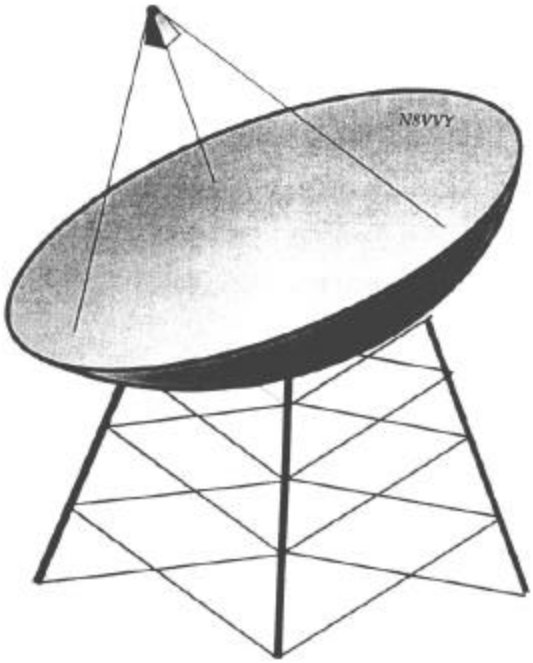
ANOMALOUS PROPAGATION

Newsletter: **The Midwest VHF / UHF Society**



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Annual Society membership is $ 10.00. Please make checks payable to Gerd Schrick

MIDWEST VHF-UHF SOCIETY

Vol. 23 No. 2 **www.mvus.org** Feb. 2009

Meeting Fri 27 February
at the Hometown Buffet near SR 725 and Yankee Rd.
in Centerville

MVUS Sunday Net at 14:30 UT (currently 10:30 **AM** local time, EDT).
The net frequencies are primarily **144.280 Mc and 28.960 Mc.**

Contents

Hamvention this Year: 15 / 16 / 17 May !!!

Re Roster. We plan to print a new roster next month, so if there have been any changes, e-mail us or drop a postcard to the editor. Thanks.

Re Pictures and Graphs. We have been posting most pictures and graphs in color on the Web. That makes it a whole lot nicer on your eyes. Of course, as a member of MVUS, you have full access to the Newsletter files.

Search For Extra Terrestrial Intelligence

Largely using radio telescopes and optical telescopes, SETI scientists seek to determine whether humankind is alone in the universe. Since Congress terminated NASA's SETI funding in 1993, The SETI League and other scientific groups have privatized the research. Amateur and professional scientists interested in participating in the search for intelligent alien life, and citizens wishing to help support it, check the SETI League Web site at http://www.setileague.org/, The SETI League, Inc. is a membership-supported, non-profit [501(c)(3)], educational and scientific corporation dedicated to the scientific Search for Extra-Terrestrial Intelligence.

Lots to talk about this month, so let's get started...

Hamvention is coming up and we will have a booth again this year. Most likely in the same location as last year. As always, I am looking for folks to help with setup and staffing, as well as ideas for neat stuff to attract attention. Anything you have built lately? Here would be a place to show it off. Interesting pictures of MVUS activities or your not-so-portable projects? We'll put them on display.

Mike Schulsinger and Red Dakin are once again putting together a first class VHF/microwave forum, with the theme of digital communications. Please plan to attend, as I think you'll get a lot out of it.

Mike Suhar is working on getting the microwave beacons ready to put on the roof at the arena. I think the bands include 1296, 2304, and 10 GHz, but that is subject to change (and corrections to my always faulty memory).

A milestone passed recently when we renewed our club call sign, W8KSE, after ten years. Hard to believe that Jules Wittebort has been gone for that long. I can still hear his voice and his always amused and amusing way of talking about things.

Believe it or not, there are signs that the 1296 beacon antenna may be installed this spring. Although I doubt it will be before Hamvention, we can hope. Mike Murphy just has a little bit of ruggedizing work on the radome to finish and we'll be ready. Also related to that tower work, there will be a UHF repeater antenna available, and MVUS will be taking over operation of the old MVFMA 444.25 MHz machine. It will be on the same tower as the beacon, but not quite as high. But at around 1500 feet ASL, coverage in these parts will be terrific. It will use the Club's W8KSE call sign. More on that to come as well.

At the last meeting, there was some discussion about a field trip to the Greenbank, WV, radio telescope installation, coupled with a swing by Morehead State to see how their new facility is coming along. Of course a trip there wouldn't be complete without stopping by to see Jeff Kruth's warehouse. We didn't set a date, but late March or early April seems reasonable. We'll have to see what is available. It was mentioned that there is a weekend around that time where there will be a large group at Greenbank, and we would not be causing much inconvenience for the staff there. More to come on this.

Also, we talked about having a Spring tech session, but no firm plans were made. Any thoughts? Let me know at n8zm@mvus.org.

We'd still like to do another FMT, but with so much going on this spring we just don't see being able to do it until after Hamvention. Maybe by then we'll have seen the return of the sunspots and a nationwide or even worldwide opportunity for a super FMT will present itself. John Ackerman has some interesting ideas for a very long transmission event to allow studying the effects of propagation variation on the stability of signals. Could be very useful data from this given that there are a number of very slow speed digital modes that have been developed for amateur applications that could benefit from this knowledge.

No doubt I have missed mentioning something important, but then that is why we have meetings, so be there on the 27th to find out what it was, and watch me get my just desserts (usually chocolate ice cream and a cookie).

De Tom, N8ZM..

Now, the Real Important Stuff:

We've been asked by AMSAT to turn our Transponder on during the Hamvention and although we missed out on the best antenna wx (at 0^{o} F or 18^{o}C) there are more opportunities coming up in about a month which coincides with John's, N8VZW, return from the South, where he hibernated. We'll keep you posted!

Gerd, WB8IFM.

This and That 2-09

Cell Shock has Good Ending. Remember last months story about the lost capacity of my cell phone battery. Well, before replacing it, I tried the number two remedy to revive a dead battery: give it a good wack! Would you believe, this did the trick. The battery is now practically as good as it was before! [Gerd, WB8IFM]

Wasteland. In 1961 Newton Minnow, from the FCC, gave a speech in which he described and decried television as "a vast wasteland." At the time one could usually just receive a handful of stations. …. Now with hundreds of channels available we know Minnow was short sighted. TV in his time was only a half wasteland. (Now) we've got the real thing! [Tom Teepen, Atlanta]

No Worry. "Don't worry about the world ending today. It's already tomorrow in Australia."
[Cartoonist Charles Schulz]

Giant Sequoias. When measured by volume, they are the world's largest living things, growing only on the western slope of the Sierra Nevada and nowhere else. Some reach the heights of 30 story buildings and have a base diameter of 36.5 feet. [National Park Service]

Fresh Water. Glaciers and polar ice like those found in Glacier Bay store more freshwater than all the world's lakes, rivers, groundwater and atmosphere combined. [National Park Service]

Back Then. In the 1930 Americans went to the movies a lot. With the population at 127 million they bought 78 million tickets a week. [George Will]

Most Needed Book of 2009. Americans should weep for death of common sense. Philip Howard's book: "Life without lawyers: Liberating Americans from Too Much Law." will be most welcome. Law is essential to, but can stifle freedom. Today, Howard writes, "Americans increasingly go through the day looking over their shoulders instead of where they want to go." [George Will]

Education. Dean Kamen, who has designed everything from the segway to artificial limbs, says: "You can print money, but you can't print knowledge. It takes12 years." [Thomas Friedman}

Tinkerer Ford. Young Henry Ford's favorite past time was dismembering watches. A neighbor remarked: "Every clock in the Ford home shuddered when it saw him coming." [They Made America by Harold Evans]

The Center: Copernicus removed the earth from the center of the Universe and Darwin took the human from the center of the creation. [Peter Kurz]

Demoralizing. I just bought an IC-91AD. This is a D-star radio. Working my way through the instruction manual, I find it rather demoralizing to realize I need to read this before jumping on this DV mode.
[*Jim Weaver, K8JE*]

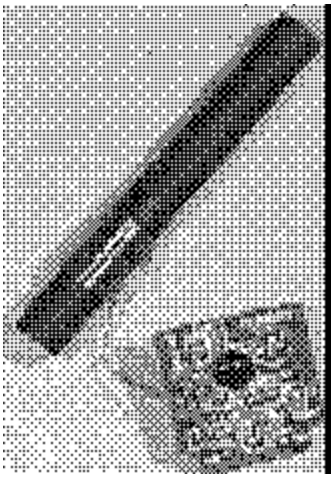
Depressed Times. The year was 1836. Samual Morse was demonstrating his telegraph to the Congress in Washington. A vote endorsed in principal some national system. Francis O.J. Smith, the Chairman of the House Committee on Commerce, enthusiastically turned on the current, proposing a grant of $ 30,000 to build 50 miles of telegraph. It did not get very far because the economy was too depressed and some congressman impeded the legislation on the grounds that Morse was surely insane. [Harold Evans]

Six Fingers. A boy has been born in California with six fingers on each hand and six toes on each foot. The sixth fingers and toes are fully formed and functional, and doctors have advised the boy's parents that surgery isn't necessary. "I realize children would tease each other over the slightest thing," said pediatrician Dr. Michael Treece. "But imagine what sort of pianist a 12-fingered person would be, imagine what sort of flamenco guitarist. If nothing else, think of their typing skills."[It must be true…I read it in the tabloids, The Week]

Beacon-Clock, a Little Microcontroller Project

By Markus, DF8OO

Whenever I tried to check the propagation conditions on 20m (with the help of a DCF77 synchronized clock and a printout list of the NCDXF beacons) I was annoyed about my own computing arts (15:52 UTC was it the first, second or third minute of the beacons pass?).



Then came the idea that this would be an application for an LCD display!

Well, a DCF77 synchronization would also be necessary, but since appropriate receiving modules are available, all it needs is a microcontroller with some software to do the job. I decided to use a PIC 16F84 by Microchip since it is cheap and I had a burning device for it.

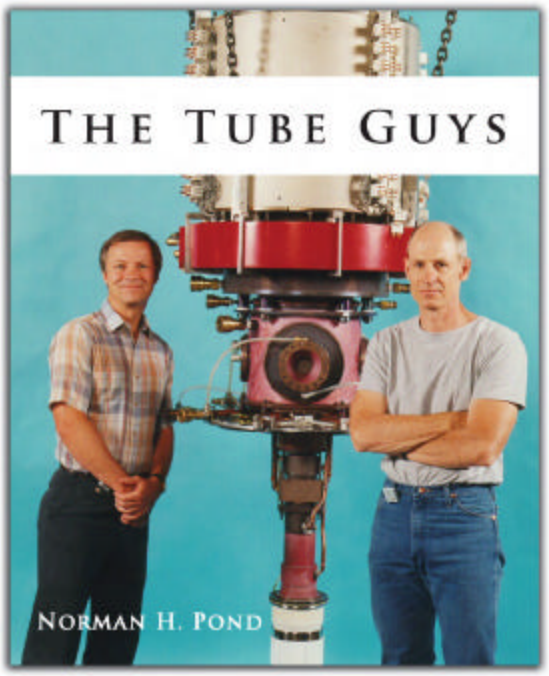
The clock receiving module receives the German time standard signal transmitted on 77.5 kHz with a small ferrite antenna and delivers a TTL pulse every second. The duration of the pulses is used for coding the UTC time, date, year and day of week. The software to decode the time from the pulses and to drive a LCD-display I found on the internet at the homepage of DK1RM.

After soldering the few parts together I put everything into a small plastic box. Most difficult for me was to cut a precise rectangular hole into the front of the box for the frame of the LCD display.
Now, what does the little beacon clock show?

When you connect the circiut to 12 V it needs about 1-2 minutes to decode the time, then it shows the time in the first line of the display with the timezone and 2 characters representing the receiving state. In the second line you can see the day of the week and the date. The 2 pushbuttons are used to switch the timezone, so the clock shows the UTC time and the second pushbutton is used to switch on the beacon display. All 5 bands the beacons transmit on are available.

As the clock was ready to go into one of the shelves in my shack I found out that the receiving condition was very poor due to the many power lines behind the shelves and lots of other cables. I ordered another receiving module and added a little stereo jack (with a switch) on the rear of clock box. So I am able to feed clean time signals from a remote location from the very top of my shelf. When I disconnect the remote receiving module from the box then the internal module is switched on.

Another improvement I work on is to put a small realtime-clock with an I2C bus into the box because I more and more dislike the 1-2 minutes to wait until the time is decoded and the display starts to show the actual beacon.



Microwave Tubes 12-24-08

When I was at Jeff Kruth's, WA3ZKR, place with Jim Miller, N8ECI and Mike Murphy, KA8ABR, a couple of weeks ago, Jeff suggested a book he had found. The book is titled

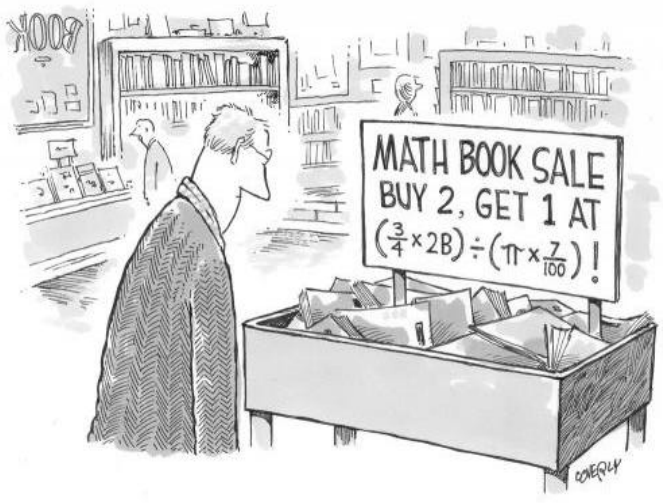
"The Tube Guys" By Norman H. Pond.

Hard cover,435 pages.

For more details and to order the book see:
http://www.russcochran.com/publishing/thetubeguys/

Review By Mike, W8RKO

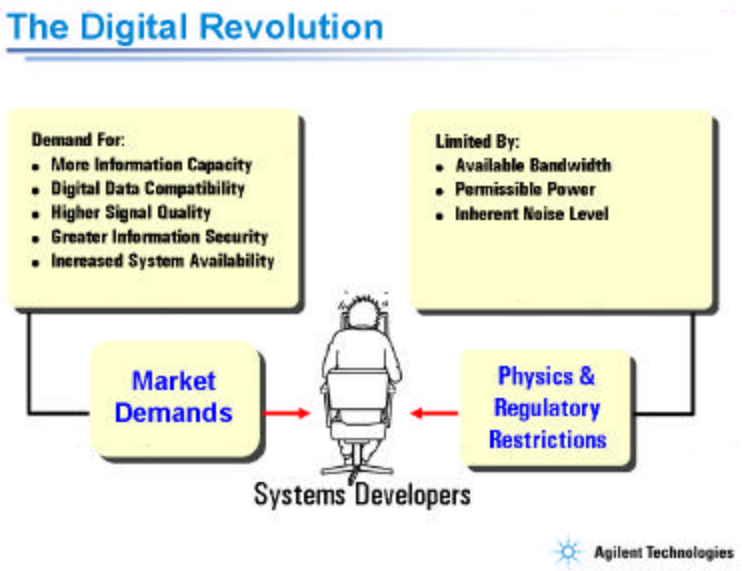
I obtained this new book (published in 2008) about the history of the microwave tube. This book records how the inventions occurred, who invented the tubes, and what businesses developed around these tubes. The book starts with the invention of the light bulb and other early developments that form the foundation for tube development. The book then goes into the invention of the Klystron, Cavity Magnetron, Traveling Wave Tube, Backward Wave Oscillator, Ubitron, and Gyrotrons. World War II necessitated the development of radar which the book covers in chapter five. The book continues past WWII through more modern developments such as the microwave oven. At that point the book goes into the history of the companies that were formed around the design and manufacture of microwave tubes. Companies covered: Sperry, GE, RCA, Sylvania, AT&T, Raytheon, Litton, Federal Telegraph Company, Westinghouse E2V, Thales, CPI (Varian), Eimac, Bomac, Huggins Labs, Hughes Aircraft, Roger White, MA/COM, Watkins-Johnson, SFD, Teledyne, Northrop Grumman, MLI, Star, M-Square, and Japanese Microwave. There is a chapter on tubes from the USSR. A short chapter covers developments in Germany. The book is 435 pages and not very expensive for a hardback at $29.95. The book is available from the publisher www.russcochran.com.

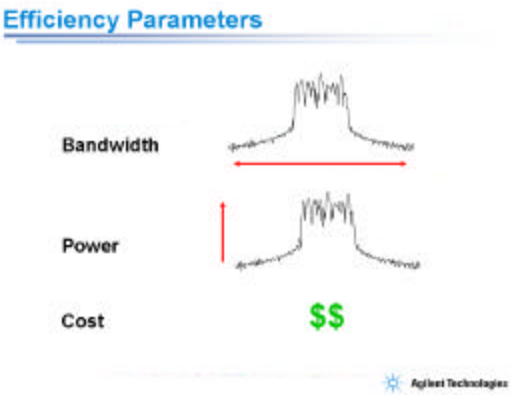


Talking about Books

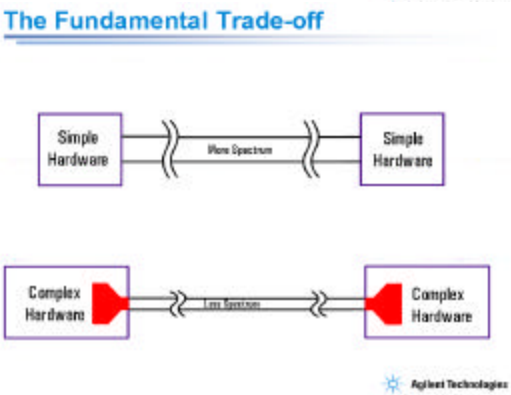
Basic Digital Communication By Tom Holmes, N8ZM

This is the first installment of a series on how digital data is sent and received over radio. This first slide shows some of the motivators for going digital.

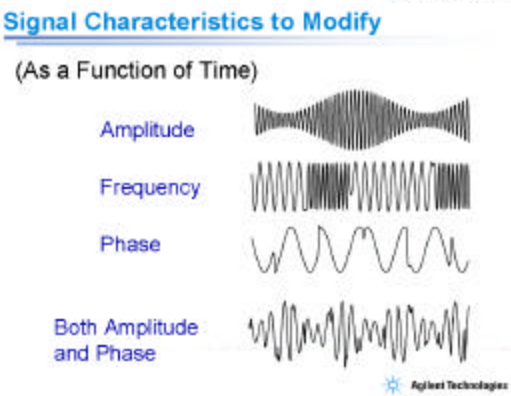




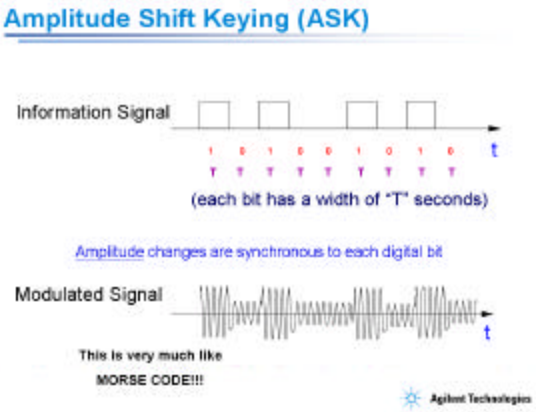
Of course, there are always engineering trade-offs to be made that ultimately affect cost, the fundamental measure of efficiency.



Because bandwidth costs money to use, and channel efficient modulation schemes add complexity ($$), this is the fundamental driver for choosing any specific scheme.



As an example, let's use amplitude as the modulated parameter. The changes in amplitude simply track the state of the bit stream. In this case, a zero bit is not zero level, but a lower level so that the receiver 'knows' there is a signal present. FM and Phase Modulation work similarly, as we will see later.



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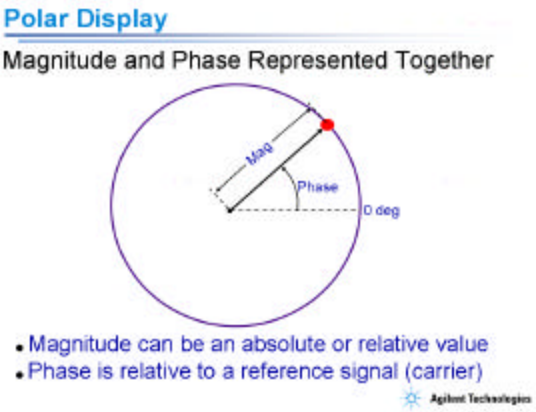
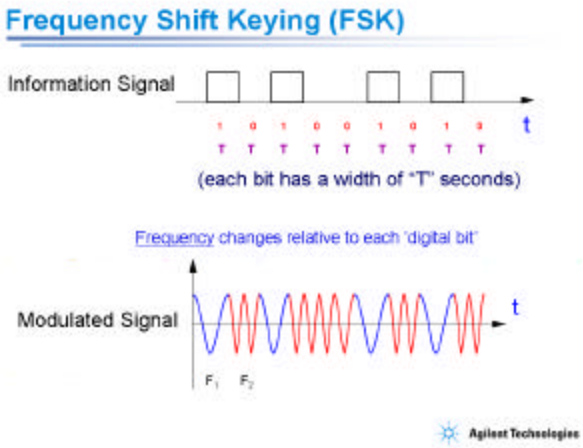
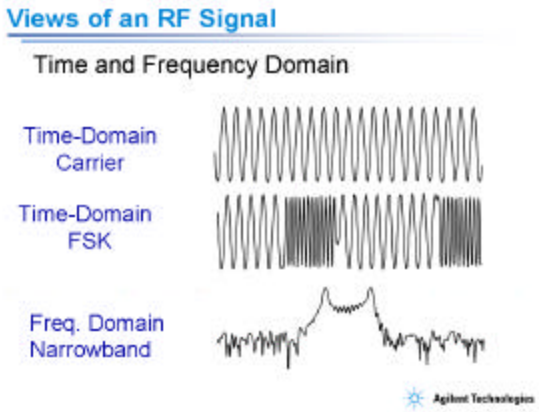


If we represent the modulation as a vector, we can better visualize what is happening to the amplitude and phase together. The red dot represents the position of the vector at the time when the signal is sampled, usually the midpoint of the bit period.



FSK is a form of FM, exaggerated some here to make it easy to see the frequency change. Think about how the phase might change, remembering that the phase is the derivative of frequency.

If we look at the FSK signal in both time and frequency, you can see that there is bandwidth consumed. Here, the BW is mainly determined by the amount of frequency shift from a 0 to a 1.



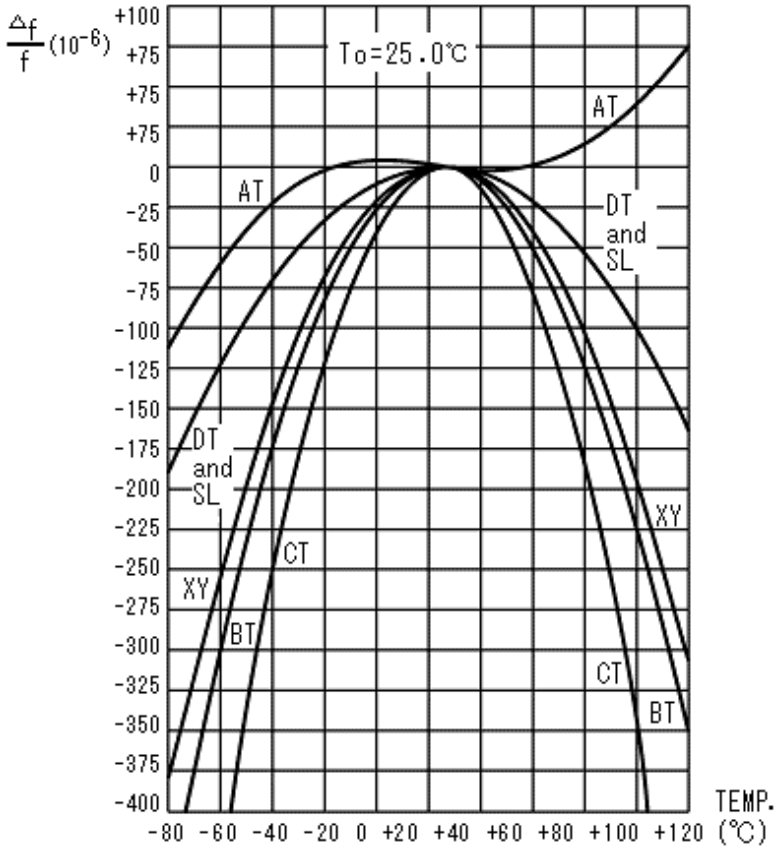
Gerd says I can only have 1 or 2 pages each month, and this first part is up to 3. Next month we'll learn about bit rates and symbols. Tom, N8ZM

Using a Quartz Crystal as a Thermometer Sensor

By John Ackermann N8UR

Any "time-nut" soon learns that crystal oscillators change frequency with temperature. In fact, any tuned circuit is temperature sensitive. As a result, one of my saying is "every resonator is a thermometer." So, usually, our goal is to isolate the crystal from any temperature change, and that's why we use ovens or even double ovens to improve frequency stability. An old quartz oscillator I have from the early '60s had an oven that maintained the crystal to within about 0.001 degree.

Apparently, some bright folks realized that you ought to be able to turn things around and use a crystal as a thermometer. A division of Hewlett-Packard called Dymec came out with the DY-2801A thermometer in the mid-1960s. Their key accomplishment was the creation of a crystal "cut" that was extremely linear over temperature. Most crystals have a very non-linear response, as shown in this chart showing several different cuts.



As you can see, these crystals all have a point of zero, or at least minimum, frequency change with temperature. OCXOs (oven controlled crystal oscillators) usually set the oven temperature to this "turning point" to minimize temperature sensitivity.

However, this sort of response is the opposite of what you want for a thermometer; it would require complex adjustment, and probably individual calibration of each crystal, to turn this very non-linear plot into a usable temperature indication. And, because the frequency change per degree is much less near the turning point, the resolution will vary over temperature.

The folks at HP/Dymec came up with a crystal cut that has a linear response over a wide temperature range. The "LC" (Linear Coefficient) crystal has a frequency change of 35.4 parts per million per degree Celsius over a wide temperature range.

With an LC cut crystal in an oscillator circuit, the frequency output can be converted directly into temperature. In principle, the crystal and oscillator could be designed to operate at any frequency. However, when this work was being done in the early 1960s, there was no such thing as a processor inside a piece of test equipment, so the designers, being clever, calculated that a crystal frequency of around 28 MHz would yield a frequency change of exactly 1 kHz per degree Celsius. They designed the circuit so that the output would be precisely 28.208 MHz at zero degrees C. Beating the temperature probe oscillator against a reference oscillator running at that frequency yields a beat note that can be counted and directly displayed as the temperature. Since a one Hertz frequency shift equals one milliDegree of temperature change, very high resolution was fairly easy to obtain.

Extending that process, the counter could very accurately measure the temperature difference between two temperature probes by beating their frequencies against each other (with some special tricks to determine which probe was the warmer of the two).

This system, introduced 1965 as the DY-2800A and DY-2801A (single and dual channel versions, later retagged as "HP" instead of "DY") had some pretty impressive specifications. It had a resolution of 0.0001 degree, linearity of better than 0.02 degrees from 0 to 100 degrees, and a short-term stability of better than

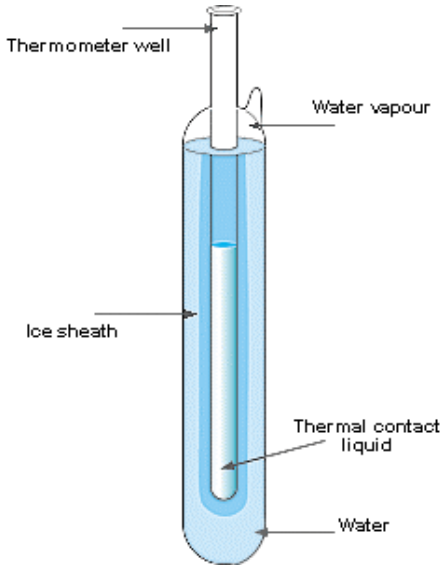
0.0002 degrees. The drift was < 0.01 degree over 30 days. The dual channel version sold for $3,250 in 1965 dollars.

HP's last version of the quartz thermometer, the 2804A, came out in the late 1970s. It works in pretty much the same manner, but the addition of a microprocessor allowed for better accuracy. The basic idea of an oscillator whose frequency was 28.208 MHz at zero degrees, and a counter that displays the offset from that frequency was retained, but in this model each interchangeable temperature probe comes with a ROM cartridge that contains calibration information for that probe. Any non-linearity or frequency offset can be calibrated out using this factory-generated calibration data. In addition, front-panel thumbwheel switches allow for easy calibration against a temperature reference.

One other feature of the new model is ability to display either Celsius or Fahrenheit temperatures. In the old unit with its largely analog temperature-to-frequency-to-display process, showing Fahrenheit temperatures was a purchase-time option that required changing counter gate times and oscillator frequencies. But thanks to the miracle of the microprocessor, the 2804A knows how to do the ***nine-fifths plus thirty-two*** trick digitally at the flip of a switch.

The 2804A's performance specs aren't actually better than the 2801's, but the same performance level is easier to obtain. The stated absolute accuracy is 0.04 degree from -50 to +150 degrees Celsius, provided that the unit has been adjusted against a reference temperature within 30 days. The long-term stability of the system is better than 0.001 degree per month.

Speaking of reference temperatures, how do you calibrate a thermometer like this? I'm just beginning to learn about this, but you normally rely on one of the natural phase transitions in a material, such as the freezing or boiling point. There are several established reference temperatures, such as the freezing point of tin (+231.88° C). However, the most precise baselines are based on the temperature at which water changes state. The definition of the Kelvin degree, in fact, is based on the ice point of water.



However, the absolutely most exact temperature reference is the “triple point” of water – that is, where water exists in all three phases (solid, liquid, and gas) simultaneously. This equilibrium occurs at a temperature of exactly 273.16° Kelvin, or 0.01° Celsius, and a partial pressure of 6.1173 millibars.

A triple point cell is a glass fixture that contains a sealed well full of water that is at least “six nines” pure. The water is surrounded by dry ice or another powerful cooling agent. Because of the way the cell is constructed, the dry ice will cool the water to the triple point, but not below. Properly used, a triple point cell can have an accuracy of 0.0001 degree.

If you don't have a triple point cell, an ice bath can be used to directly measure the ice point. This method can reach an accuracy of better than 0.01 degree, which may be usable. The ice bath is just crushed ice or ice chips along with a small amount of liquid water in a thermos bottle. The key things required to obtaining good accuracy are using distilled water, as impurities can significantly change the freezing point, and making sure that both liquid water and ice are present in the bath; that is the condition that specifies the “ice point.”

By the way, why isn't the boiling point of water used as a precise reference? The main one is that water's boiling point varies with atmospheric pressure. Starting from sea level, every 500 feet of elevation reduces the boiling point by about 0.5 degrees Celsius, and of course the current barometric reading must be taken into account. This dependency makes it very hard to realize the boiling temperature with accuracy and repeatability. The ice point or triple point are more easily established and as a result are universally used rather than boiling point measurements.