M3

New M3 already a sell-out success

Since its arrival in Australia in early 2001, the new BMW M3 has become one of the most sought after cars on the market, with this year's allocation of 150 cars for Australia spoken for, and many potential owners prepared to wait well into 2002 to get their hands on the new super coupe.

The all-new E46 M3 reasserts the BMW concept of the true high performance car cloaked in a practical and elegant, yet powerful body.

The athletic good looks of the new M3 are just the beginning. Beneath the subtle power bulge of its aluminium bonnet lurks a 3246 cc, double VANOS-controlled straight-six, which sets a new benchmark for naturally-aspirated engines.

Producing 252kW at a stirring 7900rpm – a remarkable specific output of 78kW/litre - it propels the new M3 from 0-100 km/h in just 5.2 seconds on the way to an electronically-controlled top speed of 250km/h. However the engine's tour de force is its flexibility in day-to-day driving, with 80 per cent its formidable 365Nm of torque available from just 2000 rpm.

This is almost 7 per cent more power and 4.3 per cent more torque than its highly-lauded E36 M3 predecessor.

A lot of the credit can be attributed to the M3's new engine management system (MSS 54), which is able to perform 25 million calculations per second. It also includes a driver-selectable 'sport' mode, which alters the engine-mapping to deliver sharper throttle response.

In Australia, the M3 features a new SMGII (Sequential Manual Gearbox, 2nd generation) with steering wheel paddle control as standard, however a six speed manual gearbox with a conventional clutch pedal is a no-cost option.

Together with outstanding power, the new coupe continues the M3's tradition of superb braking and pin-sharp handling.

Thanks to its sophisticated compound high performance brakes, the M3 is capable of stopping from 100 km/h in just 35 metres – a deceleration of 11 metres/sec^2.

Meanwhile the M3's new wider track suspension, specially-constructed 8x18-inch front and 9x18-inch rear light alloy wheels and trademark 50/50 ideal weight distribution, have further enhanced the model's legendary handling.

Other technical highlights include a switchable DSC (Dynamic Stability Control) system mated to the new variable M differential lock, both further adding to the M3's stability in difficult traction conditions.

As is expected of BMW M GmbH, the new M3 has undergone an extraordinary amount of high performance testing including a formidable 8000km endurance test on the northern circuit of Germany's infamous Nurburgring. There, the car lapped consistently under 8 minutes 30 seconds, putting it in the same league as the winning touring cars of just a few years ago.

In keeping with tradition, the new M3 will be fully and luxuriously equipped.

Australian M3s will feature electrically-adjustable M front sports seats and new M Texture Alcantara/Nappa leather trim. This upholstery was previously only available through the BMW 'Individual' programme and features a material which looks, feels and reacts like suede, but wears much better and does not lose its pile.

A multi-function M leather sports steering wheel incorporating cruise control, eight individual airbags, an on-board monitor with TV and on-board computer, a six-disc CD changer and Hi Fi system, washers for the Bi-Xenon headlights, rain-sensor-activated wipers with automatic headlight control, an alarm system and BMW's Park Distance Control (PDC), are also standard on the new M3.

Customer deliveries of the new M3 began in June of this year.

The Managing Director of the BMW Group Australia, Uwe Hartmann views the new M3 as not only creating great excitement amongst enthusiasts who have anticipated the new M3 since it was shown as a design study in Frankfurt 12 months ago but also as another clear statement of technical excellent from BMW M GmbH engineers further supporting BMW core value of dynamism.

"*With the new M3, BMW M GmbH has opened a new and even-more exciting chapter in the history of this dynamic sports model,"* he said. *"But their real achievement is to package this excitement in a vehicle which is comfortable and totally useable in everyday driving, while able to deliver true supercar levels of performance when called upon.*

"There can be no better example of how BMW continues to deliver Sheer Driving Pleasure whilst also rapidly progressing automotive development."

The new BMW M3

More power, more performance and more style – the new BMW M3 has more of everything. The latest version of this world-famous sports car from Munich is beyond comparison in the world market. Quite simply because it offers the customer a level of performance clearly above expectations:

BMW M3 252 kW straight-six power unit
with double-VANOS 365 Nm
0–100 km/h in 5.2 sec
fuel consumption 10.5 ltr/100 km (combined)

Even more than its predecessor, the styling of the new M3 reflects its outstanding performance and dynamic driving qualities through its exciting design. However it retains its everyday driving qualities in full, remaining a high-performance car, which, through the sum total of its supreme qualities, will once again be the leader in its class.

Athletic in style, elegant in looks.

At very first sight the new M3 exudes a sense of superb power, wide and muscular looks, as well as beautiful elegance. With its new front air dam with ellipsoid foglamps and extra-large cooling air intake scoops, it stands out from all the other models in the BMW 3 Series range. The kidney grille, slightly modified in its position, blends with the new design of the front end.

Made of aluminium, the engine compartment lid is approximately 40 per cent lighter than the same unit made of steel plate. A particularly important factor is that despite this reduction in weight the engine compartment lid offers the same

stiffness and crash safety as the steel plate unit in the 3 Series coupé. This was made possible using computer simulation to demonstrate how the geometric features responsible for stability affect the static and dynamic stiffness of the engine compartment lid.

The engine compartment lid on the M3 is characterised by the new contours of the power dome, a small hump in the middle of the lid, providing room for the new M3's engine. This sets the tone for the overall style and appearance of the M3, without one single feature serving only a visual purpose alone. Instead, all modifications versus the standard model are based on the clear rule that form follows function, offering beautiful styling and design at the same time.

The body of the new BMW M3, including the wheel arches is considerably wider (plus 20 mm) and features air scoops with the M3 emblem on the front side panels. The wider body and flared wheel arches are needed to fit both the wider track as well as appropriate tyres and wheels. Indeed, the extra-wide 225/45 ZR 18 tyres at the front and the 255/40 ZR 18 tyres at the rear on newly designed M Styling double-spoke light-alloy wheels measuring 8 inches in width at the front and 9 inches at the rear provide a perfect match for this muscular appearance, clearly distinguishing the new M3 from the "standard" 3 Series coupé. The new M3 measures 4.49 metres in length, 1.78 metres in width, and 1.37 metres in height. The car's wheelbase is 2.73 metres.

New M exterior mirrors in aspheric design fold back electrically as an option whenever required. Special side-sill covers, as well as a streamlined rear air dam and a specially designed rear spoiler accentuate this powerful, dynamic look of BMW's new M athlete. The exhaust system with twin chambers and four tailpipes, clearly identifies this model as a member of the exclusive M Car range.

The interior – sporting and elegant all in one.

Benefitting from a typical BMW M instrument cluster with special scales on the instruments, the driver has a clear view of all the new M3's functions. Again in classic BMW M style, the circular dials so typical of BMW have, on this car, red indicator needles. A feature carried over from the M5 is the rev counter with its variable warning zone: Whenever the driver starts the engine cold, orange light-emitting diodes (LEDs) are illuminated as the engine speed reaches 4000 rpm, they are then extinguished in steps of 500 rpm as oil temperature increases. As soon as there is only one orange and two red LEDs left on, the engine has reached its optimum operating temperature. A further standard feature is the oil temperature display.

The newly designed M multifunction steering wheel has a padded, extra-thick rim, M stitching and thumb supports making it not only attractive but also functional. A footrest in aluminium as well as the door cutout strips with the M3 symbol round off the special look and style of the car's interior.

The courtesy lights package, featured as standard comprises both the illuminated gearshift lever with its six-speed gearshift pattern and M logo as well as the interior mirror with its automatic anti-dazzle effect. Automatic air conditioning with separate temperature control for the driver and front-seat passenger comes as standard. Passive safety is at the same high standard offered by the entire BMW 3 Series, frontal, side and head airbags featured as standard to protect the driver and front passenger, with two side airbags standard on the rear seats.

The Power Unit of the M3

The power unit featured in the new M3 excels providing its turbine-like power combined with equally outstanding running smoothness and refinement, fortes which have long become the synonym of BMW six-cylinders the world over. Now the new engine adds new meaning to these supreme qualities, introducing

the BMW M high-speed features and technology at a standard equipment to that required by the most demanding and sophisticated competition engines in the world, the power units to be found in Formula 1. It is important to note, for example, that the pistons of the new M3 power unit move at a speed of more than 24 metres per second at the maximum engine speed of 8000 rpm. For comparison, the crankshaft in a modern Formula 1 power unit rotates up to 18,000 times a minute, each of the 10 pistons covering a distance of approximately 25 metres per second.

Outstanding efficiency at all engine speeds and under all loads guarantees superior fuel economy in everyday motoring and a low level of emissions.

In close cooperation with BMW AG, BMW M has developed a special engine management system for the M3 called MSS 54. Like the control unit on the previous model, this multi-processor system comes with two 32-bit micro-controllers and two timing co-processors operating now at a higher frequency in order to cope with even more complex function data and the higher maximum engine speed of the new model. This MSS 54 engine management unit is thus able to perform 25 million calculations per second.

The functions masterminded by MSS 54 include the timing control on the intake and outlet camshaft (high-pressure VANOS), permanent oil level control, the immobiliser, electronic throttle butterfly control, and an elaborate diagnostic system with various diagnostic routines for the workshop. Operating individually on each cylinder, this control unit calculates the ignition timing, the injection volume, and the injection timing for each load cycle as a function of engine load and speed as well as the gradient of load change. At the same time it also calculates and sets the optimum cam angles.

Optimum engine management ensured by a special in-house development from BMW M

Cylinder-specific, adaptive knock control receives its knock signal from three sound body sensors, each sensor monitoring two cylinders. These cylinders are adjusted individually for knock management as a function of load points, applying a concept able to program the best ignition data throughout the ignition angle map. A switch on the instrument panel allows the driver of the M3 to choose a more sporting, that is a more progressive map curve in terms of gas pedal travel and the throttle butterfly opening. As soon as the driver activates this more progressive gas pedal control map, the dynamic transition functions on the electronic engine management switch over to a more spontaneous application. The more comfort-oriented control map, in turn, is activated automatically each time the car is re-started.

Electronic throttle butterfly control is based on engine torque and output data, meaning that the driver's wish for power and performance is measured on the gas pedal by means of the potentiometer and translated into a specific request function. This request function is then adjusted by the power and torque manager by adding the power signals from the auxiliary engine units and is then aligned to the maximum and minimum output and torque curves allowed by the Dynamic Stability Control (DSC) and Engine Drag Force Control (EDFC). The target output and torque calculated in this way is then maintained at the desired level, taking the current ignition angle into account.

While the engine is warming up, the catalytic converter is heated as quickly as possible by the system intervening in the VANOS camshaft management, ignition, fuel injection, and the electrical secondary air pump, the output and torque manager making the necessary corrections. A further point to be added in this context is that this engine management system complies in full with all on-board diagnosis standards currently in force.

Thrust, an all-important factor

The engine specialists at BMW M are convinced that a fast-revving normal-aspiration power unit is ideal for a sports car expected by the ambitious motorist to provide outstanding performance and acceleration in all situations on the road. The crucial point when it comes to acceleration is the thrust available on the drive wheels, that is the rear wheels in the case of the M3, as with every BMW. This thrust can either be provided by a large engine running at low speeds and with a “long” overall transmission ratio or by a smaller engine running at high speeds and with a “shorter” overall transmission ratio.

The high-torque concept provided by large engines involves significant disadvantages in terms of weight and engine dimensions, since the engine and all components on the drivetrain are inevitably very large and heavy due to the high torque. Application of the high engine speed concept was therefore essential in creating the new M3, a coupé combining dynamic and agile behaviour with the performance of a sports car.

79kW per litre thanks to the high engine speed concept

The straight-six power unit displacing 3,246 cc is now featured for the first time worldwide on all national variants, developing 252 kW. Although engine capacity has been increased by only 1.4 per cent over the previous model, the high engine speed concept boosts engine output by 6.9 per cent and torque by 4.3 per cent. Improvement of the cylinder charge cycle and the improvement of flow conditions within the entire engine and drive system have increased output per litre from 74 to almost 79 kWs.

Despite its high revving nature, the engine offers a very broad power band, with no less than 80 per cent of its maximum torque at just 2000 rpm. Illustrating this are the M3’s acceleration to 100 km/h in just 5.2 seconds and acceleration in fourth gear from 80 to 120 km/h in a mere 5.4 seconds.

Exemplary fuel economy and emission management

The high standard of efficiency gives the engine not only a very high level of output and torque, but also excellent specific fuel economy reaching its peak at 235 grams/kWh. Optimisation of the valve drive system in the interest of minimum friction and the increase in compression to 11.5 : 1 makes the new engine even more fuel-efficient than its predecessor, particularly in the lower load range.

Providing an even better equilibrium of the fuel-air mixture, adaptive idle speed synchronisation offers a further reduction of fuel consumption with the engine running at low speeds near the idle range. In conjunction with the rapidly adjusting high-pressure double-VANOS, the optimisation of the injection valves as well as the configuration and position of the valves themselves allows a further reduction of specific fuel consumption especially when running under high loads at low speeds. In the upper load and speed range, the smoother flow conditions in the cylinder charge cycle help to reduce specific fuel consumption.

Despite the slight increase in the car's dimensions, BMW's chassis engineers have succeeded in enhancing the handling qualities of the former model to an even higher level, while at the same time retaining the same supreme standard of everyday driving qualities. In addition, they have improved the car's driving characteristics particularly in winter, thus avoiding the restrictions in winter so typical of a "classic" sports car.

The front axle: light, stiff and extremely precise

The single-joint spring strut front axle is roughly identical to the front axle on the former model in terms of its basic kinematic data. The particularly stiff connection of the suspension components to the body of the car makes a major contribution in increasing the M3's steering and driving precision. To

keep unsprung masses to a minimum, the front track control arm is made of aluminium.

This stiff connection to the body of the car, the modified elastokinematics, the wide track (1,508 millimetres) and the direct rack-and-pinion steering in conjunction with the ergonomically designed steering wheel rim ensure a standard of driving precision and agility never seen before.

Transmission: SMGII as standard or 6 speed manual

The Second Generation Sequential M Gearbox With Drivelogic

Since Ralf Schumacher's successes at the WilliamsF1 BMW power-house interested drivers have known that changing gears in the international superclass of motor sport is no longer done through the means of a shift lever but, instantaneously by operating so-called rocker switches on the steering wheel.

Whereas the driver of a conventional car moves his shift lever in a classic H-type gear shift pattern to select the desired gear, Ralf Schumacher and his Formula 1 competitors just briefly pull two butterfly-type rocker switches behind the steering wheel, the so-called "paddles" – pulling the right rocker switch causes the gearbox to shift up, pulling the left one will produce a downshift.

At the same time, the driver can keep his foot on the accelerator pedal: The most advanced engine electronics interrupt the engine's tractive power for just milliseconds, the control unit effects the gear change electrohydraulically and opens and closes the clutch; the clutch pedal has disappeared.

The preliminary stage of this sophisticated system, which has long become a standard feature in Formula 1, was used by BMW in its successful race-tuned

touring cars of the 1990's. With this system, albeit with a central shifter, gear changes are carried out in a rank, i.e. sequentially, as in the case of a motorcycle: For upshifting, the driver – without operating a clutch – just pulls the shift lever backwards, forward for downshifting. This system provides extremely short gear shift times on the one hand, and prevents possible shift errors on the other.

BMW is the first car maker to offer this type of gearbox.
In close collaboration with the companies of Getrag and Sachs, BMW M has transfered this motor sport experience into applications for every-day road use, and developed a new high-performance driveline concept which, in its second generation, is now arriving on the market as a "sequential M gearbox" (SMG II) in the M3.

SMG II is now the standard transmission in the E46 M3 with the traditional manual six speed gearbox available for those customers requesting it as a no-cost option.

It was as early as 1996 that BMW M, as the world's first supplier of an all-automatic manual gearbox, took centre stage and went on sale with the SMG exclusively in the M3. This system established itself very well and guaranteed that, with the M3 predecessor model, almost every other car featured this progressive driveline concept.

The second-generation SMG, which was significantly upgraded from the first variant, and is technically identical with the regular manual gearbox of the M3 with six forward speeds, is not only operated by means of a selector lever, as in the past, but also offers the driver two rocker switches on the steering wheel. The driver thus has the choice of how he or she wants to shift gears. Above all other benefits, shifting by means of the rocker switches further contributes to increased active safety, as the driver can keep his or her hands on the steering wheel at all times.

“Formula 1 feel” when shifting on the steering wheel.

This new SMG gearbox which combines both the option of sporty sequential shifting and the ease of automated shifting offers many **benefits**,

- the driver can choose between **two shift modes** at any time – the sequential (“S”) mode or the automated (“A”) mode;

- the **“drivelogic”** allows the driver to individually match the SMG’s shift characteristic to his preferred driving habits in eleven driving programs;

- when downshifting, the engine will automatically **double-declutch**;

- operating the **clutch** and consequently also the **clutch pedal** are therefore **no longer necessary** and, unlike an automatic gearbox, there is **no** energy-consuming and performance-degrading **torque converter** either;

- there is a markedly increased pleasure of shifting, as the SMG in the sequential mode can be up and downshifted instantaneously and thus produces a realistic **“Formula 1 experience”**;

- as compared with a manual gearbox, there are slightly better and, above all, **fully reproducible ride performance values**;

- the fact that the driver no longer needs to concentrate on gear changing with this gearbox makes for precise, **safer and more relaxed motoring**;

- with the sequential M gearbox, it is easier to benefit from the high power reserves of the M3 through selection of the optimum shift point with so-

called “**shift lights**” (LEDs in the cockpit indicating the optimum shift point on the tachometer).

Shifting in record time.

The second generation of the SMG gearbox stands out due to its even shorter tractive power interruption – the time required for the fastest shift operations is merely 80 milliseconds: Hardly anyone would be able to change gears manually within such a short period of time.

Furthermore, owing to **drivelogic**, the M3 driver, benefiting from sequential shifting, is able to manually match the shift dynamics to his individual driving habits in six different programs – ranging from a balanced dynamic program (S1) to a very sporty program (S5). Finally, the driver can also choose the S6 program when the DSC system (**d**ynamic **s**tability **c**ontrol), which comes as standard with the M3, is deactivated. In that case, the SMG will shift at gear change times matching the sporting performance of a true race car.

But the new sequential M gearbox also has many benefits in respect of **safety functions**:

In critical driving situations, such as when downshifting on slippery pavements, the clutch is released instantaneously. In the case of excessive engine drag torque, **the car will not break away** at the driving wheels. This will **eliminate shift errors** by the driver.

Finally, there is considerably **improved ease of operation**, because the sequential M gearbox, owing to the automated ("A") mode, generally makes for less stress and fatigue on the driver – on motorways and race circuits alike. Both in the sequential ("S") mode and in the "A" mode, the gearbox will automatically shift back into first gear when the vehicle stops; to move on all its takes is to depress the accelerator pedal.

Active also in the automated mode.
In the "A" mode, the gearbox shifts automatically, depending upon the drivelogic driving program selected, the driving situation, vehicle speed and position of the accelerator pedal. In driving program A1, for instance, the second gear is selected automatically for pulling away, the clutch is then particularly soft, which is a great advantage for instance in wintry road conditions.

If a gear-dependent minimum speed is exceeded, slow backing off the throttle can initiate upshifting which allows the driver to determine the upshift point even in the automated (“A”) mode. The respective driving situation is, in that case, identified and factored in by sensors.

To accelerate hard, for instance in passing manoeuvres, the driver can fully depress the throttle pedal, which causes rapid downshifting as a function of the respective shifting program selected.

The “shift centre” of this new system is located in the MS S54 electronic engine management unit, which was developed by BMW M itself and operates in conjunction with the control unit of the sequential M gearbox. Both control units are interconnected via an extremely powerful data bus (SMG-CAN).

The CAN bus networks eleven redundant SMG sensors. They constitute the key to many exclusive special functions of the SMG. For instance only one longitudinal “accelerometer” makes it possible to benefit from functions such as “climb assistant” or “slope identification”. The gearbox control unit is capable of being fully diagnosed by any BMW dealer workshop.

Mode of operation of the sequential M gearbox

All gears are shifted electro-hydraulically; the control elements of the SMG in the M3 operate by wire, i.e. in lightning speed and safely without any mechanical connections as in aircraft and space vehicles.

When the system is in the automated (“A”) mode when the vehicle is moving, the sequential M gearbox automatically shifts up and down in accordance with a program individually selected by the driver via the drivelogic control function. When the shift lever is operated to change from the “A” to the “S” mode – which is possible any time when the vehicle is moving – the gears can be manually

shifted up by pulling at the right rocker switch behind the steering wheel or by pushing the selector lever on the centre console back towards the driver.

Moreover, the gearbox can be shifted down by pulling at the left rocker switch or by tipping the selector lever forward. Depending upon the driving program selected and the individual driving situation, the engine will automatically double-declutch like an experienced driver, so that the downshift operation can be faster and smoother.

Gears can be “skipped” as desired if the rocker switches or selector lever are operated repeatedly. However, these shift commands are carried out by the electronics only if it is possible within the wide rev band of the M3 engine. Over revving the engine in any driving situation is therefore excluded.

Six-speed gearbox and final drive in the same format as on the M5.
The no cost option six-speed manual gearbox has been carried over from the former M3 with virtually no modifications. Together with the final drive, it enables the new M3 to exceed the 100-km/h-mark in second gear. The sixth gear, in turn, allows the M3 to reach its electronically limited top speed of 250 km/h at moderate engine speeds.

The final drive comes with the same dimensions as on the BMW M5 and therefore requires a new rear axle subframe with modified dual-elastic suspension. Here again, reflecting the high engine speed concept, the final drive has a transmission ratio of 3.62 : 1, allowing full use of the engine’s power and performance.