MARQUEE MAGNETICS SETUP 101 – A PROCEDURE   Copyright © 2004 by Bill Blue
Partial Rough Draft

Though it's possible to do a magnetics setup on an aligned projector, with the expectation of having to go back through dynamic astigmatism and focus followed by a convergence touchup, it's really best to start from scratch. The following procedure is based on starting from scratch, and for the moment is specific to the Marquee 8500 (only from the standpoint of determining the tube face center point). The 8000 and 8110 would be similar except for astigmatism adjustments (noted in text). The 8500LC's and 9500LC's require a special way of establishing true tube face center. If you have an accurate technique for this, the text will apply almost as-is.

The physical placement of the projector relative to the screen is crucial. It needs to be exactly green-tube centered to the center of the screen, and square to the screen (not the wall) as well. This section does not discuss physical projector alignment, but does depend on it.

1. **Remove the HD8 lenses** from the projector.

2. **Establish an exact center point of the tube face** of each tube. There are several ways to accomplish this and may require a little creativeness on your part. You could carefully draw a corner centered line from upper left to lower right corner, and again from upper right to lower left corner. Where they intersect would be a center point. This could be confirmed by measuring in each direction from the top, bottom, left, right edge of the phosphor, and establish points exactly equidistant from left and right, and top and bottom. The goal is to establish the exact center of the phosphor tube face. Leave a marker dot at that point.

3. **Initialize the Projector (complete)** in the Utilities 9 (service) menu. Password is 0901. After initialization the projector will turn off.

    a. Turn projector back on, Go into Utilities 9 service again, 7 stigmator adjustments. Step through each double entry setting top and bottom numbers to 50 for each color. When done with that, Save and Exit.

    b. Now go to 2 RGB Focus and check or set each entry for all colors to 50. Save and Exit.

    c. Exit Service menu, Enter Geometry and if you are really starting from scratch these should all be at 50 as well.

    d. Enter Utilities 1 (source setup) 6 (Internal Frequency) 2. Use this setting for all of the following steps. If you want to fine tune for a very high scan rate, after completing the steps at this rate, change to 5 and repeat process to see if any touch up is required. NOTE that if you have a signal applied to the inputs, if you exit a crosshatch pattern or other internal display and see your applied signal, you have just reset the frequency and will need to reset it again. Usually during this phase it's safer not to feed any external signals.

e. Set Brightness to a low number such as 20, and Contrast to a low enough number that the tube face can be easily viewed.

f. Go to Picture 2 (size) and adjust width to fill almost the entire screen left to right. Set height to about 2/3 of the tube face.

4. **Neutralize ring magnets** on the rear of each tube. Press # to display a crosshatch with dots pattern. Check to see if the rings or knobs have any hot-glue on them. If so, slowly peel it off so all components can move freely. Move the rotating knob on the ring magnet closest to the focus coil (that's the 2 pole flare ring) upright, away from the chassis. Turn the rotating knob slowly while rocking it slightly back and forth circularly. The display on the tube face will move certain amounts as you rock back and forth. As you turn the knob (while rocking) slowly, one way the screen movement will increase, the other way it will decrease. Keep turning toward the direction of least movement, until you can rock back and forth and there is no movement at all on the screen. That is your neutral point – the point where the ring is essentially doing nothing. Repeat this process for each tube. Most 8500's will have only this ring, but in some cases there will additional ones:

If there are additional rings with a knob in the position immediately behind the flare ring, that will be a 6 pole triangularity ring. Try to find the same neutral adjustment for this.

If there is a space and then a rear ring with knob, it will be a 4 pole astigmatism ring which should be set to its neutral point as well.

5. **Loosen Focus Coil wing-nuts**. There are three brass wing-nuts at the rear of the focus coil assembly. There also may be hot-glue on these or on the edges of the plate and coil assembly that the wing-nuts hold together. If there is, slowly peel it off so components move freely. The wing-nuts should be loosened just enough to allow you to freely move the body of the focus coil up/down/left/right on the neck of the tube. As you move this, you'll see the display on that tube move in the opposite direction.

6. **Position Focus Coil** to produce the center of the crosshatch pattern to be right on top of your centered mark. Counting from and including the outermost line, from the top center is 7 lines down (also 7 lines up from bottom), and from either side, 8 lines in. That intersection may not be a perfectly clear, but line its center up on your mark and tighten one of the wing-nuts to prevent the focus coil body from shifting. Repeat this process for each tube.

7. **Remove your markings and remount the lenses.** Now that the center point has been established on the tube face mechanically, remove your ink marks, clean the tube face and remount the lenses as they originally were.

8. **Compare centering**. Establish the real center point of your screen if you haven't already. You can determine the real physical center point in exactly the same manner as we did on the tube faces.

Return brightness to its normal operating level, and contrast to a few numbers below its normal operating level. Observe how the center grid alignment point of each tube's position compares to your screen center. Green, at least, should be very close. If it's not, you'll need to figure out why not and adjust the projector mount or swivel accordingly. Don't swivel unless you know it is wrong, as it's very important that the centered green tube and grid correspond directly to the center of the screen.

Once green center has been established, adjust the angle toe-in for red and blue tubes so that their grid center overlaps green in the center of the screen exactly. Don't be concerned about anything except the center point.

9. **Adjust Tilt.** On the crosshatch display, check the center horizontal line for each color. They should be perfectly horizontal to each other and the screen. If not adjust the forward-most yoke on each tube to achieve perfect level. (mechanical details omitted for now)

10. **Adjust magnetics**! Now that centers are true mechanically, we can continue the centering and flare adjustments. Again, don't be concerned with anything except in the middle, and don't try to correct anything electrically unless directed to do so.

   a. Adjust Picture 4 (focus) down to zero.

   b. Adjust Contrast to 100.

   c. Start with the green tube. Press Color and then 2 to isolate just the green. What you're looking for here for the dots, is circular blobs with a shiny dot in the middle, as well as very fat lines with a thinner shiny line in the middle. The horizontal and vertical positions of the shiny lines inside the fat lines, and the shiny dots inside the blobs will exactly correspond with each other. You'll see that as the roundness of the blob changes, the relationship of the horizontal and vertical lines also change. If the blob is perfectly round, the lines will be equal in width, etc. The tubes may vary significantly in how far off they are from each other. If the blobs are half circles, oblong or whatever, still try to find the shiny dot.

   d. Turn the flare ring knob and move it left or right, slowly, while watching where the shiny dot is and the roundness of the blob. Find the spot where the dot starts moving into the center of the blob, regardless of its shape. You'll also notice that as you move the flare ring around to achieve this goal, your grid centering is also shifting. This is normal and is why the focus coil body will need to be adjusted.

e. Now that the shiny dot is getting close to center, grab hold of the body of the focus coil with one hand holding it stationary while you loosen the wing-nut we tightened earlier. Move the body of the coil around until once again the grid is centered in the screen. You'll notice now that the shiny dot has shifted in the blob. This is normal. Go back and forth between step 10d and 10e until you are pretty close to grid centered, AND the shiny dot is in the middle of the blob. Tighten down one wing-nut and take a breather!

f. Now astigmatism enters into the picture because it also interacts with the previous steps, but to a lesser degree. If you have an astigmatism ring on the ring assembly (probably not) use it to achieve a round blob. Otherwise, you go to Utilities 9 <password> 7 (stigmator). Use the Color button to rotate through the colors, to green or the color you are working on, and adjust the center (static) field only with left/right and up/down buttons on the keypad to get as perfect a circular blob as you can. When you have achieved that, Save and Exit. Keep repeating 10d, 10e, and 10f until you have shiny dots inside round blobs (and the line equivalents) with the grid exactly centered.

g. Making progress! Now slowly advance Picture 4 (focus) to 100, or whatever number gives you a center circle (blob) about 1/2 to 3/4 inch in diameter, and return to the stigmator adjustment to fine tune this to a perfect circle. You will not usually see dots or shiny lines in this over-focused state.

h. Now slowly lower and raise Picture 4 (focus) and watch the shape of the circle blob when over focused and under focused, and what does it do at the transition. The goal is maintain a perfectly circular blob/dot at both ends of Picture 4 focus, and in the center area where it transitions through the in-focus point it should smoothly size up and down from a tight dot to a perfect circle. You may need to touch up 10d-10h until this is achieved. Try a lower contrast setting to see how it transitions – it should maintain shape at any size or brightness. Don't run the display for long periods of time at high contrast levels with focus set to tight dots, just transition through them.

i. Start back at #10 for the next color, repeating until you have achieved the goal on all three tubes.

11. Electrical Adjustments. At this point you should have perfect flare and pretty close centering (within ½") on all grids. Carefully tighten down all focus coil wing-nuts being careful not to shift the grid or bump the flare adjustments. Return contrast to a normal level, and return Picture 4 (focus) to 50.

    a. Go to Utilities 9 (service), 2 (rgb focus) and adjust center focus only for each color to be as sharp as you can. You may want to touch up optical center focus here too. You should now find that dots are quite precise and the lines are equal and sharp in the center.

    b. Now proceed to Convergence 5 (service) 2 (random) and adjust green center only to line the grid up exactly on your screen center mark. Save and Exit.

    c. Now to Convergence 3 (random) and adjust red center only to match green. Hit the Color button to change to blue and adjust blue center to green. Save and Exit.

12. Assessing Geometry. If your physical and mechanical setups have all been done correctly, what you should now see with the crosshatch/dot pattern is a perfectly centered grid and center convergence looking good but some wild deviations extending out from there. But these deviations should be fairly predictable. If the projector is floor mounted, all the colors should get wider at the top of the screen. Blue should get wider top to bottom on the left side of the screen, and red should get wider top to bottom on the right side of the screen. The reverse of all this is true if projector is ceiling mounted.

Also, the green blocks (squares) should get larger at the top, blue blocks larger on the left and red blocks wider on the right. This is due to the projection angle of the tube and lens relative to the screen. As a general guideline this will be a symmetrical display with blue and red deviations opposite each other, with green more or less in the middle. If you see this relationship, your setup is pretty good so far. If not, you may still have a physical chassis to screen alignment problem. On the plus side of that, the flare/focus magnetics adjustments are now done and won't need changing even if you move the projector.

13. Adjusting Geometry. Press # to display the first crosshatch pattern (no dots), then press Color and 2 to isolate just green. Press Geometry 1 (size) to bring width and height close to your screen requirements, then Geometry 2 (keystone). Width or height may not be the same on one side or the other of the screen. Adjust size so that the widest side left/right and top/bottom are just in the frame and opposite side is a little small.

    a. Keystone: Adjust until the crosshatch appears to be the most square to the screen on all four sides. Each side will dip in (concave) somewhat so adjust for best overall uniformity.

b. Side Pin: Adjust the curvature of the left and right sides to a minimum. Usually one side will be right on, and the other will deviate from straight just a bit. Align one side or the other to straight – which ever seem to give the best impression of total left/right straightness without any further adjustment. You may want to go between keystone and side pin a couple of times to get this as close as possible. We will re-evaluate and fine tune this later.

c. Top Pin: Adjust for a straighter top line. Note that it will affect one side of the line more than the other, so it's usually best initially to under-adjust it. Get it so that it's improved but still looks linear from one side to the other. This adjustment, Bottom Pin and Bow contribute to the famous Banding problem so we're being cautious at this point.

d. Bottom Pin: Same as above for bottom line. Under-adjust for a smooth continuity of the line.

e. C Linearity: Center linearity is often misunderstood and misadjusted. In a nutshell, it controls the relationship of the size of the left to right half of the screen (horizontal) and top to bottom half of the screen (vertical). A tape measure is required.   For horizontal C linearity, measure the distance at the screen from the center grid line to the leftmost grid line, and then the same for center to right grid lines. Adjust in small steps for an equal distance on both halves. Likewise for vertical C linearity measure from the center grid line to top line, and then to bottom line and adjust for equal distance. As you adjust these controls, the center will remain stationary.

f. S Linearity: Stretch linearity controls the linearity of object sizes from left to right of the screen (horizontal) and top to bottom of screen (vertical). For horizontal calibration, measure the width of a box on the far left, the center, and the far right. They should all be the same. Adjust until this is achieved as closely as possible. The same procedure is used for the vertical adjustment except you use top, middle and bottom boxes heights as your guideline.

C and S Linearity adjustments interact with each other to a degree so you will not be able to achieve a perfect relationship on the first pass. Rinse and repeat, rinse and repeat. If you can end up with ¼" deviation left to right, you're doing extremely well. Stop!

g. Skew: Through all of this we have assumed a left-right middle line of the grid of each tube is exactly horizontal to the screen. Even though this is the case, the middle vertical line may not be exactly vertical. Use skew if needed, to align the center vertical grid line to be perfectly vertical. Center markings on all four sides of the screen are quite helpful in gauging this.

    h.   Bow: I saved this for last since you may or may not need it. Confirm now that left to right center grid line is horizontal. Sight across the screen from one edge at the point where the center line stops, to the other edge. Get very close so that your eye sees the whole span of the line in an inch or two of width. Does it look straight or does it raise or lower in the middle? You would normally adjust Bow to make this line as straight as possible.

        Here we want to assess both its straightness, and determine if there's any tendency to band, where there may be one, two or three vertical layers showing on the screen with what looks like a black streak separating them. You can easily see this by using # to bring up the solid green screen and looking for any horizontal streaks that seem to separate sections of the screen. If you don't see any and your middle grid line is straight, you're done. If your line is not straight, carefully adjust bow a little at a time, checking for banding with a solid green or white screen. Top and bottom pin (c and d above) interact with bow differently from projector to projector. Usually, top and bottom pin will neutralize each other if bow is centered. If bow needs adjustment, it may be necessary to raise or lower one or both of the other two, and gauge the correction and amount of banding accordingly. Sometimes you'll get perfect pin and bow and no banding at all, and other times you'll have to sacrifice a little. Tune to taste.

14. **Perfect Green Geometry**. At this point on the green only screen, you should have an almost perfect symmetry with no convergence at all. Occasionally a corner might need a little tweak, or slight pin correction, but that's all. Go ahead and do that now to achieve a perfect green grid, by going to Conv 5 (green) 2 (random) and adjust very sparingly. Use only random adjustment.

15. **Red and Blue, height and width**. Now that green is done, you should be able to go back to a white screen (Press Color 8) and the grid to see red and blue still centered with green, but their oppositeness with green centered between them should be quite obvious. Before we converge red and blue to green, however, we need to normalize the heights and widths. While viewing all colors, go to Utilities 9 (service) 3 (red blue vertical size) and adjust red and blue to match green only in the very middle of the screen. If they don't match top and bottom exactly, match as close as you can top and bottom for each color. Save and Exit.   [width slug adjustment omitted for now]

16. **Dynamic Astigmatism**: Before final red/blue convergence proceed to Utilities 9 (service) 7 (stigmator) and adjust dynamic astigmatism for each color. Dynamic is everything EXCEPT center. Do not adjust center! When ready to adjust and while in the astigmatism section, enter Picture 4 (focus) and push it up to 100, then press Contrast and push it up to 100, then Picture 4 again, lowering it to create a 3/8" to 1/2" circle in the center. Then use RECALL to backup to astigmatism and adjust everything but the center for as perfect a circle as you can make for each position. It may take a couple of passes since there is averaging between areas going on. Repeat for all colors then Save and Exit. Set Contrast back to normal levels, and Pic 4 (focus) back to 50.

17. **Dynamic Focus** : Go to Utilities 9 (service) 2 (RGB Focus) and adjust all dynamic fields including the static center to the finest round dot you can. As you complete each color, fine tune the optical center focus for that tube again.

18. **Convergence of Red and Blue** : Before attacking this, put your individual grids up for each color and touchup or ballpark optical lens flapping. Initially adjust for the thinnest lines at the outside edges (left/right adjustments oppose each other, as do top/bottom). Left and right should occur at the same time, and be approximately equal to center, but slightly softer. Same with Top and Bottom. Once you have some uniformity across the screen with flapping adjustments, continue on to red and blue convergence, matching each to green. Use random only! Other adjustment options seem like they're quicker, but in reality they're not because they make errors. Do a random of red, random of blue, then another random fine tune of red and random fine tune of blue.

That's all for now. This much if closely followed should result in an excellent picture as far as magnetics, geometry, general focus and convergence are concerned. I hadn't intended to get this much out in the first pass, but so much of it is somewhat interdependent in this method that I decided to push forward. It definitely needs more editing with pictures and other little tidbits here and there, and that will come, but not right away. Hopefully this will provide a lot of useful information as-is.

I'm open to comments, suggestions, additional text or ideas, so let me know what you think. My email is bblue@netoldies.com.

--Bill Blue