ROCKET LAUNCHER

Rocket Launcher has the following features:

- capacitor-based firing system, more reliable than batteries alone
- detonator continuity test
- countdown time of 10 to 90 seconds
- alarm sound (can be muted)
- sprung connectors for easy wire attachment
- daisy chain for synchronised launches
- synchronisation delay of 0 to 9 seconds
- powered by four alkaline 1.5V AA cells
- detonation at ~14V (2 Joules of energy, 0.3 Amp seconds)

Construction

Construction is relatively straightforward. First solder the short piece of wire to the holes marked LINK. Then fit and solder the resistors R1 to R26 and trim their legs. Identify the resistors by the coloured stripes on the body. Next fit and solder the capacitors, paying attention to the polarity of the electrolytics C1 to C4 (negative is marked by a stripe on the side of the body). The ceramic capacitor C5 can be fitted either way around.

Then fit the diodes D1 to D3, transistor TR1 and regulator REG. The cathode end of the diodes is marked by a stripe on the body of the component, and on the pcb by a line on the symbol and a small 'k'. Be careful to distinguish the Schottky diode D1 from the Zener D2 (the latter is marked ‘15’). The symbols on the pcb indicate the orientation of the transistor and regulator (flat side of the component against the flat side of the symbol).

Solder FET1 to the board matching its metal heatsink side to the solid part of the symbol on the pcb. Solder LED1 matching the shorter leg (also flat on the rim) to the hole with the line.

Solder the PIEZO and inductor L1 either way around. Solder the pushbuttons S1 and S2.

Next fit the IC1 socket (matching the notch in the socket against the notch in the symbol on the board) and the dual 7-segment display (note the decimal points on the pcb symbol). Care should be taken when soldering these components to avoid solder bridges between the pins. It is not recommended that the PIC chip is soldered directly to the pcb.

Solder the terminal block CONN1 to the board within the marked outline, such that the orange levers are on the inside. Solder the jack sockets CONN2 and CONN3 (cut off the five small plastic lugs on the underside so they fit flush on the board).

Finally fit the PP3 battery snap. Support holes are drilled on the pcb for the battery snap leads. Feed the leads up through the support holes from the track side of the board and then down the solder holes. Red is positive and black is negative.

Don't fit the chip into its socket until you have thoroughly checked your construction. A good visual inspection should be the first stage. Check that all the components have been inserted correctly and that there are no dry joints and no solder bridges between pins. Match the notch in the chip to the notch in the socket when fitting the chip.

Rubber feet for the four corner holes are supplied (use pliers to pull them through the holes). Alternatively these holes can be used to mount the pcb within a small case.

Insert 4 AA cells into the battery box, observing the correct polarity. The cells used should be good quality non-rechargeable alkaline types (such as a Duracells) rather than rechargeable NiMH or NiCd types. Rechargeable cells can't be used because they only supply 1.2V and the minimum voltage requirement is 6V in total (4 x 1.5V). However 6 NiMH/NiCd AA cells could be used, or even a good 9V PP3 battery.

The software includes a power-on self-test. All the LEDs flash and *Rocket Launcher* beeps twice. If this happens then you know the power supply is okay, the processor is oscillating, and the display multiplexing is working.

How to Use

Connect your launch wires to the detonator in your rocket engine, then connect the other ends to the terminal block on the circuit board (by depressing the orange levers). As a basic precaution don't connect the wires to *Rocket Launcher* before connecting them to the engine.

The best type of launch wire to use is mains cable, heavy-duty speaker cable or any other thick wire. The launch wires should be no longer than necessary, as the longer they are the more energy is lost in the wires and not delivered to the detonator in the rocket.

The continuity status of the engine detonator is shown on the display as a rotating (closed circuit) or static (open circuit) pattern. If the static (two dashes) pattern is displayed this indicates there is a bad connection somewhere between *Rocket Launcher* and the engine, or that the detonator is faulty.

Press both pushbuttons together to start the launch countdown. As a safety feature it requires both buttons to be pressed simultaneously, pressing a single button by accident will not start the countdown. The countdown also won't commence unless a detonator is properly connected to the terminal block. The display will show "Er" if an open circuit is detected.

The large capacitors are first charged. The time taken to do this depends on how fresh the cells are. The LED flashes while the capacitors charge, and then remains on.

The countdown will then commence. *Rocket Launcher* will beep every second as the countdown proceeds, then an alarm will sound for the final 10 seconds (unless muted). When the count reaches zero the rocket will fire. Note that pressing either pushbutton will abort the countdown.

Various settings can be changed by pressing and holding down both pushbuttons for about two seconds. *Rocket Launcher* cycles through the settings while the pushbuttons are held down as follows:

- launch countdown time - 10 to 90 seconds in steps of 10 seconds (default = 20 seconds)
- synchronised launch delay - d0 to d9 seconds (default = 2 seconds)
- alarm enable - A0 = off, A1 = on (default = on)

Release the pushbuttons to alter a particular setting. The left pushbutton (S1) then decrements the setting, and the right pushbutton (S2) increments the setting. Pressing both pushbuttons together stores the new setting. Note that the settings are saved when the power is removed.

Multiple units can be daisy chained for synchronised launches. Simply connect them together using jack leads. Any unit can be the master and will control the other units in the chain. Slaves wait for the master to launch, then wait an additional synchronisation delay, launch themselves, and then signal the next unit in the chain.

For example, if a long chain is established with all the launch delays set to 2 seconds then a rocket will fire in sequence every two seconds.

Any pushbutton on any unit will abort the countdown on all units.

Component List

Resistors (all 1/4W 5% carbon film)

R1	1R (brown, black, gold, gold)
R2	47k (yellow, purple, orange, gold)
R3,R10	100k (brown, black, yellow, gold)
R4,R14-R21,R23	100R (brown, black, brown, gold)
R5,R8,R11,R22,R24	4k7 (yellow, purple, red, gold)
R6,R7	10k (brown, black, orange, gold)
R9,R12,R13,R25	1k (brown, black, red, gold)
R26	220R (red, red, brown, gold)

Capacitors

C1,C2	100uF electrolytic 16V (blue or black)
C3,C4	10,000uF electrolytic 16V (blue or black)
C5	100nF ceramic (brown, marked ‘104’)

Semiconductors

TR1	MPSA14 Darlington transistor (black)
FET1	MOSFET (black/silver)
D1	Schottky diode (black)
D2	15V Zener diode (black, marked ‘Z15’)
D3	4V7 Zener diode (orange)
LED1	5mm green
REG	LE50CZ 5V LDO regulator (black)
IC1	18-pin DIL socket + PIC16F628A-I/P microcontroller (A21X)
DISPLAY	0.56" dual 7-segment LED display, common cathode

Miscellaneous

LINK	wire link
PIEZO	piezo speaker (black)
L1	47uH inductor (black, marked ‘470’ or ‘473’)
S1,S2	miniature tactile pushbutton
CONN1	sprung terminal block (grey/orange)
CONN2,CONN3	3.5mm jack socket (black)
BATTERY	PP3 battery snap + 4 x AA battery box

PCB
Jack lead
4 x rubber feet