

# **DIY HP-IL Device Connector**

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## Introduction



This document describes a project to investigate the DIY creation of an HP-IL device connector with the ultimate aim of integrating a device connector into the PIL Box (to avoid cutting original HP-IL cables and to hopefully provide a 'neater' solution) and ultimately (if successful) provide device connectors for other hardware devices such as the PIL-IO or even original equipment that may have damaged or have missing device connectors.

Initially the project was only to create device connectors, but 2 HP-IL cables were also made.

After initial investigation and consultation of Martin Hepperle's informative DIY HP-IL Cable Guide and with some initial issues with the STL files needed by the 3D print provider, 2 sets of both the 3D device connector & cable housings were ordered on the basis that one would probably go wrong and that 1 or 2 HP-IL cables would be needed as test harnesses.

The STL file issues turned out to be 2 fold, the 3D print provider required the parts in each file to be 'connected' and the original device connector STL file was too big for the 3D print provider. Many thanks to Martin for being able to quickly supply modified STL files with the connected parts as required by the 3D print provider and a reduced resolution device connector STL file to reduce the device connector file size!

Initial tests with soldered wires & pins showed the capillary action (as indicated in Martin's DIY Cable document) caused solder to enter the female pin rendering the pin useless. I had no way of resolving this so crimping was investigated. However crimping was only viable if a low cost crimping tool could be sourced. After some research a suitable crimping tool was sourced from RS Components (see Project Costs later).

Next was to consider how to 'fix' the pins & wires in the device connector & cable housings. The only practical solution seemed to be epoxy resin but some practical means of delivery into relatively small cavities was also required. To this end syringe type epoxy resin dispensers with nozzles seemed a suitable solution.

The required connector pins (as defined in Martin Hepperle's DIY HP-IL Cable Guide) were sourced from Mouser (see Project Costs later)

With the 3D parts & pins sourced, crimping solved and the epoxy delivery mechanism determined the project was now on!

## 3D Printing

2 x sets of cable connector & device connector housings were ordered through a company called Jomatik (formerly Trinckle). This company was primarily chosen because it is the same company (Trinckle) successfully used by Martin Hepperle to create his own DIY HP-IL cable and therefore had some sort of known track record.

For further details on 3D printing please see Martin Hepperle's DIY HP-IL Cable document.

Ordering simply required dragging & dropping the 2 STL files to the WEB interface and then specifying the quantity for each (in this case 2). The WEB interface also allows the type of material to be used and again the same materials as Martin's original was chosen as a known route. The material chosen for the device connector housings was sintered polyamide (coloured black) and ABS for the cable connectors (only option white).

## *Post Production*

The device connector 3D print seemed clean & precise with only the base plate showing some accuracy/resolution issues. Real HI-IL cable connectors were used to check initial location compatibility and male & female connectors snapped perfectly into place!

The cable connector 3D print was more variable, the layers could be seen, the material at the connector front had diverged slightly and the interfaces where the connector & end cap meet were a bit rough however, none of these issues prevented creating usable connectors.

The 3D parts arrived as 'connected' parts and needed to be cut apart to create their individual parts and the excess trimmed off using a needle file or modelling drill.

The connector pin holes of both cable and device connector housings needed 'reaming' to create a suitable 'interference' fit for the crimped pins.

The HP-IL cable end caps & housings needed significant re-working to get them to 'sit' together. This required careful 'milling' of the mating lips using a hand held modelling drill in order to get the two halves to mate. This work is essential to be done before creating the cable i.e. crimping, pin insertion & gluing etc. as it is difficult to do afterwards and risks damaging the connectors & cable etc. This operation took around 1/2hr per item to get them to mate as accurately as possible.

## HP-IL Cable

For more details on creating HP-IL cables please refer to Martin Hepperle's DIY HP-IL Cable document. To make it easier to identify the plus & minus cable polarities and to avoid crossing the cable a 2 color (red & black) dual zip wire was used.

The crimping tool required significant force to get a good crimp and it was found that to get the best result a second crimp was needed on the 'other' side of the cable i.e. rotating the cable around 180 degrees and re-crimping at a slightly different point from the 1st crimp.

### *Cable Preparation*

Cut the cable to the desired length. Feed the end caps onto the cable ensuring that they are in the correct orientation to mate correctly with the connector housing and that the cable is not twisted i.e. when connected at each end the same wire connects to itself.

### *Pin Crimping*

Carefully strip each end to about 6mm bare wire for the female pins and 3mm for the male pins. Make sure that both ends of each wire are near the same length so that each connector can be inserted with the wires emanating straight out of the connector housing.

Twist the bare stripped ends to make insertion into the ferrule of the pin easier then carefully insert the bare wire into the ferrule making sure that all strands are inserted. Keep the wire and connector pin vertical with slight pressure on the pin to ensure the wire remains fully inserted in the pin ferrule.

If using the Knipex crimper place the wire and connector in the smallest crimping part (marked .25 & .50). When absolutely sure the wire & pin is correctly aligned in the jaws of the crimper tool, close & press the crimper tool handles VERY hard for ~5 seconds.

Open the crimper tool and very carefully prise the connector from the jaws (the pin & wire will be stuck to one side of the jaws). Note the orientation of the crimped wire & pin and rotate the crimped wire & pin assembly 180° move the wire & pin very slightly up or down to create a second crimp on a slightly different part of the pin and crimp again.

### *Pin Insertion*

Pin insertion will need a certain amount of judgement and 'feel' as to how and when the crimped wire & pin can be fully inserted into the connector housing. The crimping 'flattens' the round pin making it harder to insert into the pin hole but also provides a 'interference' fit that locates the pin in the hole. There is a very fine line between the size of the hole and providing an 'interference' fit that will hold the pin in the hole and allow it to be adjusted to the required depth (Martin Hepperle's DIY HP-IL Cable Guide offers some advice on the depth of insertion or use an original HP-IL cable to gauge the required depths if possible).

To insert the pins, use a pair of tweezers to insert each pin into the hole at the back of the connector housing. Initially this will just be a test insertion to feel how 'sticky' the pin hole is, do not press the connector pin fully home immediately as the pin hole may not be wide enough to allow the pin to be fully inserted to the required depth.

If the wire & pin cannot be inserted far enough use the tweezers to withdraw the crimped wire & pin and use the modelling drill to very slightly modify the width of the hole and re-try again feeling for the 'stickiness' of the pin hole. Repeat this procedure until the crimped wire & pin can be inserted with an 'interference' fit to the required depth using firm pressure.

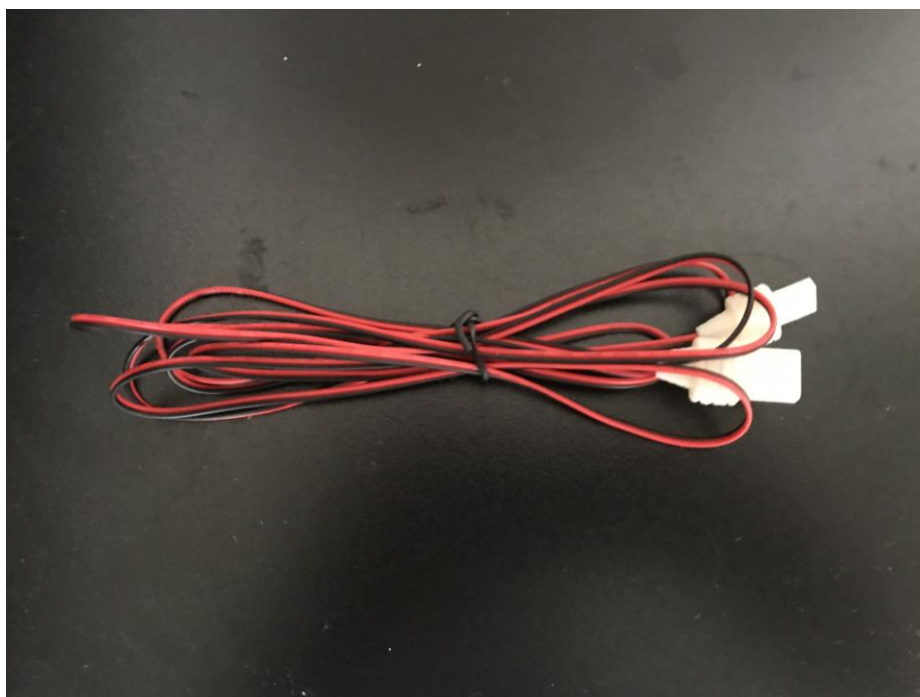
The above pin insertion procedure also applies to the device connector.

Warning! Be absolutely sure the crimped wire & pin can be inserted to the required depth before full insertion. There is a danger the crimped wire & pin cannot be retracted and if not, the connector housing will become unusable.

Note: For the female pins retracting is made easier because the closed tweezers can be inserted into the pin hole (from the front) and used to push the crimped wire & pin back out from the front of the connector. If the male pin needs retracting use a small flat ended jewellers or ordinary Allen key that fits neatly into the front of the pin hole to push the pin out.

Finally, clamp the connector housing in the modelling vice and use the 3g Epoxy syringe to 'inject' glue into the body of the connector housing. Wiggle the wires to ensure the glue flows around them and is evenly spread in the housing well.

### ***The Completed Cable***



### ***Cable Testing***

Testing each cable was performed by plugging in one end of the cable into a pre-made device connector (see below) and using the multi-meter to check continuity from the device connector wiring to the other end of the cable and was repeated for the other cable connector. This test confirmed continuity for both the cables and the device connectors.

