

POWER OUT OF THE BOX

Six tuning boxes from all price levels: from AC Schnitzer and Hartge, via Speedbuster and RaceChip, to Ecochip24 box and the plug-in from Exclusive Trading

Power boxes are used when chip tuning no longer does the job. But what are the costs, risks and advantages? We tested six extra control units for the BMW 328i

Our BMW 328i Touring doesn't seem to be feeling too well. At the front, there are two straps tied around its 18-inch wheels, at the rear a cross chain clamps against the suspension. The central info display complains about an open bonnet, warning lamps for the ESP and ABS sound the alarm. There is a medium-grade hurricane blowing through the engine bay, the four-cylinder is shrieking, the turbo howling, while the shrill, circular-saw-like noise from behind becomes ever more insistent to the ear.

This martyrdom is called performance measurement, which is carried out only too willingly at Maha. But what does that have to do with our BMW 328i? Quite a lot: it's had to take its place on the rollers around 50 times. Always on the search for more power, new maximum torque figures and a power development that is as linear as possible. In brief: for the best extra control unit you can buy for it.

So why are we doing this? Because its N20B20 four-cylinder engine has already been programmed to the optimum and the standard control unit is virtually immune to conventional chip tuning. The only way to give its turbo even more boost is to use manipulated input values, which seems rather daring, but in practice works surprisingly well.

High load from the factory with 123 hp/litre

Always assuming of course that it's not programmed beyond the limit of the engine, which brings us to the second reason for carrying out a field test on the 328i. Because in contrast to the civilized power stage in the 320i, where the four-cylinder has to output a mere 184 hp with just 0.8 bar boost, the 245 hp version with 1.1 bar boost is already under considerably higher load straight from the factory. Six suppliers of extra control units however see enough room for manoeuvre to perceptibly improve the standard power level (245 hp, 350 Nm).

Our shopping basket covers all price levels. From experienced BMW tuners like AC Schnitzer (294 hp, 420 Nm, 2150 Euro) and Hartge (290 hp, 415 Nm, 1995 Euro) via universal suppliers such as RaceChip (300 hp, 420 Nm, 549 Euro) or Speedbuster (294 hp, 440 Nm, 699 Euro), through to E-bay snippet Exclusive Trading (272 hp, 392 Nm, 359 Euro). Naturally we couldn't ignore the popularity of eco-tuning, i.e. a performance gain with associated fuel saving, so we ordered one such alleged wonder from Ecochip24 (275 hp, 400 Nm, 799 Euro, up to 15% lower fuel consumption). We bought incognito, measured officially, and evaluated the performance via driveability through to risk assessment.

Of course, we didn't really need to tune our BMW at all, as the initial measurements at the Maha premises at Haldenwang near Kempten showed. With a measured 264 hp and 387 Nm, the estate was already quite beefy. Any suspicions that the four-cylinder had already enjoyed some factory doping could be eliminated: the control unit showed the software version valid at the time of testing.

But even more impressive than pure peak values however is how the four-cylinder controls its power perfectly. The rolling road measurement starts at 2000 rpm: the torque peak comes in just 100 rpm later, and then accelerates lightning fast up to 4600 rpm, before boost pressure (1.25 bar) and power reach their peak at 5200 rpm and are then continuously dropped down. The full-load enrichment, which richens to lambda 0.8 in the mid-rev range and leans out to almost aspiration level in the upper rev range, follows the opposite curve.

The turbo is up to the job as standard

Away from theory and on to practice, which the BMW with its 8-speed sports automatic handles as superbly as the rolling road runs. Alert response behaviour, linear power development, good controllability. The driving performance is similar; the 328i sprints to 100 km/h in just 5.7 seconds, and reaches 200 km/h in 24.3 seconds. In terms of pulling power too, the turbo easily despatches many cars with bigger engines before eighth gear robs it of breath at 1400 rpm.

Measurements were always taken in sixth gear, top speed just 250 km/h

So high time for the first power upgrade from **AC Schnitzer**, which is connected via a separate wiring harness laid along the standard wiring harness to the sensors for rail pressure, charge pressure in the intake manifold, charge pressure at the intercooler and the air flow meter. AC Schnitzer also go to the CAN bus, which allows the box to pick up directly information on the engine revs, load state and oil temperature, and hence guarantees complete retention of all engine protection functions. Also the tuning only becomes active when the engine is at operating temperature.

Just as well, because with maximum 1.71 bar boost pressure, Schnitzer is really pushing the turbo hard; the tuner promises 294 hp, in the end it's 315 hp. Even more impressive is the torque, which with a maximum of 457.6 Nm exceeds that of the standard six-cylinder and doesn't occur as a sharp peak but is present as an even plateau across the rev range. Schnitzer's smart programming shows in the power plateau above 5000 rpm and the linear development up to the rev limit.

Or quite simply, in practical use - which not only offers undreamed of power reserves, but also consistent good manners. The four-cylinder still responds with agility, allows ultrafine control, and develops the power in a linear fashion which it makes the most of thanks to the newly extracted torque balance. 5.2 seconds to 100 km/h, 20.1 to 200 - these are figures which would be a credit even to the 335i. The tuning is even more clearly evident in the flexibility - in the mid-rev range in particular, Schnitzer pushes like no other.

But you can't treat the upgraded four-cylinder with complete impunity. Schnitzer has turned the boost pressure screw a bit too hard, which under full load is expressed in a slightly scratchy charger noise - clearly telling you that the compressor is not only working at its absolute limit, but sometimes even delivering more air than the engine can use. The fact that it is sometimes too much for the box was evident from a reproducible and clearly perceptible drop in power under sustained high engine load.

Success with only two connections? Yes and no

The different driving modes are retained with every extra control unit. Favourite stumbling block: many automatic transmissions are separately protected against too much torque

Finesse which shouldn't necessarily be expected from the **Exclusive Trading** control unit off the internet (E-bay). Not just because of its competitive price of just 359 Euro, but above all because it does not work through the entire engine control system but connects only at two points. In concrete terms, only the two charge pressure sensors are fed with prepared data, the rest is left to the standard control unit which adapts the injection and ignition to the higher boost pressure.

Admittedly, this method sounds almost too simple to be true, but in practice it works astonishingly well. Only on rapid, successive load shifts does the engine appear not to know quite what's happening. Around 2000 rpm when the standard map usually reaches its plateau, slight boost pressure fluctuations can be felt. The power measured however lies within the limits of what the supplier promises. The box squeezes 288 hp and 416 Nm out of the four-cylinder, and enables the estate to give very respectable driving performance. In terms of flexibility, the extra 30 Nm gives 0.5 to 1.5 seconds, in acceleration to 200 km/h almost two seconds. A result which surprised even us, since although the box admittedly extracts some power and performance, it causes a slight deterioration in engine characteristics. In other words: the gain in thrust at 5500 rpm is offset by a more significant loss. The standard engine revs freely up to 6500, with the Exclusive Trading box, the show's over at 6000.

All of which can be transferred to the box from **Ecochip24**, which looks different but has nothing new to offer in what it brings to the rollers and the road. Even the maps for ignition, lambda and boost pressure show an almost identical picture. Unity prevails between the boxes even in fuel consumption, which oscillates around just half a litre above standard level and hence can't deliver on the Ecochip24 promise of up to fifteen percent fuel saving.

With **Hartge**, even the wiring harness eliminates any risk of confusion. Like Schnitzer, the second highest priced tuner also controls its box with multiple sensors. As well as the obligatory connections to both boost pressure sensors, Hartge also goes to the rail pressure sensor, the camshaft sensor and the temperature sensor. The extra control unit spits out its own curves for injection and boost pressure, and only switches in when the engine is warm.

The electronic upgrade as such however doesn't feel as balanced as the promising wiring would suggest. The updated four-cylinder begins to pump out the power at very low revs so strongly that even the best-mounted drive train begs for mercy, then the torque curve collapses around 2000 rpm, to pull itself back together suddenly above 4000 rpm. On the rollers, the set-up reveals another unique feature: it pushes its full torque into the upper rev range on the rollers only when the acceleration phases are kept short. Problem: the harder the acceleration, the less the torque peak can form around 2000 rpm, so we decided to show two measurement curves in the graphs. Because on the road, the set-up shows a combination of the two extremes. The punch around 1500 rpm presses through your bones, and in eighth gear Hartge shows by far the best flexibility performance. The lower the gear, the smaller however the advantage over the standard vehicle, while the sprint to 200 km/h again very impressively shows that every one of the measured 303 hp is present individually.

If you've ever wondered why covers are used - here's the answer

Pure maximum values really say very little

The box from universal chip supplier **RaceChip** also has power. More precisely, it has exactly 306.0 hp and hence 3 more than Hartge. In contrast to the sophisticated tuner, RaceChip also offers a very even torque curve (maximum 439.7 Nm at 2940 rpm) and a soft transition to top power at 5500 rpm. And that's not all: in comparison with all other boxes, RaceChip mobilises the high power with very moderate boost pressure. The extra box unlocks 1.45 bar, just 0.2 bar more than standard. Astonishing, especially since RaceChip doesn't turn several screws like Schnitzer or Hartge but also only works via the charge pressure sensors.

The simple structure gets its revenge in driving mode, where the four-cylinder - with occasional bursts of boost pressure and relatively inharmonious acceleration - gives you to understand that its electronics are having to hunt around in hidden depths. Apart from that, the low-cost performance upgrade is however faultless. The engine responds as smartly as ever, revs up willingly and offers orderly power reserves even above the nominal rotation speed. But despite its athletic characteristics and the higher measured hp, the RaceChip set-up falls behind Hartge in the sprint, which may be due partly to the fact that Hartge performs better on the road than the figures from the test bed would suggest, and partly also to the fact that RaceChip gathers the greatest power reserves towards the mid-range, while Hartge is celebrating a torque comeback at 4000 revs.

A torque dissection also appears in the case of **Speedbuster**, if test bed and road are brought into a logical harmony. Because in terms of pure performance, the sixth candidate with 301 hp is at around the same level as its direct rival, RaceChip. The curves also show similar developments. The difference here lies in the detail: in the lower and mid rev range, Speedbuster pulls together considerably more torque than RaceChip, and up to 3000 rpm even generates more power than Schnitzer's software. And also because - and here, a warm welcome to the academic part of the test bed topic - in the Speedbuster measurement, a very low drag power was determined in comparison with RaceChip and Hartge, i.e. more power was present at the wheels although the total engine power is lower.

Enough about hp; the real star is the torque, which on the rollers climbs to 457.8 Nm at 2700 rpm, on the road develops at just above 2000 rpm and gives Speedbuster the best flexibility values. In acceleration too, the box punches above its weight and up to 160 km/h is equivalent to the Schnitzer, before the latter gains a few centimetres' lead by 200 km/h. Subjectively however these few tenths are not perceptible in the sprint.

So why worry about the costly high-end boxes when equivalent driving performance can be had considerably more cheaply? Because the cheaper boxes usually deal only with power and don't offer an overall package. For example, TUV approval: only AC Schnitzer can offer this. Hartge, Speedbuster and Ecochip24 are certified, but supply corresponding approval only for products in high demand. Because in this case, it costs over 1000 Euro to buy an individual approval. And if in the first years you don't constantly press the accelerator without a second thought, you have to add another 200 to 600 Euro for warranty cover. This doesn't have the scope of the self-supported tuner insurance offered by Hartge and Schnitzer, but in the event of damage can at least cover the costs.

Which brings us on to risk and hence two key questions: what do the tuners ask of the standard engine? And how do they integrate their box into the engine management? Here the principle of powerbox tuning must be taken into account. Because in contrast to software tuning, which allows individual programming of the respective control unit, an extra control unit usually only feeds delta values into the system. Problem: If the engine is already near the top of the spread ex works, the delta programmed by the tuner can provoke unhealthy

maximum values. As in the case of AC Schnitzer, whose box should really take the boost pressure from 1.1 to 1.5 bar, but ends up with 1.7 bar because the engine is already delivering 1.25 bar as standard. So Schnitzer - like Hartge - deals with this by far more extensive programming which supplies own values not only for the boost pressure but also for the injection, in addition accesses the CAN bus and hence all relevant engine protection programs. The cheaper boxes leave mixture control to the standard software, which in principle works but in extreme situations can lead to problems.

In the absolute worst case, two scenarios are conceivable: firstly, injection pressure and time exceed limit values imposed by the components, and lead to massive extra wear. Secondly, the engine control unit doesn't allow any further increase in injection quantity above a certain point, which leads to a leaner mixture, a rise in exhaust temperature and - in the extreme case - to engine damage. Because with manipulation of certain input parameters, the tuning box undermines some of the engine's own protective functions.

In the case of our 328i, we remained protected from such surprises. It never went into limp-home, under full load always set its predefined lambda value of 0.8 and after around fifty runs on the rolling road, eight complete series of measurements and 8000 kilometres in tuning trim, made its journey home perfectly - with the standard power, of course.

Summary

The serious overall package finally brings Schnitzer the win. The Aachen-based tuner offers a clean performance upgrade, full TUV blessing and extensive warranty cover, thus at least eliminating the concern left by the high boost pressure. Hartge asks less from the engine, and also offers a warranty, but falls behind because of its questionable power development and lack of TUV. In our case, the cheaper boxes also lacked approval, so despite good performance figures from Speedbuster and RaceChip, we can't recommend them. Because Power without TUV is and remains an absolute No-No!

Test score:	AC Schnitzer	Speedbuster	Hartge	Racechip	Ecochip24	Exclusive Trading
Driving performance:						
Power development						
Service / TUV / warranty						
Cost						
Total	4.0	3.4	3.3	3.3	2.7	2.7

***** to dream of ***** good enough *** acceptable
 ** could do better * weak

Performance Diagrams

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Power and torque

AC Schnitzer

Schnitzer has programmed the only set-up which can maintain a constant high torque over the entire mid rev range. With a maximum of 457.6 Nm at the rear wheels, 315 hp is achieved from 5000 rpm. The power peak runs out very cleanly.

Leistung = power

Drehmoment = torque

Motordrehzahl = engine speed

Motorleistung = engine power

Hartge

Only the slowly accelerated measurement (dotted) indicates how much raw power Hartge packs into the lower rev range. At the top, the measurement at fast shift is closer to reality. Both curves share the feature of modest torque in the mid range.

Speedbuster

The peak at 2700 rpm, where Speedbuster pulls together the highest maximum torque at 457.8 Nm, is followed by a lightly falling curve to the nominal rotation speed. But sufficient power remains to clamber to over 300 hp at 5400 rpm.

RaceChip

RaceChip with 439.7 Nm doesn't collect quite as much torque as its rival Speedbuster, but programs a slightly more even power development. Consequence: from 5600 rpm., despite less power, slightly better performance: 306.0 hp

Ecochip 24

The box from Ecochip24 shows a perceptibly measurable effect, its development of power and torque closely resembling the curves of the standard software. 416.6 Nm and 287.9 hp are developed, which gives more on the road than expected

Exclusive Trading

Apart from a slight "overswing" which gives the maximum torque of 416.4 Nm just above 2000 rpm, the cheap box offers almost identical values on the rollers to the tuning box from Ecochip24. 288.0 v. 287.9 hp, 416.4 v. 416.6 - coincidence?

Standard:

Why change anything on an engine which already offers such curves as standard? The torque is absolutely even, reaches a maximum of 386.5 Nm from 2300 rpm and transforms seamlessly to 263.8 hp at 5200 rpm.

Good cooling is half the battle

Power measurement stands and falls by the simulation of the driving state, which is primarily caused by a correct and sufficient air flow to the radiator and engine bay. It is not only the water and oil temperature, but above all the temperature of the intake air which matter. The arrangement selected by Maha with a central fan and corresponding extra component fans is a minimum configuration. Or you copy Bugatti, whose Veyron fan delivers 250 kW!

Flexibility in All Gears

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4th gear: 2600 - 4500 rpm, 60 - 100 km/h

Schnitzer and Speedbuster clearly dominate the mid-rev range with their high maximum torque. Hartge finally gets the decisive tenths; subjectively, RaceChip pulls powerfully but dawdles a little in the response behaviour.

5th gear: 2700 - 4200 rpm, 80 - 120 km/h

Similar power conditions prevail in the second mid-range measurement too. Because of the longer measuring period, RaceChip could compensate better for its delayed response behaviour. Hartge is level with Exclusive Trading and Ecochip24.

6th gear: 2100 - 3200 rpm, 80 - 120 km/h

Whereas Speedster pulls right from the start, Schnitzer takes a slightly more leisurely approach up to 2500 rpm. Hartge sprints away powerfully but then begins to flag. RaceChip accelerates very evenly, while slight boost pressure fluctuations spoil the performance of Ecochip and Exclusive Trading.

7th gear: 1750 - 2600 rpm, 80 - 120 km/h

In this rev range, Speedbuster doesn't hang about. Hartge loses the tenths above 2300 rpm, Schnitzer before this, RaceChip over the entire rev range. Ecochip and Exclusive Trading are still pumping inharmoniously in the higher gears.

8th gear: 1350 - 2100 rpm, 80 - 120 km/h

Hartge knows no mercy, pumping torque into the gearbox until the drive trembles and grabs a clear - if dubious - victory. Surprisingly, the box from RaceChip suddenly responds best at very low revs.

No one winner in every sector

Overall, the flexibility measurements support what the power curves indicated. Schnitzer owns the rev range between 3500 and 5500 rpm, Speedbuster dominates from 2000 to 3500, whereas Hartge shakes up everything below with a ridiculous amount of torque. RaceChip holds its own in all ranges, and after a short delay accelerates in a very linear fashion. Exclusive Trading and Ecochip24, in view of the maximum torque which simply can't be ignored, perform astonishingly well

The mid-rev range is where the boxes come into their own

Boost Pressure

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Schnitzer raises the boost pressure to 1.71 bar, Speedbuster peaks at 1.62. The fact that such extreme pressures are not essential is shown by the RaceChip box, which delivers a far more humane maximum at 1.46 bar. Hartge programs the highest boost pressure in the lower range.

Ladedruck im Saugrohr in bar = boost pressure in intake manifold in bar
Motordrehzahl = engine speed

Installation by Professionals

Technical support was provided by Autohaus Fink in Kempten. The BMW authorised dealer, now owned by the second generation of the family, took care of the installation and removal of the extra control units. The personnel were skilled, the service highly flexible and the tuning products treated with complete lack of prejudice.

The procedure was the same for each extra control unit: Before installation, on-board diagnostics were performed, any entries in the fault memory were cleared. Then the units were fitted as instructed, followed by an extended adaptation drive, and then the test runs. Before removal, it was back to the fault memory to check to what extent running with the tuning box had led to fault messages. Result: almost all extra control units provoked a fault message for the absolute pressure sensor. This demonstrates the lack of plausibility of pressures measured in the intake manifold, which in our case was down to the manipulated sensors, but will not necessarily be interpreted by a workshop as the result of a tuning measure. None of the extra control units were recognized as tuning software. However the manufacturer would have been able to see more via online diagnostics.

What the Suppliers Say

Does the box have approval? And in event of damage, who picks up the warranty? These are questions which many suppliers prefer to dodge. Before we ordered however, we pressed the point - with frightening results. Three of the six suppliers admittedly had warranty cover up their sleeve, but would greatly prefer the box to be removed before service work in order to maintain any possible claims against BMW. To put it more clearly: RaceChip, Speedbuster and Ecochip24 are deliberately suggesting their customers cheat! Risky, because the rumour that extra boxes can't be detected after removal is still one of the more audacious fairy tales. In typical damage instances, the manufacturers drill deep and extract all data which many tuners simply cannot see. Exclusive Trading is almost an exception here: for 359 Euro, no-one seriously expects any form of approval or warranty. The situation is worse when it comes to TUV, because in this case only AC Schnitzer can offer this. Reason: the 328i, because of its low market share, is relatively uninteresting to tuners so Hartge, EcoChip24 and Speedbuster - despite certification - have not had the test performed. Incomprehensible, because finally, no TUV, no road operating licence!

	Self-install module	Fitting by contract workshop	TUV	Warranty
RaceChip	Simple installation, instructions provided, photos of engine bay by e-mail if required	Not recommended because of possible warranty claims by owner against BMW	No	Emergency warranty by RaceChip for € 179.00/year. Recommends removing the control unit and wiring before service as it can't be detected afterwards
Speedbuster	Simple installation, instructions provided	Yes, but BMW is then aware of tuning and will reject any warranty claims	No (available for many other models)	NSA warranty up to 100,000 km for € 178.00/year. Recommends removing the control unit and wiring before service as it can't be detected afterwards
AC Schnitzer	No self-installation possible	Fitting possible by BMW authorised dealer who will order the upgrade from AC Schnitzer	Component certificate supplied	Warranty provided by AC Schnitzer for 2 years from first registration or max. 100,000 km on engine and drive train. Extended warranty for year 3 for max. 100,000 km for € 389.00
Ecochip24	Simple installation, instructions provided	Not recommended because of possible warranty claims by owner against BMW	No (available for many other models)	Warranty cover possible, price depends on vehicle type (approx. € 299). Recommends removing the control unit and wiring before service as it can't be detected afterwards
Exclusive Trading	Simple installation, instructions by e-mail on request	No information	No	No information
Hartge	No self-installation possible	Fitting possible by BMW authorised dealer who will order the upgrade from Hartge	No (available for many other models)	Hartge gives a 2-year warranty on the engine and drive train for new vehicles. Insurance free for 1 year. Can be extended for up to 5 years. From year 2 costs € 235.00/year

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Power, Acceleration, Fuel Consumption

Measurement values	Standard	AC Schnitzer	Exclusive Trading	Ecochip24	Hartge	RaceChip	Speedbuster
Test bed							
Power quoted	180 kW (245 hp)	216 kW (294 hp)	200 kW (272 hp)	202 kW (275 hp)	210 kW (290 hp)	221 kW (300 hp)	216 kW (294 hp)
Power measured	194 kW (264 hp)	232 kW (315 hp)	212 kW (288 hp)	212 kW (288 hp)	223 kW (303 hp)	225 kW (306 hp)	222 kW (301 hp)
Torque	350 Nm	420 Nm	392 Nm	400 Nm	415 Nm	420 Nm	440 Nm
Torque measured	387 Nm	458 Nm	416 Nm	417 Nm	448 Nm	440 Nm	458 Nm
Promised increase		36 kW (49 hp)	20 kW (27 hp)	22 kW (30 hp)	33 kW (45 hp)	41 kW (55 hp)	36 kW (49 hp)
Actual increase		38 kW (51 hp)	18 kW (24 hp)	18 kW (24 hp)	29 kW (39 hp)	31 kW (42 hp)	28 kW (37 hp)
Acceleration							
0 - 50 km/h	2.1 s	2.0 s	2.1 s	2.1 s	2.0 s	2.1 s	2.0 s
0 - 100 km/h	5.7 s	5.2 s	5.4 s	5.3 s	5.2 s	5.3 s	5.2 s
0 - 130 km/h	9.2 s	8.3 s	8.7 s	8.6 s	8.3 s	8.5 s	8.3 s
0 - 160 km/h	14.3 s	12.5 s	13.3 s	13.2 s	12.6 s	12.9 s	12.5 s
0 - 180 km/h	18.5 s	15.9 s	17.4 s	17.3 s	16.1 s	16.5 s	16.0 s
0 - 200 km/h	24.3 s	22.6 s	22.5 s	20.5 s	21.0 s	21.0 s	20.3 s
Consumption							
Ø over 100 km	9.5 l	9.7 l	9.9 l	9.9 l	9.6 l	9.9 l	9.7 l
Price		€ 2150	€ 359	€ 799	€ 1995	€ 549	€ 699