IDC Cable, Headers & Connectors

Confused about IDC cable and connectors? Here's a quick rundown on the way they work, and how they're used.

IN THE OLD DAYS of electronics, most cables used only a small number of wires and the connectors (plugs and sockets) needed only a small number of pins. It wasn't all that much hassle to connect the wires to the connector pin lugs, usually by hand soldering.

But as electronics developed and equipment became more complex, the number of wires needed in cables tended to grow as well. By the time the personal computer or 'PC' appeared around 1980, cables with 25 or 50 wires were quite common, needing connectors with the same number of pins.

Soldering all of the wires to the connector pin lugs had now become quite fiddly and time consuming, and the poor reliability of tiny hand-soldered joints was also becoming apparent. Many faults tended to be caused by dry joints, accidental short circuits between joints in connectors, overheating, broken wires caused by over-zealous insulation stripping and so on.

Engineers therefore started to develop alternatives to hand-soldered cable/connector junctions — not just to save time and money for manufacturers, but also to improve product reliability for the end user.

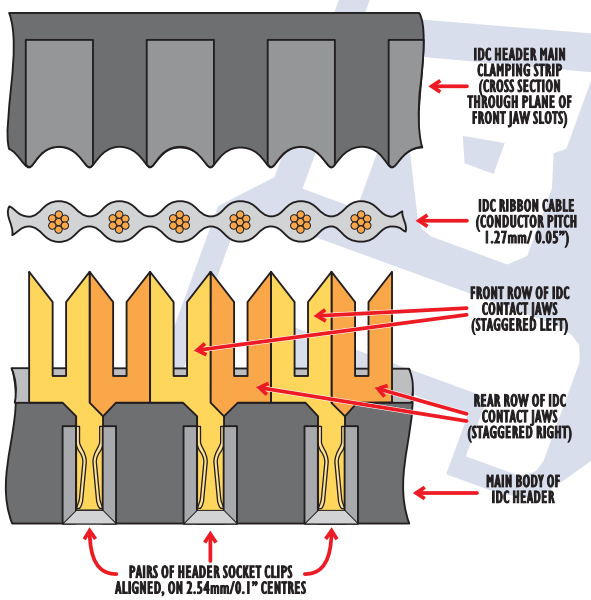
One of the more successful alternatives they developed was **insulation displacement** (IDC) technology, using a special type of cable (IDC ribbon cable) and matching connectors (IDC connectors and headers). As the name suggests, IDC technology is based on the idea of displacing or 'pushing aside' some of the insulation around the cable conductors (wires), and making a direct electrical connection that way. You can see how it works in the diagrams of Figs.1 and 2 below, which show closeup cross sections of part of an IDC header socket and cable, before and after assembly.

As you can see the back of each header socket clip is formed into a pair of tiny 'jaws', with a narrow slot down the centre. The tips of the jaws are cut at an oblique angle inwards, so they form a tapering 'mouth' for the slot. Also although the socket clips are arranged in pairs on 2.54mm (0.1") centres, the jaws of each clip in a pair are staggered in opposite directions so that the centre slots end up spaced at a pitch of 1.27mm (0.05"), in the direction at 90° to the cable wires (i.e., east-west in the diagrams).

Here's what 16-way IDC ribbon cable looks like. The insulation is all the same colour, but there's a coloured stripe down one side.

Just above the header jaws in Fig.1 you can see a cross section of part of an IDC ribbon cable. Notice that each conductor is made up of a number of small wires (often seven), and the ribbon's insulation is extruded with shallow grooves midway between the conductors, on each side. Both the conductor and groove spacing of the cable are therefore on 1.27mm pitch, to match the jaw spacing of the header.

Shown above the ribbon cable is the second main part of the IDC header, the main clamping strip. This has three important features, although only two of them



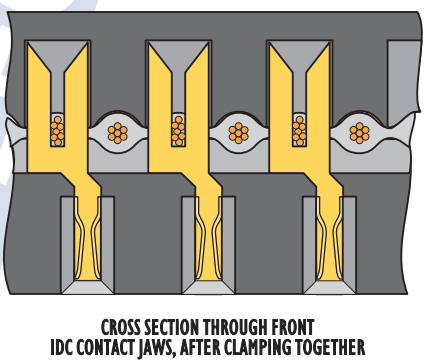
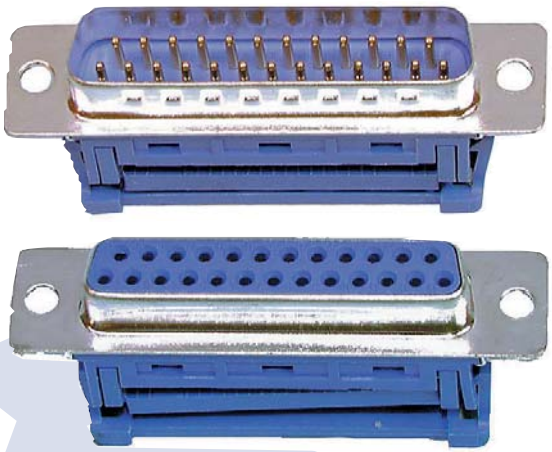


Fig.1 (left): cross section through an IDC header socket and ribbon cable, before they're assembled.

Fig.2 (above): the same socket and cable after assembly. The contact clip jaws have pierced the cable insulation and made good contact with the wires.

Above: Three IDC line sockets, of the type which mate with PC board mounting header plugs. In descending order they are the 50-way, 34-way and 16-way sizes.



Two 'DB' connectors of the IDC type: a DB-25 plug at the top, and a DB-25 socket below it.

are visible in Fig.1. One is that scalloped lower surface, which mates with the grooves in the IDC ribbon cable and therefore tends to hold the cable in position when it's all assembled. The other feature is a set of moulded narrow slots inside, each slot corresponding to the jaws of a header contact.

The remaining feature of the clamping strip is a moulded spigot at each end, which is designed to locate the strip accurately by mating with a moulded slot at each end of the header itself. The spigots also have a barb at their outer ends, to lock the clamping strip and header together once they're assembled.

To assemble the connector and fit it to the cable, the cable is laid on the top of the contact jaws with its insulation grooves carefully aligned with the jaw tips and the cable axis as close as possible to 90° with respect to the header axis (i.e., directly in and out of the paper). Then the clamping strip is fitted above the cable, with its locating spigots entering the slots at each end of the header. It's then gently pushed towards the header by hand, until the scallops on the underside of the clamping strip are sitting neatly in the grooves on the top of the ribbon cable insulation, to confirm that everything is aligned correctly. Next the assembly is squeezed together firmly, either in a small machine vyce or using a special compound-action hand tool.

As the squeezing takes place, the jaws of each header contact cut through the cable insulation in the narrow grooves, and the jaws themselves pass straight through the cable and up into the slots of the clamping strip. At the same time the wires of each cable conductor are guided down into each contact's jaw slot, which is narrow enough to force the wires together, and make good electrical contacts with the slot sides.

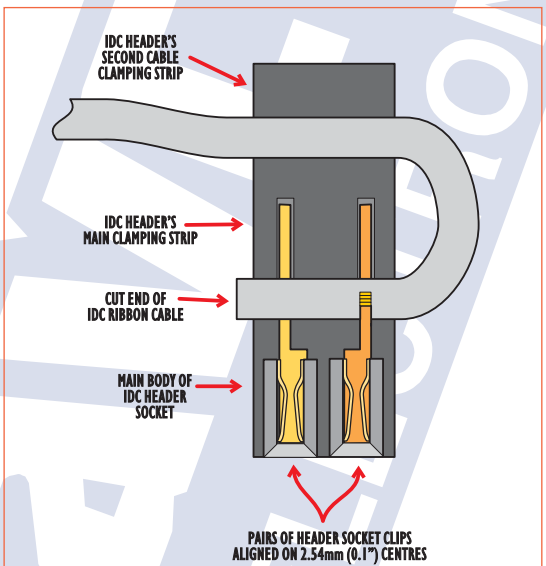


Fig.3: A side cross section of an assembled IDC line plug, showing how the second clamping strip is used.

By the time the squeezing process is completed (indicated by the barbs on the ends of the clamping strip spigots clicking into place), the wires in each cable conductor are firmly gripped inside its own header contact slot, making a reliable contact. At the same time the cable as a whole is firmly gripped between the header and the clamping strip, and the connector is properly assembled as you can see in Fig.2.

So that's the basic idea of an IDC connector and how it goes together, to make all of the connections simultaneously — and without soldering.

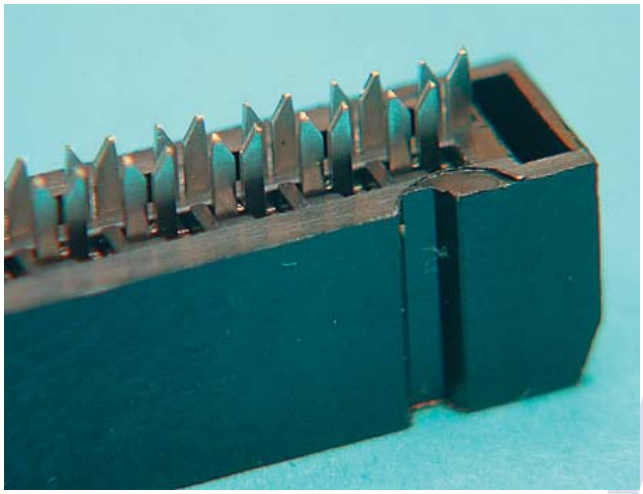
In many cases the IDC header or connector comes with a second clamping strip, which fits over the main clamping strip and is used to provide additional cable clamping. This second clamping strip also has locating spigots and locking barbs, but is only fitted after the main assembly. The ribbon cable is first bent gently back over the top of the main clamping strip, and then the second clamping strip fitted over it and pushed down over the top. When the locking barbs of the second clamping strip click into place, the assembly is complete and the cable even more firmly attached to the connector. The idea is shown at left in Fig.3.

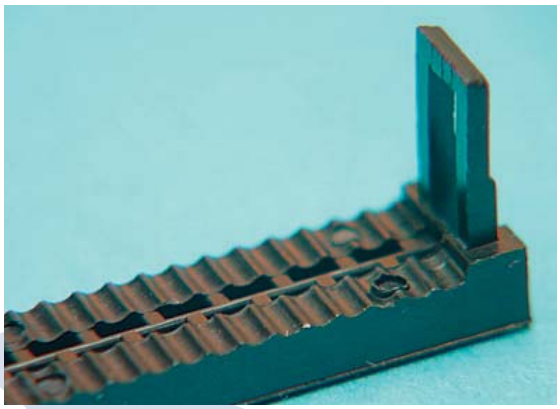
IDC connector types

Quite a few different types of IDC connector are available, each with its own applications.

For example there are male and female 'DB' connectors of the IDC type, used for making up printer and serial communications cables. You'll find DB-9, DB-15 and DB-25 IDC plugs and sockets in the Jaycar range, for example, along with 16-way, 26-way and 50-way IDC ribbon cable to suit.

You need to split off the unwanted ribbon conductors, to leave the required number for your application.





These closeup shots of an IDC line socket show the contact jaws (left) and the scalloped grooves in the underside of the clamping strip.

This is easily done by using small sidecutters to cut through one of the grooves in the ribbon at one end, after which the ribbon will readily 'pull apart' along that groove.

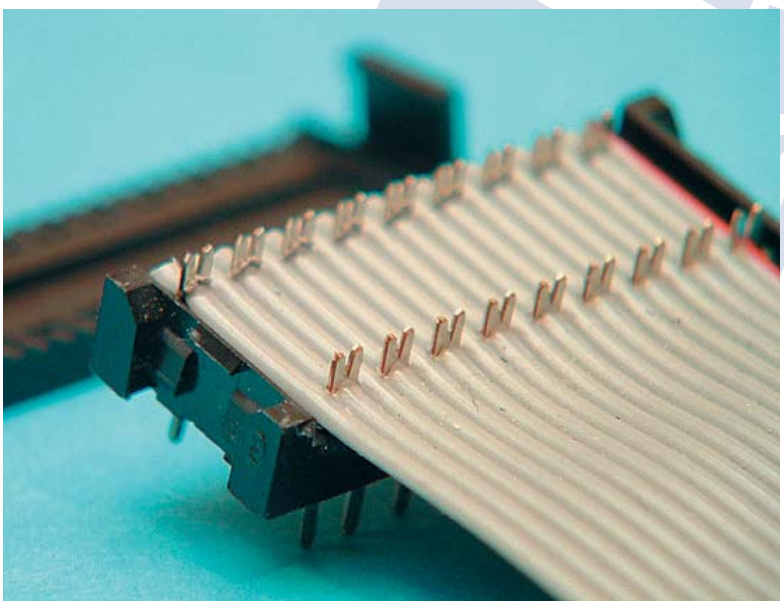
As well as DB connectors, there's also a range of IDC line sockets designed to mate with the multi-way 'header plugs' fitted on the PC board of many computer boards, disc drives etc. For example Jaycar stocks these IDC line sockets in seven different sizes: 10-way (2x5), 16-way (2x8), 20-way (2x10), 26-way (2x13), 34-way (2x17), 40-way (2x20) and 50-way (2x25). Needless to say we also stock the matching PCB-mount header plugs, in both vertical/horizontal and locking/nonlocking variations.

By the way these header plugs are often called 'IDC headers', but only because they are designed to mate with the IDC sockets. The plugs themselves do not use IDC technology; they're soldered directly to the PC boards.

True IDC header plugs are available, but mainly in a form designed to mate with DIL sockets of the same type used for ICs — i.e., with the two rows of pins and IDC jaws spaced 7.62mm (0.3") apart rather than 2.54mm (0.1"). For example Jaycar stocks the PI-6550 16-way IDC header plug, which mates with a standard 16-way IC socket.

Finally, there is one type of IDC connector which you may not recognise as such, even though it uses IDC technology. This is the 'clamp on' wire connector, used to make an insulated connection between two existing insulated wires, simply by placing it around the two wires and then clamping it shut.

This type of connector has a moulded 'clamshell' body, with two internal grooves for the wires and a single metal insert with two in-line IDC jaws (one for each wire). When you place the body around the wires and clamp it shut, the jaws cut through the insulation of both wires and make good contact with them both. At the same time the body locks together to form an insulating shell for the new joint.



A closeup of an 18-pin IDC header plug which had the main clamping strip removed again, to show the jaws passing through the cable. Note the two rows, for alternate wires.

So that's the main story about IDC cable and connectors. But to finish up, here's some practical advice so you'll be able to use IDC connectors and cable without problems.

Practical tips

1. Note that IDC ribbon cable is usually not provided with multi-coloured or 'rainbow' insulation, but with single-colour insulation — usually grey or white. However it also has a stripe of coloured ink or paint (red or black) down one side, to guide you with connector orientation. If you need to strip away some of the wires of a multi-way cable to suit the IDC connectors you're using, remove them from the side furthest from the ink stripe so it's still present on the cable.

2. It's usual to fit IDC connectors to the cable so their pin 1 end is on the stripe side of the ribbon. This also helps guide you when you're mating the cable connectors with those on the equipment, knowing that the stripe corresponds with pin 1.

3. Before clamping an IDC connector

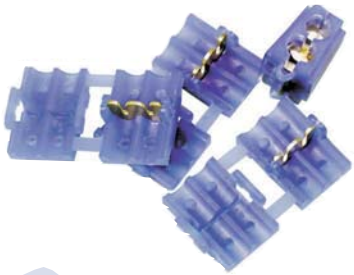
to a ribbon cable, make sure that the cable grooves are aligned with the contact jaw tips and that they are also aligned with the scallops moulded into the underside of the clamping strip.

4. Make sure too that the connector pin/jaw axis is as close as possible to 90° with respect to the ribbon cable wire axes. If the connector/ribbon angle is not close to 90°, some connections may not be made properly. If the connector is being fitted at the end of a ribbon cable, cutting the end of the ribbon cleanly square first will allow you to use it as a guide.

5. Try to squeeze the IDC connector and its clamping strip together as evenly as possible, so they remain as close as possible to parallel with each other during the operation. This too ensures that all joints are made correctly. The easiest way to squeeze them together evenly is by using a small machine vyce or a special compound-action clamping tool.

6. If an IDC connector has a second cable clamping strip, don't attempt to fit this as part of the main assembly. Assemble the main parts of the connector first on the ribbon cable, and only then fit the second clamping strip.

7. When you are bending the ribbon cable around before fitting the second clamping strip, don't pull it hard. This may loosen some of the connections inside the IDC connector. Just bend the ribbon around gently — a small amount of slack won't do any harm, and may in fact protect the IDC connections from strain.



They may not be called IDC wire joiners, but these 'contact connectors' use the same idea. They're for joining two insulated wires together quickly and reliably, without solder.

8. Whenever you are unplugging an IDC connector from a connector on equipment, never try to unplug it by yanking on the ribbon cable. This may easily loosen one or more of the cable/connector joints. Pull on the connector itself, or prize it out using a special extraction tool or a small jeweller's screwdriver.

If you follow this simple advice, your IDC cables should assemble easily and give many years of reliable operation.