

NM-AN07 – VoiceIC/MCU Requirements for controlling a NanoMuscle

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Applicable NanoMuscle Families: RS Rotary

In their standard form all NanoMuscles can provide simple full-range motion by simply applying power to the N1/N2 pins via a 2-transistor drive circuit. In many applications it is required that the motion be controller from an MCU or VoiceIC. This is typical in such cases as sound-motion synchronization (for example, Lip-sync) as well as position control (for example, tracking eye motion).

Almost all 4-bit and 8-bit VoiceICs are suitable for a NanoMuscle application. In some applications the control required over the NanoMuscle is relatively simple. For instance if the actuator is performing a one-shot operation (for instance opening a trap door, unlocking a latch etc.) then all that may be required is a simple timed pulse on the CTRL signal of the drive circuits given earlier in this document. Indeed, in some cases such control may not even require a VoiceIC at all, and can instead be implemented using a simple pulse circuit using discrete electronics.

However, many of the applications that use NanoMuscles require a tighter control over the motion of the actuator – for instance to ensure consistent motion across different environmental temperatures and battery voltage levels. The following are examples of the different level of control:

Speed Control

In applications that are cycling the NanoMuscle back and forth (for instance moving an arm up and down) it may be a requirement to ensure that the speed of the rotate and return portion of the cycle are approximately the same speed. This can be achieved by timing the portion of the cycles and modifying a Pulse Width Modulated (PWM) pulse that is driving the NM accordingly. NanoMuscle provides a free reference example of exactly this application. Almost any 4-bit or 8-bit VoiceIC that has a timer accessible from the program can implement this kind of speed control with the following resources available:

I/O Pins	2 inputs and 1 output
RAM	5 nibbles
ROM	500 words of control code

An application note (*AN03 – Speed Control*) is available that describes this kind of application in greater detail. Example code is available for the EMC 55xxx series of VoiceICs, although almost any VoiceIC can be used for this application (e.g. Winbond, SunPlus, Sonix, Alpha etc.)

Sound-Motion Synchronization (e.g. lip-sync)

This class of application typically requires the motion of the NanoMuscle to be synchronized with either voice or sound but does not require the ability to hold the NanoMuscle at an intermediate position. Depending on the accuracy required by the application, such control can be implemented on either low-cost 4-bit MCU & Voice ICs or their 8-bit versions. In order to control the motion of the NanoMuscle in a consistent fashion across voltage ranges and temperature changes, typically some control software is required to be included in the MCU/VoiceIC. The minimum requirements for the MCU/VoiceIC for such an application are:

I/O Pins	2 inputs and 1 output
RAM	20 nibbles/words
ROM	1K words of control code

To assist developers, NanoMuscle will provide the driver control software free of charge for common MCU/VoiceICs. Initially this is being provided on the following VoiceICs:

- EMC 55100 and higher, 56100 and higher, 57100 and higher and 58100 and higher
- EMC 60xxx and 61xxx series
- Winbond 588 series
- SunPlus SPC251 series

Many other 4-bit and 8-bit VoiceICs can also be supported – please contact NanoMuscle for more information.

If voice/sound is being played while moving the NanoMuscle it is recommended that a PWM direct-drive speaker circuit is used (although a DAC speaker circuit can also be used if required).

Position Control Applications (e.g. eye-motion)

This class of application typically requires the ability to move and hold the NanoMuscle at intermediate positions of its rotation. For example 2 NanoMuscles can be used to provide both left-right and up-down motion of an eye. In order to control the NanoMuscle reliably in this fashion, the MCU/VoiceIC must be able to sense the current position of the NanoMuscle. Although this can be achieved by adding an external sensor of some type, this is typically too expensive for many applications. NanoMuscle has developed electronics and control software that allows a generic MCU/Voice IC to sense this position without such a sensor. This control software typically requires an 8-bit MCU/VoiceIC. In this mode, the NanoMuscle is controlled using a spare DAC output

rather than a simple I/O pin. The minimum requirements for the MCU/VoiceIC for such applications are:

	Single NanoMuscle Application	Dual NanoMuscle Application
I/O Pins	2 inputs, 6 outputs and 1 DAC output	4 inputs, 8 outputs and 1 DAC output
RAM	20 words	30 words
ROM	2K words of control code	

To assist developers, NanoMuscle will provide the driver control software free of charge for common MCU/VoiceICs. Initially this is being provided on the following VoiceICs:

- EMC 60xxx and 61xxx series
- Winbond 588 series
- SunPlus SPC251 series

Many other 8-bit VoiceICs can also be supported – please contact NanoMuscle for more information.