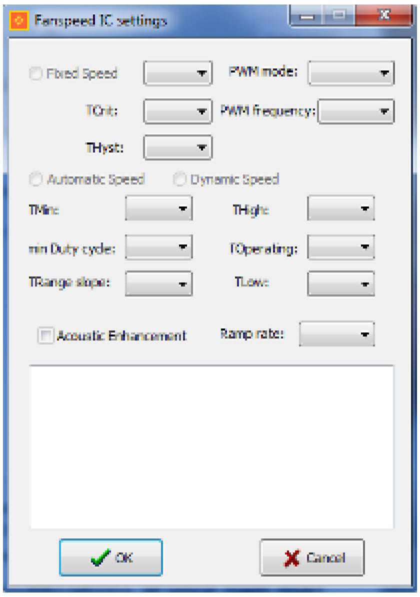
THE ULTIMATE NiBiTor"FANSPEED IC SETTINGS" GUIDE.

Is your GPU to hot ? You don't want to use software to control the "Fan speed" .
Well this could be the solution , put the Fan profile directly in to the BIOS and keep you GPU cool.

WARNING: A BIOS FLASH IS NOT WITHOUT DANGER!!!!!!!!!!!

You can use software to make fan speed profiles.



If your "Fanspeed IC settings" Tab looks like this ,with blank tab's , you can't change the Fan settings , it's programmed in a **locked BIOS** , even if you put some settings there and save the BIOS you will see when you open it again the settings are gone.

Options: Flash it with a newer BIOS that has got this support or use software to control your Fan speed.

Note : Not all GPU's have got this ADT7473 Thermal fan controller , so this can be a reason why you have blank tab's.

Fan speed IC settings.(found in the "Temperatures Tab)

Support for this function started with the 8800 (G92) series , when NVIDIA added the ADT7473 fan speed regulator. If you got one of these and up you can play around with this option. It is also possible that you got a 8800 (G92) and you just can adjust it , well time to update the BIOS , the first BIOS of the 8800 (G92) didn't have this support. Some vendors do not have full support in there BIOS for this "Thermal Fan Controller". It seems that a lot of 9800 (GT , GTX) are missing this control.

I want to remind you that the Fan speed depend not only this "Thermal Fan Controller" , the BIOS and the driver still have some influence on the actual fan speed.

First we start with introducing the "Thermal Fan Controller" ADT7473.

The ADT7473 controller is a thermal monitor and multiple PWM fan controller for noise sensitive or power sensitive applications requiring active system cooling. It can drive a fan using either a low or high frequency drive signal, monitor the temperature of up to two remote sensor diodes plus its own internal temperature, and measure and control the speed of up to four fans so they operate at the lowest possible speed for minimum acoustic noise.

The features that are interesting to us:

- Dynamic T_{MIN} control mode optimizes system acoustics intelligently.

- Automatic fan speed control mode controls system cooling based on measured temperature.

- Enhanced acoustic mode dramatically reduces user perception of changing fan speeds.

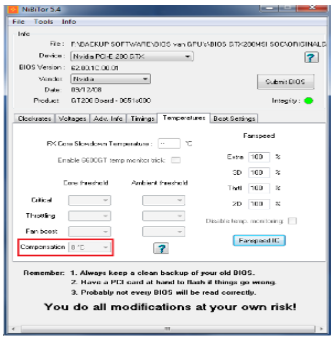
- Thermal protection feature via THERM output.

1:Automatic speed Fan Control Overview:(temperature increase = Fan speed increase).

The ADT7473 can automatically control the speed of fans based on the measured temperature. This is done independently of CPU intervention once initial parameters are set up. (TCrit , TMin , min Duty cycle , TRange slope)

Automatic fan speed control reduces acoustic noise by optimizing fan speed according to accurately measured temperature. Reducing fan speed can also decrease system current consumption. The automatic fan speed control mode is very flexible due to the number of programmable parameters, including **"TMin"** and **"TRange slope".**

The **"TMin"** and **"TRange slope"** values for a temperature channel are critical because they define the thermal characteristics of the system. The thermal validation of the system is one of the most important steps in the design process, so these values should be selected carefully.



Note that there is always a "Compensation" Value , it is seen in the Temperature Tab, it's often set at 6°C or 8°C by default , this has effect on all the temperature settings , example: 40°C "TMin" is actually 48°C with a "Compensation of 8°C , "TCrit" 90°C is actually 98°C and so on.....

1A: TMin Settings : (The temperature at which the fan turns at "min Duty cycle)

"TMin" can be programmed in 1°C increments.
Once the **"TMin"** value is exceeded, the fan will run faster than the **"min Duty cycle"**. The fan turns back to **"min Duty cycle"** once the temperature drops below **"TMin" – "THyst".(**If "Thyst" has a value).

1B: "min Duty cycle" settings.

"min Duty cycle" is the minimum duty cycle at which the fan in the GPU runs.(in %)

For maximum system acoustic benefit the **"min Duty cycle"** should be set as low as possible.
For better cooling it's recommended to start with 35%, 40%or even 45% **"min Duty cycle".**

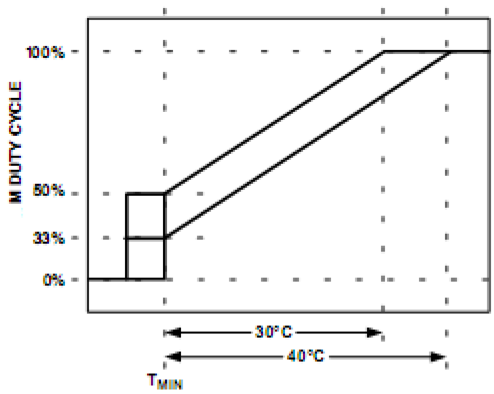
(For my GTX 280 it's set at 40%(quiet) with a lowered 2D voltage of 1.05v instead of the default 1.11v. Result: 43°C in idle).

1C: "TRange slope" settings:(Programs the "Fan Duty cycle" versus temperature control sloop)

"TRange slope" is the range of temperature over which automatic fan control occurs once the programmed **"TMin"** temperature is exceeded. **"TRange slope"** is a temperature slope, not an arbitrary value.

*Example: a **"TRange slope"** of 40°C holds true only for **"min Duty cycle"** = 33%. If **"min Duty cycle"** is increased or decreased, the effective **"TRange slope"** changes.*
*So in this case it takes 40°C for the Fan to go from **"min Duty cycle"** 33% to maximum Fan speed 100%.*
*If you change the **"min Duty cycle"** to 50% the **"TRange slope"** still set to 40° it is no longer true 40°C but 30°C , so it takes 30°C to go from **"min Duty cycle"** 33% to maximum Fan speed 100%.*

*(This you will notice when you set your wanted values for **"TMin", "min Duty cycle", "TRange slope"** in the info box at NiBiToR.)*



1D:"TCrit" settings: (If the temperature is exceeds this critical limit , the fan will run at 100% for maximum cooling)

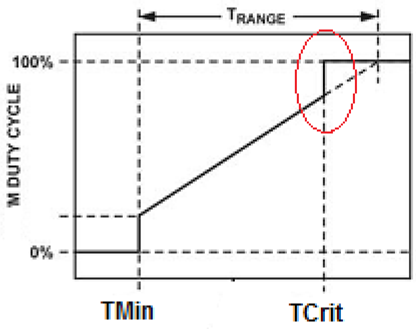
"TCrit" is the absolute maximum temperature allowed on a temperature channel or in this case the GPU. When operating above this temperature, a component might be beyond its safe operating limit. When the temperature exceeds **"TCrit"** the Fan is driven at 100% duty cycle (full speed) to provide critical system cooling.

The fans remain running at 100% until the temperature drops below **"TCrit"** –**"THyst"** (if "THyst" has a value).

The default **"THyst"** value is 2°C or 0°C. The **"TCrit"** limit should be considered the maximum worst−case operating temperature of the system. Because exceeding **"TCrit"** limit the Fan runs at 100%, it has very negative acoustic effects. Ultimately, this limit should be set up as a fail−safe, and it should not be exceeded under normal system operating conditions.

Note that the **"TCrit"** limit is nonmaskable and affect the fan speed no matter how the automatic fan control settings are configured.

Example: "TCrit" = 75°C , "THyst" = 0°C , "TMin" = 40°C , "min Duty cycle" = 35% , "TRAnge slope" = 40°C. Normally the fan will hit 100% at 79°C (40°C + 40°C on a 35%) , but the "TCrit" is set at 75°C so when 75°C temperature is reached the Fan will run 100%.



1E: "THyst" settings.

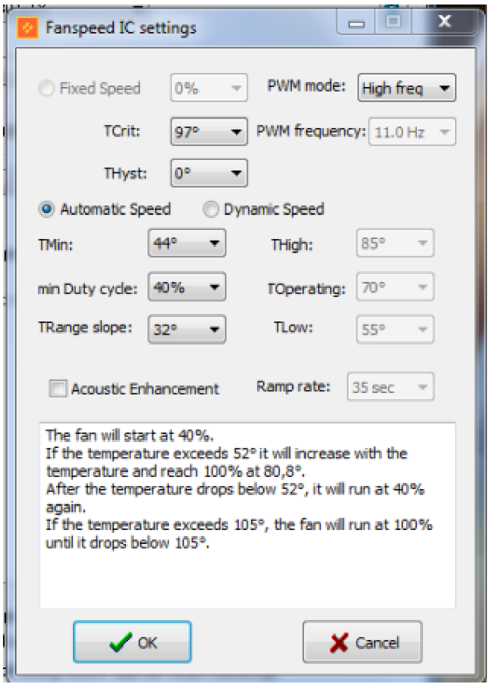
"THyst" is the amount of extra cooling a fan provides after the temperature has dropped back below **"TMin"** before the fan turns at **"min Dut cycle"**. The premise for temperature hysteresis (**"THyst"**) is that, without it, the fan would merely chatter or cycle on and off regularly whenever temperature is hovering at about the **"TMin"** setting.
"THyst" values are programmable from 1°C to 15°C. **"THyst"** value of 0°C, disables hysteresis. In effect, this could cause the fan to cycle between normal speed and faster speed determent by the **"Tmin"** and **"TRange slope"**, creating acoustic noise.

Example: "TMin" = 50°C , "TCrit" = 80°C , "THyst" = 2°C.
So when the temperature exceeds the "TMin" 50°C the fan will start running faster , but when the temperature drops below "TMin "50°C the fan will reach the "min Duty cycle" at 48°C caused by the 2°C "THyst". At passing 80°C "TCrit" the Fan will run 100%, and will slow down at 78°C , caused by the 2°C "THyst".

"THyst" is only of importance if your GPU temperature stays around "TMin" or "TCrit" temperature.
Most of the time it's set at 0°C by default at the GTX... series.

Example: "Automatic speed" fan control.

Now let's look at a example in "NiBiTor".
You always need to remember that there is a "Compensation" value , I'm going to take 8° as "Compensation value and call it 8°Cc in my example.



In the Info-Box we see what result we are going to have:

The fan will start at 40%. = Because "min Duty cycle" is set at 40% , so the Fan speed will never be lower than 40% .

If the temperature exceeds 52° it will increase with the temperature and reach 100% at 80,8°.
Why 52° ? Well 44°Tmin" + 8°Cc = 52°. When exceeding this temperature the Fan speed will start to increase like set in "TRange slope" 32° ,
Why 100% Fan speed at 80.8° ? Well 44°Tmin + 8°Cc + 32°TRange slope = 84 °C.
Why 84° becomes 80.8° is explained in the "TRange slope" paragraph 1C.

After the temperature drops below 52°, it will run at 40% again. (44° TMin + 8° Cc)

If the temperature exceeds 105°, the fan will run at 100% until it drops below 105°. This is the fail safe , TCrit set at 97° + 8°Cc = 105°. So at this temperature the Fan will always run at 100%.

If you want your fan to run 100% at 70°C , well you can set TCrit at 62° + 8°Cc.
In this case the Fan will follow the TRange slope until the temperature reaches 70°, and it will go immediately up to 100% no matter what the TRange slope end point is.
Explained in TCrit paragraph 1D
Or you can set a shorter TRange slope , so it hits 100% faster.

Note: PWM mode(High freq) and PWM frequency (11.0Hz) are left at default settings, i would not alter them.

2:Dynamic speed Fan Control Overview (smart automatic speed fan control).

This is set as default by most GPU's , because it's based on quiet operation, so if you want coolest operation this is not the way to go , this option is looking to keep the card as quiet as possible. Result: it takes a big temperature increase before the fan runs faster and the GPU gets warmer. You can change this but it is not as direct as the "Automatic speed" Fan control. For the ones who are interested in this option , I will try to make it clear.

What is "Dynamic speed" Fan Control ?

"Dynamic TMin" control mode builds on the basic "Automatic speed" fan control by adjusting the **"TMin"** value based on system performance and measured temperature. This is important because, instead of designing for the worst case, the system thermals can be defined as operating zone**("TOperation").**

The ADT7473 can self–adjust its fan control loop to maintain either an operating zone temperature or a system target temperature.
For example, it can be specified that the ambient temperature in a system should be maintained at 50°C. If the temperature is below 50°C, the fan might run very slowly. If the temperature is higher than 50°C, the fan need to throttle up.

Getting the most benefit from the "Automatic speed" Fan control mode involves characterizing the system to find the best **"TMin"** and **"TRange slope"** settings for the control loop, and the best **"min Duty cycle"** value for the quietest fan speed setting.

Using the "Dynamic speed "TMin**"** control mode, however, shortens the characterization time and alleviates tweaking the control loop settings because the device can self–adjust during system operation.
"Dynamic TMin**"** control mode is operated by specifying the "operating zone temperature"(**"TOperation"**) required for the system. Associated with this control mode are three operating point registers, one for each temperature channel. This allows the system thermal solution to be broken down into distinct thermal zones. **("THigh" , "TOperation" , "TLow")**

Dynamic "TMin" Control Parameters:

-"TLow": Defines the temperature at which the "TMin" value starts to be increased, if temperature falls below this value, the controller switches to "Automatic Speed" settings. This has the effect of reducing the fan speed, allowing the system to get hotter.

-"THigh": Defines the temperature at which the "TMin" value starts to be reduced, if temperature increases above this value, the controller switches to "Automatic Speed" settings. This has the effect of increasing fan speed to cool down the system.

-"TMin"(Dynamic): The temperature at which the fan turns at "min Duty cycle", but at "Dynamic TMin" control this is a variable.

-"TOperation": The target temperature zone , the ADT7473 attempts to keep the GPU temperature at about this "TOperation" point by adjusting the "TMin" parameters of the control loop.

-"TCrit": If the temperature exceeds this critical limit , the fan will run at 100% for maximum cooling.

-"TRange slope": Programs the "Fan Duty cycle" versus temperature control sloop.

How Dynamic "TMin" Control Works

The basic premise is as follows:

The ADT7473 increases or decreases fan speeds as necessary to maintain the "operating point" **("TOperation")** temperature. If a sensible **"TOperation"** value is chosen, any **"TMin"** value can be selected in the system characterization. If the **"TMin"** value is too low, the fans run sooner than required, and the temperature is below the operating point **("TOperation")**. In response, the ADT7473 increases **"TMin"** to keep the fans off longer and to allow the temperature zone to get closer to the operating point **("TOperation")**. Likewise, too high a **"TMin"** value causes the

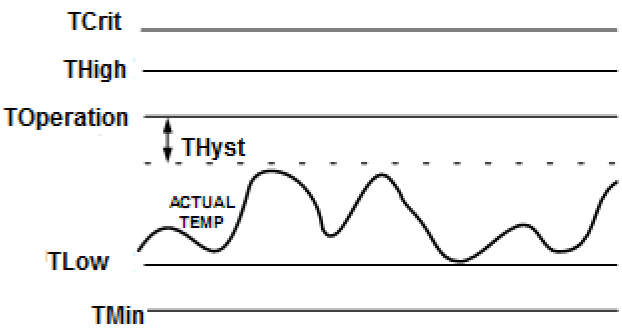
"TOperation" to be exceeded, and in turn, the ADT7473 reduces **"TMin"** to turn the fans on sooner to cool the system.

As the temperature drops below the operating point **("TOperation")** temperature, **"TMin"** is increased, and the fan speed is reduced. **However, the loop operation is not as simple as described in these steps. A number of conditions govern the situations in which Dynamic "TMin" can increase or decrease , see examples.**

<u>Example 1: Normal Operation—No Dynamic "TMin" Adjustment</u>

• *If measured temperature never exceeds the programmed **"TOperation"** minus the **"THyst"** temperature, then Dynamic **"TMin"** is not adjusted , so it remains at its current setting.*

• *If measured temperature never drops below the low temperature limit, then Dynamic **"TMin"** is not adjusted.*



Temperature between "TOperation" and "TLow" temperature limit.

Because neither the **"TOperation"** minus the **"THyst"** temperature nor the **"TLow"** limit has been exceeded, the Dynamic **"TMin"** value is not adjusted, and the fan runs at a speed determined by the fixed **"TMin"** and **"TRange slope"** values defined in the "Automatic speed" Fan control mode.

<u>Example 2: Operating Point ("TOperation) Exceeded—"TMin" Reduced</u>

*When the measured temperature is below the **"TOperation"** temperature minus the **"THyst"**, Dynamic **"TMin"** remains the same. Once the temperature exceeds the **"TOperation"** temperature minus the **"THyst"**, Dynamic **"TMin"** starts to decrease.*

Example 3: Increase Dynamic "TMin" Cycle When the temperature drops below the "TLow" limit

Increasing Dynamic **"TMin"** has the effect of running the fan slower and, therefore, quieter.

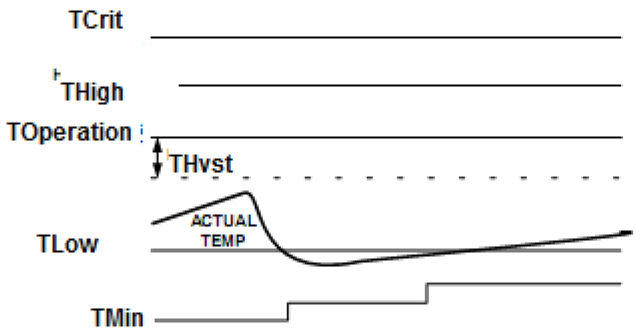
Dynamic "TMin" can increase if:

• *The measured temperature falls below the **"TLow"** limit. This means the user must choose the **"TLow"** limit carefully. It should not be so low that the temperature never falls below it because Dynamic **"TMin"** would never increase, and the fans would run faster than necessary.*

• ***"TMin"** is below the **"THigh"** limit. **"TMin"** is never allowed to set above the **"THigh"** limit. As a result, the **"THigh"** limit should be sensibly chosen because it determines how high Dynamic **"TMin"** can go.*

• ***"TMin** is below the **"TOperation"** temperature. **"TMin"** should never be allowed to set above the **"TOperation"** temperature because the fans speed would not increase until the temperature rose above the **"TOperation"**.*

• *The temperature is above **"TMin"**. The dynamic **"TMin"** control is turned off below **"TMin"**.*



Increasing "TMin" for a Quieter operation:

See how the Dynamic control adjust "TMin" , so the fan speed doesn't go up, as long the temperature doesn't exceed "TOperation" - "THyst", the fan will not go up in speed.
Temperature below "TLow" or over "THigh" = it folows the values selectes in "Automatic speed" ("TMin" , "TRange slope")
At "TCrit" the fan will always run at 100%

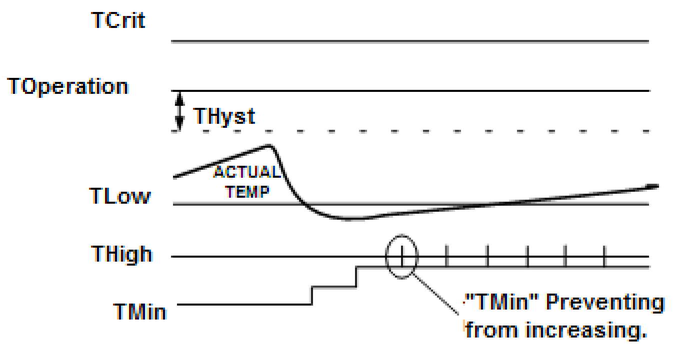
Example 4: Preventing Dynamic "TMin" from Reaching Full Scale

Because **"Tmin"** is dynamically adjusted, it is undesirable for **"Tmin"** to reach full scale (127°C) because the fan would never start to run faster as the **"min Duty cycle"**. As a result, **"Tmin"** is allowed to vary only within a specified range:

• The lowest possible value for **"Tmin"** is −127°C (twos complement mode) or −64°C (Offset 64 mode).

• **"Tmin"** cannot exceed the high temperature limit.

• If the temperature is below **"Tmin**, the fan is switched off or runs at minimum speed and dynamic **"Tmin"** control is disabled.



"TMin" Adjustment limited by the "THigh" temperature limit.

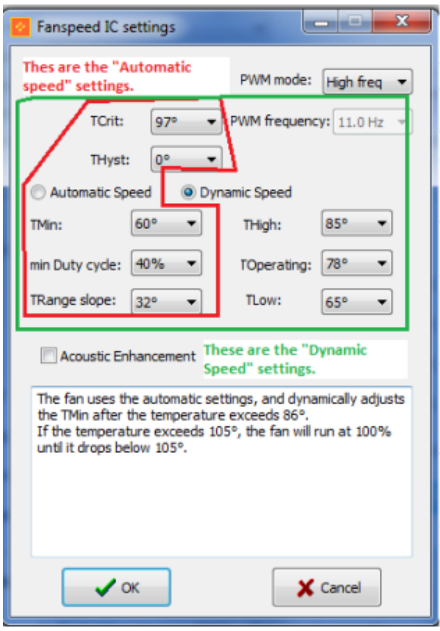
You can set THigh below TLow so that the TMin dynamic adjustment is limited , This is because TMin can never exceed THigh.

CONCLUSION ON DYNAMIC "TMin" SPEED: *"TOperation plays a very big role in this mode , using the "TOperation limit ensures that the Dynamic "TMin" speed control mode operates in the best acoustic position while ensuring that the temperature never exceeds the maximum operating temperature ("THigh). Using the "TOperation" limit allows "TMin" to be independent of system−level issues because of its self−corrective nature.*

Is this the best way for a overclocked GPU ? I prefer the "Automatic speed" mode , the GPU cooling is more direct , the fan speed increase is more and louder but the GPU stays a lot cooler. You can set your "TOperation limit at a lower limit or even stop the Dynamic "TMin" from adjusting by setting a very low "THigh"(see graf. above). If you are looking for a quiet system with not the maximum cooling but still sufficient , than "Dynamic speed" mode is your way to go. If you set the values right it can perform better as the default settings.

Example: "Dynamic speed" fan control.

Now let's look at a example in "NiBiTor".
You always need to remember that there is a "Compensation" value , I'm going to take 8° as "Compensation value and call it 8°Cc in my example.
Let's take the default settings , so you can see that they wanted to keep the Fan as quiet as possible , you will also see that they allow the temperature to go up just around critical point. Not the best case for the lifetime of the GPU.



In the Info-Box we see whet the result we are going to have.

The fan uses the automatic settings = So until it reaches 86°(TOperation 78° + 8°Cc) the fan is going to run like set in the "Automatic speed" settings.

The fan will stay at 40% until it reaches 68°C (TMin 60° + 8°Cc). Now the fan speed will increase but ones the temperature crosses TLow 65° + 8°Cc = 73° the Fan will stay at the speed that it had when it crossed TLow 73° until the temperature reaches 86° TOperation.
Now the controller is going to try to keep the temperature at this point (TOperation) by adjusting TMin so the Fan speed will increase.

At THigh(85° + 8°Cc = 93°C) the TMin is no longer adjusted and now the "Automatic Speed" settings take over again , TMin 68°(60° + 8°Cc) + TRange slope 32° = 100°C - the influence of the min Duty cycle (explained in paragraph 1C) makes it hit 100% at 96.8°C.

We are close to the Critical Temperature that is 105° for a GTX280.

If the temperature exceeds 105°, the fan will run at 100% until it drops below 105°.
This is the fail safe , TCrit set at 97° + 8°Cc = 105°. So at this temperature the Fan will always run at 100%

Changing TMin and TOperation to a lower value can make the Fan jump in Faster , as you can see this mode is designed to keep the system as quiet as possible .

Note: PWM mode (High freq) and PWM frequency (11.0Hz) are left at default settings , Iwould not alter them.

What is "ACOUSTIC ENHANCEMENT" and "RAMP RATE":

Having determined the optimal settings for the GPU cooling , you can adjust the system acoustics. The goal is a system that is acoustically pleasing without causing annoyance due to fan cycling. It is important to realize that this option is for a quieter operation , so it will effect the cooling performance.

"Enhanced acoustic" can prevent the "Fan duty cycle" from reacting instantaneously to temperature changes. "Enhanced acoustic" mode controls the maximum change "Fan duty cycle" at a given time. The objective is to prevent the fan from cycling up and down.

The temperature is measured in "time slots" or cycles , these cycles can be set in "Ramp Rate" ,

000 = 1 time slot = 35 sec
001 = 2 time slots = 17.6 sec

010 = 3 time slots = 11.8 sec
011 = 5 time slots = 7 sec
100 = 8 time slots = 4.4 sec
101 = 12 time slots = 3 sec
110 = 24 time slots = 1.6 sec
111 = 48 time slots = 0.8 sec

Another way to view the ramp rates is to measure the time it takes to ramp up from 0% to 100% duty cycle for an instantaneous change in temperature. Put simple: it takes 35 sec in "time slot 1" to go from 0% to 100% Fan speed. Remind that your lowest fan speed never 0% is. So from 40% to 100% will not take 35 sec. in a realistic environment .
For GPU cooling it's not the best solution , the GPU heats up quickly when you put load on it , and it is not recommended that the fan takes even 3 or 5 sec to go to a faster rotation speed. Again this is for quiet operation and not coolest performance , at default this is not marked by the vendor.
If you want to know what "time slot" the best is for you if you want to use this option, well you will need to test it.

Final Words:

This ADT7473 Thermal controller is designed for up to 4 fans and working on a motherboard for cpu cooling , it can also deal very well GPU cooling if you set the right values , i noticed a drop of 4°C in Idle and instead 97-98°C under load now it's 80-83°C under 100% load. So I gain about 16°C under load.

You can go for best and direct cooling with the "Automatic speed" mode , for good cooling and quiet operation you have "Dynamic speed" mode and if this is not quiet enough you can use "Acoustic Enhancement".

civato 2010.