JetCat serial interface description
V12-ECU and PRO-engines
<< ASCII protocol >>

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Change Log

30.01.2022: Throttle curve parameter can be set. Command added

17.11.2021: Oilpump test option added in “TST” command.
09.09.2021: Tanksize and “Fuel used” numbers can be set (via SER command)

27.07.2020 new engine states added (Table 2)
05.06.2020 V12.45A or higher, RPR command added

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 Slave Address, 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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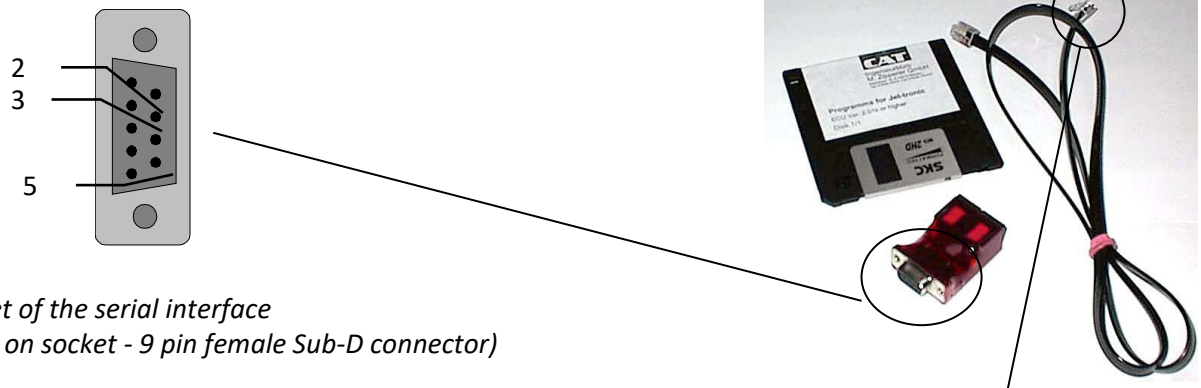
Connection between PC and the JetCat ECU:

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

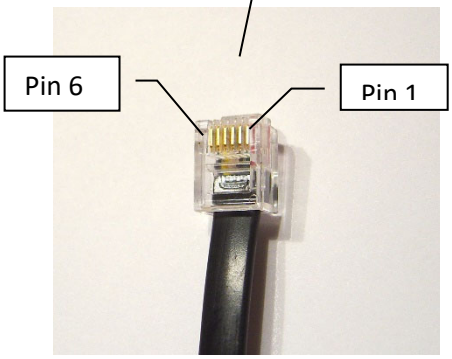
Pin	Description
2	transmit data TxD, (RS232 signal level)
3	receive data RxD, (RS232 signal level)
5	Signal ground, GND



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!).

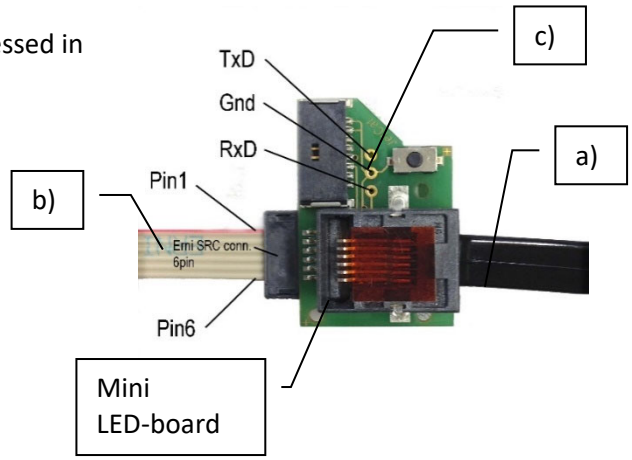
"Phone" type connector (RJ45) and Erni 6pin SRC pinout:



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 8 parameters separated by commas (,)
<CR>:	The command must be terminated by Carriage/Return (ASCII 13)

The ADR/ CMDCODE and PARAMETERLIST fields are also separated by commas ",".

Example: ADR=1; CMDCODE=TCO; PARMETERLIST=1

➔ This then forms the following string: 1,TCO,1<CR>

After receiving a RS232-command the ECU will:

1. Send the received command to the next controller (or back to the host - 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:	Return code (see table 1)
PARAMETERLIST:	1 to 8 parameters, each parameter is separated by a comma ","
CR	The handshake as any command, is terminated by ASCII-code 13 (CR)

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Table 1: Error codes

Return Code	Explanation	Parameter list
OK	command executed, no error	Up to 8 parameters
UC	unknown command	none
PA	wrong parameter number (too few or too many parameters had been specified in the parameter list)	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, possibly string / data corrupt	none

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Control Modes

The ECU allows engine control (start/stop/rpm commanding) via several control sources:

- PWM: Servo PWM signal (Throttle and AUX channels).
- GSU: Ground support unit, if connected.
- COM: Serial interface (described in this document)
- CAN: CAN-BUS interface

Therefore, different control modes are defined as follows:

PWM control mode: Default when engine is not running or is controlled via PWM signals.
EXT control mode: Default when engine has been commanded to start either via a GSU keyboard command or a command sent via the serial interface (COM), or via a command sent via the CAN-bus interface.
COM control mode: In this mode, commands will only be accepted via the COM serial interface and GSU.
CAN control mode: In this mode, commands will only be accepted via the CAN-Bus interface and GSU.
GSU control mode: In this mode engine control is only possible through the ground support unit.

Table 1, Control Modes:

	Matrix for allowed control sources, depending on control mode and engine state (=not running/running or starting up)			
Control mode	**Engine Start** (engine not yet started or running)	**Engine Stop** (engine was started or is running)	**Engine setpoint control** (engine running)	**Change of control mode after engine has been started**
PWM control (2)	PWM, GSU, COM, CAN	PWM, GSU	PWM	GSU, COM, CAN
EXT control (3)	Not defined	GSU, COM, CAN	GSU, COM, CAN	GSU, COM, CAN
COM control (4)	Not defined	COM, GSU	COM, GSU	COM, GSU
CAN control (5)	Not defined	CAN, GSU	CAN, GSU	CAN, GSU
GSU control (6)	Not defined	GSU	GSU	GSU

Whenever the engine is off/not running, the control mode is automatically set to “PWM control mode”. This basically allows all control sources to take engine control by starting the engine.
Depending on the source from which the engine start command came in first, the system would either stay in PWM control mode (when engine start has been commanded via valid PWM signal/sequence) or will switch into EXT control mode if the engine has been started via commands given by either GSU, COM or CAN interface.
Once in EXT control mode, there are commands available to switch to COM control mode, which would actively disable any commanding coming in via the CAN-Bus interface.
For basic serial communication applications, this command mode switching however is not required, as in EXT control mode, commands coming in via the serial interface would also be processed.

In all control modes manual GSU override control is possible.
GSU control mode can be activated/switched by a special key sequence on the GSU keyboard

CAN control mode can only be activated through the CAN-Bus interface with dedicated commands.

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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 % (via the throttle PWM input!) 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	V12.33 or higher only 1. Control parameter 1 or 0. 1: starts health check 0: terminates a possibly running health check. → ECU will reply in handshake with a status code (0 or 1) 0: Health check cannot be performed at this time (e.g. engine running) 1: Command accepted, Health check in progress now. Use RHC command to read health check results/progress. Health check is finished once all return values of the RHC command are unequal to zero! Health checking will take about 15 seconds to complete. If engine start is issued while health checking is in progress, health checking will be aborted, and engine start executed instantly.	 0/1
RHC	Read health check results	V12.33 or higher only 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. Glow plug health flag 7. EGT sensor health flag See table 5 (page: 17) for explanation of return codes	1 0.. 16 0.. 16 0.. 16 0.. 16 0.. 16 0.. 16 0.. 16

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CMD. CODE	Explanation	Parameter list	Range
RSS	Read system status	1. Dummy parameter to initiate transfer → ECU sends in handshake: 1. Dummy parameter (always read as 1) 2. Off-Condition 3. Actual Flight Speed 4. Proportional part of Speed regulator 5. AD-value of Airspeed input 6. AD-Zero value of Airspeed input	1 1 0..42 (see Table) 0… 500 km/h 0.. 1023 0..1023
RPR	Read values from barometric pressure sensor Firmware 12.45 or higher required!	1. Dummy parameter to initiate transfer → ECU sends in handshake: 1. Barometric pressure value in mbar 2. Pressure altitude in meters (absolute) 3. Current flight altitude in m (zero reference is the altitude were ECU was powered up) 4. Maximum flight altitude reached since ECU power up (zero reference is the altitude were ECU was powered up) 5. Temperature value reported by barometric sensor 6. T0 air inlet temperature (inlet temperature in front of compressor). This parameter is only valid on engines which do have T0 temperature sensors mounted (e.g. P1000). In case there is no T0 sensor present a value of -100 is transferred. This parameter is available only on firmware 12.49 or higher.	1 300…1100 -500…11000 -100… 11000 0…11000 -30..+60 -70.0 … +100.0
RTY	Read Information	1. Dummy parameter to initiate transfer → ECU sends in handshake: 1. firmware version text string 2. Firmware version number 3. Last Run 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. Gear Ratio Turbine to Rotor 5. Gear Ratio 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 Baud rate To activate system with new Baud rate → main power off/on of the system is required! Before power-off issue WEE,2 command to store changed Baud rate to EEPROM !!! On V12.67 or higher the baudrate will get activated and stored automatically/instant, no other action required.	Code for Baud rate 0: 2400 1: 2400 2: 4800 3: 9600 4: 19200 5: 38K4 6: 38K4 7: 57K6 8: 115K2 9: 128K (V12.60 or higher only) 10:256K (V12.60 or higher only)	0..10

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CMD. CODE	Explanation	Parameter list	Range
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
WTO	Set COMM Timeout	Value for communication timeout in seconds A value of zero would disable the COMM timeout (default). If engine is running and a non-zero value is defined for the COMM Timeout, the ECU will expect to receive valid commands via the serial interface within the timeout period. If not received, engine will be shut down with Off Condition code 42 (COM Timeout)	0..20.0s
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	
KEN	Enable / disable GSU keyboard	1. Control parameter (0→ disabled, 1→ enabled)	0, 1
RSY	Read System values	1. Control parameter to initiate transfer If 0 is sent for first parameter ECU will respond with A) If 1 is sent for first parameter ECU will respond with B) → ECU sends in handshake A) 1. TE-AD 2. KTY-AD 3. Batt-AD 4. Speed-AD 5. Thr-Plus Len 6. Aux-PulsLen B) 1. Glowplug ok/not ok (1=ok, 0=not ok) 2. Status of SafetyPin input 0: SafetyPin not asserted, pumps and solenoids disabled 1: SafetyPin is asserted, pumps and solenoids enabled 2: SafetyPin function not present on this engine (this 2nd parameter is only available on firmware 12.53 or higher)	 0…1023 0…1023 0…1023 0…1023 100…3000us 100…3000us 0,1 0/1/2
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… 35V 0… 65535 s 0…1000000ml

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CMD. CODE	Explanation	Parameter list	Range
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 (Start/Stop/ change control mode)	1. control parameter 0: Shut down/stop turbine 1: Start turbine and activate EXT control mode. In case engine should already run or being started when the command is issued, command is ignored. 2: Switch from EXT- to PWM-control mode. (=use PWM inputs for setpoint control). PWM-Throttle input must be set at idle for the transfer to work. 3: Switch from PWM- to EXT-control mode. PWM inputs are not used thereafter. 4: Switch from EXT- to COM-control mode. Typically used to 100% disable CAN-Bus control of engine.	0,1,2,3,4
tco	If command is sent in lower case letters, ECU would add in its handshake 3 return parameters. If command is sent in capital letters there will be no parameters added in the handshake.	If command is sent in lower case letters "tco", ECU would reply in handshake with 3 parameters: Engine would reply in handshake sequence with 3 parameters: 1st parameter: command executed yes/no; 1=yes, 0=no An executed "yes" reply would also happen if the engine is told to start and it has already started or is running, same applies for a stop command. If a "command not executed" is reported, the engine probably is in a control mode which does not allow engine control (e.g. CAN- or GSU control modes). 2nd parameter: Control mode before executing the command. 2=PWM, 3=EXT, 4=COM, 5=CAN, 6= GSU control modes 3rd parameter: Current Engine state, according to table 2.	 0, 1 2/3/4/5/6 0… 19

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CMD. CODE	Explanation	Parameter list	Range
WRP	Set turbine RPM (demanded setpoint)	1. Turbine Set RPM In case the transferred rpm value is out of range for the connected engine, the value demanded would be truncated/limited to the allowed range for that engine. In addition, the effective commanded rpm value would be returned with the 3rd parameter in the handshake (only on "wrp" command).	MinRpm… MaxRpm
wrp	If command is sent in lower case letters, ECU would add in its handshake 4 return parameters. If command is sent in capital letters there will be no parameters added in the handshake.	If command is sent in lower case letters "wrp", ECU would reply in handshake with 4 parameters: 1st parameter: command executed yes/no; 1=yes, 0=no If a "command not executed" is reported, the engine probably is in a control mode which does not allow access. 2nd parameter: Control mode before executing the command 2=PWM, 3=EXT, 4=COM, 5=CAN, 6= GSU control modes 3rd parameter: SetRpm effectively used 4th parameter: Real Rpm of engine	 0/1 2/3/4/5/6 MinRpm… MaxRpm 0… 300.000 1/min
WPE	Set Turbine thrust in%	1. Thrust in % 0% is equal to idle RPM 100% is equal to max. RPM There will be an automatic "thrust% demanded" to "RPM demand" conversion computed based on the parameter "Throttle curve" (Limits menu). For further explanation of this transfer function, please refer to the instruction manual of the engine. Thrust% value can be sent also with decimals like: 81.34%	0..100 %
wpe	If command is sent in lower case letters, ECU would add in its handshake 4 return parameters. If command is sent in capital letters there will be no parameters added in the handshake.	If command is sent in lower case letters "wpe", ECU would reply in handshake with 4 parameters: 1st parameter: command executed yes/no; 1=yes, 0=no If a "command not executed" is reported, the engine probably is in a control mode which does not allow access. 2nd parameter: Control mode before executing the command 2=PWM, 3=EXT, 4=COM, 5=CAN, 6= GSU control modes 3rd parameter: Set Thrust in % effectively used / forwarded 4th parameter: Real Thrust % of engine	 0/1 2/3/4/5/6 0…100 % 0…100 %
WR2	Set 2nd Shaft rpm, and engage rpm governor for second shaft ONLY FOR TWO-SHAFT ENGINES!!!	1. SetRpm of second shaft In case the given rpm2 value is out of range for the connected engine, the value demanded would be truncated/limited to the allowed range applicable for that engine. In addition, the effective commanded rpm2 value would be returned with the 3rd parameter in the handshake. 1st parameter: command executed yes/no; 1=yes, 0=no, -1= error In case a value of -1 should be returned for the first parameter, the command was refused as the engine is not a two-shaft engine, in this case 2nd and 3rd parameter will not be sent! If a "command not executed" is reported, the engine probably is in a control mode which does not allow access. 2nd parameter: Control mode before executing the command 2=PWM, 3=EXT, 4=COM, 5=CAN, 6= GSU control modes 3rd parameter: Rpm2 setpoint effectively used. With this command the governor mode for the second shaft rpm would be engaged as well!	0-70000 1/min -1/0/1 2/3/4/5/6 0… 70000 1/min

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CMD. CODE	Explanation	Parameter list	Range
SVC	**Smoker valve control** **(ECU firmwareV10.2M to V12.01S)** **V12.01T or higher**	**On/Off controls the Smoker valve output and an optionally connected BUS-Smoker pump.** **0: Smoker Pump/valve is Off** **1..100: Smoker On, (values of 1...100 define power setting for BUS-smoker pump in percent, this power setting sets/overrides also the "Smoker Flow" value in the Limits menu (only visible if a BUS-Smoker pump is actually connected.** **0: Smoker Pump/valve is Off** **1...100: Smoker On, (values of 1...100 define power setting for BUS-smoker pump in Percent** **101: If a value of 101 is sent, then the smoker pump will be run with the settings defined with parameter "Smoker Flow" in the Limits menu**	**0...100** **0… 101**
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 Glow Plug. 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 **47:** Set "Fuel used" value (in ml) ; Firmware >=12.64 required **48:** Set Tanksize in ml;Firmware >= 12.64 required **2.** Function value, Parameter 2 see above. **3.** Security parameter **Note: On newer firmware releases (V12.33 or higher) it is recommended to use the "TST" command instead**	**0, 5, 11, 12, 13** **(do not use other codes!!!)** **0... 200000** **4321**

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CMD. CODE	Explanation	Parameter list	Range
TST	**Test functions and Auto Bleed function** **Only available on ECU firmware 12.33 or higher**	**1. Function code** **1:** Test run fuel pump, main fuel valve would be opened automatically. Second parameter defines the pump voltage (range: -7.0…+7.0). Positive values run the pump forward, negative values run the pump reverse, zero stops the pump. **2:** Test run fuel pump, gas/ignition valve would be opened automatically, main valve closed. Second parameter defines the pump voltage (range: -7.0…+7.0). Positive values run the pump forward, negative values run the pump reverse, zero stops the pump. **3:** Test run fuel pump, both valves would stay closed. Second parameter defines the pump voltage (range: -7.0…+7.0). Positive values run the pump forward, negative values run the pump reverse, zero stops the pump. **4:** Open/close the main fuel valve. Second parameter defines the valve position. A value of 1 opens the valve, all other values close the valve. **5:** Open/close the gas/ignition valve. Second parameter defines the valve position. A value of 1 opens the valve, all other values close the valve. **6:** Test the starter motor. A value of 1 engages the motor, all other values stop the motor. If motor is not commanded off within 10 seconds, motor will be disengaged by system. **7:** Test the ignition device/glow plug. A value of 1 engages the igniter, all other values disable the ignitor If igniter is not commanded off within 10 seconds, igniter will be disengaged by system. **8:** Activate the "Auto bleed function". The second parameter given defines the max. allowed time in seconds for the bleeding process. The allowed range for the second parameter is: 0...50 seconds. In case a value of zero is sent for the timeout, a possibly running bleed process will be terminated. **9:** Test run the optional oil pump**.** This option is only available on engines with oilpump option (e.g. P1000) Second parameter defines to run or stop the oilpump (range: 1/0) **2.** Function value, parameter 2 see above... After having received a "TST" command the ECU will respond with one additional parameter in the Handshake. The return value tells if the command was executed or refused (0: parameter range error; 1: executed, 2: refused/currently not allowed). Test commands are only allowed when the engine is not running or cooling.	**1… 9**
RTS	**Read status of Test functions and Auto Bleed function** **Only available on ECU firmware 12.33 or higher**	1. Dummy parameter to initiate transfer → ECU sends in handshake: 1. Pump Test Voltage 2. Main fuel valve opened or closed 3. Gas/ignition valve opened or closed 4. Starter Test active/inactive 5. Ignitor test active/ inactive 6. Status of Auto bleed function: 0: not executed/refused -1; Executed but not successful (timeout or aborted by user) 1: Executed and successful 2: Auto bleed currently in process	**-7.0…0…+7.0** **1/0** **1/0** **1/0** **1/0** **-1/0/1/2**

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Table 2: Turbine states

State	Description
0	OFF (engine can be started)
1	WAIT for RPM (Stby/Start)
2	Ignite
3	Accelerate
4	Stabilize
5	Not used
6	Learn LO
7	OFF, but still cooling (engine can be started)
8	Slow Down
9	Not used
10	Auto Off
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	Auto Bleed
18	Not used
19	Keros.FullOn (only for direct Kerosene startup mode)

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Table 3: Off-Conditions

Off-Condition code	Description
0	No Off-Condition defined
1	Shut down via RC; Off via Throttle – PWM channel
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 / Igniter 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 valid messages via the CAN interface for longer than the time defined in parameter “CAN-Timeout” (Limits menu) This shut down would only be triggered if the engine was commanded to start/run via a command given through the CAN interface ahead. Furthermore, engine must be in either in EXT- or CAN-command mode! If engine is off, or e.g. commanded via PWM or RS232, this shut down will not be triggered. This function allows to verify that the CAN communication link is working. In case this function is not desired, leave the value of the parameter “CAN timeout” set to zero. If set unequal to zero, the system expects to receive valid commands sent via the serial interface within the timeout period. If this is not happening the engine

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Off-Condition code	Description
	will be shut down. Per default this supervision function is set to 15 which means 1.5 seconds timeout. ("CAN-Timeout" =0). The number given for the Timeout value is in multiples of 0,1 seconds. Therefore, a value of 15 would define a 1.5second timeout period. Only available in firmware 12.53 or higher.
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
37	Restart aborted by user
38	Engine off commanded via PWM-AUX channel
39	Engine off commanded via RS232-Off command
40	Engine off commanded via CAN-Bus Off command
41	Test Mode Off command
42	COM Timeout. Engine shut down, due to not receiving valid messages via the main serial interface for longer than the time defined in parameter "COMM-Timeout" (Limits menu) This shut down would only be triggered if the engine was commanded to start/run via a command given through the serial interface ahead. Furthermore, engine must be in either in EXT- or COM-command mode! If engine is off, or e.g. commanded via PWM or CAN-Bus, this shut down will not be triggered. This function allows to verify that the serial communication link is working. In case this function is not desired, leave the value of the parameter "COMM timeout" set to zero. If set unequal to zero, the system expects to receive valid commands sent via the serial interface within the timeout period. If this is not happening the engine will be shut down. Per default this supervision function is disabled. ("COMM-Timeout" =0). The number given for the Timeout value is in multiples of 0,1 seconds. Therefore, a value of 20 would define a 2second timeout period. Only available in firmware 12.33 or higher.
43	Preheat Timeout; preheat function timed out; only on engine with this function enabled
44	Oilpump disconnected
45	Oilpump rotor blocked
46	Oil level low

Remark:
Off Conditions 20-22 are only for multiengine communication setup (engine interlinkage via serial interface)
Off Conditions 38 only available in firmware 12.33 or higher; before, this off condition resulted in code 2.
Off Conditions 39-41 only available in firmware 12.33 or higher; before these off conditions (39-41) resulted all in Off Condition 15.

On some OEM customer specific firmware builds, codes 39-41 are re-routed to code 15, and code 38 is re-routed to code 2 (for backward compatibility).

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Table 4: 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. The "DHC" command initially also would set the flags to zero. Health check is completed once all flags are reported unequal to zero!

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 engine rpm detected, possibly starter clutch not engaging.
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 (valve 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 (valve 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 (pump defective or cable/ connector interruption)	0: ok 1: No pump rpm; Pump rotor blocked
Glow Plug "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 (ignitor 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 engine real values):

The following command is sent to the ECU (assuming slave address=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,35000,568,1.32,11,30.1,0.12<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 2)
Throttle position	= 30.1% (via throttle PWM input!)
Engine current	= 0.12A

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Example 2 (read out log data):

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

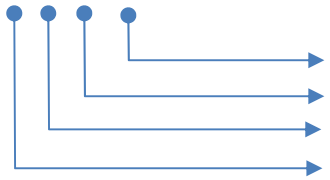
a) Start engine

For engine start, the following command is sent to the ECU (assuming slave address=1):

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

Answers of the ECU :

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



<CR>: stands for ASCII-code 13
current engine state; 0=OFF (3rd parameter)
control mode; 2=PWM-control mode (2nd parameter)
command accepted and executed (1st parameter)

→ Turbine will be started up now. In case turbine should already run, command has no effect.

Alternatively, the "older" TCO command (capital letters) can be used, here there are no parameters returned with the handshake:

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

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

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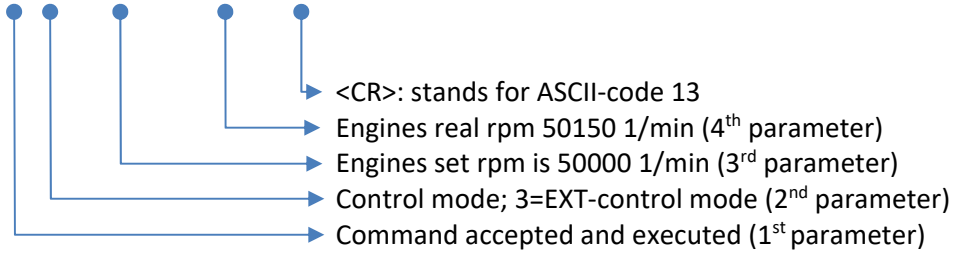
b) Set engine Rpm

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

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

Answers of the ECU :

`1,wrp,50000<CR>` → 1. Echo of the received command
`1,HS,OK,1,3,50000,50150<CR>` → 2. Handshake of ECU



In case the engine should not run, this command has no effect.

Alternatively, the older “WRP” command (capital letters) can be used, here there are no parameters returned with the handshake:

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

Answers of the ECU :

`1,WRP,50000<CR>` → 1. Echo of the received command
`1,HS,OK<CR>` → 2. Handshake of ECU

In case the engine should not run, this command has no effect.

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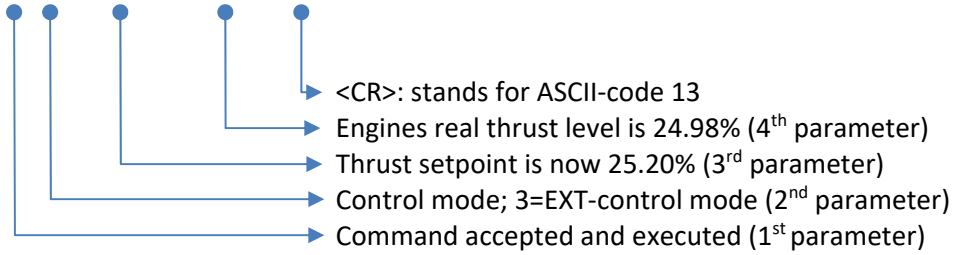
c) Set thrust in %

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

`1,wpe,25.2<CR>` → Command sent to the ECU

Answers of the ECU :

`1,wpe,25.2<CR>` → 1. Echo of the received command
`1,HS,OK,1,3,25.20,24.98<CR>` → 2. Handshake of ECU



→ Turbine RPM will be set to 25.2% thrust (For automatic flight control systems, it is recommended to use the WPE command to control the turbine thrust, instead of the WRP command).

Alternatively, the older "WPE" command (capital letters) can be used, here there are no parameters returned with the handshake:

`1,WPE,25.2<CR>` → Command sent to the ECU

Answers of the ECU:

`1,WPE,25.2<CR>` → 1. Echo of the received command
`1,HS,OK<CR>` → 2. Handshake of ECU

In case the engine should not run, this command has no effect.

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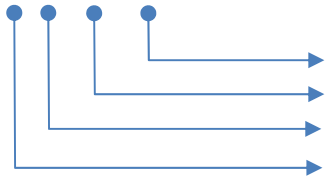
d) Stop engine

The following command is sent to the ECU (assuming slave address=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,1,3,11<CR>` → 2. Handshake of the ECU (command accepted).



<CR>: stands for ASCII-code 13
current engine state; 11=run reg (3rd parameter)
control mode; 3=EXT-control mode (2nd parameter)
command accepted and executed (1st parameter)

→ Turbine will be shut down. In case the engine should not run or be starting up, this command has no effect.

Alternatively, the older "WPE" command (capital letters) can be used, here there are no parameters returned with the handshake:

`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).

Important:

Although the ECU has a 512 Byte I/O buffer, before sending a new command it should 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)! This safely avoids possible I/O buffer overruns.

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