Application Note: Building freETarget

SUMMARY

This application is a one document starting point for building freETarget from scratch. The document is organized as:

- Building the target frame
- Installing the circuit
- Downloading the PC software
- Starting up
- Trouble shooting

The example shown here is made from plywood and plastic. You may choose to assemble it with different materials.

REQUIRED

- freETarget circuit
- Internet connection
- Hand tools
- Patience

INTRODUCTION

freETarget is an open source project to provide shooters with a low cost electronic target. One of the objectives is that the materials needed to make the target will be sourced from around the world and will be dependent on what is available locally. To do this, much of the initiative to tailor the construction to your skills and parts availability is comes from people like you.

This application note provides the basics to construct freETarget. Read all of the instructions before starting. You may have to change materials or operations based on what you have at hand.

BUILDING THE TARGET FRAME

The target frame holds the target and sensors in the correct position to record the shot. The assembly can be made of anything local, such as

- Plywood
- Plastic
- Metal
- 3D Printing
- Cardboard

A side view of the target assembly is shown in Figure 1.

Item	Description	Notes
Front Face	Face plate used to protect the circuitry and sensors	Should be made from a material that will withstand a pellet strike
LED Illumination	LED lightning strip attached to the front face to light the target	Can be obtained from a local hardware store
Face Sensor	Duplicate sensor mounted to the front face to detect a shot to the front face	Operation dependent on the material used for the front face.
Sensor	Four microphones located around the target to detect the shot	Pay careful attention to the locations stenciled on the circuit board. Sensors may be located anywhere between the front face and pellet trap.
Flat Cable	Routes from the Arduino board to the sensors	End marked with an A is the Arduino end of the cable
High Pass Filter	Small board that installs between the flat cable and Arduino	Used to attenuate report from gun
Sensor Block	Mounting block to hold sensor parallel to direction of shot	May be any non-conductive material.
Sensor Support	Back frame to hold the sensors in the correct location and orientation	
Target	Target	May be located anywhere between the front face and pellet trap.
Pellet Trap	Pellet Trap	Used to collect pellets after shooting. May be omitted if shooting on a range with a berm.
USB Cable	Fifteen meter USB cable	May be purchased locally or on line

IMPORTANT

The orientation of the sensors NORTH to WEST is as seen looking from the firing point through to the pellet trap. If you choose to mount the sensors <u>behind</u> sensor support the orientation will appear reversed.
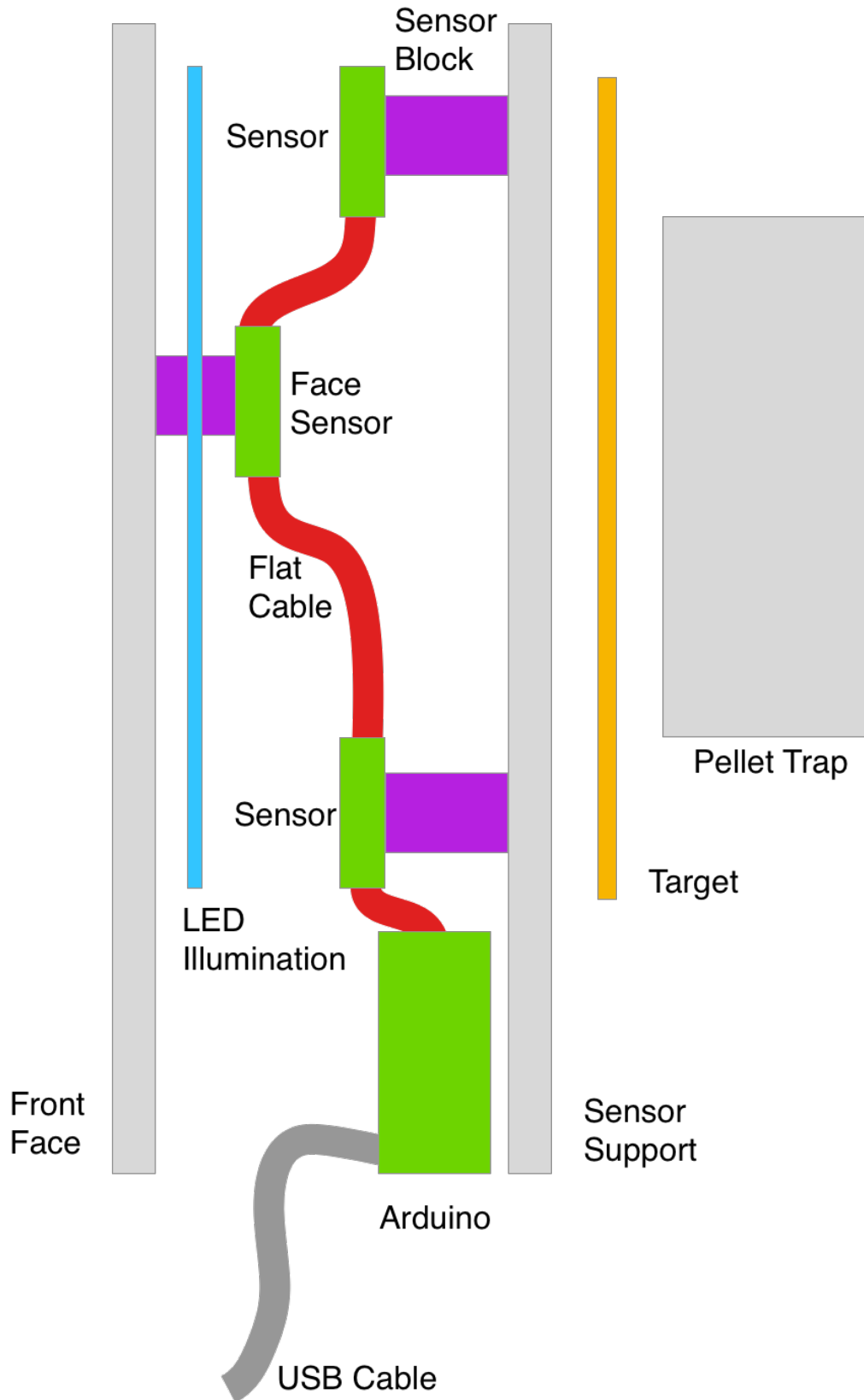
Figure 1: freETarget Layout

The only thing that is important is that the sensors be mounted at the corners of the target at a distance of 230 mm sensor-to-sensor. Figure 2 illustrates the geometry of the sensors as viewed from the firing point
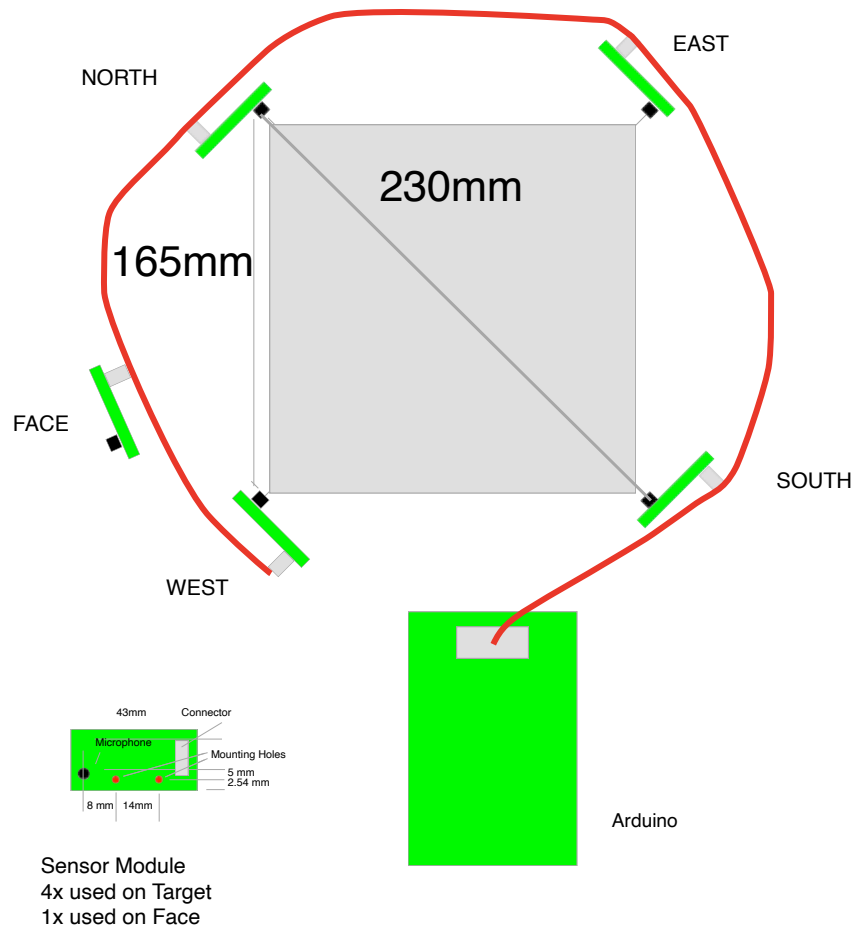

EAST

NORTH

230mm

165mm

FACE

SOUTH

WEST

43mm   Connector

Microphone

Mounting Holes

5 mm
2.54 mm

8 mm   14mm

Arduino

Sensor Module
4x used on Target
1x used on Face

Figure 2: Sensor Geometry

The example shown in this Application Note is made from plywood and plastic. Figure 3 is an illustration of a target holder.   Figure 4 shows a sample sensor block
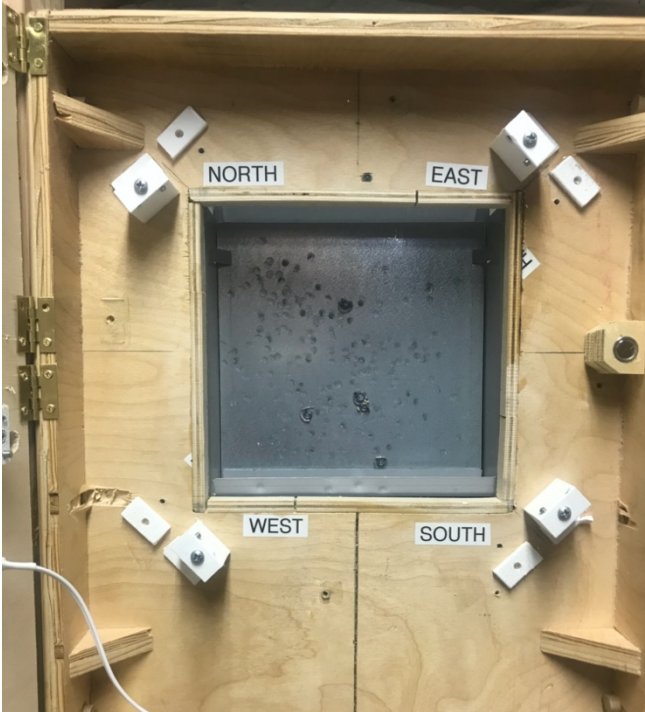
Figure 3: Plywood Target Holder

Figure 4: Sensor Block

Begin by cutting a rectangular frame and square target hole. The frame can be as large as you like, and the target hole has to be big enough to hold the target in place. The stencil given in Appendix A may be used to locate the parts.

IMPORTANT

You may need to scale the printed stencil for your printer. The 50mm reference is provide for this purpose.

The sensor mounting blocks are rectangular blocks of plastic 12mm x 25 mm x 27mm. Yours can be larger or smaller or made of any non-conducting material that you have available. Drill two holes in the top of the sensor block to mount the sensor boards (See Figure 5).

Attach the sensor blocks to the target frame in the correct location.

Attach the sensors to the blocks using the mounting holes. Use 5 minute epoxy to attach the mounting blocks to the target holder on the lines marked above. Before the epoxy cures, align the sensors to the diagonal lines and make sure that they are 230mm apart.

Once the epoxy hardens put an additional bead around the base to prevent any movement.

Locate the bullet trap behind the target holder.

INSTALLING THE SENSORS

The next step is to install the sensors.

Note that the sensors are marked

- NORTH
- EAST
- SOUTH
- WEST
- FACE (more about that later)

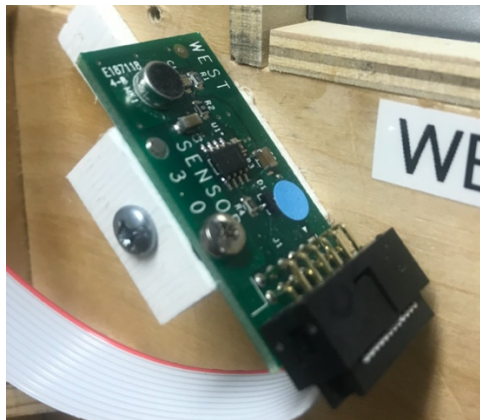Install each of the pellet sensors as shown in Figure 5 Sensor Installation

Figure 5: Sensor Installation

Install the Arduino at the bottom of the target holder and install the flat cable around all of the sensors as shown in Figure 6.

Note the location of the high pass filter. The flat cable is inserted into the pins on the filter board, and the board inserts into the cable socket. Be careful to center the cable into the board and the board into Arduino board. On later versions of the high pass filter the connectors are polarized and the red stripe will be on the opposite side.
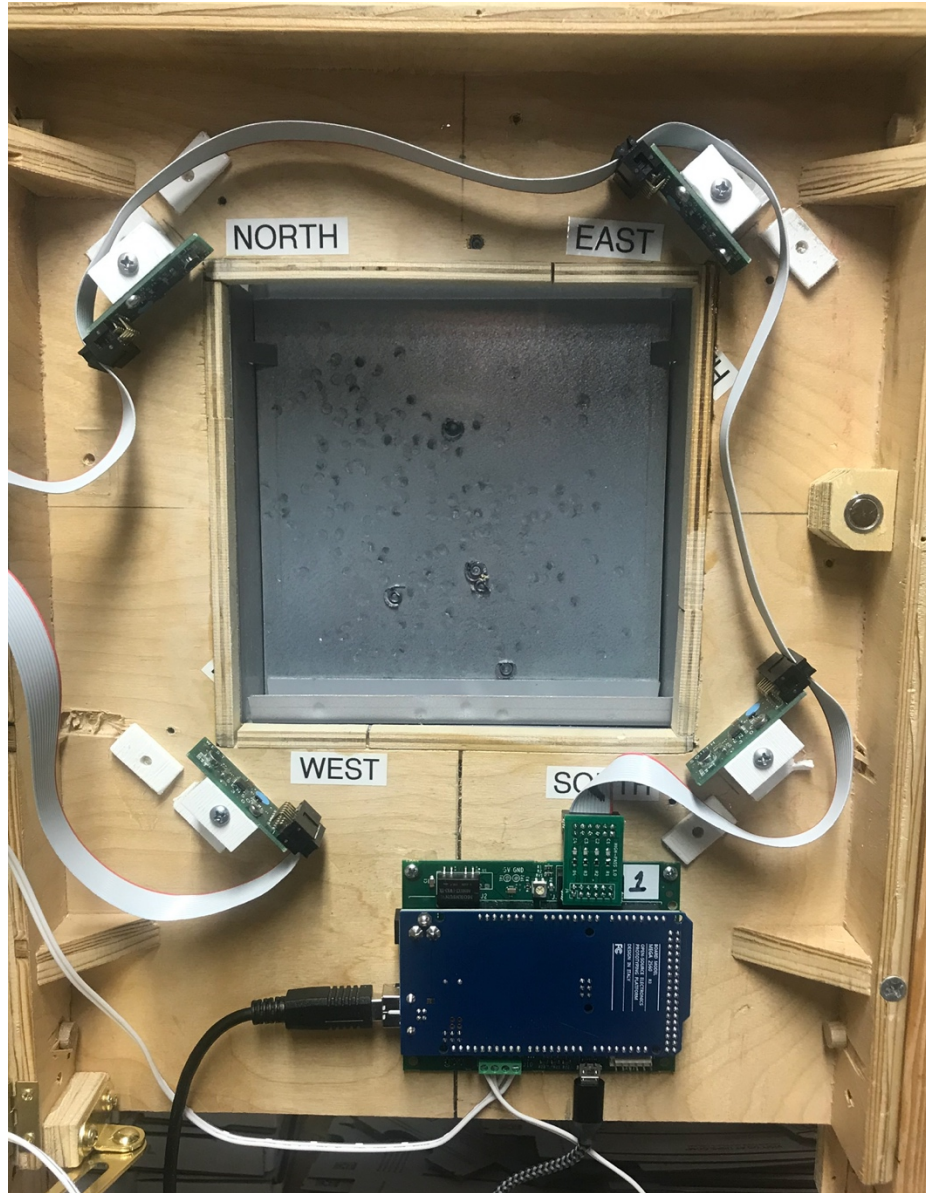
Figure 6: Flat Cable Installation. Note Location of High Pass Filter

INSTALLING THE FACE SENSOR

The face sensor detects the sound of the pellet striking the case. The face sensor works best on a metal case, and not so well on plastic or wooden structures. Depending on the material used, the face sensor may not work at all.

Attach the face sensor facing the door and with a solid material between the door and the microphone. Figure 7 illustrates the attachment.
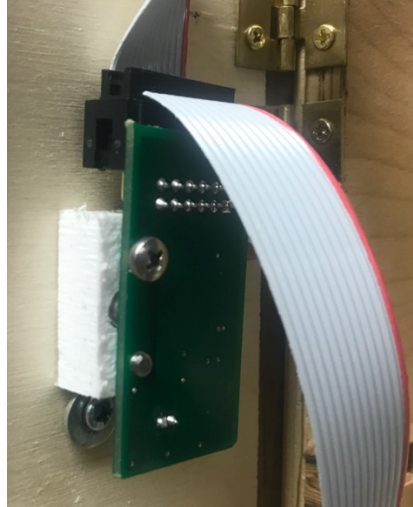
Figure 7: Face Sensor Installation

DOWNLOADING AND INSTALLING PC SOFTWARE

Click the link below to go to the downloads page

https://free-e-target.com/downloads/

Look for the PC Software section and download the software (Figure 8)

Figure 8: Download Software

Unzip the software and install on your PC.

Connect the USB cable between the target holder and the PC.

STARTING UP

Launch the PC program and look for the setup icon (GEAR WHEEL) in the upper right corner (See Figure 9)

Figure 9: Setup Icon Location

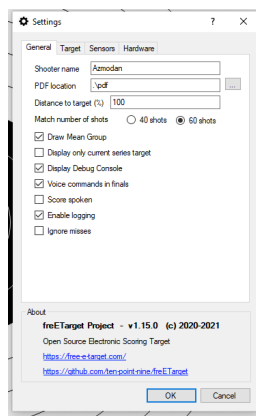Enter all of the setup information needed in Figures 9, 10, 11, and 12
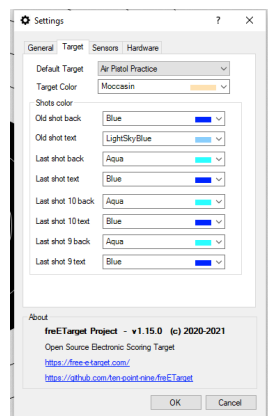

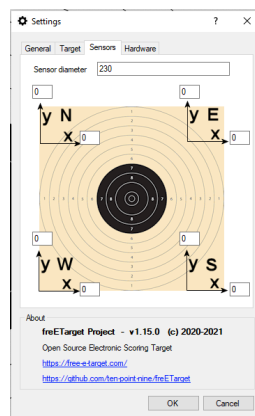Figure 10: General Settings

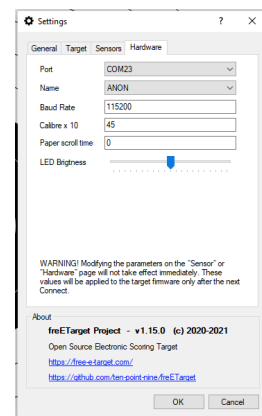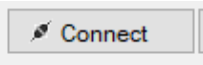Figure 11: Target Settings

Figure 12: Sensor Adjustment

Figure 13: Hardware Interface

Figure 10: This allows you to enter the shooter name and how information will be stored.

Figure 11: Choose the target you will be shooting against and the colours you will be using.

Figure 12: Fine tune the sensor position to adjust for assembly errors

Figure 13: Interface to the target hardware.

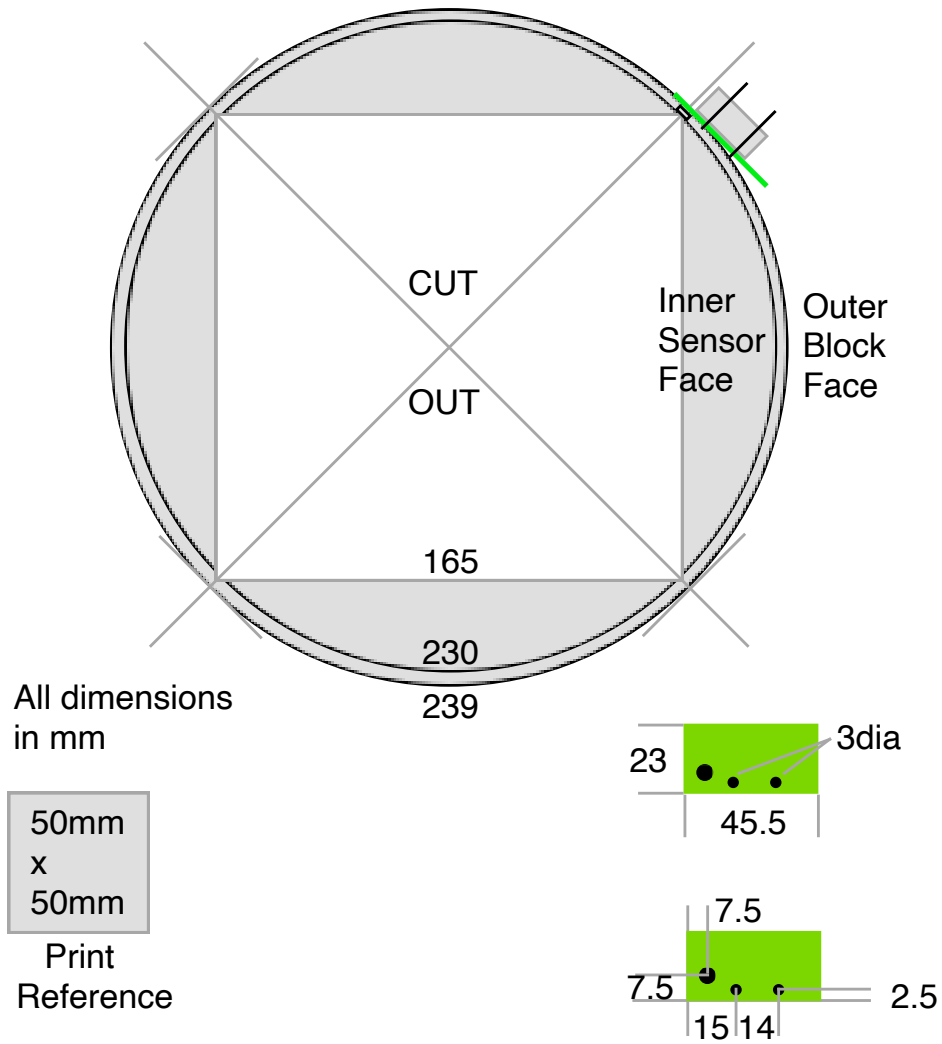Press **Connect** to begin a session.

Refer to the Commissioning Instructions from the web site. This will give you a quick summary of how the system is working

TROUBLESHOOTING

The boards are tested before shipment, but a lot can happen between the last test and the first shot. If your system is not working, please follow the trouble shooing guide below before sending an email to freETarget.com

No Shots Registered	- Check that the USB cable is attached - Check that the correct Serial port is set in the setup - Check that the wiring harness is attached to all of the sensors - Tap each of the sensors. Do the three LEDs blink?
Shots show up but in the wrong place	- From the firing line, shoot a blank shot - Do the three LEDs blink? - Yes, set a new trip point - No, Check all of the wiring - Verify that the sensors North – West are in the correct order
The shots show up but rotated 90 degrees	Verify the order of the sensors and correct
The shots are the mirror image left-right	The sensors are reversed. Switch the positions of NORTH-EAST and SOUTH-WEST

CUT

OUT

Inner
Sensor
Face

Outer
Block
Face

165

230

239

All dimensions
in mm

50mm
x
50mm

Print
Reference

23

45.5

3dia

7.5

7.5

15 14

2.5

IMPORTANT

This stencil may not print to scale on your printer.

Scale the printer output so that the 50x50 print reference is printed as a 50mm x 50mm square