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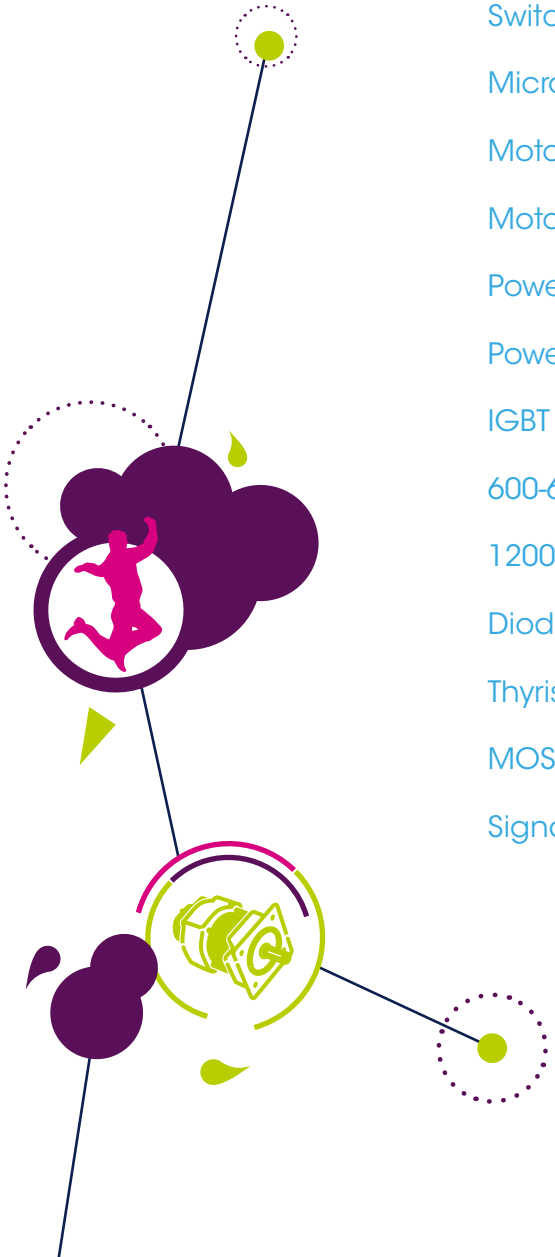
Motor control
Reference Guide

Content



Introduction

ST's commitment to motor control reinforces the environmental revolution

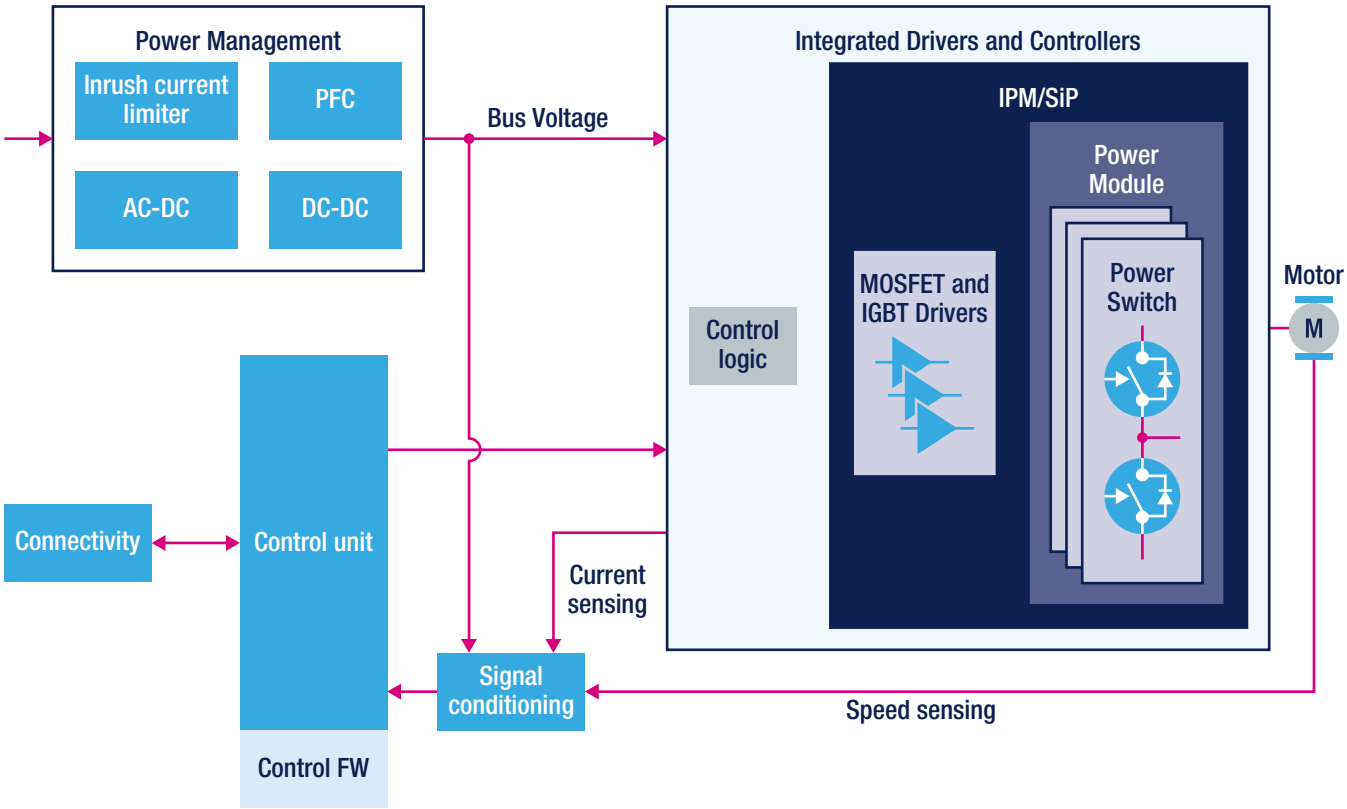
In line with the environmental revolution, electric motor control is moving very quickly in the direction of higher efficiency for motors and drives. Moreover, an increased level of integration at the lowest cost is required to support market penetration of new technologies, as well as increased safety and reliability. Committed to electric motor control for more than 20 years, ST was among the first to recognize these trends.
ST is riding the winds of change with innovations in integrated intelligent power modules and systems-in-package, monolithic motor drivers, fast and efficient power switches, voltage-transient protected Triacs, and powerful and secure microcontrollers. Whichever motor technology you use, from traditional and rugged to the most modern and efficient, ST is able to supply the right electronic devices and a complete ecosystem with a range of evaluation boards, reference designs, firmware and development tools to simplify and accelerate design cycles.

STAY UP-TO-DATE

For more information and up-to-date material, visit motor control application page on ST's website at http://www.st.com/motorcontrol

PMSM & BLDC Motors

Permanent Magnet synchronous motor and Brushless DC motors are replacing DC brush motors more and more in many applications due to advantages such as higher efficiency, quieter operation and better reliability.
Despite their different structures, all three-phase permanent magnet motors (BLDC, PMSM or PMAC) are driven by a pulse-width-modulated (PWM) three-phase bridge (three half bridges) so as to supply the motor with variable frequency and amplitude of voltages and currents.
To provide the highest level of design flexibility, ST's product portfolio includes specific products for both high- and low-voltage applications like monolithic drivers ICs, power MOSFETs, IGBTs, gate drivers, power modules and dedicated microcontrollers to address a broad range of applications.



KEY PRODUCTS

	Product family	Description with key Features	Key products
Integrated Drivers and Controllers	• STSPIN2 Series • STSPIN8 Series • STSPIN32F0 Series • L62 Series	Wide range of efficient and accurate motor drivers able to drive PMSM and BLDC motors, ranging from several watts to few kilo watts	• STSPIN23* • STSPIN830 • STSPIN32F0* • L623*
Control unit	• STM32F7 Series • STM32F4 Series • STM32F3 Series • STM32F0 Series • STM32F1 Series • STM32G0 series • STM32L4 Series • STM8s Series	General-purpose product lines ranging from a basic, cost-efficient peripheral set, up to more performance and analog functions able to manage FOC motor control	• STM32F7* • STM32F4* • STM32F30* • STM32F0* • STM32G0* • STM32L4* • ST8S*
Intelligent power Module (IPM/SiP)	• SLLIMM 2nd series • SLLIMM-nano • SLLIMM-nano 2nd series • SLLIMM-nano SMD	3-phase inverter, IGBT and MOSFET based	• STGI* • STI*
MOSFET and IGBT Drivers	• L649 series • L639 series • STGAP series • L638 series • TD35 series	STDRIVE Mosfet and IGBT Gate drivers	• L649* • L639* • STGAP* • L638* • TD35*
Power Module	ACEPACK	Six pack and CIB topology, trench gate field-stop IGBT	• AxPyySwwMz • AxCyySwwMz
Power Switch	• F6 & F7 Low Voltage MOSFET • IGBT M series • IGBT S series • IGBT H series • DM2 MOSFET	Low Voltage MOSFET High voltage IGBT and MOSFET	• STxyN6F7 • STGxyyM65DF2 • STGxyyM120DF3 • STGxyyS120DF3 • STGxyyH60DF • STxyN60DM2
Inrush Current Limiter	High Tj SCR	High Tj 50 A SCR. Strong noise immunity trade-off (dv/dt = 500 V/us, IGT = 15 mA, High turn-on capability dI/dt = 100 A/us)	TN5015H-6G

MAIN EVALUATION BOARDS

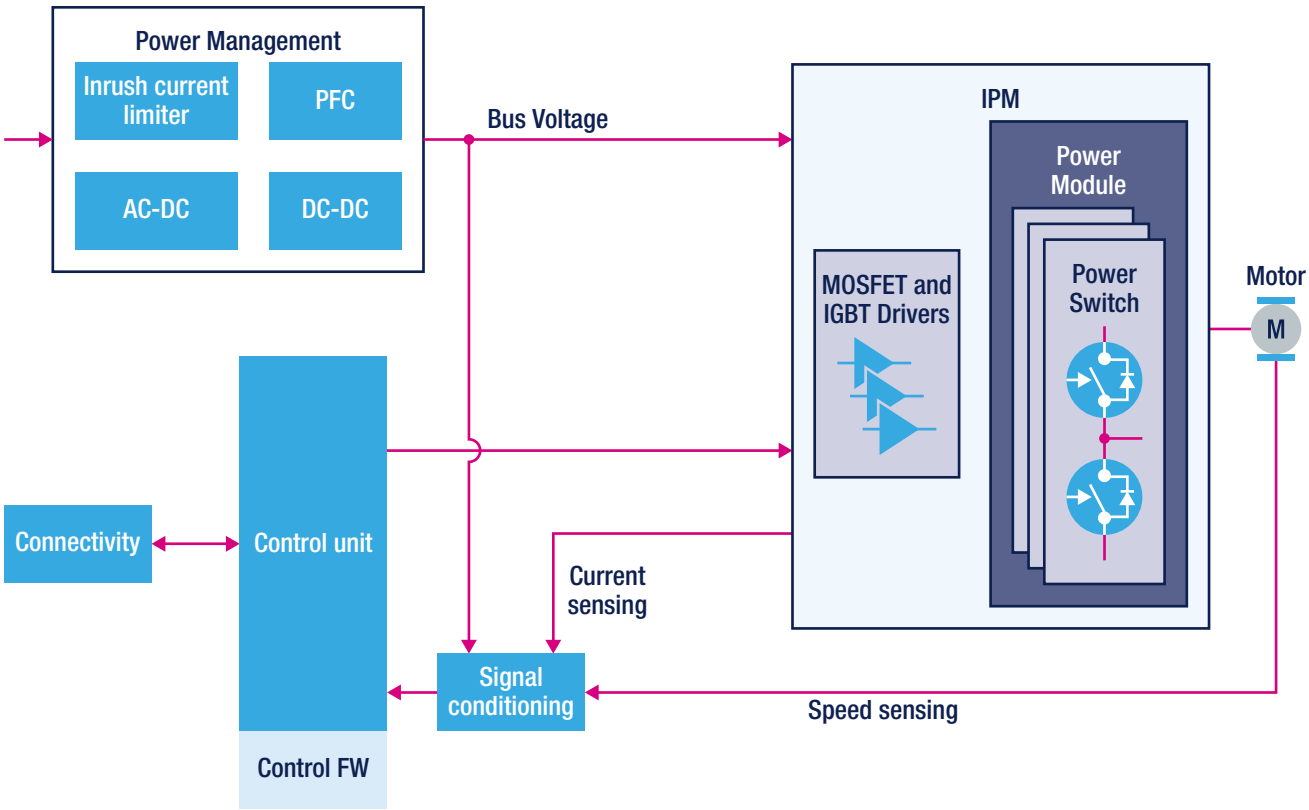
Reference/bundle	Voltage	Power/Max Current	ST parts	Application focus
STEVAL-HKI001V1	50 – 650 V_{DC}	Up to 35 A_{RMS} to the motor	• 1x A2C35S12M3-F • 7x STGAP1AS • 1x STM32F303RBT7	Motor drive: pumps, Motion/Servo Control, Industrial motor drives and more
STEVAL-CTM009V1	48 V_{DC}	Up to 5 kW	• 36x STH310N10F7-6 or STH315N10F7-6 • 3x L6491DTR • 1x A7986ATR • 1x TSZ121IYLT • 4x STTH102AY • 7x STPS5L60SY • 6x SM15T12CAY • 1x SM4T28AY • 1x ESDA14V2LY, ESDA6V2LY, ESDA5V2LY	Power board: forklifts, golf carts professional power tools, E-rickshaws and more
STEVAL-IPM05F	125 – 400 V_{DC}	Up to 500 W	• 1x STGIF5CH60TS-L	Power board: pumps, compressors, fans, home appliances
STEVAL-IPM07F	125 – 400 V_{DC}	Up to 700 W	• 1x STGIF7CH60TS-L	Power board: pumps, compressors, fans, home appliances
STEVAL-IPM08B	125 – 400 V_{DC}	Up to 800 W	• 1x STGIB8CH60TS-L	Power board: pumps, compressors, fans, home appliances
STEVAL-IPM10B	125 – 400 V_{DC}	Up to 1200 W	• 1x STGIB10CH60TS-L	Power board: pumps, compressors, fans, home appliances
STEVAL-IPM10F	125 – 400 V_{DC}	Up to 1000 W	• 1x STGIF10CH60TS-L	Power board: pumps, compressors, fans, home appliances
STEVAL-IPM15B	125 – 400 V_{DC}	Up to 1500 W	• 1x STGIB15CH60TS-L	Power board: pumps, compressors, fans, home appliances
STEVAL-IPMNM1S	125 – 400 V_{DC}	Up to 60 W	• 1x STIPNS1M50T-H	Power board: pumps, fans, small appliances
STEVAL-IPMNM2S	125 – 400 V_{DC}	Up to 100 W	• 1x STIPNS2M50T-H	Power board: pumps, fans, small appliances
STEVAL-IPMNG3S	125 – 400 V_{DC}	Up to 300 W	• 1x STGIPNS3H60T-H	Power board: pumps, compressors, fans, high-end power tools
STEVAL-IPMNM1N	125 – 400 V_{DC}	Up to 60 W	• 1x STIPN1M50T-H	Power board: pumps, fans, small appliances
STEVAL-IPMNM2N	125 – 400 V_{DC}	Up to 100 W	• 1x STIPN2M50T-H	Power board: pumps, fans, small appliances
STEVAL-IPMNG3Q	125 – 400 V_{DC}	Up to 300 W	• 1x STGIPQ3H60T-HZ	Power board: pumps, compressors, fans, high-end power tools
STEVAL-IPMNG5Q	125 – 400 V_{DC}	Up to 450 W	• 1x STGIPQ5C60T-HZ	Power board: pumps, compressors, fans, high-end power tools
STEVAL-IPMNG8Q	125 – 400 V_{DC}	Up to 600 W	• 1x STGIPQ8C60T-HZ	Power board: pumps, compressors, fans, high-end power tools
STEVAL-IHM021V2	120/230 V_{AC} (60/50 Hz)	Up to 100 W	• 3x L6390 • 1x Viper12 • 6x STD5N52U	Power board: water pumps, fans, dish washers, washing machines
STEVAL-IHM023V3	90 – 285 V_{AC} 125 – 400 V_{DC}	Up to 1 kW	• 3x L6390 • 1x Viper16 • 7x STGP10H60DF	Power board: pumps, compressors, washing machines and more
STEVAL-IHM028V2	90 – 285 V_{AC} 125 – 400 V_{DC}	Up to 2 kW	• 1x STGIPS20C60 • 1x VIPer26LD • 1x STGW35NB60SD	Power board: pumps, compressors, air conditioning and more
STEVAL-IHM032V1	86 to 260 V_{AC}	Up to 150 W	• 2x L6392D • 1x L6391D • 1x Viper12 • 6 x STGD3HF60HD	Power board: pumps, compressors, fans, home appliances and more
STEVAL-IHM034V2	230 V_{AC}	Up to 1700 W	• 1x STGIPS20C60 • 1x L6391 • 1x Viper16LD • 1x TSV914ID • 3x STTH1L06A	Motor drive with digital PFC: room air conditioning, compressor and more

Reference/bundle	Voltage	Power/Max Current	ST parts	Application focus
STEVAL-IHM035V2	120/230 V_{AC}	Up to 100 W	• 1x STGIPN3H60 • 1x VIPer16L	Power board: pumps, compressors, fans, home appliances and more
STEVAL-IHM045V1	30 - 270 V_{AC} 40 - 400 V_{DC}	Up to 100 W	• 1x STGIPN3H60A • 1x VIPer06L • 1x TSV994	Power board: pumps, compressors, fans, home appliances and more
STEVAL-ISF003V1	230 V_{AC} (or 120 V_{AC})	Up to 7.4 kW	• 1x TN5050H-12WY • 1x STTH60L10WY • 1x STM8S103K3T3	Inrush current limiter board
STEVAL-IHT008V1	230 VAC or 120 V_{AC}	Up to 800 W	• 1x T1635T-8FP • 1x ACST210-8FP • 1x ACS108-8SN • 1x Z0109MUF • 1x ViPER 26LD • 1x STM8S103K3T3C	Inrush current limiter board
STEVAL-SCR001V1	90 - 265 V_{AC}	Up to 800 W	• 2x TN5015H-6G	Inrush current limiter board
STEVAL-ESC001	11.1 up to 22.2 V_{DC}	Up to 20 Arms	• 6x STL160N4F7 • 3x L6398DTR • STM32F303CBT7 • 3x TSV991ILT • 1x STPS1L40M, 3x STPS0560Z, 7x BAT30KFILM • 1x L7986TR	Motor drive: Electronics speed controllers for drones (E.S.C.), RC vehicles (electric cars, helicopter, trucks, etc)
STEVAL-ESC002V1	6.7 - 45 V_{DC}	Up to 20 Arms	• 1x STSPIN32F0A • 1x STL140N6F7 • 1x STPS0560Z • 1x LMV321LILT	Power tools, fans, pumps, drones ESC, air purifiers, coffee machines, edu/home robots
STEVAL-SPIN3201	8 - 45 V_{DC}	Up to 15 Arms	• 1x STSPIN32F0 • 6x STD140N6F7 • 1x STPS1L60A • 7x BAT30KFILM • 1x LD3985M33R • 1x USBLC6-2SC6	Power tools, fans, pumps, drones ESC, home appliances, factory automation, edu/home robots
STEVAL-SPIN3202	7 - 45 V_{DC}	Up to 15 Arms	• 1x STSPIN32F0 • 6x STD140N6F7 • 1x STPS1L60A • 7x BAT30KFILM • 1x LD3985M33R • 1x USBLC6-2SC6	Power tools, fans, pumps, drones ESC, home appliances, factory automation, edu/home robots
STEVAL-GMBL02V1	6 - 8.4 V_{DC}	Up to 1.3 Arms	• 3x STSPIN233; • 1x STM32F303RE • 1x LSM6DSLTR • 1x M24C02-RMN6TP • 1x USBLC6-4SC6	Handheld applications and drone 3 axis gimbals
X-NUCLEO-IHM07M1	8 - 48 V_{DC}	Up to 1.4 Arms	• 1x L6230PD • 1x TSV994IPT	Fans, pumps, factory automation, money handling machines and medical equipment
X-NUCLEO-IHM08M1	10 - 48 V_{DC}	Up to 15 Arms	• 6x STL220N6F7 • 3x L6398D • 1x TSV994IPT • 1x ST1S14PHR • 1x LMV331ILT	Fans, propellers for drones
X-NUCLEO-IHM09M1	N.A.	N.A.	• Not Silicon Part	Motor control connector adapter
X-NUCLEO-IHM16M1	7 - 45 V_{DC}	Up to 1.5 Arms	• 1x STSPIN830 • 1x TSV994IPT	Antenna control, fans, robots, factory automation, home appliances and medical equipment
X-NUCLEO-IHM17M1	1.8 - 10 V_{DC}	Up to 1.3 Arms	• 1x STSPIN233 • 1x TSV994IPT	Healthcare and medical, IoT, gimbals, edu/home robots, toys, fans, small actuators
P-NUCLEO-IHM001	8 - 48 V_{DC}	Up to 1.4 A_{RMS}	• 1x L6230	Fans, pumps, factory automation, money handling machines and medical equipment

3-phase Induction Motor (ACIM)

Overview

Three-phase induction motors are brushless motors. The stator is copper-wound and the rotor is typically an aluminum squirrel cage. The typical drive configuration is a three-phase bridge (3 half-bridges) modulated to provide three sine wave voltages to the stator. Typically used in higher power applications, the driving portion can be composed of power MOSFETs or IGBTs with high-voltage gate drivers, or power modules integrating three half-bridges and related gate driving stage. Field oriented-control or scalar (volts/hertz) control algorithms are implemented in the microcontroller that controls the inverter.



KEY PRODUCTS

	Product family	Description with key Features	Key products
Control unit	• STM32F1Series • STM32F3Series • STM32F4Series • STM32F7Series • STM32L4Series		
Intelligent power Module (IPM)	• SLLIMM 2nd series • SLLIMM-nano • SLLIMM-nano 2nd series	3-phase inverter, IGBT and MOSFET based	• STGIxxyyzz • STIxxyyzz
MOSFET and IGBT Drivers	• L649 series • L639 series • STGAP series • L638 series • TD35 series	STDRIVE Mosfet and IGBT Gate drivers	• L649* • L639* • STGAP* • L638* • TD35*
Power Module	• ACEPACK	Sixpack and CIB topology, trench gate field-stop IGBT	• AxPyySwwMz • AxCyySwwMz
Power Switch	• F6 & F7 Low Voltage • IGBT M series • IGBT S series • IGBT H series • DM2 MOSFET	Low Voltage MOSFET High voltage IGBT and MOSFET	• STxyN6F7 • STGxyyM65DF2 • STGxyyM120DF3 • STGxyyS120DF3 • STGxyyH60DF • STxyN60DM2
Inrush Current Limiter	• High Temperature SCR	From 12 A to 80 A and 600 V to 1200 V SCR. Junction T_j = 150 °C Strong noise immunity trade-off (dV/dt = 500 V/us, I_{GT} = 15 mA or 1000 V/µs/50 mA)	• TN1205H-6G • TN2015H-6FP • TN3015H-6G • TN5015H-6G • TN3050H-12GY • TM8050H-8D3

MAIN EVALUATION BOARDS

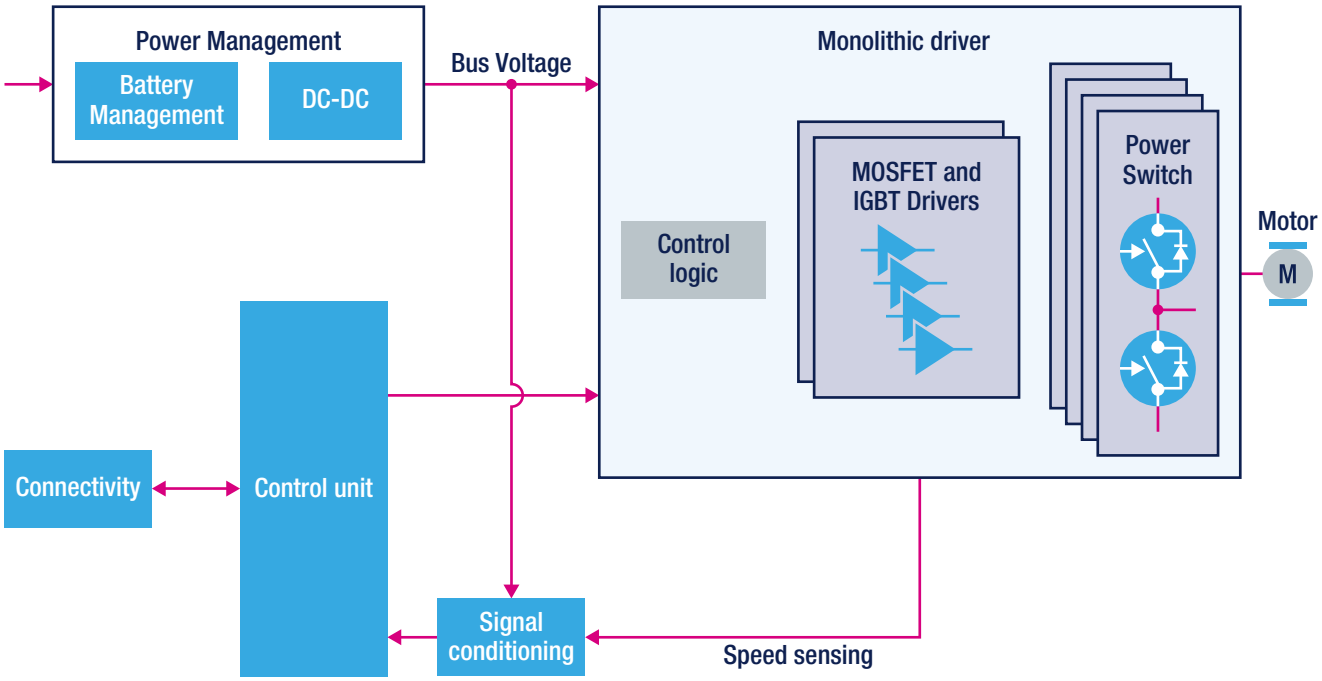
Reference/bundle	Voltage	Power/Max Current	ST parts	Application focus
STEVAL-HKI001V1	50 – 650 V_{DC}	Up to 35 A_{RMS}	• 1x A2C35S12M3-F • 7x STGAP1AS • 1x STM32F303RBT7	Motor drive: pumps, Motion/Servo Control, Industrial motor drives and more
STEVAL-CTM009V1	48 V_{DC}	Up to 5 kW	• 36x STH310N10F7-6 or STH315N10F7-6 • 3x L6491DTR • 1x A7986ATR • 1x TSZ121IYLT • 4x STTH102AY • 7x STPS5L60SY • 6x SM15T12CAY • 1x SM4T28AY • 1x ESDA14V2LY, ESDA6V2LY, ESDA5V2LY	Power board: forklifts, golf carts professional power tools, E-rickshaws and more
STEVAL-IPM05F	125 – 400 V_{DC}	Up to 500 W	• 1x STGIF5CH60TS-L	Power board: pumps, compressors, fans, home appliances
STEVAL-IPM07F	125 – 400 V_{DC}	Up to 700 W	• 1x STGIF7CH60TS-L	Power board: pumps, compressors, fans, home appliances
STEVAL-IPM08B	125 – 400 V_{DC}	Up to 800 W	• 1x STGIB8CH60TS-L	Power board: pumps, compressors, fans, home appliances
STEVAL-IPM10B	125 – 400 V_{DC}	Up to 1200 W	• 1x STGIB10CH60TS-L	Power board: pumps, compressors, fans, home appliances
STEVAL-IPM10F	125 – 400 V_{DC}	Up to 1000 W	• 1x STGIF10CH60TS-L	Power board: pumps, compressors, fans, home appliances
STEVAL-IPM15B	125 – 400 V_{DC}	Up to 1500 W	• 1x STGIB15CH60TS-L	Power board: pumps, compressors, fans, home appliances
STEVAL-IPMNM1S	125 – 400 V_{DC}	Up to 60 W	• 1x STIPNS1M50T-H	Power board: pumps, fans, small appliances
STEVAL-IPMNM2S	125 – 400 V_{DC}	Up to 100 W	• 1x STIPNS2M50T-H	Power board: pumps, fans, small appliances
STEVAL-IPMNG3S	125 – 400 V_{DC}	Up to 300 W	• 1x STGIPNS3H60T-H	Power board: pumps, compressors, fans, high-end power tools
STEVAL-IPMNM1N	125 – 400 V_{DC}	Up to 60 W	• 1x STIPN1M50T-H	Power board: pumps, fans, small appliances
STEVAL-IPMNM2N	125 – 400 V_{DC}	Up to 100 W	• 1x STIPN2M50T-H	Power board: pumps, fans, small appliances
STEVAL-IPMNG3Q	125 – 400 V_{DC}	Up to 300 W	• 1x STGIPQ3H60T-HZ	Power board: pumps, compressors, fans, high-end power tools
STEVAL-IPMNG5Q	125 – 400 V_{DC}	Up to 450 W	• 1x STGIPQ5C60T-HZ	Power board: pumps, compressors, fans, high-end power tools
STEVAL-IPMNG8Q	125 – 400 V_{DC}	Up to 600 W	• 1x STGIPQ8C60T-HZ	Power board: pumps, compressors, fans, high-end power tools
STEVAL-IHM021V2	120/230 V_{AC} (60/50 Hz)	Up to 100 W	• 3x L6390 • 1x Viper12 • 6x STD5N52U	Power board: water pumps, fans, dish washers, washing machines
STEVAL-IHM023V3	90 – 285 V_{AC} 125 – 400 V_{DC}	Up to 1 kW	• 3x L6390 • 1x Viper16 • 7x STGP10H60DF	Power board: pumps, compressors, washing machines and more
STEVAL-IHM028V2	90 – 285 V_{AC} 125 – 400 V_{DC}	Up to 2 kW	• 1x STGIPS20C60 • 1x VIPer26LD • 1x STGW35NB60SD	Power board: pumps, compressors, air conditioning and more
STEVAL-IHM032V1	86 to 260 V_{AC}	Up to 150 W	• 2x L6392D • 1x L6391D • 1x Viper12 • 6x STGD3HF60HD	Power board: pumps, compressors, fans, home appliances and more

Reference/bundle	Voltage	Power/Max Current	ST parts	Application focus
STEVAL-IHM034V2	230 V_{AC}	Up to 1700 W	• 1x STGIPS20C60 • 1x L6391 • 1x Viper16LD • 1x TSV914ID • 3x STTH1L06A	Motor drive with digital PFC: room air conditioning, compressor and more
STEVAL-IHM035V2	120/230 V_{A}	Up to 100 W	• 1x STGIPN3H60 • 1x VIPer16L	Power board: pumps, compressors, fans, home appliances and more
STEVAL-IHM045V1	30 – 270 V_{AC} 40 – 400 V_{DC}	Up to 100 W	• 1x STGIPN3H60A • 1x VIPer06L • 1x TSV994	Power board: pumps, compressors, fans, home appliances and more
STEVAL-ISF003V1	230 V_{AC} (or 120 V_{AC})	Up to 7.4 kW	• 1x TN5050H-12WY • 1x STTH60L10WY • 1x STM8S103K3T3	Inrush current limiter board
STEVAL-IHT008V1	230 V_{AC} or 120 V_{AC}	Up to 800 W	• 1x T1635T-8FP • 1x ACST210-8FP • 1x ACS108-8SN • 1x Z0109MUF • 1x ViPER 26LD • 1x STM8S103K3T3C	Inrush current limiter board
STEVAL-SCR001V1	90-265 V_{AC}	Up to 800 W	• 2x TN5015H-6G	Inrush current limiter board

Stepper motors

Overview

Stepper motors are widely used in holding and positioning applications in the computer, security, industrial automation sectors. Depending on the number of phases, the winding arrangement and the required level of motion smoothness, ST offers several types of bipolar stepper motor drivers to ensure the best performance for your application. In bipolar stepper motors, current can flow in both directions; a full-bridge converter is required to drive each of the two windings of a two-phase motor. During motion, the type of electronic control (full step, half step, microstepping) and the resulting phase current waveform impact the vibration level, the acoustic noise, motion smoothness and sensitivity to resonances. ST fully supports all of these configurations with monolithic motor driver ICs (embedding digital controllers, power devices and protection functions), and for higher power, with a controller + MOSFET combination approach.



KEY PRODUCTS

	Product family	Description with key Features	Key products
Control unit			
Monolithic driver	• STSPIN2 Series • STSPIN8 Series • PowerSTEP01 • L64 Series	Efficient and accurate stepper drivers able to reach high motion resolution, up to 256 microsteps and to fit in a wide range of applications, spanning from portable to high current industrial ones	• STSPIN220 • STSPIN820 • PowerSTEP01 • L64*

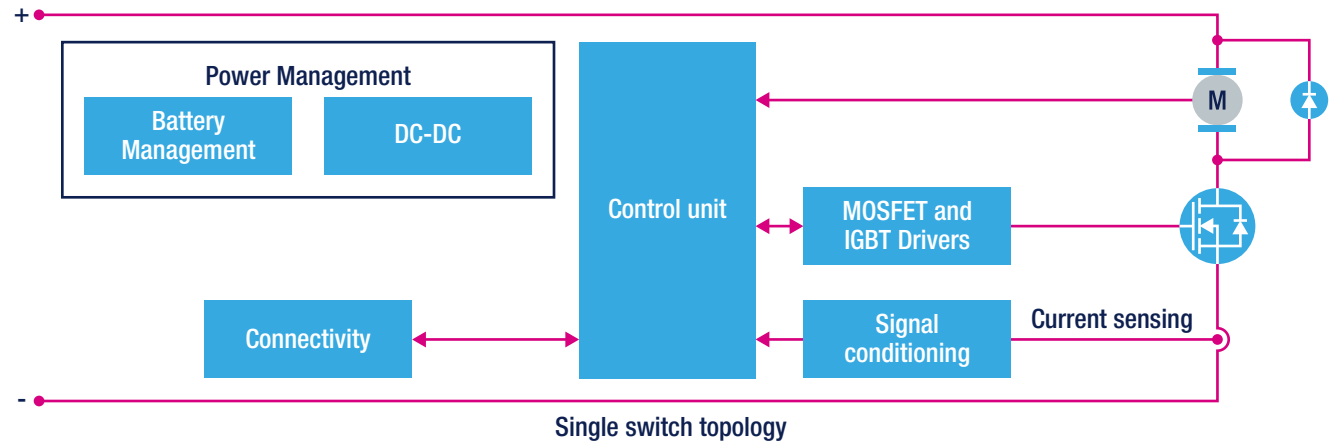
MAIN EVALUATION BOARDS

Reference/bundle	Voltage	Power/Max Current	ST parts	Application focus
X-NUCLEO-IHM14A1	7 -45 V_{DC}	Up to 1.5 A_{rms}	• 1x STSPIN820	Label printers, surveillance and dome cameras, textile machines, 3D printers, antenna control
X-NUCLEO-IHM06A1	1.8 - 10 V_{DC}	Up to 1.3 A_{rms}	• 1x STSPIN220	POS, cash registers, toys, camera control, IoT and haptic feedbacks 3D printers
X-NUCLEO-IHM05A1	8 - 50 V_{DC}	Up to 2.8 A_{rms}	• 1x L6208PD	Money handling machines, factory automation, valves, textile machines
X-NUCLEO-IHM03A1	10.5 - 85 V_{DC}	Up to 10 A_{rms}	• 1x powerSTEP01	Textile and sewing machines, pick and place machines, factory automation, industrial printers, industrial mixers
X-NUCLEO-IHM01A1	8 - 45 V_{DC}	Up to 3 A_{rms}	• 1x L6474PD	Textile machines, factory automation, industrial and 3D printers
STEVAL-3DP001V1	8 - 45 V_{DC}	Up to 3 A_{rms}	• 6x L6474H • 1x STM32F401VET6 • 1x ST1S40IPHR • 3x STL8N10F7 • 3x STT6N3LLH6	Fused Filament Fabrication 3D printers

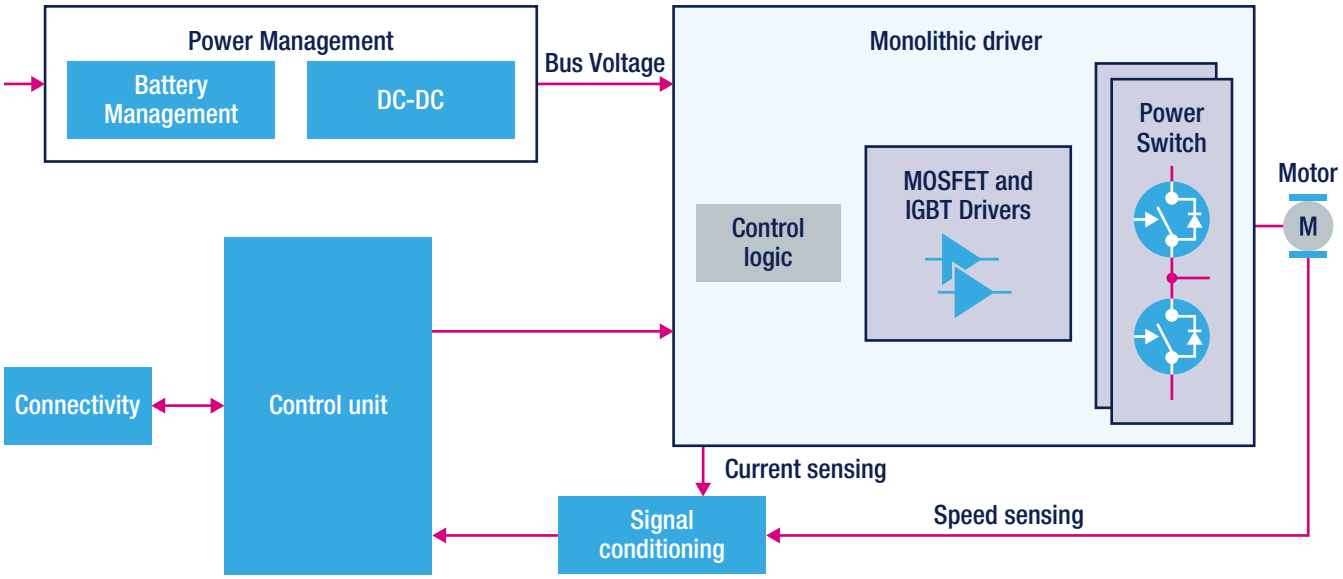
Brushed DC motors

Overview

Brushed DC motor are commonly used in industrial applications such as robots, valves and healthcare equipment. When only one direction of rotation is required, a single switch topology with PWM modulation can be used to vary the voltage applied to the motor, and thus to control its speed. When positioning is required or when both directions of rotation are needed (e.g. car windows) a full H-bridge with PWM control is used. At lower power levels, ST offers a full set of integrated motor drivers with a progressive selection of integrated features, embedded gate drivers, power transistors, protection functions, current sensing and even DC-DC converters. For higher power needs, ST's portfolio also includes discrete low voltage power MOSFETs and gate driver ICs to implement the required H-bridge. A general-purpose 8-bit microcontroller or a cost-optimized 32-bit microcontroller can be used to implement these drives.



Single switch topology

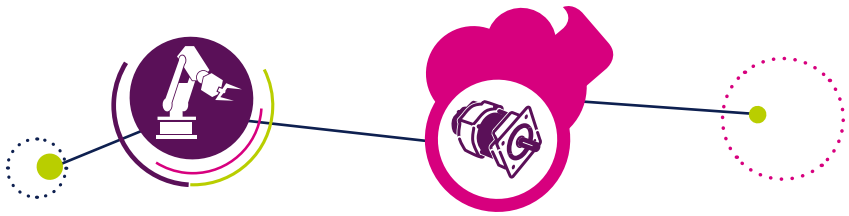


Full Bridge topology

	Product family	Description with key Features	Key products
Control unit			
Monolithic driver	• STSPIN2 Series • STSPIN8 Series • PWD Series • L62 Series	A complete set of versatile and scalable monolithic motor drivers addressing a wide range of applications, spanning from portable to high current and high voltage industrial ones	• STSPIN2* • STSPIN840 • PWD*F60 • L62*
MOSFET and IGBT Drivers	• L649 series • L639 series • L638 series • TD35 series	STDRIVE Mosfet and IGBT Gate drivers	• L649* • L639* • L638* • TD35*
Power Switch	• F6 & F7 Low Voltage	MOSFET	• STxyN4F7 • STxyN6F6
Power Schottky	• STPSx45/60/80/100	ST's power Schottky diodes combine low voltage-drop characteristics with negligible or zero recovery. They range from 15 to 200 V and from 1 to 240 A, so covering all application needs from OR-ing and 48 V converters, to battery chargers and welding equipment. They are avalanche specified for improved ruggedness	• STPS3045 • STPS41H100
FERD Diodes	• FERDx45/60/100	ST field-effect rectifier diodes (FERD) help improve designs with new versions focusing on trade-off upgrades. The design of the FERDs has allowed both a decrease in the voltage drop and a decrease in the leakage current temperature coefficient. As a result, the runaway safety margin is improved and maybe beyond the typical safety margin of Schottky barrier diodes	• FERD2045S • FERD20U60DJF • FERD30SM100DJF

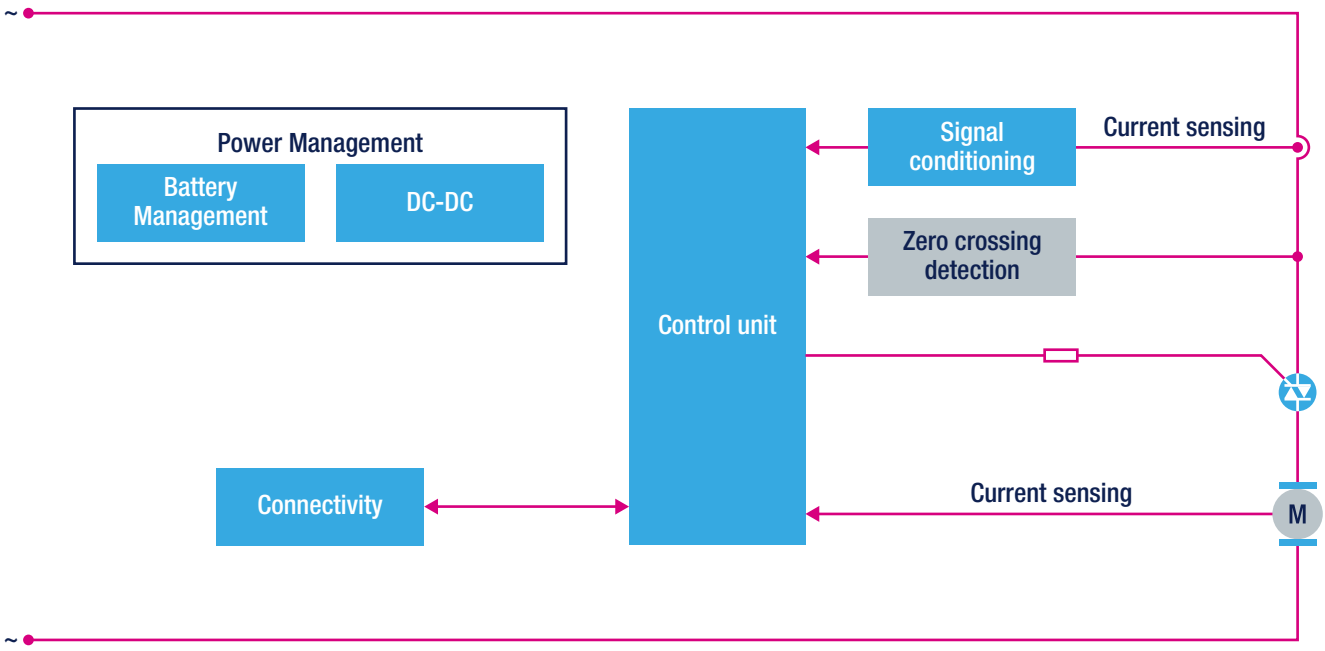
MAIN EVALUATION BOARDS

Reference/bundle	Voltage	Power/Max Current	ST parts	Application focus
X-NUCLEO-IHM15A1	7 - 45 V_{DC}	Up to 1.3 A_{rms}	• 1x STSPIN840	Stage lighting, Industrial automation, service robots, medical and health care, ATM, Vending machines
X-NUCLEO-IHM13A1	1.8 - 10 V_{DC}	Up to 2.6 A_{rms}	• 1x STSPIN250	eValves, IoT, edu/home robots, healthcare, toys, eLock, actuators
X-NUCLEO-IHM12A1	1.8 - 10 V_{DC}	Up to 1.3 A_{rms}	• 1x STSPIN240	eValves, IoT, edu/home robots, healthcare, toys, eLock, actuators
X-NUCLEO-IHM04A1	8 - 50 V_{DC}	Up to 2.8 A_{rms}	• 1x L6206PD	Stage lighting, antenna control, vending machines, factory automation



Universal motors

Universal motors can be used with AC or DC supplies and are commonly used in consumer appliances such as mixers, fans and vacuum cleaners.
Most universal motors are unidirectional. Bidirectional motors using two coils on the stator can be driven by applying a voltage to only one of them for the respective direction. The advantages of universal motors are high starting torque, very compact design and high speed. A simple controller with an AC supply can be implemented using a low-end microcontroller and a single Triac or an AC switch.



Universal Motor AC Drive (Phase control drive)

	Product family	Description with key Features	Key products
Control unit			
AC Switches	T-Series	High Tj Triac with strong dynamic behavior (dv/dt & di/dtc)	T1235T-8, T1635T-8
	H-Series	High Tj Triac: 150 °C, High turn-off commutation	T1235H-6, T1635H-6, T2035H-6, T3035H-6
	ACST-Series	Overvoltage protected ACSwitch, High static dv/dt, for IEC61000-4-5 voltage surge application compliance	ACST830-8, ACST1235-8FP, ACST1635-8FP

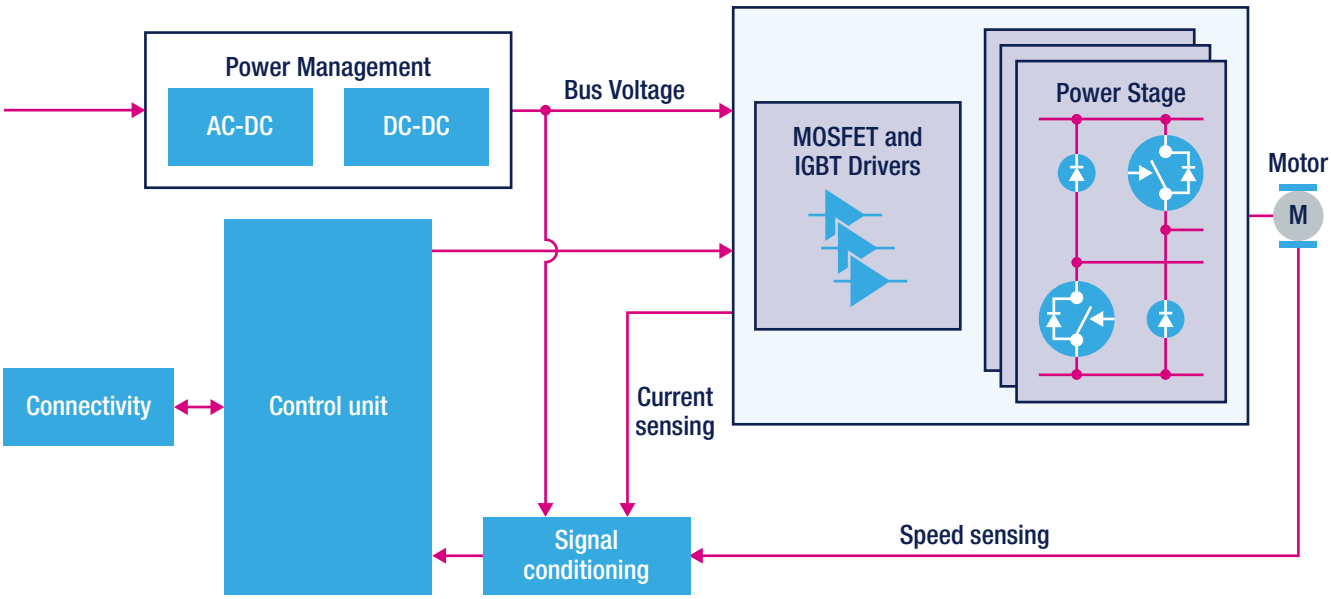
MAIN EVALUATION BOARDS

Reference/bundle	Voltage	Power/Max Current	ST parts	Application focus
STEVAL-GLA001V1	90 - 265 V_{AC} (50/60 Hz)	Up to 1 kW	• 1x T1635T-8FP • 1x ACST310-8B • 1x ACS108-8TN • 1x Viper16HD • 1x TSV631ILT	AC Load drives: up to 3 loads like lamp; Defrost resistor; door locks
STEVAL-IHT001V2	100 - 240 V_{AC} (50/60 Hz)	Up to 1.5 Arms	• 1x ACST610-8FP • 1x ACS110-7SN • 1x ACS102-6TA • 1x STM8S003F3P6 • 1x USBUF02W6	Compressor; Lamps; Defrost resistor; Fans
STEVAL-IHT003V2	100 - 240 V_{AC} (50/60 Hz)	Up to 10 Arms	• ACST610-8T • X0202NN 5BA4	Starter for Compressor
STEVAL-IHT005V2	90 - 265 V_{AC} (50/60 Hz)	Up to 150 W	• 1x T1635H-6T • 1x ACST1635-8FP • 1x Z0109MA • 3x ACS108-8SA • 1x VIPER16L • 1x STM32F100C4T6B	AC Load drives like valves, pumps, door locks, drum motors and heating resistors
STEVAL-IHM029V2	90 - 265 V_{AC} (50/60 Hz)	Up to 1.5 kW	• T1635T-8FP • VIPER16 • STTH1R06 • STM8S103	Vacuum cleaners; food processors and power tools

Switched reluctance motors

Overview

Switched reluctance motors are mainly used in traction, industrial pumps and home appliances (vacuum cleaners and certain washing machines). Their structure is similar to that of stepper motors, but switched reluctance motors have fewer magnetic poles. Despite their simple structure, external electronic commutation is needed.
The asymmetrical half-bridge PWM drive leverages the motor's best features. An independent current loop is implemented for each motor phase so that some phase current overlap is possible to attain higher speeds. For the drive, 2 x n power switches are required (with n being the number of motor phases).

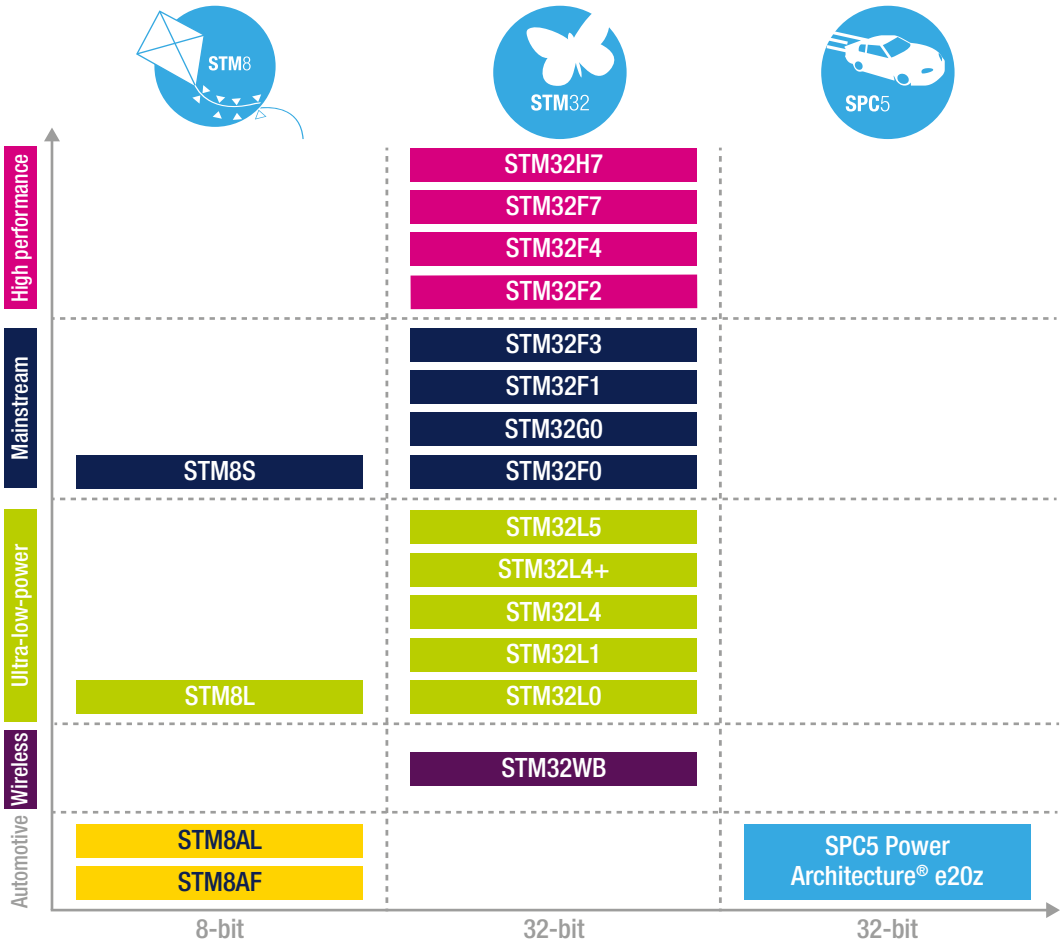


	Product family	Description with key Features	Key products
Control unit	• STM32F0		
Diode & Rectifier	• STPSx45/60/80/100 • STTHxR03/04/06 • STTHxRQ06	Power Schottky Ultrafast diodes	• STPS3045, STPS41H100 • STTH30R03 • STTH8R06 • STTH15RQ06
MOSFET and IGBT Drivers			
Power Switch	• IGBT M series • IGBT S series • IGBT H series	High voltage IGBT	• STGxyyM65DF2 • STGxyyM120DF3 • STGxyyS120DF3 • STGxyyH60DF

Microcontrollers

Microcontrollers portfolio

ST's product portfolio contains a comprehensive range of microcontrollers, from robust, low-cost 8-bit MCUs, the STM8 family, up to 32-bit Arm®-based Cortex®-M0/M0+, Cortex®-M3, Cortex-®M33 ; Cortex®-M4, Cortex®-M7 Flash microcontrollers with a rich choice of peripherals, the STM32 family.



KEY MCU SELECTION GUIDE FOR MOTOR CONTROL

Motor	STM8S	STM32F0 STM32F1 STM32G0	STM32F3 STM32F1 STM32F4 and STM32L4	STM32F4 STM32F7
Brushed DC Motors	x	x		
Single Phase AC Induction Motors	x	x		
Stepper Motors	x	x		
Switched Reluctance Motors	x	x	x	
3-phase BLDCMs/PMSMs	x	x	x	x
Universal Motors	x	x		
PFC		x	x	x

STM8S:
Brushed DC motors
Single-phase AC induction motors
Universal Motors

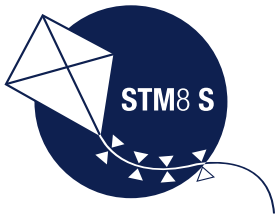
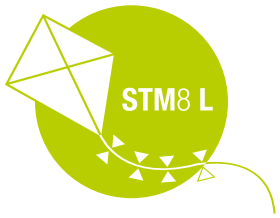
STM8S, STM32:
Stepper motors
Switched reluctance motors
3-phase brushless motors

STM8 8-BIT MICROCONTROLLERS

The STM8 MCU is part of a platform of technologies, IPs and tools which forms the basis of ST's comprehensive family of 8-bit microcontrollers. These cover, among others, many applications where there is an electric motor, from consumer electronics, including home appliances and factory automation, to automotive segments. The platform provides outstanding levels of digital and analog performance combined with a high level of cost effectiveness.

Implemented around a high-performance 8-bit core and a state-of-the-art set of peripherals and IPs, the microcontrollers in the STM8 family are manufactured using an ST-proprietary 130 nm embedded non-volatile memory technology.

One series for every need

Mainstream	Automotive		Ultra-low-power
			
	STM8AF	STM8AL	
Data EEPROM, 3 and 5 V families, precise RC	Data EEPROM, 3 and 5 V families, precise RC, LIN, CAN, grade 0	Data EEPROM, 1.65 and 3.6 V families, precise RC, LIN, grade 1	Data EEPROM, 1.65 and 3 V families, strong analog, LCD drivers, low-leakage technology
Industrial, consumer and mass market	Long-term guarantee	Long-term guarantee	Ideal combination of low-power performance and features
Robust and reliable Up to 125 °C www.st.com/stm8s	AEC-Q100 Up to 150 °C www.st.com/stm8af	AEC-Q100 Up to 125 °C www.st.com/stm8al	High-end analog IPs Active Halt < 1 A www.st.com/stm8l

Using STM8's peripherals for motor control

The STM8 comes with a set of peripherals that are suitable for many motor control topologies and applications.

The advanced timer available on the STM8S, STM8L and STM8A is a 16-bit timer capable of both centered or edge-aligned PWM pattern generation and, thanks to the availability of complimentary output on 3 of its channels, is specifically designed to address 3-phase and full-bridge topologies (for 3-phase AC IM, 3-phase PMSM/BLDC, bidirectional DC motors, stepper motor drives). The timer is also equipped with a synchronization circuit allowing the ADC to be triggered on specific events and an asynchronous emergency input.

The 12-bit ADC of the STM8L (10-bit on the STM8S and STM8A) allows motor current and voltage to be precisely sensed while its comparator could be used for hysteresis peak current control.

General-purpose 16-bit timers with their input capture capabilities are very well suited for motor speed feedback processing. In particular, the STM8L also features three input XOR gates combining the data coming from three Hall sensors to simplify speed measurement in 3-phase permanent magnet motors.

KEY FEATURES

- Advanced timer for 3-phase inverters and full-bridge converter drivers
- Fast and precise ADC can be triggered by timer events
- 5 V power supply
- Input capture on general-purpose timers for easier speed feedback processing
- Encorder operating mode only
- for DC motors

STM8S EVALUATION TOOLS FOR MOTOR CONTROL

Order code	Description	Motors covered	Documentation
STM8/128-MCKIT	3-phase brushless motor control starter kit for STM8S microcontroller	3-phase brushless motors: AC IM, BLDC, PMSM	UM0709
STM8/128-EVAL	STM8S MCU evaluation board; any motor control power stage featuring ST's standard MC connector can be connected (see 3-phase brushless motor evaluation tools section)	Depends on power stage connected through MC connector[1]	UM0482
STEVAL-IHM029V2	Universal motor control evaluation board based on high-temperature junction Triac and STM8S microcontroller	Universal, single-phase Induction motors	UM0922
STEVAL-IHM041V1	Universal motor driver with speed control based on the STM8 microcontroller and Triac (US version)	Universal, single-phase induction motors	UM1559
STEVAL-IHT001V2	Cold digital thermostat kit	Single-phase induction motors	UM1542

Note: 1. A daughter board may be required to be plugged on STM8/128-EVAL depending on the type of the control and power stage to be connected

STM8/128-MCKIT STARTER KIT

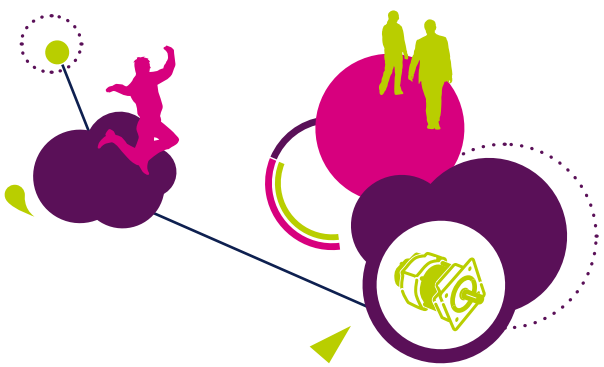
STM8/128-MCKIT is an integrated system designed to provide a complete, ready-to-use kit for evaluation of 3-phase motor control developed around ST's STM8 microcontroller.

This starter kit is particularly suited to drive 3-phase brushless motors (either AC induction or permanent magnet types).

Download for free from www.st.com the available FW library, configure it through STM8 MC Builder PC software and develop your own applications in conjunction with a third-party IDE and C compiler.

3-PHASE BRUSHLESS MOTOR CONTROL WITH STM8S IN 3 STEPS:

1. Visit www.st.com to download STM8S FW library for 3-phase motor control
2. Configure the FW library through the STM8 MC Builder PC software
3. Develop your own applications in conjunction with a third-party IDE and C compiler



STM32 32-BIT MICROCONTROLLERS

The STM32 family of 32-bit Flash microcontrollers based on the ARM Cortex-M processor is designed to offer new degrees of freedom to MCU users. By bringing a complete 32-bit product range that combines high-performance, real-time, low-power and low-voltage operation, while maintaining full integration and ease of development, the STM32 family helps you create new applications and design in the innovations you have long been dreaming about.

Most of the STM32 products lin es embed Advanced Motor Control tiimer and are supported by the STM32 full feature Motor Control ecosystem.

KEY FEATURES

- Advanced timer for 3-phase inverters and full-bridge converter drivers
- Fast 12-bit ADC (0.2µs) can be triggered by timer events
- ART Accelerator™, Control loop booster
- SIL ready, Class B, HW safety
- Integrated analog (Op-Amp, DAC, Comparator…)
- Connectivity (Ethernet, CAN, FW Com stack…)
- Temperature range up to 105 °C, 125 °C
- Precise internal oscillator (1%)

STM32F3, F1, F0
Mainstream

- Rich advanced analog (F3)
- Control loop optimized
- Advanced PWM Motor Control timer

From cost optimized to full featured SoC solution for Motor Control

STM32F7, F4, F2
High-performance

- Up to 216 MHz CPU frequency
- Advanced Connectivity
- Graphic Accelerator

Motor Control and much more…

STM32L4, L1, L0
Ultra-low-power

- EEPROM
- LCD interface
- Lowest power mode + RAM + RTC = 0.8 µA

Low power performance and features

STM32 ECOSYSTEM

Hardware tools

www.st.com/stm32hardwaretools

STM32 Nucleo board

Flexible prototyping

The highly affordable STM32 Nucleo boards allow anyone to try out new ideas and to quickly create prototypes with any STM32 MCU.

Sharing the same connectors, STM32 Nucleo boards can easily be extended with a large number of specialized application hardware add-ons (Nucleo-64 include Arduino Uno rev3 & ST morpho connectors, Nucleo-32 include Arduino Nano connectors).

Discovery kit

Creative demos

STM32 Discovery kits are a cheap and complete solution for the evaluation of the outstanding capabilities of STM32 MCUs. They carry the necessary infrastructure for demonstration of specific device characteristics, a HAL library and comprehensive software examples allow to fully benefit from the devices features and added values.

Extension connectors give access to most of the device's I/Os and make the connection of add-on hardware possible.

Evaluation board

Full-feature evaluation

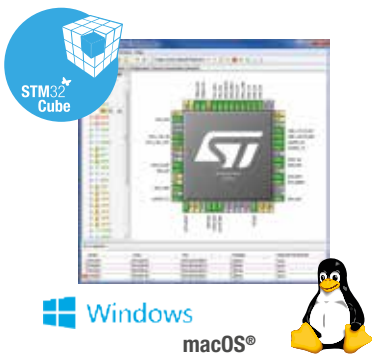
The STM32 eval boards have been designed as a complete demonstration and development platform for the Arm® Cortex STM32 MCUs.

They carry external circuitry, such as transceivers, sensors, memory interfaces, displays and many more. The evaluation boards can be considered as a reference design for application development.

Software tools

www.st.com/stm32softwaretools

STM32CubeMX



Partner IDEs

Free IDE

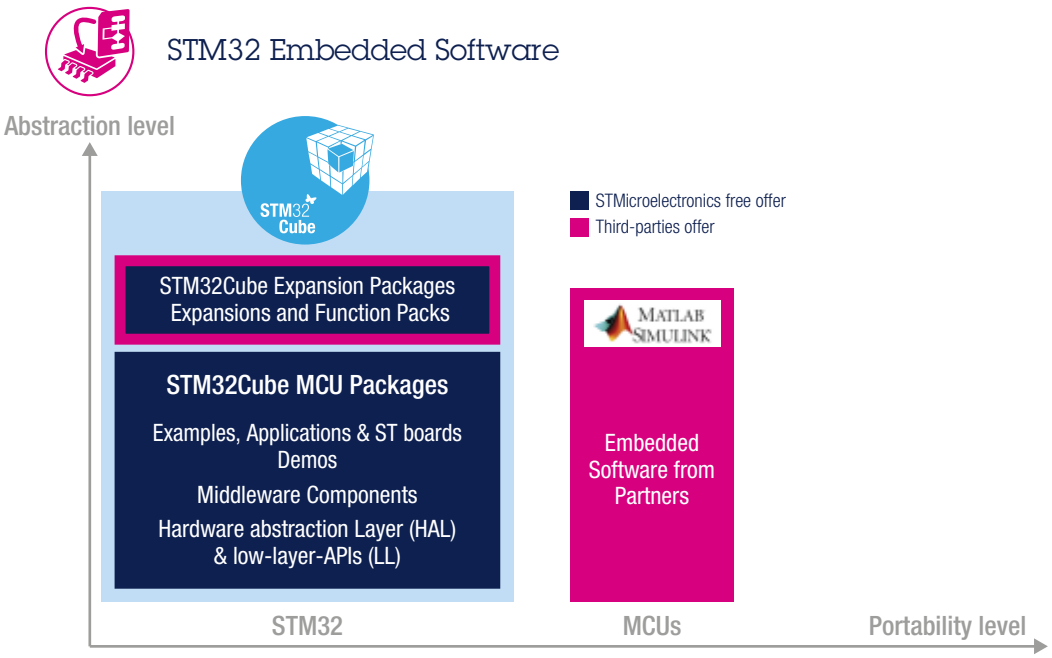
*Free only for Cortex-M0 and M0+

STM32CubeMonitor-Power STMStudio

Configure and generate code | Compile and debug | Monitor & Program

Embedded software

www.st.com/stm32embeddedsoftware



ST COMMUNITY

Ask, learn, share, discuss, become famous and engage with the community of STM32 enthusiasts on community.st.com/stm32

STM32 EDUCATION

Bring your STM32 project to life with the free educational and training resources on st.com/stm32education

ST-MC-SUITE

The STM32/STM8 Motor Control Suite is the entry point for easy access to all resources for motor-control application development with STM32 and STM8 microcontrollers. The tool lets users gather tutorials, documentation and videos, store project setups including appropriate software and a choice of applicable evaluation boards (control and power), motor-control kits, and inverters that can be purchased online.

Thereby, users can select all the resources required and include it in a bundle. At the end of the process, they can download their bundle as a zip file that will centralize everything they requested.

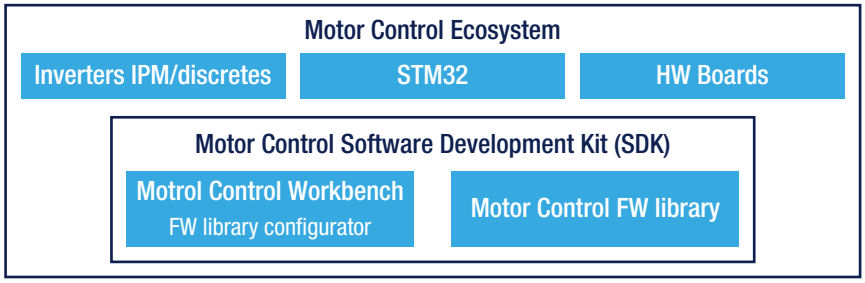
ST-MC-SUITE will thus become the birthplace of many projects by offering knowledge, training, documentation, and a structure that can help engineers focus on what they want to do rather than lose time hunting for software, components, and information.

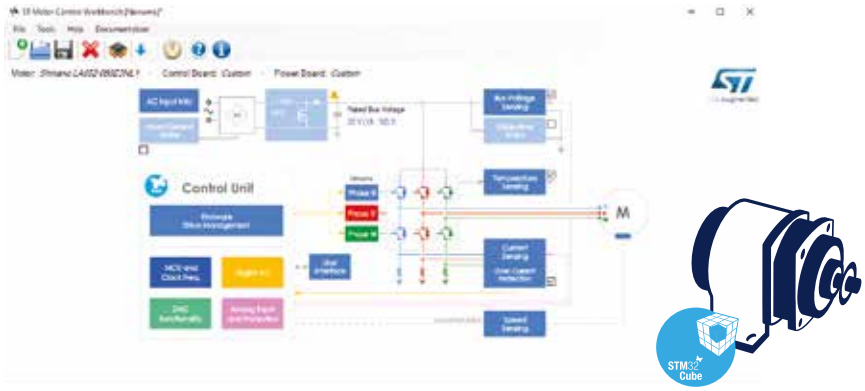
KEY FEATURES

- Browse St's MCu to find the one which fit the best with your motor control application
- Select motor control materials needed and download all of them as a .zip file
- Save your setups for future reference
- Mainly focus on PMSM (Permanent Magnet Synchronous Motors) controlled in FOC (Filed Oriented Control) Mode
- Extra motor types and control techniques will be added soon

Motor Control Ecosystem

STM32 microcontrollers offer the performance of the industry-standard Arm® Cortex®-M cores running Filed Oriented Control (FOC) modes, widely used in high-performance drives for air conditioning, home appliances, drones, building and industrial automation, medical and e-bike applications.
STM32 MC SDK (motor control software development kit) firmware (X-CUBE-MCSDK) includes the permanent-magnet synchronous motor (PMSM) firmware library and the STM32 Motor Control Workbench to configure the firmware library parameters through its graphical user interface.
STM32 Motor Control Workbench is PC software that reduces the design effort and time needed for the firmware configuration:
The user generates a project file through the GUI, and initializes the library according to the application needs. Some of the variables of the algorithm being used can be monitored and changed in real time.





FEATURES LIST AVAILABLE IN MOTOR CONTROL SDK (X-CUBE-MCSDK)

STM32 series	F0	F1	F3	F4	F7	L4	G0
1 Shunt	•	•	•	•	•	•	•
3 Shunt	•	•	•	•	•	•	•
Hall sensors	•	•	•	•	•	•	•
ICS	X	•	•	•	•	•	X
Flux weakening	•	•	•	•	•	•	•
MTPA	•	•	•	•	•	•	•
Sensorless (PLL/Cordic)	•	•	•	•	•	•	•
Feed Forward	•	•	•	•	•	•	•
Single FOC	•	•	•	•	•	•	•
Dual FOC	X	•/X	•	•	•/X	X	X

KEY FEATURES

- Single/Dual simultaneous field-oriented control (FOC)
- Motor profiler and One-touch tuning for a fast startup of unknown motors
- Simplified firmware architecture based on the STM32Cube HAL/LL libraries
- Current reading topologies supported:
  - 1 shunt resistor
  - 3 shunt resistors
  - 2 ICS (Isolated Current Sensor)
- Speed/position sensors (Encoder and Hall) as well as sensor-less operation (state observer) supported
- On-the-fly startup for fans
- Speed and torque control
- Motor control algorithms implemented for specific applications, among them MTPA (maximum torque per ampere), Flux weakening, Feed forward and Start-on-the-fly
- Full customization and real time communication through STM32 Motor Control Workbench PC software
  - New project creation starting from the board
  - Workflow supporting the STM32CubeMX GUI configurator
  - Wide range of STM32 microcontrollers supported

STM32 MOTOR PROFILER

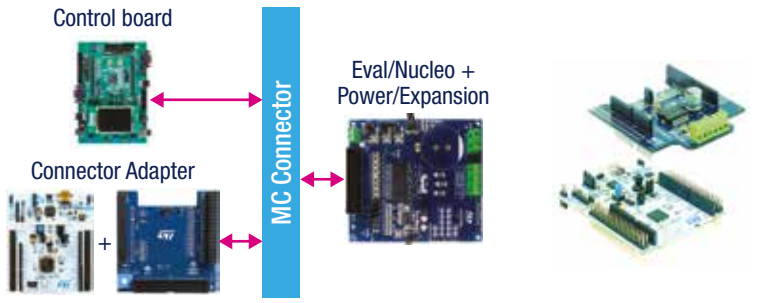
- Automatic detection of key parameters
- Zero equipment required
- Spin motor within less than 1 min
- Best accuracy when
  Rs ≥ 1 Ω and Ls ≥ 1 mH

STM32F EVALUATION BOARDS FOR MOTOR CONTROL

ST proposes a wide range of evaluation boards for comprehensive evaluation of ST's products and solutions while reducing your development time. In particular, all of ST's microcontroller evaluation boards have ST's standard MC connector on-board allowing the use of the board in conjunction with any of the power stage evaluation boards.

Control + Power

Eval/Nucleo + Power/Expansion



Inverter (Complete Drive)

MC Kits

READY TO USE MOTOR CONTROL EVALUATION KITS:

- STM3210B-MCKIT: Full features kits for 3-phase motor control application development
- STM32 Nucleo Pack for motor control (P-NUCLEO-IHM001 and P-NUCLEO-IHM002)
- Complete evaluation kit -FOC, 6-step FW example based- for evaluation, fast prototyping, makers and education

SDK5.x CONTROL BOARDS

Family	MCU	Board	Description
G0	G081B	STM32G081B-EVAL	G0 Evaluation Board
F0	F030R8	NUCLEO-F030R8	F0 Nucleo Board
F0	F072RB	NUCLEO-F072RB	F0 Nucleo Board
F0	F072VB	STM32072B-EVAL	F0 Evaluation Board
F1	F103RB	NUCLEO-F103RB	F1 Nucleo Board (MD)
F1	STM32F103ZET6	STM3210E-EVAL	F1 Evaluation Board
F3	F302R8	NUCLEO-F302R8	F3 Nucleo Board
F3	F303RE	NUCLEO-F303RE	F3 Nucleo Board
F3	F303VE	STM32303E-EVAL	F3 Evaluation Board
F4	F446RE	NUCLEO-F446RE	F4 Nucleo Board
F4	F407IG	STM3240G-EVAL	F4 Evaluation Board
F4	F417IG	STM3241G-EVAL	F4 Evaluation Board
F4	F446ZET	STM32446E-EVAL	F4 Evaluation Board
F4	F415ZGT8	STEVAL-IHM039V1	F4 Evaluation Board
F4	F401RE	NUCLEO-F401RE	F4 Nucleo Board
F7	F746ZG	NUCLEO-F746ZG	F7 Nucleo Board
F7	F769I	STM32F769I-EVAL	F7 Evaluation Board
L4	L452RE	NUCLEO-L452RE	L4 Nucleo Board
L4	L476G	STM32L476G-EVAL	L4 Evaluation Board

SDK5.x POWER BOARDS

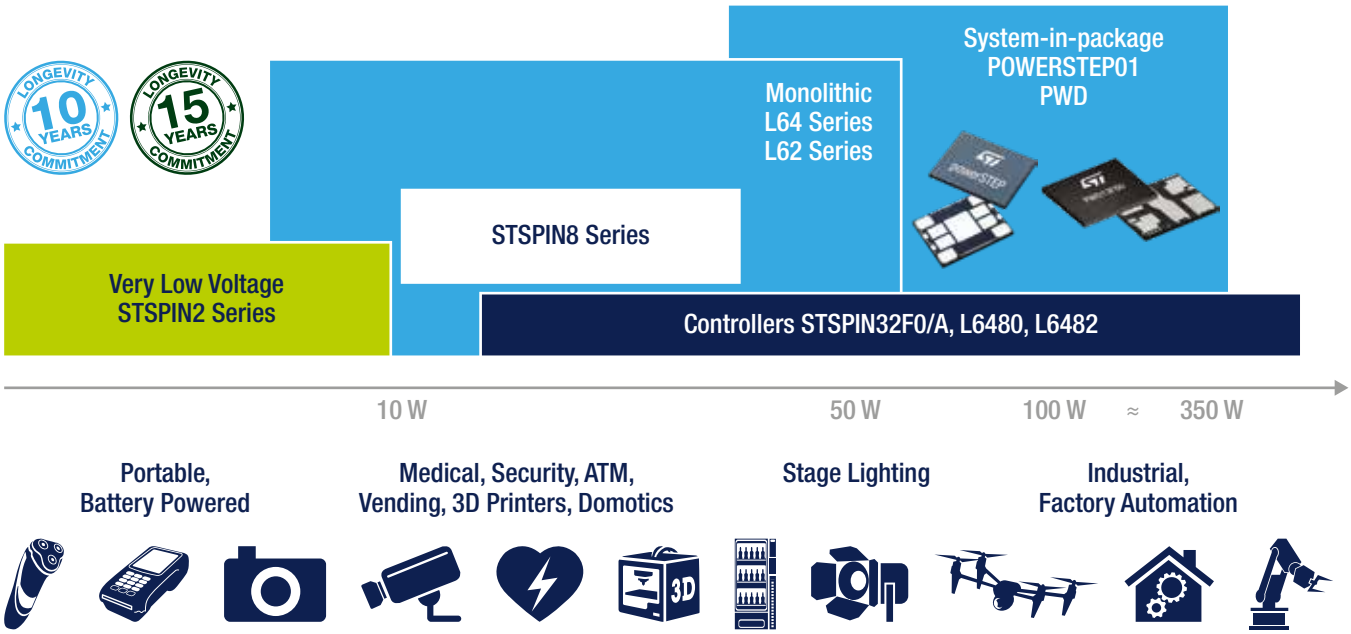
Board	Description
STEVAL-IHM023V3	1 kW 3-phase motor control evaluation board featuring L6390 drivers and STGP10H60DF IGBT
STEVAL-IHM028V2	2 kW 3-phase motor control evaluation board featuring the STGIPS20C60 IGBT intelligent power module
STEVAL-IHM045V1	3-phase high voltage inverter power board for FOC based on the STGIPN3H60A (SLLIMM™;-nano)
X-NUCLEO-IHM07M1	Three-phase brushless DC motor driver expansion board based on L6230 for STM32 Nucleo
X-NUCLEO-IHM08M1	Low-Voltage BLDC motor driver expansion board based on STL220N6F7 for STM32 Nucleo
X-NUCLEO-IHM11M1	Low voltage three-phase brushless DC motor driver expansion board based on STSPIN230 for STM32 Nucleo
STEVAL-IPM05F	Motor control power board based on the SLLIMM™; 2nd series of IGBT IPMs
STEVAL-IPM07F	Motor control power board based on the SLLIMM™; 2nd series of IGBT IPMs
STEVAL-IPM10B	Motor control power board based on the SLLIMM™; 2nd series of IGBT IPMs
STEVAL-IPM08B	in one shunt and three shunt topology-
STEVAL-IPM10F	Motor control power board based on the SLLIMM™; 2nd series of IGBT IPMs
STEVAL-IPM15B	Motor control power board based on the SLLIMM™; 2nd series of IGBT IPMs
STEVAL-IPMNG3Q	in one shunt and three shunt topology-
STEVAL-IPMNG5Q	in one shunt and three shunt topology-
STEVAL-IPMNG8Q	in one shunt and three shunt topology-
STEVAL-IPMNM1N	in one shunt and three shunt topology-
STEVAL-IPMNM2N	in one shunt and three shunt topology-

SDK5.x INVERTERS

Family	MCU	Board	Description
F0	F031	STEVAL_SPIN3201	STSPIN32F0 3-shunt
F0	F031	STEVAL_SPIN3202	STSPIN32F0A 1-shunt
F1	F103RC	STEVAL_IHM034V2	Used for PFC
F3	F303RE	X-Nucleo_IHM16 + Nucleo-F303RE	Bundle
F3	F303	STEVAL-ESC001V1	F3 ESC board

Motor Driver ICs

STSPIN motor drivers embed all the functions needed to drive motors efficiently and with the highest accuracy, and include an advanced motion profile generator to relieve the host microcontroller, while ensuring robustness and reliability thanks to a comprehensive set of protection and diagnostic features. Particularly noteworthy are the adaptive current decay control scheme used in many of the STSPIN motor driver ICs as well as the innovative voltage mode driving used in micro-stepping motor drivers that provides enhanced torque control accuracy and thus motion smoothness.
Our line-up of STSPIN motor control ICs has been developed with the objectives of modularity, scalability and robustness to provide designers a wide choice of solutions to fit different requirements and system architectures.
All products have comprehensive built-in protection and diagnostic schemes to help attain the level of long term reliability and robustness requested to cope with harsh factory automation environments.
Available in a wide selection of space-saving, thermally-optimized packages, you are sure to find a device in our STSPIN line-up that addresses your motor or motion control system requirements.



STSPIN2 SERIES

STSPIN2 series is a perfect fit for portable 2 Li-Po cells powered solutions, offering a complete set of ICs able to drive brushed DC, stepper or three-phase BLDC motors. Thanks to the extremely compact package (QFN 3x3) and the lowest standby current available on the market (max 80 nA), STSPIN2 series represents the best performance-cost trade-off.

Devices are equipped with control logic and fully protected power stage. **STSPIN220** embeds advanced microstepping circuitry able to control a stepper motor with a high resolution of up to 256 µsteps, while **STSPIN230/3** are field oriented control compliant allowing an easy implementation of 2 or 3 shunts topologies.

STSPIN220
Stepper

STSPIN230/233
3phase BLDC

STSPIN240/250
Dual DC

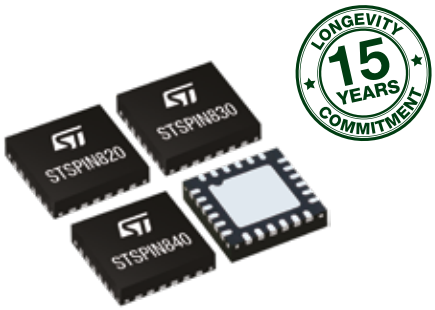
Part number	Desription	Vin min (V)	Vin max (V)	Rdson (Ohm)	I out max (Arms)
STSPIN220	Microstepping driver up to 256 microsteps	1.8	10	0.2	1.3
STSPIN230/3	3-phase BLDC driver				
STSPIN240	Dual DC motor driver				
STSPIN250	Single DC motor driver			0.1	2.6

MAIN APPLICATIONS

- Portable health care
- e-valves, meters and e-lockers
- POS or label printers
- IoT and Gimbals
- Educational robots

STSPIN8 SERIES

STSPIN8 series represents an extension of STSPIN2 series, able to operate at a higher supply voltage. It consists of 3 fully integrated motor drivers packaged in a 4x4mm QFN package, integrating both the control logic and a fully protected low RDSon power stage making them a bullet proof solution for the new wave of demanding industrial applications. **STSPIN820** allows you to control stepper motors with a high resolution of up to 256 µsteps, **STSPIN830** is field oriented control compliant and features 3 shunt resistors, while **STSPIN840** can be used in parallel mode in order to drive a brushed DC motor at a higher equivalent current.



STSPIN820
Stepper

STSPIN830
3phase BLDC

STSPIN840
Dual DC

Part number	Desription	Vin min (V)	Vin max (V)	Rdson (Ohm)	I out max (Arms)
STSPIN820	Microstepping driver up to 256 microsteps	7	45	0.5	1.5
STSPIN830	3-phase 3-shunts BLDC motor driver				
STSPIN840	Dual brushed DC motor driver			0.5 (0.25*)	1.5 (3*)

Note * Features allowed in parallel mode driving

MAIN APPLICATIONS

- Stage lighting and antenna control
- 3D printers
- Vending and textile machines
- ATM and money handling machines
- Factory automation end-points
- Medical and healthcare equipment
- Video surveillance and dome cameras

STSPIN32F0 SERIES

STSPIN32F0 series is a family of self-supplied Systems-In-Package integrating a Cortex-M0™ microcontroller and an advanced 3-phase gate driver. The embedded MCU gives the freedom to configure the device with the motion control algorithm which best fits the end application targets. The customers can choose among a set of pre-defined FW algorithms, spanning from more classical 6-step to the advanced sensorless field oriented control.

Internal 3.3 V DC/DC buck converter and 12 V LDO linear regulator supply the MCU, external components and gate drivers. Operational amplifiers are available and they can be used for signal conditioning of analog Hall-effect sensors or shunt resistor signals. Programmable threshold over current protection is guaranteed by the embedded comparator.

MAIN APPLICATIONS

- Power tools
- Fans
- Vacuum cleaners, other HA
- Industrial automation and control
- Robotic arms
- Drones (gimbal and ESC control)

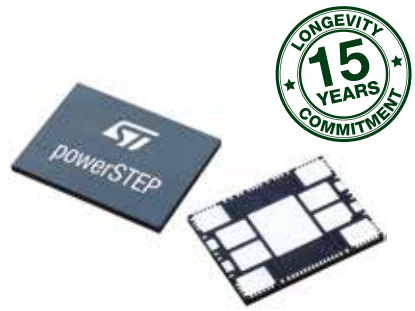
Part number	Desription	Vin min (V)	Vin max (V)
STSPIN32F0	Advanced BLDC controller with embedded STM32 MCU	8	45
STSPIN32F0A		6.7	45

POWERSTEP01

The **POWERSTEP01** is a highly configurable high current stepper motor driver able to operate up to 85 V. It integrates an advanced microstepping controller and 8 power MOSFETs, featuring a 16 mΩ $R_{DS(ON)}$.

Thanks to proprietary and patented technologies, the device can be configured to drive the motors in voltage or in current mode. The voltage mode allows to obtain very smooth and silent motion performance, while the current driving guarantees the full control of the motor current. Many other advanced features are available such as the full customization of the motion profile (acceleration, deceleration, speed, etc.), positioning calculations, sensorless stall detection, real-time diagnostics and user-configurable failure protections.

A very rich set of protections make the POWERSTEP01 bullet proof, as required by the most demanding motor control applications.



MAIN APPLICATIONS

- Textile Machines
- Sewing Machines
- Robot Welders
- Industrial label printers
- Industrial dozers and mixer

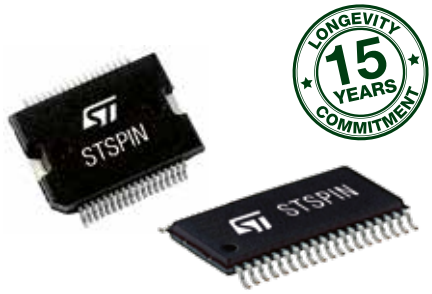
Part number	Desription	Vin min (V)	Vin max (V)	Rdson (Ohm)	I out max (Arms)
powerSTEP01	System-in-package integrating microstepping controller and 10 A power MOSFETs	7.5	85	0.016	10

L64 SERIES

The **L64** series includes ST's most advanced microstepping motor drivers and controllers. Both **L6470** and **L6480** feature advanced voltage control mode thus obtaining very smooth and silent motion and reaching high positioning precision (up to 128usteps). **L6472** and **L6482** instead drive the motors through an advanced current control algorithm with self-adapting decay and guaranteeing the target current is always supplied to the motor, with no loss of steps or control.

Many other advanced features are available such as the full customization of the motion profile (acceleration, deceleration, speed, etc.), positioning calculations, sensorless stall detection, real-time diagnostics and user-configurable failure protections.

The **L648x** controllers allow higher voltage and current through external power MOSFETs.



Part number	Product	Desription	Vin min (V)	Vin max (V)	Rdson (Ohm)	I out max (Arms)
Motor Drivers	L6470	Voltage mode driving algorithm (1/128 µstep)	8	45	0.3	3
	L6472	Predictive current control Adaptive decay (1/16 µstep)				
	L6474	Adaptive decay(1/16 µstep)				
Controllers	L6480	Voltage mode driving algorithm (1/128 µstep)	8	85	not applicable	
	L6482	Predictive current control Adaptive decay (1/16 µstep)				

MAIN APPLICATIONS

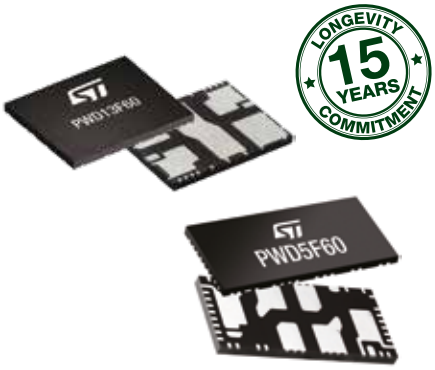
- ATM and money handling machines
- Medical equipment
- Video conferencing
- Antenna control
- Pick and place machines
- Home and factory appliances

PWD – POWER DRIVERS

PWD Series are advanced power systems-in-package integrating smart gate drivers and four N-channel power MOSFETs in dual half-bridge configuration. These full-bridge power drivers represent a uniquely efficient alternative for brushed DC or single-phase BLDC motors.

The actual offer is related to two 600V rated devices, capable of delivering 3.5 A and 8 A of continuous current per MOSFET, respectively. Embedded gate drivers integrate bootstrap diodes allowing BOM space and cost saving. Both devices are offered in highly thermally efficient tiny QFN packages.

PWD5F60 embeds also the peak-current control comparators that, in conjunction with positioning Hall-effect sensors, allow to achieve a stand-alone motor driver for single-phase BLDC motors (no need of a dedicated MCU), and thus significantly reducing the cost of such a driving system.



Part number	Desription	Vin min (V)	Vin max (V)	Rdson (Ohm)	I out max (Arms)
PWD13F60	High-density power driver - high voltage full bridge with integrated gate driver	6.5	17	0.32	8
PWD5F60		10	20	1.38	3.5

MAIN APPLICATIONS

- Industrial/Home appliances
- Factory automation
- Fans and pumps
- HID, ballasts
- Power supply units
- DC-DC and DC-AC converters
- Cooking hoods and gas heaters
- Blowers
- Power supply units

STEPPER MOTOR DRIVERS

Part number	Package	General description	$R_{DS(on)}$ (Ω)	Supply voltage (V)		Output Current-Max (A) RMS max	Operating temperature	
				Min.	Max.		Min. (°C)	Max. (°C)
PoweStep01	VFQFPN 11x14x1	System-in-package integrating microstepping controller and 10 A power MOSFETs	0.016	7.5	85	10	-40	150
STSPIN220	VFQFPN 16 3x3x1.0	Low Voltage Motor driver with up to 256 microsteps and embedded PWM current control	0.2	1.8	10	1.3		
L6474	HTSSOP28; PowerSO 36	Motor driver up to 16 microsteps with SPI and advanced current control	0.3	8	45	3		
L6472	HTSSOP28; PowerSO 36	Full features motor driver up to 128 microsteps with SPI, motion engine and advanced current control						
L6470								
L6208	PowerSO 36, SO24	Stepper motor driver with embedded current control			52	2.8		
L6208Q	VFQFPN 48 7x7x1.0							
STSPIN820	TFQFPN 4x4x1.05 - 24L	Compact advanced 256 microsteps motor driver with step-clock and direction interface	0.5	7	45	1.5		
L6258	PowerSO36	PWM controlled high current DMOS universal motor driver	0.6	12	40*	1.5*	-40*	
L6228	PowerSO 36, SO24	Stepper motor driver with embedded current control	0.7	8	52	1.4	-40	
L6228Q	VFQFPN 32 5x5x1.0							
L6219	SO24	Stepper motor driver	-	4.5*	46*	0.75*	-40*	125*
L6482	HTSSOP38	Stepper controller with SPI, motion engine, gate drivers and advanced current control featuring 128 microsteps	-	7.5	85	-	-40	150
L6480			-			-		
L297	PDIP 20; SO-20	Stepper motor controller	-	4.75	7	-		

Note * The value may vary depending on the part number

BRUSHED DC MOTOR DRIVERS

Part number	Package	General description	$R_{DS(on)}$ (Ω)	Supply voltage (V)		Output Current-Max (A) RMS max	Output Current-Max (A) max peak	Operating temperature	
				Min.	Max.			Min. (°C)	Max. (°C)
PWD5F60	VFQFPN 15x7x1 mm.	High voltage full bridge with integrated comparators	1.4	10	600	5	14	-40	125
PWD13F60	VFQFPN 10x13x1.0	High voltage full bridge with integrated smart driver	0.3	6.5	600	8	32		
STSPIN240	VFQFPN 16 3x3x1.0	Low voltage dual brushed DC motor driver	0.2	1.8	10	1.3	2	-40	150
STSPIN250		Low voltage brushed DC motor driver	0.1	1.8	10	2.6	4		
L6205	PDIP20; PowerSO-20; SO20	Versatile DMOS dual full bridge motor drivers with embedded PWM current control	0.3	8	52	2.8	7.1		
L6206	PowerSO 36; SO24								
L6206Q	VFQFPN 48 7x7x1.0								
L6207	PowerSO 36; SO24								
L6207Q	VFQFPN 48 7x7x1.0								
STSPIN840	TFQFPN 4x4x1.05 - 24L	Compact dual brushed DC motor driver with embedded PWM current control	0.5	7	45	1.5	2.5		
L6225	PDIP20; PowerSO-20; SO20	Versatile DMOS dual full bridge motor drivers with embedded PWM current control	0.7	8	52	1.4	3.55		
L6226	PowerSO 36; SO24								
L6226Q	VFQFPN 32 5x5x1.0								
L6227	PowerSO 36; SO24								
L6227Q	VFQFPN 32 5x5x1.0								
L6201	PowerSO-20; SO-20	DMOS full bridge motor driver	0.3	12	48	1	5		
L6202	PDIP 18						10		
L6203	MW 11L								
L2293Q	VFQFPN 32 5x5x1.0	Push-pull four channels motor driver with diodes	-	4.5	36	0.6	1.2		
L293D	PDIP 16; SO-20								
L293B	PDIP 16					1	2		
L293E	PDIP 20								
L298	MW 15L; PowerSO-20	Dual full bridge motor driver				2	-		

3-PHASE BRUSHLESS DC MOTOR DRIVERS

Part number	Package	General description	$R_{DS(on)}$ (Ω)	Supply voltage (V)		Output Current-Max (A) RMS max	Output Current-Max (A) max peak	Operating temperature	
				Min.	Max.			Min. (°C)	Max. (°C)
STSPIN32F0	VFQFPN 48 7x7x1	Advanced BLDC controller with embedded STM32, DC-DC; optimized for FOC	-	8	45	-	600	-40	125
STSPIN32F0A	VFQFPN 48 7x7x1	Advanced BLDC controller with embedded STM32, DC-DC, extended V Range and optimized for 6-step control	-	6.7	45	-	600		
STSPIN830	TFQFPN 4x4x1 - 24L	Compact 3-phase integrated motor driver optimized for 3 shunts configuration	0.5	7	45	1.5	2.5	-40	150
STSPIN230	VFQFPN 16 3x3x1	Low voltage 3-phase integrated motor driver	0.2	1.8	10	1.3	2		
STSPIN233	VFQFPN 16 3x3x1	Low voltage 3-phase integrated motor driver optimized for 3 shunts control	0.2	1.8	10	1.3	2		
L6229	PowerSO 36; SO-24	3-phase 6-step integrated motor drivers with embedded Hall sensors decoding logic	0.7	8	52	1.4	3.55		
L6229Q	VFQFPN 32 5x5x1		0.7	8	52	1.4	3.55		
L6235	PowerSO 36; SO-24		0.3	8	52	2.8	7.1		
L6235Q	VFQFPN 48 7x7x1		0.3	8	52	2.5	7.1		
L6230	PowerSO 36; VFQFPN 32 5x5x1	Triple half-bridge integrated motor drivers	0.7	8	52	1.4	3.55		
L6234	PDIP 20; PowerSO-20		0.3	7	52	2.8	5		

STSPIN PACKAGE OPTIONS EXAMPLES

QFN 11x14

VFQFPN 10x13

QFN 7x7 48L

QFN 3x3

POWERSO36

HTSSOP38

Dip20

SO24

A COMPLETE ECOSYSTEM IS PROVIDED TO SUPPORT DESIGN-IN AND SHORTEN TIME-TO-MARKET

Designing motor control applications becomes much easier with the outstanding performance, features and full support of STSPIN motor driver ICs that make brushed DC, stepper and brushless motor control designs more efficient in a variety of applications.

A wide range of evaluation boards is provided, together with low-cost plug-and-play discovery kits: an ideal development tool for both beginners and experienced users that is autonomous and can be used with a software interface or with a custom firmware thanks to the embedded microcontroller.

Schematics, BOMs and gerber files are available to give you a headstart with your hardware design together with comprehensive technical documentation.

Software suites are also provided to enable quick and easy development of motor driving solutions.

In addition, STSPIN motor drivers can be easily evaluated in combination with an STM32 32-bit microcontroller in an open, flexible and affordable development environment to enable fast prototyping that can quickly be transformed into final designs.

The comprehensive development environment includes:

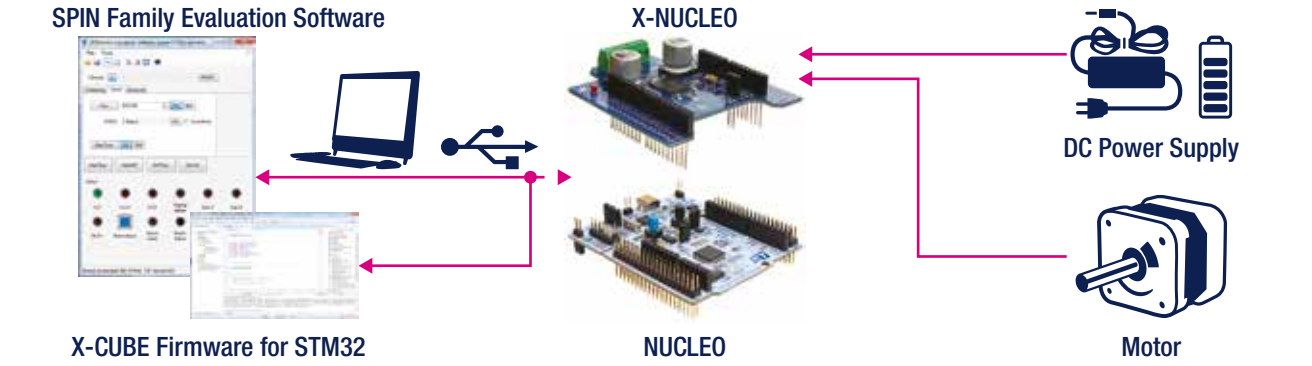
STM32 Nucleo development boards: a comprehensive range of affordable development boards for all STM32 microcontroller series.

STM32 Nucleo expansion boards: based on STSPIN motor drivers, the expansion boards can be plugged on top of the STM32 Nucleo development boards. More complex functionalities can be achieved by stacking additional expansion boards.

The expansion boards are equipped with standardized interconnections such as an Arduino Uno R3 connector or a morpho connector for a higher level of connectivity.

Each expansion board is supported by STM32-based software modules.

SPEED-UP YOUR DESIGN WITH X-NUCLEO!



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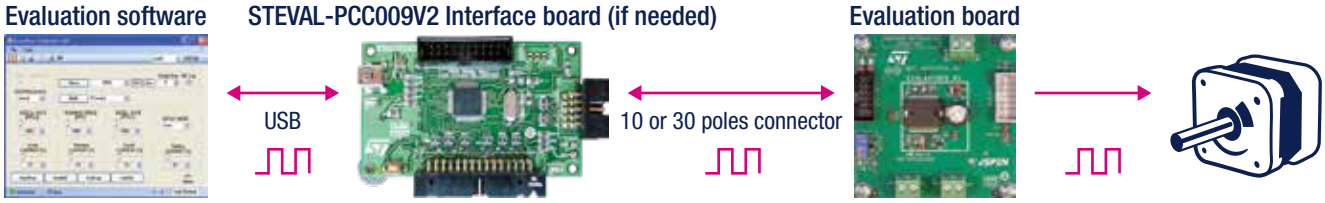
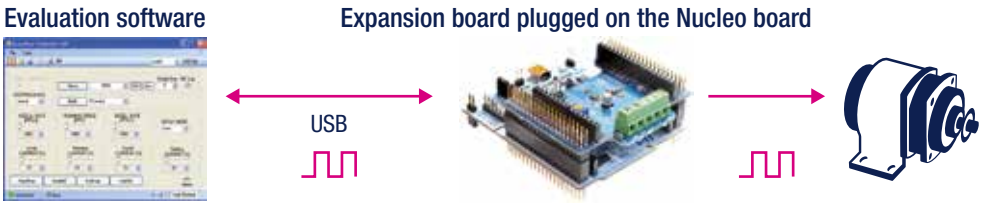
>50 ready to use Evaluation Boards

EVALUATION BOARD SETUP



DISCOVERY KIT SETUP

NUCLEO BOARD SETUP



ECOSYSTEM FOR STEPPER MOTOR DRIVERS AND CONTROLLERS

Part number	Tool type	Core product	Evaluation software	Firmware	Companion board
X-NUCLEO-IHM14A1	Expansion board for STM32 nucleo board	STSPIN820	-	X-CUBE-SPN14	NUCLEO-F030R8, NUCLEO-F334R8, NUCLEO-F401RE, NUCLEO-L053R8
X-NUCLEO-IHM06A1	Expansion board for STM32 nucleo board	STSPIN220	STSW-SPIN002	X-CUBE-SPN6	STM32 Nucleo board F4, F0 or L0 series
EVLPOWERSTEP01	Evaluation board	POWERSTEP01	STSW-SPIN002	X-CUBE-SPN3	STEVAL-PCC009V2 interface board
X-NUCLEO-IHM03A1	Expansion board for STM32 nucleo board	POWERSTEP01	STSW-SPIN002	X-CUBE-SPN3	STM32 Nucleo board F4, F0 or L0 series
EVAL6482H-DISC	Discovery kit	L6482	STSW-SPIN002	STSW-SPIN005, STSW-SPINDISC01	-
EVAL6482H	Evaluation board	L6482	STSW-SPIN002	STSW-SPIN005	STEVAL-PCC009V2 interface board
EVAL6480H-DISC	Discovery kit	L6480	STSW-SPIN002	STSW-SPIN005, STSW-SPINDISC01	-
EVAL6480H	Evaluation board	L6480	STSW-SPIN002	STSW-SPIN005	STEVAL-PCC009V2 interface board
STEVAL-3DP001V1	Reference design	L6474	STSW-3DP001	-	-
EVAL6474H	Evaluation board	L6474	STSW-SPIN002	X-CUBE-SPN1	STEVAL-PCC009V2 interface board
EVAL6474PD	Evaluation board	L6474	STSW-SPIN002	X-CUBE-SPN1	STEVAL-PCC009V2 interface board
X-NUCLEO-IHM01A1	Expansion board for STM32 nucleo board	L6474	STSW-SPIN002	X-CUBE-SPN1	STM32 Nucleo board F4, F0 or L0 series
EVAL6472H-DISC	Discovery kit	L6472	STSW-SPIN002	STSW-SPIN004, STSW-SPINDISC01	-
EVAL6472H	Evaluation board	L6472	STSW-SPIN002	STSW-SPIN004	STEVAL-PCC009V2 interface board
EVAL6472PD	Evaluation board	L6472	STSW-SPIN002	STSW-SPIN004	STEVAL-PCC009V2 interface board
EVAL6470H-DISC	Discovery kit	L6470	STSW-SPIN002	STSW-SPIN004, STSW-SPINDISC01	-
EVAL6470H	Evaluation board	L6470	STSW-SPIN002	STSW-SPIN004	STEVAL-PCC009V2 interface board
EVAL6470PD	Evaluation board	L6470	STSW-SPIN002	STSW-SPIN004	STEVAL-PCC009V2 interface board
X-NUCLEO-IHM02A1	Expansion board for STM32 nucleo board	L6470	-	X-CUBE-SPN2	STM32 Nucleo board F4, F0 or L0 series
STEVAL-IKM001V1	Evaluation kit EVAL6470H and STEVAL-PCC009V2	L6470	STSW-IKM001V1S	STSW-IKM001V1	-
X-NUCLEO-IHM05A1	Expansion board for STM32 nucleo board	L6208	STSW-SPIN002	STSW-SPIN005	STM32 Nucleo board F4, F0 or L0 series
EVAL6208Q	Evaluation board	L6208Q	STSW-SPIN003	-	STEVAL-PCC009V2 interface board
EVAL6228QR	Evaluation board	L6228Q	-	-	-
EVALSP820-XS	Evaluation board	STSPIN820	-	-	-

ECOSYSTEM FOR BRUSHED DC MOTOR DRIVERS AND CONTROLLERS

Part number	Tool type	Core product	Evaluation software	Firmware	Companion board
X-NUCLEO-IHM12A1	Expansion board for STM32 nucleo board	STSPIN240	STSW-SPIN002	X-CUBE-SPN12	STM32 Nucleo board F4, F0 or L0 series
X-NUCLEO-IHM13A1	Expansion board for STM32 nucleo board	STSPIN250	STSW-SPIN002	X-CUBE-SPN13	STM32 Nucleo board F4, F0 or L0 series
X-NUCLEO-IHM15A1	Expansion board for STM32 nucleo board	STSPIN840	-	X-CUBE-SPN14	L0, F0, F3, F4
EVALPWD5F60	Evaluation Board	PWD5F60	-	-	-
EVALPWD13F60	Evaluation board	PWD13F60	-	-	-
EVAL6227QR	Evaluation board	L6227Q	-	-	-
EVAL6227PD	Evaluation board	L6227	-	-	-
EVAL6225PD	Evaluation board	L6225	-	-	-
EVAL6207Q	Evaluation board	L6207Q	STSW-SPIN003	-	STEVAL-PCC009V2 interface board
X-NUCLEO-IHM04A1	Expansion board for STM32 nucleo board	L6206	STSW-SPIN002	X-CUBE-SPN4	STM32 Nucleo board F4, F0 or L0 series
EVAL6206Q	Evaluation board	L6206Q	STSW-SPIN003	-	STEVAL-PCC009V2 interface board
EVAL6205N	Evaluation board	L6205	-	-	-
EVAL2293Q	Evaluation Board	L2293Q	-	-	-

ECOSYSTEM FOR BRUSHLESS DC MOTOR DRIVERS AND CONTROLLERS

Part number	Tool type	Core product	Evaluation software	Firmware	Companion board
STEVAL-SPIN3201	Evaluation board	STSPIN32F0	-	STSW-SPIN3201	-
X-NUCLEO-IHM11M1	Expansion board for STM32 nucleo board	STSPIN230	-	X-CUBE-SPN11	STM32 Nucleo board F4, F0 or L0 series
STEVAL-SPIN3202	Evaluation Board	STSPIN32F0A	STSW-SPIN3202	-	NUCLEO-F030R8, NUCLEO-F103RB, NUCLEO-F302R8
X-NUCLEO-IHM16M1	Expansion board for STM32 nucleo board	STSPIN830	-	X-CUBE-SPIN16	-
X-NUCLEO-IHM17M1	Expansion board for STM32 nucleo board	STSPIN233	-	X-CUBE-SPIN17	NUCLEO-F030R8, NUCLEO-F103RB, NUCLEO-F302R8
P-NUCLEO-IHM001	Nucleo Pack with NUCLEO-F302R8 and X-NUCLEO-IHM07M1	L6230	-	X-CUBE-SPN7, STSW-STM32100	-
X-NUCLEO-IHM07M1	Expansion board for STM32 nucleo board	L6230	-	X-CUBE-SPN7, STSW-STM32100	STM32 Nucleo board F4, F0 or L0 series
STEVAL-IHM042V1	Evaluation board	L6230	-	STSW-STM32100	-
STEVAL-IHM043V1	Evaluation board	L6234	-	STSW-STM32100	-
EVAL6230QR	Evaluation board	L6230	-	-	-
EVAL6235Q	Evaluation board	L6235Q	STSW-SPIN003	-	STEVAL-PCC009V2
EVAL6229PD	Evaluation board	L6229	-	-	-

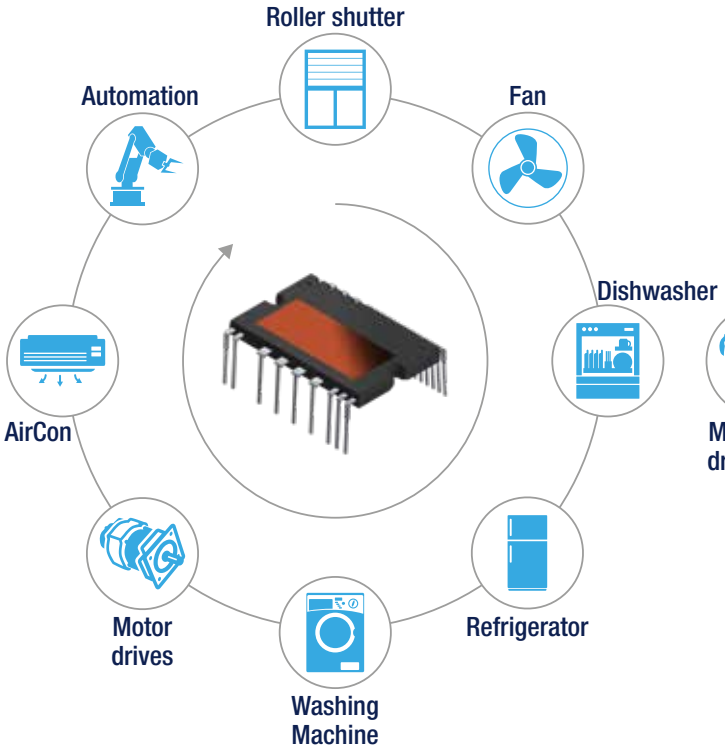
ECOSYSTEM FOR REFERENCE DESIGN

Part number	Tool type	Description	Core product	Firmware
STEVAL-ESC002V1	Evaluation kit	Electronic Speed Controller reference design based on STSPIN32F0A	STSPIN32F0A	STSW-ESC002V1
STEVAL-GMBL02V1	Evaluation kit	Reference design kit for Gimbal controller for drones and handheld applications	STSPIN233	STSW-GMBL02V1

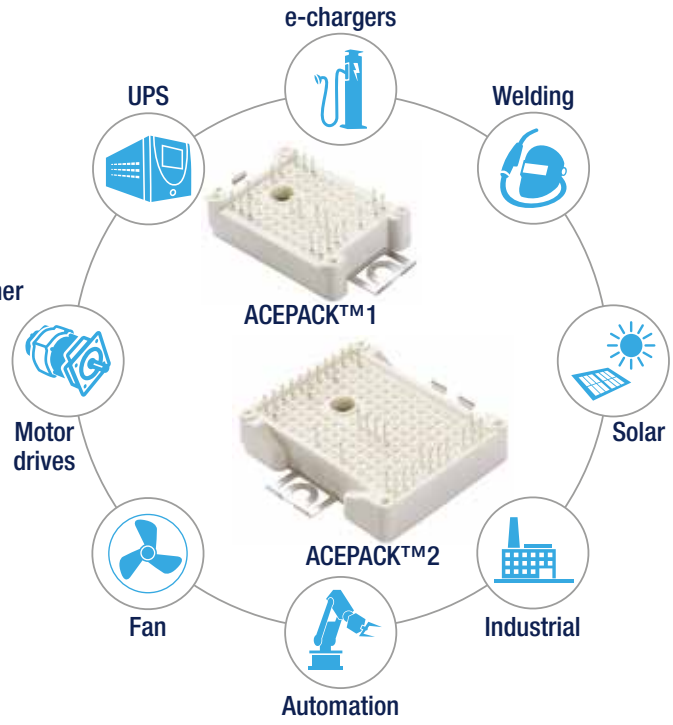
Power Modules

Reduce your design time and efforts with ST's portfolio of highly-integrated, high-efficiency power modules for flexible and robust designs ranging from tens of watts up to 30 kW. Available in a wide selection of current capability, break down voltage and space-saving packages, you are sure to find a device in our Power Module product portfolio that addresses your motor or motion control system requirements.
ST's power module portfolio includes both SLLIMM™ families of Intelligent Power Modules (IPM) as well as ACEPACK™ Power Modules for all types of power switching applications.

SLLIMM
Intelligent Power Modules



ACEPACK
Power Modules



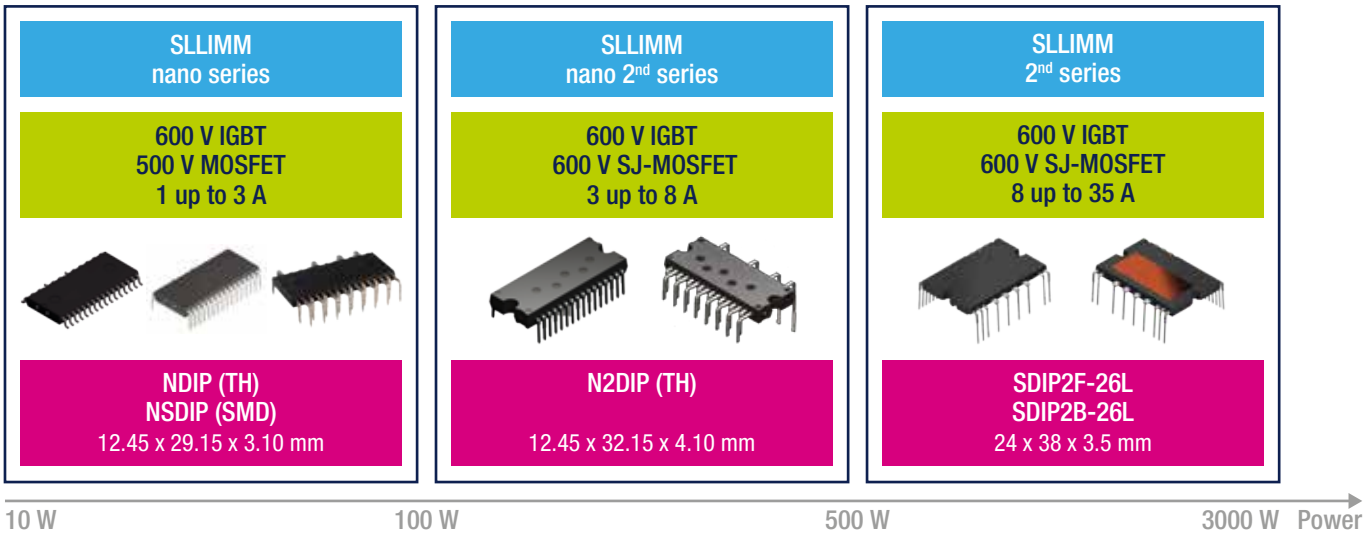
SLLIMM™ INTELLIGENT POWER MODULES

Nowadays, the market requires high performance solutions able to satisfy the increasing energy saving requirements, compactness, reliability, and system costs in home appliances and in low power industrial applications.

To address these market needs, STMicroelectronics has developed the SLLIMM (small low-loss intelligent molded module) families of compact, high efficiency, dual-in-line Intelligent Power Modules, with optional extra features.

It provides a high integrated level that means simplified circuit design, reduced BOM, smaller weight, and high reliability.

Available in different options, both packages (fully molded and DBC) and leads (through-hole and SMD), SLLIMM series can combine six power switches (IGBT, MOSFET and SJ-MOSFET) and drivers in an inverter configuration assuring the best compromise between conduction and switching energy with an outstanding robustness and EMI behavior, making the new product ideal to enhance the efficiency of 3 phases inverter and any motor drives working up to 20 kHz in hard-switching circuitries and for an application power range from 10 W to 3 KW.

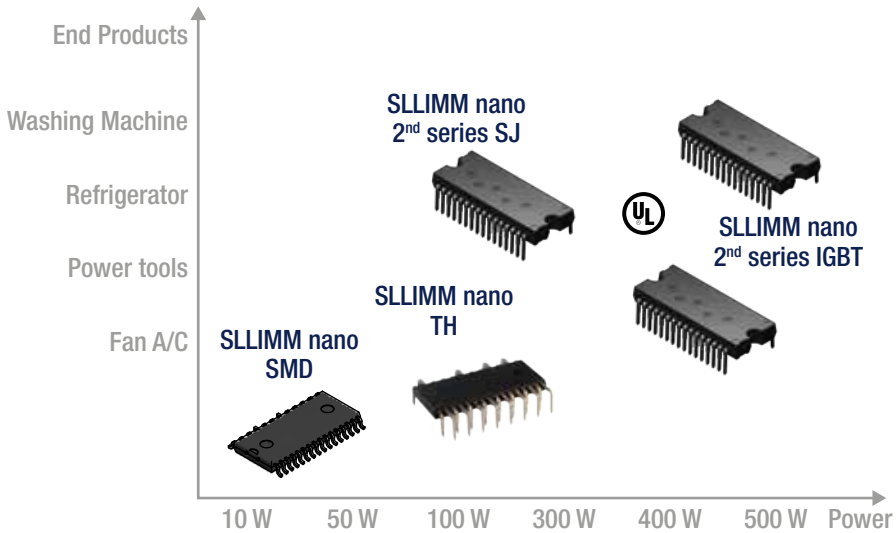


SLLIMM™ nano SERIES

Combining six switches driven by three high-voltage gate drivers in a compact DIP package, the ST's nano IPM family has been designed to cover different motor control applications from very low to medium power range.

The fully isolated SLLIMM-nano package is the ideal solution to satisfy the customer request to reduce assembly PCB/system space, without sacrificing thermal performance and reliability.

ST offers three package solutions: SLLIMM-nano SMD (Surface Mounting Device), SLLIMM-nano and SLLIMM–nano 2nd series TH (Through hole).



KEY FEATURES

- Optimized voltage drop in conduction
- IGBT (planar, TFS) and MOSFET (planar, SJ) based
- 600 V and 500 V breakdown voltage
- Current availability up to 8 A at 25 °C
- Comparator for fault protection
- OpAmp for advanced current sensing
- Open emitter configuration for individual phase current sensing
- Internal bootstrap diodes
- Interlocking function and UVLO
- Mounted slots package options
- In line and zig-zag leads options (w/wo stand-off)

Product PN	Lead type	Switch type	BV	I_{CN}	Vcesat typ/Max $R_{DS(on)}$	t_{dead} min
STGIPN3H60(A)(T)-(H)	TH	IGBT	600 V	3 A	2.15 V	1.5 µs
STGIPN3HD60-H				3 A	2.15 V	1 µs
STIPN2M50T-H/L		MOSFET	500 V	2 A	1.7 Ω	1 µs
STIPN1M50T-H				1 A	3.6 Ω	1 µs
STGIPNS3H60T-H	SMD	IGBT	600 V	3 A	2.15 V	1.5 µs
STGIPNS3HD60-H				3 A	2.15 V	1 µs
STIPNS2M50(T)-H		MOSFET	500 V	2 A	1.7 Ω	1 µs
STIPNS1M50T-H				1 A	3.6 Ω	1 µs
STIPNS1M50SDT-H						
STGIPQ3H60T-HZ/L(S)	TH	IGBT	600 V	3 A	2.15 V	1.5 µs
STGIPQ3HD60-HZ/L				3 A	2.15 V	1.0 µs
STGIPQ5C60T-HZ/L(S)				5 A	1.65 V	1.5 µs
STGIPQ8C60T-HZ				8 A	2.0 V	1.0 µs
STIPQ3M60T-HZ/L		SJ-MOSFET		3 A	1.6 Ω	1.0 µs
STIPQ5M60T-HZ/L				5 A	1.0 Ω	1.0 µs

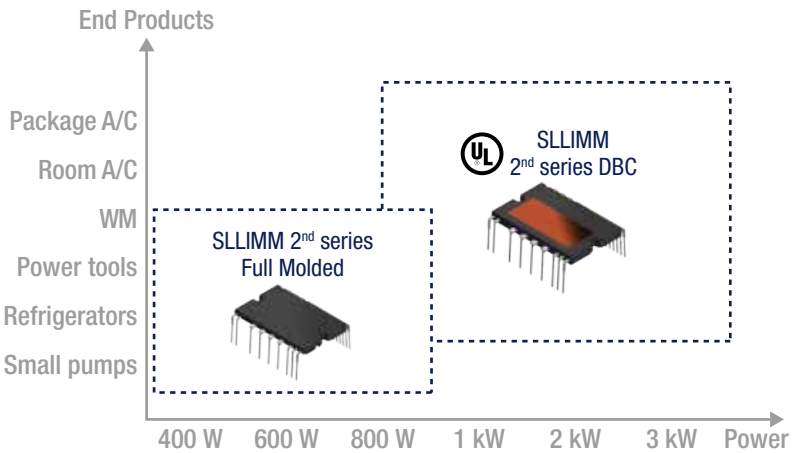
SLLIMM™ 2nd SERIES

The SLLIMM 2nd series is the last ST's family of compact, high efficiency, dual-in-line intelligent power modules, with optional extra features.

This family has been designed using a new internal configuration with two drivers, one high-side driver and one low-side driver, and with the improved trench gate field-stop IGBT or SJ-MOSFETs.

The best compromise between conduction and switching energy with an outstanding robustness and EMI behavior make the new product ideal to enhance the efficiency of compressor, pumps, fans and any motor drives working up to 20 kHz in hard-switching circuitries and for an application power range from 300 W to 3 KW.

This series will complement and overcome the already available SLLIMM series in term of power and features, package' types and flexibility and it takes over the main functions of previous one, adding some more features and enlarging the technology package option.



KEY FEATURES

- 600 V, from 8 A to 35 A DC rating at 25 °C
- Low V_{CEsat}/R_{DSon}
- Optimize driver and silicon for low EMI
- Lowest Rth value on the market for the DBC package versions
- Internal bootstrap diode
- Maximum operating junction temperature
  - 175 °C for IGBT based
  - 150 °C for SJ MOSFET based
- Separate open emitter outputs;
- NTC on board
- Integrated temperature sensor on Low side driver
- Comparator for fault protection
- Shutdown input/fault output
- Isolation rating of 1500 Vrms/min

Part Number	Switch technology	I_C @ 25 °C (@ 80 °C)	$V_{ce(sat)}/R_{DSon\ (typ)}$ @ I_C 25 °C (@ I_C 80 °C)	Max $R_{th(j-c)}$	t_{scw}
STGIF5CH60TS-L(E)(X)	IGBT	8 A (5 A)	1.7 V (1.5 V)	5.0 °C/W	5 µs
STGIF7CH60TS-L(E)(X)		10 A (7 A)		4.80 °C/W	
STGIF10CH60TS-L(E)		15 A (10 A)		4.60 °C/W	
STGIB8CH60TS-L(E)		12 A (8 A)	1.7 V (1.5 V)	3.0 °C/W	5 µs
STGIB10CH60TS-L(E)		15 A (10 A)		2.26 °C/W	
STGIB15CH60TS-L(E)		20 A (15 A)		1.85 °C/W	
STGIB20M60TS-L(E)		25A (20 A)		1.40 °C/W	8 µs
STGIB30M60TS-L(E)		35 A (30 A)		1.20 °C/W	
STIB1060DM2T-L	SJ-MOSFET	10	180 mΩ	1.59 °C/W	12 µs
STIB1560DM2T-L		15	150 mΩ	1.10 °C/W	12 µs

Note F = Full Molded package B = DBC package T = NTC on board S = Temperature sensing E = Short leads and emitter forward L = Long leads X = Medium leads

ACEPACK™

The latest ST power module family offers new ACEPACK 1 and ACEPACK 2 Power Modules on Sixpack and Converter Inverter Brake (CIB) topologies.

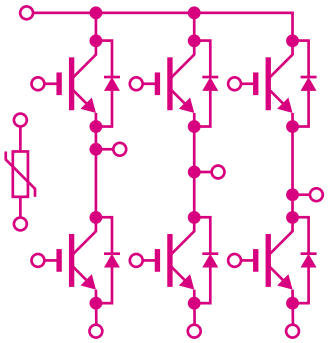
With an embedded NTC thermistor, these highly reliable power modules offer the best compromise between conduction and switching loss, maximizing the efficiency of any converter system up to 20 kHz in hard-switching circuitries for an application range from 3 to 30 kW.

Offering PressFIT and solder pin options for flexible and stable mounting, these robust power modules, which are part of ST's M series Trench Gate Field- Stop IGBTs, ensure a compact design and cost-effective system.

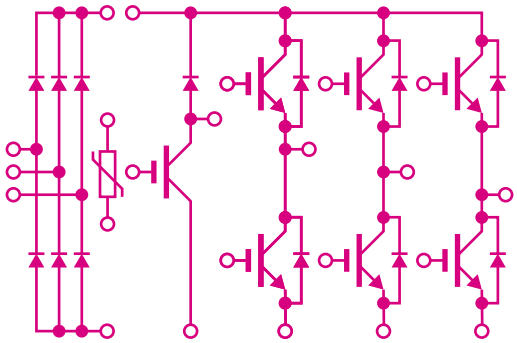
The flexibility and characteristics of ACEPACK packages bring additional power and design features to ensure the best possible solution for your applications.

ACEPACK™1

ACEPACK™2



Six-Pack + NTC



CIB + NTC

KEY FEATURES

- 15 to 75 A current rating at 25 °C
- 650 to 1200 V Breakdown voltage
- Integrated 5 kΩ NTC temperature monitoring
- Soft and fast recovery diode
- PressFIT and solder contact pin options
- Reliable and easy mounting system
- Low stray inductance module design

KEY BENEFITS

- High power density
- High reliability and quality
- 175 °C maximum junction temperature for increased robustness

Product PN	Package	Topology	BV_{CES}	I_C rating	Max isolation voltage
A1P25S12M3/-F	A1	Six-Pack	1200 V	25 A	2500 Vrms/min
A1P35S12M3/-F				35 A	
A1C15S12M3/-F		CIB	1200 V	15 A	
A1P50S65M2/-F		Six-Pack	650 V	50 A	
A2C25S12M3/-F	A2	CIB	1200 V	25 A	
A2C35S12M3/-F				35 A	
A2P75S12M3/-F		Six-Pack	1200 V	75 A	
A2C50S65M2/-F		CIB	650 V	50 A	

Note Blank = Solder pin F = Press Fit

EVALUATION TOOLS

Reference/bundle	Voltage	Power	Motor type/ control type *	ST parts	Application focus
STEVAL-HKI001V1	50 – 650 V_{DC}	Up to 35 A_{RMS} to the motor	PMSM FOC 3-shunt	• 1x A2C35S12M3-F • 7x STGAP1AS • 1x STM32F303RBT7	Power board: pumps, Motion/Servo Control, Industrial motor drives and more

ST PowerStudio- THE DYNAMIC ELECTRO-THERMAL SIMULATION SOFTWARE FOR POWER DEVICES

ST PowerStudio is a powerful and flexible simulation software for SLLIMM™ intelligent power modules and ACEPACK™ power modules.

The tool features a one-click comprehensive power and thermal analysis, avoiding long, complex and expensive application testing.

It provides a very accurate estimation of power loss, junction and case temperatures, and even explores non-testable parameters and helps in sizing a suitable heatsink.

Finally, the software helps developers select the proper device fitting the application mission profile, saving design time and resources.

ST PowerStudio (STSW-POWERSTUDIO) is based on a very precise built-in electrical and thermal model for each device and thanks to an iterative

calculation taking into account the self-heating effects, it provides a very accurate estimation of the power loss as well as junction and case

temperatures.

The software simulates mission profiles with a static load (single set of input conditions) or a dynamic load, changing the input conditions over time

and performing very long simulation profiles.

Several thermal set-up input conditions can be simulated, such as:

- devices without heatsink, estimating the case and the junction temperatures;
- fixed case temperature (with heatsink), estimating the junction temperature and the heatsink;
- fixed heatsink thermal resistance, estimating the case and junction temperatures;
- fixed heatsink thermal impedance, estimating the case and junction temperatures and considering the thermal inertia of the system.

Simulation results are shown on tables and on dedicated scope views, in function of time, load current and switching frequency.

An output report is provided with the summary of all the information and results for an easy comparison or archiving.

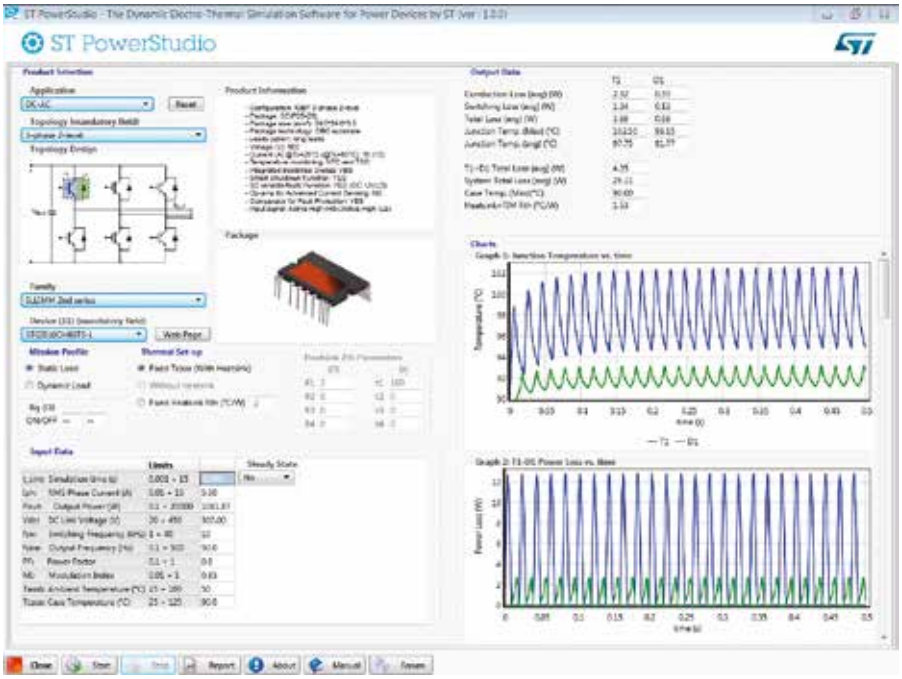
KEY FEATURES

- Comprehensive power and thermal analysis
- User-friendly interface
- Static and dynamic mission profile
- Multi thermal set-up
- Simulation with or without heatsink
- Internal self-heating model
- Output data, tables and charts, for each power device
- Quick link to the device documentation
- Output PDF report
- Online forum
- Portable software
- Multilanguage (English, Chinese and Japanese)

KEY BENEFITS

- Selection of proper device fitting the application mission profile
- Easier, faster and cheaper solution design
- Deep analysis of power loss and device temperatures
- Exploration of non-testable parameters
- Very accurate temperature-dependent output results
- Complex and long mission profile simulation
- Heatsink size estimation
- Internet connection not required for simulation

USER INTERFACE



Power MOSFETs

ST's power MOSFET portfolio offers a broad range of breakdown voltages from -100 V to 1700 V, with low gate charge and low on-resistance, combined with state-of-the art packaging. ST's process technology for both high-voltage power MOSFETs (MDmesh™) and low-voltage power MOSFETs (STripFET™) has enhanced power handling capability, resulting in high-efficiency solutions.

LOW VOLTAGE MOSFETs- STripFET™ F7 MOSFETs

ST's new STripFET F7 MOSFETs deliver among the best on resistance currently available at 40 V, 60 V, 80 V and 100 V devices to minimize conduction losses, coupled with minimal capacitances and gate charge. STripFET F7 shows furthermore Optimized intrinsic capacitances ratio (Crss/Ciss) to minimize EMI effects, high current capability and extremely low thermal resistance to improve power dissipation

The resulting devices help to simplify final designs and reduce equipment size and cost by allowing system power and efficiency targets to be met using fewer devices in small package sizes.

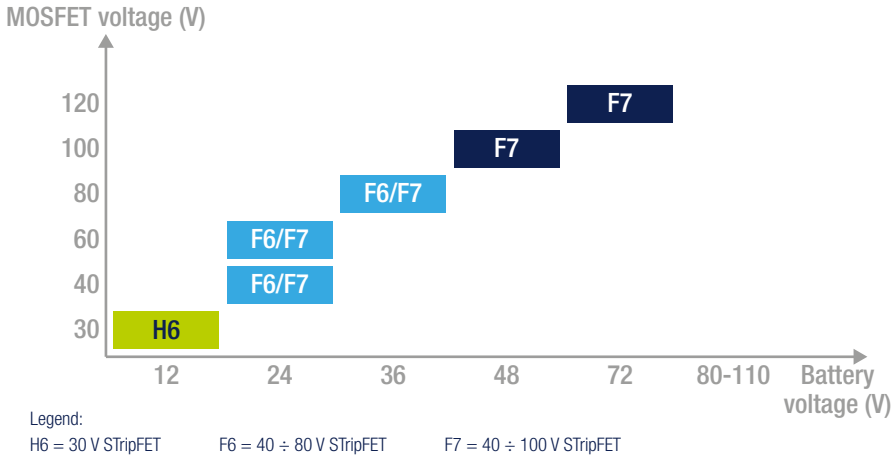
The F7 product offer is complemented with the cost effective H/F6 series, available in both, N and P-Channel polarity.

VDSS	Part number	Marketing status	Package	$R_{DS(on)}$ (@VGS = 10 V) max (Ω)	Qg typ (nC)
100	STX310N10F7	Active	TO-220/H²PAK-2/H²PAK-6	0.0023	180
	STX150N10F7	Active	TO-220/TO-220FP/H²PAK-2/I²PAK	0.0039	117
	STL110N10F7	Active	PowerFLAT™ 5x6	0.006	72
	STX100N10F7	Active	TO220/D²PAK/DPAK/TO-220FP	0.008	61
	STL90N10F7	Active	PowerFLAT™ 5x6	0.008	45
	STX80N10F7	Active	DPAK/TO-220FP	0.0095	45
	STL8N10F7	Active	PowerFLAT™ 3.3x3.3	0.02	25
80	STX270N8F7	Active	TO-220/H²PAK-2/H²PAK-6	0.021	193
	STX170N8F7	Active	TO-220/H²PAK-2	0.0037	120
	STX140N8F7	Active	TO-220/TO-220FP/H²PAK-2	0.004	96
	STL130N8F7	Active	PowerFLAT™ 5x6	0.0036	96
60	STL220N6F7	Active	PowerFLAT™ 5x6	0.0014	100
	STP220N6F7	Active	TO-220	0.0023	100
	STL140N6F7	Active	PowerFLAT™ 5x6	0.0028	55
	STX140N6F7	Active	TO-220/H²PAK	0.0032	55
	STL130N6F7	Active	PowerFLAT™ 5x6	0.0035	42
	STX130N6F7	Active	TO-220/D²PAK/DPAK	0.005	42

VDSS	Part number	Marketing status	Package	$R_{DS(on)}$ max @ 10 V	Qg (nC) 4.5 V
-60 V	STx10P6F6	Active	TO-220/DPAK	0.16	6.4*
30 V	STL260N3LLH6	Active	PowerFLAT 5x6	0.0013	61
40	STL260N4LF7	Samples available	PowerFLAT 5x6	0.0011	53
	STL260N4F7	Samples available	PowerFLAT 5x6	0.0011	67*
	STH320N4F6-x	Active	H²PAK	0.0013	240*
	STF260N4F7	Active	TO-220FP	0.0025	67*
	STP260N4F7	Active	TO-220	0.0022	67*
	STL160N4F7	Active	PowerFLAT 5x6	0.0025	29*
45	STL260N45LF7	Samples available	PowerFLAT 5x6	0.00115	46

Note * value @ 10 V

STripFET POSITIONING VS VOLTAGE BATTERY IN MC



Legend:
H6 = 30 V STripFET F6 = 40 ÷ 80 V STripFET F7 = 40 ÷ 100 V STripFET

TECHNOLOGY FEATURES

- Best in class ON-resistance
- High current capability
- Extremely low thermal resistance
- High quality & reliability
- Wide packaging options

BENEFITS

- High efficiency and system miniaturization
- Lower battery consumption
- Reliable system operation

HIGH VOLTAGE MOSFETs

BV_{DSS} (V)	Max R_{DS} (Ω)	Max I_D (A)	Qg (nC)	Trr (typ) (ns)	Sales Type	Main application	Packages	Eng. Samples	Production
600	1.55	3.5	9	70	STx5N60DM2	Motor Control	D1 dice sales/DPAK	Available	Production
	1.1	5	9	73	STx6N60DM2	Motor Control	DPAK/TO-220/IPAK	Available	Production
	0.9	6	10	75	STx7N60DM2	Motor Control	DPAK/TO-220/IPAK	Available	Production
	0.600	8	13.5	80	STx8N60DM2	SMPS, HID, Motor Control	TO-220FP/DPAK	Available	Production

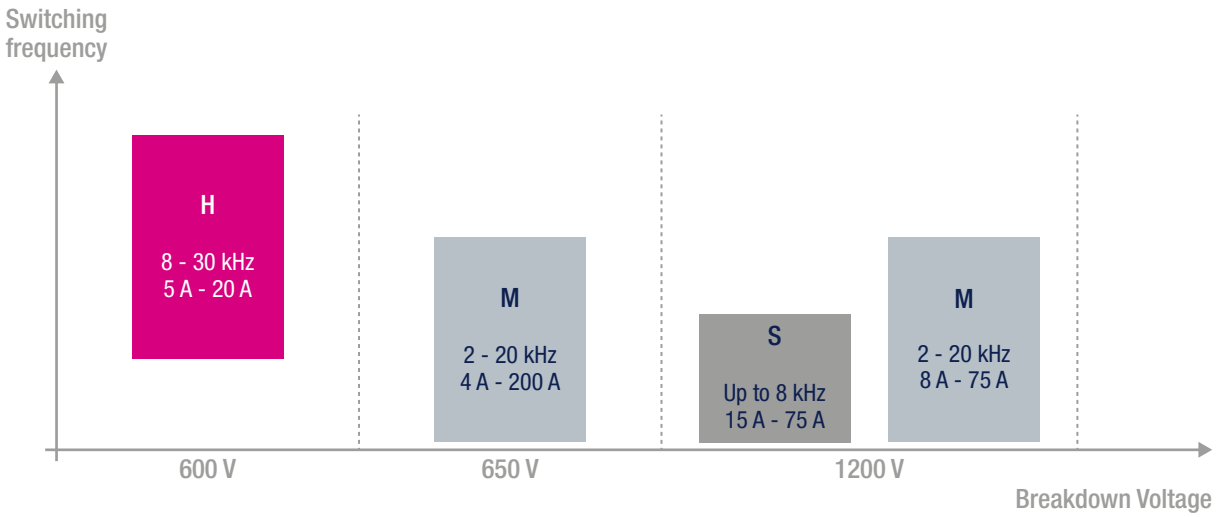
IGBT

The ST offers a very wide portfolio of IGBTs, tailored to motor control application, developed using an advanced proprietary trench-gate field stop structure, with voltage classes of 600 V, 650 V and 1200 V available both in bare die and discrete packages as well as IPMs and power modules.

Some of the highlights of our IGBT portfolio are as follows:

- Low $V_{CE(SAT)}$ for reduced conduction power losses
- Improved switch-off energy spread versus increasing temperature resulting in enhanced efficiency
- Tight parameter distribution for design simplification and easy paralleling
- Co-packaged anti-parallel diode specifically designed for improved EMC compatibility

Reported below the IGBTs series to motor control, which are: "H", "M" and "S" series.
These series combine a very low saturation voltage with a maximum operating junction temperature of 175 °C and the short circuit capability.



600-650 V IGBT series

600 V H SERIES

The 600 V “H” series, with current capability going from 5 A up to 20 A and short-circuit rated, represents an optimum compromise between conduction and switching power losses to maximize the efficiency of medium to high switching frequency inverters.

						Packages					
IGBT P/N	BV_{CES} (V)	I_{CN} [1] (A)	$V_{CE(sat)}$ [2] (V)	t_{sc} [3] (µs)	Switching frequency range	DPAK	D²PAK	TO-220	TO-220FP	TO-247	TO-3P
STG*5H60DF	600	5	1.5	3	8 - 30 kHz	D	B	P	F		
STG*7H60DF		7	1.5				B	P	F		
STG*10H60DF		10	1.5				B	P	F		
STG*15H60DF		15	1.6				B	P	F		
STG*20H60DF		20	1.6				B	P	F	W	WT

Note 1) I_{CN}: IGBT nominal collector current @ T_C = 100 °C
2) $V_{CE(sat)}$: typical conduction losses @ I_{CN}, T_C = 25 °C
3) t_{sc}: min short circuit withstanding time @ V_{CC} ≤360 V, V_{GE} = 15 V, T_{jstart} =150 °C

650 V M SERIES

The 650 V “M” series, with current capability from 4 A to 120 A (available also in die form in 200 A), represent the best GPI technology on the market, optimized in EMI thanks to soft waveforms and thanks to an outstanding short-circuit withstand time of 6 µs, it is an optimum compromise in performance to maximize the efficiency of three phase industrial drive systems where low-loss and short-circuit capability are mandatory.

						Packages						
IGBT P/N	BV_{CES} (V)	I_{CN} [1] (A)	$V_{CE(sat)}$ [2] (V)	t_{sc} [4] (µs)	Switching frequency range	DPAK	D²PAK	TO-220	TO-220FP	TO-247	TO-247 long leads	Max247 long leads
STGx4M65DF2	650	4	1.6	6	Up to 20 kHz	D	B	P	F			
STGx6M65DF2		6	1.55			D	B	P	F			
STGx10M65DF2		10	1.55				B	P	F	W		
STGx15M65DF2		15	1.55				B	P	F			
STGx20M65DF2		20	1.55				B	P	F		WA	
STGx30M65DF2		30	1.55				B	P	F	W	WA	
STGx50M65DF2		50	1.65								WA	
STGx75M65DF2		75	1.65							W	WA	
STGx120M65DF2		120	1.65									YA

Note 1) I_{CN}: IGBT nominal collector current @ T_C = 100 °C
2) $V_{CE(sat)}$: typical conduction losses @ I_{CN}, T_C = 25 °C
4) t_{sc}: min short circuit withstanding time @ V_{CC} ≤400 V, V_{GE} = 15 V, T_{jstart} = 150 °C

1200 V IGBT series

1200 V M SERIES

1200 V “M” series, with current capability from 8 A to 40 A (available in die form also in 35 A and 75 A dice), optimized in EMI and showing a minimum short-circuit withstand time of 10 µs at 150 °C, address the Motor and compressor drives offering the best trade-off performances according to the working operating frequency up to 20 kHz.

						Packages		
IGBT P/N	BV_{CES} (V)	I_{CN} [1] (A)	$V_{CE(sat)}$ [2] (V)	t_{sc} [3] (µs)	Switching frequency range	TO-247	TO-247 long leads	TO-220
STGx8M120DF3	1200	8	1.85	10	Up to 20 kHz	W	WA	P
STGx15M120DF3		15				W	WA	
STGx25M120DF3		25				W	WA	
STGx40M120DF3		40				W	WA	

Note 1) I_{CN}: : Nominal collector current @ T_J = 100 °C
2) $V_{CE(sat)}$: Typical conduction losses @ I_{CN}, T_J = 25 °C
3) t_{sc}: min short circuit whitstand time @ $T_{J\text{-start}}$ ≤150 °C, V_{CC} = 600 V, V_{GE} = 15 V

1200 V S SERIES

The 1200 V “S” series, with current capability from 15 A up to 40 A (available in die form up to 75 A) and short-cicuit withstand time of 10 µs, is tailored to get the best trade-off between conduction and switching-off energy losses to improve significantly the overall performance of three phase industrial drive systems at low switching frequency (<8 kHz).

						Packages		
IGBT P/N	BV_{CES} (V)	I_{CN} [1] (A)	$V_{CE(sat)}$ [2] (V)	t_{sc} [3] (µs)	Switching frequency range	TO-247	TO-247 long leads	TO-220
STGx15S120DF3	1200	15	1.55	10	Up to 8 kHz	W	WA	
STGx25S120DF3		25	1.60			W	WA	
STGx40S120DF3		40	1.65			W	WA	

Note 1) I_{CN}: : Nominal collector current @ T_J = 100 °C
2) $V_{CE(sat)}$: Typical conduction losses @ I_{CN}, T_J = 25 °C
3) t_{sc}: min short circuit whitstand time @ $T_{J\text{-start}}$ ≤150 °C, V_{CC} = 600 V, V_{GE} = 15 V

Diode & Rectifier

ST's ultrafast diodes range from 300 V to 1200 V with various V/T and Q/S factor trade-offs so as to achieve the best performance for any application. The «R» trade-off stands for «Rapid», and are the ones proposed in the below metric. These «R» diodes have been developped to have reduced switching time and associated reverse recovery charges, making them ideal for use in the PFC circuit of the motor control board.
The new «RQ» series, that stands for «Rapid & Quiet», achieve low reverse recovery time, combined with a soft behaviour. This will be particularly appreciated in higher power applications, where switching current are more important,. In that envrionment, a reduction of the noise generated by the commutation of the diode enable to improve the system EMI performances.
All ST products are rated up to 175 °C operating junction temperature, as a result of the reduced leakage currents.

KEY FEATURES

- Wide voltage range from 300 V to 1200 V
- Up to 200 A current range
- Low-profile PowerFLAT™ packages
- Different V_F/T_{rr} trade-offs available in different packages
- 175 °C operating junction temperature

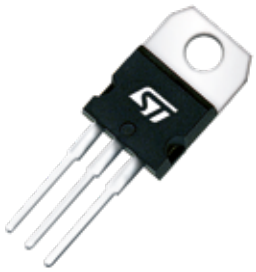
	Part number	I_{FAV} (A)	V_F max (V)/25 °C	Qrr typ (nC)/125 °C	Sfactor Typical	Package
300 V ultrafast rectifiers	STTH8R03	8	1.8	60	0.4	TO-220AC
	STTH8R03DJF	8	1	120	0.3	PowerFLAT™ 5 x 6
	STTH30R03	30	1.4	63	0.4	D²PAK, TO-247
400 V ultrafast rectifiers	STTH8R04	8	1.5	148	0.4	D²PAK, TO-220AC, TO-220AC Ins
	STTH20R04	20	1.7	225	0.3	D²PAK, TO-220AC, DO-247, TO-220FPAC
	STTH30R04	30	1.45	525	0.4	D²PAK, TO-220AC, DO-247, DOP3 Ins
600 V ultrafast rectifiers	STTH1R06	1	1.9	120		DO-41, SMA, SMB
	STTH5R06	5	2.9	110	0.35	D²PAK, TO-220AC, DPAK, TO-220FPAC
	STTH5R06DJF	5	1.2	180	0.5	PowerFLAT™ 5 x 6
	STTH8R06	8	2.9	150	0.3	D²PAK, TO-220AC, TO-220AC Ins, I²PAK, TO-220FPAC
	STTH12R06	12	2.9	180	0.2	D²PAK, TO-220AC
	STTH15RQ06	15	2.95	250	1	TO-220AC, D²PAK, DO-247
	STTH30RQ06	30	2.95	485	1	TO-220AC, D²PAK, DO-247
	STTH60RQ06	60	2.95	660	1	DO-247
800 V/1000 V/1200 V Ultrafast rectifiers	STTH108A	1	1.65			SMA
	STTH208A	2	1.65			SMA
	STTH110A	1	1.7			SMA
	STTH310S	3	1.7			SMC
	STTH810G	8	2	1100	2	D²PAK
	STTH212	2	1.75	680		SMB, SMC
	STTH1512G	15	2.1	2600	1.5	D²PAK
	STTH15S12W	15	3.1 typ	1300	2	DO-247
	STTH6012W	60	2.05	6400	1	DO-247

Thyristors (SCR) and AC Switches

ST offers a complete range of thyristors and AC switches with voltage ratings up to 1200 V, current ratings up to 100 A and a set of packages from miniature surface-mounted packages to high power dissipation isolated and non-isolated packages.
To serv control motor applications, T-Series Triacs are offering a complete range of current ratings, up to 20 Ampere. The T-seriers Snubberless Triac is able to drive high inductive load thanks to its strong turn-off capabilities (dI/dt)c. The H-Series family is featuring a strong thermal performances, fully rated at 150 °C, suitable for high power loads and hot environments.
ACSTM and ACST AC Switches are overvoltage self-protected devices, improving the application safety and reliability.
High temperature 150 °C SCR are perfectly fitting requirements to build a solid-state relay for motor starter or for inrush current limitation in AC/DC stage.

TRIACS

ST's portfolio of Triacs includes devices with voltage ratings up to 800 V and RMS on-currents up to 40 A in general-purpose standard configurations, a new high commutation T series in Snubberless™ technology, and 3-quadrant high-temperature Triacs (H series) for use in harsh environments. They are the reference for universal and induction motor drivers in appliance applications where, due to their ability to manage the stringent inrush conditions when driving inductive loads, they can switch off three times their rating current.



KEY FEATURES

- Robustness and reliability
- Wide voltage and current ranges
- Extended portfolio:
  - T-Series Snubberless™ Triacs with enhanced switch-off capability, suitable for inductive loads
  - High-temperature H series for high power loads and hot environments

	Part number	Packages	Current rating (A_{RMS})	Non repetitive surge peak on-state current (A)	Repetitive off-state voltage (V)	Operating Tj max (°C)	I_{GT} (mA)
T series	T435T-600FP	TO-220AB-FP	4	30	600	125	35
	T635T-8	TO-220AB-FP TO-220AB D^2PAK	6	45	800	150	
	T835T-8		8	60	800	150	
	T1235T-8		12	90	800	150	
	T1635T-8		16	120	800	150	

	Part number	Packages	Current rating (A_{RMS})	Non repetitive surge peak on-state current (A)	V_{DRM} - V_{RRM} (V)	Operating Tj max (°C)	I_{GT} (mA)
High-temperature Triacs	T410H	TO-220	4	40	600	150	10
	T610H	TO-220	6	60			10
	T835H-6	TO-220, D^2PAK, TO-220I	8	80			35
	T1035H-6		10	100			
	T1235H-6		12	120			
	T1635H-6		16	160			
	T2035H-6		20	200			
	T3035H-6	TO-220, TO-220I	30	270			
	T3035H-8	TO220, TO-220I, D^2PAK	30	270	800		

ACS™ AND ACST

Using innovative ASD application-specific device technology, ST's ACS™ and ACST devices are specific switches developed for home appliances and industrial control applications.

While maintaining very high switch-off capability, logic-level devices allow direct drive by a microcontroller. With integrated overvoltage protection against random transients, no external MOV protection is needed, providing system safety and transient and surge voltage immunity as defined in the IEC 61000-4-4 and -4-5 standards. The ACST series now extends from 2 A to 16 A, housed in TO-220AB and TO-220FP packages, and the ACS series is also extended to 800 V with a lower gate triggering sensitivity of 5 mA.

KEY FEATURES

- High switch off capability
- Low gate current for direct connection to MCU
- Internally protected, no need of external circuitry to meet IEC 61000-4-4 and -4-5 standards

Part number	Current rating (A_{RMS})	Non repetitive surge peak on-state current (A)	Repetitive off-state voltage (V)	Operating Tj max (°C)	I_{GATE} (mA)	Packages
ACS108	0.8	13.7	800	125	10	SOT223, TO92
ACS120	2	20	700	125	10	DPAK, TO-220AB, TO-220FPAB
ACST2	2	8	800	125	10	DPAK, TO-220FPAB
ACST3	3	20				TO-220FPAB
ACST4	4	30			10, 35	DPAK, TO-220FPAB
ACST8	8	80			30	D^2PAK, TO-220AB, TO-220FPAB
ACST1035-8FP	10	90	800	150	35	TO-220FPAB
ACST1235-8FP	12	100	800	150	35	TO-220FPAB
ACST1635-8FP	16	140	800	150	35	TO-220FPAB

HIGH TEMPERATURE SCR

High-temperature silicon-controlled rectifiers (SCRs), or thyristors, are designed to improve the reliability of applications such as overvoltage crowbar protection and motor control circuits in power tools and kitchen aids, inrush current-limiters, capacitive discharge ignition systems and voltage regulators. Perfectly suited for automotive stationary battery chargers, uninterruptible power supplies, industrial power supplies, motorbike voltage regulators and motor drive applications, they help reduce costs by using smaller heatsinks.Their voltage robustness up to 1200 V, high noise immunity and power dissipation performance at 150 °C Tj are key features for functions such as AC switches, AC phasing inverters, and AC-DC controlled rectifier bridges.

Available in SMD as well as through-hole-isolated and non-isolated packages, ST's high-Tj SCRs feature:

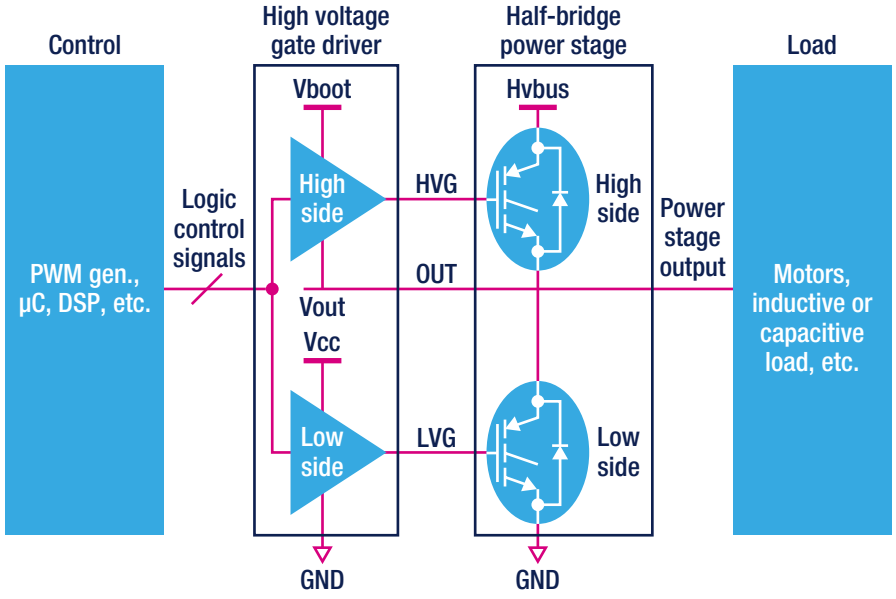
- A very low gate-triggering current (600 V SCRs only)
- A peak off-state voltage (blocking voltage) from 600 V up to 1200 V
- A maximum on-state current from 12 A to 50 A
- A maximum junction temperature of 150 °C

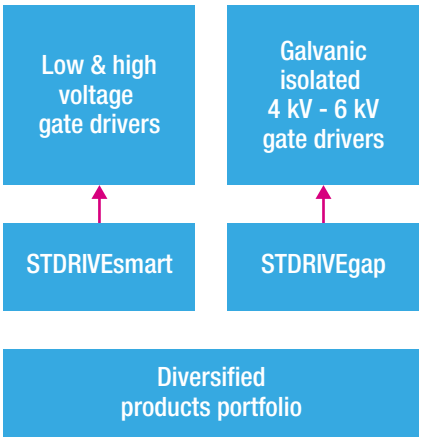
Part number	I_{TRMS} (A)	I_{GT} (mA)	dV/dT @ 150 °C (V/µs)	tg (µs)	I_{TRSM} (A)	TO-220AB	TO-220FPAB	D^2PAK	TO-220AB ins	TO-247	D^3PAK
Industrial High Temperature 600 V SCR											
TN1205H-6	12	2 to 5	100	65 typ	120	•		•			
TN1605H-6	16	6	200	70 typ	140	•	•	•			
TN1610H-6	16	10	1000	70 typ	140	•	•				
TN2010H-6	20	10	400	70 typ	180	•	•	•			
TN2015H-6	20	15	750	70 typ	180	•	•				
TN4015H-8	40	15	500	35 typ	360	•		•	•		
TN5015H-8	50	15	500	50 typ	450	•		•	•		
Automotive and Industrial High Temperature and High Voltage SCR											
TN3050H-12	30	50	1000	150 typ	300			•		•	
TN5050H-12	50/80	50	1000	150 typ	580					•	
TM8050H-8	80	50	1000	150 max	670					•	•

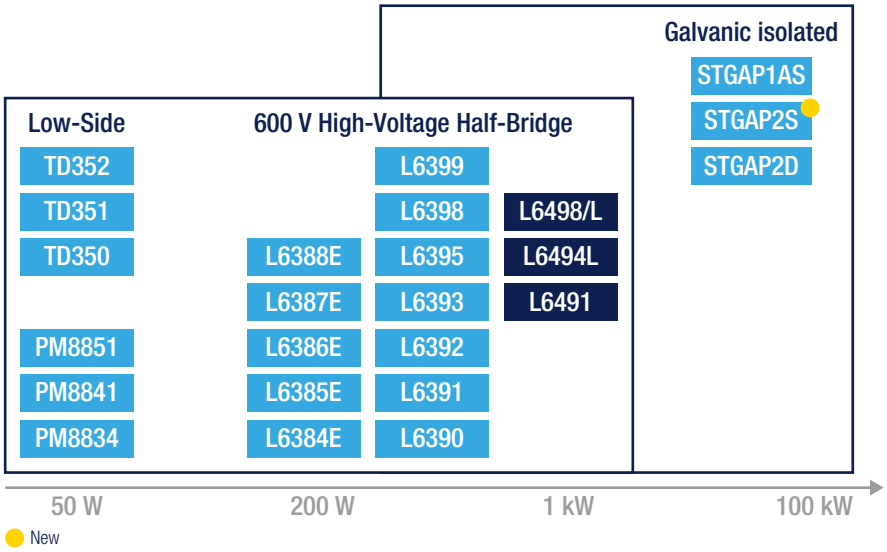
• NEW

MOSFET and IGBT Gate Drivers

A necessary companion for discrete power MOSFETs and IGBTs as well as digital – microcontrollers, DSPs and FPGs – or analog controllers in any switched-mode power converter, STDRIVE gate drivers generate the necessary voltage and current level required to accurately and efficiently activate the power stage in industrial, consumer, computer and automotive applications.
With a range spanning from single- to half-bridge and multiple-channel drivers rated for either low- or high-voltage (up to 1700 V) applications, ST also offers galvanically-isolated gate driver ICs for safety and functional requirements, System-in-Package (SiP) solutions integrating high- and low-side gate drivers and MOSFET-based power stages, responding to the industrial market trend towards higher levels of integration and lower development costs.
In many cases, there is an STDRIVE perfectly designed to fit your switched-mode power converter design. STDRIVE comes with extensive evaluation hardware and software as well as a technical documentation toolbox to help minimize time-to-market.
The benefit of our 15 years longevity program is available for our STDRIVE Mosfet and IGBT drivers.





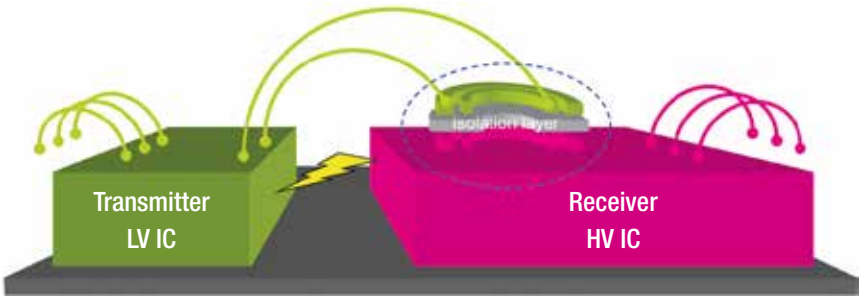


KEY FEATURES

- Half-bridge, single-channel and multichannel gate drivers
- State-of-the-art integration thanks to:
  - HV bootstrap diode
  - Op amp
  - Comparator
  - Smart shutdown
  - Undervoltage lock out (UVLO
  - Programmable deadtime

STGAP

The new STGAP1AS an innovative IGBT/ Mosfet driver 4 KV galvanically isolated which provides robustness and noise immunity, a thick oxide isolation layer is grown on-chip to build a miniature transformer which is used to inductively transfer signals between input and output, best in class protection features are embedded and high configurability level reached through SPI interface.



Package frame

General description	Supply voltage (VDD) min (V) max (V)	Input configuration	Output current-Max nom (A)	Undervoltage lockout (V) (VH ON) & (VH OFF) nom (V)	Supply voltage (VH) min, max (V)	Negative gate drive ability	Miller Clamp, DESAT detection, SENSE comparator	Pin Count nom ()
STGAP1S	3 V, 5.5 V	SD, IN+, IN-	5	programmable	4.5, 36 V	yes	yes	24

STGAP2S e STGAP2D are drivers which isolates the gate driving channel from the low voltage control and interface circuitry.

They are characterized by 4 A capability and rail-to-rail outputs, making the device also suitable for high power inverter applications such as motor drivers in industrial applications.

Part Number	Channel #	Configuration	Voltage max (V)	Output current max (A)	Common-mode transient immunity (V/ns)	Supply voltage c (V) max	TTL/CMOS logic inputs (V)	Propagation delay (ns)	Additional features	Package
STGAP2SCM	1	Miller Clamp	1700	4	±100	26	3.3, 5	80	UVLO and thermal shutdown Adjustable deadtime and HW interlocking function	SO-8
STGAP2SM		Sepatared outputs								
STGAP2D	2									SO-16

STDRIVE HIGH VOLTAGE HALF BRIDGE GATE DRIVERS

SST's high-voltage drivers are designed to optimize vector motor drive systems and feature excellent performance at high switching frequency and smart shutdown to protect the final application.

STDRIVE MOSFET and IGBT gate drivers can integrate a comparator for protection, an operational amplifier for current sensing and an integrated bootstrap diode, thus reducing the number of external components required at system level.

ST's new STDRIVE family of half-bridge MOSFET and IGBT gate drivers are designed to operate in harsh industrial environments withstanding high voltages up to 600 V, while maintaining good noise immunity and low switching losses.

L6491, **L6494**, and **L6498** high-voltage half-bridge gate drivers are particularly suited for medium- and high-capacity power switches thanks to their sink/source current capability up to 4 A.

Part Number	Supply Voltage (V) max	Protection Option Type nom	Key features nom	Output Current-Max (A) nom	Input configuration	Grade	Undervoltage lockout (V)				Operating Temperature (°C)		EVALBoard	Description
							(On VCC ON) nom	(On VCC OFF) nom	(On VBOOT ON) nom	(On VBOOT OFF) nom	min	max		
A6387	17	Interlocking function	Bootstrap diode	0.65	HIN, LIN	Automotive	6	5.5	-	-	-40	125		
L6384E	17	Undervoltage lockout	Adjustable deadtime, Bootstrap diode	0.65	SD, Single IN	Industrial	12	10	-	-	-40	125	EVALSTDRV600HB8	Demonstration board kit for L638xE and L639x high-voltage gate drivers
L6385E	17	Undervoltage lockout	Bootstrap diode	0.65	HIN, LIN	Industrial	9.6	8.3	9.5	8.2	-40	125	EVALSTDRV600HB8	Demonstration board kit for L638xE and L639x high-voltage gate drivers
L6386AD	17	Undervoltage lockout, Comparator	Bootstrap diode	0.65	HIN, LIN, SD	Industrial	9.6	8.3	-	8.2	-40	125		
L6386E	17	Undervoltage lockout, Comparator	Bootstrap diode	0.65	HIN, LIN, SD	Industrial	12	10	11.9	9.9	-40	125		
L6387E	17	Undervoltage lockout, Interlocking function	Bootstrap diode	0.65	HIN, LIN	Industrial	6	5.5	-	-	-40	125	EVALSTDRV600HB8	Demonstration board kit for L638xE and L639x high-voltage gate drivers
L6388E	17	Undervoltage lockout, Interlocking function	Adjustable deadtime, Bootstrap diode	0.65	HIN, LIN	Industrial	9.6	8.3	9.5	8.2	-40	125	EVALSTDRV600HB8	Demonstration board kit for L638xE and L639x high-voltage gate drivers
L6389E	17	Undervoltage lockout, Interlocking function	Adjustable deadtime, Bootstrap diode	0.65	HIN, LIN	Industrial	9.6	8.3	9.5	8.2	-40	125	EVALSTDRV600HB9	Demonstration board kit for L638xE and L639x high-voltage gate drivers
L6390	20	Undervoltage lockout, Interlocking function, Comparator, Smart shutdown	Adjustable deadtime, Bootstrap diode, Operational amplifier	0.43	HIN, LIN, SD	Industrial	12	10.5	11.5	10	-40	125		
L6391	20	Undervoltage lockout, Interlocking function, Comparator, Smart shutdown	Adjustable deadtime, Bootstrap diode	0.43	HIN, LIN, SD	Industrial	12	10.5	11.5	10	-40	125		
L6392	20	Interlocking function	Adjustable deadtime, Bootstrap diode, Operational amplifier	0.43	HIN, LIN, SD	Industrial	12	10.5	11.5	10	-40	125		
L6393	20	Comparator	Adjustable deadtime, Bootstrap diode	0.43	SD	Industrial	9.5	8	9	8	-40	125	EVAL6393FB	Low voltage full bridge reference design board featuring L6393 advanced high-voltage gate driver
L6395	20	-	Bootstrap diode	0.43	HIN, LIN	Industrial	9.5	8.8	8.6	8	-40	125	EVALSTDRV600HB8	Demonstration board kit for L638xE and L639x high-voltage gate drivers
L6398	20	Interlocking function	Bootstrap diode	0.43	HIN, LIN	Industrial	9.5	8.8	9	8	-40	125	EVALSTDRV600HB8	Demonstration board kit for L638xE and L639x high-voltage gate drivers
L6399	20	Interlocking function	Bootstrap diode	0.43	HIN, LIN	Industrial	9.5	8	9	9	-40	125	EVALSTDRV600HB8	Demonstration board kit for L638xE and L639x high-voltage gate drivers
L6491	20	Interlocking function, Comparator, Smart shutdown	Adjustable deadtime, Bootstrap diode	4	HIN, LIN, SD	Industrial	9.3	8.7	8.6	8	-40	125	EVAL6491HB	Demonstration board for L6491 gate driver with smart shut down feature
L6494	20	Undervoltage lockout,	Adjustable deadtime, Bootstrap diode	2	HIN, LIN, SD	Industrial	9.3	8.7	8.6	8	-40	125	EVAL6494L	Demonstration board for L6494L gate driver
L6498	20	Undervoltage lockout, Interlocking function	Bootstrap diode	2	HIN, LIN, SD	Industrial	9.3	8.7	8.6	8	-40	125	EVAL6498L	Evaluation board for the L6498L gate driver
TD350E	26	Undervoltage lockout, Active Miller clamp, 2-level turn-off, Desaturation detection	-	2.3	-	Industrial	-	-	-	-	-40	125		
TD351	26	Undervoltage lockout, Active Miller clamp, 2-level turn-off	-	1.7	-	Industrial	-	-	-	-	-40	125		
TD352	26	Undervoltage lockout, Active Miller clamp, Desaturation detection	Adjustable deadtime	1.7	-	Industrial	-	-	-	-	-40	125		
STGAP2D	26	Shudown protection	Thermal Shutdown	4	SD	Industrial	9.1	8.4	-	-	-40	125	EVALSTGAP2DM	Demonstration board for STGAP2DM isolated half-bridge gate
STGAP1AS	36	Active Miller clamp, Desaturation detection, Overcurrent detection, 2-level turn-off, VCE overvoltage protection, Temperature warning, shutdown protection, Undervoltage lockout, Overvoltage lockout	Adjustable deadtime, Thermal Shutdown	5	SD	Automotive	4.1	3.8	-	-	-40	125	EVALSTGAP1AS	STGAP1AS evaluation board
STGAP2SM	26	Active Miller clamp, Shutdown protection	Thermal Shutdown	4	SD	Industrial	9.1	8.4	-	-	-40	125	EVALSTGAP2SM	Demonstration board for STGAP2SM isolated 4 A single gate
STGAP2SCM													EVALSTGAP2SCM	Demonstration board for STGAP2SCM isolated 4 A single gate driver

Signal conditioning

Operational amplifier

ST has a wide range of op amps, including both industry-standard and high-performance op amps. Our strengths include:

- Growing 16 V CMOS portfolio including precision and wide bandwidth op amps
- Reliable high-volume supplier of both standard and high-performance op amps
- Space-saving packages, such as DFN, QFN, SOT-23 and SC-70

Our JFET, bipolar, CMOS and BiCMOS technologies allow our products to support:

- A wide supply range, from 1.5 V to 36 V
- High ratios of performance-to-power consumption

Our automotive-grade products are AEC-Q100 qualified and tested with certified high-reliability flow, to meet the very specific, rigorous demands of the automotive market.

	Nano Power	Micro Power	Low Power	Zero Drift	Precision	Energy Effective	Fast
5 V	TSU	TSV6	TSV8	TSZ	TSV7	TSV5	TSV9
16 V		TSX6			TSX7	TSX5	TSX9
36 V		TSB6			TSB7	TSB5	TSB9*

AECQ-100 * In development

HIGHLIGHT: TSB712

- Dual amplifier
- Rail-to-rail input and output
- 6 MHz bandwidth
- 2.7 V to 36 V supply voltage
- Excellent precision
- Guaranteed input offset voltage of 300 µV max at 25 °C
- Perfectly suited for a wide variety of applications such as: active filters, motor control, actuator driving, hall effect sensors and resistive transducers

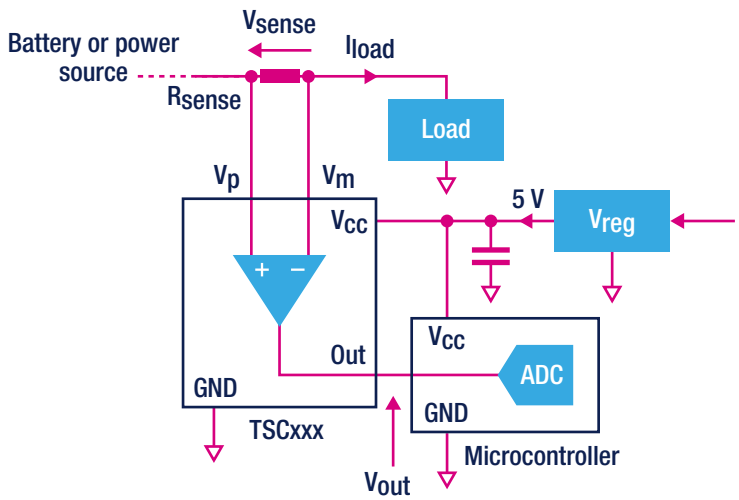
Applications	Features	Products
Low side current sensing	Precision, low Vio as good as 5 µV	TSZ121, TSV731, TSX711
Temperature sensing	Low power consumption as low as 580 nA	TSU101, TS941, TSV631, TSU111
Vibration sensing	High Bandwidth up to 20 Mhz	TSX9291, TSH22, TSV991
Angle measurement DC brushless motor	High output Current, > 100 mA	TSX561, TS982, TS507
High side current sensing	High Common-mode Voltage up to 70 V	TSC101, TSC102, TSC103
Data acquisition and instrumentation, Test and measurement equipments, Motor control, Industrial process control, Strain gauge	36 V Signal conditioning	TSB572, TSB611, TSB712, TSB7192

HIGH-SIDE CURRENT SENSING (TSC SERIES)

Accurate sensing of currents is central to enhancing application safety. Controlling the current within set boundaries avoids overheating and short circuits. Current measurement is also an essential part of energy metering.

The main features of our growing high-side current-sense amplifier portfolio are:

- Up to 70 V line monitoring
- Integrated solutions (for example, inclusion of EMI filtering on output) for faster design times and a reduced BOM
- Robust devices that do not require external protection
- Automotive-grade qualified current-sense amplifiers



HIGHLIGHT: TSZ181

- Very high accuracy and stability
- Offset voltage
- 25 µV max at 25 °C
- 35 µV max over full temperature range (-40 °C to + 125 °C)
- Gain bandwidth product: 3 MHz
- Low supply voltage: 2.2 V to 5.5 V
- Low power consumption: 1 mA max. at 5 V
- Save board space (no external trimming components)
- Accuracy virtually unaffected by temperature change
- Smallest package in the market: DFN8 (2 x 2 mm)
- Automotive-qualified variant

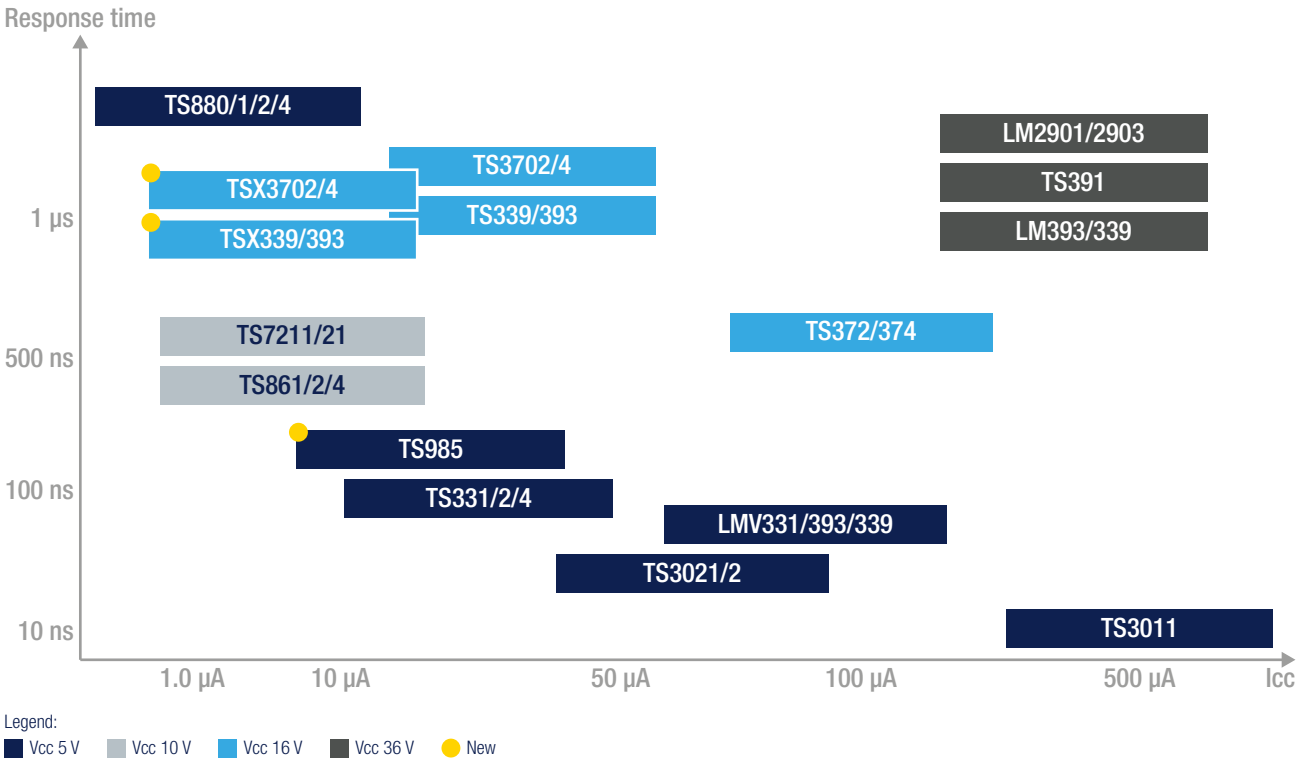
Order code	Description	Documentation
STEVAL-ISQ013V1	High-side current-sense amplifier demonstration board based on TSC101	AN3222
STEVAL-ISQ007V1	Low-side current sensing based on TS507	AN2727
STEVAL-ISQ014V1	Low side current sensing based on TSZ121	UM1737

COMPARATORS

ST is a leading supplier of comparators, and our portfolio offers:

- High-speed comparators, with response times as fast as 8 ns
- Micropower comparators with operating currents as low as 210 nA
- High-temperature (150 °C) qualified devices
- Guaranteed specified min/max electrical performances

Our automotive-grade products are AEC-Q100 qualified and tested with certified high-reliability flow, to meet the very specific, rigorous demands of the automotive market.



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Order code: RGMC0219

For more information on ST products and solutions, visit www.st.com/motorcontrol