# PLC Codes Ready to Use:

# Analog, Valve, DOL and VSD

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# 1 FUNCTION BLOCKS

## 1.1 Analogue Input Function Block

| Analogue Input Function Block | | |
|---|---|---|
| **Digital Inputs to Block** | | **Digital Outputs** |
| Enable In | | Enable Out |
| Enable Limiting | | |
| | | High High Alarm |
| Mask High High Alarm | | High Alarm |
| Mask High Alarm | | Low Alarm |
| Mask Low Alarm | | Low Low Alarm |
| Mask Low Low Alarm | | Over Range Alarm |
| | | Under Range Alarm |
| | | |
| **Analogue Inputs to Block -** | | **Analogue Outputs** |
| Raw Input (vendor) | | Scaled Value (Real) |
| Raw Input Minimum (vendor) | | |
| Raw Input Maximum (vendor) | | |
| EU Minimum (Real) | | |
| EU Maximum (Real) | | |
| | | |
| High High Setpoint (REAL) | | |
| High Setpoint (REAL) | | |
| Low Setpoint (Real) | | |
| Low Low Setpoint (Real) | | |
| | | |
| High High Alarm Timer Setpoint (UINT) | | |
| High Alarm Timer Setpoint (UINT) | | |
| Low Alarm Timer Setpoint (UINT) | | |
| Low Low Alarm Timer Setpoint (UINT) | | |
| | | |

### 1.1.1 Digital Inputs

| | |
|---|---|
| **Enable In** | Enables the analogue function block. |
| **Enable Limiting** | This enables the raw analogue input to be limited in value between the raw input minimum and maximum values. |
| **Mask High High Alarm** | This will mask the High High alarm, hence the alarm will not be generated even when the alarm condition exists. |
| **Mask High Alarm** | This will mask the High alarm, hence the alarm will not be generated even |

| | |
|---|---|
| | when the alarm condition exists. |
| **Mask Low Alarm** | This will mask the low alarm, hence the alarm will not be generated even when the alarm condition exists. |
| **Mask Low Low Alarm** | This will mask the Low Low alarm, hence the alarm will not be generated even when the alarm condition exists. |

### 1.1.2 Analogue Inputs

| | |
|---|---|
| **Raw Input** | Raw, unscaled analogue input. The data type will be dependent on the hardware platform being used. |
| **Raw Input Minimum** | Minimum value of the raw input. |
| **Raw Input Maximum** | Maximum value of the raw input. |
| **EU Minimum** | Minimum engineering value. The minimum value the scaled output needs to be. |
| **EU Maximum** | Maximum engineering value. The maximum value the scaled output needs to be. |
| **High High Setpoint** | Value from the HMI/SCADA where when the scaled output value is greater than this value, the High High alarm timer will start and raise the High High alarm when the timer has accumulated. Setpoint Value must be within the range of EU Minimum and EU Maximum. |
| **High Setpoint** | Value from the HMI/SCADA where when the scaled output value is greater than this value, the High alarm timer will start and raise the High alarm when the timer has accumulated. Setpoint Value must be within the range of EU Minimum and EU Maximum. |
| **Low Setpoint** | Value from the HMI/SCADA where when the scaled output value is less than this value, the Low alarm timer will start and raise the Low alarm when the timer has accumulated. Setpoint Value must be within the range of EU Minimum and EU Maximum. |
| **Low Low Setpoint** | Value from the HMI/SCADA where when the scaled output value is less than this value, the Low Low alarm timer will start and raise the Low Low alarm when the timer has accumulated. Setpoint Value must be within the range of EU Minimum and EU Maximum. |
| **High High Alarm Timer Setpoint** | The High High alarm timer pre-set value from HMI/SCADA. If the alarm timer has accumulated to this setpoint value, the alarm will be raised. |
| **High Alarm Timer Setpoint** | The High alarm timer pre-set value from HMI/SCADA. If the alarm timer has accumulated to this setpoint value, the alarm will be raised. |
| **Low Alarm Timer Setpoint** | The Low alarm timer pre-set value from HMI/SCADA. If the alarm timer has accumulated to this setpoint value, the alarm will be raised. |

| | |
|---|---|
| **Low Low Alarm Timer Setpoint** | The Low Low alarm timer pre-set value from HMI/SCADA. If the alarm timer has accumulated to this setpoint value, the alarm will be raised. |

### 1.1.3 Digital Output

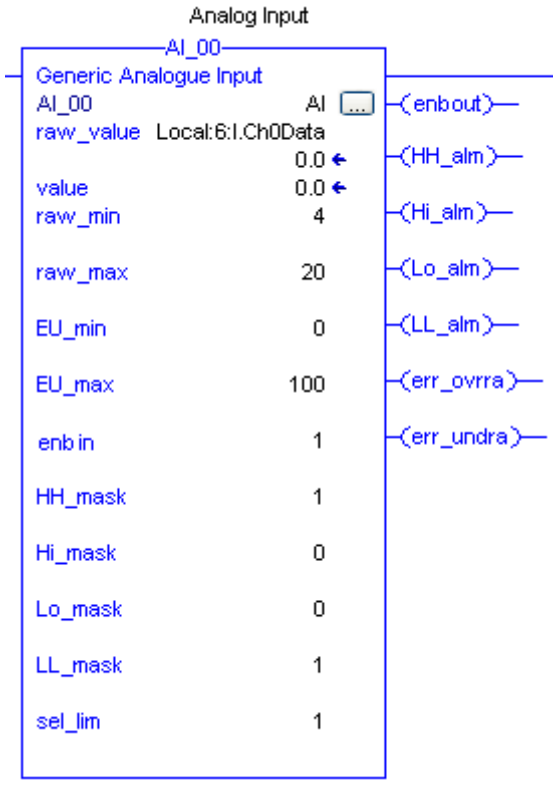
| | |
|---|---|
| **Enable Out** | The analogue function block is enabled. When enabled, the function block will generate alarms that are not masked. |
| **High High Alarm** | The analogue function block has a high alarm. Reset must be pressed to reset the alarm. A high alarm will be generated when the scaled output is greater than the high setpoint for a time greater than the high alarm timer setpoint and the function block is in service mode. |
| **High Alarm** | The analogue function block has a high alarm. Reset must be pressed to reset the alarm. A high alarm will be generated when the scaled output is greater than the high setpoint for a time greater than the high alarm timer setpoint and the function block is in service mode. |
| **Low Alarm** | The analogue function block has a low alarm. Reset must be pressed to reset the alarm. A low alarm will be generated when the scaled output is less than the low setpoint for a time greater than the low alarm timer setpoint and the function block is in service mode. |
| **Low Low Alarm** | The analogue function block has a low low alarm. Reset must be pressed to reset the alarm. A low low alarm will be generated when the scaled output is less than the low low setpoint for a time greater than the low low alarm timer setpoint and the function block is in service mode. |
| **Over Range Alarm** | Raw analogue input is greater than the raw input maximum value. When limiting is enabled, the raw input maximum value will be written to the raw input value. |
| **Under Range Alarm** | Raw analogue input is less than the raw input minimum value. When limiting is enabled, the raw input minimum value will be written to the raw input value. |

### 1.1.4 Analogue Outputs

| | |
|---|---|
| **Scaled Output Value** | Scaled value of the raw input. This value is obtained by scaling the raw input minimum and maximum values to the engineering minimum and maximum values. |

### 1.1.5 Studio5000 Example Function Block

The function block below is an example of an analogue input Add on Instruction used on Studio5000.



## 1.2 Analogue Output Function Block

| Analogue Output Function Block | | |
|---|---|---|
| **Digital Inputs to Block** | | **Digital Outputs** |
| Enable In | | Enable Out |
| Enable Limiting | | |
| | | Over Range Alarm |
| | | Under Range Alarm |
| | | |
| **Analogue Inputs to Block** | | **Analogue Outputs** |
| Input Value (Real) | | Scaled Value (Real) |
| EU Minimum (Real) | | |
| EU Maximum (Real) | | |
| Output Minimum (Real) | | |
| Output Maximum (Real) | | |
| | | |

### 1.2.1 Digital Inputs

| | |
|---|---|
| **Enable In** | Enables the analogue output function block. |
| **Enable Limiting** | This enables the input value to be limited in value between the engineering minimum and maximum values. |

### 1.2.2 Analogue Inputs

| | |
|---|---|
| **Input Value** | Unscaled input. |
| **Engineering Minimum** | Minimum value of the input. |
| **Engineering Maximum** | Maximum value of the input. |
| **Output Minimum** | Minimum output value. The minimum value the scaled output needs to be. |
| **Output Maximum** | Maximum output value. The maximum value the scaled output needs to be. |

### 1.2.3 Digital Output

| | |
|---|---|
| **Enable Out** | The analogue output function block is enabled. |
| **Over Range Alarm** | Input value is greater than the engineering maximum value. When limiting is enabled, the engineering maximum value will be written to the input value. |
| **Under Range Alarm** | Input value is less than the engineering maximum value. When limiting is |

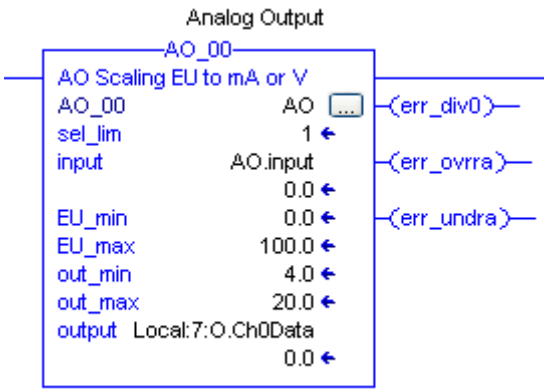
| | |
|---|---|
| | enabled, the engineering minimum value will be written to the input value. |

### 1.2.4 Analogue Outputs

| | |
|---|---|
| **Scaled Output Value** | Scaled value of the input. This value is obtained by scaling the engineering minimum and maximum values to the output minimum and maximum values. |

### 1.2.5 Studio5000 Example Function Block

The function block below is an example of an analogue output Add on Instruction used on Studio5000.



## 1.3 Single Direction DOL Control Function Block

| Single Direction DOL Function Block | | |
|---|---|---|
| **Digital Inputs to Block** | | **Digital Outputs** |
| Alarm Active | | Healthy |
| Start Permissive | | |
| Run Permissive | | |
| | | |
| Enable Input Pulse Control | | |
| | | |
| Enable Auto Mode | | |
| Enable Manual Mode | | |
| Enable Out Of Service Mode | | |
| | | |
| Request Auto Mode | | In Auto Mode |
| Request Manual Mode | | In Manual Mode |
| Request Out Of Service Mode | | In Out Of Service Mode |
| | | |
| Request Auto Run | | |
| Request Auto Stop (Input Pulse Enabled) | | |
| Request Manual Run | | Run Command |
| Request Manual Stop | | |
| Request Manual Jog | | |
| | | |
| Contactor Energised | | |
| | | |

### 1.3.1 Digital Inputs

| | |
|---|---|
| **Alarm Active** | A DOL alarm is active in the DOL alarms block. When there is an active alarm, the DOL becomes unhealthy and the DOL function block will not generate any run commands. DOL will become healthy when there are no active alarms. Active alarms include failed to run, failed to stop. |
| **Start Permissive** | Start permissive only applies to auto mode, if inactive will prevent DOL start-up. Once the DOL is running and the start permissive becomes inactive, the DOL will continue to run. The start permissive should be listed in the DOL device routine and mapped to the DOL software block. When the start permissive is inactive, no alarms are to be created as a start permissive is purely process related. |
| **Run Permissive** | Run permissive applies to both auto and manual modes, where when inactive will prevent the DOL from running. The DOL run permissive should be listed in the DOL device routine and mapped to the DOL software block. When the run permissive is inactive, no alarms are to be generated as the run permissive is purely process related. The VSD will continue to run as soon as the start and run permissives are active. |

| | |
|---|---|
| **Enable Input Pulse Control** | When enabled, the function block should be able to detect the pulsed request auto run command and needs to latch internally in the function block. When input pulse control in disabled, the request auto run command needs to be latched externally to the function block, hence the run command from the function block will be active only when the request auto run command is active. |
| **Enable Auto Mode** | When enabled allows operators to select auto for the DOL operation mode. When not enabled, auto mode is not available. |
| **Enable Manual Mode** | When enabled allows operators to select manual for the DOL operation mode. When not enabled, manual mode is not available. |
| **Enable Out Of Service Mode** | When enabled allows operators to select out of service for the DOL operation mode. When not enabled, out of service mode is not available. |
| **Request Auto Mode** | A request from the HMI/SCADA to place the function block into auto mode. |
| **Request Manual Mode** | A request from the HMI/SCADA to place the function block into manual mode. |
| **Request Out of Service Mode** | A request from the HMI/SCADA to place the function block into out of service mode. |
| **Request Auto Run** | Auto mode run command. This is a run command that is generated from the unit or system/group control or sequence routines. This command will be ignored in all modes except auto mode. This command can either be a pulsed command if the input pulse control is enabled or a latched command if the input pulse control is disabled. |
| **Request Auto Stop** | Auto mode stop command. This is a stop command that is generated from the unit or system/group control or sequence routines. This command will be ignored in all modes except auto mode. This command can only be used when the input pulse control is enabled hence can only be a pulsed command. |
| **Request Manual Run** | A request from the HMI/SCADA to run the DOL. This request will be ignored in all modes except manual mode. |
| **Request Manual Stop** | A request from the HMI/SCADA to stop the DOL from running. This request will be ignored in all modes except manual mode. |
| **Request Manual Jog** | A request from the HMI/SCADA to jog the DOL. The DOL will only jog when the jog request is active, hence must be a latched request. This request will be ignored in all modes except manual mode. |
| **Contactor Energised** | Digital Input feedback from the motor contactor when energised. |

### 1.3.2 Digital Output

| | |
|---|---|
| **Healthy** | The DOL Software block is healthy. The DOL will be healthy when there are no active alarms and either auto mode or manual mode is selected. |
| **In Auto Mode** | The DOL is in Auto mode. When in auto mode, the unit or system/group control routines control the operation of the DOL. All start and run permissives |

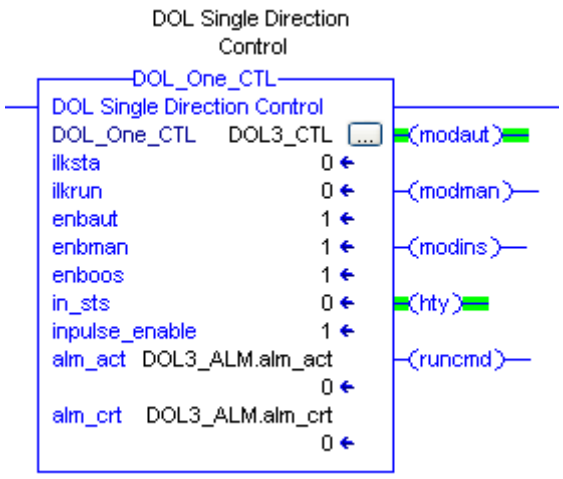
| | |
|---|---|
| | shall apply. |
| **In Manual Mode** | The DOL is in Manual mode. Manual mode authorises the operator to execute run commands from the HMI/SCADA. Automatic commands which may have been issued shall not have any effect on the field devices. Start permissives do NOT apply. Run permissives shall apply unless stated otherwise. |
| **In Out Of Service Mode** | The DOL is in out of service mode. No run commands will be executed and no alarms shall be raised. |
| **Run Command** | Run command generated by the DOL function block. This command is a digital output to energise the DOL motor contactor. When input pulse is enabled, the run command is latched internally to the function block. When input pulse is disabled, the run command is not latched internally in the block. |

The DOL motor run command will be generated when:

- The DOL is healthy (no alarms active)
- The DOL is In auto mode
  - Start permissive active
  - Run permissive active
  - Run command from unit or system/group routine is latched (Input Pulse Control disabled) or pulsed (Input Pulse Control enabled)
- The DOL is in manual mode
  - Run permissive active
  - Request to run detected or jog is active (constantly holding down the jog button).

### 1.3.3 Studio5000 Example Function Block

The function block below is an example used on Studio5000.



## 1.4 Two Direction DOL Control Function Block

| Two Direction DOL Function Block | | |
|---|---|---|
| **Digital Inputs to Block** | | **Digital Outputs** |
| Alarm Active | | Healthy |
| Start Permissive | | |
| Run Permissive | | |
| | | |
| Enable Input Pulse Control | | |
| | | |
| Enable Auto Mode | | |
| Enable Manual Mode | | |
| Enable Out Of Service Mode | | |
| | | |
| Request Auto Mode | | In Auto Mode |
| Request Manual Mode | | In Manual Mode |
| Request Out Of Service Mode | | In Out Of Service Mode |
| | | |
| Request Auto Run Forward | | |
| Request Auto Run Reverse | | |
| Request Auto Stop (Input Pulse Enabled) | | |
| Request Manual Run Forward | | Run Forward Command |
| Request Manual Run Reverse | | Run Reverse Command |
| Request Manual Stop | | |
| Request Manual Jog Forward | | |
| Request Manual Jog Reverse | | |
| | | |
| Forward Contactor Energised | | |
| Reverse Contactor Energised | | |
| | | |

### 1.4.1 Digital Inputs

| | |
|---|---|
| **Alarm Active** | A DOL alarm is active in the DOL alarms block. When there is an active alarm, the DOL becomes unhealthy and the DOL function block will not generate any run commands. DOL will become healthy when there are no active alarms. Active alarms include failed to run, failed to stop. |
| **Start Permissive** | Start permissive only applies to auto mode, if inactive will prevent DOL start-up. Once the DOL is running and the start permissive becomes inactive, the DOL will continue to run. The start permissive should be listed in the DOL device routine and mapped to the DOL software block. When the start permissive is inactive, no alarms are to be created as a start permissive is purely process related. |
| **Run Permissive** | Run permissive applies to both auto and manual modes, where when inactive will prevent the DOL from running. The DOL run permissive should be listed in the DOL device routine and mapped to the DOL software block. When the run |

| | |
|---|---|
| | permissive is inactive, no alarms are to be generated as the run permissive is purely process related. The VSD will continue to run as soon as the start and run permissives are active. |
| **Enable Input Pulse Control** | When enabled, the function block should be able to detect the pulsed request auto run command and needs to latch internally in the function block. When input pulse control in disabled, the request auto run command needs to be latched externally to the function block, hence the run command from the function block will be active only when the request auto run command is active. |
| **Enable Auto Mode** | When enabled allows operators to select auto for the DOL operation mode. When not enabled, auto mode is not available. |
| **Enable Manual Mode** | When enabled allows operators to select manual for the DOL operation mode. When not enabled, manual mode is not available. |
| **Enable Out Of Service Mode** | When enabled allows operators to select out of service for the DOL operation mode. When not enabled, out of service mode is not available. |
| **Request Auto Mode** | A request from the HMI/SCADA to place the function block into auto mode. |
| **Request Manual Mode** | A request from the HMI/SCADA to place the function block into manual mode. |
| **Request Out of Service Mode** | A request from the HMI/SCADA to place the function block into out of service mode. |
| **Request Auto Run Forward** | Auto mode run forward command. This is a run command that is generated from the unit or system/group control or sequence routines. This command can either be a pulsed command if the input pulse control is enabled or a latched command if the input pulse control is disabled. |
| **Request Auto Run Reverse** | Auto mode run reverse command. This is a run command that is generated from the unit or system/group control or sequence routines. This command will be ignored in all modes except auto mode. This command can either be a pulsed command if the input pulse control is enabled or a latched command if the input pulse control is disabled. |
| **Request Auto Stop (Input Pulse Enabled)** | Auto mode stop command. This is a stop command that is generated from the unit or system/group control or sequence routines. This command will be ignored in all modes except auto mode. This command can only be used when the input pulse control is enabled hence can only be a pulsed command. |
| **Request Manual Run Forward** | A request from the HMI/SCADA to run the DOL in the forward direction. This request will be ignored in all modes except manual mode. |
| **Request Manual Run Reverse** | A request from the HMI/SCADA to run the DOL in the reverse direction. This request will be ignored in all modes except manual mode. |
| **Request Manual Stop** | A request from the HMI/SCADA to stop the DOL from running. This request will be ignored in all modes except manual mode. |
| **Request Manual Jog Forward** | A request from the HMI/SCADA to jog the DOL in the forward direction. The DOL will only jog when the jog request is active, hence must be a latched request. This request will be ignored in all modes except manual mode. |

| | |
|---|---|
| **Request Manual Jog Reverse** | A request from the HMI/SCADA to jog the DOL in the reverse direction. The DOL will only jog when the jog request is active, hence must be a latched request. This request will be ignored in all modes except manual mode. |
| **Forward Contactor Energised** | Digital Input feedback from the motor forward contactor when energised. |
| **Reverse Contactor Energised** | Digital Input feedback from the motor reverse contactor when energised. |

### 1.4.2 Digital Output

| | |
|---|---|
| **Healthy** | The DOL Software block is healthy. The DOL will be healthy when there are no active alarms and either auto mode or manual mode is selected. |
| **In Auto Mode** | The DOL is in Auto mode. When in auto mode, the unit or system/group control routines control the operation of the DOL. All start and run permissives shall apply. |
| **In Manual Mode** | The DOL is in Manual mode. Manual mode authorises the operator to execute run commands from the HMI/SCADA. Automatic commands which may have been issued shall not have any effect on the field devices. Start permissives do NOT apply. Run permissives shall apply unless stated otherwise. |
| **In Out Of Service Mode** | The DOL is in out of service mode. No run commands will be executed and no alarms shall be raised. |
| **Run Forward Command** | Run forward command generated by the DOL function block. This command is a digital output to energise the DOL forward contactor. |
| **Run Reverse Command** | Run reverse command generated by the DOL function block. This command is a digital output to energise the DOL reverse contactor. |

The DOL run forward command will be generated when:

- The DOL is healthy (no alarms active)
- The DOL is In auto mode
    - Start permissive active
    - Run permissive active
    - Run forward command from unit or system/group routine is latched (Input Pulse Control disabled) or pulsed (Input Pulse Control enabled)
- The DOL is in manual mode
    - Run permissive active
    - Request to run forward detected or jog forward is active (constantly holding down the jog button)

The DOL run reverse command will be generated when:

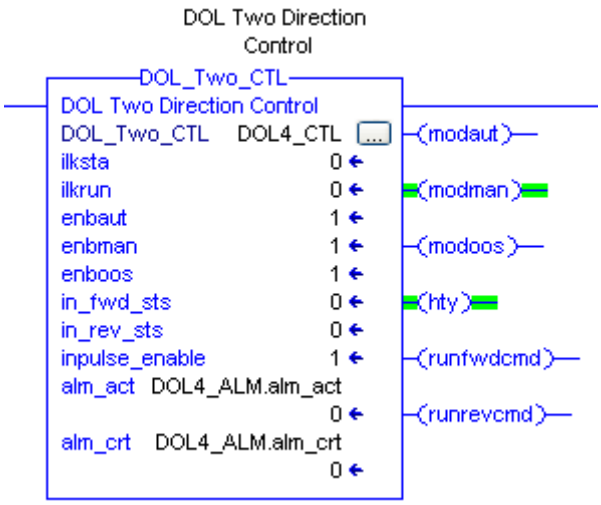
- The DOL is healthy (no alarms active)
- The DOL is In auto mode

- Start permissive active
- Run permissive active
- Run reverse command from unit or system/group routine is latched (Input Pulse Control disabled) or pulsed (Input Pulse Control enabled)

- The DOL is in manual mode
  - Run permissive active
  - Request to run reverse detected or jog reverse is active (constantly holding down the jog button).

### 1.4.3 Studio5000 Example Function Block

The function block below is an example used on Studio5000.



## 1.5 DOL Alarm Function Block

| DOL Alarm Function Block | | |
|---|---|---|
| **Digital Inputs to Block** | | **Digital Outputs** |
| | | I/O Alarm Active |
| Emergency Stop Enable | | Emergency Stop Alarm Active |
| Safety Relay Enable | | Safety Relay Alarm Active |
| Earth Leakage Enable | | Earth Leakage Alarm Active |
| Main Circuit Breaker (MCB) Enable | | Main Circuit Breaker (MCB) Alarm Active |
| Local Isolator Enable | | Local Isolator Alarm Active |
| Motor Control Centre (MCC) Enable | | Motor Control Centre (MCC) Alarm Active |
| Thermal Overload Enable | | Thermal Overload Alarm Active |
| Trip Enable | | Trip Alarm Active |
| Failed To Run Forward Enable | | Failed To Run Forward Alarm Active |
| Failed To Run Reverse Enable | | Failed To Run Reverse Alarm Active |
| Failed To Stop Forward Enable | | Failed To Stop Forward Alarm Active |
| Failed To Stop Reverse Enable | | Failed To Stop Reverse Alarm Active |
| (Alarms can be added) | | |
| | | |
| I/O Healthy | | Alarm Active |
| Emergency Stop Healthy | | |
| Safety Relay Healthy | | |
| Earth Leakage Healthy | | |
| Main Circuit Breaker (MCB) Healthy | | |
| Local Isolator Healthy | | |
| Motor Control Centre (MCC) Healthy | | |
| Thermal Overload Healthy | | |
| Trip Healthy | | |
| | | |
| Run Forward Command | | |
| Run Reverse Command | | |
| Forward Contactor Energised | | |
| Reverse Contactor Energised | | |
| DOL Out Of Service | | |
| | | |

### 1.5.1 Digital Inputs

| | |
|---|---|
| **Emergency Stop Enable** | Enable Emergency Stop (EST) Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **Safety Relay Enable** | Enable Safety Relay (SR) Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **Earth Leakage Enable** | Enable Earth Leakage (EL) Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **Main Circuit Breaker (MCB)** | Enable Main Circuit Breaker (MCB) Alarm. Alarm will be generated when |

| | |
|---|---|
| **Enable** | enabled. No alarm will be generated when disabled. |
| **Local Isolator Enable** | Enable Local Isolator (LIS) Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **Motor Control Centre (MCC) Enable** | Enable Motor Control Centre (MCC) Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **Thermal Overload (TOL) Enable** | Enable Thermal Overload (TOL) Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **Trip Enable** | Enable Trip Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **Failed To Run Forward Enable** | Enable Failed To Run Forward (FTRF) Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **Failed To Run Reverse Enable** | Enable Failed To Run Reverse (FTRR) Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **Failed To Stop Forward Enable** | Enable Failed To Stop Forward (FTSF) Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **Failed To Stop Reverse Enable** | Enable Failed To Stop Reverse (FTSR) Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **(Alarms can be added)** | Any alarms required can be added to the DOL Alarm Block |
| **I/O Healthy** | Input signal for I/O module status. When the required I/O modules are healthy, then DOL I/O is healthy. |
| **Emergency Stop Healthy** | Input signal from I/O module for emergency Stop healthy. |
| **Safety Relay Healthy** | Input signal from I/O module for safety relay healthy. |
| **Earth Leakage Healthy** | Input signal from I/O module for earth leakage healthy. |
| **Main Circuit Breaker (MCB) Healthy** | Input signal from I/O module for MCB healthy. |
| **Local Isolator Healthy** | Input signal from I/O module for local isolator healthy. |
| **Motor Control Centre (MCC) Healthy** | Input signal from I/O module for MCC healthy. |
| **Thermal Overload Healthy** | Input signal from I/O module for thermal overload healthy. |
| **Trip Healthy** | Input signal from I/O module for trip healthy. |
| **Run Forward Command** | Input from DOL Control Function Block for run forward command active. This is used for the generation of Failed to Run/Stop Forward alarm. |
| **Run Reverse Command** | Input from DOL Control Function Block for run reverse command active. This is used for the generation of Failed to Run/Stop Reverse alarm. |

| | |
|---|---|
| **Forward Contactor Energised** | Input from DOL Control Function Block for motor forward contactor energised. This is used for the generation of Failed to Run/Stop Forward alarm. |
| **Reverse Contactor Energised** | Input from DOL Control Function Block for motor reverse contactor energised. This is used for the generation of Failed to Run/Stop Reverse alarm. |
| **DOL Out Of Service** | Input from DOL Control Function Block for DOL is in out of service mode. When out of service, no alarms will be generated. |

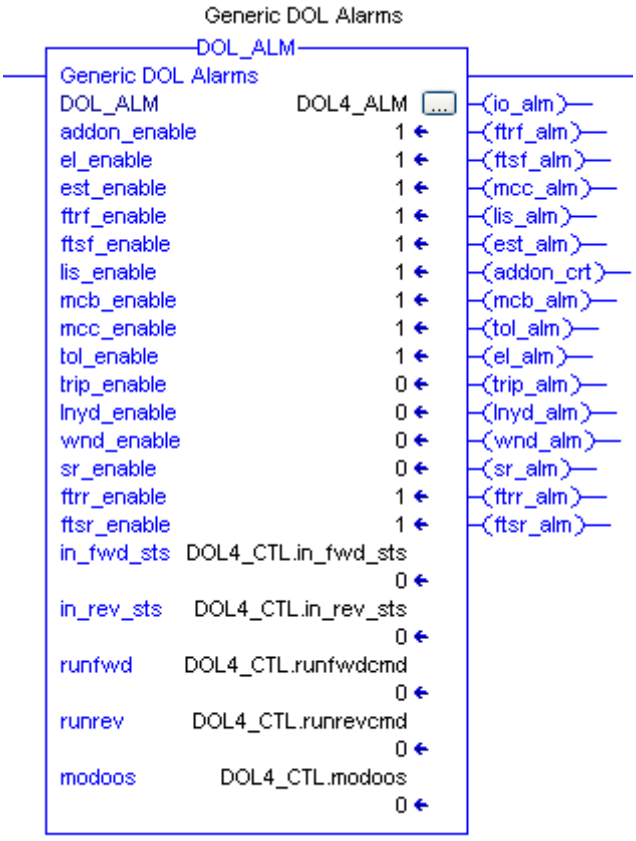
### 1.5.2 Digital Output

| | |
|---|---|
| **I/O Alarm Active** | The I/O alarm is always enabled. The I/O alarm is active when an I/O module is not healthy. Alarm is latched until condition is healthy and reset. When I/O alarm is active, no other alarms will be generated. All other alarms will only be generated when I/O is healthy. |
| **Emergency Stop Alarm Active** | An Emergency Stop alarm is active. Emergency Stop push button(s) are active. Alarm is latched until condition is healthy and reset. |
| **Safety Relay Alarm Active** | A Safety Relay Alarm Active is active. Safe Relay is not healthy Alarm is latched until condition is healthy and reset. |
| **Earth Leakage Alarm Active** | An Earth Leakage alarm is active. Earth Leakage is not healthy. Alarm is latched until condition is healthy and reset. |
| **Main Circuit Breaker (MCB) Alarm Active** | The Main Circuit Breaker alarm is active. The MCB is not healthy/not closed. Alarm is latched until condition is healthy and reset. |
| **Local Isolator Alarm Active** | The Local Isolator alarm is active. An Isolator is not healthy. Alarm is latched until condition is healthy and reset. |
| **Motor Control Centre (MCC) Alarm Active** | The MCC alarm is active. MCC is not healthy. Alarm is latched until condition is healthy and reset. |
| **Thermal Overload Alarm Active** | The Thermal Overload alarm is active. Thermal Overload is not healthy. Alarm is latched until condition is healthy and reset. |
| **Trip Alarm Active** | The Trip alarm is active. The DOL is tripped and not healthy. Alarm is latched until condition is healthy and reset. |
| **Failed To Run Forward Alarm Active** | The Failed To Run Forward alarm is active. DOL Forward contactor has failed to close when commanded to run forward. Alarm is latched until reset. |
| **Failed To Run Reverse Alarm Active** | The Failed To Run Reverse alarm is active. DOL Reverse contactor has failed to close when commanded run reverse. Alarm is latched until reset. |
| **Failed To Stop Forward Alarm Active** | The Failed To Stop Forward alarm is active. DOL Forward contactor has failed to open when commanded to stop running forward. Alarm is latched until reset. |
| **Failed To Stop Reverse Alarm Active** | The Failed To Stop Reverse alarm is active. DOL Reverse contactor has failed to open when commanded stop running reverse. Alarm is latched until reset. |

| | |
|---|---|
| **Alarm Active** | An alarm is active. This signal will be active when any one alarm is active. This signal is mapped to the DOL control block and will result in the DOL being unhealthy if alarm is active. |

### 1.5.3 Studio5000 Example Function Block

The function block below is an example used on Studio5000.



## 1.6 VSD Function Block

| VSD Function Block | | |
|---|---|---|
| **Digital Inputs to Block** | | **Digital Outputs** |
| Alarm Active | | Healthy |
| Start Permissive | | |
| Run Permissive | | |
| | | |
| Enable Input Pulse Control | | |
| Enable Auto Mode | | |
| Enable Manual Mode | | |
| Enable Out Of Service Mode | | |
| | | |
| Request Auto Mode | | In Auto Mode |
| Request Manual Mode | | In Manual Mode |
| Request Out Of Service Mode | | In Out Of Service Mode |
| | | |
| Request Auto Run Forward | | Run Pulse Command |
| Request Auto Run Reverse | | Stop Pulse Command |
| Request Auto Stop (Input Pulse Enabled) | | |
| Request Manual Run Forward | | Run Forward Command |
| Request Manual Run Reverse | | Run Reverse Command |
| Request Manual Stop | | Jog Forward Command |
| Request Manual Jog Forward | | Jog Reverse Command |
| Request Manual Jog Reverse | | |
| | | |
| Run Status | | |
| | | |
| **Analogue Inputs to Block** | | **Analogue Outputs to Block** |
| Auto Speed Setpoint (Vendor) | | Speed Reference (Vendor) |
| Manual Speed Setpoint (Vendor) | | |
| | | |
| Actual Voltage (Vendor) | | Acceleration Time (Vendor) |
| Actual Current (Vendor) | | Deceleration Time (Vendor) |
| Actual Frequency (Vendor) | | |
| Actual Power (Vendor) | | |
| Actual Power Factor (Vendor) | | |
| | | |

### 1.6.1 Digital Inputs

| | |
|---|---|
| **Alarm Active** | A VSD alarm is active in the VSD alarms block. When there is an active alarm, the VSD becomes unhealthy and the VSD function block will not generate any run commands. VSD will become healthy when there are no active alarms from the VSD Alarm block. Active alarms include failed to run, failed to stop. |
| **Start Permissive** | Start permissive only applies to auto mode, if inactive will prevent VSD start- |

| | |
|---|---|
| | up. Once the VSD is running and the start permissive becomes inactive, the VSD will continue to run. The start permissive should be listed in the VSD device routine and mapped to the VSD software block. When the start permissive is inactive, no alarms are to be created as a start permissive is purely process related. |
| **Run Permissive** | Run permissive applies to both auto and manual modes, where when inactive will prevent the VSD from running. The VSD run permissive should be listed in the VSD device routine and mapped to the VSD software block. When the run permissive is inactive, no alarms are to be generated as the run permissive is purely process related. The VSD will continue to run as soon as the start and run permissives are active. |
| **Enable Input Pulse Control** | When enabled, the function block should be able to detect the pulsed request auto run command and needs to latch internally in the function block. When input pulse control in disabled, the request auto run command needs to be latched externally to the function block, hence the run command from the function block will be active only when the request auto run command is active. |
| **Enable Auto Mode** | When enabled allows operators to select auto for the VSD operation mode. When not enabled, auto mode is not available. |
| **Enable Manual Mode** | When enabled allows operators to select manual for the VSD operation mode. When not enabled, manual mode is not available. |
| **Enable Out Of Service Mode** | When enabled allows operators to select out of service for the VSD operation mode. When not enabled, out of service mode is not available. |
| **Request Auto Mode** | A request from the HMI/SCADA to place the function block into auto mode. |
| **Request Manual Mode** | A request from the HMI/SCADA to place the function block into manual mode. |
| **Request Out of Service Mode** | A request from the HMI/SCADA to place the function block into out of service mode. |
| **Request Auto Run Forward** | Auto mode run forward command. This is a run command that is generated from the unit or system/group control or sequence routines. This command can either be a pulsed command if the input pulse control is enabled or a latched command if the input pulse control is disabled. |
| **Request Auto Run Reverse** | Auto mode run reverse command. This is a run command that is generated from the unit or system/group control or sequence routines. This command will be ignored in all modes except auto mode. This command can either be a pulsed command if the input pulse control is enabled or a latched command if the input pulse control is disabled. |
| **Request Auto Stop (Input Pulse Enabled)** | Auto mode stop command. This is a stop command that is generated from the unit or system/group control or sequence routines. This command will be ignored in all modes except auto mode. This command can only be used when the input pulse control is enabled hence can only be a pulsed command. |
| **Request Manual Run Forward** | A request from the HMI/SCADA to run the VSD in the forward direction. This request will be ignored in all modes except manual mode. |

| | |
|---|---|
| **Request Manual Run Reverse** | A request from the HMI/SCADA to run the VSD in the reverse direction. This request will be ignored in all modes except manual mode. |
| **Request Manual Stop** | A request from the HMI/SCADA to stop the VSD from running. This request will be ignored in all modes except manual mode. |
| **Request Manual Jog Forward** | A request from the HMI/SCADA to jog the VSD in the forward direction. The VSD will only jog when the jog request is active, hence must be a latched request. This request will be ignored in all modes except manual mode. |
| **Request Manual Jog Reverse** | A request from the HMI/SCADA to jog the VSD in the reverse direction. The VSD will only jog when the jog request is active, hence must be a latched request. This request will be ignored in all modes except manual mode. |
| **Run Status** | Run status mapped from the VSD. VSD is either stopped or running. |

### 1.6.2 Analogue Inputs

| | |
|---|---|
| **Auto Speed Setpoint (INT)** | The speed the VSD will run at in auto mode. The Auto Speed Setpoint should be set from the HMI/SCADA. The scaling of the setpoint is vendor specific. |
| **Manual Speed Setpoint (INT)** | The speed the VSD will run at in manual mode, including jogging speed. The Manual Speed Setpoint should be set from the HMI/SCADA. The scaling of the setpoint is vendor specific. |
| **Actual Voltage (Vendor)** | The actual motor voltage reading mapped from the VSD. The data type is vendor specific. |
| **Actual Current (Vendor)** | The actual motor current reading mapped from the VSD. The data type is vendor specific. |
| **Actual Frequency (Vendor)** | The actual motor frequency reading mapped from the VSD. The data type is vendor specific. |
| **Actual Power (Vendor)** | The actual motor power reading mapped from the VSD. The data type is vendor specific. |
| **Actual Power Factor (Vendor)** | The actual motor power factor reading mapped from the VSD. The data type is vendor specific. |

### 1.6.3 Digital Output

| | |
|---|---|
| **Healthy** | The VSD Software block is healthy. The VSD will be healthy when there are no active alarms and either auto mode or manual mode is selected. |

| | |
|---|---|
| **In Auto Mode** | The VSD is in Auto mode. When in auto mode, the unit or system/group control routines control the operation of the VSD. All start and run permissives shall apply. |
| **In Manual Mode** | The VSD is in Manual mode. Manual mode authorises the operator to execute run commands from the HMI/SCADA. Automatic commands which may have been issued shall not have any effect on the field devices. Start permissives do NOT apply. Run permissives shall apply unless stated otherwise. |
| **In Out Of Service Mode** | The VSD is in out of service mode. No run commands will be executed and no alarms shall be raised. |
| **Run Pulse Command** | Run pulse command generated by the VSD function block and mapped to the VSD. When there is a run forward command or run reverse command, the run pulse command will be pulsed. |
| **Stop Pulse Command** | Stop pulse command generated by the VSD function block and mapped to the VSD. When there is no more run forward command and run reverse command, the stop pulse command will be pulsed. |
| **Run Forward Command** | Run forward command generated and latched by the VSD function block and mapped to the VSD. This signal will be active for the whole duration the VSD is commanded to run forward. |
| **Run Reverse Command** | Run reverse command generated and latched by the VSD function block and mapped to the VSD. This signal will be active for the whole duration the VSD is commanded to run reverse. |
| **Jog Forward Command** | Jog forward command generated by the VSD function block and mapped to the VSD. This signal will be active for the whole duration the request manual jog forward signal from the HMI/SCADA is active. |
| **Jog Reverse Command** | Jog reverse command generated by the VSD function block and mapped to the VSD. This signal will be active for the whole duration the request manual jog reverse signal from the HMI/SCADA is active. |

The VSD output Run Forward Command will be generated when:

- The VSD is healthy (no alarms active)
- The VSD is In auto mode
    - Start permissive is active
    - Run permissive is active
    - Request Auto Run Forward command is latched (Input Pulse Control disabled) or pulsed (Input Pulse Control enabled)
- The VSD is in manual mode
    - Run permissive is active
    - Request Manual Run Forward is detected or Request Manual Jog Forward is active (constantly holding down the jog button on the HMI/SCADA)

The VSD output Run Reverse Command will be generated when:

- The VSD is healthy (no alarms active)
- The VSD is In auto mode
    - Start permissive active
    - Run permissive active
    - Request Auto Run Reverse command is latched (Input Pulse Control disabled) or pulsed (Input Pulse Control enabled)
- The VSD is in manual mode
    - Run permissive active
    - Request Manual Run Reverse is detected or Request Jog Reverse is active (constantly holding down the jog button).

The VSD output Run Pulse Command will be generated when:

- The VSD is healthy (no alarms active)
- The VSD is In auto mode
    - Start permissive active
    - Run permissive active
    - Request Auto Run Forward or Reverse command is latched (Input Pulse Control disabled) or pulsed (Input Pulse Control enabled)
- The VSD is in manual mode
    - Run permissive active
    - Request Manual Run Forward or Reverse is detected.

The VSD output Stop Pulse Command will be generated when:

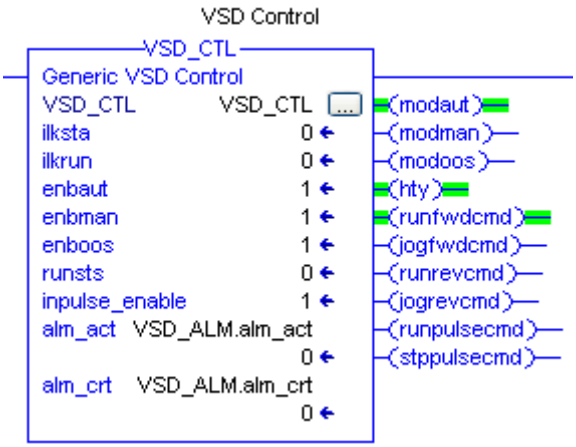
- The VSD is healthy (no alarms active)
- The VSD is In auto mode
    - Start permissive active
    - Run permissive active
    - Request Auto Run Forward and Reverse command is no longer active or the Request Auto Stop command is pulsed (Input Pulse Control enabled).
- The VSD is in manual mode
    - Run permissive active
    - Request Manual Stop is detected.

### 1.6.4 Analogue Outputs

| | |
|---|---|
| **Speed Reference (Vendor)** | The speed the VSD will run. This setpoint will vary according to the operation mode of the VSD. In auto mode, it will hold the Auto Speed Setpoint and in manual mode it will hold the Manual Speed Setpoint. The scaling of the setpoint is vendor specific. |
| **Acceleration Time (Vendor)** | Acceleration time of the VSD. The time it will take for the VSD motor to accelerate from stand still speed to the speed setpoint. The scaling of the setpoint is vendor specific. |
| **Deceleration Time (Vendor)** | Deceleration time of the VSD. The time it will take for the VSD motor to decelerate from the speed setpoint to stand still. The scaling of the setpoint is vendor specific. |

### 1.6.5 Studio5000 Example Function Block

The function block below is an example used on Studio5000.



## 1.7 VSD Alarm Function Block

| VSD Alarm Function Block | | |
|---|---|---|
| **Digital Inputs to Block** | | **Digital Outputs** |
| | | I/O Alarm Active |
| VSD Enable | | VSD Alarm Active |
| Emergency Stop Enable | | Emergency Stop Alarm Active |
| Safety Relay Enable | | Safety Relay Alarm Active |
| Earth Leakage Enable | | Earth Leakage Alarm Active |
| Main Circuit Breaker (MCB) Enable | | Main Circuit Breaker (MCB) Alarm Active |
| Local Isolator Enable | | Local Isolator Alarm Active |
| Motor Control Centre (MCC) Enable | | Motor Control Centre (MCC) Alarm Active |
| Thermal Overload Enable | | Thermal Overload Alarm Active |
| Trip Enable | | Trip Alarm Active |
| Failed To Run Enable | | Failed To Run Alarm Active |
| Failed To Stop Enable | | Failed To Stop Alarm Active |
| (Alarms can be added) | | |
| | | |
| I/O Healthy | | Alarm Active |
| VSD Healthy | | |
| Emergency Stop Healthy | | |
| Safety Relay Healthy | | |
| Earth Leakage Healthy | | |
| Main Circuit Breaker (MCB) Healthy | | |
| Local Isolator Healthy | | |
| Motor Control Centre (MCC) Healthy | | |
| Thermal Overload Healthy | | |
| Trip Healthy | | |
| | | |
| Run Command Active | | |
| Run Status | | |
| VSD Out Of Service | | |
| | | |

### 1.7.1 Digital Inputs

| | |
|---|---|
| **VSD Enable** | Enable VSD Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **Emergency Stop Enable** | Enable Emergency Stop (EST) Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **Safety Relay Enable** | Enable Safety Relay (SR) Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |

| | |
|---|---|
| **Earth Leakage Enable** | Enable Earth Leakage (EL) Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **Main Circuit Breaker (MCB) Enable** | Enable Main Circuit Breaker (MCB) Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **Local Isolator Enable** | Enable Local Isolator (LIS) Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **Motor Control Centre (MCC) Enable** | Enable Motor Control Centre (MCC) Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **Thermal Overload (TOL) Enable** | Enable Thermal Overload (TOL) Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **Trip Enable** | Enable Trip Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **Failed To Run Enable** | Enable Failed To Run (FTR) Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **Failed To Stop Enable** | Enable Failed To Stop (FTS) Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **(Alarms can be added)** | Any alarms required can be added to the VSD Alarm Block |
| **I/O Healthy** | Input signal for I/O module status. When the required I/O modules are healthy, then VSD I/O is healthy. |
| **VSD Healthy** | Input signal mapped from the VSD for VSD healthy. |
| **Emergency Stop Healthy** | Input signal from I/O module for emergency Stop healthy. |
| **Safety Relay Healthy** | Input signal from I/O module for safety relay healthy. |
| **Earth Leakage Healthy** | Input signal from I/O module for earth leakage healthy. |
| **Main Circuit Breaker (MCB) Healthy** | Input signal from I/O module for MCB healthy. |
| **Local Isolator Healthy** | Input signal from I/O module for local isolator healthy. |
| **Motor Control Centre (MCC) Healthy** | Input signal from I/O module for MCC healthy. |
| **Thermal Overload Healthy** | Input signal from I/O module for thermal overload healthy. |
| **Trip Healthy** | Input signal from I/O module for trip healthy. |
| **Run Command** | Input from VSD Control Function Block for a run command is active. This is used for the generation of Failed to Run/Stop alarms. |
| **Run Status** | Input from VSD Control Function Block for the motor running status. This is used for the generation of Failed to Run/Stop alarms. |

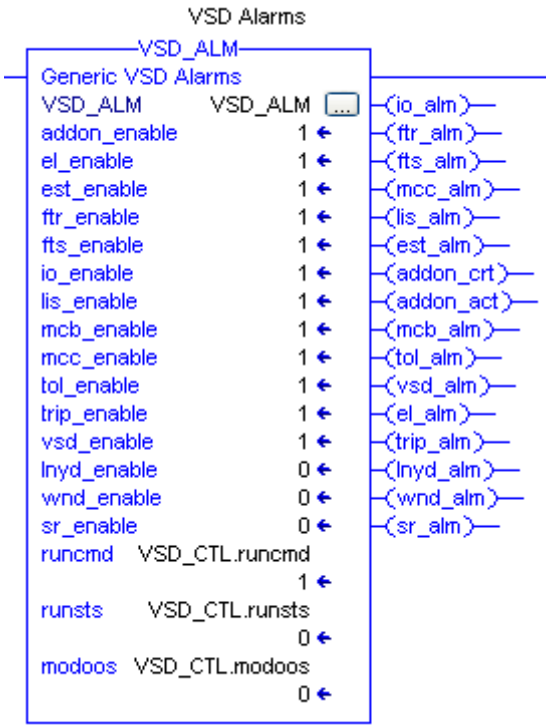
| | |
|---|---|
| **VSD Out Of Service** | Input from VSD Control Function Block for VSD is in out of service mode. When out of service, no alarms will be generated. |

### 1.7.2 Digital Output

| | |
|---|---|
| **I/O Alarm Active** | The I/O alarm is always enabled. The I/O alarm is active when an I/O module is not healthy. Alarm is latched until condition is healthy and reset. When I/O alarm is active, no other alarms will be generated. All other alarms will only be generated when I/O is healthy. |
| **VSD Alarm Active** | A VSD alarm is active. Alarm is latched until condition is healthy and reset. |
| **Emergency Stop Alarm Active** | An Emergency Stop alarm is active. Emergency Stop push button(s) are active. Alarm is latched until condition is healthy and reset. |
| **Safety Relay Alarm Active** | A Safety Relay Alarm Active is active. Safe Relay is not healthy Alarm is latched until condition is healthy and reset. |
| **Earth Leakage Alarm Active** | An Earth Leakage alarm is active. Earth Leakage is not healthy. Alarm is latched until condition is healthy and reset. |
| **Main Circuit Breaker (MCB) Alarm Active** | The Main Circuit Breaker alarm is active. The MCB is not healthy/not closed. Alarm is latched until condition is healthy and reset. |
| **Local Isolator Alarm Active** | The Local Isolator alarm is active. An Isolator is not healthy. Alarm is latched until condition is healthy and reset. |
| **Motor Control Centre (MCC) Alarm Active** | The MCC alarm is active. MCC is not healthy. Alarm is latched until condition is healthy and reset. |
| **Thermal Overload Alarm Active** | The Thermal Overload alarm is active. Thermal Overload is not healthy. Alarm is latched until condition is healthy and reset. |
| **Trip Alarm Active** | The Trip alarm is active. The VSD is tripped and not healthy. Alarm is latched until condition is healthy and reset. |
| **Failed To Run Alarm Active** | The Failed To Run alarm is active. VSD has failed to run when commanded to run. Alarm is latched until reset. |
| **Failed To Stop Alarm Active** | The Failed To Stop alarm is active. VSD has failed to stop when commanded to stop. Alarm is latched until reset. |
| **Alarm Active** | An alarm is active. This signal will be active when any one alarm is active. This signal is mapped to the VSD control block and will result in the VSD being unhealthy if alarm is active. |

### 1.7.3 Studio5000 Example Function Block

The function block below is an example used on Studio5000.



## 1.8 VSD Data Mapping

VSD data mapping should be completed in a separate routine in the I/O section of the PLC. Data mapping includes digital input, digital outputs, analogue inputs and analogue outputs. VSD mapping should not be contained in the VSD Function Block. This allows the VSD function block to be used for VSDs from any Vendor.

## 1.9 Valve (Single & Double Acting) Function Block

| Valve Function Block | | |
|---|---|---|
| **Digital Inputs to Block** | | **Digital Outputs** |
| Alarm Active | | Healthy |
| Open Permissive | | |
| Close Permissive | | |
| | | |
| Enable Input Pulse Control | | |
| Enable Auto Mode | | |
| Enable Manual Mode | | |
| Enable Out Of Service Mode | | |
| | | |
| Request Auto Mode | | In Auto Mode |
| Request Manual Mode | | In Manual Mode |
| Request Out Of Service Mode | | In Out Of Service Mode |
| | | |
| Request Auto Open | | Open Command |
| Request Auto Close (Input Pulse Enabled) | | Close Command |
| | | |
| Request Manual Open | | |
| Request Manual Close | | |
| | | |
| Open Status | | |
| Close Status | | |
| | | |

### 1.9.1 Digital Inputs

| | |
|---|---|
| **Alarm Active** | A valve alarm is active in the valve alarms block. When there is an active alarm, the valve becomes unhealthy and the valve function block will not generate any commands. The valve will become healthy when there are no active alarms. Active alarms include failed to open, failed to close. |
| **Open Permissive** | Open permissive applies to both auto mode and manual mode, unless stated otherwise. If inactive will prevent the valve from opening. Once the valve is opened and the open permissive becomes inactive, the valve open command will be inactive. The open permissive should be listed in the valve device routine and mapped to the valve software block. When the open permissive is inactive, no alarms are to be created as open permissives are purely process related. |
| **Close Permissive** | Close permissive applies to both auto and manual modes, unless stated otherwise. When inactive will prevent the valve from closing. Once the valve is closed and the close permissive becomes inactive, the valve close command will be inactive. The valve close permissive should be listed in the valve device routine and mapped to the valve software block. When the close permissive is |

| | |
|---|---|
| | inactive, no alarms are to be generated as the close permissive is purely process related. |
| **Enable Input Pulse Control** | When enabled, the function block should be able to detect the pulsed request auto open/close command and needs to latch internally in the function block. When input pulse control in disabled, the request auto open command needs to be latched externally to the function block, hence the open command from the function block will be active only when the request auto open command is active. |
| **Enable Auto Mode** | When enabled allows operators to select auto for the valve operation mode. When not enabled, auto mode is not available. |
| **Enable Manual Mode** | When enabled allows operators to select manual for the valve operation mode. When not enabled, manual mode is not available. |
| **Enable Out Of Service Mode** | When enabled allows operators to select out of service for the valve operation mode. When not enabled, out of service mode is not available. |
| **Request Auto Mode** | A request from the HMI/SCADA to place the function block into auto mode. |
| **Request Manual Mode** | A request from the HMI/SCADA to place the function block into manual mode. |
| **Request Out of Service Mode** | A request from the HMI/SCADA to place the function block into out of service mode. |
| **Request Auto Open** | Auto mode open command. This is an open command that is generated from the unit or system/group control or sequence routines. This command can either be a pulsed command if the input pulse control is enabled or a latched command if the input pulse control is disabled. This command will be ignored in all modes except auto mode. |
| **Request Auto Close (Input Pulse Enabled)** | Auto mode close command. This is a close command that is generated from the unit or system/group control or sequence routines. This command will be ignored in all modes except auto mode. This command can only be used when the input pulse control is enabled hence can only be a pulsed command. |
| **Request Manual Open** | A request from the HMI/SCADA to open the valve in the forward direction. This request will be ignored in all modes except manual mode. |
| **Request Manual Close** | A request from the HMI/SCADA to close the valve from running. This request will be ignored in all modes except manual mode. |
| **Open Status** | Digital Input feedback into I/O module for valve is open status. |
| **Close Status** | Digital Input feedback into I/O module for valve is closed status. |

### 1.9.2 Digital Output

| | |
|---|---|
| **Healthy** | The valve Software block is healthy. The valve will be healthy when there are no active alarms and either auto mode or manual mode is selected. |
| **In Auto Mode** | The valve is in Auto mode. When in auto mode, the unit or system/group control routines control the operation of the valve. All open and close permissives shall apply. |
| **In Manual Mode** | The valve is in Manual mode. Manual mode authorises the operator to execute commands from the HMI/SCADA. Automatic commands which may have been issued shall not have any effect on the device. Open and close permissives do apply. |
| **In Out Of Service Mode** | The valve is in out of service mode. No commands will be executed and no alarms shall be raised. |
| **Open Command** | Open command generated by the valve function block. This command is a digital output to energise the valve to open. For single and double acting valves, when this command is active, the valve will open. For single acting valves when this command is not active, the valve will close. |
| **Close Command** | Close command generated by the valve function block. This command is a digital output to energise the valve to close. For double acting valves, when this command is active, the valve will close. |

The valve open command will be generated when:

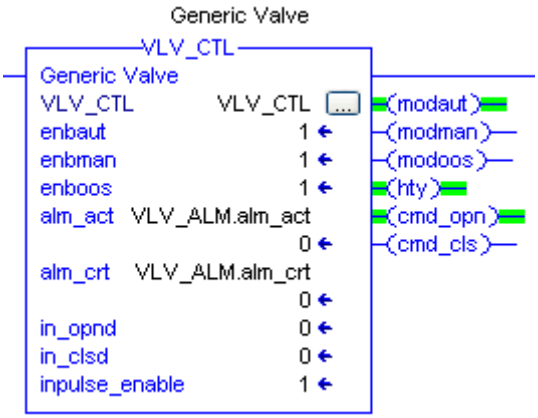
- The valve is healthy (no alarms active)
- The valve is In auto mode
    - Open permissive active
    - Request Auto Open command is latched (Input Pulse Control disabled) or pulsed (Input Pulse Control enabled)
- The valve is in manual mode
    - Open permissive is active
    - Request Manual Open is detected

The valve close command will be generated when:

- The valve is healthy (no alarms active)
- The valve is In auto mode
    - Close permissive active
    - Request Auto Open command is unlatched (Input Pulse Control disabled) or Request Auto Close command pulsed (Input Pulse Control enabled)
- The valve is in manual mode
    - Close permissive is active
    - Request Manual Close is detected

### 1.9.3 Studio5000 Example Function Block

The function block below is an example used on Studio5000.




## 1.10 Valve Alarm Function Block

| Valve Alarm Function Block | | |
|---|---|---|
| **Digital Inputs to Block** | | **Digital Outputs** |
| | | I/O Alarm Active |
| Emergency Stop Enable | | Emergency Stop Alarm Active |
| Failed To Run Enable | | Failed To Open Alarm Active |
| Failed To Stop Enable | | Failed To Close Alarm Active |
| (Alarms can be added) | | |
| | | |
| I/O Healthy | | Alarm Active |
| Emergency Stop Healthy | | |
| | | |
| Open Command Active | | |
| Close Command Active | | |
| Open Status | | |
| Close Status | | |
| VSD Out of Service | | |
| | | |

### 1.10.1 Digital Inputs

| | |
|---|---|
| **Emergency Stop Enable** | Enable Emergency Stop (EST) Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **Failed To Run Enable** | Enable Failed to Run (FTR) Alarm. Alarm will be generated when enabled. No alarm will be generated when disabled. |
| **Failed To Stop Enable** | Enable Failed to Stop (FTS) Alarm. Alarm will be generated when enabled. No |

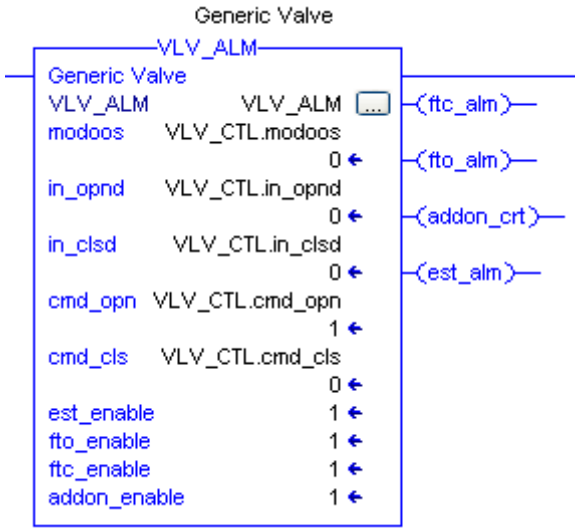
| | |
|---|---|
| | alarm will be generated when disabled. |
| **(Alarms can be added)** | Any alarms required can be added to the VSD Alarm Block |
| **I/O Healthy** | Input signal for I/O module status. When the required I/O modules are healthy, then VSD I/O is healthy. |
| **Emergency Stop Healthy** | Input signal from I/O module for emergency Stop healthy. |
| **Open Command Active** | Input from VSD Control Function Block for an open command is active. This is used for the generation of Failed to Open alarms. |
| **Close Command Active** | Input from VSD Control Function Block for a closed command is active. This is used for the generation of Failed to Closed alarms. |
| **Open Status** | Input from VSD Control Function Block for the valve open status. This is used for the generation of Failed to Open alarm. |
| **Close Status** | Input from VSD Control Function Block for the valve closed status. This is used for the generation of Failed to Closed alarms. |
| **VSD Out of Service** | Input from Valve Control Function Block for valve is in out of service mode. When out of service, no alarms will be generated. |

### 1.10.2 Digital Output

| | |
|---|---|
| **I/O Alarm Active** | The I/O alarm is always enabled. The I/O alarm is active when an I/O module is not healthy. Alarm is latched until condition is healthy and reset. When I/O alarm is active, no other alarms will be generated. All other alarms will only be generated when I/O is healthy. |
| **Emergency Stop Alarm Active** | An Emergency Stop alarm is active. Emergency Stop push button(s) are active. Alarm is latched until condition is healthy and reset. |
| **Failed To Open Alarm Active** | The Failed to Open alarm is active. Valve has failed to open when commanded to open. Alarm is latched until reset. |
| **Failed To Close Alarm Active** | The Failed to Close alarm is active. Valve has failed to close when commanded to close. Alarm is latched until reset. |
| **Alarm Active** | An alarm is active. This signal will be active when any one alarm is active. This signal is mapped to the valve control block and will result in the valve being unhealthy if alarm is active. |

### 1.10.3 Studio5000 Example Function Block

The function block below is an example used on Studio5000.

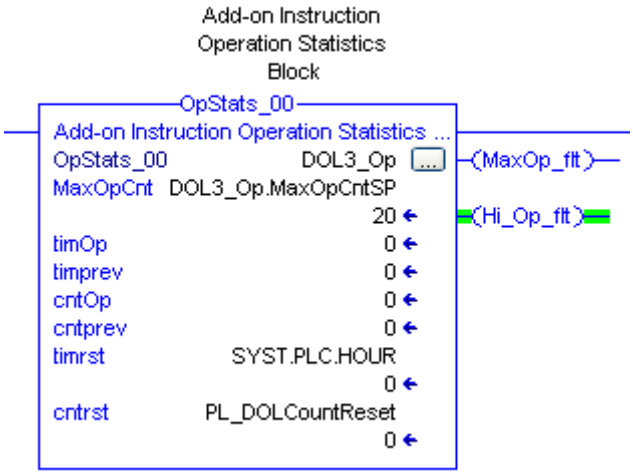



## 1.11 Device Operation Statistics Function Block

| Operation Statistics Function Block | | |
|---|---|---|
| **Digital Inputs** | | **Digital Outputs** |
| | | |
| Operations Count Reset | | High Operation Alarm |
| Alarm Reset | | |
| | | |
| **Analogue Inputs** | | **Analogue Outputs** |
| Maximum Operation Setpoint (DINT) | | Current Number Of Operations (DINT) |
| | | Previous Number Of Operations (DINT) |
| | | Current Total Run Time (Accumulative) (DINT) |
| | | Previous Total Run Time (DINT) |
| | | |

### 1.11.1 Studio5000 Example Function Block

The function block below is an example used on Studio5000.


Add-on Instruction
Operation Statistics
Block
OpStats_00
Add-on Instruction Operation Statistics ...
OpStats_00
DOL3_Op
...
(MaxOp_flt)
MaxOpCnt
DOL3_Op.MaxOpCntSP
20
(Hi_Op_flt)
timOp
0
timprev
0
cntOp
0
cntprev
0
timrst
SYST.PLC.HOUR
0
cntrst
PL_DOLCountReset
0