Basic Spark Advance Table:

SPARK ADVANCE BASE MAP (DEG BTDC)(-,-)/-

-	0	16	33	50	66	82	99	116	132	148	165	182
500	16.5	12.8	9.8	5.2	4.5	3.8	1.5	0.0	0.0	0.0	0.0	0.0
900	17.2	16.5	15.8	10.5	9.0	7.5	1.5	0.0	0.0	0.0	0.0	0.0
1300	18.8	21.8	20.2	17.2	16.5	13.5	11.2	6.0	0.8	0.0	0.0	0.0
1700	19.5	23.2	22.5	19.5	18.8	15.0	11.2	8.2	6.0	4.5	0.8	0.0
2100	20.2	23.2	23.2	20.2	19.5	15.0	12.0	9.0	5.2	3.8	0.8	0.0
2500	21.0	24.0	24.0	21.0	19.5	15.8	12.8	9.8	6.0	4.5	1.5	0.0
2900	21.8	24.8	24.8	21.8	19.5	15.0	12.0	9.8	6.0	4.5	3.0	2.2
3300	26.2	28.5	30.0	29.2	26.2	21.8	19.5	15.8	12.0	9.8	9.0	7.5
3700	31.5	32.2	33.0	33.0	30.0	26.2	23.2	20.2	16.5	15.0	12.8	9.8
4100	35.2	34.5	33.0	32.2	29.2	26.2	24.8	23.2	19.5	18.0	15.8	14.2
4500	42.0	34.5	33.0	33.0	30.8	29.2	27.8	25.5	21.8	19.5	18.0	15.0
4900	42.0	36.0	34.5	30.8	29.2	28.5	28.5	27.0	24.0	21.8	18.8	15.8
5300	41.2	35.2	28.5	27.8	27.0	27.0	27.0	27.8	25.5	22.5	19.5	16.5
5700	42.0	30.0	29.2	28.5	28.5	28.5	28.5	28.5	25.5	23.2	19.5	17.2
6100	43.5	28.5	28.5	28.5	27.8	29.2	29.2	30.0	28.5	25.5	21.8	17.2
6500	38.2	31.5	31.5	27.8	27.0	29.2	29.2	30.0	27.8	24.0	20.2	17.2

These are the base ignition timing tables. These are the lower end of the timing maps that are used. Most of the time the timing is close to these values if the knock control system is active.

ends on the engine rev number and the cylin
the table are expressed in degrees before the
TDC Factor of this table is 0.7 .

Optimum Spark Advance Table:

OPTIMAL SPARK ADVANCE 1 (DEG BTDC)(-,-)/-

-	0	18	36	54	72	90	108	126	144	162	180
500	41.2	36.0	30.8	25.5	21.8	20.2	18.8	16.5	15.8	14.2	13.5
900	42.0	36.8	31.5	27.0	23.2	21.8	20.2	18.0	16.5	15.8	15.0
1300	44.2	38.2	33.0	28.5	24.8	23.2	22.5	21.0	19.5	18.0	16.5
1700	46.5	40.5	35.2	30.8	25.5	24.8	24.0	23.2	21.8	21.0	19.5
2100	48.8	42.0	36.8	33.0	27.8	25.5	24.8	24.0	24.0	23.2	23.2
2500	54.8	48.0	40.5	36.0	31.5	29.2	27.8	26.2	24.8	24.8	24.8
2900	57.0	53.2	42.0	36.0	33.0	30.8	29.2	27.8	26.2	25.5	26.2
3300	58.5	54.0	45.0	39.0	36.0	33.8	31.5	30.0	28.5	28.5	28.5
3700	61.5	58.5	51.0	43.5	39.8	37.5	35.2	33.8	31.5	29.2	29.2
4100	64.5	60.0	50.2	44.2	39.8	37.5	36.0	34.5	33.0	31.5	31.5
4500	63.8	56.2	45.8	39.8	37.5	36.0	35.2	33.8	33.0	31.5	32.2
4900	61.5	54.0	45.0	39.0	36.0	34.5	33.8	33.8	33.0	33.0	33.0
5300	60.0	53.2	45.8	39.8	36.8	34.5	33.0	33.0	32.2	32.2	32.2
5700	58.5	52.5	45.0	38.2	36.0	34.5	33.8	33.8	33.8	33.8	33.8
6100	57.8	52.5	44.2	38.2	36.0	36.0	36.0	35.2	34.5	34.5	34.5
6500	58.5	52.5	44.2	38.2	36.0	36.0	36.0	35.2	34.5	34.5	34.5

This table relates to maximum spark advance values that a specific engine can reach for maximum performance in optimal conditions. These are the most ideal timing values for the engine and are used in the whole ignition efficiency calculation.

By increasing engine speed, we have more spark advances and by increasing engine load, we have fewer spark advances.

❓Why do we have more spark advance when engine speed increases?

The direct connection of the spark advance with the engine revolution is the ignition time in the engine. Since ignition occurs at a constant time of three thousandths of a second, there is enough time at full engine revolutions for complete ignition near the top dead center.

Therefore, making the spark advance near the top dead center is necessary. This means that a small amount of spark advance is required. As the engine revolution increases, the spark advance increases more, so that the constant-time ignition takes place right at the top dead center, i.e., the spark starts earlier so that the “Fuel-Air Mixture” has enough time to burn.

This means that the spark advance does not increase at high revolutions because the engine revolution is high and the burner propagation revolution is constant, the ignition will be dragged after the top dead center. Therefore, the maximum ignition

pressure at the high death point will not be applied to the piston and reduce the engine power. By properly adjusting the spark advance based on engine revolution, we can have the maximum ignition pressure at all rates.

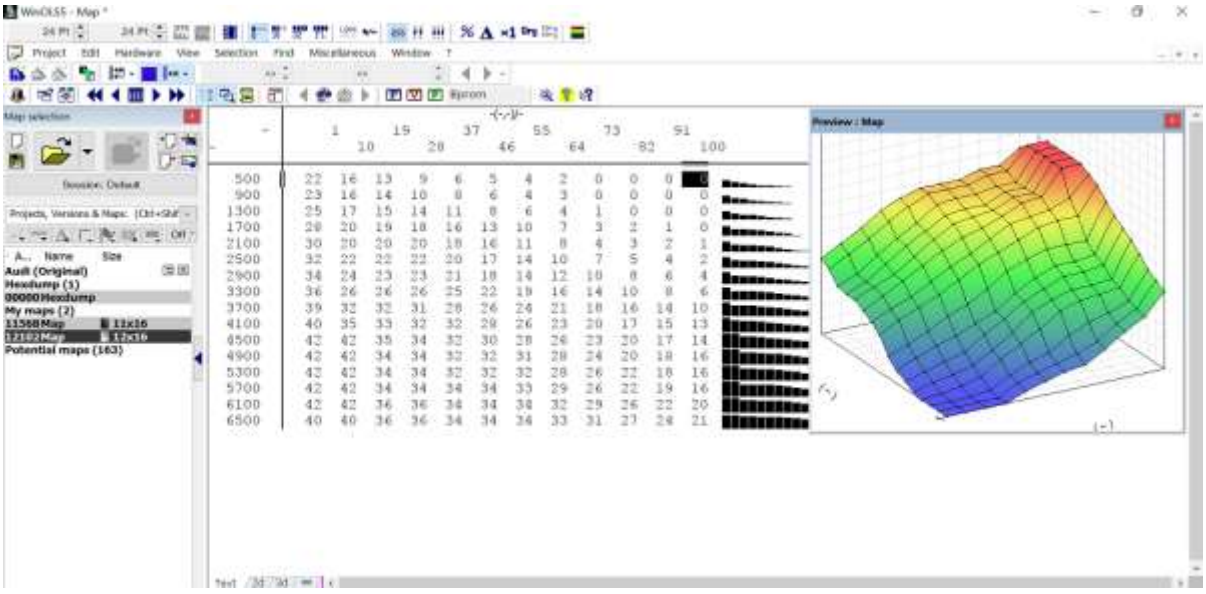
And the next question is, why does the spark advance decrease as the engine load increases or the cylinder fills with air?

ing is also dependent on the load of the engine, ra
ir/Fuel Ratio (AFR), less advance is required an
e with increasing engine compression and the a
he ignition rate increases, and as the ignition rat
spark adva

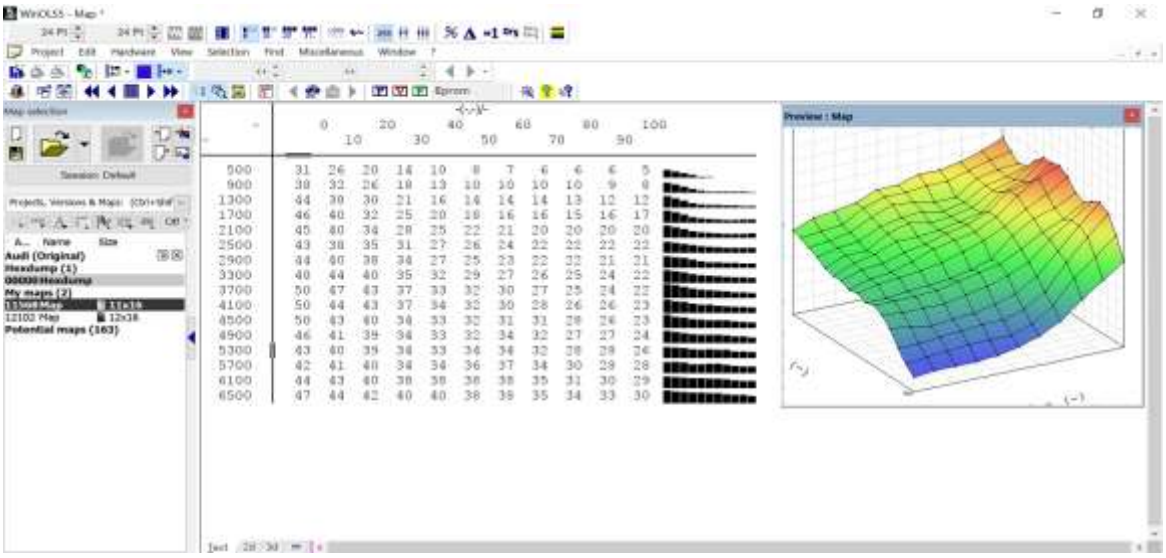
💬Spark Advance Table in WinOLS:

Now that you know about the spark advance and its types in ECU, to get acquainted with these tables and give additional explanations, we go directly to the ECU file.

We used Audi TT with Bosch ME7 ECU. Let's see what spark advance looks like in WinOLS software. As I said we have optimal spark advance and basic spark advance:



"Spark Advance"



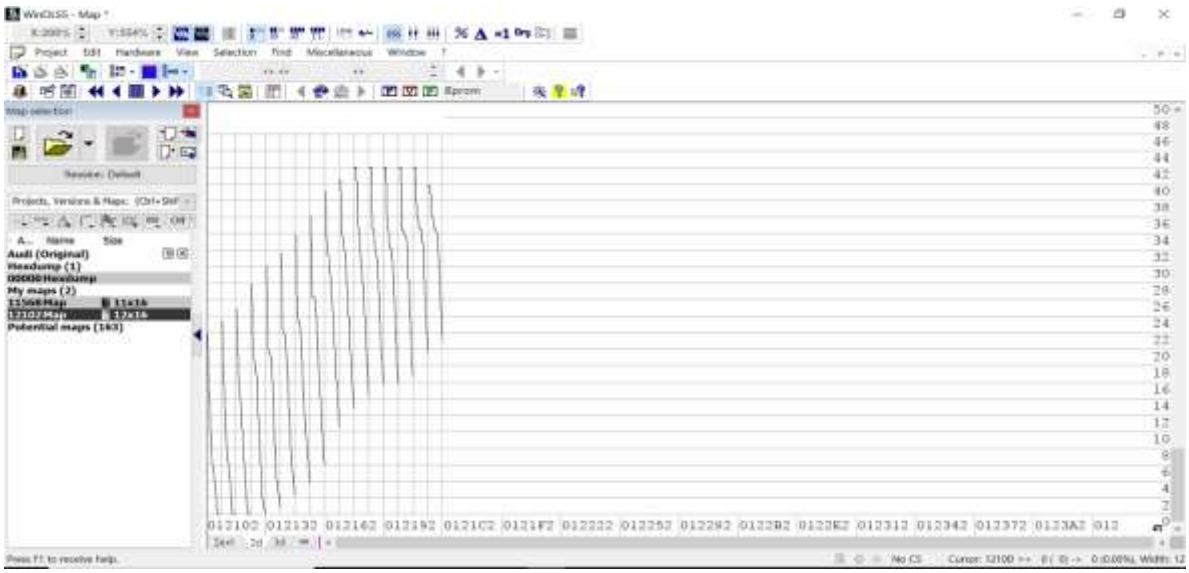
“Optimal Spark Advance”

You may have a question that “Why we have more than 1 table related to the spark advance map?”

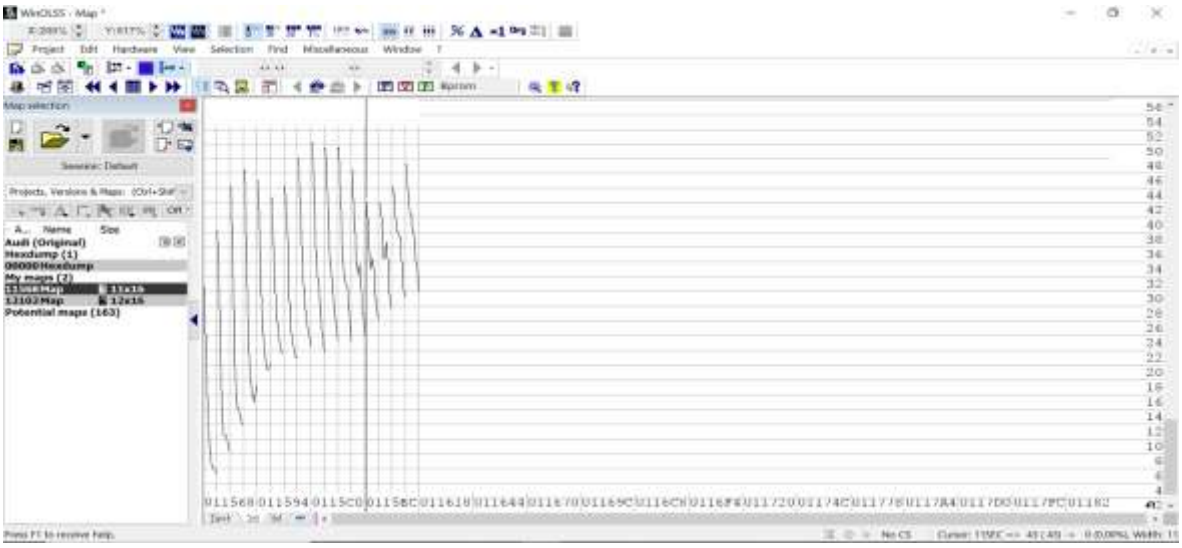
The answer is that because the engine is working in different conditions and depending on engine technology and engine working condition, we have different tables that ECU can manage and control all conditions.

some spark advance tables are related to the VV
ines with a variable valve tim

in the spark advance table, the vertical axis is t
tal axis is the percentage of cylinder air filling
ark advance before top dead center. In WinOLS
u can see in previous pictures) and



“Spark Advance 2D”



“Optimal Spark Advance 2D”

Please pay attention to the rhythm of the numbers in the table. By increasing engine speed, we have more spark advances and by increasing cylinder air filling or load, we have less spark advance.

We said that as the engine revolution increases, the spark advance increases more so that the constant-time ignition takes place right at the top dead center, i.e., the spark starts earlier so that the fuel-air mixture has enough time to burn.

And with more load and larger throttle opening and therefore AFR (Air Fuel Ratio), less advance is required and the mixture burns faster.

Because with increasing engine compression and the amount of turbulence in the Airflow, the ignition rate increases, and as the ignition rate increases, we need less spark advance.

There are four optimal spark advance tables and four basic spark advance tables.

We have already fully explained the difference between these two tables, but to better understand the functional difference between these two types of tables, we need to say more about this.

the optimal spark advance table number 1 and
table. We see that in the Full load area at 3700 to
umbers have increased from 22 to

ese numbers. Then we open the basic spa

ers in the table. You can see that in the full lo
on of 3700 to 6500 RPM, the spark advance nu
10 to 21 deg

he explanations we have previously given you
two types of tables. Compare the numbers bet
asic spark advance table. You will notice tha
e is higher by a few

The basic spark advance table provides the minimum spark advance for regular engine operating conditions. But the optimal spark advance table offers the maximum performance for the engine. In simple term, the engine usually works with the primary table, but ECU and engine conditions and efficiency determine that the spark advance numbers achieve optimal spark advance. This is why optimal spark numbers are usually greater than basic advance.

The ECU will attempt to ride in between the Base and optimal at all times. Feedback from the knock sensors can allow additional dynamic advance or retard to be applied

to the base. Timing is allowed to go below the base but will never be allowed above the optimal.

Depending on the different conditions of the engine, we can select and change other areas. For example, the idle area in a standard engine does not need to be advanced or retarded. Still, in some engines with the racing camshaft, so that engine doesn't work smoothly in idle mode, also called rough idle, we can increase the spark advance slightly in idle mode. In another example, for cars that use low-octane petrol, i.e., have knock, in the working areas of the engine facing this phenomenon, we can slightly retard the spark that the knock eliminated. But in general, if we have a standard car with good conditions and high-octane fuel, we can increase the spark in the "Wide-Open Throttle" area.

❓**This question arises: "Why does the manufacturer not set the spark advance to its maximum?"**

Keep in mind that the car manufacturer must plan the amount of spark advance so that if a car is operating at an ambient temperature above 50 degrees and the ignition temperature rises, the car engine will not be damaged. The exact vehicle should also work to be easily turned on at a temperature of -20 degrees.

💬Training summary:

1- In order to get the most torque and power from the engine, the target is to maximize the pressure in the cylinder during the power stroke. Maximizing pressure will also produce the best engine efficiency, which translates directly into better mileage. The timing of the spark is critical to success.

2- **Work = Force * Distance**

In a cylinder:

- **Force** = Pressure * Area of the piston
- **Distance** = Stroke length

So, when we're talking about a cylinder,
work = pressure * piston area * stroke length.

3- Igniting timing" refers to the number of degrees before the top dead center or BTDC that the spark will ignite the Air-Fuel Mixture in the ignition chamber during the compression stroke.

4- Advance Timing:

Can be defined as changing the timing so the ignition happens “sooner than” the manufacturer's specified time.

5- Retarded Timing:

It can be defined as changing the timing so that ignition happens “later than” the manufacturer's specified time.

For example, if the timing specified by the manufacturer was set at 12 degrees BTDC initially and adjusted to 11 degrees BTDC, it would be referred to as retarded.

And if 13 degrees BTDC, it would be referred to as advance.

11- By increasing engine compression and the amount of turbulence in the airflow, the ignition rate increases, and as the ignition rate increases, we need less spark advance.

12- By increasing engine compression and the amount of turbulence in the airflow, the ignition rate increases, and as the ignition rate increases, we need less spark advance.

13- Factor for spark advance is 0.75