Mitsubishi Evolution VIII ECU Map Load (%) Value Rescaling

A tutorial on how to rescale the Load (%) values for the timing and fuel tables of the Mitsubishi Evolution VIII stock ECU

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Table of Contents

Introduction

This tutorial will demonstrate how to edit the Timing and Fuel maps from a stock Evolution VIII to accommodate a Load (%) range from 0 to 300 instead of the default range of 0 to 260, using ECUflash (www.openecu.org). It is assumed that the reader is familiar with the basic functionality of ECUflash.

Why does the Load (%) range need to be modified?

Some modified Evolution VIIIs can exceed the maximum calculated Load percentage of 260. Running a bigger turbo, increasing the engine volumetric efficiency (VE) with cams or intake modifications, or running high boost all can lead to situations where the Load (%) value calculated by the ECU exceeds the stock maps' maximum value of 260.

In order to allow the ECU to control timing and fuel values over a wider Load (%) range, additional columns have to be defined for the table. Unfortunately the Evolution VIII ECU is limited to its existing number of columns, which are:

Timing tables: [0,10,20,30,40,50,60,70,80,90,100,120,140,160,180,200,220,240,260].

Fuel tables: [10,20,30,40,50,60,70,80,90,100,120,140,160,180,200,220,240,260].

These values will need to be redefined to reflect the new scale ranging from 0/10 to 300 (or more).

1.) Open the ECU ROM file and pull up the High Octane Ignition Map.

Figure 1 shows what the stock* High Octane Ignition Map looks like. Cars that have already been tuned will most likely have different values within their timing tables. Not to worry, for the sake of this tutorial only the column header values really matter.

Before editing any existing maps, make a backup copy of the file, which can be used as a reference to make sure no typos or other errors have crept into the editing process.

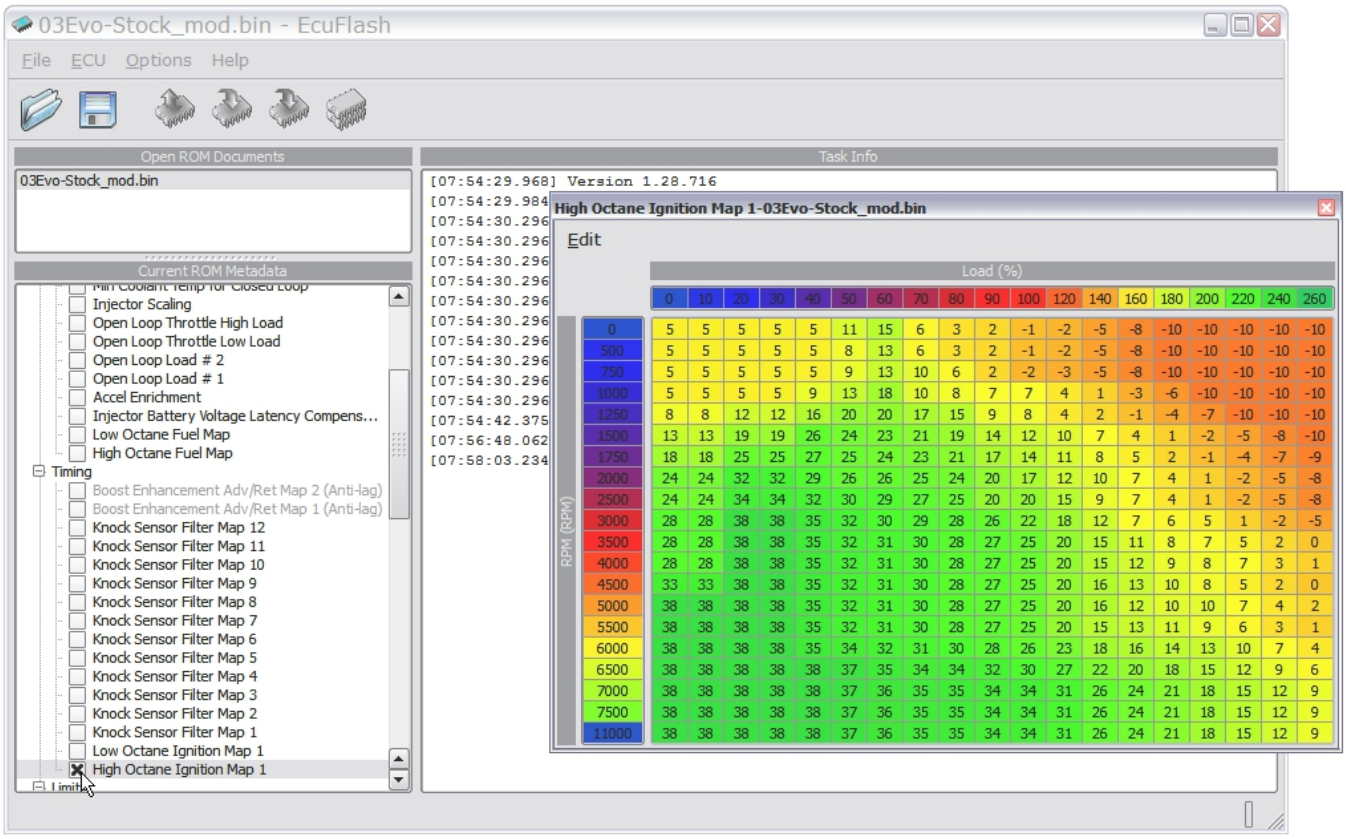

Figure 1, stock* 2003 Evolution VIII ECU High Octane Ignition Map

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*** <u>PLEASE NOTE</u>:** This map has been slightly edited to make it easier to illustrate the process of editing the map. Specifically, the timing values in the 260% Load column ranging from 3500 RPM to 5500 RPM have been increased by 1 degree.

2.) Choose which columns will be eliminated

In this tutorial we will be rescaling the Load (%) column values to a maximum value of 300. There are a number of ways in which this could be achieved:

a.) Single column edit

We could simply change the last column from 260 to 300. This will work, but it will leave a rather large range of Load percentage values beyond our immediate control. If we change the last column to 300, then the ECU will have to interpolate any value between the 240 column and the (new) 300 column. Since this is also the arguably most critical range of the maps to tune, we'll take a different approach

b.) Multiple column edit

We could attempt to mimic the stock scaling in the higher load regions to get us to a maximum value of 300%. This would mean using increments of 20% to get to 300% and would result in a 280% and 300% column. Due to the table size limitations of the ECU (see introduction), this also means that we have to 'lose' two columns to make room for the two 'new' columns.

Because of the obvious shortcomings of method (a), I chose to rescale the Load percentage values based on method (b). This is also, incidentally, how Mitsubishi chose to rescale the Load percentage values in the Evolution VII Ralliart ECU (figure 2).

High Octane Ignition Map 1-EVO7 RA578511P1 RalliArt.hex

Edit

RPM (RPM) \ Load (%)	0	10	20	30	40	50	60	80	100	120	140	160	180	200	220	240	260	280	300
0	5	5	5	5	5	11	15	3	0	-3	-6	-9	-10	-10	-10	-10	-10	-10	-10
500	5	5	5	5	5	8	13	3	0	-3	-6	-9	-10	-10	-10	-10	-10	-10	-10
750	5	5	5	5	5	8	13	3	0	-3	-6	-9	-10	-10	-10	-10	-10	-10	-10
1000	5	5	5	5	9	13	18	8	6	3	0	-3	-6	-9	-10	-10	-10	-10	-10
1250	12	12	12	12	16	20	19	15	13	10	6	2	-1	-4	-7	-10	-10	-10	-10
1500	19	19	19	19	26	24	23	20	17	13	9	6	3	0	-3	-6	-9	-10	-10
2000	32	32	32	32	29	26	26	24	21	18	13	8	5	2	-1	-4	-7	-10	-10
2500	34	34	34	34	32	30	29	27	22	20	16	14	10	7	4	2	-2	-5	-8
3000	38	38	38	38	35	32	30	28	23	21	17	15	11	8	5	3	-1	-4	-7
3500	38	38	38	38	35	32	31	28	24	22	18	16	12	9	6	4	0	-3	-6
4000	38	38	38	38	35	32	31	28	25	23	19	17	13	10	7	5	1	-2	-5
4500	38	38	38	38	35	32	31	28	26	24	20	18	14	11	8	6	2	-1	-4
5000	38	38	38	38	35	32	31	28	27	25	21	19	15	12	9	7	3	0	-3
5500	38	38	38	38	35	33	32	29	28	26	22	20	16	13	10	8	4	1	-2
6000	38	38	38	38	35	34	32	30	29	27	23	21	17	14	11	9	5	2	-1
6500	38	38	38	38	38	37	35	34	31	29	27	24	21	18	14	11	8	5	1
7000	38	38	38	38	38	37	36	35	34	33	30	27	22	19	16	13	10	7	4
7500	38	38	38	38	38	37	36	35	34	33	30	27	22	19	16	13	10	7	4
11000	38	38	38	38	38	37	36	35	34	33	30	27	22	19	16	13	10	7	4

Figure 2, 2001 Evolution VII Ralliart ECU High Octane Ignition Map

In keeping with Mitsubishi's approach I decided to eliminate the 70% and 90% Load columns to make room for the 280% and 300% columns. Whichever columns you end up choosing, you'll want to choose a set of columns that has a relatively linear relationship to each of its adjacent columns.

WARNING: Changing the column header values in the High Octane Map will also change the column header values in the associated Low Octane Map. Therefore when you edit the column headers in the High Octane Ignition Map, you are also changing the column headers in the Low Octane Ignition Map. The same holds true when editing the High Octane Fuel Map. Editing its column header values will also change the column headers in the Low Octane Fuel Map.

3.) Edit the Load (%) column header values

We'll begin by editing the High Octane Ignition Map. Click on the High Octane Ignition Map 1 to pull up the map.

a.) Modify 70% column header (figure 3)

- The first step will be to change the 70% column header to 80%
  - Click on the 70
  - Press the [=] key (this will pop-up the "please enter a value" window)
  - Type 80 into the pop-up window (next to the d =)
  - Press the [Enter] key
  - The map should now look like the map in figure 4. There should now be 2 columns that have a header value of 80.

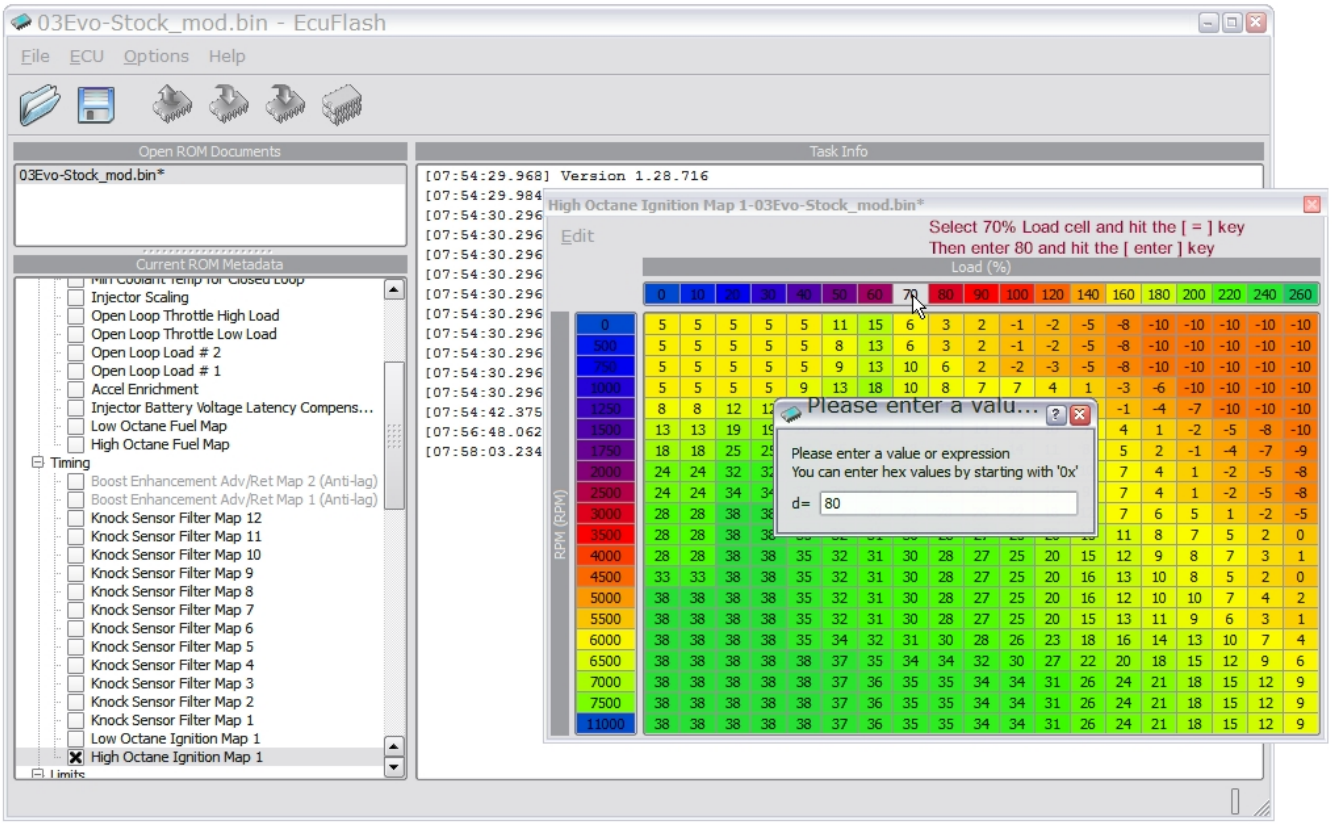

Figure 3, stock* 2003 Evolution VIII ECU High Octane Ignition Map Edit 70% Column

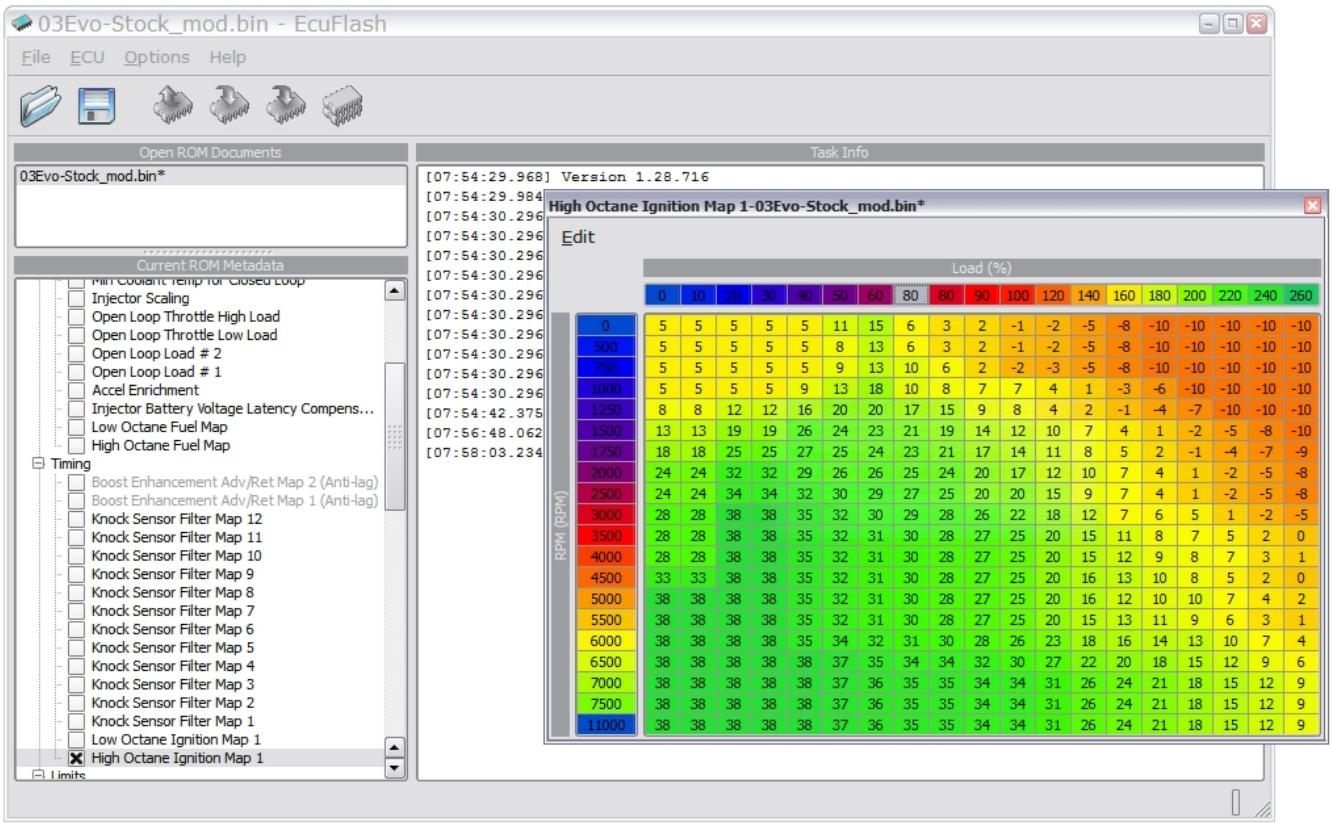

Figure 4, modified 2003 Evolution VIII ECU High Octane Ignition Map, two 80% columns

b.) Move the 100 to 260 column headers 2 cells to the left. (figures 5 to 9)

This will move the existing 100% to 260% load column headers next to the new 80% column.

- Select the 100 to 260 cells (figure 5)
  - Click on the 100
  - While holding the mouse button, drag the cursor over to the 260 cell, which should highlight all of the cells between 100 and 260. As an alternative you can also click on the 100, press the [Shift] key and then (while pressing [Shift]) click on 260. This should also highlight all of the cells from 100 to 260.
- Copy the selected cells (figure 6)
  - Click on the Edit button in the map
  - Click on Copy (as an alternative, [Ctrl] + [c] will also work)
- Paste selected cells into the original 80% Load column header (figures 7, 8)
  - Highlight the 'right' 80 (figure 7)
  - Click on the Edit button in the map (figure 8)
  - Click on Paste (as an alternative, [Ctrl] + [v] will also work)
- The map should now look like the map in figure 9. There should be two 240 and two 260 column headers.

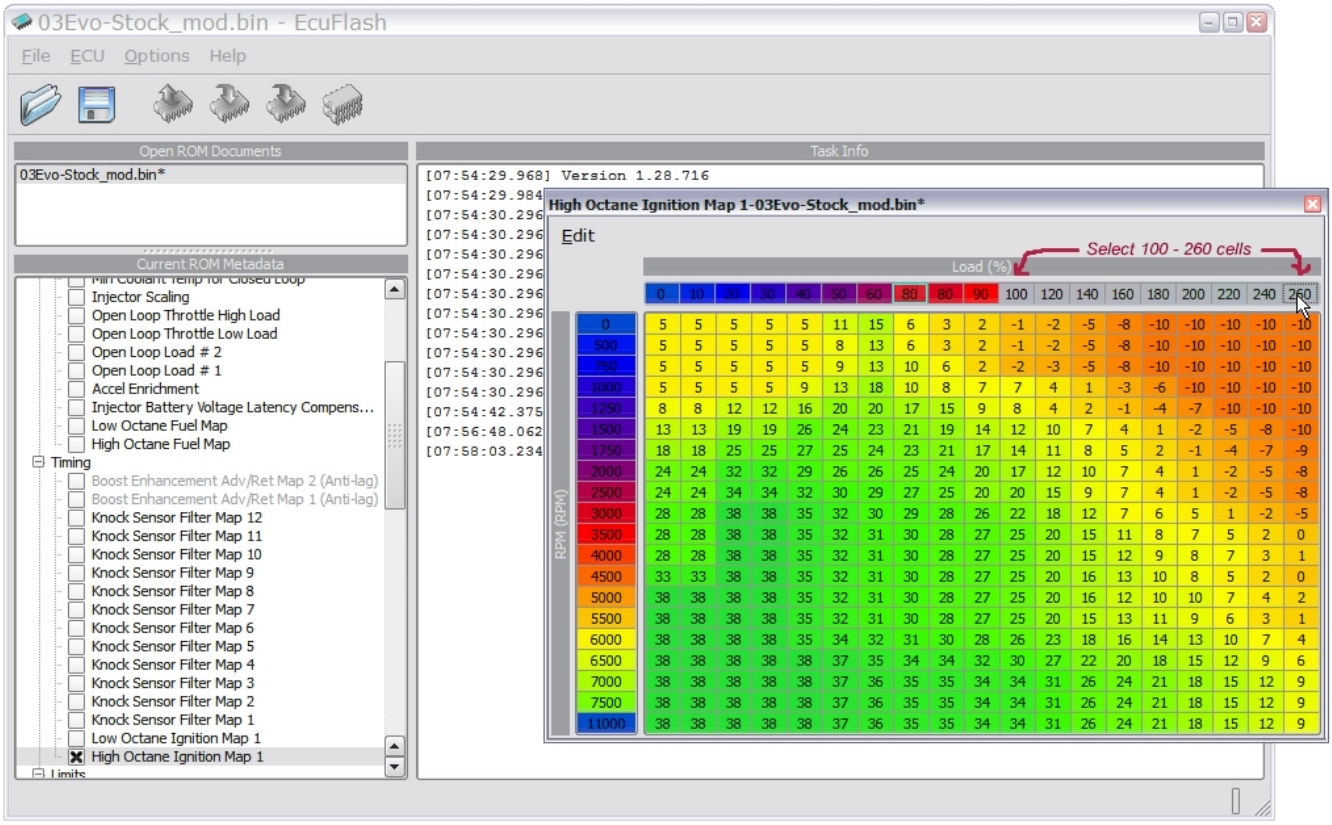

Figure 5, modified 2003 Evolution VIII ECU High Octane Ignition Map, select Load (%) cells

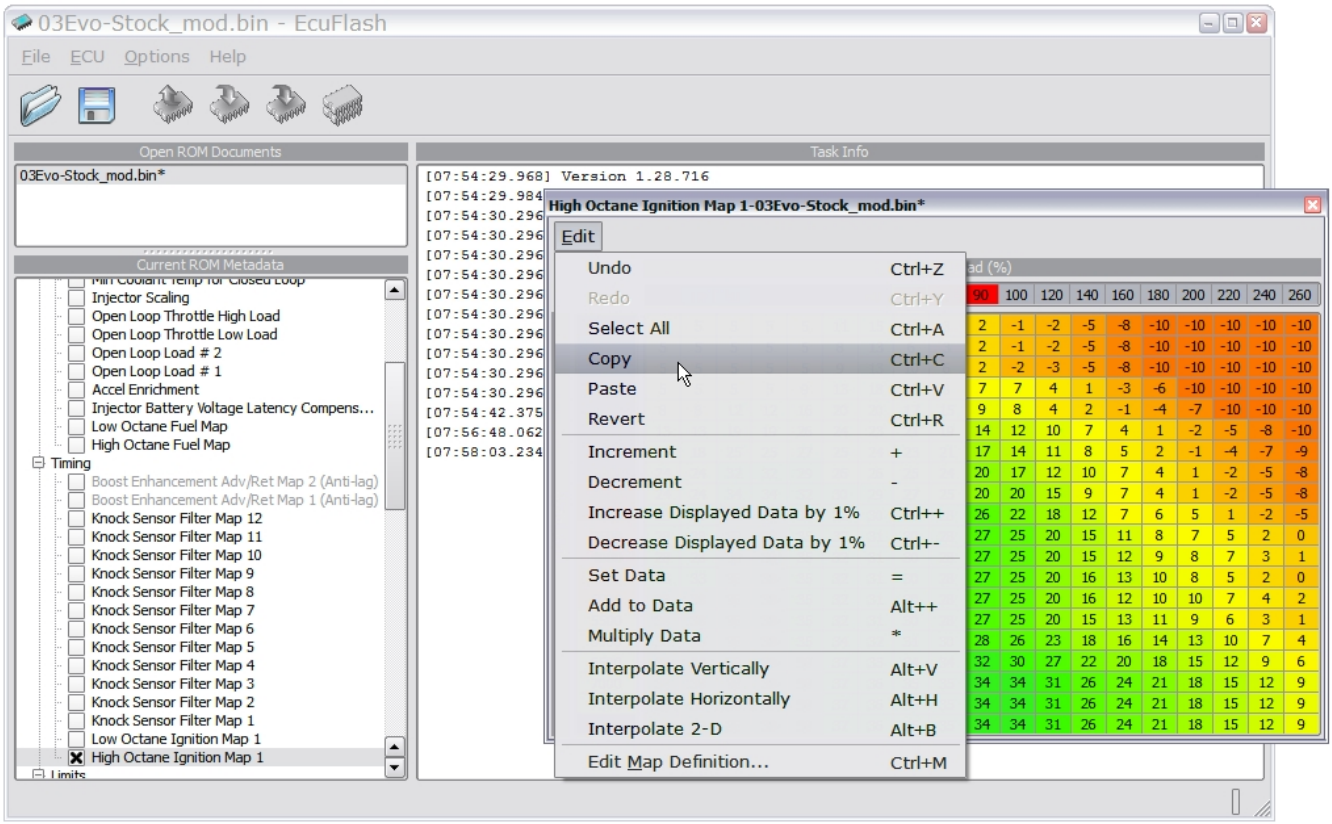

Figure 6, modified 2003 Evolution VIII ECU High Octane Ignition Map, copy cells

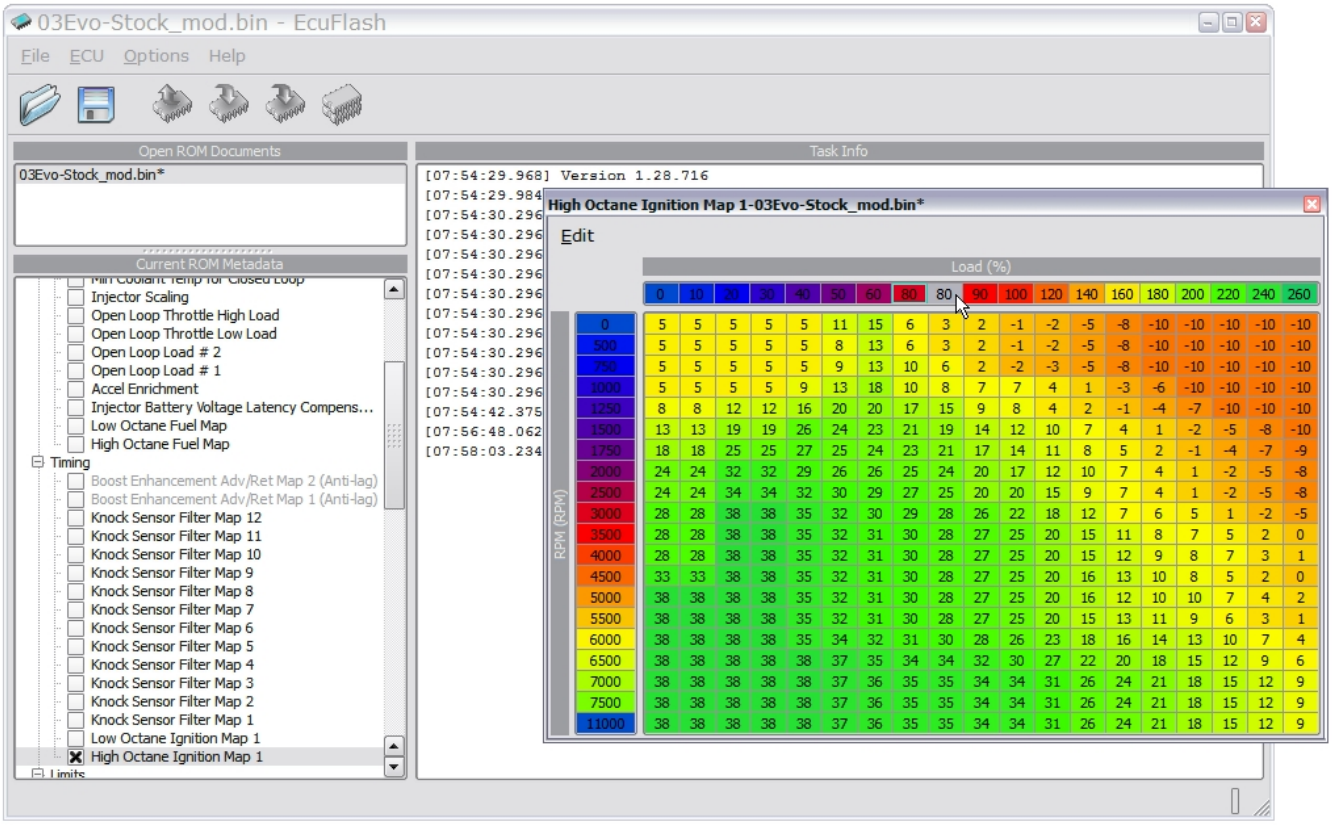

Figure 7, modified 2003 Evolution VIII ECU High Octane Ignition Map, select the 'second' 80 column header cell

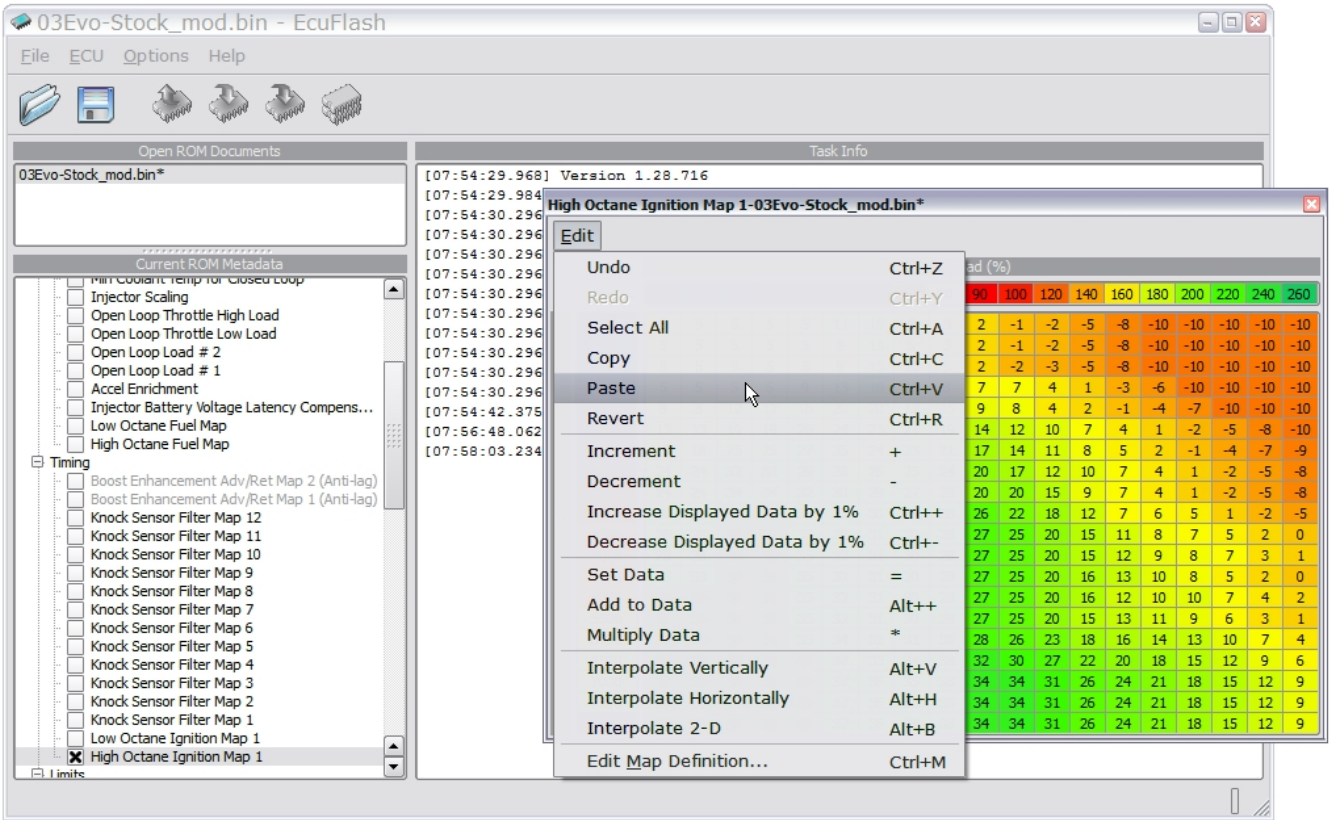

Figure 8, modified 2003 Evolution VIII ECU High Octane Ignition Map, paste

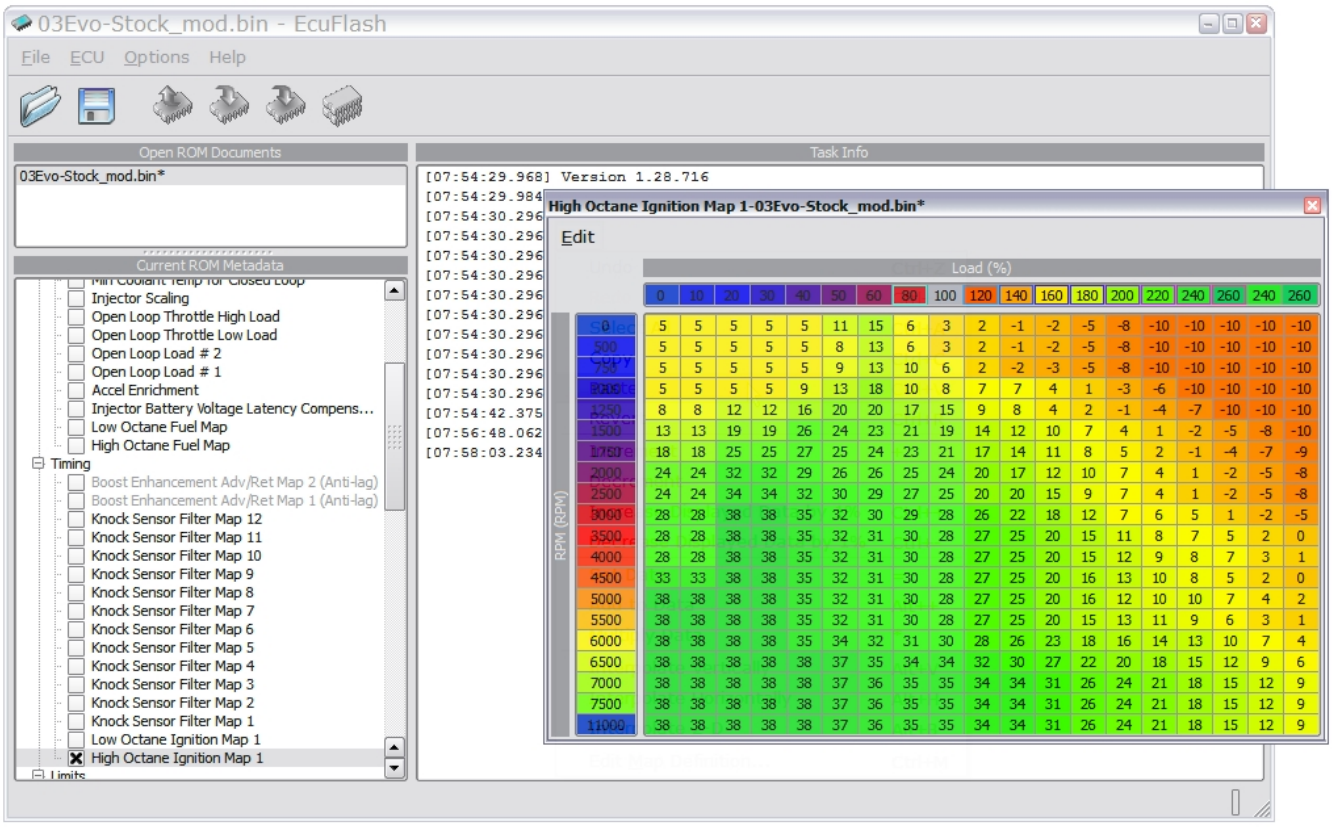

Figure 9, modified 2003 Evolution VIII ECU High Octane Ignition Map, load column headers moved

c.) Add the 280 and 300 column headers (Figure 10)

Using the same method as in step (3a), edit the last two column headers

- Click on the right-most 240 header cell (second from right)
- Press the [=] key (this will pop-up the “please enter a value” window)
- Type 280 into the pop-up window (next to the d =)
- Press the [Enter] key
- Click on the right-most 260 header cell (last cell on right)
- Press the [=] key (this will pop-up the “please enter a value” window)
- Type 300 into the pop-up window (next to the d =)
- Press the [Enter] key

The map should now have Load percentage values as shown in figure 10.

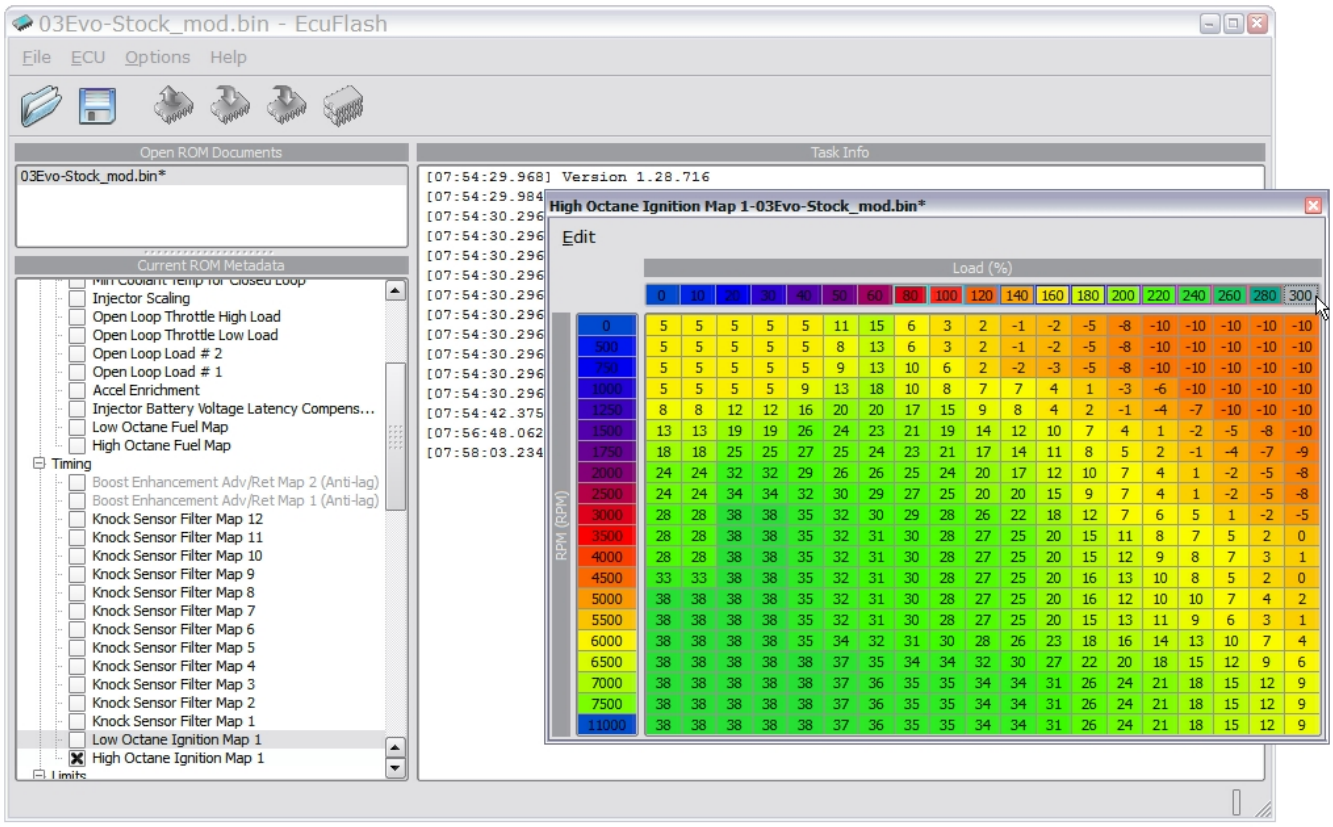

Figure 10, modified 2003 Evolution VIII ECU High Octane Ignition Map,

d.) Pause and take note of the high and low octane map headers (figure 11)

Now that the column header has been edited for the High Octane map, let's take a look at what happened to the associated Low Octane map (figure 11).

The column headers have also been changed for the Low Octane map! This only holds true for the header values of the table (both columns and rows), since both the high octane and its low octane counterpart reference the same Load (%) and RPM scale.

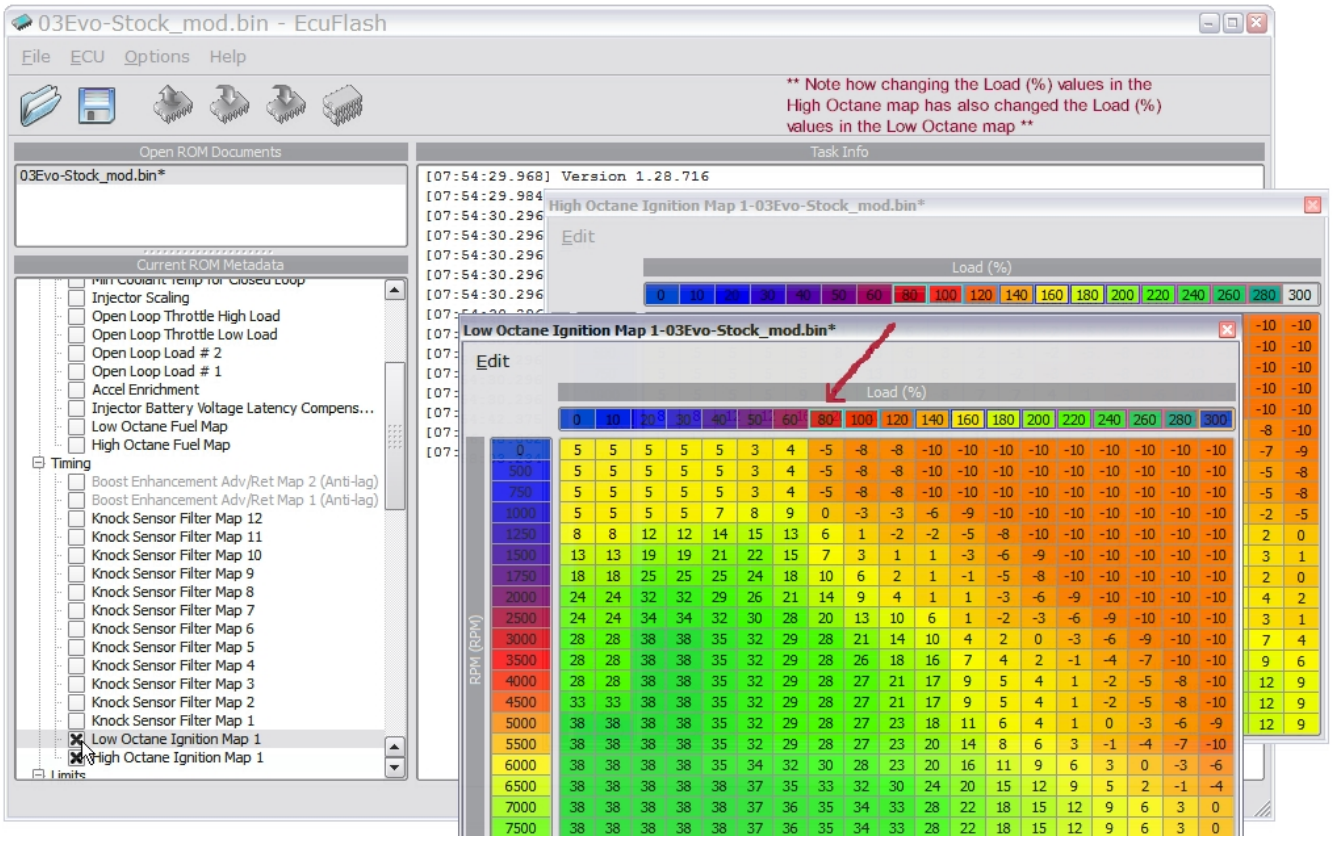

Figure 11, modified 2003 Evolution VIII ECU High and Low Octane Ignition Maps, Load (%) scale changed but map values still unchanged

4.) Move the old column values within the map to their new locations

Now that the column headers have been changed to reflect the new Load (%) scale, all of the columns need to be moved back under the correct Load (%) column. The table as it sits right now (figure 10) has the values for the 80% column sitting under the 100% header and the 100% to 260% columns are sitting under the 140% to 300% headers.

a.) Copy and paste the current 100% Load column into the 80% Load column

This will move the 80% Load timing values back under the 80% column

- Select all of the values in the 100% Load column.
  - Click on the first value (0 RPM row) in the 100% column and, while holding the mouse button, drag the cursor down to the last value in the 100% column. Alternately you can also click on the first value (0 RPM row) in the 100% column, press and hold the [Shift] key and then click on the last value in the 100% column.
  - The 100% column should now be highlighted as shown in figure 12.
- Copy the selected cells
  - Click on the Edit button in the map
  - Click on Copy (as an alternative, [Ctrl] + [c] will also work)
- Paste selected cells into the 80% Load column (figure 13)
  - Select all of the values in the 80% Load column
  - Click on the Edit button in the map
  - Click on Paste (as an alternative, [Ctrl] + [v] will also work)
- The map should now look like the map in figure 13. The 80% Load column and the 100% Load columns now contain the same values.

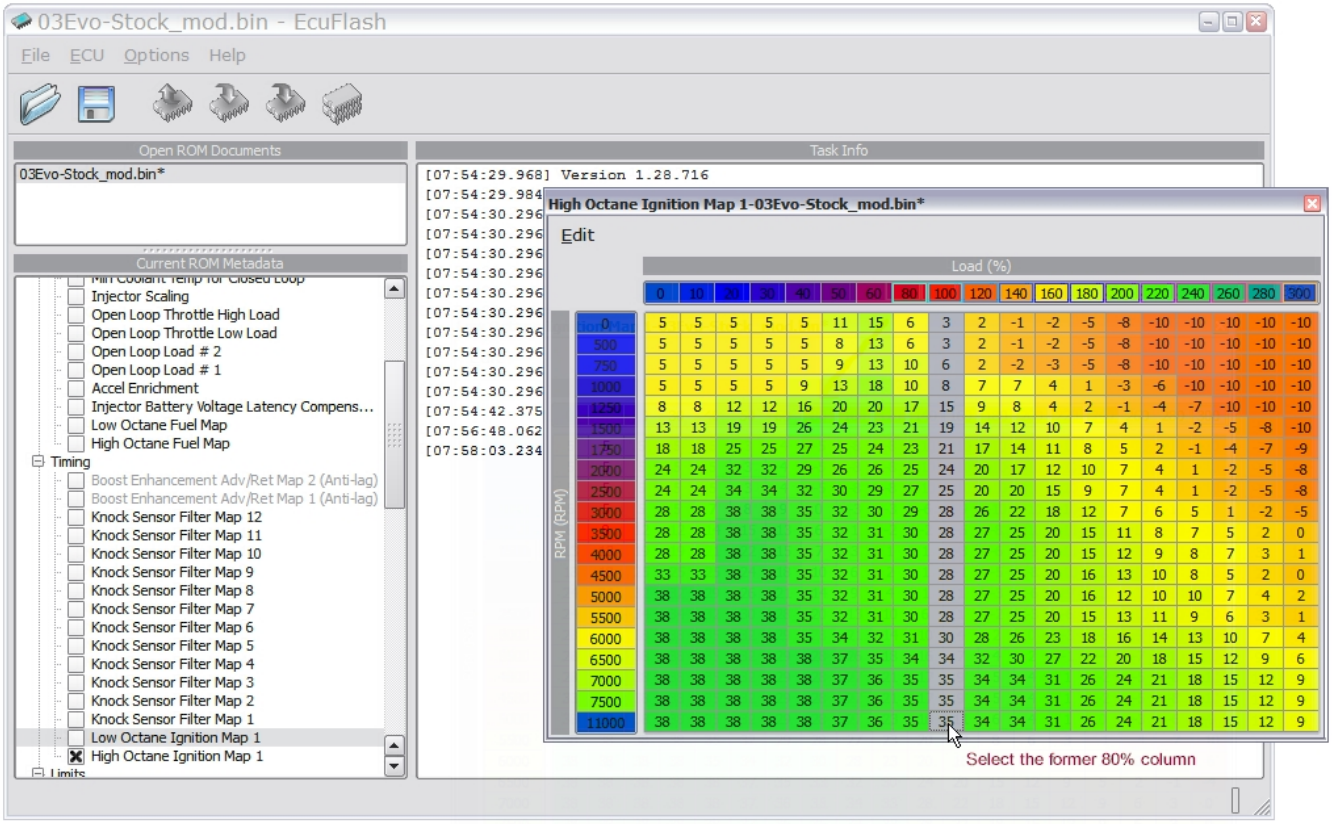

Figure 12, modified 2003 Evolution VIII ECU High Octane Ignition Map, copy 100% column

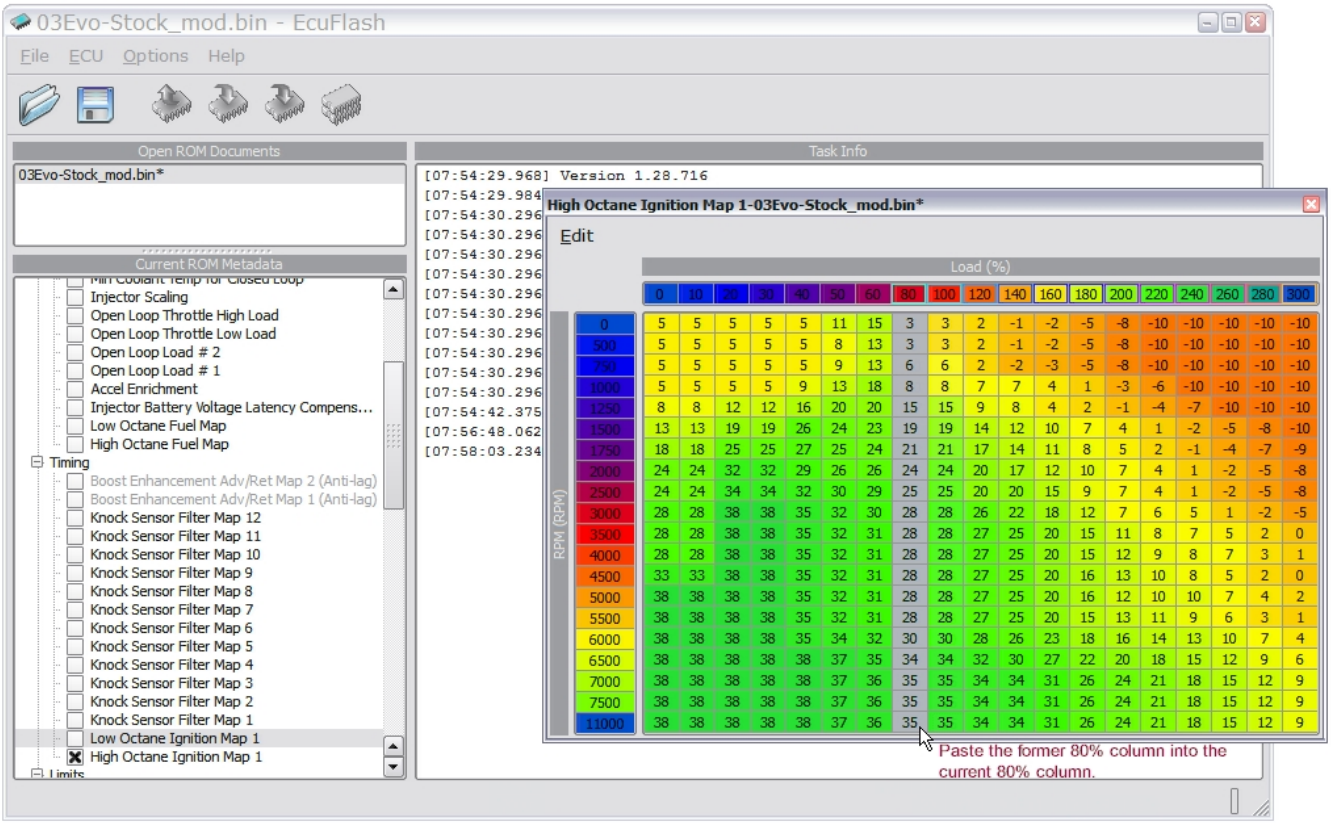

Figure 13, modified 2003 Evolution VIII ECU High Octane Ignition Map, paste 80% column

b.) Copy and paste the current 140% to 300% Load columns into the 100% to 260% columns

This will move the remaining timing values back into the correct columns

- Select all of the values ranging from the 140% Load column to the 300% Load column
  - Click on the top cell (0 RPM row) in the 140% column and, while holding the mouse button, drag the cursor down to the last value in the 300% column. Alternately you can also click on the first value (0 RPM row) in the 140% column, press and hold the [Shift] key and then click on the last value in the 300% column.
  - The 140% to 300% columns should now be selected as shown in figure 14.
- Copy the selected cells
  - Click on the Edit button in the map
  - Click on Copy (as an alternative, [Ctrl] + [c] will also work)
- Select all of the values ranging from the 100% Load column to the 260% Load column
  - The 100% to 260% columns should now be selected as shown in figure 14.
- Paste selected cells into the 100% to 260% columns (figure 15)
  - Select all of the values in the 100% to 260% columns
  - Click on the Edit button in the map
  - Click on Paste (as an alternative, [Ctrl] + [v] will also work)
- The map should now look like the map in figure 16. At this point in the process, the values in the 240% and 260% columns should equal the values in the 280% and 300% columns respectively.

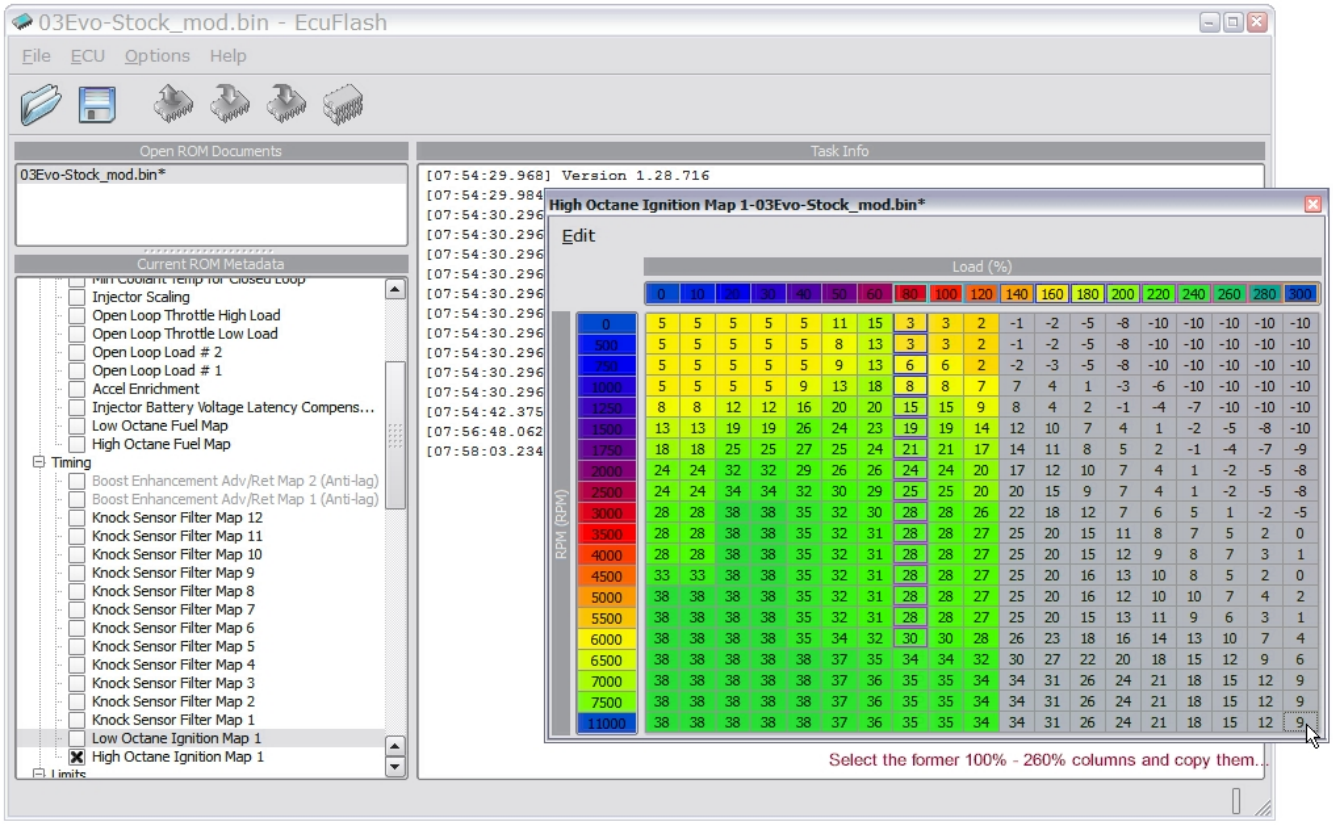

Figure 14, modified 2003 Evolution VIII ECU High Octane Ignition Map, select 140% to 300% columns and copy

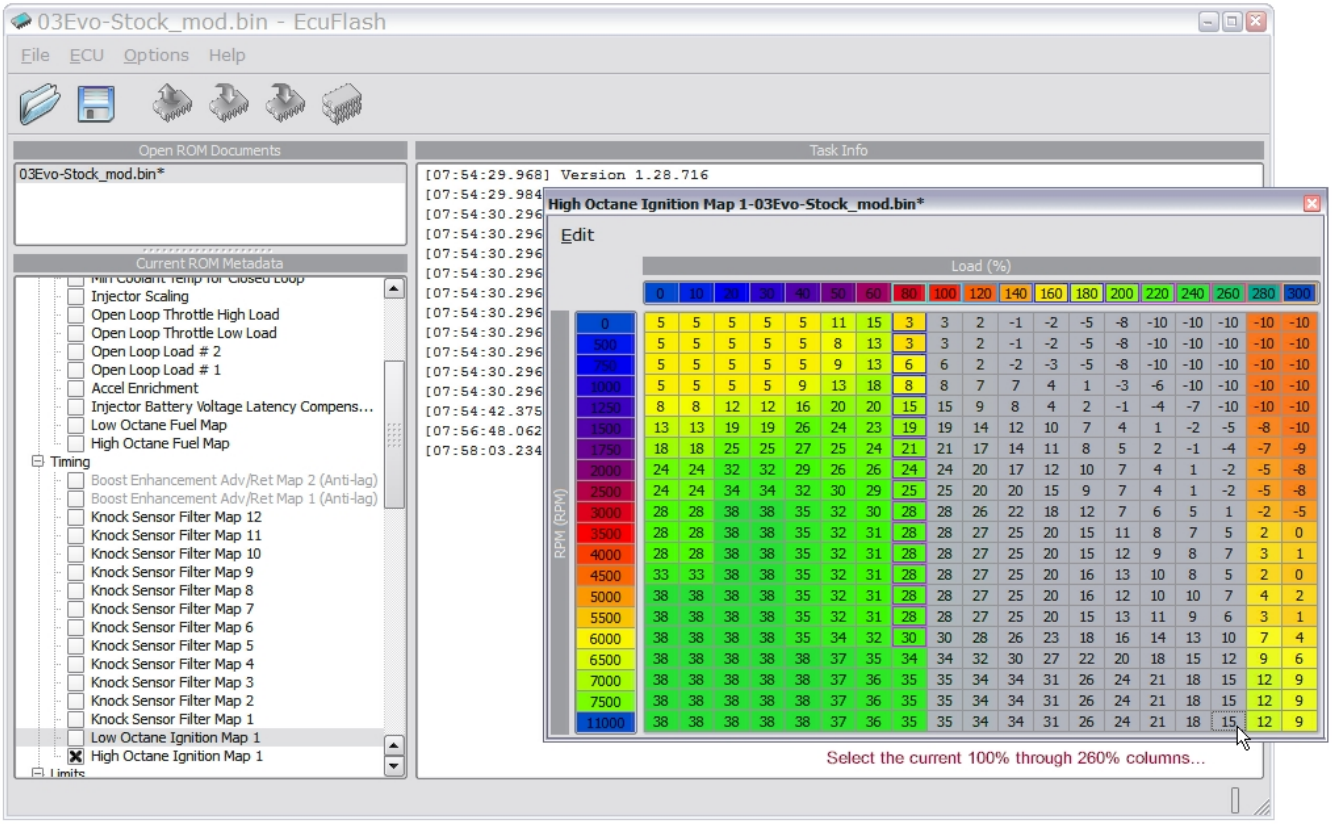

Figure 15, modified 2003 Evolution VIII ECU High Octane Ignition Map, select 100% to 260% columns

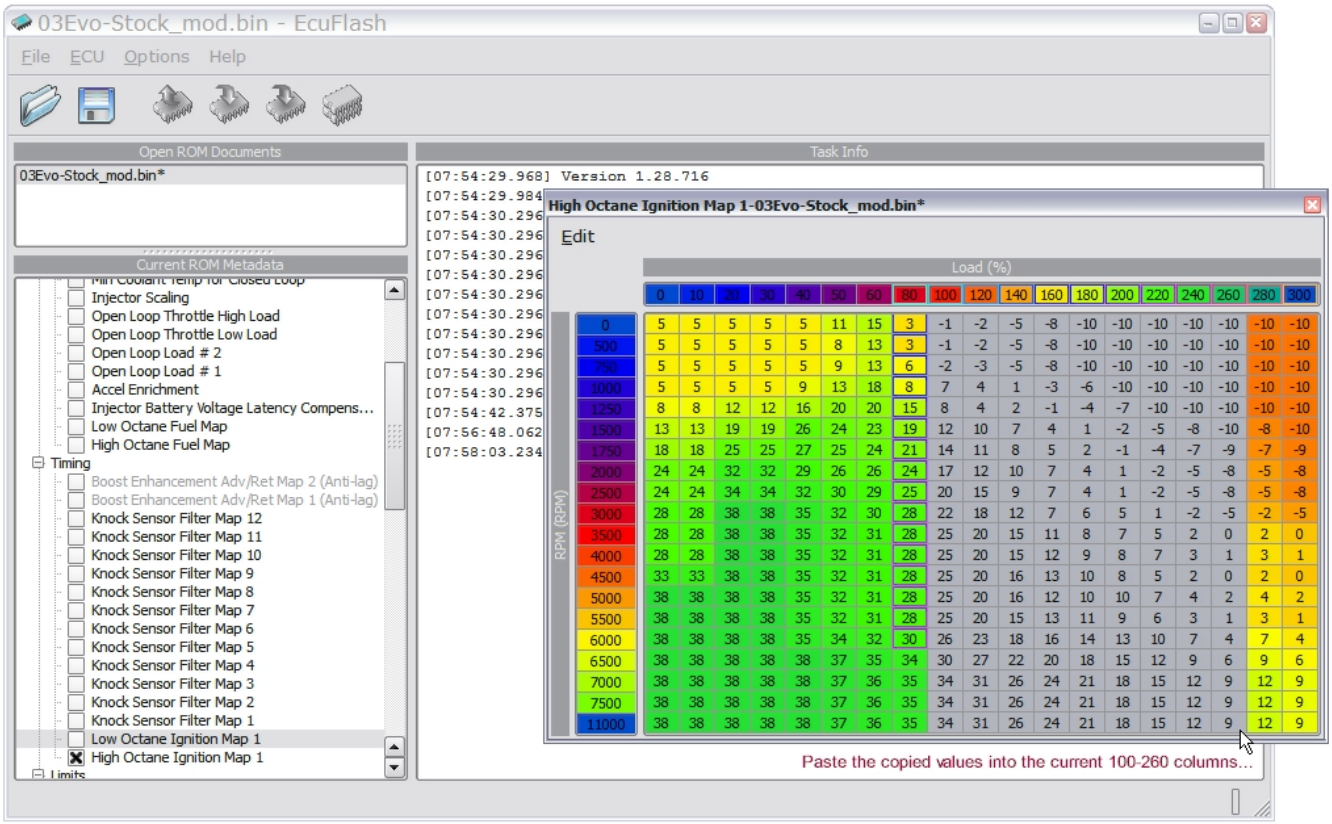

Figure 16, modified 2003 Evolution VIII ECU High Octane Ignition Map, paste into 100% to 260% columns

5.) Rescale the values contained in the new high load cells

Now that all of the original map values are back in the correct load columns, we need to turn our attention to the two new high load columns, the 280% and 300% load columns. Since these columns are currently populated with data from the 240% and 260% load columns, they will have to be rescaled to accurately reflect the higher loads which are being addressed.

a.) Copy and paste the current 300% Load column into the 280% Load column

This will set the map values of the 260-300% columns to be the same.

- Select all of the values in the 300% Load column
  - Click on the first value (0 RPM row) in the 300% column and, while holding the mouse button, drag the cursor down to the last value in the 300% column. Alternately you can also click on the first value (0 RPM row) in the 300% column, press and hold the [Shift] key and then click on the last value in the 300% column.
  - The 300% column should now be highlighted as shown in figure 17.
- Copy the selected cells
  - Click on the Edit button in the map
  - Click on Copy (as an alternative, [Ctrl] + [c] will also work)
- Paste selected cells into the 280% Load column (figure 18)
  - Select all of the values in the 280% Load column
  - Click on the Edit button in the map
  - Click on Paste (as an alternative, [Ctrl] + [v] will also work)
- The map should now look like the map in figure 18. The 260%, 280%, and 300% Load columns now contain the same values.

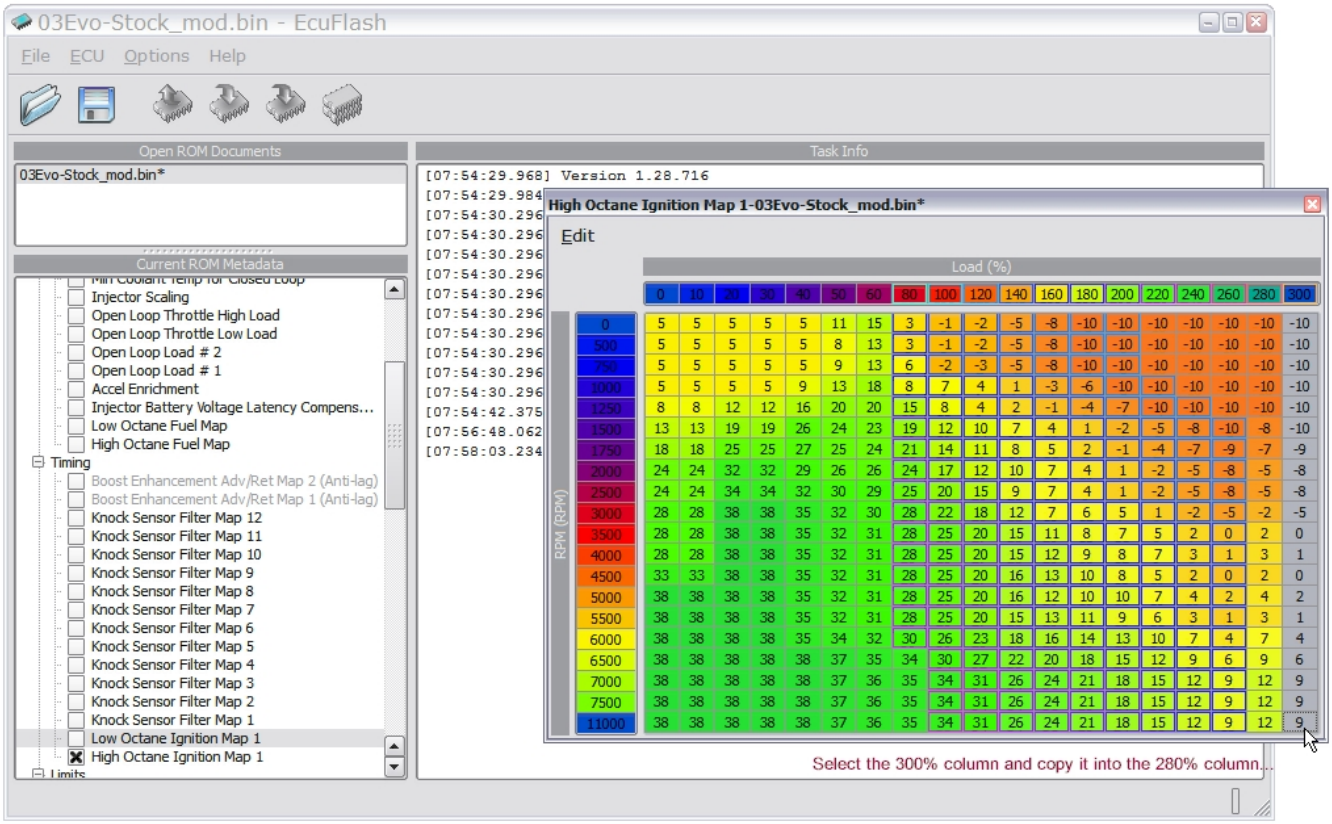

Figure 17, modified 2003 Evolution VIII ECU High Octane Ignition Map, select 300% Load column and copy

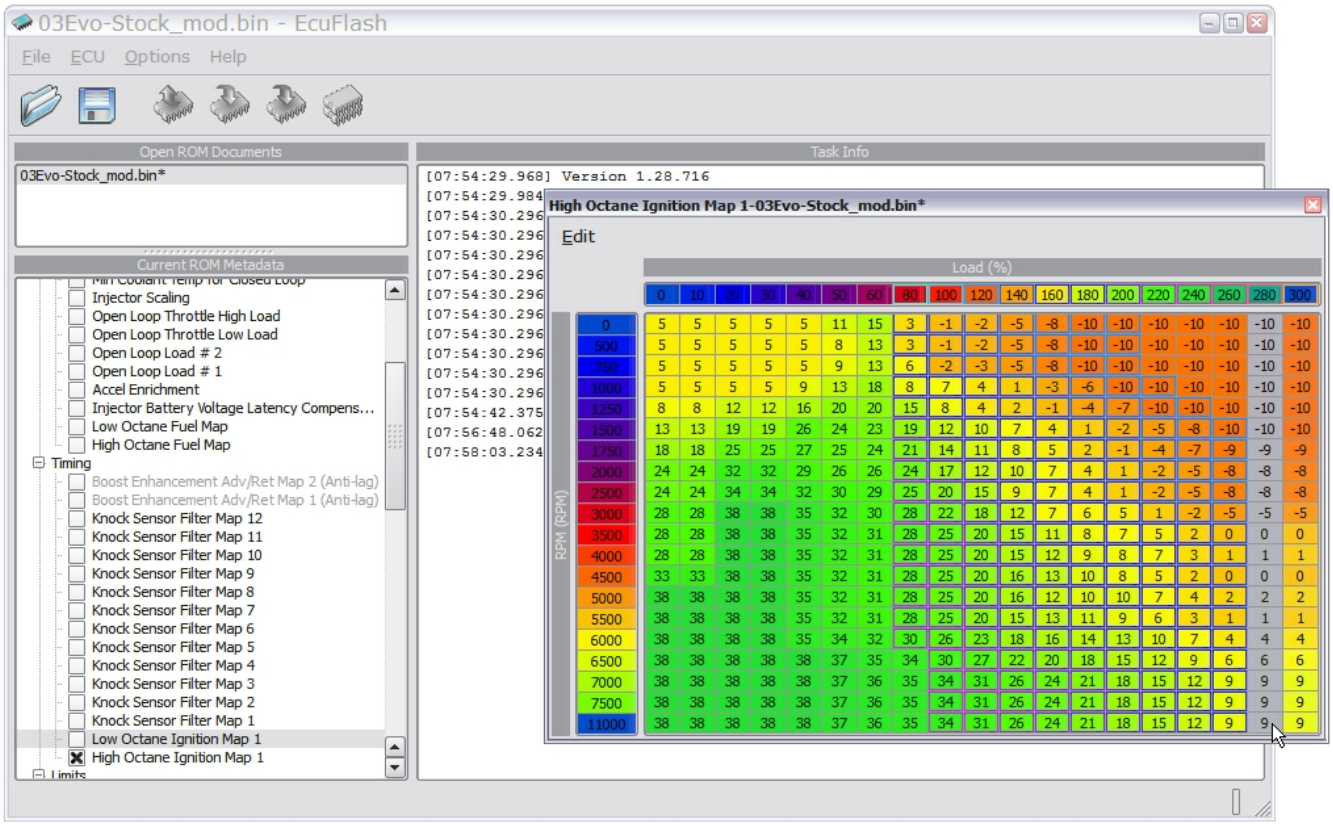

Figure 18, modified 2003 Evolution VIII ECU High Octane Ignition Map, paste into 280% Load column

b.) Adjust (timing/fuel) values in the new high load columns

Note how pasting the same the values into the new load columns has resulted in a large, flat area in the ECU table (figure 20), very much in contrast to how the stock ECU table is configured as shown in the figure 19 comparison. Since we do not know yet if the car can handle the same timing or fuel values in the higher load cells, it is prudent to reduce the values in each of the new columns to mimic the offsets already established by adjacent columns.

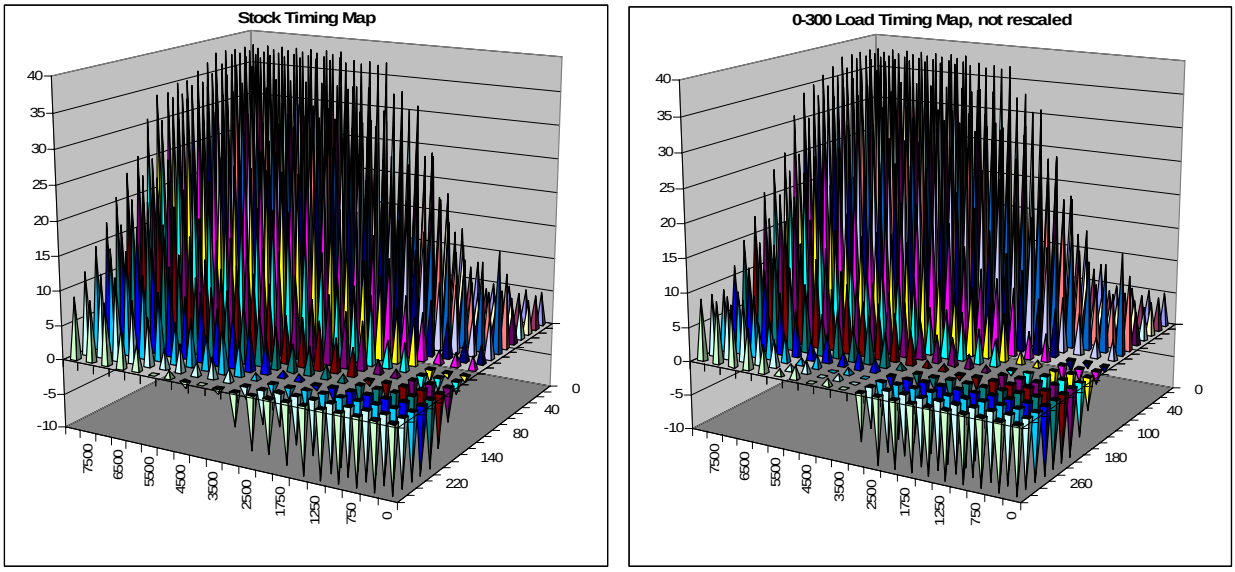

Figure 19, stock versus modified, but still flat timing values 2003 Evolution VIII ECU High Octane Ignition Map

Changing the values in the new load columns will also allow us to determine if the car is actually hitting the new load cells.

- Edit the 280% column values and 300% column values to approximate the timing curve carried forward from the 220%, 240% and 260% column in each respective row.

  For example, taking the 5000 RPM load cells, the timing values in the 220 to 260 Load columns are: 7, 4, 2. This gives us timing offsets of -3 and -2 degrees between each cell. In my rescaling I chose to carry forward an offset of -2 followed by -1, which results in a row of values as follows:

	220%	240%	260%	280%	300%
5000 RPM	7	4	2	0	-1

  Take a look at the table in figure 21 for the complete set of timing values that I chose for the new columns.

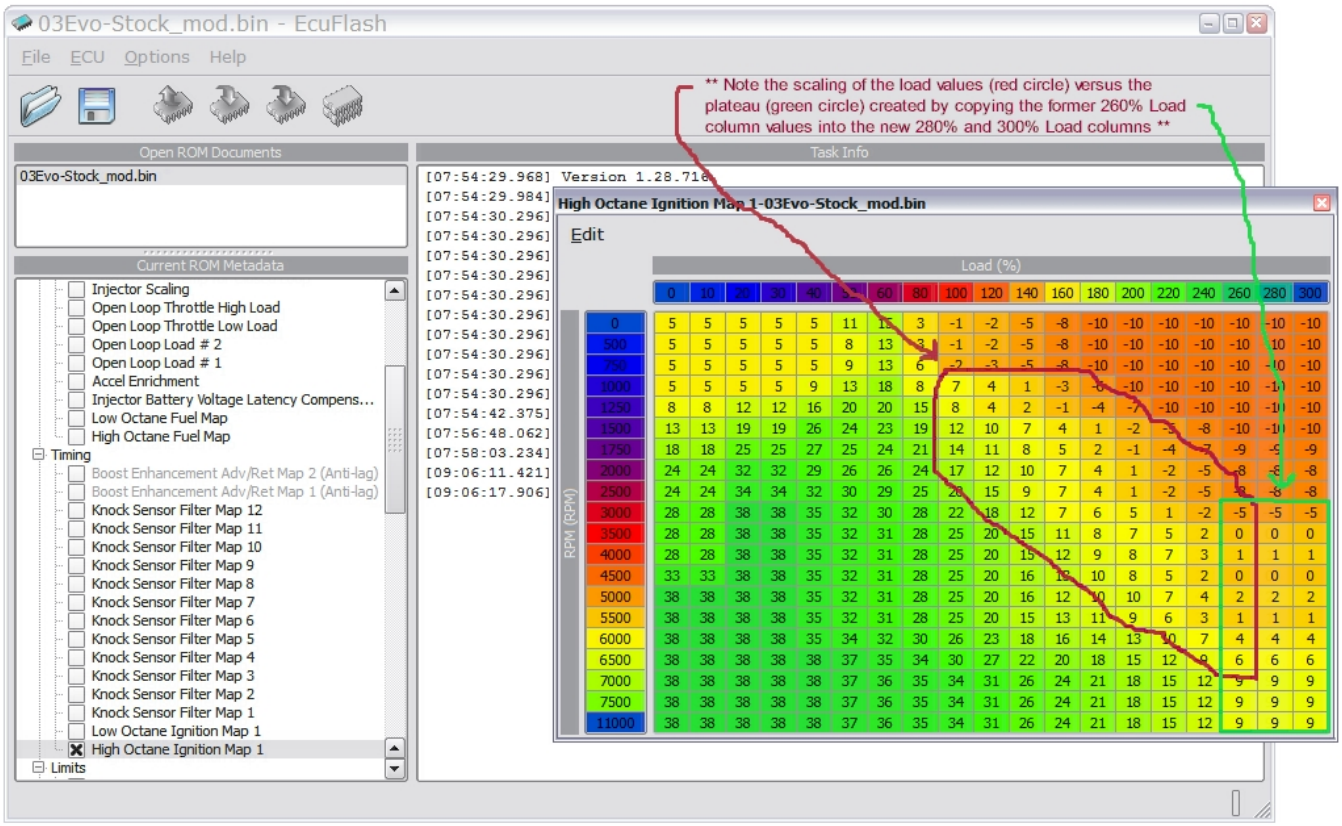

Figure 20, modified 2003 Evolution VIII ECU High Octane Ignition Map, timing plateau versus factory curve

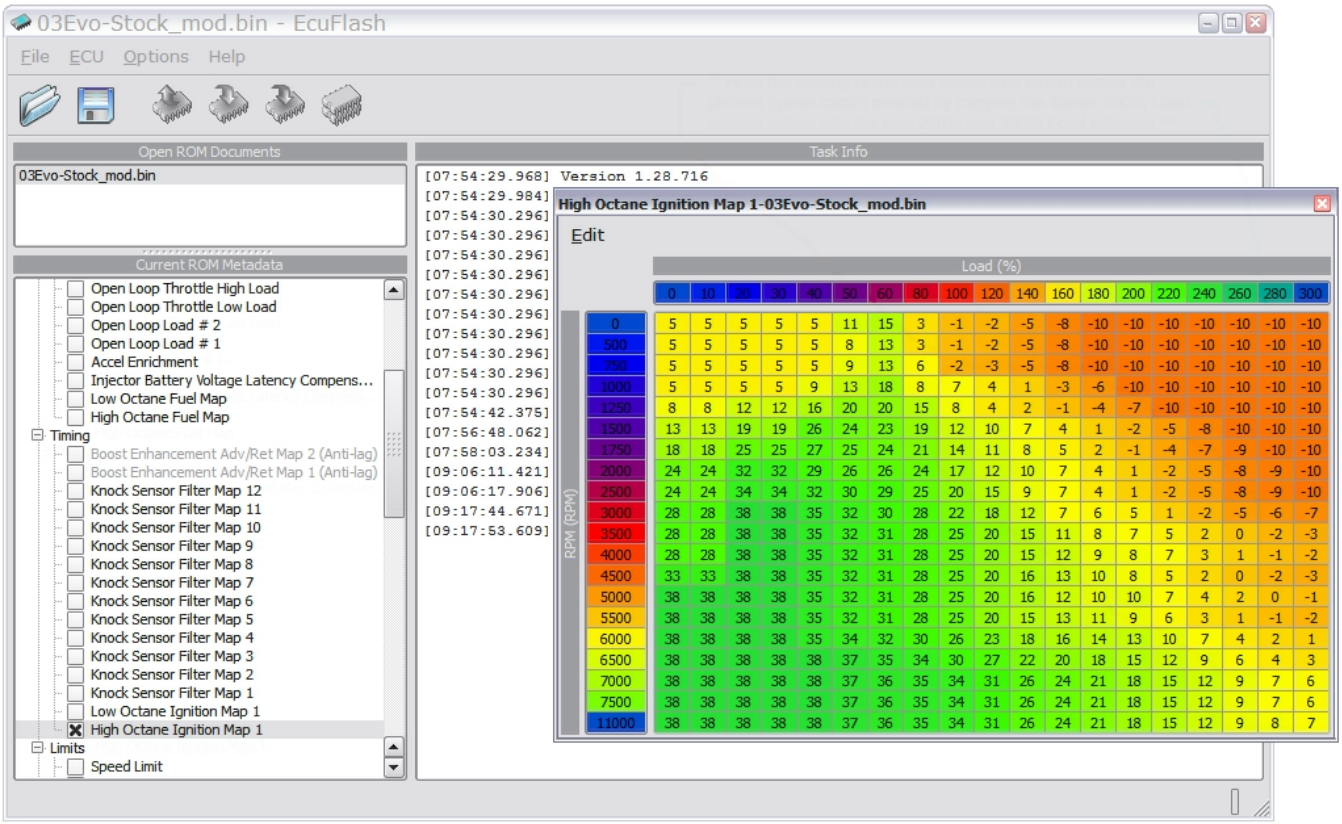

Figure 21, modified 2003 Evolution VIII ECU High Octane Ignition Map, rescaled to eliminate timing 'plateau'

Finally (because I just had to add one more cool graph) here is the comparison of the stock timing map to the new redefined and rescaled timing map (figure 22).

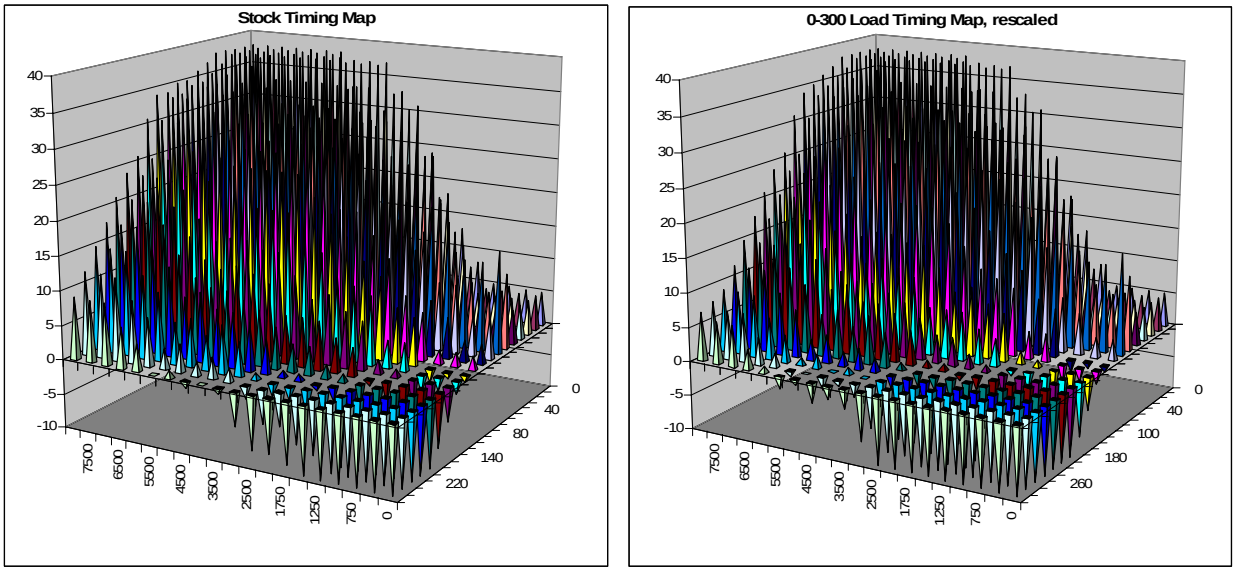

Figure 22, stock versus modified, with rescaled timing values 2003 Evolution VIII ECU High Octane Ignition Map

6.) Repeat steps 4 and 5 for the Low Octane Timing Map

Remember that by changing the Load (%) column header values in the High Octane Timing Map, we have also changed the Load (%) column header values for the Low Octane Timing Map.

Follow the instructions in steps (4) and (5), with Figure 23 and 24 as a guide. The current Low Octane Timing Map should look like the map in Figure 23. The data of the former 80% column and the former 100-260% columns need to be moved back under their correct header values (step 4), then the timing values in the 280% and 300% load columns need to be adjusted (step 5). The final Low Octane Timing Map should look like the map shown in Figure 24.

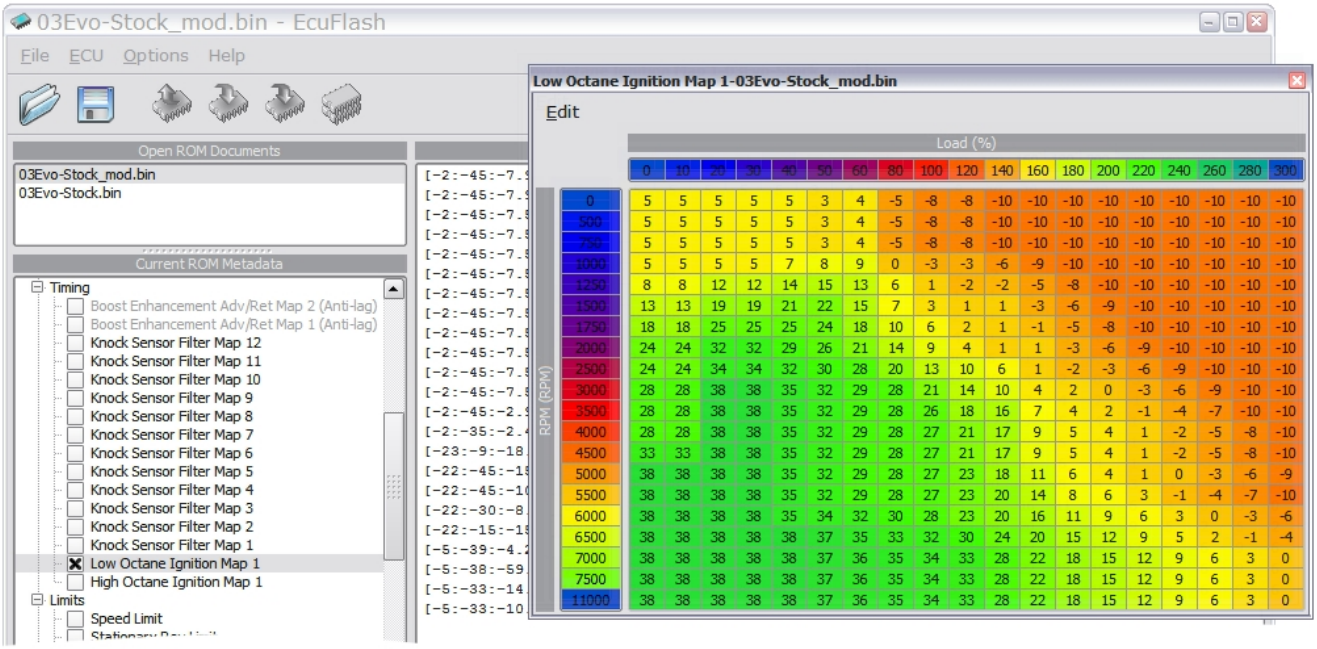

Figure 23, modified 2003 Evolution VIII ECU Low Octane Ignition Map, new Load (%) scale but still with stock timing values

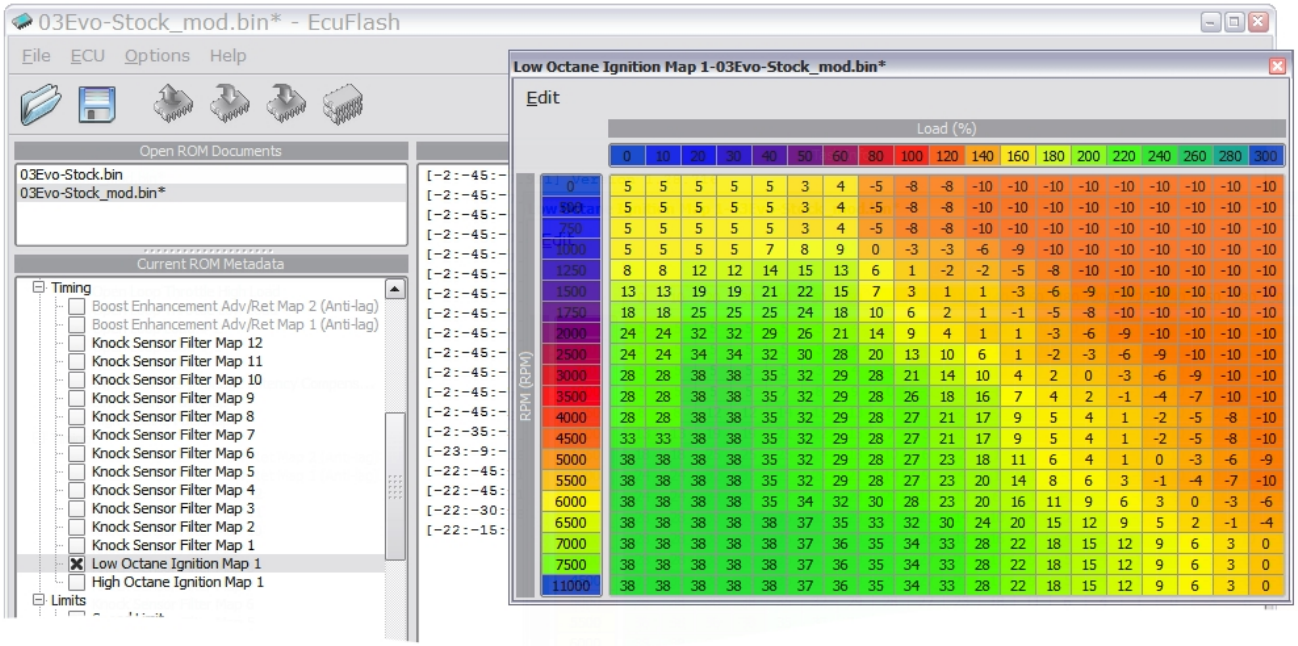

Figure 24, modified 2003 Evolution VIII ECU Low Octane Ignition Map, timing values moved and rescaled

7.) Repeat steps 2 through 6 for the High and Low Octane Fuel Maps

Follow the instructions in steps (2), (3), (4), and (5), with Figures 25, 26, and 27 as a guide. Just as with the timing maps, the column headers need to be redefined (step 2, step 3), then the values in the table need to be moved back under their respective column headers (step 4), and finally the values in the two new high load columns have to be rescaled (step 5).

Figures 25 and 26 illustrate what the High and Low Octane Fuel Maps should look like before and after the Load (%) values have been changed as part of steps (2) and (3).

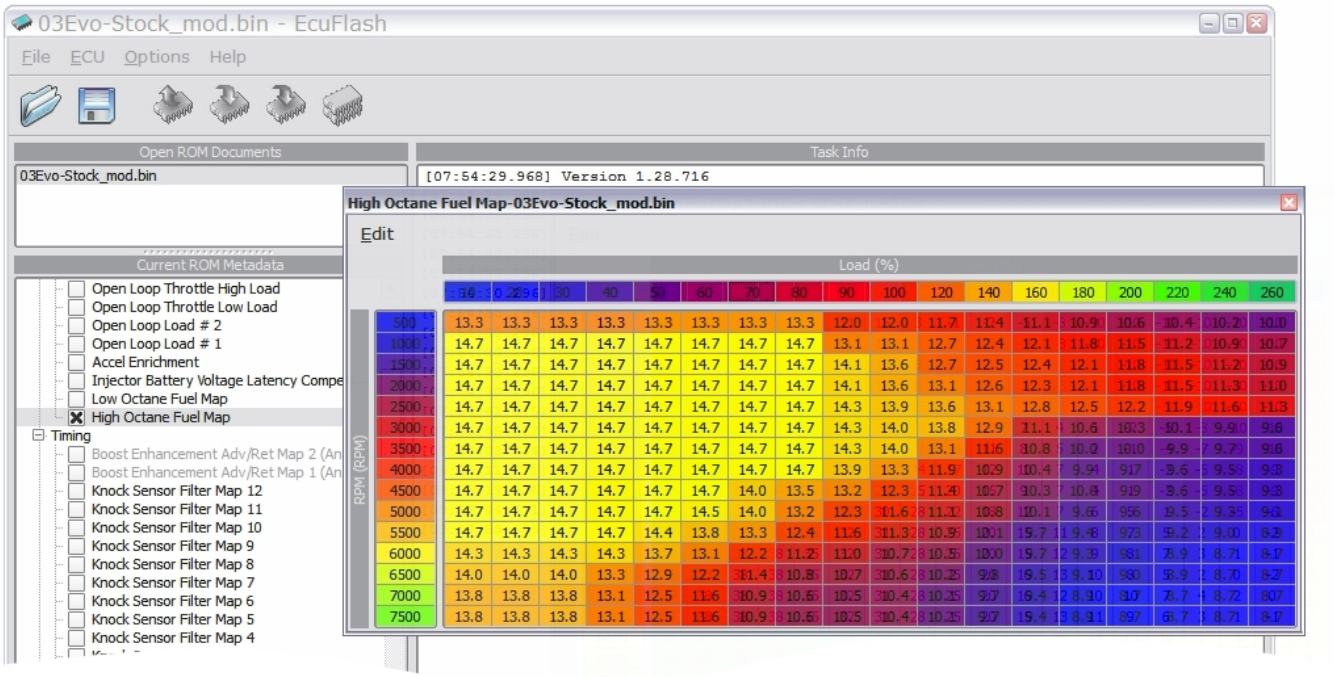

Figure 25, stock 2003 Evolution VIII ECU High Octane Fuel Map

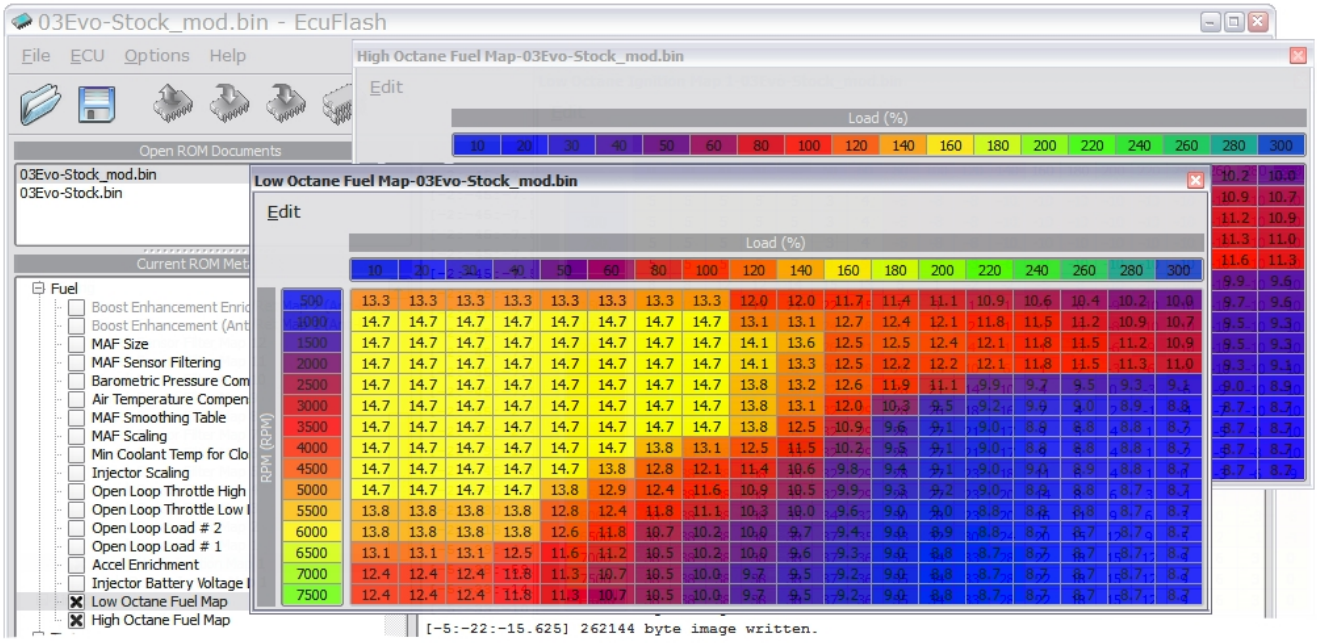

Figure 26, modified 2003 Evolution VIII ECU High and Low Octane Fuel Map, Load (%) values before adjusting fuel targets within map

Figure 27 illustrates how I chose to rescale the 280% and 300% columns in the High Octance Fuel Map. Don't forget to move the previous 80% and 100%-260% columns back under their respective headers (step 4), before rescaling the fuel target values in the 280% and 300% column (step 5).

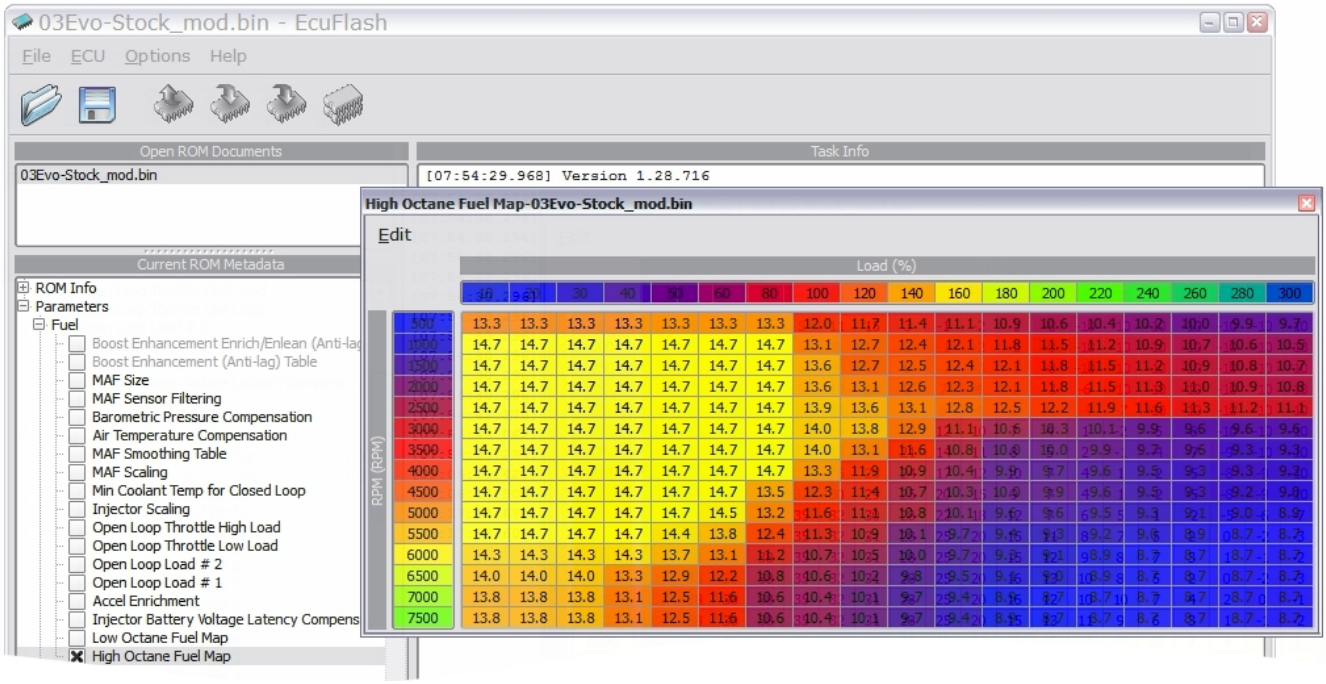

Figure 27, modified 2003 Evolution VIII ECU High Octane Fuel Map

Conclusion

Hopefully this tutorial proved helpful. Be sure to double check your work before you upload any edited maps to your vehicle.

See you at the track…

- Ludikraut -