

APPLICATION PROFILE

Studio 5000 Logix Designer Add-On Instructions

OVERVIEW

This condition monitoring Add-On Instruction is used to detect motor load disturbance & variations in Torque Estimate from Virtual Torque Sensor (available in Studio 5000 Logix Designer V33 and above) or any other drive signals that can sense the disturbance to be detected.

This AOI can detect abnormal conditions on the load, monitor production quality deviations, detect jams, assist during maintenance and perform predictive maintenance.

The magnitude and duration of this disturbance or variation that will cause this AOI to issue a fault event is programmable.

BENEFITS

This AOI will simplify the implementation and reduce the time required for customers to develop, test, and verify their Studio 5000 Logix Designer motion control applications that require Load Condition Monitoring

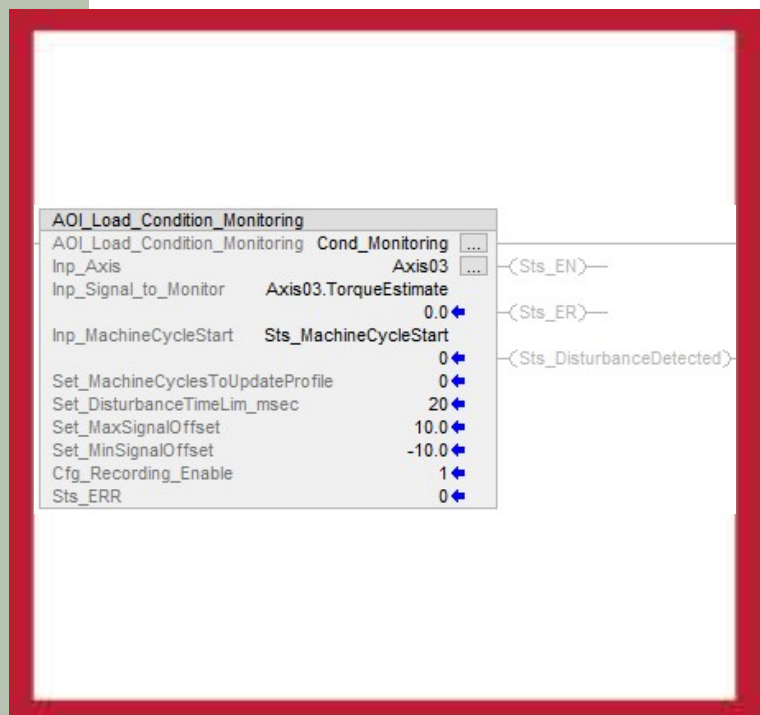
Download the necessary files for this AOI from Sample Code Library under ID 101051:

<http://samplecode.rockwellautomation.com>

Add-On Instruction:

AOI_Load_Condition_Monitoring

Enabled for VTS (Virtual Torque Sensor)



Description

The AOI_LoadConditionMonitoring is an Add-on Instruction (AOI) that continuously monitors an user-defined axis signal (Inp_Signal_to_Monitor) to detect behavior deviations or disturbances, which may be caused by jams or mechanical system issues including gear tooth fracture or breakage in gearboxes, bearing damages, damaged coupling, damaged ballscrews, and broken blades or wore blades in rotary knives. This AOI can also be used in quality control and maintenance, such as in the assistance on belt replacement to ensure that belt tension before and after replacement is consistent. The magnitude and duration of this signal disturbance that cause this AOI to detect an anomaly event is programmable.

This AOI saves the profile of signal selected in Inp_Signal_to_Monitor for one machine cycle (referred as *saved signal profile*) and compares to its instantaneous values at coarse update rate on the subsequent machine cycles. The difference between the *saved signal profile* and instantaneous value of the signal in Inp_Signal_to_Monitor is the *signal offset*. If the *signal offset* is larger than the programmable MIN and MAX limits for a certain period of time which is also programmable, the AOI indicates that an anomaly was detected. Additionally, this AOI also refreshes the *saved signal profile* every time that a programmable number of cycle machines is completed (if set to 0, the AOI will record the signal only once when the AOI is enabled). This allows to compensate for signal profile changes, if needed, which can be caused by events such as mechanical wear and load changes.

The screenshot shows the configuration window for the AOI_Load_Condition_Monitoring instruction. The window is titled "AOI_Load_Condition_Monitoring" and contains a list of parameters and their values. The parameters are:

- AOI_Load_Condition_Monitoring Cond_Monitoring ...
- Inp_Axis Axis03
- Inp_Signal_to_Monitor Axis03.TorqueEstimate
- Inp_MachineCycleStart 0.0
- Sts_MachineCycleStart 0
- Set_MachineCyclesToUpdateProfile 0
- Set_DisturbanceTimeLim_msec 20
- Set_MaxSignalOffset 10.0
- Set_MinSignalOffset -10.0
- Cfg_Recording_Enable 1
- Sts_ERR 0

On the right side of the window, there are three status indicators: {Sts_EN}, {Sts_ER}, and {Sts_DisturbanceDetected}.

Variable	Value
Cond_Monitoring	{...} AOI_Load_Condition_Monitoring
Cond_Monitoring.Cfg_Recording_Enable	1 BOOL
Cond_Monitoring.Disturbance_Counter	0 DINT
Cond_Monitoring.EnableIn	0 BOOL
Cond_Monitoring.EnableOut	0 BOOL
Cond_Monitoring.Inp_MachineCycleStart	0 BOOL
Cond_Monitoring.Inp_Signal_to_Monitor	0.0 REAL
Cond_Monitoring.Set_DisturbanceTimeLim_msec	20 DINT
Cond_Monitoring.Set_MachineCyclesToUpdateProfile	0 DINT
Cond_Monitoring.Set_MaxSignalOffset	10.0 REAL
Cond_Monitoring.Set_MinSignalOffset	-10.0 REAL
Cond_Monitoring.Sts_DisturbanceDetected	0 BOOL
Cond_Monitoring.Sts_EN	0 BOOL
Cond_Monitoring.Sts_ER	0 BOOL
Cond_Monitoring.Sts_ERR	0 DINT
Cond_Monitoring.Val_SavedSignalProfile	22.551641 REAL
Cond_Monitoring.Val_SignalOffset	0.018749237 REAL
Cond_Monitoring.Val_SignalOverLimitCounts	0 DINT

Description

The user can set the following parameters in this AOI:

- MIN and MAX Signal Offset: the maximum and minimum limits of the Signal offset.
- Disturbance Time Limit: the minimum period of time that a disturbance or deviation event has to be disturbing the input signal to make the magnitude of Signal offset be outside the limits set in MIN and MAX Signal Offset in order to detect a deviation or disturbance event.
- Machine Cycles to Update Profile: the number of machine cycles that the AOI waits to refresh the saved torque profile. If Set to 0, the counter is ignored, and the profile is saved only once at the startup of the AOI

This instruction has the following status indicators:

- If a disturbance event was detected (Sts_DisturbanceDetected)
- Instruction Error Status (Sts_ER)
- Instruction Error Code (Sts_ERR)

This AOI must remain enabled to detects events. This instruction is only re-enabled to erase the error bit and start over the detection process.

AOI_Load_Condition_Monitoring	
AOI_Load_Condition_Monitoring	Cond_Monitoring
Inp_Axis	Axis03
Inp_Signal_to_Monitor	Axis03.TorqueEstimate
Inp_MachineCycleStart	Sts_MachineCycleStart
Set_MachineCyclesToUpdateProfile	0
Set_DisturbanceTimeLim_msec	20
Set_MaxSignalOffset	10.0
Set_MinSignalOffset	-10.0
Cfg_Recording_Enable	1
Sts_ERR	0

Cond_Monitoring	{...} AOI_Load_Condition_Monitoring
Cond_Monitoring.Cfg_Recording_Enable	1 BOOL
Cond_Monitoring.Disturbance_Counter	0 DINT
Cond_Monitoring.EnableIn	0 BOOL
Cond_Monitoring.EnableOut	0 BOOL
Cond_Monitoring.Inp_MachineCycleStart	0 BOOL
Cond_Monitoring.Inp_Signal_to_Monitor	0.0 REAL
Cond_Monitoring.Set_DisturbanceTimeLim_msec	20 DINT
Cond_Monitoring.Set_MachineCyclesToUpdateProfile	0 DINT
Cond_Monitoring.Set_MaxSignalOffset	10.0 REAL
Cond_Monitoring.Set_MinSignalOffset	-10.0 REAL
Cond_Monitoring.Sts_DisturbanceDetected	0 BOOL
Cond_Monitoring.Sts_EN	0 BOOL
Cond_Monitoring.Sts_ER	0 BOOL
Cond_Monitoring.Sts_ERR	0 DINT
Cond_Monitoring.Val_SavedSignalProfile	22.551641 REAL
Cond_Monitoring.Val_SignalOffset	0.018749237 REAL
Cond_Monitoring.Val_SignalOverLimitCounts	0 DINT

Description

Parameter Definitions

Inp_Axis: (AXIS_CIP_DRIVE)

Axis to be monitored.

Inp_Signal_to_Monitor: (REAL)

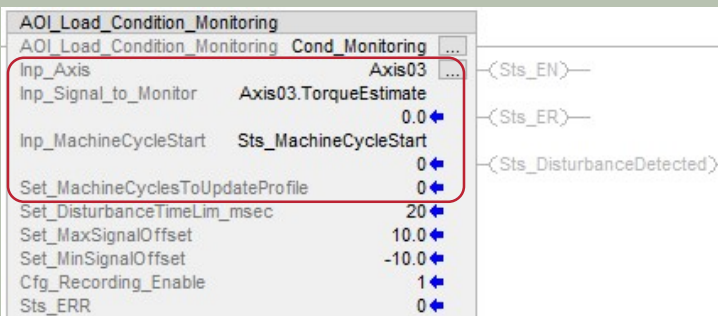
This is the signal to be monitored to detect anomalies. For drives with Virtual Torque Sensor (VTS) feature, Torque Estimate is in general assigned to this input. Current Feedback is in general used for drives without VTS. Current Feedback and Torque Estimate need to be selected in Cyclic Parameters to be updated in the controllers at the course update rate. Any real tag can be assigned to this input.

Inp_MachineCycleStart: (BOOL)

This bit informs the AOI every time a new machine cycle starts. This bit needs to be set immediately after a new machine cycle starts and reset before each machine cycle completes. You can use the 1st segment status of a cam profile for example.

Set_MachineCyclesToUpdateProfile: (DINT)

Defines the number of machine cycles that this AOI waits before refreshing (updating) the torque profile saved for one machine cycle. This AOI saves the profile of the signal defined in Inp_Signal_to_Monitor during the first complete machine cycle once the machine is in operation and the AOI is enabled. Additionally, this AOI updates the saved torque profile every time that the number of machine cycles defined in this parameter Set_MachineCyclesToUpdateProfile is reached, unless if set to 0. In this case, the profile will be saved only once when the AOI is enabled.



Cond_Monitoring	{...} AOI_Load_Condition_Monitoring
Cond_Monitoring.Cfg_Recording_Enable	1 BOOL
Cond_Monitoring.Disturbance_Counter	0 DINT
Cond_Monitoring.EnableIn	0 BOOL
Cond_Monitoring.EnableOut	0 BOOL
Cond_Monitoring.Inp_MachineCycleStart	0 BOOL
Cond_Monitoring.Inp_Signal_to_Monitor	0.0 REAL
Cond_Monitoring.Set_DisturbanceTimeLim_msec	20 DINT
Cond_Monitoring.Set_MachineCyclesToUpdateProfile	0 DINT
Cond_Monitoring.Set_MaxSignalOffset	10.0 REAL
Cond_Monitoring.Set_MinSignalOffset	-10.0 REAL
Cond_Monitoring.Sts_DisturbanceDetected	0 BOOL
Cond_Monitoring.Sts_EN	0 BOOL
Cond_Monitoring.Sts_ER	0 BOOL
Cond_Monitoring.Sts_ERR	0 DINT
Cond_Monitoring.Val_SavedSignalProfile	22.551641 REAL
Cond_Monitoring.Val_SignalOffset	0.018749237 REAL
Cond_Monitoring.Val_SignalOverLimitCounts	0 DINT

Description

Parameter Definitions

Set_DisturbanceTimeLim_msec: (DINT)

Sets the period of time in milliseconds allowed for a signal disturbance event (e.g. jam, mechanical system issue) to occur before this AOI issues a fault event by turning on the Sts_DisturbanceDetected status bit. This parameter is associated to the coarse update period of the motion group. The Set_DisturbanceTimeLim_msec is divided by the coarse update period and the truncated result defines the number of coarse updates that the disturbance offset need to be outside the limits set by the Set_MaxSignalOffset and Set_MinSignalOffset parameters before this AOI detects a disturbance event.

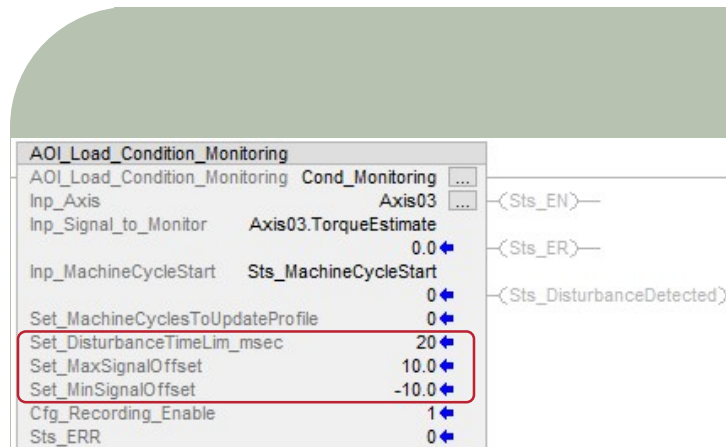
Set_MaxSignalOffset: (REAL)

Defines the maximum value for the *signal offset*. The unit for this parameter is the same for the signal selected in Inp_Signal_to_Monitor.

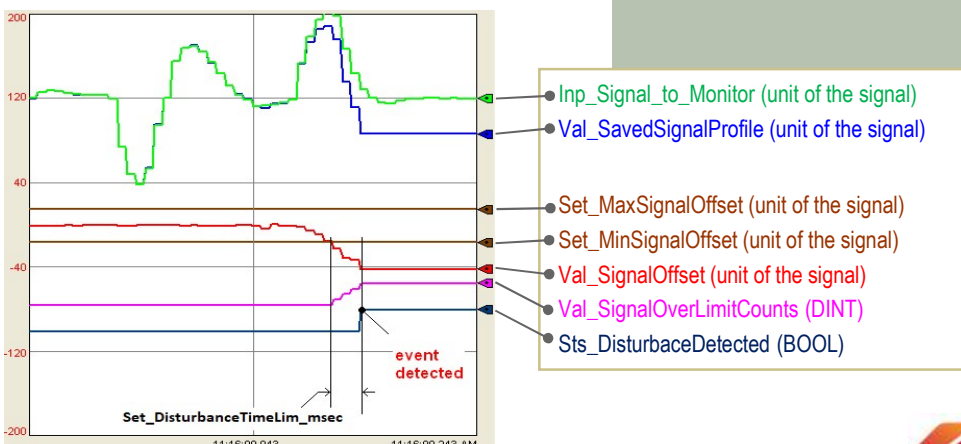
Set_MinSignalOffset: (REAL)

Defines the minimum value for the *signal offset*. The unit for this parameter is the same for the signal selected in Inp_Signal_to_Monitor.

If the *signal offset* is outside the limits set by Set_MaxSignalOffset and Set_MinSignalOffset parameters for a period of time longer than the value set in Set_DisturbanceTimeLim_msec, the Sts_DisturbanceDetected bit is turned on to identify that a fault event was detected.



Cond_Monitoring	{...} AOI_Load_Condition_Monitoring
Cond_Monitoring.Cfg_Recording_Enable	1 BOOL
Cond_Monitoring.Disturbance_Counter	0 DINT
Cond_Monitoring.EnableIn	0 BOOL
Cond_Monitoring.EnableOut	0 BOOL
Cond_Monitoring.Inp_MachineCycleStart	0 BOOL
Cond_Monitoring.Inp_Signal_to_Monitor	0.0 REAL
Cond_Monitoring.Set_DisturbanceTimeLim_msec	20 DINT
Cond_Monitoring.Set_MachineCyclesToUpdateProfile	0 DINT
Cond_Monitoring.Set_MaxSignalOffset	10.0 REAL
Cond_Monitoring.Set_MinSignalOffset	-10.0 REAL
Cond_Monitoring.Sts_DisturbanceDetected	0 BOOL
Cond_Monitoring.Sts_EN	0 BOOL
Cond_Monitoring.Sts_ER	0 BOOL
Cond_Monitoring.Sts_ERR	0 DINT
Cond_Monitoring.Val_SavedSignalProfile	22.551641 REAL
Cond_Monitoring.Val_SignalOffset	0.018749237 REAL
Cond_Monitoring.Val_SignalOverLimitCounts	0 DINT



Description

Parameter Definitions

Sts_EN: (BOOL)

Enable bit is set when the rung-in condition is true, indicating the instruction is being scanned.

Sts_ER: (BOOL)

The Error bit is set if the AOI tries to index data from the array that saved the signal profile beyond its dimension. This AOI has to be re-enabled to reset the Sts_ER bit.

Sts_DisturbanceDetected: (BOOL)

Indicates that a disturbance was detected in the signal that is being monitored. This bit may be used to take actions such as stop motion, generate an warning, or slow down the system. This AOI does not stop motion and it doesn't control the axis, it only monitors the axis behavior. This bit is reset when the AOI is re-enabled.

Cfg_Recording_Enable: (BOOL)

When this bit is set and the AOI is enabled, the AOI records the profile of the signal defined in Inp_Signal_to_Monitor for a machine cycle. The AOI will also record the profile again every time that the machine runs the number of machine cycles defined in Set_MachineCyclesToUpdateProfile. If this bit is set to 0, no recording will occur at startup or while the AOI is enabled. This is important when the original recording needs to be preserved when the AOI is disabled.

The screenshot shows the 'AOI_Load_Condition_Monitoring' configuration window. The 'Cfg_Recording_Enable' parameter is highlighted with a red box and set to 1. To the right, a red box highlights the status bits: Sts_EN, Sts_ER, and Sts_DisturbanceDetected.

Parameter	Value	Unit
Cond_Monitoring	{...} AOI_Load_Condition_Monitoring	
Cond_Monitoring.Cfg_Recording_Enable	1	BOOL
Cond_Monitoring.Disturbance_Counter	0	DINT
Cond_Monitoring.EnableIn	0	BOOL
Cond_Monitoring.EnableOut	0	BOOL
Cond_Monitoring.Inp_MachineCycleStart	0	BOOL
Cond_Monitoring.Inp_Signal_to_Monitor	0.0	REAL
Cond_Monitoring.Set_DisturbanceTimeLim_msec	20	DINT
Cond_Monitoring.Set_MachineCyclesToUpdateProfile	0	DINT
Cond_Monitoring.Set_MaxSignalOffset	10.0	REAL
Cond_Monitoring.Set_MinSignalOffset	-10.0	REAL
Cond_Monitoring.Sts_DisturbanceDetected	0	BOOL
Cond_Monitoring.Sts_EN	0	BOOL
Cond_Monitoring.Sts_ER	0	BOOL
Cond_Monitoring.Sts_ERR	0	DINT
Cond_Monitoring.Val_SavedSignalProfile	22.551641	REAL
Cond_Monitoring.Val_SignalOffset	0.018749237	REAL
Cond_Monitoring.Val_SignalOverLimitCounts	0	DINT

Description

Parameter Definitions

Sts_ERR: (DINT)

Error codes:

Sts_ERR	Description
0	No Error
20	<p>The AOI doesn't have enough memory space to store data for one machine cycle. Verify that the machine cycle time is not higher than maximum machine cycle that this original AOI can store, which is given as:</p> $\text{Max Machine Cycle Time [sec]} = 1000 \times \text{CUP [sec]}$ <p>where, CUP is the Coarse Update Period, and 1000 is the maximum number of datapoints that the AOI can store.</p> <p>If the machine cycle time is higher than this calculate Max Machine Cycle Time, the AOI with 5000 datapoints can be used:</p> <p>AOI_Load_Condition_Monitoring5000.L5X.</p> <p>On the other hand, this AOI with lower storage capacity may be convenient to reduce the amount of memory space required for this AOI as long as the AOI can still store data for one machine cycle.</p> <p>This AOI is provided with four storage capacities:</p> <ul style="list-style-type: none"> 200 datapoints: AOI_Load_Condition_Monitoring200.L5X 500 datapoints: AOI_Load_Condition_Monitoring500.L5X 1000 datapoints: AOI_Load_Condition_Monitoring.L5X 5000 datapoints: AOI_Load_Condition_Monitoring5000.L5X

AOI_Load_Condition_Monitoring

AOI_Load_Condition_Monitoring Cond_Monitoring ...

Inp_Axis Axis03 ... (Sts_EN)

Inp_Signal_to_Monitor Axis03.TorqueEstimate ... (Sts_ER)

Inp_MachineCycleStart Sts_MachineCycleStart ... (Sts_DisturbanceDetected)

Set_MachineCyclesToUpdateProfile 0

Set_DisturbanceTimeLim_msec 20

Set_MaxSignalOffset 10.0

Set_MinSignalOffset -10.0

Cfg_Recording_Enable 1

Sts_ERR 0

AOI_Load_Condition_Monitoring200

AOI_Load_Condition_Monitoring200 Cond_Monitoring200 ...

Inp_Axis Axis03 ... (Sts_EN)

Inp_Signal_to_Monitor Axis03.TorqueEstimate ... (Sts_ER)

Inp_MachineCycleStart Sts_MachineCycleStart ... (Sts_DisturbanceDetected)

Set_MachineCyclesToUpdateProfile 0

Set_DisturbanceTimeLim_msec 500

Set_MaxSignalOffset 10.0

Set_MinSignalOffset -10.0

Cfg_Recording_Enable 1

Sts_ERR 0

AOI_Load_Condition_Monitoring500

AOI_Load_Condition_Monitoring500 Cond_Monitoring500 ...

Inp_Axis Axis03 ... (Sts_EN)

Inp_Signal_to_Monitor Axis03.TorqueEstimate ... (Sts_ER)

Inp_MachineCycleStart Sts_MachineCycleStart ... (Sts_DisturbanceDetected)

Set_MachineCyclesToUpdateProfile 0

Set_DisturbanceTimeLim_msec 500

Set_MaxSignalOffset 10.0

Set_MinSignalOffset -10.0

Cfg_Recording_Enable 0

Sts_ERR 0

AOI_Load_Condition_Monitoring5000

AOI_Load_Condition_Monitoring5000 Cond_Monitoring5000 ...

Inp_Axis Axis03 ... (Sts_EN)

Inp_Signal_to_Monitor Axis03.TorqueEstimate ... (Sts_ER)

Inp_MachineCycleStart Sts_MachineCycleStart ... (Sts_DisturbanceDetected)

Set_MachineCyclesToUpdateProfile 0

Set_DisturbanceTimeLim_msec 500

Set_MaxSignalOffset 10.0

Set_MinSignalOffset -10.0

Cfg_Recording_Enable 1

Sts_ERR 0

Description

Parameter Definitions

The following parameters are not visible on the AOI but they are part of the AOI structure to help understand the behavior of this AOI.

Val_SavedSignalProfile: (REAL)

Contains the instantaneous value of the saved signal profile that is being compared to the Inp_Signal_to_Monitor signal at each coarse update period. The Inp_Signal_to_Monitor and this parameter can be trend to verify is the AOI saved the Signal profile for one machine cycle correctly.

Val_SignalOffset: (REAL)

It is the difference between the Inp_Signal_to_Monitor and the saved signal profile. If the value of the Val_SignalOffset calculated by the AOI is outside the limits defined by Set_MaxSignalOffset and Set_MinSignalOffset for a period of time higher than the value set in the Set_DisturbanceTimeLim_msec, the AOI detects a disturbance.

Val_SignalOverLimitCounts: (DINT)

Shows the number of coarse update periods that the *signal offset* is outside the limits defined by Set_MaxSignalOffset and Set_MinSignalOffset. The AOI issues a disturbance event if the value of Val_SignalOverLimitCounts is greater than the truncated result of Set_DisturbanceTimeLim_msec divided by the Coarse Update Period.

The screenshot shows the 'AOI_Load_Condition_Monitoring' parameter table. The top part is a summary table with parameters and their values. The bottom part is a detailed table for the 'Cond_Monitoring' sub-table, which is highlighted with a red box.

AOI_Load_Condition_Monitoring	
AOI_Load_Condition_Monitoring	Cond_Monitoring
Inp_Axis	Axis03
Inp_Signal_to_Monitor	Axis03.TorqueEstimate
Inp_MachineCycleStart	Sts_MachineCycleStart
Set_MachineCyclesToUpdateProfile	0
Set_DisturbanceTimeLim_msec	20
Set_MaxSignalOffset	10.0
Set_MinSignalOffset	-10.0
Cfg_Recording_Enable	1
Sts_ERR	0

Cond_Monitoring	{...} AOI_Load_Condition_Monitoring
Cond_Monitoring.Cfg_Recording_Enable	1 BOOL
Cond_Monitoring.Disturbance_Counter	0 DINT
Cond_Monitoring.EnableIn	0 BOOL
Cond_Monitoring.EnableOut	0 BOOL
Cond_Monitoring.Inp_MachineCycleStart	0 BOOL
Cond_Monitoring.Inp_Signal_to_Monitor	0.0 REAL
Cond_Monitoring.Set_DisturbanceTimeLim_msec	20 DINT
Cond_Monitoring.Set_MachineCyclesToUpdateProfile	0 DINT
Cond_Monitoring.Set_MaxSignalOffset	10.0 REAL
Cond_Monitoring.Set_MinSignalOffset	-10.0 REAL
Cond_Monitoring.Sts_DisturbanceDetected	0 BOOL
Cond_Monitoring.Sts_EN	0 BOOL
Cond_Monitoring.Sts_ER	0 BOOL
Cond_Monitoring.Sts_ERR	0 DINT
Cond_Monitoring.Val_SavedSignalProfile	22.551641 REAL
Cond_Monitoring.Val_SignalOffset	0.018749237 REAL
Cond_Monitoring.Val_SignalOverLimitCounts	0 DINT

Application code

Monitoring Torque Estimate

Torque Estimate is a parameter available in drives with Virtual Torque Sensor. Torque Estimate is a Cyclic Parameter and it needs to be enabled in Axis Properties.

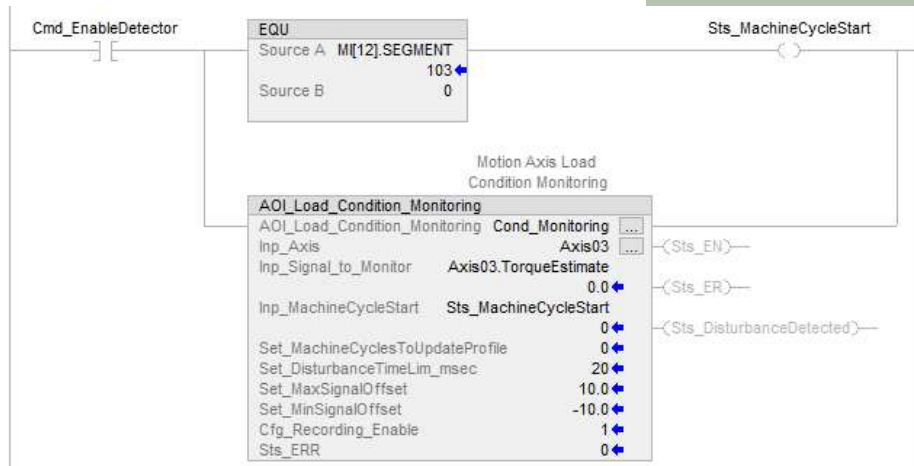
The AOI must remain enabled while the axis is monitored. Otherwise, deviation or disturbance events are not detected.

The trigger for the Inp_MachineCycleStart can be defined in multiple ways. If the axis is controlled by a cam instruction, the segment number can be used to generate the trigger as shown below. If the axis is controlled by a jog instruction, the code example also provide a suggested method to generate the trigger.

Cyclic Read/Write Parameter List

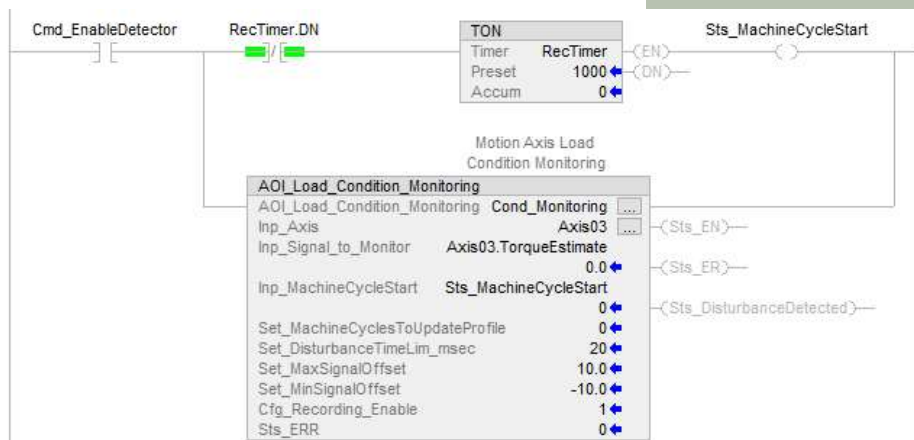
Parameters to be read each cycle, maximum 10:

	Name	Value
<input type="checkbox"/>	PositionLoopOutput	0.0
<input type="checkbox"/>	PositionReference	0.0
<input checked="" type="checkbox"/>	TorqueEstimate	0.0
<input type="checkbox"/>	TorqueLowPassFilterBandwidth...	0.0
<input type="checkbox"/>	TorqueNotchFilter2FrequencyEs...	0.0
<input type="checkbox"/>	TorqueNotchFilter2MagnitudeEsti...	0.0
<input type="checkbox"/>	TorqueNotchFilter2WidthEstimate	0.0



Axis controlled by a cam instruction

NOTE: MI[12] is the Motion Control tag of the cam instruction.



Axis controlled by a jog instruction

Application code

Monitoring an axis with machines that make multiple types of products

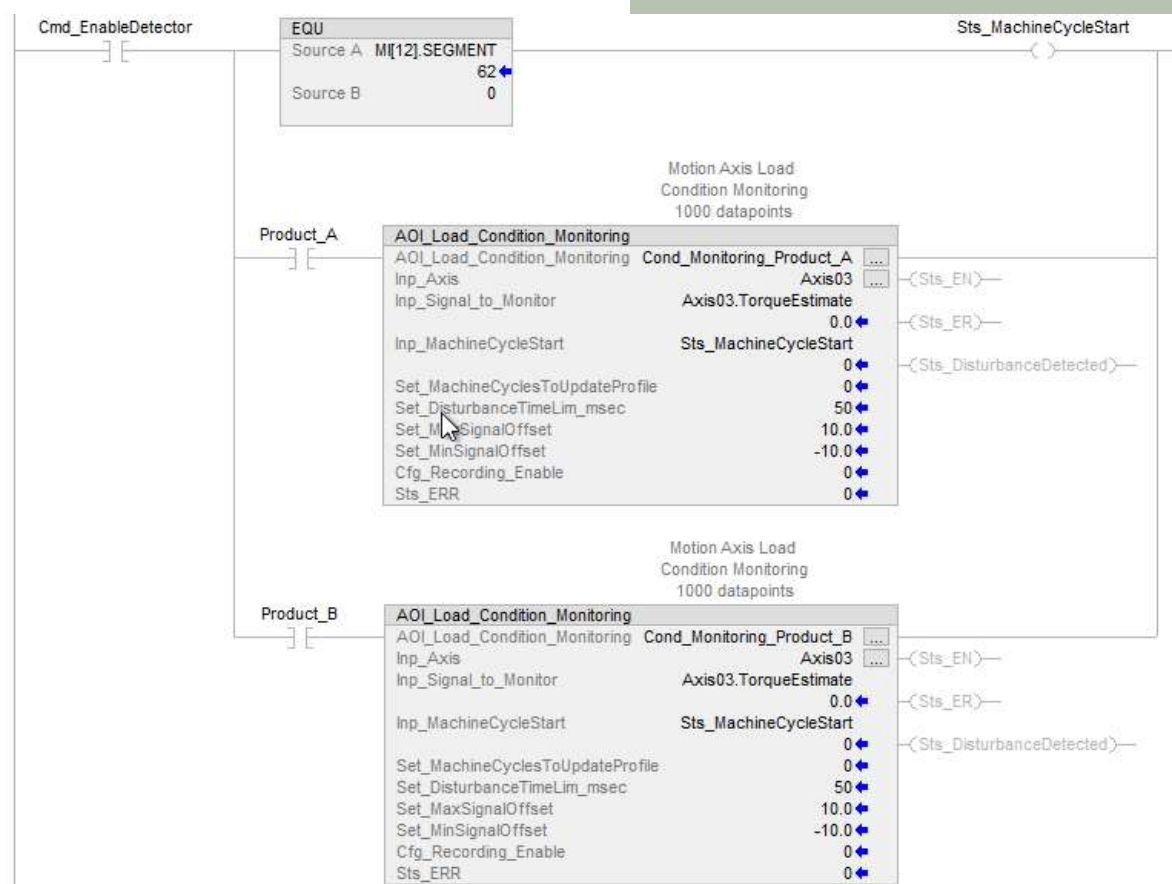
If this AOI is used to monitor events that change slowly over time such as friction changes or blade wear, and the machine is frequently switching the type of product that it makes, an instance of the AOI can be use for each product. Thus, for each type of product, the AOI will store the torque profile that the monitored axis needs to develop for each product, to properly monitor for condition changes.

The bit `Set_MachineCyclesToUpdateProfile` needs to be set to 1 during the first time that each instance of the AOI is enabled for each product. Then, this bit is set to zero and the AOI will not record again the torque profile next time that the AOI is enabled for the same type of product. An example is shown below.

Cyclic Read/Write Parameter List

Parameters to be read each cycle, maximum 10:

	Name	Value
<input type="checkbox"/>	PositionLoopOutput	0.0
<input type="checkbox"/>	PositionReference	0.0
<input checked="" type="checkbox"/>	TorqueEstimate	0.0
<input type="checkbox"/>	TorqueLowPassFilterBandwidth...	0.0
<input type="checkbox"/>	TorqueNotchFilter2FrequencyEs...	0.0
<input type="checkbox"/>	TorqueNotchFilter2MagnitudeEsti...	0.0
<input type="checkbox"/>	TorqueNotchFilter2WidthEstimate	0.0



Configuration procedure

Setting AOI Parameters:

A procedure to set the:

- Set_DisturbanceTimeLim_msec,
- Set_MaxSignalOffset, and
- Set_MinSignalOffset

is given next.

1. Set the Set_DisturbanceTimeLim_msec parameter to the limit value given by the application.
2. Next, adjust the Set_MaxSignalOffset_Perc and Set_MinSignalOffset parameters to a high value with respect to the magnitude of the Inp_Signal_to_Monitor
3. With the machine in operation, decrease Set_MaxSignalOffset gradually until the AOI stars to detect disturbance events.
4. Slightly raise the Set_MaxSignalOffset until the AOI stop detecting fault events.
5. Repeat steps 3 and 4 to set Set_MinSignalOffset.

NOTE: Create a trend with the following tags to better follow this procedure:

- Torque Estimate
- Set_MaxSignalOffset
- Set_MinSignalOffset
- Val_SignalOffset
- Val_SignalOverLimitCounts
- Sts_DisturbanceDetected

NOTE: The signal offset errors are reduced when the machine cycle period is a multiple of the coarse update period. Thus, set the machine cycle period to a multiple of the coarse update period if possible.

The screenshot shows the 'AOI_Load_Condition_Monitoring' configuration window. The 'Cond_Monitoring' tab is active, showing various parameters. A red box highlights the 'Set_DisturbanceTimeLim_msec' (20), 'Set_MaxSignalOffset' (10.0), and 'Set_MinSignalOffset' (-10.0) parameters. To the right, a table lists the tags for monitoring, with a red box highlighting 'Cond_Monitoring.Set_MaxSignalOffset' (10.0 REAL), 'Cond_Monitoring.Set_MinSignalOffset' (-10.0 REAL), 'Cond_Monitoring.Sts_DisturbanceDetected' (0 BOOL), 'Cond_Monitoring.Val_SavedSignalProfile' (22.551641 REAL), 'Cond_Monitoring.Val_SignalOffset' (0.018749237 REAL), and 'Cond_Monitoring.Val_SignalOverLimitCounts' (0 DINT).

Tag	Value	Unit
Cond_Monitoring.Cfg_Recording_Enable	1	BOOL
Cond_Monitoring.Disturbance_Counter	0	DINT
Cond_Monitoring.EnableIn	0	BOOL
Cond_Monitoring.EnableOut	0	BOOL
Cond_Monitoring.Inp_MachineCycleStart	0	BOOL
Cond_Monitoring.Inp_Signal_to_Monitor	0.0	REAL
Cond_Monitoring.Set_DisturbanceTimeLim_msec	20	DINT
Cond_Monitoring.Set_MachineCyclesToUpdateProfile	0	DINT
Cond_Monitoring.Set_MaxSignalOffset	10.0	REAL
Cond_Monitoring.Set_MinSignalOffset	-10.0	REAL
Cond_Monitoring.Sts_DisturbanceDetected	0	BOOL
Cond_Monitoring.Sts_EN	0	BOOL
Cond_Monitoring.Sts_ER	0	BOOL
Cond_Monitoring.Sts_ERR	0	DINT
Cond_Monitoring.Val_SavedSignalProfile	22.551641	REAL
Cond_Monitoring.Val_SignalOffset	0.018749237	REAL
Cond_Monitoring.Val_SignalOverLimitCounts	0	DINT

Disturbance detection

AOI Behavior:

The behavior of the AOI is demonstrated through the trends shown below as follows
(Note: each step described below is indicated on the trend):

1. The AOI saves the Inp_Signal_to_Monitor Profile for one machine cycle period when the machine starts.
2. Machine is in normal operation and the AOI starts to monitor the axis after the first machine cycle.
3. Disturbance event starts to be detected due to the disturbance on input signal
4. Disturbance is detected after *signal offset* remains outside limits defined by Set_MaxSignalOffset and Set_MinSignalOffset parameters for a period of time greater than the time set in Set_DisturbanceTimeLim_msec..
5. The Sts_DisturbanceDetected turns on and its status is used commanded to the axis to stop.

