

The Chip's Idle Controls – Part 2

Start-up Spark Advance

GN and Turbo Regal

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This is the second portion of an article describing the most critical items that affect engine idle. EPROM addresses are shown as well as the formulas to calculate data values for those who are interested and/or capable of PROM burning.

Introduction: In **The Chip's Idle Controls – Part 1**, the PROM data items controlling warm-up fuel were examined. This, Part 2, explains the spark advance controls used during engine warm-up.

Timing (Spark Advance): To compliment the added fuel for the cold engine, spark advance is added to the timing. In a manner similar to adjusting the fuel during warm-up, the spark advance is increased at startup, then reduced after a programmed amount of time. The amount of advance to add and the delay time before reduction is determined by coolant temperature.

Before we jump into the tables that add advance when the engine is started, we must first look at the tables used to calculate the *base* timing. We'll start with the Main Spark Advance table but only the portion of the table used during idle is shown. Combinations of engine speed and engine load determine which entry in the table is used. The LV8 or engine load is calculated by the ECM after measuring the airflow (MAF) and engine speed (RPM).

As an example, starting the engine at 68°F will cause a 1250 RPM (factory) programmed idle speed. The LV8 at this time will be around 38-40, so the Main Advance table “says” to delay firing the sparkplugs for 29.9°.

Main Spark Advance (\$004) – partial listing										
LV8	32		48		64		80		96	
RPM	hex	value	hex	value	hex	value	hex	value	hex	value
400	41	22.9	41	22.9	41	22.9	41	22.9	41	22.9
600	44	23.9	44	23.9	44	23.9	4A	26	4A	26
800	44	23.9	44	23.9	44	23.9	4A	26	4D	27.1
1000	50	28.1	55	29.9	55	29.9	55	29.9	50	28.1
1200	55	29.9	55	29.9	55	29.9	5B	32	55	29.9
1400	66	35.9	7D	43.9	6C	38	6C	38	61	34.1

Main Spark Advance (0 - 89.6°)

- table value stored temporarily in \$48

Provides base spark advance using engine load vs. RPM

Timing is added and/or subtracted to/from this based on other conditions.

Formula for calculating Main Advance is: $\text{Main_Adv} = N \times 90 / 256$

[SE4AB] After the ECM determines the base spark advance using the Main table (e.g., 29.9 degrees), it adjusts it based on coolant temp and load (table shown on the next page). Note: The LV8 range for the Coolant Temp vs. Load table (**\$106**) is 32 – 128. This means the table is intended to adjust timing on the low end of the power curve. This table is still used when the LV8 exceeds 128 but the value will come from the last (right-most) column.

Spark Advance Correction – Coolant Temperature vs. Load (\$106)														
Coolant (°F)	hex	Adv (deg)	hex	Adv (deg)	hex	Adv (deg)	hex	Adv (deg)	hex	Adv (deg)	hex	Adv (deg)	hex	Adv (deg)
3°	4A	10.9	4A	10.9	4A	10.9	4A	10.9	50	13	50	13	47	9.8
25°	4A	10.9	4A	10.9	4A	10.9	4A	10.9	50	13	50	13	47	9.8
46°	4A	10.9	4A	10.9	4A	10.9	4A	10.9	50	13	50	13	47	9.8
68°	2E	1.1	2E	1.1	2E	1.1	2E	1.1	33	2.8	3C	6	3C	6
90°	25	-2.1	25	-2.1	25	-2.1	25	-2.1	33	2.8	3C	6	3C	6
111°	25	-2.1	25	-2.1	25	-2.1	25	-2.1	2B	00	33	2.8	39	4.9
133°	1F	-4.2	1F	-4.2	1F	-4.2	25	-2.1	2B	00	2B	00	33	2.8
154°	1F	-4.2	1F	-4.2	1F	-4.2	2E	1.1	30	1.8	2E	1.1	30	1.8
176°	2B	00	2B	00	2B	00	2B	00	2E	1.1	2B	00	2E	1.1
198°	2B	00	2B	00	2B	00	2B	00	2B	00	2B	00	2B	0
219°	1F	-4.2	1F	-4.2	1F	-4.2	1F	-4.2	25	-2.1	25	-2.1	1F	-4.2
241°	2E	1.1	2E	1.1	2E	1.1	1F	-4.2	25	-2.1	25	-2.1	1A	-6
LV8	32		48		64		80		96		112		128 - 255	

Spark Correction – Coolant vs. Load (-15.1 – 74.5°)

– table value stored temporarily in \$47

Table value provides coolant temp correction to spark advance.

The formula for Spark Advance Correction for Load is: $Adv = (N - Bias) * 90 / 256$

Example: Coolant temperature = 68 °F, LV8 = 38.

$$Adv = (N - Bias) \times 90 / 256$$

$$Adv = (46 - 43) \times 90 / 256$$

$$Adv = (3) \times 90 / 256$$

$$Adv = 270 / 256$$

$$Adv = 1.05 \text{ (rounded to 1.1)}$$

Continuing with the example of a 68°F start, the coolant versus load correction will be 1.1 degrees. This assumes an idle LV8 value of 38.

The spark advance correction for coolant temp and load must be able to either add to or subtract from the main advance value. In order to accomplish this, the table is “biased”. This means a fixed number is always subtracted from the table value. If the table value is larger than the bias, the result is positive and timing is added. If the table value is smaller than the bias, the result is negative and timing is subtracted from the main advance value.

loc	control	hex	dec	value
\$15F	Bias for Coolant Temp vs Load Advance Correction	2B	43	15 degrees

This value is subtracted from the coolant correction table (\$106) value, allowing the table to either add or subtract spark advance.

For our example, adding the coolant temp correction of 1.1 to the base of 29.9 makes the advance total 31 degrees.

Another table that could modify the advance (but doesn't) is the MAT or Air Temperature vs. Load Correction table (\$1A0). This table was intended for the high end of the power curve as it is indexed by LV8 of 128-255. This table is not shown here because the LV8 won't be >128 at idle and besides, all the entries are 00.

There are additional tables that affect spark advance while driving but the focus of this article is idle. So let's look at the tables responsible for increasing advance when the engine is started.

Cold Start Spark Advance: The amount of advance to add because you just started the engine comes from the Spark Timeout table (\$246). It is indexed by coolant temperature.

For the example being used thus far, 4.9 degrees would be added to the previously determined 31 degrees. This makes the total advance 35.9 degrees at startup.

Spark Timeout (\$246)			
Coolant Temp (°F)	Data Value (hex / decimal)		Added (degrees)
-40°	1C	28	9.8
-18°	1C	28	9.8
3°	1C	28	9.8
25°	1C	28	9.8
46°	1C	28	9.8
68°	0E	14	4.9
90°	0E	14	4.9
111°	0E	14	4.9
133°	0C	12	4.2
154°	08	08	2.8
176°	04	04	1.4
198°	00	00	0
219°	00	00	0
241°	00	00	0

Spark Timeout (0 – 89.6°)

– table value stored in \$FE

Table value specifies additional spark advance when engine is started. This additional timing is used for a period of time (table \$254) then is gradually reduced (table \$262).

The coolant temperature at the time the engine is started determines which table entry to use.

The formula for Spark Timeout is:

$$T/O_Added = N \times 90/256$$

Example: Coolant temp is 68°.

$$T/O_Added = 14 \times 90/256$$

$$T/O_Added = 1269/256$$

$$T/O_Added = 4.922 \text{ degrees}$$

The additional advance is only needed for a brief time and the next table determines how long to wait before reducing the advance.

Spark Timeout Decay Delay (\$254)			
Coolant Temp (°F)	Data Value (hex / decimal)		Delay (seconds)
-40°	FA	250	50
-18°	FA	250	50
3°	FA	250	50
25°	FA	250	50
46°	FA	250	50
68°	7D	125	25
90°	7D	125	25
111°	96	150	30
133°	96	150	30
154°	96	150	30
176°	96	150	30
198°	96	150	30
219°	96	150	30
241°	96	150	30

Spark Timeout Decay Delay (0 – 51 seconds)

– table value stored in \$FD

Table value specifies time to wait after engine is started before reducing the (extra) spark advance.

The coolant temperature at the time the engine is started determines which table entry to use.

The formula for Spark Timeout Decay Delay is:

$$T/O_Decay_Delay = N/5$$

Example: Coolant temp is 68°.

$$T/O_Decay_Delay = 125/5$$

$$T/O_Decay_Delay = 25 \text{ seconds}$$

So for the example, the initial spark advance of 35.9 degrees is applied for the first 25 seconds after the engine is started.

Finally, the amount of reduction (in degrees) is obtained from the Spark Timeout Decay Rate table (\$262). This table specifies the size of the advance reduction “chunks”. The last part of the equation is how often to reduce the advance and this is specified by a fixed data item (\$273). It is the combination of “how much” (table \$262) and “how often” (\$273) that controls the warm-up spark advance reduction.

Spark Timeout Decay Rate (\$262)			
Coolant Temp (°F)	Data Value (hex / decimal)		Rate (degrees)
-40°	03	03	1.1
-18°	03	03	1.1
3°	03	03	1.1
25°	03	03	1.1
46°	03	03	1.1
68°	06	06	2.1
90°	06	06	2.1
111°	03	03	1.1
133°	03	03	1.1
154°	03	03	1.1
176°	03	03	1.1
198°	03	03	1.1
219°	03	03	1.1
241°	03	03	1.1

Spark Timeout Decay Rate (0 – 89.6°)

– table value stored in \$A7

Table value specifies the number of degrees to reduce the timing after the Spark Timeout Decay Delay (\$254) time has elapsed.

The coolant temperature at the time the engine is started determines which table entry to use.

The formula for Spark Timeout Decay Rate is:

$$T/O_Decay_Rate = N \times 90/256$$

Example: Coolant temp is 68°.

$$T/O_Decay_Rate = 6 \times 90/256$$

$$T/O_Decay_Rate = 540/256$$

$$T/O_Decay_Rate = 2.1 \text{ degrees}$$

After the delay time (in this example, 25 seconds), the Spark Timeout advance (\$246) will be reduced at a frequency specified by the Spark Cold Start Timeout (\$273) value.

Every 5 seconds, the advance is reduced by another 2.1 degrees. This continues until the Timeout Advance = 00. [\$E48F]

loc	control	hex	value
\$273	Spark Cold Start Timeout	18	5 seconds

Formula is:

$$Spark_C/S_T/O = (N+1) / 5$$

To summarize the example, the advance when the engine was started was 35.9 degrees BTDC. Then 25 seconds later, the advance was reduced by 2.1 degrees to 33.8 degrees BTDC. Then 5 seconds later (or 30 seconds after startup), another 2.1 is subtracted making the advance 31.7 degrees. Finally, 5 seconds later the remaining 0.7 degrees of additional advance is removed. This takes a total of 35 seconds.

Summary of the Spark Timeout Tables: Below is a combination of the previously described tables. A column has been added showing reduction time. This time is determined by dividing the added advance by the reduction rate, then multiplying by 5 seconds (rounded to the next multiple of 5). It is then added to the Delay time to get Total Time.

Spark Timeout (\$246)			Spark Timeout Decay Rate (\$262)		Spark Timeout Decay Delay (\$254)		Reduce Time	Total Time
Coolant Temp (°F)	Data (hex)	degrees	Data (hex)	degrees	Data (hex)	seconds	(seconds)	
-40°	1C	9.8	03	1.1	FA	50	45	95
-18°	1C	9.8	03	1.1	FA	50	45	95
3°	1C	9.8	03	1.1	FA	50	45	95
25°	1C	9.8	03	1.1	FA	50	45	95
46°	1C	9.8	03	1.1	FA	50	45	95
68°	0E	4.9	06	2.1	7D	25	10	35
90°	0E	4.9	06	2.1	7D	25	10	35
111°	0E	4.9	03	1.1	96	30	20	50
133°	0C	4.2	03	1.1	96	30	20	50
154°	08	2.8	03	1.1	96	30	10	40
176°	04	1.4	03	1.1	96	30	5	35
198°	00	0	03	1.1	96	30	0	30
219°	00	0	03	1.1	96	30	0	30
241°	00	0	03	1.1	96	30	0	30

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