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# **LONMARK<sup>®</sup>**

## **Functional Profile:**

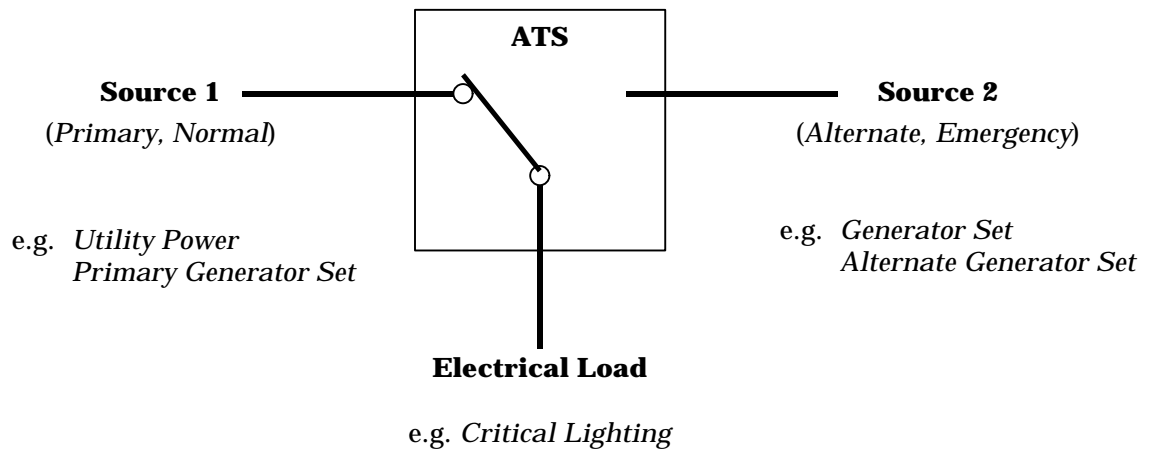
### **Automatic Transfer Switch**

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## Overview

This document describes the functional profile of an Automatic Transfer Switch (ATS) object. The ATS object does not require other nodes for operation. The object is self-contained but may be monitored and controlled by other nodes. An ATS is a piece of electrical equipment that is used to monitor and automatically connect the best of two power sources to an electrical load. Normally at least one of the two power sources is a generator set that is directed by the ATS to start when the primary power source has failed.

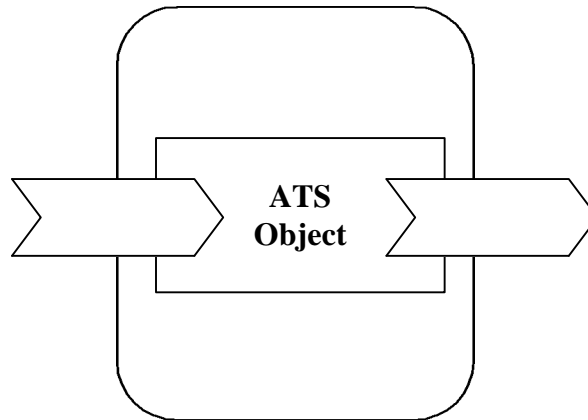
The electrical load may be connected to Source 1, Source 2, both Source 1 and Source 2 or disconnected from both sources. This document will refer to Source 1 as the primary or normal power source and Source 2 as the alternate or emergency power source. Source 1 is the preferred power source and the ATS will connect the electrical load to Source 1 if it is “available.” Available implies the power source is within an allowable voltage and frequency range. The figure below shows the functional implementation of an Automatic Transfer Switch.



**Figure 1.1** Automatic Transfer Switch

The Functional Profile is shown below.

### Automatic Transfer Switch Profile



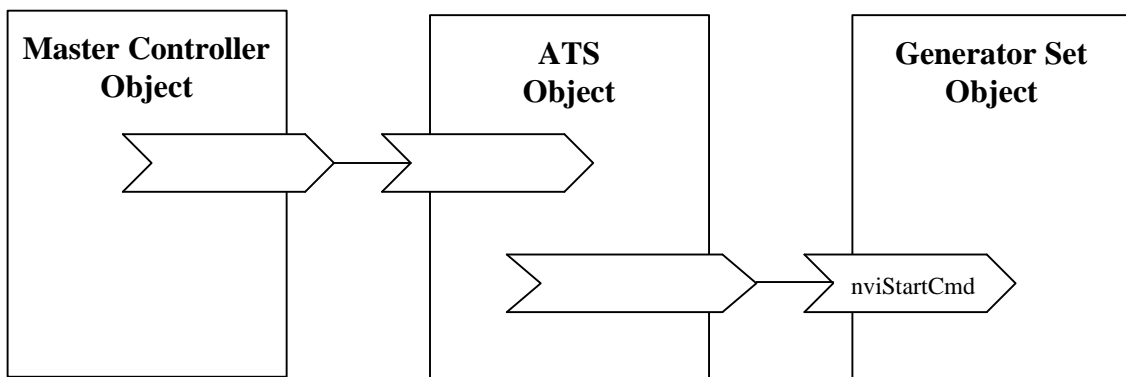
**Figure 1.2** Automatic Transfer Switch Object

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## Example Usage

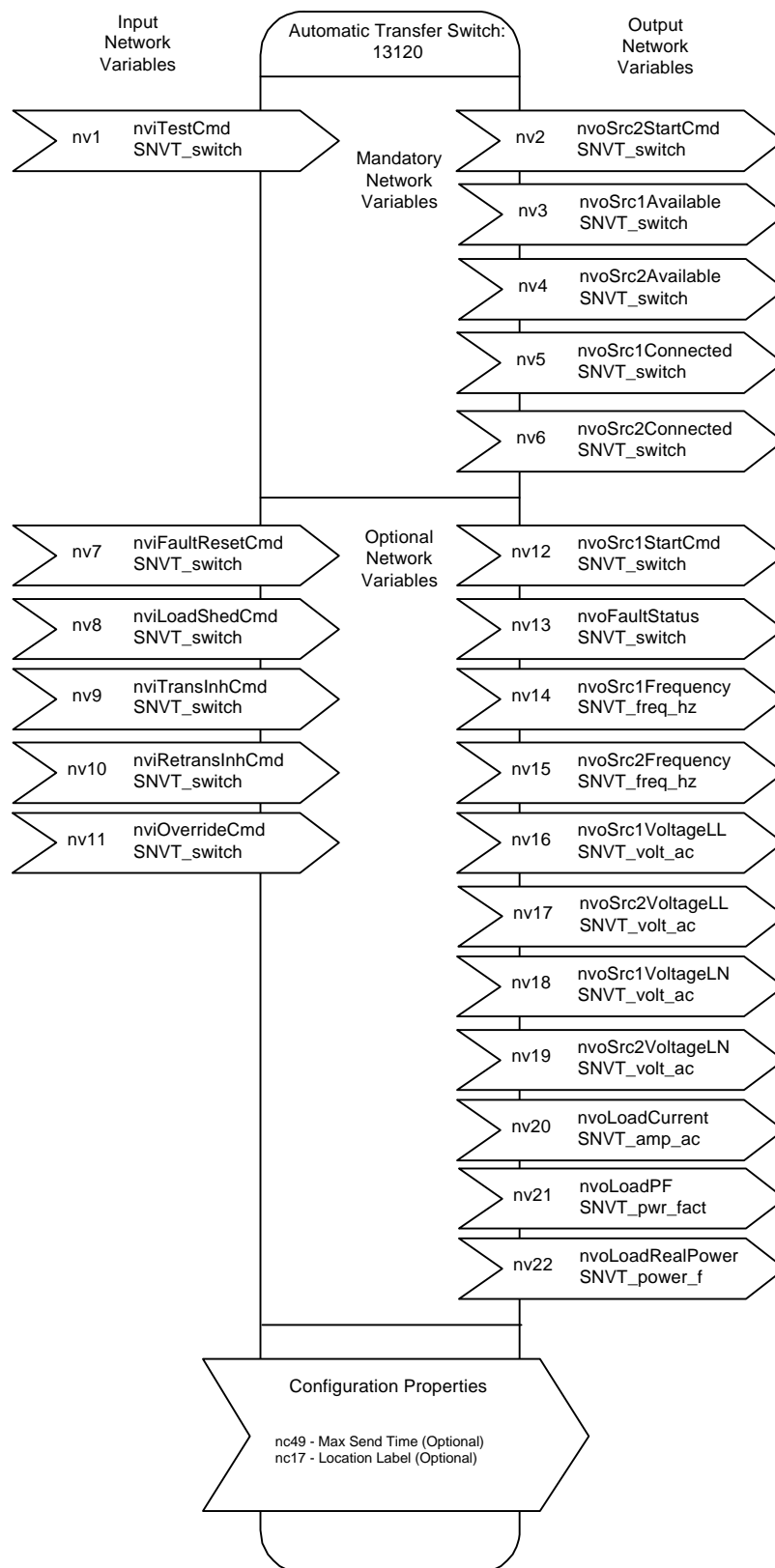
The Automatic Transfer Switch object may interact with one or more of the following LONMARK devices:

- Generator Set node
- Supervisory node (Master Controller)
- Annunciation Panel node
- Circuit Breaker node



**Figure 1.3** Example Usage of Automatic Transfer Switch Object

## Object Details



**Figure 1.4** Automatic Transfer Switch Object Details

**Table 1** SNVT Details

<b>NV # (M/O)*</b>	<b>Name</b>	<b>In/Out</b>	<b>SNVT Type (SNVT Index)</b>	<b>Class</b>	<b>Description</b>
1 (M)	nviTestCmd	In	SNVT_switch (95)	I/O	allow an external node to test the ATS operation
2 (M)	nvo Src2StartCmd	Out	SNVT_switch (95)	I/O	allow the ATS to start and stop the alternate or emergency power source
3 (M)	nvo Src1Available	Out	SNVT_switch (95)	I/O	indicate the availability of the normal power source (GenSet/Source 1)
4 (M)	nvo Src2Available	Out	SNVT_switch (95)	I/O	indicate the availability of the emergency power source (GenSet/Source 2)
5 (M)	nvo Src1Connected	Out	SNVT_switch (95)	I/O	indicate the switch position of the ATS
6 (M)	nvo Src2Connected	Out	SNVT_switch (95)	I/O	indicate the switch position of the ATS
7 (O)	nvi FaultReset Cmd	In	SNVT_switch (95)	I/O	reset or attempt to clear an ATS fault
8 (O)	nvi LoadShedCmd	In	SNVT_switch (95)	I/O	shed the electrical load of the ATS
9 (O)	nvi TransInhCmd	In	SNVT_switch (95)	I/O	inhibit the ATS from automatically transferring the load to the emergency power source (Source 2), when Source 2 becomes available
10 (O)	nvi RetransInh Cmd	In	SNVT_switch (95)	I/O	inhibit the ATS from automatically transferring the load back to the normal power source (Source 1), when Source 1 becomes available
11 (O)	nvi OverrideCmd	In	SNVT_switch (95)	I/O	override a transfer or retransfer time delay, or transfer or retransfer inhibit
12 (O)	nvo Src1StartCmd	Out	SNVT_switch (95)	I/O	allow the ATS to start and stop the Source 1
13 (O)	nvo FaultStatus	Out	SNVT_switch (95)	I/O	reports the presence of an ATS fault
14 (O)	nvo Src1Frequency	Out	SNVT_freq_hz (76)	I/O	line frequency of Source 1
15 (O)	nvo Src2Frequency	Out	SNVT_freq_hz (76)	I/O	line frequency of Source 2

16 (O)	nvo Src1VoltageLL	Out	SNVT_volt_ac (138)	I/O	line-to-line voltage(s) of Source 1
17 (O)	nvo Src2VoltageLL	Out	SNVT_volt_ac (138)	I/O	line-to-line voltage(s) of Source 2
18 (O)	nvo Src1VoltageL N	Out	SNVT_volt_ac (138)	I/O	line-to-neutral voltage(s) of Source 1
19 (O)	nvo Src2VoltageL N	Out	SNVT_volt_ac (138)	I/O	line-to-neutral voltage(s) of Source 2
20 (O)	nvo LoadCurrent	Out	SNVT_amp_ac (139)	I/O	line current(s) of the electrical load
21 (O)	nvoLoadPF	Out	SNVT_pwr_fact (98)	I/O	power factor of the electrical load
22 (O)	nvo LoadReal Power	Out	SNVT_power_f (57)	I/O	real power of the electrical load as a floating type ( in Watts)
nc49 (O)	nci MaxSendTime	–	SNVT_time_sec (107)	config	Send Heartbeat SCPTmaxSendTime
nc17 (O)	nciLocation	–	SNVT_str_asc (36)	config	Label, Location SCPTlocation

\* M = mandatory, O = optional

**Table 2** SCPT Details

<b>SCPT Index (M/O)*</b>	<b>Name</b>	<b>Association **</b>	<b>Description</b>
nci49 (O)	SCPTmaxSendTime nciMaxSendTime SNVT_time_sec (107)	nv14 (O), nv15 (O), nv16 (O), nv17 (O), nv19 (O), nv20 (O), nv21 (O), nv22 (O)	maximum period of time that expires before the ATS object will automatically update NVs
nci17 (O)	SCPTlocation nciLocation SNVT_str_asc (36)	nv0	used to provide physical location of the node

\* M = mandatory, O = optional

\*\* List of NVs to which this configuration property applies. NV index = 0 means configuration property applies to the object as a whole (nv0).

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## Mandatory Network Variables

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### Test Command Input

network input SNVT\_switch    nviTestCmd;

This input network variable is available to allow an external node to test the operation of the ATS. This input is mandatory but does not have to be bound to an external node. When state = 1, the transfer switch will begin a test of normal power source (Source 1) failure. When state = 0, the transfer switch will end the test and resume normal operation. The 'value' field is not used.

#### *Valid Range*

state	value	command
0	NA	End Test
1	NA	Start Test

#### *Default Value*

state:                            0 (End Test)  
value:                            0

---

### Start Source 2 Command Output

network output SNVT\_switch    nvoSrc2StartCmd;

This output network variable is available to allow the ATS to start and stop the alternate or emergency power source (Source 2, e.g. generator set). This output would be used when the ATS has detected the primary power source (Source 1) has failed or when the ATS is executing a test of Source 1 failing. This input is mandatory but does not have to be bound to an external node.

When state = 1, the ATS is requesting the alternate power source to start running. When state = 0, the ATS is instructing the alternate power source to stop running. The 'value' field is not used.

#### *Valid Range*

state	value	command
0	NA	Stop Source 2
1	NA	Start Source 2



### *Default Value*

state: 0 (Stop)  
value: 0

---

## Source 1 Available Output

network output SNVT\_switch nvoSrc1Available;

This output network variable is available to indicate the availability of the normal power source (Source 1). When state = 1, the normal power source (Source 1) is available for loading. When state = 0, Source 1 has either failed or is not available for loading. The 'value' field is not used.

### *Valid Range*

state	value	meaning
0	NA	Source 1 Available
1	NA	Source 1 NOT Available
0xFF	NA	Source 1 Unknown

### *Default Value*

state: 0xFF (Unknown)  
value: 0

---

## Source 2 Available Output

network output SNVT\_switch nvoSrc2Available;

This output network variable is available to indicate the availability of the emergency power source (Source 2). When state = 1, the emergency power source (Source 2) is available for loading. When state = 0, Source 2 has either failed or is not available for loading. The 'value' field is not used.

### *Valid Range*

state	value	meaning
0	NA	Source 2 Available
1	NA	Source 2 NOT Available
0xFF	NA	Source 2 Unknown

### *Default Value*

state: 0xFF (Unknown)  
value: 0

---

## Source 1 Connected Output

```
network output SNVT_switch nvoSrc1Connected;
```

This output network variable is available to indicate the switch position of the ATS. This input is mandatory but does not have to be bound to an external node. When state = 1, the ATS load is connected to the normal power source (Source 1). When state = 0, the ATS load is not connected to Source 1. The 'value' field is not used.

### *Valid Range*

state	value	meaning
0	NA	Load NOT connected to Source 1
1	NA	Load connected to Source 1
0xFF	NA	Source 1 Unknown

### *Default Value*

state: 0xFF (Unknown)  
value: 0

---

## Source 2 Connected Output

```
network output SNVT_switch nvoSrc2Connected;
```

This output network variable is available to indicate the switch position of the ATS. This input is mandatory but does not have to be bound to an external node. When state = 1, the ATS load is connected to the emergency power source (Source 2). When state = 0, the ATS load is not connected to Source 2. The 'value' field is not used.

### *Valid Range*

state	value	meaning
0	NA	Load NOT connected to Source 2
1	NA	Load connected to Source 2
0xFF	NA	Source 2 Unknown

### *Default Value*

state:	0xFF (Unknown)
value:	0

---

## Optional Network Variables

---

### Fault Reset Command Input

```
network input SNVT_switch    nviFaultResetCmd;
```

This input network variable is available to allow an external node to reset or attempt to clear an ATS fault. This input is mandatory but does not have to be bound to an external node. When state = 1, the ATS will clear all active faults. When state = 0, the ATS will do nothing. The 'value' field is not used.

#### Valid Range

state	value	command
0	NA	NA
1	NA	Reset Fault

#### Default Value

state: 0

value: 0

---

### Load Shed Command Input

```
network input SNVT_switch    nviLoadShedCmd;
```

This input network variable is available to allow an external node to shed the electrical load of the ATS. This input is only applicable when the ATS load is connected to the emergency power source (Source 2). That is, this input is not valid when the ATS is connected to the normal power source (Source 1). This input is mandatory but does not have to be bound to an external node.

When the transfer switch is connected to Source 2 and state = 1, the transfer switch will disconnect from the load. When state = 0, the transfer switch will re-connect to Source 2. The 'value' field is not used.

The optional 'override' input cannot be used to defeat the load shed command.

#### Valid Range

state	value	command
0	NA	Restore Load
1	NA	Shed Load

### *Default Value*

state: 0 (Restore Load)  
value: 0

---

## Transfer Inhibit Command Input

network input SNVT\_switch nviTransInhCmd;

This input network variable is available to allow an external node to inhibit the ATS from automatically transferring the load to the emergency power source (Source 2), when Source 2 becomes available. This input is only applicable when the ATS load is connected to the normal power source (Source 1). Once the ATS has disconnected from Source 1, this input is not available. This input is mandatory but does not have to be bound to an external node.

When the ATS is connected to Source 1 and state = 1, the ATS will be disabled from automatically transferring load to the emergency power source (Source 2). The ATS load would then have to be manually transferred (to Source 2). When state = 0, the ATS may automatically transfer load to Source 2 when it becomes available. The 'value' field is not used.

The optional 'override' input may be used to defeat the transfer inhibit command.

### *Valid Range*

State	value	command
0	NA	Automatic Transfer Enabled
1	NA	Automatic Transfer Inhibited

### *Default Value*

state: 0 (Automatic Transfer Enabled)  
value: 0

---

## Retransfer Inhibit Command Input

network input SNVT\_switch nviRetransInhCmd;

This input network variable is available to allow an external node to inhibit the ATS from automatically transferring the load back to the normal power source (Source 1), when Source 1 becomes available. This input is only applicable when the ATS load is connected to the emergency power source (Source 2). Once the ATS has disconnected from Source 2, this input is not available.

When the ATS is connected to Source 2 and state = 1, the ATS will be disabled from automatically transferring load back to the normal power source (Source 1). The ATS load would then have to be manually re-transferred (back to Source 1). When state = 0, the ATS may automatically transfer load back to Source 1 when it becomes available. The 'value' field is not used.

The optional 'override' input can be used to defeat the retransfer inhibit command.

### *Valid Range*

State	value	command
0	NA	Automatic Retransfer Enabled
1	NA	Automatic Retransfer Inhibited

### *Default Value*

state: 0 (Automatic Retransfer Enabled)  
value: 0

---

## Override Command Input

```
network input SNVT_switch nviOverrideCmd;
```

This input network variable is available to allow an external node to override a transfer or retransfer time delay, or transfer or retransfer inhibit. When state = 1, the ATS will remove all inhibits and expire any transfer or retransfer time delays, allowing immediately transfer or retransfer. When state = 0, the ATS will do nothing. The 'value' field is not used.

### *Valid Range*

state	value	command
0	NA	NA
1	NA	Transfer or Retransfer Immediately

### *Default Value*

state: 0  
value: 0

---

## Start Source 1 Command Output

```
network input SNVT_switch nvoSrc1StartCmd;
```

This output network variable is available to allow the ATS to start and stop the Source 1. This output would be used in critical applications where the emergency power source is comprised of two generator sets (for redundancy). If one of the emergency power sources should fail, an alternate would be available. If the emergency power source is required for an extensive period, the ATS may chose to 'rotate' the load between the two sources. In either scenario, an additional start command is needed to independently start each generator set.

When state = 1, the ATS is requesting the primary power source (Source 1) to start running. When state = 0, the ATS is instructing the primary power source to stop running. The 'value' field is not used.

### *Valid Range*

state	value	command
0	NA	Stop Source 1
1	NA	Start Source 1

### *Default Value*

state: 0 (Stop)  
value: 0

---

## Fault Status Output

```
network input SNVT_switch    nvoFaultStatus;
```

This output network variable will report the presence of an ATS fault. When state = 1, the ATS has detected a fault condition. When state = 0, no faults are present at the ATS or all faults have been cleared. The 'value' field is not used.

### *Valid Range*

state	value	command
0	NA	No Fault
1	NA	Fault condition exists

### *Default Value*

state: 0xFF (INVALID), indicating Fault  
Status is unknown.  
value: 0

### *When Transmitted*

The output variable is transmitted:

- Upon node reset, after obtaining valid data.
- When the fault status has changed.

### *Update Rate*

There is no maximum update rate.

### *Default Service Type*

The default service type is acknowledged.

---

## Source 2 Frequency Output

```
network output SNVT_freq_hz    nvoSrc2Frequency;
```

This output network variable will report the line frequency of Source 2.

### *Valid Range*

The valid range is 0 to 6553.4 Hz.

### *Default Value*

The default value is 0xFFFF (6553.5 Hz), indicating the frequency is unknown.

### *When Transmitted*

The output variable is transmitted:

- Upon node reset, after obtaining valid data.
- Regularly at the interval defined by the configuration variable nciMaxSendTime.

### *Update Rate*

The update rate is determined by the configuration variable nciMaxSendTime.

### *Default Service Type*

The default service type is acknowledged.

---

## Source 1 Line-to-Line Voltage Output

```
network output SNVT_volt_ac    nvoSrc1VoltageLL;
```

This output network variable will report the line-to-line voltage(s) of Source 1. For multi-phase systems, this output may have several instances in order to display the voltages between phases A-B, B-C, C-A or the average line-to-line voltage of all phases.



### *Valid Range*

The valid range is 0 to 65,534 VAC.

### *Default Value*

The default value is 0xFFFF (65,535 VAC), indicating the line-to-line voltage is unknown.

### *When Transmitted*

The output variable is transmitted:

- Upon node reset, after obtaining valid data.
- Regularly at the interval defined by the configuration variable nciMaxSendTime.

### *Update Rate*

The update rate is determined by the configuration variable nciMaxSendTime.

### *Default Service Type*

The default service type is acknowledged.

---

## **Source 2 Line-to-Line Voltage Output**

```
network output SNVT_volt_ac    nvoSrc2VoltageLL;
```

This output network variable will report the line-to-line voltage(s) of Source 2. For multi-phase systems, this output may have several instances in order to display the voltages between phases A-B, B-C, C-A or the average line-to-line voltage of all phases.

### *Valid Range*

The valid range is 0 to 65,534 VAC.

### *Default Value*

The default value is 0xFFFF (65,535 VAC), indicating the line-to-line voltage is unknown.

### *When Transmitted*

The output variable is transmitted:

- Upon node reset, after obtaining valid data.
- Regularly at the interval defined by the configuration variable nciMaxSendTime.

### *Update Rate*

The update rate is determined by the configuration variable `nciMaxSendTime`.

### *Default Service Type*

The default service type is acknowledged.

---

## Source 1 Line-to-Neutral Voltage Output

```
network output SNVT_volt_ac    nvoSrc1VoltageLN;
```

This output network variable will report the line-to-neutral voltage(s) of Source 1. For multi-phase systems, this output may have several instances in order to display the individual line voltages A, B, C, or the average line-to-neutral voltage of all phases.

### *Valid Range*

The valid range is 0 to 65,534 VAC.

### *Default Value*

The default value is 0xFFFF (65,535 VAC), indicating the line-to-line voltage is unknown.

### *When Transmitted*

The output variable is transmitted:

- Upon node reset, after obtaining valid data.
- Regularly at the interval defined by the configuration variable `nciMaxSendTime`.

### *Update Rate*

The update rate is determined by the configuration variable `nciMaxSendTime`.

### *Default Service Type*

The default service type is acknowledged.

---

## Source 2 Line-to-Neutral Voltage Output

```
network output SNVT_volt_ac    nvoSrc2VoltageLN;
```

This output network variable will report the line-to-neutral voltage(s) of Source 2. For multi-phase systems, this output may have several

instances in order to display the individual line voltages A, B, C, or the average line-to-neutral voltage of all phases.

### *Valid Range*

The valid range is 0 to 65,534 VAC.

### *Default Value*

The default value is 0xFFFF (65,535 VAC), indicating the line-to-line voltage is unknown.

### *When Transmitted*

The output variable is transmitted:

- Upon node reset, after obtaining valid data.
- Regularly at the interval defined by the configuration variable nciMaxSendTime.

### *Update Rate*

The update rate is determined by the configuration variable nciMaxSendTime.

### *Default Service Type*

The default service type is acknowledged.

---

## **Load Current Output**

```
network output SNVT_amp_ac    nvoLoadCurrent;
```

This output network variable will report the line current(s) of the electrical load. For multi-phase systems, this output may have several instances in order to display the line current of phases A, B, C, total or average current of all phases. Another instance of this output may also be used to display the neutral phase current of the load. This output is intended for monitoring the ATS load.

### *Valid Range*

The valid range is 0 to 65,534 A.

### *Default Value*

The default value is 0xFFFF (65,535 A), indicating the line current is unknown.

### *When Transmitted*

The output variable is transmitted:

- Upon node reset, after obtaining valid data.
- Regularly at the interval defined by the configuration variable nciMaxSendTime.

### *Update Rate*

The update rate is determined by the configuration variable nciMaxSendTime.

### *Default Service Type*

The default service type is acknowledged.

---

## **Load Power Factor Output**

```
network output SNVT_pwr_fact    nvoLoadPF;
```

This output network variable will report the power factor of the electrical load. This output is intended for monitoring the ATS load.

### *Valid Range*

The valid range is -1.00000 to +1.00000. Values less than zero indicate a 'leading' power factor.

### *Default Value*

The default value is 0x7FFF (+1.63835), indicating the power factor is unknown.

### *When Transmitted*

The output variable is transmitted:

- Upon node reset, after obtaining valid data.
- Regularly at the interval defined by the configuration variable nciMaxSendTime.

### *Update Rate*

The update rate is determined by the configuration variable nciMaxSendTime.

### *Default Service Type*

The default service type is acknowledged.

---

## Load Real Power Output

```
network output SNVT_power_f    nvoLoadRealPower;
```

This output network variable will report the real power of the electrical load. This output is intended for monitoring the ATS load.

### *Valid Range*

The valid range is  $-1e38$  to  $+1e37$  W. Values less than zero indicate a reverse power condition.

### *Default Value*

The default value is  $+1e38$  W, indicating the real power output is unknown.

### *When Transmitted*

The output variable is transmitted:

- Upon node reset, after obtaining valid data.
- Regularly at the interval defined by the configuration variable `nciMaxSendTime`.

### *Update Rate*

The update rate is determined by the configuration variable `nciMaxSendTime`.

### *Default Service Type*

The default service type is acknowledged.

---

## Configuration Properties

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### Maximum Send Time (Optional)

```
network input config SNVT_time_sec    nciMaxSendTime;
```

This input configuration variable sets the maximum period of time that expires before the ATS object will automatically update the following optional network variables:

nvoSrc1Frequency,	nvoSrc2Frequency,	nvoSrc1VoltageLL,
nvoSrc2VoltageLL,	nvoSrc1VoltageLN,	nvoSrc2VoltageLN,
nvoLoadCurrent,	nvoLoadPF,	nvoLoadRealPower.

#### *Valid Range*

The valid range is 1.0 to 3600.0 sec. Values outside this range are invalid and will disable the automatic update mechanism.

#### *Default Value*

The default value is 0.0 sec (no automatic update).

#### *SCPT Reference*

SCPTmaxSendTime (49)

---

### Location Label (Optional)

```
network input config SNVT_str_asc    nciLocation;
```

This configuration property can be used to provide physical location of the node. Write access can be disabled by the manufacturer.

#### *Valid Range*

Any NULL-terminated ASCII string up to 31 bytes of total length (including NULL).

#### *Default Value*

The default value is an ASCII string containing all NULLs (0x00).

#### *SCPT Reference*

SCPT\_location (17)

---

## Data Transfer

None specified.

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## Power-up State

There is no immediate network action on Power-up State.

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## Boundary and Error Conditions

None specified.

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## Additional Considerations

None.

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