



# Reading Your MINI

## Tips on using an OBD reader and making sense of what the codes tell you

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From an informational point of view, modern cars are computer networks on wheels. They're just sensors and actuators tied together with wires with signals running all over the place. Most of the time, we live in blissful ignorance of this ever-increasing level of complexity. That is, until something goes wrong and one of those little lights on the dash starts to glow. We hope to never see them: the "Check Engine" light or the little airbag light. They're left to scratch our heads and wonder, "where do I start?"

These little lights just say something isn't right. But there are literally hundreds of individual issues that can cause one of these lights to glow. When you're under warranty (and unmodified), you have less to worry about; you just drive to the dealer and say, "the lights are glowing. Fix it!" But now many of the new MINIs are out of warranty, so one has to drive to a shop, and ask fearfully "How much is this going to cost?" Often the answer goes something like this: "We don't know. We charge \$80 per hour for diagnostics and then when we figure out what it is we can give you a quote for repair. I'll

give you a call when I have some news."

But it doesn't have to be this way. There are tools out there that allow you to talk to your car and find out more about what's going on than just the glowing lights. And while many of you may be intimidated by the nature of modern diagnostic equipment, there is nothing here to fear. There is, however, a lot to learn.

### Our Friend, the OBD Port

Since about 1996, all cars sold in the US come with a standardized diagnostic port. This goes by the name the OBD-II port, for 2nd generation On-Board Diagnostics port. You can thank the Environmental Protection Agency for this mandate. (By the way, it's these very same regulations that allow for ECU tuning via the diagnostic port.) This is the funny 16-pin connector that is usually found under the dash or thereabouts (there are even regulations about how far from the steering wheel it can be). Prior to the government-forced standardization, each manufacturer had a different diagnostic connector, if it had one at all! (For example, I had a '94 Ford Explorer where I had to buy a Ford diagnostic tool, and



it would only work on Fords of certain model years.) But now, there is a basic set of functions and commands that the diagnostic port has to support and this means that you can now buy a universal code scanner that will work on pretty much all cars. (See the protocol sidebar for more information.) And at the discretion of the manufacturer, they can support extra information beyond what is mandated by the standards. This is all good!

OBD-II standards really only govern emissions related items that can trigger the check engine light. But there are zillions (well not quite that many, but a lot for sure) of other "intelligent" subsystems in the car that don't have to "speak" OBD-II. We'll get to them a bit later.

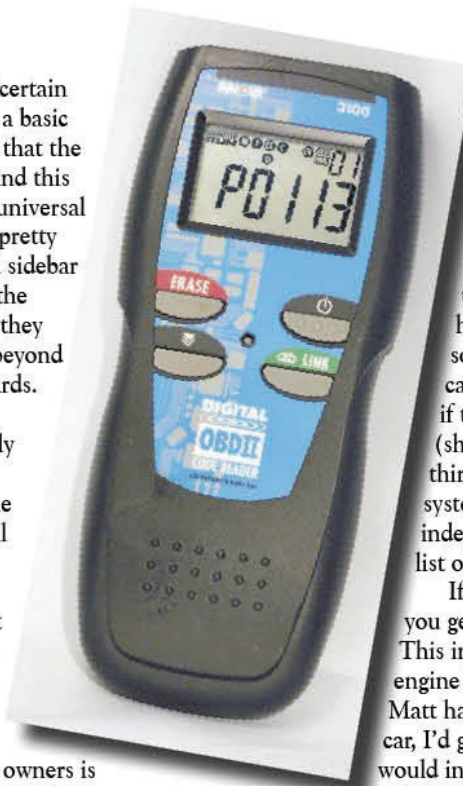
### Trouble Codes and the Check Engine Light

The biggest concern for car owners is usually passing smog inspection. To do this, we have to learn a little bit about what types of items trip the check engine light and what else inspectors look for with this port - and it is more than just not having the bulb light up.

The first type of trouble code sets the light if the fault is there, and goes away if the fault is gone. A failed pressure sensor would be a good example. Replace the sensor, drive the car, and the light goes out by itself. This is great if you can easily change the part that caused the code. The bad news here is that depending on the code that is thrown, there may be more than one possible cause and you will have to figure out exactly what went south in order to repair your car. Sometimes this is easy; sometimes it's not.

The second kind is one that sets a pending flag. If on the next trip it's present, the dash light is lit. If the fault is gone, the pending code is cleared. The systems are actually pretty smart. Anyway, the guiding concept for what defines the first type of fault from the second is the potential to cause further harm or degradation in emissions.

Once a code is activated, there is the possibility that it will go out by itself. This is to account for things like some bad gas, or a very rare misfire. For some of the codes, if the problem doesn't show up again for a certain number of driving cycles the code will be cleared. So what's a driving cycle? In OBD-talk a driving cycle is when the car starts from cold and runs until it reaches normal operating temperature. (Actually, the exact definition of a driving cycle is more complex, and is somewhat beyond the scope of this article.) This requirement assures two things: The first is that some unscrupulous driver doesn't just start and stop the car a few times to get the light out; the second is that this makes sure the cars control system is put through a range of operational states and that they're all good. If you've ever had the check engine light come on and then go off a few days later, you probably ran into one of these. It's no big deal if it only happens very rarely.



### There's Information and There's Information

So, you've got a check engine light, and it says "P0302" on your el-cheapo scanner. You go into your scanner book, and this says, "Misfire on Cylinder #2". OK, what now? While this doesn't tell you what's caused the misfire, it has already narrowed down the possible source of the problem. In fact, the codes can be broken down: P means powertrain, if the next digit is a 0 or a 3 it's a generic (shared by all manufacturers) code, the third digit being a 3 indicates ignition system, and the last two are a numerical index. (Your code scanner manual will have a list of all these items.)

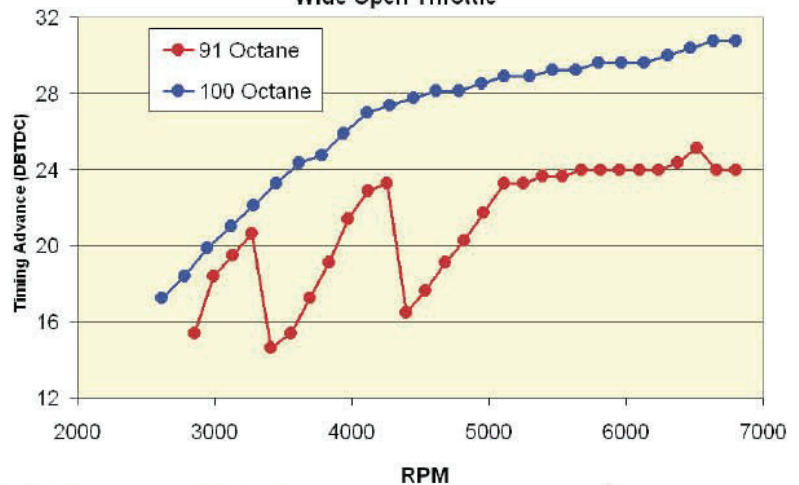
If you buy a slightly more expensive tool, you get something called "freeze frame data." This includes engine RPM, vehicle speed and engine load (how hard it was working). When Matt had a less than perfect engine tune on my car, I'd get lean codes and the freeze frame data would indicate a lean condition at about 3,000 rpm at light throttle. The remote tuner never did really believe me about what was going on, but when Jan Brueggemann tuned Matt's car, we could see the lean light throttle fueling in the tables and fixed it. It hasn't returned.

There is one other type of test information relayed via the OBD port that is used for smog testing. These are cycle tests, lower end scanners may not even report their status, but it's important to know that they are cleared whenever you clear your codes. (This would be something like oxygen sensor heater function). These are set based on driving and may take as long as 300 miles after codes are cleared to be reset by the ECU. Not all cars support all type of cycle tests, but those that are supported by your car are supposed to set at the time of getting a smog test.

This inexpensive scanner (under \$100) has paid for itself many times over. Plug it in when the car is on (it doesn't have to be running), download the codes and see what's up. The included book covers all the brand independent codes, but if the numbers are above 2000, you have to do some searching on the Internet to see it means for the MINI.

This is an example of what a good logging solution can do for you. When Matt was investigating the effect of octane on performance, he could see that CA grade premium (91 octane) wasn't good enough to keep timing pull at bay. A tank of 100 fixed it up nicely! By the way, the MINI ECU adjusts timing on a per cylinder basis. Pretty sweet!

Ignition Timing vs Octane  
Wide Open Throttle



### Data Loggers and Displays

The OBD port is useful for a couple things more than just reading and clearing engine codes. The standard also supports real-time data streaming. This is really a good thing for those that can't stand the fact that the MINI





## Decoding the Codes:

There is method to the madness of trouble codes:

### First Character:

B = Body  
C=Chassis  
P=Powertrain  
U=Network

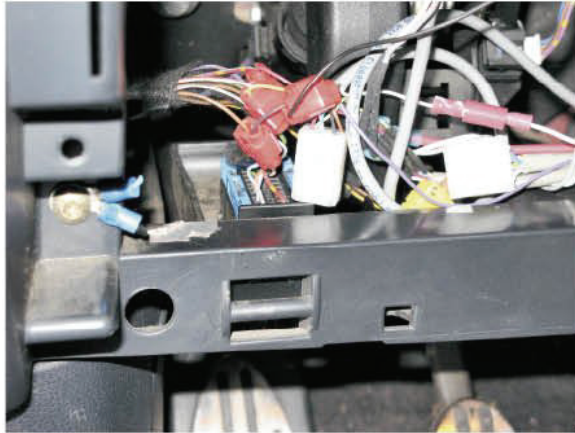
### 2nd Character:

0=Generic  
1=Manufacturer Specific  
2=Generic  
3= Both Generic and Manufacturer Specific

### 3rd Character:

1=Fuel and Air Metering  
2=Fuel and Air Metering (injector malfunction only)  
3=Ignitions System or Misfire  
4=Auxiliary Emission Control System  
5=Vehicle Speed and Idle Control Systems  
6=Computer Output Circuits  
7=Transmission  
8=Transmission

4th and 5th Characters are a numerical index.



Matt's car is used as a development lab for products ([www.fes-auto.com](http://www.fes-auto.com)) so it's hacked to bits with tons of stuff hanging here and there. The port is accessed via the footwell. On the R50, 52 and 53, this is where the OBD-II connector lives.



We haven't started hacking here so it's still clean and pretty. On US Spec cars, this is located under the dash on the driver side.



This package sells for about \$500. It works on a laptop and has an interface (shown) that is coded to the software that you bought (this is an anti-hacking feature). While you need to use a laptop, this can talk to the other systems in the car besides the ECU, so you can diagnose and clear that pesky airbag light or reset ECU adaptation values. It even can read brake line pressure from the ABS/DSC system. But it doesn't support the R55/R56 yet.

doesn't have a real engine temperature gauge. Items like the MSD DashHawk (about \$300 and CAN support only) and the ScanGauge II ([www.scangauge.com](http://www.scangauge.com), about \$170) fit the bill here perfectly. Not only can you display more than one parameter, but the units can read and clear trouble codes as well. One caveat, these units can only display data from sensors that exist on the car, so no oil pressure or temperature.

If you want to actually log data for off-line analysis the choices get more difficult. The DashHawk allows for upload of data via USB or one can step up to more complex diagnostic software like Auterra or AutoEnginuity. The nice thing with these packages is that they have versions that work with several types of PDAs that then become "intelligent displays" along with having practically unlimited storage capacity. (There are lower costs software packages as well, just Google "OBD-II software" and be prepared to spend lots of time reading.)

## What About the Rest of the Car?

Now, this just covers the engine management system. In the MINI, there are tons of other systems that have electronic brains. These include the ABS/DSC system, the airbag system, the body control module and on and on. What if you want to talk to them? This is where it gets messy. First off, there is no EPA mandated standard for talking to these systems so solutions tend to be carmaker specific. Secondly, the tools that do this stuff are more expensive. In fact, the only one that I know costing under \$1,000 is the AutoEnginuity package with BMW extensions. The last time I checked, it was about \$500, but it didn't support the R55 or R56 and only ran on the PC, so no PDA-based gauges! But what you do get with software like this is the ability to talk to other systems and troubleshoot and reset fault codes in these systems. This is particularly useful with troublesome air-bag lights.

## In Closing

It is our belief that anyone with a modern car can't afford to not have a scan-tool of some sort or another. While you may not be so hard core that you're going to data log and diagnose each and every problem that comes up, the codes can help you know if it's a big problem or a little one. I've also found that it can protect you from service scams by having some idea about what's wrong with the car when taken in to get service. If you have a "throttle body position sensor fault" and they're saying they have to fix your head gasket, you know something is up. Anyway, from the \$50 cheap code scanners to the higher end systems, there are tools out there that can help de-mystify our computer controlled cars and help you understand what your car is trying to tell you. **MC**

## Resources:

These sites will help you decipher the trouble codes:

[www.obd-codes.com](http://www.obd-codes.com)

[www.my330i.com/odb2.php](http://www.my330i.com/odb2.php)

[www.check-engine-light.com/trouble-codes](http://www.check-engine-light.com/trouble-codes)

**MC**