Tech

Low Range Lowdown

Just how much of an advantage is low range?

Words and Photos by **Robert Pepper**

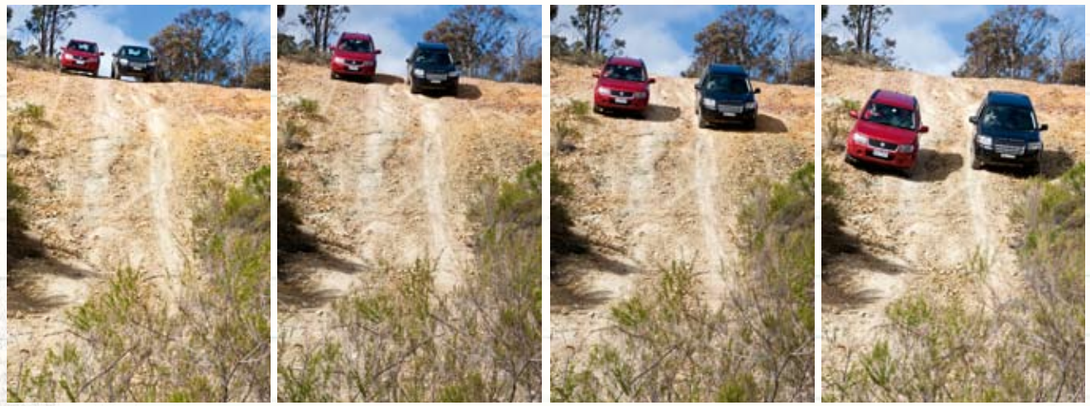
Since time immemorial 4WDs have had low range, and in the eyes of many the mere presence of crawler gears is enough to differentiate the serious from the pretenders. Low range is merely the same set of normal forward and reverse gears, but generally two or more times lower; typically second in low range is a bit lower than first gear in high range. Low range exists for several reasons; firstly it allows the car to travel very slowly while also allowing the engine to rev high enough to develop useful power and torque. This means the vehicle can be driven slowly with the clutch up so it can negotiate terrain like rocks, deep water or other very slow going. The lower gearing also helps on hills where it multiplies torque, allowing the vehicle to climb hills it would simply not be able to otherwise manage, and to do so at a slow, controlled speed. On the way down the low gearing means good engine braking, greatly reducing the need to apply the brakes and thus reducing the chance of locking a wheel through braking.

But with today's modern 4WDs, just how important is that transfer case? To find out, we took the most offroad-capable no-low-range manual 4WD, the Land Rover Freelander 2 TD4_e six-speed, and put it up against the Suzuki Grand Vitara DDiS five-speed manual. You could argue the two are in different classes, but they are similar in size and weight so the match-up is valid. But it's not just the gearing that's different; Land Rover make a point of their advanced technology, and while the Suzi certainly has its bag'o'tricks it doesn't match the Land Rover for computing power, so this comparo is also something a case of traditional values vs the electronic order. It wouldn't be fair to just drive the Vitara in high and low range as Suzuki have designed it to use low range when required, unlike the Freelander which is designed not to rely on a low box. So game on and with scene set, let's look at the statistics.

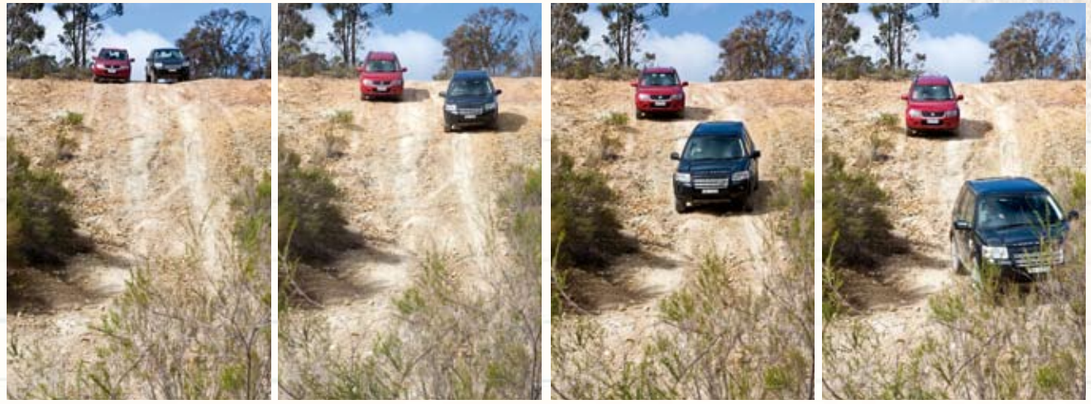
The Suzuki is a little smaller than the Freelander and it's 161kg lighter at 1614 to 1775kg. Ground clearance is 200mm for the Zook, 220 for FL2, which with figures of 31/23/34 degrees for approach, ramp departure angles comfortably beats the Suzi at 27/19/27. The Freelander continues to pummel the Suzuki on paper with its 400Nm of torque at 2000rpm and 118kw at 4000, vs 95kw at 3750 and 300Nm at 2000. Both vehicles had road tyres, and given the FL2 was optioned with the Style Pack and its 19-inch rims we couldn't air those down, so the more sensibly shod Suzuki was also kept at road pressure.

The drivetrains of the two vehicles are quite different. The Suzuki has a torque-sensing centre differential biased 43/57 percent front/rear, which is then locked for a 50/50 split in 4-High, and same in low range with a 1.9:1 reduction ratio giving a crawl ratio of 1:31.1. It has traction control and switchable stability control, plus all-independent suspension. Some Grands have a hill descent facility, but not the DDiS.

The Freelander has an electronic centre clutch biased to the front wheels, with enough drive going to the rears to claim AWD, or more as and when the computer decides it is necessary. There is no manual centre lock, but there is Terrain Response as found in the bigger brethren like the D3, except that there's no Rock Crawl, just Mud/Ruts, Sand and Grass/Gravel/Snow. Terrain Response changes the vehicle's configuration to suit the terrain, for example changing throttle sensitivity, the traction control response, shift points in autos and more. The FL2 also has electronic Hill Descent Control (HDC), with adjustable speed via cruise control.



Starting at the top: Freelander has HDC engaged, Suzuki first low, feet off the pedals. See main body for commentary.



Same race, but HDC not engaged on the Freelander. This shows how much braking HDC has to do in order to compensate for the lack of low range. The more braking, whether by computer or human, the greater the chance of a skid.

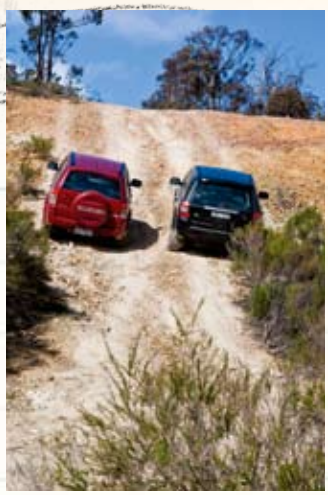
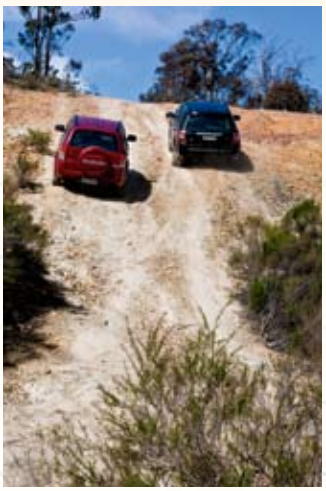
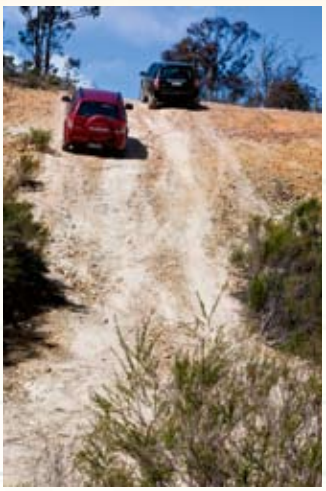
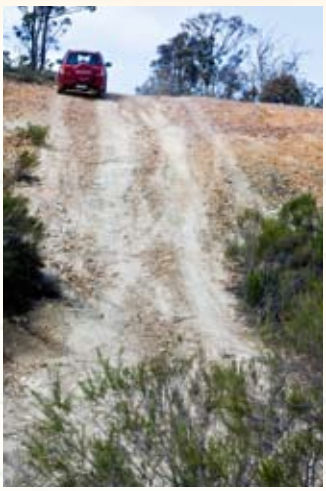
So much for the stats. Now if there's one thing you learn as a roadtester, it's that the specifications are merely interesting numbers that may, or may not be indicative of reality, and reality in this case was four experienced off-roaders driving both cars for a day, repeating many obstacles for comparison. The first thing we found was that we really missed low range in the Freelander. The small Landie just doesn't have the off-idle torque, or even much until you get beyond 1500rpm, by which time you're travelling too quickly for tough terrain. Either side of the peak you slide off the torque very quickly indeed and that doesn't feel good behind the wheel. Interestingly, the crawl ratio for the Suzuki is 1:15.6 in first high, and the FL2 is 1:15.8 so the six-speed, no-low-range FL2 has a marginally higher first gear than the Zook even without its low box. Where the Suzuki could romp in first or even second low, the Freelander struggled not to stall in first, and no amount of varying Terrain Response or playing with electronics could close the gap. There was one rocky uphill track we started to drive the Freelander up, but it was clear the clutch – already overworked that day – would need some serious slipping so we backed out. Then the Suzuki meandered its way up in first low, clutch up, with nary a care in the world. The contrast was stark. In fairness, we did need to play the Zook's clutch a little over the final ledge, but it was all far more controllable than the Freelander. In fact, controllability really sums up the off road difference between the two vehicles; the Grand has it, the Freelander doesn't. One tester even went so far to say the Freelander scared him, and that would have had something to do with reversing down a hill, which is one of the least pleasant off road situations.

Road vehicles are set up with a front brake bias, which means the front wheels get more braking effort than the rear. This is because they do most of the braking work, but also because if you're going to lock wheels better the front than the rear so you slide straight on, as opposed to spin around with the rear locked. Now when a vehicle is facing up a steep hill most of the weight, and thus traction, is on the rear wheels. But all that braking effort goes to the front wheels, so it is very easy to lock them into a skid and still keep the rears rolling. If the fronts are sliding, you can't steer and very soon you have problems which marry the words 'sideways' and 'hill' – never a good combination.

However, if you have a locked centre diff then that can't happen, because it is impossible to lock both front wheels without also locking the rears. Or another way to look at it; the huge additional traction of the downhill, rear wheels forces the lighter uphill fronts to continue turning at the same speed, thus you retain control. This is the ideal situation for backing down a hill. What is not ideal is having some form of centre diff system which disengages, allowing the front wheels to lock which they do easily, and the rears to still rotate. Which is exactly what happens with the Freelander, and that is a huge problem for safety on hills. So when you fail a hill climb, what do you do? Hill Descent Control would solve the problem as it brakes each wheel individually, thus permitting steering control, but that works far too fast for a safe descent backwards in many real-world situations, especially without low range. In any case, assume you've stopped on a hill and are holding the car on the brake. It could still slide backwards with the rears rotating and the fronts locked. The same is true of the parkbrake, which operates only on the rear wheels, thus only holds those. If the centre clutch was locked then in effect all four wheels would be locked by the parkbrake.

So the summary is when we tried to back the Freelander down a steep hill the front wheels locked and we lost steering control. The only way to recover was to release the brakes and accept an uncomfortably quick descent. The Grand Vitara did not suffer this problem primarily because it locks the centre diff 50/50, but its low range also played a part with needing far less braking effort anyway. This is disappointing to report because Land Rover has been here before with the no-centre-diff Discovery II that suffers exactly the same problem, only to add a centre lock in the IIa.

Nor do the problems end there. In general, observations are that the Freelander, regardless of Terrain

Driven as slow as possible uphill.

Response setting, seemed to wheelspin more at the front than the Suzuki, indicating the electronic front/rear torque distribution is perhaps not all it could be. Again, the Suzuki has a simple 50/50 lock which is simple and highly effective. Both vehicles had road tyres at road pressures, and similar amounts of wheel travel. However, total travel is not the whole story, and it seemed to us that the Zook had the more supple suspension for off road work, more easily flexing to stay in contact with ground. Either way, the Zook was noticeably able to get its power to the ground better than the Freelander, low range or not.

The next test was objective, and something we call a 'Slow Race'. The last to finish, wins. We set both cars at the top of a hill, first low in the Zook, first gear and HDC in the FL2. The photos show the story. The Freelander was quicker away, but the Vitara caught up by the end and even nosed ahead. The reason is simple; HDC brakes the vehicle to a set speed and will increase brake pressure as required. Mere engine braking doesn't, and as the hill steepens the car gathers speed. Without HDC it was no contest at all, easy win to the Suzuki. However, HDC is not the equaliser it appears to be. Firstly, it brakes wheels to a set speed and releases them as they are about to slip, as distinct from forcing them to turn at the required speed. The latter is what engine braking does, and that's why it's so effective. Secondly, all HDC systems including this one, are too quick for many real-world situations. So you need to brake yourself, and as you do that, HDC temporarily disengages. Which isn't actually a further disadvantage because the ABS system still works, so you braking normally down a hill gives the same effect as HDC, just that you need to do a little work. What is a problem is that you cannot brake the Freelander to a slow speed without dipping the clutch otherwise you'll stall; for really rough descents stuff you need to hold the car on the brake, then bring the clutch up to move. In the same situation the Suzuki just needed a light touch on the brake in first low with clutch up, far more controllable and less vehicle stress. HDC can also overheat after prolonged use. So while the downhill race was in theory a draw, low range still rules for downhill work.

Then we tried it a 'Slow Race Uphill', with the drivers were briefed to go as slow as they could without using the clutch. After pulling away, the Suzuki literally idled up, feet-off-pedals at 900rpm. The Freelander needed 1500rpm to avoid a stall, and was much, much quicker to the top.

Now we need to put this test in perspective. The Freelander 2, while comfortably bested by the Grand, is still a good off-roader and the best there is without low range, although that's a meaningless distinction. It did beat the Suzuki on one score in muddy ruts, where the Japanese car ran out of clearance but the Brit had a little extra so came through far easier. It is also interesting to speculate how automatics may have fared; we chose manuals as it would show up any gaps to a greater degree. The gap would have been closer with autos, but certainly not closed. Automatics have torque convertors which mean you don't need to slip the clutch, thus low-speed controllability is better, but they cannot work miracles. For example, you can't inch up inclines in first high like you can in first low, or ease over level but rocky terrain. Engine braking is also typically worse with the autos. Interestingly, the Freelander's petrol V6 beats the diesel on torque up to 1250rpm, an important rev range for off road work. The electronics in the Freelander don't seem to be as well engineered as those on the Discovery 3/4, which is the shining example of how technology can improve off road ability.

We're no Luddites here at *Overlander*, and the day will come when low range is not required for off road work, quite probably replaced by electric drive which gives you all the torque off-idle and excellent engine braking too. Land Rover are working on that, but for the moment the traditional transfer case reigns supreme.

PROPER ADVICE

4WD Tips

- If in doubt, try negotiating a slope - either up or down - in low range first.

- It is far better to use low range than it is to 'ride' the brakes either up or downhill.

- Low range allows you to closely modulate throttle inputs in heavy off road driving.