



ST Factory Automation

Analog Semiconductor Solutions from STMicroelectronics



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INTRODUCTION



With its broad product spectrum of standard and application-specific components, STMicroelectronics has singled out factory automation as a focus area.

The market as a whole, but especially manufacturers of products for the automation and process industries look for dependable, long-term supplier relationships for reliable, intelligent and efficient semiconductor solutions with adequate product life times. These are the challenges facing the semiconductor industry today. To meet these challenges, ST has established a dedicated semiconductor division, to be free of the influence of other market segments.

As a result of this strategy, the automation market can look forward each year to a bundle of new products, supporting applications like PLC, DI/DO systems, sensors and the full range of power supplies.

Savings (in US\$ millions)

	2001	2002	2003	2004	2005
Investments in environmental protection	30	32	35	35	34
Energy saving	33	59	78	102	123
Water saving	6	10	13	17	19
Chemicals saving	17	31	42	54	65
Total saving	56	100	133	173	207
Cost saving	26	68	98	138	173

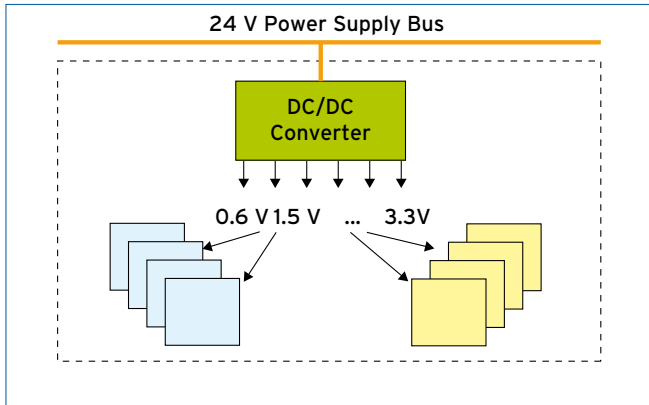
Source: STMicroelectronics - 'President's Report 2006'

ENVIRONMENTAL DECALOGUE: THE 10 ENVIRONMENTAL COMMANDMENTS OF ST

The ST Decalogue is currently in its second decade, having been updated and revised along the way. The 10 commandments are:

1. Meet the most stringent environmental regulations of any country in which we operate, at all of our locations. Comply with all international protocols at least one year ahead of official deadlines at all our locations.
2. Reduce total energy consumption, water and paper consumption by at least 5% per year. Use at least 95% recycled paper.
3. Greenhouse gas emissions: Reduce CO₂ emissions by at least a factor of 10 in 2010 versus 1990. Increase the utilisation of renewable and alternative energy.
4. Reduce pollution: noise, contaminants.
5. Chemicals: reduce by at least 5% per year.
6. Waste: reuse or recycle at least 80% of our manufacturing and packing waste.
7. Products and processes: design products for decreased energy consumption and to enable of more energy-efficient applications; lifecycle assessment.
8. Proactivity: support local initiatives. Sponsor of an annual 'Corporate Environmental Day'. Include an 'Environmental Awareness' course in the ST University curriculum.
9. Measurement: continually monitor our progress. Audits. Collaboration with international organisations. Measure progress and achievements and publish our results.
10. Validation: all our sites worldwide must be certified to ISO 14001 and be awarded EMAS validation. Certify new sites within 18 months of operational start-up.

ST SOLUTIONS FOR DC/DC CONVERSION STARTING FROM 24 V INPUT BUS



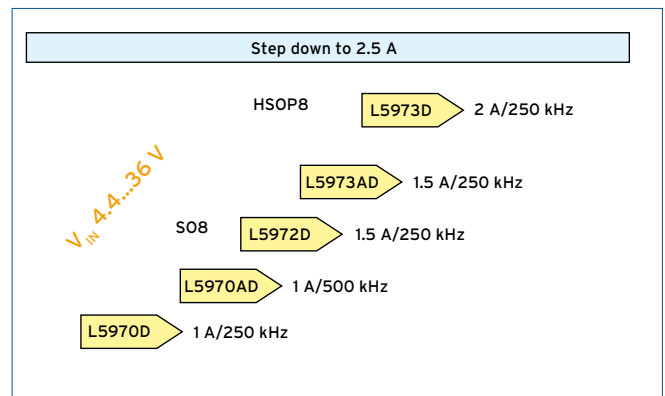
DC/DC Converter for 24 V_{DC} bus According IEC61131-2 Standard

L597x/L497x

These families comprise various monolithic step-down switching regulators capable of delivering 0.5...3.5 A and housed in small outline packages. High switching frequency and a full set of embedded protection functions means fewer and smaller external components and subsequently lower application cost. Adjustable output voltage, wide input voltage range (up to 36 V or 55 V) and synchronisation capability ensure additional design flexibility.

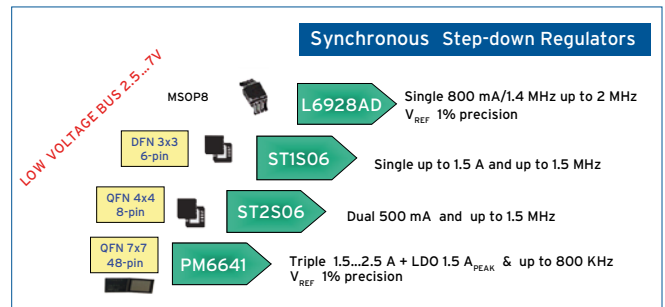
Inhibit for B

Part number	I _{PEAK} A	I _{OUT} A	V _{IN} V	V _{OUT} V	F _{SW} kHz	Extra functions	Package
L4976	1.5	1	8...55	0.5...50	Up to 300	V _{REF}	DIP8,SO16W
L4971	2	1.5	8...55	3.3...50	Up to 300	Inhibit	DIP8,SO16W
L4978	2.5	2	8...55	3.3...50	Up to 300	Inhibit	DIP8,SO16W
L4973V3.3	4	3.5	8...55	0.5...50	Up to 300	Inhibit, V _{REF} Sync	DIP18,SO20
L4973V5.1	4	3.5	8...55	5.1...50	Up to 300	Inhibit, V _{REF} Sync	DIP18,SO20
Evaluation boards		Description					
EVAL4971		Available for L4971, L4978					
EVAL4973		Available for L4973					
Part number	I _{PEAK} A	I _{OUT} A	V _{IN} V	V _{OUT} V	F _{SW} kHz	Extra functions	Package
L5970D	1.5	1	4.4...36	0.5...V _{IN}	250	Inhibit, V _{REF} Sync	SO8
L5970AD	1.5	1	4.4...36	0.5...V _{IN}	500	Inhibit, V _{REF} Sync	SO8
L5972 D	2	1.5	4.4...36	1.23...V _{IN}	250	~ ~ ~	SO8
L5973AD	2	1.5	4.4...36	0.5...V _{IN}	500	Inhibit, V _{REF} Sync	HSOP8
L5973D	2.5	2	4.4...36	0.5...V _{IN}	250	Inhibit, V _{REF} Sync	HSOP8
Evaluation boards		Description					
EVAL5970D/5972D		Available for L5970D/L5972D					
EVAL5973D/5973AD		Available for L5973D/5973AD					
Part number	I _{PEAK} A	I _{OUT} A	V _{IN} V	V _{OUT} V	F _{SW} MHz	Extra functions	Package
L6928AD	1.5	0.8	2...5.5	0.6	1.4	1 mA shutdown, pgood, sync.	MSOP8, VFQFPN8
ST1S06PUR	2.3	1.5	2.7...6	0.8	1.5	Inhibit soft start	DFN6
ST2S06BPQR	1.2	2 x 0.5	4.5...5.5	0.8	1.5	Inhibit for B	QFN12L
PM6641	up to 5.1	1.5...2.5	4.5...5.5	programmable triple	typical 0.8	Inhibit, enable	QFN 48
Evaluation boards		Description					
EVAL6928AD		Available for L6928AD					
STEVAL-ISA043V1/V2, ISA049V1/V2		Available for ST1S6PUR and ST2S06BPQR					



L6928A and STxS06

Converting microcontroller, FPGA core and peripheral supply voltages requires today's highly efficient synchronous single-chip buck converter solutions. With space and power dissipation the usual limiting factors, efficiencies of up to 95% satisfy most application needs. The products are assembled in QFN, DFNS and MSOP packages. The input voltage ranges from 2.5...7 V.



PM66xxA Family

STMicroelectronics' PM66xxA family provides the best possible integrated solution for supplying the main output voltages necessary for FPGA and MCU system power.

The devices provide multiple switching controllers (see table) with adjustable outputs and an LDO capable of supplying constant auxiliary voltage. They come in a compact VFQFPN 32-pin, 5 x 5 mm package, ideal for space-saving designs. The PM66xxA are multiple pulse-width modulation controllers configured for step-down (buck) topologies.

They provide extremely high efficiency conversion (up to 95%) through a lossless current sensing technique, and high DC output accuracy over a wide input voltage range, covering 5, 12 and 24 V bus configurations.

The constant on time architecture allows the PM66xxA to convert the 36 V input voltage to a 0.9...2.5 V output voltage, the typical core and I/O voltage range required by embedded FPGA- and MCU-based systems.

An embedded integrator control loop compensates the DC voltage error caused by the output ripple.

Ordering Information

Part number	V _{OUT} # (SW +LDO)	V _{OUTSW 1}	V _{OUTSW 2}	V _{OUT} LDO	ILDO	V _{IN} range	Package
PM6680A	2 + 1	Adj.	Adj.	5 V	200 mA	Up to 36 V	QFN 5 x 5
PM6670AS	1 + 1	Adj.	-	Fixed at V _{INLDO} /2	2 A	Up to 36 V	QFN 4 x 4
PM6675AS	1 + 1	Adj.	-	Adj.	2 A	Up to 36 V	QFN 4 x 4
PM6681A	2 + 2	Adj.	Adj.	(1)Adj. + (2)5 V	100 mA	Up to 36 V	QFN 5 x 5

Digital Inputs for PLC Applications



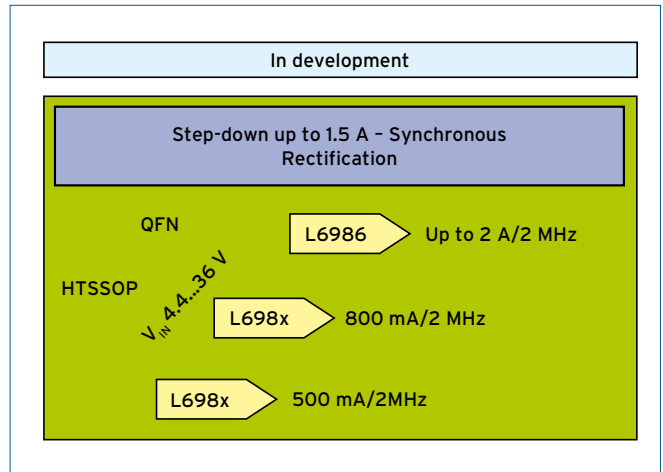
Industrial Digital Inputs

Modern control systems are highly complex applications. The trend is to use as many integrated solutions as possible in such designs, either to increase the density or to reduce physical dimensions of the modules. Either way results in more stringent requirements regarding the total power dissipation of the module. A discrete solution can obviously never hope to compete on features, protection functions and size. STMicroelectronics was quick to identify the market requirements and currently offers two mature products, the CLT3-4BT6 and PCLT-2A. Digital input termination devices are designed

Single/Dual DC/DC Controller for 24 V_{DC} Bus

Under light load conditions, a pulse-skip technique increases the efficiency with minimum impact on the output regulation accuracy. During pulse-skip mode, a minimum switching frequency of 33 kHz is available to prevent audio noise issues.

DC/DC Converter Product Outlook



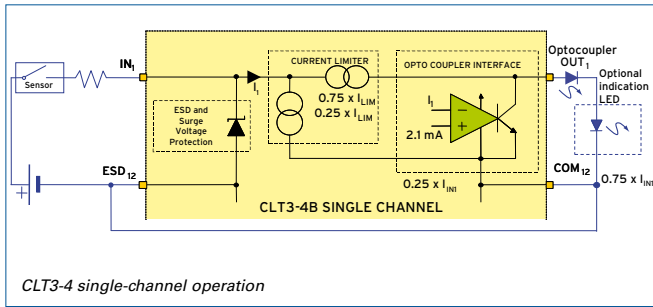
Available 1st half of 2009

for 24 V_{DC} industrial applications. Typical target applications include programmable logic controllers, programmable automation controllers and distributed I/O systems. They operate as interfaces for mechanical switches, relay contacts, two-wire or three-wire digital sensors – also known as proximity switches.

CLT3-4BT6

The chip is available in 4-channel configuration and provides a high-density termination by minimising the external component count. It is housed in a TSSOP20 surface mount package to reduce the printed board size. It comprises parallel input voltage protection, a serial input-output current limiting circuit and an optocoupler driver, each channel circuit terminates the connection between the logic input and the associated high-side sensor or switch.

The CLT3-4BT6 is used between the sensors and the optocoupler of an input module. The current limiting circuit, connected between the input and the output pins, is compensated over the full operating temperature range. Moreover, each channel operates independently of the other three. Thanks to its low tolerance, the current limitation results in a marked reduction of the dissipation compared with a resistive input solution: the whole module requires less cooling and becomes smaller. Refer to AN2527 for device functionality.



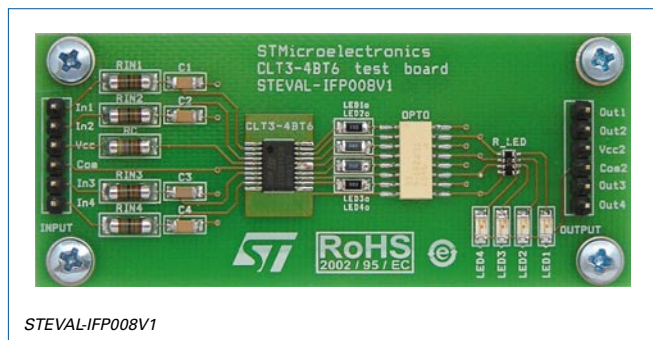
The CLT3-4 single-channel functionality in sensor off state is shown above: If the current I_{N1} is lower than the comparator reference (2.1 mA typical), the comparator drives the output transistor so it shorts the appropriate current portion to the COM12 (GND) pin. Power is removed from the optocoupler. If the input current exceeds the 2.1 mA threshold, the transistor switches off and the appropriate portion of the current starts to flow through the optocoupler.

Features

- Termination for IEC61131-2, Type 1 and 3 inputs
- 4-channel topology
- Fully integrated internally fixed current limiter
- Optocoupler output driver
- Indicative LED driver (see AN2527)
- Wide supply voltage and operating temperature ranges

Benefits

- Low power dissipation compared with discrete solution
- Few external components
- Overvoltage protection
- ESD according to IEC61000-4-2, Class 3, 8 kV air discharge, 6 kV contact discharge
- Excellent EMC robustness: voltage surge, fast transient burst immunity (± 2 kV, ± 4 kV)
- Compact TSSOP20 package



Available Support Tools

- Datasheet
- AN2527 application note
- STEVAL-IFP008V1 evaluation board

PCLT-2A

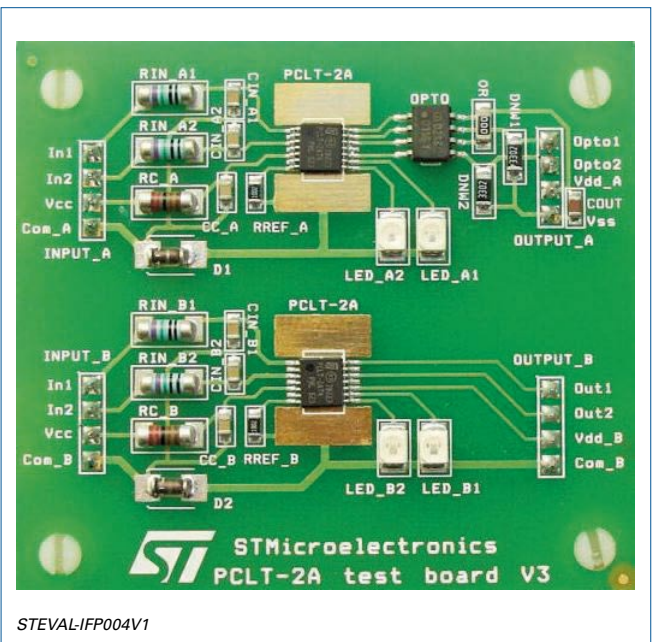
The PCLT-2A is used in applications that need to support type 2 input characteristics. The chip embeds selectable input characteristic types (1, 2 and 3) and features such as an indicative LED driver and CMOS-compatible output driver. The indicative LED driver uses current supplied by sensor and therefore does not contribute to the total module dissipation.

Features

- 2-channel topology
- Programmable current limiter
- Termination for IEC61131-2, Type 1, 2, 3 inputs
- Optocoupler driver
- Indicative diode driver
- Wide supply voltage range

Benefits

- Low power dissipation
- Overvoltage protection
- Isolated (optocoupler) or non-isolated (CMOS)
- Compact TSSOP14 package
- Input reverse polarity protection
- Indication LED driver on chip



Available Support Tools

- Datasheet
- AN2482 application note
- STEVAL-IFP004V1 evaluation board

SCLT3-8 Product Outlook

The most expensive parts in digital input modules are the isolators (optocouplers). Most applications depend on them for galvanic isolation from the industrial environment. This has resulted in a development trend that embeds serial communication peripheral in the digital input terminators. The number of isolated channels can then quickly be reduced.

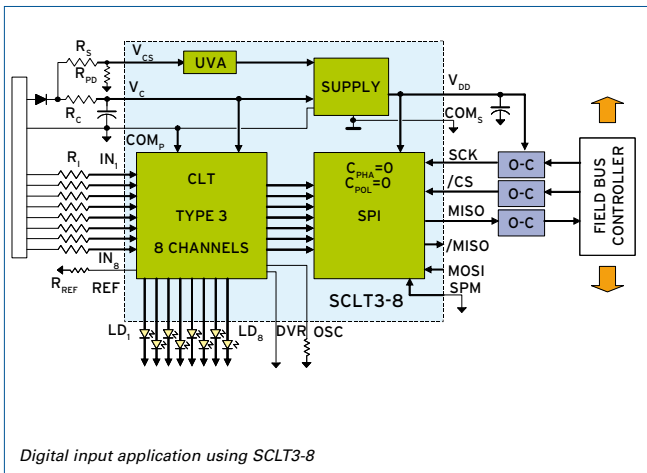
A new chip from ST scheduled for for production in December 2008 incorporates this design concept.

The SCLT3-8 is an octal digital input termination with embedded SPI communication in which a daisy-chain connection reduces the number of isolated lines to 3! It supports input characteristic type 3 and optimises power dissipation in the same way as the parent CLT products. The chip has an integrated indicative LED driver that uses the sensor current to power the LEDs.

SCLT3-8 Highlights

Features

- 8-channel topology
- Termination for IEC61131-2, type 1 and 3 inputs
- Indicative LED diode drivers
- 8- or 16-bit SPI protocol
- Embedded digital filter
- Wide supply voltage range 16...35 V
- On-chip linear regulator

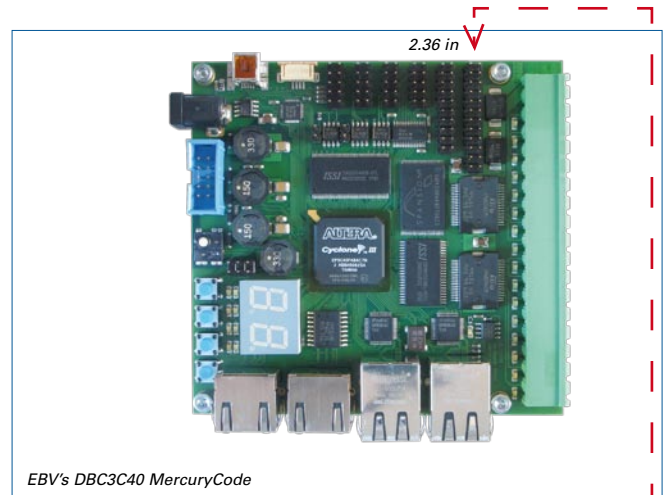


Benefits

- Low power dissipation 80 mW per channel
- Overvoltage protection
- Fewer isolators
- Filters input glitches
- Compact HTSSOP-32 package
- Input reverse polarity protection
- Indication LED drivers on chip
- Burst compliant up to 8 kV (see application note)

DBC3C40 – EBV'S MERCURYCODE-CYCLONE III INDUSTRIAL DEVELOPMENT BOARD

The Mercury development platform is based on Altera's Cyclone III FPGA designed for industrial applications such as the Ethernet-based field bus and motion control. It is used to demonstrate the ST 24 V input (SCLT3-8) and output drivers (VNI8200XP). A reference design for MercuryCode is available from ST to connect the SCLT3-8 and VNI8200XP development boards via the SPI interface. The SPI interface simplifies the galvanic isolation because of the reduction in the number of optocouplers.



SPI communication



SCLT3-8 datasheet and eng. samples available
 Production Q1/09
 STEVAL-IFP007V1 available in Q4/08

Ordering Information

Part number	Remark	IEC61131-2 Input	Output drive	Channel count	Surge level	Package
CLT3-4BT6	Tube	Type 1 & 3	Isolated	4	2 kV (see AN2527)	TSSOP-20
CLT3-4BT6-TR	Tape & Reel	Type 1 & 3	Isolated	4	2 kV (see AN2527)	TSSOP-20
Evaluation board						
STEVAL-IFP008V1	4-bit PLC Digital Input based on CLT3-4					
Part number	Remark	IEC61131-2 Input	Output drive	Channel count	Surge level	Package
PCLT-2AT4	Tube	Type 1, 2, 3	Isolated/CMOS-compatible	2	Type 1 & 3: 1 kV Type 2: 0.5 kV	TSSOP-14
PCLT-2AT4-TR	Tape & Reel	Type 1, 2, 3	Isolated/CMOS-compatible	2	Type 1 & 3: 1 kV Type 2: 0.5 kV	TSSOP-14
Evaluation board						
STEVAL-IFP004V1	2-bit PLC Digital Input based on PCLT-2					
Part number	Remark	IEC61131-2 Input	Output drive	Channel count	Surge level	Package
SCLT3-8BT8*	Tube	Type 1 & 3	Isolated through SPI	8	2 kV	HTSSOP-32
SCLT3-8BT8-TR*	Tape & Reel	Type 1 & 3	Isolated through SPI	8	2 kV	HTSSOP-32
Evaluation board						
STEVAL-IFP007V1**	16-bit PLC Digital Input based on SCLT3-8					

* available Q1/2009; ** available end of Q4/2008

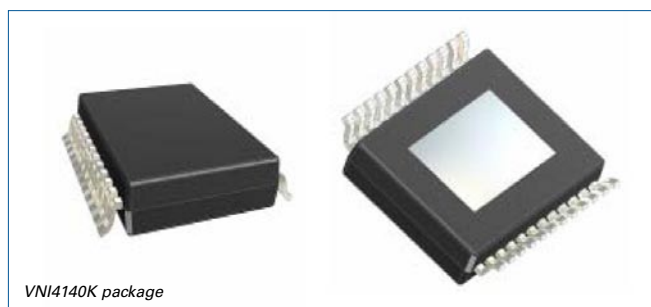
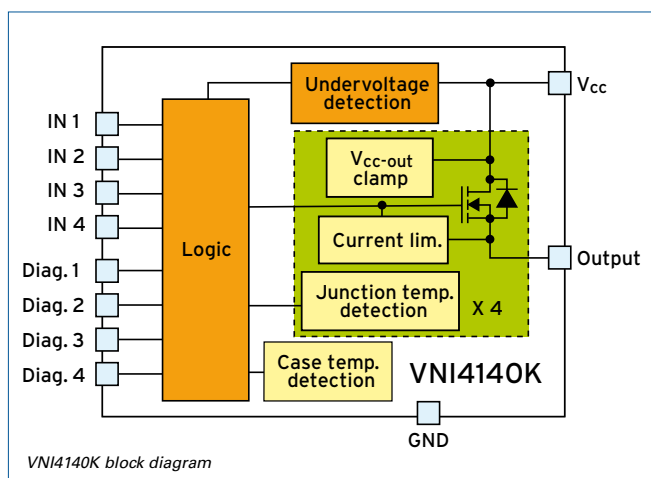
VNI2140J AND VNI4140K INTELLIGENT POWER SWITCHES (DUAL & QUAD)

Applications

IPS devices integrate a logic interface, drivers, power stage and protection circuits in chip to simplify the system design and save space in industrial applications such as peripheral output boards in PLCs, CNC machines and building automation controllers.

VNI4140K Key Features

- $R_{DS(on)} = 80\text{ m}\Omega @ 25\text{ }^\circ\text{C}$, $140\text{ m}\Omega @ 125\text{ }^\circ\text{C}$
- Quiescent current: $I_Q = 4.8\text{ mA}$
- Output current: 0.7 A per channel
- Current limitation: 1.1 A typical
- Four independent diagnostic outputs
- Shorted load protection
- Junction overtemperature protection
- Case overtemperature protection
- Thermal independence of the channels
- Protection against loss of ground
- Undervoltage shutdown
- Open drain diagnostic outputs
- 3.3 V CMOS/TTL-compatible inputs
- Fast demagnetisation of inductive loads
- Exposed slug design for optimal thermal performance
- Conforms to IEC 61131-2



Description

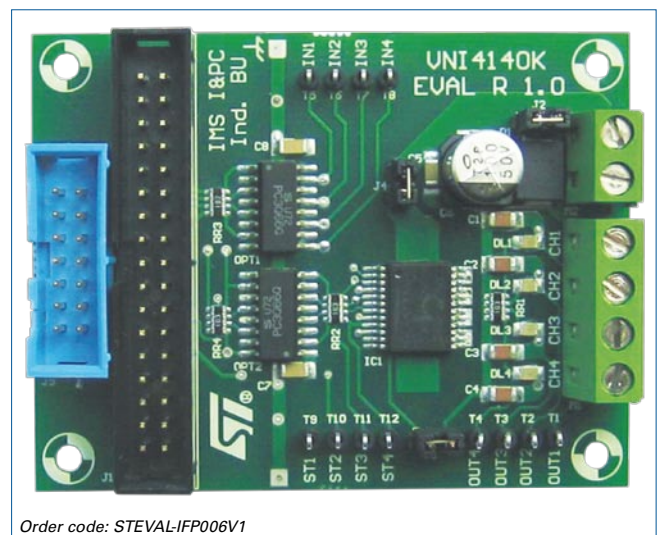
Industrial 24 V digital output boards in IP25, IP65 and IP67 packages are shrinking in size while the number of output ports is steadily increasing. This results in a higher power density/cm³. In the development of next-generation IPS products, ST has paid particular attention to thermal manage-

ment, system diagnostics and overall design costs. The new VNI4140K, VNI2140J are designed to minimise total power loss and to provide advanced diagnostics and thermal management at product and application level.

The VNI4140K and VNI2140J are quad/dual high-side drivers that can drive any type of load. The devices are manufactured using the latest generation of STM's VIPower® technology to achieve 50% savings in $R_{DS(on)}$ compared with previous devices with the same die size. Power consumption is cut by 40% compared with previous product generations. $4/2\ 80\text{ m}\Omega\ R_{DS(on)} @ 25\text{ }^\circ\text{C}$ low-voltage power MOSFETs are integrated. Each channel is fully protected against overload and short circuit (current limitation and junction overtemperature blocks); the junction overtemperature protection is thermally independent for each channel. Added protection features such as undervoltage shutdown, ground disconnection and case overtemperature made for indestructible devices in digital output applications. The case overtemperature sensor protects the FR4 substrate from hotspot damage under permanent short-circuit condition. The case sensor becomes active, if a channel is short-circuited and the package temperature reaches the upper threshold of $130\text{ }^\circ\text{C}$. The affected channel is then deactivated until the T_{case} sensor reaches the lower threshold of $105\text{ }^\circ\text{C}$. The channel then returns to its default state. Active current limitation avoids a power peak in the system power supply in the event of a shorted load. If more than one channel is overloaded, the TCSD restart is staggered to avoid high peak supply currents. Non-overloaded channels continue to operate normally. An integrated clamping network allows fast demagnetisation of large inductive loads with a single-pulse avalanche energy capability of 300 mJ , per channel at a time. Diagnostic outputs are open drain to allow wired-OR configurations with other devices.

The evaluation board supports fast evaluation of the product features and board-level-related EMC tests:

- EN61000-4-4 electrical fast transient: $\pm 4\text{ kV/A}$ (5 kHz)
- EN61000-4-5 high energy surge: $\pm 2\text{ kV/B}$ ($42\ \Omega/0.5\ \mu\text{F}$)
- With on the board Transil™ protection
- EN61000-4-6 RFI immunity 10 V_{RMS}
- With external capacitors 10 nF per each channel



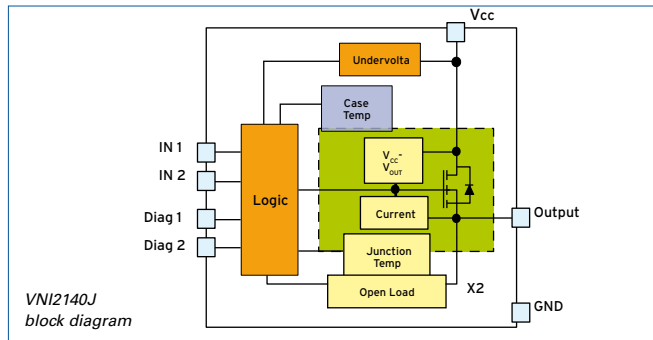
VNI2140J INTELLIGENT POWER SWITCH

Applications

IPS devices integrate a logic interface, drivers, power stage and protection circuits on one chip. This simplifies system design and saves space in industrial applications such as peripheral output boards in PLCs, CNC machines and building automation control systems.

VNI2140J Key Features

- $R_{DS(on)} = 80 \text{ m}\Omega @ 25 \text{ }^\circ\text{C}$, $140 \text{ m}\Omega @ 125 \text{ }^\circ\text{C}$
- Output current: 1.0 A per channel
- Current limitation: 1.3 A typical
- Shorted load protection
- Junction overtemperature protection
- Case overtemperature protection
- Thermal independence of channels
- Protection against loss of ground
- Open load indication
- Open drain diagnostic output
- Fast demagnetisation of inductive loads
- Conforms to IEC 61131-2



Description

The VNI2140J has the same functionality and electrical characteristics as the VNI4140K. In addition, the VNI2140J provides an open-load function in off state and supports diagnostics of a short-circuit to V_{CC} .

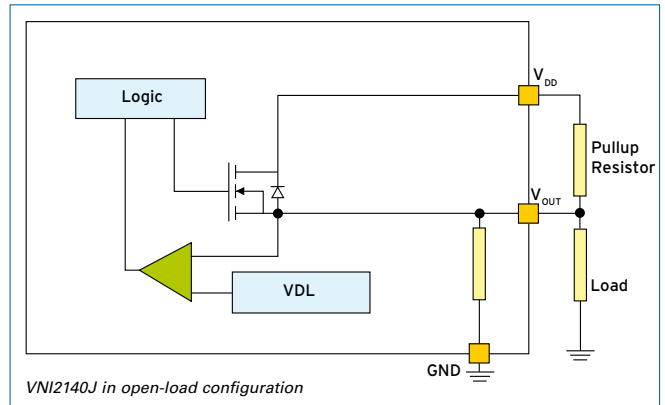
Open Load

To detect the open-load fault or the short to V_{CC} , a pull-up resistor must be connected between V_{CC} and the output pin. In a normal condition a current flows through the network made up of a pull-up resistor and a load. The voltage across the load is less than V_{OL} ; so the status is kept high. When an open-load event occurs the voltage on the output pin rises to a value higher than V_{OL} (depending on the pull-up resistor). The status pin then goes low.

Ordering information

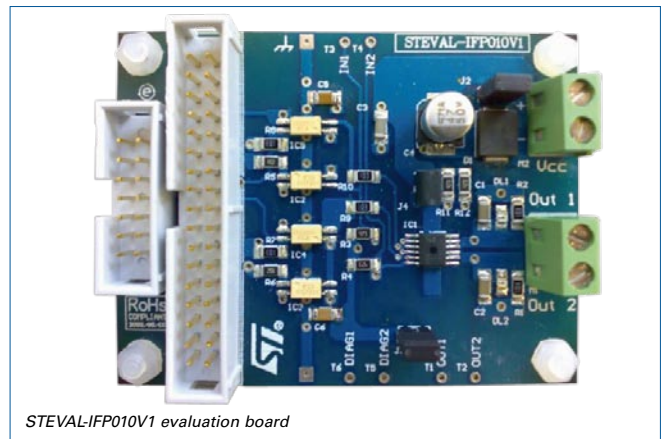
Part number	Channels	I_{OUT}	V_{CC}	$R_{DS(on)}$	V_{DEMAG}	Open-load diagnostics	Package
VNI4140K	4	0.7 A	41 V	80 m Ω	$V_{CC} \dots 50 \text{ V}$	No	PowerSSO-24
VNI2140J*	2	0.7 A	45 V	80 m Ω	$V_{CC} \dots 50 \text{ V}$	Yes	PowerSSO-12
VNI8200XP*	8	0.7 A	45 V	120 m Ω	$V_{CC} \dots 50 \text{ V}$	No	PowerSSO-36
VNI8200XPTR*	8	0.7 A	45 V	120 m Ω	$V_{CC} \dots 50 \text{ V}$	No	PowerSSO-36
Evaluation boards							
STEVAL-IFP010V1	2-bit 500 mA DO board and galvanic isolation						
STEVAL-IFP006V1	4-bit 500 mA DO board and galvanic isolation						

* available Q1, 2009



The product is supplied in a tiny 4.8 x 3.8 mm PSSO-12 package. The evaluation board supports fast evaluation of the product features and board-level-related EMC tests:

- EN61000-4-4 Electrical fast transient: $\pm 3 \text{ kV/A}$ (5 kHz)
- EN61000-4-5 High Energy Surge: 2 kV/B ($42 \text{ } \Omega/0.5 \text{ }\mu\text{F}$)
 - With on the board Transil™ protection
- EN61000-4-6 RFI immunity 10 V_{RMS}
 - With external capacitors 10 nF per each channel



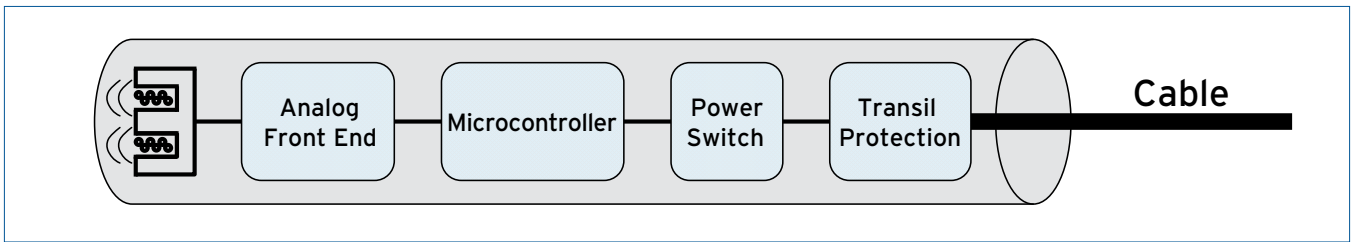
Product outlook: VNI820X XP conforms to IEC61131-2

A new OCTAL IPS family, VNI820X XP, is currently under development. This product is the first to contain a serial and a parallel interface. The typical MOSFET $R_{DS(on)}$ value is set to 120 m Ω . A highly efficient status LED control and diagnostic/LED control is implemented. Thanks to the serial and parallel interfaces, traditional parallel back panel architecture designs, as well as cost-effective SPI-based designs are possible.

Product eng. samples of VNI8200XP Q1/2009

STEVAL-IFP009V1 with proto types silicon available end of Q1/2009

SMART INDUCTIVE PROXIMITY SWITCH SYSTEM SOLUTION

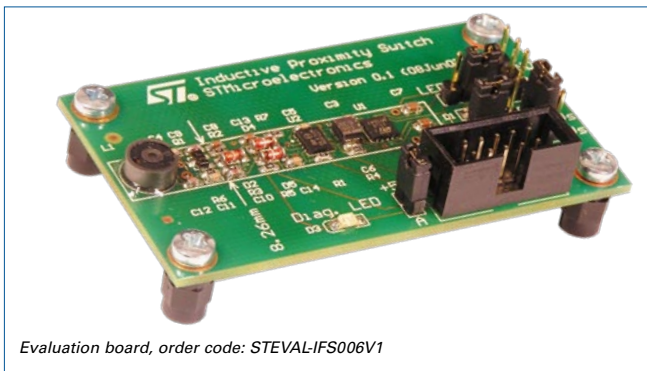


Smart Inductive Proximity Switch with ST7LITEUS5 and TDE1708DFT

Due to the cost and size of modern micro controllers, they are preferred in many applications, instead of conventional components. For example, the design of traditional inductive proximity switches relies on discrete components or ASICs. The evaluation design board solution presented here uses a low-cost general-purpose microcontroller that significantly extends the capabilities of such applications.

Description

The STEVAL-IFS006V1 is a reference design board for an inductive proximity switch based on the detection of metal bodies due to the effect of eddy currents on the HF losses of a coil. It consists from a single-transistor HF oscillator, an ST7LITEUS5 microcontroller and an TDE1708DFT intelligent power switch. The board is a highly compact and cost-effective solution designed with simplicity, large operating temperature rang and variable supply voltage in mind. After firmware upload and initial start-up the ST7 microcontroller performs a sensor functionality test. During normal operation it then controls the sensor output, based on the information it receives about oscillator amplitude and actual temperature. The on-board ICC connector offers in-circuit programming and in-circuit debugging capability to simplify the firmware development. The evaluation board output can be configured by jumpers for NPN and/or PNP functionality.



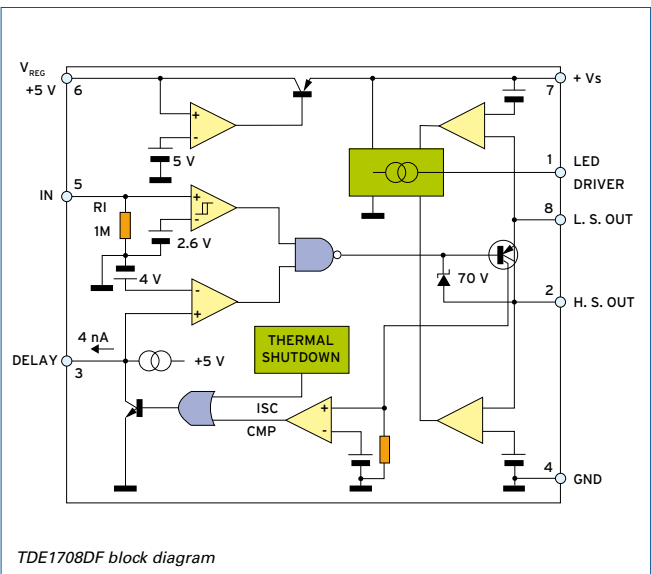
Evaluation board, order code: STEVAL-IFS006V1

ST7LITEUS5 Features

- 2 timers with input capture and PWM capability
- 10-bit A/D converter
- In-circuit programming and in-circuit debugging capability, debug module
- 5 power saving modes, watchdog
- DFN-8 4.5 x 3.5 mm package

TDE1708DFT Features

- 250 mA output current
- Low-side and high-side switch configurations
- 6...48 V supply voltage range
- Overload and short-circuit protection
- Internal voltage clamping
- Supply and output reversal protections
- Thermal shutdown
- +5 V regulated aux. voltage
- LED driver indicator status
- QFN-8 4 x 4 mm package



TDE1708DF block diagram

Triple Transil Array SPT01-335

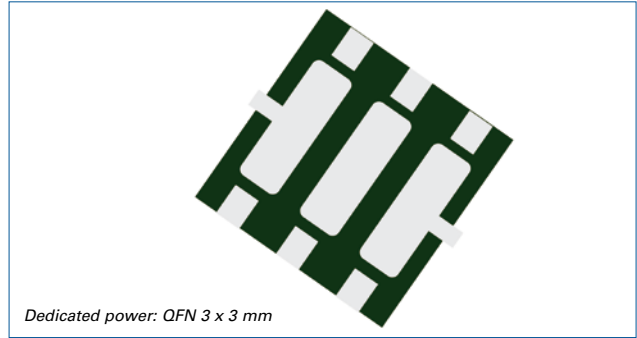
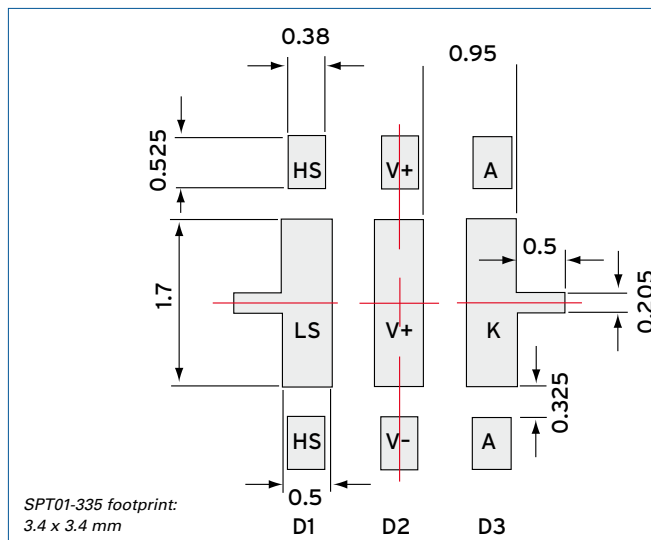
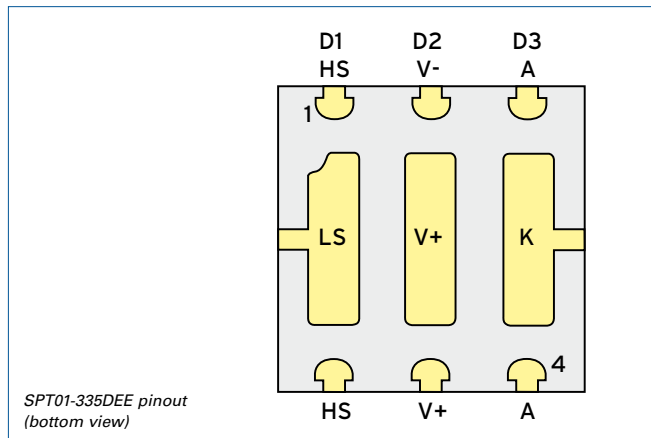
The transil protection for 24 V proximity sensors was specially designed in collaboration with our customers. It provides a very compact solution for efficient protection of bus, output power switch of the sensor and reverse blocking. Demagnetisation of an inductive load driven by the protection diode is another key feature. The transil array can be used with any output power stage. Two configurations are possible: PNP or NPN (see diagram on next page). The highly compact package means it can be used in applications that would otherwise have to omit the protection features and it also offers significant cost savings compared with traditional designs consisting of three separate transils. Thanks to high-performance technology, the SPT01 works with sensor that comply with IEC61000-4-2, IEC61000-4-4 and IEC61000-4-5 standards.

Applications

- Factory automation sensor applications
- Proximity sensor interface protection
- Transient and surge voltage protection

Features

- 6...32 V supply voltage range
- Clamping voltage: 40 V typical
- 200 mA direct sensor switch current
- Blocking diode maximum 10 ms, $I_{FSM} = 600$ mA square pulse current
- Demagnetisation of inductive load $L = 1$ H, $I = 200$ mA
- Flexible connection for PNP and NPN configurations
- Operating temperature range: -25...+85 °C
- QFN 3 x 3 mm package



Protection features

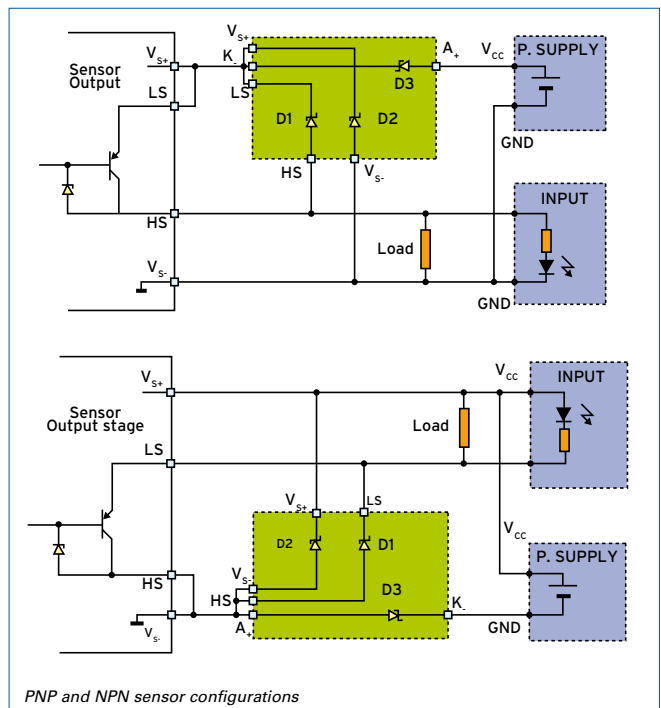
- Voltage surge: IEC61000-4-5; ± 1 kV with $R_c = 500 \Omega$
- Electrostatic discharge: IEC61000-4-2; ± 6 kV in contact; ± 8 kV in air
- Electrical transient immunity: IEC61000-4-4; ± 2 kV

Benefits

Compliant to IEC61131-2 interface with logical input type: 1, 2 & 3

Compliant with sensor standard: EN60947-5-2

Recommended for all 24 V, 200 mA power stages in PNP/NPN configurations (see diagram below)



Ordering Information

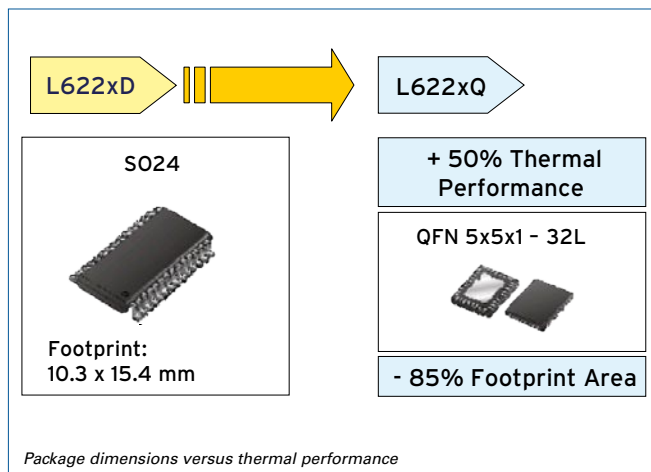
Part number	Flash Memory	RAM	ADC	Operating temperature	Package
ST7LITEUS5	1 KB (Data Retention 2 Y @ 55°)	128 Byte	10-bit	-40...125 °C	DFN (4.5 x 3.5 mm)
Part number	Config.	Output Current	Protection	Add. Features	Package
TDE1708DF	HSD/LSD	250 mA	Short Circuit, Reverse Supply	5 V LIN Reg. Indicator Status LED	DFN 4 x 4 mm
TDE1708DFT (T = T & R)	HSD/LSD	250 mA	Short Circuit, Reverse Supply	5 V LIN Reg. Indicator Status LED	DFN 4 x 4 mm
Part number	D3 Drop-Voltage	VCL	V _{cc} max.	E _{DEMAG} *	Package
SPT01-335DEE*	V _i : <1 V @ 0.3 A	<49 V @ 2 A & 8-20 μ s	>35 V	<100mJ @ I _p = 0.2 A, L = 1 H	QFN 3 x 3 mm
Evaluation board					
STEVALIFS006V1	The board comes without triple-protection array; with triple-protection array available Q1/09				

*production Q1/2009, eng. samples are available

POWERSPIN – LOW VOLTAGE MOTOR CONTROL SOLUTIONS

Low Voltage Motor Control Solutions – PowerSpin

ST offers a fully integrated family of LV motor control chips called PowerSpin. This renowned portfolio consists of dual full-bridge and triple half-bridge drivers including control core ideal for driving DC, stepper or brushless DC motors. The power stages of the chips are designed in two DMOS sizes with $R_{DS(on)}$ at 0.73Ω and 0.3Ω to provide current levels of $1.4 A_{RMS}$ (L622x) and $2.8 A_{RMS}$ (L620x). The products are available in various packages that differ by size, thermal features and cost. Refer to the overview table for detailed product configuration.



Common Features

- BDCIII, $1 \mu m$, 60 V mixed-signal power technology
- Operating supply voltage: 8...52 V
- PowerMOS output stage
 - Typical $R_{DS(on)} = 0.3 \Omega$ or 0.73Ω @ $T_j = 25^\circ C$
 - Intrinsic fast free-wheeling diodes

In 2008 most of the L622x chips became available also in QFN32 packages. This doubles the thermal performance in terms of thermal resistance of junction to case and saves approximately 85% footprint area on the printed circuit board compared with the SO24.

Dedicated Product Features per Family

Main applications: DC and Stepper Motors

L62x5

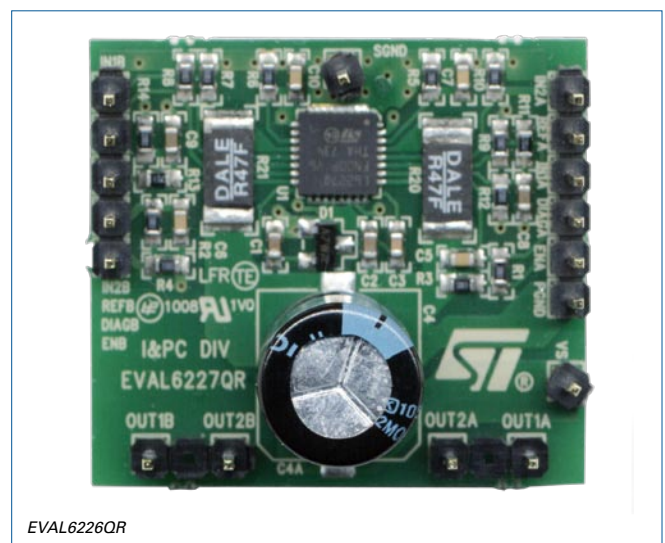
Family with a dual full-bridge and lowest pin count. Non-dissipative current sensing on the high DMOS and fixed overcurrent limit. Suitable for single/dual DC and stepper motors.

L62x6

Family with programmable overcurrent limiter on top of L62x5. Suitable for single/dual DC and stepper motors.

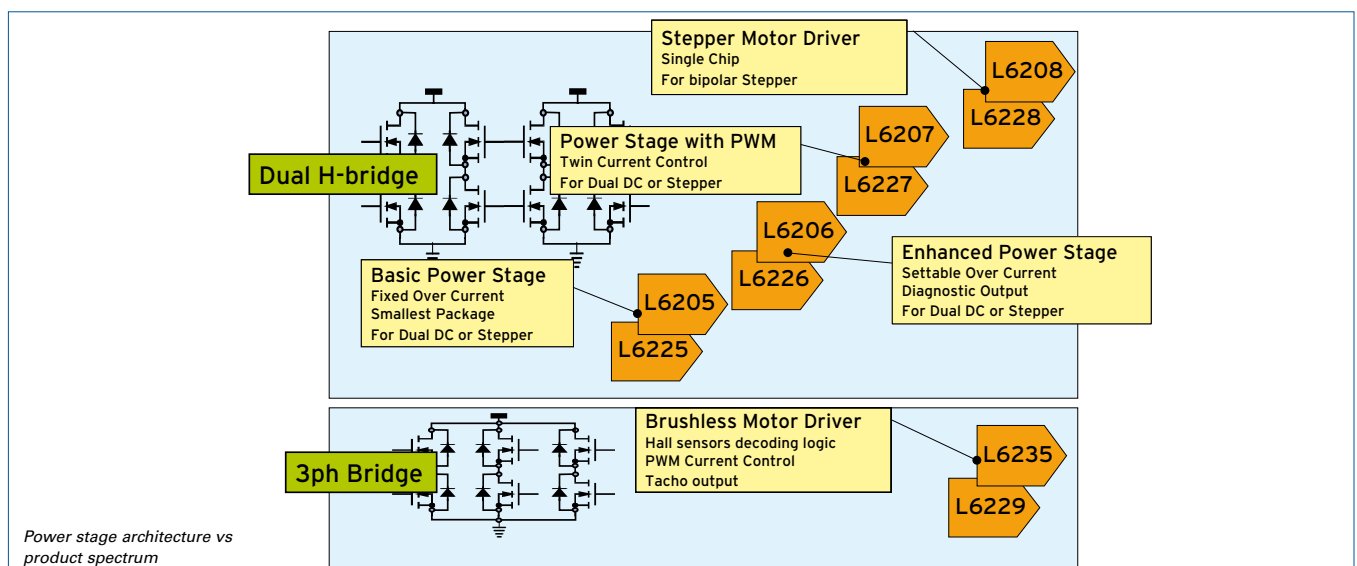
L62x7

Superset of L62x5 family with integrated PWM current control for each full bridge. Suitable for dual DC and stepper motors.



L62x8

Fully integrated stepper motor driver including sequence generator and PWM current control. Thanks to simple host interface it can be controlled by simple logic or low-performance microcontroller. Digital signals set half/full step, direction and current recirculation mode (slow/fast decay). Ideal solution for bipolar stepper motor drives.



L6229/L6235 for Brushless Motors

Fully integrated BLDC drivers including Hall-sensor decoding logic, PWM current control. Embedded tachometer output can be used to close the speed regulation loop. Current recirculation works in slow decay mode. Products for quick and easy control of BLDC motors without special effort.

Main Features

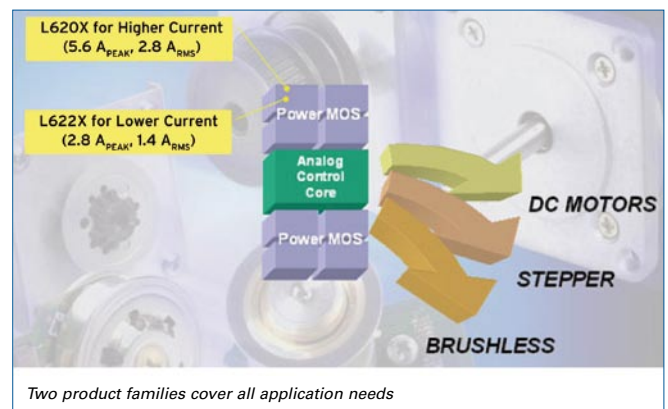
- BDCIII, 1 μm , 60 V mixed-signal power technology
- Operating supply voltage 8...52 V
- PowerMOS output stage:
 - Typical $R_{\text{DS(on)}} = 0.3 \Omega$ or $0.73 \Omega @ T_j = 25 \text{ }^\circ\text{C}$
 - Intrinsic fast free-wheeling diodes
- Two product classes covering different current ratings:
 - L620X and L6235, $5.6 \text{ A}_{\text{PEAK}}$ and $2.8 \text{ A}_{\text{RMS}}$
 - L622X, $2.8 \text{ A}_{\text{PEAK}}$ and $1.4 \text{ A}_{\text{RMS}}$
- Extensive protection schemes:
 - Non-dissipative high-side current sensing for overcurrent protection
 - Cross conduction protection
 - Thermal protection
 - Undervoltage lock out
- Operating frequency up to 100 kHz
- Cross conduction protection
- Thermal shutdown
- Adjustable overcurrent detection (L62x6)
- PWM current control (L62x7, L62x8, L6229, L6235)
- Fully integrated BLDC drive (L6229, L6235)
 - Hall-sensor decoding logic
 - Torque/speed easy drive
- PowerSO, SO, DIP, QFN package options

Application informations

Chips without PWM current control can be simply paralleled for higher output power or to decrease the application's power dissipation. The products are supported by full set of evaluation boards and PC software.

The single control board (EVALPRACTISPIN) is interfacing the power application boards with a HMI Interface for example a PC. It provides advanced control functions and works with all product evaluation boards.

Included software is used to set different speed/torque (current) and acceleration/deceleration rates. It is also possible to work in indexing mode with stepper motors, or to calculate application variables like thermal data. There are also many other functions that speed up and facilitate customer applications.



For more information visit: www.st.com/powerspin

Ordering Information

Part number	I_{out}	Function	Description	Package
L6229Q, L6229PD	$1.4 \text{ A}_{\text{RMS}}$	3-phase brushless motor drive	Hall sensor decoding logic, PWM current loop, diagnostic output, fixed overcurrent detection	QFN32PowerSO36
L6235PD	$2.8 \text{ A}_{\text{RMS}}$	3-phase brushless motor drive	Hall sensor decoding logic, PWM current loop, diagnostic output, fixed overcurrent detection	PowerSO36
L6228Q, L6228PD	$1.4 \text{ A}_{\text{RMS}}$	Bipolar stepper motor driver	Stepping sequence generation logic, twin PWM current loop, diagnostic output, fixed overcurrent detection	QFN32, PowerSO36
L6208PD	$2.8 \text{ A}_{\text{RMS}}$	Bipolar stepper motor driver	Stepping sequence generation logic, twin PWM current loop, diagnostic output, fixed overcurrent detection	PowerSO36
L6227Q, L6227PD	$1.4 \text{ A}_{\text{RMS}}$	Dual H-bridge with PWM control	Twin PWM current loop, diagnostic output, fixed overcurrent detection	QFN32, PowerSO36
L6207PD	$2.8 \text{ A}_{\text{RMS}}$	Dual H-bridge with PWM control	Twin PWM current loop, diagnostic output, fixed overcurrent detection	PowerSO36
L6226Q, L6226PD	$1.4 \text{ A}_{\text{RMS}}$	Dual H-bridge with adjustable overcurrent detection	Diagnostic output, adjustable overcurrent detection	QFN32, PowerSO36
L6206PD	$2.8 \text{ A}_{\text{RMS}}$	Dual H-bridge with adjustable overcurrent detection	Diagnostic output, adjustable overcurrent detection	PowerSO36
L6225PD	$1.4 \text{ A}_{\text{RMS}}$	Dual H-bridge with fixed overcurrent detection	Fixed overcurrent detection	PowerSO20
L6205PD	$2.8 \text{ A}_{\text{RMS}}$	Dual H-bridge with fixed overcurrent detection	Fixed overcurrent detection	PowerSO20
Evaluation Boards			Description	
EVAL6226QR			DMOs dual full-bridge driver in QFN package evaluation board	
EVAL6227QR			DMOS dual full-bridge driver with PWM current controller in QFN package evaluation board	
EVAL6228QR			DMOS stepper motor driver with PWM current controller and sequence generator in QFN package evaluation board	

Products are supplied in tube or tray or 13" tape&reel (ordering code with extension TR)

L639X: SMARTDRIVE™ FAMILY

Highly Versatile Innovative Solution for MOSFET/IGBT Drivers

The L639x is a new highly integrated, versatile high-voltage gate driver platform that makes it easy to design control systems for a wide range of inductive loads. Applications include motors for home appliances and industrial drives, HID ballasts and power supply units.

Key Features

- Half-bridge for up to 600 V off-line applications
- Current capability: 270/-430 mA typical
- 3.3, 5, 15 V input logic compatibility
- Op-amp for advanced current sensing
- Comparator for protection
- Integrated bootstrap diode
- Smart/fast shutdown block
- Dedicated pin for external SD
- Undervoltage lock-out on V_{boot} and V_{cc}
- Adjustable DT
- Dual inputs/inputs out of phase
- SO/DIP14 and SO/DIP16 packages

L639x Functional Description

The L639x, ideal for field-oriented control applications, is destined to become the new reference in motor driver design.

The integrated 8 MHz operational amplifier provides current sensing to feed, for example, A/D converters. Advanced features such as an externally adjustable dead-time and interlocking function prevent the power stage from possible cross-conduction. The embedded fast comparator can be used for the fault protection to prevent overcurrent and overtemperature situations or other types of malfunction. Patented smart shutdown circuitry provides an intelligent fault management operation.

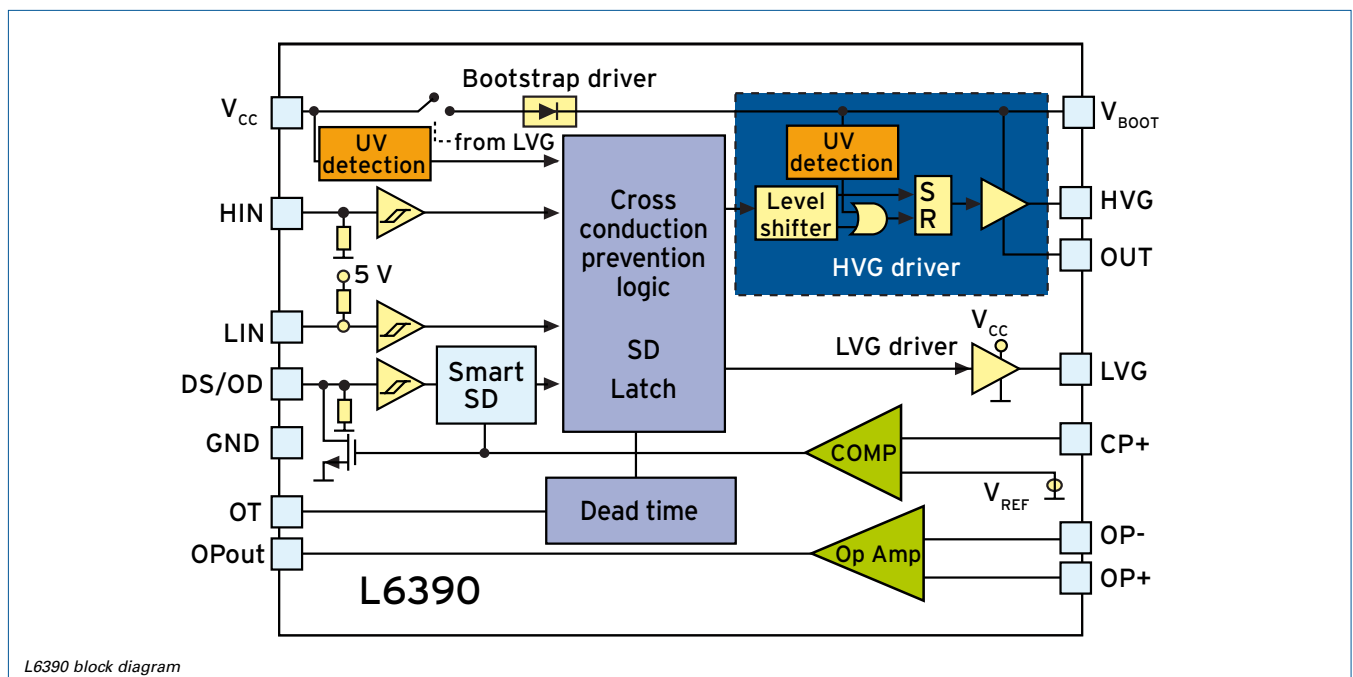
Main Applications

Home appliances: washing machines, dishwashers, air conditioning systems, field-oriented motor control systems, pumps, fans, DC motors, industrial drives in factory automation, lighting applications, HID ballasts, fluorescent lamps, PDP, LCD backlighting, power supplies, UHP7.

Advantages and Benefits

Using the L6390 results in more flexible, easier and faster designs. Moreover, applications are fully protected. Smaller BOMs mean lower costs.

The L6390 is also optimised for working in very high noise applications. The immunity is guaranteed by an external dV/dt of up to 50 V/ns on the output of the power stage, thanks to the robust design and high-performance internal level shifter.



L6390 block diagram

Ordering Information

	Current sink/source [mA]	Bootstrap voltage [V]	Supply voltage [V]	Input phasing	Dead time	Smart SD	Cross conduction logic	Comp.	Op-amp	Package
L6390	270/430	600	12...20	Out of phase	Adjust	Y	Y	Y	Y	DIP-16
L6390D										SO-16
L6392				Out of phase		N	Y	N	N	DIP-14
L6392D										SO-14
L6393				One input		N	Y	Y	N	DIP-14
L6393D										SO-14



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MEMS SENSORS

STMicroelectronics is a leading supplier of MEMS (microelectromechanical system) devices and produces a wide range of acceleration sensors.

MEMS: More than Electrons on the Move

MEMS is a new technology that exploits the mechanical properties of silicon to integrate mechanical structures sensitive to vibration, displacement, acceleration and rotation. This new technology opened the door to a new generation of compact, cost-effective and sensitive sensors. While conventional microelectronics development focuses on incremental improvements of an established technology, MEMS challenges the way designers work, compelling them to think 3-dimensionally and to acquire a unique blend of multi-disciplinary skills that combine electrical, semiconductor and mechanical design aspects.

The new generation of sensors based on MEMS technology can be grouped into four families: motion sensors, pressure sensors, RF devices and microfluidic devices.

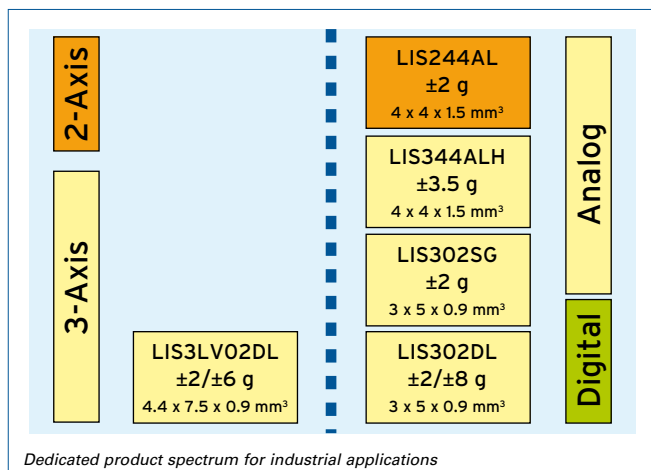
MEMS-based motion sensors are devices that sense linear acceleration in each axis or angular acceleration. ST has already approached this market and our company today offers a rich portfolio of competitive linear accelerometer sensors. The industrial market quickly acknowledged that MEMS sensors score heavily both in terms of price/performance and ruggedness when it comes to motion detection, vibration analysis, measurement equipment and robotic systems.

The Two Key Elements of MEMS

- MEMS sensor, the mechanical element made of silicon that senses the motion
- Interface chip, the IC that converts the motion measured by the sensor into an analog or digital signal

For reasons of cost and flexibility, ST has chosen to develop solutions in which the mechanical sensor and the interface chip are housed in the same standard IC package.

STM's family of MEMS-based motion sensors includes linear accelerometers that sense linear acceleration or vibration in one, two or even three linear axes.

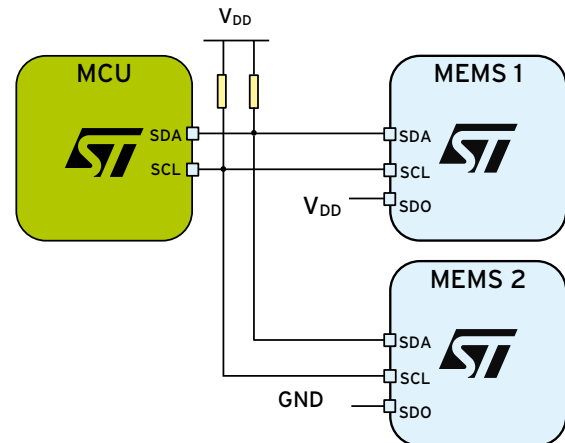


Key Features

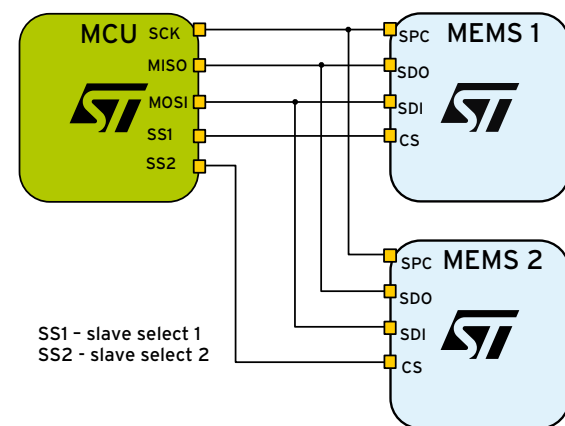
- ±2 g, ±6 g, ±8 g range
- Optimised for 2.5, 3.0, 3.3 V
- Supply voltage range: 2.16...3.6 V
- Digital MEMS with 12-bit data resolution
- Factory trimmed parameters
- Programmable thresholds
- Less than 1 mg of resolution
- Temperature range: -40...+85 °C
- Supply current <1 mA
- Robustness: 10000 g for 0.1 ms

Applications

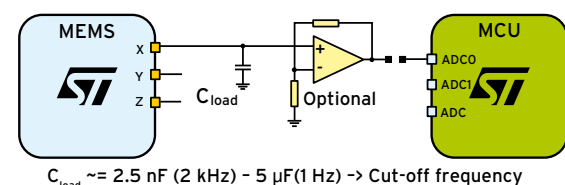
An obvious industrial application for MEMS sensors is vibration monitoring and control. MEMS sensors can be used to measure vibrations and thus help to identify potential machine problems prior to equipment failure. As such they can play a key role in the preventive maintenance of pumps, spindles, compressors, fans, gears and motors.



I²C communication interfaces for digital MEMS

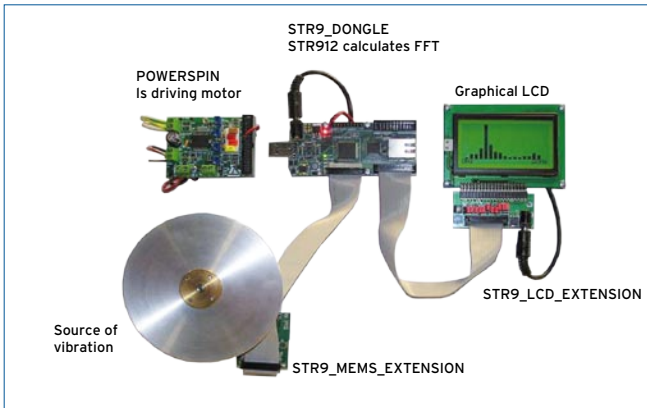


SPI for digital MEMS



Analog outputs for analog MEMS

Motor Vibration Analysis



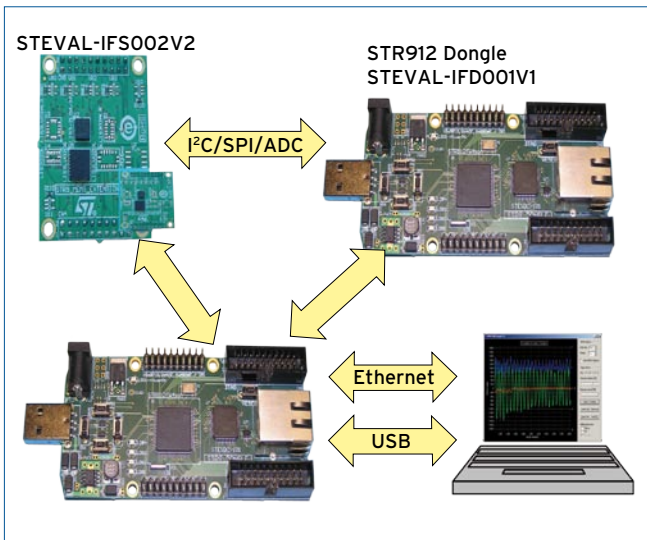
Description

- Stepper motor is the source of the vibration
- MEMS is the sensing element
- Data are transferred from MEMS to STR912
- STR912 calculates the FFT
- STR912 shows the result on the LCD

Documentation

<http://www.st.com/mems>

Evaluation Boards



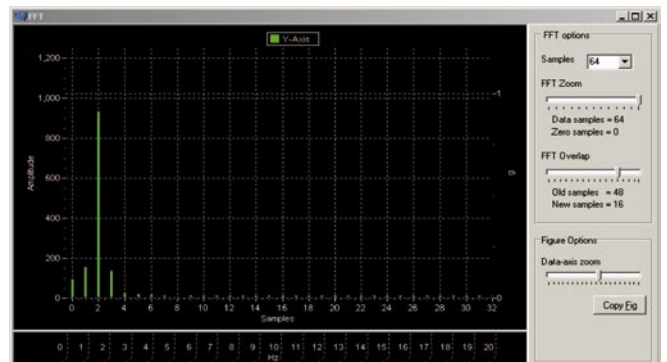
Documentation

http://www.st.com/stonline/products/families/sensors/eval_boards.htm

Software

MEMS USB Reader

- Show MEMS data
- Copy data into the excel directly via clipboard
- Copy diagram as metafile via clipboard
- Save data into a csv file
- Butterworth filter (low-pass, hi-pass,...)
- FFT for 16, 32, 64, 128 samples
- Software adapted for frequency analysis in 0...20 Hz range (MEMS allow up to 1 kHz)
- Optional FFT zoom (fill with zeros)
- Optional FFT overlap changing



Ordering Infomation

Part number	Description	Package
LIS244AL	MEMS motion sensor: 2-axis - ± 2 g ultracompact linear accelerometer	ECOPACK®
LIS344ALH	MEMS inertial sensor high performance 3-axis $\pm 2/6$ g ultracompact linear accelerometer	LGA 16L (4 x 4 x 1.5 mm) land grid array package
LIS302SG	MEMS motion sensor 3-axis - ± 2 g analog output 'piccolo' accelerometer	LGA-14 (3 x 5 x 0.92 mm) pitch 0.8 mm land grid array package
LIS302DL	MEMS motion sensor 3-axis - $\pm 2/8$ g smart digital output piccolo accelerometer	LGA14 (3 x 5 x 0.92 mm) pitch 0.8 mm land grid array package
LIS3LV02DL	MEMS inertial sensor: 3-axis - $\pm 2/6$ g digital output low-voltage linear accelerometer	LGA16 (4.4 x 7.5 x 1 mm) land grid array package
Evaluation boards		Description
STEVAL-MKI005V1	MEMS 3-axis - $\pm 2/6$ g digital output low-voltage linear accelerometer evaluation board based on LIS3LV02DQDL	
STEVAL-MKI006V1	MEMS 3-axis - $\pm 2/8$ g digital output low-power linear accelerometer evaluation board based on LIS302DL	
STEVAL-MKI009V1	LIS3LV02DL adapter board designed to be plugged into a standard DIL 20 socket	
STEVAL-MKI013V1	LIS302DL adapter board designed to be plugged into a standard DIL 24 socket	

AUXILIARY POWER SUPPLY FOR FREQUENCY INVERTER AND DC/DC CONVERTER TO CREATE A 24 V_{DC} BUS

Auxiliary Supply for Frequency Inverter

With industrial applications utilizing ever higher voltage levels, designers are often required to build a 3-phase auxiliary switched-mode power supply using a high-voltage semiconductor switch.

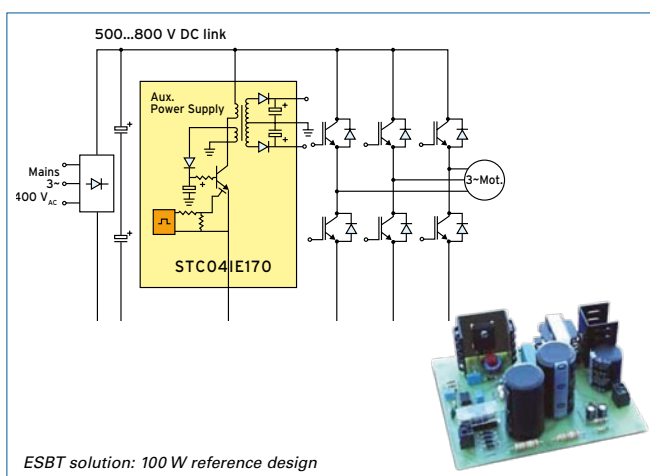
The applications either work off the 3-phase network or they need to offer a wider range of input connections (super wide range). This increase in the working voltage level inevitably results in limited safety of standard power supply components.

Examples of input voltage ranges:

- 1-phase mains AC_{NOM} ~ 240 V (UK)
- 3-phase AC_{NOM} ~ 415 V
- 3-phase DC_{NOM} ~ 587 V
- 3-phase DC_{MAX} + 6% ~ 623 V
- Super wide range 85...415 V_{AC}

ST offers different MOSFET- and ESBT-based power switch solutions depending on voltage and power needs. The target markets for these applications include heating control systems and blowers, motor control, welding, UPS, renewable energy generation and metering.

	MOSFET	ESBT
Benefits	Easy driving Possible to use for high frequencies	Available for high-voltage applications Lower 'resistance' (voltage drop) at saturation for same die size compared with HV MOSFET
Drawbacks	Large chip size for HV-MOSFET High R _{DS(on)} for HV	High base current, high driver output capability needed (PWM) Slower switching speed
Useful	For relatively low-power auxiliary supplies < ~ 50 W	Higher-power auxiliary supplies where cost benefit of ESBT outweighs additional cost of base drive

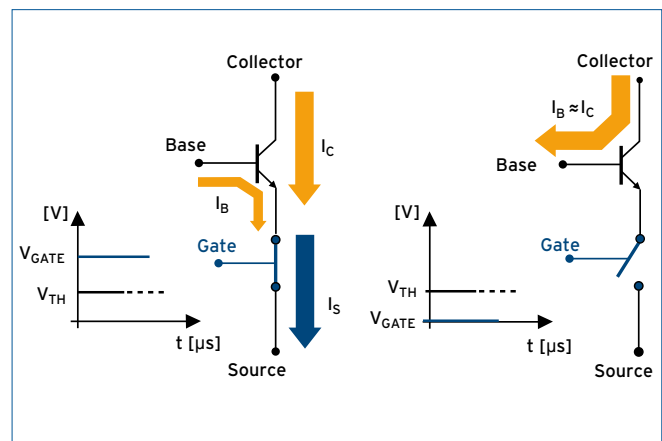


The STEVAL-ISA015V2 evaluation board uses ESBTs for maximum output power of 100 W in a fly-back topology. This choice is popular in applications where the required power is normally less than 200 W. For details of the evaluation board design refer to AN2252.

STM's ESBT family has overcome the high-voltage, high-power barrier with a new series of transistors designed for a wide range of 3-phase mains power supplies. Switching over 100 kHz, the ESBTs provide cooler and more reliable solutions for auxiliary supplies from 50 to over 200 W with a voltage capability of 900...2200 V.

STC04IE170

As a member of STM's family of monolithic ESBTs, the STC04IE170 combines on a single chip a high-voltage bipolar and a low-voltage MOSFET structure in a cascaded configuration. Like all ESBTs from STM, the STC04IE170 thus minimises conduction and turn-off losses, cost and driving power, and maximises switching frequency, efficiency and output power.

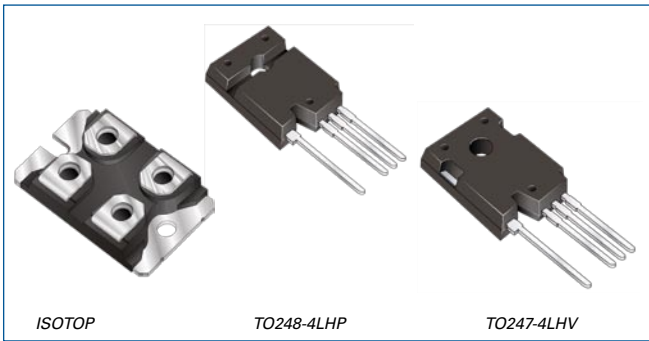


Another advantage of the STC04IE170 is its high breakdown voltage. This allows designs in fly-back topology to operate with a higher fly-back (reflected) voltage and thus a higher duty cycle. In combination with the quasi-resonant L6565 controller this results in even lower switching losses and enables power supplies to handle higher power or accept a wider input voltage range.

The monolithic integration results in a square RBSOA. This solution differs from traditional power bipolar transistors and is superior with respect to ruggedness and useful operating voltage. A 100 W auxiliary power supply reference design is available with order code STEVAL-ISA015V2.

The design can be easily adapted to new products. These include the STC03DE220HV for managing input voltages up to 690 V_{AC} in an enhanced creepage package (TO247-4L HV) and the STC03DE220HP in a fully insulated, enhanced creepage package (TO247-4L HP).

Product Features	Reference Design Highlights
<ul style="list-style-type: none"> • High voltage/high current cascade configuration <ul style="list-style-type: none"> • Low equivalent on resistance • Very fast switch, up to 150 kHz • Squared RBSOA, up to 2200 V • Very low CIS driven by RG = 47 Ω • Very low turn-off cross-over time • Complies with European Directive 2002/93/EC • Packages: TO247HP, TO247HV, fully isolated with increased creepage distance 	<ul style="list-style-type: none"> • Input voltage: 400 V_{AC} ± 20% • Output power: 100 W • High efficiency (90%) • Switching frequency: 50...85 kHz • Safety features comply with EN60950



This solution takes advantage of the 1500 V MOSFET to optimise operation of the quasi-resonant flyback converter based on the L6565 primary controller.

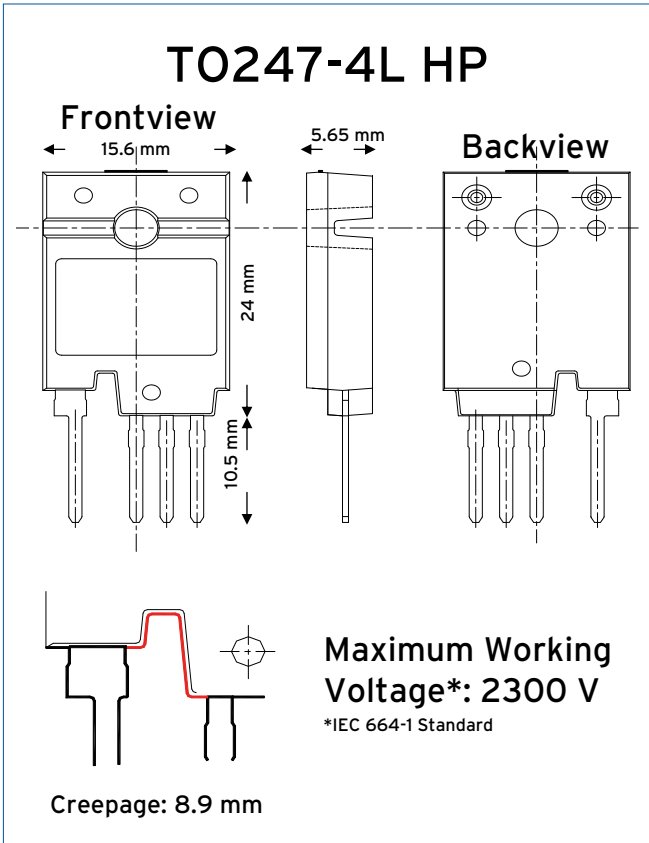
The STFW3N150 and STFW4N150 are 1500 V power MOSFETs, designed with STMicroelectronics' proprietary high-voltage MESH OVERLAY™ technology.

This technology features are a very low $R_{DS(on)}$ per area, low gate charge and high switching performance.

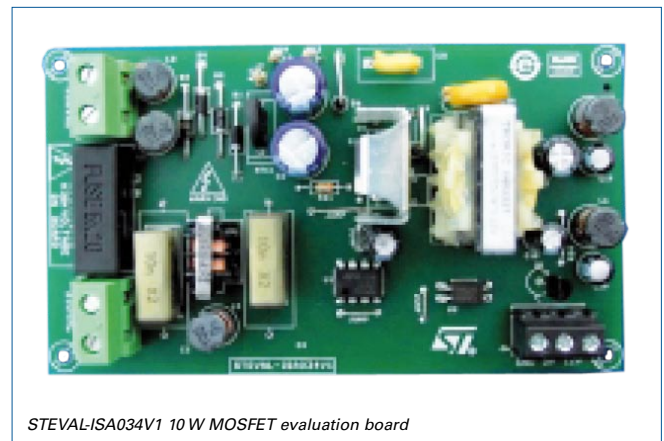
Devices are housed in TO-3PF package with increased creepage distance.

Available design tools/reference designs: STEVALISA034V1 with two isolated outputs (12 V and 5 V) with total 10 W output, STEVAL-ISA031V1 with maximum 40 W output.

For details of the evaluation board design refer to the STEVAL-ISA034V1 data brief.



Features	Reference Design Highlights
<ul style="list-style-type: none"> • Avalanche ruggedness • Gate charge minimized • Very low intrinsic capacitance • High-speed switching • Fully isolated TO-3PF package • Creepage distance path is 5.45 mm (typ.) 	<ul style="list-style-type: none"> • Input voltage range: 185...460 V_{AC} • Input frequency range: 50/60 Hz <ul style="list-style-type: none"> • Output 1: 12 V @ 0.6 A • Output 2: 5 V @ 0.55 A • Output power: 10 W • Safety: EN60950 • EMI: EN55014



MOSFET Solution: 10 W Reference Designs

For lower-power 3-phase mains industrial auxiliary power supplies ST offers reference designs with high-voltage power MOSFETs.

Ordering Information

ESBT			
Part number	Volt	Description	Package
STC04IE170HP	1700	Low equivalent on resistance, very fast switching, up to 150 kHz, squared RBSOA, up to 1700 V, very low CIS driven by $R_c = 47 \Omega$	TO247-4L HP
STC03DE220HP	2200	Hybrid emitter switched bipolar transistor ESBT 2200 V - 3 A - 0.33 Ω	TO247-4L HP
Evaluation board		Description	
STEVAL-ISA015V2		100 W, 24 V output, ESBT	
MOSFET			
Part number	Volt	Description	Package
STFW3N150	1500	N-channel 1500 V < 9 Ω - 2.5 A - very high voltage PowerMESH™ power MOSFET	TO-3PF
STFW4N150	1500	N-channel 1500 V - < 7 Ω - 2.5 A	TO-3PF
Evaluation board		Description	
STEVAL-ISA034V1		10 W, 5 V and 12 V output, MOSFET	
STEVAL-ISA031V1		40 W MOSFET	

DEFINITIONS, ACRONYMS AND ABBREVIATIONS

Acronyms and abbreviations used in this brochure:

ASIC	Application-Specific Integrated Circuit
BLDC motor	Brushless DC motor
CMOS	Complementary Metal Oxide Semiconductor
DC	Direct Current
DIP	Dual In-line Package
DMO	Digital Memory Oscilloscope
EMC	Electromagnetic Compatibility
ESBT	Emitter-Switched Bipolar Transistor
ESD	Electrostatic Discharge
FFT	Fast Fourier Transformation
FPGA	Field-Programmable Gate Array
IC	Integrated Circuit
IP	Intellectual Property
IPS	Intelligent Power Switch
IR	Infrared
LCD	Liquid Crystal Display
LDO regulator	Low-Dropout Regulator
MEMS	Microelectromechanical System
PAC	Programmable Automation Controller
PLC	Programable Logic Controller
PWM	Pulse Width Modulation
RF	Radio Frequency
SMPS	Switched-Mode Power Supply
SoC	System-on-Chip
SPI	System Programming Interface

ABOUT STMICROELECTRONICS

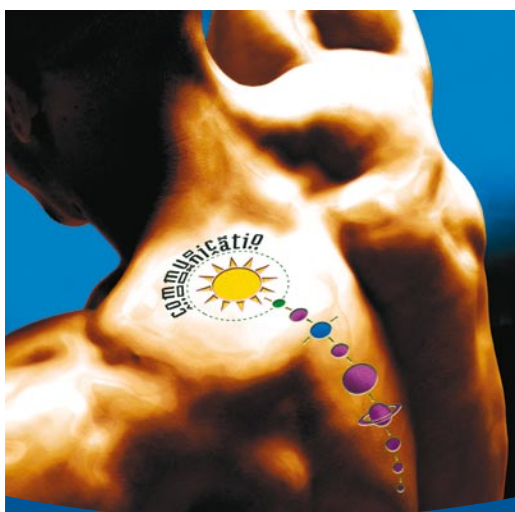
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MercuryCode

EBV Reference Design Solution for Industrial Communications



The EBV MercuryCode reference design platform was developed in conjunction with Altera®. It is based on the Cyclone III FPGA technology with several I/O transceivers and is dedicated to industrial communications.

Using a Nios® II processor and the Microsoft .NET framework, the board supports industrial I/O standards such as CAN, USB, RS485, RS232 and 24 V I/O for direct connection to the industrial automation world. The MercuryCode reference design platform is priced at € 579. An extended version includes a USB Blaster™ and Nios II license and costs € 725. For more information visit

www.ebv.com/mercurycode

STMicroelectronics industrial digital input termination and digital output power switches with SPI can be used to realize an intelligent DI/DO node that can be connected to MercuryCode via an SPI bus interface.

- STEVAL-IFP007V1 to build an intelligent DI/DO node (refer to details on page 6)
- STEVAL-IFP009VI, based on VNI8200, available 1st half 2009

