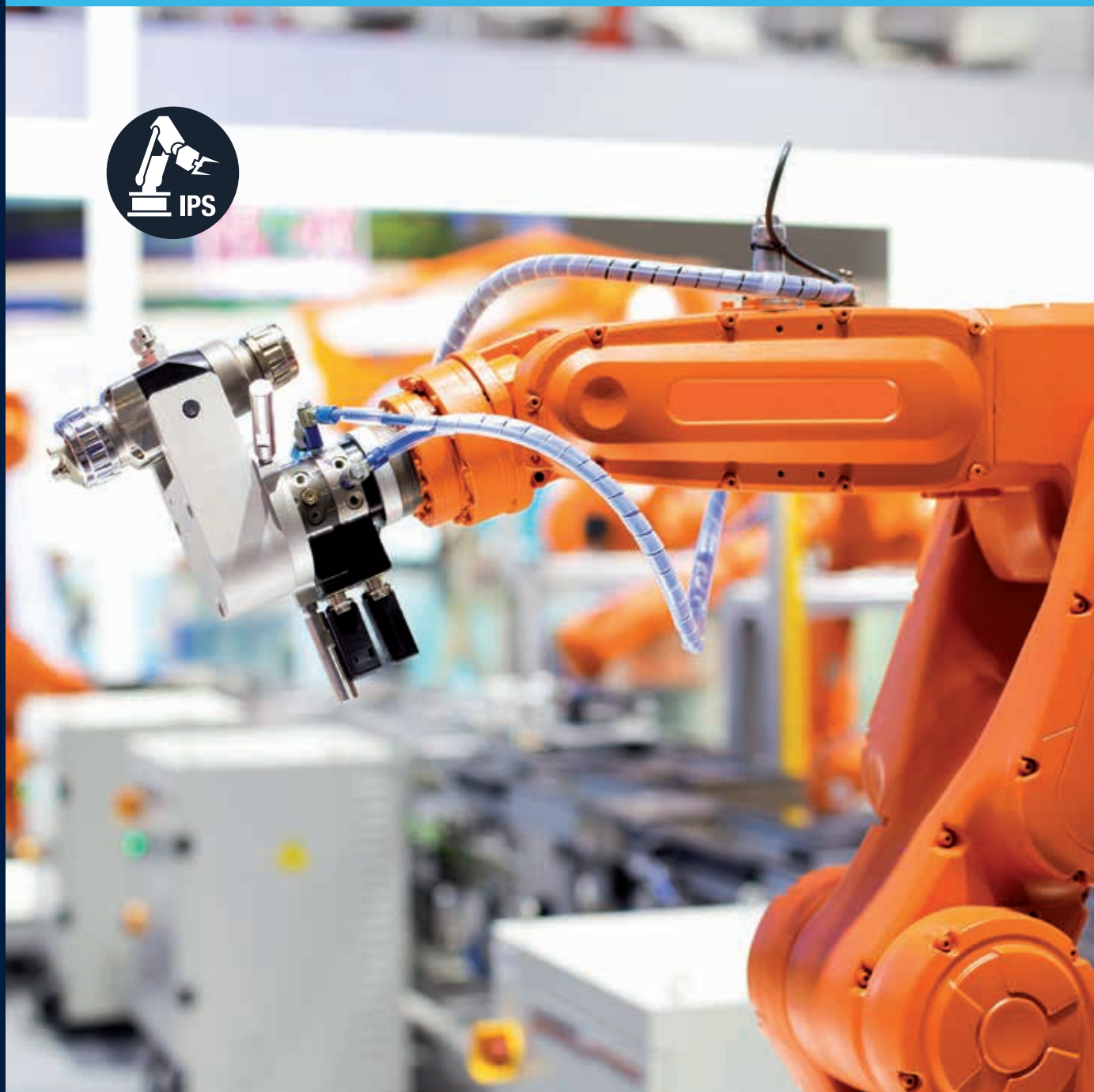




# Intelligent Power Switches (IPS)





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Power stage selection guide

# Technology overview

ST offers an industrial series of intelligent power switches (IPS) for high-side and low-side configurations. An IPS integrates a control section (logic interface, drivers, and protection) with a power stage.

IPS are based on the consolidated bipolar, multipower BCD and VIPower@M0 technologies.

New devices are designed and developed using the latest versions of the above technologies, thus offering state-of-the-art solutions in a wide range of applications.



## BENEFITS

- Increased system reliability
- Reduced part count
- Space saving
- Built-in protection
- System approach

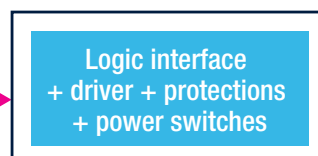
## FEATURES

- Galvanic isolation on chip
- Supply voltage up to 65 V
- High inductive load demagnetization energy
- Very low ON resistance
- Short-circuit and overcurrent protection
- Undervoltage protection and overvoltage shutdown
- Loss of ground protection
- Thermal protection: junction and case
- Extended diagnostics
- Open load detection
- Compliance with IEC 61131-2 standards
- Smart load management

## From a discrete solution



## To an intelligent solution



Integration

## SOLUTIONS FOR SAFE AND SMART FACTORY AUTOMATION

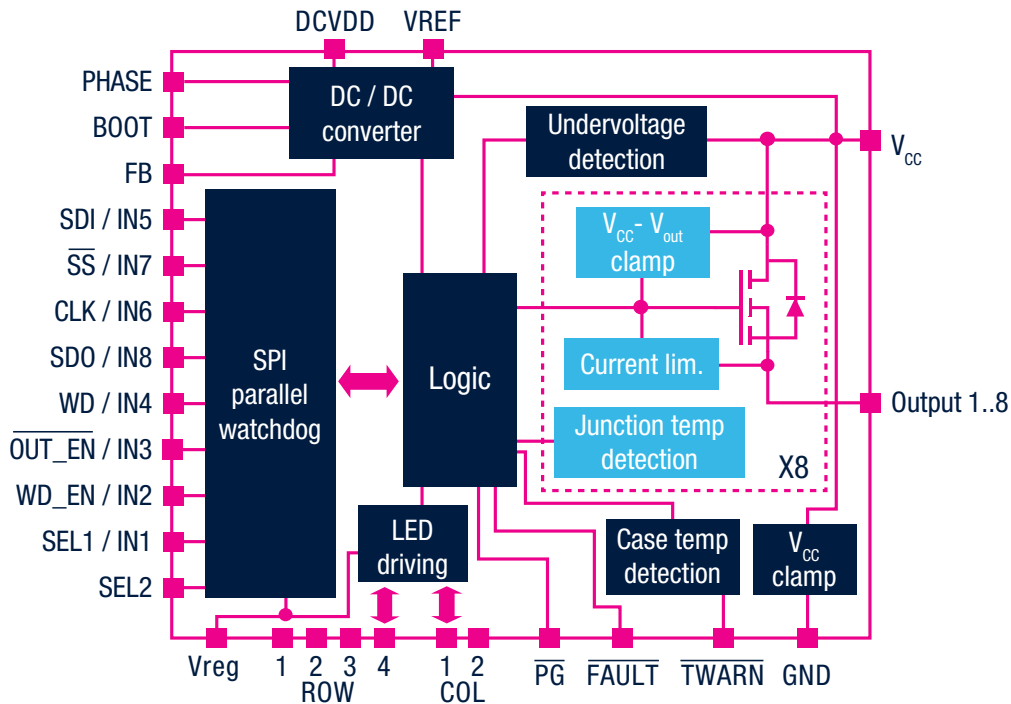
In smart industry, safety infrastructure is critical for operators, especially regarding electrical equipment, robots and heavy loads. ST embeds safety features in “SIL-ready” products to meet the safety requirements of intended applications.

With an operating supply voltage up to 60 V, embedded protections (such as overload and overtemperature), and extended diagnostics, the IPS160H–IPS161H ( $R_{DS(on)(MAX)} = 120m\Omega$ ) and IPS1025H–IPS1025HQ–IPS1025H-32–IPS1025HQ-32 ( $R_{DS(on)(MAX)} = 25m\Omega$ ) single high-side switch families offer robustness and features to help the design of safe systems.

In addition the IPS160HF, IPS161HF, IPS1025HF, and IPS1025HFQ offer fast startup supporting ( $< 100\mu s$ ) to cover application architectures based on multiple switches on high-side branches and generate appropriate test pulses.

With the recently introduced family of single high-side switches, ST is ready for current and future safety control solutions that minimize power dissipation in safety applications addressing industrial loads from 0.5 A to over 12 A.

## Typical intelligent power switch architecture (VNI8200XP)



### International standards

IPS devices are designed to safely drive every kind of load in low-voltage applications (up to 60 V), handling data in and out of the microcontroller by means of status/input signals. IPS devices are designed to comply with the following international standards for EMC and PLC equipments:

- IEC 61000-4-4 (electrical fast transient/burst)
- IEC 61000-4-2 (ESD, immunity test contact/air)
- IEC 61000-4-5 (surge test immunity requirements)
- IEC 61000-4-6 (current injection test)
- IEC 61131-2 (programmable controller, equipment requirements and tests)

ISO8200 and ISO808 isolated IPS product families comply with the following international standards for isolation characteristics and tests:

- UL 1577 (isolation voltage)
- IEC 61000-4-8 (power frequency magnetic field immunity test)
- IEC 60747-5-2 (optoelectronic devices characteristics)
- I/O Safety limits according to VDE V 0884-11 and IEC 60747-17
- UL 508 (Standard for Safety for Industrial Control Equipment)

### Packages

The high thermal capacitance of the power packages such as PowerSO-36, PowerSSO36, PowerSSO24, PowerSSO12 and HTSSOP20 allows the absorption of high-energy pulses when an inductive load is driven without any external freewheeling diode.

Technological evolution has led to smaller IPS devices, housed in tiny, flat, no-lead plastic packages (CSP, DFN, QFN) addressing size-critical applications such as slim PLC modules.

# Product portfolio

Output stage	Part number (RPN)	Output channels	Output current / Channel (Inom) (A)	RDSON (Ω) Typ.	Supply voltage (V) AMR max.	Operating supply voltage range (V) min.	Note	Package	Evaluation board	Application note / User manual
High-side	TDE1747	1	< 0.5		60	8	Adjustable lout	SO-14		
	TDE3247	1	< 0.5		36	8	Adjustable lout	SO-14		
	IPS161H	1	0,5	0,06	65	8	Open load diag	PowerSSO12	STEVAL-IFP034V1	AN4998
	IPS161HF <sup>(*)</sup>	1	0,5	0,06	65	8	Open load diag	PowerSSO12	X-NUCLEO-OUT0A1	UM2716
	L6375S	1	0,5	0,4	50	8		SO-8		
	L6377	1	0,5	0,4	50	8	Adjustable lout	SO-14		
	TDE1897R	1	0,5	0,4	50	18		SO-20		AN453
	TDE1898C	1	0,5	0,4	50	18		SO-20		AN453
	TDE1798DP	1	0,5		50	6		mini-DIP8		
	IPS1025H	1	2	0,012	65	8	Smart load management	PowerSSO-24 / QFN48L 8X6	X-NUCLEO-OUT05A1	DB4211, UM2865
	IPS1025HF <sup>(*)</sup>	1	2	0,012	65	8	Smart load management	PowerSSO-24 / QFN48L 8X6	X-NUCLEO-OUT15A1	
	VN540SP-E	1	2	0,05	45	10		PowerSO-10		
	IPS160H	1	2	0,06	65	8	Open load diag	PowerSSO12	STEVAL-IFP028V1	AN4781
	IPS160HF <sup>(*)</sup>	1	2	0,06	65	8	Open load diag	PowerSSO12	X-NUCLEO-OUT08A1	UM2715
	VN751PT	1	2	0,06	45	5,5		PPAK	STEVAL-IFP005V2	
	VN751S	1	2	0,06	45	5,5		SO-8		
	L6370	1	2	0,1	50	9,5	Adjustable lout	PowerSO-20		
	IPS1025H-32	1	5	0,012	65	8	Smart load management	PowerSSO-24 / QFN48L 8X6	X-NUCLEO-OUT06A1	DB4212, UM2866
	VNI2140J	2	1	0,08	45	9	Open load diag	PowerSSO12	STEVAL-IFP010V3	AN2985
	IPS2050H	2	2	0,025	65	8	Smart load management	PowerSSO-24 / QFN48L 8X6	X-NUCLEO-OUT03A1	DB4205, UM2727
	IPS2050H-32	2	5	0,025	65	8	Smart load management	PowerSSO-24 / QFN48L 8X6	X-NUCLEO-OUT04A1	DB4206, UM2728
	VNQ860-E	4	< 0.5	0,27	41	5,5		SO-20		
	VNQ860SP-E	4	< 0.5	0,27	41	5,5		PowerSO-10™		
	VNI4140HQ	4	0,5	0,08	41	10,5	Per channel diag	PowerSSO-24		AN2684
	IPS4140K <sup>(**)</sup>	4	0,5	0,08	41	10,5	Per channel diag	QFN48L 8X6		
	VN330SP-E	4	0,5	0,2	45	10		PowerSO-10		
	VN340SP-E	4	0,5	0,2	45	10	Per channel diag	PowerSO-10		AN2208
	L6376	4	0,5	0,64	50	9,5		PowerSO-20		
	VNI4140K-32	4	1	0,08	41	10,5	Per channel diag	PowerSSO-24	STEVAL-IFP019V1	AN4009
	IPS4140HQ-1 <sup>(**)</sup>	4	1	0,08	41	10,5	Per channel diag	QFN48L 8X6		
	VN340SP-33-E	4	1	0,2	45	10		PowerSO-10		AN2208
	VNI8200XP	8	0,5	0,11	45	10,5	LED matrix driver, DCDC, SPI, Per channel diag	PowerSSO-36	STEVAL-IFP022V1 / X-NUCLEO-PLC01A1	AN4284, UM1918
	VN808-E	8	0,5	0,15	45	10,5		PowerSO-36		AN2443, AN2208
	VN808CM-E	8	0,5	0,16	45	10,5	Logic level Inputs	PowerSO-36		AN2443, AN2208
	IPS8160HQ	8	0,5	0,16	45	10,5	Parallel interface	QFN48L 8X6	X-NUCLEO-OUT09A1	DB4738, UM3509
	IPS8200HQ	8	0,5	0,11	45	10,5	LED matrix driver, DCDC, SPI, Per channel diag	QFN48L 8X6		
	IPS8160HQ-1	8	1	0,16	45	10,5	Parallel interface	QFN48L 8X6	X-NUCLEO-OUT19A1	DB4747, UM3074
	VNI8200XP-32	8	1	0,11	45	10,5	LED matrix driver, DCDC, SPI, Per channel diag	PowerSSO-36	STEVAL-IFP032V1	AN4862
	IPS8200HQ-1	8	1	0,11	45	10,5	LED matrix driver, DCDC, SPI, Per channel diag	QFN48L 8X6		
	VN808-32-E	8	1	0,15	45	10,5		PowerSO-36		AN2443, AN2208
VN808CM-32-E	8	1	0,16	45	10,5	Logic level Inputs	PowerSO-36	STEVAL-IFP001V1	AN2443, AN2208	

Output stage	Part number (RPN)	Output channels	Output current / Channel (Inom) (A)	RDS <sub>ON</sub> (Ω) Typ.	Supply voltage (V) AMR max.	Operating supply voltage range (V) min.	Note	Package	Evaluation board	Application note / User manual
Isolated-high-side	ISO8200AQ	8	0,5	0,12	45	10,5	Isolated, SPI, Per channel diag	QFN 9x11	X-NUCLEO-OUT02A1	UM2507
	ISO8200B	8	0,5	0,12	45	10,5	Isolated, Parallel interface	PowerSO-36	STEVAL-IFP015V2	AN4373, UM2209
	ISO8200BQ	8	0,5	0,12	45	10,5	Isolated, Parallel interface	QFN 9x11	STEVAL-IFP033V1 / X-NUCLEO-OUT01A1	AN4373, UM2209
	ISO808	8	0,5	0,125	45	9	Isolated, Parallel interface	POWER-S036 / QFN 9 X 11	X-NUCLEO-OUT11A1 / STEVAL-IFP041V1	DB4833, UM3079
	ISO808A	8	0,5	0,125	45	9	Isolated, SPI	POWER-S036 / QFN 9 X 11	X-NUCLEO-OUT12A1 / STEVAL-IFP042V1	DB4834, UM3080
	ISO808-1	8	1	0,125	45	9	Isolated, Parallel interface	POWER-S036 / QFN 9 X 11	X-NUCLEO-OUT13A1 / STEVAL-IFP047V1	DB4835, UM3081
	ISO808A-1	8	1	0,125	45	9	Isolated, SPI	POWER-S036 / QFN 9 X 11	X-NUCLEO-OUT14A1 / STEVAL-IFP048V1	DB4836 UM3082
High / Low-side	TDE1708DFT**	1	< 0.5		50	6		DFN 8L 4x4	STEVAL-IFS006V2	AN2679, AN2813
	TDE1707**	1	0,5		50	6		SO-8		AN1213, AN495
Low-side	IPS4260L	4	0,5	0,26	55	8	Adjustable Iout, Open load / Per channel diag & catch diode	HTSSOP-20	STEVAL-IFP029V1	UM2297
Push-pull	L6374FP	4	< 0.5	4	50	10,8	Push-pull line driver	SO-20		

Note: (\*) Suitable for SIL applications requiring for interface type C (or D) Class 3

(\*\*) The TDE1707 and TDE1708DFT are specific IPS developed to match all types of industrial detectors. They can be coupled with inductive, capacitive, ultra-sonic or optical detectors and can be used in high-side or in low-side driver configuration in 3-wire networks"

(\*\*\*) Available in Q1 2024



	Single channel	Dual channels	Quad channels	Octal channels
				<b>1 A</b> ISO808(Q)-1 ; ISO808A(Q)-1 <b>0.5 A</b> ISO8200AQ, ISO8200B, ISO8200BQ, ISO808(Q), ISO808A(Q)
	<b>5 A</b> IPS1025H(Q)-32 <b>2 A</b> IPS160H, IPS160HF, IPS1025H(Q), IPS1025HF(Q) <b>0.5 A</b> IPS161H, IPS161HF	<b>5 A</b> IPS2050H(Q)-32 <b>2 A</b> IPS2050H(Q)		
	<b>2 A</b> VN540SP / VN751, L6370 <b>0.5 A</b> L6375, L6377, TDE1707, TDE1897, TDE1898, TDE1798 <b>&lt;0.5 A</b> TDE1708DF, TDE3247, TDE1747	<b>1 A</b> VNI2140J	<b>1 A</b> IPS4140HQ-1*, VNI4140K-32, VN340SP-33 <b>0.5 A</b> IPS4260L <b>0.5 A</b> VNI4140K, VN330SP, VN340SP, L6376, IPS4140HQ* <b>&lt;0.5 A</b> VNQ860, L6374	<b>1 A</b> VN808(CM)-32, VNI8200XP-32, IPS8160HQ-1, IPS8200HQ-1 <b>0.5 A</b> IPS8350L* <b>0.5 A</b> VN808(CM), VNI8200XP, IPS8160HQ, IPS8200HQ

(\*) Development

<b>Legend</b>				
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# IPS EVALUATION BOARDS FOR EASY GO-TO-MARKET

## Octal channel galvanic isolated IPS










Parallel version				SPI version				
IS0808 family	PowerSO-36		QFN		PowerSO-36		QFN	
	IS0808	IS0808-1	IS0808Q	IS0808Q-1	IS0808A	IS0808A-1	IS0808AQ	IS0808AQ-1
	X-NUCLEO-OUT11A1	X-NUCLEO-OUT13A1	STEVAL-IFP041V1	STEVAL-IFP047V1	X-NUCLEO-OUT12A1	X-NUCLEO-OUT14A1	STEVAL-IFP042V1	STEVAL-IFP048V1
IS08200 family	IS08200B		IS08200BQ		IS08200AQ			
		STEVAL-IFP015V2		X-NUCLEO-OUT01A2		X-NUCLEO-OUT02A1		

## IPS 60V suitable for safety integrity level systems

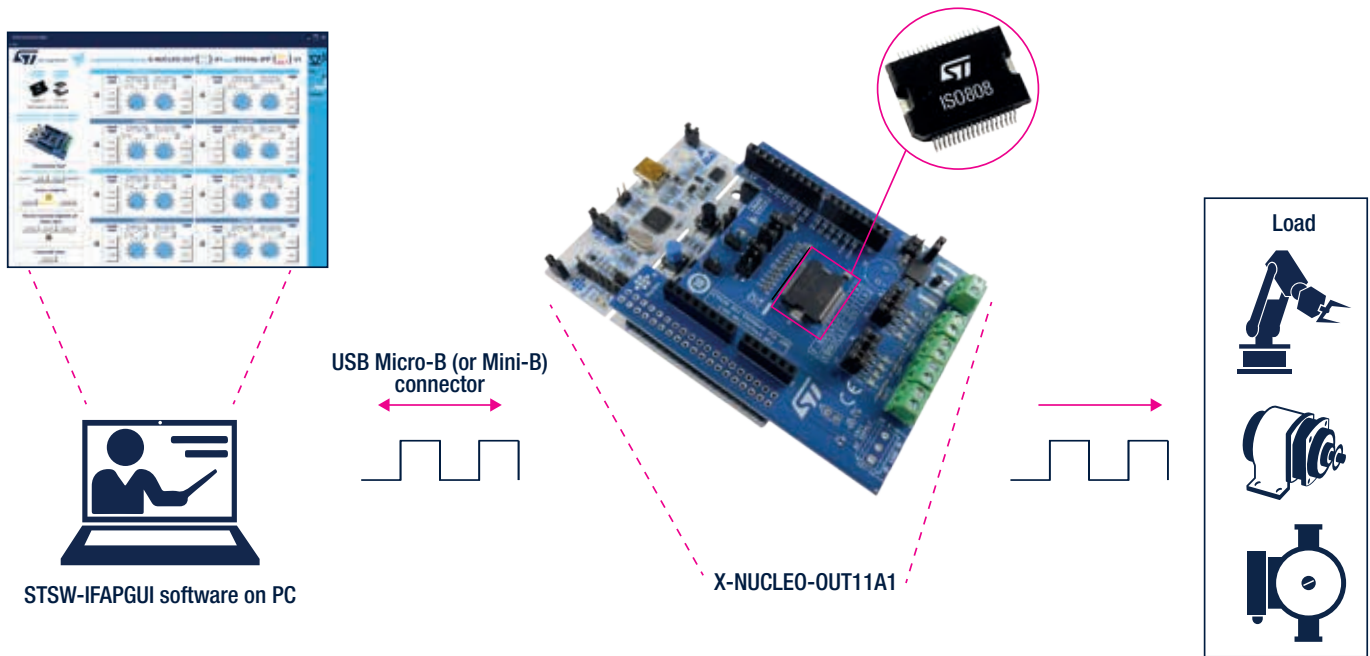
Single channel				Dual channel			
PowerSS012		PowerSS012		PowerSS0-24			
IPS160H	IPS160HF	IPS161H	IPS161HF	IPS2050H	IPS2050H-32		
STEVAL-IFP028V1	X-NUCLEO-OUT08A1	STEVAL-IFP034V1	X-NUCLEO-OUT10A1	X-NUCLEO-OUT03A1	X-NUCLEO-OUT04A1		
PowerSS0-24			QFN48L 8X6			QFN48L 8X6	
IPS1025H	IPS1025H-32	IPS1025HF	IPS1025HQ	IPS1025HQ-32	IPS1025HFQ	IPS2050HQ	IPS2050HQ-32
X-NUCLEO-OUT05A1	X-NUCLEO-OUT06A1	X-NUCLEO-OUT15A1	STEVAL-IFP045V1	STEVAL-IFP046V1	STEVAL-IFP040V1	STEVAL-IFP043V1	STEVAL-IFP044V1



**IPS compact lines and high end features**

Single channel		Quad channel	Octal channel			
PPAK		HTSSOP-20	PowerSS0-36			
VN751PT		IPS4260L(*)	VNI8200XP	VNI8200XP	VNI8200XP-32	
						
STEVAL-IFP005V2		STEVAL-IFP029V1	STEVAL-IFP022V1	X-NUCLEO-PLC01A1	STEVAL-IFP032V1	
Dual channel			QFN48L 8X6			
PowerSS012		PowerSS0-24	IPS8160HQ	IPS8160HQ-1	IPS8200HQ	IPS8200HQ-1
VNI2140J		VNI4140K-32				
STEVAL-IFP010V3		STEVAL-IFP019V1	X-NUCLEO-OUT09A1	X-NUCLEO-OUT19A1	X-NUCLEO_OUT016A1	X-NUCLEO_OUT017A1

**BASIC EVALUATION BOARD SETUP**



# IPS solutions

## Transceiver ICs

### Industrial transceiver ICs for IO-LINK and SIO mode

By using a state-of-the-art technology (MultiPower BCD) that allows the design of the logic part and robust LV power MOSFETs allowing hundreds kHz switching frequency in the same chip, ST offers an efficient, compact and cost-effective solution to drive any 3-wire digital sensor. Modern sensors and actuators require:

- remote service
- standardization
- sensor functionality verification
- diagnostics
- monitoring

The L6360, L6362A and L6364 I/O industrial transceiver ICs meet all these requirements. These ICs offer the market IO-LINK sensors/actuators that work without special cables. They feature an advanced solution that can even be integrated in old systems, that is neutral to any field bus, and keeps the point-to-point communication. Industrial transceiver ICs are designed in order to guarantee EMC immunity (burst/fast transient, ESD contact/air, surge pulse, RF emission/conducted), according to the IO-LINK specification and SIO mode requirements.



### Industrial transceiver IC product range

Part number	Supply voltage (V)	V <sub>DD</sub> (V)	Output current (A)	I <sub>max</sub> linear reg. (mA)	Technology	Output channels	Input channels	Package
<b>L6360 (Master)</b>	18 to 32.5	3.3/5	0.5	65	MultiBCD	2	2	QFN 26L 3.5 x 5 mm
<b>L6362A (Device)</b>	7 to 36	3.3/5	0.22	10	MultiBCD	1	1	DFN 12L 3 x 3 mm
<b>L6364Q (Device)</b>	6 to 35	3.3/5	0.25/0.5(*)	50	MultiBCD	2	2	QFN 20L 4 x 4 mm
<b>L6364W (Device)</b>	6 to 35	3.3/5	0.25/0.5(*)	50	MultiBCD	2	2	CSP 19 2.5 x 2.5 mm

Note: (\*) join mode

### IO-Link evaluation boards

Part number	Order code	Description	Application note / User manual
<b>L6360</b>	STEVAL-IDP004V2	IO-Link master multi-port evaluation board based on L6360	AN5041
	STEVAL-IOM001V1	IO-Link master evaluation board based on L6360 equipped with ST morpho connectors for STM32 Nucleo	UM2414
	P-NUCLEO-IOM01M1	STM32 Nucleo pack for IO-Link master based on L6360 device with IO-Link v1.1 (PHY and stack)	UM2421
<b>L6362A</b>	STEVAL-IDP003V1	IO-Link industrial modular sensor board based on L6362A	AN5041
	STEVAL-BFA001V2B	Multi-sensor predictive maintenance kit with L6362A and IO-Link stack v.1.1	UM2663
	STEVAL-IOD003V1	IO-Link (PHY) device evaluation board based on L6362A with Arduino connectors for STM32 Nucleo	UM2424
	P-NUCLEO-IOD01A1	STM32 Nucleo pack for IO-Link device based on L6362A device fully compatible with IO-Link v1.1.3 (PHY and stack UM2425)	UM2425
<b>L6364Q</b>	X-NUCLEO-IOD02A1	Expansion board IO-Link device based on L6364Q device fully compatible with IO-Link v1.1 (PHY and stack)	UM2741
	P-NUCLEO-IOD02A1	STM32 Nucleo pack for IO-Link device applications based on L6364Q transceiver, industrial sensors and STM32L452RE MCU	UM2782
	STDES-IOD002V1	Dual channel IO-Link device reference design based on L6364Q and STM32L051	
	P-NUCLEO-IOD04A1	STM32 Nucleo pack for IO-Link device applications based on L6364Q transceiver, IPS2050H-32 power switch and STM32L073RZ	
<b>L6364W</b>	STEVAL-IOD002V1	Dual channel IO-Link device expansion board based on L6364W for STM32 Nucleo	UM2822
	STEVAL-IOD004KT1	Industrial smart sensor kit based on L6364W dual IO-Link device transceiver	UM2942



## IO-LINK COMMUNICATION MASTER / DEVICE TRANSCEIVER IC

### Evaluation boards

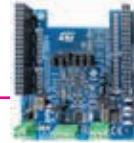


QFN 26L 3.5 x 5



P-NUCLEO-IOM01M1 kit

EMBEDDED  
IO-LINK STACK BY  
TE Concept



STEVAL-IOM001V1



STEVAL-IDP004V2

EMBEDDED  
IO-LINK STACK BY  
TE Concept



DFN 12L 3 x 3



P-NUCLEO-IOD01A1 kit

EMBEDDED  
IO-LINK STACK BY  
TE Concept



STEVAL-IOD003V1



STEVAL-IDP003V1



STEVAL-BFA001V2B

EMBEDDED  
IO-LINK STACK BY  
TE Concept



QFN 20L 4 x 4



P-NUCLEO-IOD02A1 kit  
ST Stack included !



X-NUCLEO-IOD02A1  
ST Stack included !



STDES-IOD002V1  
ST Stack included !



P-NUCLEO-IOD04A1



CSP 19L 2.5 x 2.5



STEVAL-IOD002V1



STEVAL-IOD004KT1  
ST Stack included !

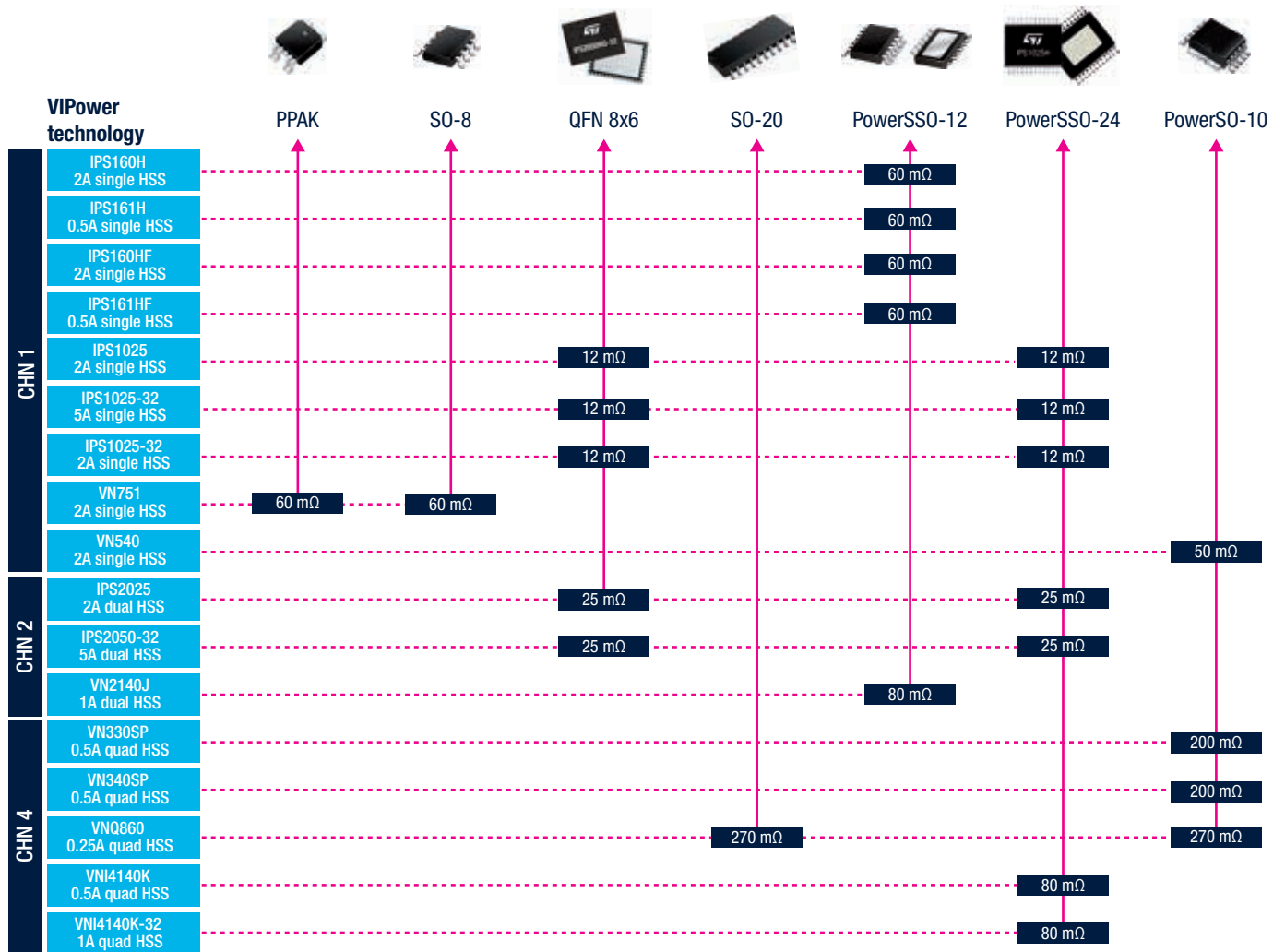


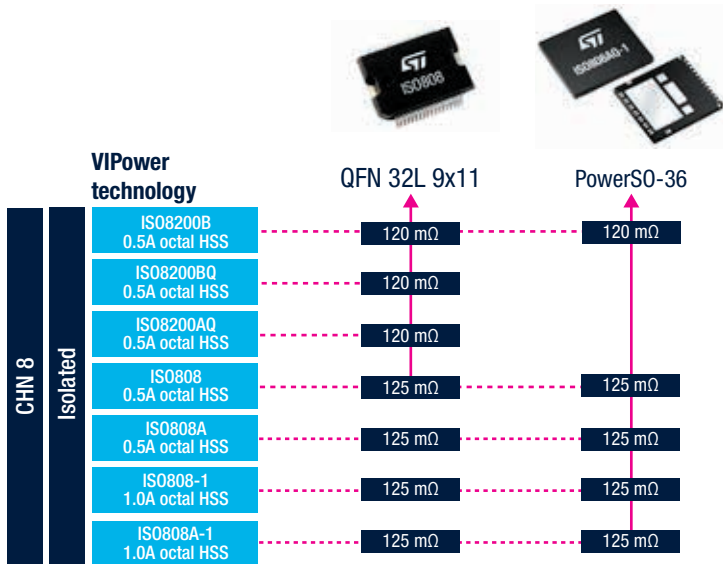
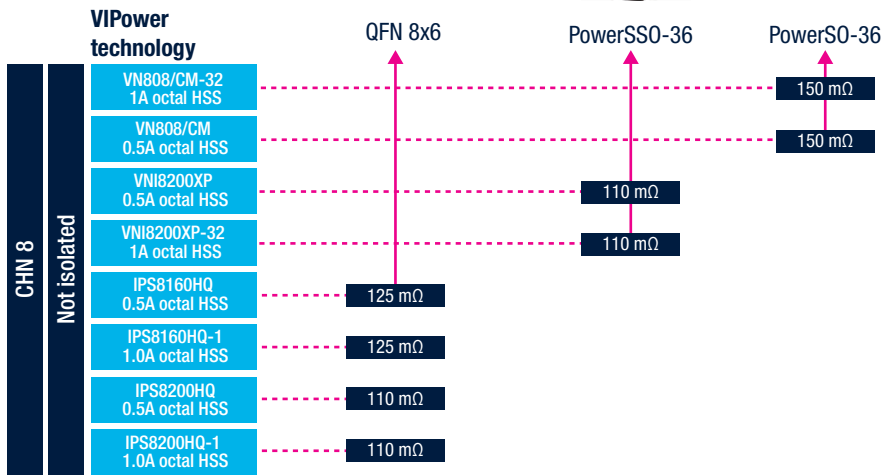
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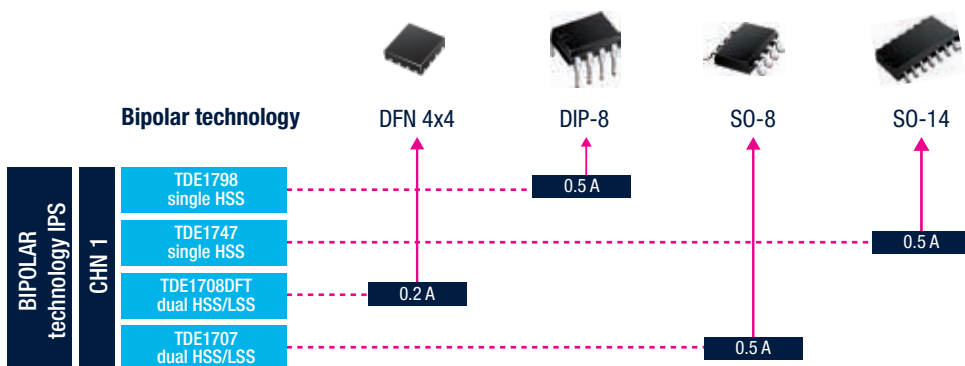
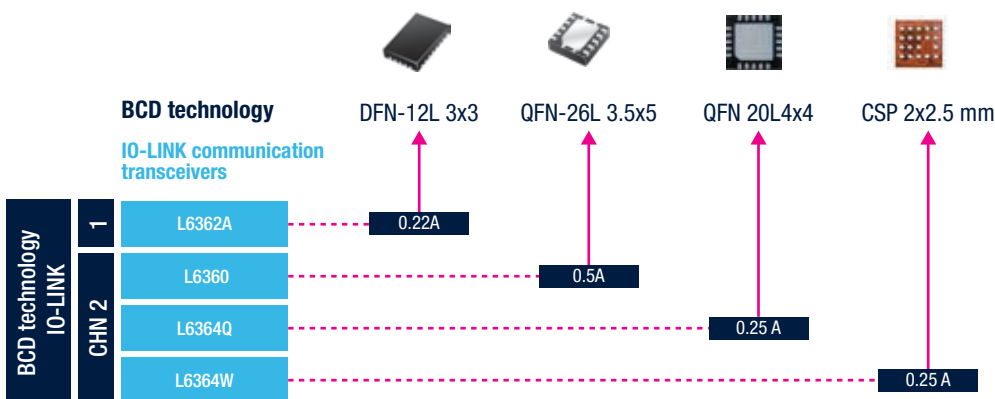
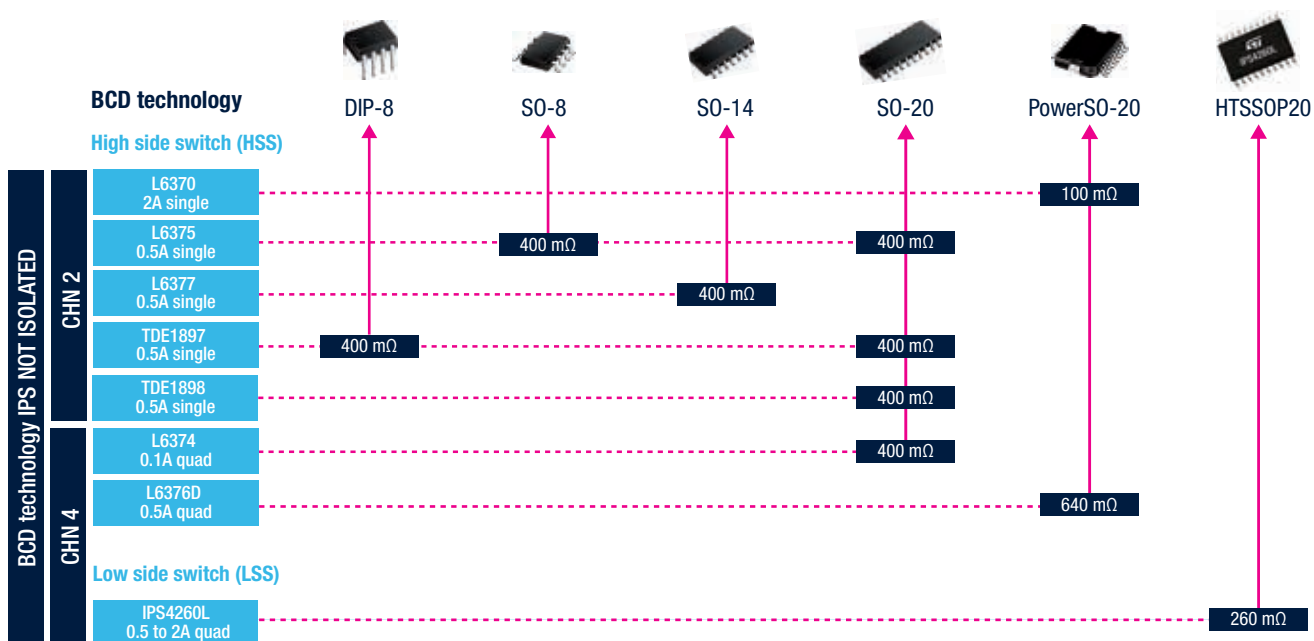
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# IPS solutions

## Power stage selection guide









# At STMicroelectronics we create technology that starts with You



Order code: **BR2310IPS**

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