

A guided tour of the Newmar Comfort Drive steering system with questions and answers

By Ken Sherwin, revised on November 28, 2017

This article is divided into three parts:

- The Short Version contains is a brief overview of the system, intended for those who are mildly curious about why all the fuss over this system.
- The Experience Version, starting on page 2, is a guided tour of the system as you drive along in your coach. This will demonstrate and explain all the normal features while you feel them in familiar surroundings – your coach. It also has a brief background on the system.
- The Extended Version, starting on page 8, is formatted as a series of questions and answers, intended for those who have read and participated in the first two parts and are still thinking “Yes, but what about.....?”

The Short Version

The purpose of a CD is to reduce the work the driver has to do in all driving conditions. Features include:

- Low steering effort when the coach is standing still.
- Higher steering effort while driving down the highway (proportional to speed).
- Consistent steering effort or “feel” at any given position of the steering wheel by reducing friction.
- Excellent reversibility from any turn angle at any vehicle speed while going either forward or backward.
- “Pull compensation” to avoid the tiresome task of holding the steering wheel against a side wind or the crown of the road.
- The driver can make the high-speed efforts heavier or lighter at any time.

The net result of these changes in the steering system is that the driver is much less fatigued at the end of a driving day and is therefore a more alert and safe driver.

The Experience Version

Let's take a drive together in your Newmar coach equipped with a Comfort Drive steering system. As I ride along while you drive, I'll point out various features of the Comfort Drive. Before we do, we need to understand a few things, more or less in random order.

First, let me introduce myself. My name is Ken Sherwin and I was one of a very small team who started development of this product in 2000 and we did the first customer showings in 2005 in an old Newmar Kountry Star diesel pusher. I chose the features to be included and how they should work, wrote the initial specifications, and wrote much of the prototype code. I also did all the lab and field testing, technical interaction with customers, and initial production support. I continued to do this as well as develop new features until my retirement in 2017. I have as much experience with the system as it is installed in motorhomes and other large vehicles as anybody in the world. My background gives me the insight to accurately discuss this product.

Another member of our team reviewed the code and rewrote it as necessary. This code has also been independently reviewed multiple times. We started with an existing electric power steering system then being made by TRW in Europe and modified the code to work together with the existing hydraulic power steering system. This product was not the result of just a one-pony circus.

Comfort Drive is Newmar's name for a product originally called ColumnDrive by a company originally called TRW. The product was recently renamed ReAX-C and the company was recently renamed ZF, who bought TRW, but the product is the same. The essential hardware is a computer-controlled electric motor, initially used as the power source in an electric power steering system in Europe. It originally drove a manual rack and pinion steering gear that required a lot of torque to steer. Because we used it above a hydraulic power steering system, we only needed about 10% of the available power. This is why we could use it on transit buses that spend a lot of time turning. The only mechanical changes needed were to replace the upper steering column and steering wheel and the lower intermediate shaft with a variety of more robust commercial steering components.

Let's also clarify a few terms before starting the engine.

CD – the ColumnDrive or Comfort Drive or ReAX-C system discussed in this article.

SW torque – the amount of torque the driver feels when he holds on to the steering wheel. Because the wheel has a fixed diameter, the SW torque translates directly into the load the driver applies with his hands, knees, or elbows. Excuse me.....I meant hands because nobody ever steers with his knees or elbows, right?

SG torque – the torque applied to the input shaft of the steering gear. This torque is amplified by the steering gear to become the output torque that actually turns the roadwheels.

Motor torque – the torque created by the CD itself. The CD combines the SW torque and the motor torque to become the SG torque.

Pull – the SW torque the driver must continually apply in a coach NOT equipped with the CD to resist crosswinds and road crown. While the absolute magnitude of this torque is not large, having to apply it for a long time gets very tiring.

Clockspring – this component provides a continuous electrical connection between the moving steering wheel and the stationary column. Because it is a continuous wire with a fixed length, it has a maximum travel only slightly larger than that of the steering gear. That being said, if the clockspring is not on center at the same time as all the other parts of the steering system, the end can rip out, killing all the switching functions of the Smart Wheel.

EOT – the end of steering travel where the steering system hits a soft hydraulic stop in the steering gear, followed closely by a hard mechanical stop on the axle that prevents the system from moving any further. There are both left and right EOT positions and they are probably at slightly different angles.

Center – the place where the roadwheels make the coach drive straight on flat pavement with no wind. The steering linkages, steering gear, CD, clockspring, and steering wheel should all be at their respective centers at the same time as the roadwheels.

Straight ahead – the place where the entire steering system makes the coach drive straight under whatever conditions it finds itself at any given time. Center and straight ahead can differ by a fairly large amount when something is applying an external side force on the coach. The maximum difference I have measured was 54 degrees of steering wheel position while I was driving in the crosswind of a bad snowstorm. All the sane people were tucked away snugly in their beds but my boss and I had get-home-itus. (Yes, we got home.)

Efforts knob – the driver-controllable efforts control. This control is implemented at Newmar as a knob numbered 1 through 6 where 1 gives the lightest steering and 6 gives the heaviest steering. The location and labeling of this control depend on the year and model of the coach.

OEM – Original Equipment Manufacturer

Tire patch – the contact area between a front tire and the ground.

Tire windup – as you turn the roadwheels a little bit while parked, the tire sidewalls deflect and allow the tire patch to stay in one place on the ground. As you continue to turn the wheels, the tire patch finally begins to skid, rotating with the rest of the tire but lagging behind the steel wheel due to the elastic deflection of the tire sidewalls. This deflection is the tire windup. For this discussion, it only matters when standing still.

Efforts – another term for SW torque.

Light efforts – when very little force (only a few ounces) is required to either move the steering wheel toward the EOT or restrain it from coming back to straight ahead. This level of SW torque can easily be applied with a thumb and one finger on the steering wheel rim or even just a single finger on a steering wheel spoke.

Heavy efforts – significant force (as much as 7 pounds) is required on the rim of the wheel to either move the steering wheel toward the EOT or restrain it from coming back to straight ahead. This level of SW torque can typically require both hands firmly grasping the wheel.

This article will first describe each test you should perform, either in your imagination or, even better, in real life at the wheel of your coach. Then it will discuss what you should notice during that test. By the end of this drive, you should have a much better understanding of what the CD does for you.

DO - I think it's finally time to start the engine once you adjust the seat, steering wheel, mirrors, and in general get ready to drive. NOTICE – If the steering wheel was not very straight with the engine off (we'll discuss how that can happen later), the steering wheel will straighten up on its own as the CD starts doing what it's supposed to do: it's trying to bring the steering wheel back to straight ahead. It is generating motor torque to hold the steering gear against the tire windup of the off-center tires.

DO – check out the coach as air pressure builds. NOTICE – look for kids, trees, toys, and any other impediments to moving the coach. Actually, all this is just to kill some time because the real thing you should notice is that 5 minutes after starting the engine and seeing the steering wheel move back to straight ahead, the wheel could have moved by itself again. It moved back to the position it was before you started the engine. What really happened was that at the end of 5 minutes of no movement from either the coach or the steering wheel, the CD relaxed its motor torque, allowing the tires to relax by moving the steering system.

Let's finally do something real. DO – turn the efforts knob to full light (typically labeled 1) and steer to one EOT, then to the other EOT, then back to straight ahead. NOTICE – the SW torque is seriously light, almost to the point that you might think it is disconnected. You can easily steer it with just one finger. You might even be tempted to peek out a window to see if the tires are really moving. Be assured that everything is okay. The CD is doing what it's supposed to do: it's reducing the work the driver has to do when parking.

At this point, you may be convinced that this coach is going to drive terribly at high speed, just based on your experience with conventional power steering. If it's this light now, it must be undrivable at 60 mph, right? WRONG! Experience with conventional power steering does not prepare you for what's to come in just a little while, so please reserve judgment until you've seen and felt the whole demonstration.

DO – turn the efforts knob to full heavy (typically labeled 6) and steer from one EOT to the other EOT then back to straight ahead. NOTICE – the SW torque is just the same as it was with the light setting.

This is because the efforts knob has no effect while standing still. Why would a driver want heavy efforts while standing still? But be patient. We will see this control have a big effect later in the drive.

Let's start driving around the campground or local streets. Do – turn the efforts knob to full light then drive straight, in bends, and around sharp corners at various speeds as the roads allow. NOTICE – the SW torque stays very light. The steering wheel wants to return to center by itself. In fact, had you let go of the steering wheel completely (that is ABSOLUTELY NOT recommended), you would have watched the CD bring the steering all the way back, all by itself.

Continue driving around the area. Do – turn the efforts knob to full heavy then drive straight, in bends, and around sharp corners at various speeds as the roads allow. NOTICE – the SW torque is now somewhat heavier than when the knob was set at full light. The steering wheel wants to return to center by itself. In fact, had you let go of the steering wheel completely (it is still ABSOLUTELY NOT recommended), you would have watched the CD bring the steering all the way back all by itself. The CD is doing what it's supposed to do: it's reducing the work the driver has to do when driving slowly.

DO – try going straight and turning corners while backing up. NOTICE – the SW torque required is so much lighter that you can do it with one hand while spending most of your effort looking at where you are going in your mirrors and listening to your spotter. You did use a spotter, didn't you? Also notice that if you let go of the steering wheel completely, the CD brings the wheel all the way back to straight ahead for you so you can back straight up when you want to without searching for it. At the very slow speeds that we back these coaches up, releasing the wheel and letting the CD get the wheels straight so you can back straight is not a bad technique. Remember that YOU are still responsible for where the coach goes, so don't run over anything valuable. The CD is doing what it's supposed to do: it's reducing the work the driver has to do when backing up.

DO - Now get out on the streets and get the speed up to about 30 to 35 mph, driving straight, going around bends, and turning corners as roads permit. Turn the efforts knob to full light. NOTICE – the SW torque is now again seriously light. Also notice that the steering wants to return to straight ahead better than you remember coaches normally behaving.

DO – Turn the efforts knob to full heavy and continue to drive around at 30 to 35 mph. Notice at these higher speeds, the SW torque is somewhat heavier than when at full light and heavier than at lower speeds. Also notice that the steering wants to return to straight ahead much better than you remember coaches behaving. The CD is doing what it's supposed to do: it's reducing the work the driver has to do when driving at mid-speeds.

DO - Now get out on an interstate with not much traffic. This test will work best if there is no wind. Get the speed up to about 60 to 65, driving straight and around bends as roads permit. Turn the efforts knob to full light. NOTICE – the SW torque is now again seriously light, requiring only very light contact with the steering wheel to maintain control. Also notice that the steering wants to return to straight ahead better than you remember coaches normally behaving, in spite of the very light SW torque. You will probably think this is too light, but a few people like it this way. Right now, we are just exploring the range of features, not finding preferences.

DO – While still at 60 to 65mph, turn the efforts knob to full heavy. NOTICE – the SW torque is now very heavy, requiring both hands firmly grasping the wheel to get it to turn. The CD is now actively providing more resistance than the steering gear by itself. You probably think this is too heavy, but a few people like it this way.

DO – while still on the interstate with the efforts knob set at full heavy, drive in the right lane on a straight section of road for a couple of miles. This allows the CD to learn the difference between center and straight ahead. There should be no pull or torque on the steering wheel. Now shift briskly to the left lane when traffic permits. If you creep over to the left lane very slowly, you will not be able to feel what I'm about to describe but if you yank it over there too fast, you'll throw the dog off the couch and get us both scolded. NOTICE – in the right lane, you could maintain a straight path with very little SW torque but in the left lane, you had to turn the wheel 5 to 10 degrees to the right and hold some SW torque to the right to keep it there. But continue to pay attention because the CD is learning the new difference between center and straight ahead, taking over the task of holding the required SG torque so you don't have to. It could take as much as a minute for the CD to completely reduce the pull to zero. This is low-level pull compensation in action.

If you are like most people, you probably thought the steering was too light with the efforts knob set at full light and too heavy with the efforts knob set at full heavy. DO – continue to drive around and adjust the efforts knob to the place you find most comfortable. NOTICE - At some point in the range of the efforts knob, all of a sudden, the steering will feel just right. NOTICE – If you want just a small steering correction, only a little pressure on the wheel is needed. If you want a larger correction, a little more pressure gives it to you. Relaxing the pressure will bring the wheel back to straight. The friction of conventional steering is gone and lane placement becomes a matter of increasing and decreasing your finger pressure on the wheel, just like in a car. The CD is doing what it's supposed to do: it's reducing the work the driver has to do at high speed by making the driver comfortable. The days of wrestling with the wheel are over. The longer you drive, the more you will feel even small differences in the efforts knob setting and you can adjust it to be the most comfortable at the moment quite easily. On the other hand, a few people discover that they can adapt to changes in SW torque very easily and don't really feel the difference in efforts knob setting. They wonder what the fuss over the driver being able to control the SW torque is all about. They're happy with whatever they happen to have.

DO-let the coach drift over onto the rumble strip for just a few seconds. NOTICE – the CD does not hide the vibration of the rumble strip. There is no question that you are out of your lane and should do something about it right now. Just don't yank it back into the lane. The dog is still on the couch. remember?

Let's finish up this drive. As you get into your parking place but before you release the steering wheel, the wheel might be very near center because the wheels were straight when you stopped rolling. When you release the wheel and turn off the engine, it stays in that position. When you start the engine the next time, the wheel will still stay in that position. If, however, the wheels happen to be away from center when you release the steering wheel, the CD will bring it back to center and hold it there against the tire windup. When you turn off the engine, both the hydraulic power to the steering gear and the

electric power to the CD will stop, allowing the tire windup to relax by moving the entire steering system, including the steering wheel. What you will see is a small kick in the steering wheel when you stop the engine. This is completely normal and will not damage anything as long as you don't put your arm through the wheel when you stop the engine. The next time you start the engine, the wheel will move back to straight ahead, renewing the tire windup.

DO – as you continue to drive your coach around in the next several weeks, occasionally play with the efforts knob. NOTICE – you may discover that the first place you found that you liked remains the place you like. On the other hand, you may discover that your “happy setting” changes over time. Many people start out liking it rather heavy but want it a little lighter after an hour, yet lighter after the first day, lighter again after the first week, and lighter still after 6 months. You won't really know what you really like until you experiment for yourself.

DO – drive your coach in crosswinds. NOTICE – you don't have to hold torque into the wind and you don't have to do anything to make that happen because the CD handles the average or continuous part of the crosswind automatically. It doesn't compensate for the gusts so you still have to steer. DO – try turning the efforts knob up and down to find a new “happy setting” for gusts. Some people feel that lighter settings make it easier to steer and easier to hold the lane position. Others feel that a heavier setting gives them a better feeling of control. And some people feel that the one place they like is the best setting for everything and they want to leave it alone for years. The really slick part is that every one of them is exactly correct. You won't know what you prefer until you try it.

DO – drive your coach for 6 to 8 hours in one day. NOTICE – At the end of the day, your arms, neck and back muscles don't hurt like they did in the old coach without CD. The CD is doing what it's supposed to do: it's reducing the work the driver has to do during long drives.

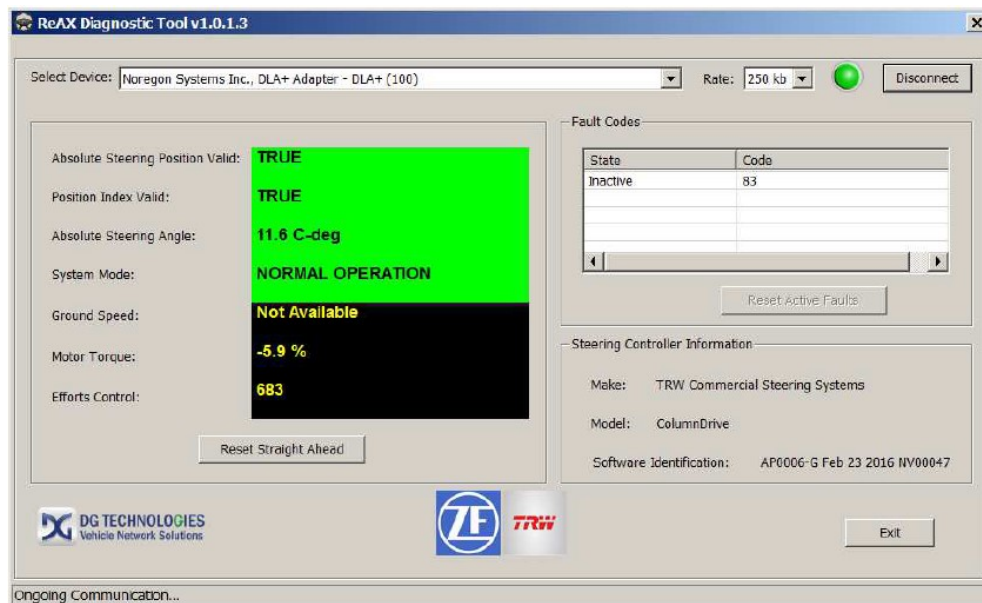
The Extended Version

This section is formatted as a series of questions and answers, taken from threads on IRV2 and conversations with real owners over the last 13 years. I can't sort these in order of importance because every question was the most important to the person who asked it. If you are reading this section at all, you probably have some question already in mind so quickly scan through just the questions to see if yours has been included. After you have satisfied your immediate concerns, then at your convenience, read through all the questions and their answers to get the fullest appreciation for this device and how it helps you as a driver.

1. What routine maintenance is needed? None. There are no serviceable parts inside the CD.
2. The CD obviously contains a computer. What happens if it locks up or messes up somehow? The CD stops working and independent hardware disconnects the motor from the battery so it can't do anything dumb. The coach will then drive just like any other coach that does not have a CD. The CD's response to any internal problem is to stop working under the theory that it's better to do nothing than to do something wrong. In fact, most of the software in the CD is devoted to self-checks of both hardware and software to make sure it doesn't do anything wrong.
3. What do I do if the CD stops functioning while I'm travelling? Am I stranded? Am I at the non-existent mercy of the first guy with a wrench that I find? The coach is safe to drive with the CD not functioning but it will drive just like a coach without CD. You can complete your trip and get to a place where you trust the service, with no harm done to the coach.
4. If the CD has a problem, is there a fault light on the dashboard to indicate this? The CD follows the SAE J1939 standard for diagnostics so a fault message is generated at the discovery of a fault and at 1 second intervals thereafter. Thus far, no OEM has chosen to make use of that message.
5. What happens if the steering requires more power than is available from the steering gear? In a conventional hydraulic steering system, the SG torque and HW torque both go up dramatically so it gets very hard to steer. If this happens with a CD, regardless of the cause, the CD tries to maintain the correct SW torque. As the driver turns the wheel and the steering gear needs more torque, the CD applies more torque to the gear, assisting the driver, up to the maximum torque of the CD. The CD is powerful enough to fully actuate the hydraulic valve of the steering gear but is not powerful enough to completely replace the hydraulic system.
6. What can cause the steering to need excessive power?
 - Steering too fast, outrunning the hydraulic pump.
 - Grossly overloading the front axle.
 - A severe difference in the braking capabilities of the two front brakes, generally caused by lack of service on the S-cams or a missing tire.
 - A failed power steering pump or hose.
 - A failed seal in the steering gear.

- The carcass of a failed tire getting caught on something in the wheel well.
7. Will the CD shut off if it determines that the steering gear requires excessive power? Absolutely not. Instead, it will do its best to assist the driver and provide that power.
 8. Can the CD rip the steering wheel out of the driver's hands? No. It can only build about 7 pounds of force at the steering wheel rim. This is more than enough to generate full power from the hydraulic system. Even then, many things would have to be massively wrong identically and at exactly the same time to generate that much torque into the steering wheel.
 9. Can the CD ever steer toward the EOT? No. It always wants to steer gently toward straight ahead.
 10. What does the diagnostic program do?

This is a screen shot of the only page in the program. Everything can be seen or controlled here.



It allows a service technician to answer the following questions:

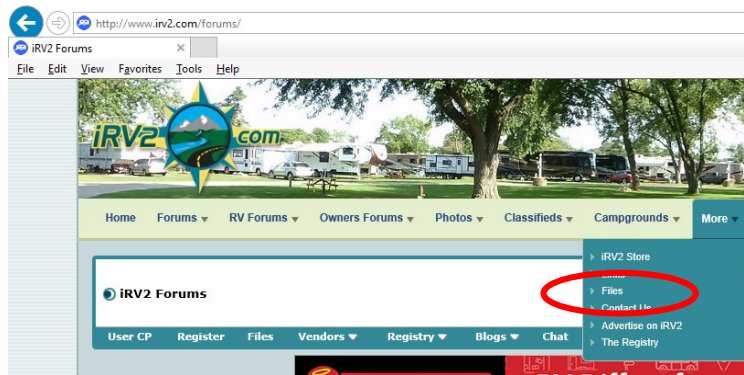
- Is it wired correctly? The CD will obviously not work at all if the battery or ignition switch wiring is incorrect. The efforts knob and the speed proportional efforts will not work if the vehicle data bus is not wired correctly even though the base CD will continue to function.
- Is it operating correctly? The program shows whether or not the CD knows its center position and if there are any fault codes that will prevent proper operation. It can also reset any fault codes in case they were only intermittent. By looking at the motor torque being created right then, it can also separate hydraulic issues from CD issues.
- Is it installed correctly? The only new installation requirement for the CD over a non-CD column is that it must be installed with its center position close to that of the roadwheels. The diagnostic program allows that to be measured.
- Is it calibrated correctly? The CD must have its center position aligned with that of the roadwheels. Close isn't good enough. The diagnostic program allows that alignment to be read and reset if necessary.

- Are the right messages being sent from the vehicle? The efforts knob and the speed-proportional efforts depend on the vehicle correctly broadcasting the efforts message and vehicle speed message on the data bus. For example, the ground speed message is missing in the screen shot above. Even without those messages, the CD will continue to operate because missing messages are not failures internal to the CD. In several cases, we have found the efforts knob actually not plugged into the dashboard, disabling that feature.
- Is it the correct part? The part numbers of the installed software (the example screen shows AP0006-G and NV00047) and their release date (the example screen shows Feb 23, 2016) are displayed.

If you are interested in it, you might wish to download the instructions for the program to get a little different view of the CD. They are supposed to be written in clear English, not techno-speak. They are actually supposed to be understandable!

11. What do the fault code numbers mean? Short answer: I won't tell you. Long answer: There are over 200 fault codes in a CD, all of which mean that the CD must be replaced. It contains no serviceable parts. Even I can't service anything inside. Do you or the technician really need to know precisely which relay, capacitor, or memory location is faulty in order to replace the unit? On the other hand, ZF/TRW's competitors would love to have a list of all the things that are tested to make sure they haven't missed anything. Why should I publish that list and make it easy for them?
12. I have seen where some diagnostics are available on the glass screen on the dashboard. Are CD diagnostics available there? The CD follows the SAE J1939 standards for diagnostic reporting so they could be available if Newmar and the chassis builders so choose. As far as I know, no OEM has done that.
13. What does the diagnostic program cost? Both the program and its accompanying instructions are free but a hardware adapter is required between the computer's USB port and the coach's J1939 diagnostic port. Any shop that can read Allison transmissions or Cummins engines already has this hardware.
14. Where can I get the diagnostic program? If you review old posts about the CD, you will see that a website operated by TRW was mentioned but it no longer has the program. The folks here at IRV2 have allowed me to put the program and instructions in the files section of IRV2.
 - Program location: <http://www.irv2.com/forums/downloads.php?do=file&id=217>
 - Instructions location: <http://www.irv2.com/forums/downloads.php?do=file&id=216>

If you don't want to follow the links, hover your mouse over the 'More' tab in the top row of tabs on IRV2.com, then click 'Files'.



A list of the various categories of files is shown so click on 'Chassis'.

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A list of the stored files will be shown in order by filing date. The program and instructions were filed on 5-19-2017 and 5-20- 2017.

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✓	Freightliner RV Chassis Maintenance manual : Freightliner RV Chassis Maintenance manual 2017 Thread Discussion [more] (1.43 MB)	09-22-2017	62
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✓	TRW ColumnDrive diagnostic software instructions : The instructions for the ColumnDrive diagnostic software Thread Discussion ... [more] (369.2 KB)	05-19-2017	40
✓	Diesel Throttle recalibrate -Troubleshooting - Electronic Throttle position sensor calibrate and	05-15-2017	3

There is also a useful set of manual diagnostic instructions that were filed on 5/22/2015 at: <http://www.irv2.com/forums/downloads.php?do=file&id=150>.

✓	TRW ColumnDrive Diagnostics : Thread Discussion (840.0 KB)	05-22-2015	176
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15. I'm having a steering system issue and the dealer wants to replace the CD, in case it is causing the problem but I think he just wants to change it because he doesn't understand it. Now what should I do? They would never remove the engine or the transmission without checking the fault codes first, so insist that they check and document the fault codes in the CD BEFORE removing it. Fault codes cannot be checked away from the coach without a specialized test rig.

We got quite a few CDs back in warranty that had no problems, just because somebody threw parts at a problem while not understanding it.

16. I tried checking the CD fault codes with my Cummins diagnostic software but it didn't work right. Why not? I have no idea how any other vendor-specific diagnostic software works or what it might do to the CD and I would not expect engine-specific software to even come close to working with a CD. Some general software from Noregon and DG Technologies works correctly to read fault codes but will not have the other features of our free program that I strongly recommend.
17. How does the CD compare with the other steering assist devices now available? After a lawyer from the maker of an aftermarket device complained to our general manager who clouded up and rained all over me, I will not discuss other people's products. This goes for both aftermarket and the more recent OEM products.
18. Can I put an aftermarket steering assist device on my coach with CD? Of course I cannot prevent you from doing this but it is strongly not recommended. Both the CD and the aftermarket devices try to hold the wheels where they think the wheels should be. That's why these devices exist. The problem comes when those places are not the same. Remember from our drive that the CD dynamically adjusts itself to hold the roadwheels at straight ahead so the coach tracks straight and that the straight ahead position moves around quite a bit. The two systems will fight with each other about where the wheels should be and that will generate heat and wear in the steering system. If you do this, you will be the experimental test driver, so you have to decide about doing it. My question is "Why would you even want to spend the money for an aftermarket device when you have CD?"
19. How much does a CD really cost Newmar? I have no idea. I was an engineer so I was kept FAR away from cost information, even our own. I just didn't need to know that.
20. What new features are being worked on? You know I'm not going to talk about that on a public forum!
21. What specific tests were performed on this system to qualify it, and what were the results? You know I'm not going to talk about that on a public forum either! Let's just say that I let MY family ride behind a CD.
22. How, specifically, does the CD determine the level of motor torque to develop? For enough millions of dollars, I'm sure ZF will sell you that proprietary information but they're sure not going to give it away.
23. You keep saying retrofits are difficult because the CD is larger than a conventional column. Why didn't you just make it the same size? (Yes, somebody actually asked that!) In addition to all the regular column parts, a computer, a motor, a gear reducer, and a housing to put it all in had to go on the column someplace. The only space available was between the dash and the floor.

24. How can I turn the CD off completely? Pull the ignition fuse, pull the battery fuse, or pull one of the connectors off of the CD housing. You could also wire a switch in series with the ignition line to the CD but I would not recommend it. Why introduce another thing to fail? More importantly, why would you want to turn the CD off at all? You can't turn off your computer-controlled ABS or your computer controlled engine management.
25. In spite of your attempting to discourage me, I did put a switch in the ignition line to the CD. It works when standing still but not while driving. Why not? Even though the CD thinks you turned off the engine, it is still seeing the ground speed. Because you can't be going 60 mph with the engine off, the CD thinks the ignition wire must be broken so the CD keeps working until the coach stops. This is a safety provision from the original electric power steering and we saw no need to eliminate it.
26. Can I put a switch in the data bus too? Sure, if you're a CANbus wiring expert and know how to prevent unintended consequences.
27. How can I disable or change certain features that I don't like? Short answer: You can't. Long answer: If you and enough of your friends can convince Newmar, who can then convince the chassis makers, who can then convince ZF, a change in the software could be made and either field-upgraded in existing coaches or rolled into production on new coaches. In the first ten years of production, exactly zero existing production coaches have had their software upgraded so don't count on that one too strongly. Getting something changed is probably going to cost you and your friends a bunch of new coaches. Letting Newmar know what changes you would like to see in the CD, or any other part of the coach for that matter, is always a good idea. A suggestion could spark a fire in an engineer who could make it happen.
28. Is there anything else I can do with the efforts knob? Yes. While some people set it once and leave it alone for years, others tune it to suit the situation of the moment. For example, I like to set it rather heavy first thing in the morning, then turn it lighter as the day goes on, ending up at nearly full light by the end of the day. I like to set it lighter when there is no traffic but set it heavier in heavy traffic where there is a lot of competition for my attention - downtown in Chicago at the start of rush hour in the rain, for example. I know an idiot is close by but I don't know which car he's in. A very light steering setting just won't feel good then. Another rumor I've heard is that some folks turn the efforts to full heavy and lean forward on the wheel, driving with their elbows while they stretch out their back muscles that are tired from sitting so long. After a few minutes of this, they turn the efforts back down, sit back, and relax while they continue their drive. Of course, I NEVER do this and neither do you. We always stop, walk around the coach, look at the tires and feel if they're hot, and generally stretch out for a little bit before continuing. Sure we do.
29. What is the "normal" setting for the efforts knob? If by "normal" you mean 'What do most people prefer?', it doesn't matter any more than 'What is the normal driver's seat position?' or 'What is the normal windshield wiper speed?' The correct setting is the one you prefer at the

moment. If by “normal” you mean ‘What setting most approximates a conventional steering gear?’, it depends on the brand and model of the steering gear and the speed you are driving at the time. At 60 mph, a setting of 3 gives you about the same SW torque as the steering gear on Newmar coaches, but the friction is still eliminated so it is a completely different feel in the wheel. At 5 mph, the CD is much lighter than conventional steering, regardless of the efforts knob setting.

30. Will the efforts knob go to ‘11’? What the label actually says is irrelevant because they are all programmed the same. Smaller numbers are lighter efforts and larger numbers are heavier efforts. I suspect the questioner was just making a semi-humorous reference to the movie Spinal Tap, but I have included it for completeness in case he was serious.

31. What is involved in retrofitting a CD to my coach that doesn’t have one now? A column equipped with a CD is larger so it is not electrically or mechanically compatible with a non-CD column, especially one made by another company. To retrofit a CD to a coach without one, the following things must be designed, manufactured, and installed:

- The battery and ignition wiring to the CD.
- The wiring to the J1939 data bus, using the proper technique to avoid screwing up the entire data bus.
- The turn signals.
- The efforts knob.
- A properly programmed and wired controller to connect the efforts knob into the J1939 data bus.
- The shroud around the column. A stock one probably won’t fit your dashboard.
- The structural mount from the column to the chassis. The existing one was welded in before the dash and wiring were installed. Just using an adapter plate will probably put the new column too close to the driver’s seat. Be careful how you weld this up, as the lives of you, your family, and any nearby strangers depend on it.
- The intermediate shaft from the column through the floor to the miter box or steering gear. Be careful how you weld this up, too.
- A new seal between the floor and the intermediate shaft.
- Possibly a new dashboard that clears the new larger column.

You also have to figure out which of several different CD part numbers you need to purchase as a service part. Different part numbers have different tunings for different coach versions. Which one do you need and how do you know?

32. Can I get somebody to do this retrofit for me? I suspect the folks who I worked for would do one for 10 million dollars but I also know they have refused 50 thousand dollars. That makes it a negotiation over price. Newmar, Spartan / FCCC, and ZF have no interest in upgrading an old coach, because they would rather sell you a new coach. If you think about it, the Ford factory won’t retrofit a 2017 transmission into a 2008 pickup truck either. If I wanted to do the job, I would demand at least 75 thousand dollars, but I don’t want to do it so the cost would be a lot

higher. I have not looked for a shop that does customizing to see if they would be interested. I expect they would be expensive too. In reviewing my past posts for this article, I see that I frequently offered this advice: "If you think there's money to be made in this, form a company and get rich." Thus far, nobody has taken me up on it.

33. Is there any way I can screw up the CD and how do I fix it? When you disconnect the chassis battery, as everybody does occasionally, the CD will lose its center position and must find it again when the battery is reconnected. Normally, the CD will pull the wheels back close to straight ahead when you park the coach. When the battery is reconnected, the CD starts looking for center and typically finds it easily. Normal wiggling of the steering wheel will allow it to find center. If you park the coach and hold the steering wheel about 180 degrees away from center when you stop the engine and disconnect the battery, the CD will not be able to find center at all and will not start working. The cure is to turn the wheels to center, stop the engine for a minute or so, then restart the engine. The CD will find its center when you move the wheel a few times. Just the movement to get the coach away from the parking area will frequently be enough. Everything will operate normally then.

If you hold the steering wheel about 2 full revolutions away from center when you stop the engine and disconnect the battery, the CD is very likely to find a false center point at two revolutions away from the real center. This will make the coach pull rather badly in that direction. The cure is to turn the steering wheel to one EOT then to the other EOT. Near one EOT or the other, the CD should stop working. When this happens, steer back to the real center, stop the engine for a minute or so, then restart the engine. Once again, a few movements of the steering wheel will let the CD find its center point and everything will operate normally. This whole problem is avoided by just allowing the wheels to be near center when the battery is disconnected.

Another way to screw up a CD is to hose down the CD with soap and water. We caught a transit bus property doing that after they destroyed several CDs by getting soapy water in them. Motorhome coaches have better shrouds but leave the garden hose outside, please.

34. Is this wake-up procedure documented anyplace? Yes it is. An installation and diagnostics document was provided to both Spartan and FCCC, but I have no control how or even if they pass it along to Newmar, the owners, and all the dealers in the country. The best I can do is file it here on IRV2 and tell you about it. Look at:
<http://www.irv2.com/forums/downloads.php?do=file&id=150>.
35. Do I need to do anything special when I park my coach for the winter? No. If you drive the last few feet with the wheels at straight ahead, it will be easier for the CD to find the correct center when the batteries are reconnected, though.
36. On my old coach, it was very tiring when driving on rough or deteriorating roads and those constant jolts in the steering wheel made my hands hurt. How does the CD react to rough or deteriorating roads? Not only is the computer fast enough to monitor and compensate for much

of that road noise, the motor itself is geared such that its inertia is magnified 16 times, mechanically preventing those frequent small shocks from getting to the steering wheel.

37. I don't want something between me and the steering gear that will slow me down in an obstacle avoidance situation. How fast does the CD work? The hydraulic part of the steering system is designed to operate as fast as 500 steering wheel degrees per second but the CD is designed and proven to operate at over 1,000 steering wheel degrees per second. It will never prevent you from steering quickly.
38. If I let go of the steering wheel when completing a corner, the CD brings it back to straight ahead too quickly. How can I slow it down? The CD is tuned on purpose to come back just a little faster than most people prefer. This lets you control the return speed by putting a little drag on the returning wheel with your fingers, just like you do in your car. Alternatively, you can hold the palm of one hand on the wheel and follow it back. In either case, the idea is for you maintain complete control of the coach's direction, not relinquish it to the CD.
39. How many versions of CD software are out on the streets? There are only two versions of production application code. The first did not have the efforts knob and the second one does. Due to an unavoidable computer change in the CD at the same time, the newer code will not work in the older hardware. The older code has been operating since 2007 and newer code has been operating since 2008 without finding a single issue in either version that required a field action. This has been an extremely stable product. There are many different tuning sets that customize the CD for specific vehicle application with more being added all the time. Every new tuning set results in a new final column part number so it looks like there have been a lot of changes.
40. How can I add an efforts knob to my 2008 Essex? Due to a change in the computer of the CD, the complete CD column has to be changed. The production efforts knob is a potentiometer that shares a controller with the dashboard. This controller is not compatible with older dashboards so you will have to find another controller then figure out how to wire and program it to generate the correct message on the SAE J1939 data bus.
41. Does the CD require anything special when doing vehicle alignment? The only new thing is that the CD has a center position just like the steering wheel, clockspring, steering gear, linkage, and both roadwheels do. **They *all* have to be on center at the same time.** The diagnostic program allows the CD position to be measured but it is not really necessary. The manual diagnostic procedure at: <http://www.irv2.com/forums/downloads.php?do=file&id=150> describes how to find center and reassemble the system correctly.

If the steering wheel is crooked after alignment, it is because some part discussed in the previous paragraph is no longer on center and that is the one that needs to be fixed. To repair this, DO NOT just pull the steering wheel off and reposition it because that will not cure the original error. The shop must find out where the error is and fix it there.

42. Will the CD steer the coach by itself like some ads I've seen on TV? No. The position of the steering wheel and therefore the roadwheels is completely determined by the driver. You remain in complete control of your coach at all times.
43. Why does the steering pull when I come out of a very long sweeping turn? Short answer: It is the result of an engineering compromise. Long answer: First assume as an engineering goal that if a coach is driving straight, the SW torque felt by the driver ought to be zero. The CD has no knowledge of the actual vehicle path so it makes the assumption that most vehicles on most roads spend most of their time driving an average of straight ahead. Therefore, the average steering wheel position over the recent past must be straight ahead so the CD supplies whatever SG torque is needed so the driver doesn't have to do it. This works well on most roads most of the time but it doesn't work as well in long sweeping turns. The CD cannot tell the difference between a driver holding the steering wheel at 10 degrees to the right of center to counteract a crosswind and the same driver holding the wheel at the same 10 degrees to the right of center to negotiate a very long sweeping turn. To solve this problem, the CD must know about the real vehicle path so it can determine when to correct and when not to. This knowledge must come from inertial sensors just now becoming available on automobiles but are not yet on motorhomes. Once these sensors are on the coach, this issue can be resolved with a new version of code that takes advantage of the new information.
44. If the CD cancels a pull from road crown and crosswind, how will a driver be able to tell if he has a low tire? Short answer: It's not a problem. Very long answer: For this to be a meaningful question, the assumption had to be made during program development that a driver could feel a low tire and respond correctly if the CD just wouldn't hide it from him. To find out how bad the problem might be, I tested lowering the pressure in one steer tire with full pressure in the other in our Kountry Star test coach. Not believing my own result, I repeated the test on a straight truck and a semi tractor. The result was the same in all 3 vehicles. There was no measureable or detectable pull in any vehicle, with tire pressures in one wheel as low as 30 psi, with either tire being the low one, with or without a CD, at any speed. Later testing on a fully loaded inter-city bus, without a CD but with 18,000 pounds on the front axle, showed the same result. In that series of nearly 20 tests, the left front tire pressure was slowly lowered in 5 psi increments until the tire failed, the tire failure being the desired result in each test. Even with the left front tire pressure at 35 psi, causing a complete tire failure in fewer than 20 miles, there was no measureable or detectable pull. The test driver, who strongly believed that low tires should pull, insisted something must be masking it in all the tests done so far. An opportunity arose to perform this same low tire test on his personal antique Silver Eagle bus with manual steering. This test was even done on the local roads near his home. (The so far undiscovered pull couldn't hide behind the power steering this time!) Same result. With 35 psi in the left tire and 110 psi in the right tire, the driver, who was very familiar with both the coach and the roads, could not detect any pull. The conclusion must be drawn that the driver cannot count on feeling a pull from a low tire in time to prevent a tire failure. The assumption behind the initial question was false, making the question meaningless. This is why tire pressure monitors were created.

45. What were the results of that inter-city bus test? That information belongs to the people who funded the test.
46. Does the CD help with blowouts? The CD is not advertised or sold as a mitigation aid for blowouts, so that specific situation will not be discussed for liability reasons.
47. Why isn't the CD available on Newmar's gas coaches, other brands of coaches, semi's, or transit buses? It is available as an option on Gillig transit buses because one customer demanded it. They drove a prototype for several weeks and liked it so well that they threatened to take their checkbook elsewhere if they didn't get the CD. That initial customer's entire fleet is now operating with CD systems, including the initial prototype with more than half a million miles. There are now more CDs on transit buses than on motorhomes. As to why it isn't more popular in other places, I have no idea. If I did, I'd be in Sales.
48. I don't understand a lot of what you said here. Now what do I do? Do the driving tour at the beginning of this article a time or two and most of it should be understandable because you just felt it demonstrated. If some of the questions and answers don't make sense to you, it's okay because you don't need detailed information to enjoy the benefits of the system. Many of those questions came from the insatiably curious. If, on the other hand, you think I've written in Engineer instead of English, contact me so I can clear up the muddy parts in this article. It is my real desire that everybody feels comfortable with this system at whatever level of understanding they want. (Not counting those who demand all the proprietary details, of course.)
49. Can I drive with a CD in the snow? Yes. It does not interfere with handling in the snow but be loudly warned: It does NOT improve traction either! You can get stuck as easily with a CD as you can without one. One of my biggest disappointments was that I never got to put a CD on a snowplow. It would really help those drivers handle the stress and the long hours by reducing the efforts and the pull caused by the plow.
50. After a 10 minute test drive, I decided I don't like the CD because it doesn't feel normal. What do you think about that? First, it is your opinion and you're entitled to it. But let me ask you a question. How long did it take for you to decide if your spouse was the correct person for you to marry? Ten minutes or longer than that? A single short exposure to people, situations, or things that are different is frequently not enough to make a valid decision. I completely agree that a coach with the CD feels very different than one with conventional power steering. I would be strongly disappointed if it didn't. But what's so great about conventional power steering other than we're used to it?
51. What should I do about people who have never driven or even studied a CD, yet loudly proclaim that it's useless....a gimmick in search of a problem? How much should you listen to somebody about any topic if they have no experience with it compared to somebody who has experience? My vote goes to someone who knows what he's talking about.

52. Will the CD make my turn radius tighter? Short answer – no. Longer answer - Turn radius is determined by the angles of the front wheels and the CD will not change that. However, if you are driving straight when you start turning the wheels, the lighter efforts of the CD will allow you to get to the EOT quicker and start using all the available wheel travel sooner. The net result could be a tighter turn radius. Thousands of transit bus drivers take advantage of this every day. Because this technique is entirely up to the driver's turning style, it's not measureable or repeatable, so it's not claimed as a feature.

53. Why is the steering wheel crooked in a crosswind? I thought the CD took care of that. Short answer – The CD takes care of the SW torque, not the position. Long answer - Wind blowing on the side of a coach will generate a side force that tries to move the coach in its lane. The only way the coach can resist that force is through the tires and the only way the tires can generate a side force is to run at a slight angle to the direction of travel. This is called the slip angle.

To generate that slip angle, the driver must turn the steering wheel into the wind to the angle necessary to counteract the wind at that moment. The CD cannot cause that position change but it can make the wheel easier to turn if that is what the driver wants. Personally, that's how I adjust it. On the other hand, if the driver wants the steering to be heavier so he feels that has more control authority and is therefore more comfortable, he can adjust it to his liking. Generally, those who like it heavier just let the coach move a few inches in the gusts rather than chase every little movement, but that is also a driver choice.

For a steering system to completely eliminate the effect of short-term gusts, it would have to know exactly where the road is and maintain lane placement. This is the essence of autonomous guidance. There are several prototype systems being worked on but are not ready for production yet for financial, technical, and legislative reasons.

54. How much parasitic power does the CD use when the key is off but the battery is still connected? Less than 1 milliamp.

55. You said the clockspring has only limited travel. Why not make it with a lot more travel, eliminating the possibility of damage? A clockspring cannot be made with a continuous wiring connection that has unlimited travel. If a careless mechanic could ignore a clockspring with 4 turns of travel, he could also ignore one with 6, 8, or even more turns of travel. Also, the manufacturer of the clockspring wanted an unreasonably large tooling and development cost to create a new clockspring that would have a very limited production volume. It was decided that 4 turns in the clockspring was adequate because there are less than 3 turns available in the steering gear and even less in the axle.

56. Can the kick in the steering wheel be eliminated? Remember that the kick is caused by the sudden release of both electrical and hydraulic power that is holding against the tire windup. Eliminating the kick means eliminating the tire windup which means eliminating returning to center when the coach is not rolling. Every time I have asked coach owners to choose, the

choice has always been to keep the recentering at the cost of occasional wheel kick, so it has been left that way.