KIT 74. PC PARALLEL PORT RELAY BOARD

With the rapid progress in computer technology many people now have a surplus 8088 or 286 computer just gathering dust somewhere. Any thoughts that it could be given away magnamously to 'the kids' are quickly dashed when those same kids immediately recognize the offer for what it is, turn up their noses & bring out their own CD-ROM games & Pentium II, 450MHz computers connected to the Internet.

Thus these computers are free to be used as dedicated controllers for a variety of uses: turning on/off lights or other devices around the home, office, laboratory or factory come to mind. All that is needed is the interface to connect it to the real world.

This Kit provides both the hardware and the software to do this. The hardware PCB plugs in directly to the parallel (printer) port of your computer. It carries 8 relays. Each relay is switched on or off by one bit of the output byte which usually goes to your printer to print a character. Two types of software are provided: one operates under DOS while the other is a more detailed program which runs under Windows 3.1.

The kit is constructed on single-sided printed circuit boards. Protel Autotrax & Schematic were used.

HARDWARE

The PCB contains eight identical switched relay positions, power input positions to the relays (either 2.5mm jack centre positive, or via the terminal block) and a Centronics connector to the parallel port of a PC. To keep the kit simple no input latches have been put on it. If your application is important then you should use a UPS to keep the computer operating in the case of a mains power supply failure. If the board is accidently disconnected from the parallel port then the 10K pulldown resistors will turn the relay off. The diodes protect the transistors from the back-emf which is occurs when the relay is turned off and its magnetic field collapses.

Solder the resistors into place first. Make sure to get the right ones in the right place. The components for the first relay position are given in the Components listing. Add the relays last.

The relays are under direct control of the output byte (8 bits) from the parallel port. When a pin is high a nominal 5V is presented to the base resistor R1. Since there is a fixed 0.6V drop across the BE junction of Q1 there is 4.4V across R1 (5V - 0.6V). So by Ohms law 1.33 mA flows through the 3K3 resistor. There is also 0.6V across the 10K pulldown resistor which draws 0.06mA. If we assume a hFE of 100 for Q1 then 127mA flows through the CE leads of Q1 when it is turned on ($I_C = I_B.h_{FE}$). Since the 12V relay turns on at around 30mA this current is more than enough to turn on the relay. The relay has a coil resistance of around 400 ohms and a coil power consumption of 30mW.

Note that this analysis assumes 5V is available from the parallel port pin. In more modern computers this may not be so. If the LED turns on but the relay does not then you will know that the transistor is not saturating. Reduce the value of R1 (and all the similar resistors) to 2K7 from 3K3 will probably fix this. Measure the voltage on the collector. When the relay is on then the voltage should be around 0.1V. If it is 3V - 4V then the transistor is not fully on.

In january, 1999 we started to use a new 15A/120V; 12A/250V rated relay **RWH-SH-112L**. The pinout is the same as the RUDH relay it replaced.

SOFTWARE

We have provided two independent sets of software with the kit. First is a set of DOS-based utilities. If you have some experience writing batch files then you can easily write a program to control the relay board. A sample test program is provided. The second is a fully-featured Windows-based utility. It was written especially for this application.

Of course, you can write your own programs in any language to output a byte to the printer port and the bits which are high will turn on the corresponding relay. The overlay on the PCB shows which bit in the output byte turns that particular relay on. For example, output 00010001, or 11 in hex turns on relays 1 & 5. Each relay number is also marked on the overlay for easy reference.

DOS-based Utilities.
There are three utilities in the set:

- RELAY outputs a hex byte to the designated parallel port

- DELAY waits for a user defined number of seconds

- WAITFOR waits until a specified time (HH:MM)

Batch files using these programs can be written to control the operation of any of the eight relays on the board.

The programs were written using Borland Turbo C/C++ 3.0. The C source code is also provided on disk.

RELAY.EXE
Syntax: RELAY <hex byte>, to LPT1, or

RELAY/1 <hex byte>, to LPT1, or

RELAY/2 <hex byte>to LPT2

Output the hex byte to the specified parallel port. The value of hex byte can be in the range 00h (all relays turned off) to FFh (all relays turned on.)

The parallel port can be specified following the command name (as in the last two examples above.) If none is given then LPT1 is used by default.

KIT 74. PC PARALLEL PORT RELAY BOARD

Example: RELAY 5A
Outputs the hex value 5A (binary 0101 1010) to LPT1, causing relays RL2, RL4, RL5 and RL7 to turn on.

DELAY.EXE
Syntax: DELAY <seconds>

Waits for the number of <seconds> before exiting. The maximum number of seconds allowed is 32,767. The program does not test for values greater than 32,767 or less than 0. For delays more than 32,767 seconds just use the command again on the next line of the .bat file.

During operation, the remaining number of seconds is displayed. The program can be terminated at any time by pressing the ESC key.

Exiting via the ESC key causes the program to return an exit code of 1. This condition can be detected within batch files using the "IF ERRORLEVEL ..." command.

Example: DELAY 100

Causes the program to wait until 100 seconds has elapsed before exiting.

WAITFOR.EXE
Syntax: WAITFOR <hh:mm>

Waits until the specified time hh:mm is reached before exiting. A 24 hour clock is used to specify the time. The program does not test for invalid time settings eg. 25:00 or 12:75.

During operation, the current time in HH:MM:SS is displayed and updated every second. The program can be terminated by pressing the ESC key.

Exiting via ESC causes the program to return an exit code of 1. This condition can be detected within the batch files using the "IF ERRORLEVEL ..." command.

Example: WAITFOR 18:30

Causes the program to wait until 6:30pm before exiting. The indicated time 6:30pm is, of course, the time as set in the computer cmos setup. It may not correspond to the real time.

The test.bat batch file on the floppy disk illustrates the use of these utilities. The batch file waits until the time is 11:00am and then sequentially operates each relay in turn for 5 seconds. Pressing the ESC key during operation causes the batch program to terminate immediately. All relays are turned off upon exit by the final relay 00 command. Print out the batch file & run it. Note that when you first turn your computer on the byte on the parallel port is undefined. So before using the relay board you should first run a program to capture the port (that is, to put it in a known state.) For example, a line in your autoexec.bat file relay 00 will do this automatically for you whenever the computer is turned on.

Windows-based Utility
See the readme file in the WIN subdirectory of the floppy disk for information how to setup the utility program.

Print out the relay.txt file for the details of how to run the program. Anyone who has had experience with Windows this have no problems installing and running these programs.

COMPONENTS		
Resistors 5%, carbon, 1/4W:		
1K brown black red	R3 6 9 12 15 18 21 24	8
10K brown black orange	R2 5 8 11 14 17 20 23	8
3K3 orange orange red red	R1 4 7 10 13 16 19 22	8
1N4004 diode	D1 2 3 4 5 6 7 8	8
5mm red LED	L1 2 3 4 5 6 7 8	8
2 pole terminal block		1
3 pole terminal block	X1 2 3 4 5 6 7 8	8
100uF/25V ecap		1
BC547 transistor	Q1 2 3 4 5 6 7 8	8
12V relay		8
Power jack 2.5mm		1
Centronics connector		1
Kit 74 pcb		1
Floppy disk		1

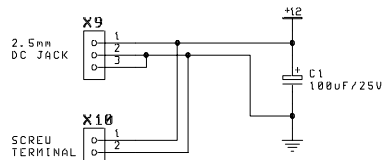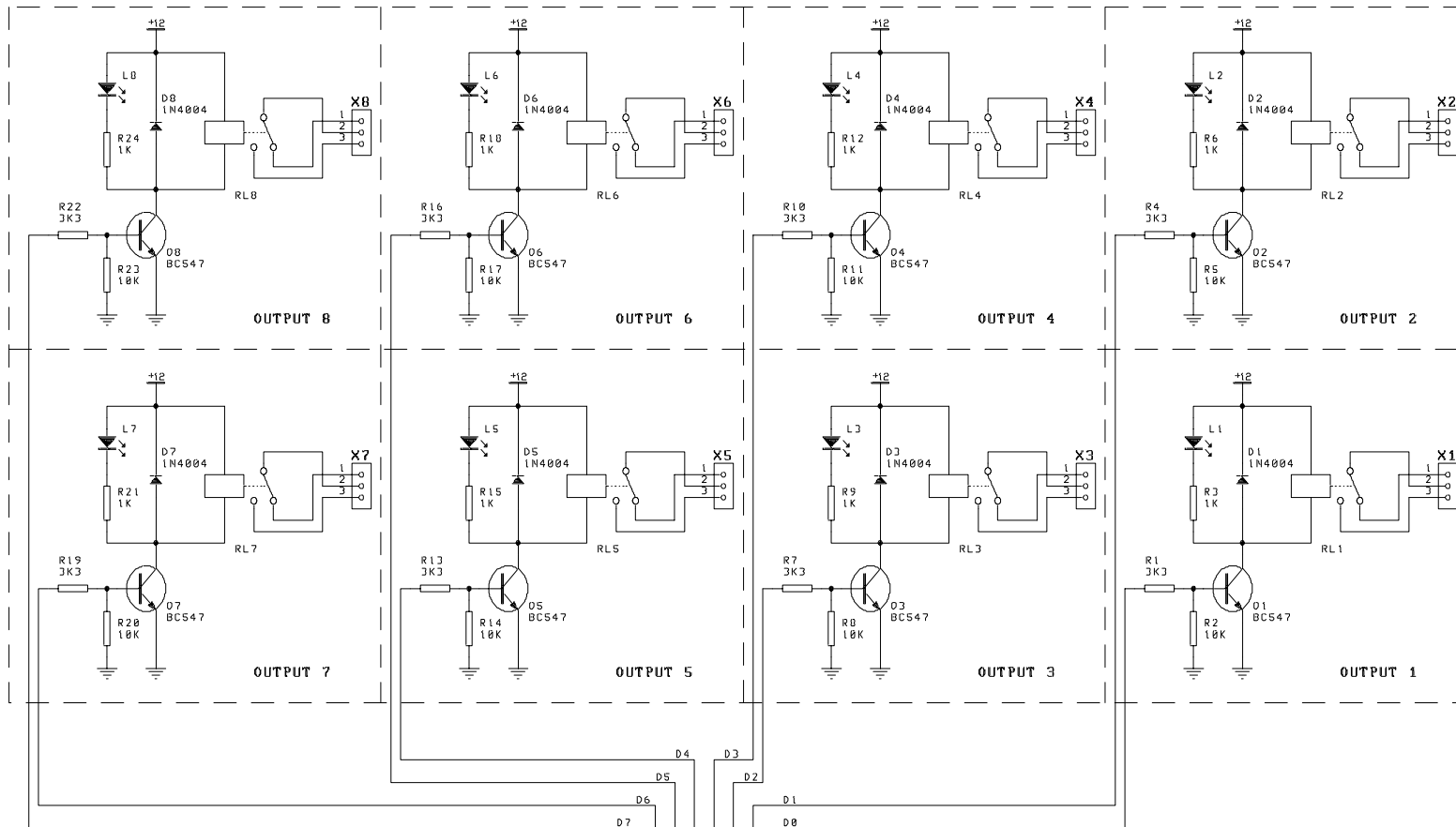The software in this kit may also be downloaded from the software download page of

http://kitsrus.com

You may email Frank Crivelli, the designer of this kit at

ozitronics@c031.aone.net.au

- - - - - - - - - - - - - - - -

KIT 74. PC PARALLEL PORT RELAY BOARD

OUTPUT 8
+12
L8
D8 1N4004
R24 1K
R22 3K3
R23 10K
Q8 BC547
RL8
X8
1 2 3

OUTPUT 6
+12
L6
D6 1N4004
R18 1K
R16 3K3
R17 10K
Q6 BC547
RL6
X6
1 2 3

OUTPUT 4
+12
L4
D4 1N4004
R12 1K
R10 3K3
R11 10K
Q4 BC547
RL4
X4
1 2 3

OUTPUT 2
+12
L2
D2 1N4004
R6 1K
R4 3K3
R5 10K
Q2 BC547
RL2
X2
1 2 3

OUTPUT 7
+12
L7
D7 1N4004
R21 1K
R19 3K3
R20 10K
Q7 BC547
RL7
X7
1 2 3

OUTPUT 5
+12
L5
D5 1N4004
R15 1K
R13 3K3
R14 10K
Q5 BC547
RL5
X5
1 2 3

OUTPUT 3
+12
L3
D3 1N4004
R9 1K
R7 3K3
R8 10K
Q3 BC547
RL3
X3
1 2 3

OUTPUT 1
+12
L1
D1 1N4004
R3 1K
R1 3K3
R2 10K
Q1 BC547
RL1
X1
1 2 3

D0 D1 D2 D3 D4 D5 D6 D7

CN1
18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19

PC PARALLEL PORT
(CENTRONICS)

X9
2.5mm DC JACK
1 2 3

+12
C1
100uF/25V

X10
SCREW TERMINAL
1 2

12V DC INPUT

KIT 74. PC PARALLEL PORT RELAY BOARD