'give me your call'. It is remarkable that in most of the above erroneous uses of "QRZ" there is a link to the idea of "callsign". But please, do use 'QRZ' in the one and only meaning it has: 'who called me'

- During pileups (see § III.1) we will often hear the DX station saying 'QRZ', not because in the first place he previously missed a call but to tell the pileup he is listening again. This use of 'QRZ' is not quite correct.

Example:

CQ ZK1DX	ZK1DX calls CQ
ON4YYY you're 59	ON4YYY calls ZK1DX who replies with a report
QSL **QRZ** ZK1DX	ZK1DX confirms the report ('QSL') and adds 'QRZ', which in this case means *I am listening again for the stations calling me* rather than *who called me?* which is the real meaning of 'QRZ'. Although you could argue that he heard other stations before and hence can call 'QRZ', the use of 'QRZ' followed by 'ZK1DX' is certainly not the most efficient procedure.

What we hear even more and which is completely wrong:

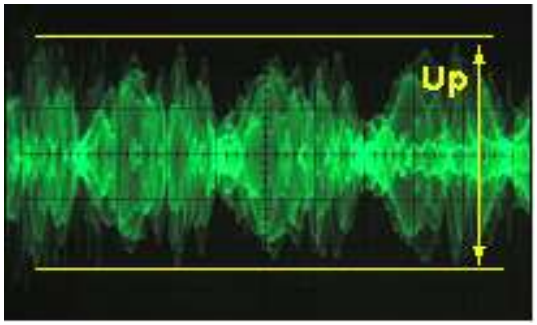
...	
QSL **QRZ**	in this case ZK1DX does not identify at all. The pileup wants to know who the DX station is.

The correct and most efficient procedure is as follows:

...	
QSL ZK1DX	ZK1DX confirms the report he received by saying 'QSL'. This is followed by his call, which is the sign for the pileup to call him.

II.8.8. Check your transmission quality

- Have you properly adjusted your transmitter?
- Is the microphone gain not set too high?
- Is the speech processing level not too high? The background noise level should be at least 25 dB down from your voice peak level. This means that when you don't speak the output level of the transmitter must be at least approximately 300 times lower than the peak power when you speak.

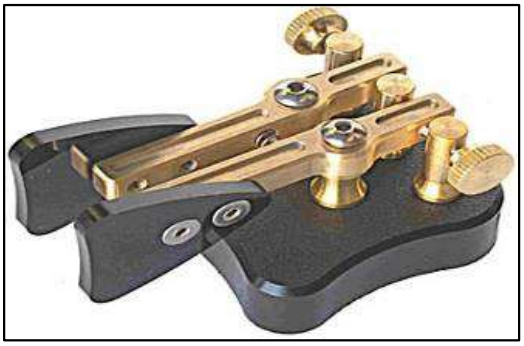


- Ask a local ham to check your transmission for *splatter*.
- Having an oscilloscope in line with the output signal so you can monitor for flat topping is the best continuous monitoring system.

II.9. THE ART OF TELEGRAPHY (CW, MORSE CODE)

- Morse code is a code for transmitting text. The code is made up by sequences of short and long audio tones. A short tone burst is called a **DIT**, the longer one a ***DAH***. The *DAHs* are 3 times as long as the *DITs*. These are frequently but

incorrectly called *DOTS* and *DASHES*, which make us think of something visual rather than sounds.



- Morse code is **not** a series of written *DOTS* and *DASHES*, although originally, in the 19th century, Morse code was scribed as *DOTS* and *DASHES* on a moving paper strip. Telegraph operators soon found out it was easier to copy the text by listening to the buzz of the scriber machine than trying to read it off the paper strips. So the letter '**R**' is **not** *SHORT LONG SHORT* nor *DOT DASH DOT*, nor **. - .** but ***DIT DAH DIT***.
- In some languages the letter '**R**' will be written as **DIT DAH DIT**, in others as **DI DAH DIT**. What we are trying to make clear is that there are only two sounds, the short sound (**DIT** or **DI**) and the long sound (**DAH**). Representing two sounds by three words may be confusing; therefore we use only **DIT** and **DAH** in this document.
- CW makes extensive use of *Q codes*, *abbreviations* and *prosigns*. These are all shortcuts to make communicating faster and more efficient.
- Hams normally use the word ***CW*** for telegraphy. The term *CW* stems from *Continuous Wave* although CW is far from being a *continuous wave*, but rather a wave which is constantly interrupted at the rhythm of the Morse code. Hams use the terms *Morse* and *CW* interchangeably – they mean the same thing.
- The -6dB bandwidth of a properly shaped CW signal is approximately 4 times the sending speed in WPM (Words Per Minute). Example: CW at 25 WPM takes 100 Hz (at -6dB). The spectrum required to transmit one SSB (voice) signal (2,7 kHz) can hold more than a dozen CW signals!
- The intrinsic narrow bandwidth of CW results in a much better Signal-to-Noise ratio under marginal conditions as compared to wide band signals such as SSB (a wider bandwidth contains more noise power than a narrower bandwidth). This is why DX contacts under marginal conditions (e.g. working stations in other continents on 160m and working EME) are most frequently done in CW.
- What's the minimum receiving speed you need to master to be able to regularly make QSOs in Morse code?
  - 5 WPM can get you a starter's certificate, but you will not be able to make many contacts except on the special *QRS* (*QRS* means: reduce your sending speed) frequencies. These *QRS* frequencies can be found in the IARU Band Plan.
  - 12 WPM is a minimum, but most experienced CW operators make their QSOs at 20 to 30 WPM and even higher speeds.
- There is no secret recipe to master the **Art** of CW: training, training, training, just as in any sport.
- CW is a unique language, a language which is mastered in all countries of the world!

II.9.1. The computer as your assistant?

- You will **not** learn CW by using a computer program that helps you to decode

CW.

- It is acceptable though to send CW from a computer (pre-programmed short messages). This is commonly done in contests by the logging program.
- As a newcomer you may want to use a CW decoding program to **assist** you in order to be able to verify that a text was correctly decoded. However, if you really want to learn the code, you will need to decode the same CW text yourself using your ears and brain.
- CW decoding programs perform very poorly under anything but perfect conditions; our ears and brains are far superior. This is mainly because Morse code was not developed to be automatically sent nor received, as is the case with many modern digital codes (RTTY, PSK etc.).
- A large majority of **CW operators** use an electronic keyer (with a paddle) instead of a hand key to generate Morse code. It is much easier to send *good* Morse code using an electronic keyer than with a hand key.

II.9.2. Calling CQ

- What should you do first of all?
  - Decide which band you will use. On which band is there good propagation for the path you want to cover? The monthly MUF charts, published in magazines and on many ham websites can be very helpful in this respect.
  - Check which band portions are reserved for CW work. On most bands this is at the bottom end of the bands. Consult the **IARU Band Plan** on the IARU website.
  - Listen for a while on the frequency you would like to use to find out whether it is clear or not.
  - And then?
  - If the frequency seems clear, ask if the frequency is in use. Send 'QRL?' at least twice, with a few seconds in between. Sending '?' only is not the proper procedure. The question mark just says 'I asked a question'; the problem is that you did not ask anything.
  - 'QRL?' (with the question mark) means 'is this frequency in use?'.
  - Do not send 'QRL? K' as we sometimes hear. It means 'is the frequency in use? Over to you'. To whom? Just 'QRL?' is correct.
  - If the frequency is in use, someone will answer 'R' (roger), 'Y' (yes), or 'R QSY', or 'QRL', 'C' (I confirm) etc.
  - 'QRL' (without question mark) means: the frequency **is** in use.
    In such a case you will have to look for another frequency to use.
- And if a clear frequency was found?
- Call CQ. How?
- Send CQ at the speed at which you would like to be answered. Never send faster than you can copy.
- 'CQ CQ G3ZZZ G3ZZZ G3ZZZ AR'.
- 'AR' means 'end of message' or 'I am through with this transmission', while 'K' means 'over to you' etc. This means you should always terminate your CQ with 'AR' and never with 'K', because there is nobody there yet whom you can turn it over to.
- Do **not** end your CQ with 'AR K': it means 'end of message, over to you'. There is nobody to turn it over to yet. End your CQ with 'AR'. It is true that we often

hear 'AR K' on the band, but it is not a proper procedure!

- The use of 'PSE' at the end of a CQ (e.g. 'CQ CQ de… PSE K') may seem to be very polite, but is not necessary. It has no added value. In addition, the use of the 'K' is incorrect. Simply use 'AR' at the end of your CQ.
- Send your call 2 to 4 times, certainly not more!
- Don't send an endless series of CQs, with your call just once at the end. Thinking that a long CQ will increase the chances of getting a response is wrong. It actually has the opposite effect. A station that may be interested in calling you first wants to know your call, and certainly is not interested in listening to an almost endless series of CQ CQ CQ …
- It's much better to send a number of short CQs ('CQ CQ de F9ZZZ F9ZZZ AR') than one long spun CQ ('CQ CQ CQ ... -15 times- de F9ZZZ CQ CQ CQ ... -15 more times- de F9ZZZ AR').
- If you call CQ and want to work *split* (listening on another frequency than you transmit on), specify your listening frequency **at each CQ**. Example: end your CQ with 'UP 5/10...' or 'UP 5...' or 'QSX 1822...' (which means that you will listen on 1.822 kHz). 'QSX' means 'I listen on ...'.

II.9.3. Prosigns

- **Prosigns** (short for *procedural signs*) are symbols formed by combining two characters into one *without the inter-character space*.
- 'AR', used to end a transmission, is a *prosign*.
- Other commonly used prosigns are:
  - 'AS' (see § II.9.9)
  - 'CL' (see § II.9.6)
  - 'SK' (see § II.9.6)
  - 'HH' (see § II.9.20)
- 'BK' (see § II.9.7) and 'KN' (see § II.9.10) are **not** prosigns, as the two letters of these codes are sent with a space in between.

II.9.4. Calling 'CQ DX'

- Just send 'CQ DX' instead of 'CQ'. If you want to work DX from a specific region, call e.g. 'CQ **JA** CQ **JA** I1ZZZ I1ZZZ **JA** AR' (a call for stations from Japan), or 'CQ **NA** CQ **NA**...' (a call for stations from North America) etc. You can also make your CQ DX call more explicit by adding that you do not want to contact European stations: 'CQ DX CQ DX I1ZZZ I1ZZZ DX **NO EU** AR', but this sounds a little aggressive.
- You can also specify a continent: NA = North America, SA = South America, AF = Africa, AS = Asia, EU = Europe, OC = Oceania.
- Even if a station from your own continent calls you, always remain courteous. Maybe he is a newcomer. Give him a quick contact and log him. You may actually be a new country for him!

II.9.5. Calling a specific station (a directive call)

- Let us assume that you want to call DL0ZZZ, with whom you have a *sked* (*schedule*, *rendez-vous*). Here's how you do this: 'DL0ZZZ DL0ZZZ SKED DE G3ZZZ KN'. Note the 'KN' at the end, which means you do not want other stations to call you.

- If, despite your directive call someone else calls you, give him a quick report and send 'SRI HVE SKED WID DL0ZZZ 73…'.

II.9.6. Carry on and wrap up the CW QSO

- Assume W1ZZZ is answering your CQ: 'G3ZZZ DE W1ZZZ W1ZZZ **AR**', or 'G3ZZZ DE W1ZZZ W1ZZZ **K**' or even 'W1ZZZ W1ZZZ **K**' or 'W1ZZZ W1ZZZ **AR**'.
- While replying to a CQ, do not send the call of the station you are calling more than once, better still is not to send it at all (you can trust the operator knows his own call…).
- Should the calling station end its call with 'AR' or 'K'? **Both are equally acceptable**. 'AR' means 'end of message' while 'K' means 'over to you'. The latter sounds a little more optimistic, as maybe the station you call will return for another station…
- There is however a good reason to use 'AR' rather than 'K'. 'AR' is a prosign (see § II.9.3) which means that the letters A and R are sent without any space between them. If one sends 'K' instead of 'AR' and if the letter 'K' is sent somewhat close to the callsign, the letter 'K' may be considered as being the last letter of the call. It happens all the time. With 'AR' this is quite impossible as 'AR' is not a letter. Often no closing code (neither AR nor K) is used, which reduces the risk of making errors.
- Assume you want to reply to W1ZZZ who called you. You can do that as follows: 'W1ZZZ DE G3ZZZ GE (good evening) TKS (thanks) FER (for) UR (your) CALL UR RST 589 589 NAME BOB BOB QTH LEEDS LEEDS HW CPY (how copy) W1ZZZ DE G3ZZZ K'. This is the time to use 'K' at the end of your transmission. 'K' means *over to you*, and now the *you* is W1ZZZ.
- Do not end your *over* with 'AR K': it means 'end of message, over to you'. It is clear that when you turn it over you have finished your message, no need to say so. End your transmissions (*overs*) during a QSO with 'K' (or 'KN' when necessary, see § II.9.10). True, we hear 'AR K' frequently, but it is incorrect.
- The reason for the improper uses of either 'AR', 'K', 'KN', 'AR K', or 'AR KN', is that many operators do not really know what each of these prosigns exactly mean. Let's use them properly!
- We explained that it is not necessary to use the term 'PSE' (*please*) to end a CQ; do not use it either at the end of your *over*. So no 'PSE K' or 'PSE KN'. Let's keep it simple, and leave out the 'PSE', please…
- On the VHF bands (and higher) it is customary to exchange the QTH-locator. This is a code indicating the geographic location of your station (example: JM12ab).
- The **RST report**: R and S stand for Readability (1 to 5) and signal Strength (1 to 9) as used for phone signals (see § II.8.4). The T (1 to 9) in the signal report stands for Tone. It indicates the pureness of the sound of the CW signal, which should sound like a pure sine wave signal without any distortion.
- These original tone ratings attributed to the different T values stem from the early days of amateur radio where often a pure CW tone was an exception rather than the rule. The above table lists the more modern CW tone ratings as published in 1995 (source: W4NRL).

T 1	60 Hz (or 50 Hz) AC or less, very rough and broad
T 2	Very rough AC, very harsh
T 3	Rough AC note, rectified but not filtered
T 4	Rough note, some trace of filtering
T 5	Filtered rectified AC, but strongly ripple-modulated
T 6	Filtered tone, definite trace of ripple modulation
T 7	Near pure tone, trace of ripple modulation
T 8	Near perfect tone, slight trace of modulation
T 9	Perfect tone, no trace of ripple or modulation of any kind

- In practice we generally use just a few levels of T with a definition which meets the general status of technology today:
  - **T1**: heavily modulated CW, signs of wild oscillation or extremely rough AC (means: get off the air with such a poor signal!).
  - **T5**: very noticeable AC component (often due to poor regulation of a power supply of the transmitter or amplifier).
  - **T7 – T8**: slightly or barely noticeable AC component.
  - **T9**: perfect tone, undistorted sine waveform.
- /Nowadays the most common CW signal deficiencies are **chirp** and even more common **key clicks** (see § II.9.25).
- A long time ago chirp and key clicks were very common problems with CW signals: every CW operator knew that a 579**C** report meant signals exhibiting chirp, and 589**K** meant signals with key clicks. Few hams nowadays know what the C and the K at the end of an RST report stand for, so better send 'CHIRP' or 'BAD CHIRP', and 'CLICKS' or 'BAD CLICKS' in full words as part of your report.
- A typical way to gracefully end the QSO would be: '…TKS (thanks) FER QSO 73 ES (=and) CUL (see you later) W1ZZZ de G3ZZZ SK'. 'SK' is the prosign meaning 'end of contact'.
- 'DIT DIT DIT DAH DIT DAH' is the prosign 'SK' (from 'stop keying') and not 'VA' as published in some places (SK sent without inter letter spacing sounds the same as VA sent without inter letter spacing).
- Do not send '…AR SK'. It does not make sense. You are saying 'end of transmission' + 'end of contact'. It is quite obvious the end of your contact is at the end of your transmission. You will quite often hear '...AR SK', but the AR is redundant, so avoid using it.
- If at the end of the QSO you also intend to close down your station, you should send: '…W1ZZZ DE G3ZZZ SK CL' ('CL' is a prosign meaning 'closing' or 'closing down').

Typical CW QSO for the beginner:

QRL?

QRL?

CQ CQ G4ZZZ G4ZZZ CQ CQ G4ZZZ G4ZZZ AR

G4ZZZ DE ON6YYY ON6YYY AR

ON6YYY DE W4ZZZ GE TKS FER CALL UR RST 579 579 MY NAME BOB BOB QTH HARLOW HARLOW HW CPY? ON6YYY DE W1ZZZ K

G4ZZZ DE ON6YYY FB BOB TKS FER RPRT UR RST 599 599 NAME JOHN JOHN QTH NR GENT GENT W1ZZZ DE ON6YYY K

ON6YYY DE G4ZZZ MNI TKS FER RPRT TX 100 W ANT DIPOLE AT 12M WILL QSL VIA BURO PSE UR QSL TKS QSO 73 ES GE JOHN ON6YYY DE G4ZZZ K

G4ZZZ DE ON6YYY ALL OK BOB, HERE TX 10 W ANT INV V AT 8M MY QSL OK VIA BURO 73 ES TKS QSO CUL BOB G4ZZZ DE ON6YYY SK

73 JOHN CUL DE G4ZZZ SK

- An overview of the *closing codes*:

CODE	MEANING	USE
AR	end of transmission	at end of CQ **and** at the end of your transmission when you call a station (1)
K	over to you	at the end of an *over* (2) **and** at the end of your transmission when you call a station (1)
KN	over to you only	at the end of an *over*
AR K	end of transmission + over to you	**do NOT use**
AR KN	end of transmission + over to you only	**do NOT use**
SK	end of contact (end of QSO)	at end of QSO
AR SK	end of transmission + end of contact	**do NOT use**
SK CL	end of QSO + closing down station	when closing down

(1) when you reply to a station calling CQ or QRZ
(2) a transmission or an over is NOT the same as a QSO (contact). A QSO usually consists of a series of overs

II.9.7. Using 'BK'

- 'BK' (*break*) is used for switching quickly back and forth between stations without exchanging callsigns at the end of the transmission. In a way it is the CW equivalent of 'over' in phone.
- Example: W1ZZZ wants to know the name of G3ZZZ he's in contact with and sends: '…UR NAME PSE BK'. G3ZZZ answers immediately: 'BK NAME JOHN JOHN BK'.
- The break is announced with 'BK', and the transmission by the correspondent starts with 'BK'. The latter *BK* however is not always sent.

II.9.8. Still faster

- Often even the 'BK' code is not used. One just stops sending (in *break in* mode, which means that you can listen between words or characters) giving an opportunity to the other station to start sending, just as in a normal face to face conversation, where the word is also passed back and forth without any formality.

II.9.9. Using the prosign 'AS' (DIT DAH DIT DIT DIT)

- If, during a QSO, someone *breaks in* (transmits his call on top of the station you are working, or gives his call when you switch over), and you want to let him know that you first want to finish the QSO, just send 'AS', which means 'hold on', 'wait' or 'stand by'.

II.9.10. Using 'KN'

- 'K' = 'over'. Sending just 'K' at the end of your over leaves the door open for other stations to break in. If you don't want to be interrupted, send 'KN'.
- 'KN' means that you want to hear ONLY the station whose callsign you just sent (= 'go ahead, others keep out' or 'over to you only'), in other words: no breakers at this time please.
- 'KN' is mainly used when chaos is around the corner. A possible scenario: different stations are coming back to your CQ. You are decoding one partial call and you send: 'ON4AB? DE G3ZZZ PSE UR CALL AGN (again) K'. The station *ON4AB?* answers you, but in addition several other stations call simultaneously, making it impossible to copy his call. The procedure is to call *ON4AB?* again and end your call with 'KN' instead of 'K', this to emphasize you only want to hear *ON4AB?* come back to you. Example: 'ON4AB? DE G3ZZZ KN' or even 'ONLY ON4AB? DE G3ZZZ KN'. If you are still short of authority on the frequency you may try 'ON4AB? DE G3ZZZ KN N N N' (keep some extra space between the letters N). Now you are really getting nervous...

II.9.11. How to answer a CQ

Assume W1ZZZ has called CQ and you want to make a QSO with him. How do you go about it?

- Do not send at a higher speed than the station you're calling.
- Do not send the call of the station you are calling more than once; most of the time the call is not sent, it is obvious who you are calling.
- You can use either 'K' or 'AR' to end your call (see § II.9.6): 'W1ZZZ DE G3ZZZ G3ZZZ K', 'G3ZZZ G3ZZZ K', 'W1ZZZ DE G3ZZZ G3ZZZ AR' or 'G3ZZZ G3ZZZ AR'.
- In many cases one sends only the callsign without any *closing code* (AR or K) at all. This is also common practice in contests.
- Do not end your call with either '...**PSE** AR' or '...**PSE** K' (see § II.9.6).

II.9.12. Someone sends an error in your call

- Assume W1ZZZ has not copied all the letters of your call correctly. His answer is something like: 'G3ZZ**Y** DE W1ZZZ TKS FOR CALL UR RST 479 479 NAME JACK JACK QTH NR BOSTON BOSTON G3ZZ**Y** DE W1ZZZ K'.
- Now you go back to him as follows: 'W1ZZZ de G3ZZZ ZZZ G3ZZZ TKS FER

RPRT…'. By repeating part of your call a few times, you emphasize this part of the call to get your correspondent's attention so he can correct the error.

II.9.13. Call a station that's finishing a QSO

- Two stations are in QSO, the QSO comes to an end. If they both sign with 'CL' ('closing down') it means the frequency is now clear as they both closed down. If one or both ended with 'SK' (end of transmission), it may well be so that one or the other will remain on frequency for more QSOs (in principle the station that initially called CQ on that frequency).
- In this case, it is best to wait a while and see if either one calls CQ again.
- Example: W1ZZZ finished a QSO with F1AA: '…73 CUL (see you later) F1AA de W1ZZZ SK'.
- As neither one calls CQ after the QSO, you can call either one.
- Assume you (G3ZZZ) want to call F1AA. How do you go about it? Simply send 'F1AA de G3ZZZ G3ZZZ AR'.
- In this case calling without mentioning the callsign of the station you want to contact would be inappropriate. Send the call of the station you want to work once, followed by your call once or twice.

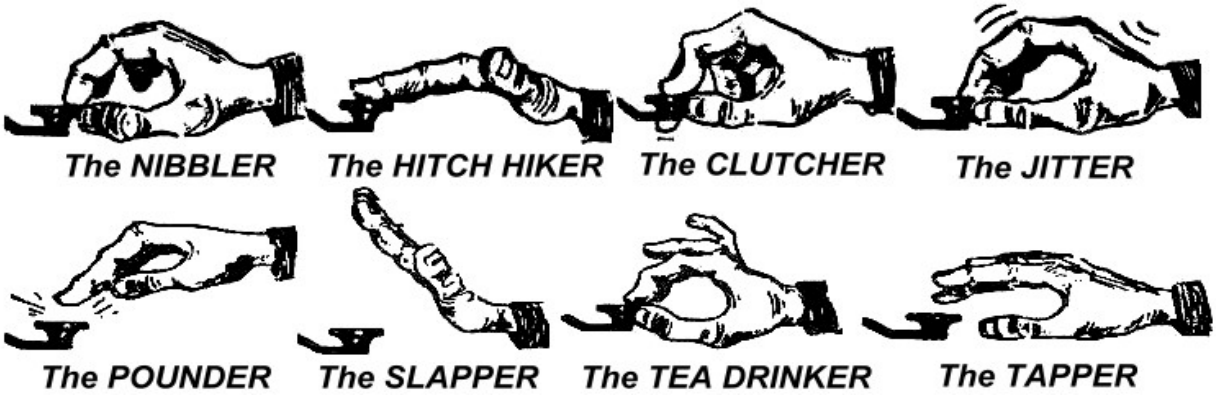
II.9.14. Using the '=' sign or 'DAH DIT DIT DIT DAH'

- Some call it 'BT', because it is like a letter B and T sent without space (like 'AR' is sent without space), but simply is the equality sign (=) in CW.
- DAH DIT DIT DIT DAH is used as a ***filler*** to pause for a second while you think of what you are going to send next. It is also used as a ***separator*** between chunks of text.
- As *filler* it is used to prevent your correspondent from starting to transmit, because you haven't finished your sentence yet, or you have not finished sending what you want to send. It is clearly the equivalent of *euh* or *eh*.
- Some CW operators seem to use 'DAH DIT DIT DIT DAH' spread all over their QSOs as a *text separator*, to make the text more readable. Example: 'W1ZZZ DE G4YYY = GM = TU FER CL = NAME CHRIS QTH SOUTHAMPTON = RST 599 = HW CPI? W1ZZZ DE G4YYY KN'. The use of this separation mark seems less common nowadays, and is considered by many as a waste of time. 'W1ZZZ DE G4YYY GM TU FER CL NAME CHRIS QTH SOUTHAMPTON RST 599 HW CPI? W1ZZZ DE G4YYY KN' is as readable as the version of the text with the separators.

II.9.15. Send good sounding code

- Listening to your CW should be like listening to good music, where one never feels like *working* at deciphering an unknown code or assembling a puzzle.
- Make sure you *space* letters and words appropriately. Fast sending with a little extra spacing usually makes overall copying easier.
- Experienced CW operators don't listen for letters but for words. This can of course only be done successfully if the right spacing exists between words. Once you start hearing words instead of a stream of letters, you are getting there! In normal face to face conversation we also listen for words, not for letters, don't we?
- On an automatic keyer, adjust the DIT/space ratio (weight) correctly. It will

sound nicest (most pleasing) if the ratio is a little bit on the high side (DIT a little longer than a space), compared to the standard 1/1 ratio.
- Remark: weight is not the same as DIT/DAH ratio! The DIT/DAH ratio is usually fixed at a 1/3 ratio on most keyers (not adjustable).



II.9.16. I am a QRP station (= low power station)

- A **QRP** station is a station transmitting with a power of maximum 5 W (CW) or 10 W (SSB).
- Never send your call as 'G3ZZZ/QRP', this is **illegal** in many countries (e.g. Belgium). The QRP information is **not** part of your callsign, so it cannot be sent as a part of it. In many countries the only permitted call suffixes are /P, /A, /M, /MM and /AM..
- If you are really a QRP station, chances are that you will be *relatively weak* with the station you are calling. Adding unnecessary ballast (the slash and the letters QRP) to your callsign will make it even more difficult to decipher your callsign!
- You can of course always mention during the QSO you are a QRP station, e.g.: '…PWR 5W 5W ONLY…'.
- If you call CQ as a QRP station and you want to announce that during your CQ, you can do it as follows: 'CQ CQ G3ZZZ G3ZZZ QRP AR'. Insert a little extra space between the call and 'QRP' and do not send a slash (DAH DIT DIT DAH DIT) between your call and 'QRP'.
- If you're looking for QRP stations specifically, call CQ as follows: 'CQ QRP CQ QRP G3ZZZ G3ZZZ QRP STNS (stations) ONLY AR'.

II.9.17. The correct use of 'QRZ?'

- 'QRZ?' means 'who called me?', and nothing else. Use it when you could not quite copy the station (or stations) that called you.
- In CW always send QRZ followed by a **question mark** ('QRZ?'), as is done with all Q codes when used as a question.
- Typical use: after a CQ F9ZZZ was unable to decipher any of the callers. Then he sends: 'QRZ? F9ZZZ'.
- If you have been able to copy part of a call (ON4…), and if more stations were calling you, do not send 'QRZ' but rather 'ON4 AGN (again) K' or 'ON4 AGN KN' ('KN' indicates clearly you only want to hear the ON4 station come back to you). Note that in this case you use 'K' or 'KN' and **not** 'AR' because you turn it back to one station in particular, the ON4 station whose suffix you missed.

Don't send 'QRZ' in this case or all the stations will start calling you again.

- 'QRZ' does **not** mean 'who is there?' or 'who is on the frequency?'. Assume someone passes by a busy frequency and listens in. After quite a while nobody having identified, he wants to find out the calls. The proper way to do so is to send 'CALL?' or 'UR CALL?' (or 'CL?', 'UR CL?'). Using 'QRZ' is inappropriate here. By the way, when you send 'CALL?', you should in principle add your call, otherwise you make an unidentified transmission, which is illegal.

II.9.18. The use of '?' instead of 'QRL?'

- Before using an apparently clear frequency, you need to actively check if no one is there already (maybe you are not hearing one end of a QSO because of propagation).
- The normal procedure is: send 'QRL?' (on CW) or ask 'is this frequency in use?' on phone.
- On CW, some simply send '?', because it is faster and thus potentially creates less QRM if someone else is using that frequency.
- But '?' can be interpreted in many ways (it says: *I am asking a question, but I did not say which one…*). Therefore always use 'QRL?'. Merely transmitting a question mark can create a lot of confusion.

II.9.19. Sending 'DIT DIT' at the end of a QSO

- At the end of a QSO both QSO partners often send as very last code two DITs with some extra spacing between them (like e e). It means and sounds like 'bye bye'.

II.9.20. Correcting a sending error

- Assume you make a sending error. Immediately stop sending, wait a fraction of a second and send the prosign 'HH' (= 8 DITs). Not always easy to send exactly 8 DITs, you're already nervous because you made an error, and now they want you to send exactly 8 DITs: DIT DIT DIT DIT DIT DIT DIT DIT, not 7 nor 9!
- In actual practice, many hams send just a few (e.g. 3) DITs, with extra space in between the DITs: 'DIT _ DIT _ DIT'. These extra spaced DITs indicate that the sender is not sending the code for a letter nor figure.
- Resend the word where you made an error and carry on.
- Often even these 3 DITs are left out altogether. When the sender realizes he's sending an error, he stops for about second and starts sending the same word again.

II.9.21. CW contests

- See § II.8.6 as well.
- Contest means speed, efficiency and accuracy. Hence, send only what's strictly necessary.
- The most efficient contest CQ is as follows: 'GM3ZZZ GM3ZZZ TEST'. The word *TEST* should be placed at the end of the CQ call.
  - Why? Because anyone tuning across the frequency at the end of your CQ then knows that you call CQ.
  - Assume you end your CQ contest call with your callsign: a passer-by noticed he needs that call, but does not know whether you called someone else or

called CQ. So he has to wait one more round to find out: a waste of time.
  - Therefore, always end your contest CQ with word *TEST*. Note that even the word *CQ* is left out from a contest CQ as it contains no additional information.
- An experienced contester will come back to your CQ contest call by just giving his call once. Nothing more. Example: 'W1ZZZ'. If you don't get back to him within 1 second, he will likely send his call again unless you returned to someone else.
- You copied his call and reply to him as follows: 'W1ZZZ 599001' or 'W1ZZZ 5991' provided the contest rules admit you to drop the leading zeros. Still faster would be to use *cut numbers* (abbreviated numbers): 'W1ZZZ 5NNTT1' or 'W1ZZZ 5NN1' (see § II.9.22)
- In most contests the exchange consists of a RST report followed by e.g. a serial number. Do not send anything else. No 'K' at the end, no '73', no 'CUL' (see you later), no 'GL' (good luck); there is no room for all of this in a contest where *speed* is the name of the game.
- Ideally W1ZZZ will answer e.g. as follows: '599012' or '5NNT12'.
- If he did not copy your report he would have sent: 'AGN?'. As he did not do that, it means that your report was received OK. No need to send 'TU', 'QSL', 'R' or whatever else to confirm reception of the report. It is a waste of time.
- All that's left to be done is to end the contact. A polite way of doing this: 'TU GM3ZZZ TEST'. *TU* says the QSO is over (thank you), *GM3ZZZ* identifies you for stations wanting to call you and *TEST* is a new CQ contest. If the QSO rate is very high, you can leave out the *TU*.
- There are of course slight variations possible, but the key words are speed, efficiency and accuracy.
- Most contesters use a computer contest program, which in addition to logging also allows them to send CW via pre-programmed short messages (CQ, reports etc.). A separate CW paddle and keyer allows for the operator to manually intervene if necessary. Such a setup makes long contests less tiring and will increase accuracy. Contest logging with pen and paper is almost history.
- If you want to look for *multipliers* or stations you have not yet worked, you will need to scan the band looking for such stations. When you find one, call as follows: 'GM3ZZZ'. Do not send his callsign, it's a waste of time. You can be sure the operator knows his own call. And he also knows you are calling him, because of the timing and of the fact that you give your call on the frequency where he is operating! Also, do not send 'DE GM3ZZZ', the word *DE* contains no additional information.
- If he does not come back within a second, give your call again, etc.

Example of a CW contest QSO:

DL0ZZZ TEST (CQ call from DL0ZZZ)

G6XXX (G6XXX calls DL0ZZZ)

G6XXX 599013 (DL0ZZZ gives G6XXX a report)

599010 (G6ZZZ gives DL0ZZZ his report)

TU DL0ZZZ TEST (DLOZZZ confirms reception and calls CQ Contest)

II.9.22. Abbreviated numbers (cut numbers) used in contests

- The code to be exchanged in most contests consists of a series of numbers, e.g. RST, followed by a 3-digit serial number.
- To save time, the CW code for some numbers (digits) is often shortened (cut):

  1 = A (DIT DAH, instead of DIT DAH DAH DAH DAH)
  2, 3 and 4 are usually **not** abbreviated
  5 = E (DIT instead of DIT DIT DIT DIT DIT)
  6, 7 and 8 are usually **not** abbreviated
  9 = N (DAH DIT instead of DAH DAH DAH DAH DIT)
  0 = T (DAH instead of DAH DAH DAH DAH DAH)

- Example: instead of sending '599009' one could send 'ENNTTN'. Most frequently you will hear '5NNTTN'. As we expect numbers, and although letters are received, we write down numbers. The better computer contest programs allow you to type in letters (in the exchange field); the program will automatically convert these letters to numbers.
- A4 instead of 14 (or a5 instead of 15 etc.): in some contests (e.g. CQ WW) you need to send your CQ zone number as part of the contest exchange. Instead of sending e.g. '59914' we often send '5NNA4' or even 'ENNA4'.

II.9.23. Zero beat

- A major advantage of a CW QSO is the narrow bandwidth such a QSO uses (a few hundred Hz), provided both stations in a QSO transmit on the exact same frequency.
- For most standard contacts, both stations will transmit on one and the same frequency (**simplex** operation). They are said to be ***zero beat*** with one another.
- The term *zero beat* comes from the fact that if two stations transmit on exactly the same frequency, the resulting beat from mixing the two signals would have a frequency of zero Hz: these signals are said to be *zero beat*.
- Often however, they do not transmit on exactly the same frequency. For this there are two major reasons (often a combination of both):

  - One of them is the incorrect use of the RIT (Receiver Incremental Tuning) on the transceiver. Most modern transceivers have an RIT function which makes it possible to listen on a frequency which is (slightly) different from the transmit frequency.
  - A second reason is that the operator does not apply the correct zero beat procedure. With most modern transceivers the zero beat procedure consists of making sure that the pitch of the side tone (CW monitor signal) of the transmitter is at exactly the same frequency as the tone (pitch) of the station you listen to. If you listen at 600 Hz and the side tone pitch is set at

1.000 Hz, you will transmit 400 Hz away from the station you are calling.

- On modern transceivers the frequency of the CW side tone monitor (pitch) is adjustable, and tracks the BFO frequency offset.
- Many experienced CW operators listen at a fairly low beat tone (400 – 500Hz, sometimes even as low as 300 Hz) instead of the more usual 600 – 1,000 Hz. For most people a lower pitch frequency is less tiring during long periods of listening and, in addition it allows for better discrimination between close spaced signals.

II.9.24. Where can one find slow speed CW stations (QRS)?

- 80 m: 3.550 - 3.570 k
- 20 m: 14.055 - 14.060 kHz
- 15 m: 21.055 - 21.060 kHz
- 10 m: 28.055 - 28.060 kHz

- *QRS* means : send more slowly
- *QRQ* means : send faster

II.9.25. Do I have key clicks?

- Not only the content and the format of what you send needs to be OK … but also the quality of the CW signals you transmit must be good.
- Quality problem # 1 is **key clicks**.
- Key clicks are always shown by the envelope waveform of the transmitted signal looking like a (nearly) perfectly square wave, with no rounded off edges, often including overshoot leading end spikes. All of this results in wide sidebands, which are witnessed as *clicks* left and right of the CW signal. There are three main technical causes for this problem:

  - One is an improperly shaped keying waveform containing a lot of harmonics (square edges). The cause of this is most often a poor circuit design by the manufacturer. Fortunately, a number of circuit changes have been published on internet to solve these problems.
  - The second one is having too much driving power to the amplifier combined with improper ALC (*automatic level control*) action (too slow attack time), resulting in leading edge spikes. It is always recommended to manually adjust the required drive power and not to rely on action of an ALC circuit.
  - A third one is improper open/closure sequence timing of RF relays in full break in.

- How can you detect key clicks generated by your own station? A well experienced ham in your close neighbourhood can listen carefully for clicks.
- Much better is to continuously monitor all transmissions using an oscilloscope displaying the waveform of your transmitted signal.
- Note that even some of the popular fairly recent commercial transmitters have outspoken key clicks.
- If you notice key clicks on your transmission or if you get reports on excessive key clicks, correct the problem or find help to do so. Your key clicks are causing problems with your other hams. Hence getting rid of your key clicks is a question of *ethics*!

II.9.26. Too fast?

- Is the CW speed you master not high enough to be able to make many QSOs?
- To increase your receiving speed, you need to exercise at a speed which is at the limit of your capabilities, where you gradually and constantly increase the speed (à la RUFZ, see § II.9.27).
- Up to approx. 15 WPM you can write down a text sent in CW letter by letter.
- At over 15 or 20 WPM you should recognize words, and write down only what's essential (name, QTH, WX, power, antenna etc.).

II.9.27. CW training software

- UBA CW course on the UBA-website (www.uba.be)
- G4FON Koch method trainer (www.g4fon.net)
- Just learn Morse code (www.justlearnmorsecode.com)
- Contest simulation (www.dxatlas.com/MorseRunner)
- Increase your speed using RUFZ (www.rufzxp.net)
- etc.

A few important hints:

- Never learn CW by counting *DITs* and *DAHs*...
- Never learn CW by grouping together similar characters (e.g. e, i, s, h, 5): this will make you count *DITs* and *DAHs* forever!
- Never describe the CW code for a character using the words *dot* and *dash* but rather using the words ***DIT*** and ***DAH***. *Dots* and *dashes* make us think of something visual, *DITs* and *DAHs* make us rather think of sounds.

II.9.28. Most used CW abbreviations

AGN:	again
ANT:	antenna
AR:	end of message (prosign)
AS:	wait a second, hold on (prosign)
B4:	before
BK:	break
BTW:	by the way
CFM:	(I) confirm
CL:	call
CL:	closing (down) (prosign)
CQ:	general call to any other station
CU:	see you
CUL:	see you later
CPI:	copy
CPY:	copy
DE:	from (e.g. W1ZZZ de G3ZZZ)
DWN:	down
ES:	and
FB:	fine business (good, excellent)
FER:	for

GA:	go ahead
GA:	good afternoon
GD:	good
GD:	good day
GE:	good evening
GL:	good luck
GM:	good morning
GN:	good night
GUD:	good
HI:	laughter in CW
HNY:	Happy New Year
HR:	here
HW:	how (e.g. HW CPY)
K:	over to you
KN:	over to you only, go ahead please and others keep out
LP:	long path (propagation)
LSN:	listen
MX:	Merry Christmas
N:	no (negation)
NR:	number
NR:	near
NW:	now
OM:	old man (male ham)
OP:	operator
OPR:	operator
PSE:	please
PWR:	power
R:	roger, yes, I confirm, received
RCVR:	receiver
RX:	receiver
RIG:	equipment
RPT:	repeat
RPRT:	report
SK:	end of contact (prosign)
SK:	silent key, a deceased ham
SP:	short path (propagation)
SRI:	sorry, excuse me
TMW:	tomorrow
TMRW:	tomorrow
TKS:	thanks
TNX:	thanks
TRX:	transceiver
TU:	thank you
TX:	transmitter
UFB:	ultra fine business
UR:	your
VY:	very
WX:	weather

XMAS:	Christmas
XYL:	wife, spouse, ex-young lady
YL:	young lady
YR:	year
51 and 55	is CB slang. Do not use it.
73:	best regards 73 is also commonly used in phone: never say or write *73s*, *best 73* or *best 73s*; all of these are corruptions. Say *seventy three* and NOT *seventy threes*.
88:	love and kisses. Same remarks as for '73'.

SUMMARY (most important Q codes and prosigns)

- **AR:** *end of transmission*: indicates the end of a transmission which is not addressed to anyone in particular (e.g. at the end of a CQ)
- **K:** *over to you*: ends a transmission of a conversation between 2 or more stations.
- **KN:** *over to you only*: similar to 'K' but you emphasize you do not want to hear any other callers or breakers.
- **SK:** *end of QSO*: is used to end a QSO (SK = Stop Keying).
- **CL:** *closing down station*: last code sent before closing down your station (CL = closing down)
- **QRL?:** *is the frequency in use?*: you must always use it before calling CQ on a new frequency.
- **QRZ?:** *who called me?*: QRZ has **no** other meaning.
- **QRS:** *reduce your sending speed*
- **AS:** *just a moment, hold on…*
- **= :** *I am thinking, hold on, uh…* (also used as a separator between portions of text)

II.10. OTHER MODES

So far we have discussed operational behavior for phone and CW operating in great detail, as these are by far the most frequently used modes in amateur radio. You will have noticed that general operational behavior is very similar in both modes, and differences are mainly due to the use of the Q code, prosigns and other specific terminologies.

The basic procedures as outlined for phone and CW apply to most of the other frequently used modes, such as RTTY, PSK(31), SSTV etc.

Radio amateurs also use highly specialized modes such as Fax, Hell (schreiber), contacts through satellites, EME (moonbounce, Earth Moon Earth), meteor scatter, Aurora, ATV (wideband amateur television), etc., which, to a certain extent, may call for specific operational procedures.

In the next few pages we will cover some of these *other* modes.