ELEKTROMOTUS

Display Unit
User Manual

Contents

Specifications

Display Specifications

Display Color	White
Resolution	128×64
Screen size	2.42"

Absolute Maximum Ratings

	MIN	TYP	MAX	UNIT
Operating voltage	9	–	32	V
Current consumption @ 12 V	–	30	–	mA
Current consumption @ 24 V	–	15	–	mA
Operating temperature	-40	–	85	°C
Life Time @ 90 cd/m^2	–	100 000	-	hours

Characteristics

	MIN	TYP	MAX	UNIT
Brightness	60	80	–	cd/m^2
Contrast	–	10 000:1	–	
Viewing Angle	–	173	–	°

Communication Interfaces: USB 2.0 RS-232
Ingress protection (IP) rating: IP 55

Get started

Wiring

At the back of the device you can find two connectors: USB 2.0 micro and custom RS-232 connectors. Device is communicating with PC via USB interface. This communication is used mainly for device firmware upgrade and configuration tasks. Device is also bus powered, meaning it can operate with USB cable attached. This connector uses

Fig. 1: Display Unit connectors

USB 2.0 micro B pinout. RS-232 connector is used to connect to the Emus BMS Control Unit. All data is transmitted using Emus BMS Serial Communication Protocol. Pinout for RS-232 connector is described in the following list:

+ V   wire from positive potential of power supply unit

RX   wire for RS-232 serial communication reception of data (device side)

TX   wire for RS-232 serial communication transmission of data (device side)
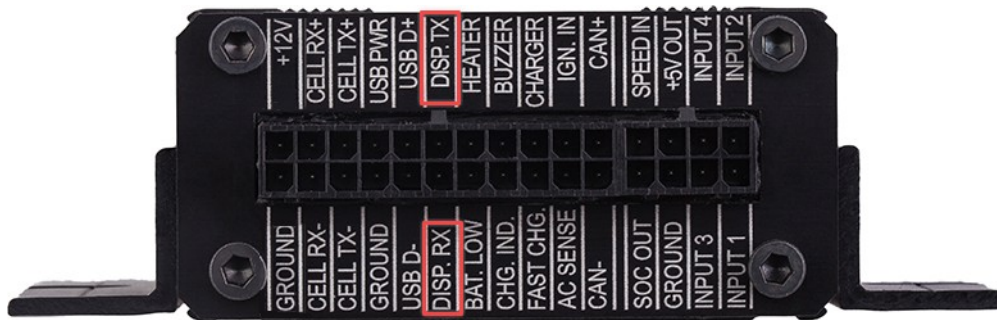
GND   wire from negative potential of power supply unit

Fig. 2: Connection pins for Display Unit

NOTE: Device should be connected to Emus BMS Control Unit DISP. TX and DISP.RX pins. Power cords must be connected to system's power supply.

Application interface

Firmware upgrade

This topic will introduce you with firmware upgrade process.

NOTE. If the upgrade instructions are not followed properly, the firmware could be malfunctioning.

- Visit *www.elektromotus.lt* website to download latest firmware. Search for image file e.g. 'EmusBMS_DisplayUnit_v1.0.0.img'.
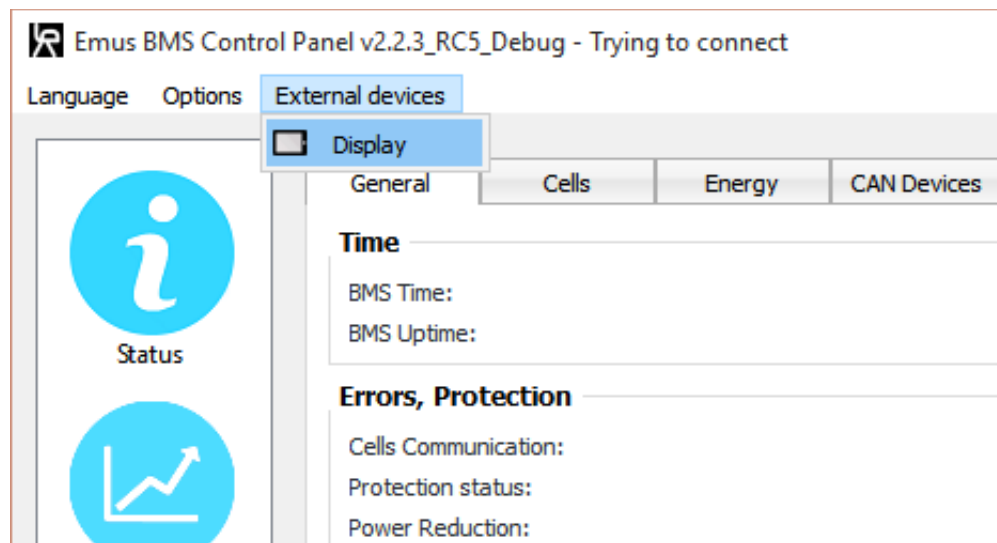

Fig. 3: Location of 'External Devices" menu

- By this step we assume that you are familiar with Emus BMS Control Panel. It can be download from the website mentioned in the previous step. Open Emus BMS application and from the top-bar menu select '**External Devices**' option.

- You should now see floating window with related information to Display Unit. In '**Device information**' section you could find your device current firmware version. Below in '**Firmware upgrade**' sector there are three information fields and two buttons:

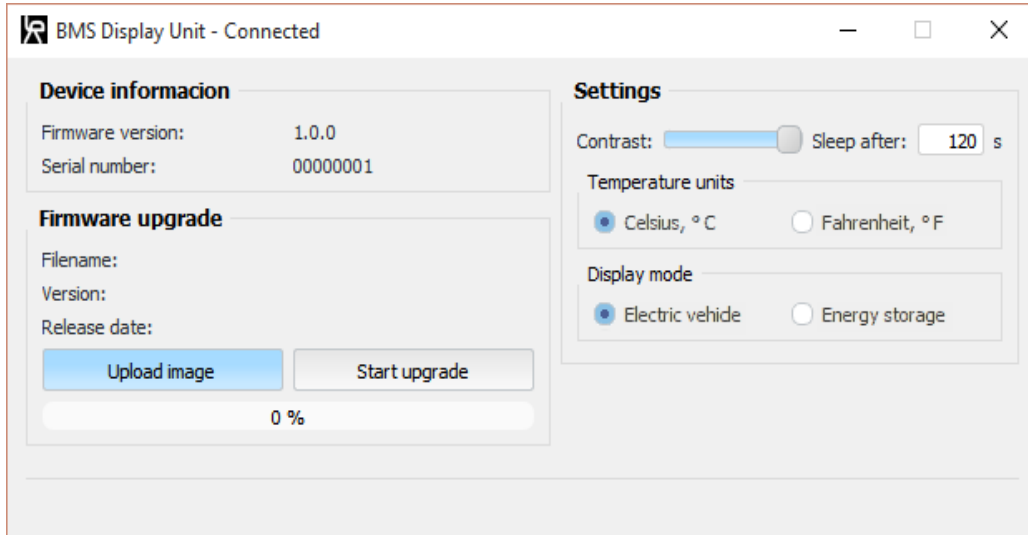|	
Filename	displays selected firmware image name.
Version	displays selected firmware image version.
Release date	displays release date of selected firmware image.
Upload image	invokes navigation window. This window allows you to select desired firmware image file.
Start update	initializes firmware upgrade process.

Fig. 4: Display Unit menu window

- Press '**Upload image**' button and select newly downloaded firmware image.
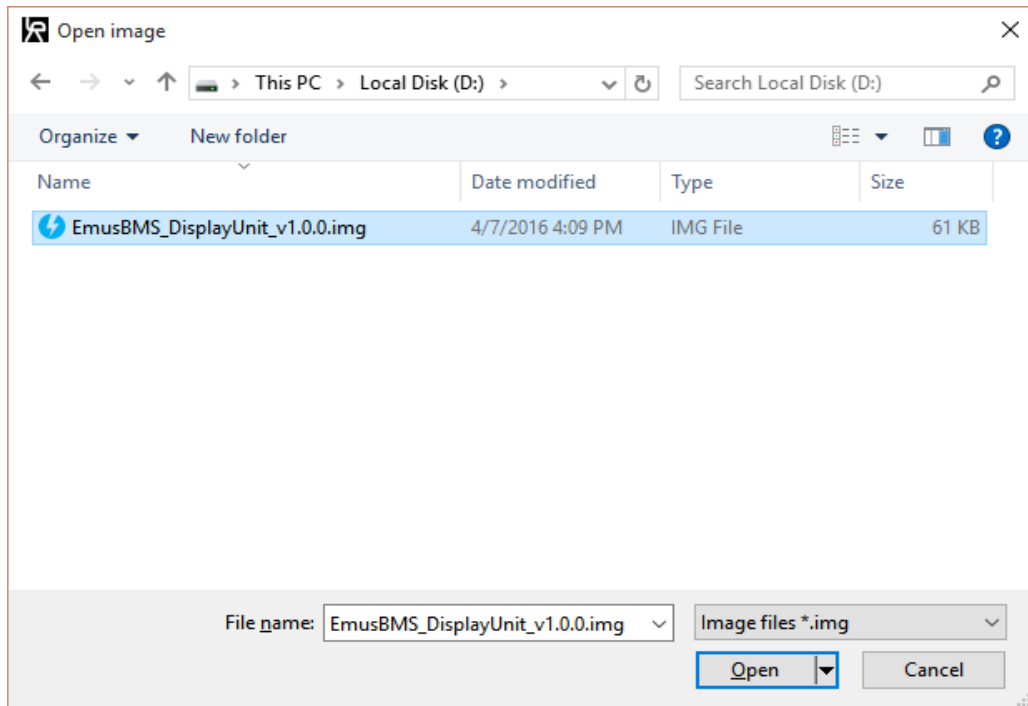

Fig. 5: Selecting firmware image file

- After selecting image, **Filename**, **Version** and **Release date** fields will be updated with information from this image file.
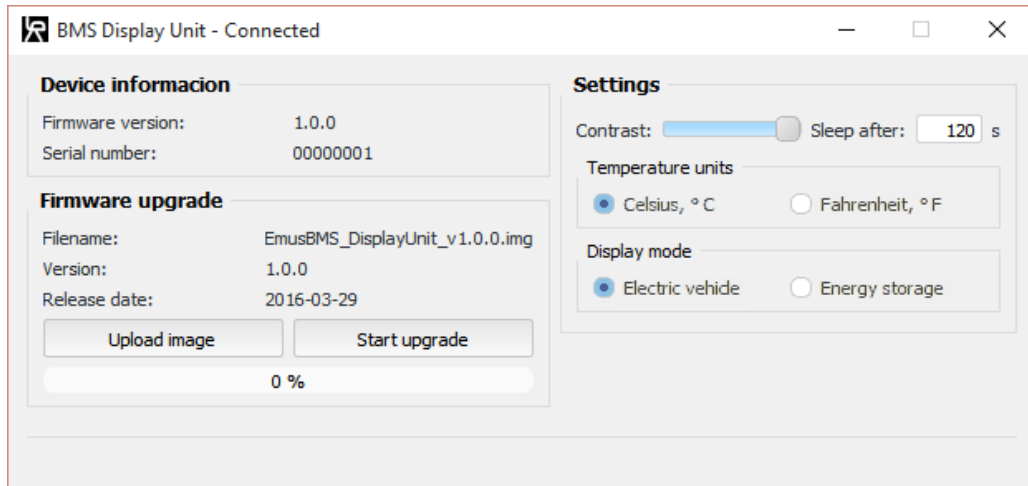
Fig. 6: Firmware upgrade field are updated with information from selected file

- If you are satisfied with selected firmware image press '**Start upgrade**' button and wait until progress bar fills-up.
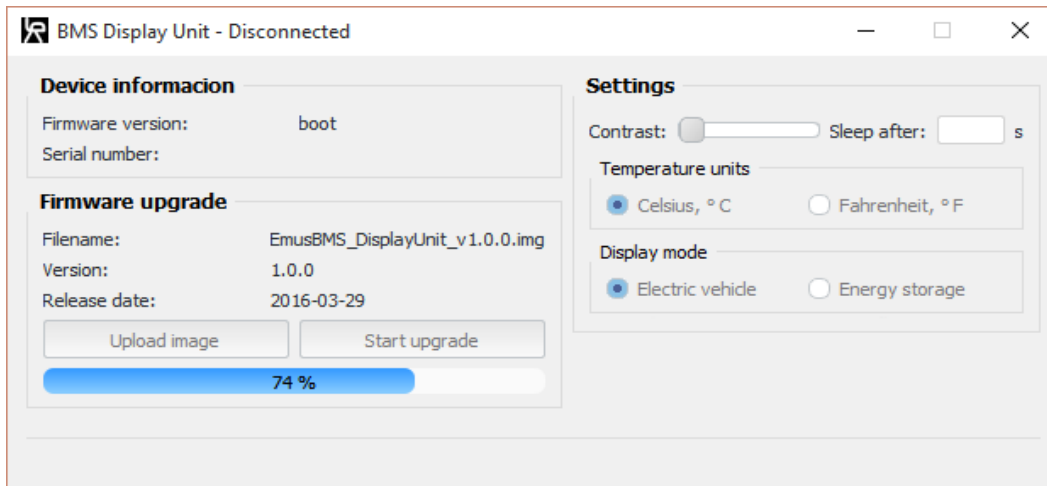

Fig. 7: Upgrading device firmware

NOTE: When firmware upgrade process is started you should see '**boot**' text displayed inside '**Firmware version**' field. It means that device firmware indeed is being updated.

Settings

Using graphical user interface user is allowed to change device configuration. On the right side of '**Display Unit**' window you can see '**Settings**' menu. These changes reflect on device only when Display Unit is connected to a computer. Every single option can be modified from device interface.
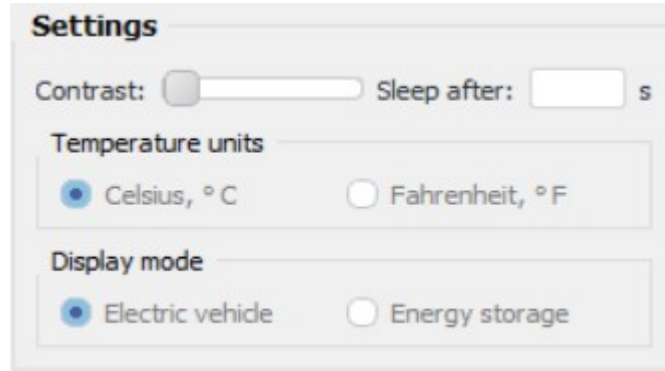

Fig. 8: Settings menu

All available parameters are described in the following list:

Contrast   sets display contrast level from 0 to 100 percent.

Sleep after   parameter that tracks time and decides when display must go to sleep by turning its lighting off. Setting '**0**' value prevents device to go to sleep and it stays awake all the time.

Temperature units   recalculate all temperature related parameters to *Celsius* or *Fahrenheit* scale.

Display mode   parameter allows to select information presentation mode. All modes have their own dedicated information types. More on this in later chapter.

Display interface

Controls

Device has one control point – rotary switch knob. It has 3 degrees of freedom: rotate clockwise, rotate counter-clockwise, and push-release. All modifications and control is performed using it.

Fig. 9: Rotary switch knob

After device power-up main menu will be showed. To change to another layout knob should be rotated to the right or to the left. Menu is implemented in such way that rotating knob only to the right or to the left way eventually will get back to the same layout where was started from.

In order to switch to settings menu knob should be pressed and held for a second. There applies the same rotating rules. To change value of particular parmeter, knob should be pressed one time and rotated in either way. By pressing knob one more time, value of selected parameter will be confirmed and user will be returned back to the settings menu. In order to return to main menu from settings menu knob should be pressend for a second and released when menu changes.

NOTE. Display unit will not work if it is not connected to the Emus BMS Control Unit. Only splash screen will be displayed.

Settings

Display Unit has the same controls mentioned in 'Application interface' -> 'Settings'.

List of all settings inside device:

- Contrast;
- Sleep after;
- Display mode;
- Temperature units.

Contrast – set display contrast level from 0 to 100 percent.

Fig. 10: Contrast option

Sleep after – parameter that tracks time and decides when display must go to sleep by turning its lighting off. Setting '**0**' value prevents device to go to sleep and it stays awake all the time.
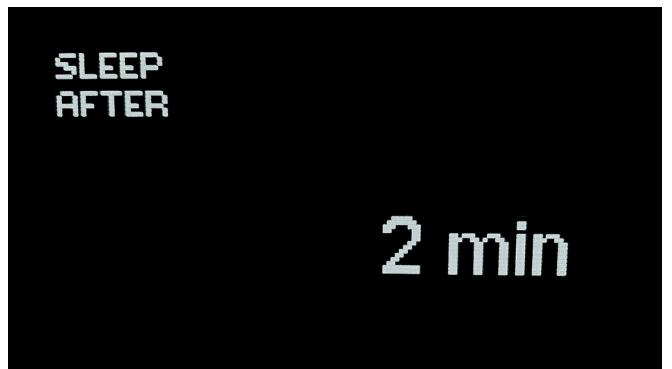

Fig. 11: Sleep option

Temperature units – are used to recalculate all temperature related parameters to *Celsius* or *Fahrenheit* scale.

Fig.12: Temperature scale option

Display mode – this parameter allows to select information presentation mode. All modes have their own dedicated information types.
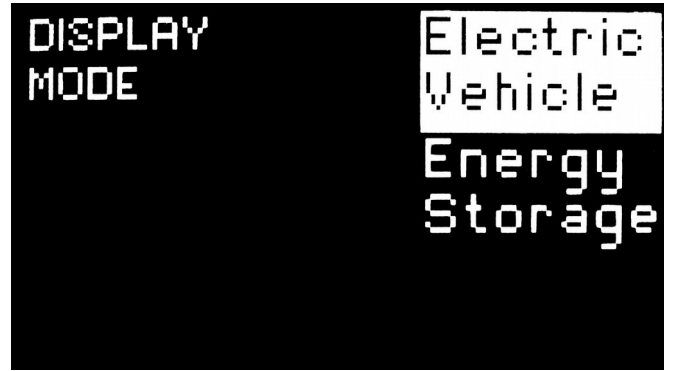

Fig. 13: Display mode option

Modes

Mode is a group of layouts that is dedicated to a specific type of application. Layout is a group of unique parameters which contain broadcasted information from Emus BMS and has dynamic presentation style. Dynamic presentation style could be described as data and its units change in time domain. All data can be scaled and according to its scale factor, units are also changed to make a match.

Display unit has several display modes:
- Electric vehicle
- Energy storage

'**Electric vechicle**' mode contains layouts related to consumption, speed information, while '**Energy storage**' mode focuses on displaying detailed information about system.

Layouts

There are several different layouts implemented into device. Each layout has various parameters, which will be discussed in this chapter. Parameters in these layouts are combined in such way that they have relations to each other.

Layout #1 we have 3 parameters:
- Total voltage;
- SoC;
- Current.

Fig. 14: Layout #1

Total voltage 'voltage'   accumulated voltage value from all cells. Parameter precision is 1 digit after decimal point.

State of charge 'SOC'   amount of chargedremaining inside batteries. Presented in percentage format. Parameter precision is 1 digit after decimal point.

Current 'current'   momentary current flowing from/to batteries. Parameter precision is 1 digit after decimal point.

Layout #2 have 3 parameters:
- Power;
- Consumption;
- Ttemperature.

Fig. 15: Layout #2

Power 'power'   momentary power used by system. Parameter precision is 2 digits after decimal point.

Consumption 'unnamed'   power consumed over hour to travel 1 distance unit. It is a momentary value. Parameter precision is 1 digit after decimal point.

Temperature 'temp'   average cell temperature measured from all cells. Temperature can be scaled to *Celsius* or *Fahrenheit*. Parameter has no decimal point.

Layout #3 has 3 parameters:
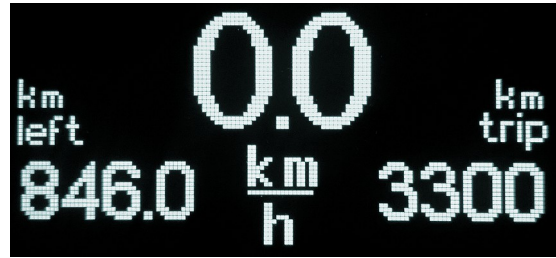
- Distance left;
- Speed;
- Distance traveled.

Fig. 16: Layout #3

Distance left 'left' Estimated travel distance left. Calculated based on remaining batteries charge. This parameter can have any type of distance unit. e.g. km, mi, yr, nm. Its precision is 1 digit after decimal point.

Speed 'unnamed' momentary travel speed. Moving speed equals to distance unit traveled over an hour. Parameter precision is 1 digit after decimal point.

Distance traveled 'trip' Distance traveled from last time batteries were charged. This parameter can have any type of distance unit. e.g. km, mi, yr, nm. Its precision is 1 digit after decimal point.

Layout #4 Total voltage;

- Total voltage;
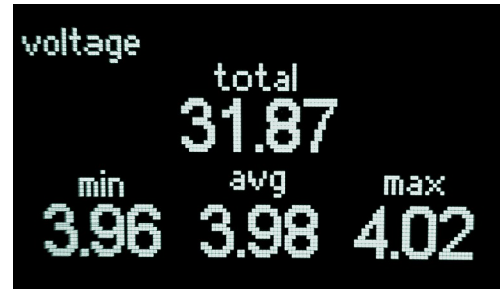- Minimum voltage;
- Average voltage;
- Maximum voltage.

Fig. 17: Layout #4

Total voltage 'total' accumulated voltage value from all cells. Parameter precision is 2 digits after decimal point.

Minimum voltage 'min' minimum voltage value from all cells. Parameter precision is 2 digits after decimal point.

Average voltage 'avg' average voltage value from all cells. Parameter precision is 2 digits after decimal point.

Maximum voltage 'max' maximum voltage value from all cells. Parameter precision is 2 digits after decimal point.

Layout #5 has 7 parameters:

- Charging stage;
- Total voltage;
- Current;
- Charging stage duration;
- Fan indicator;
- Heater indicator;
- Battery state of charge.

Fig. 18: Layout #5

Charging stage   name of a current charging stage. There are 8 different stages:
  • Disconnected;
  • Not Charging;
  • Pre-heating;
  • Pre-charging;
  • Main charging;
  • Balancing;
  • Finished;
  • Charging error.

Total voltage   accumulated voltage value from all cells. Parameter precision is 2 digits after decimal point.

Current   momentary charging current. Parameter precision is 1 digit after decimal point.

Charging Stage Duration counts time for how long particular charging stage is active. It is reset when stages change.

Fan indicator   symbol presence indicates whether fan is turned on or off.

Heater indicator   symbol presence indicates whether headet is turned on or off.

Battery state of charge graphically displays state of charge for battery pack.

Layout #6 has 6 parameters:

- Minimum internal temperature;
- Average internal temperature;
- Maximum internal temperature;
- Minimum external temperature;
- Average external temperature;
- Maximum external temperature.

Fig. 19: Layout #5

Internal temperature 'min, avg, max' shows minimum, average and maximum temperature values of internal temperature sensors.

External temperature 'min, avg, max' shows minimum, average and maximum temperature values of external temperature sensors.

All layout parameters are created to be scalable. That means if value of single parameter has increased so it does not fit its display field, then it is down-scaled and its units are changed also. For example: if current value in Layout #1 increased from 999 A to 1000 A, then that value would be divided by 1000 to get result of 1 and unit is changed from 'A' to 'kA'.

Package information

Outline drawing