FreeETarget

Service Manual

Version 5.2.18

When using freeTarget:

- Wear eye protection
- Maintain a safe distance
- Do not shoot into any areas except the open target areas.

The freeETarget project or contributors will not be responsible for any injuries when using this target of it's components.

Target shooting can be dangerous so apply caution in everything you do.

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COMMISSIONING

SUMMARY

This document is the service manual for FreeETarget Version 5. It contains information about the operation for both the target and PC client. For details about the construction of individual components, please see the component documentation.

The document is organized in chapters:

Commissioning	Putting your target in service for the first time
LED Indicators	What to the LEDs mean
Multifunction Switches	Configuring the switches for your needs
WiFi Operation	Setting up the WiFi for your environment
Settings	How to configure the target to your applications
Uploading Firmware	How to put new software into the target
Trouble Shooting	Steps to take to resolve errors

It is suggested that you skim over all of the chapters to get an idea of what FreeETarget is capable of and what are the main elements of the system. Once that is done, start at the introduction and work up to commissioning.

At the end of commissioning, you should be able to shoot into the target and observe the results on the PC display.

If that fails, look into the trouble shooting chapter to make sure that there is no obvious fault that can be quickly fixed.

If all else fails, TeamViewer can be used to remotely log in and observe what is going on.

GLOSSARY

Term	Description
Circuit	The signal processor to read the sensors and compute the shot location
PC Client	The program the user needs to see their score
Sensor	Microphone assembly to detect paper tearing when the projectile hits the target
Target	The assembly consisting of the circuit, housing, and target holder
TeamViewer	Web based client software that allows remote diagnostics

INTRODUCTION

INTRODUCTION

FreeETarget is an open source project to make a low cost electronic target that can be used for training and reginal competitions.

The features that FreeETarget provides are:

- Low cost of entry
- Uses a standard Windows PC or laptop
- Precise representation of the score
- Ability to upgrade the software in the field
- Operation with WiFi or USB cables

A FreeETarget installation consists of three major elements:

- Target – - The thing that detects the shot
- Network - The means to transmit the shot information
- Client - The display device

The typical setups are shown in Figure 1:

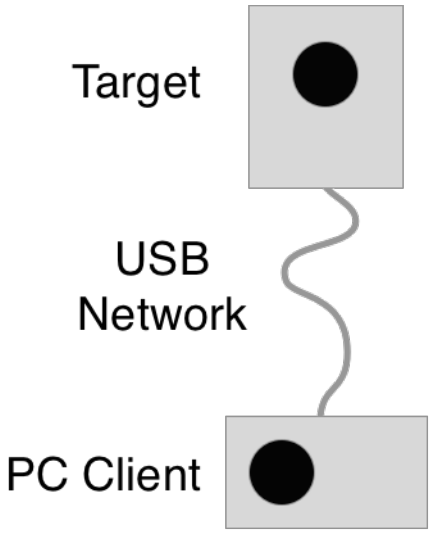


Figure 1A. Simple USB Installation

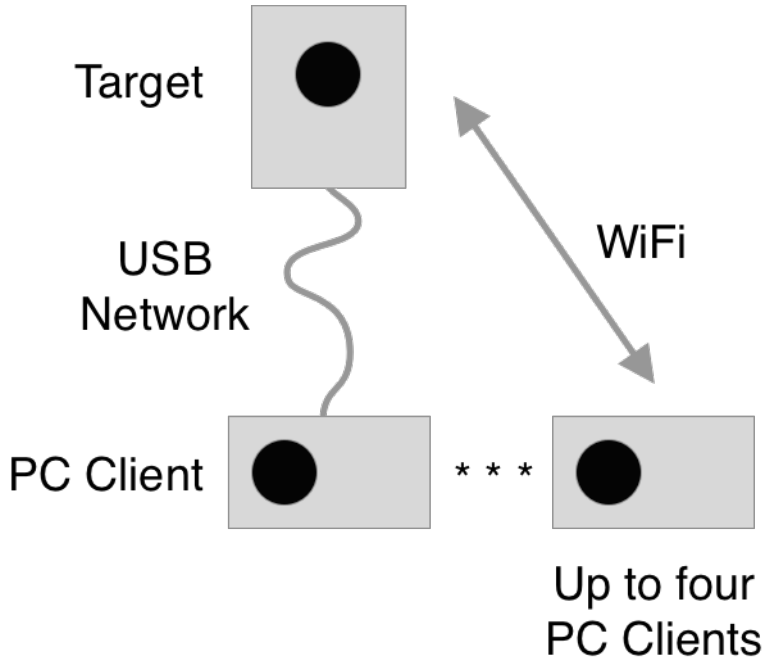


Figure 1B: Mixed Mode Installation

INTRODUCTION

The simplest method is to connect the target to the PC client using a 15 meter USB cable. These are readily available on Amazon or the local computer store. The USB connection allows for a direct connection between the two and is resistant to interference.

A more complex installation is to connect the target to the PC client over a WiFi connection. In this case, up to four PC Clients can be connected to the target:

- Shooting display
- Coach
- Parent
- Visitor

Details on the setup of each of these networks is discusses later.

PC CLIENT

Instead of a dedicated display module, FreeETarget uses a standard Windows PC or laptop. The computational burden is very low, so any PC with Windows 10 or 11 should work fine.

The software is available from the website free-e-target.com. Look for Technical Support and then downloads.

Once installed, launch the PC client and the display will look like the image shown in Figure 2.

The PC client allows the user to

- Connect to the target to begin a session
- Adjust the image to match the target (calibration)
- Load new firmware into the target
- Look at the inside of the target and debug it's operation
- Setup the operating modes (ex WiFi network)
- Select an event to shoot
- Verify the software version of the PC client.

INTRODUCTION

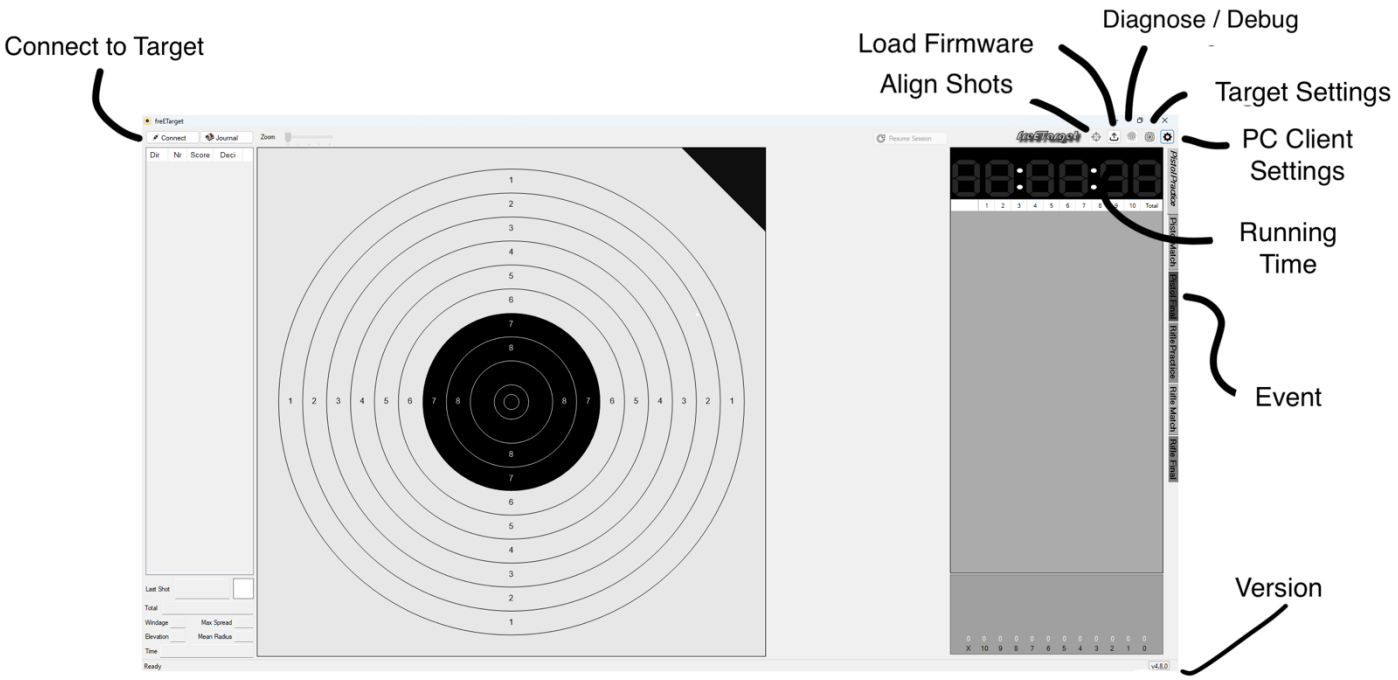


Figure 2: PC Client Menu Items

TARGET

The target is the device that detects the shot location and transmits the score to the PC Client for display.

The target 'listens' for the sound of the pellet breaking the paper. The sound radiates out from the hole and reaches four sensors located in the corner of the target. Based on the time delay between when the sensors detect the sound the algorithm computes a shot location.

Since the circuit detects the paper breaking, the sensors cannot detect a shot that penetrates an existing hole. For this reason, if you consistently shoot into the same hole, witness paper is required to present a fresh target for each shot.

Targets can be built from scratch with a circuit and some carpentry, Alternately, the target can be made up from a kit. Regardless of the method used to build the target, all targets contain the elements shown in Figure 3.

INTRODUCTION

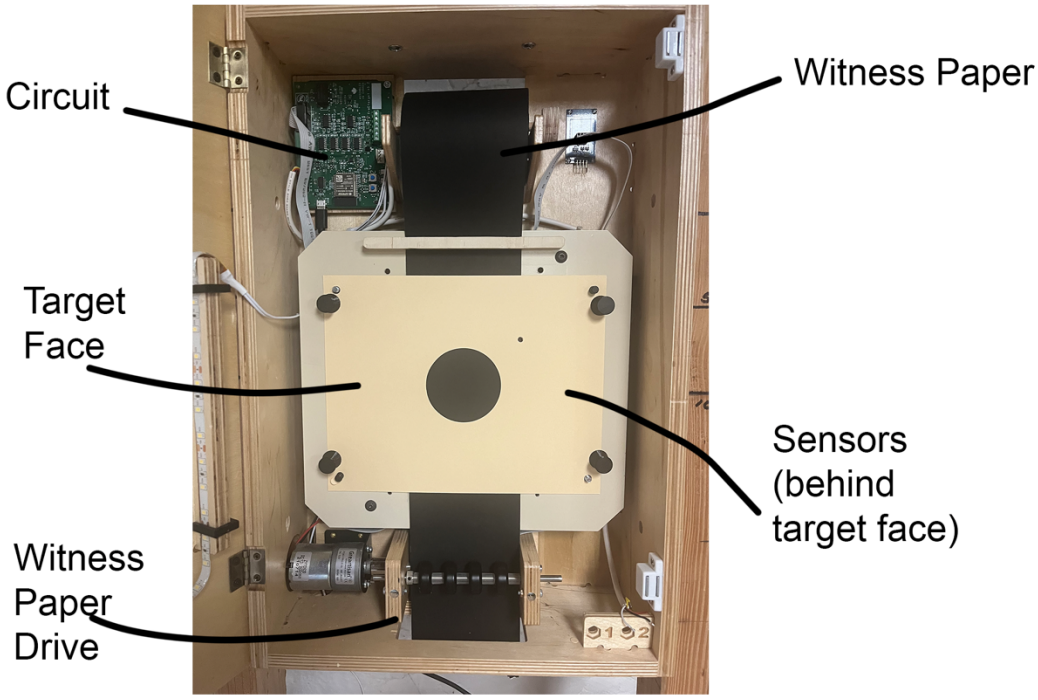


Figure 3: Typical Target Assembly

CONTROL CIRCUIT

The control circuit brings together all the electrical components needed to detect the shot. In addition, the circuit provides a user interface to control the operation of the target. The circuit is shown in Figure 4.

The firmware is located in an ESP32 that setup the hardware and eventually transmits the results. The incoming sound from the sensors is conditioned to detect the leading edge of the sound and start timers inside of the processor. Version 5 boards detect the sound at two points and use the time delay between the detections to work ou the slope of the sound and hence accurately time the shot.

Additionally, the circuit board has two switches to control the target without requiring a PC, and the status LEDs are used to display the running state and provides simple diagnostics information.

Temperature and humidity sensors adjust the algorithm to compensate for changes in the speed of sound based on the environment.

INTRODUCTION

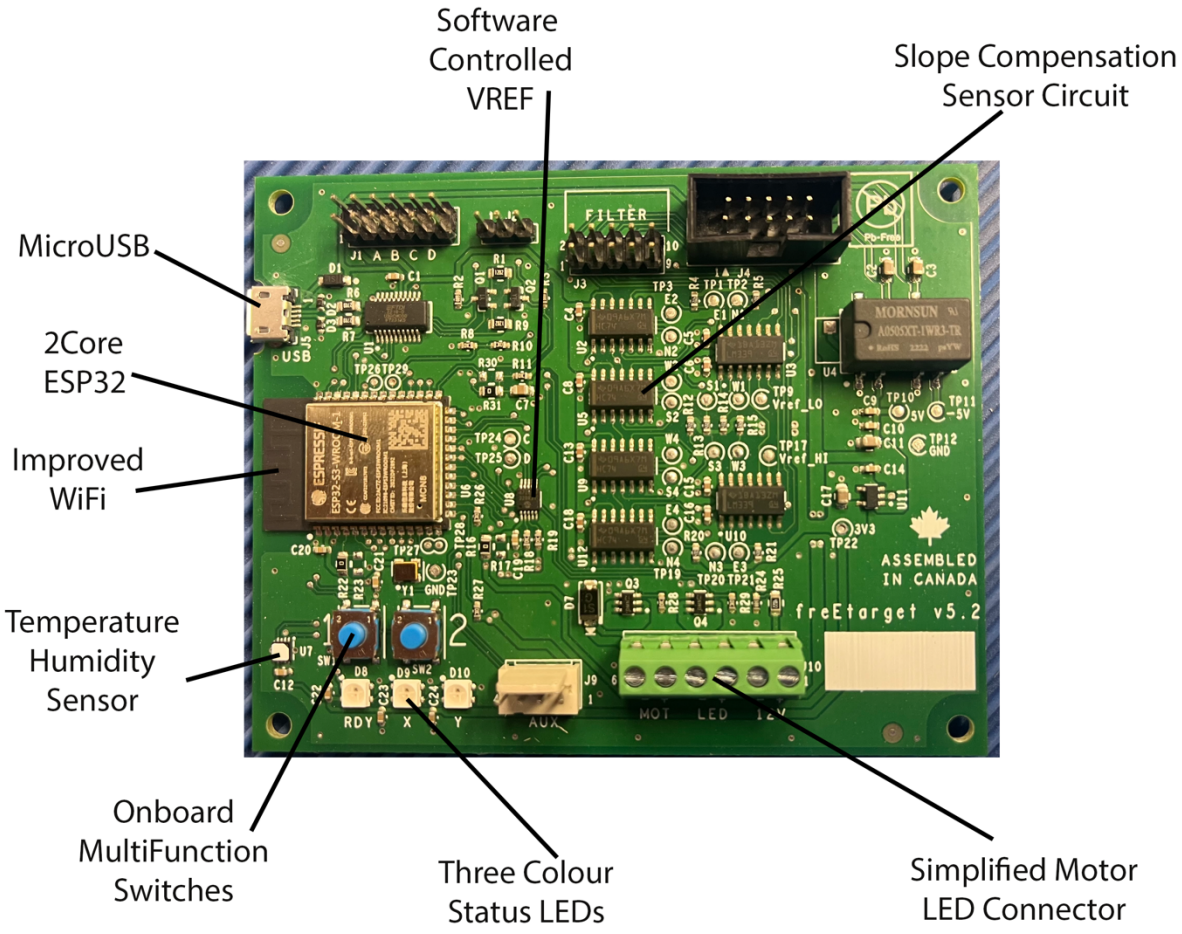


Figure 5: Circuit Annotation

USB OR WIFI?

All Version 5 boards support WiFi and USB operation. For all practical purposes both USB and WiFi will provide the same target information. The differences are in the details of the connection media. The USB and WiFi are summarized

USB Operation

Needs a purpose. Built 15 meter cable. DO NOT try to attach eight two-meter cables together
Some PCs do not supply enough current to drive the cable and the board. You may need to add a power adapter near the target
USB is needed to reflash the software
Power on diagnostics only operate on the USB connection

INTRODUCTION

WiFi Operation

Operates in both Access Point (easy) or Station Mode (allows internet access)
Software flashing cannot be done over WIFi
Supports up to four connections to each target

It is recommended that the first target installation uses the USB connection, and subsequent ones can be a combination of USB and WiFi.

COMMISSIONING

COMMISSIONING

Like any complex piece of technology, FreeETarget can be intimidating if not familiar with it's operation. Commissioning is the sequence of steps that put the system into operation.

The steps to get an operating FreeETarget are

- Gather the tools to complete the installation
- Install the target
- Install the PC Client
- First shots
- Advanced operation

GATHERING THE TOOLS

The following are required to begin installing a target system

- freETarget PC Client 4.5 or higher
- Firmware V5.2 or higher
- Target assembly

Network Minimum

- 2 meter USB cable
- 110 or 220 VAC outlet

Preferred

- 15 meter USB cable
- 110 or 220 VAC outlet
- WiFi network

INSTALL THE TARGET

After you have assembled the freETarget into the target holder, inspect the following

- The flat cable is pressed firmly into the sensors and signal board
- There are no kinks or sharp bends in the flat cable.
- All of the sensors are correctly installed North through West
- When using the LED illumination
    - Verify the 12V supply wires are attached to the board
    - Verify that the LED wires are attached to the board

COMMISSIONING

- When using the DC Motor witness paper drive
  - Verify that the 12V supply wires are attached to the board
  - Verify that the motor wires are correctly attached to the board
-
- When using the Stepper Motor witness paper drive
  - Verify that the stepper motor driver circuit is attached to the multifunction switch connector

- With the USB cable plugged into the PC, turn on the PC
  - Verify that the RDY LED is blinking green (or Blue)
  - Verify that no other LEDs are blinking

INSTALL THE PC CLIENT

Visit the free-e-target.com -> Technical Support > Downloads to obtain the latest PC Client Software

Open the downloaded file from the download folder and install the software

SETUP THE PC CLIENT

Launch the PC client and select Application Configuration from the upper right icons (Settings)

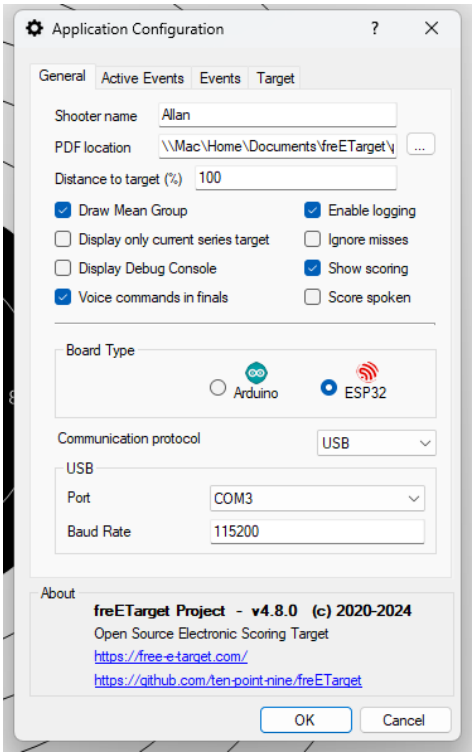


Figure X: Application Configuration

COMMISSIONING

- Enter the information needed,
- Select ESP32 for Version 5 hardware
- Choose the USB port (for the initial setup)

FIRST SHOT

Set the target up ten meters from the firing point. Press the CONNECT button on the upper right of the PC client.

- Verify that after a few seconds the PC connects to the target
- The running timer increments or decrements.
- The target colour changes

If the target does not connect then review the connections and settings. Common mistakes include

- USB not configured correctly
  - Check the settings
- USB cable not plugged in correctly
  - Check the USB cables
- Defective USB cable
  - Repeat the setup but use a shorter (less than 2 meters) USB cable

Once the target connects, fire five shots into the paper. Try to separate the shots into 10, 8, 6, 4, 2 rings.

- Did the shots register in the correct place?
  - Yes, you're done
  - No.
    - Did five shots register anywhere – Yes circuit works.
    - No shots registered – Recheck cables and connections
    - Press the DEBUG button (upper right)
      - Does it show an error?
      - Do all 10 shots show up on the display?
        - No, check the cables and settings
      - Are the shots correct, but the mirror image?
        - The sensors are installed correctly, but mirror image.
        - Swap North and East
        - Swap West and South
        - Go back to the beginning and test the circuit.
      - Are the shots correct, but the reversed top and bottom?
        - The sensors are installed correctly, but upside down.
        - Swap North and West
        - Swap South and East
        - Go back to the beginning and test the circuit.

COMMISSIONING

ADVANCED OPERATION

Once you have the target correctly registering shots, it is time to move onto other features:

- WiFi Operation
  - Access Point – Simple operation
  - Station – Connect to your home network
  - Allow multiple people to watch your shooting
- Tabata Training
  - Select the ON and OFF time
  - Select how long between shots
- Rapid Fire shooting
  - Select the competition type

Refer to the relevant chapters here or the supplemental documentation contained on the web site

LED INDICATORS

LED INDICATORS

The LED indicators are used to show the internal operation of the target, and fault diagnostics.

LED INDICATORS, NORMAL OPERATION

RDY	X	Y	
RED	WHITE	BLUE	Power on self test (Hello World) to show that the software has booted and the circuit has some functionality
GREEN			The software has started but not ready for a shot
BLINK GREEN			The software has completed startup and ready to receive shots
BLUE			The target has gone to sleep
	BLINK GREEN		The WiFi is in station mode but not connected to a PC
	GREEN		The WiFi is in station mode and connected to a PC
	BLUE		The WiFi I in access mode but not connected to a PC
	BLINK BLUE		The WiFI is in station mode and connected to a PC
		RED	Insufficient voltage on the motor/LED 12V supply
		YELLOW	Voltage present on the motor connector, but not enough to drive the motor.
		BLINK GREEN	Voltage sufficient for motor drive
		BLUE	Witness Paper disabled by setting PAPER_TIME = 0

LED INDICATORS, FAULT OPERATION

RDY	X	Y	
RED	RED	RED	Failure detected on NORTH sensor
RED	RED	GREEN	Failure detected on EASH sensor
RED	RED	BLUE	Failure detected on SOUTH sensor
RED	RED	YELLOW	Failure detected on WEST sensor
RED	GREEN	RED	Miss detected

MULTIFUNCTION SWITCHES

MULTIFUNCTION SWITCHES

The Multi Function Switches are general purpose inputs and outputs that can be set to perform a user defined operation.

The multifunction connector is located on the upper left side of the circuit board. It provides four signals A, B, C, and D along with ground references and a voltage supply. The intention is that additional switches or LEDs can be added to the target and the operation determined by software configuration.

The connector is illustrated in Figure 5.

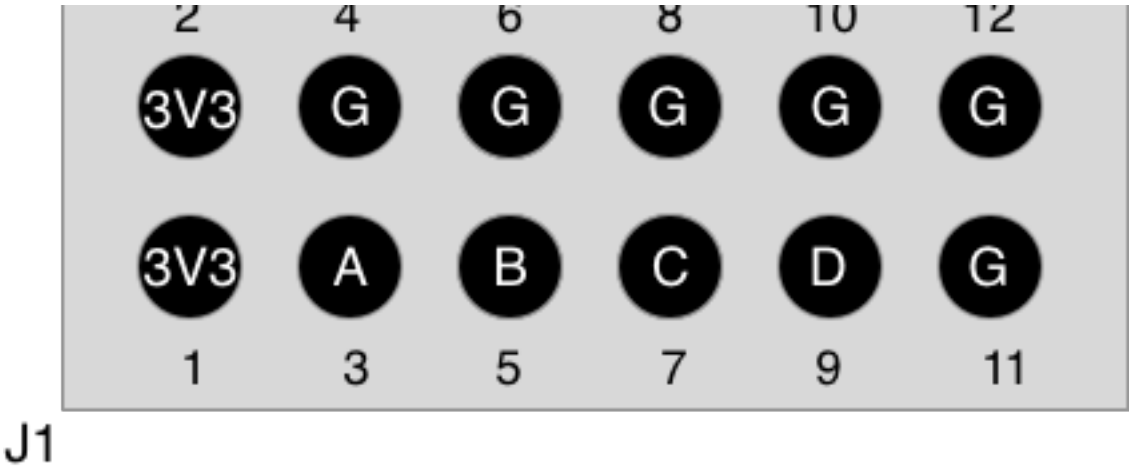


Figure 5: Multifunction Connector

In addition, two switches on the circuit board marked 1 and 2 are connected directly to inputs A and B on the multifunction connector.This allows the user to manage the target without additional hardware

CONNECTOR ASSIGNMENT

The 12 pins are assigned

1, 2	3.3 Volt , 50mA supply for interfaces
4, 6, 8,10, 11, 12	Digital Ground
3	Digital input A, also connected to push button 1
5	Digital input B, also connected to push button 2
7	Digital input or output C, defined in software
9	Digital input or output C, defined in software

MULTIFUNCTION SWITCHES

DIGITAL INPUTS A/B (1/2)

Push button switches 1 and 2 are routed to discrete inputs A & B and have five modes of operation

- Tap switch 1
- Tap switch 2
- Hold switch 1
- Hold switch 2
- Hold switches 1 and 2 together

When pressed, the software starts a timer, if the switch is released inside of 2 seconds, it is considered a tap. If the switch is held for more than 1 second, it is a hold. If both are held at the end of 1 second, then BOTH switches are held

DIGITAL INPUT OPERATION

The switches are configured by using the JSON command to each of the switches and modes, Instructions for using the JSON commands are found in the section SETTINGS found in this document.

- {“MFS_HOLD_1”:X}
- {“MFS_HOLD_2”:X}
- {“MFS_HOLD_12”:X}
- {“MFS_TAP_1”:X}
- {“MFS_TAP_2”:X}

Where the value of X is defined in Table A

Table A: Digital Input MFS Values

Value	Action	Description
0	Power Tap.	Wake the target up if it has gone to sleep
1	Paper Feed	Turn on the witness paper drive to feed paper
2	LED Adjust	Increase the brightness of the LEDs until 100% and then reset to zero
3	Paper Shot	Advance the paper a set distance as if a shot has been recognized
4	PC Test	Simulate a random shot sent to the PC client
5	On / Off	Put the target to sleep
6		
7		
8		

MULTIFUNCTION SWITCHES

DIGITAL INPUTS OR OUTPUTS C/D

Connections C and D can be programmed as input or outputs depending on the

INPUT OR OUTPUT OPERATION

The switches / outputs are configured by using the JSON commands

- {“MFS_HOLD_C”:X}
- {“MFS”HOLD:D”:X}
- {“MFS_SELECT_CD”:X}

Where the value of X is defined in Table B

Table B: Digital I/O MFS Values

Value	Action	Description
9	No action	
10	Target Type	Used to inform the PC of a specific target type
18	Rapid RED	Output is used to drive the RED indicator when in rapid fire
20	Rapid GREEN	Output is used to drive the GREEN indicator when in rapid fire
22	Rapid LOW	Set the rapid indicator LED to be active low (0 turn on LED)
24	Rapid HIGH	Set the rapid indicator LED to be active high (01turn on LED)
26	Stepper Drive	The output is used to drive a stepper motor

FACTORY RESET

Holding the 1 and 2 buttons closed and applying power until the RDY light flashes will reset the board back to the factory defaults.

WIFI OPERATION

WIFI OPERATION

The Version 5 hardware has two modes of WiFI operation

- Access Point. The target provides its' own SSID, typically FET-TARGET. Each target is a unique SSID
- Station. The target uses the local (home) SSID. Multiple targets can be on the same SSID

The default operation of the FreeETarget is to be an access point, This allows for simple setup, but means that the Client PC cannot be on the internet at the same time as the target is connected.

While harder to setup, Station mode allows multiple targets to be on the same network as the PC and an internet connection

ACCESS POINT

Access point is the default operation. Access point sets the SSID of the target to be FET-name, where name can be changed through a command line

The controls for the access point are:

Control	Description
{"NAME_ID":x}	The NAME_ID allow the operator to select an SSID from a list of available SSIDs 0 – FET-TARGET. (Default) 1 – FET-1 2 – FET-2 3 – FET-3 4 – FET-4 5 – FET-5 6 – FET-6 7 – FET-7 8 – FET-8 9 – FET-9 10 – FET-10 11 – DOC 12 – DOPEY 13 – HAPPEY 14 – GRUPMY 15- BASHFUL 16 – SNEEZY 17 - SLEEPY 18 – RUDOLF 19 – DONNER

WIFI OPERATION

	20 – BLITZEN 21 – DASHER 22 – PRANCER 23 – VIXEN 24 – COMET 25 – CUPID 26 - DUNDER 27 – ODIN 28 – WODEN 29 – THOR 30 - BALDAR
{“WIFI_CHANNEL”:X}	Sets the WiFi channel Use this control if there is a conflict with another network near the target Range 1-11, Default 6. U
{“WIFI_HIDDEN”:X}	Hides the SSID from the network 0 – Visible 1 - Hidden
{“WIFI_PWD”:”xxxx}	Assigns a password to the target SSID

IMPORTANT

When used in Access Mode, the target sets itself to a fixed IP address of 192.168.10.9 and port 1090

The SSID used by the PC must match the one assigned by NAME_ID, and is typically FET-TARGET

STATION MODE

Station mode allows the target to be on the same network as other devices in the building. For example, the target can be on the home network allowing the target and teamViewer to be active at the same time on the same network

The controls for the Station Mode are:

Control	Description
{“WIFI_PWD”:”xxxx”}	Assigns a password to the active SSID
{“WIFI_SSID”:”xxxx”}	Selectes the SSID to be used by the target

IMPORTANT

When used in Station Mode, the router assigns the IP address to the target. To find the IP address that has been assigned to the target, use the {“ECHO”:0} command to list the settings and look for

WIFI_IP_ADDRESS: A.B.C.D, where A.B.C.D is the address that needs to be entered into PC client configuration

WIFI OPERATION

When using Station Mode, the PC Client will issue a warning that the SSID is not of the form FET-name. This is for information only and can be ignored.

WIFI RESETTING THE TARGET

While shooting, the target keeps track of the last 100 (40 sighters, 60 on score) shots. When the PC Client connects over WiFi, the scores from the beginning of the session are downloaded at once. This is done so that (say) a coach can log into their student's target and see all of the shots since the beginning.

In operation, connecting over USB will automatically reset the target back to the beginning. Connecting by WiFi does not have this feature since resetting every time that someone connects on WiFi would be confusing. To get around this problem, the target has the setting

{"WIFI_RESET":X}.

The default is 0, so that the target is not reset. Setting X to 1 will reset the target whenever the FIRST user logs in over WiFI.

The ideal operation is for the firing point to be connected by USB and the target is reset every time the firing point connects. If no USB is used, then {"WIFI_RESET":1} should be used so that the shooter resets the target on the first connection.

SETTINGS

SETTINGS

The software has a number of settings that affect the operation of the unit

Settings on the target are changed using the debug tab on the PC client.

1. Connect to the target as if you were shooting a match
2. Select the Debug icon on the upper right (looks like a finger print). If it is not visible, make sure that ESP32 is selected in the setup.
3. The debug menu will appear as shown in Figure

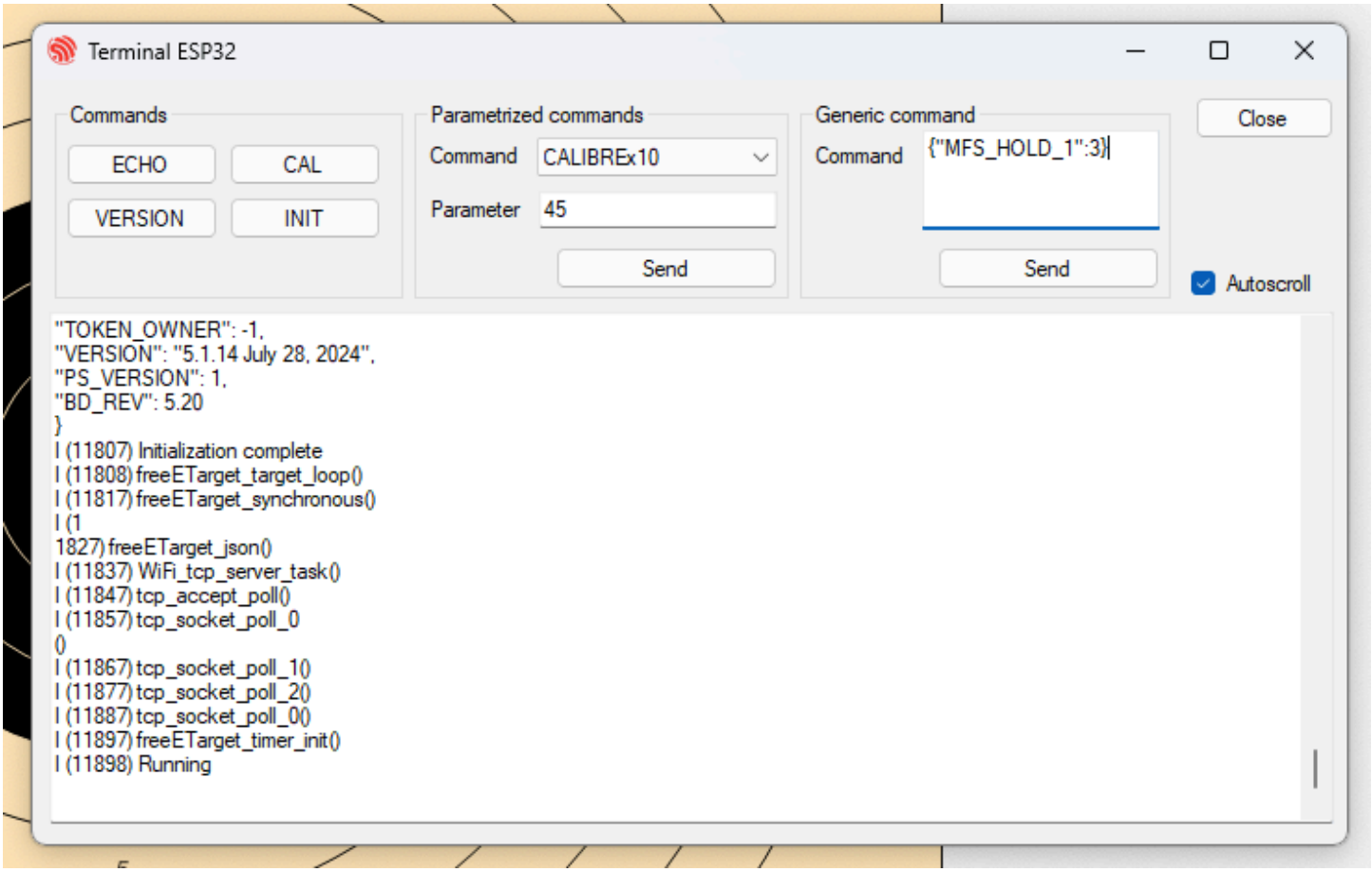


Figure Z: Debug Dialog Box

4. Enter the setting in the Generic Command box and press [SEND] to setting to the target.
5. Results from the target appear in the large dialog box

SETTINGS

CONTROL SETTINGS

The settings that are available are shown in Table S. To change a settings, use the text in the Setting column and form the JSON command

{“setting”:value}

For example {“FOLLOW_THROUGH”:4} or {“SENSOR_DIA”:232.5}

Table S: FreeETarget Settings

Setting	Description	Typical Value	Saved
ANGLE	Orientation of the sensors from vertical	45 degrees	Y
AUX_PORT_ENABLE	Enables the AUX port for operation	0 – AUX port disabled	Y
FACE_STRIKE	Enables face strike detection	Must be zero	Y
FOLLOW_THROUGH	Time to wait before transmitting score	0 – Immediate, 5 - Training	Y
KEEP_ALIVE	WiFI beacon used to keep the WiFi connection alive	120	Y
LED_BRIGHT	LED brightness 0-100%	0 – Off, 100 - fully on	Y
MFS_HOLD_12	Action to perform if both MFS switches are held down	2 – LED adjust	Y
MFS_TAP_2	Action to perform if switch 2 is tapped	0 – Wake up	Y
MFS_TAP_1	Action to perform if switch 1 is tapped	3 – Paper shot	Y
MFS_HOLD_2	Action to perform when switch 2 is held for 2 seconds	5 – Turn the target off	Y
MFS_HOLD_1	Action to perform when switch 1 is held for 1 second	1 – Paper feed	Y
MFS_HOLD_C	Action to perform with GPIO C	9 – No action	Y
MFS_HOLD_D	Action to perform with GPIO D	9 – No acton	Y
MIN_RING_TIME	Time before next shot is recognized after the current shott	500 ms	Y
NAME_ID	Index to select a target name for FET-	0-31, default 0	Y
PAPER_ECO	Distance in mm to ignore shot and not move paper	0 – Disabled, 1 to 100 mm	Y
PAPER_SHOT	How many shots to fire before advancing paper	0 – Advance every time	Y
PAPER_TIME	Sets the time the motor turns to advance the witness paper	500ms	Y
PCNT_LATENCY":	Uses a calibrated offset to improve the detection accuracy	0 – Disabled, 32 Typical	Y
POWER_SAVE	Idle time in minutes before going to sleep	0 – Off, Typical 30 minutes	Y
RAPID_COUNT	How many shots in a rapid fire string		N
RAPID_ENABLE	Enable rapid fire mode	1 - Enable	N
RAPID_TIME	How long will the rapid fire event last in seconds		N
RAPID_WAIT	How long to delay after rapid fire has been enabled		N
SEND_MISS	Send a record to the PC whenever a shot has been missed	0 – Miss not sent	Y
SENSOR_DIA	Calibrated distance between sensor faces	232mm for air pistol or air rifle	Y
SN	Serial number	Cannot be changed	
STEP_COUNT	How many steps to issue stepper motor witness paper	0 – Disabled	Y
STEP_RAMP	How many cycles to change during ramp-up	0 – Disabled	Y
STEP_START	Number of cycles to start stepping at	0 – Disabled	Y
STEP_TIME	Time interval in ms between steps	0 – Disabled	Y
TABATA_ENABLE	Enable the Tabata training mode	0 – Disabled	N
TABATA_ON	Time in seconds that the LEDs are on during a Tabata cycle		N
TABATA_REST	Time in seconds that the LEDs are off between shots		N
TABATA_WARN_OFF	Time in seconds that the LEDs are off after the warning		N

SETTINGS

TABATA_WARN_ON	Time in seconds that the LEDs are on to warn the shooter		N
TARGET_TYPE	Target Override for alternate targets	0 – No override 4 – 5 bull target 74mm 5 – 5 bull target 79mm 11 – 10bull + sighters (Orion) 12 – 10 bull + sighters (NRA)	Y
TEST	Run diagnostics test	0 – Show help menu	N
TOKEN	Enable Rapid Fire token ring	0 – Disable, 1 Enable	Y
TRACE	Display diagnostics trace. Cleared on next power cycle DLT_CRITICAL – Error effects normal operation DLT_INFO – Internal operational information DLT_APPLICATION – Scoring calculations	1-DLT_CRITICAL 2-DLT_INFO 4-DLT_APPLICATION 8-DLT_COMMUNICATION 16-DLT_DIAG 32-DLT_DEBUG 64-DLT_SCORE 128-DLT_HEARTBEAT	N
VREF_LO	Shot detection low voltage threshold	1.25 Volts	Y
VREF_HI	Shot detection high voltage threshold (VREF_HI > VREF_LO)	2.0 Volts	Y
WIFI_CHANNEL	WiFi channel used with Access Point targets	1 – First 6 – Recommended 11 - Last	Y
WIFI_HIDDEN	Hide the SSID of an access point target (FET-xxx_	0 Visible SSID 1 – Hode SSID	Y
WIFI_PWD	WiFi password associated with SSID. Both Access point and Station Modes	Default is empty, no password	Y
WIFI_RESET_FIRST	Reset the target when the FIRST WiFi connection is made	0 – Do not reset 1 – Reset on first connection	Y
WIFI_SSID	SSID associated with Station Mode targets	Default is empty, Access Mode Non empty, Station Mode	Y
X_OFFSET	Offset applied to X axis to calibrate score	0 – Disabled until calibrated	Y
Y_OFFSET	Offset applied to Y axis to calibrate score	0 – Disabled until calibrated	Y
Z_OFFSET	Vertical distance from target plane to sensor plane	13mm typical	Y
NORTH_X/NORTH_Y	Correction in mm from ideal location. + away from centre	0 recommended	Y
EAST_X/EAST_Y	Correction in mm from ideal location	0 recommended	Y
SOUTH_X/SOUTH_Y	Correction in mm from ideal location – closer to centre	0 recommended	Y
WEST_X/WEST_Y	Correction in mm from ideal location	0 recommended	Y

INFORMATION ONLY

The items shown in Table S provide insight into the operation but cannot be changed by the user

RUN_STATE	Internal running state	1 – Startup 2 – In operation (normal) 4 – Test Mode 8 - Sleep	N
RUNNING_MINUTES	How long the target has been turned on		N

SETTINGS

TIME_TO_SLEEP	How long before the target goes to sleep		N
TEMPERATURE	Temperature in C inside the target. Used to calculate speed of sound		N
RELATIVE_HUMIDITY	Humidity inside the target. Used to calculate speed of sound		N
TIMER_COUNT	Expected maximum time expected to occur after shot	1 LSB – 100ns	N
V12	LED / Witness paper drive voltage	Nominally 12V	N
WIFI_MAC	MAC address of the WiFI		N
WIFI_IP_ADDRESS	IP address used by target		N
WIFI_MODE	Access Point or Station mode programmed into target		N
TOKEN_RING	Assigned token ring address		N
TOKEN_OWNER	Which target is the master of the token ring	Should be 1	N
VERSION	Current firmware version		N
PS_VERSION	Persistent storage version. Used for automatic updates		Y
BD_REV	Board revision		

TYPICAL SETTINGS

The settings to implement typical actions are provided below.

DC MOTOR WITNESS PAPER

The DC motor witness paper drive turns on the motor for a short period of time. Roughly speaking the paper will advance 40mm with a 500ms ON time. To change the amount of paper that advances, it is necessary to shorten or lengthen the time the motor runs.

Duration = 500 x Desired Movement / 40

To correctly set up the DC motor drive, use the following settings

{“PAPER_ON”:500}

{“STEPPER_COUNT”:0}

{“STEPPER_TIME”:0}

The setting {“PAPER_ECO”:X} is used to enable the witness paper drive if the hole is within X mm of centre.

STEPPER MOTOR WITNESS PAPER

The stepper motor requires a separate circuit, for example ROB-14450 available from DigiKey. This circuit converts pulses from the FreeETarget board into energizing the stepper motor windings.

To setup a stepper motor use the following settings:

SETTINGS

{“PAPER_ON”:0

{“STEPPER_COUNT”:60}

{“STEPPER_RAMP”:10}

{“STEPPER_START”:100}

{“STEPPER_TIME”:20}

{“MFS_HOLD_C”:26}

{“MFS_HOLD_D”:28}

IMPORTANT

The settings will be strongly influenced by the stepper motor used on the target and settings may need to be adjusted in place

The STEPPER_COUNT=X determines how far the paper advances, and STEPPER_TIME= is the duration of each pulse to the stepper (typically in the order of 20ms)

MFS_HOLD_C = 26 converts MFS signal C into the stepper motor driver pulse

The setting {“PAPER_ECO”:X} is used to enable the witness paper drive if the hole is within X mm of centre.

SENSOR PLACEMENT

The sensors are located a distance apart that corresponds to the size of the 1 ring. For a pistol target, this is 230mm. There may be an adjustment if the sensing circuit is behind the front surface of the microphone.

If the target is set up for 50m small.bore, or large bore rifles, the sensors will need to be relocated, to another distance.

{“SENSOR_DIA”:X}

Where X is the distance in mm across the target. X does not necessarily need to be a whole number, the value X=232.5 is a legal value.

WIFI STATION

The WiFI station mode (the target is on the home network) is enabled by setting

{“WIFI_SSID”:”home network”}

{“WIFI_PWD”:”home password”}

SETTINGS

WIFI ACCESS POINT MODE

The WiFi accces point mode means that the target generates it's own SSID, typically FET-TARGET. To enable acces point mode, it is necessary to turn off the station mode.

{"WIFI_SSID":""}

{"WIFI_PWD":"password"}	The target has a password
{"WIFI_PWD":""}	The target does not have a password
{"WIFI_HIDDEN":X}	X = 0 the SSID is not hidden, X=1 hides the target
{"NAME_ID":Y}	Change the name of the target (see settings in WiFi Operation)

AUXILARY CONNECTOR

The Auxilary Connector is used as an alternative communications connector. This would be used to connect an RS-485 interface, tor connect multiple targets together using a Token Ring

The four pin AUX connector has the following connections

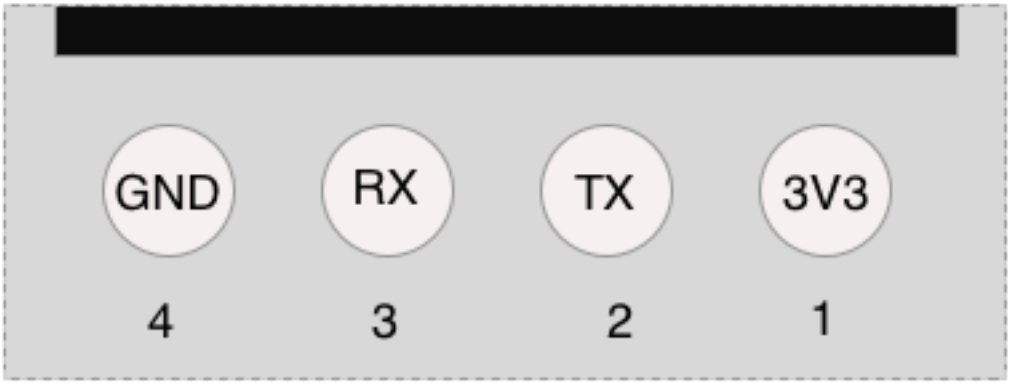


Figure Z: Auxiliary Connector

The connector provides 3.3 volts to drive an RS-232 or RD-485 convertor. Current is limited to about 50mA

TOKEN RING

The Auxiliary connector can be used as a token ring connector to join up to 7 targets and transmit the scores to the PC.

The connection for the token ring is shown in the figure below.

The transmit of 1 goes to the receiver of the next, and all the way round the ring. All of the ground connections are joined together. Be careful to ensure that there are no ground loops before attaching the token ring cable.

For the target that is connected to the PC Client, set {“TOKEN”:1}. The remainder are set to {“TOKEN”:2}

The token ring is disabled if any of the targets are set to {“TOKEN”:0}

AUXILARY CONNECTOR

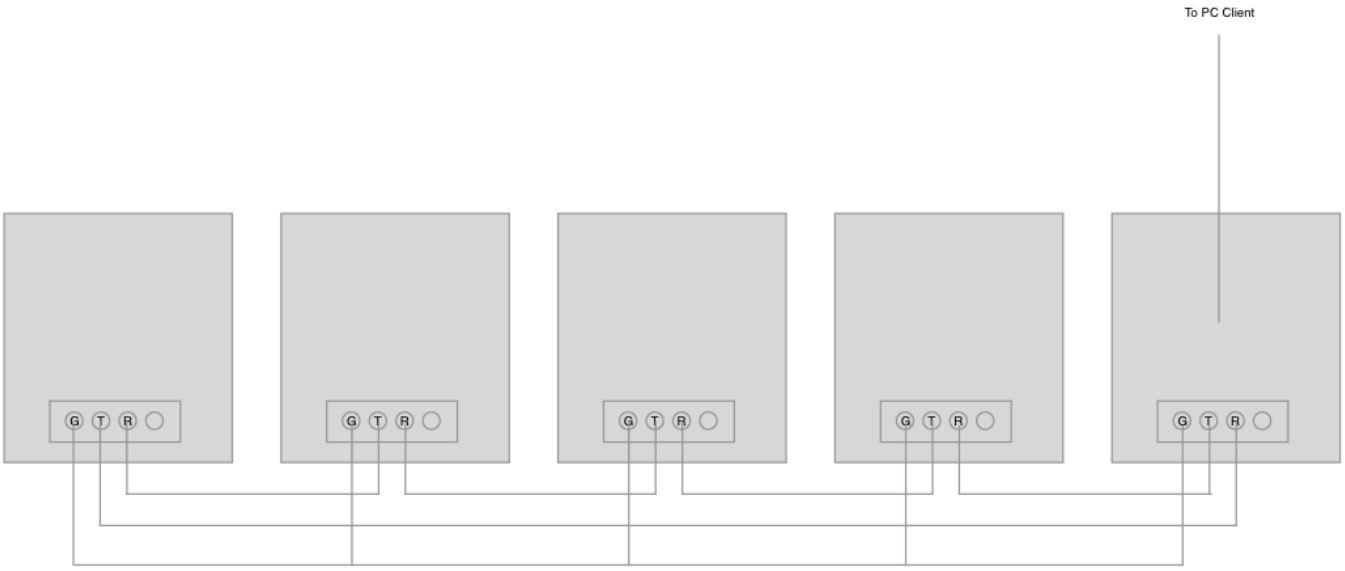


Figure Z: Token Ring Wiring

DOWNLOADING FIRMWARE

DOWNLOADING FIRMWARE

The target has the ability to be reprogrammed when new features are added or bugs fixed.

Downloading to the target performed in two steps

- Preparation – Setting up the PC Client download software, done once
- Upload – Uploading new software to the target

PREPARATION

Version 5 hardware uses an ESP32 microcontroller. The download software is provided by a Python module that must be installed before the firmware can be loaded. Once the Python module have been downloaded once, there is no need to do it again

DOWNLOAD PYTHON

From your web browser, search fo PYTHON DOWNLOAD

Follow the link and select Download

Python (Note the version number may be higher than shown here)

Download and install Python.

If prompted, select OVERRID MAX PATH LENGTH

Restart your computer to update the PATH variable

INSTALL ESPTOOLS

Once the PC has finished restarting, launch a command prompt and run the command

pip install esptool

The PC will return something that looks like

DOWNLOADING FIRMWARE

```
C:\Users\allan>pip install esptool
Requirement already satisfied: esptool in
c:\users\allan\appdata\local\packages\pythonsoftwarefoundation.python.3.11_qbz5n2kfra8p0\localcache\local-
packages\python311\site-packages (4.7.0)
Requirement already satisfied: bitstring>=3.1.6 in
c:\users\allan\appdata\local\packages\pythonsoftwarefoundation.python.3.11_qbz5n2kfra8p0\localcache\local-
packages\python311\site-packages (from esptool) (4.1.4)
Requirement already satisfied: cryptography>=2.1.4 in
c:\users\allan\appdata\local\packages\pythonsoftwarefoundation.python.3.11_qbz5n2kfra8p0\localcache\local-
packages\python311\site-packages (from esptool) (42.0.2)
Requirement already satisfied: ecdsa>=0.16.0 in
c:\users\allan\appdata\local\packages\pythonsoftwarefoundation.python.3.11_qbz5n2kfra8p0\localcache\local-
packages\python311\site-packages (from esptool) (0.18.0)
Requirement already satisfied: pyserial>=3.0 in
c:\users\allan\appdata\local\packages\pythonsoftwarefoundation.python.3.11_qbz5n2kfra8p0\localcache\local-
packages\python311\site-packages (from esptool) (3.5)
Requirement already satisfied: reedsolo<1.8,>=1.5.3 in
c:\users\allan\appdata\local\packages\pythonsoftwarefoundation.python.3.11_qbz5n2kfra8p0\localcache\local-
packages\python311\site-packages (from esptool) (1.7.0)
Requirement already satisfied: PyYAML>=5.1 in
c:\users\allan\appdata\local\packages\pythonsoftwarefoundation.python.3.11_qbz5n2kfra8p0\localcache\local-
packages\python311\site-packages (from esptool) (6.0.1)
Requirement already satisfied: intelhex in
c:\users\allan\appdata\local\packages\pythonsoftwarefoundation.python.3.11_qbz5n2kfra8p0\localcache\local-
packages\python311\site-packages (from esptool) (2.3.0)
Requirement already satisfied: bitarray<3.0.0,>=2.8.0 in
c:\users\allan\appdata\local\packages\pythonsoftwarefoundation.python.3.11_qbz5n2kfra8p0\localcache\local-
packages\python311\site-packages (from bitstring>=3.1.6->esptool) (2.9.2)
Requirement already satisfied: cffi>=1.12 in
c:\users\allan\appdata\local\packages\pythonsoftwarefoundation.python.3.11_qbz5n2kfra8p0\localcache\local-
packages\python311\site-packages (from cryptography>=2.1.4->esptool) (1.16.0)
Requirement already satisfied: six>=1.9.0 in
c:\users\allan\appdata\local\packages\pythonsoftwarefoundation.python.3.11_qbz5n2kfra8p0\localcache\local-
packages\python311\site-packages (from ecdsa>=0.16.0->esptool) (1.16.0)
Requirement already satisfied: pycparser in
c:\users\allan\appdata\local\packages\pythonsoftwarefoundation.python.3.11_qbz5n2kfra8p0\localcache\local-
packages\python311\site-packages (from cffi>=1.12->cryptography>=2.1.4->esptool) (2.21)

[notice] A new release of pip is available: 24.0 -> 24.1.2
[notice] To update, run:
C:\Users\allan\AppData\Local\Microsoft\WindowsApps\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\python.exe -m pip
install --upgrade pip
```

Type

PATH

Verify that a line resembling

C:\Users\user_name\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\Scripts;

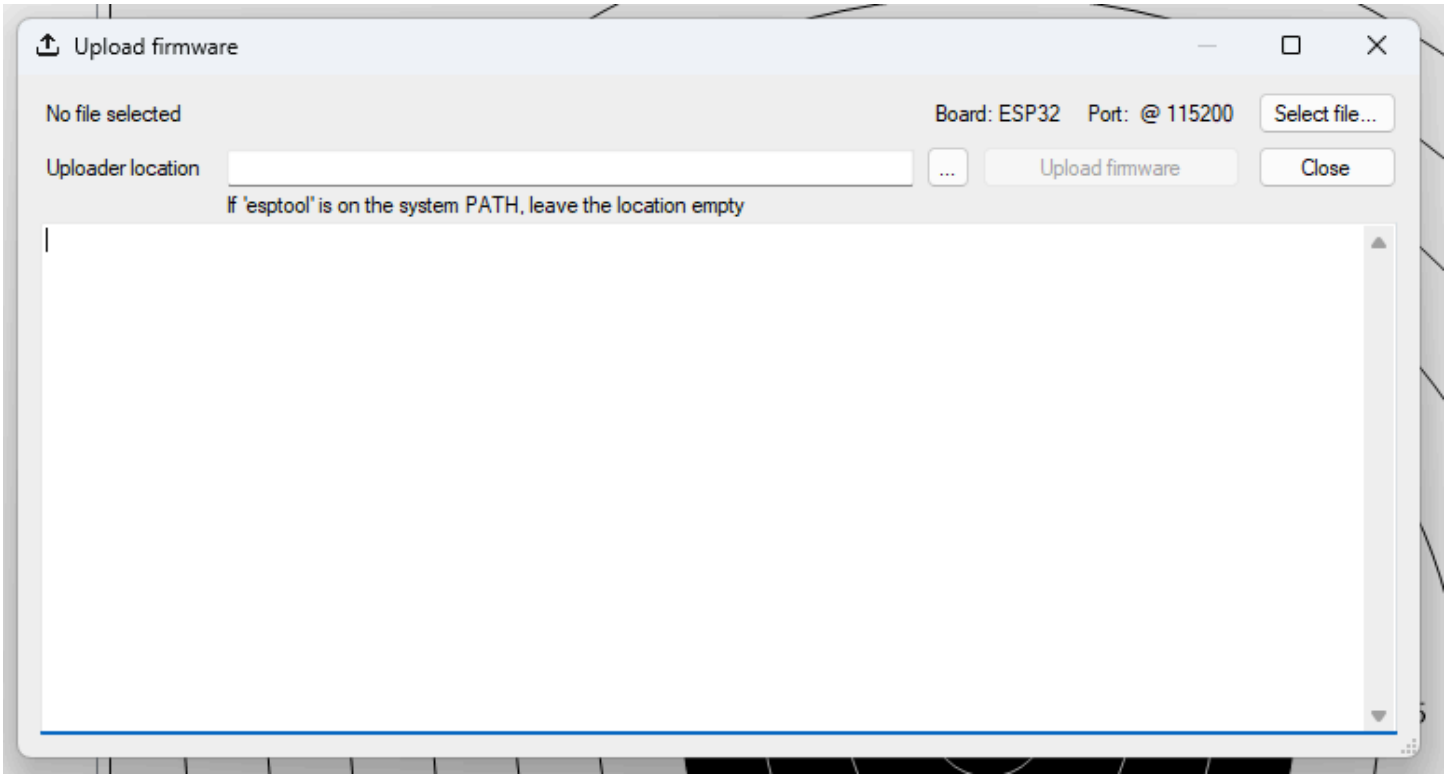
Should appear in your path variable

DOWNLOADING FIRMWARE

Once the basic download package has been installed, you can download new firmware whenever necessary

Visit the free-e-target.com -> tech support -> download for the current release software. Download and save the file (typically to your download folder)

In the PC client, from the upper right corner, select the download icon. The download menu will appear



Select the download file, typically freetarget_version.bin

Press the download firmware button. If everything is properly installed the PC will connect to the target and begin the download.

TROUBLESHOOTING

TROUBLE SHOOTING

The FreeETarget is a complicated system that relies on a number of components to work together. When they work it's great, but I something is out of place it may be difficult to determine the fault and take corrective action. This section goes over the common faults and fixes for the target.

Rougly speaking, there are two phases to the failures:

- Construction failures due to assembling the target incorrectly
- Operational failures due to debris or parts coming loose.

The troubleshooting section treats this as separate sections

ASSEMBLY TROUBLE SHOOTING

You've put the target together and it doesn't record shots, what to do.

Step	Expected Result	Yes	No
1	When power is first applied do the LEDs show RED-WHITE-BLUE	The circuit has powered up and begun operation	Check the USB cable for power
2	After RED-WHITE-BLUE does the RDY LED start blinking	The self test has completed and begun normal operation	The LEDs will stop with a pattern, Refer to the section LED Indicators to determine the fault. Verify that all of the connections are in place
3	From the PC client, CONNECT to the target. After a few seconds doe the PC report connected, and the timer start counting	The USB is operational	Open the DEBUG tab. Is there an error or some message on the window? Folllow the corrective action recommended by the debugger
4	Take a shot into the target Is a shot registered more-or-less correctly	The circuit has detected the pellet and reported the location. Errors in assembly may introduce an error that can be calibrated out	Open the DEBUG tab. Is there a shot registered on the display? Is there an error message? Common Problems Cable not installed correctly Sensors in the wrong location
5	The shot looks good, but is the mirror image of what it should be	Reverse the NORTH-EAST and WEST-SOUTH sensors	
6	Is the LED illumination working?	The LEDs have been correctly installed	Verify that the LED wiring is installed correctly Verify that the 12V supply is attached to the screw terminals Verify that the polarity of the wires is correct

TROUBLESHOOTING

7	When the shot was fired did the witness paper move	The witness paper is correctly installed	Verify that the 12V supply is attached to the screw terminals Verify that the polarity of the wires is correct

WIFI TESTING

Once the basic functionality has been verified the WiFi can be turned on and verified

Preparation

Step	Expected Result	Yes	No
1	From the DEBUG menu While connected to the USB, begin the WiFI configuration by typing {“WC”} [SEND] Does the WiFI configuration menu appear on the display?	The WiFI is ready for configuration	Verify the USB connection Retry the command Is there ANY information on the PC client?
2	If using Station mode Set the SSID		
3	If using a password, set the password		
4	If using an Access Point, set the Channel to 6		
5	Exit the configuration		
6	On the PC Client, DISCONNECT and CONNECT		
7	Using the DEBUG menu, look down the list of settings. Find the WIFI_IP setting		
8	If Access Point was used Is the IP address 192.168.10.9:1010	The WiFi is configured correctly	Check that the value WIFI_SSID is empty (“”)
9	If Station Mode was used Is the IP address of the form 123.456.789.101:1090	The WiFI is configured correctly Record this IP address	Reenter the WIFI_SSID and the WIFI_PWD and try again
10	Verify that the PC is on the correct SSID for the target	The PC is configured correctly	Change the PC SSID to match the target
11	From the SETTINGs tab, set the connection type to TCPIP and enter the IP address recorded in Steps 8 or 9 as appropriate		
12	Press CONNECT After a few seconds does the client show CONNECTED	The PC is connected to the client	Repeat Steps 1 to 11

TROUBLESHOOTING

OPERATIONAL TROUBLE SHOOTING

Once you have successfully shot the first ten rounds into the target, you've proven that the target has been constructed correctly and all of the settings are correct. The target should continue to operate indefinitely.

Should the target stop working, it is most likely due to something being changed or an accumulation of dirt in the sensors. Follow the Table below for troubleshooting

MISPLACED OR NO SHOTS

When shooting a target, the shot is not recorded, or recorded in the wrong place

Step	Expected Result	Yes	No
1	The RDY LED is blinking green or blue	The target is receiving power and is operating correctly	The target is not receiving power or a short in the circuit Look for debris on the board Look for debris on the sensors, particularly West and South
2	Take a shot, Is a shot recorded in the right place	The sensors and calculations are correct	Make sure the flat cable is connected from the circuit board to all of the sensors. Press the cable in place Make sure that there is no debris on the West or South connectors Make sure that there is nothing blocking the sensors When using a SUIS target mask, or a regular mask with a hole in it, ensure that the witness paper is supported. Layer the target as Target Plate Scrap target Witness Paper Front Facing Target

TROUBLESHOOTING

WITNESS PAPER DOES NOT MOVE

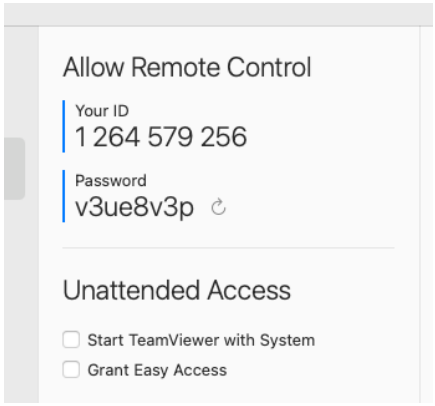
The witness paper should move as each shot is registered. If it does not, use the table below to identify the error

Step	Expected Result	Yes	No
1	Paper moves after every shot	The witness paper is operating correctly	Verify that the cables are connected and secure in the connector
2	The setting PAPER_TIME or STEP_COUNT are non zero	The setting appears to be correct	Program the correct value for your target
3	Press the paper advance button on the circuit Paper advances	The witness paper hardware is installed correctly	Verify the cables Verify the connectors Verify that the AC adapter is plugged in

USING TEAMVIEWER

When all else fails TeamViewer can be used to manage the target from a distance.

- Download Teamviewer from teamviewer.com
- Install and launch TeamViewer
- Look for the remote control ID and password



- Email these two numbers to free-e-target.com
- Connect the target to the PC using a USB cable
- Launch the PC Client

When connected you will see changes made to the PC Client screen and occasionally searches for software that should be installed on your computer.

If your help is needed, you will see a message box appear with instructions or questions.