Flex Tuning/Switchpatch

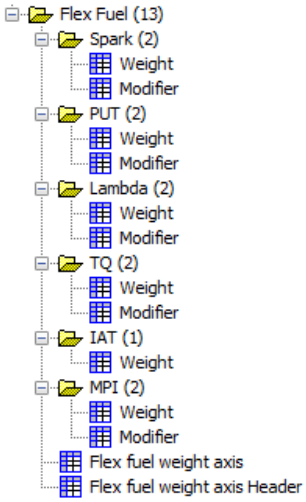
To utilize full flex tuning, there are several pre-requisites:

- Required fueling hardware
- Ethanol sensor wired in
- Latest Switchpatch (28.15 as of this writing) applied to your BIN, and a full flash to your ECU
- See ***Ethanol Senso***r settings in the *ECU Basics* document to enable it to read E content on the fly - confirm it reads accurately before proceeding

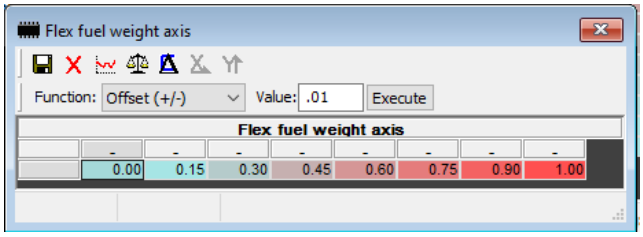
Depending how your existing basemap is set up, there are several approaches to using the flex modifiers in the switchpatch. The most straightforward is to take a vetted pump gas map and apply positive modifiers to timing/boost/etc based on added ethanol content. The inverse is to take a map designed for full ethanol content and apply negative modifiers as ethanol content drops, which are the examples shown here.

Within the switchpatch there are currently 5 different map slots available, each map slot has the ability to enable or disable flex tuning. Keep this in mind when determining your tuning approach.

Let's take a look at the flex fuel tables and start with enabling the global modifiers first, then we'll decide which maps we want to enable them on.



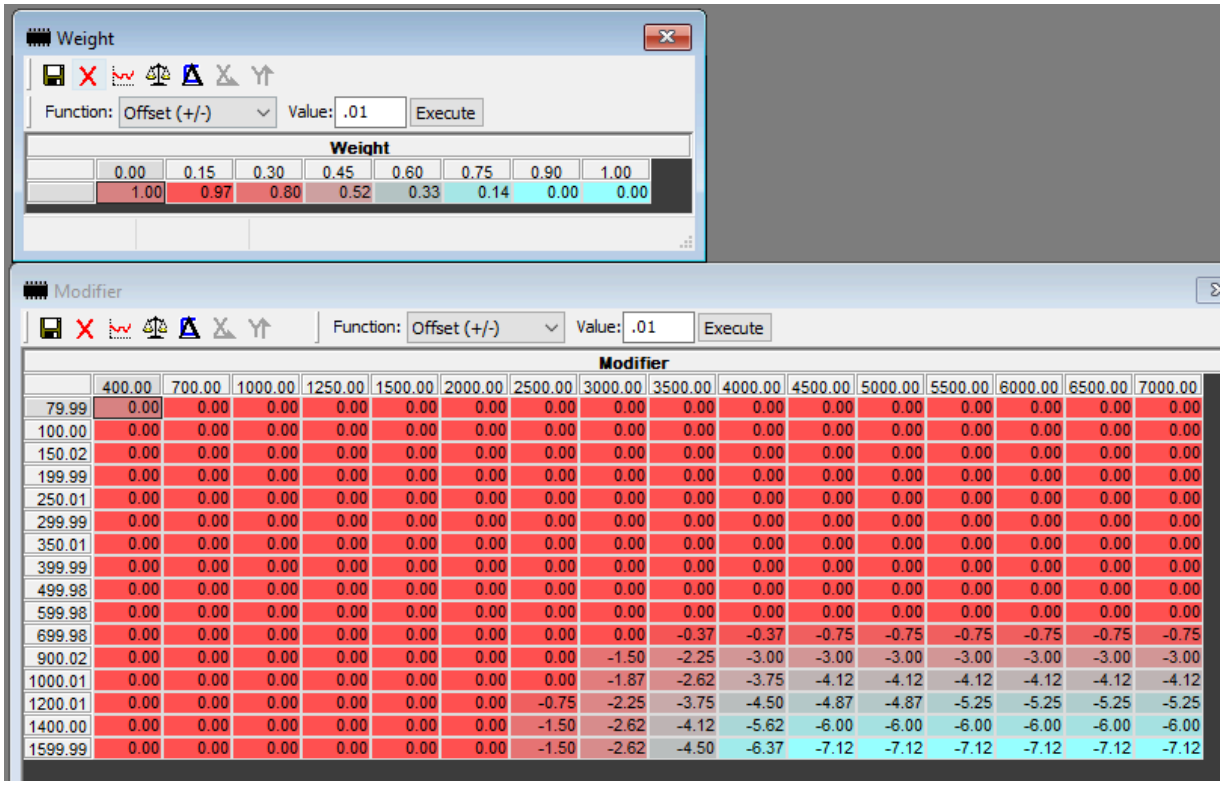
The Flex Fuel Weight Axis table sets the weight for which each parameter is flexed based on reported ethanol content.



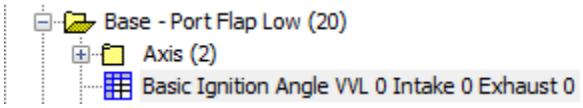
For the most part, using flex to control timing/spark will be the most commonly used function so the examples below are more heavily discussed using spark tables. You typically wouldn't need to flex boost or lambda/AFR with ethanol content changes. Ethanol content won't impact how much boost you can push through a turbo and running the same lambda/AFR on pump gas and full E85 isn't going to make the motor blow up. But with flex the option is certainly there to make adjustments if you wanted to.

Spark:

Below is an example of using negative modifiers, the base map has already been tuned for full E85 and the weight is inverted here (keeping the axis the same). So when E content is 0 (the axis) it's using 100% of my modifier table (timing pull in this case). Note the non-linear curve as well where there are no negative modifiers above around E85. This is a conservative start to see where more timing/boost needs to be pulled based on less ethanol content. Base timing is about 15 degrees on full E at 7000rpm, so the goal here was to bring that to around 8 degrees on pump at that rpm with similar pull down the rev range.



Base Table



Basic Ignition Angle VVL 0 Intake 0 Exhaust 0

Function: Offset (+/-) Value: 1.0 Execute

Basic Ignition Angle VVL 0 Intake 0 Exhaust 0

	400.00	700.00	1000.00	1250.00	1500.00	2000.00	2500.00	3000.00	3500.00	4000.00	4500.00	5000.00	5500.00	6000.00	6500.00	7000.00
79.99	17.62	21.37	23.25	26.62	33.00	37.12	37.12	37.12	40.12	40.12	40.12	40.12	40.12	40.12	40.12	40.12
100.00	16.50	18.00	18.37	21.37	31.12	33.00	34.12	34.87	37.87	40.12	40.12	40.12	40.12	40.12	40.12	40.12
150.02	10.12	10.12	10.50	15.00	30.00	34.12	30.00	34.87	37.12	40.12	40.12	40.12	40.12	40.12	40.12	40.12
199.99	8.25	8.25	9.75	16.87	28.87	32.25	30.00	30.00	28.12	31.12	39.00	34.87	31.87	31.87	33.00	34.12
250.01	6.37	6.37	9.75	16.12	24.75	24.37	24.00	25.12	25.87	28.87	34.87	33.00	28.87	27.00	28.12	28.87
299.99	5.62	5.62	9.37	15.00	21.37	21.37	21.00	22.12	22.87	25.87	28.12	30.00	28.12	25.87	25.12	25.87
350.01	4.87	4.87	9.37	14.25	17.62	18.75	16.87	18.00	19.12	22.12	25.87	25.12	24.00	22.12	21.75	22.87
399.99	4.50	4.50	6.00	9.00	12.75	13.12	16.12	16.87	18.00	19.12	22.12	22.12	21.00	21.00	20.62	21.00
499.98	4.50	4.50	0.37	3.00	4.50	9.37	12.37	13.12	13.87	16.87	16.50	16.87	17.62	19.87	19.12	19.87
599.98	-1.87	-1.87	0.75	-3.00	3.00	6.00	7.87	10.12	12.00	15.37	15.75	16.50	16.87	18.00	19.12	19.87
699.98	-4.12	-4.12	-2.25	-3.75	1.12	4.12	6.00	6.00	9.00	12.00	13.12	13.87	14.25	16.12	18.00	18.37
900.02	-4.87	-5.62	-3.00	-4.12	0.37	1.12	2.62	1.87	4.87	8.25	9.37	11.25	13.12	15.00	16.87	18.00
1000.01	-6.00	-6.00	-6.00	-4.87	-3.00	-3.00	0.00	0.75	1.87	5.62	7.87	10.12	12.00	13.87	16.12	16.87
1200.01	-7.87	-7.87	-7.87	-6.00	-4.87	-3.00	-2.62	-0.37	0.37	2.62	6.00	9.00	10.12	12.00	13.87	16.12
1400.00	-7.87	-7.87	-7.87	-6.00	-4.87	-4.87	-3.00	-3.00	-1.12	0.00	5.25	7.87	9.37	11.62	13.50	15.37
1599.99	-7.87	-7.87	-7.87	-7.12	-6.00	-6.00	-5.62	-3.00	-1.12	0.00	4.12	7.12	9.00	11.25	13.12	15.00

What the ECU will actually run with the negative modifier above when it sees there is no ethanol in the fuel.

Theoretical new timing table (the table isn't actually being changed, this is just showing what timing you would expect to see in your logs)

Basic Ignition Angle VVL 0 Intake 0 Exhaust 0

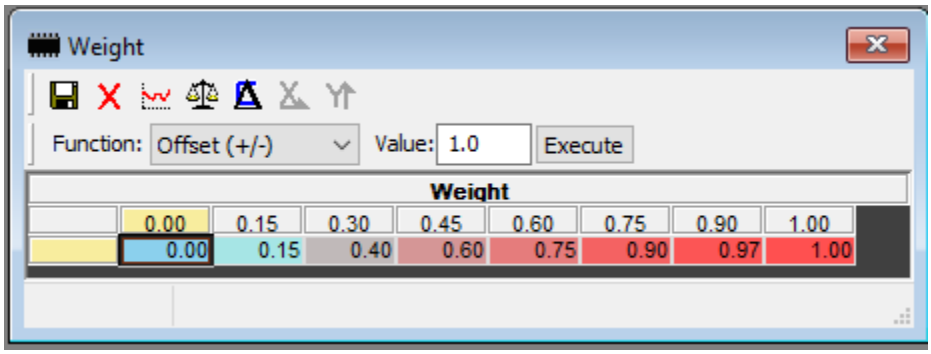
Function: Offset (+/-) Value: 1.0 Execute

Basic Ignition Angle VVL 0 Intake 0 Exhaust 0

	400.00	700.00	1000.00	1250.00	1500.00	2000.00	2500.00	3000.00	3500.00	4000.00	4500.00	5000.00	5500.00	6000.00	6500.00	7000.00
79.99	17.62	21.37	23.25	26.62	33.00	37.12	37.12	37.12	40.12	40.12	40.12	40.12	40.12	40.12	40.12	40.12
100.00	16.50	18.00	18.37	21.37	31.12	33.00	34.12	34.87	37.87	40.12	40.12	40.12	40.12	40.12	40.12	40.12
150.02	10.12	10.12	10.50	15.00	30.00	34.12	30.00	34.87	37.12	40.12	40.12	40.12	40.12	40.12	40.12	40.12
199.99	8.25	8.25	9.75	16.87	28.87	32.25	30.00	30.00	28.12	31.12	39.00	34.87	31.87	31.87	33.00	34.12
250.01	6.37	6.37	9.75	16.12	24.75	24.37	24.00	25.12	25.87	28.87	34.87	33.00	28.87	27.00	28.12	28.87
299.99	5.62	5.62	9.37	15.00	21.37	21.37	21.00	22.12	22.87	25.87	28.12	30.00	28.12	25.87	25.12	25.87
350.01	4.87	4.87	9.37	14.25	17.62	18.75	16.87	18.00	19.12	22.12	25.87	25.12	24.00	22.12	21.75	22.87
399.99	4.50	4.50	6.00	9.00	12.75	13.12	16.12	16.87	18.00	19.12	22.12	22.12	21.00	21.00	20.62	21.00
499.98	4.50	4.50	0.37	3.00	4.50	9.37	12.37	13.12	13.87	16.87	16.50	16.87	17.62	19.87	19.12	19.87
599.98	-1.87	-1.87	0.75	-3.00	3.00	6.00	7.87	10.12	12.00	15.37	15.75	16.50	16.87	18.00	19.12	19.87
699.98	-4.12	-4.12	-2.25	-3.75	1.12	4.12	6.00	6.00	8.62	11.62	12.37	13.12	13.50	15.37	17.25	17.62
900.02	-4.87	-5.62	-3.00	-4.12	0.37	1.12	2.62	0.37	2.62	5.25	6.37	8.25	10.12	12.00	13.87	15.00
1000.01	-6.00	-6.00	-6.00	-4.87	-3.00	-3.00	0.00	-1.12	-0.75	1.87	3.75	6.00	7.87	9.75	12.00	12.75
1200.01	-7.87	-7.87	-7.87	-6.00	-4.87	-3.00	-3.37	-2.62	-3.37	-1.87	1.12	4.12	4.87	6.75	8.62	10.87
1400.00	-7.87	-7.87	-7.87	-6.00	-4.87	-4.87	-4.50	-5.25	-4.87	-5.62	-0.75	1.87	3.37	5.62	7.50	9.37
1599.99	-7.87	-7.87	-7.87	-7.12	-6.00	-6.00	-6.37	-5.62	-5.62	-6.37	-3.00	0.00	1.87	4.12	6.00	7.87

Be very careful when setting these up as you don't want to inadvertently add positive timing to your pump tune while still on pump gas. A good first test when starting out might be to use negative modifiers just to verify it's working and the weighting is correct.

If you are working from the opposite direction (going from pump gas to E85) you would set your weight table in the opposite direction.

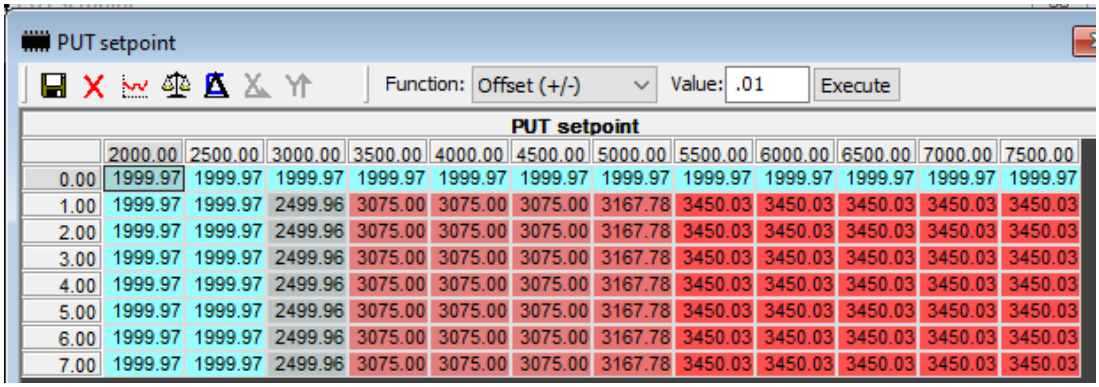


And instead of pulling timing you would add timing. Same modifier table as above but instead of negative you would make the numbers all positive where you want to add timing. Fill it up with E85 and make any adjustments needed. Try E30 and see how it responds and adjust from there. E50-60 should be very similar to E85

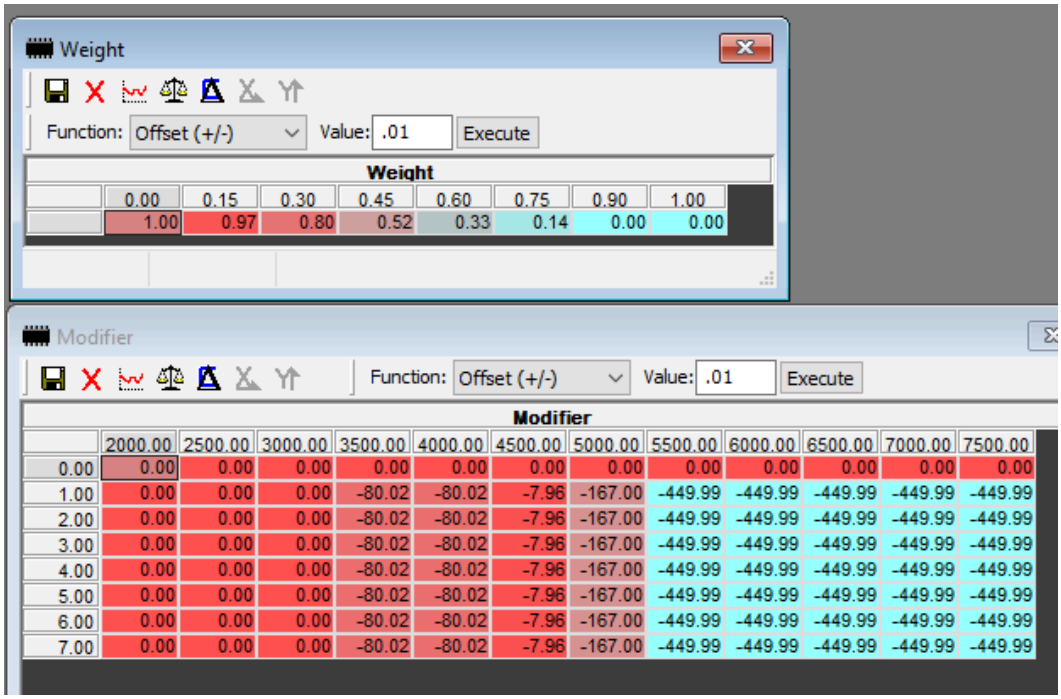
PUT:

Similar concept here, copy paste the weighting you set previously to keep things consistent. The modifier will add/subtract from your PUT setpoint in the Boost By Gear within whichever map switch you are in. In this example you can see the boost target and the negative modifiers pulling everything to about 3000 mbar as the new target, down from the reverse tapered 3450 mbar.

Base PUT setpoint table from Map1

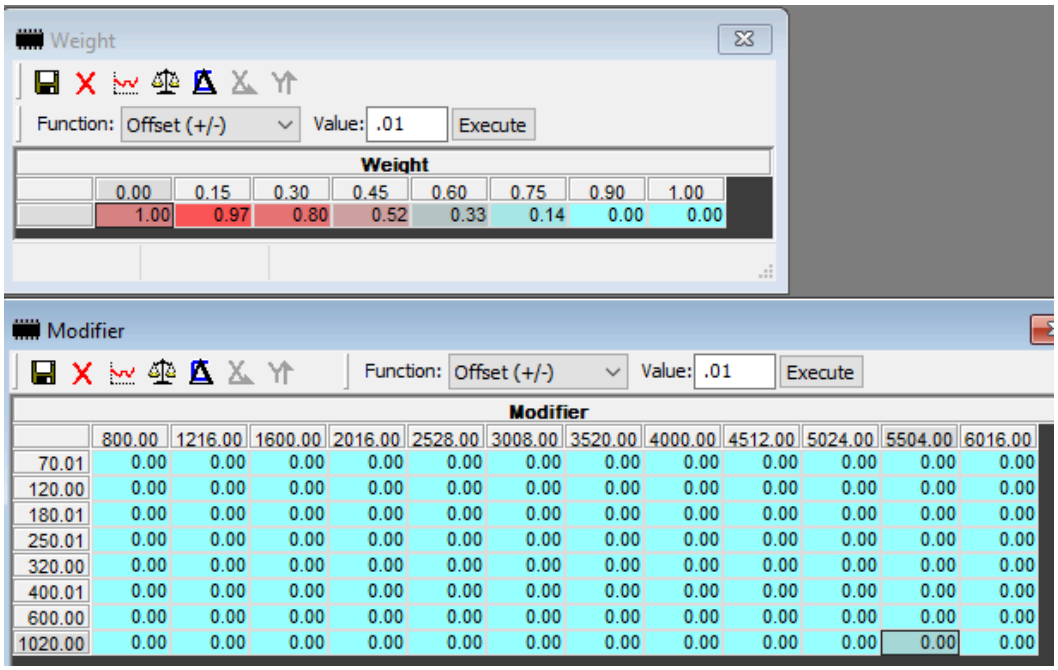


PUT weight table and modifier:



Lambda:

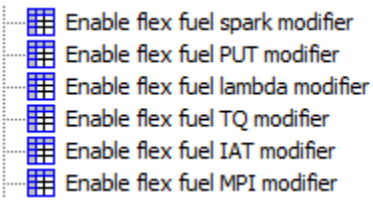
Same concept here, copy paste your weights and add/subtract to your lambda targets. You may want to run richer on pump or leaner on ethanol, or leave them zeroed for no effect.

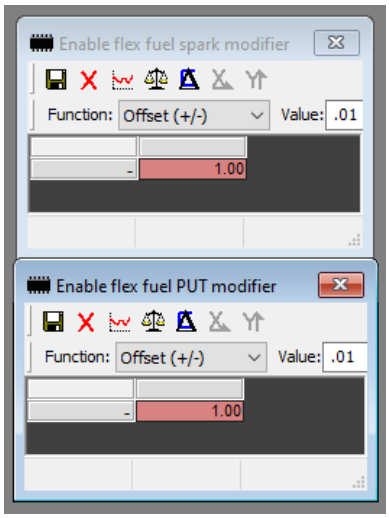


You can follow the same approach for the other variables, favoring DI/MPI depending on content, torque, etc.

Setting Flex by Map

To finish enabling flex tuning you'll need to go into the Map you want it to be enabled on and enable the modifiers you've set above. So if you only want to use spark/PUT modifiers then go to the desired map and flip the enablers from 0 to 1, then go back and double check once you've saved the settings.





PUT and Spark Flex have been enabled within this Map.