

Intelligent Power Switches (IPS)

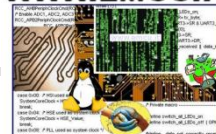
*Driving inductive loads in
industrial applications*

Modena, 15 Aprile 2014



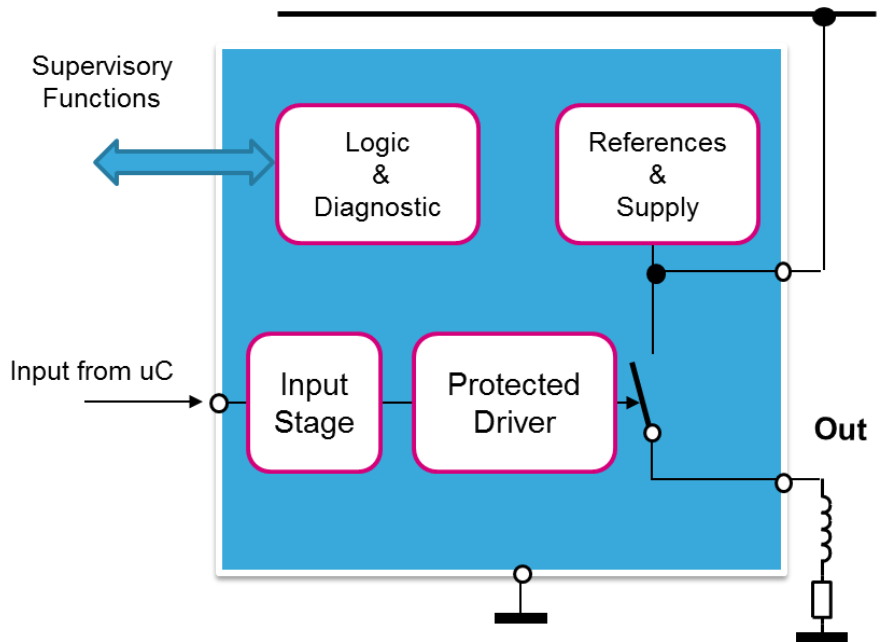
Power 'n More
SILICA Power Solutions

WWW.EMCU.IT



► To replace mechanical switches in driving **loads (inductive, capacitive and resistive)** thanks to:

- Monolithic Fully Protected Power Stage and Control
- Designed for Harsh Environment ($-40^{\circ}\text{C} \dots +150^{\circ}\text{C}$)
- Exhaustive Diagnostics



► Factory Automation

- Programmable Logic Controller
- Programmable Automation Controller
- Distributed I/O modules
- Process Instrumentation

► Textile Industry

- Sewing machines

► Building Automation

- Alarms / Security systems

► Agricultural Systems & Vehicles

- Hydraulics/pneumatics control (due to 24V supply system)

► Green Energy Applications

- Windmills (auxiliary functions)

► Motor Drives

- AC Variable Speed Drives
- Additional I/Os for sensors / actuators



- ▶ **Compactness: Space Saving**
- ▶ **No Contacts: No Wear-out !**
- ▶ **Protections and Diagnostics: On Chip**

Reliability

Cost effectiveness

- ▶ **Compliance with norms made easy**
 - ▶ IEC 61000-4-2: ESD Test=2000V at Human Body Model condition
 - ▶ IEC 61000-4-4: Burst Test (capacitive signal coupled into the control/diag wires)
 - ▶ IEC 61000-4-5: Surge Test (2KV high current signal applied to output, GND and Vcc pins, at 24V and 0.5A load)
 - ▶ IEC 61000-4-6: Current Injection Test (sweep signal applied to the output: 10VDC, 150KHz<f<80MHz, length=2.3s, 1kHz AM)
 - ▶ IEC 61131-2: Programmable controllers equipments requirements and tests.

Single Channel

- TDE1737DP
- TDE1747
- TDE1787
- TDE1798
- TDE1897RFPT
- TDE1898
- TDE3247
- L6370
- L6375
- L6377
- VN540
- VN751
- TDE1707BFP
- TDE1708DFT

Dual Channel

- L6360 ¹⁾
- VNI2140J

¹⁾ 2 drivers + 2 receivers

Quad Channel

- L6374
- L6376
- VN330 (-32)
- VN340 (-33)
- VNI4140K
- VNI4140K-32
- VNQ860

Octal Channel

- VN808
- VN808-32
- VN808CM
- VN808CM-32
- VNI8200XP **New**
- ISO8200B **New**

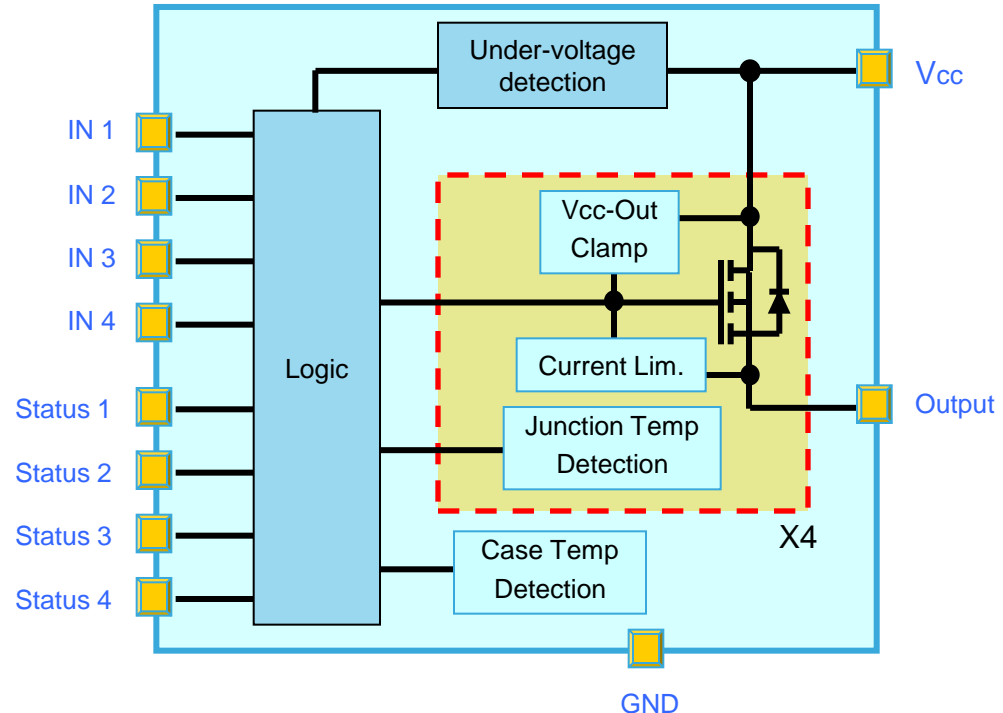


Legend:

Marketing focus
products

Features

- ▶ Supply Voltage 10.5V to 41V
- ▶ $R_{DS(on)} = 80m\Omega$ (max. @25°C), 0.7A / 1A (-32) per channel
- ▶ Narrow current limitation spread 0.7A ÷ 1.7A / 1A ÷ 2.6A (-32)
- ▶ Low quiescent supply current 250μA (All OFF), 2.4mA (All ON)
- ▶ Four independent diagnostic outputs
- ▶ Protections:
 - ▶ Short circuit
 - ▶ Junction over-temperature protections (each channel)
 - ▶ Additional case over-temperature protection (common for all chan.)
- ▶ Non-simultaneous channel restart to minimize supply current peak & EMI
- ▶ Conform to IEC61131-2

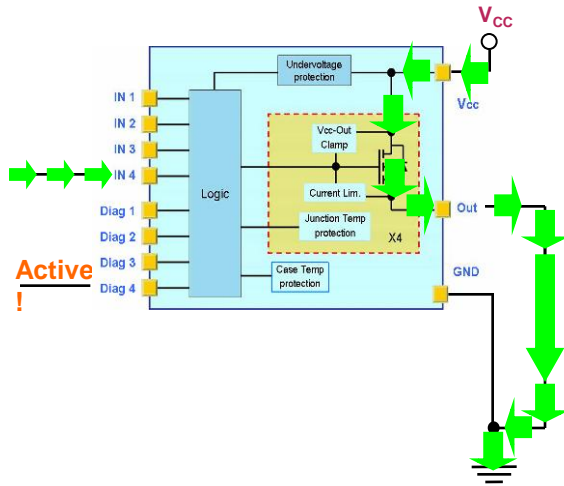


PowerSSO-24

$R_{th(J-C)} 2^{\circ}C/W$ (max.)

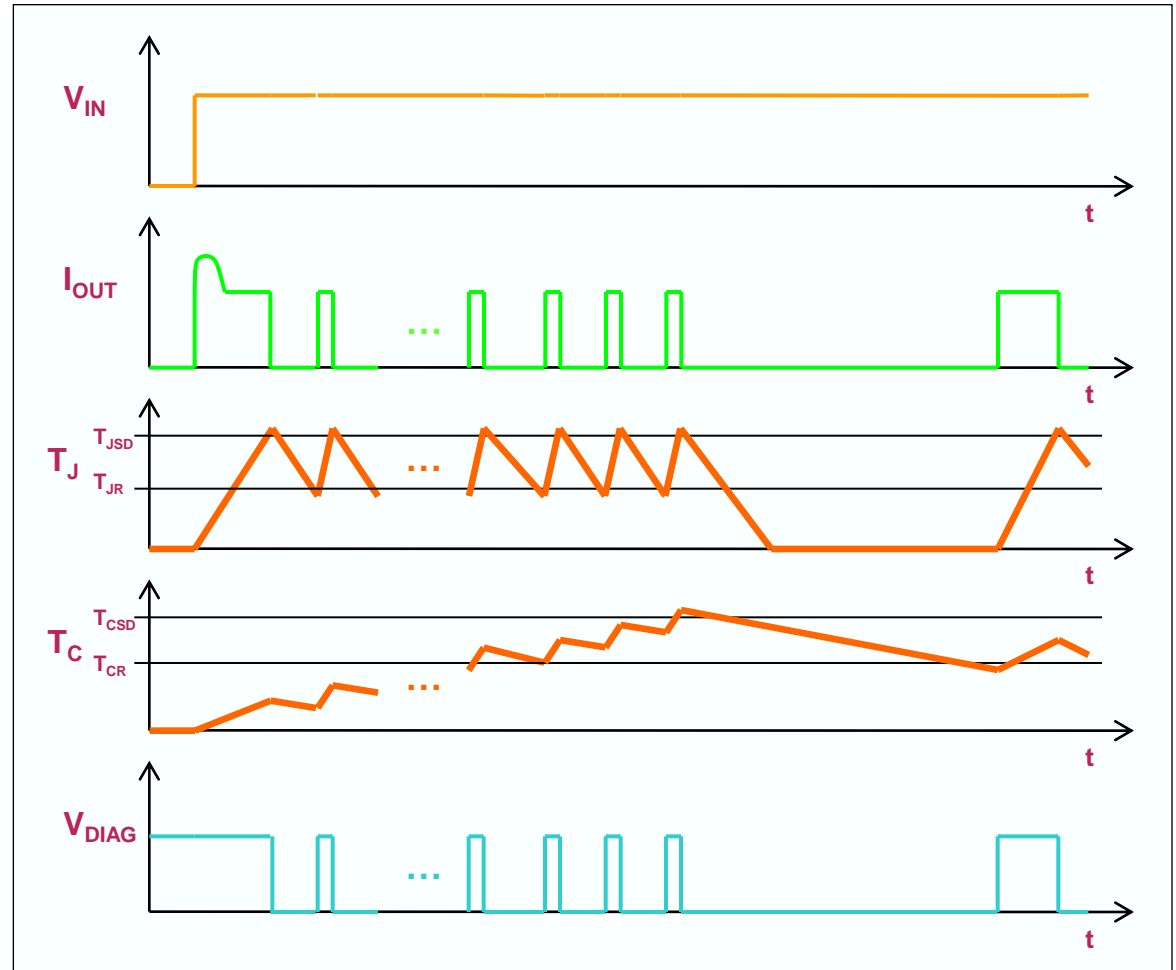
$R_{th(J-A)} 30^{\circ}C/W$ simply reachable with passive cooling

short circuit protection

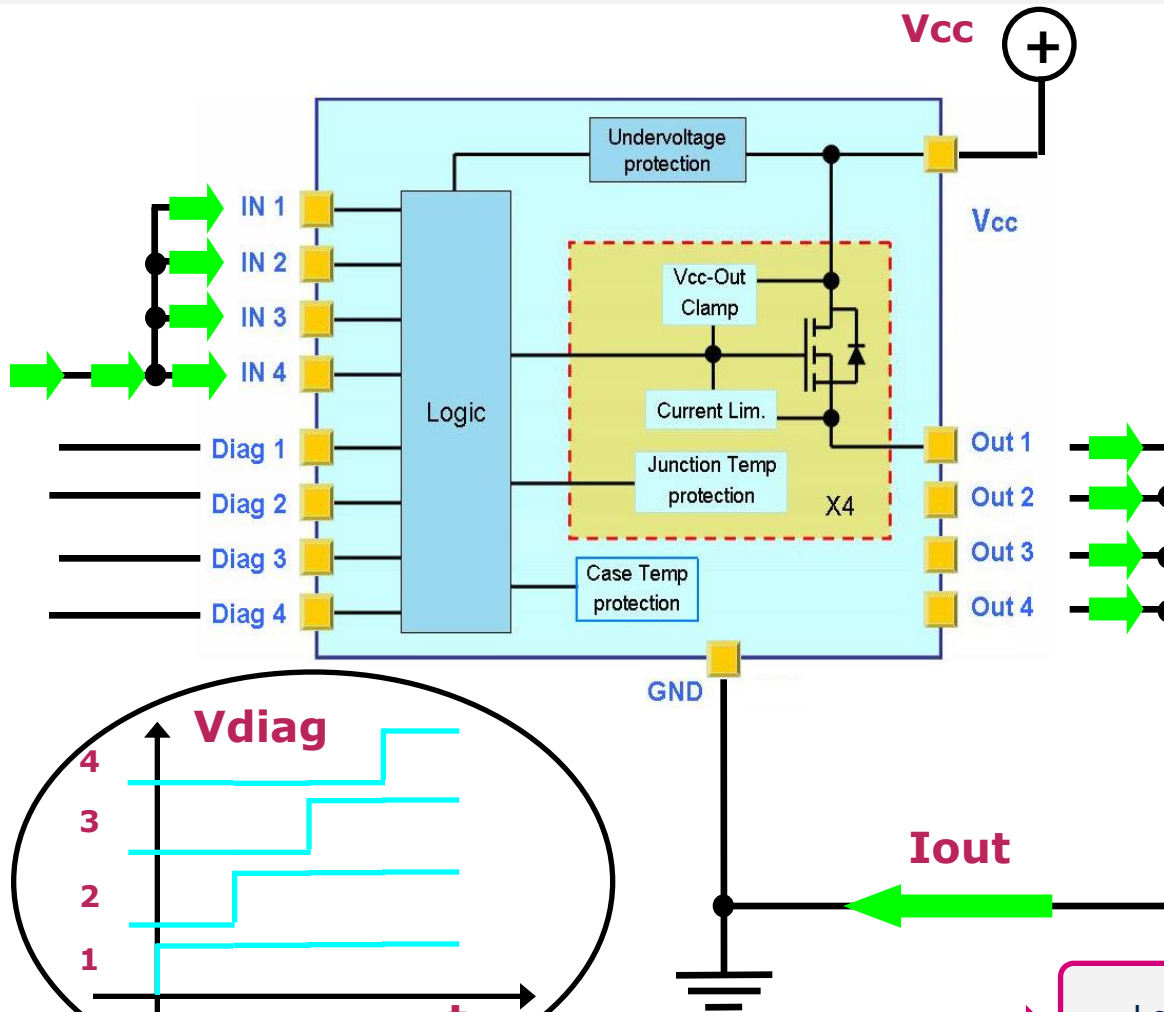


DIAG pin

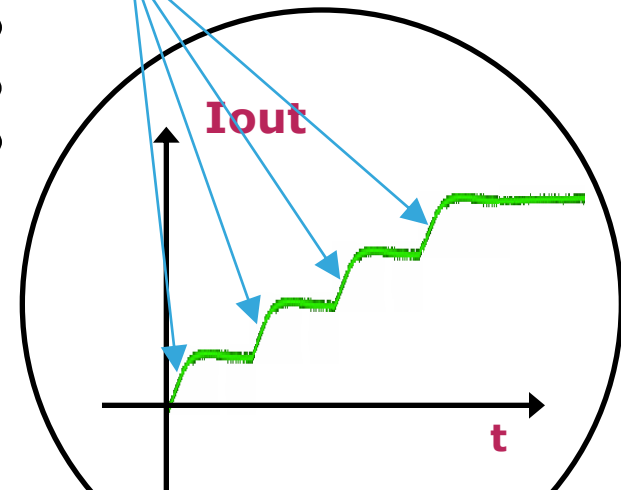
- Provides only the over-temperature indication
- The short circuit itself is not indicated



Non simultaneous restart



- If case temperature is exceeded, overloaded channels are shut down
- When the chip is cooled down, channels operation is restarted
- Channels are activated sequentially, not at the same time



- Lower inrush current
- Better EMI

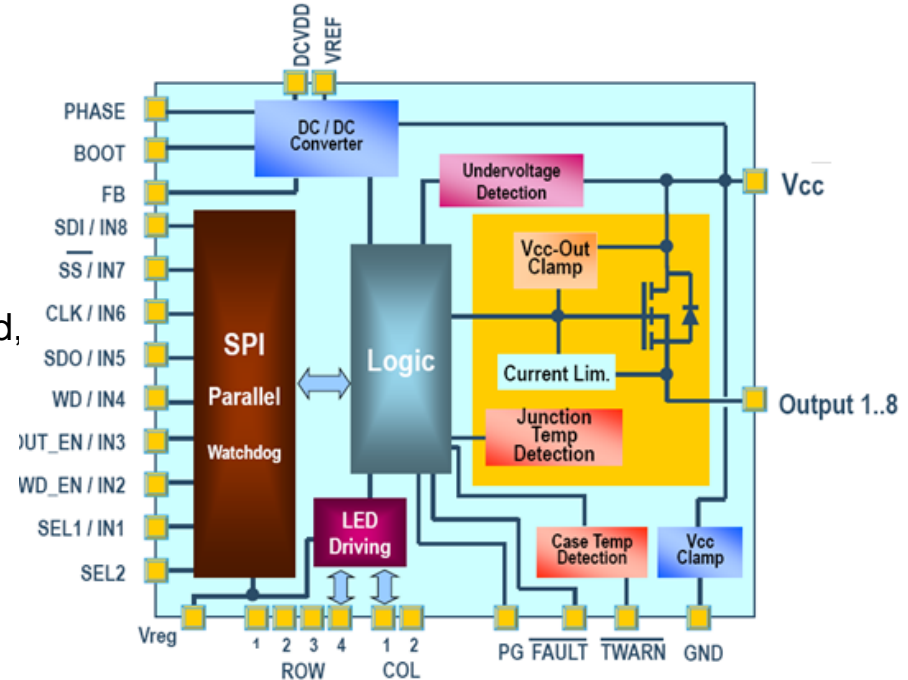
8 channels standard and isolated

Product	Characteristics	Application target	System Benefit
VNI8200XP	<ul style="list-style-type: none"> 8 channels Selectable SPI/Parallel interface Daisy-chain operation support 	<ul style="list-style-type: none"> Wide range use High channel count Output modules 	<ul style="list-style-type: none"> Minimized amount of isolators thanks to SPI bus Only 4 isolators necessary Extended diagnostics
ISO8200B	<ul style="list-style-type: none"> 8 channels Parallel interface Direct / Synchronous operation Galvanic isolation included 	<ul style="list-style-type: none"> Wide range use 8/16 bit Digital Output modules 	<ul style="list-style-type: none"> No external isolators High reliability

VNI8200

features

- ▶ Maximum supply voltage: 45V
- ▶ 8 Channel with Inductive Clamping (VCC - 45V) / parallelable
- ▶ 0.11Ω typ / 0.2Ω max @ 125°C , 0.7A per channel
- ▶ Serial/parallel selectable interface
- ▶ 8 bit and 16 bit 5MHz SPI Interface for IC command, and diagnostic, daisy-chain
- ▶ Protections:
 - Short Circuit
 - thermal protection with pre-warning detection
 - Junction over-temperature (each channel)
 - Additional case over-temperature
 - Loss of GND
 - Under-voltage
- ▶ Power Good diagnostic
- ▶ VCC clamp
- ▶ Common fault open drain output
- ▶ Integrated 3.3V/5V 100mA DC/DC converter
- ▶ Programmable Watchdog
- ▶ 4x2 Led Matrix integrated driver (outputs status)
- ▶ IEC 61131-2 compliant

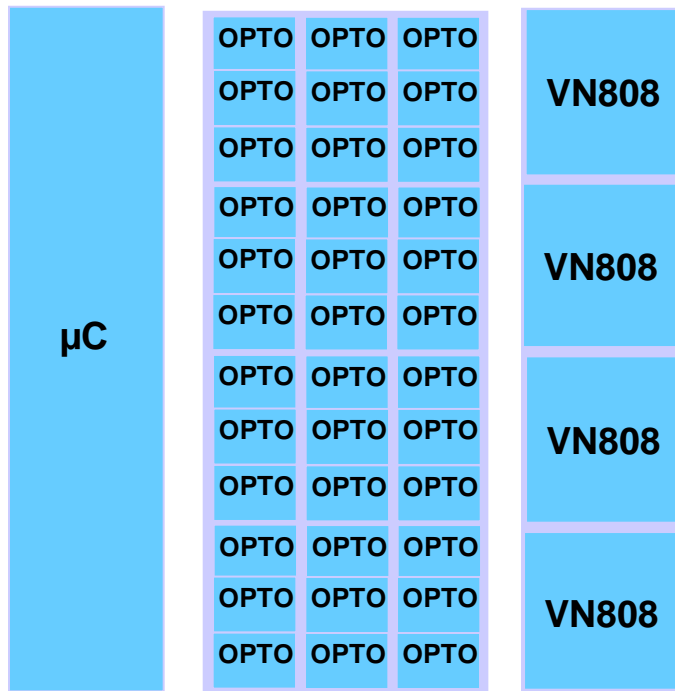


System Benefits

- Reduced component count
- Reduced amount (&cost) of isolators
- Reduced power losses
- Safe Operation
- Less amount of controller I/Os

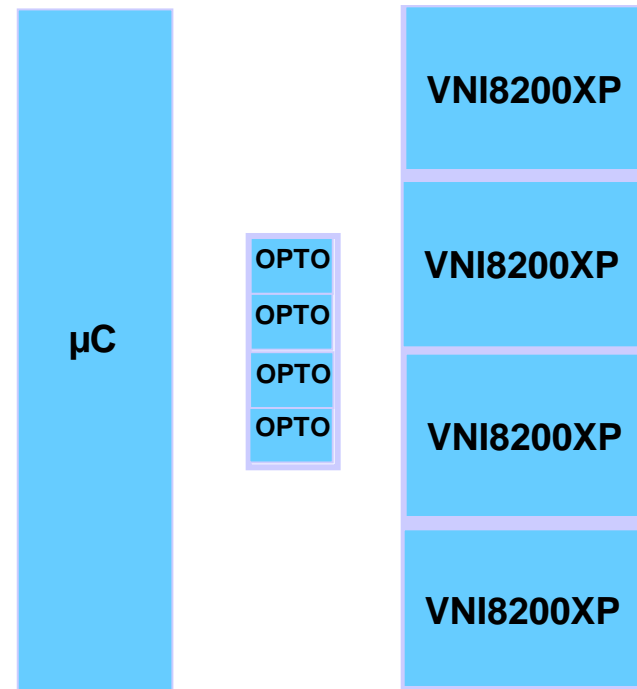
SPI Advantage @32 channel output module

Conventional Solution
with Parallel interface



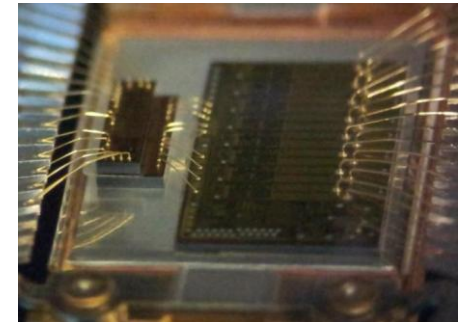
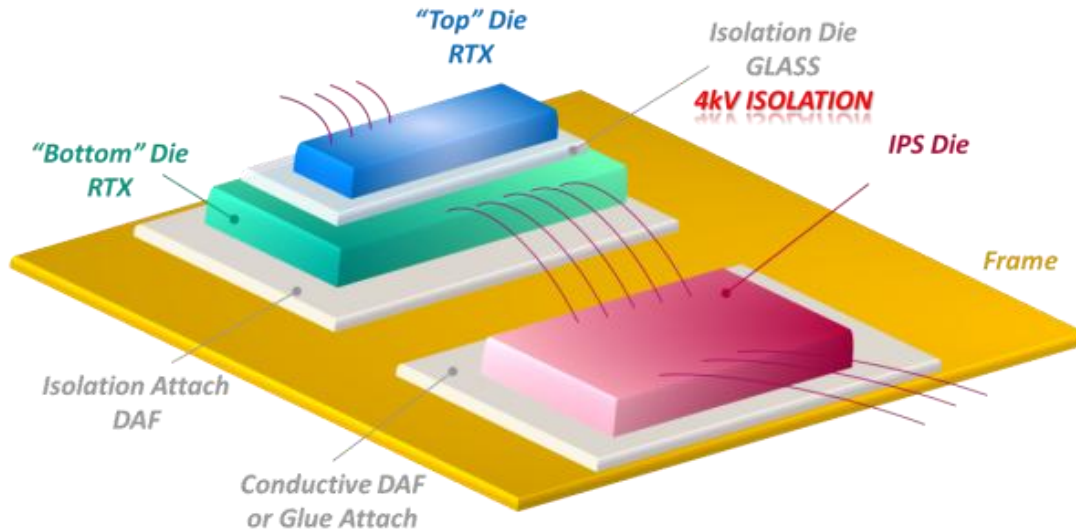
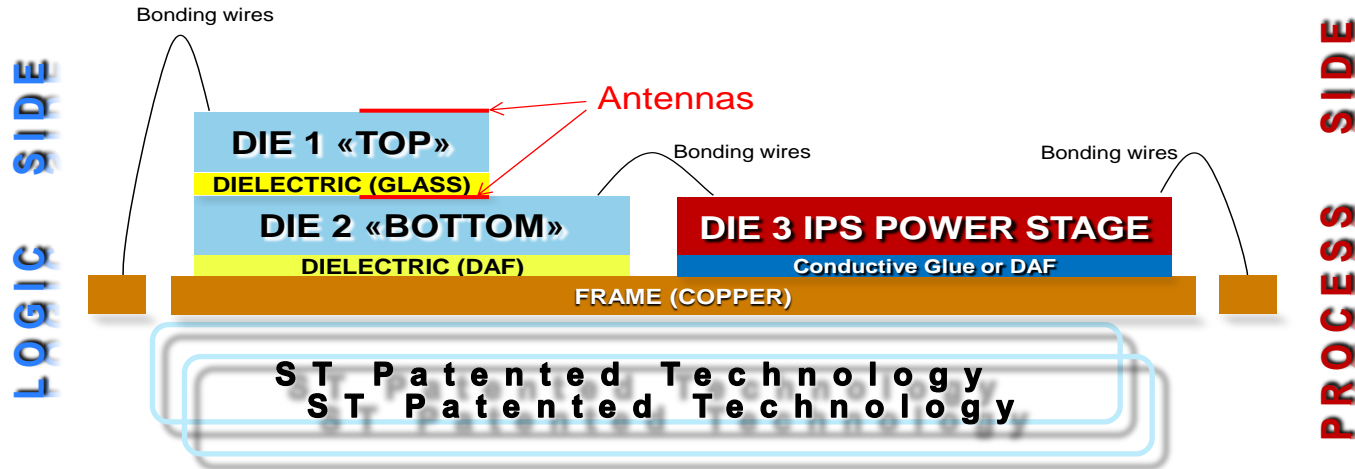
36 Isolators (optocouplers)

VNI8200XP Solution
with SPI interface



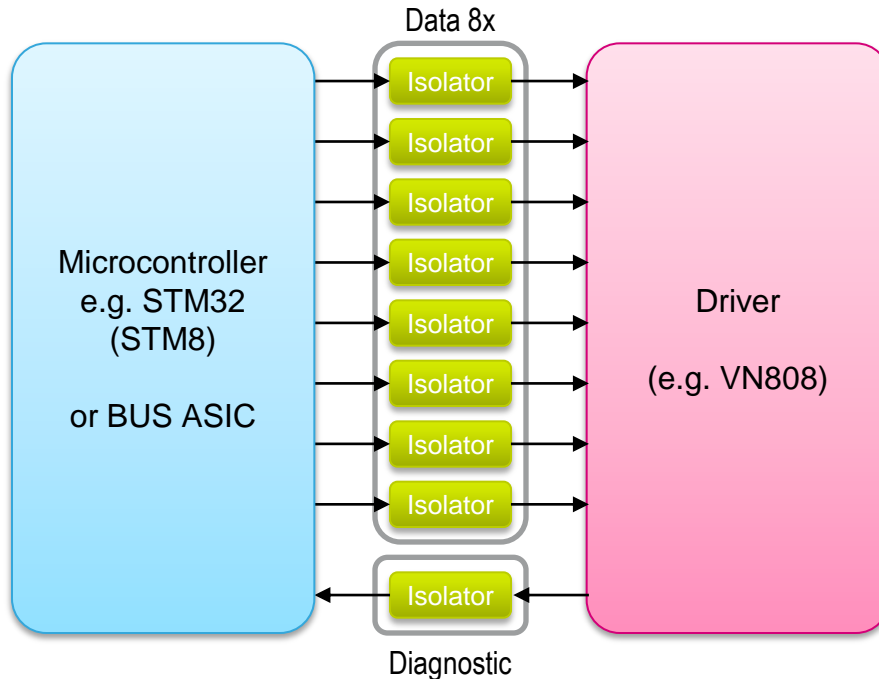
4 Isolators only !

**Amount of isolated channels
is reduced rapidly thanks to the SPI bus**



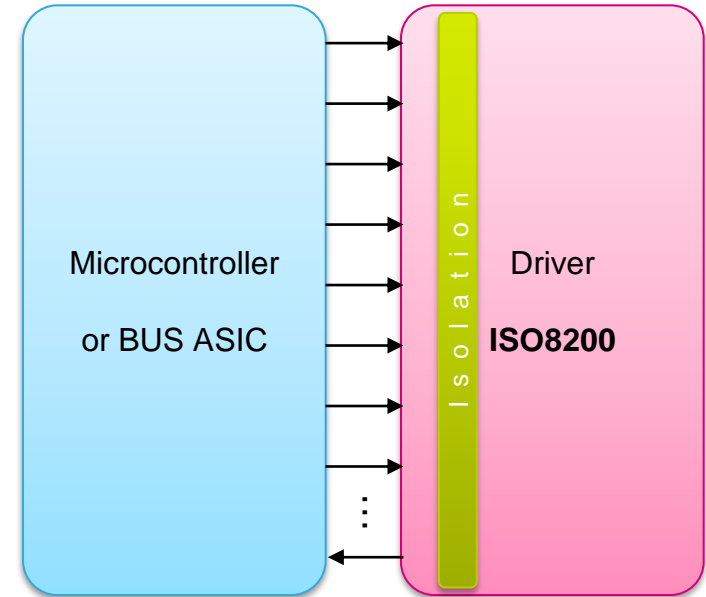
ISO8200B architecture

Conventional solution



- More components
- More space on a PCB
- Lower reliability (soldering issues etc.)
- More difficult to layout (EMC Immunity)

ISO8200 solution

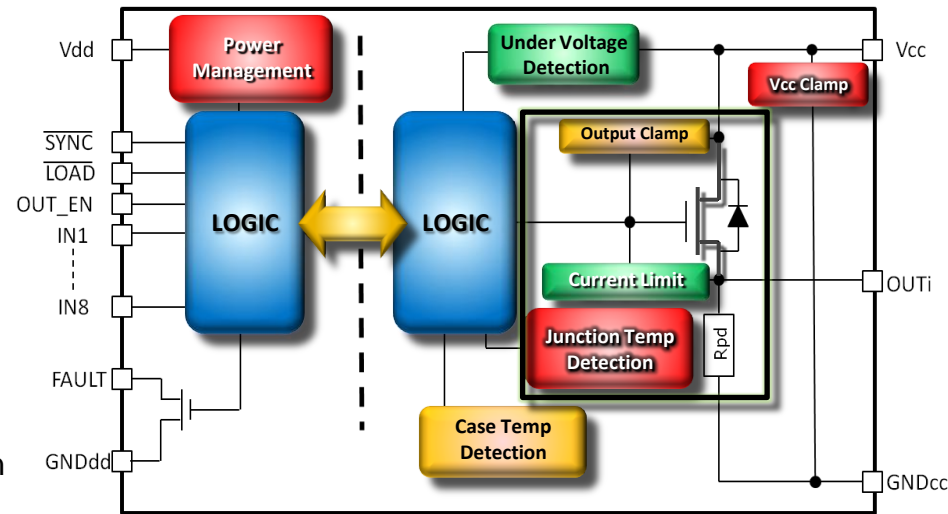


- Less components
- Less space on a PCB
- High reliability
- Safe solution
- Simple to layout

ISO8200B

features

- ▶ Galvanic Isolation according to EN 60664-1
Transient Overvoltage max. 3500VPEAK
- ▶ 8 Channel with Inductive Clamping (VCC - 45V)
- ▶ Maximum supply voltage: 45V
- ▶ 0.1Ω typ. / 0.2Ω max. @125°C
- ▶ Output Current: 0.7A per channel
- ▶ Parallel interface with Output Disable pin
- ▶ Direct Control Mode, Synchronous Control Mode
- ▶ Embedded Watchdog
- ▶ Short Circuit protection and thermal protection
- ▶ Channel independent over-temp detection and protection
- ▶ Drives all type of loads (resistive, capacitive, inductive)
- ▶ Loss of GND protection
- ▶ Under voltage protection
- ▶ VCC clamping
- ▶ Low supply current
- ▶ Common fault open drain output
- ▶ IEC 61131-2 compliant



PowerSO36:
Excellent thermal
performance!

System Benefits

- Reduced component count
- Reduce System Level Losses
- Safe Operation



benchmark with competition

Parameter	ISO8200B	Closest competitor	Benefit
Power Stage ON resistance $R_{DS(on)}$	110m Ω typ. @25°C 200m Ω max. @ 125°C	150m Ω typ. @25°C 320m Ω max. @ 125°C	Less dissipation
Sync mode support	✓	✗	Possible to synchronize outputs
Temperature Operating range	-40-125°C	-25-125°C	Extended temp. range
Internal communication across the isolation	RF Modulated signal	Pulse transfer	More reliable, better EMC immunity
			Much lower EMI noise
Smaller propagation delay in "Direct mode"	18 μ s to 38 μ s	26 μ s to 40 μ s	Faster reaction on the input change

Dominant probability of 18 μ s, occurrence of 38 μ s is negligible

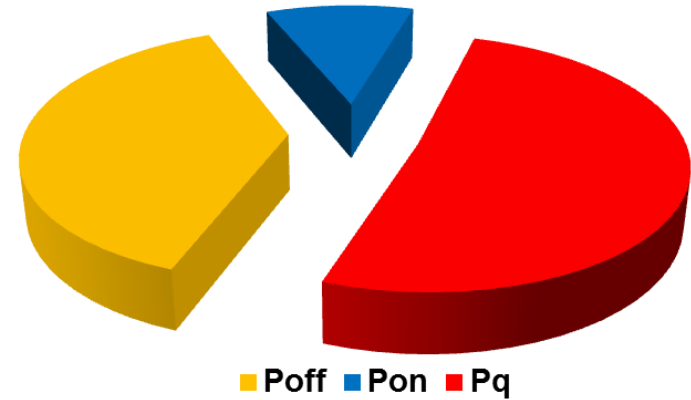
Same probability of 26 μ s and 40 μ s

ISO8200B supports synchronous mode which allows outputs synchronization of several devices in order to update multiple outputs at the same time, jitter is minimized to approximately 2 μ s in this mode.

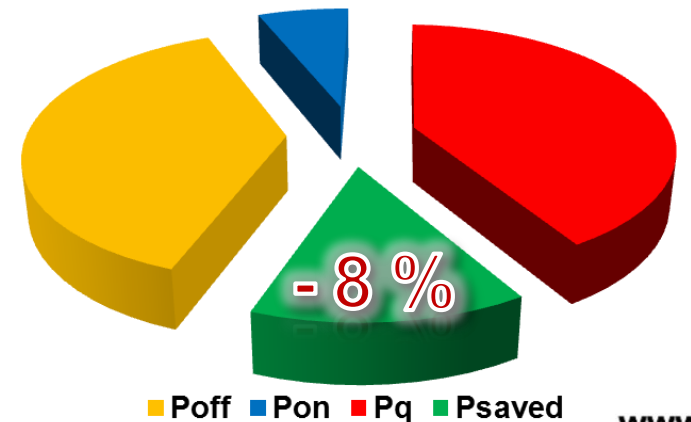
benchmark with competition

	Competitor	ISO8200B		Diff.	
Iload	0.625	0.625 A			
Rload	48.00	48.00 Ω			
Vcc	30.00	30.00 V			
Vclamp	53.00	45.00 V			
L	1.15	1.15 H			
f	0.5	0.5 Hz			
Duty Cycle	50%	50%			
Ron	0.32	0.20 Ω			
Iq	10.00	8.00 mA			
# Ch Active	2	2			
Eoff	0.45	0.45 J	0.00		
Poff	0.22	0.22 W	0.00		
Pon	0.06	0.04 W	-0.02		
Pq	0.30	0.24 W	-0.06		
Psaved		-0.08 W		-8.1%	
P	1.04	0.95 W	-0.08		

Competition



ISO8200B



Eval boards and next steps



► Order Code: STEVAL-IFP022V1



STEVAL-IFP015V1

- Application Immunity verified (outperforming the IEC61131-2 levels)
 - IEC61000-4-2, ESD, Contact / Air, both higher than $\pm 25\text{kV}$ (no silicon degradation)
 - IEC61000-4-4, Burst, $> \pm 4\text{kV}$, performance criteria A
 - IEC61000-4-5, Surge, $42\Omega/0.5\mu\text{F}$, $> \pm 2\text{kV}$, common / differential modes

IPS in Development

Part	$R_{\text{DS(on)}} [\Omega]$	Package	Datasheet	Eng. samples	Comment
L6362A	2	DFN-10L 3x3 mm	Available	Q3/2014	General purpose transceiver / IO-Link Device physical layer
IPS4200H / L	0.2	HTSSOP-20	Available	Q2/2014	Quad High and Low side drivers with adjustable limiter, open load, - cost effective



$R_{DS(ON)}$	1 OUTPUT CHANNEL PACKAGE / STATUS	2 OUTPUT CHANNELS PACKAGE / STATUS	4 OUTPUT CHANNELS PACKAGE / STATUS
4 mΩ	VN7004AH Available Available May / 14	VND7004AY Available Dec /14 15 May	LEGEND: Part Numbering: VNx7yyyAz x: None, D, Q or P according to # of ch. yyy: $R_{ds(ON)}$ in mOhms at 25° C (No asym.) z: according to package as below H: OCTAPAK J: PowerSSO-16 Y: PowerSSO-36
7 mΩ	VN7007AH Available Available May / 14		
10 mΩ	VN7010AJ Qualified		
12 mΩ		VND7012AY Available Available Apr /	
16 mΩ	VN7016AJ Qualified		
20 mΩ	VN7020AJ Qualified	VND7020AJ Qualified	
30 mΩ		VND7030AJ Qualified	
40 mΩ	VN7040AJ/AS Qualified	VND7040AJ Qualified	Available VNQ7040AY Available Apr / 14
50 mΩ	VN7050AJ/AS Qualified	VND7050AJ Qualified	VNQ7050AJ Qualified
140 mΩ	VN7140AJ/AS Qualified	VND7140AJ Qualified	VNQ7140AJ Qualified

Eng. Samples

Final Samples

Qual. completed (final silicon)

Revision 3.9 – Mar, 24th 2014

This document overrules all previously numbered and dated versions

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