Manual Supplement

Model Number: 8681-N2
8681-N2-M (Metric)

Product/System Title: Adaptive Offset Controller with 2-Point Flow Calibration and N2 Communications

Contents of this manual supplement include:

1) Sequence of operation
2) Model 8681-N2 Menu structure diagram
3) Model 8681-N2-M Menu structure diagram
4) Description of new software items
5) Deleted software menu items
6) Description of N2 variables
7) Model 8681-N2 variable map
8) Model 8681-N2-M variable map
9) Wiring Information
10) Wiring Diagram

N2 communications are installed on the Model 8681-N2 and Model 8681-N2-M adaptive offset room controllers. This document provides the technical information needed for the host DDC system to communicate with the Model 8681-N2 and Model 8681-N2-M units. This document assumes the programmer is familiar with the N2 protocol. Further technical assistance is available from TSI if your question is related to TSI interfacing to a DDC system. If you need further information regarding N2 programming in general, please contact Johnson Controls.

NOTE: The Model 8681-N2 adaptive offset room controller will only display values in standard or imperial units.
The Model 8681-N2-M adaptive offset room controllers will only display values in metric units.

NOTE: Here after, in this document, except where noted specifically, the manual supplement will reference either the Model 8681-N2 or Model 8681-N2-M as a Model 8681-N2.

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Sequence of Operation

The Model 8681-N2 uses the standard Model 8681 pressure and tracking control algorithm. The Model 8681-N2 also features temperature control. The temperature control scheme provides modulation of supply volume for cooling and modulation of a reheat valve for heating.

The Model 8681-N2 laboratory control system uses a through-the-wall room pressure sensor to measure pressure differential (direct pressure measurement) between the laboratory and corridor (reference space), and receives temperature information from the temperature sensor (1000 Ω platinum RTD, 50-85°F). The pressure sensor is located on the corridor (reference space) side of the wall. The Model 8681-N2 laboratory controller continuously monitors the temperature sensor information. The Model 8681-N2 control algorithm modulates supply and general exhaust air flows to provide adequate fume hood replacement air while maintaining room pressure differential and temperature control.

Pressure Control Sequence:

The Model 8681-N2 receives the pressure differential signal from the pressure sensor. If pressure is at set point, the control algorithm maintains the offset. If pressure is not at set point, the offset value is changed until pressure is maintained, or the minimum or maximum offset value is reached. If the offset value:

Increases, the supply air is reduced until one of three events occur:

- Pressure set point is reached. The Model 8681-N2 maintains the new offset.
- The offset range is exceeded. The offset will be at maximum attempting to reach pressure set point. An alarm will trigger to inform you pressure differential is not being maintained.
- Supply air minimum is reached. The general exhaust begins to open (was closed) to maintain pressure differential.

Decreases, the supply air increases until one of three events occur:

- Pressure set point is reached. The Model 8681-N2 maintains the new offset.
- The offset range is exceeded. The offset will be at minimum attempting to reach pressure set point. An alarm will trigger to inform you pressure differential is not being maintained.
- Supply air maximum is reached. The alarm will trigger to inform you pressure differential is not being maintained.

NOTE: The pressure differential is a slow secondary control loop. The system initially starts with a calculated offset value and then slowly adjusts the offset value to maintain pressure differential.

The Model 8681-N2 continuously monitors and displays pressure differential between the laboratory and corridor (reference space). When the pressure differential is adequate, a green

light indicates a safe pressure differential is being maintained. Room pressure alarm set points, configured into the controller, activate a red light and audible alarm when the room pressure becomes insufficient or too great. In addition to a local indication of room pressure, alarm contacts and RS 485 communications may be used to provide extensive information to a building management system.

Temperature Control Sequence:

Temperature control is maintained by the Model 8681-N2 controller. The 8681-N2 receives a temperature input from a 1000 Ω platinum RTD (50-85°F).

(1) Controls supply and general exhaust for ventilation and cooling
(2) Controls the reheat coil for heating

The Model 8681-N2 has three supply flow minimum set points. The ventilation set point is the minimum flow volume required to meet ventilation needs of the laboratory (ACPH). The temperature supply set point (COOLING FLOW) is the minimum flow required to meet temperature needs of the laboratory. The unoccupied set point is the minimum flow required when the lab is not occupied. All of these set points are configurable.

The Model 8681-N2 continuously compares the temperature set point to the actual space temperature. If set point is being maintained, no changes are made. If set point is not being maintained, and the space temperature is rising, the controller will first modulate the reheat valve closed. If the reheat valve is closed the controller will then increase the supply volume to meet the cooling demand. If the space temperature is falling the controller will first reduce the supply volume. If the supply volume reaches its minimum, ventilation or hood demand, the controller will then modulate the reheat coil open to meet the heating demand.

If the general exhaust is in the closed position and fume hood loads require additional replacement air, the Model 8681-N2 will override ventilation or temperature set points to modulate supply for pressurization control. Temperature will then be controlled by reheat in this sequence.

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Menu and Menu Items

The SUREFLOW is a very versatile device that can be configured to meet your specific application. This section describes all of the menu items available to program and change. Changing any item is accomplished by using the keypad, or if communications are installed, through the RS-485 Communications port. If you are unfamiliar with the keystroke procedure please see **Programming Software** for a detailed explanation. This section provides the following information:

- Complete list of menu and all menu items.
- Gives the menu or programming name.
- Defines each menu item's function; what it does, how it does it, etc..
- Gives the range of values that can be programmed.
- Gives default item value (how it shipped from factory).

The menus covered in this section are divided into groups of related items to ease programming. As an example all set points are in one menu, alarm information in another, etc. The manual follows the menus as programmed in the controller. The menu items are always grouped by menu and then listed in menu item order, not alphabetical order. Figure 1 shows a chart of all the Model 8681-N2 controller menu items. New or modified menu items are shown in **bold**.

SETPOINTS	ALARM	CONFIGURE	CALIBRATION
SETPOINT	LOW ALARM	**UNITS**	TEMP CAL
VENT MIN SET	HIGH ALARM	EXH CONFIG	SENSOR SPAN
COOLING FLOW	MIN SUP ALM	NET ADDRESS	
UNOCCUPY SET	MAX EXH ALM	ACCESS CODES	
MAX SUP SET	ALARM RESET		
MIN EXH SET	AUDIBLE ALM		
TEMP SETP	ALARM DELAY		
MIN OFFSET	ALARM RELAY		
MAX OFFSET	MUTE TIMEOUT		

CONTROL	SYSTEM FLOW	FLOW CHECK	DIAGNOSTICS
SPEED	TOT SUP FLOW	SUP FLOW IN	CONTROL SUP
SENSITIVITY	TOT EXH FLOW	EXH FLOW IN	CONTROL EXH
CONTROL DIR	OFFSET VALUE	HD1 FLOW IN	CONTROL TEMP
KC VALUE	SUP SETPOINT	HD2 FLOW IN	SENSOR INPUT
TI VALUE	EXH SETPOINT		SENSOR STAT
KC OFFSET			TEMP INPUT
REHEAT SIG			ALARM RELAY
TEMP DIR			RESET TO DEF
TEMP DB			
TEMP TR			
TEMP TI			

SUPPLY FLOW	EXHAUST FLOW	HOOD FLOW
SUP DCT AREA	EXH DCT AREA	HD1 DCT AREA
SUP FLO ZERO	EXH FLO ZERO	HD2 DCT AREA
SUP LO SETP	EXH LO SETP	HD1 FLO ZERO
SUP HI SETP	EXH HI SETP	HD2 FLO ZERO
SUP LO CAL	EXH LO CAL	MIN HD1 FLOW
SUP HI CAL	EXH HI CAL	MIN HD2 FLOW
RESET CAL	RESET CAL	HD1 LOW CAL
		HD1 HIGH CAL
		HD2 LOW CAL
		HD2 HIGH CAL
		FLO STA TYPE
		TOP VELOCITY
		RESET CAL

Figure 1: Menu Items - Model 8681-N2 Controller

SETPOINTS

SETPOINT
VENT MIN SET
COOLING FLOW
UNOCCUPY SET
MAX SUP SET
MIN EXH SET
TEMP SETP
MIN OFFSET
MAX OFFSET

ALARM

LOW ALARM
HIGH ALARM
MIN SUP ALM
MAX EXH ALM
ALARM RESET
AUDIBLE ALM
ALARM DELAY
ALARM RELAY
MUTE TIMEOUT

CONFIGURE

UNITS
EXH CONFIG
NET ADDRESS
ACCESS CODES

CALIBRATION

TEMP CAL
SENSOR SPAN

CONTROL

SPEED
SENSITIVITY
CONTROL DIR
KC VALUE
TI VALUE
KC OFFSET
REHEAT SIG
TEMP DIR
TEMP DB
TEMP TR
TEMP TI

SYSTEM FLOW

TOT SUP FLOW
TOT EXH FLOW
OFFSET VALUE
SUP SETPOINT
EXH SETPOINT

FLOW CHECK

SUP FLOW IN
EXH FLOW IN
HD FLOW IN

DIAGNOSTICS

CONTROL SUP
CONTROL EXH
CONTROL TEMP
SENSOR INPUT
SENSOR STAT
TEMP INPUT
ALARM RELAY
RESET TO DEF

SUPPLY FLOW

SUP DCT AREA
SUP FLO ZERO
SUP LO SETP
SUP HI SETP
SUP LO CAL
SUP HI CAL
RESET CAL

EXHAUST FLOW

EXH DCT AREA
EXH FLO ZERO
EXH LO SETP
EXH HI SETP
EXH LO CAL
EXH HI CAL
RESET CAL

HOOD FLOW

HD DCT AREA
HD FLO ZERO
MIN HD FLOW
HD LOW CAL
HD HIGH CAL
FLO STA TYPE
TOP VELOCITY
RESET CAL

Figure 2: Menu Items - Model 8681-N2-M Controller

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Description of New Software Menu Items

The following menu items have been added.

CONFIGURE MENU

Item	Description	Item Range Default (bold)
UNITS	The UNITS item selects the unit of measure that the DIM displays all values (except calibration span). These units display for all menu items set points, alarms, flows, etc.	
	NOTE: The Model 8681-N2 will display values in standard or imperial units: FT/MIN or "H_2O.	Model 8681-N2 FT/MIN or "H_2O **"H_2O**
	The Model 8681-N2-M will display values in metric units: m/s or Pa.	Model 8681-N2-M m/s or Pa **Pa**

FLOW CHECK MENU (for the Model 8681-N2-M only)

Item	Description	Item Range Default (bold)
HD FLOW IN	The HD FLOW IN menu item displays the current exhaust flow from a fume hood. This item is a diagnostics tool to compare the hood flow reading to a traverse of the duct work. If flow reading and traverse match within 10%, no change is needed. If flow error is greater than 10%, calibrate flow station. When a volt meter is hooked to the flow station output, a voltage should be displayed. The exact voltage displayed is relatively unimportant. It is more important that the voltage is changing which indicates the flow station is working correctly.	NONE: Read only value **NONE**

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HOOD FLOW MENU (for the Model 8681-N2-M only)

Item	Description	Item Range Default (bold)
HD DCT AREA	The HD DCT AREA item inputs the fume hood exhaust duct size. The duct size is needed to compute the flow out of the fume hood. This item requires a flow station to be mounted in each fume hood exhaust duct. If the DIM displays English units, area must be entered in square feet. If metric units are displayed area must be entered in square meters.	0 - 10 square feet (0 - 0.9500 square meters) The DIM does not compute duct area. The area must be first calculated and then entered into the unit. **0**
HD FLO ZERO	The HD FLO ZERO item establishes the flow station zero flow point. A zero or no flow point needs to be established in order to obtain a correct flow measurement output (see **Calibration** section). All pressure based flow stations need to have a HD FLO ZERO established on initial set up. Linear flow stations with a minimum output of 0-5 VDC do not need a HD FLO ZERO.	NONE
MIN HD FLOW	The MIN HD# FLOW menu items adjust the minimum flow value for each fume hood input. Use this menu item if the fume hood flow measurements are too low when the sash is closed.	**0**
HD LOW CAL	The HD LOW CAL menu items display the currently measured fume hood flow rate and the calibrated value for that fume hood flow. The calibrated hood flow can be adjusted using the ▲/▼ keys to make it match a reference measurement. Pressing the **SELECT** key will save the new calibration data.	

HOOD FLOW MENU (continued-for the Model 8681-N2-M only)

Item	Description	Item Range Default (bold)
HD HIGH CAL	The HD HIGH CAL menu items display the currently measured fume hood flow rate and the calibrated value for that fume hood flow. The calibrated hood flow can be adjusted using the ▲/▼ keys to make it match a reference measurement. Pressing the **SELECT** key will save the new calibration data.	

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Deleted Software Menu Items

The following items have been replaced or eliminated in the 8681-N2-M:

SETPOINTS	**ALARM**	**CONFIGURE**	**CALIBRATION**
UNOCC TEMP			ELEVATION
CONTROL	**SYSTEM FLOW**	**FLOW CHECK**	**DIAGNOSTICS**
		HD1 FLOW IN HD2 FLOW IN	
SUPPLY FLOW	**EXHAUST FLOW**	**HOOD FLOW**	
		HD1 DCT AREA HD1 FLO ZERO MIN HD1 FLOW HD1 LOW CAL HD1 HIGH CAL HD2 DCT AREA HD2 FLO ZERO MIN HD2 FLOW HD2 LOW CAL HD2 HIGH CAL FLO STA TYPE TOP VELOCITY	

Figure 3: Deleted Menu Items - Model 8681 Controller

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N2 Communications
Description of Variables

NPT - Network Point Type
Variables are defined as analog inputs, binary inputs, and analog outputs. Analog inputs are current control parameters and items that the controller is measuring. Binary inputs represent controller states. Analog outputs are the programmable setpoints for the isolation room pressure controller and monitor. These setpoints can be changed through the keypad or by overriding the current setpoint.

NPA - Network Point Address
Address of the desired point.

Override Analog Input Command
Analog Input values can be set using the override command. These values will be reset to the correct items when the Override is released. There is not a time-out on the override command.

Override Binary Input Command
Overriding a 1 to Emergency binary inputs enables that mode. To release the controller from emergency state, override a 0 to the Emergency input or press either the emergency or reset key. Releasing the override will return the controller to the Normal state.

The alarm and data error variables can be overridden, but this will not affect the controller. Overriding the low alarm variable will result in a change of status, but will not put the controller into low alarm mode. The local alarm modes can only be controlled locally. Only override these variables for diagnostic purposes, and release them for normal operation.

Binary Input Data Error
Data Error binary inputs are used to indicate if something has gone wrong with the controller. Data Error indicates when some of the data stored on the device has been corrupted. The calibration and setpoint values should be checked on the controller.

Override Analog Output Command

The analog output variables can be overridden to change their values. The overridden value will be checked for validity. If invalid, the override command will be ignored, and the value will not change. The override flag will not be set when the value is ignored. The override command will be cleared when the variable is reset in the menus. The variable will not reset with the release command.

Supported Commands

Command	Response
Request Device ID	Returns 0x10
Synchronize Time Command	Acknowledged. There Is No Internal Clock To Synchronize.
Poll Without/With Ack Message	Any Change Of Status Is Returned
Read Analog Input Command	Variable Value
Read Binary Input Command	Variable Value
Read Analog Output Command	Variable Value
Write Analog Input	Acknowledge
Write Binary Input	Acknowledge
Write Analog Output	Acknowledge
Override Analog Input Command	Acknowledge
Override Binary Input Command	Acknowledge
Override Analog Output Command	Acknowledge
Override Release Request	Acknowledge
Identify Device Type Command	Returns 0x10h

Note: Poll Without/With Ack Message will need to be sent twice in order to receive all of the possible change of status variables.

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Model 8681-N2 Variable Map

NPT	NPA	UNITS	DESCRIPTION	
AI	1	ft/min, in. H_2O	Room Pressure Value	
AI	2	CFM	Total Supply	
AI	3	CFM	General Exhaust	
AI	4	CFM	Hood Flow 1	
AI	5	CFM	Hood Flow 2	
AI	6	°F	Current Temperature	
AI	7	0-100% OPEN	Supply Control Output	
AI	8	0-100% OPEN	Exhaust Control Output	
AI	9	0-100% OPEN	Temp. Control Output	
AI	10	CFM	Offset	
BI	1		Low Pressure Alarm	0=Normal 1=Low Alarm
BI	2		High Pressure Alarm	0=Normal 1=High Alarm
BI	3		Min. Supply Flow Alarm	0=Normal 1=Low Flow Alarm
BI	4		Max. Exhaust Flow Alarm	0=Normal 1=High Flow Alarm
BI	5		Emergency Mode	0=Normal 1=Emergency
BI	6		Unoccupied Mode	0=Normal Mode 1=Unoccupied Mode
BI	7		Data Error	0=Normal 1=Data Error
AO	1	ft/min, in. H_2O	Control Setpoint	
AO	2	°F	Temperature Setpoint	
AO	3	CFM	Minimum Supply Volume Ventilation Setpoint	
AO	4	CFM	Minimum Supply Volume Temperature Setpoint	
AO	5	CFM	Minimum Supply Volume in Unoccupied Mode	
AO	6	ft/min, in. H_2O	Low Alarm Setpoint	
AO	7	ft/min, in. H_2O	High Alarm Setpoint	
AO	8	CFM	Minimum Supply Flow Alarm Setpoint	
AO	9	CFM	Maximum Exhaust Flow Alarm Setpoint	
AO	10	#	Units	0= CFM 1= Inches H_2O

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Model 8681-N2-M Variable Map

NPT	NPA	UNITS	DESCRIPTION	
AI	1	m/s, Pa	Room Pressure Value	
AI	2	l/s	Total Supply	
AI	3	l/s	General Exhaust	
AI	4	l/s	Hood Flow	
AI	5	°C	Current Temperature	
AI	6	0-100% OPEN	Supply Control Output	
AI	7	0-100% OPEN	Exhaust Control Output	
AI	8	0-100% OPEN	Temp. Control Output	
AI	9	l/s	Offset	
BI	1		Low Pressure Alarm	0=Normal 1=Low Alarm
BI	2		High Pressure Alarm	0=Normal 1=High Alarm
BI	3		Min. Supply Flow Alarm	0=Normal 1=Low Flow Alarm
BI	4		Max. Exhaust Flow Alarm	0=Normal 1=High Flow Alarm
BI	5		Emergency Mode	0=Normal 1=Emergency
BI	6		Unoccupied Mode	0=Normal Mode 1=Unoccupied Mode
BI	7		Data Error	0=Normal 1=Data Error
AO	1	fm/s, Pa	Control Setpoint	
AO	2	°C	Temperature Setpoint	
AO	3	l/s	Minimum Supply Volume Ventilation Setpoint	
AO	4	l/s	Minimum Supply Volume Temperature Setpoint	
AO	5	l/s	Minimum Supply Volume in Unoccupied Mode	
AO	6	m/s, Pa	Low Alarm Setpoint	
AO	7	m/s, Pa	High Alarm Setpoint	
AO	8	l/s	Minimum Supply Flow Alarm Setpoint	
AO	9	l/s	Maximum Exhaust Flow Alarm Setpoint	
AO	10	#	Units	0= l/s 2= Pascal

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Wiring Inforamation:

Back Panel Wiring
MODEL 8681-N2

PIN #	Input / Output / Communication	Description
	DIM / AOC	
1, 2	Input	24 VAC to power Digital Interface Module (DIM). **NOTE**: 24 VAC becomes polarized when connected to DIM.
3, 4	Output	24 VAC power for Pressure Sensor
5, 6	Input	0 - 10 VDC pressure sensor signal
7, 8	Communications	RS - 485 communications between DIM and pressure sensor
9, 10	Output	0–10 VDC, general exhaust control signal. 10 VDC = open (n.o. damper) - See menu item CONTROL SIG
11, 12	Input	0 - 10 VDC flow station signal - fume exhaust (HD1 FLOW IN).
13, 14	Output	Alarm relay - N.O., closes in low alarm condition. - See menu item ALARM RELAY
15, 16	Communications	RS - 485 communications; AOC to building management system.
17, 18	Output	0–10 VDC, supply air control signal. 10 VDC = open (n.o. damper) - See menu item CONTROL SIG
19, 20	Input	0 - 10 VDC flow station signal - General exhaust (EXH FLOW IN) .
21, 22	Input	0 - 10 VDC flow station signal - Supply air (SUP FLOW IN).
23, 24	Input	1000Ω platinum RTD temperature input signal
25, 26	Output	0–10 VDC, reheat valve control signal. 10 VDC = open (n.o. damper) - See menu item REHEAT SIG
27, 28	Input	0 - 10 VDC flow station signal - fume exhaust (HD2 FLOW IN).

WARNING: The wiring diagram shows polarity on many pairs of pins: + / -, H / N, A / B. Damage to DIM may occur if polarity is not observed.

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Back Panel Wiring
MODEL 8681-N2-M

PIN #	Input / Output / Communication	Description
	DIM / AOC	
1, 2	Input	24 VAC to power Digital Interface Module (DIM). **NOTE**: 24 VAC becomes polarized when connected to DIM.
3, 4	Output	24 VAC power for Pressure Sensor
5, 6	Input	0 - 10 VDC pressure sensor signal
7, 8	Communications	RS - 485 communications between DIM and pressure sensor
9, 10	Output	0–10 VDC, general exhaust control signal. 10 VDC = open (n.o. damper) - See menu item CONTROL SIG
11, 12	Input	0 - 10 VDC flow station signal - fume exhaust (HD FLOW IN).
13, 14	Output	Alarm relay - N.O., closes in low alarm condition. - See menu item ALARM RELAY
15, 16	Communications	RS - 485 communications; AOC to building management system.
17, 18	Output	0–10 VDC, supply air control signal. 10 VDC = open (n.o. damper) - See menu item CONTROL SIG
19, 20	Input	0 - 10 VDC flow station signal - General exhaust (EXH FLOW IN) .
21, 22	Input	0 - 10 VDC flow station signal - Supply air (SUP FLOW IN).
23, 24	Input	1000Ω platinum RTD temperature input signal
25, 26	Output	0–10 VDC, reheat valve control signal. 10 VDC = open (n.o. damper) - See menu item REHEAT SIG
27, 28	Input	Not used.

WARNING: The wiring diagram shows polarity on many pairs of pins: + / -, H / N, A / B. Damage to DIM may occur if polarity is not observed.

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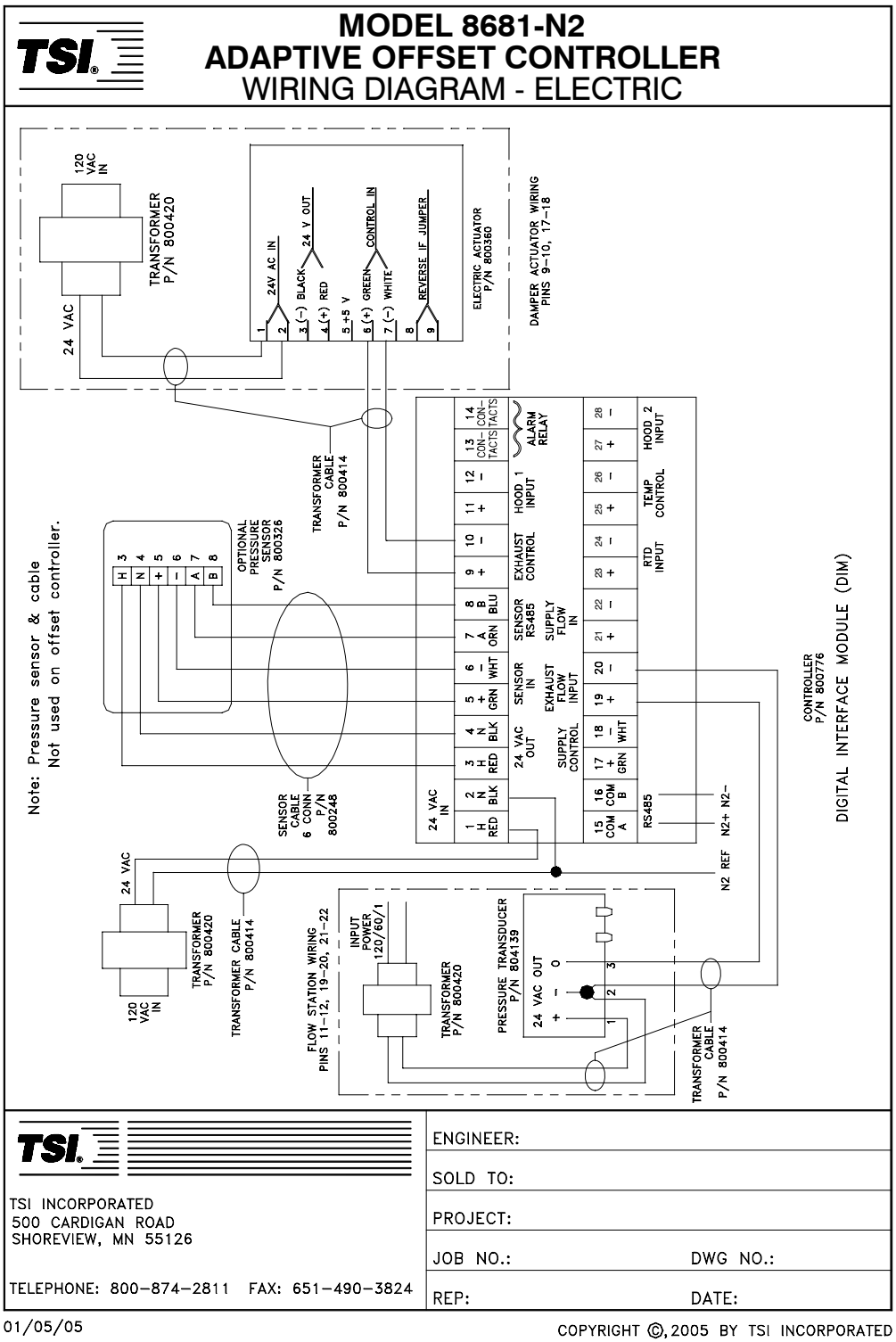
Wiring Diagrams



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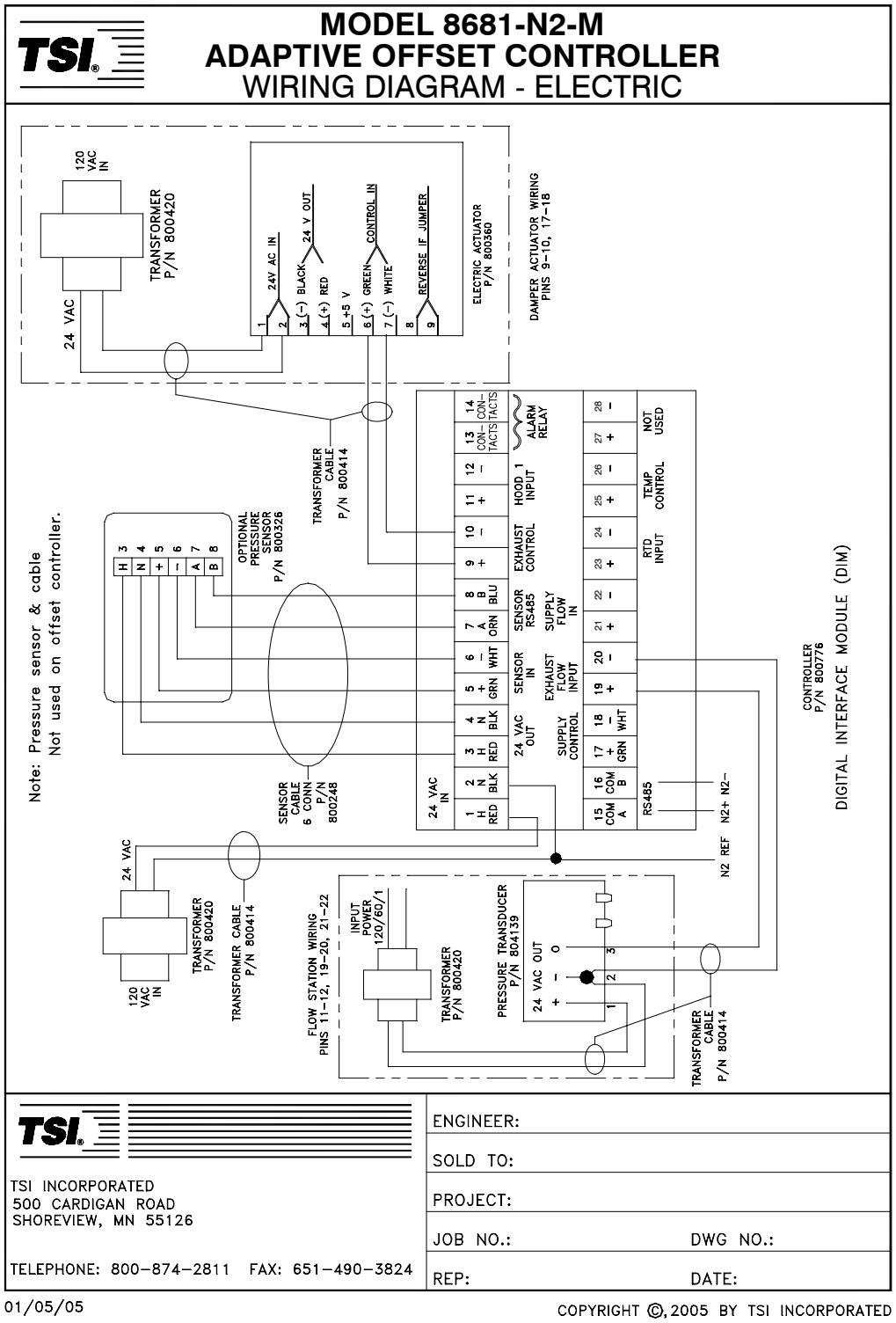
Wiring Diagrams (continued)



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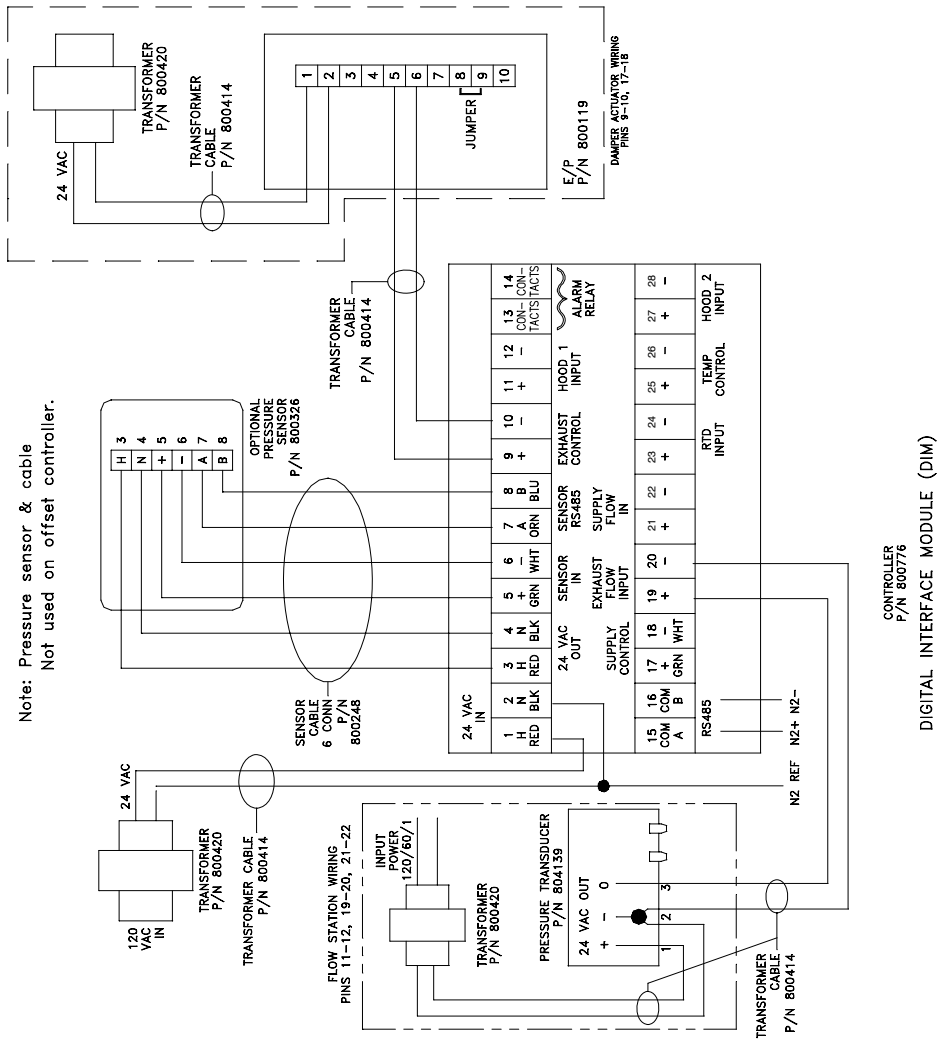
Wiring Diagrams (continued)

MODEL 8681-N2
ADAPTIVE OFFSET CONTROLLER
WIRING DIAGRAM - PNEUMATIC



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Wiring Diagrams (continued)

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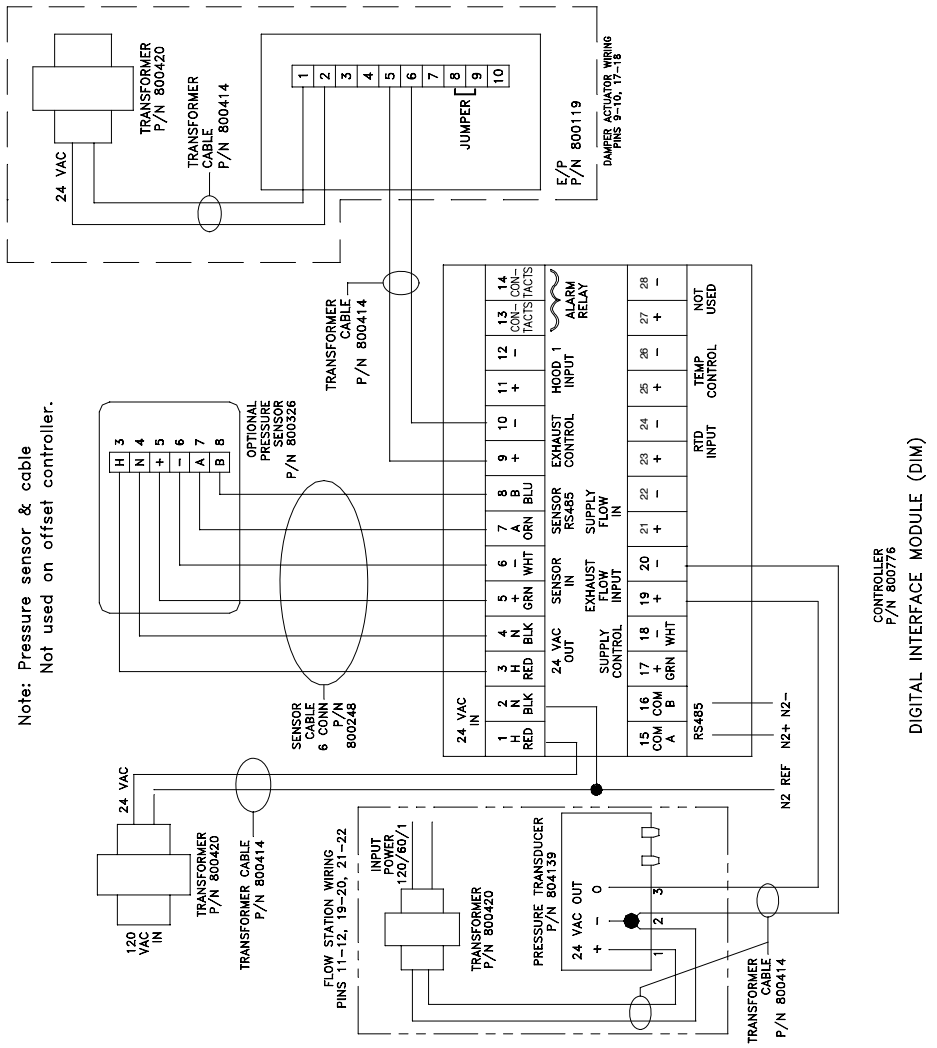
ADAPTIVE OFFSET CONTROLLER
WIRING DIAGRAM - PNEUMATIC



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