

**FRAGTAG**

# FragTag “Thor’s Hammer” Simulated Time Bomb Users Manual

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# FragTag Thor's Hammer User Manual

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## Introduction

Welcome to FragTag©, one of the world's only advanced, dual format commercial 'laser' tag systems that follows open standards. The FragTag Thor's Hammer is a hardware and software package that uses state of the art electronics to simulate the operation of a Time Bomb in a perfectly safe manner. This can add great variety to laser Skirmish scenarios; you can create games like in "Counter Strike" where players must plant and arm it in a target zone, or it could be planted and armed before the game starts and the players must locate the disarm code and enter it before it detonates.

Please note that this device is in no way suitable for any illegal or terrorist activities. It is no more suitable for these purposes than a common alarm clock. FragTag is in no way liable for any usage outside of its intended purpose, and we recommend that owners and users take care to avoid any possibility of confusing the public or law enforcement officers.

# Thor's Hammer Features

## Transmission Protocol

- ❖ Dual transmission protocol support, user selectable at power-up.
- ❖ Supports WoW (World of Wonder) compatible equipment.
- ❖ Supports MilesTag 56K – full support for the 'open' protocol, MilesTag (based on the industry standard 56kHz carrier frequency).

## Display

- ❖ Supports a 16x2 character LCD (liquid crystal display) for all system feedback information (English only).
- ❖ Onboard trimpot for adjusting LCD screen contrast.
- ❖ LCD backlight support with power saving timer. Activates when buttons are pressed.

## Sound

- ❖ Fully integrated programmable solid-state sound effects chip – based on the Winbond® ISD25xx series of Chipcorder® devices.
- ❖ Integrated 1-watt audio amplifier (requires speaker).

## Infrared Outputs

- ❖ When set to MilesTag mode, "radiation leak" feature that gives players a small amount of damage points every few seconds (not available in Wow mode)
- ❖ On detonation, multiple hits are given to any players in range.

## Special Features

- ❖ Tilt/motion sensing. If the device is tilted beyond a set angle in any direction, it can be set to detonate. This prevents players from moving the device (optional.)
- ❖ "Ticking" sound effects that get faster when it is closer to detonation

# Thor's Hammer PCB Layout

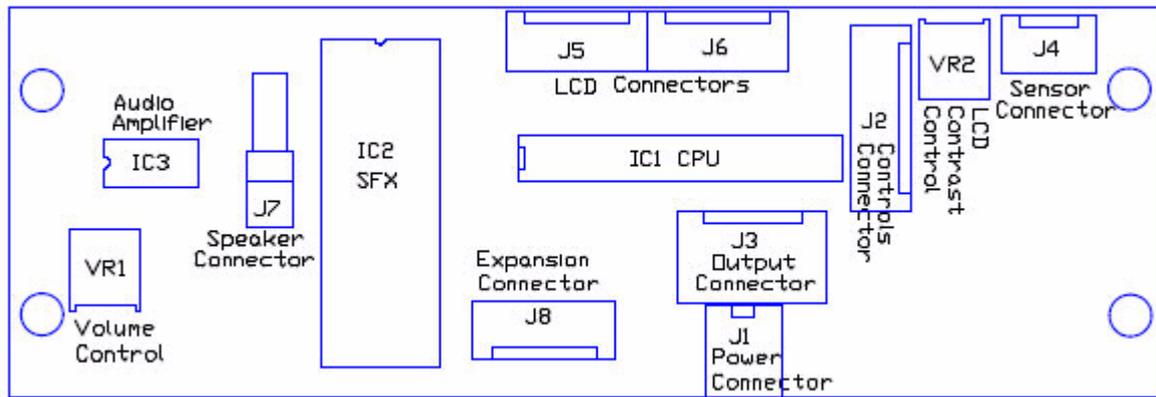


Figure 1. FragTag Thor's Hammer v1.2 main component layout

## Dimensions & Installation

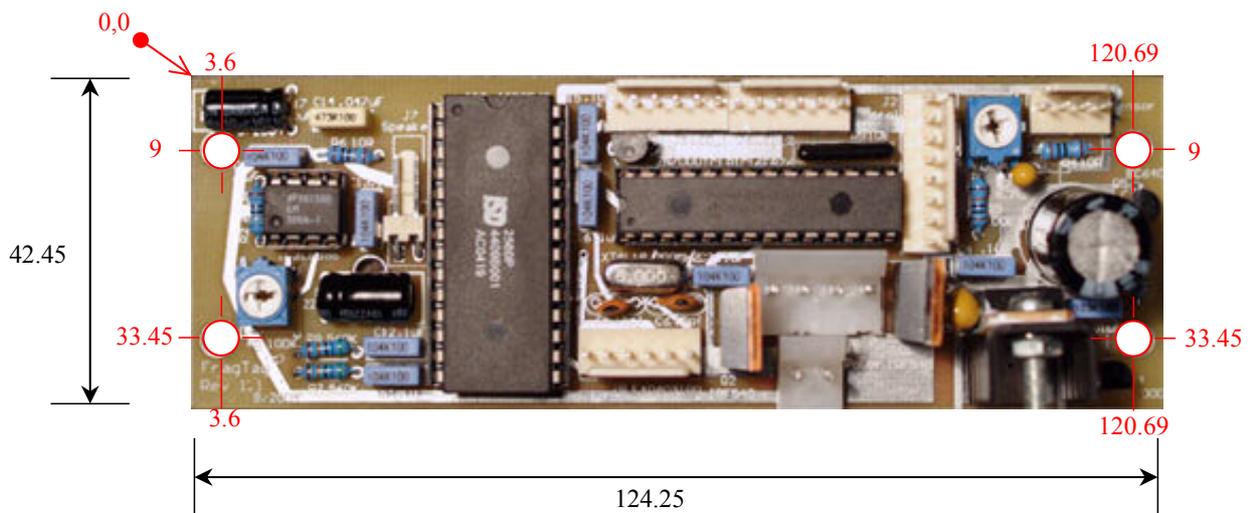
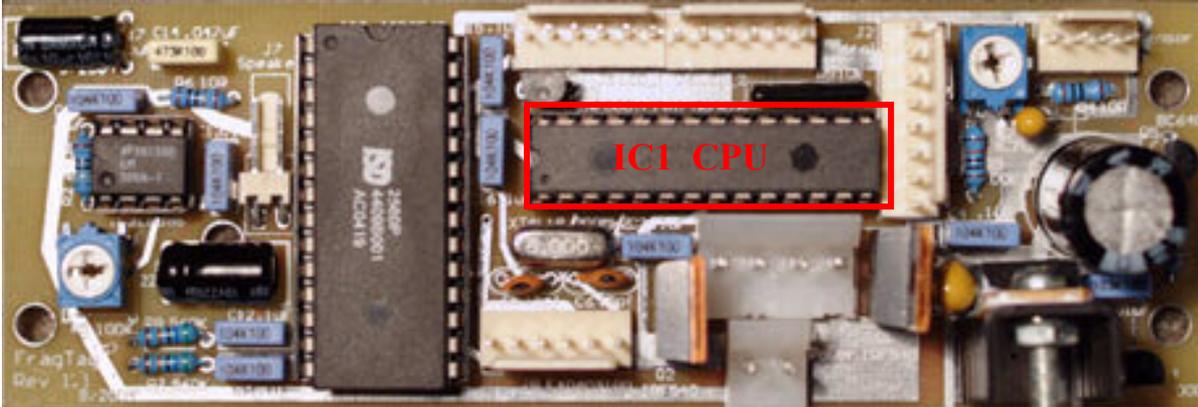


Figure 2. Thor's Hammer PCB dimensions and mounting holes highlighted in red (all dimensions in mm).

The PCB is provided with 4 (M4) mounting holes. Insulating washers (i.e. not electrically conductive) must be used on both surfaces of the mounting holes to prevent the board from shorting to any conductive surface inside the casing. Care must also be taken not to over tighten mounting screws to prevent damage to the board. Failure to follow these instructions will void the limited warranty.

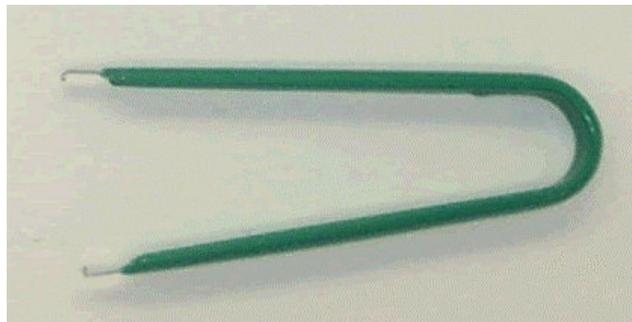
## Hardware Installation and Configuration

### IC1 – Central Processing Unit (CPU)



**Figure 3. IC1 Central Processing Unit (CPU)**

The FragTag Thor's Hammer operates with a pre-programmed MicroChip® PIC16LF876A microcontroller (see Figure 3). The mainboard uses a 28-pin narrow IC socket for easy CPU installation/removal. Care must be exercised when inserting and removing the CPU so as to prevent damaging the IC pins. It is recommended the operator is sufficiently 'earthed' to prevent static electricity from damaging the CPU. An 'IC extraction tool' is also recommended for removing and inserting the CPU (refer Figure 4). Bent or otherwise damaged CPU pins are not covered under the limited warranty.



**Figure 4. IC extraction tool.**

## IC2 – Sound Effects Controller (SFX)

The FragTag Thor's Hammer PCB is equipped with a pre-programmed WinBond® ChipCorder ISD2560 for storing all the required sound effects (see Figure 5). The mainboard uses a standard 28-pin IC socket for easy SFX Controller installation/removal. Care must be exercised when inserting and removing the SFX Controller so as to prevent damaging the IC pins. It is recommended the operator is sufficiently 'earthed' to prevent static electricity from damaging the SFX Controller. We recommend the use of an 'IC extraction tool' for removing and inserting the SFX Controller (refer Figure 4).

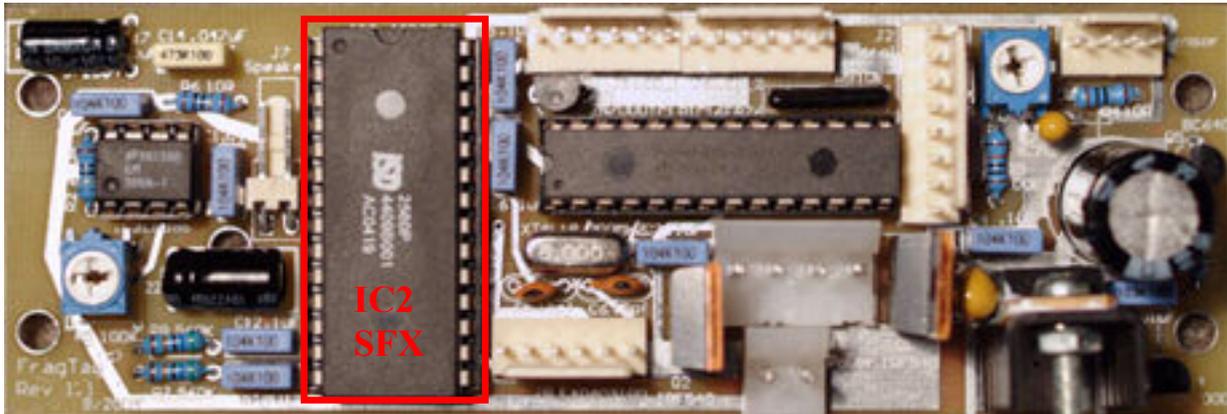


Figure 5. IC2 Sound Effects Controller (SFX)

## Sound List

The SFX controller does come pre-recorded with a set of quality sound effects, however, the following information is provided for those who may wish to customize their sound effects. The system uses a list of pre-recorded sound effects for various system events, such as explosion, arming etc. A specific order of sound effects is required for the proper function of the SFX. Each sound event can be of varying length, but the total recorded time (i.e. All sound events) must not exceed the chip's capacity of 60 seconds. All sound event slots must be filled to preserve the list numbers of sound events. The sound list is as follows:

List #	Sound Event Label	Notes
1	Fast Beep	Played as the device is very close to detonation
2	Medium Beep	Played as the device is nearing detonation
3	Slow Beep	Played as the device is a long way from detonation
4	Keypad	Played every time a key is pressed
5	Armed	Played when the device is armed
6	Disarmed	Played when the device is disarmed
7	Detonate	Played when the device detonates
8	Game start	Not currently used
9	Game stop	Not currently used
10	Boot up	Played as the device is first switched on

For some hints and tips on recording your own sound effects on the ISD25xx series chips please refer to our website ([http://www.fragtag.com.au/ISD\\_recorder.htm](http://www.fragtag.com.au/ISD_recorder.htm)).

## VR1 Volume Control

The volume can be set by adjusting this trimpot (see Figure 6). It is recommended that the volume be adjusted down to prevent distortion at the speaker. The actual level will be determined by the specifics of the speaker that is connected.

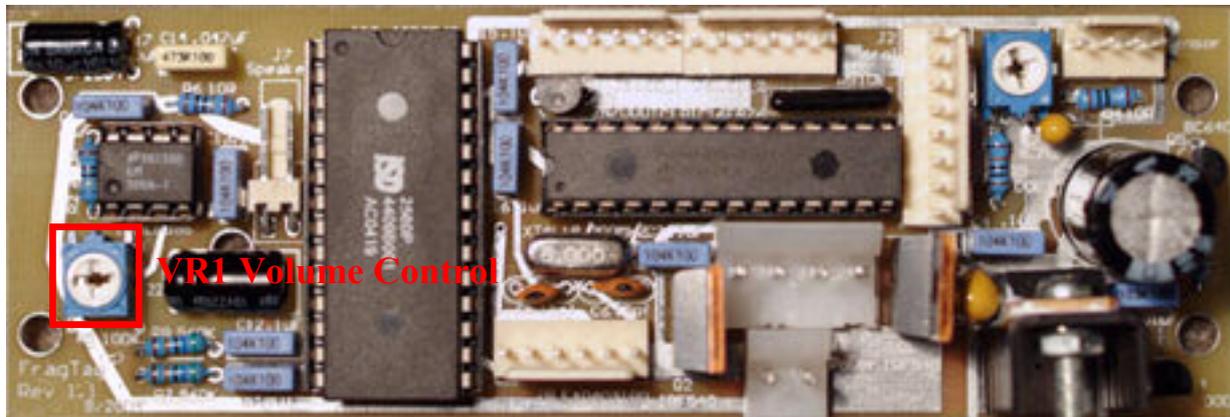


Figure 6. VR1 Volume Control Trimpot

## VR2 LCD Contrast Adjustment

The contrast of the LCD display may be set by adjusting this trimpot (see Figure 7). Generally this control will be set (if the board was supplied with a LCD), otherwise the contrast will need to be adjusted to suit the particular LCD model being used.

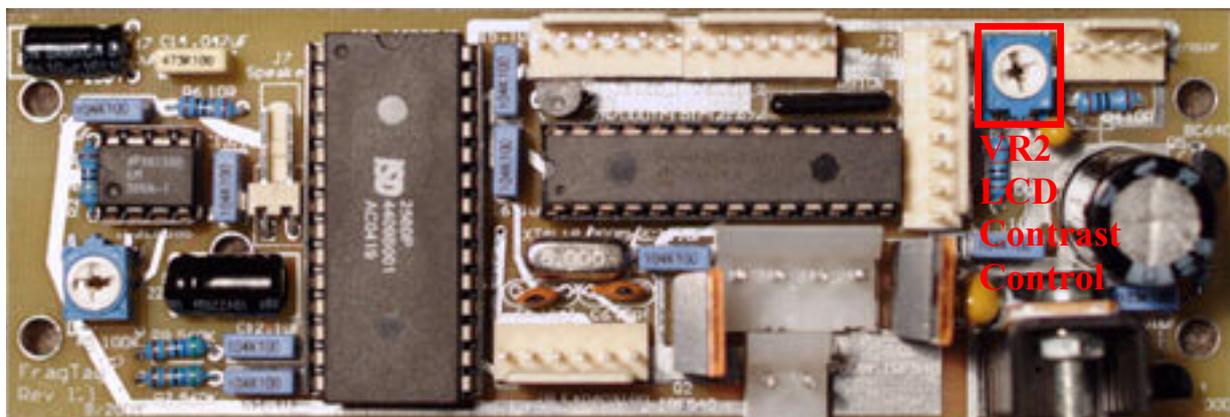


Figure 7. VR2 LCD Contrast Control

## J1 – Power Connector

J1 (refer Figure 8) requires a 2-way standard .156" polarised and locking header socket. The FragTag Thor's Hammer PCB requires a battery source of 7.2v and is connected here to J1. From left to right the pins are:

- 1- GND
- 2- +7.2v

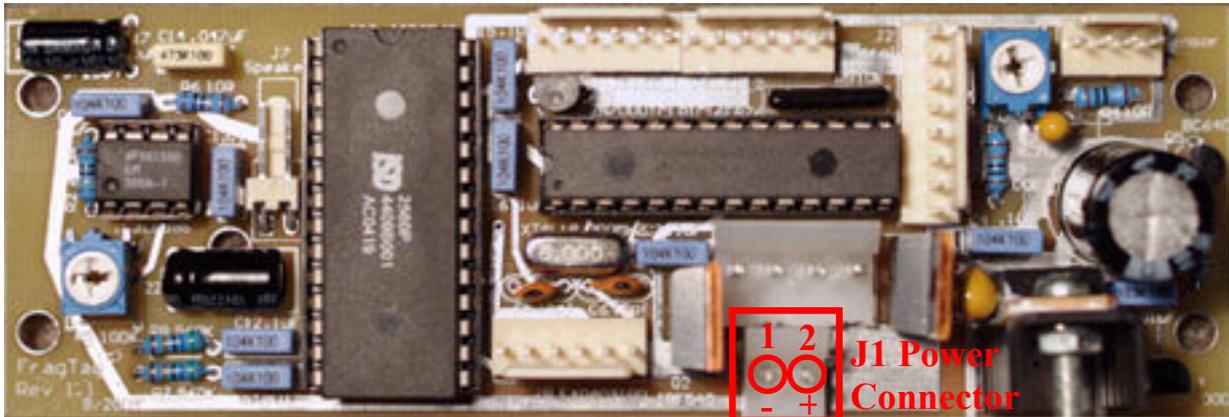


Figure 8. J1 - Power Connector

We recommend the use of a 7.2v rechargeable NiMh battery pack commonly used in radio controlled cars (refer Figure 9). The exact specifications can vary but we suggest obtaining a battery pack with a supply of at least 2000mAh capacity (3000mAh preferred).



Figure 9. Suggested Battery supply. A typical RC model car 'racing pack'

It is suggested that a keyswitch be mounted in the device to turn off the power supply to the board and a switched DC jack port be installed for charging the batteries without having to remove them from your casing. We provide a schematic for your reference of the suggested power sub-circuit (Figure 10). A switched DC jack port used in this configuration isolates the board from the charging supply providing an extra level of protection from mains supply in the event a fault occurs with the charger.

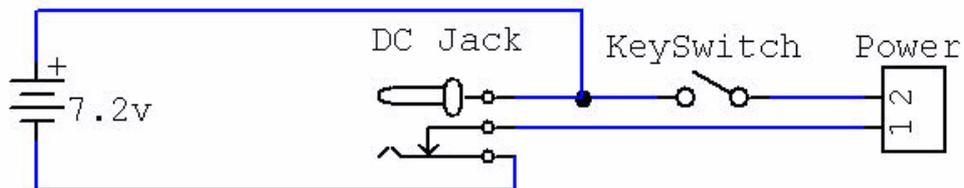


Figure 10. Suggested Power sub-circuit.

## J2 and J8 Keypad and Tilt Switches Connector

J2 (refer Figure 11) requires a 8-way standard .100" polarised and locking header socket. J2 is the connection for part of the Keypad (pins 2,4,6,7 of the keypad.)

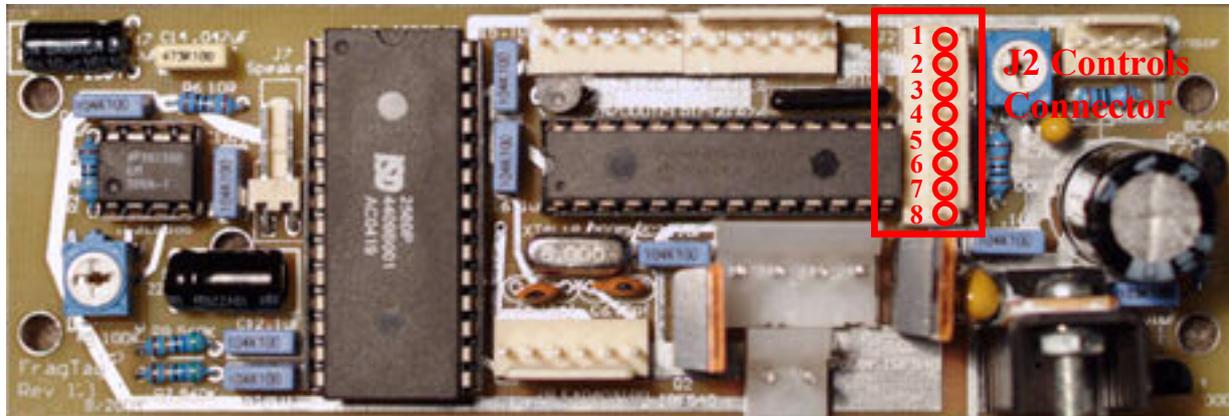
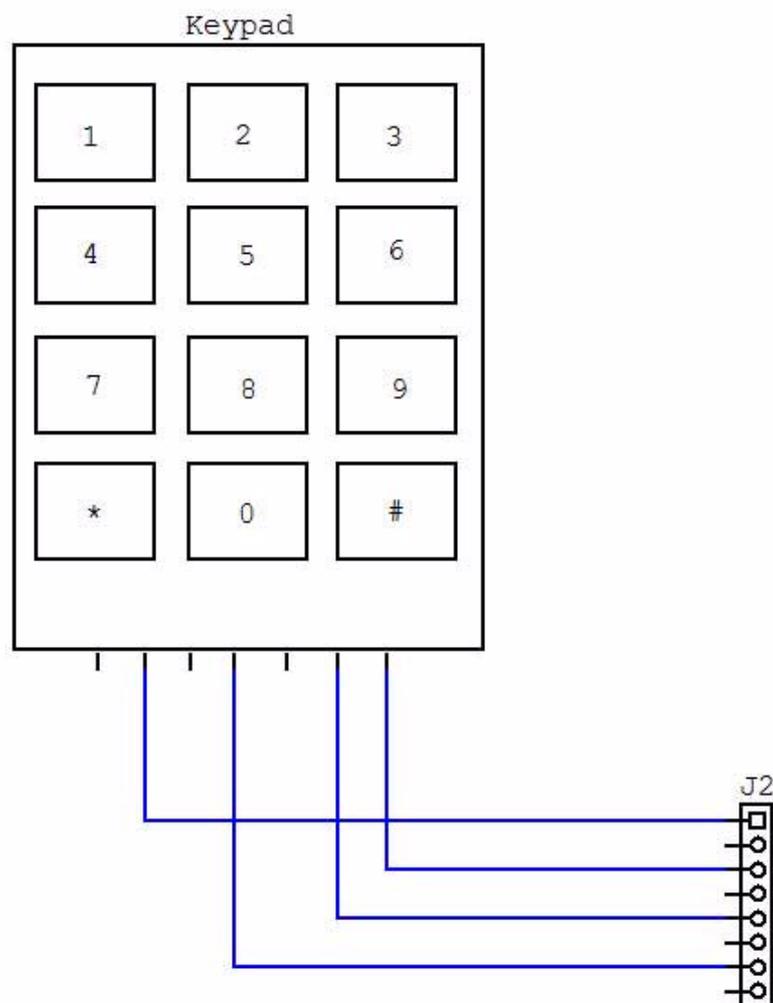


Figure 11. J2 Keypad Connector



J8 (see Figure 12) requires a 6-way standard .100" polarised and locking header socket. This is the connection for the remainder of the Keypad (pins 1,3,5) and for the Motion sensing tilt switches.

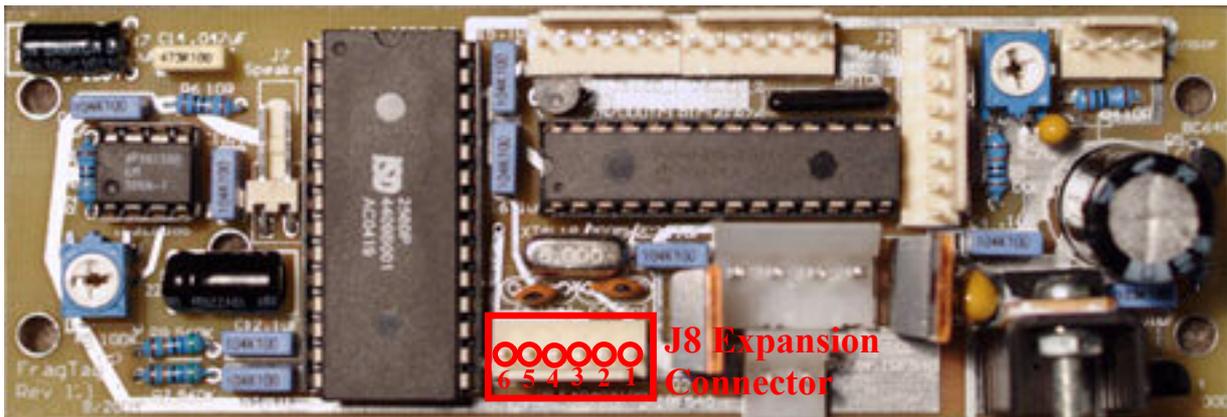
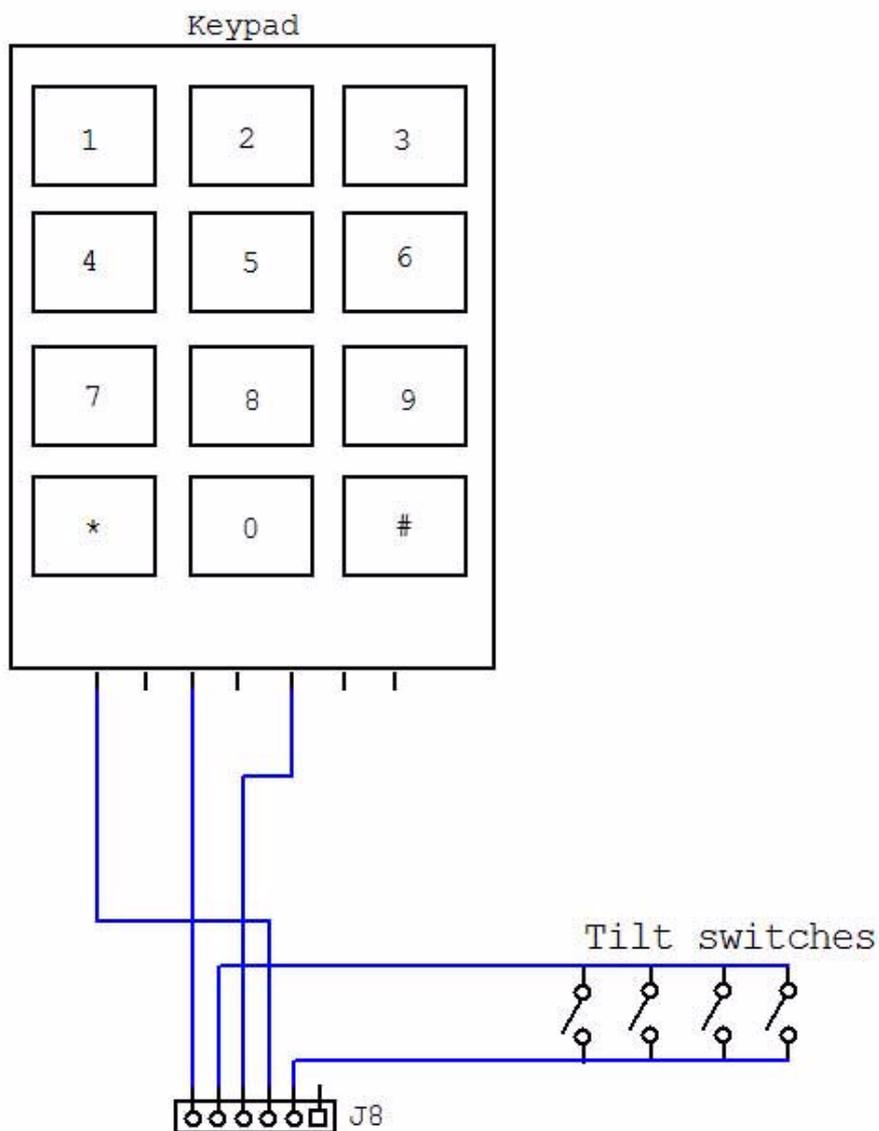


Figure 12. J8 Keypad and Tilt Switches Connector



### J3 Output Connector

J3 (refer Figure 13) requires a 4-way standard .156" polarised and locking header socket. J3 is the connection for the LED outputs for the primary fire and secondary infrared led outputs

\* **NOTE** \* All LED's require a load resistor to be connected in series with the respective LED. Load resistors are not installed on the mainboard. The pinouts from left to right of J3 are:

- 1- Primary Output LED +ve
- 2- Primary Output LED -ve
- 3- Secondary Output +ve
- 4- Secondary Output -ve

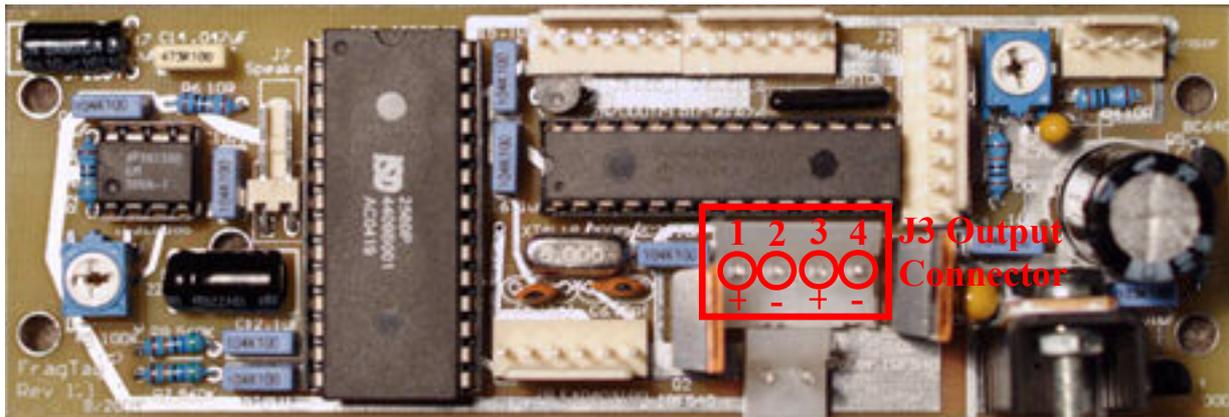


Figure 13. J3 Output Connector

Primary and Secondary outputs are both fired together when the device detonates, and are provided to simplify the wiring of multiple leds to cover a larger area. You can use either or both outputs to wire one or many leds. We recommend to not exceed 4 amps of total current per output.

The suggested IR LED to be used with the board is the TSAL6100. **An external resistor must be used to limit the current through the LED to prevent overdriving and damaging it.**

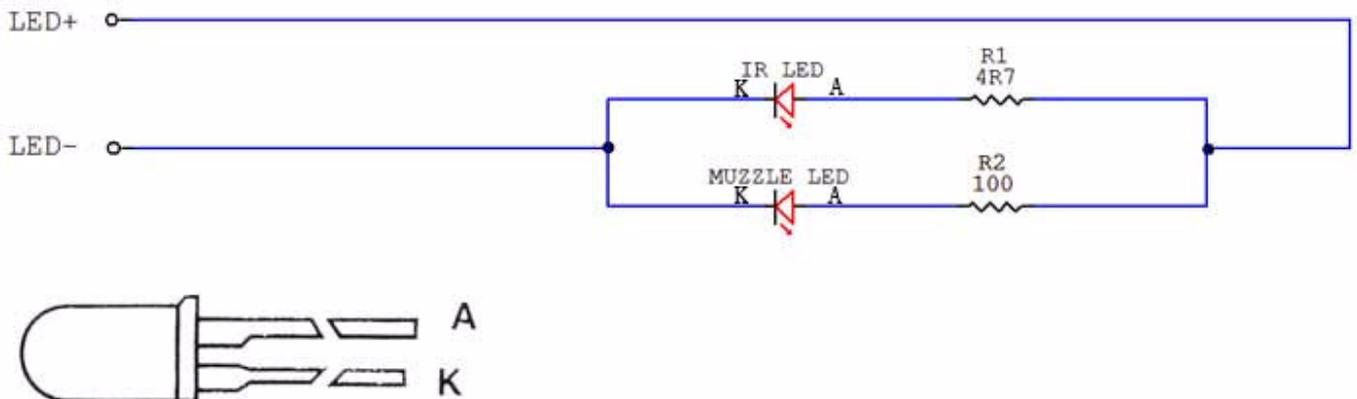


Figure 14. LED Wiring

In this schematic a “muzzle flash” led is also shown; this is a visible led that can optionally be connected to give a bright flashing output that will be visible to players.

The value for R2 Muzzle Flash LED resistor can be calculated from the peak current capability of your LED:

Resistor value (ohms) =  $5.6 / \text{LED peak current in Amps}$

**Example: for a LED with a peak current of 150 mA, Resistor =  $5.6 / 0.15 = 37$  ohms**

Lower values can be used if desired but may result in led burnout.

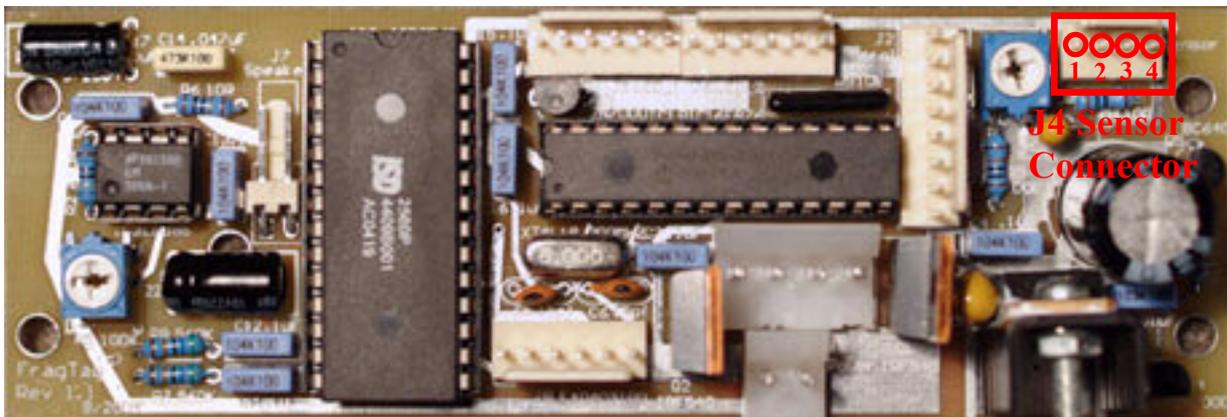
## Suggested Infrared LED Mounting Locations

We recommend the following locations for the IR Leds:

- ❖ 1 near the keypad, facing upwards towards anyone using the keypad.
- ❖ For a rectangular box, 2 on each side of the long sides, angled at 45 degrees to each other, and pointing on an upwards angle.

## J4 Sensor Connector

- 1- J4 (refer Figure 15) requires a 4-way standard .100" polarised and locking header socket. J4 is not currently used on this product.



**Figure 15. J4 Sensor Connector**

## J5 & J6 LCD Connectors

J5 and J6 (see Figure 16) each require a 6-way standard .100" polarised and locking header socket. The FragTag Thor's Hammer requires a 16x2 character LCD for displaying system messages. The LCD needs to be connected to the mainboard at J5 and J6. Most LCD displays follow a 16-pin convention. As this product uses the 4-bit data transmission protocol for communicating with the LCD display, only 12 of the 16 pins are required. J5 and J6 are numbered from left to right as follows:

### J5

- 1- Backlight GND
- 2- Backlight +5v
- 3- Data Bit 7
- 4- Data Bit 6
- 5- Data Bit 5
- 6- Data Bit 4

### J6

- 1- Enable Signal
- 2- Read/Write
- 3- Register Select
- 4- Contrast Adjust
- 5- Vcc (+5v)
- 6- GND

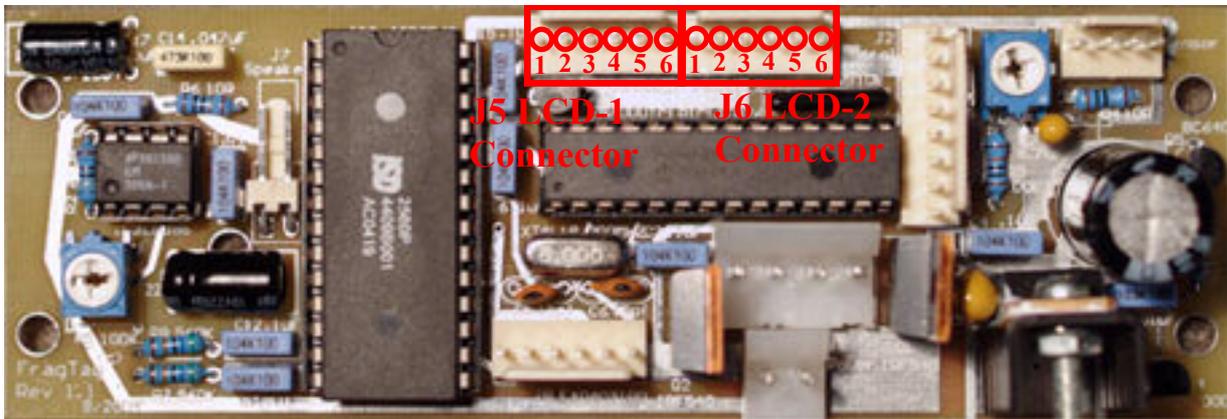


Figure 16. J5 & J6 LCD Connectors

Provided below is a table of the LCD pinouts and corresponding board connections for reference. Please note each LCD module may not necessarily follow this convention and the documentation for your particular model should be consulted first. FragTag supplied LCDs will all follow this table.

Table 1. Common LCD pinouts & Corresponding FragTag Mainboard Connections

LCD Pin*	Mainboard Pin	Function	LCD Pin*	Mainboard Pin	Function
1	J6-6	GND	9	Not Connected	
2	J6-5	VCC(+5V)	10	Not Connected	
3	J6-4	Contrast ADJ	11	J5-6	Data Bit 4
4	J6-3	Register Select	12	J5-5	Data Bit 5
5	J6-2	Read/Write	13	J5-4	Data Bit 6
6	J6-1	Enable Signal	14	J5-3	Data Bit 7
7	Not Connected		15	J5-2	Backlight +5v
8	Not Connected		16	J5-1	Backlight GND

\* LCD pinouts listed are what is most common on a 16x2 LCD display; however check pinouts on your LCD to verify this first.

## J7 Speaker Connector

J7 requires a 2 way standard .100" polarised and locking header socket. J7 is the connection point for a speaker (see Figure 17). Two 8-ohm speakers of at least 68mm are recommended, connected in parallel. It may be necessary to adjust the volume control (VR1), for the particular speaker to prevent distortion (too loud). The pinouts for J7 from left to right are:

- 1- +ve Speaker
- 2- -ve Speaker

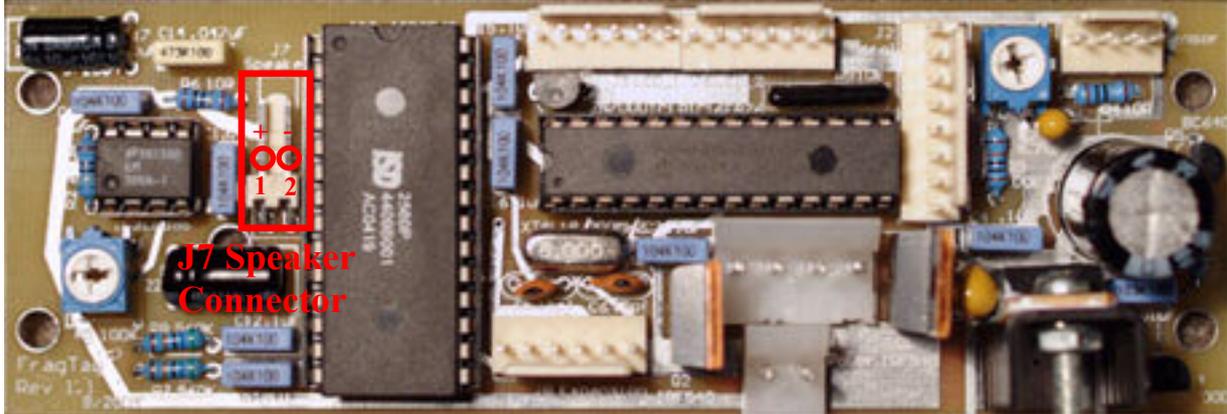


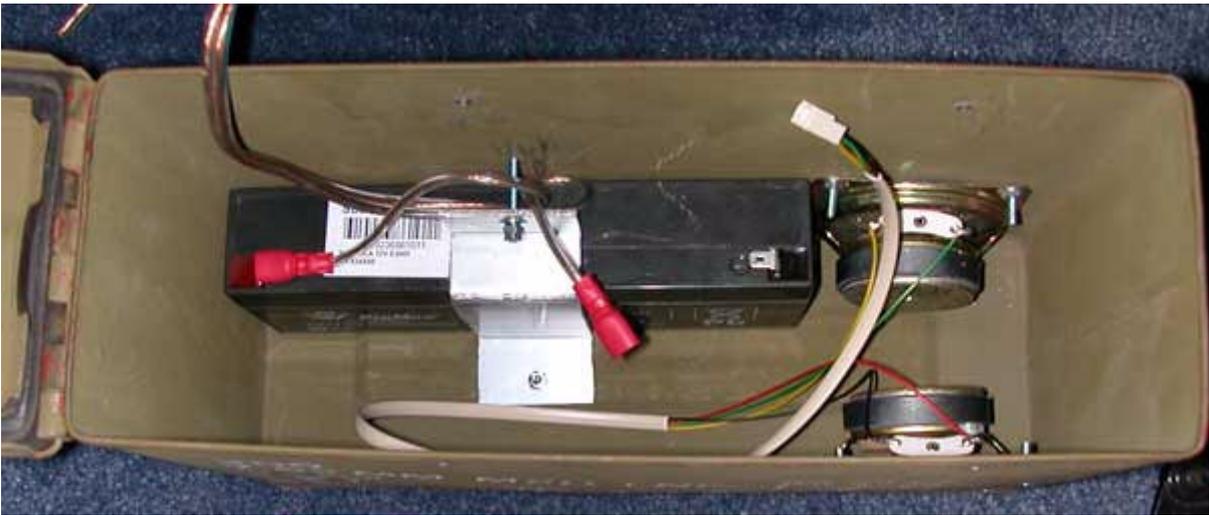
Figure 17. J7 Speaker Connector

## Examples of Completed Installations

Here are some photos of completed Thor's Hammer for reference. The box used here is an ex-army ammo box, purchased for A\$10 from a local surplus disposals store.







## Setting the Configuration

When the device is switched on, you will be shown the current configuration settings on the LCD display:



Protocol setting. (MLS = MilesTag, WOW = Wow)

Motion Sensing enable (1 = on, 0 = off)

Detonation Time in minutes (here 180 minutes, or 3 hours)

If the shown settings are what you desire, simply wait a few seconds and Thor's Hammer will finish booting up and will be ready for use.

If you wish to change the configuration, press the # key on the keypad. This will take you to the configuration menus.

Configuration settings are saved in a manner that are retained even when the power is switched off.

## **Configuring Detonation Time**



This menu item allows you to set the time in Minutes before the device detonates, after it has been armed. Enter a value using the numbers on the Keypad, and then press the # key to accept it and move to the next configuration menu.

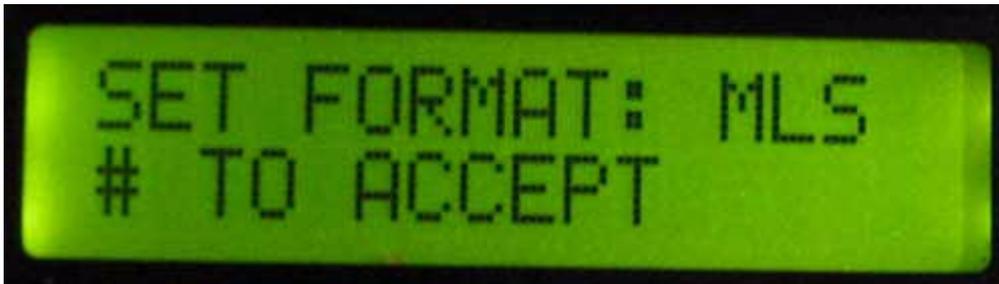
## Configuring Motion/Tilt Sensing



This menu item allows the enabling/disabling of the motion/tilt sensing feature. When set to a value of 1, the device will detonate when any of the tilt switches are activated. When set to 0 the sensors are ignored.

Press any button on the keypad from 0 to 9 to toggle the setting between 1 or 0, and press # to accept the setting and move to the next menu.

## Configuring the Protocol



This menu item allows the setting of one of two "protocols." The MLS setting is for use in "MilesTag" mode, a highly advanced digital protocol that is the usual setting on FragTag equipment. The WOW setting is for compatibility with Battlefield Sports™ and other standard "Worlds of Wonder" compatible equipment, or for FragTag equipment when also set to Wow compatibility mode.

**This setting is very important; if set to WOW mode, a FragTag gun set to MilesTag mode will not take hits from the device. When set to MLS mode then BFS equipment will not take any hits from the device.**

## Entering the Arm Code

After the configuration has been completed (or after a few seconds without the # key being pressed after power on) the main idle screen will be displayed:



The upper line tells you that the device is not currently armed. The bottom line is requesting an "Arm Code." An Arm Code is any 4 digit number that you choose. In order to defuse the device, the same code number must be entered as was used to arm the device.

In typical scenario's the Arm Code is written on a piece of paper and placed such that a team can locate it and enter the value.

To enter an Arm Code, type the number on the Keypad, and then press the # key. Pressing the # key will start the Arming of the device. If you make a mistake and press the wrong key, pressing the \* button will clear the number and let you start again.

## Arming



Once you have entered the Arm Code and pressed the # key, the above is shown and the Arming sound effect is played. You now have 16 seconds to clear the area before any "radiation leaks" begin and the device starts to count down.

## Counting Down

Once the Arming period has expired, the device will arm and begin counting down.

Time until detonation, in hours:minutes:seconds



During this time, the “beeping” sounds will be heard. These start out slowly, and get faster as the detonation time approaches.

During this time, if you have selected MilesTag mode then “radiation leak” damage will be released from the device every few seconds. Anybody in range will take two points of damage from their health for every hit, and their FragTag gun will show “RADIATION DAMAGE: 2” on the screen.

In Wow mode, this radiation leak feature is not possible.

## Disarming

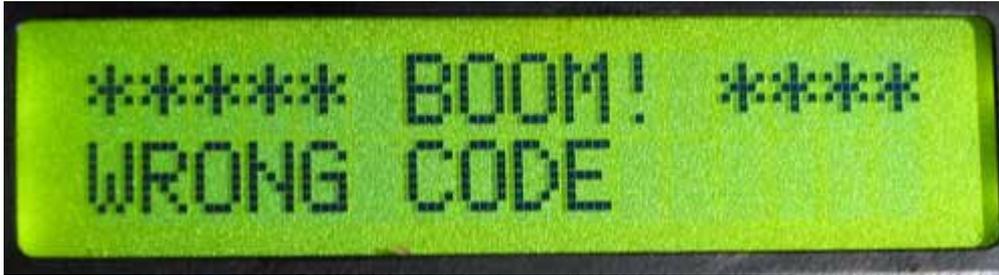
To disarm the device, enter the same code as was used to arm, using the keypad. Press the # key to accept the code, or the \* key to cancel and try again.



Once the correct code has been entered, the device will show DISARMED on the screen and will stop counting down.

## **Wrong Disarm Code**

If the incorrect disarm code is entered, the device will detonate immediately.



The display shows “WRONG CODE” so that the game referee is able to determine the cause of the detonation.

When the device detonates, any nearby players will receive damage. In MilesTag mode, this will usually be sufficient to kill a player. In Wow mode the amount of “lives” taken will depend on the hit delay of the system used. The infrared outputs will fire 3 times per second for a total of 6 seconds, and a loud explosion sound will be heard.

## **Motion Detection**

If the motion sensing feature is enabled (refer to configuration section) then any tilting of the device or sudden moves are likely to cause the device to detonate.



The display shows “MOTION DETECT” so that the game referee is able to determine the cause of the detonation.

## **Resetting**

After any detonation, the device must be reset by switching the power off and then on again.