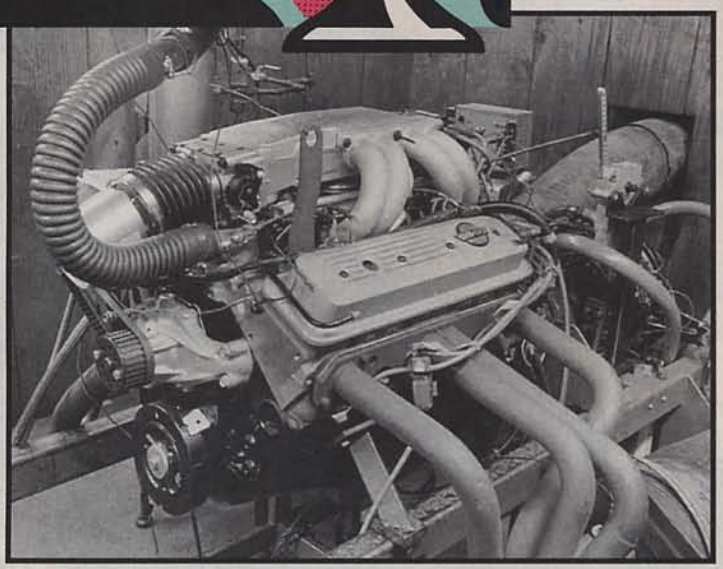
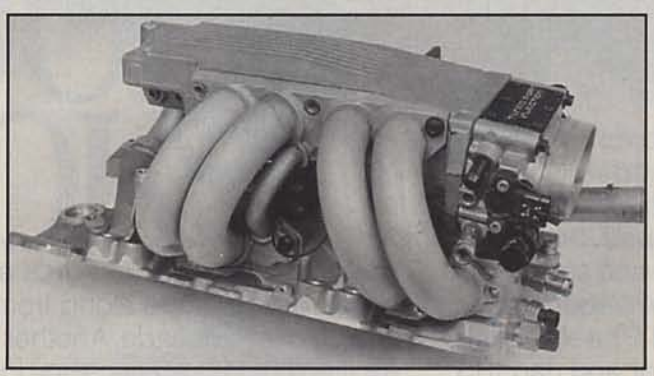
SMART SQUIRTERS

A SIMPLISTIC ELECTRONIC FUEL-INJECTION SYSTEM FOR THE STREET

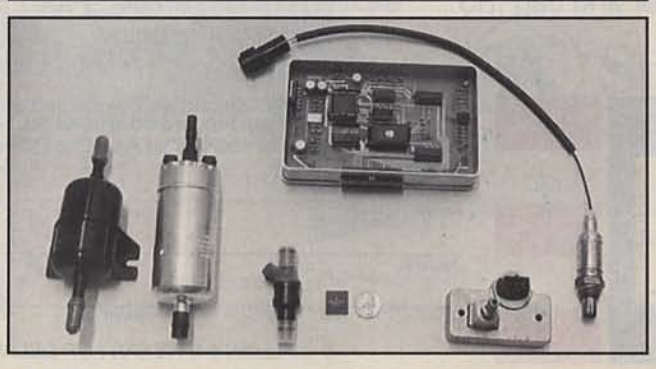
By Jeff Smith



At first, DFI will offer a complete Chevy TPI system compatible with its fuel-injection system for a 383 small-block that is capable of up to 360 horsepower and over 450 lbs.-ft. of torque!



If you already have a Chevy TPI unit from either a Corvette or a Camaro, DFI will sell you the pieces you need to make the system operational in virtually any street machine or rod. The pieces include a fuel pump, fuel filter, MAP sensor, oxygen sensor, and the complete ECU. The actual brain of the ECU is the microcomputer, shown next to the quarter and a Bosch fuel-injector for size comparison. Not shown here would be the required wiring harness and matching camshaft.



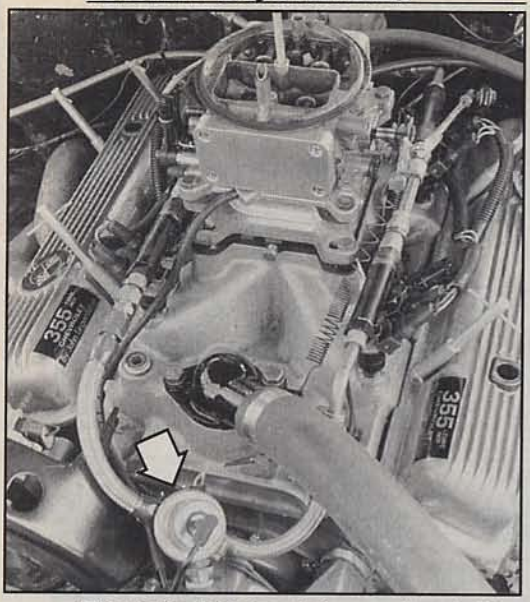
Let's cut right to the heart of our story and forget the trick introductions and flowery metaphors. What we have here is nothing less than the next great breakthrough in the world of street performance. Sound like tall words? Possibly, but we believe that electronic fuel-injection (EFI), similar to the systems used on current production performance cars, has so many performance advantages over carburetion that it's only a matter of time before EFI will become *the* choice for enthusiasts demanding ultimate performance.

Before we get started, you should keep in mind that there are a great many ways to build a performance EFI system for the street. There's throttle body injection (TBI), which injects fuel at the throttle body, and then there's multipoint fuel-injection, which has a fuel injector for each individual cylinder, usually just ahead of the cylinder head intake port. The advantage of multipoint fuel-injection over a throttle body system is in superior mixture distribution and more accurate fuel metering to the cylinders.

While the new-car manufacturers have been successfully employing electronic fuel-injection for many years, the aftermarket has been slow to respond, generally due to a lack of knowledge and experience with electronics. Combine this with the difficulty in producing a stand-alone system that would meet the needs of an almost infinite variety of engines and component combinations and you can see why it has taken this long for these systems to hit the marketplace.

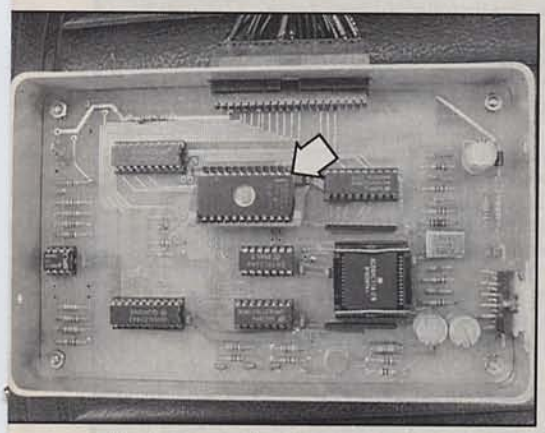
Our investigations into the netherworld of automotive electronics has led us to a group of young men who have combined their hot rodding background with an expertise in electronics to come up with a very slick, multipoint EFI system that will at first be available only for a very limited selection of small-block Chevy engines. The company's name is Digital Fuel Injection (DFI); the movers behind this company are the Meaney brothers, Leo and John, along with

Illustration: Joe Goebel



This is the initial prototype system built by DFI that is on its early small-block Camaro. The engine is a Lingenfelter 355 with a Victor, Jr. intake and a 750 Holley carb used as a throttle body with the metering plates and bowls blocked off. Note the fabricated fuel rail and inline fuel pressure regulator (arrow).

While DFI's early system will not provide for one-off systems, we thought we'd show this photo just to illustrate how easy it is to adapt fuel-injectors to non-EFI intake manifolds. The aluminum adapters are merely epoxied into any manifold and then connected to a custom fuel rail. Simple.



This is an overhead view of DFI's prototype ECU. The rectangular chip (arrow) *is the PROM that holds the programming for the fuel delivery curve. Production ECUs will come with three outside diagnostic light-emitting diodes (LED). One light will indicate a TPS failure, one will indicate a MAP sensor failure, and one will indicate that the computer is in the "limp-home mode" (required only if the MAP sensor fails). All the sensors are high-quality GM or Bosch products that are easily replaced.*

Wayne Groleau and their computer wizard Perry Paielli.

DFI's approach to its initial stand-alone, multipoint EFI system was to produce the most accurate fuel management system possible while keeping the cost low enough to attract the typical street enthusiast. To this end, the first effort will be aimed at a modified Chevrolet Tuned Port Injection manifold for a 383 Mouse motor. In fact, DFI will be offering a complete engine assembly through John Lingenfelter Racing that can make as much as 360 horsepower and over 450 lbs.-ft. of torque! Those, gang, are big-block numbers.

The reason for this limited first effort is to produce a package that will offer a significant performance advantage over carburetion while simultaneously improving mileage and driveability. While the EFI system may at first sound complicated, it really is very simple once you understand the basic system concepts.

The heart of any EFI is its "black box," or the electronic control unit (ECU). The DFI system is based on the speed density design (similar to the EFI used on late-model Mustangs), eliminating the need for a mass airflow sensor, which reduces the complexity and cost of the system. Combined with only five sensors—water temperature, manifold absolute pressure (MAP), throttle position (TPS), an ignition pickup from the coil, and oxygen (O_2) from the exhaust—the DFI system is extremely simple, as evidenced by the electronic and hydraulic schematics. The only other connections are the electric fuel pump and the eight injectors.

The specific operation of the DFI system is described in the accompanying sidebar (see "How It Works"), but basically the ECU controls the amount of fuel delivered to the engine based on throttle position, rpm, and engine load as read by the MAP sensor. Because the ECU must be programmed to deliver a specific amount of fuel to the engine, DFI is limiting its initial system to a TPI-manifolded 383 small-block Chevy. If you wish to do it yourself, you can follow DFI's recommendation for a camshaft and cylinder head, and then they will sell you a very simple add-on package to allow you to be up and running with a Tuned Port Injected setup on virtually any kind of street-driven car, from a '32 Ford to a '69 Camaro.

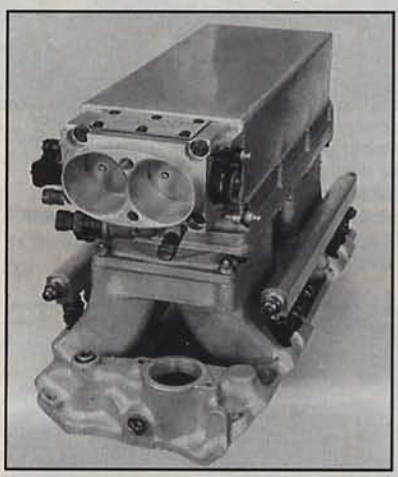
While the people at DFI are still improving their initial system, they did fabricate a prototype system for evaluation on a Lingenfelter-built 355 Camaro that we had an opportunity to drive. Their prototype utilized an Edelbrock Victor, Jr. intake manifold outfitted with eight Bosch injectors located downstream from a reworked Holley carburetor configured as a throttle body. The system performed flawlessly, with no surging or glitches in the acceleration curve. Then we had an opportunity to witness a dyno

test demonstration with a system DFI had installed on a John Lingenfelter 540-cid Rat motor at Lingenfelter's shop in Decatur, Indiana.

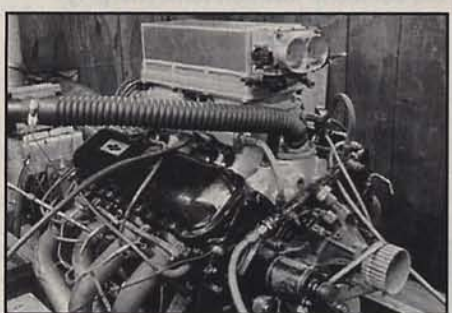
The baseline run on the dyno was with an 850-cfm Holley and modified Holley Strip Dominator intake. Then the carburetor and intake were removed and DFI's system was installed, utilizing a Lingenfelter-adapted tunnel ram with an enlarged Chevy TPI throttle body assembly. After the system was dialed in, the 540 was able to generate 20 more horsepower at peak power with the DFI injection—while utilizing 10-percent less fuel! While a direct comparison utilizing similar intake manifolds would have been a more accurate test, the reduced fuel usage relative to the increased horsepower indicates the potential advantages of the DFI system over carburetors.

As you can see from our sidebar of advantages and disadvantages (see "Pros and Cons"), there are numerous points to consider if you are interested in an EFI system. Cost is certainly an important factor, and there are many different approaches you can take, with some more expensive than others.

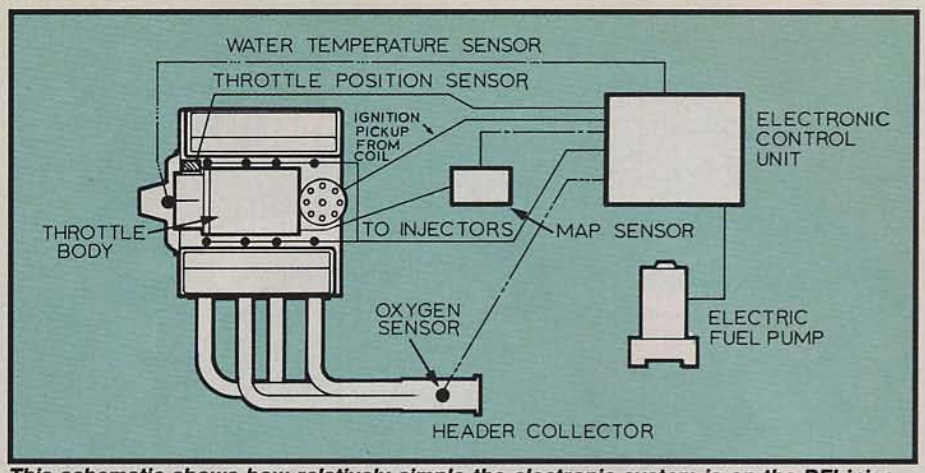
Obviously, this is an early effort in the



EFI also offers the opportunity to build a slick intake such as this Lingenfelter tunnel ram constructed out of a Weiand Rat motor intake. Note the enlarged throttle body (from a Chevy TPI) and custom fuel rail and injectors at the base of the intake.

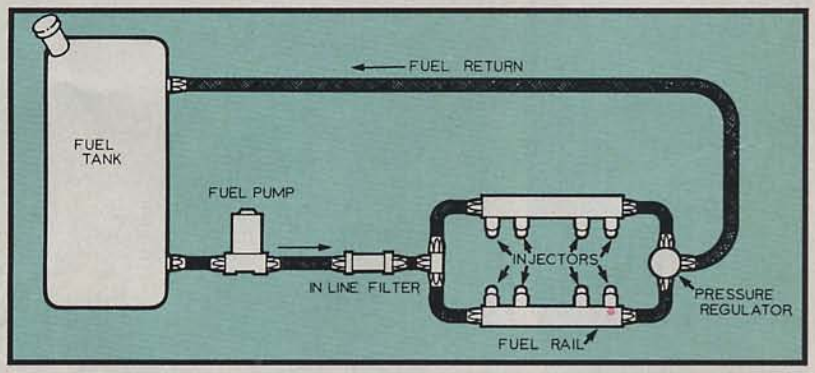


The trick big-block intake was dyno tested on a Lingenfelter 540-cid monster motor against a typical single 4-barrel, single-plane intake, and 850 Holley carburetor. The DFI injection was worth 20 more horsepower at 10-percent less fuel with better idle quality and part-throttle response even with the tunnel ram!

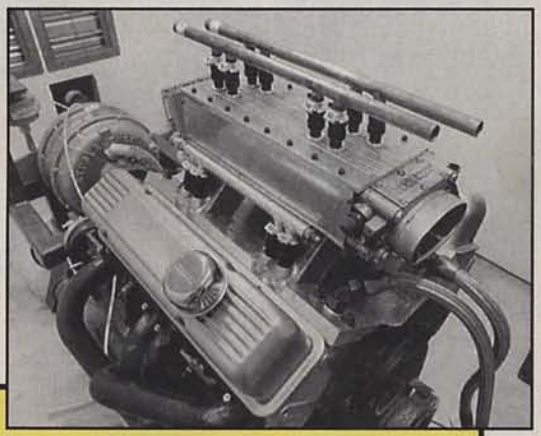


This schematic shows how relatively simple the electronic system is on the DFI injection system. Given eight injectors, there are only six other connections to complete the system. The key to the system is the ECU, which determines the amount of fuel delivered to the injectors based on the engine's fuel needs.

The hydraulic schematic is even simpler than the electronic side. A high-pressure pump is required, along with a return line, a high-volume fuel filter, and a vacuum-modulated pressure regulator.



One of DFI's latest experimental efforts is with a 16-injector small-block manifold to generate horsepower numbers in the 400 to 500 horsepower range! Wouldn't this look wild in a '55 Chevy?



PROS AND CONS

Below are listed both the advantages and disadvantages of EFI. Some hot rodders will probably never give up their carburetors, while others will want to switch immediately. We'll let you decide for yourself.

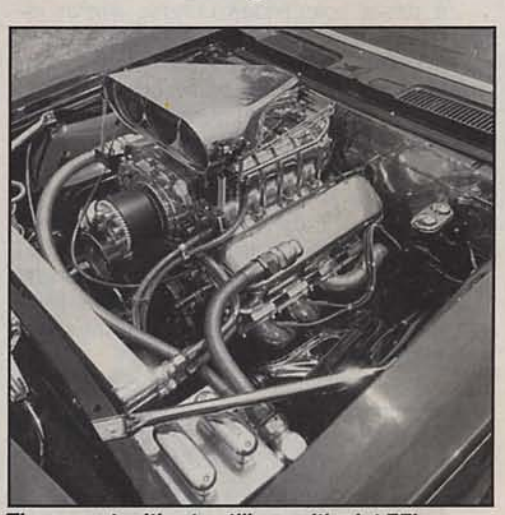
ADVANTAGES

- More power with less fuel due to very accurate fuel metering
- Better fuel economy and reduced emissions at part throttle
- Better idle quality, especially during cold start
- Easily adaptable to turbocharging or nitrous
- Expandable to include control of ignition or nitrous and can monitor other engine functions easily
- Uses off-the-shelf factory components that are easily and inexpensively replaced if they fail
- Allows easy experimentation with intake manifold design without worry of mixture distribution problems
- No fuel slosh problems, especially for boats and off-road trucks

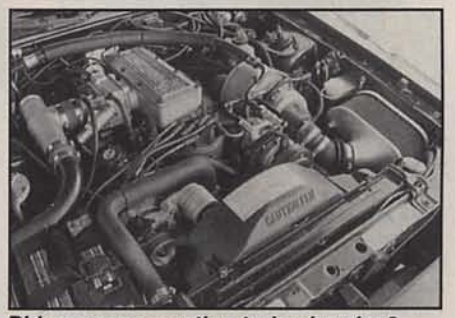
DISADVANTAGES

- Cost: significantly more expensive than a typical carb and intake manifold
- Electronics/intimidation factor created by new technology
- Requires some fabrication and installation expertise
- Limited applications initially

new world of performance electronic fuel-injection. In fact, DFI is currently still tooling up for production runs on the computer circuit boards and wiring harnesses, and it will probably not be until after the first of next year before they are ready to deliver components in quantity. Nevertheless, DFI has come up with what we think is a very sophisticated system that is also affordable and not overly complex to install. Certainly there will be many other injection systems to follow. But either way, the future is clear: EFI is the next step in the performance promise of tomorrow's street engines. **HR**



The opportunities to utilize multipoint EFI are almost endless. Imagine utilizing a 6-71 blower with a bug-catcher injector hat (similar to this mechancial effort) with EFI that would forever end idle and low-speed surging problems. You could get rid of most of that messy plumbing, too!



Did someone mention turbocharging? DFI acknowledged that its system could easily be adapted to a pressurized, turbocharged effort with only the addition of a different MAP sensor and the required fuel curve programming. This would eliminate all the hassles involved with carbureted turbocharging systems.

SOURCES

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