CT490 – Introduction to the New Kinetix® 5700 Safety Monitoring Capabilities

Jim Grosskreuz
Todd Garski
Rockwell Automation
May 2018
Today’s Session

- CT490 – Introduction to the New Kinetix® 5700 Safety Monitoring Capabilities: Learn about the new drive safety instructions for Logix Designer V31 and the Kinetix® 5700, such as Safely Limited Speed (SLS) and Safe Stop 1 (SS1). This session combines a solution overview presentation with an instructor lead demonstration of the new Studio 5000 Logix Designer® drive safety instructions along with basic introduction of how they can be used.
Solution Benefits

Architecture

Instructions

Demo
Kinetix® 5700 Advanced Safety

Scalable

**Scalable Safety Level**
SIL CL2, Up to PLo – Single Encoder
SIL CL3, Up to PLe – Dual Encoder

Productive

**Studio5000 Logix Designer**
Configure Safety and Motion Control

Flexible

**New Safety Functions in GuardLogix**
Safety applications that are customized for any industry

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Safe Monitoring Solution

1. GuardLogix 5580 controller or CompactGuardLogix 5380 controller

2. Kinetix 5700 ERS4 Safe Monitoring Servo Drives

3. Studio5000 Logix Designer Version 31

VP Motors with SIL CL2 safety rated encoders
Safe Monitoring Benefits

- Controller based safety functions enable powerful safety machinery solutions.
  - *Machines can remain active while simultaneously being safely monitored.*
  - No longer necessary to stop a machine to perform maintenance etc.
  - *This results in a smarter and more productive machine.*
Safe Monitoring Benefits

- Controller based safety functions can be **flexibly** integrated into the overall machine:
  - Seamless safety communications over EtherNet/IP
  - Multiple safety functions can be sequenced across the machine
  - Dynamic safety set points
  - Complete solution integration from sensor to actuator
Why controller based safe monitoring

- Using the GuardLogix based monitoring has distinct advantages over traditional standalone safety systems.
  - Ability to perform intricate safety logic
  - Manage multiple safety zones
  - Inherent flexibility, modularity, and scalability
  - Manage a large number of safety I/O devices
  - Tightly integrates safety diagnostic data
  - Sequenced safety actions across multiple drives
IEC 61800-5-2 Safety Functions

- V31 release:
  - SFX Safe Feedback Scaling
  - SS1 Safe Stop 1
  - SS2 Safe Stop 2
  - SOS Safe Operational Stop
  - SLS Safely-Limited Speed
  - SDI Safe Direction
  - SBC Safe Brake Control
  - SLP Safely-Limited Position
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SIL2/PLd Solution

Controller owns everything – I/O devices, feedback scaling, safety configurations, safe feedback monitoring.

Kinetix 5700 - provides safe feedback from encoders to the safety controllers STO and SS1 in drive.

Motion & Safety Data over EtherNet/IP

Safety I/O over EtherNet/IP

Safety Task

VP motor with SIL CL2 safety rated encoder

MP motor with “M” and “S” encoder options

Controller owns everything – I/O devices, feedback scaling, safety configurations, safe feedback monitoring.
SIL3/PLc Solution

Controller owns everything – I/O devices, feedback scaling, safety configurations, safe feedback monitoring

Motion & Safety Data over EtherNet/IP

Kinetix 5700 - provides safe feedback from encoders to the safety controllers STO and SS1 in drive

Motion & Safety Data over EtherNet/IP

Safety I/O over EtherNet/IP

VP motor with SIL CL2 safety rated encoder

842HR sin/cos encoder

Safety I/O over EtherNet/IP

Controller owns everything – I/O devices, feedback scaling, safety configurations, safe feedback monitoring

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Motion & Safety Data over EtherNet/IP

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VP motor with SIL CL2 safety rated encoder

842HR sin/cos encoder
SIL CL2 Rated Kinetix® VP Motors

Will support advanced safety functions via Kinetix® 5700 “ERS4”
Safe Speed Monitoring drives

New “W” and “Q” Encoder Options provide 9 & 12 bit safety channel feedback when used within Integrated Safety systems

23 bit primary channel feedback provides greater performance (Frame size 100 and above)

Current encoder options (non-safety) remain active for ease of ordering

SIL CL2 TÜV Certification on optical encoder
Flexible Architecture

Safety and standard tasks in a single controller....
Flexible Architecture

Safety and standard tasks with **multiple controllers**
Use cases - Kinetix

- PLd System with MP with “S” and “M” encoder
- SIL CL2/PLd System with VP motor
- SIL CL3/PLe System with VP motor and 842HR encoder going into K5700 drive
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Demo
Safety Instructions

- Instructions run in the GuardLogix 5580 controller or CompactGuardLogix 5380 controller
- Instructions are safety certified by TÜV
- Instructions support SIL CL2/PLd and SIL CL3/PLe monitoring and stopping functions.
Safe Stop 1 (SS1)

- SS1 instruction initiates and monitors the motor deceleration within set limits to stop a motor in a controlled manner.

- Output of the instruction signals when the motor speed is at or below the “Standstill Speed” input parameter.

- Output is then used to initiate an STO in the drive(s) over EtherNet/IP via program logic.
**Safe Stop 2 (SS2)**

- SS2 instruction initiates and monitors the motor deceleration within set limits to stop the motor in a controller manner.

- Instruction monitors when the motor speed is at or below the “Standstill Speed” input parameter (zero speed).

- Then the instruction initiates the Safe Operating Stop (SOS) function.

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**Stop Functions – Safe Stop 2**

- Zero Speed Monitoring
- Fault Zone
- Safe Stop 2 Request
- Access Granted

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**Variables**

- SS2
- RestartType
- CoolStartType
- FeedBackSPXRequest
- StopMonitorDelay
- StopDelay
- SS2StandstillSpeed
- DecelRefSpeed
- DecelSpeedTolerance
- Mode
- CheckDelay
- StandstillDeadband
- SOSStandstillSpeed
- SS2Active
- SOSActive
- SOSStandstill
- SS2Fault
- SOSFault
- Reset
- SS2FaultType
- SOSFaultType
- DiagnosticCode
Safe Operating Stop (SOS)

- SOS instruction initiates and monitors zero speed (standstill speed) based on either speed or position, depending on the “Mode” input setting.
  - Position Check
  - Speed Check
- Output is then used as a condition to initiate an STO in the drive(s) over EtherNet/IP via program logic.
Safe Brake Control (SBC)

- SBC instruction controls and monitors redundant outputs used to engage an external brake.
- SBC initiation is programmatically tied to an STO event.
- The reaction time for brake feedback is configurable.
Safe Direction (SDI)

- SDI instruction monitors and indicates if the motor shaft moves in the unintended direction by more than a specified limit.
- If the limit is exceeded, the SDI Limit output is signaled.
- The output is used to initiate a user defined Safe Stop Function (STO, SS1, SS2 or SOS).
Safely Limited Speed (SLS)

- SLS instruction initiates and monitors the motor speed to verify it does not exceed the specified “active speed” limit
  - “Active speed” limit is dynamically changeable

- If the specified speed limit is exceeded, the SLS Limit output is signaled

- The output is used to initiate a user defined Safe Stop Function (STO, SS1, SS2 or SOS).
Safely Limited Position (SLP)

- SLP instruction initiates and monitors the motor position to ensure it does not exceed the specified position limit(s)
  - Two travel limits
  - Dynamically changeable
- If the specified position limit is exceeded, the SLP Limit output is signaled
- The output is used to initiate a user defined Safe Stop Function (STO, SS1, SS2 or SOS)
## SS1 – Two Methods of Execution

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Drive based execution</th>
<th>Controller-based execution</th>
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<tbody>
<tr>
<td>Where monitoring performed</td>
<td>In the Kinetix® 5700 drive</td>
<td>In the controller</td>
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<td>Configuration of SS1</td>
<td>Add-on Profile (AOP)</td>
<td>Part of instruction</td>
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<td>Configuration changes</td>
<td>Fixed, change with AOP and re-download</td>
<td>Change parameters when function not active (not being requested)</td>
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<td>Function initiation</td>
<td>SS1 drive request bit (Output Assembly)</td>
<td>SS1 instruction request</td>
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<td>Safety reaction time</td>
<td>Faster</td>
<td>Not as fast as drive based execution</td>
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Drive Based SS1 Configuration

- SS1 Timed
- SS1 Monitored
IEC-61800-5-2 › Adjustable speed electrical power drive systems – Safety requirements - Functional

- New “Drive Safety” Instructions (8)
  - SFX (Safe Feedback Scaling)
  - SS1 (Safe Stop 1)
  - SS2 (Safe Stop 2)
  - SOS (Safe Operating Stop)
  - SLS (Safety-limited Speed)
  - SLP (Safety-limited Position)
  - SDI (Safe Direction)
  - SBC (Safe Brake Control w/ external brake)

- Available in the CompactLogix 5380 and ControlLogix 5580 family of controllers
Controller-based Safety
Safety Instruction Breakdown

- Configurable Inputs:
  - Safety function parameters

- Inputs:
  - FeedbackSFX – the link to the SFX instruction for an axis
  - Request – initiate the safety function monitoring
  - Reset – safety instruction reset

- Pass through:
  - Safety Assembly Output tags that will pass safety function status information from the Safety Task of the Safety Controller to the Safety Core of the drive to the Standard Task of the controller.

- Outputs:
  - Fault Type – instruction fault code
  - Diagnostic Code – additional detail on fault
  - O1 – instruction status indicator
  - RR – Reset Required
  - FP – Fault Present
Safety Task Programming

Safety demand initiates monitoring of the SLS Safety Function

“SLS Active” status sent to drive

“SLS Active” status is then passed to the Standard Task

Standard Task Programming

“SLS Active Status” initiates change of motion speed

Safety Output Assembly Tag | Axis Tag
---|---
module:SO.SLSActive | Axis.SLSActiveStatus
module:SO.SLSILimit | Axis.SLSILimitStatus
module:SO.SLSFault | Axis.SLSFault
Safety Feedback Interface (SFX)

- Any safety axis of motion that requires that a safety function be executed on it would require an SFX instruction.
- The SFX function is to convert position and velocity feedback from the safety drive into user-defined units for position and speed, and to define an absolute reference position.
- Though the SFX instruction is a safety instruction, it alone does not perform a safety function.

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Kinetix 5700 Drive Setup for Safety

Add K5700 ERS4 Module in I/O Configuration

1. Configure Axis in Motion Group
2. Configure K5700 ERS4 Add-On Profile (AOP)
3. Add Drive Safety Functions to Safety Task Program
Module Properties

New Content
Axis Properties

New Content
Agenda

- Solution Benefits
- Architecture
- Instructions
- Demo
Safe Monitoring Demo

Machine Access

- Actual Velocity: 4.29 Revs
- Actual Speed: 4.48 Revs
- SLS Active Limit: 4.75 Revs
- Speed Control: 4.50

Limit Low: [ ]
Limit Max: [ ]
Safely Reset: [ ]
SS1 Request: [ ]
SLS Request: [ ]
SLS Limit Select: [ ]

Safely Limited Speed

Stop Functions – Safe Stop 1
Safe Monitoring: Breaking It Down

1. Gate entry request starts SLS monitoring
2. Motion program adjusts speed below SLS Active Limit within the Check Delay time – access granted after delay time ends
3. Application requires velocity change, SLS Limit can adjust dynamically
4. Drive velocity reaches the SLS Limit and the programmed limit action requests SS1 monitoring
5. Motion program initiates stopping action
6. On SS1 monitoring completion, STO is requested
Thank You!