Application Note

TSI MODEL 8680 SUREFLOW™ MODBUS™ COMMUNICATIONS

Modbus communications are installed in all Model 8680 adaptive offset room pressure controllers. This document provides the technical information needed to communicate between the host DDC system and the Model 8680 units. This document assumes the programmer is familiar with Modbus 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 Modbus programming in general, please contact:

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The Modbus protocol utilizes the RTU format for data transfer and Error Checking. Check the Modicon Modbus Protocol Reference Guide (PI-Mbus-300) for more information on CRC generation and message structures.

The messages are sent at 9600 baud with 1 start bit, 8 data bits, and 2 stop bits. Do not use the parity bit. The system is set up as a master slave network. The TSI units act as slaves and respond to messages when there correct address is polled.

Blocks of data can be written or read from each device. Using a block format will speed up the time for the data transfer. The size of the blocks is limited to 20 bytes. This means the maximum message length that can be transferred is 20 bytes. The typical response time of the device is around 0.05 seconds with a maximum of 0.1 seconds.

Unique to TSI
The list of variable addresses shown below skips some numbers in the sequence due to internal Model 8680 functions. This information is not useful to the DDC system and is therefore deleted. Skipping numbers in the sequence will not cause any communication problems.

All variables are outputted in English units: ft/min, CFM, or inches H_20. The room pressure control setpoints and alarms are stored in ft/min. The DDC system must convert the value to inches of water if that is desired. The equation is given below.

Pressure in Inches $H_2O = 6.2*10^{-8}*(\text{Velocity in ft/min} / .836)^2$

XRAM Variables

These variables can be read using Modbus command **03 Read Holding Registers**. They can be written to using Modbus command **16 Preset Multiple Regs**. Many of these variables are the same "menu items" that are configured from the SUREFLOW keypad. The calibration and control items are not accessible from the DDC system. This is for safety reasons, since each room is individually setup for maximum performance. TSI offers a number of different models, so if a feature is not available on a unit, the variable is set to 0.

8680 Variable List

Variable Name	Variable Address	Input Provided to Master System	Integer DDC system receives
Software Version	0	Current Software Version	1.00 = 100
Controller Type	1	Controller Model Number	8680
Emergency Mode	2	Emergency Mode Control **Write only variable.**	0 Leave emergency mode 1 Enter emergency mode
Control Mode	3	Control mode of device.	0 Normal 1 Unoccupied (Setback)
Status Index	4	Status of SURFLOW device	0 Normal 1 Dim Data Error 2 Alarm = Low Pressure 3 Alarm= High Pressure 4 Alarm=Min Supply 5 Alarm=Min Exhaust 6 Data Error 7 Cal Error 8 Emergency Mode
Room Velocity	5	Velocity of room pressure	Displayed in ft/min.
Room Pressure	6	Room Pressure	Displayed in inches H2O. Host DDC system must divide by 100,000 to report pressure correctly
Total Supply Flow	7	Total supply into laboratory	Displayed in CFM.
Total Exhaust Flow	8	Total exhaust out of laboratory	Displayed in CFM.
Offset Setpoint	9	Current offset setpoint	Displayed in CFM.

XRAM Variables (cont.)

Variable Name	Variable Address	Input Provided to Master System	Integer DDC system receives
Air changes per hour	10	Calculated room air changes	Displayed in number per hour. Host DDC system must divide value by 10 to report ACPH correctly.
Fume Hood Flow	11	Flow measured by flow station connected to hood input.	Displayed in CFM.
Exhaust Flow	12	Flow measured by flow station connected to general exhaust input.	Displayed in CFM.
Supply Flow	13	Flow measured by flow station connected to supply flow input.	Displayed in CFM.
Temperature Input	14	Signal connected to the temperature input.	Voltage input. Host DDC system must divide by 10 to report input voltage correctly.
Pressure Setpoint	15	Pressure control setpoint	Displayed in ft/min.
Min Vent Setpoint	16	Minimum flow setpoint for ventilation.	Displayed in CFM.
Min Temp Setpoint	17	Minimum flow setpoint for temperature control.	Displayed in CFM.
Unoccupied Min Setpoint	18	Unoccupied (Setback) minimum flow setpoint.	Displayed in CFM.
Low Alarm	19	Low pressure alarm setpoint	Displayed in ft/min.
High Alarm	20	High pressure alarm setpoint	Displayed in ft/min.
Min Supply Alarm	21	Minimum supply flow alarm	Displayed in CFM.
Min Exhaust Alarm	22	Minimum general exhaust alarm	Displayed in CFM.
Min Offset Setpoint	23	Minimum offset setpoint	Displayed in CFM.
Max Offset Setpoint	24	Maximum offset setpoint	Displayed in CFM.
Max Supply Setpoint	25	Maximum supply setpoint	Displayed in CFM.
Min Exhaust Setpoint	26	Minimum exhaust setpoint	Displayed in CFM.
Temp Low Setpoint	27	Low limit to switch into temperature mode	Voltage signal from thermostat. Host DDC system must divide by 10 to report correctly.

XRAM Variables (cont.)

Variable Name	Variable Address	Input Provided to Master System	Integer DDC system receives
Temp High Setpoint	28	High limit to switch into temperature mode	Voltage signal from thermostat. Host DDC system must divide by 10 to report correctly.
Alarm relay configuration	29	Use of alarm relays	0 Pressure 1 Flow
Exhaust Configuration	30	Configuration of exhaust duct work.	0 Unganged 1 Ganged
Elevation	31	Elevation above sea level	0-10,000 feet. Displayed in 1,000 feet increments.
Hood Duct Area	32	Duct area in square feet	Host DDC system must divide value by 1,000 to report duct area correctly.
General Exhaust Duct Area	33	Duct area in square feet	Host DDC system must divide value by 1,000 to report duct area correctly.
Supply Duct Area	34	Duct area in square feet	Host DDC system must divide value by 1,000 to report duct area correctly.
Room Volume	35	Room volume in cubic feet (needed or ACPH calculation)	Displayed in cubic feet.
Control Action	38	Control output signal direction	0 Reverse 1 Direct
Hood Top Velocity	43	Fume hood maximum velocity range of flow station.	0-5,000 ft/min
Exhaust Top Velocity	44	General exhaust maximum velocity range of flow station.	0-5,000 ft/min
Supply Top Velocity	45	Supply maximum velocity range of flow station.	0-5,000 ft/min
Audible Alarm	46	Audible alarm indication	0 Off 1 On
Mute Delay	47	Length of time alarm is muted when mute key is pressed	Host DDC system must divide value by 600 to report mute delay correctly.
Network Protocol	48	Network protocol for RS485 communications	0 Modbus 1 Cimetrics
Network Address	49	Communication address of device	Range is 1-247
Alarm Delay	60	Time delay before alarm activates	Host DDC system must divide value by 10 to report alarm delay correctly.

XRAM Variables (cont.)

Variable Name	Variable Address	Input Provided to Master System	Integer DDC system receives
Averaging Index	61	Display averaging period	0 .75 sec. 4 5 sec. 1 1 sec. 5 10 sec. 2 2 sec. 6 20 sec. 3 3 sec. 7 40 sec.
Units	62	Current pressure units displayed	0 Feet per minute 1 meters per second 2 inches of H_2O 3 Pascal 4 millimeters H_2O
Access code enables	63	Enables the pass codes for the menus.	Bit Mapped 0 Off 1 On Bit 0 Set Code Bit 1 Alarm Code Bit 2 Conf Code Bit 3 Cal Code Bit 4 Control Code Bit 5 System Code Bit 6 Flow Code Bit 7 Diag Code Bit 8 Inter Code Bit 9 Hood Code Bit 10 Exhaust Code Bit 11 Sup Code
Hood Flow Station Type	64	Type of flow station being used in fume hoods.	0 Pressure based 1 Linear
Exhaust Flow Station Type	65	Type of flow station being used in general exhaust.	0 Pressure based 1 Linear
Supply Flow Station Type	66	Type of flow station being used in supply.	0 Pressure based 1 Linear
Alarm Mode	67	Latched or unlatched alarms	0 Unlatched 1 Latched

*Note: Items in *italics* are **read only** variables.

EXAMPLE of **16 (10 Hex) Preset Multiple Regs** function format:
This example changes the minimum ventilation setpoint to 1000 CFM

QUERY		**RESPONSE**	
Field Name	(Hex)	Field Name	(Hex)
Slave Address	01	Slave Address	01
Function	10	Function	10
Starting Address Hi	00	Starting Address Hi	00
Starting Address Lo	10	Starting Address Lo	10
No. Of Registers Hi	00	No. of Registers Hi	00
No. Of Registers Lo	01	No. of Registers Lo	01
Data Value (High)	03	Error Check (CRC)	--
Data Value (Low)	E8		
Error Check (CRC)	--		

Example of **03 Read Holding Registers** function format:
This example reads the total supply and total exhaust.

QUERY		**RESPONSE**	
Field Name	(Hex)	Field Name	(Hex)
Slave Address	01	Slave Address	01
Function	03	Function	03
Starting Address Hi	00	Byte Count	04
Starting Address Lo	07	Data Hi	03
No. Of Registers Hi	00	Data Lo	8E (1000 CFM)
No. Of Registers Lo	02	Data Hi	04
Error Check (CRC)	--	Data Lo	B0 (1200 CFM)
		Error Check (CRC)	