

X-TRAIL is also available with a choice of two petrol engines, displacing 2.0 and 2.5-litres respectively. Both are members of Nissan's QR range of all-alloy engines and both have four cylinders, twin overhead camshafts, 16 valves and CVTC (Continuous Valve Timing Control). Offering good levels of refinement and ample power and torque, both units provide quiet and smooth on-road performance and off-road ability.

The 2.0-litre unit develops 140PS and 192Nm of torque to give a maximum speed of 110mph with 0-62mph taking just 11.0 seconds in two-wheel drive guise. Combined fuel consumption is 31.0mpg.

Broadly similar in layout, the 2.5-litre version offers more performance all round. Power rises to 165PS and torque to 230Nm. Maximum speed increases to 118mph with 0-62mph taking 9.9 seconds (automatic 111mph and 11.1 seconds, respectively). At 30.1mpg (automatic 29.4mpg) average fuel consumption is on a par with the 2.0-litre version.

Emissions from both petrol models are also commendably low; the 2.0 litre achieves 217g/km, for example.

Both engines have been designed not just for strong performance but also for excellent refinement with potential vibrations minimised and low friction materials being used wherever possible. The aluminium block has a ladder-frame construction, which improves strength while also reducing weight and resonance. Further weight reduction is achieved by the adoption of a resin intake manifold.

Low friction materials and lightweight items like the valve springs and the silent running timing chain all combine to offer a refined response under all engine loads. Any vibration is then countered by the twin chain-driven balancer shafts.

SMOOTHER SHIFTING

So wide is the spread of torque from the diesel engine that it is matched with a slick six-speed manual transmission as standard. Five close-ratio lower gears are topped by a 'long' overdrive top gear for optimum motorway cruising where the resulting low engine speeds mean better economy and less noise.

For the petrol engines, Nissan has used a typically slick shifting five speed. A four speed automatic is an option on the 2.5 litre unit. It's a high-efficiency E-flow unit which offers better fuel figures than previous generation boxes. A mechanical lock-up on fourth gear improves fuel consumption on longer journeys. With a drive-by-wire throttle and electronic throttle chamber (ETC) both sensitive to throttle depression speed, the gearbox works out whether the driver wants high or low response rates and at what engine speed the gearbox should change up or down.

DYNAMIC TECHNOLOGY

"By equipping X-TRAIL with the most advanced four-wheel drive system on the market and matching it with the most up-to-date traction and stability control system available, we have developed a genuinely versatile SUV that offers freedom of mobility with no compromise."

ADVANCED ELECTRONICALLY CONTROLLED ALL MODE 4x4

At the heart of X-TRAIL lies some of the most sophisticated technology available anywhere on the 4x4 market. Developed by Nissan, the ALL MODE 4x4 system allows secure and relaxed driving under all conditions, both on- and off-road, with advanced electronics taking care of all traction needs.

In essence, ALL MODE 4x4 ensures X-TRAIL has grip at all times no matter how severe the conditions. But unlike some other

automatic four-wheel drive systems, ALL MODE uses advanced electronics to ensure drive is transferred between wheels and axles the instant a problem arises. Via the electronic throttle control, the system is able to anticipate low traction situations, and engage four-wheel drive before traction is lost.

Only by using electronic sensors can this happen instantaneously: other systems might sound similar on paper, but usually operate via a dual pump system, whereby the slipping of one pair of wheels pumps up the system to bring in the other pair. Because a wheel has to slip for anything to happen, there's a delay of several wheel rotations before traction is restored by which time the car could well be stuck.

Nissan's ALL MODE system anticipates loss of traction meaning that it only takes a few degrees of a single wheel rotation for torque to be reapportioned.

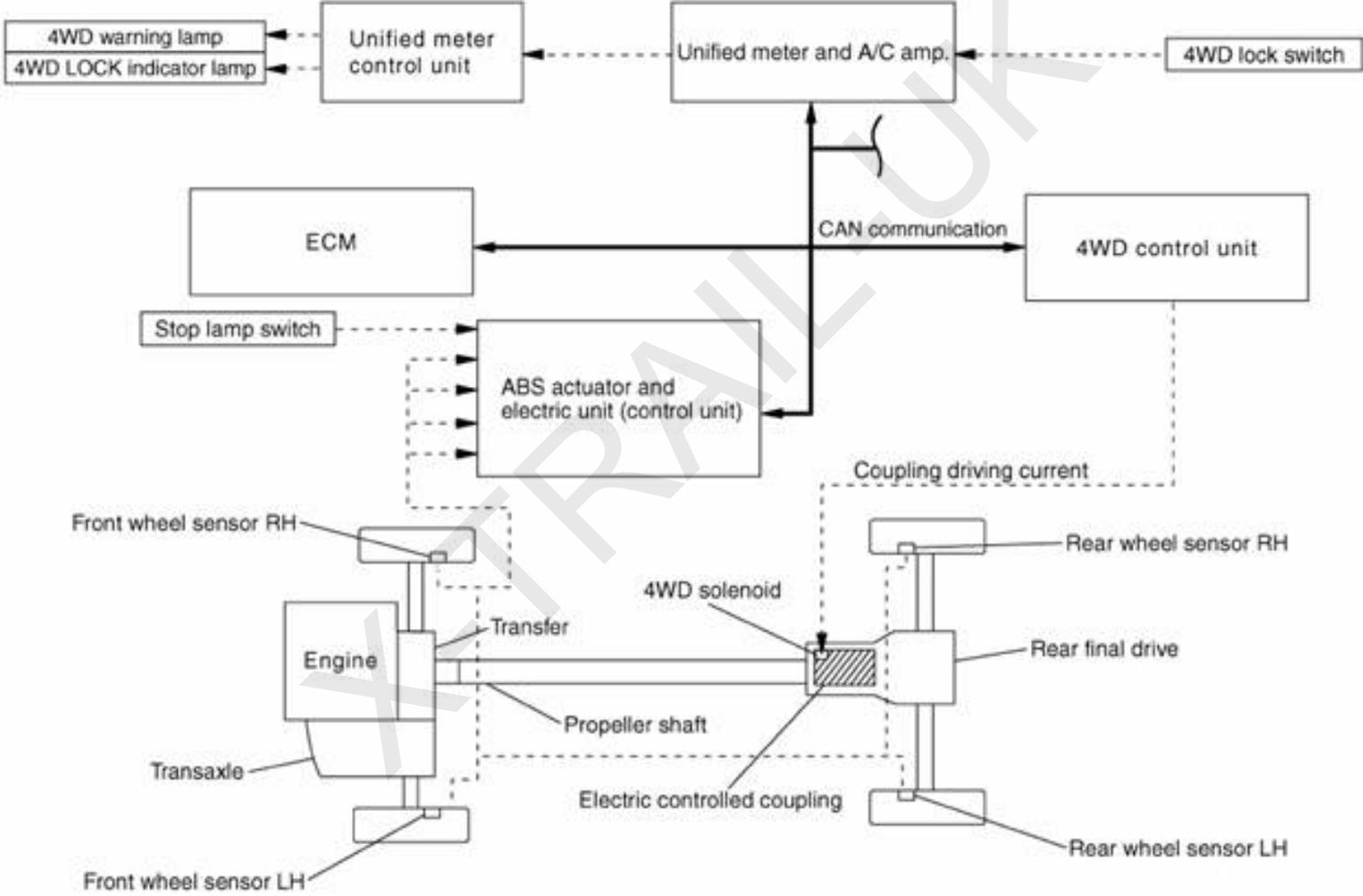


Fig.1: Schematic of the X-TRAIL's ALL MODE system

MODE ONE: 2WD

In X-TRAIL, the system has three modes, selected via a rotary switch on the dashboard. Under normal road conditions, eg around town or on a dry motorway, the X-TRAIL should be run in '2WD' – with the front wheels doing the 'driving'. Lower fuel consumption and tyre wear (or lack of) result. But should the system detect massive slip from the front wheels, 'AUTO' is selected till normal traction is

resumed.

MODE TWO: AUTO

Should the driver's pace quicken, the road surface become less firm or the weather deteriorate due to rain, snow or ice, it's time to switch to 'AUTO' in which the system is left to its own devices. A green warning light immediately illuminates under the speedo to show that automatic four-wheel drive has been selected. This can be done at any speed and allows ALL MODE to apportion torque to each axle based on a number of inputs, eg accelerator opening, wheel speed sensor, engine speed, G sensor and the brakes.

Torque can be redirected as much as 100 per cent front (with 0 per cent to rear) or up to 43 per cent rear (57 per cent front) almost immediately and as required. The percentage split is constantly varying anyway. Keen drivers may even wish to leave their X-TRAIL in 'AUTO' all the time. Left in Auto, the system will automatically compensate for unexpected slippery conditions on-road, such as wet leaves in autumn, early morning winter ice or loose gravel at any time of the year. It also adds the benefit of better fuel economy in 2WD with the safety of 4WD when needed.

MODE THREE: LOCK

The X-TRAIL offers a further four-wheel drive mode, 'LOCK', in which the centre clutch locks to divide drive 57:43 (front to rear), a ratio chosen because that's how the car's weight is apportioned over its front and rear axles. This is for serious off road use or for extreme conditions such as when starting off on an incline covered in deep snow or driving through deep mud. You don't even have to press 'AUTO' when the conditions become kinder because the car will do it for you.

HOW IT WORKS

When operating in 2WD or AUTO, engine torque is transferred to the transmission and to the front transfer case, and the transfer case in turn is in constant mesh with, and driving the propeller shaft (but not the rear wheels) at all times. Sensors linking the engine's ECU and the anti-lock brakes, meanwhile, constantly monitor and anticipate wheel slippage.

Located just ahead of the rear final drive is an electronically-controlled coupling (Fig.2) which enables drive to be fed through both front and rear axles. Its main clutch is connected to the propeller shaft, while a control clutch connects to the rear drive.

Current commanded from 4WD control unit

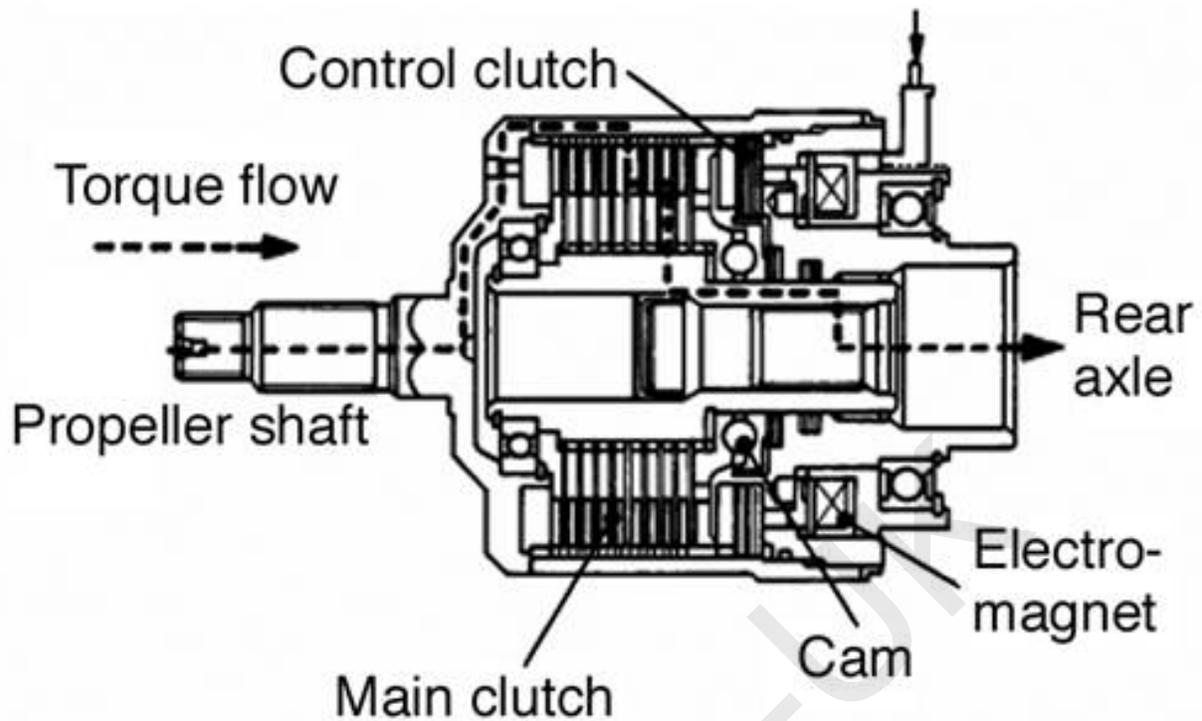


Fig 2: The ALL MODE system's electronically-controlled coupling

The control clutch features a cam system comprising two plates with asymmetric grooves on both faces, separated by a series of ball bearings. In order to activate rear-wheel drive, the control clutch is engaged by an electromagnet and this causes one of the plates to be slowed down, causing the ball bearings to move to one end of the grooves. This forces the plates to separate which in turn applies pressure to the main clutch, and torque is transmitted between the two to give rear-wheel drive (Figs. 3 and 4). The main clutch transmits torque relative to the current applied to the electromagnet and the resulting engagement pressure.

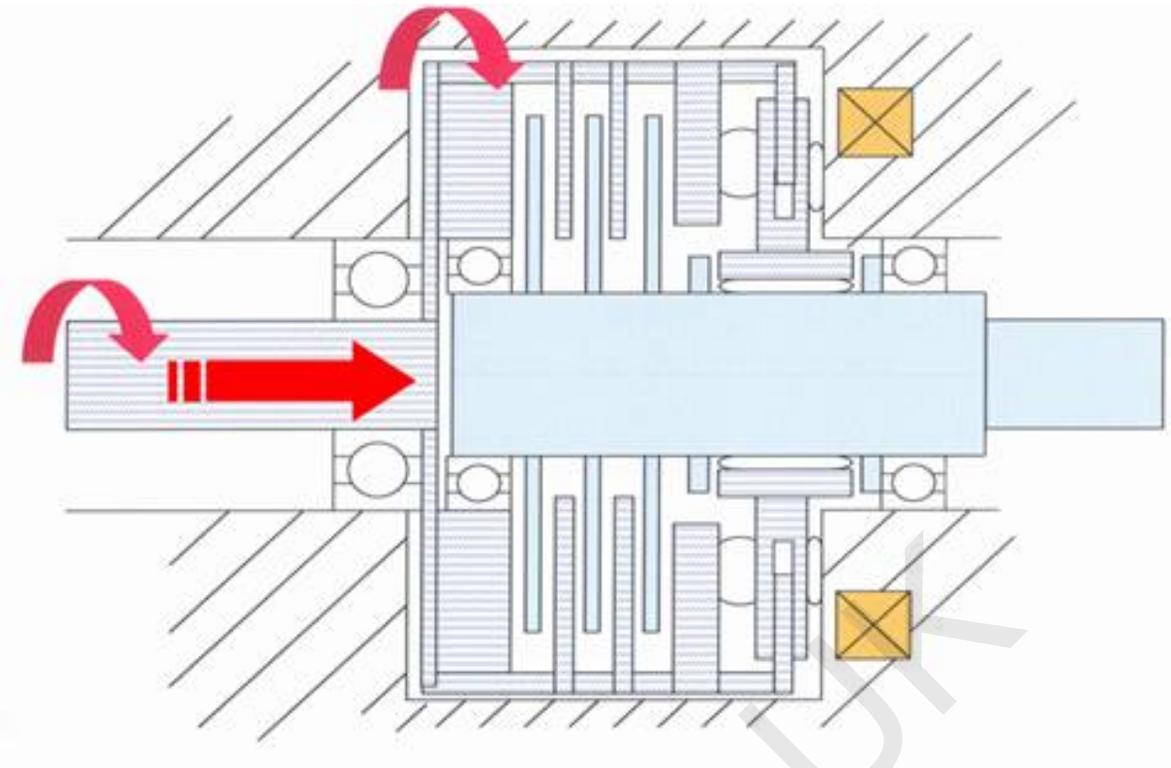


Fig.3: The electronically-controlled coupling operating in two-wheel drive. The unit's clutch is not engaged at this point.

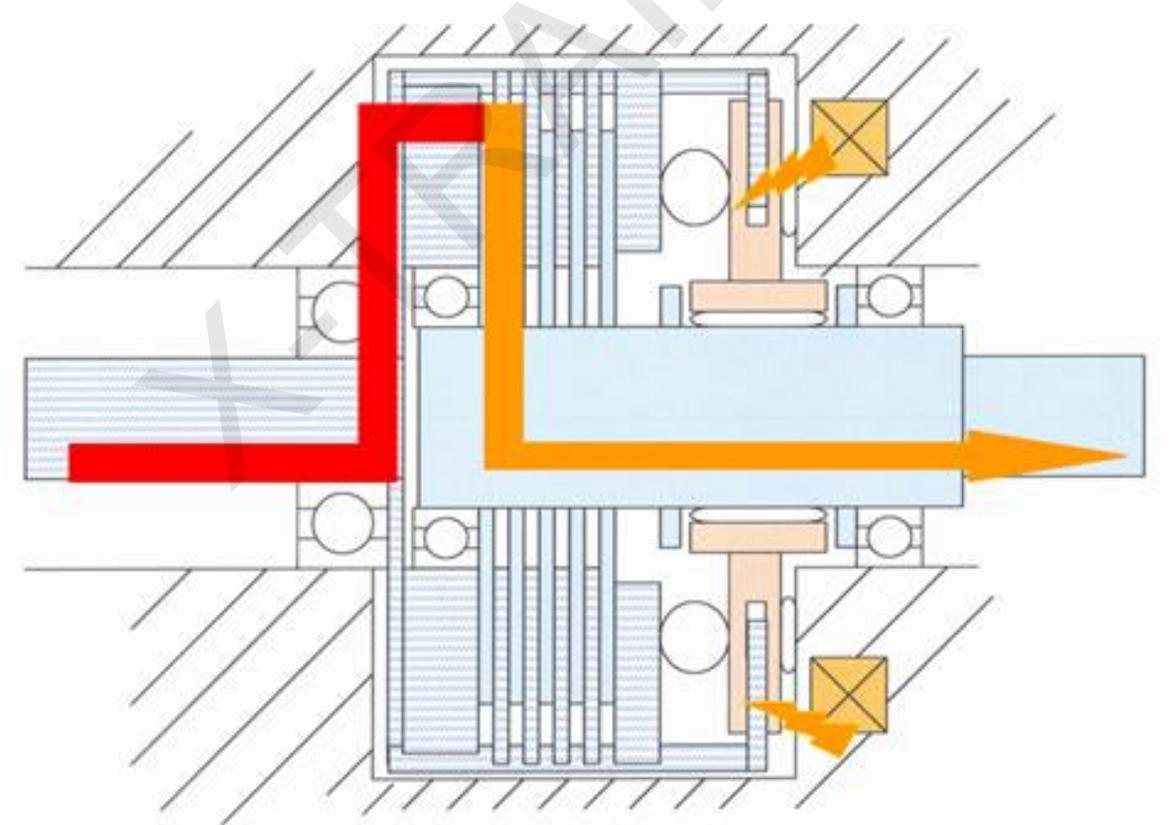


Fig. 4: The electromagnetic clutch is activated and torque is transmitted to the rear wheels.

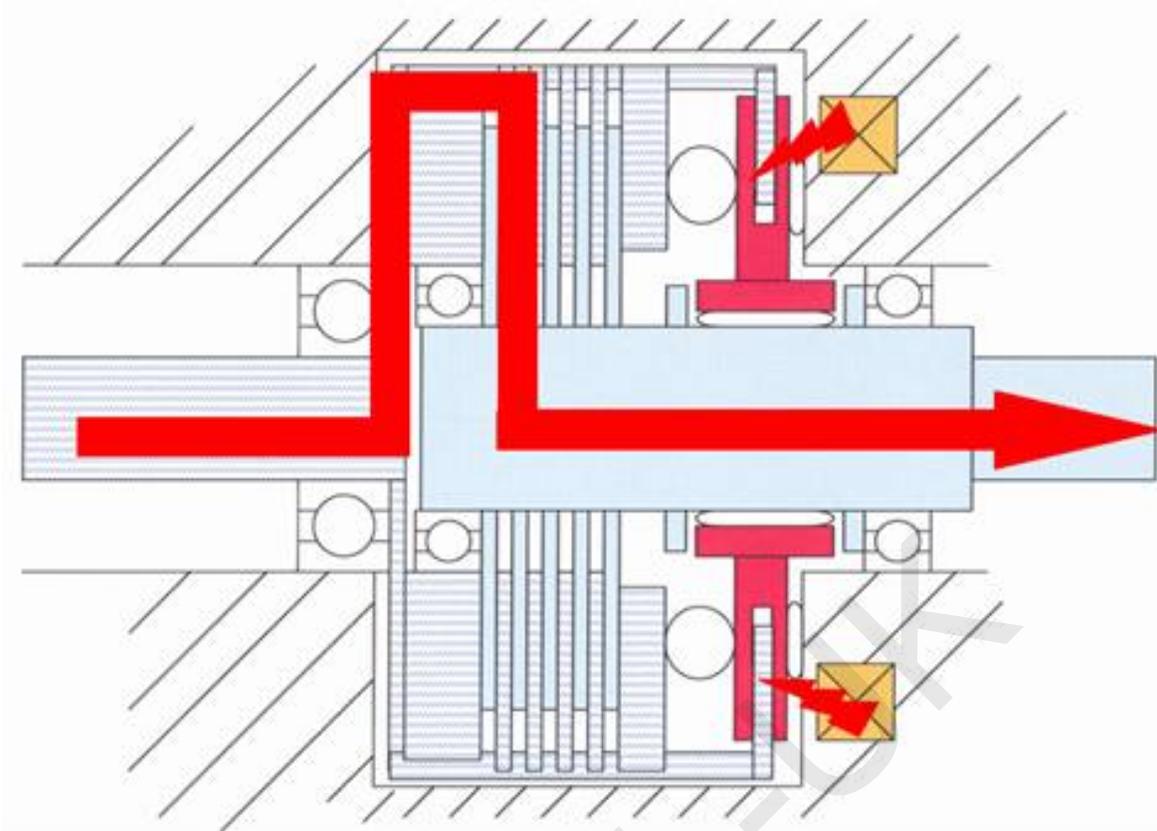


Fig. 5: When ALL MODE is switched to 'Lock', maximum current is supplied to the electromagnet. This results in maximum pressure to the main clutch to give a 53/47 front/rear split in transmitted drive.

If the system is switched to AUTO, and in certain circumstances 2WD, then the instant ALL MODE anticipates wheel slippage when encountering unexpected slippery conditions on-road, such as mud, wet leaves or ice, the coupling is automatically activated and drive is correctly apportioned, the maximum torque split being 53/47 front-to-rear. A torque-limiter prevents excessive torque being sent to the rear wheels.

When LOCK is selected, the control unit supplies the maximum amount of current to the electromagnet (Fig.5). This causes the control clutch cam plates to apply maximum pressure to the main clutch to give a 53/47 split in transmitted drive, and this is available up to a speed of approximately 18 mph. Over this speed, the system reverts to Auto operation, switching back to Lock when the X-TRAIL is slowed.

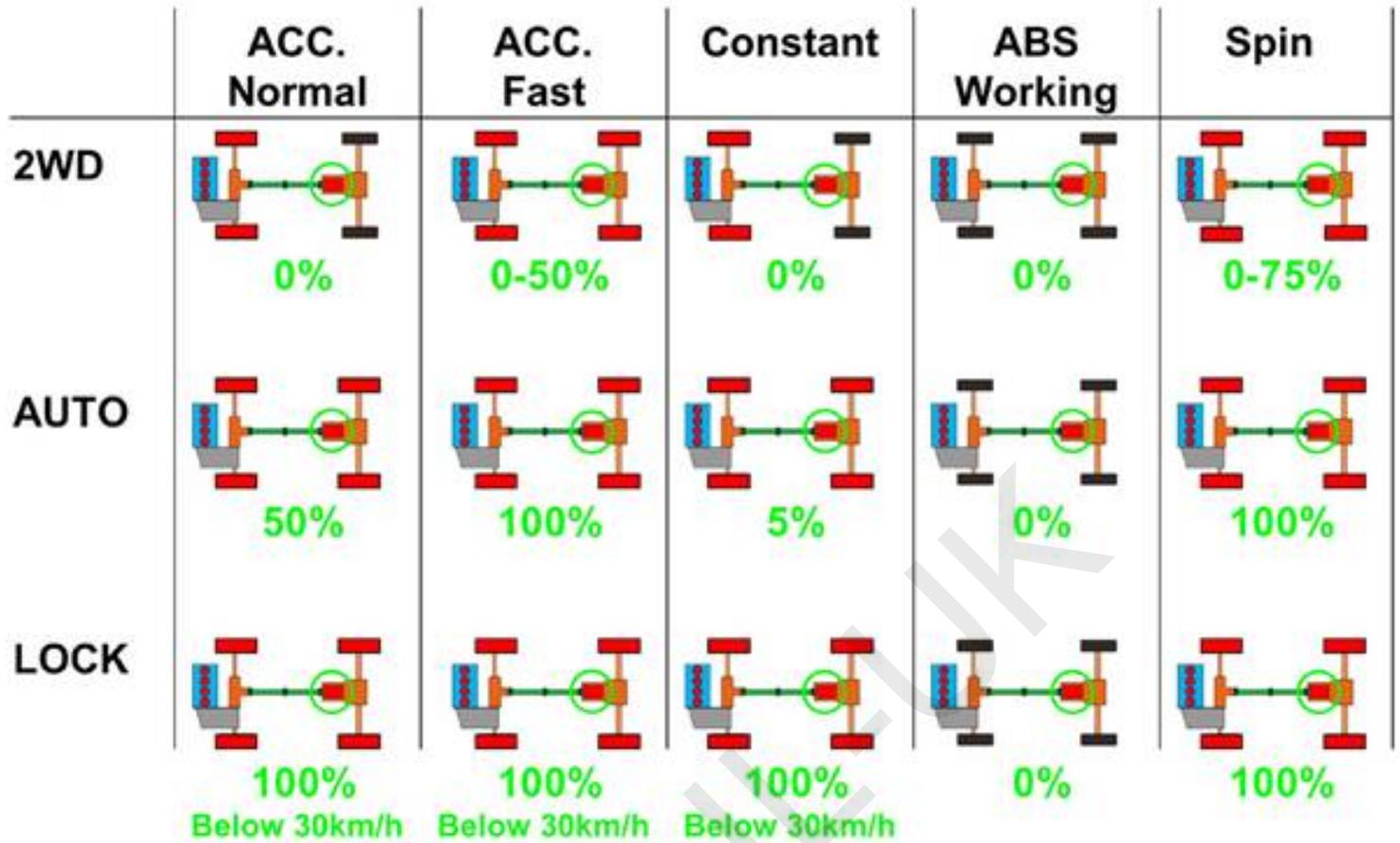


Fig. 6: This diagram shows the engagement of the electromagnetic clutch unit under a variety of conditions.

100 % indicates that maximum torque split is taking place, ie 53% front and 47% rear.

ALL MODE offers further sophistication during everyday driving (Fig. 6). Even in 2WD mode some torque is transferred to the rear wheels under certain circumstances, namely during hard acceleration when the electromagnetic clutch is engaged by 50%, and if massive slippage occurs at the front wheels, in which case the clutch is engaged by 75 %.

If AUTO is selected, under light acceleration the electromagnetic clutch is engaged by up to 50%, dividing the torque to suit the conditions. During hard acceleration, the unit is fully engaged (100%) to allow the maximum permissible front/rear torque split of 53/47.

And when the X-TRAIL is being driven in AUTO at fairly constant speeds, a small drag current is supplied to the electromagnet to ensure that the system is ready to act instantaneously.

Finally, when the ABS is operated, the coupling is de-energised so that the front and rear axles can be controlled individually.

MONOCOQUE CONSTRUCTION

X-TRAIL uses a monocoque construction for low weight whilst maintaining, excellent torsional rigidity. The suspension system is attached to the shell via two sturdy subframes, insulated from the body to reduce noise, vibration and harshness. The front suspension is by MacPherson strut and coils with the independent rear suspension using parallel links.

Light and stiff – it features an aluminium transverse link – the rear suspension is designed to move the rear wheel trajectory backwards on compression, rather than forward, thus minimising tyre impact when an obstacle is hit and providing a compliant ride under all conditions.

Its long travel benefits off road ability but doesn't compromise on-road comfort: X-TRAIL has been benchmarked against premium passenger cars.

With a commanding driving position, excellent manoeuvrability, fine handling and comfort and a tight turning circle – 10.6m – X-TRAIL is as easy to drive on-road as it is able off-road. Manoeuvrability is especially important when towing and an X-TRAIL 2.0 will lug 1.5 tonnes of braked trailer, the 2.2dCi and manual 2.5 an even heavier 2 tonnes.

The vital off-road statistics are an approach angle of 29 degrees, departure 26 degrees (2.2 dCi 25 degrees) and a ramp angle of 21 degrees (2.2 dCi 23 degrees). Minimum ground clearance is 200mm, with a maximum 48 degree tilt angle.

SAFETY

ACTIVE AND PASSIVE SAFETY

As the system is electronic, ALL MODE 4x4 is fully integrated with X-TRAIL's array of electronic traction aids, collected together under the ESP+ banner. Standard on Aventura models, ESP+ offers more than traditional stability systems and is ideally suited to a dual role vehicle such as X-TRAIL.

The ABS sensors, steering angle sensor, G-sensor, yaw rate sensor, ALL MODE 4x4 controller and drive-by-wire throttle all communicate with each other to detect a loss, or potential loss of traction on any wheel. ESP+ works by determining the intentions of the driver through the steering wheel position sensor on the steering column and through the wheel speed sensors at the wheels. It then calculates how the car should ideally be behaving, and compares this with what it's actually doing monitored through the yaw rate sensor (measures turning velocity about the vertical axis of the vehicle), wheel speed sensors and the lateral acceleration sensor, and then calculates what needs to be done to marry the two. Stability is restored by varying any, or as many as is necessary of the following: brake pressure to individual wheels (using the ABS and EBD), the mode of four-wheel drive and engine output.

An Active Brake Limited Slip Differential, also controlled by the ABS sensors, applies the brakes to any wheel that has lost traction and, in so doing, transfers drive to the opposite wheel on the same axle.

As a result of this integrated approach, ESP+ can either apply the brake or redirect torque to any individual wheel independently, thus controlling understeer and oversteer on the road and ensuring maximum traction is maintained off-road or when the going gets slippery.

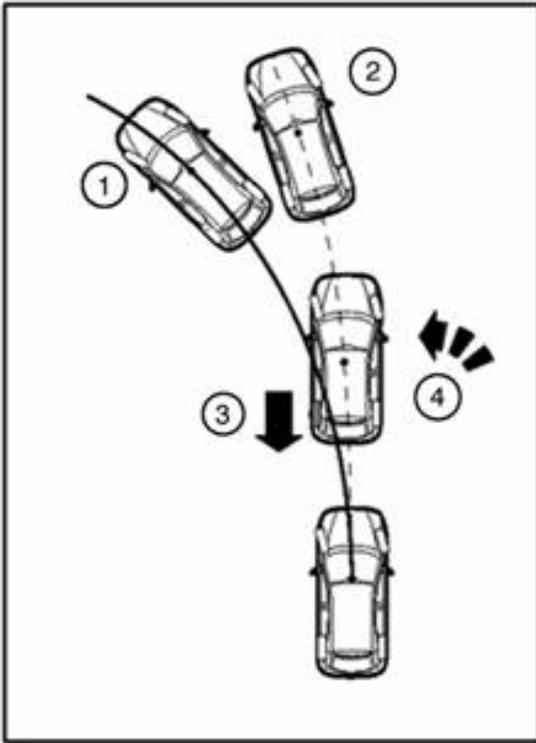


Fig.7: Intervention of ESP+ during understeer.

**(1) With ESP+ (2) Without ESP+
(3) Braking force (4) Balancing yaw movement**

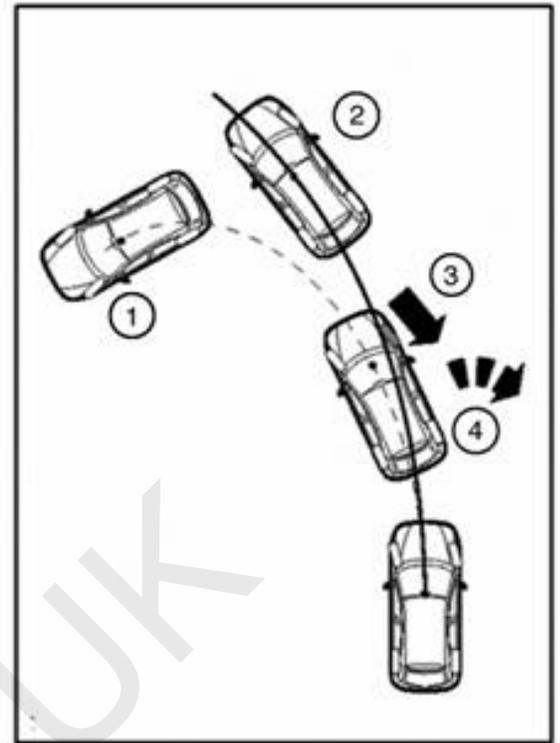


Fig.8: Intervention of ESP+ during oversteer.

**(1) Without ESP+ (2) With ESP+
(3) Braking force (4) Balancing yaw movement**

In simple terms, at the onset of understeer (Fig.7) the rear wheel on the inside of the bend is braked which turns the vehicle back in the direction of the bend; since the front wheels have insufficient grip, ESP mostly uses the rear brakes since more grip is available here.

During oversteer (Fig.8), the rear end needs to be brought into line and this is achieved by braking the front wheel on the outside of the bend. Again, ESP mostly uses the front brakes as more grip is available here.

X-TRAIL offers particularly short stopping distances thanks to ventilated disc brakes front and rear and are controlled by the latest generation four-channel, five-sensor ABS system which incorporates Nissan Brake Assist for maximum emergency stopping power and Electronic Brakeforce Distribution for even braking under all conditions.

The combination of ALL MODE 4x4 and ESP+ means X-TRAIL has one of the most advanced active safety systems available on any passenger car. It is backed up by a computer-analysed structure giving excellent passive safety protection with highly effective crumple zones front and rear. Twin front SRS airbags are standard on all grades along with head and thorax side bags. Front seats are equipped with active headrests, three point belts with pretensioners and load limiters, while ISOFIX child seat fastenings and three point harnesses in the rear are also standard.