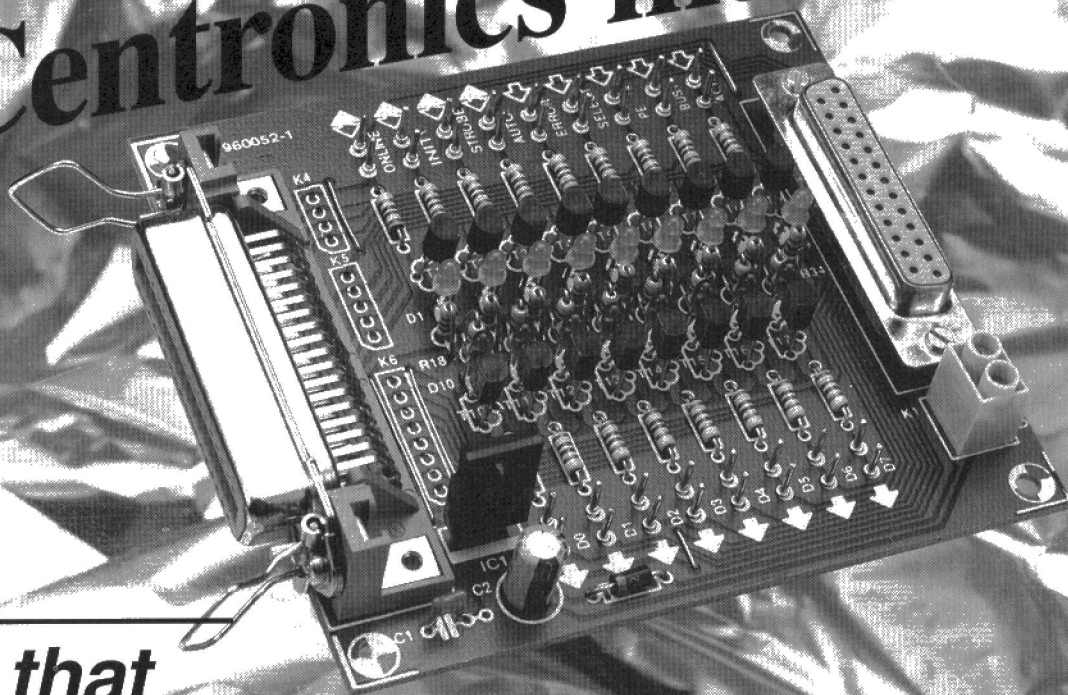




Centronics interface



use that printer port!

Lots of people seem to think that computers show the results of their number crunching activities on screens only. The highly educational circuit described here demonstrates that a standard PC interface such as the parallel printer port may be used for applications which are off the beaten track. It may be used, for example, to drive external circuits. After your experiments, the circuit may be used as a permanently installed data exchange monitor in the PC-to-printer link.

Design by J. Feltes

Most, if not all, modern PCs feature a Centronics port to drive a printer with parallel data. It is possible to do more with that port, however. Just add a little hardware and software and you can turn it into a versatile controlling device for lots of external circuits.

The Centronics interface described in this article gives access to the control and data lines contained in the Centronics port. An array of LEDs (light-emitting diodes) provides a permanent indication of the logic levels on the various interface lines.

Let's start by examining the parallel printer port in some detail. It consists of three sections: an 8-bit output, a 5-bit input and a 4-bit bidirectional port. Bidirectional means that the latter four bits may be used as inputs or outputs, depending on how they are programmed. The eight outputs are designated D0 through D7. The five inputs are called Busy, Ack, Pe, Online and Error. The meanings of these descriptions are not discussed here because they are irrelevant to the present application. What we do explain, however, is how the printer port may be turned into a versatile digital control port with the aid of a couple of simple BASIC instructions.

INSIDE THE PC

Practically every PC has a Centronics port, usually in the form of a 25-pin sub-D connector at the back of the case. The pin functions on this connector are shown in figure 1. Inside the PC, this connector is wired to a special integrated circuit which acts as

an intermediate memory for output signals, and as a buffer for input signals. To the computer, this IC looks like an ordinary memory location where data can be read and written.

PCs recognize two types of address: 'ordinary' memory addresses and so-called 'input/output' (I/O) addresses. The Centronics IC is located in the I/O address range, and occupies three base addresses. The standard configuration in a PC allows up to three Centronics ports, LPT1, LPT2 and LPT3, to be defined. The respective base addresses reserved for these ports are 378_H, 278_H and 3BC_H.

PRACTICAL CIRCUIT

The Centronics interface is a compact and straightforward circuit. Its structure is evident from figure 2. Each I/O line is fitted with its own on/off indicator consisting of an n-p-n transistor, two resistors and an LED. The LED lights as soon as a logic high level (2.4-5 V) exists on the line, irrespective of it being programmed to function as an input or an output. In other words, it is irrelevant whether the high level is generated by the computer or the peripheral device connected to the Centronics interface.

To make sure that the operation of the circuit remains simple and easy to observe, each of the three signal groups (inputs, outputs and bidirectional lines) has its own LED colour. Each of the eight outputs has a red LED, while the inputs have green LEDs. The four bidirectional lines are marked by yellow LEDs.

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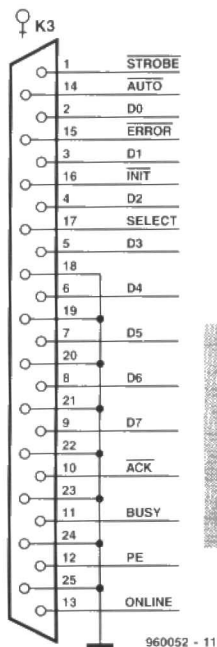


Fig. 1. At the printer side, the printer cable usually has a 36-way Centronics plug. At the computer side, a 25-pin sub-D plug is used.

pair indicates which I/O lines they are connected to. These pins may be used to connect TTL (transistor-transistor logic) compatible circuits, i.e., most logic circuits operating at a supply voltage of 5 V.

Because a relatively high current is required to make the LEDs light, the circuit is endowed with its own power supply. This supply consists of a voltage regulator (IC1, the ubiquitous 7805) and two decoupling capacitors (C1 and C2). Diode D18 acts as a polarity reversal protection.

CONSTRUCTION

Building the circuit really should not cause any problems. If you make use of the ready-made printed circuit board supplied through our Readers

Services (artwork shown in figure 3), it is all plain sailing – just follow the information in the parts list and the component references print-

ed on the board.

Start by fitting the five wire links, then fit the connectors. Socket K1 is a screw-type PCB terminal block, K2 is a PCB-mount Centronics socket, and K3 is a 25-way sub-D connector with straight solder pins, also for PCB mounting. Connectors K4, K5 and K6 are simple to make by cutting pieces of four, five and six pins from a 20-pin SIL pin header with 0.1-inch (2.54-mm) raster. Next, mount all capacitors, resistors, transistors and LEDs. The last two components are polarized, and care should be taken to mount them the right way around.

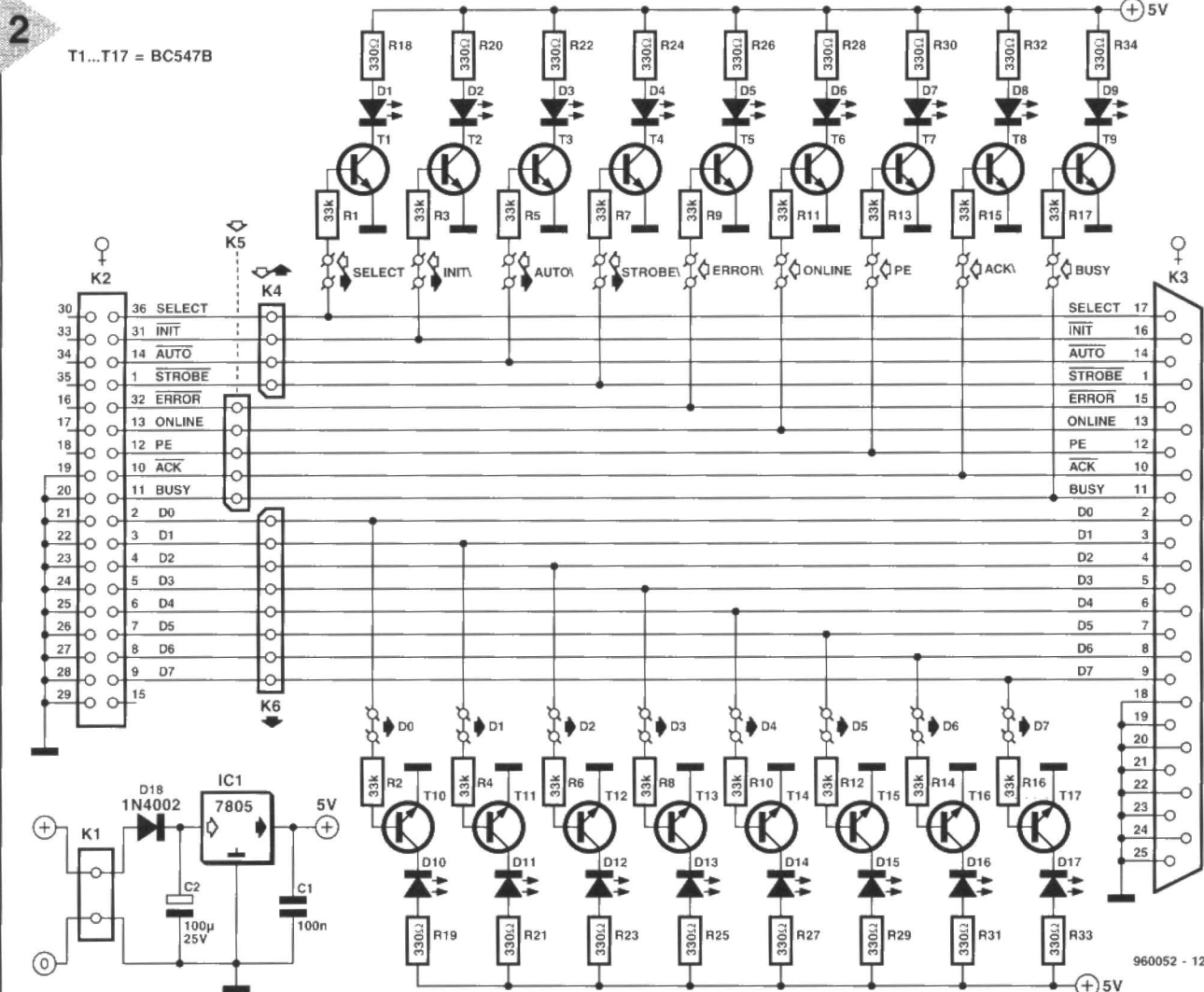
Give the completed circuit a thorough visual inspection to make sure there are no short-circuits or other mounting faults.

TESTING AND FAULTFINDING

Provided the visual check does not reveal any errors, the circuit is ready for some practical testing. That is best done by inserting the interface into an existing link between a computer and a peripheral. Apart from the interface, you will need a 9-volt d.c. mains adapter and an extra printer cable for this test.

The inputs/outputs which may be used for experiments are always formed by two PCB pins. Their practical use is simple because the text printed near each pin

Fig. 2. The circuit is simple by almost any standard, consisting of no more than 17 transistor driver stages and a voltage regulator.



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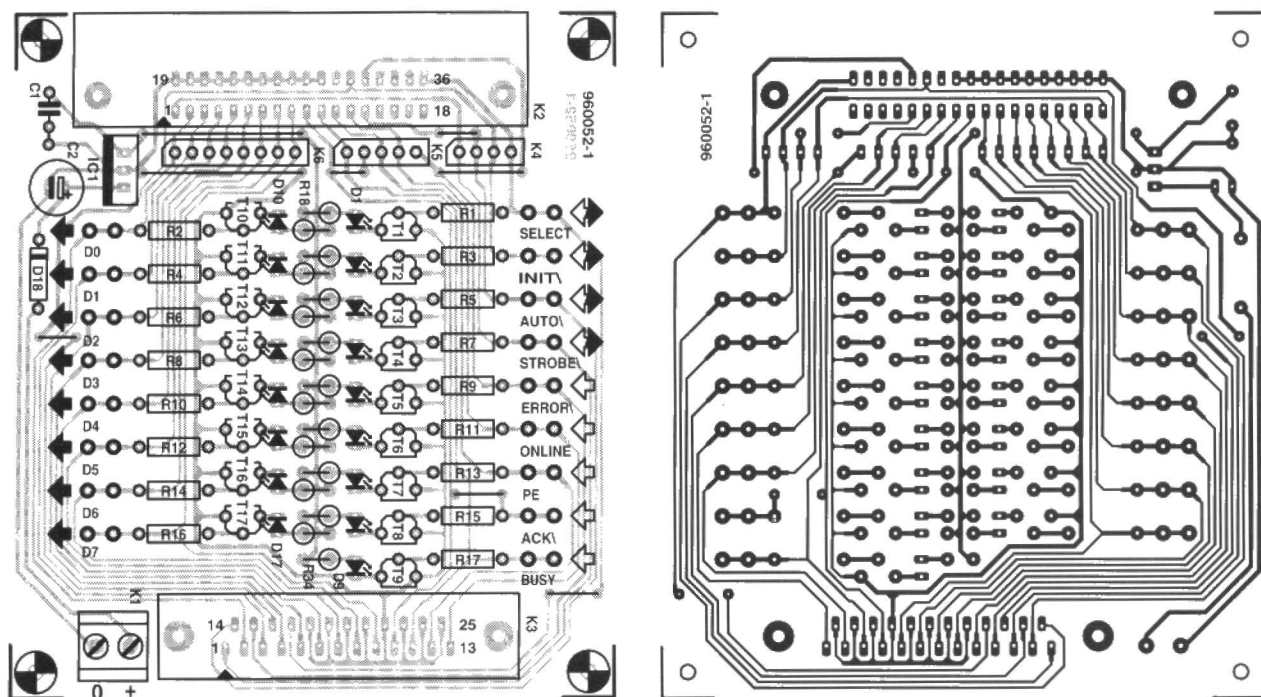


Fig. 3. Track layout and component mounting plan (90%) of the printed circuit board designed for the Centronics interface (board available ready-made, see page 70).

of the Centronics interface and the input of the printer, as illustrated in figure 4. After this simple modification, it should be possible to use the printer as before. If so, you may connect the mains adapter to the circuit. The LEDs

Disconnect the printer cable from the printer, and connect the cable end to the Centronics socket on the interface. Then connect the extra printer cable between the output

should flash if text or graphics are sent to the printer. If that happens, you may safely assume that the interface works properly.

In the unfortunate (and unlikely) case of the communication between the computer and the printer being interrupted after the circuit is inserted in the link, it is recommended to first check if the printer cables are all right and properly plugged into the sockets. Next, check that the solder work on connectors K₂ and K₃ is okay. If the cables are all right, the solder work is almost certainly the cause of the problem.

If the link between the computer and the printer appears to be intact, but the LEDs do not light, check the presence of the 5-V supply voltage (it can be measured across capacitor C₁). If the voltage is present, but the LEDs still do not light, you may have used the wrong transistors, or the LEDs may be fitted the wrong way around.

LET'S DO IT WITH BASIC

Once the interface is completed, the control of the LEDs may be tackled with the aid of BASIC. Actually, it is recommended to use the program 'QBASIC' which is supplied with any recent DOS.

Start by tracing the base address of the interface. Do this with the help of the computer. Change to the directory which contains the file QBASIC.EXE, and start this program by typing

QBASIC <enter>

Enter the program printed below. The number after 'LPT=' is the number of

the printer port you wish to use. If you have only one printer port, the number will be '1' as shown in the listing. The operating system (DOS) stored the printer port addresses during its boot-up procedure. The BASIC program reads this data. The texts behind the apostrophes (') are comment only, and may be left out if you hate typing.

```
DEFINT A-Z
LPT=1 'determine LPT address,
LPT=1, 2 or 3
DEF SEG = 0 'select segment
A = &H408 + 2 * (LPT - 1) 'compute address
lsbaddr = PEEK(A) 'read 8 bits from memory
msbaddr = PEEK(A + 1) 'read 8 bits from memory
LPTaddress = lsbaddr + &H100 * msbaddr 'make 16 bit address
DEF SEG
PRINT HEX$(LPTaddress) 'print LPT address
in HEX on screen
END
```

Once the base address of the printer port is known, you also know the addresses of the 5-bit input port (base address+1) and that of the bidirectional port (base address+2).

BIT MANIPULATIONS

The Centronics port addresses are easily accessed from BASIC by making use of the instructions OUT (write to an address) and INP (read an address). When you use the instruction INP, the PC 'knows' that an address in the I/O range is meant, rather than an address in the 'regular' memory (which can be accessed with the PEEK and POKE instructions).

Using OUT or INP to access the base address of the Centronics port actually actuates the 8-bit output section. Increasing the base address by 1 gives access to the 5-bit input. The 4-bit bidirectional port, finally, is located at base

COMPONENTS LIST

Resistors:

R1-R17 = 33kΩ
R18-R34 = 330Ω

Capacitors:

C1 = 100nF
C2 = 100μF 25V radial

Semiconductors:

D1-D4 = LED, 3mm, yellow
D5-D9 = LED, 3mm, green
D10-D17 = LED, 3mm, red
D18 = 1N4002
T1-T17 = BC547B
IC1 = 7805

Miscellaneous:

K1 = 2-way PCB terminal block, raster 5mm
K2 = Centronics socket, angled pins, PCB mount
K3 = 25-way sub-D socket, straight, PCB mount
K4 = 4-pin SIL header
K5 = 5-pin SIL header
K6 = 8-pin SIL header
Printed circuit board and Windows software on diskette, order code: 960052-C (see page 70).
Diskette also available separately, order code 960008-1 (see page 70)