Performance Differentials

Contained in this document: Choosing a Performance Differential, Doing the Maths, What works best in your E28, Real World Examples (E28, E23), E28 Final Drive Ratios, E28, E23, E24 General Information, E36 Final Drive Ratios, E36 General Information, E30 General Information, Rebuilding Tips, What Does a Limited Slip Differential Do?, Differential Bushing Upgrade.

See also: Differential Oil Recommendations, Final Drive Ratio Calculation, Driveline Shudder.

Choosing a Performance Differential

Date: Sun, 24 Jan 1999 (Update 11 Jan 2001)
From: Richard Nott <Richard.Nott@dpws.nsw.gov.au>
Subject: E28 Diff Swap Options for 535i, 533i, 528i.

There are two reasons most people change their differential ratio. Either the original gearing is too tall, or they are sports oriented drivers wanting a lot more power in 3rd and 4th gear. The people who benefit most from a ratio change are those whose car is too heavy for the engine, such as the E36 320, 325 or the E28 528.

Your Gearings Too Tall: Originally the 528i, 535i & 735i were sold with a 3.25:1 diff ratio. Whenever you approached a small incline with a headwind the cars were too heavy to maintain the speed and it was necessary to change down a gear. In some markets, BMW later changed the ratio to 3.46:1 to overcome the problem. They didn't go to the 3.64 because this would have hurt fuel economy and made the car a lot noisier. The later E34 535 was heavier than the older E28, so BMW was forced to select the 3.64 ratio for the manual and 3.91 for the automatic, while using the same ratios in the gearbox as the older E28. Some E28 528i owners changed the diff to a 3.46 and removed the air pulse tubes from the exhaust manifold. This transformed the car. It no longer ran out of puff in 5th and became a strong motor with plenty of power in all gears. On the US M5 the factory selected a 3.91 to achieve similar performance to the higher power and lighter European M5 with 3.73 diff ratio. The M5 used lower gearing because they were made for Sports Oriented Drivers.

Sports Oriented Driver: People who want more power for sports driving and like to listen to the engine don't mind the extra noise. By going from 3.45 to a (lower) 3.64:1 ratio you benefit most in 3rd, 4th and 5th Gears by the engine accelerating more strongly. The disadvantage is that 1st and 2nd Gears are much lower and are no longer matched to the engines power. For example: you'll feel that if 2nd was a fraction lower, you wouldn't need 1st at all, meaning that on an everyday basis you have to change from 1st to 2nd before attaining any real speed... and wasting time. This is the compromise you make when

selecting a lower ratio, and the lower (numerically higher) you go 3.64, 3.73, 3.91, the worse this compromise becomes.

What Works Best In Your E28

General consensus suggests the **best final drive ratio for a manual E28 535i/528i is 3.64**. Many argue that the 3.73 will provide the best 'Bang for the Buck' because of the slightly higher acceleration... "if your going to generate extra cabin noise, you may as well select the ratio that gives the best acceleration". However, going higher to a 3.73 means 1st and 2nd become too low, and this can actually harm your acceleration from the lights and make driving around town a real pain... The benefit though is on the track, where the car will have noticably better pulling power through 3rd and 4th gears. Using a higher ratio means your engine is working harder all the time and generating a lot more cabin noise. If you want your car to be more suited to highways than the track, the 3.46 is the best choice because it will minimise noise and you really don't gain that much pulling power going to the 3.64. Of note, BMP recommends the 3.64 as the best performance ratio for this model.

If you own an automatic 535i, 528i or 735i however, **the best performance ratio is the 3.73**. This is because the automatic gearbox is taller geared and therefore acceleration through 1st and 2nd is still good. The penalty here is that revs will increase by 500rpm and your car will always be noisier inside the cabin. Personally, I chose the 3.64 for my 535i automatic because I wanted to keep the noise down... (Revs increased by only 300rpm) If I wanted maximum performance I would have chosen the 3.73 (but I have a later 155kW engine with Schrick cam), so I thought I'd have all the performance I'd need without it.

Apart from performance, **the other considerations when choosing** the best differential ratio **are engine noise, additional frequency of gearchanges (esp. in lower gears), and your cruising speed.** Do you want your car to be quiet, do you want more power in 3rd, 4th and 5th, do you want 1st and 2nd gears to be too low... The additional performance isn't free. It comes at a cost. Consider the power of your engine (higher power means you don't need as big a change. What will your RPM's be with this new ratio?. What ratio will you be most happy with over the long term... This is the hard part. It costs quite a bit to change your diff ratio, so be warned, if you select a ratio that's either too tall (low number eg 3.23) or too short (high number eg 3.91) you'll end up with a costly mistake that's actually worse than your existing setup. Begin by deciding whether you want to build the car for driving around town or long highway trips. My final tip is too look at what BMW chose for your model. They spent a lot of time and money deciding which ratio would be the best '*compromise*' for both city AND country driving. Deviate too far from this and *you will* impair one or the other. Sometimes even BMW gets it wrong and will alter the ratio at a later time, but this will usually be no more than one step in either direction. Because this is so important, it is my final tip for you: When you change ratios, only go up by one or two steps. Be very careful when you go further than this. I can almost guarantee you, any more than two steps and you won't be happy with the result.

Real World Examples: (E28, E23)

Leaded 1986 E23 735i Automatic with 10:1 compression, ported head, free flow exhaust and the 3.73 final drive, delivering 150kW (201HP) to the rear wheels. This is an impressive car with the heavy 7 easily able to spin the wheels when pushed. Surprisingly the 3.73 does not feel too low geared in the Seven with the sports auto. I was surprised, as the 3.91 in a manual 5 Series with 5 speed overdrive was too low and unpleasant to drive in lower gears... This emphasises just how different the gearing is for Automatics compared to Manuals and shows that what works for one, will not for the other. The Dyno Shop that tested the car said they'd never had a six cylinder put that much power to the rear wheels... impressive.

Of interest to Automatic drivers will be BMW's decision to use the same gearbox ratios for I, II, III, & IV in all their Automatics (E28-535i, E23-735i, E34-535i). Surprisingly, Porsche also uses the same gear ratios in their Tiptronic S - 911 with 3.64 Final Drive Ratio... the E34 Auto uses a 3.91.
The " Tiptronic S " accelerates 0-100km/h in 6.4 seconds with 210kW@6100rpm. (3.6 liters, 340Nm@5250rpm, 11.3:1 Compression. 1425kg.)
The BMW E34 535 accelerates 0-100km/h in 9.5 seconds with 155kW@5700rpm. (3.4 liters, 305Nm@4000rpm, 9.0:1 Compression. 1540kg.)

Earlier I wrote about my 1983 E28 528i 5 speed with 3.25 diff ratio. This gearing was too tall and the engine could not maintain speed up slight inclines at 100 km/h, (60mph) unless the pollution equipment was removed!. Later, BMW changed to a 3.46 ratio after realising 3.25 was too tall for Australian Conditions: (110 Km/h max). 3.46 seemed an ideal compromise for low noise, good fuel economy, and good power for general highway driving. I wanted the car to accelerate up hills in 5th gear, so I decided to change the crown wheel and pinion (diff ratio) to 3.91. Unfortunately this was not a good choice and actually slowed the car down because reaching 80 km/h required 3 gearchanges instead of 2... Not good for city driving. On the highway it was also bad, because of the extra noise generated by the engine revving hard. It was simply too low geared. If I did this exercise again, I would choose the 3.64 as the best compromise... good power up hills in 5th and not too low in 1st and 2nd driving around town.

For my larger 535i auto, I was hoping to keep the 3.46 final drive ratio. But the 3.5L (E32-155kW) engine, even with a free flow exhaust and cam, was unable to accelerate up hills in top gear... Therefore, I chose the 3.64 knowing there is a noise penalty... (I'd rather have the engine quiet to enjoy a good sound system). This resulted in a very slight improvement up hills, but no difference in 0-100km/h times.

At this time, I still haven't had a custom chip made for the engine conversion, and the standard Motronic program is not able to benefit from the higher compression engine. So time will tell how big a difference this makes and whether I can go back to the 3.46.

Companies such as Alpina or Hartge in Germany fit even taller diff ratios than the 3.25 because their engines are more powerful and they are doing higher speeds, so can sit in the peak torque band at around 3500 RPM's doing 160-200 km/h!...

At 160 km/h they'd be a beautifully quiet car.

What are your Options?
According to BMW the following final drive ratios were fitted to the E28. There is a large range to choose from. Ratio's available include:

Final Drive Ratios - E28

Model	Rear Axle Ratio
518i, 520i	4.10
520iA, 535i-E34-Auto	3.91
525e	2.93
525eA	3.07
525e Cat	2.93
525i, 535i-E34-Man	3.64
528i, 320i-E36	3.46
528i (Sports Gearbox)	3.25
535iM	3.07
535iM Cat	3.25
524td	3.15
325 E30	3.73

Gear Ratios - E28 525, 528, 535

Gear	5 Sp OD	Auto
1	3.83	2.48
2	2.20	1.48
3	1.40	1.00
4	1.00	0.73
5	0.81	-
Reverse	3.46	2.09

Final Drive Ratios

BMW occasionally change these to suit the individual market. There are lots of other ratios fitted. In E23, E24, E28, E30, E36 the Crown Wheel and Pinion that determine the Final Drive Ratio are interchangeable, even though the housings are different and not interchangeable. eg E28, E30, E36.

Hints, Tips & Tricks:
1. The ratio is always stamped on a metal tag, and can be found on the back plate of the diff joined by a bolt to the housing. Don't trust this though, it could be swapped.

2. An S stamp at the beginning of the number indicates that the Diff is limited slip, eg: "S 4.10" indicated Limited Slip with 4.10:1 Final Drive Ratio. These are also marked with a large white S spray painted onto the diff housing.

3. The E28 520i diffs have different half-shaft output flanges compared to the E28 528i, but these can be simply prised out from the side and swapped for the original.

4. Someone suggested that E30 differentials were interchangeable with E28's by swapping the rear plate with the original. I can't verify this. It may be possible, as long as you know the trick of prising out the wheel flanges to the half shafts, to swap with your originals.

Good Luck,
Richard

Doing the Maths

See also: Final Drive Ratio Calculation.

Date: Sat, 29 Apr 2000
From: "Gary Derian" <gderian@oh.verio.com>
Subject: Re: [uuc] 3.23:1 vs 3.4 diff for 328i (96)

The rpm is proportional to the gear ratio. 3.23/2.9=1.11. Your new rpm will be 11% higher. With the 3.41, the new rpm will be 18% higher. That is about the same as driving around in 4th gear. Just do that, its way cheaper.

If you can spin the rear tires in first gear with the setup you have, a lower axle gear will not improve the 0-60 time.

Gary Derian <gderian@oh.verio.com>

Date: Sun, 28 May 2000
From: "Richard Nott" <gis@s054.aone.net.au>
Subject: **Determining the RPM's with a new Diff Ratio (Maths)**

To determine the difference in RPMs when changing your diff ratio, I've included a demonstration of the equation you need to use:

RPM = Diff Ratio x Transmission ratio x 336 x MPH / Tire Diameter in inches

Eg:

RPM	=	3.46	x	0.73	x	336	x	87 / 24	
3000	=	3.46	x	0.73	x	336	x	87 / 24	(= 3076 rpm)
2500	=	3.46	x	0.73	x	336	x	74.5 / 24	(= 2634 rpm @ 120kph)
2637	=	3.64	x	0.73	x	336	x	74.5 / 24	(= 2771 rpm @ 120kph)

Real Road Speeds (corrected for speedometer inaccuracy):
3.46:1 Diff: 2500 = 3.46 x 0.73 x 336 x 68.35 / 23.875 (= 2430 rpm @ 120 kph/68mph)
3.64:1 Diff: 2626 = 3.64 x 0.73 x 336 x 68.35 / 23.875 (= 2556 rpm @ 120 kph/68mph)

You will notice that both this formula, and the one from Gary above, will both give the same results. Gary's method is the quickest.
Eg: 3.64/3.46 = 1.05 or 5% higher.
Therefore: 2500rpm x 1.05% = 2630 rpm (almost equal to 2637 above)

Cheers,
Richard

E28 E23 E24 General Information

Date: Fri, 26 Feb 1999
From: Jason Lile <jason@zionsvilleautosport.com>
Subject: Re: <E24 M6> LS Diff., was Re: <E-30> <86 325 ///ESI> .... Diff....

James Moran wrote:
>
> Jason and others,
>
> Any leads on where I can find a limited slip diff. with a ratio higher than
> 4.10 (E30 M3). I'm contemplating a swap and am wondering what options are
> out there. I thought I saw a model that had a 4.45 - maybe an A/T 318ti?
>
> Jim Moran
> '88 M6

Hi Jim-

I'll assume your wanting this for the M6? In that case, you only have one option. There are only three cars in the US that come with shorter gears than 4.10 and none of those diffs will actually bolt into your M6. The E30 318ic cars came with 4.27 gears and the 318ti and 318i AT cars (E36) both came with 4.45 gear ratios. However, these are "small case" differentials and they will not bolt into your car. The ring and pinion set is also smaller and will not transfer to your diff case. That leaves the late model E34 535i AT cars. The later years (like 91 or 92 and later) came with a 4.27 in a larger case diff that would fit into yours. You'd have to pick one of these up used and swap the gears into your case (or another that fits into your M6) because the E34 differential case will not fit the E24. BMW no longer sells ring and pinion sets so your only option is used. I've heard you can buy some 4.45 sets directly from the Motorsport division, but I'm sure they ain't cheap! Good luck.

Jason Lile Administrator
Parts Manager BMW Parts Digest
Zionsville Autosport ICQ# 31376168
http://www.zionsvilleautosport.com

Date: Thu, 1 Apr 1999
From: ABARTH037@aol.com
Subject: Some Differential opinons <ALL> Manual

I recently put a 3.73 in my 535i (stock is a 3.25), this yeilds a 15% difference in Ratio. I drove the car for about 2 weeks, then **I reinstalled the 3.25**. **The car seemed no faster to me** and having to yank 3rd at 45 mph
(*Note*: I can confirm this. I installed a 3.64 in a 4 speed auto 535 and this made no difference to acceleration or power on hills. It simply raised revs by 300rpm. However, I'd recommend a 3.46 ratio for a 5sp Manual, so the engine's transmitting a bit more power to the road. The main benefit is on long hills in top gear, meaning that way you won't have to change gears as much on long trips. Going any higher than that seems to be too low for 1st & 2nd. However, BMW fitted a 3.64 to the E34 535i. *Ed.*)
sucks!! I honestly believe that BMW (the best engineered cars in the world) did their homework to assure the best ratio to use horsepower and torque. Another note, the car went from 2000 rpms @ 50 MPH in 5th to 2500 rpms. **It sounded like the thing was ready to explode**. Do want you want with ratios, I am just stating my point of view and experience with the whole diff swap thing. Now I guess all you other 535 owners will be hounding me for the 3.73 right? Well sorry, I traded it back to the place where I got it.

Nathan
85 535i

"The Matrix" ROCKS!!! Go see it!! It could be happening right now!!

Date: Wed, 08 Nov 2000
From: TR <tomrobsn@gis.net>
Subject: [uuc] 535i,is Diff.

Don't feel short changed if you have an E28 535i or is with an open diff or lsd.
Put in an E30 3.73 lsd and have Fun. Not much money used, for a lot more bang.

TomR.

Date: Mon, 07 Feb 2000
From: Carol & Steve Willoughby <willoug4@gte.net>
Subject: [uuc] **3 Chip Comparison (528e)**

After a few upgrades to my **'87 528e (rebuilt head, "i" cam/springs, 3.25 LSD, larger throttle body from '88 325i) I replace the stock chip with Dinan**'s latest. No dyno figures, etc., but there seemed to be an increase in upper rpm performance. **No noticeable change until around 3k, and then the power increase is apparent.** After a few months, I **replaced the stock chip for comparison, and there wasn't a lot of difference.** Either stock or Dinan, **I attributed the better performance to the other upgrades. Until I went to the Conforti chip, that is! This chip unlocks this motor, and the power comes on smoothly, all the way to the limiter (5300 rpm). Torque is great at lower rpm, and gas mileage is fine** at 22-25 in town. Better than 30 on the road, and **the car will run all day at 75-80mph while turning around 3k rpm, even in the mountains** of western Washington.
So, if you want some great bang for $, and I mean cheap, get a Conforti chip and 3.25 LSD. I experimented with a 3.46 LSD, and it made the motor too busy at most speeds. Went back to the 3.25. **If you're inclined, an "i" cam makes a huge difference over stock, and they are cheap**, too.
Don't do this one until you're ready to pull the head for some other reason, i.e. leaking gasket, etc. If you have an eta motor built prior to '88, don't bother with a larger throttle body. You won't get much, if any, improvement, using this on a stock head/valve configuration.
BUT, if you want to buy a T/B, I'll sell mine for $100, and throw in the intake bellows!

Date: Sat, 19 Feb 2000
From: shilohz@jps.net
Subject: [uuc] <e28> swapped final drive

I swapped out the old **2.93** final drive **in the 86 528e and put in a 3.25**

final drive from a 533i. **I had to swap the cover as they were different.** The old final drive whined a bit and had 236k miles. The newer one has 177k miles and appear to be quiet. **The 10% difference in gearing feels seat of the pants faster, but not to bad with rpms or noise. I am happy with the swap and found it was pretty easy**, just about **2.50 hours** for the R&R.

Date: Fri, 8 Oct 1999
From: bricks@dreamscape.com
Subject: Re: [uuc] re: [E24]Gear Ratio Options

Hey group;

A discussion on 6er gear ratios has been recently going on in the 6er group. Here is a copy of the info. I'm not the author and I'm not sure he's on this list. Hope it is helpful to all.

BR
85 635csiA
Syracuse, NY

My info source tells me that the standard (non-M) diff cases are, as are the ring and pinion and diff body of course, interchangeable with all of the E23, E24, E28, E30, and I think E36's. The covers and stub axles are different for some of the cars (E30, E36) but E24 covers and stubs (same as E23, E28) are swappable directly on to a donor
diff case from any of the above.

So, you can do 3.07, 3.XX...3.YY, 3.73, 3.91, 4.10, LSD or non-LSD, and so on, any ratio that you can get you hands on.

As you may remember I did this exact thing by taking a 4.10 LSD off of an E30 M3 and swapping a cover and stubs from an E23 to make my super-low diff. that's currently on my M635.

Ahh.....the options.

I posted the story back a few months ago...but here goes:

I located a 4.10 LSD off an E30 M3 from a Roundel advertiser. After ordering the diff. I purchased refurbished E23/E24 stub axles and a refurbed cover.

I also rounded up some new waver washers and a few correct

length bolts for the cover attachment (check your fiche or CD - the E30 cover has a couple long ones, the E23/E24 bolts are all the same length). Lastly I got some replacement lock nuts for the drive shaft attachment.

Next I jacked the car up.....as high as you can get....you'll need all the leverage you can get on some of those diff to subframe bolts. Follow the diff removal steps per the service manual - making sure to support the lump with an extended jack to keep from squishing your skull as you remove that last bolt. The removal involved all of 5 bolts - 4 diff to subframe, one cover to diff mount and 4 nuts - diff to drive shaft. Of course you'll also have to unbolt the half shafts too (8 hex head bolts per side)

The whole thing lowers nicely after that. In my case I actually cleaned up and sold my M sized (read large) 3.73 diff as the cover and stub shaft splines are larger on the M diffs - not retrofittable to the E30 diff.

So....after waiting a week or so, I got the donor diff, took the cover off, popped the stubs out (they're just held in with spring loaded circlips) cleaned it up a bit and replaced the cover and stubs with the E23/E24 bits I got from Jim. Now would be the time to check the stub seals for wear too. I used silicone gasket during the reassembly as my paper gasket always tended to seep fluid. I torqued the bolts to the correct specs in the correct order, filled it with redline hypoid (much easier before assembly) and slapped the doner diff back up on the car - assembly is the reverse of dissassembly.

All in all a pretty straight forward but muscle intensive job - it probably took me 8 hours total, a couple of weekends part time. Better than paying the service dudes $200 plus though. Make sure you use your jack to support the old diff and to help line up the new one - these suckers are heavy, other than that - enjoy.

I have a feeling that E30 4.10's might get as scarce as the Motorsport gearsets are if everyone follows my lead, but hey, the whole thing cost me $450 for the diff and $130 for the covers, stubs and hardware....a lot less than the $1500 plus the Korman's or MM guys of the world are charging for the Motorsport gearsets not to mention what they would charge for the retrofit and the rebuild they would want to do while the thing was apart.

Hey, everyone likes cheap torque!

One thing that I failed to mention was the the compatibility of the different platform differentials (E23/E24/E28/E30) are only for 6 cylinder motors. The E30 4cylinders, except the M3 use a yet smaller diff size.

So, BMW has a family of diffs:

Baby Bear (E21/E30/E36) 4 cyl.
Mama Bear (E23/E24/E28/E30M3/E36) 6 cyl.
Papa Bear (M Cars, 8cyl and, 12cyl)

E36 Final Drive Ratios

Date: Wed, 27 Jan 1999
From: ohenri@bellsouth.net
Subject: **E36 Differentials**

Model (E36)	Stock Gear Ratio	Recommended Ratio
318iS, Ti Manual Transmission	3.45	3.90
318iS, Ti, Automatic Trans	4.44	4.75
325 Manual Transmission	3.15	3.46
328 Manual Transmission	2.93	3.46
325/328 Automatic Transmission	3.91	4.27
M3 3.0	3.15	3.46
M3 3.2 , Auto and Lightweight	3.23	3.46

The above information comes from Kormans' website catalogue. I am not associated with Kormans in anyway.

Henry
'92 325i sharked, 3.46 diff (wow!)

E36 General Information

Date: Fri, 19 Feb 1999
From: ohenri@bellsouth.net

Subject: Differential Upgrade

Date: Fri, 19 Feb 1999
From: Skoobahead@aol.com
Subject: E36 Differential upgrade

I have a stock 1994 325i with a 3.23:1 differential. I am looking for more off the line performance without the cost of a supercharger. Have any of you upgraded to a higher ratio? Im not looking to get to radical. Maybe 3.73:1 at the most. What kind of cost am I looking at.

Thanks, John

John
I believe the stock diff in the E36 325i is 3:15 with manual transmission and 3:91 with auto transmission. The M3 3.2 , auto and lightweight comes stock with 3:23 ratio. I upgraded my stock 3:15 diff to a 3:46 with 50% limited slip. This provides a significant increase in acceleration in all gears! The rpm's increase is about 400 more at any given speed. I had mine rebuilt at Kormans for 1,500.00 and 220.00 more for the increase limited slip from 25% to 50%. I've seen BMP advertise rebuilts starting at 1550.00 and Turner at about 1600.00. **I did not think the car could accelerate any faster after the diff upgrade until added an aluminum lightweight flywheel last week. Now I'm getting paranoid because there must be a law against having so much fun** driving. "officer, I have tried to slow down, but these damn mods just make the car take off like crazy, honest".
Henry
'92 325i sharked, 3:46 diff, lightweight flywheel,ram air and borla

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Date: Sat, 29 Apr 2000
From: "Henry Caldwell" <ohenric@mindspring.com>
Subject: [uuc] 3:23 vs 3:41 Differential in a 328

J.G.,
Going from a 3:15 to a 3:46 in my '92 325i 5sp, resulted in 450 rpm's difference. No drivability change whatsoever. Big difference in acceleration. I would suspect **the 3:23 would be a better choice as a daily driver.** You might contact Kormans at their website for more info at: www.kormansfastbmw.com
Henry

>Does anyone posess a set of charts which show the increase in rpm
>when either a 3.23 differential or a 3.41(?) replaces a 2.9 stock in the
>328i (96-5 speed)?

Date: Fri, 19 Feb 1999
From: "Holeman, David" <david.holeman@viaticus.com>
Subject: Diff upgrade response

John...

I have a stock 1994 325i with a 3.23:1 differential. I am looking for more off the line performance without the cost of a supercharger. Have any of you upgraded to a higher ratio? Im not looking to get to radical. Maybe 3.73:1 at the most. What kind of cost am I looking at.
Thanks, John

I upgraded to a 3.46:1 (50% limited slip) **from a 3.15**:1 **and this had a significant impact on my acceleration. This does come at a cost of high end speed. You can count on a cost of about 500 rpm per gear.** In other words when I was comfortable in 2nd I am now in 3rd. **This is an awesome upgrade given my original low ratio. You are already at a decent ratio for your car. You have to accept that your car will be more of what is known as a buzz bomb.** Quick on the start but short on the top speed. The cost for an M3 is anywhere from $1500-$1700 depending on the condition and level to which it was rebuilt. This does not include cost of labor. Hope this helps.

David Holeman
www.mpower.com

E36 M3 1995 Alpine White
* JimC, Euro HFM and Dinan cool air intake with K&N cone.
* Bilstein sport shocks and springs
* Motorsport strut bar
* X Brace
* Euro floating rotors
* Stillen DOT stainless steel brake lines
* BL/SS Bent
* 3.46:1 Differential w/Alpina cover
* LTW Oil Pan
* Porsche Big Brakes (in the box)
* Roll cage (on the way)
* Lost my mind (already?)

Date: Mon, 28 Aug 2000
From: Dave Meyer <dbyker@ix.netcom.com>
Subject: [uuc] <E36> '**99 328is Mods & Results** (Long)

Greetings fellow listers,

I've gotten a lot of good information from this list in the past, and want to give back in a very small way if I can. **I** purchased a new '99 E36 328is Sport 5-Speed in April '99, and have **made a number of modifications** based primarily on recommendations from fellow listers here. *Snip*...

Snip...

Performance (Straight-line acceleration):

Snip...

E36 ///M3 3.23 Limited Slip Differential: This is not a no-brainer upgrade. **It has trade-offs besides initial cost.** On the plus side, **it does improve acceleration noticably over my stock 2.93 open diff, though not quite as much as I had hoped. It also adds limited slip to the car**, which should improve both dry and wet weather handling. **On the minus side, it increases revs (and so engine noise) at cruising speed, requires more shifting, and necessitates fourth gear instead of third around town to keep the revs (and engine noise) down.** Where I used to cruise **at 80mph in 5th gear at 3,100rpm, I now do it at 3,500rpm**, which significantly increases engine noise. **If ultimate acceleration is your objective, this is one way to achieve it.** OTOH, **it has changed the character of my car so much**, from a nice sporty daily driver to a more narrow-focused sports car, **that I am actually considering going back to stock** on this one mod - although I am getting used to the additional revs and noise. **Your call. About $800-$1,100.**

Snip... (*Note*: To see this article in full click here. *Ed*.)

Dave Meyer
99 328is
Lorton VA

Date: Thu, 17 Aug 2000
From: abigG@webtv.net (gggg gggg)
Subject: Re: [uuc] <E36> What are the different diff ratios?

Sir Rob,
Having just put a 3.23 in my 96 328ic, I can at least tell you **stock** with five speed **was 2.91. I can only say that this increase is quite enough for me,** and when I asked on this site, **most** but not all **respondents said, about the 3.46, that its cheaper and the same to "just leave your car in fourth gear". You might try the M3 automatic, which** I believe **is 3.39, but I really wouldn't want anymore highway noise than**

my mod **ratio** has added. Good luck!
JG

Date: Thu, 17 Aug 2000
From: TeamZ3@aol.com
Subject: [uuc] Re: E36 diff ratios

I believe the auto E36 M3's have the most favorable diff gear ratios; 3.23 for 95 auto model (**same for 96+** manuals), **and 3.31**(?) **for 96+ auto M3** models. **Best bet is to go down to the dealer and peruse the parts CD** for the various models.

Sipe

Date: Wed, 29 Mar 2000
From: "Daniels, Jason S" <JDANIELS@amfam.com>
Subject: Re: [uuc] 328ic/M3

John,

Chips work, try a conforti chip... I you want that shove in the back, you picked the wrong car. Only forced induction will really help there. **And final drives are fine if you have a track car. Trust me you don't want to do that because the 600-900 gain in RPM's at highway speed may not seem like a lot, but after an hours it is. Your gas milage will also go down** and you will be right in that 5000 plus thing you don't want a lot faster. Besides ltd slip diffs are expensive.

jason daniels

Date: Wed, 31 May 2000
From: "ra rabmw" <rabmw@hotmail.com>
Subject: Re: <E36><M3>Differential Ratios

>From: "Franklin W. Nelson" <fnelson@earthlink.net>
>Subject: <E36><M3>Differential Ratios
>Date: Wed, 31 May 2000
>
>I have a late production (8/95) '95 M3. According to Korman's website, I'm
>supposed to have a 3.15 lsd. However, when I do the calculations (using the
>formula also provided by Korman) it keeps coming up 3.23. I thought only
>auto trans cars (mine's a manual) and LTW's came with 3.23's in '95. Can
>anyone explain this? Is there any way (other than driving the car and doing
>the calculations) to verify what ratio I have in my car? I was getting ready

>to put in a 3.46, but if I've got some sort of rare factory setup I may want
>to leave it alone. The car also came with LTW wheels.
>
>Frank Nelson
>'95 M

Frank;
See below for my reply from a long term supplier on different
ratios, as to what was and is available originally.
"RA"/Bob G.

From: Armand,VAC Motorsports.
Subject: E36/E46 Differential Ratios

Bob, there is no "direct factory bolt-on" in that ratio (3.46 LSD) for
E36. Stock options were only 3.15, 3.23, 3.38, & 3.91.We may have
some of those ratios in used items.
We can custom build LSD ones in 3.46, 3.64, & 3.73, usually
for about $1,200.

Date: Fri, 23 Jun 2000
From: "Rob Hatrak" <Hatrak@ix.netcom.com>
Subject: [uuc] 95 M3 gets a 3.38 rear end

A few weeks ago I asked the group for opinions about **upgrading** the rear end in **my 95 M3 to a 3.38**. I got a bunch of great emails and help from many people. I would like to throw a special "Thank You" out to Bob Tunnel, Skip Bogard, Sean Hester, Ben Liaw, and Mike Mount. Thank you, gentlemen, for helping me make this decision. I truly appreciate it.

For those that are curious, **I am very pleased with the results. The car really pulls a good bit harder. Some people warned me that I would be shifting a lot more with the new gears, but I have found the reverse to be true. Previously I would need to downshift into 4th on the freeway or 3rd on the street to make a pass, but now it seems like the car has great power in every gear. The car will still hit 60 in second gear with my slightly taller-than- stock 245/40 tires**, and the loss of 350 RPM at redline is soon forgotten.

I am not sure if it would be worth spending money on this upgrade if you are going from a 3.23 to the 3.38, but from my original 3.15, this is a very worthwhile upgrade. **I highly recommend it for the 95 M3 crowd.**

Thanks again to those people listed above!

Rob

Sin City Chapter

Date: Fri, 23 Jun 2000
From: "ra rabmw" <rabmw@hotmail.com>
Subject: Re: [uuc] 95 M3 gets a 3.38 rear end

Rob;
Thanks for the report. The cars running 3.23's can get the same results using a 3.46 diff. That's not a stock ratio, but can be easily made up for a reasonable price in open and LSD by VAC Motorsports and others.

```
o/______\o "RA"/Bob G.
(Oo=00=oO)
[]=****=[]
```

E30 General Information

Date: Mon, 15 May 2000
From: "K.C. Boyce" <k_boyce@yahoo.com>
Subject: [uuc] <E30> diff

Manuel,

My experience is with the **6-cylinder diff**s, which differ slightly in the way they mount from the 4-cylinder diffs. So, this advice may or may not be applicable, though I suspect the gist is similar.

However, the **procedure** is fairly simple. You don't need a lift, though it does help a lot not to spend lots of time on your back getting road grime all over yourself... :-)

You'll need to disconnect the half-shafts (6 bolts ea.) and the driveshaft (4 nuts). The driveshaft is easy. For the half-shafts, just set the parking brake, and rotate the wheels when you need to get at the last two bolts. Then disconnect the four axle carrier bolts and the rear mounting bolt(s?). The diff should drop right out, assuming you disconnected the speedo sensor.

The toughest part of the swap was to get the four bolts on the axle carrier undone. Penetrating oil, large prying and hitting tools, and a liberal dose of cursing should do the trick for you. Really, it's not that bad. :-)

Be sure to support the diff before undoing all the bolts, as you don't

want that thing crashing down on you (all 80 lbs. worth!).
Installation is the reverse of removal.

KC Boyce
'**85 325e**
E30 Eta Page: http://rikki.coloradocollege.edu/~k_boyce/

Date: Wed, 29 Dec 1999
From: "Ian Reid" <ian@gmail.nccinc.org>
Subject: Jim C. VS. Dinan Chip, and research ever done to see whos best?

Snip...
>> I was wondering what types of changes would take place if I switched out
>> my LS diff that is probably a 3.46. to a 4.10.
>>
>> The guy that is trying to sell the 4.10 to me says, "that it will make
>>the car accelerate much faster,

I have a 4.10 diff in my E30 325i instead of the stock 3.73 and it is definitely the best 'bang for the buck' modification wise that I have done.

better than the conforti chip, better than the K&N cone filter, better than the lowering springs

I just drove a similar aged 325is back to back with my car and mine definitely felt peppier, squirted away with more torque

yes, mpg is down a couple
yes, **rpm cruising are up ~500 but it is certainly not annoying or intrusive**

as far as better gearing.. for *me* **I find the gearing better..** no need to downshift to get the oooomph

ie **cruising at ~90mph in 5th is ~4000rpm which is *right* on the power band.. want to pass - push the go pedal and you are *gone***
(*Note*: 60mph in 5th = ~2700rpm. *Ed*.)
cruising at 60mph in 4th (back roads, spirited driving) same thing

chris pawlowicz
'89 325i
'74 2002

Date: Sun, 07 Feb 1999

From: Pat Donahue <pdonahue@erols.com>
Subject: Re: <E-30> Diff swap

Keith asks:
>
> Hi all,
> **I may have located a 4.10 limited slip to suit my needs. It's out of an E-30**
> **M3. Will it swap directly into my '84 318i?**

You must be raving mad! :) Actually, **the E30 325 and M3 share the same axles but the 318 axles are smaller. I _don't_ know for sure if the axle flange on the sides of the diff is smaller.** I do know you can't just swap in the parts outside of the diff.

Pat Donahue CCA 125031
Vienna, VA
'91 M5 4GTFUL <- For sale: http://www.bubbaclub.com/pat/m5sale.html
'88 325is destined for ITS <- 'cause of this one

Date: Mon, 8 May 2000
From: "Henry Caldwell" <ohenric@mindspring.com>
Subject: [uuc] RCM Driving School

K.C.
I'm curious about the diff comment. What was the original diff ratio and which one did you install. **My experience with diff upgrade was quite an improvement in acceleration in all gears.**
Henry
'92 325i with 3:46 diff

>Also, the E36 steering rack made a big difference -- less sawing at the
>wheel. It was interesting because the rack and the diff don't make a
>huge difference on the street, but boy do they on the track!

Date: Tue, 9 May 2000
From: "K.C. Boyce" <k_boyce@yahoo.com>
Subject: [uuc] Diff ratio (was RMC driver's school)

Henry asks about my diff ratio...

My **car came stock with a 2.79** open diff. Geoff Patterson and **I changed it out for a 3.25** limited-slip diff (from an E28 533i).

Acceleration *is* noticably quicker, as is the fact that the wheels are

mechanically connected now.

KC Boyce
'**85 325e**
E30 Eta Page: http://rikki.coloradocollege.edu/~k_boyce/

Date: Mon, 13 Nov 2000
From: "VanAusdal, Thi" <thiv@crystal.cirrus.com>
Subject: RE: [uuc] RE: 325 mods...

> thanks - so it's obvious you can't just "upgrade" to an i head.
> I presently cruise at 2,000rpm/60 mph - I'll double check on
> the way home.
> What can I expect with a 3.25 or a 3.73?

The **2.91 gear changing to 3.25 means 2000 rpm >> 2234 rpm.**
The **2.91 >> 3.73 means 2000 rpm >> 2564 rpm.**
I personally drove an E21 323i with a 3.90 motor and eta longblock.
In spite of using the stock K-Jet, I got 24/28 mpg. And, man, that
thing was at least even with my dad's '87 325is.

> What is HP and torque for an i motor?
> What is HP and torque from an M50 I have heard about?
Snip...
> Thanks,
> 1st

The M20 (325i SOHC) motor is 164 bhp, ~170 lb-ft. But the eta motor
has just as much torque, across a low and broad RPM band. The i motor
has to spin up.

The M50 (325i DOHC) is, er 189 bhp.

Thi

Date: Fri, 26 Feb 1999
From: Jason Lile <jason@zionsvilleautosport.com>
Subject: Re: <E-30> <86 325 ///ESI> Needing a 3.45 LSD Diff. from a ?????? Help.

BRI29ATL@aol.com wrote:
> Digesters:
>
> I am wanting to upgrade my rear end again! What Bmw had a 3.45 LSD Diff. that
> will mate up to the E-30?

The E23 735 AT cars came with 3.46 ratio diffs. You can also find them in some '88 528e cars and some of the 635csi cars. Any of them will fit the E30 with a rear cover change and a swap of the stub axles. I happen to know where one is if you're interested ;)

Date: Sun, 7 Feb 1999
From: BMWROSS@aol.com
Subject: Re: <E-30> Diff swap

> Date: Sun, 07 Feb 1999
> From: Pat Donahue <pdonahue@erols.com>
> Subject: Re: <E-30> Diff swap
>
> Keith asks:
> >
> > Hi all,
> > I may have located a 4.10 limited slip to suit my needs. It's out of an E-30
> > M3. Will it swap directly into my '84 318i?
>
> You must be raving mad! :) Actually, the E30 325 and M3 share the same axles
> but the 318 axles are smaller. I _don't_ know for sure if the axle flange on
> the sides of the diff is smaller. I do know you can't just swap in the parts
> outside of the diff.

The flanges on an e30 323i are definitely smaller than a 325i (ask me how I know.... anyone want to buy a used 325i 3.25 open diff ;-)). I read in European Car that the 318i uses the smaller diff. **I heard you can swap the shafts just by prying them out, but when I tried this the replacements from the 323i didn't mate properly with the 325i housing.**

Ross Walsmith
83 323i/2.7
84 528e

Date: Sun, 7 Feb 1999
From: VeeDubJeff@aol.com
Subject: Re: bmwuucdigest V1 #62

I don't think they will swap directly. If I remember right E30 differentials will swap right in all 6 cylinders, and all 4 cylinders... with exception of the M3 that uses 6 cyl parts down there. Somebody please correct me if I'm wrong because there is a GOOD chance I'm wrong.
A nice **guy with a E30 set up a E30 page... he also has a copy of European**

Car's tech review on E30 diff swaps.. go read it, trust me it will give you all the info you need!
Here is the URL:
http://rikki.cc.colorado.edu/~k_boyce/

Good luck and let me know on how the job comes out if you do it.
Jeff Patch
86 Alpine White 325es - K&N, 17" Giovanna/Dunlop

<< Hi all,
> I may have located a 4.10 limited slip to suit my needs. It's out of an E-30
> M3. Will it swap directly into my '84 318i?
>>

Date: Fri, 30 Jun 2000
From: "ra rabmw" <rabmw@hotmail.com>
Subject: Re: [uuc] **Diff ratios/for E30 3.2**

Dwight is right about the 2.93, but if you want a bit more, I would suggest you go no farther than the 3.25LSD you will find out of 5-speed E28 535i's. it should give you more than enough extra, and not shorten things too much.
The nice part is, that I've advised a few digesters recently to remove their E28 3.25's in favor of E30 3.73's, and you can probably pick up a 3.25LSD very reasonably.

```
o/______\o "RA"/Bob G.
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[]=****=[]
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Rebuilding Tips

Date: Sun, 02 Apr 2000
From: "Neil Deshpande" <Ndeshp@Roushind.com>
Subject: [uuc] <E30> Diff. Bearing. DIY? NOT!

KC:

As far as I know, the bearings on a diff. have to be set pretty carefully for lash. Set the lash too high and you get noise and higher impact forces on the gears. Set the lash too low and the heat expansion makes for interference and wear of the gears. Various shims are involved when setting the lash.

Brett Anderson once mailed me a procedure on rebuilding a diff. I read the some 30 point procedure

and decided it was not worth it for now. Perhaps when I have spare transport, I will do this out of interest. Mr. Jack Money has rebuilt a Mustang diff. at work and I'd probably enlist his help.

Neil Hitze has witnessed a diff. rebuild done by a mechanic friend and suggested getting it done professionally.

>From what I can tell, it is a tedious task, but with some mechanical common sense and lots of patience (and a spare car) one can pull this off. Not at all in the same category as doing the seals though. Those are easy!

Neil Deshpande
1988 325 iS
1989 325 iC

***

I believe that the bearings are DIY replaceable. If anyone knows any differently, let them speak now or forever hold their peace. I'm just doing the seals & mounting bushing on the diff going into my car. I'm still waiting for the rubber to show up, though...

Date: Sun, 2 Apr 2000
From: "Brett Anderson" <brett@koalamotorsport.com>
Subject: [uuc] Re: E30 diff install BA

> From: "K.C. Boyce" <k_boyce@yahoo.com>
> Subject: [uuc] E30 diff install
>
> Raymond asks about the seals & output bearings on a 5-series diff going
> into an E30 Eta.
> - - input shaft seal (remove big tight nut on input shaft, remove flange
> with a puller, then replace the seal)

One HUGE caveat here.

Mark both the nut and the pinion before removing the nut.

DO NOT tighten the nut more than 1 or 2 degees past the original position,
use Loctite to make sure it stays there.
Tighten it further and you'll chew up your pinion bearing in an instant.

> I believe that the bearings are DIY replaceable. If anyone knows any
> differently, let them speak now or forever hold their peace.

Absolutely not. The side bearings are not entirely difficult to change but
will require setting of back lash afterwards.

Pinion bearings require a number of special tools and I'd also suggest some experience.
Incorrect setting of the pinion can and will result in bearing and/or gear wear.

Trust me, I blew up my first one or two.....
(in my own cars of course.....)

Brett Anderson
www.koalamotorsport.com
Home of the E30 M3 CD-ROM repair manual

What Does a Limited Slip Differential Do?

Date: Thu, 18 May 2000
From: Joe Tan <jtan71@yahoo.com>
Subject: limited slip differentials

Man, This guy needs a lot of help. Anyone?
nobody?, ok then I'll give it a shot.
James,
A limited slip differential (LSD) will not add any power to your car. It will however make better use of the power you already have. **When cornering a car with an open differencial (non-LSD) the inside wheel will get too much power and it will smoke your tire thus wasting your power. With a LSD, the power will be transfered to the outside wheel where it can make better use of it and help you power you out off the corner faster. The only way a LSD will add more "power" to you car is if the differential is numerical higher where you would get better off line accleration in exchange for a nosier ride at highway speed.** If you are looking to add some real HP you will need to do some engine work or forced induction.

Joe T.

(*Note*: Many road accidents have occurred to non-LSD equipped cars when driven quickly around corners because the inside wheel lifts, all power is transferred to the spinning wheel which upsets the cars balance, loosing rear traction and causing the car to spin. If you don't catch it, it could spin off the road and cause a serious accident. Limited Slips help reduce this possibility. *Ed.*)

Differential Bushing Upgrade

Date: Wed, 7 Mar 2001
From: Neil Deshpande <neildeshpande@yahoo.com>
Subject: [uuc] Upgraded diff bushings?

Joel:

I asked the precise question a few months ago. **The M Coupe bushing fits. Price is a few cents different** at The BMW Store, Cincinnati, OH. Check http://yp.yahoo.com for their number.
Check http://www.e30m3performance.com for details on the bushing.

Neil Deshpande
http://www.neilwerke.com

***

Joel Gallun <joel@tux.org>
I've got a 4.10 LSD sitting in the back of my truck just waiting to go in my E30 track car. Before I put it in I was thinking that it might be nice to upgrade the bushing. **Does anyone know of a source for an upgraded bushing?** I checked Turner and Bimm