



Working Together for a Greener Society

Future of Power Electronics and the Earth

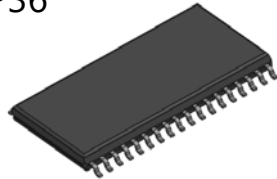


# High-efficiency/High-performance Motor Driver ICs with Sinusoidal Control SX6812xM Series

# Selection Guide and Recommended Applications

## ◆ SX6812xM Series Selection Guide

SOP36



Part Number	$V_{DSS}$	$I_D$	$R_{DS(ON)}$	Rotation Pulse Signal	Status*
SX68128MA	600 V	1.5 A	3.6 $\Omega$ (max.)	3 ppr	Active
SX68128MB		1.5 A	3.6 $\Omega$ (max.)	2.4 ppr	Active
SX68127MA		2.0 A	2.5 $\Omega$ (max.)	3 ppr	Active

\* Refers to the latest product status on our website. "Active" means the product is in mass production.

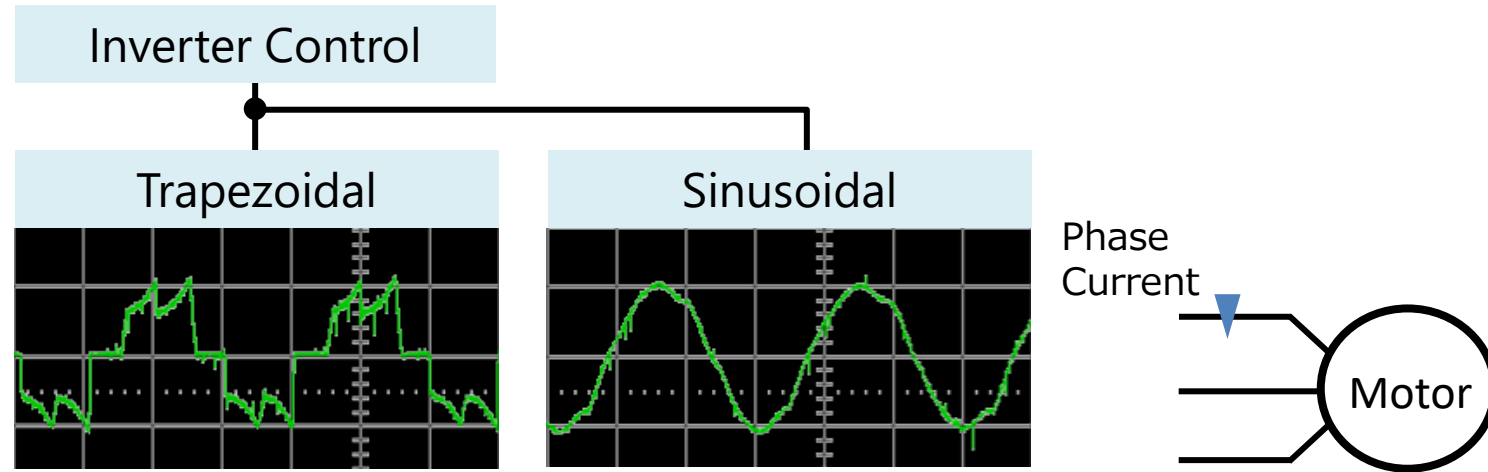
## ◆ Recommended Applications

- Indoor A.C. Unit Fan Motor
- Air Purifier Fan Motor



## ◆ Motor Driving System

The motor driving system includes trapezoidal and sinusoidal controls.



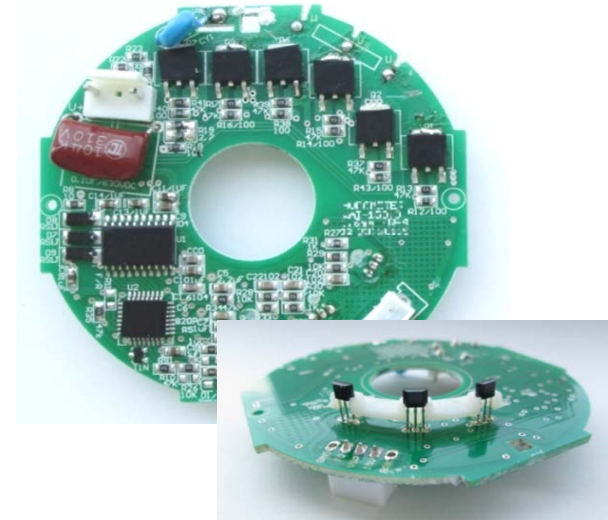
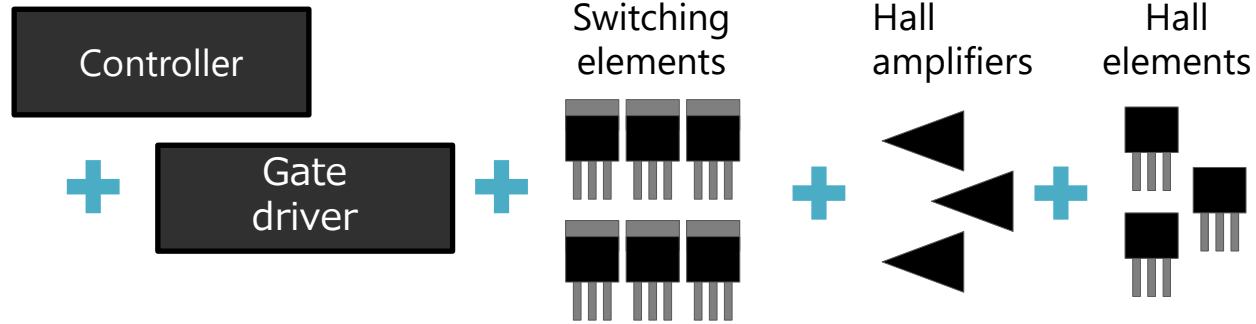
## ◆ Features

The following table shows the driving controls and motor features.

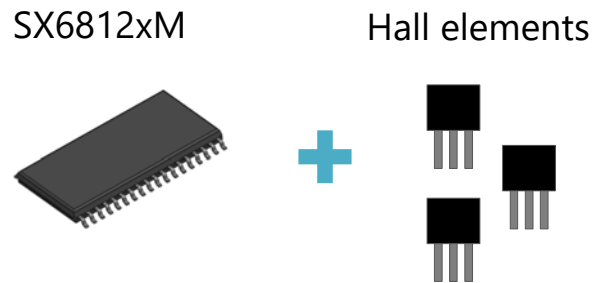
The SX6812xM series uses the sinusoidal control that is excellent in efficiency and quietness.

Driving Control	Parameters			
	Motor Efficiency	Switching Efficiency	Quietness	Torque Ripple
Trapezoidal	High	Higher	Quiet	Large
Sinusoidal	Higher	High	Quieter	Small

## ◆ Existing Motor Driver Configured with many discrete elements



## ◆ SX6812xM Series Configurable with only an SX6812xM series device and Hall elements

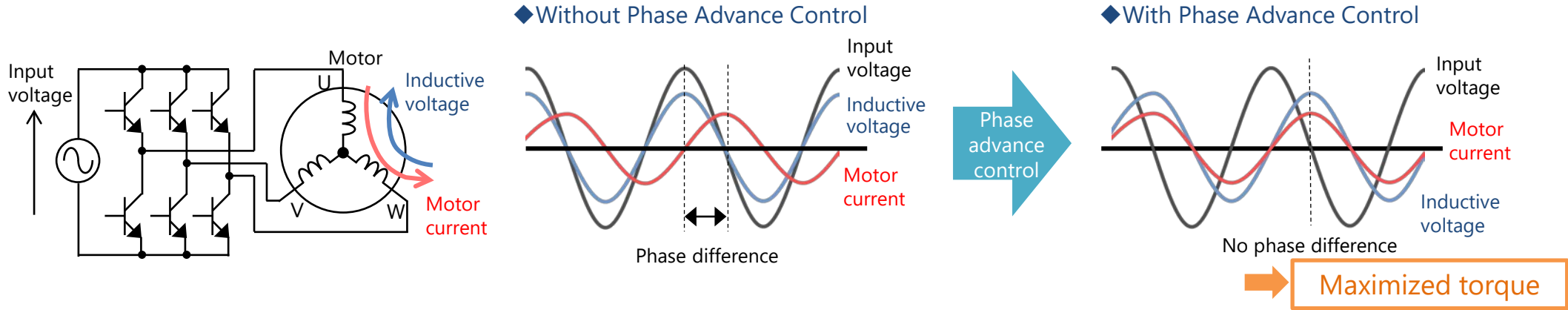


- Significant reduction in component counts
- Smaller PCB area
- Auto-mountable SOP package

# Phase Advance Function

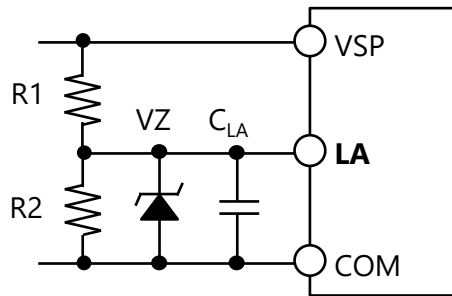
A phase of the current through the motor normally gets behind a phase of inductive voltage due to winding inductance.

The SX6812xM series has the phase advance function that matches the phases of inductive voltage and motor current. As a result, the motor can run at a maximum torque.

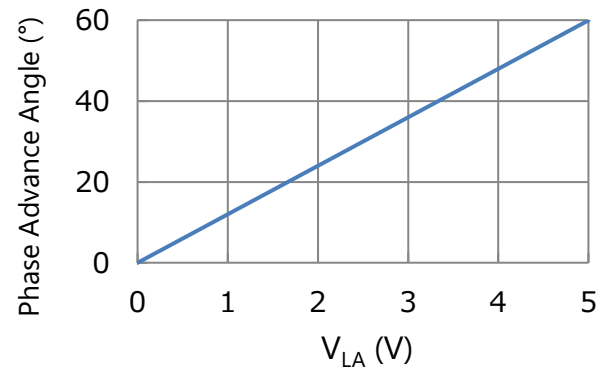


The SX6812xM series can adjust the phase of inductive voltage with the LA pin voltage.

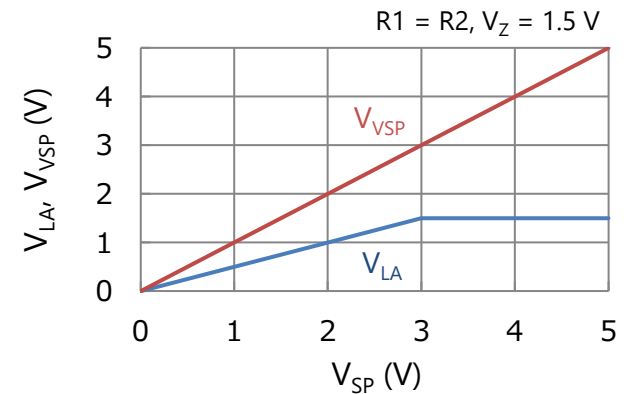
◆ LA Pin Peripheral Circuit



◆ LA Pin Voltage vs. Phase Advance Angle



◆ Example of Phase Advance Angle Setting



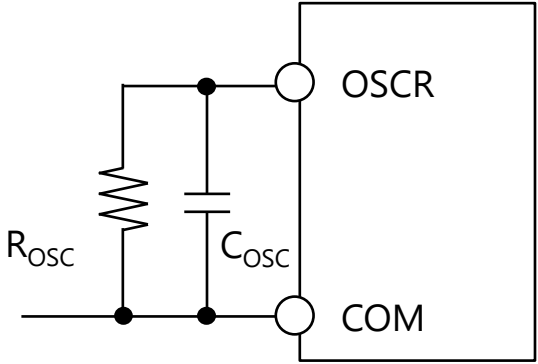
The SX6812xM series has a built-in motor control part that simultaneously monitors drive signals and the motor driver's state. In addition to typical protections, the motor lock protection, the reverse rotation detection, and the Hall signal abnormality detection are incorporated. With higher IC performance achieved, the SX6812xM series allows circuit configuration with fewer external components, smaller system sizes, reduced designing resources, and higher system reliability.

Protection	Description
Undervoltage Lockout for Power Supply (UVLO)	Prevents the power elements from critical damage due to their increased losses. Integrated into the VB and VCC pins.
Thermal Shutdown (TSD)	Detects a temperature of the monolithic IC, $T_j$ . Turns off all the switching elements when $T_j \geq 130 \text{ }^\circ\text{C}$ . Returns to normal operation when $T_j \leq 90 \text{ }^\circ\text{C}$ .
Overcurrent Limiting Function (OCL)	Turns off the high-side switching elements on a pulse-by-pulse basis when the motor current reaches the setting value or more.
Overcurrent Protection (OCP)	Turns off all the switching elements when the motor current reaches the setting value or more. Auto-restarts after a lapse of the OCP hold time (15 ms).
Motor Lock Protection	Turns off all the switching elements for 35 seconds when the Hall elements stay in the same position for $\geq 6$ seconds.
Reverse Rotation Detection	Shifts to the trapezoidal control when the motor rotates in a direction opposite to the preset direction.
Hall Signal Abnormality Detection	Turns off all the switching elements when position sensing signals from the three Hall elements are either at high or low levels at once.

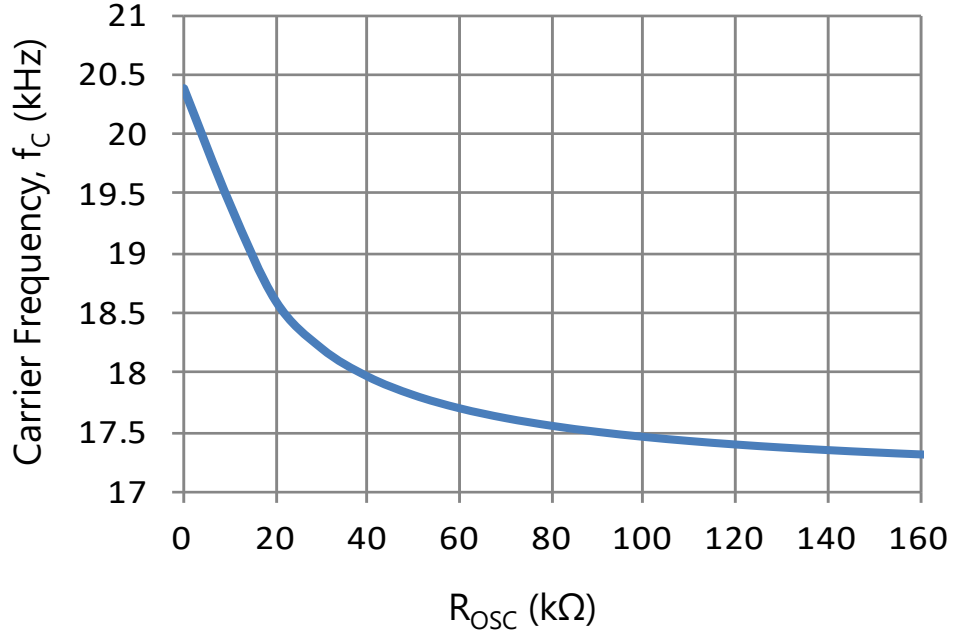
# Carrier Frequency Adjustment

$R_{OSC}$  connected to the OSCR pin adjusts carrier frequency.

◆ OSCR Pin Peripheral Circuit



◆ Carrier Frequency vs. Resistance



◆ Carrier Frequency Adjustable Range

$R_{OSC}$ (k $\Omega$ )	Carrier Frequency, $f_c$ (kHz)
Short	20.4
Open	17.0

# Switching of Speed and Driving Controls

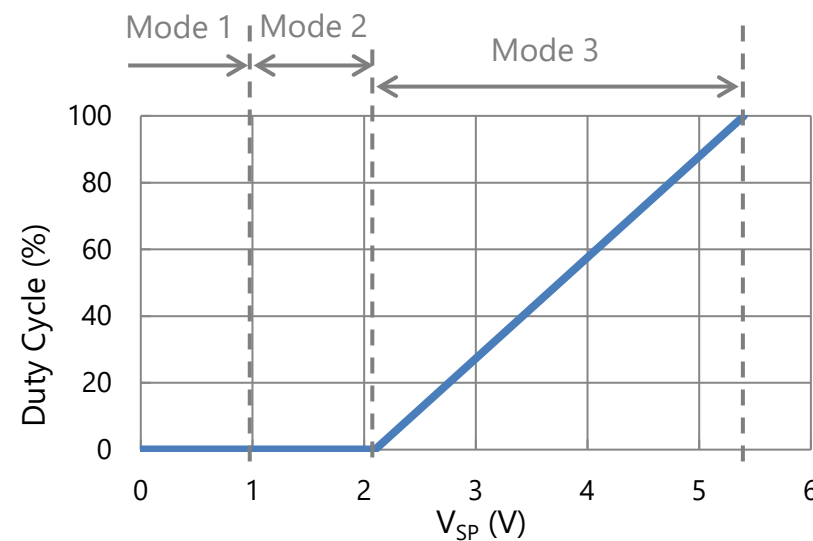
The SX6812xM series switches the motor driving controls according to a frequency. Based on a motor speed detected by the VSP pin, the IC enters the operation mode determined by the VSP pin voltage. This leads to a stable startup operation.

## ◆ Driving Controls

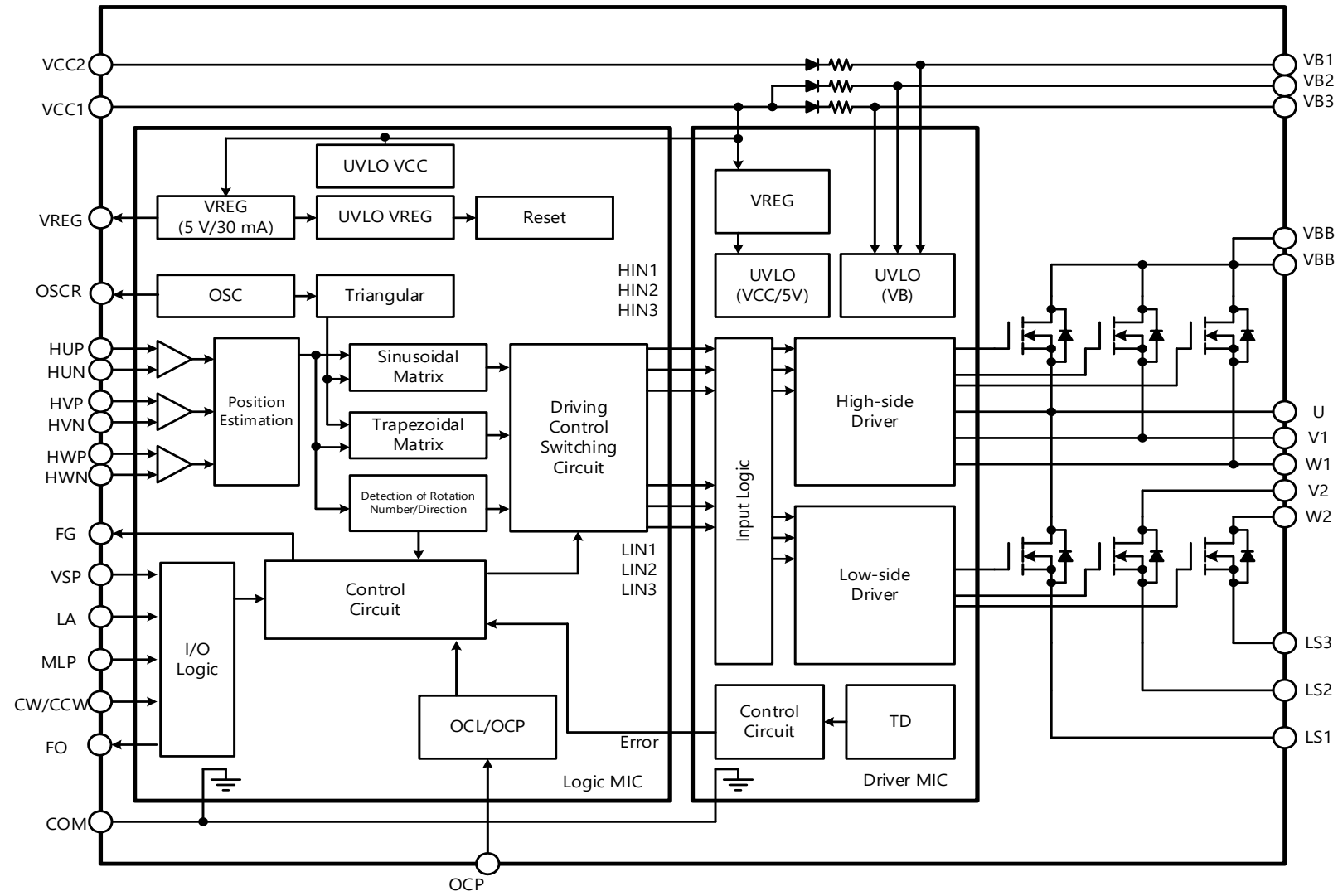
Frequency	Driving Control
<1 Hz	Trapezoidal
≥1 Hz	Sinusoidal two-phase modulation

## ◆ Operation Modes (see the right graph)

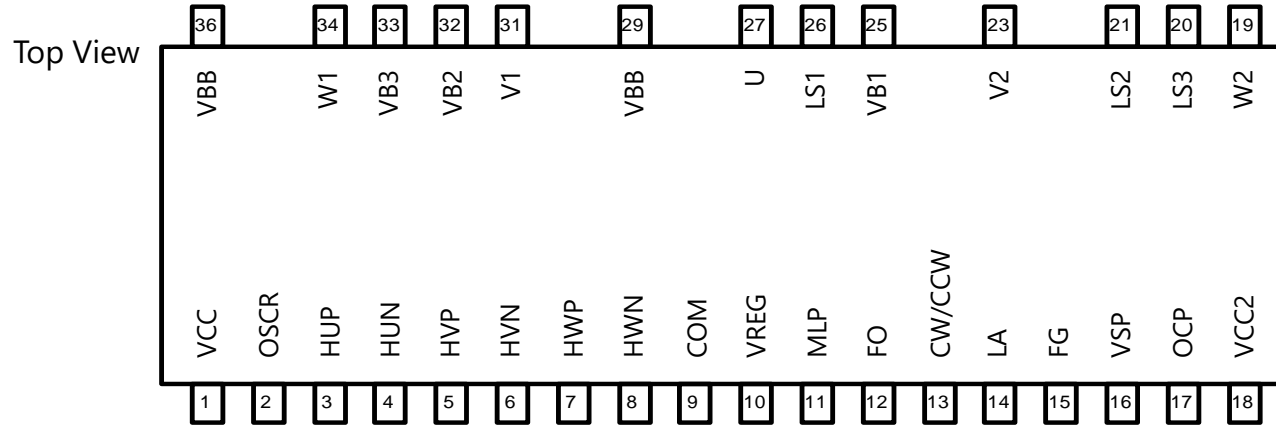
Mode	VSP Pin Voltage	Operation
1	0.0 V to 1.0 V	Turns off all the switching elements
2	1.0 V to 2.1 V	Charges the bootstrap capacitors (turns off the low-side switching elements)
3	2.1 V to 5.4 V	Performs PWM modulation





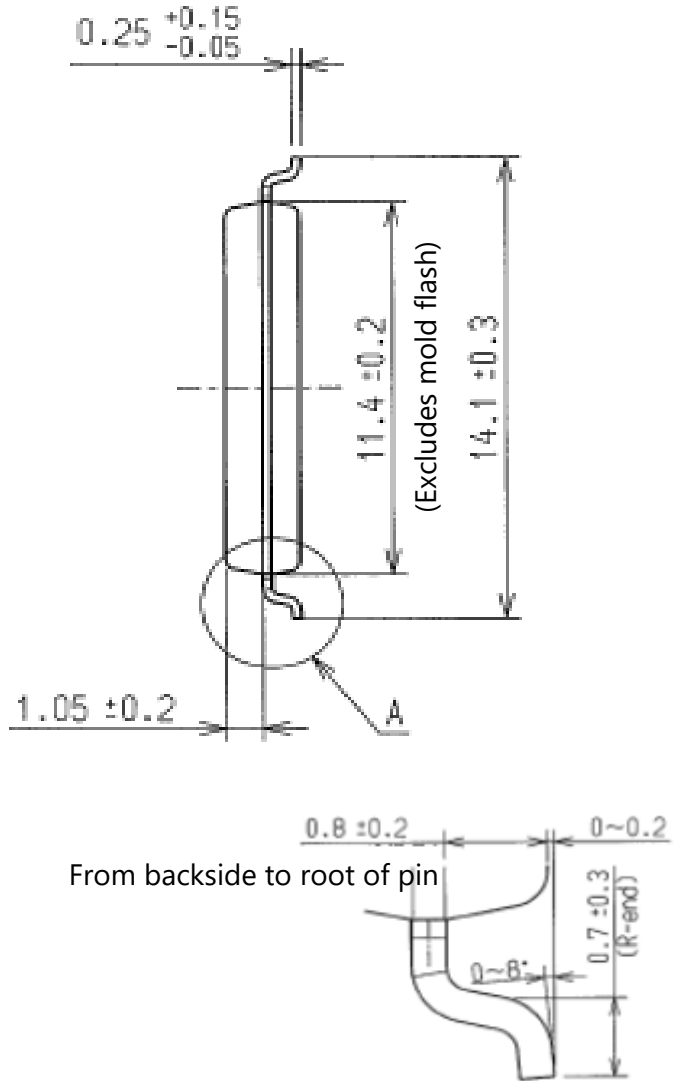
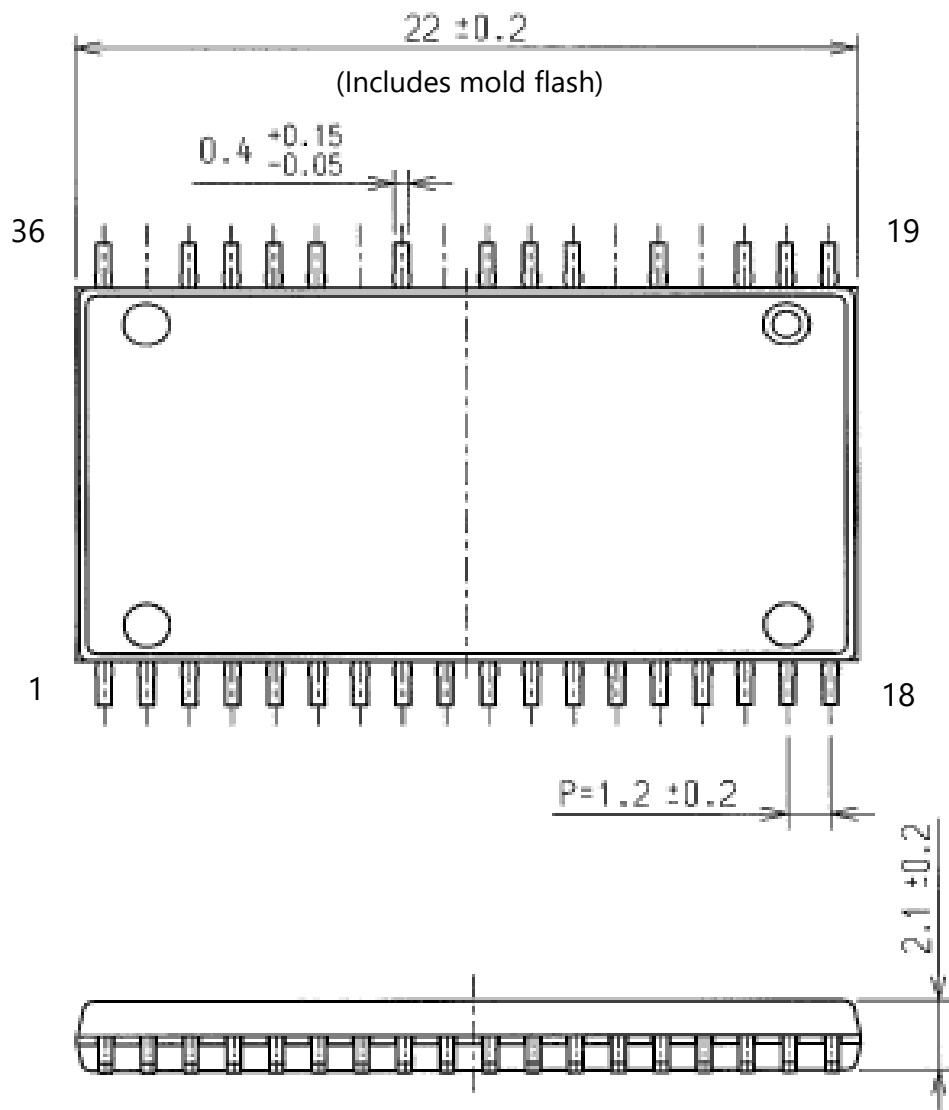


# Pin Assignment



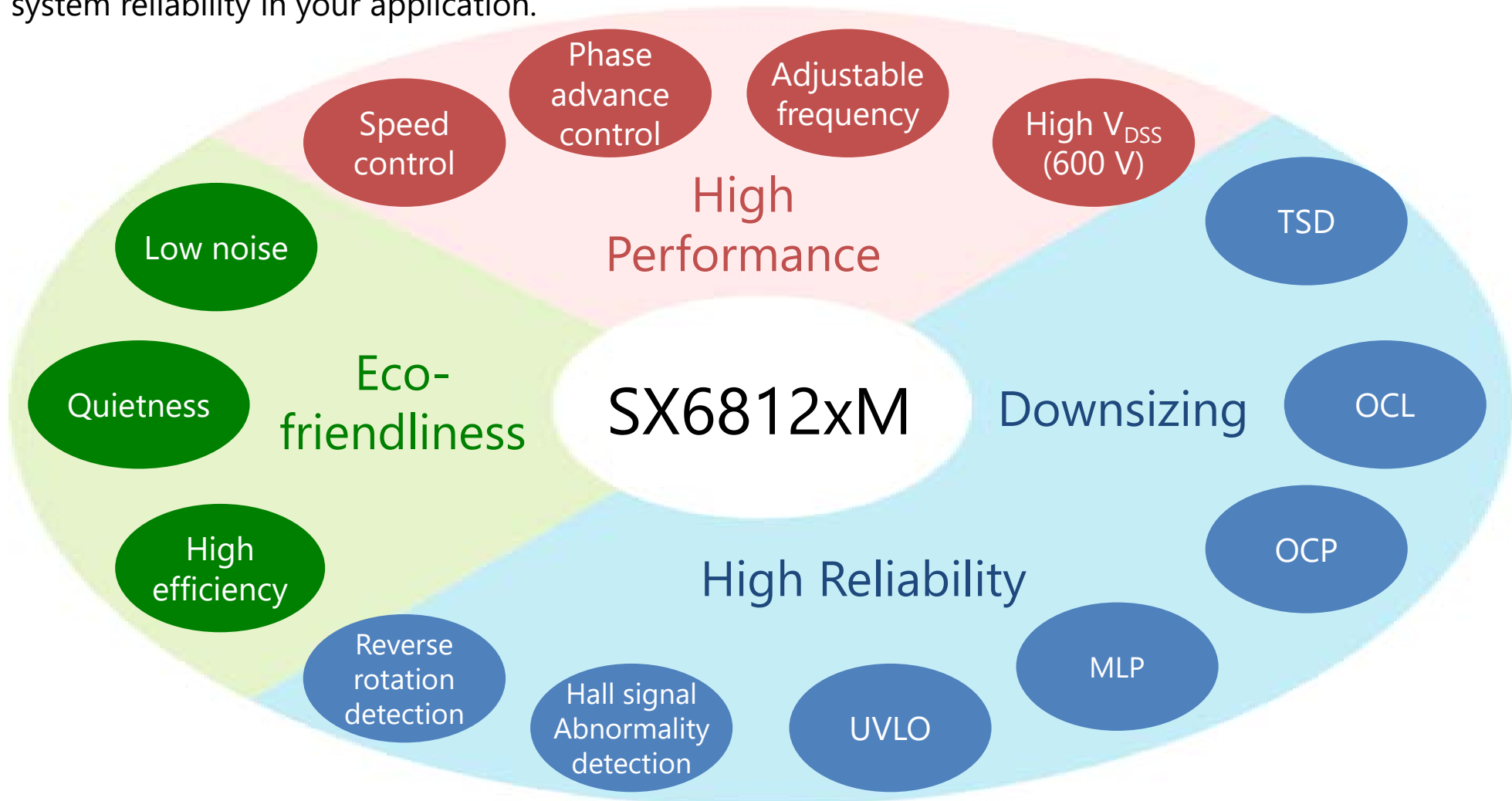
Number	Name	Description
1	VCC1	Logic supply voltage input
2	OSCR	Switching frequency adjustment input
3	HUP	U-phase hall element input (+)
4	HUN	U-phase hall element input (-)
5	HVP	V-phase hall element input (+)
6	HVN	V-phase hall element input (-)
7	HWP	W-phase hall element input (+)
8	HWN	W-phase hall element input (-)
9	COM	Logic ground
10	VREG	Built-in regulator output
11	MLP	Motor lock protection setting input
12	FO	Fault signal output
13	CW/CCW	Rotation direction switching setting input
14	LA	Phase advance angle and driving control setting input
15	FG	Position signal output
16	VSP	Speed control command input
17	OCP	Overcurrent detection signal input
18	VCC2	Logic supply voltage input

Number	Name	Description
19	W2	W-phase output (connected to W1 externally)
20	LS3	Low-side source 3 (connected to LS1, LS2 externally)
21	LS2	Low-side source 2 (connected to LS1, LS3 externally)
22	—	Pin removed
23	V2	V-phase output (connected to V1 externally)
24	—	Pin removed
25	VB1	U-phase high-side floating supply voltage input
26	LS1	Low-side source 1 (connected to LS2, LS3 externally)
27	U	U-phase output
28	—	Pin removed
29	VBB	Main power supply
30	—	Pin removed
31	V1	V-phase output (connected to V2 externally)
32	VB2	V-phase high-side floating supply voltage input
33	VB3	W-phase high-side floating supply voltage input
34	W1	W-phase output (connected to W2 externally)
35	—	Pin removed
36	VBB	Main power supply



# Summary

The SX6812xM series, driven by the sinusoidal control, provides a motor with high efficiency, quietness, and low noise. This series comes in a compact SOP package, including a control circuit, drive circuit, and various protections. Its enhanced performance brings about not only system downsizing but also higher system reliability in your application.



## Important Notes

- All data, illustrations, graphs, tables and any other information included in this document (the “Information”) as to SanKen’s products listed herein (the “SanKen Products”) are current as of the date this document is issued. The Information is subject to any change without notice due to improvement of the SanKen Products, etc. Please make sure to confirm with a SanKen sales representative that the contents set forth in this document reflect the latest revisions before use.
- The SanKen Products are intended for use as components of general purpose electronic equipment or apparatus (such as home appliances, office equipment, telecommunication equipment, measuring equipment, etc.). Prior to use of the SanKen Products, please put your signature, or affix your name and seal, on the specification documents of the SanKen Products and return them to SanKen. When considering use of the SanKen Products for any applications that require higher reliability (such as transportation equipment and its control systems, traffic signal control systems or equipment, disaster/crime alarm systems, various safety devices, etc.), you must contact a SanKen sales representative to discuss the suitability of such use and put your signature, or affix your name and seal, on the specification documents of the SanKen Products and return them to SanKen, prior to the use of the SanKen Products. The SanKen Products are not intended for use in any applications that require extremely high reliability such as: aerospace equipment; nuclear power control systems; and medical equipment or systems, whose failure or malfunction may result in death or serious injury to people, i.e., medical devices in Class III or a higher class as defined by relevant laws of Japan (collectively, the “Specific Applications”). SanKen assumes no liability or responsibility whatsoever for any and all damages and losses that may be suffered by you, users or any third party, resulting from the use of the SanKen Products in the Specific Applications or in manner not in compliance with the instructions set forth herein.
- In the event of using the SanKen Products by either (i) combining other products or materials or both therewith or (ii) physically, chemically or otherwise processing or treating or both the same, you must duly consider all possible risks that may result from all such uses in advance and proceed therewith at your own responsibility.
- Although SanKen is making efforts to enhance the quality and reliability of its products, it is impossible to completely avoid the occurrence of any failure or defect or both in semiconductor products at a certain rate. You must take, at your own responsibility, preventative measures including using a sufficient safety design and confirming safety of any equipment or systems in/for which the SanKen Products are used, upon due consideration of a failure occurrence rate and derating, etc., in order not to cause any human injury or death, fire accident or social harm which may result from any failure or malfunction of the SanKen Products. Please refer to the relevant specification documents and SanKen’s official website in relation to derating.
- No anti-radioactive ray design has been adopted for the SanKen Products.
- The circuit constant, operation examples, circuit examples, pattern layout examples, design examples, recommended examples, all information and evaluation results based thereon, etc., described in this document are presented for the sole purpose of reference of use of the SanKen Products.
- SanKen assumes no responsibility whatsoever for any and all damages and losses that may be suffered by you, users or any third party, or any possible infringement of any and all property rights including intellectual property rights and any other rights of you, users or any third party, resulting from the Information.
- No information in this document can be transcribed or copied or both without SanKen’s prior written consent.
- Regarding the Information, no license, express, implied or otherwise, is granted hereby under any intellectual property rights and any other rights of SanKen.
- Unless otherwise agreed in writing between SanKen and you, SanKen makes no warranty of any kind, whether express or implied, including, without limitation, any warranty (i) as to the quality or performance of the SanKen Products (such as implied warranty of merchantability, and implied warranty of fitness for a particular purpose or special environment), (ii) that any SanKen Product is delivered free of claims of third parties by way of infringement or the like, (iii) that may arise from course of performance, course of dealing or usage of trade, and (iv) as to the Information (including its accuracy, usefulness, and reliability).
- In the event of using the SanKen Products, you must use the same after carefully examining all applicable environmental laws and regulations that regulate the inclusion or use or both of any particular controlled substances, including, but not limited to, the EU RoHS Directive, so as to be in strict compliance with such applicable laws and regulations.
- You must not use the SanKen Products or the Information for the purpose of any military applications or use, including but not limited to the development of weapons of mass destruction. In the event of exporting the SanKen Products or the Information, or providing them for non-residents, you must comply with all applicable export control laws and regulations in each country including the U.S. Export Administration Regulations (EAR) and the Foreign Exchange and Foreign Trade Act of Japan, and follow the procedures required by such applicable laws and regulations.
- SanKen assumes no responsibility for any troubles, which may occur during the transportation of the SanKen Products including the falling thereof, out of SanKen’s distribution network.
- Although SanKen has prepared this document with its due care to pursue the accuracy thereof, SanKen does not warrant that it is error free and SanKen assumes no liability whatsoever for any and all damages and losses which may be suffered by you resulting from any possible errors or omissions in connection with the Information.
- Please refer to our official website in relation to general instructions and directions for using the SanKen Products, and refer to the relevant specification documents in relation to particular precautions when using the SanKen Products.
- All rights and title in and to any specific trademark or tradename belong to SanKen and such original right holder(s).

DSGN-CEZ-16003