CW-ADD

Universal CW Adapter for SSB Transceivers

Assembly manual

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ea3gcy@gmail.com

Updates and news at: **www.ea3gcy.com**

Thanks for building the Universal CW Adapter kit **"CW-ADD"**

Have fun assembling it ! 73, Javier Solans, ea3gcy

PLEASE READ ALL OF THE ASSEMBLY INSTRUCTIONS COMPLETELY AT LEAST ONCE BEFORE BEGINNING.

SPECIFICATIONS

- Add CW to any voice transceiver (SSB / DSB).
- Generates CW by injecting an audio tone into the microphone input.
- Automatic PTT activation.
- TX to RX semi-break delay of about 400 - 500ms (modifiable).
- Built-in side-tone oscillator monitor.
- Built-in side-tone audio amplifier with speaker output.
- Built-in 750Hz audio filter for CW reception. Bandwidth 200Hz to -3dB.
- Power supply: 12 -14V
- PCB dimensions: 100 x 35 mm.

PARTS LIST

Resistors					
Checked		**Ref.**	**Value**	**Identified/Comment**	**Circuit section**
		R1	220K	red-red-yellow	Audio filter
		R2	22K	red-red-orange	Audio filter
		R3	22K	red-red-orange	Audio filter
		R4	22K	red-red-orange	Audio filter
		R5	470K	yellow-violet-yellow	Audio filter
		R6	220K	red-red-yellow	Audio filter
		R7	22K	red-red-orange	Audio filter
		R8	470K	yellow-violet-yellow	Audio filter
		R9	220K	red-red-yellow	Audio filter
		R10	1K	brown-black-red	Side-tone
		R11	22K	red-red-orange	Side-tone
		R12	22K	red-red-orange	Side-tone
		R13	1K	brown-black-red	Side-tone
		R14	1K	brown-black-red	Side-tone
		R15	1K	brown-black-red	Out K+5 (5V keyed)
		R16	10K	brown-black-orange	Side-Tone
		R17	22K	red-red-orange	Switching circuit
		R18	22K	red-red-orange	Switching circuit
		R19	1K	brown-black-red	Switching circuit
		R20	68K	blue-grey-orange	Switching circuit
		R21	1K	brown-black-red	Switching circuit
		R22	330	orange-orange-brown	Zener R. limiter
		R23	10	brown-black-black	Audio Amp.
		P1	5K	502 or 53E trimmer	Side-tone
		P2	5K	502 or 53E trimmer	Side-tone

Capacitors					
Checked		**Ref.**	**Value**	**Identified/Comment**	**Circuit section**
		C1	2n2	222	Audio filter
		C2	2n2	222	Audio filter
		C3	10uF	10uF electrolytic	Audio filter
		C4	2n2	222	Audio filter
		C5	2n2	222	Audio filter
		C6	100n	104 or 0.1	Audio filter
		C7	100n	104 or 0.1	Audio filter
		C8	22n	223 or 0.022	Side-tone
		C9	27n	273 or 0.027	Side-tone
		C10	22n	223 or 0.022	Side-tone
		C11	22n	223 or 0.022	Side-tone
		C12	470n	474 or 0.47	Side-tone
		C13	100n	104 or 0.1	Side-tone
		C14	100n	104 or 0.1	Side-tone
		C15	100n	104 or 0.1	Switching circuit
		C16	22n	223 or 0.022	Switching circuit
		C17	10uF	10uF electrolytic	Switching circuit
		C18	100uF	100uF electrolytic	Power supply
		C19	100uF	100uF electrolytic	Power supply
		C20	**10uF**	**10uF OPTIONAL (see text)**	**Audio Amp.**
		C21	100n	104 or 0.1	Audio Amp.
		C22	100n	104 or 0.1	Audio Amp.
		C23	100uF	100uF electrolytic	Audio Amp.

Semiconductors					
Checked		**Ref.**	**Type**	**Identified/Comment**	**Circuit section**
		Q1	BS170	BS170	Side-tone
		Q2	BC557/558	BC557 or BC558	Side-tone switch
		Q3	BS170	BS170	Switching circuit
		Q4	BS170	BS170	Switching circuit
		IC1	UA747	UA747	Audio filter
		IC2	LM386	LM386	Audio Amp.
		D1	1N4148	4148	Switching circuit
		D2	1N4148	4148	Switching circuit
		D3	5V1 Zener	5V1	Filter 5.1V supply

Hardware					
Checked		**Qty.**	**Type**	**Identified/Comment**	**Circuit section**
		2	Screws	M3 x 5mm screw	---
		2	Nuts	M3 Nuts	---
		2	Spacers	5mm hexagonal spacers	---
		21	Pins	Terminal pins 12+2+2+2+2+1	---
		1	Socket	14 legs IC socket for IC1	---
		1	Socket	8 legs IC socket for IC2	---
		1	PCB	CW Adpater PCB 100 x 35mm	---

TIPS FOR FIRST TIME BUILDERS

Tools required:
- A fine-tipped 30W soldering iron, good-quality electronic-type solder, small diagonal wire cutters, needle-nose pliers, and tweezers to hold the SMD component.
- You will need good lighting and a magnifying glass to see the fine print on the components and other assembly details.

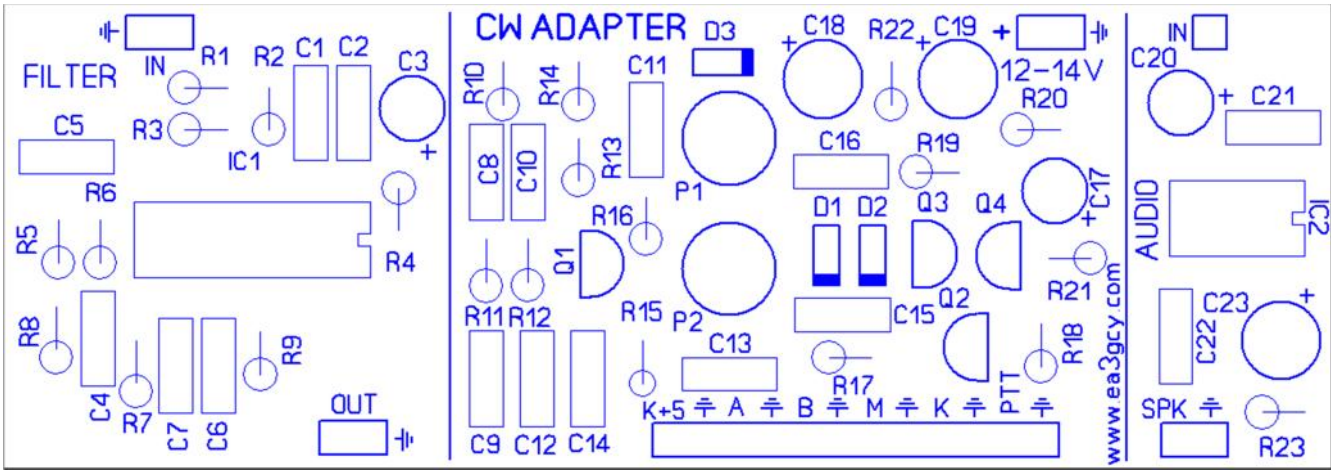
Soldering:
There are two important things which need to be done to ensure successful operation of a kit. The first is to put the component into the proper place on the circuit board; the second is good soldering.
To solder properly, you must use an electronic-type solder of the highest quality possible and the correct type of iron.

Use a quality-brand soldering iron with a short, fine-pointed tip. For this kit, the soldering iron should be about 30-35 Watts (if it is not thermostatically controlled). Use only high-quality electronic-type solder. NEVER use any extra flux. You should hold the hot soldering iron in contact with both the circuit board and the component lead for about two seconds to heat them up. Then, keeping the soldering iron in place, touch the solder at the junction of the lead and trace and wait about two seconds or so until the solder flows between the lead and the trace to form a good joint. Now remove the soldering iron. The soldering iron should have been in contact with the work piece for a total time of about 4 seconds. When soldering leads that connect to large trace surfaces, you will need to preheat the junction for a little longer so that the solder flows correctly.
You should clean the soldering tip before soldering each joint. This prevents accumulating solder on the tip and mixing in residues from previous soldering operations with the next one.

RECOMMENDED ASSEMBLY SEQUENCE

It is recommended to assemble the kit in the following order:

1. Following the list of components, place and solder all resistors R1 to R23. Make sure they are properly placed on the board as shown in the pictures. Also install the two trimmers P1 and P2.
2. Then place and solder D1, D2 and D3 diodes, pay attention to position them with their correct orientation. There is a stripe at one end of each diode that has to match the drawing of the board. D1 and D2 are 1N4148 and D3 is a 5V1 zener diode.
3. Then install and solder C1 to C23 capacitors. The C3, C17, C18, C19 and C23 are electrolytic type, they should be placed with their longest end coinciding with the "+" sign printed on the board. DO NOT install the C20 capacitor, it is optional, see the section "Audio amplifier for side-tone".
4. Place the IC1 (14 legs) and IC2 (8 legs) sockets in place, note that they have a notch that should match the silhouette printed on the bord. Then you can insert the integrated circuits into the sockets. Note that the notch must match the socket.
5. Now Install Q1 to Q4 transistors. Q1, Q3 and Q4 are BS170 and Q2 is a BC557 or BC558. Place them so that their shape matches the print on the board.
6. Install and solder the pin terminals in their places. Cut a strip of 12 pins, 4 strips of 2 pins and one strip of 1 pin.



WHAT DOES THE CW ADAPTER "CW-ADD"

The CW-ADD is an extremely versatile circuit. It is composed of three stages that can be used independently or combined to have everything necessary to generate CW in a transceiver that only has SSB (phone).
In case you do not require the audio filter or the side-tone amplifier, the board has printed lines where one of the stages can be cut.

Note: Although the "CW ADD" circuit is relatively simple, the user has to have some experience so that he can understand the best way to adapt it to his transceiver.
In order to install the "CW-ADD" in your particular case, you must understand the basic operation of your circuits and understand how the CW is transmitted and received on an SSB transceiver.
You should be able to plan how you will adapt the circuit in your transceiver.
Installation on one or another type of transceiver can vary significantly.

Audio filter for CW reception

The built-in audio filter on the "CW-ADD" is an active 2-pole filter that improves the reception of CW signals making your listening easier. Its passband is centered around 750Hz and the bandwidth is 200Hz to -3dB. The filter is sandwiched into the audio stages of the receiver, before the audio output power stage. It is usually connected to the receiver's volume potentiometer. The signal input is through the "IN" terminals and the output to "OUT".
Note: The audio filter that incorporates the "CW-ADD" is simple and has a moderate efficiency. If you want to further improve the reception of the CW you can use more elaborate filters or a DSP filter.

PIN	USE
"IN"	Input to audio filter
"OUT"	Output from audio filter

Adapter

The CW Adapter is the fundamental stage of the "CW-ADD" that generates an audio tone that is injected into the microphone input of the transceiver and which is also used as "tone-side" to monitor CW keying. The adapter also incorporates the switching and delay circuits that control the PTT of the transceiver and that are activated from the input "K" that connects to the CW key. There is a pin marked "M" that activates the tone-side but does not activate PTT switching, this input is used to hear the tone-side without transmitting or as a practice oscillator.

PIN	USE
“K+5”	5V output. Activated when the tone generator is activated (for equipment requiring a voltage to generate CW carrier)
“A”	Output tone A. Its level is set by P1
“B”	Output tone B. Its leve lis set by P2
“M”	Input that activates the tone generator but does not activate the PTT output. You can hear the tone to compare it with the received station or as a practice oscillator.
“K”	Input "KEY" activates tone generator and PTT output with proper delay.
“PTT”	PTT output to the transceiver. Activates the transceiver transmission with a small delay in the TX to RX return (semi-breack in delay)
“12-14V”	Power input for all circuits.

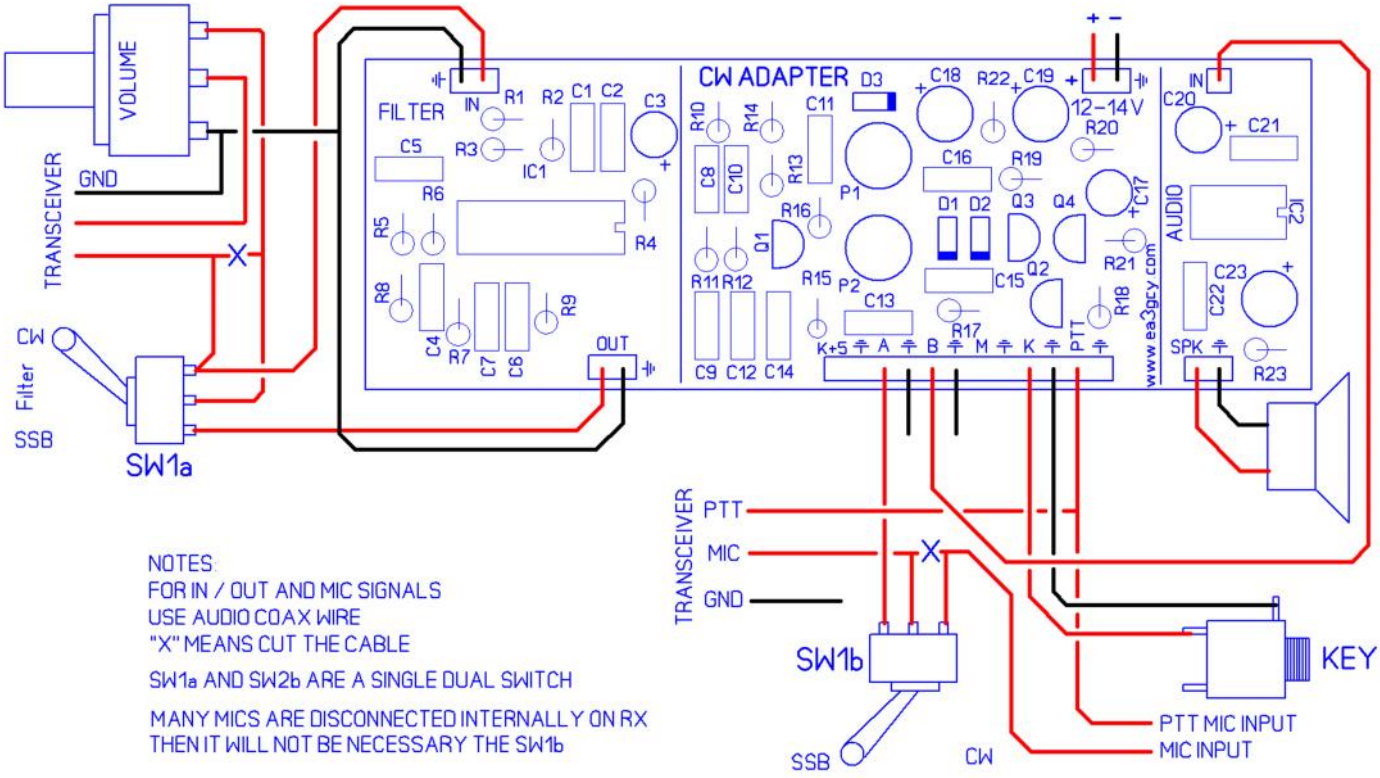
* A and B outputs are identical but allow two different signal levels, are set by P1 and P2 respectively, one is used for the transmission audio tone and the other for "side-tone" or keying monitor.

Side-Tone Audio Amplifier

The audio amplifier built-in on "CW-ADD" is the LM386 integrated circuit. The "sidetone" is used to listen to "monitor" our telegraphic keying when we transmit.
Sometimes the "side-tone" monitor can be injected into the transciever audio amplifier itself if this is still active when transmitting. In other cases, the audio amplifier of the transceiver is disconnected while transmitting, then we can use the audio amplifier of the "CW-ADD" to excite the own speaker of the transceiver or to add a separate mini-speaker to monitor our transmission. The LM386 can be configured as low or high gain amplifier. If we place the capacitor C20 we get a high gain and if we do not put it we get a low gain. **The high gain is necessary if we want to use the same speaker of the transceiver, then we must intercalate a resistor in series (try between 100 and 1000 ohms) so that it does not affect the reception of the transceiver.**
The low gain is sufficient to drive a separate "mini speaker", or if the audio stage of the transceiver does not have enough gain, you can use the LM386 to pre-amplify the "CW-ADD" side-tone signal.

PIN	USE
“IN”	Signal input
“SPK”	Audio / Speaker Output

WIRING



HOW DOES IT WORK

To help you plan the installation of the "CW-ADD" in your particular setup, we will continue and understand how the signals circulate in the wiring diagram.

- The "live" terminal of the volume potentiometer is disconnected from the receiver and connected to the common terminal of SW1a switch, the signal coming from the receiver is connected to one side of the switch and to the input of the "IN" filter. The other side of the switch is connected to the "OUT" filter output. When the switch is in the "CW" position, the potentiometer receives the audio signal from the filter output. When the switch is in the "SSB" position the potentiometer receives the signal from the receiver without going through the filter.

- The input of the telegraph key is connected to the pin "K" of the board.
- The cable coming from the microphone-input connector is disconnected from the transceiver and connected to one side of the switch SW1b.
- The "A" (tone output) pin of the "CW-ADD" board is connected to the other side of the SW1b switch.
- With the switch in SSB position, the microphone input goes to the transceiver and with the switch in the "CW" position the microphone is switched off and the "CW-ADD" tone is sent to the microphone input of the transceiver.

Important note: Many microphones are internally disconnected when the PTT is not pressed (RX), then SW1b will not be required and the microphone signal and the "CW-ADD" tone signal can be connected together.

- The "PTT" pin of the "CW-ADD" is connected together to the PTT connection of the transceiver and the one that comes from the microphone input.

- When the switch is in the CW position and connect the pin "K" to GND (press the key) the following happens:
A tone is generated by the pin "A" and at the same time the "PTT" pin is set to GND which activates the transmission of the transceiver and injects an audio tone of about 750Hz to the microphone input, carrier "CW".
When the key is released, the tone is instantly stopped and after a short delay (400-500ms) the PTT output is deactivated and the transceiver returns to reception. This delay allows to be operated in CW "semi-break" mode. The delay time can be modified to suit your CW operation (see section "Settings and last notes").

- The tone output pin "B" can be connected directly to the audio stages of the transceiver (if the audio stages remain active in transmission) or can be connected to the "IN" pin of the audio amplifier of the "CW- ADD ". The "SPK" output of the audio amplifier can be used in three ways:

1) Connect to the same speaker of the transceiver itself through a resistance of 100 to 1000ohms (Install C20 for high gain).
2) Connect to a separate mini speaker that acts as a key monitor (C20 is not installed).
3) Connect to the audio stages of the transceiver if the tone signal without amplifying does not have sufficient level (C20 is not installed).

As explained in the "Side-tone" audio amplifier section, the "CW-ADD" audio amplifier can be set to either high or low gain depending on the amplification that is needed.

SETTINGS AND LAST NOTES

There are only two settings that need to be made in the "CW-ADD"
P1- P2: adjust tone output "A" and "B". It is the same tone but with different levels.
(The settings of P1 and P2 interact slightly, this is normal.)

- Modification of the "semi-break in delay": The TX to RX return delay is about 0.4-0.5 sec. This delay can be varied by modifying the value of R20. If the value of R20 decreases, the delay decreases and vice-versa. It can vary between about 47K and 100K

- “M” pin use: Input that activates the tone generator but does not activate the PTT output. You can hear the tone to compare with the received station (see "How to operate in CW with the CW-ADD") or can be used as a practice oscillator.

- "PTT" connection: In some cases the "PTT" connection of the microphone and the "CW-ADD" may interact negatively, in this case try to place a 1N4148 diode in series before the "PTT" pin of the "CW-ADD" (with cathode, the end of the diode carrying the color band) in the direction of the pin.

- Warning: Most amateur-built transceivers use RX-TX switching relays (antenna, voltages, etc.). Many times they do not incorporate diodes of protection in the relays coil, since these are not necessary in the mechanical switching of the push button of the microphone but they are needed if electronic switching is used.
Place a 1N4148 or similar diode in parallel with the relay coil of your transceiver (if not incorporated). The cathode (the end of the diode that has a dark band) must go toward the side of the coil that goes towards the positive.

- If you do not use the "LM386" audio amplifier: it is preferable to remove the integrated circuit from the socket.

To avoid overheating of the final TX transistors of the SSB transceiver it is recommended not to exceed 50%-60% of the maximum transceiver power.

HOW TO OPERATE IN CW WITH THE “CW-ADD”

To ensure that you transmit on the carrier frequency of the other station, you must tune the receiver to hear a note about 750Hz, which is the center (the strongest point) of the CW audio filter.
You can disconnect the CW filter while performing a general tuning for CW stations, but when you are actually transmitting, you must ensure that the received note of the station you want to contact is near 750Hz. which is the same tone frequency you will transmit.

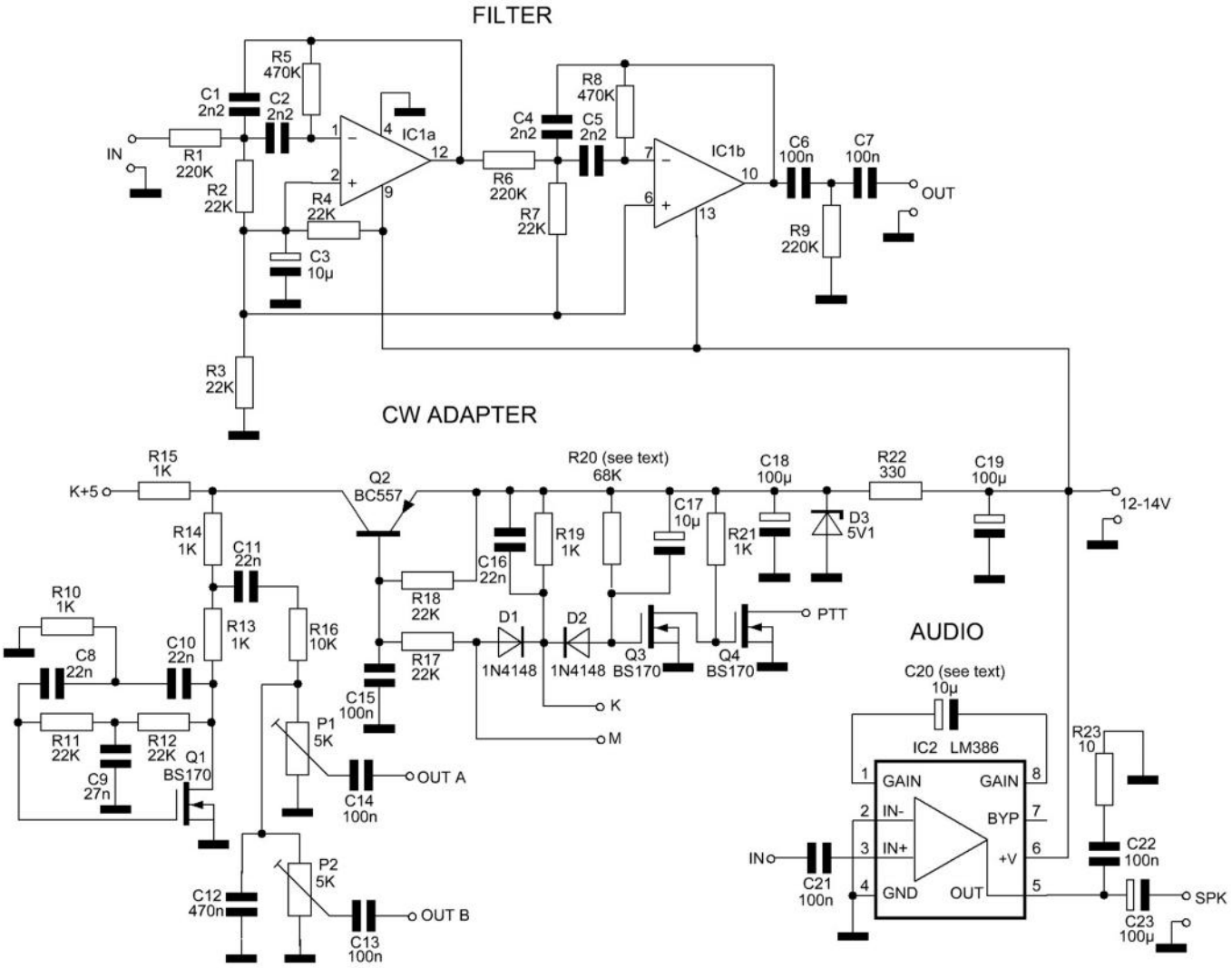
You should refer to the frequency of the side-tone note.

Alternatively, you can check that the "pitch" of the received tone is correct by connecting the "M" pin to GND, this activates the tone generator but does not activate the transmitter. When the two tones are of the same frequency (that of the received station and the one generated by the "CW-ADD") it will be in the perfect tuning point. The ground connection (GND) of the "M" pin can be made with a switch or auxiliary pushbutton. In some transceivers this is called the “spot” tone.

You can also press the key to radiate a signal and listen to the side-tone, but this is not recommended because it can disturb other stations.

When used with a "DBL" double sideband transmitter, the equipment will produce 750Hz tones on both sides of the "suppressed" carrier. Both stations must use their equipment in a normal way and ignore the unwanted signal.

SCHEMATIC


FILTER
R5 470K
C1 2n2
C2 2n2
IN
R1 220K
R2 22K
R4 22K
C3 10µ
IC1a
R8 470K
C4 2n2
C5 2n2
R6 220K
R7 22K
IC1b
C6 100n
C7 100n
OUT
R9 220K
R3 22K
CW ADAPTER
R15 1K
K+5
Q2 BC557
R20 (see text) 68K
C18 100µ
R22 330
C19 100µ
12-14V
R14 1K
C11 22n
C16 22n
R19 1K
C17 10µ
R21 1K
D3 5V1
R10 1K
C8 22n
R13 1K
R16 10K
R18 22K
D1 1N4148
D2 1N4148
Q3 BS170
Q4 BS170
PTT
C10 22n
R17 22K
C15 100n
K
M
AUDIO
C20 (see text) 10µ
IC2 LM386
R23 10
P1 5K
OUT A
C14 100n
R11 22K
R12 22K
Q1 BS170
C9 27n
GAIN
GAIN
IN-
BYP
IN+
+V
GND
OUT
C22 100n
IN
C21 100n
P2 5K
C12 470n
OUT B
C13 100n
SPK
C23 100µ

LIMITED WARRANTY

Please read carefully BEFORE building your kit

All electronic components and hardware supplied with the kit are under warranty in case of any manufacturing defect for the period of one year after purchase. The warranty does not include the transmitter final amplifier transistor.

The original purchaser has the option of examining the kit and manual for 10 days. If within this period, the buyer decides not to build the kit, he/she may return the entire unassembled kit, shipping expenses however at their own expense. The shipping expenses and sales commissions (i.e. bank, Ebay, and Paypal commissions) included in the purchase price will not be returned.
Please, BEFORE returning a product, request instructions by email at: ea3gcy@gmail.com.

Javier Solans, EA3GCY, warrants this device to function according to the specifications, provided that it is assembled and adjusted as described in this documentation, and used correctly according to all provided instructions.
It is your responsibility to follow all the instructions in the manual, to identify all the components correctly, and to use good workmanship and proper tools and instruments in the construction and adjustment of this kit.
REMEMBER: This kit will not work as a commercially manufactured product; however, in some situations, it can give very similar results.

If you believe that there is a missing component for the kit, please do a thorough inventory of all parts using the parts list in the manual. Check all bags, enveloppes and boxes carefully. If needed, you may email me and I will replace any component that you are missing. Even if you can find the exact part locally, please let me know so that we are aware of the problem to help other customers.
I can also supply any part that you have lost, damaged or broken accidentally.
If you find any errors in this manual or would like to make a comment, please do not hesitate to contact me at: ea3gcy@gmail.com

THANKS for building the **CW-ADD** kit.
Enjoy QRP!
73 Javier Solans, ea3gcy