DIY
HP-IL Device Connector
Part 2

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Device Connector

It was broadly found that the pin holes in the device connector were too small (especially for crimped pins) and that they would need to be reamed out. As with the cable, the rule of thumb is to create pin holes of a size that when the pins are tentatively inserted up to the crimped part, they have a 'sticky' feel. When this occurs a suitably 'interference' fit has been drilled (probably!), using a pair of tweezers can then be pushed home to the correct depth.

The sintered form of the device connector is very hard and to ensure a good 'interference' fit for the connector pins the pin holes required some vigorous (yet very careful & incremental) reaming and repeated testing of the pin fit making sure not to make the hole too wide!

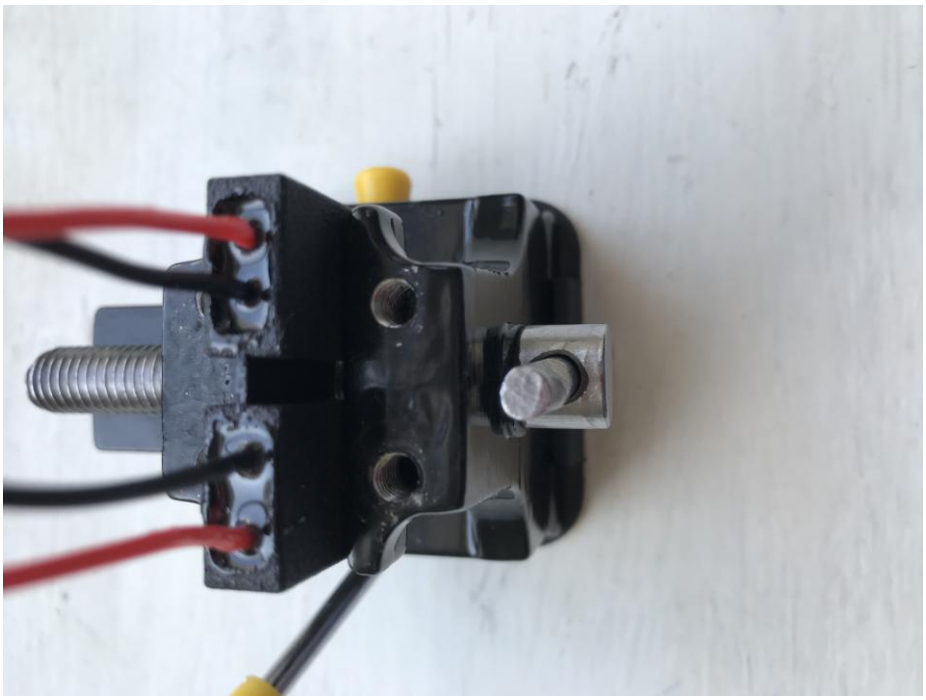
Pin/Cable Preparation

For the female pins strip ~6mm of bare wire
For the male pins strip ~ 3mm of bare wire
Wire - 4 pieces of silicone wire 6.5cm long per device connector

For pin insertion details see the 'Pin Insertion' procedure described in the HP-IL cable section. Use the more flexible silicone wire cut to ~6.5cm long for each pin to cater for the longer path to the PIL Box PCB connections.

If a pin needs to be removed from the connector (for example if the wire breaks off) before the pins are glued in, please refer to pin retraction described in the HP-IL Cable section.

Use the Epoxy syringe to 'inject' glue into the well of the device connector housing. Wiggle the wires to ensure the glue goes all around them and evenly in the well of the housing.



PIL Box Modification

The PIL Box case needed significant modification to cater for the size of the device connector housing as described below. In this case the PIL Box PCB came fitted with wire terminals that also prevented the device connector housing from being fitted.

PCB & Case

The device connector housing size meant that the PIL Box PCB wire terminators and case screw pillars prevented the device connector housing from fitting in the PIL Box case.

To accommodate the device connector housing, first the wire terminators need to be removed (the wires from the device connector can be directly soldered to the PIL Box PCB). Then use the modelling drill to cut away about 2/3rds vertically and just over 1/2 horizontally of the two cover screw pillars at the wire terminator end of the PIL Box case or remove them completely as the screw pillars cannot be used once the device connector has been fitted.

The picture above shows the screw pillars (right) cut away to allow space for the device connector housing, the PCB still rests nicely on the smaller posts.

Top cover modification

The screw pillars on the other half of the case also need to be removed down to the level of the adjoining strengthening rib or removed completely as again they cannot be used after fitting of the device connector housing.

The picture above shows the other case half of the PIL Box that also needs the screw fixing posts to be reduced or removed to allow for the device connector.

The PIL Box modifications are somewhat rough & ready but they work!

Next, the base plate of the device connector is slightly wider than the PIL Box case side panels so use the modelling drill trim the sides of the PIL box case back accordingly to accommodate the device connector base plate and square up the corners for a neater fit of the device connector base plate. This is important as the front panel needs to locate properly in order to complete the PIL Box end plate & device connector assembly.

End Plate

The PIL Box End Plate (HP-IL connection end) needs to be modified with a slot into which the device connector will be inserted. This requires determining the position & size of the slot than cutting the slot in the end plate for the device connector. There are two strengthening ribs on the back of the PIL Box end plate that co-incidentally can be used to locate the position of the slot as these strengthening ribs fit exactly between the two halves of the device connector housing.

Position & Slot size - Use the modelling drill or a needle file trim back the strengthening ribs ~6mm or until the device connector housing can be located centrally with maximum end plate material around the position of the device connector housing. Use a fine draughtsman's pen or scalpel to accurately mark the outline of the device connector housing.

Slot Cutting - Use the modelling drill to incrementally drill out around the outline of the device connector housing well on the ***inside*** of the outline! Then use a flat needle file to trim the slot to the exact size of the device connector housing. Be cautious with drilling right through the end plate as the plastic will melt and clog the drill bit, instead use small dabbing movements to gradually drill through the plate.

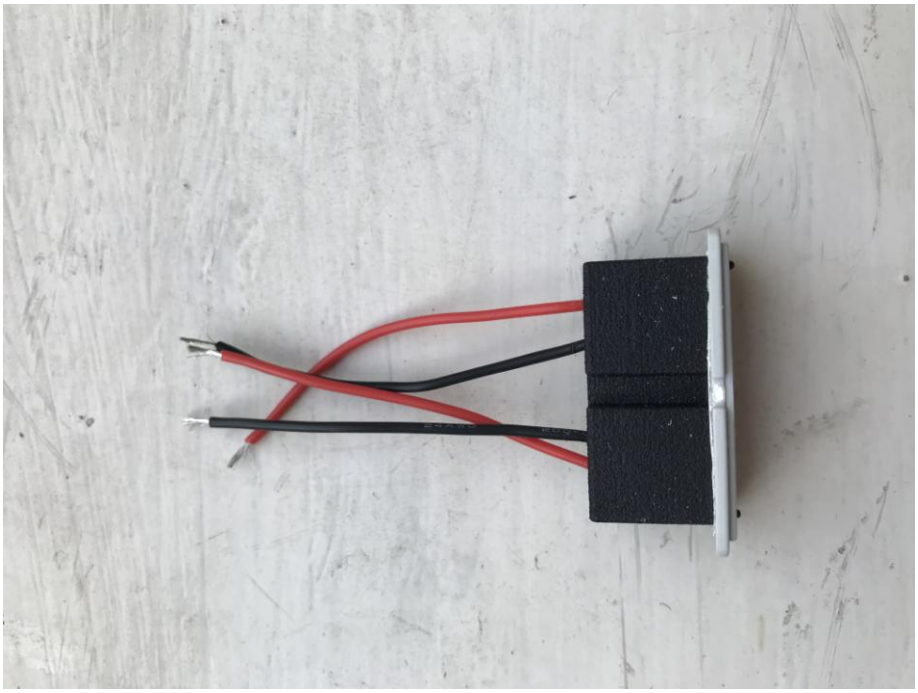
When performing the above operation locate the plate in a small modelling vice to make it easier to drill and file however take into account the vice 'flattens' the curved top of the end plate so take the end plate out regularly to check the 'squareness' of the slot.

Device Connector Assembly

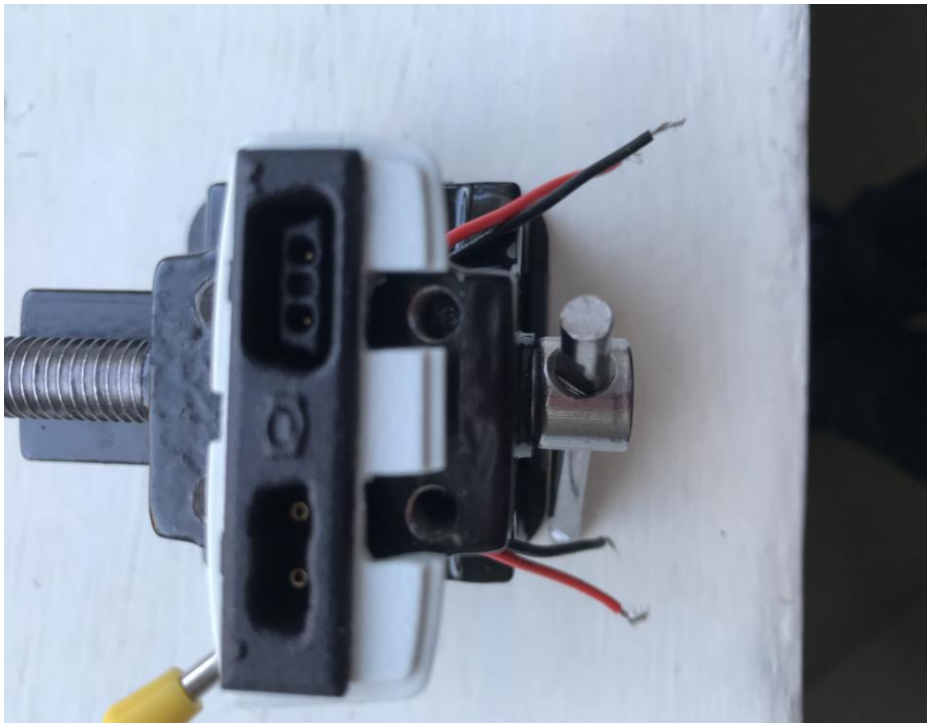
This is a 2 part process first fixing the device connector into the PIL Box end plate slot followed by attaching the device connector base plate to the device connector & PIL Box end plate. Note the 2 small locator lugs on the device connector and the device connector front plate. These locator lugs will be used to mate with and locate the device connector base plate to the PIL Box end plate/device connector assembly later.

Carefully insert the device connector into the end plate slot (should be interference fit) so the device connector is held by the PIL Box end plate. Make sure the device connector is the right orientation! Use the DIY HP-IL Cable document and PCB polarities as reference to the device connector orientation.

Use the 2 part epoxy to mix some hardener and resin and apply around the device connector & PIL Box end plate where they meet.

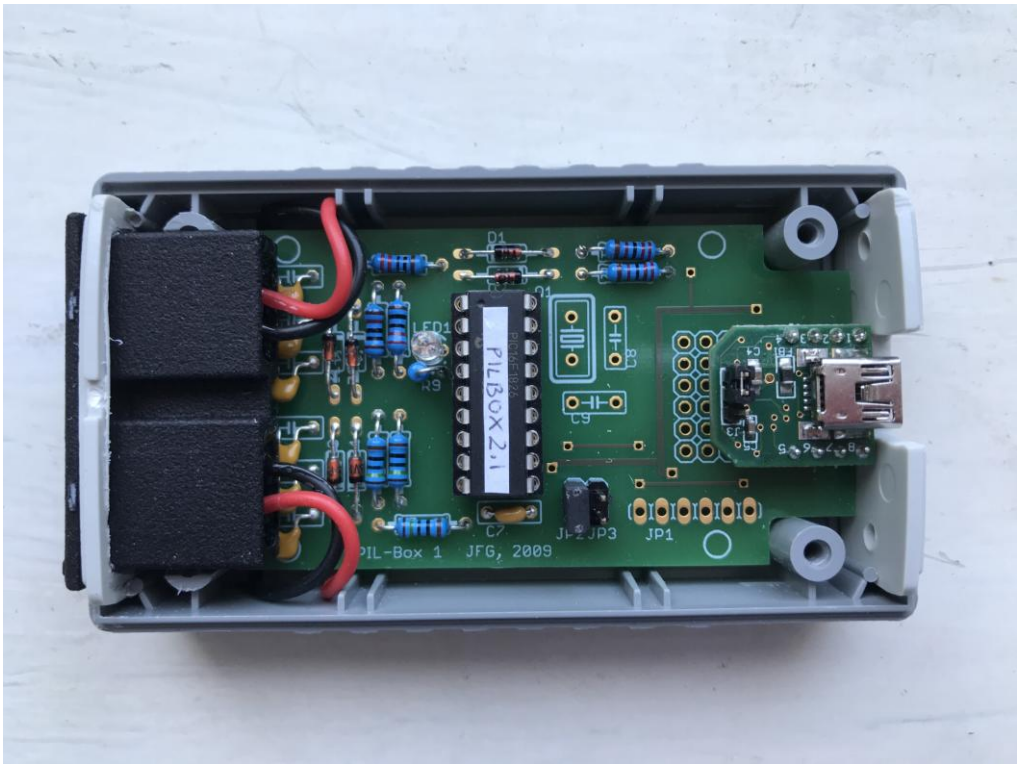


The picture above shows the device connector housing inserted into the PIL Box end plate slot created earlier. Note the device connector base plate location lugs poking just past the PIL Box end plate. When dry, place the assembly in the vice and locate & glue the device connector base plate on to the front of the PIL Box end plate.



The picture above shows the device connector base plate fixed to the PIL Box end plate with the device connector housing behind (mounted in the modelling vice for display purposes). When dry, remove the PCB from the case and solder the device connector wires to the back of the PIL Box PCB then reassemble device connector & PCB back into the case ensuring the wires go past the PCB sides.

The Result



The picture above shows the assembled device connector installed into the PIL Box case. The device connector wires are soldered into the back of the PCB and guided around the various spigots & strengthening ribs of the PIL Box case. The wires need to go down between the edges of the PCB and the case as there is no room directly under the device connector housing. They will be a bit fiddly to place and a pair of tweezers to manoeuvre the wires in place while getting the PCB to sit properly will help greatly.

Front View

The picture above shows the device connector fully assembled in the PIL Box. HP-IL cables can now be plugged directly into the PIL Box (the original end plate cut outs for the wires can still be seen)! The picture for some reason looks a bit wonky this may be because the case at this end is no-longer clamped down with screws, but it looks much better in real life!

Project Summary

The project was a great success with the primary aim of creating a device connector for the PIL Box with a bonus of creating 2 new HP-IL cables! The project has demonstrated a viable way, at a cost less than purchasing old equipment (mostly), of creating HP-IL device connectors (the missing part in being able to re-create real HP-IL hardware systems). With the PIL Box in-conjunction with the V41 & the PIL-IO board it is now a real possibility to create whole real & virtual HP-IL ecosystems once again!

Furthermore, device connector creation required much less detailed and/or intricate work, however it took about 1/2 hour vigorous (but careful) reaming of the pin holes to create a suitable fit for the crimped connectors otherwise the actual creation of the crimped wires/pins and insertion took just a few minutes. After epoxy potting, it is well worth waiting a good 24hrs for the epoxy to harden adequately.

The 3D HP-IL cable male connector doesn't 'snap' into the female 3D device connector half instead only slid in (but reasonably firmly), continuity tested OK. This may be due to the 3D resolution and/or quality of the 3D parts (the male connector pair snapped together).

If someone can convince Swiss Micros to include real HP-IL on the proposed DM41X then we could have a 21st century solution to the continuing use of the fantastic HP-IL protocol!

Upside

The 3D printed device connector housing is almost a perfect way to easily create a HP-IL connection mechanism especially if space is not an issue e.g. fixing to a chassis bracket. The device connector creation was surprisingly easy and I recommend this approach to anyone needing a device connector.

Downside

Fairly serious modification of the PIL Box case halves and the device connector end plate was required. The modifications meant that the PIL Box cover is now only held by the 2 screws at the USB connector end however this could be supplemented with some clear tape wrapped round the body at the 'device connector' end to help with a firmer yet removable fixing mechanism.

Getting the HP-IL cable end caps to fit & glued to their fitted position quite difficult in fact they failed fit properly but may be better on the 317th cable! I think some form of jig to hold them in place is needed. Breaking news! - It is only now I realised the modelling vice had some round screw-in plastic grips that could have been used as a jig to hold the cable connectors during gluing (I removed them for the main task!). Oh well next time!

Potential Improvements

The device connector housing could possibly be made ~2.5mm shorter making it easier to fit in the current PIL Box design and avoid having to bend the PCB capacitors away from interfering with the device connector housing.

Further research into the different 3D print materials and accuracy could resolve the reaming and pin insertion issues enabling device connectors to be created more easily and faster!

The PIL Box end plate could be 3D printed with a pre-fabricated device connector slot removing the need for the original cable cut outs increasing the PIL Box professional finish.

Finally, the device connector housing design could possibly be offered in another version to include a flange for screw mounting to metal or any other type of chassis mounting.

The Device Working!

Finally the picture below shows a PIL Box working directly connected to original HP-IL cables from a HP-IL module in a working (just) 38 year old HP-41CX!

The result is a neat, fairly robust connection solution to the PIL Box and potentially any other device that needs an HP-IL cable compatible connector.

I hope this inspires or encourages people to 'have a go' if they need HP-IL device connectors or cables, with a bit of hard work it certainly works!

Tools & Materials Required

Cable & Connector Pins
Cable & Device Connector 24 AWG Wire
Wire Cutters
Tweezer Set
Needle File Set
Knipex Crimping tool
Modelling Drill c/w 1.5mm drill
Model Makers Vice
Soldering Iron + Solder etc.
3g Epoxy Resin Syringe
2 Part Epoxy Resin Pack
Multi-Meter

Note: The 3g Epoxy Resin Syringe only comes with a single nozzle. This is sufficient if only creating a single cable and/or device connector while the nozzle greatly helps epoxy delivery into the cable & connector housings but the syringe solution can be somewhat wasteful (choose the syringe size carefully!).

Project Costs

The costs of purchasing all the materials, tools and components was a bit expensive just for 2 cables and 2 device connectors (partly because I had none of the materials, tools or parts!). However, I can now make as many HP-IL device connectors/cables as required.

Item	Supplier	Part No.	Cost
10 x Male Pins	Mouser.co.uk	965-031-9540-000	£11
10 x Female Pins	Mouser.co.uk	965-030-9542-001	£8
2 x Device Connector Housings	Trinckle.com	None	£30
2 x Cable pairs (2 cables)	Trinckle.com	None	£30
1 x Modelling Drill	Amazon		£8
1 x Knipex Crimper Tool	RS Components (uk.rs-online.com)	2601548	£27
1 x Set Tweezers	Amazon		£10
1 x Set of Needle Files	Amazon		£5
1 x Modelling Scalpel	Amazon		£3
1 x Yakamoz Model Makers Vice	Amazon		£8
33' Red/Black 24 AWG zip wire	Amazon		£5
10' Silicone Red & Black 24 AWG ultra flexible single wires	Amazon		£9
1 x 3g Epoxy Resin Syringe	RS Components (uk.rs-online.com)	7396923	£4
1 x 2 Part Araldite Crystal Epoxy Resin Pack	Amazon		£5
TOTAL			£163.00

Note: Prices exclude tax & delivery charges (£ = UK pound sterling)

The quantities above enable 2 x HP-IL cables & 2 x device connectors to be made.

Unit Costs

The unit costs have been calculated on the material costs only (add tool costs as required). The total material costs came to ~£100 for 2 sets of cable connectors and 2 device connector housings or 4 connector sets in total making each connector set ~£25 each. Not too bad a price (compared to eBay old equipment prices) apart from the (un-costed) labour!

Acknowledgements

DIY HP-IL Cable Guide - Martin Hepperle
3D STL Cable & Device Connector Housing Files - Martin Hepperle
IL Per - J-F Garnier & Christoph Giesselink
PIL Box - J-F Garnier
V41 - Warren Furlow

Many thanks to Martin Hepperle in providing modified STL files to meet the 3D manufacturer's requirements and effectively made this project possible.