This design was originally 'knocked together' to test out a prototype DAC circuit to allow the digital codes to be entered manually. The circuit was later modified to test an opto-isolated low side switch which required an open collector transistor driver. The final circuit combines the virtues of both designs.

Hardware design: Adrian Grace

byte generator

for testing DACs and digital controls

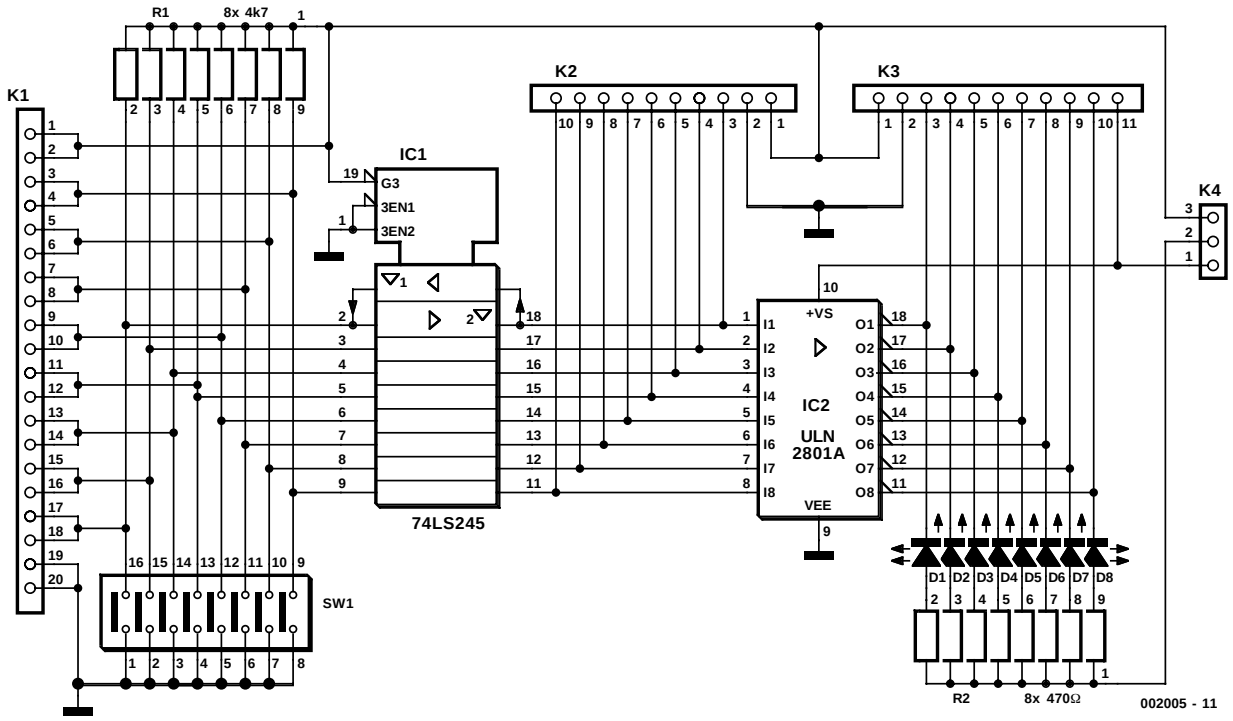

Figure 1. Circuit diagram of the byte generator.

In the circuit diagram, **Figure 1**, SW1 is a 16-pin 8-way DIL switch and is fitted into a 16 way DIL socket (more about this later). The common side of the switch is grounded and the switched side is pulled up to +5V via a 4.7 kΩ SIL resistor network (R1). This is then connected to K1 (which is a doubled up 10-way SIL header or 20-way IDC header), and from there to the inputs of IC1, a 74LS245 which is configured as a buffer. The outputs of IC1 are connected to both K2 and the inputs of IC2. IC2 is a ULN2801A, which is an octal Darlington driver chip with open collector outputs. The outputs of IC2 are available on K3.

Operation of SW1 will result in a TTL output on K2, or an open collector output on K3. As can be seen from **Table 1**, the pin-out for K2 and K3 are virtually the same with the exception of the extra terminal (pin 11) on K3. The ULN2801A (IC2) incorporates internal protection diodes for driving inductive loads — like relays. These internal diodes are commoned together on pin 10 of IC2 and should be connected to the voltage supply of the load. This will 'shunt' any inductive kicks created by switching the load, back into the load's power supply away from the circuit itself.

The circuit can be powered via pins 1 (+5 V) and 2 (0 V) of K2 or K3 and pin 11 of K3 as required, depending upon the application.

The main circuit also includes a simple logic indicator. If the circuit to be mon-

itored is connected to K1, a series of eight LEDs connected to the open-collector outputs of IC2 shows the circuit's status. Connector K4 allows the LED supply voltage to be selected. A link between pins 2 & 3 for +5 V operation, and between pins 1 & 2 for an external voltage source.

Extensions

With a simple extension, this circuit can be modified to include an external clock source — see **Figure 2**.
If the 8-way switch is removed (or ensured that all switches are open) and a daughter board is plugged into K1, the main circuit can be driven by a clock source, rather than manually.
The external clock source is connected to the main board via a 20-way ribbon cable. I found it easier to use a 20-way IDC ribbon cable connection (2 × 10) even though the 10 signal lines are doubled-up, than attempt to use a 10 way crimp connector version (1 × 10). The cable is terminated at the clock source board by a 20-way transition, and at the main board end in a standard 20-way IDC connector.
The clock source itself is based around IC1, a 74HCT4040. This is a +5 V TTL output version of the standard CMOS 4040 chip. Eight sequential outputs, Q0 through Q7 (CT0 through CT7) are fed to the ribbon cable connection whilst Q8 through Q11 (CT8 through CT11) are not connected. IC1 is reset on power-up via R1-C1, and D9 discharges C1 on power down.
The (TTL-level) clock source is connected to GND and CLOCK. Depending on the frequency required, connecting a length of wire to CLOCK may be used as a simple clock source by relying on mains pick-up.

(002005-1)

Article editing: Jan Buiting

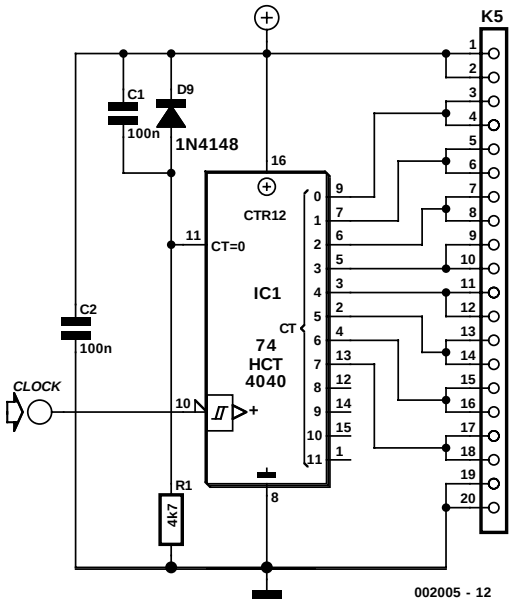

Figure 2. Optional clock extension circuit for connecting to K1 of the byte generator circuit.

COMPONENTS LIST

Resistors:
R1 = 8 × 4K7Ω SIL resistor pack
R2 = 8 × 470Ω SIL resistor pack

Integrated Circuits:
IC1 = 74LS245 or 74HCT245
IC2 = ULN2801A

Miscellaneous:
D1-D8 = 5 mm ⇔ 2mm wide LED, high efficiency
K1 = 20 way IDC connector
K2 = 10 way SIL pin header
K3 = 11 way SIL pin header
K4 = 3 way SIL connector with jumper
16 way turned pin DIL socket

COMPONENTS LIST
Clock divider extension

Resistor:
R1 = 4k7Ω

Capacitor:
C1 = 100nF

Semiconductor:
D9 = 1N4148

Integrated Circuit:
IC1 = 74HCT4040

Miscellaneous:
K4 = 20 way DIL transition
K5 = 20 way IDC
20 way ribbon cable

Table 1. Connector pin functions

K1 pin #	Function
1,2	+ 5 V
3,4	DI-1
5,6	DI-2
7,8	DI-3
9,10	DI-4
11,12	DI-5
13,14	DI-6
15,16	DI-7
17,18	DI-8
19,20	0 V

K2 pin #	Function
1	+ 5 V
2	0 V
3	D0-1
4	D0-2
5	D0-3
6	D0-4
7	D0-5
8	D0-6
9	D0-7
10	D0-8

K3 pin #	Function
1	+ 5 V
2	0 V
3	D0-1
4	D0-2
5	D0-3
6	D0-4
7	D0-5
8	D0-6
9	D0-7
10	D0-8
11	V+