DESIGNING AND MAKING A SMARTCARD CONTROL SYSTEM

WHAT YOU WILL LEARN

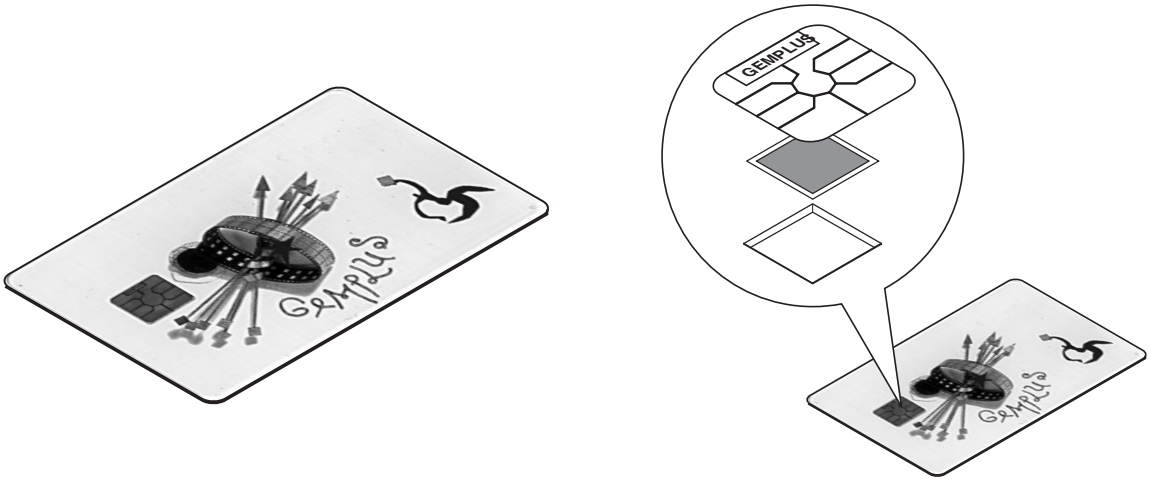
After completing this project, you should understand:

- What a smart card is.
- How smart cards can be used for control.
- How to program a smart card.
- How to design and make a system controlled by a smart card.

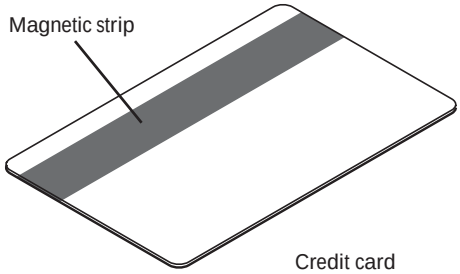
After completing this project, you should be able to:

- Use a smart card for controlling lights and other outputs.
- Design and make a smart card - based control system.
- Program a smart card for a specific control application.

A smartcard is the same shape and size as a credit card but has a built-in integrated circuit. A simple smartcard can only store information - e.g. “credits” for making telephone calls. A more advanced smartcard can contain a chip which is a complete computer - far more powerful than credit card calculators.



Smartcards are rapidly taking over from other types of card for storing information. A conventional credit card, for example, stores information on a magnetic strip but the memory is very small.



Hotels often use plastic cards with punched holes instead of normal keys for extra room security. Both of these are being replaced by smart cards which have a larger memory, can be reprogrammed easily - and appear to “think” for themselves - hence the name smartcard.

The TEP smartcard is a 2K memory card produced by GEMTECH - the largest manufacturer of smartcards in Europe. It can store up to 2000 individual bits of data - or 2000 on/off instructions. It can be re-programmed any number of times and can be thought of as a floppy disk for storing control programs. The uses of the TEP smartcard are many and varied - from electronic locking to robotic control. The example given below is for a lighting display unit.

YOUR TASK

➤ DESIGN BRIEF

Design and make a programmable lighting unit for a purpose you select. It might be a “dynamic” display for a shop window or a small disco lighting unit. The display might use motors and mirrors for optical effects as well as one or more lamps.

DESCRIBING YOUR TASK

➤ SPECIFICATION

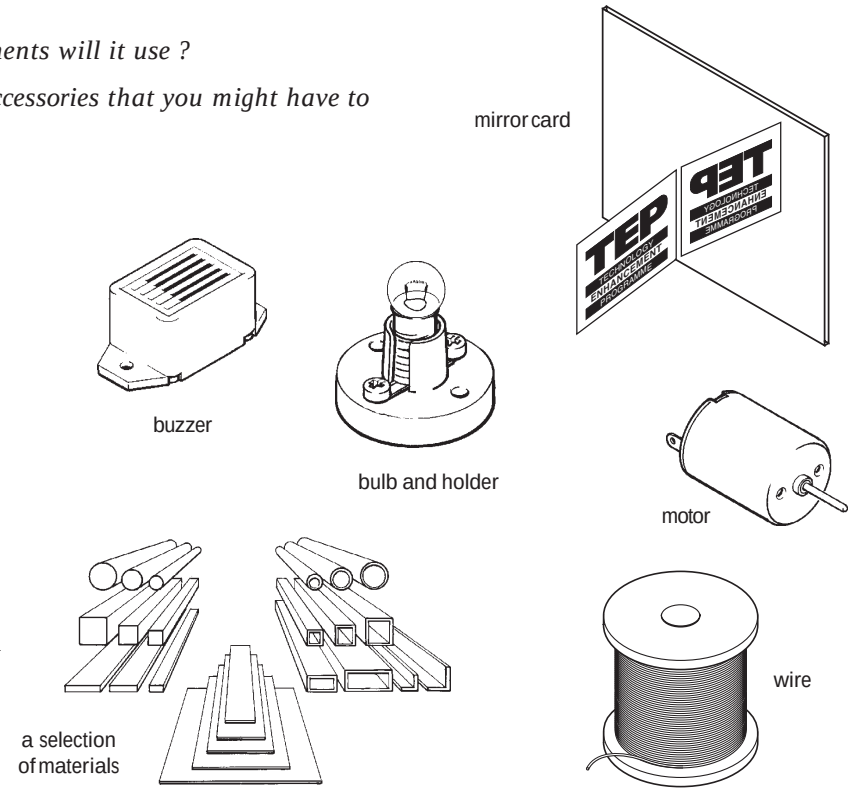
First you need to describe in detail what the product will be like, what it will do and who will use it. This is called a design specification and will guide your design work and help you judge how well the outcome works.

Here are some questions to help you with your design specification:

- *What is the lighting display for ?*
- *Who will operate and program the display ?*
- *What should it cost ?*
- *What materials and components will it use ?*
- *Will it require any special accessories that you might have to research ?*

EQUIPMENT, MATERIALS AND COMPONENTS PROVIDED

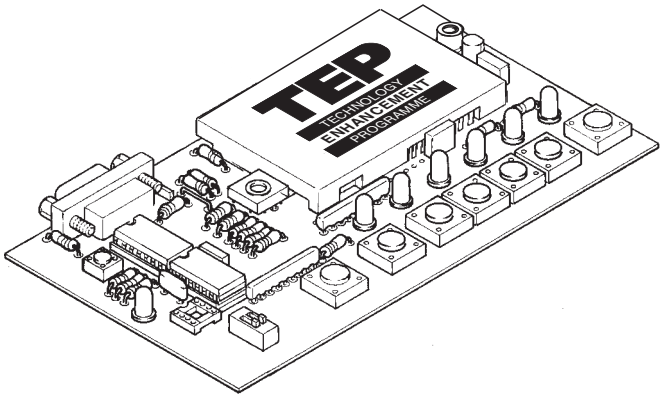
Before you get on with your design work, you need to know what materials and components are available. Your teacher will give you access to the smartcard programmer and controller units. Make a note of what else is available and what you think you can supply.



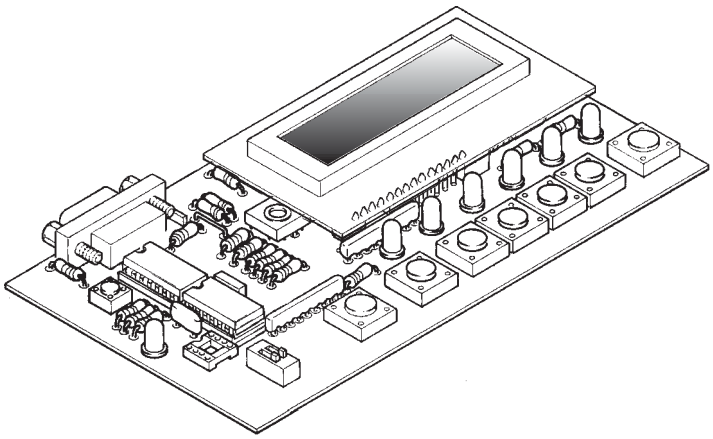
THE SMARTCARD PROGRAMMER AND READER

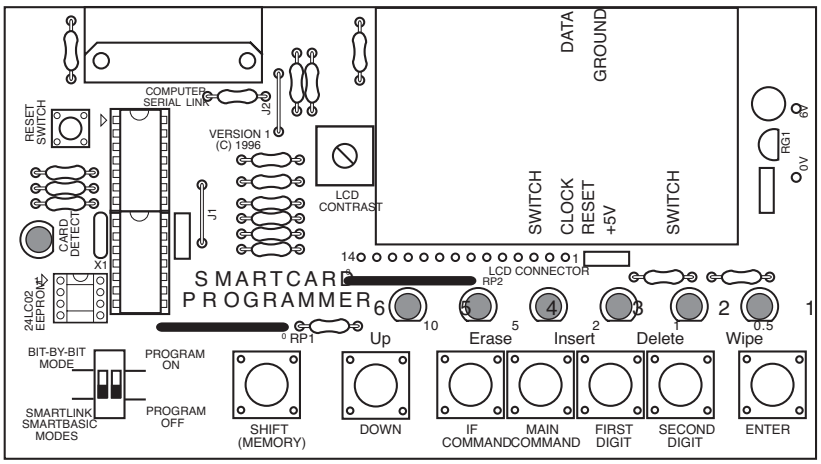
The TEP smartcards are programmed using either one of two controllers.

1. Bit by bit programmer.
This enables you to write control programs to turn up to 6 outputs on or off. The maximum program length is 100 lines. (The programming is exactly like programming TEP's original bit by bit controller.)



2. LCD programmer.
This enables you to do everything the bit by bit programmer does but also you can write programs using BASIC instructions - with commands such as “GOTO” “WAIT” “IF”. This gives more flexible control.

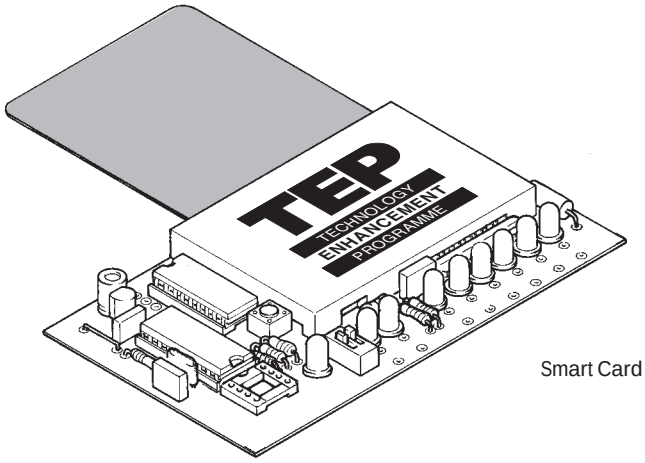




NOTE

Detailed instructions for using both programmers are given at the back of this book. see Study File 17).

A programmed card is accessed by means of a small reader board. The same board is used whatever type of programmer is used. When the card is inserted in the reader, the program will run. It can be stopped either by removing the card, pressing the “reset” switch or using one of the two pause inputs.



Smart Card Reader

IN WHAT FOLLOWS WE WILL ASSUME THAT ONLY THE BIT-BY-BIT PROGRAMMER IS USED.

WORKING OUT YOUR DESIGN

◀ DESIGN PROPOSALS

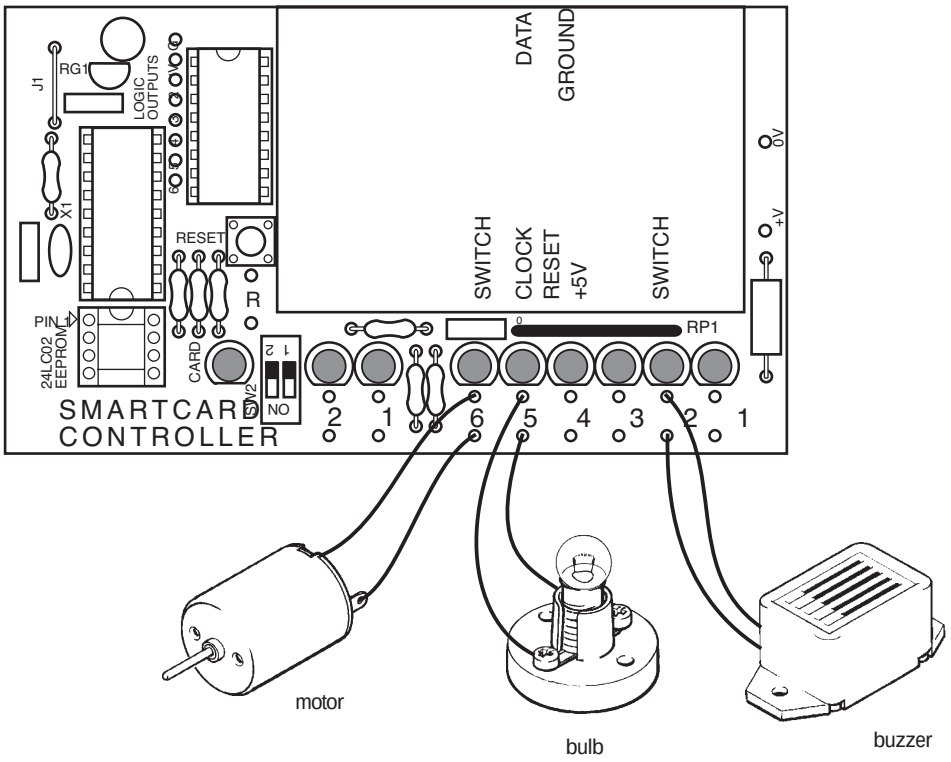
When you know what materials and components are available, you need to think in more detail about the design:

- *Set your ideas down on paper*
- *Experiment with your ideas*
- *Check your ideas against your specification*
- *Decide which is the best design*
- *Do a detailed drawing of the bst design*
- *You need to end up with a working drawing which you or someone else can use to mark out, make and assemble the parts. It will be a good idea to draw out your design full size.*

The following notes will give you some ideas about lighting units. They do not give you answers, though ! You must make the important decisions so that the parts can be assembled in many different ways.

The smartcard controller board provides for up to 6 outputs for turning things on and off. Each output will provide a current of up to 0.5A - enough to run most small DC motors or a standard 0.3A bulb. DO NOT EXCEED THIS LIMIT.

Important: To avoid electrical noise and interference, an electric motor should be suppressed by connecting a small ceramic capacitor across the terminals.



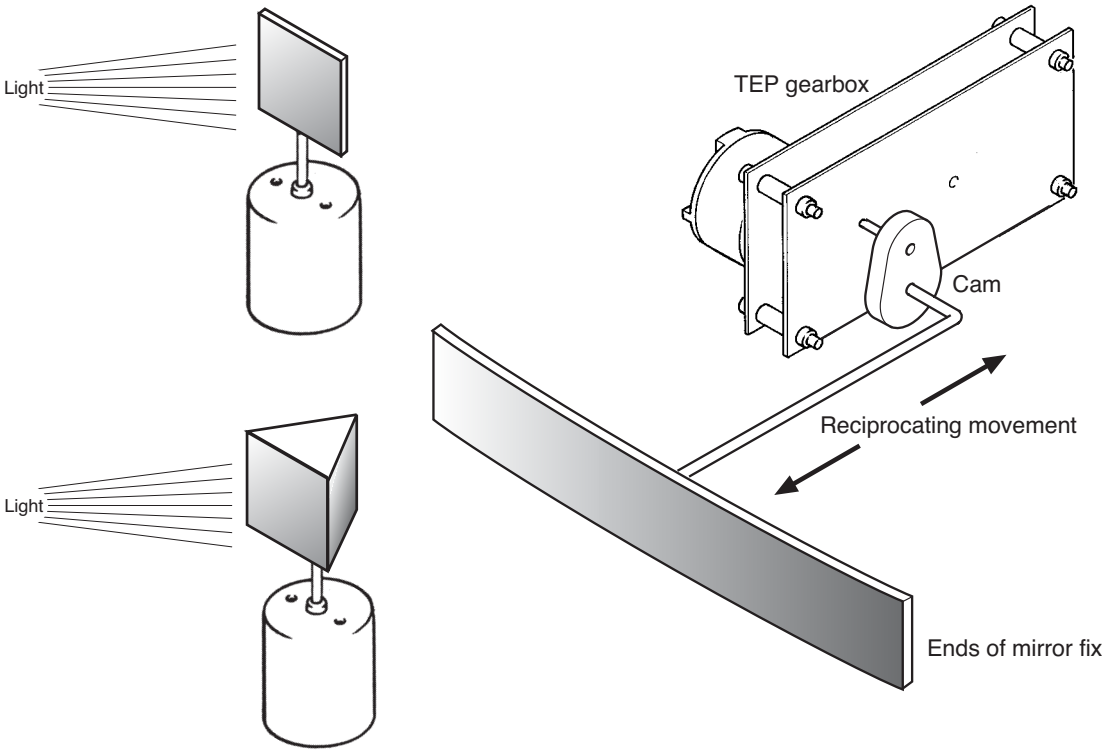
Components shown connected to outputs 2, 5 and 6. Note, if an electric motor is used it should be suppressed by connecting a small ceramic (0.2 - 0.5µF) capacitor across the terminals.

A programmable lighting display may use lamps that turn on or off in a special sequence - e.g. “chaser” lights that turn on one after the next in a straight line or circuit. Because the smartcard can be programmed for up to 100 lines, several lamps can be made to switch on and off in a very complex sequence - say - over an hour.

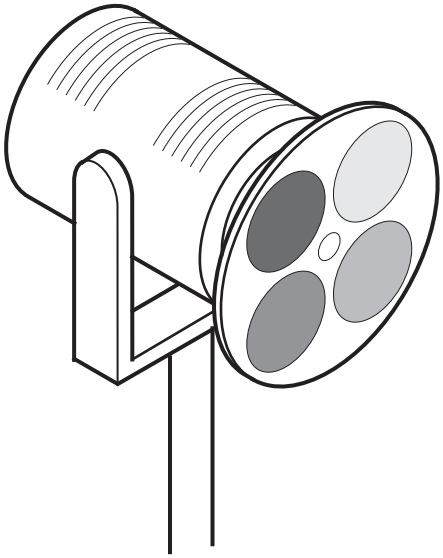
To supplement the effects of lamps turning on and off, lighting displays - especially in disco lighting - also use other optical effects.

These include moving mirrors, changing colour filters and moire effect screens.

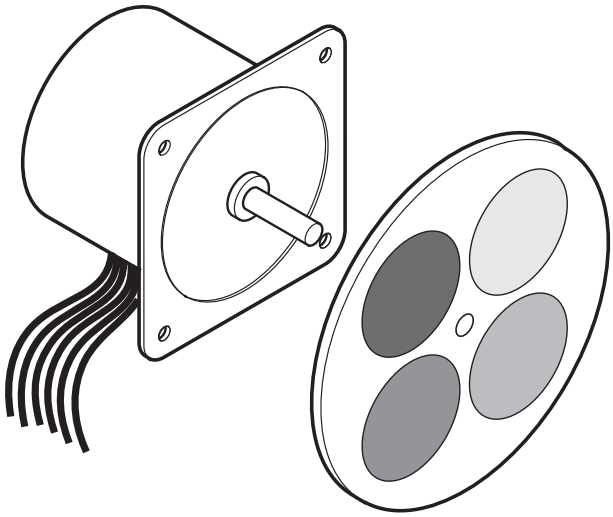
1. Moving mirrors.
Inexpensive mirrors are made from polystyrene with a reflective surface. These can be cut and drilled and heat formed. They can also be flexed to provide interesting optical effects. The illustrations give two methods of using mirrors driven by motors programmed to turn on and off.



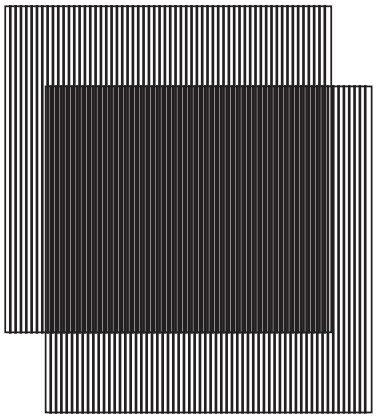
2. Colour changing filters.
Theatre spotlights are projected through coloured gels for special colour effects. These consist of thin plastic heat-resistant sheets which can be trimmed to size using scissors. They can be mounted in a colour-change wheel to make colour selection easy.



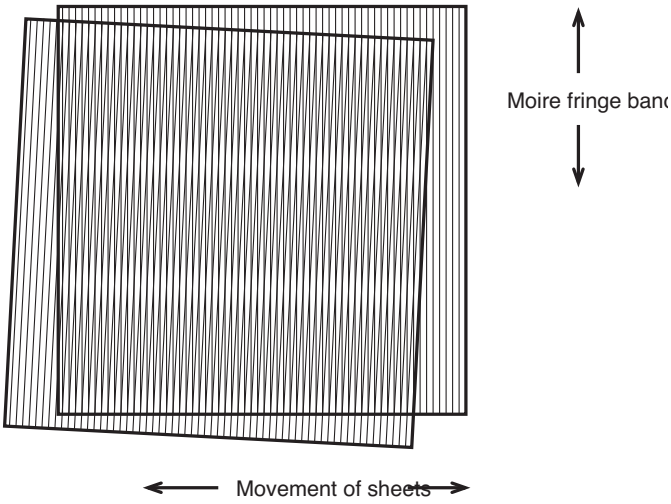
This kind of change wheel needs accurate indexation to ensure that the right filter stops at the right point each time there is a change. This can be achieved using a stepper motor to drive the wheel. A stepper motor is a special form of motor whose rotor (the turning part) moves in fixed steps when an electrical signal is applied to the coils. The Astrosyn 395 is a common type of stepper motor having a permanent magnet rotor surrounded by 4 coils. When these are switched on and off in the right sequence, the rotor moves around in steps of 7.5° . Four outputs of the controller will drive a stepper motor using either of the two 4-line programs below. The second program gives higher torque ("turning power").



3. Moire fringe effects.
A moire fringe is an optical effect that arises when two similar grid patterns are moved in relation to one another. Moire fringes sometimes appear when a cyclist or motorist moves under a bridge and looks through two sets of railings.



When a grid of parallel lines printed on acetate sheet is passed across an identical grid placed at a slight angle, you see wider dark bands passing down the sheet. These are moire fringe bands. They move rapidly and with great effect when the acetate sheet is moved very slightly.



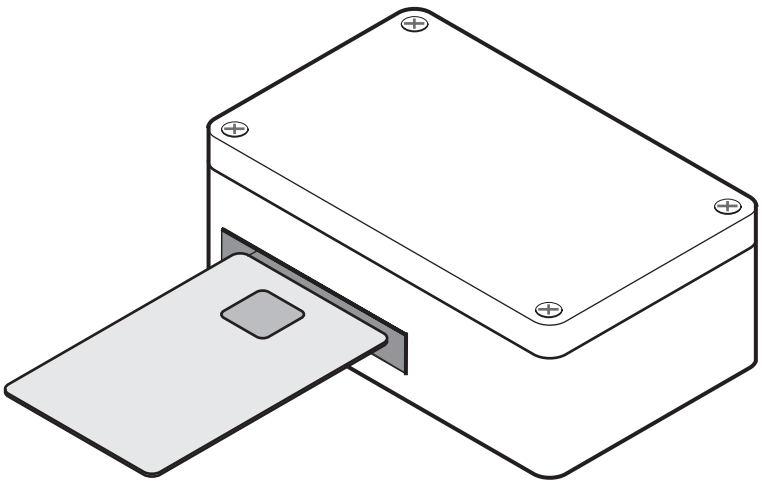
If two acetate sheets are placed in front of a lamp and moved to create moire fringe bands, the effect can be projected onto a wall or other surface. The acetate can be moved using a motor and gearbox or a length of smartwire connected to one output of the controller. Smartwire contracts by about 5% in length when heated with a small current. Because the wire takes about 2 seconds to cool and relax, the controller has to be programmed to give a slow cycle of movement.

PUTTING IT ALL TOGETHER

SYSTEM SYNTHESIS

The lighting display might consist of a combination of lamps mirrors and other optical parts. You must remember, however, that the controller has only 6 outputs - four of which could be taken up driving a stepper motor.

Ideally, the smartcard reader should be placed in a protective case leaving access for the card. The reset switch and indicator LEDs may be carefully unsoldered from the board and replaced with long leads to connect to components on the outside of the case. An on/off switch can also be added.



EVALUATING YOUR LIGHT DISPLAY

The evaluate your display, you must ask whether it meets your specification. You need to carry out a range of tests to see if it produces the optical effects you want. Here are some important points to look out for:

- *Do each of the optical effects work ? If not, is it a matter of adjustment ?*
- *Does the program work properly to control the display or is re-programming needed ?*
- *Does the display work reliably over a long period of time ?*
- *What do other people think of the display ?*
- *Is the lighting display safe ?*