

Reprogramming Your ECU

Just What Are Your Options?

In today's very regulated world, you can be sure that the tuning supplied with your car isn't optimized for exactly what you want out of your engine. This is particularly true when you start to make changes to your powertrain, especially those beyond the standard intake, pulley, and exhaust. The engine control unit makes all the decisions for you. But that can be changed...sort of. All it takes is a little money.

My last article explained the general concepts of what the little black box of mystery, the ECU does, but did nothing to explain how to modify it. And it turns out that while it is just a computer, how it's programmed is kept a closely guarded secret by the MINI engineers.

The tuners who specialize in reprogramming the ECU aren't going to reveal those secrets either, because they had to reverse engineer the sucker, and that takes a very, very long time full of frustration. So the long and the short of it is that anyone who has hacked the ECU isn't giving their work away for free. I find this particularly frustrating, because my car is always changing, and I'd love to have a software package I could use to tune my own car, without resorting to e-mail or a visit to a custom tuning house. And what makes this even more frustrating is that software like this is available for other marques, so we all know it can be done.

The purpose of this article is to briefly describe what tuning options are available to us in the U.S. market, what features are offered, as best I could find out, and some of the constraints imposed by a particular choice. With an understanding of the pros and cons of the various options, the hope is that you, the consumer, can make an informed choice that best suits your particular needs. With that in mind, let's get down to business.

Making More Power

Why re-tune the car at all? I mean, Mini has all those smart programmers that optimized the code for our cars. They have engine dynos and data acquisition the like of which guys like me can only dream, and they have the keys to the treasure chest, so to speak, intimate knowledge of how the whole thing works. Don't they do a good enough job? Well for most people, the answer is yes, the stock programming is fine. But for many, especially those that modify the car, stock programming either isn't what's desired, or just won't work with certain types of modifications. Here's an example of why: Let's say you've put some pulleys on the car to spin the supercharger faster. The stock car only makes 10 lbs of boost, and now your car is making 16. There may be no map values for this high a boost, so the ECU will just use values from the edge of it's stock map, and hope for the best. Yes, this is what it sounds like, far from optimal.

So, what does a good tuner do? A good tuner gets a list of all the modification that you've done to your car, and works on *all* the internal ECU routines that are related to the mods. The *all* is what is key here. The reason I say that is that not all of the tuners work on all of the parts of the programming that are affected by your mods.

Pretty much all tuning options allow for changes in Wide Open Throttle (WOT) operation, as the car is running in open loop (not looking at the oxygen sensor output), the throttle body is wide open and the only things you really can control is the fuel and the timing. But other than Wide Open Throttle maps, no one is really saying all the stuff they can change, so it's hard to sort out the hype from the truth. The key to a really good tune is that you get your WOT power, but that you don't sacrifice any part-throttle drivability (and maybe even improve it).

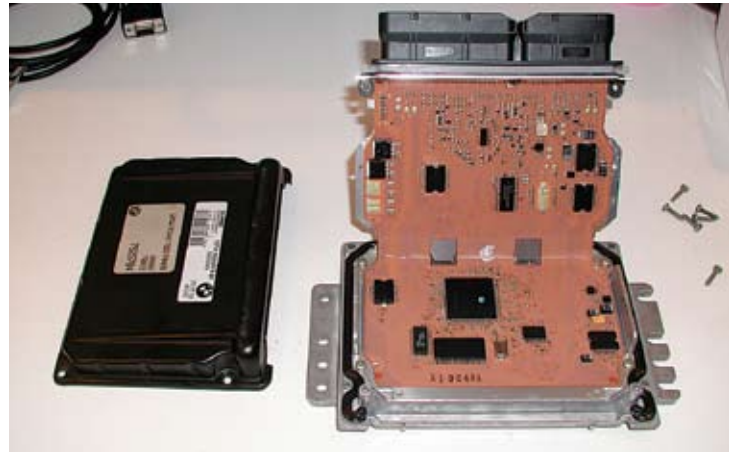
If a piggy-back is being used, then it may not be possible to modify some features, like rev limiters or traction control settings. This makes choosing a tuning option pretty hard. And there are no perfect solutions yet.

There is one other important item to keep in mind. In the 2005 model year, MINI switched revisions of the Siemens ECU. So all the tuners had to figure out how to hack the new one, and not all of them have. As you shop for ECU upgrades, some will offer tunes only for 04 and earlier cars, and some for all years. Some tuners only offer options for the S, or don't support the automatic transmission. So take your time in selecting your tuning solution. Needless to say, piggy-backs don't have any constraint like this.

Approaches to Tuning.

Like I've mentioned before, there are really two approaches to modifying how the engine is run. One involves changing the internal programming of the ECU, the other class involves using a piggy-back set-up to trick the ECU into doing something different than Mini intended. There are some basic pros and cons to each one.

by
Matt Richter, Ph.D.
Technical Editor



Two views of the ECU: Removed from its slot, showing the wiring harness plugs; Open, showing that it's just a little computer, not unlike your laptop.

Changing the internal code on an ECU doesn't change the stock look of the engine compartment. Some vendors may be able to modify things like rev limits and traction control behavior, but flash remapping requires additional hardware to upload to the ECU, tunes are written over by dealer ECU upgrades, and a remap may not address much more than WOT behavior. To make matters worse, some vendors require that you send them your ECU in order to get it programmed.

Piggy-backs can be either easy (using factory connectors like the UniChip) or hard (splicing the wiring harness like the Apexi) to install. And while they may have the advantage of being able to provide extra inputs and outputs, they may not be able to modify electronic top speed limits or increase the red-line of the car.

The custom tuning house can go either way; it's a shop that has the equipment and know-how to tune either the ECU or your preferred piggy-back. This is really the only way to get every bit of whatever you're looking for, especially if your combination of hardware modifications is unusual. But you have to go to a shop, and one with the right skills may not be near, and it won't be cheap.

So those are the basic constraints of the various tuning methods. Now let's start looking at the options. I'll start with the ECU flashes, the Piggy-backs and lastly I'll list a couple of examples of custom tuning houses.

Flash Remapping

Conforti Shark Injector (no direct web site, check your favorite vendor) – This is one of the first offerings in Mini engine tuning. Jim Conforti has been tuning BMW systems for years. His product is neat in that it's a self contained little unit that plugs into the diagnostic port. You press a button on it, and it loads the tune. Press the button again, and it returns the car to stock. It's a smart little bugger, and will code itself to a particular car the first time it's used, so you can't buy just one and tune your entire car club! The downside is that it's only available for 04s and earlier. But it does come in a 91 or a 93 octane version.

There is another like this from Europe called the AMD One-Click, but they don't distribute the product in North America.

Dinan (www.dinancars.com) – Dinan has been doing ECU remapping for BMWs for quite a while, and they do offer several programs for Minis as well. Turns out the Siemens ECU is used in lots of BMWs, so they have prior experience with the unit. While they do offer a flash for a stock MCS (\$300, claimed increase to 175 HP @ 7000 RMP, and a 300 RPM increase in the rev limiter, to 7300), most of the Dinan software has been optimized for specific combinations of Dinan hardware. While this is a bit of a constraint, basically tying you to a single vendor, I had the pleasure of driving the Dinan development car, and it is both strong and smooth. Maybe even

smoother than the stock programming! It sure is a nicer drive than what's in my car now.

The top of the line Dinan car claims 209 HP @ 7000 RPM and 180 ft-lbs of torque at 4500 RPM. This is a combo of hardware and software, including a cam. One interesting item of note is that Dinan doesn't use larger injectors, but they do provide revised fuel delivery to increase fuel rail pressure. For what it's worth, this (Dinan's Stage 6) was what was on the car I got to drive for a few days. Boy was that fun!

You do have to go to a Dinan dealer to get the ECU modified. When I visited Dinan at the end of June, they said they had relationships with 40 of the current Mini dealers, adding one or two every month.

EVOTech (www.evotechusa.net) – EVOTech has been doing ECU remapping for quite a while, on cars like Mercedes, Ferrari, Porsche and the like, so the Mini is in good company. These re-maps are available from Webb Motorsports, MiniMania and Dyno-Comp, among others, I'm sure. EVOTech claims a 15 HP bump over stock, raises the red-line to 7500 RPM, and also removes the electronic top speed limiter.

There are two downsides to EVOTech's offering: First is that it's expensive (Lists for around \$700) and second that you have to send in your ECU for programming. So your car will be down for a few days.

GIAC (www.giacusa.com) – GIAC is a well known name in the world of Porsche, Bentley, VW and Audi tuning. They have offerings for all model years of MCS, but don't offer upgrades for the Cooper. They also have maps optimized for both stock and cars with pulleys (either a 15% pulley with stock injectors, or a 19% pulley with JCW injectors), but I've read of some users that have modified their cars past the capabilities of the GIAC tune. Pricing is much more attainable at \$325 from Helix Minisports, but at this time you have to go to a GIAC dealer to get the flash loaded. GIAC claims to have an end user interface cable in development so the car owner can upload and download tunes from the car, but it is not yet available, so you're tied to a local GIAC dealer. If there isn't one near you, this may not be a good option for your car, at least until they release their interface cable.

MiniPowerProg (www.minipowerprog.com) – This is a new player in the market. It's from an Italian company. For 250 Euros, you get the interface cable, the software to run on your computer, and a manual. Since they are new on the scene, I don't have all the details on them. But they do support all years and all models of Mini (including the OneD!). Future tunes are no cost, but only for the car that you first installed it on.

There are some very nice features about how this system works. The software presents you with a screen where you can select the

The door to all wisdom is the OnBoard Diagnostic slot, that connects to the ECU, here with the computer interface plugged in. Not only does this slot supply diagnostic information, it also allows a computer or the internet to talk to the ECU in order to reprogram the ECU.



modifications to your car, and then the software contacts the company's server, sends in your current ECU map and mod list, and you receive a tune file to upload to your car at your convenience. This is a very nice degree of process automation. Also, if you are a tinkerer, always changing what's bolted to the motor, unlimited tunes is a very appealing feature.

Since this so new, I don't have any direct feedback from users to see how well it works, but it is an option that seems to be worthy of consideration.

MTH (www.mth-minipower.de) – MTH is a German company that has been offering tunes for Minis for quite some time. They also tune for BMW and Rover. The sell through a network of distributors/tuners (to find the one closest to you, go to the MTH website). One of the nice things about MTH is that the car owner does the upload and download of the maps. But it's not as automated as the MiniPowerProg offerings, done by manual e-mail. You can have a selection of maps (one for street gas and one for race gas, for example) and switch between them as needed. But there is a price for this convenience, you must buy the interface cable separately (approximately \$100), in addition to the cost of the tune, about \$300 for the performance maps.

I must admit that I've been an MTH user for quite some time, so I am more familiar with both the good and the bad for this particular offering. The reason I chose them is several years ago, the MTH tune for the Mini was just 60 Euros (about \$73 when I bought it). Just too cheap not to try.

My favorite two things that I like about this software, is that the user can upload and download maps from the ECU at will, and that the software makes the traction control much less intrusive, so no more trying to enter traffic, start to spin a tire, and have the car basically stop. These features are available in the base software that cures drivability issues, and their tuner software, that does that and goes for more power and an enhanced red-line. Another nice feature is that they seem to be willing to code for virtually any combination of mods, although MTH has balked at some extreme requests.

Piggy-Back Controllers

Is there a way around this? Well, yes and no. You don't have to change the programming to get a different tune, you can use an external device (commonly called a piggy-back controller) that allows the stock ECU to do its thing, while modifying ECU inputs and outputs, so that you can change the timing or injector duty cycle. But this by itself doesn't guarantee that you will be able to program

the device yourself. What's in these babies is protected as well, so for some you STILL have to go to a tuner shop that specializes in your particular piggy-back. And the custom tune cost is on top of the price of the piggy-back, and costs start to add up. It's never easy, is it?

As mentioned before, you don't have to change the stock maps to tune your car. You can install a secondary engine control computer between the ECU and the wiring harness, or actually cut wires to integrate the secondary system. So far, I've just found 3 that have been used on Minis (if you know of any more, please e-mail me at mattr@ix.netcom.com).

A'PEXi Super-AFC Select (www.apexi-usa.com) – While this unit requires that the user actually splices into the wiring harness and it only affects fuel, not timing, it does have one feature that does make it rather compelling: It is currently the only user tunable option out there! Our cars run very rich with the factory tune, and leaning the mixture at pretty much all RPMS above 4500 can lead to power improvements. Another appealing feature is its cost, just north of \$300.

I've spoken with several A'PEXi users who really love the unit. It's also interesting that the Fireball Tim twincharge crowd really like it as well. But installation isn't for the feint of heart. Pass the wire-cutters and soldering iron!

Hydra (www.altaminiperformance.com) – Alta will be the exclusive Mini distributor for and is close to releasing to sales the Hydra piggy-back (www.hydraems.com). What's interesting about it is that it will be available in several flavors. Units will be available in "standard" configurations to support common combinations of mods, much like the other offerings in this article. I'm more interested in the fully unlocked version, allowing for user tuning! There is an even more curious feature available: Auto-tuning. This requires the additional wideband O2 sensor. You enter a desired A/F ratio as a function of RPM and engine load and drive around and the software builds the control maps. But this level of sophistication doesn't come cheap. If you go all the way, you can spend close to \$2k!

Currently, the Hydra is in the final stages of integration engineering, and should be available shortly.

UniChip (www.unichip.us) – The UniChip is much easier to install (there's a plug and play version that uses factory connectors to make installation and reversion to stock easy). It is available from many vendors, and has many configurations of mods where you can get optimized maps installed when you buy it. Some vendors like Webb Motorsports have developed maps for the unit as well. And you



Piggy-back units, such as that made by UniChip, are named for obvious reasons, and are connected between the engine and the ECU.

can take the unit to a UniChip tuner to do custom tunes too. While on Gary Anderson's stock MCS, we did see an up to 7 HP increase in the upper RPM ranges, the folks at UniChip say the unit really shines as the cars get farther and farther from stock. The unit isn't cheap, listing in the mid \$700s, but it does modify both timing and fuel.

UniChip is a large company, with versions of the product for too many makes and models of car to be listed here. So you can rest assured that there will be continued support for the product, with new versions coming out every so often. Currently, it has to be programmed at a UniChip distributor (I looked on their web site, and there are 7 in the greater SF Bay Area alone!), but they are developing ways to do remote updates.

There is one very interesting feature of this product, and that is programmable outputs. For example, one could have the unit programmed to change an output used to run an intercooler sprayer based on state logic. That is "if air intake temps are above X and intake pressure is above Y then turn on the IC nozzle" type of programming. But the sad thing is while this is possible (Webb Motorsports has had this option listed as "in development" for a while), I haven't heard of a single user that's taken advantage of it.

Full Race ECUs

There are many race piggybacks available, but most of them currently don't support the drive-by-wire way the Mini throttle body is controlled. Because there's no easy integration path for these types of products, I won't cover them here.

Also, if you're at the point where you're contemplating a Greddy eManage or a Motec stand-alone, you probably don't need an introductory article to explain the pros and cons of using one! We're going to skip them today....

Examples of Custom Tuning Houses

Besides tuners that will optimize your piggy-back for you, more and more tuners have cracked the Mini ECU. Each month, there seems to be a new shop offering custom tunes. Since this is a very dynamic market, I'll just mention a couple. If this is of interest to you, you have to do more homework than the other options.

You have to look for a tuning house that isn't too far away, that has rates that you can afford, and is staffed with people that you can do business with. In the case of a custom tuning house, you're not buying a tune as much as starting a tuning relationship.

“ The Engine Control Unit makes all the decisions for you, but that can be changed... sort of. All it takes is a little money. ”

EvoSPORT (www.evSPORT.com) – This is a company in Southern California. The reason that I mention them is that there is a very good example of their work on the European Car website. During one of the Mini builds described there, Evosport tuned an already pumped up car and made good power. For the EC article, the tune was a bit over \$700, and they were very pleased with the results.

Myens Automotive (www.mynperformance.com) – This is another new player (in the Mesa, AZ area) that has my curiosity working overtime. Here's the reason why: They appear to be able to tune pretty much everything on the car, from WOT power to part throttle operation (part throttle is the key to around town drivability. Besides the standard HP, rev limiter and top speed modifications offered for the not insignificant price of \$600, for \$75 more they also offer services for optimizing the transition from closed loop (think cruising) to open loop (think acceleration) operation, map sensor scaling to deal with highly boosted engines and the like. The reason this gets me interested is I have a flat spot in my car's operation, when I start to accelerate (gently) on the freeway, the car starts to lean, and the exhaust gas temps rise. This flat spot seems to get a bit worse as I go farther from stock (and very large throttle bodies make it very pronounced). I think the transition from closed loop to open loop is the key here, and my car is far from optimized in this area.

Summary

Tuning our cars sure isn't an easy task. No matter which way you turn, there is some sort of inherent compromise. Some points to keep in mind:

- If it can only be tuned at a distributor or tuning house, it's a good idea to live close enough to one that you can take advantage of the services offered without having to go on a three day road-trip!
- When you make your selection, keep in mind the follow-on costs. Do you have to pay for future tunes? How much will it cost to get it optimized at a tuning house? If you do a little math, you can see that getting an optimized tune at every stage of engine modification can become a very expensive endeavor.
- What exactly is changed with the new tune? If only the WOT fuel and timing is tuned, you may be left with part-throttle drivability issues. Talk to people who have similar mods and see what their experience has been with the different tuning options. While most of the customers for each and every tuning option are happy, there are a few that have run into situations that can't be handled by some of the various vendors. *MC²*

by Gary Anderson

Installing the Unichip Engine Management System



The Unichip engine management system is a “piggy-back” approach to engine management, as discussed in the preceding article. As such it offers several advantages over the “reflash” approach to overriding the MINI’s ECU. The system doesn’t change anything in the engine’s ECU, so it is easy to return the engine to stock when servicing is needed, changes to take advantage of performance modifications are made directly into the Unichip computer, and the company offers a growing variety of programs that can be easily downloaded into the computer to accommodate different combinations of modifications, and the system can be custom-tuned for cars with sophisticated and non-standard upgrades. In fact, as Joshua Levy – the technical wizard from Unichip who oversaw our installation – put it, the more advanced the upgrades, the better the Unichip performs relative to standard systems.

We were particularly interested in the company’s promise that the system could easily be installed by a reasonably handy owner, with a program already installed to handle the owner’s mods. Plug and play is what the company says, and though we did have ours installed at Edge Motorsports in Dublin, California, I’m convinced I could have done the job myself. It’s about as complicated as unpacking and installing your home office computer.

The system is installed in a three-step process. First, the cable that will connect the ECU interface

to the control computer is inserted through the grommet surrounding the steering column. You use a box knife to cut a small slit in the grommet, then use the stiff plastic tube that is provided to create an opening through the grommet. The connecting cable is fed through the tube, then the tube is removed, and you’re ready to plug in.

You remove the ECU box cover, exposing the wiring harness connections, unplug the wiring harness plugs from the ECU, and plug in the Unichip interface into the ECU. Then the car’s wiring harness connections are plugged into the Unichip interface plugs. A few zip ties to neaten up the package, and the engine compartment side is done.

Inside the car, the other end of the cable is plugged into the Unichip computer, and a two-phase switch is tucked into the glove compartment. Finally the computer is fastened with double-sided velcro tape up under the dash and out of the way.

The two-phase switch will soon be replaced by a plug-in system that will allow the owner to hook up a personal data assistant. This will dramatically expand the utility of the system making it very easy to download a new program from Unichip through the internet and load it into the Unichip computer, as well as getting continuous read-outs of a variety of engine functions.

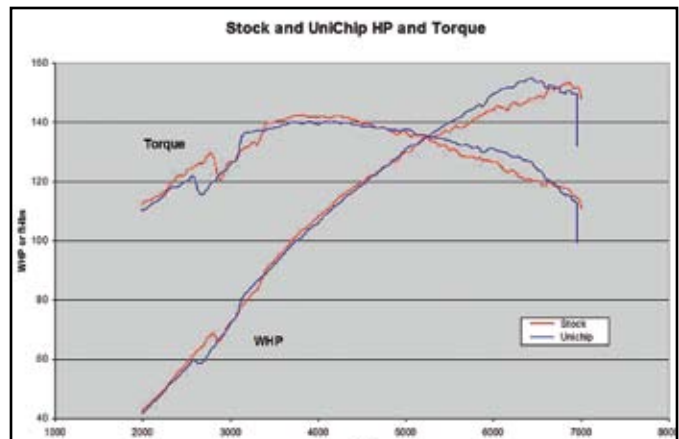
Once the system was installed, we tried it out by running some dyno pulls which could be compared to the pulls that had been done on the car before the installation. We weren’t expecting much, since the car is otherwise quite stock now, but we were pleased to see a gain of about five



The system easily plugs in to the car’s wiring harness and ECU, with the computer inside the driver wheelwell under the dash. Dynamometer runs showed the immediate contribution of the system.

horsepower at higher revs, as well as a smooth curve and more torque. One fascinating piece of misleading data was a hiccup at about 2800 rpm. Josh used his laptop to trace it to an abrupt reduction in ignition advance, which he was able to override, illustrating how easy it is to custom-tune engine behavior using the Unichip interface. However, he and Eric of Edge Motorsports agreed the behavior was probably a reaction to shop heat during the dyno runs, so he reversed his programming. Sure enough, when we confirmed the behavior of the system on some highway runs, the hiccup had disappeared.

MC²





THREE MORE BRAKE UPGRADES TO MAKE YOUR CAR QUICK ON THE PEDAL

By Matt Richter
and Gary Anderson

At the risk of seeming to have put the cart before the horse, there are three more brake upgrades that we believe most Mini drivers should consider for their cars. In addition to replacing your original equipment brake pads, as we showed you how to do last issue, we also recommend replacement of the OEM brake lines, brake caliper bushing guides, and brake fluid with higher quality components.

The cart and horse issue is simply because one can replace the pads and other components all at the same time, which is what we did on our project car last week. The total job requires little mechanical aptitude, only simple tools and takes about four hours.

The net results are brakes that are quick to respond to the pedal and give a firm response that we believe is superior to the original equipment.

This improvement comes from the woven steel brake lines that don't compress as brake fluid is forced through them, the metal caliper guides that prevent any wobble as the calipers press on the pads and – though we haven't put it to the test yet – the higher-quality brake fluid that will stand up to continuous usage at higher temperatures than the stock fluid.

Parts and Tools Required

1. For the upgrades, we ordered the Stage 1 Brake Upgrade Kit from MiniMania, which includes woven steel brake lines for front and rear brakes, as well as EBC Green Stuff front and rear brake pads, for \$335, plus a Brake Caliper Bushing Stiffening Kit made by BMW, which was on sale for \$129.95 per axle. We replaced the fluid with a quart of GT-LMA brake fluid from Castrol, which exceeds DOT3 and DOT4 specifications, from our local auto store.

For the job, we needed the same tools we used for the brake pad repair, plus a brake caliper compressor we bought from the auto parts store for about \$10. Also we needed a drip pan and a plastic hose and jar to catch brake fluid and bleed the brakes.

Getting Up and Under

2. This job is easier if you also raise the rear end, placing jack stands at the inner pivot points of the rear trailing arms. Then you can remove all four wheels at the same time. Raise the front of the car first, and brace it on jack stands, as we did for the brake pad replacement job in last issue. Then place the rear jack stands. Give the car a couple of good shoves to make sure it is absolutely secure and doesn't rock at all.

3. You may find, as we did, that the wheels will be hard to remove, generally because light rust has developed between the wheels and hubs.

If that's a problem, a couple of taps with a shop hammer will break the wheel loose. We'll take care of the rust at the end of the job.

4. Starting with the front brake calipers, remove the calipers following the instructions in the last issue. (Briefly, a 7mm Allen wrench is used to remove the caliper guides, which releases the calipers. Then the pads can easily be removed.)

Now remove the rubber caliper guide bushing from the caliper, using a pair of pliers to yank the rubber bushing out. No need to be gentle; this piece is now rubbish.



Do It Yourself



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Replacing the Guide Bushings

5. Shown here are the bronze replacement bushings (a BMW product) above, compared to the OEM products below.

6. The bronze bushing is slid into the brake caliper, following the instructions in the kit, and is secured with the circlip provided. A circlip pliers makes this job easier, but it can be done with a small needle-nose.

7. With both bushings in place on the calipers, we can move on to replacement of the brake lines.



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Replacing the Front Brake Lines

8. Positioning a drip pan underneath the brake line, we start by unfastening the brake line from the solid line in the fender well.

9. Next the line can be removed from the brake caliper itself.

10. To install the new brake lines, start by fastening the new line to the brake caliper.

11. Then the flexible brake line can be fastened to the solid brake line in the fender well.

12. With the brake line securely fastened to the solid line, it can be clipped under the fastening bracket.

13. Before re-assembling the brakes, we'll put anti-seize lubricant on the clips under which the brake pads slide back and forth.

14. We'll also put anti-seize lubricant on the threads and shafts of the brake caliper guides so that they can move easily in the bushings, and so there's no chance they might rust and seize up.

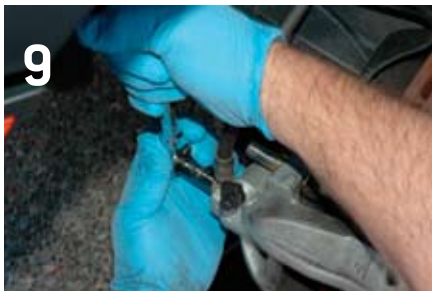
With this done, the front brake calipers can be reassembled just the same way we did them in the previous issue (or just put them back together in the reverse order you took them apart. The only tricky part is that the new brake pads are thicker than the used pads, so the caliper needs to be compressed before it can be put back over the brake rotor.)



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Doing the Rear Lines and Pads

15. The rear pads and lines are done in pretty much the same way as the front pads, with one difference that we'll discuss. The job starts by using your 7mm Allen wrench to remove the brake caliper guide. We're not replacing the caliper guides on the rear, because they're not as important as the front. However, if you're the thorough type, you might order and install a second kit, in the same way you installed them in the front, following the instructions in the package.

16. Once the old pads have been removed from the calipers, we're ready to install the new pads. However, to do this we have to retract the brake piston. The rear calipers have an extra fixture for the parking brake, so the pistons have to be rotated as they're compressed, which requires a special tool.



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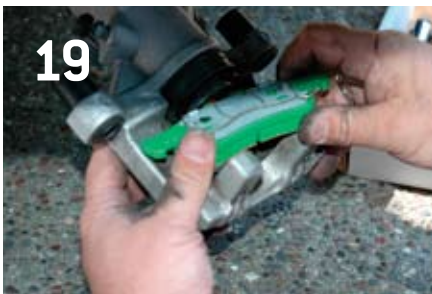
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17. Your dealer has a special tool that rotates the piston as it is pressed in, but you don't need one of those. You will need a brake caliper press, but these cost less than \$10 at your local auto parts emporium.



18. The trick is to use a channel-lock pliers to gently rotate the piston a quarter turn at a time, as you press it in with the tool.



19. Once that's done, it's a simple job to slide the rear brake pad in, with the clip on the pad sliding over the channel in the piston.



20. Now it's a simple matter to slide on the pads, using a little anti-seize lubricant.



21. Don't forget to re-install the rear brake pad thickness sensor.



22. With the wheel off, this is a good time to remove the screw that secures the rotor in place and put anti-seize lubricant on it as well, to make sure you'll be able to remove it later.



23. With the pads and calipers back in place, you can remove the old brake lines and replace them with the woven steel lines. Start by unclipping the line that shares the brake line clip, to get at the brake line.



24. Now the old brake line can be removed from the solid line, and the new one attached.



25. Likewise the old line can be detached from the brake caliper, and the new one fastened on.

Replacing Fluid and Bleed Brakes



26. With that work done on all four wheels, you're ready to replace the brake fluid and bleed the brake lines. To do this without introducing air into the brake lines, you'll need a short piece of plastic hose with a 3/8 inch inside diameter that will slide over the brake bleed screw. The other end of the hose is immersed in brake fluid in a jar with a screw-on lid through which you've drilled a hole for the hose. More sophisticated versions of this tool are available from auto parts stores, but this will work fine.

Start by topping up the brake reservoir in the engine compartment with new fluid. Then you force fluid through the system with the help of an assistant. You release the bleeder screw, then tell your assistant to "press" the pedal to the floor. Then you tighten the screw so the fluid won't be sucked back and tell your assistant to "release."

You will repeat this process, topping up the brake fluid reservoir with new fluid after every 15 or 20 pumps. This presses new fluid through the brake lines, pushing out the old brake fluid plus any air that got in when you replaced the line. Keep it up until the fluid coming into the jar is the color of the new fluid.

The first wheel will take the longest, because you're pushing all the old fluid out of the car, but the other three wheels will be easier. As you do each wheel, when you first start pumping, you'll see air bubbles come through. Continue pumping until no more bubbles come out.

With just a little patience, the job will be

done in 20 minutes or so. If the pedal is firm when you've completed all four wheels, you're all set. If not, give each wheel a few pumps to remove the remaining air.

Now, put the wheels back on, first brushing off that old hub rust and putting a light coat of anti-seize on hubs. Now follow the instructions on bedding in the brake pads that came with the pads and you'll be all set; Another good job done and a safer, better-handling car as the well-earned result..

MC²



TEN TIPS TO KEEP YOUR MINI FINISH LOOKING GOOD

Shining up the car is something that's been done since Simonizing was a verb. But there's a lot more to it than just getting admiring glances on the show field – keeping that exterior finish looking good is the key to protecting the paint and eventually the resale of your MINI when you're ready to trade it in for a turbo. The technical quality of the products has improved significantly since a can of Classic Car Wax was the ultimate in polish, and what you use is important, but how you use it and when also matters. Here are ten tips from professional detailers.

1. Wash the car at least once a week.

Your new MINI comes with a pretty good finish right out of the showroom, but the junk in the atmosphere and the dust on the road, not to mention bugs and bird droppings, will cover up that sheen. If left on for too long, that dirt will cause that sheen to deteriorate to the point that it can't be recovered.

That's a real shame, when all it takes is a quick 30-minute wash job once a week to keep the car looking good and protect its finish. Find time to do it, and do it right, and you'll have a car that you can be proud of every time you take it out. When it comes time or you to trade it in, or sell it, those few hours invested will pay you back in real money.

2. Clean the dirty stuff first.

It's tempting to start from the top down, but that turns out to be exactly wrong. The wheels are the hardest to clean because they pick up road grease and tar, as well as brake dust, and they're complicated to clean.

So, start with the wheels and tires and the protective panels on the rocker panels and over the wheel wells, and finish them first. That way, any of the residue from that work that gets on the paint can be washed off as you do the paint.

This is one place where a harsher product makes sense. Start with a degreaser product, such as Simple Green and a good brush to clean the wheels, tires, and vinyl, and then rinse it well. A rag will help get into the crevices, but use one that you can throw away, because there's no way of washing the dirt out of the rag after use. Once these areas are clean, wipe them down with an old towel.

3. Protect the rubber and vinyl.

As soon as you've gotten the wheels and black areas clean and dry, then treat them with a vinyl/rubber/plastic protectant. For some reason, many otherwise careful owners pay little attention to these components, but clean rubber and vinyl makes a major difference in the appearance of the car, and use of a good product also protects them from ultraviolet deterioration, keeping them looking rich and black for the life of the car.

The finish companies all make good products that clean and protect the rubber and vinyl. Lexol also makes a good vinyl/rubber product with some protection properties, but for the best protection, 303 is really good.

4. Use a soap intended for cars.

When you wash the painted finish of the car, use a product that is specifically formulated to wash cars. Made by all the finish product companies, like Meguiars, Griot's Garage, and Mothers, these products are strong enough to cut through the dirt and dust, but gentle enough so that they won't remove the protective wax or cause deterioration to the clear coat surface finish.

by Gary
Anderson



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Stage 1: No Excuse for a Dirty Car. Clean the car weekly with soap and water to remove impurities that will eventually ruin the paint. Pay particular attention to wheels, rubber, and vinyl, and then coat them with vinyl/rubber protectant.



Stage 2: Keep the Shine Looking Good. Once every few weeks, or whenever you want the car to look its best, use an instant detailer applied and removed with a microfiber cloth. If you want a little extra, use a one-step polish/wax.



Stage 3: Get Serious When Needed. If you want a knock-out shine, or your finish has deteriorated over the last few years, the answer is a three-step process. Clean the surface with clay, polish the surface, and then apply wax.

In contrast, dish and laundry detergents are much more aggressive, and will strip off the wax. Used frequently, they will even create microabrasions in the clear coat that cause the paint to look dull.

I've recently started using a product from Mr. Clean that mixes a special car soap with the wash water as it's being sprayed from the hose, and then has a filter and special nozzle so clean and atomize the rinse water so that the car will dry without spotting. I like it, but it's a little expensive for the soap and filters, and it may not be necessary except in areas with very hard water.

5. Rinse frequently.

If you aren't using the Mr. Clean product, then the best way to wash the car is to use two buckets, one with the soapy water in it and the other with clear water to rinse out the wash mitt. Soak the wash mitt in the soapy water, wring it out slightly, and then clean a portion of the car as big as you can reach without moving.

Then rinse the mitt out in the clear water, and repeat the process on the next section. As soon as you've done a quarter of the car, use the hose to rinse off the car, rinsing from the top down. When you've done all four quadrants, then rinse off the whole car.

6. Synthetic materials are best.

For years, detailers swore by cotton diapers, terry cloth, and natural chamois. However, industry had come up with better products to replace each of them. For nearly all surface work, microfiber cloth is best. The big catalog companies sell a pretty expensive version, but the warehouse discount houses sell a similar version at prices cheap enough that you can toss them out if you didn't want to wash them after each use.

For application of wax and other paste products, a synthetic applicator will work as well or better than the traditional terrycloth/foam applicator. Even more important, the hide chamois were good at drying the car without streaks, provided they were clean, which they rarely were. Instead, the best product out there now is "The Absorber," a synthetic porous cloth that is three times as absorbent as chamois, stays moist in its container, and can easily be washed in a washing machine. It's available at any auto store, Walmart, or other stores stocking auto cleaning supplies.

7. Instant detailers are usually enough.

Owners often ask if they should wax their new cars. Actually, if the car is washed carefully, that's usually enough, but for a little extra shine, use an "instant detailer" manufactured by one of the major polish sources. I particularly like Griot's product, but Meguiar's and Mothers both make good products. Just spray on, wipe with one microfiber cloth to clean the dirt, and then polish with another clean cloth. If you want a little more shine, then use a high-quality one-step wax and polish. Zymol is good, but expensive; Consumer Reports recently ranked the Turtle Wax cream as best of all the products it tested.

8. Glass needs special attention.

Don't neglect the glass. Windex is always good, but we recently tried Griot's Glass Polish which really works well to clean off bugs, water spots, and can be polished to a streakless finish. In addition, wipe the windshield with RainX, which helps rain water slide off in sheets, making the wipers almost redundant.

9. Paint cleaning clay cleans off the hard stuff.

If you want a super show shine, or your finish is several years old and hasn't gotten good care, then paint cleaning clay, a mainstay of detailers for many years because of its non-abrasive ability to remove paint oxidation, layers of old wax, and other surface grunge. It's available from all the manufacturers, and is used in tandem with their instant detailer for lubricant, then polished off to leave the surface supersmooth before polishing and applying wax.

10. Shine means wax and polish.

To follow the claying, a great show finish requires use two separate products, a polish to smooth the finish and remove imperfections below the level of the surface, and a wax to coat the surface and protect the paint. We particularly like Zymol for this serious work. Do it properly and it will last six months. We would also mention Zaino, a product I haven't used myself but, judging from the instructions, appears to be a two-part polymer finish, with the two products blending on the surface into a strong synthetic finish. *MC²*



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Brakes, and Rims, and Power, Oh Boy!

by Gary Anderson



In its first major upgrades, the Vicar gets a brake upgrade, Wheels and Tires from Edge Racing, and a Stage 2 power kit, plus sway bar, from Dinan.

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Look at the Mess I've Made of My MINI

by Matt Richter



Even before the new Mini came out I wanted one. With the reports of the excellent handling right out of the box, it sure sounded fun.

At that time, in 2002, I was going through sports car withdrawal with my Mustang in the second year of what should have been a three month suspension job, so when my wonderful wife Cheryl saw that I was reading yet another MINI evaluation, she whispered in my ear, "Just get the freakin' car already...and get the powerful one. I don't want to hear you complain later!"

So after a fruitless discussion with my local dealer, and a little online time, I flew to Salt Lake City and just over three hours later, I was on my way home in my very own CR/W MCS. The drive back was a blast, as in just under 18 hours I was back in my own bed, exhausted but happy.

The following spring, I took the MINI to In-fineon Raceway. In two days of driving, I pretty much ruined the front tires because the cars don't have enough negative camber. RDR camber plates were on sale, and so I'd found my very first mod. I haven't stopped since.

So, what's bolted onto my car? It's been an evolving list, but I've tried to keep a goal in mind, and to acquire items used or on sale so I could keep the total spending down. Nonetheless, I've still spent more than \$10k on the car. Right now, I'm putting somewhere around 180 horsepower at the wheels. I'm pretty sure that there's more to be had with better tuning. (*See the complete list on page 93.*)

I like a balanced car, so in addition to power, I've worked on the suspension and the brake system, adding the big brakes, springs, shocks, sway bar, and links.

I'm a function dictates form kind of guy, so my car looks pretty stock right now (from the outside, the only obvious cues are the wheels, and the unpainted black M7 hood scoop).

On closer inspection you might spot the big brake kit, the lower rear control arms, or maybe notice that you only see one muffler.

From the inside, the fact that the car isn't stock is more obvious. The PLX and G-Tech displays are permanently mounted to the dash cover, and always provoke questions. And there's a fire extinguisher mounted in the passenger foot well,

hinting at a more serious type of driving than just commuting to work.

My Mini is my daily driver, and I live in hills. If traffic and weather allows it, the car gets quite a little workout just driving day to day. I take it out to the track three to five days a year. I don't race, but instead do club events, mostly with the Nor-Cal Shelby Club.

While driving a Mini on the street is fun, it pales in comparison to driving on a track. Prepared surfaces, corner workers and sharing the track with other enthusiasts is an automotive rush that is quite addicting. And there's no other place to really see what the car can do.

Since I'm a tinkerer by nature, and an experimental scientist by training, I really wanted to find out if there was anything to all the claims of enhanced horsepower with this mod or that one. But there wasn't much good independent data out there about what mods worked or offered the best value so I got my G-Tech and my PLX.

The G-Tech is a neat little performance computer with internal accelerometers. You input the car's weight, and it gives you horsepower and torque vs speed, rpm or time (among many other functions). But one has to keep in mind that the power the G-Tech measures is different that what a dyno gives you. The G-Tech data is from a moving car, so there's aerodynamic drag to take into consideration. And you need to find a good, flat area to do your power runs.

If the G-Tech tells you whether a mod made things better or worse, the PLX lets you know what the engine is doing so you know what to change in the tune to get things even better. It can get data from six sources ten times a second.

I also use BiM-COM beta from Ross-Tech LLC. While BiM-COM can log many more variables, the diagnostic interface isn't as fast as the PLX. The combination of these three items really allows me to see what the motor is up to, and quantify the effects of the power adders that I bolt on.

This leads to one other thing I do with my car: I test add-ons. With the G-Tech I can quantify performance, and since I'm not paying for dyno time, I can get as many runs as needed to get good statistics. The PLX and BiM-COM data allows me to see how a part affects the car's operation, and I'll add other sensors if I need them.



The only clues to Matt's obsession are the black M7 air induction system under the hood, the PLX and G-Tech read-outs and fire extinguisher on the inside, and the M7 hood scoop. *Complete mods list is on page 93.*

So, what did I learn in my four years of MINI ownership? I've learned that while the MINI is good out of the box, it sure can be made better.

I also have learned that our cars are complex, and if you just change things without really understanding how you're affecting the whole system, I can guarantee that you will spend more dollars than you have to, and be occasionally disappointed as well.

And the most surprising thing I learned is that while the Mini isn't very big, it is large enough for a family of three to have very fun roadtrips.

So what's next for me and my MINI? More motoring for sure. Whether it's a local run or a larger event, the whole family is into the Mini driving experience.

So what's next? I'm happy with the brakes, but the suspension isn't perfectly sorted yet, and I've got a few more mods to do to the motor and I'll basically be done with the car... I think.

Because I'm curious by nature, I'll keep up the parts testing. Last but not least, I'll spend time on the track, as much as I can afford. Overall, the MINI is the most automotive all around fun I've ever had, and I plan on enjoying it for quite some time.

MC²

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