AFCI EVK Board User Manual

Instructions

1. Initialization
The Beta EVK must always be reinitialized whenever power is turned OFF.
On the FINAL EVK, only need to reinitialize if the EVK is not able to detect correctly.
Please follow the initialization page.

2. CT Coil
The CT coil is designed to handle **DC currents up to 28A** effectively.
Important: If the DC current exceeds **30A**, the CT coil will become saturated.
In this state, it will not be able to detect ARC effectively on the line.

3. Training the Board
Wait for the inverter to stabilize before pressing the Learn Button. From observation, if the Inverter is Grid connected, the inverter will need some for it to sync with the grid, and in those moments, the system will change.

- Set the highest current for the circuit you want to monitor when doing the training
- The board has built in AI to recognize Normal operation, Arcing and open circuit

4. Change the Gain of OP-AMP
- If the Signal have clipping on the dashboard, please change the OP-AMP gain to a lower Gain value.
- After changing, press button 1 to retrain the board

***Special Note*:**
The AI model is specifically trained to **analyze circuit noise**. Therefore, during testing, it is essential to:
- **Use an electronic load to simulate the inverter noise injection to the circuit** or
- **Connect directly to a solar inverter as the load**

*** DO NOT use a pure resistive load,** as the AI model may misinterpret it as an open circuit, even if the circuit is closed. Ensuring the correct testing setup will help achieve accurate results.*

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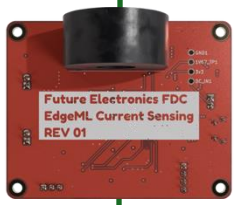
Test Setup

Power Supply
Or
Solar PV

ARC Generator

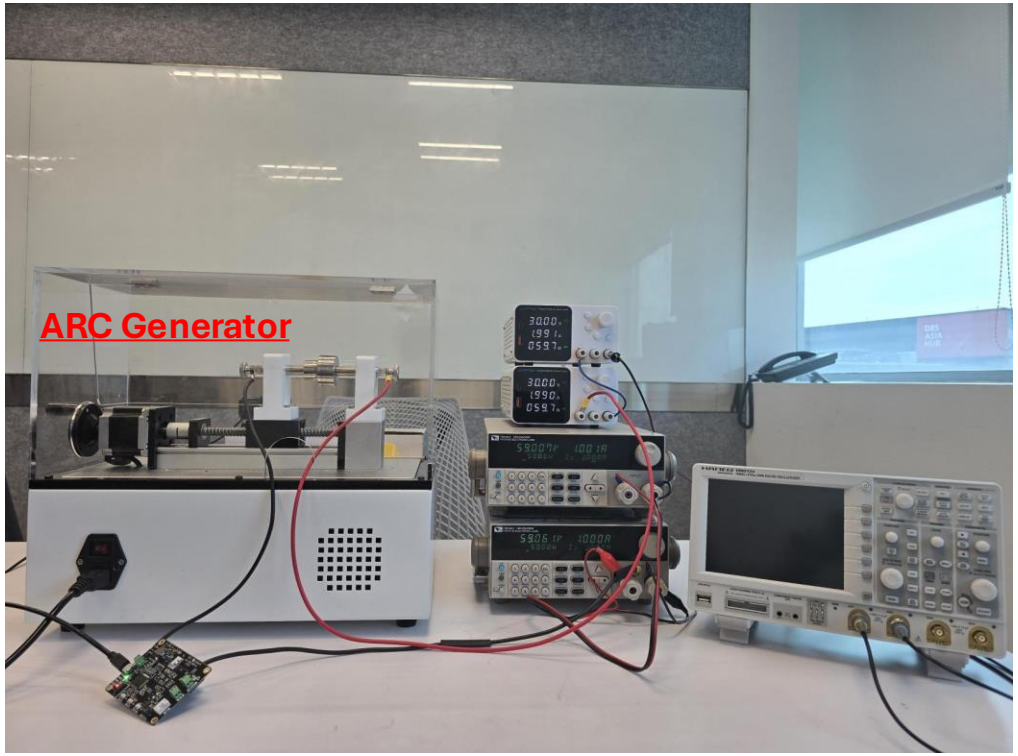
Edge Sensor



Solar Inverter or Electronic Load ONLY

External Load
(only if use inverter)

Use EMC certify Inverter



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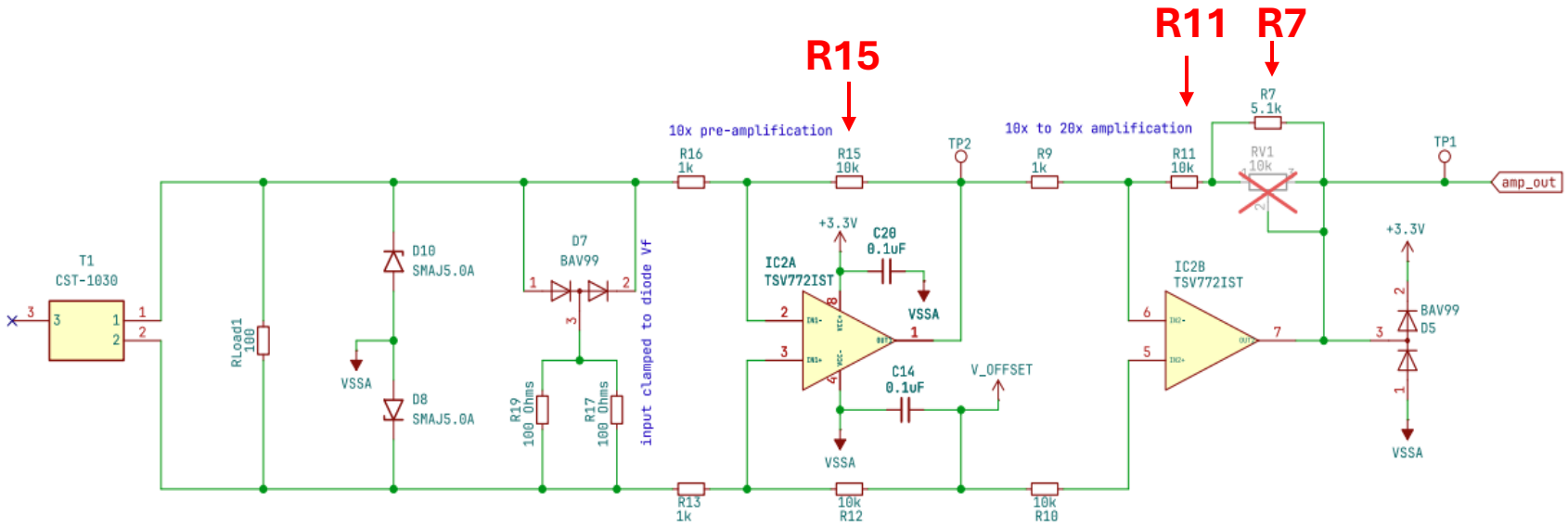
Op AMP Gain Reduction



Reduce GAIN of OP-AMP there is clipping

1. **Default Gain** :150 (As of above setting)
2. **Gain** : 51 (Short R11)
3. **Gain** : 10 (Short R11 and R7)
4. **Gain** : 1 (Short R11, R7 and R15)

**** The CT Coil has a coil ratio of 1:1000***

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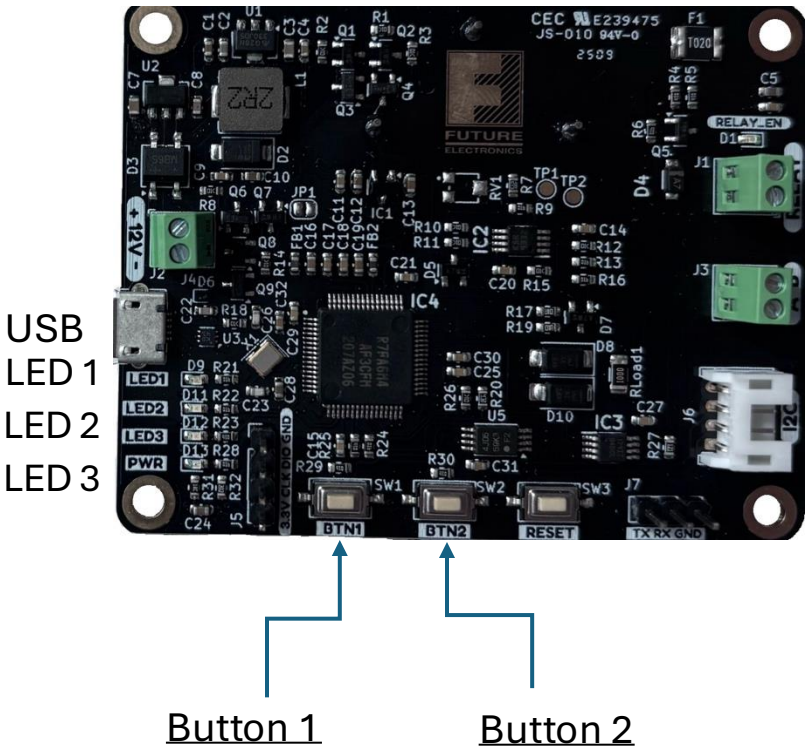
Initialization



1. Connect the board as shown on test setup page
2. Connect a USB power to the Edge sense board
3. Ensure that the circuit is closed, set the **highest operating current** that the inverter can run or set the highest CT coil rated current (28A).
4. Press button 1 once, you will see the LED run indicating learning. When learning is complete, the LED will stop at LED1
5. Maintain the power ON, open circuit at the arc generator
6. Press button 2 to learn open circuit. The indicating LED will run and will stop at LED1,2& 3 when learning is complete
7. Close the circuit using the arc generator, and if closed properly, LED 1 will light up indicating **NORMAL operation**
8. Simulate Arc by slowly opening the arc generator. When arc is detected, LED 3 will light up

If the board indicates ARC while ARC generator is securely closed, press button 1 again to retrain.

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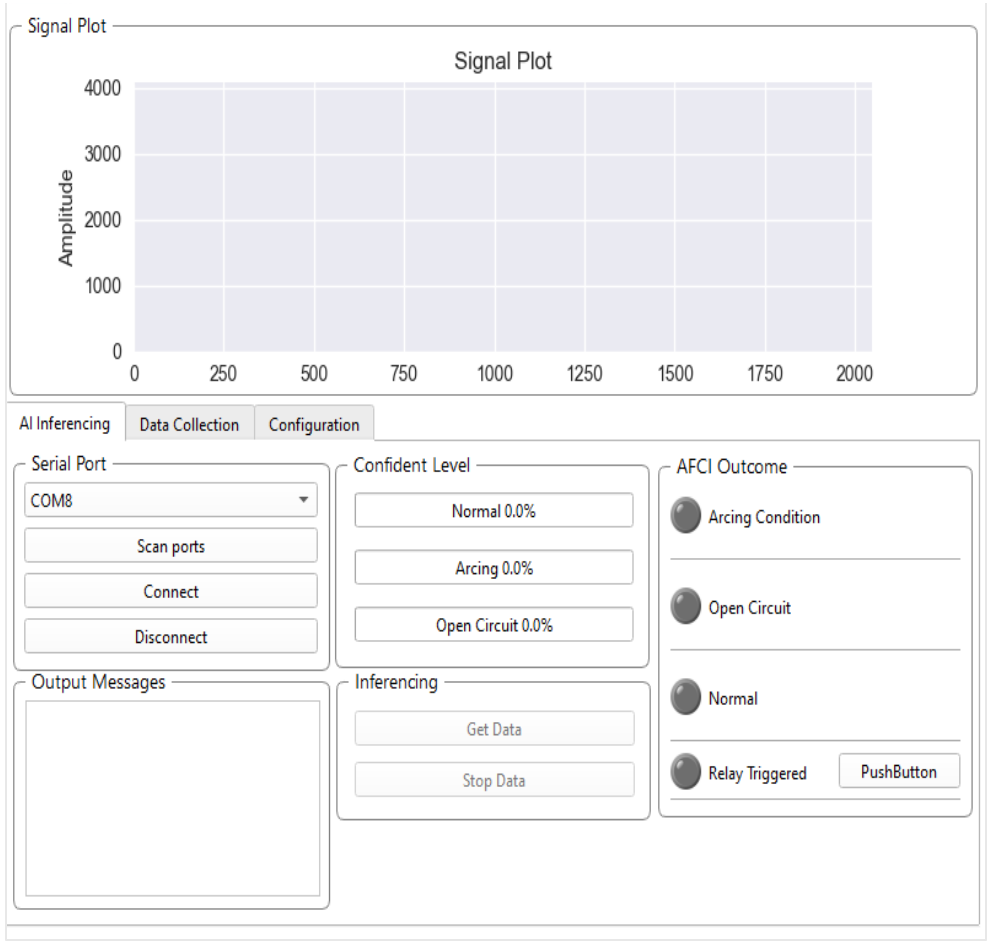
Dashboard user manual – AI Inferencing



1. **Loop the Measured Wire into the CT Coil**:
   - ➢ Ensure the wire to be measured is properly looped into the CT coil.

2. **Connect the FDC Board to the Computer via USB**:
   - ➢ Plug the FDC board into the computer using a USB cable.

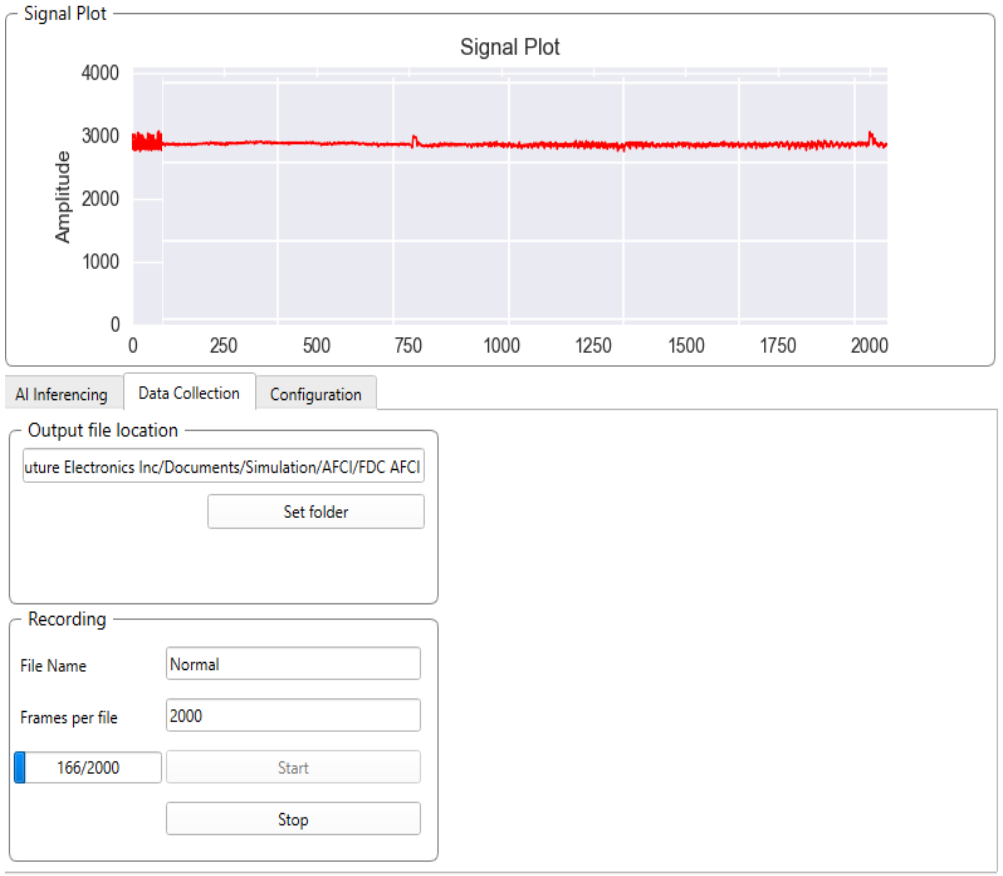
3. **Scan and Select the Correct Port**:
   - ➢ Press "Scan Ports".
   - ➢ Choose the correct port corresponding to the connected USB.

4. **Establish the Connection**:
   - ➢ Press "Connect".
   - ➢ If successfully connected, the message “Connected to serial port.” will appear in the output.

5. **Retrieve Signal Data**:
   - ➢ Press “Get Data”.
   - ➢ The board will begin capturing signals from the CT coil and display them on the Signal Plot.
   - ➢ Confidence levels of the detected signals will also be shown based on their position.

- ➢ **Noisy Signal**
  - ➢ Not enable
- ➢ **Relay Triggered**
  - ➢ When arc happens, this relay will always ON until it is being reset

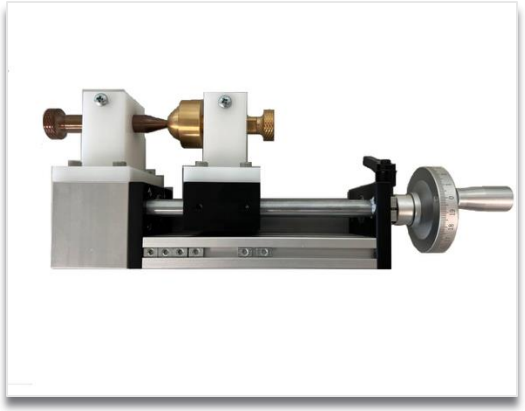
Dashboard user manual – Data Collection



1. **Stop Data**
   - Ensure the "Stop Data" is chosen before going to the Data Collection
2. **Output file location**
   - Choose a file location for the Data to be stored
3. **File Name**
   - Edit a file name that is representative of the data that you are collecting (Example ARC, Normal, Open, Noisy)
4. **Frames per file**
   - This is to let the system to save how many data points to the file. Recommended data to be collected is **2000**
5. **Start**
   - Press "Start".
   - The % bar will start to increment when **Start** is pressed**.** **DO NOT** change the status of the measurement when it is recording
   - When completed to 100%, you can repeat the recording with different status of the ARC.

Troubleshooting Guide for the ARC Generator

1. **Cleaning the ARC Generator:**
    - Regularly inspect the ARC generator for carbon buildup.
    - If a carbon layer accumulates, use **sandpaper** to clean the surface and restore proper conductivity.
2. **Troubleshooting False Readings:**
    - If the ARC generator produces **false readings** (e.g., not returning to normal even after pressing **Button 1** while the circuit is closed***), follow these steps:***
3. **Diagnostic Test:**



- ➢ Step 1: Turn off the power to the ARC generator.
- ➢ Step 2: Measure the ohmic resistance of the ARC generator in the position where false readings happen.
- ➢ Step 3: If the resistance exceeds 1 ohm, carbon buildup may cause poor conductivity.
- ➢ Step 4: Use sandpaper to carefully remove the carbon deposits.
- ➢ Step 5: Repeat the resistance test after cleaning. If resistance is within the acceptable range, restore power and verify proper operation.

✓ *Regular maintenance ensures accurate performance and extends the lifespan of the ARC generator.*

FAQs

1. **Why do some boards complete the learning process quickly, while others take much longer?**

The variation is primarily caused by the **system noise level** during the learning phase.

- If the system noise is low, the board can quickly establish a baseline and complete learning in a short time.
- If the system noise is high (due to EMC interference), the board requires more time to analyze and calibrate the signal.

The board will attempt up to 20 reading cycles before timing out. If it times out, it defaults to the least sensitive setting, which may not be adequate for ARC detection.

To ensure consistent and reliable learning, please use EMC-certified equipment and maintain a clean electrical environment.

2. **Can it support more than 1 channel?**

Yes, it supports multiple channels. In our evaluation, we demonstrated arc detection across up to 30 channels within 500 milliseconds.
This multi-channel capability is currently under design review and can be deployed upon customer request.

3. **Can it detect arcs at distances of 400 to 1000 meters?**

Detection at such distances depends heavily on system noise levels. Our AI model is trained to recognize specific arc fault signatures.
However, if the arc signal is masked or overwhelmed by system noise, detection accuracy will be compromised.

4. **How small an arc can it detect?**

The minimum detectable arc size is influenced by the **noise floor of the system**. In a low-noise environment, our AI model is capable of detecting very **small and weak arcing events** effectively.

5. **What other faults can it detect?**

Currently, the model is trained exclusively for **DC arc fault detection**. Expansion to other fault types will require additional AI training and system configuration.

6. **Can it detect powerline (AC) arc faults?**

Yes, it is possible. However, this requires a **new AI model** trained specifically for **AC arc fault characteristics**, along with a redesign of the **analog front end** to accommodate AC signal behavior.