

TSDZ2 controller firmware v0.20 beta 1

[📄 Configuration Menu](#)

- [0: Basic Setup](#)
- [1: Battery Setup](#)
- [2: Power Assist](#)
- [3: Torque Assist](#)
- [4: Cadence Assist](#)
- [5: eMTB Assist](#)
- [6: Walk Assist](#)
- [7: Cruise](#)
- [8: Main Screen Setup](#)
- [9: Street Mode](#)
- [10: Advanced Setup](#)
- [11: Advanced Technical Data](#)

0: Basic Setup

The parameters in the Basic Setup should always be configured before using the bike.

Submenu number	Configuration name	Description
0	Unit	(Metric) (Imperial) Press the UP or DOWN button to switch between metric (km/h, kilometers, Celsius) or imperial units (mph, miles and Fahrenheit).
1	Maximum wheel speed	Enter speed limit from where the motor will fade out power from. The power fade starts from -0.5 km/h to +2,0 km/h. If you enter 0 as a speed limit there will be no speed limiting. Enter your wheel circumference in millimeters so that speed and distance are correctly calculated.
2	Wheel circumference	Tip: Search on Google how to measure the wheel circumference. Below are approximate values for a quick setup. Remember to calibrate with GPS for finer adjustments. 26 inch wheel = 2050 mm 27 inch wheel = 2150 mm 27.5 inch wheel = 2215 mm 28 inch wheel = 2250 mm 29 inch wheel = 2300 mm
3	Motor voltage type	(0) 48 V motor. (1) 36 V motor. (2) Experimental 48 V motor, high cadence mode. (3) Experimental 36 V motor, high cadence mode.

Depending on the version of TSDZ2 you have there are two different kind of motors. Set the appropriate value so that the FOC calculations are correctly executed. The voltage of the battery does not matter, this value should always be set depending on type of motor.

- Note that there is a chance that the experimental mode is not good for the motor, use at your own risk. Probably only suitable for the 36 V motor.
- The TSDZ2 52 V version has a 48 V motor.

4	Motor power limit	Set value after user preference. Install the motor temperature sensor if a lot of power is frequently needed so as not to overheat the motor.
5	Set odometer	Set the odometer to preferred value.
		(0) Day time mode enabled on system startup (1) Night time mode enabled on system startup (2) Remember light mode through power cycles
6	Light mode configuration	Day time mode is when the external lights are off and the screen brightness percentage is set slightly lower. During night time mode the external lights are enabled and the screen brightness increases to better see the display when dark. Switch between light modes by pressing and holding the UP button on the main screen.
7	Screen brightness, day time mode	Preferred screen brightness percentage during day time mode.
8	Screen brightness, night time mode	Preferred screen brightness percentage during night time mode.
9	Screen auto power off	Automatic power off after amount of minutes.
10	Reset to defaults	Reset to default values. Enter the sub menu so that the number 42 starts blinking. Hold the POWER button a short amount of time and the system will reset to default values.

1: Battery Setup

In the Battery Setup menu it is possible to configure all battery parameters.

Submenu number	Configuration name	Default value	Description
0	Maximum battery current	16 A	Set maximum allowable current to be pulled from the battery. The controller is software limited internally to the safe value of 18 A.
1	Battery low-cut-off	39 volt	The controller will reduce power to not get below the minimum

	voltage		<p>voltage limit. Calculate the limit by multiplying amount of cells in series with the safe cut-off-voltage per cell, which is usually between 2.8 - 3.0 volts. Example: 13 cells in series * 3.0 volts safe minimum = 39.0 volts for the entire battery pack.</p> <p>Tip: The standard Samsung cells allow down to 2.75 V but you need some safety margin because not all cells have exactly the same capacity. But setting a too large value you loose range and power.</p> <p>Set this value so the battery state indicator works properly. This value can be any integer from 7 to 14</p>
2	Number of cells in series	13	<p>Example values: 7 for 24 V battery; 10 for 36 V battery; 13 for 48 V battery; 14 for 52 V battery.</p> <p>Set this value so the battery state indicator does not display a lower state of charge when pulling a lot of power from battery and the voltage sags.</p> <p>Explanation: If you set the value to 0, you will see the battery state indicator fluctuating whenever the motor draws current from the battery. This is due to the internal resistance in the battery. The fluctuation will disappear and be filtered out with a correct value.</p>
3	Battery internal resistance	130 milliohms	<p>How to calculate the battery pack resistance:</p> <ol style="list-style-type: none"> 1. Limit the battery current to a known value, e.g. 10 amps 2. Read the voltage drop when motor is pulling the 10 amps 3. Calculate the resistance value <p>Example for 10 amps current, $R = U / I$, $R = 1.2 \text{ volts drop} / 10 \text{ amps}$, $R = 0.120 = 120 \text{ milliohms}$.</p> <p>This is the battery voltage adjusted with the configured internal resistance of the battery.</p>
4	Battery voltage (SOC)	-	<p>Tip: It is possible to evaluate and test how the configured internal resistance affects the voltage reading by looking at this value when riding the bike. It should not change much regardless of power used.</p>
5	Enable and set State of Charge function	0	<p>(0) Function disabled (1) Function enabled (100 % to 0 %) (2) Function enabled (0 % to 100 %) If the function is enabled it is possible to have it display state of charge percentage remaining (100 % to 0 %) or percentage consumed (0 % to 100 %). Choose whatever is preferable.</p>
6	Threshold voltage to reset watt-hour meter	54.2 volt	<p>The system will compare this value to the battery voltage. If it is lower, the battery is expected to be fully charged and the watt-hour meter is reset.</p>

Tip: To find a suitable value, fully charge the battery and measure the voltage on the KT-LCD3, use a slightly lower value for the threshold voltage.

Example: A 48 V battery charges up to 54.6 volts, so set the threshold voltage to 54.2 volts.

Set the total battery capacity in watt-hours.

Tip: fully charge the battery and then discharge it completely and use the measured value to input here.

7 Total watt-hours of battery 0

Tip: roughly calculate the capacity by multiplying the nominal voltage with the nominal ampere hours. Example: a 48 volt, 14.5 Ah battery has a nominal watt-hour capacity of 696 Wh.

8 Consumed watt-hours -

This value represents consumed watt-hours since last reset. It is reset automatically when you power on the LCD and the battery voltage is above the set threshold voltage, i.e. fully charged.

2: Power Assist

Here you can configure if you wish to enable the Power Assist riding mode. And also what multipliers to use for the different assist levels.

The assist level multipliers sets the motor power as a factor of the power the rider is generating at the crankshaft. For instance, if the rider is generating 100 watts of power and the multiplier is 1.0, there will be another 100 watts of assistance from the motor.

This riding mode is based on the generated power from the rider. The power you generate on the crank the more assistance you will receive. This relationship is proportional to the power assist level multipliers.

Submenu number	Configuration name	Description
0	Power Assist Enable	(0) Disable Power Assist (1) Enable Power Assist
1	Number of assist levels	Select the desired number of assist levels from a minimum of 1 to a maximum of 9.
2	Power Assist level 1	This is the value with which the human pedaling power is multiplied with.
X	Power Assist level X	This is the value with which the human pedaling power is multiplied with.

3: Torque Assist

Here you can configure if you wish to enable the Torque Assist riding mode. And also set the multipliers for the different assist levels.

The assist level multipliers sets the motor power as a factor of applied torque on the pedals. The values are relative and are somewhat dependent on the configuration and bike setup. Please configure levels comfortable for your riding style.

This riding mode is only using the torque sensor to determine how much assistance to give. More torque applied on the pedals will result in more assistance. This relationship is proportional to the torque assist multiplier.

Submenu number	Configuration name	Description
0	Torque Assist Enable	(0) Disable Torque Assist (1) Enable Torque Assist
1	Number of assist levels	Select the desired number of assist levels from a minimum of 1 to a maximum of 9.
2	Torque Assist level 1	
X	Torque Assist level X	

4: Cadence Assist

Here you can configure if you wish to enable the Cadence Assist riding mode. And also set the assistance level for each and every assist level.

Submenu number	Configuration name	Description
0	Cadence Assist Enable	(0) Disable Cadence Assist (1) Enable Cadence Assist
1	Number of assist levels	Select the desired number of assist levels from a minimum of 1 to a maximum of 9.
2	Cadence Assist level 1	
X	Cadence Assist level X	

5: eMTB Assist

Here it is possible to configure the eMTB Assist riding mode. This riding mode automatically adjusts motor torque depending on the torque applied on the pedals. More pedal torque equals a greater percentage of motor torque. Meaning that you can get everything from normal assistance all the way to absolute maximum power without changing assist levels.

Submenu	Configuration	Description
----------------	----------------------	--------------------

number	name	
0	eMTB Assist Enable	(0) Disable eMTB Assist (1) Enable eMTB Assist
1	eMTB assist sensitivity	Higher values correspond to more responsive assistance depending on the force applied on the pedals. The sensitivity can be set as an integer value from 1 to 20 where 20 is the most sensitive level.

6: Walk Assist

Enable or disable walk assist with a long hold of DOWN button at speeds below 8 km/h (approximately 5 mph). The motor will start to give assistance configured by user and maintain that as long as the DOWN button is being pressed. At the same time the walk assist symbol will light up. To set different power levels simply select appropriate assist level.

Below you can enable or disable the walk assist function and also configure the motor duty cycle in each and every enabled assist level.

The walk assist PWM value sets the motor duty cycle. It is an open loop controller. A PWM value of 30 will set the target duty cycle to 30. Maximum settable PWM in the walk assist function is limited to a value of 100.

Please use low gears when using Walk Assist. This causes the motor to rotate faster and consequently the blue gear. This will put less of a strain on the drive train.

NOTES:

- Use as low gear as possible. Having high gears can cause a lot of strain on the blue gear.
- There are only as many walk assist levels as there are assist levels.
- Carefully test and set appropriate values.
- The function can only be activated at speeds below 8 km/h or around 5 mph.
- Number of walk assist levels correspond to number of configured assist levels.

Submenu number	Configuration name	Description
0	Enable/disable walk assist function	(0) Walk Assist disabled (1) Walk Assist enabled
		(0) milliseconds by default
1	Walk Assist button bounce time	This parameter defines how many milliseconds before Walk Assist is turned off after the DOWN button is released. Useful when the bike bounces around in rough terrain or when in any other challenging situation that can cause accidental button releases.
		Configure the time in milliseconds. It is set to 0 by default and this immediately turns off Walk Assist as soon as the DOWN button is released.

The system will immediately turn off Walk Assist if the button is not pressed long enough. This provides an extra layer of safety with minimized risk of runaway events.

- Walk assist level 1
- Walk assist level 2

7: Cruise

Enable or disable the cruise function with a long hold of DOWN button at speeds above 8 km/h or slightly above 5 mph. If the function is enabled it will by default save the current wheel speed and maintain it for as long as the DOWN button is pressed. It is also possible to enable a feature where you enter the desired wheel speed and the cruise function will automatically accelerate or decelerate to that speed and maintain it. Both modes of operation are activated the same way as described above.

The cruise symbol will light up to let the user know that the function is active.

If it is preferred to set a target speed and let the cruise function maintain that speed there are two ways in which the user can set the speed. The first way is through the configuration menu. The second way is by enabling the cruise display in the odometer field in the Main Screen Setup. This will display an extra sub field where the target speed is displayed in the odometer field. Pressing the UP or DOWN buttons will not change the assist level in this sub field, instead, it will change the target speed.

NOTES:

- It is recommended to install and use the E-brakes when using Cruise.
- The cruise function only works at speeds above 9 km/h or slightly over 5 mph.
- The motor power will not exceed set power limits.

Submenu number	Configuration name	Description
0	Enable/disable cruise function	(0) Cruise disabled (default) (1) Cruise enabled
1	Set speed to maintain	(0) Disabled (default) (1) Enabled Set speed to maintain feature. This will enable the user to set desired speed and the cruise function will maintain that speed.
2	Set target speed	Here it is possible to set the target speed for the cruise function to maintain. This is when the "set speed to maintain" feature is enabled.
3	Display set target speed for cruise	(0) Disabled (default) (1) Enabled Display of user set target speed in which the cruise function will try to maintain. In this menu the UP and DOWN buttons will increment or

decrement target speed. The target speed is displayed in the odometer field if enabled.

8: Main Screen Setup

In the Main Screen Setup it is possible to configure and customize the main screen.

NOTES:

- Some variables can only be reset in the odometer field so it is required to enable those variables to be able to reset.

Submenu number	Configuration name	Default value	Description
0	Distance data	1	Display of distance data, i.e. trip distance, distance since power on and odometer, in the odometer field is enabled (1) by default. Set (0) to disable.
1	Battery SOC	1	Display of battery state of charge, i.e. watt-hours consumed or percentage of state of charge, in the odometer field is enabled (1) by default. Set (0) to disable.
2	Battery state	1	Display of battery state, i.e. voltage and current, in the odometer field is enabled (1) by default. Set (0) to disable.
3	Pedal data	1	Display of pedal data, i.e. rider pedal power, pedal cadence or pedal torque, in the odometer field is enabled (1) by default. Set (0) to disable.
4	Energy data	1	Display of energy data, i.e. average consumed power since power on, in the odometer field is enabled (1) by default. Set (0) to disable.
5	Time measurement	1	Display of time measurement, i.e. TM or TTM, in the odometer field is enabled (1) by default. Set (0) to disable.
6	Wheel speed	1	Display of wheel speed, i.e. current wheel speed, average wheel speed or peak wheel speed, in the odometer field is enabled (1) by default. Set (0) to disable.
7	Motor temperature	1	Display of motor temperature in the odometer field is enabled (1) by default. Set (0) to disable. This will only be shown if the motor temperature sensor is installed and the function is enabled. Read more about this mod here. How-to-install-motor-temperature-sensor
8	Display target speed for cruise	0	Display of user set target speed in which the cruise function will try to maintain. This menu will only be shown if the function is enabled. Press UP or DOWN buttons to increment or decrement target

speed. The target speed is displayed in the odometer field and is enabled (1) by default. Set (0) to disable.

9 Enable main screen power menu 1

When this feature is enabled (1) a power menu can be displayed from the main screen so the user can quickly set the motor power limit. Instead of going to the Configuration Menu. This menu can be accessed from the main screen by long pressing the ON/OFF and UP buttons. Press or hold the UP or DOWN button to increase or decrease the power limit. Exit the menu by holding the ON/OFF button. The main screen power menu can not be accessed when Street Mode is enabled. Set (0) to disable this menu altogether.

In this sub menu it is possible to set the temperature field to display different data depending on user preference. Such as:

10 Temperature field setup 0

- (0) = Display nothing
- (1) = Motor temperature
- (2) = Battery state of charge in percent
- (3) = Instantaneous voltage on battery
- (4) = Instantaneous current drawn from battery
- (5) = Pedal cadence
- (6) = Average wheel speed since power on

NOTE: If the motor temperature is hitting the temperature limits the field will temporarily flash the motor temperature and override any other data.

9: Street Mode

Street Mode is a function that can be configured as a street legal riding mode. It is possible to limit speed and power in Street Mode and it can be configured so that the throttle and/or Cruise are either enabled or disabled in Street Mode.

If the Street Mode function is enabled and activated the "ASSIST" symbol will be solid. Switch to Offroad mode by pressing and holding the POWER and DOWN buttons until the "ASSIST" symbol starts to blink. This indicates that Street Mode is disabled. To enable Street Mode simply press and hold the POWER and DOWN buttons once again until the "ASSIST" symbol is solid.

Submenu number	Configuration name	Description
0	Enable Street Mode	(0) Street Mode disabled (1) Street Mode enabled (2) Street Mode enabled on system startup
1	Street Mode Speed limit	Speed limit when Street Mode is enabled. The motor will fade out power to prevent overspeeding.
2	Limit power in Street Mode	(0) Disables power limit in Street Mode

		(1) Enables power limit in Street Mode
3	Street Mode Power limit	Power limit in watts when Street Mode is enabled
4	Throttle Enabled	(0) Throttle disabled in Street Mode (1) Throttle enabled in Street Mode
5	Cruise Enabled	(0) Cruise disabled in Street Mode (1) Cruise enabled in Street Mode

10: Advanced Setup

In the Advanced Setup it is possible to setup parameters and functions for slightly more experienced users.

NOTES:

- The throttle and the motor temperature protection can not be active simultaneously. This is because they use the same hardware ports to operate.
- If the motor temperature sensor is installed it is not possible to use the throttle. Do NOT enable throttle if that is the case.

Submenu number	Configuration name	Default value	Description
			Set value after user preference. Higher values are more suited for low nominal voltage batteries and the 48 volt motor. Lower values are better suited for higher nominal voltage batteries and the 36 volt motor. Set carefully and be mindful not to set a higher value than necessary as it can put greater stress on the drive train.
0	Motor acceleration adjustment	0 %	<p>Default value = 0 %</p> <p>36 volt motor, 36 volt battery = 35 %</p> <p>36 volt motor, 48 volt battery = 5 %</p> <p>36 volt motor, 52 volt battery = 0 %</p> <p>48 volt motor, 36 volt battery = 45 %</p> <p>48 volt motor, 48 volt battery = 35 %</p> <p>48 volt motor, 52 volt battery = 30 %</p> <p>(VALUES NEED VALIDATION FROM USER FEEDBACK, work in progress)</p> <p>(0) Disabled (X) Enabled with torque sensitivity X %</p>
1	Startup assist without pedal rotation	0	If you wish to enable startup assist without pedal rotation it is done by appropriately configuring this variable. If set to (0), startup assist without pedal rotation will be disabled. But any value above (0) will enable assist without pedal rotation. The percentage value will determine the sensitivity of torque applied. 100 % sensitivity will

assist from the slightest of torque applied. It is advised to use e-brakes if startup assist without pedal rotation is enabled.

When configuring it is good to incrementally increase the sensitivity until you are satisfied. Do not start with too high values. The sensitivity is different for each and every bike and should be configured after personal preference with the main riding mode you intend to use.

Recommended values range between 10-15 %.

Set the pedal torque conversion so that the displayed weight is correct in the sub menu number 3. This is so that the human power calculation is correct and so that Power Assist operates optimally. It does not affect the resolution nor range of the torque sensor. To change the accuracy and range of the torque sensor you instead need to calibrate the hardware.

2	Pedal torque conversion factor	67	Do not use weights over 25 kg when calibrating if you want maximum accuracy for the human power calculation! The torque sensor has an operating range of around 0 -> 40 kg. So the calibration should be performed with a calibration weight somewhere in between. But if the human power accuracy is not a priority it is possible to use a slightly heavier calibration weight. The result would be a feeling of a slightly wider operating range on the torque sensor and therefore a more responsive feeling.
3	Weight on pedals -		<p>Here you can see the weight on the pedals. If it is not correct try adjusting the Pedal torque conversion factor in sub menu number 2. The weight will be displayed in either metric or imperial units depending on system configuration (IMPERIAL MEASUREMENTS NOT YET IMPLEMENTED).</p> <p>(0) Standard Mode (1) Advanced Mode (*)</p> <p>(*) If you wish to enable the Advanced Mode a simple calibration is needed. See this page for more information.</p>
4	Cadence sensor mode	0	<p>The Advanced Mode has a better operating range and a faster response time. It makes the system respond quicker and improves the experience in many ways. Highly recommended for all users. Especially if using the TSDZ2 coaster brake version. Note that the advanced mode only works after a proper calibration. See this page for more information.</p> <p>(0) lights ON when enabled</p>
5	External lights configuration	0	<p>(1) lights FLASHING when enabled (2) lights ON when enabled and BRAKE-FLASHING when braking</p>

(3) lights FLASHING when enabled and ON when braking

(4) lights FLASHING when enabled and BRAKE-FLASHING when braking

(5) lights ON when enabled, but ON when braking regardless if lights are enabled

(6) lights ON when enabled, but BRAKE-FLASHING when braking regardless if lights are enabled

(7) lights FLASHING when enabled, but ON when braking regardless if lights are enabled

(8) lights FLASHING when enabled, but BRAKE-FLASHING when braking regardless if lights are enabled

(0) Not in use

(1) Motor temperature control

(2) Throttle

6 Optional ADC channel 0

NOTE: Do NOT enable the throttle if you have installed the [motor temperature sensor](#). If you have the sensor installed you need to either have the motor temperature limit function enabled or everything disabled, i.e. set to either (1) or (0).

Please read more about the temperature control or throttle function in the appropriate parts in the beginning of this manual.

7 Minimum temperature in Celsius -

Set the motor temperature from where the motor temperature protection will start to limit the power.

8 Maximum temperature in Celsius -

Set the maximum motor temperature. At this temperature the motor will be turned off.

11: Advanced Technical Data

Submenu number	Configuration name	Description
0	Optional ADC value	The optional ADC is used for either throttle or motor temperature control. Here it is possible to see the instantaneous value.
1	Throttle or temperature limiting value mapped from 0 to 255	See the instantaneous value.
2	Torque sensor ADC value	See the current value.

3	Pedal cadence	The instantaneous value of the pedal cadence. This value is not filtered.
4	PWM duty cycle	This is the instantaneous duty cycle of the motor. It ranges from a value of 0 to 254.
5	Motor speed in ERPS	This value is the instantaneous rotational speed of the motor. The ERPS value can be divided by eight (8) to get the motor shaft revolutions per second. Or it can multiplied with 7.5 to get the motor shaft revolutions per minute, RPM.
6	FOC angle	See the current value. This value must be multiplied by 1.4 to get angle value in degrees.
7	Cadence sensor magnet pulse percentage	This value is the percentage or duty cycle of the high state during the Advanced Mode of the cadence sensor.