

# DM02 Display Functionality Introduction

Product Name: Colored IPS Screen Display

Product Model: DM 02



	Signature	Date
Editor	Leo Liao	2020.10.05
Checked		
Approved		

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## Modification History



<b>Version No</b>	<b>Reviser</b>	<b>Date</b>	<b>Revision content</b>
V1.01	Leo Liao	2020.10.05	Initial version
V1.02	Leo Liao	2021.3.7	1. Add declaration content 2. Revise description of functions 3. Revise standard outlet definition 4. Other revisions

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## **Declaration**

**DM02 functional definition is a function definition description of the standard-version DM02 display produced by Velofox , and is part of the technical documentation.**

**All of Velofox’s display products are customized according to the electric system’s requirements. While this document is a reference for complete function definitions, operation instructions, and error codes, any configuration difference between your display and the standard DM02 is possible, due to various technical requirements in different ebike applications. Please consult your drive system supplier for additional function requirements and data display.**

**If you have any questions about DM02 functional definition, please consult our sales or technical support team.**

**Our company (VeloFox ®) reserves all the rights to interpret and explain DM02 functional definitions.**

**Hangzhou Velofox Intelligent Technology Co., Ltd**



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## A Product Introduction

### 1. Product name and model

IPS display of electric power assist bikes

Product model: DM02

- DM02 includes two versions of UART communication and CAN BUS communication  
DM02\_U corresponds to UART communication version;  
DM02\_C corresponds to CAN BUS communication version.
- All DM02 products are available to add Bluetooth function in its hardware.

### 2. Product introduction

- ✧ Tempered glass screen with beveled edge
- ✧ 2.0 inch HD high brightness full viewing angles IPS LCD display
- ✧ Special screen fitting technology, great sunlight and outdoor readability
- ✧ Independent operating buttons with ergonomic design
- ✧ IP65 waterproof level, excellent for outdoor use
- ✧ Built-in Bluetooth function, compatible with CAN-BUS and UART communication
- ✧ Service Tool function for fast firmware upgrade, parameter setting, and easy maintenance

### 3. Range of application

Suitable for all E-bikes that comply with EN15194 standard

### 4. Appearance and size

The shell material of DM02 is PC+ABS , the screen is made of imported tempered glass with beveled edge. This product is suitable to be installed on a horizontal handlebar tube size of  $\phi$  22.2mm,  $\phi$  25.4mm, and  $\phi$  31.8mm.



## 5. Display coding rules

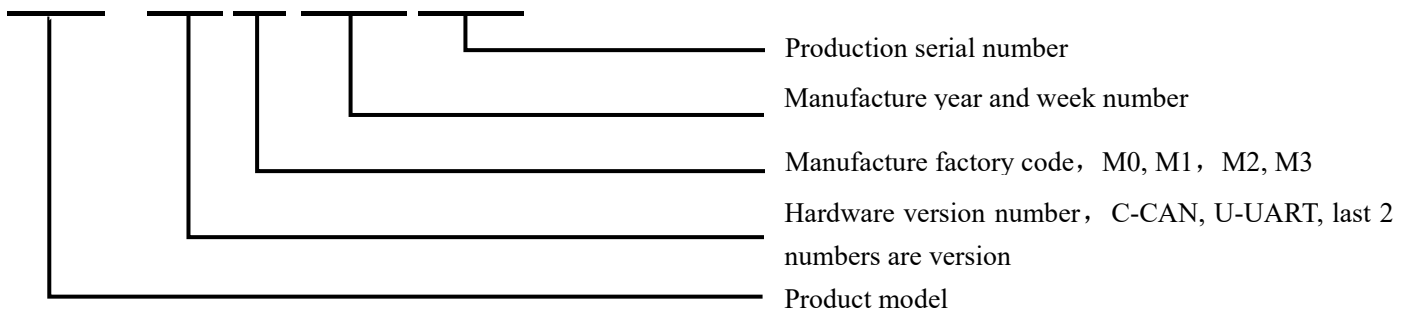


DM02A-C01M020340001

A08.01-36V2570XX

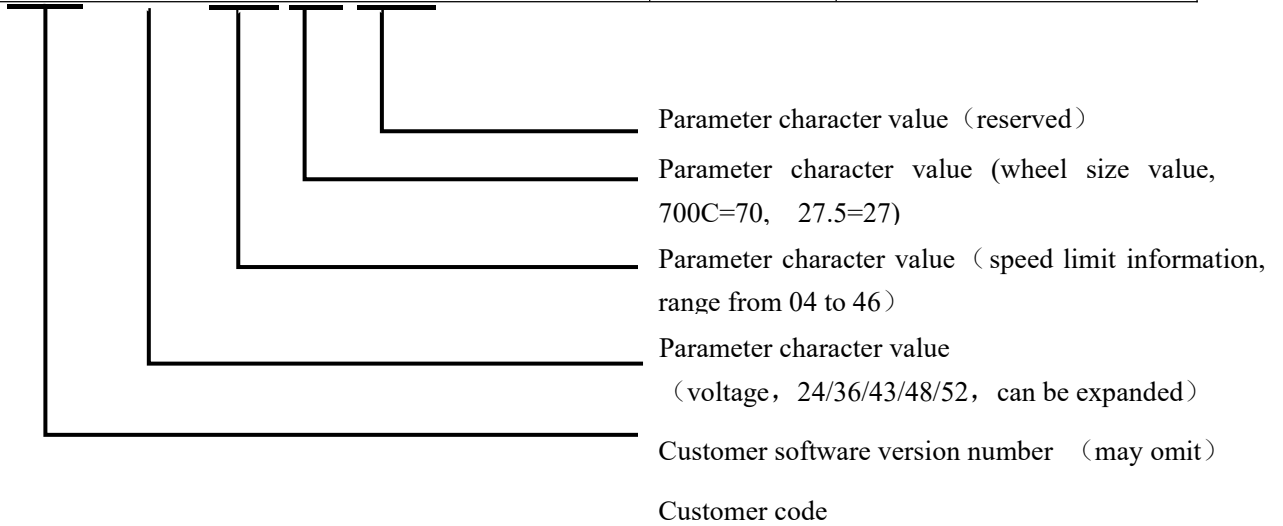
As shown in above picture:

DM02A-C01M020340001



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## B. Product manual

### 1. Specifications

- ① Power supply: DC 24V/36V/48V
- ② Rated current: 23 mA
- ③ Shutdown leakage current: <1uA
- ④ Screen specification: 2.0 inch IPS LCD display, resolution 320\*480
- ⑤ Communication method: UART/ CAN-BUS
- ⑥ Operating temperature: -20° C ~ 60° C
- ⑦ Storage temperature: -30° C ~ 80° C
- ⑧ Waterproof level: IP65

### 2. Function overview

- ① Left side independent buttons with ergonomic design
- ② Customization of boot interface and UI
- ③ Unit: Km/Miles, Language: English/German
- ④ Display key riding data, speed, mileage, battery info, etc.
- ⑤ Statistical function for power assist mode
- ⑥ Walk assist function
- ⑦ Auto headlight on/off function

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- ⑧ Error code indication
- ⑨ Real-Time Clock for a current time indication
- ⑩ Range and battery indication (\*available if BMS provides necessary info)
- ⑪ Percentage Analysis of total power output shared between engine and rider (\*available if torque sensor provides necessary info)
- ⑫ Health info statistics (\*available if connected to external bluetooth device)
- ⑬ Include Bluetooth hardware, for wireless connection to a smartphone to achieve GPS function
- ⑭ Maintenance service reminder and setting
- ⑮ Parameters setting and advanced setting

### 3. Installation

- ① Display locking clip includes two handlebar sizes, size A  $\Phi 31.8\text{mm}$ , and size B  $\Phi 25.4\text{mm}$ . Please include the requested locking clip size in the purchase order.

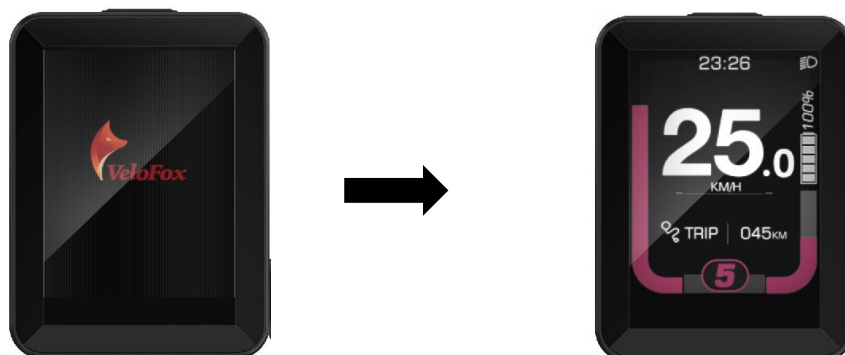
Installing DM02 display: Adjust display to a position easy to operate, using M3\*10 hex set to screws and tighten. Tightening torque: 0.8N.m

**\*Note: Damage caused by excessive torque is not covered by the warranty.**

- ② Place button on the left side of horizontal tube, using M3\*10 hex set to screws and tighten. For more button models, please refer to Velofox product catalogue
- ③ Connect the 5 pin plug to the docking plug of the controller

### 4. Interface

#### 4.1 Boot interface





Boot logo interface is displayed for 3 seconds after the display is turned on. When the communication connection is established, display enters the main interface which shows information obtained from the controller. ( All data displayed is following communication protocol provided by the customer)

**\* Animated boot interface available for customization**

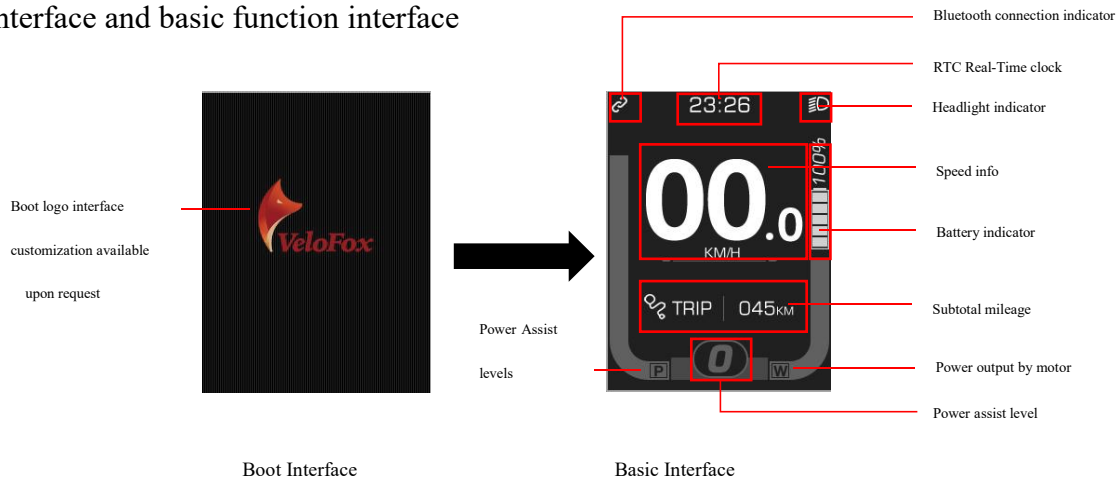
#### 4.2 Basic interface and operation



- ① All RM series buttons are compatible with DM02 series displays, the power-on button is located on the top side of the display.
- ② Standard Outlet is a board end connector, which is convenient for after-sales maintenance and replacement.
- ③ 2.0 inch HD high brightness IPS LCD screen meets the need for customization of the boot interface and UI interface

### 4.3 Function interface introduction

#### Boot interface and basic function interface



Boot logo interface is displayed for 3 seconds after display is turned on. When the communication connection is established, display enters the main interface, showing real-time information stored in the controller and battery BMS according to the communication protocol. (Battery indicator will not show battery percentage if BMS info is not available)

#### Other function interfaces

##### Function interface I

Function interface I mainly display speed information, including average speed, maximum speed, and TRIP info which is subtotal mileages as shown on basic interface. Speed display value has 3 digits, maximum value is 99.9KM/H, including one digit after the decimal point. Subtotal mileage TRIP value has 4 digits, including one digit after the decimal point. After 9999.9 KM is exceeded, the decimal point is not indicated, and a 5-digit mileage value is displayed directly, with a maximum value of 99999km. After the maximum value is exceeded, the value is shown as the actual mileage value deducted by 100,000.

Data on function interface I can be cleared by a button operation



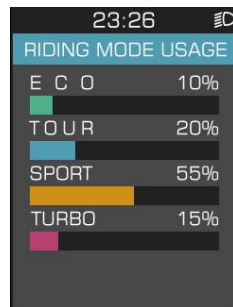
### Function interface II

The function interface II mainly displays battery information, including voltage, capacity percentage, accumulated charging cycles, and Range which is endurance mileage. Accumulated charging cycles are provided by battery BMS, if it is not available from BMS, display shows ---- for charging cycles. The Range is calculated by controller using battery BMS capacity info, if controller can not provide range info, range info shows----.

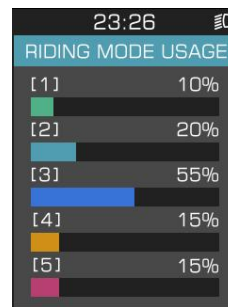


### Function interface III

Function interface III displays time usage analysis under each PAS level, data are calculated by the display according to the actual riding state, shown as a percentage. To clear the time usage data under PAS level, use button operation.



PAS Eng gears



PAS Digital gears

### Function interface IV

Function interface IV displays power output analysis, including average power output by motor, the maximum output by motor, and power output shared between rider and motor. Power output by motor will follow data provided by controller, if requested info is not available from controller, display will calculate using collected voltage and electric currents data.

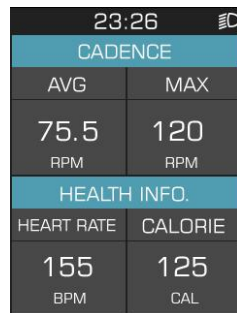
\* Power output shared between rider and motor requires controller's support



### Function interface V

Function interface V displays cadence info and health info, in which the cadence info needs the support of torque sensor and other system parts, and the data source is provided by the controller.


Health info includes heart rate and calorie consumption. Heart rate info requires peripheral Bluetooth or ANT+ equipment. Calorie consumption is calculated by the controller.

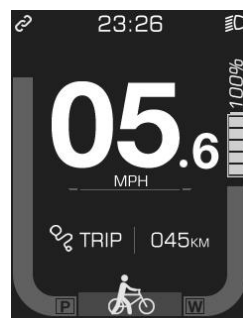


\* The above function interfaces require electric system and peripheral sensors to support data acquisition. Without the necessary data, display will not show above information.

In the basic function interface, short press M button to switch between each function interface. If no operation for 5s, display auto returns to basic interface.

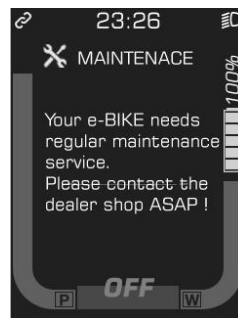
### Walk assist interface

Long press  to enter walk assist mode, interface shown as below:



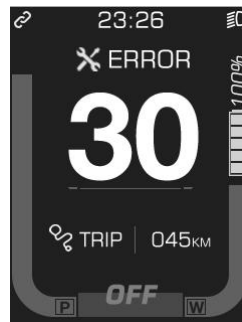
### Maintenance reminder interface

The display can be set with regular maintenance reminders, and when reaches the set mileage value, display will notify the user through the maintenance reminders. After the maintenance reminder mileage is reached, display will show a notification interface every time being turned on to prompt the user to carry out daily vehicle maintenance. Notification interface can be cancelled by short press M button manually. After connecting to service tool box, the maintenance reminder can be reset through after-sales diagnostic tool, and meanwhile, the maintenance record will be registered.




### Error code interface

When the display receives the error info returned by controller, it will show a detailed error code on interface, indicating relevant electrical system fault information. The error code will be displayed numerically in the speed display area.

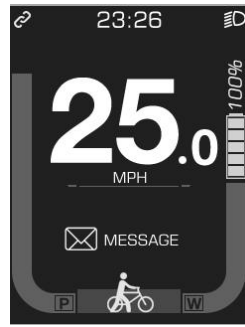


### Bluetooth connection and information reminding interface

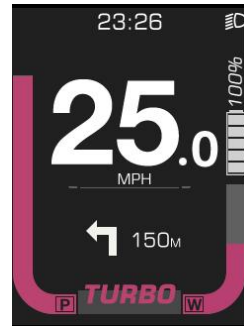
Display supports Bluetooth function, on the premise of matching mobile App. After establishing Bluetooth connection between display and matching mobile App, message reminding and navigation info reminding can be realized. When a Bluetooth connection is established, display will show  symbol on the top left conner.



Incoming call reminder



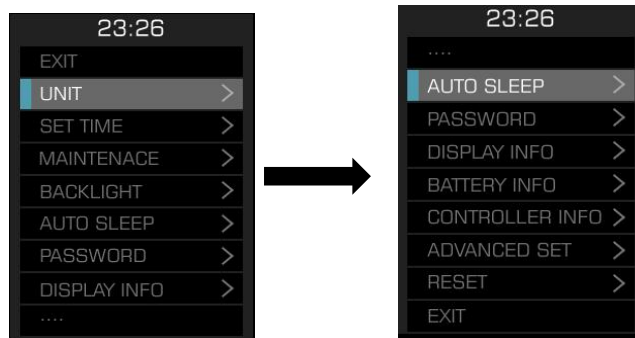
Message reminder



Navigation info reminder

## Setting interface

Within 10s after turning on display, long press M button to enter the setting interface, short press  $\wedge$ 、 $\vee$  to switch between setting interfaces. Short press  $\wedge$ 、 $\vee$  to enter parameter picking state.



Setting interface level 1 menu page

**For more setting operation illustration, please refer to part 7**

## 5. Button definition

### 5.1 Button name



Power button: Turn on/off the display

Adjust button: Adjust the assisting power level during riding and switch functions

Long press the adjust buttons to perform specific function operation

Mode button: Switch interface functions and enter into parameter setting interface



Walk assist button: Long press to enter walk assist mode

## 5.2 Definition of button operation

Operation Type	Description
<b>Short press</b>	Press the button and soon released, while the button is released, the function activated accordingly
<b>Long press</b>	Press the button and hold, when the hold time exceeds the setting time (generally 2 seconds), the function activated accordingly.

## 6. Basic function operation

### 6.1 Turn on/off the display

To turn on, long press  button until boot logo interface appears and shortly enters the basic interface. To turn off, long press  button until display is turned off. If the rider does not perform any operation on the display within set shutdown time, while speed is 0, and current is less than 1A, then the display will be turned off automatically. Set shutdown time is self-defined by user.

### 6.2 Assist level switch

During normal working state, short press 、 buttons to switch assist level, and change assist mode

**\* Default power assist display modes are available in two versions. Please indicate your choice of mode in the purchase order.**




Power assist display modes as shown below:

Digital gear: 0-5 levels



English version gear: ECO, TOUR, SPORT, TURBO



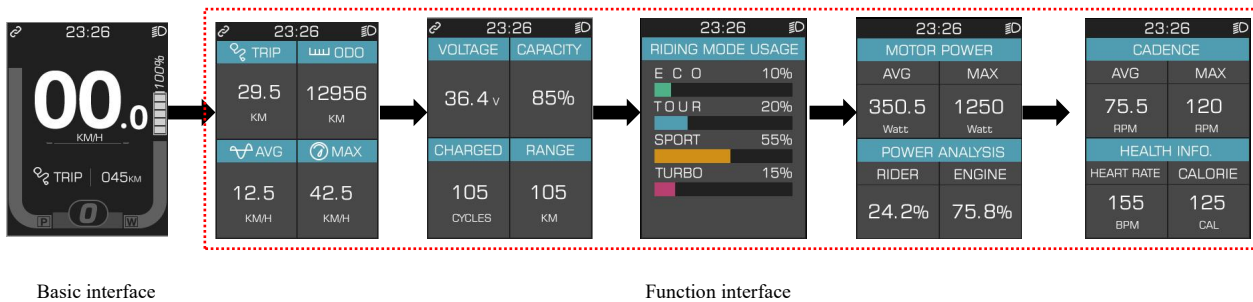
Short press 、 button to switch assist level. Switching level is not cycled, that is, after reaching 5<sup>th</sup> level, short press  button to return to off level. It's the same when adjusting up.



### 6.3 Information switch

In a power-on state, short press M button to switch alternately from basic interface, function interfaces. In a normal riding state, if the bike speed is greater than 0, and the display is not in the basic interface, then basic interface will be automatically returned to after 5 s no operation on the M button.

The switching process of each interface, as shown below:



### 6.4 Light control function

Display supports automatic lights-on/off function, when loaded with battery and is turned on, the default is to automatically turn on/off lights, that is the display automatically detects the ambient light intensity and controls the turning on/off of the lights. The icon on the top right corner of the basic interface indicates automatic lights-on state.

When automatic lights-on/off function fails, long press button to manually turn on the front light, a light icon on top left corner of screen will appear indicating light-on status. Long press button to manually turn the lights off.

Automatic lights-on/off function is disabled, after manually turn off the headlight. Re-start display to enable automatic lights-on/off function.

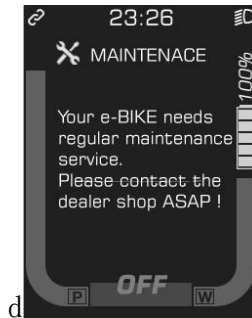
When headlights are on, screen brightness will be lowered to preset brightness level.

### 6.5 Maintenance reminder




Display supports maintenance reminder function, when this function is enabled, the display will remind the user to give ebike a maintenance check once the total mileage reached a preset value. maintenance reminder function can be turned on/off in the setting interface and is turned on by

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default. The factory default reminding mileage is 5000km which is not modifiable by users, that is, display will remind the user to give a maintenance check once the total mileage reached 5000km.



## 6.6 Walk assist function

When speed is 0, long press  button to enter walk assist mode, motor outputs power according to the set speed and control the actual walk speed, display shows the walk assist icon  and the real-time speed. Release  button or any other button to exit walk assist mode, the motor is turned off, and the display gets back to the basic interface. Walk assist interface, shown as below:



## 6.7 Battery power indicator and assist power output

Battery power information is divided into battery bar indication and remaining percentage indication. When battery power is normal, battery capacity is divided into 5 bars. Before communication is established, the battery percentage is not displayed, and the power bar is full and blinks at 2Hz. After battery info is acquired, power bar will stop blinking, and displays the power percentage. If communication is not successful within 3s, it will stop blinking and no power percentage will be displayed.





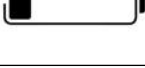
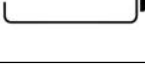

After battery capacity is lower than 5% or the voltage is lower than low voltage value, display will enter the low-voltage mode. In this mode battery level showed level 0 and border blink at 1Hz,

with no power output from the motor, and disabled assist level switch. Power assist level is displayed as OFF or 0.

To get out of low-voltage mode, reset, and increase the voltage above low-voltage value and battery capacity above 5%.

Percentage of battery power (C) and power level table

(Battery % info is required from BMS or controller):

SOC	Battery level	Description
$80\% \leq \text{SOC}$		Full battery level 5
$60\% \leq \text{SOC} < 80\%$		Level 4
$40\% \leq \text{SOC} < 60\%$		Level 3
$20\% \leq \text{SOC} < 40\%$		Level 2
$10\% \leq \text{SOC} < 20\%$		Level 1
$5\% \leq \text{SOC} < 10\%$		Level 0
$0\% \leq \text{SOC} < 5\%$		Level 0 and icon blink at 1Hz

● Remarks about battery indicator:





When there is a battery communication error:

1. Display will estimate the power according to the voltage and show the battery level accordingly;
2. No battery percentage information will be shown;
3. Range information will not be displayed;
4. If the voltage is lower than the low-voltage value, the effect of the current on voltage needs to be considered when converting to a voltage at 0 current

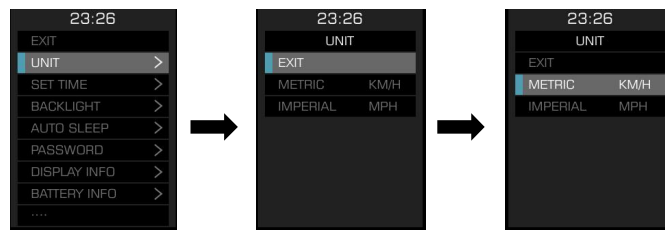
## 7. Setting function

Display provides specific parameter setting functions. The optional items of setting function will be deleted according to different market and product standards. The following is the complete

parameter setting, information reading function description under the default state of display. Please contact our sales and technical support team for confirmation in case of any discrepancies.

Within 10s after turning on display, long press M button to enter setting interface, short press ,  button to switch between setting interfaces. In any setting interfaces, short press M button to enter parameter editing state, the blue mark indicates chosen parameter, and selected option or value will be indicated by a white font with a grey background. Short press ,  button to edit parameters. Long press M button to confirm parameter selection. Long press M button again to exit and return to previous page

Selected option or value will be indicated by a white font with grey background, as shown below:



In any setting interfaces, short press M button to enter the next level menu, and long press M button to return to the previous level menu.

First level parameter setting interface, and the description of each parameter interface is as follow:

Setting items	Interface	Description	Setting data	Remark
Unit setting		UNIT	Value=KM/H MPH	Default Value=KM/H  KM/H—Metric MPH—Imperial
Clock setting		SET TIME	Customization	Default=12: 00



Maintenance reminder		MAINTENANCE	Fixed value	Default=5000km
Backlight level setting		BACK LIGHT	Value= LEVEL 1, backlight level 60% Value= LEVEL 2, backlight level 80% Value= LEVEL 3, backlight level 100%	Default Value= LEVEL 3
Auto shutdown time		Auto sleep	Value=OFF, 5-30 min	Default Value=5min OFF means no auto shutdown
Power on Password setting		Password	Value= OFF and ON; When is ON, user is allowed to set 4-digit password	Default value: OFF
Display info		Display information	read only	According to communication protocol
Battery info		Battery information	read only	According to communication protocol
Controller info		Controller information	read only	According to communication protocol

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* Advanced setting options		ADVSET=Advanced setting	Go to advanced setting secondary parameter setting interface	See advanced settings
Reset to factory setting		RESET	Reset	All parameters will be restored to the factory setting

## 8. Advanced setting functions

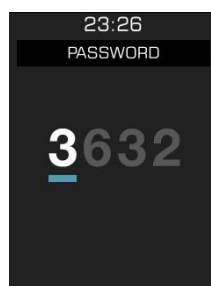
### \*Warning

The advanced setting function is based on specific protocol content, allowing to modify and set the controller and system parameter through display side. This feature is only available to specific groups of people, such as bike manufacturers, dealers and other entities with professional technical capabilities. Debugging and maintenance are allowed through advanced setting functions. In case of improper parameter setting or other setting problems, the whole system will work improperly or even have failure problems. **Please be cautious about whom to open this feature to.**

Advanced settings require a specific password, if you need to use this feature, please communicate with our company sales and technical support team to confirm compatibility with your current hardware version. In the meantime, please confirm with our sales and technical support team for adequate maintenance capacity, before obtaining the password.

### Advanced setting operation instructions

After selecting the advanced setting in the first-level menu, short press M button to enter the login password. Short press M button to select the corresponding password digit in the 4-digit password field. The selected password digits will be highlighted with a white background. Short press  $\wedge$ 、 $\vee$  to edit password value, and short press M button again to confirm the input. The password input interface is as follows:



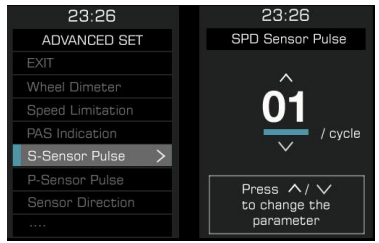
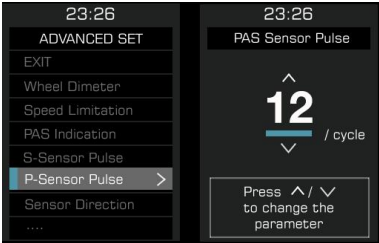

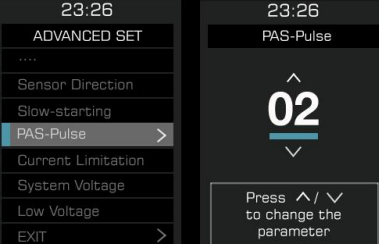
After the password is typed correctly, advanced setting is entered, divided into two-page contents. Short press  $\wedge$ 、 $\vee$  to pick and select.



Advanced setting functions descriptions:

Setting item	Interface	Description	Setting data	Remark
Wheel size setting		WheelDI=Wheel diameter	Value=12, 14, 16, 20, 24, 26, 27, 27.5, 700C, 28, *29, *CCF (*Value is optional)	Default value: 26
Speed limitation setting		SpdLtd=Speed limitation	Value= 5 to 46	Default Value= 25 Step=1
Power assist display setting		PAS= Power assistant Mode	Value= Dig-3; Dig-5; ICON	Dig-3: Digital 3 gear levels Dig-5: Digital 5 gear levels ICON: Eng version gears



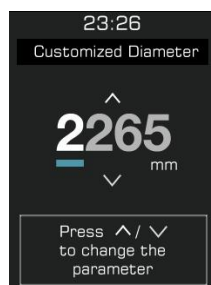
<p>Power assist level setting`</p>		<p>PAS= Pedal assistant Level</p>	<p>Value= L1 to L5; 0-100%</p>	<p>L1-L5 Power assist level corresponding to each gear Step=1%</p>
<p>Speed sensor magnet numbers</p>		<p>Ssensor=Speed sensor</p>	<p>Value= 1--12</p>	<p>Default value: 1 Step=1; magnets detected by motor</p>
<p>Power assist magnet number</p>		<p>P-Sensor= PAS sensor</p>	<p>Value= 1-64</p>	<p>Default value: 12 Step=1; Power assist magnet number</p>
<p>Power Assist Magnet direction</p>		<p>Direc= PAS sensor direction</p>	<p>Value= F or R</p>	<p>F=Forward R=Reversed Signal direction of sensor, can be adjusted corresponding to right or left instalation</p>
<p>Slow acceleration</p>		<p>Slow-ACC= slow acceleration</p>	<p>Value= 0-3</p>	<p>Default value: 0</p>
<p>Number of poles for power assist magnet</p>		<p>P-Pulse=assist ance started pulse</p>	<p>Value= 2-63</p>	<p>Default value: 2 Step=1 Number of starting magnets</p>



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		版本号	1.02	
Current limit setting		CurLtd= current limitation	Value= 0-31.5A	Default Value: 12 Step=0.5A Controller's current limit setting
System voltage setting		SysVol= select system voltage	Value= 24V/36V/48V	Default value: 36V Choose system voltage
Low voltage protection setting		LowVol= low voltage level	Value= 10.0-52.0V	Default value: 31.5V Step=0.5V Select the low-voltage value for protection

\* Note: The wheel diameter option CCF is the wheel diameter perimeter setting, which needs to be supported by the controller communication protocol. Parameter 29 = wheel diameter of 29 inches, which needs to be supported by a corresponding controller communication protocol. When the CCF value is selected for the wheel diameter parameter, user is allowed to customize the wheel diameter circumference value (four-digit length value in mm).

Wheel diameter input operation: Short press  $\wedge$ 、 $\vee$  button to enter the parameter value, short press M button to switch to the next number, long press M button to confirm each digit input. After confirming the wheel diameter value input, long press M button to exit the current setting and return to previous menu. The type of wheel diameter configuration will be recorded to the controller. If customer confirms wheel diameter CCF option, then CCF page will be displayed directly when entering the wheel diameter setting.

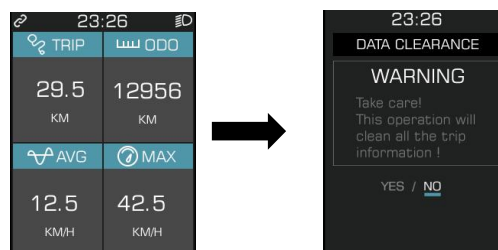


Reference table for the circumference value corresponding to common wheel diameters

ETRTO		kmh	ETRTO		kmh
16 x 1.75 x 2		mph	16 x 1.75 x 2		mph
47-305	16x1.75x2	1272	32-630	27x1 1/4	2199
47-406	20x1.75x2	1590	28-630	27x1 1/4 Fifty	2174
37-540	24x1 3/8 A	1948	40-622	28x1.5	2224
47-507	24x1.75x2	1907	47-622	28x1.75	2268
23-571	26x1	1973	40-635	28x1 1/2	2265
40-559	26x1.5	2026	37-622	28x1 3/8x1 5/8	2205
44-559	26x1.6	2051	18-622	700x18C	2102
47-559	26x1.75x2	2070	20-622	700x20C	2114
50-559	26x1.9	2089	23-622	700x23C	2133
54-559	26x2.00	2114	25-622	700x25C	2146
57-559	26x2.125	2133	28-622	700x28C	2149
37-590	26x1 3/8	2105	32-622	700x32C	2174
37-584	26x1 3/8x1 1/2	2086	37-622	700x35C	2205
20-571	26x3/4	1954	40-622	700x40C	2224
	14x1.75	1046		12x1.75	957

## 9. Data clearance

Data clearance is aimed at the removal of data information such as subtotal mileage TRIP, average speed, and maximum speed. 10s after display is turned on when display is at function interface, long press M button to show data clearance window, and short press 、 button to select accordingly. To remove the pop-up clearance window, long press M button or remain no operation for 30s.

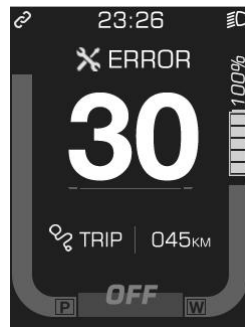


After clearance, the subtotal mileage TRIP is 0, average speed, and max speed is 0. ODO information can't be cleaned manually on the display, professional service tools are required.

## 10. Error information

Display can warn bike faults. When faults are detected, error code will be shown on the interface and blink at 1Hz. When error code is shown, button functions will not be affected, meaning interfaces can be shown normally by pressing buttons. If no button operation after 5s, the display will return to the error code interface.

Error code interface as shown below:



Bafang protocol's error code information table:

Error code	Error description	Suggest operation
"04" shown at speed	throttle doesn't turn back to zero position (stay on the high position)	Check if the throttle turned back
"05" shown at speed	throttle failure	Check throttle
"07" shown at speed	overvoltage protection	Check battery voltage
"08" shown at speed	failure of motor's hall signal wire	Check motor
"09" shown at speed	failure of motor's phase wire	Check motor
"11" shown at speed	failure of the motor's temperature sensor	Check controller
"12" shown at speed	failure of the current sensor	Check controller
"13" shown at speed	failure of the temperature of the battery	Check battery
"14" shown at speed	Controller temperature is too high, and reaches the protection point	Check motor
"21" shown at speed	failure of the speed sensor	Check the install position of the speed sensor
"22" shown at speed	Failure of BMS communication	Change battery
"30" shown at speed	communication failure	Check connector to controller

(\* Different communication protocols are different in error code system. If an error code

appears, please communicate with our sales and technical support team to verify and confirm!)

## 11. Wire definition

### 11.1 Standard wires definition:

The standard outlet of the display is defined by Velofox according to the conventional application, and the standard outlet needs to match the corresponding conversion harness. Our company has corresponding standard settings for the conversion line length and interface standards. If the standard settings cannot meet your requirement, a customized conversion harness is required.

Standard outlet in a sample is shown in the figure below:

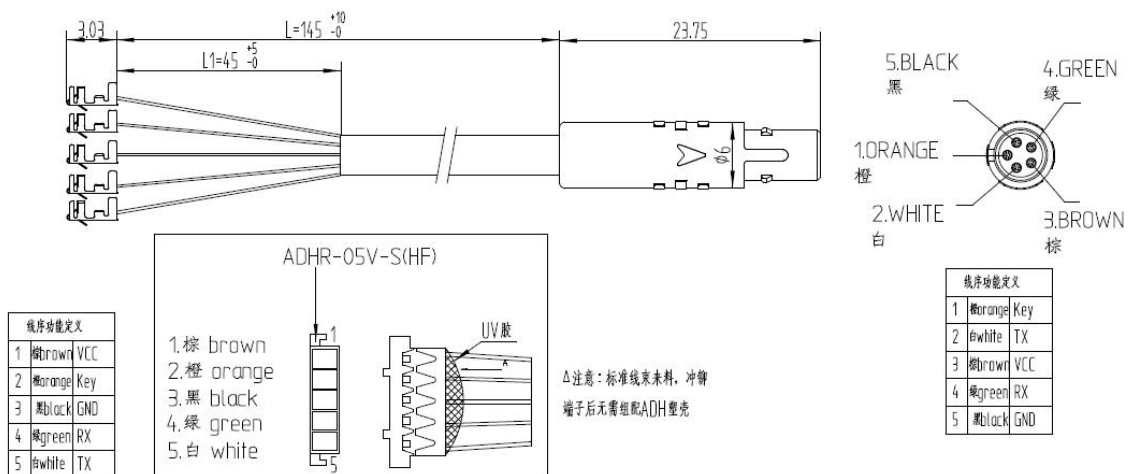
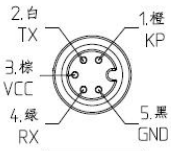


Table 1 Standard wire definition

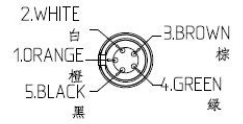
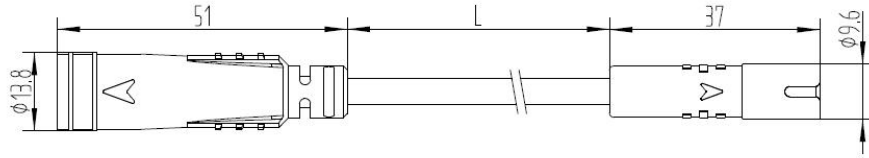
No.	Color	Function
1	Orange(KP)	Power lock control wire
2	White(TX)	Data transmission wire of display
3	Brown(VCC)	Power wire of display
4	Green(RX)	Data receiving wire of display
5	Black(GND)	GND of display
6	reserve	reserve

## 11.2 Standard conversion wire specifications:

### Adaptor-C2H:



线序功能定义	
1	Orange Key
2	White TX
3	Brown VCC
4	Green RX
5	Black GND

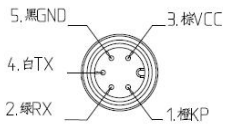


线序功能定义	
1	Orange Key
2	White TX
3	Brown VCC
4	Green RX
5	Black GND

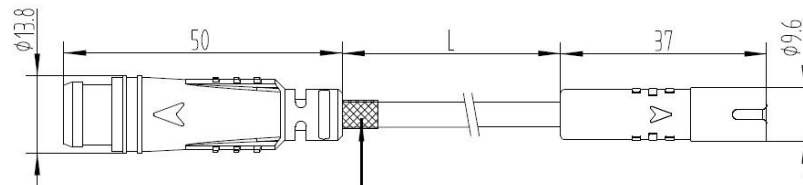
线长L允许根据客户订单调整，优先选用推荐线长尺寸，推荐规格如下：

L<mm>	50	100	150	350	550	650	850

### Adaptor-C2J:



线序功能定义	
1	Orange Key
2	Green RX
3	Brown VCC
4	White TX
5	Black GND



线序功能定义	
1	Orange Key
2	White TX
3	Brown VCC
4	Green RX
5	Black GND

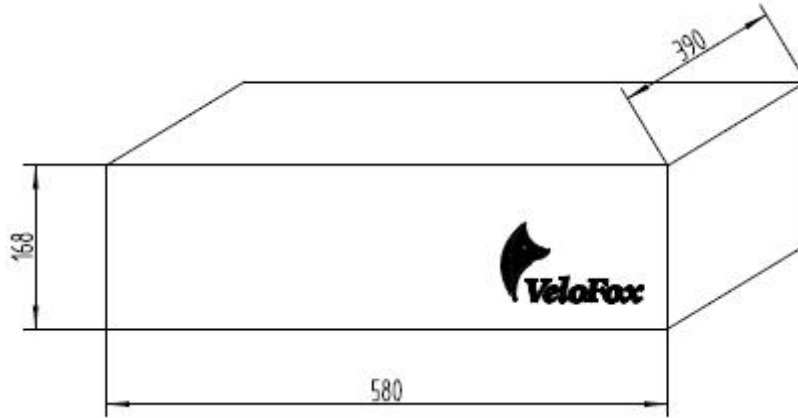
线长L允许根据客户订单调整，优先选用推荐线长尺寸，推荐规格如下：

L<mm>	50	100	150	350	550	650	850

## C Package specifications

Standard delivery, in double corrugated box packaging. The inner layer is a double corrugated septum plus EPE foam product bag.

Outer box size: 580\*390\*168mm (L\*W\*H)



## D Note

- ✧ In the use of the display, pay attention to the security, do not plug the display in and out when the power is on;
- ✧ Try to avoid exposure in harsh environments like heavy rain, heavy snow, and strong sunlight
- ✧ When the display can't be used normally, it should be sent to repair as soon as possible