Ramp Profile MSS Software Implementation

User Guide

Microsemi

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Ramp Profile Theory

A motor consists of a stationary stator and a moving rotor. Avoid subjecting the rotor to sudden and large magnitudes of speed changes. Sudden change in the motor speed applies a lot of mechanical stress on the motor system and leads to its malfunctioning. Hence, the speed of the rotor must be gradually increased with respect to time from the stationary position to the desired or reference speed. This change in speed characteristic of a motor is indicated by ramp-up profile, as shown in Figure 1. Similarly, the speed of the rotor must not come down abruptly from its maximum speed to a significantly lower reference speed or even its stationary position (0 rpm). The speed of the rotor must be gradually reduced. This is indicated by ramp-down profile as shown in Figure 2.

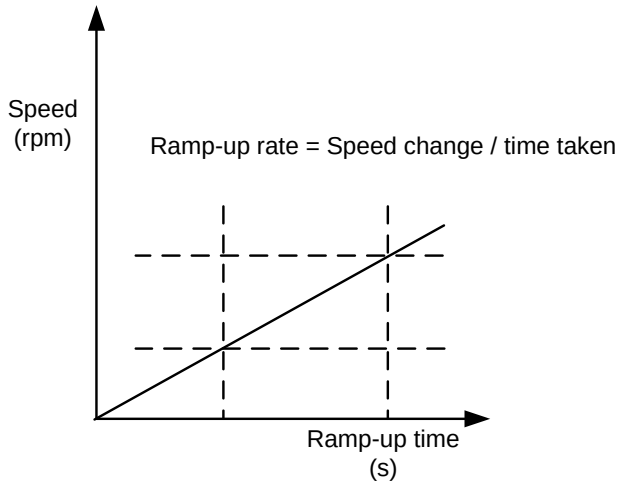

Figure 1 · Acceleration/Ramp-up Profile

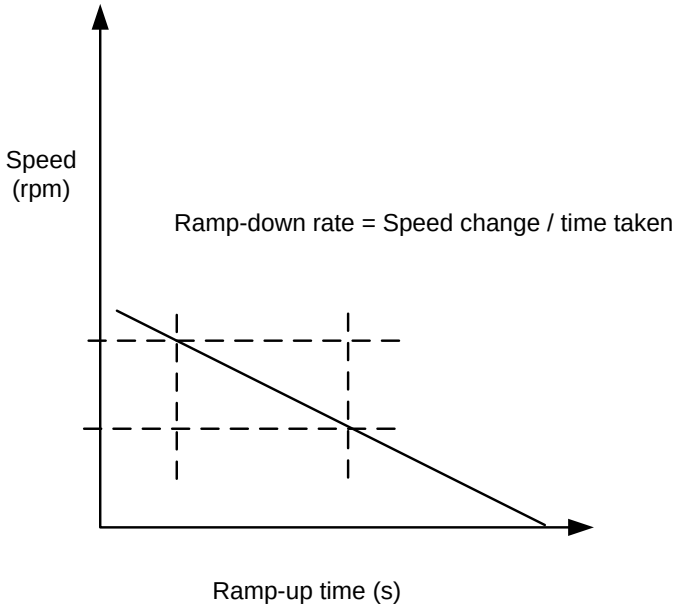

Figure 2 · Deceleration/Ramp-down Profile

The variation of speed with respect to time or slew rate of a motor for a particular application can be expressed in two ways:

- Slew rate in reference variable count/sec
- Slew rate in reference variable delay count

Slew Rate in Reference Variable Count/Sec (T_{sr})

For example, the required slew rate is 500 rpm/sec. Assume, the timer or timer interrupt service routine (ISR) is running at time interval T_c; where T_c is the time taken for the timer overflow.

Consider T_c to be equal to 50 µs.

The time taken for each variable count = $1/T_{sr}$ = 1/500 = 2 ms.

Hence, the ramp count = 2ms/50µs = 40.

The ramp count should be calculated at run time. The incremental variable can be of integer type. Care must be taken for achieving the desired ramp for a wide range of dynamic configuration of slew rate. The timer must be initially configured to achieve the desired variable count time. For example, for lower slew rates such as 50 rpm/sec, the time taken for each variable count will be 20 ms and the timer available must be capable of measuring this time.

Slew Rate in Reference Variable Delay Count

The ramp count is given directly in terms of counts. For example, consider a variable delay count of 100 counts and T_c equal to 50 µs. The time taken for each ramp count is 100 * 50 µs = 5ms.

API Type Definitions

This section lists the structure type definitions of the various APIs required to implement the microcontroller subsystem (MSS) software libraries of ramp profile.

ramp_rate_profile_type

Table 1 discusses the type definition of ramp_rate_profile_type.

Table 1 · ramp_rate_profile_type

Name	ramp_rate_profile_type	
Type	typedef struct {uint32_t slew_rate; uint32_t slew_count; }ramp_rate_profile_type;	
File	Lib.h	
Range	uint32_t slew_rate;	The delay count for each reference variable increment
	uint32_t slew_count;	The rate at which the desired reference value is to be achieved

ramp_count_profile_type

Table 2 discusses the type definition of ramp_count_profile_type.

Table 2 · ramp_count_profile_type

Name	ramp_count_profile_type	
Type	typedef struct {int32_t set_reference; int32_t ref_value; int32_t ref_max; int32_t ref_min; int8_t ref_flag; uint32_t slew_count; }ramp_count_profile_type;	
File	Lib.h	
Range	int32_t set_reference	The desired reference value
	int32_t ref_value	The current reference value
	int32_t ref_max	The saturation maximum limit.
	int32_t ref_min	The saturation minimum limit
	int8_t ref_flag;	Flag that indicates, if the desired reference value is achieved
	uint32_t slew_count;	The delay count for each reference variable increment

API Functions Description

In this section, the functions required to implement various tasks of ramp profile are described.

Ramp_Reference_Lib_Calculate

Table 3 describes the Ramp_Reference_Lib_Calculate function which is used to increase the variable ramp_count value until it reaches the delay count for each reference variable increment (slew_count value). The function also adjusts the present reference value (ref_value) in case it is greater than slew_count value.

Table 3 · Specification of API Ramp_Reference_Lib_Calculate

Syntax	void Ramp_Reference_Lib_Calculate (ramp_count_profile_type *ramp_ptr)
Re-entrancy	Re-entrant
Parameters (Inputs)	ramp_ptr: Pointer to the Ramp Count Profile structure.
Parameters (Output)	ramp_ptr: Pointer to the Ramp Count Profile structure.
Return	None

Algorithm Description	if(ramp_count > slew_count)
	{
	if(ref_value <set_reference)
	ref_value = ref_value + 1;
	else if(ref_value >set_reference)
	ref_value = ref_value – 1;
	if(ref_value > ref_max)
	ref_value = ref_max;
	elseif(ref_value < ref_min)
	ref_value = ref_min;
	ramp_count = 0;
	}
	else
	ramp_count = ramp_count+1;

Ramp_Count_Lib_Calculate

Table 4 describes the Ramp_Count_Lib_Calculate function which is used to compute the rate at which the desired reference value is to be achieved (slew_count value).

Table 4 · Specification of API Ramp_Count_Lib_Calculate

Syntax	void Ramp_Count_Lib_Calculate (ramp_rate_profile_type *ramprate_ptr, uint32_t time_base)
Re-entrancy	Re-entrant
Parameters (Inputs)	ramprate_ptr: Pointer to the Ramp rate Profile structure. uint32_t time_base: Overflow time of the timer in µs.
Parameters (Output)	ramprate_ptr: Pointer to the Ramp rate Profile structure.
Return	None
Algorithm Description	ramprate_ptr->slew_count = 10^6 / (ramprate_ptr->slew_rate * time_base)

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Fax, from anywhere in the world **408.643.6913**

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Microsemi SoC Products Group staffs its Customer Technical Support Center with highly skilled engineers who can help answer your hardware, software, and design questions about Microsemi SoC Products. The Customer Technical Support Center spends a great deal of time creating application notes, answers to common design cycle questions, documentation of known issues and various FAQs. So, before you contact us, please visit our online resources. It is very likely we have already answered your questions.

Technical Support

Visit the Microsemi SoC Products Group Customer Support website for more information and support (http://www.microsemi.com/soc/support/search/default.aspx). Many answers available on the searchable web resource include diagrams, illustrations, and links to other resources on website.

Website

You can browse a variety of technical and non-technical information on the Microsemi SoC Products Group home page, at http://www.microsemi.com/soc/.

Contacting the Customer Technical Support Center

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The technical support email address is soc_tech@microsemi.com.

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ITAR Technical Support

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