

# Proven Technology for Safety Instrumentation Systems



**ProSafe-SLS™**

The ultimate solution - safety without compromise

Bulletin 48B03A00-01E-E

[www.yokogawa.com/eu](http://www.yokogawa.com/eu)

**vigilantplant.®**  
The clear path to operational excellence

**YOKOGAWA** 



**SEE  
CLEARLY**

***Powerful, state-of-the-art technology ...***

... In ProSafe-SLS, solid-state elements process the functional logic, handling all typical safety tasks as well as related non-safety-critical functions.

**KNOW  
IN ADVANCE**

***Leading package...***

...ProSafe-SLS is inherently fail-safe: the self-testing nature of its basic circuitry mean it will invariably fail safely, without the need for additional test or diagnostic circuitry.

**ACT  
WITH AGILITY**

***Success in critical applications...***

... ProSafe-SLS is designed to deliver safety without compromise, demonstrating verifiable adherence to the highest Safety Integrity Levels.

# ProSafe-SLS™

Today, over one thousand ProSafe-SLS systems have been installed in the world protecting people, the environment, valuable assets and production installations.



## The ProSafe range

Yokogawa covers the spectrum of requirements for today's safety systems with two product lines, ProSafe-SLS and ProSafe-RS, each geared to the needs of specific safety applications.

For the highest-integrity, SIL 4-rated applications, ProSafe-SLS offers a superior solution - for the spectrum of applications in oil and gas, petrochemical and chemical, and conventional and nuclear power industries, including:

- Emergency-shut-down systems in safety-critical process units
- Environmental and asset protection systems
- Burner management systems for incinerators, furnaces and boilers
- Compressor protection systems for rotating and piston type compressors
- Process and emergency shutdown systems on offshore platforms and FPSO's
- High integrity protection systems for critical processes and pipeline protection
- Wellhead protection systems and sub-sea systems
- Liquefied natural gas (LNG) storage and loading installations
- High-integrity protection systems in chemical process plants as well as applications where previous-generation relay-based systems are to be upgraded.

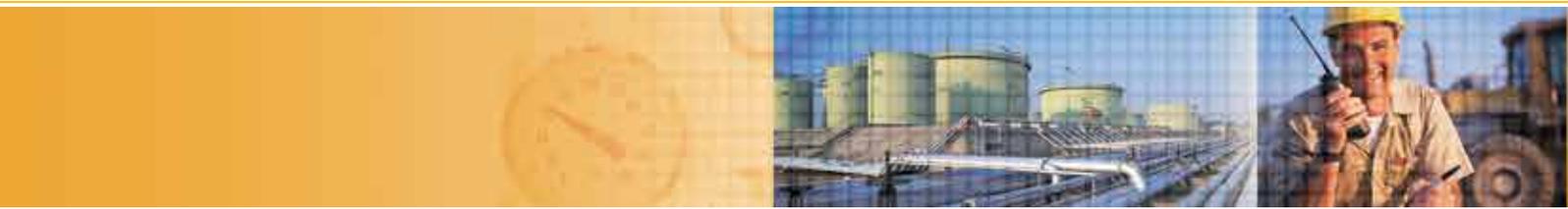


## vigilantplant.®

The clear path to operational excellence

When safety cannot be compromised, ProSafe-SLS is the solution

## Safeguarding System Solutions



### *When safety cannot be compromised, ProSafe-SLS is the solution*

ProSafe-SLS is a Safety Instrumented System specifically designed for applications which require the highest Safety Integrity Levels (SIL 3 and 4).

At the heart of ProSafe-SLS are solid-state elements which process the functional logic. This technology is capable of executing all typical safety tasks, as well as supplementary non-safety-critical functions such as interfacing with a Human Machine Interface, Process Control System, Sequence of Event Recording, (Event Loggers) or SCADA system, for example.

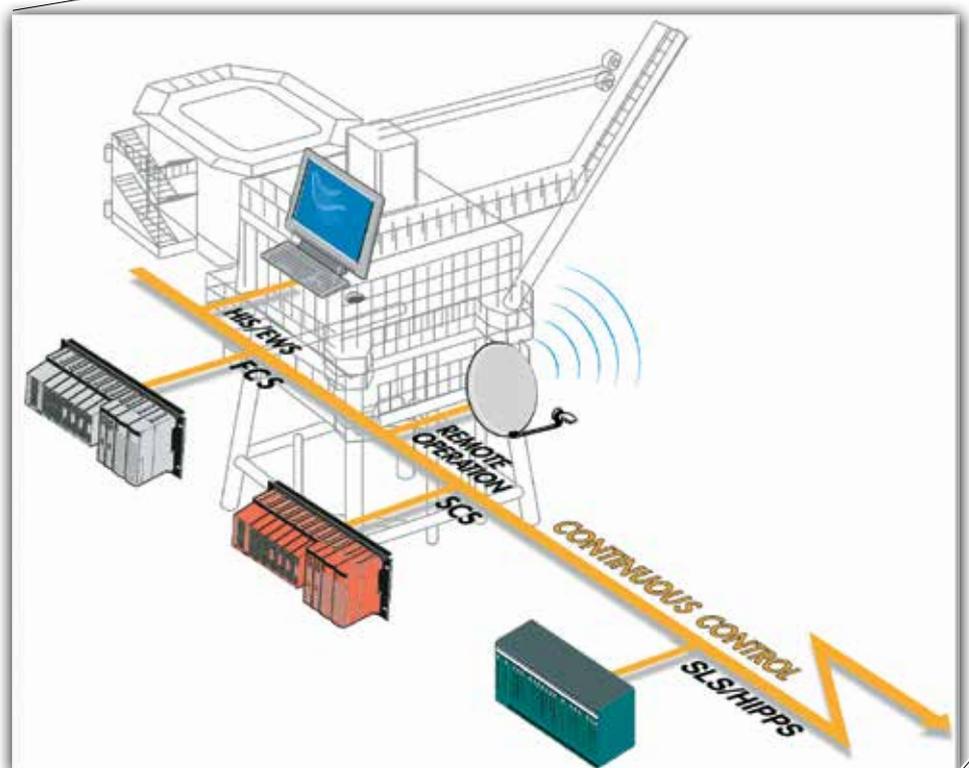
Sophisticated design and superior safety performance have made ProSafe-SLS the reference standard for solid-state Safety Instrumented Systems. With ProSafe-SLS, there's no need for operating system and

self-diagnostics software. Instead, it uses a unique inherently self-testing technology, for all safety-related functionality.

Modular design allows users to create fault-tolerant systems with very high availability, without compromising the superior safety performance. A 1 out of 2, or 2 out of 3 configuration, as defined by the IEC 61508/61511 and ISA 84.01 standards, allows redundant sensors and actuators to be connected in a very cost-effective way - enabling users to balance

the availability of these field devices with the high system availability of the ProSafe-SLS system.

These redundant structures support on-line repair to restore the original fault-tolerant architecture, without the need to shut down the process, and without compromising safety.





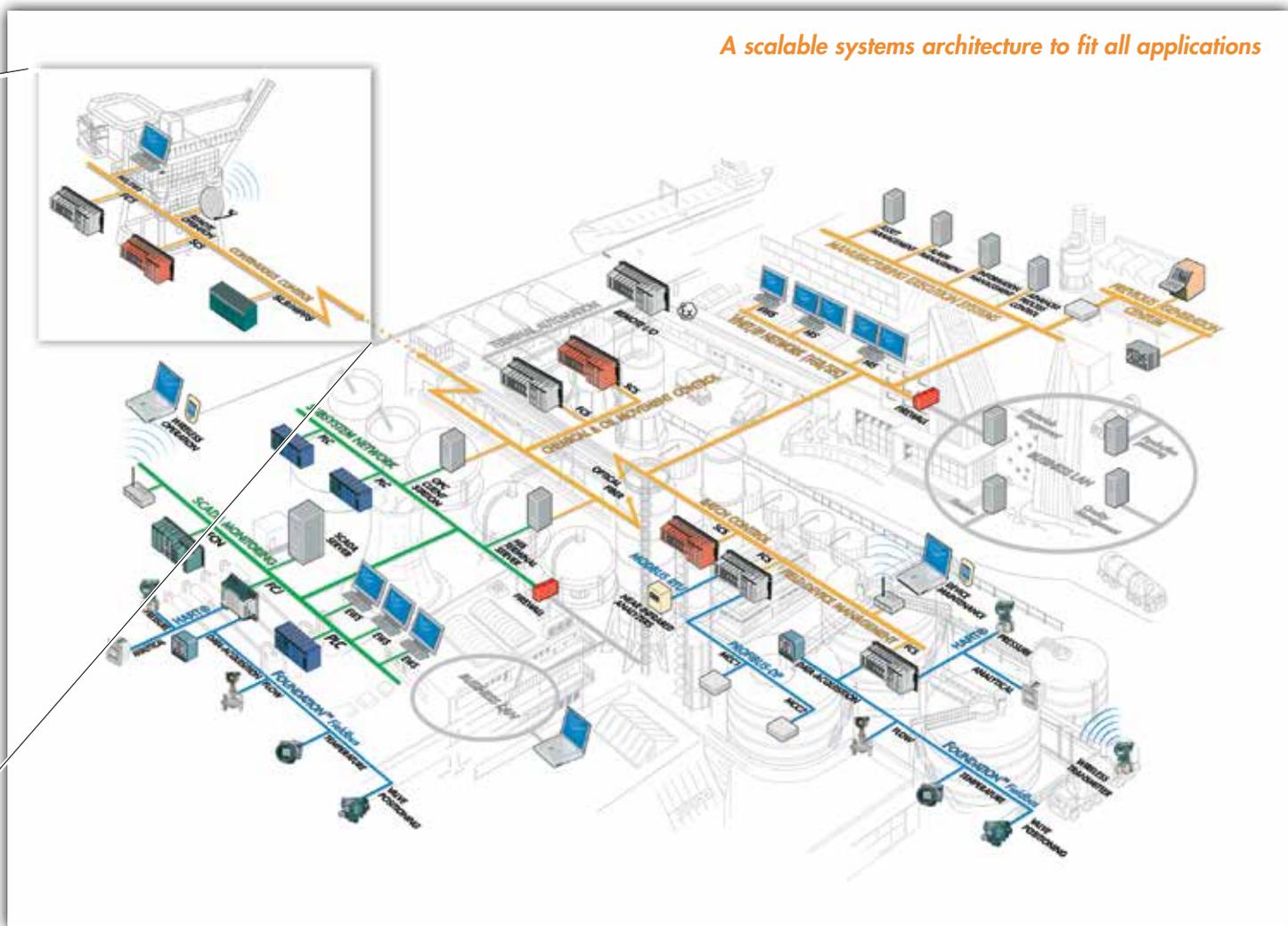
### Total solution

Yokogawa delivers total automation and control solutions that comprise field instruments, control systems, safety and production management systems.

Depending on your requirements, the solution may vary from the supply of a single recorder to the execution of a complex project as your main automation contractor.

Whatever the size and complexity of your solution, our goal is "fit for purpose" and seamless integration of production processes and management systems.

### A scalable systems architecture to fit all applications





### The ProSafe-SLS System Concept

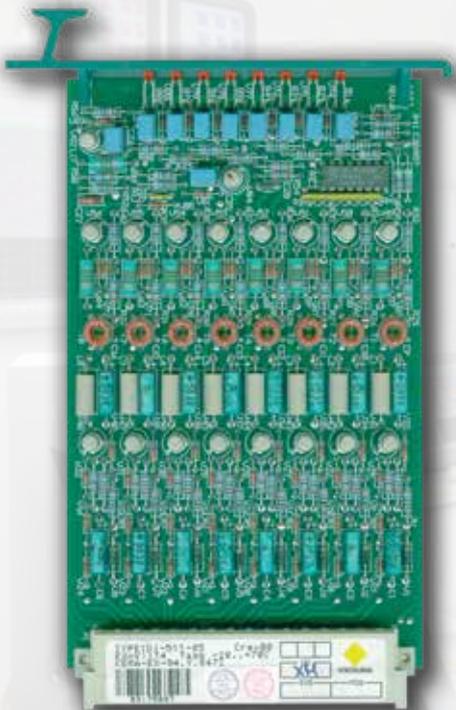
” **SLS when Safety allows no compromise** ”

The SLS (Solid State Logic Solver) System was designed with the objective of establishing an uncompromising safeguarding system: one which would meet the highest Safety Integrity Levels, and whose performance could be verified.

The ProSafe-SLS concept has successfully eliminated all known sources of unsafe failures. Each logic processing unit performs inherent self-test, while working with the real functional logic of the application. Therefore, logic processing and self-test are carried out simultaneously, and by the same hardware components. During every scan, which takes just one millisecond, the system outputs are recalculated by executing the complete functional logic. So the safety critical parts do not require memory elements to store the results of the logic solver for longer than one millisecond.

This unique intrinsic self-testing technology creates a robust safety environment where potential hazards are effectively eliminated

Non-safety-critical functions and computer interfaces are implemented using microprocessor technology.



ProSafe-SLS Modular Card





## The SLS magnetic core technology

The effect of this unique technology is to render ProSafe-SLS inherently fail-safe - the self-testing nature of the basic circuit means it will always be fail safe, without the need for additional test or diagnostic circuits. The logical signal status, which reflects the 'safe' condition of critical process parameters, is represented by pulse-trains. In this way all the circuits remain dynamic continuously, during normal operation.

Logic functions are processed by bi-stable magnetic core elements, which have inherent fail-safe characteristics. Amplifying transistors serve only to restore any energy lost by the pulse-trains as they pass through these magnetic logic elements.

### The essence of the ProSafe-SLS, solid-state

**logic solver.** The basic principle behind ProSafe-SLS is magnetic logic - or MagLog.

Since its invention in 1965, it has proved its worth in numerous Safety Instrumented System

(SIS) installations in the hydrocarbon, chemical and (nuclear) power industries. We've taken this technology,

and upgraded it with up-to-date components and fabrication methods, while retaining its unique inherent safety characteristics.

The simplicity of this underlying principle is a key strength of ProSafe-SLS: it supports any method of in-depth safety assessment and verification. And quantitative methods have shown that the SLS system scores highest on the scale of safety.



ProSafe-SLS Module

” **The SLS is inherently fail-safe** ”



### **The Communication interface ProSafe-COM**

The functions of communication, sequence of event recording and remote input and output functions are handled by our modular ProSafe-COM system, with specific functions implemented by software and dedicated ProSafe-COM modules. ProSafe-COM supports commonly used industrial communication standards, including Modbus, Ethernet and OPC, supporting open communications with other systems

### **Non-safety-critical I/O**

ProSafe-COM and additional modules handle non-safety-critical I/O - such as the control of annunciation matrices and mimic panels - highly cost-effectively. Features include:

- Bi-directional serial communication with other systems, operating as a master or as a slave, using the Modbus protocol
- Handling non-safety-critical functions
- Standard alarm sequences and first-up handling and other functions, which are readily available in the engineering tool
- Point-to-point connections by dedicated modules

### **A unique - and deserved - reputation**

ProSafe-SLS has earned its reputation through a number of factors, including:

- Superior fault-tolerance for unsafe errors, appropriate for SIL 4 safety categories
- Mean time between testing (according to IEC 61508 methodology) typically in excess of 10 years
- High availability (or low false trip rate) through low parts count and reliable design, with further improvements through redundancy of associated field devices
- A robust design, which can handle harsh environmental conditions such as extreme temperatures and Electromagnetic Interference (EMI)
- No software required for safety functions (so no costly updates!)
- Fast response-time, independent of system size or I/O count
- Integrated computer interfaces and sequence of events recorder
- Provision of a PC-based engineering tool to keep documentation up-to-date
- Longevity (we still service systems we delivered in the early 1970s)
- Low power consumption
- Independently isolated inputs and outputs
- Many reference projects at leading companies on all continents including offshore projects

### **Standards compliance**

- IEC standards 61508 & 61511
- ISA standard 84.01
- HSE, Health & Safety Executive, PES/SIS documents 1 and 2
- EEMUA Publication 160 - 'Category 1' applications
- Standard engineering practices, as implemented by prominent operating companies

”  
**The ProSafe-SLS  
successfully f**



## ***Applications***

- Refinery
- Wellhead
- Furnace
- Train
- Tank farm
- FPSO

***SLS system was assessed for Safety & Availability by: TÜV, SINTEF, TNO, WIB, KEMA*** ”

## Services



### **Project organization**

Yokogawa has engineering offices and production facilities for safety systems in the Netherlands, Japan and Singapore, and operates via a world-wide network of Yokogawa sales and service subsidiaries.

Our project organization has a strong commitment to quality and is ISO29001 certified. It operates on a world-wide basis, implementing turnkey projects, and providing after sales service and technical customer training. We provide advice on safety assessments and related issues via Yokogawa offices and regional subsidiaries.

### **Safety assessment**

Safety Instrumented Systems play an increasingly crucial role in many process plants today. Safety standards such as IEC 61508/61511 and ISA 84.01 are now recognised worldwide, creating increasingly stringent safety requirements for process plants. Users in the process industry need system suppliers who understand the standards and can offer solutions to meet today's safety requirements. At our European Service Center, we have a department of specialists who will ensure adherence to the safety standards, and are able to provide Safety Assessment Certificates for individual applications.

### **Training**

Yokogawa provides extensive training for all levels of plant personnel, to ensure that your enterprise gains the maximum benefit from its Yokogawa systems and integrated solutions. The training program includes product and system overviews, detailed system configuration, maintenance, operations, and fundamentals of safety and process control.



# ProSafe-SLS systems protecting our world



## Customer support

Our customers can choose from a wide range of standard training courses, and customized courses are tailored to match the customer's specific needs. Project-specific courses can also be arranged. In all cases Yokogawa provides the training equipment. The Yokogawa training center supports comprehensive training directly with customers worldwide. Training can be conducted in one of our Centers of Excellence, or any other Yokogawa facility or at the customer site.

The Yokogawa training center is permanently staffed with highly qualified trainers and an administrative co-ordinator. Close co-operation with the System and Application Engineering team means that expertise is readily available for project specific training.

## Specification highlights:

<b>Principle of operation</b>	Magnetic cores serve as logic processing elements; Inherent self-testing in Fail-safe Inputs & Outputs.
<b>Special Features</b>	Inherently fail-safe; No system software in Safety-Critical parts; Galvanic isolation of I/O and logic-solver.
<b>Electromagnetic interference</b>	High immunity to EMI, >30V/M.
<b>Operating Temperature</b>	-20° C to +70° C.
<b>Number of Inputs &amp; Outputs</b>	Unlimited.
<b>Input range</b>	Discrete: 24 Vdc.; Analogue: 0-20 mA, 0-10 V or 0-5 Vdc.; Communication: Inputs via ModBus and Ethernet interfaces.
<b>Output range</b>	Fail-safe: 5 Watts & 20 Watts; 24 Vdc., 48Vdc. or 110 Vdc.; Relay: DC and AC; Communication: Outputs via ModBus and Ethernet Interfaces.
<b>Timer Range</b>	7 millisecond to 70 hours.
<b>Scan-time</b>	1 millisecond for I/O scan and Safety logic processing; independent of number of I/O.
<b>Auxiliary modules for</b>	Line-fault detection. Microprocessors for non-critical functions such as: Annunciation, Communication & SER-Diagnostics.
<b>Engineering tool</b>	ProSafe-SLS SET logic symbols related to the SLS circuits.
<b>Programming</b>	Hardwired programming of the Safety Interlocks with protected (IP 20) cold crimp contacts.
<b>Safety certification by TÜV:</b>	SIL 1-4 based on IEC 61508 & 621511

**SEE**  
CLEARLY

**KNOW**  
IN ADVANCE

**ACT**  
WITH AGILITY

***VigilantPlant excels at bringing out the best in your plant and your people - keeping them fully aware, well informed, and ready to face the next challenge.***

**Trademarks**

FAST/TOOLS, CENTUM, ProSafe, STARDOM, PRM are registered trademarks of Yokogawa Electric Corporation. DPHarp, Exaquantum, YEWFO are trademarks of Yokogawa Electric Corporation. FOUNDATION™ Fieldbus and a logo mark of Fieldbus Foundation are registered trademarks of Fieldbus Foundation. Windows is registered trademark of Microsoft. Ethernet is a registered trademark of XEROX Corporation.

Other company and product names in this bulletin are trademarks or registered trademarks of the respective companies.

**vigilantplant.®**

**The clear path to operational excellence**

**SEE**  
CLEARLY

**KNOW**  
IN ADVANCE

**ACT**  
WITH AGILITY

VigilantPlant is Yokogawa's automation concept for safe, reliable, and profitable plant operations. VigilantPlant aims to enable an ongoing state of Operational Excellence where plant personnel are watchful and attentive, well-informed, and ready to take actions that optimize plant and business performance.

**YOKOGAWA EUROPE B.V.**

Euroweg 2,  
3825 HD Amersfoort, The Netherlands  
[www.yokogawa.com/eu](http://www.yokogawa.com/eu)

**YOKOGAWA ELECTRIC CORPORATION**

World Headquarters  
9-32, Nakacho 2-chome, Musashino-shi,  
Tokyo 180-8750, Japan  
[www.yokogawa.com](http://www.yokogawa.com)

**YOKOGAWA CORPORATION OF AMERICA**

2 Dart Road, Newnan,  
Georgia 30265, U.S.A.  
[www.yokogawa.com/us](http://www.yokogawa.com/us)

**YOKOGAWA ENGINEERING ASIA PTE. LTD.**

5 Bedok South Road,  
Singapore 469270, Singapore  
[www.yokogawa.com/sg](http://www.yokogawa.com/sg)

**YOKOGAWA MIDDLE EAST B.S.C.(c).**

P.O. Box 10070, Manama  
Building 577, Road 2516,  
Busaiteen 225, Muharraq, Bahrain  
[www.yokogawa.com/bh](http://www.yokogawa.com/bh)

Represented by: