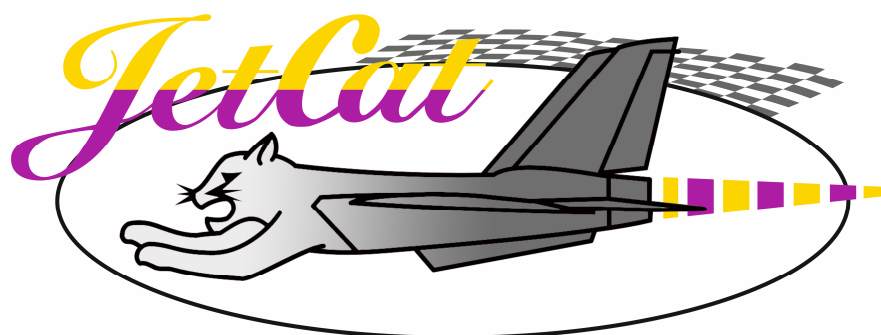


09/2016

Operating instructions



Telemetry Adapter V1-0



S.BUS2





HOT
HOBBY TELEMETRY TRANSMISSION

MSB
MULTIPLEX SENSOR BUS






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Safety notes, meaning of symbols

	<p>Attention!</p> <p>This symbol highlights the following information that require the compliance of the user! Any disregard for the adjacent instructions can impair the safety function as well as the safety of the user himself.</p>
	<p>Attention!</p> <p>This symbol highlights limitation that require compliance by the user! Any disregard for the adjacent limitations can impair the safety function as well as the safety of the user himself.</p>
	<p>This symbol highlights instructions, which should be strictly observed by the user to ensure safe operation of the unit.</p>
	<p>Attention!</p> <p>Risk of fire and explosion!</p>

Warnings and safety instructions

	<p>WARNING!</p> <p>Faults and defect during construction and or commissioning of the model can lead to injury or even have fatal consequences.</p>
	<p>ATTENTION!</p> <p>Before you start operating a model air plane, you have to learn about the relevant legal provisions. From a legal point of view, a flying model is an aircraft and is subject to the relevant laws which have to be observed. The brochure “Luftrecht für Modellflieger” (Air Traffic Law for Model Flyers) provides a summary of the German laws; it is also available from specialist retailers. For models with jet engines an ascent permit must be available; in addition there are insurance obligations. Postal regulations regarding radio control systems also have to be observed. The regulations of the respective countries also have to be adhered to.</p>
	<p>WARNING!</p> <p>The CAT JetCat model jet engines have been designed exclusively for model flying and are not suitable for any other purpose. Any other use is not permitted, except solely for model air plane flights since any other uses may lead to personal injury or death.</p>
	<p>WARNING!</p> <p>Any deviations from the instructions in this manual or of the respective manufacturer, the use of other parts or materials and changes to the design which may have a negative effect on the functioning and operational safety of the engine have to be avoided under all circumstances.</p>
	<p>Prior to starting a model, check all functions and all rudders and the reach of the remote control while the remote control system is switched on without the antennae being extended (or acc. to the remote control manufacturer requirements).</p> <p>This operating check has to be repeated with the engine running and with all accessories. The instructions for the radio control system also have to be observed.</p>

EXCLUSION OF LIABILITY AND DAMAGES

The adherence to the assembly and operating instructions in connection with the model and the model jet engine as well as the installation, operation, use and maintenance of components related to the model can **not** be supervised by CAT, M. Zipperer GmbH (hereinafter referred to as "JetCat"). JetCat and its employees therefore assumes no liability for losses, damages or costs resulting from the incorrect operation, erroneous behaviour or in any way with the above-mentioned. If not otherwise regulated by law, the liability of JetCat to pay damages due the use of the model, for whatever reasons, is excluded (incl. personal injury, death, damage to buildings and damage due to loss of sales or business loss from trading interruption or other indirect or direct consequential damages). The liability is regulated under all circumstances and in any case by the legal regulation of the service contract.

THE COMMISSIONING AND OPERATION OF THE MODEL AND/OR the ENGINE NEXT TO ITS ACCESSORIES TAKE PLACE AT THE SOLE RISK OF THE USER.

You affirm that JetCat cannot oversee and monitor that instructions for the setting up, operation, use of the model aircraft, model jet engine and use of the radio control are followed. On the part of JetCat, neither assurances, contractual agreements nor guarantees or other agreements have been made to persons or companies in terms of functionality and commissioning of the model and the model jet engine. In acquiring this model or model jet engine, you as user have relied on your own expert knowledge and your own powers of judgement.

Telemetry Adapter V1-0, description

The JetCat Telemetry Adapter allows the transmission of various ECU system values to the telemetry system of different providers.

Presently supported telemetry providers:

- Multiplex Sensor Bus (MSB v2) (M-Link Telemetry)
- HoTTv4
- Futaba S.Bus

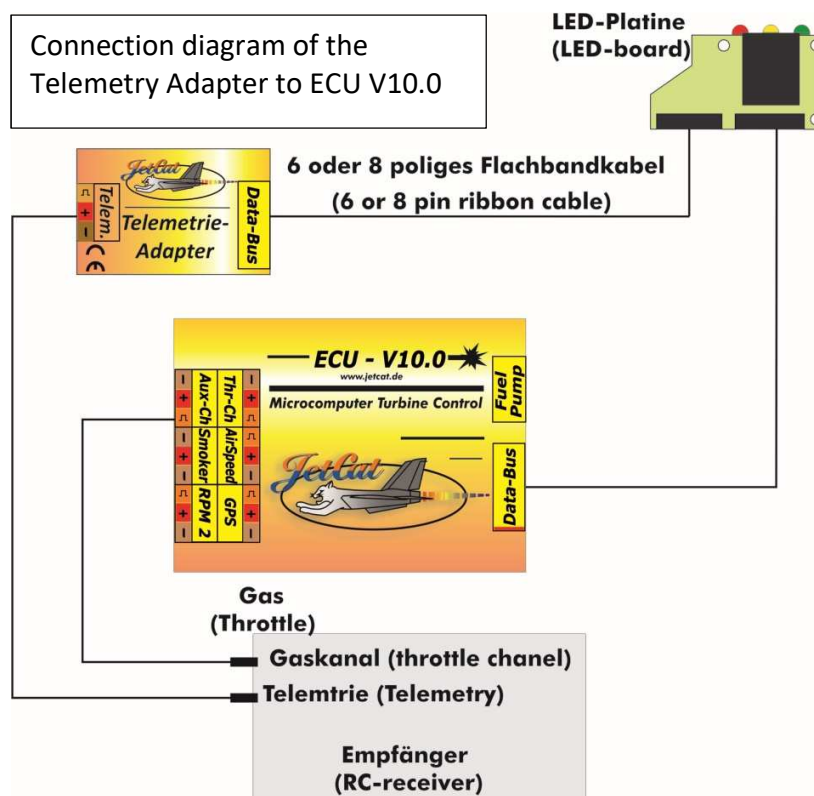
Functional principle

The JetCat Telemetry Adapter is connected directly to the ECU data bus.

The output of the Telemetry Adapter typically goes directly to the receiver (telemetry input of the receiver). The sensor has two parallel switched outputs for the second output to be able to be connected to another device or sensor.

The telemetry type (Multiplex MSB, Graupner/SJ HoTTv4, Futaba SBUS2) must be set in the engine ECU using the GSU through the Limits menu (described on Page 9).

The data transmitted by the Telemetry Adapter to the receiver will depend on the telemetry type selected.



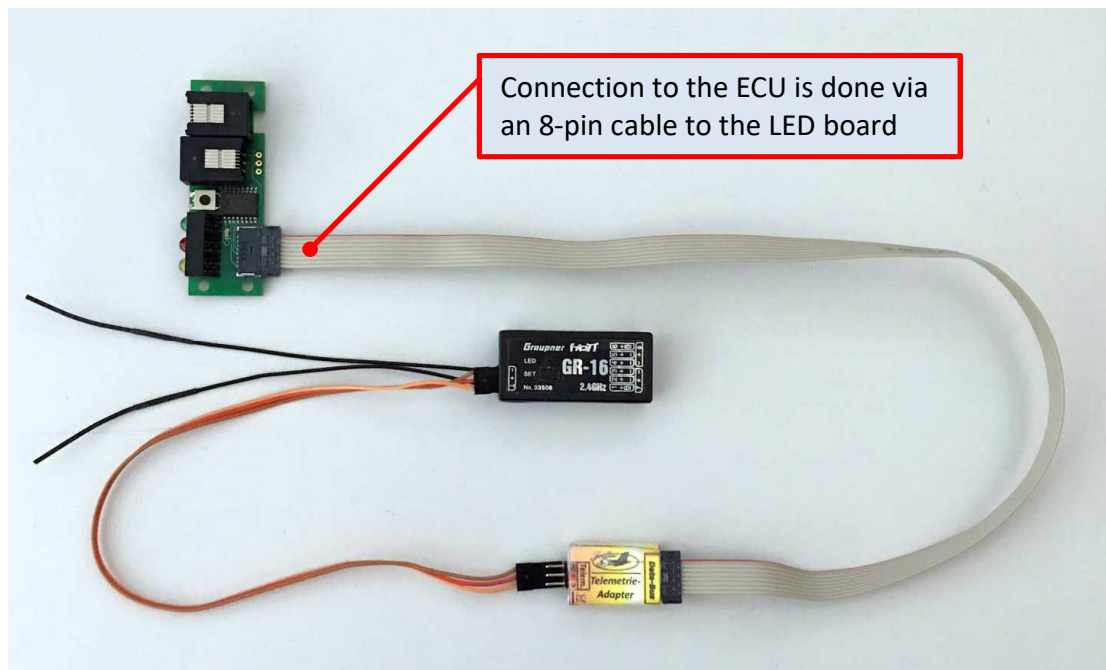
Connection of the Telemetry Adapter to the ECU

Connection to the ECU V6.0



The software version of the ECU V6 must be at least **V6.3S** or higher!

Connection diagram to the LED board of a V6-ECU:



Connection to the ECU V10

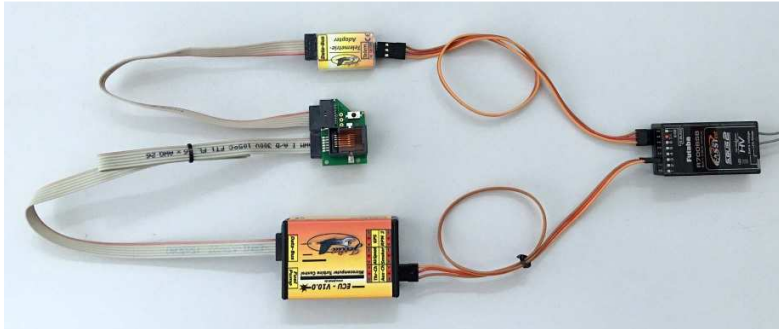


The software version of the ECU V10 must be at least **V10.3S** or higher!

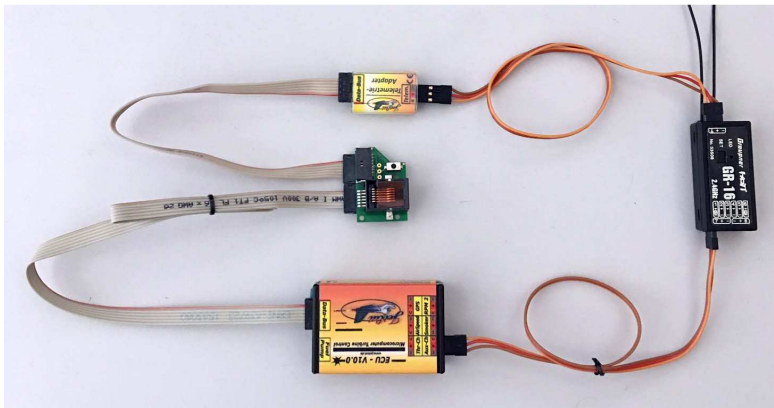
Connection to the ECU is done via a 6-pin cable.

Attention: Do not accidentally plug in the 6-pin cable into the 8-pin bus connector of the Telemetry Adapter!!!

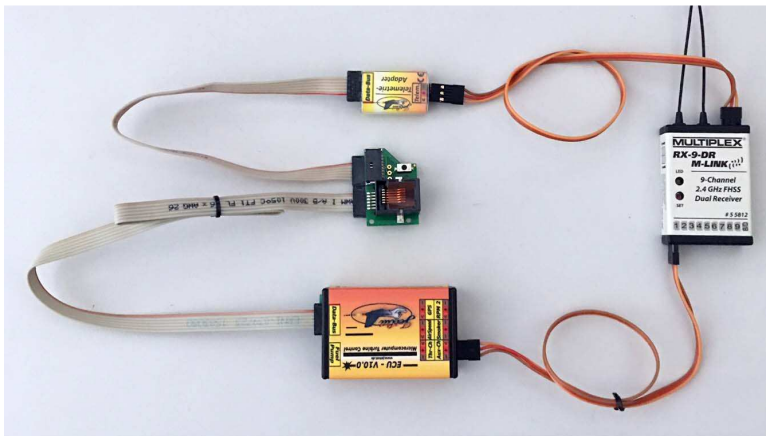
Connection to the Futaba S.BUS2 receiver



Connection to the Graupner HoTT receiver



Connection to the Multiplex MSB receiver



Setting the ECU to the desired telemetry provider/type

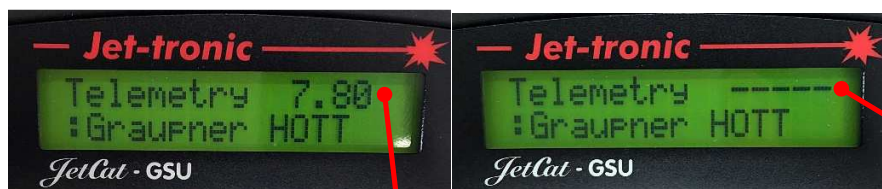
After the Telemetry Adapter is connected to the ECU, use the GSU to set the ECU to the desired telemetry type. (Please refer to previous connection diagrams for your specific radio and ECU).

Proceed as follows:

- With the system completely connected (ECU, engine and receiver).
- Switch off ECU (→ switch off receiver, if the display of the GSU is still active afterwards, press the “Set” and “Run” button on the GSU at the same time. This will switch off the ECU if it is in self holding mode.)
- Switch on ECU (→ switch on receiver power supply)
- After the ECU has booted up, press the “Limits” button on the GSU (→ Limits menu will open).
- Now, using the “+/-” keys of the GSU scroll through the Limits menu until the parameter “Telemetry” is displayed.
- Now, press and hold the “Change value” key on the GSU and using the +/- keys select one of the following options:

NOT USED	(Telemetry switched off / not used)
Futaba SBUS-2	(Futaba SBUS-2 Mode)
Graupner HOTT	(Graupner HOTTv4 Mode)
MPX M-Link1	(Multiplex Sensor Bus, MSB Mode, old transmitter)
Jeti	(Jeti Mode, presently not usable!!!)
MPX M-Link2	(Multiplex Sensor Bus, MSB Mode for new transmitter)

- Let go of the “Change value” key (→ Telemetry Type is saved).
- Now completely switch off the ECU and switch on again. This activates the newly set telemetry mode.



If correctly detected, the Telemetry Adapter version number will automatically be shown.
Here: V7.8 connected

If it is not detected, “-----” is shown!

Futaba S.BUS2 Mode

If Futaba S.BUS2 System is selected as the telemetry type, the JetCat telemetry sensor has to be registered as a new sensor in the transmitter. The JetCat Telemetry Adapter will occupy 14 of the 32 possible sensor slots (= time slot) of the SBUS2 system.

Proceed as follows:

Registering the JetCat Telemetry Adapter as new S.BUS2 sensor on the Futaba transmitter

(The output of the Telemetry Adapter has to be connected to the programming jack of the transmitter. Please refer T18MZ photo

First switch off the ECU by turning off the receiver!

To register the Telemetry Adapter as a new sensor, connect using one of two following methods:

Connections with transmitter method A

Power supply via the ECU

For this, the complete system must be wired with the ECU.

Only difference: The telemetry cable which usually goes to the receiver is being pulled and instead plugged into the programming jack of the transmitter. There must not be any other connection of this signal e.g. to a receiver!

After all connections have been provided, the receiver power supply can be switched on
→ The ECU switches on → the Telemetry Adapter is supplied with power via the Bus connection cable.

Connections with transmitter method B

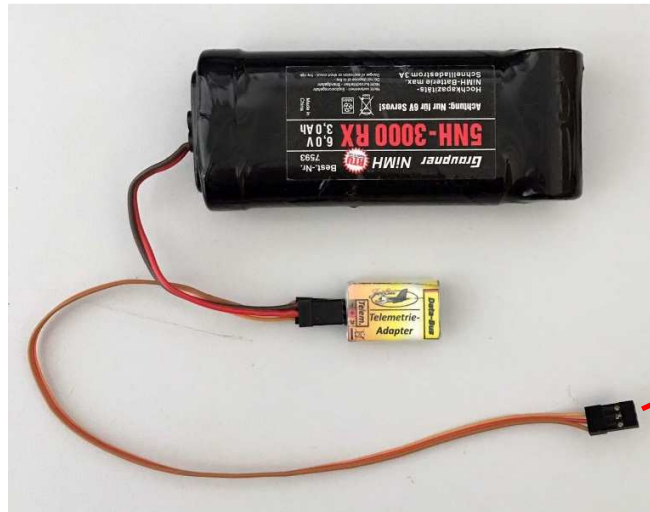
Power supply via separate battery (4.8-10 V)

For this, a suitable battery is connected to the second free output of the Telemetry Adapter, this supplies the adapter with the required operational voltage.

The telemetry cable usually connected to the receiver is plugged in the programming jack intended for the programming process on the transmitter.

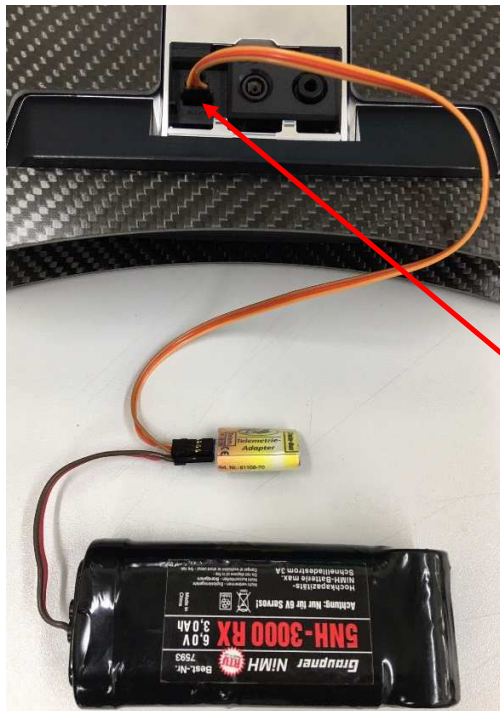
There must not be any other connection of this signal e.g. to a receiver!

The ribbon cable to the ECU system does not have to be plugged in.



To the programming jack on the transmitter

Register process using the T18MZ as an example

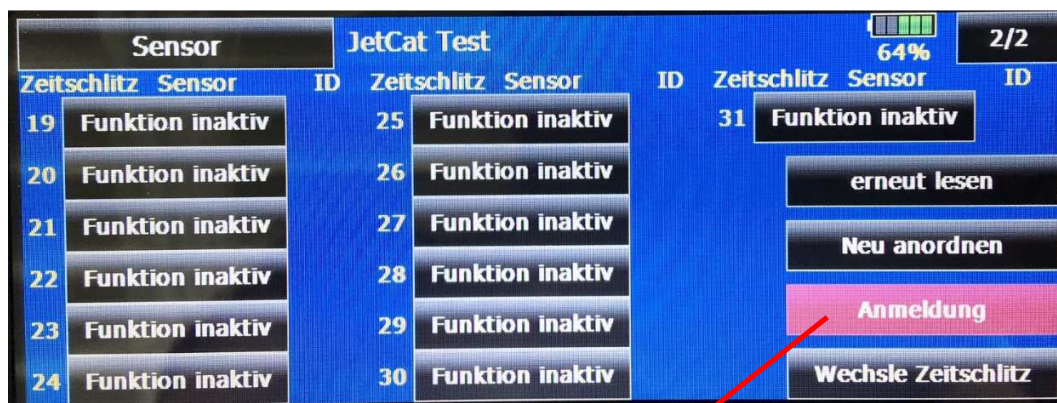


After the connections have been completed using either method A or B (see above), the registering of the sensor (Telemetry Adapter) via the transmitter can continue. In both cases, the telemetry cable which normally plugs into the receiver has to be plugged into the programming jack on the transmitter.

The photo to the left shows the required connection using method B (supply via separate battery) to the T18MZ transmitter.

Programming jack on the transmitter (bottom)

To register a new sensor, refer to the user manual of the Futaba transmitter, if required. Important: Install current software on the transmitter, on older software the JetCat sensor might not be supported!



Click here to start the registering process

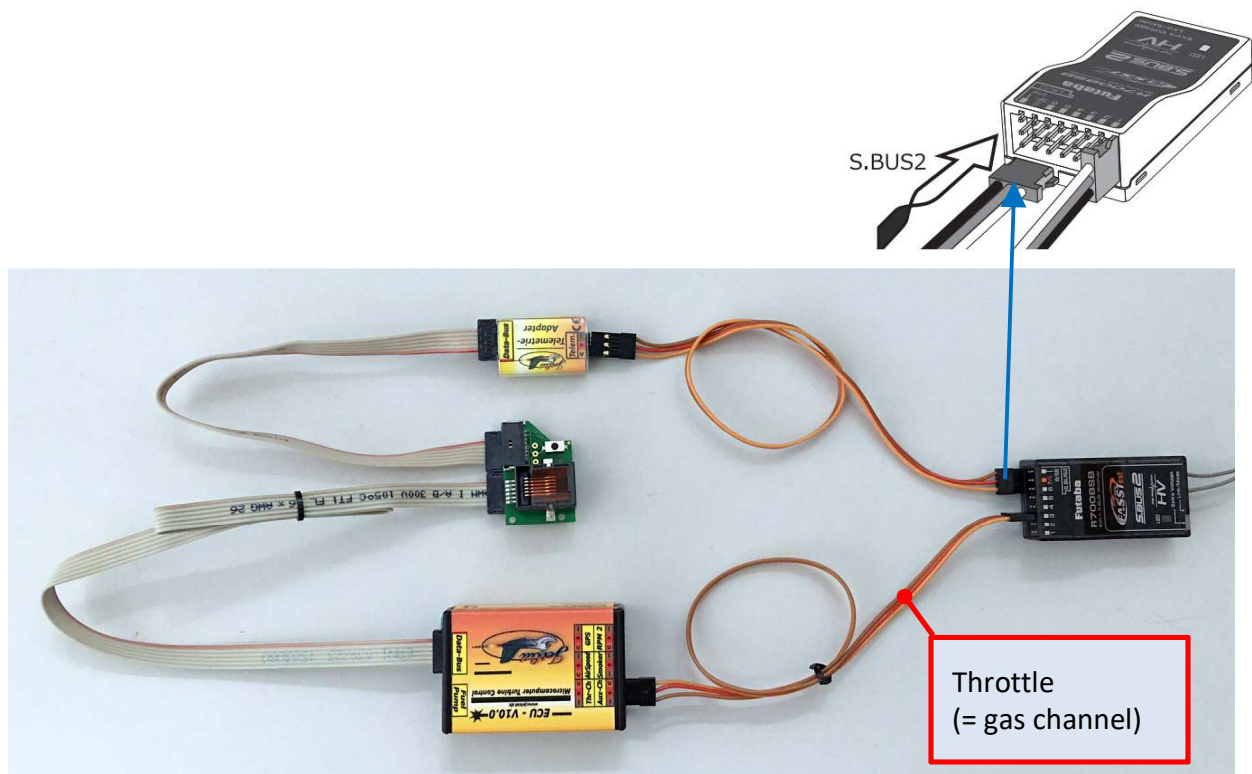
After successful registration the overview of the registered sensors looks something like this or similar:

Sensor			JetCat Test			65%			1/2
Zeitschlitz	Sensor	ID	Zeitschlitz	Sensor	ID	Zeitschlitz	Sensor	ID	
1	JetCat V10	815	7	JetCat V10		13	JetCat V10		
2	JetCat V10		8	JetCat V10		14	JetCat V10		
3	JetCat V10		9	JetCat V10		15	Funktion inaktiv		
4	JetCat V10		10	JetCat V10		16	Funktion inaktiv		
5	JetCat V10		11	JetCat V10		17	Funktion inaktiv		
6	JetCat V10		12	JetCat V10		18	Funktion inaktiv		

As can be seen, in total 14 time slots are occupied.

Connection of the JetCat Telemetry Adapter to the S.BUS2 of the Futaba receiver

After the JetCat Telemetry Adapter has been successfully registered as a new sensor on the transmitter, it can now be connected with the Futaba receiver:



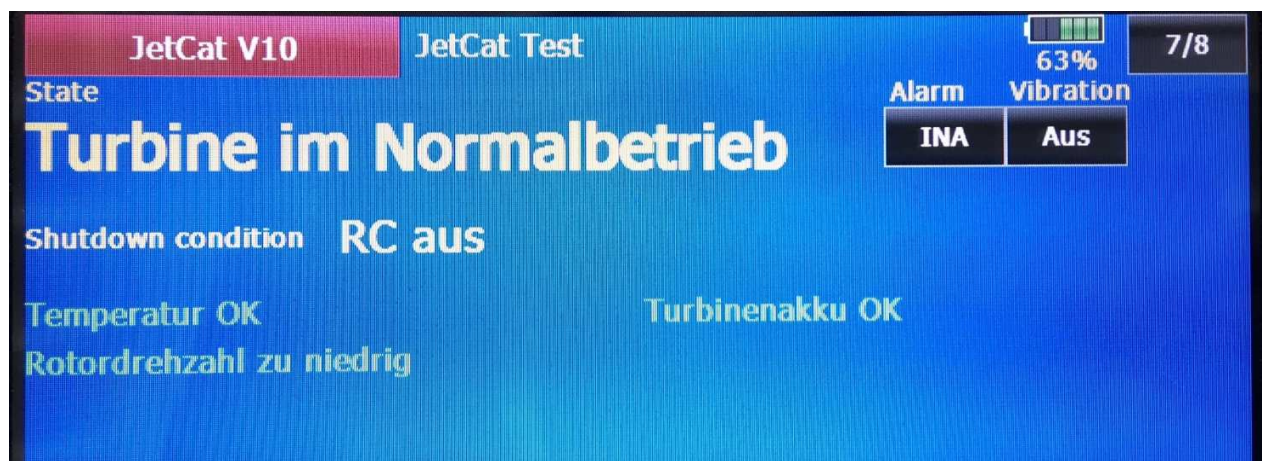
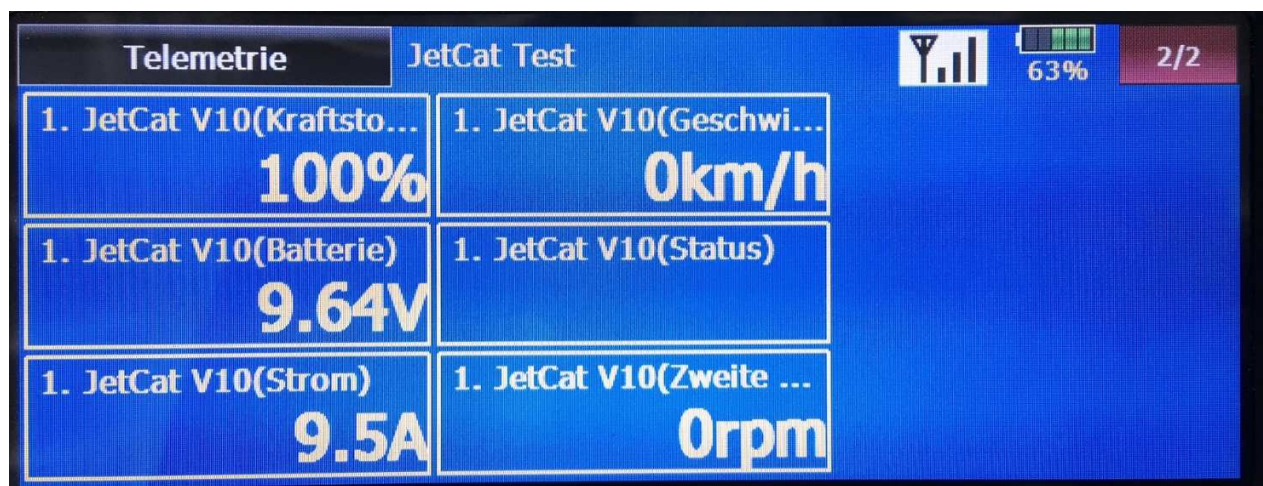
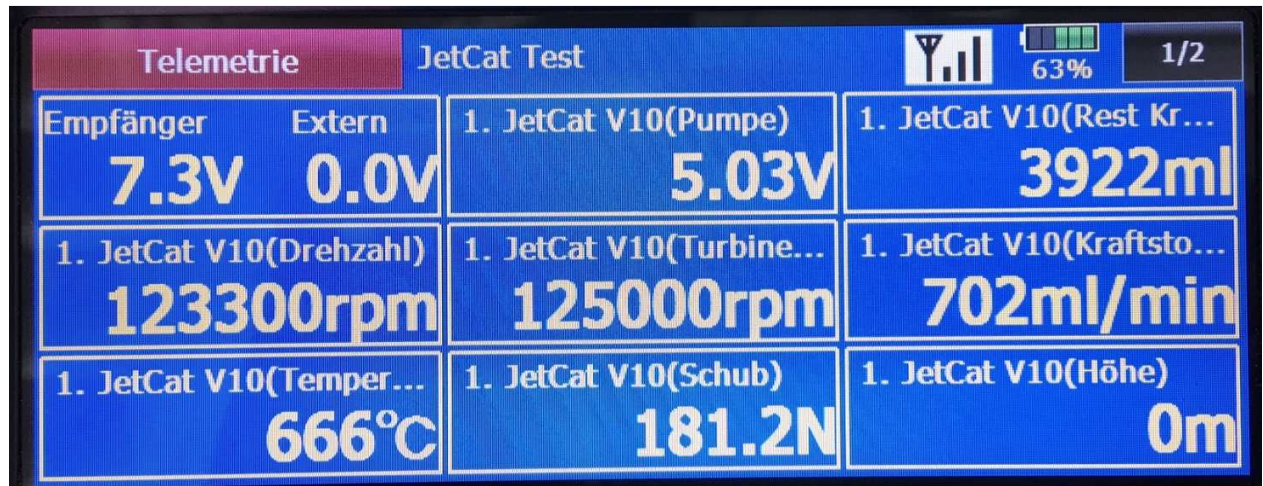
Transmitted data (Futaba S.BUS2 mode)

The JetCat telemetry sensor sends the following values/information to the S.BUS2 telemetry system:

Value/designation	Remarks
Engine actual speed in rpm	
EGT, Exhaust gas temperature in °C	
Pump voltage in V	
Engine set speed in rpm	
Thrust in N	
Remaining fuel in ml	
Fuel consumption in ml/min	
Flying height in m	Only on ECU V10.0 or higher, otherwise 0
Fuel quality	Only on P90-RXi /P140-RXi /P180-RXi
Voltage of engine battery in V	
Current consumption	Only on ECU V10.0 or higher, otherwise 0
Airspeed in km/h	Only with the connected Airspeed sensor, otherwise 0
Engine state and error codes	
Speed of 2nd shaft	Only on 2-shaft or helicopter engines

Example representation of JetCat telemetry values in the Futaba transmitter T18MZ

For this, open the telemetry menu of the transmitter...



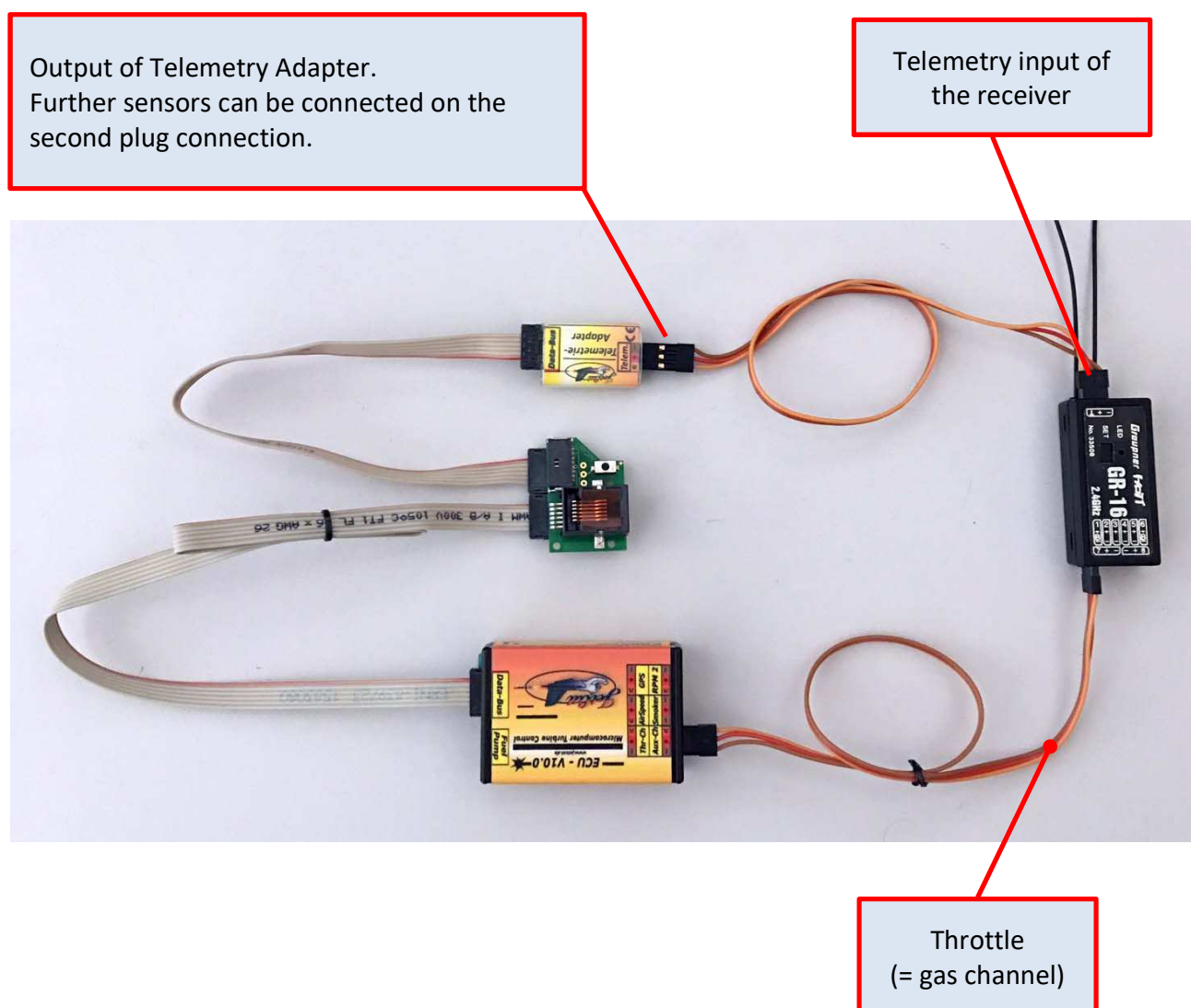


Graupner HoTT Mode

After the Graupner HoTT mode is selected as the telemetry type, the JetCat Telemetry Adapter can be connected to a suitable Graupner HoTT receiver.

The JetCat Telemetry Adapter logs on to the transmitter as “GAM module” (General Air Module). Here, only the so-called graphic mode of GAM sensor type is used at the moment.

Connection of the JetCat Telemetry Adapter to a Graupner HoTT receiver



Transmitted data (Graupner HoTT mode)

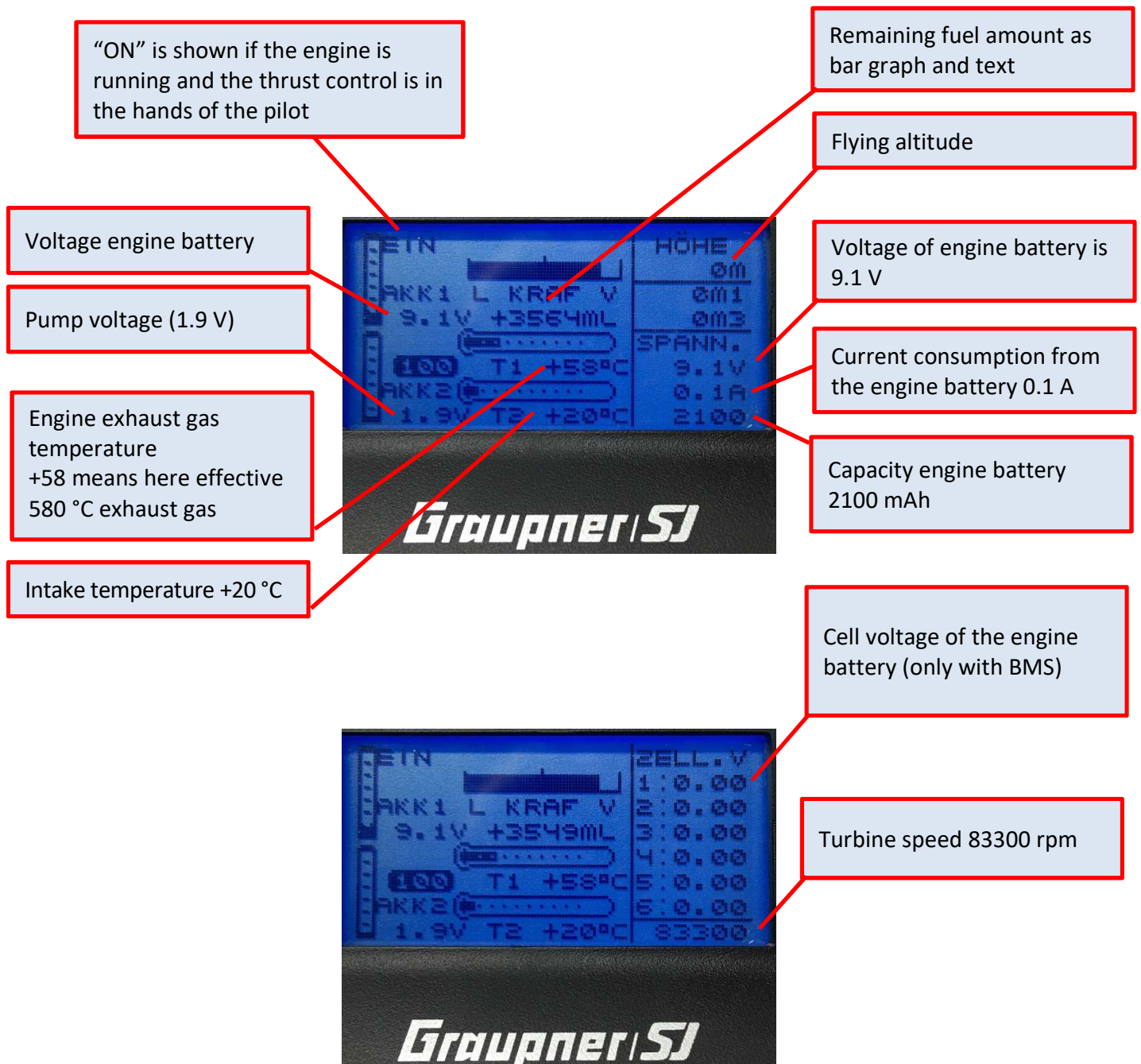
The JetCat Telemetry Adapter logs on to the transmitter as “GAM module” (General Engine Module).

The following values/information is transmitted to the HoTT telemetry system:

Value/designation	Remarks
Cell voltage 1-3 of the engine battery	Only on engines with connected BMS (=Battery Management System), otherwise display of 0
Voltage of engine battery in V	
Pump voltage in V	
EGT, Exhaust gas temperature in °C	On temperatures below 220 °C the value in the display of the transmitter is shown “unaltered”. On real measurement values over 220 °C, the displayed value is shown divided by a factor of 10. The reason for this is that from the HoTT protocol unfortunately only values between -20 and + 235 °C are possible for temperature values. To be able to show values above this range this “trick” has been resorted too. In practice, this means the following: If the engine is switched off, the temperature is displayed correctly (because the temperature will probably always be below 220 °C). When the engine is running, the value displayed must be multiplied by 10 to obtain the real temperature (for example, a display of 48 °C then means effectively 480 °C exhaust gas temperature)
Ambient temperature in °C	Temperature at front on the engine housing
Remaining fuel in %	0—100 %
Remaining fuel in ml	
Engine actual speed in rpm	
Flying height in m	Only on ECU V10.0 or higher, otherwise 0
Current consumption	Only on ECU V10.0 or higher, otherwise 0
Engine battery capacity in mAh	Will be updated only in engines with generator function, otherwise e.g. 2100 mAh
Airspeed in km/h	Only with the connected Airspeed sensor, otherwise 0
Speed of 2nd shaft	Only on 2-shaft or helicopter engines, otherwise 0; Will be transmitted but unfortunately is presently not shown by the transmitter software!

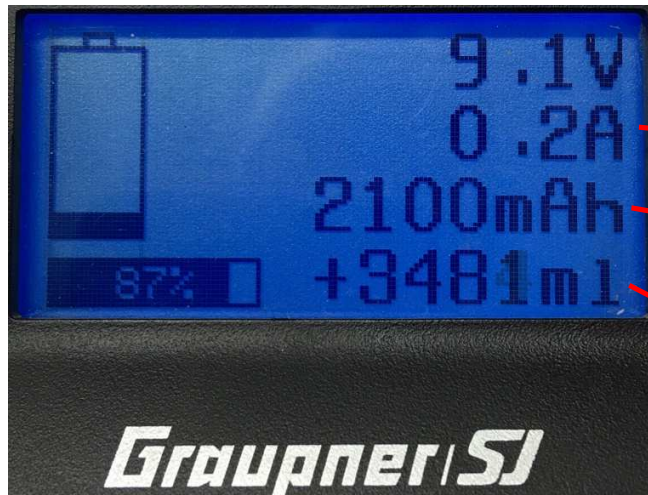
Example representation of JetCat telemetry values in the Graupner MC32 transmitter T18MZ

As already explained, the JetCat Telemetry Adapter simulates a Hott General Engine Module. This produces the following images in the transmitter display showing the graphical telemetry data. The JetCat Telemetry Adapter uses this fixed predetermined Graupner display screens to visualize the operating data of a JetCat engine.



Voltage engine battery
ins9.1 V

Capacity engine battery
2100 mAh



Voltage engine battery is
9.1 V

Current consumption from
the engine battery is 0.2 A

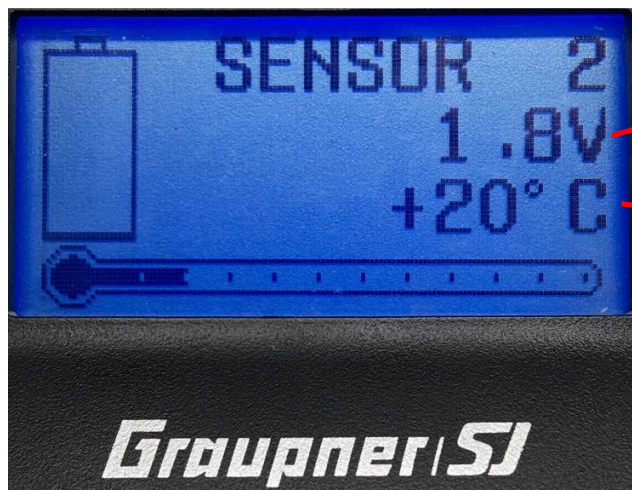
Capacity of engine battery
2100 mAh

Remaining fuel amount as
bar graph and text



Voltage of engine battery is
9.1 V

Exhaust gas temperature
580 °C



Pump voltage 1.8 V

Intake temperature +20 °C



Engine speed: 96200 rpm

Maximum measured engine speed: 124700 rpm

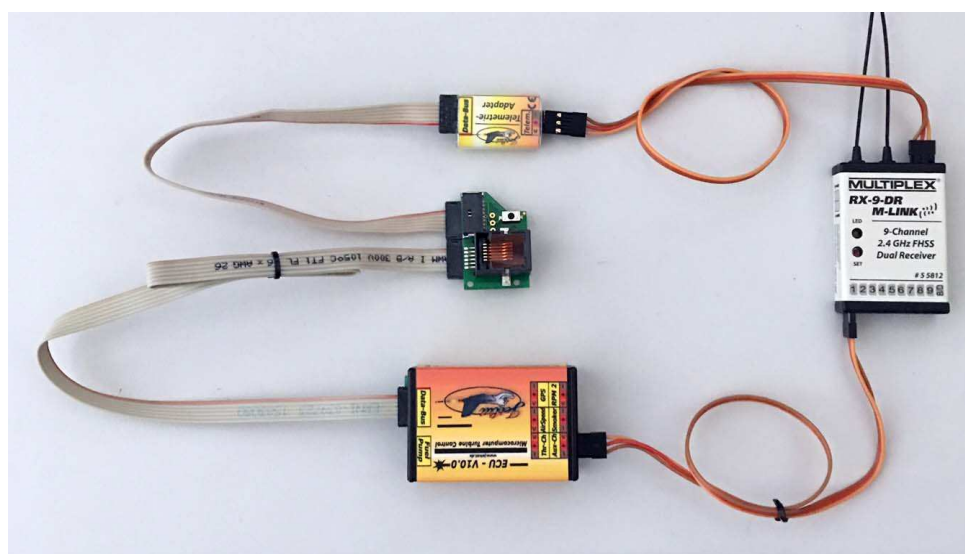


Measured flight speed via air pressure sensor (AirSpeed Sensor) 268 km/h

Multiplex Sensor Bus, MSB Mode

Connection of the JetCat Telemetry Adapter to a Multiplex MSB receiver

The output of the Telemetry Adapter is connected with the telemetry input of the receiver. More MSB sensors can be connected on the second (parallel) outputs of the Telemetry Adapter. In this case, it should be noted that the JetCat Telemetry Adapter already occupies fixed the addresses 3 to 14/15!



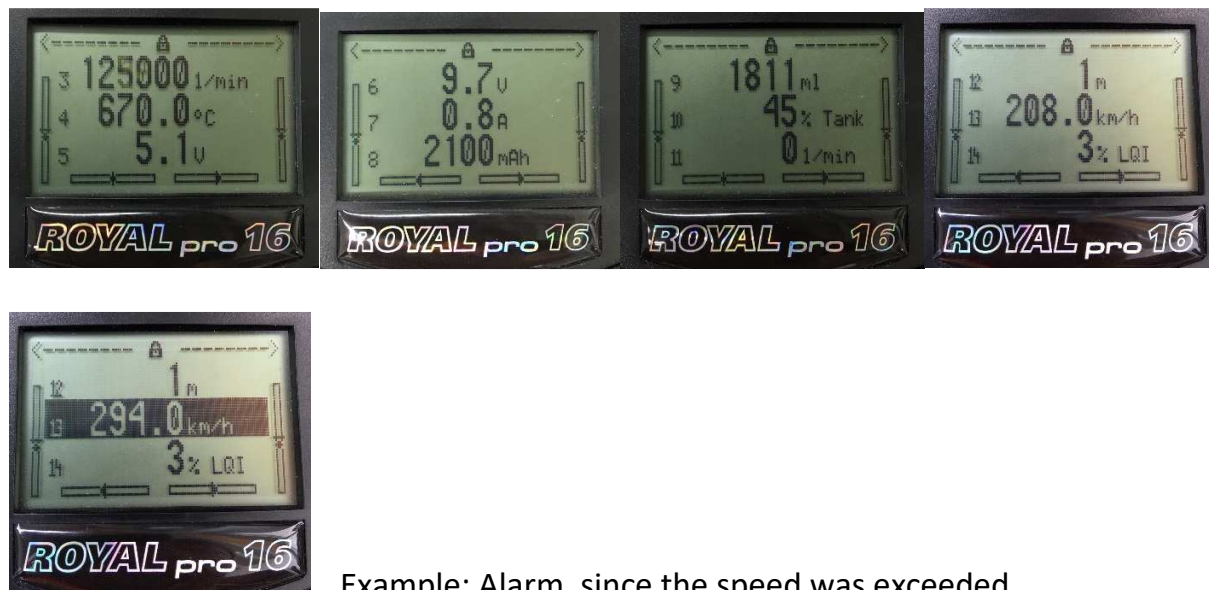
Data transmitted (Multiplexed MSB mode "MPX M-Link1" for older transmitters)

At the moment the following fixed MSB addresses and values assignments are used/occupied:

Address	Value/designation	Remarks
3	Engines actual speed in rpm	
4	EGT, Exhaust gas temperature in °C	
5	Pump voltage in V	
6	Engine battery voltage in V	An alarm is initiated during under-voltage
7	Current consumption	
8	Battery capacity in mAh (engine battery)	Will be updated only in engines with generator function, otherwise display fixed on e.g. 2100 mAh
9	Remaining fuel in ml	An alarm is initiated once the calculated remaining fuel amount drops under the value programmed in the ECUs Limits menu under "Low Fuel Limit".
10	Remaining fuel in %	An alarm is initiated once the calculated remaining fuel amount drops under the value programmed in the ECUs Limits menu under "Low Fuel Limit".

11	Speed of 2nd shaft	Only on 2-shaft or helicopter engines An alarm is issued once the sensor of the second shaft has a fault
12	Flying height in m	Only on ECU V10.0 or higher
13	Airspeed in km/h	Only if the connected Airspeed sensor is active, otherwise 0. An alarm is initiated once the measured speed exceeds the value programmed in the ECUs Limits menu under "Max.AirSpeed".
14	Internal engine state 0-3 0: OFF 1: Starting/cranking 2: At idle, it is waited that the stick is moved to idle. 3: Normal operation	This value is shown as % LQI since the multiplex system currently does not allow for clear text display. An alarm is initiated once the engine enters into state "0" = OFF.

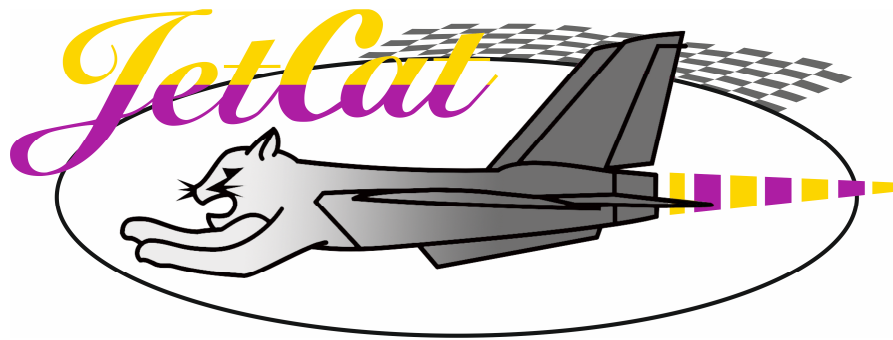
Example views of telemetry values in the Multiplex transmitter



Data transmitted (Multiplexed MSB mode “MPX M-Link2” for newer transmitters)

At the moment the following fixed MSB addresses and values assignments are used/occupied:

Address	Value/designation	Remarks
3	Engines actual speed in rpm	
4	EGT, Exhaust gas temperature in °C	
5	Pump voltage in V	
6	Engine battery voltage in V	An alarm is initiated during under voltage
7	Current consumption	
8	Battery capacity in mAh (engine battery)	Will be updated only in engines with generator function, otherwise display fixed on e.g. 2100 mAh
9	Remaining fuel in ml	An alarm is initiated once the calculated remaining fuel amount drops under the value programmed in the ECUs Limits menu under “Low Fuel Limit”.
10	Remaining fuel in %	An alarm is initiated once the calculated remaining fuel amount drops under the value programmed in the ECUs Limits menu under “Low Fuel Limit”.
11	Speed of 2nd shaft	Only on 2-shaft or helicopter engines An alarm is issued once the sensor of the second shaft has a fault
12	Flying height in m	Only on ECU V10.0 or higher
13	Airspeed in km/h	Only if the connected Airspeed sensor is active, otherwise 0. An alarm is initiated once the measured speed exceeds the value programmed in the ECUs Limits menu under “Max.AirSpeed”.
14	Internal engine state	Display in clear text in the telemetry display An alarm is initiated once the engines enters into state “0” = OFF.
15	Last reason for switching off	Display in clear text in the telemetry display



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