Drives-Based
Safety Integrated
Featuring Sinamics Drives
dbSI SIPEC Event
Overview

Introduction
Basic commissioning of SINAMICS G120 drive (optional)
Safety Integrated discussion
Lab 1 – Hardwired Safe Torque Off
Lab 2 – Hardwired Safe Stop 1 (optional)
Discuss additional drive based SI functions and Safety Networks
Basic commissioning of G120 for PROFINET control (optional)
Lab 3 – Configuring dbSI functions controlled via PROFIsafe
Sinamics S120 positioning demonstration with dbSI
Review advantages of drive applications utilizing dbSI
**SINAMICS AC drives**

<table>
<thead>
<tr>
<th>Application example</th>
<th>V-Series</th>
<th>G-Series</th>
<th>S-Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirements</td>
<td>• Basic performance&lt;br&gt;• Ease of use&lt;br&gt;• Ruggedness</td>
<td>• Efficient&lt;br&gt;• Application optimized&lt;br&gt;• High usability</td>
<td>• High performance&lt;br&gt;• Highest functionality&lt;br&gt;• Innovation driver</td>
</tr>
<tr>
<td>Closed-loop control performance</td>
<td>☐</td>
<td>☒</td>
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<tr>
<td>Integration into automation systems</td>
<td>☐</td>
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<tr>
<td>Energy recovery topology</td>
<td>—</td>
<td>☒</td>
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<tr>
<td>Integrated safety functions</td>
<td>—</td>
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</table>
SINAMICS G120 demo
Basic configuration

*Optional exercise to gain familiarity with the G120 drive

In this optional hands-on lab we will use the commissioning wizard in the Startdrive software to configure a G120 drive from its default settings to run via the demo station you will be using during this event
A central topic for Siemens
From the beginning

"The prevention of accidents must be seen not as a legal stipulation, but as an act of humanity, human obligation and economic sense."

- Werner von Siemens, 1880
Safety requires protection against various hazards

<table>
<thead>
<tr>
<th>Electric shock</th>
<th>Heat and fire</th>
<th>Dangerous radiation</th>
<th>Hazards due to functional faults</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Electric shock icon" /></td>
<td><img src="image2.png" alt="Heat and fire icon" /></td>
<td><img src="image3.png" alt="Dangerous radiation icon" /></td>
<td><img src="image4.png" alt="Hazards due to functional faults icon" /></td>
</tr>
</tbody>
</table>

**Functional** safety is part of **overall** safety: a mechanism that depends on the correct function of the safety-related (control) system.
Hazards that are created due to functional faults
Must be prevented before they actually occur

<table>
<thead>
<tr>
<th>Man</th>
<th>Machine</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Man Image]</td>
<td>![Machine Image]</td>
<td>![Process Image]</td>
</tr>
</tbody>
</table>

**Safety Integrated** provides additional advantages for Functional Safety

- Lower system costs by reducing hardware and installation time
- Higher productivity as a result of a more functional safety solution with faster recovery
- Higher level of coordination for the increasing automation trends in manufacturing
- **Safer environments than tradition safety systems**
Risk analysis
The basis of today's globalized safety standards

Risk assessment
- Describe the machine
- Identify hazards
- Assess the risks

Risk minimization
- Develop a safety concept
- Implement safety concept
- Document measures

Verification
- Carry out the validation
- Document proof

Unsafe actions:
- cutting wheel > cutting off
- chips > cutting into
- clamping > crushing
- material feed > crushing
- control cabinet > electric shock
Safety
Requires safety measures

Risk assessment
- Describe the machine
- Identify hazards
- Assess the risks

Risk minimization
- Develop a safety concept
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Verification
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Safety control system
Key functions

All from a single source
Integrated safety solutions for recording, evaluating, all the way to responding.
Why safety integrated technology in drives?
STO (Safe Torque Off)
The most basic safety function

After STO is activated, the **energy supply** to the motor is **interrupted in a safety-relevant fashion** and as a consequence the motor coasts down.

After STO has been activated it is not permissible that the drive generates torque – resulting in hazardous motion.

The STO condition must be reset before the drive can be restarted.
The classic implementation
Using an external circuit

Hardware safety technology

External components
• Safety relays, contactors…

Two-channel wiring
An innovative solution
With drive-based safety

Safety technology integrated into drive technology

Drive with integrated safety
Two-channel processing

Detect
Evaluate
Reaction
Implementation of stop functions
According to standards using safety functions integrated in the drive

IEC 60204

Stop category 0
- Energy feed is immediately shut down
- Electromechanical or electronic shutdown
- Electrical isolation is not stipulated

Stop category 1
- Drive is electrically braked to standstill
- At standstill, the energy feed is shut down
- Electromechanical or electronic shutdown
- Electrical isolation is not stipulated
Drives-based safety integrated

Lab # 1
- Configure STO via hardwired inputs in SINAMICS G120 demo

Lab # 2 (optional)
- Configure SS1 via hardwired inputs
Drives-based safety integrated
The market leader

Most VFD’s in the market today offer a built-in or optional STO / SS1 functions that I can wire up!

What makes SINAMICS drives different?

1. The capability to receive a fail safe telegram with safety signals on the same cable as the control signals

2. A full range of safety-certified drives-based safety functions
Overview of safety functions in drives
According to safety standards

- **Function for safe shutdown**
  - Safe Torque Off (STO)
  - Safe Stop 1 (SS1)
  - Safe Stop 2 (SS2)
  - Safe Operating Stop (SOS)

- **Function for safe brake management**
  - Safe Brake Control (SBC)
  - Safe Brake Test (SBT)

- **Function for safely monitoring motion**
  - Safely-Limited Speed (SLS)
  - Safe Speed Monitor (SSM)
  - Safe Direction (SDI)

- **Function for safely monitoring position**
  - Safely-Limited Position (SLP)
  - Safe Position (SP)
Defining the safety functions for a cutting machine
Example: saw

<table>
<thead>
<tr>
<th>Safety function</th>
<th>Detecting</th>
<th>SINAMICS G120 with CU250S-2</th>
<th>SINAMICS G120C</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF1</td>
<td>Stops all axes for an Emergency Stop and when the protective doors are opened</td>
<td>Emergency Stop button or position switch</td>
<td>STO + SBC</td>
</tr>
<tr>
<td>SF2</td>
<td>When the protective doors are opened, the cutting disk/wheel is stopped, and the feed is operated with acknowledgment button and safely reduced speed</td>
<td>Position switch and acknowledgment button</td>
<td>STO</td>
</tr>
</tbody>
</table>
An innovative solution
Past the limits of conventional technology

Conventional safety

Integrated safety
Innovative machine concepts
How can safety engineering be easily integrated in the machine?

»Up to 12 wirings per drive were required for setup mode with safely reduced speed. A PROFIsafe connection suffices today.«

Matthias Stech,
Management Axman
Let's Review

https://www.youtube.com/watch?v=S3tbB9-8X4Y&index=12&list=PL3F91F9D4F5FEABBF
Drives-based safety integrated

Lab # 3

- SINAMICS G120 and SIMATIC S7-1500F
- Experiment with STO, SS1, SLS and SSM via PROFIsafe
Application with extended safety
Animation for storage / retrieval machine
Drives-based safety integrated

Demonstration of STO, SS1, SLS, and SLP via PROFlsafe

- SINAMICS S120 and SIMATIC S7-1500F
Safety functions
Example: converting machine

Diaper machine

Products
- SIMATIC S7 416F PLC with PROFIBUS and PROFINET
- 7 SIMOTION D445
- 96x SINAMICS S120
- SIMOTICS S 1FK7
- Safety integrated with PROFISAFE

Solution

Requirements / benefits
- Integrated concept
- High-performance control
- Flexibility for implementing customer requirements
- Faster engineering with standard software
### Safety functions
**Example: crane technology**

<table>
<thead>
<tr>
<th>Task</th>
<th>Solution</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency Stop</td>
<td>SS1 SBC</td>
<td>The drive remains connected to the line supply and can immediately restart</td>
</tr>
<tr>
<td>Verifying the safe operation of the mechanical brake</td>
<td>SBT</td>
<td>System is monitored at regular intervals to detect unsafe conditions</td>
</tr>
<tr>
<td>The protected area is safely released in operation if the</td>
<td>SDI</td>
<td>Increased productivity by releasing the protected area</td>
</tr>
<tr>
<td>operator moves the axis away</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safe limiting of the traversing range stop</td>
<td>SLP</td>
<td>Continuous protected area monitoring without additional components (limit switches)</td>
</tr>
</tbody>
</table>
Success Stories with innovative safety

KUKA Reduces Machine Safety Components by 85% While Increasing Machine Safety

KUKA Flexible Production Systems is one of the most prominent producers of Automated/Robotic production systems for car bodies and chassis.

When KUKA decided to become a Tier 1 supplier of automobile bodies to DaimlerChrysler, they needed to use their extensive knowledge of body shops and find a partner that was willing to work with them to change the landscape of the North American market. KUKA was faced with designing a body shop utilizing BBiOM (Design, Build, Own, Operate, and Maintain) philosophy with no restrictions on the equipment used. The only criteria, "Utilize only field proven technology." The result: A partnership with Siemens that utilized field proven revolutionary technology realizing substantial cost savings, while significantly improving system safety, manufacturing flexibility and Mean Time To Repair (MTTR). This is all happening at the KUKA Texfo Productions Operation LLC (KTPO) assembly plant, which produces the Body-In-White on the DaimlerChrysler (DCh) Jeep JK vehicles, currently the Wrangler Model.

Programmable Logic Controller (PLC); little has been done to garner similar improvements in machine safety systems.

Knowing this was a major source of costs and complexity, KUKA looked to simplify the safety system with a new, more cost effective method for safety management and controls using a fail-safe controller with high diagnostic capability. While this alone would have saved thousands in wiring and troubleshooting, Kuka saw moving from hard wired safety relays to a stand alone Safety PLC-based method was not enough. Combining both machine safety and standard machine control on one field bus was key to nearly eliminating all relays and “out to the field” wiring, creating significant reductions in control panel space requirements, hardware requirements, engineering design, troubleshooting and overall wiring costs.

https://youtu.be/C2ZTjDwGHeC
Innovations with Integrated Safety
Safe, cost-optimized and productivity boosting

The advantages at a glance

Higher level of safety due to faster-responding, protection from manipulation, certified safety functions, and sophisticated interaction with personnel

✓ High productivity due to practical safety that offers higher level of collaboration
✓ Simple and economic implementation by elimination of hardware components and low wiring complexity
✓ Faster and smarter reaction for safety with higher level of protection against failure and manipulation
Function examples and applications
Wide selection

Navigate in the product tree and look for your topics

usa.siemens.com/drives-safety
Thanks
And be safe!

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