Iambic Keying - Debunking the Myth

by
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Iambic or "squeeze" keying is one of the "Great Expectations" in CW operation. Operators will agonize over a huge variety of features in electronic keyers, but support for iambic keying itself is a given. But Iambic keying is really of very limited value, and it's easy to become convinced that it was a BAD IDEA that happened to catch on.

First, Some Definitions...

Keying System A keying system is a switch or switching system used to turn a transmitter on and off. Keying systems range in complexity from simple switches (straight keys and cootie keys) through very complex electro-mechanical or electronic devices including paper tape machines, electronic keyers with paddles, and computers.

Keyer The term “keyer” is generally used to refer to an "electronic keyer," which is a device that will generate dots or dashes depending on which of the two input switches is closed. Usually a device called a "paddle" is used for input switching (sending). The earliest keys had the same function of a bug, that is, they sent dots automatically but dashes were made by hand. The earliest keyers used vacuum tubes using the RC time constant to control the speed of the dots. In the late 1940s vacuum tube keyers with automatic dots and dashes became available. The were big, power-hungry, difficult to adjust, and expensive.

Finally, with the availability of transistors in the late 1950s, electronic keyers became readily affordable and "iambic" keyers were introduced. An iambic keyer is simply an electronic keyer that can be operated with a dual paddle (see below), and responds to a closure of both levers at the same time by sending a series of alternating dots and dashes. The term “iambic” describes the *rhythm* of the alternating dots and dashes. It comes from poetry, where an "iambic meter" is a rhythmical pattern of alternating stressed and unstressed syllables. For example, "twas BRILLig AND the SLITHey TOVES did GYRE and GIMbal IN the WABE." That line from Lewis Carroll's Jabberwocky is actually "iambic heptameter" if anyone is counting. Poetry teachers used to vocalize this iambic meter or rhythm as "deDum deDUM deDUM" which sounds a lot like "di-dah di-dah di-dah."

An iambic keyer will send "di-dah di-dah di-dah." as long as both paddles are held closed (or "squeezed," – *if* the dot lever is pressed a little bit *before* the dash lever. If the dash lever is pressed first, the keyer will send "dah-di dah-di dah-dit.", or DUMde instead of deDUM. Those of you who didn't sleep through English 101 will remember that the latter rhythm is called trochaic, so the "iambic keyer" could just as well be called the "trochaic keyer," or the "iambic/trochaic keyer." And yes, before you ask, it doesn’t matter what keying device you are using– an A is always an iamb, an N is always a trochee, and a U is absolutely an anapest!

That's a lot more information that you need, so just remember that:

1. An electronic keyer can support the iambic sending technique, in which case it is an "Iambic Keyer." The term Iambic has nothing to do with the paddle!.

2. Iambic sending requires a dual-lever paddle.

3. An "iambic keyer" can be driven with a single-lever paddle, and a "non-iambic keyer" can be driven with a dual-lever paddle..

Paddle -- a simple horizontal (usually!) switching device used to control an electronic keyer. It can have a single lever (moved right for dots and left for dashes) or two separate levers. Usually the two levers of a "dual paddle" can be squeezed so that both sets of contacts are closed at the same time, telling the iambic keyer to send iambically. With some dual paddles the levers can be "locked together" so that only the dot OR dash contacts can be closed, making it impossible for an iambic keyer to receive a "squeeze."

Iambic Keying -- also known as "squeeze keying," the technique of squeezing the levers together to use the iambic features of the keyer. There are two kinds of squeeze.

True Squeeze: if both paddles are held closed, the keyer will send an alternating string of dots and dashes, starting with which ever (dot or dash) was closed first, if only my a millisecond. For example, to send a period (di-dah-di-dah-di-dah) you would squeeze the levers together, making sure that the thumb or dit lever closes slightly ahead of the dah lever, wait for the keyer to send di-dah-di-dah-di-dah, and release the squeeze.

The second type of squeeze is "character insertion" where one paddle is held closed and the other is tapped to insert the opposite element into the string. For example, to send the letter F (di-di-dah-dit) you would hold the thumb or dot lever closed, wait for the keyer to send the second dit, and "tap in" a dah *without releasing the dot lever*. Technically it is still a "squeeze" to the extent that both levers are closed for a brief moment, but the student usually learns these as two separate techniques for different types of characters.

What good is Iambic Keying?

It sounds like a great idea, doesn't it? Just squeeze the levers together instead of moving the levers individually back and forth. If you reduce the number of movements that your hand must make, then you are increasing the efficiency of your sending!

It's true, but only u*p to a point.* You really should ask yourself these two questions:

How much more efficient is it?

What price do you pay to achieve that additional efficiency?

It's elementary cost/benefit analysis, but the answers might surprise you.

How much more efficient is it? Not very much.

What price to you pay? Too much.

This is *fact*, not theory, common wisdom, or the author's opinion! The presumed benefit of iambic keying is that it is more efficient. Fewer movements of the hand are required in order to generate any given piece of Morse code text. Fewer hand movements result in reduced strain on the muscles of the hand and hence easier, more comfortable operation of the keying system. Here's where we get to question one above– how much more efficient is it?

Chuck Adams, K7QO, has done an exhaustive analysis of the keystrokes (hand motions) required to generate code using each of the common devices. You can read his complete tutorial on sending code at http://www.qsl.net/k7qo/sending.html . Chuck counted the keystrokes needed to generate the 26 letters of the alphabet and the ten numbers from zero through nine. In the table of his results below please note that Non-iambic Electronic Keyer includes an iambic keyer used with a single lever paddle or otherwise without using the iambic features, and Iambic Electronic Keyer is used with dual lever paddles.

Device	Keystrokes
Straight Key	132
Semi-automatic Bug	87
Non-iambic Electronic Keyer	73
Iambic Electronic Keyer	65

There is a **HUGE** improvement in going from a **straight key to a bug**-- and in addition to the reduction of keystrokes the change from vertical to horizontal keying motion went a long way toward relieving "glass fist" as carpal tunnel syndrome was known in the trade. The keystroke count has been reduced by an amazing **34.1%**.

There is a **SUBSTANTIAL** improvement in going from a **bug to a non-iambic keyer**, again with a side benefit of a fairly light touch on an electric paddle compared with the effort to move a lever attached to a pendulum. The keystroke count has been reduced by a noticeable and beneficial **16.1%**

There is a **SLIGHT** improvement in going from a **non-iambic keyer to an iambic one**, but no other benefit. On Chuck's numbers, you will use 10.9% fewer keystrokes. Rounding it up, moving from non-iambic to iambic keying will give you an **11%** improvement in efficiency.

Or will it?

Looking at these numbers alone is dangerously misleading, unless you are in the habit of sending the entire alphabet and numbers all the time. What you will actually be sending on the air is a variant of "plain English text" in which some letters are sent more often than others. Consider:

1. The benefit of iambic keying is seen only in some of the longer letters and specifically those with alternating dots and dashes.

2. The Morse code was deliberately designed (by Vail, but that's another story) so that the more common letters are shorter.

Put it another way, Morse code is already optimized for efficiency and the advantages of iambic keying are available only on letters that are less commonly used in plain English text. Referring back to Chuck's work, here are the letters which can be squeezed, or which offer some reduction in keystrokes when sent iambically:

C, F, K, L, Y, Q, R

There is a standard reference of cryptographers and typesetters called the "frequency table" or "letter distribution table." This is a table that shows how frequently each letter occurs in ordinary text (there are specialized frequency tables for specialized forms of text, where a different pattern is evident, such as scientific English).   Almost all of the tables for English agree through the first four or five letters, E, T, A, O, I, N. The most commonly known frequency table is that used by typesetters, and it begins ETAOINSHRDLU which not coincidentally is the first line of keys on a Linotype machine

Frequency list: E,T,A,O,I,N,S,H,R,D,L,U

Squeezable letters: L............C,F,K,Y,Q,R

A quick inspection shows that ONE of the letters which can be squeezed can be found in the list of the TWELVE most common letters in English. It follows that in plain English text the increased efficiency derived from squeeze keying is *much less than the 11% calculated above!*

Of course a CW QSO is a *variant* of "plain English" and its frequency table is substantially different. It is true that we send the letters CQ a lot (unless we push a button on a memory keyer). We use Q codes, and callsigns are more or less random selections of characters. But the bottom line is that the additional benefit of squeeze keying is considerably less than is commonly thought. It should be possible to derive an appropriate frequency table for QSO text, and work out the actual numbers, but my educated guess would be that **the actual efficiency improvement that can be gained with iambic keying is on the order of 4 to 6 percent**. The longer the QSO, the more "plain English" you will send, and the lower the efficiency difference!

Let's use 5% as our benchmark because it is a nice round number that it easy to think about.

How much is Five Percent?

It's a lot, if you are talking about the price of groceries or gasoline. After all, we'll drive across town to save 5 cents a gallon on gas, and that might be only TWO percent savings.

It's not much, if you're talking about the level of water in your bathtub. Even if you could measure it accurately, you aren't likely to notice it.

Electronic keying is more like bathwater– you can't see a 5% change in the level of water in your bathtub unless you are really looking for it. You might aim to fill the tub to the same level every time, but you will be very lucky to get within 5%, and you probably don't care. Similarly, there is so little effort involved in operating a paddle that you won't notice an increase or decrease of 5%. How often do send code with a paddle for long enough that your hand gets tired? Of those cases, how often would a 5% difference in the number of keystrokes make a noticeable difference in how tired your hand is?

And What's the Cost?

If you reduce your bathwater by 5% it doesn't cost you anything apart from remembering to turn the tap off a few seconds sooner. So in this respect, our 5% efficiency gain is more like a 5 cent per gallon savings on gas. If you thought it through, you might realize that it is going to take you half an hour to get to the cheaper gas station and back, during which you are going to burn probably half a gallon of gas, and if you buy 20 gallons of gas you will end up with a total "savings" of a dollar or less. If you force yourself to squeeze every possible character, you will expend more time and effort in learning to do that, than any possible efficiency savings.

It *is* difficult to learn squeeze keying, and many CW operators give up on it, or use it only on a few characters.

The iambic keyer uses a "timing cycle" to determine what to do and when. There are timing "gates" during which a squeeze is recognized, or during which a dot can be inserted into a string of dashes, etc. The duration of these "gates" is directly related to the sending speed. The faster you go, the narrower the gates are and the more precision you will need in order to place a keystroke exactly where it needs to be. In fact, at very high speeds the gates are so close together that it becomes almost impossible to hit them reliably.

Here's an illustration of the keystrokes used in sending the letter F.

There are at least three different ways you can send the letter F with a dual paddle and an iambic keyer– (1) with an individual paddle press for each dit and dah, (2) by holding the dit paddle in for the first two dits and then sending the remaining dah and dit individually, (3) “squeezing,” by holding the dit paddle closed and “inserting” the dah between the last two dits. Only method 3 is ‘iambic’ keying, and lets look at what’s involved.

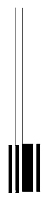
The vertical lines at the beginning of the second dit and the dah represent the “timing gate” during which you can initiate a squeeze (close the dah paddle) to trigger the dash insertion. For the record, the diagram uses “Curtis Mode B” timing; but more about that later.

For the sake of argument, let's say that the chart is "calibrated" for a speed of five words per minute. At that speed you can hear what is being sent as easily as you can see the markings in the drawing.

> At five words per minute the duration of a single dit and the following space is approximately half a second.
>
> At twenty words per minute, the duration of the dit and the following space is approximately a tenth of a second.
>
> At forty words per minute, the duration of the dit and following space is approximately 60 milliseconds.

In practice, anybody who can send at 5 wpm with a paddle can “squeeze key” effectively. At 20wpm it takes a lot of practice and some people just can’t do it. Above 40wpm the more complicated squeezes are forgotten about even by operators who “squeeze” everything at slower speeds.

Looking at the timing diagram again, let’s compress the horizontal time access and see what 50wpm looks like: In practice, it is as hard to hit those gates with keystrokes as it is to see them in the drawing.



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At higher speeds most operators who routinely use squeeze keying will shift to non-iambic keying.   In fact, most high speed European operators prefer single lever paddles, non-iambic keyers, or dual paddles with a piece of cardboard jammed between the levers to keep them from squeezing!

Proof of the pudding-- get a good single lever paddle and see what you can do with it! Seriously, if you set up a dual paddle next to a single lever paddle, you are going to find that you can reliably send the letter F (and other squeezable letters) much faster with the single than a squeeze. There's another ergonomic factor involved here– with a dual paddle, in order to generate a "squeeze" you must move your thumb and your fingers independently and very precisely. With a single lever (or a dual that you are not squeezing) you can hold your thumb and fingers still, touching the lever(s), and rock your hand back and forth on the heel of your palm. That particular motion uses the large, strong muscles of the forearm, and it is also a very useful technique for operators who have arthritis or wrist problems.

It would be remiss of me not to add that the dual lever paddle can offer a couple of slight advantages over a single lever paddle, even if the keyer is set for non-iambic operation. First, on many dual lever paddles the spring tension can be set independently for each of the two levers. This is of some advantage where the operator is making the transition from a bug to a paddle because the dit lever movement on a bug is usually a good bit heavier than the dah lever movement. Generally speaking, though, the tension should be equal on both sides, and with a less-precisely made paddle it is often necessary to use spring tension to compensate for a difference in the pivot bearings.   In very high speed operation you get some advantage from the fact that one lever can start its motion before the other has returned to the resting position, but this will only be relevant if you are moving your thumb and fingers separately. .

The Myth Exposed

The idea that iambic keying is more efficient has been around for a long time, and few operators ever question it, even if they are having trouble doing it. They might blame themselves, or the paddle, and it stops being fun. At first it does seem to have a certain "cool" factor, and no doubt that's why it was invented to start with. Some computer programmer looked at an electronic keyer, realized that he was looking at logic states (dot is on or off, dash is on or off) and decided to fill in the rest of the truth table– he was using "either a or b ," and he was using "neither a nor b" but he wasn't doing anything with "both a and b."   In other words there was a third "switch" that wasn't being used. Not a bad idea on the face of it, and we've been paying the price ever since.

Iambic keying became all the rage, and manufacturers got to make a bunch of new-fangled dual paddles. Somewhere in there electronic keyer designers decided to offer “refinements” of the basic principles, giving everybody Iambic A vs Iambic B to argue about, and distracting them from any consideration of whether Iambic Anything was worth bothering with. It’s like saying the emperor has no clothes, but I’ll say it anyhow– iambic keying is clever, and fun, but of very little practical value. Worse, it can impose a speed limit on your sending, and ruin another perfectly good amateur radio myth– the widely accepted notion that anyone can send twice as fast as he can receive. But let’s talk about that one another time.....

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