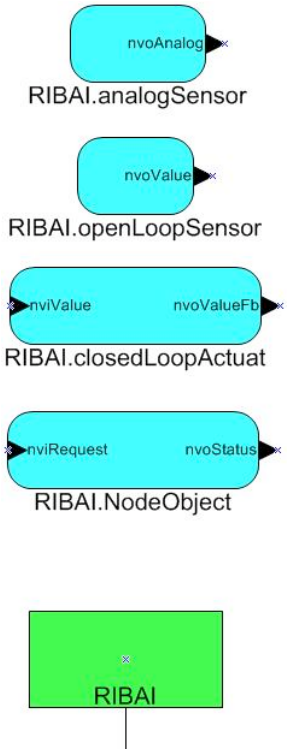
RIB-LNAI application and its associated network interface were designed to meet LonMark compliance standards. In keeping with the nature of the device and LonMark standards, the device contains four functional blocks, a 'Node Object', a 'Closed-Loop Actuator' functional block, an 'Open-Loop Sensor' functional block, and finally an 'Analog Sensor' functional block.



Each functional block includes a set of network variable inputs, outputs, and configuration parameters, which in the case of this device, were implemented as standard configuration input network variables.

NodeObject Functional Block

nviRequest (mandatory input network variable per the LonMark Node Object Functional Profile, used to provide a mechanism for requesting an operation or a mode for a functional block or all blocks within a device)

nvoStatus (mandatory output network variable per the LonMark Node Object Functional Profile, used to report back the status for any functional block on the device or the device as a whole)

nciDevMajVer(optional configuration property used to store the major version number)

nciDevMinVer(optional configuration property used to store the minor version number)

For more information on the functionality of the Node Object functional block, refer to the LonMark document for the corresponding profile (0000_20.pdf), which can be downloaded from LonMark's website. The RIB device supports the following requests via nviRequest, and properly reports back unsupported for those optional requests that are not mandatory.

RQ_NORMAL - Place the designated functional block into the normal, operating state.

RQ_DISABLED - Disable the functional block
RQ_UPDATE_STATUS - Report back the status of the requested functional block via nvoStatus
RQ_SELF_TEST - Perform a self-test and report back results (Actuator block)
RQ_REPORT_MASK - Report back supported commands via nvoStatus
RQ_ENABLE - Enable the requested functional block (same as RQ_NORMAL)

The device application is designed with the functional blocks in the normal, operating state. Through the nviRequest / nvoStatus mechanism, the device can be disabled, which puts it into a mode where it ignores updates to change the position of the actuator. The self-test mode causes the device to operate a simple self-test mechanism, whereby it will turn the relay and the status led on and off in a series of three 3-second cycles in order to verify that the led and actuator operate properly. This test can be initiated from within LonMaker by simply right-clicking on the device and selecting the 'Manage' menu option. This brings up a window that includes a 'Test' button for testing the device, which causes the RIB to execute the sequence described above.

Closed-Loop Actuator Functional Block

nviValue (mandatory input network variable of type SNVT_switch, which allows another device to instruct the RIB to open (100.0 0) or close (100.0 1) the relay coil)

nvoFbValue (mandatory output network variable of type SNVT_switch, which provides a feedback output from the actuator to other devices within the network, i.e. reports the current state of the actuator)

nciDefault (optional configuration property, used to supply the RIB with a default actuator position (100.0 1 for 'On', 100.0 0 for 'Off))

nciMaxReceiveT (optional configuration property of type SNVT_elapsed_tm, which provides a configurable means for specifying a maximum elapsed timeout period whereby the actuator will revert to its default state (nciDefault) if this much time elapses since the last update via nviValue)

The closed-loop actuator functional block controls the actuator itself. On power up, the RIB places the relay into the position specified by nciDefault, and controls the status led according to the following…

4 hz blink followed by solid on, repeating pattern (default 'on' state)
4 hz blink followed by solid off, repeating pattern (default 'off' state)

This default state persists until the device receives its first update to the nviValue input network variable. If commanded 'on' (100.0 1), the device asserts the relay coil, reports the 'on' state via the nvoFbValue network variable, and turns on the status led solid. Likewise, if commanded 'off' (100.0 0), the device de-asserts the relay coil, reports the 'off' state via nvoFbValue and begins blinking the status led at a 1 hz rate.

As mentioned above, nciMaxReceiveT is a configuration parameter of type SNVT_elapsed_tm, which provides a means for specifying a timeout value. This timeout value controls the expected update rate for the input network variable nviValue.

Only the hour, minute, and second fields are used in this structure. If nciMaxReceiveT.hour / minute / second are all zero, then the actuator does not attempt to enforce any timing update requirements. If however, nciMaxReceiveT is not zero, then the device starts counting down following an update via

nviValue. If this time period elapses without a subsequent update via nviValue, then the device will switch itself to the nciDefault case, and drive the actuator and status led accordingly. In addition to providing a visual indication via the status led that it is in this timeout mode, the device also sets a comm_failure bit, which can be retrieved on the network via nvoStatus. The maximum timeout period that can be specified is 17 hours, 59 minutes, 59 seconds. Any hourly value greater than 17 will be treated as 17 hours.

Open-Loop Sensor Functional Block

nvoValue (mandatory output network variable of type SNVT_switch, which allows indicates the state of the switch closure input (100.0 1) closed or (100.0 0) open)

nciInvert (optional configuration property of type SNVT_lev_disc, which provides a configurable means for inverting the active / inactive interpretation for the digital input. Under default conditions (nciInvert = ST_OFF), nvoValue indicates closed / open as listed above. If nciInvert is set to ST_ON, then the input logic is inverted and nvoValue outputs (100.0 0) for a closed condition and (100.0 1) for an open condition)

nciMaxSendT (optional configuration property of type SNVT_elapsed_tm, which provides a configurable means for specifiying a maximum elapsed time period since the last update to nvoValue, after which the functional block will resend nvoValue, even if the state of the switch closure has not changed)

nciMinSendT (optional configuration property of type SNVT_elapsed_tm, which provides a configurable means for specifying a minimum time period required between updates to nvoValue. This is used for optional throttling control for the functional block's output network variable)

The open-loop sensor functional block monitors the state of the switch closure input and provides this information via nvoValue. On power up or enabling of this particular functional block, the device reads the switch closure and asserts nvoValue appropriately, depending on the status of the nciInvert configuration network variable. At this point the input is monitored for any change, which is reported via nvoValue, based upon the constraints of nciMaxSendT and nciMinSendT. Both nciMaxSendT and nciMinSendT use the same SNVT_elapsed_tm structure described above for nciMaxReceiveT. In addition, they follow the same logic where only the hour, minute, and second fields are used and the maximum time period allowed is 17 hours, 59 minutes, 59 seconds. As before, a value of zero for these fields indicates that the given configuration timer is not used and any hourly value greater than 17 will be treated as 17 hours.

As described above, nciMaxSendT provides a means for specifying a maximum amount of time allowed between propagations of the output network variable nvoValue, when programmed to something other than zero. If this configurable amount of time expires since the device last propagated nvoValue, it will resend this value, regardless of whether the switch closure state has changed or not. Integrators will often use this type of timer as a form of a heartbeat mechanism.

In similar fashion, nciMinSendT provides a means for specifying the minimum amount of time required between propagations of the output network variable nvoValue. If this configurable timer is non-zero, then the device will not update nvoValue (even if the switch closure state has changed) until this minimum time period is met. Integrators typically use these types of timers as throttling mechanisms to protect the network bandwidth from being saturated by a run-away device. Under normal usage,

nciMaxSendT is typically set to a value much greater than nciMinSendT, e.g. nciMaxSendT = 120 seconds, nciMinSendT = 2 seconds. However, if the user programs a value for nciMinSendT that is larger that nciMaxSendT, nciMinSendT takes precedence and will inhibit the transmission of nvoValue until the minimum time period has expired, despite the fact that the nvoMaxSendT period has elapsed.

Analog Sensor Functional Block

nvoAnalog (mandatory output network variable of type SNVT_lev_percent, which reports the value of the analog input from a range of 0.000 % to 100.000 % (percent of span) with 0.005 % resolution)

nciMaxSendT1 (optional configuration property of type SNVT_elapsed_tm, which provides a configurable means for specifiying a maximum elapsed time period since the last update to nvoAnalog, after which the functional block will resend nvoAnalog, even if the value of the analog input has not changed)

nciMinSendT1 (optional configuration property of type SNVT_elapsed_tm, which provides a configurable means for specifying a minimum time period required between updates to nvoAnalog. This is used for optional throttling control for the functional block's output network variable)

nciMinDelta (optional configuration property of type SNVT_lev_percent, which provides a configurable means for specifying the minimum change amount required between updates to nvoAnalog. As in the case of nciMinSendT1, this is used to help throttle the functional block's output network variable)

The analog sensor functional block is a form of the open-loop sensor profile that monitors the state of the analog input and provides this information via nvoAnalog. On power up or enabling of this particular functional block, the device reads the analog input once a second and updates nvoAnalog appropriately. If nciMinDelta is set (non-zero), the output will only update if the value has changed by the amount specified by nciMinDelta, or if the time associated with nciMaxSendT1 has expired (heartbeat). Both nciMaxSendT1 and nciMinSendT1 use the same SNVT_elapsed_tm structure described above for nciMaxReceiveT1. In addition, they follow the same logic where only the hour, minute, and second fields are used and the maximum time period allowed is 17 hours, 59 minutes, 59 seconds. As before, a value of zero for these fields indicates that the given configuration timer is not used and any hourly value greater than 17 will be treated as 17 hours.

As described above, nciMaxSendT1 provides a means for specifying a maximum amount of time allowed between propagations of the output network variable nvoAnalog, when programmed to something other than zero. If this configurable amount of time expires since the device last propagated nvoAnalog, it will resend this value, regardless of whether the switch closure state has changed or not. Integrators will often use this type of timer as a form of a heartbeat mechanism.

In similar fashion, nciMinSendT1 provides a means for specifying the minimum amount of time required between propagations of the output network variable nvoAnalog. If this configurable timer is non-zero, then the device will not update nvoAnalog (even if the analog input value has changed by more than nciMinDelta) until this minimum time period is met. Integrators typically use these types of timers as throttling mechanisms to protect the network bandwidth from being saturated by a run-away device. Under normal usage, nciMaxSendT1 is typically set to a value much greater than nciMinSendT1, e.g. nciMaxSendT1 = 120 seconds, nciMinSendT1 = 2 seconds. However, if the user programs a value for nciMinSendT1 that is larger that nciMaxSendT1, nciMinSendT1 takes precedence

and will inhibit the transmission of nvoAnalog until the minimum time period has expired, despite the fact that the nvoMaxSendT1 period has elapsed.