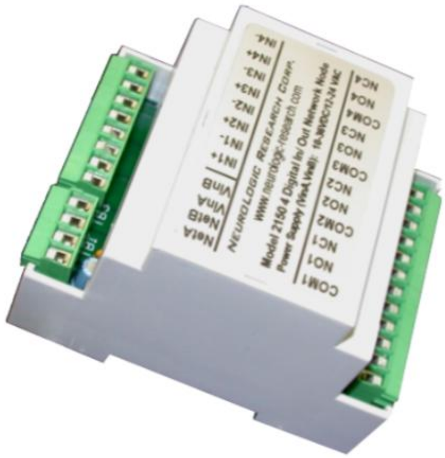
NEUROLOGIC RESEARCH CORPORATION MODEL 2150

FOUR DIGITAL INPUT / FOUR DIGITAL OUTPUT NETWORK NODE



- Very compact design available in DIN Rail and NEMA 4X enclosures.
- LonWorks FTT-10A network interface with all inputs and outputs communicated via Standard Network Variable Types (SNVT)
- Switching power supply allows operation from a wide range of low voltage AC or DC.
- Four isolated outputs via Form C relays with transient voltage clamps and LED status indicators.
- Four isolated inputs capable of handling 3-36VDC or 3-24 VAC @ 50/60 Hz. Inputs have transient voltage protection and LED status indicators.
- Removable terminal blocks on all connections.
- Two non-dedicated Temperature Alarm Blocks.
- Two non-dedicated Percent Alarm Blocks.
- Inputs have user configurable debounce.
- Outputs are controlled via a flexible output block that is capable of user specified Boolean logic functions on multiple Input Network Variables.
- Outputs have configurable minimum on and off time to prevent equipment damage and tailor output waveform.
- Outputs types of pulse, toggle, cycle, and flash are supported.

DESCRIPTION

The Model 2150 is a LonWorks based product that has four isolated relay outputs and four isolated inputs. All inputs and outputs are communicated via Standard Network Variable Types (SNVT).

The outputs are four Form C relays. Form C relays are single pole double throw with Normally Closed and Normally Open output contacts. Four red LEDs indicate the status of the output relays.

The four isolated inputs are capable of detecting a wide range of low voltage AC or DC input. The inputs can be used with voltage output, dry contact, sinking (NPN), and sourcing (PNP) type devices. All inputs and outputs have transient voltage suppression. Four green LEDs indicate the presence of an input signal.

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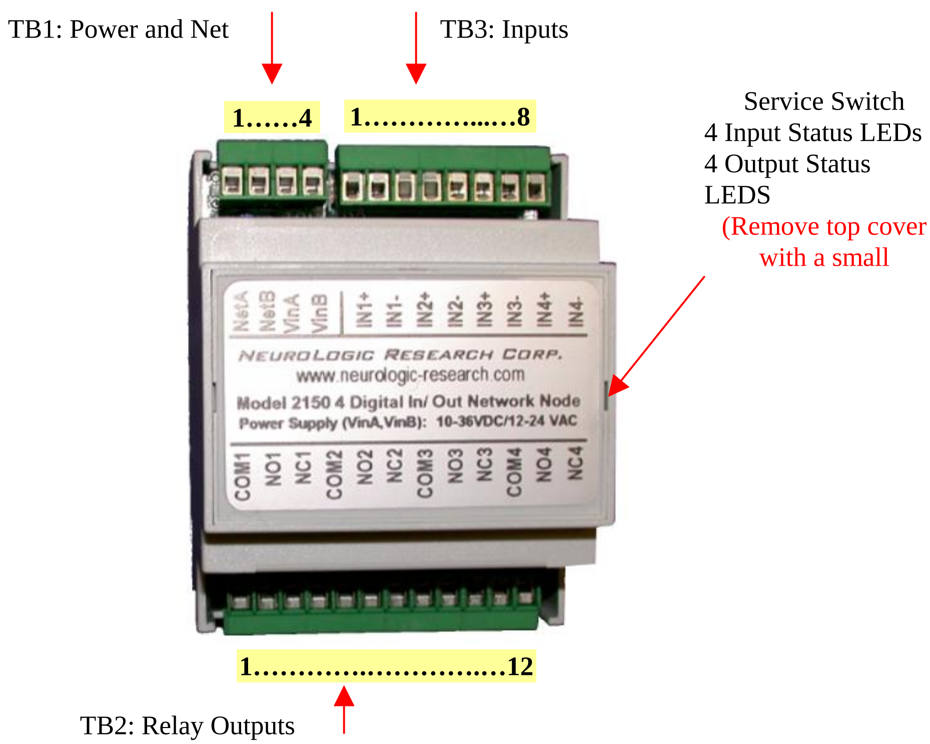
Additionally, the Model 2150 includes a flexible firmware layer that includes two Temperature Alarm Blocks, two Percent Alarm Blocks, four Hardware Input Blocks and four Hardware Output Blocks. The Firmware Blocks can be used individually or tied together to accomplish more complex logic. For example, a relay output can be tied to the Temperature Alarm Block to turn on a warning light if a temperature set point is exceeded.

For efficient use of input power, the Model 2150 uses a switching power supply. It can operate from a wide range of low voltage DC or AC.

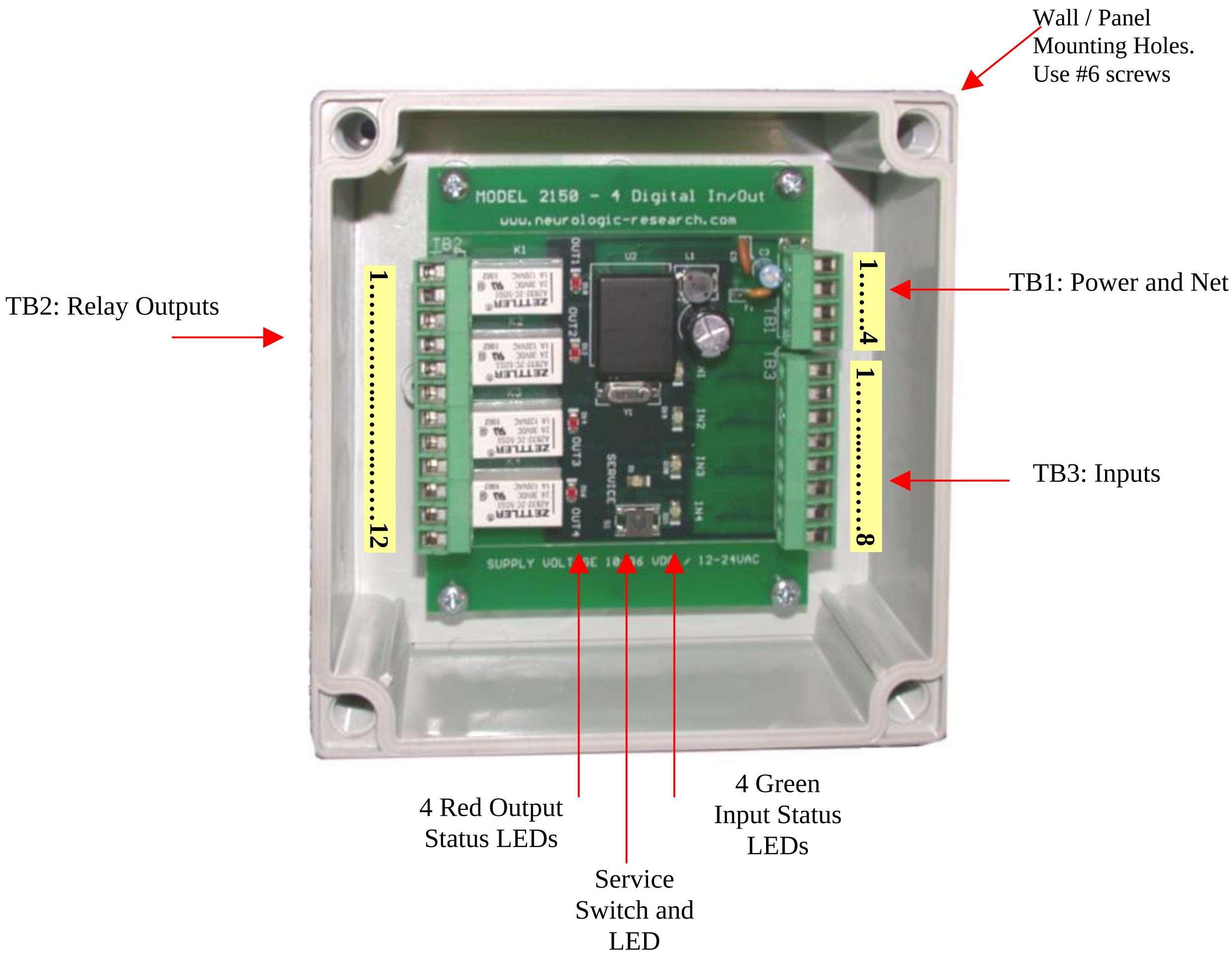
DIN Rail Enclosure

The DIN Rail Enclosure allows mounting on a standard 35 mm DIN Rail. Please see the diagram below. Note, you must remove the top cover with a small screwdriver to access the Service Switch and view the input and output Status LEDs.



NEMA 4X Enclosure

A diagram and layout of the NEMA 4X Enclosure option is shown below. The enclosure can be wall or panel mounted and is appropriate for outdoor environments. To do so, remove the cover. See picture below. Use a #6 screw and drop into mounting holes shown below. Note, mounting holes do not violate the enclosure seal. **Please do not drill holes into the bottom of the enclosure. This voids the NEMA 4X rating.**



The sides of the enclosure have knockouts of different diameters. Please see the diagram below. The enclosure is shipped with all knockouts intact. This allows the customer to use the one most appropriate for the installation. Please note the 20 mm knockout should work well with ½" NPT conduit hubs as well as cable glands. The larger knockouts of 32/20 mm are located at top and bottom sides in the orientation shown above. **For best results, conduit entries should be attached to the bottom side**. This prevents condensation in the conduit from draining into the enclosure.

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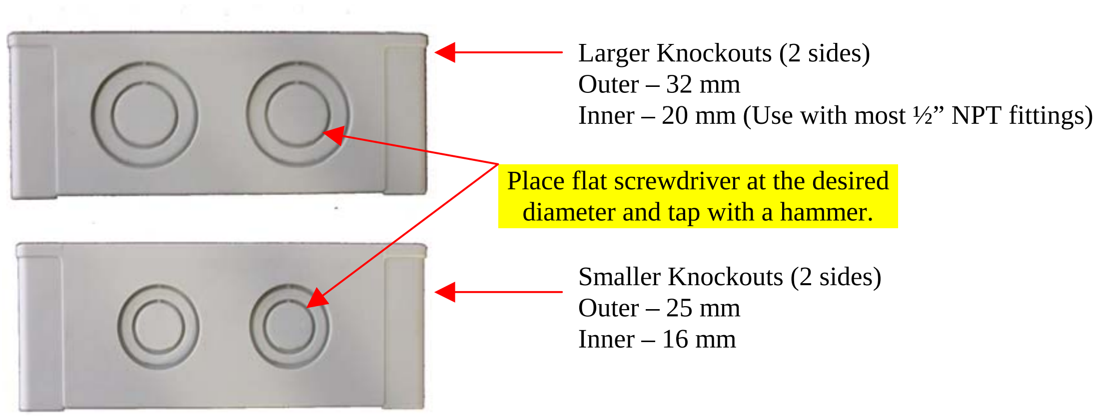


Input Power and Network Interface

The Model 2150 has an efficient switching power supply that operates from 10 to 36 Volts DC or 12 to 24 Volts AC. It typically draws less than 1.5 watts.   Input power is reverse voltage protected and fused. Fuses do not need to be replaced.

The network interface is Echelon’s FTT-10 Free Topology Transceiver. The interface includes DC blocking capacitors for compatibility with Link Power Transceivers. The network connection is not sensitive to polarity. Please note, the Model 2150 does not include any network termination and it must be added externally.

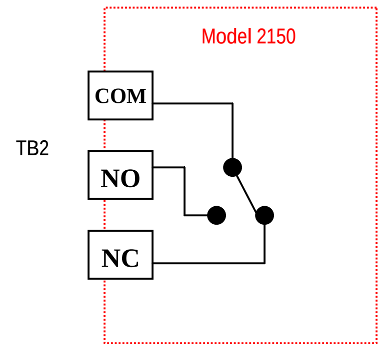
Power and network are connected via terminal block TB1 or TB2. The two connectors are identical to allow for daisy chaining.

TERMINAL BLOCK	FUNCTION
TB1	Power and Network Connection. 1: NetA 2: NetB 3: VinA = Polarity insensitive power supply connection: 10-36 VDC or 12-24 VAC 4: VinB = Polarity insensitive power supply connection: 10-36 VDC or 12-24 VAC

Hardware Outputs

Hardware outputs in the Model 2150 are accomplished by four Form C relays, which provide Normally Open and Normally Closed contact outputs. A simplified diagram of a single output is shown below

TERMINAL BLOCK	FUNCTION
TB2	**Relay Outputs Connector** 1: Relay Output Common #1 2: Normally Open Relay Output #1 3: Normally Closed Relay Output #1 4: Relay Output Common #2 5: Normally Open Relay Output #2 6: Normally Closed Relay Output #2 7: Relay Output Common #3 8: Normally Open Relay Output #3 9: Normally Closed Relay Output #3 10: Relay Output Common #4 11: Normally Open Relay Output #4 12: Normally Closed Relay Output #4



WARNING

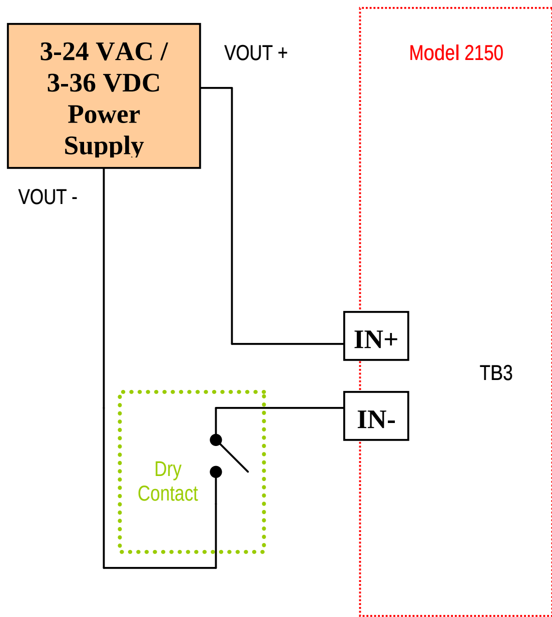
Externally fuse the Relay Outputs using a 2 Amp rated fuse.
Please wire any high voltage AC input before applying electrical power.
Failure to do so may result in electrical shock.

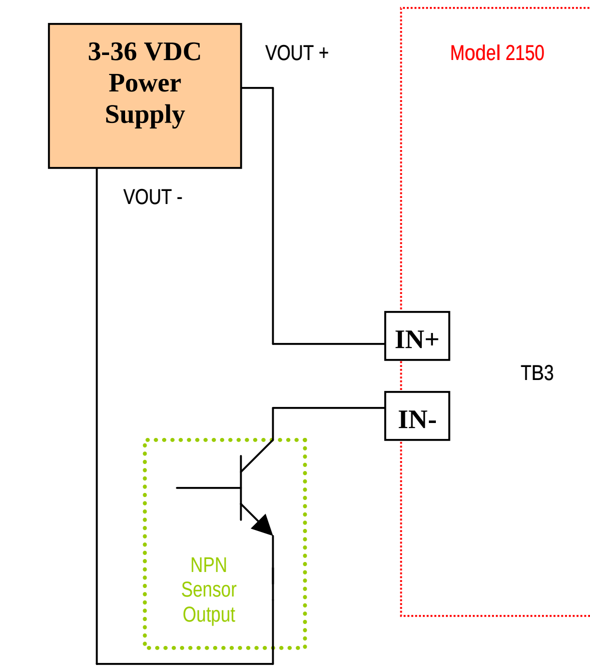
Hardware Inputs

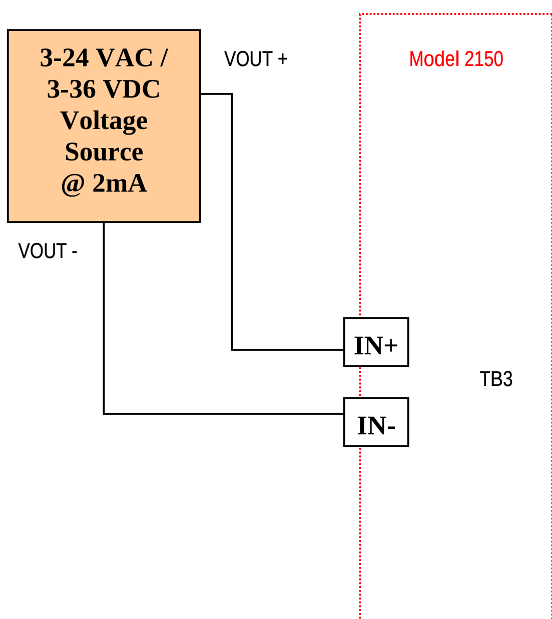
All hardware inputs are accessed via Terminal Block TB3. The four hardware inputs essentially sense a voltage input. They are isolated from each other and will detect a wide range of low voltage AC or DC inputs. They can be used with many types of inputs including dry contact, Sinking, and Sourcing types. Please see the following diagrams for wiring configurations.

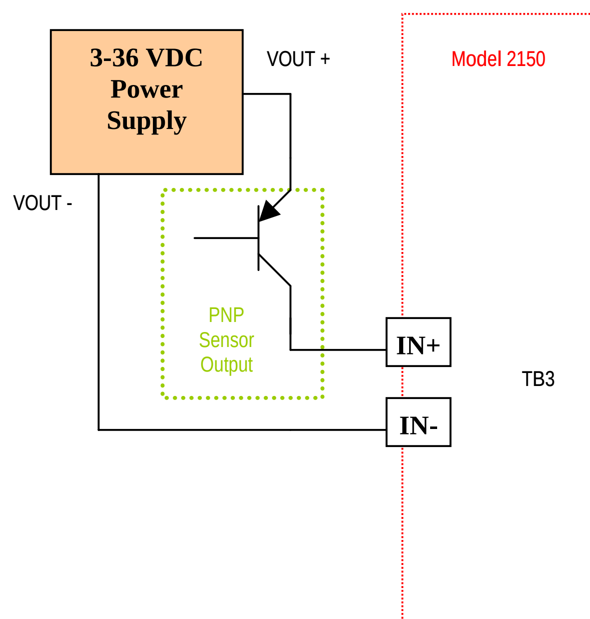
TERMINAL BLOCK	FUNCTION
TB3	**Digital Inputs Connector** 1: Input #1 (+) DC Positive, polarity insensitive for AC input 2: Input #1 (-) DC Negative, polarity insensitive for AC input 3: Input #2 (+) DC Positive, polarity insensitive for AC input 4: Input #2 (-) DC Negative, polarity insensitive for AC input 5: Input #3 (+) DC Positive, polarity insensitive for AC input 6: Input #3 (-) DC Negative, polarity insensitive for AC input 7: Input #4 (+) DC Positive, polarity insensitive for AC input 8: Input #4 (-) DC Negative, polarity insensitive for AC input

Input Connection Diagrams





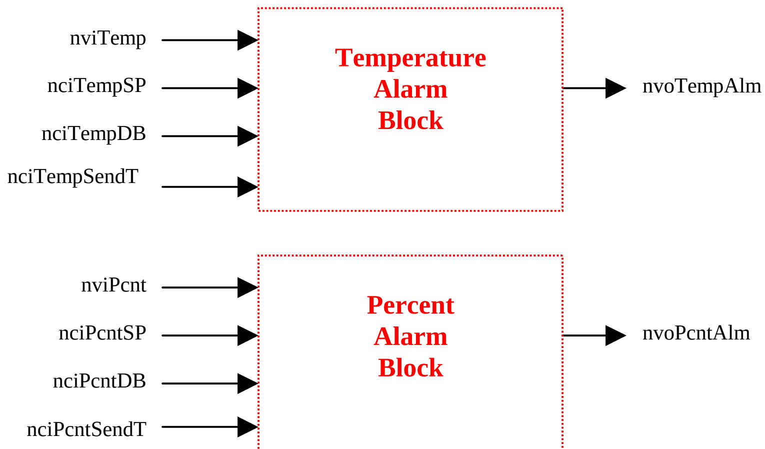




FIRMWARE

The Model 2150 implements its firmware using multiple Logic Blocks. Each Block performs a specific function. Blocks are configured, controlled and provide output via network variables. They can be tied together or cascaded by binding of outputs and input network variables. Connecting Blocks together allows more complex functions to be performed. Connected Blocks can reside on the same physical device or separate devices attached via a LonWorks network.

Temperature and Percent Alarm Blocks



The Model 2150 contains two Temperature and two Percent Alarm Blocks. Block diagrams are shown above. Each alarm block has a real-time value, a setpoint, and a deadband. Real-time value for Temperature Alarm Blocks is via nviTemp. Real-time value for Percent Alarm Blocks is via nviPcnt. Setpoint and deadband inputs are saved in non-volatile memory. The deadband is used to prevent intermittent alarms when close to the setpoint. Each block has an output indicating the status of the alarm condition. Please see the Network Interface section for a detailed description of the network variable types.

Configuring Alarm Block for High or Low Alarm Output

To configure the Block output as a high alarm, the deadband must larger or equal to zero. For low alarms configure the deadband as a negative value. In both cases, the absolute value of the deadband is used.

How Alarms are Evaluated?

A high alarm is defined as follows:

If Value > Setpoint
    Alarm Output = ST_ON
If Value <= (Setpoint – Deadband)
    Alarm Output = ST_OFF

A low alarm is defined as follows. Note, the deadband network variable is defined as a negative to tell the firmware that this is a low alarm. The absolute value is used in the logic below.

If Value < Setpoint
    Alarm Output = ST_ON

If Value >= (Setpoint + Deadband)
Alarm Output = ST_OFF

Overriding an Alarm Block and Reset Condition

If real-time value, setpoint, or deadband of an Alarm Block contains a value of 32767, the alarm output will be forced to an ST_NUL. The output of the Alarm Blocks has a type of SNVT_lev_disc. ST_NUL is a special value, equal to 255, which indicates data is undefined. Many sensors will force their temperature or percentage output value to 32767 to indicate an error condition.

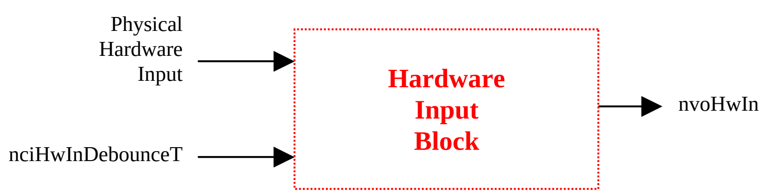
Factory defaults for the setpoint and deadband are forced to 32767. Each time the Model 2150 is turned on, it initializes its real-time input for each Alarm Block to 32767. This insures the firmware logic is always operating on valid data.

For an Alarm Block to operate, the user must enter a valid setpoint and deadband upon receiving it from the factory. Additionally, the firmware must receive a network variable update on its real-time input for the output to be valid.

Network Variable Update Control for Alarm Blocks

The configuration network variable nciTempSendT and nciPcntSendT control updates to nvoTempAlm and nvoPcntAlm output network variables respectively. These are the minimum time between updates even if changes occur. The nciMaxSendT network variable controls the maximum updates of all output network variables.

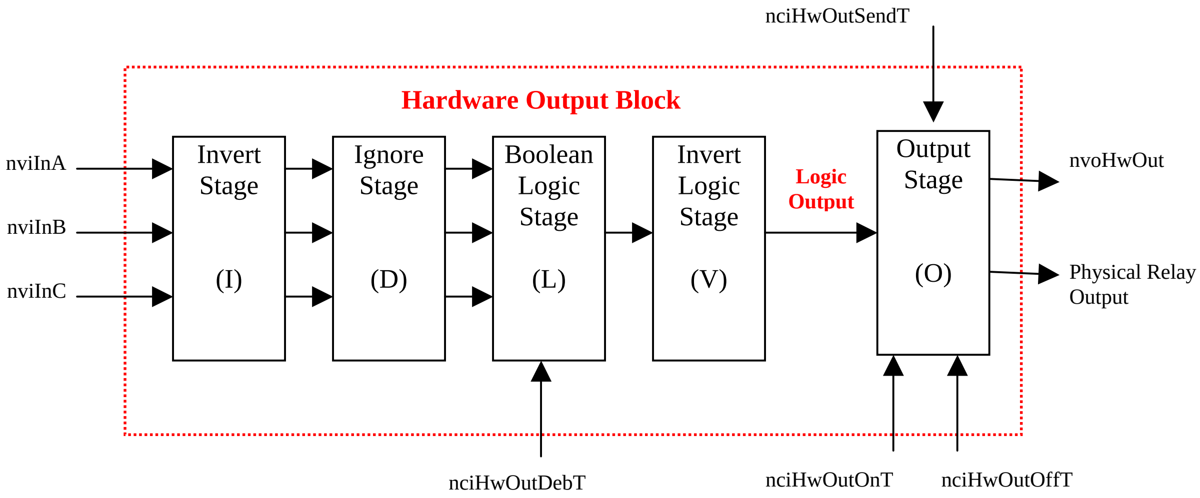
Hardware Input Blocks



The Model 2150 contains four Hardware Input Blocks. A diagram is shown above. The block receives its input from the physical hardware. A configurable debounce time can be set via the nciHwInDebounceT network variable. The output of the block is available using nvoHwIn Output Network Variable.

Please note that nciHwInDebounceT also controls updates to nvoHwIn output network variables. It is the minimum time between updates even if changes occur. The nciMaxSendT network variable controls the maximum updates of all output network variables.

Hardware Output Blocks



The Model 2150 firmware contains four Hardware Output Blocks. The output of each block controls the corresponding physical relay output. The Blocks are highly configurable but simple to use. Hardware Output Blocks have the following features:

- Controlled by up to three input network variables: nviInA, nviInB, and nviInC.
- Each input can be individually inverted.
- Each input can be individually ignored.
- A Boolean logic of AND / OR / Exclusive OR can be performed on the inputs
- The Boolean logic output can be inverted
- The output can be configured to follow the Logic Output, toggle, pulse, flash or cycle.
- Configurable on and off times can be specified to prevent equipment damage and specify output characteristics.
- The output of the block controls the physical output relay and written to a network variable for propagation to other devices or cascading to other Blocks.
- All inputs are simultaneously debounced before any logic is performed.
- The output can be overridden allowing quick shutdown in case of error conditions.

Form C Relay Outputs

The Model 2150 has Form C relay outputs. Normally Open and Normally Closed contacts are available. The OFF condition implies that the Normally Open contact is open. The ON condition implies that the Normally Open contact is closed. The Normally Closed contact will be the opposite.

Debouncing Inputs

Input debouncing can be specified using the nciHwOutDebT network variable. All inputs that are not ignored are debounced simultaneously. That is, a change on any of the inputs will restart the debounce timer. This insures inputs are stable before any logic is performed.

Configuration of Hardware Output Blocks using nciHwOutConfig

All four Hardware Output Blocks are configured via the nciHwOutConfig network variable. It is an ASCII string of 27 characters in the following format:

IDLVOX,IDLVOX,IDLVOX,IDLVOX

Please note that each Block is configured via a series of 6 ASCII characters identified as: IDLVOX. A comma separates the sets for each of the four Blocks. Commas do not have spaces before or after them. The left-most set configures the first Block. The right-most set configures the fourth Block and so on. The characters above are only for identification of each position in the configuration string and are not what is actually specified. Please see the diagram above. For example the first character identified by 'I' configures the "Invert Stage" of the Block. The character identified by 'D' configures the "Ignore Stage" of the Block and so on.

The length and format of the string is very important. It must be 27 characters long and have commas in the positions shown. If invalid values are entered, it will cause that block to go into over-ride, turn the output relay off, and set the network variable output to ST_NUL. Each configuration character is defined below. All values are in ASCII. Low and upper case are allowed.

Configuration Character ID	Usage	Description
I	Configures input inversion stage	0 = No inputs are inverted (Factory Default) 1 = Input A is inverted 2 = Input B is inverted 3 = Inputs A and B are inverted 4 = Input C is inverted 5 = Inputs A and C are inverted 6 = Inputs B and C are inverted 7 = Inputs A, B, and C are inverted
D	Configures ignore / don't care stage	0 = No inputs are ignored 1 = Input A is ignored 2 = Input B is ignored 3 = Inputs A and B are ignored 4 = Input C is ignored 5 = Inputs A and C are ignored 6 = Inputs B and C are ignored (Factory Default) 7 = Inputs A, B, and C are ignored
L	Configures Boolean logic stage	O = Boolean OR (Factory Default) A = Boolean AND X = Boolean Exclusive OR
V	Configures inversion of logic stage	N = Normal, do not invert (Factory Default) L = Invert logic output
O	Configures output type	N = Normal: Output follows logic output (Factory Default). The nciHwOutOnT and nciHwOutOffT are used to define the minimum on and off times even if the Logic Output changes. Prevents equipment cycling. T = Toggle: Output toggles every time Logic Output goes from off to on. C = Cycle: Output cycles on/off, square wave, as long as Logic Output is on. On time is defined by nciHwOutOnT. Off time is defined by nciHwOutOffT F = Flash: Variation on Cycle Type. Please see text for full description. P = Pulse: Output will produce an output pulse equal to nciHwOutOnT when Logic Output goes from off to on.
X	Future usage	Not used, but must be left as a place holder.

Flash Output Type

A 'Flash' output type can be specified for the output. This type is explained in detail here. The Flash output type works as follows and essentially allows the first input, nviInA to turn the output on, off, or flash at different rates.

LogicOut	nviInA	Hardware Output
On	ST_OFF	Off
On	ST_ON	On
On	ST_HIGH	Output cycles on/off: On for nciHwOutOnT, Off for nciHwOutOffT
On	ST_MED	Output cycles on/off: On for 2 X nciHwOutOnT, Off for 2 X nciHwOutOffT
On	ST_LOW	Output cycles on/off: On for 4 X nciHwOutOnT, Off for 4 X nciHwOutOffT
Off	Don't care	Off

Overriding the Block Output and Reset Condition

Upon reset, the Model 2150 initializes all inputs to the Block to ST_NUL. A value of ST_NUL on any of the input that is not being ignored will force the physical hardware output off and the output network variable to ST_NUL.

This accomplishes two tasks. One, it forces the block to wait for data on all inputs that are not ignored before performing any logic. Two, it allows any input, that is not being ignored, to over-ride any output being performed by the Block and turn off the physical output.

Default Factory Configuration

The factory default value loaded into the nciHwOutConfig string is shown below:

06ONNX,06ONNX,06ONNX,06ONNX

The above configuration simply configures each hardware output to be controlled via the nviInA network variable. Note, nviInB and nviInC are ignored and must be enabled if they are to be used. The 'OR' logic function on a single input, nviInA, allows the output to follow the state of nviInA. Please note, the hardware output will observe the minimum on and off periods set by nciHwOutOnT and nciHwOutOffT configuration variables.

Network Variable Update Control for Hardware Output Blocks

The configuration network variable nciHwOutSendT control updates to nvoHwOut output network variables. It is the minimum time between updates even if changes occur. The nciMaxSendT network variable controls the maximum updates of all output network variables.

NETWORK INTERFACE

CONFIGURATION NETWORK VARIABLES

Network Variable	Format	Description
Temperature Alarm Block		
nciTempSP[2]	SNVT_temp_p	Setpoint input. Default is 32767
nciTempDB[2]	SNVT_temp_p	Deadband input. Default is 32767.
nciTempSendT[2]	SNVT_time_sec	Minimum time between nvoTempAlm updates even if changes occur. This is sometimes called throttle.
Percent Alarm Block		
nciPcntSP[2]	SNVT_lev_percent	Setpoint input. Default is 32767
nciPcntDB[2]	SNVT_lev_percent	Deadband input. Default is 32767.
nciPcntSendT[2]	SNVT_time_sec	Minimum time between nvoPcntAlm updates even if changes occur. This is sometimes called throttle.
Hardware Input Block		
nciHwInDebounceT[4]	SNVT_time_sec	Debounce time for each of the Hardware Input Blocks. This parameter is also the minimum time between nvoHwIn updates even if changes occur. This is also called throttle.
Hardware Output Block		
nciHwOutConfig	SNVT_str_asc	ASCII configuration string used to control function of all Hardware Output Blocks. Please see Hardware Output Blocks Section for complete specification.
nciHwOutDebT[4]	SNVT_time_sec	Debounce time for all inputs to Hardware Output Blocks.
nciHwOutOnT[4]	SNVT_time_sec	On time for output stage
nciHwOutOffT[4]	SNVT_time_sec	Off time for output stage
nciHwOutSendT[4]	SNVT_time_sec	Minimum time between nvoHwOut updates even if changes occur. This is sometimes called throttle.
All Blocks		
nciMaxSendT	SNVT_time_sec	Maximum time between network variable updates even if no changes occur. This is sometimes called heartbeat. A 0 disables the heartbeat.

INPUT NETWORK VARIABLES

Network Variable	Format	Description
Temperature Alarm Block		
nviTemp[2]	SNVT_temp_p	Real-time temperature data.
Percent Alarm Block		
nviPcnt[2]	SNVT_lev_percent	Real-time percent data.
Hardware Input Block		
None		Hardware Input Block get their input from the physical inputs on the Model 2150.
Hardware Output Block		
nviInA[4]	SNVT_lev_disc	First input of Hardware Out Block. Initialized to ST_NUL on power-up.
nviInB[4]	SNVT_lev_disc	Second input of Hardware Out Block. Initialized to ST_NUL on power-up.
nviInC[4]	SNVT_lev_disc	Third input of Hardware Out Block. Initialized to ST_NUL on power-up.

OUTPUT NETWORK VARIABLES

Network Variable	Format	Description
Temperature Alarm Block		
nvoTempAlm[2]	SNVT_lev_disc	Output of Temperature Alarm Blocks.
Percent Alarm Block		
nvoPcntAlm[2]	SNVT_lev_disc	Output of Percent Alarm Blocks.
Hardware Input Block		
noHwIn[4]	SNVT_lev_disc	Output of Hardware Input Blocks.
Hardware Output Block		
noHwOut[4]	SNVT_lev_disc	Output of Hardware Output Blocks.

MODEL 2150

SPECIFICATION

General

CPU	Neuron @ 10 MHz
Operating Temperature	-40 – 85º C
Operating Humidity	0-95% Relative Humidity non-condensing
Input Power	10-36 VDC or 12-24 VAC
Input Power Protection	Input power is fused and transient voltage protected. (Fuses do not need to be replaced)
Current Consumption	1.5 watts typical with all inputs and outputs on.
Network Transceiver Type	Echelon FTT-10A transceiver at 78 kbps. DC blocking capacitors for LPT10 network.
Input Power and Network Wiring	Removable terminal blocks. Input power and network wiring are polarity insensitive.

Isolated Hardware Inputs

Type	Individually isolated voltage input.
DC Voltage Input Range	3-36 Volts. Input must be able to supply 2 mA maximum.
AC Voltage Input Range	3-24 Volts. Input must be able to supply 2 mA maximum.
Protection	Reverse voltage protection and transient voltage suppressors
Isolation	500 Volts minimum.

Relay Outputs

Type	Form C relay with normally open and normally closed outputs
Contact Rating	30 VDC @ 2 A or 125 VAC @ 2A Resistive load.
Isolation	500 Volts RMS minimum.
Protection	Transient voltage suppression. **Must be externally fused via 2A fuse.**

Dimension and Materials

DIN Rail Enclosure's external Dimension	71 mm (2.8") W x 90 mm (3.54") L x 58 mm (2.28") H
DIN Rail Enclosure's Material	Grey frame retardant Noryl UL94
NEMA 4 Enclosure's external Dimension	130 mm (5.12") W x 130 mm (5.12") L x 60 mm (2.36") H
NEMA 4 Enclosure's Material	Grey polycarbonate with translucent polycarbonate cover. Flame retardant UL94

ORDERING INFORMATION

2150	**Model 2150 Four Digital Output / Four Digital Input Network Node**

Code	**Enclosure / Housing Options**
-0	NEMA 4X
-1	DIN-Rail Mount

Code	**Network Communications Option**
-0	TP/FTT-10A - LonWorks

2150	**-1**	**-0**	**Model 2150 with LonWorks FTT-10A transceiver in DIN-Rail housing**