

UAV engine EFI components Specifications Manual

-In miniature sizes

- For 20cc to 300cc engines

V2.2

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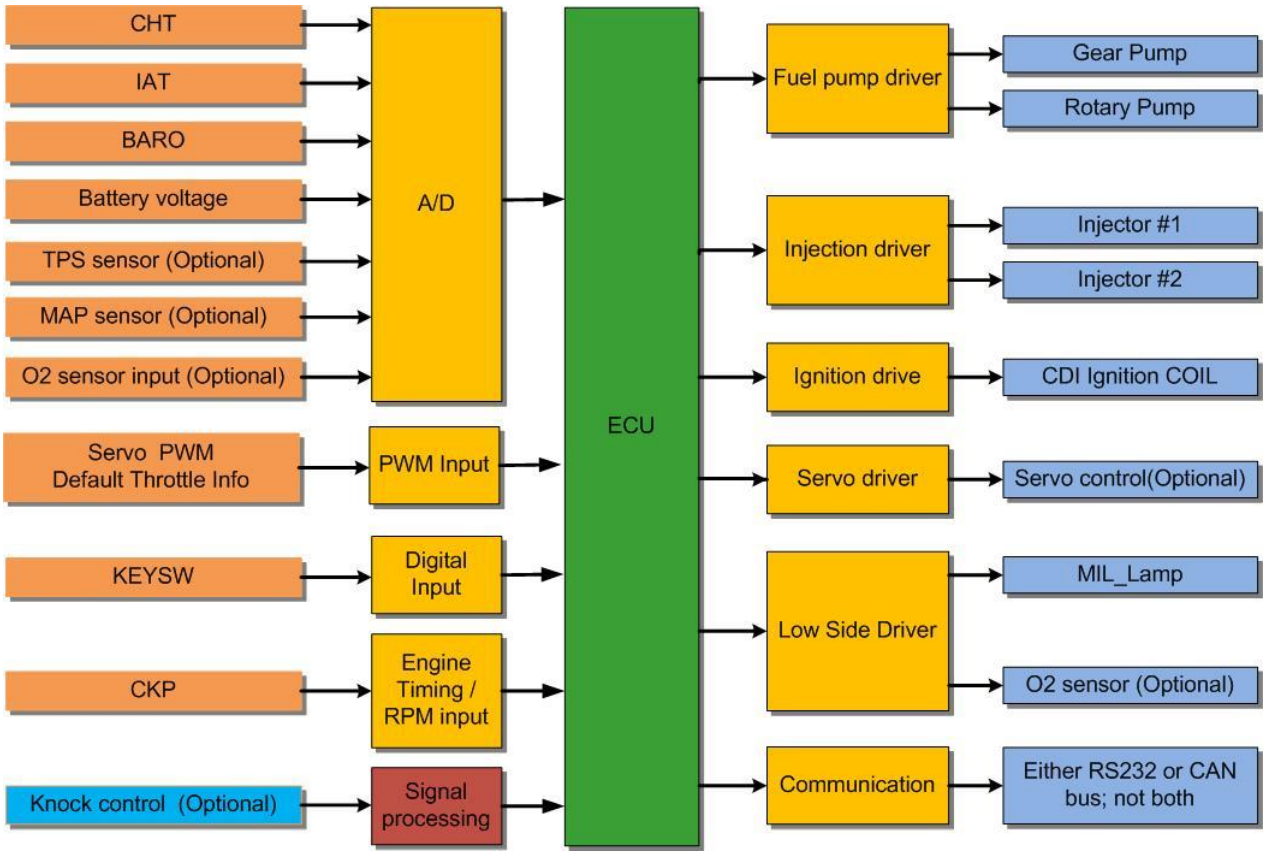
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To meet the requirement of UAV small engine EFI systems, Ecotron has developed a series of mini-size EFI components.

1. UAV EFI System Overview

1.1 EFI System Block Diagram



Abbreviation:

IAT: Intake Air Temperature Sensor

CHT: Engine Temperature or Cylinder Head Temperature Sensor

BARO: Barometric Pressure Sensor

MAP: Manifold Absolute Pressure Sensor

TPS: Throttle Position Sensor

KEYSW: Key Switch or Ignition Switch input

CKP: Crank Position Sensor

ROUT: Relay control Output

INJ: Injector control output

CDI: Capacitor Discharge Ignition Controls

SERVO: Servo motor which controls the throttle position

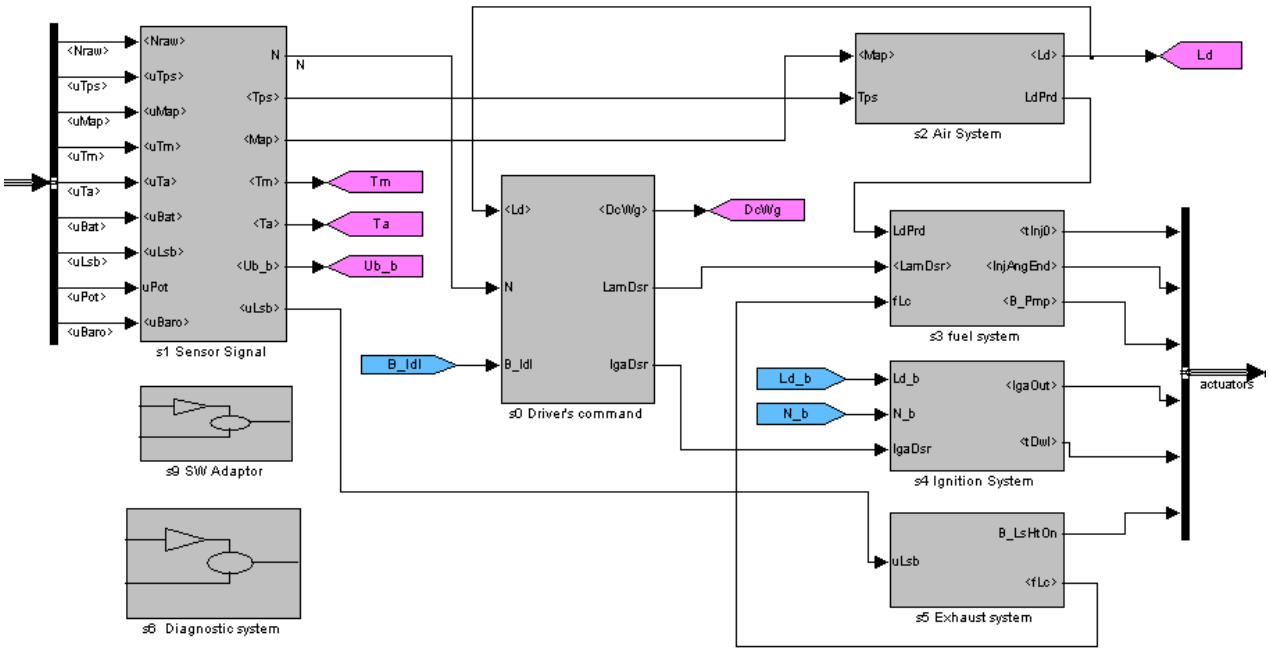
CAN: Controller Area Network or CAN bus

FGP: Gear Pump

FRP: Rotary Pump

Knock: Knock sensor for ignition control closed-loop

1.2 Control Strategy Block Diagram



Control Strategy Block Diagram (as above)

Major control strategies:

- Charge detection and prediction.
- Fuel injection controls.
- Ignition system controls.
- Fuel pump controls.
- Idle speed controls
- Transient fuel compensations.
- Decel-fuel-cut-off.
- Altitude compensations.
- Temperature compensations (winter, summer, etc.).
- Engine protections.
- Diagnostics and serial communications.
- Servo motor controls (optional).
- Knock Control (optional).

2. ECU

2.1 ECU Overview

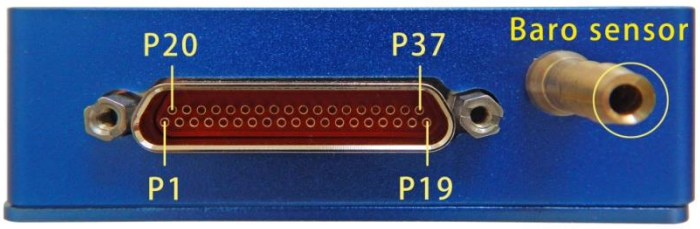
The core part of Ecotron ECU is **Freescale**'s 16 bit or 32 bit microprocessor that is specifically designed for powertrain controls. ECU also includes some Application Specific Integrated Circuits, or ASIC chips, from world famous automotive semiconductor manufacturers, like **Infineon**, and **International Rectifier** etc. Most importantly, Ecotron ECU contains the state-of-art engine control software which combines both efficiency and flexibility of the modern engine control technology.

Ecotron has a few small engine ECUs; all small sizes and light weight.
Below is the latest version, the mini-size UAV ECU (smaller than a business card).
It has a Built-in BARO pressure sensor for altitude compensations on ECU.







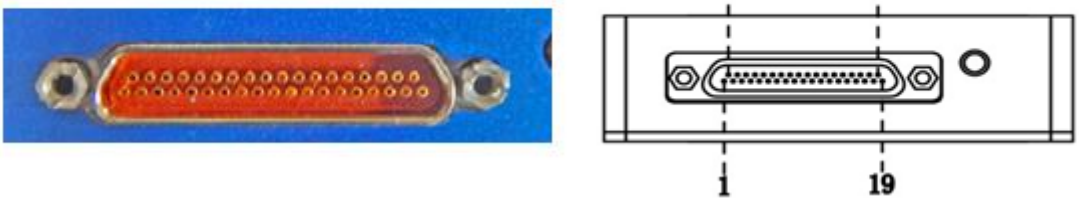


2.2 ECU Technical Parameters

Voltage	9~16V DC
Current	≤60mA
Storage Temperature	-40~125℃
Working Temperature	-40~125℃
Time before Overhaul (TBO)	≥10000h
Weight	**≤120g**

2.3 ECU Pin Definition and Description

ECU Connector View：



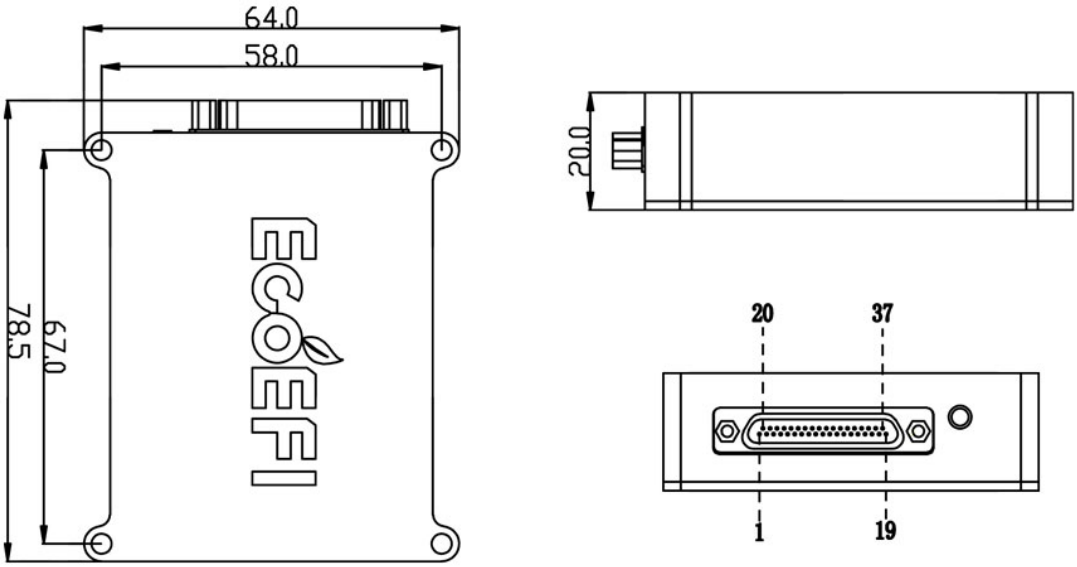
Definition of pins:

Number	Define	Color	instructions
1	INJ1	White	Fuel injector # 1 low side driver output
2	KEYSW	Blue	Fuel injector # 1 power output
3	GND	Black	Power ground
4	GND	Black	Power ground
5	ROUT	White	Relay low side driver output
6	KEYSW	Blue	Relay power output
7	GND	Green	CKP(pick-up) sensor ground
8	CKP	White	Crank Position sensor input (Pickup)
9	VCC	Yellow	Power of Hall sensor
10	CANL	Green	CANL

11	CANH	Yellow	CANH
12	MAP	White	Intake manifold pressure sensor (Optional)
13	RXD	White	Goes to RXD of RS232
14	TXD	Yellow	Goes to TXD of RS232
15	GND	Green	RS232 ground
16	PWMIN	White	Servo motor PWM input
17	PWMOUT	White	Servo motor control PWM output (Optional)
18	GND	Green	Servo motor ground
19	VCCM	Yellow	Power of servo motor (Optional)
20	NULL	----	---------
21	NULL	----	---------
22	GNDP	Blue	Power ground
23	GNDP	Red	Power ground
24	KEYSW	Blue	Power of Mil-Lamp
25	Mil-lamp	White	Mil-Lamp
26	12V+	Blue	ECU power input
27	12V+	White	ECU power input
28	CHT	White	Cylinder head temp sensor input
29	GND	Green	CHT ground
30	GND	Green	IAT ground
31	IAT	White	Intake air temp sensor input
32	VCC	Yellow	+5V Power of Throttle position sensor
33	TPS	White	Throttle position sensor signal
34	GND	Green	Ground of throttle position sensor
35	Per_SW	White	Performance switch
36	GND	Green	Ground
37	CDI-PG	White	Control signal of CDI

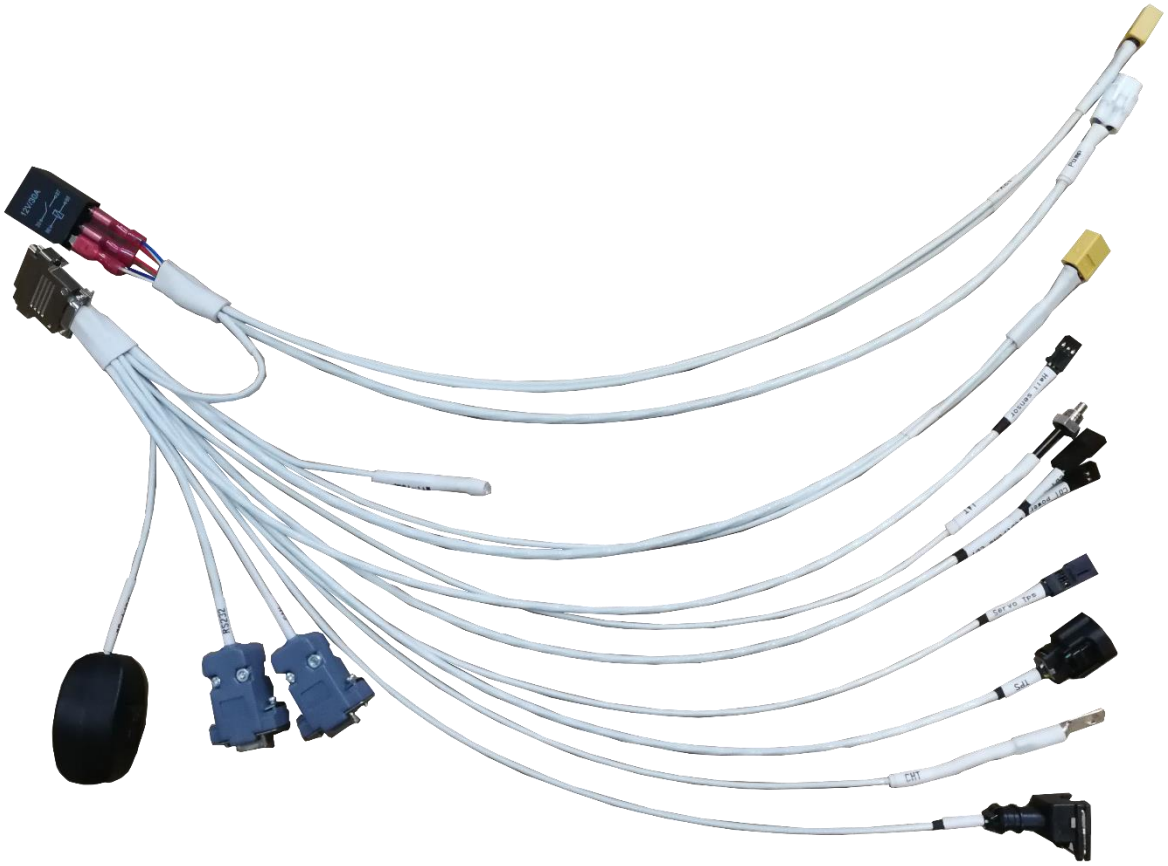
2.4 ECU Mechanical CAD drawing and dimensions

All dimensions are in “mm”, or millimeters.



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3. EFI Harness



Harness Picture and Weight

Harness Weight: <280g (depending on the final length and EFI parts, with CHT and IAT sensor), 0.5 meter long.

Time before Overhaul (TBO): ⩾10000h.

The example harness is for rotary fuel pump with Relay, CHT and IAT sensor.

4. UAV CDI

4.1 UAV CDI Overview

Ecotron UAV CDI ignition system can control one or two spark plug for 2 stroke small UAV engines. This UAV CDI can be programmed by the user. This UAV CDI only needs one input from Ecotron ECU, which controls the exact ignition timing. Ecotron UAV CDI ignition system includes single channel and dual channel ignition.



UAV CDI- single channel ignition



UAV CDI- dual channel ignition

If there are two spark plugs on your 2 stroke engine, you need to install the UAV CDI with dual channel ignition, and make high voltage cable go to the spark plug directly.



UAV CDI- dual channel ignition

4.2 Technical Parameters

CDI system (single channel) weight: 120g
CDI system (Dual channel) weight: 160g
Power supply: 12V
CDI Unit Size: 50x38x29mm
Time before Overhaul (TBO): ⩾5000h

1) Minimum RPM limitation of firing: < 250 r/min
2) Working RPM range: 250r/min~11000r/min
3) Withstand voltage: The secondary peak voltage 35kV, without breakdown in continuously 1 minute.
4) Resistance between primary and secondary coil.
Measured with digital multimeter: Primary coil 4.0Ω+10%:
Secondary coil:13.5kΩ+10%
Measured with Digital inductance meter: Primary coil: 6.5mH+1 0%
Measured with bridge: Secondary coil: 20H+10%
5) Spark cap resistance: 5kΩ+10%
6) The secondary peak voltage: when the primary voltage is 200V, the secondary voltage is higher than 22kV.
7) Without breakdown in continuously 30 seconds, 2500r/min

5. Throttle Body

5.1 Throttle body with servo assembled

Note:
The throttle body is 60g;
The servo motor is 30g;
The total assemble is 100g;
Time before Overhaul (TBO) of throttle body is ⩾20000h;



14mm Throttle Body **18mm Throttle Body**



22mm Throttle Body



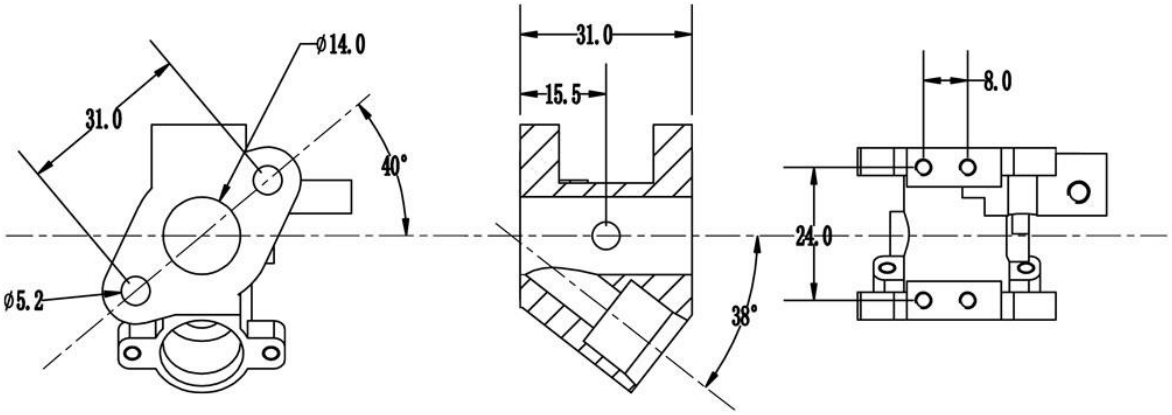
28mm Throttle Body



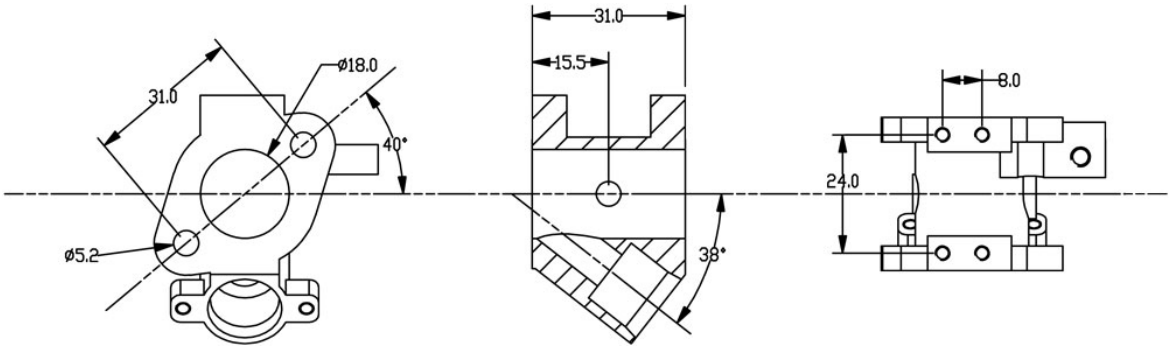
34mm Throttle Body

5.2 Mechanical CAD drawing

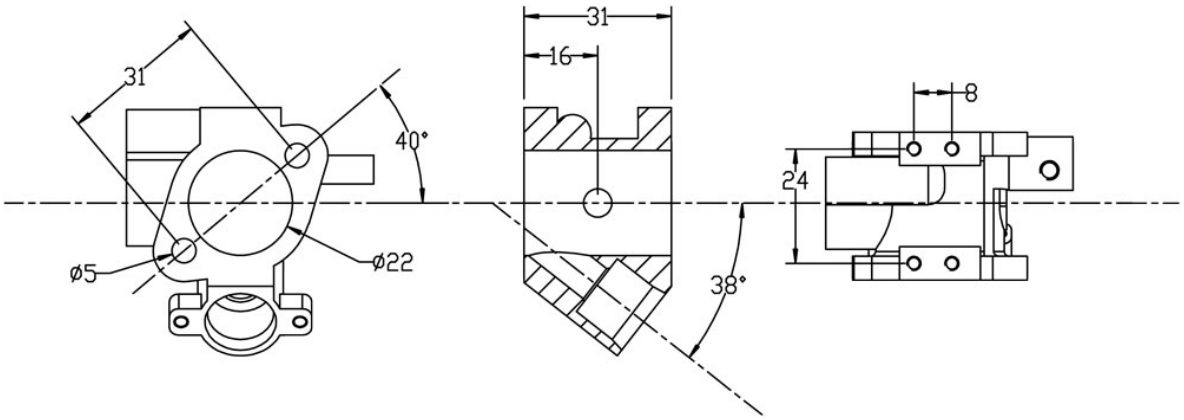
14mm TB CAD drawing:



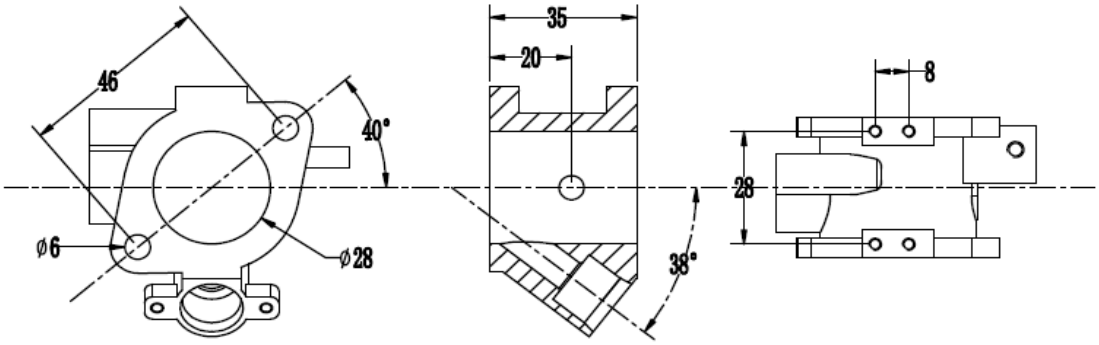
18mm TB CAD drawing:



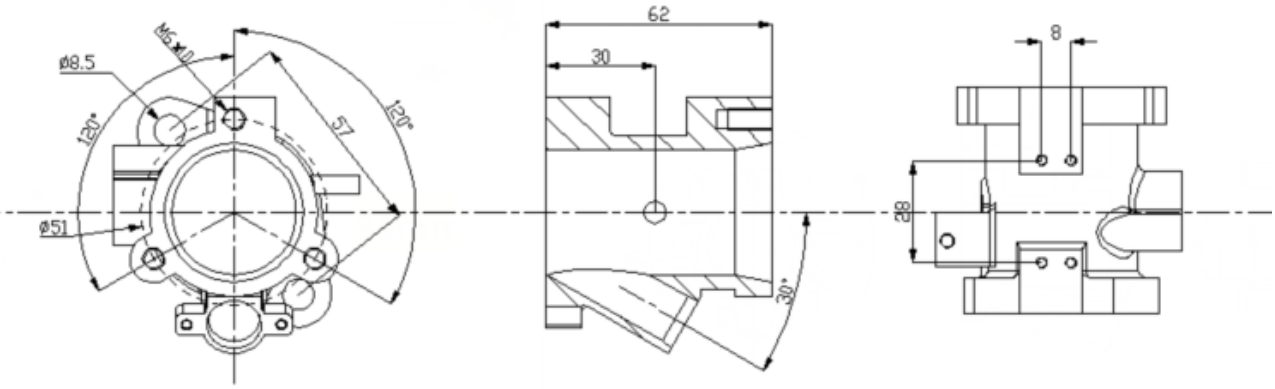
22mm TB CAD drawing:



28mm TB CAD drawing:



34mm TB CAD drawing:



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6. Fuel supply system

We have two kinds of fuel supply system, one is rotor pump assembly, the other one is composed of gear pump and gear pump controller. In comparison, the gear pump system is light in weight and low in power consumption.

Basic characteristics

	Rotor Pump	**Gear Pump**
Supply voltage	12VDC	(+11~15) VDC
Working current	<2.5A	<1.5A
Flow	25L/h	>=12L/h@3bar
Weight	**460g**	**80g**
Installation Style	External	External
Working temperature	（-40~+80）°C	(-25~+70) °C
Fuel type	Gasoline Gasoline with <=20% ethanol	Gasoline Gasoline with <=20% ethanol
Storage Temp Range	-30°C~60°C	-20~100 °C
Humidity	<=60%	--
Time before Overhaul (TBO)	>2000h	>=500h
Storage period	<=2 years	--

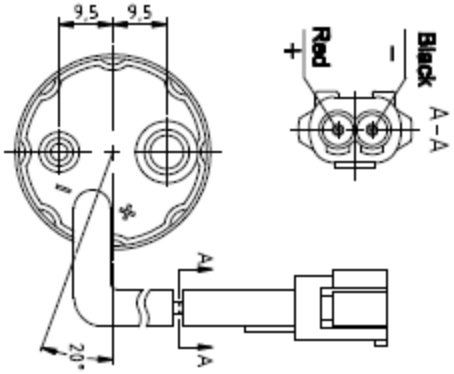
6.1 Rotor pump assembly

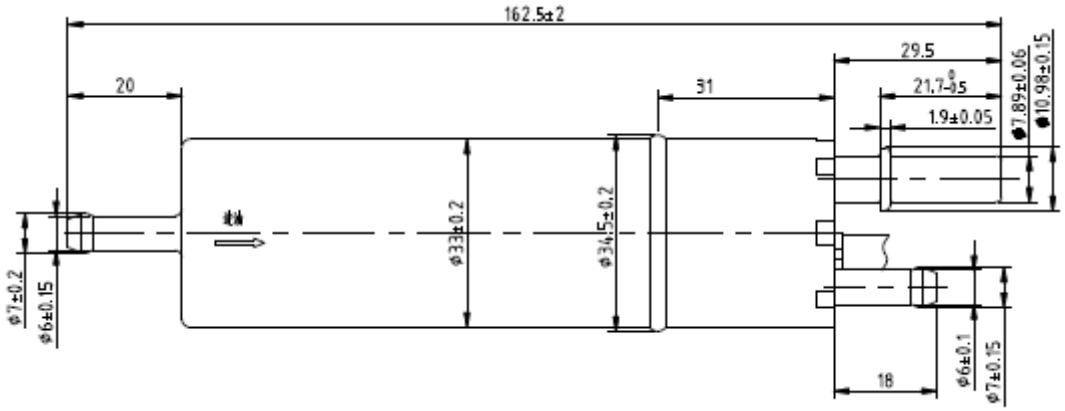
6.1.1 Picture of rotor pump assembly



Rotor Pump Assembly

6.1.2 Mechanical Dimensions of the rotor pump assembly





6.2 Gear pump system

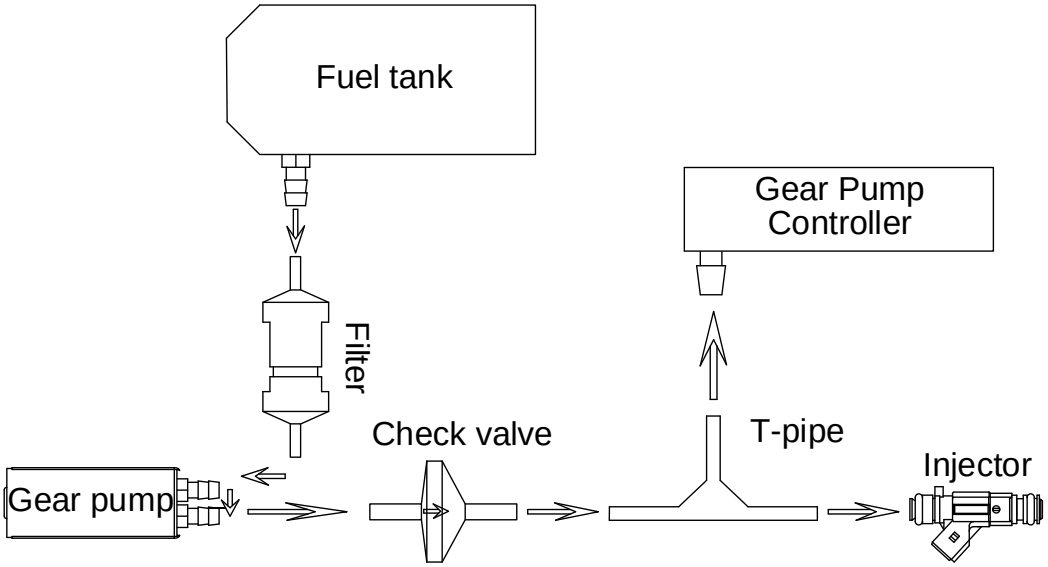
6.2.1 Picture of Gear pump

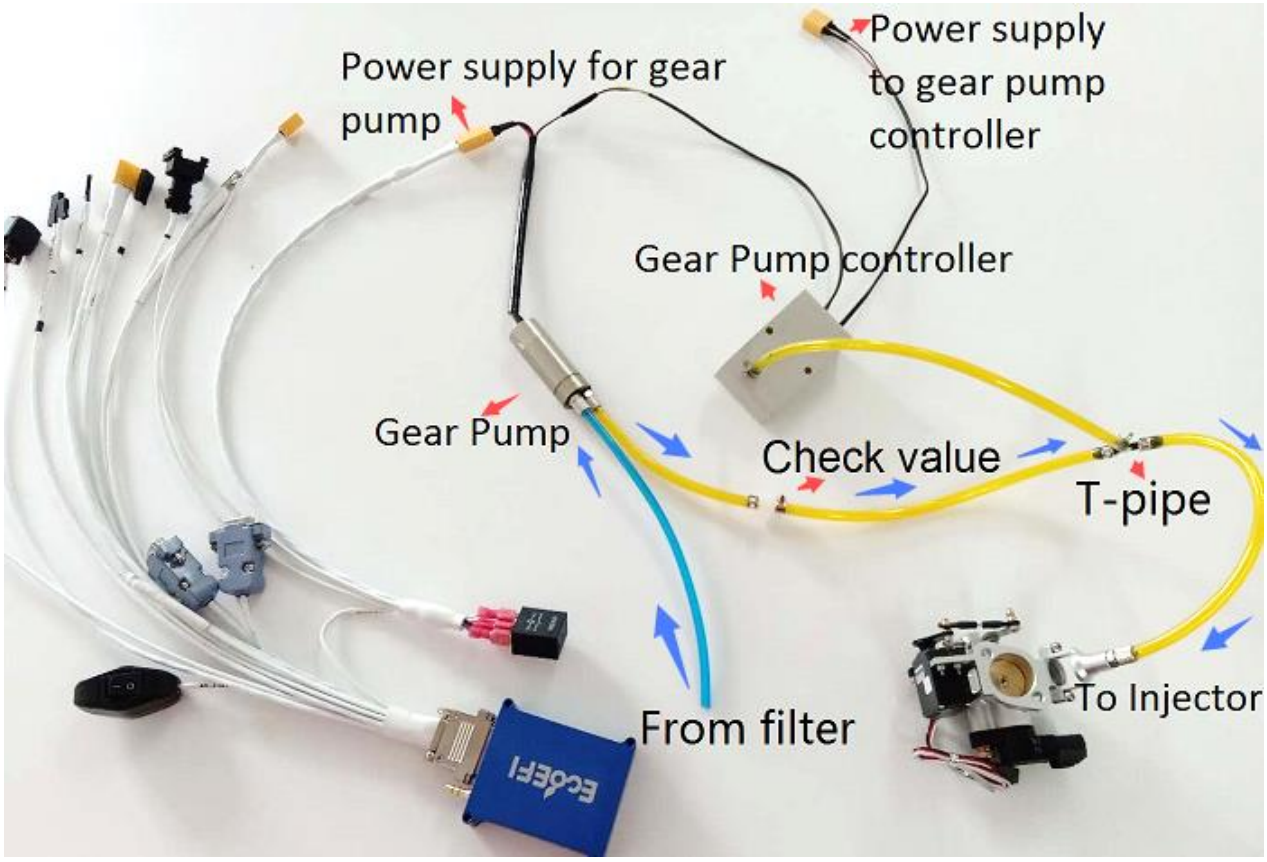


Gear Pump

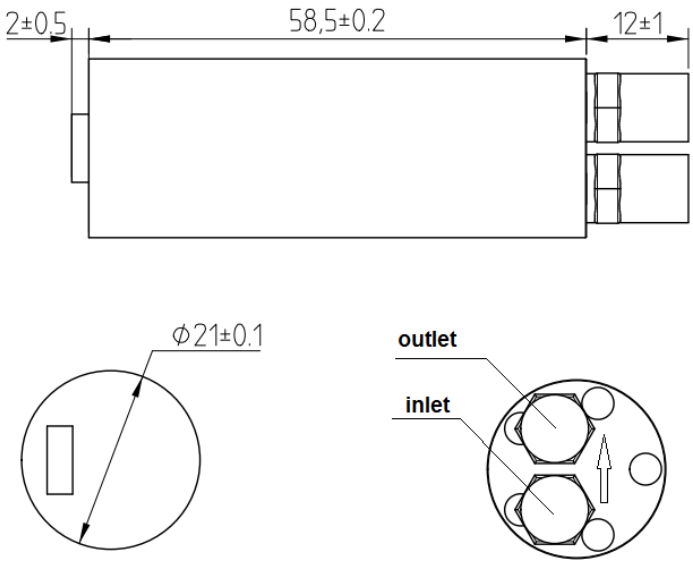
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6.2.2 Connect instructions for Gear pump assembly



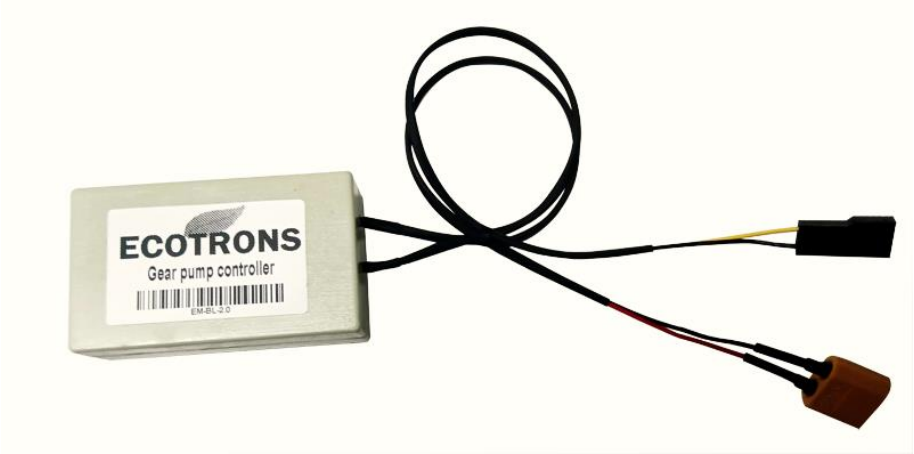


6.2.3 Mechanical Dimensions of the fuel pump (Unit: mm)

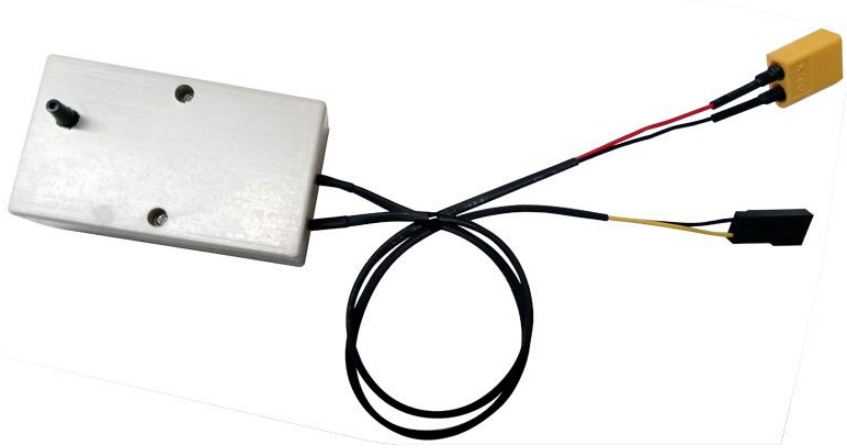


6.2.4 Gear Pump controller

Gear Pump controller (EMCU-BL-2) is the controller from ECOTRON, which is designed for EFI micro gear pump controls to provide constant fuel pressure (3Bar or 43.5psi). Gear Pump Controller can keep constant fuel pressure, and you do not need an external fuel pressure regulator.



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EMCU-BL-2.0

1) Electrical Characteristics

Controller	
Supply voltage	(+11~15) VDC
Working current	<1.5A
Weight	45g
Installation Style	External
Working temperature	(-25~+70) ° C
Storage Temp Range	-20~50 ° C
Size	73x43x34mm

2) Pin-out definitions

Input: Red wire 12V+

Black wire 12V-

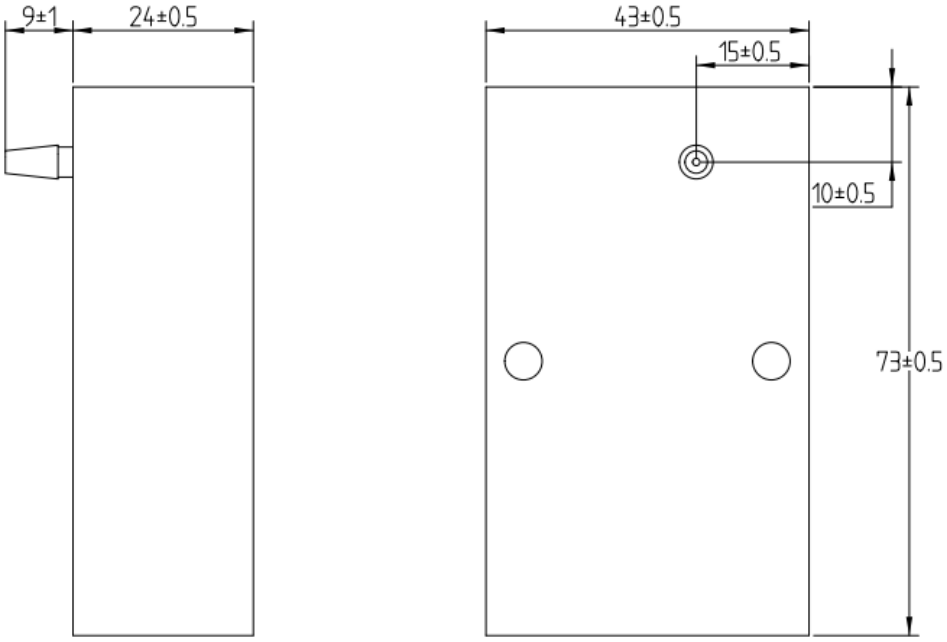
Output: Yellow wire signal

Black wire GND

1. Connect the output connector to the gear pump.

2. Connect the Red/Black input wires to the 12V power.

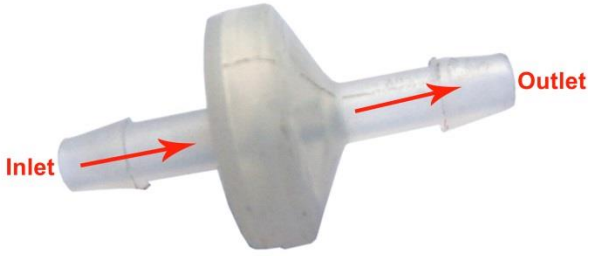
3) Mechanical Dimensions



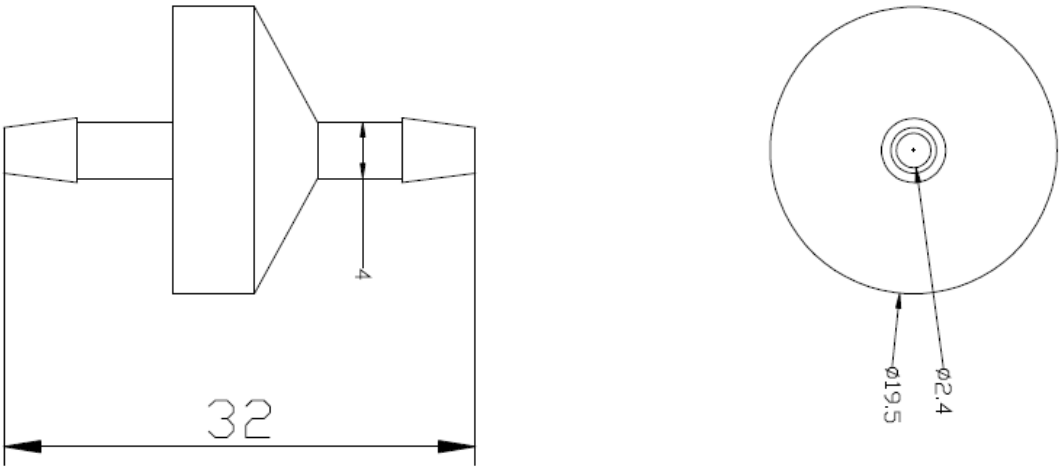
6.2.5 Check value

Note: Check value is only used with gear fuel pump (weight <1g)

Working pressure: 3Bar (Gauge pressure)



CAD drawing:



6.3 Fuel injector

1) Picture of Fuel injector, the weight is 20g.

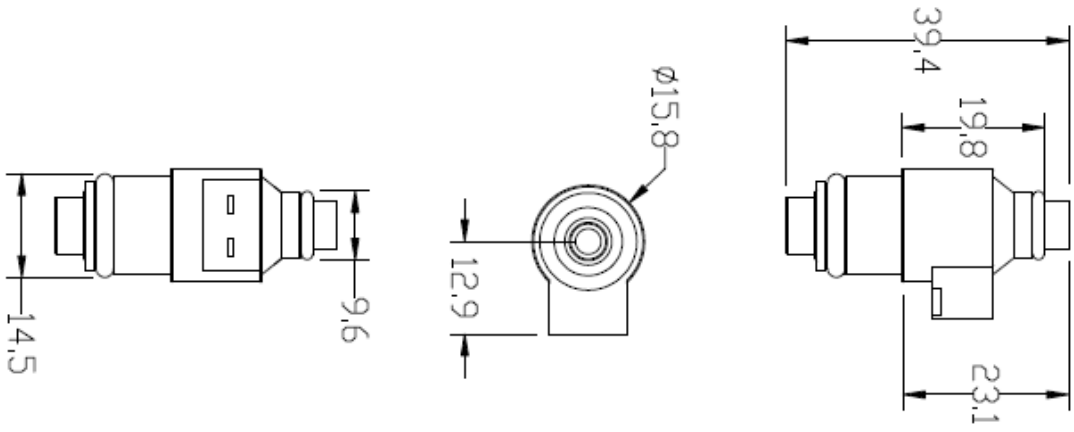


2) Basic parameter

type		Parameters
General technical requirements	Working temperature	-30°C-+120°C
	Storage temperature	-40°C -+75°C
	Working voltage	10v-16v
	Working fuel pressure	200Kpa-450kpa
Open time		0.9ms(no-load),1ms(300Kpa load)
Close time		0.65ms
Difference between open and close time		≤2%(1000times operated at any linear pulse)
The static flow (300Kpa@60s fully open flow)		**30g/min, 38g/min**, 60, 80, 128g/min etc.

Weight		≤20g
Time before Overhaul (TBO)		⩾1600h
Coil resistance		12Ω~14.5Ω
Uniformity of the static and dynamic flow		＜±3%
The offset of the spraying flow		＜±3%
Dynamic flow linear error		＜±3%
Required operating voltage	The minimum voltage for operating	＜7v
	The required overload operating voltage	after24@60s: the offset of dynamic flow＜±4%
Seal leakage		＜0.3cc/min(400kpa)
Atomized particle (50% SMD)		70
Low temperature test		Dynamic flow＜±3% Seal leakage ＜0.3cc/min(400kpa)
High temperature test		
Thermal shock test		
Physical performance test		
Durability test for 0.6billion		
Socket performance test of injectors		In accordance with QC/T417
Noise performance test of injectors		＜70db(A)
Salt performance test of injectors		No corrosion marks on the injectors Offset of dynamic flow ＜±3%,

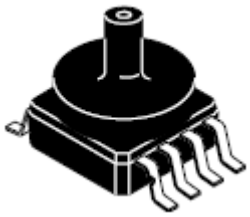
3) Mechanical CAD Drawing

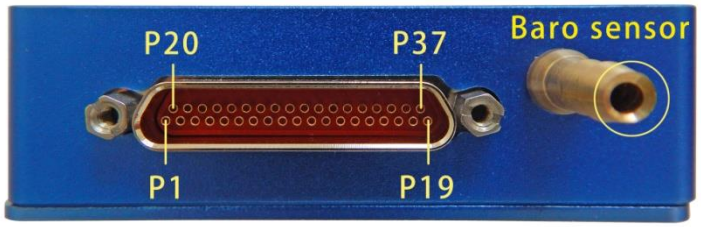


7. Barometric Pressure Sensor

7.1 BARO sensor

BARO sensor is build-in the ECU for altitude compensations.





7.2 Sensor electrical parameters

Supply Voltage	5±0.25 VDC
Working current	<10mA
Response time	<=1ms
Static accuracy	±1.5%FS
Pressure Range	15～115kPa
Output Voltage	0.2~4.8VDC
Operating Temperature	-40~ +125℃
Storage Temperature	-40~ +125℃
Time before Overhaul (TBO)	⩾10000h

8. Map Sensor (Optional for 4 stroke engine only)

8.1 Electrical connection

This MAP sensor requires a +5v power supply, and a ground return and has an analog voltage output.

The sensor output is in 0-5v range. It is linear proportional to the pressure measured.

The MAP sensor usually is used four stroke single cylinder UAV engine.





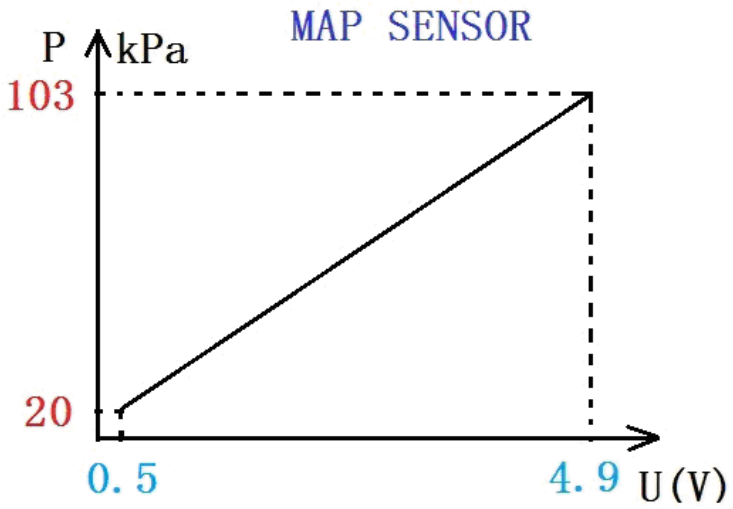
Pin1:	Signal wire	Output	Blue
Pin2:	Ground wire	Ground	White
Pin3:	Power wire	+5V	Red

8.2 Sensor electrical parameters

Working current	<10mA
Weight	**10g**
Response time	<2ms
Static accuracy	±1.8%FS
Pressure Range	20～103kPa
Operating Temperature	－40 ºC ~ 120 ºC
Compensated Temperature	0 ºC ~ 80ºC
Storage Temperature	－40 ~ 130 ºC
Max. Voltage	7 VDC
Supply Voltage	5±0.5 VDC
Output Voltage	0.5~4.9VDC
Pressure Port size	4mm hose (fuel resistant)
Overload Pressure	300kPaA
Output Type	0-5V
Pressure Cycles	30,000kms or more than one year
Media Compatibility	Air

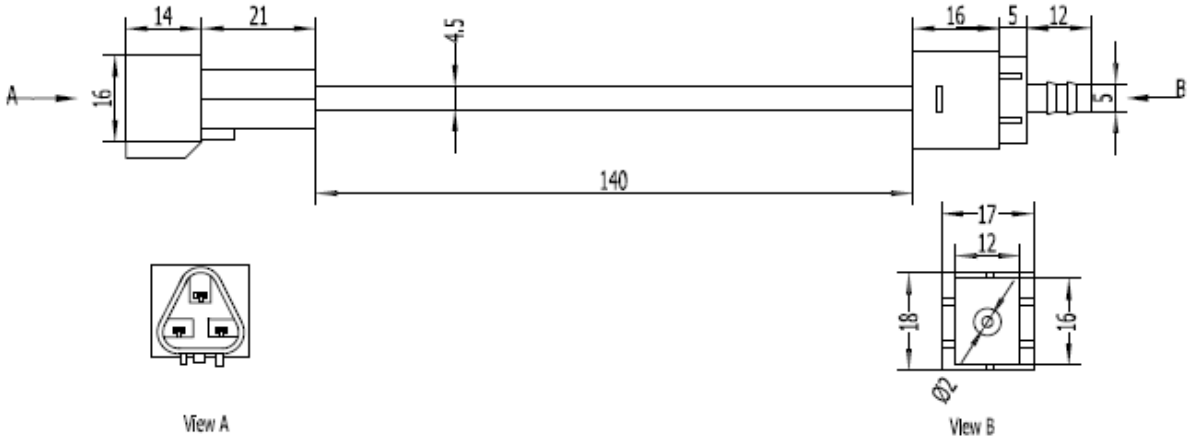
Time before Overhaul (TBO)	⩾5000h

8.3 Nominal characteristic curve



8.4 Mechanical CAD Drawing

Unit: mm



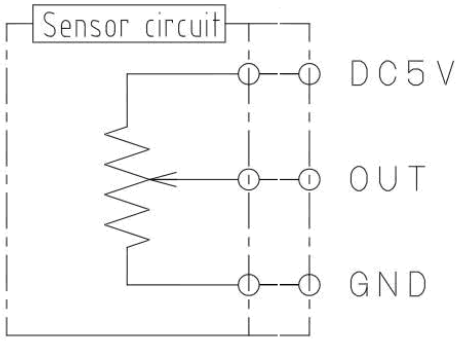
9. TPS sensor (optional for 60cc or bigger engines)

We usually provide the TPS sensor for 60cc or bigger engines. The TPS sensor is mounted on the throttle body.

For 20cc to 40cc engines, ECU uses servo motor signal as equivalent TPS signal.

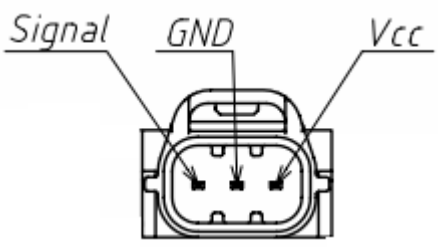


9.1 Circuit diagram of TPS

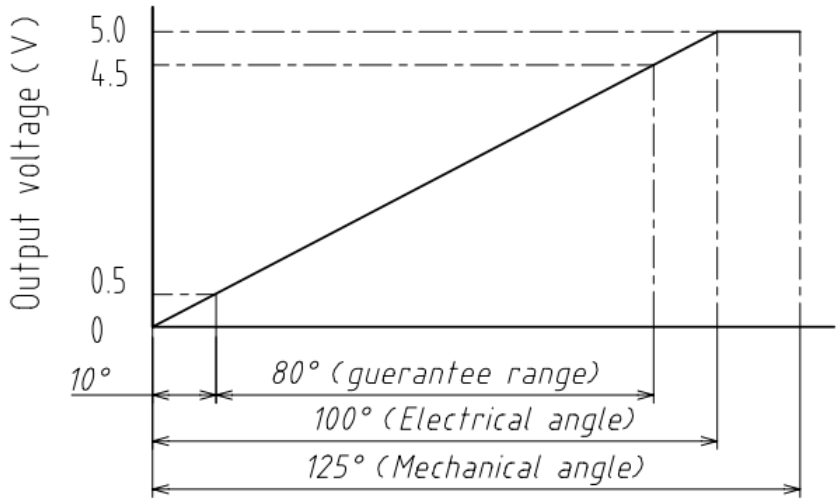


9.2 Electrical connection





9.3 Output characteristics



9.4 Sensor specifications

1) Basic specifications

NO.	Item	Criteria
1	Electrical rotation angle	100°
2	Mechanical rotation angle	125°
3	supply voltage	DC +5V
4	Storage temperature	-40 °C --120 °C
5	Operating temperature	-40 °C --120 °C
6	Total resistance	3kΩ±20%
7	Output Linearity	±2%
8	Installation torque	49.03 mN.m(MAX)
9	**Weight**	**15g**

2) Durability:

Rotation life cycles:	5 million, Cycle
Time before Overhaul (TBO)	⩾5000h
Vibration durability:	50~2000Hz, Max 25G
Thermal shock:	-40 °C ~120 °C,
Water resistance	JIS D0203
Oil resistance:	Gasoline, Oil, 24Hr

10. Servo motor

10.1 Servo motor Picture

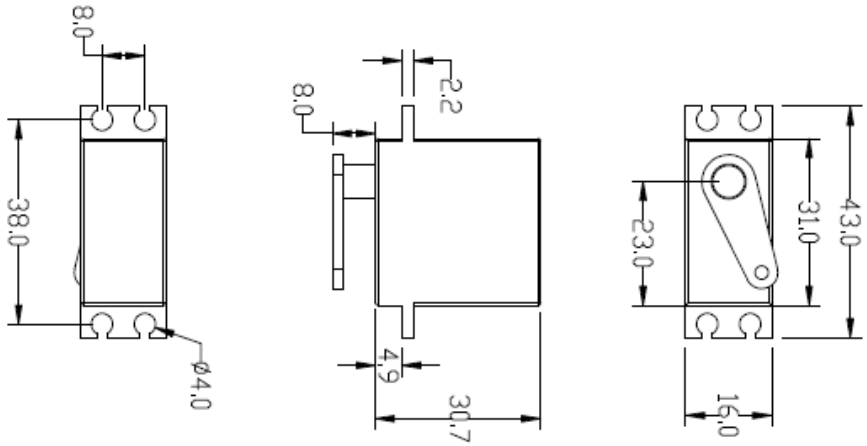


10.2 Servo motor electrical characteristics

Steering gear type	S3016 Servo (Futaba)
Dimensions	1.2" x 0.6"x 1.2" (30 x 15 x 30mm)
Product Weight	1.2oz. (34g)
Output Shaft Style	25 Tooth
Voltage Range	4.8V - 6.0V
Current range (with the throttle body)	20mA - 200mA
No-Load Speed (4.8V)	0.25 sec/60°
No-Load Speed (6.0V)	0.20sec/60°
Stall Torque (4.8V)	47 oz/in. (3.6kg.cm)
Stall Torque (6.0V)	58 oz/in. (4.6kg.cm)

Pulse Amplitude	3-5V
Operating Temperature	-20 to +60°C
Continuous Rotation Modifiable	Yes
Direction w/ Increasing PWM Signal	Counter Clockwise
Motor Type	3-Pole Motor
Potentiometer Drive	Indirect Drive
Output Shaft Support	Ball Bearing
Gear Type	Straight Cut Spear
Gear Material	All Metal Gears
Wire Length	12" (3048mm)
Time before Overhaul(TBO)	≥200

10.3 Mechanical CAD Drawing



11. Temperature sensors

11.1 Intake air temperature sensor (IAT)

1) Sensor Picture

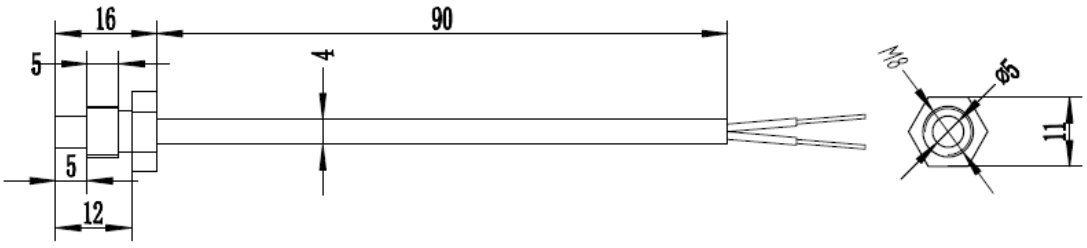


IAT sensor installation: it can be inserted into the air filter or installed in the air inlet of manifold.

2) Sensor electrical characteristics

Zero power resistance	R25=2KΩ+1%	25 °C
B-value	B25/50=3470k±1%	
Thermal time constant	7s max	in static air
Dissipation constant	0.6mW/°C ~0.95mW/ °C	in static air
Power rating	3mW	
Operating temperature range	-40 °C ~150 °C	
Storage temperature range	0~120 °C	
Time before Overhaul (TBO)	≥43800h	
Weight	**<=7g**	

3) Mechanical CAD Drawing



11.2 Engine temperature sensor

1) Cylinder Head Temperature Sensor Picture

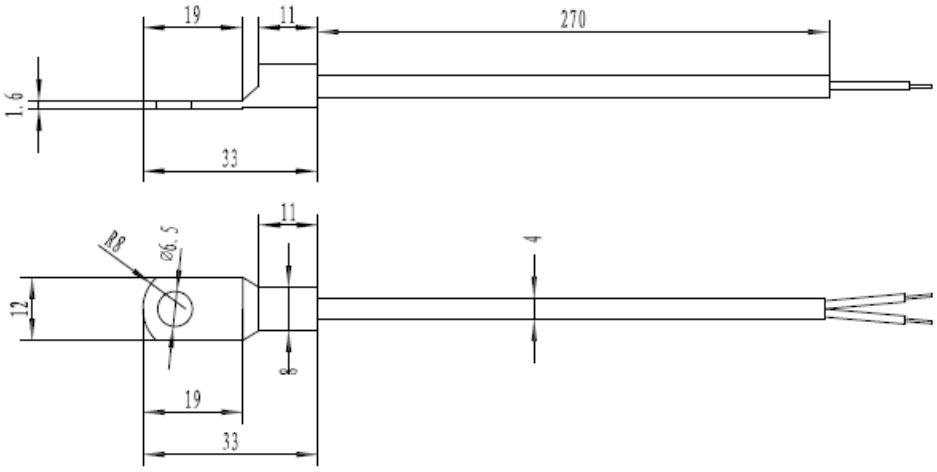


CHT sensor is PT100 type temperature sensor. It can be bolted on to the engine cylinder head with any existing bolt.

2) Sensor electrical characteristics

Measuring range	-40 ℃ ~ + 250 ℃
Allow deviation delta △℃	A#: ±(0.15+0.002 | t |); B#: ±(0.30+0.005 | t |)
The thermal response time	< 30 s
Minimum in depth	≥200 mm
Allow electricity	≤5mA
Advantages	Resistance to vibration, Stability is good, High accuracy, Resistance to high pressure etc.
Time before Overhaul (TBO)	≥43800h
Weight	**<=10g**

3) Mechanical CAD Drawing



12. Hall sensor

12.1 Hall sensor Picture

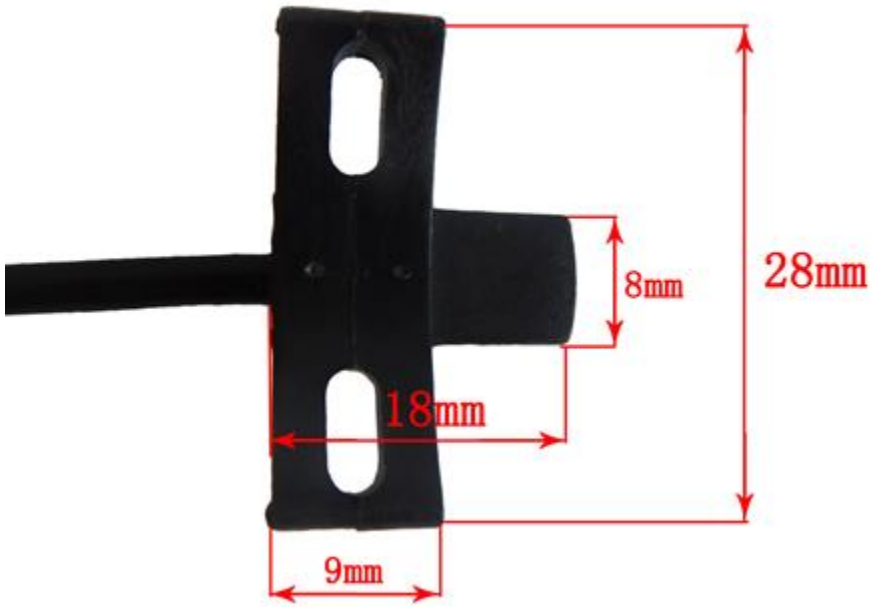


12.2 Hall sensor Parameters

Electrical Characteristics

Supply voltage…… (+4.5~30)VDC
Supply Current (MAX)……10mA
Current output……<300mA
Operating temperature…… ..(-25~+70)°C
Voltage output (MAX)……40V
Current output (MAX)……20mA
Output type……....OC (OPEN COLLECTOR)

Mechanical Dimensions



12.3 Pin-out definitions

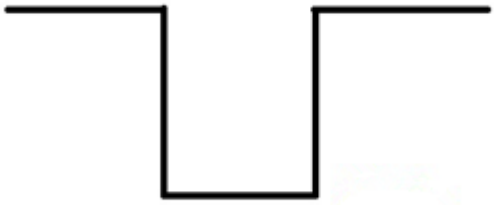


Pin1: Signal wire **White**

Pin2: Power + wire (+5V) **Red**

Pin3: Ground wire **Black**

Hall Effect sensor works with S-pole magnet, when it works, the voltage of signal will be low.



Typical signal