# Display operating manual

*TSDZ2 open source firmware mb.20beta1.A*
*modified version of 20 beta 1 (C)*
*adapted to the original VLCD5 - VLCD6 - XH18 displays*

Before using the software, refer to the parameter configuration guide.
If necessary, edit them in the config.h file, as needed.
Check the correctness of the type of motor, battery and display.

The basic operation of the displays remains the original one.
The following will never refer to the name of the key used but to the function called, this is because on the various displays, the functions are called by different buttons.
In particular, we will use:

"lights"
"Walk assist"
"Change of level"

The lights button is always active to turn the lights on and off, pressed once.
The additional functions can be called up with a combination of the light button, pressed twice and the selected level.
There are two ways of using the display, data visualization and parameter setting.

## DISPLAY DATA

In this mode it is possible to view on the display data relating to the operation of the engine.
By default this mode is active.
The data are displayed in the speed field, with values between 3.4 and 99.9, lower values are ignored, this is a limitation of the displays.
I remember that the data visualization works only by setting a wheel diameter on the display from 21 "up and with the speed in km/h. If set in mph it does not work!
The data can be called up on all gear levels (from 1 to 4, ECO - TOUR - SPORT - TURBO)
Level 0 - OFF is reserved for changing the display mode.
They can be recalled by pressing the light button, the first press displays a code indicating the position of the data, pressing a second time within 5 seconds, the data value is displayed.
At this point, you still have 5 seconds, while viewing the data, to move on to the next, always pressing the lights button 2 times.
The data that can be displayed in sequence are 3, by default:

E02 - battery residual capacity%
E03 - battery voltage
E04 - adc torque (8 bit)

A second set of 3 additional data is available by enabling the parameter ENABLE_DISPLAY_DOUBLE_DATA in the config.h file (default disabled).
They can be recalled after the first 3.
Default codes and types, of the second series:

| | |
|---|---|
| E05 - power absorbed by the motor | (E02 with XH18) |
| E06 - pedal cadence | (E03 with XH18) |
| E07 - engine temperature | (E04 with XH18) |

Other data are available and viewable: current absorbed by the motor, adc torque (10 bit).
The data to be displayed can be organized in the preferred order.
The default display time is 5 seconds, this time can be customized for each individual data up to 25 seconds.
For these settings, see the configuration guide of the config.h file.

You can stop viewing a data before the end of time by changing the level.

Attention, the display always interprets the data received as a speed and consequently increases the odometer, even when the bike is stationary.
By enabling the parameter ENABLE_ODOMETER_COMPENSATION in the config.h file (default enabled), it is possible to recover the kilometers added and not traveled, during this operation the speed displayed while driving remains at zero until the kilometers are equalized.

The remaining battery capacity is displayed when the display is turned on for 5 seconds, within this time it is possible to manually reset the residual percentage (99.9%), selecting the 4-TURBO level and pressing the light button twice.
With the battery fully charged, the reset is automatic.

## PARAMETERS SETTING - FUNCTIONS

To modify the parameters it is necessary to change the display mode, from data visualization to parameter modification.
Parameter management is organized as a menu, where the 5 levels are the main items and 3 sub-items for each level.

The procedure for changing the settings is similar to that for retrieving data, after choosing the level (main menu item), the first time the light button is pressed, a code is displayed, which combined with the selected level, identifies the parameter to be changed , pressing the lights button a second time within 5 seconds confirms and the code flashes.
At this point you still have 5 seconds while the code is flashing, to move on to the next parameter, always pressing the light button 2 times.
Otherwise at the end of the 5 seconds, the change is confirmed.
The secondary menu codes are the same as the data, in sequence E02, E03, E04
Attention, in the sequence of the secondary menus only the last parameter set remains confirmed.

The parameter modification mode is activated at level 0-OFF by setting E02 - SET PARAMETER, light button 2 times (valid only if the default display mode is the data display).
Now you can change the parameter setting as per the menu listed below.
It is an extra step, but also a security against involuntary changes.
Choose the desired menu level and the parameter to be modified following the procedure described. To return to the data display, at level 0-OFF, set E03- DISPLAY DATA, light key 2 + 2 times.
Otherwise, by enabling the parameter ENABLE_RETURN_DEFAULT_DISPLAY_MODE (default enabled) in the config.h file, the display automatically returns to the data view after 30 seconds, time modifiable in config.h.
The order of the first two menu items at level 0 and 1 is dynamic, the first item is an alternative to the default one, this is to facilitate changing the settings.
The menu items at level 2, 3, 4 are in order of priority, in the first place those most likely used. There is no command to return to the default values, if necessary, just turn off and on again. It is possible to save the current settings as default, at 0-OFF level, set E04-SAVE DEFAULT, light button 2 + 2 + 2 times.
It will also be used to save the sensor calibration values (to be done).

**Description of the menu items and values of the default assistance levels:**

**LEVEL 0** - OFF -> DATA / PARAMETER MODE display mode change and saving settings

E02 - SET PARAMETER to modify the parameters with the default DISPLAY DATA
or - DISPLAY DATA to display data with default SET PARAMETER
E03 - DISPLAY DATA to display the data with the default DISPLAY DATA
or - SET PARAMETER to modify the parameters with the default SET PARAMETER
E04 - SAVE DEFAULT to save the current settings (become default)

**LEVEL 1** - ECO -> STREET / OFFROAD MODE change of road or off-road mode and cadence sensor standard mode

E02 - OFFROAD MODE with default STREET MODE
or - STREET MODE with default OFFROAD MODE
E03 - STREET MODE with default STREET MODE
or - OFFROAD MODE with default OFFROAD MODE
E04 - CADENCE SENSOR STANDARD MODE
- TORQUE SENSOR CALIBRATION (to do)

**LEVEL 2** - TOUR -> ASSIST MODE 1 change of assistance mode 1

E02 - POWER ASSIST ECO-70 TOUR-120 SPORT-210 TURBO-300 (30-500%)
E03 - TORQUE ASSIST ECO-70 TOUR-100 SPORT-130 TURBO-160 (up to 254)
E04 - CADENCE ASSIST ECO-70 TOUR-100 SPORT-130 TURBO-160 (up to 254)

**LEVEL 3** - SPORT -> ASSIST MODE 2 change of assistance mode 2 and advanced mode cadence sensor

E02 - EMTB ASSIST ECO-6 TOUR-9 SPORT-12 TURBO-15 (1-20)
E03 - CRUISE MODE ECO-15 TOUR-18 SPORT-21 TURBO-24 (km / h)
E04 - CADENCE SENSOR ADVANCED MODE
- CADENCE SENSOR CALIBRATION (to do)

**LEVEL 4** - TURBO -> LIGHTS MODE light operating mode

E02 - LIGHTS FLASHING
E03 - LIGHTS ON & BRAKE FLASHING
E04 - LIGHTS FLASHING & BRAKE ON

5 assistance modes are available, choose your preferred one.

POWER ASSIST assistance proportional to the power on the pedals
TORQUE ASSIST assistance proportional to the couple 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
CRUISE MODE assistance with speed control.

In each mode, there are 4 levels of assistance ECO - TOUR - SPORT - TURBO, the assistance values can be modified in the config.h file. At level 0-OFF the motor is stopped.
The power-on assistance mode (default POWER ASSIST), can be changed in the config.h file parameter RIDING_MODE_ON_STARTUP, or by saving the chosen mode on the display.

## How to assist WALK ASSIST

To be used when assistance is needed to push the bike on foot up to 6 km / h.
Activated with the dedicated button, consult the manual of your display.
There are 4 levels of assistance ECO - TOUR - SPORT - TURBO, the assistance values can be modified in the config.h file. At level 0-OFF no assistance except for the XH18 display, due to internal problem. Using low gears, high gears stress the transmission.
An anti-rebound time is available on the walk assist activation button, useful on rough terrain when a rebound can cause the button to be unwanted released.
To enable and configure, refer to the configuration guide of the config.h file

### Choice of road mode.

- street mode, set at level 1, second voice, E03 - STREET MODE, only if enabled by default, otherwise first voice.
  It is a function that can be configured as a legal driving mode, it is possible to limit the speed and power of the engine. The throttle and cruise mode are disabled.
  For these settings, refer to the parameter configuration guide of the config.h file. To inquire about legislative restrictions regarding the speed and power limits of the motor.

- off-road mode, set at level 1, first entry, E02 - OFFROAD MODE, only if road mode is enabled by default, otherwise second entry.
  Mode to be used outside public roads, it is possible to set speed and power limits other than those in road mode.

### Cadence sensor mode choice.

- standard mode, set at level 1, third item, E04 - CADENCE SENSOR STANDARD MODE (enabled by default).in this position of the menu there is also the calibration of the effort sensor (to be done).

- advanced mode, by controlling the rising and falling edge, double the pulses, you get a better resolution and a better reactivity. It is set at level 3, third item, E04 - CADENCE SENSOR ADVANCED MODE. Choosing advanced mode requires calibration.in this position of the menu there is also the calibration of the cadence sensor (to be done).

### Choice of light operating mode.

There are 3 modes besides the default one, choose the preferred one.

- default With light control ON, on
- E02 With light control ON, flashing
- E03 With light control ON, on and flashing during braking also with light control OFF
- E04 With light control ON, flashing and on during braking also with light control OFF

Braking modes are only available with brake sensors installed.
Other modes are configurable in the config.h file.

Original display settings.
Notes on settings in the hidden display functions menu.
Consult the manual of the installed model.

- 6 km / h, if present set to 1-ON to use the walk assist mode.

- wheel diameter, set the wheel diameter in inches. Attention, this value is no longer used for calculating speed and kilometers traveled, but only for displaying data.
  For this use it is important that the value is between 21 "min and 32" max, as it is no longer used for calculating the speed, it can be different from the actual diameter of the wheel.
  It is therefore possible to use bikes with wheels with a diameter of less than 21 ", setting it to 21".

- speed units, speed measurement unit. Set km/h, in miles/h the data display does not work.

- speed limit. By default it is not used, the speed limits are those set in the config.h file, if you want to use the one on the display as the maximum speed limit, enable the parameter ENABLE_WHEEL_MAX_SPEED_FROM_DISPLAY in the config.h file.
  However, the speed limit is always active in STREET mode.
  Attention, when the speed limit on the display is lower than that in STREET mode, the one on the display has priority. Example:
- display limit 30 km / h, STREET limit 25 km / h, limit used 25 km / h
- display limit 20 km / h, STREET limit 25 km / h, limit used 20 km / h

## ERROR CODES

The errors and related codes listed in the original display manuals are no longer valid.
They are replaced by the following:

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 ignition.
Switch off and on again so that the system can recalibrate, without forcing the pedals.
Check on the display the value of "8 bit adc torque", at rest it should be between 25 and 35, while the difference between the value at rest and that with maximum effort, should be between 25 and 30.
With higher values at rest or lower range, mechanical calibration may be required.

- E03 - ERROR_CADENCE_SENSOR_CALIBRATION

You have set the advanced mode without calibrating the cadence sensor.
Calibrate the sensor otherwise switch to standard mode.

- E04 - ERROR_MOTOR_BLOCKED

Motor or wheel blocked, excessive current absorption without motor rotation.
Check the cause. After 10 seconds the error disappears and the bike can be reused.

- E06 - ERROR_OVERTEMPERATURE

If the parameter ENABLE_TEMPERATURE_ERROR_MIN_LIMIT is enabled in the config.h file (default enabled), it indicates that the motor temperature has exceeded the minimum set value. The engine is running on limited power.
The power gradually decreases up to the maximum temperature limit, then the engine stops. If, on the other hand, the parameter is disabled, the error code indicates that the maximum temperature limit has been exceeded, the motor has stopped after the power limitation. Only with temperature sensor installed.

- E08 - ERROR_OVERVOLTAGE

Battery voltage higher than the maximum expected value.
Probable error in setting the battery parameters.

- E09 - ERROR_WRITE_EEPROM (E08 flashing for XH18)

Error writing to eeprom. Turn it off and on again to try again.
Writing to eeprom occurs only the first time it is turned on after loading the program, or manually via the display command.