# PowerFlex 755 – Integrated Safety with 20-750-S3 card

Objective

This document describes a sample setup of the PowerFlex 755 drive using the Embedded EtherNet port (EENET) with the 20-750-S3 Safety option card in Integrated Safety operation with a GuardLogix Safety Controller.

Description

The PowerFlex 755 drive with the 20-750-S3 safety card offers the option of Integrated Safety, a controller based safety function that is configured within Studio 5000 Logix Designer software to provide the Safe Torque-Off function. This method uses EtherNet/IP to communicate safety information (CIP Safety) and remove the need for discrete safety wiring to the drive. Rated Cat.3 and PLe per ISO 13849-1.
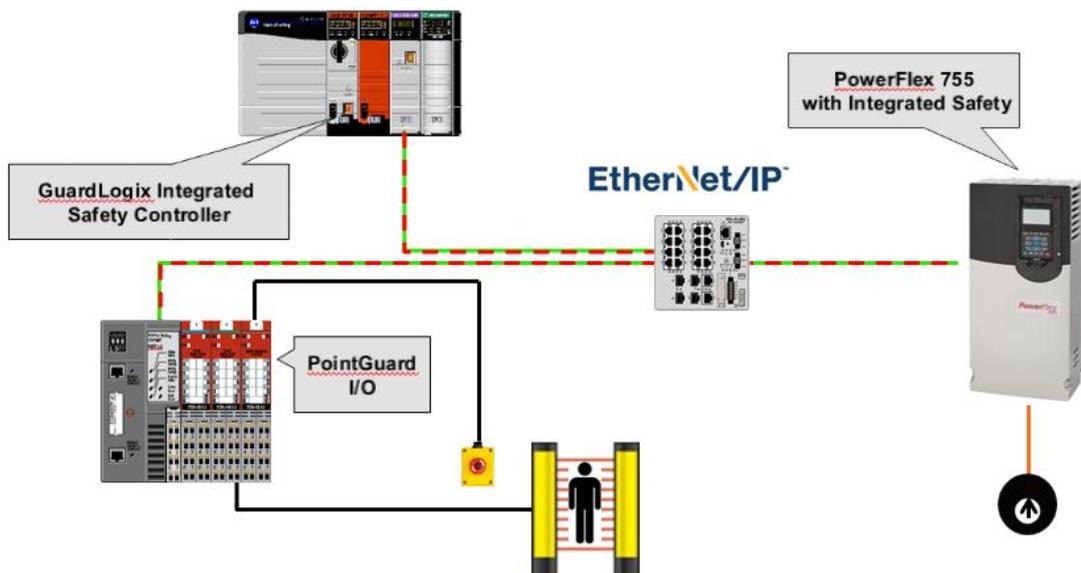
The following software, AOP and firmware versions are required:
- Studio 5000 Logix Designer V30 (and later)
- Drives AOP V4.09 (and later)
- GuardLogix 5570 or Compact GuardLogix 5370 safety controller with firmware V30 or higher
- GuardLogix 5580 or Compact GuardLogix 5380 safety controller with firmware V31 or higher
- PowerFlex 755 drives with firmware V13 (and later)

Installation

The 20-750-S3 can be connected in the slots 4, 5 and 6 of the PowerFlex 755 drive.

The main control board SAFETY jumper must be removed.

Allen-Bradley · Rockwell Software

Rockwell Automation

Setup in Studio5000

These is the hardware of our example setup:

GuardLogix 5580 safety controller with firmware V32
PowerFlex 755 drive with firmware V14.002
20-750-S3 card

Setup Steps:

1. Open **Studio 5000 Logix Designer** and create a new project for the **L8xES** controller.
2. Add the **PowerFlex 755-EENET** (AC Drive via Embedded EtherNet) to the EtherNet/IP network.

    We can also use the Dual port EtherNet card **20-750-ENETR** but <u>only</u> in **Tap** mode. Select also **PowerFlex 755-EENET** as drive profile type.

3. In the **Device Definition** dialog box enter a name for the drive and the EtherNet address. Enter also the drive revision and rating . You can automatically load this information from the online network drive by clicking the **Upload** option.

4. In the drop down menu for **Connection** select **Standard and Safety** (Both control and network safety connections are managed by this controller). When a network safety connection is selected, the **20-750-S3** safety card is selected by default.

Identity

Type:	PowerFlex 755
Connection:	Standard and Safety
Safety Peripheral:	20-750-S3
Safety Instance 1:	Stop Torque Only

5. Click **Peripherals** in the navigation tree and change the port location of the **20-750-S3** card if needed. Ports 4, 5 or 6 can be used.

Peripherals

Need more options?

Type:	Network STO *S3
Vendor:	Allen-Bradley
Parent:	MyDrive
Port:	4 - Network STO *S3
Revision:	1 . 002
Electronic Keying:	Compatible Module
User Text:	

6. Click **OK** to save the changes.
7. Click **Create** to create the drive and have it added to the I/O Configuration folder.
8. Save the project and download. When downloading completes, place the controller in **Run** mode.
9. Double-click the drive in the I/O configuration to reopen the drive properties window. Click **Connection** in the navigation tree and tick the box for **Inhibit Module**.

10. Click **Safety Configuration** in the navigation tree and click the **Reset Ownership** button. Click **Yes** in the next window to confirm the reset.

11. Click **Connection** in the navigation tree and untick the box for **Inhibit Module**.
12. Verify that the yellow icon has disappeared and the drive is in the **Running** status.

Integrated Safe Torque-Off functionality

1. The PowerFlex 755 drive should display "**Not Enabled**".

2. Go to the Controller tags and locate the drive safety input and safety output tags. Notice that the **TorqueDisabled** and **ResetRequired** bits in the input are high **"1".**

Drive:SI	{...}	{...}	
Drive:SI.ConnectionFaulted	0		Decimal
+ Drive:SI.ConnectionStatus	2#0000_0000_0000_0000_...		Binary
Drive:SI.ResetRequired	1		Decimal
Drive:SI.RunMode	1		Decimal
Drive:SI.SafetyFault	0		Decimal
+ Drive:SI.Status	2#1000_0001		Binary
Drive:SI.TorqueDisabled	1		Decimal

3. Set the **SafeTorqueOff** bit in the output to 1. This bit needs to be energized in order to allow torque.

Drive:SO	{...}	{...}	
+ Drive:SO.Command	2#0000_0001		Binary
Drive:SO.Reset	0		Decimal
Drive:SO.SafeTorqueOff	1		Decimal

The Reset bit is not required. See below auto reset timing diagram using network Safe Torque-Off.

Drv:SO.SafeTorqueOff	Disable Torque		Permit Torque
Drv:SO.Reset		Reset Not Required	
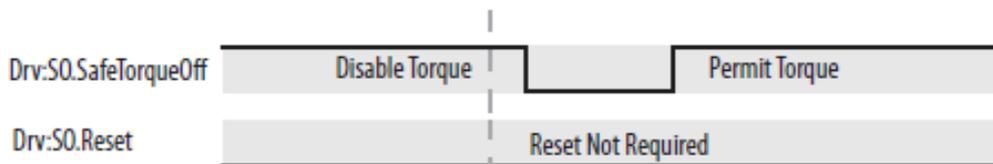
4. Notice that the **TorqueDisabled** and **ResetRequired** bits goes low **"0".**

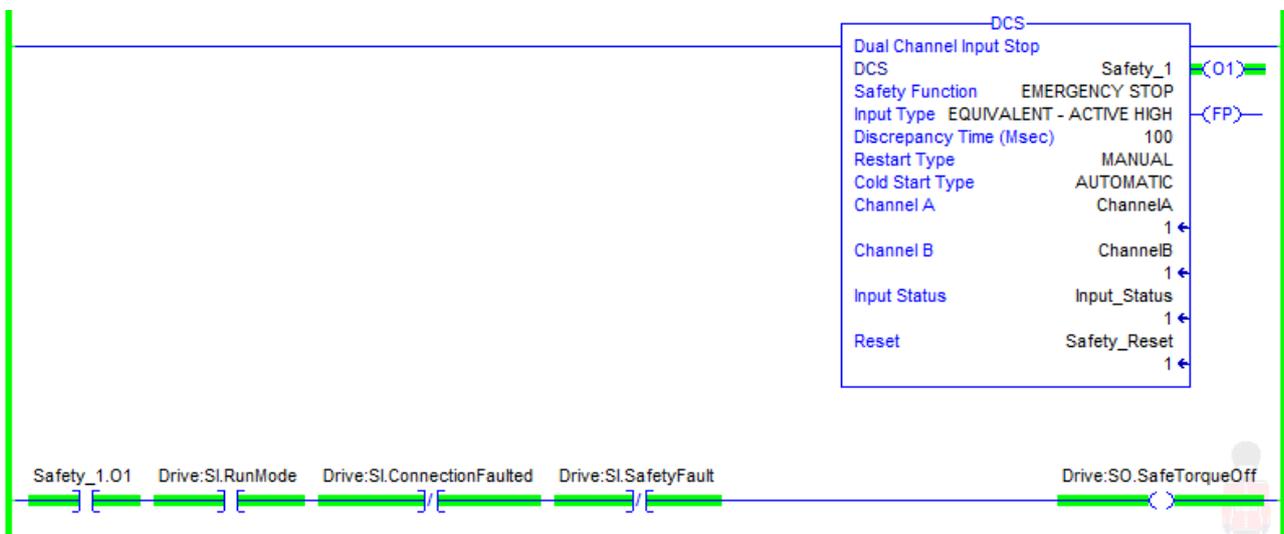| Drive:SI	{...}	{...}	
Drive:SI.ConnectionFaulted	0		Decimal
+ Drive:SI.ConnectionStatus	2#0000_0000_0000_0000_...		Binary
Drive:SI.ResetRequired	0		Decimal
Drive:SI.RunMode	1		Decimal
Drive:SI.SafetyFault	0		Decimal
+ Drive:SI.Status	2#0000_0000		Binary
Drive:SI.TorqueDisabled	0		Decimal

5. Now the PowerFlex 755 drive should display "**Stopped**".

6. Go to the Controller tags and locate the drive input and output tags. Notice that the **Ready** bit in the input is high **"1"**. You can now start and stop the drive.

Sample safety code

The following code is an example for a category 0 stop (coast). We use a **Dual Channel Input Stop (DCS)** instruction to monitor a dual-input safety device like an E-stop, light curtain or a safety gate.

The drive **STO** output is energized if both input channels are high (1), there are no faults, there is a valid connection, and there is a falling edge on the reset bit.

When the two inputs channels goes to low (0), the **DCS** instruction output bit (O1) goes to low (0) and drive **STO** output immediately goes to low (0) as well.

```
                                              ┌─────────────DCS────────────┐
                                              │ Dual Channel Input Stop     │
                                              │ DCS                 Safety_1 ├─(O1)─
                                              │ Safety Function  EMERGENCY STOP
                                              │ Input Type  EQUIVALENT - ACTIVE HIGH ─(FP)─
                                              │ Discrepancy Time (Msec)    100
                                              │ Restart Type          MANUAL
                                              │ Cold Start Type     AUTOMATIC
                                              │ Channel A            ChannelA
                                              │                            1 ←
                                              │ Channel B            ChannelB
                                              │                            1 ←
                                              │ Input Status       Input_Status
                                              │                            1 ←
                                              │ Reset             Safety_Reset
                                              │                            1 ←
                                              └─────────────────────────────┘

  Safety_1.O1   Drive:SI.RunMode   Drive:SI.ConnectionFaulted   Drive:SI.SafetyFault          Drive:SO.SafeTorqueOff
──┤ ├──────────────┤ ├──────────────────┤/├──────────────────────┤/├──────────────────────────────( )──
```

ISO 13849-1 stipulates that instruction reset functions must occur on falling edge signals. To comply with this requirement, a **One Shot Falling (OSF)** instruction is used on the reset rung. Then, the **OSF** instruction output bit is used as the reset bit for the **DCS** instruction.

```
   reset                                                    ┌──────────OSF──────────┐
──┤ ├────────────────────────────────────────────────────│ One Shot Falling        │
                                                           │ Storage Bit      store1 ├─(SB)─
                                                           │ Output Bit  Reset_FallingEdge ├─(OB)─
                                                           └───────────────────────┘

  Reset_FallingEdge    ESTOP                                                    Safety_Reset
──┬──┤ ├──────────────┤/├────────────────────────────────────────────────────( )──
  │
  │ Safety_Reset
  └──┤ ├──
```

Resources

PowerFlex 755 Integrated Safety – Safe Torque Off Option Module User Manual

http://literature.rockwellautomation.com/idc/groups/literature/documents/um/750-um004_-en-p.pdf