DIGIPAK JETS

UNIVERSAL ECU V2 POWER

Product Manual

https://jet.digipak.org/

Contents

Revision History

Revision	Date	Notes
Initial Release	28 July 2025	For more information please contact customerservice@jet.digipak.org
Update 1	17 August 2025	Added notes about ESC calibration and WiFi Web Interface . Updated error handling table. Fuel control method is now working in addition to RPM control
Update 2	16 December 2025	Update according to new ECU Firmware 143
Update 3	4th September 2026	Updated according to new ECU Firmware 144 and for integrated power module

Firmware Version: 144

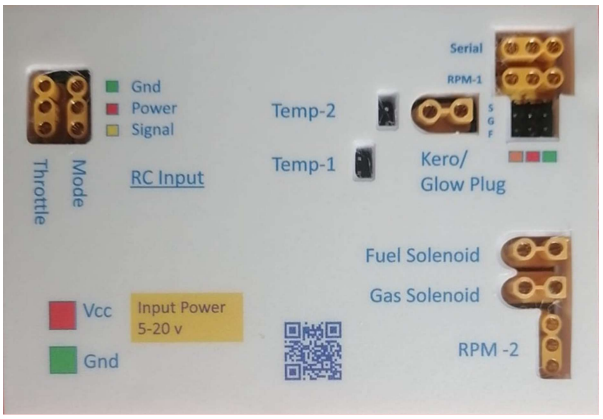
Introduction

DigiPak Universal ECU is developed to serve two diverse community of users.

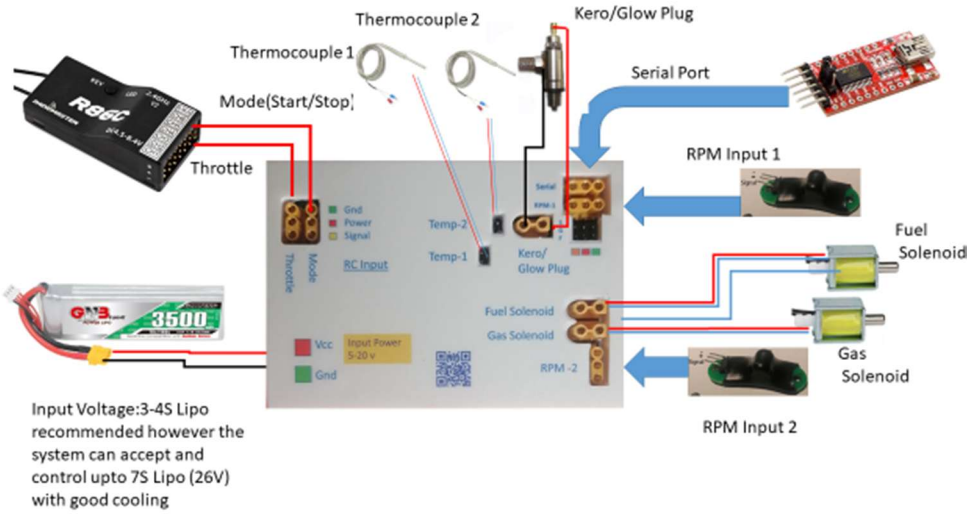
1- Model RC Jet flyer who wants a reliable but not extremely expensive solution to controlling model jet engines.
    a. With its settings file DigiPak Universal ECU can be configured to control a jet engine with previously setup parameters thus quickly adapting the same ECU to multiple jet engines. You don't need an ECU for each engine but can switch ECU between different engines, load the corresponding settings file over WiFi and the system is ready to go.
    b. Extremely flexible setup system allows the Universal ECU to be "Universal". It can be configured to run, kerostart, Gas start, Brushless or Brushed starter, Brushless or Brushed fuel pump, Kero Plug or Glow Plug enabled engines. In addition, it can be configured to limit maximum voltage to each component thus giving option to power the system from say 4S Lipo but use a 12V fuel Pump or 6v Starter.
    c. Once the ECU is setup, the engine can be simply started with the flip of a switch and the Jet flown without worrying about complex processes happening in background.
    d. Second user base that this ECU serves is the DIY-Enthusiast, the tinkerer, the Engineer who is trying to build his/her own jet engine or trying to understand how a jet engine works.
    e. The ECU has a broad set of options to collect and visualize the data from the engine. Data can be transmitted through serial port on ECU and be received/saved on any serial port enabled device. Another option is to save all data on a micro sd card and download it over WiFi whenever it needs to be examined. Real time data display screens provide an immediate graphical review of engine state over a simple WiFi webpage.
    f. A wide set of engine controlling variables are available to the user for setup and change. This gives a user much more control over operation of the engine. With this flexibility, almost any type of model jet engine can be controlled by DigiPak Universal ECU as long as the hardware setup is suitable and sized for the given engine. As mentioned previously, the ECU has been used successfully to control gas start/kero start engines, with brushed or brushless starter or fuel pump and with a diverse combination of RPM and temperature sensors.
    g. It is possible to update the ECU firmware online thus current user will not be left behind if any new features are added to the ECU in future. This is not automatic so user has complete control if they want to update the ECU or keep it running on existing firmware.
    h. ECU Power changes most of the connections from pin headers to MR30 connectors for better reliability under vibrations. It contains two built in Escape32 based ESC which are capable of driving brushless or brushed motors. The ECU interface is updated so that the Escape32 ESC settings can be changed from ECU interface according to motors used. In addition to built in ESC and Kero driver module, ECUV2Power still allows to connect external ESC and kero driver if required.

The Hardware Setup

ECU Outputs



Connection Diagram



Inserting microSD card

A microSD card can be used to record engine data during running. This is optional and ECU will perform normally with or without micro SD card. To install micro SD card, the case will need to be opened. ECU case is a snap fitting of bottom and top part with no screws. The case can be pulled apart by exerting force and the ECU board taken out. The ECU should not be powered during micro SD card insertion.

The micro SD card should be a maximum of 32 GB size and minimum class 10 speed class.

Once inserted all file operations can be performed using WiFi and there is no need to remove micro SD card for downloading files.

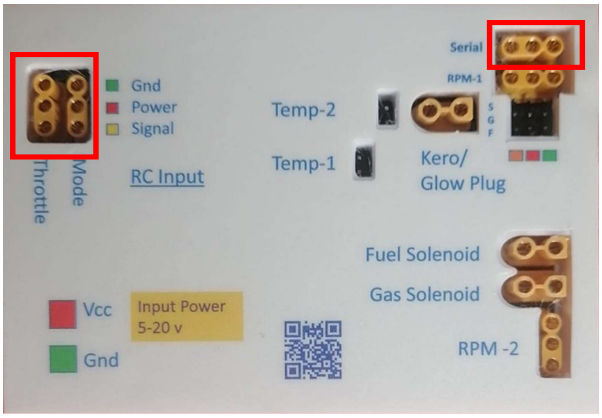
Power Input:

DigiPak ECU is powered through an XT-60 connector. Recommended power supply ranges from 2S Lipo to 4S Lipo or about 5-20V DC. ECU van tolerate upto 26V or 7SLipo however good cooling airflow should be used as temperature can rise and damage the ECU with higher voltage.

ECU will supply 4-5v power to connected RC Receiver and external supply to rc receiver is not required unless high current draw from receiver output is expected.

Control Inputs:

ECU can be controlled by providing input in three different ways



1- RC Input (Default)

Two RC inputs are provided that used RC signals from an rc receiver or servo tester to control the engine. The two inputs are 1)Throttle input to control the speed of engine. This

Input must be low while starting the engine. 2) Mode Input. This is used to start and stop the engine. This also serves as an emergency abort at any stage to shut down the engine.

2- Serial Input

Serial port can be used to control the engine by sending appropriate commands at 115200 8N1 data rate through ECU serial port. Serial command set provides ability to start.stop and abort the engine operation. It provides commands to control the throttle as well as almost complete control of changing engine control parameters. See the list of serial commands that are available to control ECU over serial port.

3- Wifi Web interface

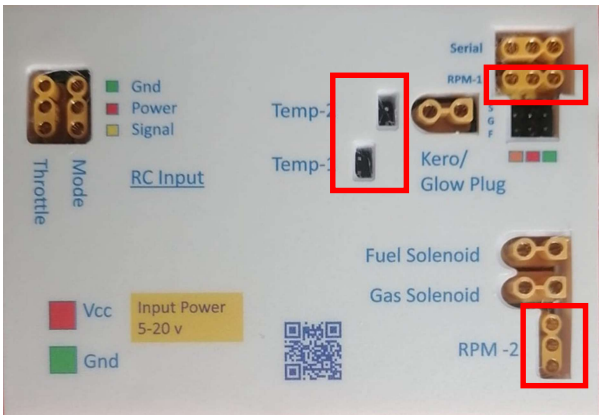
Wifi Web interface is primarily used as data terminal. It is used to setup engine parameters and to view graphical output when running the engine on ground. Additionally it provides means for downloading data from ECU, updating firmware and loading of setup files to change ECU setup. WiFi Web interface allows any phone, Tablet or computer to be used to view and setup engine parameters and data.

ECU comes with a default SSID of “DigiPak_ECU” and default password of “admin123”

Both these can be changed by user to secure access to the ECU.

Note: WiFi password needs to be more than 7 characters to be valid

Sensor Inputs



The Universal ECU V2 has four sensor inputs that can be used to detect engine state

2x RPM Sensor and 2xThermocouple inputs. At any given time only one RPM and one thermocouple input will be used to make the control decisions and second inputs will only be used for recording data if the input sensors are connected. Selected input will not change automatically and can only be manually changed.

1- RPM Input

Most of engine control decisions are based on engine RPM therefore it is extremely important to setup RPM sensor correctly. RPM input is essentially counting 5v/3v pulses at RPM input as the engine rotor spins. Number of pulses/revolution is selectable through the user interface of ECU. Normally magnetic nut based sensors will count 1 pulse/revolution while through hole optical sensors will count 2 pulses /revolution. In addition there are garrett induction sensors for turbocharger RPM measurement which can have higher number of pulses per revolution as these count the number of

turbocharger blades. DigiPak ECU V2 can adapt to arbitrary pulses/revolution as it is possible to even enter fractional numbers if garrett type sensor is selected as RPM input.

RPM-1 and RPM-2 are powered by ECU with a 5v supply.

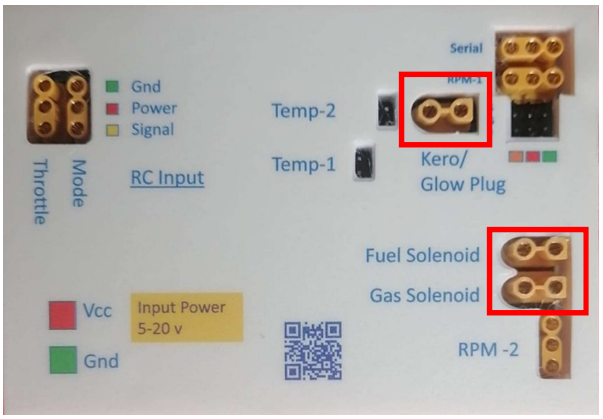
Only one RPM sensor is required for engine operation, second RPM is not mandatory to be connected. Any of the two RPM inputs can be designated as primary input.

2- Thermocouple Input

DigiPak Universal ECU V2 has two built in max 31855k thermocouple ic's that allow two separate thermocouple inputs. Only K type thermocouple probes are required to be connected to measure the temperature. No additional hardware is needed. All temperature based decisions will be made based on primary thermocouple which is designated through user interface. Connecting two thermocouples is not mandatory and only one thermocouple can be used and made primary if only one thermocouple is available.

Outputs

XT-30 Connector outputs



1- Glow Plug/Kero Plug

This output can be used to control Kero Plug for Kero Start engines or Glow Plug for Gas Start engines with RC engine style glow plug.

To use this output, the following settings must be enabled on page3 of user interface

ECU must be in Glow Plug PWM Mode

☑ Glow Plug PWM control

Maximum voltage to Glow /Kero Plug must be enabled and limited appropriately

☑ Limit glow plug voltage with PWM control

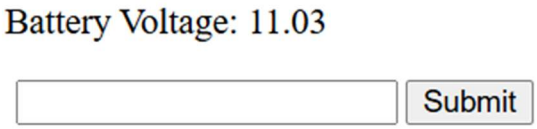
Most modern hobby engines have internal glow plugs which are not easily replaceable . If damaged, the engine needs to be disassembled to replace the glow plug. For this reason it is extremely important to set the maximum voltage limit of glow plug correctly . If in doubt, start from zero and increase in small increments until

good heating on glow plug is observed.

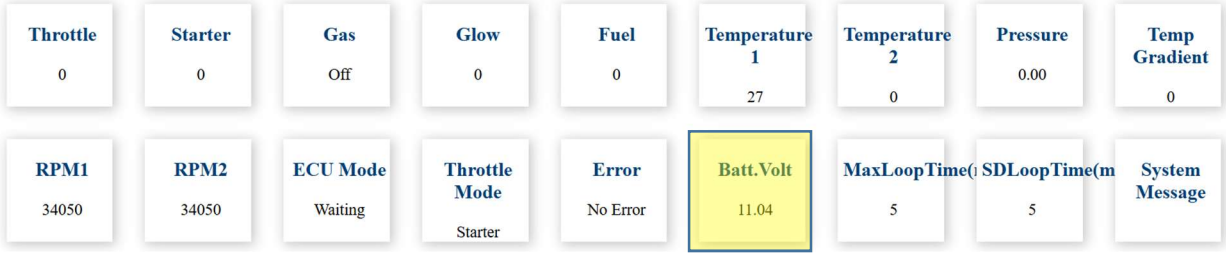
Note: For Gas start engines Glow Plug voltage should be set as 0.13 v. Higher values might burn the RC style glow plugs. Slight adjustments around this value are ok to get the best heating of glow element

For above setting to work, the ECU voltage reading must be calibrated. The voltage sensor output can be viewed on Page 1 or Page 6 of ECU WiFi interface. If ECU is reading significantly different from supply voltage , it can be corrected by entering correct voltage on Page 1 in Battery Voltage settings

Page 1



Page 6

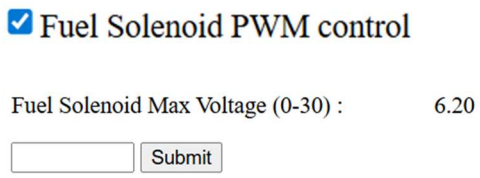


2-Fuel Solenoid Output

Fuel Solenoid output provides power to Fuel solenoid valve controlling fuel flow.

Fuel Solenoid Supply Voltage Control: The voltage to Gas Solenoid output can be controlled by using PWM mode. Without the PWM mode, the full supply voltage will be used to control the fuel solenoid.

To limit the voltage to fuel solenoid, the fuel solenoid PWM control must be enabled and fuel solenoid Max voltage set to appropriate voltage.



2-Gas Solenoid Output

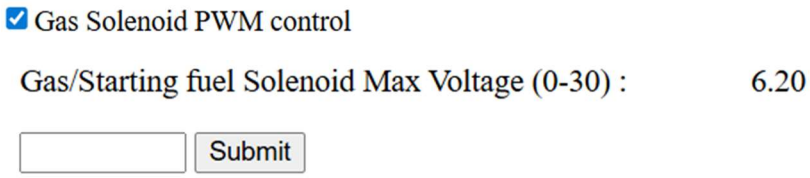
Gas Solenoid output provides power to solenoid valve controlling gas flow Or Fuel flow for kero start engines.

In Gas start mode this solenoid will simply open or close to allow or stop the flow of gas to the engine.

In Kero Start mode, this valve will oscillate to control fuel flow through kero valve. The frequency of oscillation and duty cycle are controlled through Kero plug settings.

Gas Solenoid Supply Voltage Control: The voltage to Gas Solenoid output can be controlled by using PWM mode. Without the PWM mode, the full supply voltage will be used to control the gas solenoid.

To limit the voltage to gas solenoid, the gas solenoid PWM control must be enabled and gas solenoid Max voltage set to appropriate voltage.



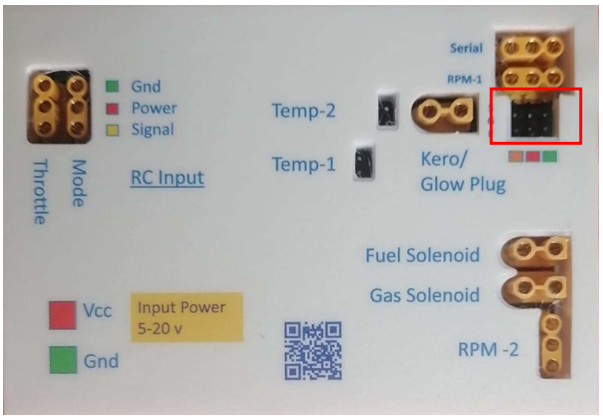
MR-60 Connector outputs (Starter Motor and Fuel Pump)

Two MR-60 connectors provide output to control 1- Starter Motor and 2- Fuel Pump

Both these connectors are driven by internal ESC running Escape32 firmware. These outputs can be used to control Brushed motors as well as brushless motors by changing ESC settings.

Pin Header Connectors

DigiPak ECUV2Power can also provide RC or PWM signals for external control method. If you want to connect an external brushless ESC instead of using builtin ESC, you can connect it to appropriate pin headers to provide the output. Pin headers are provided for Starter, Glow plug and Fuel pump control

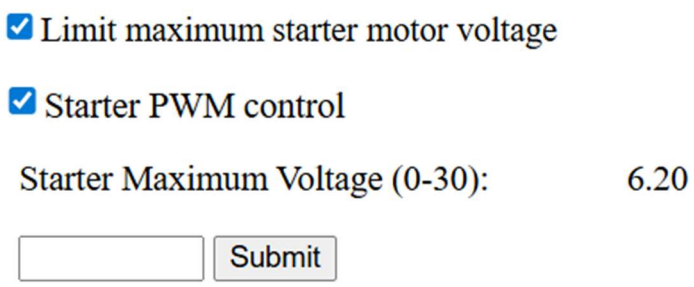


1- Starter Motor Control (Output)

DigiPak ECU V2 can control two types of starter motors through this output. By Default it is providing an RC type output signal with 1-2ms pulse width and 50Hz repetition rate. An RC Style ESC(Electronic Speed controller) can be connected to control the starter motor. ESC's are available for both brushless and brushed motors so both can be controlled using an ESC sized for the starter motor. This port requires 5v which is supplied by BEC (Battery Eliminating Circuit) from the speed controller.

This port can also output PWM Signal of 5KHz to control a brushed motor using appropriate driver board. Duty Cycle of PWM will be proportional to the speed required.

The maximum value of output can be limited to protect starter motors with lesser maximum voltage. This setting will be applicable by selecting the options as shown below



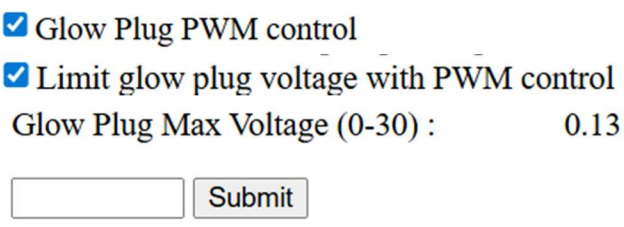
2- Glow Plug Control (Output)

This port is provided to use external Glow Plug control modules. DigiPak ECU V2 has a built in glow plug driver which can drive both Kero Plug systems and RC Style glow plugs through the XT-30 connector. Changing the glow plug settings will affect both the internal driver as well as this port.

Similar to Starter motor output DigiPak ECU V2 can also control Glow Plugs through this output. This output however cannot provide high current and is limited to providing a control output signal only. By default it is providing an RC type output signal with 1-2ms pulse width and 50Hz repetition rate. An RC Style glow plug driver can be connected to control the glow plug for gas start engines. This port requires 5v which is supplied by BEC (Battery Eliminating Circuit) from the glow plug driver.

This port can also output PWM Signal of 5KHz to control a glow plug using appropriate driver board. Duty Cycle of PWM will be proportional to the heating required.This is the method used to control internal glow/kero plug driver.

The maximum value of output can be limited to protect glow plugs with lesser maximum voltage. This setting will be applicable by selecting the options as shown below

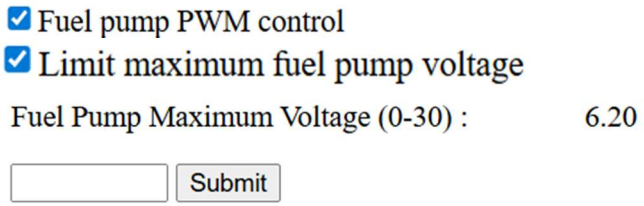


3- Fuel Pump Control (Output)

DigiPak ECU V2 can control two types of fuel pump motors through this output. By Default it is providing an RC type output signal with 1-2ms pulse width and 50Hz repetition rate. An RC Style ESC(Electronic Speed controller) can be connected to control the fuel pump. ESC's are available for both brushless and brushed motors so both can be controlled using an ESC sized for the fuel pump motor. This port requires 5v which is supplied by BEC (Battery Eliminating Circuit) from the speed controller.

This port can also output PWM Signal of 5KHz to control a brushed motor fuel pump using appropriate driver board. Duty Cycle of PWM will be proportional to the speed required.

The maximum value of output can be limited to protect fuel pump motors with lesser maximum voltage. This setting will be applicable by selecting the options as shown below



Initial Setup

1- Only connect the power to ECU . No sensors connected. ECU can take 5-20 v Power. Initial test is recommended at 12 v or 3S Lipo power supply. Green powerup light will come up indicating ECU has power. ECU will work with upto 26v or 7 cell Lipo battery however it may overheat and get damaged if appropriate cooling is not provided.

2- Open WiFi on a computer or mobile device and look for DigiPak_ECU and connect to it. The password for DigiPak_ECU is admin123

3- After successful connection open a web browser and in address bar type 192.168.4.1 . On some browsers you need to type http://192.168.4.1/

4- Go through Page1 to Page 9 to see all the inputs that are possible
   a. Pay special attention to Glow Plug/Kero Plug setup. Most engines have internal kero plugs and if damaged, they can only be replaced by disassembling the engine. Set the glow plug voltage to a low value from page 3 and test, if the glow is not enough then only increase glow plug voltage in small increments until good kero plug heat is achieved

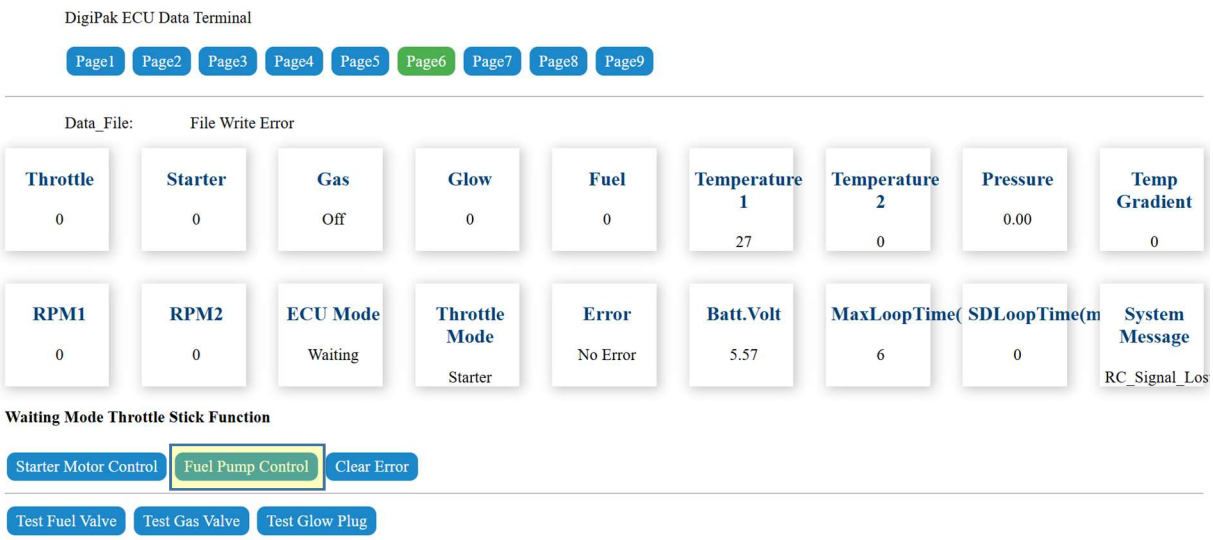
5- Page1 to Page 3 are used to setup engine parameters. Review each parameter carefully and adjust as per engine

6-Page 4 is a realtime display of RPM and Temperature and will be used while running the engine and Page 5 shows more gauges to display engine state

7- Page 6 can be used to test each input and output and view the input output values

8- Page 8 shows ECU usage

9- Page 9 is for downloading ECU data, Uploading, downloading settings and updating the ECU firmware



Testing

1- ECU Testing will be done step by step by connecting one input at a time and checking its functionality

2- Page 6 on ECU interface will be used to check all inputs and outputs

Before connecting an input or output to ECU. It is recommended to power down the ECU, Make the connection and then power up for testing

Action	Success Criteria	Notes
1- Physical Check of ECU	No loose connections, No bent pins, No physical damage	
2- Connect Power to ECU (12v)	Connect to WiFi and review Page 1-9 . Update the values as per engine	Ensure correct polarity of power . ECU board can be damaged by supplying wrong polarity power.
3- Connect Thermocouple	Values read are correct. Use some heating and cooling to check thermocouple behaviour	Page 6 will display temperature values
4- Connect Throttle and Mode Input to ECU	By changing throttle input the ECU should display the change in Throttle and Starter values. By changing the mode input, ECU will show a change in ECU mode	Page 6 will display these readings

Action	Success Criteria	Notes
5- Insert microSD card in the slot (optional) Upto 32GB class 10 microSD card has been tested	On page 6 Data file will show the name of data file being written on micro SD card	Less than class 10 micro SD cards slow down the writing speed and slow down the ECU response
6- Connect the Serial connection through Serial to USB module and open serial terminal on the computer (Optional)	After power up sensor and input values will be transmitted over serial terminal	Serial setup is 115200 8N1. 115200 bits per second ,8 data bits ,No Parity, 1 Stop Bit
7- Connect the RPM Sensors	By rotating the engine compressor, the RPM should read a tangible value	ECU provides 5v power to RPM-1 sensor. RPM-2 Sensor is powered by RC voltage supply
8- Connect Starter ESC.	By moving throttle stick, starter motor should respond as per throttle	Setup the starter ESC with active braking. i.e. when starter throttle is zero, the motor will brake and resist rotation

Action	Success Criteria	Notes
9- Connect Fuel pump ESC. On page 6 press the fuel pump control button and use throttle to control the fuel pump	Fuel pump should respond as per throttle input	If testing with fuel tank connected, make sure no fuel goes into engine. Disconnect the fuel line from engine and use a container to collect the pumped fuel or cycle back to fuel tank.
10-Connect Glow plug. Enable the PWM control and set glow plug voltage on Page 3 as per glow plug specifications	By pressing Test Glow plug button on Page 6- Glow plug should light up for a few seconds	Glow plug will glow red hot. Ensure it is not close to combustible material and not being touched as it can cause severe burns
11- Connect the two solenoid valves to Fuel and gas valve pins.	The valves should engage by pressing “Test Gas Valve” and “Test Fuel Valve” buttons. In Kero mode Gas valve test will turn the Valve on and off at selected frequency	Enable PWM mode and limit voltages for solenoid valves if the rating is less than battery voltage

Action	Success Criteria	Notes
12- At this point all the sensors and inputs have been tested and verified to work properly and now we can test the startup mode		
13- Engage the startup sequence by switching the mode switch	1- ECU will perform a purge cycle 2-Glow plug will be switched on 3-Starting fuel will be pumped and fuel solenoid will start oscillating 4- Engine RPM will vary between two limits as defined during setup	Achieving and sustaining starting ignition will be considered a success for this test

Action	Success Criteria	Notes
15- On engine settings page2 limit the maximum RPM to just above Idle RPM and perform a normal start	Good startup, idle and then reaching the limit RPM at max throttle will be considered successful	If RPM oscillates at Idle or maximum, increase the RPM tolerance value
16- On engine settings page2 Increase the max RPM Limit to half way between idle and maximum RPM and perform a normal start	Good startup, idle and then reaching the limit RPM at max throttle will be considered successful	
17-On engine settings page2 Increase max RPM limit to engine continuous operating RPM limit and perform a normal start	Good startup, idle and then reaching the limit RPM at max throttle will be considered successful	

Components Selection

RPM Sensor:

DigiPak ECU works by counting the number of pulses to detect the engine RPM. Electrically the pulses should be 3.3v or maximum 5v Pulses. Pulse to RPM relationship is selected on Page 3 of Web interface. Conventionally magnetic rpm sensors provide 1 pulse per revolution and optical rpm sensors provide 2 pulses per revolution of input. Turbocharger RPM sensors provide pulses by counting number of vanes passing infront of sensor and can be widely varying. Selecting garrett type sensor a custom pulses per revolution can be entered to accommodate this case.

Temperture Sensor:

DigiPak ECU uses k-type thermocouple to measure exhaust gas temperature. ECU requires only the thermocouple probe to be connected to ECU. The adapter ic is already built into the ECU module. Thermocouple probe should ideally be placed as close to turbine as possible for exact temperature at turbine stage.

Fuel Pump:

Often overlooked part of a jet engine is the fuel pump. The fuel pump of a jet engine must be able to supply maximum required fuel at the full internal pressure of the jet engine. Small jet engines develop around 1 bar of internal pressure while 40kg or 80 kg class engines can develop more than 3 bars of internal pressure. Considering a small engine with 1 bar internal pressure and maximum fuel consumption of 1 litre per minute, the fuel pump must be able to supply 1 litre per minute at 1 bar. 1 bar is around 33 ft head of water so in perspective the fuel pump should be able to pump 1 litre/minute of water around three stories high. If the fuel pump is not able to do it then the engine can not be run

upto full speed. If fuel pump cannot deliver this quantity of fuel at this pressure, you may be able to start the engine but as soon as the internal pressure of engine reaches pump capacity, the pump will not be able to supply fuel and the engine will not accelerate further.

On the other hand at the lower end of the range the fuel pump is required to provide very small quantity of fuel at precise rates. This is required so proper air fuel mixture is created and fuel can be ignited. Too much fuel at start up and engine will fail to start or start with a big flame that can damage the turbine.

Gear pumps ususally meet the requirements of the jet engine and are a popular choice in this area as they can provide high pressure fuel at required flow rates

Starter Motor:

Starter motor is another important part of a jet engine that has some very specific requirements. A jet engine by itself cannot start without some initial RPM to its rotor. The initial RPM creates the airflow which is then mixed with fuel, ignited and the hot gases then drive the turbine which then in turn drives the compressor.

Every jet engine has a self sustaining RPM. This is the minimum RPM at which the engine rotor will run under its own power without a starter motor. Self sustaining RPM is a function of engine design and is affected by engine components such as turbine and compressor efficiency, bearing condition etc. Although engine can run at self sustaining RPM, the minimum rpm at which the engine is run is idling RPM which is higher than self sustaining RPM. In hobby jet engines Idling RPM can be 5000 to 10000 RPM higher than self sustaining RPM.

Starter motor of a jet engine is required to spin the rotor from zero to above self sustain RPM. Once the engine reaches the self sustaining RPM and is running under its own power, the starter motor can be switched off and engine can be run on fuel only. This is essentially the selection criteria of a starter motor.

In RC applications , the motor is required to be light as it only functions at startup and is dead weight during flight.

In summary a light weight brushed or brushless motor that can spin the engine rotor to above self sustain RPM is require to start the jet engine. To keep margin of safety a motor should capable of pushing RPM higher than self sustaining RPM and close to idling is even better.

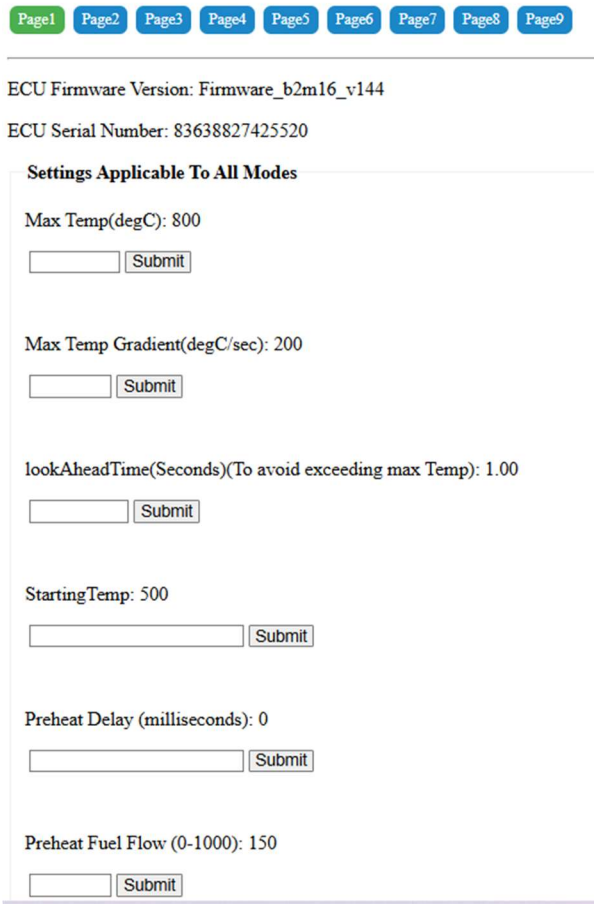
WiFi webServer Interface

DigiPak ECU V2 creates a WiFi webserver at power up.

Default SSID is “DigiPakECU” and default password is “admin123”. After power up the user can connect to this webserver by typing 192.168.4.1 in the address bar of web browser. Current firmware provides 9 pages for setting parameters, data display and other operations. Following describes the Webserver interface in detail:

Note: On mobile devices it has been noticed that mobile data may need to be switched off and only Wifi is enabled. This is because some mobile devices try to search for ECU web interface over internet while it is only accessible over WiFi.

Page 1



Current Firmware version of the ECU

ECU Serial Number

Max Temperature. If during running temperature exceeds this value, the fuel flow will be reduced to bring the temperature down

Maximum temperature gradient. Used during startup to avoid hot start

Look ahead time will reduce fuel flow if temperature is going to exceed maxTemp after lookahead time

Starting Temperature. During startup, ECU maintains this temperature by balancing fuel and starter. IF it is too low, there is a risk of flame out and if it is too high , the result could be a hot start

Preheat Delay is used to heat up the engine before startup sequence. This helps startup in cold weather

Preheat Fuel Flow is the fuel flow during preheat delay

Pump On Voltage: 1.300

Submit

Pump Off Voltage: 1.300

Submit

Battery Voltage: 0.00

Submit

Purge Time(millisec): 3000

Submit

Purge Throttle (0-1000): 150

Submit

Starter Delay(millisec): 5

Submit

Acceleration Delay (millisec): 60

Submit

Deceleration Delay (millisec): 80

Submit

Low RPM Acceleration Delay (millisec): 600

Submit

Low RPM Deceleration Delay (millisec): 500

Submit

Ignition Threshold Temp.(degC): 100

Submit

This is the voltage at which pump just starts pumping fuel. Most pumps require a certain speed below which they will not pump any fuel.

This is the voltage at which pump just stops pumping. Most pumps require a certain speed below which they will not pump any fuel. This is usually below the pump On voltage.

This value should read current battery voltage. Measured voltage is used to limit maximum voltage to Starter,Fuel Pump, Kero Plug etc in PWM mode.

Before startup engine spools up to clear of any unburnt fuel and gases for a time equal to Purge Time.

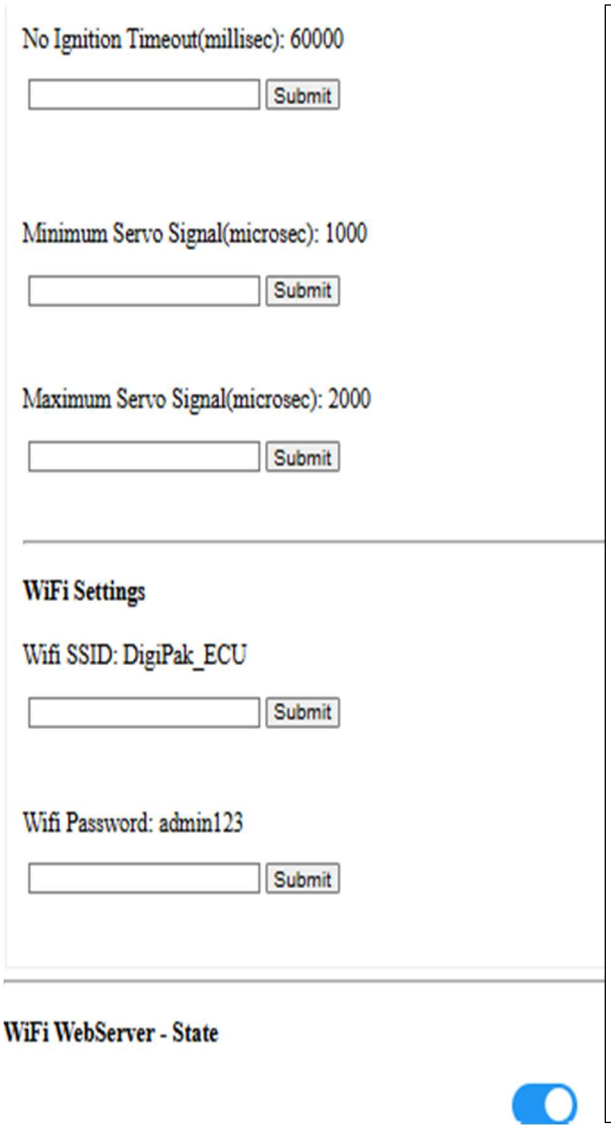
Purge throttle determines maximum RPM during purge sequence.

Starter delay controls acceleration of starter motor inversely. The bigger the number, the slower the acceleration

Acceleration and deceleration delay determines how quickly the fuel pump changes while responding to throttle. The bigger the value, the slower will be the response. Too small a number and engine might start oscillating as fuel supply may overshoot engine response.

Low RPM Acceleration and deceleration delays control fuel pump response from startup to idling stage. During this time RPM is changing slowly so fuel pump should also change slowly otherwise a wet start or hot start may happen.

Ignition Threshold is the temperature when ECU determines that ignition has been established. For Gas Start engines 100degC is a good number. For Kero start ignition threshold is generally lower and about 20-30 degC above ambient temperature



No Ignition timeout is the time limit used during startup. if ECU does not detect temperature increase and the timeout is reached, the ECU decides that ignition was not established and aborts the startup.

Minimum and Maximum Servo Signal values are used to output RC Servo Signals for Starter, Fuel Pump and RC Glow Driver.

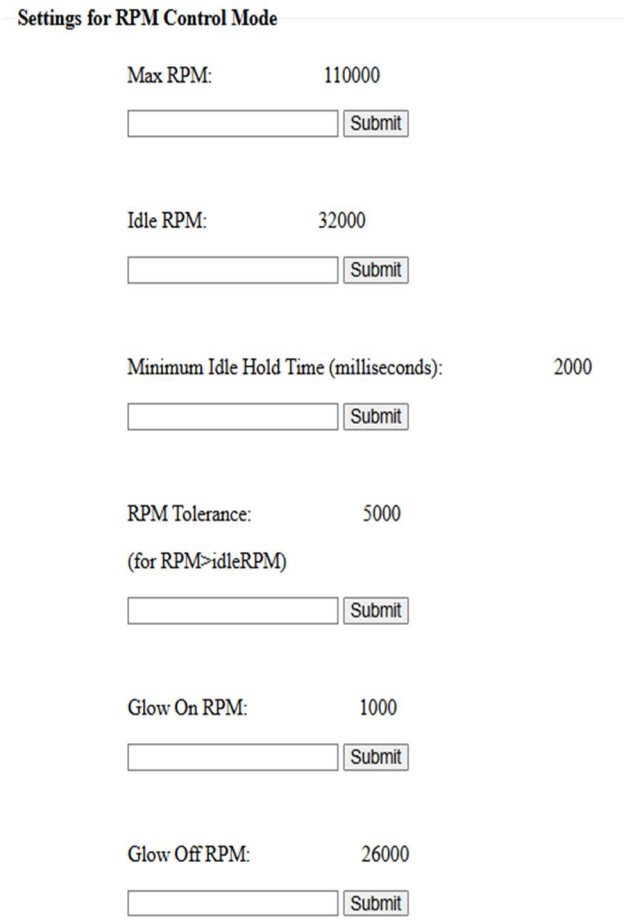
ECU comes with a default SSID of Ardu_ECU or DigiPak_ECU and a default password of admin123.

These can be changed to secure access to ECU over WiFi.

The SSID and password must be more than 8 characters.

If lost or forgotten after a change, These values cannot be reset. The ECU will still work as per settings but WiFi server will not be accessible without correct credentials.

WiFi Webserver will always be on at startup but can be switched off if required.



ECU will limit engine rpm to maxRPM value. If RPM exceeds above maxRPM, the ECU will reduce fuel supply to control RPM.

During startup ECU will accelerate to Idle RPM and hold there until throttle is moved to increase RPM OR Mode switch is used to shutdown the engine.

After reaching idle RPM, ECU will hold engine at idle RPM for minimum idle hold time before reacting to throttle.

During normal operation, ECU will maintain engine RPM based on throttle position. It will use the RPM tolerance to stay in target range. IF this number is too small, engine may start oscillating around target RPM.

During Startup, Glow plug or Kero Plug will switch on as soon as engine RPM exceeds GlowOnRPM.

Glow Plug/Kero Plug will be switched off as soon as engine RPM exceeds Glow Off RPM.

Ignition Cycle Method

◉ Use RPM Cycling ○ Use Throttle Cycling

Ignition RPM High: 6000

[ ] Submit

Ignition RPM Low: 2200

[ ] Submit

Gas On RPM: 2000

[ ] Submit

Gas Off RPM: 26000

[ ] Submit

Starter Off RPM: 24000

[ ] Submit

Fuel On RPM: 1000

[ ] Submit

Before ignition engine RPM cycles between a high and a low values to find the right air fuel mixture for ignition. This cycling can be done on two RPM values or two throttle values.

During startup engine will oscillate between Ignition RPM High and Ignition RPM Low and keroplug/glow plug will be switched on as well as gas flow will start. This will create the ignition after which the fuel can be pumped and engine accelerated. These values should be selected to create airflow to support initial ignition.

Gas On RPM is the value at which gas flow in gas start engines or fuel flow to kero plug in kero start engines will begin. Ideally this should be slightly below IgnitionRPMLow.

GasOffRPM is chosen when ignition is established and engine is running on fuel and there is no risk of flameout. This value is usually close to Idle RPM.

Starter Off RPM is the RPM when engine can accelerate under its own power and does not need starterfor acceleration. This value is above self sustaining RPM for the engine.

Fuel on RPM is the RPM at which the main fuel to engine starts flowing. This value should be just below ingintionRPMHigh.

Settings for Fuel Control Mode

Ignition Throttle High (0-1000): 110
[ ] Submit

Throttle High Time(milliseconds): 1000
[ ] Submit

Throttle Low Time(milliseconds): 2500
[ ] Submit

Glow Off Pump Voltage(0-30V): 1.300
[ ] Submit

Gas Off Pump Voltage(0-30V): 1.300
[ ] Submit

Starter Off Pump Voltage(0-30V): 1.300
[ ] Submit

Idle Pump Voltage(0-30V): 1.300
[ ] Submit

Maximum Pump Voltage(0-30V): 3.000
[ ] Submit

Target Volt Tolerance(0-30V): 0.300
[ ] Submit

Fuel control mode is used where RPM sensor is not available

During High/Low cycling of engine for ignition, IgnitionRPMHigh value sets the high throttle

This sets the time throttle will stay at high value to give time for engine to spool up

This is the time throttle will remain at low value

When fuelPumpVoltage reaches this value, the Glow Plug is switched off

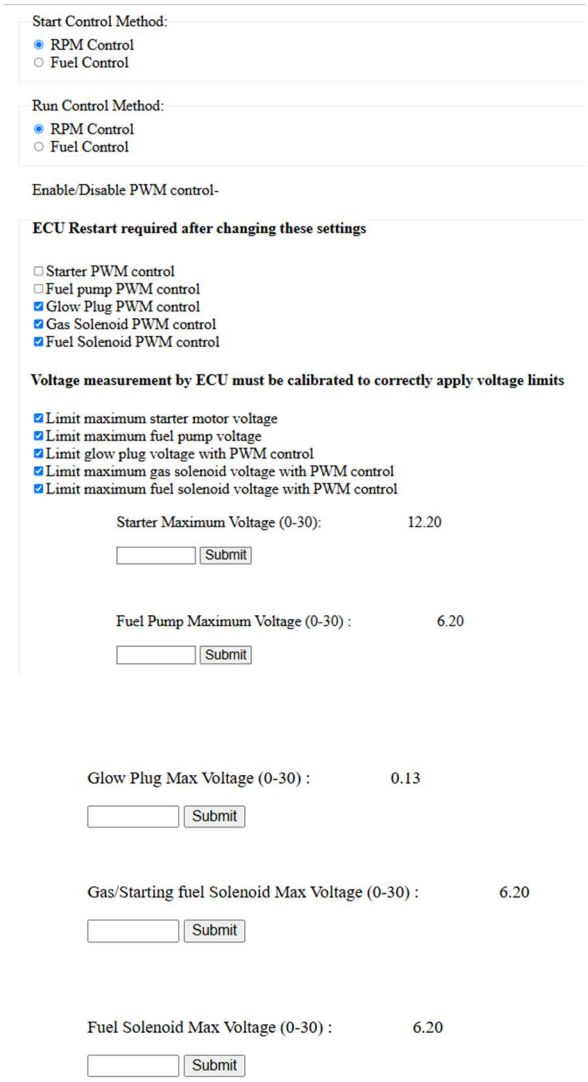
When fuelPumpVoltage reaches this value, the gas valve or kero fuel valve is switched off

As RPM is not used, once Fuel Flow reaches this value, engine is considered to be idling and starter is switched off

Once fuel pump voltage reaches Idle Pump Voltage, the pump voltage is held at this voltage as long as throttle is minimum

Irrespective of Throttle Fuel flow will not exceed Maximum Pump Voltage plus tolerance

The voltage tolerance at which target fuel flow will be maintained.



RPM Control for start and run control methods is default. Fuel Control can be used as an alternate method if RPM sensor is not available.

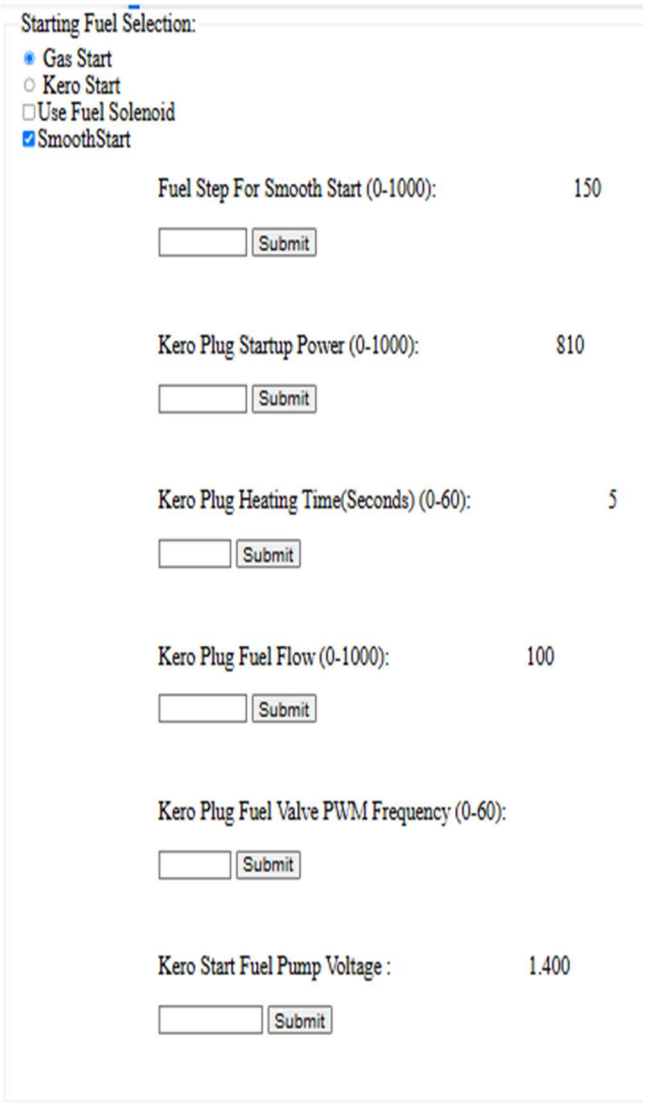
For ECUV2Power Starter and Fuel pump PWM must be unchecked.

Glow Plug, Gas and Fuel Solenoid should have PWM control checked.

If any component runs at less than supply voltage then the voltage can be reduced to the attached component and set in this section.

Ensure that PWM is set and voltage limits for Glow plug are enabled , the limit can be entered here. For nitro engine RC Glow plug this value should be 0.13-0.14 volts.Wrong limit can damage the glow plug

Solenoid voltages can be set as per component specifications



This section is for selecting starting method e.g. Gas or Kero Start and setting up parameters for Kero Start.

Smooth start gradually switches between Kero flow and main fuel flow. Fuel Step determines how smooth this transition is.

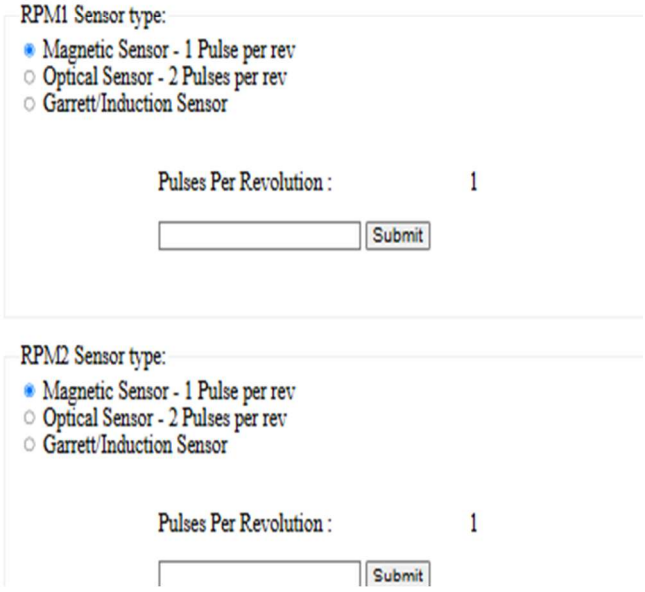
Kero Plug Startup power will determine how much voltage is applied to Kero Plug for heating. A value of 1000 will apply full supply voltage to Kero Plug.

Kero Plug Heating time is a preheating time after which the fuel will start flowing as Kero plugs require a few seconds to reach maximum temperature.

Kero Plug fuel flow determines the percentage of time the kero valve will remain open as it switched on and off.

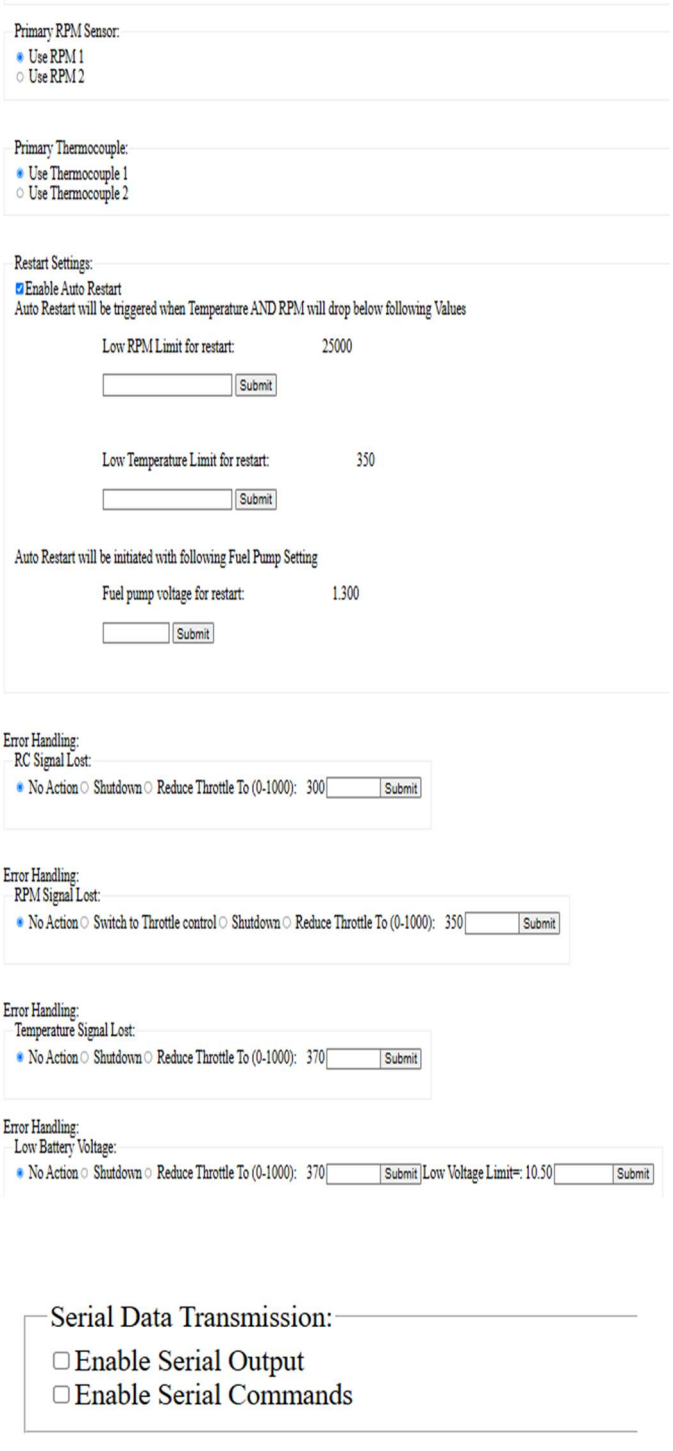
Kero Valve PWM Frequency determines the frequency at which kero plug oscillates to control the fuel flow.

Kero Start Fuel Pump Setting determines the fuel pump speed for kero start.



RPM Sensor type settings determine the counts per revolution for the RPM1 Sensor and RPM2Sensor.

Garrett/Induction sensor setting can be setup for fractional counts per revolution as these sensors count the number of blades and not the actual revolutions.



Primary RPM Sensor will be used to determine RPM for engine control. If only one sensor is connected than it should be used as primary sensor.

Primary thermocouple can be selected as Thermocouple1 or Thermocouple 2.

Enable/Disable Auto restart

Restart will trigger when **RPM AND Temperature** fall below set points

RPM trigger for Restart

Temperature Trigger for Restart

Once restart is triggered , fuel pump will start at this voltage and kero plug will switch on.

This setting determines the action if RC signal is lost

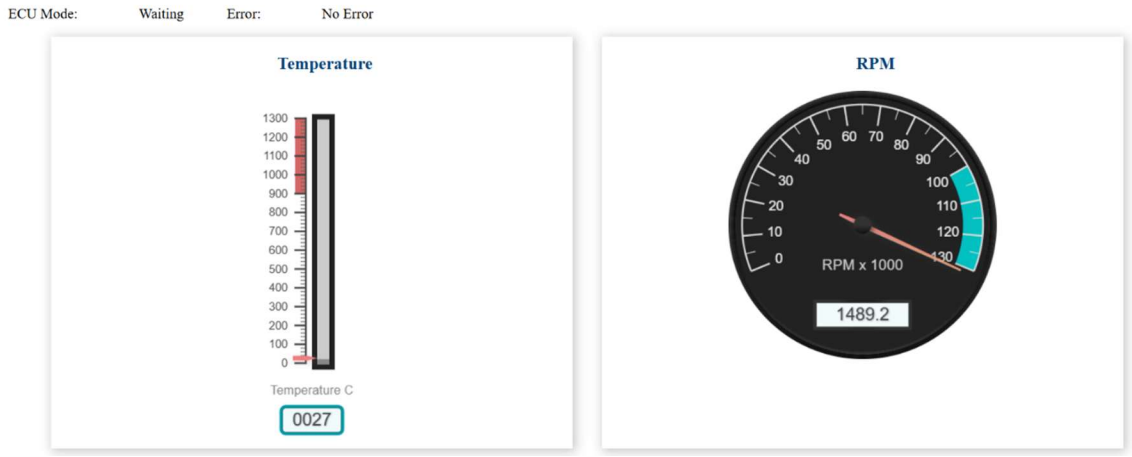
This setting determines the response in case of RPM signal loss.

This settings determine the ECU actions if temperature signal is lost.

This setting handles the low battery voltage situation.

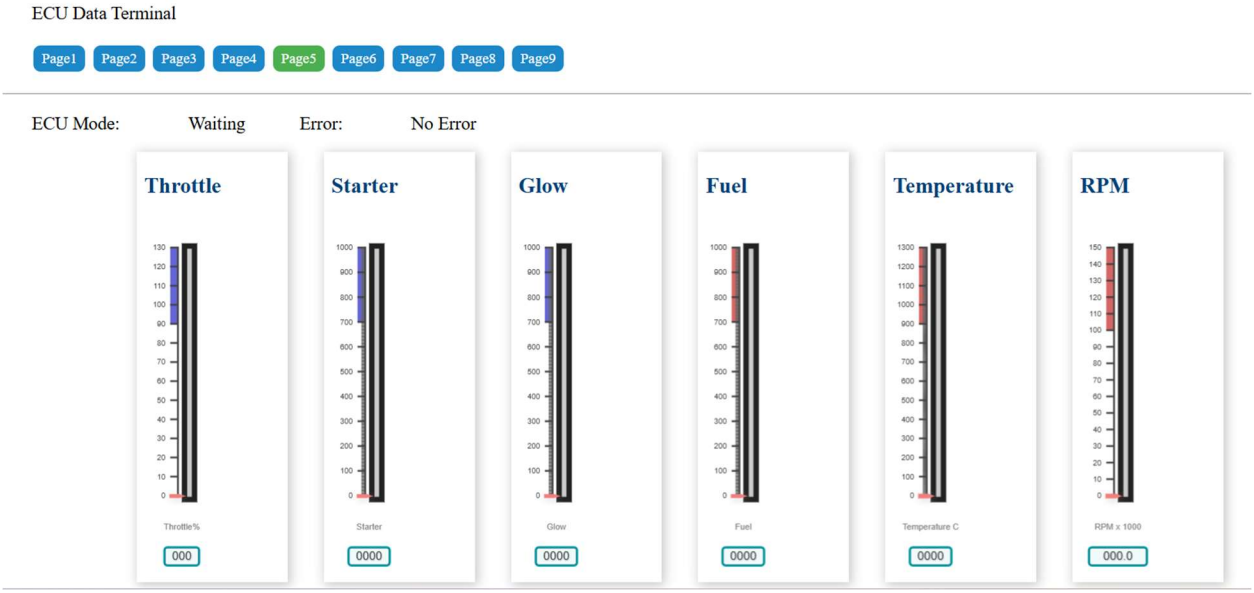
These settings enable and disable serial input/output. ECU will accept serial commands only when enable serial commands checkbox is selected.

Page 4



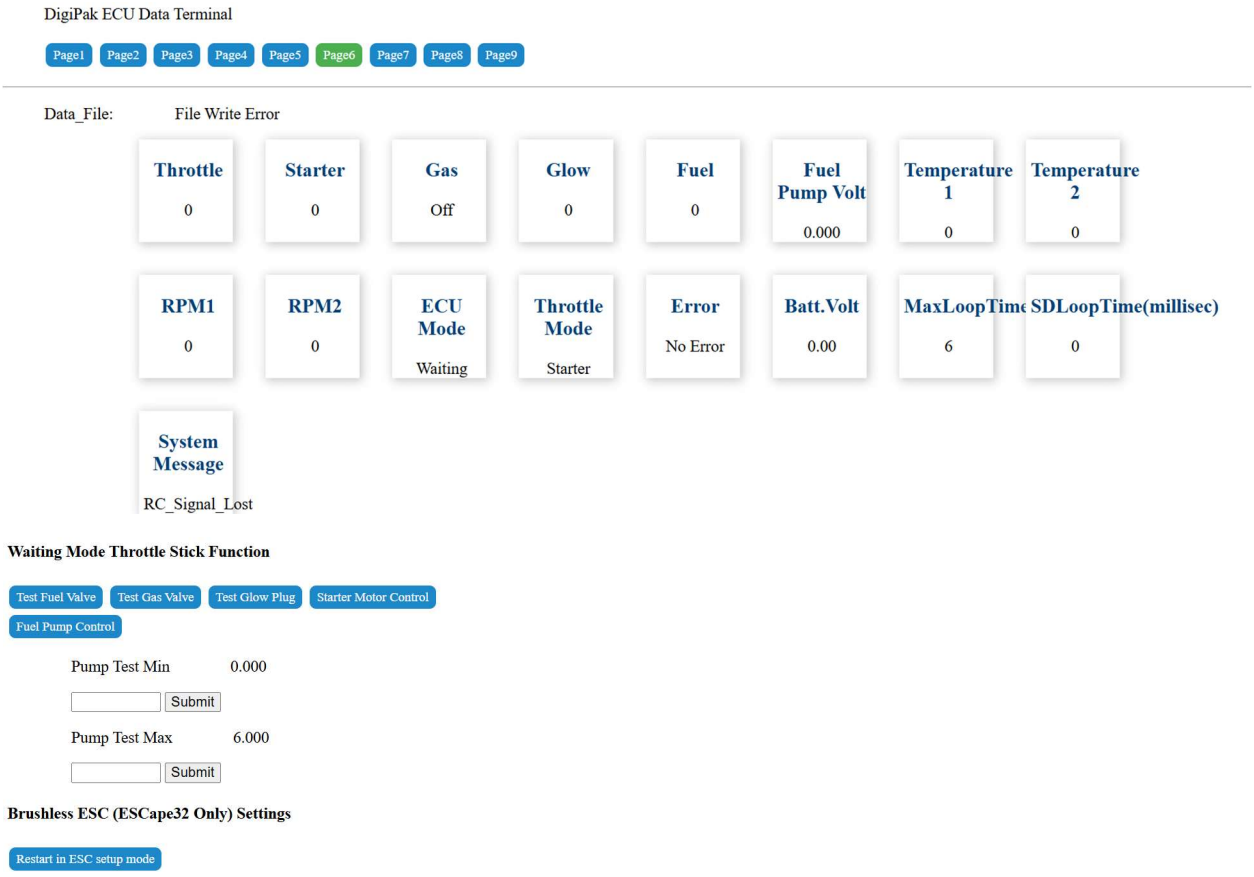
This is a display page that will display ECU mode and Error in text while Temperature readings and RPM using the graphical interface.

Page 5



Page 5 displays multiple values in graphical form for a quick overview of engine state during running.

Page 6



Page 6 is used for data display as well as for testing engine components.

Top of the page displays Data file being recorded on micro SD card if an SD card is present.

Box Displays shows the current values of important engine parameters.

All the buttons work only when ECU is in waiting mode. During operation these buttons cannot be used.

When ECU is powered up and is in the waiting state, the throttle input will control starter. This way starter can be tested while ECU is in waiting mode.

When fuelpump control button is pressed, throttle mode changes to fuel pump. In this mode the throttle stick will control fuel pump. This can be used to test the fuel pump as well as prime the fuel pump.

Test Fuel valve will switch on the fuel valve for a few seconds and then turn it back off. The clicking of fuel solenoid can be used to confirm connection and functionality.

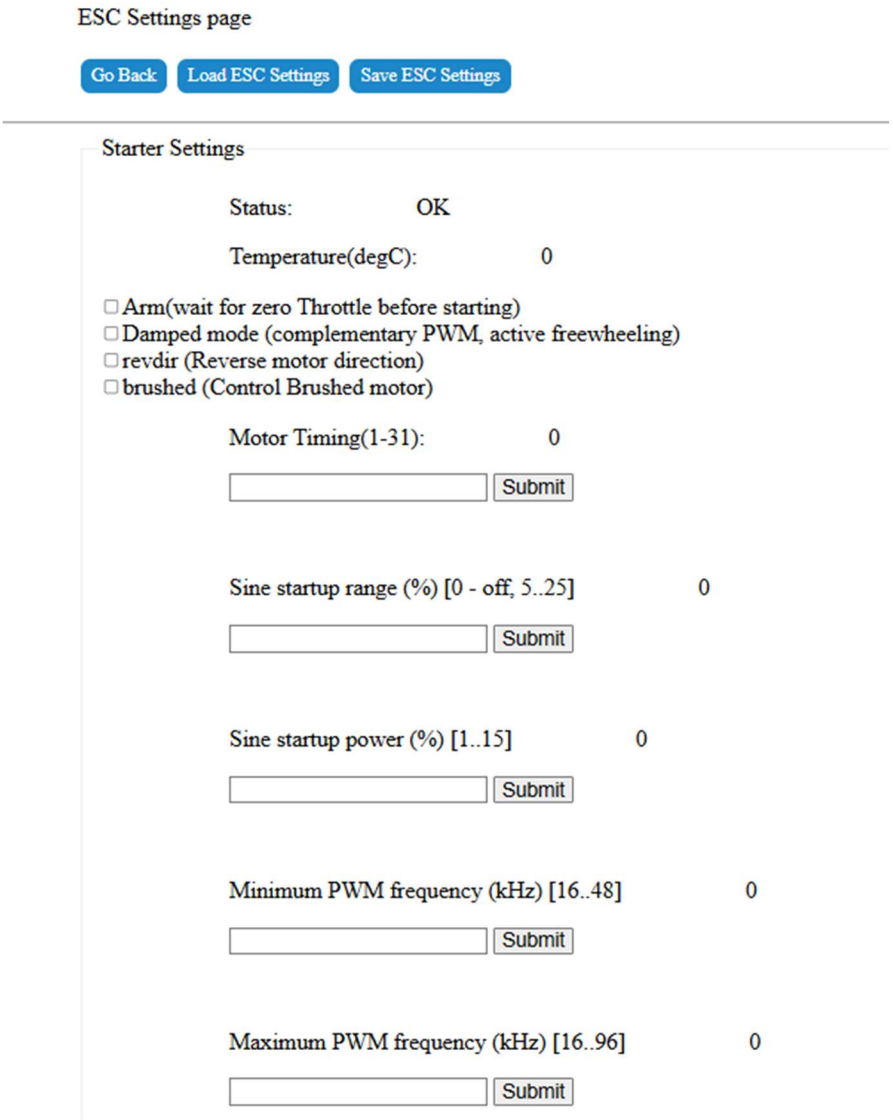
Similarly test gas valve will switch on the gas/Kero solenoid for a few seconds and then turn it off. On a Gas start engine make sure that gas is not being supplied as this may release combustible gases during gas valve test.

Test Glow Plug will switch on the glow plug for a few seconds. Glow Plug or Kero plug will usually glow red and become extremely hot during this test and therefore proper precautions must be taken to avoid damage to people or property.

Escape32 ESC Setup

To change settings of internal ESC, the ECU needs to be restarted in ESC Setup mode by pressing the button at bottom of page 6. This will cause ECU to restart in ESC setup mode. Now when you go to page you will find two additional buttons for starter and fuel pump ESC.

Pressing these buttons will take you to ESC setup page where ESC settings can be loaded from ESC, Changed and saved to ESC. Note: to save your changes you must press Save ESC Settings button otherwise changes will be lost. After saving the settings , ECU will need to be restarted to return to normal mode.



Page 7

DigiPak ECU Variables at Abort time

RPM:	0
Temperature:	0
Fuel Flow:	0
Starter:	0
Gas Flow:	0
Fuel Flow:	0
Ignition State:	0
RC Mode:	0
RC Throttle:	0
Glow Signal:	0
ECU Mode:	0
StartStage:	0
Battery Voltage:	0.00
Error Code:	0

Page 7 displays the last readings before an abort action was executed by ECU. This can help in determining reason for an abort.

Page 8

Lifetime Usage Data

ECU Powerup Count: 122

Reset

Engine Starting Count: 7

Reset

Engine Run Time-Total(minutes): 342.00

Reset

Engine Run Time-Current Run(minutes): 0.00

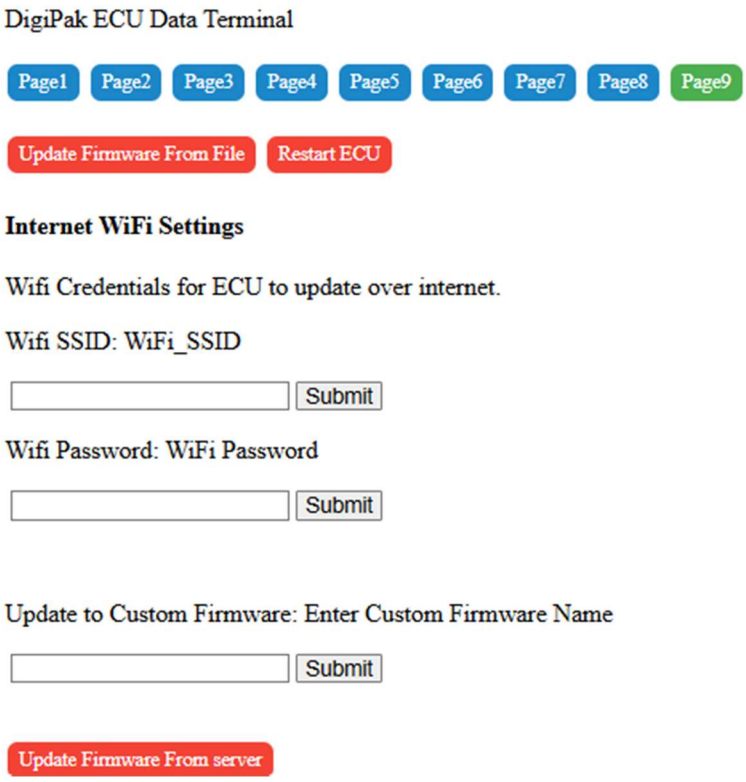
Page 8 Displays lifetime usage data for ECU and the engine. This data is stored in flash memory and is not lost between power cycles.

Page 9

Following section provides for updating firmware of the ECU. Update from file is used when you have a firmware file available, however for normal users “Update firmware from server” will be used. This option will connect the ECU to DigiPak server over internet and look for an updated firmware. IF available the new firmware will be downloaded and installed.

Update to Custom Firmware is used if there is a custom firmware requested by client from DigiPak otherwise this can be left blank.

The user will need to provide local WiFi access for ECU to connect to internet. WiFi_SSID and WiFi Password need to be stored in ECU before update from server can be performed.



DigiPak ECU can save all settings in a file on microSD card and these can be loaded when return to these settings is required. This makes DigiPak ECU portable across multiple engines. Just load the settings for the engine and ECU is ready to run that engine.

In addition to settings , ECU records various measured and calculated parameters in a file on SD card as soon as ECU is powered up. These are useful for reviewing the engine performance and trouble shooting. microSD is not mandatory. If no microSD card is available, the ECU will skip the recording and perform normally.

Load Settings From File

Choose File No file chosen Upload

Save Settings

Save Settings

File Recording

Stop Recording Start Recording Open New File Delete All Files

Data Files

Name	Size		
Data1.txt	63.9 KB	Download	Delete
Data2.txt	24.2 KB	Download	Delete
Data3.txt	23.3 KB	Download	Delete
Data4.txt	5.3 KB	Download	Delete
Data5.txt	15.3 KB	Download	Delete
Data6.txt	6.3 KB	Download	Delete
Data7.txt	5.3 KB	Download	Delete

Serial Port Commands

Control Commands:

Following commands can be used to control ECU over serial port. The Serial data rate required is 115200 8N1. Commands are not case sensitive

startwifi	Start the WiFi Server
stopwifi	Stop WiFi Server
startSerialControl	Stop responding to RC control and ECU is only controlled by serial commands
stopSerialControl	Stop responding to serial control and only controlled by RC commands
reboot	Reboot the ECU
abort	Abort current operation, shut down fuel pump, starter and all solenoid valves and glow plug
start	Start the engine(Will only work if serial control is enabled by “startSerialControl")
throttle XXX(0-100)	Set throttle to XXX (Will only work if serial control is enabled by “startSerialControl")
cooldown	Shutdown if engine is running and initiate cooldown
savesettings	Save all current settings to EEPROM
testFuel	Test Fuel Solenoid
testGas	Test Gas/Kero Solenoid
testGlow	Test Glow Plug
testPump	Switch to Pump prime mode
testStarter	Switch to Starter control mode

Setup commands

These commands change ECU settings and will stay in memory till power down. Each command is followed by a space and then the parameter value. If these changes are to be saved permanently then “savesettings” must be used to write these changes to EEPROM. The units of these commands are same as in WiFi interface.

glowpower XXX	Set glow Power during startup (0-1000)
maxRPM XXX	Set the maximum RPM limit to XXX
maxTemp XXX	Set the maximum Temperature limit to XXX

idleRPM XXX	Set idle RPM value to XXX
rpmTolerance XXX	RPM tolerance value for target RPM
glowOnRPM XXX	Set the glow on RPM value to XXX
glowOffRPM XXX	Set glow off RPM value to XXX
ignitionRPMHigh XXX	Set ignition RPM High value to XXX
ignitionRPMLow XXX	Set ignition RPM Low value to XXX
gasOnRPM XXX	Set gas on RPM to XXX
gasOffRPM XXX	Set gas off RPM to XXX
starterOffRPM XXX	Set Starter off RPM to XXX
fuelOnRPM XXX	Set fuel on RPM to XXX
pumpOnVolt X.XX	Set pump on volt to X.XXvolts. As soon as the pump starts it will jump from zero to this value
pumpOffVolt X.XX	Set pump off volt to X.XXvolts. As soon as the pump stops it will jump to zero from this value
purgeThrottle XXX	Set purge throttle for the purge cycle to XXX
purgeTime XXX	Set purge time to XXX milliseconds
starterIDelay XXX	Set starter increment delay to XXX milliseconds. The higher the number the slower will be starter acceleration
noIgnThreshold XXX	Set the no ignition threshold time to XXX milliseconds
ignThreshold XXX	Set the ignition threshold temperature to XXX degC
accelDelay XXX	Set fuel pump increment delay to XXX milliseconds.applicable after idle.
decelDelay XXX	Set fuel pump decrement delay to XXX milliseconds .applicable after dle.
startingTemp XXX	Set the starting temperature value to maintain during startup.
maxTempGrad XXX	Maximum temperature gradient for engine control.
maxMotorVolt XXX	Set maximum Starter motor voltage in PWM mode.
maxPumpVolt XXX	Set maximum fuel pump motor voltage in PWM mode.
MIN_MICROS XXX	Set minimum Servo Signal time for output (microseconds)
MAX_MICROS XXX	Set maximum Servo Signal time for output (microseconds)
lowADelay XXX	Set delay in milliseconds for each increment of fuel pump below idle.
lowDDelay XXX	Set delay in milliseconds for each decrement of fuel pump below idle.
cpr1 XXX	counts per revolution for RPM1 sensor Integer Value
garcpr1 XXX	counts per revolution for RPM1 sensor floting point value
cpr2 XXX	counts per revolution for RPM2 sensor-Integer

garcpr2 XXX	counts per revolution for RPM2 sensor-floating point
kerostart	Will set the engine to kerostart mode
gasstart	Will set the engine to gas start mode.
keroTime XXX	Kero plug heating time in XXX milliseconds
keroPower XXX	Kero plug heating power 0-1000
keroValve XXX	Kero fuel flow valve settings 0-1000
keroFreq XXX	Kero valve frequency (0-60)
keroPumpVolt X.XX	Kero fuel flow pump voltage settings X.xx volts
glowOffFuelVolt X.XX	Glow off fuel pump voltage in fuel control mode
gasOffFuelVolt X.XX	Gas/Kero Valve off fuel pump voltage in fuel control mode
starterOffFuelVolt X.XX	Starter off fuel pump voltage in fuel control mode
idleFuelVolt X.XX	Fuel pump voltage for idle running in fuel control mode
maxFuelVolt X.XX	Maximum fuel pump voltage in fuel control mode
fuelTolVolt X.XX	voltage tolerance in fuel control mode
startSerialD	Start transmitting Serial Data
stopSerialD	Stop transmitting Serial Data
stopSerialC	Stop Serial Command mode and switch to RC control
phDelay XXX	Preheat delay between ignition and ramp up to heat the engine (milliseconds)
primaryThermo X	Primary Thermocouple 1 or 2
fuelPWM	Enable fuel pump PWM control mode
fuelRC	Enable fuel pump RC signal control mode- used with brushed or brushless ESC's
startPWM	Enable starter motor PWM control mode
startRC	Enable starter motor RC signal control mode- used with brushed or brushless ESC's
glowPWM	Enable PWM control mode for glow plug/kero plug
glowRC	Enable RC signal control mode for glow plug/kero plug driver
gasPWM	Enable PWM mode for gas solenoid control
gasonoff	Enable simple on/off control for gas solenoid
fuelsolenoidPWM	Enable PWM control mode for fuel solenoid
fuelsolenoidonoff	Enable simple on/off control mode for fuel solenoid
startVL	Enable starter motor voltage limit
startnoVL	Disable starter motor voltage limit (apply upto full supply voltage)

fuelVL	Enable fuel pump voltage limit
fuelnoVL	Disable fuel pump voltage limit (apply upto full supply voltage)
glowVL	Enable glow plug voltage limit
glownoVL	Disable glow plug voltage limit (apply upto full supply voltage)
gasVL	Apply gas solenoid voltage limit (applicable in PWM mode)
gasnoVL	Disable gas solenoid voltage limit (apply full supply voltage to turn on solenoid)
fsVL	Apply fuel solenoid voltage limit (applicable in PWM mode)
fsnoVL	Disable fuel solenoid voltage limit (apply full supply voltage to turn on solenoid)
sVolt XXX	Set starter motor maximum voltage limit to XXX
pVolt XXX	Set fuel pump maximum voltage limit to XXX
gVolt XXX	Set glow Plug/Kero plug maximum voltage limit to XXX
gsVolt XXX	Set gas solenoid maximum voltage limit to XXX
fsVolt XXX	Set fuel solenoid maximum voltage limit to XXX
rcfResponse XXX	RC failure response (XXX =0=do nothing, 1=Abort, 2=reduce throttle)
rpmfResponse XXX	RPM failure response (XXX=0=Throttle based control, 1=Abort, 2=reduce throttle)
tempfResponse XXX	Temperature sensor failure response(XXX=0=Do nothing, 1=Abort, 2=reduce throttle)
lowBResponse XXX	Low Battery response (XXX=0=Do nothing, 1=Abort, 2=reduce throttle)
rcFailureThrottle XXX	Throttle value for RC signal failure (0-100)
rpmFailureThrottle XXX	Throttle value for rpm sensor failure(0-100)
tempFailureThrottle XXX	Throttle value for temperature sensor failure(0-100)
lowBThrottle XXX	Throttle value for low battery failure(0-100)
lowVLimit XXX	Low voltage value to consider low battery failure
primaryRPM XXX	Primary RPM sensor . XXX Must be 1 or 2
primaryThermo XXX	Primary thermocouple for temperature measurement . XXX Must be 1 or 2
enableRestart	Try restart in case of engine flameout
disableRestart	do not restart if engine has a flameout during running
restartRPM	RPM value below which restart will be triggered if temperature is also below limit
restartTemp	Temperature limit below which restart will be attempted if rpm is also below restart rpm
restartFuelVolt	Pump voltage for restart fuel flow