The FOC Guide to Morse Code Proficiency

by Gary Hinson, ZL2iFB Version 1.5 September 2020

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Introduction

Properly-formed Morse code is a delight to hear when strong, and copiable by ear even when signals are quite weak. Despite being monotonic and irregular, good Morse has a curiously musical quality, far from monotonous. However, on the air we typically face **QRM**, **QRN**, **QSB**, weak/marginal signals leading to errors and gaps in the copy, confusion, fatigue and frustration. Throw in badly-sent **CW** such as mis-sent characters, uncorrected errors, spelling mistakes, stray dits and missing dahs, variable timing with seemingly random spacing, plus off-frequency transmitters, drift, chirp, ringing filters and so on, and making contact may become, let's say, challenging.

Prompted by a lively discussion around W1RM Pete's sage comment ⇒ this guide offers advice on improving proficiency in Morse code for those already using **CW** (= **C**ontinuous **W**ave, not **C**an't **W**ork!) on the amateur bands. After explaining the key issues, you will find tips for both sending and receiving. *Both* aspects are important and can be improved - no matter how good, we can always do better. However, I don't intend to teach you the code from scratch: you'll have to look elsewhere for that. My main aim is to encourage everyone (including me!) to make the effort to improve.

> "One of the goals of every skilled **CW** operator is to send well. That means good character formation and character spacing. It makes little difference what you use to do the sending, be it straight key, bug, keyer, *etc.* The object of the exercise is to send **CW** that´s easy to copy." (W1RM, 2017).

I apologise in advance if this comes across as critical or dogmatic. These are merely opinions. I'm not getting at you, honest, simply trying to explain the things that catch my ear as an active Morse user for decades. If you prefer phone or the digital modes to **CW**, that's fine by me. If you are doing your bit to keep history alive with Wabun (Wikipedia, 2017a) or American Morse (Wikipedia, 2017b), mechanical keys and the like, fantastic, I'm genuinely impressed!

I am human. I don't have all the answers; my sending is imperfect and my receiving capabilities have a way to go yet. I'm still learning and enjoying the process of continuous improvement. Despite all that, I hope you find something of value here, and that my passion for Morse code on the amateur bands comes across in a way that inspires you too.

Speed

As on our roads, speeding is perhaps the most widespread issue with **CW**. For a start, fewer and fewer hams will be able to copy you as you speed up. Most **CW** operators are comfortable sending and receiving at between 15 and 25 WPM (Words Per Minute) or so. Good ones try to send at about the same speed at the guy at the far end, slowing down for slow callers or poor conditions and - if comfortable - speeding up to match the faster ones.

Figure 1 Roadrunner - beep beep!

> "Real skill begins when we no longer think of the code as code, but only of the content. A good operator is one who feels quite at home with code, fluent in it. He is able to copy accurately up from a low of about 15 up to about 25 wpm and can think and talk in telegraphic words, almost as if it were ordinary language at speeds sometimes up to 3Ø-35 wpm ("conversational **CW**" as one teacher happily called "rag chewing")." (N0HFF, 2001).

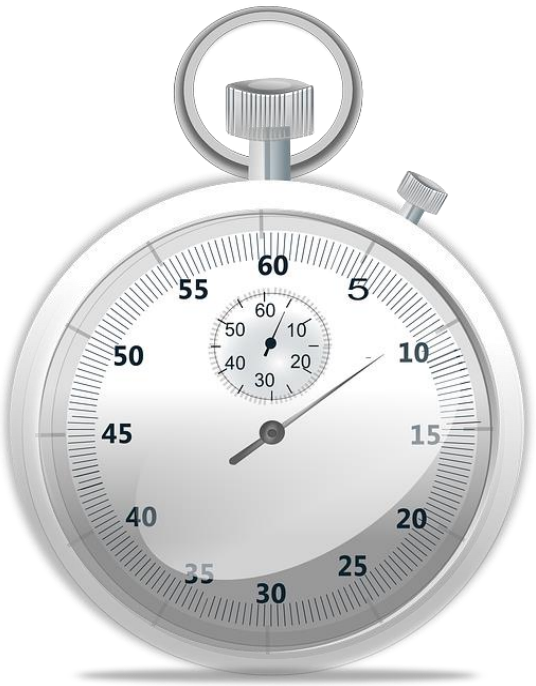
CW contesters generally send and receive at between 20 and 35 WPM, some sending the 5NN signal reports faster like a burst of machine gun fire to save a few valuable milliseconds per **QSO**.

By about 40 WPM, the proportion of **CW** operators who can copy you by ear is probably down to just a few percent. Even the code readers start to struggle. High speed telegraphists can send and receive way beyond that, but they are rare beasts who, like those code readers, need good (as in well-formed and reasonably strong) signals on clear channels to achieve their best rates.

> "Even if you never use high-speed **CW**, having the ability to copy fast is helpful when others are transmitting at lower speeds and especially when you're dealing with noise and sloppy fists." (K3WWP, 2017).

Slower speeds down to about 5 WPM are more common around the novice frequencies towards the upper ends of the normal **CW** sub-bands. Personally, I find it progressively harder to understand even properly-formed **CW** sent below about 15 WPM. Above that point, my brain seems to grasp the sound of each character as a whole. Below it, I hear the individual character elements - the dits and dahs - and have to reconstruct the entire character mentally before interpreting it. For that reason, I prefer Farnsworth spacing for slow **CW**, meaning that the characters are formed at a fixed speed (*e.g.* 18 WPM) but the spacing between characters is deliberately extended to give the desired overall rate (KE3Z, 1990). Farnsworth spacing is a useful technique for learning the code, the longer inter-character gaps giving the student's brain more time to look up and recognize the sound signature of each complete Morse letter.

By the way, there may be an innate biological basis for that, something to do with the brain's capacity to recognise audio patterns and to comprehend language. In the same way, we don't normally notice the individual notes that a pianist plays, so much as the tune, the melody - unless, that is, the pianist plays a bum note which sticks out like a sore thumb!



Ti ming is ever y thing

Speaking of pianists, if a musician played a well-known piece of music with all the correct notes in the correct sequence but wrongly timed, it would be hard for listeners to figure out what was being played. In effect, the tune would be lost. Timing is a critical factor with Morse too, one that deserves more emphasis when we are teaching or learning the code or simply aiming to improve.

Morse code comprises defined sequences of *three* elements: dots (normally spoken as "dits" to emphasize their shortness), dashes ("dahs" - longer sounds) and spaces of various lengths. *All three* are important. Properly-formed Morse characters have the correct element lengths and spacings, consistently, with little if any fluctuation. They sound musical, with a fixed pitch and a natural rhythm, cadence or flow.

"Accurate **CW** is generally understood to be the correct dots and dashes and this after all **is** the first priority; valid communication goes rapidly adrift when there are too few dots or too many dashes in a letter. But stopping to think about it for a moment, it goes far beyond that. Wrong dot/dash ratio can reduce intelligibility and even use of weird abbreviations can throw the recipient off balance. Most important, and to which least attention is paid, would appear to be spacing." (G3SXW, 1989).

The timing of well-formed Morse at any speed is defined relative to the dot-length:

- A dot is 1 time unit of signal ("mark").
- A dash signal is 3 dot-lengths long.
- Elements or bits *within* a character are separated by 1 dot-length of no signal ("space").
- Characters in a word are separated by *no less than* 3 dot-lengths (with Farnsworth spacing, the inter-character spaces are deliberately increased, but the individual characters are properly timed).
- Words are separated by *no less than* 7 dot lengths (longer pauses are commonly used to separate sentences with or without punctuation).

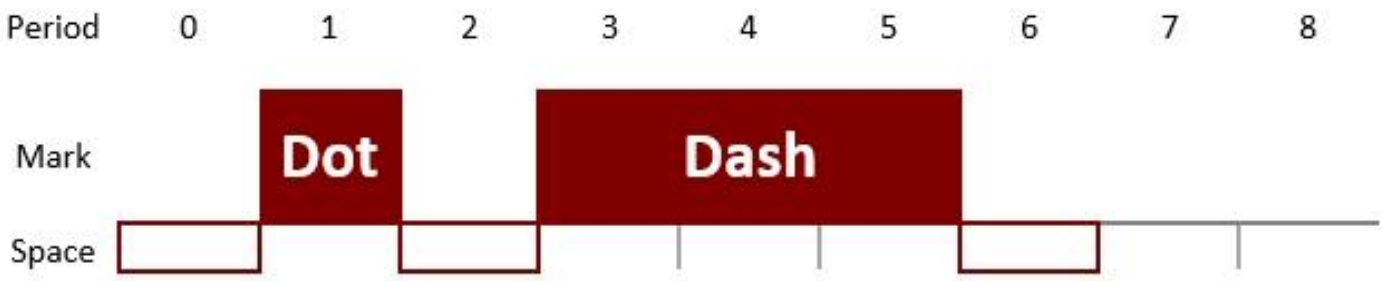
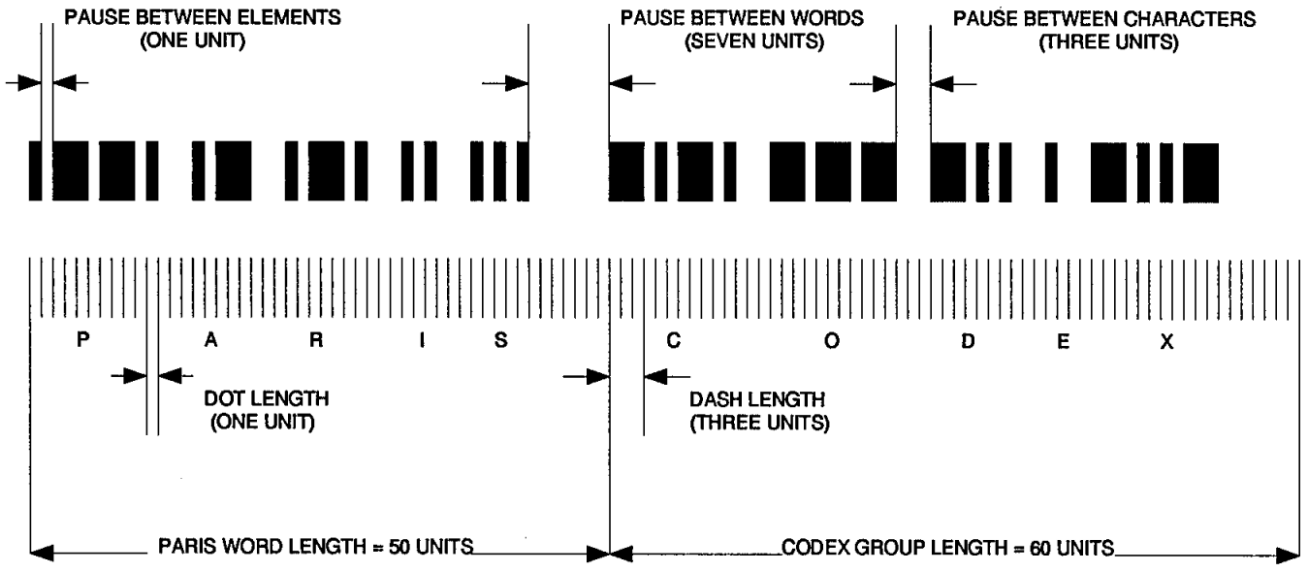


Figure 2 Timing diagram for the letter A in Morse code, based on dot-lengths

With the correct timing, a dot plus the following space lasts for 2 time periods in total, whereas a dash with its space takes 4: the 100% difference between these allows listeners to distinguish them quite easily. However, as the timing departs from ideal, the signal becomes increasingly ambiguous and harder to copy:

- If the transmitter is slow to start transmitting *e.g.* a slow mechanical transmit-receive changeover relay), the first mark is truncated and may even be completely lost, changing the meaning of the first character. A callsign such as EA4ABC may become A4ABC, for instance, or a **CQ** call may start with FQ or RQ. Since this happens in the transmitter or amplifier sequencing, the sender may be unaware of it unless he listens to his own signal, notices that people often miss the start of his overs, or some kind soul tells him about it.
- If the sender decreases the weighting, the mark periods are shortened while spaces are lengthened. Lightweight Morse sounds "choppy". It may be caused by the operator literally pressing too lightly on a straight key or bug, hence the name. Badly-designed or maladjusted QSK (full break-in) can also cause it, especially with high speed **CW** since the delays are normally fixed at a few milliseconds which becomes an appreciable fraction of fast dots and dashes.
- If the sender increases the weighting (*e.g.* literally pressing too heavily on the key or adjusting the keying parameters of his keyer or computer), the mark periods are lengthened while the spaces are shortened. Taken too far, heavyweight Morse sounds like a solid tone punctuated by short gaps: the mark dominates the signal. Conversely, overly lightweight Morse sounds "dotty".
- If the sender fails to leave enough space between elements, characters or words, they run together and becomehardertodistinguish.

"Code speed is given as a number of words per minute (WPM). Because characters take different amounts of time to send, and because words have different numbers of characters (although we use 5 letters as the average word size), code speed must be based on the sending of a standard 'word'. Two choices, PARIS and CODEX, are commonly used as this standard word. PARIS, which takes 50 units of time to send (including the space between words) is representative of standard English text; i.e., it takes about the same amount of time to send as the average word … CODEX, which takes 60 units of time to send (including the space between words) is representative of words consisting of random letters; i.e., CODEX takes the same amount of time to send as the average 5-letter 'word' of random characters." (Eason, 2020).



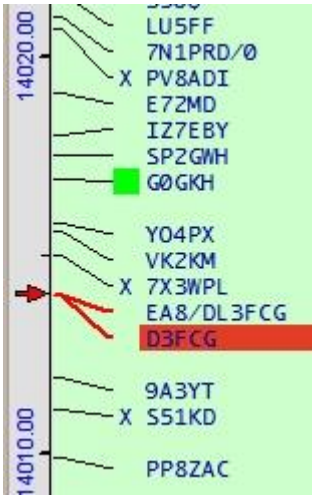
Since everything is defined relative to dot length, if the sender's timing is inconsistent, varying regularly or randomly during the course of an over, the recipient may struggle to discern the meaning. It's hard work trying to make out what they are saying, mentally compensating for spacesi inthewro ngplaces and dots that sound like dashes or *vice versa*. Highly skilled **CW** operators can copy or interpret bad code more easily but even the best may be tripped-up by truly awful sending. Ultimately, the **QSO** becomes a pointless exercise with little to no meaningful communication taking place and no fun, unless you enjoy a perverse challenge!

> "Morse has been referred to as being a 'language'. Well, my first language is Hungarian and I had to actually learn English. Morse is not my first language either; I had to learn it. I can tell you from experience that it is possible to learn a language the wrong way and the same is true with Morse. There **is** an acceptable deviation from the ratio of dits and dahs which still yields easy-to-copy Morse. I guess what we debate is the limit, beyond which it is difficult to copy." (VE3USP, 2017).

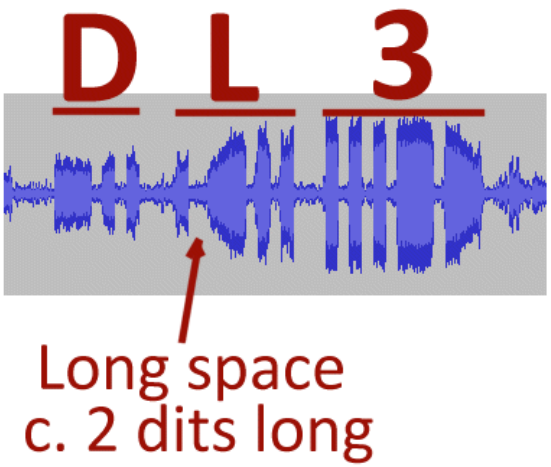
Here are some commonly-heard sender spacing errors:

- **CQCQCQCQCQCQ** with no letter spaces.
- **C QC QC QC QDE** with word spaces $^{off}_{set}$.
- CallCall instead of Call Call - this can be particularly troublesome if the combined string contains several possible callsigns: which is the correct one?
- **DROM** instead of **DR OM** meaning dear old man. This word puzzled me for months after I got my license until a friend explained, and we still laugh about it some 4 decades later!
- **AR** **K** instead of just **AR** or **AR K** - that delayed **K** tends to double with the start of the next over, perhaps interrupting the other person's sending if they are using **QSK** (full break-in).
- **AR** instead of **AR** and **BT** instead of **BT** - there's more on these double-underlined sequences below.

Thanks partly to the message content (*e.g.* guessing from the typical sequence of information in a rubber-stamp **QSO**, and common abbreviations) and context (*e.g.* contest **QSO**s with a predictable exchange), the human brain can compensate to some extent for timing variations, more so than the current crop of automated code readers such as Skimmer. All too often, I notice busted callsigns circulating on the Reverse Beacon Network due (usually) to sending errors such as malformed/badly-spaced calls. Busted spots that would be 'new ones' for me get highlighted on my bandmaps and ding the PC's bell, catching my eye … but a glance at spots on the same frequency or nearby hints at the error and quick listen usually confirms it.



Here's a genuine on-air example. A guy was struggling to send the L in his callsign as one fluid Morse character. He quite often sent an extended space between the first dit and the dah of the L character, only a slight hesitation but enough, it seems, for Skimmer to be confused by the malformed character, hence the busted spot shown in red on the band map ⇒



⇐ This shows the key section of his sending in the form of an audio plot (audio strength against time) using the Audacity software recorded from my radio in NZ. Ignoring the obvious **QSB**, it's quite easy to make out the spaces and marks of the individual bits of the characters DL3. His sending is fine *apart* from the space of approximately two dot-lengths within the L character - that's about twice the correct value.

Here's another example: this is supposed to be an X but the third inter-element space is 2 to 3 dot-lengths, making it closer to DT ►. I suspect the cause may simply have been a badly-adjusted paddle, with one or other of the contact gaps set so wide that there was a noticeable delay in the dit-dah sequence. On a single paddle or bug, those alternating sequences require precise side-to-side hand movements, so poor ergonomics or technique are possibilities too, perhaps arthritis. The giveaway is that both stations made the same little mistakes repeatedly, suggesting that either they weren't paying attention to their own sending or that they simply didn't realise the error – a bad habit: maybe they are more error-tolerant than me, but then I *am* picky!

"A paddle and keyer generates standard length dots and dashes. Dexterity is still an issue, but fatigue is almost totally eliminated. Upper speed limit increases significantly with a paddle and keyer, but only in concert with the sender's sense of timing. If your brain and your hand aren't in sync, and you are losing the sense of rhythm, then you need to slow down." (W7AQK, 2017).

"I remember when there was no machine (PC) generated **CW**, and even 'professional' **CW** ops had a rather wide variety of 'personality' when sending. I think in those days being a 'good **CW** op' implied the ability to be a good "copier' of others' **CW**, not just sending **CW** that met whatever rhythms and ratios one's own ears preferred." (KF7E, 2017).

In due course, if such errors are not noticed and corrected by attentive listeners, busted calls may be logged and spotted by amateurs on the main DXcluster network, perpetuating the mistake. Many a pileup has formed around such busted calls. Worse still, inept and inexperienced operators tend not to identify themselves often enough, especially once the pileup forms and chaos descends. We should all be copying callsigns ourselves rather than trusting the cluster or code readers, where necessary asking the stations we contact to repeat or confirm their calls. It's not really a legitimate contact otherwise.

Figure 3 CW should flow between QSO partners like a beautiful dance

The brain is capable of guessing missing letters in common words (especially in the middle, less so at the ends) and compensating for spelling errors, especially within the context of the sentence and message structure (Wolchover, 2012). A burst of QRM or dip in signal strength, for instance, might take out most or all of the word NAME, but it's not unreasonable for the recipient to assume that was sent in an initial over in a contact, during an inaudible period of about the right length followed by, say, JOHN JOHN. Judging by the

length of the gap or from any partial characters received, he might even guess whether it was OP or NAME or I AM that was missed.

The brain also uses forward error correction, in the sense that in the course of communications, we routinely anticipate what might be coming next - the end of a word, next word, end of a phrase or sentence, end of the over or whatever. This innate ability allows two experienced **CW** operators to conduct a conversation using QSK in a more natural fashion, interjecting and picking up on even quite short pauses at natural break points, without the need to send K or BK. The QSO flows back and forth between the parties like a choreographed dance, except without the choreographer. Or the ballet shoes.

Pitch

There's an interesting point to do with audio frequencies. We hear Morse transmissions on our radios as audio tones, either a beat frequency or a computer-generated audio signal. The normal frequency of a properly-tuned **CW** signal (the "pitch") is about 1 kHz by default on most radios, but may be configurable.

Figure 4 ON7UF is not the only op with a musical ear

Stations transmitting, say, 250 Hz lower on the band than a properly-tuned desired **CW** signal will produce an audio tone 250 Hz or 25% lower than the pitch of the desired signal and may well interfere with reception. However if the radio's pitch setting is reduced to, say, 500 Hz, the exact same 250 Hz difference becomes 50% of the pitch, making it easier for the listener to distinguish the different signals.

The ideal pitch comes down to personal preference. Having tried out various settings over many years, my normal choice is 500 Hz - at least it suits my ears today. It may change tomorrow! Some of my musical acquaintances prefer 440 Hz, the conventional A-note used for tuning instruments (apparently). Others use still lower frequencies, down to about 300 Hz or so - especially those poor souls digging out weak DX on narrow, overcrowded bands such as topband.

Notice that I'm not talking here about changing the radio's filters: the magic is purely down to the **CW** pitch setting. I'll leave other authors to explain filtering, Digital Signal Processing and so forth.

By the way, even if your radio has a fixed pitch setting, you can achieve a similar effect simply by tuning the VFO closer to the signals you want to hear. It's not quite as effective for two reasons: (1) move in too close and your filters may noticeably reduce the strength of the desired signal relative to any higher-frequency interfering signals; and (2) your transmit signal will remain at the centre frequency of the radio's pitch setting, unless you use RIT, XIT or split to offset it. [There's a tip about netting below.]

Q-codes, abbrev's, punctuation & prosigns

On-air **CW** contacts make extensive use of shorthand forms such as abbreviations that have evolved over the past century or more. Amateurs have been using our version of TXT for *decades* before cellphones and SMS were invented.

The most obvious reason is to save time, making more efficient use of the path. It's *much* quicker to send **RST**, for instance, than **R**EADABILITY **S**IGNAL STRENGTH AND **T**ONE. Such abbreviations literally saved money in the days when telegraphs were charged by the letter.

Abbreviations and codes have more subtle advantages, too. Some (such as **73**) are almost universally used on the air on all modes. In effect, they form a common language, the *lingua franca* for radio amateurs. English speaking amateurs know that **73** stands for "best wishes", "all the best", "cheers!" or something similar, while for non-English speakers, **73** might stand for "salut!" or "à bientôt!" or whatever the equivalent parting greeting might be in their mother tongue.

Other common ones are:

- **CQ** – I would like to make a contact, is anybody hearing me?
- **DE** – French for *from*
- **K** – Go ahead, someone, it's your turn <over>
- **BK** – **B**rea**K**, please jump in to answer my question or take up the baton, I need a break
- **PLS** or **PSE** – please – and **TNX** or **TU** – thanks or thank you. We amateurs are such a polite bunch!

"The so called 'Lake Erie Swing' was a typical semi-automatic 'bug' keying style of marine operators on the Great Lakes, characterized by short dots and dashes of exaggerated and varying length. This made for a somewhat melodic and musical sound, quite pleasant to copy once one got the hang of it. It was later adopted by many airline and police **CW** operators." (DJ5IL, 2017).

Q-codes are three-letter codes starting with Q. They are used by commercial radio operators such as pilots as well as radio amateurs hence there are lots of Q-codes. You will hear these most often on the amateur bands:

- **QSO** means contact, implying a meaningful exchange of information using the radio.
- **QTH** means location, such as the nearest town or city.
- **QSL** means confirmation of the contact details, either on a postcard or electronically on LoTW or email.
- **QRN** means natural/atmospheric noise, and **QRM** means man-made noise, both of which cause interference.
- **QSB** means the signal is fluctuating, either slowly (over several seconds or more) or rapidly (fluttering).
- **QRZ** and **QRZ?** both mean please send your callsign again, I missed it the first time.
- **QRS** means please send slower, while **QRQ** means please send quicker. If it's not obvious already, add question marks to turn these into questions: **QRS?** = Shall I slow down? and **QRQ?** = Shall I speed up?
- **QSY** means either I am going to move to a different frequency, or please would you move to a different frequency, depending on the context. **QSY?** means shall we both move to a different frequency?
- **QRT** means I am about to turn off my radio, so please don't bother calling me now: you've missed your chance. Better luck next time. **QRT?** Means has he gone? Have I missed my chance?
- **QRL** means **this frequency is busy**, please stop sending here. **QRL?** means is the frequency busy? Is there anyone here already, and is it OK if I start transmitting here**?**

QRL is often confused by amateurs who neglect to send the **vital question mark**, a simple oversight that flips the meaning of the Q-code from the intended question into a statement of fact requiring no response, leading them to conclude – wrongly sometimes – that the frequency is clear. It is just as annoying as someone who asks **QRL?** … but doesn't actually listen for any responses.

Prosigns (short for **pro**cedural **sign**als) denote the parts of a message. Some of the most common ones are:

- **AR** means the sender has reached the end of the message content. There may be further overs if there is more to say.
- **SK** means the entire contact is completed: there's nothing left to say (at this time). SK (no ligature) can mean straight key or silent key (as in dead), depending on the context.
- **AS** (or **RI**) means wait, hold your horses (rein-it-in!), QRX, shut up and listen for further instructions.
- **KN** means please go ahead the nominated person (only). Everyone else on the side, please wait your turn as I am trying to converse with one specific station, probably not you.

Thankfully very uncommon is **SOS**, the internationally-recognized distress signal.

> "**SOS** should be sent as a single code character with a sound unlike any other character, thus arresting the attention of anyone hearing it." (ARRL, 2017).

Notice that prosigns are double-red-underlined in this article: I'm using the bar to indicate that the letters are run together as a ligature, sent as one contiguous character *without* a character space in the middle, unlike simple character sequences and abbreviations. **SOS** is *not* the same as **SOS**.

Aside from demonstrating one's mastery of Morse, sending prosigns correctly without spurious spaces avoids the confusion potentially caused by the individual characters, especially given that there are several different ways to divide-up the prosigns into characters (*e.g.* **RI** and **AS** sent properly are identical, whereas **RI** and **AS** are quite different; likewise with **SK** and **VA**). What's worse, some of those sequences (such as **SK**) are *themselves* abbreviations or codes with other meanings, a recipe for chaos.

Figure 5 A 1935 McElroy Deep V key from WB6BEE Don's fine collection, still in daily use

Although strictly speaking they are not prosigns, **punctuation symbols** are sometimes represented as ligatures in the same way, for instance:

- **BT** is used as a break between sentences ... or as a pause for thought.
- **NR** (or **DN** or **TF** *etc.*) is the slash or stroke character, normally used to separate location modifiers from a callsign *e.g.* AB1C/M would be AB1C operating mobile and F/G1ABC would be G1ABC in France.
- **GW** (or **MIM** *etc.*) is the comma, separating clauses, or parts, of a sentence, like this.
- **RK** (or **AAA** *etc.*) is the full-stop, period or decimal point, most often heard when spelling out URLs. I have always struggled to send this one correctly, despite using a squeeze keyer that *should* make it easy. More practice required!

Again, there is huge potential for confusion if spurious space is incorporate within the symbol, typically turning punctuation symbols into discrete letters. *Don't do it!* Remember, the barred-letters are just a convenient way to express complex sounds simply in print, and perhaps to recall the sequences when learning the code. *They were never intended to be transmitted individually.*

Swings and fists

"Morse messages are generally transmitted by a hand-operated device such as a telegraph key, so there are variations introduced by the skill of the sender and receiver — more experienced operators can send and receive at faster speeds. In addition, individual operators differ slightly, for example, using slightly longer or shorter dashes or gaps, perhaps only for particular characters. This is called their 'fist', and experienced operators can recognize specific individuals by it alone. A good operator who sends clearly and is easy to copy is said to have a 'good fist'. A 'poor fist' is a characteristic of sloppy or hard to copy Morse code." (Wikipedia, 2017c).

Mechanical bugs such as the Vibroplex and McElroy use spring mechanisms to bounce the dot contact at a fairly steady rate, determined by the mechanical characteristics of the spring and counterweight. Without adjustment, the duration and spacing of the dots remains fixed, generally about 20+ WPM. However, the dashes are manually timed by the operator and can vary infinitely, hence it is possible to send dashes at, say, 15 WPM with dots at 20 WPM. "A unique cadence … It gives the bug a very sing-songy sort of swing to it which makes it a little hard for a beginner to copy" (N4PBQ, 2015). Taken too far, such inconsistency *can* mess up the normal rhythm of **CW**. Likewise, sending dashes at, say, 25 WPM with dots at 20 WPM makes it harder to distinguish the two - not impossible, just harder.

"Make sure the bug's dot contacts are very clean and when adjusting the dot spacing, connect an old fashioned analogue ohmmeter. The meter should read half scale when the arm is vibrating, if the dot spacing is adjusted correctly." (G4HZV 2020)

Some bug and straight key users refer to "swing" or "fist", implying that they are *deliberately* using a unique, recognisable style of sending to stand out from the crowd, and in a sense they are right. Unfortunately, though, *some* stand out for the wrong reasons when the resulting code becomes garbled and indecipherable. That said, bugs and straight keys make it possible to emphasize certain characters or words by adjusting the timing - for instance sending the **DE** between callsigns as *daaaah didit dit* rather than *dah didit dit* as normal. Also *dah di daaah* to end an over, and one extended dash for a zero. Such little personalizations work best when the remainder of the sending is correctly formed.

"That's another advantage of a bug. Most computers can't decode them, so you're more likely to be talking with a real person." (W2RS 2017)

Users of keyers including computer keying can achieve a similar effect by changing speed as they send - the machine-gun 5NN being a common example. Extending or reducing the spacing between elements, characters or words may also be possible within limits imposed by the keyer or computer code … but it's all too easy to mess up the timing. Again, done *subtly,* small timing changes can work nicely but overdoing them to the

"Keyers and paddles can be misadjusted, and not everyone will agree on which keying mode suits them best. So experimentation with different paddles and modes is also advisable. Someone whose paddle/keyer keying isn't quite what they want and expect might be encouraged to try different paddles and different modes with different keyers." (WA9AQN, 2017).

point they become obvious is crude, and counterproductive if they reduce copiability.

"You'll remember me!" may be literally true … but some things are best forgotten

Morse quality metric

Using a scalar metric and table like this, it's possible to measure various parameters of a Morse transmission:

Seemingly random transmissions with no discernible form or pattern	Several characters are malformed *e.g.* spurious dots, dashes and spaces	Occasional, minor sending errors, barely noticeable	All characters are perfectly formed, as per the ITU Morse standard
Numerous errors, all remain uncorrected	Several errors, few corrected	Few errors, *all* corrected	No errors made
The length of dots, dashes and spaces vary randomly	Timing varies noticeably but different elements are generally distinguishable	Timing is reasonably consistent: variations are hardly noticeable	Timing is absolutely perfect, entirely as per the ITU standard
Speed varies frequently and randomly	Speed varies markedly during transmissions	Speed varies a little, occasionally	Speed is fixed and consistent
No useful information exchanged	Some vaguely useful information exchanged	Useful information exchanged, and then some	Lots of useful and interesting information freely exchanged
Transmissions are totally undecipherable, even by a highly experienced and competent **CW** operator	Transmissions are quite hard to decipher: most operators and all programs struggle or fail to copy	Transmissions are quite easy to decipher by most operators and programs	Transmissions readily deciphered by all

The final row of the table acknowledges that highly experienced and competent **CW** operators are more capable than most at compensating for the sender's deficiencies, but clearly there are limits! The necessary concentration and focus on decoding what is being sent by an inept **CW** operator can be tiring, detracting from understanding and enjoying the conversation. Sometimes, it's simply not worth the effort.

Hinson tips

Sending better CW

- Unless you have acquired or are actively acquiring the requisite skills, use a paddle and electronic keyer or computer in preference to a bug or **S**traight **K**ey - the keyer or computer should form and space the character elements properly, reducing inconsistency, although even so you can still get things wrong (*e.g.* excessively light or heavy weighting, wro ngs pacing, and of course speling erors). If you are determined to use a bug or SK, that's fine but please pay extra attention to the following tips.

- Set things up correctly in the first place. There are lots of adjustments to check, things such as contact spacing and cleanliness, height of the key/paddle/bug above the desk, its angle and placement relative to the operator, weighting and speed on a keyer or computer program, and the counterweight on a bug. If sending Morse is awkward, tense and physically tiring, poor ergonomics are probably to blame and quite likely result in sending worse code than if you were comfortable and relaxed. Overdo it and you might get 'carpal tunnel syndrome' or 'repetitive strain injury', the original 'glass arm' of professional telegraphers.

"The arthritis in my fingers makes **CW** a tough go on days when it flares up. A few years ago I went back to a single lever paddle because my fingers were not releasing the opposite paddle quickly enough. That resulted in an annoying extra dit or dah because of the iambic action. The single lever paddle solved most of that problem since only one contact can be closed at a time." (W0VX, 2017).

- "Be careful cleaning those contacts! The very best burnishing tool for fine contacts is a new dollar bill. The first time you pull that bill through the contacts (pressure applied) you will leave a streak on the bill … and usually, that's it." (N2KW, Allen)
- Send at a comfortable speed, rather than racing along with a high error rate. Don't try to send too fast, too far beyond your comfort zone, for too long. Definitely avoid sending faster than you can receive. The mental effort required to concentrate and avoid errors is tiring, and your error rate tends to increase with tiredness, hence beyond a certain speed your sending is likely to fall apart. Aside from sounding terrible, it becomes increasingly unintelligible and, frankly, embarrassing. Either slow down to regain your composure or take a rest break. Ask yourself why you are in such a hurry to reach the end point. Relax, enjoy the journey! Most of us prefer well-formed **CW** to fast but inept **CW**.
- Don't send too fast for the guy at the far end. Take your cue from his sending speed, plus other massive clues such as anything other than a 5NN report and asking for repeats or simply ignoring/not responding to whatever you are saying. If the channel is clear and signals reasonably strong, there's a fair chance your sending is as much to blame as his hearing or ability to copy, so try slowing down and being *extra* careful with your spacing. If the channel is noisy and signals are weak, it usually helps to slow down anyway.

"Another FOC member said 'When I learnt the bug key I listened to myself on a tape recorder, why not try it and see what you think of your fist?' … Well I bought myself a cheap recorder from Argos. Put it this way: I have altered my fist somewhat and now sound a lot better!!!" (G4FAD, 2017).

- Concentrate on the *quality* of your sending more than the *speed*. If it helps, write out the standard parts of your messages so you have something to refer to as you send. Try hard to spot and correct your own errors: simply re-sending the word shows that you care. Monitor and ideally record your own sending, and listen to it later, dispassionately critiquing your style. Check for things such as inconsistent spacing, stray or extra dots (*e.g.* the number 5 sent as a string of *at least* 6 dots), and missing, truncated or extended dots, dashes and spaces. Ask friends who are competent at **CW** to comment on your sending and offer improvement suggestions. If you can, monitor your own sending on a code reader: they tend to be quite unforgiving so if you see errant gaps and incorrect characters, you probably need to up your game. Avoid over-doing the swing or fist. Less is more.
- Use the abbreviations, Q-codes, prosigns *etc*. correctly. In particular, do not send prosigns and punctuation symbols as separate letters - respect the ligature bar.

- When calling a **CW** DX station, don't be *too* accurate in netting precisely on his frequency. It helps to transmit *near* the frequency that the other chap is listening, within his receive bandwidth, but if you net on the same frequency as others calling at the same time, your signal may be lost in the commotion. This tip is handy when clicking cluster spots, or when a DX op says "UP 1": generally what that means is "UP *ABOUT* 1 KHZ … BUT PLEASE SPREAD OUT A LITTLE". Don't forget, by the way, to listen where you intend to transmit and/or check the display on your panadapter to avoid stomping rudely on top of other callers, ideally to find a clearer frequency where you are more likely to be heard.

Figure 6 Rubber-stamp QSOs can seem empty, largely devoid of meaning, pointless even

- Think about what you are saying. If the opportunity arises, conditions are favourable and the other guy seems to be copying OK, it's cool to stray off the beaten track. There's more to life than UR 5NN I AM FRED IN LONDON! Going beyond standard/canned messages or prepared text, conversational **CW** is an art form within an art form, one that can be immensely satisfying. Open up a little, perhaps saying something about your family, where you live, your other hobbies and interests, your profession or line of work, who you've bumped into lately, what awards you are chasing. Listen, think and respond to whatever you are told. Take an interest. Ask open-ended questions. Relax and slow down a bit maybe. Make personal connections and the friendships will flourish … There's plenty of latitude here to improve on the rubber-stampiness of many **QSO**s today, once you think about it. It's fun! Just don't try this in a contest or pileup. There's a time and a place.

- Practice, practice, practice. Operate on **CW** every single day if you can - even as little as a single **CW QSO** per day means you will progress, albeit slowly. In your head, translate car number plates, advertisements, newspaper headlines and TXT/email messages into Morse. Any bit of text will do. You can even play out both sides of imaginary **QSO**s, using your sidetone only or saying the dits and dahs out loud. When you are ready to transmit, find a clear frequency and call CQ at a speed you find comfortable: there's no need to race. Demonstrate and focus on prowess, not haste.

Copying CW better

Figure 7 Are you aurally skilled or aurally challenged?

- Tune around to find amateurs sending at a speed you can copy and listen carefully to their conversations. When you are learning, try to find people sending good quality, consistent, well-timed Morse with few errors. Check out slow speed Morse transmissions designed to help people learn the code. As your skills improve, you'll find it easier to copy - or at least get the gist of - imperfect Morse too, as well as coping with interference and other issues.

- Learn to configure your receiver properly to help deal with **QRM**, **QRN**, **QSB** *etc*. As a simple example, swapping to the other sideband or sliding a few tens of Hertz will often cut down on high-pitched **QRM**.

- Look after your hearing. Wear ear-protectors (plugs or muffs) in noisy environments. Avoid 'all knobs to 11' syndrome. Listening attentively down at the noise floor and digging out weak callers separates true DXers from the *hoi palloi*. Flutter, echo and rasp are massive clues about the path: are you clued-up on propagation?

- Copy in your head rather than on paper or keyboard (unless you are a budding contester). Concentrate on understanding what people mean - the information content they are expressing, the message, more than the specific characters they are sending. Aim for more natural conversations.
- Obsess about accurate copy, not speed. It is a good sign if you notice errors in someone's sending, including your own. Better still if you correct them on the fly, in your head when receiving and on air when transmitting. Speed will come naturally with practice.
- Listen to the sound of the words rather than the individual letters, just as you hear the characters rather than the individual dots and dashes. Through familiarity, short sequences such as **CQ**, **ES**, **5NN**, **HI**, **73**, **AR** and **SK** become recognisable sound units in their own right. Gradually other, longer and less common words also become recognisable units. As you become truly fluent, you will eventually be copying most words as complete words, only consciously spelling out in your head the lengthier and more obscure ones.
- Practice, practice, practice. Try to listen to **CW** every single day, for as long as you can manage with breaks whenever you get tired. On-air activity trumps off-air practice since you will have to cope with the realities of noisy and crowded amateur bands and propagation, plus other operators who do not necessarily send good Morse. Mind you, when the bands are dead, there are some realistic **CW** simulators and training apps out there - MorseRunner for instance.

Conclusion

I'll end with a special plea. *Please* be tolerant of other amateurs, even the ones whose Morsing is *special*. Some of us are struggling with physical and mental afflictions, old age, distractions and exhaustion - "gritty joints, shattered nerves and decaying intellect" as Mort G2JL put it. Some are 'characters' who relish our very uniqueness, or learners struggling to tame the technology. A few have evidently over-indulged or are over-excited or plain rude (though we may not realise it - sorry). Many of us take criticism badly although hopefully those who resent the merest hint that they may not be absolutely perfect never even started reading this guide!

Most of us are only humans, after all, learning as we go, doing our level best to make friends, share and enjoy this wonderful hobby. We all had to start somewhere. The *Wouff Hong* is seldom deserved (ARRL, 2017).

Have fun, and **long live Morse code**!

> "First class ops are those willing to try to learn something old or new, and those that help them" (K5KV, 2017).

Reader feedback

Your comments on this article are very welcome. It has already benefited greatly from inputs and feedback from passionate fans of Morse code. Further tips would be good: what do *you* recommend? What works best for you?

If you notice errors and omissions in this guide, including aspects that it doesn't even cover and areas where you think I am wrong or misguided, please email me (Gary@G4iFB.com) … or contact me on the bottom ends of whichever bands are open to New Zealand.

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