



ST100 SafeMax

The Next Generation Machine Protection System

Welcome to the new world of turbine protection, where speed, torque, acceleration, creep, can now be combined with inputs from other sources together with PLC like functions to provide sophisticated protection and control in a single system.

Embrace ST100 SafeMax – a game changing innovation offering up-to-date solutions for EN 61508 SIL2 & SIL3 in High Demand.

Key ST100 SafeMax Characteristics:

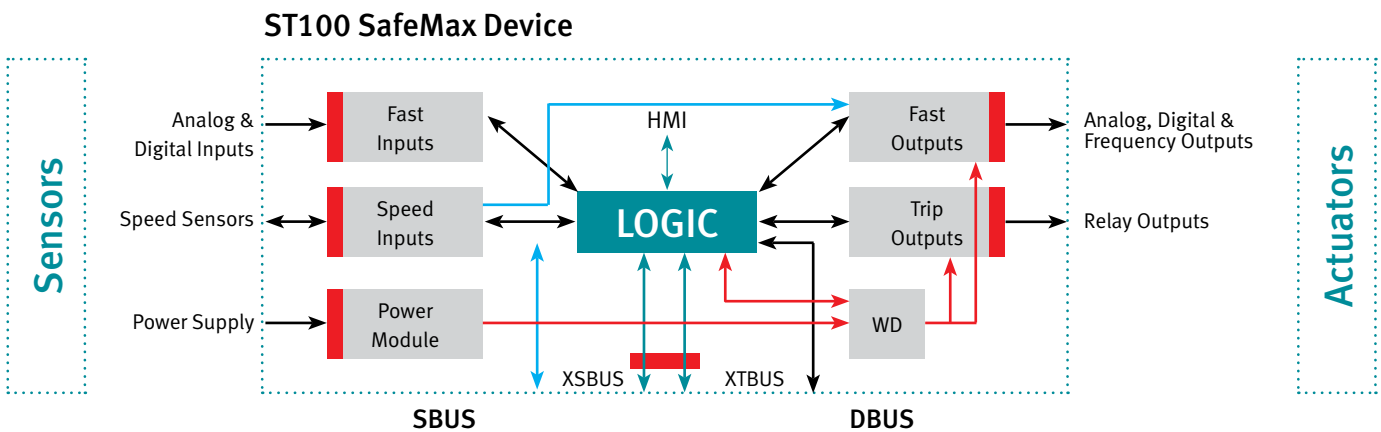
In- and outputs (per module)

- 1 frequency input for speed + 1 additional frequency input for Creep and direction with front end DSP (Digital Signal Processing) for advanced diagnostics per module
- 6 safe digital inputs at PLC levels for status and control e.g. start monitoring & control
- 3 fast frequency outputs having negligible latency e.g. for vibration analysis
- 6 safe digital outputs at PLC levels for alarms, controls or as expansion relay drivers
- 1 analogue input and 1 analogue output per channel
- 2 safety relays for trip control plus 1 additional relay with change-over contact
- 1 dedicated digital input and 1 local push button for parameter acknowledgement

Special features

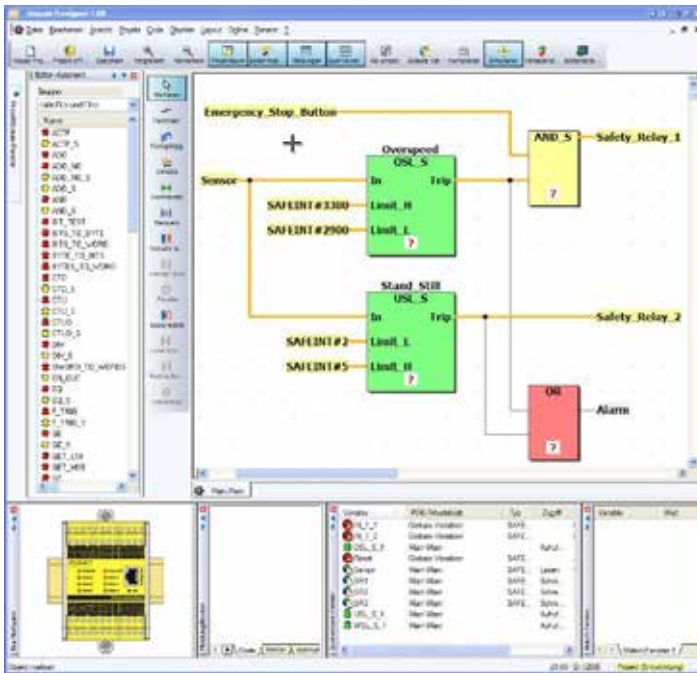
- Ultra Modular Concept, with high availability & increased reliability compared with other systems
- Torque + acceleration + pre-alarm monitoring as forewarning of over-speed
- Wide ranging machine monitoring including analogue & digital I/O
- Relative position measurement via missing gear tooth detection and counting
- Wide range of qualification covering multiple demanding applications
- Speed measurement with most speed sensors, including for over-speed, under-speed, acceleration, creep detection
- Fast over-speed protection – typically <15ms including relay time
- Scope to expand safe & non-safe functions, I/O and communication interfaces
- Compact enough to be mounted next to machines, saving wiring costs
- Solutions for Ex and non-Ex applications
- Time related control, measurement and logging features e.g. number of times acceleration limit exceeded
- PLC like capabilities e.g. sequential shutdown control
- Speed regulation also with non-linear characteristics having up to 10 calibration points

Each ST100 SafeMax consists of the same building blocks to form a safe system architecture. The red bars indicate galvanic isolation:



Two to four ST100 SafeMax's are typically integrated into one system to form a SIL2 or SIL3 solution.

System configuration via SafeMax Configurator Software:



The safe programming system SafeMax Configurator is used to define the ST100 SafeMax system safety logic. SafeMax Configurator is based on the IEC 61131-3 standard and meets the safety requirements defined in the IEC 61508 standard up to SIL3. Safe programming on the PC is ensured by numerous forward-thinking and fault detecting measures.

SafeMax Configurator includes all required tools for the different development phases of your ST100 SafeMax application:

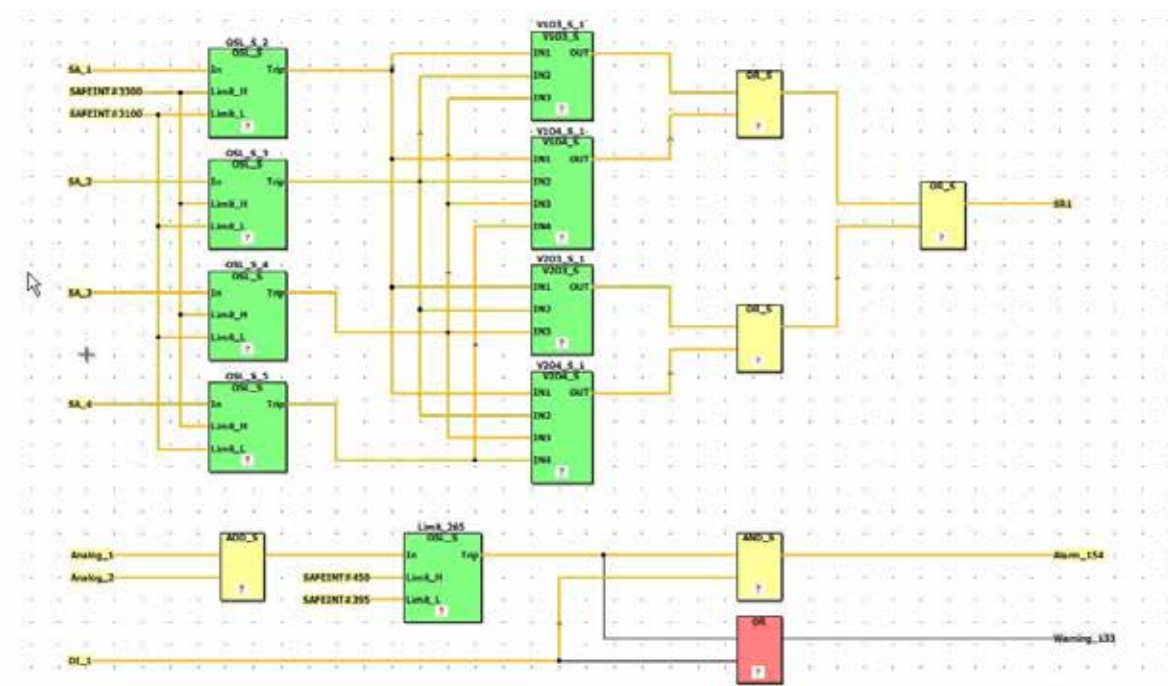
- Editing the safety application
- Compiling the project
- Downloading the project to the ST100 SafeMax
- Controlling the ST100 SafeMax (e.g. starting, stopping, resetting, etc.)
- Performing a function test
- Monitoring and debugging the safety application
- Documenting the project
- Printing the project documentation

Confidence via Safety Function Simulation

Safety functions can be simulated in the configuration program prior to sending the configuration file to a ST100 SafeMax. An example would be applying a virtual speed value to the input of an over speed safety block and seeing how the safety function reacted. Nothing is left to chance with ST100 SafeMax.

Cascadable Function Blocks form complex functions (result becomes next input)

Function Definition



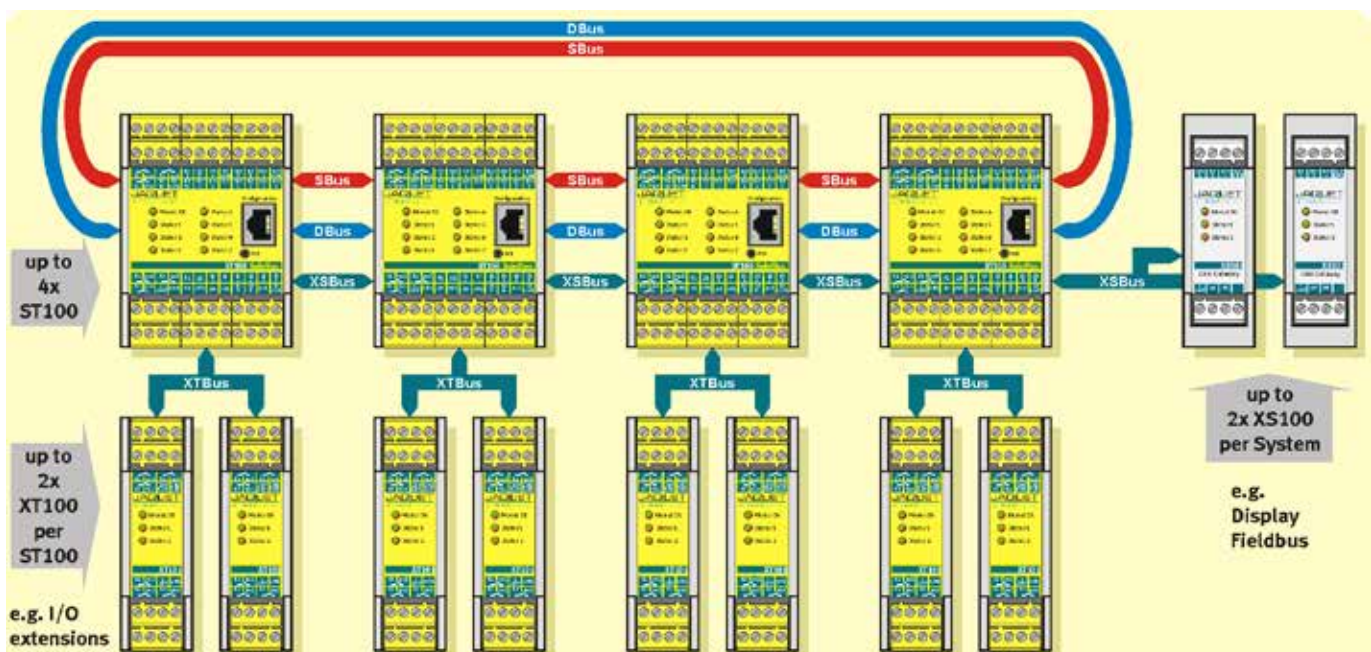
Mechanical construction:

- ST100 SafeMax's are built in metal housings for DIN rail mounting
- A back-plane is formed when several modules are assembled together. The back-plane carries the communication bus
- JAQUET also offers 19" rack replacements using ST100 SafeMax and as an example, 4 ST100 SafeMax's plus four XTBUS expansion modules and one Fieldbus will fit into a 19" rack with a smaller depth requirement than previously
- For hazardous area applications ST100 SafeMax is small enough to be mounted into protective housings with isolators or barriers as needed

Basic system configurations:

	<p>2 ST102 Modules for 1oo2 SIL2</p>
	<p>3 ST103 Modules for 1oo3 SIL3 3 ST103 Modules for 2oo3 SIL2</p>
	<p>4 ST104 Modules for 2oo4 SIL3</p>
	<p>6 ST103 Modules for 2oo3 SIL3 e.g. supplied in a 19" rack for retrofit applications. Plus expansion modules as required e.g. for additional digital and/or analogue I/O and gateways</p>

System expansion up to 14 modules



ST100 SafeMax Innovations

- Front end DSP allows signal amplitude and pulse width measurements for comparison and diagnostic purposes e.g. to monitor signal degradation over time
- Quadruple bus structure for data exchange between modules providing enhanced system integrity and allowing processing of data from more than one module
- Relays & wiring are saved via logical combinations of trips from different sources before the safety relays or digital outputs
- Trip shutdown sequences can be realized within ST100 SafeMax – potentially saving a PLC
- Machine start control & monitoring via start command or assumed start e.g. ST100 SafeMax sees the temperature rising

The Quad Bus Concept

- SBUS makes real time digital speed signals from all channels available to all modules in a group allowing constant inter-module diagnosis & safety relevant functions such as sensor voting, creep detection and direction discrimination
- DBUS connects all ST100 SafeMax's in a group to allow diagnostics of their safety logic and I/O information (includes expansion module measured values)
- XSBUS provides standard and customer specific safety and non-safety system expansion capabilities, such as MMI or fieldbus gateway. It allows 2 extensions accessible by the whole system
- XTBUS provides standard and customer specific safety and non-safety module expansion capabilities, such as additional inputs and outputs. It allows 2 extensions per ST100 SafeMax module
- In addition, Ethernet is provided as a configuration interface and for integration into a communications network
- Commonly used Fieldbuses are supported via XSBUS modules e.g. for Profibus or Modbus

ST100 SafeMax certifications

Environment Standards

IEC 60068-2-1:2007
IEC 60068-2-2:2007
IEC 60068-2-3:1986
IEC 60068-2-6:2007
IEC 60068-2-14:2009
IEC 60068-2-27:2008
IEC 60068-2-30:2005
IEC 60068-2-31:2008
IEC 60068-2-60:1995
IEC 60721-3-3:1994
IEC 60529:1989
IEC 61163:2006

Intl. Standards

API670 & 612
GL & ABS
GOST & PAC
C_CSA_US
ATEX 94/9/EC
Vestas standards

EU Standards

2006/42/EC
2004/108/EC
95/16/EC
2006/95/EC
2011/65/EU
2002/96/EC
2009/125/EC
1907/2006

EMC Standards

IEC 61000-6-2:2005
IEC 61000-6-4:2006
IEC/TR 61000-5-2:1997
IEC 61326-3-1 & -2
IEC 60255-26:2008
DIN EN 12016:2011
DIN EN 12015:2005
IEC 61400-24:2010
FCC Part 15

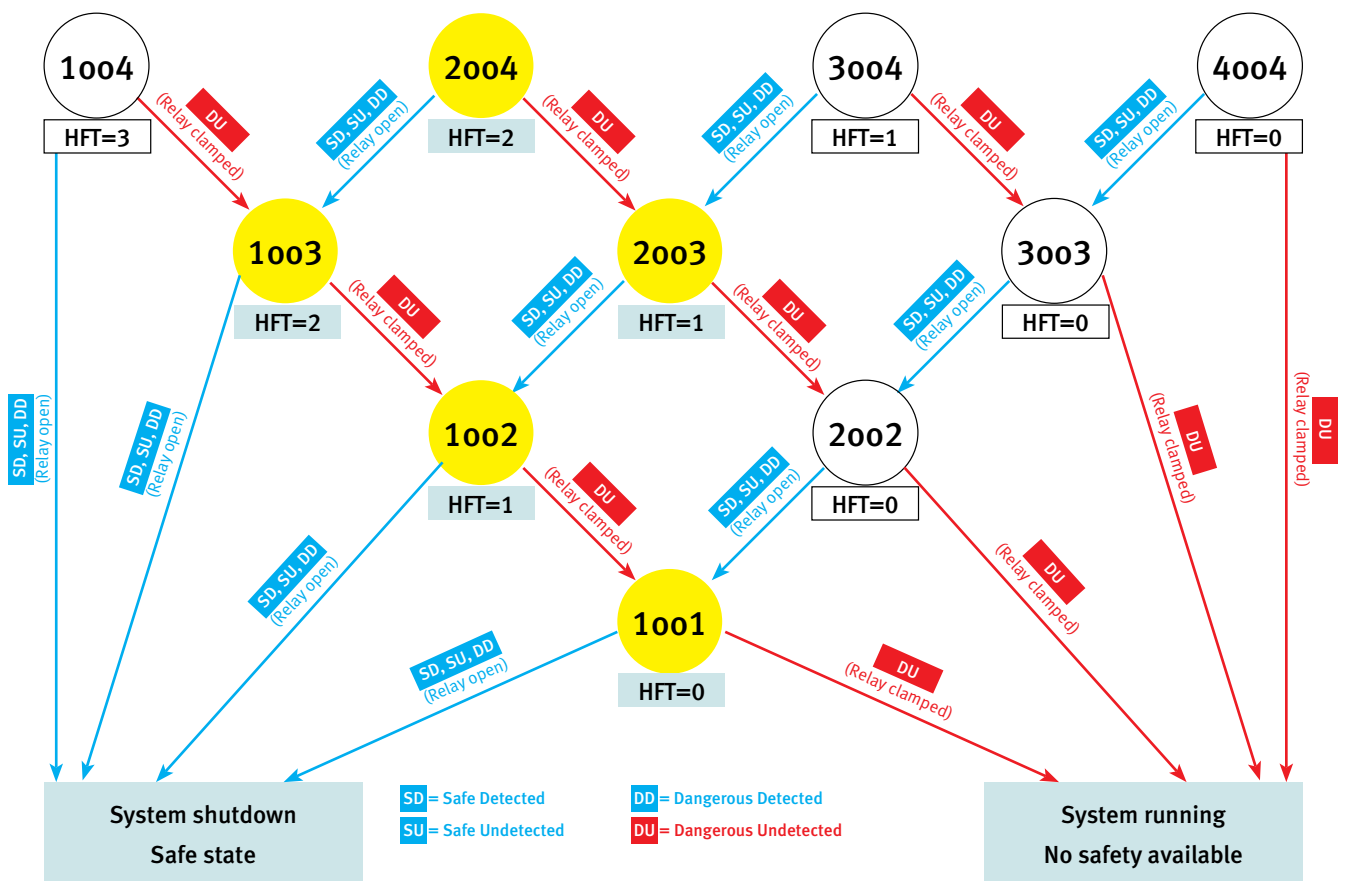
Safety Standards

IEC 61010-1:2010
EN 50178:1997
IEC 60204:2011
IEC 61508-1/2/3/4:2010
IEC 61511:2004
ISO 13849-1:2008
IEC 62061:2005
IEC 61784-3
EN 50205:2002
IEC 61800-5-2
IEC 60255-5:2000
IEC 60255-27:2005
IEC 61131-2
CAN/CSA C22.2 No. 61010-1-12
UL Std. No. 61010-1
EN 81-1:2009
EN 81-2:2009
EN 115-1:2008
(IEC 61513)

So having read this far you are probably wondering why 4 channels for SIL3? The answers will provoke new thinking:

- In a system with relay voting the output consists of 2 terminals whether it's 2oo3 or 2oo4. The difference is in the additional sensor. However, even in a 3 channel system a 4th sensor is normally installed. We want to connect to that to be sure it's available if and when needed.
- ST100 SafeMax's need only be tested once every 20 years. A ST100 SafeMax 2oo4 system contribution to plant non-availability is less than 15 minutes out of 20 years.
- JAQUET provides dual isolated channel VR and Hall sensors. Only 2 sensor locations are therefore needed to create a 4 channel system. This provides an easy solution for upgrading 2 channel SIL2 systems to 4 channel SIL3.
- For retrofit actions we can provide a virtual 3 channel SIL3 solution using 6 ST100 SafeMax's.

The following diagram shows the different voting logics (ST100 SafeMax possibilities marked in yellow) and the relationship between HFT/Reliability/SIL versus availability of the systems.



ST100 SafeMax allows you to re-evaluate your turbine protection solution. We welcome the opportunity of demonstrating how this new modular concept can create a step change in the performance, safety and availability of your machine.

SIL3 Sensors



JAQUET's new line of SIL3 capable speed sensors now enables added functional safety in these and many other applications with an associated reduction in risk level.



Designed to conform to safety standards ANSI/ISA 84.00.01, IEC61508 & IEC61511 plus certified by TÜV, these new speed sensors from JAQUET are intended & approved for use in high demand applications up to and including SIL3. These are defined as having a probability of dangerous failure per hour (PFH) of $\geq 10^{-8}$ to $< 10^{-7}$

3 VR coil systems are initially offered for targets ranging from Module 1 to 10, Pitch (DP) 2.5 to 25 in housings fully closed at the front & potted at the back to eliminate ingress risks.

The environment temperature range for the VR sensors is $-40 \dots +150^{\circ}\text{C}$, with either integral connector or integral cable. All in a package best matched to your application.

Dual coil & Ex rated VR sensors plus various Hall models will be introduced under a rolling program driven by customer demand. When used in conjunction with Safety Instrumented Systems, JAQUET SIL3 sensors provide the until now missing link in the fully certified speed measurement safety chain.

Swiss know-how and quality matched to your demands

JAQUET manufactures speed sensors in quantities from 1 to millions per project per year. These typically customer specific solutions add value through being matched to individual applications. *Since 1889, a spirit of excellence complementing tradition and innovation.*



Automotive turbochargers

Turbocharger for trucks, passenger cars, construction equipment

- Speed of VG/VNT turbochargers
- Gearbox shaft and retarder speed



Railway systems

- Optimum traction control
- WSP (wheel slide protection) systems
- Speed information for automatic train control



Power generation

Gas, hydro, steam and wind turbines

- Overspeed protection
- Speed measurement and control



Hydraulics

Agricultural machinery, construction and mining equipment, cranes, ROV – remote operated vehicles

- Motors and pumps, flowrate measurement
- Position measurement, traction synchronization



Diesel and gas engines

Large diesel and gas engines in marine, rail, off-road applications and power production.

- Cam and crank shaft for dynamic position
- Turbocharger speed, engine diagnostics

Quality systems

ISO TS 16949
ISO 9001
AS 9100
IRIS



Worldwide and local to you through

JAQUET Technology sales offices, subsidiaries and distributors.