SATCOM Legacy Products

Please **Contact MITEQ** For More Information...

SATCOM SALES
Email:satcomsales@miteq.com
(631) 439-9108

Click Here For More Contact Options...

RF/Microwave Assemblies

Although MITEQ offers one of the broadest lines of standard communications products, the bulk of MITEQ's business is in customized components, assemblies, sub-systems, systems multi-function assemblies and Integrated Microwave Assemblies designed specifically around the customer's needs. MITEQ's heavy emphasis on internal R&D throughout its history has lead to the creation of a company with the ability to adapt quickly to the changing needs of the customer and market while at the same time offering competitive prices and fast turnaround times. MITEQ's total in-house microwave component design capability allows us to serve and satisfy our customer's needs expeditiously with single-function components or multifunction assemblies.

Most of the multifunction assemblies are designed to unique customer requirements. A multifunction assembly is more compact, smaller in size and lighter in weight than a structure consisting of discrete system building blocks. In addition, a purchased multifunction assembly normally has all of the system interface problems solved at the manufacturing level, and the input/output performance will conform to design specifications when installed at the next level of system integration.

- Amplifier Assemblies
- Converter Assemblies
- Levelers
- Log, Limiter, Discriminator
- Monopulse Detectors
- Multiplexer Assemblies
- Receiver Assemblies
- Reflectometers
- Switch Assemblies

RF/Microwave Assemblies Catalog Listing - Click Here

These components are sometimes referred to as super components, multi-function assemblies, IMA or integrated microwave assembly, integrated RF/Microwave Assemblies and/or RF and microwave sub-assemblies.MITEQ concentrates on applying our overall corporate talents along with direct interface with the customer to solve engineering and manufacturing design problems.Typical Assemblies Include:Remote Exciter ModulesMonopulse ReceiversSAR Exciter/Receiver SystemsResearch and Development SubsystemsSpaceborne Components Three-Channel Monopulse Receiver Front EndsFive-Channel Phase Interferometer Receiver SystemsBlock ConvertersSwitch Filter BanksPhased Array Radar SubsystemsRF Signal Distribution Subsystems

Please contact Component Sales with any special requirements you may have:Tel: 631-436-7400Fax: 631-436-7430Our Integrated Assembly products are backed by MITEQ's3-Year Warranty and most are available as RoHs Compliant components.

Parent Categories:

Spaceborne Products

Related Products

Mixers | Modulators | Multipliers

Please **Contact MITEQ** For More Information...

COMPONENT SALES
Email:components@miteq.com
(631) 439-9220

SATCOM SALES
Email:satcomsales@miteq.com
(631) 439-9108

Click Here For More Contact Options...

New Products:

Broadband Image Rejection Mixer	
Compact, Ka-Band Gain Controlled Amplifier, 20-26 GHz	
Ultimate Performance and Space Savings with 1/3 Rack Up- and Downconverters	
High Reliability Fiber Optic Transmitter	
6 to 18 GHz Low Noise with 1 Watt Input Protection Amplifier	

Weatherproof Ka-Band Low Noise Amplifier

Lightweight 400W Peak Ku-Band TWT Amplifier

Wideband, Millimeter LNA

Show All New Products

RF/Microwave Components

MITEQ is a recognized leader in the advanced development of RF and microwave products and sub-systems for both military and commercial applications. These component solutions are backed by MITEQ's 3-Year Warranty and most are available as RoHs Compliant components.Customize Your Components: MITEQ maintains dedicated engineering resources to modify our standard designs in support of custom-generated specifications.

- Amplifiers
- Bias Tees
- Coaxial Terminations
- Converter Modules
- DC Blocks
- Directional Couplers
- Fiber Optic Links
- Frequency Discriminators
- Frequency Oscillators
- Frequency Synthesizers
- Hybrid Couplers
- Mixers
- Modulators
- Multipliers
- Phase Shifters
- PIN Diode Attenuators
- PIN Diode Switches
- Power Dividers and Combiners

Related Products

Component Literature

Please **Contact MITEQ** For More Information...

COMPONENT SALES
Email:components@miteq.com
(631) 439-9220

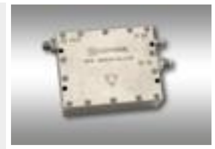
SATCOM SALES
Email:satcomsales@miteq.com
(631) 439-9108

Click Here For More Contact Options...

New Products:

Low Noise Ka-Band Amplifier

Broadband Single Sideband Upconverter



12-18 GHz Low Power Consumption Low Noise Amplifier

Q-Band High Performance, Antenna Mount Block Up- and Downconverters

DBS-band, 17.3 to 18.4 GHz, 9900 SERIES FREQUENCY CONVERTERS

Waveguide Ku-Band Low Noise Amplifier

Weatherproof Ka-Band Low Noise Amplifier

3W Wideband GaN PA 12V Operation and With Heat Sink With Fans

Show All New Products

Spaceborne Products

MITEQ has supplied hardware for space-flight missions for over twenty-six years. Our emphasis is predominantly in technically challenging requirements, particularly in the area of:

- Low-noise amplifiers
- High-performance microwave mixers
- Frequency synthesizers
- Oscillators
- Logarithmic amplifiers
- Custom designed assemblies

For many years MITEQ's primary area of expertise for space products was in low-noise amplifiers. However, MITEQ has been able to provide a wide spectrum of products and designs by utilizing mature technology delivered on other high-reliability programs. With our extensive space experience, we have been able to use qualification data from our existing designs while delivering custom-engineered units, thereby offering reduced cost and shorter delivery times to our customers.

- Amplifiers
- Coaxial Terminations
- Converter Modules
- Directional Couplers
- Frequency Oscillators
- Frequency Synthesizers
- Hybrid Couplers
- Log Amplifiers
- Mixers
- Modulators
- Multipliers
- Phase Shifters
- PIN Diode Attenuators
- Power Dividers and Combiners
- RF/Microwave Assemblies

Below is a list of space programs which MITEQ has supported:

MITEQ Customer	End User	Program
Northrop Grumman	NASA	NPOESS
Northrop Grumman	-	Corvair
NT-Space	JAXA	Global Precipitation Measurement
Jet Propulsion Labs	NASA	Mars Science Lab
Comdev	JPL	Cloudsat
NASA	NASA	Aquarius
Applied Physics Lab	NASA	New Horizons
ASTRIUM GmbH	DLR	Tandem X
ASTRIUM SAS	ISRO	Megatropics
MacDonald Dettwiler	CSA	Radarsat II
ALCATEL Space	German DOD	Sar-Lupe
ALCATEL Space	JPL	Jason-2
Lockheed Martin	U.S.A.F.	Alpha Extension
University of Bordeaux	ESA	Herschel
SRON	ESA	Herschel
Technologica	CSA	Herschel
Max Plank Inst.	ESA	Herschel
Dornier	DLR	Terrasar X
Jet Propulsion Labs	NASA	Cloudsat, Miro, EOS-MILS
Assurance Technology	U.S. Navy	Windsat
ITT	U.S.A.F	Alpha I-IV

Motorola/GD	U.S.A.F	P-94-99, 02
E- Systems	JPL	SEAWINDS
Matra Marconi	EUMESAT	MHS
E-Systems	JPL	GEOSAT
Aerojet	U.S.A.F	SSMIS, AMSU-B
Millitech	U.S.A.F.	SSMIS
Lockheed	U.S.A.F.	STS-54
Applied Physics Lab	U.S. Navy	Seasat, Spinsat, Topex, Extended TestBed

MITEQ's continued advancements in this state-of-the-art and unique capability have led to a wide acceptance by the microwave community as a forerunner in spaceborne technology. Our space-qualified components include mixers, oscillators, amplifiers, synthesizers, and super-components. MITEQ's Space-Qualified Quality Assurance Plan establishes the actions necessary to provide confidence that the end item will meet the quality, reliability, and electrical performance required for space-qualified applications.

Related Information

About MITEQ | Facilities | Manufacturing and Design Capabilities

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Please **Contact MITEQ** For More Information...

COMPONENT SALES
Email:components@miteq.com
(631) 439-9220

SATCOM SALES
Email:satcomsales@miteq.com
(631) 439-9108

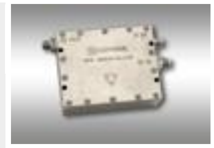
Click Here For More Contact Options...

Products:

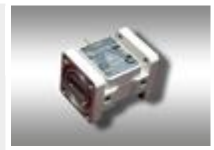
Waveguide Ku-Band Low Noise Amplifier

High Dynamic Range, Wideband LNA

Broadband Single Sideband Upconverter



Airborne K-Band Low Noise Amplifier



Ku-Band Low Noise Waveguide Amplifier

WS Ka-Band Block Converters Cover Wideband Commercial and Military Band Requirements

High Reliability Fiber Optic Transmitter

Energy Efficient Outdoor TWTAs

Show All New Products

Custom Solutions

Although MITEQ offers one of the broadest lines of standard catalog items, the bulk of our business is in customized components, assemblies, and systems designed specifically around customer needs. MITEQ maintains dedicated engineering resources to modify our standard designs in support of custom-generated specifications. This can include new design efforts, modifications to existing designs for performance and mechanical needs, as well as additional testing and environmental screening.

In addition to housing separate engineering and manufacturing groups, MITEQ prides itself on its support groups including: drafting, which uses the latest commercial CADD and proprietary software programs; and an extensive machine shop, which includes top-of-the-line numerically-controlled Okuma, Mitsui, Seiki and Matsuura vertical machines capable of machining to the tightest of tolerances, guaranteeing repeated accuracy and reliability.

To accomplish the engineering, manufacturing and testing of MITEQ's components and assemblies, MITEQ invests heavily in capital equipment. This state-of-the-art equipment includes a wide array of vector network analyzers and synthesized sources, phase noise test sets, custom noise figure measuring equipment, glass furnace equipment to control the process of glass sealing, thermal/humidity chambers, and PIND and shock and vibration stations for environmental screening, to name just a few.

- Facilities
- Manufacturing and Design Capabilities

MITEQ's heavy emphasis on internal R&D throughout its history has lead to the creation of a company with the ability to adapt quickly to the changing needs of the customer and market while at the same time offering competitive prices and fast turnaround times.

Related Information

About MITEQ

Please **Contact MITEQ** For More Information...

COMPONENT SALES
Email:components@miteq.com
(631) 439-9220

SATCOM SALES
Email:satcomsales@miteq.com
(631) 439-9108

Click Here For More Contact Options...

New Products:

Airborne HPA

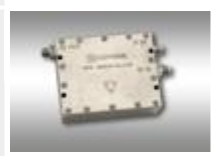
Compact, Ultra-Broadband Medium Power Amplifier

Waveguide Ku-Band Low Noise Amplifier

DBS-band, 17.3 to 18.4 GHz, 9900 SERIES FREQUENCY CONVERTERS

Surface Mount SLSM Series Phase-locked Oscillators

Broadband Single Sideband Upconverter



WS Ka-Band Block Converters Cover Wideband Commercial and Military Band Requirements

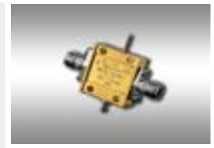
26-40 GHz Low-Noise/Medium Power Amplifier

Show All New Products

Broadband Image Rejection Mixer

6 to 18 GHz Low Noise with 1 Watt Input Protection Amplifier

Coaxial and Compact Ka-Band Line Amplifier



WS Ka-Band Block Converters Cover Wideband Commercial and Military Band Requirements

High Reliability Fiber Optic Transmitter

3W Wideband GaN PA 12V Operation and With Heat Sink With Fans

Airborne K-Band Low Noise Amplifier

Ultra-broadband Single Pole Four Throw Switch

Show All New Products

Ariane 5 orbits the EUTELSAT 21B and Star One C3 satellites

2012-11-10 - MITEQ congratulates Arianespace, Eutelsat and Star One on a sucessfull launch on November 10,2012. This is the 52nd consecutive success for the Ariane 5 dating back nearly ten years. The combined weight of the two communications satellites was over 9.2 metric tons delivered perfectly on-target in GTO. Mark your calendar for Arianespace's next launch on November 30th.
(read more)

Upcoming Events:

CABSAT
Dubai, UAE
2013-03-12 - 2013-03-14

SATELLITE 2013
Washington, DC, USA
2013-03-19 - 2013-03-21

NAB
Las Vegas, NV, USA
2013-04-08 - 2013-04-11

(more events)

MITEQ, an acronym for (M)icrowave (I)nformation (T)ransmission (EQ)uipment, is a recognized leader in the advanced development and manufacturing of RF and Microwave Components, Assemblies and Systems for both military and commercial applications. MITEQ also maintains dedicated engineering resources to modify our standard designs in support of special requirements and Custom products.

Located on Long Island, New York for more than forty three years, MITEQ has grown into a company which is dedicated to achieving technical excellence, producing quality products and satisfying our customer's specific needs. (More About MITEQ)

http://www.miteq.com/