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High voltage solutions for 10 kW motor drives

STMicroelectronics



High voltage solutions for 10 kW motor drives

Overview



ACEPACK* Power Modules



STGAP Isolated Gate Drivers



Evaluation Boards & Tools



High voltage solutions for 10 kW motor drives

Overview

What is a drive?

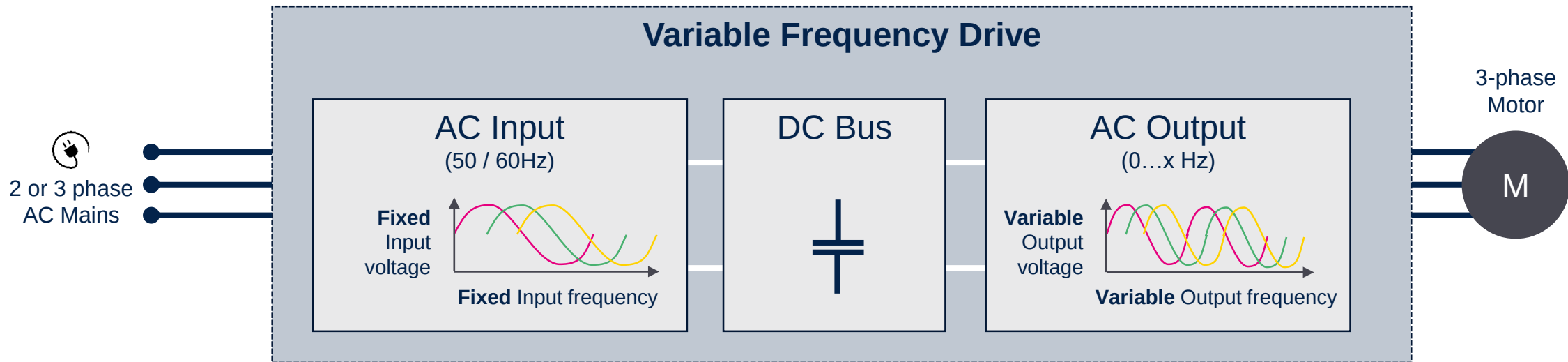
Simplified Block Diagram

Products Overview

What is a drive?

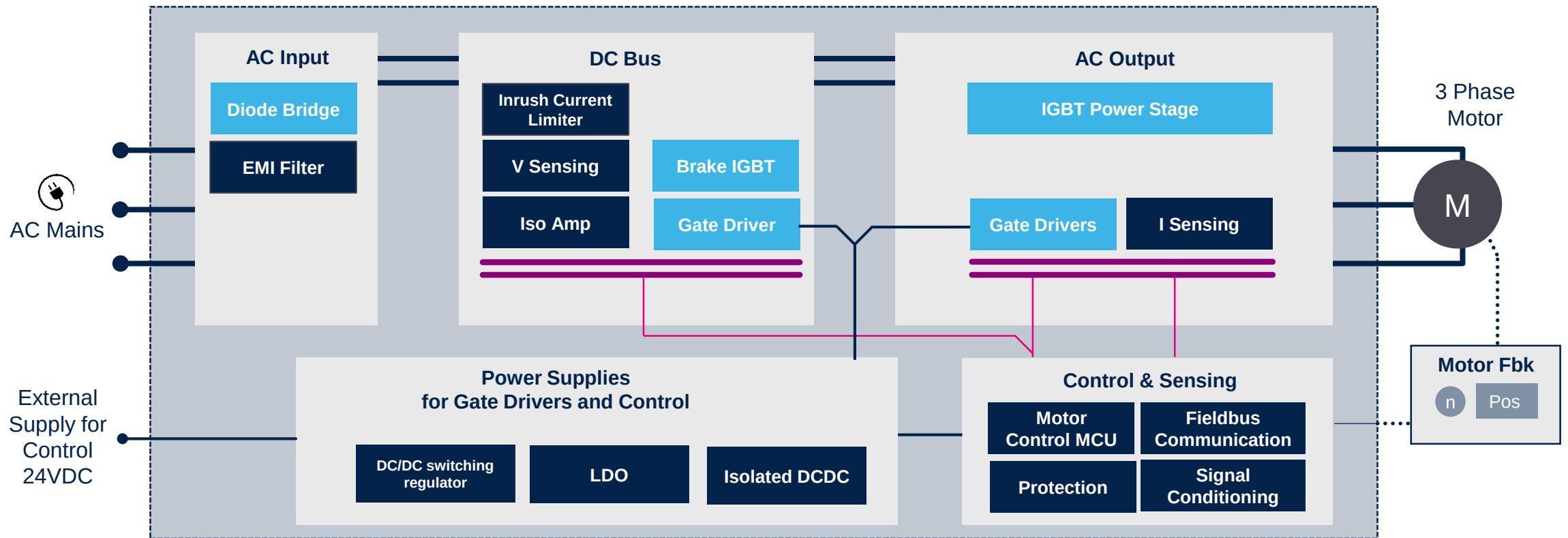
Variable Frequency Drive (VFD)

- **Converts static** frequency & **static** voltage to **variable** frequency & **variable** voltage
- **Controls motion** of an electric motor **by varying frequency and voltage**
- **AC-to-AC Converter**



10 kW variable frequency drive simplified block diagram

Variable Frequency Drive (VFD)





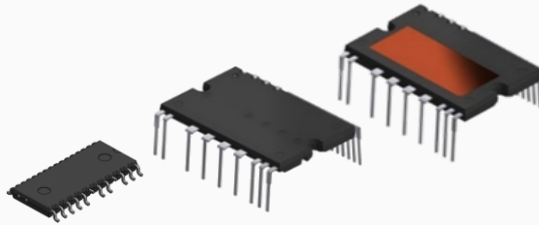
ST Power Products Portfolio Overview

Analog & Power Solutions for Industrial Motor Control



Discrete, ICs, Drivers & SiP

Typical Power: 10W ÷ 5kW



SLLIMM* IPM

Typical Power: 20W ÷ 3kW



ACEPACK* Power Modules

Typical Power: 3kW ÷ 20kW

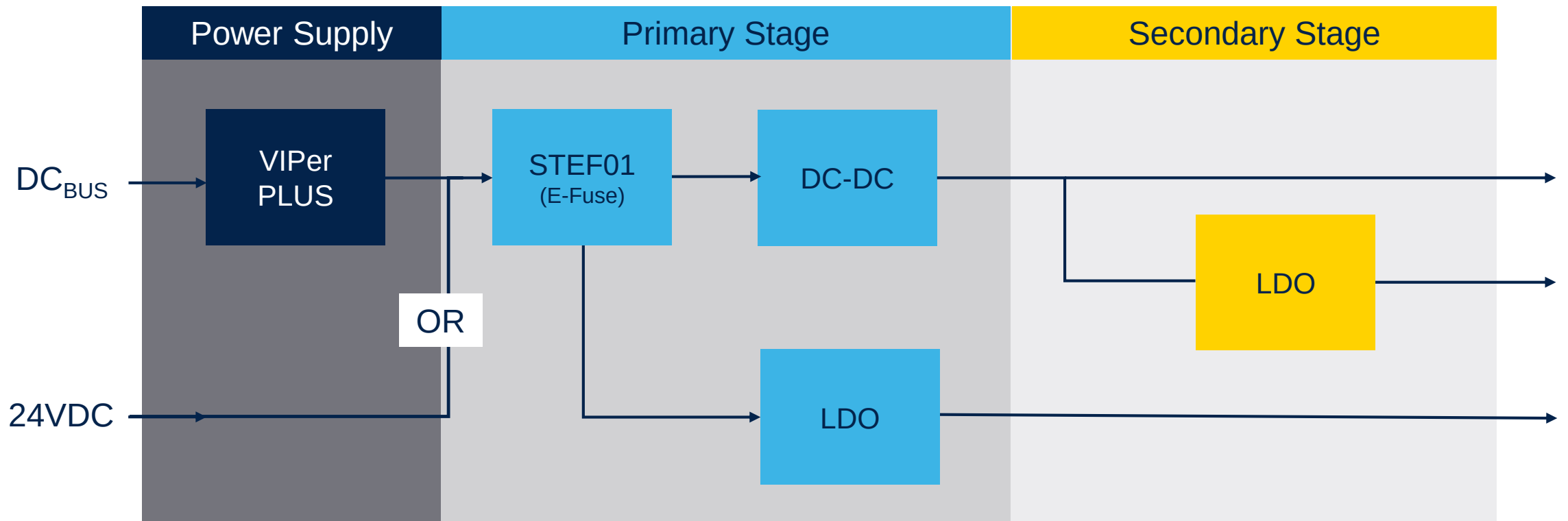


Ideal solutions for:

Industrial & Robotic Drives, Home Appliances, Welding, Pumps, Fans & Blowers, Air Conditioning

Power management products

Typical topology overview

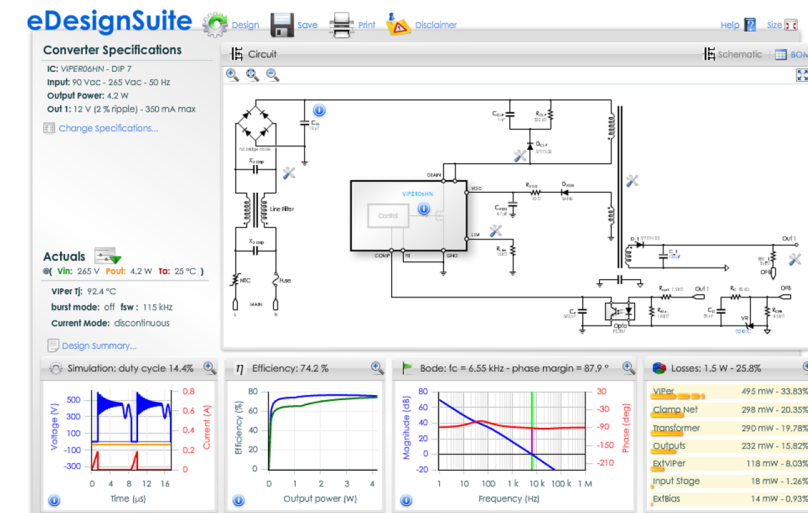
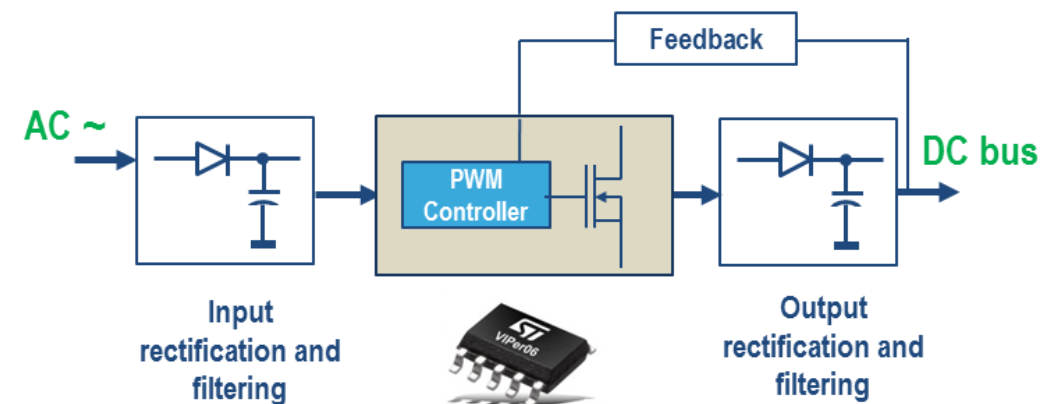




Power management VIPerPlus family

HV Converters for auxiliary SMPS

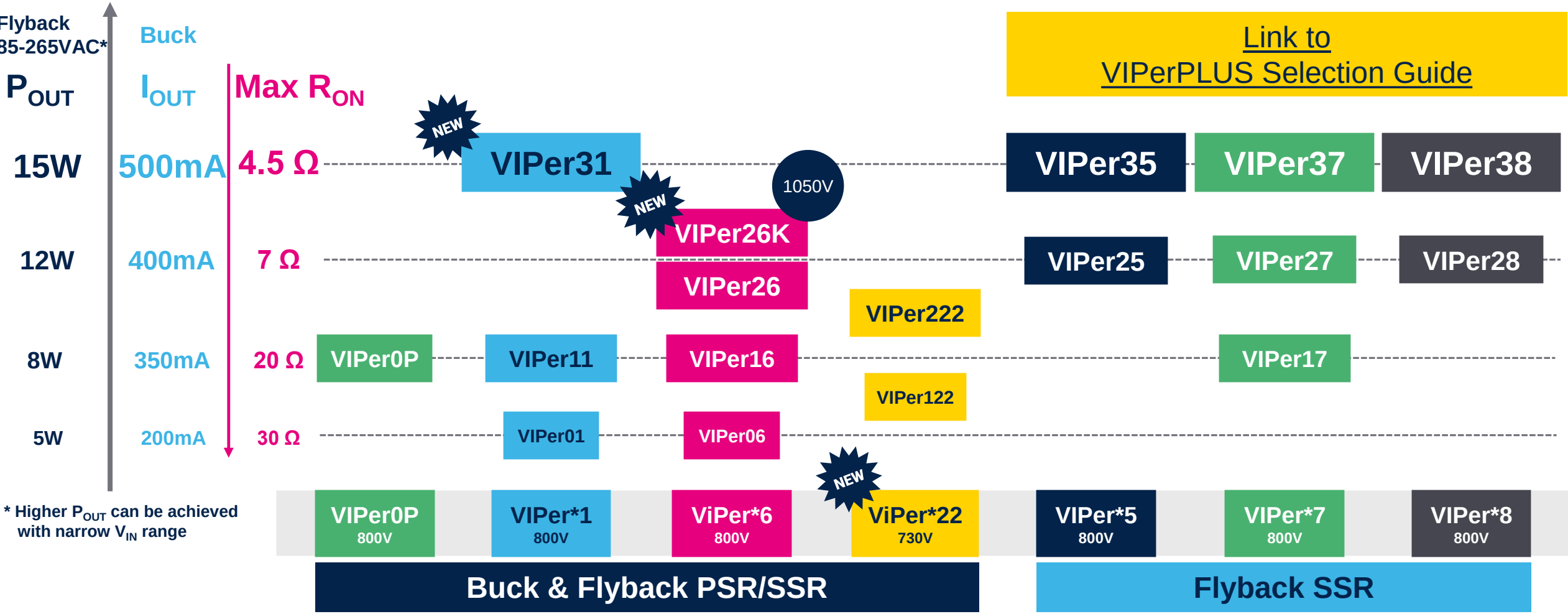
- Converters for auxiliary power supplies up to 15-20W
- Embedded 800V avalanche-rugged power MOSFET
- Suitable for
 - Buck
 - buck-boost
 - flyback with secondary or primary side regulation (SSR & PSR)
- Best-in-class energy saving
- Low EMI & BOM optimization
- Online simulation tool for easy design ([eDesignSuite](#))





Power management VIPerPlus family

[Link to
VIPerPLUS Selection Guide](#)

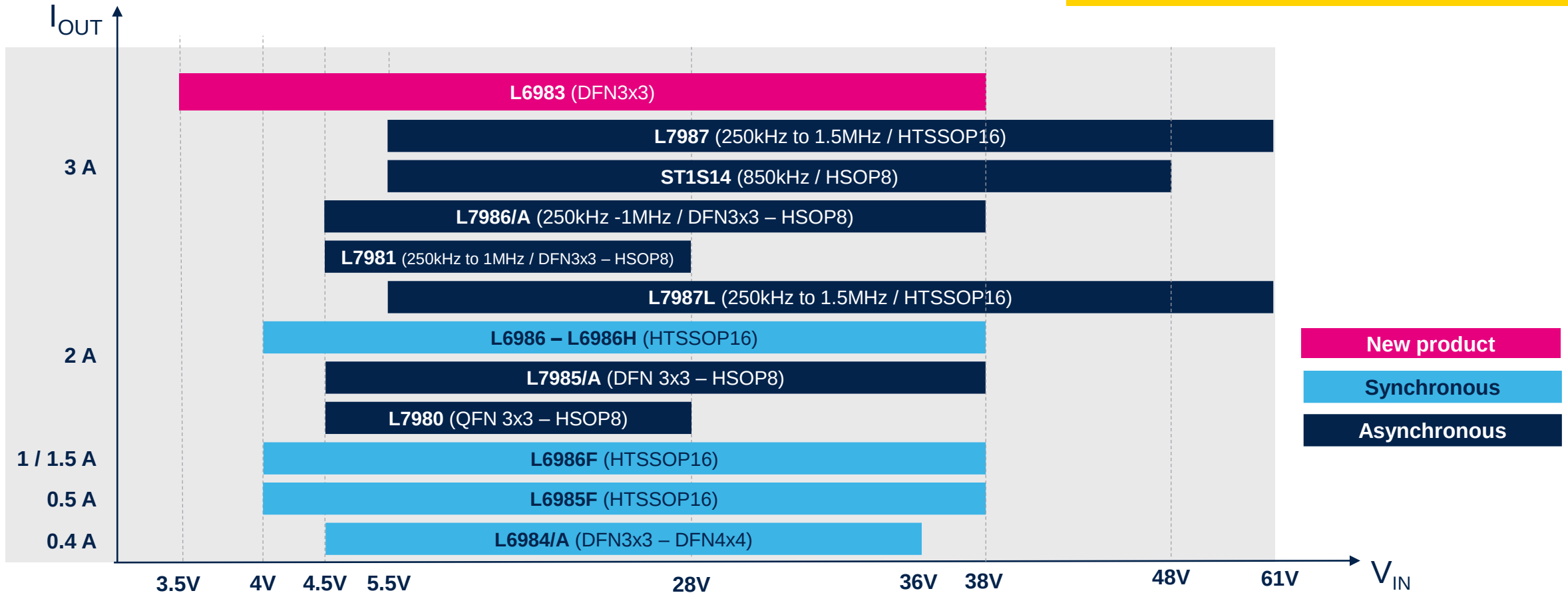


* Higher P_{OUT} can be achieved with narrow V_{IN} range

Power management

DC-DC Converters high input voltage

[Link to
Quick Reference Guide](#)

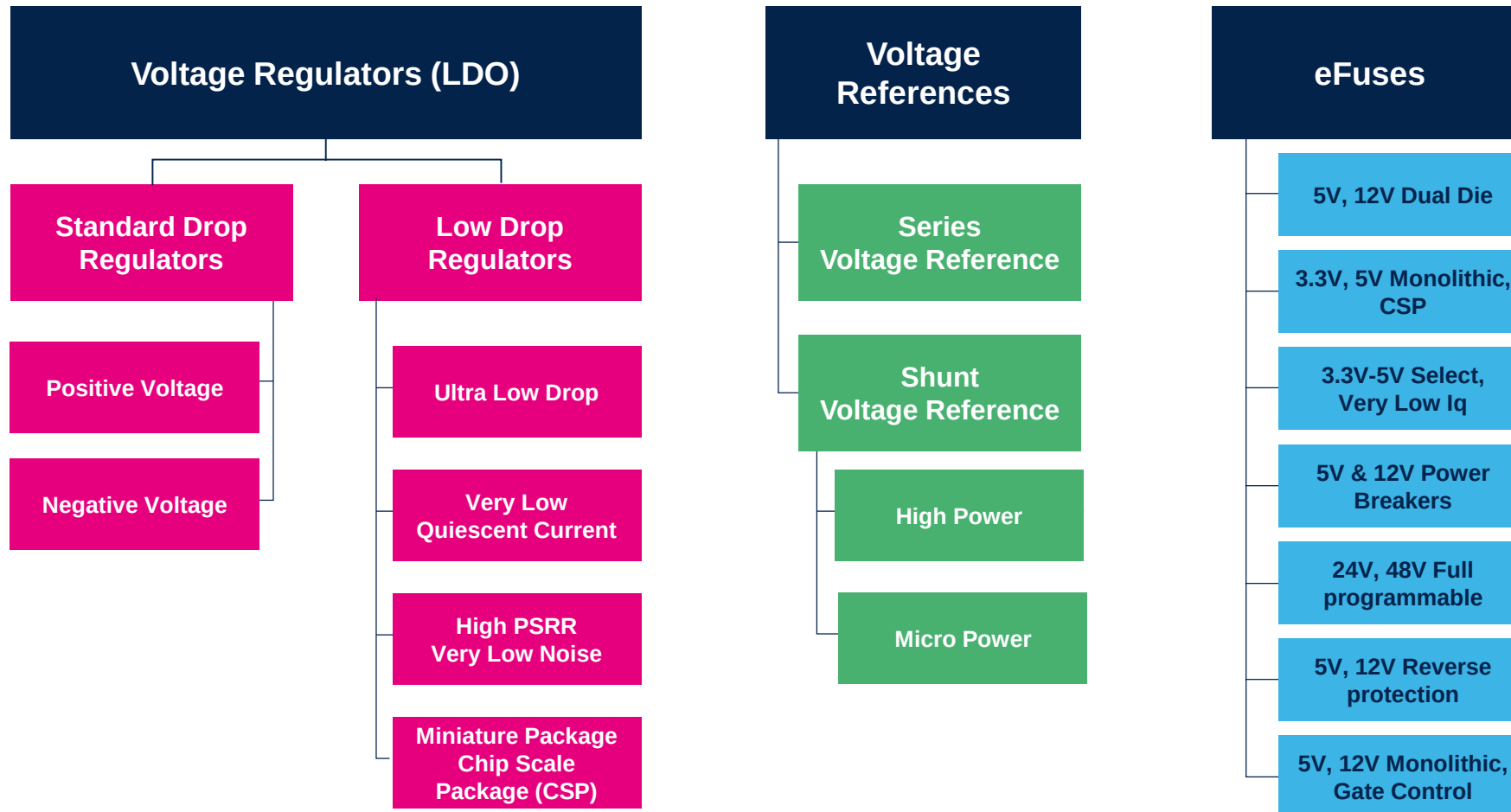


Power management

Linear Vreg, Vref & eFuse portfolio overview

More than 110 part numbers available

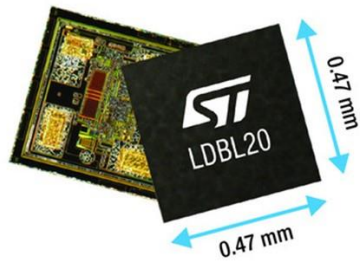
[Link to
E-Fuse Reference Guide](#)



Power management high performance LDOs – product highlights

Tiny package

Miniaturized package for space saving



LDBL20

World's smallest LDO
0.47 x 0.47 mm

[Link to
LDO Quick Reference Guide](#)

Ultra Low-Dropout

When system efficiency
and minimum power dissipation are key

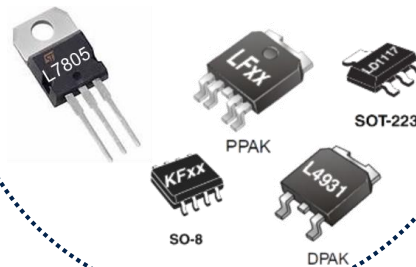
- LD59150: 1.5A, 65mV drop LDO, AG
- LD39200: 2A, 130mV drop LDO
- LD56050: 0.5A, 80mV drop LDO
- LD57100: 1A, 50mV drop LDO
- LDO40L: 0.4A, 140mV drop LDO, AG

Low noise, high PSRR

Extremely clean output voltage
Suitable for sensitive loads

- LD56100: 1A, 13µV RMS noise, Low drop
- LDLN025: 250mA, 6.5 µV RMS
- LDLN030: 300mA, 7.5 µV RMS, 80dB PSRR
- LD56020: 200mA, 8.8 µV RMS, 90dB PSRR Low Vin

From the leader in industry standard
(L78/9/317, LD1117)
and power packages (TO220)

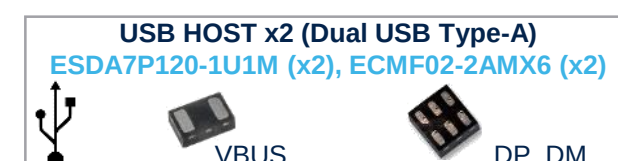
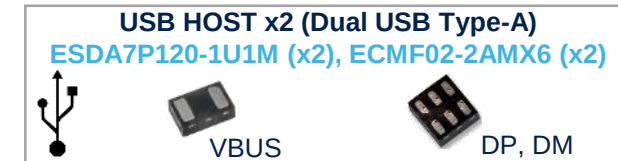
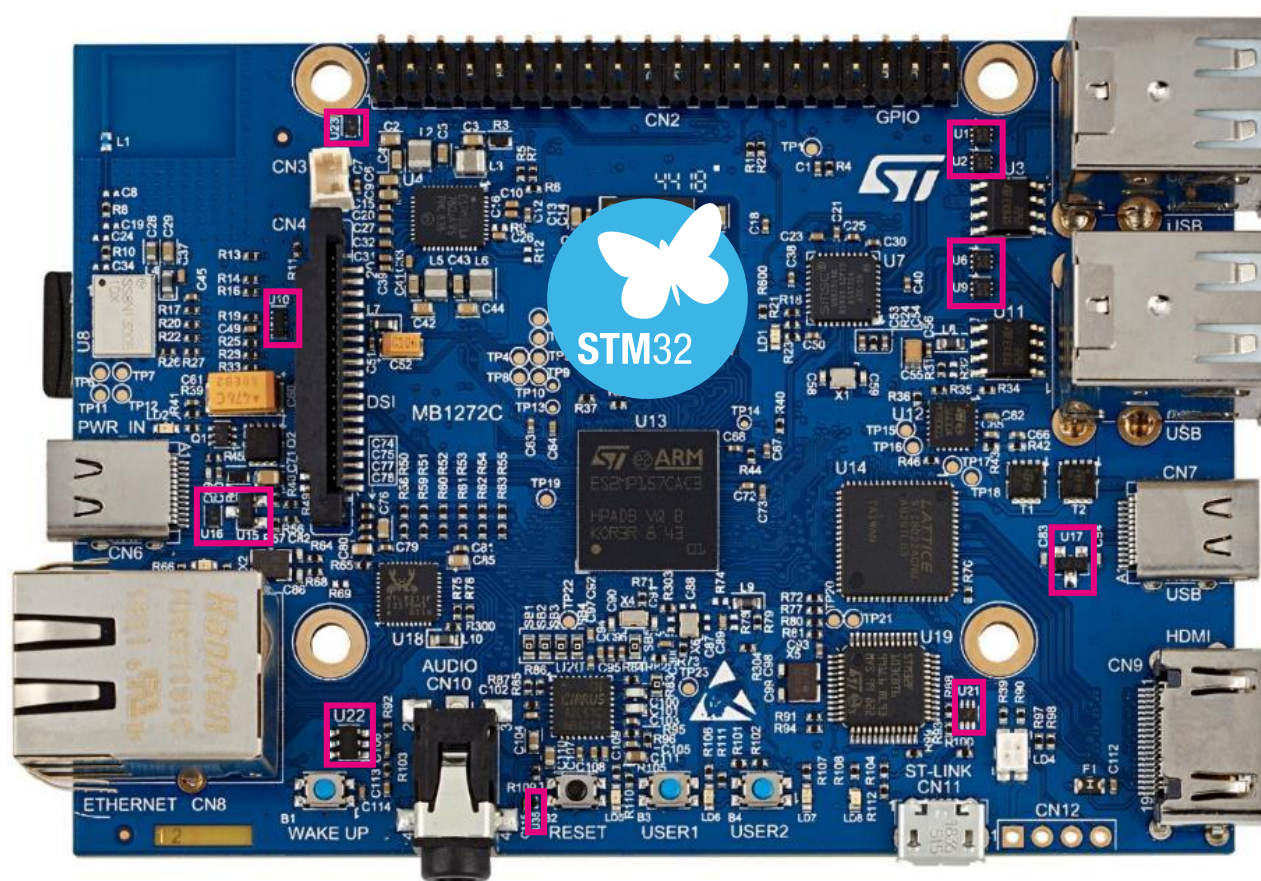


Low Quiescent Current

Minimum supply current without sacrificing
performance

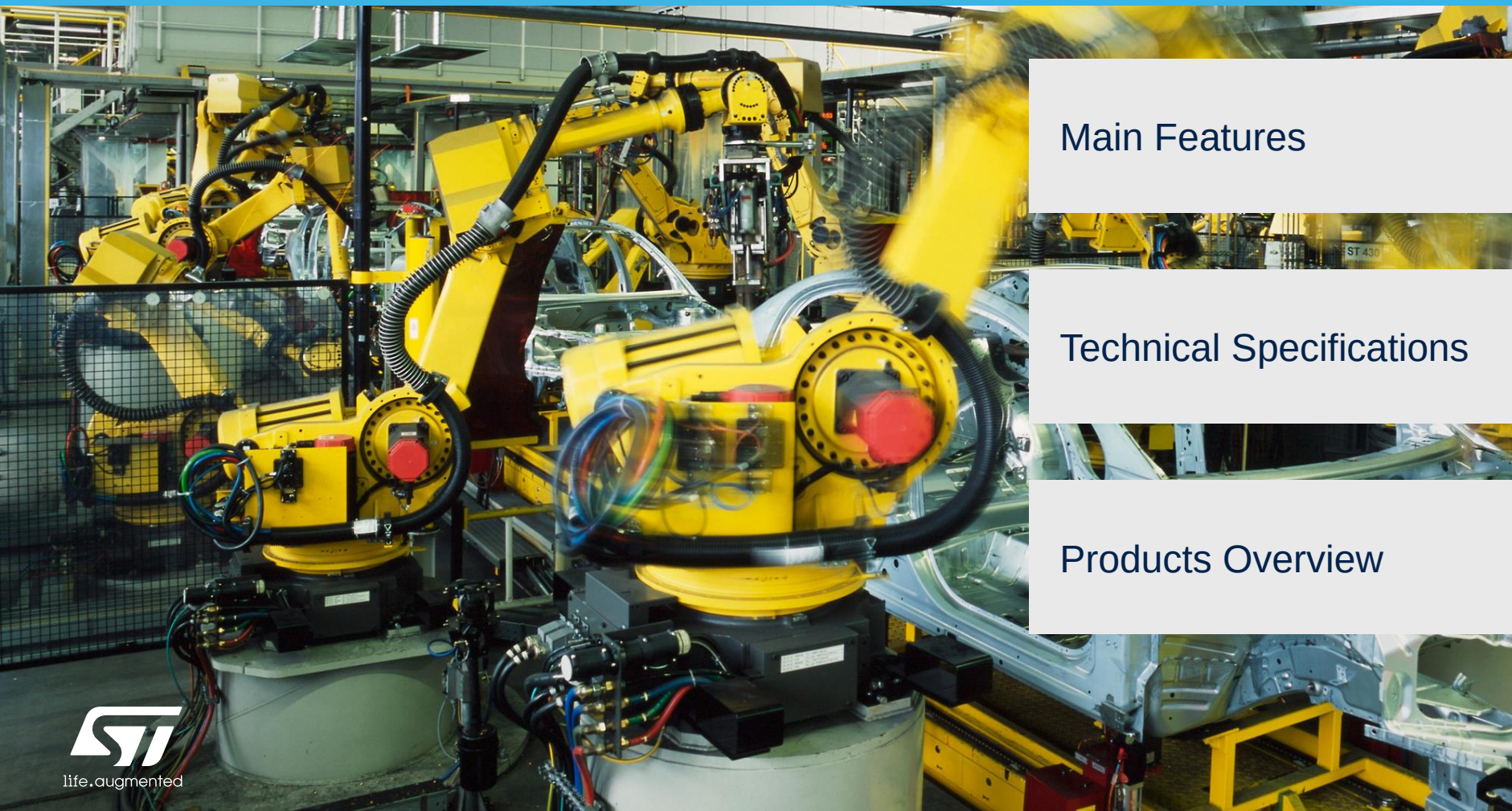
- STLQ020: 200mA, 0.3µA Iq LDO
- LD39130S: 300mA, 1µA Iq LDO

ESD protections around the microcontroller



High voltage solutions for 10kW motor drives

ACEPACK™ Power Modules

A large yellow industrial robotic arm is shown in a factory setting, working on a car body. The arm is mounted on a base and has various cables and hoses connected to it. The background shows other industrial equipment and a factory floor.

Main Features

Technical Specifications

Products Overview



ACEPACK* power modules

Flexible Package with High Current Density



Solder-Pin & Press-Fit pin options

Up to 1200 V Breakdown Voltage

Easy mounting

Modules include power switches and NTC

Several current ratings available



Available in CIB and Sixpack topology

High reliability and robustness

Low stray inductance Module design

Compact design for a cost effective system approach

High power density

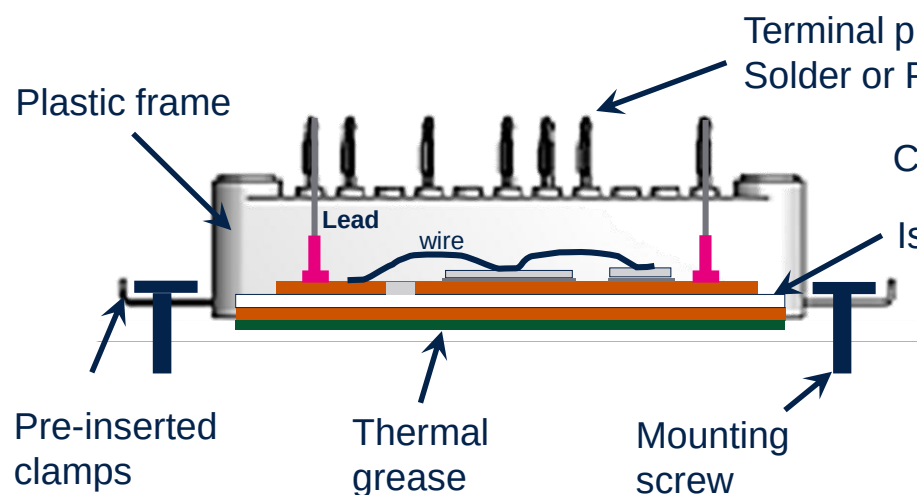




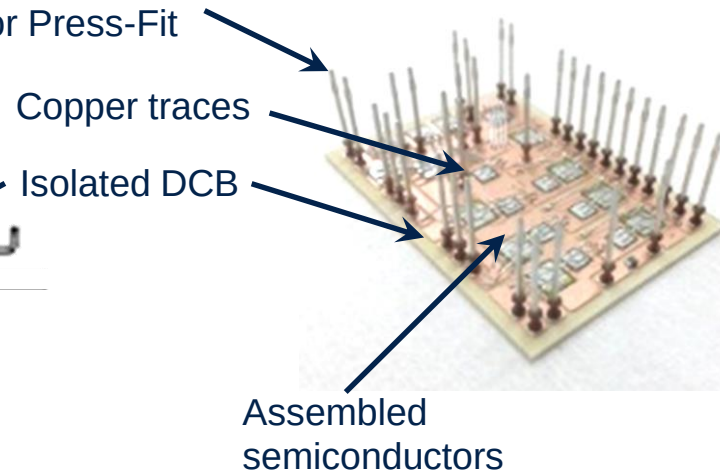
ACEPACK* power modules package technology

Built from DBC, high current pins and plastic housing

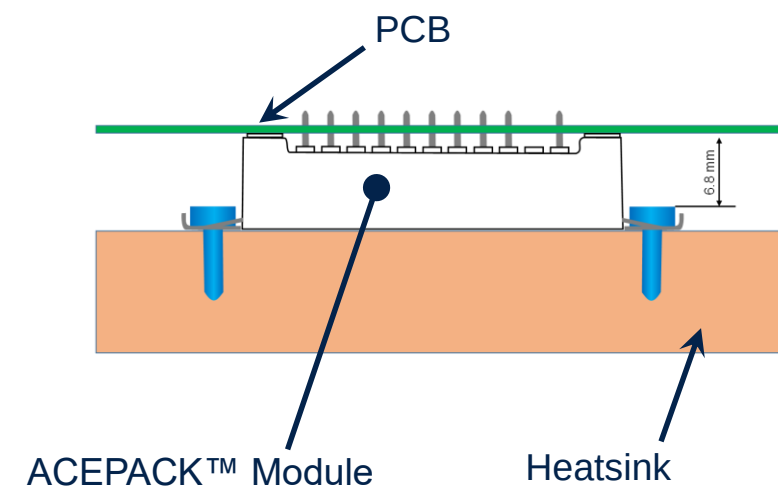
ACEPACK™ assembly structure



DBC internal view



Assembled module

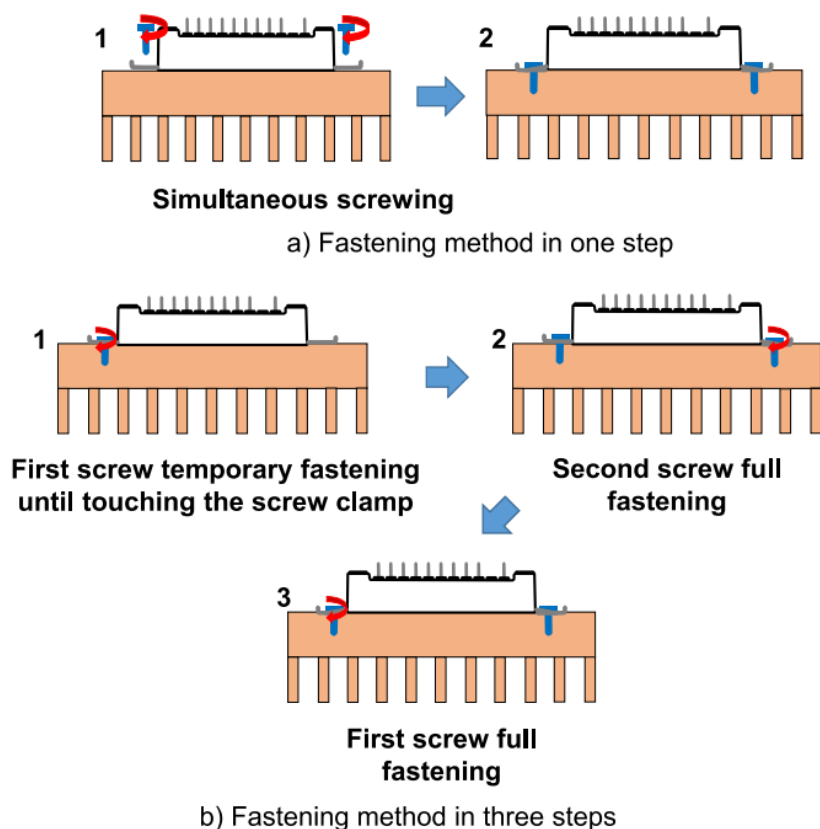


Housing provides best-in-class technology standards

ACEPACK* power modules

Easy mechanical assembly

Heatsink mounting



Press-Fit or Soldering mounting



PCB requirements

	Min	Typ	Max	Unit
Hole drill diameter	1.12	1.15	-	mm
Copper thickness in hole	> 25		< 50	µm
Metallization in hole			< 15	µm
End hole diameter	0.94		1.09	mm
Copper thickness of conductors	35	70 - 105	400	µm
Metallization of circuit board	Tin (chemically)			
Metallization of pin	Tin (galvanic)			

Technical Note

For more details, please check the Technical Note [TN1250](#)



TN1250
Technical note

Press-fit ACEPACK™ power modules mounting instructions



ACEPACK* power modules

Qualified according to industrial standards

Test	PC	Std ref.	Conditions	SS	Steps
Die Oriented Tests					
TEST		User specification	All qualification parts tested per the requirements of the appropriate device specification.		
External visual		JESD22 B-101	All devices submitted for testing		
HTRB	N	JESD22 A-108	T _j = 125°C, BIAS = 960V T _j = 125°C, BIAS = 520V	25	1000 h
HTGB	N	JESD22 A-108	T _j = 125°C, BIAS = 30V	25	1000 h
HTSL	N	JESD22 A-102	TA = 125°C	25	1000 h



Test	PC	Std ref.	Conditions	SS	Steps
Package oriented test					
H3TRB	N	JESD22 A-101	TA=85°C ; RH=85% BIAS = 100V	35	1000 h
AC	N	JESD22 A-102	Pa=2Atm / Ta=121°C	35	96 h
TC	N	JESD22 A-104	Ta = -40°C to 125°C	50	500 cy
PwCy	N	Mil-Std 750D Method 1037	ΔT _j ≥100°C , I _{max} =75A (A2P75S12) I _{max} =35A (A1P35S12) I _{max} =15A (A1C15S12)	15	200Kcy
IOL	N		ΔT _c =60°C (ΔT _j ≥100°C) , I _{max} =75A , Ton=1sec / toff=39sec	15	10Kcy
ESD		ESDA-JEDEC JES-001 ANSI-ESD S5.3.1	HBM	9	
Vibration Test		JESD22 B-103	VIBRATION: a=3g; f=5/500Hz; 4' x 3 orientat. x 4cycles		

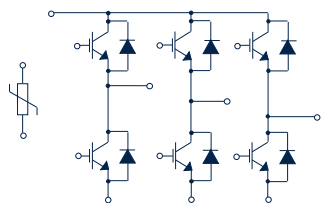




ACEPACK* power modules

Product portfolio

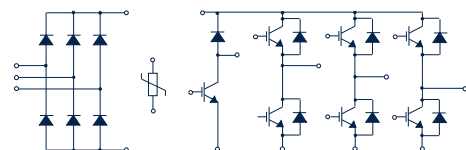
Available in Solder-Pin and Press-Fit pin options



Sixpack + NTC



ACEPACK 1



CIB + NTC



ACEPACK 2



Part Number	Topology	V _{CES}	I _C rating
A1P25S12M3/-F	Sixpack	1200V	25A
A1P35S12M3/-F			35A
A1C15S12M3/-F	Converter Inverter Brake	1200V	15A
A1P50S65M2/-F	Sixpack	650V	50A

Part Number*	Topology	V _{CES}	I _C rating
A2C25S12M3/-F	Converter Inverter Brake	1200V	25A
A2C35S12M3/-F			35A
A2P75S12M3/-F	Sixpack	1200V	75A
A2C50S65M2/-F	Converter Inverter Brake	650V	50A



High voltage solutions for 10kW motor drives

STGAP Isolated Gate Drivers

Portfolio Overview

STGAP2S, Industrial single gate drivers

STGAP2, Industrial dual gate drivers



Gate drivers for motor control

Portfolio overview

A differentiated portfolio for a wide range of applications

Electric/ Hybrid vehicles

600/1200 V Inverters



Server, UPS



Compressors



Factory Automation



White goods



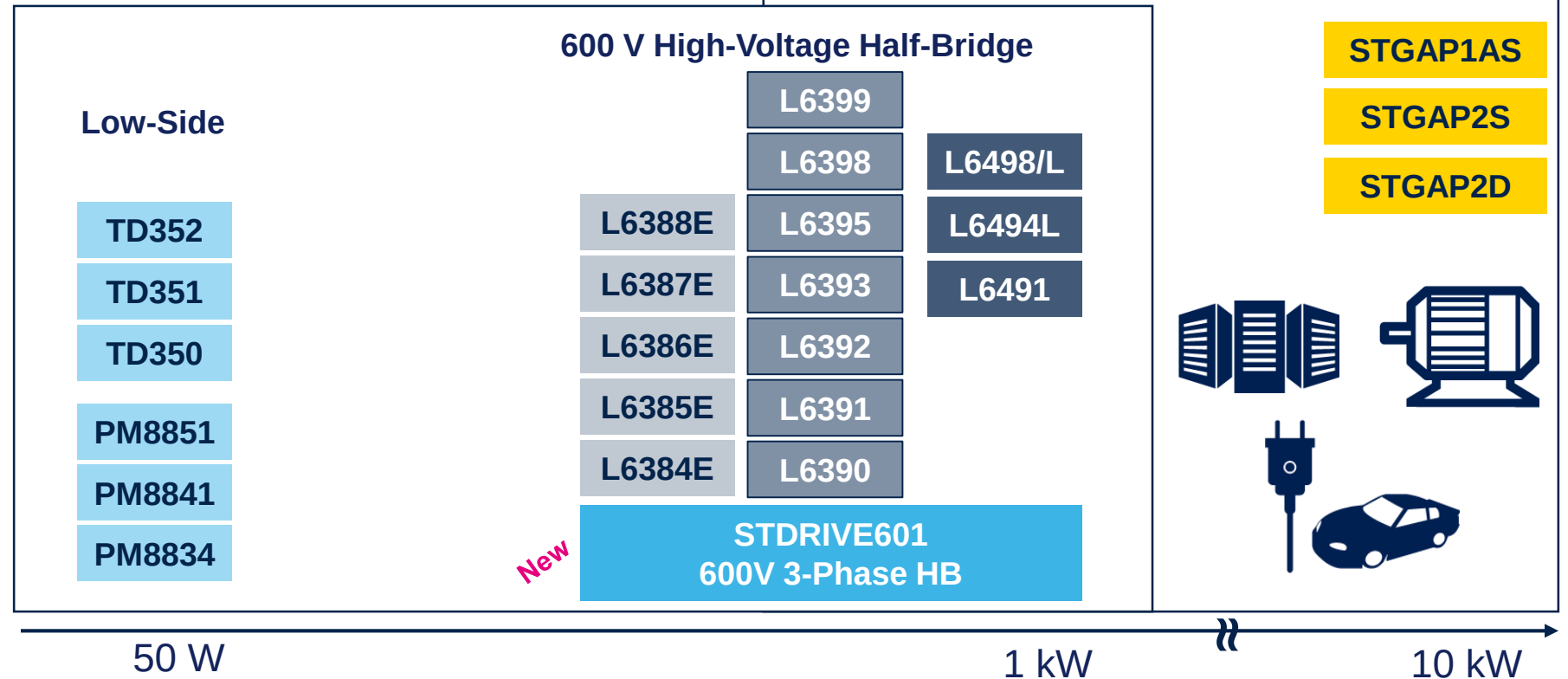
Solar



E-bikes



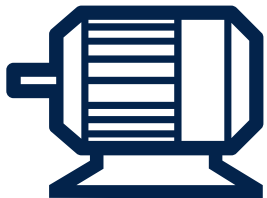
Galvanic Isolated Drivers





Isolated gate drivers for motor control STGAP2S & STGAP2D

Different flavors for different needs



STGAP2S

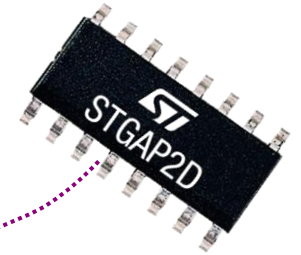
- 1.7kV Isolation
- 4A sink and source current
- Single channel
- Active Miller Clamp or G_{ON}/G_{OFF} pins

SO8N

STGAP2D

- 1.7kV Isolation
- 4A sink and source current
- Dual channel
- Compact layout
- Industrial grade

SO16N



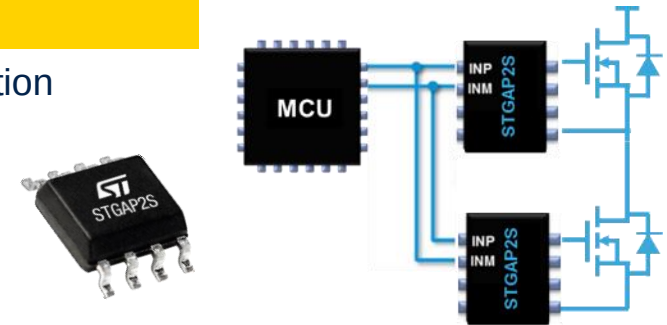


Isolated gate drivers for motor control STGAP2S

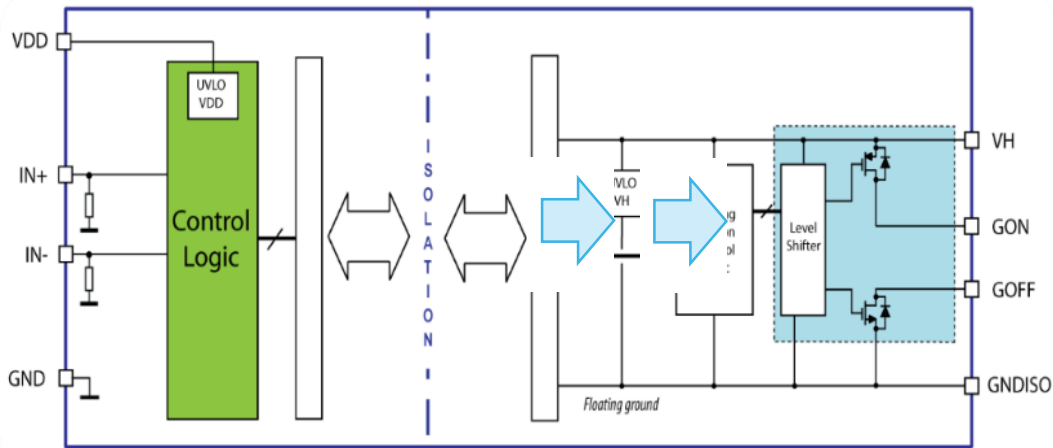
Galvanically Isolated Single Gate Driver, 1700V, 4A

- High voltage rail up to 1700 V
- 4 A Sink/Source current capability
- Up to 26 V supply voltage
- Short propagation delay: 80 ns
- Active High & Active Low input pins, for HW interlocking

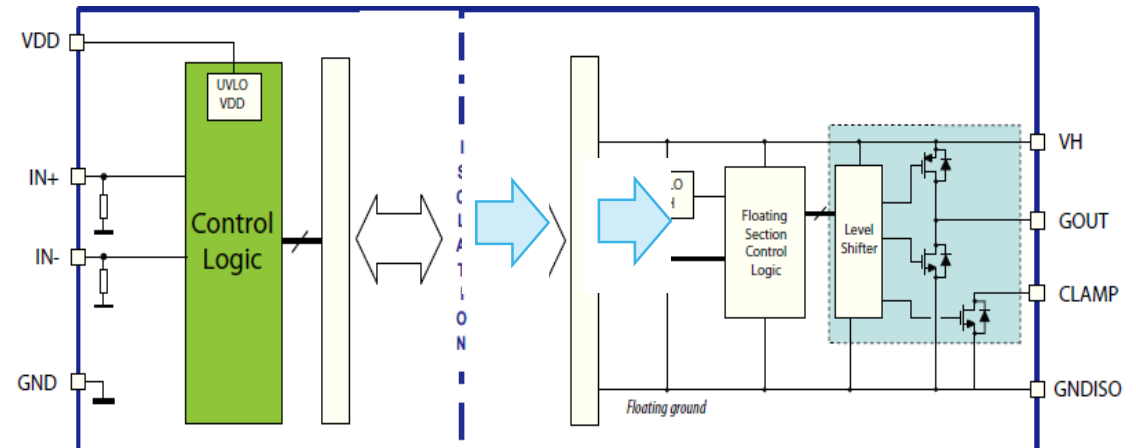
- Temperature shut-down protection
- 100 V/ns CMTI
- Negative gate drive ability
- UVLO Function
- Stand-by function
- SO8 Package



STGAP2SM: separated outputs option for easy gate driving tuning



STGAP2SCM: Miller clamp pin option to avoid induced turn-on





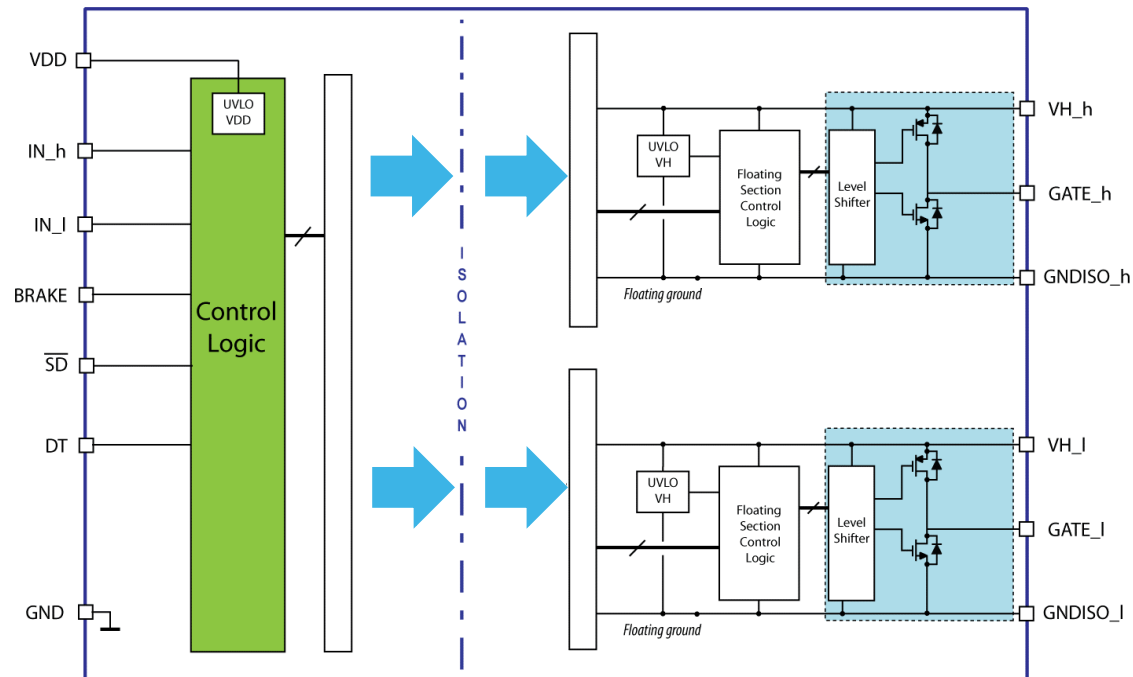
Isolated gate drivers for motor control

STGAP2D

Galvanically Isolated Dual Gate Driver, 1700V, 4A



- High voltage rail up to 1700 V
- 4 A Sink/Source current capability
- Up to 26 V supply voltage
- Short propagation delay: 80 ns
- UVLO Function
- Stand-by function
- 100 V/ns CMTI
- Single input pin, in phase with output
- Shut-Down SD pin, with integrated pull-down
- BRAKE pin
- Interlocking
- Negative gate drive ability
- Temperature shut-down protection
- SO16 Package

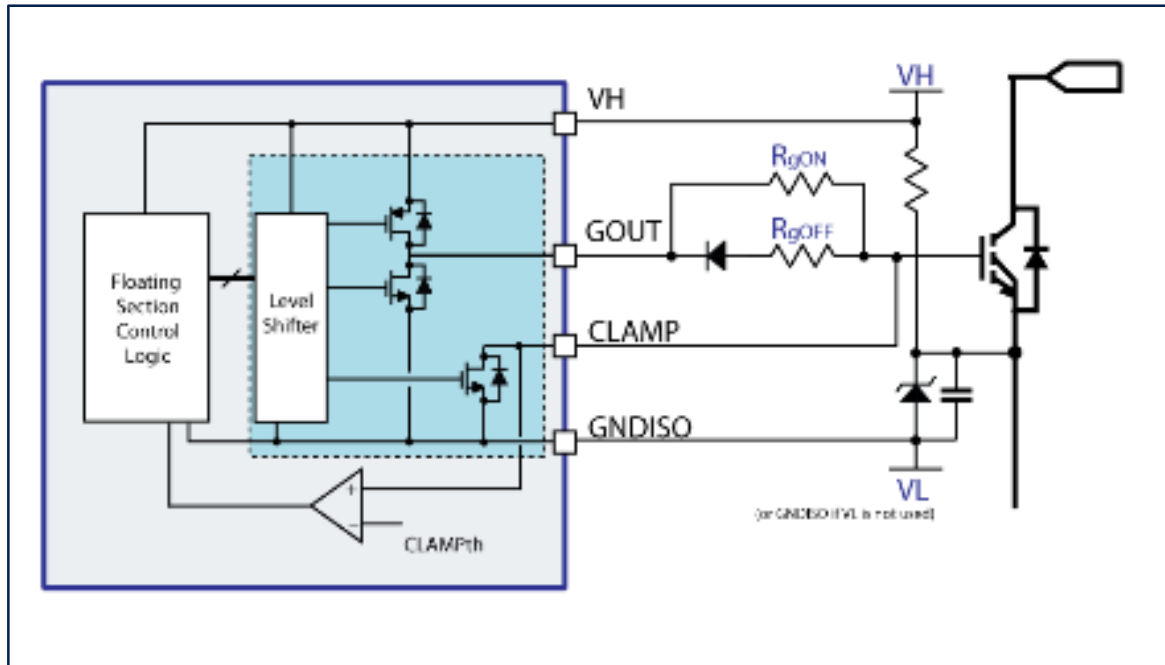




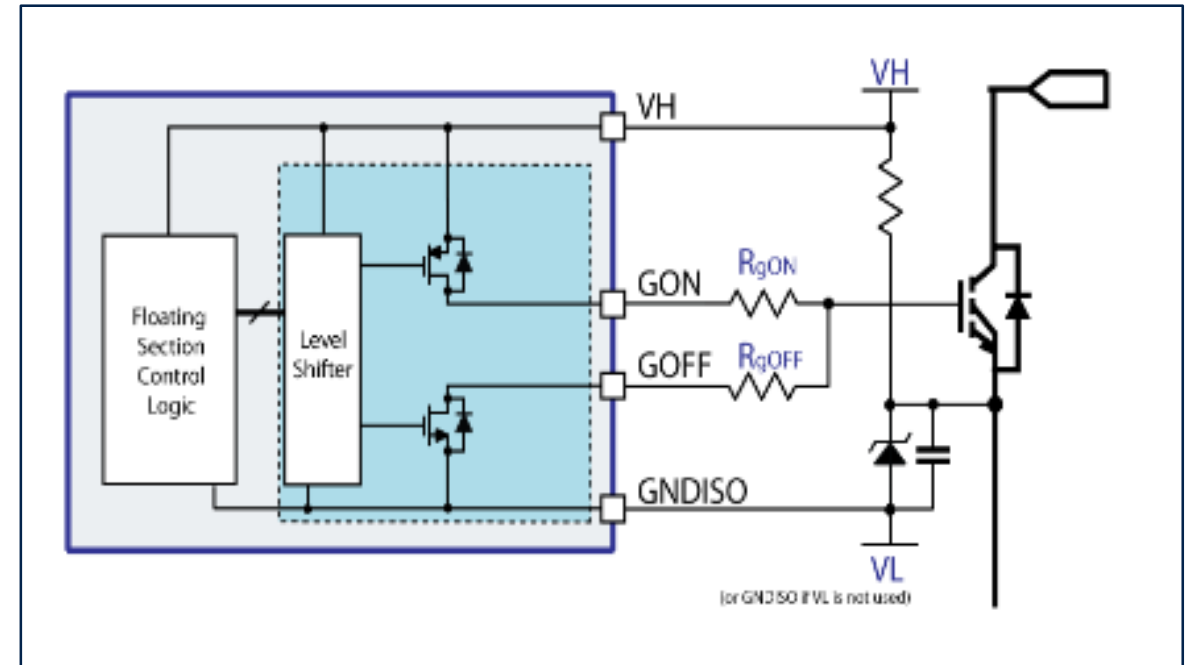
Isolated gate drivers for motor control

STGAP2 allows negative gate driving

Galvanically Isolated Gate Drivers, 1700V, 4A



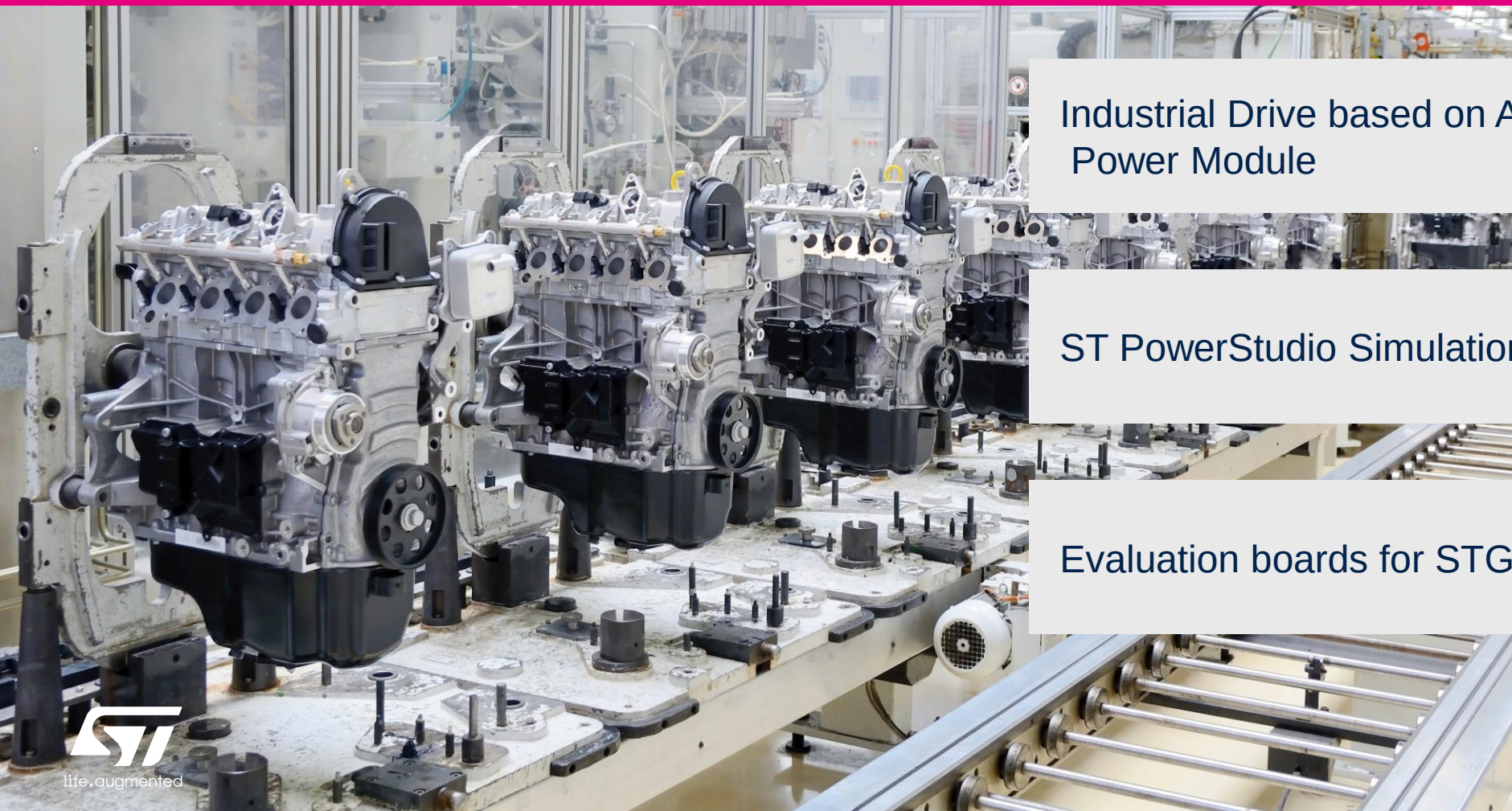
Option 1:
Single output and Miller clamp



Option 2: Separated gate_{ON} and gate_{OFF} pins

High voltage solutions for 10kW motor drives

Evaluation Boards and Tools

A photograph showing a row of industrial motor drives on a factory floor. The drives are silver and black, with various components and wiring visible. They are mounted on a metal frame.

Industrial Drive based on ACEPACK*
Power Module

ST PowerStudio Simulation Tool

Evaluation boards for STGAP gate drivers



ACEPACK* power module tools STEVAL-HKI001V2

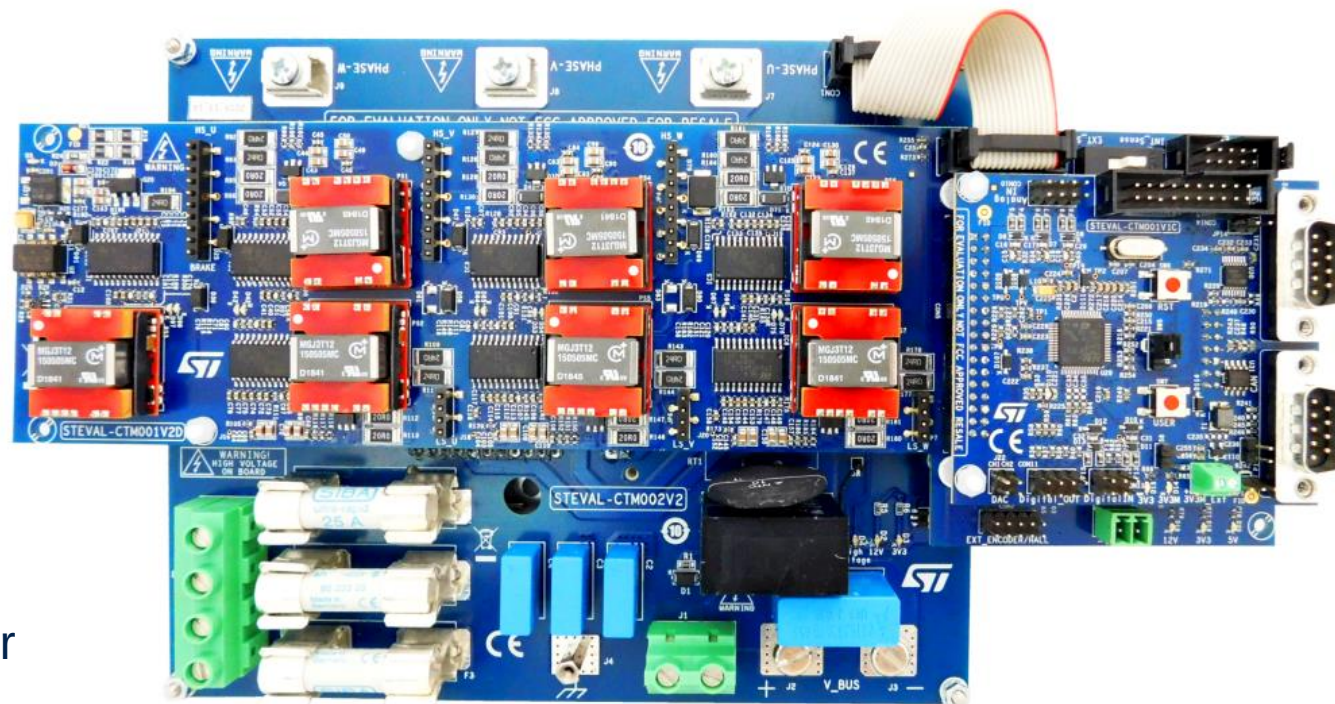
Industrial Drive based on ACEPACK 2 Power Module

Features:

- 3-phase AC-Input and Output
- Overvoltage and Overcurrent protection
- Fully compatible with STM32 Ecosystem
- RS232 and CAN communication interfaces

Key products:

- A2C35S12M3-F ACEPACK Power Module
- STGAP1AS Galvanically isolated Gate Driver
- STM32F303RB STM32 Microcontroller



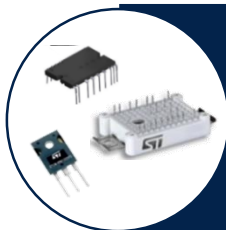
STEVAL-HKI001V2



ACEPACK* power modules tools

ST PowerStudio

Thermal-electrical Simulation Tool



Developed for:

- SLLIMM* IPM and ACEPACK modules
- Windows
- Languages: English, Chinese and Japanese



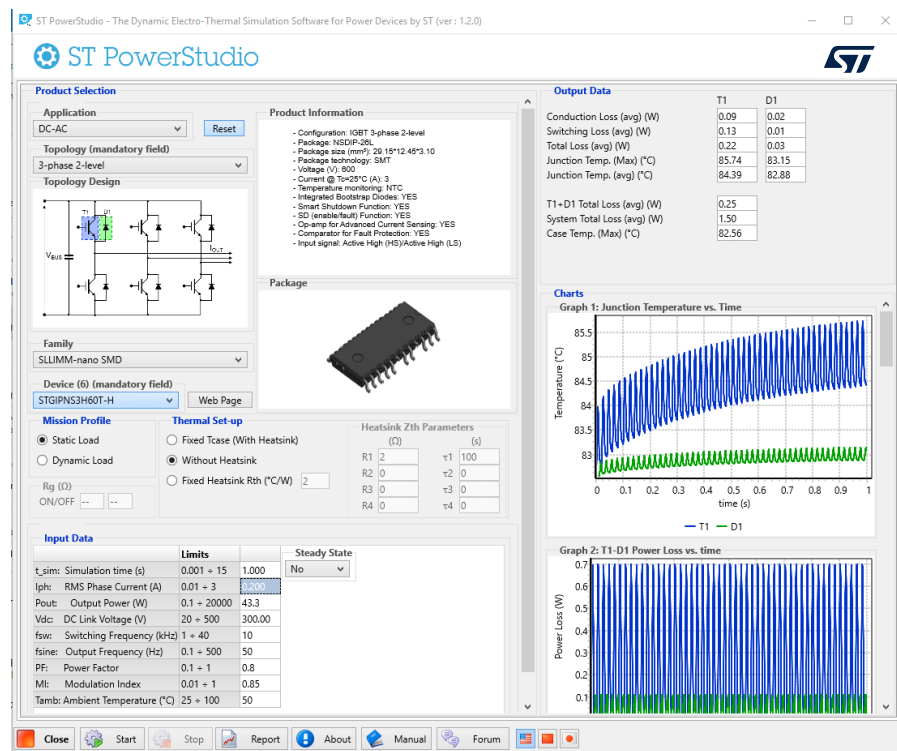
Powerful and flexible:

- Dynamic load simulation (up to 10 steps)
- Long mission profile duration of hours
- Flexible thermal setup



Connectivity:

- Quick link with st.com documents
- PDF Output Report



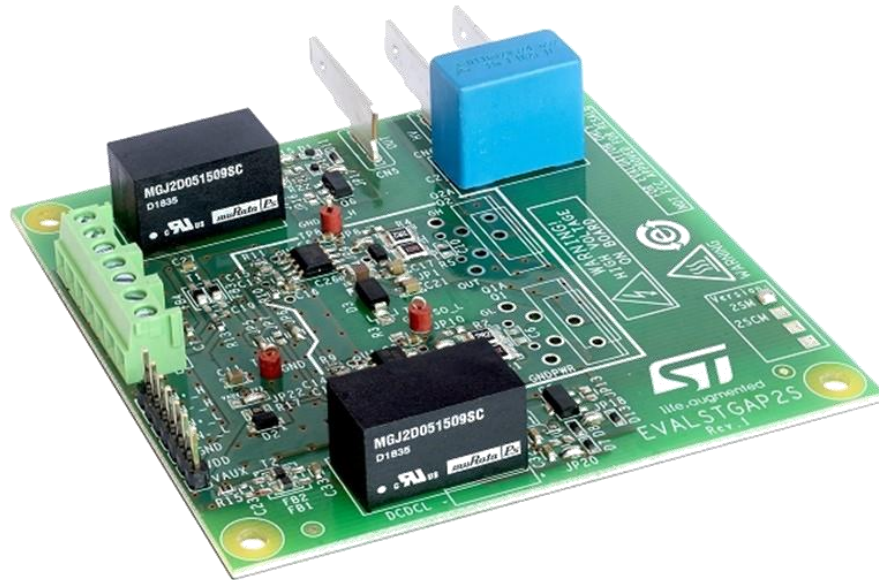
st.com/powerstudio





Isolated gate drivers for motor control STGAP2 evaluation boards

Drive 650V and 1700V Si/SiC MOSFETs & IGBTs



EVALSTGAP2SM and EVALSTGAP2SCM

Half-bridge topology, 2x STGAP2S in SO8N

- With separated output pins (SM)
- With Miller Clamp pin (SCM)



EVALSTGAP2DM

Half-bridge topology, 1x STGAP2D in SO16N

Thank you

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