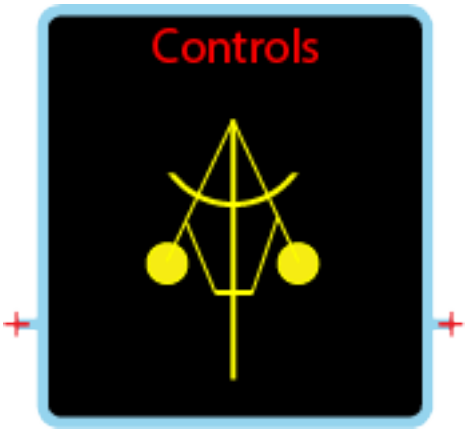
ENGINEERING
TOMORROW

User Manual

# PLUS+1® GUIDE Software

## PLUS+1 Function Block Library—Control Function Blocks



## Revision history

*Table of revisions*

| Date | Changed | Rev |
|---|---|---|
| January 2019 | Rebranding | 0101 |
| May 2016 | Updates for new library version. | CA |
| April 2014 | Supports Rev 3.00 | BC |

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## Risk Reduction

Design, test, and secure applications that you develop to reduce risks of personal injury and equipment damage.

### Design, Test, and Secure to Reduce Risks

Applications created with PLUS+1® GUIDE typically control equipment such as tractors, cranes, and harvesters.

Using heavy, powerful, and mobile off-road equipment always involves the risk of personal injury and equipment damage, even when this equipment is operating under normal operating conditions. Abnormal operating conditions greatly increase the risk of personal injury and equipment damage.

The PLUS+1® program has no automatic protections against these risks. The tool has no protection against the risks that result from bugs in the tool software, errors in the tool manual, or incompatibilities between software versions of the tool.

You must:

- Design your application to reduce these risks.
- Test your application to reduce these risks.
- Secure your application against unauthorized changes in its operating parameters to reduce these risks.

### Design

As you design your application, you must include the fault checking and the error handling needed to reduce risks in normal and abnormal operating conditions.

Consider the following when developing fault checking and error handling for your PLUS+1® GUIDE application:

- How the machine is normally used.
- Possible operator errors and their consequences.
- Industry safety standards and legal requirements.
- Input and output failures and their consequences. These failures can include:
  - Joystick, sensor, and other inputs suddenly going to ±100 % or to 0 %.
  - Joystick, sensor, and other inputs suddenly going to ±100 % or to 0 %.
  - Outputs that control machinery direction, speed, and force suddenly changing direction or going to ±100 % or to 0 %.

    Decide how likely each failure is. The more likely a failure, the more you need to protect against the consequences of the failure.
- The sequence of events and consequences of a fault or error.
- The sequence of events and consequences of an emergency stop.

### Test

After creating an application, you are responsible for testing the application.

Download your application to hardware and test its operation under both normal and abnormal operating conditions. Make sure:

- Individual inputs produce expected outputs.
- Fault handling and error checking work as designed.

You must repeat your tests when you make configuration, calibration, or software changes to the application.

## Risk Reduction

### Secure

You have the responsibility to secure your application against unauthorized changes.

Always use the PLUS+1® GUIDE program's Toolkey feature to restrict access to your application's operating parameters.

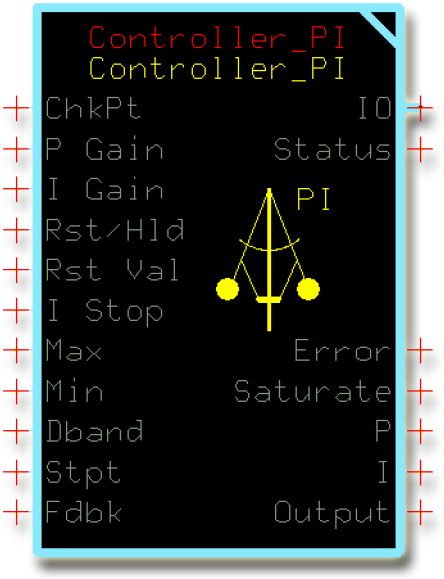
- Without Toolkey protection, there is an increased risk that unauthorized personnel could use the PLUS+1® Service Tool program to change your application's operating parameters.

  Changes in your application's operating parameters might cause unexpected machinery movement that results in personal injury and equipment damage.
- Toolkey protection reduces the risk that unauthorized personnel could use the PLUS+1® program to change your application's operating parameters.

Refer to *How to Use the Toolkey to Restrict Service Tool Access to Application Values* in the *PLUS+1—How-to* chapter of the *PLUS+1 GUIDE User Manual* (Danfoss part 10100824).

## Controller_PI Function Block

Use the **Controller_PI** (Proportional and Integral) function block to control a closed-loop application.




This function block achieves closed-loop control by changing its output signal to get its feedback signal to equal its set point signal.

You can use this function block in:

- Constant speed control applications.
- Propel functions such as cruise control or straight tracking.
- Work functions such as transit mixers.

The **Controller_PID** function block is available to implement closed-loop control through proportional, integral and derivative (PID) functions. See *Controller_PID Function Block*. The **Controller_PI** function block uses less memory than the **Controller_PID** function block.

### Inputs

The inputs to the **Controller_PI** function block are described.

Use only the data types specified in this table. Other data types cause compiler errors.

| Item | Type | Range | Description |
|---|---|---|---|
| **ChkPt** | BOOL | —— | • True—include the function block's built-in **Advanced Checkpoint with Namespace** in the compiled LHX download file.<br>• False—exclude the function block's built-in **Advanced Checkpoint with Namespace** components from the compiled LHX download file. |
| **P Gain** | S16 | -32768–32767 | The proportional gain (**P Gain**) factor that determines how much the difference between **Stpt** and **Fdbk** influences the **Output**.<br>1000 = 1 (unity gain) |
| **I Gain** | S16 | -32768–32767 | The integral gain (**I Gain**) factor that determines how much the continual summing of the difference between **Stpt** and **Fdbk** influences the **Output**. Integration occurs on every process loop. **I Gain** multiplies by **OS.ExecTm** to take account for processing time differences.<br>10000 = 1 (unity gain) |
| **Rst/Hld** | U8 | 0–3 | The reset/hold (**Rst/Hld**) setting:<br>• 0 = Normal operation—no reset or hold.<br>• 1 = Hold the integrator to the current values.<br>• 2 = Reset the integrator to the **Rst Val**.<br>• 3 = Reset the entire **Output**. |

## Controller_PI Function Block

| Item | Type | Range | Description |
|---|---|---|---|
| **Rst Val** | S16 | -32768–32767 | The reset value (**Rst Val**) set in during a reset operation.<br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, and **Output**. |
| **I Stop** | U16 | 0–65535 | Sets the value at which the integral pauses where: Absolute (**Stpt**-**Fdbk**) > **I_Stop**.<br>Use to limit overshoot due to large steps changes in errors. To disable this feature, set **I_Stop** = 65535.<br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, and **Output**. |
| **Max** | S16 | -32768–32767 | The maximum allowed output value.<br>When (**P** + **IMax**, the integrator holds and can only be reduced.) ><br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, and **Output**. |
| **Min** | S16 | -32768–32767 | The minimum allowed output value.<br>When (**P**) + **I**) < **Min**, the integrator holds and can only be increased.<br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, and **Output**. |
| **Dband** | U16 | 0–65535 | The allowed difference between **Stpt** and **Fdbk** before the function block begins error correction. The function block makes no corrections until the error becomes greater than this value. The error used in PID error calculation stays at zero until it becomes greater than the **Dband** value.<br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, and **Output**. |
| **Stpt** | S16 | -32768–32767 | The system set point (**Stpt**). The desired system output.<br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, and **Output**. |
| **Fdbk** | S16 | -32768–32767 | The system feedback (**Fdbk**). The actual, measured system output.<br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, and **Output**. |

### Outputs

The outputs of the **Controller_PI** function block are described.

| Item | Type | Range | Description |
|---|---|---|---|
| **IO** | Bus | —— | Outputs a bus with all of the function block's input and output signals.<br>The bus conveniently distributes this function block's signals to your application. |
| **Status** | U16 | —— | Reports the status of the function block.<br>This output follows the standard bitwise scheme described in the *Status* topic. |
| **Fault** | U16 | —— | Reports the faults of the function block.<br>This output follows the standard bitwise scheme described in the *Fault* topic. |
| **Error** | S32 | -65535–65535 | The error or difference between the **Stpt** and the **Fdbk**.<br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, and **Output**. |
| **Saturate** | U8 | 0–2 | Output saturation indicator:<br>• 0 = No saturation.<br>• 1 = Down saturation. The function block's **Output** value equals its **Min** value.<br>• 2 = Up saturation. The function block's **Output** value equals its **Max** value. |
| **P** | S16 | -32768–32767 | The proportional calculation's contribution to the **Output**.<br>**P** = **(Stpt** – **Fdbk**) * **P Gain**) / 1000<br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, and **Output**. |

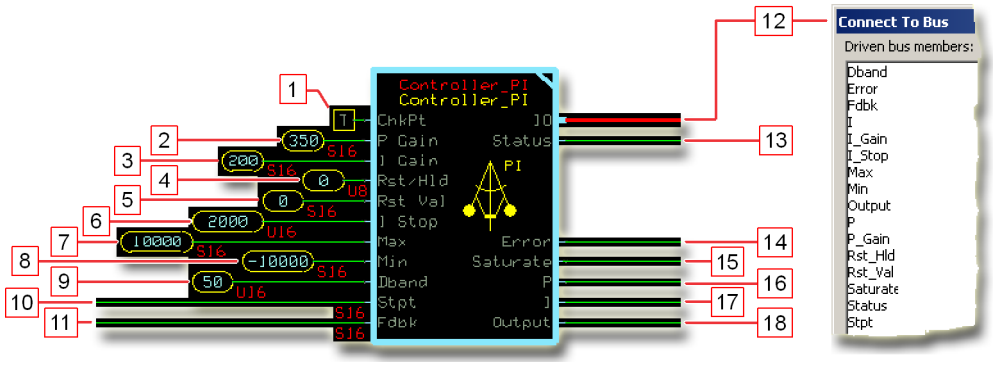
## Controller_PI Function Block

| Item | Type | Range | Description |
|---|---|---|---|
| **I** | S16 | -32768–32767 | The integral calculation's contribution to the **Output**.<br>**I** = Σ [(**Stpt** – **Fdbk**) * **I Gain** * **OS.ExecTm**)/10000]<br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, and **Output**. |
| **Output** | S16 | -32768–32767 | Sum of the internal **P** and **I** values.<br>The sum of **P** and **I** may not equal **Output** because the function block:<br>• Calculates the **P** and **I** as S32 data types and then restricts them to the S16 range before returning an output.<br>• Calculates the **Output** before it restricts the **P**, **I**, and **D** values to the S16 range.<br>• Bounds the **Output** to within a range defined by the **Max** and **Min** values.<br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, and **Output**. |

## Controller_PI Function Block

### Function Block Connections

Connections you can make with the function block are described.




| Item | Description |
|---|---|
| **1.** | • True—include the function block's built-in **Advanced Checkpoint with Namespace** in the compiled LHX download file.<br>• False—exclude the function block's built-in **Advanced Checkpoint with Namespace** components from the compiled LHX download file. |
| **2.** | The proportional gain (**P Gain**) factor that determines how much the **Output** is influenced by the difference in **Stpt** and **Fdbk**. |
| **3.** | The integral gain (**I Gain**) factor that determines how much the **Output** is influenced by continual summing of the difference between **Stpt** and **Fdbk**. |
| **4.** | The reset/hold (**Rst/Hld**) setting:<br>• 0 = Normal operation—no reset or hold.<br>• 1 = Hold the integrator to the current values.<br>• 2 = Reset the integrator to the **Rst Val**.<br>• 3 = Reset the entire **Output**. |
| **5.** | The reset value (**Rst Val**) set during a reset operation. |
| **6.** | Sets the value at which the integral pauses where: Absolute (**Stpt**-**Fdbk**) ≥ **I_Stop**. |
| **7.** | The maximum allowed output value. |
| **8.** | The minimum allowed output value. |
| **9.** | The allowed difference between **Stpt** and **Fdbk** before the function block begins error correction. |
| **10.** | The system set point (**Stpt**). |
| **11.** | The system feedback (**Fdbk**). |
| **12.** | Outputs a bus with all of the function block's input and output signals. |
| **13.** | Reports the status of the function block. |
| **14.** | The error or difference between the **Stpt** and the **Fdbk**. |
| **15.** | Output saturation indicator:<br>• 0 = No saturation.<br>• 1 = Down saturation. The function block's **Output** value equals its **Min** value.<br>• 2 = Up saturation. The function block's **Output** value equals its **Max** value. |
| **16.** | The proportional calculation's contribution to the **Output**. |
| **17.** | The integral calculation's contribution to the **Output**. |
| **18.** | Sum of the internal **P** and **I** values. |

## Controller_PI Function Block

### Status Logic

This topic describes how status logic is indicated for the function block.

| Condition | Hex* | Binary | Cause | Response | Correction |
|---|---|---|---|---|---|
| Invalid setup. | 0x8008 | 1000 | **Rst/Hld** value is out of range. | **Rst/Hld** becomes 0. | Return the **Rst/Hld** value to within its expected range. |

* Bit 16 set to 1 identifies a standard Danfoss status or fault code.

### Identical Function Blocks Need Different Namespace Values to Successfully Compile

If you use the same function block more than once in an application, you must change each function block's namespace value to avoid compiler errors.

All function blocks contain Advanced Checkpoint with Namespace components that enable the PLUS+1® Service Tool to read block input and output values.

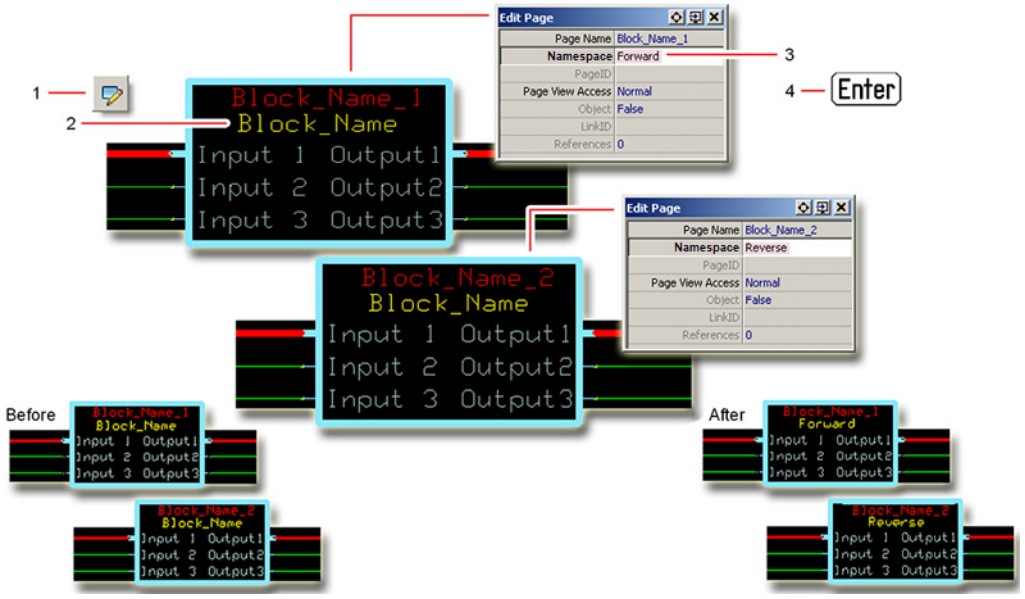
Some function blocks contain non-volatile memory components that store function block operating parameters.

Both these components use memory names ("aliases") to allocate memory. Identical memory names cause compiler errors.

The namespace value adds a unique prefix to each component name to avoid errors. Keep each namespace value short to save controller memory.

#### Change Namespace Value

To successfully compile your application, change the namespace value for function blocks that are used more than once in an application.



### Controller_PI Function Block

1. In the PLUS+1® GUIDE menu bar, click the **Query/Change** button.
2. Click on the function block whose namespace you want to set to a unique value.
   The **Edit Page** window opens.
3. In the **Edit Page** window, enter a meaningful **Namespace** value.
   - **Namespace** values are case-sensitive.
   - To save controller memory, use a short namespace value.
4. Press **Enter**.
5. Repeat these steps to enter unique namespace values for other identical function blocks.

## Controller_PI Function Block

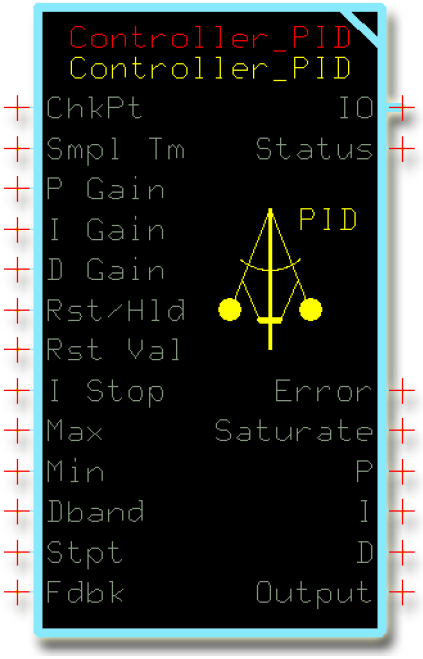
### IEC 61508-3 Annex D Supplemental Information

The following table provides IEC 61508-3 Annex D supplemental information.

| Item | Description |
|---|---|
| Function block name | Controller_PI |
| Function block version | 4.0. |
| Function block development environment | PLUS+1® GUIDE version 8.1 and later. |
| Compatible hardware | Verified in the PLUS+1® GUIDE compile process.<br>When the PLUS+1® GUIDE compiler finds a function block that is incompatible with hardware, it aborts the compile process and logs an error message. The error message gives the location of the function block and states "Error 80: component not supported in hwd." |
| Function block developed in compliance with | Danfoss Software Product Development Process (PDP), which includes ISO 9001 and IEC 61508-3 standards. |
| Competence required of function block integrator | The knowledge, competence, and training required to:<br>• Understand this manual.<br>• Use the PLUS+1® GUIDE program to develop a machine control application.<br>• Follow quality software practices to develop a machine control application. |
| Contacting Danfoss | *https://www.danfoss.com/en/products/software/dps/plus1-software-services-support-and-training/plus1-support-and-services* |

## Controller_PID Function Block

Use the **Controller_PID** (Proportional, Integral, and Derivative) function block to control a closed-loop application.




You can use this function block in:

- Constant speed control applications.
- Propel functions such as cruise control or straight tracking.
- Work functions such as transit mixers.

The **Controller_PI** function block is available to implement closed-loop control through proportional and integral (PI) functions. See *Controller_PI Function Block*. The **Controller_PI** function block uses less memory than the **Controller_PID** function block.

### Inputs

The inputs to the **Controller_PID** function block are described.

Use only the data types specified in this table. Other data types cause compiler errors.

| Item | Type | Range | Description |
|---|---|---|---|
| **ChkPt** | BOOL | —— | • True—include the function block's built-in **Advanced Checkpoint with Namespace** in the compiled LHX download file.<br>• False—exclude the function block's built-in **Advanced Checkpoint with Namespace** components from the compiled LHX download file. |
| **Smpl Tm** | U16 | 0–32767 | Time between samples of the **D Gain** input. After ten samples, the function block calculates the average error for the **D Gain** input.<br>1000 = 1000 ms |
| **P Gain** | S16 | -32768–32767 | The proportional gain (**P Gain**) factor that determines how much the difference between **Stpt** and **Fdbk** influences the **Output**.<br>1000 = 1 (unity gain) |
| **I Gain** | S16 | -32768–32767 | The integral gain (**I Gain**) factor that determines how much the continual summing of the difference between **Stpt** and **Fdbk** influences the **Output**. Integration occurs on every process loop. **I Gain** multiplies by **OS.ExecTm** to take account for processing time differences.<br>10000 = 1 (unity gain) |

## Controller_PID Function Block

| Item | Type | Range | Description |
|---|---|---|---|
| **D Gain** | S16 | -32768–32767 | The differential gain (**D Gain**) factor that determines how much the difference between the current **Stpt**- **Fdbk** error and the previous **Stpt**-**Fdbk** error influences the **Output**.<br>100 = 1 (unity gain) |
| **Rst/Hld** | U8 | 0–3 | The reset/hold (**Rst/Hld**) setting:<br>• 0 = Normal operation—no reset or hold.<br>• 1 = Hold the integrator to the current values.<br>• 2 = Reset the integrator to the **Rst Val**.<br>• 3 = Reset the entire **Output**. |
| **Rst Val** | S16 | -32768–32767 | The reset value (**Rst Val**) set in during a reset operation.<br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, **D**, and **Output**. |
| **I Stop** | U16 | 0–65535 | Sets the value at which the integral pauses where: Absolute (**Stpt**-**Fdbk**) > **I_Stop**.<br>Use to limit overshoot due to large steps changes in errors. To disable this feature, set **I_Stop** = 65535.<br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, **D**, and **Output**. |
| **Max** | S16 | -32768–32767 | The maximum allowed output value.<br>When (**P** + **I** + **D**) > **Max**, the integrator holds and can only be reduced.<br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, **D**, and **Output**. |
| **Min** | S16 | -32768–32767 | The minimum allowed output value.<br>When (**P** + **I** + **D**) < **Min**, the integrator holds and can only be increased.<br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, **D**, and **Output**. |
| **Dband** | U16 | 0–65535 | The allowed difference between **Stpt** and **Fdbk** before the function block begins error correction. The function block makes no corrections until the error becomes greater than this value. The error used in PID error calculation stays at zero until it becomes greater than the **Dband** value.<br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, **D**, and **Output**. |
| **Stpt** | S16 | -32768–32767 | The system set point (**Stpt**). The desired system output.<br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, **D**, and **Output**. |
| **Fdbk** | S16 | -32768–32767 | The system feedback (**Fdbk**). The actual, measured system output.<br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, **D**, and **Output**. |

### Outputs

The outputs of the **Controller_PID** function block are described.

| Item | Type | Range | Description |
|---|---|---|---|
| **IO** | Bus | —— | Outputs a bus with all of the function block's input and output signals.<br>The bus conveniently distributes this function block's signals to your application. |
| **Status** | U16 | —— | Reports the status of the function block.<br>This output follows the standard bitwise scheme described in the *Status* topic. |
| **Fault** | U16 | —— | Reports the faults of the function block.<br>This output follows the standard bitwise scheme described in the *Fault* topic. |
| **Error** | S32 | -65535–65535 | The error or difference between the **Stpt** and the **Fdbk**.<br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, **D**, and **Output**. |
| **Saturate** | U8 | 0–2 | Output saturation indicator:<br>• 0 = No saturation.<br>• 1 = Down saturation. The function block's **Output** value equals its **Min** value.<br>• 2 = Up saturation. The function block's **Output** value equals its **Max** value. |

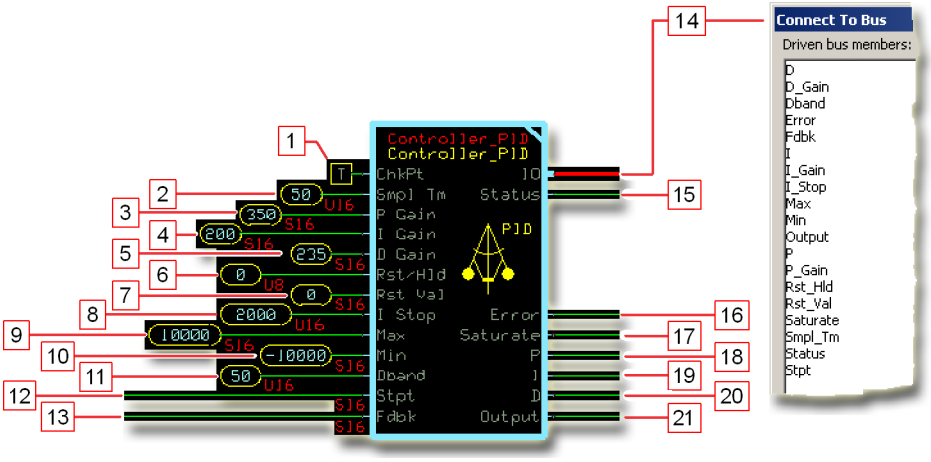
## Controller_PID Function Block

| Item | Type | Range | Description |
|---|---|---|---|
| **P** | S16 | -32768–32767 | The proportional calculation's contribution to the **Output**.<br>**P** = **(Stpt** – **Fdbk**) * **P Gain**) / 1000<br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, and **Output**. |
| **I** | S16 | -32768–32767 | The integral calculation's contribution to the **Output**.<br>**I** = Σ [(**Stpt** – **Fdbk**) * **I Gain** * **OS.ExecTm**)/10000]<br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, and **Output**. |
| **D** | S16 | -32768–32767 | The derivative calculation's contribution to the Output.<br>**D** = [(**Stpt** – **Fdbk**)Current - (**Stpt** – **Fdbk**)Last] * **D Gain**/(**Smpl_Tm** * 1000)<br>• (**Stpt** – **Fdbk**)Current is the average of the most recent samples of **Smpl_Tm**/**OS.ExecTm** values.<br>• (**Stpt** – **Fdbk**)Last is the average of the last nine samples of **Smpl_Tm**/**OS.ExecTm** values.<br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, **D**, and **Output**.. |
| **Output** | S16 | -32768–32767 | Sum of the internal **P**, **I** and **D** values<br>The sum of **P**, **I** and **D** may not equal **Output** because the function block:<br>• Calculates **P**, **I** and **D** as S32 data types and then restricts them to the S16 range before returning an output.<br>• Calculates the **Output** before it restricts the **P**, **I** and **D** values to the S16 range.<br>• Bounds the **Output** to within a range defined by the **Max** and **Min** values.<br>This item has no predefined unit value.<br>Assign the same unit values to **Rst Val**, **I Stop**, **Max**, **Min**, **Dband**, **Stpt**, **Fdbk**, **Error**, **P**, **I**, **D**, and **Output**. |

## Controller_PID Function Block

### Function Block Connections

Connections you can make with the function block are described.




| Item | Description |
|---|---|
| **1.** | • True—include the function block's built-in **Advanced Checkpoint with Namespace** in the compiled LHX download file.<br>• False—exclude the function block's built-in **Advanced Checkpoint with Namespace** components from the compiled LHX download file. |
| **2.** | Time between samples of the **D Gain** input. |
| **3.** | The proportional gain (**P Gain**) factor that determines how much the **Output** is influenced by the difference in **Stpt** and **Fdbk**. |
| **4.** | The integral gain (**I Gain**) factor that determines how much the **Output** is influenced by continual summing of the difference between **Stpt** and **Fdbk**. |
| **5.** | The differential gain (**D Gain**) factor that determines how much the difference between the current **Stpt**-**Fdbk** error and the previous **Stpt**-**Fdbk** error influences the **Output**. |
| **6.** | The reset/hold (**Rst/Hld**) setting:<br>• 0 = Normal operation—no reset or hold.<br>• 1 = Hold the integrator to the current values.<br>• 2 = Reset the integrator to the **Rst Val**.<br>• 3 = Reset the entire **Output**. |
| **7.** | The reset value (**Rst Val**) set during a reset operation. |
| **8.** | Sets the value at which the integral pauses where: Absolute (**Stpt**-**Fdbk**) ≥ **I_Stop**. |
| **9.** | The maximum allowed output value. |
| **10.** | The minimum allowed output value. |
| **11.** | The allowed difference between **Stpt** and **Fdbk** before the function block begins error correction. |
| **12.** | The system set point (**Stpt**). |
| **13.** | The system feedback (**Fdbk**). |
| **14.** | Outputs a bus with all of the function block's input and output signals. |
| **15.** | Reports the status of the function block. |
| **16.** | The error or difference between the **Stpt** and the **Fdbk**. |
| **17.** | Output saturation indicator:<br>• 0 = No saturation.<br>• 1 = Down saturation. The function block's **Output** value equals its **Min** value.<br>• 2 = Up saturation. The function block's **Output** value equals its **Max** value. |
| **18.** | The proportional calculation's contribution to the **Output**. |
| **19.** | The integral calculation's contribution to the **Output**. |

## Controller_PID Function Block

| Item | Description |
|---|---|
| **20.** | The derivative calculation's contribution to the **Output**. |
| **21.** | Sum of the internal **P**, **I**, and **D** values. |

### Status Logic

This topic describes how status logic is indicated for the function block.

| Condition | Hex* | Binary | Cause | Response | Correction |
|---|---|---|---|---|---|
| Invalid setup. | 0x8008 | 1000 | **Rst/Hld** or **Smpl Tm** value is out of range. | Either:<br>• **Rst/Hld** becomes 0.<br>• **Smpl Tm** clamps at either 0 or 32767. | Return the **Rst/Hld** or **Smpl Tm** value to within its expected range. |

* Bit 16 set to 1 identifies a standard Danfoss status or fault code.

### Identical Function Blocks Need Different Namespace Values to Successfully Compile

If you use the same function block more than once in an application, you must change each function block's namespace value to avoid compiler errors.

All function blocks contain Advanced Checkpoint with Namespace components that enable the PLUS+1® Service Tool to read block input and output values.

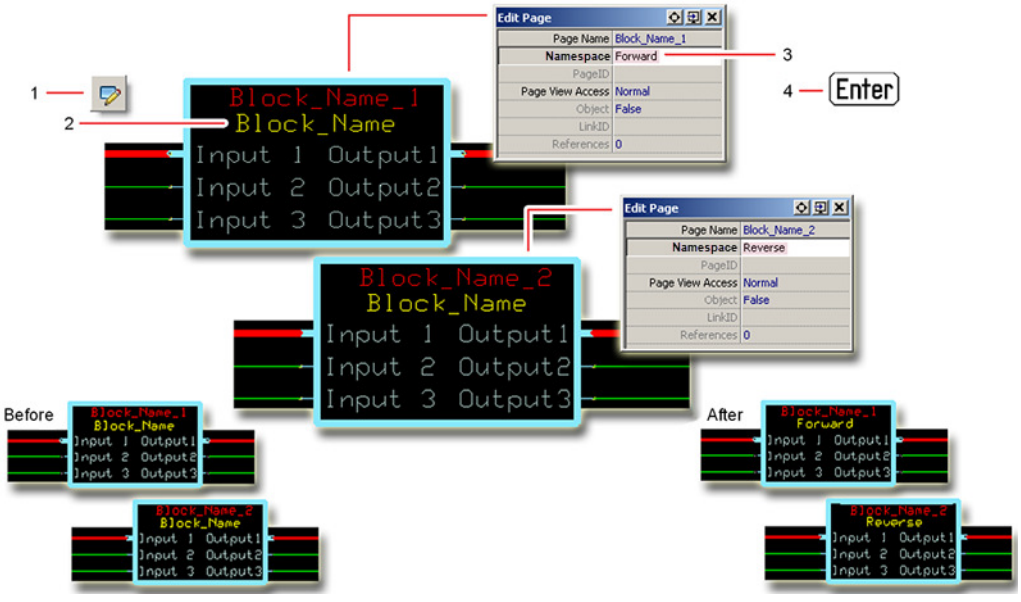
Some function blocks contain non-volatile memory components that store function block operating parameters.

Both these components use memory names ("aliases") to allocate memory. Identical memory names cause compiler errors.

The namespace value adds a unique prefix to each component name to avoid errors. Keep each namespace value short to save controller memory.

#### Change Namespace Value

To successfully compile your application, change the namespace value for function blocks that are used more than once in an application.



### Controller_PID Function Block

1. In the PLUS+1® GUIDE menu bar, click the **Query/Change** button.
2. Click on the function block whose namespace you want to set to a unique value.
   The **Edit Page** window opens.
3. In the **Edit Page** window, enter a meaningful **Namespace** value.
   - **Namespace** values are case-sensitive.
   - To save controller memory, use a short namespace value.
4. Press **Enter**.
5. Repeat these steps to enter unique namespace values for other identical function blocks.

## Controller_PID Function Block

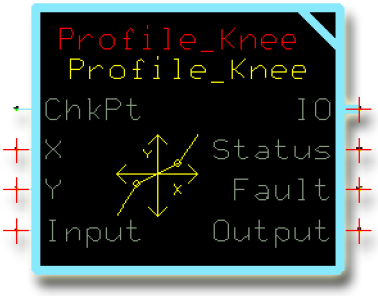
### IEC 61508-3 Annex D Supplemental Information

The following table provides IEC 61508-3 Annex D supplemental information.

| Item | Description |
|---|---|
| Function block name | Controller_PID. |
| Function block version | 4.0. |
| Function block development environment | PLUS+1® GUIDE version 8.1 and later. |
| Compatible hardware | Verified in the PLUS+1® GUIDE compile process.<br>When the PLUS+1® GUIDE compiler finds a function block that is incompatible with hardware, it aborts the compile process and logs an error message. The error message gives the location of the function block and states "Error 80: component not supported in hwd." |
| Function block developed in compliance with | Danfoss Software Product Development Process (PDP), which includes ISO 9001 and IEC 61508-3 standards. |
| Competence required of function block integrator | The knowledge, competence, and training required to:<br>• Understand this manual.<br>• Use the PLUS+1® GUIDE program to develop a machine control application.<br>• Follow quality software practices to develop a machine control application. |
| Contacting Danfoss | *https://www.danfoss.com/en/products/software/dps/plus1-software-services-support-and-training/plus1-support-and-services* |

## Profile_Knee Function Block

Use the **Profile_Knee** function block to change the curve characteristics of a signal.




One X-Y parameter pair along with fixed endpoints (X = 0, Y= 0 and X =10000, Y =10000) create a two-segment profile that defines how the function block's **Output** values follow changes to its **Input** values.

Typically, you use this function block to:

- Increase control resolution at slow speeds or low power output.
- Linearize a sensor signal.
- Create a non-linear control signal for a non-linear actuator.

When using this function block, note the following:

- The function block's **Input** and **Output** values can range from -10000 to 10000.
- A change in the polarity of the function block's **Input** values from positive to negative or from negative to positive produces mirrored **Output** values.

### Inputs

The inputs to the **Profile_Knee** function block are described.

Use only the data types specified in this table. Other data types cause compiler errors.

| Item | Type | Range | Description |
|---|---|---|---|
| **ChkPt** | BOOL | —— | • True—include the function block's built-in **Advanced Checkpoint with Namespace** in the compiled LHX download file.<br>• False—exclude the function block's built-in **Advanced Checkpoint with Namespace** components from the compiled LHX download file. |
| **X** | U16 | 1–9999 | Scaling input parameter. When **Input** = **X**, **Output** = **Y**.<br>0 < **X** < 10000 |
| **Y** | U16 | 0–10000 | Scaling output parameter.<br>When **Input** = **X**, **Output** = **Y**. When **Input** = -**X**, **Output** = -**Y**. |
| **Input** | S16 | -10000–10000 | The input signal to be profiled. |

### Outputs

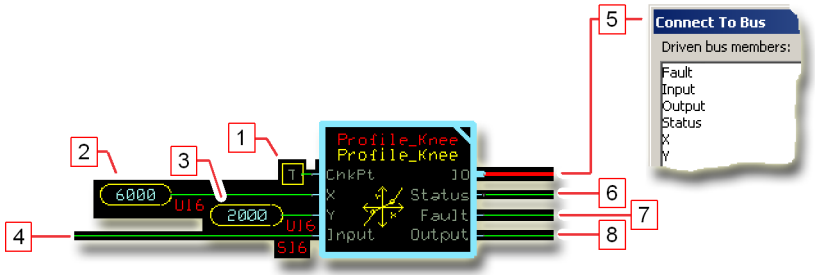
The outputs of the **Profile_Knee** function block are described.

| Item | Type | Range | Description |
|---|---|---|---|
| **IO** | Bus | —— | Outputs a bus with all of the function block's input and output signals.<br>The bus conveniently distributes this function block's signals to your application. |
| **Status** | U16 | —— | Reports the status of the function block.<br>This output follows the standard bitwise scheme described in the *Status* topic. |
| **Fault** | U16 | —— | Reports the faults of the function block.<br>This output follows the standard bitwise scheme described in the *Fault* topic. |
| **Output** | S16 | -10000–10000 | The **Input** signal after profiling. |

## Profile_Knee Function Block

### Function Block Connections

Connections you can make with the function block are described.

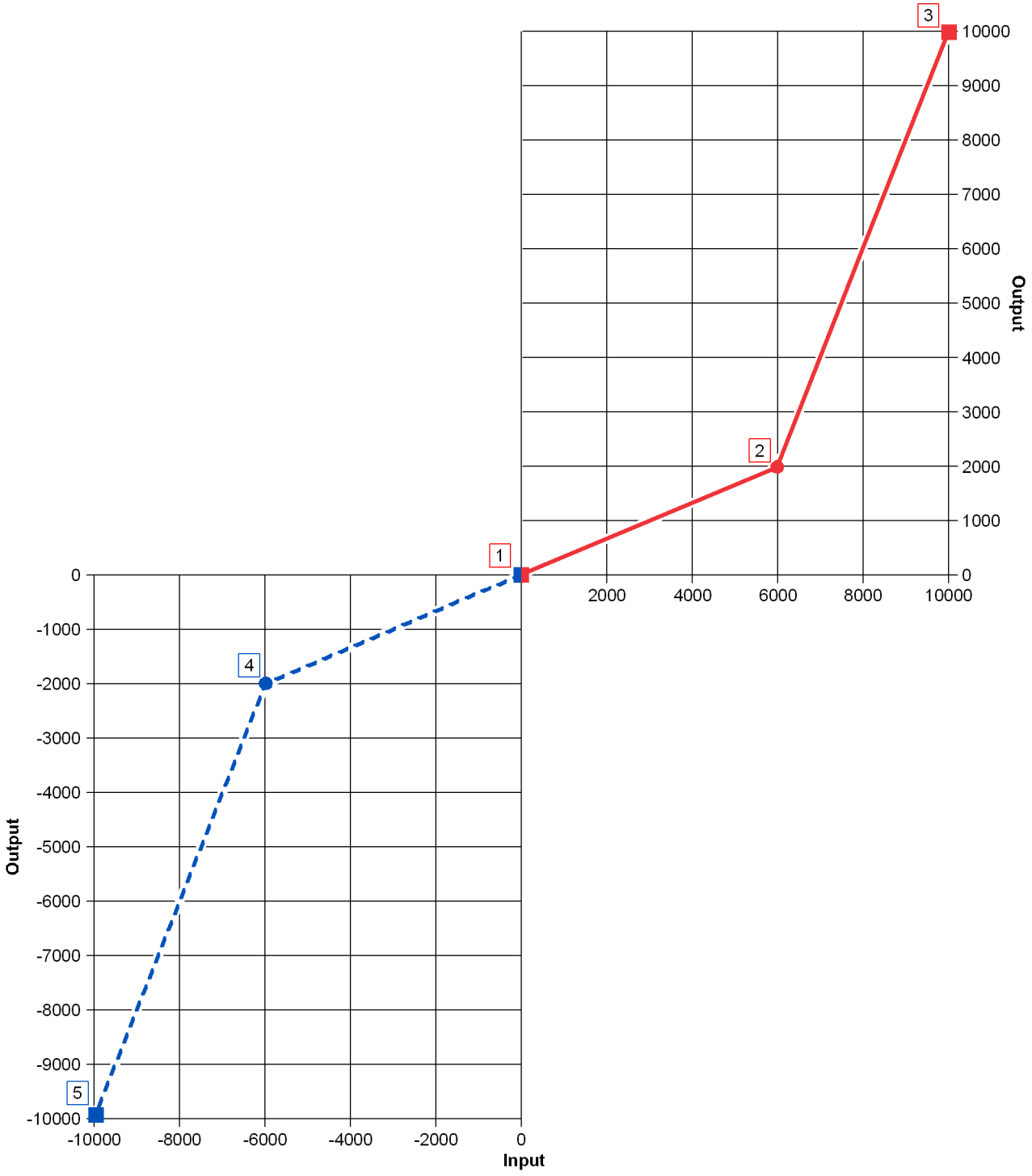



| Item | Description |
|---|---|
| **1.** | • True—include the function block's built-in **Advanced Checkpoint with Namespace** in the compiled LHX download file.<br>• False—exclude the function block's built-in **Advanced Checkpoint with Namespace** components from the compiled LHX download file. |
| **2.** | Input for **X** parameter.<br>The **X**-**Y** parameter pair profiles how the function block's **Output** values follows changes to its **Input** values. |
| **3.** | Input for **Y** parameter.<br>The **X**-**Y** parameter pair profiles how the function block's **Output** values follows changes to its **Input** values. |
| **4.** | The signal to be profiled. |
| **5.** | Outputs a bus with all of the function block's input and output signals. |
| **6.** | Reports the status of the function block. |
| **7.** | Reports the faults of the function block. |
| **8.** | The **Input** signal after profiling. |

## Profile_Knee Function Block

### Function Block Example

Use the following example to understand how configuration and operation changes impact the output of the function block.



### Profile_Knee Function Block

| Item | Symbol | Description |
|---|---|---|
| 1. | | Fixed, software-defined profile point where:<br>• **X** = 0<br>• **Y** = 0<br>An **Input** value of 0 produces an **Output** value of 0. |
| 2. |  | User-defined profile point created by the parameter pair **X**-**Y** where:<br>• **X** = 6000<br>• **Y** = 2000<br>An **Input** value of 6000 produces an **Output** value of 2000. |
| 3. | | Fixed, software-defined profile point where:<br>• **X** = 10000<br>• **Y** = 10000<br>An **Input** value of 0 produces an **Output** value of 0. |
| 4. | | Negatively mirrors the user-defined profile point created by **X**-**Y** where:<br>• **X** = -6000<br>• **Y** = -2000<br>An **Input** value of -6000 produces an **Output** value of -2000. |
| 5. | | Negatively mirrors the fixed profile where:<br>• **X** = -10000<br>• **Y** = -10000<br>An **Input** value of -10000 produces an **Output** value of -10000. |

### Status and Fault Logic

Use status and fault codes to determine proper program operation.

#### Status Logic

This topic describes how status logic is indicated for the function block.

| Condition | Hex* | Binary | Cause | Response | Correction |
|---|---|---|---|---|---|
| Invalid setup. | 0x8008 | 1000 | **X** parameter is out-of-range. | **X** parameter clamps at 9999 or 1. | Return the **X** parameter to within its 1–9999 range. |
| | | | **Y** parameter is out-of-range. | **Y** parameter holds at 10000. | Return the **Y** parameter to within its 0–10000 range. |

* Bit 16 set to 1 identifies a standard Danfoss status or fault code.

#### Fault Logic

This topic describes how fault logic is indicated for the function block.

| Condition | Hex* | Binary | Cause | Response | Correction |
|---|---|---|---|---|---|
| Input value is too low. | 0x8001 | 0001 | **Input** value < -10000. | **Output** = -10000 | Return the **Input** to the valid range. |
| Input value is too high. | 0x8002 | 0010 | **Input** value > 10000. | **Output** = 10000 | |

* Bit 16 set to 1 identifies a standard Danfoss status or fault code.

### Identical Function Blocks Need Different Namespace Values to Successfully Compile

If you use the same function block more than once in an application, you must change each function block's namespace value to avoid compiler errors.

All function blocks contain Advanced Checkpoint with Namespace components that enable the PLUS+1® Service Tool to read block input and output values.

Some function blocks contain non-volatile memory components that store function block operating parameters.

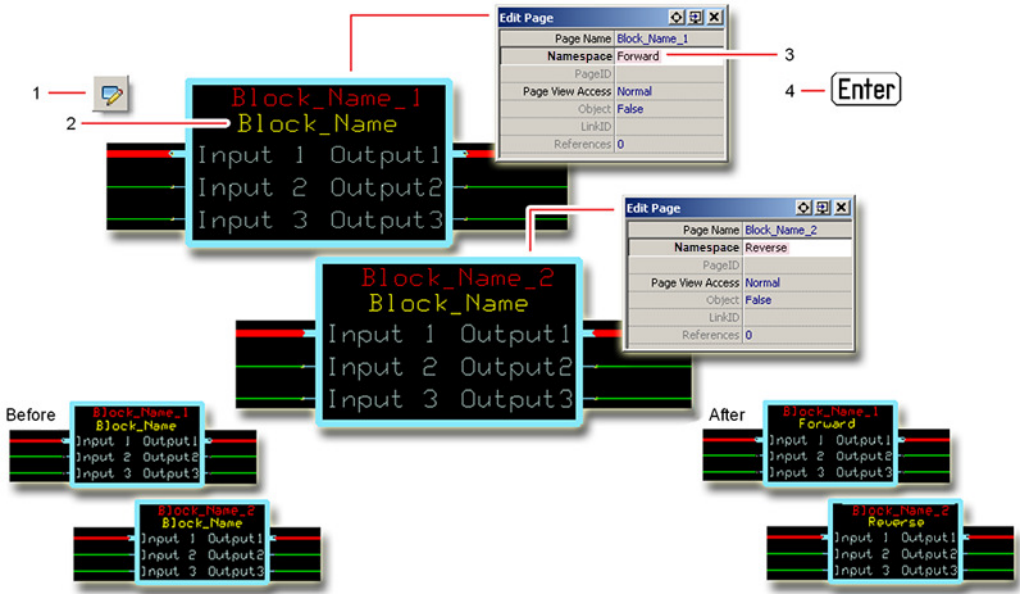
## Profile_Knee Function Block

Both these components use memory names (“aliases”) to allocate memory. Identical memory names cause compiler errors.

The namespace value adds a unique prefix to each component name to avoid errors. Keep each namespace value short to save controller memory.

### Change Namespace Value

To successfully compile your application, change the namespace value for function blocks that are used more than once in an application.




1. In the PLUS+1® GUIDE menu bar, click the **Query/Change** button.
2. Click on the function block whose namespace you want to set to a unique value.
   The **Edit Page** window opens.
3. In the **Edit Page** window, enter a meaningful **Namespace** value.
   - **Namespace** values are case-sensitive.
   - To save controller memory, use a short namespace value.
4. Press **Enter**.
5. Repeat these steps to enter unique namespace values for other identical function blocks.

## Profile_Knee Function Block

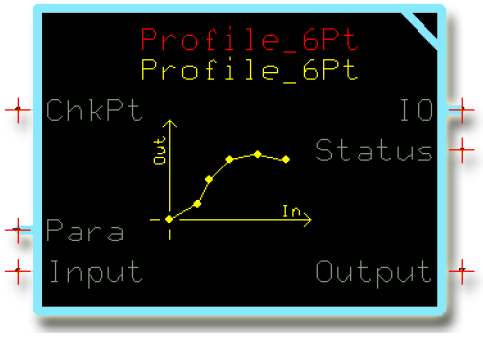
### IEC 61508-3 Annex D Supplemental Information

The following table provides IEC 61508-3 Annex D supplemental information.

| Item | Description |
|---|---|
| Function block name | Profile_Knee. |
| Function block version | 4.0. |
| Function block development environment | PLUS+1® GUIDE version 8.1 and later. |
| Compatible hardware | Verified in the PLUS+1® GUIDE compile process.<br>When the PLUS+1® GUIDE compiler finds a function block that is incompatible with hardware, it aborts the compile process and logs an error message. The error message gives the location of the function block and states "Error 80: component not supported in hwd." |
| Function block developed in compliance with | Danfoss Software Product Development Process (PDP), which includes ISO 9001 and IEC 61508-3 standards. |
| Competence required of function block integrator | The knowledge, competence, and training required to:<br>• Understand this manual.<br>• Use the PLUS+1® GUIDE program to develop a machine control application.<br>• Follow quality software practices to develop a machine control application. |
| Contacting Danfoss | *https://www.danfoss.com/en/products/software/dps/plus1-software-services-support-and-training/plus1-support-and-services* |

## Profile_6Pt Function Block

Use the **Profile_6Pt** function block to change the curve characteristics of a signal.




Six X-Y parameter pairs create a seven-segment profile that define how the function block's **Output** values follow changes to its **Input** values.

**Input** values that are:

- Less than the minimum X parameter produce **Output** values that follow the slope of the segment produced by the X1-Y1 and X2-Y2 parameter pairs.
- Greater than the maximum X parameter produce **Output** values that follow the slope of the segment produced by the X5-Y5 and X6-Y6 parameter pairs.

You can use this function block to:

- Increase control resolution at slow speeds or low-power output.
- Linearize the signal from a sensor.
- Create a non-linear control signal for a non-linear actuator.

When using this function block, note the following:

- The function block's **Input** and **Output** values can range from -32768 to 32767.
- A change in the polarity of the function block's **Input** values from positive to negative or from negative to positive does **not** produce mirrored **Output** values.

### Inputs

The inputs to the **Profile_6pt** function block are described.

Use only the data types specified in this table. Other data types cause compiler errors.

| Item | Type | Range | Description |
|---|---|---|---|
| **ChkPt** | BOOL | —— | • True—include the function block's built-in **Advanced Checkpoint with Namespace** in the compiled LHX download file.<br>• False—exclude the function block's built-in **Advanced Checkpoint with Namespace** components from the compiled LHX download file. |
| **Para** | Bus | —— | Input for six X-Y parameter pairs.<br>These pairs profile how the function block's **Output** values follows changes to its **Input** values. |
| **X1** | S16 | -32768–32767 | Scaling input parameter.<br>When **Input** = **X1**, **Output** = **Y1**.<br>-32768 ≤ **X1** < **X2** < **X3** < **X4** < **X5** < **X6** ≤ 32767 |
| **X2** | S16 | -32768–32767 | Scaling input parameter.<br>When **Input** = **X2**, **Output** = **Y2**.<br>-32768 ≤ **X1** < **X2** < **X3** < **X4** < **X5** < **X6** ≤ 32767 |
| **X3** | S16 | -32768–32767 | Scaling input parameter.<br>When **Input** = **X3**, **Output** = **Y3**.<br>-32768 ≤ **X1** < **X2** < **X3** < **X4** < **X5** < **X6** ≤ 32767 |

## Profile_6Pt Function Block

| Item | Type | Range | Description |
|---|---|---|---|
| **X4** | S16 | -32768–32767 | Scaling input parameter.<br>When **Input** = **X4**, **Output** = **Y4**.<br>-32768 ≤ **X1** < **X2** < **X3** < **X4** < **X5** < **X6** ≤ 32767 |
| **X5** | S16 | -32768–32767 | Scaling input parameter.<br>When **Input** = **X5**, **Output** = **Y5**.<br>-32768 ≤ **X1** < **X2** < **X3** < **X4** < **X5** < **X6** ≤ 32767 |
| **X6** | S16 | -32768–32767 | Scaling input parameter.<br>When **Input** = **X6**, **Output** = **Y6**.<br>-32768 ≤ **X1** < **X2** < **X3** < **X4** < **X5** < **X6** ≤ 32767 |
| **Y1** | S16 | -32768–32767 | Scaling output parameter.<br>When **Input** = **X1**, **Output** = **Y1**.<br>**Y** values can increase, decrease, or stay the same. |
| **Y2** | S16 | -32768–32767 | Scaling output parameter.<br>When **Input** = **X2**, **Output** = **Y2**.<br>**Y** values can increase, decrease, or stay the same. |
| **Y3** | S16 | -32768–32767 | Scaling output parameter.<br>When **Input** = **X3**, **Output** = **Y3**.<br>**Y** values can increase, decrease, or stay the same. |
| **Y4** | S16 | -32768–32767 | Scaling output parameter.<br>When **Input** = **X4**, **Output** = **Y4**.<br>**Y** values can increase, decrease, or stay the same. |
| **Y5** | S16 | -32768–32767 | Scaling output parameter.<br>When **Input** = **X5**, **Output** = **Y5**.<br>**Y** values can increase, decrease, or stay the same. |
| **Y6** | S16 | -32768–32767 | Scaling output parameter.<br>When **Input** = **X6**, **Output** = **Y6**.<br>**Y** values can increase, decrease, or stay the same. |
| **Input** | S16 | -32768–32767 | The input signal to be profiled. |

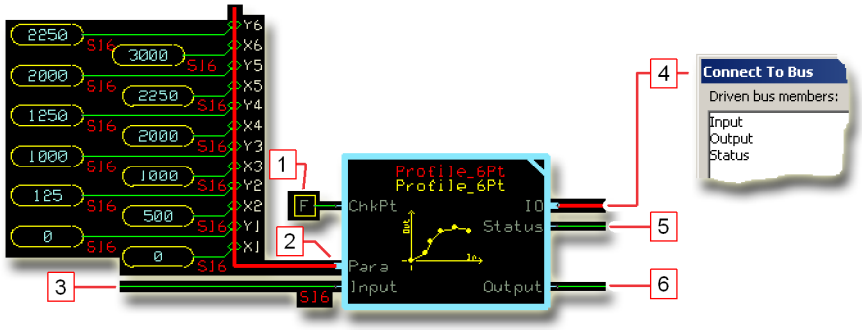
### Outputs

The outputs of the **Profile_6Pt** function block are described.

| Item | Type | Range | Description |
|---|---|---|---|
| **IO** | Bus | —— | Outputs a bus with all of the function block's input and output signals.<br>The bus conveniently distributes this function block's signals to your application. |
| **Status** | U16 | —— | Reports the status of the function block.<br>This output follows the standard bitwise scheme described in the *Status* topic. |
| **Fault** | U16 | —— | Reports the faults of the function block.<br>This output follows the standard bitwise scheme described in the *Fault* topic. |
| **Output** | S16 | -10000–10000 | The **Input** signal after profiling. |

### Function Block Connections

Connections you can make with the function block are described.

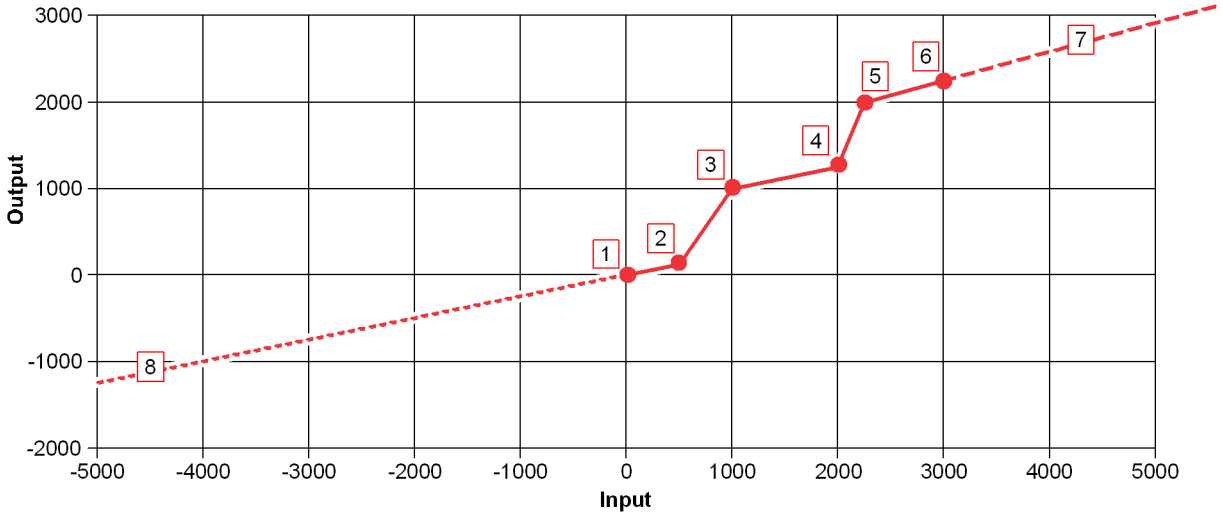


## Profile_6Pt Function Block

| Item | Description |
|---|---|
| 1. | • True—include the function block's built-in **Advanced Checkpoint with Namespace** in the compiled LHX download file.<br>• False—exclude the function block's built-in **Advanced Checkpoint with Namespace** components from the compiled LHX download file. |
| 2. | Input for six X-Y parameter pairs.<br>These pairs profile how the function block's **Output** follows changes to its **Input** values. |
| 3. | The signal to be profiled. |
| 4. | Outputs a bus with all of the function block's input and output signals. |
| 5. | Reports the status of the function block. |
| 6. | The **Input** signal after profiling. |

### Function Block Example

Use the following example to understand how configuration changes impact the output of the function block.




| Item | Symbol | Description |
|---|---|---|
| 1. | | Profile point created by parameter pair **X1**-**Y1** where:<br>• **X1** = 0<br>• **Y1** = 0<br>An **Input** value of 0 produces an **Output** value of 0. |
| 2. | | Profile point created by parameter pair **X2**-**Y2** where:<br>• **X2** = 500<br>• **Y2** = 125<br>An **Input** value of 500 produces an **Output** value of 125. |
| 3. | | Profile point created by parameter pair **X3**-**Y3** where:<br>• **X3** = 1000<br>• **Y3** = 1000<br>An **Input** value of 1000 produces an **Output** value of 1000. |
| 4. | | Profile point created by parameter pair **X4**-**Y4** where:<br>• **X4** = 2000<br>• **Y4** = 1250<br>An **Input** value of 2000 produces an **Output** value of 1250. |

### Profile_6Pt Function Block

| Item | Symbol | Description |
|---|---|---|
| 5. | | Profile point created by parameter pair **X5**-**Y5** where:<br>• **X5** = 2250<br>• **Y5** = 2000<br>An **Input** value of 2250 produces an **Output** value of 2000. |
| 6. | | Profile point created by parameter pair **X6**-**Y6** where:<br>• **X6** = 3000<br>• **Y6** = 2250<br>An **Input** value of 3000 produces an **Output** value of 2250. |
| 7. | | Slope extrapolated from the slope created by parameter pairs **X5**-**Y5** and **X6**-**Y6**.<br>**Input** values that are greater than 3000 produce **Output** values that follow this slope.<br>The S16 data type sets the limits to the maximum **Input** values and the maximum **Output** values. |
| 8. | | Slope extrapolated from the slope created by parameter pairs **X1**-**Y1** and **X2**-**Y2**.<br>**Input** values that are less than 0 produce **Output** values that follow this slope.<br>The S16 data type sets the limits to the maximum **Input** values and the maximum **Output** values. |

### Status Logic

This topic describes how status logic is indicated for the function block.

| Condition | Hex* | Binary | Cause | Response | Correction |
|---|---|---|---|---|---|
| Invalid setup. | 0x8008 | 1000 | **X1**-**X6** parameters do not successively increase in value. | **Output** = 0. | Successively increase **X** parameter values. |

* Bit 16 set to 1 identifies a standard Danfoss status or fault code.

### Identical Function Blocks Need Different Namespace Values to Successfully Compile

If you use the same function block more than once in an application, you must change each function block's namespace value to avoid compiler errors.

All function blocks contain Advanced Checkpoint with Namespace components that enable the PLUS+1® Service Tool to read block input and output values.

Some function blocks contain non-volatile memory components that store function block operating parameters.

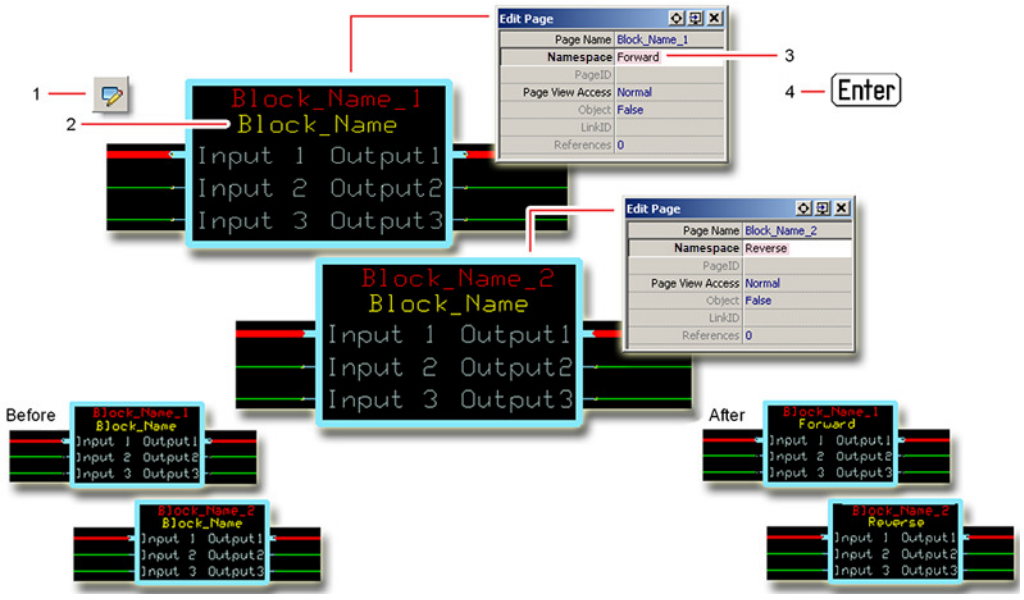
Both these components use memory names ("aliases") to allocate memory. Identical memory names cause compiler errors.

The namespace value adds a unique prefix to each component name to avoid errors. Keep each namespace value short to save controller memory.

## Profile_6Pt Function Block

### Change Namespace Value

To successfully compile your application, change the namespace value for function blocks that are used more than once in an application.




1. In the PLUS+1® GUIDE menu bar, click the **Query/Change** button.
2. Click on the function block whose namespace you want to set to a unique value.

   The **Edit Page** window opens.
3. In the **Edit Page** window, enter a meaningful **Namespace** value.
   - **Namespace** values are case-sensitive.
   - To save controller memory, use a short namespace value.
4. Press **Enter**.
5. Repeat these steps to enter unique namespace values for other identical function blocks.

## Profile_6Pt Function Block

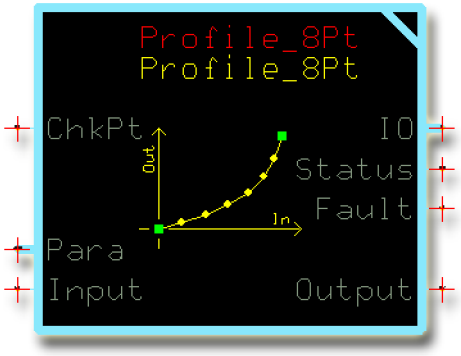
### IEC 61508-3 Annex D Supplemental Information

The following table provides IEC 61508-3 Annex D supplemental information.

| Item | Description |
|---|---|
| Function block name | Profile_6Pt. |
| Function block version | 4.0. |
| Function block development environment | PLUS+1® GUIDE version 8.1 and later. |
| Compatible hardware | Verified in the PLUS+1® GUIDE compile process.<br>When the PLUS+1® GUIDE compiler finds a function block that is incompatible with hardware, it aborts the compile process and logs an error message. The error message gives the location of the function block and states "Error 80: component not supported in hwd." |
| Function block developed in compliance with | Danfoss Software Product Development Process (PDP), which includes ISO 9001 and IEC 61508-3 standards. |
| Competence required of function block integrator | The knowledge, competence, and training required to:<br>• Understand this manual.<br>• Use the PLUS+1® GUIDE program to develop a machine control application.<br>• Follow quality software practices to develop a machine control application. |
| Contacting Danfoss | *https://www.danfoss.com/en/products/software/dps/plus1-software-services-support-and-training/plus1-support-and-services* |

## Profile_8Pt Function Block

Use the **Profile_8Pt** function block to change the curve characteristics of a signal.




Six X-Y parameter pairs along with fixed endpoints (X = 0, Y= 0 and X =10000, Y =10000) create a seven-segment profile that defines how the function block's **Output** values follow changes to its **Input** values.

You can use this function block to:

- Increase control resolution at slow speeds or low-power output.
- Linearize the signal from a sensor.
- Create a non-linear control signal for a non-linear actuator.

When using this function block, note the following:

- The function block's **Input** and **Output** values can range from -10000 to 10000.
- A change in the polarity of the function block's **Input** values from positive to negative or from negative to positive produces mirrored **Output** values.

### Inputs

The inputs to the **Profile_8Pt** function block are described.

Use only the data types specified in this table. Other data types cause compiler errors.

| Item | Type | Range | Description |
|---|---|---|---|
| **ChkPt** | BOOL | —— | • True—include the function block's built-in **Advanced Checkpoint with Namespace** in the compiled LHX download file.<br>• False—exclude the function block's built-in **Advanced Checkpoint with Namespace** components from the compiled LHX download file. |
| **Para** | Bus | —— | |
| **X1** | U16 | 1–9999 | Scaling input parameter.<br>When **Input** = **X1**, **Output** = **Y1**.<br>0 < **X1** < **X2** < **X3** < **X4** < **X5** < **X6** < 10000 |
| **X2** | U16 | 1–9999 | Scaling input parameter.<br>When **Input** = **X2**, **Output** = **Y2**.<br>0 < **X1** < **X2** < **X3** < **X4** < **X5** < **X6** < 10000 |
| **X3** | U16 | 1–9999 | Scaling input parameter.<br>When **Input** = **X3**, **Output** = **Y3**.<br>0 < **X1** < **X2** < **X3** < **X4** < **X5** < **X6** < 10000 |
| **X4** | U16 | 1–9999 | Scaling input parameter.<br>When **Input** = **X4**, **Output** = **Y4**.<br>0 < **X1** < **X2** < **X3** < **X4** < **X5** < **X6** < 10000 |
| **X5** | U16 | 1–9999 | Scaling input parameter.<br>When **Input** = **X5**, **Output** = **Y5**.<br>0 < **X1** < **X2** < **X3** < **X4** < **X5** < **X6** < 10000 |

## Profile_8Pt Function Block

| Item | Type | Range | Description |
|---|---|---|---|
| **X6** | U16 | 1–9999 | Scaling input parameter.<br>When **Input** = **X6**, **Output** = **Y6**.<br>0 < **X1** < **X2** < **X3** < **X4** < **X5** < **X6** < 10000 |
| **Y1** | U16 | 0–10000 | Scaling output parameter.<br>When **Input** = **X1**, **Output** = **Y1**.<br>**Y** values can increase, decrease, or stay the same. |
| **Y2** | U16 | 0–10000 | Scaling output parameter.<br>When **Input** = **X2**, **Output** = **Y2**.<br>**Y** values can increase, decrease, or stay the same. |
| **Y3** | U16 | 0–10000 | Scaling output parameter.<br>When **Input** = **X3**, **Output** = **Y3**.<br>**Y** values can increase, decrease, or stay the same. |
| **Y4** | U16 | 0–10000 | Scaling output parameter.<br>When **Input** = **X4**, **Output** = **Y4**.<br>**Y** values can increase, decrease, or stay the same. |
| **Y5** | U16 | 0–10000 | Scaling output parameter.<br>When **Input** = **X5**, **Output** = **Y5**.<br>**Y** values can increase, decrease, or stay the same. |
| **Y6** | U16 | 0–10000 | Scaling output parameter.<br>When **Input** = **X6**, **Output** = **Y6**.<br>**Y** values can increase, decrease, or stay the same. |
| **Input** | S16 | -10000–10000 | The input signal to be profiled. |

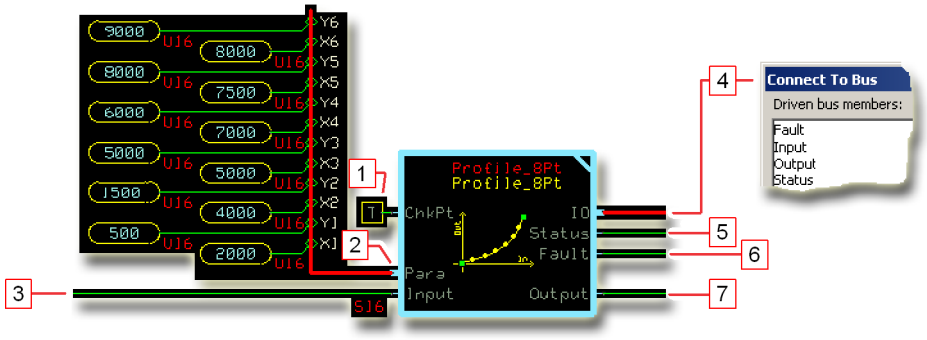
### Outputs

The outputs of the **Profile_8Pt** function block are described.

| Item | Type | Range | Description |
|---|---|---|---|
| **IO** | Bus | —— | Outputs a bus with all of the function block's input and output signals.<br>The bus conveniently distributes this function block's signals to your application. |
| **Status** | U16 | —— | Reports the status of the function block.<br>This output follows the standard bitwise scheme described in the *Status* topic. |
| **Fault** | U16 | —— | Reports the faults of the function block.<br>This output follows the standard bitwise scheme described in the *Fault* topic. |
| **Output** | S16 | -10000–10000 | The **Input** signal after profiling. |

### Function Block Connections

Connections you can make with the function block are described.



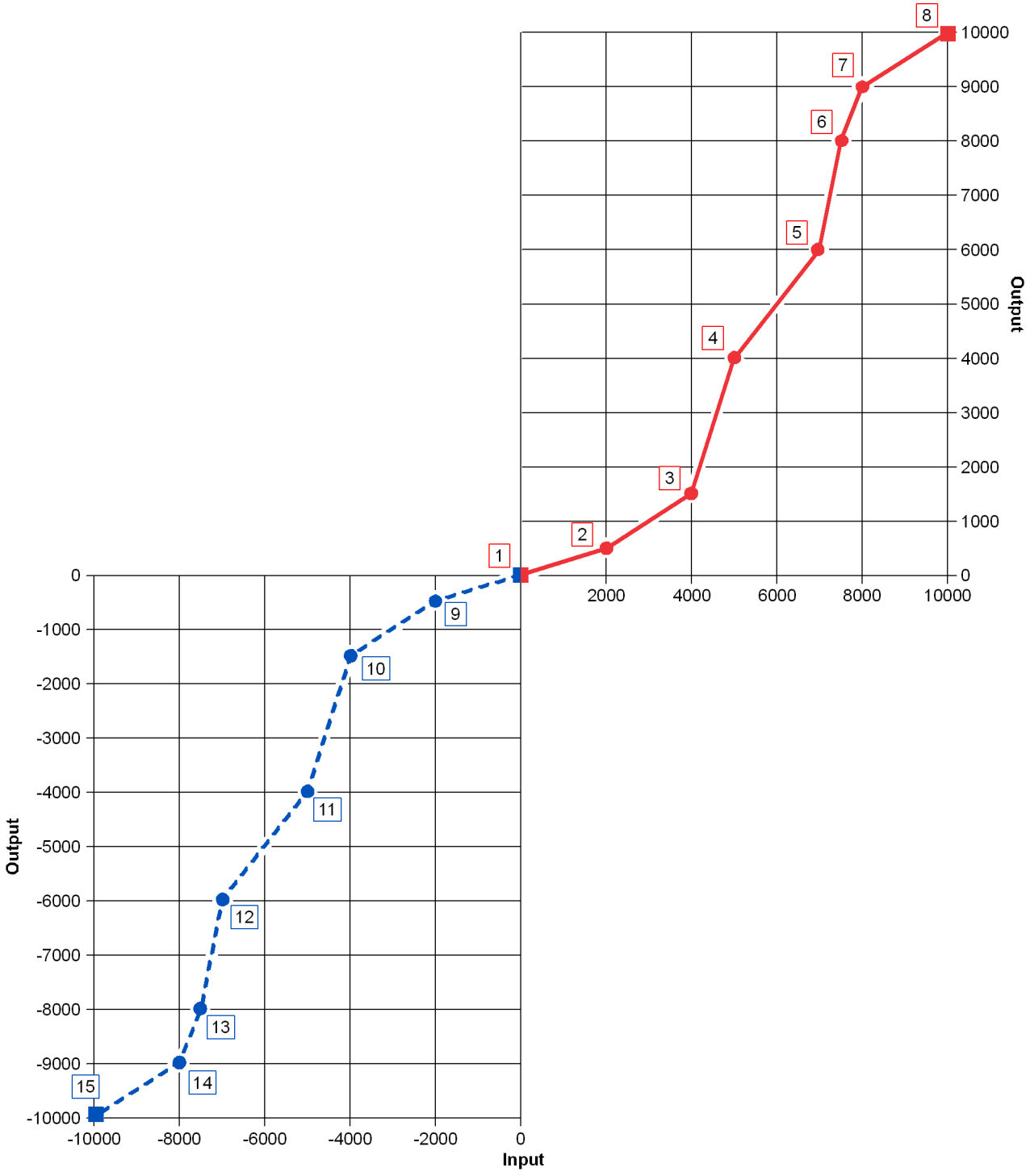
## Profile_8Pt Function Block

| Item | Description |
|---|---|
| **1.** | • True—include the function block's built-in **Advanced Checkpoint with Namespace** in the compiled LHX download file.<br>• False—exclude the function block's built-in **Advanced Checkpoint with Namespace** components from the compiled LHX download file. |
| **2.** | Input for six X-Y parameter pairs.<br>These pairs profile how the function block's **Output** follows changes to its **Input** values. |
| **3.** | The signal to be profiled. |
| **4.** | Outputs a bus with all of the function block's input and output signals. |
| **5.** | Reports the status of the function block. |
| **6.** | Reports the faults of the function block. |
| **7.** | The **Input** signal after profiling. |

## Profile_8Pt Function Block

### Function Block Example

Use the following example to understand how configuration changes impact the output of the function block.



## Profile_8Pt Function Block

*Figure Details*

| Item | Symbol | Description |
|---|---|---|
| **1.** | | Fixed, software-defined profile point where:<br>• **X** = 0<br>• **Y** = 0<br>An **Input** value of 0 produces an **Output** value of 0. |
| **2.** | | User-defined profile point created by the parameter pair **X1**-**Y1** where:<br>• **X1** = 2000<br>• **Y1** = 500<br>An **Input** value of 5=2000 produces an **Output** value of 500. |
| **3.** | | Profile point created by parameter pair **X2**-**Y2** where:<br>• **X2** = 4000<br>• **Y2** = 1500<br>An **Input** value of 4000 produces an **Output** value of 1500. |
| **4.** | | Profile point created by parameter pair **X3**-**Y3** where:<br>• **X3** = 5000<br>• **Y3** = 4000<br>An **Input** value of 5000 produces an **Output** value of 4000. |
| **5.** | | Profile point created by parameter pair **X4**-**Y4** where:<br>• **X4** = 7000<br>• **Y4** = 6000<br>An **Input** value of 7000 produces an **Output** value of 6000. |
| **6.** | | Profile point created by parameter pair **X5**-**Y5** where:<br>• **X5** = 7500<br>• **Y5** = 8000<br>An **Input** value of 7500 produces an **Output** value of 8000. |
| **7.** | | Profile point created by parameter pair **X6**-**Y6** where:<br>• **X6** = 8000<br>• **Y6** = 9000<br>An **Input** value of 8000 produces an **Output** value of 9000. |
| **8.** | | Fixed, software-defined profile point where:<br>• **X** = 10000<br>• **Y** = 10000<br>An **Input** value of 10000 produces an **Output** value of 10000. |
| **9.** | | Negatively mirrors the user-defined profile point created by the parameter pair **X1**-**Y1** where:<br>• **-X1** = -2000<br>• **-Y1** = -500<br>An **Input** value of -2000 produces an **Output** value of -500. |
| **10.** | | Negatively mirrors the user-defined profile point created by the parameter pair **X2**-**Y2** where:<br>• **-X2** = -4000<br>• **-Y2** = -1500<br>An **Input** value of -4000 produces an **Output** value of -1500. |
| **11.** | | Negatively mirrors the user-defined profile point created by the parameter pair **X3**-**Y3** where:<br>• **-X3** = -5000<br>• **-Y3** = -4000<br>An **Input** value of -5000 produces an **Output** value of -4000. |
| **12.** | | Negatively mirrors the user-defined profile point created by the parameter pair **X4**-**Y4** where:<br>• **-X4** = -7000<br>• **-Y4** = -6000<br>An **Input** value of -7000 produces an **Output** value of -6000. |

## Profile_8Pt Function Block

*Figure Details (continued)*

| Item | Symbol | Description |
|---|---|---|
| 13. | | Negatively mirrors the user-defined profile point created by the parameter pair **X5**-**Y5** where:<br>• **-X5** = -7500<br>• **-Y5** = -8000<br>An **Input** value of -7500 produces an **Output** value of -8000. |
| 14. | | Negatively mirrors the user-defined profile point created by the parameter pair **X6**-**Y6** where:<br>• **-X6** = -8000<br>• **-Y6** = -9000<br>An **Input** value of -8000 produces an **Output** value of -9000. |
| 15. | | Negatively mirrors the fixed profile point where:<br>• **X** = -10000<br>• **Y** = -10000<br>An **Input** value of -10000 produces an **Output** value of -10000. |

### Status and Fault Logic

Use status and fault codes to determine proper program operation.

#### Status Logic

This topic describes how status logic is indicated for the function block.

| Condition | Hex* | Binary | Cause | Response | Correction |
|---|---|---|---|---|---|
| Invalid setup. | 0x8008 | 1000 | One or more **Y** parameters is out-of-range. | Out-of-range **Y** parameters clamp at 10000. | Return **Y** parameters to within their 0–10000 range. |
| | | | **X1**–**X6** parameters do not successively increase in value. parameter is out-of-range. | **Output** = 0. | Successively increase **X** parameter values. |
| | | | **X1** is less than 1 or **X6** is greater than 9999. | **X1** clamps at 1 and **X6** clamps at 9999. | Return the **X1** and **X6** values to within their 1–9999 range. |

* Bit 16 set to 1 identifies a standard Danfoss status or fault code.

#### Fault Logic

This topic describes how fault logic is indicated for the function block.

| Condition | Hex* | Binary | Cause | Response | Correction |
|---|---|---|---|---|---|
| Input value is too low. | 0x8001 | 0001 | **Input** value < -10000. | **Output** = -10000 | Return the **Input** to the valid range. |
| Input value is too high. | 0x8002 | 0010 | **Input** value > 10000. | **Output** = 10000 | |

* Bit 16 set to 1 identifies a standard Danfoss status or fault code.

### Identical Function Blocks Need Different Namespace Values to Successfully Compile

If you use the same function block more than once in an application, you must change each function block's namespace value to avoid compiler errors.

All function blocks contain Advanced Checkpoint with Namespace components that enable the PLUS+1® Service Tool to read block input and output values.

Some function blocks contain non-volatile memory components that store function block operating parameters.

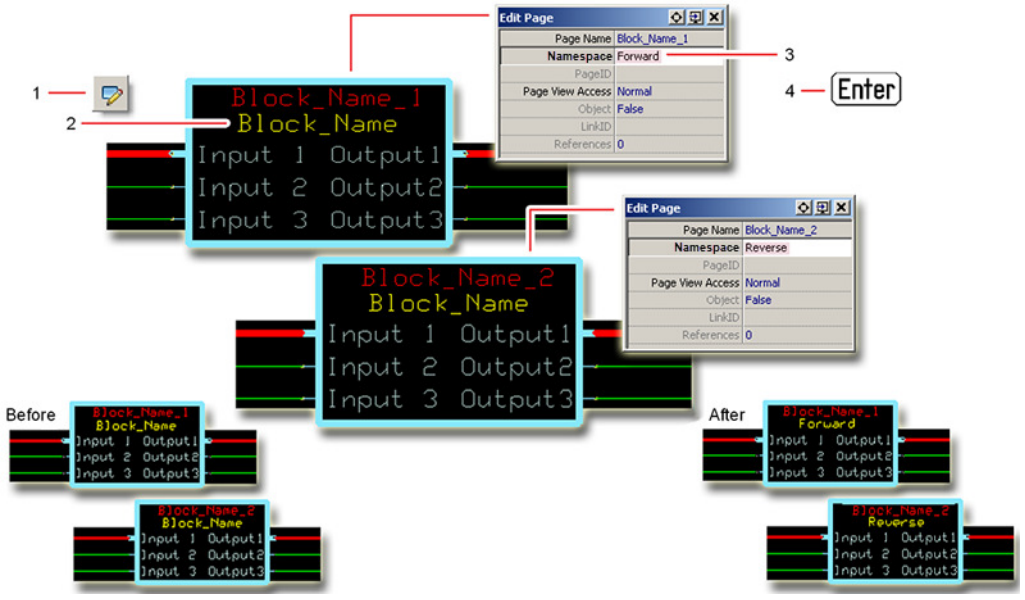
Both these components use memory names ("aliases") to allocate memory. Identical memory names cause compiler errors.

## Profile_8Pt Function Block

The namespace value adds a unique prefix to each component name to avoid errors. Keep each namespace value short to save controller memory.

### Change Namespace Value

To successfully compile your application, change the namespace value for function blocks that are used more than once in an application.




1. In the PLUS+1® GUIDE menu bar, click the **Query/Change** button.
2. Click on the function block whose namespace you want to set to a unique value.

   The **Edit Page** window opens.
3. In the **Edit Page** window, enter a meaningful **Namespace** value.
   - **Namespace** values are case-sensitive.
   - To save controller memory, use a short namespace value.
4. Press **Enter**.
5. Repeat these steps to enter unique namespace values for other identical function blocks.

## Profile_8Pt Function Block

### IEC 61508-3 Annex D Supplemental Information

The following table provides IEC 61508-3 Annex D supplemental information.

| Item | Description |
|---|---|
| Function block name | Profile_8Pt. |
| Function block version | 4.0. |
| Function block development environment | PLUS+1® GUIDE version 8.1 and later. |
| Compatible hardware | Verified in the PLUS+1® GUIDE compile process.<br>When the PLUS+1® GUIDE compiler finds a function block that is incompatible with hardware, it aborts the compile process and logs an error message. The error message gives the location of the function block and states "Error 80: component not supported in hwd." |
| Function block developed in compliance with | Danfoss Software Product Development Process (PDP), which includes ISO 9001 and IEC 61508-3 standards. |
| Competence required of function block integrator | The knowledge, competence, and training required to:<br>• Understand this manual.<br>• Use the PLUS+1® GUIDE program to develop a machine control application.<br>• Follow quality software practices to develop a machine control application. |
| Contacting Danfoss | *https://www.danfoss.com/en/products/software/dps/plus1-software-services-support-and-training/plus1-support-and-services* |

## Comparison of 6Pt, 8Pt, and Profile_Knee Function Blocks

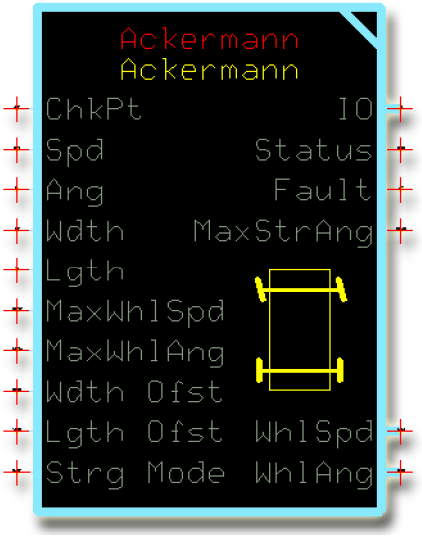
Use the comparison table to determine which function block you want to use in your application.

| Function Block | Input Value Range | Output Value Range | Segments In Profile | Negative Input Produces Negative Mirrored Output? |
|---|---|---|---|---|
| **Profile_6Pt** | -32768–32767 | -32768–32767 | 7 | No.* |
| **Profile_8Pt** | -10000–10000 | -10000–10000 | 7 | Yes. |
| **Profile_Knee** | -10000–10000 | -10000–10000 | 2 | Yes. |

* **Input** values that are less than the minimum **X** parameter produce **Output** values that follow the slope of the segment produced by the **X1**-**Y1** and **X2**-**Y2** parameter pairs. **Input** values that are greater than the maximum **X** parameter produce **Output** values that follow the slope of the segment produced by the **X5**-**Y5** and **X6**-**Y6** parameter pairs.

## Ackermann Function Block

Use the **Ackermann** function block to calculate the wheel speeds and wheel angles for a given average steering command input and vehicle speed command input.




You can use this function block to calculate wheel angles and wheel speeds:

- For four-wheel propel applications that independently control the speed of two or four wheels.
- To determine the expected wheel speed when detecting wheel spin.

### Inputs

The inputs to the **Ackerman** function block are described.

Use only the data types specified in this table. Other data types cause compiler errors.

| Item | Type | Range | Description |
|---|---|---|---|
| **ChkPt** | BOOL | —— | True—include the function block's built-in **Advanced Checkpoint with Namespace**<br>False—exclude the function block's built-in **Advanced Checkpoint with Namespace** components from the compiled LHX download file. |
| **Spd** | S16 | -20000–20000 | Requested vehicle speed.<br>1000 = 1000 mm/s |
| **Ang** | S16 | -9000–9000 | Requested steering angle.<br>1000 = 10.00° |
| **Wdth** | U16 | 200–10000 | Width of the vehicle's wheelbase.<br>1000 = 1000 mm |
| **Lgth** | U16 | 800–20000 | Length of vehicle's wheelbase.<br>1 = 1 mm |
| **MaxWhlSpd** | U16 | 0–20000 | Maximum allowed wheel speed in both a positive and a negative direction. Once one wheel reaches the **MaxWhlSpd**, the wheel speeds of the other wheels stop increasing.<br>1000 = 1000 mm/s |
| **MaxWhlAng** | U16 | 0–9000 | The maximum allowed wheel steering angle in both a positive and a negative direction. Once one wheel reaches the **MaxWhlAng**, the wheel angles of the other wheels stop increasing.<br>1000 = 10.00° |

## Ackermann Function Block

| Item | Type | Range | Description |
|---|---|---|---|
| **Wdth Ofst** | S16 | -10000–10000 | Width offset for the center of rotation when steering.<br>• A positive **Wdth Ofst** value shifts the center of rotation when steering to the right of the vehicle.<br>• A negative **Wdth Ofst** value shifts the center of rotation when steering to the left of the vehicle.<br>Use the **Wdth Ofst** to shift your vehicle's center of rotation when steering if:<br>• You attach an implement to the left or right side of your vehicle.<br>• Your vehicle's wheelbase does not determine the center of rotation when steering.<br>If your vehicle's wheelbase determines the center of rotation when steering, set the **Wdth Ofst** value to 0.<br>1000 = 1000 mm |
| **Lgth Ofst** | S16 | -10000–10000 | Length offset for the center of rotation when steering.<br>• A positive **Lgth Ofst** value shifts the center of rotation when steering toward the front of the vehicle.<br>• A negative **Lgth Ofst** value shifts the center of rotation when steering toward the rear of the vehicle.<br>Use the **Lgth Ofst** to shift your vehicle's center of rotation when steering if:<br>• You attach an implement to the front or rear of your vehicle.<br>• Your vehicle's wheelbase does not determine the center of rotation when steering.<br>If your vehicle's wheelbase determines the center of rotation when steering, set the **Wdth Ofst** value to 0.<br>1000 = 1000 mm |
| **Strg Mode** | U8 | 1–4 | Vehicle steering mode:<br>• 1 = Two-wheel front-steering.<br>• 2 = Two-wheel rear-steering.<br>• 3 = Four-wheel coordinated-steering.<br>• 4 = Four-wheel crab-steering. |

### Outputs

The outputs of the **Ackermann** function block are described.

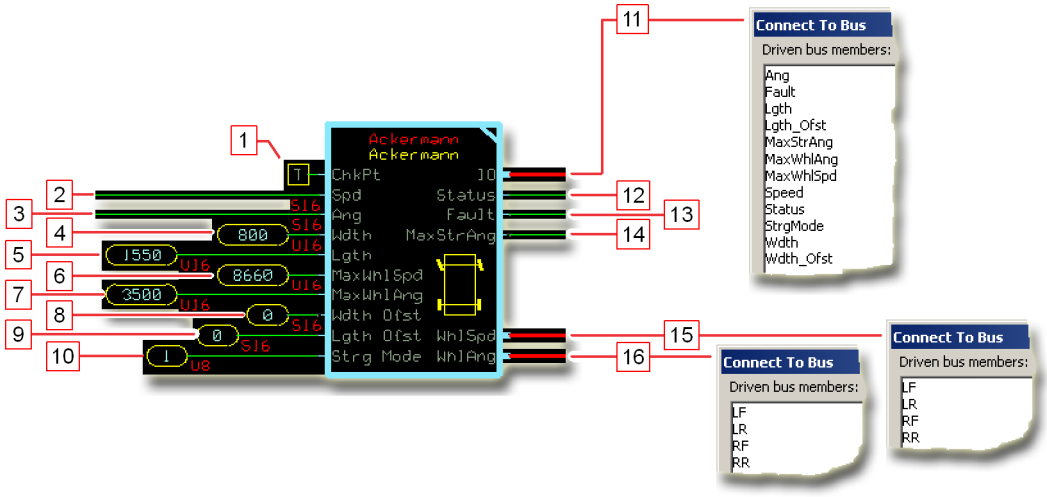
| Item | Type | Range | Description |
|---|---|---|---|
| **IO** | Bus | —— | Outputs a bus with all of the function block's input and output signals.<br>This bus provides a convenient way to distribute this function block's signals to your application. |
| **Status** | U16 | —— | Reports the status of the function block.<br>This output follows the standard bitwise scheme described in the *Status Logic* topic. |
| **Fault** | U16 | —— | Reports the faults of the function block.<br>This output follows the standard bitwise scheme described in the *Status Logic* topic. |
| **MaxStrgAng** | U16 | 0–9000 | The maximum effective **Ang** input in both a positive and a negative direction.<br>Any **Ang** inputs above this value cause no change increase in wheel angles.<br>The function block calculates this output based on maximum allowed wheel angles and vehicle geometry.<br>1000 = 10.00° |
| **WhlSpd** | Bus | —— | Outputs a bus with calculated wheel speed signals for the left-front, right-front, left-rear, and right-rear wheels. |
| **LF** | S16 | -20000–20000 | Calculated wheel speed for the left-front wheel.<br>1000 = 1000 mm/s |
| **RF** | S16 | -20000–20000 | Calculated wheel speed for the right-front wheel.<br>1000 = 1000 mm/s |
| **LR** | S16 | -20000–20000 | Calculated wheel speed for the left-rear wheel.<br>1000 = 1000 mm/s |
| **RR** | S16 | -20000–20000 | Calculated wheel speed for the right-rear wheel.<br>1000 = 1000 mm/s |
| **WhlAng** | Bus | —— | Outputs a bus with calculated wheel angle signals for the left-front, right-front, left-rear, and right-rear wheels. |
| **LF** | S16 | -9000–9000 | Calculated wheel angle for the left-front wheel.<br>1000 = 10.00° |

## Ackermann Function Block

| Item | Type | Range | Description |
|---|---|---|---|
| **RF** | S16 | -9000–9000 | Calculated wheel angle for the right-front wheel.<br>1000 = 10.00° |
| **LR** | S16 | -9000–9000 | Calculated wheel angle for the left-rear wheel.<br>1000 = 10.00° |
| **RR** | S16 | -9000–9000 | Calculated wheel angle for the right-rear wheel.<br>1000 = 10.00° |

### Function Block Connections

Connections you can make with the function block are described.




| Item | Description |
|---|---|
| **1.** | • True—include the function block's built-in **Advanced Checkpoint with Namespace** in the compiled LHX download file.<br>• False—exclude the function block's built-in **Advanced Checkpoint with Namespace** components from the compiled LHX download file. |
| **2.** | Requested speed. |
| **3.** | Requested steering angle. |
| **4.** | Width of the vehicle's wheelbase. |
| **5.** | Length of the vehicle's wheelbase. |
| **6.** | Maximum allowed wheel speed in both a positive and a negative direction. |
| **7.** | The maximum allowed wheel angle in both a positive and a negative direction. |
| **8.** | Width offset for the center of rotation when steering. |
| **9.** | Length offset for the center of rotation when steering. |
| **10.** | • 1 = Two-wheel front-steering mode.<br>• 2 = Two-wheel rear-steering mode.<br>• 3 = Four-wheel coordinated-steering mode.<br>• 4 = Four-wheel crab-steering mode. |
| **11.** | Outputs a bus with all of the function block's input and output signals. |
| **12.** | Reports the status of the function block. |
| **13.** | Reports the faults of the function block. |
| **14.** | The maximum effective **Ang** input in both a positive and a negative direction. **Ang** inputs above this value cause no further change in wheel angles. |

## Ackermann Function Block

| Item | Description |
|---|---|
| **15.** | Outputs a bus with calculated **LF**, **RF**, **LR**, and **RR** wheel speed signals. |
| **16.** | Outputs a bus with calculated **LF**, **RF**, **LR**, and **RR** wheel angle signals. |

### Status and Fault Logic

Use status and fault codes to determine proper program operation.

#### Status Logic

This topic describes how status logic is indicated for the function block.

| Condition | Hex* | Binary | Cause | Response | Correction |
|---|---|---|---|---|---|
| Invalid setup. | 0x8008 | 1000 | **Wdth**, **Lgth**, **MaxWhlSpd**, **MaxWhlAng**, **Wdth Ofst**, or **Lgth Ofst** value is out of range. | Output values based on the out-of-range value clamped at either its minimum or maximum value. | Return the out-of-range value to within its correct range. |

* Bit 16 set to 1 identifies a standard Danfoss status or fault code.

#### Fault Logic

This topic describes how fault logic is indicated for the function block.

| Condition | Hex* | Binary | Cause | Response | Correction |
|---|---|---|---|---|---|
| Input value is too low. | 0x8001 | 0001 | **Ang** value is less than -9000. | • **WhlSpd** outputs hold at 0.<br>• **MaxStrgAng** and **WhlAng** outputs hold their previous valid value. | Return the **Ang** input to within its -9000 to 9000 range. |
| | | | **Spd** value is less than -20000. | | Return the **Spd** input to within its -20000 to 20000 range. |
| | | | **Strg Mode** value is less than 1. | | Select a **Strg Mode** input of 1, 2, 3, or 4. |
| Input value is too high. | 0x8002 | 0010 | **Ang** value is greater than 9000. | | Return the **Ang** input to within its -9000 to 9000 range. |
| | | | **Spd** value is greater than 20000. | | Return the **Spd** input to within its -20000 to 20000 range.. |
| | | | **Strg Mode** value is greater than 4. | | Select a **Strg Mode** input of 1, 2, 3, or 4. |

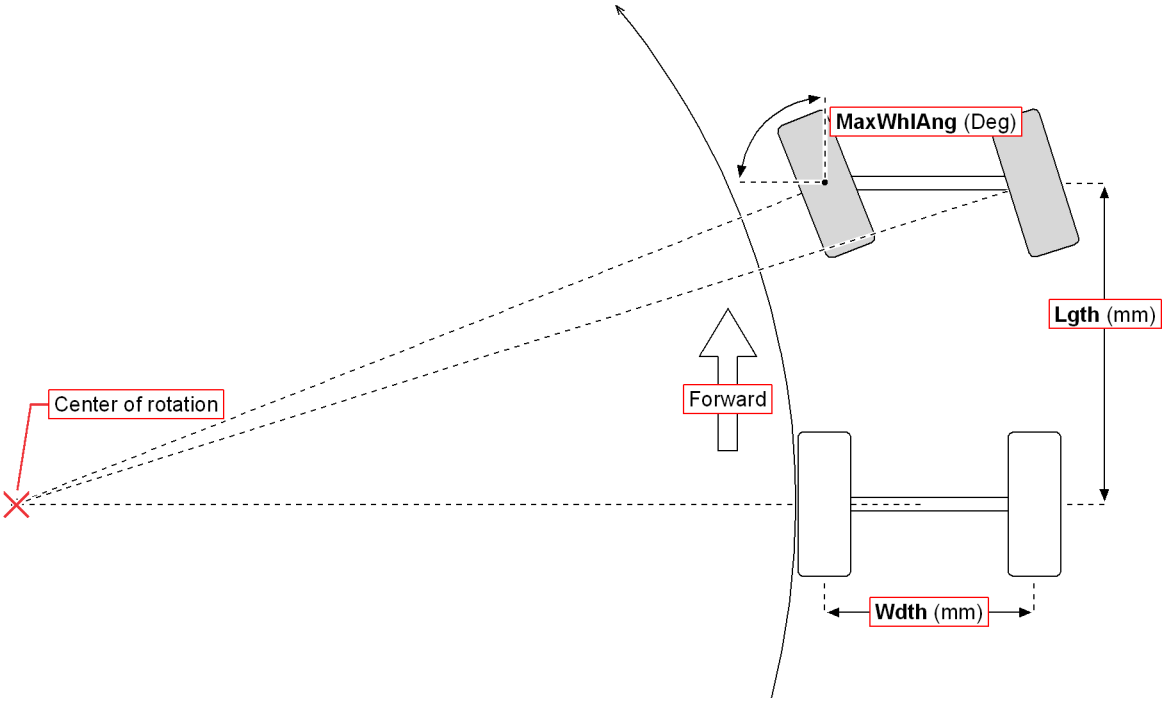
* Bit 16 set to 1 identifies a standard Danfoss status or fault code.

## Ackermann Function Block

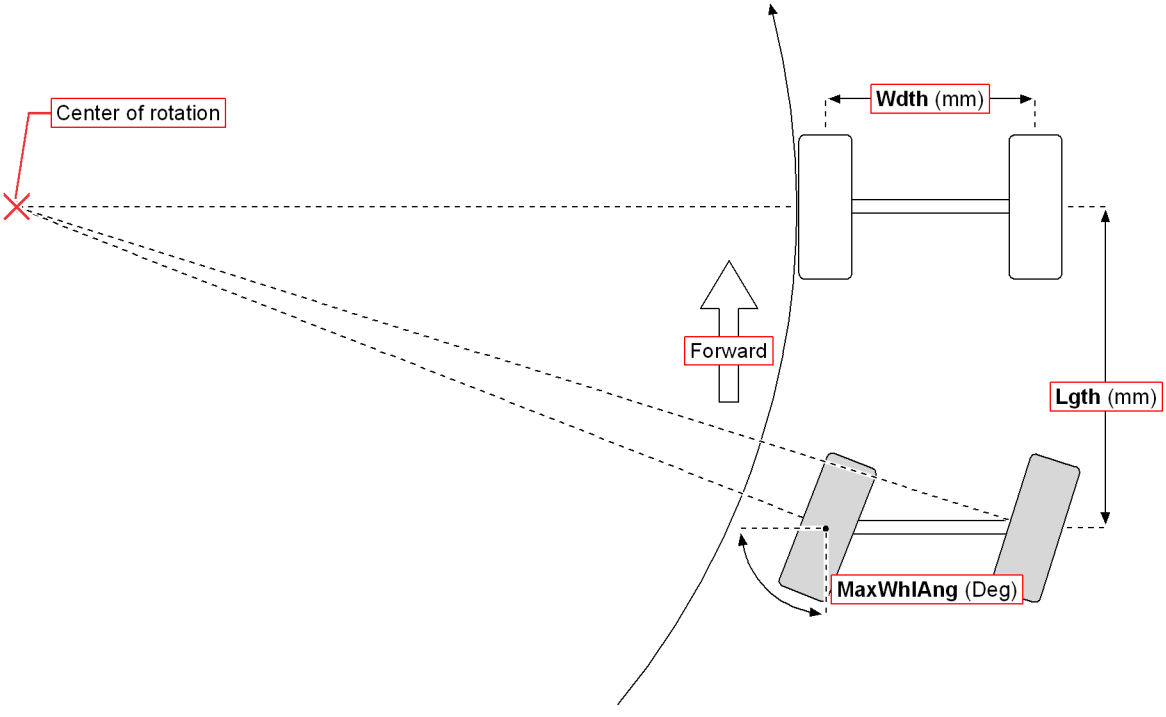
### Steering Modes

Available steering modes are illustrated.

*Two-Wheel Front Steering Mode*

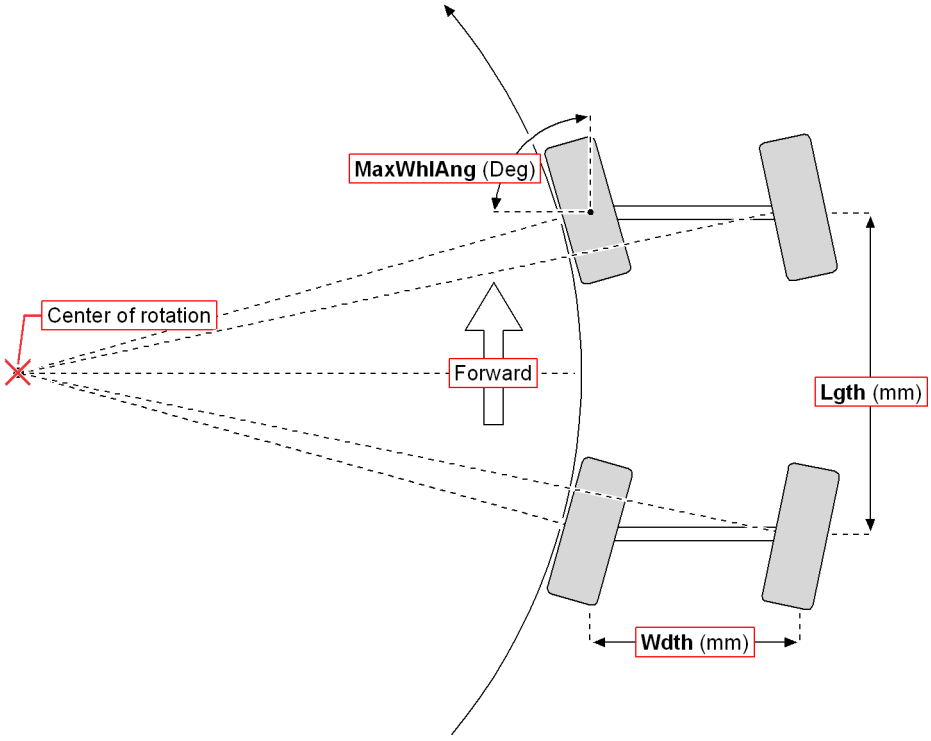



*Two-Wheel Rear Steering Mode*

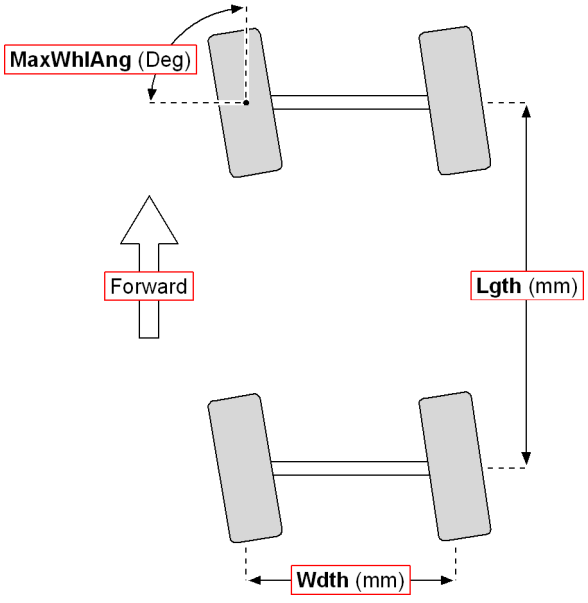


## Ackermann Function Block

*Four-Wheel Coordinated Steering Mode*




*Four-Wheel Crab Steering Mode*




### Identical Function Blocks Need Different Namespace Values to Successfully Compile

If you use the same function block more than once in an application, you must change each function block's namespace value to avoid compiler errors.

All function blocks contain Advanced Checkpoint with Namespace components that enable the PLUS+1® Service Tool to read block input and output values.

## Ackermann Function Block

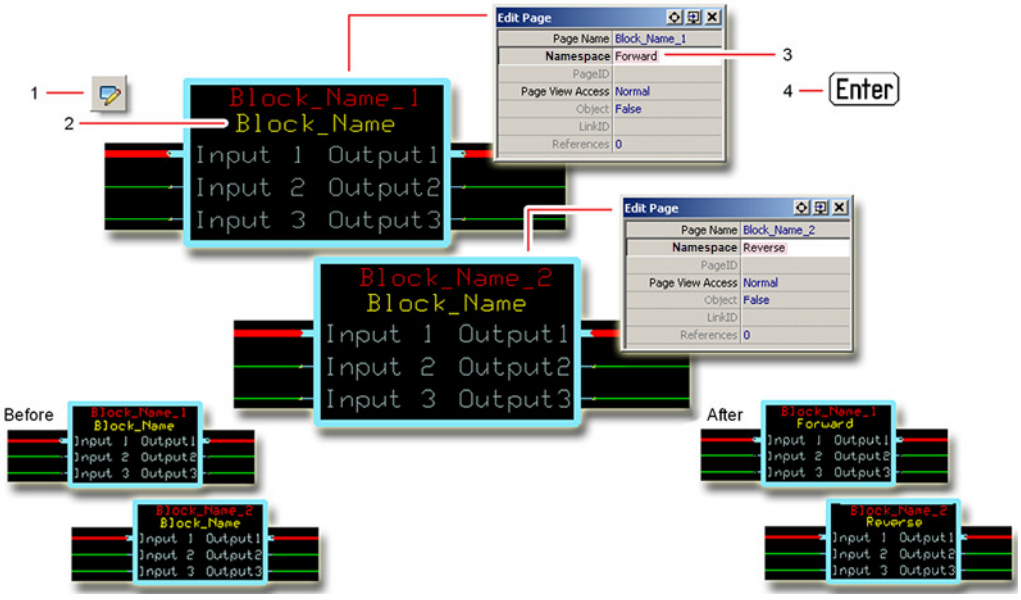
Some function blocks contain non-volatile memory components that store function block operating parameters.

Both these components use memory names (“aliases”) to allocate memory. Identical memory names cause compiler errors.

The namespace value adds a unique prefix to each component name to avoid errors. Keep each namespace value short to save controller memory.

### Change Namespace Value

To successfully compile your application, change the namespace value for function blocks that are used more than once in an application.




1. In the PLUS+1® GUIDE menu bar, click the **Query/Change** button.
2. Click on the function block whose namespace you want to set to a unique value.
   The **Edit Page** window opens.
3. In the **Edit Page** window, enter a meaningful **Namespace** value.
   - **Namespace** values are case-sensitive.
   - To save controller memory, use a short namespace value.
4. Press **Enter**.
5. Repeat these steps to enter unique namespace values for other identical function blocks.

## Ackermann Function Block

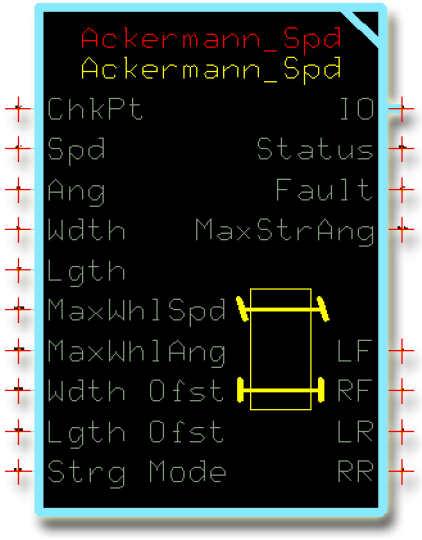
### IEC 61508-3 Annex D Supplemental Information

The following table provides IEC 61508-3 Annex D supplemental information.

| Item | Description |
|---|---|
| Function block name | Ackermann. |
| Function block version | 4.0.1 |
| Function block development environment | PLUS+1® GUIDE version 8.1 and later. |
| Compatible hardware | Verified in the PLUS+1® GUIDE compile process.<br>When the PLUS+1® GUIDE compiler finds a function block that is incompatible with hardware, it aborts the compile process and logs an error message. The error message gives the location of the function block and states "Error 80: component not supported in hwd." |
| Function block developed in compliance with | Danfoss Software Product Development Process (PDP), which includes ISO 9001 and IEC 61508-3 standards. |
| Competence required of function block integrator | The knowledge, competence, and training required to:<br>• Understand this manual.<br>• Use the PLUS+1® GUIDE program to develop a machine control application.<br>• Follow quality software practices to develop a machine control application. |
| Contacting Danfoss | *https://www.danfoss.com/en/products/software/dps/plus1-software-services-support-and-training/plus1-support-and-services* |

## Ackermann_Spd Function Block

Use the **Ackermann_Spd** function block to calculate the wheel speeds for a given average steering command input and vehicle speed command input.




You can use this function block to calculate wheel speeds for vehicles with:

- Two-wheel front steering.
- Two-wheel rear steering.
- Four-wheel coordinated steering.
- Four-wheel crab steering.

### Inputs

The inputs to the **Ackerman_Spd** function block are described.

Use only the data types specified in this table. Other data types cause compiler errors.

| Item | Type | Range | Description |
|---|---|---|---|
| **ChkPt** | BOOL | —— | True—include the function block's built-in **Advanced Checkpoint with Namespace**<br>False—exclude the function block's built-in **Advanced Checkpoint with Namespace** components from the compiled LHX download file. |
| **Spd** | S16 | -20000–20000 | Requested vehicle speed.<br>1000 = 1000 mm/s |
| **Ang** | S16 | -9000–9000 | Requested steering angle.<br>1000 = 10.00° |
| **Wdth** | U16 | 200–10000 | Width of the vehicle's wheelbase.<br>1000 = 1000 mm |
| **Lgth** | U16 | 800–20000 | Length of vehicle's wheelbase.<br>1 = 1 mm |
| **MaxWhlSpd** | U16 | 0–20000 | Maximum allowed wheel speed in both a positive and a negative direction. Once one wheel reaches the **MaxWhlSpd**, the wheel speeds of the other wheels stop increasing.<br>1000 = 1000 mm/s |
| **MaxWhlAng** | U16 | 0–9000 | The maximum allowed wheel steering angle in both a positive and a negative direction. Once one wheel reaches the **MaxWhlAng**, the wheel angles of the other wheels stop increasing.<br>1000 = 10.00° |

## Ackermann_Spd Function Block

| Item | Type | Range | Description |
|---|---|---|---|
| **Wdth Ofst** | S16 | -10000–10000 | Width offset for the center of rotation when steering.<br>• A positive **Wdth Ofst** value shifts the center of rotation when steering to the right of the vehicle.<br>• A negative **Wdth Ofst** value shifts the center of rotation when steering to the left of the vehicle.<br>Use the **Wdth Ofst** to shift your vehicle's center of rotation when steering if:<br>• You attach an implement to the left or right side of your vehicle.<br>• Your vehicle's wheelbase does not determine the center of rotation when steering.<br>If your vehicle's wheelbase determines the center of rotation when steering, set the **Wdth Ofst** value to 0.<br>1000 = 1000 mm |
| **Lgth Ofst** | S16 | -10000–10000 | Length offset for the center of rotation when steering.<br>• A positive **Lgth Ofst** value shifts the center of rotation when steering toward the front of the vehicle.<br>• A negative **Lgth Ofst** value shifts the center of rotation when steering toward the rear of the vehicle.<br>Use the **Lgth Ofst** to shift your vehicle's center of rotation when steering if:<br>• You attach an implement to the front or rear of your vehicle.<br>• Your vehicle's wheelbase does not determine the center of rotation when steering.<br>If your vehicle's wheelbase determines the center of rotation when steering, set the **Wdth Ofst** value to 0.<br>1000 = 1000 mm |
| **Strg Mode** | U8 | 1–4 | Vehicle steering mode:<br>• 1 = Two-wheel front-steering.<br>• 2 = Two-wheel rear-steering.<br>• 3 = Four-wheel coordinated-steering.<br>• 4 = Four-wheel crab-steering. |

### Outputs

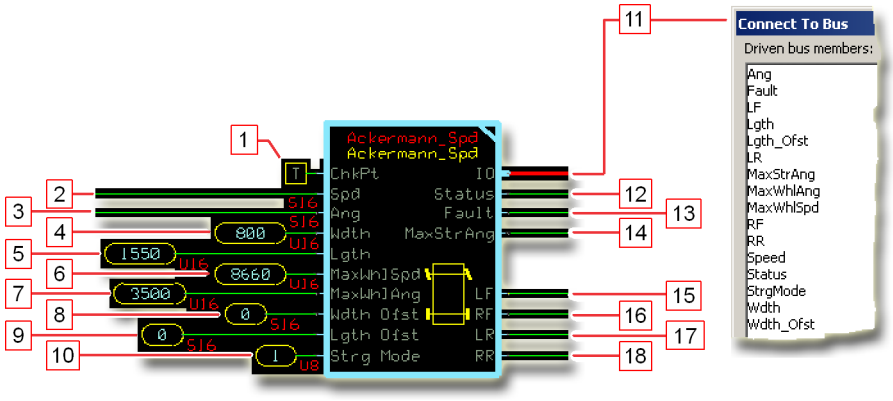
The outputs of the **Ackermann_Spd** function block are described.

| Item | Type | Range | Description |
|---|---|---|---|
| **IO** | Bus | —— | Outputs a bus with all of the function block's input and output signals.<br>This bus provides a convenient way to distribute this function block's signals to your application. |
| **Status** | U16 | —— | Reports the status of the function block.<br>This output follows the standard bitwise scheme described in the *Status Logic* topic. |
| **Fault** | U16 | —— | Reports the faults of the function block.<br>This output follows the standard bitwise scheme described in the *Status Logic* topic. |
| **MaxStrgAng** | U16 | 0–9000 | The maximum effective **Ang** input in both a positive and a negative direction.<br>Any **Ang** inputs above this value cause no change increase in wheel angles.<br>The function block calculates this output based on maximum allowed wheel angles and vehicle geometry.<br>1000 = 10.00° |
| **LF** | S16 | -20000–20000 | Calculated wheel speed for the left-front wheel.<br>1000 = 1000 mm/s |
| **RF** | S16 | -20000–20000 | Calculated wheel speed for the right-front wheel.<br>1000 = 1000 mm/s |
| **LR** | S16 | -20000–20000 | Calculated wheel speed for the left-rear wheel.<br>1000 = 1000 mm/s |
| **RR** | S16 | -20000–20000 | Calculated wheel speed for the right-rear wheel.<br>1000 = 1000 mm/s |

## Ackermann_Spd Function Block

### Function Block Connections

Connections you can make with the function block are described.




*Function Block Connections*

| Item | Description |
|---|---|
| **1.** | • True—include the function block's built-in **Advanced Checkpoint with Namespace** in the compiled LHX download file.<br>• False—exclude the function block's built-in **Advanced Checkpoint with Namespace** components from the compiled LHX download file. |
| **2.** | Requested speed. |
| **3.** | Requested steering angle. |
| **4.** | Width of the vehicle's wheelbase. |
| **5.** | Length of the vehicle's wheelbase. |
| **6.** | Maximum allowed wheel speed in both a positive and a negative direction. |
| **7.** | The maximum allowed wheel angle in both a positive and a negative direction. |
| **8.** | Width offset for the center of rotation when steering. |
| **9.** | Length offset for the center of rotation when steering. |
| **10.** | • 1 = Two-wheel front-steering mode.<br>• 2 = Two-wheel rear-steering mode.<br>• 3 = Four-wheel coordinated-steering mode.<br>• 4 = Four-wheel crab-steering mode. |
| **11.** | Outputs a bus with all of the function block's input and output signals. |
| **12.** | Reports the status of the function block. |
| **13.** | Reports the faults of the function block. |
| **14.** | The maximum effective **Ang** input in both a positive and a negative direction. **Ang** inputs above this value cause no further change in wheel angles. |
| **15.** | Outputs a bus with calculated **LF**, **RF**, **LR**, and **RR** wheel speed signals. |

## Ackermann_Spd Function Block

### Status and Fault Logic

Use status and fault codes to determine proper program operation.

#### Status Logic

This topic describes how status logic is indicated for the function block.

| Condition | Hex* | Binary | Cause | Response | Correction |
|---|---|---|---|---|---|
| Invalid setup. | 0x8008 | 1000 | **Wdth**, **Lgth**, **MaxWhlSpd**, **MaxWhlAng**, **Wdth Ofst**, or **Lgth Ofst** value is out of range. | Output values based on the out-of-range value clamped at either its minimum or maximum value. | Return the out-of-range value to within its correct range. |

* Bit 16 set to 1 identifies a standard Danfoss status or fault code.

#### Fault Logic

This topic describes how fault logic is indicated for the function block.

| Condition | Hex* | Binary | Cause | Response | Correction |
|---|---|---|---|---|---|
| Input value is too low. | 0x8001 | 0001 | **Ang** value is less than -9000. | • **LF**, **RF**, **LR**, and **RR** outputs hold at 0.<br>• **MaxStrgAng** output holds at its last valid value. | Return the **Ang** input to within its -9000 to 9000 range. |
| | | | **Spd** value is less than -20000. | | Return the **Spd** input to within its -20000 to 20000 range. |
| | | | **Strg Mode** value is less than 1. | | Select a **Strg Mode** input of 1, 2, 3, or 4. |
| Input value is too high. | 0x8002 | 0010 | **Ang** value is greater than 9000. | | Return the **Ang** input to within its -9000 to 9000 range. |
| | | | **Spd** value is greater than 20000. | | Return the **Spd** input to within its -20000 to 20000 range.. |
| | | | **Strg Mode** value is greater than 4. | | Select a **Strg Mode** input of 1, 2, 3, or 4. |

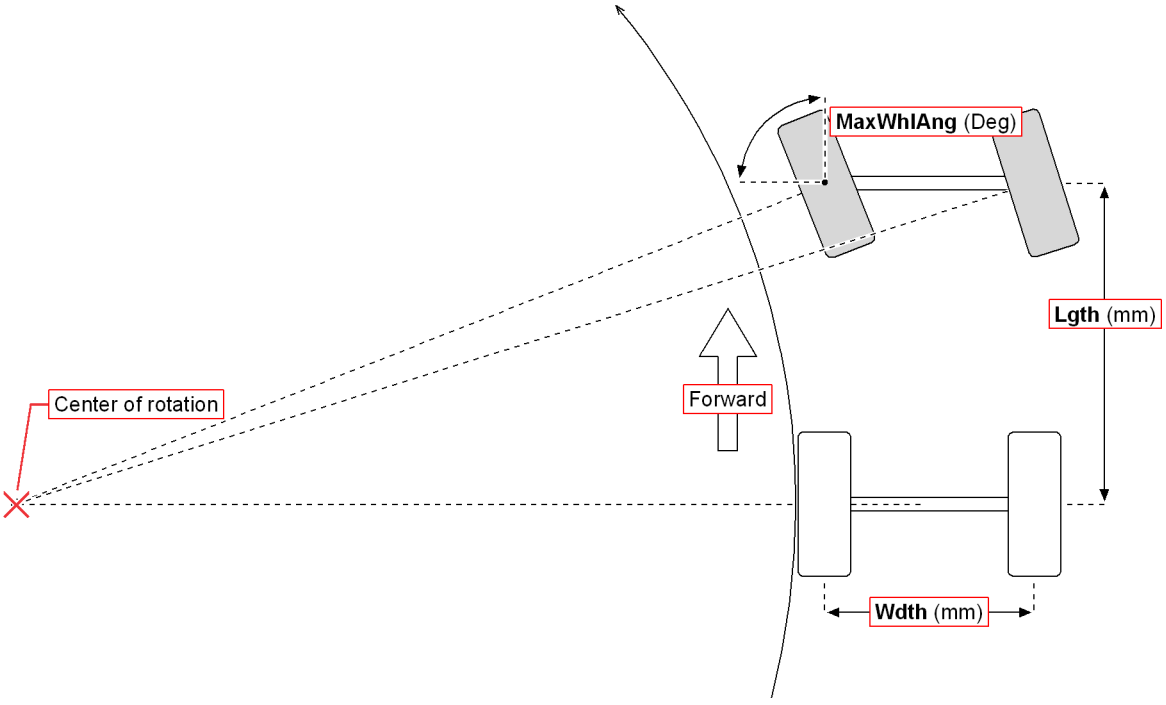
* Bit 16 set to 1 identifies a standard Danfoss status or fault code.

## Ackermann_Spd Function Block

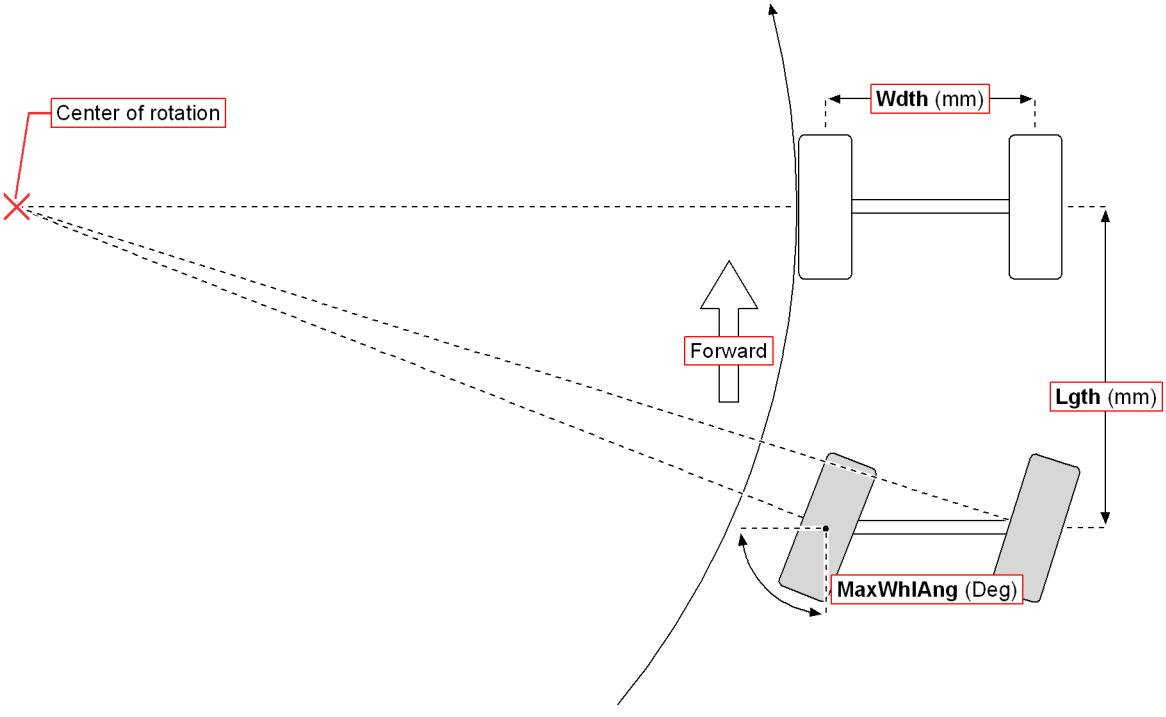
### Steering Modes

Available steering modes are illustrated.

*Two-Wheel Front Steering Mode*

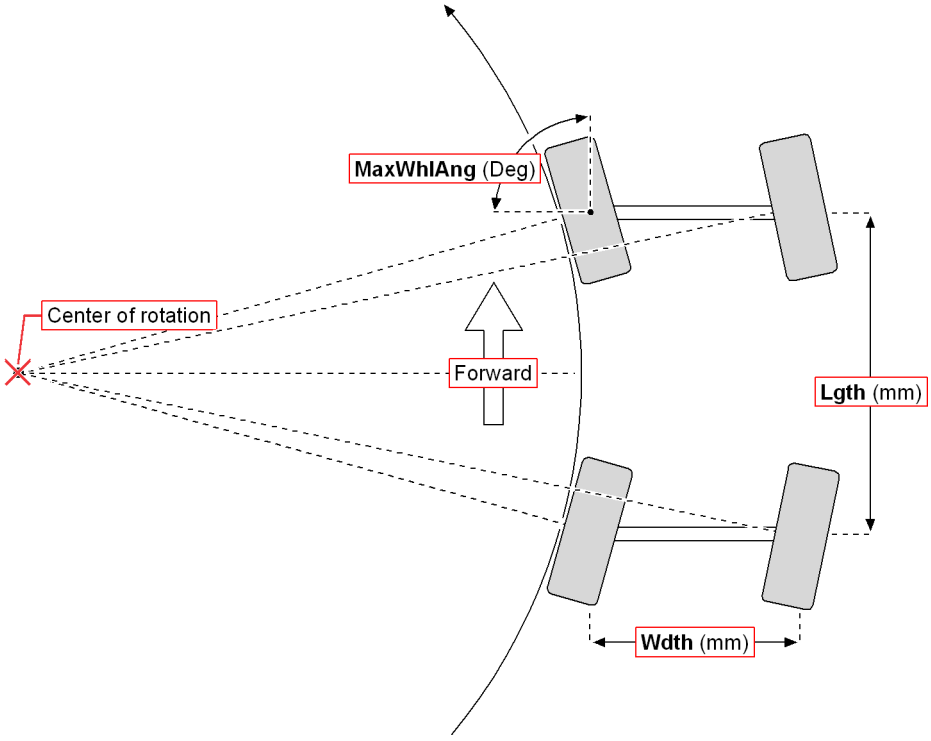



*Two-Wheel Rear Steering Mode*

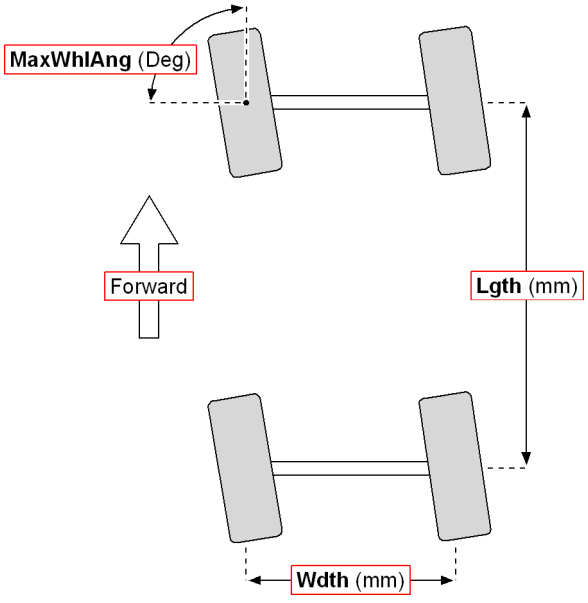


## Ackermann_Spd Function Block

*Four-Wheel Coordinated Steering Mode*




*Four-Wheel Crab Steering Mode*




### Identical Function Blocks Need Different Namespace Values to Successfully Compile

If you use the same function block more than once in an application, you must change each function block's namespace value to avoid compiler errors.

All function blocks contain Advanced Checkpoint with Namespace components that enable the PLUS+1® Service Tool to read block input and output values.

## Ackermann_Spd Function Block

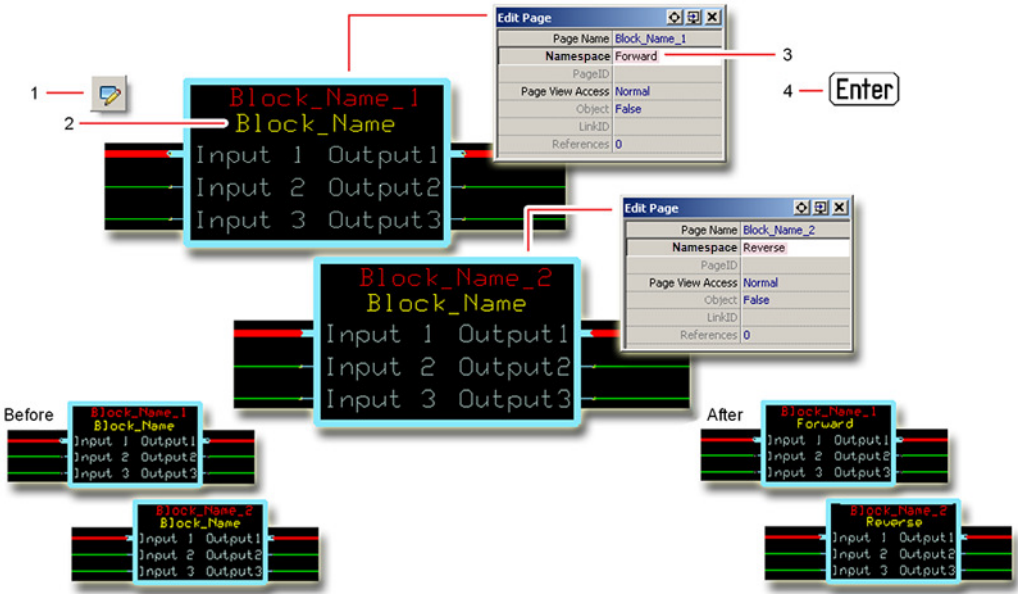
Some function blocks contain non-volatile memory components that store function block operating parameters.

Both these components use memory names (“aliases”) to allocate memory. Identical memory names cause compiler errors.

The namespace value adds a unique prefix to each component name to avoid errors. Keep each namespace value short to save controller memory.

### Change Namespace Value

To successfully compile your application, change the namespace value for function blocks that are used more than once in an application.




1. In the PLUS+1® GUIDE menu bar, click the **Query/Change** button.
2. Click on the function block whose namespace you want to set to a unique value.
   The **Edit Page** window opens.
3. In the **Edit Page** window, enter a meaningful **Namespace** value.
   - **Namespace** values are case-sensitive.
   - To save controller memory, use a short namespace value.
4. Press **Enter**.
5. Repeat these steps to enter unique namespace values for other identical function blocks.

## Ackermann_Spd Function Block

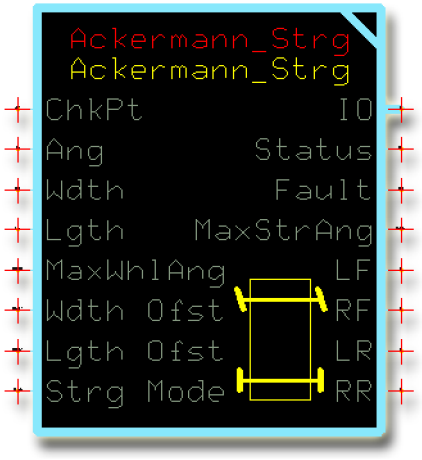
### IEC 61508-3 Annex D Supplemental Information

The following table provides IEC 61508-3 Annex D supplemental information.

| Item | Description |
|---|---|
| Function block name | Ackermann_Spd. |
| Function block version | 4.0.1 |
| Function block development environment | PLUS+1® GUIDE version 8.1 and later. |
| Compatible hardware | Verified in the PLUS+1® GUIDE compile process.<br>When the PLUS+1® GUIDE compiler finds a function block that is incompatible with hardware, it aborts the compile process and logs an error message. The error message gives the location of the function block and states "Error 80: component not supported in hwd." |
| Function block developed in compliance with | Danfoss Software Product Development Process (PDP), which includes ISO 9001 and IEC 61508-3 standards. |
| Competence required of function block integrator | The knowledge, competence, and training required to:<br>• Understand this manual.<br>• Use the PLUS+1® GUIDE program to develop a machine control application.<br>• Follow quality software practices to develop a machine control application. |
| Contacting Danfoss | *https://www.danfoss.com/en/products/software/dps/plus1-software-services-support-and-training/plus1-support-and-services* |

## Ackermann_Strg Function Block

Use the **Ackermann_Strg** function block to calculate the wheel angles for a given average steering command input.




You can use this function block to calculate wheel angles for vehicles with:

- Two-wheel front steering.
- Two-wheel rear steering.
- Four-wheel coordinated steering.
- Four-wheel crab steering.

### Inputs

The inputs to the **Ackerman_Strg** function block are described.

Use only the data types specified in this table. Other data types cause compiler errors.

| Item | Type | Range | Description |
|---|---|---|---|
| **ChkPt** | BOOL | —— | True—include the function block's built-in **Advanced Checkpoint with Namespace**<br>False—exclude the function block's built-in **Advanced Checkpoint with Namespace** components from the compiled LHX download file. |
| **Spd** | S16 | -20000–20000 | Requested vehicle speed.<br>1000 = 1000 mm/s |
| **Ang** | S16 | -9000–9000 | Requested steering angle.<br>1000 = 10.00° |
| **Wdth** | U16 | 200–10000 | Width of the vehicle's wheelbase.<br>1000 = 1000 mm |
| **Lgth** | U16 | 800–20000 | Length of vehicle's wheelbase.<br>1 = 1 mm |
| **MaxWhlSpd** | U16 | 0–20000 | Maximum allowed wheel speed in both a positive and a negative direction. Once one wheel reaches the **MaxWhlSpd**, the wheel speeds of the other wheels stop increasing.<br>1000 = 1000 mm/s |
| **MaxWhlAng** | U16 | 0–9000 | The maximum allowed wheel steering angle in both a positive and a negative direction. Once one wheel reaches the **MaxWhlAng**, the wheel angles of the other wheels stop increasing.<br>1000 = 10.00° |

## Ackermann_Strg Function Block

| Item | Type | Range | Description |
|---|---|---|---|
| **Wdth Ofst** | S16 | -10000–10000 | Width offset for the center of rotation when steering.<br>• A positive **Wdth Ofst** value shifts the center of rotation when steering to the right of the vehicle.<br>• A negative **Wdth Ofst** value shifts the center of rotation when steering to the left of the vehicle.<br>Use the **Wdth Ofst** to shift your vehicle's center of rotation when steering if:<br>• You attach an implement to the left or right side of your vehicle.<br>• Your vehicle's wheelbase does not determine the center of rotation when steering.<br>If your vehicle's wheelbase determines the center of rotation when steering, set the **Wdth Ofst** value to 0.<br>1000 = 1000 mm |
| **Lgth Ofst** | S16 | -10000–10000 | Length offset for the center of rotation when steering.<br>• A positive **Lgth Ofst** value shifts the center of rotation when steering toward the front of the vehicle.<br>• A negative **Lgth Ofst** value shifts the center of rotation when steering toward the rear of the vehicle.<br>Use the **Lgth Ofst** to shift your vehicle's center of rotation when steering if:<br>• You attach an implement to the front or rear of your vehicle.<br>• Your vehicle's wheelbase does not determine the center of rotation when steering.<br>If your vehicle's wheelbase determines the center of rotation when steering, set the **Wdth Ofst** value to 0.<br>1000 = 1000 mm |
| **Strg Mode** | U8 | 1–4 | Vehicle steering mode:<br>• 1 = Two-wheel front-steering.<br>• 2 = Two-wheel rear-steering.<br>• 3 = Four-wheel coordinated-steering.<br>• 4 = Four-wheel crab-steering. |

### Outputs

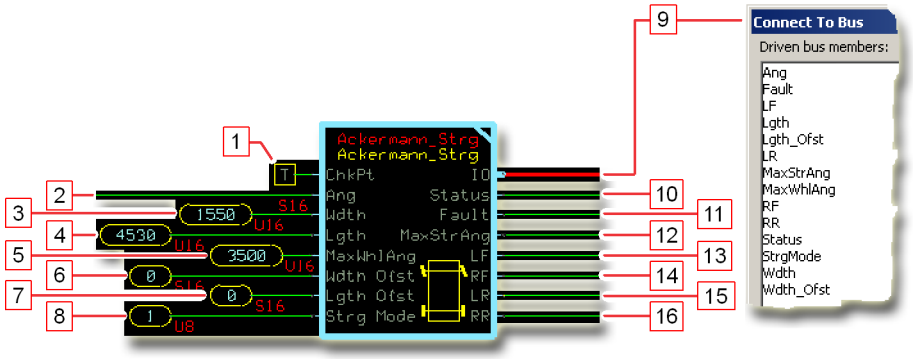
The outputs of the **Ackermann_Strg** function block are described.

| Item | Type | Range | Description |
|---|---|---|---|
| **IO** | Bus | —— | Outputs a bus with all of the function block's input and output signals.<br>This bus provides a convenient way to distribute this function block's signals to your application. |
| **Status** | U16 | —— | Reports the status of the function block.<br>This output follows the standard bitwise scheme described in the *Status Logic* topic. |
| **Fault** | U16 | —— | Reports the faults of the function block.<br>This output follows the standard bitwise scheme described in the *Status Logic* topic. |
| **MaxStrgAng** | U16 | 0–9000 | The maximum effective **Ang** input in both a positive and a negative direction.<br>Any **Ang** inputs above this value cause no change increase in wheel angles.<br>The function block calculates this output based on maximum allowed wheel angles and vehicle geometry.<br>1000 = 10.00° |
| **LF** | S16 | -9000–9000 | Calculated wheel angle for the left-front wheel.<br>1000 = 10.00° |
| **RF** | S16 | -9000–9000 | Calculated wheel angle for the right-front wheel.<br>1000 = 10.00° |
| **LR** | S16 | -9000–9000 | Calculated wheel angle for the left-rear wheel.<br>1000 = 10.00° |
| **RR** | S16 | -9000–9000 | Calculated wheel angle for the right-rear wheel.<br>1000 = 10.00° |

## Ackermann_Strg Function Block

### Function Block Connections

Connections you can make with the function block are described.




| Item | Description |
|---|---|
| **1.** | • True—include the function block's built-in **Advanced Checkpoint with Namespace** in the compiled LHX download file.<br>• False—exclude the function block's built-in **Advanced Checkpoint with Namespace** components from the compiled LHX download file. |
| **2.** | Requested steering angle. |
| **3.** | Width of the vehicle's wheelbase. |
| **4.** | Length of the vehicle's wheelbase. |
| **5.** | The maximum allowed wheel angle in both a positive and a negative direction. |
| **6.** | Width offset for the center of rotation when steering. |
| **7.** | Length offset for the center of rotation when steering. |
| **8.** | • 1 = Two-wheel front-steering mode.<br>• 2 = Two-wheel rear-steering mode.<br>• 3 = Four-wheel coordinated-steering mode.<br>• 4 = Four-wheel crab-steering mode. |
| **9.** | Outputs a bus with all of the function block's input and output signals. |
| **10.** | Reports the status of the function block. |
| **11.** | Reports the faults of the function block. |
| **12.** | The maximum effective **Ang** input in both a positive and a negative direction. **Ang** inputs above this value cause no further change in wheel angles. |
| **13.** | Calculated angle for the left-front wheel. |
| **14.** | Calculated angle for the right-front wheel. |
| **15.** | Calculated angle for the left-rear wheel. |
| **16.** | Calculated angle for the right-rear wheel. |

## Ackermann_Strg Function Block

### Status and Fault Logic

Use status and fault codes to determine proper program operation.

#### Status Logic

This topic describes how status logic is indicated for the function block.

| Condition | Hex* | Binary | Cause | Response | Correction |
|---|---|---|---|---|---|
| Invalid setup. | 0x8008 | 1000 | **Wdth**, **Lgth**, **MaxWhlAng**, **Wdth Ofst**, or **Lgth Ofst** value is out of range. | Output values based on the out-of-range value clamped at either its minimum or maximum value. | Return the out-of-range value to within its correct range. |

* Bit 16 set to 1 identifies a standard Danfoss status or fault code.

#### Fault Logic

This topic describes how fault logic is indicated for the function block.

| Condition | Hex* | Binary | Cause | Response | Correction |
|---|---|---|---|---|---|
| Input value is too low. | 0x8001 | 0001 | **Ang** value is less than -9000. | **LF**, **RF**, **LR**, **RR** and **MaxStrgAng** outputs hold their previous valid value. | Return the **Ang** input to within its -9000 to 9000 range. |
| | | | **Strg Mode** value is less than 1. | | Select a **outputs hold their previous valid value.Strg Mode** input of 1, 2, 3, or 4. |
| Input value is too high. | 0x8002 | 0010 | **Ang** value is greater than 9000. | | Return the **Ang** input to within its -9000 to 9000 range. |
| | | | **Strg Mode** value is greater than 4. | | Select a **Strg Mode** input of 1, 2, 3, or 4. |

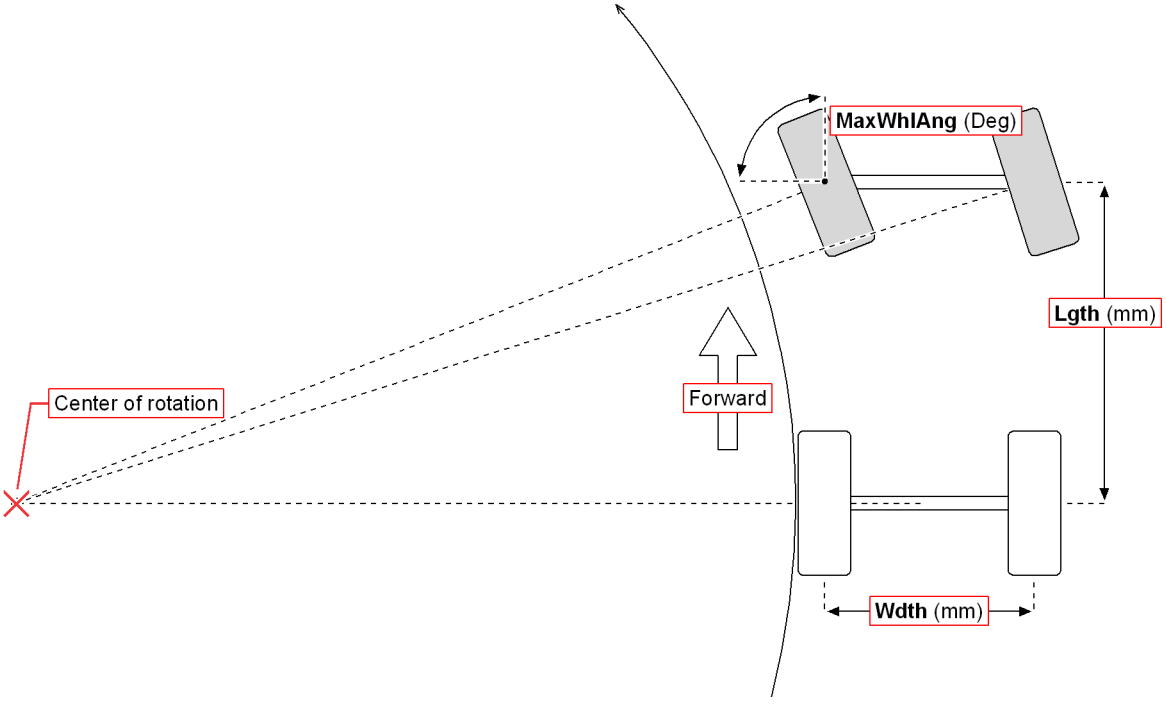
* Bit 16 set to 1 identifies a standard Danfoss status or fault code.

## Ackermann_Strg Function Block

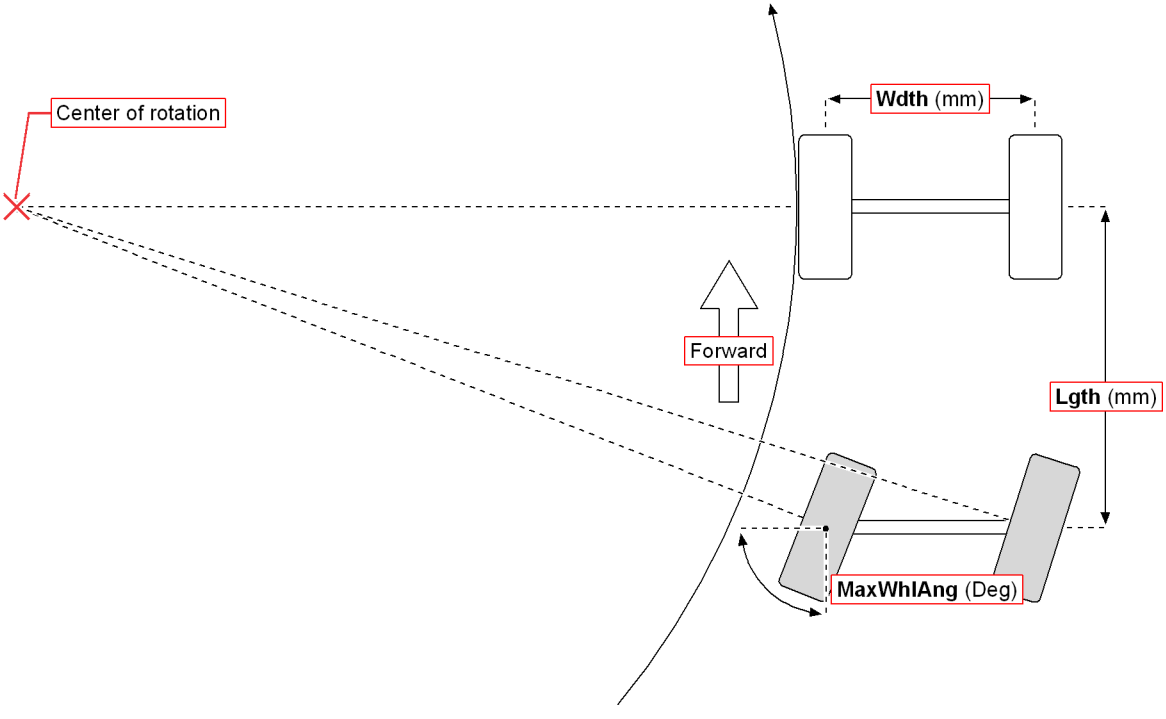
### Steering Modes

Available steering modes are illustrated.

*Two-Wheel Front Steering Mode*

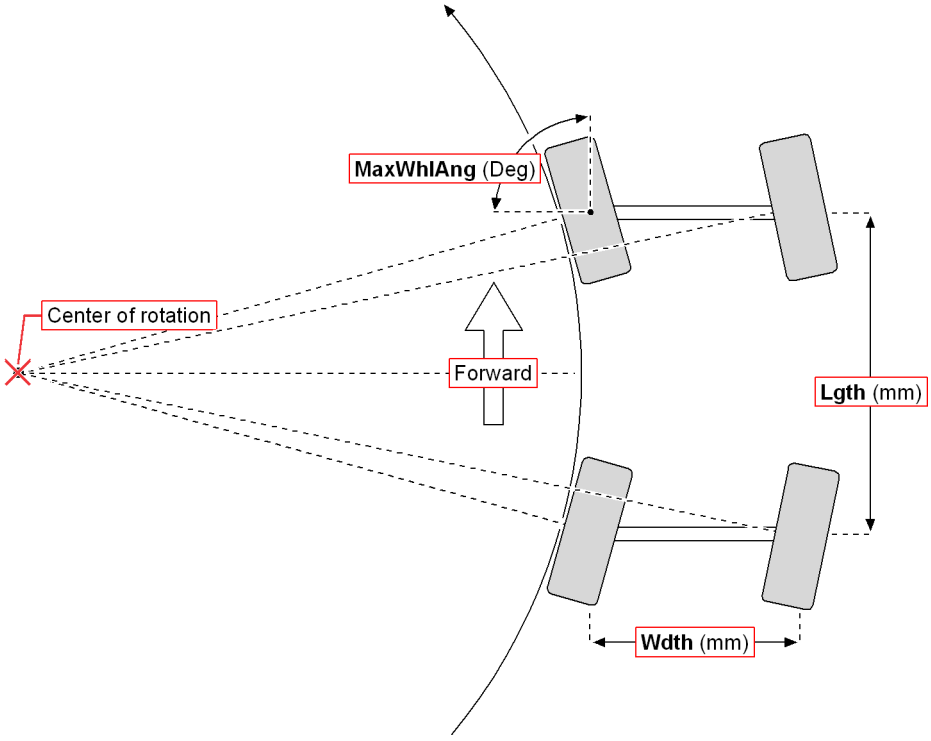



*Two-Wheel Rear Steering Mode*

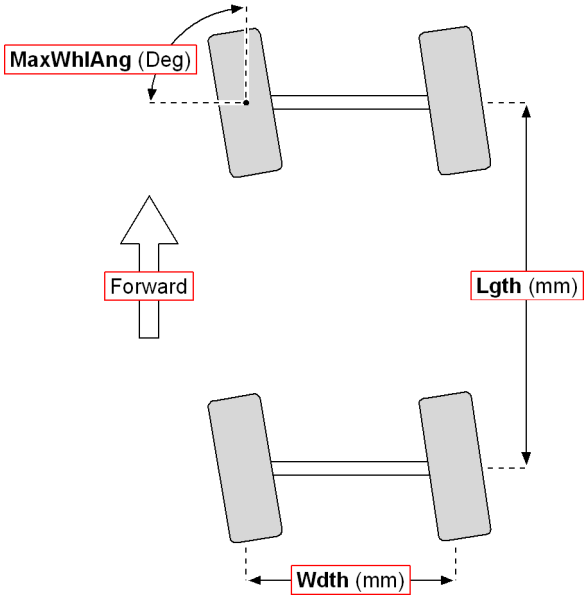


## Ackermann_Strg Function Block

*Four-Wheel Coordinated Steering Mode*




*Four-Wheel Crab Steering Mode*




### Identical Function Blocks Need Different Namespace Values to Successfully Compile

If you use the same function block more than once in an application, you must change each function block's namespace value to avoid compiler errors.

All function blocks contain Advanced Checkpoint with Namespace components that enable the PLUS+1® Service Tool to read block input and output values.

## Ackermann_Strg Function Block

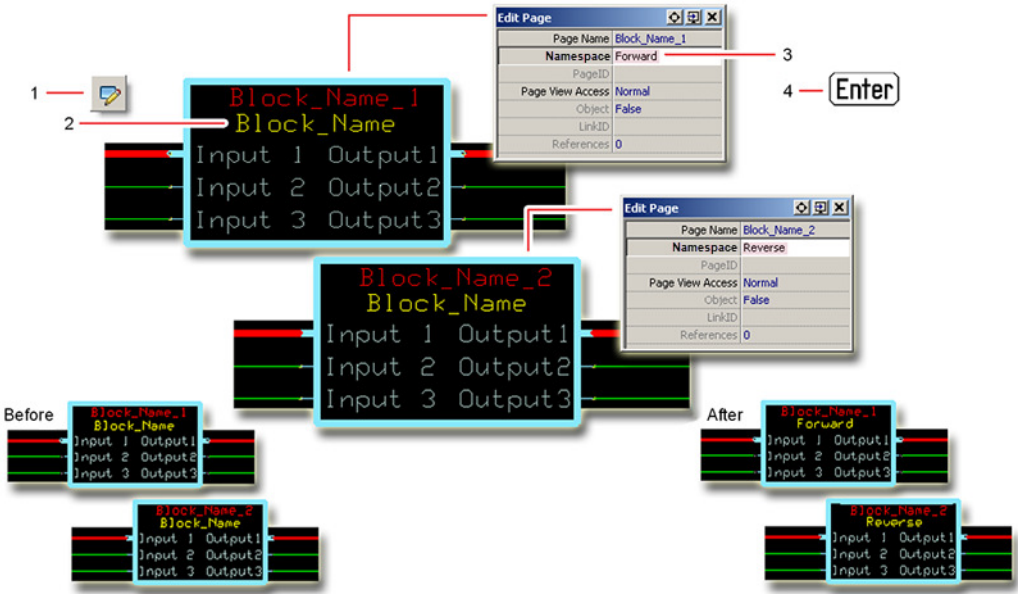
Some function blocks contain non-volatile memory components that store function block operating parameters.

Both these components use memory names (“aliases”) to allocate memory. Identical memory names cause compiler errors.

The namespace value adds a unique prefix to each component name to avoid errors. Keep each namespace value short to save controller memory.

### Change Namespace Value

To successfully compile your application, change the namespace value for function blocks that are used more than once in an application.




1. In the PLUS+1® GUIDE menu bar, click the **Query/Change** button.
2. Click on the function block whose namespace you want to set to a unique value.
   The **Edit Page** window opens.
3. In the **Edit Page** window, enter a meaningful **Namespace** value.
   - **Namespace** values are case-sensitive.
   - To save controller memory, use a short namespace value.
4. Press **Enter**.
5. Repeat these steps to enter unique namespace values for other identical function blocks.

## Ackermann_Strg Function Block

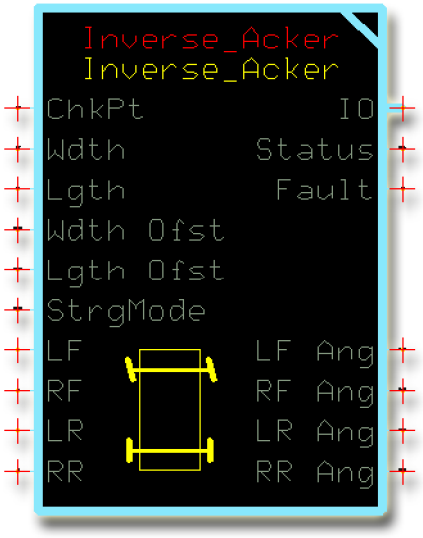
### IEC 61508-3 Annex D Supplemental Information

The following table provides IEC 61508-3 Annex D supplemental information.

| Item | Description |
|---|---|
| Function block name | Ackermann_Strg. |
| Function block version | 4.0. |
| Function block development environment | PLUS+1® GUIDE version 8.1 and later. |
| Compatible hardware | Verified in the PLUS+1® GUIDE compile process.<br>When the PLUS+1® GUIDE compiler finds a function block that is incompatible with hardware, it aborts the compile process and logs an error message. The error message gives the location of the function block and states "Error 80: component not supported in hwd." |
| Function block developed in compliance with | Danfoss Software Product Development Process (PDP), which includes ISO 9001 and IEC 61508-3 standards. |
| Competence required of function block integrator | The knowledge, competence, and training required to:<br>• Understand this manual.<br>• Use the PLUS+1® GUIDE program to develop a machine control application.<br>• Follow quality software practices to develop a machine control application. |
| Contacting Danfoss | *https://www.danfoss.com/en/products/software/dps/plus1-software-services-support-and-training/plus1-support-and-services* |

## Inverse_Acker Function Block

The **Inverse_Acker** function block uses measured wheel angles and steering mode to determine the original steering angle command.




Steer-by-wire systems typically do not save the last known steering angle when the system powers off.

Smaller steering systems may initialize the steering to zero degrees on startup to align the wheels with the steering. This can be a potentially dangerous safety situation for anyone near the wheels during alignment.

Use the **Inverse_Acker** block to preset the steering system based on the angle of the tires to minimize wheel re-alignment motion.

You can use this function block to:

- Calculate wheel angles for vehicles with independently actuated steering applications.
- Calculate wheel angles for vehicles with steer-by-wire applications that do not store the last steer angle in non-volatile memory.
- Determine the commanded steering angle before the vehicle shut down.
- Detect if a wheel lost alignment while the vehicle was shut down to allow for a warning before wheel realignment occurs.

### Inputs

The inputs to the function block are described.

Use only the data types specified in this table. Other data types cause compiler errors.

| Item | Type | Range | Description |
|---|---|---|---|
| **ChkPt** | BOOL | —— | True—include the function block's built-in **Advanced Checkpoint with Namespace**<br>False—exclude the function block's built-in **Advanced Checkpoint with Namespace** components from the compiled LHX download file. |
| **Spd** | S16 | -20000–20000 | Requested vehicle speed.<br>1000 = 1000 mm/s |
| **Ang** | S16 | -9000–9000 | Requested steering angle.<br>1000 = 10.00° |
| **Wdth** | U16 | 200–10000 | Width of the vehicle's wheelbase.<br>1000 = 1000 mm |
| **Lgth** | U16 | 800–20000 | Length of vehicle's wheelbase.<br>1 = 1 mm |

## Inverse_Acker Function Block

| Item | Type | Range | Description |
|---|---|---|---|
| **MaxWhlSpd** | U16 | 0–20000 | Maximum allowed wheel speed in both a positive and a negative direction. Once one wheel reaches the **MaxWhlSpd**, the wheel speeds of the other wheels stop increasing.<br>1000 = 1000 mm/s |
| **MaxWhlAng** | U16 | 0–9000 | The maximum allowed wheel steering angle in both a positive and a negative direction. Once one wheel reaches the **MaxWhlAng**, the wheel angles of the other wheels stop increasing.<br>1000 = 10.00° |
| **Wdth Ofst** | S16 | -10000–10000 | Width offset for the center of rotation when steering.<br>• A positive **Wdth Ofst** value shifts the center of rotation when steering to the right of the vehicle.<br>• A negative **Wdth Ofst** value shifts the center of rotation when steering to the left of the vehicle.<br>Use the **Wdth Ofst** to shift your vehicle's center of rotation when steering if:<br>• You attach an implement to the left or right side of your vehicle.<br>• Your vehicle's wheelbase does not determine the center of rotation when steering.<br>If your vehicle's wheelbase determines the center of rotation when steering, set the **Wdth Ofst** value to 0.<br>1000 = 1000 mm |
| **Lgth Ofst** | S16 | -10000–10000 | Length offset for the center of rotation when steering.<br>• A positive **Lgth Ofst** value shifts the center of rotation when steering toward the front of the vehicle.<br>• A negative **Lgth Ofst** value shifts the center of rotation when steering toward the rear of the vehicle.<br>Use the **Lgth Ofst** to shift your vehicle's center of rotation when steering if:<br>• You attach an implement to the front or rear of your vehicle.<br>• Your vehicle's wheelbase does not determine the center of rotation when steering.<br>If your vehicle's wheelbase determines the center of rotation when steering, set the **Wdth Ofst** value to 0.<br>1000 = 1000 mm |
| **Strg Mode** | U8 | 1–4 | Vehicle steering mode:<br>• 1 = Two-wheel front-steering.<br>• 2 = Two-wheel rear-steering.<br>• 3 = Four-wheel coordinated-steering.<br>• 4 = Four-wheel crab-steering. |
| **LF** | S16 | -9000–9000 | Feedback angle from the left-front wheel.<br>1000 = 10.00°. |
| **RF** | S16 | -9000–9000 | Feedback angle from the right-front wheel.<br>1000 = 10.00°. |
| **LR** | S16 | -9000–9000 | Feedback angle from the left-rear wheel.<br>1000 = 10.00°. |
| **RR** | S16 | -9000–9000 | Feedback angle from the right-rear wheel.<br>1000 = 10.00°. |

### Outputs

The outputs of the **Inverse_Ackermann** function block are described.

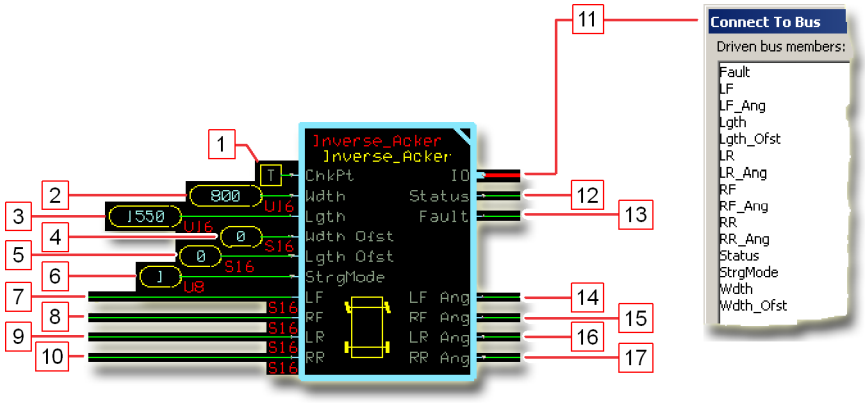
| Item | Type | Range | Description |
|---|---|---|---|
| **IO** | Bus | —— | Outputs a bus with all of the function block's input and output signals.<br>This bus provides a convenient way to distribute this function block's signals to your application. |
| **Status** | U16 | —— | Reports the status of the function block.<br>This output follows the standard bitwise scheme described in the *Status Logic* topic. |
| **Fault** | U16 | —— | Reports the faults of the function block.<br>This output follows the standard bitwise scheme described in the *Status Logic* topic. |
| **LF Ang** | S16 | -9000–9000 | Estimated vehicle steering input command based on the feedback angle from the left-front wheel.<br>1000 = 10.00° |
| **RF Ang** | S16 | -9000–9000 | Estimated vehicle steering input command based on the feedback angle from the right-front wheel.<br>1000 = 10.00° |

## Inverse_Acker Function Block

| Item | Type | Range | Description |
|---|---|---|---|
| **LR Ang** | S16 | -9000–9000 | Estimated vehicle steering input command based on the feedback angle from the left-rear wheel.<br>1000 = 10.00° |
| **RR Ang** | S16 | -9000–9000 | Estimated vehicle steering input command based on the feedback angle from the left-rear wheel.<br>1000 = 10.00° |

### Function Block Connections

Connections you can make with the function block are described.



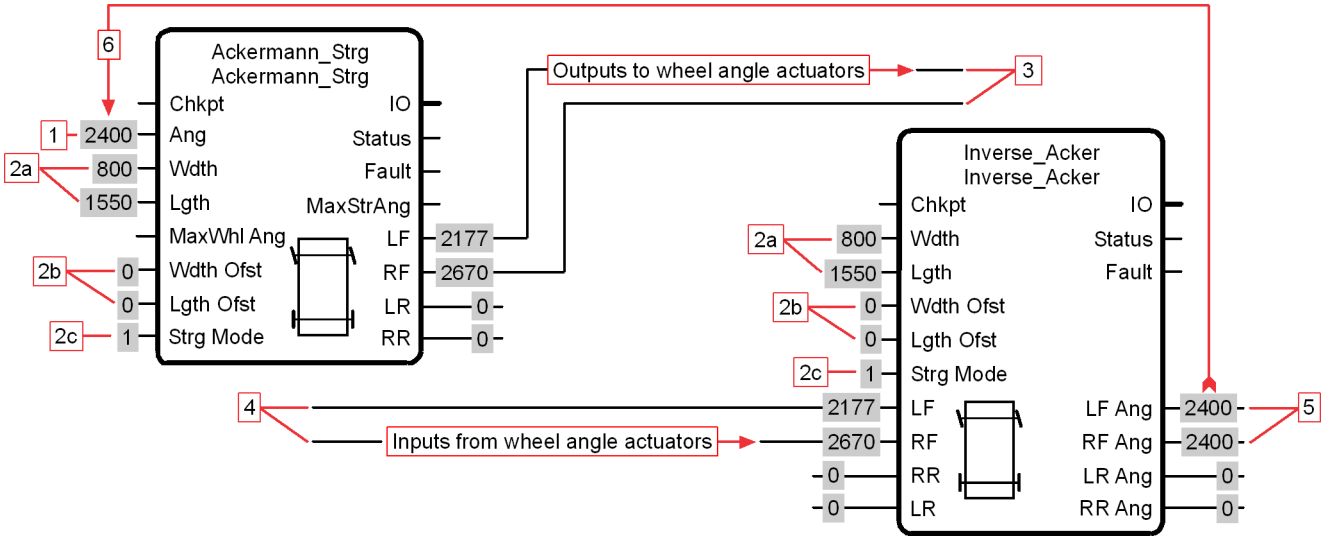

| Item | Description |
|---|---|
| **1.** | • True—include the function block's built-in **Advanced Checkpoint with Namespace** in the compiled LHX download file.<br>• False—exclude the function block's built-in **Advanced Checkpoint with Namespace** components from the compiled LHX download file. |
| **2.** | Width of the vehicle's wheelbase. |
| **3.** | Length of the vehicle's wheelbase. |
| **4.** | Width offset for the center of rotation when steering. |
| **5.** | Length offset for the center of rotation when steering. |
| **6.** | • 1 = Two-wheel front-steering mode.<br>• 2 = Two-wheel rear-steering mode.<br>• 3 = Four-wheel coordinated-steering mode.<br>• 4 = Four-wheel crab-steering mode. |
| **7.** | Feedback angle from the left-front wheel. |
| **8.** | Feedback angle from the right-front wheel. |
| **9.** | Feedback angle from the left-rear wheel. |
| **10.** | Feedback angle from the right-rear wheel. |
| **11.** | Outputs a bus with all of the function block's input and output signals. |
| **12.** | Reports the status of the function block. |
| **13.** | Reports the faults of the function block. |
| **14.** | Estimated vehicle steering input command based on the feedback angle from the left-front wheel. |
| **15.** | Estimated vehicle steering input command based on the feedback angle from the right-front wheel. |
| **16.** | Estimated vehicle steering input command based on the feedback angle from the left-rear wheel. |
| **17.** | Estimated vehicle steering input command based on the feedback angle from the right-rear wheel. |

## Inverse_Acker Function Block

### How the Inverse_Acker Function Block Works to Restore Lost Ang Inputs

The **Ang** input to an **Ackermann** or **Ackermann_Strg** function block can be used to control wheel angles.

Depending on an application's configuration, the **Ang** input may be lost on power down. Loss of the **Ang** input can cause unpredictable and possibly unsafe wheel movements on power up. The following figure shows how the **Inverse_Acker** function block can restore the lost **Ang** input on power up. The logic shown here applies to both **Ackermann_Strg** and **Ackermann** function blocks.




| Item | Description |
|---|---|
| **1.** | The **Ang** value input to the **Ackermann_Strg** function block requests a steering angle. |
| **2a.** | The **Ackermann_Strg** and **Inverse_Acker** function blocks have identical **Wdth** and **Lgth** values. |
| **2b.** | The **Ackermann_Strg** and **Inverse_Acker** function blocks have identical **Wdth Ofst** and **Lgth Ofst** values. |
| **2c.** | The **Ackermann_Strg** and **Inverse_Acker** function blocks have identical **Wdth** and **Lgth** values. |
| **3.** | The **Ackermann_Strg** function block outputs calculated **LF** and **RF** wheel angles that position the vehicle's wheels. Depending on an application's configuration, powering down the application can cause the **Ang** value that produces these wheel angles to be lost. Loss of the **Ang** value can cause unpredictable wheel movements when the application again powers up. |
| **4.** | The **Inverse_Acker** function block's **LF** and **RF** inputs receive wheel angle inputs. On application power up, the **Inverse_Acker** function block uses these inputs to calculate the original **Ang** input (item **1**) that produced each wheel angle. |
| **5.** | Typically, the **LF Ang** and **RF Ang** outputs:<br>• Equal or nearly equal to each other.<br>• Equal or nearly equal the original **Ang** input (item **1**) to the **Ackermann_Strg** function block. |
| **6.** | The application software averages the **Inverse_Acker** function block's **LF Ang** and **RF Ang** outputs. It then applies the result to the **Ackermann_Strg** function block's **Ang** input (item **1**.). This restores the original **Ang** value that was lost when the application powered down. Steering control resumes without unpredictable wheel movement. |

## Inverse_Acker Function Block

### Status and Fault Logic

Use status and fault codes to determine proper program operation.

#### Status Logic

This topic describes how status logic is indicated for the function block.

| Condition | Hex* | Binary | Cause | Response | Correction |
|---|---|---|---|---|---|
| Invalid setup. | 0x8008 | 1000 | **Wdth**, **Lgth**, **Wdth Ofst**, or **Lgth Ofst** value is out of range. | Output values based on the out-of-range value clamped at either its minimum or maximum value. | Return the out-of-range value to within its correct range. |

* Bit 16 set to 1 identifies a standard Danfoss status or fault code.

#### Fault Logic

This topic describes how fault logic is indicated for the function block.

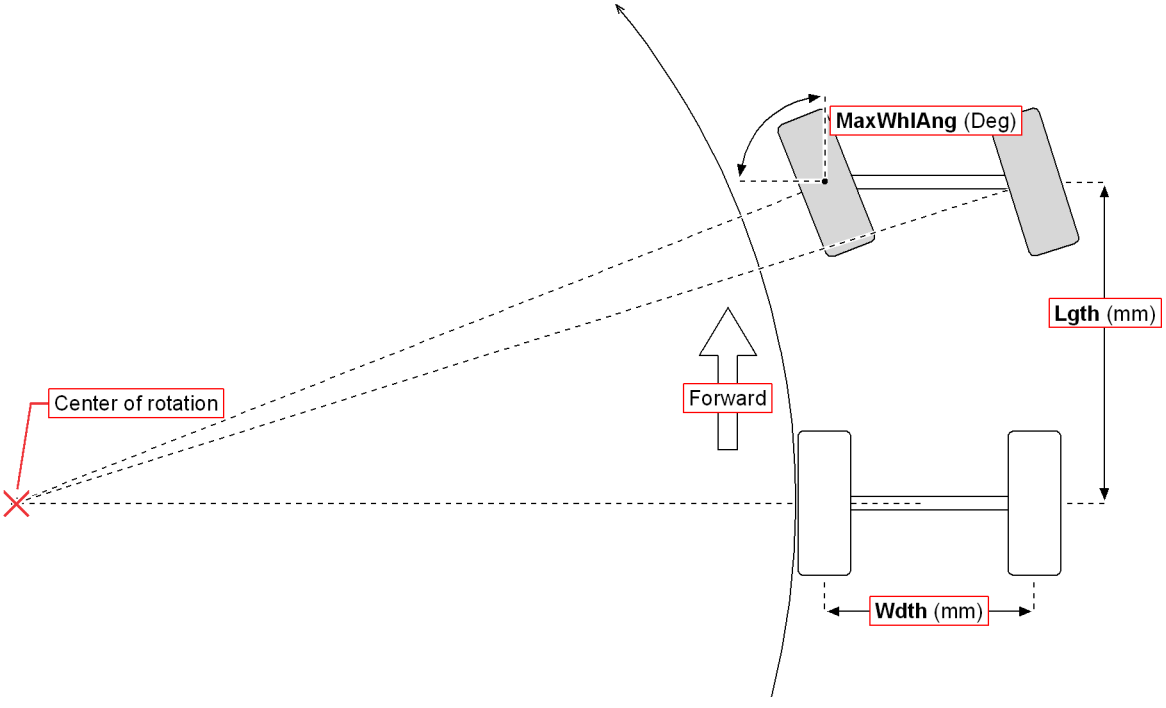
| Condition | Hex* | Binary | Cause | Response | Correction |
|---|---|---|---|---|---|
| Input value is too low. | 0x8001 | 0001 | **LF**, **RF**, **LF**, or **RR** value is less than -9000. | **LF Ang**, **RF Ang**, **LR Ang**, and **RR Ang** outputs hold at their previous values. | Return the **LF**, **RF**, **LF**, or **RR** input to within its -9000 to 9000 range. |
| | | | **Strg Mode** value is less than 1. | | Select a **Strg Mode** input of 1, 2, 3, or 4. |
| Input value is too high. | 0x8002 | 0010 | **LF**, **RF**, **LF**, or **RR** value is greater than 9000. | | Return the **LF**, **RF**, **LF**, or **RR** input to within its -9000 to 9000 range. |
| | | | **Strg Mode** value is greater than 4. | | Select a **Strg Mode** input of 1, 2, 3, or 4. |

* Bit 16 set to 1 identifies a standard Danfoss status or fault code.

### Steering Modes

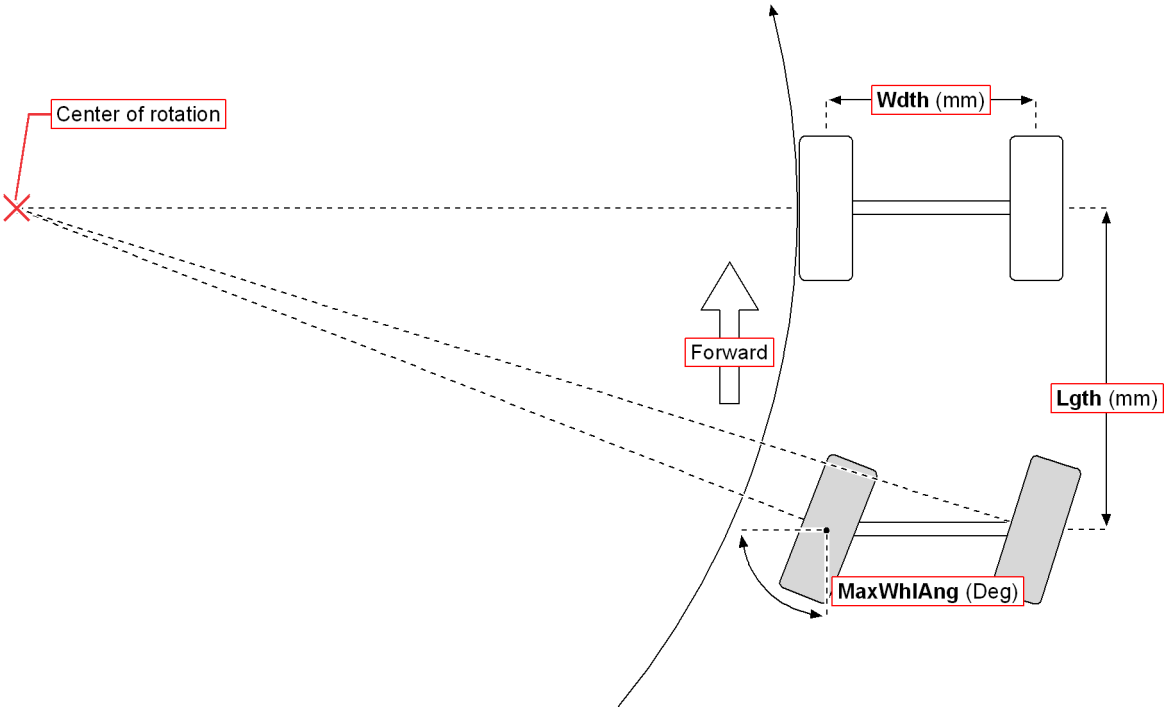
Available steering modes are illustrated.

*Two-Wheel Front Steering Mode*

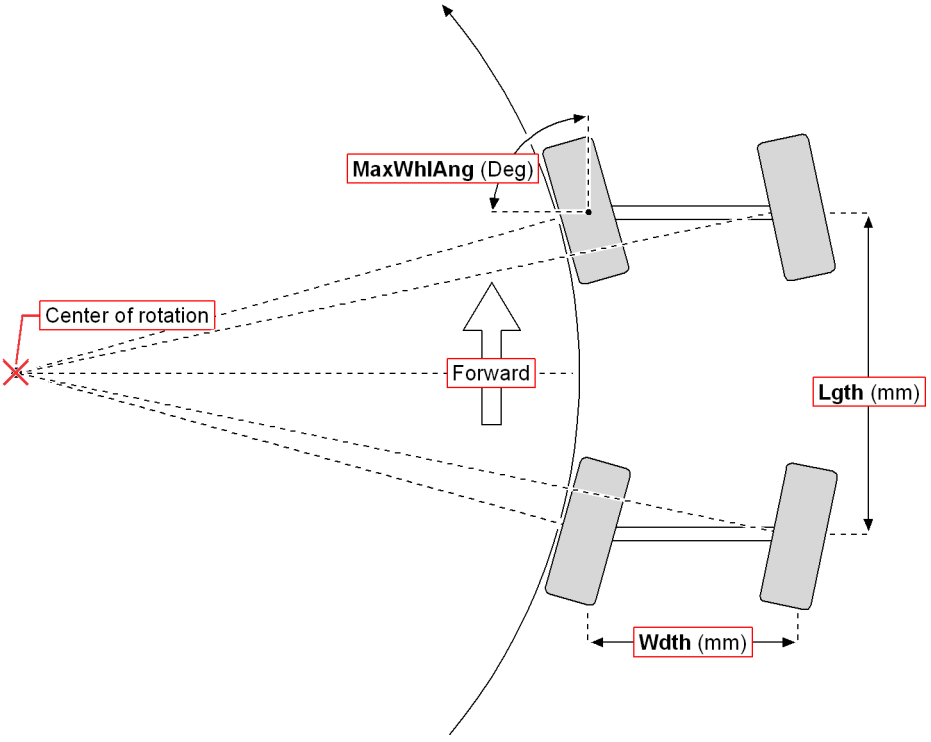


## Inverse_Acker Function Block

*Two-Wheel Rear Steering Mode*

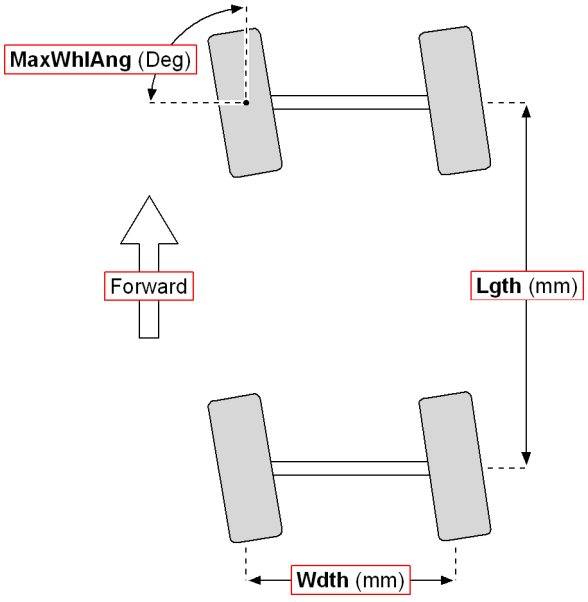



*Four-Wheel Coordinated Steering Mode*



## Inverse_Acker Function Block

*Four-Wheel Crab Steering Mode*




### Identical Function Blocks Need Different Namespace Values to Successfully Compile

If you use the same function block more than once in an application, you must change each function block's namespace value to avoid compiler errors.

All function blocks contain Advanced Checkpoint with Namespace components that enable the PLUS+1® Service Tool to read block input and output values.

Some function blocks contain non-volatile memory components that store function block operating parameters.

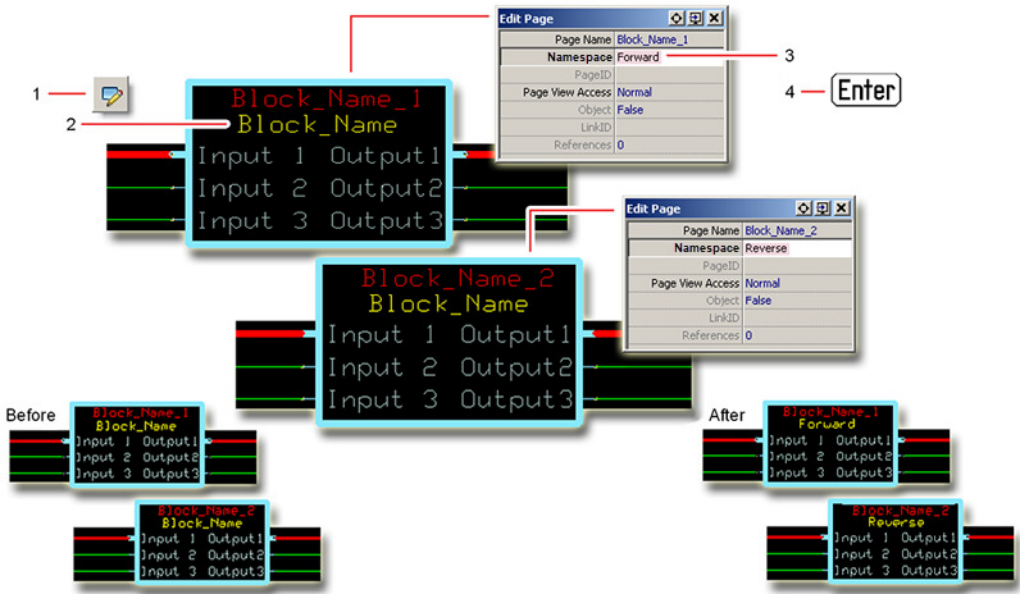
Both these components use memory names ("aliases") to allocate memory. Identical memory names cause compiler errors.

The namespace value adds a unique prefix to each component name to avoid errors. Keep each namespace value short to save controller memory.

## Inverse_Acker Function Block

### Change Namespace Value

To successfully compile your application, change the namespace value for function blocks that are used more than once in an application.




1. In the PLUS+1® GUIDE menu bar, click the **Query/Change** button.
2. Click on the function block whose namespace you want to set to a unique value.

   The **Edit Page** window opens.
3. In the **Edit Page** window, enter a meaningful **Namespace** value.
   - **Namespace** values are case-sensitive.
   - To save controller memory, use a short namespace value.
4. Press **Enter**.
5. Repeat these steps to enter unique namespace values for other identical function blocks.

## Inverse_Acker Function Block

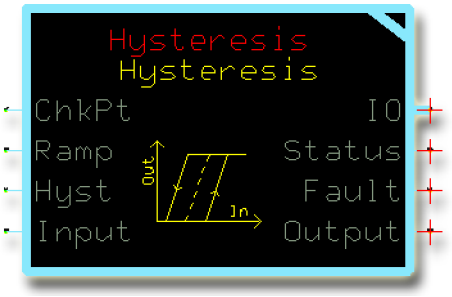
### IEC 61508-3 Annex D Supplemental Information

The following table provides IEC 61508-3 Annex D supplemental information.

| Item | Description |
|---|---|
| Function block name | Inverse_Acker. |
| Function block version | 4.0.1 |
| Function block development environment | PLUS+1® GUIDE version 8.1 and later. |
| Compatible hardware | Verified in the PLUS+1® GUIDE compile process.<br>When the PLUS+1® GUIDE compiler finds a function block that is incompatible with hardware, it aborts the compile process and logs an error message. The error message gives the location of the function block and states "Error 80: component not supported in hwd." |
| Function block developed in compliance with | Danfoss Software Product Development Process (PDP), which includes ISO 9001 and IEC 61508-3 standards. |
| Competence required of function block integrator | The knowledge, competence, and training required to:<br>• Understand this manual.<br>• Use the PLUS+1® GUIDE program to develop a machine control application.<br>• Follow quality software practices to develop a machine control application. |
| Contacting Danfoss | *https://www.danfoss.com/en/products/software/dps/plus1-software-services-support-and-training/plus1-support-and-services* |

## Hysteresis Function Block

Use the **Hysteresis** function block to remove hysteresis from an input by adding an offset when the input increases and subtracting an offset when the input decreases.




When the input is constant the offset ramps to zero, eventually resulting in an output that equals the input.

You can use this function block to:

- Compensate for mechanical lags.
- Improve an application's response to hysteresis step-changes in an input signal. In this use, the signal input to this function block should not command frequent direction changes. In an application, sudden changes in this function block's output should be tolerated or desirable.

### Inputs

The inputs to the **Hysteresis** function block are described.

Use only the data types specified in this table. Other data types cause compiler errors.

| Item | Type | Range | Description |
|---|---|---|---|
| **ChkPt** | BOOL | —— | True—include the function block's built-in **Advanced Checkpoint with Namespace**<br>False—exclude the function block's built-in **Advanced Checkpoint with Namespace** components from the compiled LHX download file. |
| **Ramp** | U16 | 0–32767 | The function block applies a **Hyst** offset to its **Output** to compensate for hysteresis.<br>The Ramp value sets the time that the function block takes to linearly ramp the **Hyst** offset to 0. With a steady **Input**, this function block's **Output** will equal its **Input** at the end of the **Ramp** time.<br>1000 = 1000 ms. |
| **Hyst** | U16 | 0–32767 | The hysteresis offset that the function block applies to its **Output** when its **Input** changes.<br>When the function block's **Input**:<br>• Increases, the function block adds the **Hyst** value to its **Output**.<br>• Decreases, the function block subtracts the **Hyst** value from its **Output**. |
| **Input** | U16 | 0–32767 | The input signal that needs hysteresis compensation. |

### Outputs

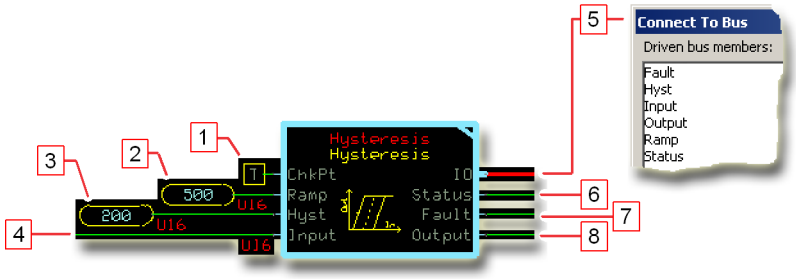
The outputs of the **Hysteresis** function block are described.

| Item | Type | Range | Description |
|---|---|---|---|
| **IO** | Bus | —— | Outputs a bus with all of the function block's input and output signals.<br>This bus provides a convenient way to distribute this function block's signals to your application. |
| **Status** | U16 | —— | Reports the status of the function block.<br>This output follows the standard bitwise scheme described in the *Status Logic* topic. |
| **Fault** | U16 | —— | Reports the faults of the function block.<br>This output follows the standard bitwise scheme described in the *Status Logic* topic. |
| **Output** | U16 | 0–32767 | The **Input** signal after hysteresis compensation. |

## Hysteresis Function Block

### Function Block Connections

Connections you can make with the function block are described.



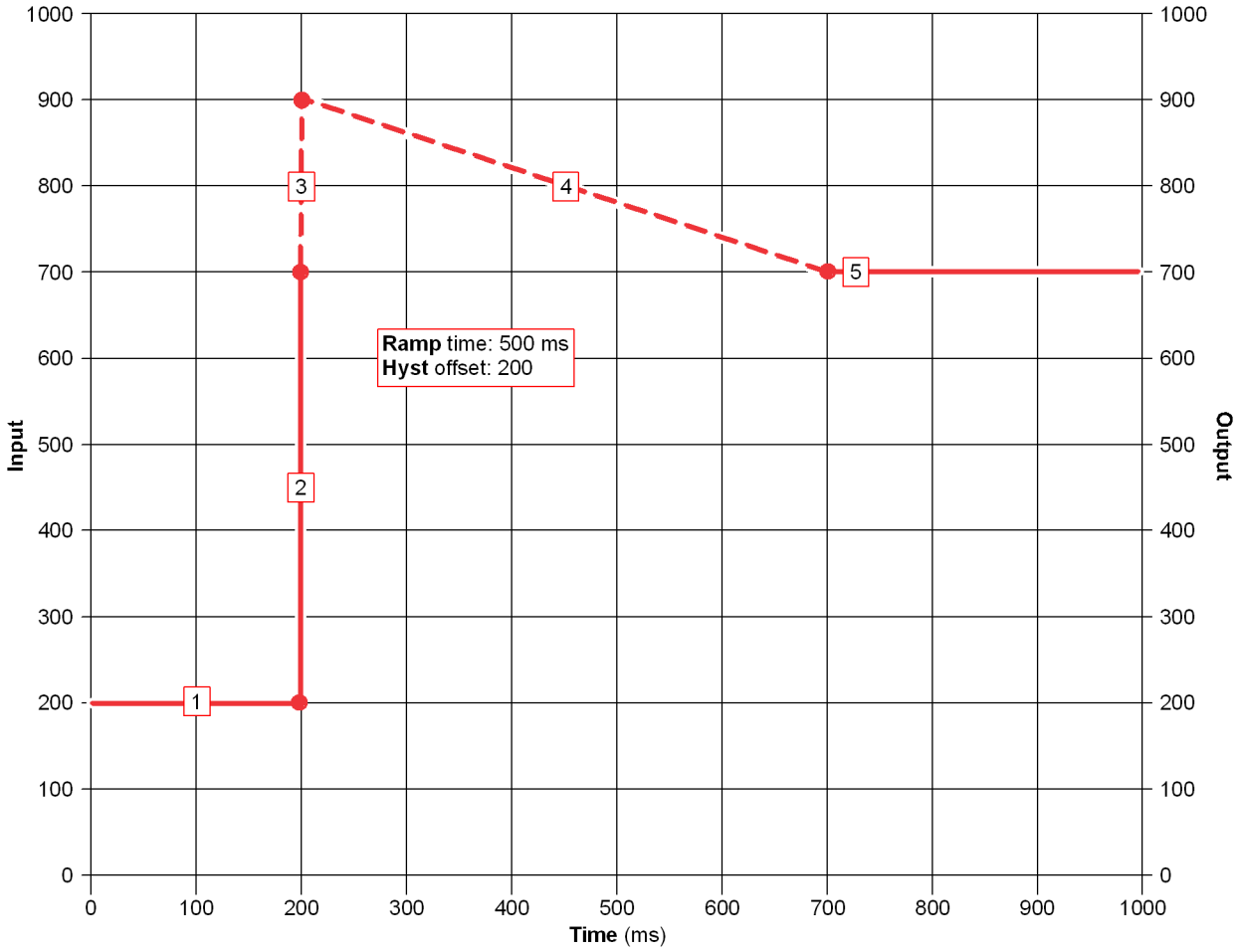

*Function Block Connections*

| Item | Description |
|---|---|
| **1.** | • True—include the function block's built-in **Advanced Checkpoint with Namespace** in the compiled LHX download file.<br>• False—exclude the function block's built-in **Advanced Checkpoint with Namespace** components from the compiled LHX download file. |
| **2.** | The function block applies a **Hyst** offset to its **Output** to compensate for hysteresis. The **Ramp** value sets the time that the function block takes to linearly ramp the **Hyst** offset to 0. |
| **3.** | The hysteresis offset applied to the function block's **Output** when its **Input** changes. |
| **4.** | The input signal that needs hysteresis compensation. |
| **5.** | Outputs a bus with all of the function block's input and output signals. |
| **6.** | Reports the status of the function block. |
| **7.** | Reports the faults of the function block. |
| **8.** | The **Input** signal after hysteresis compensation. |

## Hysteresis Function Block

### Function Block Example

Use the following example to understand how configuration changes impact the output of the function block.

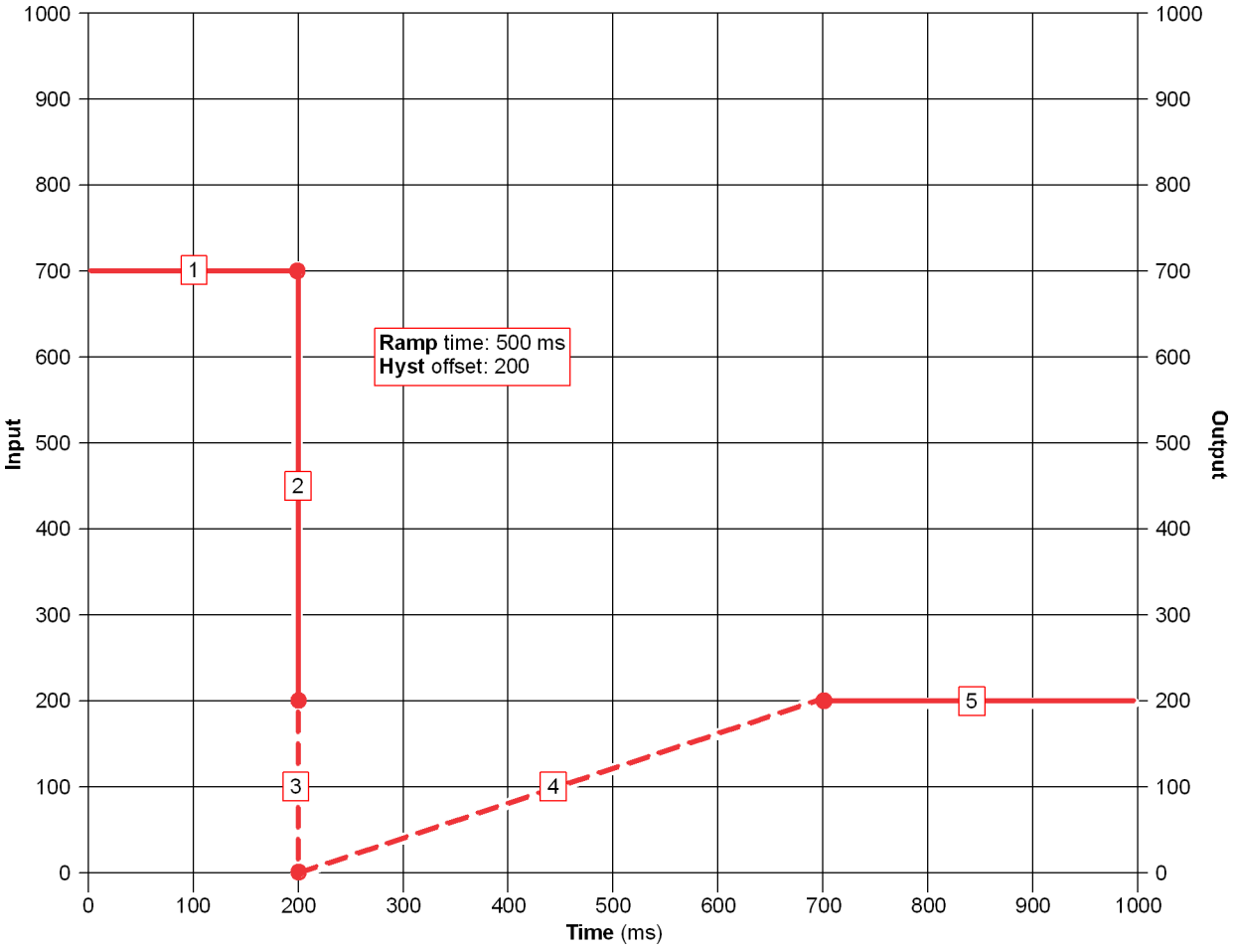



The plot above shows how the **Hysteresis** function block applies hysteresis compensation when the value of its **Input** signal suddenly increases.

*Figure Details*

| Item | Description |
|---|---|
| **1.** | From 0 ms to 200 ms, an **Input** of 200 to the function block produces a steady **Output** of 200. |
| **2.** | At 200 ms, the **Input** to the function block increases by 500, from 200 to 700. From 200 ms on, the **Input** holds at 700. |
| **3.** | At 200 ms, the function block applies a **Hyst** offset of 200 to increase its **Output** from 700 to 900. |
| **4.** | Between 200 ms and 700 ms, the function block applies a **Ramp** time of 500 ms to ramp down the **Hyst** offset applied to its **Output** to 0. |
| **5.** | At 700 ms, at the end of the **Ramp** time, the function block's **Output** equals its **Input**. |

## Hysteresis Function Block




The plot above shows how the **Hysteresis** function block applies hysteresis compensation when the value of its **Input** signal suddenly decreases.

*Figure Details*

| Item | Description |
|---|---|
| **1.** | From 0 ms to 200 ms, an **Input** of 200 to the function block produces a steady **Output** of 700. |
| **2.** | At 200 ms, the **Input** to the function block decreases by 500, from 700 to 200. From 200 ms on, the **Input** holds at 200. |
| **3.** | At 200 ms, the function block applies a **Hyst** offset of 200 to decrease its **Output** from 200 to 0. |
| **4.** | Between 200 ms and 700 ms, the function block applies a **Ramp** time of 500 ms to ramp down the **Hyst** offset applied to its **Output** to 0. |
| **5.** | At 700 ms, at the end of the **Ramp** time, the function block's **Output** equals its **Input**. |

## Hysteresis Function Block

### Status and Fault Logic

Use status and fault codes to determine proper program operation.

#### Status Logic

This topic describes how status logic is indicated for the function block.

| Condition | Hex* | Binary | Cause | Response | Correction |
|---|---|---|---|---|---|
| Invalid setup. | 0x8008 | 1000 | **Ramp** or **Hyst** parameter is out-of-range. | Limits the **Ramp** or **Hyst** value to the defined maximum. | Return the **Ramp** or **Hyst** parameter to the valid range. |

* Bit 16 set to 1 identifies a standard Danfoss status or fault code.

#### Fault Logic

This topic describes how fault logic is indicated for the function block.

| Condition | Hex* | Binary | Cause | Response | Correction |
|---|---|---|---|---|---|
| Input value is too high. | 0x8002 | 0010 | **Input** value > 32767. | **Output** = 32767 | Return the **Input** to the valid range. |

* Bit 16 set to 1 identifies a standard Danfoss status or fault code.

### Identical Function Blocks Need Different Namespace Values to Successfully Compile

If you use the same function block more than once in an application, you must change each function block's namespace value to avoid compiler errors.

All function blocks contain Advanced Checkpoint with Namespace components that enable the PLUS+1® Service Tool to read block input and output values.

Some function blocks contain non-volatile memory components that store function block operating parameters.

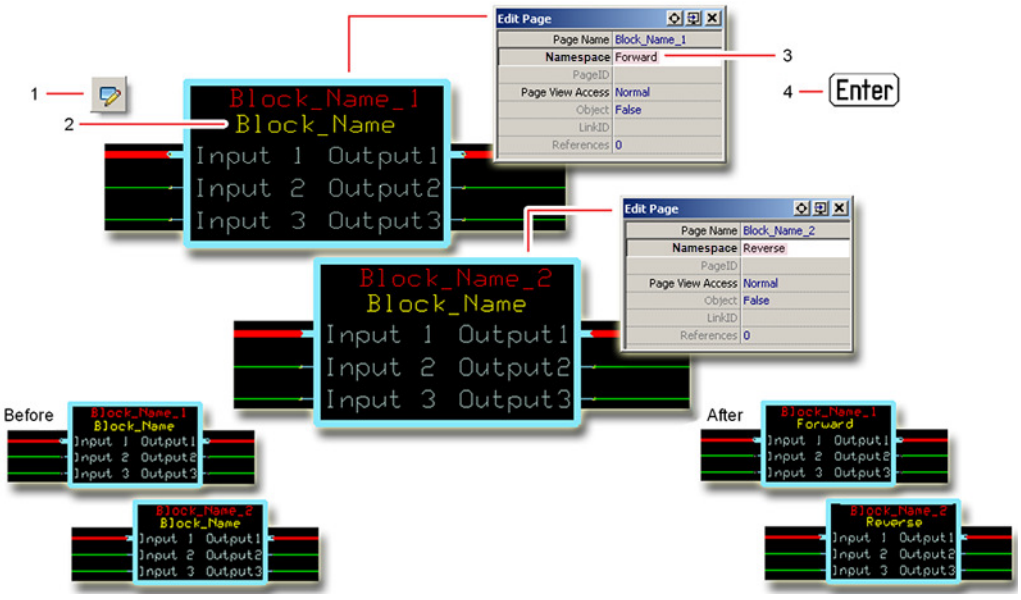
Both these components use memory names ("aliases") to allocate memory. Identical memory names cause compiler errors.

The namespace value adds a unique prefix to each component name to avoid errors. Keep each namespace value short to save controller memory.

## Hysteresis Function Block

### Change Namespace Value

To successfully compile your application, change the namespace value for function blocks that are used more than once in an application.




1. In the PLUS+1® GUIDE menu bar, click the **Query/Change** button.
2. Click on the function block whose namespace you want to set to a unique value.

   The **Edit Page** window opens.
3. In the **Edit Page** window, enter a meaningful **Namespace** value.
   - **Namespace** values are case-sensitive.
   - To save controller memory, use a short namespace value.
4. Press **Enter**.
5. Repeat these steps to enter unique namespace values for other identical function blocks.

## Hysteresis Function Block

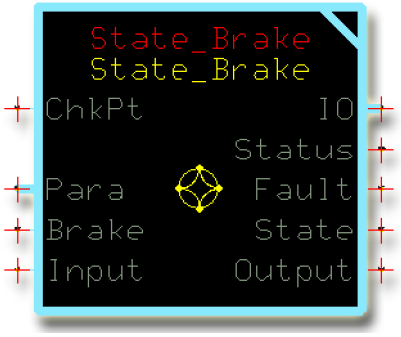
### IEC 61508-3 Annex D Supplemental Information

The following table provides IEC 61508-3 Annex D supplemental information.

| Item | Description |
|---|---|
| Function block name | Hysteresis. |
| Function block version | 4.0. |
| Function block development environment | PLUS+1® GUIDE version 8.1 and later. |
| Compatible hardware | Verified in the PLUS+1® GUIDE compile process.<br>When the PLUS+1® GUIDE compiler finds a function block that is incompatible with hardware, it aborts the compile process and logs an error message. The error message gives the location of the function block and states "Error 80: component not supported in hwd." |
| Function block developed in compliance with | Danfoss Software Product Development Process (PDP), which includes ISO 9001 and IEC 61508-3 standards. |
| Competence required of function block integrator | The knowledge, competence, and training required to:<br>• Understand this manual.<br>• Use the PLUS+1® GUIDE program to develop a machine control application.<br>• Follow quality software practices to develop a machine control application. |
| Contacting Danfoss | *https://www.danfoss.com/en/products/software/dps/plus1-software-services-support-and-training/plus1-support-and-services* |

## State_Brake Function Block

Use the **State_Brake** function block in applications that need smooth transition signals.




This function block has parameters to smooth:

- Acceleration transitions.
- Coasting transitions.
- Change of direction transitions.
- Braking transitions.
- Deceleration to neutral.

Typically, you use this function block in propel applications that require smooth starting and stopping but need faster ramp rates for other conditions.

### Inputs

The inputs to the **State _Brake** function block are described.

Use only the data types specified in this table. Other data types cause compiler errors.

| Item | Type | Range | Description |
|---|---|---|---|
| **ChkPt** | BOOL | —— | True—include the function block's built-in **Advanced Checkpoint with Namespace**<br>False—exclude the function block's built-in **Advanced Checkpoint with Namespace** components from the compiled LHX download file. |
| **Para** | Bus | —— | Input for acceleration and deceleration parameters that set how this function block's **Output** ramps in response to changes in its **Input**. |
| **Brake** | BOOL | —— | • True—ignore the **Input** value and apply the **Brake** parameters to ramp the **Output** value to 0.<br>• False—apply the appropriate acceleration and deceleration parameters to the **Output** value in response to changes in the **Input** value. |
| **Input** | S16 | -10000–10000 | Command signal to be ramped. |

### Outputs

The outputs of the **State_Brake** function block are described.

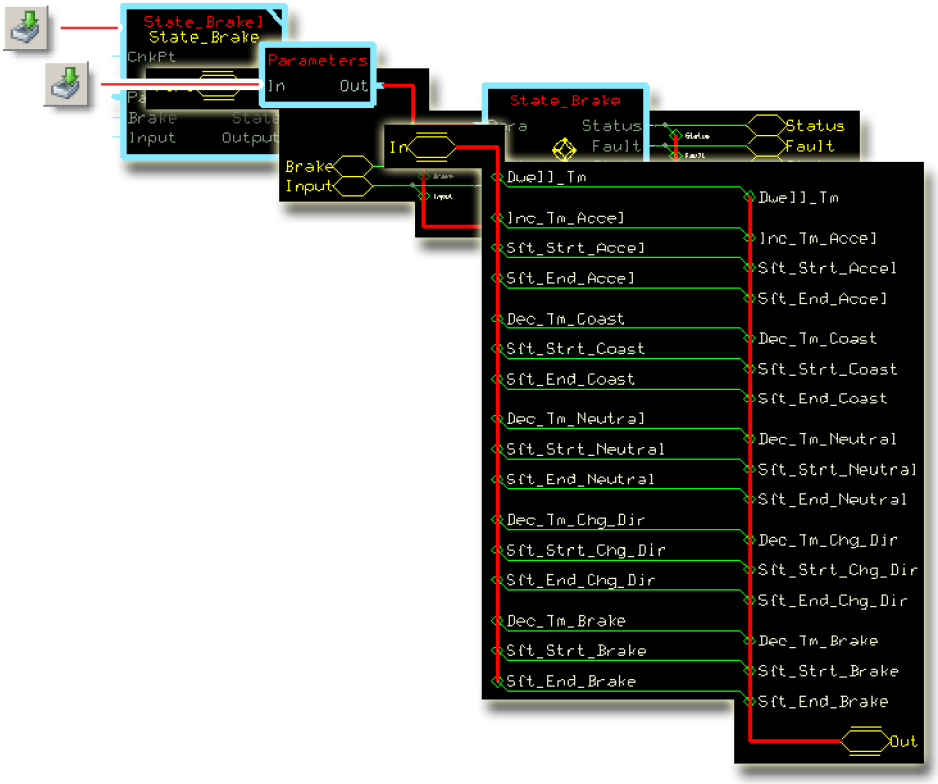
| Item | Type | Range | Description |
|---|---|---|---|
| **IO** | Bus | —— | Outputs a bus with all of the function block's input and output signals.<br>This bus provides a convenient way to distribute this function block's signals to your application. |
| **Status** | U16 | —— | Reports the status of the function block.<br>This output follows the standard bitwise scheme described in the *Status Logic* topic. |
| **Fault** | U16 | —— | Reports the faults of the function block.<br>This output follows the standard bitwise scheme described in the *Status Logic* topic. |

## State_Brake Function Block

| Item | Type | Range | Description |
|---|---|---|---|
| **State** | U8 | 0–5 | Reports the function block's current state.<br>• 0 = Not ramping; the **Input** equals the **Output** and the brake is not active.<br>• 1 = The **Input** commands a deceleration but not a deceleration to neutral. The function block applies **Coast** parameters to its **Output**.<br>• 2 = The **Input** commands deceleration to neutral. The function block applies **Neutral** parameters to its **Output**.<br>• 3 = The **Input** commands a change in direction. The function block applies **Chg_Dir** and **Dwell_Tm** parameters to its **Output**.<br>• 4 = The boolean **Brake** input goes true and commands braking to neutral. The function block applies **Brake** parameters to its **Output**.<br>• 5 = The **Input** commands forward or reverse acceleration. The function block applies **Accel** parameters to its **Output**. |
| **Output** | S16 | -10000–10000 | The **Input** command after ramping. |

### Parameters

The parameters of the **State_Brake** function block are described.




The **Parameters** page provides access to the function block's parameter (configuration) values.

Typically, you input parameter values from an external page to this function block through its **Para** input.

## State_Brake Function Block

| Item | Type | Range | Description |
|---|---|---|---|
| **Dwell Tm** | U16 | 0–65535 | The time that the function block's **Output** must remain at 0 when its **Input** commands a change in direction.<br>1000 = 1000 ms |
| **Inc_Tm_Accel** | U16 | 0–65535 | The time that the function block's **Output** takes to go from 0 to 10000 or from 0 to -10000 when its **Input** commands 100.00% acceleration.<br>1000 = 1000 ms |
| **Sft_Strt_Accel** | U16 | 0–10000 | The non-linear, soft-start portion of the **Inc_Tm_Accel** ramp as a percentage of this ramp's total time.<br>10000 = 100.00%. |
| **Sft_End_Accel** | U16 | 0–10000 | The non-linear, soft-end portion of the **Inc_Tm_Accel** ramp as a percentage of this ramp's total time.<br>10000 = 100.00%. |
| **Dec_Tm_Coast** | U16 | 0–65535 | The time that the function block's **Output** takes to go from 10000 to 1 or from -10000 to -1 when its **Input** commands deceleration to 1 or -1.<br>• The **Dec_Tm_Coast** value applies when the **Input** commands a deceleration but not a deceleration to neutral.<br>• The **Dec_Tm_Neutral** value applies when the **Input** commands a deceleration to neutral.<br>1000 = 1000 ms |
| **Sft_End_Coast** | U16 | 0–10000 | The non-linear, soft-end portion of the **Dec_Tm_Coast** ramp as a percentage of this ramp's total time.<br>10000 = 100.00%. |
| **Sft_Strt_Coast** | U16 | 0–10000 | The non-linear, soft-start portion of the **Dec_Tm_Coast** ramp as a percentage of this ramp's total time.<br>10000 = 100.00%. |
| **Dec_Tm_Neutral** | U16 | 0–65535 | The time that the function block's **Output** takes to go from 10000 to 0 or from -10000 to 0 when its **Input** commands deceleration to neutral.<br>• The **Dec_Tm_Coast** value applies when the **Input** commands a deceleration but not a deceleration to neutral.<br>• The **Dec_Tm_Neutral** value applies when the **Input** commands a deceleration to neutral.<br>1000 = 1000 ms |
| **Sft_Strt_Neutral** | U16 | 0–10000 | The non-linear, soft-start portion of the **Dec_Tm_Neutral** ramp as a percentage of this ramp's total time.<br>10000 = 100.00%. |
| **Sft_End_Neutral** | U16 | 0–10000 | The non-linear, soft-end portion of the **Dec_Tm_Neutral** ramp as a percentage of this ramp's total time.<br>10000 = 100.00%. |
| **Dec_Tm_Chg_Dir** | U16 | 0–65535 | The time that the function block's **Output** takes to go from 10000 to 0 or from -10000 to 0 when its **Input** commands a change in direction.<br>1000 = 1000 ms |
| **Sft_Strt_Chg_Dir** | U16 | 0–10000 | The non-linear, soft-start portion of the **Dec_Tm_Chg_Dir** ramp as a percentage of this ramp's total time.<br>10000 = 100.00%. |
| **Sft_End_Chg_Dir** | U16 | 0–10000 | The non-linear, soft-end portion of the **Dec_Tm_Chg_Dir** ramp as a percentage of this ramp's total time.<br>10000 = 100.00%. |
| **Dec_Tm_Brake** | U16 | 0–65535 | The time that the function block's **Output** takes to go from 10000 to 0 or from -10000 to 0 when its boolean **Brake** input goes true.<br>1000 = 1000 ms |

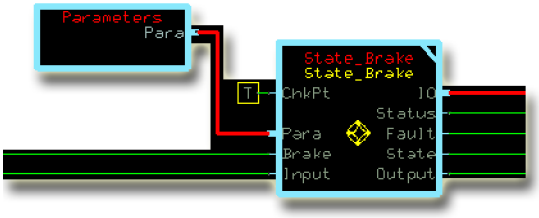
## State_Brake Function Block

| Item | Type | Range | Description |
|---|---|---|---|
| **Sft_Strt_Brake** | U16 | 0–10000 | The non-linear, soft-start portion of the **Dec_Tm_Brake** ramp as a percentage of this ramp's total time.<br>10000 = 100.00%. |
| **Sft_End_Brake** | U16 | 0–10000 | The non-linear, soft-end portion of the **Dec_Tm_Brake** ramp as a percentage of this ramp's total time.<br>10000 = 100.00%. |

### About the Para Input

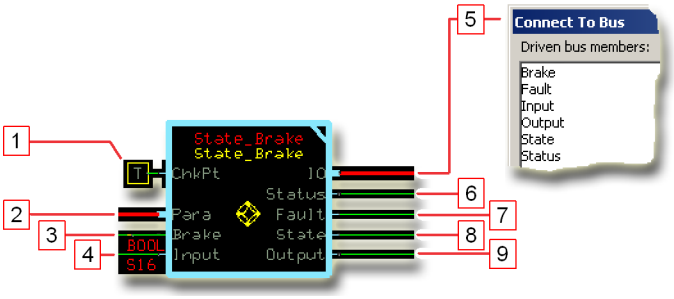
Typically, you input parameter (configuration) values from an external page to this function block through its **Para** input.

The **Parameters** page in the following figure has memory component for each of the function block's parameters.




### Function Block Connections

Connections you can make with the function block are described.



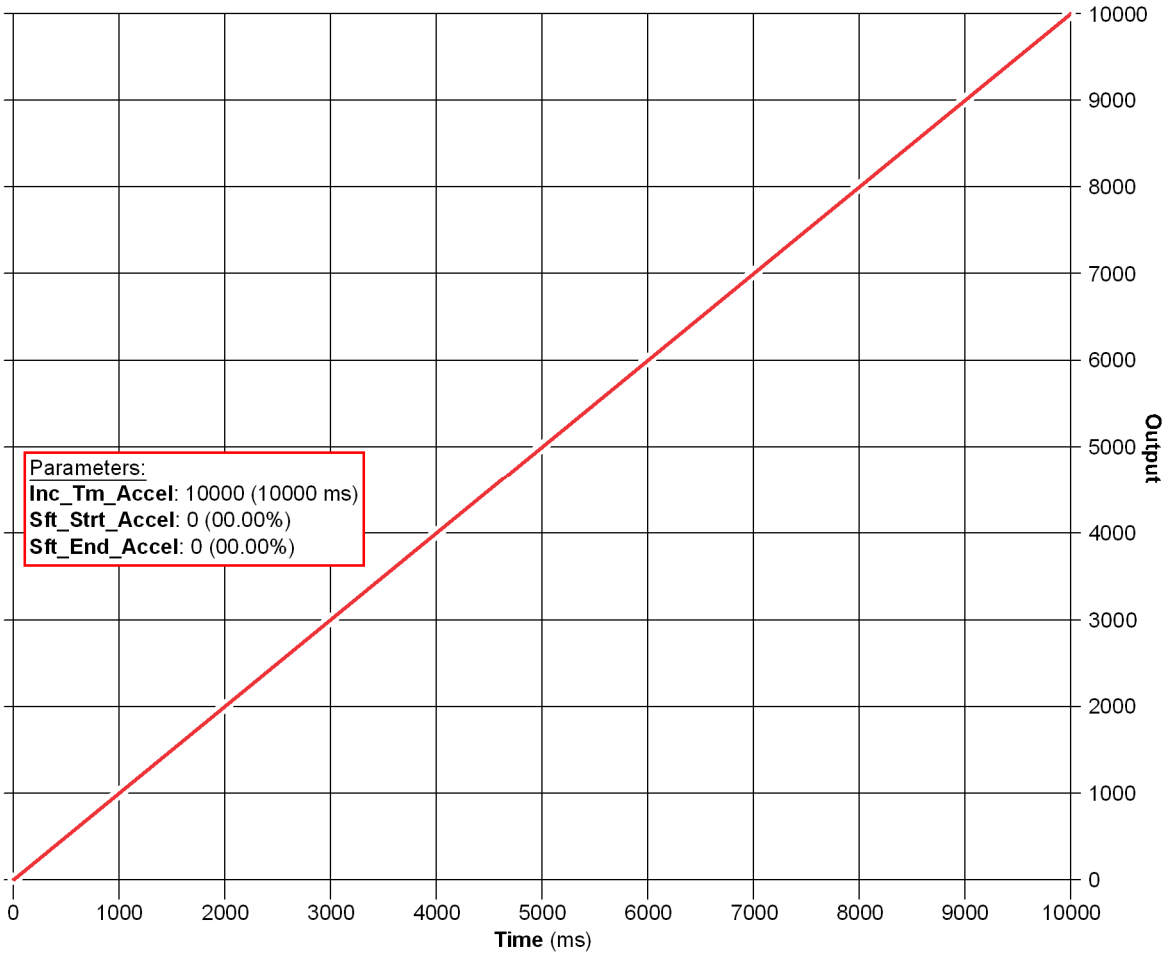

*Function Block Connections*

| Item | Description |
|---|---|
| **1.** | • True—include the function block's built-in **Advanced Checkpoint with Namespace** in the compiled LHX download file.<br>• False—exclude the function block's built-in **Advanced Checkpoint with Namespace** components from the compiled LHX download file. |
| **2.** | Input for the acceleration and deceleration parameters that set how this function block's **Output** ramps in response to changes in its **Input**. |
| **3.** | • True—ignore the **Input** value and apply the **Brake** parameters to ramp the **Output** value to 0.<br>• False—apply the appropriate acceleration and deceleration parameters to the **Output** value in response to changes in the **Input** value. |
| **4.** | Command signal to be ramped. |
| **5.** | Outputs a bus with all of the function block's input and output signals. |
| **6.** | Reports the status of the function block. |
| **7.** | Reports the faults of the function block. |
| **8.** | Reports the function block's current state. |
| **9.** | The **Input** command after ramping. |

## State_Brake Function Block

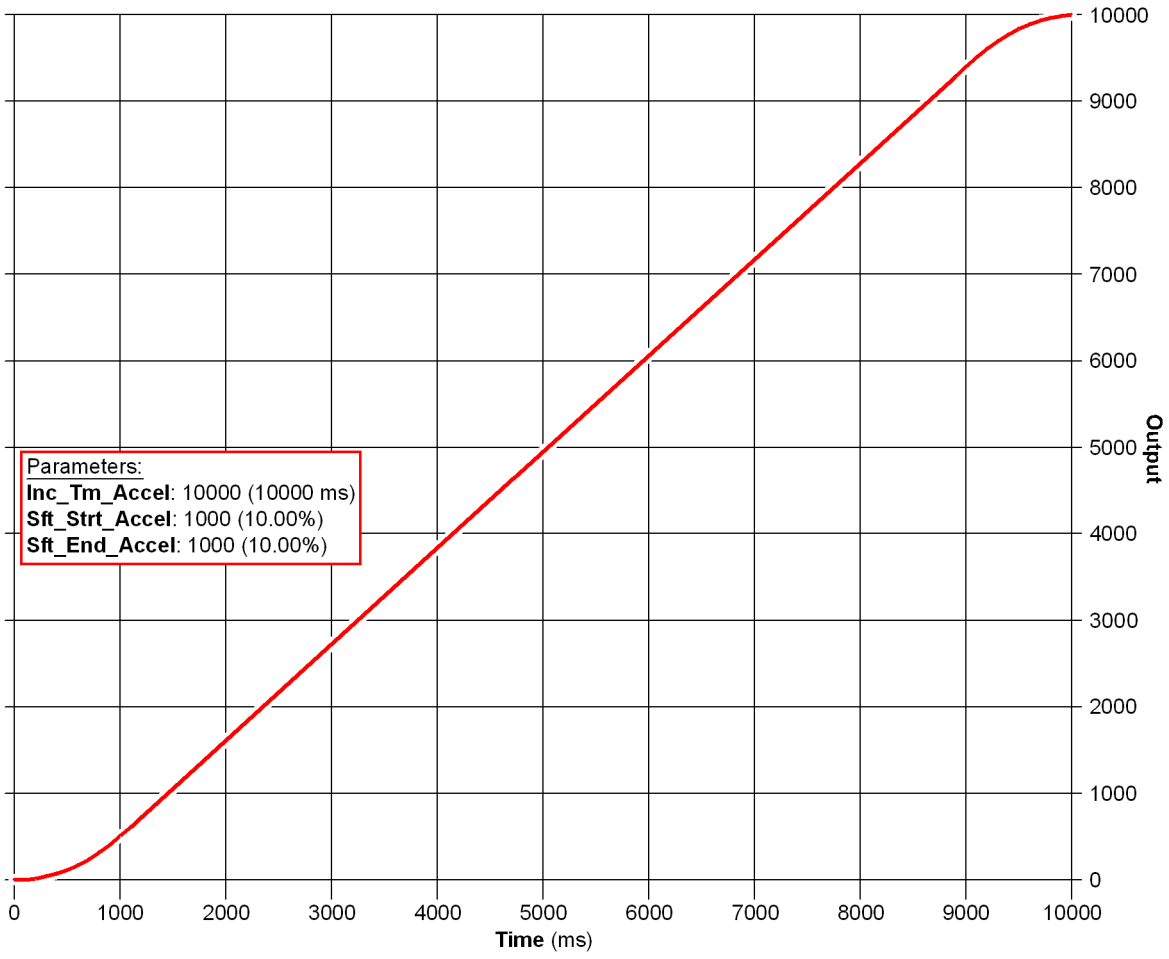
### Function Block Examples

Use the following examples to understand how configuration changes impact the output of the function block.




The parameters applied in this figure make the ramp completely linear.

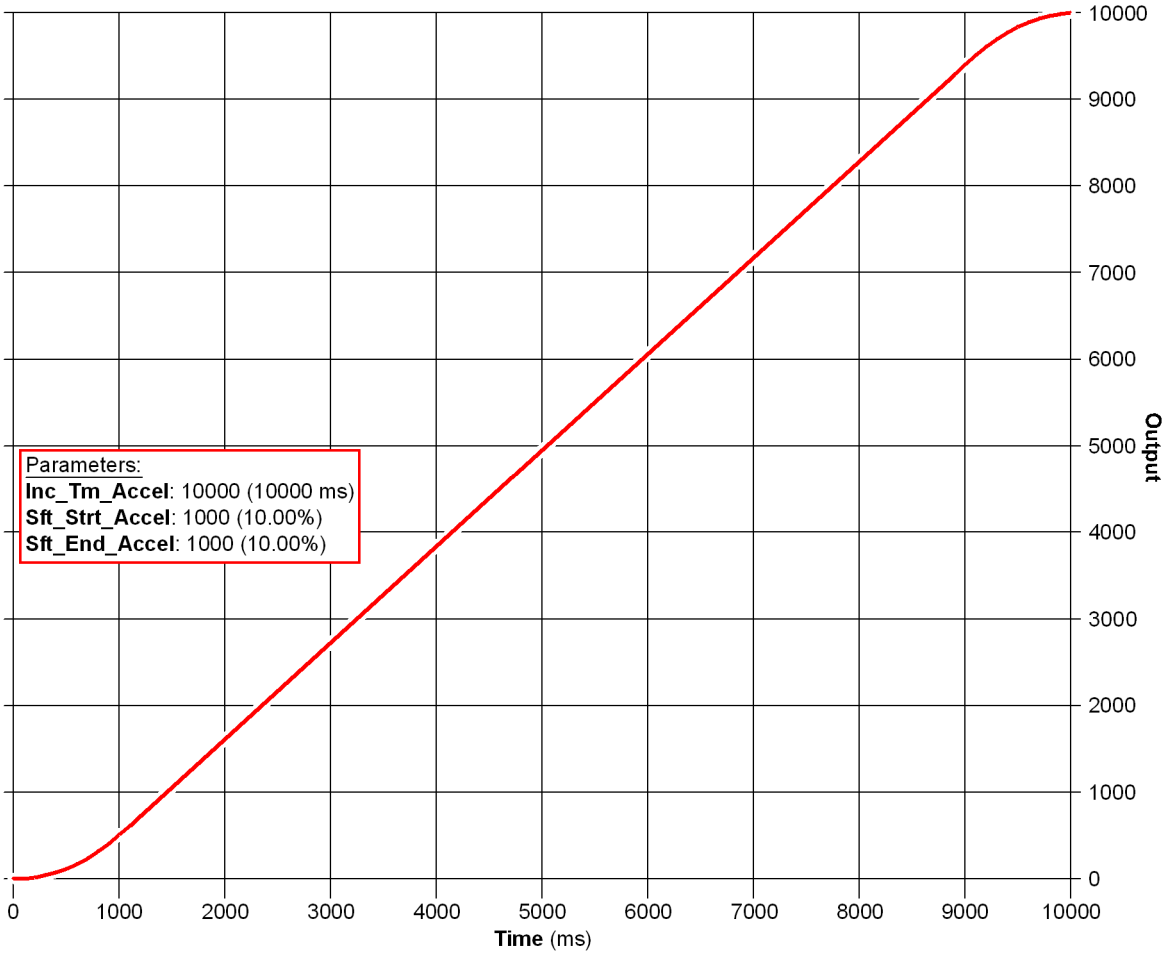
### State_Brake Function Block




With the parameters shown in this figure, the:

### State_Brake Function Block

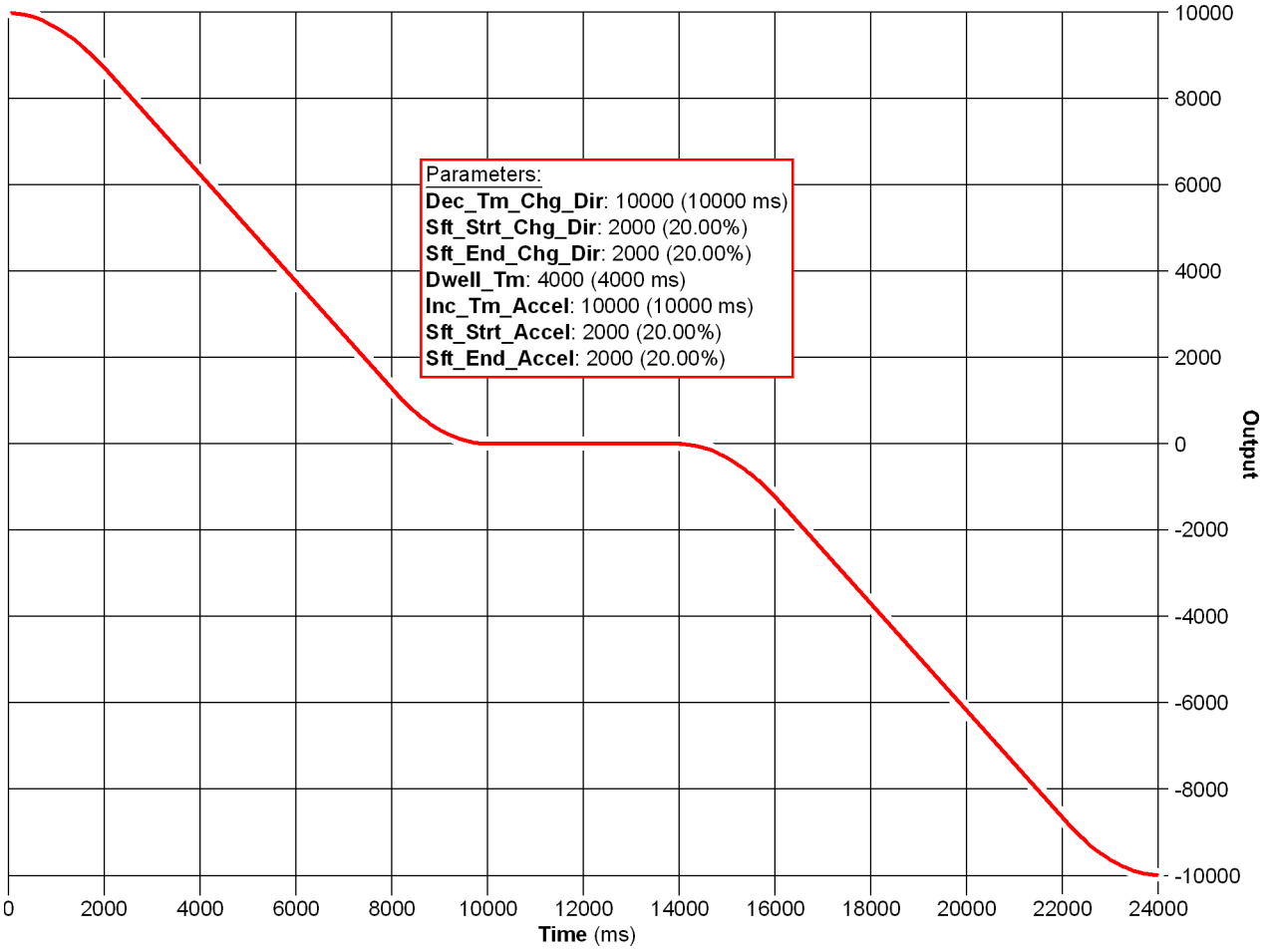
- The **Sft_Strt_Accel** time starts at 0 ms and ends at 1000 ms.
- The **Sft_End_Accel** time starts at 9000 ms and ends at 10000 ms.




With the parameters shown in this figure, the:

## State_Brake Function Block

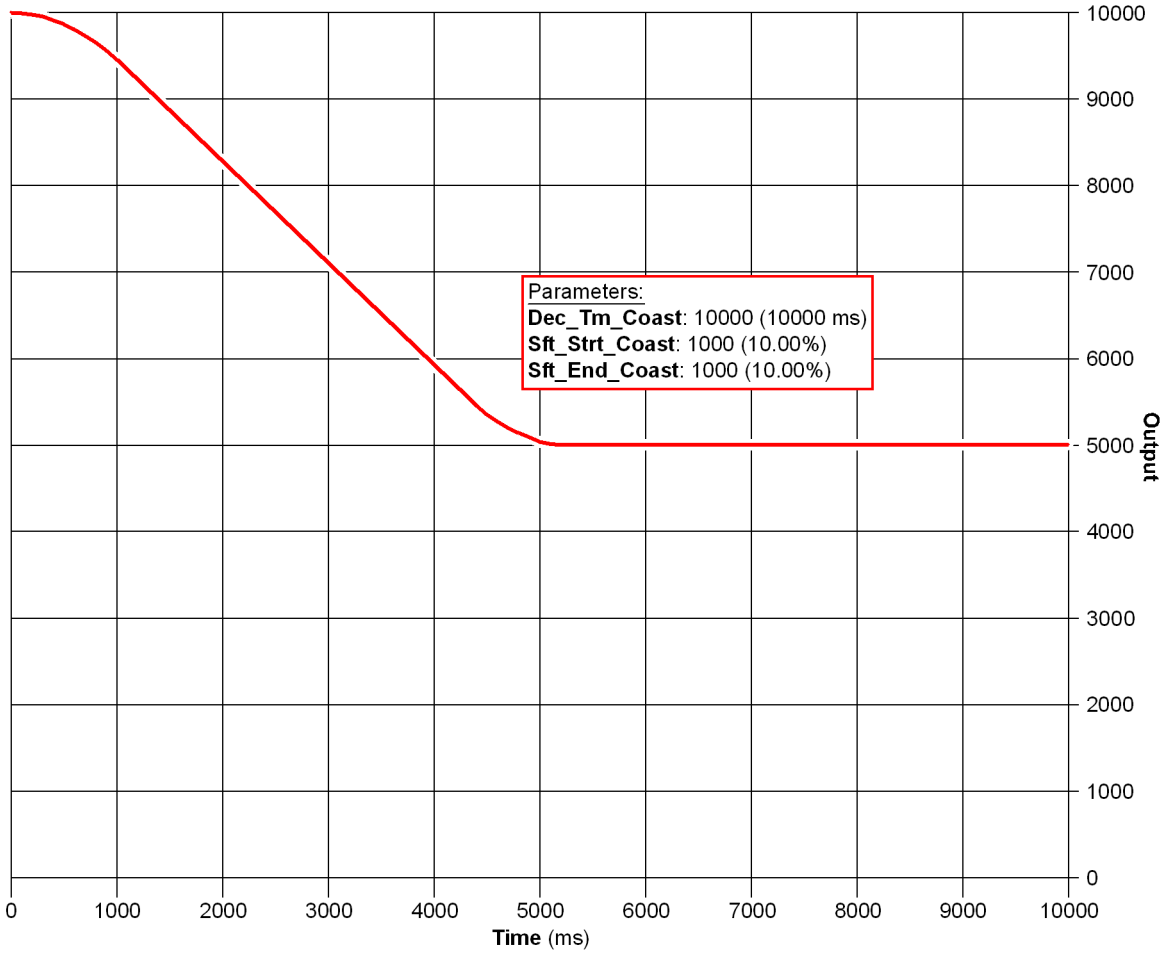
- The **Sft_Strt_Accel** time starts at 0 ms and ends at 2000 ms.
- The **Sft_End_Accel** time starts at 8000 ms and ends at 10000 ms.




With the parameters shown in this figure, the:

- **Sft_Strt_Chg_Dir** time starts at 0 ms and ends at 2000 ms.
- **Sft_End_Chg_Dir** time starts at 8000 ms and ends at 10000 ms.
- **Dwell_Tm** starts at 10000 ms and ends at 14000 ms.
- **Sft_Strt_Accel** time starts at 14000 ms and ends at16000 ms.
- **Sft_End_Accel** time starts at 22000 ms and ends at 24000 ms.

### State_Brake Function Block




With the parameters shown in this figure, the:

- **Dec_Tm_Coast** time starts at 0 ms with an **Output** of 10000 and ends at 5000 ms with an **Output** of 5000.
- 50.00% decrease in the **Output** takes 5000 ms. (A 100.00% decrease in the **Output** takes 10000 ms.)
- **Sft_Strt_Coast** time starts at 0 ms and ends at 500 ms.
- **Sft_End_Coast** time starts at 4500 ms and ends at 5000 ms.
- **Sft_Strt_Coast** and **Sft_End_Coast** times are equal to 10.00% of the ramp time and each take 500 ms.

### Status and Fault Logic

Use status and fault codes to determine proper program operation.

## State_Brake Function Block

### Status Logic

This topic describes how status logic is indicated for the function block.

| Condition | Hex* | Binary | Cause | Response | Correction |
|---|---|---|---|---|---|
| Invalid setup. | 0x8008 | 1000 | • A **Sft_Strt** or **Sft_End** value is out-of range.<br>• The sum of**Sft_Strt** and **Sft_End** is greater than 10000. | The out-of-range **Sft_Strt** or **Sft_End** value is limited to 10000. | Return the **Sft_Strt** or **Sft_End** parameter to the valid range. |

* Bit 16 set to 1 identifies a standard Danfoss status or fault code.

### Fault Logic

This topic describes how fault logic is indicated for the function block.

| Condition | Hex* | Binary | Cause | Response | Correction |
|---|---|---|---|---|---|
| Input value is too low. | 0x8001 | 0001 | **Input** value < -10000. | **Input** limited to -10000. | Return the **Input** to the valid range. |
| Input value is too high. | 0x8002 | 0010 | **Input** value > 10000. | **Input** limited to 10000. | |

* Bit 16 set to 1 identifies a standard Danfoss status or fault code.

## Identical Function Blocks Need Different Namespace Values to Successfully Compile

If you use the same function block more than once in an application, you must change each function block's namespace value to avoid compiler errors.

All function blocks contain Advanced Checkpoint with Namespace components that enable the PLUS+1® Service Tool to read block input and output values.

Some function blocks contain non-volatile memory components that store function block operating parameters.

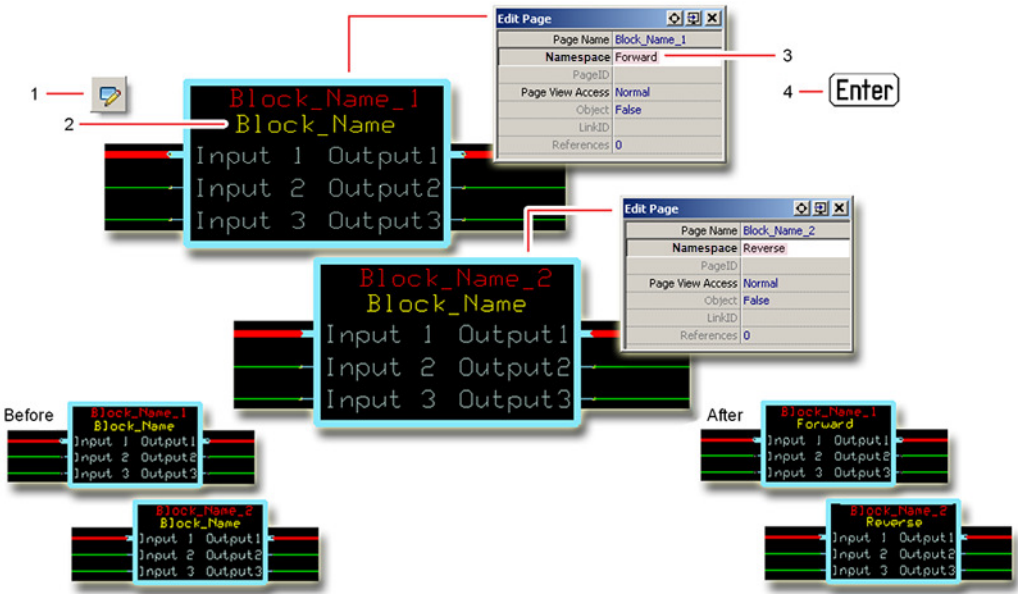
Both these components use memory names ("aliases") to allocate memory. Identical memory names cause compiler errors.

The namespace value adds a unique prefix to each component name to avoid errors. Keep each namespace value short to save controller memory.

## State_Brake Function Block

### Change Namespace Value

To successfully compile your application, change the namespace value for function blocks that are used more than once in an application.




1. In the PLUS+1® GUIDE menu bar, click the **Query/Change** button.
2. Click on the function block whose namespace you want to set to a unique value.

   The **Edit Page** window opens.
3. In the **Edit Page** window, enter a meaningful **Namespace** value.
   - **Namespace** values are case-sensitive.
   - To save controller memory, use a short namespace value.
4. Press **Enter**.
5. Repeat these steps to enter unique namespace values for other identical function blocks.

## State_Brake Function Block

### IEC 61508-3 Annex D Supplemental Information

The following table provides IEC 61508-3 Annex D supplemental information.

| Item | Description |
|---|---|
| Function block name | State_Brake. |
| Function block version | 4.0. |
| Function block development environment | PLUS+1® GUIDE version 8.1 and later. |
| Compatible hardware | Verified in the PLUS+1® GUIDE compile process.<br>When the PLUS+1® GUIDE compiler finds a function block that is incompatible with hardware, it aborts the compile process and logs an error message. The error message gives the location of the function block and states "Error 80: component not supported in hwd." |
| Function block developed in compliance with | Danfoss Software Product Development Process (PDP), which includes ISO 9001 and IEC 61508-3 standards. |
| Competence required of function block integrator | The knowledge, competence, and training required to:<br>• Understand this manual.<br>• Use the PLUS+1® GUIDE program to develop a machine control application.<br>• Follow quality software practices to develop a machine control application. |
| Contacting Danfoss | *https://www.danfoss.com/en/products/software/dps/plus1-software-services-support-and-training/plus1-support-and-services* |

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