How to modify a standard PC floppy drive to be used as a Yamaha MDR/EL floppy drive:

Many floppy drives in Yamaha EL organs and Music Disk Recorders (MDRs) are worn-out and failing.
Because the replacement drives on the market are very expensive, we have investigated the possibility to use the much cheaper standard PC floppy drives for use in Yamaha EL organs and MDRs.

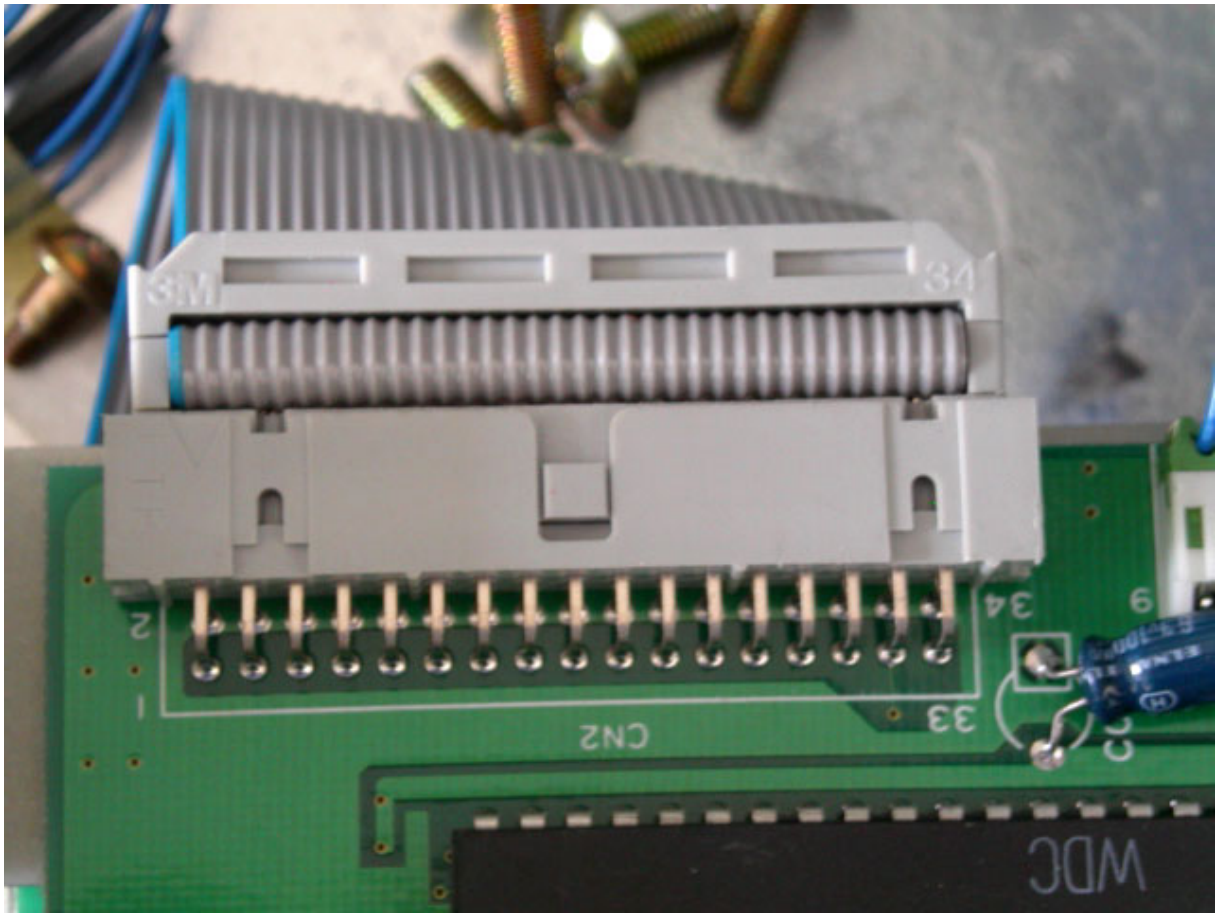
It turns out that in an EL90 organ and an MDR-3 this is possible with only a few relatively simple modifications.
We expect this same modification to work on any EL organ and any type of MDR that use a 3,5'' DD floppy drive.

In short the differences between a Yamaha floppy drive and a PC floppy drive are:

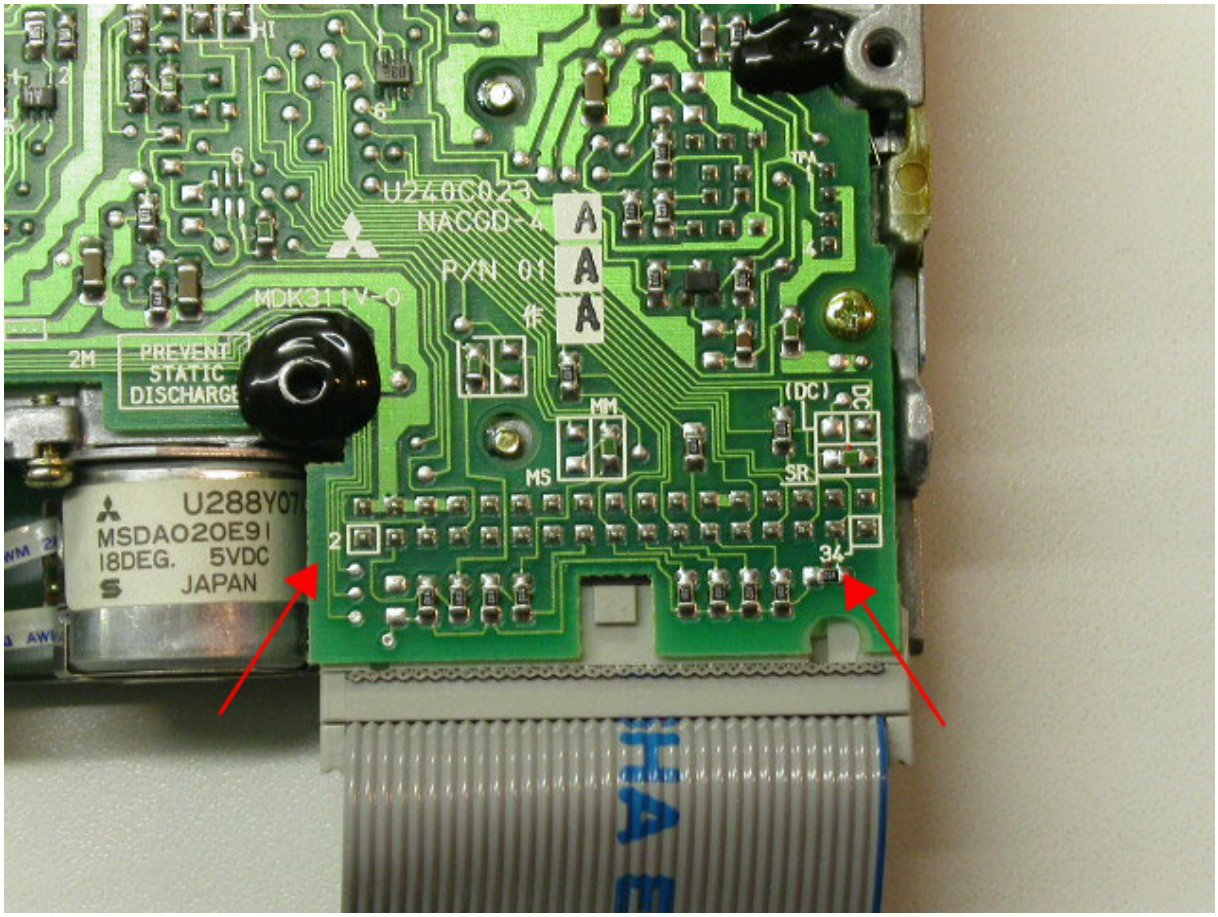
1. The floppy drives in Yamaha EL/MDR equipment are a different interface standard than standard PC floppy drives.
2. The Yamaha drives are pre-set as drive 0 while PC drives are pre-set as drive 1.

The physical interface is identical. Both types of floppy drives use a 34-pin ribbon cable as interface between the floppy drive and the floppy controller.

The pictures 1 and 2 below show an example of this 34-pin ribbon cable and connectors.



Picture1: The 34-pin connector of the floppy controller of an EL90 organ.



Picture 2: The 34-pin connector of the floppy drive of an EL90 organ.

Notice that the ribbon cable seems to be connected incorrectly in picture 2. The blue line on the cable indicates pin 1 and normally should be connected on the side of pin 1 of the floppy drive. In this case it is correctly(!) connected on the side of pin 34 of the floppy drive.

When we looked at the schematics of the connector on the floppy controller side (as shown in table 1 below), it was obvious what the reason was for this.
The engineers that where responsible for the design of the floppy controller board seem to have made a simple mistake!
In all known 34-pin floppy standards the pin numbering is completely opposite from the numbering used by the Yamaha engineers.
For example: Pin 1 in table 1 should have been called pin 34 and pin 34 in table 1 should have been called pin 1.

1	!RDY	VSS	2
3	!SIDE	VSS	4
5	!RDD	VSS	6
7	!WPRT	VSS	8
9	!TR00	VSS	10
11	!WG	VSS	12
13	!WD	VSS	14
15	!STEP	VSS	16
17	!DIR	VSS	18
19	!MON	VSS	20
21	NC	VSS	22
23	!SEL2	VSS	24
25	!SEL1	VSS	26
27	!TDX	VSS	28
29	NC	VSS	30
31	INUSE	VSS	32
33	!DISK	VSS	34

Table 1: EL90 floppy controller pinout

This means that the 34-pin cable is in fact connected the wrong way around on the controller side! Because of this, the cable must also be connected wrong on the floppy side for it to work correctly.

From this point on we will ‘correct’ this mistake and use the pinout as shown in table 2 below for the Yamaha floppy controller:

34	!RDY	VSS	33
32	!SIDE	VSS	31
30	!RDD	VSS	29
28	!WPRT	VSS	27
26	!TR00	VSS	25
24	!WG	VSS	23
22	!WD	VSS	21
20	!STEP	VSS	19
18	!DIR	VSS	17
16	!MON	VSS	15
14	NC	VSS	13
12	!SEL2	VSS	11
10	!SEL1	VSS	9
8	!TDX	VSS	7
6	NC	VSS	5
4	INUSE	VSS	3
2	!DISK	VSS	1

Table 2: Corrected EL90 floppy controller pinout

Next we looked at the interface of a standard PC floppy drive. We took a readily available type of floppy drive and analyzed the interface to be as shown in table 3 below. The differences with the EL90 floppy controller pinout are indicated in bold:

34	**!DC**	VSS	33
32	!SIDE	VSS	31
30	!RDD	VSS	29
28	!WPRT	VSS	27
26	!TR00	VSS	25
24	!WG	VSS	23
22	!WD	VSS	21
20	!STEP	VSS	19
18	!DIR	VSS	17
16	!MON	VSS	15
14	NC	VSS	13
12	!SEL2	VSS	11
10	!SEL1	VSS	9
8	!TDX	VSS	7
6	NC	VSS	5
4	**NC**	VSS	3
2	**NC**	VSS	1

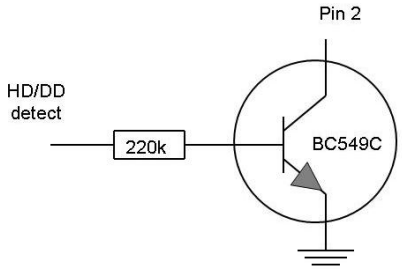
Table 3: standard PC floppy drive interface

The differences in interface pinout are on pins 34, 4 & 2.

Pin 34:
Testing has shown that the Yamaha floppy controller requires a **!RDY** (Drive ready) signal on pin 34. A standard floppy drive however provides a different **!DC** (Disk Change) signal on pin 34.
To solve this we have disconnected pin 34 of the floppy drive from de circuitry of de drive and connected pin 34 to the floppy detect switch of the drive.
The effect of this that whenever a disk is entered in the drive the EL90 floppy controller will get the required **!RDY** signal.
Because both the floppy detect switch and the **!RDY** signal are active low in the drive we used we can connect this signal unchanged to pin 34.

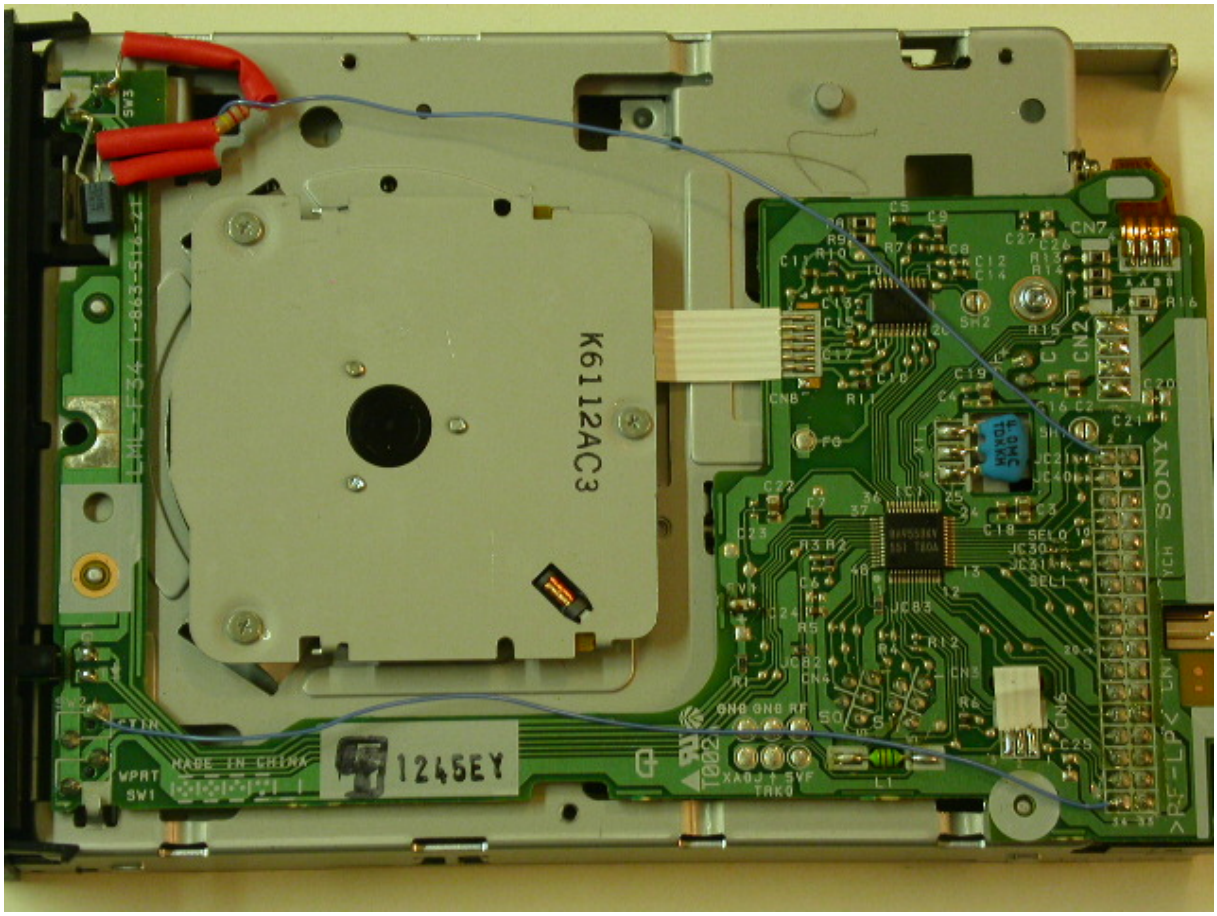
Pin 4:
Testing has shown that this signal is not used or required in order to make a standard floppy drive work in an EL90 organ or in an MDR-3.

Pin 2:
Testing has shown the Yamaha floppy controller requires a signal from the floppy drive indicating if the type of disk in de drive is a DD or HD disk.
To solve this we have connected the HD/DD detect switch to the unused pin 2 of the floppy drive.
However, because the HD/DD detect switch signal in this drive is the inverse of the signal required by the Yamaha floppy controller we had to invert the signal before connecting it to pin 2.
To invert this signal we used a BC549C NPN transistor and a 220K base resistor. The resistor is connected to the output of the HD/DD detect switch, the emitter of the transistor is grounded and the collector is connected to pin 2 of the controller interface as follows:



Pins 10 & 12:
The only difference that remains is that a Yamaha floppy controller requires a drive that is pre-set as drive 0. Standard PC drives are pre-set to drive 1.
Note: To pre-set a drive to drive 0 instead of drive 1 means to make the drive respond to a select signal on pin 10 instead of pin 12.
There are 2 basic solutions for this: Either use a PC floppy cable with a twist at the end or pre-set the drive to drive 0. On some drives there may be a jumper to do this. On the drive we used there was a 0 Ohm SMD resistor on the board to control this. We chose to make a change on the circuit board of the drive in order to pre-set it to drive 0.

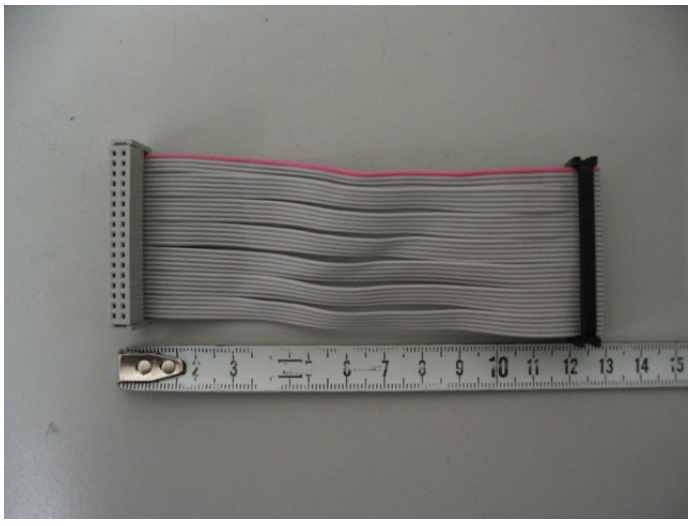
See the picture below for an example of a modified circuit board of a standard PC floppy drive:



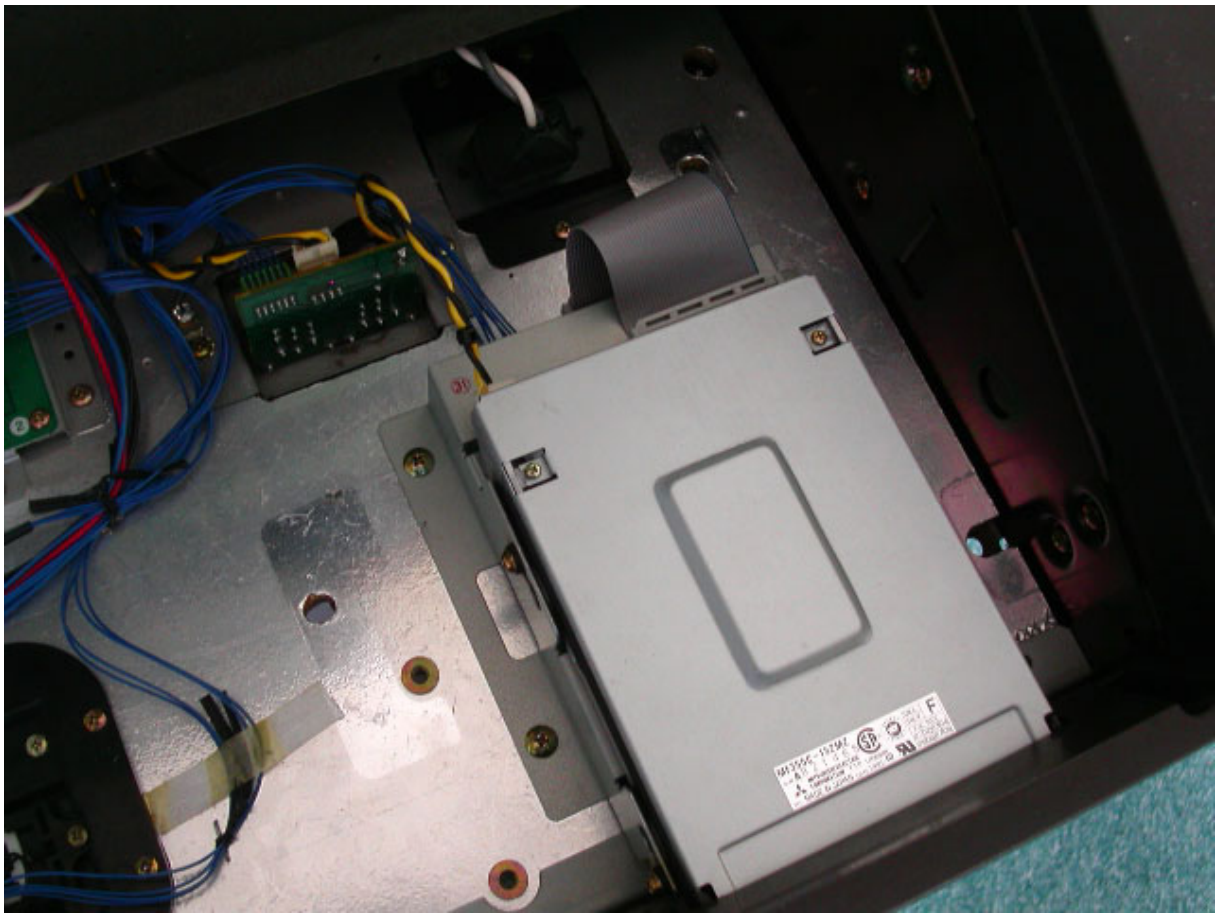
Technically the drive is now ready to be used in an EL organ or MDR.
There are still a few mechanical problems to be resolved however.

- Most standard PC floppy drives have their 34-pin connector on the left side instead of the right side requiring a longer ribbon cable.
- The pins on that connecter are reversed requiring the ribbon cable to twist completely.
- The power connector of most standard PC floppy drives is in the middle and not on the left side. The standard power cable of an EL90 is just long enough to reach this power connector.

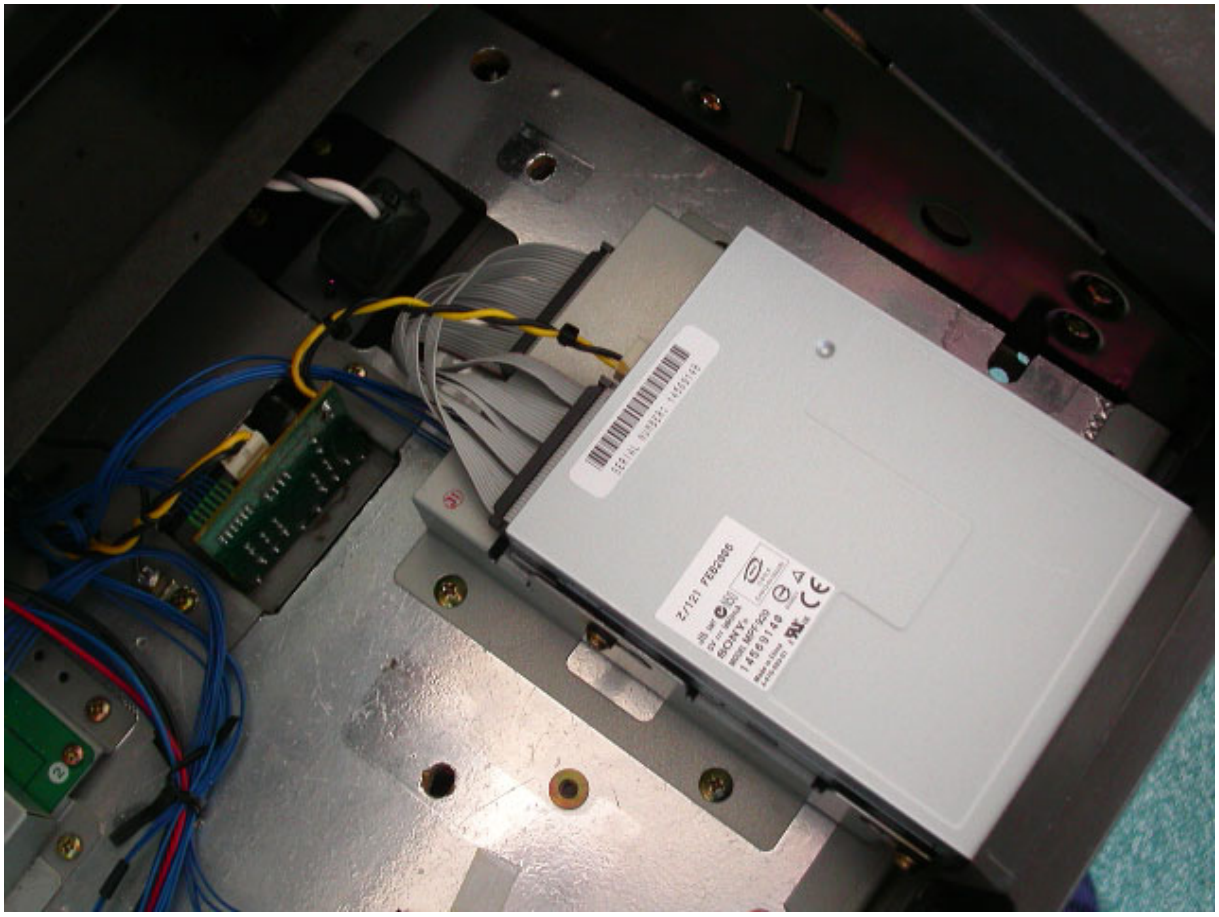
Making the twist in the cable turned out to be a bit of a puzzle. We have solved this by dividing the cable in small sections as shown below:



A standard EL90 looks like this:



A modified EL90 looks like this:



We have determined that with these changes the drive will work in an EL90 and MDR-3. We have been testing and using drives modified like this for many months in two EL90s without problems.
We have done these changes with only a basic understanding of floppy drive interfaces and with trial and error testing method. We invite everybody to provide feedback, comments or information to improve this.

With special thanks to Dolf de Waal who provide us with valuable feedback and improvements. In particular for the help with the inverter and the elegant solution for the cable twist problem.

Yvonne & Léon Sprenger