

The NR-108F1 Portable Radio

An uncommon receiver with 150 kHz-520 MHz continuous coverage

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Introduction

The NR-108F1 (Figure 1) is a portable receiver designed and built in the '90 years of the last century that had a relatively good diffusion among radio listeners in spite of a quite high selling price.

It was one of the first portable radios featuring frequency synthesis and PLL circuits with a rotary encoder for tuning and LCD displays for parameters readout; but the feature that makes it still unique in its kind is the extremely wide frequency coverage, ranging from 150 kHz to 520 MHz continuously.

Even nowadays, if we exclude some handheld scanners (which, however, belong to a different category of equipments), there is no other portable radio with similar receiving capabilities.

Perhaps due to this reason the NR-108F1 receiver, although it has been no longer in production for a long time, is still sought after by many radio fans and collectors.



Figure 1: The NR-108F1 portable radio

Historical Notes and Trivia

The NR-108F1 portable receiver was produced in Japan between 1986 and 1990 and it was marketed under different brand names, mainly *MARC II*, *Pan Crusader 8000* and *Technimarc Digit Master* (Fig. 2), depending upon the country in which the radio was sold and/or on the importer-distributor choices.



Figure 2: Different brand names for the same radio [5]

In Italy the NR-108F1 was marketed under the *MARC II* brand name, its first public appearance was on page 126 of the Marcucci catalog "Transceivers and Accessories 1987" (Figure 3), with a list price of 976,000 Italian Lire (currently about 500 Euros). The radio appeared on the Italian importer/distributor catalogs for a few years, its last appearance was on page 69 of the 1990 edition of the above mentioned booklet.



MARC II RICEVITORE MULTIGAMMA

Ricevitore molto atteso dalle notevoli caratteristiche e di medie dimensioni. Permette di ricevere emissioni AM, FM, CW, SSB entro un ampio spettro estendentesi da 150 KHz sino a 30 MHz e da qui sino a 520 MHz con esclusione del modo SSB/CW. Questo ricevitore potrebbe definirsi sotto certi aspetti un ibrido, in quanto include delle funzioni comuni in apparati professionali, quali ad es. BFO e rivelatore a prodotto, mentre altre funzioni sono caratteristiche del «Consumer» come ad es. lo «sleep timer». La sintonia su una stazione può essere fatta immediatamente mediante la tastiera, oppure con la rotazione del controllo di sintonia. Ne deriva perciò che quest'ultimo controllo sarà molto utile per escursioni ristrette di frequenza, mentre per entità notevoli converrà ricorrere all'impostazione.

Un visore è dedicato soltanto alla visualizzazione dell'ora, mentre il secondo, oltre che alla frequenza, indica altri parametri, quali il tipo di rivelatore inserito, gli incrementi di sintonia, l'impostazione della sintonia: oscillatore locale da VFO, oppure da quello registrato in memoria, il tipo di memoria selezionata, la selettività FM e così via. Venti sono le memorie in dotazione, per cui si potranno registrarvi le frequenze più comunemente usate assieme al modo operativo, oppure effettuarvi la ricerca con salto delle memorie non registrate.

Gli incrementi di sintonia possono essere di 1 KHz o di 10 KHz; piccoli incrementi utilissimi nella ricezione SSB o RTTY possono essere fatti ricorrendo alla polarizzazione del tipico varicap. La selezione della banda laterale viene fatta con il BFO (ad esempio predisponendolo su -2 KHz circa si riceverà la USB). Il livello del segnale è dato da una successione di 5 Led. La selettività dell'AM/SSB è costante, mentre quella della FM può essere selezionata su tre valori. Altri utili controlli previsti sono lo Squelch, il tono e l'antenna trimmer. L'apparato può essere alimentato da rete o mediante sei pile formato torcia ubicata internamente. Un apposito circuito permette di accertare lo stato di carica delle batterie.

Ref. 5-810-070 L. 976.000

CARATTERISTICHE TECNICHE

Frequenze operative: 0.15-26.1 MHz (AM/SSB/CW); 26.1-30 MHz (AM/SSB/CW/FM/N2); 87.5-108 MHz (AM/FM-1/FM-W); 30-520 MHz (AM/FM-N1/FM-W).

Selettività FM: N1: 15 KHz a -6 dB; N2: 6 KHz a -6 dB; W: 100 KHz a -3 dB.

N. memorie: 20.

Orologio: indicante l'ora ed il tempo mancante allo «Sleep».

Dimensioni: 350 x 200 x 90.

Peso: 2 kg.

**ATTENZIONE
AI NUOVI NUMERI
TELEFONICI**

124 CATALOGO MARCUCCI (Riproduzione vietata, anche parziale)

Figure 3: The first appearance of the NR-108F1 in Italy (on the Marcucci 1987 Catalog)

The NR-108F1 followed its predecessors NR-52F1, NR-82F1 and NR-94F1 (Figure 4), the famous "big portables" which also allowed reception in various VHF and UHF bands (not as continuous coverage, however).



Figure 4: The “big portables” NR-52F1, NR-82F1 and NR-94F1 (from left to right)

They too had been produced under different brand names: the NR-52F1, as an example, had been also marketed under the renowned *Hallicrafters* brand (TW-1200 Model). The less common NR-94F1, that derived directly from the NR-82F1 radio, was provided with a cassette recorder. Incidentally, the NR-52F1 was produced between 1975 and 1980, the NR-82F1 in the 1980-1985 period and the NR-94F1 between 1982 and 1985.

Some Notes on the NR-108F1 Manufacturer and the Available Technical Documentation

About the NR-108F1 manufacturer (which almost certainly also built all the previous models), until now the subject has been surrounded by a sort of mystery.

On the specific matter various assumptions have been made in several Internet blogs and forums, but nobody ever came close to the truth: some people take for certain that the builder was the Tokyo Electric Co. (TEC), others believe that the radio was built directly from Toshiba (the manufacturer of the CPU used in the receiver) and there is also someone who even brings up Toyota (!). According to the documents in my possession I can affirm with certainty that the manufacturer (at least of the NR-108F1 model) was a relatively small company located in Osaka, the *New Hope Industrial Co., Ltd.* instead [1].

About the technical documentation concerning the NR-108F1 portable radio it should be noticed that, while the original Instruction Manuals of the previous models – often including their schematic diagrams and some service notes - can be easily found on the Web (just try a Google search), about this radio, except for a leaflet and for the Instruction Manual downloadable in some languages [2], for years there was nothing else available, in spite of the extensive researches performed by many fans and collectors.

Some time ago, however, I stumbled upon a full copy of the Service Manual of the NR-108F1 receiver and, believing that such a documentation should be made available for free to all the interested people, I scanned that Manual and uploaded the resulting .pdf file (together with the one concerning the Italian translation of the NR-108F1 Instruction Manual written by I2AMC, SK) to the ***mods.dk*** website held by Erik Hansen OZ1TF-OZ2AEP [3].

Anyway, both the Manuals should be available soon also on the website of the Italian Magazine *RadioKit Elettronica* (RKE) [4].

NR-108F1 Specifications and Features

The NR-108F1 specifications and features are summarized in the leaflet that appears in Figure 5.

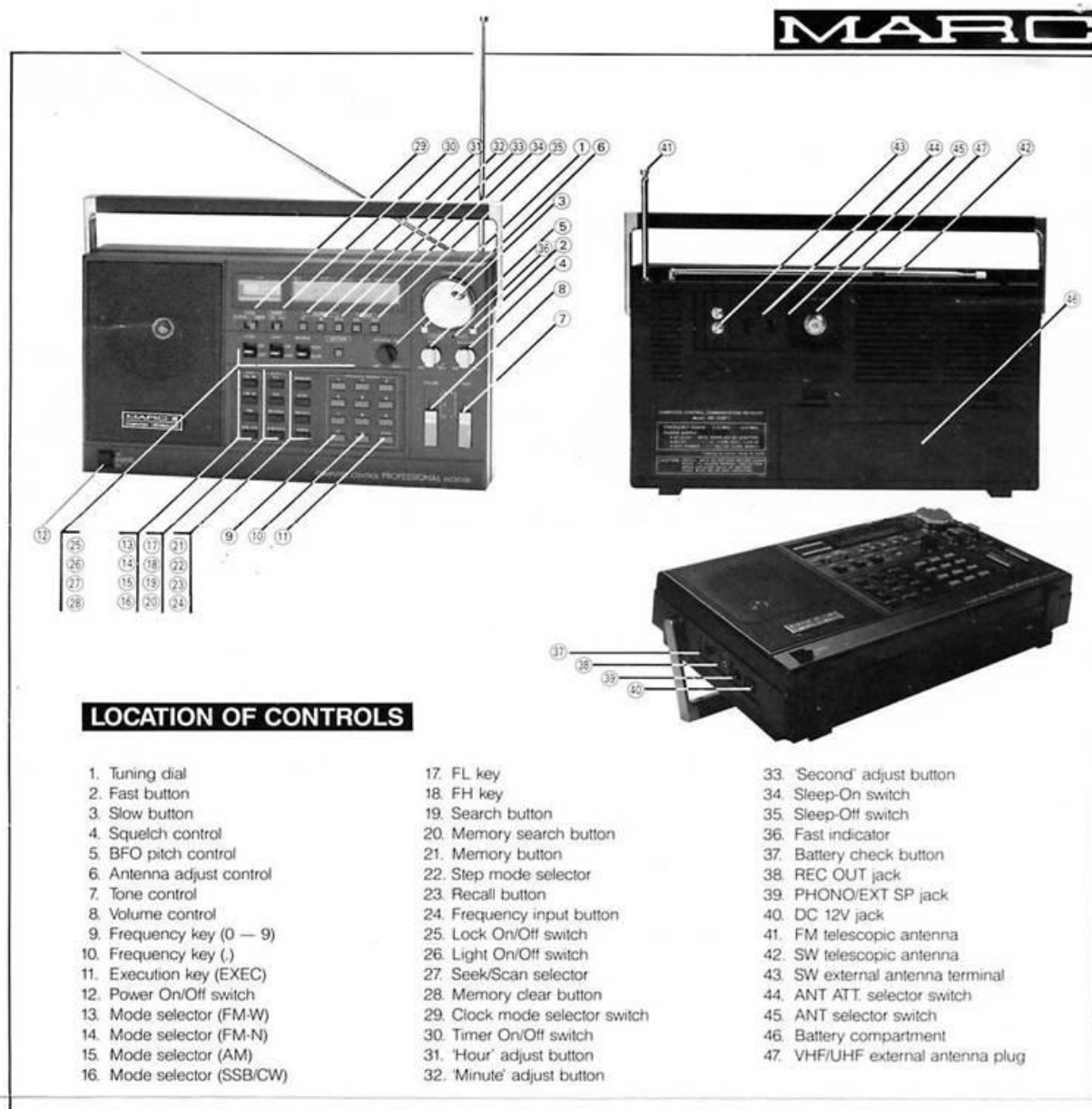


Figure 5: Specs of the NR-108F1 and location of controls

The receiving frequency range goes from 150 kHz to 520 MHz without any interruption.

The reception modes are: AM and CW/SSB from 150 kHz to 26.100 MHz; AM, CW/SSB and FM narrow "N2" between 26.101 and 29.999 MHz; AM and FM (narrow "N1" or large "W") between 30 and 520 MHz.

The NR-108F1 is a "synthesized" receiver, so the desired frequency can be entered directly through the keyboard or reached by means of the Tuning knob (that drives a rotary encoder provided with two selectable speeds). The radio is equipped with twenty memory channels and with search functions between them, as well as with scanning capability between two selected frequencies.

There is also a timer for turning the radio on and off when desired.

The specified IF selectivity values are: +/- 2 kHz in the CW/SSB mode, +/- 3 kHz in the AM and narrow-FM "N2" modes, +/- 7.5 kHz in the narrow-FM "N1" mode and +/- 90 kHz in the wide-FM "W" mode.

The tuning steps are 1, 5, or 10 kHz (in all the possible modes) from 150 kHz to 29.999 MHz and 5, 10 or 100 kHz (in both the allowed AM and FM modes) between 30 and 520 MHz. The radio is provided with Volume, Tone, Squelch and BFO controls, as well as with an "Antenna Trimmer" that operates in conjunction with the internal ferrite antenna (in the range 0.15-2 MHz), with one of the two telescopic antennas (the longer one working from 2 to 30 MHz, the shorter whip operates in the 30-520 MHz range instead) or with an external HF antenna.

On the back side of the cabinet there are two screw terminals for the connection of a possible external HF antenna (SW), a SO-239 coaxial socket for an external VHF/UHF antenna and two slide switches (one for selecting the desired antenna type and another one for the insertion of an attenuator).

The readout of the received frequency and of the operating status of the radio is provided by an LCD display; a further and smaller LCD display is used for the clock/timer instead.

The set requires two "AA" batteries (UM-3) for managing the clock/timer and the memories and six "C" batteries (UM-2) for operating the radio; of course the NR-108F1 can be powered also by an external 12V DC source (preferably regulated).

This portable radio measures 35 x 20 x 9 cm. (W x H x D) and weighs about 2 kg (excluding the batteries).

The Figure 6 shows the Block Diagram of the NR-108F1 receiver and allows to better understand its circuit configuration: the 150 kHz-520 MHz reception range is divided into 14 bands (three from 150 kHz to 2 MHz, four between 2 and 30 MHz, seven between 30 and 520 MHz).

In the 0.15-30 MHz range a triple frequency conversion scheme (with IF values of 65.0 MHz, 10.7 MHz and 455 kHz) is employed; the first "variable oscillator" signal actually comes from a PLL synthesizer whose clock signal is supplied by a 4 MHz crystal oscillator. The circuit includes various ceramic IF filters, some of them are used in the AM mode and other ones for CW/SSB. The 30 to 57 MHz band is handled by discrete components (a special input circuit and a subsequent conversion to 10.7 MHz managed by a VCO), while all the remaining VHF/UHF ranges - with the exception of the 87.5-108 MHz broadcasting band - make use of a combined group of tuners, all employing the already mentioned PLL synthesizer and provided with a 44.0 MHz IF output (that is then converted to the 10.7 MHz IF value).

The 87.5-108 MHz broadcasting band is handled by a separate tuner that operates the conversion to the IF value of 10.7 MHz directly.

All the IF outputs are managed by a CPU (Toshiba TMP47C420AF) that also provides routing the signal to the most appropriate detection path and then toward the audio stages of the radio.

From a practical point of view, the receiver consists of several printed circuit boards (two large sized hosting most circuits, a smaller one relative to the main VHF/UHF tuner and various other little boards); all the interconnections make use of miniaturized multi-pole plugs and sockets. The Figure 7 shows the NR-108F1 with its back cover removed; further details on the structure and operational details of the radio can be better understood by the examination of the wiring diagrams and the PCB layouts (look at the Service Manual).



Figure 7: Inner view of the NR-108F1 receiver (back cover removed) [5]

Anyway, looking at the above figure allows to localize most of the receiver parts: the square metal cover in the center of the picture acts as a shield for the Time Base (4 MHz Xtal Oscillator) and for the main PLL circuits, the large brown PCB (“B-312”) hosts all the LW-MW-SW RF circuits (from 150 kHz to 29.999 MHz), the various IF circuits, the AM/FM/CW-SSB detectors and the Audio Output stage (the “L-shaped” aluminium bracket visible under the speaker is the heatsink for the Power IC).

The small metal box at the bottom left of the PLL cover is the 87.5-108 MHz Tuner (“TU-22”) for the FM broadcasting band, while under the green PCB (“B-304”) at the bottom left of the picture there are the V-UHF Tuner (“TU-24”) and all the associated circuits.

In Figure 7 are also shown the two small accessory PCBs (“B-305A” and “B-305C”) and, partially, the Control PCB (“B-303B”) which hosts all the front controls of the radio, the displays and the main microprocessor IC-201 (Toshiba TMP47C420AF). Its metal shield can be seen in the picture just aside the rotary encoder (top left), while in the Fig. 13 is shown the bare μP (shield removed).

The front side of the “B-303-B” PCB (when removed from the case of the radio) is also shown in Figure 14, look at the next pages of this paper.

About the changes that had occurred during production of the NR-108F1, after the *mule* (a prototype built for promotional purposes at the end of 1985 and shown on the pages of the Marcucci catalogs, look at Figure 3 above) that had a slightly different appearance from the final receiver, there had been no significant circuit variations except for the antenna input boards, of which several versions exist (with or without L-C Input filters and/or an “active” stage, the Figures 8 and 9 show some examples).

Different Versions of the Same Receiver

It should be noticed that the NR-108F1 was produced not only under different brands, but also in some different versions in order to abide by the regulations of the countries in which the receiver was to be marketed.

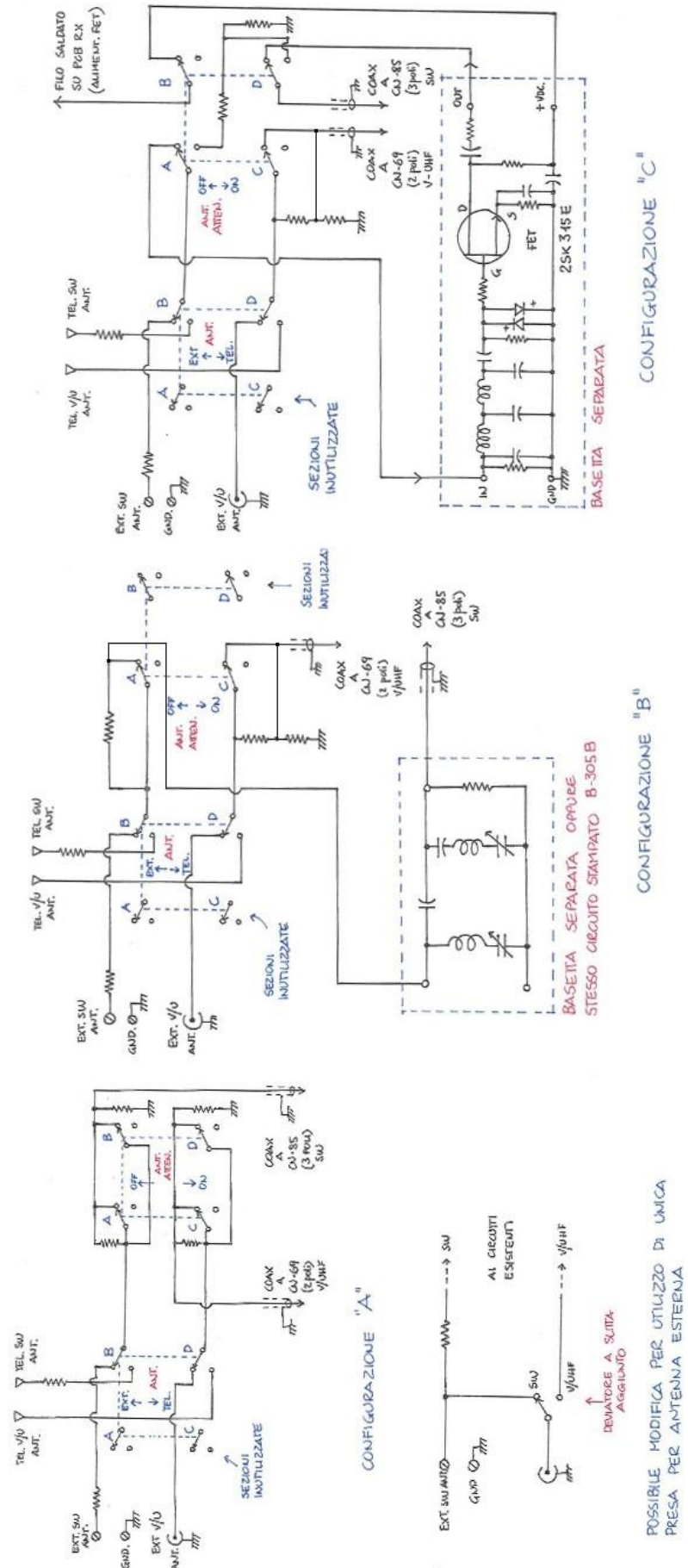


Figure 8: Various configurations of the antenna input board in the NR-108F1 portable radio.

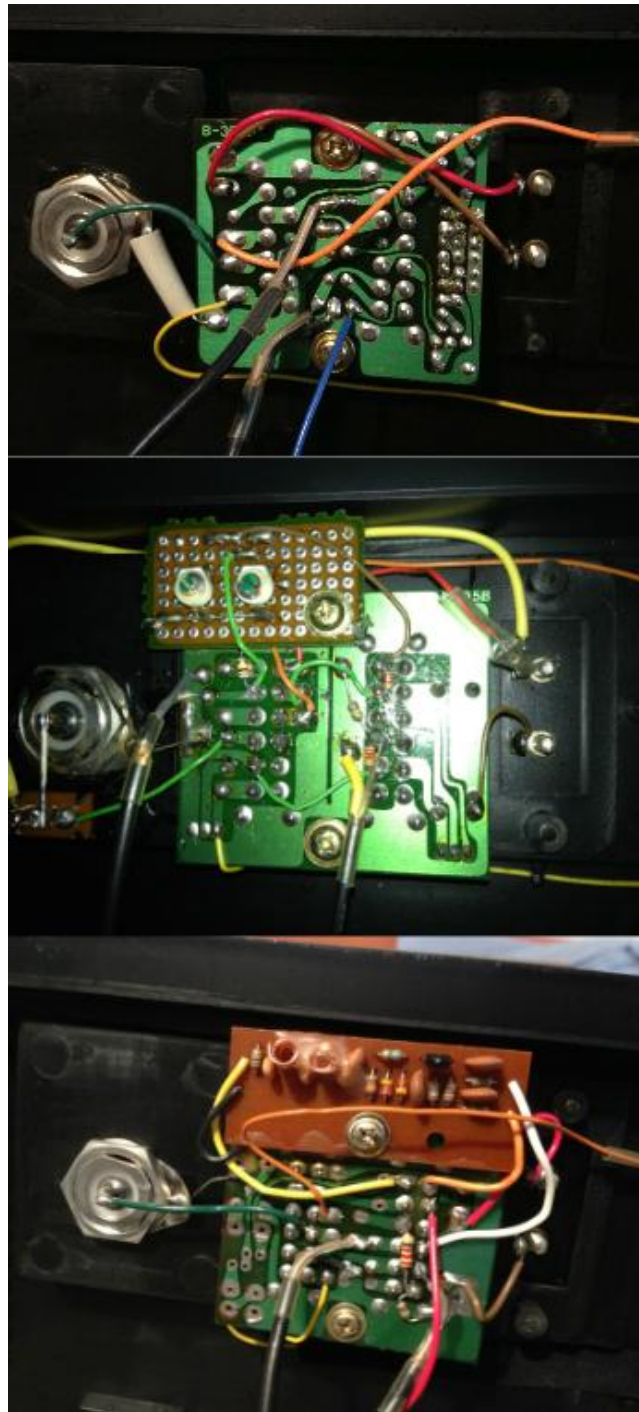


Figure 9: Pictures of some different antenna input boards found in the NR-108F1 receiver.

Thus, whilst the “basic” version of the NR-108F1 is capable of a continuous coverage of the range 150 kHz - 520 MHz, there are also other versions with reduced - or increased - frequency coverage. The Figure 10, showing different types of labels that appear in the receiver back, is almost self-explanatory about this matter.

The label in the center belongs to a NR-108F1 of the “basic” version, sold under the brand names *MARC II* or *Technimarc Digit Master* in most countries, while the label in the top of the photo belongs to a NR-108F1 sold under the name *Pan Crusader 8000* in Germany (please notice the “Swiss Horn” German Post Logo).

As in those years listening through consumer radios to short-wave frequencies higher than 26.100 kHz or to VHF/UHF frequencies outside the FM broadcast band and TV audio channels was not

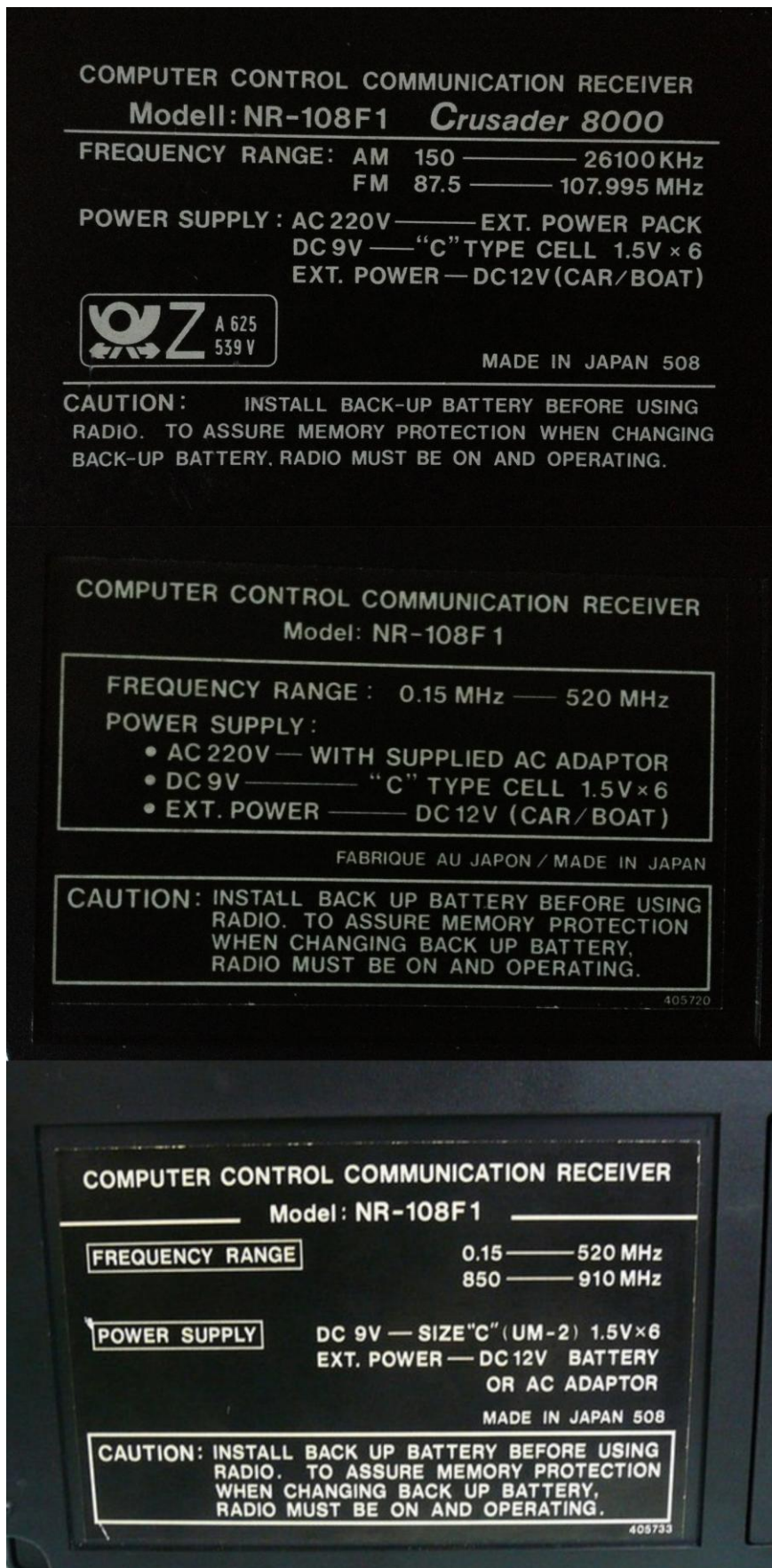


Figure 10: Different rear labels found in the NR-108F1 Receiver

allowed in Germany, the NR-108F1 had to comply with those local regulations in order to be placed on the market. The goal could have been simply achieved by not equipping the NR-108F1 with the “TU-24” V-UHF Tuner (Figures 11 and 12) and by making minor circuit modifications; it was preferred to leave the set unmodified and to disable the reception of all the forbidden frequencies instead.

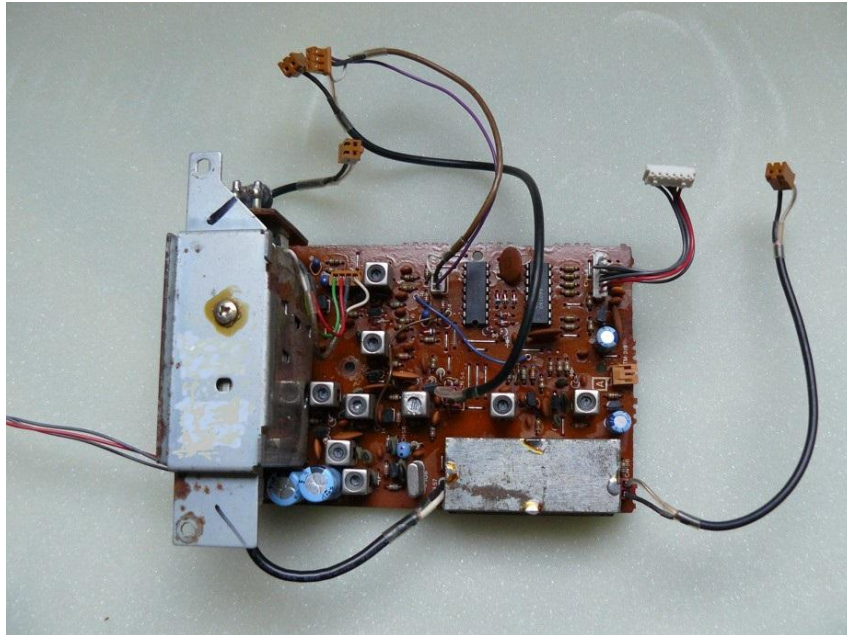


Figure 11: The “TU-24” V-UHF Tuner and its associated circuits [5]



Figure 12: A NR-108F1 with the V-UHF tuner removed [5]

This was achieved by using proper jumpers, miniature connectors and switching diodes in the receiver PCBs, so that it was possible for experienced users to circumvent these limitations easily enough.

But something very interesting emerges from the label shown in the bottom of Figure 10: that label belongs to a rare *MARC II* radio that is capable to receive the 850-910 MHz band in addition to the 150 kHz-520 MHz continuous coverage.



Figure 13: The Toshiba TMP47C420AF main processor of the NR-108F1 (shield removed) [5]

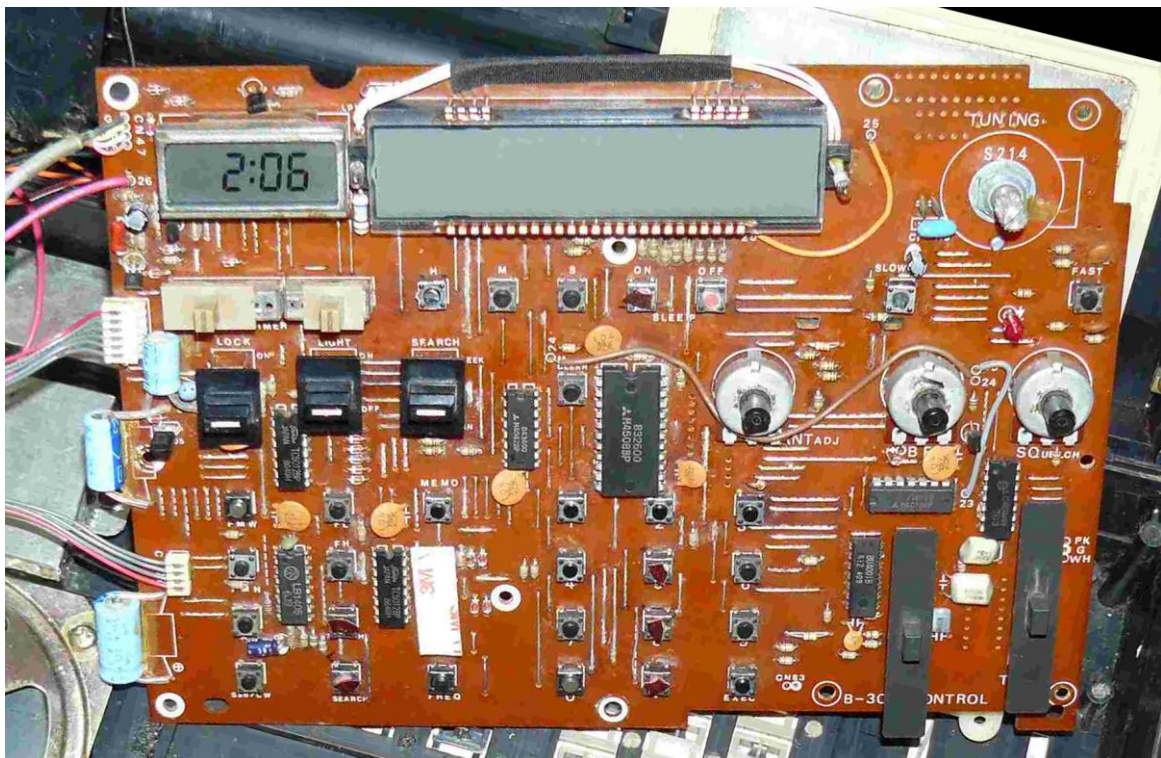


Figure 14: The front side of the “B-303-B” Control PCB [5]

Such a version of the receiver was primarily intended for the Japanese domestic market: at those times in the 850-910 MHz band were located the analog TACS cell-phones, the MCA service (*Multichannel Access System*, a first-generation type of land mobile business communication also allowing group conferences between the main station and the remote terminals) and also some UHF bugs; listening to that band was allowed in Japan and in a few other countries however.

But... how was it possible for that band to be added to the NR-108F1 reception capabilities? I do not have a receiver of such a version currently at hand, so I can only make assumptions; a detail in a photo of the back of that NR-108F1 version is of some help anyway.

A small label with an arrow is placed directly under the antenna attenuator switch (Figure 15); this label warns that, when the "ANT ATT" selector is moved down (ON Position), in the 250-310 MHz interval (as shown on the front LCD display) the true received frequencies are ranging between 850 and 910 MHz instead.

In other words, the 850-910 MHz band is converted into the 250-310 MHz range through a special Input circuit (a "Down-Converter") that is activated by placing the "ANT ATT" switch downside.

As no differences to the standard NR-108F1 version appear from the outside of the radio (there are no additional switches or sockets), it is possible to assume that the "Down-Converter" structure is more or less similar to the one represented in Figure 16.

Most probably the antenna attenuator function for that receiver is active only in the SW range (below 30 MHz), and the three remaining sections of the same switch are used for applying/removing power to the Down-Converter (and to the eventual active HF Input Filter) and for conveniently switching its input and output as shown in the schematic I drew.



Figure 15: The label placed under the antenna attenuator switch of the Japanese version of the NR-108F1 receiver

So, when receiving the V-UHF bands (from 30 to 520 MHz) it is not possible to apply any attenuation to the incoming RF levels (and this could represent a major problem in presence of strong signals, particularly in the 87.5-108 MHz range).

Obviously, when one chooses to receive the 850-910 MHz band through such a radio, he must always add 600 MHz (exactly) to the frequency that appears in the receiver display, but this is an easy mental operation.

As shown in Figure 16, most likely the Down-Converter makes use of the same antenna employed for the 30-520 MHz range and consists of an Input stage (a Band-Pass filter centered at 880 MHz or

a “Gigafil”) followed by a mixer that is fed also by a fixed 600 MHz beat signal (produced by a VCO or a similar device).

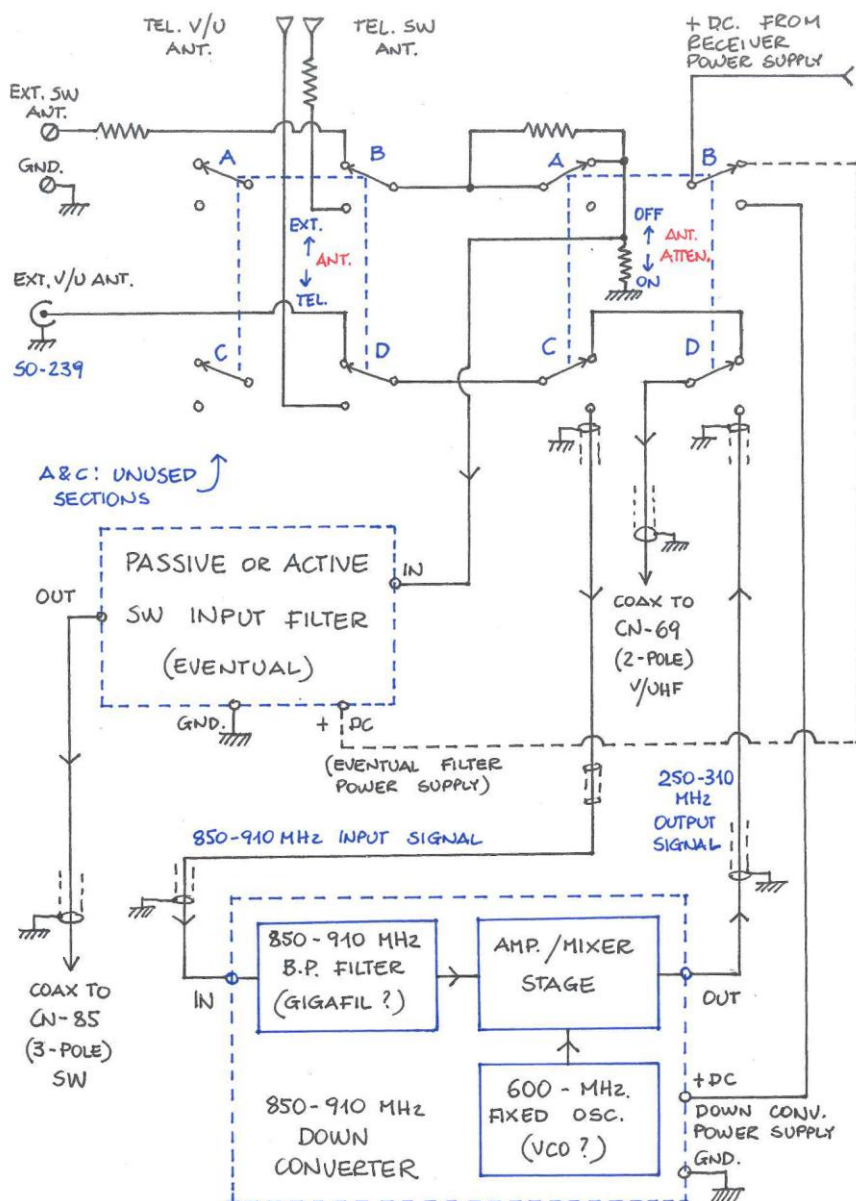


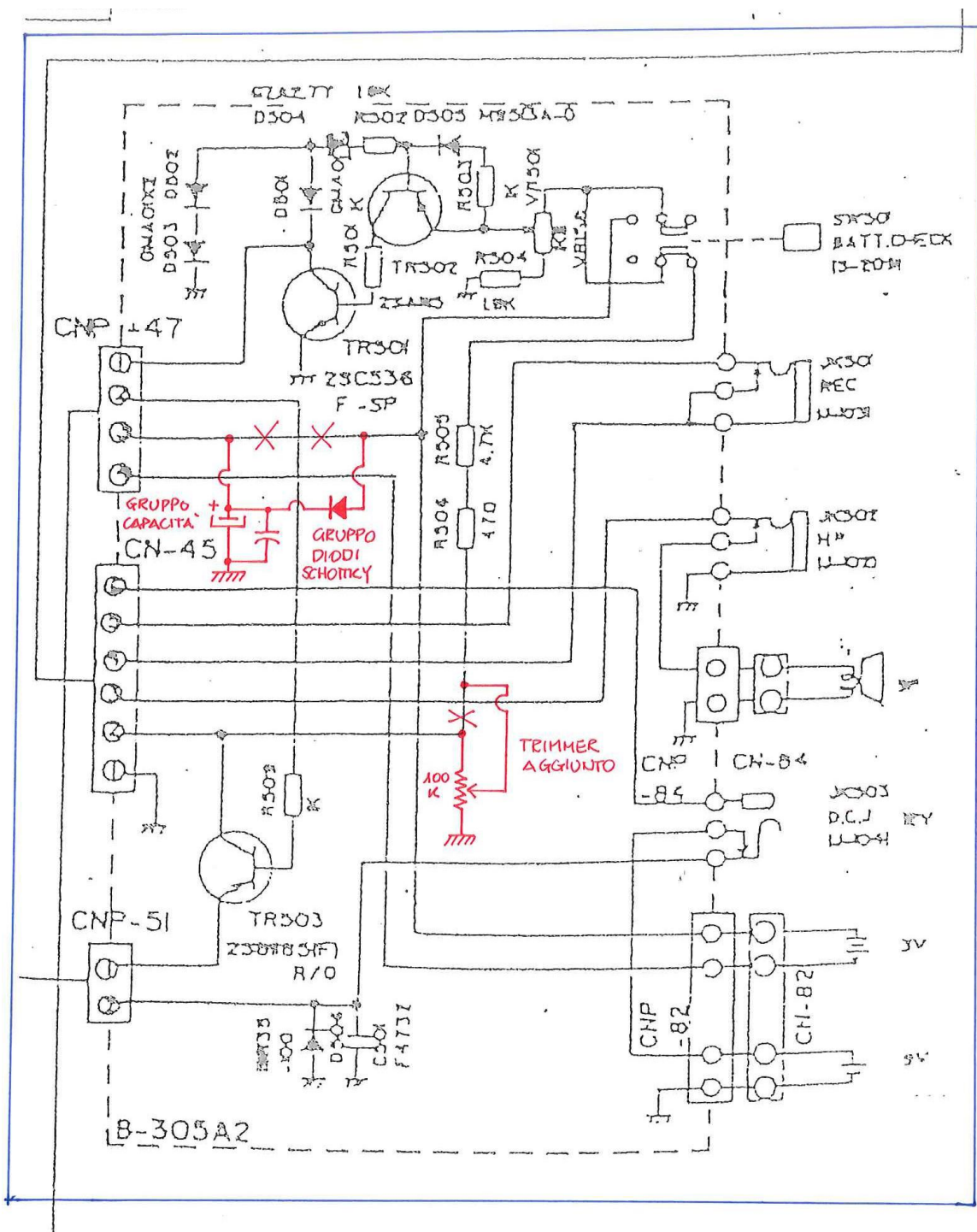
Figure 16: Supposed structure of the input circuits in the Japanese version of the NR-108F1

Maybe the Down-Converter circuit is located in a small additional PCB fastened to the rear cover of the receiver directly.

It is worth to say that this somewhat special version of the NR-108F1 portable radio is interesting as a curiosity or from a collector's point of view only: there are no longer analog signals in that frequency range nowadays, so that the 850-910 MHz receiving capability would be almost useless. Anyway, this particular version of the NR-108F1 receiver was one of the very few portable radios (if not the only one in the world) that allowed the reception of a mobile phone band. Lastly and just for information, no version of this portable radio holds the “CE” marking, as this was introduced only after July 1993.

Some Considerations About the NR-108F1 and Two Minor Modifications

It should be noted first that the NR-108F1 is a non-professional receiver built about thirty years ago using the criteria and the components of that period, so that nowadays you cannot expect too much from an old radio (even it had been really an advanced product under many respects). Among the downsides of this receiver should be taken into account: the synthesizer noise, various "spurious" signals that appear here and there, a poor dynamic range, a low S/N ratio, a somewhat difficult SSB reception and the presence of a "step encoder" (that is primarily responsible of the very scarce feeling of the tuning knob).



Other small idiosyncrasies of the radio consist in the low reliability of the level indicator of the main batteries (often erroneously reported as "full" and with a few hours of residual life instead), and in the unwanted erasure of all the preset memories (that are inexorably cleared whenever the two backup batteries are removed, this is very annoying if they need to be replaced).

I tried to remedy these drawbacks by two simple modifications: the addition of a multi-turn resistive trimmer to the charge indicator circuit of the main batteries and the addition of a set consisting of "super-capacitors" and Schottky diodes to the memory backup circuit [6].

The diagrams that appear in Figures 17 and 18 are self-explanatory, the pictures of Figures 19 and 20 show the perforated board on which the additional components are mounted, its placement (the added board has been fastened by hot glue in the only available space within the receiver) and also the aforementioned multi-turn trimmer.

A further small modification (whose schematic is shown in the left side of Figure 8) concerns the addition of a small slide switch in the back cover of the radio, in order to allow using the SO-239 socket as a unique external antenna input for all bands (if desired).

Finally it should be kept in mind that, in order to get the best possible performances from this portable radio, it is VERY IMPORTANT to proceed to the replacement of any "aged" or defective component first (in particular of some electrolytic capacitors). It is also recommended the careful cleaning and lubrication of the various contacts (multi-pole connectors, potentiometers, battery holders, etc.) and finally a precise realignment of the circuits as shown in the Service Manual.

A complete circuit realignment, however, requires experience, skillness, patience and the use of proper instrumentation. So, if these requirements are not fulfilled, for sure it is better to leave everything "as is" and to have the job performed by a specialized and experienced laboratory instead.

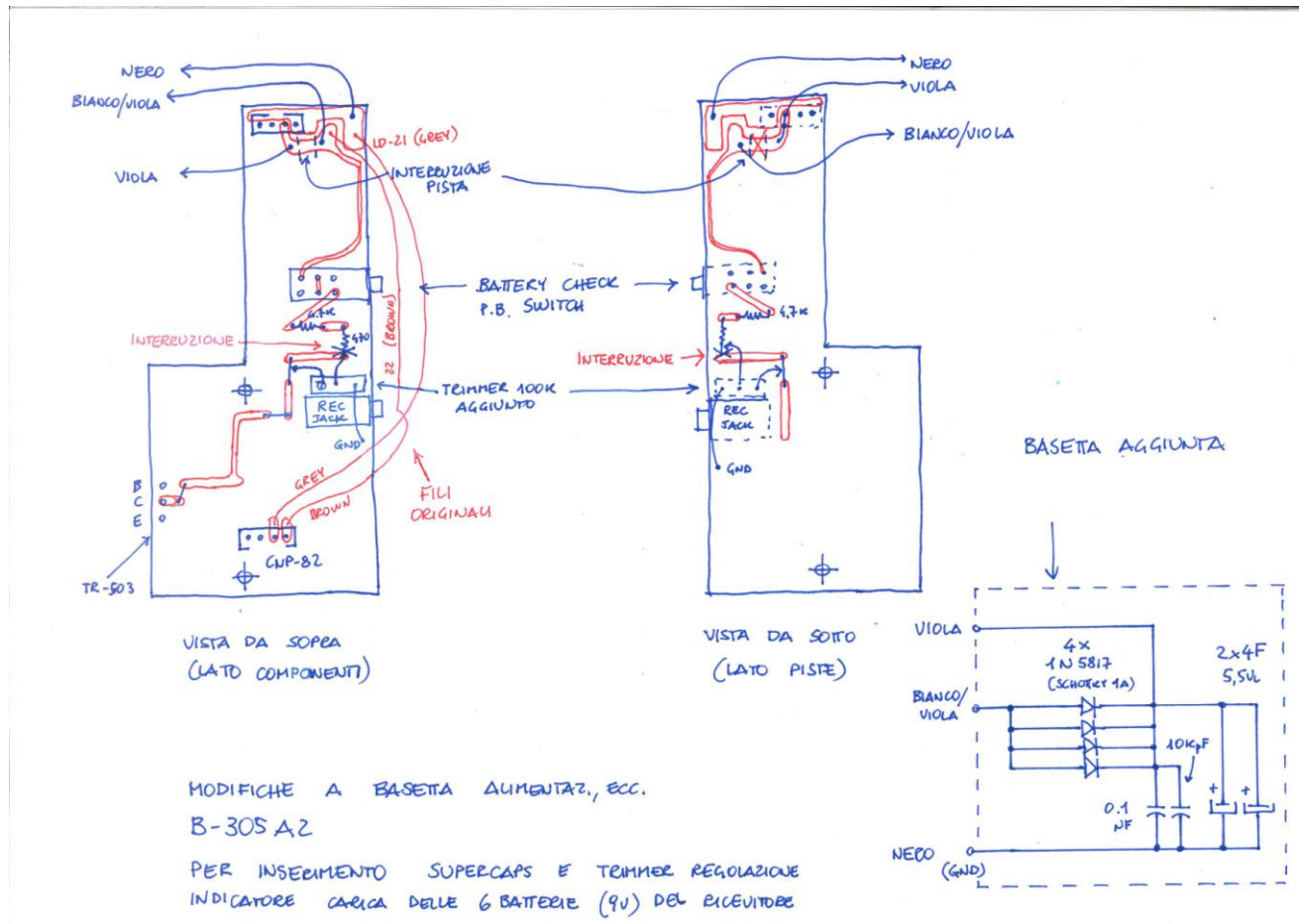


Figure 18: Details of the proposed mods

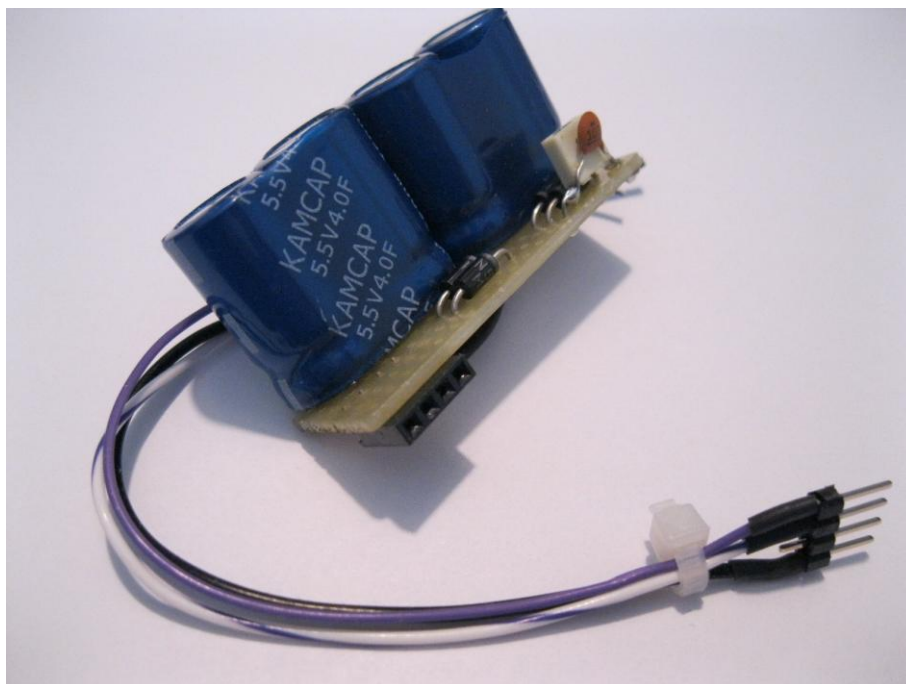


Figure 19: The added “Super-Capacitor Board”



Figure 20: Location of the added board and of the multi-turn resistive trimmer

Conclusions

Despite the nearly thirty years of age, this portable radio still remains unique in its kind and, especially if suitably rejuvenated and realigned as recommended above, it can be advantageously used for listening activities during outings or excursions (or even in fixed locations, especially if equipped with proper external antennas).

Yes, it is true that nowadays the Medium and Short Wave bands have been "emptied" and that in the VHF/UHF bands digital modes are almost universally employed; however, if you are patient (and even a bit lucky), the NR-108F1 receiver is still able to offer good gratifications.

Paolo Viappiani

La Spezia, Italy, May 2016

References:

[1] So it appears from the NR-108F1 Service Manual, edited in 1986. The *New Hope Industrial Co., Ltd.*, which no longer exists, was an OEM manufacturer of radio equipment for civil and household applications that was based at the address: 1567 Guminoki Sayama-Cho Minami-Kawachi-gun, Osaka, Japan. The Company had obtained accreditation from the American FCC (Federal Communications Commission) in order to import its products into the US territory. (FCC ID number: A6T9LA81F1, see at: <https://fccid.io/A6T9LA81F1>).

[2]: See at the address: <http://www.marcucci.it/#cataloghi> and: http://ita.marcucci.it/e_download_1.htm#multibanda (for the Instruction Manual in Italian); http://radioescuchadx.com/receptores_archivos/marc2_archivos/manualmarc2.pdf (for the Instruction Manual in Spanish).

[3] See: http://www.mods.dk/manual.php?brand=_other
The Instruction Manual (in Italian language) and the Service Manual (original) of the NR-108F1 Portable Radio can be found under the names "Marcucci Mark-II (Pan Crusader 8000) Instruction manual (Ita).zip" and "Marcucci Mark-II (Pan Crusader 8000) Service manual.zip" respectively. In the file names "Marc" is erroneously written with the final letter "k", but it is not my fault.

[4]: <http://www.radiokitelettronica.it/index.php/download?folder=Programmi%2BUtili&start=120>

[5]: The Figures 2 (bottom only), 7, 11, 12, 13 and 14 are taken from a very interesting forum that appears in the Russian website: <http://www.radioplaneta.ru/forum/viewtopic.php?f=5&t=11492>
The Author's nickname is "Scover" and he is from Riga, Latvia.

I recommend to visit the website and also to read all the Scover's posts in the forum (they are written in Russian language but it's easy enough to get a translation through *Google Translate*). There are very interesting information also on the Toshiba TMP47C420AF microprocessor and on the M4508BP and TC4051B ICs. Many thanks, Scover!

[6]: The additional circuit makes use of four parallel-connected 1N5817 Schottky diodes, of four "super-capacitors" (for a total of 8F/5.5VL) and of two small bypass capacitors. The diodes connected "in parallel" *tout-court* do not constitute a "circuit heresy" in this special situation: the normal current drain of the memories is in the order of μA 's, whilst each 1N5817 can handle more than 1A, so the "mutual unbalance" subsequent to the chosen configuration is virtually insignificant. I used four diodes both in order to reduce the total voltage drop as much as possible and to withstand the initial charging current of the "super-capacitors"; incidentally the circuit works properly.

Please also notice that, thanks to the presence of the diodes, the battery status indicator LEDs (when you press the pushbutton in the left side of the radio) still show the true residual charge of the two backup cells.

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