Machine Safety

Safety Integrated Introduction

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What is Safety Integrated....?

.....Siemens product portfolio for Industrial Safety



Failsafe Automation Systems (process & factory)> SIMATIC Safety Integrated



Failsafe Operator Control & monitoring> SIMATIC HMI Mobile Panels & Key Panels



Failsafe Industrial Controls > SIRIUS monitoring devices

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Failsafe Drive Technology

SINAMICS Safety Integrated



Failsafe communication

PROFISafe with PROFINET & PROFIBUS



Safety Integrated – Factory Automation Safety functions and subsystems



A machine safety function is reliant on correct product selection and implementation of those products in each of the respective subsystems



But it's often the selection of product in the 'evaluation' subsystem which is the most challenging

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Safety Integrated – Factory Automation Considerations for the evaluation subsystem

Size of application Small or large number of safety functions? System/logic complexity Hardware or software parameterisation? (t)Integration with control ÷ Stand alone safety system or fully integrated? **Economics** Budget or performance priorities? **Diagnostics** Flashing LEDs within control cabinet or operator with HMI?

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Safety Integrated – Factory Automation Siemens safety – evaluation solutions for all applications

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SIMATIC Safety



SIRIUS Safety



Safety Integrated – Factory Automation Siemens safety – evaluation solutions for all applications







Evaluating with.....SIRIUS safety



SIRIUS Safety - 3SK & MSS safety relays Hardware parameterisation or software configuration



3SK1		customer's requirement	3SK2 & MSS			
	-	most simplest logic				
		more complex logic	denne denneterner			
	-	additional functions (e.g. Muting/Interlock)	SIEMENS SIRIUS Later with with with			
		only wiring allowed				
		time off delay				
		complex time functions				
		powerful outputs	94C152.2000			
		enhanced diagnostics				
		simplification of commissioning				
	-	less space consumption				

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SIRIUS Safety - 3SK safety relays ES software for easy parameterisation



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SIRIUS Safety ES..... Demo





Evaluating with.....SIMATIC safety integrated







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SIMATIC fail-safe controllers can operate as a stand alone safety solution..... if that's what you want.



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SIMATIC Safety Siemens Safety Integrated through the years

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1980	SIMATIC S5-110F			SIMATIC S7-300F SIMATIC S7-400F	2002
1988	SIMATIC S5-115F		PROFI	PROFINET & PROFIsafe SIMATIC ET200S F-CPU	2005
1994	SIMATIC S5-95F			SIMATIC S7-1500 STEP 7 Safety Advanced V13	2014
1999	PROFIBUS & PROFIsafe SIMATIC S7-400FH	PROFI BUS		SIMATIC S7-1200 SIMATIC ET200SP F-CPU STEP 7 Safety Basic V13	2015

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Typical fail safe controllers operate by the principles of structural redundancy. One fail safe program is written and two or more processors are used to handle the program. The results are then compared and, if necessary, preventative action is taken.

Classical principle of an F-controller:

Structural redundancy (HFT)

- Two (or more) identical controllers
- All are executing the same program
- · Results are compared



e.g. S5-95F

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Structural redundancy Concept

Typical fail safe controllers operate by the principles of structural redundancy. One fail safe program is written and two or more processors are used to handle the program. The results are then compared and, if necessary, preventative action is taken.

Multiple processors can significantly add to the cost of a fail-safe PLC

Siemens SIMATIC fail-safe controllers **DO NOT** adopt the structural redundancy concept

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SIMATIC fail-safe controllers work on the principles of time redundancy and diversity – not structural redundancy.

This allows the implementation of a fail safe system which is reliant on only one processor.

This is a Siemens patented concept and is fully certified by third party governing bodies such as ...



F-User Programm Free hand programmed F-User Program by the use of F-LAD and F-FDB A, B ► Operation C Operators Output AND Coding Comparison Stop by D ≠/C OR Diversity Diverse . Diversity Output Operators /A, /B Operation D = /C**Time redundancy** Time Compiler Failsafe program generated by Compiler out of F-User Program Compiler automatically adds F-Systemblocks and F-I/O-Handling through PROFIsafe for error detection and control

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Siemens SIMATIC Fail Safe Hardware

Coexistence of standard program and safety related program on one CPU.

Changes to the standard program have no effect on the integrity of the safety related program section.



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Module evaluation Passivation/reintegration



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Second generation of SIMATIC Safety – SIMATIC Safety in the TIA Portal





The SIMATIC Controllers Portfolio Always the right controller – plus integrated added value!



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SIMATIC S7-1200 with Safety Integrated Portfolio overview

CPU I/O-Cards CPU1212FC CPU1214FC CPU1215FC SM1226 F-DI SM1226 F-DQ SM1226 F-RLY up to 4 2 16 fail-safe fail-safe fail-safe digital **Relay**digital inputs outputs outputs **Technical data** (PL d/ SIL 2) each (up to 5A) please refer to next slide pm-switching or 8 (up to 2A) fail-safe digital input (PL e/ SIL 3)

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SIMATIC S7-1200 with Safety Integrated Technical Data F-CPUs



CPU1214FC



CPU1215FC

	CPU 1212FC	CPU 1214FC	CPU 1215FC			
СРИ-Туре		DC/DC/DC, DC/DC/RL	1			
Work Memory, Integrated	100 KB	125 KB	150 KB			
Load Memory, Integrated	1 MB	4 1	ИB			
Retentive Memory, Integ.		10 KB	KB			
Bit Memory (M)	4 KB	8 KB				
Integ. Standard Digital I/O	8 Inputs / 6 Outputs	14 Inputs / 10 Outputs				
Integ. Standard Analog I/O	2 Ir	nputs	14 Inputs / 10 Outputs 2 Inputs / 2 Outputs			
Process Image Size	1024 Byte	s for Inputs / 1024 Bytes	for Outputs			
Signal Board Expansion	2 Inputs 2 Inputs 2 Inputs 2 Outputs 2 Outputs 1024 Bytes for Inputs / 1024 Bytes for Outputs 1 max.					
Signal Module Expansion	2 max.	nax.				
Max. Local I/O – Digital	82	284	284			
Max. Local I/O – Analog	19	67	69			

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SIMATIC S7-1200 with Safety Integrated Practice oriented Application samples for faster results



Contains 5 Scenarios with in total 30 examples

covering

- E-STOP
- Gate Monitoring with or w/o Interlock
- for PL c/SIL 1, PL d/SIL 2, PL e/SIL 3
- Depending on the selected type of actuator (electro mechanic/ electronic)

For each example a ready to use function block is provided in a STEP7-library



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Link

Modular Controller with integrated safety functionalityfor Advanced Control applications



S7-1500 with Safety Integrated



- CPU 1515F
 - CPU 1511FCPU 1513F

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Feature / Function All standard controllers also available as fail-safe controllers One controller for standard and fail-safe automation F-runtime group for autonomous prioritization and

- autonomous prioritization and timing settings
- All controllers with Onboard Status-Display
- Additional password for access to F configuration & F program

	Benefit
	 Simplified CPU selection thanks optimized portfolio
	 Minimization of types and parts
	 Efficient engineering in the TIA Portal
	 Diagnostics messages without programming device
ร เ	 Maximum protection against manipulation

Fail-safe modules for SIMATIC ET 200MP ...high channel modules for optimum utilisation of cabinet volume ET 200MP

- 16 F-DI 24V
- 8 F-DQ 2A PPM

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Feature / Function

- Fail-safe, digital input and output modul for S7-1500 and ET 200MP
- Reduction in module width of 60% or more
- Signal-test (ort-circuit, wire breakage, ...) onboard
- Fault messages in plain text
- PROFsafe address configured via software and saved in the coding module

Benefit

Þ

 Minimization of types and parts via simply add of failsafe modules to the standard I/O

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- Optimum utilization of control cabinet volume
- High availability via easy and rapid localization of faults
- Simple commissioning and module replacement

Modular Controller with integrated safety functionalityfor Distributed Control applications



Fail-safe ET 200SP F-CPU



CPU 1510SP FCPU 1512SP F

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and the second second

Feature / Function

- One controller for distributed standard and fail-safe automation
- Samesoftware concept and features as fail-safe SIMATIC S7-1500 CPU
- Smaller footprint
- Centrally expandable with all standard and fail-safe modules of the ET 200SP
- F-runtime group for autonomous prioritization and timing settings

Benefit

- Optimized solution for machines with distributed architecture
- Minimization of types and parts
- Customer project can be used on a compact desgin
- Up to 30% space gain
- High functional density and low size on the narrowest space
- Efficient engineering with the TIA Portal

ET 200SP – Optimal use of the space in the control cabinet

Investment protection	Easily add fail-safe modules to the standard I/O
Easy commissioning	PROFIsafe address is configured via the software and saved in the coding element
Easy device replacement	PROFIsafe address is automatically imported from the intelligent coding element
High availability	 Onboard signal test: short circuit, wire break Easy and quick fault localization by means of fine-granular error messages in plain text
Optimal utilization of the control cabinet volume	 Reduction of the module width by 50% or more Load group formation without power module





• F-PM-E (2 F-DI/1 F-DQ)

- F-DI 8, F-DQ 4, F-AI 4 0(4)...20mA
- 1 F-RQ
- F-CM AS-i Safety

Coding elements save PROFIsafe address





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No DIP switches Easy module replacement

ET 200SP – interface modules

ET 200SP	IM DP HF	IM PN ST	IM PN HF
Number of modules	32	32	64
Fail-safe I/O modules	\checkmark	\checkmark	\checkmark
Isochronous mode (synchronization with program cycle)		~	
Hot swapping	Multiple	Simple	Multiple
Media redundancy (MRP)	×	\checkmark	\checkmark
Prioritized startup	×	\checkmark	\checkmark
RUN with gaps	\checkmark	\checkmark	\checkmark



ET 200SP – F-DI 8x24VDC HF – interconnection possibilities

Emergency stop command device

Module diagnostics

- Two-channel evaluation (2v2), channels 0+4 form a channel group
 A signal in the presses
 - \rightarrow 1 signal in the process image
- Internal sensor supply
- Short circuit monitoring
- Discrepancy monitoring
- → High diagnostics (up to SIL 3/PL e)





The sensor supply can be assigned in any way per input



ET 200SP – F-DI 8x24VDC HF – interconnection possibilities

OSSD output (safety door switch or light curtain)

Module diagnostics

- Two-channel evaluation (2v2), channels 0+4 form a channel group
 - \rightarrow 1 signal in the process image
- External sensor power supply
- No short circuit monitoring of the module (integrated in sensor)
- Discrepancy monitoring
- → High diagnostics (up to SIL 3/PL e)









ET 200SP – F-DQ 4x24VDC/2A PM HF



Properties Central/distributed application 4 fail-safe digital outputs 2A (P/M-switching) up to SIL 3 Open circuit/overload monitoring Cross circuit monitoring Module passivation in fault scenario Width: 15 mm



ET 200SP – F-DQ 4x24VDC/2A PM HF – interconnection possibilities

Two-channel contactor control

Module diagnostics

- Short circuit P to L+
- Short circuit M to ground
- Cross circuit monitoring
 P-... to P-...
 or M-... to M-...
- Open circuit/overload monitoring P-switch
- → High diagnostics (up to SIL 3/PL e)¹
- ¹ When implementing feedback circuit monitoring (FDBACK block) in the F-user program

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ET 200SP – F-DQ 4x24VDC/2A PM HF –



Two-channel contactor control (example showing single point of failure - PP)



ET 200SP – F-DQ 4x24VDC/2A PM HF – dark test





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ET 200SP – F-DQ 4x24VDC/2A PM HF – light test





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STEP 7 Safety Advanced ... using all the TIA Portal properties to the benefit of safety

Getting started quickly

- Uniform usability
- F-program structure created automatically by inserting an F-CPU
- Integrated, certified library with all commonly safety functions

Simplified validation

- Global library concept for IO modules and function blocks including signature
- Standard-compliant program documentation



Usability Uniform Look & Feel for all safety resources Logbook for a simple change tracking Efficiency Central Safety Administration Editor for displaying and setting of safety parameters Investment protection Migration of existing Distributed Safety code

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TIA Portal V15 – Overview of Software components – Scalability in hardware and software functions



SIMATIC STEP 7/STEP 7 Safety		SIMATIC WinCC		SINAMICS Startdrive		SIMOTION SCOUT/SCOUT TIA		Soft Starter ES/SIMOCODE ES			
Programming languages (F-)LAD, (F-)FBD, ST, STL ¹), S7-GRAPH ¹		Machine-oriented operator control and monitoring and process visualization (SCADA)		Integration of drives		Integration of SIMOTION		SIMOCODE Motormanagement System SIRIUS Sanftstarter			
				SCADA		Comfortable and guided acceptance of					Additional access via PROFIBUS/ PROFINET
sw-Col	S7-1500 (F) S7-1500 ontroller (F) S7-300/400/			PC singe station		Safety Integrated functions for SINAMICS G120		SINAMICS S120 SIMOTION C	VII		Additional graphical parameterization and extended diagnosis
	WinAC (F)			Comfort and Mobile Panels	f charge)	Commissioning, opti- mization and diagnosis SINAMICS G120, G130, G150, S120, S150 & Medium Voltage		SIMOTION P SIMOTION D	f charge)		Additional online functions via SIRIUS PtP
Basic Basic Professional Advanced	S7-1200 (F)	Basic Comfort	Advanced	Basic Panels	STEP 7 integr. Basic (free o Advanced	SINAMICS V90 PROFINET	Professional		STEP 7 integr. Basic (free o	Standard	List parametrization with PN/PB parameterization within startup
Communication PROFIBUS, PROFINET, AS-i, IO-Link, ET 200, network topology PROFIsafe via PROFIBUS and PROFINET											
Overall functions e.g. system diagnosis. import/expo					ort to excel, und	lo					
Engineering options		e.g. TIA Portal Multiuser, SIMATIC Energy Suite, SIMATIC ProDiag …									

1 Not for S7-1200



SIMATIC safety integrated..... Demo



SIMATIC Safety



SIMATIC Safety Systems are certified according to

- IEC 61508: 2000 SIL 1-3
- EN 954-1: 1997 Cat. 2-4
- EN ISO 13849-1: 2006 PL a-e
- IEC 61511: 2003
- EN 60204-1: 1997
- IEC 62061: 2005
- NFPA 79-2002, NFPA 85





And thus fulfils the highest requirements for the Australian industrial market - including mining

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DF FA application examples in the SIOS – Safety

Entry ID: 89260861



Mode selection

Safety with the S7-1200 FC CPU

emergency stop applications, you have an

S7-1200 FC CPU

For a total of 30 scenarios of protective door and

F-block at your disposal for the direct use of an

In addition to the use of the S7-1200 FC CPU

there is also an explanation of what must be considered for reaching a specific PL/SIL

Entry ID: 109478932

- These FAQ describe the requirements for a mode selection with standard modules
- They describe the standard-related backgrounds as well as those specified by the machinery directive

Safety Integrated programming guideline

Entry ID: 109750255

- Supplement to the program guidelines for S7-1200/1500 controllers, with safety-specific information
- You will gain many advantages if your adhere to the recommendations cited here
 - Reusability of program components
 - Easier acceptance (code review, error detection and correction)
 - Reduction of programming errors

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PROFIsafe address assignment

Entry ID: 109740240

In various system configurations, there are different requirements for the network-wide and CPU-wide unambiguity of PROFIsafe addresses. This document explains the requirements based on example configurations

SLS specification via HMI

Entry ID: 67634251

- This application example supports you when creating
- a safety-oriented input function for setpoint values for a drive via an HMI system
- It provides you with a safety concept, which you can use to solve the task described above up to SIL 2 according to IEC 62061 or PL d according to ISO 13849-1

Configuration control with safety

Entry ID: 109481852

- This application example describes how F-modules behave when configuration control is used
- It explains which procedure is needed for using this functionality

Thank you for your attention





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