LON DDC Controller

Unit DDC Controls

Application, Operation & Maintenance

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LON Controller Overview & Features

The LON controller is an interoperable, LONMark® compliant controller. The LON controller has factory loaded application specific software which allows optimal control of our water source heat pumps in buildings which require DDC control.

The ASW01, ASW02, and ASW03 sensors are digital wall mounted temperature sensors to be used with the LON controller. The LON controller and ASW digital wall sensors communicate via Sensor Link (S-Link) communications protocol. S-Link is a simple two wire communication protocol which provides power to the ASW wall sensor as well as transmits information between the ASW wall sensor and the LON controller. The S-Link protocol is NOT polarity sensitive and does NOT require shielded cable.

The ASW wall sensors have an optional wiring connection which allows access to the LON network via a LON jack on the left side of each ASW wall sensor.

The LON controller can function in either stand-alone mode, or as part of a LONWorks® FTT-10 Free Topology communications network. When connected to a network, the operator can monitor LON controller performance and edit operational values.

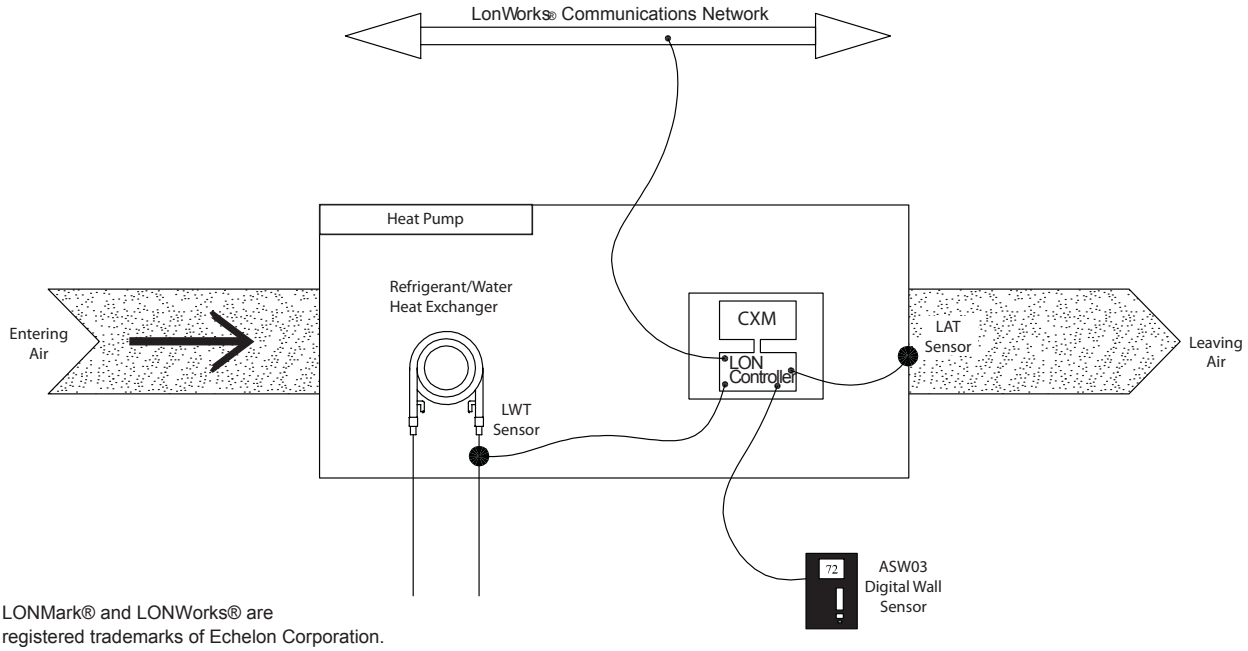
LON Controller

- Uses LONMark® HVAC profiles for interoperability.
- Capability to function in stand-alone mode or as part of a LONWorks® FTT-10 Free Topology communications network.
- Proportional Plus Integral (PI) control for heating and cooling.
- Protective hinged covers provide easy access to field wiring terminals.
- Onboard LED indication without cover removal.
- Occupied/Unoccupied modes of operation.
- Intermittent or continuous fan operation.
- Non-polarized wiring between LON controller and wall sensors.
- Programability provides for custom applications.

ASW Digital Wall Sensors

- Contemporary, low-profile design.
- Digital zone temperature indication (selectable for 0.1 or 1 degree display resolution of °F or °C).
- Accepts virtually any wiring type including unshielded pairs without termination resistors.
- Separate wiring subbase and electronics.
- Occupancy override push-button on ASW02 and ASW03 wall sensors allows occupants to switch to timed Occupied Mode for after hours operation.

Figure 1: Typical Heat Pump System Diagram



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Hardware Specifications

LON Controller

- Dimensions
  4.3" high x 4.31" wide x 2" deep.
  [109mm x 111mm x 51mm]
- Enclosure
  Conforms to NEMA-1 requirements.
- Power Supply Input
  20 to 30Vac, 50/60Hz.
- Maximum Power Consumption
  15VA@ 24Vac, 50/60Hz, excluding relay output power.
- Surge Immunity Compliance
  ANSI C62.41 (IEEE-587, Category A & B).
- Agency Listings
  FCC, Class B
  UL Listed
  UL-916 (File #E71385 Category PAZX)
  UL Listed to Canadian Safety Standards
  (CAN/CSA C22.2).
- European Community - EMC Directive
  Emissions EN50081-1.
  Immunity EN50082-1.
- Ambient Operating Temperature Limits
  -40 to 140 °F [-40 to 60°C].
- Shipping and Storage Temperature Limits
  -40 to 160 °F [-40 to 71°C].
- Humidity
  5 to 95% RH, non-condensing.
- Wiring Terminals
  All terminals rated for AWG #16 to #24 [1.5 mm^2 maximum] wire.
- Digital Inputs
  Requires dry contact. Detection of closed switch requires less than 300 Ohms. Detection of open switch requires more than 1.5k Ohms.
- Digital Outputs
  Each DO is an isolated Form A (SPST) relay.
  Current ratings of 24VA at 24Vac, pilot duty.
- Universal Inputs
  Leaving Air Temperature and Leaving Water Temperature sensors are 10K Ohm thermistors with an 11k Ohm shunt resistor. Monitors range of –40 to 250°F [-40 to 121°C].

ASW Digital Wall Sensor

- Dimensions
  4.81" high x 3.25" wide x 0.93" deep. [122mm x 83mm x 24mm]
- Enclosure Conforms to NEMA-1 requirements.
- Surge Immunity Compliance
  ANSI C62.41 (IEEE-587, Category A & B).
- Agency Listings
  FCC, Class B
  UL Listed
  UL-916 (File #E71385 Category PAZX)
  UL Listed to Canadian Safety Standards
  (CAN/CSA C22.2)
- European Community – EMC Directive
  Emissions EN50081-1
  Immunity EN50082-1
- Ambient Operating Temperature Limits
  32 to 122 °F [0 to 50°C].
- Shipping and Storage Temperature Limits
  -40 to 160 °F [-40 to 71°C].
- Humidity
  5 to 95% RH, non-condensing.
- Wiring Terminals
  Four screw terminals rated for AWG #18 to #24 (1.0 mm^2 maximum) wire.
- Display (ASW03 only)
  Temperature setpoint, room temperature, Lockout code (if heat pump has locked out).

Table 1: Relay Output Load Specifications

Specifications	Value
Maximum relay contact switched output voltage	24VAC
Maximum output load @ 24VAC, pilot duty	24VAC
Minimum permissible load	10.0 mA at 5VDC
Minimum cycles at rated load @ 0.4 power factor	300,000 cycles

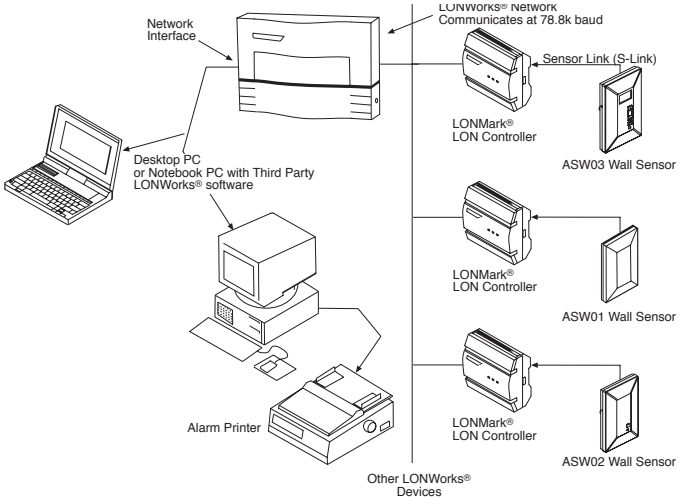
Communications wiring includes a connection between the LON controller and an ASW digital wall sensor via the S-Link and a connection between the LON controller and the LON network. An optional LON connection between the LON controller and the ASW digital wall sensor is also possible. See CXM Single Stage Heat Pump Wiring Schematic.

- Communication wire pairs must be dedicated to S-Link and LON network communications. They cannot be part of an active, bundled telephone trunk.
- Shielded cable is not required for S-Link or LON wiring.
- If the cable is installed in areas of high RFI/EMI, the cable must be in conduit.
- If shielded wire is used, the shield must be connected to earth ground at one end only by a 470K Ohm 1/4 Watt resistor. Shield must be continuous from one end of the trunk to the other.

Sensor Link (S-Link) Wiring

S-Link wiring powers and enables the ASW Sensor. The S-Link needs at least 24 gage [0.51mm], twisted pair, voice grade telephone wire. The capacitance between conductors cannot be more than 32 pF per foot [0.3m].

Figure 2: Typical LONWorks® Controller Connectivity.



If shielded cable is used, the capacitance between any one conductor and the others, connected to the shield, cannot be more than 60 pF per foot [0.3m]. Maximum wire length is 200 ft. [61m].

Note:

- **LON Controller supports only one ASW digital wall sensor.**
- **S-Link wiring is not polarity sensitive.**
- **If conduit is used between an ASW Sensor and a LON controller, the LONWorks® network and S-Link wiring can be in the same conduit.**

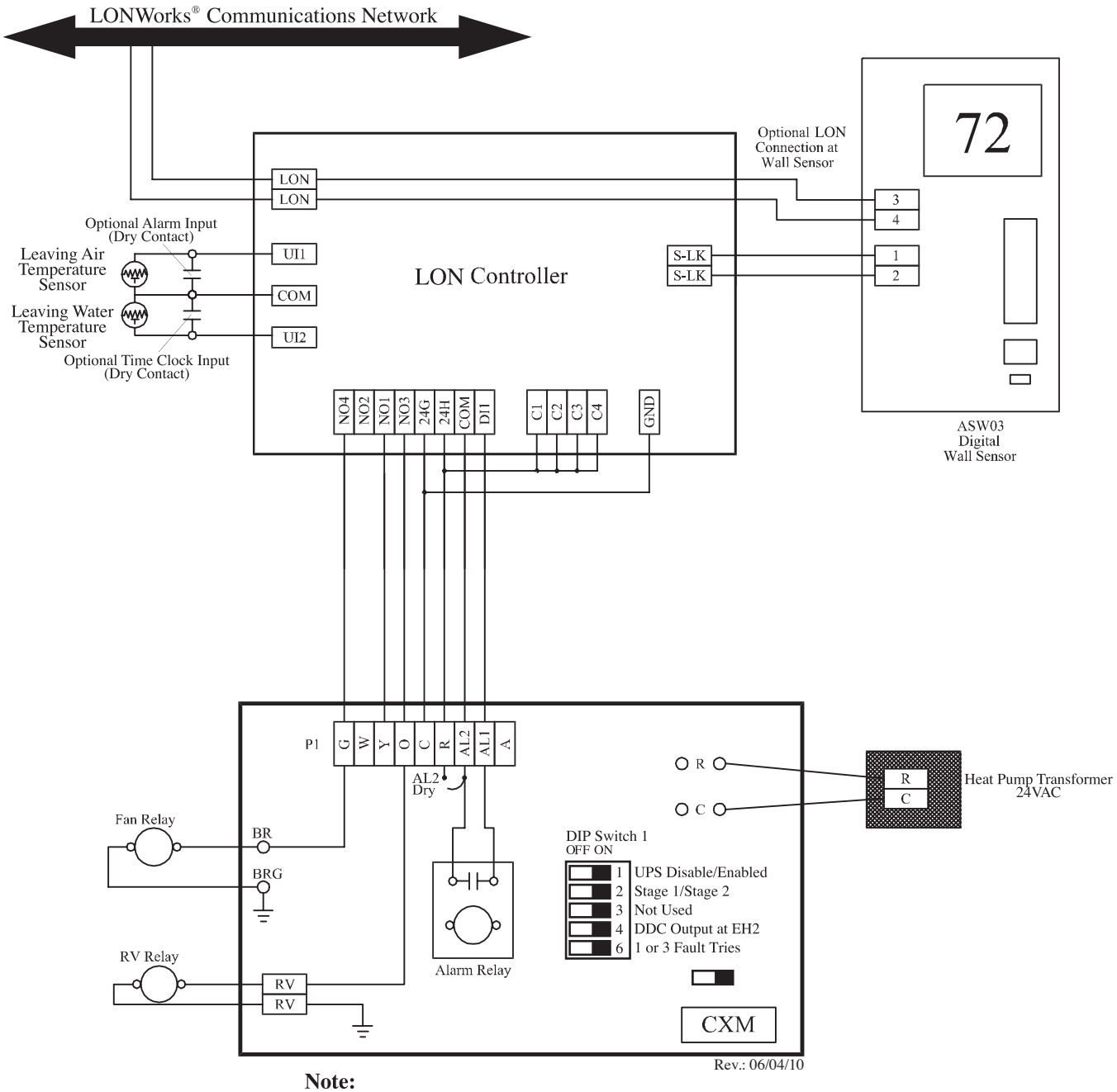
LON Network Wiring

A Category 4, twisted-pair (two conductors) cable may be used for both S-Link and optional LON connection between the LON controller and ASW Sensor. LON wiring is not polarity sensitive.

LON controllers use LONWorks® Free Topology Transceiver (FTT-10) and support polarity insensitive bus wiring topologies. A maximum of 62 nodes can be connected per segment. See Invensys Building Systems I/A Series MicroNet System Engineering Guide, F-26507 to design a LONWorks® FTT-10 network, including recommended topologies and approved cable types (see Table 6).

Neuron ID - Identical pairs of factory barcode labels are attached to each LON controller. The labels can be used to select LON controllers for application downloading purposes. Each pair of labels contains a unique Neuron ID. One of the labels remains on the LON controller permanently; the other label can be placed on a job site node list plan. The Neuron ID can then be entered into a job network database through a third party network management tool. The service pin button on the LON controller is also used to select LON controllers. When this button is pressed, the LON controller sends a broadcast message containing its Neuron ID to the third party network management tool.

Typical LON Controller Wiring Schematic - CXM Single Stage Heat Pump



Note:

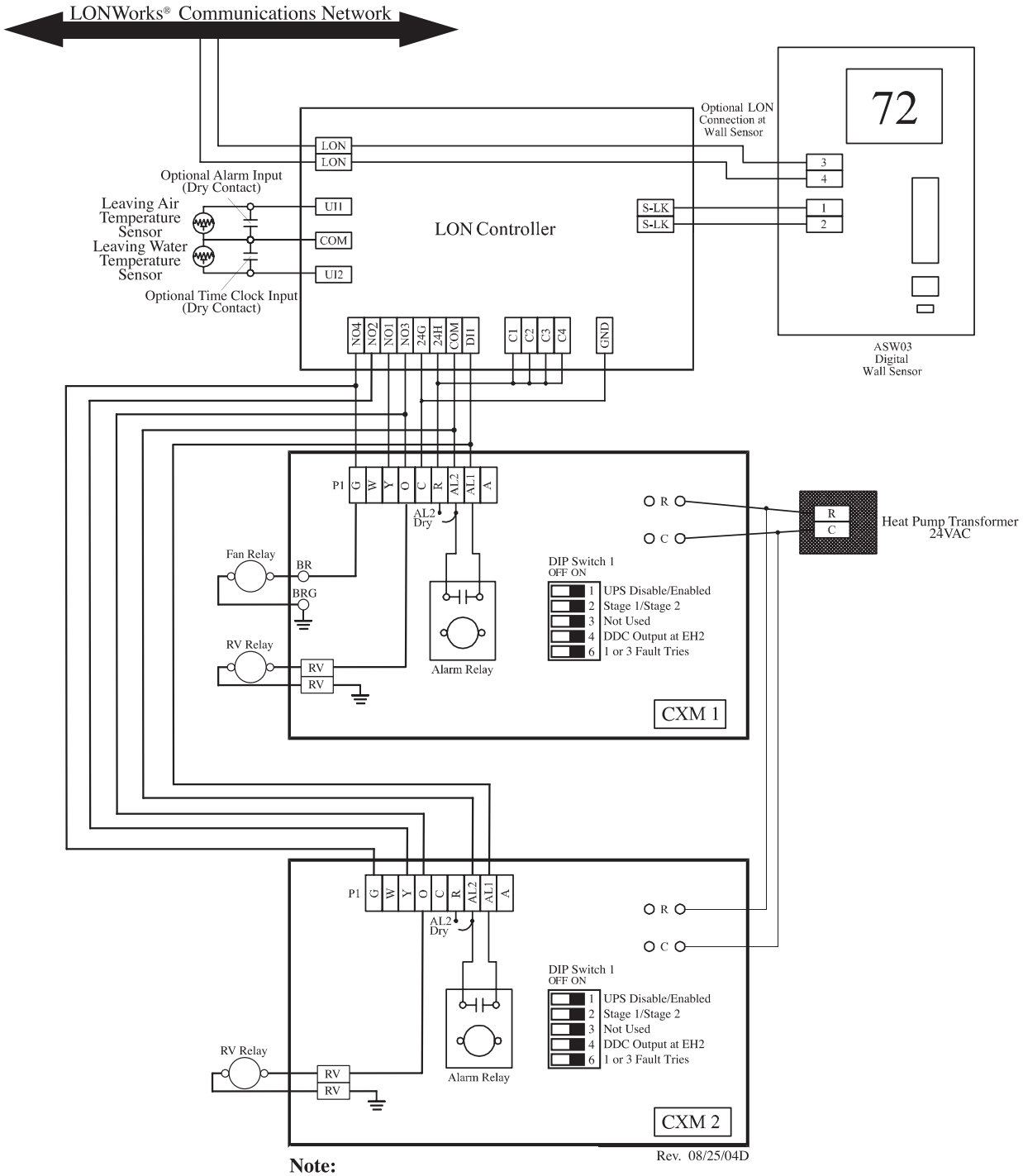
1. CXM control board should be set for Stage 1 operation. (Dip 2 in ON Position). This is needed for the signal to the LON controller.

2. "AL2 Dry" jumper must be clipped.

3. For Optional Alarm Input, contact should be closed during Unoccupied Mode.

4. For Optional Time Clock Input, contact should be closed during Unoccupied Mode.

Typical LON Controller Wiring Schematic - CXM Dual Stage Heat Pump



Note:

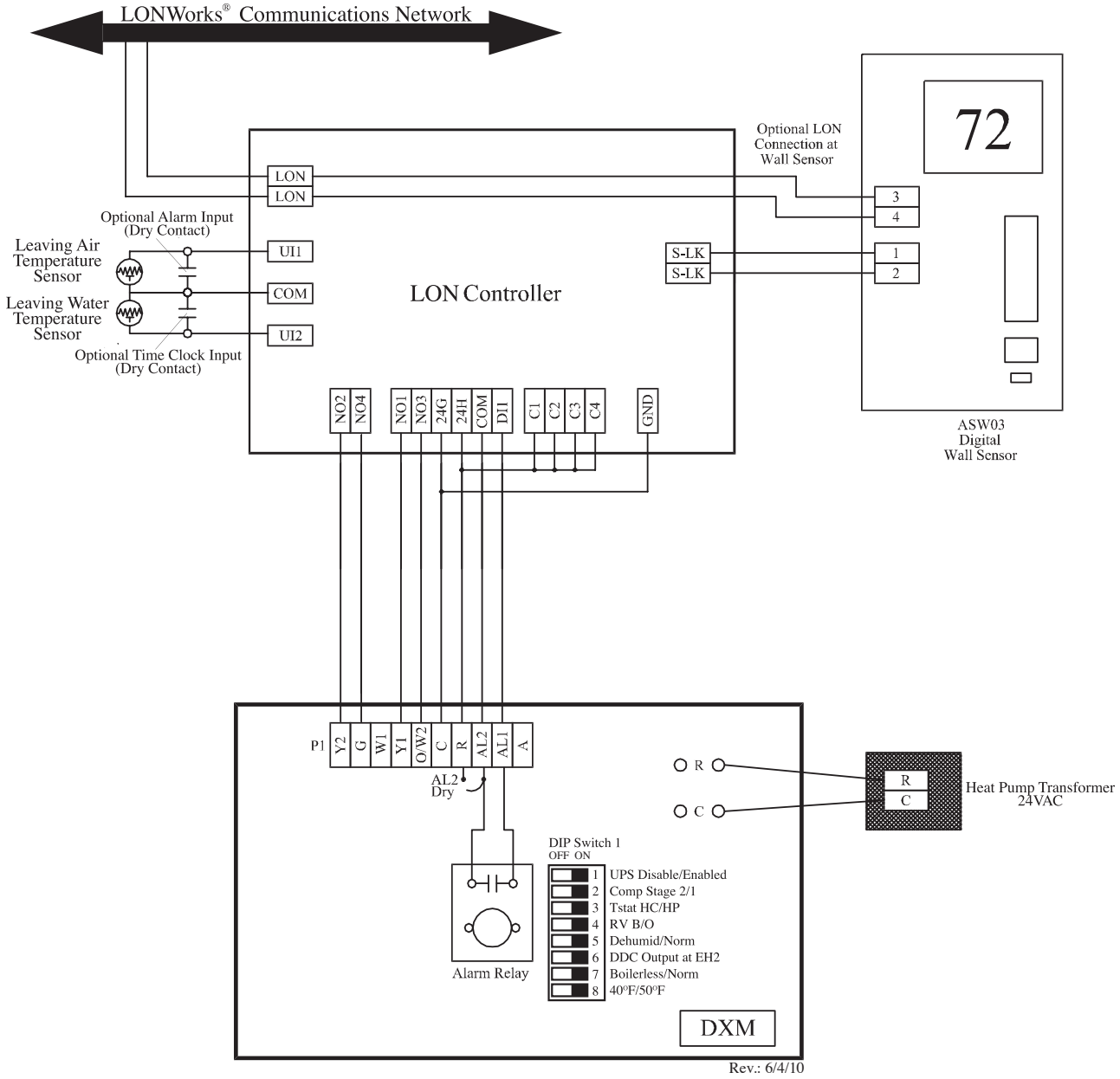
1. Both CXM control boards should be set for Stage 2 operation. (Dip 2 in OFF Position). This is needed for the signal to the LON controller.

2. Both "AL2 Dry" jumpers must be clipped.

3. For Optional Alarm Input, contact should be closed during Unoccupied Mode.

4. For Optional Time Clock Input, contact should be closed during Unoccupied Mode.

Typical LON Controller Wiring Schematic - DXM Single Stage Heat Pump



Note:

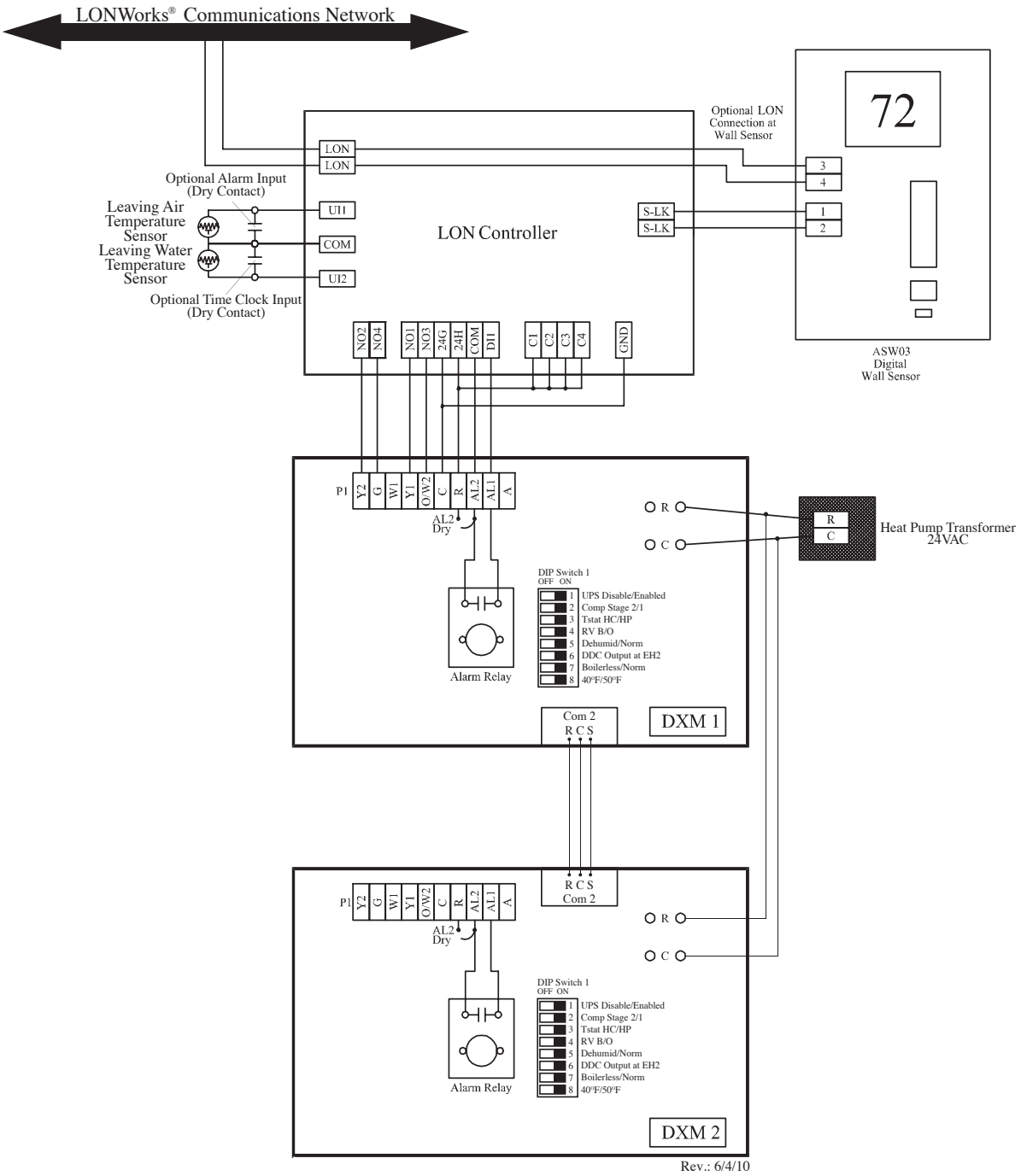
1. DXM control board should be set for Stage 1 operation. (Dip 1.2 in ON Position). This is needed for the signal to the LON controller.

2. "AL2 Dry" jumper must be clipped.

3. For Optional Alarm Input, contact should be closed during Unoccupied Mode.

4. For Optional Time Clock Input, contact should be closed during Unoccupied Mode.

Typical LON Controller Wiring Schematic - DXM Dual Stage Heat Pump



Note:

1. DXM 1 should be set for Stage 1 operation. (Dip 1.2 in ON Position). DXM 2 should be set for stage 2 operation. This is needed for the signal to the LON controller.

2. Both "AL2 Dry" jumpers must be clipped.

3. For Optional Alarm Input, contact should be closed during Unoccupied Mode.

4. For Optional Time Clock Input, contact should be closed during Unoccupied Mode.

Operations Description

Fan Operation

Digital output point N04 is the fan output and is connected to the "G" terminal on the CXM or DXM control. If Fan Mode (software point within the LON controller) is set to On Mode, then the fan is energized continuously during occupied times and intermittently during unoccupied times. If Fan Mode is set to "Auto" Mode, then the fan is energized only during a call for heating or cooling. "Auto" Mode is the default mode of operation.

Heating/Cooling Changeover

Digital output point N03 is the RV output and is connected to the "O" terminal on the CXM or the "O/W2" terminal on the DXM. N03 is energized during a call for cooling. The LON controller employs "smart RV" control. This ensures that the RV will only switch positions if the LON controller has called for a heating/cooling mode change.

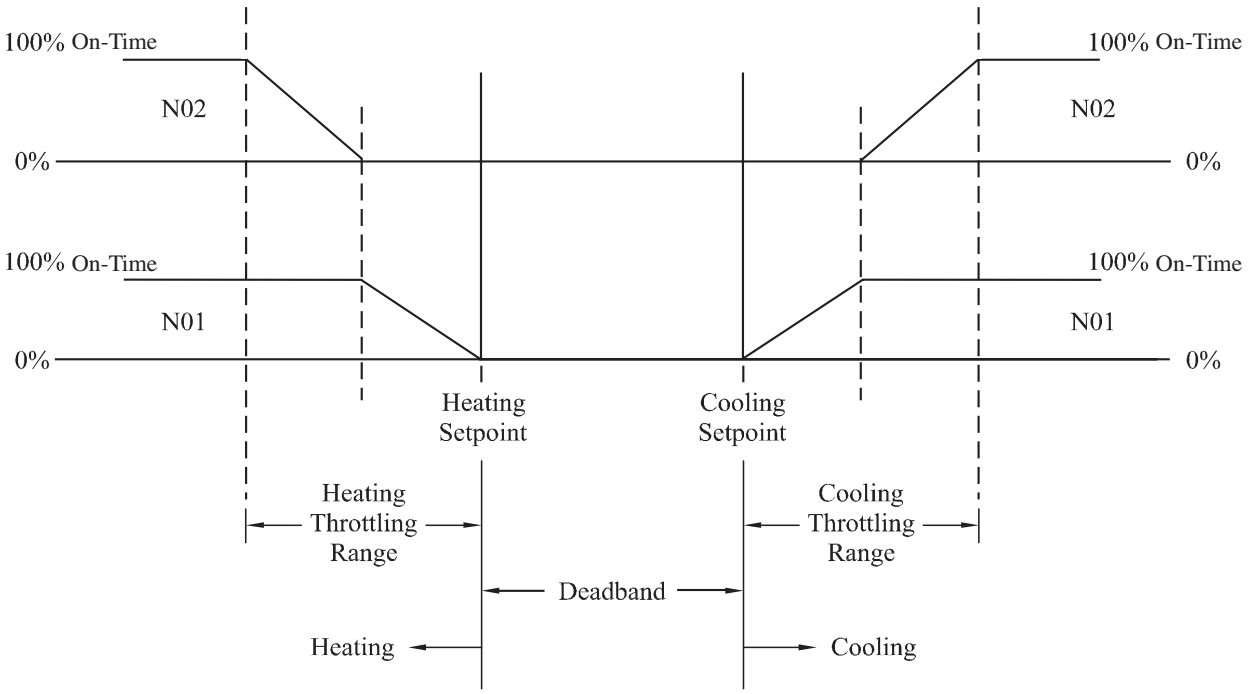
Cooling Operation

Digital output points N01 and N02 are the outputs for compressor stage 1 and compressor stage 2, respectively. N01 is connected to the "Y" terminal on the CXM or the "Y1" terminal on the DXM. If the heat pump is a dual stage heat pump, then N02 is used to control the Stage 2 compressor. N02 (if used) is connected to the "Y" terminal on the stage 2 CXM or the "Y2" terminal on the stage 1 DXM.

N01 and N02 are Off when the zone temperature is between the occupied heating and cooling setpoints. (See figure 3). As the zone temperature rises above the cooling setpoint, N01 is turned On for a proportional amount of time as required to maintain the cooling setpoint. N03 (RV output) would be turned On, if not already On. The N01 On and Off times vary depending upon the difference between the zone temperature and the cooling setpoint, and is controlled over the first half of the cooling throttling range. N01 will be On 100% of the time when the zone temperature exceeds the cooling setpoint by one half of the cooling throttling range.

If the zone temperature continues to rise above the cooling setpoint by more than one half of the cooling throttling range, then N02 is turned On for a proportional amount of time as required to maintain the cooling setpoint. The N02 On and Off times vary depending upon the difference between the zone temperature and the cooling setpoint, and is controlled over the second half of the cooling throttling range.

Figure 3: N01 and N02% On Time



The LON controller's cooling throttling range and cooling setpoint provide the percent of time over which the N01 and N02 outputs will cycle. For example, at 25% throttling range above the cooling setpoint, the N01 output will be On one half the cycle time and Off one half the cycle time; with N02 output being Off. At 75% throttling range above the cooling setpoint, the N01 output is On 100% of the time with the N02 output On one half the cycle time and Off one half the cycle time.

Application defaults may be adjusted to satisfy the requirements of a particular heat pump.

Heating Operation

Digital output points N01 and N02 are the outputs for compressor stage 1 and compressor stage 2, respectively. N01 is connected to the "Y" terminal on the CXM or the "Y1" terminal on the DXM. If the heat pump is a dual stage heat pump, then N02 is used to control the Stage 2 compressor. N02 (if used) is connected to the "Y" terminal on the stage 2 CXM or the " Y2" terminal on the stage 1 DXM.

N01 and N02 are Off when the zone temperature is between the occupied heating and cooling setpoints. (See figure 3). As the zone temperature drops below the heating setpoint, N01 is turned On for a proportional amount of time as required to maintain the heating setpoint. N03 (RV output) would be turned Off, if not already Off. The N01 On and Off times vary depending upon the difference between the zone temperature and the heating setpoint, and is controlled over the first half of the heating throttling range. N01 will be On 100% of the time when the zone temperature drops below the heating setpoint by one half of the heating throttling range.

If the zone temperature continues to drop below the heating setpoint by more than one half of the heating throttling range, then N02 is turned On for a proportional amount of time as required to maintain the heating setpoint. The N02 On and Off times vary depending upon the difference between the zone temperature and the heating setpoint, and is controlled over the second half of the heating throttling range.

The LON Controller's heating throttling range and heating setpoint provide the percent of time over which the N01 and N02 outputs will cycle. For example, at 25% throttling range below the heating setpoint, the N01 output will be On one half the cycle time and Off one half the cycle time; with N02 output being Off. At 75% throttling range below the heating setpoint, the N01 output is On 100% of the time with the N02 output On one half the cycle time and Off one half the cycle time.

Application defaults may be adjusted to satisfy the requirements of a particular heat pump.

Occupied/Unoccupied Changeover

When the LON controller is in the Stand-Alone Mode of operation, and no time clock input is available, the LON controller defaults to the Occupied Mode.

When an optional external time clock is connected to the UI2 input, occupancy changeover can be provided. Alternatively, the occupancy changeover may be provided through another LON device on the network through either the nviOccCmd, nviOccupSw.State, or nviOccSchedule.currentstate network variables.

Communications Hardware Checkout

1. Verify controlled equipment is in a manually controlled, safe state.
2. Place LON controller power breaker in the ON position. See job wiring diagrams.
3. Observe green Data Transmission LED on top of LON controller (see figure 4.) and do the following:
   a) If green Data Transmission LED is steady on or blinking, go to step 4.
   b) If green Data Transmission LED is off, check power.
4. Observe red Service LED and yellow date reception LED and do the following:
   a) If red service LED is blinking (1/sec), use third party network management tool to download application into the LON controller.
   b) If red service LED is steady on, turn power off to controller, wait 5 seconds, then turn power back on. If red service LED is still steady on, turn power off and contact service personnel.

Mechanical Hardware Checkout

1. Verify wiring between ASW Wall Sensor and LON controller is installed according to job wiring diagram and with national and local wiring codes.

Note: Wiring of the S-Link and LON network between the sensor and the LON controller is not polarity sensitive.

2. If LON controller is part of a LON network, verify the FTT-10 LONWorks® network wiring between LON controller and other devices is installed according to job wiring diagram and national and local electrical codes.

Service

Components within the LON controller can not be field repaired. If there is a problem with a LON controller, follow the steps below before contacting your local service office.

1. Make sure LON controllers are connected and communicating to desired devices.
2. Check all sensors and controlled devices are properly connected and responding correctly.
3. If LON controller is operating, make sure the correct profile and application is loaded by checking the LONMark® Program ID and the nciSECModelNum using third party network management tool.

Record precise hardware setup indicating the following:

- Version numbers of application software.
- Controller firmware version number.
- A complete description of difficulties encountered.

Figure 4: LON Controller

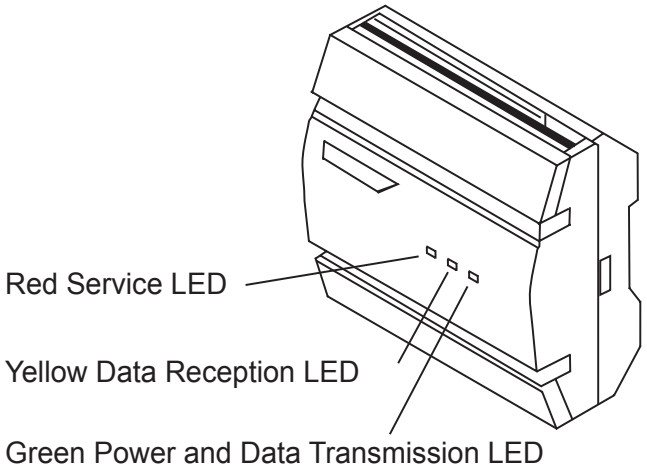


Table 2: LED Indication

Indicator	Context	Status	Corrective Action
Data Reception LED - Yellow	Anytime	Blinks when the LON controller receives data from the LON	None required
		ON indicates the LONWorks network wire may be disconnected	Check connections on all nodes
		OFF indicates that data reception is not taking place	
Data Transmission LED - Green	Anytime	Blinks when the LON controller transmits data to the LON	None required
		On indicates that the LON controller is not transmitting data, ON also indicates that power is being applied to the LON controller	
		OFF indicates no power to LON controller	Check power
Service LED - Red	Power-up	If a valid application is loaded, the LED blinks once to indicate successful power-up	None required
	Wink mode	Blinks ON and OFF five times to indicate physical location of the LON controller	
	Power-up	ON indicates that the neuron application is not running, neuron applications are not field replaceable	Replace the LON controller
	Power-up	Blinks (1/second) to indicate that the neuron application is loaded, but the neuron's communication parameters are not loaded, are being reloaded, or have been corrupted. Communications parameters cannot be configured by field personnel	Use their party network management tool to download the appropriate application. If the red service LED continues to blink, download the application two to three more times. If the red LED is still blinking, replace the LON controller.
	Power-up	OFF indicates that the neuron application is loaded but the device is off line. In this state, a pre-loaded HVAC application will not run, and you will be unable to download an application to the LON controller.	If you are unable to download and/or run an HVAC application, use third party network management tool to put LON controller online. It will be possible to download and/or run an HVAC application.
	Power-up	OFF may also indicate a normal state, in this state, the LON controller operates normally, and you can download and/or run HVAC applications.	If the LON controller is able to accept and/or run downloaded HVAC application, no action is required.

ASW Wall Sensors

Table 3: Model Chart

Model	Description	Keypad	Display
ASW01	Sensor Only	None	None
ASW02	Sensor with Override	One-Key	LED Override Status Indication
ASW03	Sensor with Setpoint Adjustment and Override	Three-Key	LED Override Status Indication and Digital LCD

Figure 5: Digital Wall Sensor Models

ASW01

ASW02

ASW03

Table 4. shows the setup options associated with ASW03 Digital Wall Sensor that have been implemented in the LON controller. This programming resides in the LON controller and is in effect any time an ASW03 is connected to the LON controller.

Table 4: Setup of ASW03 Sensor

Item	Resource Tag Name	Default	Display Format	Icons Enabled	Minimum Value	Maximum Value
Temperature Units	*	°F	*	*	*	*
PB Override Time	PBOccMode	120 Minutes	*	*	*	*
Fan Mode	Fan Mode	AUTO	*	*	*	*
HVAC Mode	HVAC Mode	AUTO	*	*	*	*
Setpoint Value	Occ Heat SP	80	XX	°	56	84
Current Status Display	Room Temperature	Room Temperature	XX	°F	*	*

LON Controller - Network Heat Pump Profile

Table 5: Profile Network

SNVT Name	LON		Water-Air		Water-Water	
	Point Type	NV Index	Default	Description	Default	Description
nviSpaceTemp	SNVT Temp p	0	NA	Network input for reading the space temperature from a designated wall sensor. This value can be from another unit on the network (highest priority) when multiple units share a single sensor or from a wall sensor (lowest priority).	NA	Network input for the heating setpoint in the occupied mode. Maximum is 140°F.
nviSetPoint	SNVT Temp p	1	NA	Network input for the heating/cooling setpoint in the occupied mode.	NA	Network input for the heating setpoint in the unoccupied mode. Maximum is 140°F.
nvoSpaceTemp	SNVT Temp p	2	NA	Network output for monitoring a wall sensor or monitoring a space temperature from another unit on the network if sharing a common sensor.	NA	Indicates the last fault code in memory on the CXM/DXM board. Refer to CXM/DXM manual for fault codes.
nvoUnitStatus.Mode	SNVT hvac status	3	NA	Network output indicating the current HVAC mode (0=auto, 1=heat, 3=cool, 6=shutdown, 9=fan only)	NA	NA
nvoUnitStatus.Heat1	SNVT hvac status	3	NA	Network output indicating the current heating status in percent. Range 0% - 100%. Where 0% indicates unit is not in heating mode.	NA	NA
nvoUnitStatus.Cool	SNVT hvac status	3	NA	Network output indicating the current cooling status in percent. Range 0% - 100%. Where 0% indicates unit is not in cooling mode.	NA	NA
nvoUnitStatus.Alarm	SNVT hvac status	3	NA	NA	NA	Current cooling status.
nviApplicMode	SNVT hvac mode	4	NA	Network input for the current HVAC mode (0=auto, 1=heat, 3=cool, 6=shutdown, 9=fan only)	NA	NA
nviOccCmd	SNVT occupancy	5	NA	Occupancy Status (0=occupied, 1=unoccupied, 2=bypass, 3=standby)	NA	Occupancy Status (0=occupied, 1=unoccupied, 2=bypass, 3=standby)
nviOccupSw.State	SNVT switch	6	NA	Occupancy Status (0=off -unoccupied, 1=on - occupied)	NA	Occupancy Status (0=off -unoccupied, 1=on - occupied)
nviSetPtOffset	SNVT Temp p	7	NA	Network input for temperature setpoint offset. This offset is applied to both heat/cool setpoints in both the occupied/unoccupied modes of operation.	NA	Heating Differential network input. For example if the setpoint is 105°F and the HTD is 5°F then the unit will remain on until the water temperature reaches 110°F. Range 3°F - 10°F.
nvoEffectSetpt	SNVT Temp p	9	NA	Network output indicating the actual controlling setpoint based on if the unit is in heating/cooling mode and occupied/unoccupied.	NA	NA
nviOccSchedule.CurrentState	SEC tod event	11	NA	Occupancy Status (0=occupied, 1=unoccupied, 2=bypass, 3=standby)	NA	Occupancy Status (0=occupied, 1=unoccupied, 2=bypass, 3=standby)
nviOverride.State	SNVT hvac overid	12	NA	Network input to put the unit into occupied mode during unoccupied time.	NA	NA
nviSatTemp1	SNVT temp p	13	NA	Network input for outdoor air temperature. This can be used to write the actual outdoor air temperature directly to the wall sensor.	NA	Cooling Differential network input. For example if the setpoint is 53°F and the CLD is 5°F then the unit will remain on until the water temperature reaches 48°F. Range 3°F - 10°F.
nviSatTemp2	SNVT temp p	14	NA	NA	NA	Network input for the cooling setpoint in the unoccupied mode. Minimum is 35°F.
nviSatPercent1	SNVT lev percent	15	NA	Network input for resetting the fault code.	NA	NA
nviSatPercent2	SNVT lev percent	16	NA	NA		Mode control network input to turn the reversing valve ON/OFF.
nviSatCntIncF1	SNVT count inc f	19	NA	NA		Network input for the cooling setpoint in the occupied mode. Minimum is 35°F.
nvoOccCmd	SNVT occupancy	24	NA	Indicates whether the WSHP is in occupied mode (OFF) or unoccupied mode (ON).	NA	Indicates whether the WSHP is in occupied mode (OFF) or unoccupied mode (ON).
nvoSatTemp1	SNVT temp p	25	NA	Network output indicating the leaving air temperature of the WSHP.	NA	Entering water temperature of WSHP load coil.
nvoSatTemp2	SNVT temp p	26	NA	Network output indicating the leaving water temperature of the WSHP.	NA	NA
nvoSatPercent1	SNVT lev percent	27	NA	Network output indicating the unit alarm code.	NA	Indicates if compressor 1 is ON/OFF.
nvoSatPercent2	SNVT lev percent	28	NA	NA	NA	Indicates if RV is ON/OFF.
nvoSatSwitch1.State	SNVT switch	29	5°F	Network output indicating if the current error code is done counting (OFF=count is not complete, ON=count is complete)	NA	Current heating status.
nvoSatCntIncF1	SNVT count inc f	31	NA	NA	NA	Indicates if compressor 2 is ON/OFF.
nciSetpnts.OccHeat	SNVT temp setpt	32	69.8°F	**Network -** Network configuration input for the heating setpoint in the occupied mode. **Stand-Alone - All sensors -** configuration input for the default heating setpoint in the occupied mode.	105°F	Network configuration input for the heating setpoint in the occupied mode.
nciSetpnts.OccCool	SNVT temp setpt	32	73.4°F	**Network -** Network configuration input for the cooling setpoint in the occupied mode. **Stand-Alone - All sensors -** configuration input for the default cooling setpoint in the occupied mode.	53°F	Network configuration input for the cooling setpoint in the occupied mode.
nciSetpnts.UnoccHeat	SNVT temp setpt	32	60.8°F	**Network -** Network configuration input for the heating setpoint in the unoccupied mode. **Stand-Alone - S4 & S5 sensors** configuration input for the default heating setpoint in the unoccupied mode. **Stand-Alone - S1, S2 & S3 sensors** configuration input to determine occupied deadband	85°F	Network configuration input for the heating setpoint in the unoccupied mode.
nciSetpnts.UnoccCool	SNVT temp setpt	32	82.4°F	**Network -** Network configuration input for the cooling setpoint in the unoccupied mode. **Stand-Alone - S4 & S5 sensors -** configuration input for the default cooling setpoint in the unoccupied mode. **Stand-Alone - S1, S2 & S3 sensors -** configuration input to determine occupied deadband	73°F	Network configuration input for the cooling setpoint in the unoccupied mode.
nciSetpnts.SBHeat	SNVT temp setpt	32	66.2°F	**Network -** Network configuration input for the heating setpoint in the standby mode. **Stand-Alone - All sensors -** configuration input to determine unnocupied deadband	NA	NA
nciSetpnts.SBCool	SNVT temp setpt	32	77°F	**Network -** Network configuration input for the cooling setpoint in the standby mode. **Stand-Alone - All sensors -** configuration input to determine unoccupied deadband	5°F	Cooling Differential network configuration input. For example if the setpoint is 53°F and the CLD is 5°F then the unit will remain on until the water temperature reaches 48°F. Range 3°F - 10°F.
nciSndHrtBt	SNVT time sec	33	120 s	Automaic update period.	120 s	Automaic update period.
nciRcvHrtBt	SNVT time sec	34	300 s	Bound input fallback time.	300 s	Bound input fallback time.
nciLocation	SNVT str asc	35	/0	Physical location description.	/0	Physical location description.
nciMinOutTm	SNVT time sec	36	5 s	Minimum send time.	5 s	Minimum send time.
nciSatConfig1	SNVT count inc f	37	3	Network configuration input for the cooling throttling range.	NA	NA
nciSatConfig2	SNVT count inc f	38	0	Network configuration input for the cooling integral.	NA	NA
nciSatConfig3	SNVT count inc f	39	2	Network configuration input for the heating throttling range.	NA	NA
nciSatConfig4	SNVT count inc f	40	0	Network configuration input for the heating integral.	NA	NA
nciSatConfig5	SNVT count inc f	41	100	Space temperature control set to 100 for wall sensor control (stand-alone). Set to 0 for network control for S4155 sensor or command setpoint.	NA	NA
nciSatConfig6	SNVT count inc f	42	0°F	Network configuration input for the leaving air temperature input offset.	0°F	Network configuration input for the entering water temperature input offset.
nciSatConfig7	SNVT count inc f	43	3 min	Network configuration input for the compressor minimum on time.	NA	NA
nciSatConfig8	SNVT count inc f	44	0°F	Network configuration input for the leaving water temperature input offset.	5°F	Heating Differential network configuration input. For example if the setpoint is 105°F and the HTD is 5°F then the unit will remain on until the water temperature reaches 110°F. Range 3 °F - 10°F.
nciSatConfig9	SNVT count inc f	45	Auto	Network configuration input for the default fan mode (0 = Auto, 100 = On)	NA	NA
nciSatConfig10	SNVT count inc f	46	120 min	Network configuration input for the default occupancy override time.	NA	NA
nvoDeviceInfo	SNVT str asc	47	NA	MNL-10RH3-702A	NA	MNL-10RH3-702A

Wall Sensor Application

ASW Sensors are wall-mounted digital temperature sensors for use with LON Controllers. These sensors feature Sensor Link (S-LINK) communication protocol which provides a simple two wire interface for power and exchange of sensor and LON Controller information. Available in three models, these ASW Sensors provide integral analog to digital conversion for elimination of electrical interference between sensor and LON controller. An optional wiring connection allows access to the LON network via a LON jack on the left side of each controller.

ASW Sensors are suitable for direct-wall, 2" x 4" electrical box, 1/4 DIN electrical box, or surface box mounting.

Installation

The ASW Sensor is packaged disassembled in one container and consists of three major parts:

- A pre-wireable base plate for wiring to the LON controller and to the LON network.
- An electronic assembly containing the sensor and associated circuitry.
- A removable cover.

Inspection

Inspect carton for damage. If damaged, notify carrier immediately. Inspect sensors for damage. Return damaged products.

Figure 6: ASW Digital Wall Sensors

ASW01

ASW02

ASW03

Table 6: Model Chart

Model	Description	Keypad	Display
ASW01	Sensor Only	None	None
ASW02	Sensor with Override	One-Key	LED Override Status Indication
ASW03	Sensor with Setpoint Adjustment and Override	Three-Key	LED Override Status Indication and Digital LCD

Installation Operations Description

Obtain the following prior to installation:
- Job wiring diagrams.
- Tools:
  - Drill and bits for mounting screws
  - Level
  - Static protection wrist strap
- Two mounting screws.
- Drywall anchors for direct-wall mount
- Accessories (if required) from Invensys.
  -AT-1104 Cast aluminum guard with steel base plate.
  -AT-1155 Clear plastic guard with solid and ring base, tumbler type key lock.
  -AT-1163 Wire guard with steel base plate.
  -MNA-STAT-1 Replacement covers (qty. 12).
  -MNA-STAT-2 Designer inserts for ASW01 model (qty. 25).

⚠ WARNING! ⚠

WARNING! Electrical shock hazard! Disconnect power before installing or removing the cover.

Precautions

- Installer must be a qualified technician.
- Follow static precautions when installing this equipment.
- Use copper conductors that are suitable for 167°F (75°C).
- Make all connections according to electrical wiring diagram, national and local electrical codes.

Static Precautions - Static charges damage electronic components. The microprocessor and associated circuitry are extremely sensitive to static discharge. Use the following precautions when installing, servicing, or operating the system.
- Work in a static-free area.
- Discharge static electricity by touching a known, securely grounded object.
- Use a wrist strap connected to earth ground when handling the controller's printed circuit board.

Federal Communications Commission (FCC) - This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in residential installations. This equipment generates, uses, and can radiate radio frequency energy and may cause harmful interference if not installed and used in accordance with the instructions. Even when instructions are followed, there is no guarantee that interference will not occur in a particular installation. If this equipment causes harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/television technician for help.

Canadian Department of Communications (DOC) - This class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

⚠ CAUTION! ⚠

- **Avoid locations where excessive moisture, corrosive fumes, vibration, or explosive vapors are present.**
- **Avoid electrical noise interference. Do not install near large contractors, electrical machinery, or welding equipment.**
- **Locate where ambient temperatures do not exceed 122°F [50°C] or fall below 32°F [0°C] and relative humidity does not exceed 95% or fall below 5%, non-condensing.**

Location - ASW Sensors are suitable for indoor use only. Locate the ASW Sensor on an inside wall where the sensor is exposed to at least 30 feet (9 meters) per minute of unrestricted air circulation. The location should represent the average temperature in the room or space. Make certain sensor is located out of direct sunlight, away from sources of heat or cold, and away from concealed ducts or pipes.

Mounting - ASW Sensors can be direct-wall, 2" x 4" electrical box, 1/4 DIN electrical box, or surface box mounted. See Figure 7 and Figure 8 for appropriate mounting dimensions.

Installation

Figure 7: Dimensions for Direct-wall, 2x4 Electrical Box, and Surface Box Mounting

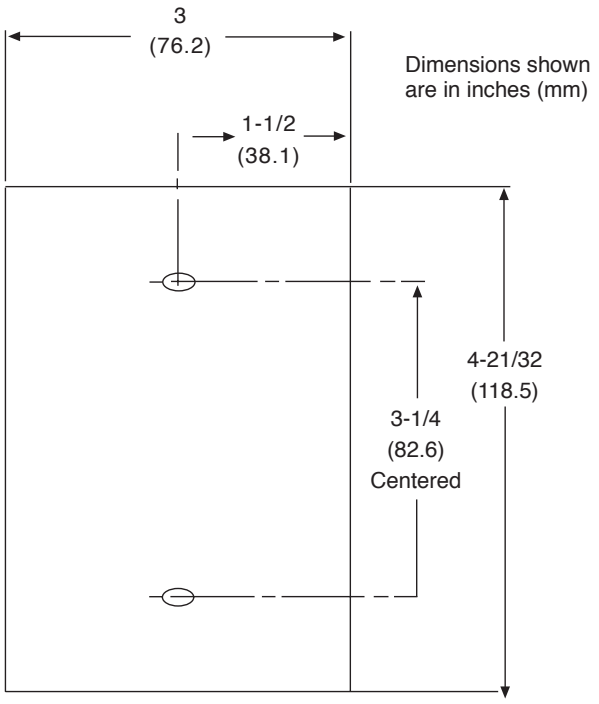
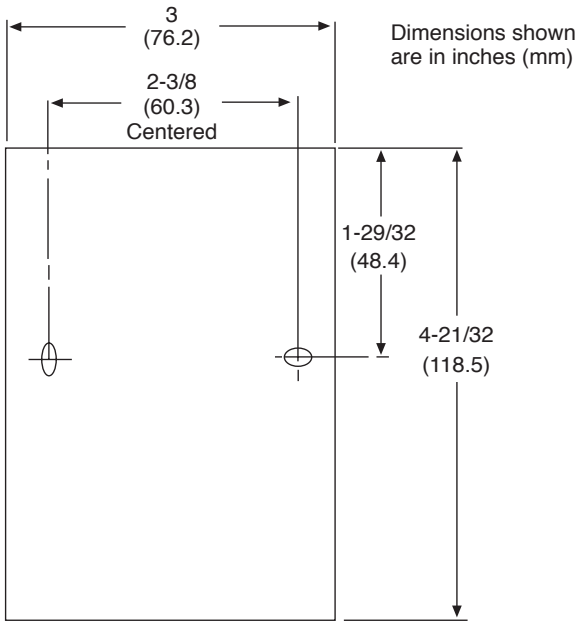


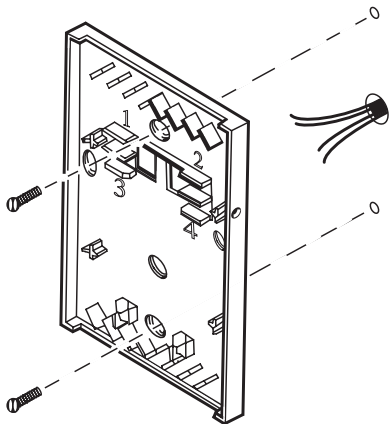
Figure 8: Dimensions for 1/4 DIN Electrical Box Mounting



Direct-wall Mount

1. Use mounting dimensions shown in Figure 7.
2. Feed S-LINK wires through base plate.
3. If required, feed LON wires through base plate.
4. Using two appropriate screws (use drywall anchors as necessary), mount base plate to wall. (Figure 9)

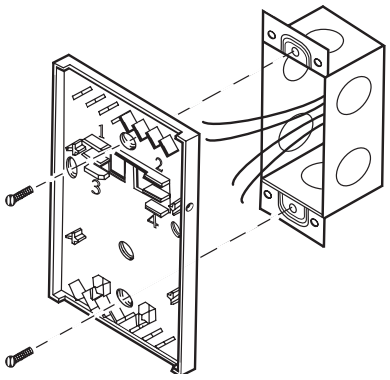
Figure 9: Direct Wall Mounting



2" x 4" Electrical Box Mount

1. Use mounting dimensions shown in Figure 8.
2. Feed S-LINK wires from electrical box through base plate.
3. If required, feed LON wires through base plate.
4. Using two 6-32 x 5/8 in. flat head screws (not provided), mount base plate to electrical box. (Figure 10).

Figure 10: 2x4 Electrical Box Mounting



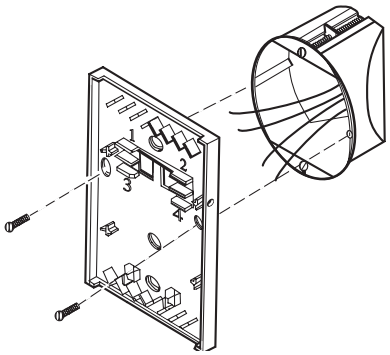
1/4" DIN Electrical Box Mount

1. Use mounting dimensions shown in Figure 8.
2. Feed S-LINK wires from electrical box through base plate.
3. If required, feed LON wires through base plate.
4. Using two appropriate screws (not provided), mount base plate to electrical box using vertical mounting holes indicated. (Figure 11)

⚠ CAUTION! ⚠

CAUTION! Failure to use horizontal mounting holes as shown in Figure 8 may cause a short of the LON.

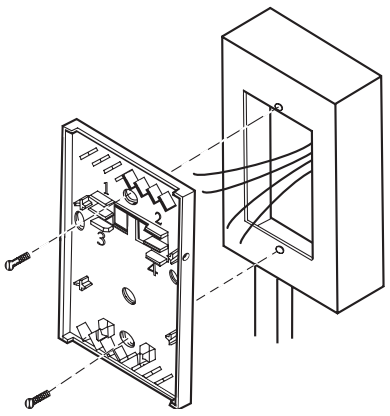
Figure 11: 1/4 DIN Electrical Box Mounting



Surface Box Mount

1. Use mounting dimensions shown in Figure 7.
2. Feed S-LINK wires from electrical box through base plate.
3. If required, feed LON wires through base plate.
4. Using two 6-32 x 5/8 in. flat head screws (not provided), mount base plate to surface box. (Figure 12)

Figure 12: Surface Box Mounting



Communications Wiring

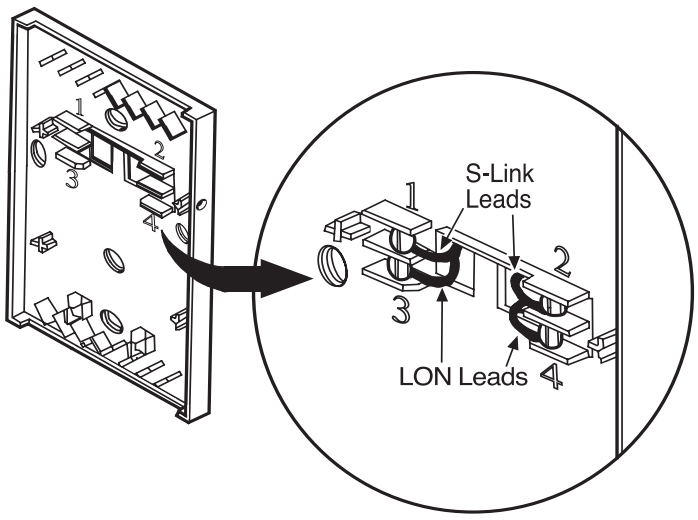
The following electrical connections can be made to the ASW Sensors:
- Sensor Link (S-LINK) Wiring.
- LON network Wiring.

Communications Wiring - Communications wiring includes a connection between the LON controller and an ASW Sensor via the S-LINK and an optional connection between the sensor and the LONWorks® network. Figure 13 shows S-LINK and LON wiring terminations.

⚠ CAUTION! ⚠

- **Communication wire pairs must be dedicated to the S-LINK LON controller and to the LON network. They cannot be part of an active, bundled telephone trunk.**
- **Shielded cable is not required for S-LINK or LON wiring.**
- **If the cable is installed in areas of high RFI/EMI, the cable must be in conduit.**
- **Do not mix S-LINK or LON with UI, DI, AO, DO, or power types of wiring. If conduit is used between an ASW Sensor and a controller, LON wiring and S-LINK wiring can be in the same conduit.**
- **If shielded wire is used, the shield must be connected to earth ground at one end only by a 470K Ohm 1/4 Watt resistor. Shield must be continuous from one end of the trunk to the other.**

Figure 13: S-LINK and LON Connections



Sensor Link (S-LINK) Wiring - S-LINK wiring powers and enables the ASW Sensor. The S-LINK needs at least 24 gage (0.51mm), twisted pair, voice grade telephone wire. The capacitance between conductors cannot be more than 32 pF per foot (0.3m). If shielded cable is used, the capacitance between any one conductor and the others, connected to the shield, cannot be more than 60 pF per foot (0.3m). Maximum wire length is 200 ft. (61m).

Note:
- **S-LINK wiring is not polarity sensitive.**
- **If conduit is used between an ASW Sensor and a**
- **controller, the LONWorks® network and S-LINK wiring can be in the same conduit.**
- **S-LINK wiring and LON wiring can not be in the same conduit with UI, AO, and DI Wiring.**

Connect the S-LINK to ASW Sensor
1. Strip 1/4 in. (6mm) of insulation from S-LINK wires.
2. Connect wires to screw terminals 1 and 2 (Figure 13) The S-LINK terminals are polarity insensitive.
3. Push excess wire back through the base plate to minimize air flow restriction.

LON Network Wiring - An approved two-pair cable may be used for both S-LINK and optional LON connection between the controller and ASW Sensor. LON wiring is polarity insensitive.

ASW Sensors use LONWorks® Free Topology Transceiver (FTT-10) and support polarity insensitive bus wiring topologies. Four wires (a daisy chain connection) must be used to connect an ASW Sensor to a doubly terminated bus. Use two wires to connect sensors to LON network. Free topology rules apply.

See I/A Series® MicroNet System Engineering Guide, F-26507 to design a LONWorks® FTT-10 network, including recommended topologies and approved cable types (See Table 10).

Connecting the LON network to an ASW Sensor provides local access to the LON network via the sensor's LON jack. This connection is optional.

Connect LON to ASW Sensor

1. Strip 1/4 in. (6mm) of insulation from LON wires.
2. Connect wires to screw terminals 3 and 4. (Figure 13) The LON terminals are polarity insensitive.
3. Push excess wire back through the baseplate to minimize air flow restriction.

Wiring Checkout - Verify wiring between ASW Sensor base plate and the LON Controller is installed according to job wiring diagram, national and local wiring codes.

Electronic Assembly and Cover Installation

1. Set electronic assembly onto bottom hooks of baseplate.
2. Secure electronic assembly to base plate by tightening two screws at top of assembly. (Figure 14)
3. Insert bottom tabs of cover and then snap top into place.

Note: To remove sensor cover, place thumb in middle of sensor, grasp top edge of cover with fingers and pull firmly.

LON Network Jack - A LON jack is located on the left side of each sensor model. The mating plug for the LON jack is a 1.3mm DC power plug. (Figure 15) shows location of the LON jack.

Figure 14: Electronic Assembly Installation

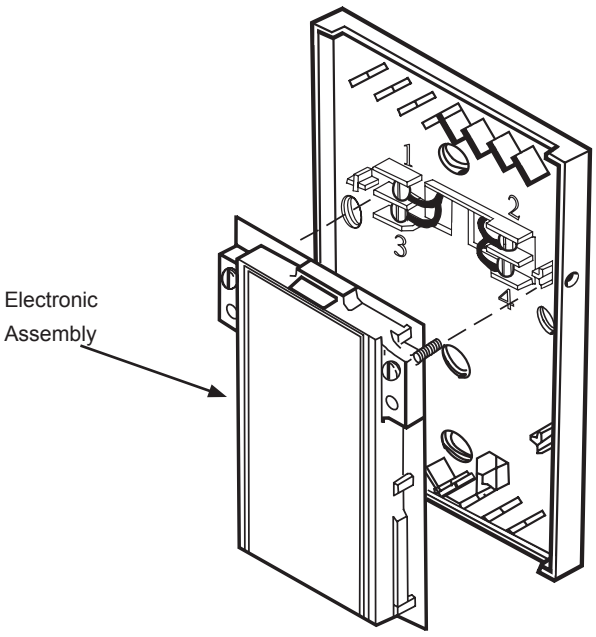


Figure 15: Location of the LON jack

ASW Operation

Table 7: ASW Sensor Model Descriptions

ASW Sensor Model	Description	Zone Temperature Sensing	Override Key and LED	Setpoint Adjustment	LON Jack	Display Screen
ASW01	The ASW01 has no display or keypad. Its primary function is to provide zone temperature to the controller via the S-LINK. Provides a LON Jack for commissioning, testing, and monitoring.	X			X	
ASW02	The ASW02 provides zone temperature to the controller via the S-LINK and features an Override Key, with LED indicator, which forces the controller into timed Occupied Mode. Provides a LON jack for commissioning, testing, and monitoring.	X	X		X	
ASW03	The ASW03 provides the same functionality and features as the ASW02. In addition, the ASW03 has a digital liquid crystal display and allows controller setpoint adjustment. The ASW03 offers one setpoint and one default display screen.	X	X	X	X	X

Push-button Override - During the Unoccupied Mode of operation, if the "Override" button on the ASW02 or ASW03 sensor is pressed for 1 to 3 seconds, the LON controller switches to the Occupied Mode of operation. Control is based on occupied attribute values. The override is in effect for the time specified by the sensor's Override Time set up option. The default value is 120 minutes.

If the "Override" button is pressed for less than 4 seconds during the override operation, the override timer resets to its starting value. The override can be canceled by pressing the "Override" button for more than 4 seconds. The override feature can be enabled or disabled by changing the Object Control Logic within the LON controller.

The override LED indicator flashes when timed override has less than 5 minutes remaining. If the override time is left to expire, the controller returns to the Unoccupied Mode.

- **To override the Unoccupied Mode:**
  Press (for less than 4 seconds) and release the Override key (LED Indicator turns on). The controller goes into the Occupied Mode for override time specified by controller.

- **To reset override time:**
  If override time has not expired, press (for less than 4 seconds) and release Override key. Override time resets to time specified by controller.

- **To cancel override:**
  Press and hold Override key for 4 seconds (LED Indicator turns off). Override is cancelled and controller returns to Unoccupied Mode.

Reading Lockout Code at ASW Wall Sensor
If a given heat pump experiences a lockout condition, for example, a heat pump locks out due to High Pressure refrigeration failure; then a corresponding code will be displayed at the wall sensor if an ASW03 is being used.

Codes at the ASW03 wall sensor:
High Pressure Lockout Code= "2"
Low Pressure Lockout Code= "3"
Water Coil Low Temperature Limit Lockout Code= "4"
Air Coil Low Temperature Limit Lockout Code= "5"
Condensate Overflow Lockout Code= "6"
Over/Under Voltage Shutdown Code= "7"
UPS Warning Code= "8"
CXM Dual Stage Heat Pump Lockout Code= "9"

See CXM or DXM Application Manuals for detailed description of lockout type.

The Lockout code will be displayed along with the current zone temperature. For example, if a high pressure lockout has occurred, then the ASW03 will display.

"75….2….75….2….75….2….75….2…."

Note: If LON controller is connected to a dual compressor heat pump with 2 CXM controls, the wall sensor will display code 9 when there is a lockout. If the LON controller is connected to a dual compressor heat pump with 2 DXM controls, the wall sensor will always display the lockout code for the compressor stage 1, even if the stage 2 compressor locks out. If the dual stage DXM heat pump locks out via either compressor, a warning code, of some type, will always be displayed at the wall sensor.

Resetting Lockout at ASW Wall Sensor
To reset a heat pump lockout via the ASW02, ASW03 or ASW04 wall sensors, the user can accomplish this by using the override button:

A) If the ASW02 or ASW03 is NOT in "Override" mode (red LED is not on), then push the "Override" button for 1 to 3 seconds and the red LED will turn on momentarily. The LON Controller turns off the N01 and N02 outputs, which in turn resets the CXM or DXM control.
B) If the ASW02 or ASW03 is in "Override" mode (red LED is on), then push the "Override" button for more than 4 seconds and the red LED will turn off. Re-enter Override mode by pressing the Override button for 1 to 3 seconds and the red LED will turn on. Once ASW Sensor enters "Override" mode, the LON controller turns off the N01 and N02 outputs which in turn resets the CXM or DXM control.

Fail Safe Mode
When communications between the LON controller and its ASW wall temperature sensor is interrupted, the LON controller's digital outputs default to the Off state. When communication is restored, the LON controller resumes normal control.

Display Screen Functions
The ASW03 model has one display screen slot. The connected LON controller's application defines what is visible in each slot. The first display screen slot always shows the sensor's default display.

Sensor time-out - The ASW Sensor times out and returns to the default display if left idle for 15 seconds. If sensor is in diagnostics mode, then time out is 30 seconds.

To enter a selection: Press any key besides the Up/Down Key after making your selection. The selection will be automatically entered after a 5 second timeout.

To fast scroll toggle for increasing or decreasing values: Press and hold either end of the Up/Down Key and tap and release Override Key. To terminate fast scroll, release Up/Down Key.

Service Pin - To command controller to send controller service pin to the LON: Press and hold Override key for eight seconds. The service pin of connected controller is sent out on the LON.

Setpoint Functions - The ASW03 model has one setpoint slot. The setpoint assigned to each slot depends on LON controller application and sensor's configuration.

Service - Components within ASW Sensors can not be field repaired. If there is a problem with a sensor, follow the steps below before contacting your local Service office.

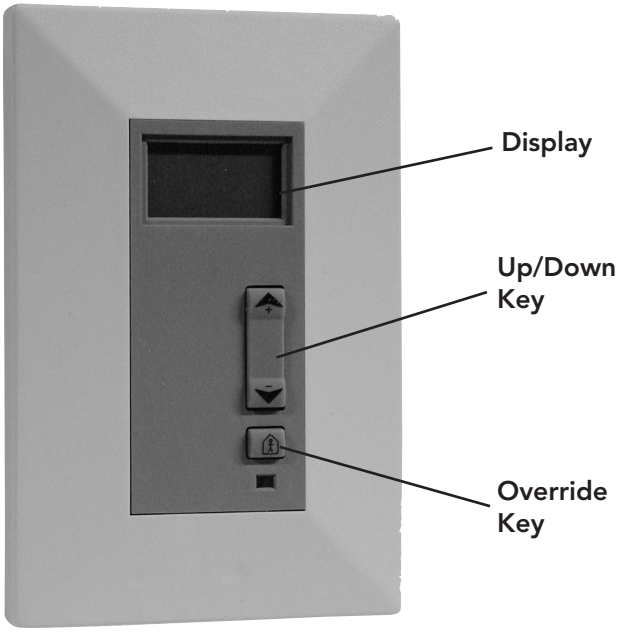
1. Make sure sensors are connected and communicating to desired devices.
2. Record precise hardware setup indicating the following:
   - Version numbers of applications software.
   - Controller firmware version number.
   - A complete description of difficulties encountered.

Table 8: Troubleshooting

Sensor Condition	Corrective Action
LCD remains blank	Check sensor and LON Controller wiring and correct, if necessary. If wiring is okay, check to see if power is being applied to the sensor by pushing the Override Key for less than four seconds. If the Override LED lights up, the sensor is powered. If the Override LED does not light up, the sensor may not be receiving power. Check LON Controller power to verify presence. If the above measures do not address the problem, download a new application to the LON Controller.
Sensor displays "Abn" Indefinitely.	Check the documentation to make sure the sensor model is compatible with the LON Controller application and then choose one of the following options. If the sensor and application are compatible, download a new application to the LON Controller. If the sensor and application are incompatible, download an application that is compatible with the sensor. Or, install a sensor that is compatible with the LON Controller application.
All LCD icons light up and remain lit.	Check to see if the LON Controller is constantly resetting and correct, if necessary. Check sensor and LON Controller wiring and correct, if necessary. If reset and wiring are okay, download a new application to the LON Controller. If the above measures do not address the problem, the LON Controller may need to be configured. For configuration instructions, consultdocumentation associated with the network management tool.

ASW03 Digital Wall Sensor

Figure 16: ASW03 Digital Wall Sensor



Notes:

Notes:

LONWORKS DDC Controls

Rev.: 14 July, 2016

Revision History

Date:	Item:	Action:
07/14/16	Logo	Updated
04/15/16	Tect-Images	Updated-Removed
01/09/12	Controller Wiring Schematic	Corrected Alarm Relay Wiring
01/03/11	Format - All Pages	Updated
06/11/10	Format - All Pages	Updated
04/23/10	S4 Sensor	Content updated
01/01/07	Format - All Pages	Minor Format Update
01/01/06	First Published	

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