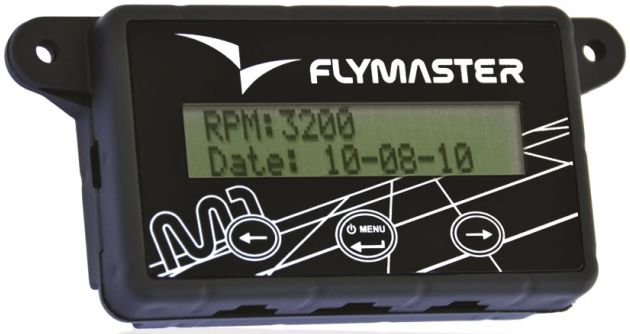
FLYMASTER M1

ADVANCED MOTOR MANAGEMENT



M1 USER MANUAL

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1. Introduction

Thank you for choosing FLYMASTER M1. If you have any questions or comments regarding the use of our instruments you can visit our website or contact our Support Department (support@flymaster-avionics.com). This manual covers Firmware versions up to 1.33. If have a more recent version of firmware some of the features may not be covered.

2. Getting Started

Fully charge battery before using FLYMASTER M1 for the first time. The battery may be charged by either connecting the M1 USB connector to the wall socket charger or USB cable. M1 connector can be found on the left side of the M1 (see Figure 1).

Figure **1**: Battery charger connection

2.1 Charging the Battery

The charging process is automatic. The end of the charging process is indicated by the screen message “Charging Complete”. Usually, completely charging the M1 battery takes approximately 7 hours.
M1 uses a Lithium-ion polymer battery, which is not prone to “memory effect”. Therefore the

battery does not need to be totally discharged before recharging. In fact, in order to avoid battery degradation total battery discharge should be avoided.

2.2 M1 Keys

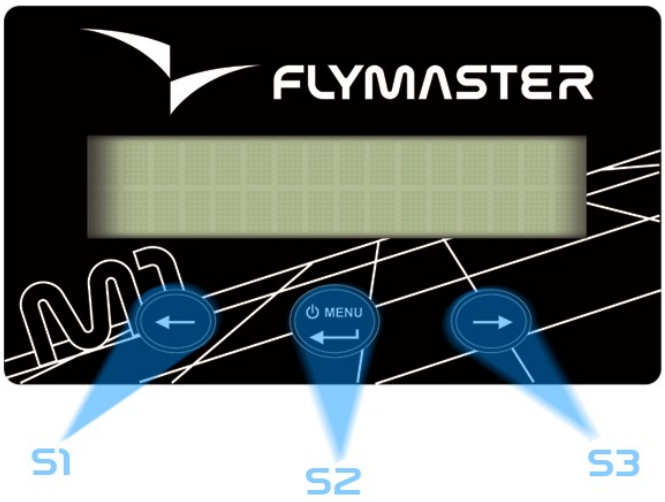


Figure **2**: M1 Keys

Three keys are used to interact with M1 (see Figure 2). Depending the context each key can have more than one function. Key functions are indicated by a symbol, or word. The available functions are indicated in Table 1.

Table 1 – Key Functions

KEYS	Function	
	Flight Mode	Menu Mode
S1	Change Line 1 Data.	Change Menu Option (left option). Decrements parameter values.
S2	Turn On. Change to Menu Mode.	Confirm Actions.
S3	Change Line 2 Data.	Change Menu Option (Right option). Increments parameter values.

2.3 Switching M1 On and Off

To switch on the M1, briefly push the S2 key. This will display the start up screen showing the M1 serial number, firmware version and a 10 second countdown. Pushing S3 before the end of

the countdown will initiate the M1. To switch off the M1 , activate menu mode by pushing the S2 (menu) key. Using keys S3, or S4, chose “Shutdown” menu option. Finally, push the S2 (Enter) Key to confirm.

3. Flight Data

The M1 screen has two 16 character lines. Each one can show a certain type of information. Changing upper line data can be done by pressing S1 key, while S3 key will change the lower line data. Each time one of these keys is pressed information changes according with the scheme shown in Figure 3.

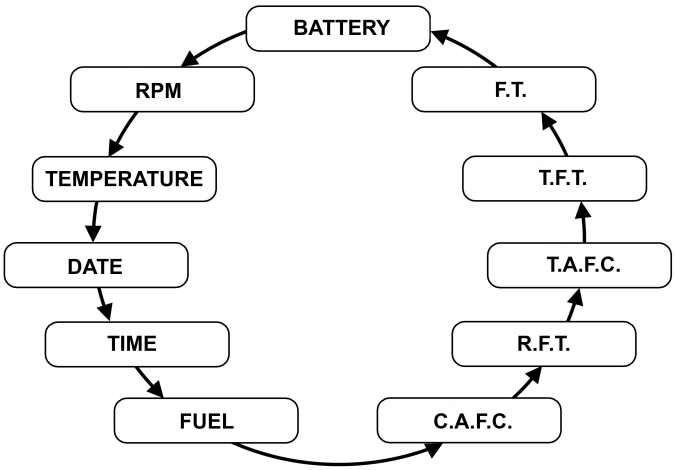


Figure **3**: M1 available Information

The meaning of each data field is the following:

Table **1**: Data fields Description

Data Field	Description
Temperature	External probe temperature in °C or °F (see section 7.1). (maximum temperature is 250°C/482°F).
Date	Date in the format Year:Month:Day. Data can be adjusted using menu (see section 7.6).
Time	Time in the format Hour:Minute:Second. Time can be adjusted using menu (see section 7.6).

Data Field	Description
Fuel (level)	Indicates the tank fuel level. The fuel level can be in centilitres,Gallons(Uk or Us) or percentage, according with the "fuel units" settings (see section). The fuel level is calculated by measuring the fuel column, therefore its' accuracy depends on tank calibration and inclination. To correctly calibrate the tank refer to the "Tank Calibration" section.
C.A.F.C.	Current Average Flight Consumption - Indicates the average consumption since last user change. The average consumption is updated periodically once rpm is greater than zero. The Average Consumption value can be changed by the user in the "Fuel Settings" menu (see section 7.4.4).
R.F.T.	Remaining Fuel/Flight Time - Gives the remaining fuel time in the format Hour:Minute. This time is calculated considering the tank level and average fuel consumption.
T.A.F.C.	Total Average Flight Consumption - Indicates the Total average fuel consumption made, considering all the flights.
TOTAL	Shows the total flight time since last timer reset. Timer reset can be done trough Reset Counter menu option (see section).
FLIGHT	Indicates current flight time. The timer is started once rpm is detected.
BATTERY	Indicates the remaining battery level in percentage. M1 uses a Lithium-ion polymer battery, which is not prone to "memory effect", Therefore the battery does not need to be totally discharged before recharging. In fact, in order to avoid battery degradation total battery discharge should be avoided.
RPM	Motor angular speed in Revolutions Per Minute. The motor RPM is determined using an electromagnetic sensor which detects the supply spark plug current. Depending on the motor type, in order to have the correct value of RPM the number of spark plug ignitions detected must be multiplied by a certain factor. This multiplication factor may be adjusted by the user on the configuration menu (see section 7.3).

4. Settings

Settings menu allows the configuration of several M1 parameters. To access the different items on the Settings menu you can use the LEFT(S1) and RIGHT(S3) keys. Pushing the ENTER (S2) enter the selected function.

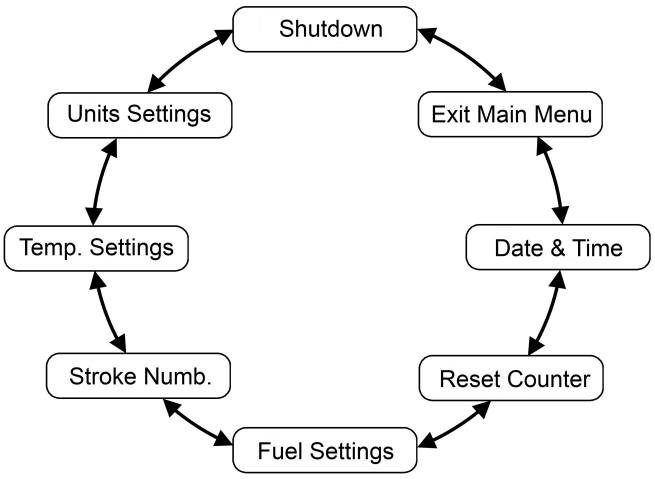


Figure **4**: M1 Settings

A short description of each option can be seen in Table .

Table **2**: Menu Item Description

Menu Item	**Description**
Shutdown	Switches off the M1
Units Settings	Allows the user to change the M1 interface units
Temp. Settings	Change the number of Temperature Sensors
Stroke Number	Configuration of the type of Motor
Fuel Settings	Allows the adjustment of several parameters, and procedures related with the fuel level measurement and sensor
Reset Counter	Allows the user to reset the total flight time counter.
Date and Time	This menu option allows the user to set the clock and calendar
Exit Main Menu	Returns to Main screen

4.1 Units Settings

The "Units Settings" menu option allows the user to change the M1 interface units. In this Settings the user can change the Temperature Sensor , and the Fuel Units.

4.2 Temp. Settings

The "Temp. Settings"' menu option allows the user to define the Temperature Sensors used. At this moment the user can choose if one or two CHT sensors are used.

4.3 Stroke Number

The motor rotation is determinate using an electromagnetic sensor which detects the supply spark plug current.
Depending on the motor type, in order to have the correct value of R.P.M. the number of spark plug ignitions detected must be multiplied by a certain factor. This multiplying factor can be changed by the user trough this option.
The current version of firmware allows three settings, specifically 1 spark per 1 revolution, 2 spark per 1 revolution and 1 spark per 2 revolution.

4.4 Fuel Settings

The “Fuel Settings” submenu allows the adjustment of several parameters, and procedures related with the fuel level measurement and sensor. The available options in this submenu are described in the following sections.

4.4.1 Tank Calibration

The available fuel on tank is calculated from the measure of the fuel height on tank. Depending on tank configuration, the same fuel height can give different fuel quantity. In order to get a more accurate value , is need to calibrate the thank. This calibration procedure establishes a relation between fuel height and fuel quantity. The calibration procedure is explained in section 6.

4.4.2 Sensor Calibration

The fuel sensor supplied with M1 is factory calibrated. However, the sensor length can be cut to size . Cutting the fuel sensor length involves several tasks being the last one the Sensor Calibration. This menu option allows fuel sensor calibration after being cut. The calibration procedure is necessary in order the M1 recognize the new length. The procedure is explained in section 5.

4.4.3 Tank Empty

The tank calibration procedure is made in certain conditions which can be different from that on flight day. This option allows the definition of a new empty set point. In order to define the new empty point the following procedure should be done: 1. Completely empty the fuel tank; 2. Choose “Tank Empty” option and follow the instructions on screen.

4.4.4 Average Fuel Consumption

The average consumption is calculated during flight, dividing periodically the value of consumed fuel by the elapsed time. This calculation is repeated indefinitely when the rotation is greater than 0 and the fuel level can be determinate. The Average Fuel Consumption is shown in Litres

per Hour (L/H). This menu option allows the user to change the Average Fuel Consumption value. Since values need to be calculated using averages, these need some time to be obtained, therefore the user can manually insert a reference value so that other calculations that depend on this value can be immediately carried out.

4.4.5 Set Sensor

The M1 automatic detects if a fuel sensor is connected, but if the user is using the M1 without the fuel sensor, or want to turn it off in the current flight, in the "Set Sensor" option the user can set the Sensor Off or On.

4.5 Reset Counter

The M1 includes two flight time counters. One indicates the current flight time, and the other indicates the total flight time since the last reset. Both timers are automatically started when RPM is detected, and stopped when RPM is zero. However, whilst the flight time counter is initiated whenever the flight starts, the total flight time counter accumulates the total of all flights. The “Reset Counter” menu option allows the user to reset the total flight time counter. The total flight time counter is useful to control the number of motor working hours in order to schedule preventive maintenance tasks.

4.6 Date and Time

The M1 has a internal clock, and calendar, which are responsible for time parameters. The “Date and Time” menu option allows the user to set the clock and calendar. After “Date and Time” menu option selected the date and time will appears on the screen. To change the data and Values can be set using S1 and S3 key. Confirming one value will allow changing the next one.

5. Fuel Sensor Installation Procedure

Caution: The fuel sensor installation is a delicate, and potentially dangerous, process, which should only be carried out by skilled technicians. The sensor is fuel certified, but the incorrect installation, or use, may have serious consequences.

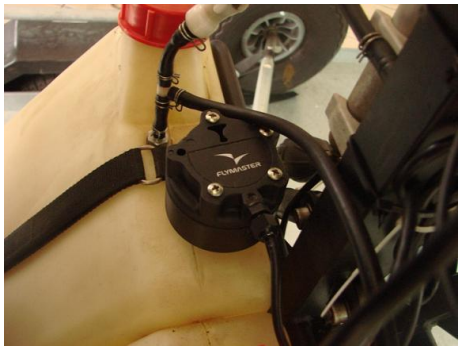


Figure **5**: Fuel Sensor Installation Example

5.1 Fuel Sensor Position

Considering the height measured by the sensor is proportional to the length of the immersed part, the fuel sensor should be vertically installed (see Figure 6 a)). However, an inclined position is possible provided that sealing is guaranteed (see Figure 6 b)).

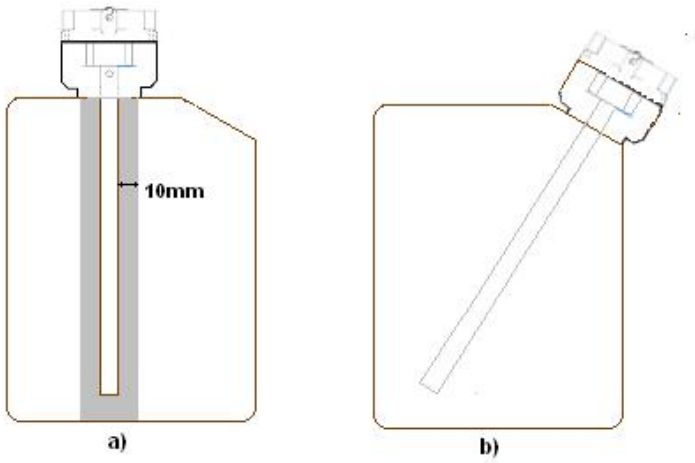


Figure **6**: Installation position

In order to grant the measure accuracy the sensor tube should not have any obstacle closer than 10 mm (see Figure 7)). Special care should be taken with the distance to the tank bottom. If required the sensor length can be reduced trough the procedure defined in section 5.2 Fuel Sensor .Cutting Procedure.Otherwise, the installation continues with tank calibration according section 5.4 Tank calibration.

5.2 Fuel Sensor .Cutting Procedure

The fuel sensor supplied with M1 has a default length. If required the sensor can be shortened. The first step for shortening the fuel sensor is to decide the correct length of the metallic tube which will be inserted in the tank.

5.2.1 Deciding Sensor Length

In order to determine the sensor length it is necessary to consider the following points:

- The minimum sensor length is 200 mm.
- A minimum distance of 10 mm should be maintained between the sensor metallic tube and any other surface, including the tank walls.

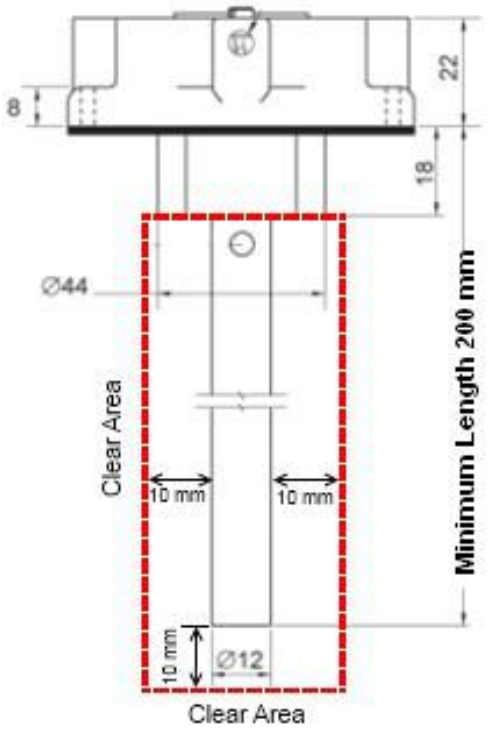


Figure **7**: Critical Sensor Measures

Taking into account the previous points the length can be easily calculated. For a vertical installation the length corresponds to the value L of Figure 8.

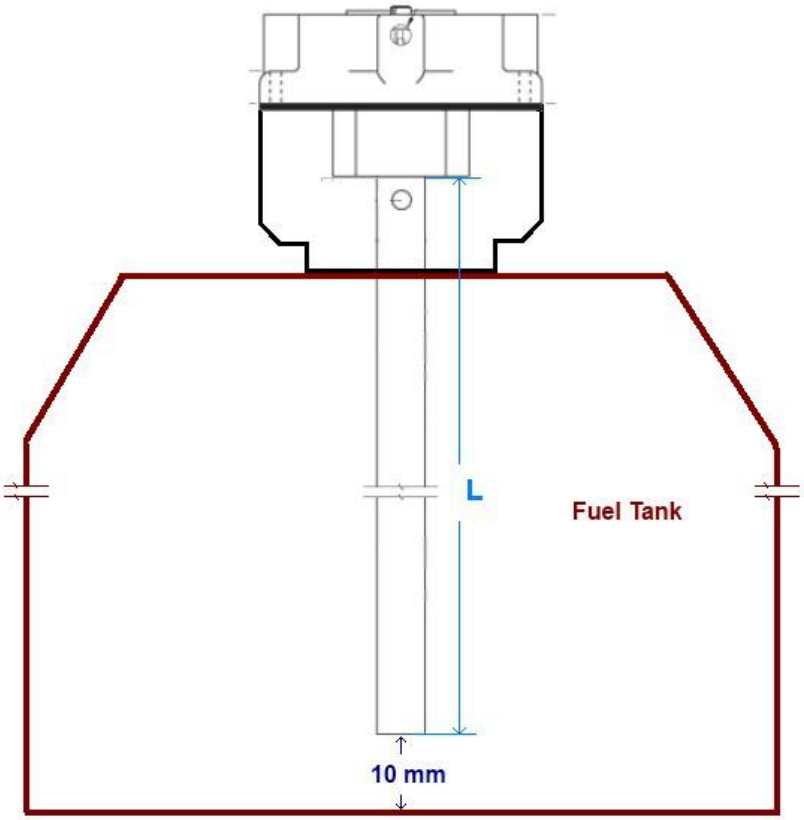


Figure **8**: Sensor length

5.2.2 Cutting the Metallic Tube

The sensor cut should be made using an adequate tool (eg. Pipe Cutter; fine toothed hacksaw).

Figure **9**: Cutting the Sensor

After cutting the metallic, outer, and inner tube carefully remove the remaining jagged edges using adequate tool.

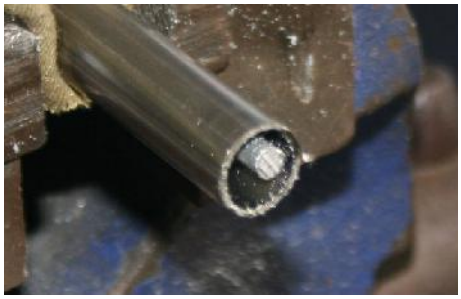


Figure **10**: Sensor after being cut

The sensor has a small hole on the bottom. This hole is necessary to allow fuel entry. (see Figure 11).

Figure **11**: Sensor hole

If cutting the sensor leads to the elimination of the hole a new one should be made using 4 mm drill.
After all the above procedures were done all the surfaces must be cleaned and specially without filings. The cutting procedure is terminated with the insertion of the special PTFE terminator supplied with the sensor (see Figure 12).
The main objective of this terminator is to avoid the contact between the centre aluminium rod and the outer tube. Furthermore, the distance between the rod and the outer tube should be keep constant along all sensor length.
Attention: Contact between the centre aluminium rod and the outer tube alters significantly the measures.

Figure **12**: End Plug placement

After introducing the end plug, the outer tube should be slightly, and symmetrically, smashed

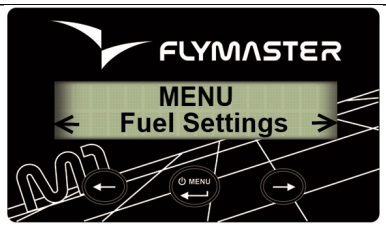
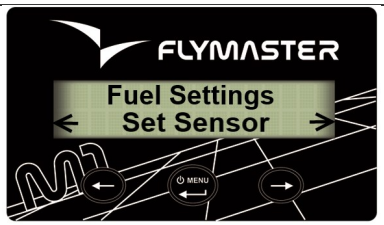
in order to ensure that the plug will not getting out (see Figure 13)

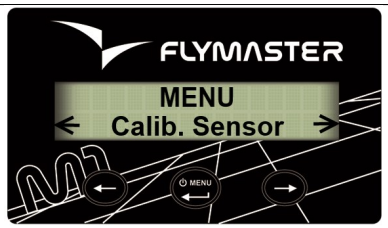
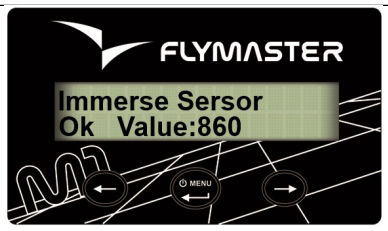
Figure **13**: Finishing the tube

After cutting the sensor it is necessary to calibrate it according to the next procedure.

5.2.3 Sensor Calibration Procedure

Sensor calibration allows the M1 to recognize the new probe length after the cutting process. The calibration process should be made after install the sensor on the tank. However, it can also be made before the installation using an adequate fuel recipient. Before start the calibration process assure that you have enough fuel to totally immerse the probe. You should also guaranty that M1 is charged. Then do the following Steps:

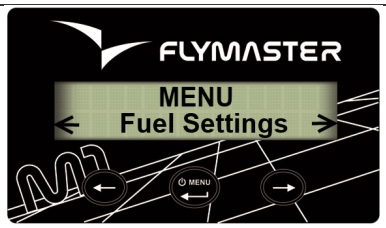
1- With M1 off connect the fuel sensor. The thank should be empty and the sensor not in contact with fuel.	
2- Turn on the M1, enter the MENU and select the "Fuel Settings" option	
3-The fuel sensor by default is off, to enable the fuel sensor choose the option "Set Sensor", select "YES" and press enter to confirm, and return to Fuel Settings Menu	

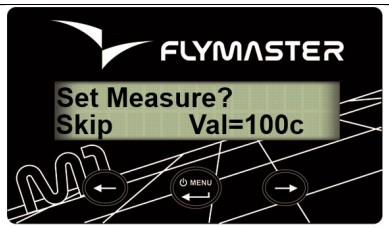
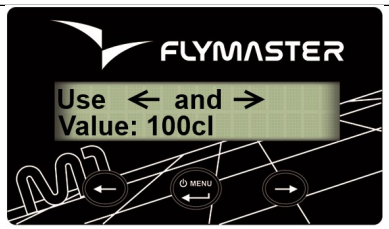
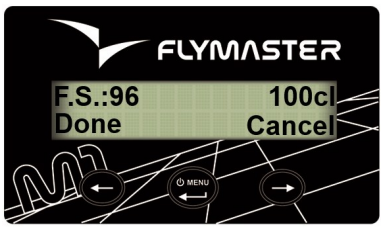
3-Choose the "Calib. Sensor" option	
4- The M1 ask you to confirm the sensor calibration process. By default the flashing option is "No", so you should choose "Yes" to proceed.	
5- The M1 will ask you to confirm that sensor is dry (i.e. not in contact with the fuel). You should choose "Yes".	
6- A message "Wait..." appears on the display while the M1 acquire the empty tank state. The acquisition takes approximately 3 seconds.	
7- After 3 seconds have elapsed ,the M1 will inform you fill the tank to full capacity , making sure the sensor is fully immersed.	
8- When the tank is completely full ,and the value shown on the screen is stable, confirm the value using S2 key.	

9- A message "Wait..." appears on the display while the M1 acquire the full tank state. The acquisition takes approximately 6 seconds.	
10- If the calibration was successful than the message "Sensor Calibrated" appears on the screen, otherwise an error message will be shown. Despite the message you should press a key in order to continue.	

6. Tank calibration

The available fuel is calculated from the measure of the fuel height on tank. Depending on tank configuration, the same fuel height can give different fuel quantities. In order the right calculation can be made a calibration procedure is necessary. This calibration procedure establishes a relation between fuel height, and fuel quantity. The calibration process is based on a simple idea. After asking for a standard measure definition, the M1 keeps asking the user to spill measures on the tank until it is full. For each added measure the corresponding height is saved. Later the fuel quantity can be calculated by interpolation. The calibration process requires one M1 and a calibrated fuel sensor correctly installed. If enough fuel is available to completely fill the tank ,follow the next steps:

1- 1- Start with an empty tank, and the fuel sensor correctly connected to the M1.	
2- Turn on the M1, enter the MENU and select the "Fuel Settings" option	

3- Within the Fuel Settings menu select "Calibrate Tank" option.	
4- The first step is the definition of the standard measure. By default the standard measure is 100 cl. In this step user can alter the standard measure value, or skip the alteration and maintain the previews definition.	
5- The standard measure value can vary between 5cl and 200cl. Value can be altered using keys S1 and S3 and confirmed using S2 Key.	
6- Depending on the first value measured by the sensor the M1 can ask the user to confirm if tank is really empty. In case "No" is selected the calibration process is aborted.	
7- In this step M1 waits for a fuel quantity, equal to the "standard measure" value, be added in the tank. For example, if the standard measure value is 100 cl, then 100 cl of fuel should be added in the tank. After putting the fuel on tank it is important to wait for the stabilization of the fuel before selecting "Done" option.	
8- After a measure being added the M1 asks the user if tank is full. If "No" is selected the process returns to point 7, otherwise, all values are saved in memory and calibrations ends.	

9-.If the calibration was successful than the message "Tank Calibrated" appears on the screen, otherwise an error message will be shown.	

Note: Smaller "standard measure" values allow more accurate fuel level calculation, particularly in tanks with irregular shapes. However, the chosen value should cause fuel height variations greater than 1 centimetre. The maximum number of measures is 30. Once the calibration is done M1 can calculate data as: fuel level; average fuel consumption; remaining flight time.