

# Resources for Learning Morse Code

This document collects together useful resources for those beginning their CW journey and for those that wish to improve their speed and proficiency.

## Hamfesters Amateur Radio Club

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## Table of Contents

Table of Tables .....	5
Table of Figures.....	6
Table of Authorities.....	6
Who is this document for?.....	7
Document Revision History .....	7
Why Choose CWOps Academy .....	8
The 6 Bad Habits of CW: .....	9
Daily Morse Code “Scales” Sending Warm Up.....	11
Understanding Universal Coordinated Time (UTC) and Daylight Savings Time .....	12
<i>UTC, GMT and Daylight-Saving Time</i> .....	12
Slow Speed CW Nets .....	13
W1AW Operating Schedule, CW Speeds, and Frequencies .....	15
Morse Code - Web Resources .....	16
<i>Learning and Resource Websites</i> .....	16
Morse Code - Learning and Reference Software .....	17
<i>Software that runs on Microsoft Windows</i> .....	17
<i>Software that runs on Windows or Mac OS</i> .....	17
<i>Software that runs on Windows, Mac OS, or Linux</i> .....	18
MP3 Player Practice Files .....	18
<i>Amazon Alexa Skills</i> .....	19
<i>Software that runs on Apple iOS and iPadOS</i> .....	19
<i>Software that runs on Google Android OS</i> .....	19
<i>U.S. Army Training Video from 1966</i> .....	20
Social Media Sites .....	20

<i>Facebook</i> .....	20
CW Ops.....	20
CW.QRS.....	20
Appendix A – CW Operating Aids .....	21
<i>Morse Code Timing Rules</i> .....	22
<i>The most common CW abbreviations Q-codes, Prosigns, and most used words</i> .....	23
<i>United States – State, Territory, and Commonwealth Abbreviations</i> .....	24
<i>The Most Common Procedural Signs (or Prosigns) for Morse Code</i> .....	25
<i>CW Abbreviations</i> .....	27
<i>Q-Codes</i> .....	29
<i>RST (Readability Signal Tone)</i> .....	31
Appendix B - How to Make a Short CW Contact.....	32
Appendix C - Morse Code Ninja’s Advice for Beginners and Beyond .....	34
<i>DOs</i> .....	34
<i>DON'Ts</i> .....	35
<i>So, you want to go faster:</i> .....	36
<i>Levels of Morse code proficiency:</i> .....	37
1. Conscious decoding of Dits and Dahs in Your Head.....	37
2. Instant Character Recognition (ICR) .....	38
3. Instant Word Recognition (IWR).....	40
4. Focus on the Meaning of the Message.....	41
<i>The Dirty Dozen:</i> .....	42
Appendix D - Morse Code History .....	45
<i>Morse code receiver, recording on paper tape</i> .....	45
<i>Comparison of historical versions of Morse code with the current standard.</i> .....	46
<i>A U.S. Navy Morse Code training class in 2015. The sailors will use their new skills to collect signals intelligence.</i> .....	47
Appendix E - Here are some commonly heard CW sender spacing errors .....	48
<i>Ti ming is ever y thing</i> .....	48
<i>Sending Proficiency</i> .....	49

Appendix F– Other CW References ..... 50

*Books* ..... 51

Appendix G - CW Reverse Beacon Network ..... 52

*CW Reverse Beacon Network* ..... 52

*Reverse Beacon Network* ..... 53

*What Beacons are Being Heard?* ..... 53

Appendix H - Acknowledgements ..... 54

INDEX ..... 55

Resources for Learning Morse Code V1.0 2021-02-24 17:50 CST AB9MZ

## Table of Tables

<i>Table 1 Document Change History</i> .....	7
<i>Table 2 Slow Speed CW Nets</i> .....	14
<i>Table 3 WIAW Operating Schedule</i> .....	15
<i>Table 4 Learning and Resource Websites</i> .....	17
<i>Table 5 Software that runs on Microsoft Windows</i> .....	17
<i>Table 6 Software that runs on Microsoft Windows or Apple Mac OS</i> .....	18
<i>Table 7 Software that runs on Microsoft Windows, Apple Mac OS, or Linux</i> .....	18
<i>Table 8 MP3 Player Resources</i> .....	18
<i>Table 9 Amazon Alexa Skills</i> .....	19
<i>Table 10 Software that runs on Apple iOS and iPadOS</i> .....	19
<i>Table 11 Software that runs on Google Android OS</i> .....	19
<i>Table 12 U.S. Army Training Video from 1966</i> .....	20
<i>Table 13 United States – State, Territory, and Commonwealth Abbreviations</i> .....	24
<i>Table 14 Commonly used Procedural Signs (Prosigns)</i> .....	25
<i>Table 15 Additional procedural signs</i> .....	26
<i>Table 16 Use cut numbers 5NN instead of 599 during a contest</i> .....	31
<i>Table 17 Signal Report (Readability, Signal Strength, and Tone) (RST)</i> .....	31
<i>Table 18 How to Make a Short CW Contact (1 of 2)</i> .....	32
<i>Table 19 How to Make a Short CW Contact (2 of 2)</i> .....	33
<i>Table 20 Copying Methods</i> .....	39
<i>Table 21 The ABC's of success</i> .....	40
<i>Table 22 The Dirty Dozen</i> .....	44
<i>Table 23 Books about Morse Code</i> .....	51

## Table of Figures

<i>Figure 1 Savvytime Time conversion sample screen shot</i> .....	12
<i>Figure 2 Morse Code Spacing and Timing Elements</i> .....	22
<i>Figure 3 The most common CW abbreviations Q-codes, Prosigns, and most used words</i> .....	23
<i>Figure 4 Full list of CW abbreviations (1 of 2)</i> .....	27
<i>Figure 5 Full list of CW abbreviations (2 of 2)</i> .....	28
<i>Figure 6 Q-Codes (Q-Signals)</i> .....	29
<i>Figure 7 QN-Codes (QN-Signals)</i> .....	30
<i>Figure 8 Morse code speed vs proficiency</i> .....	36
<i>Figure 9 CW Reverse Beacon Network</i> .....	52
<i>Figure 10 NCDXF Reverse Beacon Network</i> .....	53

## Table of Authorities

### Authority

Federal Communications Commission (FCC) .....	47
International Telecommunications Union (ITU) .....	46

## Who is this document for?

This document is for anyone curious about Morse code, but it also has lots of resources for improving your CW speed and proficiency. If you are unfamiliar with Morse Code, I have included several appendixes with resources to help you along your journey. Appendix A contains useful CW learning and operating aids. Appendix B provides an example of a short CW contact. Appendix C offers the Morse Code Ninja's advice for beginners and beyond. Appendix D briefly covering the history and development of Morse code. Appendix E contains some commonly heard CW sender spacing errors. Appendix F has some additional references. Appendix G provides information about CW Reverse Beacon Networks.

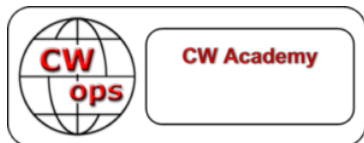
## Document Revision History

This table lists all significant changes to this document.

Date	Version	By	Description of Change
2021-02-24	1.0	Gregg (AB9MZ)	Original draft document
2021-02-25	1.1	Gregg (AB9MZ)	Published document
2021-03-04	1.1b	Gregg (AB9MZ)	Added the Long Island NY CW Club per Kurt AD0WE. Added information about CW Reverse Beacon Networks.

Table 1 Document Change History

## Why Choose CWOps Academy



### For the beginner

- Want to communicate with fellow hams around the world using even a modest rig and antenna?
- Want to stay in touch when on vacation to some remote area where you don't have access to a repeater or cell phone service?
- Want to meet a whole new community of amateurs that share a common bond?
- Want to expand your operating capabilities with little or no cost? If you answer "Yes" to any of the questions, then becoming skilled in CW is the answer. CWops CW Academy advisors are ready and willing to teach you a new skill that will open a world of fun and opportunity

### For those having experience with CW who want to improve or regain proficiency

- am getting bored with voice and digital modes
- My CW skills are not what they used to be
- I'm too rusty or embarrassed to get back on CW
- I want to be able to copy in my head

If you know the code but are rusty, can't copy or send as proficiently as you once could, then CWops CW Academy is right for you

### For those that want something new but are not confident to take the plunge

- love chasing DX and I want to try something new
- I like contesting and would like to be better at CW radio sport
- I've tried CW learning aids, but nothing seems to work for me
- CW intrigues me but I'm worried about the challenge



If this sounds like you, then CWops CW Academy is absolutely right for you and is available to anyone, anywhere.

There is no cost or obligation to participate in CWops CW Academy Classes and membership is not required. Enrollment is open to anyone with the desire to learn or improve their proficiency in Morse Code.

**Please Note:** CW Academy training and mentoring for Beginners and those with Morse Code experience needing help are offered three times a year, in two-month increments: January through February, April through May, and September through October.

**Sign up and learn what CW Academy can do for you.**

<https://cwops.org/cw-academy/cw-academy-options>.

### The 6 Bad Habits of CW:

Our CWops Academy Instructor Ken (AC5EZ) provided the following list of bad habits of CW..

- **Counting dits and dahs:** The best way to stop counting dits and dahs is to keep the character speed at 25 to 30 wpm or above. Farnsworth adds extra spacing between the characters to slow down the actual speed. Start by using a Farnsworth setting of around 4. Then slowly increase your Farnsworth setting over time as your brain learns the rhythm of each code character.
- **Mental lookup table (and other extra steps):** You must eliminate every mental process between hearing the characters and recognizing them. The Morse character must be equivalent to the sound of the character itself in your mind. You hear di-di-dah-dit, and F pops into your mind. No extra steps!
- **Holding on to unrecognized characters:** You must drop missed characters immediately in order to be ready for the next character. This “Letting Go” is a skill that takes practice and requires you to get comfortable missing characters. Always be ready for the next character - MISS FAST!
- DO NOT pause and ponder!
- **Crutches – Pencils, decoders, etc.:** These “tools” destroy your goal of comfortably copying the code. They are not “training wheels.” They are a hard obstacle. Just close your eyes and listen. Relax about missed characters – that’s not a failure; it’s normal. Get used to it!
- **Not Getting on the Air:** You may think “When I improve my CW proficiency I’ll get on the air.” The truth is: “When I get on the air, I will improve my CW proficiency.”

**NOTE: See Appendix C - Morse Code Ninja’s Advice for some useful DOs and DON’Ts.**

## When Copying and Sending CW

### RELAX and CLOSE YOUR EYES:

At first, you will certainly write down all incoming letters. But you should try to relax and copy in your head. As your skill evolves you will start to recognize words and later phrases. It will take you some time to get to that point. For example, when the other station starts to describe their station. Part of the text may well be a description of his antenna. So, you can expect him/her to say, "the antenna here is a dipole up 40 feet". So as the letters arrive there is no need to write this phrase down. You are starting to copy in your head. Soon you will expand your skill in copying without writing down everything. Practice by listening to other slow speed CW QSOs and see how much you can copy in your head. You may be surprised. Do this while you are working in the shack with your shortwave receiver on. Listen to the ongoing QSO in the background. You will begin to pick up words and phrases. With practice you will be copying more and more in your head. This will greatly enhance the pleasure of conversing in Morse Code. Becoming a good skilled CW operator is proud feeling and if you are into DXing or contesting, worth much to your success.

### THERE ARE NO SHORTCUTS:

Instant Character Recognition is the foundation of CW Head Copy. Keep practicing Instant Character Recognition throughout this course and beyond!

**PRACTICE, PRACTICE, PRACTICE!**

## Daily Morse Code “Scales” Sending Warm Up

Bob Carter – (WR7Q) 2018-12-09

- Do the “Warm Up” every day before you send anything
- Do the “Exercise” as needed...to get better at letters and numbers
- Do the “Drill” as needed...to increase your sending skills

*Send all five characters in each character group or each word without error or start “it” again!*

**IMPORTANT:** Spaces below are for readability only. You should ignore them when sending your code.

Warm Up
EEEEE TTTTT IIIII MMMM SSSSS OOOO HHHHH 0000 5555 AAAAA NNNNN UUUUU DDDDD VVVVV BBBB 4444 6666 ABCDEF GHIJK LMNOP QRSTU VWXYZ 12345 67890 / , . ? THE QUICK BROWN FOX JUMPS OVER THE LAZY DOGS BACK 7 0 3 6 4 5 1 2 8 9
Exercise
AAAAA BBBB CCCCC DDDDD EEEEE FFFFF GGGGG HHHHH IIIII JJJJ KKKKK LLLLL MMMM NNNNN OOOO PPPPP QQQQQ RRRRR SSSSS TTTTT UUUUU VVVVV WWWW XXXXX YYYYY ZZZZ 11111 22222 33333 44444 55555 66666 77777 88888 99999 00000
Drill
THE QUICK BROWN FOX JUMPS OVER THE LAZY DOGS BACK 7 0 3 6 4 5 1 2 8 9 THE QUICK BROWN FOX JUMPS OVER THE LAZY DOGS BACK 7 0 3 6 4 5 1 2 8 9 BENS BEST BENT WIRE/5 BENS BEST BENT WIRE/5 BENS BEST BENT WIRE/5 ///// ,,,,, ..... ????? +++++ ===== $\overline{AK}$ $\overline{AR}$ $\overline{BK}$ $\overline{BT}$ $\overline{HH}$ $\overline{SK}$

## Understanding Universal Coordinated Time (UTC) and Daylight Savings Time

All times are provided in Universal Coordinated Time (UTC). Some refer to it a Coordinated Universal Time (CUT) or Zulu (Z). Greenwich Mean Time (GMT) is often interchanged or confused with Coordinated Universal Time (UTC). One key difference is that **GMT<sup>1</sup>** is a **time zone** and **UTC** is a **time standard**.

- **GMT is a time zone** officially used in some European and African countries. The time can be displayed using both the 24-hour format (0 - 24) or the 12-hour format (1 - 12 am/pm).
- **UTC is not a time zone**, but a time standard that is the basis for civil time and time zones worldwide. This means that no country or territory officially uses UTC as a local time.

## UTC, GMT and Daylight-Saving Time

Neither UTC nor GMT ever change for **Daylight Saving Time** (DST). However, some of the countries that use GMT switch to different time zones during their DST period. For example, the **United Kingdom is not on GMT all year**, it uses **British Summer Time** (BST), which is one hour ahead of GMT, during the summer months. I have provided a link to my favorite time zone converters <sup>2</sup>.

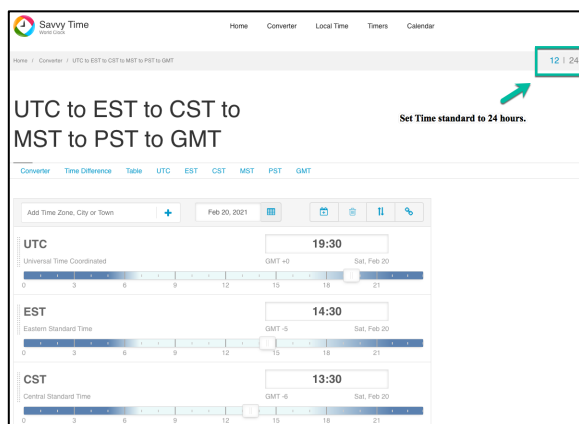


Figure 1 Savvytime Time conversion sample screen shot.

Sources:

- (1) <https://dateandtime.com>
- (2) <https://savvytime.com/converter/utc-to-est-cst-mst-pst-gmt> or <https://www.worldtimeserver.com/time-zones/z/>

**Slow Speed CW Nets**

Updated 2021-02-15

NET / SOURCE	PURPOSE	FREQ +/-	Time UTC	DAYS	Net Control Station and Notes
<a href="#">Carolina Slow Net (CSN)</a> <sup>1</sup>	Traffic/Practice	3.571.00	01:00Z	Daily	W4EAT
<a href="#">Empire Slow Speed (ESS)</a>	Traffic/Training	3.576.00	23:00Z	Daily	WI2G
Florida Med.Speed Net	Traffic/Training	3.552.00	23:30Z	Daily	AG4RJ
<a href="#">Georgia CW Training Net</a> <sup>1</sup>	Traffic/Training	3.549.00	02:00Z	Daily	WE4GA
<a href="#">Hit and Bounce Slow Net</a> <sup>1</sup>	Traffic/Training	7.112.00	12:30Z1	Daily	N7MPS
Hoodview CW Net <sup>2</sup>	CW Practice	28.130.00	00:00Z	Daily	AB7BI
<a href="#">Idaho Montana CW Net</a> <sup>2</sup>	Traffic/Training	3.647.00	00:00Z	Daily	N7MPS
<a href="#">K9YA Slow Net</a> <sup>1</sup>	Practice/Fun	7.122.00	00:00Z	Thursday	N9BOR
<a href="#">LIDS QRS CW Net</a>	Practice	7.035.00	None	None	By arrangement
<a href="#">Maine Slow Speed Net</a> <sup>1</sup>	Training	3.585.00	23:00Z	Weekdays	KA1LPW
<a href="#">Maryland CW Slow Net (MSN)</a> <sup>1</sup>	Traffic/Training	3.563.00	00:30Z	Daily	W8CPG
Midsouth CW Training Net	Training	3.593.00	23:00Z	Daily	WD4PTJ
<a href="#">NAQCC QRS Net</a> East Texas QRS Net (ETN) MIDWEST QRS Net (MWN)	Traffic/Training Summer Winter	7.066.00 3.566.00 7.031.00	01:00Z 01:00Z 01:30Z	Tuesday Tuesday Tuesday	Allen KA5TJS (TX) Allen KA5TJS (TX) Bob W0CC (KS)

NET / SOURCE	PURPOSE	FREQ +/-	Time UTC	DAYS	Net Control Station and Notes
Pacific Northwest 80 Net (PNW80) 1Land QRS Net (1LND)		3.556.50 3.560.00	01:00Z 00:00Z	Thursday 2 <sup>nd</sup> /4 <sup>th</sup> Sunday	Stewart KE7LKW Ed K1RID (ME)
NARL CW Slow Net	Traffic/Training	28.180.00	00:30Z	Daily	AA1GW
NJ CW Slow Net	Traffic/Training	3.547.00	23:30Z	Daily	K2PB
<a href="#">Northern CA Slow Net</a> <sup>1</sup>	Traffic/Training	3.705.00	02:00Z	Daily	WB6UZX
<a href="#">Ohio CW Slow Net</a> <sup>1</sup>	Traffic/Training	3.705.00	23:10Z	Daily	WD8Q
Oklahoma CW Training Net	Traffic/Training	7.120.60	22:20Z	Daily	WB5KND
<a href="#">Oregon Section Net</a> <sup>1</sup>	Practice/Chat Traffic/Training Traffic/Training	7.085.00 3.587.00 3.587.00	14:00Z 03:00Z 02:00Z	Daily Daily Daily	KC7SRL KC7SRL W7IZ
PA CW Training Net	Code Practice	3.537.00	04:30Z	Daily	N3SW
Sandia Valley Slow Net	Code Practice	7.063.00	02:00Z	Wed	WB7RHT
<a href="#">Tennessee Slow Speed Net</a>	Training	3.682.00	01:30Z	Daily	
<a href="#">Texas Slow Net (TSN)</a> <sup>1</sup>	Traffic/Training	3.552.00	00:45Z	Daily	W5ESE
<a href="#">Utah CW Net</a> <sup>1</sup>	Traffic/Training	3.570.00	00:30Z	Daily	NA7G
<a href="#">VE2UMS CW Traffic Net</a> <sup>1</sup>	Traffic	3.578.00	01:00Z	Daily	VE2CBW
<a href="#">West Coast Slow Net</a> <sup>1</sup>	Traffic/Training	3.540.00	00:00Z	Daily	K7WCN

Table 2 Slow Speed CW Nets

## W1AW Operating Schedule, CW Speeds, and Frequencies

ARRL last updated this schedule on 2021-01-04

Frequencies MHz <sup>1</sup>	1.8025 21.0675	3.5815 28.0675	7.0475 50.350	14.0475 147.555	18.0975
Slow Code = practice sent at 5, 7-1/2, 10, 13 and 15 words per minute (wpm). Fast Code = practice sent at 35, 30, 25, 20, 15, 13 and 10 wpm. Code bulletins are sent at 18 wpm.					
Time UTC <sup>2,3</sup>	Monday	Tuesday	Wednesday	Thursday	Friday
14:00Z		Fast Code	Slow Code	Fast Code	Slow Code
21:00Z	Fast Code	Slow Code	Fast Code	Slow Code	Fast Code
22:00Z	<a href="#">Code Bulletin</a>				
00:00Z	Slow Code	Fast Code	Slow Code	Fast Code	Slow Code
01:00Z	Code Bulletin				
03:00Z	Fast Code	Slow Code	Fast Code	Slow Code	Fast Code
04:00Z	Code Bulletin				
(1) CW frequencies include code practices, Qualifying Runs and CW bulletins. (2) W1AW's transmitting schedule occurs at the same local Eastern time throughout the year. Source: <a href="http://www.arrl.org/w1aw-operating-schedule#cw_info">http://www.arrl.org/w1aw-operating-schedule#cw_info</a> . (3) Because the schedule may change if your local time does not use Daylight Savings Time adjustments all times are listed in UTC (Z).					

Table 3 W1AW Operating Schedule

## Morse Code - Web Resources

### *Learning and Resource Websites*

Site Owner / Maintainer	Description / Website
CWops CW Academy	Home: <a href="https://cwops.org/cw-academy">https://cwops.org/cw-academy</a> Student Resources: <a href="https://cwops.org/cw-academy-2/cw-academy-student-resources">https://cwops.org/cw-academy-2/cw-academy-student-resources</a> Morse Code Trainer: <a href="https://morsecode.world/international/trainer/trainer.html">https://morsecode.world/international/trainer/trainer.html</a>
Straight Key Country Club (SKCC)	Beginners Corner: <a href="http://www.skccgroup.com/member_services/beginners_corner">http://www.skccgroup.com/member_services/beginners_corner</a>
A Beginner's Guide to Making CW Contacts By Jack Wagoner WB8FSV	<a href="http://felge.us/BeginGuideCW.htm">http://felge.us/BeginGuideCW.htm</a>
Deep Morse (Puzzles)	This site has a collection of CW Puzzles that test your ability to copy Morse code (also known as CW). Each Puzzle has been curated and contains some specific challenge that makes it difficult to copy CW. <a href="https://deepmorse.com">https://deepmorse.com</a>
Master CW	<a href="https://www.mastercw.com">https://www.mastercw.com</a>
Seiuchy	<a href="http://seiuchy.macache.com">http://seiuchy.macache.com</a>
LCWO	<a href="http://lcwo.net">http://lcwo.net</a>
Lockdown Morse	<a href="https://www.youtube.com/channel/UCu8HOu-LB4pY4WKLYKarYNg">https://www.youtube.com/channel/UCu8HOu-LB4pY4WKLYKarYNg</a>
Morse Camp	<a href="https://morse.camp">https://morse.camp</a>
AA9PW Code Practice	<a href="http://aa9pw.com/morsecode">http://aa9pw.com/morsecode</a>
Morse Code Ninja	They provide great tools for structured practice. I have been using their state practice. Code Course: <a href="https://morsecode.ninja/learn/index.html">https://morsecode.ninja/learn/index.html</a> Practice: <a href="https://morsecode.ninja/practice/index.html">https://morsecode.ninja/practice/index.html</a>
Long Island CW Club (LICW)	<a href="https://longislandcwclub.org">https://longislandcwclub.org</a> . Another option for online personalized guidance in learning Morse code.



Table 4 Learning and Resource Websites

## Morse Code - Learning and Reference Software

You can find two great lists of Morse Code learning resources and software at [Morse Code Ninja](#)'s and [CWOps Academy](#) websites. I have included a few of my favorites below.

### Software that runs on Microsoft Windows

Author / Software / Version	Description / Website
G4FON Koch Morse Trainer V10	Probably the most popular computer program is <i>Ray Goff G4FON's Koch Morse Trainer</i> . This uses the proven Koch Method and provides additional features for improvers such as Word training. You can also use it to convert text files into Morse code. The program can be used to generate Windows sound (.wav) files. By installing some free MP3 software, you can also use it to generate MP3 files for your MP3 player. <a href="http://www.g4fon.net/CW_Trainer2.php">http://www.g4fon.net/CW_Trainer2.php</a>
Tancredi Mathias Kolpe, DL4MM & Alessandro Vitiello, IV3XYM, RufzXP 2019-09-23	RufzXP is an excellent training program for improving code speed and CW practice, particularly (ultra) high speed memory copying of true amateur radio calls. Focusing on improvement of CW proficiency, it is no contest simulator and does not provide for QRM. It provides additional tools for keeping track of training progress and comparing with other operators via International RufzXP. <a href="http://www.rufzxp.net">http://www.rufzxp.net</a>
Just Learn Morse Code	Just Learn Morse Code is designed to make it easy to learn Morse code, as well as improve the skills of those who already know the code. The basic methods used to achieve this are <a href="#">Koch's method</a> and <a href="#">Farnsworth timing</a> . <a href="http://justlearnmorsecode.com">http://justlearnmorsecode.com</a>

Table 5 Software that runs on Microsoft Windows.

### Software that runs on Windows or Mac OS

Software / Version	Description / Website
Morse Runner v10 Afreet Software, Inc. Alex Shovkopyas VE3NEA	The Morse Runner program simulates contest pile ups with interference from other stations etc. Even if you're not interested in taking part in contests, this program can be fun and help you learn to cope when conditions get busy on the air. <a href="http://www.dxatlas.com/MorseRunner">http://www.dxatlas.com/MorseRunner</a>  Detrick KI4STU has created a <a href="#">WineSkin wrapper</a> for Morse Runner to run it on the Mac computers.

Table 6 Software that runs on Microsoft Windows or Apple Mac OS

**Software that runs on Windows, Mac OS, or Linux**

Software / Version	Description / Website
QRQ	<a href="https://fkurz.net/ham/qrq.html">https://fkurz.net/ham/qrq.html</a>
CW Teacher	<a href="http://www.n3fjp.com/cwteacher.html">http://www.n3fjp.com/cwteacher.html</a>
CyberCW Contest	<a href="http://bbcyber.com/cybertest.htm">http://bbcyber.com/cybertest.htm</a>
ebook2cw	<a href="https://fkurz.net/ham/ebook2cw.html">https://fkurz.net/ham/ebook2cw.html</a>

Table 7 Software that runs on Microsoft Windows, Apple Mac OS, or Linux

**MP3 Player Practice Files**

MP3 Audio Resources	Description / Website
<b>W1AW Practice Files</b>	The ARRL (USA national radio society) provides copies of the W1AW Code Practice MP3 Files for various MP3 speeds between 5 wpm and 40 wpm in MP3 files, which you can either listen to online or download for your player. These provide a mixture of plain language (taken from the ARRL QST magazine) and callsign training. As well as the most recent files, there are hundreds of additional files available. <a href="http://www.arrl.org/code-practice-files">http://www.arrl.org/code-practice-files</a>
South Manchester Radio & Computing Club Practice Files	The S.M.R.C.C. Morse Practice web page provides MP3 Morse files with text, QSOs and letter groups at 12, 18 and 25 w.p.m. <a href="http://smrcc.org.uk/Morse/morse.htm">http://smrcc.org.uk/Morse/morse.htm</a>

Table 8 MP3 Player Resources.

**Amazon Alexa Skills**

Skill Author / Maintainer	Description / Website
Continuous Wave	Allows you to learn or practice your Morse code. Say “Alexa Launch Continuous Wave Skill”. <a href="https://www.amazon.com/N3HEE-Continuous-Wave/dp/B07C7HS47J">https://www.amazon.com/N3HEE-Continuous-Wave/dp/B07C7HS47J</a>

Table 9 Amazon Alexa Skills.

**Software that runs on Apple iOS and iPadOS**

Software / Version	Description / Website
Morse-IT (Free/\$)	<a href="https://pacolabs.com/iOS/MorseIt/">https://pacolabs.com/iOS/MorseIt/</a>
Morse Toad (\$)	<a href="https://itunes.apple.com/us/app/morse-toad/id906586079?mt=8">https://itunes.apple.com/us/app/morse-toad/id906586079?mt=8</a>

Table 10 Software that runs on Apple iOS and iPadOS

**Software that runs on Google Android OS**

Software / Version	Description / Website
IZ2UUF Morse Koch CW (Free)	<a href="https://play.google.com/store/apps/details?id=net.iz2uuf.cwkoch&amp;hl=en">https://play.google.com/store/apps/details?id=net.iz2uuf.cwkoch&amp;hl=en</a>
AE0S Claus' Morse Trainer (Free)	<a href="https://play.google.com/store/apps/details?id=com.niesens.morsetrainer">https://play.google.com/store/apps/details?id=com.niesens.morsetrainer</a>
Koch Morse Trainer Pro (\$)	<a href="https://play.google.com/store/apps/details?id=uk.co.bitninja.kmtpro&amp;hl=en_US">https://play.google.com/store/apps/details?id=uk.co.bitninja.kmtpro&amp;hl=en_US</a>
Morse Machine for Ham Radio (\$)	<a href="https://play.google.com/store/apps/details?id=com.iu4apc.morsemachine&amp;hl=en_US">https://play.google.com/store/apps/details?id=com.iu4apc.morsemachine&amp;hl=en_US</a>
KG9E Practice Oscillators Japanese (\$) KG9E Morse code trainer (\$)	<a href="https://play.google.com/store/apps/details?id=appinventor.ai_izzybella419.AmateurHamRadioPracticeKeysWabun">https://play.google.com/store/apps/details?id=appinventor.ai_izzybella419.AmateurHamRadioPracticeKeysWabun</a> <a href="#">10 WPM</a> <a href="#">15 WPM</a> <a href="#">20 WPM</a> <a href="#">25 WPM</a> <a href="#">30 WPM</a>
Caller name in Morse code (?)	<a href="http://100dof.com/software/morsenotifier/morse_notifier_free_303.apk">http://100dof.com/software/morsenotifier/morse_notifier_free_303.apk</a>

Table 11 Software that runs on Google Android OS.

### ***U.S. Army Training Video from 1966***

Training Video	Description / Website
US Army Hand Sending Training film	There's a very entertaining, helpful and humorous US Army training film from 1966 on hand-sending Morse and adjusting keys, entitled INTERNATIONAL MORSE CODE, HAND SENDING. Part of the film covers American style hand/arm positioning, but the majority of the film is very relevant to all styles of sending.  <a href="http://www.archive.org/details/gov.archives.arc.36813">http://www.archive.org/details/gov.archives.arc.36813</a>

Table 12 U.S. Army Training Video from 1966

### **Social Media Sites**

Social media websites and apps can be a useful resource for finding learning resources, learning what is going on in the CW community, and a great place for asking questions.

#### ***Facebook***

Some Facebook pages are open to the public and some require membership to access.

#### **CW Ops**

This is a closed Facebook group for members of the CWOps CW club. Please do not send request to join this Facebook group unless you are a member of CWOps. You have to send code at 25 WPM to join. <https://www.facebook.com/groups/1621569471440493>

#### **CW.QRS**

<https://www.facebook.com/groups/cw.qrs/>

## Appendix A – CW Operating Aids

Most of the operating aids that are included in this document were provided by Ken AC5EZ who was our CWOps Academy Instructor for our beginner class that started in January / February 2021 ran on Monday and Thursday nights at 19:00 CST.

This appendix contains the following Morse Code learning and operating aids:

- Morse Code Timing Rules
- The most common CW abbreviations, Q-codes, Prosigns, and most commonly used words.
- United States – State, Territory, and Commonwealth Abbreviations
- Procedural Signs (or Prosigns).
- Q-Codes (Q Signals).
- Signal Report (Readability, Signal Strength, and Tone) (RST)).

**NOTE:** Our CWOps Academy advisor Ken AC5EZ provided us with full page printable versions of these operating aids that I printed double-sided and laminated. You can find these files attached to the Hamfesters website <http://w9aa.org>.



***The most common CW abbreviations Q-codes, Prosigns, and most used words.***

Common CW Abbreviations			
AGN	Repeat, Say again	HW?	How copy
ANT	Antenna	NAME	Name
CPY	Copy	NR	Number
CQ	Calling any station	OM	Old man
CW	Continuous wave	PSE	Please
DE	This is	PWR	Power
DX	long distance	R	Received
ES	And	RPT	Report
FB	Fine business	RST	Signal report
FER	For	SLD	Solid
GA	Good afternoon	TKS	Thanks
GD	Good, Good day	TNX	Thanks
GE	Good evening	TU	Thank you
GM	Good morning	WX	Weather
GN	Good night	XYL	Wife
HI	Laughing in CW	YL	Young lady
HR	Here, hear	73	Goodbye
HW	How	88	Love & kisses

Most used Q Signals			
QRL	Is frequency in use	QRZ	Who is calling
QRM	Manmade interference	QSB	Signal fading
QRN	Natural interference	QSY	Change frequency
QRQ	Send faster	QTH	Station location
QRS	Send slower		

ProSigns			
\AR	End of message	\AS	Standby, wait
\BK	Break	\BT	Separation

Most often used words									
I	AND	THE	YOU	THAT	A	TO	KNOW	OF	IT
IN	DO	SO	BUT	IS	LIKE	HAVE	WAS	WE	ITS
JUST	ON	OR	NOT	THINK	FOR	WELL	WHAT	ABOUT	ALL
THATS	OH	ONE	ARE	RIGHT	THEM	AT	THERE	MY	MEAN
DONT	NO	WITH	IF	WHEN	CAN				

Figure 3 The most common CW abbreviations Q-codes, Prosigns, and most used words.

***United States – State, Territory, and Commonwealth Abbreviations***

<b>United States – State, Territory, and Commonwealth Abbreviations</b>							
<b>AL</b>	Alabama	<b>AK</b>	Alaska	<b>AR</b>	Arkansas	<b>AZ</b>	Arizona
<b>CA</b>	California	<b>CO</b>	Colorado	<b>CT</b>	Connecticut	<b>DE</b>	Delaware
<b>FL</b>	Florida	<b>GA</b>	Georgia	<b>HI</b>	Hawaii	<b>IA</b>	Iowa
<b>ID</b>	Idaho	<b>IL</b>	Illinois	<b>IN</b>	Indiana	<b>KS</b>	Kansas
<b>KY</b>	Kentucky	<b>LA</b>	Louisiana	<b>ME</b>	Maine	<b>MD</b>	Maryland
<b>MA</b>	Massachusetts	<b>MI</b>	Michigan	<b>MN</b>	Minnesota	<b>MO</b>	Missouri
<b>MS</b>	Mississippi	<b>MT</b>	Montana	<b>NC</b>	North Carolina	<b>ND</b>	North Dakota
<b>NE</b>	Nebraska	<b>NH</b>	New Hampshire	<b>NJ</b>	New Jersey	<b>NM</b>	New Mexico
<b>NV</b>	Nevada	<b>NY</b>	New York	<b>OH</b>	Ohio Nevada	<b>OK</b>	Oklahoma
<b>OR</b>	Oregon	<b>PA</b>	Pennsylvania	<b>RI</b>	Rhode Island	<b>SC</b>	South Carolina
<b>SD</b>	South Dakota	<b>TN</b>	Tennessee	<b>TX</b>	Texas	<b>UT</b>	Utah
<b>VA</b>	Virginia	<b>VT</b>	Vermont	<b>WA</b>	Washington	<b>WI</b>	Wisconsin
<b>WV</b>	West Virginia	<b>WY</b>	Wyoming	<b>DC</b>	Washington D.C.	<b>AS</b>	American Samoa
<b>GU</b>	Guam	<b>MP</b>	Northern Mariana Is.	<b>PR</b>	Puerto Rico	<b>VI</b>	U.S. Virgin Is.
<b>FM</b>	Micronesia	<b>MH</b>	Marshall Islands	<b>PW</b>	Palau		
Color Key							
	State		Federal District		Commonwealth		Freely Associated State

Table 13 United States – State, Territory, and Commonwealth Abbreviations.



### *The Most Common Procedural Signs (or Prosigns) for Morse Code*

The following table shows the most commonly used procedure signs (Prosigns) used in Morse Code. When sending a Prosign you send the characters together. Prosigns like  $\overline{AK}$  are shown with an overbar. You might also see them show like <SK>. Either designation is your clue to run the characters together.

Prosign	Meaning	Code symbol	Explanation
$\overline{AR}$	<EOM>	■ ■ ■ ■ ■ ■ ■ ■	End of message. $\overline{AR}$
$\overline{AS}$	Stand by	■ ■ ■ ■ ■ ■ ■ ■	Stand by or wait.
$\overline{BK}$	Break-In	■ ■ ■ ■ ■ ■ ■ ■ ■ ■	Emergency break-in.
$\overline{BT}$	Pause	■ ■ ■ ■ ■ ■ ■ ■	Separation (pause while you are thinking).
$\overline{HH}$	Error	■ ■ ■ ■ ■ ■ ■ ■ ■ ■	Sent when you made an error and need to start over. You may here some folks using six dits instead of eight. They call this a shortcut or cut word.
$\overline{SK}$	End of contact	■ ■ ■ ■ ■ ■ ■ ■ ■ ■	Indicates the end of the QSO or contact.

Table 14 Commonly used Procedural Signs (Prosigns).

The following Prosigns are sent as normal characters with the normal 1-element spacing.

Prosign	Meaning	Code symbol	Explanation
AA	All after	■ ■■■■ ■ ■■■■	Please resend all after ...
AB	All before	■ ■■■■ ■■■■ ■■■■	Please send all before ...
BN	All between	■■■■ ■■■■ ■■■■ ■■■■	Please send all between.
CL	Closing station	■■■■ ■■■■ ■■■■ ■■■■ ■■■■	Shutting down station.
CQ	Call any station	■■■■ ■■■■ ■■■■ ■■■■ ■■■■ ■■■■	General call to any station. CQ CQ CQ DE AB9MZ.
DE	This is	■■■■ ■■■■ ■■■■	[his/her callsign] this is [Your callsign].
K	Over	■ ■■■■ ■■■■	Over to you.
SOS	Save our ship	■■■■ ■■■■ ■■■■ ■■■■ ■■■■ ■■■■	Calling for emergency assistance. This applies to any emergencies, not just those on ships.
?	Say again	■■■■ ■■■■ ■■■■ ■■■■	Can be used to ask a question or to fill in missing letters. Ask how they copied what you sent. HW CPY ? Ask to fill in missing letters in a callsign. AB9?Z

Table 15 Additional procedural signs.

## CW Abbreviations

<b>A</b>		
AA	→	--All after
AA	→	--End Of Line
AB	→	--All before
ABT	→	--About
ADEE	→	--Addressee
ADR	→	--Address
ADS	→	--Address
AGN	→	--Again
AM	→	--Amplitude Modulation
ANI	→	--Any
ANS	→	--Answer
ANT	→	--Antenna
AR	→	--End of message
AS	→	--Stand by; wait
AT	→	--used for the @ sign for E-Mail Addresses
	→	--New proposal is AC run together
<b>B</b>		
B	→	--More to follow
BCI	→	--Broadcast Interference
BCL	→	--Broadcast Listener
BCNU	→	--Be seeing you
BD	→	--Bad
BK	→	--Break, Break in
BN	→	--All between; Been
BT	→	--Separation (break)
BTH	→	--Both
BTR	→	--Better
BTW	→	--By The Way
BUG	→	--Semi-Automatic key
BURO	→	--Bureau
B4	→	--Before
<b>C</b>		
C	→	--Yes, Correct
CB	→	--CallBook
CBA	→	--Callbook Address
CFM	→	--Confirm; I confirm
CK	→	--Check
CKT	→	--Circuit
CL	→	--I am closing my station; Call
CLBK	→	--Callbook
CLD	→	--Called
CLG	→	--Calling
CMG	→	--Coming
CNT	→	--Can't
CONDX	→	--Conditions
CPI	→	--Copy
CQ	→	--Calling any station
CRD	→	--Card
CS	→	--Call Sign
CU	→	--See You
CUAGN	→	--See You Again
CUD	→	--Could
CUL	→	--See You later
CUM	→	--Come
CUZ	→	--Because
CW	→	--Continuous wave
<b>D</b>		
DA	→	--Day
DE	→	--From, This Is
DIFF	→	--Difference
DLD	→	--Delivered
DLVD	→	--Delivered
DN	→	--Down
DR	→	--Dear
DSW	→	--Russian CW abbreviation for goodbye
DWN	→	--Down
DX	→	--Distance
<b>E</b>		
EL	→	--Element
ES	→	--And
ENUF	→	--Enough
EU	→	--Europe
EVE	→	--Evening
<b>F</b>		
FB	→	--Fine Business, excellent
FER	→	--For
FM	→	--Frequency Modulation: From
FONE	→	--Phone
FQ	→	--Frequency
Freq	→	--Frequency
FWD	→	--Forward
<b>G</b>		
GA	→	--Go ahead; Good Afternoon
GB	→	--Good bye, God Bless
GD	→	--Good, Good Day
GE	→	--Good Evening
GESS	→	--Guess
GG	→	--Going
GLD	→	--Glad
GM	→	--Good morning
GN	→	--Good night
GND	→	--Ground
GP	→	--Ground Plane
GS	→	--Green Stamp
GUD	→	--Good
GV	→	--Give
GVG	→	--Giving
<b>H</b>		
HH	→	--Error in sending
HI	→	--The telegraph laugh; High
HPE	→	--Hope
HQ	→	--Headquarters
HR	→	--Here; Hear, Hour
HRD	→	--Heard
HRS	→	--Hours
HRD	→	--Heard
HV	→	--Have
HVG	→	--Having
HVY	→	--Heavy
HW	→	--How, How Copy?
<b>I</b>		
II	→	--I Repeat
II	→	--Short form of HH
IMI	→	--Repeat, Say Again
INFO	→	--Info
<b>J</b>		
JA	→	--Japanese Station
<b>K</b>		
K	→	--Invitation To Transmit
KA	→	--Beginning of message
KLIX	→	--Key Clicks
KN	→	--Go only, invite a specific station to transmit
<b>L</b>		
LID	→	--A poor operator
LNG	→	--Long
LP	→	--Long Path
LSN	→	--Listen
LTR	→	--Later; letter
LV	→	--Leave
LVG	→	--Leaving
LW	→	--Long Wire., Long Wave
<b>M</b>		
MA	→	--Mill amperes
MGR	→	--Manager
MI	→	--My
MILL	→	--Typewriter
MILS	→	--Mill amperes
MNI	→	--Many

Figure 4 Full list of CW abbreviations (1 of 2).

MOM	→	->Moment
MSG	→	->Message; Prefix to radiogram
MULT	→	->Multiplier
<b>N</b>		
N	→	->No, Negative, Incorrect, No More
N	→	->Nine (as in Signal Report)
NCS	→	->Net Control Station
ND	→	->Nothing Doing
NIL	→	->Nothing; I have nothing for you;
	→	->Not In Log
NM	→	->No more
NR	→	->Number, Near
NW	→	->Now; I resume transmission
<b>O</b>		
OB	→	->Old boy
OC	→	->Old chap
OK	→	->Correct
OM	→	->Old man
OP	→	->Operator
OPR	→	->Operator
OT	→	->Old timer; Old top
OW	→	->Old Woman
<b>P</b>		
PBL	→	->Preamble
PKG	→	->Package
PSE	→	->Please
PT	→	->Point
PWR	→	->Power
PX	→	->Press, Prefix
<b>R</b>		
R	→	->Received as transmitted
RC	→	->Rag chew
RCD	→	->Received
RCVR	→	->Receiver
RE	→	->Concerning; Regarding
REF	→	->Refer to; Referring to; Reference
RFI	→	->Radio frequency interference
RIG	→	->Station equipment
ROTFL	→	->Rolling on the floor laughing
RPT	→	->Repeat, Report
RTTY	→	->Radio teletype
RST	→	->Readability, strength, tone
RX	→	->Receive, Receiver
<b>S</b>		
SA	→	->Say
SASE	→	->Self-addressed, stamped envelope
SED	→	->Said
SAE	→	->Self-Addressed Envelope
SEZ	→	->Says
SGD	→	->Signed
SHUD	→	->Should
SIG	→	->Signature; Signal
SINE	→	->Operator's personal initials or
	→	->nickname
SK	→	->Out; clear, end of contact;
	→	->no reply expected (Silent Key)
SKED	→	->Schedule
SN	→	->Soon
SP	→	->Short Path
SRI	→	->Sorry
SS	→	->Sweepstakes
SSB	→	->Single Side Band
STN	→	->Station
SUM	→	->Some
SVC	→	->Service; Prefix to service message
SWL	→	->Short Wave Listener
/ST	→	->Short timer on check in
<b>T</b>		
T	→	->Zero (with numbers)
TEMP	→	->Temperature
TEST	→	->Testing or Contest
TFC	→	->Traffic
TIA	→	->Thanks In Advance
TMW	→	->Tomorrow
TKS	→	->Thanks
TNX	→	->Thanks
TR	→	->Transmit
T/R	→	->Transmit/Receive
TRBL	→	->Trouble
TRIX	→	->Tricks
TRX	→	->Transceiver
TT	→	->That
TTS	→	->That is
TU	→	->Thank you
TVI	→	->Television interference
TX	→	->Transmitter; Transmit
TXT	→	->Text
<b>U</b>		
U	→	->You
UFB	→	->Ultra Fine Business
UNLIS	→	->Unlicensed
UR	→	->Your; You're
URL	→	->Universal Resource Locator
	→	->Address for a Webpage
URS	→	->Yours
<b>V</b>		
VE	→	->Understood (VE)
VERT	→	->Vertical
VFB	→	->Very fine business
VFO	→	->Variable Frequency Oscillator
VY	→	->Very
<b>W</b>		
W	→	->Watts
WA	→	->Word after
WATSA	→	->What Say
WB	→	->Word before
WD	→	->Word
WDS	→	->Words
WID	→	->With
WKD	→	->Worked
WKG	→	->Working
WL	→	->Well; Will
WPM	→	->Words Per Minute
WRD	→	->Word
WRK	→	->Work
WUD	→	->Would
WW	→	->Would
WX	→	->Weather
<b>X</b>		
XCVR	→	->Transceiver
XMAS	→	->Christmas
XMTR	→	->Transmitter
XTAL	→	->Crystal
XYL	→	->Wife
<b>Y</b>		
YF	→	->Wife
YL	→	->Young lady
YR	→	->Year
<b>Z</b>		
Z	→	->Zulu Time
30	→	->I have no more to send
33	→	->Fondest Regards
55	→	->Best Success
73	→	->Best Regards (NOT 73's)
88	→	->Love and kisses (NOT 88'S)
161	→	->73+88=161 "Best regards to you
	→	->and your XYL"
?	→	->question.....Section Break (Continuous).....

Figure 5 Full list of CW abbreviations (2 of 2).

**Q-Codes**

<b>International Q Signals</b> .....Section Break (Continuous).....	
A Q signal followed by <u>a</u> ? asks a question. ¶	
A Q signal without <u>the</u> ? answers the question affirmatively, unless otherwise indicated. ¶	
.....Section Break (Continuous).....	
<b>QRA</b> → What is the name of your station?¶	<b>QSG</b> → Shall I send _____ messages at a time?¶
<b>QRG</b> → What's my exact frequency?¶	<b>QSK</b> → Can you work break-in?¶
<b>QRH</b> → Does my frequency vary?¶	<b>QSL</b> → Can you acknowledge receipt?¶
<b>QRI</b> → How is my tone? (1-3)¶	<b>QSM</b> → Shall I repeat the last message sent?¶
<b>QRK</b> → What is my signal intelligibility? (1-5)¶	<b>QSO</b> → Can you communicate with _____ direct?¶
<b>QRL</b> → Are you busy?¶	<b>QSP</b> → Will you relay to _____?¶
<b>QRM</b> → Is my transmission being interfered with?¶	<b>QSV</b> → Shall I send a series of V's?¶
<b>QRN</b> → Are you troubled by static?¶	<b>QSW</b> → Will you transmit on _____?¶
<b>QRO</b> → Shall I increase transmitter power?¶	<b>QSX</b> → Will you listen for _____ on _____?¶
<b>QRP</b> → Shall I decrease transmitter power?¶	<b>QSY</b> → Shall I change frequency?¶
<b>QRQ</b> → Shall I send faster?¶	<b>QSZ</b> → Shall I send each word/group more than once?¶
<b>QRS</b> → Shall I send slower?¶	→ (Answer, send twice or _____)¶
<b>QRT</b> → Shall I stop sending?¶	<b>QTA</b> → Shall I cancel number _____?¶
<b>QRU</b> → Have you anything for me? (Answer in negative)¶	<b>QTB</b> → Do you agree with my word count? (Answer negative)¶
<b>QRV</b> → Are you ready?¶	<b>QTC</b> → How many messages have you to send?¶
<b>QRW</b> → Shall I tell _____ you're calling him?¶	<b>QTH</b> → What is your location?¶
<b>QRX</b> → When will you call again?¶	<b>QTR</b> → What is your time?¶
<b>QRZ</b> → Who is calling me?¶	<b>QTV</b> → Shall I stand guard for you _____?¶
<b>QSA</b> → What is my signal strength? (1-5)¶	<b>QTX</b> → Will you keep your station open for further → communication with me?¶
<b>QSB</b> → Are my signals fading?¶	<b>QUA</b> → Have <u>you</u> news of _____?.....Section Break (Continuous).....
<b>QSD</b> → Is my keying defective?¶	

Figure 6 Q-Codes (Q-Signals).

**ARRL QN Signals for CW NET Use**

The QN signals listed below are special ARRL signals for use in amateur cw nets only. They are not for use in casual amateur conversation. Other meanings that may be used in other services do not apply. Do not use QN signals on phone nets. Say it with words. QN signals need not be followed by a question mark, even though the meaning may be interrogatory.

Section Break (Continuous)

<p><b>QNA*</b> → Answer in prearranged order.</p> <p><b>QNB*</b> → Act as relay between _____ and _____</p> <p><b>QNC</b> → All net stations Copy. ...I have a message for all net stations.</p> <p><b>QND*</b> → Net is Directed (controlled by net control station).</p> <p><b>QNE*</b> → Entire net stand by.</p> <p><b>QNF</b> → Net is Free (not controlled).</p> <p><b>QNG</b> → Take over as net control station.</p> <p><b>QNH</b> → Your net frequency is High.</p> <p><b>QNI</b> → Net stations report In.* ...I am reporting into the net. → (Follow with a list or traffic or QRU).</p> <p><b>QNJ</b> → Can you copy me? → Can you copy _____?</p> <p><b>QNK*</b> → Transmit message for _____ to _____</p> <p><b>QNL</b> → Your net frequency is Low.</p> <p><b>QNM*</b> → You are QRMing the net. ...Stand by.</p> <p><b>QNN</b> → Net control station is _____, → What station has net control?</p> <p><b>QNO</b> → Station is leaving the net.</p>	<p><b>QNP</b> → Unable to copy you. Unable to copy _____</p> <p><b>QNQ*</b> → Move to <u>frequency</u> _____ and wait for _____ to _____ → finish handling traffic. Then send him traffic for _____</p> <p><b>QNR</b> → Answer _____ and Receive traffic.</p> <p><b>QNS*</b> → Following Stations are in the net. *(Follow with list.) → Request a list of stations in the net.</p> <p><b>QNT</b> → I request permission to leave the net for _____ minutes.</p> <p><b>QNU*</b> → The net has traffic for you. Stand by.</p> <p><b>QNV*</b> → Establish contact with _____ on this frequency. If successful, move to frequency _____ and send him traffic for _____</p> <p><b>QNW</b> → How do I route messages for _____?</p> <p><b>QNX</b> → You are excused from the net. → * Request to be excused from the net.</p> <p><b>QNY*</b> → Shift to another frequency _____ → (or to _____ kHz) to clear traffic with _____</p> <p><b>QNZ</b> → Zero beat your signal with mine. → I will zero beat my signal with yours. ....</p>
--	---

Section Break (Continuous)

**\* For use only by the Net Control Station.**

Figure 7 QN-Codes (QN-Signals)

## RST (Readability Signal Tone)

Signal reports are helpful for quickly communicating how well both stations are receiving each other. For CW, the report is composed of three numbers — **Readability**, **Signal strength**, and **Tone**. The most common reports are **559** and **339**. The first **RST** of **559** indicates an extremely strong signal that is perfectly copyable with perfect tone. In contrast, an **RST 339** indicates a readable signal with some difficulty while copying a weak signal with perfect tone.

**Signal strength** and **Tone** numbers range from **1** to **9**, while Readability ranges from **1** to **5**. On occasion, an additional letter is appended to the **RST**. **C** indicates there is a **Chirp**, such as **559C**. The letter **A** indicates **Aurora flutter**. And the letter **K** indicates a problem with **key clicks**.

Because **S-meters** are rarely calibrated, **consider describing the Signal strength relative to your band noise, QRM**, and other stations. Anything below **5** means you are having trouble hearing the other station. Strength **5, 6, or 7** means that the other station is above the **general noise**. **S8** means the signal is **well above the noise**, and **S9** is **strong**.

In contests, an **RST** of **599** is virtually always used. To save time you can use a cut number like **5NN** instead of **599** to keep things simple and let you focus on the contest and making contacts. However, outside of contest exchanges, please consider providing honest and useful **RST** reports. It will help the other operator evaluate what to send, such as choosing to **send critical information twice** or **slowing down**.

When communicating with others the **Readability, Signal Strength, and Tone (RST)** report you give lets the other party know how their signal is being received by you. The **tone signal report** is only used with CW communications. It serves no purpose in voice or digital modes.

UR RST 579 579

Table 16 Use cut numbers 5NN instead of 599 during a contest.

Readability	Signal	Tone	Value
Not Used	Extremely strong signals	Perfect tone	9
Not Used	Strong signals	Near perfect tone	8
Not Used	Moderately strong signals	Near pure tone	7
Not Used	Good signals	Filtered tone	6
Perfectly readable	Fairly good signals	Filtered rectified	5
Readable with practically no difficulty	Fair signals	Rough note	4
Readable with considerable difficulty	Weak signals	Rough a.c. tone	3
Barely readable, occasional words distinguishable	Very weak signals	Very rough	2
Unreadable	Signals barely perceptible	Sixty cycle a.c. or less	1

Table 17 Signal Report (Readability, Signal Strength, and Tone) (RST))

## Appendix B - How to Make a Short CW Contact

CWOps Academy Advisor - **Ken** AC5EZ

*If you call CQ, the calling sequence looks like this:*

**CQ CQ CQ DE** [your callsign] [your callsign] **K**

*A station answers your CQ call:*

[your callsign] [your callsign] **DE** [his/her callsign] [his/her callsign] **K**

*You respond:*

[his/her callsign] **DE** [your callsign]

**TNX FER CALL UR RST** [your rpt] [your rpt]

**NAME** [your name] [your name]

**QTH** [your QTH] [your QTH]

**HW CPY?** [his/her callsign] **DE** [your callsign] **K**

*The other station responds:*

[your callsign] **DE** [his/her callsign]

**TNX** [your name or call sign] **UR RST** [his/her rpt] [his/her rpt]

**NAME IS** [his/her name] [his/her name]

**QTH** [his/her QTH] [his/her QTH]

**HW CPY?** [your callsign] **DE** [his/her callsign] **K**

*You have an option to “say goodbye” or continue the QSO (on the next page)*

*Closing the QSO “saying goodbye”*

Table 18 How to Make a Short CW Contact (1 of 2).



```
[his/her callsign] DE [your callsign]
TNX [his/name name] VY NICE TO MEET U
73 ES CUL SK
[his/name callsign] DE [your callsign] K
```

*The other station might say:*

```
[your callsign] DE [his/her callsign]
TNX [your name] FER QSO
73 [your callsign] DE [his/her callsign]
E E
```

*And you may respond:*

```
E E
```

*You can continue the QSO with the following:*

```
[his/her callsign] DE [your callsign]
```

*Then you can respond with any or all of these lines:*

```
Solid copy [his/her name] rig here is [your transceiver]
ANT is [your antenna] up [how high]
WX here is [temperature] deg F and [weather condition]
HW CPY? [his/her callsign] DE [your callsign] K
```

*The other station might respond with his/her information:*

*When you're finished ready to close the QSO go back to "Closing the QSO" above.*

Table 19 How to Make a Short CW Contact (2 of 2).

## Appendix C - Morse Code Ninja's Advice for Beginners and Beyond

By the Morse Code Ninja

### DOs

- Realize that learning Morse code is not hard. However, it takes diligent practice to become proficient. Think of it as learning to play the piano, but without taking years to become proficient.
- Learn the characters using the [Koch](#) or [Farnsworth](#) method. Try both. One approach will work better for you than the other.
- Learn the characters at a speed of **20 wpm**. If using the Farnsworth method, increase the spacing between characters and words to start with an overall speed of 10 wpm. If you can count the dits and dahs, start at a higher character speed. You may need to go as high as **30 wpm**.
- Develop a habit of practicing regularly. More frequent practice for shorter periods is more effective than fewer more extended sessions. Ideally, practice twice a day for 10 to 15 minutes every day.
- Set a goal for the level of proficiency you want to achieve and write it down. This simple act will improve your chances of accomplishing your goal! Read [this](#) for more details.
- Keep a log of your practice and proficiency. Look back on it when you fail to see all the progress you have made. Persistence pays off.
- If you get bored with your practice routine, change it up. Keep it fresh and fun. Perhaps practice with a friend.
- Learn to copy all the characters before learning to send. This will help you listen for the sound pattern of characters instead of counting dits and dahs.
- If you run into difficulty, seek out the help and advice of an Elmer.
- Use efficient practice methods and techniques. Some methods are not efficient compared to others and will take you longer to reach your goals. Seek out the advice of an Elmer if you do not see the progress you expect.
- Consider learning or improving your proficiency with Morse code by taking a [CW Academy](#) class. It is a free online class where you can get personalized guidance.
- Protect your hearing! Listen to Morse code at the lowest usable volume, especially if using headphones.

***DON'Ts***

- Don't learn Morse code at **5 wpm!**
- Don't use Morse code sound-alikes! It is tough to let go of this mnemonic as you transition to higher speeds.
- Don't use a Morse code tree or any other kind of visual representation to learn Morse code.
- Don't memorize the sequence of dits and dahs for each character. Conscious thinking is slow compared to the unconscious mind's ability to process information. Using a lookup table is difficult, and it will prevent you from going faster than 10 to 13 wpm.
- Avoid repeating characters in your mind. Work to develop Instant Character Recognition.
- Don't learn to send without continuous evaluation of your timing. Use an elmer or software to monitor your progress. It can be challenging to break bad habits formed early on.
- Avoid becoming tense and stressed as you practice. If you miss a letter or word, let it go.

Resources for Learning Morse Code V1.0

### *So, you want to go faster:*

At some point in our Morse code journey, we all yearn to copy faster. However, as a reminder, accuracy should always trump speed in the real-world. If you are working at a higher speed than your proficiency or band conditions allow, at best, you may frustrate yourself and the other operator. And at worst, you may fail to communicate successfully.

So, what does it take to go faster? In short, it requires learning to operate at a higher proficiency, as shown in the diagram to the right. Knowing this and achieving it are two different things. First, let us cover some theory, and then we will look at approaches to move from one proficiency level to the next.

There are two types of mental processes — conscious and unconscious. The conscious mind is amazing. It allows us to solve complex and difficult problems, such as a calculus homework assignment. It empowers us to engage in abstract, logical, and analytical thinking. Anytime we stop to focus and concentrate, we are almost certainly employing our conscious mind. The downside is how slow it is compared to the unconscious mind!

By comparison, the unconscious mind is lightning fast. It is effortless, automatic, and continuous. It is also where the majority of our information processing takes place. The unconscious mind feeds higher-level information to the conscious mind. For example, in everyday conversation, our

unconscious mind does all of the hard work of interpreting phonemes, words, and grammatical structure. It also allows our conscious mind to focus on the meaning of what is being said, and it enables us to understand someone casually talking at **150 wpm** effortlessly.

The unconscious mind's lightning-fast ability to process information is the key to copying code faster. As a general principle, as the Morse code speed increases, a larger amount of the processing and interpretation must be done by the unconscious mind. And this is directly related to the four levels of Morse code proficiency.

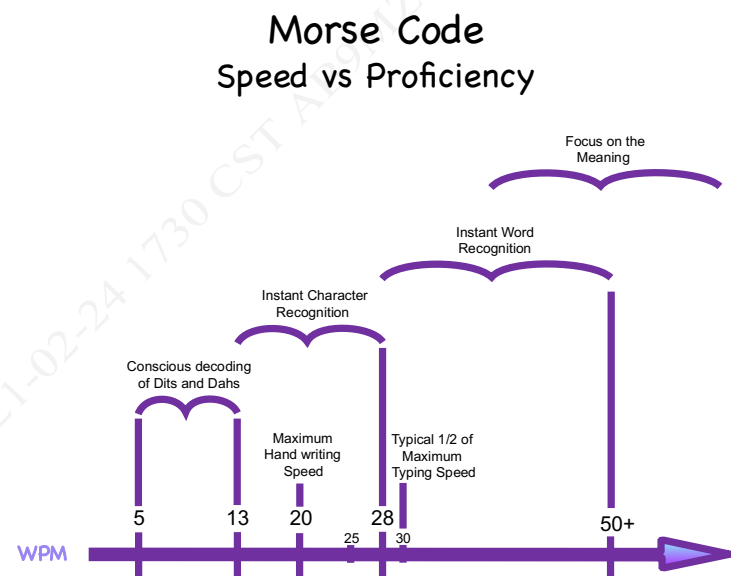


Figure 8 Morse code speed vs proficiency.

### ***Levels of Morse code proficiency:***

- Conscious decoding of Dits and Dahs.
- Instant Character Recognition.
- Instant Word Recognition.
- Focus on the Meaning.

Before we dive into these levels, it is helpful to understand that they are not used exclusively. It is not uncommon to shift back and forth. As an analogy, consider the act of breathing. It is nearly always under the control of the unconscious mind. But by drawing our focus to it, we may control it with our conscious mind. With enough experience, it is possible to shift our Morse code proficiency level to best match the context and speed of the code being copied. For example, a call sign must be copied character by character, while a word can be copied as a complete sound pattern.

So, what are the four proficiency levels? And how do they relate to your ability to copy at higher speeds?

#### **1. Conscious decoding of Dits and Dahs in Your Head**

At this proficiency level, you actively (consciously) listen to the dits and dahs. Once there is a word or inter-word space, the sequence of dits and dahs is looked up in your conscious mind to identify the character being sent. For example, you might hear Di-Dah-Dit, think Dit - Dah - Dit, and then look up the sequence to identify it as the letter R.

If you find yourself repeating the sound pattern in your mind, you may also be at this level.

At this basic proficiency level, the conscious mind is doing all of the work to decode and interpret the Morse code! And because the conscious mind is so much slower than the unconscious mind, you will be unable to go faster than 10 to 13 words a minute at this level.

If you learn Morse code at **5 wpm**, using sound-a-likes, memorization charts, or other learning-aids, you will inevitably start your Morse code journey at this proficiency level. This is not advised since you may inevitably get stuck and unable to copy code beyond **13 wpm**. Some people get stuck for years despite heroic efforts to overcome it! And others transition to higher speeds without much of a problem.

## 2. Instant Character Recognition (ICR)

At this level of proficiency, the unconscious mind is doing the hard work of instantly recognizing each letter as it is sent. The characters are recognized instantly and effortlessly. For example, when you hear **di-dah-dit**, you think of the letter **R**. Then the slow, conscious mind follows letter by letter to form words, abbreviations, and callsigns.

To begin learning Morse code with **ICR (Instant Character Recognition)**, you will need to use either the **Farnsworth** or **Koch Method**.

The **Koch Method** is a learning technique named after German psychologist **Ludwig Koch**. With this method, the full target speed is used, starting with just two letters. Once strings containing those two characters can be copied with **90%** accuracy, an additional character is added. This step is repeated until the full character set is mastered.

The **Farnsworth method** is a learning technique named after **Donald R. "Russ" Farnsworth (F6TTB)**. With this method, you are taught to copy characters at their full and standard speed. However, the spacing is lengthened between characters and words, which gives you time to think about the sound pattern you just heard. Typically, students start with a character speed of **20 wpm** and an effective speed of **10 wpm**. Like the **Koch method**, students start with two characters and continue to add characters as soon as they reach **90%** accuracy.

The key to mastering **ICR** with the Koch Method and Farnsworth Method is to ensure that you learn the sound pattern of characters at a speed of at least **20 wpm**. If you can count the dits and dahs at **20 wpm**, you will need to learn at a higher speed, probably **25 to 30 wpm**. Otherwise, it is almost impossible to avoid counting the dits and dahs. And with the Farnsworth method, you will need to use an overall speed that prevents you from repeating the sound pattern in your head. Typically, an overall speed of **10 wpm** is sufficient.

Does it matter how you copy with **ICR**? Yes! It will affect the maximum speed you can achieve, which may be anywhere from **20 to 30 wpm**. There are three ways that you can copy Morse code using **ICR** and the previous proficiency level of Conscious Decoding of Dits and Dahs.

**Pencil-Copy:** With this method, each letter is written down on paper after being instantly recognized. The speed limit comes down to the fact that people cannot write very fast, and it is tiresome. Even using a modified printing style for speed, most people will only sustain **20 wpm** while putting each letter down on paper.

This method is often employed at slower speeds since it does not require a computer, it is simple to learn, and it alleviates the conscious mind from having to keep track of a sequence of letters to form words and abbreviations. And it frees the conscious mind from keeping track of more higher-level statements and sentences.

**Keyboard-Copy:** With this method, each letter is typed on a keyboard. Instead of hearing **di-dah-dit** and thinking of the letter **R**, you associate the **di-dah-dit** sound pattern with pressing the letter **R** on a keyboard.

With keyboard-copy, the unconscious mind is doing even more of the work compared to **ICR** with pencil-copy. And the interpretation of the meaning often comes from reading the words and abbreviations formed on the screen! This can create an odd sensation when the conscious mind does not know what is being sent until it is read on the screen!

Keyboard-copy is faster than pencil-copy. Our continuous keyboard-copy ability will be half our steady typing speed. For instance, most proficient touch typists can sustain a typing speed of **60 wpm**, which puts their maximum sustained keyboard-copy speed at **30 wpm**.

**Head-Copy:** With this method, nothing is recorded outside of the mind's eye. Using this method with **ICR**, the unconscious mind does the hard work of instantly recognizing the sound patterns and prompting the conscious mind with each character. The conscious mind must then take on the hard work of following character-by-character to identify words, abbreviations, and then the higher-level meaning of statements and sentences.

If you are head copying, this method is sometimes described as the process of affixing letters on a blank blackboard or tickertape in the mind's eye as each letter is received. Then you read what is on the board. Perhaps, this description is more of an analogy than reality for most people.

Using **ICR** and head copy, most people will max out somewhere between **25** and **30 wpm**. This maximum speed refers to continuous copying. At higher speeds, it is possible to copy a short burst of characters such as a callsign or serial number, which is often a skill developed to participate in contests at **30** to **40 wpm**. The world record for unaided callsign copy is **195 wpm**!!

I recommend starting your Morse code journey learning to head-copy with **ICR**. This will allow you to quickly achieve **25** to **30 wpm** real-world speeds operating on the air, and it will enable you to progress to the next two proficiency levels.

Table 20 Copying Methods.

### 3. Instant Word Recognition (IWR)

At this proficiency level, the unconscious mind does most of the hard work. You hear the sound pattern of entire words and abbreviations as a whole, and then you instantly and effortlessly recognize them. While the unconscious mind does a lot of hard work, the conscious mind must keep track of words and the grammatical structure to form meaningful sentences. For example, you hear *dah-di-dah-dit dah-dah-di-dah* and think **CQ**.

This proficiency level often allows users to achieve speeds of **50 wpm** or greater with enough practice, and it is nearly always done with head-copy. It is interesting to note that this level of proficiency often develops early on with real-world practice. It is common to learn the sound pattern of **CQ**, **599**, **5NN**, **TEST**, and your callsign without trying to learn them as sound patterns, and you can copy them at much higher speeds than anything else.

Gaining proficiency at this level is a matter of building up a vocabulary of sound patterns. Consider the following ABC's of success to master **IWR (Instant Word Recognition)**.

#### The ABC's of success

- A. Learn the sound pattern of words and abbreviations at or slightly above your maximum **ICR** speed. Working at that speed will encourage you to focus on the word's entire sound pattern and not follow letter-by-letter. It's analogously to why we learn **ICR** at a character speed of **20 Words Per Minute (wpm)** or faster — in that case, we want to avoid focusing on individual dits and dahs.
- B. After learning to copy the sound pattern of individual words, strive to copy two and then three words at a time. You may find my n-gram Morse code practice sets useful in developing this skill — Sets of 2 Words and Sets of 3 Words — and perhaps using them at 30wpm. They are based on the most common two and three-word combinations in the English language. And because they are so common and familiar, it helps ease copying multiple words for the first time. If you copy one of the words, you may easily guess the missing word(s).

Copying multiple words at a time is mostly a matter of giving your conscious mind enough space or mental capacity to take on the challenge of remembering several words at a time.

- C. After learning to copy handfuls of words at a time, strive to master copying an entire sentence. I recommend starting with the easiest sentences made up of the most common 100 words in the English language. And then move on to sentences that use larger vocabularies. You may find my practice sets — Sentences from the Top 100 Words, Sentences from the Top 200 Words, and so on — very useful.

Once you have built up a vocabulary of sound patterns at a given speed and understand them in statements and sentences, it is straightforward to increase your maximum copy speed. Diligently and incrementally, practice at ever faster speeds to reach your goal.

As a tip, if you listen to Morse code without headphones, pay close attention to any echo in the room. You may need to make adjustments to minimize echo, which can interfere with clearly hearing Morse code at or above **40 wpm**.

Table 21 The ABC's of success



#### 4. Focus on the Meaning of the Message

At this proficiency level, the unconscious mind is doing all of the hard work! The conscious mind is free to focus on the meaning of what is being sent. This level of proficiency is the nirvana that most aspire to achieve. It is equivalent to listening to someone talk to you in your primary language. It is easy and effortless.

This level of proficiency develops with extensive practice and experience. As the unconscious mind takes on ever greater responsibility, it increasingly frees up the conscious mind to focus on the meaning.

If you would like to watch my talk on Morse code Proficiency vs Speed, feel free to watch the 17-minute YouTube video below.

<https://youtu.be/5BlhhBK1CBw>

## ***The Dirty Dozen:***

If you are running into difficulties learning Morse code, consider the following dirty dozen. They are twelve interrelated problems caused primarily by improper teaching or self-learning techniques coupled with bad habits formed during the learning and proficiency improvement process. Most students encounter one or more of these problems through the course of gaining proficiency. (The credit for this section goes to Jack Ritter, [W0UCE](#), Silent Key. The entire article can be found [here](#).)

**1) Anticipating what is being sent:** A common problem develops when paper and pencil are used to write or print each letter as it is sent versus learning to copy complete words by their distinct rhythm and sound by ear.

*For example, the letters A N Y are written down individually, and the person copying them down is focused on each letter. They have no idea of words or sentence flow. They are not learning to use Morse as a language and are merely copying down individual characters. Then if the next letter to follow ANY is W, the mind's eye anticipates ANYWAY or ANYWHERE. If a different letter than what is expected follows, their focus is diverted. This is the problem with anticipation.*

*The most efficient way to overcome anticipation is to learn to recognize complete words by their unique sound and rhythm while learning to copy by ear and copying behind. Practice identifying the sound and rhythm of the most common double letter, two and three letter combinations based upon the frequency of usage in the English language helps to form word sounds.*

- Common double letter combinations:  
ll, ee, ss, tt, oo, mm, ff, pp, rr, nn, cc, dd.
- The thirty most frequent two-letter combinations comprise one third of all letter usage:  
th, he, in, er, an, re, on, en, at, es, ed, te, ti, or, st, ar, nd, to, nt, is, of, it, al, as, ha, ng, co, se, me, and de.
- *The most common three-letter combinations are:*  
the, and, tio, ati, for, tha, ter, res, ere, con, ted, com, hat, ent, ion, nde, has, ing.

**2) Attention loss, lack of accuracy:** Attention loss is often related to Problem 10 during the learning phase and often causes frustration. Practice sessions should not exceed thirty minutes in duration. Break up practice sessions in ten or fifteen-minute increments. And practice thirty minutes a day, seven days a week.

*Lack of accuracy is related to Problems 1, 3, 4, 6, 7, and 10. There is no substitute or better way to learn and improve proficiency than learning to copy by ear and only take notes versus putting individual characters on paper. Practices learning the sound of short words then progress to short phrases such as my dog. Then add a follow-on word to start building phrases and sentences. Common QSO exchanges help build confidence to get on the air.*

**3) Counting Dits and Dahs:** Learning Morse code by counting Dits and Dahs is a terrible habit that is difficult to break. Counting is typically caused by learning Morse at **5 or 10** words per minute character speed. While some instructors endorse using the Farnsworth method, adding extra space between characters often leads to unintentional counting. And a long delay can allow a student to replay the sound pattern in their head. (Counting is directly related to Problems 7, 8, 9, and 12.)

*Consider starting with a **20 wpm** character speed with a bit of extra space between short words. For example, TEA followed by EAT. Then progress to three-word phrases. Eliminate extra spaces between words as quickly as possible to learn and use Morse with normal speed and spacing. Why teach or learn at 5 or 10 wpm when it just as easy to learn at **20 wpm**.*

**4) Dit and Dah Transposition:** Transposition is primarily related to learning at slow character speed and tone frequency being either too low or too high for an individual's hearing frequency range. The most common character reversals or transposition are: er-re, es-se, an-na, it-ti, on-no, en-ne, ot-to, ed-de, st-ts, at-ta, ar-ra, in-ni.

*To overcome the problem of transposition, practice copying and sending the numbers 1 through 10.*

**5) Inability to break old habits:** The obvious answer to overcoming this problem is not to develop bad habits in the first place! Bad habits developed in the early learning stage are the most difficult to overcome.

*The key to breaking old habits is to focus on exercises, methods, and techniques that help overcome or break specific old habits. The first step is to determine what bad habits individuals have and make a list. Then focus on overcoming the worst bad habit or habits first. Develop a plan and follow it.*

**6) Inability to copy behind:** This problem is directly related to Problem 12. Until students or those with experience "break the pencil and toss out the paper" and learn to copy entire words by their distinct sound and rhythm, this problem will automatically become problem 5, 8, 9 and 10. And this problem must be broken to become proficient and use Morse code as a language.

*To overcome this problem, set up exercises comprised of short word phrases. Repeat two or three times if necessary and practice retaining phases such as MY RED HAT, HER OLD CAT, BIG BAD BEN, UR RST 599, MY RIG IS A K3.*

**7) Inability to distinguish spaces and timing:** This problem is usually related to learning to copy at slow speed and copying individual letters versus words. Concerning sending, we can tune the bands most any day and hear poorly formed code. This sender is said to have a "bad fist."

*While an experienced instructor will not encourage using code readers, new radios such as the Elecraft K-3 can display Morse as it is sent. Students can benefit by using a Morse display actually to see that they are sending with proper character spacing and timing. Watching a display while practicing sending helps overcome spacing and timing issues.*

**8) Increasing speed:** This problem concerns copying and is directly related to every other problem on the Dirty Dozen List. Identify and address each problem individually. This will make increasing speed easier to achieve.

*Then if you are still stuck, consider that most everyone reaches a "plateau" or bump in the road where they seem to be stuck at a certain speed. To overcome problems with a given plateau or bump in the road, "jump the bump." For example, if you are stuck at 20 wpm, increase the speed to **21** or **22 wpm**. Increasing the speed by even one or two words per minute is the best way to increase receiving speed proficiency.*

**9) Lack of confidence:** This problem is usually related to "getting on the air" and making QSOs. One way to gain confidence is to have QSOs with yourself. Use a code practice oscillator or key the sidetone on a transceiver without going on air. Make up a list of QSO exchanges using different call signs, names, and QTH, and then use it to practice with yourself.

*Even if contesting is not something an individual wants to do, they are excellent confidence builders as the exchanges are short (except for the Sweepstakes) and there are plenty of state QSO parties to take part in. Practice makes perfect.*

**10) Mental fatigue:** This problem is common with many activities and practicing Morse code is no different. Too much too often is not productive. Don't practice when you are tired or just after coming home from a hard day at work. Consider practicing when relaxed, early in the morning when you are fresh, or whenever you have a genuine desire to practice. The latter being the best time. Contest or Radio Sport participants are well aware of what a toll fatigue can do to their performance. Don't overdo it.

**11) Memorization versus hearing words:** This problem is directly related to problems 1, 2, 3, 4, 6, and 7. Until individuals develop the ability to recognize complete words by their sound and rhythm, copying behind, and use Morse as a language, this problem will remain on their bad habit list. To overcome this problem practice copying by ear and copying behind.

**12) Writing or typing each letter as it is heard:** This problem is the significant obstacle standing in the way of becoming proficient in Morse code. It is our worst enemy and by all means, the first bad habit to break. Break the pencil and toss out the writing pad to learn to copy by ear and copy behind. It should be the number one priority for every beginner or anyone with the desire to improve their skill in using Morse code. Learn to use it as a language; this is a rule of thumb to live by.

Table 22 The Dirty Dozen.

## Appendix D - Morse Code History

Source: [https://en.wikipedia.org/wiki/Morse\\_code#Development\\_and\\_history](https://en.wikipedia.org/wiki/Morse_code#Development_and_history)

Early in the nineteenth century, European experimenters made progress with electrical signaling systems, using a variety of techniques including static electricity and electricity from Voltaic piles producing electrochemical and electromagnetic changes. These experimental designs were precursors to practical telegraphic applications.

Following the discovery of **electromagnetism** by **Hans Christian Ørsted** in **1820** and the invention of the **electromagnet** by **William Sturgeon** in **1824**, there were developments in electromagnetic telegraphy in Europe and America. Pulses of electric current were sent along wires to control an electromagnet in the receiving instrument. Many of the earliest telegraph systems used a single-needle system which gave a very simple and robust instrument. However, it was slow, as the receiving operator had to alternate between looking at the needle and writing down the message. In **Morse code, a deflection of the needle to the left corresponded to a dot and a deflection to the right to a dash**. By making the two clicks sound different with one ivory and one metal stop, the single needle device became an audible instrument, which led in turn to the **Double Plate Sounder System**.

### *Morse code receiver, recording on paper tape*

The American artist **Samuel F. B. Morse**, the American physicist **Joseph Henry**, and **Alfred Vail** developed an **electrical telegraph system**. It needed a method to transmit natural language using only electrical pulses and the silence between them. Around **1837**, Morse, therefore, developed an early forerunner to the modern **International Morse code**. **William Cooke** and **Charles Wheatstone** in Britain developed an electrical telegraph that used electromagnets in its receivers. They obtained an English patent in **June 1837** and demonstrated it on the London and Birmingham Railway, making it the first commercial telegraph. **Carl Friedrich Gauss** and **Wilhelm Eduard Weber (1833)** as well as **Carl August von Steinheil (1837)** used codes with varying word lengths for their telegraphs. In **1841**, Cooke and Wheatstone built a telegraph that printed the letters from a wheel of typefaces struck by a hammer.

The **Morse system for telegraphy**, which was first used in about **1844**, was designed to make indentations on a paper tape when electric currents were received. Morse's original telegraph receiver used a mechanical clockwork to move a paper tape. When an electrical current was received, an electromagnet engaged an armature that pushed a stylus onto the moving paper tape, making an indentation on the tape. When the current was interrupted, a spring retracted the stylus and that portion of the moving tape remained unmarked. Morse code was developed so that operators could translate the indentations marked on the paper tape into text messages. In his earliest code, Morse had planned to transmit only numerals and to use a codebook to look up each word according to the number which had been sent. However, the code was soon expanded by **Alfred Vail** in **1840** to include letters and special characters so it could be used more generally. Vail estimated the frequency of use of letters in the English language by counting the movable type he found in the type-cases of a local newspaper in Morristown, New Jersey. The shorter marks were called "dots" and the longer ones "dashes", and the letters most commonly used were assigned the shorter sequences of dots and dashes. This code, first used in **1844**, became known as *Morse landline code* or **American Morse code**.

### ***Comparison of historical versions of Morse code with the current standard.***

1. American Morse code as originally defined.
2. The modified and rationalized version used by Gerke on German railways.
3. The current International Telecommunications Union (ITU) standard.

In the original Morse telegraphs, the receiver's armature made a clicking noise as it moved in and out of position to mark the paper tape. The telegraph operators soon learned that they could translate the clicks directly into dots and dashes, and write these down by hand, thus making the paper tape unnecessary. When Morse code was adapted to radio communication, the dots and dashes were sent as short and long tone pulses. It was later found that people become more proficient at receiving Morse code when it is taught as a language that is heard, instead of one read from a page.

To reflect the sounds of Morse code receivers, the operators began to vocalize a dot as "dit", and a dash as "dah". Dots which are not the final element of a character became vocalized as "di". For example, the letter "c" was then vocalized as "dah-di-dah-dit". Morse code was sometimes facetiously known as "iddy-umpty" and a dash as "umpty", leading to the word "umpteen".

The Morse code, as it is used internationally today, was derived from a much-refined proposal by **Friedrich Clemens Gerke** in **1848** that became known as the "**Hamburg alphabet**". Gerke changed many of the codepoints, in the process doing away with the different length dashes and different inter-element spaces of **American Morse**, leaving only two coding elements, the dot and the dash. Codes for German umlauted vowels and "ch" were introduced. Gerke's code was adopted by the **Deutsch-Österreichischer Telegraphenverein (German-Austrian Telegraph Society)** in **1851**. This finally led to the **International Morse code** in **1865**. The International Morse code adopted most of Gerke's codepoints. The codepoints for "O" and "P" were taken from **Steinheil's code**. A new codepoint was added for "J" since Gerke did not distinguish between "I" and "J". Changes were also made to "X", "Y", "Z". This left only four codepoints identical to the original Morse code, namely "E", "H", "K" and "N", and the latter two have had their dashes lengthened. The original code being compared dates to **1838**, not the code shown in the table which was developed in the **1840s**.

In the **1890s**, Morse code began to be used extensively for early radio communication before it was possible to transmit voice. In the late 19th and early 20th centuries, most high-speed international communication used Morse code on telegraph lines, undersea cables and radio circuits. In aviation, Morse code in radio systems started to be used on a regular basis in the **1920s**. Although previous transmitters were bulky and the spark gap system of transmission was difficult to use, there had been some earlier attempts. In **1910**, the **US Navy** experimented with sending Morse from an airplane. That same year, a radio on the airship America had been instrumental in coordinating the rescue of its crew. Zeppelin airships equipped with radio were used for bombing and naval scouting during World War I, and ground-based radio direction finders were used for airship navigation. Allied airships and military aircraft also made some use of radiotelegraphy. However, there was little aeronautical radio in general use during World War I, and in the **1920s**, there was no radio system used by such important flights as that of **Charles Lindbergh** from New York to Paris in **1927**. Once he and the Spirit of St. Louis were off the ground, Lindbergh was truly alone and incommunicado. On the other hand, when the first airplane

flight was made from California to Australia in **1928** on the Southern Cross, one of its four crewmen was its radio operator who communicated with ground stations via radio telegraph.

Beginning in the **1930s**, both civilian and military pilots were required to be able to use Morse code, both for use with early *communications systems and for identification of navigational beacons* that transmitted continuous two- or three-letter identifiers in Morse code. Aeronautical charts show the identifier of each navigational aid next to its location on the map.

**Radiotelegraphy** using Morse code was vital during **World War II**, especially in carrying messages between the warships and the naval bases of the belligerents. Long-range ship-to-ship communication was by radio telegraphy, using encrypted messages because the voice radio systems on ships then were quite limited in both their range and their security. **Radiotelegraphy** was also extensively used by warplanes, especially by long-range patrol planes that were sent out by those navies to scout for enemy warships, cargo ships, and troop ships.

In addition, rapidly moving armies in the field could not have fought effectively without **radiotelegraphy** because they moved more rapidly than telegraph and telephone lines could be erected. This was seen especially in the blitzkrieg offensives of the Nazi German Wehrmacht in Poland, Belgium, France (in **1940**), the Soviet Union, and in North Africa; by the British Army in North Africa, Italy, and the Netherlands; and by the U.S. Army in France and Belgium (in **1944**), and in southern Germany in **1945**.

***A U.S. Navy Morse Code training class in 2015. The sailors will use their new skills to collect signals intelligence.***

Morse code was used as an international standard for maritime distress until 1999 when it was replaced by the Global Maritime Distress and Safety System. When the French Navy ceased using Morse code on **January 31, 1997**, the final message transmitted was "Calling all. This is our last cry before our eternal silence." [26] In the United States the final commercial Morse code transmission was on July 12, 1999, signing off with Samuel Morse's original 1844 message, "What hath God wrought", and the prosign "<SK>" ("end of contact").

As of **2015**, the United States Air Force still trains ten people a year in Morse. The United States Coast Guard has ceased all use of Morse code on the radio, and no longer monitors any radio frequencies for Morse code transmissions, including the international medium frequency (MF) distress frequency of 500 kHz. However, the **Federal Communications Commission (FCC)** still grants commercial radiotelegraph operator licenses to applicants who pass its code and written tests. Licensees have reactivated the old California coastal Morse station **KPH** and regularly transmit from the site under either this call sign or as **KSM**. Similarly, a few U.S. museum ship stations are operated by Morse enthusiasts.

## Appendix E - Here are some commonly heard CW sender spacing errors

The following is taken from "The FOC Guide to Morse Code Proficiency" by Gary Hinson, ZL2iFB Version 1.4 January 2019

[https://g4foc.org/resources/Documents/FOC\\_Guide\\_to\\_Morse\\_Code\\_Proficiency\\_v1.4.pdf](https://g4foc.org/resources/Documents/FOC_Guide_to_Morse_Code_Proficiency_v1.4.pdf)

### *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 learning the code or 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.

- **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 call signs: which is the correct one? **AB9MZAB9MZ** vs **AB9MZ AB9MZ**
- **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 to this day!
- **AR K** instead of just  $\overline{AR}$  or  $\overline{AR} K$  - 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  $\overline{AR}$  and **BT** instead of  $\overline{BT}$ .



## Sending Proficiency

For successful communication, strive for a high level of sending proficiency. Consider evaluating yourself or having an experienced CW operator evaluate your sending across these five criteria. It will provide critical feedback on where to focus your improvement efforts.

Attribution goes to Gary [ZL2IFB](#). With his permission, I have reproduced this chart. Please consider reading his [FOC Guide to Morse Code Proficiency](#) for an in-depth review on Speed, Timing, and much more!

<b>Sending Proficiency Scale</b>					
					Row Scores
	0%	33%	67%	100%	
<b>Character Formation</b>	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	%
<b>Number of Errors</b>	Numerous errors, all of which remain uncorrected	Several errors, few corrected	Few errors, all corrected	No errors made	%
<b>Timing Consistency</b>	The length of dots, dashes, and spaces vary frequently and randomly	Speed varies markedly during transmissions	Speed varies a little, occasionally	Speed is fixed and consistent	%
<b>Information Exchanged</b>	No useful information exchanged	Some vaguely useful information exchanged	Useful information exchanged, and then some	Lots of useful and interesting information freely exchanged	%
<b>Intelligibility</b>	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	%
<b>Overall Score (mean)</b>					%

## Appendix F– Other CW References

Gary Hinson, ZL2iFB. “[The FOC Guide to Morse Code Proficiency](#)” Version 1.4 January 2019

*The following references are from the above document.*

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**Books**

Updated 2021-02-10

Here is a collection of books I found on the Internet and . or Amazon.com.

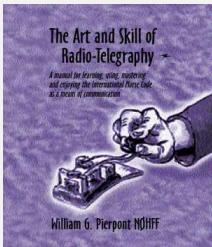
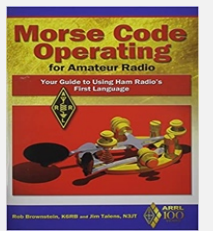
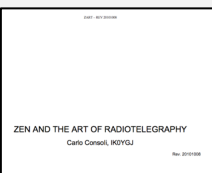
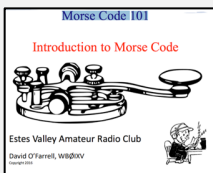
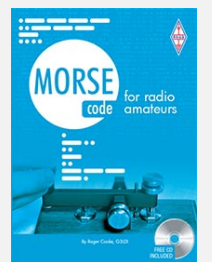
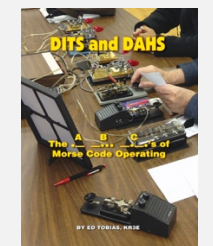

	<p><b><u>The Art &amp; Skill of Radiotelegraphy.</u></b>  <i>By William G. Pierpont, NOHFF (SK)</i>                  Copyright © 2002-04-20 This contains much information on learning Morse to a very high standard and is essential reading for anyone with an interest in Morse code. (Free)</p>		<p><b><u>Morse Code Operating for Amateur Radio</u></b>  <i>By ARRL, Inc.</i>                  Copyright © April 29, 2013                  \$15.95</p>
	<p><b><u>Zen and the Art of Radiotelegraphy</u></b>  <i>By Carlo Consoli, IK0YGI</i>                  Copyright © 2010-09-08 This is a Morse tutor book with an emphasis on the psychology. (Free)</p>		<p><b><u>Morse Code 101 – Introduction to Morse Code</u></b>  <i>Estes Valley Amateur Radio Club</i>  <i>By David O'Farrell, WBØIXV</i>                  Slide set - Copyright © 2016</p>
	<p><b><u>Morse Code for Radio Amateurs (W/ CD)</u></b>  <i>By Roger Cooke, G3LDI via RSGB</i>                  12<sup>th</sup> Edition, 64pages, ISBN: 9781 9101 9319 8  <b>Sorry Currently Out of Print. You can find this occasionally on Amazon Marketplace or other used book sellers.</b> The 1st edition was published in 1947.</p>		<p><b><u>DITS and DAHS: The ABC's of Morse Code Operating</u></b> <i>By Ed Tobias, KR3E via CQ Communications</i>                  This small but solid guide is the perfect read for those interested in learning or improving CW operating techniques! Copyright © 2017.                  \$18.95 (includes shipping charge)</p>
	<p><b><u>The Morse Code Trainer</u></b>  <i>By Steve WK5S, John K5JHF, and Kees K5BCQ 11 Feb 2018 Rev A04 Copyright © 2018</i>                  Reaching the pinnacle of CW Operations! Finally, an all-in-one tool for learning and increasing Morse code operations. The Morse Code Trainer enhances the learning experience by immersing the user in word sounds, and how to send words correctly. It also contains the smoothest and most responsive Keyer available and the one and only tool all experienced CW operator must have to enhance their proficiency and operating skills. The Morse Code Trainer will put the DX world, Contesting, and Rag Chewing at your fingertips!</p>		

Table 23 Books about Morse Code.

## Appendix G - CW Reverse Beacon Network

### CW Reverse Beacon Network

<http://www.reversebeacon.net>

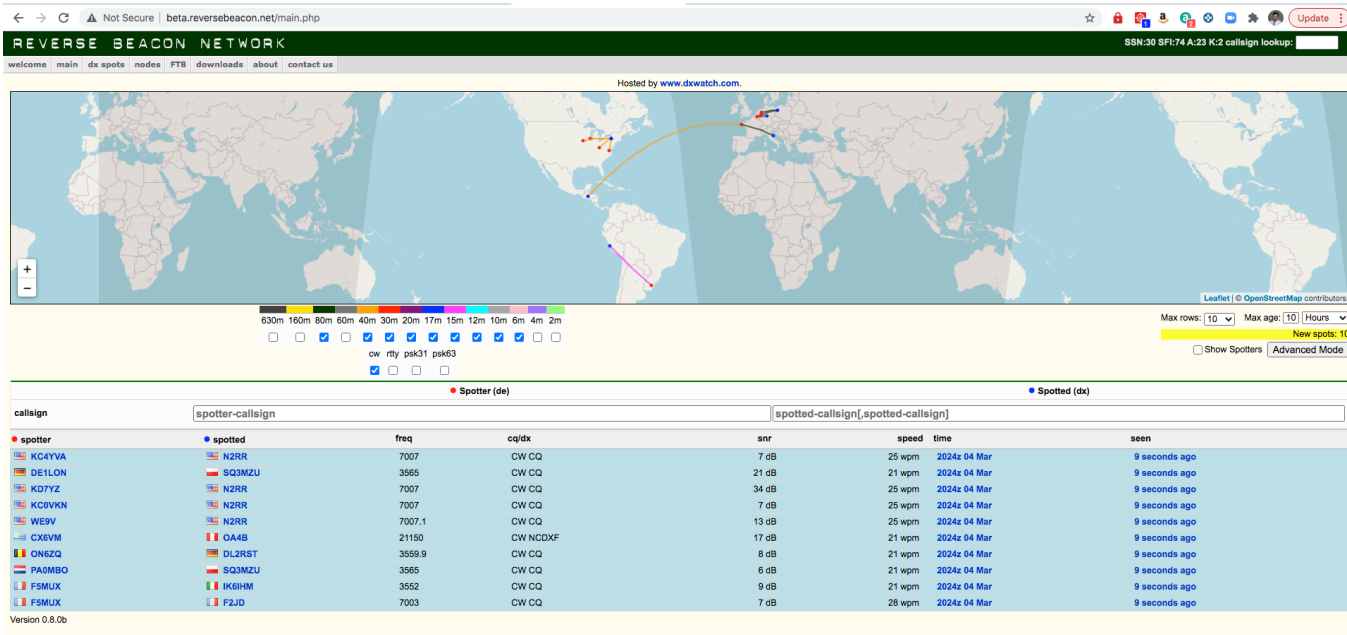


Figure 9 CW Reverse Beacon Network.

### CW Reverse Beacon Network - How to Guide

<https://www.hamsci.org/cw-reverse-beacon-network-how-guide>

For further information, watch the RBN blog and the RBN-OPS group on groups.io: <https://groups.io/g/RBN-OPS>

## Reverse Beacon Network

<https://www.ncdxf.org/beacon/RBN.html>

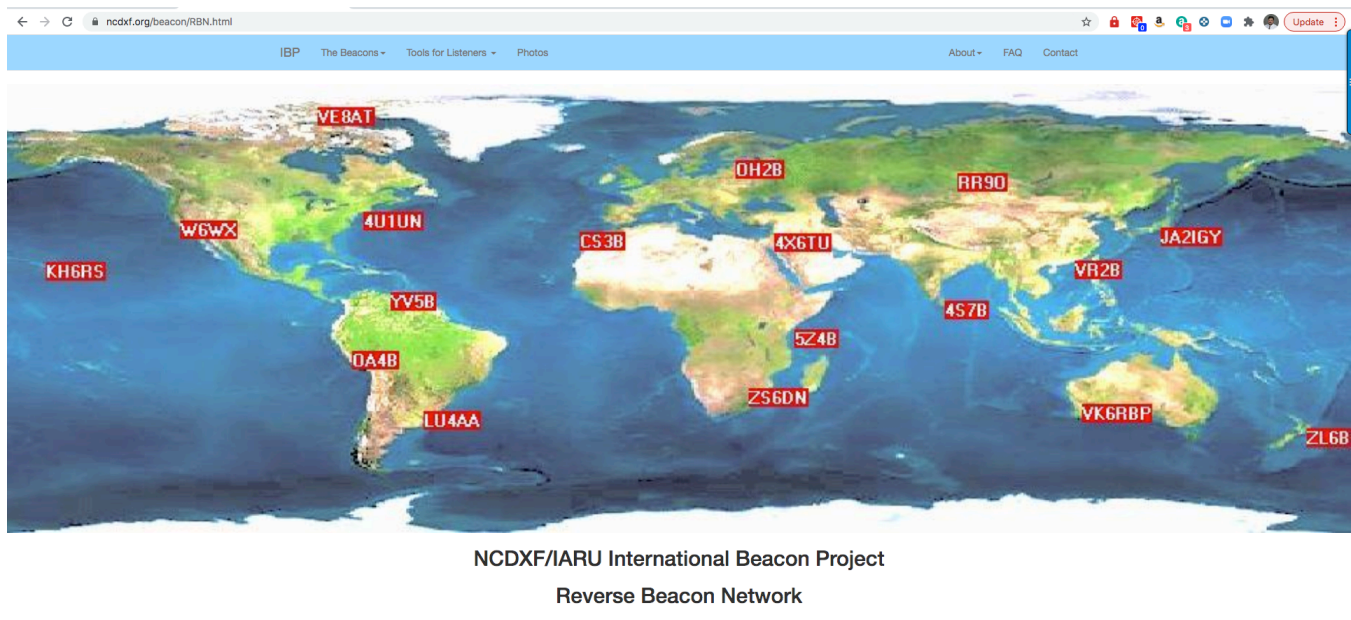


Figure 10 NCDXF Reverse Beacon Network

## What Beacons are Being Heard?

There are three ways to determine which beacons are being heard in various parts of the world. You can check for reception reports (spots) made manually by amateurs who have heard the beacons and have posted a spot on a local [DX Cluster](#) or directly to [DX Summit](#). Or you can check with web pages showing automated [reception reports of the beacons by Faros software](#) or the Reverse Beacon Network.

## Appendix H - Acknowledgements

No one person is an expert on everything. I will be the first person to tell you that I am still at the beginning of my new CW journey. It didn't matter that I learned the code and used it on 10 meters in the late '60s. I frankly learned it the wrong way. Now I am slowly undoing my bad habits thanks to CWOps Academy.

- I offer my undying gratitude to CWOps Academy for the wonderful classes they run and all of the thoughtfully curated resources they provide to their students. I can't recommend their classes and mentoring enough.
- I want to especially thank Ken AC5EZ who was our CWOps Academy Advisor for his excellent mentoring during the January / February 2021 Beginners class.
- I further wish to thank Brian Davis (W9HLQ) and Kurt (W9FMC) for their efforts in reviewing this document and giving me the excellent feedback, they provided.
- Thanks to the Morse Code Ninja Kurt AD0WD for reviewing this document and providing additional suggestions.

**INDEX**

Abbreviations		Pencil-Copy.....	39
73 (Best Regards).....	33	CW Learning Methods	
ANT (Antenna).....	33	Farnsworth .....	9, 17, 34, 38, 43
CQ (Calling any station).....	32	Koch.....	17, 34, 38
CUL (See You Later).....	33	CW Recognition Methods	
E (End of QSO).....	33	Conscious decoding of Dits and Dahs .....	37
ES (AND).....	33	Focus on the Meaning.....	41
FER ( For).....	32	ICR.....	See Instant Character Recognition
HW CPY? .....	33	Instant Character Recognition.....	38
HW CPY? (How did you copy?) .....	32	Instant Word Recognition .....	40
K (Over).....	33	IWR.....	See Instant Word Recognition.
QSO (Contact) .....	33	CW Speed	
QTH (Your location).....	32	10 to 13 wpm .....	35
TNX (Thanks).....	32, 33	10 wpm.....	34, 38
U (You).....	33	150 wpm.....	36
UR RST.....	32	195 wpm.....	39
VY (Very).....	33	20 to 30 wpm .....	38
WX (Weather).....	33	20 wpm.....	34, 38, 43, 44
CW Copy Methods		21 or 22 wpm .....	44
Head-Copy .....	39	25 to 30 wpm .....	9, 38, 39
Keyboard-Copy.....	39	25 wpm.....	20

30 to 40 wpm .....	39	< BT > (Pause) .....	25
30 wpm.....	34	< HH > (Error) .....	25
30 wpm.....	39	< SK > (End of Contact).....	25, 33
40 wpm.....	40	AA (All after).....	26
5 or 10 wpm .....	43	AB (All before) .....	26
5 to 40 wpm .....	18	BN (All between).....	26
5 wpm.....	35, 37	CL (Closing station).....	26
50 wpm.....	40	CQ (Calling any station) .....	26
60 wpm.....	39	DE (This is).....	26, 32, 33
Beyond 13 wpm .....	37	K (Over) .....	26, 32
Words Per Minute .....	40	SOS (Save our ship).....	26
wpm.....	See Words Per Minute	RST	
Prosigns		599.....	40
? (Say again) .....	26	5NN.....	31, 40
< AR > (EOM).....	25	UR RST 579 579.....	31
< AS > (Stand by).....	25	UR RST 599.....	43
< BK > (Break-in) .....	25		