**SCADA\_DEV\_AIT**

**Version History**

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| --- | --- |
| **Version** | **Release Notes** |
| 5.0 | Updated to align with the latest PLC programming standard |

**Description**: This UDT is used in the evaluation of all real analog input signals wired to the PLC. It may also be used in conjunction with virtual or calculated analog signals when features like process alarming are required.

**Naming Conventions**: Tags created with this UDT should use the first 5 fragments from the tagname standard, which describes the high level device. All Fragment 5 and 6 tags are child members of the UDT.

**UDT Members**

| **UDT Member** | **Datatype** | **Description** | **Usage** |
| --- | --- | --- | --- |
| ADDON | Analog\_V5 | Analog Signal Evaluation AOI | Provides all signal conditioning and process condition evaluation for the instrument |
| TOTALIZER | Analog\_Totalizer\_V1 | Analog Totalizer AOI | Used to implement totalizing of the analog signal, if required |
| AI\_CV | REAL | Current Engineering Value | The Scaled Engineering value of the tag; used for Automatic Control, operator display, and historizing |
| AI\_AT | REAL | Average Value Today | If the programmer implements an average value calculation it should be stored in this tag |
| E2\_CV | REAL | Engineering Value Secondary Units | Optional value of the tag in a secondary unit for display on the HMI |
| E3\_CV | REAL | Engineering Value Tertiary Units | Optional value of the tag in a third unit for display on the HMI |
| AO\_EM | REAL | Process Engineering Zero | The engineering value at 4 mA, entered from the HMI |
| AO\_XM | REAL | Process Engineering Span | The engineering value at 20 mA, entered from the HMI |
| AO\_SV | REAL | Simulation/Override Value | When simulation mode is enabled, the raw signal scaling is ignored and this value is used as the AI\_CV value instead |
| AI\_TD | REAL | Total Today | Used with Totalizer to hold today’s Total |
| AI\_YT | REAL | Yesterday’s Total | Used with Totalizer to hold yesterday’s Total |
| AI\_ND | REAL | Min. Value Today | The minimum engineering value observed today |
| AI\_NP | REAL | Min. Value Yesterday | The minimum engineering value observed yesterday |
| AI\_XD | REAL | Max. Value Today | The maximum engineering value observed today |
| AI\_XP | REAL | Max. Value Yesterday | The maximum engineering value observed yesterday |
| AO\_HH | REAL | HIHI Process Alarm Setpoint | Configured from HMI |
| SN\_HH | REAL | HIHI Process Alarm Delay | Configured from HMI |
| AO\_HI | REAL | High Process Alarm Setpoint | Configured from HMI |
| SN\_HI | REAL | High Process Alarm Delay | Configured from HMI |
| AO\_LO | REAL | Low Process Alarm Setpoint | Configured from HMI |
| SN\_LO | REAL | Low Process Alarm Delay | Configured from HMI |
| AO\_LL | REAL | LOLO Process Alarm Setpoint | Configured from HMI |
| SN\_LL | REAL | LOLO Process Alarm Delay | Configured from HMI |
| AO\_ZA | REAL | Deviation Alarm Setpoint | Configured from HMI. Used with an analog signal that has a tracking setpoint. |
| SN\_ZA | REAL | Deviation Alarm Delay | Configured from HMI. Used with an analog signal that has a tracking setpoint. |
| AI\_DC | DINT | Engineering Range 1 Decimals | Number of Decimal Places to Display on HMI with ACP units |
| E2\_DC | DINT | Engineering Range 2 Decimals | Number of Decimal Places to Display on HMI for secondary units |
| E3\_DC | DINT | Engineering Range 2 Decimals | Number of Decimal Places to Display on HMI for tertiary units |
| PB\_HH | PB\_EN\_RA\_DLR\_1\_2 | HIHI Alarm Enable Controls | Used on HMI |
| PB\_HI | PB\_EN\_RA\_DLR\_1\_2 | High Alarm Enable Controls | Used on HMI |
| PB\_LO | PB\_EN\_RA\_DLR\_1\_2 | Low Alarm Enable Controls | Used on HMI |
| PB\_LL | PB\_EN\_RA\_DLR\_1\_2 | LOLO Alarm Enable Controls | Used on HMI |
| PB\_ER | PB\_EN\_RA\_DLR\_1\_2 | Signal Error Alarm Enable Controls | Used on HMI |
| PB\_ZA | PB\_EN\_RA\_DLR\_1\_2 | Deviation Alarm Enable Controls | Used on HMI |
| PB\_SC | BOOL | Scan Enable | Controls Processing of raw signal value |
| PB\_SV | BOOL | Simulation/Override Enable | When set the simulation/override value is used in place of the current analog value |
| PB\_AR | BOOL | Alarm Acknowledge/Reset | Used on HMI |
| PB\_MM | BOOL | Min/Max Enable | Enables whether min/max statistics are tracked |
| PB\_SM | BOOL | Alarm Simulate PB | Simulates all alarms associated with the instrument for display on the HMI |
| DA\_HH | BOOL | HIHI Alarm | Used on HMI |
| DA \_HI | BOOL | HI Alarm | Used on HMI |
| DA \_LO | BOOL | LO Alarm | Used on HMI |
| DA \_LL | BOOL | LOLO Alarm | Used on HMI |
| DA \_ER | BOOL | Signal Error Alarm | Used on HMI |
| DA \_ZA | BOOL | Deviation Alarm | Used on HMI |
| DI\_SC | BOOL | Scan Enabled | Indicates raw signal is within allowable range and enabled for scan from SCADA |
| DI\_AD | BOOL | Alarm Disabled | Indicates if the HIHI, High, Low, LOLO, or Signal Error Alarms are disabled. For use on HMI |
| PB\_RS | BOOL | Totalizer Reset | Allows for user reset of totalizer, if programmed. |

**AOI**

Each device will have its own routine in the device program in which the AOIs will be deployed. The AOIs may also be deployed in another device routine if they are associated with that device (e.g. speed feedback for a VFD).

| **AOI Parameter** | **Requirement** | **Default Value** | **Description** | **Implementation Guideline** |
| --- | --- | --- | --- | --- |
| Analog\_V5 | Mandatory | *Tagname*.ADDON | AOI tag | N/A |
| Alarm\_Sim\_Enable | Mandatory | *Tagname*.PB\_SM | Alarm Simulate PB | N/A |
| Raw | Mandatory | *Tagname.*ADDON.Raw | Raw Signal Value | Mapped in AI\_MAP routine |
| Minimum\_Range | Mandatory | SYS\_AIT\_RANGE\_MIN | Raw Open Circuit Value | N/A |
| Maximum\_Range | Mandatory | SYS\_AIT\_RANGE\_MAX | Raw Short Circuit Value | N/A |
| Minimum\_Raw | Mandatory | SYS\_AIT\_RAW\_MIN | Raw 4mA Value | N/A |
| Maximum\_Raw | Mandatory | SYS\_AIT\_RAW\_MAX | Raw 20 mA value | N/A |
| Minimum\_Engineering | Mandatory | *Tagname*.AO\_EM | Engineering 4 mA Value | N/A |
| Maximum\_ Engineering | Mandatory | *Tagname*.AO\_XM | Engineering 20 mA Value | N/A |
| Safe\_State | Optional | *Tagname.*ADDON.Safe\_State | Scaled value to use in the event of device not on Scan | 0 = Minimum\_Engineering Value used  1=Maximum\_Engineering Value used |
| Scaled\_CV\_Value | Mandatory | *Tagname*.AI\_CV | Scaled Engineering Value | N/A |
| Signal\_Error\_Enable | Mandatory | *Tagname.*PB\_ER | Signal Error Alarm Enable UDT | N/A |
| Signal\_Error\_Seal | Optional | *Tagname.*ADDON.Signal\_Error\_Seal | Signal Error Seal-in Configuration | Program Outside the AOI. When set to true, the alarm remains set even when process conditions return to normal operating range. The alarm must be cleared from the HMI |
| Signal\_Error\_Mask | Optional | *Tagname*.ADDON.Signal\_Error\_Mask | Signal Error Alarm Mask | Program Conditions Outside of the AOI that inhibit the alarm condition |
| Signal\_Error\_Alarm | Mandatory | *Tagname.*DA\_ER | Signal Error Alarm | N/A |
| Scan\_Enable | Mandatory | *Tagname.*PB\_SC | Scan Enable PB | N/A |
| Scan\_Status | Mandatory | *Tagname.*DI\_SC | On Scan Status | N/A |
| Alarms\_Enable | Mandatory | *Tagname.PB\_AE* | Global Alarm Enable UDT | Does not impact Signal Error or Deviation Alarm |
| HIHI\_Enable | Mandatory | *Tagname.*PB\_HH | HIHI Alarm Enable UDT | N/A |
| HIHI\_Seal | Optional | *Tagname*.ADDON.HIHI\_Seal | HIHI Alarm Seal | Program Outside the AOI. When set to true, the alarm remains set even when process conditions return to normal operating range. The alarm must be cleared from the HMI. |
| HIHI\_Mask | Optional | *Tagname*.ADDON.HIHI\_Mask | HIHI Alarm Mask | Program Conditions Outside of the AOI that inhibit the alarm condition |
| HIHI\_Setpoint | Mandatory | *Tagname.*AO\_HH | HIHI Alarm Setpoint | N/A |
| HIHI\_Delay | Mandatory | *Tagname.*SN\_HH | HIHI Alarm Delay | N/A |
| HIHI\_Alarm | Mandatory | *Tagname.*DA\_HH | HIHI Alarm | N/A |
| HI\_Enable | Mandatory | *Tagname.*PB\_HI | High Alarm Enable UDT | N/A |
| HI\_Seal | Optional | *Tagname*.ADDON.HI\_Seal | High Alarm Seal | Program Outside the AOI. When set to true, the alarm remains set even when process conditions return to normal operating range. The alarm must be cleared from the HMI. |
| HI\_Mask | Optional | *Tagname*.ADDON.HI\_Mask | High Alarm Mask | Program Conditions Outside of the AOI that inhibit the alarm condition |
| HI\_Setpoint | Mandatory | *Tagname.*AO\_ HI | High Alarm Setpoint | N/A |
| HI\_Delay | Mandatory | *Tagname.*SN\_ HI | HI Alarm Delay | N/A |
| HI\_Alarm | Mandatory | *Tagname.*DA\_ HI | HI Alarm | N/A |
| LO\_Enable | Mandatory | *Tagname.*PB\_LO | LO Alarm Enable UDT | N/A |
| LO\_Seal | Optional | *Tagname*.ADDON.LO\_Seal | Low Alarm Seal | Program Outside the AOI. When set to true, the alarm remains set even when process conditions return to normal operating range. The alarm must be cleared from the HMI. |
| LO\_Mask | Optional | *Tagname*.ADDON.LO\_Mask | Low Alarm Mask | Program Conditions Outside of the AOI that inhibit the alarm condition |
| LO\_Setpoint | Mandatory | *Tagname.*AO\_ LO | Low Alarm Setpoint | N/A |
| LO\_Delay | Mandatory | *Tagname.*SN\_ LO | Low Alarm Delay | N/A |
| LO\_Alarm | Mandatory | *Tagname.*DA\_ LO | Low Alarm | N/A |
| LOLO\_Enable | Mandatory | *Tagname.*PB\_LL | LOLO Alarm Enable UDT | N/A |
| LOLO\_Seal | Optional | *Tagname*.ADDON.LOLO\_Seal | LOLO Alarm Seal | Program Outside the AOI. When set to true, the alarm remains set even when process conditions return to normal operating range. The alarm must be cleared from the HMI. |
| LOLO\_Mask | Optional | *Tagname*.ADDON.LOLO\_Mask | LOLO Alarm Mask | Program Conditions Outside of the AOI that inhibit the alarm condition |
| LOLO\_Setpoint | Mandatory | *Tagname.*AO\_ LL | LOLO Alarm Setpoint | N/A |
| LOLO\_Delay | Mandatory | *Tagname.*SN\_ LL | LOLO Alarm Delay | N/A |
| LOLO\_Alarm | Mandatory | *Tagname.*DA\_ LL | LOLO Alarm | N/A |
| Scaled\_SP\_Value | Optional | *Tagname*.ADDON.Scaled\_SP\_Value | Setpoint in Eng. Units for Deviation Alarm Calculation | Map outside of AOI |
| Deviation\_Enable | Mandatory | *Tagname.*PB\_ZA | Deviation Alarm Enable UDT | N/A |
| Deviation \_Seal | Optional | *Tagname*.ADDON.Deviation\_Seal | Deviation Alarm Seal | Program Outside the AOI. When set to true, the alarm remains set even when process conditions return to normal operating range. The alarm must be cleared from the HMI. |
| Deviation \_Mask | Optional | *Tagname*.ADDON.Deviation\_Mask | Deviation Alarm Mask | Program Conditions Outside of the AOI that inhibit the alarm condition |
| Deviation\_Setpoint | Mandatory | *Tagname.*AO\_ ZA | Deviation Alarm Setpoint | N/A |
| Deviation \_Delay | Mandatory | *Tagname.*SN\_ ZA | Deviation Alarm Delay | N/A |
| Deviation\_Alarm | Mandatory | *Tagname.*DA\_ ZA | Deviation Alarm | N/A |
| Dialer\_Trigger | Optional | *Tagname*.ADDON.Dialer\_Trigger | Set to true when any alarm programmed as a dialer alarm is active | Use in a dialer routine to trigger callout of any alarms associated with the analog device |
| System\_Day\_Reset | Mandatory | SYS\_Day\_Reset | Perform Statistical Housekeeping at Midnight | N/A |
| Simulation\_Enable | Mandatory | *Tagname*.PB\_SV | Enable Override/Simulation | N/A |
| Simulation\_Value | Mandatory | *Tagname*.AO\_SV | Override/Simulation Value | N/A |
| Clamping\_Enabled | Optional | *Tagname*.ADDON.Clamping\_Enabled | Enable Low-range signal clamping to Engineering Minimum | Set to true outside AOI if signal clamping is to be used |
| Clamping\_Limit | Optional | *Tagname*.ADDON.Clamping\_Limit | Eng. Value below which value is clamped | Set to an appropriate engineering value outside the AOI, below which the signal should be clamped |
| Max\_Min\_Enable | Optional | *Tagname*.ADDON.Max\_Min\_Enable | Enables Min/Max calculations | Map to *Tagname*.PB\_MM outside the AOI if enabling/disabling of min/max calculations can be set from the HMI |
| Max\_Value\_Today | Mandatory | *Tagname*.AI\_XD | Today’s Maximum Eng. Value | N/A |
| Max\_Value\_Yesterday | Mandatory | *Tagname*.AI\_XP | Yesterday’s Maximum Eng. Value | N/A |
| Min\_Value\_Today | Mandatory | *Tagname*.AI\_ND | Today’s Minimum Eng. Value | N/A |
| Min\_Value\_Yesterday | Mandatory | *Tagname*.AI\_NP | Yesterday’s Minimum Eng. Value | N/A |
| Alarm\_Acknowledge | Mandatory | *Tagname*.PB\_AR | Alarm Acknowledge and Reset | N/A |
| Global\_Acknowledge | Optional | *Tagname*.ADDON.Global\_Acknowledge | Alarm Acknowledge Reset | Reserved for Future Use with a Global Alarm Reset Pushbutton. To be programmed outside of the AOI. |
| Alarm\_Disabled | Mandatory | *Tagname*.DI\_AD | At least one alarm disabled | Does notinclude check for deviation alarm. Includes check for device on scan. |
| Max\_Min\_Mask | Optional | *Tagname*.ADDON.Max\_Min\_Mask | Mask Evaluation of Max/Min Values | Used with instruments that operate intermittently (e.g. flow meter). Program conditions to inhibit calculation of Max/Min value when device is idle. |
| Scale\_CV\_Decimals | Mandatory | *Tagname*.AI\_DC | Eng. Units number of decimal places visible on HMI | Set tag value outside of AOI. Value must be between 0 and 3. |
| Scale\_EU2\_Decimals | Mandatory | *Tagname*.E2\_DC | Secondary Units number of decimal places visible on HMI | Set tag value outside of AOI. Value must be between 0 and 3. |
| Scale\_EU3\_Decimals | Mandatory | *Tagname*.E3\_DC | Tertiary Units number of decimal places visible on HMI | Set tag value outside of AOI. Value must be between 0 and 3. |
| Units\_Visibility | Mandatory | *Tagname*.AI\_VI | Number of Engineering Values visible on the HMI | Set tag value outside of the AOI. Value must be between 1 and 3, defaults to 1 if not pre-configured. |

The following table details parameters for the Totalizer AOI, if it is used with the analog device.

| **AOI Parameter** | **Requirement** | **Default Value** | **Description** | **Implementation Guideline** |
| --- | --- | --- | --- | --- |
| Analog\_Totalizer\_V1 | Mandatory | *Tagname.*Totalizer | Totalizer Add-on Instruction | N/A |
| Scaled\_CV\_Value | Mandatory | *Tagname*.AI\_CV | Value to be Totalized | Avoid use of totalizing the secondary or tertiary Eng. Value. Use the parameters within the AOI to achieve the desired units. |
| Scan\_Status | Mandatory | *Tagname*.DI\_SC | Analog Tag is on Scan | N/A |
| System\_Day\_Reset | Mandatory | SYS\_Day\_Reset | Perform statistical housekeeping at Midnight | N/A |
| Totalizer\_Enable\_Bit | Optional | *Tagname*.Addon.Totalizer\_Enable\_Bit | Enables Totalizing | Program Outside the AOI to control when the totalizer operates. In most cases this tag is always set to 1. |
| Daily\_Totalizer\_Division\_Factor | Optional | *Tagname*.Addon.Daily\_Totalizer\_Division\_Factor | Performs any scaling of the CV signal if totalized units are different than the input signal units | Default is 1000 for converting from L/s to m3 |
| Daily\_Totalizer\_TimeBase | Optional | *Tagname*.Addon.Daily\_Totalizer\_TimeBase | Indicates the time units of the input tag | Default is 0, for seconds. See RSLogix Help for the TOT instruction for allowable values |
| Daily\_Totalizer\_Target | Optional | *Tagname*.Addon.Daily\_Totalizer\_Target | Rollover Value for the Totalizer | Default is 100000. It is recommended to set this value as large as possible so daily rollovers are not a factor in the totalizing calculation. |
| Daily\_Totalizer\_Target\_Flag | Optional | *Tagname*.Addon.Daily\_Totalizer\_Target\_Flag | Set when the Daily Totalizer Target is Reached | N/A |
| Daily\_Total | Mandatory | *Tagname*.AI\_TD | Today’s Total | N/A |
| Daily\_Total\_Yesterday | Mandatory | *Tagname*.AI\_YT | Yesterday’s Total | N/A |
| Manual\_Reset | Mandatory | *Tagname*.PB\_RS | Manual Reset of Totalizer | Not implemented on SCADA by default, use as required |
| Manual\_Reset\_Value\_Daily | Optional | *Tagname*.Addon.Manual\_Reset\_Value\_Daily | When the totalizer is reset the last totalized value is stored here | Use as required |

**Typical AOI Operation Description**

The status and control AOI performs the following functions:

* Signal conditions engineering value visibility and decimal selection values to allowable ranges
* Executes alarm simulation logic
* Checks for disabled alarms.
* Validate and clamp raw signal
* Perform scaling to engineering units, or use simulation value if enabled.
* Clamp value if near lower operating limit
* Process Alarm Evaluation
* Min/Max Evaluation
* Perform check of alarm enable statues for indication of any disabled alarms
* Set the dialer bit for any configured alarms
* Reset of any pushbutton values

The totalizing AOI performs the following functions

* Enables totalizing if the device is on scan and the external enable bit is set
* Performs totalizing according to the configured parameters, including handling of any programmed rollover
* Resets the totalizer if the day reset, manual reset, or rollover is detected
* Performs housekeeping at midnight using the totalized values
* Unlatches any pushbuttons

**Programming Examples**

There are three general scenarios where this AOI would be used

* Signal processing of a primary analog instrument (e.g. Flowmeter)
* Signal Processing of an analog instrument associated with another primary device (e.g . VFD Speed Feedback or Valve Position Feedback)
* Signal Processing for a virtual or calculated value (e.g. Overflow flow rate calculated using the Manning Formula)

For a primary analog instrument, the general programming flow within a device routine would be as follows

* For devices that operate intermittently, program any alarm masks to prevent false alarms when the device is idle
* For devices that operate intermittently , program the max/min mask so the value check is only done when the device is not idle
* Set any configuration bits to 1 to seal in process alarms, if required
* Set any dialer enable bits to 1 to permanently disable any process alarms that should not trigger the dialler
* Execute the AOI
* Perform calculation of the secondary and tertiary engineering value if required for display on SCADA. The sample programming routines provide calculations to convert signals to 0-100% and 4-20 mA. If the secondary or tertiary units are just using a different measuring scale (e.g. going from metric to imperial), a simple multiplication of the engineering value signal can be performed instead of using a full compute instruction or function block scaling.
* If the totalizer is to be used, the totalizer enable bit should be set to 1, followed by the execution of the totalizer logic.

For a feedback signal, the general programming flow would be as follows

* Execution of logic associated with the primary device
* Map the setpoint from the primary device to the Scaled\_SP\_Value
* Perform any required configurations for unused analog functions. Generally, the only process alarm used with a feedback signal is the deviation alarm, so the PB\_AE.RE tag can be set to 1.
* Configure any deviation alarm masking and max/min masking.
* Set any dialer enable bits to 1 to permanently disable any process alarms that should not trigger the dialler
* Execute the AOI

A virtual instrument will generally be configured in the manner above with regard to masks and disabling of dialer alarms. The main difference is that the scaling tags (Minimum\_Range, Maximum\_Range, Minimum\_Raw, Maximum\_Raw) will be replaced with values representing the full scale of the calculated value. The signal error alarm can also be disabled, if desired, to add further security that this alarm will not accidently trigger due to an error in the calculation of the virtual value. The Minimum\_Engineering and Maximum\_Engineering values will generally be set to the same value as Minimum\_Raw and Maximum\_Raw, respectively, in order to produce a 1:1 scale.

The totalizer AOI and related tags should only be used with instruments that produce a rate signal. The totalizer enable bit should always be set to 1 unless there are requirements for the totalizer to only function under certain conditions.

**HMI Integration**

This AOI is primarily intended for use with the following pop-ups:

* Analog Device control v5\_0
* Advanced Analog v5\_0

Motor and Valve pop-ups will also reference the analog driver if there is feedback associated with the device. Refer to the programming documentation for those devices for more details on scripting and deployment.

HMI objects that reference an analog driver can be easily modified by selecting the object and performing a Substitute Tag operation to replace the placeholder tags with the correct device tagging. Template objects that reference the analog driver can be found on the “Symbols Library – Analog” screen in the InTouch Baseload.

The following settings must be configured manually in the pop-up action script, if required:

ANIN SRV – If the device is located on a remote server, then this indirect tag must be changed to point at that server. By default, it looks at the Hot Backup Pair configuration for the local system.