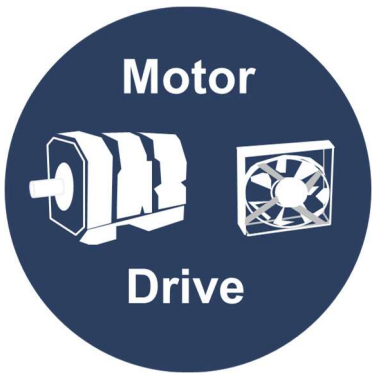
# Strata 10-100V BLDC MDK EVB User Guide






**September, 2021 – Rev. 0**

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## Introduction

The Strata 10-100V BLDC MDK EVB provides an easy to use evaluation kit within the Strata Development Studio for driving BLDC motors. There are 4 variants with 4 different voltage ranges:

- Variant A: 10-16V
  - STR-10-16V-BLDC-MDK-GEVB
- Variant B: 16-30V
  - STR-16-30V-BLDC-MDK-GEVB
- Variant C: 30-60V
  - STR-30-60V-BLDC-MDK-GEVB
- Variant D: 60-100V
  - STR-60-100V-BLDC-MDK-GEVB

Through Strata, the developer can access datasheets, BOMs, schematics, and other collateral they may need.

## Features

- VIN Range 10V to 100V
- Unipolar / bipolar selection
- Programmable
  - Switching Frequency
  - OTP/OVP/OCP
  - Acceleration
- Up to 1200W of power

### Applications

- Robotics
- Power Tools
- Fans
- Autonomous Battery Vehicles

# User Guide

This section will explain how to use the Strata 10-100V BLDC MDK EVB's in a step by step manner. It will cover the hardware required, how to use the User Interface in Strata, and the controls specific to this EVB.

## Hardware Setup

The hardware required to use the Strata 10-100V BLDC MDK EVB's are a computer (with Windows), a power supply, and a motor. Sense lines are recommended if available with equipment being used. Follow the steps below.

1. Connect the Trenz motor controller board to the MDK EVB as in Figure 1
    a. USB connector should be on same side as the input lugs
    b. https://www.onsemi.com/design/tools-software/evaluation-board/seco-te0716-gevb
2. Connect the motor windings
    a. U, V and W are marked on the board
3. Connect the hall sensors
    a. Default configuration uses an on board 5V rail
    b. An external voltage can be used by switching SW1 to "EXT" and connecting a power supply to J20
        i. It is recommended to supply at least 2.5V and no more than 20V
4. Connect the power supply to the input of the EVB using the threaded lugs J29 and J28. Do not apply more than the variants max voltage to the input. The minimum voltage needed for the EVB to turn on is variant dependent
    a. Variant A – 10V
    b. Variant B – 16V
    c. Variant C – 28V
    d. Variant D – 54V
5. If available, connect sense lines to the input using TP40 and TP32, turn on the input power supply
6. Connect the computer to the EVB using the USB connector J13 on the Trenz board.
    a. The input supply must be powered on first before the USB connector can be connected
    b. Disconnect the USB before turning the main board power OFF
7. Make sure SW2 is ON
    a. See the image below for position
    b. This switch is a master shut off. At any point if this switch is switched off the motor will shut down and not be usable until it is switched to the on position

An example picture of the setup is shown in Figure 1.

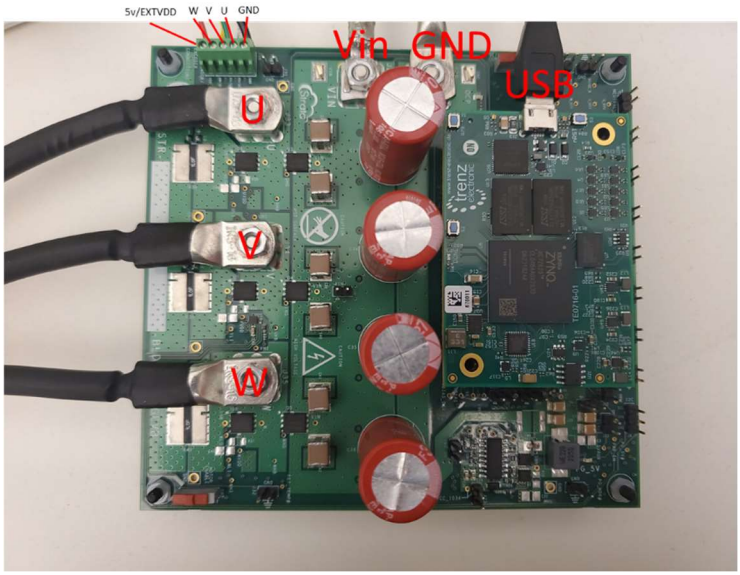


**Figure 1 MV MDK EVB**

## User Interface

The UI within the Strata app allows the user to control the EVB and monitor its telemetry without needing other lab equipment or training to do so. The steps below cover what is in the UI.

1. First, download and install the most recent version of Strata. It can be found here: https://www.onsemi.com/support/strata-developer-studio
2. Open the Strata app. Login and the home screen will appear.
3. The app will automatically detect the device and will bring up the UI for the board that is plugged in.
    a. Depending on user settings, the UI may not automatically come up, but the connected board will be the first choice

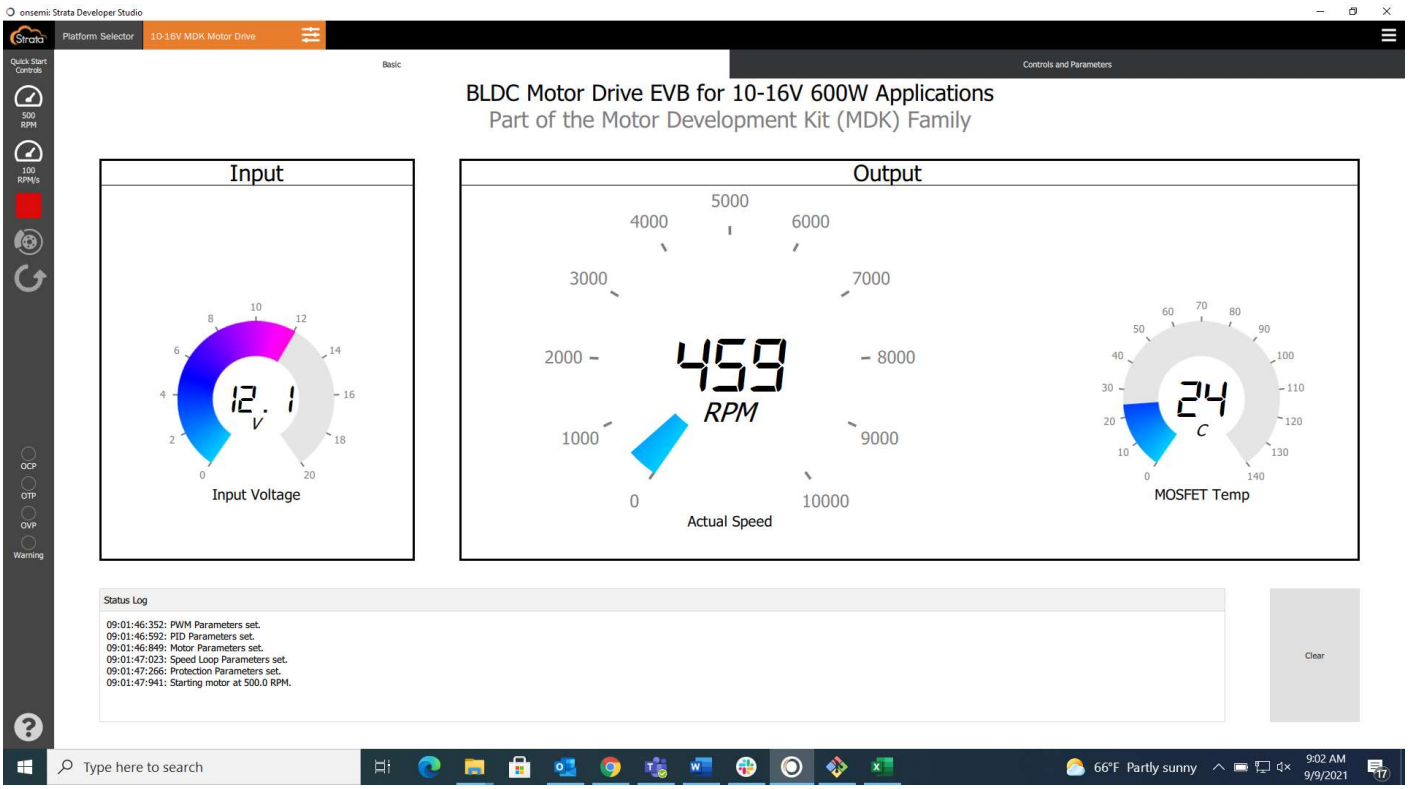


**Figure 2 Basic View**

4. Figure 2 shows the view for the 12V EVB, one of the 4 available variants of the BLDC MDK EVB. It offers telemetry such as: input voltage, RPM, MOSFET temperature, fault status: OCP, OVP, OTP, and a status log for error and warning messages. It also offers controls for RPM, acceleration, Run/Stop and direction of the motor.
5. A Controls and Parameters tab is also available and is shown in Figure 3.

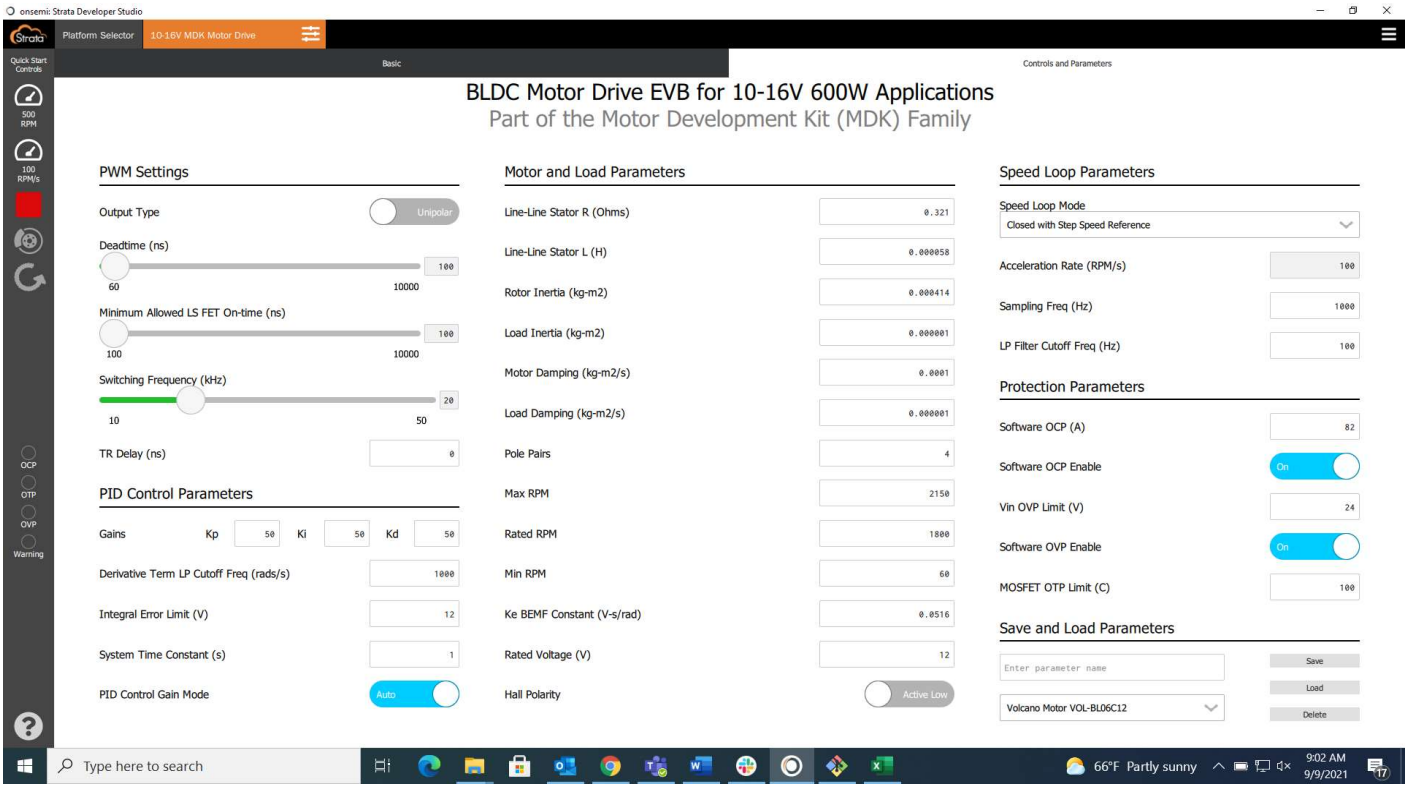


**Figure 3 Advanced View**

6. The round button with a question mark in the bottom left corner of the screen is the help button, which will give the user a description of what everything on the UI does.
7. To view the collateral provided with the EVB, click on the “Platform Selector” tab at the top of the screen. Once back in the Platform Selector, click on “Browse Documents” next to the platform that is plugged in.

## Controls and Functionality

This section will go over controls and functionality specific to this EVB. Please note that these changes will not be noticed if the motor is running. Once the motor is stopped and started again can the changes be noticed.

1. PWM Settings
    a. Output Type
        i. Bipolar
        ii. Unipolar
    b. Deadtime
        i. [60 – 10000]ns
        ii. 10ns increments
    c. Minimum Allowed LS FET On-time
        i. [100 – 10000]ns
        ii. 10ns increments
        iii. DOES NOT SUPPORT 100% DUTY CYCLE OPERATION
    d. Switching frequency
        i. [10 – 50]kHz
        ii. 1kHz increments
    e. TR Delay
        i. Clock cycles to delay ADC sampling from midpoint of PWM on time
        ii. 1 cycle = 10ns
        iii. Must be an integer > 0
2. PID Control Parameters
    a. Gains
        i. Kp – Proportional gain
        ii. Ki – Integral gain
        iii. Kd – Derivative gain
            1. Set to 0 for PI controller only
    b. Derivative Term LP Cutoff Freq (rads/s)
    c. Integral Error Limit (V)
        i. Normally set to DC bus voltage
    d. System Time Constant (s)
        i. System time constant for auto IMC-calculated PID gains
        ii. A lower value will have a faster reaction
    e. PID Control Gain Mode
        i. Auto
        ii. Manual
3. Motor and Load Parameters
    a. Line-Line Stator R (Ohms)
    b. Line-Line Stator L (H)
    c. Rotor Inertia (kg-m^2)
    d. Load Inertia (kg-m^2)
    e. Motor Damping (kg-m^2/s)
    f. Load Damping (kg-m^2/s)
    g. Pole Pairs
    h. Max RPM
    i. Rated RPM
    j. Min RPM
    k. Ke BEMF Constant (V-s/rad)
    l. Rated Voltage (V)
    m. Hall Polarity
        i. Active low or active high
        ii. Changing this will change the motor direction

4. Speed Loop Parameters
    a. Speed Loop Mode
        i. Closed with Step Speed Reference
        ii. Closed with Ramped Speed Reference
        iii. Open Loop
    b. Acceleration Rate (RPM/s)
        i. Only works in open loop mode
    c. Sampling Freq (Hz)
        i. Sampling rate for the speed loop
    d. LP Filter Cutoff Freq (Hz)
5. Protection Parameters
    a. Software OCP (A)
        i. Adjustable up to:
            1. Variant A ~82A
            2. Variant B ~82A
            3. Variant C ~61A
            4. Variant D ~41A
    b. Software OCP Enable
    c. Vin OVP Limit (V)
        i. Adjustable up to:
        ii. Variant A – 24V
        iii. Variant B – 45V
        iv. Variant C – 90V
        v. Variant D – 150V
    d. Software OVP Enable
    e. MOSFET OTP Limit (C)
        i. Configurable from -55°C to +125°C
6. Save and Load Parameters
    a. Parameter file name text box
    b. Saved Configuration drop down box

## Programming the UCB

This section is only necessary if different variants are being used with one UCB, or newer FW is available. Follow the steps below to re-program the UCB

1. Remove the USB cable from the UCB
2. Turn off input power, if it was being supplied
3. Remove the UCB from the MV MDK EVB
4. Push in on the SD card, found at the opposite end of the USB connector on the bottom of the board
    a. The card should pop out a few mm
    b. Figure 4 shows the bottom of the UCB

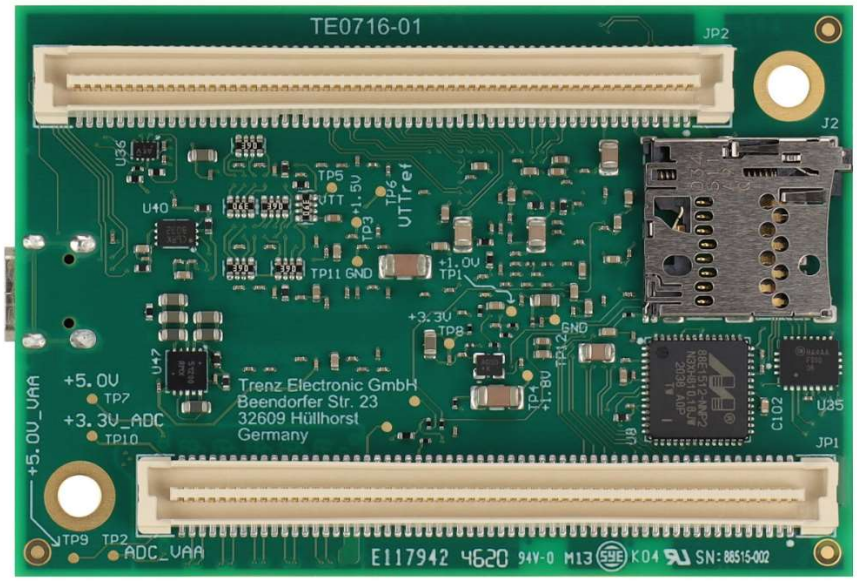


**Figure 4 Bottom of UCB**

5. Pull the SD card out
6. Connect the SD card to an appropriate device
    a. Either directly into a computer, or in an SD to USB adapter
7. Delete the boot.bin file that is on the SD card
8. Copy or paste the new boot.bin file
9. Remove the SD card and install it back into the UCB
10. Follow the steps in the HW setup section for further instructions