

ST Parallel Port Buffer

One of the office ST's that is hitched to both an HP DeskJet and an NEC P2200 recently blew its sound chip - the chip that controls the parallel port and the floppy disk drives. In this article, Jon Ellis outlines how a kludge can be made to protect the sound chip from such unwarranted interference.

This is a simple hardware project for the ST. It provides a buffered output from the parallel port which should be sufficient to implement fully the Centronics standard. This will cure problems that are due to marginal logic levels experienced with some printers such as the HP DeskJet Plus and NEC P2200. Furthermore, it also fixes the power-up sequencing problem with the DeskJet Plus. To keep the description brief, I will assume you are familiar with soldering, and know a little about the ST hardware. The design for the circuit is an amalgam of ideas originating from John Logajan, Frans Hoesel (USA) and Hartmut Semken (Germany).

Figure 1 is the circuit schematic. The chip is an octal, non-inverting bus transceiver package, configured for output from the ST to the printer. In the ST, the parallel port is actually bi-directional, but is set to output by the operating system. The port is Port B of the YM2149 sound chip (register 15; read/write), and the direction is controlled by bit 7 of register 7 (1=output, 0=input). With the circuit as it stands, you can only output from the ST. If you require input also, you will need to fit a switch to pin 1. Ground pin 1 for output, and take it high for input. The STROBE line is taken from bit 5 of Port A (register 14). This port cannot easily be used as an input port in the ST, therefore the buffering is uni-directional.

Notice that there is no provision for a separate power supply: the chip takes its power from one of the lines from the printer (ERROR). This will remain high except during dramatic printer errors. These, it is hoped, occur rarely, and besides, as the printer will not be responding, it does not matter if the ST output is blocked. Ideally, the chip should be powered from the printer HI line which remains high as long as the printer is turned on. However, in most parallel printer cables this line is not brought through to the 25-way D plug which connects to the computer. In order to power the chip this way, it is essential that it should have as low a power consumption as possible. The chip specified, 74HCT245, is a CMOS device with TTL compatible inputs (the HC and T respectively).

Please be sure to get this version, as the 74LS245 has a higher power consumption. Before proceeding further, it is probably a good idea to check that the ERROR line is connected in your cable: pin 15 at the ST end should be connected to pin 32 at the printer end.

The chip is used to buffer the 8 data lines. The STROBE line (which is actually the line thought to be most at risk in unbuffered output) is buffered with a single discrete transistor. This saved using another chip, which would have made the circuit board too big to fit in the box. The ACKNLG and BUSY lines from the printer are not buffered.

As with all hardware projects, you build them and attach them to your equipment at your own risk. Neither I, nor ST Applications, can accept responsibility for any unpleasant results. We provide this information for your interest and in good faith. You should check the circuit and board layouts thoroughly. If you do not understand the circuit, or suspect an error, consult someone competent before proceeding. Having said that, I should add that my buffer has worked perfectly in my ST system for several months.

Construction

Caution: The buffer chip is a CMOS device and therefore sensitive to static electricity. Do not remove it from the conducting foam until it is required. If possible, work on an earthed metal tray with an earthed wrist-strap. Avoid touching the pins as much as possible. Earth yourself frequently, keep your feet off nylon carpets, and feel lucky.

The parts required are listed in Figure 3. Part numbers and prices are from the September 1990 edition of the Maplin catalogue. These parts should be readily available from other outlets, with the possible exception of the box. In addition to these parts, you will need a miniature soldering iron, solder and wire. A multimeter or continuity tester is useful, but not essential.

The entire circuit is built on a scrap of Vero-board (13 strips by 11 holes) and fitted into a small plastic box which is designed for making null modems, etc. This box is formed to take a 25-way D connector at each end, with a 36 x 38 x 11mm volume between the connectors. The box plugs into the ST parallel port, and your existing printer cable simply plugs into the other end of the box, making a compact and tidy unit.

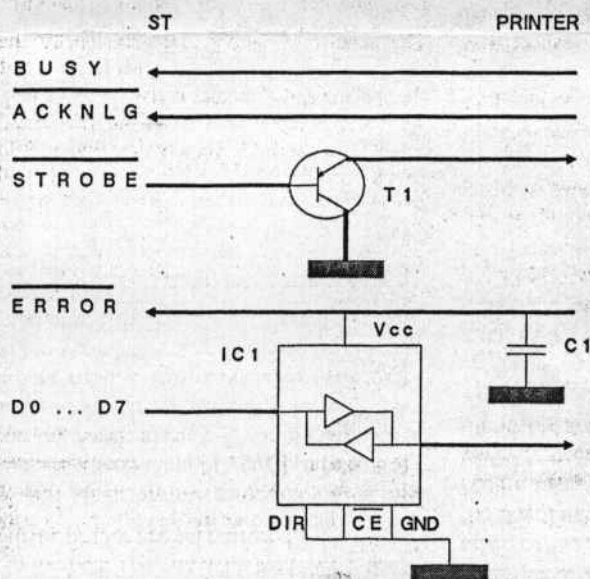


Figure 1

Schematic of the buffer circuit. IC1 contains 8 copies of the bi-directional bus transceiver unit shown. DIR is shown grounded for data flow from ST to printer (bank B to bank A). If the CE line is taken high, all ports are placed in a high impedance state.

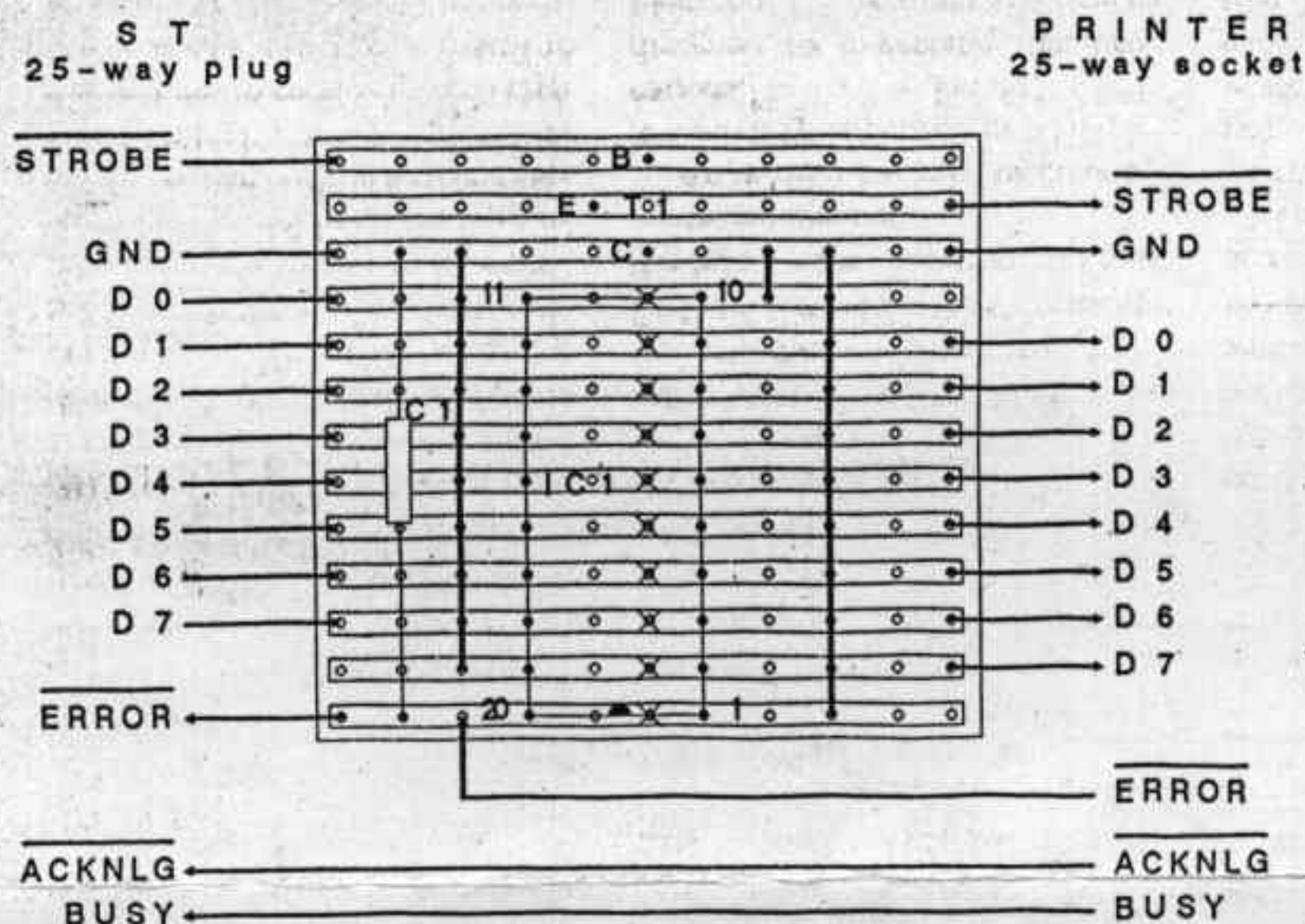


Figure 2

Stripboard layout for the circuit. View from the component side, assuming a transparent board. Bold lines are wire links. Note particularly the orientation of IC1 and T1. Crosses mark places to break the copper strips (10 instances). Arrows indicate data flow. The line designations correspond to the pins of both 25-way connectors as follows:

STROBE..... pin 1
D0-D7..... pins 2-9 in order
ACKNLG..... pin 10
BUSY..... pin 11
ERROR..... pin 15
GND..... pins 18-25 (common ground).

Strictly, you do not need to wire the ACKNLG line as the ST does not use it. However, including it makes the buffer circuit useful for other machines.

Start by cutting the Veroboard to size: check that it will fit in the box, allowing a little room at each end (yes, it is a tight fit!). Break the tracks (10 breaks) as shown in Figure 3; make the 3 wire links and solder them onto the board. Single core wire is best for these links, but anything will do. Next, solder on the 20 pin DIL socket, being especially careful not to create solder bridges between adjacent tracks. Now is probably a good time to check the joints and links with a multimeter.

The capacitor and transistor should be soldered on next. Take care to ensure that the transistor is oriented correctly, and do not keep the soldering iron in contact with it longer than necessary. Make up a set of wires to connect the board to the two 25-way connectors. The data line wires will need to be quite short to fit in the box, the other lines rather longer. Using two pieces of bare wire (cropped capacitor legs are ideal!), common pins 18-25 of each of the 25-way connectors. Now comes the fiddly bit, wiring the connectors to the board. I suspect that whichever order you wire them it will be equally awkward. I connected the non-data lines first, then soldered the data line wires to the board, and then to the connectors, using a pair of forceps to hold each wire in place while it was soldered. Please ensure that you connect the correct bank of wires to each connector. Notice also that the two blocks of data lines are one row out of register with each other. I used ribbon cable for the data lines. Finally, solder in the two straight-through links: BUSY and ACKNLG. You are now ready to put the chip into the socket. Do this carefully but firmly, ensuring that it is oriented correctly.

The board can be tested now, before assembly into the box. With your ST and printer turned OFF, gently engage the connectors

with your ST and printer cable. Remember that pins on the connectors are wired directly to the chip. Turn on the printer and ST, and print out a small ASCII file. If the file does not contain a form-feed, you may have to use the FF button. If all is well, turn everything off, unplug carefully and assemble the box around the board. It will fit, providing that the wires are short. You may need to apply some 'persuasion'. Plug it in, turn on, and test again. If all is well, congratulations!

The buffer should be compatible with all printers. If it does not work with one particular model, check that the printer implements the BUSY line normally. If problems persist, simply unplug the unit!

Debugging

Do not plug in or remove the circuit with either the printer or the ST turned on. It probably will not hurt either machine, but there is no point in taking risks.

If the file does not print, check the following:

- ✓ Is the chip in the right way round?
- ✓ Is the transistor correctly oriented?
- ✓ Is the board powered (4.5V between pins 10 and 20)?
- ✓ Are the STROBE and BUSY connections correct?
- ✓ Check all the wiring between board and connectors.

If the file does print, but the output is not what you expected, the board is almost working properly. You probably have either crossed or unconnected data lines. You can check each wire in turn with a multimeter. Unplug the circuit first, and it is probably best to remove the chip as well. Alternatively, you can track the problem down by feeding known characters to the printer. By comparing the binary representations of what you sent and what you got, you should be able to determine which bits are affected.

List of Parts

Part Description	Quantity	Code	Price
IC1 74HCT245	1	UB68	£0.68
C1 100nF ceramic/epoxy	1	YY11	£0.48
T1 2N2907	1	QR19	£0.32
20-pin DIL socket	1	HQ77	£0.14
Plastic D25 Box	1	JB03	£0.75
25-way D plug	1	YQ48	£0.68
25-way D socket	1	YQ49	£1.20
Stripboard 2939	1	JP47	£1.20