

## 860C additional manual

TSDZ2 open source firmware v20.1C.4 update 3 for APT- 860C display  
modified version of 20 beta 1 (C)

Before using the software, please read the following instructions and the display wiki carefully:

[Features and configurations on display · OpenSourceEBike/TSDZ2\\_wiki Wiki · GitHub](#)

This manual is a supplement only.

**Important before flashing: if there is already an older version on the display, make a note of the Odometer value, so that it can be entered in the new version.**

### - Set assist mode

There are 5 assistance modes available, the choice is in the main screen.

POWER ASSIST	assistance proportional to the power on the pedals
TORQUE ASSIST	assistance proportional to the torque on the pedals
CADENCE ASSIST	assistance subordinated to the movement of the pedals
EMTB ASSIST	assistance with progressive percentage of the torque on the pedals
HYBRID ASSIST	combined torque + power assistance

At level 0, ON/OFF button to view the current mode, UP/DOWN button to change, ON/OFF button to confirm. Assistance values for all modes from 1 to 254, for eMTB from 1 to 20.

“Hybrid assist” is a combination of the “Torque assist” and “Power assist” modes.

The result is excellent low-cadence assistance typical of Torque mode, and the extension of high-cadence Power mode.

The assistance parameters are the same used in the two modes, combined with the same level.

### - Menu items changed or added

#### Bike

Replaces the Wheel menu.

All parameters in this menu can be password protected.

#### Max speed

Speed limit with motor assistance.

As the speed approaches this value, the motor gradually reduces power until it stops.

Find out about the legislative restrictions on the speed limit.

#### Circumference

This parameter is used to calculate the speed and kilometers travelled.

Enter the perimeter of the wheel in millimeters.

It is recommended to measure the actual perimeter and check the distance traveled with GPS.

#### Max power limit

Maximum power supplied by the battery in Watts, it is also the maximum motor power limit that can be set in OFFROAD (Motor menu) and STREET (Street mode menu) modes.

#### Assist with error

Moved from the Various menu.

No / Yes. The presence of an error disables assistance in all modes.

However, it is possible to force assistance even with an error if this is caused by a problem with a sensor. Torque, cadence or speed sensor.

You will need to choose the assist mode that does not involve using the faulty sensor.

Use only when needed, with this feature enabled there are limitations in assistance. See error codes.

#### Throttle

Enable / disable throttle if installed, choice:

- **disabled**, throttle disabled.
- **pedaling**, the operation of the throttle depends on the movement of the pedals.

When you stop pedaling, the motor stops.

- **6 km/h only**, the throttle is only enabled up to 6 km/h, even without pedaling.
- **6 km/h & pedaling**, the throttle is enabled up to 6 km/h without pedaling, beyond 6 km/h pedaling is required.
- **unconditional**, the throttle is always enabled, without conditions.

Regarding the use, find out about the legislative restrictions of your country.

The installation of brake sensors is recommended.

At 0-OFF level the throttle is disabled.

The choice also applies to the virtual throttle.

## Cruise

Enable / disable the cruise function, Walk assist must also be enabled, choice:

- **disabled**, cruise function disabled.
- **pedaling**, the operation of the cruise depends on the movement of the pedals.

When you stop pedaling, the motor stops.

- **unconditional**, the cruise function is always enabled, without conditions.

Regarding the use, find out about the legislative restrictions of your country.

The installation of brake sensors is recommended.

At 0-OFF level the cruise mode is disabled.

Use: by pressing and holding the DOWN button at speeds above 9 km/h and with the function enabled, the current speed is memorized and maintained for as long as the button is pressed.

Speed may not be achieved due to limited motor power.

The speed limit takes priority.

## Password enable (no / yes)

Enable the use of the password.

Irreversible choice after changing the password.

## Password

Enter your password. The default one, to be used at the first access, is 1000. With the default password the parameters cannot be modified but only a new password can be entered. Valid passwords from 1001 to 9999.

After entering the password, you need to confirm with **login** or **change**.

## Confirm

Operation on the entered password, choice:

- **logout**, closes access to password-protected parameters. Or the logout is automatic by exiting the configuration menu.
- **login**, to confirm the entered password, if valid, the wording login is kept and the protected parameters can be modified or a new password entered, otherwise it changes to logout.
- **change**, to confirm the password change, choice possible only after having logged in and entered the new password. After confirmation with change, login is automatic. This operation must be done at the first login.
- **wait**, waiting for confirmation (login or change) after entering the password.

## Reset

In case of forgotten password, set Reset = yes.

Turn off the display within 10 seconds and update the firmware (re-flashing).

## Battery

Max current

Low cut-off

Voltage cal %

Parameter to correct the voltage value shown on the display.

Example, with a fully charged battery of nominal 36V, the voltage must be close to 42V, if it is lower try increasing the parameter one tenth at a time until reading 42V, vice versa if the displayed value is higher, the parameter must be decreased.

Resistance  
Voltage est  
Resistance est  
Power loss est

## SOC

Text

### Calculation

Choice of the method for calculating the remaining battery percentage.

Auto - soc% calculation with Wh used.

Automatic reset at power on when the soc% calculated with Wh consumed is different from that calculated with the voltage (+/- "Auto reset%"), useful when you put a not fully charged battery.

Wh - soc% calculation with Wh used, reset only with fully charged battery (100%).  
Or manual reset.

Volts - soc% calculation with battery voltage, it is less accurate than the other methods. It can be useful if you have two batteries of different capacity. To obtain a correct correspondence between soc% and voltage, it may be necessary to adjust the values of "Reset at voltage" and "Low cut-off".

Reset at voltage

Battery total Wh

Used Wh

Manual reset (no/yes)

Use when putting on an incompletely charged battery or at the first power on after the flashing. In this case, "Used Wh" is calculated with reference to voltage.  
When the battery is fully charged, the reset to 100% is automatic.

### Auto reset %

Percentage difference (+/-) between socWh and socVolts for automatic reset at power on with "SOC Calculation" = Auto. Default 15%.

### Charge cycles

Full battery charge cycles counter.

## Motor

Motor voltage

Max motor power

Maximum motor power, set an adequate value to contain the motor heating and compatible with the power that the battery can deliver.

A maximum value of 500W is recommended.

Attention, it does not have to be continuous!

Maximum value that can be set = Max power limit (Bike menu).

Motor acceleration

Acceleration of the motor.

As a first setting, use low values, then gradually increase if necessary.

Consider the values in the table as maximum values.

Set carefully, aware that setting a higher value than necessary can cause greater stress on the transmission.

Recommended values:

36 Volt motor, 36 volt battery = 35

36 Volt motor, 48 volt battery = 5

36 Volt motor, 52 volt battery = 0

48 Volt motor, 36 volt battery = 45

48 Volt motor, 48 volt battery = 35

48 Volt motor, 52 volt battery = 30

#### Motor deceleration

Set to zero, the default deceleration ramp is active, if set to 100% the minimum deceleration ramp (faster stop).

#### Field weakening

Enabled / Disabled. The field weakening function increases the motor cadence (up to 120 RPM when possible) but there is also a loss of efficiency.

If enabled, field weakening is automatically activated when the PWM value is greater than 100%.

### Torque sensor

#### Torque ADC threshold

In addition to the initial assistance with just the push on the pedals, without rotation for an immediate start, now this function is also activated with the bike in motion, when you resume pedaling after a break.

Attention, by enabling the BOOST function at the same time, the effect increases!  
This can cause greater transmission stress.

#### Assist w/o pedal rotation

#### Coast brake

#### Coast brake ADC

#### Calibration

Enabled / Disabled. Enable only after having entered the actual values of "Pedal torque ADC offset" and "Pedal torque ADC max", obtained from the calibration.

Enabling without having entered the correct values can lead to unpredictable operations.

Calibration procedure: see "ADC torque sensor" in the "Technical" menu, enter the ADC value of the torque sensor without any push on the pedals in "Pedal torque ADC offset".

Enter the ADC value of the torque sensor with the maximum thrust applied to the pedal (cyclist standing on the right pedal in horizontal position) in "Pedal torque ADC max".

Torque sensor calibration is required if the working range is limited.

"Pedal torque ADC max" - "Pedal torque ADC offset" < 140.

Caution. The ADC values of the torque sensor over time may change, check periodically.

#### Torque adc step

Torque conversion factor applied to the pedal with calibration disabled.

It is used to calculate the correct ratio between the assistance factor and the human power (only in "Power assist") and for the calculation of the human power to be shown on the display, the actual value obtained from the calibration can be entered.

**Warning:** enter the "ADC torque step calc" value with calibration disabled.

The "Torque adc step" value is inversely proportional to the ADC range of the torque sensor

#### Torque adc step adv

Torque conversion factor applied to the pedal with calibration enabled.

It has the same function as the previous parameter, but only with calibration enabled.

In the calculation of human power, "Torque offset adj" and "Torque range adj" are also evaluated.

Do not use to change the amplification of the assistance levels, for this purpose use "Torque range adj".

An optional weight calibration is also provided for this parameter.

Warning: enter the "ADC torque step calc" value with calibration enabled.

The value of "Torque adc step adv" is constant, independent of the ADC range of the torque sensor.

#### Torque offset adj

Parameter for adjusting the ADC offset of the torque sensor.

Values from 0 to 34, default value 20 (neutral).

When you need to increase the sensitivity at the start, for example with a hand-bike, set a

value lower than 20. Warning, a value that is too low can cause an undesired start and / or a delayed stop of the motor.

If, on the other hand, you want to decrease the sensitivity at the start, set a value greater than 20.

With a value less than 20 it is recommended to disable "Assist without pedaling" and "Startup boost".

#### Torque range adj

Parameter for adjusting the ADC range of the torque sensor.

Values from 0 to 40, default value 20 (neutral).

A value below 20 decreases the amplification of the range, a value greater than 20 increases it. This variation has an effect at all levels in torque sensing modes.

Necessary first, enable the torque sensor calibration and enter the actual values of "Torque ADC offset" and "Torque ADC max".

The range value is fixed at 160 (133 with 0, 186 with 40).

#### Torque angle adj

Parameter for adjusting the initial angle of the torque sensor curve. Value from 0 to 40, default value 20 (neutral).

Try 20, then adjust to "feel". With a value below 20, more gradual response and less consumption. With a value greater than 20, more reactive but with higher consumption. See the explanatory chart.

This variation has an effect at all levels in torque sensing modes.

It is necessary to first enable the torque sensor calibration and enter the actual values of "Pedal torque ADC offset" and "Pedal torque ADC max".

With a value greater than 20, it is advisable to disable "Startup boost".

#### Torque adc offset

ADC value of the torque sensor without any push on the pedals.

It is obtained from the calibration procedure to be carried out on the display.

Do not use to modify the sensitivity of torque sensor on startup, for this purpose use "Torque offset adj".

#### Torque adc max

ADC value of the torque sensor with the maximum thrust applied to the pedal (cyclist standing, on the right pedal in horizontal position).

It is obtained from the calibration procedure to be carried out on the display.

Do not use to change the amplification of the torque sensor range, for this purpose use "Torque range adj".

#### Weight on pedal

Weight to be applied to the pedal for the calibration of the ADC value of the torque sensor used in the calculation of the human power to be shown on the display.

Use a weight of 20 to 25Kg.

#### Torque adc on weight

ADC value of the torque sensor for the calculation of human power to be shown on the display. It is not used for the calculation of the assistance factor.

It is obtained from the calibration with a weight from 20 to 30Kg, to be carried out on the display.

Calibration procedure: see "ADC torque sensor" in the "Technical" menu, enter the value read, with the weight applied to the pedals in a horizontal position, in "Torque adc on weight".

#### ADC torque step calc

Conversion factor of the torque applied to the pedal obtained from the calibration with the weight or from the calculation of the estimated value.

It can be used for the calculation of the human power shown on the display and for a correct ratio in the assistance calculation (only in "Power assist").

Warning: with calibration enabled or disabled, the calculated value is different.

With calibration disabled, enter the value in the "ADC torque step" parameter.

With calibration enabled, enter the value in the "ADC torque step adv" parameter.

#### Default weight (no/yes)

After having entered the calibration values in "Torque ADC offset" and "Torque ADC max", with this function it is possible to calculate an estimated value of "Torque adc on weight" and "ADC torque step calc" with a weight of 25Kg. The values are less accurate than those obtained with real calibration, but are adequate for the purpose.

### Assist level

#### Number of assist levels

##### Power assist

"Power assist" is an assistance mode proportional to the power on the pedals.

Levels available from 1 to 9. Set assistance levels according to your needs. Value% / 2, maximum 254.

For example, applying 100 Watt to the pedals, with 150 assist, the motor delivers 300 Watt. These assistance parameters are also used in the hybrid mode.

##### Torque assist

"Torque assist" is an assistance mode proportional to the torque on the pedals.

Levels available from 1 to 9. The power delivered by the motor is proportional to the applied torque and the set assistance values.

Set assistance levels according to your needs. Relative values, maximum 254.

These assistance parameters are also used in the hybrid mode.

##### Cadence assist

"Cadence assist" is an assistance mode subject to pedal movement.

Levels available from 1 to 9.

The power supplied by the motor depends partly on the assistance values set and partly on the cadence of the pedals. Relative values, maximum 254.

It is recommended to use this assistance mode with the brake sensors installed and enabled.

##### eMTB assist

"eMTB assist" is an assistance mode with progressive percentage of the torque on the pedals. Levels available from 1 to 9. The power delivered by the motor is progressively proportional to the applied torque. There are 20 predefined sensitivities.

Higher values correspond to more responsive assistance, quicker to reach maximum motor power.

### Walk assist

#### Feature (enable/disable)

##### Speed (da 1 a 9)

For each level, you set the speed to reach and maintain, in km / h x10 or in mph x10.

Maximum value 60 (6.0 km / h) or 37 (3.7 mph). Try low values and gradually increase.

Recommended values from 25 to 45 (2.5 to 4.5 km / h) or 15 to 28 (1.5 to 2.8 mph).

Starting "Walk assist" there will be an overrun of the set speed, this is an auto calibration.

It is used to define the ratio between wheel speed and motor revs, and to calculate the maximum power required in those conditions of use (gear ratio and slope to be overcome), then it stabilizes at the set speed.

The adjustment is made on the motor revolutions, therefore it remains constant even when setting undetectable speed values.

If necessary, it is possible to repeat the self-calibration, release the button and press again.

The set speed may not be achieved due to the power limitation.

With speed sensor problems, walk assist does not work properly.

By enabling on the display in the "Various" menu, "Assist with error", walk assist will work like the previous versions, without speed control.

## Startup boost

Feature (enable/disable)

Startup boost torque factor

It is used to increase the starting assistance and at low cadence.

"Startup boost" must be enabled. Available only in "Power assist" mode.

It works both with standing start and with resuming pedaling in motion.

The value of this parameter is the percentage increase in torque applied to the pedals with cadence = 0. This value gradually decreases as the cadence increases, depending on the next parameter.

Set carefully, aware that setting too high a value can cause greater stress to the transmission. Value in %, recommended 250, maximum 500.

Startup boost cadence step

It is used to calculate the decrease in the boost torque factor as the cadence increases, until extinction.

Recommended value 25. Limits from 10 to 50, higher value = shorter effect.

Startup boost at zero (cadence 0 speed)

Startup Boost Mode:

- Cadence It intervenes both starting from a standstill and resuming pedaling with the bike in motion.
- Speed It only intervenes starting from a standstill, recommended for motors with coaster brake.

Startup assist (enabled/disabled)

Enabled / Disabled. It is used to start from a stationary on difficult climbs.

If enabled, it is activated by pressing the "Up" button and holding it down, start pedaling.

After starting, release the button. Function that can be activated up to 6 km/h.

With the button pressed, the operation is similar to the throttle but to start you need to pedal, the power delivered depends on the level of assistance and the thrust on the pedals.

## Motor temperature

Feature

Min limit

Max limit

Units

Choice of temperature measurement units

- Auto, Celsius with SI, Fahrenheit with Imperial.
- Celsius
- Fahrenheit

Sensor type

Choice of temperature sensor type:

- LM35
- TMP36

Brake

If the throttle input is not available, a thermostat can be installed, using the brake input. Brake input choice:

- **brake**, if brake sensor is installed.
- **temperature**, if an on/off thermostat is installed (NO max 85°C).

Attention, the choice affects only the display message, "BRAKE" or "Temp Shutdown".

In theory, both can be installed (contacts in parallel), but the message is only one.

## Street mode



Enable mode  
Enable at startup  
Speed limit  
Motor power limit

Maximum motor power in STREET mode.

Maximum value that can be set = Max motor power (Motor menu).

#### Throttle

Enable / disable throttle in STREET mode, choice:

- **disabled**, throttle disabled.
- **pedaling**, the operation of the throttle depends on the movement of the pedals.  
When you stop pedaling, the motor stops.
- **6 km/h only**, the throttle is only enabled up to 6 km/h, even without pedaling.
- **6 km/h & pedaling**, the throttle is enabled up to 6 km/h without pedaling, beyond 6 km/h pedaling is required.
- **unconditional**, the throttle is always enabled, without conditions.

Regarding the use, find out about the legislative restrictions of your country.

The installation of brake sensors is recommended.

At 0-OFF level the throttle is disabled.

The choice also applies to the virtual throttle .

Limit setting = Throttle mode (Bike menu)

#### Cruise

Enable / disable cruise function in STREET mode, Walk assist must also be enabled, choice:

- **disabled**, cruise function disabled.
- **pedaling**, the operation of the cruise depends on the movement of the pedals.  
When you stop pedaling, the motor stops.
- **unconditional**, the cruise function is always enabled, without conditions.

Regarding the use, find out about the legislative restrictions of your country.

The installation of brake sensors is recommended.

At 0-OFF level the cruise mode is disabled.

Use: by pressing and holding the DOWN button at speeds above 9 km/h and with the function enabled, the current speed is memorized and maintained for as long as the button is pressed.

Speed may not be achieved due to limited engine power.

The speed limit takes priority.

Limit setting = Cruise mode (Bike menu)

Hotkey enable

#### Various

Lights configuration

Lights configuration. Inquire about compliance with current regulations.

Choose your preferred mode from the 9 available.

With light control ON:

- 0 - on
  - 1 - flashing
  - 2 - on and fast flashing when braking
  - 3 - flashing and on when braking
  - 4 - flashing and fast flashing when braking
  - 5 - on and on during braking also with light control OFF
  - 6 - on and fast flashing when braking even with the light control OFF
  - 7 - flashing and switched on when braking even with the light control OFF
  - 8 - flashing and fast flashing when braking even with the light control OFF
- The braking modes are only available with the brake sensors installed.

Virtual throttle step

Odometer

#### A service

Enabled / Disabled



Enable maintenance warning when the set distance is reached.

A service distance

Distance for maintenance warning, in km or miles.

B service

Enabled / Disabled

Enables maintenance warning when the set travel time is reached.

B service hours

Travel time for maintenance warning in hours.

## Display

...

### Config shortcut key (no/yes)

By enabling this function (yes), with assistance level greater than zero, it is possible to directly access the configuration menu with a long press of the M button.

Only with level = 0, long pressing of the M button activates the customization of the numerical fields and graphs in the 3 main screens.

It is always possible to access the configuration menu with the UP + DOWN + ON/OFF buttons.

...

### Confirm reset (no/yes)

Confirm the default reset.

## Technical

ADC battery current

ADC throttle sensor

Throttle sensor

ADC torque sensor

Torque sensor ADC values, to be used for calibration.

- Value of "Torque adc offset" without any push on the pedals.

- Value of "Torque adc max" with the maximum thrust applied to the pedal (standing cyclist, on the right pedal in a horizontal position).

- Value of "Torque adc on weight" with a weight from 20 to 25Kg applied to the pedal.

Take note of the values obtained and enter them in the items of the "Torque sensor" menu.

ADC torque delta

ADC value of the torque sensor without offset.

It is possible to observe and analyze the variations resulting from the calibration.

ADC torque boost

ADC value of the torque sensor without offset and with the increase of the "Startup boost" function if enabled. Only in "Power assist" mode.

Pedal cadence

PWM duty-cycle

Motor speed

Motor FOC

Hall sensors

## - Error codes

Error codes and description:

### E01 – MOTOR\_NOT\_INIT

Communication problem, the display receives data from the motor controller, but the controller does not receive it from the display. Check the wiring.

### E02 - ERROR\_TORQUE\_SENSOR

A mechanical problem may have occurred with the torque sensor or the calibration at startup has not been performed correctly. A torque was probably applied to the pedals during power on.

Switch off and on again so that the system can recalibrate, without forcing the pedals.

If the "Torque sensor calibration" function is enabled, check on the display if the value of "Pedal torque ADC offset" with free pedals and "Pedal torque ADC max" with maximum effort, correspond to those entered.

### E03 - ERROR\_CADENCE\_SENSOR

While pedaling, no pulses are generated by the cadence sensor, possibly faulty.

### E04 - ERROR\_MOTOR\_BLOCKED

Motor or wheel blocked, excessive current absorption without motor rotation.

Check the cause. After 6 seconds the error disappears and the bike can be reused.

### E05 THROTTLE\_FAULT

Throttle input check on power up, failed.

### E06 - ERROR\_COMMS

Communication problem between motor controller and display, check the wiring.

### E07 - OVERCURRENT

Excessive current draw. Turn the display off and on again.

### E08 - ERROR\_SPEED\_SENSOR

Faulty speed sensor or magnet too far away.