



Working Together for a Greener Society

Future of Power Electronics and the Earth



Sine-wave Driving, High Voltage 3-phase Motor Drivers
with Built-in Hall Amplifiers

SX6814xM Series



Suppressed Audible Noise at Startup and Stop of Spoke Motors

For audible noise suppression, the IC employs a sensorless-controlled sine-wave driving system at startup, and ramp-down control during stop operation to gradually decrease the current.

Highly Flexible Phase Advance Settings

The phase advance function has options allowing motor-appropriate settings: the external phase advance and the internal phase advance (with linear to cubic function operations).

Support for 8-pole / 10-pole Motors

The IC can output a rotation pulse signal equivalent to an 8-pole motor when a 10-pole BLDC motor is used. This allows 10-pole BLDC motors to be driven with conventional 8-pole BLDC motor systems.

■ Overview

The SX6814xM series are high voltage 3-phase motor drivers, which are driven by a sinusoidal control and suitable for 8- and 10-pole motor systems. Whereas a typical 10-pole DC motor outputs a rotation signal of 15 pulses, the IC can output a 12-pulse rotation signal which is equivalent to an 8-pole motor. This enables your application to use an existing 8-pole DC motor system for 10-pole DC motor driving with no change.

The IC supports Hall elements and Hall IC inputs. In addition, with its sensorless-controlled sine-wave driving system at startup, the IC offers suppressed audible noise, such as in a spoke motor startup operation.

Supplied in a thin SOP36 package, where a controller, a gate driver, the output transistors of three phases, and bootstrap diodes are highly integrated, the SX6814xM series requires only a few external components for building a motor driver. This also allows a motor driver to be highly reliable in performance and design-friendly with its compactness.

■ Application

For motor drives such as:

- Fan Motor for Air Conditioner
- Fan Motor for Air Purifier and Electric Fan

■ Package

SOP36



■ Selection Guide

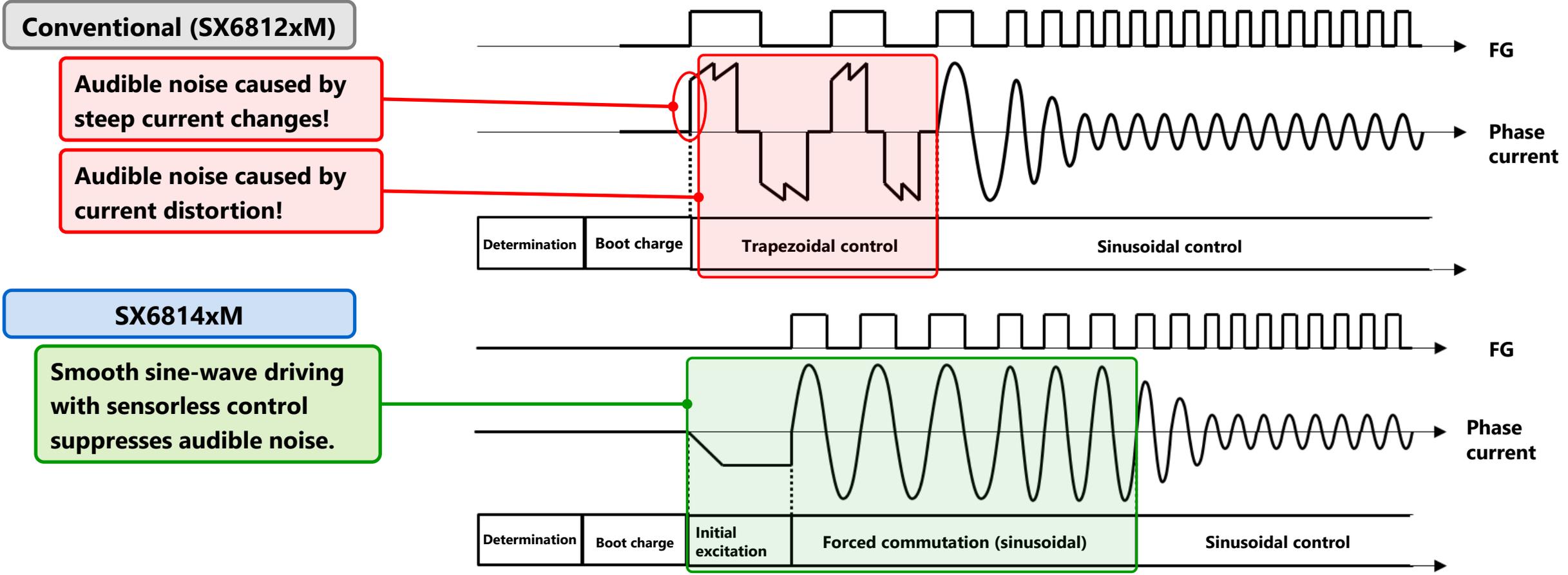
Part Number	Output Transistor	V_{DSS}	I_D	$R_{DS(ON)}$ (max.)
SX68141M*	Power MOSFET	250 V	2.0 A	1.5 Ω
SX68140M*			1.0 A	6.0 Ω
SX68144M		600 V	1.5 A	3.6 Ω
SX68145M			2.0 A	2.5 Ω

* Under development

Suppressed Audible Noise at Startup and Stop

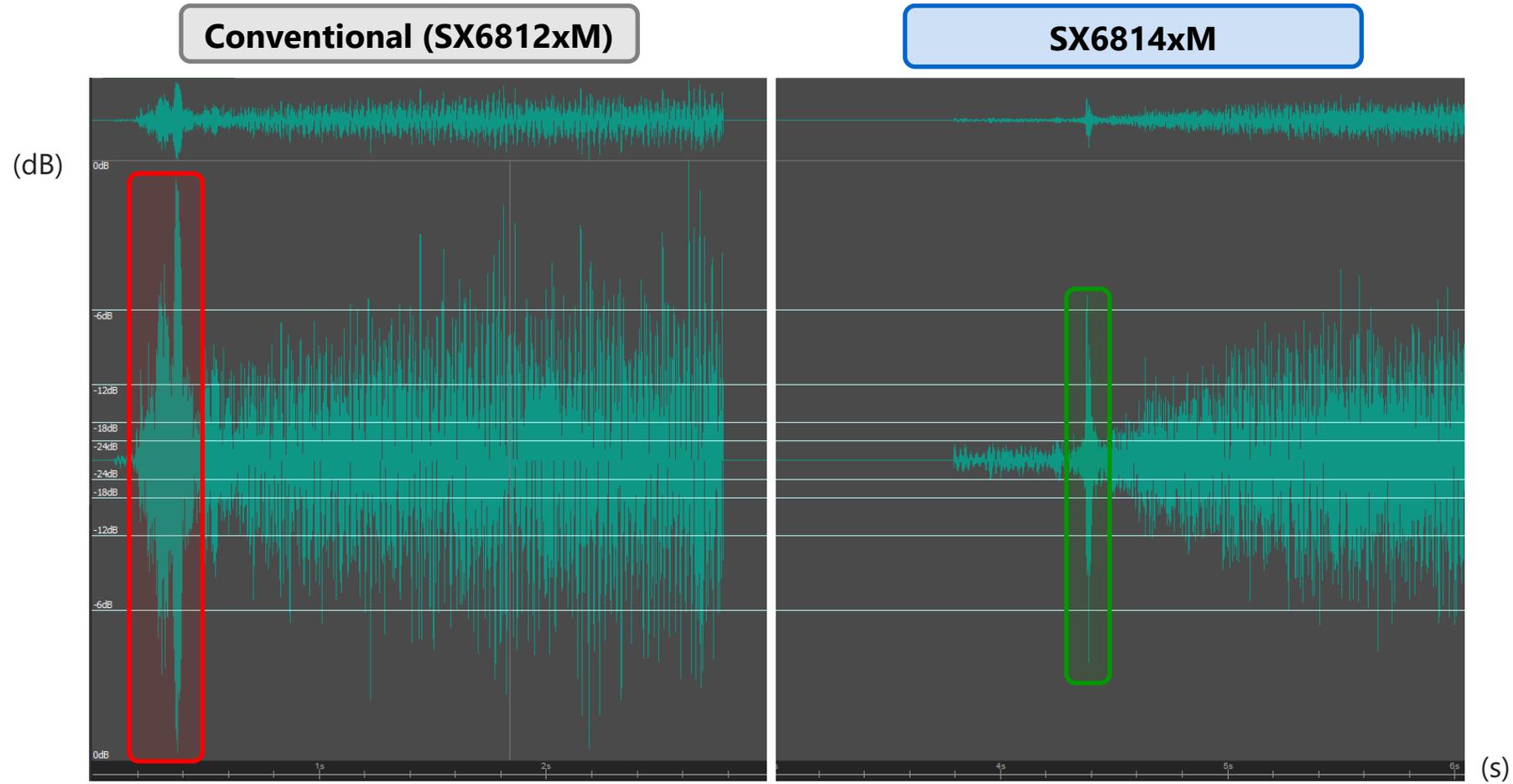
In recent years, lower-cost spoke motors have been increasingly used as alternatives. However, spoke motors tend to generate higher noise, requiring audible noise reduction. For audible noise suppression, the SX6814xM series employs a sensorless-controlled sine-wave driving system at startup and ramp-down control during stop operation to gradually decrease the current.

Operational Waveforms at Startup



Suppressed Audible Noise at Startup and Stop

■ Noise Level Waveforms at Startup



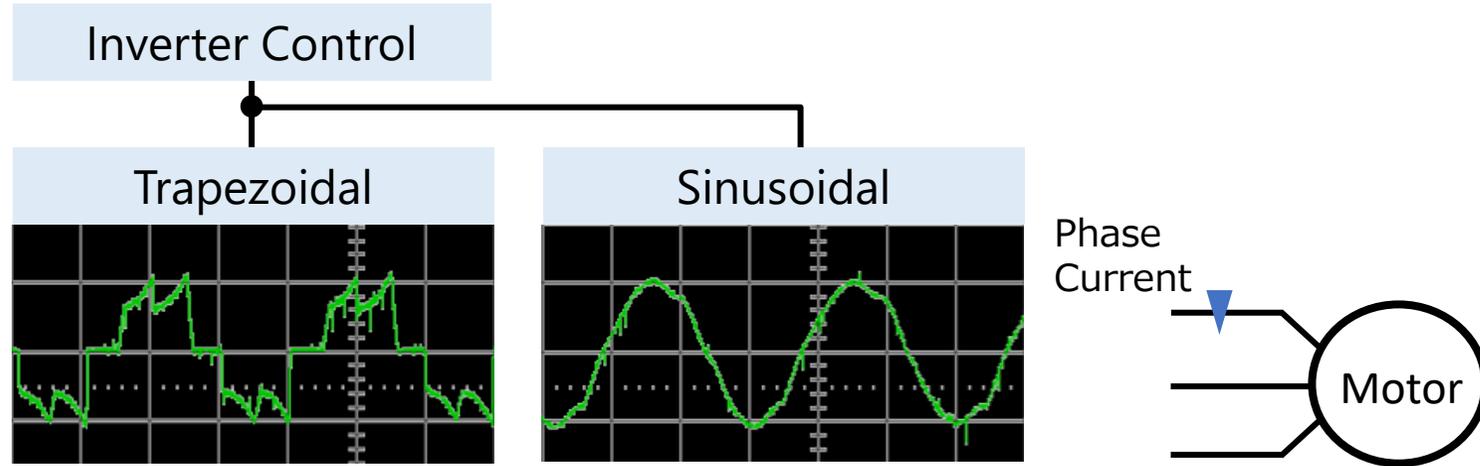
* Result under our test environment.

**Improved noise level at startup in both peak level and duration.
As quiet as an SPM (Surface Permanent Magnet) motor!**

Features of Sinusoidal Control

The motor driving system includes trapezoidal and sinusoidal controls.

The SX6814xM series uses the sinusoidal control that is excellent in efficiency and quietness.



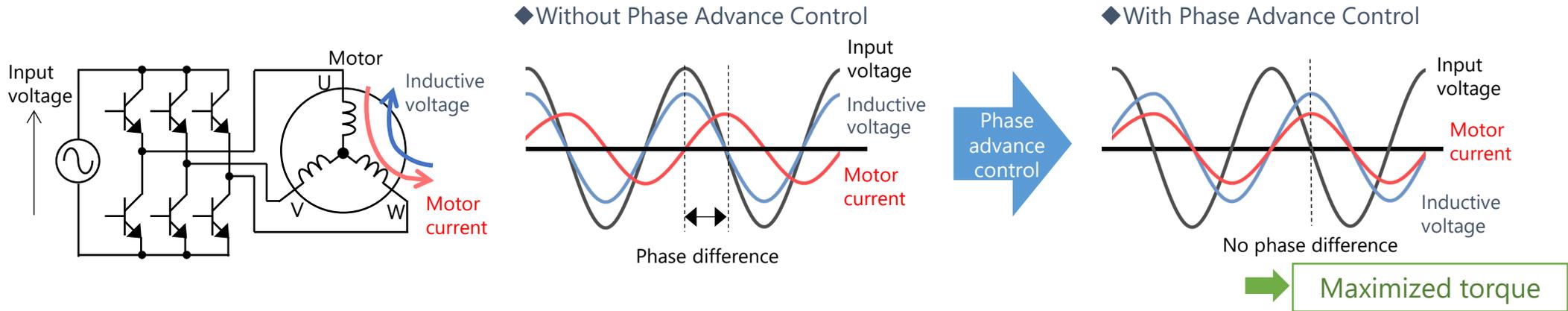
The following table shows the driving controls and motor features.

Sinusoidal control is more efficient and quieter than trapezoidal control.

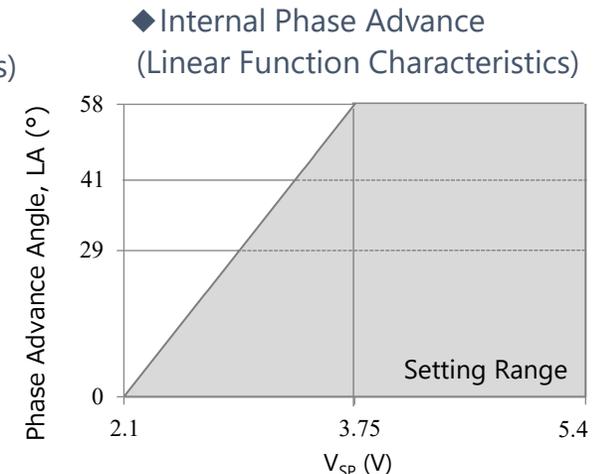
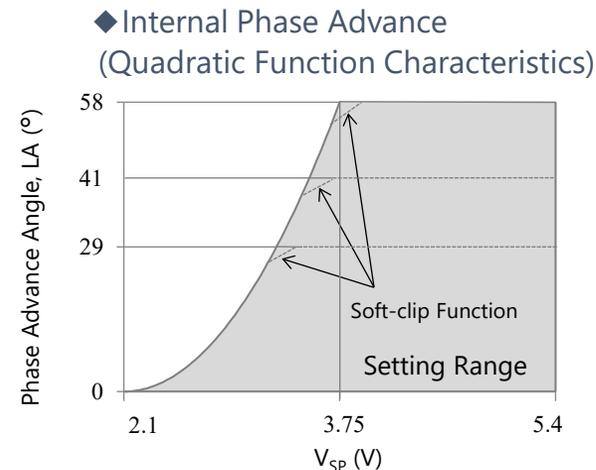
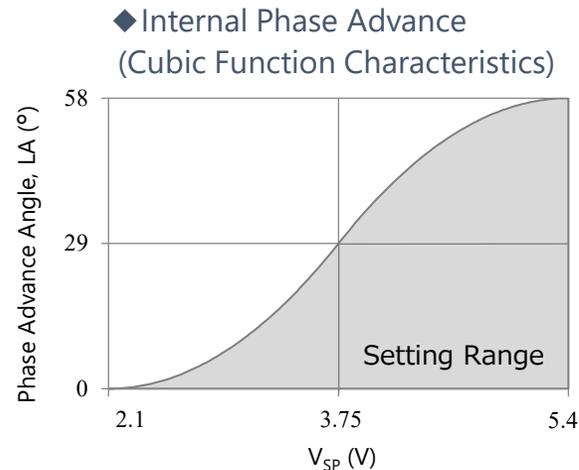
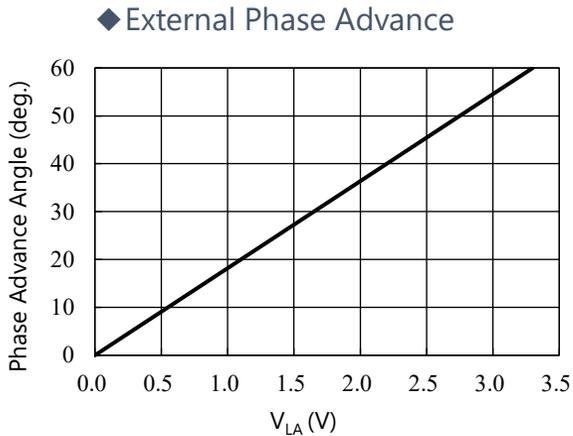
Driving Control	Parameters			
	Motor Efficiency	Switching Efficiency	Quietness	Torque Ripple
Trapezoidal	High	Higher	Quiet	Large
Sinusoidal	Higher	High	Quieter	Small

Phase Advance Function

A phase of the current through the motor normally gets behind a phase of inductive voltage due to winding inductance. The SX6814xM 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 SX6814xM series features the phase advance function that includes external advance and internal advance (with linear to cubic function operations). The phase can be optimally adjusted for the motor.



■ Support for 8-pole / 10-pole Motors

The IS1 pin sets the number of motor poles, the rotation pulse period, the number of output pulses, and the standby function. This allows the IC to output a rotation pulse signal equivalent to an 8-pole motor when used with a 10-pole BLDC motor. As a result, a 10-pole BLDC motor can be used without changing the existing system for an 8-pole BLDC motor.

IS1 Pin Voltage (Typ.)	Number of FG Output Pulses			Standby Function
	Number of Motor Poles	Rotation Pulse Periods per Electrical Angle of 360°	Number of FG Output Pulses per Motor Rotation	
0 to $1/8 V_{REG}$	8 poles	3 ppr	12 pulses	Enabled
$1/8 V_{REG}$ to $2/8 V_{REG}$	8 poles	3 ppr	12 pulses	Disabled
$2/8 V_{REG}$ to $3/8 V_{REG}$	10 poles	2.4 ppr	12 pulses	Enabled
$3/8 V_{REG}$ to $4/8 V_{REG}$	10 poles	2.4 ppr	12 pulses	Disabled
$4/8 V_{REG}$ to $5/8 V_{REG}$	10 poles	0.8 ppr	4 pulse	Disabled
$5/8 V_{REG}$ to $6/8 V_{REG}$	10 poles	0.8 ppr	4 pulse	Enabled
$6/8 V_{REG}$ to $7/8 V_{REG}$	8 poles	1 ppr	4 pulse	Disabled
$7/8 V_{REG}$ to $8/8 V_{REG}$	8 poles	1 ppr	4 pulse	Enabled

■ Optimal phase advance angle adjustment for motors

The IS2 pin determines the phase advance control.

IS2 Pin Voltage (Typ.)	Phase Advance Function	Setting Range of Phase Advance Angle
0 to $1/8 V_{REG}$	External phase advance	0° to 59.53125°
$1/8 V_{REG}$ to $2/8 V_{REG}$	Cubic function operation	0° to 58°
$2/8 V_{REG}$ to $3/8 V_{REG}$	Quadratic function operation	0° to 29°
$3/8 V_{REG}$ to $4/8 V_{REG}$	Quadratic function operation	0° to 41°
$4/8 V_{REG}$ to $5/8 V_{REG}$	Quadratic function operation	0° to 58°
$5/8 V_{REG}$ to $6/8 V_{REG}$	Linear function operation	0° to 29°
$6/8 V_{REG}$ to $7/8 V_{REG}$	Linear function operation	0° to 41°
$7/8 V_{REG}$ to $8/8 V_{REG}$	Linear function operation	0° to 58°

■ Customizable for the motor

The IS3 pin selects the rotation direction, enables and disables the motor lock protection, and sets the startup torque.

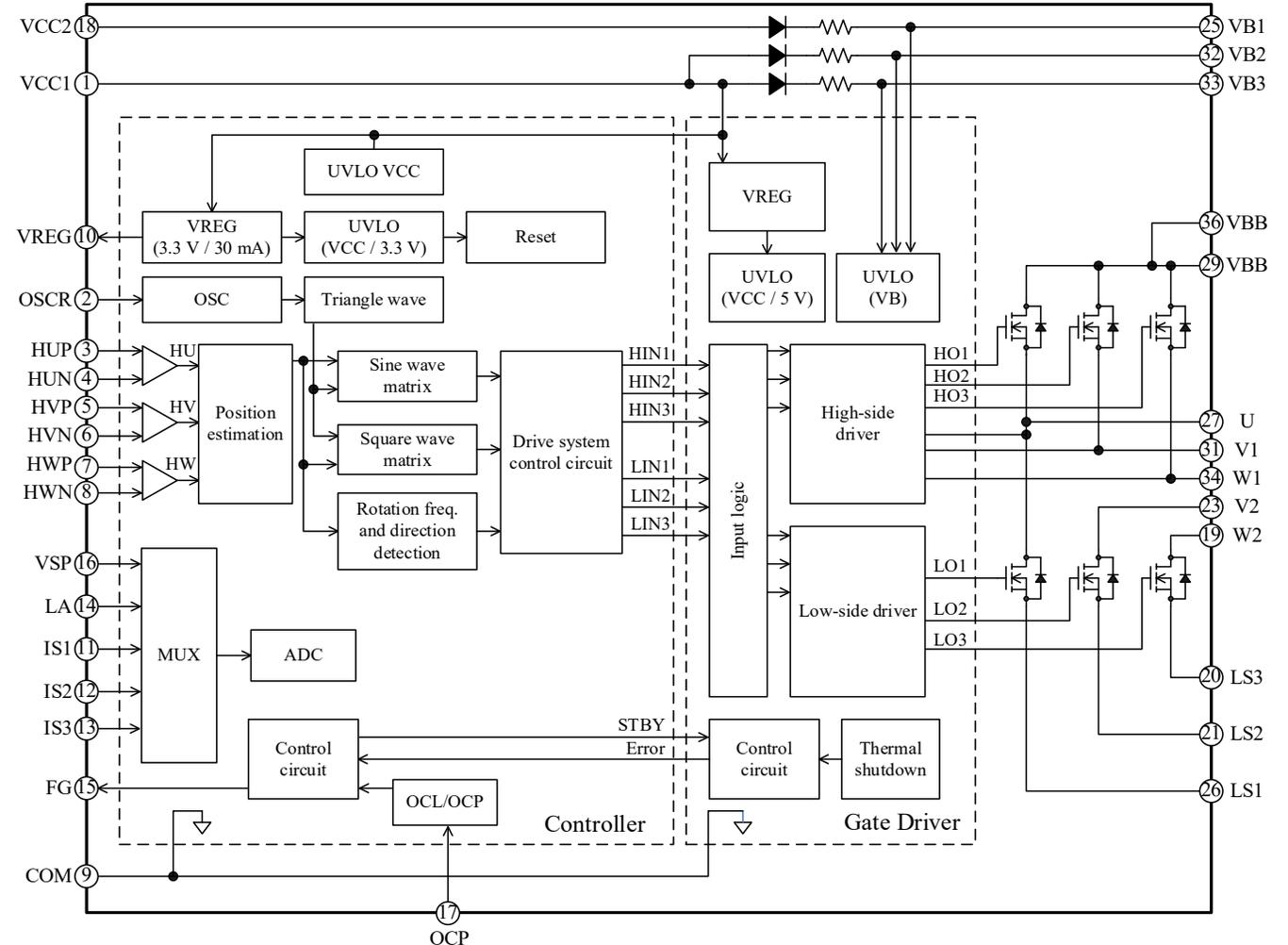
IS3 Pin Voltage (Typ.)	Rotation Direction	Motor Lock Protection	Torque at Startup
0 to $1/8 V_{REG}$	Reverse (CCW)	Enabled	Small
$1/8 V_{REG}$ to $2/8 V_{REG}$	Reverse (CCW)	Enabled	Large
$2/8 V_{REG}$ to $3/8 V_{REG}$	Reverse (CCW)	Disabled	Small
$3/8 V_{REG}$ to $4/8 V_{REG}$	Reverse (CCW)	Disabled	Large
$4/8 V_{REG}$ to $5/8 V_{REG}$	Forward (CW)	Disabled	Large
$5/8 V_{REG}$ to $6/8 V_{REG}$	Forward (CW)	Disabled	Small
$6/8 V_{REG}$ to $7/8 V_{REG}$	Forward (CW)	Enabled	Large
$7/8 V_{REG}$ to $8/8 V_{REG}$	Forward (CW)	Enabled	Small

Various Protection Functions

The IC has various protection functions as follows:

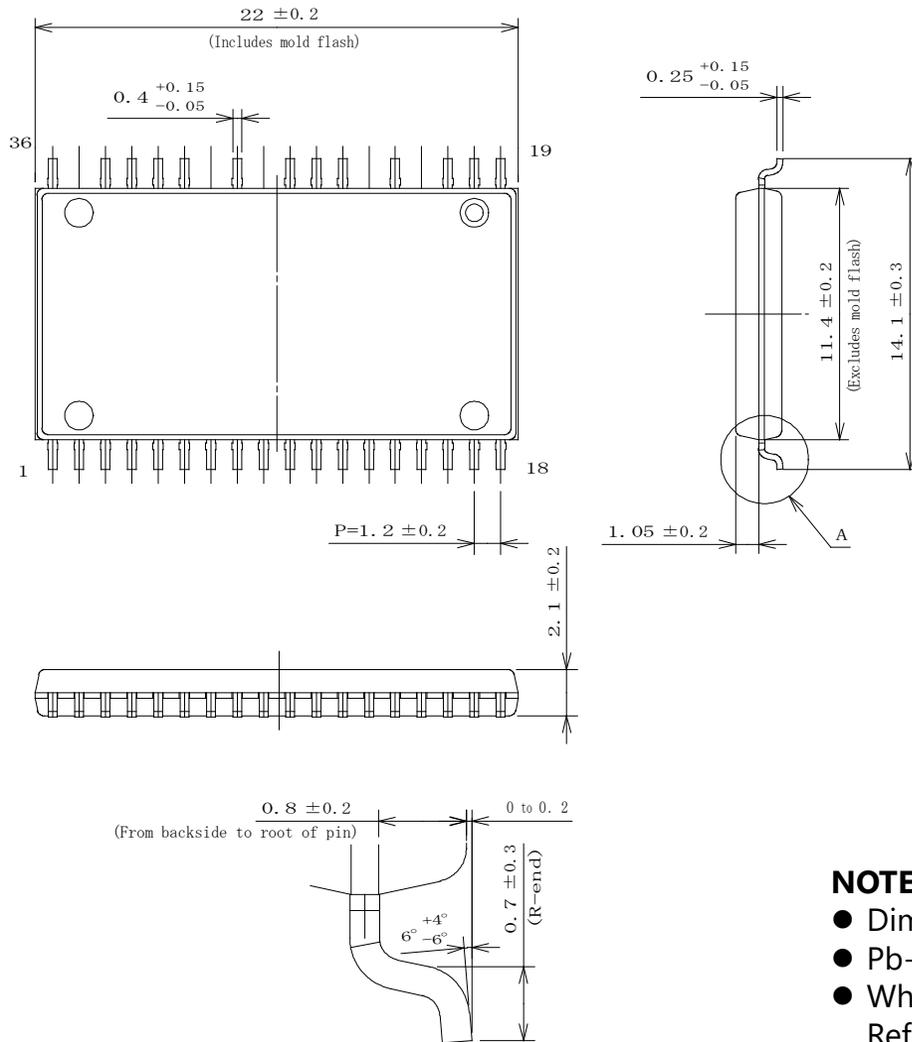
Protection Functions

- VREG Pin Undervoltage Lockout (UVLO_REG)
- Undervoltage Lockout for Power Supplies
 - VBx Pin (UVLO_VB)
 - VCC1 Pin (UVLO_VCC)
- Overcurrent Limit (OCL)
- Overcurrent Protection (OCP)
- Thermal Shutdown (TSD)
- Motor Lock Protection (MLP)
- Reverse Rotation Detection
- Hall Signal Abnormality Detection



Physical Dimensions

SOP36



Enlarged view of A (S = 20/1)

NOTES:

- Dimensions in millimeters
- Pb-free (RoHS compliant)
- When soldering the products, it is required to minimize the working time within the following limits:
 Reflow (MSL3):
 Preheating: $180\text{ }^\circ\text{C} / 90 \pm 30\text{ s}$
 Solder heating: $250\text{ }^\circ\text{C} / 10 \pm 1\text{ s}$ ($260\text{ }^\circ\text{C}$ peak, 2 times)
 Soldering iron: $380 \pm 10\text{ }^\circ\text{C} / 3.5 \pm 0.5\text{ s}$, 1 time

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