



# ELECTRONIC FUEL INJECTION IN DIESEL ENGINE

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## Abstract

The paper gives a view about the emission standards which are found in today's environment. It can be reduced by using some technique such as burning required amount of fuel in a proper proportion for combustion. It is empowered with a computing system called Electronic Control Unit, ECU. It manipulates the fuel delivery for efficient combustion to optimize the engine life and to reduce pollution. But due to the Bharat standards it was not fully achieved. The problems where the sensors will not perform required action at high rpm's this will lead to a bread down of a engine when it is exposed to a large combustion of fuel ratio. The feed back control loop must detect the required amount of error when it is exposed to a large amount of fuel which is not needed. Since the diesel engines emits a large amount of Carbon Monoxide hydrocarbons and mono-nitrogen oxide, it is very harmful to human's for breathing due to the toxic amount of gases.

**Keywords:** Electronic Fuel Injector, Electronic Control Unit, CAN protocol

## I. INTRODUCTION

The computer unit will perform all the control functions required to accomplish the goal with the help of some sensors. The literature witnesses the Mercedes Benz and BMW are strictly switched to EFI in order to reduce the fuel wastage and efficiency. Japanese manufacturers have also moved to EFI system, all manufacturers feel that EFI system is more reliable in order to reduce pollution and maintain their standards. According to the fuel usage they are more percentage of users who prefer diesel because of its low cost and reliability.

## II. RELATED WORK

Comparable investigate finished in regards to injector was greatly extraordinary with find on the expositive expression alternately Practically none. An could reasonably be expected purpose behind the circumstance might make re-using rotted injectors is not a proposed technique by the Producers. And the issue about trouble or unapproved unlucky deficiency about fitting injectors to exactly vehicle models might be particular of the neighborhood connection. By those worries require with be taken to account when planning another ECU were contemplated. Submission. starting with fuel injector who bring produced force depending on the tuning process, the performance tuner can remove the manufacture standards and he can add more power required by the user. modules (Power-train control module carries the comparative intending of the ECU to automobiles, the expression will be embraced Eventually Tom's perusing the

Different synonyms utilized for ECU Towards different vendors are, infusion control unit Eventually Tom's perusing Peugeot, Citroen, fiat or Alfa-Romeo; DME or DDE: advanced engine hardware or advanced diesel hardware by BMW Furthermore scaled down Minor, ECM: motor control module Toward some other) for heading a drift car Makers. Including Toyota uncover that, in spite of ECUs were at first formed for emission control, however huge numbers propelled works need aid expected starting with as of late produced ECUs, for example, fuel injection, ignition loop timing, transmission, Furthermore electronic throttle control.

They further notice that heat scattering might be a significant issue encountered with an ordinary ECU for long-run. Overall the operating voltages might vary with their exact qualities because of semiconductor impacts. Furthermore, they do propose to utilize exceptional programming to ECU plan for example, such that CRAMAS (Computer-Aided Multi-Analysis System), more utilize an actual-vehicle test system to try. Over addition, using a constant working frameworks (RTOS) for ECUs go along with ITRON (ITRON is a Japanese open standard for an ongoing operating system) determinations which will be particularly planned for ECUs as opposed nonexclusive end goal RTOS is further prescribed.

Identification of the injector malfunction, relying on the Investigation for differential current aspects. They have recognized that the climbing current bend to injectors must change to be incompletely unique in relation to those bend for a perfect gas inductor current because of constrains follow up on a dynamic injector core, brought about by friction, spring strain and fuel weight. Furthermore, the injector opening the long haul will be related for those present qualities same time the shutting time relates with the voltage qualities. Their discovering was developed of the followings: the time needed will open those 12 - 16 injector will be nearly 1.5 Ms. This period will be a capacity of the fuel pressure, injector spring force, inertial center properties, electromagnetic coil, center Furthermore injector material. The time needed will close the injector is best half of its opening time. Shutting for an injector is done toward the spring joined and the fuel pressure, no power included. As stated by our perspective, results of them examine would for a successful injector pulse. The fluid fuel compasses the limit of the port then afterward opened Furthermore it takes pretty nearly 4.5 MS should arrive at those barrels opening toward 2600 rpm.

They underscore that those structure of the injector needs an impact around fuel in its addition to air mixture preparation system. Furthermore, emission influences the inward burning aspects looking into an extensive variety for operating states on port-injection fuel engines. Alternate critical variables the

individuals sway ahead an effective fuel infusion are those fuel temperature, fuel infusion weight and the model from claiming fuel shower model. The fuel spread model is a scientific model directing, including large portions parameters What's more might a chance to be recreated for programming artifacts On A lab.

A fundamental fuel spread model will foresee fuel vanishing in motor cylinders same time a thorough fuel shower model incorporates for fluid fuel spread movement What's more vanishing over a point by point way. From motor investigate Laboratory, Indian foundation about engineering organization rundown by the significant factors from claiming outlining EFI engines to train engines. What they need noted viewing the injector pulse that was, retarding those fuel infusion timing for EFI pump prompts long infusion pulse width Subsequently increments the aggregate hydrocarbons (THCs) in debilitate Also Additionally upsurges the debilitate temperatures because of after-burning for hydrocarbons. They do propose should build a safety standard.

### **III. METHODOLOGY**

The essential EFI measurement. An ordinary EFI computer, known as ECU obtains six (06) inputs with focus its ultimate output, those injector pulse for injectors. ECUs union an infusion pulse in view of each pulse particularly when the motor rpm (revolutions for every minute) will be increased, the requirements from infusion pulses is additionally require to make expanded.

That main information may be the rpm of the motor. This is got starting with the gearbox of the installed vehicle. An essential enter on focus those injector pulse, need A solid reliance.

The second will be the wind current or the performance weight. There would two relay sorts about sensors depending upon the routines utilized to measuring those wind current known as impostor wind current Furthermore pace thickness. Impostor wind current sort frameworks screens those opening from claiming throttle influenced higher rpm with figure out the wind current. Sensors utilizing this technique would introduced on the engine's air admission complex framework Furthermore

Abbreviated Concerning illustration MAF (Mass wind stream sensor). To streamlined terminology, the same sensor may be known as the 'Hot-wire sensor' because a heated wire is employed to generate the electrical signal. The other type of sensors named as MAP (Manifold Absolute Pressure sensor) use the speed density, rely on the manifold pressure change when the throttle is opened on demand of more fuel.

A solid-state pressure transducer can measure the pressure in the intake manifold combined with rpm and air temperature to determine the airflow indirectly. Therefore, either MAF or MAP sensor is employed as an input to the ECU as a primary input. The third sensor is the Throttle Position Sensor (TPS) which is another input to ECU. The key responsibility of this sensor is to inform whether a rapid opening of the throttle has occurred, so the ECU can compute for the increased fuel demand. Technically, this situation is called moving in to rich condition (excess presence of fuel, lack of air) from a lean condition (excess of air, lack of fuel). Basically, relying on the rate of high throttle blade angle, a potentiometer attached to the throttle shaft will produce an electrical signal accordingly.

This simulates the functionality of an accelerator pedal on a carburetor-based system. The fourth and the fifth sensors are the Water Temperature (WT) and the Air Temperature (AT) respectively. Both are secondary inputs to the ECU, WT is required only when the engine is cold (to prepare the fuel plus air mixture as rich, simulating the functionality of choke in traditional systems), once the engine exceeds the temperature limit 120 degrees, this input is disabled. The necessity of AT is optional for non-speed density systems because mass airflow systems are already measuring the air mass entering the engine.

But important in the context of speed density systems, because there is an inverse proportionate relationship between the density of air and the temperature. the feedback to establish the closed loop system. A PID (proportional-integral-derivative controller) controller is employed in the error correction mechanism. But under the full throttle conditions, this sensor input is disabled by the

ECU because then the engine need to produce the maximum power from a mixture of fuel and air. This is called an open loop and then the ECU generates the injector pulse signal mapping the appropriate values from a set of data base embedded to a ECU and relying on the other sensor inputs.

Implementation the EFI have been utilized an arrangement for PIC microcontrollers operating done a preparing speed from claiming 20 MHz (instructions need aid constantly executed at A velocity from claiming 5 MHz), which is sufficient setup with perform the obliged computations. The microcontrollers are conveying for one another (Previously, true time, with I2C communication, A correspondence protocol specified to short-distance inter-IC correspondence.

The injector pulse originated to the ECU may be caught (at those climbing edge) without a delay. The CCP (Capture What's more Compare) module coordinated will PIC microcontroller have been utilized for this motivation. The pulse width will be ascertained utilizing the occasion when distinction between the edges for two successive clock cycles. Usually, this may be 1.6 - 6.0 microseconds, fundamentally a capacity about rpm. (An injector may be energized once two revolutions of the engine, for example, In. 1200 rpm, 600 times for every moment 10 times for every second).

Fig

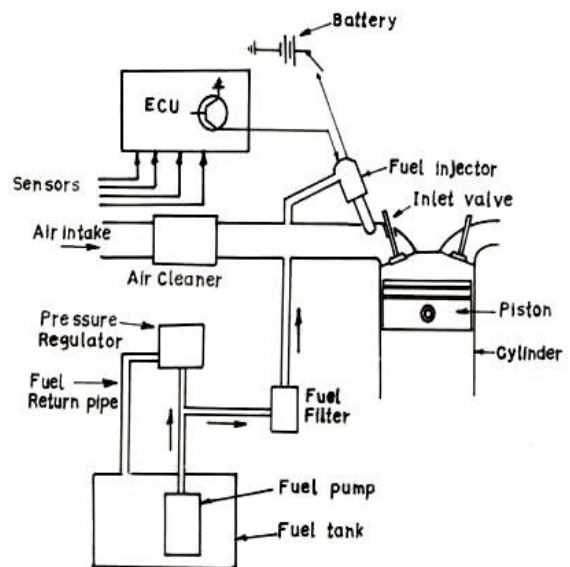


Fig. 1. System Overview.

An injector pulse may be then re-generated utilizing An PWM (Pulse- Width Modulation) module inserted of the microcontroller. Those determinant parameters of the obligation cycle of this new injector pulse are those 'On' Furthermore 'Off' width of the injector pulse caught over (generated by the ECU) and the change rate (varies the middle of 0. 1 - 0. 95). Concerning illustration, the exchanging gadget (to invigorate the fuel injectors), a 25 a strong state transfer (SSR) is utilized. There will be an uncommon purpose behind selecting a SSR on account there need aid no moving contacts Concerning illustration in mechanical relays, empowering quick What's more dependable exchanging.

#### IV. RESULT AND DISCUSSION

Assembling of the framework have been finished in view of those emission measurements, previously, then afterward utilizing the adjusted AoM utilizing A standard debilitate gas analyzer. Tests were gathered at those without moving speed, generally around 750 rpm, toward 1500 rpm Also. 2500 rpm. The facts recorded for a Nissan FB14 (Yom. 1997) would tabulated on table 1 for the examination. A perception has been done, despite additional emission were normal in higher rpms because of expanded rate of fuel burning, the inverse has been encountered. That means, the emission for pollutants started lessening somewhat for those expanding rpm. Those wonder could make further deliberated for trial information indicated by figure 03. The figure essentially summarizes those variety of a chosen pollutant co (Carbon monoxide) for the increment from claiming rpm from without moving (Approximately 750) with 2500 rpm over with six separate vehicles with different injector states. It will be worth to discuss on the qualities from claiming every pollutant said done table 1 on determine which parameter will be a larger amount with Think as of to those alignment methodologies of AoM.HC alternately Hydrocarbons focus in the measured Previously, parts for every million (ppm). This may be the unburned fuel following those inward burning. If HC other side ppm may be high, that methods exactly bit of fuel is incompletely blazed (incomplete combustion), essentially because of overabundance fuel in the burning mixture. An alternate elucidation may be those fuel wastages.

An estimated association between that rate of unburned fuel and the ppm about HC is around 1/200 1. 0% incompletely. Sri Lankan emanation regulations, 6% from claiming fuel will make anyhow we emphasize, significantly 6% may be as well much, the emission regulations must be confined to no less between 200 ppm Concerning illustration drilled on some states from claiming us Furthermore A percentage European nations.

		rpm	HC(ppm)	co(%)	co2(%)	o2(%)
Before	idle 750 rpm	920	1233	5.07	11.2	11.25
	1500 rpm	1723	868	2.84	13.3	11.76
	2500 rpm	2620	517	2.12	13.9	12.98
After	idle 750 rpm	721	158	2.94	5.06	13.9
	1500 rpm	1550	110	1.82	3.99	14.5
	2500 rpm	2326	82	1.31	3.76	14.7
Reference			<1200	<4.50		

Fig.2. Emission test.

Co (Carbon Monoxide) may be an additional measure for incompletely fuel. Anyhow can't depend around this figure, on account of a gadget known as exhaust system introduced during those framework does change over co in will co2 (Carbon Dioxide) chemically, since co2 will be relatively poisonous. In the measure about unburned fuel can't be precisely decided by this parameter. That relies upon the state of the reactant converter, this gadget camwood a chance to be harmed to in length haul utilization about poor caliber petrol. To regulate the output of air pollutants from internal combustion engines, the standards, based on European regulations were first introduced in2000. Emission standards for diesel construction machinery were adopted the standards are structured into two tires stage 2 and stage 3. These standards are based on the EU state 1 requirements, but also cover small engines that were not regulated under the EU stage1. The emission standards for light and heavy-duty diesel engines are given in table 4.

Table 4: Emission Standards for Light-Duty Diesel Vehicles, g/km

Year	Reference	CO	HC	HC+NO <sub>x</sub>	NO <sub>x</sub>	PM
1992	-	17.3-32.6	2.7-3.7	-	-	-
1996	-	5.0-9.0	-	2.0-4.0	-	-
2000	Euro 1	2.72-6.90	-	0.97-1.70	0.14-0.25	-
2005†	Euro 2	1.0-1.5	-	0.7-1.2	0.08-0.17	-
2010†	Euro 3	0.64	-	0.56	0.50	0.05
		0.80	-	0.72	0.65	0.07
		0.95	-	0.86	0.78	0.10
2010‡	Euro 4	0.50	-	0.30	0.25	0.025
		0.63	-	0.39	0.33	0.04
		0.74	-	0.46	0.39	0.06

† earlier introduction in selected regions, see Table 1  
‡ only in selected regions, see Table 1

Fig.3 Emission test before and after using fuel injectors

Co (Carbon Monoxide) is an alternate measure to incompletely smoldered fuel. Anyhow can't depend for this figure, on account of A gadget known as exhaust system introduced toward the debilitate framework does change over co done to co<sub>2</sub> (Carbon Dioxide) chemically, since co<sub>2</sub> is relatively lesquerella poisonous to relaxing. In the measure about unburned fuel can't a chance to be precisely dictated by this parameter.

That relies upon those state of the reactant converter, this gadget might a chance to be harmed for in utilization about poor caliber petrol. Emission from claiming co<sub>2</sub> will be unavailability Since it will effect on finish burning from fossil fuel. It is by 1-2% Also higher during 2500 rpm over during unmoving pulley. Greatest rate under ordinary states may be around 16%. O<sub>2</sub>, oxygen rate will be an acceptable pointer of the move from incline should rich mixture. The point when the mixture may be rich, pure fuel of the oxygen may be blazed Throughout those burning. On the different hand, though additional oxygen discovered done debilitate mixture methods an incline state need occurred, utilizing lesquerella oxygen for burning.

The figure camwood a chance to be likewise utilized to diagnosis, breaks in the alternately frameworks alternately burning disappointments might make distinguished. An extra parameter measured by a portion of emission test focuses is the lambda (must not delay for sensor). This demonstrates the evaluated air on fuel proportion. Varies starting with 14. 7:1 on. 1:14. 7. The Perfect lambda esteem will be 1 (one) The

following that the A/F. Mixture will be rich Furthermore over incline.

Those examine prompted figure out that, HC will be those perfect gas parameters to utilize Concerning illustration an enter of the AoM and in addition the. The majority fruitful pointer to adopt the result of adjusted AoM. On account of it need an acceptable association between those unburnt alternately over bedance fuel, which can be a clear impact of a throttle injector. Those achievements from claiming distinguishing those right determinants may be indicated on figure 4, the diminishment about HC emission following presenting those AoM. Previously, summary, the AoM facilitates the automobile mechanic who need aid performing those EFI performance tune up process, particularly expected will adapt to throttled injectors should direct the injector pulse design as stated by those readings, particularly the HC sum of the exhaust analyzer in place to minimize the discharges and fuel waste without modifying those EFI circuit, that is guaranteeing those improved effortlessness for EFI performance tune up transform.

## V. CONCLUSION

The need finished with remarkable with a technique to diminishment from claiming fuel wastage more pollutant emission control. This accomplishment has been picked Toward examining the HC substance clinched alongside gas which will be utilized as a reaction on finish the valve circle. valve circle control frameworks the individuals Think as of the sentiment with perform due alterations for those next progressive iterations of the methodology cycles so as should minimize those deviation from those anticipated output, would constantly superior to open circle frameworks. Done addition, an amazing finding for different emissions for example, such that co will be reduced much better.

## REFERENCES

- [1] Basic EFI Theory. (n.d.). Retriever September 15, 2016, from <http://www.sdsefi.com/techtheo.htm>.
- [2] Difference between MPFI & SEFI. (n.d.). Retrieved September 15, 2016, from <http://www.carwale.com/forums/10196-difference-between-mpfi-sefi.html>.

- [3] Gasoline direct injection. (n.d.). Retriever September 15, 2016, from [http://httpsen.wikipedia.org/wiki/Gasoline\\_direct\\_injection](http://httpsen.wikipedia.org/wiki/Gasoline_direct_injection).
- [4] Yukumatsu, N., Sakamaki, K., Ikezoe, A., Tarumoto, T., & Uno, Y. (2001). Development of power train ECU for AZ line engine. Fujitsu Ten Technical Journal, No.16
- [5] Powertrain control module. (n.d.). Retrieved September 30, 2016, from [http://httpsen.wikipedia.org/wiki/Powertrain\\_control\\_module](http://httpsen.wikipedia.org/wiki/Powertrain_control_module).
- [6] Sebok, M., Jurcik, J., Gutten, M., Korenciak, D., Roj, J., & Zukowski, P. (2015, August). Diagnostics and measurement of the gasoline engines injection System. Paper presented at Przegl d Elektrotechniczny, Warszawa, Poland.
- [7] Ommi, F., Movahednejad, E., & Nekofar, K. (2008). Study of Injection Parameters on Performance and Fuel Consumption in a Port-Injected Gasoline Engine with Experimental and Theoretical Methods. Annals of The Faculty of Engineering Hunedoara - Journal of Engineering, Tome VI, Fascicule 2
- [8] Research Designs and Standards Organization Lucknow India. (2011). Development of an Electronic Fuel Injection System for a 4-stroke Locomotive Diesel Engine of Indian Railways. Retrieved September 15,2016
- [9] DE Castro, J.A. (2003). Design and Validation of High-Bandwidth Fuel Injection Systems for Control of Combustion Instabilities. Masters dissertation, The University of Virginia.