

Morserino-32

User Manual

Version 9.x

September 2026
for the Morserino-32, 1st and 2nd edition



M32 – User Manual

Edition V 9.x, September 2026 – for the Morserino-32, 1st and 2nd edition

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This document has been revised for firmware version 9.x. The font family used is Lato.

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1 Preface



"Morserino-32 – A multi-functional Morse Code Device, ideal for learning and training, and having fun."

This manual reflects the features of firmware Version 9.x of the Morserino-32. This edition of the manual describes the **Morserino-32 1st and 2nd edition**; the newer Morserino Pocket has its own edition of this manual. The functionality provided by this version is basically the same for all three Morserino editions, with the exception that the M32Pocket does not have LoRa transceiver capabilities, but offers new features such as a colour display, games, and a battery status icon.

I would like to thank all those who contributed—through code, comments, suggestions, criticism, reviews, blog entries, Youtube videos and other means—to making the Morserino-32 a successful and outstanding product. Among the many contributors, one deserves special mention: Hari, OE6HKE — without him the M32 Pocket wouldn't exist!

What is new in Version 9?

- A single firmware installer for every Morserino, at <https://www.morserino.info/install.html>. It asks the processor in your device which Morserino it is, so you no longer have to know whether to start on the page for the classic M32 or the one for the M32 Pocket - there is only one page now. It also tells you which firmware version is currently on the device before you install anything, and lets you choose whether your settings are kept or erased. The two previous installer pages forward to it, so existing bookmarks keep working.
- M32 Pocket only: the installer can now also install the **Accessibility Edition**, which speaks the menus and settings aloud for blind and partially sighted operators (the games are not included in it). Standard and Accessibility Edition are offered for the same device and you can move between them at any time; your settings are kept.
- M32 Pocket, Accessibility Edition only: the device now tells you when something is wrong with its voice clips, instead of simply staying quiet about it. The clips are stored separately from the program, so re-installing the program on its own - or an installation that is interrupted part-way - can leave a Morserino that runs perfectly well but has nothing left to speak with, or only the clips of an older version. Either way you now hear four pairs of alternating high and low tones on switching on, and the screen says which it is: „No voice clips!“ (nothing there, the device stays silent) or „Wrong voice

pack!“ (clips from another version - it goes on speaking, but whatever was added or reworded since those clips were made stays silent). Running the installer again puts it right. The warning is deliberately neither speech nor Morse code: it has to work when speech is exactly what is missing, and it must not assume you can already read Morse.

- There are now three versions of the user manual, each in two languages (English and German): one for the “classic” Morserino-32 (1st and 2nd edition), one for M32 Pocket, and one for the Accessibility Edition of the M32 Pocket. Each variant leaves out the parts that are not relevant for that particular hardware/firmware.
- The new firmware update utility and the configuration utility now provide links to the respective version of the user manual.
- Extended BLE features. Apart from BLE Keyboard output, there is now also the capability of using BLE for the serial protocol. This means utilities can be written (or ported) to use cable-less connectivity, also to portable devices like phones or tablets.
- M32 Pocket only: It is now possible to set the time constant for the Blackman-Harris tone shaping, which is responsible for the „softness“ of CW Audio (tone without clicks). The default is 5 ms, you can change that between 1 and 9 ms (1ms is rather hard, with clicks, while 9ms is definitely too long for high speed CW).
- M32Pocket only: When you practice with the Koch trainer, the M32Pocket will record statistics about performance; these can either be looked at through the Configuration Tool, or via the M32’s built in web server, so you can use a browser to view the statistics.
- M32Pocket only: after a firmware install with the erase option (or a firmware install to a completely new device), it took up to 10 seconds until something was visible on the screen, while the non-volatile file system was being prepared. To avoid panic, a modified splash with some informative message is being displayed now in such cases.
- M32Pocket only: a new preference **Font Size** lets you switch the scrolling display area between the normal text size and a smaller one, which fits more characters per line and shows five lines instead of four. Handy at higher speeds or with longer words, when you want to see more of what has just been sent.
- The serial protocol used by the Configuration Tool and other utilities has been extended to **version 1.4**. A connected program can now read the full details of all preferences in a handful of requests instead of one request per preference, ask the device which of the optional commands it actually supports (instead of trying them out to find out), and read or clear the stored game scores. Everything from version 1.3 keeps working unchanged, so programs written for it need no adaptation. The protocol is described in the separate *M32 Protocol* document.
- The Configuration Tool’s Preferences tab now shows the **default value** of every setting, next to the setting itself, and marks the ones you have changed away from it — one click on the marked value puts that single setting back to its default, without touching anything else. Useful after a spell of experimenting, when you want to know what a setting started out as but do not want to reset the whole device. The Morserino

reports its defaults over the serial protocol from this version on; connected to older firmware the Tool simply leaves the column out.

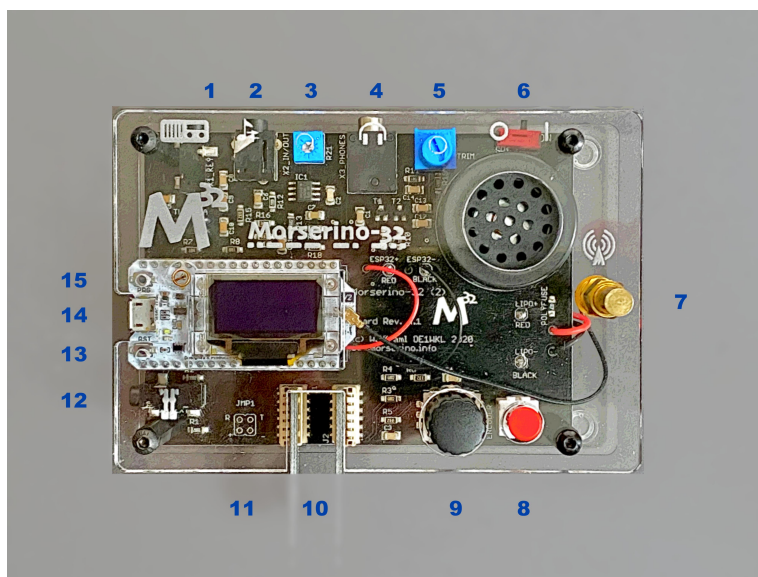
- M32 Pocket only: the Configuration Tool now shows the **game scores** stored on your device - the high score tables of all games, and whether Radio Cave has a saved game - on the User Identity tab, next to the call sign and name they were played under. A button there clears them all, doing the same as „Reset Scores“ in the preferences menu on the device.
- The Koch Trainer has a new entry, **Preview Char**, next to **Learn New Chr**. It opens a list of every character of your Koch course — in the order you learn them — and then plays the one you pick, over and over, exactly the way Learn New Chr does. Useful for going back to a character that never quite stuck, or for hearing what is still ahead of you. While it is playing, the FN button has a third position beyond speed and volume: with the ENCODER set to „character“ you can step through the whole course by ear, without going back to the list, and the top line shows which lesson and character you are on. Thanks to Christian, OE1CKO.
- A new preference **Boost Practice** makes the characters of your **Practice Set** turn up more often — Moderate or Strong — instead of your only being able to drill them on their own. It applies to the Random Characters exercises of CW Generator and Echo Trainer, and to the Koch Trainer's own character generation. It never introduces a character the exercise would not have produced anyway: it only shifts the odds within whatever you already have selected, so a Practice Set digit has no effect while you are practising letters only. Off by default. The **Practice Set** picker itself now sits directly next to it in the preferences of the CW Generator, the Echo Trainer and the Koch Trainer, so you can choose the characters and decide how hard to push them in one place, instead of having to go to the top-level **Set Preferences** for the one and back for the other. Thanks to Christian, OE1CKO.
- A new preference **Echo Think T**. gives you thinking time in the Echo Trainer: after the prompt, the Morserino waits a further 0 to 20 seconds before it starts expecting your answer. This is meant for head copy — hearing a whole call sign or word and putting it together in your head before you touch the paddle. Until now the only way to buy that time was to slow the prompt down or to widen the character and word spacing, and both of those change the exercise itself, on the whole device rather than only in the Echo Trainer. The number you set is the number of seconds waited; 0, the default, leaves the Echo Trainer exactly as it was. Nothing else changes: as soon as you start keying, your answer is judged the moment you finish it, as before. The idea and the original implementation are Ian Gilchrist's, VK1HF, who built it for his own head-copy practice; thanks to him, and to Christian, OE1CKO, who reworked it.
- The installer now works in **Firefox** as well (from version 151, which added support for the Webserial API), alongside Chrome, Edge and Opera. Safari still does not support it.

- Custom Characters is now working like any other built-in Koch order, you can use select lesson, learn new character and the other Koch modes in the same way as with the built-in Koch sequences.
- There is a new feature called „Practice Sets“ that takes the place of the previous Custom character sets, which allows you to train a subset of individual characters which you pick directly on the device and then you can use them for CW generator or Echo Trainer.
- On the display, words are not broken up at the end of a line, but starting at a new line whenever the word length is known in advance (all CW generator modes, and Trx modes like LoRa or WiFi Trx), and the word would not fit into the current line.
- „Select Lesson“ now also shows the total # of characters in the selected Koch sequence.
- A few more cosmetic display output fixes.
- The Configuration Tool's Preferences tab now loads in a fraction of the time it used to, because it reads the preferences in a few requests instead of one per preference. The difference is most noticeable over Bluetooth.
- M32 Pocket only: all sound is cleaner. The audio chip's internal gain was set so high that every tone was being clipped inside the chip, before it ever reached the volume control - audible as a harsh, buzzy tone that no Tone Volume setting could cure. The CW sidetone, the spoken menus of the Accessibility Edition and your own uploaded success/error sounds are now all reproduced undistorted. Two things follow from this that you will notice: the sidetone is a clean sine now instead of the harmonically rich sound it was, which on the small built-in loudspeaker can seem slightly less penetrating even though it is not quieter; and sounds you uploaded yourself will be quieter than before, because they are no longer being distorted (see the note in the Echo Trainer section of the manual). Loudspeaker and headphone levels have been rebalanced against each other. Thanks to Christian, OE1CKO, for finding this.
- M32 Pocket only: the two signals that tell you whether your answer was right or wrong - in the Echo Trainer, and in the games - have been reworked. After the clipping fix above they had become much too quiet on the small built-in loudspeaker, having unintentionally been relying on the distortion for their carrying power. They are now built from a full set of harmonics rather than a plain tone, which that loudspeaker reproduces far better: the acknowledgement is bright and trumpet-like, the error signal darker, more like a bassoon. Both are clearly audible again while sitting a little below the volume of the Morse code itself, whatever Tone Volume you have set - they are meant to inform you, not to startle you. The error signal also falls in pitch, the way it always has on the classic Morserino, instead of rising like the acknowledgement; a rising “error” had crept into the M32 Pocket version by mistake. If you would rather have something else entirely, both signals can still be replaced by MP3 files of your own (see the note in the Echo Trainer section of the manual).

- M32 Pocket only: the volume steps for the built-in loudspeaker have been redistributed. A small loudspeaker needs considerably more drive than headphones before it produces anything audible, so with the now undistorted tone the lowest few settings had become inaudible and that part of the range was simply wasted. The steps are now smaller and span a narrower range, so every setting from 1 upwards does something. The maximum is unchanged - but because the steps in between are smaller, your usual setting will now be at a different number than before. Headphones are unaffected and keep their almost-silent lowest setting; they are, however, about 3 dB quieter at maximum, which was too loud.
- A Bluetooth (BLE Serial) connection now has to be allowed on the Morserino itself. When an app asks for a session, the device shows „Allow connect?“ and waits for you to press FN - a USB cable has to be plugged in by someone standing next to your device, while anything within radio range can connect over Bluetooth, so the Morserino asks before it hands over control. You are only asked in the main menu (in a training mode the request is refused without interrupting you), an app that reconnects within a minute is let straight back in, and while a session is open a small Bluetooth symbol in the top line shows that something is connected.
- The **Practice Set** picker is now reachable from the preferences of the CW Generator, the Echo Trainer and the Koch Trainer, and not only from the top-level **Set Preferences** — it sits next to the new **Boost Practice** setting that acts on it.
- The **VK/ZL** setting of **Calls Region** now generates call signs that look like the ones you actually hear on the air down there. It used to pick the call area at random, which made VK8 (the Northern Territory, about a quarter of a million people) as likely as VK2 (New South Wales, over eight million); the areas are now weighted by population, and roughly one call in six is a ZL rather than a VK. Suffixes are two or three letters, as they are in practice. **Calls Region** was also missing from the manual entirely — it has been there since V8.1 — and is now described in both languages. Thanks to Ian Gilchrist, VK1HF, whose setting this is and who worked out the weighting.

2 Connectors and Controls

2.1 Morserino-32 2nd edition



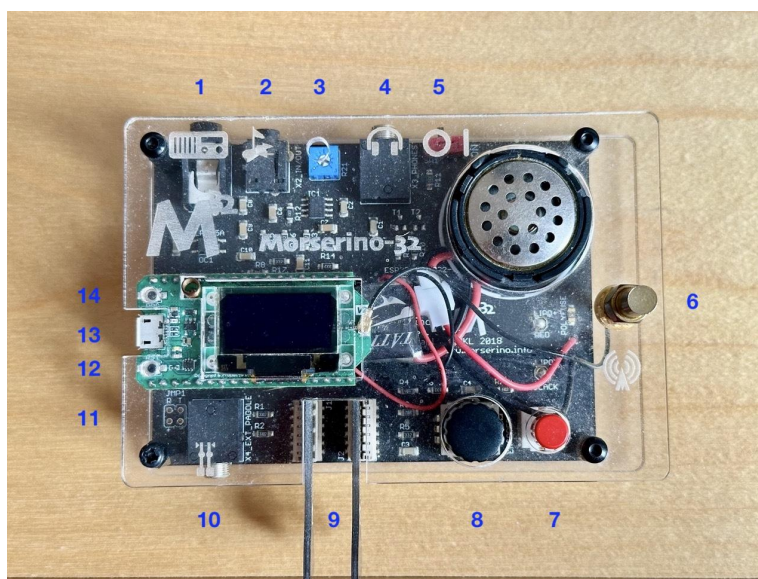
The Morserino-32 2nd edition: the circuit board in a clear acrylic case, seen from above. The loudspeaker is the round grille on the right, the display the small panel on the left. Numbered labels 1 to 15 mark the connectors and controls listed in the table below.

#	Connector / Control	Usage
1	3.5mm Phone Jack (3 poles): to TX	Connect this to your transmitter or transceiver if you would like to key them with this device. Only the tip and sleeve are being used.
2	3.5mm Phone Jack (4 poles): Audio In / Line Out	Audio input for the CW decoder; connect the audio output of a receiver for decoding CW signals. Audio output (pretty close to a pure sine wave) that is not influenced by setting the loudspeaker volume. The assignments to the jack are as follows: Tip and 1st ring – audio in; 2nd ring: ground; sleeve: audio out.
3	Audio Input Level Trimmer	Adjust audio input level with the help of this potentiometer; there is a special function to help with level adjustment, see the appendix Adjusting Audio Level .

#	Connector / Control	Usage
4	3.5 mm Phone Jack (3 poles): Headphones	Connect your headphones here (any stereo headphones with standard phone jacks from mobile phones should work) to listen through headphones and switch off the speaker. You cannot attach a loudspeaker directly to this jack without providing some interface (headphone out needs a DC connection to ground through 50 – 300 Ohms).
5	Phones Level Trimmer	Used to adjust the headphone level for maximum comfort. 1st edition M32 does not have this.
6	Power Switch	Connect / disconnect the LiPo battery from the device. For frequent use of the Morserino-32 you can leave the battery connected. The ON position is towards the side of the antenna connector. If you will not use the device for several days, disconnect the battery (through the Power Switch), as otherwise it will be slowly discharged. For charging, the battery needs to be connected, i.e. the switch must be in the ON position!
7	SMA female Antenna Connector	Connect an antenna suitable for the operating frequency (standard is around 433 MHz) for LoRa operation. Do not transmit LoRa without an antenna or a dummy load!
8	FN Button (RED button)	When the device has gone into deep sleep, this wakes up and restarts your Morserino. When the device is up and running (performing one of the operation modes), a short press of the FN button toggles the rotary encoder between adjusting the keyer speed and volume control. A long press of the FN button allows you to scroll the display with the rotary encoder, pressing the button again changes the function back to speed control. While in the menu, a long press starts the mode to adjust audio input level. See the section Using the ENCODER Knob and FN Button for further details. A double click of this button reduces display brightness in several steps.
9	ENCODER – Encoder and its Pushbutton Switch	Can be rotated and is also a push-button switch. Used to make your selection within menus, to adjust speed, volume, or scroll the display, and to set various preferences and options.
10	Connectors for Touch Paddles	These PCB connectors accept the capacitive touch paddles. If you are only using an external paddle (or for transport), you may remove the touch paddles.
11	Serial Interface	You can connect a cable (directly or through a 4-pole pinhead connector) to an external serial device, e.g. a GPS receiver module (this is currently not supported by the firmware). The 4 poles are T (Transmit), R (Receive), + and - (3.3V power from the Heltec module).

#	Connector / Control	Usage
12	3.5 mm Phone Jack (3 poles): External Paddle	Use this to connect either an external (mechanical) paddle (tip is left paddle, ring is right paddle, sleeve is ground), or a straight key (tip is the key).
13	Reset Button	Through a small hole you can reach the Reset button of the Heltec module (not needed for normal operation).
14	USB – Micro USB Connector	Use a normal 5V USB Charger to power the device and charge its LiPo Battery. The microcontroller firmware can also be reprogrammed through USB. You can also output keyed or decoded characters on the USB serial device to use this information in a computer program – see the preference Serial Output for further information.
15	PRG Button	Through a small hole you can reach the Programming Button of the Heltec module (not needed for normal operation).

2.2 Morserino-32 1st edition



The Morserino-32 1st edition: the circuit board in a clear acrylic case, seen from above. The loudspeaker is the round grille on the right, the display the small panel on the left. Numbered labels 1 to 14 mark the connectors and controls listed in the table below.

#	Connector / Control	Usage
1	3.5mm Phone Jack (3 poles): to TX	Connect this to your transmitter or transceiver if you would like to key them with this device. Only the tip and sleeve are being used.
2	3.5mm Phone Jack (4 poles): Audio In / Line Out	Audio input for the CW decoder; connect the audio output of a receiver for decoding CW signals. Audio output (pretty close to a pure sine wave) that is not influenced by setting the loudspeaker volume. The assignments to the jack are as follows: Tip and 1st ring – audio in; 2nd ring: ground; sleeve: audio out.
3	Audio Input Level Trimmer	Adjust audio input level with the help of this potentiometer; there is a special function to help with level adjustment, see the appendix Adjusting Audio Level .
4	3.5 mm Phone Jack (3 poles): Headphones	Connect your headphones here (any stereo headphones with standard phone jacks from mobile phones should work) to listen through headphones and switch off the speaker. You cannot attach a loudspeaker directly to this jack without providing some interface (headphone out needs a DC connection to ground through 50 – 300 Ohms).
5	Power Switch	Connect / disconnect the LiPo battery from the device. For frequent use of the Morserino-32 you can leave the battery connected. The ON position is towards the side of the antenna connector. If you will not use the device for several days, disconnect the battery (through the Power Switch), as otherwise it will be slowly discharged. For charging, the battery needs to be connected, i.e. the switch must be in the ON position!
6	SMA female Antenna Connector	Connect an antenna suitable for the operating frequency (standard is around 433 MHz) for LoRa operation. Do not transmit LoRa without an antenna or a dummy load!
7	FN Button (RED button)	When the device has gone into deep sleep, this wakes up and restarts your Morserino. When the device is up and running (performing one of the operation modes), a short press of the FN button toggles the rotary encoder between adjusting the keyer speed and volume control. A long press of the FN button allows you to scroll the display with the rotary encoder, pressing the button again changes the function back to speed control. While in the menu, a long press starts the mode to adjust audio input level. See the section Using the ENCODER Knob and FN Button for further details. A double click of this button reduces display brightness in several steps.

#	Connector / Control	Usage
8	ENCODER – Encoder and its Pushbutton Switch	Can be rotated and is also a push-button switch. Used to make your selection within menus, to adjust speed, volume, or scroll the display, and to set various preferences and options.
9	Connectors for Touch Paddles	These PCB connectors accept the capacitive touch paddles. If you are only using an external paddle (or for transport), you may remove the touch paddles.
10	3.5 mm Phone Jack (3 poles): External Paddle	Use this to connect either an external (mechanical) paddle (tip is left paddle, ring is right paddle, sleeve is ground), or a straight key (tip is the key).
11	Serial Interface	You can connect a cable (directly or through a 4-pole pinhead connector) to an external serial device, e.g. a GPS receiver module (this is not supported by current firmware). The 4 poles are T (Transmit), R (Receive), + and - (3.3V power from the Heltec module).
12	Reset Button	Through a small hole you can reach the Reset button of the Heltec module (not needed for normal operation).
13	USB – Micro USB Connector	Use a normal 5V USB Charger to power the device and charge its LiPo Battery. The microcontroller firmware can also be reprogrammed through USB . You can also output keyed or decoded characters on the USB serial device to use this information in a computer program – see the preference Serial Output for further information.
14	PRG Button	Through a small hole you can reach the Programming Button of the Heltec module (not needed for normal operation).

3 Quick Guide to Using the M32



This is for the impatient, but is not a replacement for reading the whole manual!



Make sure you have a suitable battery for your Morserino. The M32 1st and 2nd edition use a 3.7 V LiPo battery.

3.1 The Basics

Controls to be used:

- **ON/OFF (Battery):** Sliding switch located on the back near the loudspeaker. Connects/disconnects battery.
- **ENCODER:** The knob that you can rotate and press (the black one on the first and second edition Morserinos).
- **FN:** The other push-button switch (the red one on the first and second edition Morserinos).

How To Turn On the M32

Either connect a USB power supply, or, if you have a battery installed, turn the battery switch to ON (I).

A start-up screen will briefly appear, showing the firmware version and battery status. Then you will be in the Main Menu ("Select Mode:"), unless you selected the quick start preference; in that case the last operational mode you had chosen will start automatically.

If there is no change in the display for a long time after turning on the M32, it will go into sleep mode. You can wake it up by pressing the FN button.

How To Select a Mode (Menu):

Rotate the ENCODER to find the desired mode. Click the ENCODER to select it or to enter the next lower menu level. Press and hold the ENCODER to exit or go up one level.

How to Change Speed or Volume, and Scroll the Display

This is done with FN and the ENCODER when you are in one of the operational modes. These do not work while you are in the menu.

- Change speed: rotate ENCODER.
- Change volume: click FN, then rotate ENCODER to adjust volume, click FN again to revert to speed setting.
- Scroll display: Press and hold FN. Scroll back and forth with the ENCODER. Exit by clicking FN.

The speed setting is written to permanent memory after 12 characters are keyed at the same speed. The volume setting is written as soon as you toggle back from the volume setting mode to the speed setting mode with the FN button.

How To Change the Brightness of the Display

There are five levels of brightness. Each double-click of the FN button reduces the brightness slightly. When the lowest level is reached, a double-click resets the display to full brightness.

How To Change Preferences (Settings):

Double-click the ENCODER, then rotate the ENCODER to select the preference you want to change. Press and hold the ENCODER to exit the preference menu.

When a mode is active, only the relevant preferences for that mode are shown. When called from a menu, all preferences are shown.

There are numerous preferences, see the chapter **Preferences** to find out what they are for.

You can also store and recall preferences in so called “snapshots”, see section **Snapshots**.

How to Use External Paddles and Keys

You can connect external paddles (dual lever or single lever), or a straight key (normal, or sideswiper) to your M32, by using the 3.5 mm connector for external keys.

To use a straight key, you can use the CW decoder mode without changing any preferences. This mode decodes Morse either through the audio I/O connector or from your key. To use the Echo Trainer or Transceiver modes with a straight key, change the **Keyer Mode** preference to **Straight Key**.

Note that the **CW Keyer** mode works differently with a straight key: it behaves the same way as in Decoder mode; with a straight key, you are the keyer, not the Morserino!

You can use the built-in capacitive touch paddles like a sideswiper / cootie key when the Keyer Mode is Straight Key (but not an external paddle, unless it is wired as a sideswiper)!

How To Charge the Battery

Connect USB power, switch battery switch to ON (I).

With the M32 1st or 2nd edition, an orange LED will light up very brightly. When the orange LED is dark, the battery is fully charged. When the orange LED is lit or flickering dimly, the battery is not connected or switched on.

4 Using the M32, Step by Step

4.1 Powering On and Off / Charging the Battery

If you want to use the device with USB power, just plug a USB cable in from virtually any USB charger — it consumes a max of 200 mA when charging the battery, so any 5 V charger will do.

If you run it from battery power, slide the sliding switch to the ON position.



Make sure you install the battery with the correct polarity before turning the switch to the ON position. Reversing the polarity could destroy your Morserino!

When the device is off but with the battery connected (sliding power switch is on), it is in deep sleep – in reality: almost all functions of the microcontroller are turned off, and power consumption is minimal (less than 5% of normal operation).

To turn the device on from deep sleep, press the FN button briefly.

When the Morserino-32 boots up, a startup screen will appear for a few seconds. The top line shows the LoRa frequency that the M32 is configured to use, as a five-digit number. Below the version number you will see the battery voltage, and a symbol showing how much battery power is left. If the battery is low, connect your device to a USB power source. The battery will drain even if you never turn the device on. Although the drain is minimal in deep sleep mode, the battery will be empty after a few days. Therefore, if you intend not to use the Morserino for a longer period of time, disconnect the battery from the device using the power switch at the back.

If the battery voltage is dangerously low when you try to turn on the device, an empty battery symbol will appear on the screen, and the device will not boot up. If you see this symbol, begin charging your battery as soon as possible.

First edition of M32 only: After using any of the WiFi functions, battery measurement does not work correctly until the Morserino-32 is powered down and up again (or a reset with the Reset button has been performed). This is due to a hardware problem on the Heltec board V2.0. In such cases the Morserino-32 displays “Unknown” instead of the battery voltage, and the battery symbol is shown with an inscribed question mark. After a power cycle everything should work OK again.

If the display shows the empty battery symbol although sufficient power should still be available, it is advisable to perform a battery measurement calibration. This is not necessary and hence not available on the M32Pocket. See the section **Calibration of Battery Measurement**.

To disconnect the device from the battery (turning it off, unless you are USB powered), slide the sliding switch to the OFF position.

To put the device into deep sleep, you have two options:

- In the main menu, select the option **Go To Sleep**
- If a **Time Out** value has been set in the preference menu, do nothing. If there is no display update, the device will power itself off and enter deep sleep mode after the set time has passed.

To charge the battery, connect the device to a reliable USB 5V power source with a USB cable, such as your computer or a USB charger like your phone charger.



Make sure the hardware switch of the device is ON while charging – if you disconnect the battery through the switch, the battery cannot be charged.

When charging a 1st or 2nd edition M32, the orange LED on the ESP32 module is lit brightly, and when the battery is disconnected, this LED will not be lit brightly, but rather be blinking nervously or half lit. Once the battery has been fully charged, the orange LED will not be lit anymore.

You can of course always use the device when it is powered by USB, if the battery is charging or not.



To prevent deep discharge of the battery, always turn off the Morserino-32 via the main slide switch. Do not leave it in sleep mode for extended periods of time. A couple of days is okay if the battery is fully charged.

There is circuitry on board for charging the battery, and it prevents overcharging quite well. But it has no prevention of deep discharge!



Deep discharge leads to diminished battery capacity and eventually early death of the battery!

4.2 Using the ENCODER Knob and FN Button

Selecting the various modes and setting preferences is done using the **rotary ENCODER** and its **push-button** function.

Rotating the ENCODER leads you through the options or values, **clicking** the ENCODER knob once selects an option or value, or brings you to the next level of the menu (there are up to three levels in the menu).

A **double click** of the ENCODER brings you to the preference setting menu. If you do this from the menu, you can change all preferences. If you do this from an active operational mode, only the relevant preferences for the current mode are shown and can be changed.

A **long press** brings you back to the menu from any of the modes, and within the menu promotes you a level up.

A **double click of the FN button** reduces display brightness; there are five levels of brightness. Once the lowest level is reached, a double-click resets the display to full brightness.

For *M32 1st and 2nd* edition only, while you are selecting a menu (e.g. immediately after power-on), a **long press of the FN button** starts a function to adjust the audio input level (and possibly the output level on a device you connected to the Morserino-32's line-out port).

A click of the FN button turns this function off again. See **Adjusting Audio Level**.

While one of the operational modes (keyer, generator, echo trainer etc.) is executed the FN Button allows you to **quickly toggle between speed control and volume control** with a single click.

A **long click of the FN button while a mode is active** changes the display and encoder to scroll mode (the display has a buffer of 15 lines, and normally only the bottom three lines can be seen; in scroll mode you can scroll back to the previous lines; while you are in scroll mode, a scroll bar is shown at the far right side of the display, indicating roughly where you are within the text buffer). Clicking FN again in scroll mode changes the screen to its normal operating mode and brings the encoder back to speed control.

When you are **in the preference setting menu**, a **short click of the FN button** recalls a preference snapshot, and a **long press of the FN button** stores a preference snapshot. See the section **Snapshots** for further details.

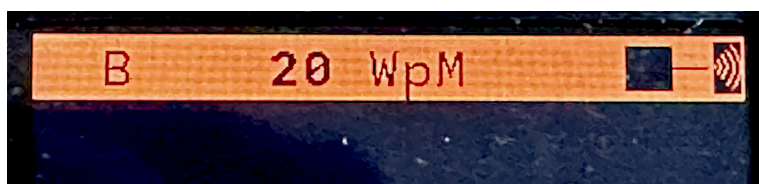
4.3 The Display

The display is divided into two main sections: on top is the **status line**, that gives important information according to the current state of the device, and below that is an area of **three scrolling lines** where the generated Morse code characters are shown in clear text. All characters from Morse code are shown in *lower case*, for better readability (but there is a preference to change it to *UPPER* case); Procedural (“pro”) signs are shown as letters in brackets, like <ka> or <sk>. In addition, when in Echo Trainer mode (see below), the result of your attempt to enter the correct Morse code is shown as *ERR* or *OK* (together with some audible signals).

Although only three lines of scrolling text are shown, an internal buffer of 15 lines is available. After pressing and holding the FN button, you can use the encoder to scroll back and make previous lines visible. This works while you are in any mode with screen output. Nothing is lost, and the display reverts to normal behavior once you exit scroll mode.

The Status Line

While a menu is presented to you (either the start menu, or a menu to select preferences), the status line tells you what to do (**Select Mode:** or **Set Preferences:**).



Close-up of the status line across the top of the display: the keyer-mode letter B on the left, the speed 20 WpM in the middle, and on the right the volume bar followed by the wireless-transmission symbol.

When in Keyer Mode, CW Generator Mode or Echo Trainer Mode, the status line shows the following, from left to right:

- **A, B, U, N** or **S**, indicating the automatic keyer mode: Iambic **A**, Iambic **B**, **Ultimatic**, **Non-Squeeze** or **Straight Key** (for details on these modes see below in section **CW Keyer**).



In CW Decoder mode, the letter **d** appears in that position, and whenever a signal is detected, a small square shows to the left of it.

- The currently set **speed** in words per minute (the reference word is the word **PARIS**, which also means that 1 wpm equals 5 characters per minute). In CW Keyer mode as **nnWpM**, in CW Generator or Echo Trainer mode as **(nn) nnWpM**. The *value in brackets*

shows the effective speed, which differs when inter-word spacing or inter-character spacing are set to other values than those defined by the norm (length of 3 dits for inter-character spacing, and length of 7 dits for inter-word spacing). See the notes in section **CW Keyer** regarding the preferences you can set in CW Keyer mode.



When in a transceiver mode, you also see two values for speed – the one in brackets is the speed of the signal received, and the other the speed of your keyer.

When using a straight key, the speed shows how fast your keying actually is.

When the digits indicating the speed are shown as **bold**, turning the rotary encoder will change the speed. When they are shown in normal characters, turning the rotary encoder changes the volume.

- A horizontal “progress” bar that extends from left to right indicates the **volume** of the side tone generated by the device (full length of the bar means top volume). This normally shows a white frame around the black progress bar (an extension of the rest of the status line); if this is reversed (white progress bar within black surroundings – and the WpM digits are not bold), turning the rotary encoder will change the volume and not the speed.
- An indicator symbolizing radio transmission will appear on the far right end of the status line whenever a wireless mode is active (if the device is in LoRa or Wi-Fi transceiver mode or if you have set a preference to transmit LoRa or Wi-Fi while in one of the CW generator modes). The WiFi symbol looks similar to the usual WiFi logo (a 90-degree sector of concentric circles), and the LoRa symbol consists of concentric half circles.

4.4 Hardware settings

You might need to change certain hardware settings, e.g. the screen orientation, or the calibration of the battery measurement. Or you might want to reset (almost) all preferences to their factory value. All these settings are covered in **Hardware Configuration Menu**.

5 Top Menu and Morserino Modes

You select the operational mode of your Morserino-32 by rotating the ENCODER knob, and quickly pressing (“clicking”) that knob to select that mode (or, in several cases, a sub-menu for a more detailed selection), when you see the menu on the display.

5.1 CW Keyer

This is an automatic keyer that supports Iambic A, Iambic B (these are sometimes also called Curtis A and Curtis B), and Ultimatic mode, as well as Non-squeeze mode (emulating a single lever key with a dual lever paddle). You can either use the built-in capacitive paddle, or connect an external paddle (dual or single lever paddle). Internal and external paddles work in parallel, so there is no need to configure this.



There are a number of **preferences** that determine how the automatic keyer works. See the section **Preferences regarding Key, Paddles and Keyer** for the details. The following are particularly important here:

External Pol.: If your external key is wired “the wrong way around”, you can correct this here.

Paddle Polarity: On which side do you want the dits and on which the dahs?

Keyer Mode: Select Iambic A or B, Ultimatic mode, Non-Squeeze mode or Straight Key mode.

What are these **Iambic Modes**? When both paddles of an Iambic keyer are pressed, dashes and dots will be generated alternately. They start with the paddle that was hit first. The name “Iambic” comes from the fact that in an Iambic verse, there are alternating short and long syllables. The name “Curtis,” on the other hand, also used for “Iambic” sometimes, comes from the developer of the groundbreaking Curtis Morse keyer chip, John G. “Jack” Curtis, K6KU (ex W3NSJ).

The difference between modes A and B is how they behave when both paddles are released while the current element is being generated. In Mode A, the keyer stops after the current element. In Mode B, the keyer adds another element opposite the one during which you released the paddles.

In other words, in Curtis B (iambic B) mode, the opposite paddle is checked while the current element (dit or dah) is output. If a paddle is pressed during that time, an additional element opposite the current one is added. This is not the case in Mode A. Since Mode B is tricky to use, it was later changed so that the paddles are checked only after a certain percentage of the element's duration has elapsed. You can set this percentage with the preferences **CurtisB DahT%** and **CurtisB DitT%**.

If you set them to 0, the lowest value, the Mode is identical with the original Curtis B Mode; the later developed “enhanced” Curtis B mode uses a percentage of roughly 35%-40%. If you set the percentage to 100, the highest value, the behavior is the same as in Curtis A mode.

This preference allows you to set any behavior between Curtis A and original Curtis B modes on a continuous scale, and you can set the percentage for dits and dahs separately (this makes sense, as the timing for dits is just a third of that for dahs, and so you might find that you want a higher percentage for dits to feel comfortable).

Ultimatic Mode: In Ultimatic mode, pressing both paddles generates a dit or dah. The type of sound generated depends on which paddle is hit first. Afterwards, the opposite sound is generated continuously. This is advantageous for characters like J, B, 1, 2, 6, and 7. Control always belongs to the paddle that was closed *last*: with both paddles held down, briefly releasing one of them and closing it again — just a flick — hands control back to that paddle, which then keeps sending its own element type until you release it again or flick the other one. This works for either paddle, including the one that started the character.

Every closure of a paddle is remembered, and is guaranteed to produce at least one element of its type — however briefly you touch it, and wherever in the current element it falls.

Ultimatic therefore has no use for the timing preferences of the iambic modes: **CurtisB DahT%**, **CurtisB DitT%** and **Latency** all have no effect in Ultimatic mode. Contact bounce is taken care of instead by a short fixed guard, so a chattering contact — or a touch pad that loses contact for an instant — does not add an element you did not ask for.

Non-Squeeze Mode: This simulates the behavior of a single-lever paddle when using a dual-lever paddle. Operators who are accustomed to single-lever paddles may have difficulty using dual-lever paddles because they sometimes squeeze the paddles inadvertently, especially at higher speeds. Non-squeeze mode ignores squeezing, which makes it easier for these operators to use a dual-lever paddle.



The iambic and Ultimatic modes can only be used with the built-in touch paddle or an external dual-lever paddle. The selection of these modes is irrelevant when using an external single-lever paddle.

The preference **Latency** defines how long the paddles will be “deaf” after generating the current element (dot or dash). In earlier firmware versions, this was set to 0. This resulted in generating more dots than intended, especially at higher speeds. This was because you had to release the paddle while the last dot was still “on.” Now, you can set this value between 0 and 7. This means 0/8 to 7/8 of a dot’s length. The default is 4, or half a dot’s length. If you still generate unwanted dits, increase this value.

For the preference **AutoChar Spce** (defining a minimum length for the space between characters) see the section **Preferences regarding Key, Paddles and Keyer** for details.

Straight Key Mode: This is not really an automatic keyer mode, but it enables the Morserino-32 to be used with a simple straight key.

If you have connected a simple straight key, and have set the Keyer Mode to **Straight Key**, you can use all Morserino modes (like Echo Trainer, e.g.), but the mode CW Keyer works differently (it works like the Decoder mode); with a straight key, YOU are the keyer, not the Morserino!

5.1.1 CW Memory Keyer

Starting with version 5.1, the Morserino incorporates a memory keyer. There are eight memories available, and each can contain up to 47 characters. In addition to standard Morse code characters (letters, numbers, and punctuation), it can also contain pro-signs and a pause marker. For the textual representations of pro-signs and the pause marker, see **Encoding of text files** in section **What can be generated?** below.

Memories can be *recalled* in the **CW Keyer** and **iCW/Ext Trx** modes (but **not** in the **WiFi Trx** or **LoRa Trx** modes for technical reasons). **To recall a memory, quickly press the ENCODER knob once.** If any memories have been defined, the top line will allow you to scroll through them with the encoder. There is also an EXIT option if you change your mind. An error message will appear if no memories have been defined.

Memories 1 and 2 play repeatedly until stopped by keying something manually; all other memories play once.

Definition of Memories

The memories can only be defined through the serial protocol, either through some computer software that implements this protocol, or manually through a terminal program. (The serial protocol has been specified in a separate document.)

The command to define a memory is the following:

```
PUT cw/store/<n>/<content>
```

This stores <content> in permanent memory number <n> (n is 1 .. 8); if <content> is an empty string, this memory is deleted. <content> can be normal Morse code characters, pro signs, e.g. “<bk>”, and also “[p]” or “\p” for a pause.

If you are using the manual method through a **terminal**, you need to initiate the serial protocol through the command `PUT device/protocol/on` before you can enter further commands, and you should also terminate the use of the protocol with the command `PUT device/protocol/off`.



A much simpler way to store memory content is by connecting your Morserino with a USB cable to a computer, and follow the instructions in **Using a Browser to set up M32 Preferences**.

5.2 CW Generator

This either generates randomized groups of characters and words for CW training purposes, or plays the contents of a text file in Morse code. You can set a number of options by choosing appropriate preferences (see the section **Preferences regarding CW Generation** below).

You can **start** and **stop** the CW Generator by **quickly pressing a paddle** (either one side or both), or by **clicking the ENCODER knob** (when using a straight key, you can also press that key to start and stop the session).

When it starts, it will first alert you by generating `vvv<ka>` (`..._ ..._ ..._ ._. .`) in Morse code, before it actually begins generating groups or words. On the display, this opening `vvv<ka>` – and, if **Max # of Words** is set, the closing “+” that marks the end of the sequence (see **Preferences regarding CW Generation**) – are shown in **bold**, so you can immediately see where a sequence begins and ends.

Enabling the preference **Stop/Next/Rep** will cause the Morserino to play only one word or group of characters, after which it will stop and wait for paddle input. Pressing the left paddle repeats the current word, and pressing the right paddle generates the next word. This is useful for training your head-copy proficiency. Let it play a word without looking at the screen, and try to decode it in your head. If you are not sure, press the left paddle to repeat the word. If you think you have it right, compare it with the display. You can then either repeat the word (by pressing the left paddle) or look away and press the right paddle for the next word. (You can remember the functions of the left and right paddles by thinking of typical music player buttons – left is back and right is forward.)



Please note that the **Each Word 2x** and **Stop/Next/Repeat** options (see section **Preferences regarding CW Generation**) are incompatible with each other. If you set one to ON, the other will automatically be set to OFF.

Once you touch a paddle, it shows what it just had played, so you can check if you decoded it correctly. When you touch a paddle again, it will play the next word. This is useful for learning to decode in your head.

Normally the Morserino-32 just continues to generate until you pause it manually, but there is a preference that can be set which makes the device pause after a certain number of words (or letter groups). See **Max # of Words** in section **Preferences regarding CW Generation**.

5.2.1 What can be generated?

You can choose between the following at the second level of the menu:

- **Random:** Generates groups of random characters. The length of the groups as well as the choice of characters can be selected in the preferences, by double clicking the ENCODER knob (see the description of preferences for details).
 - **CW Abbrevs:** Random abbreviations and Q-codes that are very common in CW transmissions (through a preference setting you can choose the maximum length of the abbreviations you want to train). See **List of common CW abbreviations used by Morserino-32** for the abbreviations that can be generated, and their meaning.
 - **English Words:** Random words from a list of the 5.000 most common words in the English language (again you can set a maximum length of a word through a preference).
 - **Call Signs:** Generates amateur radio call signs (these are not always real call signs, and there will be some generated that would not exist in the real world, as certain suffixes might not have been assigned to anyone). The maximum length can be selected through a preference, as well as (if you like it so) the continent of the call signs generated, and if it should not generate call signs with extremely rare prefixes.
 - **Mixed:** Selects randomly from the previous possibilities (random character groups, abbreviations, English words and call signs).
 - **File Player:** Plays in Morse code the content of a file that has been uploaded to the Morserino-32. Currently it can hold just one file, as soon as you upload a new one, the old one will be overwritten. But your file can have **up to 16 parts** (see below about encoding and creating multi-part files), and you can choose which of the parts you are going to use!
- Upload of files** works through WiFi from your PC (or Mac or tablet or smartphone or

whatever – see the section **Uploading a Text File** for instructions how to do this), or by using the method described in **Using a Browser to set up M32 Preferences**.

- **Practice Set:** Generates random characters from a pool you pick yourself, right on the device – e.g. just the few characters you personally find difficult. Build (and change) the pool with the **Practice Set** entry in the preferences menu (see **Preferences regarding Practice Set** below); it is saved on the device and stays in effect until you change it again. This is unrelated to the Koch Trainer's own **Custom Chars** lesson (see the section **Koch: Select Lesson**, last paragraph) – the two character sets are stored and edited separately.



The file player mode remembers where you stopped. (Exit this mode by pressing and holding the encoder. **Do not just switch it off** or wait for time-out; if you do, the Morserino will not be able to remember where you were.) It will then resume playing from that point the next time you restart the file player. Once the end of the file (or the file part) is reached, it will start at the beginning again.

Encoding of text files for file player

The file should contain ASCII characters only (upper or lower case does not matter) - characters that cannot be represented in Morse code are just ignored. Pro-signs can be in the file, they need to be written as 2 character representations with either [] or <> around them, e.g. <sk> or [ka], or prepended with a backslash, e.g. \kn.

Pro Signs

The following pro signs are recognized (see further down in **Koch: Select Lesson** about the meaning of pro signs):

- <ar>: will be shown on display as + (plus sign) -
- <bt>: will be shown on display as = (equal sign)
- <as>
- <ka>
- <kn>
- <sk>
- <ve>
- <bk>

There are three more “special characters”, formed in the same way like pro signs, that are recognized while playing a file:

Pauses

It is possible to introduce pauses (useful e.g., when you play a QSO text – you can have longer pauses between phrases or when switching from station A to station B). Do this by using `<p>` or `\p` (with a space before and after): each `<p>` (or `[p]` or `\p`) introduces a pause of three regular inter-word spaces. Use several pause markers (e.g. like `\p \p \p`) if you want longer pauses.

Be careful to have the pause marker separated with spaces from each other and from the rest of the text – if not, the whole word (e.g. `cq<p>`) will be replaced by a pause!

Tone Changes

With the second special character you can introduce tone changes in the file (useful, when you play QSO text, e.g. to distinguish station A from station B). Do this by inserting `<t>` or `\t` or `[t]` (as a separate word, i.e. with at least a blank space before and after!) as a tone marker. At this point, the tone will change (unless you have set the preference **Tone Shift** to **No Tone Shift**), and at the next occurrence of the tone marker it will change back to the original tone.

Be careful to have the tone marker separated with spaces from the rest of the text – if not, the whole word (e.g. `cq<t>`) will be considered as the tone marker, and the rest of the word (in our case “cq”) will be lost!

In Echo Trainer Mode, the tone marker is ignored.

Comments

The third special character within text files serves the purpose of inserting comments. `<c>` or `\c` in a word or by itself make this word and the rest of the line a comment that will not be played by file player.

Part separators & Multi-part Files

A part separator is a special form of a comment: If a line starts with a comment indicator and is followed by a dollar sign (\$) and some text, this is treated as a part separator. The text after the dollar sign should be short and is treated as a name for the part that starts here. An example for a part separator line would be:

```
<c>$ Chapter One
```

If the file starts with a part separator as its first line, the file will be treated as a multi-part file, and when you start file player, it lets you select which part of the file to use (it will display the text after the dollar sign to show you the part name). It then treats this part exactly in the same way as if it were a file by itself (remembers where it stopped playing it, and wraps around to the beginning of the part when it reaches the end of the part).

Randomizing file content

There is also a file player preference called **Randomize File**. If it is set to “On” (the default is “Off”), the device will skip a random number of words (between 0 and 255) after each word sent. As the file reads wrap around at the end of the file (or file part), you will eventually see

all the words in the file (but it could take a while). If your file is an alphabetical list of words, for example, the words generated will still be in alphabetical order during one pass of the file. To get more unpredictable results, it is best to start with a random list of words.

What can this be used for? For example, you could take a list of call signs and upload the file to the Morserino-32. (Check the Morserino-32 GitHub repository for a file containing active HF contest call signs). File Player now lets you practice with these call signs in a random fashion. Visit the Morserino-32 GitHub repository to find more suitable files for training.

Important preferences for CW Generator are:

Intercharacter Space. This describes the amount of space inserted between characters. The “norm” is a space that is three dits long. To facilitate copying code sent at high speeds and to help learn Morse code, this space can be extended. The code should be sent at a high speed (>18 wpm) to make it difficult to count dits and dahs and to encourage learning the rhythm of each character. In general, it is better to increase the space between words rather than the space between characters. Therefore, it is recommended that this value be set between 3 and 6. See below.

Interword Space. This is normally defined as the length of seven dits. In CW Keyer mode, a new word is determined after a 6-dit pause to avoid text appearing on the display without spaces between words. In CW Trainer mode, you can set the interword space to values between six and 45 dits (more than six times the normal space) to make copying code easier at high speeds. Similar to Farnsworth spacing (see below), this is called Wordsworth spacing. It’s an even better way to learn to copy high-speed code word by word in your head. You can, of course, combine both interword and intercharacter spacing methods.

Since character spacing can be set independently, you can set it higher than the interword spacing, which could cause confusion. To avoid this, the interword spacing will always be at least four dit lengths longer than the character spacing, even if a smaller interword spacing has been set.

The ARRL and some Morse code training programs use a technique called “Farnsworth spacing”, where the spaces between characters and words are lengthened proportionally by a certain factor. You can emulate Farnsworth spacing by increasing both the intercharacter and interword spaces. For example, set the intercharacter space to 6 and the interword space to 14, which effectively doubles all spaces between characters and words. If you do this at a character speed of 20 wpm, the resulting effective speed will be 14 wpm. This will be shown on the status line as (14)20 WpM.

Random Groups: Defines which characters should be contained in the random character groups. You can choose between Alpha / Numerals / Interpunct. / Pro Signs / Alpha + Num / Num+Interp. / Interp+ProSn / Alpha+Num+Int / Num+Int+ProS / All Chars.

Length Rnd Gr: Defines how many characters there should be in a random group. You can either select a fixed length (1 to 6), or a randomly chosen length between 2 to 3 and 2 to 6 (length chosen randomly within these limits).

Length Calls: The length of call signs that will be generated. Choose a value between 3 and 6 or Unlimited.

Length Abbrev and **Length Words:** The length of common CW abbreviations or common English words, respectively, that will be generated. Choose between 2 and 6, or Unlimited.

Each Word 2x: Each “word” (characters between spaces) will be output twice, as a help to learn to copy by ear (ON). This is also called word doubler. If an increased space between the characters has been selected (“Farnsworth Spacing”), the repetition can also be generated with a smaller space (**ON less ICS**) or without Farnsworth Spacing (**ON true WpM**).

For the less frequently used preferences **Key ext TX**, **CW Gen Displ** and **Generator Tx** see the section **Preferences regarding CW Generation**.

5.3 Echo Trainer

In this mode the Morserino-32 generates a word or group of characters as a prompt. You have the same selection options as with the CW Generator. Then, it waits for you to repeat these characters using the paddle (or a straight key). If you wait too long or your response is not identical to what was generated, an error is indicated on the display and by sound (a signal that falls in pitch, while the acknowledgement rises), and the prompt word is repeated. If you enter the correct characters, this is indicated acoustically and on the screen. Then, you are prompted for the next word.

In this mode, the prompt word will not normally be displayed; only your response will be shown.

The sub-menus are the same as for the CW Generator: Random, CW Abbrevs, English Words, Call Signs, Mixed, File Player and Practice Set.

Like in CW Generator mode, you **start** this mode **by pressing a paddle** (or the ENCODER, or – if you are using one – the straight key), and then the sequence “vvv<ka>” will be generated as an alert before the echo training starts. You cannot stop or interrupt this mode by pressing the paddle or the straight key – after all, you use the paddle (or straight key) to generate your responses! **So the only way to stop this mode is a click of the ENCODER button.**

During your response, if you realize you made an error, you can “reset” your response by entering the character for “ERROR”, i.e. a series of 8 dots (sometimes also represented as pro-Sign <HH>; the Morserino accepts any series of dots equal or longer than 7 dots). <err> will show on the display, and you can restart your entry from the beginning.

The M32 also accepts a series of four times the letter e (“eeee”) as a way to reset the response.

Again, like with the CW Generator, you can set a huge range of preferences to fine tune the generation of things. Of particular interest for the Echo Trainer are the ones described below.

Important preferences for Echo Trainer are:

Echo Repeats: how often the same word is repeated when the response is either too late or erroneous, before a new word is being generated.

Echo Prompt: This defines how you are prompted in Echo Trainer mode. The possible settings are: **Sound only** (default; best for learning to copy in your head), **Display only** (the word you are supposed to enter is shown on the screen, no audible code is generated; good for training paddle input), and **Sound & Display**, i.e you hear the prompt AND you can see it on the display.

Confrm. Tone: Normally an audible confirmation tone is sounded in Echo Trainer mode. If you turn it off, the device just repeats the prompt when the response was wrong, or sends a new prompt. The visual indication of “OK” or “ERR” will still be visible when the tone is turned off.

Max # of Words: As with CW generator, you can make the M32 pause after a specified number of words.

If this preference is set to a value between 5 and 250 (and not to “Unlimited”), the M32, when pausing after that number of words, will show (for 5 seconds) how many incorrect entries you made (and the number of words) on the top line of the display. *Be aware that you can make repeated errors regarding one word, and all of them will be counted!*

Adaptv. Speed: This should help you to train for maximum speed. Whenever your response was correct, the speed will be increased by 1 wpm (word per minute); whenever you make a mistake, it will decrease by 1 wpm. Thus you will eventually always train at your limit, which certainly is the best way to push your limits...

Echo Speed Max: Set this to the maximum speed you would like to use for keying in Echo Trainer mode. If you set the speed faster than this value with the Encoder, or if it is getting faster as a result of adaptive speed, the speed for keying your input stays at that maximum (so you can train your copying at faster speeds than you are comfortable to use when keying).

Echo Think T.: Adds a fixed pause of 0–20 seconds after the prompt, before the Echo Trainer expects your response. This is particularly useful for head-copy practice with call signs, where you need time to mentally reconstruct what you heard before keying it back, without having to reduce the prompt speed or change the dot/dash ratio or word spacing — which would affect the whole device, not just the Echo Trainer.

Intercharacter Space and Interword Space: The first preference defines the pause between characters in the prompt the M32 is generating (the same as in the Generator modes, see there); both preferences also have an influence on the “grace time” you have when responding to the prompt. If that grace time is exceeded, the M32 concludes that you finished your input.

5.4 Koch Trainer

In the 1930s, the German engineer Ludwig Koch developed a method for learning Morse code, in which each lesson introduces an additional character. The order is not alphabetical or sorted by the length of the Morse codes, but rather follows a rhythmic pattern. This way, the individual characters are learned as a rhythm rather than a succession of dits and dahs.

Should you want to use the Koch method for learning Morse code (learning and training one character after the other), **you will find everything you need in the Menu item “Koch Trainer”**.

It has a submenu to enter the lesson you want to set (defining the character you want to add), one to practice just this one new letter (using the mechanism of echo trainer mode, so you are encouraged – but not required – to repeat what you hear), and the modes **CW Generator** and **Echo Trainer**, each of the last two with the submenus for **Random** (groups of random characters out of the so far encountered characters), **CW Abbrevs** (the abbreviations usually used in CW QSOs), **English words** (the most common English words) and **Mixed** (random groups, abbreviations and words mixed randomly). Of course, **only the already learned characters will be used** –s which means, that while you are still struggling with your first characters, the number of abbreviations and words will be quite limited.

In order to prevent counting dits and dahs, or thinking of and reconstructing what you heard, the speed should be sufficiently high (min. 18 wpm), pauses between characters and words should not be lengthened enormously (and it is always better to just lengthen the pauses between words, and keep the inter-character spaces to more or less the normal space). The M32 allows you set interword space independently from intercharacter space, so you can find a setting that perfectly fits your needs.

5.4.1 Koch: Select Lesson

Select a “Koch lesson” (with the default M32 sequence, you will learn 51 characters in total through the Koch method; other sequences have a different number of lessons – see **Koch Sequence** in the section **Preferences regarding Koch Character Sequence**). The menu shows the number of the lesson, the total number of lessons in the currently selected Koch sequence, and the character associated with that lesson – for example 21–39: y for lesson 21 of 39, which teaches the character “y”.

The order of the characters learned has not been strictly defined by Koch, and therefore different learning courses use slightly different orders. Here we use the same order of characters as defined by the program “Just Lean Morse Code” as default, which again is almost identical to the order used by the “SuperMorse” software package (see <http://www.qsl.net/kb5wck/super.html>).

This order is as follows:

Lesson	Character	Lesson	Character	Lesson	Character / Pro Sign
1	m	18	0 (zero)	35	7
2	k	19	y	36	c
3	r	20	v	37	1
4	s	21	, (comma)	38	d
5	u	22	g	39	6
6	a	23	5	40	x
7	p	24	/	41	– (minus)
8	t	25	q	42	= (also used as Pro Sign BT indicating white space or a paragraph / new section of message)
9	l	26	9	43	SK (Pro Sign: OUT / end of contact / end of work)
10	o	27	z	44	AR (+, also Pro Sign: OUT / end of message)
11	w	28	h	45	AS (Pro Sign: WAIT)
12	i	29	3	46	KN (Pro Sign: OVER / go ahead, specific named station)
13	. (dot)	30	8	47	KA (Pro Sign: ATTENTION / new message)
14	n	31	b	48	VE (Pro Sign: VERIFIED / understood)
15	j	32	?	49	BK (Pro Sign: BREAK-IN / let me interrupt)
16	e	33	4	50	@
17	f	34	2	51	: (Colon)



There is another Pro Sign, not covered in the Koch lessons as such: this is the sign <HH> (eight consecutive dits), which indicates an error (the receiver should disregard the previous character(s)).

Different character sequence order

There is also an option to select the sequence of characters. In addition to the native sequence of characters, you can choose the sequence that is used by the popular on-line training tool **Learn CW On-line (LCWO)**, or the sequence the **CW Ops CW Academy** courses are using, or the order of the “Carousel” curriculum of the **Long Island CW Club (LICW)**. This can be set in the preferences menu of the Morserino-32, under **Koch Sequence**.

In the case of attending a course with **LICW**, you should also set the preference **LICW Carousel** according to your entry point into their curriculum (eg. if you start a course within BC1 – Basic Course 1 – with the characters **p**, **g** and **s**, set this to “BC1: p g s”. All further characters you are going to learn in BC1 will be reflected in the same order as your Koch lessons in the Morserino.

Once you have finished BC1, you will enroll in BC2, say beginning with characters **7**, **3** and **?**, and so you should now set this preference to “BC2: 7 3 ?”.)

The sequence of characters when “**LCWO**” is chosen is as follows:

Lesson	Character	Lesson	Character	Lesson	Character
1	k	18	f	35	7
2	m	19	o	36	c
3	u	20	y	37	1
4	r	21	, (comma)	38	d
5	e	22	v	39	6
6	s	23	g	40	0
7	n	24	5	41	x
8	a	25	/	42	-
9	p	26	q	43	SK
10	t	27	9	44	AR
11	l	28	2	45	KA
12	w	29	h	46	AS

Lesson	Character	Lesson	Character	Lesson	Character
13	i	30	3	47	KN
14	.	31	8	48	VE
15	j	32	b	49	BK
16	z	33	?	50	@
17	=	34	4	51	:

And the **CW Academy** sequence of characters is this:

Lesson	Character	Lesson	Character	Lesson	Character
1	t	18	m	35	k
2	e	19	w	36	j
3	a	20	3	37	8
4	n	21	6	38	0
5	o	22	?	39	=
6	i	23	f	40	x
7	s	24	y	41	z
8	1	25	,	42	BK
9	4	26	p	43	SK
10	r	27	g	44	.
11	h	28	q	45	-
12	d	29	7	46	KA
13	l	30	9	47	AS
14	2	31	/	48	KN
15	5	32	b	49	VE
16	u	33	v	50	@
17	c	34	AR	51	:

The sequence of the **LICW** courses is as follows:

Lesson #	Character	Lesson #	Character Pro Sign	Lesson #	Character / Pro Sign
1	r	18	b	35	6

Lesson #	Character	Lesson #	Character Pro Sign	Lesson #	Character / Pro Sign
2	e	19	k	36	.
3	a	20	m	37	z
4	t	21	y	38	j
5	i	22	5	39	/
6	n	23	9	40	2
7	p	24	,	41	8
8	s	25	q	42	BK
9	g	26	x	43	4
10	l	27	v	44	0
11	c	28	7	45	
12	d	29	3	46	
13	h	30	?	47	
14	o	31	+	48	
15	f	32	SK	49	
16	u	33	=	50	
17	w	34	1	51	



The LICW curriculum teaches just 44 characters – if you want to learn the remaining characters (- <KA> <AS> <KN> <VE> @ :), you have to set the character sequence to **CW Academy** and continue there with lesson 45.

Koch: Train with a customized set of characters

You can also use the Koch Trainer to practice with a specific set of characters. First, upload a text file to the file player that contains the characters you want to train. They can be one “word” or several words on one line or more. Then, set the preference **Koch Sequence** to the new option **Custom Chars**. The Koch Trainer will then read the characters from the file.

Now, you can use the Koch Trainer (CW Generator or Echo Trainer), and it will use those characters for your training. The **Koch Lesson** setting acts as an index into your custom character set: at lesson N, only the first N characters of the set are used as the active training pool (capped at the actual length of the set, so a lesson number larger than your

character set simply uses all of it). The lesson maximum adjusts automatically to the length of your custom character set (up to 51 characters; characters beyond the 51st are not reachable).

To change the character set, upload a new text file and select **Custom Chars** again. Even if it had been selected before, you must select **Custom Chars** again to prepare the new character set. If you just upload a new text file, the custom character set will not change. You must go into preferences and select **Custom Chars** again.

This is a feature, not a bug!

It means you can switch between training your characters and using a different text file for the file player. Setting **Koch Sequence** to M32, LCWO, LICW, or CW Academy reverts to the “normal” Koch Trainer option.



Looking for a quicker way to just drill a handful of characters you find difficult, without going through a text file or the Koch lesson mechanism? See **Practice Set**, a separate feature reachable directly under **CW Generator** and **Echo Trainer** (not under Koch Trainer) – described where those modes are introduced, and in **Preferences regarding Practice Set**. It uses its own, separately stored character set and does not affect or get affected by **Custom Chars** here.

5.4.2 Koch: Learn New Chr

By selecting this menu item a new character will be introduced (according to the Koch lesson selected – see the previous menu entry) – you will hear the sound, and see the sequence of dots and dashes quickly on the screen, as well as the character displayed on the screen. This will be repeated until you stop by pressing the ENCODER knob. After each occurrence you have the opportunity (but no obligation) to repeat with the paddles what you have heard, and the device will let you know if this was correct or not.

Once you have mastered the new character, you can progress to either **CW Generator** or **Echo Trainer** within the Koch Trainer, in order to practice the newly learned character in combination with all the characters you have learned so far.

5.4.3 Koch: Preview Char

Sometimes you don't want the newest character, but an earlier one you'd like to hear again on its own – or you're curious what a character further ahead in the course sounds like. Selecting this menu item shows a small picker listing every character of the whole course, in the same learning order as your Koch lessons (or, if **Koch Sequence** is set to **Custom Chars**, in the order of your custom character set) – turn the ENCODER to move through the list and click it to pick a character.

The picked character then plays continuously, exactly like **Learn New Chr**: you see and hear it repeat, and you can still adjust the speed by turning the ENCODER, same as everywhere else.

In this mode, the FN button's usual speed/volume toggle click gets a third stop: clicking it cycles the ENCODER between **speed**, **volume**, and **character**. While the ENCODER owns character, turning it steps live through the whole course, one lesson at a time — no need to open the picker again. Playback follows a moment after you stop turning, so spinning through several lessons stays quiet and only the character you settle on is sent. While the ENCODER owns the character, the status line shows the lesson number and the character itself in bold where the speed is normally displayed — a prosign appears as its tag, e.g. <ka>, not as a bare letter — the same “the ENCODER owns this” convention the WpM figure and the volume bar already follow. Press the ENCODER knob for longer to leave and return to the menu.

While the picker itself is open, the usual FN double-click (display brightness) and ENCODER double-click (preferences menu) both still work, same as everywhere else.

5.4.4 Koch: CW Generator and Echo Trainer

The functionality is the same as described above for these two functions, with the following small differences:

- Only the characters up to the selected Koch lesson will be generated (or the characters defined through your specific character set, see above)
- The preference **Random Groups** will be ignored.
- There is no sub-menu **File Player**.
- In Koch Echo Trainer there is also a sub-menu **Adapt. Rand.**, see below.

5.4.5 Koch Echo Trainer: Adaptive Random

The **Adaptive Random** mode modifies the random selection of characters with feedback from the keyed responses. A wrong character will increase its probability to be selected. A correctly keyed character will reduce its probability.

To start the adaptive mode select: **Koch Trainer > Echo Trainer > Adapt. Rand.**

Remarks:

- Probabilities will be reset to its default every time you start **Adaptive Random** mode.
- The last koch lessons / characters have a higher probability at the beginning of the session.
- At the beginning of the session, every character will be selected once (in random order).
- After every character was selected once, the next characters are selected randomly, characters that have been keyed wrong will have a higher probability to be selected.

- A wrong keyed character will also increase the probability of the character before and after. E.g., when “z/?” is asked and you reply with “g/?”. Then the probability of z will be increased and the probability of / will also be increased a little.
- Only the first wrong character will be analyzed. Subsequent input will not be analyzed. E.g., if “z/?” is asked and you reply with “gz/?”, the probabilities will be increased the same way as in previous example.
- Do not expect to have any fun in this mode (but use it nevertheless!). The adaptive mode will tease you with the characters that you cannot key 100% correctly every time. Once you have keyed a character wrong, that will give you the chance to key the character wrong again and thus increasing its probability to be selected again. Once you have reached a total level of frustration, switch back to normal Koch random mode and relax a bit before using the **Adaptive Random** mode again ;-).

5.5 Transceiver

The Morserino-32 has these transceiver modes:

- **LoRa Trx** is a self contained transceiver for communication with Morse code, using LoRa spread spectrum radio technology (in the standard version on the 433 MHz band).
- **WiFi Trx** uses the Internet Protocol (specifically UDP on port
1. for communicating across an IP network, using WiFi connected to an access point.

There is now also an alternative WiFi mode (**EspNow**), that allows peer-to-peer communication between Morserinos in close vicinity without the use of an access point.

- **iCW/Ext Trx** is a transceiver mode that can be used either with an external transceiver (e.g. a shortwave amateur radio transceiver) or with a protocol like iCW (CW over Internet) or VBand. In all transceiver cases the CW keyer and a receiver or CW decoder are active at the same time.

5.5.1 LoRa Trx



This is only available if your Morserino includes a hardware LoRa transceiver (as was the case with 1st and 2nd edition Morserinos, but is not the case with the M32Pocket in its default configuration)!

As mentioned earlier, this is a Morse code transceiver that uses LoRa to transmit Morse code to other Morserino-32s. In addition to the CW keyer functionality, it sends whatever you key through the LoRa transceiver. This uses a special data format that encodes the dots

and dashes you key, regardless of whether they are legal Morse code characters. It also listens on the band when you are not keying, so you can have interactive conversations in Morse code between two or more Morserino-32 devices! Please be aware that characters are transmitted word by word. Therefore, there is a slight delay on the receiving end, so QSK is not possible. This encourages you to use proper handover procedures.

More Information about the LoRa transceiver mode

Basically, the LoRa transceiver mode uses the same interface as the CW Keyer. But as soon as you receive something, the status line also shows the speed of the sending station in addition to your own speed – you see something like *18r20sWpM*, which indicates you are receiving a station with a speed of 18 Wpm, and you are sending at 20 WpM. In addition, the volume bar on the right of the status line changes its function: instead of indicating the current volume level, it gives you an indication of the signal strength – a crude form of an S-Meter, if you like. the full bar indicates an RSSI level of roughly -20dB, and the bar begins to show at a level of roughly -150dB.

Pressing the FN Button still enables you to set the audio output level.

Morse characters received by the transceiver are shown in bold in the (scrollable) text area on the display, while everything you are sending is shown in regular characters.

Another feature is worth mentioning here: The frequency of the tone you are hearing when you are receiving the other station is adjusted through the “Pitch” preference, as in the other modes. When you are transmitting, the pitch of the tone can be the same, or a half tone higher or lower than the receiving tone – this is being set through the **Tone Shift** preference, in the same way as in Echo Trainer mode.

One other thing you might want to know: the LoRa CW Transceiver does not work like a CW transceiver on shortwave, where an unmodulated carrier is being keyed, and the delay between sender and receiver is just defined by the delay in the path of the electromagnetic waves carrying the signals. LoRa uses a spread spectrum technology to send **data packets** – in a way a bit similar to WiFi that you use on your phone or PC. Therefore all you are keying in is being encoded into data first – essentially the speed and all the dots, dashes and pauses between characters. As soon as the pause is long enough to be recognized as a pause between words (as a blank space, as it were), the whole data packet assembled so far is being transmitted and in due course being played back at the indicated speed by the receiving Morserino-32.

More information about LoRa can be found in **More information about LoRa**.

5.5.2 Wifi Trx

You can use this transceiver mode to communicate with your CW buddy using WiFi, either on your local area network, or across the Internet, or even peer-to-peer without an access point – this method is called *EspNow*, and the Morserino uses its broadcast functionality–

this is then very similar to using LoRa, and obviously the range is limited (depending on the environment, from a few meters up to maybe 50 meters if there is a clear line of sight). See further down in section **WiFi Select** how to select either an access point or EspNow for the WiFi Trx mode.

Using two different EspNow Channels

Morserino-32 can make use of two channels when operating in EspNow mode. This can be used, for example, in a class room situation, to create two independent groups that do not interfere with each other, or in environments suffering from very high WiFi “noise” - when the primary channel does not work properly, try the secondary channel.

The channels are selected through the preference **Trx Channel**, see section **Preferences regarding Transmitting, Decoding and QSO Bot**.

Using standard WiFi with an access point (WiFi router)

To use traditional Wi-Fi, you must be connected to a Wi-Fi access point. This means you must have performed the **Wi-Fi Config** function beforehand. It is very easy to use transceiver mode on your local network: select it from the menu to communicate without configuring a peer address. It will send to the broadcast address 255.255.255.255, which can be received by all devices on the network. The Morserino-32 uses UDP port 7373 for asynchronous communication.

When you start WiFi Trx, the IP address of your peer (or “IP Broadcast”) will briefly appear on the display. If you are using EspNow, EspNow will be indicated.

To communicate with a specific Morserino-32 over the internet, configure the IP address of your peer. This is done through the **Config WiFi** menu item, which has a third field in addition to SSID and Password. Enter the IP address or DNS host name of your peer in this field, and the Wi-Fi transceiver will send packets to that IP address.

There are some services on public Internet servers that can communicate over the protocol used by the Morserino, e.g. a “chat bot” on *cq.morserino.info* – these can normally be used without further set-up, unless your Internet router does not allow all port numbers to go through; the situation is more complicated, if your peer is also behind a firewall or NAT router:

If the IP address is not on your local network and you are behind a firewall or router that treats your network as private, the Morserino can send packets to the internet (unless specific firewall rules block most UDP ports), but packets from your peer behind another firewall will be blocked by the router. In this case, you need to configure “port forwarding” to tell the router to send all UDP packets on port 7373 to your Morserino. At the same time, you need to give your buddy your outside IP address (i.e., the IP address of your router’s interface with your internet provider), and he or she must do the same by giving you his or her internet-facing IP address, which you will enter into your Morserino. It sounds complicated at first, but it isn’t really that bad.

Another option, perhaps a bit more complicated, would be to set up a VPN (Virtual Private Network), so that both your Morserinos are on the same “virtual network” and hence can talk to each other without any firewall rules blocking the traffic. How to do this goes clearly beyond the scope of this manual – ask an Internet guru for further details!

5.5.3 iCW/Ext Trx

In this mode a transceiver connected to the Morserino-32 is being keyed, or you can use the line-out audio to either key for example an FM transceiver, or use CW over the Internet (iCW – this uses Mumble as an audio exchange protocol). Using Bluetooth, you can also connect to a computer and through that computer to VBand, another Internet-based CW facility (see the section **Preferences regarding Key, Paddles and Keyer** for choosing the VBand bluetooth setting).

Any CW signals coming in as audio through the audio-in port are being decoded and displayed on the screen. An external transceiver connected through the connector “to Tx” will be keyed by the keyer, or you can use the audio output on the Line-Out connector to feed it into a computer, or into an FM transceiver.

5.5.4 QSO Bot

The QSO Bot is a simulated CW QSO partner that lets you practise complete, realistic radio contacts off-air. The bot sends in Morse code and copies what you key back, reacting in character – so you can rehearse the give and take of a real contact at your own pace, without going on the air. It is a training partner only: it **never transmits over LoRa, WiFi or the external transmitter** – it only sounds on the local sidetone, so it is safe to use at any time.

There are three QSO types, selectable from the menu under **Transceiver → QSO Bot**:

- **SOTA/POTA** – a Summits-On-The-Air or Parks-On-The-Air contact (callsign, signal report, summit/park reference). The bot picks SOTA or POTA at random and tells you which in its CQ.
- **Standard** – a classic “rubber-stamp” QSO: signal report, name and QTH, then station details (rig, antenna, weather, age), then a sign-off.
- **Contest** – a continuous run of very short contest QSOs. The exchange format is set with the **Contest Type** preference (see **Preferences regarding Transmitting, Decoding and QSO Bot**): **CQ WW** (RST + CQ zone) or **WPX/Sprint** (RST + serial number).

Display and controls

The QSO Bot uses the same screen layout and controls as the CW Keyer and transceiver modes. What the bot sends appears in **bold**; what you key is shown as it is decoded. The top status line shows the keyer mode and your speed. Turning the ENCODER changes

speed (or volume, after a short press of the FN button); a long press of FN switches to scroll mode so you can read back the transcript; a double-click of the ENCODER button opens the preferences; a long press of the ENCODER button leaves the QSO Bot.

Who calls CQ

When you start a QSO type, the bot listens for a few seconds. **If you call CQ**, the bot answers you — you are the activator (SOTA/POTA) or the running station (contest). **If you stay silent**, the bot calls CQ and you answer it. There is no preference to set for this; just as on the air, whoever calls CQ takes the lead. The bot uses a fresh callsign for every contact, so you get plenty of different calls to copy.

Keying to the bot

The bot is deliberately forgiving, so practice feels natural rather than like a spelling test:

- It recognises your information inside the usual conversational padding — `de oe1wkl k, r ur 599 599 bk, qth vienna vienna` all work; the filler words are ignored.
- Signal reports may be sent as full numbers or as **cut numbers** (`5nn` for 599, `t` for 0, `a` for 1, `n` for 9).
- **The bot waits for you to finish.** It only answers once you send an end-of-over signal (`k`, `<sk>`, `<ar>`, `bk`, `73`) or pause for a couple of seconds — it will not key over you while you are still sending.
- **To correct a mistake**, send `<err>` (a run of dits) or `eeee`, then send the corrected information; the bot discards what you retracted and takes the new version. For a single value such as an RST or a callsign you can also just send the corrected version again later in the same over (for example `599 = 579`) — the most recent one counts.
- **To ask for a repeat**, send `agn`, `rpt`, or simply `?`; the bot repeats its last over. You can also ask for one item — `rpt rst`, `rpt call`, `rpt qth` — and the bot repeats just that.
- **To change the bot's speed**, send `qrs` (slower) or `qrq` (faster); the bot adjusts its sending and you hear the new speed on its next over. Send it again to keep nudging. This changes only the bot's speed, not your own keyer/sidetone speed (which you set with the encoder as usual).

If you key something the bot cannot make sense of, or you go quiet partway through, it reacts the way a real operator would — asking for a repeat with a varying prompt such as `agn agn`, `agn?`, `pse rpt`, or `qrz?`, or by repeating its last over — rather than simply stopping.

How forgiving and how chatty the bot is can be set with the **QSO Difficulty** preference (**Beginner** / **Intermediate** / **Advanced**). On **Beginner** the bot gives you more time, allows an extra retry, spells signal reports out in full (599 instead of 5nn), uses clear, calm prompts, and always sends at your own speed. On **Intermediate** and **Advanced** the bot sometimes

calls at a speed a few WpM away from yours, so you get to practise asking for `qrs / qrq`; **Advanced** also keeps a tighter rhythm and answers more tersely. This applies to all QSO Bot modes.

In a **Standard** QSO the bot also mirrors your formality: once the contact is under way, if you drop the `<call> de <call>` framing between overs, the bot drops it too. **Beginner** always keeps the full framing; **Advanced** drops it readily once the QSO is established. The opening and the final sign-off always use the full callsign framing.

SOTA / POTA

The bot plays a summit or park activation. If it calls CQ, it is the activator and sends a summit/park reference chosen to match the country of its callsign (`oe/st-002` for an Austrian call, `w6/ss-001` for a US call, and so on); you call in as the chaser and exchange signal reports. If **you** call CQ, you are the activator and the bot chases you. Occasionally the bot that answers your CQ turns out to be an activator too, and sends its own reference — a Summit-to-Summit / Park-to-Park contact (it can even be SOTA-to-POTA). A SOTA/POTA session is a single contact; the bot signs off when it is done.

Standard

This is a full “rag-chew”-style rubber-stamp QSO in three rounds: first signal report, name and QTH; then station details (rig, antenna, weather, age); then the sign-off. The bot sends realistic details of its own and copies yours. It parses your information from the **field keywords** — `name`, `qth`, `rig`, `ant`, `wx`, `age` — so it does not matter whether you separate them with `=`, with `es`, or with nothing at all, and values may be more than one word (`rig icom 7300`). It picks up your name and uses it when it comes back to you (`fb dr willi`). A valid contact needs a signal report, so if your first over has a name and QTH but no RST, the bot asks `pse ur rst?` before going on.

Contest

Contest practice is a continuous session of very short QSOs. Set **Contest Type** first: **CQ WW** exchanges a signal report plus CQ zone (the bot uses the real zone for its callsign's country), **WPX/Sprint** exchanges a signal report plus a serial number. As soon as one QSO finishes, the running station calls CQ again — if the bot is running it calls CQ with a new callsign; if you are running, a new station answers your next CQ. The session keeps going as long as you keep working stations, and ends automatically after about fifteen seconds with no reply (nobody answering the bot's CQ, or you not calling CQ again). Press a button to return to the menu when the session ends.

5.6 CW Decoder

In this mode, Morse code characters are being decoded and shown on the screen. The Morse code can either be entered via a Morse key ("straight key" - connected to the jack where you would normally connect an external paddle; you can also use one or both of the touch paddles to manually key the decoder). Using the decoder in this way, you can control and improve your keying with a straight key, by checking, if the decoder decodes correctly what you tried to send.

You can also decode a tone input (at the audio input port) taken for example from a receiver. The tone should be at around 700 Hz. Optionally there is a pretty sharp filter (implemented in software) that detects just tones in a very narrow range around 700 Hz, and disregards all others. This is being used by selecting the preference "Narrow" (see the section **Preferences regarding Transmitting, Decoding and QSO Bot**).

The status line is slightly different from the other modes. First of all, the rotary encoder is always in the volume setting mode – speed is determined from the decoded Morse code and cannot be set manually. Pressing the ENCODER button will end the decoder mode and bring you back to the Start Menu.

On the left of the status display at the top, you will see a small square or rectangle whenever the key is pressed (or a 700 Hz tone is detected), and to the right of it the letter **d** – this replaces the indicator for the keyer mode that is visible in the other Morserino modes.

The current speed as detected by the decoder is displayed as WpM on the status line.

This mode does not have many preferences (see the section **Preferences regarding Transmitting, Decoding and QSO Bot**); maybe the most important is the ability to switch the filter bandwidth of the audio decoder between narrow (ca 150 Hz) and wide (ca 600 Hz). For decoding signals from a transceiver (where there might be other signals in the vicinity), it is usually best to set the bandwidth to **Narrow** and tune the signal to 700 Hz ($\pm 5\%$). For decoding signals from an FM transceiver, or from iCW or other environments with little interference, it is better to use the **Wide** setting – in that case the audio frequency does not need to be very close to 700 Hz.

5.7 WiFi Functions

Apart from the functionality of WiFi Transceiver, you can use the WiFi feature of the ESP32 processor used in the Morserino-32 for several other functions of the device, when you are using WiFi through an access point.

Two of them were of high importance in the past:

- Uploading a text file to the Morserino-32 that can then be played in CW Generator mode or Echo Trainer mode.
- Uploading the binary file of a new firmware version to do a firmware update.

For both of these functionalities the file to be uploaded (be it a text file or the compiled binary file for the software update) must be on your computer (even a tablet or smartphone will work, as you only need basic web-browser functionality on that device), and your Morserino must be connected to the same WiFi network as your computer.



Both these functions can now be accomplished much easier by connecting your Morserino to a computer that runs Chrome, Edge, Opera or Firefox - see appendices 6 and 7 of this manual!

In order to connect your Morserino-32 to your local WiFi network, you usually need to know the SSID (the “name”) of the network, and the password to connect to it, known also as the “credentials”. And you must enter these two items into your Morserino-32. As it does not have a keyboard for convenient entry of this information, we use another way of doing it, and for this end another WiFi function has been implemented: **network configuration** (Config WiFi), which is the first you have to use before you can use any of the other WiFi functions.

For home networks that use a list of allowed MAC addresses (for security reasons), you have to configure your router and enter the M32’s MAC address before you can connect your M32 to the network. In order to be able to do so, there is also a function implemented to show the MAC address on the display.

All network related functions can be found under the menu entry **WiFi Functions**.

In software version before 2.0 the WiFi functions were not integrated into the main menu. In case you want to update from version 1.x to version 2.x through WiFi, please read **Updating the Firmware via WiFi for Versions < 2.0**.

If you have selected “EspNow” instead of an access point, the only WiFi Function available is “WiFi Select”, as all other functions require the use of an access point!

5.7.1 Displaying the MAC Address

This is the first entry under the menu **Wifi Functions**, and it displays the Morserino’s MAC address in the status line. Each Morserino has a unique MAC address.

You can use this information to allow the Morserino access to your WiFi network, if your router is configured to recognize only certain MAC addresses.

If you press the FN button, the Morserino-32 will return onto the menu normally. If you do nothing, the Morserino will go into deep sleep, depending on the settings you defined for that, as usual.

5.7.2 Network Configuration

Select the sub-menu **WiFi Config** to proceed with network configuration.

The device will start **WiFi as an access point**, thus creating its own WiFi Network (with the SSID “**morserino**”). If you check the available networks with your computer or smartphone, you will find it easily; please select this network on your computer (or tablet, or smartphone – you will not need a password to connect).

Once you are connected, enter *http://m32.local* into the browser on your computer. If your computer or smartphone does not support mDNS (Android, for example, is not supporting it, and Windows only rudimentary), you have to enter the IP address **192.168.4.1** into the browser instead of *m32.local*. You will then see a little form with just 3 times 3 empty fields in your browser: *SSID of WiFi network?*, *WiFi Password?* and *WiFi TRX Peer IP?*.

You only need to fill in one set of fields, but you can use two or three sets if you want to store different network configurations for different usage scenarios (e.g., connection to different WiFi networks). There is a separate entry in the WiFi menu to select which configuration you want to use.

Enter the name of your local WiFi network, and the corresponding password (you can leave the third field empty for now), and click on the “Submit” button. Your Morserino-32 will store these network credentials and then restart itself (so the network “morserino” will disappear).

The third field (*WiFi TRX Peer IP/Host?*) is used, when you want to use the Wifi Transceiver functionality using an access point, i.e. to talk to another Morserino user or other service that supports the Morserino protocol over the Internet. In such a case you have to enter the IP address or the DNS host name, if it has any, of the other Morserino or the service into this field. See section **Wifi Trx** above. If you communicate with other Morserinos **on your local network**, you don’t need an IP address there (it will use the broadcast address by default, so all Morserinos can receive what one of them sends).

Your Morserino cannot make use of a WiFi network with a “captive portal”, as they are often used on public networks. These networks require that a browser is available on the device that wants to connect to the network, and the Morserino-32 does not have a browser...

Your Morserino-32 only supports WiFi networks in the 2.4 GHz band, not in the 5 GHz band.



If you previously selected EspNow through the WiFi / Select menu, you need to select an access point before you can perform WiFi configuration!



If you have configured your WiFi before, and perform this step again, the previously entered SSID name will be pre-filled in the form, and you only need to change it if necessary. The password field will be empty, but if you do not enter a new one, the old password will still be used. The TRX Peer IP address field will also be pre-filled with a value if you have entered one before. If you now delete the values in this field, this IP address will be deleted.

You can configure three different network settings; from version 4.5.1 on the network configurations will not be stored in Snapshots, this means you cannot use snapshots to recall different network settings.



An easier way to configure access points is by using your Morserino connected via USB to a Chrome, Edge, Opera or Firefox browser, and using the instructions in **Using a Browser to set up M32 Preferences**.

5.7.3 Checking your network connectivity

Use the sub-menu entry **Check WiFi** under **WiFi Functions** to test network connectivity.

This either shows an error message ("No WiFi" and the SSID you had entered), or a success message ("Connected!"), the SSID and the IP address the Morserino got from your WiFi router.

You might have to move your Morserino pretty close to your WiFi router (within the same room is usually OK)! The WiFi antenna of the Esp32 module is rather small and might not pick up very weak WiFi signals.

When you get an error message although you had entered the correct credentials and the Morserino is in direct vicinity of your WiFi router, you should try again – sometimes the first try is not successful, for whatever reasons...

If you press the FN button, this functions returns to the menu. If you do nothing, the Morserino will go into deep sleep, depending on the settings you defined for that, as usual.

5.7.4 Uploading a Text File

Once you configured your Morserino-32 with your local WiFi credentials, you are ready to upload a text file to use for your Morse code training. Currently only one file can reside on the Morserino-32, This means, whenever you upload a new file, the old one will be overwritten.

The **file** that you upload should be a plain ASCII text file without any formatting (no Word files, pdf documents etc.). German characters (ÄÖÜäöüß) encoded as UTF-8 are allowed and will be converted to *ae*, *oe*, *ue* and *ss*. The file can contain uppercase and lowercase letters, and all the characters that are part of the Koch method set, including pro-signs (51 different characters in total). Any other characters will just be disregarded when the file is played in Morse code. The file that you upload can be pretty large – you have about 1 MB space available for it (enough to store a copy of Mark Twain’s “The Adventures of Huckleberry Finn”).



See the information about encoding of text files in section **What can be generated?** – for example, you can separate a file into several parts, each of which will be treated like a separate file by the File Player.

In order to upload the file, select **File Upload** from the **WiFi Functions** menu. After a few seconds (it needs to connect to your Wifi network first) Morserino-32 will indicate that it is waiting for upload. You point the browser of your computer to *http://m32.local* (or, if that does not work, replace “m32.local” with the IP address shown on the display).



For the upload function your Morserino-32 (and of course your PC or tablet etc.) must be on your local WiFi network again!

First you will see a Login screen on your browser. Use **m32** as User ID and **upload** as password. On the next screen in your browser you will find a file selection dialog – select the file you want to upload (its name or extension doesn’t matter) and click the button labelled “Begin”. Once the upload is completed (it will not take long) the Morserino-32 will return to the menu, and you can now use the uploaded file in CW Generator or Echo Trainer mode.

If for any reason you need to abort the process, you have to restart the device either by completely disconnecting it from power (battery off and USB disconnect), or (for M32 1st or 2nd edition) pressing the Reset button with the help of a tiny screwdriver or a ball point pen (the reset button can be reached through the hole next to the USB connector, towards the external paddle connector).



If it fails: Make sure you use the password **upload** and NOT **update**!

5.7.5 Updating the Morserino-32 Firmware through WiFi

Updating the firmware of the Morserino-32 through WiFi is one way of doing it; you can also do this by using the Arduino IDE (or PlatformIO) on your computer (you also need to install a bunch of specific files and libraries for support of the hardware, and then compile the binary from the source code), or, much easier, by using a special update utility (see **Updating the Firmware via USB and an update program**), or – and **this is the easiest way** – by just using a browser and USB (see **Updating the Firmware via USB and a Browser (Webserial)**).

You can update to any version, you can “jump” versions, you can also go back to an older version.

Updating the firmware via WiFi is very similar to uploading a text file. You first need to get the binary file from the Morserino-32 repository on GitHub (<https://github.com/oe1wkl/Morserino-32> - look for a directory under “Software” called “Binaries”). Get the latest version and download it to your computer. The file name probably looks like this:

m32_Vx.y[...].bin with x.y being the version number.

Now get the **WiFi Functions** menu again and select the item **Update Firmw.** Similar to file upload, you point the browser of your computer to *http://m32.local* (or, if that does not work, the IP address shown on the display, *http://n1.n2.n3.n4* – replace n1.n2.n3.n4 with that IP address), and you will eventually see a Login screen. This time you use the user name **m32** and the password **update** (not **upload**!).

Again you will see a file selection screen next, you select your binary file and click the button labelled “Begin”. This time the upload will take longer – it can take a few minutes, so be patient. The file is big, needs to be uploaded and written to the Morserino-32 and verified to make sure it is an executable file. Finally, the device will restart itself and you should notice the new version number on the display during start-up.

To sum it up, these are the steps for updating the firmware through WiFi:

1. Do the network configuration as described above (for this the Morserino sets up its own WiFi network, and you use your browser to enter the name and password of your home WiFi network). You do this only once, as the Morserino will remember these credentials for future use. You might want to use the “Check WiFi” function to make sure your Morserino can connect to your network. Remember that your Morserino has to be pretty close to your WiFi router!
2. You download the new binary from GitHub to your computer.
3. You start “Update firmware” on your Morserino. After a while it will show you an IP address (which is on your home network!) and a message, that it is waiting for an update.
4. You leave your computer on your home network, and point your browser either to the IP address shown on the Morserino (*http://ww.xx.yy.zz*), or to *http://m32.local* (this works on Macs and iPhones, usually, it does not work on Windows PCs or Android devices).

5. You will get a login screen on your browser. Enter *m32* as username and *update* as password.
6. You will see a file selection dialogue. You select the binary file in your download folder, and then click „Begin”. You will see a progress bar, and after some time (can take a few minutes – even when the progress bar already shows 100%) the Morserino will restart itself, and show the new version number on the startup screen. Then you know the update was successful.



If it fails: Make sure you use the password **update** and NOT **upload**!

5.7.6 WiFi Select

Here you can select which network configurations should be used. SSID and Peer Host are being displayed, and you use the encoder to go through the available network configurations.

The item shown when you start this is the currently selected network configuration. If that is what you want, just go back to the menu with a long press of the ENCODER.

The first entry (numbered 0) lets you choose EspNow (WiFi peer-to-peer communication) instead of using an access point.

5.8 Go To Sleep

This menu item, when selected, puts the Morserino-32 into a deep sleep mode, where it will consume considerable less power than when operating normally. But it will still drain the battery within a certain number of days, so this is only meant for shorter breaks between your training sessions. See the section **Powering On and Off / Charging the Battery** further up in this manual.

6 Preferences

You always reach the preferences menu by **double clicking** the rotary ENCODER button. This provides you with a menu of settings (you will see a > character in front of the current preference, and the line underneath shows the current value). Rotate the encoder to lead you through the available preferences. If you want to leave the preference setting menu, just press the encoder button a bit longer, and you will be back in the operational mode from which you called the preference setting menu (or back in the menu, if you entered a double click from the menu).

When you have reached the preference you want to change, click once. Now the ">" character will be at the bottom line in front of the preference value, indicating that rotating the encoder will change this value. Once you are satisfied with the value, **click once** to return to the selection of preferences, or **press the button a bit longer** to leave the preference menu.

Obviously the preferences that can be set vary depending on the mode you are in: **When you double click while in a particular mode, you will only get to those preferences that are relevant for the current mode.** Did you double click from the Start Menu, you will be presented the complete range of preferences.



Almost all preferences can be reset to their factory value through the Hardware Configuration Menu. See **Hardware Configuration Menu** for further information.

6.1 Snapshots

For different types of training you usually need different settings of the preferences – you might want to change the intercharacter- or interword spaces, or the length of character groups or words, etc. So going from one type of training to the next would require you to change various settings every time.

In order to make this easier, you can use "**snapshots**" of the settings: once you have changed everything for your first mode of training, you store all current preferences in one of eight snapshots; then you do the same with your other training modes. You can then quickly recall the settings by recalling a particular snapshot.

The “Koch Lesson” that you selected will be stored in non-volatile storage and hence will be available after a restart, but it will not be stored or overwritten in one of the snapshots. The same is true for WiFi settings, the “Serial Out” preference, the screen timeout, or your setting of speed and speaker volume.

Snapshots contain only settings that are relevant for training. Settings that concern the device itself, its connections are **not** stored in snapshots, and recalling a snapshot will never change them:

- Hardware settings: **Paddle Polar.**, **External Pol.**
- Transmitter and network settings: **Key ext TX**, **Generator Tx**, the LoRa channel
- Bluetooth keyboard settings: **BLT Kbd Output**, **BLT <AR>**
- Audio routing: **Headphone Output**, **Decoded on IO**
- Device behavior: **Encoder Click**, **Quick Start**
- The QSO Bot settings (**Contest Type**, **QSO Difficulty**)

(Snapshots stored with older firmware versions may still contain some of these settings; they are ignored when recalling, and cleaned out when you overwrite the snapshot.)

6.1.1 Storing a snapshot

First, double click to get into the preference menu. Now a **long press** of the **FN button** gives you an opportunity to select with the ENCODER at which location you want to store the current settings, from **Snapshot 1** to **Snapshot 8**; a further option reads **Cancel Store** and allows you to get out without storing a snapshot. Snapshot locations that are **already in use** are shown in **bold**, but you can overwrite those as well. Clicking on the ENCODER knob stores the snapshot in the desired location, and gives you a quick indication about its success: “Snap N STORED” means the snapshot has been written and verified; if the settings storage is full, you will see “Snap N FAILED!” instead – in that case free up space by deleting a snapshot you no longer need, or by using **Reset Scores** in the preferences menu.

If the settings storage is running low, the Morserino warns you right after switching it on (“Settings mem. almost full!”), together with the same advice: delete snapshots you no longer need, or reset the game scores.

6.1.2 Recalling a snapshot

Again, you double click the ENCODER knob first to get into the preferences menu. Now a **short click on the FN button** lets you select with the ENCODER which of the stored snapshots you want to recall, and you recall it by clicking the ENCODER button; again, there is an option that reads **Cancel Recall**, which allows you to get out without recalling a snapshot. If there are no snapshots stored, you get a message “NO SNAPSHOTS” and you can leave by clicking any of the buttons.

6.1.3 Deleting a snapshot

You can also delete a snapshot that is no longer needed, or that was created in error. Proceed as if you wanted to recall a snapshot, select the one you want to delete, and then **click the FN button** for deleting it. There will be a confirmation dialog to make sure you really want to delete that snapshot. If you rotate the ENCODER to “Yes” and click it, that snapshot will be deleted, and, like with storing and recalling snapshots, a short message will indicate that the action was successful.

The easiest way to configure your preferences and snapshots is to connect your Morserino via USB to a computer running Chrome, Edge, Firefox or Opera and using the instructions in the appendix **Using a Browser to set up M32 Preferences, and upload Text Files**.

6.2 Player identity and game scores

Two preferences let you tell the Morserino who you are. **Call Sign** and **Op Name** are used by the **QSO Bot**. Select either item in the preferences menu and an on-screen text editor opens (it works the same on the OLED and the LCD):

- **turn the ENCODER** to choose a character,
- **click the ENCODER** to add it to the text,
- **click the FN button** to delete the last character,
- **long-press** either button when you are done.

Call Sign accepts letters, digits and the slash; Op Name accepts letters and a space. The current value is shown next to the preference.

Reset Scores clears the saved high scores and game progress for all games. Selecting it shows a confirmation: press **FN** to confirm, or click the ENCODER to cancel.

6.3 List of All Morserino-32 preferences

Bold values are default or recommended ones. When called from the start menu, all preferences are available for modification, when called from a running mode, only those that are relevant for this mode are available.

6.3.1 General Preferences

A number of preferences are very generic in nature, and therefore apply to all modes of the Morserino-32.

Preference Name	Description	Values
Encoder Click	Turning the encoder may generate a short tone burst, or be silent	Off / On
Tone Pitch Hz	The frequency of the side tone, in Hz	A series of tones between 233 and 932 Hz, corresponding to the musical notes of the F major scale from Bb3 to Bb5 (2 octaves)
Time Out	If the time specified in this preference passes without any display updates, the device will go into deep sleep mode. You can restart it by pressing the FN button.	No timeout / 5 min / 10 min / 15 min
Quick Start	Allows you to bypass the initial menu selection, i.e. at startup the device will immediately begin executing the mode that had been in effect before last shutdown.	ON / OFF
Output Case	This changes the case of decoded characters on the display (and also on serial output via USB, and on Bluetooth keyboard output!) from lower case to UPPER CASE.	lower / UPPER
Serial Output	Here you control what is being sent to serial port (USB connector); distinction is made between keyed characters (output from the iambic keyer), decoded characters (from CW decoder or using a straight key), and “generated” characters (from CW Generator etc., also from the receiver side of the LoRa or WiFi Transceiver modes). Nothing sends out none of these characters (but certain system or error messages might still appear), while All send out everything. In addition, other information can be sent and received via the serial port through the M32 Serial protocol, if the connected computer software supports this. See also Using the Serial Output of the M32 . This setting also applies to the character stream sent to an app connected over Bluetooth (see the Bluetooth Use preference in the section Preferences regarding Key, Paddles and Keyer).	Nothing / Keyer / Decoded / Keyed+Decoded / Generated / All (default since V. 4.3)

6.3.2 Preferences regarding Key, Paddles and Keyer

These preferences control the behavior of the paddles (built in or external), primarily also the timing preferences relevant for Iambic Keying, or the use of an external straight key (set the **Keyer Mode** to **Straight Key** in order to use a straight key).

Preference Name	Description	Values
Paddle Polarity	Defines which paddle side is for dits, and which for dahs	-. dah-dit / .- di-dah
External Pol.	Allows to reverse the polarity of an external paddle. Use this if your external paddle is wired “the wrong way”, so that dots and dashes of internal and external paddle are all on the same side.	Normal / Reversed
Keyer Mode	Sets the lambic Mode (A or B), Ultimatic, Non-Squeeze or Straight Key; see the section CW Keyer	Curtis A / Curtis B / Ultimatic / Non-Squeeze / Straight Key
CurtisB DahT%	Timing in Curtis B mode for dahs; see the section CW Keyer . Applies to lambic B only – Ultimatic ignores it. 0 – 100, in steps of 5	[35 – 55]
CurtisB DitT%	Timing in Curtis B mode for dits; see the section CW Keyer . Applies to lambic B only – Ultimatic ignores it. 0 – 100, in steps of 5	[55 – 95]
AutoChar Spce	Minimum spacing between characters	Off / min. 2 / 3 / 4 dots
Latency	Defines how long after generating the current element (dot or dash) the paddles will be „deaf”. If it is 0%, you have to release the paddle while the last element is still „on”. If set to 87.5%, the paddles will only react to a paddle press after 7/8 of a dot length. Has no effect in Ultimatic mode, which handles the paddles its own way.	A value between 0% and 87.5%, meaning 0/8 to 7/8 of a dot length (default is 50% , i.e. half a dot length).

Preference Name	Description	Values
Bluetooth Use	Defines what the Bluetooth radio is used for. The first four options (besides No Bluetooth) are keyboard modes: The VBand option allows the Morserino to be used as a VBand dongle (for VBand see https://hamradio.solutions/vband/), Decoded output sends all decoded characters not only to the display, but also out via Bluetooth, and the Generic Kbd option does more or less the same as Decoded output , but it sends the code for the “Enter” Key (New Line) when you key <KA> (new message), and for the “Backspace” key when you key <HH> (i.e. 8 dits). The M32 will appear as a US keyboard (QWERTY layout). <i>Bluetooth keyboard output is only active in CW Keyer mode (see also Using the Bluetooth Keyboard functionality)</i> . The last option, BLE Serial , instead makes the M32 Serial Protocol (see Using the Serial Output of the M32) available over Bluetooth Low Energy, so apps on phones and tablets can remote-control the Morserino and send text to be keyed as CW – without a USB cable; it takes effect on the next return to the main menu. Note that, like a USB protocol session, an active BLE protocol session prevents the automatic power-off timeout – keep this in mind when running on battery.	No Bluetooth / VBand Kbd / Decoded output / VBand+Decoded / Generic Kbd / BLE Serial
BLT <AR>	Only relevant in Generic Kbd mode (see Bluetooth Use above). Determines how the <AR> prosign is sent over Bluetooth: as the literal character “+” or as a soft line break (Shift+Enter).	+ / Linefeed

6.3.3 Preferences regarding Koch Character Sequence

If you follow courses by various institutions, they will follow a certain order introducing Morse code characters to you. Here you can select which order you want to follow.

Preference Name	Description	Values
Koch Sequence	This determines the sequence of characters when you use the Koch method for learning and training. You can also use your customized character set by choosing Custom Chars – see the section Koch: Select Lesson , the last paragraph.	M32 (native order, also used by JLMC – Just Learn Morse Code) / LCWO / CW Academy / LICW Carousel / Custom Chars /

Preference Name	Description	Values
LICW Carousel	This defines the “Entry Point” into the LICW Carousel curriculum (only relevant if the preference Koch Sequence is set to LICW Carousel). When you start a course in BC1, you should set this accordingly, and also set it again when you join the carousel classes for BC2.	BC1: r e a / BC1: t i n / BC1: p g s / BC1: l c d / BC1: h o f / BC1: u w b / BC2: k m y / BC2: 5 9 , / BC2: q x v / BC2: 7 3 ? / BC2: <ar> <sk> = / BC2: 1 6 . / BC2: z j / BC2: 2 8 <bk> / BC2: 4 0

6.3.4 Preferences regarding Practice Set

This is unrelated to the Koch Character Sequence above – it feeds the **Practice Set** entries under **CW Generator** and **Echo Trainer** (sections 5.2 and 5.3), not the Koch Trainer’s own sequence. The one place it does reach the Koch Trainer is **Boost Practice** below, which can make these characters come up more often within whatever your current Koch lesson has already unlocked.

Preference Name	Description	Values
Practice Set	Opens an on-device picker to build your own practice character pool: turn the ENCODER to browse letters, digits and punctuation, click to add the highlighted one (each character can be added only once), the FN button removes the last one added, and a long press finishes and saves the set. Shows as “(not set)” until you have added at least one character.	<i>(opens the picker; not an adjustable value)</i>

6.3.5 Preferences regarding CW Generation

The following preferences control how characters are generated and played randomly, or how text files are being played as Morse characters. I’d like to draw your attention to **Interchar Spc** and **Interword Spc** primarily, as through those preferences you can achieve what is otherwise known as “Farnsworth Speed” or “Wordsworth Speed”, respectively. Of course, these preferences are also relevant for the Echo Trainer!

Preference Name	Description	Values
Interchar Spc	The time (in lengths of a dit) that is inserted between characters (see section CW Generator).	3 – 45 [3]

Preference Name	Description	Values
Interword Spc	The time (in lengths of a dit) that is inserted between words (see section CW Generator). This also has some effect in the decoder, as it helps the decoder to decide when to insert a space.	6 – 105 [7]
Random Groups	For the output of groups of random characters, determine which character subsets should be included	Alpha / Numerals / Interpunct. / Pro Signs / Alpha+Num / Num+Interp. / Interp+ProSn / Alpha+Num+Int / Num+Int+ProS / All Chars
Length Rnd Gr	Here you select how many characters there should be in each group of random characters; traditionally this is 5, but for training it might make sense to start with a smaller number.	Fixed lengths 1 – 6, and 2 to 3 – 2 to 6 (length chosen randomly within these limits) [5]
Boost Practice	Raises the odds that characters from your Practice Set (see Preferences regarding Practice Set above) come up: in Random Characters groups, on top of the Random Groups subset selected above; and in the Koch Trainer's character generation (fixed or Adaptive), on top of whichever characters the current Koch Lesson has unlocked. It never overrides Koch's own weighting of newer/adaptive characters – it only asks Koch's scheme again when the draw misses a Practice Set character, so the “learn new characters more” behaviour is preserved exactly. Only affects character generation – Words, Abbreviations and Call Signs are unaffected. Has no effect while Practice Set is empty; a Practice Set character outside the currently active character pool (the Random Groups subset, or the current Koch Lesson) is never boosted in on its own.	Off / Moderate / Strong
Length Calls	Select the maximum length of generated call signs	Unlimited / max. 3 – max. 6

Preference Name	Description	Values
Calls Region	Select if you want to see call signs from around the world, or just from a certain continent. VK/ZL narrows it further still, to Australian and New Zealand call signs only: the call areas are weighted by population, so VK2 and VK3 come up far more often than VK8 or VK0, and roughly one call in six is a ZL. This parameter is ignored when the call length has been set to a maximum of 3 characters — there is no 3-character VK or ZL call either.	All / Europe / N America / S America / Africa / Asia / Oceania / VK/ZL
Call Prefixes	You can use this setting to filter out very rare prefixes, and get only call signs with more common prefixes.	Common only / All
Length Abbrev	Select the maximum length of the randomly generated common CW abbreviations and Q groups	Unlimited / max. 2 – max. 6
Length Words	Select the maximum length of the randomly generated common English words	Unlimited / max. 2 – max. 6
Max # of Words	When the specified number of words or letter groups has been generated, the Morserino-32 will generate a final AR (“+”) pro sign to indicate that this sequence is over, and then pause and wait – with a touch of a paddle (or clicking the ENCODER knob) it will continue and generate the next sequence of words. This closing “+”, like the opening vvv<ka>, is shown in bold on the display. <i>(When “Auto Stop” is active, this preference will be ignored in CW Generator mode.)</i>	Unlimited / 5 to 250 in steps of 5
Stop/ Next/Rep	Stops the generating of morse characters after each word in CW Generator and Koch Generator modes to help with learning head copying. Continue by touching the right paddle to play the next word, or by touching the left paddle to repeat the word. <i>This option and the option ‘Each Word 2x’ are not compatible with each other, setting one to ON, will set the other to OFF automatically.</i>	ON / OFF
CW Gen Displ	Select, how the CW Generator or the CW Transceivers should display what is generated or received	Display off / Char by Char / Word by word
Randomize File	If set to „On”, file player will skip n words after each word sent (n = random number between 0 and 255)	Off / On

Preference Name	Description	Values
Each Word 2x	In the CW Generator mode, each “word” (characters between spaces) will be output twice, as a help to learn to copy by ear. <i>This option and the option ‘Stop/Next/Rep’ are not compatible with each other, setting one to ON, will set the other to OFF automatically.</i> There are three ON settings: ON (if an increased inter-character space has been set, it will also be honored during the repetition; ON less ICS : the additional inter-character space will be reduced during the repetition; ON true WpM : the increased inter-character space will be ignored during the repetition.	OFF / ON / ON (less ICS) / ON (true WpM)

6.3.6 Preferences regarding Echo Trainer

The following preferences control the essential properties of the Echo Trainer (however, Tone Shift is also interesting for the transceiver modes).

Increasing the value for “Interword Space” also increases the “grace time” after the prompt before you must begin keying your response!

Preference Name	Description	Values
Echo Repeats	Here you can set how often a word is repeated if the answer is either too late or incorrect before the Echo Trainer generates a new word. If the value is 0, then the next word is always a new one, regardless of whether the response was right or wrong.	0 – 6 / Forever (Default is 3)
Echo Prompt	This defines how you are prompted in Echo Trainer mode. The possible settings are: Sound only (default; best for learning to copy in your head), Display only (the word you are supposed to enter is shown on the screen, no audible code is generated; good for training paddle input), and Sound & Displ , i.e you hear the prompt AND you can see it on the display.	Sound only / Display only / Sound&Displ
Confrm. Tone	This defines if an audible confirmation tone should be sounded in Echo Trainer mode. If you turn it off, the device just repeats the prompt when the response was wrong, or sends a new prompt. The visual indication of “OK” or “ERR” will still be visible when the tone is turned off.	ON / Off

Preference Name	Description	Values
Tone Shift	The pitch of the tone, when you are using the Echo Trainer mode or transmitting in a transceiver mode, can either be the same as the one you get from the receiver (or from the prompt in Echo Trainer mode), or can be a half tone lower or a half tone higher.	No Tone Shift / Up 1/2 Tone / Down 1/2 Tone
Adaptv. Speed	If this is set to ON, the speed will be increased by 1 WpM whenever you gave a correct response in Echo Trainer mode, and will be decreased by 1 whenever you made a mistake.	ON / OFF
Echo Speed Max	Set this to the maximum speed you would like to use for keying in Echo Trainer mode. If you set the speed faster than this value with the Encoder, or if it is getting faster as a result of adaptive speed, the speed for keying your input stays at that maximum.	No limit / 5 – 50 wpm (in steps of 5 wpm)
Echo Think T.	Adds a fixed pause after the prompt before the Echo Trainer expects your response, useful for head-copy practice.	0 s – 20 s (in steps of 1 s)

6.3.7 Preferences regarding Transmitting, Decoding and QSO Bot

These preferences control some functions available for transmitting (either directly through LoRa or Wifi, or through keying an external transmitter), for decoding Morse code characters, and for the QSO Bot (see section **QSO Bot**).

Preference Name	Description	Values
Key ext TX	Here you determine, if a connected Transmitter will be keyed when you use the device. Gen = generator modes, RX = LoRa or WiFi Receiver modes. The option Keyer & Gen. makes the Morserino key an external transmitter also from generator mode, useful for training transmissions, for example. The option Keyer&Gen.&RX is useful if you want to transmit on your transmitter what the Morserino received through LoRa or WiFi (for remote operations).	Never / CW Keyer only (and also for Transceiver modes) / Keyer & Gen. / Keyer&Gen.&RX

Preference Name	Description	Values
Generator Tx	This allows the CW Generator to send, what it generates, either via LoRa or via WiFi – so you can have one device generating something, and several others receiving the same sequence. This can be used in all CW Generator and Koch / CW Generator modes, including File Player. Could be useful for groups of learners, as you can transmit e.g. contents of a file to a group of people. Obviously this should only be used with caution (and not for extended period of time) on public M32 chat servers, but can be very handy for a group on the same network segment, using broadcast as TrX peer, or a privately set up chat server, or via LoRa (or WiFi Trx using EspNow) when all participants are close enough together. <i>Be aware that you must have an antenna connected when you transmit via LoRa, otherwise the LoRa transceiver will eventually be destroyed!</i>	Tx OFF (= do not transmit generated CW) / LoRa Tx ON (transmit generated code through LoRa) / WiFi Tx ON (transmit generated code through WiFi).
Trx Channel	Selects which channel LoRa or EspNow (a peer to peer Wifi mode, not using access points) will be used. For LoRa this is a virtual channel, for EspNow it actually changes the QRG between WiFi channel 6 (Standard Ch) and 1 (Secondary Ch). More infos on EspNow can be found in the section Wifi Trx .	Standard Ch / Secondary Ch
Bandwidth	Defines the bandwidth the CW decoder is using (this is implemented in software using a so called Goertzel filter). Wide = ca. 600 Hz, Narrow = ca. 150 Hz; center frequency = ca 700 Hz.	Wide / Narrow
Decoded on I/O	Normally, decoded CW that comes from an external source (when using any of the transceiver modes, or using the decoder to decode audio input) is played on the speaker (or headphones), but not sent to the external audio I/O port. With this preference set to „ON“, the audio is also sent to the external audio I/O port. On the M32Pocket, this setting is ignored!	On / Off
Contest Type	Only relevant in the QSO Bot's Contest mode (section QSO Bot): which contest exchange the bot uses. CQ WW sends 5NN + the CQ zone of the bot's callsign; WPX/Sprint sends 5NN + a serial number.	CQ WW / WPX/Sprint

Preference Name	Description	Values
QSO Difficulty	How forgiving and how chatty the QSO Bot partner is (all QSO Bot modes, section QSO Bot). Beginner is patient (more time to reply, an extra retry), spells signal reports out in full (599 rather than 5nn), and uses clear, calm prompts. Advanced keeps a tighter rhythm and uses curt, seasoned-operator prompts. Intermediate sits in between.	Beginner / Intermediate / Advanced

6.3.8 Preferences regarding Player Identity and Scores

These items appear at the very end of the preferences list. The first two set your personal identity, which is used by the **QSO Bot** (section **QSO Bot**); **Reset Scores** clears the stored game scores. Call Sign and Op Name can also be set over USB through the M32 Serial protocol (for example with a browser configuration tool).

Preference Name	Description	Values
Call Sign	Your own amateur radio call sign. Enter it with the encoder and buttons. It is stored in upper case and used as your station call in the QSO Bot .	up to 8 characters (stored as UPPER CASE)
Op Name	Your operator name (for example your first name). Enter it with the encoder and buttons. It is stored in upper case.	up to 8 characters (stored as UPPER CASE)
Reset Scores	This is an action, not a setting: it clears the stored high scores and saved progress of the games. You are asked to confirm by pressing the FN button. (Fight the Pileup keeps no persistent high score and is not affected.)	press FN to confirm

7 Appendices

7.1 Hardware Configuration Menu

There is a hardware configuration menu that can be reached by **pressing a paddle (or external paddle or straight key) while switching the M32 on**. You can then select the configuration you want to perform by rotating the encoder knob, and pressing it once the right option shows up.

The selectable options are **Calibr. Batt.** (calibration of battery measurement), **Flip Screen**, **Reset Defaults** (reset all preferences to their factory values), **LoRa Config.** and **Cancel** (which just leaves this menu and continues with regular start-up of the M32).

7.1.1 Flipping the display screen for left-hand use

This is probably only relevant for the M32Pocket! With the M32Pocket, if you want to key with your left hand, the normal display would be upside down; with this configuration option the display is rotated by 180° to allow left-hand use.

1. Start your M32 while holding the touch paddles (or external paddles, or straight key) pressed.
2. Select the Option **Flip Screen** with the rotary encoder, and pressing the ENCODER knob.

The M32 will re-boot, with the display now rotated 180°.

7.1.2 Calibration of Battery Measurement



For the M32Pocket, calibrating battery measurement is not necessary, and therefore this item is only available on 1st and 2nd edition Morserinos.

The built-in capability of Heltec modules to measure battery voltage unfortunately is not very reliable. Various factors apparently contribute to the problem: a measurement error within the ESP32 processor due to a slight variation of the reference voltage for each chip (leading to a relatively small error), and problems with the voltage divider circuit on the Heltec module (leading to pretty big variations among the modules). Although measuring

the battery is not very crucial for the operation of the Morserino-32, it is nevertheless a nuisance, and can also lead to the situation that the M32 cannot be switched on, as the firmware thinks that the voltage is too low, when in reality it would still be sufficient.

In order to calibrate the voltage measurement, you have to measure the actual battery voltage of your Morserino-32 with the help of a multimeter. Once you know this value, you perform the following steps:

1. Start your M32 while holding the touch paddles (or external paddles, or straight key) pressed.
2. Select the Option **Calibr. Batt.** with the ENCODER, and pressing the ENCODER knob.
3. You will see a voltage value (in Millivolts) on the display. Now rotate the ENCODER until the displayed value is as close as possible to the measured battery voltage.
4. Press the ENCODER knob to store the calibration value, and to continue with a new boot-up of the M32.



If your battery is reasonably new, and you know for sure that it is fully charged, as it has been in charging mode long enough (>10 hours for 1st & 2nd edition Morserinos, >3 hours for M32 Pocket), you can assume a battery voltage of 4.2V and use that value instead of measuring the battery.

7.1.3 Configuring LoRa Band, Frequency and Output Power

Obviously this section is only applicable if you have a Morserino with LoRa capability (like a 1st or 2nd edition Morserino).

If you have a standard 433 MHz Heltec module in your Morserino-32 (1st or 2nd edition), which is practically always the case, it has been already preconfigured for the right band and a default frequency within that band.

If you have to change either the LoRa frequency within the standard band, or you use a Heltec module for the 868 and 920 MHz bands, you have to configure your Morserino-32 before you use the LoRa capabilities.

The following bands and frequency ranges can be configured in the Morserino-32 for Heltec modules supporting the upper UHF LoRa modules:

- 868 MHz band: 866.25 to 869.45 MHz in steps of 100 kHz (default: 869.15 MHz)
- 920 MHz band: 920.25 to 923.15 MHz in steps of 100 kHz (default: 920.55 MHz)

The default Heltec modules supports the 433 MHz band only, and the Morserino-32 can be configured to use 433.65 to 434.55 MHz in steps of 100 kHz (default: 434.15 MHz).

In order to configure the Morserino-32 for non-standard frequencies and bands, or to configure the output power, please proceed as follows:

1. Start your M32 while holding the touch paddles (or external paddles, or straight key) pressed.
2. Select the Option **LoRa Config.** with the rotary ENCODER.
3. First you will be asked to select the desired band (select 433 for the default LoRa module, and either 868 or 920 for the upper UHF LoRa module); rotate the encoder to the desired band, and click the ENCODER knob once. **The band selection has to fit the Heltec module you are using!**
4. Now you are being asked to select a frequency within your selected band. The first frequency shown is the default for that band – if that is OK, just click the ENCODER knob once, otherwise select a frequency by rotating the ENCODER and clicking the knob once you have found the correct frequency.
5. In a further step you can configure the output power of the LoRa transceiver. The default is 14 dBm (= 25 mW), and you can set it in several steps between 10 dBm (=10 mW) and 20 dBm (=100 mW).



Be aware of applicable regulations in your jurisdiction, there might be a legal limit regarding output power! Be also aware that the higher the output power, the higher the risk of destroying the LoRa transceiver when used without proper termination (a suitable antenna or a dummy load).

Immediately after that the Morserino-32 will start normally, with the now selected LoRa settings in effect. On the top line of the Startup Screen you will see the configured QRG for LoRa as a 5-digit number (e.g. 43415 for the default in the 433 MHz band).

7.1.4 Resetting Preferences to their Factory Defaults

This item — **Reset Defaults** in the Hardware Configuration menu — resets all preferences to their factory default, but it does not change any hardware configuration settings, nor does it delete or modify any settings stored in snapshots.

7.2 More information about LoRa

When morse code is packed into a LoRa data packet, dots, dashes and pauses are encoded; it is not so that the clear text would be sent as ASCII characters. Therefore it is possible to send “illegal” morse code characters, or characters that might only be used in certain languages. They will be transmitted correctly (but shown on the display as non-decodable).

Sending the code word by word means there is a significant delay between sender and receiver, and the delay depends to a large degree on the length of the words being sent, and on the speed that is being used. As most words in a typical CW conversation are rather short (7 characters or more already constitutes a very long word), this is nothing to worry about (unless you are sitting both in the same room using no headphones – then it will be really confusing). But try sending really long words, say 10 or more character long, at really low speed (5 WpM), and you will see what I am talking about!

Using two different LoRa “Channels”

LoRa data packets are addressed with a so called “Sync Word” – receivers discard packets that do not show the sync word they are expecting.

Morserino-32 can make use of two different sync words, thus effectively creating two different “channels” over which it can communicate. This can be used, for example, in a classroom situation, to create two independent groups that do not interfere with each other.

Normally M32 LoRa works with sync word 0x27 (we call it the “Standard” channel), but through the setting LoRa Channel in the preferences menu can be switched to 0x66 (called “Secondary” channel).

The channels are selected through the preference **Trx Channel**, see section **Preferences regarding Transmitting, Decoding and QSO Bot**.

Using different LoRa frequency bands and/or frequencies

By default the Morserino-32 kits are being shipped with a LoRa module that works in the 70 cm band, and as standard frequency within that band on 434.150 MHz (within the 70 cm Amateur band and within a region 1 ISM band).

If for whatever reason you cannot use this frequency (maybe because of band plans, regulatory reasons etc.), you can change the frequency on the standard LoRa Module between 433.65 and 434.55 MHz in steps of 100 kHz.

Should you require a LoRa frequency either around 868 MHz or around 920 MHz, you need to get a Heltec module that support this higher frequency range (which might be difficult now as Heltec has discontinued the versions of these modules used in Morserinos 1st and 2nd edition.). For these bands, you **MUST** configure your Morserino to use the correct band and frequency.

See **Hardware Configuration Menu** to learn how you can configure LoRa for modules that support the 868 and 920 MHz bands, and how to change the LoRa frequency settings.

Technical Details of LoRa Trx

- Frequency: Default is 434.150 MHz – but see the notes above for choosing other frequencies
- LoRa Spreading Factor: 7

- LoRa Bandwidth: 250 kHz
- LoRa CRC: no CRC
- LoRa Sync Word: 0x27 (= decimal 39) for standard channel, and 0x66 (= decimal 102) for secondary channel
- HF Output: by default 14 dBm (= 25 mW), can be increased to 20 dBm (100 mW)

7.3 Adjusting Audio Level

You can also reach **one other function** while you are positioned within the Start Menu – not through a menu selection, but through a **long press on the FN button**:



This function behaves differently on the M32Pocket than on the 1st and 2nd edition M32!

1st and 2nd edition M32 only: This starts a function to adjust the **audio input level**: make sure a tone signal is available on the input, for example from your shortwave receiver, and a bar graph will indicate the voltage of the input signal. Adjust it with the blue trimmer potentiometer, so that the left and right ends of the solid bar are within the two outer rectangles.

All Morserinos: When this function is active, a sinus signal is output on line-out, and the transceiver output is shortened (keying a transmitter, should you have one connected – disconnect your transceiver first if this is not what you want!). You can now, for example, adjust the level of the output signal on a connected computer, or check whether a transmitter is being keyed.

1st and 2nd edition only: A simple test or demo for the audio-in adjustment is to connect line-out with audio in (connect tip with sleeve), feeding the output sine wave into the audio input. When you turn the potentiometer, at one end of the potentiometer range you can see the solid bar graph changing leaving just a tiny solid bar in the middle and exposing the two rectangles on both ends of the graph (essentially you are just measuring the noise on the operation amplifiers input), and on the other end of the potentiometer sweep you see the solid bar graph extending beyond the rectangles on both ends. Now you can set the potentiometer so that the solid bar is almost touching the outer bounds of the rectangles. This is the optimal setting for the audio in level. Obviously you have to perform this for the audio source you are planning to use, e.g. for your radio receiver.



Only while you are in the **menu** will the **FN button long press** activate the level adjustment function.

While you are executing one of the Morserino modes (Keyer, Generator, Echo Trainer, Transceiver etc.) a long press of the FN button activates the **scroll mode of the display** to enable you to read text that has already scrolled away...

7.4 Updating the Firmware via WiFi for Versions < 2.0

With firmware versions **1.x** the WiFi functions were not accessible directly from the main menu, but **by quickly pressing the FN button three times**. Once you are in the WiFi menu, the process is the same for the various WiFi functions as described in section **WiFi Functions!**

Of course you can also **update through USB** when you are still on an older software version (see next 2 appendices).



If you are still on version 1.x, you really should update to a newer firmware - otherwise you are missing out on many new features (and bug fixes, too).

7.5 Updating the Firmware via USB and an update program

This simple update procedure for Morserinos has become possible through work by Matthias Jordan and Joe Wittmer.

For an M32 1st or 2nd edition make sure you have a **driver** for the Silicon Labs CP210x USB to serial device, used by the Heltec module for its USB interface. Current versions of Windows 10 install this automatically; if yours doesn't, you can get the driver from here: <https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers>

To check if you have the correct driver installed in Windows, and to see to which port it connects, open the Device Manager on your computer (in the search field in the lower left of the screen start typing "settings: device" and it will come up for selection). OSX or Linux users can use command line tools to find out which serial ports are available.

Connect your Morserino with a USB cable to your computer. On Windows the device manager should update its screen and show an entry “Ports” - open it and it should indicate something like Silicon Labs CP210x ... (COM3). Could be another COM port in your case, so please remember your correct port name.



Make sure you have a cable that is a “proper” USB cable, not just a cable for a charger!

Now download the update utility from Joe’s GitHub repository, making sure you get the correct zip File for your operating system: <https://github.com/joewittmer/Morserino-32-Firmware-Updater/releases>

Unzip that file. You will find a program (in the case of the Windows OS) *update_m32.exe* (without a filename extension for other operating systems) - copy that to a folder of your choice (I usually prefer the folder Downloads). Then get the binary Morserino firmware file for the version you want to install from the Morserino GitHub, ideally into the same directory.



Be aware that from V.7.0 onwards there are two different binaries for each version, one for Morserinos 1st and 2nd edition and one for the M32Pocket – make sure you take the one for the 1st and 2nd edition.

Now open a command box on your computer (for Windows: in the search field in the lower left of the screen start typing “cmd” and it will come up for selection). First “cd” (change directory) to the directory where the utility and the binary file are located; e.g., if you used the Downloads directory:

```
cd Downloads
```

Then enter the following command line:

```
update_m32 -p <COMx> -f <binaryfilename>
```

replacing <COMx> with your COM port name, and <binaryfilename> with the correct name of the Morserino binary file.

In my case that was (on a Windows machine):

```
update_m32 -p COM3 -f m32_V9.0.bin
```

or on OSX or Linux:

```
./update_m32 -p /dev/tty[...] -f m32_V9.0.bin
```

After a short while your Morserino should restart, showing the updated version number.

There is also an option to fully erase the M32's permanent memory before installing the firmware again; this can be useful if your device's permanent memory has been corrupted. To do this add the optional erase parameter `-e`. As an example (here for OSX or Linux):

```
./update_m32 -p /dev/tty[...] -f m32_V9.0.bin -e
```

7.6 Updating the Firmware via USB and a Browser (Webserial)

Some browsers support the Webserial extension, which allows to access a serial port directly from the browser; currently these are **Google Chrome**, **Microsoft Edge**, **Firefox** (from version 151), and at least on some platforms also **Opera**. By using such a browser, updating the firmware to the latest release becomes really very easy (no firmware download necessary, and no command lines...).

Make sure you have a USB cable that allows data transfer.



For M32 1st and 2nd edition, make sure you have a driver for the SiLab CP210x chip.

This method does NOT work with the Safari browser, nor with versions of Firefox before 151. On a computer managed by a company or a school, Webserial may also be switched off by policy.

For updating your firmware, connect your Morserino-32 to your computer via USB and go to <https://www.morserino.info/install.html>.

One page installs every Morserino. You no longer have to know whether you own a classic Morserino-32 or an M32 Pocket: the installer asks the processor in your device which one it is, and offers only the firmware that fits it.

The installer takes you through three steps:

1. **Connect** — click *Connect* and pick the port your Morserino is connected to from the pop-up your browser shows.

::: note The Morserino's screen goes **dark** the moment the browser connects to it. That is normal: talking to the flash chip means putting the device into its ROM update mode, and the firmware — and its display — are not running while that mode is on. If you decide not to install after all, press *Cancel* on the page: the Morserino restarts and the screen comes back on its own. :::

2. **Choose what to install** — the page tells you what it found and, where it can, which firmware version is on the device at the moment. Then you pick the version you want. If you own an M32 Pocket you also choose the **edition** here (see below). Finally you decide what happens to your settings:
 - *Keep my settings* (the normal choice) — your preferences, snapshots and high scores survive the update.
 - *Erase everything* — wipes preferences, snapshots, high scores and any text you uploaded for the File Player. Only use this if your device's permanent memory has been corrupted.

::: note After *Erase everything*, the Morserino has to build a new file system the next time it starts. This happens **before** the start screen appears, so the display stays dark for a while — considerably longer than a normal start. That is normal and not a fault: let it finish, and do **not** switch the device off while it is dark. :::
3. **Installing** — wait for the progress bar. Do not disconnect the device. When it finishes, the Morserino restarts by itself.

Older bookmarks pointing at the previous two separate installer pages still work; they now forward to this one page.

7.6.1 If the Morserino Does Not Respond: Recovery Boot Mode

If an update has gone wrong, the Morserino may seem dead: the screen stays dark or frozen, it ignores all controls, and the installer cannot find it on USB. It is almost certainly not broken. Every Morserino can be forced into the processor's built-in update mode (the same ROM update mode the installer uses), which does not depend on the firmware at all:

1. **Switch the power off completely.** Unplug the USB cable. If your Morserino has a battery, also set the power switch to off.
2. With the device off, **press and hold the FN button.**
3. Keep holding it and **plug the USB cable back in.** If you have a battery, leave the power switch off - USB supplies the power for the recovery.
4. Once the device has power, **release the FN button.** The Morserino is now in recovery boot mode and the installer can reach it again.

On the Morserino-32 1st and 2nd edition, the FN button is the red button.



The screen stays dark the whole time the device is in recovery boot mode. That is expected: the firmware is not running.

Now run the installer as described above and choose *Erase everything*, which also removes any corrupted settings that might stop the new firmware from starting. Your preferences, snapshots and high scores are lost in the process.

On the 1st and 2nd edition, USB is handled by a separate chip (the CP210x), so the device normally appears on USB even when the firmware is broken. If it does not show up at all, suspect the cable or the CP210x driver first. The recovery boot mode is still the right thing to try if the installer finds the port but cannot connect.

Thanks to Brian, N6UGP, for describing this procedure.

7.7 Using a Browser to set up M32 Preferences, and upload Text Files

There are currently three sites that enable you to set up M32 preferences through a browser on your computer, and another one that implements an M32 File Manager.

- There is the “official” morserino.info website which hosts a comprehensive configuration tool at https://www.morserino.info/m32_config_tool.html. It allows to view and set all preferences, and also to set, delete, view, compare, export and import snapshots. In addition it contains file utilities, see below.
- Christof, **OE6CHD**, wrote a Javascript program that makes it very easy to set preferences, WiFi access point credentials, and keyer memories, as well as to upload text file for the File Player.
- Similar functionality has been integrated by Oliver, **OM0RX**, into his *Morse Trainer Pro* application.

The quickest way to do all that is to connect your Morserino via USB to a computer running Chrome, Edge, Opera or Firefox (or any other browser that supports the Webserial protocol), and going to either

- https://www.morserino.info/m32_config_tool.html (for the “official” configuration tool),
- <https://tegmento.org/> (for the application by OE6CHD), or
- <https://morsetrainerpro.com/morserino-config.html> (for the application by OM0RX).



- The “official” tool is a simple html/javascript program that can also run locally. The source is also available at the Morserino GitHub site. There you will also find a help file in JSON format which enables tool tips within the application (explainign the purpose of the various preferences).
- This tool also contains a **file manager** for uploading text and sound files, and for viewing the standard text file, as well as a **file builder**, which allows to combine several files into a mulit-part file that can be used with the M32 file player; **this file builder accepts not only text files, but also pdf, epub and word processing formats and converts them into simple text suitable for the file player.**
- You can also run Christof’s javascript program locally, the source code is available at <https://github.com/cdaller/morserino32-trainer>.

On these websites, you need to click a “Connect” button (in a pop-up window, you need to tell the browser which port to use); otherwise, these websites explain everything you need to know to use their functionality.

In addition to the setup functionality, Christof also implemented a few nice training features, a QSO bot, and voice output for all menu items and preferences settings, to assist vision-impaired operators, all to be found on <https://tegmento.org>.

Also, Oliver implemented a lot of additional training features on his site, to be found at <https://morsetrainerpro.com/index.html>.

This utility also gives information about free space for files, and you can also delete files on the M32.

These feature were made possible by implementing a serial protocol into the Morserino; see the next appendix for more information.

7.8 Using the Serial Output of the M32

The Morserino-32 is able to output data via the serial USB interface. This can be used, for example, to show the characters that are shown on the display in a computer terminal window. This way you can show the Morserino output on a big screen or projector; this could be useful for presentations or classroom use.

In version 5, a full two-way protocol called “M32 Serial Protocol” was implemented. This allows (via software on a computer connected via USB) screen or voice output of menus and settings (e.g. to make the M32 usable for blind or partially sighted people), and also allows remote control of all Morserino functions from the computer (e.g. settings, preferences, changing speed and volume, exiting and entering menus and even automatic CW generation). The protocol is described in a separate document available on GitHub.

A baud rate of 115200 must be selected for the serial port used on the connected computer.

One can use serial communications in conjunction with computer software written specifically for the Morserino-32 to enhance one's training skills. There are currently four software products available for this purpose:

- **Morserino-32 CW training** by Christof, OE6CHD (see <https://tegmento.org/>) using the serial protocol functions, see also the previous appendix.
- **Morse Trainer Pro** by Oliver, OM0RX (very comprehensive functionality, some functionalities require a paid membership, Morserino setup functionality is free; see <https://morsetrainerpro.com/index.html>, and the previous appendix.
- **CW Trainer for Morserino** by Enzo, IW7DMH (see <https://iw7dmh.jimdofree.com/other-projects/cw-trainer-for-morserino-32/>), and
- **Morserino Phrases Trainer** by Tommy, OZ1THC (see <https://github.com/Tommy-de-oz1thc/Morserino-32-Phrases-trainer>).
- See also the description of the **Serial Output** preference in section **General Preferences**.

7.8.1 Using the M32 Serial Protocol over Bluetooth (BLE Serial)

The M32 Serial Protocol is not tied to the USB cable: when the preference **Bluetooth Use** (see section **Preferences regarding Key, Paddles and Keyer**) is set to **BLE Serial**, the very same protocol is also available over Bluetooth Low Energy. This is particularly useful for phones and tablets — on iOS, for example, apps cannot open a classic serial connection over Bluetooth at all, while BLE works fine. An app can remote-control the Morserino exactly like a program connected via USB, including sending text that the Morserino keys as CW (`PUT cw/play/...`).

After selecting this option (it takes effect on the next return to the main menu), the Morserino advertises itself as “**Morserino-32**” whenever it is at the main menu or in one of the training modes and no client is connected. No pairing is necessary, but connecting is not quite like plugging in a USB cable: nobody can plug in a cable without standing next to your Morserino, whereas anything within radio range can connect. The Morserino therefore asks you before it hands over control.

When an app starts a session with the usual `PUT device/protocol/on` command, the Morserino shows

```
Allow connect?  
FN = yes  
click = no
```

Press **FN** to allow the connection. A click on the encoder knob refuses it, and so does simply doing nothing for about 20 seconds — the connection is never granted by accident. The app will tell you that it is waiting for this.

Three things are worth knowing:

- You are only asked at the **main menu**. If you are in a training mode the request is refused immediately, without interrupting you: the app reports “DEVICE BUSY”, and you return to the main menu and try again.
- Once you have allowed a connection, an app that reconnects within the next minute is admitted without asking you again. That is what lets an app which was briefly in the background, or a link that dropped, pick up where it left off — including while you are in a training mode.
- An app written before this feature existed may report a failed connection the first time. Press **FN** anyway, then connect again: the second attempt succeeds.

While a session is open, a small Bluetooth symbol appears at the right of the top line, both in the main menu and in the training modes, so you can always see that something is connected. It disappears as soon as the app disconnects.

A few things to be aware of:

- USB and BLE sessions are independent and can even be active at the same time; each is started and ended with its own `PUT device/protocol/on / off`.
- Any function that needs the WiFi radio (WiFi transceiver modes, multiplayer games, file upload, firmware update, WiFi configuration) suspends the Bluetooth connection for the remainder of that activity — a short notice (“BLE Ser. susp.”) appears on the display; it becomes available again when you return to the main menu.
- The **Bluetooth Use** selector assigns the Bluetooth radio either to the keyboard output (**Using the Bluetooth Keyboard functionality**) or to the serial protocol, so BLE Serial and the Bluetooth keyboard can never be active at the same time.
- An active protocol session prevents the automatic power-off timeout, just like a USB session does — remember this when running on battery.

For developers: the technical details (service UUIDs, framing, transport behavior) are described in the *M32 Protocol* description in the `Documentation/Protocol Description` folder on GitHub; a ready-made test and demo script (`ble_m32_test.py`, using Python and *bleak*) can be found in the `devdocs/ble-serial` folder.

7.9 Using the Bluetooth Keyboard functionality

In “CW Keyer” mode, the M32 can send the keyed Morse code as keyboard codes via Bluetooth to a computer (including cell phones and tablets).

To do this, the “**Bluetooth Use**” setting must be set to one of the keyboard options (for more information, see section **Preferences regarding Key, Paddles and Keyer**).



This feature is only active in CW Keyer mode! The keyboard will only become visible on your PC, tablet, etc. once CW Keyer has been launched!



The Morserino works like a keyboard with a US key layout – this may need to be set accordingly on the computer you are using.

7.10 List of common CW abbreviations used by Morserino-32

The list contains definitions in English and German, separated by a slash. Not all abbreviations are very common in all languages; abbreviations uncommon in English are in square brackets [].

A

Abbr	Meaning
aa	all after / alles nach
ab	all before / alles vor
abt	about / ungefähr, um
ac	alternating current / Wechselstrom
adr	address / Adresse
af	audio frequency / Niederfrequenz
agc	automatic gain control / automatische Verstärkungsregelung
agn	again / wieder
alc	automatic level control / automatische Pegelanpassung
am	amplitude modulation / Amplitudenmodulation
am	ante meridiem / vormittags
ans	answer / Antwort
ant	antenna (aerial) / Antenne

Abbr	Meaning
atv	amateur TV
avc	automatic volume control / automatische Lautstärkeregelung
award	Award / Amateurfunkdiplom
awdh	[good bye] / auf Wiederhören
awds	[good bye] / auf Wiedersehen

B

Abbr	Meaning
b4	before / bevor
bc	broadcast / Rundfunk
bci	broadcast interference / Rundfunkstörung(en)
bcnu	be seeing you / hoffe dich wieder zu treffen
bd	bad / schlecht
bfo	beat frequency oscillator / Überlagerungssoszillator
bk	break / Aufforderung zur Unterbrechung
bpm	[characters per minute] / Buchstaben pro Minute
btr	better / besser
btw	by the way / nebenbei bemerkt
bug	Bug / mechanisch-automatische Taste
buro	(QSL) bureau / QSL Büro

C

Abbr	Meaning
call	call sign / Rufzeichen
cfm	confirm / bestätige
cl	closing / schließe meine Station
conds	conditions / (Ausbreitungs-)Bedingungen
condx	conditions for dx / Bedingungen für DX
congrats	congratulations / gratuliere

Abbr	Meaning
cq	cq (calling anybody) / allgemeiner Anruf
cu	see you / hoffe auf ein weiteres Treffen
cuagn	see you again / hoffe auf ein weiteres Treffen
cul	call you later / rufe dich später
cw	continuous wave (=Morse code) / Morsetelegrafie

D

Abbr	Meaning
db	deziBel
dc	direct current / Gleichstrom
de	from (call sign) / von (Rufzeichen)
diff	difference / Unterschied
dr	dear / liebe(r)
dwn	down / abwärts, hinab
dx	(great) distance / große Entfernung

E

Abbr	Meaning
ee	end / Ende
el	(antenna) element(s) / (Antennen) Element(e)
elbug	Elbug (= electronic bug) / Elbug (elektronische autom. Taste)
es	and / und
excus	excuse me / Entschuldigung

F

Abbr	Meaning
fb	fine business / ausgezeichnet
fer	for / für
fm	frequency modulation / Frequenzmodulation
fone	telephony / Telefonie

Abbr	Meaning
fr	for / für
frd	friend / Friend
freq	frequency / Frequenz
fwd	forward / vorwärts

G

Abbr	Meaning
ga	[good evening] / Guten Abend
gb	good bye / Auf Wiedersehen
gd	good / gut
gd	good day / guten Tag
ge	good evening / guten Abend
gl	good luck / viel Glück
gm	good morning / guten Morgen
gn	good night / gute Nacht
gnd	ground / Erde (Erdpotenzial)
gp	ground plane / Groundplane-Antenne
gs	greenstamp / 1-Dollar-Note
gt	[good day] / guten Tag
gud	good / gut

H

Abbr	Meaning
ham	ham (radio amateur) / Funkamateureur
hf	high frequency / Hochfrequenz
hi	hi(larious) – laughing / ich lache
hpe	hope / ich hoffe
hr	here / hier
hrd	heard / gehört

Abbr	Meaning
hrs	hours / Stunden
hv	have / habe
hvy	heavy / schwer
hw	how (copy) / wie werde ich gehört?

I

Abbr	Meaning
i	I / ich
iaru	International Amateur Radio Union
if	intermediate frequency / Zwischenfrequenz
ii	I repeat / ich wiederhole
info	information / Information
inpt	input / Eingangsleistung
irc	international return coupon / internationaler Antwortschein
itu	International Telecommunications Union / internationale Fernmeldeunion

K

Abbr	Meaning
k	come (please answer) / bitte kommen (bitte antworten)
khz	kiloHertz
km	kiloMeter
kw	kiloWatt
ky	key / Morsetaste

L

Abbr	Meaning
lbr	[dear] / lieber
lf	low frequency / Niederfrequenz
lid	bad operator / Funker mit schlechter Betriebstechnik
lis	licensed / lizenziert

Abbr	Meaning
lng	long / lang
loc	locator / Standort(kenner)
log	log book / Stationstagebuch
lp	long path / langer Ausbreitungsweg
lsb	lower sideband / unteres Seitenband
luf	lowest usable frequency / niedrigste brauchbare Frequenz
lw	long wire (antenna) / Langdrahtantenne

M

Abbr	Meaning
ma	milliAmpere
mesz	[middle European summer time] / mitteleuropäische Sommerzeit
mez	[middle European time] / mitteleuropäische Zeit(zone)
mgr	(QSL) manager / (QSL-)Manager
mhz	megaHertz
min	minute / Minute
mins	minutes / Minuten
mm	maritime mobile / Station auf einem Schiff zur See
mni	many / viele
mod	modulation / Modulation
msg	message / Nachricht
mtr	meter / Messinstrument
muf	maximum usable frequency / höchste brauchbare Frequenz
my	my / mein

N

Abbr	Meaning
n	no / nein, kein
net	network / (Funk-)Netzwerk

Abbr	Meaning
nf	[low frequency] / Niederfrequenz
nil	nothing / nichts
no	no / nein, kein
nr	near / nahe
nr	number / Nummer
nw	now / jetzt

O

Abbr	Meaning
ok	ok / in Ordnung
om	old man, ham / Anrede f. Funkamateure
op	operator / Funker
osc	oscillator / Oszillator
oscar	OSCAR (satellite) / OSCAR Amateurfunksatellit
output	output / Ausgangsleistung
ow	old woman / Funkamateurin

P

Abbr	Meaning
pa	power amplifier / Endstufe, Leistungsverstärker
pep	peak envelop power / Hüllkurvenspitzenleistung
pm	post meridiem, afternoon / Nachmittag
pse	please / bitte
psed	pleased / erfreut
pwr	power / Leistung
px	prefix / Präfix, Landeskenner

Q

Abbr	Meaning
qaz	closing because of thunderstorm / ich beende wegen Gewitter

Abbr	Meaning
qra	name of my station is... / der Name meiner Funkstelle ist
qrb	distance between stations is ... / Entfernung zwischen den Stationen ist...
qrg	exact frequency is ... / genaue Frequenz ist ...
qrl	I am busy, don't interfere / bin beschäftigt, bitte nicht stören
qrm	interference / Störung
qrn	atmospheric noise (static) / atmosphärische Störungen
qro	increase power / erhöhe die Senderleistung
qrp	decrease power / vermindere die Senderleistung
qrr	send faster / gib schneller
qrs	send slower / gib langsamer
qrt	suspending operation / Einstellen des Sendebetriebs
qu	I have nothing (more) for you / ich habe nichts (weiteres) für dich
qrv	I am ready / ich bin betriebsbereit
qrx	will call you again (on frequ. ...) / werde dich wieder anrufen (auf Frequ. ...)
qrz	you are called by ... / du wirst von ... gerufen
qsb	your signals are fading / die Stärke deiner Zeichen schwankt
qsk	I can hear between my signals / ich kann zwischen meinen Zeichen hören
qsl	I acknowledge receipt / ich gebe Empfangsbestätigung
qso	I can communicate (with ...) directly / ich kann direkt (mit ...) verkehren
qsp	I will relay (to ...) / ich werde (an ...) vermitteln
qst	broadcasting to all / Nachricht an alle
qsy	change (transmit) frequency to ... / ändere (Sende-)frequenz auf...
qsz	send each word twice / jedes Wort zweimal senden
qtc	I have messages for you / ich habe Nachrichten für dich
qth	my position is ... / mein Standort ist ...
qtr	correct time UTC is ... / genaue Zeit UTC ist ...

R

Abbr	Meaning
r	right, received, "roger" / richtig, (korrekt) empfangen
rcvd	received / empfangen
re	regarding / bezüglich
ref	reference / Bezug, Referenz
rf	radio frequency / Hochfrequenz
rfi	radio frequency interference / Hochfrequenzstörung
rig	rig, equipment / Stationseinrichtung, -ausstattung
rppt	report / Rapport (Empfangsbericht)
rpt	repeat / wiederhole
rst	RST (readability, signal strength, tone) / Lesbarkeit, Lautstärke, Ton
rtty	radio teletype / (Funk-)Fernschreiben
rx	receiver / Empfänger

S

Abbr	Meaning
sase	self addressed stamped envelope / frankiertes Kuvert mit eigener Adresse
shf	super high frequency / Zentimeterwellenbereich
sigs	signs / Zeichen
sked	schedule / Verabredung
sn	soon / bald
sp	short path / kurzer Ausbreitungsweg
sri	sorry / tut mir leid
ssb	single sideband / Einseitenbandmodulation
sstv	slow scan tv / Schmalbandfernsehen
stn	station / Station
sure	sure / sicher
swl	short wave listener / Kurzwellenhörer
swr	standing wave ratio / Stehwellenverhältnis

T

Abbr	Meaning
t	turns, tera-, abbr. f. 0 / Windungen, tera-, Abk. f. 0
temp	temperature / Temperatur
test	test, contest / Versuch, Kontest
tia	thanks in advance / danke vorab
tk	thanks / danke
tnx	thanks / danke
trx	transceiver / Sendeempfänger
tu	thank you / danke dir
tvi	TV interference / Fernsehstörungen
tx	transmitter / Sender

U

Abbr	Meaning
u	you / du (Sie)
ufb	ultra fine business / ganz ausgezeichnet
uhf	ultra high frequency / Ultrakurzwelle, Dezimeterwellenbereich
ukw	(very high frequency, vhf) / Ultrakurzwelle
unlis	unlicensed / unlizenziert (Pirat)
up	up / nach oben
ur	your / dein
usb	upper sideband / oberes Seitenband
utc	universal time coordinated / Koordinierte Weltzeit

V

Abbr	Meaning
v	variable (frequency), voice / variable (Frequenz), Telefonie
vert	vertical (antenna) / Vertikalantenne
vfo	variable frequency oscillator / Oszillator mit einstellbarer Frequenz
vhf	very high frequency / UKW-Bereich, Meterwellenbereich

Abbr	Meaning
vl	[many] / viel
vln	[many] / vielen
vy	very / sehr

W

Abbr	Meaning
w	Watt
watts	watts / Watt (plural)
wid	with / mit
wkd	worked / gearbeitet
wkg	working / arbeite gerade
wl	will / werde
wpm	words per minute / Wörter pro Minute
wtts	watts / Watt (plural)
wx	weather / Wetter

X

Abbr	Meaning
xcus	excuse me / Entschuldigung
xcvr	transceiver / Sendeempfänger
xmas	christmas / Weihnachten
xtal	crystal / Qua

0 – 9

Abbr	Meaning
33	female ham greeting / Gruß unter Funkerinnen
44	WFF greetings
55	[I wish you success] / Viel Erfolg!
72	QRP greeting / Gruß unter QRP Stationen
73	best wishes / viele Grüße

Abbr	Meaning
88	love and kisses / Alles Liebe
99	get lost / verschwinde!

7.11 Glossary

Term	Definition
Access Point	A WiFi router or base station that wireless devices connect to in order to communicate over a network.
BLE	Bluetooth Low Energy — a power-efficient variant of Bluetooth used for wireless keyboard output and for the M32 Serial Protocol over Bluetooth (see the Bluetooth Use preference).
CW	Continuous Wave — the traditional term for Morse code communication, where a radio carrier is keyed on and off.
CW Keyer	A device (or mode) that automatically generates properly timed dits and dahs from paddle input.
Deep Sleep	A very low power state where the microcontroller is mostly shut off. The device can be woken up by pressing the FN button.
Dit / Dah	The two basic elements of Morse code. A dit is a short tone (one unit), a dah is a long tone (three units). Also called dot and dash.
Dual-lever Paddle	A Morse key with two separate levers — one for dits, one for dahs. Used with iambic keyers.
ENCODER	The rotary knob on the Morserino that can be turned and clicked. Used for navigation, speed/volume adjustment, and character selection.
ESP32	The microcontroller (by Espressif Systems) at the heart of the Morserino-32. It provides WiFi, Bluetooth, and processing power.
ESPNOW	A peer-to-peer WiFi protocol by Espressif that allows direct communication between ESP32 devices without an access point. Range is typically up to 50 metres.
Farnsworth Spacing	A training technique where Morse characters are sent at full speed, but the pauses between characters are lengthened. This encourages learning character rhythms rather than counting dits and dahs.
FN Button	The secondary push-button on the Morserino (red on the 1st and 2nd edition). Used for toggling speed/volume, scrolling, brightness, and other functions.

Term	Definition
Goertzel Filter	A digital signal processing algorithm used in the CW decoder to detect tones at a specific frequency (around 700 Hz).
Iambic Keying	A keying mode where squeezing both paddles simultaneously produces alternating dits and dahs. Named after the poetic metre with alternating short and long syllables.
iCW	Internet CW — a method of sending Morse code over the Internet using audio protocols such as Mumble.
Koch Method	A learning method developed by Ludwig Koch in the 1930s. Characters are introduced one at a time in a specific order based on rhythmic similarity, rather than alphabetically.
LoRa	Long Range — a spread-spectrum radio technology used for low-power, long-range communication. Used in 1st and 2nd edition Morserinos for wireless CW transceiver mode.
M32Pocket	The third-generation Morserino, featuring a colour TFT display, USB-C, and a compact 3D-printed case.
MAC Address	Media Access Control address — a unique hardware identifier assigned to every network interface. Used to identify your Morserino on a WiFi network.
mDNS	Multicast DNS — a protocol that allows devices to be found by name (e.g., <i>m32.local</i>) on a local network, without a dedicated DNS server. Supported on macOS and most Linux systems; limited support on Windows and Android.
MOPP	Morserino Packet Protocol — the data format used to encode Morse code elements (dits, dahs, pauses) into compact binary packets for transmission via LoRa or WiFi/ESPNow.
NVS	Non-Volatile Storage — persistent memory on the ESP32 that retains data across power cycles. Used to store preferences, snapshots, Koch lesson progress, and player identity.
Pro Sign	Procedural signal — a special Morse code character formed by running two letters together without the normal inter-character pause. Examples: <SK> (end of contact), <AR> (end of message), <KN> (go ahead, named station only).
QSK	Full break-in — the ability to hear between transmitted elements. Not possible in LoRa/WiFi transceiver modes due to packet-based transmission.
RSSI	Received Signal Strength Indicator — a measurement of the power level of a received radio signal. Displayed as an S-meter bar in LoRa transceiver mode.
Single-lever Paddle	A Morse key with one lever that swings between two contacts — one for dits, one for dahs. Only one contact can be made at a time (no squeezing).

Term	Definition
Sideswiper	A Morse key (also called a cootie key) where the operator moves a lever side to side. Both sides produce the same output — the operator manually times dits and dahs. The Morserino's touch paddles can emulate a sideswiper in Straight Key mode.
Snapshot	A saved set of all Morserino preferences. Up to eight snapshots can be stored and recalled, allowing quick switching between different training configurations.
Spread Spectrum	A radio transmission technique where the signal is spread across a wider bandwidth than necessary for the data. LoRa uses this to achieve long range at low power.
Straight Key	The simplest type of Morse key — a single lever that makes contact when pressed down. The operator manually times all dits, dahs, and pauses.
Tone Shift	A preference that changes the pitch of the sidetone when transmitting or responding, making it a half tone higher or lower than the received tone. Useful for distinguishing sent and received signals.
UDP	User Datagram Protocol — a lightweight network protocol used by the Morserino for WiFi transceiver communication on port 7373.
VBand	An Internet-based CW practice platform (hamradio.solutions/vband). The Morserino can connect to VBand via Bluetooth.
Webserial	A browser API (supported in Chrome, Edge, Opera, and Firefox from version 151) that allows web pages to communicate directly with serial devices via USB. Used for firmware updates and preference configuration.
Wordsworth Spacing	A training technique (similar to Farnsworth) where only the pauses between words are lengthened, while inter-character spacing remains normal. Encourages head-copying word by word.
WPM	Words Per Minute — the standard measure of Morse code speed. The reference word is PARIS (each occurrence equals 50 dit-lengths), so 1 WPM = 5 characters per minute.