JetCat Serial Interface description

Content

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Change Log

05.03.19 **V12.01T or higher**
SVC command (smoker valve control) changed, added functionality

Serial interface of the JetCat ECU, PRO engines

The serial interface (RS232) of the JETCAT ECU facilitates remote access of all controller functions as well as readout and change of all system parameters

A special daisy chaining feature facilitates chaining multiple ECU's via their serial interfaces only through one PC-interface (RS232)

To set-up a daisy-chain, the transmit line (TxD) of the PC is connected to the receive line (RxD) of the first ECU. The transmit line of this ECU is then connected to the receive line of the next ECU in the chain. The transmit line of the last ECU in the chain is returned to the receive line of the PC, which closes the link and forms the ring connection.
To address a specific controller in a daisy-chain, each controller carries a so called SlaveAdress, which can be any number from 1 to 255 (default setting: 1).

Parameters of the serial interface:

baud rate:	4800-115000 baud	(9600 default)
data bits:	8	
parity:	none	
stop bits:	1	
default slave address:	1	

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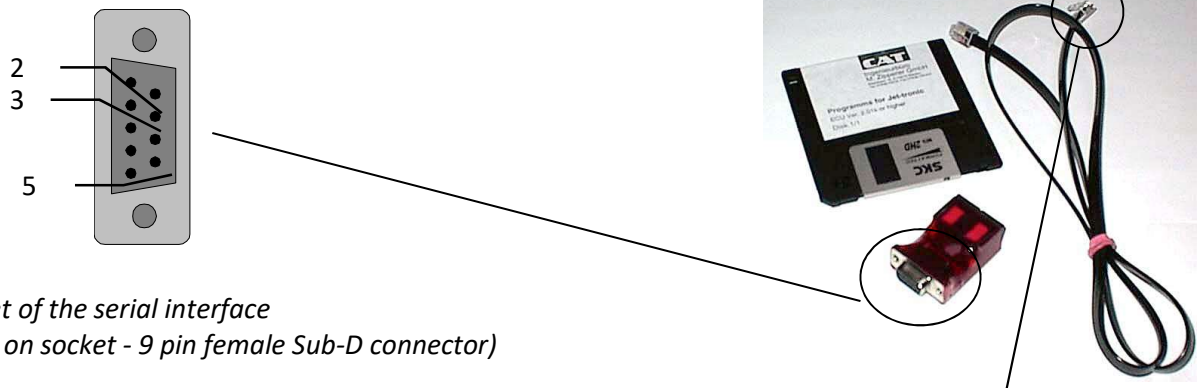
Connection between PC and the JetCat ECU:

Pinout of the 9-pin SUB-D female connector of the JetCat RS232 adapter:

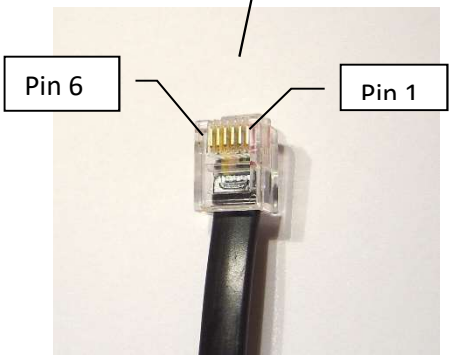
Pin	Description
2	transmit data TxD, (RS232 signal level)
3	receive data RxD, (RS232 signal level)
5	Signal ground , GND



Socket of the serial interface
(view on socket - 9 pin female Sub-D connector)

For connection to a PC-RS232 port, a standard 9-pin prolongation cable may be used (1 to 1 connection, pins not crossed !).

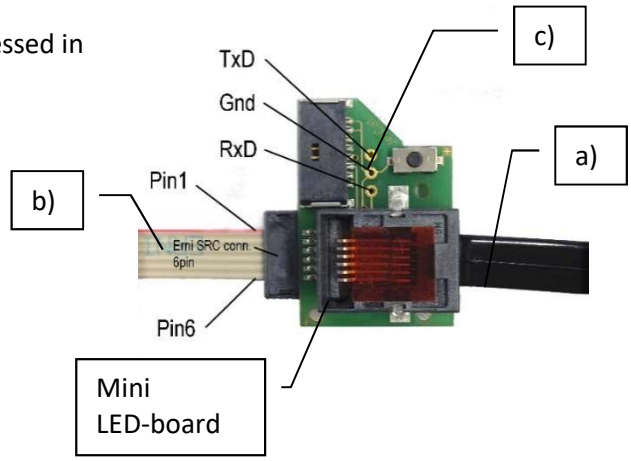
"Phone" type connector (RJ45) and Erni 6pin SRC pinout:



Pin	Description
1	transmit data TxD, 3,3V level
2	+5V output, max. 60mA
3	Data Bus-C (do not connect !!!)
4	Data Bus-D (do not connect !!!)
5	Signal ground , GND
6	receive data RxD, 3,3V level

The serial interface of the ECU (TTL-level) can be accessed in 3 ways:

a) RJ45 connector (pin 1,5,6)
b) 6-pin ERNI SRC connector (pin 1,5,6)
c) 3-pin "solder joint" outlet



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Format of a RS232-Command:

ADR , CMDCODE , PARAMETERLIST <CR>

Description:

ADR: Slave Address of the desired ECU (0-255 allowed, 1 is default)

CMDCODE: Command-code

PARAMETERLIST: 1 to 7 parameters separated by commas (,)

CR: The command string must be terminated by Carriage/Return (ASCII 13)

Format of the Controller Handshake

After receiving an RS232-command the ECU will :

1. Send the received command to the next controller (or back to the PC - daisy chaining)
2. Answer with a handshake string, which is defined as follows:

ADR,"HS",RETCODE,PARAMETERLIST <CR>

Explanation:

ADR: Slave Address of the Controller sending the handshake
RETCODE: Error code (see Table 1 below)
PARAMETERLIST: 1 to 6 parameters, each parameter is separated by a colon ","
CR The handshake as any command, is terminated by ASCII-code 13 (CR)

Table 1: Error codes

Return Code	Explanation	Parameterlist
OK	command executed, no error	Up to 6 parameters
UC	unknown command	none
PA	wrong parameter number (too few or too many parameters specified)	none
NA	command is not allowed in actual operation mode	1. actual turbine state
PR	at least one parameter is out of range	none
PL	at least one parameter is too long	none
DF	unknown data format	none

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ECU RS232-commands

CMD. CODE	Explanation	Parameter list	Range
RAC	Read actual values	1. Dummy parameter to initiate transfer → ECU sends in handshake: 1. Turbine RPM 2. EGT °C 3. Pump voltage 4. Turbine State 5. Throttle position in % 6. Engine current in Amps (V10.2Z or higher only)	1 0..200000 -20..1400 0..7 0.. (see table) 0..100 0..40
RGV	Read generator values (currents/voltages)	V12.01K or higher; only engines with generator 1. Dummy parameter to initiate transfer → ECU sends in handshake: 1. Engine current (current consumed by engine: ECU/pumps/valves etc) 2. Generator output current 3. Charge/supply current into battery/external equipment. This is the current flowing in the engine supply leads. Negative numbers indicate that current is taken out of the supply battery, positive numbers indicate that currents are flowing from engine into battery/external equipment. 4. Generator DC output voltage (before DC/DC regulator)	 1 0…+62.50A 0…+40.00A -62.50…+40.00A 0.. 60.00V
DHC	Do health check	V12.01K or higher only 1. Dummy parameter to initiate transfer → ECU sends in handshake: 1. Status of health check 0: Health check cannot be performed at this time (e.g. engine running) 1: Health check in progress Health checking will take about 3-8 seconds to complete. If engine start is issued while health checking is in progress, health checking will be aborted, and engine start performed.	 0..1
RHC	Read health check results	1. Dummy parameter to initiate transfer → ECU sends in handshake: 1. Starter health flag 2. Main valve health flag 3. Starter valve health flag 4. Rpm Sensor health flag 5. Pump health flag 6. Glowplug health flag 7. EGT sensor health flag See table 5 (page: 13) for explanation of return codes	1 0.. 16 0.. 16 0.. 16 0.. 16 0.. 16 0.. 16 0.. 16
RAD	Read AD-Converter value	1. Channel # → ECU sends in handshake: 1. AD-value of selected AD input.	0..7 0… 1023

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RSS	**Read system status**	**1. Dummy parameter to initiate transfer** **→ ECU sends in handshake:** **1. Dummy parameter (allways read as 1)** **2. Off-Condition** **3. Actual FlightSpeed** **4. Proportional part of Speed regulator** **5. AD-value of AirSpeed input** **6. AD-Zero value of AirSpeed input**	**1** **1** **0..17 (see Table)** **0… 500 km/h** **0.. 1023** **0..1023**
RTY	**Read Information**	**1. Dummy parameter to initiate transfer** **→ ECU sends in handshake:** **1. firmware version type** **2. Version no.** **3. LastRun Time** **4. Total Operation time** **5. Serial No** **6. Turbine type**	**1**
RS1	**Read Rpm Information of second shaft** **ONLY FOR TWO SHAFT ENGINES !**	**1. Dummy parameter to initiate transfer** **→ ECU sends in handshake:** **1. Set Rpm of second shaft** **2. Real Rpm of second shaft** **3. Output Rpm after gearbox** **4. GearRatio Turbine to Rotor** **5. GearRatio Tail to Rotor** **Parameter 4&5 only available on software version V6.00U or higher**	 **0… 80000** **0… 80000** **0… 80000** **0… 200** **0… 20**
WBD	**Set Baudrate** **To activate system with new Baudrate → main power off/on of the system is required !** **Before power-off issue WEE,2 command to store changed Baudrate to EEPROM !!!**	**Code for Baudrate** **0: 2400** **1: 2400** **2: 4800** **3: 9600** **4: 19200** **5: 38K4** **6: 38K4 (only ECU V10.0 and higher)** **7: 57K6 (only ECU V10.0 and higher)** **8: 115K2 (only ECU V10.0 and higher)**	**0..8**
WDF	**Set EEPROM to default**	**1. Security parameter** **2. Reset action code (1→ Full reset, 2 → everything but temp. & RC calibration)**	**1234** **1,2**
WEE	**Store Settings to EEPROM**	**1. Identifier: (2→ Setup data, 123 → calibration data, 103→Log data**	**1234**
WSA	**Set RS232 slave-address,** **+ renumber slaves**	**1. New slave-address of ECU**	**1...255**
RA1	**Read**	**1. Dummy parameter to initiate transfer** **→ ECU sends in handshake:** **1. Off Condition** **2. Ambient temp.** **3. Min Pump Voltage** **4. Max Pump Voltage**	 **0.. 22 (see table)** **-20… 70** **0… 7** **0…7**
RI1	**Read Statistic info**	**1. Dummy parameter to initiate transfer** **→ ECU sends in handshake:** **1. Run´s OK** **2. Starts failed** **3. Total Operation time** **4. Last Run Time** **5. System Time**	
WTH	**Write throttle value**	**Pulse width value**	**100…3000**

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WAU	**Write AUX value**	**Pulse width value**	**100…3000**
KEN	**Enable / disable GSU keyboard**	**1. Control parameter (0→ disabled, 1→ enabled)**	**0, 1**
RSY	**Read System values**	**1. Dummy parameter to initiate transfer → ECU sends in handshake 1. TE-AD 2. KTY-AD 3. Batt-AD 4. Speed-AD 5. Thr-Plus Len 6. Aux-PulsLen**	** 0…1023 0…1023 0…1023 0…1023 100…3000 100…3000**
WSM	**Set Serial (RS232) control mode If activated Throttle&Aux PWM values will be taken only via RS232, not the physical PWM inputs**	**1. Serial control ON/OFF 0: OFF 1: ON**	**0,1**
RFI	**Read fuel info**	**1. Dummy parameter to initiate transfer → ECU sends in handshake 1. Actual fuel flow 2. Rest volume in tank 3. Set RPM 4. Actual Battery voltage (V) 5. Last Run time (s) 6. Fuel consumed on actual run**	** 0 … 10000ml/min 0… 1000000ml 0… 250000 0… 15V 0… 65535 s 0…1000000ml**
RAI	**Read airspeed info**	**1. Dummy parameter to initiate transfer → ECU sends in handshake 1. Actual flight speed 2. Set Air Speed 3. Flight Distance 4. Max Airspeed 5. Average AirSpeed**	
RRC	**Read RC Data info**	**1. Dummy parameter to initiate transfer → ECU sends in handshake 1. Thr Pos % 2. Thr Pulse length 3. AUX Pos % 4. AUX Pulse len 5. Fail Safe counts 6. Fail Safe time**	** 0.. 100% 0… 3000us 0.. 100% 0.. 3000 us 0.. 65535 0. 10000 s**
TCO	**Turbine control**	**1. control parameter 0: Shut down turbine 1: Start turbine, and activate RS232 Rpm control. In case engine should already run or being started when the command is issued, command is ignored. 2: Switch from RS232-control to RC-control. (=use PWM inputs for setpoint control). 3: Switch from RC (=PWM) to RS232-Control**	**0,1,2,3**
WRP	**Set turbine RPM**	**1. Turbine RPM**	
WPE	**Set Turbine thrust in% (ECU V5.00c or higher required)**	**1. Thrust in % 0% is equal to idle RPM 100% is equal to max. RPM**	**0..100**

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WR2	**Set 2nd Shaft rpm, and engage rpm govenor for sencond shaft** **ONLY FOR TWO-SHAFT ENGINES!!! (ECU V5.10e or higher required)**	**1. SetRpm of second shaft**	**0-70000**
SVC	**Smoker valve control** **(ECU V10.2M or higher required)**	**1. Smoker on/off control** **On/Off controls the Smoker valve output and an optionally connected BUS-Smokerpump.**	**0...100** **0: Smoker Off** **1..100: Smoker On, (values of 1..100 define power setting for BUS-smokerpump in Percent, this Power setting sets/overrides also the "Smoker Flow" value in the Limits menu (only visible if a BUS-Smokerpump is actually connected)**
	V12.01T or higher	**1. Smoker on/off control** **On/Off controls the Smoker valve output and an optionally connected BUS-Smokerpump.**	**0… 101** **0: Smoker Pump/valve is Off** **1..100: Smoker On, (values of 1..100 define power setting for BUS-smokerpump in Percent** **101:** **If a value of 101 is sent, then the smokerpump will be run with the settings defined with parameter "Smoker Flow" in the Limits menu**

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SER	**Service functions**	**1.**	**Function code** **0:** Calibrate EGT probe to ambient temperature. Parameter 2 gives ambient temperature **.** Engine must be OFF for this function to work. **5:** Test GlowPlug. Parameter 2 is on/off control (1=ON. 0=OFF). Engine must be OFF for this function to work. **11:** Test starter motor. Parameter 2 is on/off control (1=ON. 0=OFF) .Engine must be OFF for this function to work. **12:** Test fuel pump. Parameter 2 defines pump voltage (0=OFF. value > 0 → pump runs with given voltage) Fuel valve will automatically open when fuel pump is commanded to run! Engine must be OFF for this function to work. **13:** Test kerosene starter valve. Parameter 2 is for on/off control (1=ON. 0=OFF). Fuel pump will be automatically run at a preset low voltage, as long as test function is activated! Typically this function is used to drain the fuel lines of the kerosene starter system. Engine must be OFF for this function to work. . ECU firmware version 10.2N or higher required	**0, 5,11,12** **(do not use other codes!!!)**
		2.	Function value, Parameter 2 see above.	**0... 200000**
		3.	Security parameter	**4321**

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Table 2: Turbine states

State	Description
0	OFF
1	WAIT for RPM (Stby/Start)
2	Ignite
3	Accelerate
4	Stabilize
5	Not used
6	Learn LO
7	Not used
8	Slow Down
9	Not used
10	AutoOff
11	Run (reg.)
12	Acceleration delay
13	SpeedReg (Speed Ctrl)
14	Two-Shaft-Regulate (only for turbines with secondary shaft)
15	PreHeat1 (only for direct Kerosene startup mode)
16	PreHeat2 (only for direct Kerosene startup mode)
17	Not used
18	Not used
19	Keros.FullOn (only for direct Kerosene startup mode)

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Table 4 : Off-Conditions

Off-Condition code	Description
0	No Off-Condition defined
1	Shut down via RC
2	Over temperature
3	Ignition timeout
4	Acceleration time out
5	Acceleration too slow
6	Over RPM
7	Low Rpm Off
8	Low Battery
9	Auto Off
10	Low temperature Off
11	Hi Temp Off
12	Glow Plug defective
13	Watch Dog Timer
14	Fail Safe Off
15	Manual Off (via GSU)
16	Power fail (Battery fail)
17	Temp Sensor fail (only during startup)
18	Fuel fail
19	Prop fail (only two shaft engines)
20	2nd engine fail
21	2nd engine differential to high
22	2nd engine no communication
23	No oil (only on engines with separate oil reservoir)
24	Over current
25	No fuel pump connected/found
26	Wrong fuel pump connected
27	Fuel pump communication error
28	Out of fuel shut down (only on engines with fuel sensor, like RXi types)
29	Low Rpm shutdown, possibly due to Pump failure
30	Low Rpm shutdown, possibly due to front board failure
31	Clutch fail (starter motor clutch is not decoupling)
32	ECU reboot due to re-matching of new engine connected
33	Engine shut down, due to not receiving CAN-Bus messages longer than 2 seconds. E.g. CAN-Bus cable interruption This shut down would only be triggered if the engine was commanded to run via a CAN Bus command ahead. If engine is off, CAN-Bus cable disconnection/interruption would not generate an error / shutdown.
34	NO_RC_PULSE; Only applies for engines controlled via RC-PWM signal and if engine was started via RC-PWM control.
35	ROTORBLOCKED Engine rotor blocked, not turning.
36	SAFETY PIN signal; connection to GND removed

Remark: OffConditions 20-22 are only for multiengine communication setup (engine linkage via RS232, special ECU-firmware required)

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Table 5: Health check results

After power up all flags will report “0” (=not tested). To perform health check the “DHC” command needs to be issued for the flags to be set.

Bit state in return value	Return value Bit 0	Bit1	Bit2	Bit3
Starter “ok”	0: not tested 1: Ok, system works All other values define error code (Bit 1 to Bit 3 set in return value)	0: Driver ok 1: Driver error	0: ok 1: No current /open circuit (Motor defective or cable/ connector interruption)	0: ok 1: No starter motor rpm detected, possibly rotor of starter motor blocked
Main valve “ok	0: not tested 1: Ok, system works All other values define error code (Bit 1 to Bit 3 set in return value)	0: Driver ok 1: Driver error	0: ok 1: No current /open circuit (Motor defective or cable/ connector interruption)	Not defined
Starter valve “ok”	0: not tested 1: Ok, system works All other values define error code (Bit 1 to Bit 3 set in return value)	0: Driver ok 1: Driver error	0: ok 1: No current /open circuit (Motor defective or cable/ connector interruption)	Not defined
RPM Sensor “ok	0: not tested 1: Ok, system works All other values define error code (Bit 1 to Bit 3 set in return value)	0: Driver ok 1: Driver error	Not defined	0: ok 1: No rpm detected; bad rpm sensor; or engine rotor stuck
Pump “ok”	0: not tested 1: Ok, system works All other values define error code (Bit 1 to Bit 3 set in return value)	0: Driver ok 1: Driver error	0: ok 1: No current /open circuit (Motor defective or cable/ connector interruption)	0: ok 1: No pump rpm; Pump rotor blocked
GlowPlug “ok”	0: not tested 1: Ok, system works All other values define error code (Bit 1 to Bit 3 set in return value)	0: Driver ok 1: Driver error	0: ok 1: No current /open circuit (Motor defective or cable/ connector interruption)	0: ok 1: Current too low/ out of range, Bad glow element!
EGT Sensor	0: not tested 1: Ok, system works All other values define error code (Bit 1 to Bit 3 set in return value)	0: Driver ok 1: Driver error	0: ok 1: open circuit, possibly bad thermocouple / broken connection	Not defined

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EXAMPLES

Example 1 (reading turbine real values):

The following command is sent to the ECU (assuming slave adress=1):

```
1,RAC,1     <CR>
```
→ Command sent to the ECU

Answers of the ECU :

```
1,RAC,1     <CR>
```
→ 1. Echo of the received command

```
1,HS,OK,35000,568,1.32,11,30.1 <CR>
```
→ 2. Handshake of the ECU
(Command accepted and is executed).

This gives the following information:

Turbine RPM	= 35000 1/min
Turbine EGT	= 568 °C
Pump voltage	= 1.32 V
Turbine State	= 11 → State=”Run reg” (see table 3)
Throttle position	= 30.1% (via throttle PWM input)

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Example 2 (read out log data):

The following command is sent to the ECU (assuming slave adress=1):

```
1,XLO,1     <CR>
```
→ Command sent to the ECU

ECU answer (example):

```
1,XLO,1
```
→ 1. Echo of the received command

```
Time    Rpm     SetRpm  Temp    Pump    State   THR     AUX     Batt    AirSpd  SetSpd
34      1420    0       20      0.00    1       59      0       8.13    0       0
35      3920    0       20      0.00    2       99      0       8.04    0       0
36      4980    0       19      0.00    2       100     0       7.99    0       0
37      5120    0       20      0.00    2       31      0       7.97    0       0
38      5330    35500   42      0.27    3       18      0       7.94    0       0
39      6960    35500   87      0.29    3       18      0       7.88    0       0
40      8630    35500   118     0.30    3       18      0       7.83    0       0
41      10410   35500   190     0.32    3       18      0       7.78    0       0
42      12880   35500   296     0.35    3       18      0       7.73    0       0
43      15600   35500   394     0.38    3       18      0       7.70    0       0
44      17560   35500   461     0.40    3       18      0       7.67    0       0
45      20440   35500   515     0.44    3       18      0       7.65    0       0
46      23900   35500   552     0.46    3       18      0       7.63    0       0
47      27940   35500   572     0.50    3       18      0       7.62    0       0
48      31760   35500   596     0.54    3       18      0       7.62    0       0
49      37330   55000   631     0.58    4       18      0       7.66    0       0
50      43820   55000   664     0.63    4       18      0       7.72    0       0
51      50310   55000   667     0.68    4       18      0       7.77    0       0
52      55200   55000   637     0.69    6       18      0       7.82    0       0
53      55930   35000   593     0.60    6       18      0       7.85    0       0
54      51190   35000   546     0.51    6       18      0       7.88    0       0
55      45020   35000   510     0.44    6       18      0       7.91    0       0
56      39920   35000   490     0.41    6       18      0       7.93    0       0
57      36850   35000   489     0.39    6       18      0       7.95    0       0
58      34400   35000   502     0.39    11      18      0       7.96    0       0
59      33310   35000   517     0.40    11      18      0       7.97    0       0
60      33150   35000   544     0.40    11      18      0       7.98    0       0
61      33130   35000   564     0.41    11      18      0       7.99    0       0
62      33180   35000   574     0.42    11      18      0       8.00    0       0
DATA END
```
→ end of log data

```
1,HS,OK
```
→ (command accepted and was executed).

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Example 3 (engine control):

a) (Start engine)

The following command is sent to the ECU (assuming slave adress=1):

```
1,TCO,1     <CR>
```
→ Command sent to the ECU

Answers of the ECU :

```
1,TCO,1     <CR>
1,HS,OK     <CR>
```
→ 1. Echo of the received command
→ 2. Handshake of the ECU (command accepted and is executed).

→ Turbine will be started up now

b) (Set engine Rpm)

The following command is sent to the ECU (assuming slave adress=1, and turbine allready running):

```
1,WRP,50000      <CR>
```
→ Command sent to the ECU

Answers of the ECU :

```
1,WRP,50000      <CR>
1,HS,OK     <CR>
```
→ 1. Echo of the received command
→ 2. Handshake of the ECU (command accepted and is executed).

→ Turbine RPM will be set to 50000 1/min

c) (Set thrust in %)

The following command is sent to the ECU (assuming slave adress=1, and turbine allready running):

```
1,WPE,25    <CR>
```
→ Command sent to the ECU

Answers of the ECU :

```
1,WPE,25    <CR>
1,HS,OK     <CR>
```
→ 1. Echo of the received command
→ 2. Handshake of the ECU (command accepted and is executed).

→ Turbine RPM will be set to 25% thrust (For automatic flight control systems, it is recommended to use the WPE command to control the turbine thrust, instead of the WRP command)

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d) (Shut down engine)

The following command is sent to the ECU (assuming slave adress=1):

`1,TCO,0 <CR>` → Command sent to the ECU

Answers of the ECU :

`1,TCO,0 <CR>` → 1. Echo of the received command
`1,HS,OK <CR>` → 2. Handshake of the ECU
(command accepted and is executed).

→ Turbine will be shut down

Important:

Before sending a new command it must be assured, that the echo and the handshakes of all addressed devices have been received (especially when assuming that more than one ECU is connected) !

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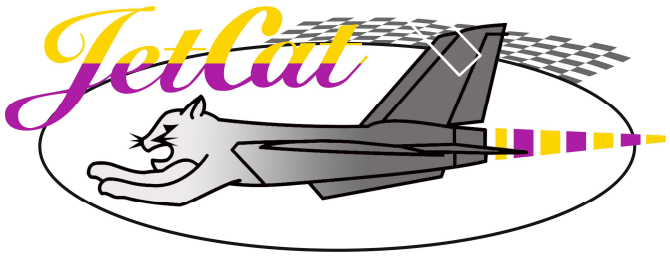

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