ZEN AND THE ART OF RADIOTELEGRAPHY

Carlo Consoli, IK0YGJ

Rev. 20101008

TABLE OF CONTENTS

Introduction

This book is the result of several years of experience in amateur radiotelegraphy. It suggests, for the first time, a learning methodology based on an integrated and multidisciplinary approach designed to accompany the apprentice from the first steps in ham radio all the way to a world-class proficiency in telegraphy. The book introduces, ad-hoc tailored to amateur radio, techniques used successfully by competitive athletes, including extreme sports such as free diving, adapted to the difficult process of learning telegraphy.

This book is not only written for the benefit of amateur radio operators who want to learn this beautiful art, but it also meets the urgent need felt by the author to narrate his own path of development that has radically transformed him and the many friends with whom he shared the pleasure of such a long learning process and the immense joy of the discovery, both from the technical and from the human point of view.

Wireless telegraphy is the discipline of sending and receiving signals in Morse code and, although it started “only” as a technical tool, it soon proved to be an art. Definitely a special kind of art: like a butterfly, it had a shiny but short life, rising and falling throughout the 20th century. The first implementation of Morse code was created in 1832, employing a numeric code for the most common English words, and the numbers translated into a sequence that used just two symbols: dash and dot.

Morse code, as we know it today, i.e., encoding letters and numbers in a series of dots and dashes, is actually an invention of Alfred Vail, an assistant to Samuel Morse in 1844. It is a historical reality that Morse, in fact, stole the idea from Vail. Morse code was created initially as a combination of dots, dashes, long dashes, short and long spaces. We had to wait for wireless telegraphy, and therefore the twentieth century, to find the definition of the standard Morse code or “International Morse”, made of dots and dashes, spaced according to standard criteria.

It was only thanks to the genius of Guglielmo Marconi that telegraphy "took off", by leaving the ground (i.e. transmission cables) in the true sense of the term, and getting “on the air”. On December 12th, 1901 Marconi sent the first Morse signals across the Atlantic, and a new invention, whose gigantic power was still to be fully understood, arose: wireless telegraphy. Since then, many lives were saved, as in the famous case of the Titanic (1912), and the wireless telegraph has evolved and excelled as no one could have imagined.

After a century of successes, in 1998, coastal maritime radiotelegraphy installations have been replaced by satellite communications, which eventually provided a much more secure and reliable connection. As a result, telegraphy is slowly sliding into oblivion. As a direct and inevitable consequence, in 2005 telegraphy also disappeared from amateur radio exams. Surprisingly, this condition of uselessness elevated radiotelegraphy to the rank of an art.

Despite this aging process, telegraphy is still very much alive with radio amateurs, because it offers the possibility of communicating over great distances using inexpensive transmitting and receiving devices. Such devices are even simpler to build. A contact based on telegraphy is made in a universal language that, like Esperanto, pulls down any social, geographical and cultural barrier. The amateur radio operator uses a code that not only shortens the speech, but also allows him to communicate with people living in any part of the world, near or distant, regardless their language or culture. Thus, wireless operators can greet each other using a common language even if one is Chinese and the other Guatemalan.

The question is: what is so special about radiotelegraphy, in the era of the Internet and global mass communication, compelling us to accept a long and arduous path of learning, requiring mental and practical training, trying harder and harder to learn such a language?

Anyone starting the exciting and hard journey into radiotelegraphy is attracted by the fact of pursuing an art requiring style and precision, two characteristics that may be obtained only through study and practice. It is also matter of aesthetics: a contact in telegraphy made with precision and respect for procedures is a work of art, unique and unrepeatable in time. The wireless telegraphy radio operator, today, is a person who not only learns to "play" a very special instrument, but also learns a new language, made of a single tone, cadenced by rhythmic intervals. Learning radiotelegraphy is a journey within our own emotions and feelings that requires a transformation of the way we learn and how we feel. Much like a child, who must learn to speak, revealing a new mode of expression and communication with the outside world. It is a steep and thorough experience requiring continuous contact with the deeper layers of our being.

So strong is the passion for radiotelegraphy that, in Italy, Elettra Marconi, president of Marconi Club ARI Loano and daughter of Guglielmo Marconi, today releases the honorific title of wireless radio operator to whom excels in the practice of this art. Oscar Wilde used to say that art is useless: as such radiotelegraphy is, too. Having fallen into disuse for practical applications, it lives its moment of glory as an art in the hands of the few people who, in a "swinging mood" made of sweet intermittent sounds, are keeping it alive.

Learning CW

The issue of radiotelegraphy obsolescence (CW mode emission, or Continuous Wave) is being passionately discussed in the amateur radio world: today CW is definitely decommissioned, in Italy and in several parts of the world, in all professional activities: military, maritime, postal, railways.

Since 1998, all CW maritime radio transmissions were replaced by satellite systems, which can provide greater reliability and security of the link. Telegraphy was also removed from amateur radio exams, resulting in increased overcrowding in those parts of the HF bands allocated to the voice modes of amateur radio, since passing the exam was much easier than before. So, many amateurs turned back to consider CW, in part attracted by the opportunity to enjoy portions of bandwidth exclusively reserved for CW, but mainly because of the attraction to exercise an art that requires precision and style and has to be developed constantly, with study and practice.

Is, then, the art of radiotelegraphy, undisputed protagonist of the twentieth century, destined to disappear into thin air? We would say that it might not be the case: by quoting Urbano Cavina, I4YTE ("Marconisti d'Alto Mare" Ed C & C): CW is left with enough health to be hailed as the Latin of the new era, and even more, the Esperanto of the new millennium.

Once learnt, CW can never be forgotten: all the hard work is rewarded by a precious art that will accompany the ham for life. As the English say, "there is no free lunch": learning CW is a lengthy process that must be tackled in stages, training every day for a period consistent with the stage of learning. CW is an art and like all arts it cannot be learnt only by studying: however hard you try or how much time you spend, you need to achieve the mental condition to *be* a wireless radio operator, not to do wireless telegraphy. And, there is a big difference.

The four stages of learning

Talent matters, of course. Aside from that, what really is important here is your ability to get in touch with the deepest levels of your mind to acquire, day after day, the mental structures of being a wireless operator. It is quite a long journey in which the prize is the journey itself.

According to Zen Buddhism, learning is a journey through awareness and knowledge in four stages:

- Unawareness of lack of knowledge
- Conscious lack of knowledge
- Conscious knowledge
- Unawareness of knowledge

The initial stage is about unconscious lack of knowledge: where we simply do not know what we want to learn. The student approaches the subject he wants to learn, hopefully with an open mind. He has not even the slightest idea of what stands before him and the challenges he could be facing. The student does not even know what he doesn't know! Of central importance at this stage is the leadership role of the teacher, who welcomes and guides, step by step, the student on his way from ignorance to knowledge. The phase of unawareness of lack of knowledge lasts for a relatively short time. A careful student is able to immediately understand what he needs to do, especially if the path is steep. In learning CW, the stage of unconscious lack of knowledge begins when you decide to learn telegraphy and listen for the first time to the intermittent sounds of dots and dashes. You immediately understand that there must be a pattern, a meaning, a structure behind these harmonious sounds but you cannot perceive it.

Start your journey open-mindedly towards this new art, cast aside the many questions and doubts, and keep up your willingness to learn. Rest assured: you will be able to answer and cope with all of your doubts and uncertainties.

The second stage is the conscious lack of knowledge: the disciple began his studies in continuous contact with the teacher, learning step by step all the basics but he practices with uncertainty. He knows what he has learnt and has to improve his practice. He also knows what else is yet to be learnt. The student knows that he is not knowledgeable. Later, he will discover that he had always known, but he was not certain he actually did! This stage usually lasts just long enough to learn all the basic elements of the object of his study. In CW, this phase is focused on learning the sounds of letters, numbers and symbols of Morse code. Remain open-minded and simply skip over everything you might not understand. Be confident of the fact that you will be able to retain everything you are able to decode for the first time. This means that when you understand a sound, the relationship between the sound of each letter, and the word it is part of will remain yours forever.

The third stage is the conscious knowledge: the student has learnt and he is aware of what he has learnt. Each time he uses the knowledge gained, he is fully aware of it and acts wisely to achieve the goals he planned for himself, leveraging on the gained knowledge. The student knows and knows he knows. This phase is the longest and, in certain arts, it could last for decades. But do not worry because it is

also the phase bringing to you the greatest satisfaction: remember that the prize is the journey itself, not the final goal. In learning CW, at this stage you will be perfectly able to understand Morse code but you will need paper and pencil to jot down what you receive. You will be limited in terms of speed of reception and transmission and some words will seem incomprehensible. At this stage it is of fundamental importance to practice on a daily basis. On some days you will go like a lightning, and on others it will seem to you like you forgot everything. Stay cool, stay focused and open-minded. Ignore any error, it will resolve itself.

The fourth phase is about unconscious knowledge: the student has learnt about all there is to learn (from others) and obtains additional knowledge from the practice of the art itself. At this stage, he is no longer even conscious of exercising knowledge. The student knows and uses what he knows spontaneously. In CW, this is the stage where you will be able to receive and transmit at speeds limited only by your physical capabilities and by the mechanical features of your telegraph key, you will be able to listen and understand signals amid utterly deafening noise or while you're busy doing other tasks, without writing or making any conscious effort. This will hold true both in transmitting and in receiving.

The learning roadmap

We will approach learning in the four stages, in a form specifically designed for learning CW, in three distinct phases:

1. Learning the elements of the Morse code alphabet and their spacing.
2. Speed consolidation up to a maximum of 20 words / 100 characters per minute, using paper and pencil to copy down what you receive.
3. Increase speed and decode "in your head."

In the first phase, for six weeks, we study each Morse code alphabet element, learning it as a sound. A group of characters per week. Keep practicing every day, not exceeding the time assigned for your training sessions. Practice often, for a short time. At this stage, we focus exclusively on the receiving. To start learning CW we will use software (therefore you must be equipped with a personal computer) and enable it to introduce letters and numbers gradually. We will learn the letters by groups: ETANIM / DSOURC / KPBGWL / QHFY / ZVXJ / 12345 / 67890. Letters are grouped together in increasing length. Our training will be focused on receiving letters and numbers, copying down on paper. Sessions will last no more than 10-15 minutes a day. Speed will be starting from a minimum of no less than 10 (preferably 15) WPM. When you are able to copy on paper all the letters of a group, you move on to the next one.

In the second phase, lasting about 5-7 weeks, we introduce punctuation marks and procedural signals. We also consolidate reception and transmission speed up to 100 characters (or 20 words) per minute, always using pen and paper. At this stage we begin to use a straight key. Do the best you can to transmit with a timing and spacing as close as possible to the one you just heard from the computer. As we can copy on paper 90% of the characters sent by the PC, we increase the speed by 1-2 WPM or 5-10 characters per minute. Our goal is to reach a speed of 20 WPM.

The purpose of the third phase, of variable duration, is to achieve the delicate transition of abandoning pen and paper and decoding entirely in your head. Here you will learn new words and improve your reception speed gradually but inexorably. Remember: *accuracy transcends speed* – it is better to go slower and be understood. Exercise the art of CW with style. Obviously, achieving a remarkable accuracy in transmission requires practice and if you do not try, you will never succeed. Finding a ham radio friend, patient enough for long CW contacts, is an absolute must. Go, freewheel at speeds above 20 WPM. Always keep yourself within your own limits, try to correct your errors, but don't feel blocked or overwhelmed by them. Simply, keep going!

Learning CW for a naval radio operator requires (well, actually required) instruction by a qualified radio operator. The main difference between an amateur radio operator and a marine officer is that the latter is instructed to transmit and receive at an impeccable commercial speed of 25 WPM, for long shifts and under adverse environmental conditions. Such a capability requires a radically different approach to learning.

The amateur, conversely, learns CW to use it, generally speaking, for a relatively short time, in a stress-free and optimal environment. In these sheltered conditions, the amateur can operate at a speed twice as fast as the commercial operator. Such a way of using CW requires a specific method of learning. The method proposed in this book is aimed at ham radio operators by providing them all the relevant information for building a "career" as a CW expert. We will discuss the "career" of a CW amateur radio operator in a dedicated chapter in this book. This method stems from hands-on experience by the author, who has learnt by trial and error, mistakes and corrections, to develop a method proven effective for teaching.

Our goal may seem overwhelming, but if we break it down in small parts, the whole path will be developing by itself. In the course of the book you will be given specific targets, each representing only a small step and requiring solely a certain constancy of practice and study. Always stay focused to your next target and, sooner than you might think, the end of your journey will be in sight.

Especially during the first stage, in preparation for high-speed CW (or, in amateur radio shorthand, QRQ), we must keep practicing each and every day. We need to settle, literally "embed", the sounds corresponding to different letters into ourselves. QRQ will be great fun, we will face it in the third stage of learning. This

stage could be also conducted using other methods, such as various software-based Koch methods or the Learn CW Online web site (http://lcwo.net/) by Fabian DJ1YFK. What really matters, here, is to the learn characters as sounds, not as a composition of distinct graphic elements.

The method proposed in the first phase of learning, in this book, is specifically aimed to achieve the fastest possible transition to the next stage and, thus, gain a solid foundation for the QRQ phase. It is important to say, again, that the student must focus on learning sounds. This is the reason why a radiotelegraph key is not adopted until the end of the first phase.

The physiology behind learning

To learn CW means approaching the learning process in a completely new fashion. Well, actually new only for an adult, because we already underwent this learning experience in our childhood. CW is not learnt with the "mad and desperate study" like Leopardi, the Italian poet, did. We do not need to learn things by heart but, rather, by applying a constant and assiduous sedimentation of few, simple elements.

Our brain, in its intricate complexity, is made of several “departments”, each devoted to specific functions. Among them, the brain cortex is responsible for "conscious" thought, for calculus, evaluation and measurement. The cerebral cortex, the so-called "gray matter", attends to memory, attention, thought, consciousness and language processes. It allows us to perform complex calculations: it is a very powerful part of the human brain. Unfortunately, the gray matter is as powerful as it is slow. While learning a new language, we must engage the cerebral cortex at the beginning of our learning process: new “brain departments” will be created, built, to store and attend to the language just learned. CW also, from the perspective of the brain, is a language itself: we must learn to "listen" (receive) and "talk" (transmit) in telegraphy as it is for all other “ordinary” languages. For all such activities, the cerebral cortex is essential.

William Pierpont N0HFF, author of the ground-breaking book “The Art & Skill of Radiotelegraphy”, in the introduction, tells us about the gigantic difficulties he faced in overcoming a certain threshold in speed of reception. Like many other hams, he learned, at first, the Morse alphabet in a purely cortical fashion: he studied the graphic signs, made of dots and dashes, instead of sounds. Douglas tells of the enormous effort he had to go through to get rid of this handicap and re-learn the letters as sounds using completely different areas of the brain.

As we make progress in learning telegraphy, we find that the cerebral cortex makes us also somewhat awkward. Its enormous potential for calculus is also a source of anxiety, uncertainty and disturbance to the "free flow" of a CW message, both in reception and transmission.

In receiving, in fact, we must create new brain structures attending to the automatic conversion process of sounds in our ears into ideas in our brain. Be careful: we are not talking about dots, dashes, letters or words, but concepts. This fact is extremely important in developing our capability to receive and transmit. This capability, as we will see later with some practical examples, is virtually unlimited.

We want to reach a certain part of our brain, while learning of telegraphy: the amygdala, a cluster of neurons located in the temporal lobe responsible for memory processes and emotional reactions. This brain layer is very primitive but it has a significant advantage for our goal: it is unbelievably fast. The amygdala attends to primary processes of reaction, such as the response of flight or attack, with a surprising speed and efficiency . If someone wakes us up in the middle of the night, shouting "fire", we jump onto our feet from the bed before we can even realize it.

The great martial arts masters show lightning reaction times. They are able to pierce a telephone directory with a single punch, or break a glass with a finger nail. These are examples of how powerful this incredible part of our brain can be, whose possibilities have barely been explored by modern science.

Cortex and amygdala, unfortunately, are somewhat at odds, because the brain is structured in different layers. What happens is that a very pronounced cortical activity inhibits (or rather confuses) the electrical signals flowing in the amygdala. That's why we need to relax and stay relaxed to boost our CW learning process.

Children undergo a very characteristic phase, in which they need to put objects in their mouth. This behaviour is a typical response of the temporal part of the brain: infants have not yet developed the cortical part, so they are not allowed to "understand" the nature of things by observing or touching them. Rather, they need to bring things to the mouth. This is the way a child brain learns. The result of this learning process is stored directly in the temporal lobe.

Daniel Goleman in his "Emotional Intelligence", reports an experiment made on rats, aimed to measure the time of reaction for the flight reflex, channeled via the amygdala: about 12 milliseconds. The same reflex mediated by the cortical layer is more than twice as long. Fabian Kurz, a German radio amateur (DJ1YFK) was the first person who copied CW up to 1000 characters per minute: at this speed, a dot lasts few milliseconds. Hence, we would say it is unlikely that Fabian is using his cortical layer to decrypt CW. To achieve such performances, we must keep in mind our experience as children when we painfully learned not to touch hot things. Eventually, we were able to remove our fingers from a burning object by means of an instant reaction: this reaction was generated by the amygdala. However, as adults we instead learned to drive a car with the cerebral cortex. The reaction time provided by the amygdala is much, much shorter than the one of the cortex.

The most primitive layers of the brain need simple and straightforward instructions to work: all of our doubts, uncertainties, indecisions introduced through the cortical layer (i.e., conscious mental processes) confuse our most primitive brain layers wich, when instructed with contradictory goals, react erratically. That's why

we react to a burning sensation as fast as Fabian can receive CW. And, if we can remove our fingers from a hot iron in a fraction of a second, surely we can use the same mechanism to receive CW.

Learning and self-image

In learning CW we have to keep that very same state of mind we had as children. It is not surprising, then, that you will be feeling somewhat nervous during your first CW radio contact. Just as a small child that makes a great effort to speak, you will experience the same feelings. Keep cool, everything is absolutely normal.

Did you observe how children learn? They repeat and repeat and keep repeating endlessly, seemingly without ever getting tired. Martial arts practitioners do the same thing, tirelessly repeating sequences of movements to a state of perfection. If you then watch a child play, the first thing that catches your eye is that the child becomes the character he is pretending to be. His cortical underdevelopment allows him to behave, think and move as if he really was another person. In other words, he is able to temporarily change his self-image.

A child, playing every day, slowly builds a general "framework", some kind of map, of his person. This framework includes primarily physiological limits as height, weight, color, and sex in order to clearly define his own characteristics. That's why children, even if they stumble down in a disastrous fall, rarely get hurt, or why they refuse to make a jump that seems harmless. The child does what his self-image allows him to do. Only when he will feel strong enough, he will try the jump. When he feels sufficiently skilled to remain in balance, he will start cycling, and so on.

Self-image is thus a mental representation of the self, consisting of real brain connections, physically built in our brains. Just as a computer records electrical levels in its memory, the human brain builds neural connections to store perceptions, including self-image. These brain structures are responsible for the way we think and for our reaction patterns.

Dr. Rogers research team, back in 1977, found that the information that represents our self-image is constantly retrieved and used during mnemonics testing and, therefore, during all human activities. This phenomenon is called " Self-referential Encoding".

The self-image is built up through experiences that combine three factors:

- Authoritative sources of information.
- Repetitive experiences.
- Emotional intensity of an experience.

Consequences of this are rather broad in scope: people who, at school, are exposed to frequent criticism, particularly by teachers, develop a negative self-image and will report significant problems in everyday life.

Maxwell Maltz, an American plastic surgeon back in the '30s, observed a very interesting phenomenon: some people who had suffered accidents serious enough to disfigure their face, after surgical repair – successful repair from a technical point of view – significantly changed their personality. People, who for forty years had been shy and awkward, suddenly became bold. In some cases they pushed forward much beyond the limit of shamelessness. In some cases, however, people who had had a big nose and ears for years, after a facial plastic surgery, despite their new "perfect" nose and ears, continued to feel as "ugly" as before.

Dr. Maltz then began to observe that the majority of his patients developed a self-image that, in many cases, remained unchanged even after surgery. In some other cases, instead, the self-image changed instantly. In many cases it was not a matter of performing surgery. Rather, many people needed a higher level of self confidence. That is, a lot of patients needed “just” a system to change how they perceive themselves. No surgery, no pain, just a (complex, indeed) change of attitude. Dr. Maltz full story is told in his best-seller “New Psycho-Cybernetics".

All human activities that are never forgotten, like riding a bike, have something in common: they require a permanent change in our self-image. Skills attained by changing our self-image become permanent assets of our person. The capability of transmitting and receiving Morse code is among them.

When learning CW, therefore, we must establish a new component in our self-image and, when doing so, we need to be relaxed. Always practice during the same time of day and in a place where you can experience positive feelings of comfort and pleasure. When we make a mistake we are always ready to blame ourselves. This is the way we learnt from our environment during childhood, often accepting any fault as our own error or weakness.

This potentially destructive mechanism can be used to build a positive self-image, rather than demolish it. A mistake must be considered a signal, pointing us in the right direction. If you fail, let your mistake pass away, with no blame or irritation. Learn CW in a relaxed mood, enjoy the pleasure of learning something new, repeat your exercises every day and be confident in the self-programming abilities of your self-image. Just a few minutes a day: you can take care of your "more serious" stuff later on.

Keep in mind the 3 main pillars for effective learning:

1. Be relaxed.
2. Repeat every day.
3. Take every mistake as a chance to correct yourself. Keep focused on the repetition of the exercise.

First relaxation exercise

This exercise is based on the well-proven autogenic training by Dr. Schultz, a German psychologist during the first half of the last century. Dr. Schultz first applied specific relaxation techniques to manage anxiety and stress. Autogenic Training techniques are now fully employed in all sports, especially the competitive or extreme ones.

Practice this exercise every day, before making your CW exercises.

1. Be sure not to be disturbed for about a quarter of hour.
2. Find a convenient and comfortable place, preferably an armchair or a soft mat.
3. Close your eyes, relax your face and jaw muscles, feel the weight of your relaxed hands and arms.
4. If a thought distracts you, imagine enclosing it inside a plastic ball.
5. Imagine putting the ball in a large plastic jar with a cap closing the bottom.
6. After a while, imagine you remove the cap. The balls, with your thoughts inside, will float away. Listen to the sound of the plastic balls slipping through the bottom of the jar.
7. Enjoy your new feeling of thoughtlessness.
8. Imagine your forehead.
9. Tense your forehead, keep it contracted for a while and, then, relax it.
10. Enjoy the feeling of the relaxed forehead.
11. Now, relax your neck, shoulders and trunk. Keep in mind the difference between tenseness and relaxation you just experienced on the forehead. Relax each body part in the same way, until you reach the toes.
12. Keep visualizing the part you are relaxing.
13. Having relaxed the toes, enjoy the sensation of the whole body, completely, relaxed.
14. Before you get up, open your eyes and slowly move your legs and arms. Stretch yourself.
15. Get up slowly.

Getting started with Morse code

The first phase lasts, on average, around a month and a half. It is important to respect your own learning pace: there is no hurry. After all, learning CW is not a job and should remain a pleasant hobby. At this stage we focus exclusively on letters and numbers, ignoring punctuation marks and procedural signs (in short *prosigns*).

Before each training session, do your relaxation exercises in a quiet place. Be sure not to be distracted; try to do your best to train at the same time of day. Simply forget that letters are made up of dots and dashes: carefully listen to the unique sound effect of each letter in terms of presence and absence of tone. Let the letter sound be "yours."

Phase 1 lasts 6 weeks, each devoted to a group of letters:

- First Week: ETANIM
- Second Two: DSOURC
- Third Week: KPBGWL
- Fourth Week: QHFY
- Fifth Week: ZVXJ
- Sixth Week: 1234567890

Groups are organized by increasing letter duration. The first day of each week we introduce the new group of letters and we train only to receive this group. In the remaining days of the week, we train on all the letters studied up to now, i.e., we add the groups learnt in the previous weeks.

Each week, your goal is to learn a new set of letters. At the end of each week you should be able to decode 25 groups of 5 characters, writing down what you received by pen and paper.

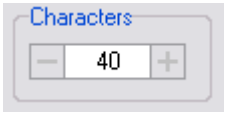
First Week

In the first week we focus on the basic elements of metrics and introduce the first group:

ETANIM

The 5 letters in the group ETANIM are related because they represent all the permutations of one or two dots and dashes.

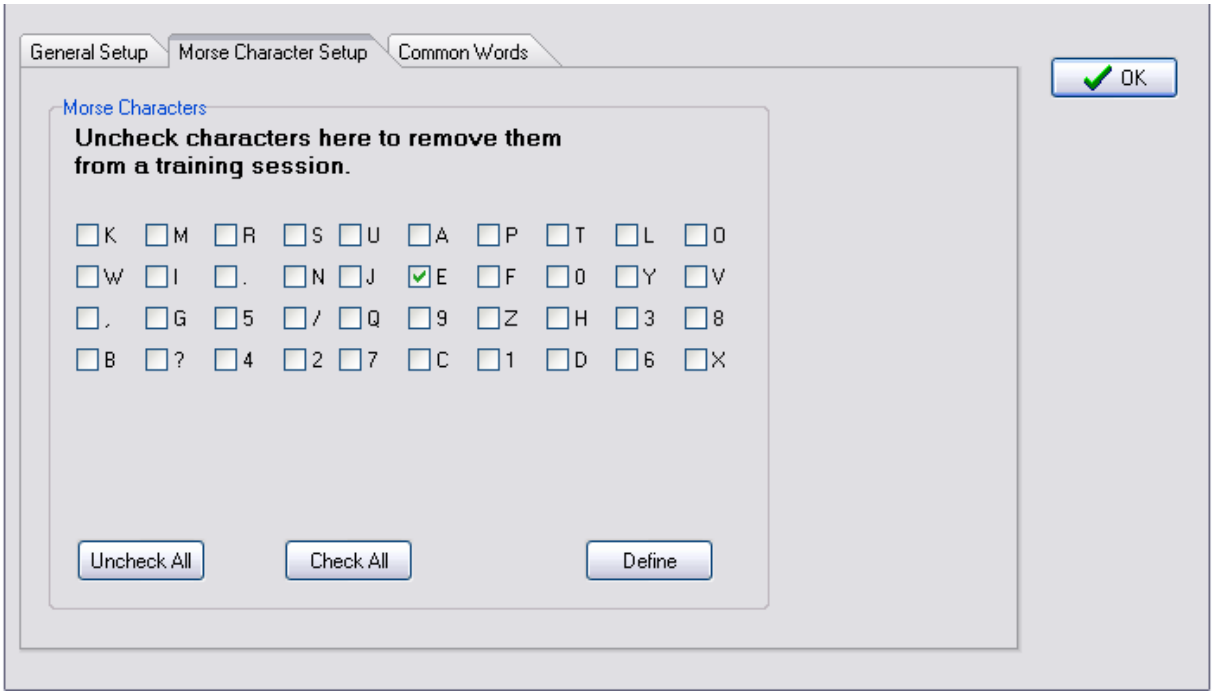
Download and install the software G4FON (http://www.g4fon.co.uk/). After installing the program, in the main window, set the number of characters to 40.



Characters box

Go to Set-up and check the box "Morse Character Setup", set the checkmarks so that only the letter E is selected.

Set –Up Button

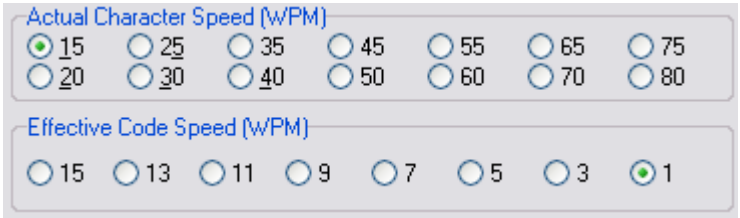


Selecting letter E

Now we are ready to begin: do your relaxation exercises and get ready to listen, preferably using a comfortable headset. Earphones, like the ones used in MP3 players are much more comfortable than headphones. Listen to the lowest possible volume so that you do not get discomforted or fatigued.

In the main window, set "Actual Character Speed (WPM)" equal to 15 and "Effective Code Speed (WPM)" equal to 1. Do not worry about the meaning of these two steps: we shall discuss this later.

Relax and focus just on listening. Enjoy your first experience with Morse code.



Selecting character Speed

Listen to the sole letter E: *dit*. Listen to the dryness of the single dot, focus on the spacing between two consecutive E "EE" and the same, separated by a space: "E E". We set a wider spacing to grant you more time to mentally “recap” the sound of the previous word. We will apply the correct spacing later on.

The software is designed to first play a group of letters and then to display it on the screen. Listen and build an automated mental link between letter sounds and their image displayed on the screen right after.

If you train every day, you will achieve quite the same result: when you will hear a CW word, right after the space separation, the corresponding letters will automatically appear in your mind.

When you feel confident, open again the window "Morse Character Set-Up", and add the letter T: *daah.*

Now hear the difference between the letter E and T: E is a single dot and T a single dash.

Focus on the difference in terms of sound length between dots and dashes. Listen with particular attention to the relationship between the length of a dot, of a dash, and the space between the two. During the lesson we will discuss the details behind the concepts of spacing and speed. For now, just ignore such details, relax, listen and do nothing else.

When you are confident with the difference between E and T, add the letter A: *dit-daah.*

Can you hear the difference in sound between the character A and the two consecutive characters "ET"?

Now take off your headphones and think about this story. It has been told about a Zen master who met his disciples before a large blackboard. This board was so large that a man had to walk several steps to go from one end to the other. The Master then drew a tiny dot with chalk, but so tiny that the disciples could hardly see it. And then he asked: "What do you see?”

Now close your eyes, relax, and imagine the same scene. Imagine it before going on reading. What would *you* see?

Focusing on the tiny dot, ignoring the huge blackboard where the dot is drawn, is one of the most classic mistakes we make in our everyday life. Of course, that's a mistake in CW also.

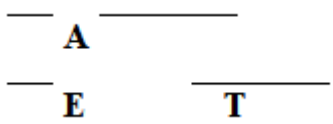
The container is as important as the content, and the same holds true in CW: the space among elements is of absolute importance.

In CW, the duration in time where a signal is present (the sound) is called *Mark.* Conversely, the separation among Marks is called *Space.* So, saying that the letter A is made up of dots and dashes is, in fact, quite a big mistake. Remember: always focus on the dot *and* on the blackboard. In fact, the letter A is made up of a *mark,* lasting a dot long, one *space* lasting again one dot, then a *mark* 3 dots long, followed by another *space,* again one dot long.

Now, listen again to the 3 characters, paying attention to the sound difference between the sequence of letters ET and the letter A. Here are the spacing rules (do not learn them by heart, just listen):

- A dot is the base unit of measure.
- A *dit* is a sound of one dot followed by a silence of one dot
- A *daah*, the sound of a dash, is 3 dots long followed by a silence of one dot.
- The space between letters is 3 dots long. (the dot ending the preceding *dit* or *daah plus* 2 dots)
- The space between words is 7 dots long (3 of the preceding letter space plus 4 dots)

A correct CW transmission respecting these rules is said to have the correct *timing* (correct timing ratio among marks) and *spacing* (correct ratio among spaces*).*



Graphic representation of the letter A and the sequence of letters ET

A correct timing and spacing is the essence of a faithful CW transmission.

Now add the letter N: *daah-dit.* Listen to the difference with the letter A. Try to depict the sound of letters with a mental image. For instance, the letter A *(dit-daah)* has a sound that resembles a vowel open sound, in latin languages. The N, instead *(daah-dit)* has a truncated sound, remembering somehow the tongue pressed up in the palate.

Finally, add the letters I *(dit-dit)* and M *(daah-daah),* to complete the group. Listen carefully to the whole group of letters and relax. Take a small break, and get ready for the receiving exercise. Every day we will train to receive groups of 5

characters. Copy the letters of each group to a text file, and press the "Text File" button to start the exercise.

The Text File Button

Make yourself comfortable and, first, listen to the entire file, keeping the book open in front of you and following the groups as they are transmitted. Keep relaxed and listen. Try to grasp the subtle differences in *timing and spacing* between individual letters and the various sequences as the computer plays them.

Now close the book, take pen and paper and relax. Play again the file and write all the characters you manage to copy. You will notice that some characters are harder to copy. Never mind, let them go away and keep focused on the flow of characters as they are played by the PC. If you lose some character, ignore it. If you skip a group or more, again, ignore them. Re-synchronize yourself until you are able to copy again.

You will notice that this exercise is tiring, despite the few characters transmitted. What really matters here is that you remain relaxed. Do not get nervous for the groups that, *physiologically,* you will miss.

The purpose of the exercises is not to *memorize* the letters, but to establish an *automatic reaction* of your brain as you listen to them. Such automated reaction is achieved only by means of repetition. Keep in mind that relatively few people are able to establish this process automatically in a short time. The daily rhythm proposed, therefore, *is purely tentative.*

There is absolutely no hurry: if you think it might be the case, simply repeat the same exercise as many times as you feel appropriate. If you are not satisfied with how many characters you copied one day, you can always repeat the exercise the next day, making sure *not to exceed 15 minutes of exercise a day.* If you want to, by using the Record Audio File command in the File menu, you can record an MP3 to save an audio file to be played with your favorite audioplayer or CD player. You can, then, listen to your groups during other times of the day. It is crucial that you train *every day.*

If you decide to listen to CW during your daily occupations, thus outside the daily training session, be sure to do it *while attending to other tasks*. Leave CW in the background while doing other things. You should *sediment* it in your mind, rather

than actively learn it. Studying must be *solely* done during the 15 minutes of your daily workout session.

Next day, you will do your usual relaxation exercises and directly go to the listening exercise, reading groups from the book and decoding them right away, always using pen and paper.

Groups of the Week

Day 1:

TANTE	NTENT	NMEMN	MEEII	NMMMN
ETEII	EIMNM	AAEMM	ITENM	NAANA
TMTNE	AAIET	TETNN	ITEEE	EIENI
TIMIA	NNEAT	IMNNA	MIMIN	TINAM
MMENT	AMMTE	ANTMA	EEETT	NNIAE

Day 2:

TEAIM	AAETN	INATE	EAINI	EITNI
MIETA	NTNEE	MEEIE	IIIAT	ENAIA
MAMIT	EAMNI	ANEIA	TTMIM	TAAEA
TETAN	IMTIA	ENNMM	NTIAT	IEMAI
TEEMN	NAEMN	NANAN	NITMT	EMIAA

Day 3:

EINEN	AETMI	ATTMT	NAMIA	TMIIT
ETIEE	MTIIT	MIAIE	MTNAM	MENNA
IAAMM	ETANM	ETNMA	IETTM	NMNAE
ETAAA	TATAI	NNANN	NMEMA	ANTET
AENTE	EIIAE	ANNAI	IENTI	TTENN

Day 4:

TIAMA	INNAA	TMINN	TTNTA	ENITN
TEAAM	NTTNA	AMEMI	NMMMA	NMANE
AIIMN	TMIEM	NNTTI	NMTME	NMTMN
IEEET	AIEIE	TETTE	NNENN	IMINI
INAEE	MMTAM	ATAMT	ANEMA	TMMEM

Day 5:

ANATA	AMMAM	ITIAT	IIEEE	ATAEM
NAMAM	MIETT	NIINN	IEAEA	IMMMN
ITTNM	MITTN	TIETA	TMTMA	MITMN
AETET	MEMII	ITEIE	NNIAI	TAEET
EITMA	MMMNE	TMNEN	TNTNT	MIINT

```
Day 6:
INIAM     AIETI     EMAAE     AEMEA     IIIIE
ANATI     MTTAM     ITTTI     TAEIT     TAMMN
ATIIT     MEEMM     ATTAT     MNEMN     TNMMI
TTAIE     TEIEM     AMIMI     EETEM     METNE
MITIA     EIMIN     ITMAT     IAINT     IMETT

Day 7:
INIAM     AIETI     EMAAE     AEMEA     IIIIE
ANATI     MTTAM     ITTTI     TAEIT     TAMMN
ATIIT     MEEMM     ATTAT     MNEMN     TNMMI
TTAIE     TEIEM     AMIMI     EETEM     METNE
MITIA     EIMIN     ITMAT     IAINT     IMETT
```

Second Week

The second week is dedicated to the group:

DSOURC

As in the previous week, the first session only introduces new characters.

Do not forget your relaxation exercises, then go to Setup / Morse Character Set Up in G4FON, remove all the letters studied in the previous week and select only the letter D: *daah-dit-dit*.

Listen to this sound; it does resemble the phoneme ‘D’, doesn’t it? *Daah-dit-dit*. Listen for a while.

Now add letter S: *dit-dit-dit*, three dots in a row yields an effect of "suspension dots". This sound is like a hiss: "ssssss" *dit-dit-dit*.

Now go for the letter O: *daah-daah-daah*. Indeed, a "full" sound, much like the “roundness” of the letter O.

When I was desperately trying to increase reception speed and abandon paper and pen, I used to listen to Meteomar, a meteo bulletin, broadcast in CW in plain Italian and English on the frequency of 4292 kHz. The first time I heard the word "MOSSO" (i.e.: “rough sea”) I was surprised by how much this sound effectively represented a rising wave, then lowering and rising again. Try to picture the sound of

this word in your mind: M prepares the additional increase in sound fullness, of the letter O, immediately damped by the two following S, and again rising by the final O.

Try to create mental images like these, try to *create emotions* while listening to CW. Do you remember the success factors for changing the self-image?

- Authoritative sources of information.
- Repetition
- Emotional intensity of the experience.

Keep "coloring" your study with emotions: you will learn at a faster pace and with an unimaginable simplicity and ease.

Now add the letter U, the mirror of D: *dit-dit-daah*. The final dash seems almost like an accent, a resembling the sound of the letter U (as it is pronounced in Italian).

The letter R, *dit-daah- dit,* is special because it is the first to introduce a syncope, i.e. a change of speed, with a dash between two dots. The middle *daah* recalls the sound of your tongue against the palate, typical of the phoneme *R*.

Finally, the letter *C: daah-dit-daah-dit,* the first character to be composed of 4 elements. You will hear it many times in your career as an amateur radio operator, because it is the first letter of *CQ,* the letters of a "general call" (aka *seek you*). The letter C is probably the most famous of the 26, with its very characteristic swing.

Now it is time to practice receiving the new group of 5 characters just introduced. As in the previous week, first you listen to the groups with the opened book and then practice receiving the same groups copying them down with paper and pencil.

Tomorrow, you will directly go to the groups of the second day, which will include the group you studied in the previous week. Repeat this exercise every day, until you complete all the groups of the second week.

Groups of the Week

Day 1:

CDDDC	CSROU	SUCCS	CDORU	SUSCS
UDRSC	RDDSC	RUCSC	SUUOU	ORSOS
ODDSS	UUDSO	RCSSU	CRRRR	RODDD
CCCOR	OCCOS	SSDSO	URDSR	CUDOD
CSCOS	CROSO	CDDOC	SRROC	RCSUC

Day 2:

SNMIT	TADND	SRNOM	RDAMC	RMNDR
RCUIO	ITDSM	RAIDT	CSOES	EETDO
DSIUS	RADER	OETRT	AODCS	CESRA
EOAUD	DETIC	SCMEO	TRSEO	AUCCO
TCSST	IEUMA	TUMMR	NDAAA	CRIOR

Day 3:

COINR	CMIEM	CCIMR	OCMSA	OIIIT
OTOMN	DINRS	UASIN	OIERD	IOCMI
SMAIS	CDRRO	CUODS	AMOER	ACTAD
AAEOU	EUNEM	UATUI	OOEMD	NROUI
INNMC	ONAUS	TECNM	SIRED	ISDID

Day 4:

SSSOS	RSMDN	RCOTA	TUSRR	USDAM
MITMA	MEEMD	OMUDN	RAETS	CESUC
RUSMR	NRDSR	DMUII	AAACS	UODEU
UNIOI	SIOEO	EMSNR	IADMS	MNRNS
ODREU	SCRES	INONR	UADUO	ORNNE

Day 5:

DTOUU	OSCTC	TTCUM	UUTRN	TNIDD
ESANT	RUAAO	OCNEU	STEID	AEMOM
ACNRU	IUECA	RAIUI	NNECT	CNCDI
CCMCI	ONINM	DCCUN	OIUUN	NNNSI
RSDNU	RDTMI	INAUT	TUTCA	MSEOE

Day 6:

DSUTS	AOTRU	CUUIT	NNTOS	ESNOA
MRTTN	UTDCU	OTTDA	MOTTU	IMOCN
IMESS	SNMMA	TRSUC	ICOAO	UENTO
NIDSS	ORRAR	MUTTI	ISIAD	SDACS
MMUTA	MUDOR	DAEIT	OESOU	TIRIS

Day 7:

NOODO	IARCO	OTOOU	MTDAC	ATSME
CMAAI	NIDDA	ERDMD	UAMMU	REIMA
NUOCA	DISRT	EDIRE	SSMMA	MUONR
ROISE	ECISN	RMUUA	UUTST	ASNOR
AOTTC	CTUTD	RTSRE	DMDAE	RENDN

Third Week

The group of the third week is:

KPBGWL

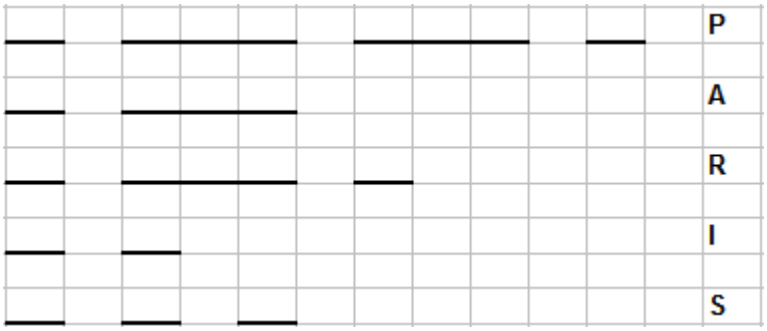
All the characters of this group are made of 3 or 4 elements. Listen carefully because they differ from the characters of the preceding groups only in how the elements (dots and dashes) are combined. Thus, K is an R with dots and dashes reversed, the same holds for G and U, D and W. Always remember to listen to sounds. Try to build a mental picture, to give a "shape" - the one that best suits you - to each sound. This will help you to establish an automatic reception reflex between the sound and the mental visualization of the correspondent letter.

Now relax, run the G4FON software and configure it to play the single letter K: *daah-dit-daah*. Mentally recall the difference with the letter R (*dit-daah-dit*). Notice that, while visually inverted, the two letters have a completely different sound.

Now add the letter P: *dit-daah-daah-dit*. The letter P is a consonant whose sound is distinctive because, although it has 4 elements like many other consonants, the two central dashes give it a unique sound image. Keep listening for a while and get ready to take a break.

The introduction of the letter P allows us to better define the concept of speed in CW. The unit of speed is the WPM (Words Per Minute) or CPM (Characters Per Minute).

An E, for instance, takes a fraction of time of an A. Thus, the measured speed in character per minutes depends on which characters are actually sent. To overcome this problem a standard measurement system has been defined to evaluate speed in words per minute. The base unit of measurement is the word PARIS.



Elements of the letters in the word PARIS

Let's do a quick calculation of the number of dots, our elementary timing unit:

- Letter P: 11 dots + 3 of letter spacing.
- Letter A: 5 dots + 3 of letter spacing.
- Letter R: 7 dots + 3 of letter spacing.
- Letter I: 3 dots + 3 of letter spacing.
- Letter S: 5 dots.
- Word spacing: 7 dots.

By summing all, we get a grand total of 50 dots, including the word space at the end.

One word per minute (WPM), therefore, corresponds to 50 dots per minute, 2 WPM to 100 and so on. It has been agreed, as a convention, that the speed in CPM is evaluated by multiplying the WPM speed by 5. 1 WPM corresponds, then, to 5 characters per minute. Now let's split the sample word PARIS in dashes, dots and spaces:

- 4 dahs
- 10 dits
- 9 separation dots between dits and dahs
- 19 separation dots between characters (including 7 of word spacing)

in total, 38 dots and 4 dashes. We have seen before that the length of a dash defines the weighing ratio. Hence, the duration of a dot in seconds, taking into account the weighing relation **W =** number of dots composing a dash, is:

$$\Delta p = \frac{60}{WPM \times (38 + 4W)}$$

When applying a standard 3:1 weighing ratio (length of a dash equal to 3 dots), we obtain the simplified formula

$$\Delta p = \frac{6}{CPM}$$

where CPM is the speed in characters per minute.

Considering a dot as a bit, the baud rate is:

$$v = \frac{1}{\Delta p}$$

The following table shows the relation among speed (for a 3:1 weighing ratio) using different units of measurement: WPM, CPM, baud and dot duration in milliseconds:

WPM	CPM	Baud	Dot (ms)
5	25	4	240
10	50	8	120
15	75	13	80
20	100	17	60
25	125	21	48
30	150	25	40
35	175	29	34
40	200	33	30
50	250	42	24
60	300	50	20
70	350	58	17
100	500	83	12
150	750	125	8
200	1000	167	6

Comparative table of speeds in different units of measure

Before getting back to our first session of this week, it is important to stress once more on the role of relaxation. We talked before about Fabian, DJ1YFK, who receives at the speed of 1000 characters per minute. Time for some small calculation: 1000 CPM = 200 WPM = 10000 dots per minute. In a minute there are 60 seconds, for a total of 167 points per second: at 200 WPM, a dot takes about 6 milliseconds.

Let's get down to a more "human" level: some hams practice, on a daily basis, in long chats at a speed of 50 WPM, i.e. approximately 42 dots per second. At these speeds a dot takes about 24 milliseconds. Scientific experiments on rats show that the reaction speed, mediated by the brain's cortical layer, is just about 24 milliseconds. At 50 WPM, then, we are at around the limit of our physiological ability. Yet several ham radio operators today practice with ease at these speeds, without tiring. How is this possible?

The secret is in relaxation and in the human brain's amazing ability to aggregate information at higher levels. We will return to this point in a chapter specifically dedicated to high speed CW (or QRQ). Still, keep in mind that this phase of learning is crucial to establish that automatic reflex allowing you to recognize whole words first, and then whole concepts, effortlessly. Relax, keep listening without making any conscious effort: if you fail to copy one or more characters, simply let them go. Keep focused on those characters you receive and trust the incredible ability of your brain to learn unconsciously.

Now add the letter B: *daah-dit-dit-dit*. Sounds "slippery", does it not ?

Then, when you feel comfortable, add the G: *daah-daah-dit*, although it is an U with dots and dashes reversed, it has an unmistakable sound.

With the letter W: *dit-daah-daah*, we complete the set of palindrome letters (the W, in addition to being a D with dashes instead of dots, is the reverse of a G). Listen to the sound and let your automatic sound-image mechanism work for you, the rest will follow.

At last, the letter L: *dit-daah-dit-dit* is the third character we meet composed of 4 elements. From the next week on we will learn all the letters made of 4 elements. Listen to them carefully.

Now continue training as usual, receiving the groups of the first day with the book open and, then, close the book and start receiving them using paper and pen. The rest of the week is devoted to rehearse the whole set of groups met to date.

Groups of the Week

Day 1:

GKPGP	BPKPP	WKGLG	GBBBW	GPGWB
LBPLK	WGLLW	KPWWG	PBGPB	KBPBW
PGWKP	GWKBW	KPBGP	KGPLL	GBBPW
KGGWG	PKPLG	BGGWB	PKKPG	KGKBW
WPLLP	GKPLL	BLKWG	WGKKB	BPGGW

Day 2:

EDGMK	IBCUR	GWNRB	BTISI	PWGOS
TOMLD	UGUWP	CEIPD	CBMDB	DWTOB
OSCSP	ABRGW	MIASM	GGORA	UGURA
GKBTK	CSKBD	GCOMM	MKARA	NLALD
PLEKD	GUMEO	EACPU	KANNK	TOPRT

Day 3:

BWLRP	LCEIL	LCKIR	BNMKO	RRDLR
LOOTN	IOLLE	AKKIA	SLELA	IBKEB
NPTKA	GKMCO	AWSDO	EDGAM	TRMNW
LAWCR	SLKDU	SIAPE	IKKSN	BDMSM
WSTPR	SWENU	LMIUW	RPMSO	BLWLT

Day 4:

RPAUW	PNTDT	WILBE	WOKPR	APPEL
ETULT	DGUBP	OODBG	AKOUI	TEAUU
OOKSG	CNMOC	SIOSK	KADWL	MSGAO
ISMUG	GTCIN	APNPL	EPRRA	RSBWN
DEOWI	IWTAE	RMTRL	GKCMS	AASAU

Day 5:

PSMPN	MGDWG	SBLOP	UIULW	KEKPG
LABTB	TTRCL	WCILA	DDDOM	EBKLD
SLWIR	KOCUG	NRKKB	SWBEC	OMTWO
KTMOB	BGRWM	OEKEK	DSNRI	KCKOA
RNLIB	MUEKR	IBWIB	IDPMG	WPCBL

Day 6:

PIRTC	AGBCU	ARBCC	GIDGD	TDMAB
OAMSL	UTACC	UETNB	NPSDW	CACOD
TGIWI	KPWOE	GBULO	RRAOA	CWAOG
BKPLA	LREPK	UMPOK	CCCUO	RKEMK
AUTUN	LISME	TDKWG	LEDRR	ILOGR

Day 7:

LAMOC	WTCCS	DUGNE	SIBRR	KIICA
OSAIL	MROOE	WURDU	PKUNN	GDRKI
DSIRN	KUIBI	MEDIB	BEROD	GNCPL
AUUCC	LIGML	WKCDG	ENLCP	MULAO
GTBSA	PBBRB	BIRWI	EBTWN	BSUGB

Fourth Week

The fourth week group is made of only 4 characters.

QHFY

Do not forget your relaxation exercises and listen to the letter Q: *daah-daah-dit-daah*. It recalls the beginning of the Italian national hymn. C and Q make the most famous sound, heard daily by radio amateurs all around the world: CQ. Hearing a CQ, immersed in a background noise, with a small radio receiver and a small antenna, even better from an isolated island in the ocean is an unforgettable experience.

The letter H: *dit-dit-dit-dit*, completes the series of letters composed by dots:,E, I, S, H. Carefully listen to the difference in sound between an S and an H,. At high speeds they become very similar, except small details that a trained ear and a relaxed mind can grasp with ease.

The F: *dit-dit-dah-dit*, is quite similar to the letter L, listen to it again and again. It is advisable to practice with a dedicated listening session, with only the letters F and L. Relax, listen to the sound and simply watch the letters as they appear on the screen, right after their sound is being played.

Finally, the Y: *daah-dit-daah-daah*, which differs from the letter C for the final dash, but it sounds radically different. Both these letters are included in the group of this week. Use the excersises of the first day of this week to practice with the letters and, thus, become familiar with the sounds of Q and Y.

As always, it is now time to listen with the book opened and, then, decode the letters with the book closed, copying with paper and pen.

Groups of the Week

Day 1:

HFQQY	YFFQH	YQQQH	FYHHQ	YHFHY
QYYYY	YFFFF	FYYHH	FQYYF	YYHQF
QYQHF	QQYQY	QFFHH	QYHQY	FQFFH
FQFQH	QHQYY	HFHHH	YHFYQ	YQHQH
QYQQY	YFHQH	YHQQH	YQHQY	FQHQQ

Day 2:

QPRRR	EFHPL	FICMU	FAUQM	NQSRR
WHPOO	FOHTB	AUMGF	GUWYE	ITYIO
MWPGI	BOLSR	COOMY	MLMOH	TMGUB
MNDDE	NPCEC	NWWDY	AFBQM	QCUFL
CWHKU	EDOKS	PFMYD	UCUFY	EGYTS

Day 3:

SKMFI	ECRNE	ETIEW	BPCSU	QHQDY
TMAWH	IANPT	ISTAO	LCKKO	WLATG
BTBBU	LLFEP	PBHPS	AAHKE	HTLYH
OCMCM	LEFAE	BKRNP	MEOFY	WNRCO
BIFIQ	WPLWL	LEIOH	PIYAR	BMCHP

Day 4:

HIQRR	ANQUI	MKKOM	UPTWT	WWBWE
NUEIW	RMIDT	QUMII	BGPCN	GHCIP
ESWPO	QCSMQ	WHBDM	NPHRS	DRYDM
EAFSA	KCEYH	BHGCB	WDWLE	BKLCG
OSTPG	QAPUF	HACNT	LNSKH	IFPTI

Day 5:

IGBRO	DGMQU	CLNQE	STBPT	WYONR
LTOSO	SRPGQ	POSYR	ECRCW	YBUUS
IKNDI	WDYWF	BMAEM	ULUIM	TTTCU
MCCLN	NDPMP	CAINO	EATHB	NNNBA
HCGKL	TTACC	HMECH	BGSTM	NSLOT

Day 6:

FPPAM	PNQGN	OUTCI	ONNTC	SUTUA
OTLYU	WLNPE	UCPTG	IQNIE	FBQDC
GGILS	RWTGF	UMKDB	PYAYA	IGBRT
TNMRY	CSTGY	WIEQE	GOPPN	MHWIG
FAOEB	ROGAG	BDUUR	KCENW	OPEIF

Day 7:

SOCSL	PEMEH	NWFQF	HHSPT	UGBQG
IEQQS	UWBAC	EQSEW	GGDCC	OFUDI
FCMGL	YUUBU	LSWCY	ERUAO	KSCHB
OFSBG	AKHPQ	BWKTY	QQBFT	BSOOG
NTRKC	WIUIO	IQTNO	SOAGY	EQYHY

Fifth Week

With the fifth week we finish all the letters of the alphabet:

ZVXJ

After the usual relaxation exercise, start listening to the letter Z*: daah-daah-dit-dit*. Over the years, I associated the "long" sound of the first two dashes and the short of the two end dots with the graphic sign of a Z. Try to visualize the sound, giving it a “shape”, a “color”, or some general “tangible” attributes. The more senses you involve in learning, more intense will be the lasting memory of what you have just learnt.

Listen now to the letter V: *dit-dit-dit-daah*. For decades it has been the beginning signal for coastal broadcasting stations around the world. It has a distinctive sound: it seems the attacking tune of the fifth (in Roman numerals, incidentally, V) Symphony by Ludwig Van Beethoven.

The letter X: *daah-dit-dit-daah* is rather unique, because of the two central dots. It is a P with dots and dashes inverted but, again, it has a completely different sound.

Finally, the letter J: *dit-daah-daah-daah*, it sounds quite lengthy, and could be confused with the W because of the final additional dash. Carefully listen to how to the sound differs from the letter W.

Despite what one would expect, the “most difficult” letters are the shorter ones, because they require you to react much faster. The letter J, for example, consists of 16 dots (always remember to count marks and spaces): twice as long as an S and four times longer than an E.

It is therefore important to learn the letters by sound, not by their graphical elements. If you do so, you will incur in a series of handicaps that, to be corrected, will require a painful work.

1. If you memorize dots and dashes you will be forced to split each single letter you receive into elements. This will require a very long decoding time.
2. Longer letters will be extremely difficult to learn.
3. When increasing the speed you will compound the problem of decoding the short letters, because they are too fast, and the long ones, because they are too complex.

4. It will be almost impossible to exceed the speed of 40 characters per minute.

In Italy, the exams for obtaining the Amateur Radio license were at 40 CPM, so I learnt CW exactly at this speed. I remember it took to me a huge effort to get my speed from 40 to 80/100 CPM, the minimum required for a satisfactory CW contact.

Now, go on with the usual exercises, throughout the week, starting from tomorrow and going on for 6 days: you will practice with the entire alphabet. You are almost done!

Remember: stay relaxed, let the mistakes go away and stay focused on what you receive. Eventually, skip the whole group of 5 characters if you should miss two or more consecutive characters. Get resynchronized using the space before the next group.

Groups of the Week

```
Day 1:
ZJXJJ    JZJJX    JVVZX    VXXZX    ZZXJV
JVZZJ    ZXVVJ    VJJVZ    ZZZVX    XVXVJ
XXXVX    VXJZJ    JVZJJ    VZVJV    ZZZZJ
ZXJJV    JJZZX    JZVJX    ZXJXV    VJJXX
JXZJV    JJVXJ    ZZZVV    XJJVX    ZJVJZ

Day 2:
JWWRC    PSQRK    HEDRN    BPNAH    VRSDO
MCMLO    PAKBM    XFTJR    SZYEN    TEEFP
AJPRU    OSQBV    UYPDD    DXXIC    UYEUW
HLWIG    IJVXY    SCRZM    ISGZE    SOHYD
NWZBF    WGYNX    DUXLZ    VXKHT    TQAFK

Day 3:
CHVYQ    CSZGZ    QVZFC    BNXUP    PDGMH
OEVLH    BHMSK    UFFPK    KGBIH    ZPUIV
FGVFK    IVMCY    HJBNO    HZJZH    MGDED
ZTVDH    QUGZI    HSACZ    QZLUW    XLQCG
DOOGN    MBJBK    PSAON    IOJQB    GBMKN

Day 4:
WAWNZ    ALEQR    RDGUP    JPDXM    RCJLM
DDLFY    DPCLK    OQPJY    SUJFR    PKEJP
```

```
WZZQD    IVZEP    BBCVJ    HTTOM    RRRIP
IHSFT    JNJWT    XFRML    ADIKX    PFUFA
DWOBR    VZXAU    HAYWY    RQMIR    QLHIW

Day 5:
JUMTU    GPGHS    LNQLQ    MLUQF    OPRZI
JSFBE    NAXBU    HLWRL    ISUSU    VXUHA
MSILK    ATXVN    HQAMT    QUAVI    MUHRQ
CRSJY    ACTMC    KWJVB    FSXLX    GXQZM
KGAOM    APGUQ    ZBYSY    VSLTW    TUCRM

Day 6:
XBVOS    CPKAE    HYMBW    ZLRNK    XNFJP
MIFBT    BDHBB    SLUGO    FSRXL    PQWJU
XQQXP    WIVYW    MLBKC    CHIVS    AVJQW
BNWQX    ZPUWV    KHAPU    OZEBL    BERSI
ZRNAN    XBSWS    KOJPD    IJCXZ    TLKIO


Day 7:
GZQCE    ZTPWL    ADMRR    UURZL    ABYXY
EMJFM    HXIYE    SLITF    DWOST    CODEK
ATAQH    VVFPV    EAPJQ    JJKVQ    JSYFZ
UPBGZ    NZLMR    BZHMG    VYBYM    EPNKA
KZIKW    DGQTH    HEMAS    CMZZM    VPGEE
```

Sixth Week

With this week we introduce the numbers:

1234567890

There is a simple mnemonic rule:

- All numbers are all 5 elements long.
- Numbers from 1 to 5 start with 1, 2, 3, 4 5 dots.
- Numbers from 6 to 0 start with a dash, up to 5 dashes for the number 0.

You can directly listen to the whole set of numbers, altogether. After a few minutes the mnemonic rule will become obvious: a 0 is so long to be unmistakable. Pay attention to the difference between 2 and 3, and between 7 and 8.

The exercises for this week are organized so as to not mix letters and numbers: when a group starts with numbers, stay with your mind focused on the characteristic sound of the numbers you learnt during the first practice session.

Congratulations! From the second day on you are decoding the whole Morse code alphabet!

Groups of the Week

Day 1:

33141	12525	24435	51213	52411
52425	35413	12515	55335	42215
34512	44514	23554	41243	42122
53221	41354	41145	14253	34154
43132	25521	24153	21331	54155

Day 2:

XVZBQ	68499	HPXWP	60896	QHBJT
BMHPK	93208	XUFXS	16504	VIUME
KLGXF	82508	IGTSL	66304	XMIYJ
UWJKE	16139	JDYHG	33288	EBAMH
NSBVO	78156	EUXKX	79385	IRDRC

Day 3:

OUSNC	78136	AFHSZ	02369	ZIIZO
RTSEN	39103	PBFQD	35514	WLFBQ
NLQTH	04053	IVMZO	04393	TOWNY
FVTKF	67407	PGCNG	73035	EQVDF
ITJVO	76293	ILZFQ	69459	NUUIC

Day 4:

EUUCL	28997	NFNKR	82127	BZPOS
QIKYR	16952	MEGQI	63601	MEBFX
FIJOW	24877	SSKEH	64762	MZZAW
NZGFM	05813	GDGBX	63328	VVHTN
QATJK	49307	FIWEU	45555	NNHYF

Day 5:

WKNOE	45839	FAQAY	83508	HLGMT
DUCPI	09406	NSBMN	11423	DPCZY
OTDPU	61271	ULRMA	67692	HUNEU
BQRTW	42668	NYMSZ	75670	DASRK
OBOFA	31623	DDGHQ	12913	SUNQK

Day 6:

CEAZK	94686	LGYCI	07706	OSDXX
BQYJY	40051	OWAIP	90862	CPDRY
YUUBK	80146	HNALK	19601	OXVBH
ZNLJN	79062	YZOWL	95891	WFKJC
GDTWB	66336	FVLPE	59559	MZNKM

Day 7:

KGFAD	38144	EFLPV	89500	LKVVN
NCBJV	58831	XYRMT	79169	KBAYZ
CRNKK	76717	MVBSB	03521	SHSTN
YRDOM	75330	WJHMP	53191	LDIXO
UQMJV	31922	DXVXV	46672	FQVEQ

Increasing speed: let's go on-air

This stage of learning is aimed at increasing reception and transmission speed up to 20 WPM.

The work we did in the previous phase over the course of a month and a half is the basis for correct transmission, with the proper timing and spacing. Only a series of carefully designed daily listening sessions, for an extended time, can produce a mental representation of the sound of each letter. By the end of this phase you will be able to transmit with a rhythm as close as possible to the computer, i.e. with a proper weight ratio of 3:1 and correct spacing between letters and words.

Training sessions will all take place in the same way:

- Listening to groups of 5 characters.
- Transmission, using a telegraph key, of the same groups.

We will use a straight key. An entire chapter of this book is devoted to this kind of key. The ideal key should have a long lever, resting firmly on the desk in a comfortable position, but, at first, we cannot immediately adopt such a key (often called "Swedish"), because the long lever strains the beginner. Wrist fatigue, at this stage, is to be avoided because it results in inconsistent timing and, most importantly, prevents both mental and physical relaxation, which are essential for a proper learning process.

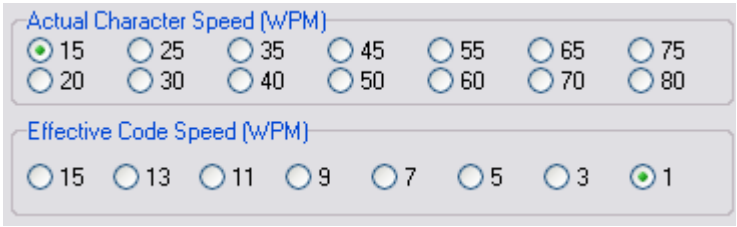
Your first radiotelegraphy key must, therefore, be precise and easy to handle. These are typical qualities of all Second World War production keys. Two magnificent keys are the Junker and the Lionel J-38. They can be found for around 50 dollars, shipping included, at the most popular online auction sites or at the usual military surplus stands that can be found in some trade fairs.

The second phase may have a minimum duration ranging between one and two months, but it is highly advisable that it lasts long enough to allow you a proper absorption of rhythm and spacing, both in transmission and reception.

Objectives of the second phase are:

- Match the spacing between words with the speed of 15 WPM.
- Make your first CW contacts (QSO).
- Gradually increase reception and transmission speed up to 20 WPM

In the first phase we learnt all the elements of the Morse alphabet, but we applied a spacing between groups of characters corresponding to a speed much slower than 15 WPM.



Selection box for actual and character speed in G4FON

The G4FON software can play the characters with adjustable speed and spacing among words. We will use this feature to facilitate the learning process. We will set G4FON to play characters at 15 WPM, and the space between words as slow as 1 WPM. In fact, it is unclear how this speed is calculated, as a rate of 1 WPM should generate about a group of 5 characters per minute, which appears not to be true. Anyway, we will take advantage of the capability of extending spacing between words, allowing us to learn individual letters at a decent speed for our first CW contacts. After we have learnt characters at a good speed, we will focus exclusively on reducing the spacing.

At this stage you should train in daily sessions of about 5 minutes in reception and do your best to transmit the very same characters you just received to reproduce the same speed, spacing and rhythm produced by the computer. When you are able to copy on paper about 90% of the characters, then you increase the speed gradually up to 15 WPM. After the initial uncertainty in transmitting with a straight key, you will immediately notice that it is significantly more difficult to receive than to transmit (although, it must be said, that transmitting with the proper

timing and spacing is extremely difficult). This is not a trivial consideration: at high speeds things get reversed!

We said that the minimum duration of this phase is a couple of months but if you really want to achieve excellence, it should be much longer. In fact, it is in this phase that we instinctively acquire the elements of rhythm. If you deliberately shorten this phase, which - ideally - should last at least a year, it will be very hard to fix the consequent bad habits you might have introduced.

It is also time to make your first QSO in CW. The best approach would be to find a colleague to act as a sparring partner, much as in boxing. It is important that, in your training sessions, the band where you practice is silent (VHF is perfect in the first 150 kHz, specifically dedicated to CW) and that your training partner is as precise as possible in transmission, at least in the first weeks. Normally, you reach 15 WPM in about a month and, at this point, you are fully equipped to make CW QSOs on a regular basis.

As you practice transmitting, also introduce the procedure signals (see the paragraph “the QSO in CW”) and the punctuation marks:

?	..--..
,	--..--
:	---...
.	.-.-.-
-	-....-
/	-..-.
'	.----.

Punctuation marks

Directly practice to transmit the new characters, always concentrating on the sound that you hear. Train yourself to transmit short sentences with punctuation marks.

Second relaxation exercise

In transmission it is important to be both mentally and physically relaxed. To do this, we integrate the first exercise with “heaviness” relaxation techniques. Such techniques are derived by the ones used in Dr Schultz Autogenic Training.

- Begin the first relaxation exercise.
- Imagine your two hands and visualize them clearly.
- Imagine that your hands become increasingly heavy, slowly pressing down on the mattress or the armchair under their own weight.
- Visualize a very thick and strong elastic band attached to your wrist, tying your wrists to the ground.
- Imagine a friend who tries to raise your arms, but fails because of the strength of retention provided by the elastic band.
- Concentrate especially on the wrist of the hand that you will use for the transmission, i.e. your right wrist if you are right-handed.
- Now repeat the same exercise for the legs.
- When done, enjoy the feeling of relaxation you achieved with the first exercise and the heaviness gained from the second. Stay as long as you like in this state.
- Slowly move your arms and legs.
- Open your eyes and, slowly, get up.

Now focus on the sensation of looseness and pliability of your wrist. Keep this sensation so you can recall it before you start transmitting with your CW key.

Adjusting spacing to speed

In the last weeks, you learned the elements of the Morse code alphabet at a speed of 15 words per minute, listening to groups of 5 characters deliberately wide-spaced to give you the opportunity to visualize the characters and write them down comfortably.

We have seen, however, that a correct CW transmission is based on the relationship between mark and space and on a proper rhythm. We now shorten the

space between groups of 5 characters until we achieve the correct spacing, corresponding to a speed of 15 WPM.

In the third week we dealt with the concepts of speed: at 15 WPM a dot lasts for 80ms, the rules provide for 7 dots of spacing between each word, for a total of 560ms for the space between words, or just over half a second: this is your new objective.

Numbers aside, you'll notice immediately how powerful the visualization process is, guaranteed by the daily repetition of your practice. Keep focused on the relationship between the duration of each group and the spacing between the groups, as it shortens.

Training sessions are divided into two parts, one for receiving and one for transmitting. In transmission do your best to replicate the same spacing you just heard, as reproduced by the PC.

After running the first and second relaxation exercise, run G4FON and set the actual speed ("Effective Code Speed") to 3 WPM. Use groups of the second day of the sixth week (with numbers and letters) and start to receive.

Remember, if you lose a letter, simply let it go, get resynchronised with the stream of characters, even skipping the entire group.

At the end of the reception session, grab your straight key, read the chapter of this book dedicated to straight keys. Play with the key for a while, observe it, press the lever and listen to the pounding sound when closing the contact: the American radio operators call this sound “Brass Pounding”. Now start transmitting the characters you just received, maintaining the same rhythm and spacing as played by the PC.

Then, check what you received: if you have copied at least 90% of the characters (missing at most a dozen characters), you can increase the speed, bringing it to 5 WPM. Take note of the characters you miss more often and work on them using the character generator of G4FON, selecting only those characters.

Every day, change the groups of 5 characters, by choosing them among those of the sixth week of phase 1. Tomorrow, therefore, the groups will be the ones of the third day of the sixth week, the day after those of the fourth and so on. When you get to the groups of the seventh day, start over again from the second day (the first contains only numbers). The fact of repeating groups listened to a few days before is of great advantage, because it reinforces your automatic reception reflex. After a few weeks, you will feel like "cheating" because, maybe, you heard the beginning of a group that you might know by heart. This is what we want to achieve: by that time you will have reached the very purpose of receiving CW, i.e., to associate groups of

sounds to mental images. This is a very valuable capability, we will return back to this later.

Take your time: it is a game. If you reach the target within a week it is very good, but if you should take two months or more, it is even better! You will have, then, learned this valuable ability much more intensely. The more time you spend repeating your exercise, the better your skills will become.

A QSO in CW

When you're ready or you feel like going on-the-air, you can start having fun with CW by making your first contacts or QSOs. It is advisable for you to make the first QSO when you have adjusted the spacing to the speed of 15 WPM. Seventy-five characters per minute are a more than respectable speed for contacts in telegraphy. At this speed the sound of CW is simply spectacular, provided, of course, that it is transmitted with a rhythmic and correctly spaced pace. It is like tasting a vintage brandy. Enjoy these magical moments.

The CW QSO relies on three important elements:

- Abbreviations and Q code.
- Procedural signals (in bold, are sent together as one character).
- A more or less defined structure.

The rag-chew QSO is, instead, a purely free-wheeling conversation. The following list shows the main Q codes, abbreviations, and procedural signs (in bold):

QTH: station location.
PSE: please
AR End message
TNX: Thanks
FR: for
UR: your
HR: here
CQ: General Call "Seek You"
SK: end of transmission
HPE: hope
CUAGN: See You Again
73: Greetings
K: Call to transmit (go on)
KN: Call to transmit only for the station being called

GM, GA, GE: Good Morning, Afternoon, Evening (to be used depending on the time of day)
BT: speech separation
OM: old man, ham radio operator
ES: the conjunction "and"
QSB: fading
QRM: noise from other stations
QRN: atmospheric noise
HW: How do you hear me?
INFO: Information
RPRT: signal report
DR: dear
OP: operator name, used in place of NAME
RIG: Transceiver
ANT: antenna
PWR: output power
WX: Weather, weather conditions (CLOUDY, SUNNY, CLEAR)
TMP: Temperature
BK: break, used to pass the key to the other station without using the callsign
R: received, I confirm, I have understood
FB: Fine Business, good
VY: very
TU: Thank You
QSL: postcard for contact confirmation, it can be VIA BURO (via ham radio local qsl service) or VIA DIRECT (via conventional snail-mail)
QRS: can you send slower ?
QRQ: can you send faster?
AGN: retransmit the last message
SRI: sorry
GL: Good Luck
GD: Good

The signs in bold are the so-called Prosigns (procedural signs), providing control signals to the QSO. They are sent as a single letter, for example:

KN -.- -.

The general call, or CQ is made in this way:

CQ CQ DE IZ0AAA IZ0AAA PSE K

The response to a call is:

IK0BBB DE IZ0AAA K

At this point, once the two stations hear each-other, the first station replies:

IK0BBB DE IZ0AAA GM OM **BT** TNX FER CALL **BT** UR RST 599 QSB **BT** MY QTH IS ROME IS ES MY NAME IS PAOLO **BT** HW? IK0BBB DE IZ0AAA K

CW has something to do with chivalry. A correct CW operation relies on the following unwritten rules:

- always transmit at a speed allowing you to avoid mistakes
- always greet and thank the other station and answer any questions
- always slow down to match the speed of the slower operator, even if it were just 10 characters per minute.

It is recognized as a good practice to repeat the name and QTH twice, while IS and ES can be omitted.

So, the first calling station says good morning / afternoon / evening and thanks the correspondent for the call. Next, the caller passes the signal report using the RST scale: R - Readability 1 to 5, S – Signal Strength 1 to 9, T - Quality of tone from 1 to 9. If there is QRM, QRN or QSB, such information must be given right after the RST report.

The station then, which was asked HW, in turn should provide his RST report right after the pleasantries:

IZ0AAA DE IK0BBB = GM DR OM PAOLO TNX FR RPRT = UR RST IS 599 = QTH ROMA OP PIERO = MY RIG IS FT 817 PWR 5W ES ANT IS VERTICAL = HR WX IS SUNNY TEMP 10C = IZ0AAA DE IK0BBB K

If a station did not copy something, a question can be asked (always PSE) without repeating calling and caller callsigns, by means of the prosign **BK,**

BK DE IZ0AAA PSE UR PWR IS 5W? **BK**

BK DE IK0BBB R MY PWR IS 5W **BK**

if you did not understand the answer, you may ask to repeat the last message:

BK DE IZ0AAA ?? SRI QRM PSE AGN **BK**

if the correspondent says he still did not copy, it is imperative to repeat the requested information more slowly two or three times

BK DE IK0BBB R MY PWR PWR IS 5W 5W **BK**

after the response, you confirm you understood and go on with the QSO:

BK DE IZ0AAA R R TNX FR INFO VY FB UR PWR ES 5W QRP **BT** MY RIG IS FT 817 PWR 5W ES ANT IS DIPOLE **BT** HR WX IS CLOUDY TEMP 12C IK0BBB DE IZ0AAA K

Notice that it is appropriate to first thank for the information received and, then, return the same info to the sender.

At this point the QSO can be closed or go on indefinitely, even if in most cases it is ended here. Of course, with some common pleasantries:

IZ0AAA DE IK0BBB DR PAOLO TNX FER INFO ES FER QSO MY QSL VIA BURO **BT** IZ0AAA DE IK0BBB 73 ES HPE CUAGN **SK** TU

usually, after the TU you end up with the classical "two bits", i.e. with two final dots (*dit* - *dit*). Again, the corresponding returns the greetings.

BK DE IZ0AAA TNX FER VY FB QSO DR OM PIERO MY 73 GL ES GD DX IK0BBB DE IZ0AAA 73 **SK** TU

As you practice QSOs, try if you can already leave paper and pen aside and write down only the main information, like names or cities.

The DX Code of Conduct

Using CW in DX can be an exciting activity. A high skilled operator should also hold an on-air behaviour inspired to a consequent ethical standard. The author actively supports the DX Code of Conduct (for more info http://www.dx-code.org/) as first published in the article "DXEtiquette" in the March 2010 issue of QST by Randy Johnson W6SJ, and actively spreaded worldwide by Bob G3PJT:

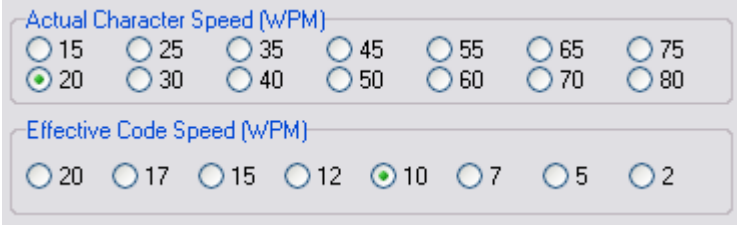
- I will listen, and listen, and then listen again before calling.
- I will only call if I can copy the DX station properly.
- I will not trust the cluster and will be sure of the DX station's call sign before calling.
- I will not interfere with the DX station nor anyone calling and will never tune up on the DX frequency or in the QSX slot.
- I will wait for the DX station to end a contact before I call.
- I will always send my full call sign.
- I will call and then listen for a reasonable interval. I will not call continuously.
- I will not transmit when the DX operator calls another call sign, not mine.
- I will not transmit when the DX operator queries a call sign not like mine.
- I will not transmit when the DX station calls other geographic areas than mine.
- When the DX operator calls me, I will not repeat my call sign unless I think he has copied it incorrectly.
- I will be thankful if and when I do make a contact.
- I will respect my fellow hams and conduct myself so as to earn their respect.

Increasing speed

The objective of this phase is to increase the effective transmission and reception speed up to 20 WPM, the practical limit for receiving by copying down with a pen and paper (unless you follow a special training). Up to now, you are able to receive and transmit in CW with a spacing that is consistent with a speed of 15

WPM or 75 characters per minute. The exercises are held in the same way: you first receive groups of 5 characters and repeat them by transmitting with a straight key.

When you are able to copy characters and lose at most a dozen of them, increase the speed of a step. At first, we will make quite a leap: we will bring the transmission speed up to 20 WPM, and lower the effective speed to 10 WPM, as in the following figure:

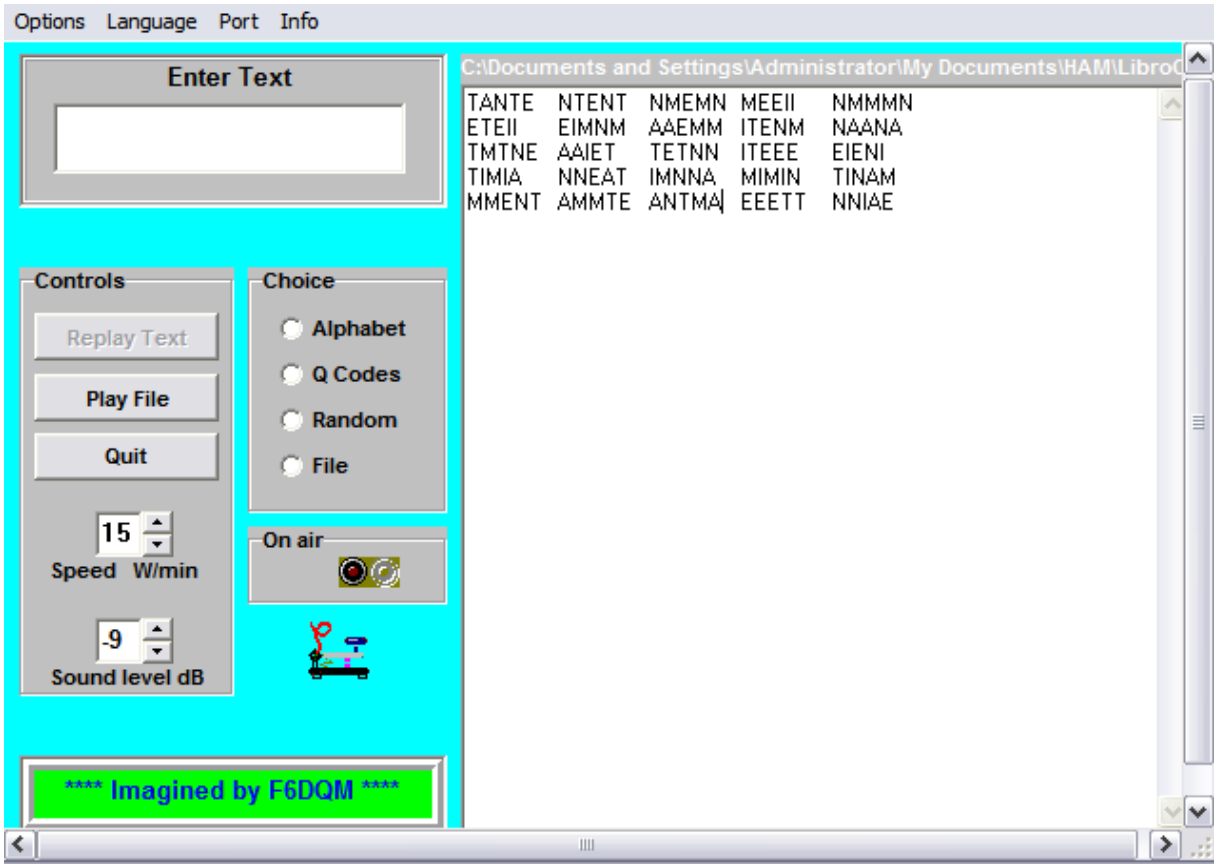


Initial Settings with G4FON for training at 20 WPM

As our workout progresses, we will adjust the spacing accordingly. This approach is quite similar to the previous phase.

The increase in speed is considerable: one third faster. We also reduce the effective speed to 10 WPM to grant some more time to our automatic decoding process, introduced so far, to recover the "images" of each character as we receive.

If you find the increase too steep, download the program CWPLAYER (http://www.f1orl.org/cwpI.htm), which increases the speed in steps of 1 WPM.



The CWPLAYER program

To listen to the file with the exercises in groups, with CWPLAYER, follow these simple steps:

- Select the speed of 15 WPM.
- Select the File box.
- Load the file with the groups of the day.
- Press the 'Play File' button.

For proper spacing, make sure that groups of characters are separated by a space, not the tab character. With CWPLAYER you can also practice receiving Q codes, if you like.

You might adopt G4FON or CWPLAYER depending on your style of learning. If you find it easier to copy letters, but have difficulty transcribing the group before the beginning of the next one, then you may be more comfortable with G4FON. If you have an ear for music and prefer to move forward with evenly spaced intervals, then CWPLAYER does more for you.

In learning telegraphy, it is important *to keep in contact with your inner self,* listen to yourself and try to determine the mode of learning that puts you at maximum

ease. The main indicator is your level of relaxation: always choose places, times, methods and tools that make you feel more relaxed and serene as possible. This phase is delicate and must be conducted with the policy of the 'small steps', it is absolutely inappropriate, therefore, to change your straight key.

Use the same groups of characters in the sixth week of phase 1, then, each day, go to the next group for the day. In transmitting, as usual, focus on proper rhythm and spacing. If necessary, try listening again, to part or all of the characters you just received.

Limit the duration of the training sessions to 15 minutes, no more. Instead of training more at your PC, increase the number of QSOs you make on the air. Remember that effective learning, at any stage, is based on repetition and relaxation. If you cannot find a quiet time of day and a quiet spot for your training, you will have a better chance tomorrow. It is important to avoid practicing in conditions of haste, anxiety or stress.

Increasing your speed is a very delicate phase of your learning processes. Respect your own pace and *trust your innate learning ability,* all difficulties you will be facing are quite physiological. The problems that arise in this phase are common to everyone.

Well known problems are:

The *Plateau:* around 15 WPM you will notice considerable difficulties to increase your speed. This is the phenomenon of the so-called "Plateau" or threshold. Simply keep working and exercising, once you have progressed beyond a plateau you will advance quite quickly up to the next one. Typically, people find plateaus at 15, 20, 30, 40 WPM. The most important plateau is undoubtedly found when trying to abandon paper and pen and start copying in your head. If you find a plateau, it is useless to train harder. Just make QSOs for a few minutes a day and eventually you will overcome that barrier.

Sense of regression: especially in transmission, you will feel to have worse performances as compared to the past days. It is a good sign, it means that your brain is overcoming a plateau and, suddenly, one morning, you will make QSOs with no problems, even advancing a couple of WPM. Try to lower the frequency of your workouts.

The *tendency to anticipate characters:* it may happen to you to mentally anticipate the ending of a word while it is being transmitted. Often, the result of this habit is that you lose the rest of the whole word or phrase. If it should happen, never mind; just ask for repetition of the lost message. Try to stay focused on the sound of the stream of characters, forgetting the characters that you just received and ignoring those which are yet to be received. Reflect on the story of a Zen Master who, chased

by a tiger, falls off a cliff and clings to a strawberry. The strawberry was beautiful, red and inviting but also very delicate. Inevitably, the stem breaks under the weight of the Master, who falls. While falling, the Master eats the strawberry. His last thought was "this strawberry is delicious". Whatever you are doing, under any condition, *live the moment,* the *here and now,* never mind what has been and what will be. Concentrate on what *it is going on right now.* This also applies to CW.

Fatigue: when you start doing CW, after a few minutes, you may notice a decline in your performance, both in reception and in transmission (often this happens especially in transmission). It is absolutely normal, your brain is learning to work in a different way, by activating and physically sculpting new areas. This is rather fatiguing. Do not worry or blame yourself, it is our human nature. If you eventually should feel fatigued, simply turn off the radio and go do something else. As in sports, it is useless to demand more from a strained muscle, better stretching it. So, just relax doing other things. If you wish: listen to classical music, take in a bit of air, go for a walk, or whatever relaxes you. Like muscles, the brain is trained in response to a stimulus of stress, and changes its shape. Just take your time.

Do you remember about the four stages of learning? Well, you are in the *conscious awareness* stage. Up to now, you trained for a few months, you made a few hundred QSOs and you are fully aware of what you can do and what your limits as a CW operator are. You also know what is missing and where to improve. When you are able to receive and transmit at 20 WPM, it's really important to continue practicing for enough time, find yourself a great telegraphy key, preferably a Swedish or long lever one. Enjoy it fully: it is a fantastic object.

You have to play with this key for long enough to become so familiar with CW, that the concepts of rhythm and spacing are now wired inside you. You have to *forget you are using a straight key* much in the same way as you forget that you are driving your car when you get back home tired from work.

High Speed CW, going QRQ

Now, it is time to slowly slip into the *unconscious knowledge,* and to do so, you have to abandon pen and paper and change your telegraph key. It is now time to use the paddle.

Abandoning pen and paper means that you have to leave the decoding modes you were introduced to so far. Let's do an experiment: turn on the radio or television and listen to your favourite program. Try to repeat the words as you hear them. Why is it so difficult?

When you listen to a dialogue you actually do not record instantly word after word. Instead, you literally *absorb* the concepts while they are being formulated. Each concept is represented by your brain as a whole, not as individual words. When we try to repeat the words we just heard, we activate two distinct brain areas, one for listening and one for expressing concepts in term of the words you just heard. When repeating words, we thus apply a process of *recoding*. Working as an interpreter is a difficult job for this reason: he or she not only must know the language, but he also must be able to recode more or less instantaneously each concept into another language.

In CW, then, rewriting the characters on paper is an additional process consuming mental resources, preventing you from reaching high speeds. There are no experiments on the subject, but it is reasonable to assume that it is virtually impossible to copy on paper at speeds higher than 25-30 WPM.

A successful approach to high speed CW (or QRQ) requires teaching our brain to work in a very peculiar way. There are plenty of examples of operators who are quite good at receiving and transmitting high-speed CW who find difficult to memorize a string of callsigns sent (without repetition) at speeds even half of their maximum receiving speed. As a high-speed CW operator, I tried playing with a program, CW Freak, sending 25 callsigns at a speed starting at 25 WPM and increasing every time a callsign is copied correctly (by typing it on a keyboard). Although I usually have QSOs at twice this speed, I needed some practice to copy the sequence of callsigns, enough to reach a maximum speed of just over 40 WPM. Quite a surprise: 20% less than my usual operational speed.

Here is another example: Nicola IN3LBQ is an Italian ham radio operator who is able to decode up to a remarkable speed of 625 characters per minute (125 WPM). Surprisingly, Nicola says that he still had to learn to have a real QSO, having done only reception activity in CW. He trained for years with RUFZ, a software specifically designed to train on receiving callsigns.

So, my mental automatism was trained for fifteen years to make QSOs, either rag-chew or DX, both in Italian and English, but not to copy callsigns and repeat them on a keyboard. Nicola, instead, built over these years an automatic mental reflex allowing him to copy callsigns, up to speeds that might seem impossible for ordinary human beings, but not for making an ordinary QSO, even if it is conducted at a fraction of his maximum speed. No surprise, then, that we both have developed specific capabilities, as a result of specific training sessions. Nicola himself often quotes a quite fitting Russian motto: 'repetition is the mother of learning'.

To do high-speed telegraphy, you must create an automatic mental and physical reflex, very similar to the one that lets you walk to the bathroom passing throughout the corridor in the dark, at home. Athletes, in addition to daily training, use very sophisticated techniques of relaxation and visualization reinforcing their training on a "mental space", so to say. A record high jump is also the result of a proper mental image of the same athlete, visualizing himself approaching the pole, turn on his back, jump, lift over the pole, draw the legs and fall to the ground.

Dr. Maltz's best selling book *Psycho-Cybernetics,* asserts that the human brain is equipped with an automatic system (aka servo-mechanism) that, to function properly, must be instructed with clear and well defined objectives. How many times have you left home with lingering doubts of having actually locked the door? It was your automated system that actually locked the door for you, without even allowing you to realize this gesture. Your servomechanism works automatically in such a way that you find yourself *struggling to remember a gesture that you yourself did.* This is a perfect example of unconscious knowledge: locking a door has become for you such a trivial task that you do not to remember about it anymore. Yet, if we were to write down all the brain activities involved in such a gesture, we would fill a volume of several hundred pages. In spite of the immense complexity of the instructions given by your brain to your arm and hand muscles to lock the door, not only did you not even realize such a gesture, but if someone you meet should ask you " did you lock the door this morning? ", you would start brooding over it all throughout the day.

Did I make you doubt? Trust your servomechanism: the door is locked.

Your servomechanism needs clear objectives and simple unambiguous statements. Give it a clear order, let it work for you on its own *without interference from doubts, uncertainty or anxiety* and it will accomplish the results you were

looking for. Do not forget that it is your servomechanism that brings you home every evening, driving your car!

Sigmund Freud argues that lapses and forgetfulness are not entirely random. For example, if you systematically forget your house keys, this happens because, actually, deep down in your heart, you feel discomforted at home. Lapses and oversights happen because our servomechanism is instructed with ambiguous commands and confused by anxiety, stress and uncertainty.

In high-speed telegraphy, we need to decode in a spontaneous and automatic way, with ease of mind and relaxation, by activating the automatic processes allowing us to listen and transmit in CW with a rhythm and spacing appropriate to the speed. Leaving behind paper and pen is quite delicate because it is a step requiring the introduction of an automatic decoding process, based on a new kind of brain activity. High speed CW, by its nature, requires a specific mental state, rather than a set of techniques, and poses a major challenge because it is not dealing with learning new tricks, but with transforming the perception of our own person. Ultimately, doing high speed CW requires a skill that is the essence of CW itself: you cannot do telegraphy, but must *be a radiotelegraphist.*

Feel the Force Luke!

It is one of the most powerful words ever invented in the history of cinema *(George Lucas, Star Wars, 1978).* Applying it to real life may seem ridiculous, but … *trust your automatic mechanism to receive CW.*

One of the most incredible aspect of all arts, and also of high speed CW, is that after having acquired a certain degree of ability, we learn not by adding new skills, but by removing superfluous attitudes, elements, and habits. The real artist *evolves by synthesis,* not by increasing complexity. Jazz music is just one of such examples. If we listen to a progressive song, dated 1970, *Catfood* by King Crimson (in the album *The Wake of Poseidon*) and compare it with its jazz version (in the album *The King Crimson Songbook Volume One,* performed by the *Crimson Jazz Trio),*we observe that, although the latter may seem simpler (there are "fewer sounds" and "fewer instruments"), among the two the jazz version is of a unique sophistication.

To evolve by synthesis means removing anything that is not absolutely necessary, distilling the essence. The first step of evolving by synthesis in CW is to abandon pen and paper: *you do not need them.*

Actually, you already know how to decode at speeds much higher than the one you are currently using, which is what you have wired into your servomechanism.

You just have to give yourself the permission to increase speed. You already know how to do it.

Try this experiment: open G4FON and bring the speed to 40 WPM, listen to groups of random characters for a couple of minutes. Now relax and repeat the same exercise but this time listening to a QSO, always at 40 WPM. Let go away every word you do not understand, just listen. You'll notice that, occasionally, some words will appear clear in your mind. It is your servomechanism that is activating. Have you noticed how it "powers down" automatically when you stop and think what you are listening to? This is why with CW Freak it is so difficult reaching high speeds with ease: when we receive a callsign, which is already in our head, as soon as we are consciously aware of it, we forget to type a few characters. It is our servomechanism going on stand-by due to the irritation that follows.

You do not need to learn anything new, you just have to give the permission to your servo to stay on. Do not start from the idea of having to learn to decode without pen and paper, rather start with a conviction that you are *already able to do so.* Make QSOs and keep listening, writing only the bare minimum information needed (callsign, name, city). From time to time, practice to transmit with the radio off, just tap on the straight key. Feel the Force, that is, free your servo and let it do wonders for you.

"Speed. I am Speed"

In the cartoon *Cars,* the main character *Lightning McQueen* is a racing car, young, arrogant and damn fast. The film opens with McQueen who imagines the race, in every detail, including engine sounds, the tires on the asphalt, the opponents running like hell. McQueen uses a technique known in psychology and adopted in all competitive sports: visualization. Imagine being immersed in the competitive activity with the utmost vividness and richness of detail, it is a very valuable technique to tune our servomechanism for the performance we expect. Just try it! There's no risk.

Relax, do the first and second relaxation exercise and imagine listening to CW at your current operational speed. Obviously, with eyes closed and arms relaxed you cannot write. This exercise strengthens your self perception and eases the task of *accepting your new ability to receive without effort.* Practice visualization as often as possible, preferably before turning on the radio. Results will materialize quickly.

The technique of *creative visualization* is adopted in the far-east cultures, with Yoga, as early as 900 BC, which in turn became popular in the western world thanks to the *New Thought* movement and its frontman Wallace Wattles, between the nineteenth and twentieth century. Wattles, in his book *The Science of Getting Rich,*

said that by visualizing intensely, constantly and repetitively, specific objectives could be turned in real-life accomplishments. Regardless of esoteric tendencies, behind all that there is a fundamental truth: a visualization rich in detail, with sounds, tactile sensations, smells and so forth, can produce a real change of selfimage and, consequently, of the effectiveness with which we approach our goals. The more vividly we visualize our goals, the more clearly we are able to instruct our servomechanism to independently pursue them on behalf of us.

Training and visualization techniques shape our selfimage according to our desires and, consequently, dramatically increase the likelihood of success. Invent a motto, a phrase, even a picture or find an object that *metaphorical represents your objective:* McQueen's motto is "speed, I am speed".

Do not underestimate the mental programming power of words and images: Usain Bolt is the fastest runner in the world; at the Beijing Olympics in 2008 he ran 100 meters in 9"69 looking back over his shoulders while running with an undone shoe. At the end of the race he shouted to the cameras "I am the Bolt". Yes, the world-class phenomenon born in 1986 is named Bolt (it is not a stage name, his father is William Bolt)! Put altogether athleticism, tireless training and a family name that is already an omen, and the rest just comes by itself.

Training to visualize

The purpose of this exercise is to recreate, with the greatest possible vividness, the sensations of a CW contact. The higher the vividness, the stronger the training effect.

- Complete the first and second relaxation exercises.
- Wait a few minutes, then imagine you are sitting at your radio station. Feel the pressure of the chair on your legs.
- Imagine turning on the power supply and your radio, feel the edginess of the power buttons.
- Imagine moving the telegraph key to accommodate it on your desk, feel its weight.
- Imagine putting your fingers on the key knob or the paddle finger pieces, feel your fingertips deforming under the pressure.
- Now, imagine making a QSO, hear the noise, the fading signal, paddle ticking or the pounding of the straight key.
- Imagine that your transmission is a continuous, uninterrupted signal flow, without smearing.
- If you imagine making a mistake, simply let it go, continue to mentally transmit.

- Open your eyes, Stretch your muscles and get up slowly.

Learning new words

After hundreds of QSOs, it is time to start sending and receiving in rag-chew mode. Listen to the sound of a QSO of this kind; the uninterrupted flow resembles a machine gun or a waterfall. When you start listening to stations communicating in various languages, you will soon discover that every language has its own characteristic sound. French sounds so typical because of the frequent groups TON, SON, EU; German for the ICH, SS, BER, VER groups and so on. Just like in the "real" world, different languages have different auditive “footprints”.

At these speeds, you must practice to learn the sound of the most common words, which must be copied in your head, without transcribing them. Start listening to stations transmitting in your own language; initially you may understand few words, but as soon as you understand them for the first time, you will not forget them any more. Save some newspaper articles in text format and make G4FON play them for you, select your preferred operating speed and keep listening, without writing. You will soon discover you will have formed a real vocabulary of words whose sound is unmistakable. Try receiving at high speeds (25-30 WPM) while doing something else; you can save audio files in MP3 format from G4FON and make a CD to listen to at any convenient occasion. Assume a relaxed attitude, without even asking yourself the question if you are able to decode: just listen.

When I trained for VHSC, a club that accepts members who must be able to decode CW at 40 WPM for at least 30 minutes (in rag-chew QSOs), I made a CD to be listened to in the car. The text was related to various tips to increase the speed in CW. For several months, I found a certain point of the transmission to be impossible to understand. One day, while waiting at traffic lights and looking out of the car window, the sentence "KEEP THE SESSIONS SHORT" (a deadly series of dots) appeared in my head straight away. I had completely forgotten about the CD playing in the background. I even turned down the volume after a phone call! As soon as I stopped concentrating consciously on decoding, my servomechanism had accepted the goal of decoding and presented the results sought for so long. So great was my surprise: I just decoded without even wanting to do it. Today, I still remember that phrase, three years later. Some time later, I acquired all the sponsors needed to apply for the club.

Practice, practice, practice

Luckily enough, you do not have much more to learn, you just have to keep working and be active. In short: practice, practice and again, practice. Increase the frequency and duration of your training sessions and give yourself a goal: for example, joining HSC (High Speed Club - see the chapter on the career of an amateur radio operator). QSO with as many stations as possible and, most importantly, match your transmission and reception speeds.

At this stage we observe an opposite phenomenon, when compared to the beginning: *it is much harder to transmit (correctly) than to receive,* At a speed of about 25 - 30 WPM, you will start noticing how hard is to cope with bad habits (such as incorrect timing and spacing) you might have acquired in the previous phases. These habits often require painful work to be undone. High-speed transmission becomes an art in itself, requiring a lot of practice and a trained ear. It would be great to record your transmission and rehearse it, trying to decode it by yourself. A decoding device such as the AEA PK232 or the Begali CW Machine is of great help, indeed.

Obviously, arriving at a remarkable accuracy in transmission requires practice and if you never try, you will never succeed. It is essential for you to find a colleague / friend and arm both of you with holy patience in long freewheeling QSOs in QRQ. Just send code, trying eventually to correct mistakes, but do not to be blocked by them.

Changing the telegraph key

If at least one year has passed after you got started with CW, try to find out which telegraph key is best suited for you. After reading the chapters in this book dedicated to telegraph keys, you can choose between a bug or a paddle. A straight key is best suited for slower speeds, while the semi-automatic or the paddle will take you to interesting speeds for studying and you will find big fun in practicing with them. The adoption of a fast key will push you to transmit faster and, thus, to increase your reception speed at the same time.

Changing your key is not painless, but it is a necessary step. Keep trying harder, even when you appear to be at a standstill. If you find progress too hard, try

suspending or lengthening the time between training sessions. Keep up your activity in QSOs / DX.

Although, historically, the paddle was born before the semi-automatic key, the latter is rarely used by OMs, because it is a mechanical device requiring a non-trivial technique. The paddle is a less personal device, but it also is much easier to use. If you can, borrow and try them both before deciding with which one you want to go with.

It is advisable to adopt a key that allows you increasing your operating speed in a constant way. Some may prefer a paddle, some a bug, and some a single lever key. Just choose the key that best suits you. There is no common definition of QRQ, but let's say that from 25 WPM and above, you are already "running".

Discover your limits, and go beyond

Have you ever accelerated with an old car up to the maximum? From a certain moment on, the vehicle starts vibrating, the tires imbalances cause resonance and clearly noticeable vibrations.

Dr. Maltz gives an enlightening experience: try to insert a thread through the eye of a needle. As long as your hands are far apart, they are stable and motionless, but as the tip of the thread is approaching the eye, your hands are starting to tremble. Emotion? Not really. What actually happens is that your brain controls the muscles through a mechanism of automatic error detection and correction, developed over the years from experience and play. In this experiment we are trying to obtain from our automatic mechanism a precision far beyond the conditions for which we trained it in the past. That's why our servomechanism starts overcompensating and keeps behaving so, until it enters into oscillation. In other words, when we approach the eye of the needle, we realize that we need corrections on the order of millimetres first, then tenth of a millimetre and so on. Finally, we get to a point where our brain sends to our muscles impulses causing corrections which are too large, thus triggering compensation in the opposite direction. Oscillation is a tell tale sign that we are at the structural limit of our performance.

In learning CW, this phenomenon manifests itself clearly when we push our performance to the limit. Both in reception and transmission, if we oscillate, i.e.: our operating technique is sometimes perfect and bumpy at other times, it means that we have identified our current operating limit; in competitive sports this is called the *ceiling.*

Work around your ceiling, identify its variability and use this information to determine your rate of real improvement. Do not worry too much about it, *simply keep working on it.*

Working around your ceiling assiduously, you will soon stop trying consciously and enter into a very peculiar state of mind, much similar to the vacuum but with an open and active mind. This powerful state of mind will allow you to take your performance to the top.

The rest, coming by itself

Have you seen the effort that a child who just learnt to speak makes? Figure out how he might feel: the concept is clear in his head, but he cannot express it. He's learning, day after day, to activate brain areas that he never used before. He *knows he can do it,* but he still cannot.

The feeling you get when you make your first QSOs are more or less comparable with the experience of that child. You already know that, with practice, everything comes by itself. What's interesting here is that the more we try to correct ourselves, the more we are afraid of making mistakes, the more mistakes we make. In QRQ this phenomenon becomes evident, at some point it is as if everything messes up, we are not able to understand anything any more and our transmissions may be completely garbled. Just stop worrying, everything is ok.

The problem is solved simply *by stopping and trying to solve it,* let the CW message go as it comes, if you do it wrong, it doesn't matter: the recipient will understand your message anyway (of course, this should not be taken as an excuse to stop improving). This is especially true if you're doing a rag-chew QSO. Transmitting a word with or without a couple of letters in a rag-chew QSO, is completely insignificant: we will be understood anyway. Be sure that next time you will do better.

A child learns because he is spontaneous, he does not care if he makes mistakes while talking: he knows that he can be understood anyway. For an adult, unfortunately, everything is much more difficult, because he needs to look capable, solid, never in disgrace. In CW, but also in everyday life, this is a burden of which we should mentally liberate ourselves.

For a long time I attended a freediving school, where I realized I had a sort of *built-in* limit. Freedive tests are carried out in various ways: a first test (static apnea) consists of staying relaxed, face-down on the water surface as long as possible. A second test, dynamic apnea, is to swim underwater in the pool as long as possible. The third test, freedive apnea, consists of descending into the deep sea as deep as

possible. After two years of school, I reached 100m in dynamics (in about 1'45"), 2'45"in static and 19m freedive. After reaching 100m in training, I was able to stand in the second national category, with 80.25 m during an official competition. The strange thing here is that all the other athletes who were able to perform between 80m and 100m in dynamic, had a much higher performance in static apnea, than I was able to do (around 4'), and a freedive depth of about 25m.

My instructor pointed out that in dynamic apnea I was moving like I was myself "dissolved in water", while in the other two kind of competitions I was much more rigid. Eventually, I realized that such difference was caused by my mental attitude. In dynamic apnea, for innate reasons, the fact of moving completely distracted me from my actual condition of staying underwater. During the competition, I had such a good performance because *I completely forgot that I was in water.*

Awareness and consciousness, in an artistic or sports context, are obstacles to our performance: they lead to anxiety, uncertainty, excessive self-correction, and lock out our innate abilities. In freediving, the mere awareness of being immersed in water, without breathing, is sufficient to warn the whole body and consume your reserve of oxygen in a fraction of a second.

Relax and *let the CW flow by itself.*

Keys and Keyers

This chapter introduces the CW keys in an order that, in the opinion of the author, is physiologically more suited to a less painful as possible learning process. There are, as we know today, four kind of CW keys (in chronological order):

- The straight key.
- The Sideswiper.
- The Bug.
- The Paddle.

At the CW world speed championship , HST 2008, held in Pordenone (Italy) the Belarus team has presented a key which is actually a hybrid between a paddle and a sideswiper. With such key, the Belarus team has reached and surpassed the stunning speed transmission of 70 WPM. This key was later produced by Piero Begali i2RTF as the HST, it is actually a single lever paddle with lever and transmission designed in such a peculiar way that it could be classified as a fifth kind of telegraph key of its own.

The Straight Key

The straight key was originally designed in 1844 by Alfred Vail, who built a prototype for the experiments for wireline telegraphy transmissions made by Samuel Morse. It is an object of extreme simplicity: a lever is resting on a fulcrum, maintained in a horizontal position by a pin and a screw. This screw controls the lever when returned back to the resting position by a spring. The lever closes the circuit on a dedicated contact, whose distance is adjustable via an adjustment screw. All adjustments are kept firm by a lock nut.

Little has changed in 150 years; the first design changes were related mainly to the lever. Examples of such design changes are the first prototypes of Camelback keys, with the characteristic hump on the lever, in 1848. By the end of the century, another kind of key was largely produced: the "post-office key", with a short, straight

lever and small knob. From the end of the Second World War on, the telegraph keys mainly adopted by the navy and army were the "Swedish" or "pump" ones, with their typical very long lever and a spring made of a thin metal foil, above the lever.

The straight key is a very simple mechanism that defers to the operator's wrist all the precision required for a correct transmission, in terms of timing and spacing. It must be literally "played" as if it was a musical instrument. Remember that a dot serves as the basic metrical unit for the construction of the entire message. It determines the spacing between the elements according to the rules we have seen in the past chapters:

- Dot: 1 unit.
- Spacing between dots and dashes: 1 unit.
- Dash: 3 units.
- Spacing between letters in a word: 3 units.
- Spacing between words: 7 units.

These rules are not meant to be learnt by heart, but understood as you "play" with the straight key.

With the straight key, the transmission should be done with a soft wrist, index and middle fingers on top of the knob and the thumb slightly below it (another popular style is to place the thumb and middle finger below, and only the index finger on top). Dashes are obtained by lowering the wrist, and dots by lowering the tip of the fingers. Give yourself enough space on the table, so that you are not disturbed during the manipulation by too close objects, which could prevent a correct wrist movement. Ensure that the key stays firmly put on the desk. Also make sure that the base is long enough to reach underneath the knob; this will avoid that your key will raise its back during the manipulation. Wrist, hand and forearm should be relaxed and you should pay close attention to not contract the forearm muscles during the manipulation; this mistake could lead to a well-known problem among the professional radio operator community: the Glass Arm or inflammation of the tendon near the elbow. Epicondylitis is a typical tendon inflammation syndrome provoked by repetitive movements at certain intensity. Relaxation is essential, therefore, to manipulate with the least possible effort.

Keep focused on reproducing spacing and character sounds exactly as played by the PC. it might be useful to adopt a modem like the AEA-PK232 or a sophisticated keyer as the Begali CW Machine, enabling you to self-monitor your manipulation. Some software, such as the Super Morse, allow you to connect the straight key directly to a computer serial port, other programs, like CWGET, are able to copy CW up to a certain speed, using a microphone.

The proper use of a straight key is an essential prerequisite for learning CW. There are relatively few cases of people who can jump right to another kind of

telegraph key, such as a paddle or a bug. Surely, having a musical ear helps a lot to speed your progress and achieve a deeper understanding of timing and spacing in CW. The maximum speed achieved with precision, using a straight key, is the trade speed of 25 WPM. It goes without saying that there are obviously exceptions represented by professionals of rare calibre, who are able to reach higher speeds.

Remember the motto of the CW community: "Accuracy transcends speed".

The straight key is a mechanical device - a machine - and, like all machines, it should be kept in proper working order: cleaned, adjusted and oiled. It is made of the following elements:

- Rigid and heavy base.
- Lever and knob.
- Fulcrum.
- Lever resistance adjustment spring.
- Adjustment screw for the distance between the contacts at rest.
- Contacts on the base and the lever.

Operating a straight key is disarmingly simple: the operator, placing his fingers on the knob, pushes down the lever, whose resistance to motion is adjusted by a spring and closes a contact, after having travelled a certain distance in the vertical direction. A straight key is built to be an essential but highly efficient device,

The base of a straight key must be designed to avoid displacement during the manipulation. Lever and knob must be sized to allow the operator to manipulate with the outmost comfort, with a relaxed wrist and with relatively little effort. The fulcrum defines the position where the lever is hinged on the base and, thus, determines the leverage ratio. The lower that ratio, the higher will be the intensity of the effort required to close the contact. The spring hardness adjustment allows to fine tune the energy required for the manipulation. If you are the "heavy wrist" kind, then opt for a harder setting (and thus more required force). The distance screw between the contacts at rest determines the "time of flight" between the time in which you start pressing the lever and the actual moment when the contact is closed: it should be adjusted accordingly to your operating speed, but to also the degree of stiffness of your wrist. When manipulating, rigid wrists will require, as a rule of thumb, shorter contacts spacing. Vice versa, wider spacing will be best suited for loose wrists.

The first step in having an efficient straight key is to clean all the contacts, clean and lubricate the pivot and make the contacts as shiny as possible. Oiling is necessary to ensure a smoother lever motion. This will ensure a firm and clean contact closure and a perfect CW tone. Contact oxidation produces a very characteristic sound, uncertain and sometimes interrupted.

Now put the first, second finger and thumb on the knob, hold your wrist loose and press down the lever, if you feel that movement as if it is "falling down", increase spring hardness, conversely, if the lever resistance feels too hard to your wrist, before you close the contact, loosen the spring.

Do a series of V: if you feel that the rhythm, especially the spacing between dots, is unnaturally large, i.e. the contact comes after what you'd expect, reduce the distance between contacts. If, instead, you think that contact closure occurs too far in advance, then increase it. Duration and distance of the spring contacts are determined by the speed of manipulation, find the combination that lets you send at a ratio as close to 3:1 as possible. In general, higher speeds require less distance between the contacts and a harder contact resistance. On the other hand, spring resistance makes handling more difficult. This is the price to pay for a faster return of the lever to the resting position, so you can start manipulating the next element of the character sooner.

The first phase of learning proposed in this book is crucial: when you manipulate the key for the first time, you must have mature concepts of instinctive timing and spacing, in order to “play” the key with a spontaneous, unforced, natural and relaxed manipulation. The straight key is a physical device, but for a proper handling, it must somehow "disappear" from your conscious perception: in transmission it is important to get the feeling that it is your intentions which produce the output sound. In short, act as if the key does not even exist.

In essence, the perfect manipulation is the one you get when *you forget* that your are using a telegraph key.

The Paddle

The first article on electronic manipulation appeared in QST magazine, by Harry Beecher, W2ILE, back in 1940. We had to wait past the Second World War (1948) for the first electronic keyer to appear on the shelves: the Mon-Key manufactured by Electric Eye Equipment Co. A couple of years later, in 1950, Eldico "Electronic Key” company, started selling the model EE-3. The first electronic keyer will came only in 1959, and a year later, Vibroplex introduced the Vibro-Keyer, a single lever paddle.

Since then, the market has seen a succession of new inventions, mostly focused on the electronics, while the history of the Paddle, now, it is still to be written and sees the big industrial producers like Bencher, Kent, GHD, Vibroplex and the finest craftsmen like Begali, Alberto Frattini, Salvatore Canzoneri, Schurr.

The Paddle is available in two versions: double and single lever. It allows reaching speeds much higher than a straight key (60 WPM). Chronologically, the paddle is an evolution of the Bug, but thanks to the ease of manipulation most of the amateur world actually skipped the passage to the bug. The vast majority of OM jumped directly to electronic keyers.

The paddle is essentially made of two switches, activated by two levers: one for the dots and one for the dashes. Being "only" a double switch, it must be used in combination with an *electronic keyer* (or just *keyer*). The paddle, for a right-handed operator, works as follows:

- The right paddle emits dashes, while holding down it, the keyer sends a series of dashes.
- The left paddle emits dots, while holding down it, the keyer sends a series of dots.

The dual-lever paddle allows you to transmit alternating series of dots and dashes through the technique of *squeezing,* i.e. pressing both the paddles at the same time:

- By pressing the right paddle, keeping it pressed, then pressing the left one and holding both pressed, the keyer sends a series of dash-dot.
- By pressing the left paddle, keeping it pressed, then pressing the right one and holding both pressed, the manipulator sends a series of dot-dash.

The recent surprising results of the high-speed CW world championship held in Pordenone, HST 2008, seem to show that squeezing, at very high speeds (over 70 WPM in transmission), is less efficient than a non-squeezing technique, applied to a single-lever ad-hoc designed key. Since 2009, Piero Begali is the only manufacturer for such kind of single-lever key, named HST. A paddle is made of:

- Rigid and heavy base.
- Double or single lever.
- Double or single lever fulcrum.
- Contact for dots and dashes.
- Screws and locknut fasteners for dots and dashes.
- Magnetic or spring retention system for adjusting the paddle resistance to motion.
- Finger pieces.

As for the straight key and, generally, for all telegraph keys, the base should be as heavy as possible, so as to make the key stable. The paddle is manipulated horizontally in both directions, so it is extremely important that it stands still, practically nailed to the desk. A shift of a few tenths of an inch, with a paddle, already at 25 WPM may change the timing enough to make a mistake.

The lever, whether double or single, must be light and rigid, and must react to provide a consistent feeling during manipulation. The precision of the bearing where the fulcrum is hinged to is therefore crucial. It is of fundamental importance that the bearing is protected from dust or dirt. The distance between finger pieces and fulcrum and from the fulcrum to the contacts defines the paddle leverage ratio. Keys designed for QRQ have a leverage ratio close to 1:1.

Contacts and adjustment screws must be of high quality non-corroding material. The adjustment screws allow you to calibrate the distance between the contacts. Contacts must be kept absolutely free of oxide, to ensure a prompt and reliable contact closing.

The retention system, magnetic or spring, is used to adjust the resistance to the manipulation of the paddle levers. Magnetic adjustment has the advantage of producing an easier touch and, above all, removes a mechanical component, the spring, which can deteriorate over time.

Finally, the finger pieces must be of rigid material and comfortable. They should not leave pressure marks on your fingers during long QSOs and, consequently, give the operator a less fatiguing experience.

The transition from a straight key to a paddle is, in fact, mandatory if you want to reach a transmission speed of 25 WPM and above. The transition is not painless: you will completely change your manipulation style. That's why, at this stage, the basic elements of spacing and timing must have been acquired to perfection. In turning to the paddle you find yourself starting virtually from scratch and it is important to have a clear mental picture of *the sound you want to get,* to be perfectly spaced with a 3:1 ratio.

The letter C for instance, is achieved by squeezing the dot and dash paddles and releasing both when the C is completely transmitted. The F is obtained by pressing the dot paddle, then just touching the dash paddle and immediately releasing it, while keeping the dot paddle pressed; ditto for the L, except that the touch of the dash paddle is made a little bit before. The letters E, I, S, H, 5, T, M, O, 0 require pressing only one of the two paddles and, simply, keeping it pressed.

To switch successfully to the paddle you must learn again to send individual letters of the Morse code. Each one, in fact, is characterized by a specific paddle manipulation sequence. The recipe is simple: take a written text and practice transmitting it until you get bored, beginning at a speed of about 20 WPM. When you are able to transmit with enough proficiency, start making QSOs. From now on, it is just a matter of training.

The paddle choice should be made carefully, weighing various factors.

- If you have a heavy hand and you have a kind of "slapping" manipulation, opt for a paddle with a large and heavy base.
- If you have big hands and fingers, go for a paddle with widely spaced finger pieces, at least 15mm. Regular or small hands will benefit from paddles having smaller distances: from 12 to 14mm. To determine the paddle width suited for you, put your hand resting on the finger pieces; if you feel the muscles contracting when you pull back the fingers (i.e. widening them), after a short time, it means that the paddles are spaced too widely.
- If you are not a QRQ fan and you're not going to be, you can opt for mass-production paddles, such as Kent and Bencher. The Kent, in particular, is a key that can take you up to high speeds, but it is characterized by a rather wide paddle distance. The Bencher, by contrast, is a key with mechanics suited for lower speeds, but it is a light and beautiful key.
- If your CW activity is mostly in portable, consider the small telegraph keys, made by various craftsmen around the world. They are light, precise and well performing devices.
- If you want a key to accompany you throughout your career of amateur radio, then the products of specialized craftsmen are the best fit. They offer world-class production quality, both from the technical and the aesthetical point of view. Costs and waiting times are amply rewarded by the quality of the product.

The paddle is manipulated with the thumb on the dot paddle and the first (or first and second) finger on the dash paddle, keeping the fingers at rest at an adequate distance to get a correctly spaced manipulation. This distance determines the *time of flight,* i.e. the time between your intention to move the fingers and the actual touch of the paddles. The difficulties encountered initially in manipulating the paddle are absolutely physiological, since you will find yourself with a device that automatically spaces dots and dashes, while the character and word spacing is left to your skills. A correct spacing between two elements of a letter is made by closing the next contact, both with and without squeezing, in a time less than or equal to the length of the current element plus a lag time that is dependent on the iambic mode in which you set your keyer. This manipulation technique enables the keyer to play the next item with the correct spacing of a dot.

For example, the manipulation with proper spacing of the B letter is done by:

1. Tapping (pressing and immediately releasing) the dash paddle.
2. During first dash, press the dot paddle.
3. Keep the dot paddle pressed until you emit 3 dots.
4. Wait for a time correspondent to 3 dots before transmitting the next letter.

The description above is aimed solely to make you understand how the electronic keyer works, it should not be memorized: all these operations are not to be performed in a conscious way, but automated through repeated exercises over time. Listen to the sound coming from your keyer and correct your manipulation in an instinctive and automatic way, until your B will not sound any more like a T followed by three E. You must keep trying until the sound you hear *corresponds to your mental image of timing and spacing.* Now it is clear why, if the time you spent with a straight key was insufficient for you to sediment the sound corresponding to a proper manipulation with a 3:1 ratio, the transition to the paddle will be harder.

This procedure is aimed primarily at optimizing the resistance of the paddles and the paddle-contact distance to match the speed of transmission. As a precision mechanical device made for driving an electronic keyer, the paddle keeps its essential characteristic of a double switch, regardless of the calibration. The undoubted advantage of the paddle is, therefore, that, adjusted or not, it sounds good anyway. It goes without saying that to get a correctly spaced manipulation, especially at higher speeds, you need to fine-tune resistance and spacing. Moreover, at higher speeds it is essential that the mechanics of the paddle must be precise enough to stay adjusted over time.

Contact distance should be adjusted so that the minimum time that the paddles take from when they start moving to the actual contact closure, plus the flight time, i.e., the time it takes to move your fingers from the rest position to the touch of the finger pieces, corresponds roughly to the duration of a dot. So, the higher the speed the smaller should be the contact gap. Therefore, to reduce the flight time, the fingers should also be kept closer to the finger pieces.

Again, paddle resistance shall be adjusted to be progressively harder with increasing speed, making sure not to introduce excessive resistance to not tire your hand muscles. Pay attention to the difference in muscle power between the thumb and the other fingers. The thumb is known to be stronger than average so you should adjust paddle resistance accordingly. The relaxation exercises in this book will help you to better understand when your muscles are getting tired, even imperceptibly, and you should use these insights for proper paddle adjustment.

The Electronic Keyer

The electronic keyer is, actually, the other half of a paddle. The keyer is the ultimate unit which manipulates the transceiver according to our commands. A paddle built with sophisticated mechanic principles is virtually useless unless it is not coupled to a high quality electronic device. The keyer incorporates all the essential functions to manage our manipulation, such as speed, weight ratio, and other useful additional functions like a convenient set of memory banks.

Although all modern transceivers have built-in electronic keyers, the CW community often adopts an external keyer. Today, in the market, it is possible to find different keyers in every price range: in this chapter we will introduce the main functions of a typical keyer. The keyer is a device that provides all functions needed to drive a rig according the sequence in which we press the paddles. A good keyer is designed to support both operations in portable / low speed or in a fixed station, eventually in QRQ, and must be chosen to accommodate both the needs of the newcomer operators and the most experienced ones. In a typical keyer we find a lot of functions, such as emulation modes or programmable beacon: we will focus on a small sample of functions, to show the capability you may find in a typical commercial keyer.

A typical keyer price range starts from around $20, with physical dimensions starting from a Quarter coin (as the Dale Botkin PicoKeyer, for example) to much powerful devices with an embedded LCD display and decoding capabilities, computer interfacing and so on (as the Begali CW Machine). A good keyer should have a basic set of features such as programmable memory banks, beacon functions, internal speaker, bug / paddle / straight key mode, programmable weighing ratio, adjustable speed up to at least 50WPM and a potentiometer for adjusting the speed.

Keyers are often offered in kit form, usually made of a handful of components, a speaker and an optional lithium battery. Even a novice can assemble them in few hours.

The main requirement for a good keyer is *versatility:* a good keyer must be designed to operate with solid performance both with the smaller QRP rigs and the heavier transceiver. An internal speaker is necessary (better if operated with a battery) so that the keyer can be used to practice CW with different kinds of telegraph keys, whether they are automatic, semiautomatic or manual.

Some keyers, offered in kit form, are so tiny that they can be embedded in virtually every transceiver, even vintage rigs. Such kits often incorporate a voltage regulator instead of the lithium battery, making it extremely simple, both mechanically and electrically, to use them in different rigs.

Typical small keyers, although they may have features such as automatic numbering of QSOs and beacon mode, are not suitable for contest operation because they usually provide few function keys (one or two), often used to scroll within menu items. For contest operation, a keyer with more function keys (four or more) is much better suited. A typical keyer has a potentiometer for adjusting the speed, some function buttons to access the configuration menu, an input jack for the paddle and an output jack to the transceiver.

Operating a keyer is simple, with the potentiometer you adjust the transmission speed, in a typical range between 5 and 60 WPM (i.e. between 25 and 300 characters per minute). Although not all the commercial keyers have a potentiometer for adjusting the speed, a potentiometer is absolutely a must for comfortable operation. Speed is increased by turning the potentiometer clockwise, and decreased by turning it counterclockwise.

Some keyers allow setting the speed without using a potentiometer through menu items. That option is adopted to reduce keyer size; on the other hand, operating a keyer without a potentiometer is not always an easy task, since it forces the operator to access the configuration menu to change the speed. Very uncomfortable.

Every keyer has a *setup* mode, where it is possible to configure the parameters for keying the transmitter. Usually the keyer plays - in CW, of course ! – the letter corresponding to the menu option accessed. Each keyer has its own setup functions, the rest of this paragraph will introduce the typical ones.

Speed calibration

Most keyers can operate from a minimum to a maximum speed. To accommodate your transmission habits or needs, the keyer can be configured to send (within the available range) at a given minimum speed, achieved by turning the potentiometer fully counterclockwise and at a maximum speed, achieved with the potentiometer turned fully clockwise. For example, if I am a novice operator and want to operate at speeds lower than 20 WPM, I can configure, via a setup function, my keyer to limit the potentiometer range from 5 to 20 WPM.

Sidetone Setting

Allows you to turn the sidetone through the internal speaker off or on. Usually your transmitter will provide the sidetone, and you would turn the keyer sidetone off, but turning it on is a very useful feature for training sessions. A similar menu option

allows you to change the sidetone pitch. Usually set to 600 Hz, you can change it to accommodate your need and taste.

Message mode

A keyer usually provides memories, which are accessed by a short press of the corresponding function key. Memories are used to store predefined messages, making contest operation a straightforward task. Messages are associated with function keys, and several messages may be grouped in memory banks. The operator can record a message for each function key, transmitting in CW as usual with the paddle or entering it on a computer screen. Special characters can be used as macro placeholders, i.e. characters that perform specific actions, such as message repetition, message delay, pausing functions and so on.

Dash / Dot Weighing ratio

It allows configuring the duration ratio between dashes and dots, increasing or decreasing it according to your needs. By default this weighing ratio is set to 50% (corresponding to 3:1), increasing it will produce longer dashes.

Keyer emulation mode

Electronic keyers were invented half a century ago. Since then, many things have changed and many keying styles were applied. The most sophisticated electronic keyers are able to emulate several keyers of the past. Today, the main difference you can find in a keyer is in the way squeezing is managed. Among all kinds of emulation, for our purposes we will focus only in the most important difference: *iambic mode A and B*. The Iambic mode defines how the keyer manages squeezing, or, more precisely, what happens if both paddles are squeezed and then released simultaneously. In mode A, the keyer, when both paddles are released, ends the current element (dot or dash). In mode B instead, it adds the opposite element if the paddles were still squeezed at the midpoint of the last element (dash or dot). For example, releasing the paddles in mode B when the keyer is sending a dash, will cause the keyer to transmit the current dash *plus* an additional dot, even if paddles contacts are no longer closed at the end of the dash. If you do not know how to choose between the two iambic modes, simply start transmitting. If you find that the keyer often “steals” you a dot, especially with the letter C or a dash in the prosign **AR,** then you're best accustomed to the mode B. The old Curtis keyers operate in mode A, while the most recent keyers are using mode B. Some keyers are configured by default in mode A. Iambic mode B is easier to learn because it is more forgiving when you make subtle timing mistakes.

Telegraph key mode

Most keyers allow choosing among three kinds of telegraph key: straight key, paddle or bug. In straight key mode, the keyer will be “transparent” acting as a simple switch: key pressed / rig in transmit mode. In bug mode, a paddle can be used to emulate a semiautomatic key (see next paragraph), with dots generated by the keyer and dashes keyed manually by the operator.

The Bug

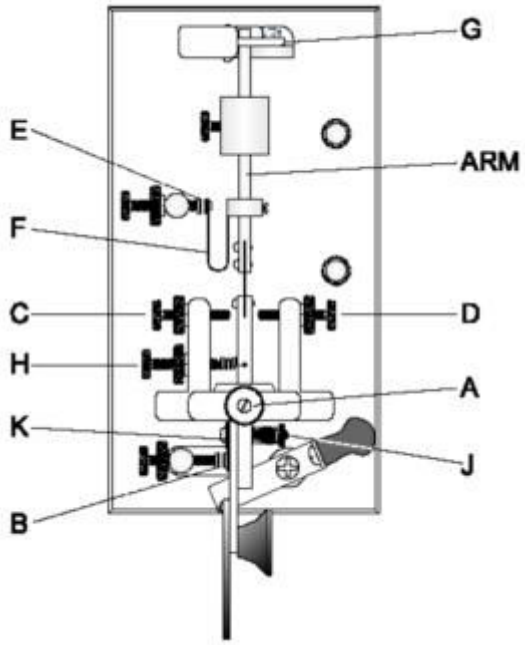
The bug was born in the early twentieth century in response to the need to send code at high speeds without straining the forearm. Horace G Martin, in 1902, presented a telegraph key able to generate dots automatically and dashes manually (from that, the name of *semi-automatic)* and patented the Autoplex in order to ensure the exclusivity of all mechanical keys with automatic dot generation. At that time Martin founded the Vibroplex Company, undisputed leader in the production of this type of telegraph key. The factory is still active. At the Vibroplex web site you can find all the historical information of this prestigious house. In 1904, the Vibroplex Original key was first produced and it is still marketed today. To work around the patents enforced by Horace Martin, Mecograph built the first right-angle semiautomatic key, in 1906.

After a tough legal battle and the purchase of Mecograph, Martin ensured the exclusive production of semiautomatic keys, calling them "Albright Bug", as a trademark of original production. In 1914 Martin built the Blue Racer: a characteristic bug with a narrow, blue base. The few specimen still available in the market today, demand considerable prices and are mechanically flawless, despite their age of nearly100 hundred years. The Lightning Bug is born in 1923 and would remain in production until the 70's. It is characterized by a broad base and a square frame around the damper. Horace Martin left Vibroplex in 1930, inventing various other telegraphy keys, all destined to leave a mark in history, like the Les Logan, the Speed-X and the Flash Key.

In 1942 the U.S. Signal Corps retained Vibroplex to produce the telegraph keys for World War II operations. The company responded with a special version of the Lightning Bug, the J-36. During the conflict, Vibroplex was unable to cope with the required production and the key schemes were passed on to Lionel, a toy manufacturer. Over the years, the Lionel J-36 would prove one of the best telegraph keys ever made. During those very same years, the Melehan Valiant key was born: a rare key able to automatically generate both dots and dashes.

The following years definitely established the success of Vibroplex in this particular niche market, despite other aggressive productions in limited editions, like

those of Ted McElroy, an undisputed talent of the time. Vibroplex is still active today, run by Scott Robbins, W4PA, who acquired the company in 2009.



Schematic representation of a bug

The semiautomatic key is the precursor of the paddle. These two keys can be compared as a piano and an electronic organ. The sound offered by the bug is unique and unmistakable, making it possible - a considerable feature for a mechanical key - to achieve speeds of 40 WPM and more without straining the forearm and producing the characteristic phenomenon of epicondylitis *(*Glass Arm*)*.

The bug consists of a horizontal pendulum (ARM), held by a mainframe (A) and damped by a damper (G). The operator moves the arm in the direction of the dot contact (A) and a spring provides repulsion from the contact itself initiating an oscillating motion, controlled by the position of a small weight on the arm (ARM), which produces a corresponding series of dot contacts. The dashes are produced manually, moving the arm towards the dash contact (B). The C, D, H, J adjustments allow you to precisely control important parameters, such as the spacing between dots, dot and dash spring tension, the degree of damping, the residual kinetic energy of the arm during its movement. To use a bug with proficiency, it is essential to know

in detail all the mechanical components. The semiautomatic key is a very complex machine, each sample has a "voice" and an operating speed range of its own.

The base of a bug is built to be stable and rigid, to absorb the mechanical energy of the arm in motion. Some types of bugs have a narrow base (Vibroplex Blue Racer, Zephyr) for the benefit of portability, but require the use of the left hand to be held in place during manipulation.

The heart of the bug is the arm (in the figure, *ARM)* made of a thin rod, round or flat, connected by a spring at the front to a thicker and stiffer arm which is hinged at the pivot and ends in the paddle for manipulation. Attached to the arm are the dot contact spring (*E*) and the dash contact *(B)*. A moving weight changes the frequency of oscillation of the arm and thus the speed of transmission.

The bearing block around the arm holds the adjustment screws and the bearings which support the vertical pivot pin.

The damper *(G)* consists of a mobile structure or a disk of rubber to dampen the oscillation of the arm when it comes to rest. The vibrating arm returns some kinetic energy to the spring holding the dot contact *(E)*.

The dot contact spring, mechanically energized at each contact, pushes the arm in the opposite direction with energy proportional to its compression. Ideally, it should be of negligible mass and a response proportional to the compression, so it must be of good quality material to retain its elastic properties over time.

The stop screw *C* determines the excursion of the arm towards the dot contact and therefore the energy that is available for the vibrating arm. In combination with the adjustment of the dot contact in front of the spring *E*, it determines the relationship between mark and space, when transmitting dots. These two adjustments are of crucial importance to achieve a 1:1 ratio between the length of a dot and the spacing between two consecutive dots.

The adjusting screw *H* controls the compression of the dot spring attached to the arm. This spring, together with the fulcrum adjustment screw controls the degree of mechanical resistance felt while manipulating dots.

Finally, the dash contact *(B)* must meet up with its counterpart on the arm *(K)* for a perfect fit, while the dash spring *(J)* adjusts the resistance against manipulation.

With such mechanical complexity, it is obvious that the calibration of a bug is absolutely crucial to obtain a transmission ratio of 3:1, properly spaced. Here is the calibration procedure:

- Clean contacts B, E.

- Oil the joints between the arm (ARM) and the bearing block (A).
- Loosen the spring H and widen adjustment C.
- Compress the spring H about a couple of turns.
- Calibrate the adjustment D so that the arm touches the damper G lightly.
- Loosen the spring H about a turn and a half, check that the arm still touches the damper.
- With the help of an electronic keyer, adjust the contacts C and E until the bug emits a series of dots spaced to sound like the keyer.
- Adjust B at will, usually by setting it at a distance comparable to the contact dash E.
- Adjust the hardness of the dash spring J to allow transmission of a series of dashes separated by the proper spacing.

The manipulation of a bug is done by placing the index finger and middle finger on the dash paddle and the thumb on the dot knob: the bug is a mechanical instrument which is played with virtually the whole body, much like a piano. The spacing of thumb and index finger, the slight rotation of the wrist, the kinetic energy given to the arm, are all fundamental manipulation features. It is important to find your own style, provided you achieve a perfect timing and spacing with a 3:1 dash/dot weighing ratio. The perfect manipulation of a bug is achieved when it sounds like a paddle, combined with an electronic keyer.

Due to the inherent mechanical complexity, the transition to a semiautomatic key is a process that requires having a perfect concept of proper timing and spacing, thus mentally perfect CW. Like with a paddle, each letter is characterized by a specific manipulation sequence and must be learnt by practicing with consistency. The greatest difficulties are typically found with a series of dashes such as in O and 0, because they highlight the mechanically weak point of the bug: the return spring of the dash contact. The response of this spring, in fact, is not always consistent because, in the series of dashes, it works in conditions of preloading. It often happens that the arm is not able to go back quickly enough to properly separate two consecutive dashes. To overcome this problem, you must learn to manipulate by turning your wrist slightly, rather than pressing the forefinger and middle finger toward the paddles.

As with every kind of telegraph key, even with the bugs, you should exercise in a way to reach a spontaneous manipulation, not "rational". The key should be calibrated and manipulated in perfect agreement with our manipulation style, so as to allow a free flow of transmission without hindrance or fatigue. The code sent must be spaced properly, without interruptions and uncertainties: a skill that, as usual, is obtained only by practice and exercise. The recipe is straightforward, transmit as much as you can, maybe listening again to a recording of your sending to correct yourself promptly.

The Sideswiper

The sideswiper was born in 1888; Bunnel marketed it under the name of "Double Speed". This rare kind of key was designed to cope with the need of finding a solution to the terrible phenomenon of the glass arm. Terrible, indeed, because it forced radio operators around the world to rest, unable to work, for a long time. The sideswiper offered a simple and straightforward solution: instead of moving vertically the lever moved horizontally, closing a pair of contacts, one at the right and one at the left. The history of this key practically ends here. The semiautomatic key was already under development and was going to be adopted soon. After Martin invented the bug, the sideswiper fell into oblivion. In the mid-50s, this key was renamed the "cootie-key" because of the mechanical simplicity that characterizes it. Mostly Russian radio operators for marine traffic, both military and civilian, have adopted this key. Today, in 2009, radio amateurs who use it regularly can really be counted on your fingers, so this type of key and its own manipulation techniques have been largely forgotten.

The sideswiper is composed of a base, not necessarily heavy, with a central lever ended by a manipulation paddle, and two contacts. The electrical path can be closed either right or left. At first glance, one might think that you can mock-up a sideswiper with a single lever paddle. Actually, the two keys are very different. First, the fulcrum in a sideswiper is located at the opposite end of the paddle. Moreover, the sideswiper has a longer lever, which in a single lever paddle is mechanically shortened by the presence of the fulcrum right in the middle of the base. All these factors lead to a mechanical response of the paddle which predisposes it for use with an electronic keyer.

The efficiency of this kind of key, however, is striking: you can easily transmit in the 30 WPM range with a modest degree of fatigue. Manipulation, in fact, is simply an alternation of your wrist from right to left, closing the contacts on either the right or the left side. Be the current element a dot or a dash, you simply keep alternating in a left/right fashion, always being careful to maintain the proper timing and spacing. The secret of this kind of manipulation is in the rotation of the wrist and in the correct spacing between the thumb and index finger, which allows a flight time consistent with the transmission speed.

The sideswiper is commercially produced in series by GHD, while two Italian craftsmen make special versions of the sideswiper: Salvatore Canzoneri IK1OJM and Alberto Frattini I1QOD. Constructive solutions adopted originally by the original Bunnel key did not allow much variation, just the distance between lever and contacts. With the revival of interest in this type of key, the Italian craftsmen have been introducing technical improvements such as magnetic retention, a solution borrowed from the experience in paddle construction, and a very important

improvement for making manipulation easier and less straining. The sideswiper, in fact, has remained unchanged over the years thanks to its relatively low popularity among professionals, with the consequence that the initial design never developed as it would happen with a commercial product.

The transition to a sideswiper is not easy, because it requires a manipulation style all of its own. It is important to understand the correct wrist rotation, which happens in such a way that is not comparable to the one adopted in manipulating a bug. With a bug, the wrist rotates along the axis of the forearm. With a sideswiper, the wrist alternates right and left using the wrist as a pivot. In other words the wrist "vibrates" right and left, leaving the thumb, index finger and middle finger describing an arc.

The most complex aspect of using a sideswiper is the manipulation of dots and dashes, which may occur on either the right or the left contact. This type of key is a severe test for the radio operator because it shows, mechanically, that it is absolutely necessary to have mentally absorbed the proper timing and spacing. A paddle and a bug turn the difference between dots and dashes into a physical experience. That is, when we manipulate one of these two keys we instinctively associate the dash with the pressure of a paddle and a movement from right to left, and the dot with the opposite movement. The result of this manipulation is that the distinction between dots and dashes is physically manifested, because every element is supported by the experience of pressing the paddle in one or the other direction, causing a distinct perception of a dot and a dash. A more instinctive approach to radiotelegraphy, however, requires that these differences are blurred, or rather, the operator should have sedimented and acquired the sound of each element and the gesture of transmitting it in such a way that he simply forgets about them. The sideswiper is so hard to manipulate because it eliminates the very initial difference: dots and dashes are made during a constant left-right pendulum motion, and the manipulation becomes actually a modulation of the steady flow of alternate dots, dashes and the space between them according to the proper 3:1 timing and spacing.

It is an approach much similar to that of the spoken word: the lungs emit the airflow, the vocal cords transform it into sound and the mouth modulates it into structured elements. With a sideswiper, the pendulum motion of the hand is the airflow of the lungs, the modulation of the mouth is given by the contact closure with the appropriate timing for dots and dashes, and the sidetone provides a voice to all that, as the vocal cords do. It is clear that undue concentration on only one of two elements, pendulum motion and duration of contact either right or left, is a serious obstacle to a proper manipulation. The secret is always the same: *let your manipulation flow in accordance with the mechanical characteristics of your key.* Simply keep trusting your automatic control mechanism, alternating the wrist and executing dots and dashes wherever they are found. Keep this motion fluent, listening to the feedback coming from the sidetone.

It is advisable to approach the manipulation of a sideswiper this way: *first build the instinctive pendulum motion, then differentiate it into dots and dashes*. Start simply working out with your sideswiper, repeating a series of dots, each spaced exactly the same way: a dot of sound duration and a dot of space in between. Take a paddle with an electronic keyer, set a comfortable speed for you, between 15 and 20 WPM, and hold the dot paddle. Listen to the sound and replicate it using the sideswiper.

Afterwards, do the same exercise with the dashes, feeling instinctively the 3:1 ratio and manipulating accordingly. Now press the dash side of your paddle and listen to the sound. Feel the difference. Finally, practice to transmit eight dots, four dashes, eight dots, always comparing the manipulation between the sideswiper and the paddle. When you feel confident enough, go ahead with your first QSO, the more QSOs you make, the faster will be your time in transitioning to the sideswiper. On the Internet, there is a group of operators who are reviving this kind of key: the Sideswiper Net. You can find them at this address

`http://sites.google.com/site/sideswipernet2/home`

Finally, a very Zen exercise: close your eyes, relax, shut down the sidetone volume completely and start manipulating by sending the first thing that comes into your mind. A correctly spaced manipulation of a sideswiper is pure meditation. It's all in the head, the sidetone is not needed.

Building a CW career

CW is indeed a passion and, as such, many people around the world found it necessary to bound together in specialized and dedicated interest groups. Inevitably, this fact led to the establishment of various clubs. Most clubs are open to all international radio amateurs requesting to join, while others have some requirements before applying for membership, such as having served as a professional CW operator (military or civilian), or the need of making some test QSOs in order to obtain the so-called sponsor, essentially a certificate of appreciation from a certain number of club members.

Attaining such skills to become a member of different international clubs can be regarded as a genuine career development. The requirements imposed by each club represent real challenges, demanding first a significant development of your abilities and, as well, a proper behavioural etiquette that is distinctive, in a positive way, of course.

The number of clubs that bring together CW fans, all over the world, is impressive: FISTS, AGCW, Marconi Club ARI Loano, iQRP to name just a few. It is obviously impossible to describe them all. However, some clubs with limited membership or restricted access deserve special mention because they require admission criteria of excellence.

This chapter describes the most important international clubs open to amateurs and the requirements to be a member. Developing your abilities in order to become a member of such clubs builds a real CW ham radio career, pushing your skills to the top. These are prestigious clubs, founded decades ago, and entering these clubs is a reason of great satisfaction, not only for yourself but also for the CW world in general.

Naval Clubs

Naval Clubs are available in several countries and admit, as ordinary members, operators who have served in the Navy (Merchant, Military and telegraphy services generally related to the armies) with a radio operator qualification. Naval clubs, thus, usually admit as ordinary members all those people who work or have worked professionally in the field of telecommunications using radiotelegraphy. Some naval clubs admit also associated members: radio amateurs holding the general licence, who are able to operate with skill and diligence in telegraphy and can contribute to the knowledge and dissemination of CW.

In Naval Clubs, ordinary members are, thus, the former professionals, and associate members are amateur radio operators whose ability is such that they can be regarded as professionals. In some clubs, restrictions apply for associate and ordinary members, but being a member of such clubs is an honour for a ham radio operator. Some other clubs are not open to non-professionals but may admit ham radio members having attained special skills or for outstanding merit. To apply for membership as an associate member you must obtain sponsorship by other members. This ensures that your degree of skill and diligence in studying and applying radiotelegraphy is outstanding. Members are also requested to comply with certain rules of etiquette and *bon ton*: a member must engage in a conduct that does not reflect poorly on the Naval Club and, generally, be respectful of the unwritten rules defining *Ham Spirit*.

If you are interested in becoming a member of these clubs, be active on the bands, showing your proficiency, both, in terms of the ability to receive and transmit and in the way you manage a QSO.

What is particularly popular among Naval Clubs is not the speed - many QSOs are regularly held between the members with the straight key at around 20 WPM - but your passion. Of course, an outstanding transmission style is a must.

Club members are active every day on the main bands. They are open and willing to help novices to develop their abilities as wireless operators: do not worry if your manipulation is uncertain or too slow, they will help you for sure. Spend some time listening, identify the most active members and try to absorb their style of manipulation and the way they behave on the air. Take it easy, but always within the bounds of common sense: keep in mind that the majority of the members are professional radio operators, who have done their job with CW and have decades of experience. Be diligent, the same members will start noticing you and possibly propose your name as a sponsor. Absolutely avoid asking explicitly for sponsorship.

The level of technical ability required to enter Naval Clubs can be achieved with study and constant practice and the right mix of training, with various ingredients. The first key ability is to operate effectively in in QSO / DX situations. This will come in handy to show your abilities during the major contests, worldwide. During a contest you can show your operating style, which must be flawless. Work

out with the software Morse Runner, a freeware easily found on the Internet that allows you to learn to handle a pile-up.

The second key point is the ability to have a rag-chew QSO for a certain amount of time. The speed is not important, but you must know how to do long chats at will, in plain text. Enjoy these talks: here you will find many stories of the sea and of radio told by the radio operators. Sit relaxed, maybe in a nice armchair, with a pair of good headphones and a key that you particularly appreciate, in front of a nice cup of tea. Hours will fly and, eventually, you'll have the sound of the sea in your ears.

Although it is not a requirement and, indeed, a straight key would be more than enough, it goes without saying that knowing how to work with all kind of telegraph keys is certainly a plus. To a much lesser extent, the ability of operating at higher speed (as long as you maintain absolute precision) may be another positive factor.

Naval Clubs around the world are:

- ANARS Australian Naval Amateur Radio Society (Australia)
- ARMI Associazione Radioamatori Marinai Italiani (Italy)
- BMARS Belgian Maritime Amateur Radio Society (Belgium)
- FNARS Finish Naval Amateur Radio Society (Finland)
- INORC Italian "Navy Old Rhythmers Club" (Italy)
- MARAC Marine Amateur Radio Club Netherlands (Netherlands)
- MF Marinefunker-Runde e.V (Germany)
- MFCA Marine Funker Club Austria (Austria)
- NRA Núcleo de Radio Amadores da Armada Portugal (Portugal)
- RNARS Royal Naval Amateur Radio Society (United Kingdom)
- YO-MARC Romanian Marine Radio Amateur Club (Romania)

High Speed Clubs

In the '50s, when amateur radio CW started growing at a steady pace, several international clubs started as well. Among these clubs are HSC, VHSC, SHSC EHSC, each devoted to a minimum operating speed of 25, 40, 50 and 60 WPM, respectively.

The HSC, *Radio Telegraphy High Speed Club,* was founded in 1951 within the German National Amateur Radio Association DARC. In a certain sense it could be considered as the "black belt" of a CW radio operator, internationally recognized. HSC is member of the European Association for the CW (EUCW) and works closely with other clubs for the preservation of telegraphy, at an international level. To date, sixty years after its foundation, HSC counts almost 1900 members in 70 countries. The requirements for joining HSC are plain and simple: a member must be able to transmit and receive at 25 WPM, or 125 characters per minute, the same operating

speed as professional radio operators. The amateur who wishes to join must submit to the HSC Secretary 5 confirmation postcards (QSL) with the explicit statement of the sponsor declaring that a QSO of at least 30 minutes at 25 WPM, without the aid of electronic decoders, was held.

Every first Saturday of the month, the stations DL0HSC and DK0HSC broadcast, in English, the HSC bulletin (25WPM, of course) at 1500 UTC on the frequency 7025 kHz and 2100 UTC (2000 UTC during summer) on the frequency 3555 kHz. Listening to the bulletin is a useful opportunity to train receiving at the standards required by HSC. Twice a year, HSC is organizing a contest and a Marathon, important opportunities to get in touch with members of the Club and get a feeling for the style that characterizes them.

The test QSO is quite demanding, and requires a perfect ability in reception and transmission (always within certain limits, errors in transmission are physiological). You must be able to answer questions (eventually in full break-in mode) that are simple in content but challenging for the operator, who must engage in a genuine rag-chew dialogue. Language is not an obstacle, since the club has several operators around the world. Requesting a sked for a test QSO via e-mail is a commonly accepted practice, given the relatively small number of members.

To prepare for the test QSO it is advisable to listen to recorded audio files with an MP3 player or CD at different times of day, at a speed of 25 WPM and build up perfect decoding capabilities. In transmission it is necessary to train for 30-40 minutes with any text, so as to minimize the number of errors. Finally, practice rag-chew QSOs, as long as possible (an hour or more) with a ham friend, chatting of this and that. It can be reasonably expected to achieve the required capabilities for the club after at least three years of activity in telegraphy, since it is necessary to acquire a perfect ability to transmit and receive, thus having passed the cornerstone of abandoning paper and pen and conduct a rag-chew QSO in telegraphy for a long time. These are abilities achieved with assiduous practice.

The VHSC *(Very High Speed Club)* was founded in 1961, still within DARC, and gathers ham radio operators who can decode at least at a speed of 40 WPM. The club has fewer than 400 members around the world. To join VHSC , you must collect 4 sponsors, always by QSL card confirmation, with 4 different members of VHSC to certify the ability to decode at 40 WPM for 30 minutes, with the additional difficulty of not being able to ask explicitly for a test QSO. Sponsors must be collected within a three year time range. Admission to the Club is therefore complicated by factors such as the small number of members, the impossibility to explicitly request a test QSO, and the limited duration of sponsors.

Once the 4 sponsoring QSL cards are collected, the candidate sends an application to the club secretary, who, in turn, discloses the request to all members via a newsletter. The membership process also stipulates a grace period of 3 months, in which a member may object to the application. At the end of this "trial period", the candidate becomes an effective member.

The expertise required to conduct a test QSO of 30 minutes at 40 WPM is such that all these difficulties are overcome by the acquired skill level. Some years of practice in CW are needed to reach the standard required by the club, so, when entering it, you will be perfectly equipped for its demanding prerequisites.

Preparation for VHSC is similar to that required for HSC, but more focused on stamina, thus with long training sessions on the air and a lot of practice in transmission. It is absolutely necessary to develop the capability that you do not feel fatigued: a bit like the marathon, the only recipe for training is simply to run.

From here onwards, there is an important phenomenon: *it is easier to transmit than to receive;* the real barrier here is the ability to transmit properly, given the high speeds. From 200 characters per minute on, only in transmission, any increase in speed must be maintained with exercise and can be lost by regression.

The SHSC *(Super High Speed* Club) and EHSC *(Extra High Speed Club)* both born in 1982, count an even smaller number of founding members, less than 200 the first and around 100 the latter. The requirements for these two clubs are "only" 3 sponsoring QSL cards, with the explicit statement of the duration of not less than 30 minutes and a speed of, respectively, 50 and 60 WPM (250 and 300 characters per minute). Entering the clubs, given the very tiny number of members worldwide, is much less cumbersome, so it is "enough" to collect the 3 sponsors cards and send them to the secretary. The amateur who joins SHSC or EHSC has an undoubtedly long and proven track record and has by now passed all the pitfalls of learning, in short, he is in phase of *unconscious knowledge*. He no longer practices CW consciously.

Starting at 250 characters per minute, the only difficulty lies in the transmission, which is physically tiring, difficult to maintain at a proper pace and requires constant training, complicated by the natural spontaneous regression which occurs if the training is not performed steadily. To maintain, in fact, an ability to transmit with the least number of errors possible, at 250 characters per minute and beyond, you need to train almost every day.

FOC

FOC (First-Class CW Operator's Club) is an international club, founded in 1938 and limited to a number of 500 members around the world. The spirit of this club is that of a close brotherhood among members and their families, who are active in numerous events and meetings. FOC’s goal is to promote and encourage high standards in the ability to operate in radiotelegraphy and an exemplary behaviour on the air.

The operator is required to be absolutely outstanding in all aspects of CW, absolute accuracy at a minimum speed of 25 WPM is a must, so is a certain etiquette, socially and on the air, that is highly valued among FOC members. Members are

selected in such a way that they demonstrate absolute excellence. A solid knowledge of the English language is a must: the FOC candidate must be able to conduct a long rag-chew QSO in English, without showing any sign of fatigue.

The process of joining FOC is lengthy but commensurate with the Club standards: you must collect five sponsors from at least two continents, one of which has to be in the UK. The candidate must show absolute excellence in both reception and transmission for an extended period. He cannot ask for test QSO or, worst, solicit a sponsor, but simply be active on the bands and be heard. After the first sponsor QSO, the other sponsors are required to be collected during a period of six months, after which the candidate is promoted to a list of potential members (the starred list), for another three months. If no FOC member objects, you receive the invitation letter and the FOC number. FOC members are expected to be active on the ham bands as well as to attend social events, held mostly in England, Germany and the United States. A new member may not be a sponsor before one year after he entered the Club. Of course, even after being admitted to the club, a member must adhere to an explicit code of behaviour and must be active on all fronts: from being active in radio to promoting wireless telegraphy in all its forms. A member must comply with the *FOC conduct,* a formally codified set of principles for achieving excellence.

Obtaining sponsorship is a complex task, the candidate must demonstrate not only to be skilled in transmitting and receiving CW, but also maintain a constant level of activity on at least two bands. The sponsorship does not, therefore, take place by means of a test QSO, as in the xHSC clubs, but only after a reasonable period of activity.

Amateur telegraphy from a linguistic perspective

Telegraphy was born as an encoding of natural language, to enable you to transmit messages on a transmission line (cable or radio), so that:

- the message is not ambiguous
- reception of the message is certifiable
- the message is as short as possible

Since the mid-nineteenth century the telegraph was employed to transmit messages on a dedicated wire connection, with almost absolute certainty that a message sent would be received. In the twentieth century, with the invention of radio, telegraphy has been used with great success in broadcasts over the air (wireless telegraphy). The language used in telegraphy was extended to incorporate control signals *(procedural signs* or *prosigns),* designed to provide operators with a control protocol that let them monitor if the message sent was actually received.

Telegraphy and wireless telegraphy, therefore, had a mere procedural connotation. Less than a language, being "just" a process of encoding, regulated by special procedures, to support sending and receiving signals.

At the end of the last century radiotelegraphy was gradually abandoned and, since 1998, all earth-bound maritime radio systems have been replaced by satellites which would provide better reliablitiy and security of the link. Telegraphy, however, is still in great vogue in the amateur radio community, because it offers a means of communication which achieves contacts over longer distances with less power than voice modes. Moreover, it requires much simpler and less expensive transmitting devices. The majority of amateur radio operators know CW: to get the license, until 2006, learning it was mandatory and a good 30-40% of ham radio operators still use it today.

From a linguistic perspective, this fact is important: as long as telegraphy was used for professional purposes it remained rigidly codified within defined structures, with no possibility of change. The telegraph operator had a professional obligation to strictly observe both the cadence of transmission (rhythm), and the procedures. The amateur, fortunately, is not forced to comply with strict rules and is virtually free to accommodate the use of this language at will.

Although CW was discontinued for all professional applications, the latest developments show, fortunately, very comforting news about "health status" of this language.

Not only is CW a language still used around the world, but it is showing a level of unexpected vitality: millions of radio amateurs use it, regardless of their geographical location. This chapter is written in collaboration with Prof. Augusto Ancillotti, Professor of Linguistics at the University of Perugia, Italy and discusses in detail the linguistic aspects of CW, as it is used today. Here are, analyzed for the first time, the linguistic aspects of amateur radiotelegraphy.

The lexicon

The lexicon (or vocabulary) of amateur telegraphy is composed of three kinds of terms

- "Q" code: coded 3-letter words that begin with Q, borrowed from the naval telegraph language
- abbreviations (mostly of English words)
- procedural signals

The list below shows just an example of Q codes:

QTH: station location

QSB: fading

QRM: interference from other stations

QRN: atmospheric noise

QSL: contact confirmation

QRS: you can send slower?

Q codes were originally inspired by the code used in the Navy, but the meaning has changed over time and has been adapted to the specific needs of amateur radio operations.

Examples of abbreviations are:

GM, GA, GE: Good morning / afternoon / evening
73: Greetings
OM: old man, amateur radio operator
HW: How do you copy me?
INFO: Information
RPRT: signal report

Abbreviations come primarily from English, but also from the first code that was historically used in telegraphy *(American Morse)* and involved the use of numbers instead of letters. So '73 'means ‘greetings’, '88' ‘kisses, and so on.

Finally, the procedural signals

AR: end of message
SK: end of transmission
KN: Call to transmit only to the called station
BT: separator
BK: break, used to reply to a message without repeating callsigns.

These signs are sent as if they were a single letter, and the resulting sounds are very characteristic.

The syntax

Radio amateurs have developed a procedural system that manages radio contacts based on a very simple syntax: nominal part (usually impersonal) / verbal part/ nominal part (direct object). This syntax is applied to build simple phrases, enriched by a series of conventional patterns, designed to control the radio contact in a typical call / response / confirmation scheme.

The following example shows a hypothetical contact between two radio stations I0AAA and UA0AAA, following this simple pattern.

The radio station UA0AAA makes a general call in this way

CQ CQ DE UA0AAA UA0AAA **AR** K

(translation: *UA0AAA calls and listens, is there anyone?)*

The radio station I0AAA answers

UA0AAA DE I0AAA **AR** K

(*UA0AAA from I0AAA, listening)*

Once the two correspondents have heard each other, the first station sends his message:

I0AAA DE UA0AAA GM OM TNX FER CALL **BT** UR RST IS 599 QSB **BT** MY QTH IS MOSCOW ES MY NAME IS SERGEJ **BT** HW ? I0AAA DE UA0AAA K

(*I0AAA from UA0AAA good morning and thanks for the call. Your report is 599 with signal fading. My station is located in Moscow and my name is Sergej. How do you copy me? I0AAA from UA0AAA back to you.*)

The other station received the signal report, confirms the reception and provides the same information:

UA0AAA DE I0AAA **BT** GM DR OM SERGEJ TNX FER RPRT **BT** UR RST IS 599 **BT** QTH ROMA OP MARIO **BT** MY RIG IS FT 817 PWR 5W ES ANT IS VERTICAL **BT** HR WX IS SUNNY TEMP 10C **BT** UA0AAA DE I0AAA K

(*UA0AAA from I0AAA hello dear Sergej and thanks for the signal report. Your report is 599. My station is located in Rome and my name is Mario. My transceiver is an FT817 with 5W power and my antenna is a vertical. The weather here is sunny with a temperature of 10 degrees centigrade. UA0AAA from I0AAA back to you.)*

the next response will follow the same confirmation / information giveback schema:

BK DE UA0AAA R TNX FER INFO VY FB UR PWR ES 5W QRP **BT** MY RIG IS IC706 PWR 50W ES ANT IS DIPOLE **BT** HR WX IS CLOUDY TEMP 12C I0AAA DE UA0AAA K

(*from UA0AAA received thanks for the info, very well, your power is low and 5W. My transceiver is an IC706 with 50W power and my antenna is a dipole. The weather here is cloudy and the temperature is 12 degrees centigrade. I0AAA from UA0AAA back to you.)*

The contact among these two stations is finally closed using, again, a typical pattern:

UA0AAA DE I0AAA DR SERGEJ TNX FER INFO ES FER QSO MY QSL VIA BURO **BT** 73 ES HPE CUAGN UA0AAA DE I0AAA **SK** TU (trad: *UA0AAA from I0AAA. Dear Sergei, thanks for the information and for the contact, my confirmation postcard will be sent by mail. Greetings and hope to see you again.UA0AAA from I0AAA End of transmission. Thank you)*

A linguistic analysis of amateur telegraphy

This language has, from a linguistic perspective, very interesting properties:

- it is a kind of jargon, used by a homogeneous group of people (ham radio, in this case)
- has an evolving lexicon
- expresses, albeit in to a limited extent, emotions
- is an expression of cultural characteristics of the people using it
- it was spontaneously produced by a community of individuals spread evenly throughout the world and is a shared language
- its vocabulary is derived from various codes and languages (English, American Morse code and naval code)
- it has a syntactic structure, and no morphological structure
- it is procedural
- it is constantly changing, i.e., new terms are added to the lexicon, often having new meanings
- it shows signs of specialization with respect to sub-cultural domains.

Surely, amateur telegraphy is not able to express complex concepts; it is limited to convey information about a small number of subjects, while more varied contents can only be expressed by directly using a natural language encoded into Morse code. A complex sentence like *today I woke up with stomachache and I will not eat anything until this evening*, can only be expressed using a natural language. In that case, Morse code is used as a mere codification process.

Due to its lack of expressive potential, amateur radiotelegraphy, therefore, does not have the quality of language itself.

However, amateur telegraphy has two varieties: the first is tied to particular contexts of use and the latter is a means of communication within the small selected group of amateur radio operators who use a natural language outside of the group itself. Amateur radiotelegraphy, thus, is a code with which some of the communication needs are accomplished, while for others the use of a natural language is required.

Is amateur radiotelegraphy, as a language, reduced to a mere collection of slang expressions or jargon, then?

Jargon is a language based on conventional processing of words of a language or one or more dialects, with exotic or newly coined lexical items, used by those who belong to restricted groups in order to guarantee the identity of the group and not to be understood by people external to the group itself. From a linguistic perspective, typical jargons are the military jargon and student slang, which originally developed as a partial alternative language in barracks, schools and colleges. All these situations are such that communal life creates a special solidarity among members.

Such situations are typically characterized by lexemes whose use is limited to small groups of speakers, aimed at avoiding comprehension from members outside this group and establishing a high level of membership exclusivity.

Often it happens that some individuals keep using these slang terms even after they leave the group or lose their status as a member, thus disclosing these terms to the outside world. As a result, it becomes necessary to replace such terms with new words in the jargon. This makes every slang language evolving, albeit within a very limited range. The lexicon of a jargon, like the language of amateur telegraphy, consists of lexemes coming from various sources, in the case of amateur telegraphy, English, American Morse code and the naval Q code.

Thus, the jargon is the set of expressive tools that, among alternative terms and phrases, makes the dialogue of two members of the same social class or small group immediately recognizable. In fact, when two amateur radio operators meet, they can use phrases like *"Tonight I QSY with my XYL,"* to say, *"Tonight, my wife and I go out."*

Amateur radiotelegraphy, however, does not provide a mere collection of alternative words or phrases, but also a structure of an alternative language, which is valid for people from different cultural and international backgrounds.

These jargons are not as expressive; this is a typical characteristic of the so-called *pidgin* languages.

A pidgin is the result of a simplification of one or more languages to get a primary communication tool between speakers of different languages. This is always a hybrid that is not recognized as being a mother tongue by any user, but can serve as a communication tool among groups from different nations.

Typical features of the pidgins are:

- Function of a "communication vehicle " to serve as a common linguistic tool among different communities.

- They result from regular contacts among different cultures, which need to communicate in absence of a common language.

- Simplified structure of Subject / Verb / Object with no complex or structured complements.

- Total reduction of syllabic tails, almost all terms are made solely by a base form or even monosyllabic.

-Past, plural and superlatives forms are very simplified.

Like jargons and pidgins, amateur telegraphy has local variations and / or individual uses. Like the pidgins, amateur telegraphy has a strong international connotation.

Amateur radiotelegraphy as a jargon, in fact, does not show the following characteristics

- It is not and is not intended as a sign of social identity, i.e., to highlight the fact of belonging to the group of amateur radio operators.
- It is not aimed to exclude other social groups from the communication.
- Is not made for exclusive use by a definite group.

Another interesting aspect of amateur telegraphy is that it is beginning to show signs of *linguistic specialization*. The various amateur communities, depending on the cultural context that characterizes them, have developed typical expressions. Such expressions come from a homogeneous cultural context using specific terms as signs or “markers”.

Thus, for example, among amateur radio operators are also ex-professionals who are distinguished by several features of their expressive style. For example, in Italy, all marine radio officers never use the character 'comma'. The comma was in fact used in the navy for insulting the correspondent and to report serious defects in his manipulation of the telegraph key. Again, a radio officer often uses the term *QSP* almost unused by amateur radio operators, with a meaning similar to the one originally used in the Navy, but adapted to the context of amateur radio.

In the Navy, ships were receiving long lists of messages from coastal stations, while waiting for their turn to receive, and had to be swift and effective in recording such messages because the coastal station had no time for repetition. Sometimes, though, reception conditions were so poor (for various reasons, frequency overcrowding, severe weather conditions, etc.) that an operator might lose part of the messages. This event was, unfortunately, far from rare and often other ships acted as a 'repeater' for the lost message. The radio operators officers were in fact very loyal to each other; if a ship had been unable to communicate with the coastal station, then the message (in Q code it is called QTC) was repeated by another vessel which had a better radio connection.

This mode of transmission was called, in Q code, *QSP*.

What is left of all this in amateur telegraphy?

A marine radio operator uses the term *QSP* in a meaning adapted to new needs: “Will you relay to...?”. For example, if a station wants IK0AAA to say to IK0BBB to change frequency, he would transmit: IK0AAA PSE QSP TO IK0BBB QSY.

This is a common feature in all forms of human communication and, therefore, also in jargons and pidgins.

Amateur telegraphy also shows signs of the so-called *areal variance,* i.e., it expresses the geographic area of origin by means of appropriate phrases and idioms. For example, several amateurs from the former Soviet countries, started using the term RIG, which means transceiver, to indicate the radiated power rather than the model of the transceiver itself. Thus, while the rest of the ham radio world say MY PWR IS 100W*,* some Russians say MY RIG IS 100W. Notice that this 'mistake' is used in a homogeneous cultural context (former Soviet countries) and serves as a real marker of this context. The most likely reason for this expression is the fact that in Russia building radio equipment is very popular, in such a case it would not make sense to talk about make and model of the transceiver, instead giving electrical and construction features.

There are several other examples relevant to the phenomenon of linguistic specialization in telegraphy and several others are produced continuously: amateur telegraphy language is therefore not stable but constantly changing. New terms or procedural elements are added from time to time and 'propagate' themselves in the air as ham radio operators decide to use them. When the use is widespread enough, the new terms or idioms become a permanent heritage to everyone.

A striking example is the need to communicate emotions. In naval telegraphy, obviously, a term devoted to communicate moods has not been defined, with telegraphy being a professional means specifically intended for technical communication. Among amateurs, instead, this need is present and alive.

Over the years, the use of the term HI has become frequent to indicate a laugh. It is not just a sequence of two characters “H” and “I”: it is a real new term with the function of specific sign. The "liberalization" of the amateur telegraphy language is even leading to produce 'phonetic' articulation phenomena.

In the Navy, messages were to be transmitted with perfect timing and spacing: all elements are encoded with specific rules. A dash is three dots long, the separation among dashes and dots is a dot long, and the words must be separated by a wider break of seven dots. All operators were required to comply with these rules, for the sake of clarity. Basically they were educated in schools to 'play' all the same.

In amateur radiotelegraphy, of course, there are no schools, so everyone learns the spacing and timing of transmission in a spontaneous way.

This freedom of manipulating a telegraph key produces very interesting phenomena: the laughter, HI, for example, is not transmitted accurately H (four dots), followed with the proper spacing by the I (two dots), it but is transmitted as four-dots, a light syncope, a dot, another syncope and a final dot. The resulting sound is incredibly similar to that of a real laugh. Once heard, it cannot be forgot.

This phenomenon is a real articulation of language, vehicle of a specific meaning: the telegraphic message is articulated in different ways to communicate different meanings for the same term.

The term HI means, in fact, also *high,* hence the need to send the two terms differently.

Another example of an articulation words is the way the procedural signal “end of the transmission” (**SK**) is often stretched beyond measure, and then followed by two quick dots. The sound is very distinctive and identifies a very experienced amateur radio operator, often a former Marine radio operator.

CW: the Esperanto of the Third Millennium ?

Amateur radiotelegraphy has, therefore, a quality of language equal or very close to that of a pidgin, in fact:

- it is a veritable "interlanguage" that allows the world to communicate through a common language.

– It stems from one language and is codified and developed independently by regular contacts between different cultures. Spontaneous expressions as "HELLO" or "A BIEN TOT" are typically used even among people who originally did not use these phrases.

– It has a simplified Subject / Verb / Object structure, with no additional complex or structured clauses (eg. MY QTH IS ROME, or HR WX ES CLOUDY).

- Features a total reduction of syllabic tails; almost all terms are made solely by a base form or monosyllabs. Terms are in fact codes, abbreviations or prosigns QTH, HPE, CUAGN.

– Past forms, plural and superlatives are very simplified, borrowed from English (tail ending S for the plural, usage of MORE / MOST, use of only the auxiliary BE / HAVE - WAS / HAD).

Amateur radiotelegraphy is a pidgin, then. Pidgin languages (if they survive enough time) can evolve into a language called *creole,* provided that this process requires specific conditions.

The process of evolution from pidgin to creole is very complex and requires first the need for interchange between people of different languages. A pidgin is therefore used as a bilateral talk language, some sort of third language, among speakers of different languages. Its usage is limited to the specific need of exchange between non-native speakers, learned by everyone as if it were a language itself consolidated by a *de facto* standard. The most widely used pidgin today is the neomelanesian, whose morphosyntactic structure is essentially invariant in the juxtaposition of words (mostly English-based) and the lexicalization of grammatical

functions primary as the plural, future, past, etc, for example *plentimàn* “men in quantity” is the plural of ”man”.

Amateur radiotelegraphy is characterized by the need of communication among radio amateurs of different languages. However, this condition is not sufficient: surveys performed by sociolinguists have shown that a pidgin can be formed within a couple of generations. The same time span is required for a creole language.

A creole is a mixed language that stems from a set of initial languages, then permanently adopted inside a community, eventually becoming the mother tongue of the community, in which it identifies its ethnicity. Of course for this to happen each individual in the cultural community is required to lose the usage of his mother tongue for his daily purposes. This happens for many different reasons. For example, the circumstances that favored the formation of Caribbean Creole languages are due to the violent transplantation of slaves with varying languages, intentionally reshuffled and redistributed to the plantations of the islands and to the coasts of the Caribbean. These areas were previously emptied of indigenous population by massacres and diseases. In each plantation the only language in use was the language of the white settlers. The slaves, even to communicate with each other, were forced to use the same foreigner talk that the owners were using with them, hastily learned and reproduced according to their vocal habits. Within two or three generations this pidgin became the only language of the local community and was taught, learnt and used as a mother tongue, while at the same time enriched the expressive possibilities and "got complicated" to reach the complexity of a standard language. Thus, we have today French-based creole languages (Guyana, Trinidad, West Indies, Haiti, Louisiana), English-based ones (Guyana, Jamaica, Honduras, Virginia) and Portuguese-based (Curaçao). Many other creole languages were then absorbed by European languages and eventually disappeared (Brazil, United States).

To allow amateur radiotelegraphy continuing in its growth process as a language, time must pass first, and, more importantly, people using it should lose the ability to use their own native language and be forced to use only the telegraphic language as a means of interchange.

It should be noticed that these conditions are already partially in place: a ham radio operator, in front of his equipment, is like transplanted to a "virtual" land where in fact he cannot use his mother tongue. Needless to say, at the end of a radio contact, each operator gets back home!

Telegraphy is not only a living language: as an elegant pastime of its connoisseurs, it is demonstrating that it can evolve into a language itself. Thus, while as an international language Esperanto has found adoption in a more or less stable community of around 120 countries worldwide - mainly between Europe and China - amateur telegraphy spread evenly around the planet and is constantly evolving.

Whether and how amateur telegraphy will evolve into a language itself, therefore, only time will tell. We are just amateurs but we play a decisive role:

whenever we use CW we do not just keep it alive but we also keep helping its process of growth and evolution and we become active participants in a very interesting linguistic phenomenon that sheds a very comforting light on the state of health of this magnificent language.

Keying techniques compared

Recent outstanding results in the HST (High Speeds Telegraphy) championships threw in a strong debate among the CW community on the effective utility of iambic keyers with twin lever paddles versus non iambic ones on single lever keys. This chapter analyses in detail the different keying techniques of a straight key, a bug, a single lever key on non iambic keyer and a twin lever key on a iambic keyer.

Keying techniques are compared counting the average key presses, weighted taking in account letter frequency distribution in five languages: English, French, German, Spanish. The resulting analysis shows the following interesting facts:

- Letters that can be emitted using the squeezing technique, here referred as “iambic letters”, are frequent from a range of 16,43% for the German language to 18.96% for the Spanish language.
- The manipulation of a bug, non iambic single-lever, iambic twin lever paddle can be regarded as a “compression” of the manipulation of a straight key. Different compression ratios are evaluated for the five languages, with a peak of 40,6% for iambic, twin-lever keying in English language.
- Iambic keying is the most efficient keying technique, resulting in an overall compression rate ranging from 11,3% for German to 13,1% for the Italian language (compared against non iambic keying).

On the other hand, in the HST championship all the top-rated operators achieve the highest scores using specially designed, long and single lever keys. This fact will be also discussed in this chapter.

Morse code and letter distribution

In different languages, not all the letters are distributed evenly: if we evaluate the letter distribution, each language has its own unique "footprint", as shown in the following table:

Letter	English	French	German	Spanish	Italian
A	8,17%	7,64%	6,51%	12,52%	11,74%
B	1,49%	0,90%	1,89%	1,42%	0,92%
C*	2,78%	3,26%	3,06%	4,67%	4,50%
D	4,25%	3,67%	5,08%	5,85%	3,73%
E	12,70%	14,72%	17,40%	13,67%	11,79%
F*	2,23%	1,07%	1,66%	0,68%	0,95%
G	2,02%	0,87%	3,01%	1,00%	1,64%
H	6,09%	0,74%	4,76%	0,69%	1,54%
I	6,97%	7,53%	7,55%	6,24%	11,28%
J	0,15%	0,55%	0,27%	0,43%	0,00%
K*	0,77%	0,05%	1,21%	0,00%	0,00%
L*	4,03%	5,46%	3,44%	4,96%	6,51%
M	2,41%	2,97%	2,53%	3,14%	2,51%
N	6,75%	7,10%	9,78%	6,70%	6,88%
O	7,51%	5,38%	2,51%	8,67%	9,83%
P	1,93%	3,02%	0,79%	2,50%	3,05%
Q*	0,10%	1,36%	0,02%	0,87%	0,51%
R*	5,99%	6,55%	7,00%	6,86%	6,37%
S	6,33%	7,95%	7,27%	7,97%	4,98%
T	9,06%	7,24%	6,15%	4,62%	5,62%
U	2,76%	6,31%	4,35%	3,92%	3,01%
V	0,98%	1,63%	0,67%	0,89%	2,10%
W	2,36%	0,11%	1,89%	0,01%	0,00%
X	0,15%	0,39%	0,03%	0,21%	0,00%
Y*	1,97%	0,31%	0,04%	0,89%	0,00%
Z	0,07%	0,14%	1,13%	0,51%	0,49%
Other (accented)	0,00%	3,12%	0,00%	0,11%	0,05%

Morse code was originally designed to assign shorter codings to the most frequent letters. Reading from the table above, we find that, in English, the letters E and T are the most frequent: 12,7% and 9,06% respectively. To these letters are assigned, than, the coding of one dot (E) and one dash (T), the procedure of building the whole code set goes on in a similar fashion.

Latin languages have also accented letters, seldom used in CW, except for the French language where they appear in more than 3% of the whole text. For the purpose of this analysis, the "other" category has been uniformly distributed among the other 26 alphabet letters. This choice yields an approximation that is shallower in the case of French language and almost negligible for the other languages.

In the table above some letters are marked in red with an asterisk (*): these characters can be "squeezed" (we will call them "iambic letters"), using a twin lever paddle attached to a iambic keyer. The following table compares the frequency of iambic and non iambic letters:

	English	French	German	Spanish	Italian
Iambic lett.	17,86%	18,89%	16,43%	18,96%	18,85%
Non-iambic	82,14%	81,11%	83,57%	81,04%	81,15%

We recall that by "squeezing" is intended the act of pressing both the dot and dash palettes of a twin lever key. In this computations, letters that can be squeezed but squeezing is substantially equivalent to the conventional keying technique (as an "A" or a "N") are counted as "non-iambic". The first important result of this analysis is that squeezing, albeit related to less frequent letters, is applied in manipulating no less than 16% of the letters of a text. In latin languages, iambic letters are present in little less than a ratio of one to five and, thus, squeezing can be regarded as far from being negligible.

Keys and keying techniques

The following table compares the number of key presses needed to manipulate each letter using different type of keys: the straight key, requiring as many key presses as the elements of a letter, the bug that emits dots automatically and dashes manually, the non iambic single lever key and the iambic twin lever key:

	Straight	Bug	Non-iambic	Iambic
A	2	2	2	2
B	4	2	2	2
C*	4	4	4	2
D	3	2	2	2
E	1	1	1	1
F*	4	3	3	2
G	3	3	2	2
H	4	1	1	1
I	2	1	1	1
J	4	4	2	2
K*	3	3	3	2
L*	4	3	3	2
M	2	2	1	1
N	2	2	2	2
O	3	3	1	1
P	4	4	3	3
Q*	4	4	3	2
R*	3	3	3	2
S	3	1	1	1
T	1	1	1	1
U	3	2	2	2
V	4	2	2	2
W	3	3	2	2
X	4	3	3	3
Y*	4	4	3	2
Z	4	3	2	2
TOTAL	***82***	***66***	***55***	***47***

Now look at the “straight key” column: as many elements are present in a letter, as many key presses are required to emit the letter using a conventional straight or “pump” key. For example, letter “A” is made of a dot and a dash, and requires 2

key presses of straight key, letter “G” 3, letter “J” 4 and so on. Please remind that longer codings in morse code are assigned to less probable letters.

A bug requires less key presses than a straight key because it transmits the series of dots automatically. So, to transmit a “B” we would use 2 key presses instead of 4 of a straight key. The bug or semiautomatic key is designed to decode back, mechanically, our series of key presses in a longer series of contact closures. This means that, with a bug, if we make the series of two key presses corresponding to the letter B, the bug will convert them to a series of contact closures, equivalent to 4 key presses of a straight key. In such a case, a bug will achieve a *compression ratio* of 50%.

In the table above, the columns related to the non-iambic single lever key and iambic twin lever key differs only for the iambic letters. It is important to recall that such iambic letters are far from rare in a text: they appear in a range of about 16%-19%, depending on the language. Now take a look at the whole table and please notice that each kind of key “compresses” (mechanically or electronically) the key presses of the operator and decodes them in the corresponding contact closing required to operate a straight key.

A quantitative comparison

To compare each other each keying technique in the various languages we need to find the average number of elements that we *expect* to manipulate, taking in account the frequency distribution of each language and the number of key presses required for each type of key. To find this number, we need a special statistic measure called “expected value”, a formula that weights each measure using the frequency of the element it is related to. The formula of the “expected value” reads as follows:

$$E(x) = \sum_{i=1}^{26} p(x_i) m(x_i)$$

Where $m(x_i)$ is the measure associated to the element x_i and $p(x_i)$ is the probability of finding the object x_i in our sample.

For example, if we want to know the average number of key presses we would expect to do with a straight key when transmitting in English language, we should compute the following sum of 26 elements:

$$E(x) = 8,17\%x2 + 1,49\%x4 + \ldots + 0,07\%x4 = 2,54$$
(lett. A) (lett. B) ... (lett. Z)

This means that, in plain English, we should expect to find 2,54 elements (dots and dashes) in a letter. Please notice that this kind of evaluation takes in account the frequency of each letter, iambic included.

The following table compares the expected values for different languages and different keys:

	Straight	Bug	Non-Iambic	Iambic
English	2,54	1,98	1,72	1,51
French	2,50	2,01	1,79	1,56
German	2,44	1,87	1,72	1,53
Spanish	2,54	2,08	1,81	1,58
Italian	2,53	2,07	1,79	1,55
AVERAGE	***2,51***	***2,00***	***1,77***	***1,55***

The table can be interpreted as follows: given a text in English language, the number of key presses expected to transmit each character of the text is 2,54 using a straight key, 1,98 using a bug, 1,72 using a non-iambic single lever paddle and 1,51 using a iambic twin lever paddle. Differences might appear negligible, but if we evaluate the percentage of gain (or reduction, or compression) from key to key, the resulting perspective is quite clear:

	Straight	Bug	Non-Iambic	Iambic
English	0,0%	22,2%	32,5%	40,6%
French	0,0%	19,8%	28,6%	37,5%
German	0,0%	23,4%	29,5%	37,5%
Spanish	0,0%	17,8%	28,5%	37,8%
Italian	0,0%	18,4%	29,4%	38,6%

A bug requires 22,2% key presses less than a straight key, a non-iambic single lever 32,5% and a iambic twin lever 40,6%. In particular, if we observe how much compression improves when using a iambic key vs a non-iambic key, we see that we obtain a much better compression, i.e. we have to work less to operate the key in a range from 11,3% to 13,1%, depending on the language:

English	12,0%
French	12,5%
German	11,3%
Spanish	13,0%
Italian	13,1%

The table above shows that, for the English language, if we operate a iambic two lever key we close contacts 12% less than we would on a single lever non-iambic, 12,5% for French and so on. The advantages of using a iambic twin lever key are, then, even stronger for latin languages.

Single vs twin lever keys: evaluating the myth

From a statistical point of view, then, there is no doubt that the most efficient manipulation technique is the iambic twin lever. Such efficiency is even more improved when using Iambic mode B with dot and dash memory, since this mode reduces further the time (and, thus, the effort) needed to keep paddles pressed.

Even if rare, iambic letters are, collectively, likely to be transmitted in a good portion of the QTC (around 18%) and, especially in QRQ, they must be treated properly by the operator, who must rely on good iambic keying skills to avoid errors.

Why, then, the world champions use single lever keys instead of twin lever paddle ?

Iambic keying has a significant drawback: the lack of mechanical feedback. In iambic mode the operator is not aware when the keyer will emit the next alternating dot or dash, while squeezing. At higher speeds (40WPM and above) this fact augments the probability of making a mistake. In HST competitions, maximum 3 uncorrected mistakes are allowed and each mistake must always be corrected to avoid penalties.

The form factor of a single lever key is also important. When manipulating a single lever key built according the specifications for HST, with a long lever and pivot point at the end, the operator feels in an unmistakable way the feedback of each contact closure. On the other hand, to move such a lever a greater effort is indeed required. All in all, during competitions the operator privileges feedback accuracy at

the price of some more fatigue: better making some more effort and be sure of avoiding mistakes. Even at lower speeds (30 WPM or less), HST keys are so precise that the operator feels some sort of “buffering”, i.e. he has the sensation to “key in advance”, by closing first the contact and then feeling the sidetone in return. It is thanks to the strong mechanical feedback that the operator does not even need to hear the sidetone itself, since he already felt the contact hit returning at his fingers.

All these advantages have their own price: the operator must move the key lever more times (we saw about 12% more). Accuracy in change of muscle effort, a quite fair trade for a competition and also for QRQ operation in general. At lower speeds this trade might be less favourable, depending on operating style and personal taste. However, 12% more effort is far from negligible and, for long rag-chew QSOs it might yield too much fatiguing with respect to a conventional twin-levered paddle.

About the author

Carlo Consoli, IK0YGJ, was born in 1969 in Rome, Italy. He started his adventure in the ham radio world back in 1989 as a CB operator. Today, he only operates in CW, with all four kinds of keys: straight, paddle, sideswiper, bug.

He is member of the following ham radio clubs:

AGCW, CTC, CWOPS, EHSC, FOC, HSC, INORC, iQRP, MARCONISTA, SHSC, SKCC. VHSC.

He started with CB radio in 1989, then took the general license (144Mhz and above) as IW0DKQ in September, 1990. In September, 1994 he passed the CW exams for the extra license as IK0YGJ and, since then, never abandoned CW. He had to part for some years with ham radio, due to the most important facts of life such as earning a degree in Computer Science, finding a home, getting married and having a child, suspending activities from 1998 to 2003. He got back on the air (CW only, of course) back in 2003 and joined HSC, the Italian Naval club INORC and Marconi Club in 2004. In 2006 he entered VHSC, while in the same year was ranked in the RUFZ world top-speed list (>70 WPM). He joined SHSC in 2008, EHSC in 2009, CWOPS and FOC in 2010. He was appointed member of the Board of Directors of INORC for 2010-2013.

While publishing several articles devoted to CW and its art in the Italian ham radio Magazine RadioRivista, by the end of 2008 he wrote the Italian edition of this book "*Lo Zen e l'Arte della Radiotelegrafia*". He is a great fan of the Italian CW key craftsmen like Piero Begali I2RTF, Salvatore Canzoneri IK1OJM, Alberto Frattini I1QOD and has an ever-increasing collection of Vibroplex keys. You may find additional information on his web site: http://ik0ygj.ham.org.

When he can get away from family and work tasks, he never misses a chance to stop by at his friend and mentor Claudio, IK0XCB, who owns a super-station with a 25m tower, is a professional sommelier, and runs a first-class restaurant where the most rare and precious bottles of wine can be tasted, to shamelessly take advantage of all these facilities. If you are wondering whether he feels guilty of taking over his friends station, turn all the radio knobs, beam his antennas wherever he likes, tasting a rare wine from the restaurant cantina while his friend is working hard to earn a living, the answer is … of course: no.

Acknowledgments and Dedications

I wish to thank Claudio Tata IK0XCB, having taught me practically everything I know about wireless telegraphy. This book has been entirely translated by me, from scratch; thanks to Antonio Giudici I0GOJ who, between a QRQ session and another, has pushed me to complete this work. Thanks also to Giordano Giordani IK0XFD for having supported me in long chats in CW, since 1994. To my INORC Naval Club friends for teaching me about the real telegraphy, made of sacrifices, skill and outstanding endurance. To Giuliano Sandal I1SAF and Sandro D'Onofrio I7ALE for the revision of the sections on INORC and FOC. To Maurizio Orienti IZ0GPP who, talking with gestures, in a situation that would have sapped the will of any human being on this earth, radically changed my approach to life and gave me the strength not to give up under any circumstance. Thanks to Prof. Augusto Ancillotti, professor of linguistics at University of Perugia, for the important contribution in the chapter on linguistic analysis of radiotelegraphy. A special thanks to Ulrich Steinberg, N2DE, for having had the incredible patience to revise the whole book and, trust me, revising a book originally written in Italian and translated to English by the same author (who is not a native English speaker) it is like writing it again from scratch! Thanks, Ulrich, without your outstanding effort, this book would have never crossed the Italian borders.

I dedicate this book to my wife Marika who, with infinite patience, has been close to me in these recent years also in times of extreme difficulty and danger, and to my eight year old son Marco, hopefully, to teach him that passion is the true and only creative force.

Bibliographic References

All bibliographic references are expressly referenced in the relevant chapters. This book is inspired by many sources, among them, the interested reader can see:

• Urbano Cavina, I4YTE *Marconisti d'Alto Mare*

• William Pierpont N0HFF, *The Art & Skill of Radiotelegraphy*

• Daniel Goleman, *Emotional Intelligence*

• Maxwell Maltz, *New Psycho-Cybernetics*

• Nyogen Senzaki and Paul Reps, *101 Zen Stories*

Copyright Notices

Revision History

Version no.	Revision Details
ZART_r20100118	First Edition
ZART_r20100209	Typo / misspellings corrections
ZART_r20100601	Update of Chapter "About the Author"
ZART_r20100812	Added chapters • "Revision History" • "Keying techniques compared"
ZART_r20101008	Added paragraph "DX Code of Conduct"