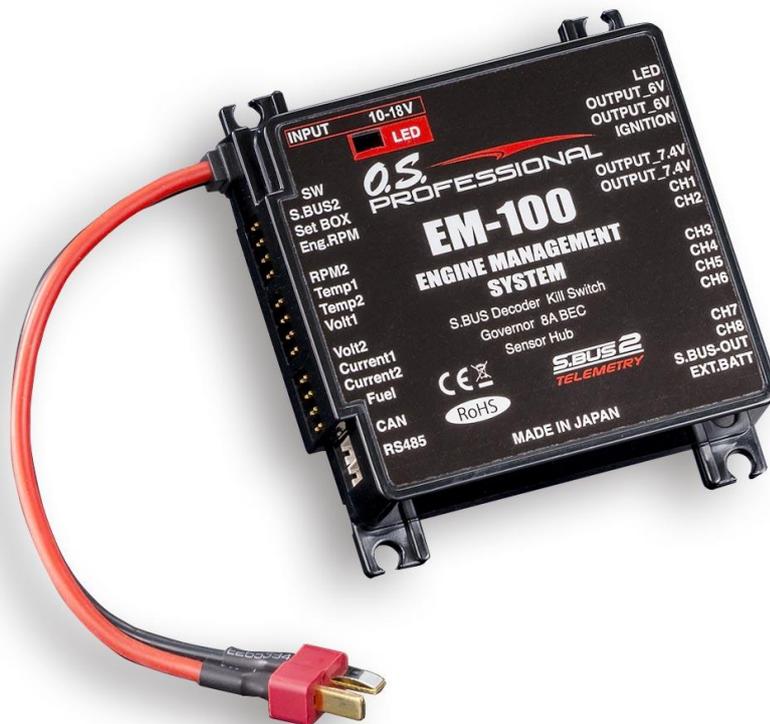


# ENGINE MANAGEMENT SYSTEM

# EM-100

## INSTRUCTION MANUAL



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## 1. ABOUT THE INSTRUCTION MANUAL

It is of vital importance, before attempting to operate EM-100, to read this booklet and adhere to the advice contained herein.

- Do not copy the instruction manual even a part of it without permission.
- The instruction manual may be subject to change without prior notice.
- The instruction manual is made with every effort, but in case there are some unclear points, errors in it, please contact us.
- We cannot assume the responsibility in case of wrong use.

### SAFETY INSTRUCTIONS AND PRECAUTION

#### MEANING OF SPACIAL MARKINGS

Pay special attention to safety where indicated by the following marks:

MARKINGS	MEANING
 <b>DANGER</b>	Procedures which may lead to dangerous conditions and cause death or serious injury to the user if not carried out properly.
 <b>WARNING</b>	Procedures which may lead to a dangerous condition or cause death or serious injury to the user if not carried out properly, or procedures where the probability of superficial injury or physical damage is high.
 <b>CAUTION</b>	Procedures where the possibility of serious injury to the user is small, but there is a danger of injury or physical damage, if not carried out properly.

symbols:

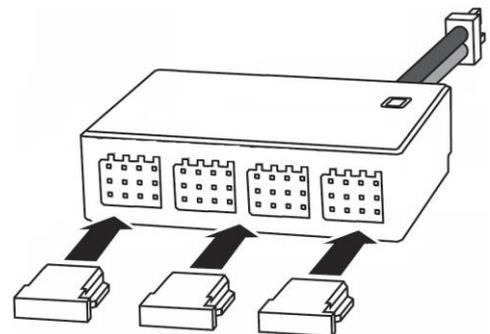
 : Prohibited       : Mandatory

#### CONNECTOR INSERTION PRECAUTION

 **WARNING**

**Do not connect the connector by mistake as shown on the right.**

- There a possibility of short circuit, explosion, and fire.



 **Do not connect in this direction.**

## 1. ABOUT THE INSTRUCTION MANUAL

---

### BEFORE EACH FLIGHT

#### WARNING

-  **Connect EM-100 only to an S-BUS2 port of a Futaba receiver with telemetry functions.**
  - EM-100 does not work if you connect it to a conventional S.BUS port and a CH output port.
-  **Keep away from conductive materials to avoid any short circuits.**
  - A short circuit damages EM-100.
-  **If it does not operate properly during operation test before use or during actual use, stop using it.**
-  **Always check the transmitter and receiver battery voltage to ensure they have enough remaining capacity to complete the flight.**
  - Decide the flight time with some margin in advance during test flight.
-  **Confirm that EM-100 is operating in the correct mode.**
  - Make sure that EM-100 is operating on the correct mode without LEDs' blinking or lighting that alarm abnormality.

### ABOUT BATTERIES

-  **Do not use different batteries together, for example Li-po and Li-Fe or ones with different voltages.**
-  **Remove the batteries when not in use.**
-  **Do not connect a battery to the receiver directly. The 7.4V power is supplied to the receiver through EM-100.**
-  **Remove the short connector (RED) when a BEC type ESC is used. In this case the ESC supplies the power to the servos.**

### ABOUT CONNECTORS

-  **Insert surely the connector such as sensor, servo, connection cord, battery cord etc.**
  - If it is not securely inserted all the way in, it may come off due to vibration during flight and there is a danger of crash landing.
-  **Do not connect with reverse polarity.**
  - There is a possibility of malfunction or fire.
-  **Use a Deans type connector to the power source battery for EM-100.**

### ABOUT WIRING

-  **Please secure the wiring so that it does not rub against the carbon frame or other such items that could cause wear.**
-  **Start monitoring electric voltage only after turning on EM-100 main switch.**

**ABOUT VIBRATION ISOLATION AND WATERPROOFING**

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- ❗ Fix EM-100 with the screws in the set and a dedicated mounting pad and aircraft performs sufficient anti-vibration measures so as not to receive strong vibration during flight. If there is a risk of the EM-100 getting wet, place it in a plastic bag and take waterproof measures.
- 

**ON FLIGHT PRECAUTION****⚠ WARNING**

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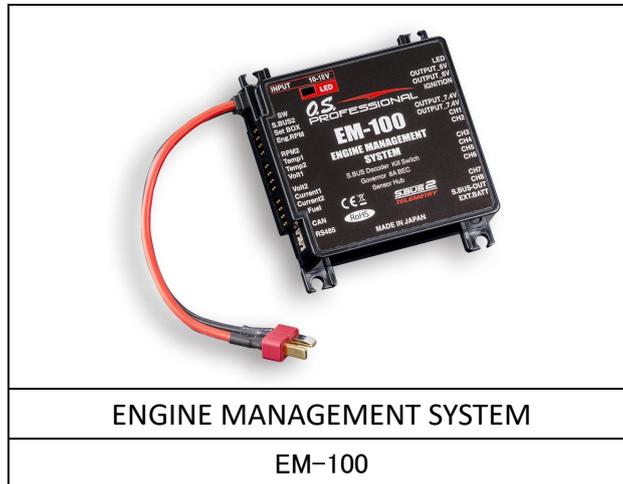
- ❗ Always exit programming mode of EM-100 before attempting to fly the aircraft.
- ❗ Select the mode according to what type of servos you are using. The EM-100 can be applicable to both digital and analog servos. In correct setting may damage the EM-100 or the servos, possibly resulting in a loss of control during flight.
- ❗ Avoid rapid change of temperature.
- ❗ Do not hit the EM-100 with a hard material or drop on a hard floor to avoid strong impacts.
- ❗ When the governor function in the EM-100 is used, use the fail-safe function on the transmitter for the channel that turns the governor on and off to set the fail-safe position to the point at which the governor is turned off. Set the fail-safe position to the point at which the governor is turned off. This setting turns the governor function off when the fail-safe function is activated.
- ❗ When using the condition hold function on the transmitter, always set the throttle servo maximum operating point to less than the point at which the governor is activated. If this is not done, the governor may activate while in condition hold.
- ❗ While preparing for flight or starting the engine, always ensure the throttle remains below the governor activation point and do not select any flight modes that may activate the governor.
- ❗ If you prefer to activate the governor while the aircraft is still on the ground, always ensure that you have at least -1 degree of pitch in the aircraft before activating the governor. This negative pitch is necessary to prevent an unexpected lift off as the governor activates and the head speed increased to the desired RPM.
- ❗ If you prefer to activate the governor while the aircraft is still on the ground, always ensure that you have at least -1 degree of pitch in the aircraft before activating the governor. This negative pitch is necessary to prevent an unexpected lift off as the governor activates and the head speed increased to the desired RPM.
- ❗ Periodically check the RPM sensor out to ensure proper governor operation. Due to the high level of vibration and centrifugal forces the magnet may come loose or the sensor alignment may change. Every 10<sup>th</sup> flight verifies that the magnet and sensor are properly mounted.
- ❗ If abnormality such as vibration etc, is recognized on the aircraft side during operation, be prepared to turn off the governor immediately.

## 1. ABOUT THE INSTRUCTION MANUAL

Make sure all the following products are included into your packet.

※ Please notice that there is some slightly differences between pictures showing as followings and real products.

### PRODUCT

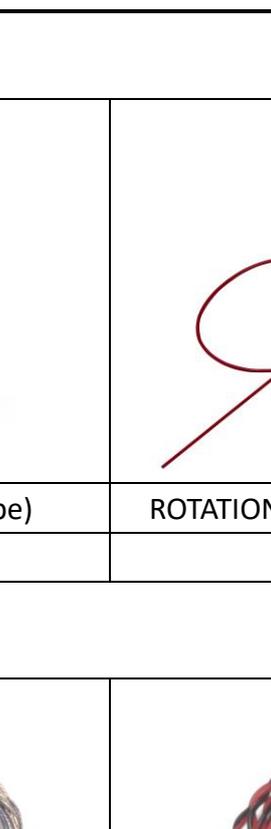


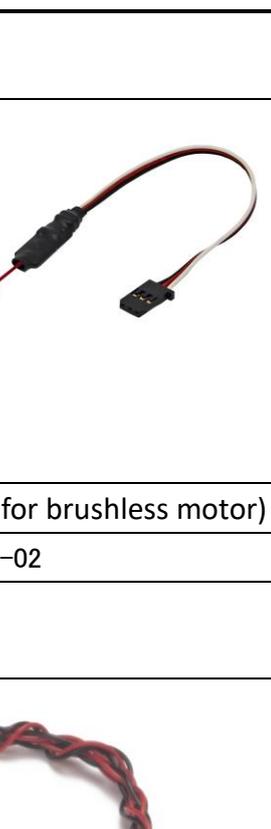
### ACCESSORIES

CONNECTING CORD(4pcs)	SUPPORT CD
SWITCH	MONITOR LED
MOUNTING ROBBER BUSH, EYELET, SCREW(4PCS)	JUMPER(RED • YELLOW)

**OPTIONS**

	
<p>ROTATION SENSOR (magnet type)</p>	<p>ROTATION SENSOR (for brushless motor)</p>
<p>SR-01</p>	<p>SR-02</p>

	
<p>TEMPERATURE SENSOR</p>	<p>VOLTAGE SENSOR</p>
<p>ST-01</p>	<p>SV-01</p>

	
<p>CURRENT SENSOR</p>	<p>FUEL SENSOR</p>
<p>SC-01</p>	<p>SFL-01</p>

## OPTIONS

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※Option products are only provided when purchased.

## 2. Overview of EM-100

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### 2.1 Overview

The engine management system EM-100 (hereafter EM-100) is developed for management of engines mounted on UAVs.

1. EM-100 is equipped with two regulators which have different electric output voltage.

1) Equipped with an insulated regulator (output: 6V, rated current 2A) being supplied electricity from external power supply, you can turn on/off the engine remotely.

The insulated regulator prevents receivers and other electronic devices from being damaged by noises from igniters.

You can turn on/off the 6.0V output by a transmitter. You can cut the engine power remotely.

2) Equipped with non-insulated regulator (output: 7.4V, rated current 8A)

Electricity can be supplied to 7.4V type servos and a receiver.

(How many servos can be used depends on specifications of a servo.)

2. EM-100 is equipped with an external battery connector, so servos can be supplied electricity from another external power supply.

3. Equipped with a converter with 8 outputs, which enable you to use conventional servos.

4. You can monitor the data from sensors; remaining fuel, muffler temperature of the engine, propeller rpm, altitude, battery voltage, electric current on the display of transmitter in real time.

5. The governor function (control range 700 – 4,000rpm) regulates engine RPM and stabilize the aircraft.

6. EM-100 can send various data to flight controller via CAN/RS485 communication.

7. S.BUS2 system enables simple connecting between EM-100 and a receiver.

### Features

- Two independent BEC supply constant electricity to an ignitor and servo/receiver respectively.
- The BEC for an ignitor is insulated type.
- Maximum 26 pcs of servos can be used. EM-100 is equipped with two different BEC electric outputs.
- The connector for an external power supply enables servos to use other power source.
- EM-100 is equipped with a kill switch, so you can turn on/off the engine remotely using a transmitter.
- Equipped with a governor (parameters can be changed via EM-link)
- Equipped with S.BUS decoder to use conventional servos (Maximum 8 pieces).
- Various telemetry data (RPM x 2, temperature x 2, battery voltage x 2, electric current x 2, fuel gauge, altitude, atmospheric pressure) can be monitored.
- Supporting Futaba telemetry transmitter/receiver (for example T18SZ, T16SZ)
- Different channel can be allotted each servo output of EM-100
- CAN/RS485, two-way communication is possible.
- Supporting Futaba S.BUS2 system
- Supporting firmware update

### 2.2 PRODUCT SPECIFICATION

Table 1 — product overview		
Name	EM-100	
Code	740010400000	
Weight	73g	
Power supply voltage/ Current	DC 10~18 V (Li-po3cell~Li-HV4 cell) / Max 300 mA (without servo)	
Communication specification	Input signal	S.BUS2 / RS485
	S.BUS2 data rate	100kbps
	Output signal	RS485 / CAN
	RS485 data rate	115.2kbps
	CAN data rate	1Mbps
Power supply / communication connector	Deans Ultra Plug / DF13-6P-1.25DSA (HIROSE ELECTRIC CO., LTD.)	
Voltage regulator for receiver /servo	Main function: use for 7.4V receiver / servo power supply Output voltage: 7.4V Output current: 8A (Max12A/30s)	
Voltage regulator for ignitor	Main function : use for 6.0 V ignitor power supply Output voltage : 6V Output current : 2A (Max 3A/30s)	
Governor	Control system: advance, adaptive PID control Rotation speed detection method: directly detect engine rotation Control resolution: 0.1Hz (±6rpm : engine rotation speed) Rotation speed stability accuracy: within ±1% Rotation speed control range: 700~4,000 rpm (rotor rotation speed)	
Environmental durability	Temperature : operating temperature -20°C~+70 °C / storing temperature -40°C~+85 °C Humidity : below 95% @70°C(about to condensate)	
Software operating environment	Microsoft Windows 7、Windows 8、Windows 8.1、Windows10 Or over than the level of Intel Core i5 processor	
Standard accessories	Standard power cord : the cable of connecting with receiver Dedicated switch Monitoring LED, socket, rubber bush, eyelet and screws for mounting on product	
Only available as cost option	Rotation sensor (SR-01, SR-02) Temperature sensor (ST-01) Voltage sensor (SV-01) Current sensor (SC-01) Fuel sensor (SF-01) USB adaptor (U2S-1) : attach the product with PC	

※1 S.BUS2 is a name of standard serial communication for R/C system of Futaba electricity industry.

Table 2—features of sensor output			
Item		Performance	Remark
Rotation speed 1	Output unit	Rotation speed per second (rpm)	
	Detection range	0~50,000 rpm	engine rotation speed data
	Output resolution	±0.1Hz(±6rpm)	
Rotation speed 2	Output unit	Rotation speed per second (rpm)	
	Detection range	0~50,000 rpm	rotor rotation speed data
	Output resolution	±0.1Hz(±6rpm)	
Temperature 1	Output unit	Centigrade (°C)	
	Detection range	0~300 °C	Engine temperature data
	Output resolution	±1°C	
Temperature 2	Output unit	Centigrade (°C)	
	Detection range	0~300 °C	outside temperature data
	Output resolution	±1°C	
Voltage 1	Output unit	Voltage (V)	
	Detection range	0~100 V	power battery voltage data
	Output resolution	±0.1V	
Voltage 2	Output unit	Voltage (V)	
	Detection range	0~100 V	generator voltage data
	Output resolution	±0.1V	
Current 1	Output unit	Ampere (A)	
	Detection range	-20~20 A	power battery current data
	Output resolution	±0.1A	
Current 2	Output unit	Ampere (A)	
	Detection range	-20~20 A	generator current data
	Output resolution	±0.1A	
Residual fuel ※	Output unit	Percentage (%)	
	Detection range	0~100 mm	fuel level data
	Output resolution	±1%	
Height	Output unit	Meter (m)	
	Detection range	-700~5,500 m	The height data which calculated from atmospheric pressure
	Output resolution	±0.1m (height difference)	
Atmospheric pressure	Output unit	Pascal (hPa)	
	Detection range	260~1,260 hPa	The atmospheric pressure around EM-100
	Output resolution	±0.1hPa	

※1 Contact us if you need a longer measurement range type.

## 2. Overview of EM-100

### 2.3 Configuration Diagram

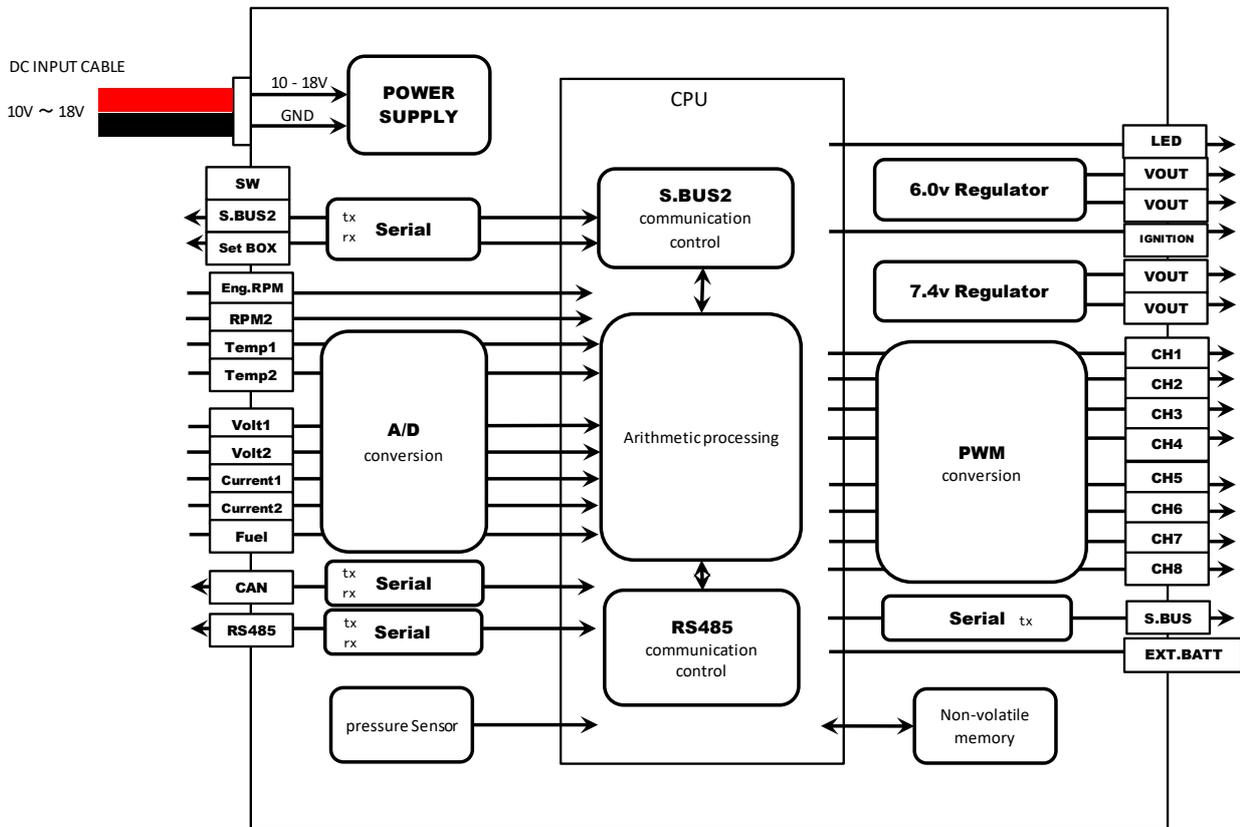


Figure 1. Construction

### 2.4 Dimension

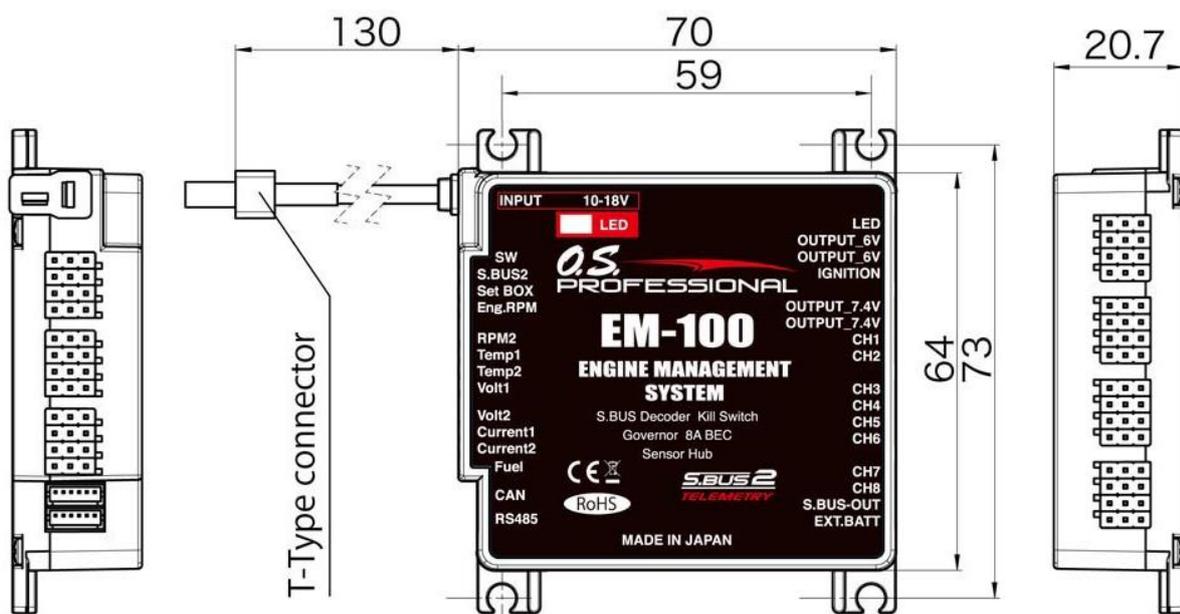


Figure 2.Dimension

### 2.5 Pin Function

Table 3. Pin Function		
Name	Input /output	Function
INPUT	Input	Connect to the 10~18V (Li-po3cell ~Li-HV4cell ) power supply.
SW	Input	Connect to the exclusive switch
S.BUS2	Input/output	Connect to the receiver S.BUS2 port. Do not connect the receiver battery since it is charged by the 7.4V power supply.
Set BOX	Input/output	Connect to the USB adaptor when setting up the parameter or firmware updating.
Eng.RPM	Input	Connect to the rotation speed sensor when starting the governor function
RPM2	Input	Connect to the rotation speed sensor.
Temp1	Input	Connect to the temperature sensor
Temp2	Input	Connect to the temperature sensor
Volt1	Input	Connect to the voltage sensor
Volt2	Input	Connect to the voltage sensor
Current1	Input	Connect to the current sensor
Current2	Input	Connect to the current sensor
Fuel	Input	Connect to the fuel sensor
CAN	Output	The connection of external device for CAN serial data transmission
RS485	Input/output	The connection of external device for RS485 serial data transmission
LED	Output	Connect to the accessory LED
OUTPUT_6V	Output	Connect to the ignitor power cord
OUTPUT_6V	Output	Connect to the ignitor power cord
IGNITION	Output	Connect to the ignitor signal cord
OUTPUT_7.4V	Output	Regulator power supply output (only connect to the 7.4V external device)
OUTPUT_7.4V	Output	Regulator power supply output (only connect to the 7.4V external device)
CH1	Output	Connect to the servo (not only S.BUS, any servo are ok) When updating the firmware, connect the short connector (yellow).
CH2	Output	Connect to the servo (not only S.BUS, any servo are ok)
CH3	Output	Connect to the servo (not only S.BUS, any servo are ok)
CH4	Output	Connect to the servo (not only S.BUS, any servo are ok)
CH5	Output	Connect to the servo (not only S.BUS, any servo are ok)
CH6	Output	Connect to the servo (not only S.BUS, any servo are ok)
CH7	Output	Connect to the servo (not only S.BUS, any servo are ok)
CH8	Output	Connect to the servo (not only S.BUS, any servo are ok)
S.BUS-OUT	Output	Connect to S.BUS / S.BUS2 servo
EXT.BATT	Input	Connect the supplied short connector (red). When using a separate power supply for servo, remove the short connector to connect the battery.

## 2. Overview of EM-100

### 2.6 Communication interface overview

#### 2.6.1 Communication interface

This product has been designed to interface with other devices, which is equipped with the RS-485.

The procedures of communication interface and the character configuration are respectively shown as the below table 4 and figure 3.

Table 4- data transmission procedure	
Item	Content
Interface	RS-485
Baud Rate	115200bps
Word Length	8 bit
byte order	LSB first
Parity	even
start bit	1 bit
stop bit	1 bit
Frequency	70Hz

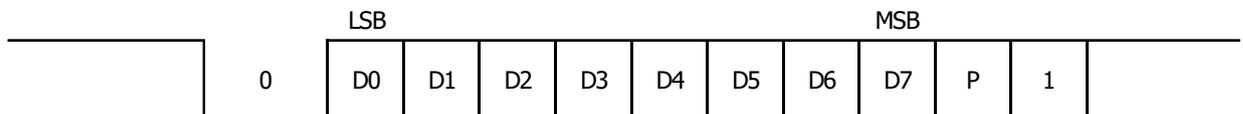


Figure 3 –character configuration

As shown in the following figure 4, the communication message byte strings are transmitted as a RS-485 serial communication data by the EM-100 at 14(ms) intervals.

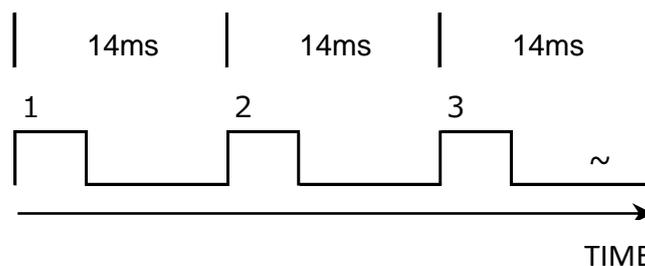


Figure 4 transmitting timing

2.6.2 Communication Message

(external device ⇒EM-100)

Table 5 — message structure				
No.	Name	Size [byte]	Content	Remark
1	Header	1	0xAA(fixed)	
2	length	1	size of data :34(fixed)	
3	data_ch1	2	0x0000 (880 usec) ~ 0x07FF (2160 usec)	unused (0400 fixed)
4	data_ch2	2	0x0000 (880 usec) ~ 0x07FF (2160 usec)	unused (0400 fixed)
5	data_ch3	2	0x0000 (880 usec) ~ 0x07FF (2160 usec)	unused (0400 fixed)
6	data_ch4	2	0x0000 (880 usec) ~ 0x07FF (2160 usec)	unused (0400 fixed)
7	data_ch5	2	0x0000 (880 usec) ~ 0x07FF (2160 usec)	unused (0400 fixed)
8	data_ch6	2	0x0000 (880 usec) ~ 0x07FF (2160 usec)	unused (0400 fixed)
9	data_ch7	2	0x0000 (880 usec) ~ 0x07FF (2160 usec)	unused (0400 fixed)
10	data_ch8	2	0x0000 (880 usec) ~ 0x07FF (2160 usec)	unused (0400 fixed)
11	data_ch9	2	0x0000 (880 usec) ~ 0x07FF (2160 usec)	unused (0400 fixed)
12	data_ch10	2	0x0000 (880 usec) ~ 0x07FF (2160 usec)	unused (0400 fixed)
13	data_ch11	2	0x0000 (880 usec) ~ 0x07FF (2160 usec)	unused (0400 fixed)
14	data_ch12	2	0x0000 (880 usec) ~ 0x07FF (2160 usec)	unused (0400 fixed)
15	data_ch13	2	0x0000 (880 usec) ~ 0x07FF (2160 usec)	unused (0400 fixed)
16	data_ch14	2	0x0000 (880 usec) ~ 0x07FF (2160 usec)	unused (0400 fixed)
17	data_ch15	2	0x0000 (880 usec) ~ 0x07FF (2160 usec)	unused (0400 fixed)
18	data_ch16	2	0x0000 (880 usec) ~ 0x07FF (2160 usec)	unused (0400 fixed)
19	data_DG1	1	0 or 1	
20	data_DG2	1	0 or 1	
21	Footer	1	0xFF(fixed)	
22	CRC	2	CRC(Header to Footer), CRC-16-CCITT	

(EM-100 ⇒ external device)

Table 6— message structure				
No.	Name	Size [byte]	Content	Remark
1	Header	1	0xAA(fixed)	
2	length	1	size of data :30(fixed)	
3	RPM1	2	0x0000 (0 rpm)~0xFFFF (65,535 rpm)	
4	RPM2	2	0x0000 (0 rpm)~0xFFFF (65,535 rpm)	
5	Temperature1	2	0x0000 (0 °C)~0xFFFF (65,535 °C)	
6	Temperature2	2	0x0000 (0 °C)~0xFFFF (65,535 °C)	
7	Voltage1	2	0x0000 (0.0 V) ~0xFFFF (6,553.5 V)	
8	Voltage2	2	0x0000 (0.0 V) ~0xFFFF (6,553.5 V)	
9	Current1	2	0x8000(-3,276.8 A) ~0x7FFF(+3,276.7 A)	
10	Current2	2	0x8000(-3,276.8 A) ~0x7FFF(+3,276.7 A)	
11	Fuel	2	0x0000(0%) ~0x0064(100%)	
12	Altitude	2	0x8000 (-3,276.8 m) ~0x7FFF (3,276.7 m)	
13	Pressure	2	0x0000 (0.0 hPa) ~0xFFFF (6553.5 hPa)	
14	Killswitch status	1	bit0 : Kill switch on/off 1:on 0:off	
15	Governor status	1	bit0 : Governor on/off 1:on 0:off	
16	Target _RPM	2	0x0000 (0 rpm)~0xFFFF (65,535 rpm)	
17	Reserve	1	—	
18	Reserve	1	—	
19	Reserve	1	—	
20	Reserve	1	—	
21	Footer	1	0xFF(fixed)	
22	CRC	2	CRC(Header to Footer), CRC-16-CCITT	

2.6.3 16 bit CRC value calculation

The following is the 16bit CRC value calculation method.

Refer to the page 46. Reference List 1 C language for the detail calculation of table76 formulation.

Here we assume the short type is as length as 16 bit. (finished checking the operation by MS-Windows7 + Microsoft Visual Studio 2010)

Table 7—CRC value calculation method			
No.	Item	Content	Remark
1	Bit length	16bit	
2	Generated Polynomial	$X^{16}+X^{12}+X^5+1$	CRC-16-CCITT
3	Bits sent	Standard (left sent)	
4	Default value	0	
5	Inverted output	none	

## 3. Each part name and function

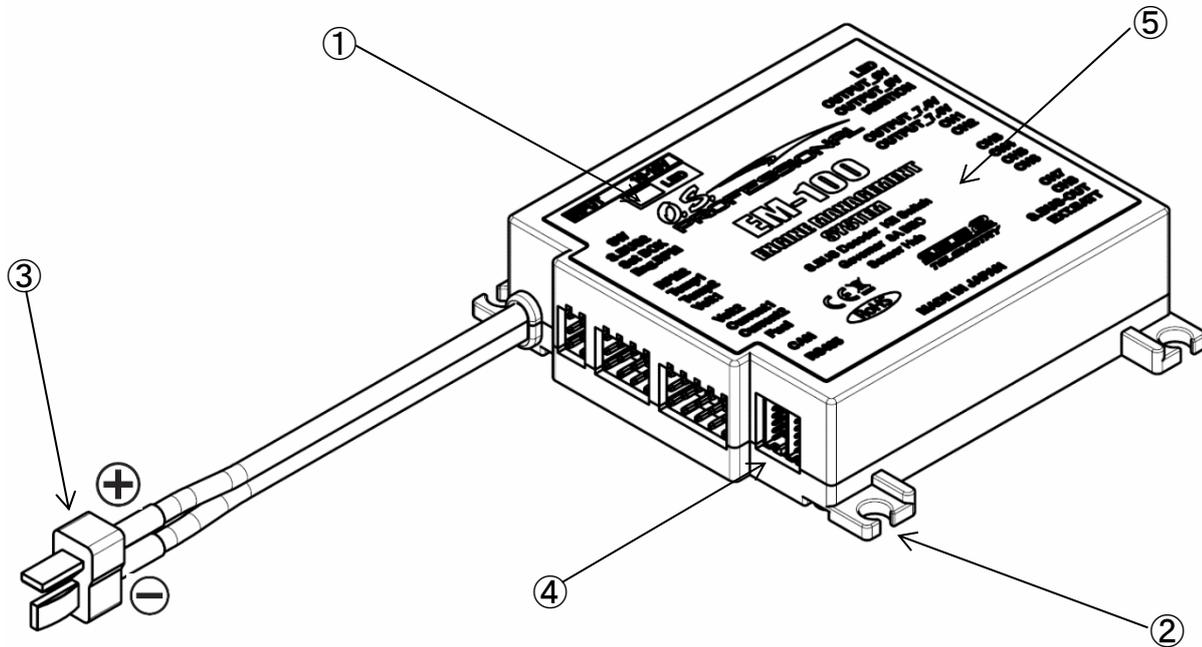


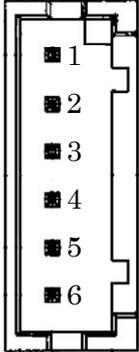
Figure 5

- ① Display LED  
Showing which position the device is at.  
LED is flashing between green and red color.
- ② Screw mounting hole  
For tightening the EM-100 to your device, the size of each hole is  $\phi 4.5\text{mm}$ .  
And there are 4 places having them.
- ③ Power supply connector  
Deans Ultra Plug (male type) for connecting power supply battery is recommended.
- ④ Communication connector  
For connecting with the other communication devices, using it to connect with device cables.  
Type of connector: DF13-6P-1.25DSA  
(On the cable side the DF13-6S-1.25C type of connector is recommended)
- ⑤ Nameplate  
The model number, serial number etc. of this EM-100 are listed.

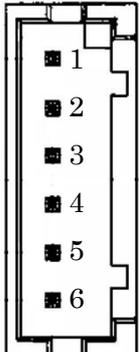
4. Outside interface communication

4. outside interface

4.1 RS-485 communication connector pin assign and signal definition

Table 8—connector pin assignment				
Connector type	Pin number	Signal name	Polarity	Signal summary
HIROSE ELECTRIC CO., LTD. DF13-6P-1.25DSA   Mating Side View	1	RS-485 TXD(+)	OUT	RS-485 send (+)signal
	2	RS-485 TXD(-)	OUT	RS-485 send (-)signal
	3	RS-485 RXD(-)	IN	RS-485receive (-)signal
	4	RS-485 RXD(+)	IN	RS-485 receive(+)signal
	5	7.4V POWER	OUT	+7.4V power output
	6	GND	—	GND

4.2 CAN communication connector pin assign and signal definition

Table 9—connector pin assignment				
Connector type	Pin number	Signal name	Polarity	Signal summary
HIROSE ELECTRIC CO., LTD. DF13-6P-1.25DSA   Mating Side View	1	CANL	OUT	“L” level CAN bus line
	2	CANH	OUT	“H” level CAN bus line
	3	Reserved	—	—
	4	Reserved	—	—
	5	7.4V POWER	OUT	+7.4V power output
	6	GND	—	GND

## 5. Using method

### 5.1 Setting up a PC

#### 5.1.1 Software download, unzip files and installation

Download the EM-Link program file, EM-Link\_v4\_0\_eng.zip from OS Engines homepage

<http://www.os-engines.co.jp/dll/air>

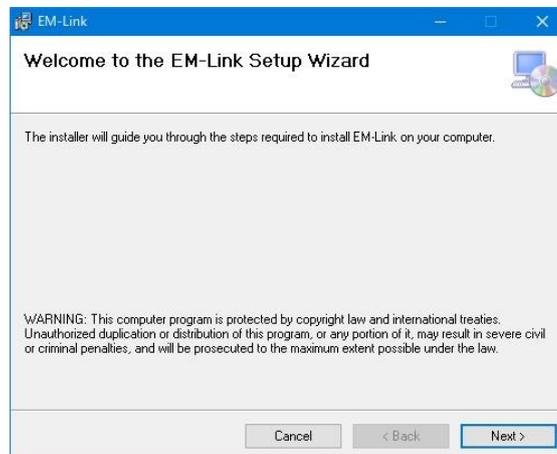
The file is in ZIP type compressed file.

#### ●Decompression of the ZIP file

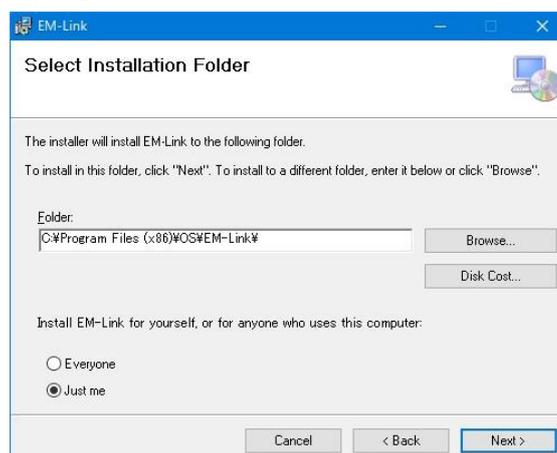
1. In case of Windows® 10/8.1/8/7 system, double click the icon of EM-Link\_v4\_0\_eng.zip.
2. The EM-Link setup Wizard starts.
3. Store the file at the same location where EM-Link\_v4\_0\_eng.zip is stores. Two files, EMLink msi and setup.exe are stored in the EM-Link\_v4\_0\_eng folder.

#### ●How to install EM-Link

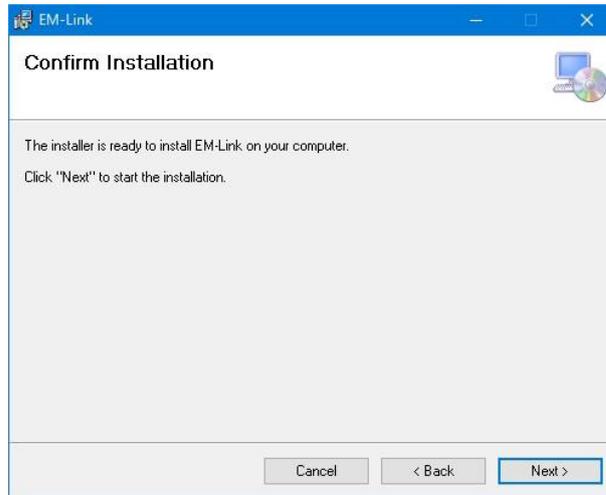
1. Execute the setup.exe
2. Installer is being executed. Click the “Next” button.



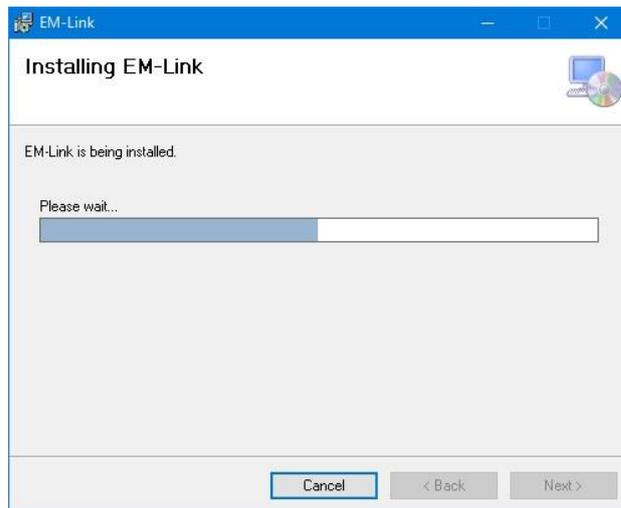
3. Select a folder to install the program and click the “Next” button.



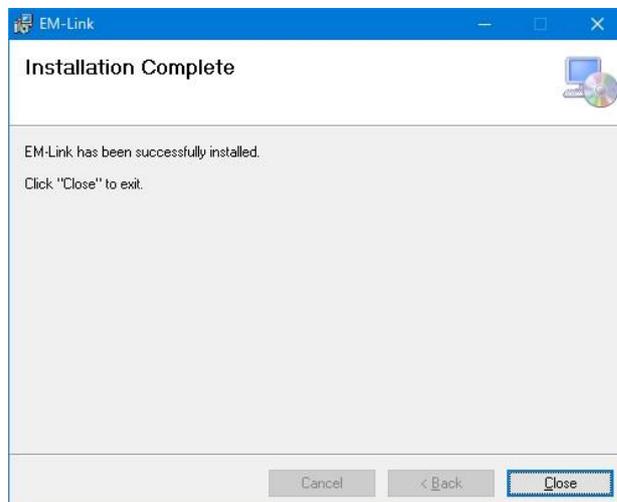
4. Click the "Next" button.



5. The installation is being executed.



6. The following is displayed after completing the installation.



## 5.1.2 How to connect EM-100 to a PC

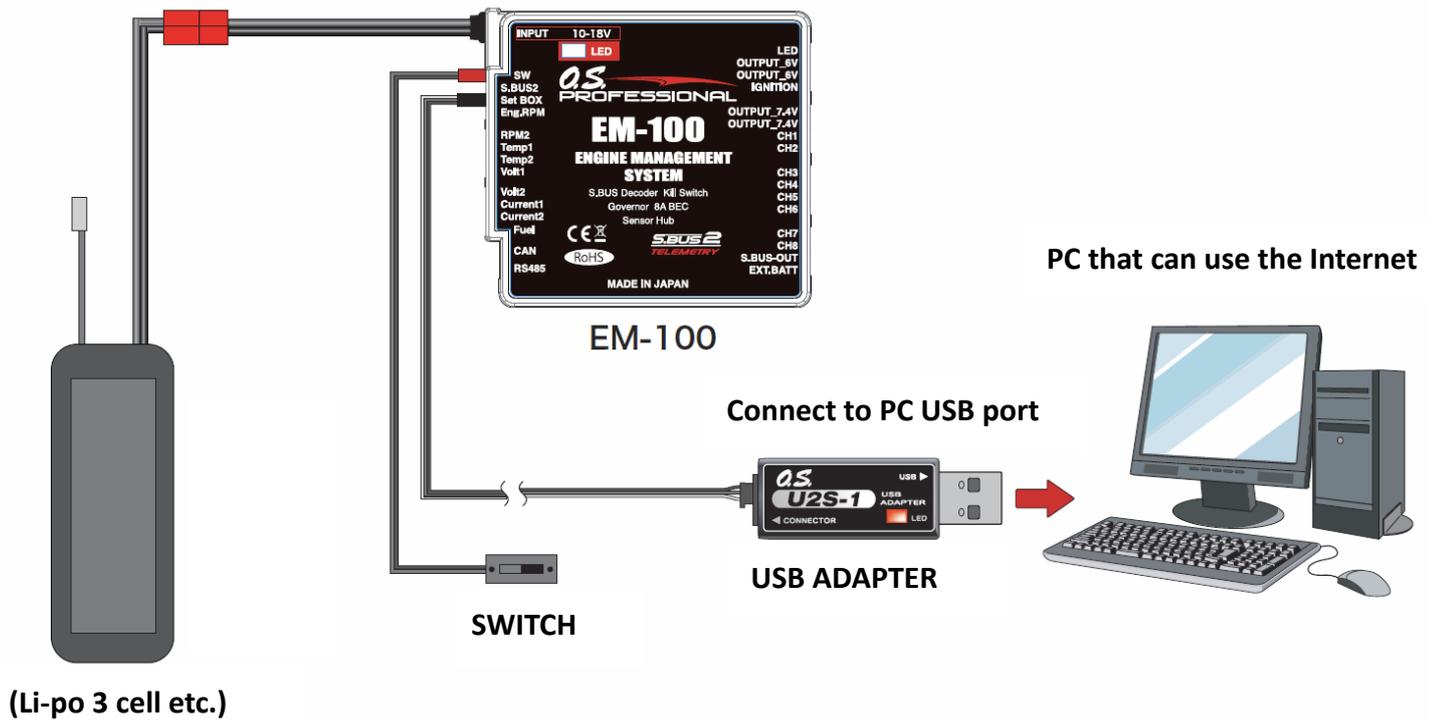
(preparation)

**Install the U2S-1 device driver.**

When U2S-1 is connected to a PC, it automatically connects to Windows update and the driver software is installed in the PC.

### ●Connecting U2S-1 to EM-100

1. Connect U2S-1 to the “Set BOX” terminal of EM-100 with an accessory cable in the set.
2. Connect a battery to EM-100.
3. Turn on the switch.
4. Connect U2S-1 to a USB port of the PC and a green LED is lit.



※In case EM-100 is already mounted in an aircraft and all the cables are connected, keep the receiver connected and turn on EM-100.

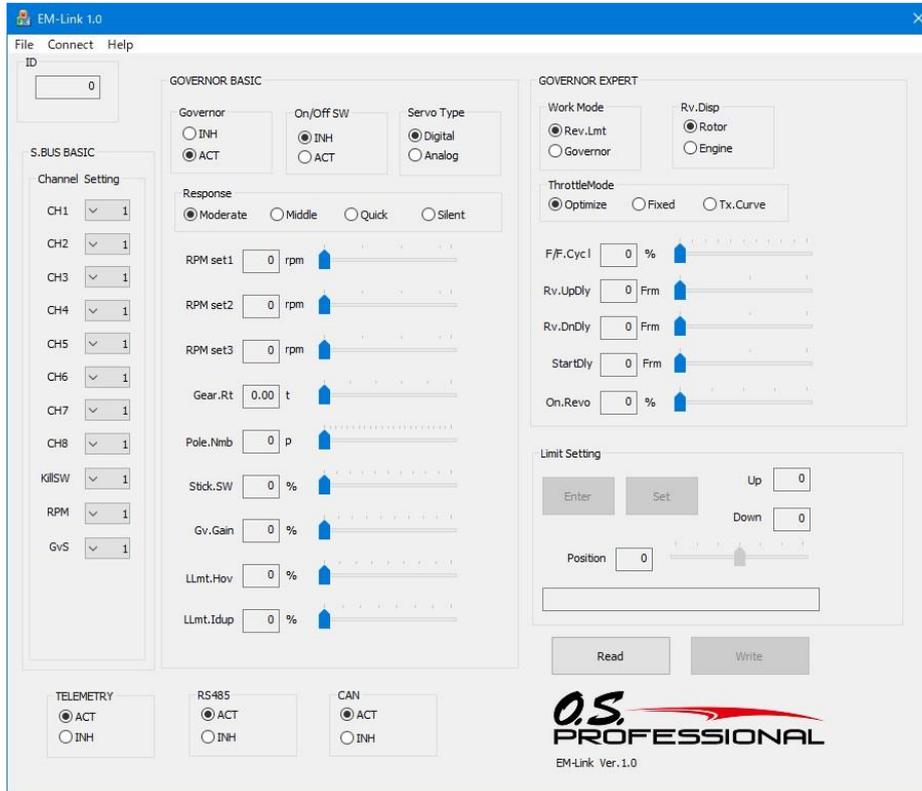
5. Using method

5.1.3 Software instruction

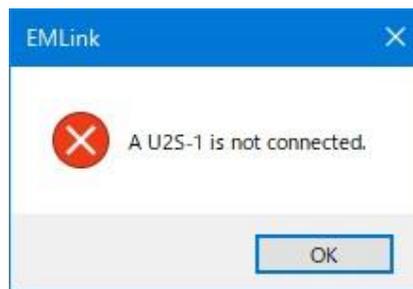
● Start the program file

- Using the same method mentioned before connect EM-100 to the PC, following the below steps to get the Parameter setting screen.

Windows start button → all programs → click the program file EM-Link.

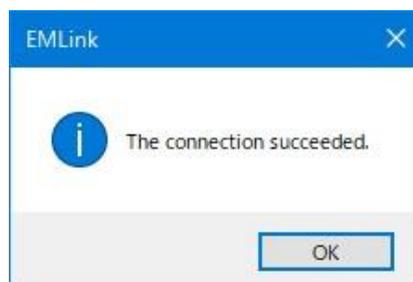


✂The following showed up means U2S-1 could not connect correctly with PC, click the ok and redo the connection again.



● How to read the EM-100 setting data

- Click the 'Read' button. After connecting the PC, click the 'OK' button when the message shown on the screen.



- ※'Read error' shows on the screen when the connection between EM-100 and PC wasn't correct.  
Click the ok button, remove the U2S-1 from PC, and then plug in and redo the connection again,  
then click the 'Read' button.



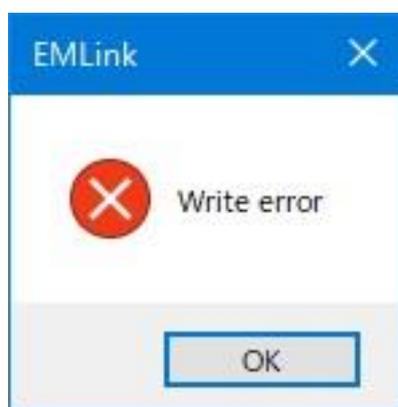
2. On the parameter setting screen, the EM-100 setting data is read.

● How to write the parameter data on EM-100

1. After setting up the parameter data, click the 'Write' button, which will send the new parameter data to the EM-100.
2. When the new parameter data has finished sending to EM-100, click the 'OK' button.

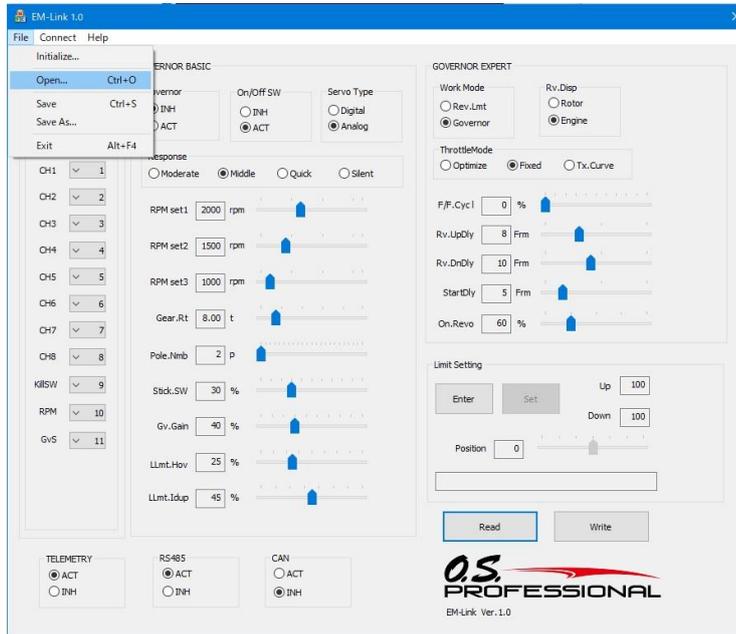


- ※If the 'write error' appeared, click the 'OK' button then rewrite it again.



●How to read the parameter data which is saved in PC.

1. Click the file then choose the open button.



2. In the EM-100 dialog, choose which file you want to open, click the file(.edt file) to open it.

The parameter data will change to new after finishing reading.

※Only clicking the 'Read' button, the parameter data will not send it to the EM-100.

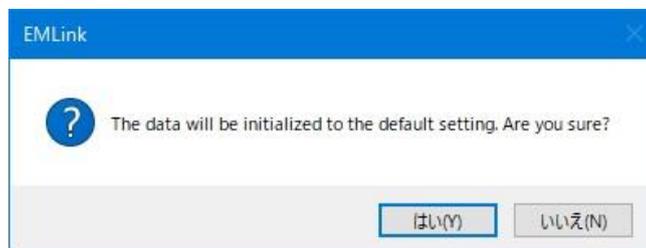
If you wrote in the EM-100, and click the 'Write' button, then the new parameter data will be sent to the EM-100 directly.

●How to save the parameter data to the PC

1. Open the file and then choose the save button, choose where you want to save the parameter data and name the file(.edt file), then click 'OK' button to save it.
2. In the data save dialog, select the save location and press the 'Save' button to set the parameters.  
The screen setting data is saved as a file on the PC.

●Parameter data initialization

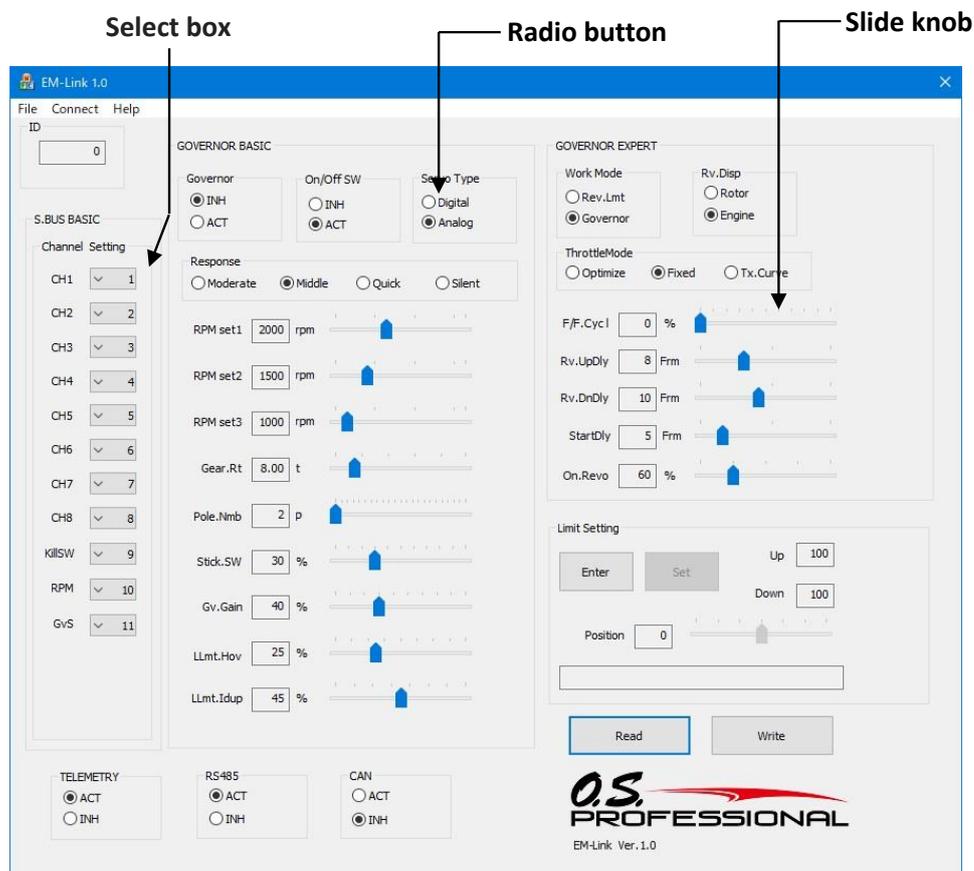
1. Click the 'Initialize' button on the file menu, then the message will come out as following.



2. Click yes if you want to initialize all parameter setting data.

※Initialized the parameter data on PC system, which doesn't mean the data has been sent to the EM-100. After press the 'Write' button on the screen, EM-100 parameter can be initialized.

### 5.1.4 The setting of parameter screen



(Parameter initial value setting screen)

1. Click the left arrow of select box to choose which channel you want.
2. By clicking the radio box, you can select any mode of governor, governor on/off, servo type, response and governor expert and so on.
3. If you move the 'slide knob' as shown on the pic, the other set up values would have changed with it. Also, it is possible to use the direction button on your key board to change the specific value in detail.
4. The setting of 'servo limit point' should be started after applied the EM-100 on the aircraft, then you can set and adjust it while checking how the servo position moving. Click the 'Enter' button first, it will appear to setting mode. Moving the 'slide knob' to select the point you like, by click the 'Set' button to memorize current setting. The right and left side of limit position can be set separately.
5. After done all of setting up, click the 'Write' button to make all new parameter data inputted in the PC system.

Attention: Do not unplug any lead wires or power supply wires while writing the new parameter data into EM-100.

Attention: Double check and test the servo working direction after rewriting new parameter data into EM-100.

### 5.1.5 Explanation of each parameter

#### ●ID

Serial number, which you cannot change.

### S.BUS basic settings

CH (channel) settings for each function according to your transmitter

EM-100 requires an S.BUS2 receiver.

#### ●Channel (default: kill switch=9, RPM = 10, Governor ON/OFF = 11) (setting range 1 – 16 channel, DG1, DG2)

You can use CH 1 – CH8 freely.

Decide CH number of Kill switch channel, RPM setting channel, Governor ON/OFF channel.

### Governor basic settings

Whenever you use governor function, governor basic settings is necessary.

✂After completing throttle linkage, set the servo limit setting first and foremost before any other settings.

✂In case you use a Futaba transmitter, set the throttle channel of Servo reverse function “REVERSE”.

#### ●Servo limit point settings (default: Left = 100, Right = 100) (setting range: 50 – 150)

This is to set the moving angle of a servo. The settings are to be done after mounting EM-100 on the aircraft. Click “INPUT” to enter the setting mode. Move the slide knob to the end and check the servo movement not to push/pull the linkage too much. Click “SET” button to memorize the position. Then move the slide knob to the other end and do the same. The limit value cannot be set less than 50%. When the both positions are decided, click “Write” button to transmit the data to EM-100.

#### ●Governor movement (default: INH)

This is to set the governor movement. Default setting is governor INH. Select INH in case you do not use the governor.

#### ●Governor ON/OFF switch (default: ACT)

This is to turn ON/OFF the governor using a lever switch on the transmitter.

#### **Setting of the governor function by an ON/OFF switch**

✂Choose the channel for the ON/OFF switch in S.BUS2 basic setting, “governor ON/OFF channel”

When you turn on the switch, the governor is ready to work as follows.

- When the throttle stick is moved up from the bottom to 60% up or more, the governor is turned ON.
- When the throttle stick is moved down to the bottom, the governor is still ON.
- When the ON/OFF switch is turned off, the governor is turned OFF.

## ●Choosing the servo type (default: analog servo)

This is to decide which type of servos is used. Digital servos respond quicker than analog ones.



The servo type parameters within the EM-100 must match the type of servo you are using. Incorrect setting may damage the servos, possibly resulting in a loss of control during flight.

## ●Governor response (default: Middle)

This is to set the speed of governor response. The governor performs best when the speed of governor response and the speed of acceleration/deceleration of the engine (motor) is the same. Generally, the setting of this parameter we recommend is as follows.

Glow engine → Middle

Gasoline engine → Moderate

Brushless motor → Quick

Brushless motor using a RPM sensor, which picks up RPM data directly from an ESC → Silent

## ●RPM setting (setting range: 700 – 4,000 rpm)

This is to set rpm of the main rotor. Determine the engine rpm from the gear ratio of the main shaft.

## ●Determine the gear ratio (Default: 8.00) (setting range: 1 – 50)

Input the gear ratio of the main shaft.

About the rotor gear ratio

Incorrect gear ratio setting makes discrepancy between the set rpm and the actual rpm of the engine.

The gear ratio is written in instruction manual of the aircraft (helicopter). Determine the gear ratio as follows in case not.

Engine pinion gear N2

Rotor main gear N1

Gear ratio =  $N1/N2$

※Round off the value less than 1/1000

## ●Pole number (default: 2p) (setting range: 2p – 24p)

This is to set the poles of motor. Input the quantity of pole in the brushless motor to detect rpm. In case of using an internal combustion engine, input the value 2P (default setting).

The range of input signal of the rotation sensor should be between 0V and 3.0V. Make sure not to exceed the maximum voltage not to damage the EM-100.

● **Stick switch (default: 30%) (setting range 0% - 100%)**

The governor can be activated by throttle stick position. When the governor ON/OFF switch function is inhibited (INH), or the governor ON/OFF switch is not functioned, the stick switch is always activated (ACT).

**When idle up**

When the throttle curve is set at idle up, when the throttle output is over the set value (default: 30%), the governor will always remain ON even if the stick is lowered to the bottom.

**When turn ON/OFF the governor with the switch**

In advance, select the ON/OFF switch channel with "GOV sw channel" on "SBUS BASIC" menu.

When the governor turned ON/OFF by switch, setting the switch to the ON position turns on the governor.

The following describes this operation.

- When the stick switch stays within a governor ON position and output level is more than 60% → the governor is ON
- When the stick switch stays within a governor ON position → the governor is kept turned ON
- When the stick switch is moved down lower than the governor ON position → the governor is turned OFF

(Governor operating point)

Set speed

Set point or more and 60% of set speed

(OFF at slow side)

Set point or less (OFF range)

● **Governor gain (default: Moderate = 30%, Middle = 40%, Quick = 60%, Silent = 10%) (setting range: 10% - 100%)**

This is to set the governor operation sensitivity. When the response of the governor is changed, all the settings become default. Too low of number causes fluctuation of the RPM with collective pitch and cyclic changes. Too high of gain causes the RPM oscillation and possibly surging during flight.

● **Low limit hovering (default: 0%) (setting range 0% - 80%)**

This is to set the limit to control excessive throttle close during hovering when the governor is activated.

● **Low limit idle up (default: 10%) (setting range 10% - 80%)**

Low RPM limit sets the minimum amount of throttle that the governor will command during an over-speed situation. Too low of the value, the engine could shut off or would not recover power quickly enough during the next collective movement. If the value is set too high, the governor will not control over-speed with the rotor head unloaded.

## Governor expert settings

### ●Governor working mode (default: governor mode)

This is to set the governing type mode.

RPM is entirely controlled by the governor once it has engaged. The governor will do whatever it takes to hold a constant RPM throughout flight. In Rev. limit mode, set the throttle data mode "Tx curve" mode and set the throttle curve with a transmitter.

### ●RPM display mode (default: ENGINE)

Ability to choose to display desired Rotor RPM or Engine RPM.

### ●Throttle data mode (default: Fixed)

This parameter selects the throttle input operation.

**Optimize:** EM-100 sets the throttle input signal to optimum. There is no need to consider the throttle curve setting on the transmitter.

**Fixed:** The fixed throttle input is utilized related to the revolution. It is recommended for electric motors.

**Tx. Curve:** EM-100 uses the exact throttle input from the transmitter. The throttle curve setting on the transmitter is required. When the Rev. limit mode is selected, this mode should be selected.

### ●Feed forward cyclic mode (default: 0%) (setting range: 0% ~)

Increasing the value will add throttle with cyclic commands to aid in RPM stability.

### ●Revolution up delay (default: 8) (setting range: 2 – 20)

How quickly the RPM changes when increasing RPM between two different RPM conditions and flight modes. A higher value slows the RPM change rate; a lower value speeds up the RPM change rate.

### ●Revolution down delay (default: 10) (setting range: 2 – 20)

How quickly the RPM changes when reducing RPM between two different RPM conditions and flight modes. A higher value slows the RPM change rate; a lower value speeds up the RPM change rate.

### ●Start delay (default: 5) (setting range 2 – 20)

How quickly the RPM stabilized to the set RPM from when the governor is turned ON. A higher value slows down the spool up rate; a lower value speeds up the spool up rate.

### ●Governor ON revolution setting (default: 60%) (setting range: 50 – 90%)

This parameter tells the governor at what percentage of the set RPM it is to become active. The default value is 60%. In this case, the governor will not engage until the engine RPM reaches 60% of the set RPM. IF you feel that the time for governor engagement is too slow, decrease the value to 50 – 55%. The starting time will become faster.

### ●Telemetry(default:ACT)

Switch between using telemetry function (ACT) and not using (INH).

### ●RS485 communication(default:ACT)

Use RS485 communication function (ACT) or not use (INH).

### ●CAN communication(default:INH)

Switch between using CAN communication function (ACT) and not using (INH).

**5.2 Mounting EM-100**

Fix EM-100 with four M2 screws as shown Fig.6 below.

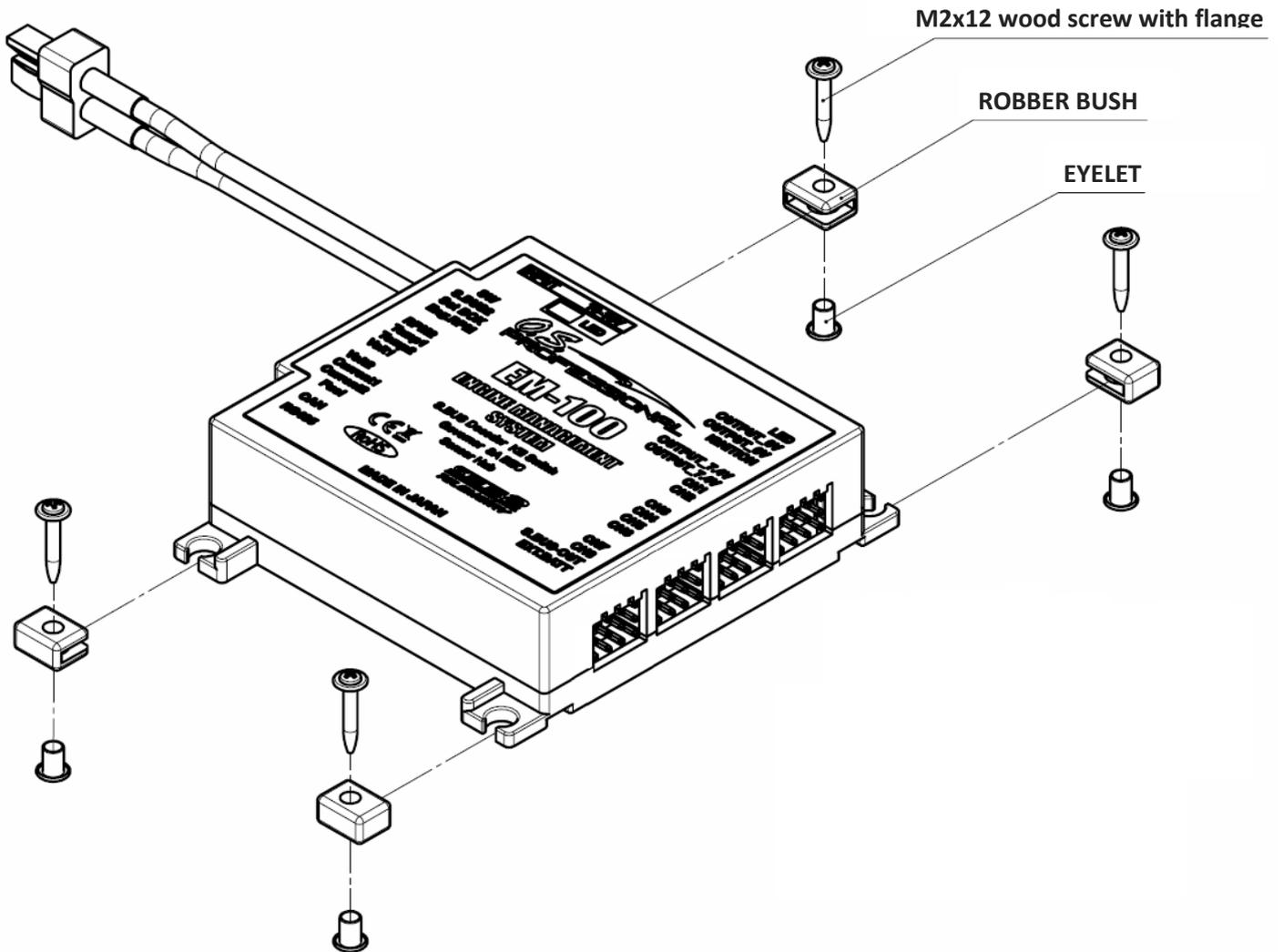


Figure 6-How to install the device

## 5.3 Connecting the equipment

### 5.3.1 Setting up the equipment

#### ● Setting of the EM-100

1. Connect the S.BUS2 port of EM-100 and that of the receiver with a Futaba Gyro cord.
2. Connect the engine RPM sensor cord to the Eng. RPM port of EM-100.
3. Connect the ignitor signal cord to the IGNITION port of EM-100.
4. Connect the ignitor power cord to the OUTPUT\_6V port of EM-100. You need a Futaba Gyro cord for the connection, which is included as a standard accessory.
5. Connect the accessory LED to the LED port of EM-100.
6. Connect the servos to CH1 – CH8 port respectively.
7. Connect other sensors to RPM2 – Fuel port respectively.
8. Connect the accessory short connector(red) to the EXT.BATT port.

#### ● Setting of the transmitter

The initial setting of the kill switch channel of EM-100 is ID=09.

The initial setting of Futaba T16SZ and T18SZ does not allot kill switch channel. Allot kill switch channel to CH9 in “function” in the “Linkage menu” of the transmitter. Allot CH9 to SF switch of the transmitter and decide kill switch ON-OFF position.

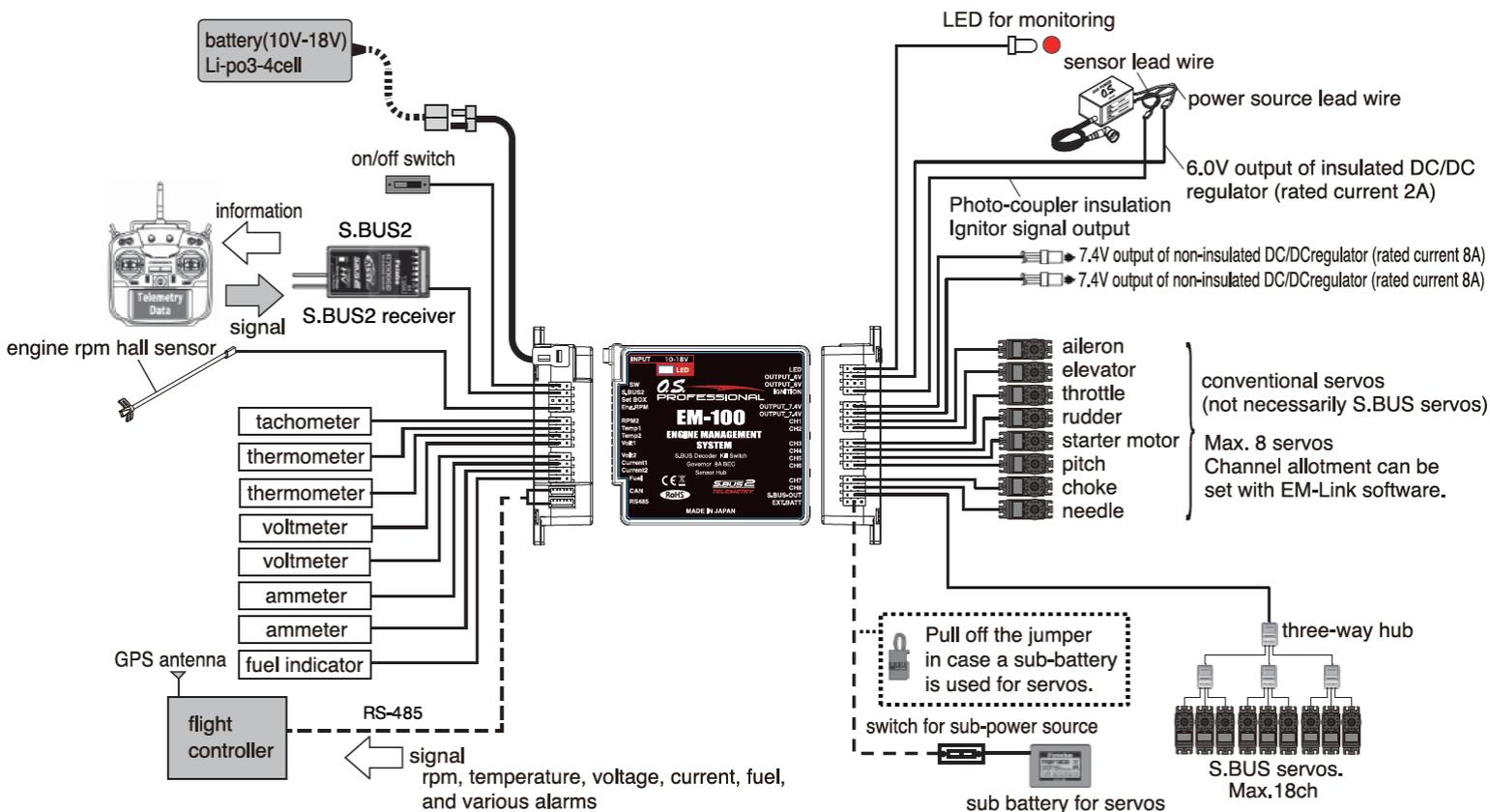


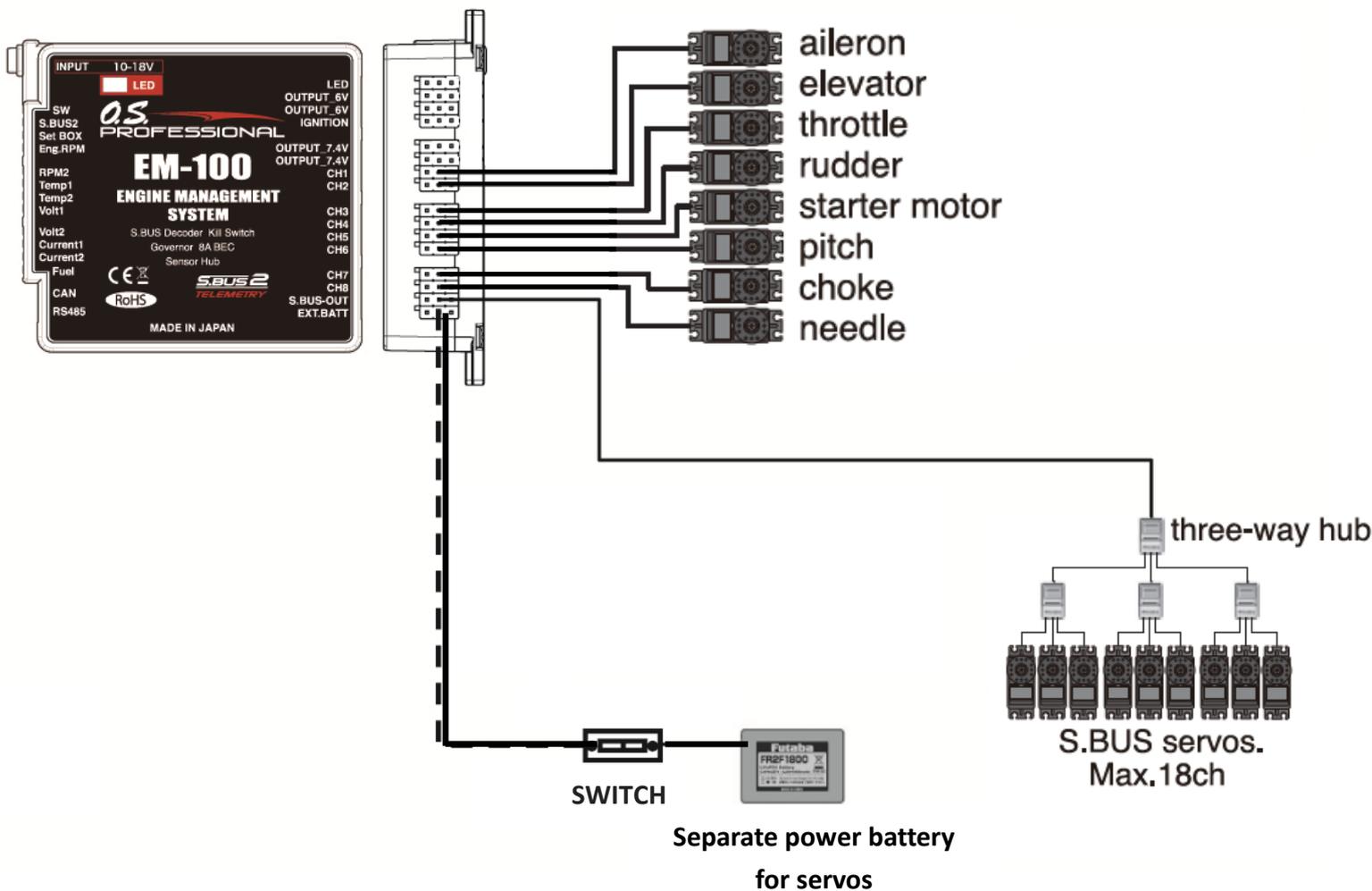
Figure 7–Connection example of this device

5. Using method

**5.3.2 An example to operate the servos with a separate battery.**

If a large number of high-end servos are used and the current consumption increases, the current may become insufficient. If the current consumption is high, use a servo with a separate power supply. This device has a separate power port. When using the servo with a separate power supply, remove the short connector (red) and connect the servo battery.

- \* If the number of servos increases, it is recommended to use a separate power supply. As a guide, it is recommended to use up to 8 Futaba high torque servos in total.



## 5.4 Starting-up EM-100

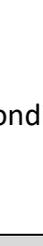
Fix EM-100 to the aircraft and connect the cables to start up.

After starting up, EM-100 shows 15 seconds of the starting-up sequence as follows.

- ① Initializing EM-100 and checking the sensors
- ② Calculating the altitude and atmospheric pressure and outputting the data
- ③ Warming-up

## 5.5 LED status

The LED shows status of EM-100 to recognize the current condition of EM-100.

Graph 12—LED status		
LED		Content
Green light on		Normal operation
Red light on		No signal detected
Green and Red LEDs both light on		when a slot number is on setting
Green and Red LEDs blink alternately		Abnormal (memory trouble etc.) Consult OS customer service in case it does not recover after restarting.

5. Using method

5.6 Registering EM-100 in the transmitter

1. Press "Sensor" in "Linkage menu". The EM-100 uses 12 consecutive slots. The starting slot is set to 16.

Sensor		Model1	6.6V		2/3
Sensor type		Normal	Sensor type		ID
		ID			
13	GPS		19	---	
14	GPS		20	---	
15	GPS		21	---	
16	---		22	---	
17	---		23	---	
18	---		24	---	

2. Choose "OS EM-100" in the sensor choice display.

Sensor		Model1	6.6V		1/2
---		GPS	Vario-F1672		
Temperature	Servo sensor	Curr. F1678			
Voltage	Speed sensor	Kontronik ESC			
Current	Temp-F1713	Castle TL0			
rpm sensor	GPS-F1675	JetCat V10			
Altitude	Vario-F1712	PowerBox			

Sensor		Model1	6.6V		2/2
O.S. EM-100		Normal			

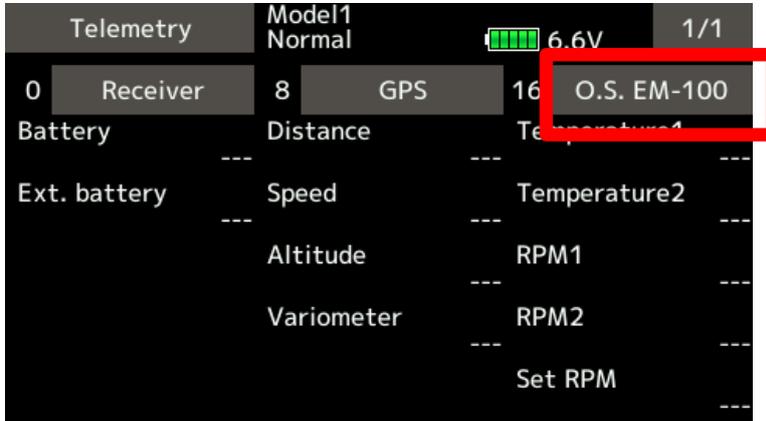
3. EM-100 has been registered.

	Sensor	Model1 Normal	 6.6V	2/3
	Sensor type	ID	Sensor type	ID
13	GPS		19	O.S. EM-100
14	GPS		20	O.S. EM-100
15	GPS		21	O.S. EM-100
16	O.S. EM-100	0	22	O.S. EM-100
17	O.S. EM-100		23	O.S. EM-100
18	O.S. EM-100		24	O.S. EM-100

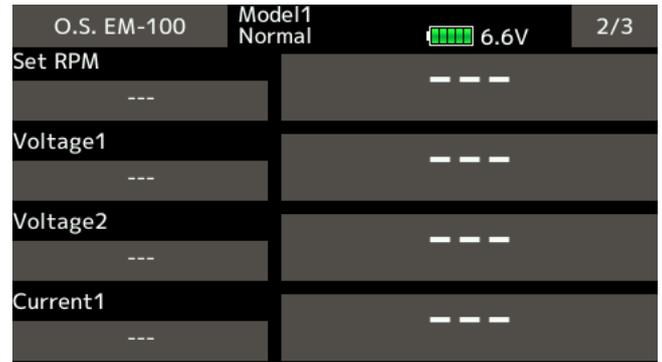
5. Using method

5.7 Telemetry display of EM-100

1. Open “Telemetry” display in “Linkage menu”. It displays sensors which are already allotted.  
Press “OS EM-100”.



2. The details of EM-100 are displayed.

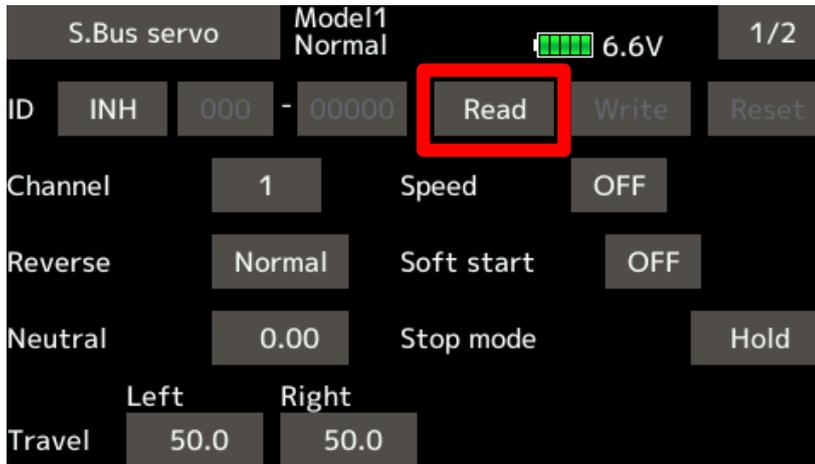


3. Press each item to display the “Alarm setting”.

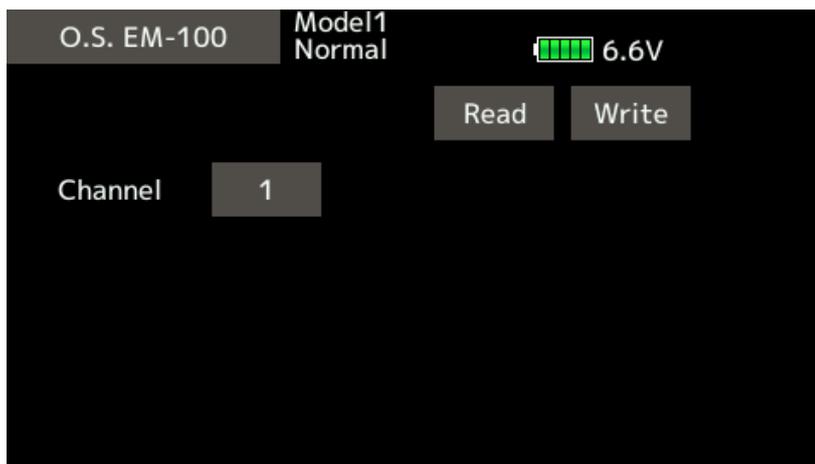




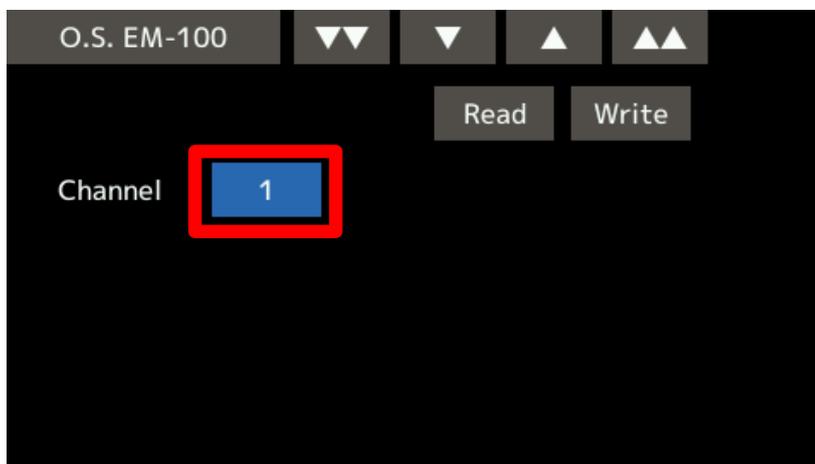
2. Select [S.Bus servo] at the System menu.



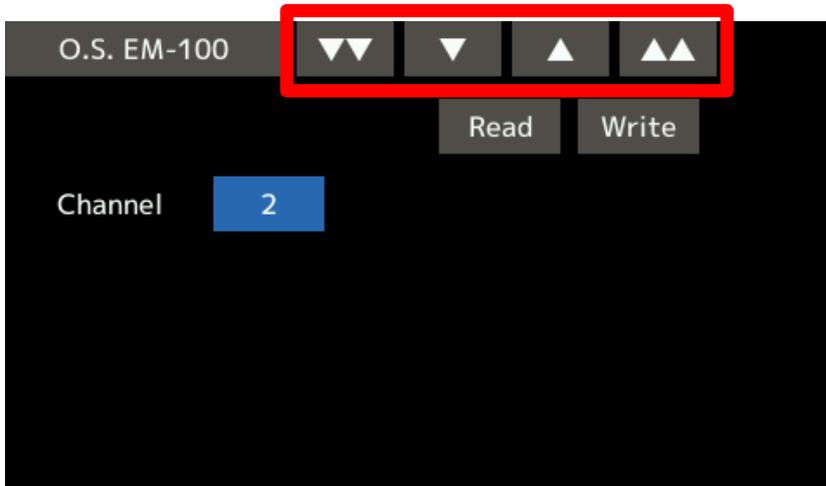
3. Tap [Read] to go to [O.S.EM-100] for channel settings.



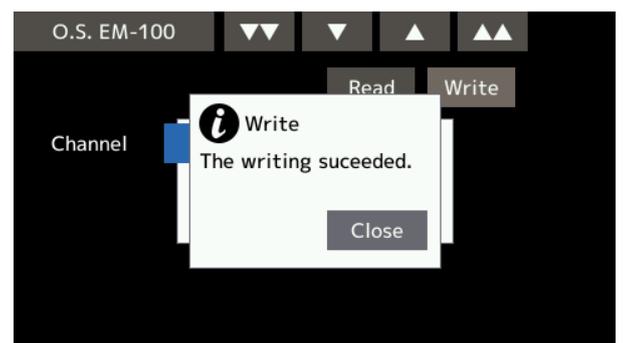
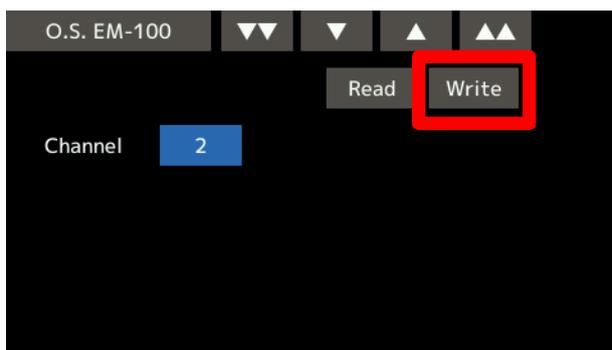
4. Tap the channel number to set a channel number.



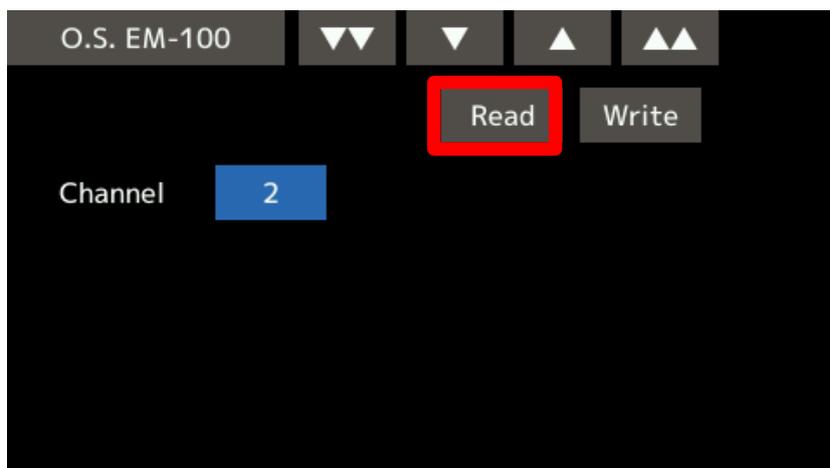
5. Select the channel number by tapping “▽” or “△” button.



6. Tap the [Write] button to memorize the setting.



7. Tap the [Read] button to read the setting data from EM-100.



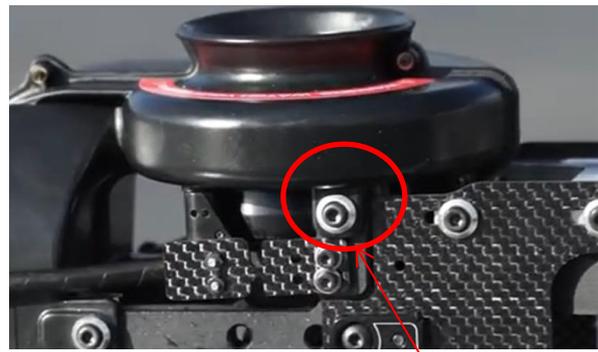
## 5.9 How to acquire the data

### 5.9.1 Measuring R.P.M.

EM-100 outputs the RPM data using SR-01, an optional Rotation sensor. It enables you to monitor the RPM in real time on an LCD display of the transmitter after making the telemetry setting at [O.S.EM-100]. FASSTest 18ch should be selected for system type to activate the telemetry system.



Rotation sensor



Rotation sensor (SR-01) (option)



Figure 8—Telemetry display screen

## 5.9.2 Measuring cylinder head temperature

EM-100 outputs the temperature data using ST-01, an optional temperature sensor, which enables you to monitor the temperature in real time on a LCD display of the transmitter.



Temperature sensor (ST-01) (option)



Figure9—Telemetry display screen

5.9.3 Measuring electric voltage/current

EM-100 outputs the voltage/current data using SV-01/SC-01, optional sensors, which enable you to monitor the voltage/current in real time on a LCD display of the transmitter.

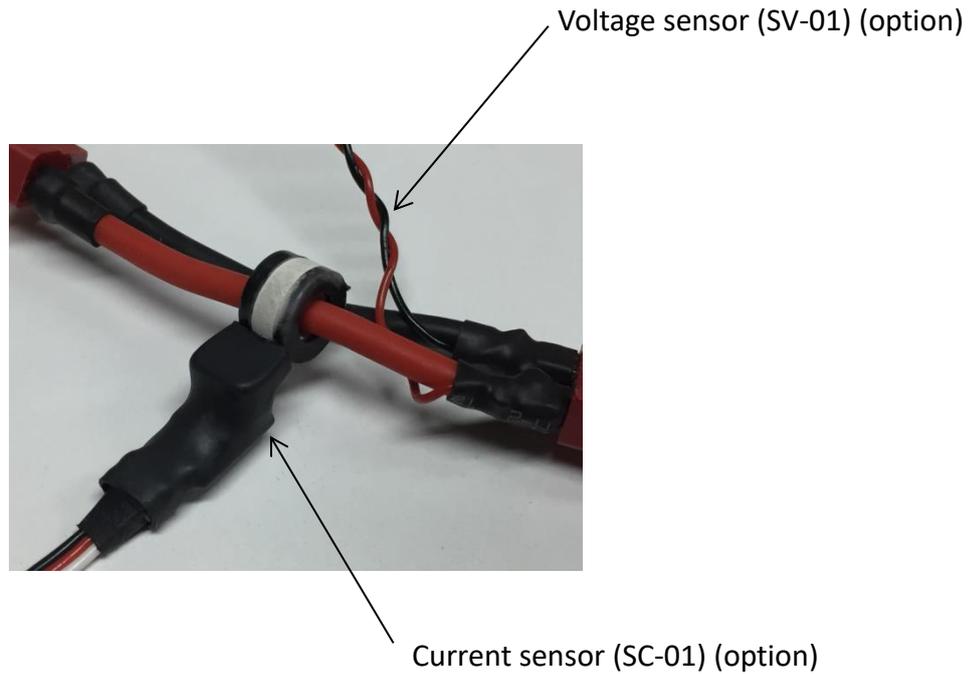


Figure10—Telemetry display screen

## 5.9.4 Measuring remaining fuel in a fuel tank

EM-100 outputs the remaining fuel data using SFL-01, an optional sensor, which enable you to monitor the remaining fuel in a fuel tank in real time on a LCD display of the transmitter.

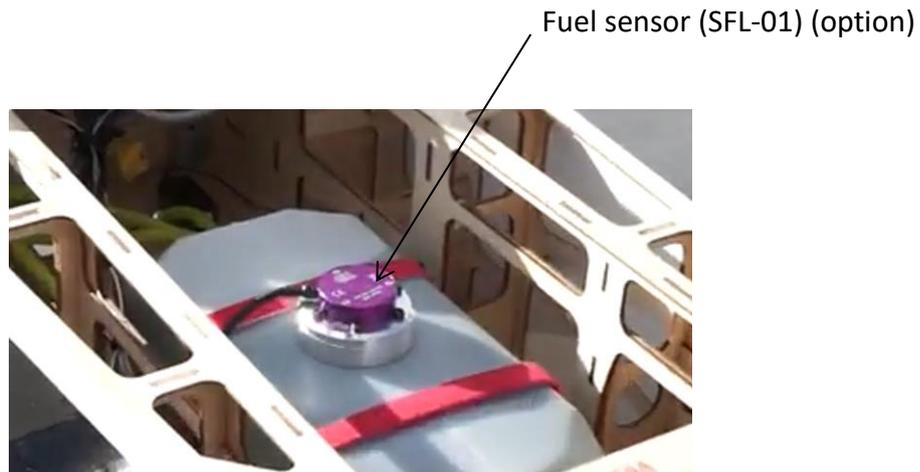


Figure11 – Telemetry display screen

5.9.5 Measuring altitude/atmospheric pressure

EM-100 outputs the altitude/atmospheric pressure data using a built-in atmospheric pressure sensor. The transmitter displays 0m at the point you turn it on and shows relative altitude on the LCD display. You can reset 0m on the transmitter.



Figure12—Telemetry display screen

### 6. Software Update

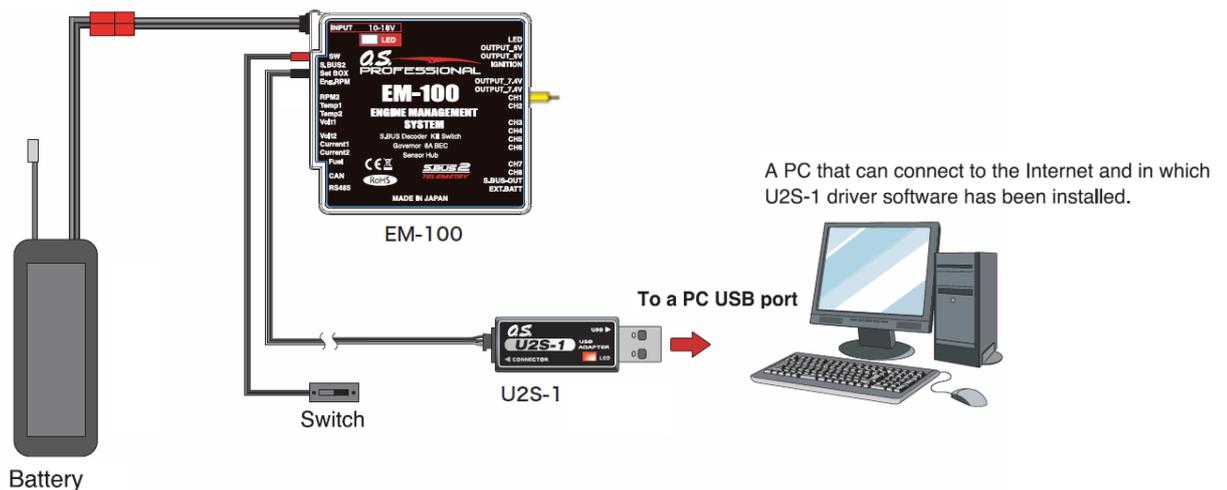
EM-100 can update the program. If there is a program change, O.S. ENGINES WEB site

Please download the update file from <http://www.os-engines.co.jp/dll/air> and update according to the following procedure.

#### ●Required

- ① EM-100 ② PC that can use the Internet ③ Battery for EM-100 (10-18V) ④ Switch ⑤ U2S-1 (sold separately)

#### ●Connection method



Update the EM-100 software using the following method. However, please download and install the U2S-1 driver software in advance so that the U2S-1 can operate on the PC.

#### [Connecting method]

1. As shown in the figure above, connect the U2S-1 unit to the USB port of your PC.
2. Connect the other end connector of U2S-1 to the Set BOX input port of EM-100.
3. Connect the short connector (yellow) to the CH1 port.
4. Connect the power supply to the EM-100.

#### [Update procedure]

1. Download the update software from the web. The downloaded file is a compressed file in zip format  
So unzip it using the windows app. The unzipped file has two files, EM-100.bin and Update.exe.
2. Supply power to the EM-100 with the short connector (yellow) on the CH1 port of the EM-100.  
EM-100 The LED turns red and green.
3. Double-click the Update.exe file on your PC to launch it. Confirmation box display whether to execute the update Appears, click the "Yes" button. The update will start.
4. The execution status will be displayed on the PC screen as a bar graph.  
The LED of EM-100 will also blink red.
5. It takes about 1 minute to write the program. When the writing is completed, the writing completion message is displayed from the PC. Also, the LED of EM-100 is lit green.
6. Turn off the power of EM-100. Turn off the CH1 port short connector (yellow) and then turn it on again.

7. Reference

7.1 CRC calculation processing C language sample · source code

```

#define NUM_TABLE      256
#define POLY_16_CCITT_LEFT      ((unsigned short)0x1021U)      /* X^16 + X^12 + X^5 + 1 */

/*=====
 * File scope global variable
 *=====*/
static unsigned short      g_pwTable[NUM_TABLE];

/*=====
 * Full Name      Initialize CRC 16 bit
 * Function      16bit Initialize CRC operation
 * Commentary    CCITT Left feed
 *
 * Return        None
 *=====*/
void InitCrc16(void)
/*=====*/
{
    unsigned short      wTmp;
    int                  i;
    int                  j;

    for (i = 0; i < NUM_TABLE; i++)
    {
        wTmp = (unsigned short) (i << (16 - 8));
        for (j = 0; j < 8; j++)
        {
            if ((wTmp & 0x8000U) != 0U)
            {
                wTmp = ((unsigned short) (wTmp << 1)) ^ POLY_16_CCITT_LEFT;
            }
            else
            {
                wTmp = (unsigned short) (wTmp << 1);
            }
        }
        g_pwTable[i] = wTmp & 0xFFFFU;
    }
}

/*=====
 * Full Name      Calculate CRC 16 bit
 * Function      16bit CRC calculation
 * Commentary    CCITT Left feed, initial value 0, no output value inversion
 *
 * Return        16bit CRC value
 *=====*/
unsigned short CalcCrc16(
    const unsigned char pbyBuffer[], /* IN : CRC Data to be calculated */
    int iBytes) /* IN : Number of bytes of data */
/*=====*/
{
    unsigned short      wWork;
    int                  i;

    wWork = 0U;

    for (i = 0; i < iBytes; i++)
    {
        wWork = (wWork << 8) ^ g_pwTable[(unsigned char) (wWork >> (16 - 8)) ^ pbyBuffer[i]];
    }

    return wWork;
}

```

List 1—16bit CRC calculation processing C language sample · source code

## 7.2 option parts

### EM-100 option parts

Code	Name	Remark
540660000000	SR-01	EM-100 rotation sensor (magnet type) 1pc
540690000000	SR-02	EM-100 rotation sensor (brushless motor) 1pc
540650000000	ST-01	EM-100 temperature sensor 1pc
540600000000	SV-01	EM-100 voltage sensor 1pc
540670000000	SC-01	EM-100 current sensor 1pc
540680000000	SFL-01	EM-100 fuel sensor 1pc
740010500000	U2S-1	EM-100 USB adapter 1pc

## 7. Reference

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### 7.3 When you need to repair

Read the instruction first before sending it to us for repair. Contact to our customer center to get detail repair instruction.

#### Information we need

Send a letter of specific descriptions about trouble situation with your product.

- product the trouble situation
- the transmitter and receiver, servo type
- aircraft (name of aircraft, how to equip it to the aircraft)
- product code and quantity
- address, name, telephone number

Contact to the OS engine serves when you need repair or after services.

Telephone available time : 9:00 ~ 12:00 • 13:00 ~ 17:00

***O.S. ENGINES*** MFG.CO.,LTD.

6-15 3-Chome Imagawa Higashisumiyoshi-ku

Osaka 546-0003, Japan TEL. (06)6702-0225

<http://www.os-engines.co.jp> FAX. (06)6704-2722