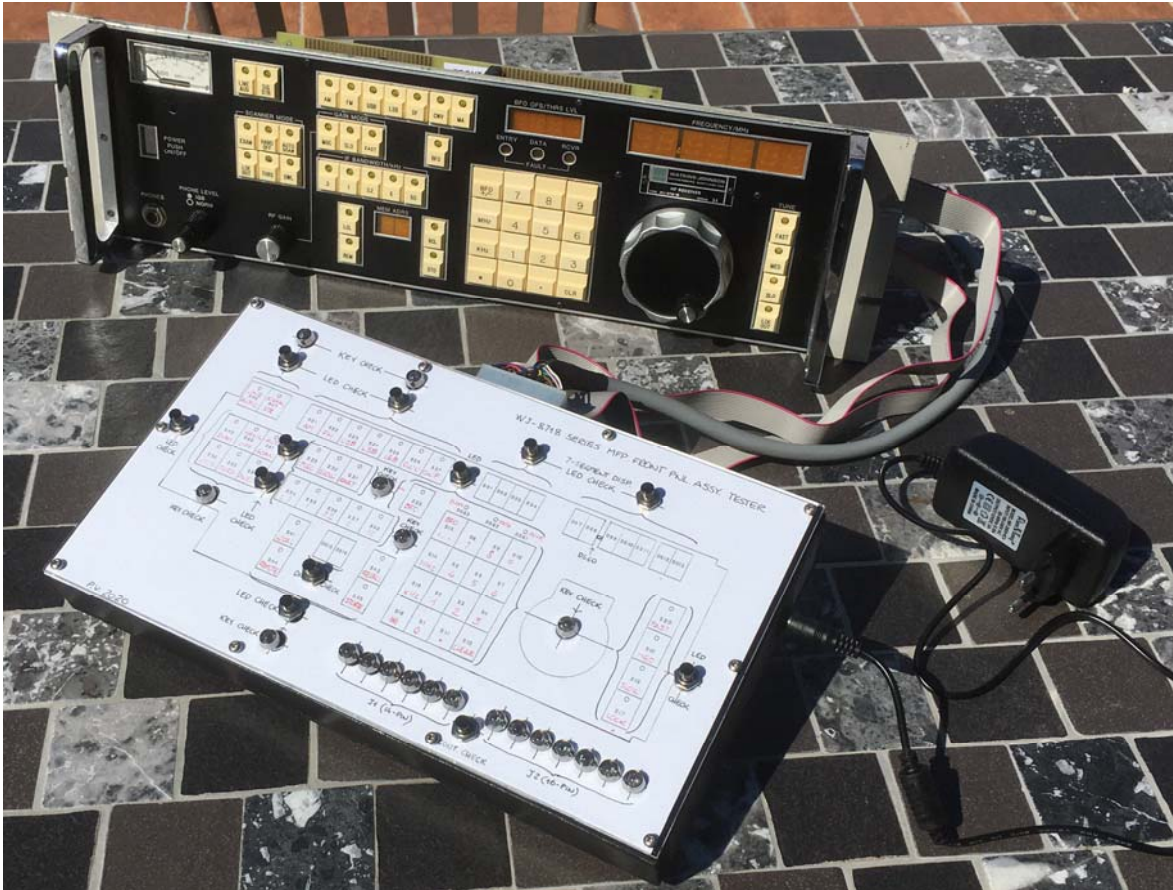


A WJ-8716/8718 MFP FRONT PANEL TESTER  
(Rev. 04-Final Version, September 2020)

by Paolo Viappiani, Italy, 2020



*After my paper concerning the Field Modifications Instructions for installing the MFP Option [1], I received a very good feedback from many readers and also some complaints concerning the very long and exhausting procedure that is needed for checking the full functionality of a used MPF front panel.*

*On the other hand, it is very important that the front panel to be used for an MFP upgrade is perfectly working (I know that a few units recently found on the Internet had some issues and needed repairs).*

*So I decided to tackle that annoying problem thoroughly and I developed a simple enough device that can be built from scratch (it requires some time, work and a bit of skillness however).*

*It should be noted that this tool can be used to check any type of MFP panel of the WJ-8716 and WJ-8718 series of receivers, both the old versions (with larger numeric keys) and the new ones, and also (thanks to a very simple optional addition that will be described later in this article) the special front panels designed for receivers equipped with the 1-Hz and 10-Hz BFO options.*

*Once you have this MFP Front Panel Tester at hand, you'll be able to check the functionality of any WJ-8716-WJ-8718 MFP Front Panel and to locate possible LED and/or key issues in minutes; for sure it will save you from wasting time and unpleasant headaches.*

### ***Preliminary Description***

This *MFP Front Panel Tester* consists of four main parts:

- 1) A *PCB Probe Card* that has to be plugged into the two sockets placed behind the MFP front panel (that usually host the MFP-A1A1 *Front Panel Encode Card* 796056-X);
- 2) Three connecting cables: a 20-pole round cable (routing from the above mentioned *PCB probe card* to the *Tester Main Unit*), a 16-pole and a 14-pole ribbon cables (routing from the J2 and J1 plugs on the *Front Panel Switch/Encoder* small MB located behind the MFP front panel to the *Tester Main Unit*);
- 3) The *Tester Main Unit*;
- 4) A regulated DC (12V-1A) wall power supply.

All the above mentioned parts are shown in Figure 1.



Figure 1: All the *MFP Front Panel Tester* parts.

## Principles of Operation

The simple principles of operation of the *MFP Front Panel Tester* are shown in Figure 2 below.

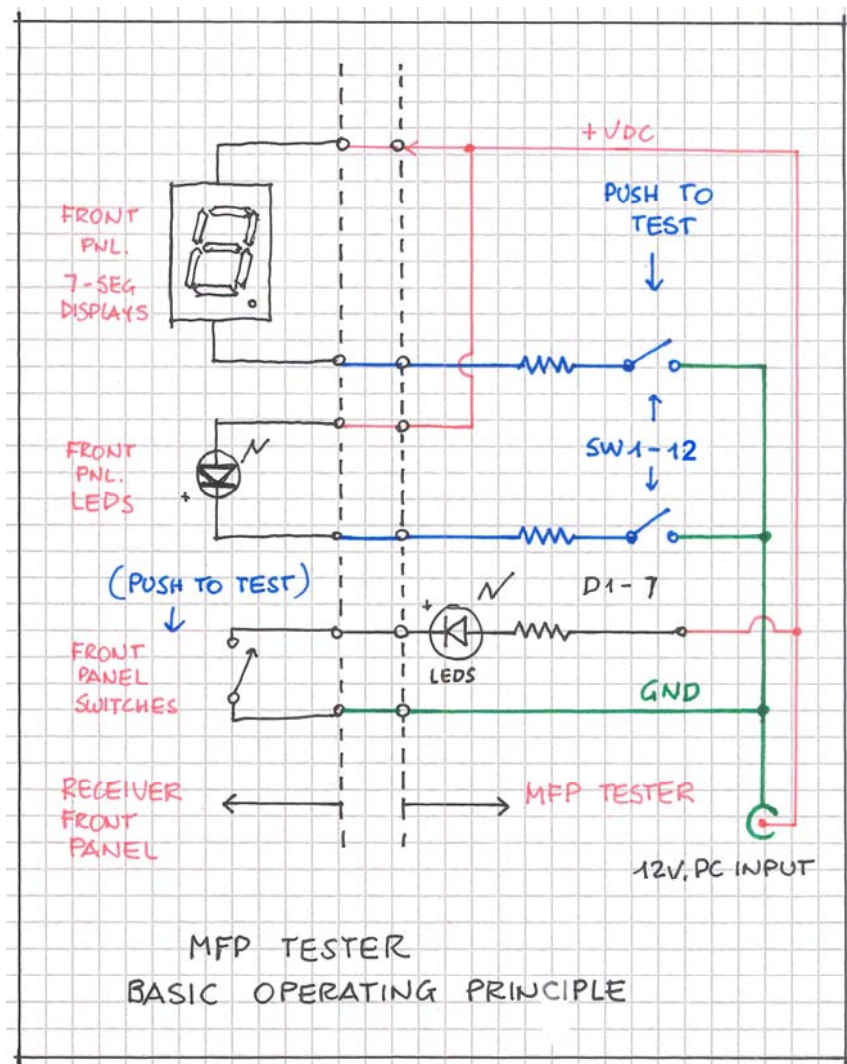


Figure 2: *MFP Front Panel Tester* principles of operation.

In order to check all the MFP front panel 7-segment displays and LEDs, a positive DC voltage is applied to them all, and twelve push-button momentary switches (SW1 to SW12) provide shorting them to ground (by some resistors of appropriate values).

For checking all the MFP push-button front keys, a positive DC voltage (in series with a LED located on the Tester front panel and provided with a proper dropping resistor) is applied to them, and a LED lights up whenever a key on the MFP front panel is pressed.

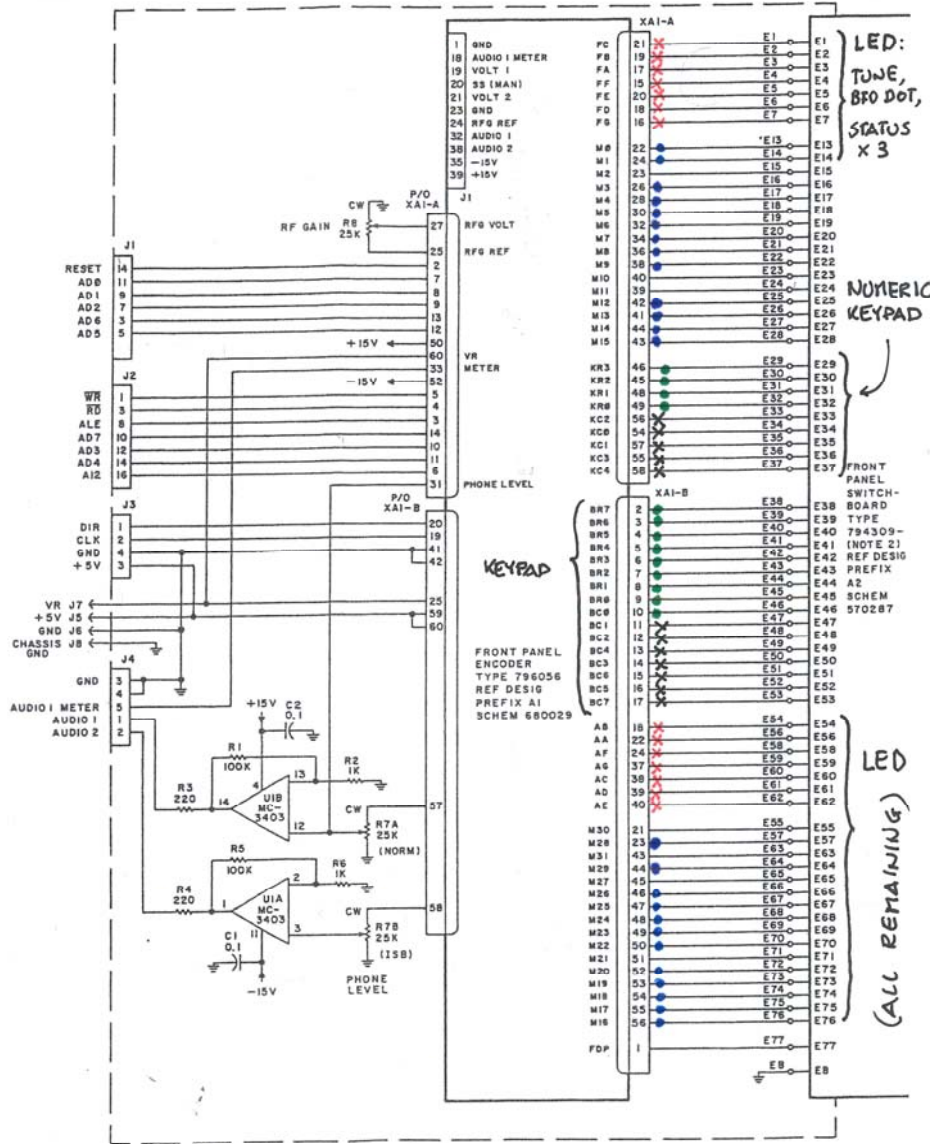
Also the continuity of all the J2 and J1 contacts can be checked by pushing a momentary switch on the Tester, 13 LEDs will show if every contact is OK or if there is a problem concerning one or more of them.



### Front Panel Tester Schematics

Figures 76, 67 and 65 of my article quoted in [1] show the connection paths of both the MFP-A1 small motherboards sockets to the MFP front panel keys and LEDs (and also to J2 and J1 plugs).

Those Figures are shown again here as Figures 3/a, 3/b and 3/c for convenience:



- = LED CATHODES
- × = LED ANODES
- × = KEYPAD ROWS
- = KEYPAD COLUMNS

Type 794310-1-2-3 Front Panel Interconnect (MFP-A1), Schematic Diagram 570291

Figure 3/a: MFP-A1 Front Panel Interconnect board schematics showing the connections to the MFP-A1A2 Front Panel switchboard and also to J1 and J2.

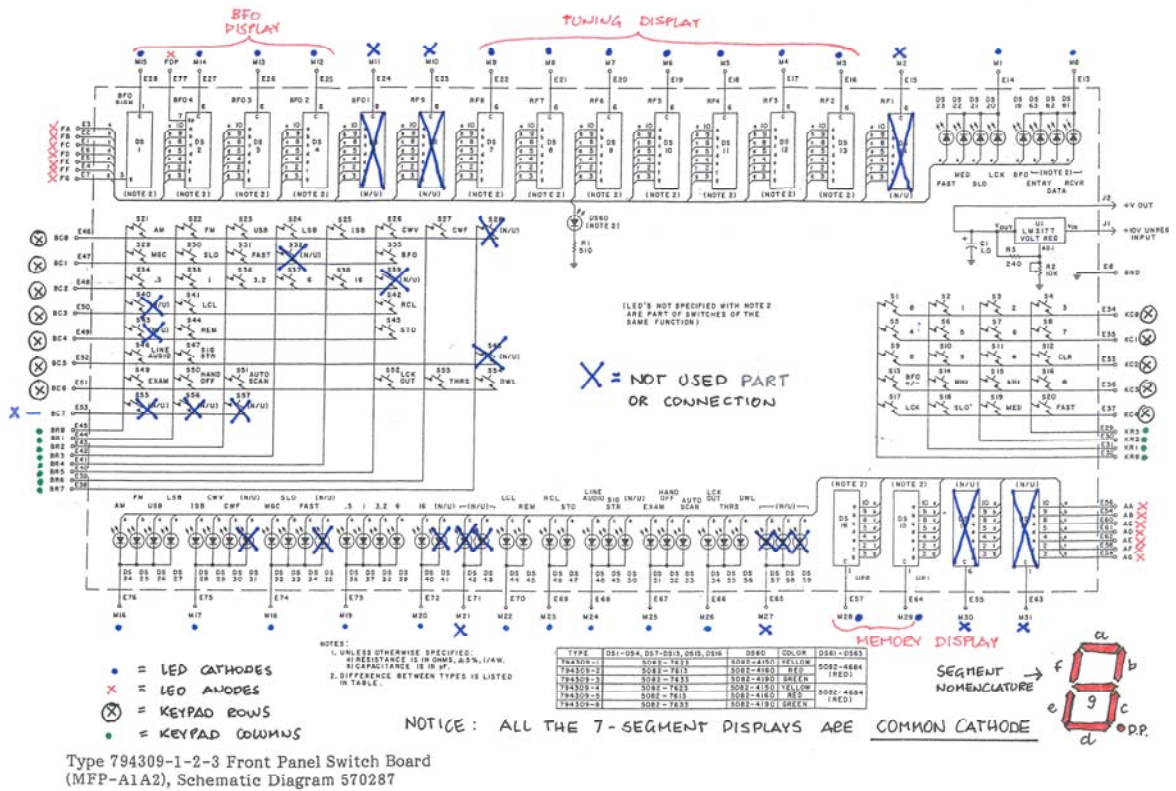


Figure 3/b: The MFP-A1A2 Front Panel Switch Board schematic.

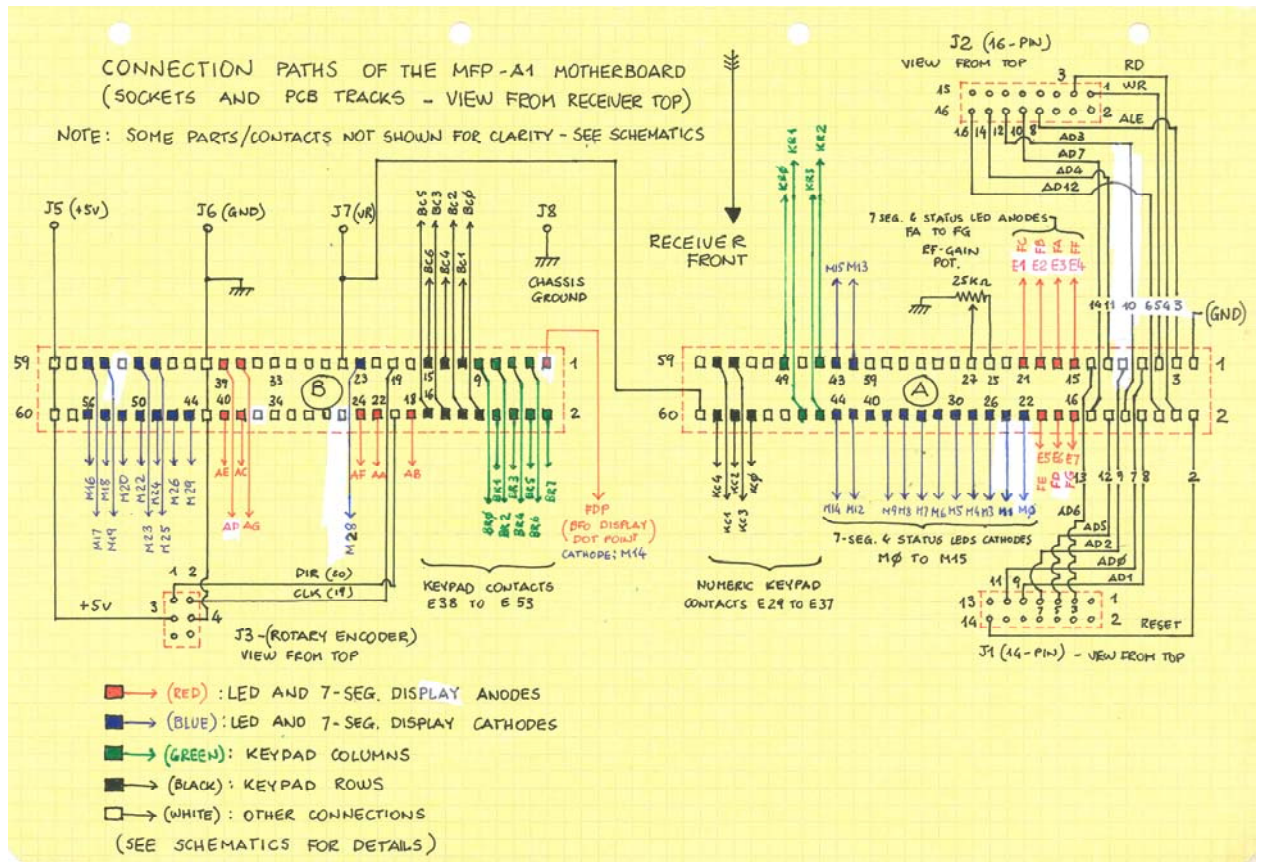


Figure 3/c: Connection paths of both the MFP-A1 small motherboards sockets.

Based on the above figures I developed a *PCB Probe Card* that has to momentarily replace the MFP-A1A1 *Front Panel Encode Card* 796056-X; Figure 4 shows its schematic.

I drew the various contacts using colors (*blue* for MFP Front Panel Key and 7-segment display LEDs, *red* for +DC voltage, *green* for GND contacts, *black* for the MFP Front Panel Keys rows, *transparent* for the contacts to J2 and J1, according to the colors I used in the previous figure) for clarity.

Please also notice that in the upper part of the drawing the FRONT (*even*) contacts of the Probe Card appear, while in the bottom part the REAR (*odd*) contacts are shown.

At the right of the schematic the 20-leads (named from “A” to “T”) that have to come to the *MFP Front Panel Tester* main unit (by a 20-pole cable provided with proper connectors) are shown.

Please notice that if you also connect M2 (E15), lead “I” (pins 22, 24, 26, 28, 30, 32, 34, 36 and 38 of the front right comb of the Front Panel Tester *PCB Probe Card* represented in Figure 4 top right) to pin 23 of the rear right comb of the same card (figure 4 bottom right), you’ll be able to check also the special MFP Front Panels designed for receivers equipped with the 1-Hz (8-Digit Frequency Display to 1 Hz resolution) and 10-Hz BFO options.

A closer look at Figures 3/a and 3/b above clarifies how this useful option works.

Even if the above mentioned connection is not shown in the *PCB Probe Card* schematic of Figure 4 and in the pictures of Figure 11, I recommend adding that optional lead in any case: it does not create problems whatsoever and also it increases the versatility of this MFP Front Panel Tester.

Figure 5 shows the schematic diagram of the MFP Front Panel Tester *Main Unit*; please notice that the very same colors and letters of Figure 4 have been used.

I guess that the schematics of the Figures 4 and 5 are self-explanatory (please also look at the ***Principles of Operation*** paragraph above) and do not need of any further comment.

The values of all the resistors shown in the schematics have been calculated using voltage and current data of all the involved LEDs and 7-segment displays (about 20 mA for each segment of the original HP-5082 devices used by Watkins-Johnson); of course, resistors of the nearest standard values have to be used in practice.



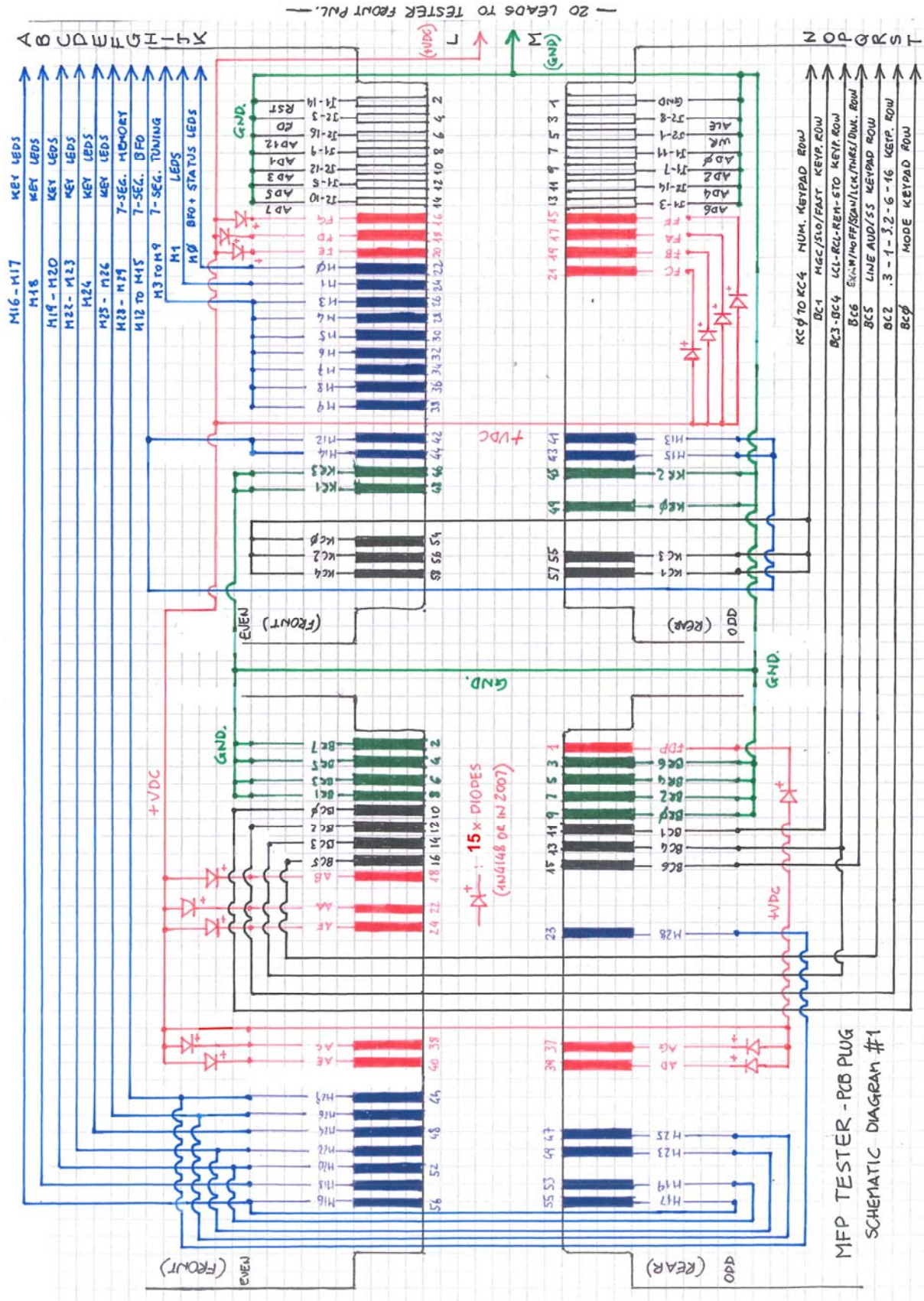


Figure 4: MFP Front Panel Tester: PCB Probe Card Schematic

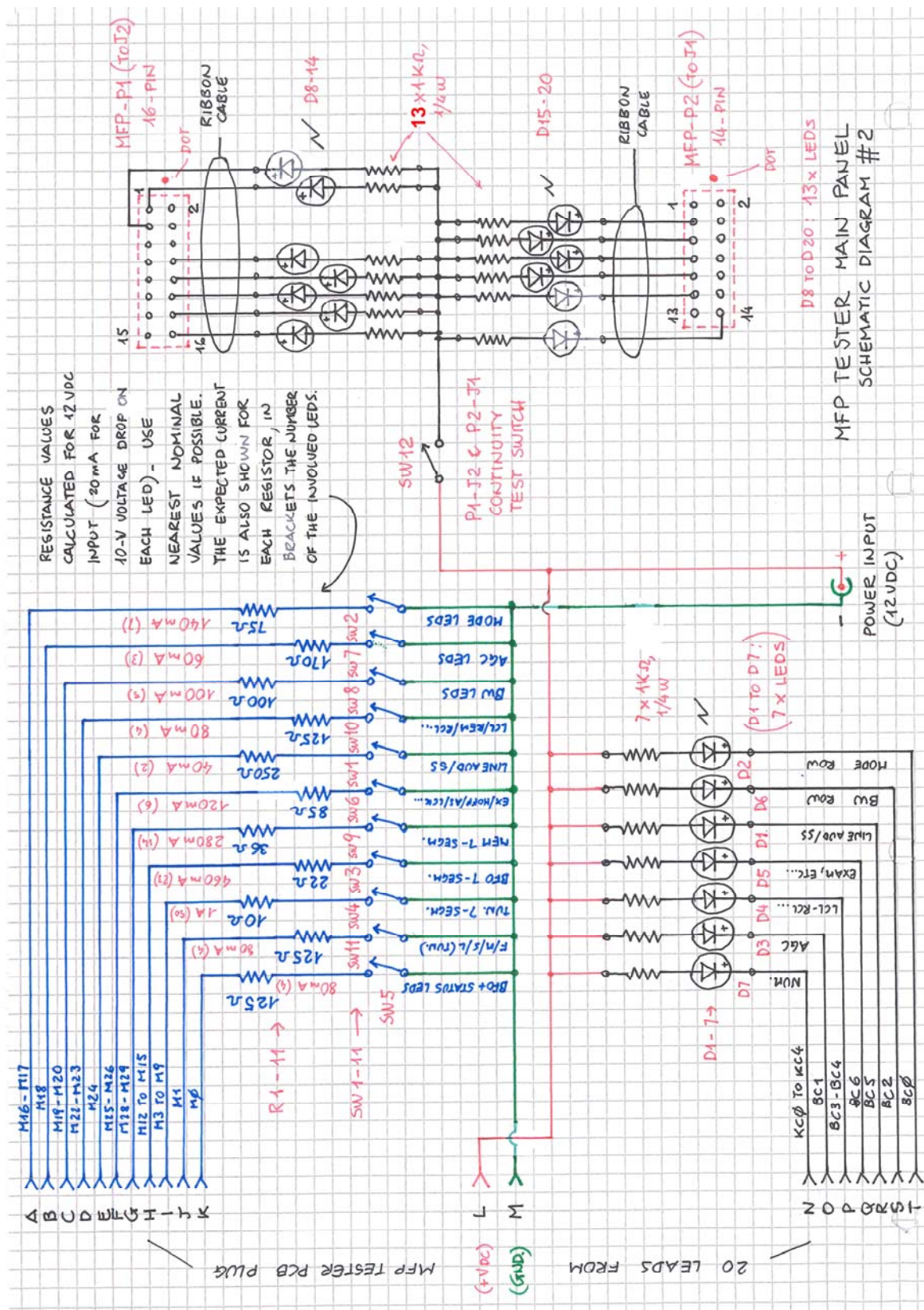


Figure 5: MFP Front Panel Tester: Main Unit Schematic



### ***Constructional Details***

For building this *MFP Front Panel Tester* the following parts are required:

- A specially designed fiberglass double-sided printed circuit board (see below);
- A specially designed front panel for the Main Unit and a suitable case;
- A 20-pole round cable (no matter if shielded or unshielded) of about 60-65 cm. in length;
- 2 x 20-pole Molex “*Mini-Fit Jr.*” MX-5566-20A connectors (already provided with male contacts, see below);
- 2 x 20-pole Molex “*Mini-Fit Jr.*” MX-39-001-2200 connectors (without contacts, see below);
- 40 x Molex “*Mini-Fit Jr.*” MX-5556-T2L (female 22-28AWG contacts for the above, see below);
- 15 x diodes (1N4007’s or else 1N4148’s) for the *PCB Probe Card*;
- 20 x LEDs (each complete with a LED panel holder and a series dropping 1-kOhm resistor) for the *MFP Tester Main Unit* (D1-D20 in the schematics);
- 12 x push-button momentary switches for the *Main Unit* (SW 1-SW12 in the schematics);
- 11 x 1/4W (or 1/2W) dropping resistors for the *Main Unit* (R1-R11 in the schematics):  
1 x 10 Ohm, 1 x 22 Ohm, 1 x 36 Ohm, 1 x 75 Ohm, 1 x 85 Ohm, 1 x 100 Ohm, 3 x 125 Ohm, 1 x 170 Ohm, 1 x 250 Ohm. About these values (also shown in the schematics), they derive from calculation; obviously any nearest “standard” value may be used for each of them.
- *Rigid* and *stranded* insulated wires (colored *blue*, *red*, *green* and *black*) of convenient lengths for all the connections in the *PCB Probe Card* and in the *Main Unit*.
- Some heat shrink tubing (various diameters and lengths) and other small parts;
- A DC power connector (panel type) and a regulated switching 12V-1A wall PSU.

Below is a detailed description of each part.

#### ***1) - PCB Probe Card***

The *PCB Probe Card* requires the use of a double-sided printed circuit board that can be self-built (if you have the required tools and experience) or ordered from some specialized firms, locally or via the Internet.

I was fortunate enough to find a very good and cheap firm a few miles away from my home, and they provided building a few of the needed cards very quickly and at a nominal cost based on my drawings [2].

Figure 6 shows my drawing, while in Figure 7 is shown their one (both sides identical).

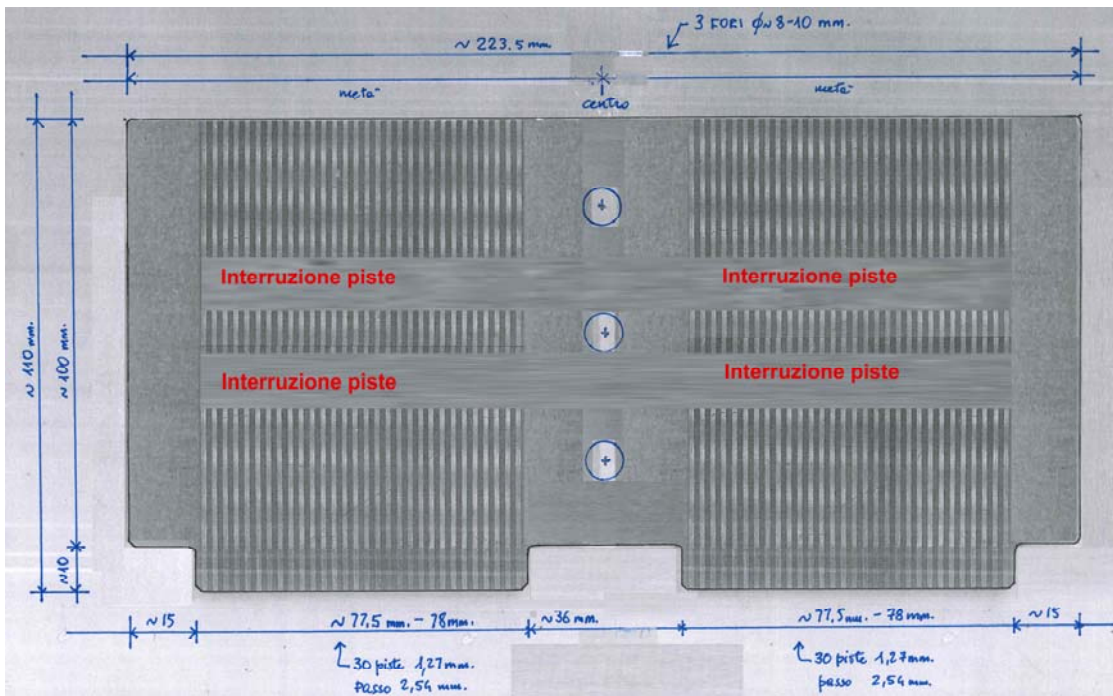


Figure 6: My preliminary drawing (quoted) for the *PCB Probe Card*.

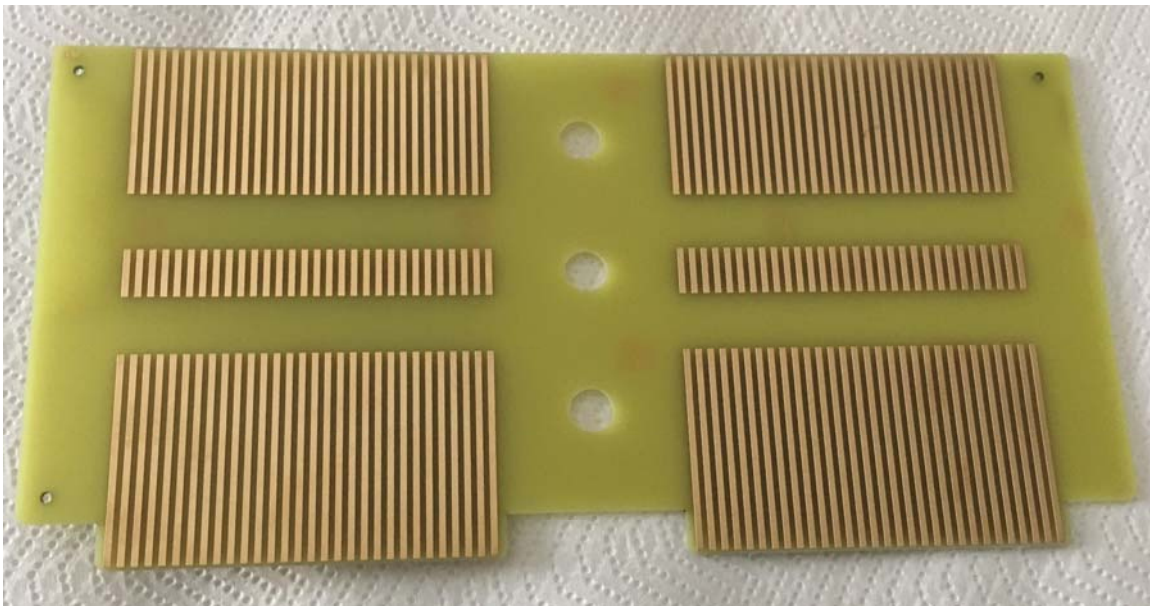


Figure 8: the *PCB Probe Card* as obtained from the PCB Factory

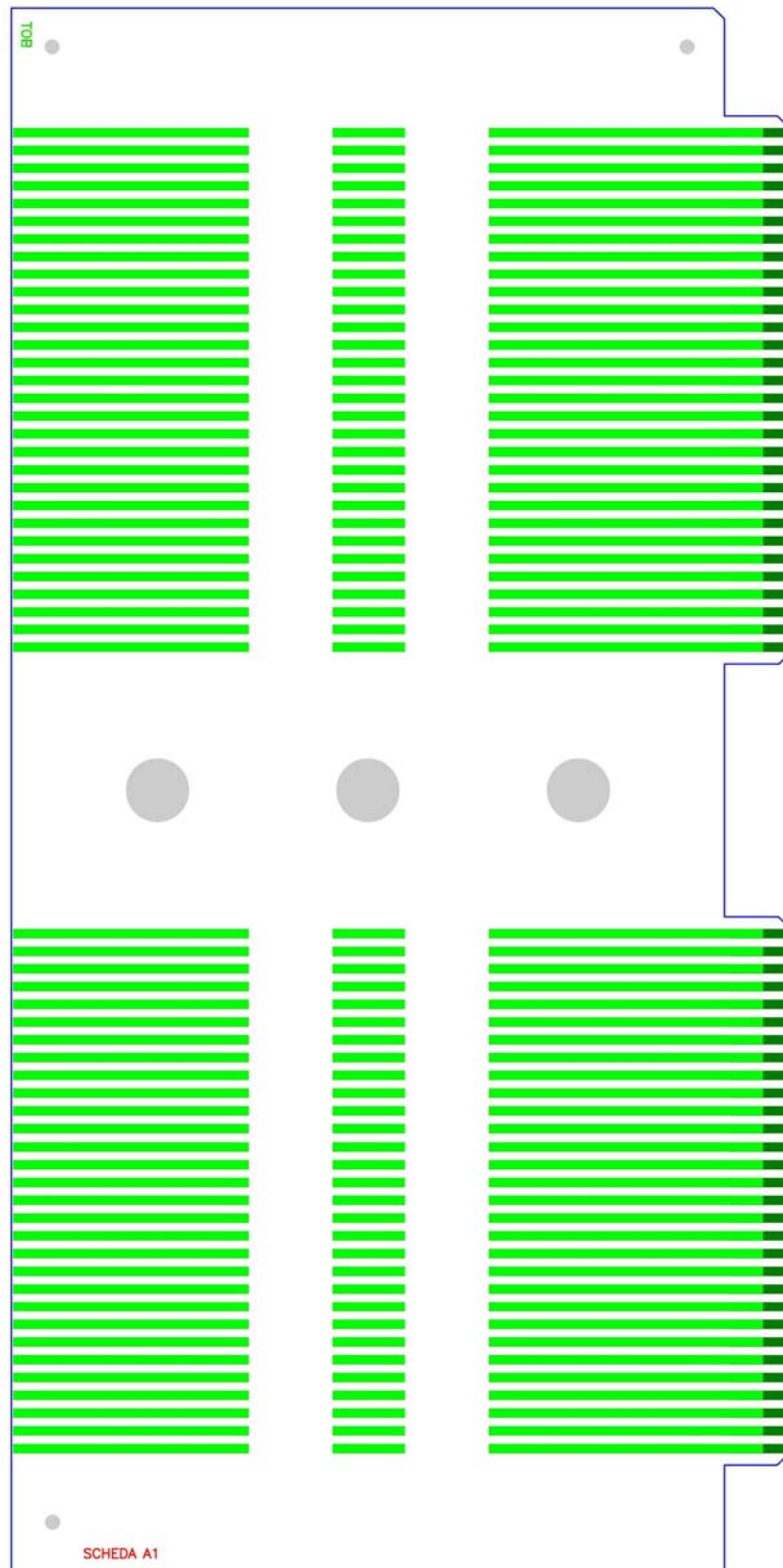


Figure 7: The drawing by the PCB Lab (for reference only, it must be scaled precisely if needed!).



Substantially the required PCB card is a glass-fiber based, 1.6 mm thick and double-sided one; the two faces are identical and are provided with two comb-terminated track series (30 x 1.27 mm. contacts each, 2.54 mm. spaced), look at Figure 8.

All the PCB tracks are gold-plated and have two interruptions on each card side (for installing diodes on some of them); they have been also provided with three holes in the center (size not critical) for wiring convenience.

At the right end of the card a 20-contact Molex “*Mini-Fit Jr.*” (MX-5566-20A, Figure 9) male plug has been glued on the front side, Figure 10.

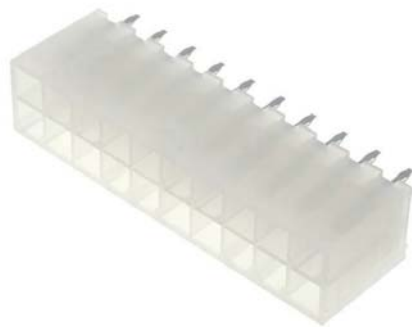


Figure 9: A 20-contact Molex “*Mini-Fit Jr.*” MX-5566-20A connector with male contacts.

It is worth to notice that all the connections from the comb tracks (at the base of each side of the *PCB Probe card*) to the Molex plug contacts have been made using insulated solid wire of the very same colors used in the schematic of Figure 4, in order to avoid any confusion.

It’s obvious that a great care and attention is needed in the assembling procedure, under penalty of failure or malfunction of the Tester.

And please don’t forget that all the time spent in building this device will be saved by its use!

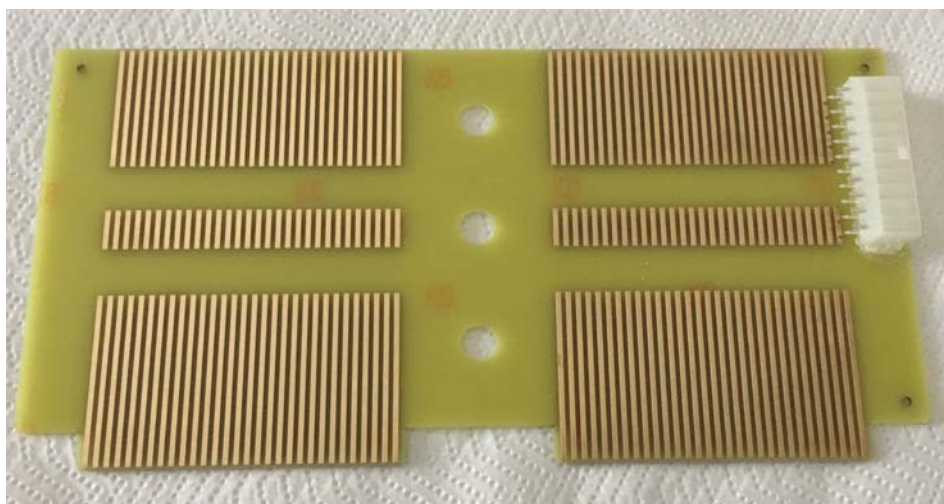
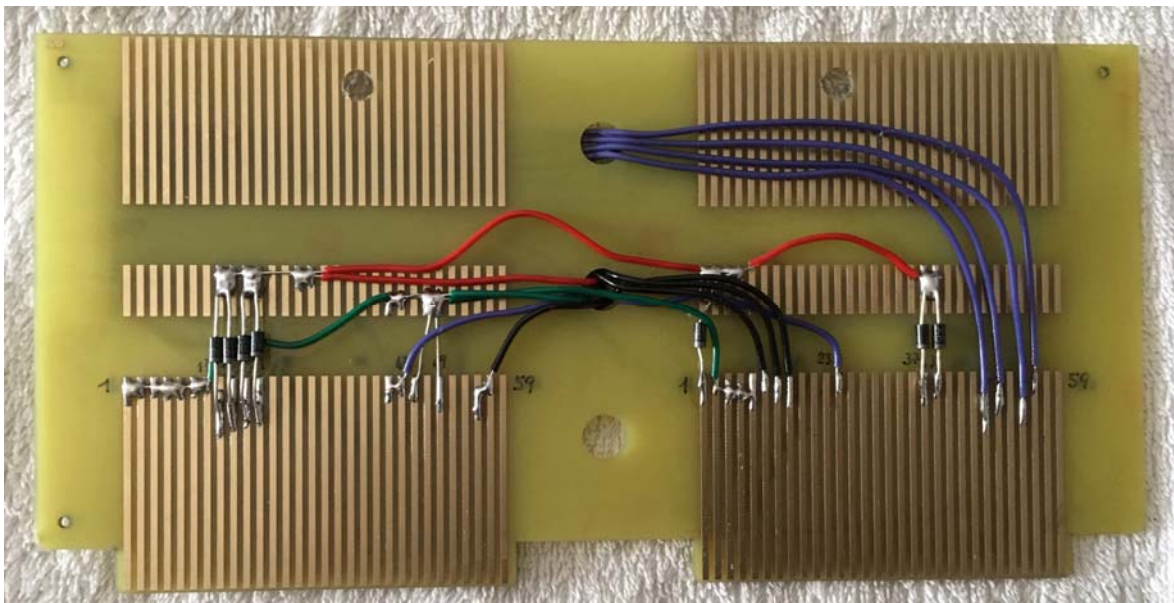


Figure 10: The *PCB Probe Card* with the Molex connector glued at its right front side.

Figures 11/a and 11/b show a fully assembled and ready to use *PCB Probe card*.

The wiring can be glued to the PCB card on some points, held by some cable ties or else attached with pieces of adhesive tape.

Please also notice the two 5 mm. dia. holes on the top of the PCB card, they have been drilled with the same spacing of the original MFP-A1A1 card in order a common W-J removing tool (metal handle with hooks) can be used for unplugging the *PCB Probe Card*.



Figures 11/a and 11/b: A fully assembled *PCB Probe Card* (front and rear sides).

As shown in Figure 1, I used grey adhesive tape for holding in place and protecting the card wiring on both card sides; the two holes for the W-J removing tool (metal handle) have been protected by plastic LED holders instead.

## 2)- Connecting Cables

The 20-pole connection cable between the *PCB Probe Card* and the *MFP Tester Main Unit* has been built using a 20-pole shielded cable (for availability convenience, shielding is really unnecessary) terminated at both ends with two Molex “*Mini-Fit Jr.*” connectors (MX 39-01-2200 provided with 20 x MX 5556-T2L 22-28AWG female contacts, Figure 12).

Figure 13 shows the 20-pole cable cut at a length of about 60-65 cm. but still unterminated at both ends.



Figure 12: A 20-contact Molex “*Mini-Fit Jr.*” (MX 39-01-2200) empty connector.



Figure 13: The 20-pole shielded cable cut at a length of about 65 cm.



In order to make the assembly of the end connectors easier, the color coding as for the DIN 47100 rules (Figure 14) was used, but that's not mandatory.

In any case it is very important not to get confused and to make the correct connections between the two sockets at each end of the connection cable, check them twice when done!

| <b>Cable identification to DIN 47100</b> |              |            |
|--|--------------|------------|
| Number                                   | Color        | Short form |
| 1  | white        | WH         |
| 2  | brown        | BN         |
| 3  | green        | GN         |
| 4  | yellow       | YE         |
| 5  | grey         | GY         |
| 6  | pink         | PK         |
| 7  | blue         | BU         |
| 8  | red          | RD         |
| 9  | black        | BK         |
| 10                                       | violet       | VT         |
| 11                                       | grey-pink    | GYPK       |
| 12                                       | red-blue     | RDBU       |
| 13                                       | white-green  | WHGN       |
| 14                                       | brown-green  | BNGN       |
| 15                                       | white-yellow | WHYE       |
| 16                                       | yellow-brown | YEBN       |
| 17                                       | white-grey   | WHGY       |
| 18                                       | grey-brown   | GYBN       |
| 19                                       | white-pink   | WHPK       |
| 20                                       | pink-brown   | PKBN       |

Figure 14: Color cable codes according to DIN 47100.

In order to make things easier, Figure 15 shows the Molex pin code numbers for their “*Mini-Fit Jr.*” connectors, a male plug MX-5566-20A (just of the type that has to be glued to the front right side of the *Probe Card* and to the upper rear side of the *Main Unit*) is represented.

Please notice that the pin numbered “1” is near a thin bulge that is present on one side of the connector.

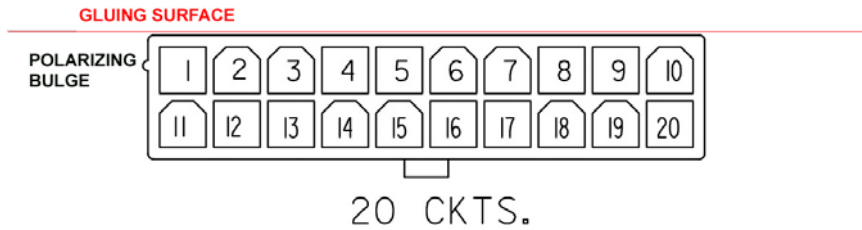


Figure 15: Pin numbering of the Molex 20-contact “Mini-Fit Jr.” (MX-5566-20A) male plug.

For assembly convenience I used the following correspondence between the “A” to “T” points in the schematics and the pin numbers of the Molex connectors:

A = 1, B = 2, C = 3, D = 4, E = 5, F = 6, G = 7, H = 8, I = 9, J = 10, K = 11 (*blue* colored wires);

L = 12 (*red* colored wires);

M = 15 (*green* colored wires);

N = 13, O = 14, P = 16, Q = 17, R = 18, S = 19, T = 20 (*black* colored wires).

Of course this is not mandatory, provided that all the connections between the *PCB Probe Card* and the *Main Unit* are correct however.

About Molex connectors, please be aware of their particularity and don’t get confused: the one that could look as a female socket (MX-5566-20A part, look at Figure 9) contains MALE contacts; on the contrary, the one that could look as a male plug (MX 39-01-2200 part, look at Figure 12) contains FEMALE contacts. On their availability, please look at [4].

Important notice on the Molex connectors: it is usually quite difficult to push hard (and/or to disconnect each other) the plug-in connectors having a lot of contacts, and this is also the case for the 20-pole ones that have been employed in this project.

Consequently, please do not apply too much force to these connectors, moderately press them together when plugging and hold the detachable one firmly when unplugging.

Never pull the entire cable in order to unplug the connectors (from the *Probe Card* and from the Tester Main Unit): if it is too difficult to detach from each other try prying them by a flat blade screwdriver rather.

This is particularly important if you crimped (or soldered) the leads to the female contacts using common tools (the original Molex crimping, extraction and insertion tools cost a fortune!).

In any case please pay a great attention not to break any of the leads when disconnecting!

As for me, I assembled the female contacts of the 20-lead cable by crimping them by ordinary tools first and by applying some solder finally; for sure it is a slow procedure that requires some patience, but good results are guaranteed.

As for the 16-pole and 14-pole ribbon cables, they are two simple socket-terminated flat cables (about 80 cm. each in length) coming from the *MFP Tester Main Unit* and going to the corresponding plugs placed on the MFP-A1 small motherboard.

The free ends of the two 14 and 16 pole ribbon cables enter the *MFP Tester Main Unit* from the upper side of its front panel (just under the Molex connector) and 13 of their wires (see schematics) are connected to the corresponding LEDs (all with series dropping resistors) and to ground via SW12, the “*continuity check*” push-button momentary switch.

Both the ribbon cables are shown in Figure 16.

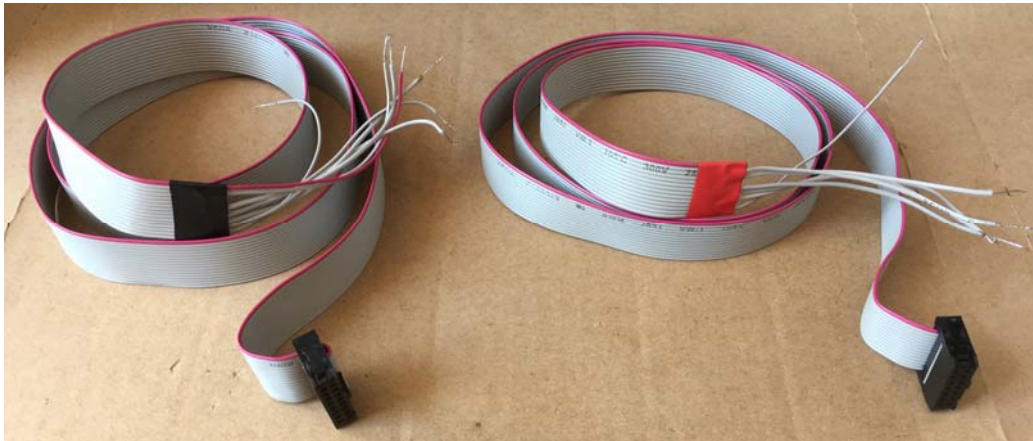


Figure 16: The 16 and 14-pole ribbon cables ready for the *MFP Tester Main Unit*.

### 3) - *The Tester Main Unit*

The *Tester Main Unit*, whose schematic is shown in Figure 5, can be built in different shapes; for convenience and ease of use, I built it using a modified drawing of the WJ-8718/MFP front panel (Figure 17/a) printed on a paper sheet.

That paper sheet was then conveniently drilled (by use of paper punchers) and interposed between two thin layers of Plexiglass (2 mm. thick each, Figure 18) as a *sandwich*. The two cut to size and drilled Plexiglass foils have been obtained cheaply from a specialized Italian firm [3].

For sure I could have used a screen-printed metal front panel, but in that case the costs would have been much higher; I chose the cheapest solution and in my humble opinion the results are acceptable enough.

The Tester front panel size is 29.7 cm. width and 17 cm. height in my case, but other sizes can be conveniently adopted.

All the holes are for push-button momentary switches and for metal LED holders (cheap Chinese components found on the Internet).

In Figure 19 is shown a template of my *MFP Tester* front panel with indication of all the required holes.



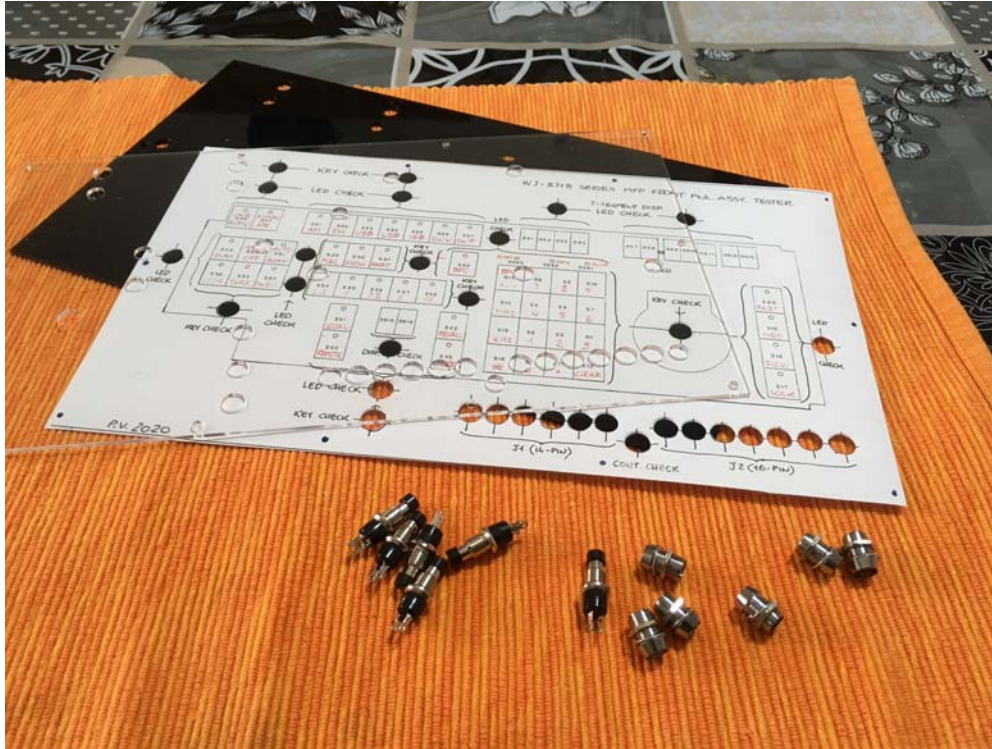


Figure 18: The front panel of my *MFP Tester*, composed of two drilled Plexiglass foils (transparent and black) 2 mm. thick and a paper sheet interposed between them. Visible are also some push-button switches and LED holders.

An almost assembled *MFP Tester* front panel (before wiring) is shown in Figure 20, while Figures 21 show a completely assembled one (front and rear).

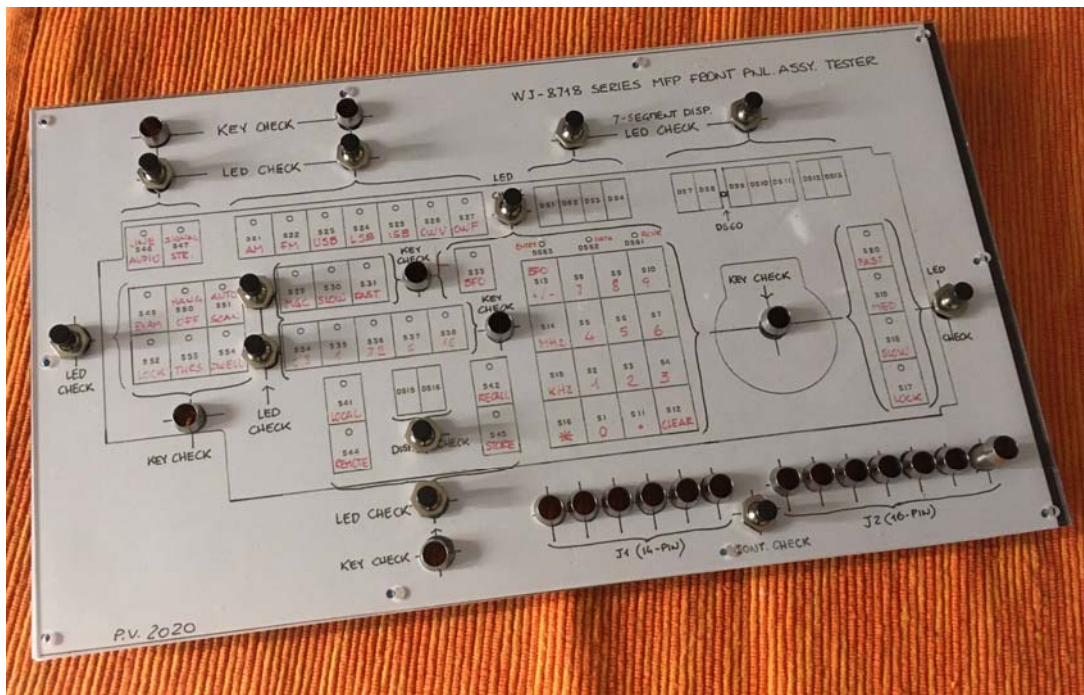


Figure 20: My *MFP Tester* front panel during assembly.

WJ-8718 SERIES MFP FRONT PNL. ASSY. TESTER

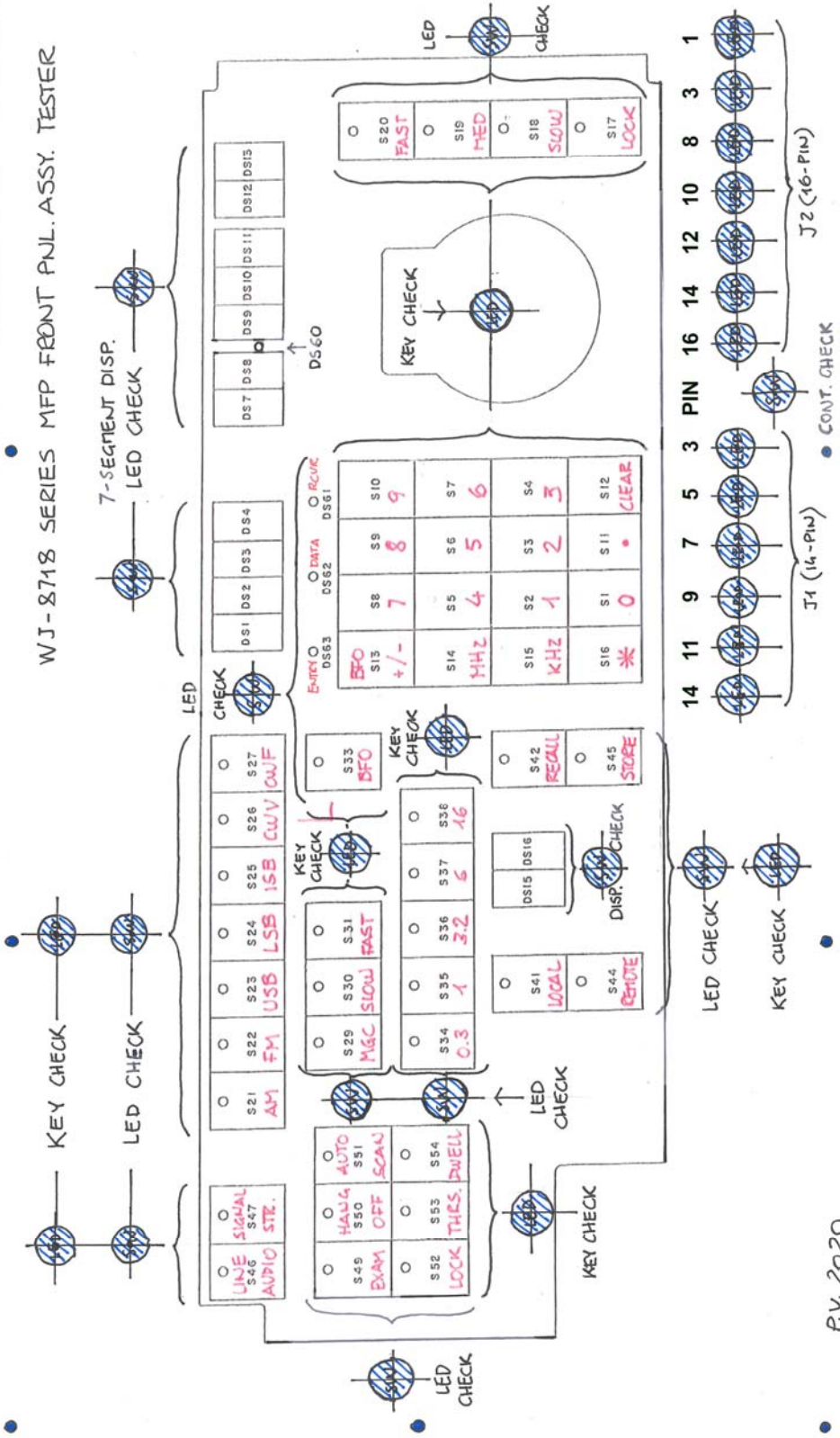


Figure 17/a: Front Panel layout of my MFP FP Tester.



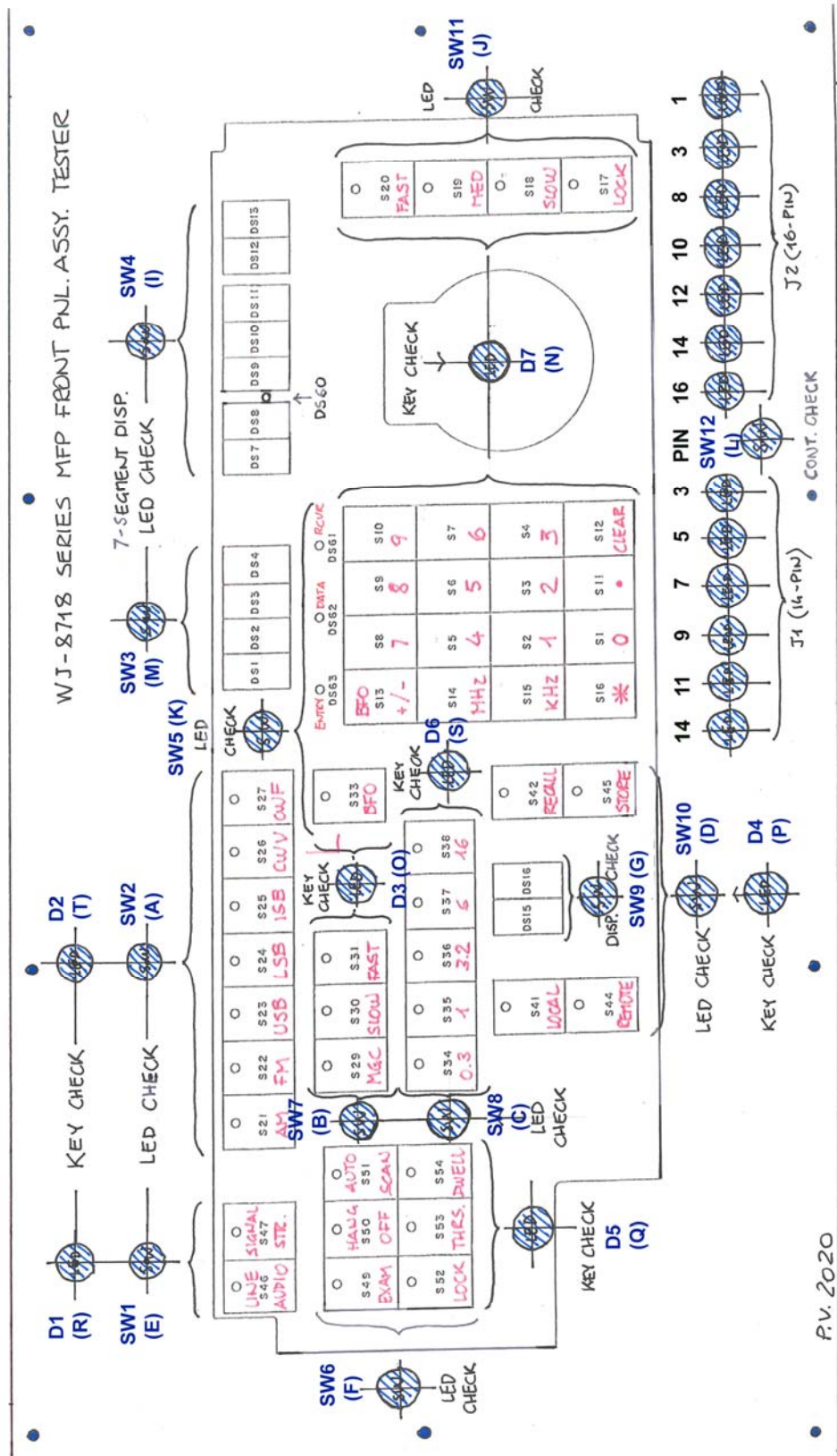


Figure 17/b: Component identification on the Tester front panel (as per the nomenclature shown in Figure 5).



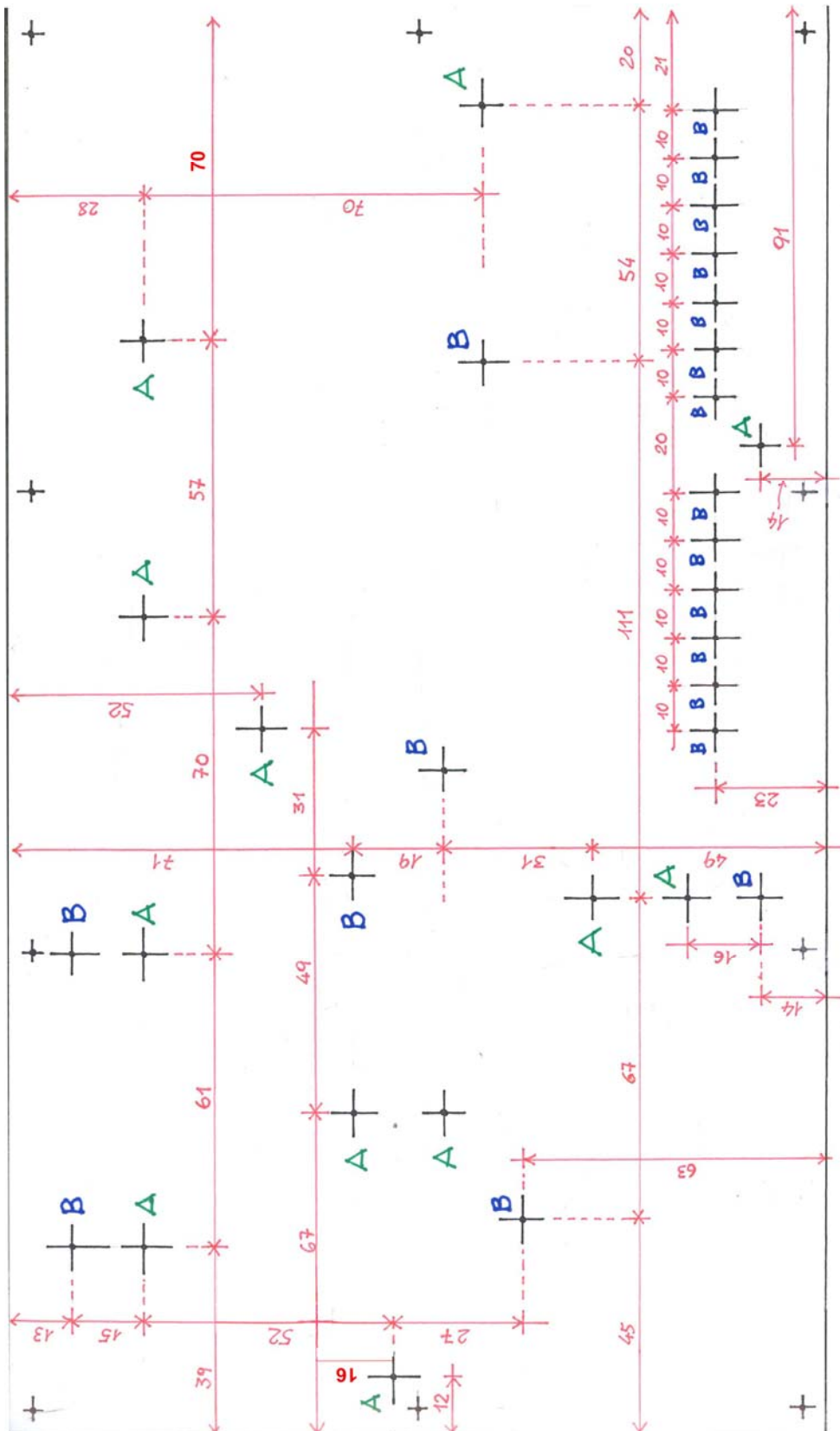


Figure 19: Front panel drilling layout for my *MFP Front Panel Tester* (dimensions in mm.)

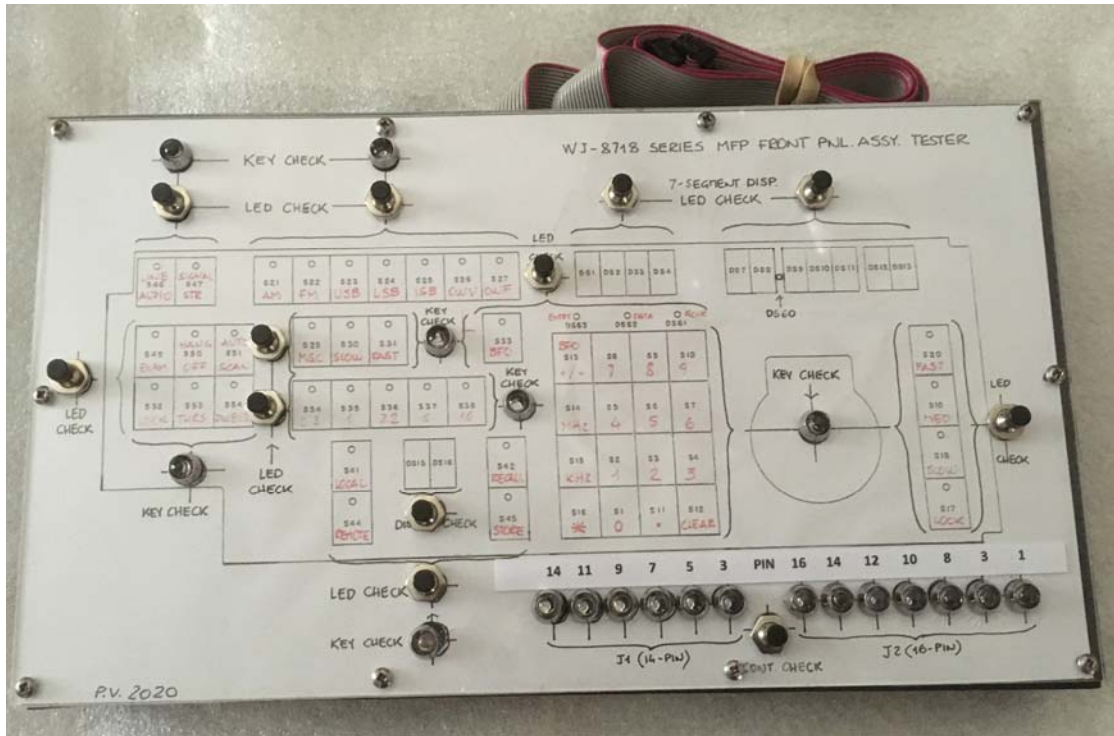


Figure 21/a: The *MFP Tester* front panel once assembled (from front).

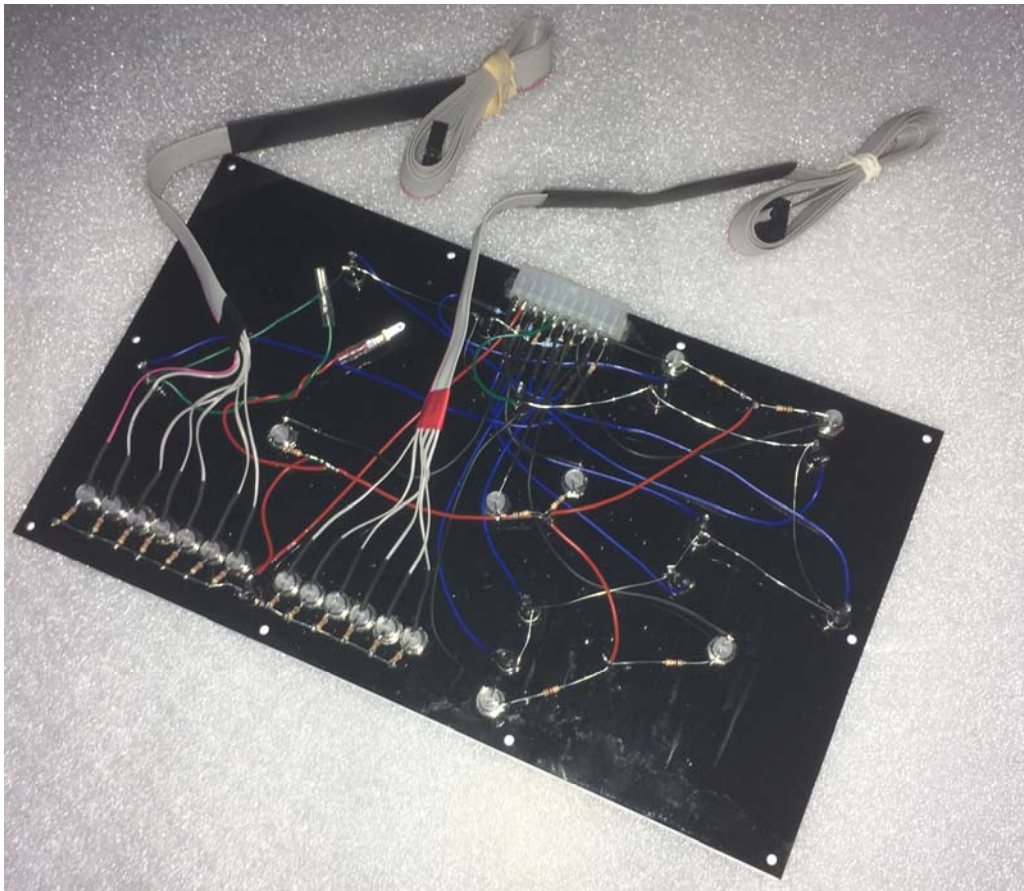


Figure 21/b: The *MFP Tester* front panel once assembled (from rear).

I housed the *MFP Tester Main Unit* in a cheap wooden case (pictures and drawings in Figures 22 and 23), but really the choice is up to you. As for me, the wooden case is provided with rubber feet and removable wooden wedges (fastened by self-adhesive *Velcro* to the bottom of the case) for ease of use, and a 12V DC Input socket is placed on the right.

Of course my prototype box required some adjustments (milling some internal points), but the results seem to be quite acceptable.

The front panel of the Tester was finally fastened to its wooden rear box using 10 x 2.8 mm – 1 cm. length self-tapping chrome-plated screws on its perimeter.

Just for info, I employed 1N4007 Diodes and 5-mm. green LEDs thoroughly (as I have plenty of them); of course, also 1N4148 diodes and other size and color LEDs can be used.



Figure 22: A picture of my black-painted wooden case for the *MFP Tester Main Unit*.

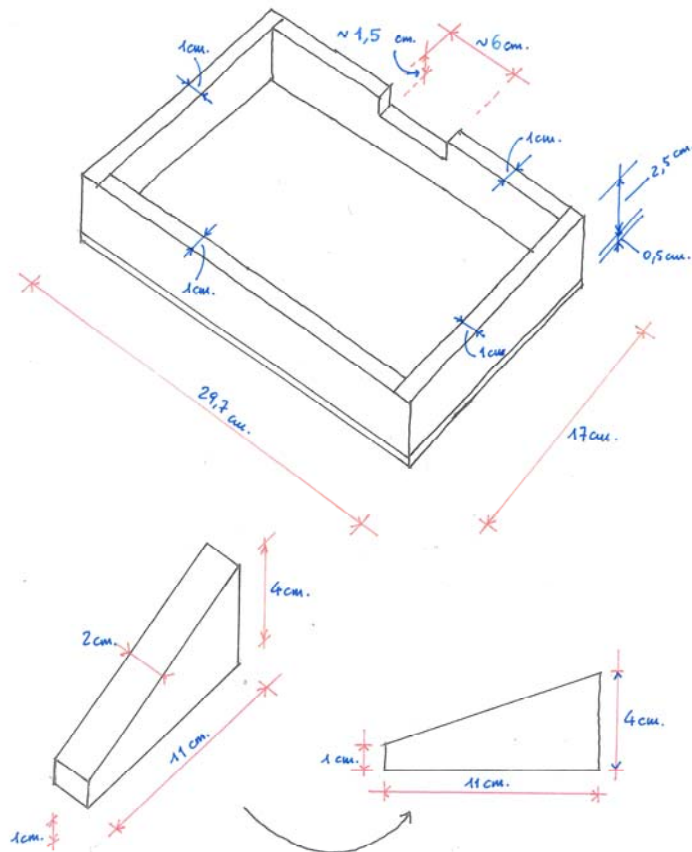


Figure 23: A rough sketch of the wooden case and wedges. The slot in the upper sides allows room for the 20-contact Molex “Mini-Fit Jr.” plug and socket and for the two flat (16 and 14 contacts) ribbon cables. A hole in the right side (not shown) hosts the DC Input socket, all the quotes are in cm.

#### 4) - The external DC PSU

As for the external PSU, I used a cheap switching-type regulated DC (12V-1A) wall power supply that I found on the Internet (Figure 24) and I had no problems until now. The current drain is very low in any case and any 12V DC PSU allowing a current of about 1A may be used.



Figure 24: The cheap regulated 12V DC PSU I currently use.



### Directions for use

The use of the MFP Front Panel Tester is very simple and it can be used both on existing MFP receivers (in this case it is advisable to disconnect the receiver from the AC Line first and - but this is not mandatory - to detach momentarily the Front Panel Assembly from the receiver chassis in order to gain some room) and on stand-alone MFP Front Panels.

In any case you have to unplug and set apart the original MFP-A1A1 *Front Panel Encode* card 796056-X (that is placed just behind the receiver front panel) and the two 16 and 14 pin ribbon cable plugs (MFP-P1 and MFP-P2) from J2 and J1 on the MFP-A1 PCB ([5] and Figure 25 here).

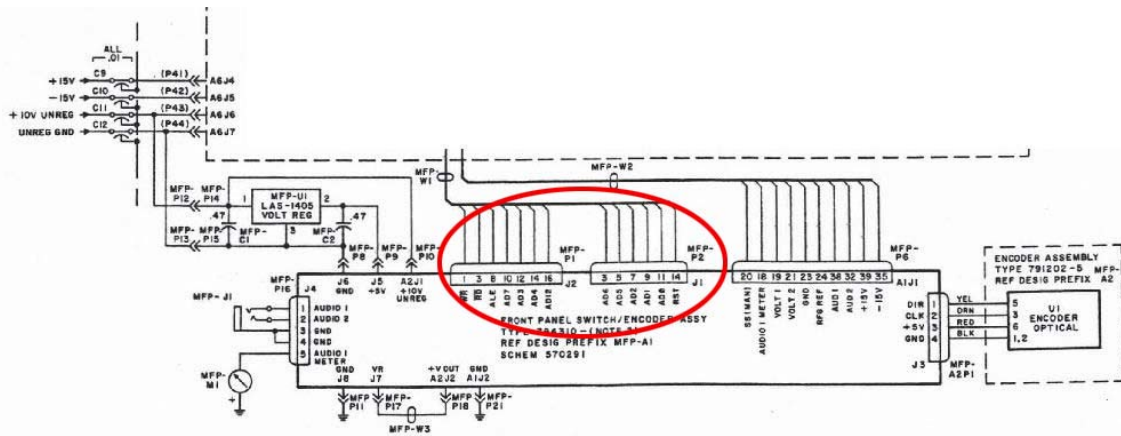


Figure 25: The two 16-pin and 14-pin ribbon cables going to J2 and J1

After that, carefully connect the *PCB Probe Card* to the *Tester Main Unit* using the 20-pole cable terminated with Molex connectors at both ends; then insert the *PCB Probe Card* into the two sockets (reserved for the MFP-A1A1 cards) that are located behind the receiver front panel (please notice that the front side of the *PCB Probe Card* has the Molex connector at its right).

Place the *Tester Main Unit* on a convenient place at the right of the radio and conveniently route the two 16 and 14 pole ribbon cables coming from there into the receiver and plug their end connectors to J2 and J1 on the MFP-A1 small motherboard (the red wires of both the ribbon cables correspond to “pin 1”). Please ascertain that both the connectors are plugged correctly, Pin 1 of both J2 and J1 should be indicated by red dots on the MFP-A1 motherboard (to the right of the PCB seen from the receiver top).

Plug the DC connector of the 12V PSU to the DC Input socket of the *Tester Main Unit* (at the right side of the box) and insert the PSU into a wall AC power Socket.

If everything is OK (and if the MFP front panel is still attached to the receiver mainframe), Diode D60 on the receiver Front Panel will lit (it will remain lit when the *Tester* is properly connected to an MFP Front Panel and during all the checks).

If the MFP front panel under test is *stand-alone* instead (i.e., detached from the receiver mainframe), D60 will remain always turned OFF.

[Notice: if you prefer to have DS60 always lit in any situation, please connect pins 41 and 42 (at left of the PCB Probe Card) to the GND line (pins 3, 5, 7 and 9 at rear left of the same Probe card, look at Figure 4 and at the MFP-A1A2 *Front Panel Switchboard* schematic, [6] and Figure 3/b above). These permanent GND connections allow the DS60 LED to be always lit].

For checking all the buttons on the receiver front panel, just push them (*one at a time*); if the corresponding key contacts are good, a LED will lit on the *Main Unit* of the *Front Panel Tester*.

You can also check all the LEDs present on the receiver front panel (7-Segment displays, Key LEDs, stand-alone LEDs) by simply pressing a momentary switch on the *Front Panel Tester Main Unit*, the writings on it should be self-explanatory.

It is greatly recommended to proceed to the various checks by pushing each button (on the receiver and/or on the Tester front panel) *one at a time*.

About checking J1 and J2 continuity, it must be noticed that each LED of the two adjacent 6 and 7 rows on the bottom right of the *MFP Tester* front panel corresponds to one of the used J1 (14-pin) and J2 (16-pin) contacts. All the active contacts have been numbered descendingly from left to right, i.e. their order is:

For the left row (J1-14 pin): 14, 11, 9, 7, 5, 3 from left to right;

For the right row (J1-16 pin): 16, 14, 12, 10, 8, 3, 1 from left to right.

Thus any LED that should remain off on the Tester indicates no continuity on the corresponding J1 and/or J2 pins (interruption of a PCB track in the MFP-A1 *Front Panel Interconnect* board or other failure that can be easily investigated)

In any case a complete check of an MFP front panel using this Tester requires a few minutes only, and after that you will be able to locate and fix any possible issue.

For simplicity's sake, this *MFP Front Panel Tester* was not deliberately provided with circuits for checking the *Rotary Encoder*, the *RF Gain pot* and the *audio circuits* located on the front panel PCBs of the receivers; all these components and stages can be easily and quickly checked with the help of the MFP-A1 *Front Panel Interconnect* board schematic ([7] and Figure 3/a above).

In order to confirm that this tester can be used for checking all the various types of WJ-8718/MFP front panels, Figure 26 shows the device connected to a WJ-8718-19FE front panel (the S/N 34 from my collection) during a 7-segment frequency display check.

As noticed above, the DS60 LED remains turned off as the MFP panel under test is *stand-alone*, i.e. it is fully detached from the receiver mainframe.



Figure 26: During a check of a WJ-8718-19FE front panel.

***Some short notes about building the MFP Front Panel Tester***

First of all, I recommend to pay a great attention to the wiring and also to check its correctness several times (also the right polarity of the LEDs and the resistor values have to be checked in order to prevent any possible error): if a tester is not correctly assembled, how could it test anything?

About the wiring, any insulated (*rigid* or *braided*) copper wire can be used; I recommend colored wires according to the schematics for ease and clarity anyway.

As for gluing the Molex male connectors to the *PCB Probe Card* and to the *MFP Tester* front panel, they are made of Nylon and a special glue (for Nylon and PTFE) is required; a number of proper glues (bi-component or not) is currently available on the Internet however.

Of course all the usual precautions in building electronic circuits have to be used, including checking the right polarity of the DC Input socket from the external PSU.

About the required *PCB board* and *Main Unit front panel*, I guess anyone who is interested could provide by himself (sincerely I do not believe that is cheap enough to order from abroad those parts to the Italian firms listed in the References, but an attempt to contact them could be worth doing, as they have retained all the constructional drawings and files and probably are able to charge for quite affordable prices).

I sincerely hope that the present paper is useful to as many WJ-8716/8718 users as possible, please contact me at [uviappiani@tin.it](mailto:uviappiani@tin.it) for any question or request.

Best 73,

Paolo Viappiani, September 2020.

**Notice:**

In order to allow a better readability of the most important diagrams and pictures, in this article the Figures do not always appear respecting their progressive numbering. Sorry for the drawback.

**References:**

[1]: cfr: [http://watkins-johnson.terryo.org/documents/hobby-tech-articles/WJ-8718-Field-Install-PRE-\(Paolo-Viapianni\).pdf](http://watkins-johnson.terryo.org/documents/hobby-tech-articles/WJ-8718-Field-Install-PRE-(Paolo-Viapianni).pdf)

[2]: PCB Direct Lab - Via Amerigo Vespucci, 30 - 19020 Bolano (SP), Italy – Phone: +39-0187-765523, +39-392-9130103, <https://www.pcbdirectlab.com/>

[3]: Plexishop - Global Engineering Network srl, Via A. Volta n.23 - 31030 Dosson di Casier (TV), Italy – Phone: +39-0422-383939, <https://www.plexishop.it/it/plexiglass.html>

[4] All the required Molex parts are currently available also on eBay (items 202801311825, 202985382758 and 202150401307) from the UK seller *vuelectroniccomponents*, or can be purchased directly from their online shop of Manchester, UK (mail: [order@vuec.co.uk](mailto:order@vuec.co.uk))

[5]: Look at Figure 75 of Ref. [1] (Figure 25 above).

[6]: Look at Figure 67 of Ref. [1] (Figure 3/b above).

[7]: Look at Figure 76 of Ref. [1] (Figure 3/a above).