



So you're new to astronomy and like me, you have discovered that the limitation of visual astronomy just isn't quite fulfilling and you would like to make pretty dive into the mysterious world of Astrophotography. Well hold on tight because you're in for a ride.

One of the big choices Astrophotographers have to make is the selection of a mount. This is no simple task as the choices are many and the information about the mounts, the technology used in the mounts and the associated costs for mounts vary widely.

After much research I decided to take the plunge and go for the newest technology in mounts, the direct drive system. Why you ask? Well, after much research I concluded that this was the future of mount technology and in 10 to 15 years gears would be a thing of the past, at least for mid to high end mounts. Of course, I am new to Astrophotography, well, actually astronomy in general, so what do I know?

I bit the bullet and shelled out the 9K for the ASA DDM60 Pro Direct Drive System. I am going to keep this part of the story short, but I had a problem with the mounts electronics and it had to go back. In the process, I was offered a great deal on upgrading it to the DDM85X-SL and I took it, so this review will focus on the DDM85 model.

I would like to say that since the return of my DDM60 Pro mount, ASA has redesigned the DDM60 to use the same "fixed" encoder resolution system as they DDM85. This is important to anyone considering buying either mount as the fixed encoder system is far superior. I only mention this because had they not changed it, I would likely only recommend the DDM85, but know with both systems using fixed encoders, I think either system is a bargain at their current prices.

So, why6 the DDM85 you ask. Well the answer is quite simple. Direct drive mounts with fixed high end optical encoders like the Renishaw encoders in the DDM85 eliminate a plethora of issues that have plagued modern amateur astronomers for years. I am referring to the elimination of auto-guiding, period error, backlash and other issues only inherent in a gear drive system. In addition to eliminating these issues, the direct drive system offers the capability to correct other reproducible errors such as polar misalignment, collimation error, mount angle error and tube flexure measured independently on the east and west side.

Does it work? You bet it does and it works well. Is it complicated? The answer to this question is maybe! For me, yes the mount was overwhelming at first and quite complicated, but I attribute much of that to my general lack of understanding of Astronomy, Astrophotography and mount technology. Keep in mind, this was my second mount, having only previously had a fork mounted Celestron CPC-1100 which I would say that while pretty cool for visual work is a pretty poor choice for Astrophotography.

So, how does it work? Let me explain.

The mount itself is pretty simple to setup. Although heavy it breaks down into several manageable pieces. Until I move I am using mine as a portable setup. I use it in my driveway at home and I travel with it, hauling it in my trailer and occasionally taking it on flights. Yes, it can be taken with you but it isn't cheap! I purchased the flight cases with mine and I store it in the flight cases when not in use. I highly recommend them.

I setup my Losmandy tripod and level it. I purchased a custom plate from ASA for the Losmandy tripod. It is well machined and matches the tripod and the base of the mount as if they were all made from the same company. I then set the RA axis on the custom plate. There is a pin in the back of the RA Axis that matches only one hole in the plate, then it "drops" right into place. There are three machined retaining screws to hold the RA Axis in perfect position, but I don't tighten them complete yet because I haven't

made my polar alignment. The next step is to get a rough adjustment of my polar angle. There are 10 degree markings on both side of the mount for convenience.

At this point is important to ensure the angle is setup correctly because the main adjustment for the polar height is mechanically limited to a range. There are set screws tucked inside the polar height cradle that allow incremental changes to the polar height, then fine adjustment is made by the big knob in front of the RA axis. Basically, one should center the fine adjustment knob in its range, then loosen the cradle retaining screws (hold the mount to prevent it from falling) and make a rough adjustment. Once the rough adjustment has been made, the fine adjustment can later be made using the built in laser. While not required to use the mount, I highly recommend ordering the mount with the built in laser. It makes short work of your polar alignment.

Now that you have a rough polar height adjustment for you latitude, you can mount the DEC axis to the RA Axis. ASA has done a brilliant job of connecting these two pieces. There are three pins in the DEC axis that fall precisely into the RA axis which makes mating the brass pin connectors for your electronics a snap. There are three retaining knobs/screws that bolt the DEC axis to the RA axis. You should tighten these completely.

To keep the mount from flopping around there are two clutch screws, one at the top of the DEC plate and one on the side of the RA axis. You should tighten these just a bit to prevent the mount from falling to one side or another under its own weight. Whenever power is not applied to the mount, I am in the habit of tightening these clutches to keep the mount firmly in place.

I ordered my DDM85 with all the cabling through the mount. I can power my camera, filter wheel, rotator, focuser and other accessories from the mounts built in wiring. In addition, I have a built in USB hub and an OK3 controller for use with the OK3 focuser on my ASA N10 Astrograph. Believe me when I say it is amazing to have all your cables passing through the mount. I have no cables dangling from my equipment allowing the mount to move in its full range with nothing getting tangled or catching on the pier or other wires.

Now that I have the RA and DEC axis connected, I screw in the monster counter weight shaft and weights. It's time to connect the power and control to the mount. ASA provided premade power cables and USB cables for the mount. This brings me to one of my few complaints. The USB cables for the COM control and built in USB hub are male to male flat style plugs. I think ASA should change the plug on the mount to a female square style plug. While extremely infrequent, I have managed to pull the male plug loose enough to lose connection. Now I strap all the cables with Velcro so there is no chance of doing that again, but I would prefer to see female style plus for the USB ports on the back of the mount. The power cables are multi-pin din and screw on and stay nicely in place.

At this point it is best to do your initial rough polar alignment with the laser. For this, you'll need a clear view of Polaris. The process is quite simple. Once Polaris is visible, turn on the laser in Autoslew (it's off by default) then press the lit red button on the back of the mount. The built in 5mw laser will turn on and you can make a pretty good polar alignment. ASA recommends aligning the mount to point the laser directly on Polaris and making the final adjustments later after creating an initial pointing file. While this

method gets you really close, I prefer to align the laser according to the Kochab clock method. Basically, I determine which direction Kochab is and I hold my pinky finger at arm's length with Polaris on one side and Kochab on the other and align the laser so that it is just on the Kochab side of my pinky. This method almost always gets my polar alignment to within 10-15 arc minutes and often less. ASA's method is probably just as good though because the process of finalizing the polar alignment is simple and precise.

Not that the mount is roughly polar aligned it's time to mount your telescope and gear. As stated, I highly recommend that you order the mount with all of the cabling passing through the mount. You can even order an extra 12v 5amp galvanic power connection for accessories. On the front of my DEC axis I have a DIN plug for the OK3 focuser power and controller and three USB ports. On the back, I have three DIN plugs, one to power the fans, one for custom data connection and one for powering my equipment.

Once all your gear is mounted it's time to adjust the servo motors. I am not going to go into a lot of detail here because I can't say that I completely understand it all, but ASA has provided documentation with explicit instructions on tuning your mount. This is probably one of the most time consuming processes in the entire setup, but fortunately it only needs to be done once for each configuration of equipment you place upon the mount. Fortunately, ASA provided a method to save profiles which you can name appropriately for your different gear. I have one for each of my telescopes, ASA N10 and AT12RC, plus additional profiles for those scopes with my Lunt solar scope mounted on top of them. It is important to properly tune these motors for optimum performance. An improperly tuned servo motor can prevent you from taking unguided exposures. The basically process is like this. You select the axis you want to tune, the slew speed (sidereal, medium, fast) and then click go. The mount will move the telescope back and forth on the selected axis and you tune the P I D parameters. The overall goal is to get a smooth motion of the mount with no hum, whistling or other noise. ASA provides a graph that shows the oscillation of the mount and the idea is to smooth this line to within a few arc seconds on either side of zero. Unless you understand servo motor tuning quite well, this is the one area that I recommend fully reading the manual BEFORE you start, then practicing while referring to the manual. ASA, and myself, recommend you do this indoors in your home before you take the mount out at night. It sounds like a daunting task, and for me it was at first, but once you do it and get it right, additional telescope configurations are easy and you can use previous settings as a starting point. I believe AS A has also made a YouTube video about this procedure.

Now it's time balance it all. ASA has provided a remarkable tool to fine tune your balance. Once you have completed a rough balance manually, you can launch the servo motor dialog and then choose the balance option. ASA's software can help you fine tune the balance of both axis with this tool. Basically, you select the axis you want to balance and the mount then begins a back and forth motion on the selected axis, applying varying amounts of current to the motors and visually shows you via a bar graph how much current is needed to "push" the mount. Two bars are shown in yellow simultaneously with a red mark left at the peak. You simply adjust your counter weights until both yellow bars, and particularly their red peak marks, are identical. Voila, your balance is perfect! While this is not completely necessary for taking 5 minute unguided subs, the longer your exposure time the more important this perfect balance becomes. I recommend doing it right from the start. It takes less than 5 minutes for both axis.

Now that my system is tuned and perfectly balanced it's time to make a pointing file and precisely polar align the system. This is a multi-step process. Once pointing file is used to precisely polar align the mount and another is used to measure the pointing accuracy and correct for errors. While this process can be done manually (I started out doing it this way) I recommend taking the time to learn how to use Sequence 8 and plate solving (requires Pinpoint and GSC). I will describe the software involved for my system and the process I use to do it.

I load Autoslew (mount control software) and let it go through its No Hall Autofind process which basically checks that the servos are working properly. Once complete, I load the ASCOM tool POTH and connect it to Autoslew. POTH is the ASCOM driver used to connect Autoslew with TheSkyX, my planetarium software, which I load next. It is critical that both Autoslew and TheSkyX know your coordinates. ASA has provided a method to use a GPS receiver to obtain the current coordinates, which can be shared with POTH and Sequence, but to my knowledge, not TheSkyX. So I input the coordinates into the TheSkyX manually. Next I load Sequence 8 and click the connect button which launches MaximDL. Once everything is connected, I am ready to begin.

It is recommended that a precise polar alignment be made by using stars only on one side of the mount. In Sequence 8 I setup my plate solving parameters for my telescope. Basically I tell Sequence the length of exposure I want, the filter to use, to take a dark frame first, my resolution in arc seconds and a few other parameters relating to where to take images and I am ready. I create an autogrid and Sequence asks how many points I want to image. I select 10 for the initial polar alignment and Sequence begins taking pictures. Once completed, I point to the directory where the images are and Sequence uses Pinpoint to plate solve them and create a pointing errors file. Once this is complete I open the pointing error file in Autoslew and click Calculate. It begins make calculations and shows me the errors in a grid which depicts the star and the direction of the error as a lone extending from the star. I am given a choice to discard, use the model but don't save, use it and save or use it save it and load it on next start. For the precise polar alignment, I only choose use now as I am going to make another much larger pointing model after I adjust the mount. Now that the calculation is completed, I click on Polar Adjust and the mount instructs me to slew to a star in the south near the Meridian between 10 and 40 degrees above the horizon and center the star. It is very important to ensure that you know the star you are centering is the correct star, particularly if you are using a long focal length telescope because Autoslew is now going to move that star exactly the distance of your polar misalignment but in the opposite direction. With a long focal length telescope this could easily be out of the view of the camera. I have done this at both 900mm and 2432mm focal lengths. I recommend a couple of things. First, ensure you have a good red dot finder or spotting scope on your telescope and that it is properly aligned. You can use this when adjusting the mechanical mount to bring the star roughly to the center, and then precisely align it in MaximDL with your camera. So I now click Move Star and Autoslew move the mount in the opposite direction of my polar misalignment. At this point DO NOT touch the joystick or move the mount with software controls. Now is the time that we use the fine RA and DEC controls on the mounts base to bring the star back to center. Once we center the star we can now lock down the mounts retaining screws tightly. Your mount is now polar aligned. I have repeatedly been told that getting this to

less than 5 arc minutes is sufficient, but I am a bit of a perfectionist and I have always managed to get my polar alignment to within a single arc minute or less.



Now that we are polar aligned, it's time to make a pointing model, but first I need to slew to a star, center it and synchronize with TheSkyX. It is best to choose a star that is far from the HomeFind position (counterweight shaft east and OTA at zenith is the location of internal reference marks) so that I can set a New Home Position which will measure the angle offset from the reference marks and the start to which I am synchronizing. Once this new Home Position is created, as long as the mount isn't moved, I can power it off and back on again and all I need to do move to the Park 1 position of counter weight shaft east and OTA at the zenith and then issue a HomeFind command. Once Autoslew finds its internal reference marks it saves the Home Position angular offset along with the GPS coordinates and time and it knows precisely where it is in the Sky. Brilliant, wouldn't you say?

ASA and Dr. Philip Keller have made great improvements to the process of making pointing models and correcting for pointing errors, but more importantly, the software is capable of measuring many different types of reproducible errors as mentioned above, and then makes real time corrections several times per second while tracking.

The tracking accuracy, not the pointing accuracy, is the most important reason to make a good pointing model. Initially, my pointing models were small because my QSI camera took 29 seconds to download an image, but now that I have an FLI camera that downloads full frame images in less than 2 seconds it only takes me 42 minutes to create a pointing model with 100 stars, 50 on each side of the Meridian.

To create the pointing file, we use the same procedure in Sequence. We create an Autogrid, this time selecting the option for both sides of the sky; choose 100 points which are then randomly created on both sides of the grid. It is important to note there are many options in Sequence for creating these grids. Not only can you choose the number of points to image, but we can set parameters for the altitude and azimuth as well as manually carve out areas that may be blocked by trees, mountains and other obstacles. It makes no sense to image into a tree so ASA has thoughtfully provided a simple method for creating a custom grid for creating these pointing files.

This is where it gets fun. You'll want your spouse, kids, relatives and even your neighbors to watch as Sequence, Autoslew, and MaximDL take over and your telescope whirls around all over the sky taking images for the pointing file. The whisper quiet mount moves effortlessly swinging my fully loaded Astro Tech AT12RC (49lbs) and equipment (about 65lbs loaded) from point to point.

Once completed. We plate solve the images. For 100 images it usually takes about 2-3 minutes on my Sony laptop with an Intel 3Ghz Core Duo and 4GB of RAM. Once I have completed the plate solving, I return to Autoslew, open the pointing error file and have it calculate the results. I then check my polar alignment again and if good, I select Save Now and Use on Next Start. Now each time I power on the mount and load Autoslew, this pointing model will be used, so as long as I don't move the mount or change equipment, I am good to go!

There are a number of advanced tuning capabilities that can be employed once a good pointing model is created. Because errors in collimation, tube flexure, mount angle, and polar misalignment are reproducible errors, Autoslew can correct for them in real time. In the Advanced Pointing Control dialog, all parameters are adjustable. They provide both Formel fit and Fourier tuning procedures to further refine the pointing and tracking accuracy of the mount. In the new version of Autoslew, there is even an Optimization Wizard which can automate the advanced process automatically.

At this point, compared to other amateur mounts, once would think we have really gotten advanced and that's about it, but hold on, there's more!

Now that you have tuned your servos, precisely balanced your gear, precisely polar aligned your mount, created a pointing model and optimized it you can locate your object and get ready for imaging. But before you start the imaging sequence you should know that Sequence now has the ability to predict your image run and calculate the precise error along the path with which your target will follow. What?

Yes, that's right. Once you have slewed to your target. Hold off on clicking the button to start your image run. Instead, open Sequence and setup the brand new Multi-Point Local Tracking feature. Basically, you tell Sequence the length of your images, how many you want to take and it calculates where the mount would travel based upon normal sidereal tracking speed, then takes a image at each

point in the sky where you object will travel and based upon the previous errors it calculate in the pointing model, it calculate the error and tunes the session to correct these errors when needed.

Ok, I probably haven't explained that very well, but let's just say that if you have an RA error of 4 arc minutes, the MLPT can reduce it to 2.2 arc seconds! That is a 100x improvement over just the optimized pointing model!

I have been able to achieve up to 20 minute unguided long exposures with my AT12RC at 2432mm FL with just an optimized pointing file and the old LPT (local precision tracking). Here is an image with 10 minute unguided exposures take with my ASA N10 Astrograph on the DDM85X-SL.



Now with MLPT (multi-point local precision tracking) ASA has achieved 3 twenty minute unguided exposures at f/9 4500mmFL. That's amazing. Further to that, it is being reported that unguided exposures are now able to be taken at short to medium FL's up to 45 minutes!

Needless to say, after all the hard work I have put into learning astronomy, astrophotography and specifically this wonderful DDM85 mount, I am extremely pleased. I am 100% confident that I made the right choice in selecting the direct drive technology and further to that ASA has proven not only to be a leader in direct drive technology, but they continue to improve upon the product and get those improvements to their customers quickly. In fact, when I purchased the mount, almost all of the

documentation was nonexistent or in German only and now they have invested in properly translating the documentation to English and it is very good!

I highly recommend astrophotographers give serious consideration to this mount. If you would like to see it in action, let me know and perhaps we can make some arrangements for a demonstration as I travel extensively, particularly in the western United States. I also plan to bring the DDM85X-SL to the 2012 Texas Star Party!