



THREE PHASE BOX MANUAL

CP2429

Inspiring The Next
Generation Of Engineers

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Introduction

The Matrix Three Phase Box is a versatile device capable of generating three-phase output voltages and frequencies. It can be controlled in three different ways:

1. **Manual Touch Screen** – Directly from the front panel.
2. **Matrix Three Phase PC App** – Via a USB connection.

Specifications

- **Frequency Range:** 0.1Hz to 400Hz
- **Voltage Output:** 12Vrms per phase (Line voltage: 20.75V)
- **Current Output:** 6.5Arms per phase
- **Connectivity:** USB-B for PC control, Ethernet
- **Power Supply:** Can be powered by the Matrix Battery Simulator or an external power source
- **Cooling System:** Two fans – one for the power supply and one for internal electronics
- **Safety Features:** Main power switch, internal fuse for overcurrent protection

Front Panel Overview

The front panel of the box includes:

- **Touch Screen Display** for manual control.
- **Six 4mm Connectors:**
 - Three (in a triangular arrangement) for three-phase output.
 - One neutral connector (fixed at 24V with respect to ground).
 - Two additional connectors (Red and Black) for connecting the Matrix Battery Simulator.

Rear Panel Overview

The back of the unit features:

- **Main Power On/Off Button**
- **USB-B Port** for PC connectivity
- **Ethernet Port** for remote control via the web app
- **Two Cooling Fans** that adjust speed based on current draw

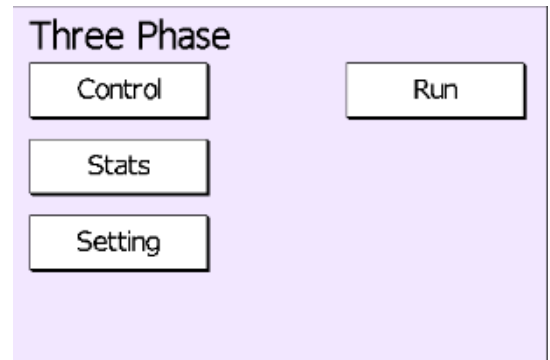
Operating the Box

1. Manual Operation via Touch Screen

Home Screen

Upon powering on, the home screen appears with the text “Three Phase” and four buttons:

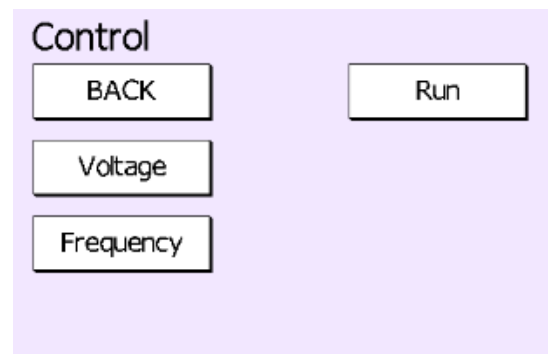
- **Control** – Adjust voltage and frequency settings.
- **Stats** – View real-time voltage and current measurements.
- **Setting** – Configure network settings and reset the box in case of an overcurrent fault and Bootloader.
- **Run/Stop** – Enable or disable the output. This button remains in the same location across different screens.



Control Screen

Pressing Control takes you to the control menu, where four buttons are available:

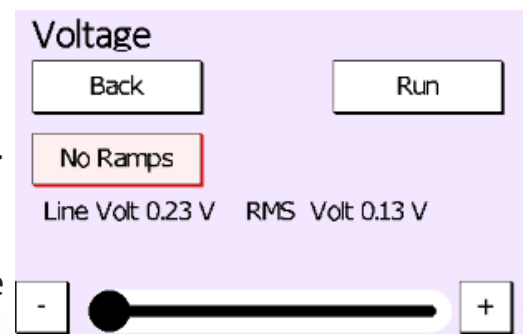
- **Back** – Returns to the home screen.
- **Voltage** – Adjust output voltage settings.
- **Frequency** – Adjust output frequency settings.
- **Run/Stop** – Enable or disable the output.



Setting Voltage

The voltage adjustment screen includes:

- **Back** – Returns to the control screen.
- **Ramp Mode** – Enables gradual voltage adjustment. If disabled, voltage changes instantly.
- **Slider** – Adjusts voltage to the desired setting.
- **Increment/Decrement Buttons** – Fine-tune the voltage by 1% increments.

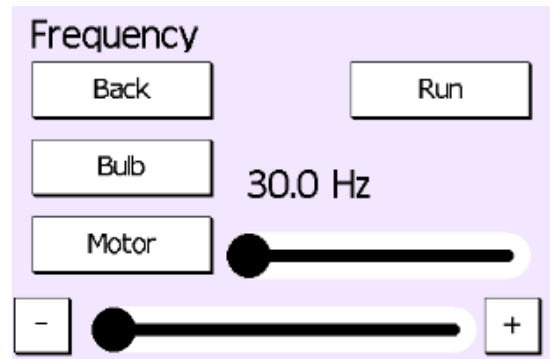


Operating the Box

Setting Frequency

The frequency adjustment screen contains:

- **Back** – Returns to the control screen.
- **Bulb Mode** – Allows frequency adjustment between 0.1Hz and 30Hz.
- **Motor Mode** – Allows frequency adjustment between 30Hz and 500Hz.
- **Slider** – Adjusts frequency settings.
- **Increment/Decrement Buttons** – Fine-tune the frequency.
- **Run/Stop** – Enable or disable the output.



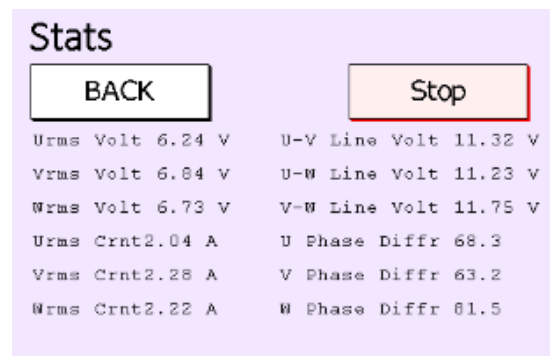
The user can run the motor in bulb mode and the bulb in motor mode. In bulb-in-motor mode, high frequency prevents visible changes in the bulb's behavior. If the motor runs in bulb mode, the box shuts down due to overcurrent. To operate the motor at lower frequencies, limit the voltage to a maximum of 6Vrms per phase.

Returning to the control screen and pressing Back again will take you to the home screen.

Viewing System Stats

Pressing Stats from the home screen displays:

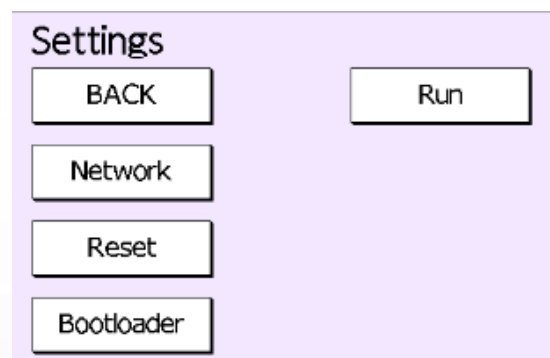
- **Back** – Returns to the control screen.
- **Three-phase RMS voltages**
- **Line voltages between phases**
- **RMS current for each phase**
- **Phase angle between voltage and current**
- **Run/Stop button** – Control output directly from this screen



Resetting Overcurrent Faults

From the Network menu, the user can:

- **Network** button is not available currently
- **Reset the output** if it shuts down due to overcurrent.
- **Bootloader** button is for the user, if there is firmware update available.

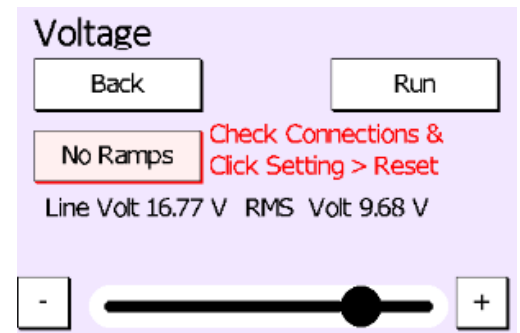


Overload/Short-Circuit Protection

The Three Phase Box is equipped with built-in overload and short-circuit protection to prevent damage due to incorrect wiring or excessive current draw. Below are the conditions that may trigger the protection mechanism and how users should respond.

1. Short-Circuit Protection

If there is an incorrect wiring connection that results in a short circuit, the system will automatically shut down the output to prevent damage. When this occurs, the following message will appear on the screen:



"Check Connections & Click Setting and Reset"

This message will be displayed regardless of the current screen the user is on. To restore functionality:

- Check all wiring connections to ensure there are no short circuits.
- Correct any wiring errors.
- Click on Settings and then Reset to restart the system.

2. Overload Protection

The Three Phase Box monitors the current draw per phase and will shut down the output if the current exceeds 6.5A RMS per phase. The following conditions may cause an overload:

A) Running a Motor at Low Frequency with High Voltage

- If a motor is operated at a low frequency (e.g., 10 Hz) with a higher voltage (e.g., 10Vrms), the current may exceed 6.5A RMS per phase.
- When this happens, the output will shut down, and the warning message will be displayed.
- To avoid this, reduce the voltage at lower frequencies to maintain a current below 6.5A RMS per phase.

B) Running a Motor in Delta Mode

- Operating the motor in Delta Mode can result in a higher current draw.
- For example, at 50Hz, the system may not allow supplying more than 10Vrms.
- At higher frequencies (above 50Hz), the voltage can be increased up to 12Vrms.
- At lower frequencies (below 50Hz), the voltage needs to be reduced further to ensure the current remains below 6.5A RMS per phase.

Overload/Short-Circuit Protection

3. User Guidelines

To prevent triggering the protection mechanism, follow these guidelines:

- Always ensure wiring is correctly configured before powering on the system.
- Do not exceed 6.5A RMS per phase.
- Adjust voltage levels appropriately based on frequency.
- If the system shuts down, follow the instructions on the display, check connections, and reset the system.
- Before you change any output it is recommend to stop the output. Set volage to zero, set the desired frequency, go back to voltage control make sure the ram button is on, run the box and then change the voltage. Having the ram can prevent spike in current.

4. Changing Output Settings Safely

To safely change the output settings, follow these steps:

1. Stop the output before making any changes.
2. Set the voltage to zero.
3. Set the desired frequency.
4. Go back to voltage control.
5. Ensure the Ramp Volts button is on.
6. Run the box output.
7. Gradually increase the voltage to desired value.

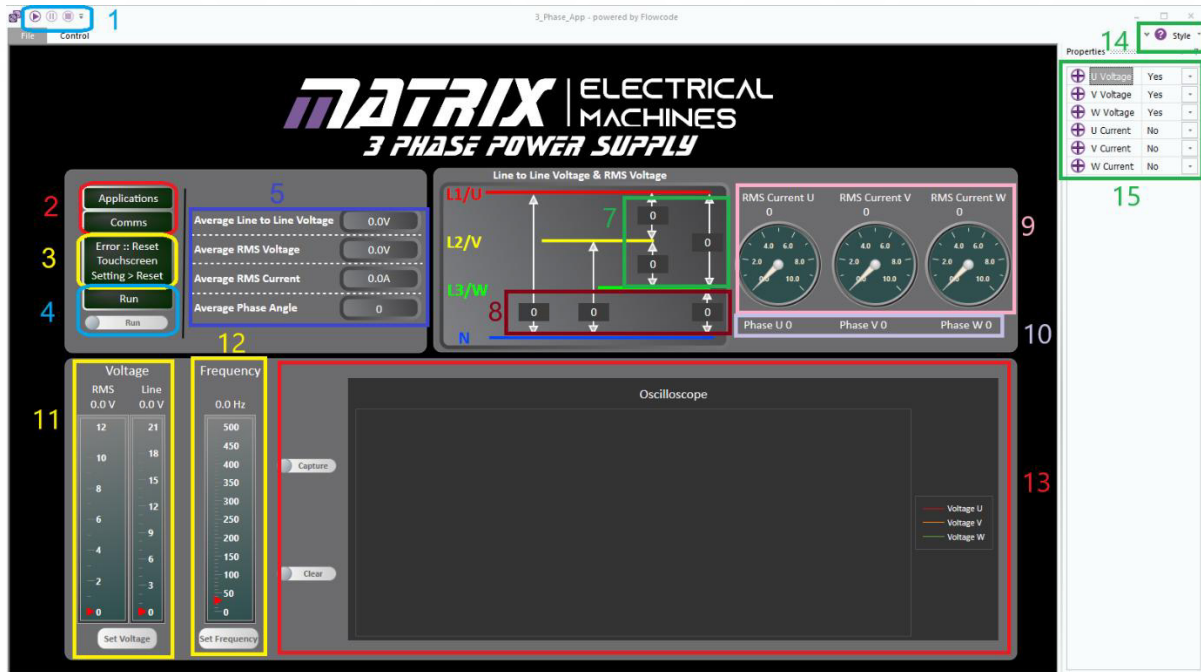
By following these precautions, users can ensure the Three Phase Box operates reliably and safely.

PC App Control

The Matrix Three Phase Box can also be controlled via:

- **PC App** – Connect via USB-B to adjust settings and monitor outputs.

PC Application for Three Phase Box



How to Use the PC Application for Three Phase Box

This guide explains the features and functionalities of the PC application used to control and monitor the Three Phase Box.

1. Running and Stopping the Application

- Click the **Run/Stop** button (Labelled "1" in Sky Blue) to start or stop the application.

2. Application and Communication Status

- The **Application Status** (Labelled "2" in Red) will turn **Light Green** when active.
- The **Communications Status** will also turn **Light Green** if the application successfully detects the Three Phase Box.

3. Fault Indicator

- The **Fault Indicator** (Labelled "3" in Yellow) toggles between **Red** and **Green**.
- It turns **Red** if the Three Phase Box shuts down due to overcurrent or overheating.

4. Enabling and Disabling Output

- Use the **Output Control** (Labelled "4" in Sky Blue) to enable or disable the Three Phase Box output.

5. Sensor Data Summary

- The **Sensor Data Display** (Labelled "5" in Dark Blue) provides the average readings for:
 - Line Voltage
 - Phase Voltage
 - RMS Current
 - Phase Angle

PC Application for Three Phase Box

6. Voltage Sensor Readings

- The **Voltage Sensor Display** (Labelled "6" in White) shows all voltage values measured by the voltage sensors in the box.

7. Line Voltage Between Phases

- The **Line Voltage Display** (Labelled "7" in Green) shows the voltage measured between two phases.

8. Phase RMS Voltage

- The **RMS Voltage Display** (Labelled "8" in Maroon) shows the RMS voltage of each phase (voltage between a phase and neutral).

9. RMS Current Readings

- The **RMS Current Display** (Labelled "9" in Pink) shows the RMS current measured for each phase.

10. Phase Angle Display

- The **Phase Angle Display** (Labelled "10" in Silver) shows the phase angle between voltage and current for each phase.

11. Setting Phase Voltage

- The **Voltage Control** (Labelled "11" in Yellow) allows the user to set the voltage for each phase:
- Adjust using the **slider** or press the **Set Voltage** button to enter a specific value (0V - 12V).
- The line voltage is automatically calculated and displayed next to the slider.

12. Setting Frequency

- The **Frequency Control** (Labelled "12" in Yellow) allows the user to set the output frequency:
- Adjust using the **slider** or press the **Set Frequency** button to enter a value (0.1Hz - 500Hz).

13. Capturing Waveforms

- The **Waveform Capture** (Labelled "13" in Red) allows users to:
- Capture voltage and current waveforms by pressing **Capture**.
- Clear the captured data by pressing **Clear**.
- Data is automatically stored in a CSV file when **Capture** is pressed.

PC Application for Three Phase Box

14. Theme Selection

- The **Theme Toggle** (Labelled "14" in Green) allows users to switch between **Dark Mode** and **Light Mode**.

15. Customizing Graph Display

- The **Graph Display Control** (Labelled "15" in Green) allows users to:
- Show or hide specific voltage and current waveforms.
- View only voltage, only current, or specific phase data.

By following these instructions, users can effectively control and monitor the Three Phase Box using the PC application.

Safety Precautions

- Ensure the correct voltage and current settings before enabling the output.
- Do not exceed the rated current of **6.5Arms per phase**.
- Keep the cooling fans unobstructed to prevent overheating.
- Use only authorized power sources and connectors.

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