Fermi National Accelerator Laboratory

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D0 HVAC SYSTEM
HEAT PUMP CONTROLLER PROGRAMMING, NETWORKING, AND OPERATING INFORMATION

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Overview

The purpose of this engineering note is to provide the necessary information to setup, program, and network the Electronic Systems USA Heat Pump Controller with the LON network card and Intellution Fix32 to operate properly within the HVAC system at D-Zero. The heat pump controllers are used for local temperature control of the office environments on the fifth and six floors of D-Zero. Heat pump units 1-6 are located in the ceiling of the sixth floor. Heat pump units 7-12 are found in the fifth floor ceiling. Heat pump unit 13 is in the Southeast corner of the fifth floor.

Heat Pump Preparation

Prior to installation the heat pump controller must be properly prepared to operate correctly in the HVAC system.

Manufacturer Programming

Each heat pump unit must contain firmware (software) version 1.31 to operate properly on the network. Controllers with version 1.30 will not be able to communicate over the LON network. The manufacturer can only update the firmware version.

Intelligent Stat Programming

Before installation a series of heat pump setpoints must be manually set using the Intelligent Stat. Connect the Intelligent Stat via the serial cable or wired connection. Press "Room/Outside" and "*" buttons simultaneously for several seconds. When "Password" appears use the up and down arrow keys to select 5001, then press the "Override" button. This will allow access to the heat pump configuration parameters. Use the "Room/Outside" and "*" keys to move forward and backward through the list of variables. Find those variables listed in Table 1, and correct their value, using the up and down arrow keys. After selecting the value press the "Override" button to send the change to the heat pump controller. A "->->" should appear in the upper right-hand corner when the change has been sent. Move forward and back again to verify that the setpoint has been changed. The other setpoints seen on the display will be adjusted using the NexTool software program. Only those setpoints in Table 1 need to be changed for all heat pump units. Assign a different node address to each unit. Label each unit based upon its assigned node address so it is properly installed within the system.

NexTool Programming

The remaining setpoints in the heat pump controller can be downloaded to each unit using NexTool. Connect the controller via the serial port. For each heat pump controller save the default configuration, using the heat pump unit's node number. Then use the restore configuration command to send the default programming settings. Note that not all of the configuration setpoints are saved or downloaded. Only those setpoints found in Table 2 are downloaded to the heat pump controller. Subnet and node addresses are not saved, nor are any of the setpoints in Table 1. After this is completed all heat pump programming is complete.

Notes On Configuration Setpoints

Those items marked with a "*" on Tables 1 and 2 are settings which may seem to differ from the user manuals supplied with the heat pump. The first of these is the "Loop Enable Air Source" setpoint. The setting is "1" for "Air" even though the unit source is water. By setting this to "1" the compressors will operate normally. If the setting was "0" for "Water" the compressors would not turn on without a "Loop Enable" command sent over the network. The second setpoint is for "Econ. Enable" this is used to determine if there are dampers present in the system. Since our system doesn't use dampers this should be disabled. According to the manual this should be a "1." However, by observing compressor activation in relation to the thermal load a "0" deactivates the use of dampers. The third setpoint is the "Fan Mode." Our system uses a continuous fan (running all the time). According to the manual this is a setting of "0." However, once again in observing the function of the unit, a "0" allows the fan to turn off, while a "1" is a continuous fan.

NodeUtility Downloads

Now that the heat pump is properly configured there are two pieces of information, which are necessary to properly incorporate the controller into the network. This information is gathered using another software program called NodeUtility. When using this program the controller must be connected via the LON network. Intellution Fix32 must be shutdown, so the program can communicate over the network. Use the "Service" button on the controller to send a pin message. This will be displayed on the screen. Use "List Node" command in NodeUtility to see the controller's Neuron ID. (Note that NodeUtility assigns its node numbers based upon the order in which pin messages are received, or if a "Find Node" command is used the order in which the controllers are networked together. It does not use the

programmed node addresses.) For each heat pump controller record the Neuron ID. This will be useful if a node stops responding and cannot be found on the network when in the system. The Neuron ID can be used to find the malfunctioning unit, and perhaps restore functioning without removing it from the system. The other piece of information is the "Network Variable Configuration Table." This should be saved as a text file and printed. This document contains the memory locations for the network variables, which can be controlled over the network.

Table 1: Heat Pump Manual Programmed Setpoints

Intelligent Stat Setpoints	Display	Function	Setting	Units/Setting
Subnet Address	Subnet	Sets the subnet address for the controller.	1	
Node Address	Node	Sets the individual node address for the controller.	1-13	
Fan Status Enable	FanStsEn	Enable/Disable of feedback to determine fan status.	0	Disable
Fan Status Delay	FanStsDy	Minimum amount of waiting time before changing display of fan state.	15	Sec.
Reverse Valve Direction	RVlvDir	Sets valve direction when ON for heating or cooling.	0	Heating
Reverse Valve Delay Time	RVlvDly	Minimum amount of time before the valve can switch.	300	Sec.
Compressor Stages	CompStgs	Number of compressor stages used.	1	1st Stage
Compressor Interstage Delay	Comp Dly	Minimum delay time between successive compressor activation.	0	Sec.
Compressor Minimum On Time	MinOn Tm	Minimum time a compressor must be on.	30	Sec.
Compressor Minimum Off Time	MinOffTm	Minimum time a compressor must be off.	300	Sec.
Compressor Emergency Heat	EmrgHtg	Enable/Disable for emergency heating.	0	Disable
Compressor Emergency Heat Holdoff	EmrgHold	Minimum amount of waiting time before emergency heating.	1.0	F
Loop Enable Air Source	ArSrEn	Sets systems as water or air source.	1	Air*

Table 2: Heat Pump Downloaded Configuration Settings

HP Configuration Parameter	Function	Setting	Units/Setting
Stat Display Units	Sets the type of units used.	0	English
Stat Time Display	Sets AM/PM or Military time.	0	AM/PM
Stat Type	Sets temperature input from a thermostat or sensor.	1	Sensor
UI 1 Calibration	Temp. calibration for discharge air temperature.	0.0	F
UI 2 Calibration	Temp. calibration for mixed air temperature.	0.0	F
UI 3 Calibration	Temp. calibration for space temp./return air temperature.	0.0	F
UI 4 Calibration	Temp. calibration for outside air temperature.	0.0	F
UI 5 Invert	Inverts the signal for the fan status.	0	Disable
UI 6 Invert	Inverts the signal for an emergency shutdown.	0	Disable
Setpoint Maximum	The maximum user setpoint.	83.0	F
Setpoint Minimum	The minimum user setpoint.	65.0	F
User/Cooling Setpoint	The user setpoint.	74.0	F
Override Time	The length of time the controller will remain in override mode.	60	Min.
Low Limit Enable	Enable/Disable for a low limit shutdown.	0	Disable
Low Limit Setpoint	The low limit setpoint for shutdown.	38.0	F
Low Limit Deadband	The additional low limit shutdown and reset deadband.	0.0	F
Low Limit Delay	The minimum amount of time before a reset can occur.	0	Min.
Local Emergency	Enable/Disable for a local emergency shutdown.	1	Enable
Setpoint Occupied Cooling	Cooling setpoint in the occupied mode.	74.0	F
Setpoint Occupied Heating	Heating setpoint in the occupied mode.	72.0	F
Setpoint Economy Cooling	Cooling setpoint in the economy mode.	78.0	F
Setpoint Economy Heating	Heating setpoint in the economy mode.	68.0	F
Setpoint Unoccupied Cooling	Cooling setpoint in the unoccupied mode.	95.0	F
Setpoint Unoccupied Heating	Heating setpoint in the unoccupied mode.	55.0	F
Mixed Air PID Proportional	Proportional gain for the mixed air PID loop.	18.0	F
Mixed Air PID Integral	Integral gain for the mixed air PID loop.	0	Sec.
Mixed Air PID Derivative	Derivative gain for the mixed air PID loop.	0	Sec.
Mixed Air PID Scan Time	Scan time for the mixed air PID loop.	0	Sec.
Mixed Air Setpoint	Setpoint for the mixed air temperature.	55.0	F
Cooling PID Proportional	Proportional gain for the cooling PID loop.	4.0	F
Cooling PID Integral	Integral gain for the cooling PID loop.	300	Sec.
Cooling PID Derivative	Derivative gain for the cooling PID loop.	0	Sec.
Cooling PID Scan Time	Scan time for the cooling PID loop.	30	Sec.
Heating PID Proportional	Proportional gain for the heating PID loop.	4.0	F
Heating PID Integral	Integral gain for the heating PID loop.	300	Sec.
Heating PID Derivative	Derivative gain for the heating PID loop.	0	Sec.
Heating PID Scan Time	Scan time for the heating PID loop.	30	Sec.
Econ. LON Economizer	Sets Local or LON control of the economizers.	0	LON
Econ. Enable	Enable/Disable of economizer dampers.	0	Disable*
Econ. OAT Setpoint	Low outside air temperature for damper deactivation.	55.0	F
Econ. Dead	Deadband for economizer use.	0.0	F
Econ. Min. Outside Air Position	Minimum damper position.	0	%
Econ. 2 Position	Type of damper used.	0	Floating
Fan Mode	Sets the fan for continuous or automatic running.	1	Continuous*
Fan Minimum Run Time	Minimum amount of time the fan must run after the compressor turns off.	90	Sec.

Intellution FIX32 Programming

While all poll table, database and picture programming has already been completed, the following information is provided in the event it must be reconstructed due to a system failure.

Device Programming

The poll table should be programmed with 13 devices using the naming convention HP-* where "*" is replaced by the node number. All subnet addresses are 1, and the node address matches the programmed node address. Note that prior to installation and arrival of all 13 heat pumps, the device drivers for heat pumps 2-10, and 13 have been programmed to look at node address 12. Change the node addresses when the units are installed, then save and reload the table.

Poll Table Records

Each device should contain the poll records found on Table 3. Use this table to reprogram the poll records for each device. The NV (Network Variable) function, direction, address location, and length can all be found using NodeUtility. The function corresponding to the NV number can be found using the "List Network Variables" command. The direction and addresses are found in the "Network Variable Configuration Table," which should have been printed out. Note the direction used in the poll records is opposite those in the "Network Variable Configuration Table." The reasoning is an output from the controller is received as an input to the network card. Likewise an input to the controller would be an output from the network card. The directions used in the poll records are from the network card's point of view, not the controller's. The memory address or NV Selector is listed in hexadecimal form. This must be converted to decimal form to be used in the poll record. Make sure each of the heat pump units for the NV's listed in Table 3 use the same memory addresses. If not make the necessary corrections in the poll records for that heat pump. This is why the "Network Variable Configuration Table" is printed for each heat pump unit. Finally the length can be found from using the "Poll Network Variable" command.

Database Blocks

<u>Analog Input Blocks</u>

Table 4 contains the programming specifications for the analog input blocks in the database. Duplicate these blocks for each heat pump controller replacing "*" with the node number for that unit.

Analog Register Blocks

Table 5 contains the programming specifications for the analog register blocks in the database. Duplicate these blocks for each heat pump controller replacing "*" with the node number for that unit.

Digital Input Blocks

Table 6 contains the programming specifications for the digital input blocks in the database. Duplicate these blocks for each heat pump controller replacing "*" with the node number for that unit.

Digital Register Blocks

Table 7 contains the programming specifications for the digital register blocks in the database. Duplicate these blocks for each heat pump controller replacing "*" with the node number for that unit.

Multiple Digital Input Blocks

In some situations a setpoint is still digital, however, it has more than just an "OFF" and "ON" state. The Multiple Digital Input blocks allow up to eight different states by using three different bits to form a number indicating the current state of a setpoint. These blocks only allow the input of data. Sending data of this format is explained in "Picture Programming." These blocks are used for readouts of the current "Application", "Occupancy", and "Emergency" modes of the controller. The block uses three devices, which each look at a specific bit. Device 0 looks at the least significant bit and Device 2 looks at the most significant bit. The "Options" box sets the starting reference bit. After the colon in the address the bit offset is programmed. In each case the starting bit is 0 or the first bit. Device 0 has a 0 bit offset so bit 0 is used. Device 1 has a 1 bit offset so bit 1 is used. Device 2 has a 2 bit offset so bit 2 is used. The device states are entered in accordance to the decimal equivalent of the binary number read. More information about the modes and their associated decimal numbers can be found in the heat pump controller manual. Table 8 contains the programming specifications for these blocks. Duplicate these blocks for each heat pump controller replacing "*" with the node number for that unit.

Picture Programming

When a function has more than two states, or involves more than one byte, programming scripts must be used to correctly activate or deactivate a function. Table 9 lists the

lines of script necessary to activate each of the functions listed. The ".F_0" extension indicates a real number value being sent to bit 0 of that memory address. The "Application" and "Occupancy" commands have more than two states, therefore the script files write the numbers 0-7 in binary for the "Application Mode", and 0-2 in binary for the "Occupancy Mode". The "Local Emergency" commands use two bits to activate the command. Through experimentation the proper bits necessary to change the state were found. Only the items marked with an "^" are used on the graphical interface. The others are listed in the event they wish to be added at a later time (see "Additional Programming Suggestions").

Table 3: Fix32 Driver Poll Table Programming

NV	Name	NV Name	Direction	NV Selector		Length	Poll Time	Access Time	Exception Type
				HEX	*DEC*	*(Bytes)*	*(Sec.)*	*(Sec.)*	
17	Space Temperature	SPACE-TEMP	IN	3FEE	16366	2	5.0	300.0	DISABLED
20	Manual Occupancy Mode	MAN-OCC-CMD	OUT	3FEB	16363	1	5.0	300.0	DISABLED
21	Manual Occupancy Mode	MAN-OCC-STAT	IN	3FEA	16362	2	5.0	300.0	DISABLED
22	User Setpoint	USER-SP-CMD	OUT	3FE9	16361	2	5.0	300.0	DISABLED
26	Application Mode	APPLIC-CMD	OUT	3FE5	16357	1	5.0	300.0	DISABLED
32	Active Setpoint	ACTIVE-SP	IN	3FDF	16351	2	5.0	300.0	DISABLED
34	Emergency Command	EMER-STAT	IN	3FDD	16349	1	5.0	300.0	DISABLED
36	Thermal Load	THERM-LD	IN	3FDB	16347	2	5.0	300.0	DISABLED
52	Digital Output 1 (Fan)	DO1	IN	3FCB	16331	2	5.0	300.0	DISABLED
54	Digital Output 2 (Rev. Valve)	DO2	IN	3FC9	16329	2	5.0	300.0	DISABLED
56	Digital Output 3 (Compressor)	DO3	IN	3FC7	16327	2	5.0	300.0	DISABLED

Table 4: Analog Input Database Block Programming

Tag Name		SPACETEMP-HP*
Description		Heat Pump * Space Temperature
Start Block On Scan		YES
Scan Time		5
Smoothing		0
Hardware Specifications	*Device*	LNI
	Hardware Options	ULI:0
	I/O Address	HP-*:SPACE-TEMP
	Signal Conditioning	LIN
Engineering Units	*Low Limit*	32.00
	High Limit	1211.74
	Units	F
Initial Mode		AUTOMATIC
Alarms	*Enable Alarming*	NO
	Alarm Areas	D
	Low Low	65.00
	Low	66.00
	High	74.00
	High High	75.00
	Rate Of Change	0.00
	Deadband	0.20
	Priority	LOW
Security Areas	*1*	D0 HVAC
	2	NONE
	3	NONE

Replace "" with the node number of the heat pump controller.*

Table 6: Digital Input Database Block Programming

Tag Name		COMP-STG1-STAT-HP*	FAN-STAT-HP*	REV-VL-STAT-HP*
Description		Heat Pump * Compressor Stage 1 Status	Heat Pump * Fan Status	Heat Pump * Reversing Valve Status
Hardware Specifications	*Device*	LNI	LNI	LNI
	Hardware Options	BIT:1	BIT:1	BIT:1
	I/O Address	HP-*:DO3:0	HP-*:DO1:0	HP-*:DO2:0
Initial Mode		AUTOMATIC	AUTOMATIC	AUTOMATIC
Start Block On Scan		YES	YES	YES
Scan Time		5	5	5
Invert Output		NO	NO	NO
Labels	*Open*	OFF	OFF	OFF
	Close	ON	ON	ON
Alarms	*Enable Alarming*	NO	NO	NO
	Event Msg	NO	NO	NO
	Alarm Areas	D	D	D
	Priority	LOW	LOW	LOW
	Type	NONE	NONE	NONE
Security Areas	*1*	D0 HVAC	D0 HVAC	D0 HVAC
	2	NONE	NONE	NONE
	3	NONE	NONE	NONE

Replace "*" with the node number of the heat pump controller.

Table 7: Digital Register Database Block Programming

Tag Name		APPLIC-CMD-HP*	MANOCC-CMD-HP*
Description		Heat Pump * Application Command	Heat Pump * Manual Occupancy Command
Hardware Specifications	*Device*	LNI	LNI
	Hardware Options	BIT:0	BIT:0
	Address Type	DECIMAL	DECIMAL
	I/O Address	HP-*:APPLIC-CMD:0	HP-*:MAN-OCC-CMD:0
Output	*Output Enable*	YES	YES
	Event Msg.	NO	NO
	Invert Output	NO	NO
Labels	*Open*	NORM	OCCUP'D
	Close	ERROR	UNOCCUP
Security Areas	*1*	D0 HVAC	D0 HVAC
	2	NONE	NONE
	3	NONE	NONE

Replace "" with the node number of the heat pump controller.*

Table 8: Multiple Digital Input Database Block Programming

Tag Name		APPL-MODE-HP*	EMER-STAT-HP*	OCCUP-MODE-HP*
Description		Heat Pump * Application Mode Status	Heat Pump * Emergency Status	Heat Pump * Occupancy Mode Status
Hardware Specifications	*Device0*	LNI	LNI	LNI
	Options0	BIT:0	BIT:0	BIT:0
	Address0	HP-*:APPLIC-CMD:0	HP-*:EMER-STAT:0	HP-*:MAN-OCC-STAT:0
	Enable Device 1	YES	YES	YES
	Device1	LNI	LNI	LNI
	Options1	BIT:0	BIT:0	BIT:0
	Address1	HP-*:APPLIC-CMD:1	HP-*:EMER-STAT:1	HP-*:MAN-OCC-STAT:1
	Enable Device 2	YES	YES	YES
	Device2	LNI	LNI	LNI
	Options2	BIT:0	BIT:0	BIT:0
	Address2	HP-*:APPLIC-CMD:2	HP-*:EMER-STAT:2	HP-*:MAN-OCC-STAT:2
Scan Time		1	1	1
Start On Scan		YES	YES	YES
Re-alarm		NO	NO	NO
Device States	*0 State Name*	AUTO	NORMAL	OCCUPIED
	0 Alarm	NO	NO	NO
	1 State Name	HEAT	PRESSURE	UNOCCUP'D
	1 Alarm	NO	NO	NO
	2 State Name	WARMUP	DEPRESS	ECONOMY
	2 Alarm	NO	NO	NO
	3 State Name	COOL	PURGE	INVALID
	3 Alarm	NO	NO	NO
	4 State Name	NITEPURGE	SHUTDOWN	INVALID
	4 Alarm	NO	NO	NO
	5 State Name	OFF	INVALID	INVALID
	5 Alarm	NO	NO	NO
	6 State Name	TEST	INVALID	INVALID
	6 Alarm	NO	NO	NO
	7 State Name	FAN ONLY	INVALID	INVALID
	7 Alarm	NO	NO	NO
Alarms	*Enable Alarm*	NO	NO	NO
	Alarm Areas	NONE	NONE	NONE
Alarm Priority		LOW	LOW	LOW
Security Areas	*1*	D0 HVAC	D0 HVAC	D0 HVAC
	2	NONE	NONE	NONE
	3	NONE	NONE	NONE

Replace "" with the node number of the heat pump controller.*

Table 9a: Picture Programming Script Files

Mode	Command	Script		
		Line 1	*Line 2*	*Line 3*
Application Mode	AUTO^	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_0 0	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_1 0	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_2 0
Application Mode	HEAT	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_0 1	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_1 0	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_2 0
Application Mode	WARMUP	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_0 0	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_1 1	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_2 0
Application Mode	COOL	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_0 1	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_1 1	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_2 0
Application Mode	NIGHT PURGE	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_0 0	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_1 0	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_2 1
Application Mode	OFF^	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_0 1	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_1 0	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_2 1
Application Mode	TEST	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_0 0	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_1 1	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_2 1
Application Mode	FAN ONLY	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_0 1	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_1 1	SETVAL D0_RUSS1:APPLIC-CMD-HP*.F_2 1
Occupancy Mode	OCCUPIED^	SETVAL D0_RUSS1:MANOCC-CMD-HP*.F_0 0	SETVAL D0_RUSS1:MANOCC-CMD-HP*.F_1 0	SETVAL D0_RUSS1:MANOCC-CMD-HP*.F_2 0
Occupancy Mode	UNOCCUPIED	SETVAL D0_RUSS1:MANOCC-CMD-HP*.F_0 1	SETVAL D0_RUSS1:MANOCC-CMD-HP*.F_1 0	SETVAL D0_RUSS1:MANOCC-CMD-HP*.F_2 0
Occupancy Mode	ECONOMY	SETVAL D0_RUSS1:MANOCC-CMD-HP*.F_0 0	SETVAL D0_RUSS1:MANOCC-CMD-HP*.F_1 1	SETVAL D0_RUSS1:MANOCC-CMD-HP*.F_2 0

Table 9b: Picture Programming Script Files

Mode	Command	Script
Local Alarm Mode	ACT LOC EMERGENCY	SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_0 1
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_1 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_2 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_3 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_4 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_5 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_6 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_7 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_8 1
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_9 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_10 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_11 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_12 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_13 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_14 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_15 0
Local Alarm Mode	DEACT LOC EMERGENCY	SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_0 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_1 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_2 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_3 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_4 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_5 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_6 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_7 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_8 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_9 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_10 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_11 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_12 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_13 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_14 0
		SETVAL D0_RUSS1:LOC-EM-CMD-HP*.F_15 0

Items marked with a "^" are currently used on the graphical interface.
Replace "" with the node number of the heat pump controller.*

Heat Pump Operation Notes

Upon power-up the heat pump controller will start in "Automatic" and "Occupied" modes. The "Application Mode" controls how the controller operates. The "Occupancy Mode" is used to determine heating and cooling setpoints. These are the desired default states for the heat pump. This will allow normal heating and cooling by the controller and use the "Occupied Mode" heating and cooling setpoints. These setpoints are based off of the programmed setpoints found on Table 2. However, the actual cooling setpoint will match the "User Setpoint", and the heating setpoint will be a two-degree offset from this. The offset is formed from the difference in the cooling and heating setpoints programmed for the "Occupied Mode". The programmed values are to determine the heating offset not the actual heating and cooling setpoints. The same is true for the "Economy Mode." In this case the offset is larger with a ten-degree deadband. The "Unoccupied Mode" setpoints are the actual heating and cooling setpoints used in this mode regardless of the "User Setpoint".

Overriding normal operation in one of these modes would be a "Local" or "LON" emergency command. The "Local Emergency" is directly wired to the controller such as a fire alarm and will cause a shutdown of the controller. The "LON Emergency" is a network command sent to send the controller into a 100% cooling mode. Overriding the emergency states is the "Override" command. This command makes the heat pump controller perform like it does in the "Occupied Mode". The "Override" command will remain active for sixty minutes from activation unless deactivated before then.

The "Thermal Load" is an indicator of the amount of heating or cooling being performed by the heat pump. The "Thermal Load" is –100 to 0% when heating is required. In this situation the room temperature has fallen below the heating setpoint. When the "Thermal Load" is from 0% -100% cooling occurs. Now the room temperature is above the cooling setpoint. If the "Thermal Load" is 0% neither heating nor cooling is done. The room temperature lies between the heating and cooling setpoints.

The "Active Setpoint" is another indicator of the heat pump operation. When heating is being performed the "Active Setpoint" will read the heating setpoint. When cooling it will read the cooling setpoint. When the "Thermal Load" is 0% the "Active Setpoint" will match the current room temperature. This is the setpoint that the controller is using to determine the "Thermal Load".

Graphical Interface Instructions

The current user interface for each heat pump has the following features (Figure 1). The "User Setpoint" for each heat pump unit can be entered through the interface. Valid numbers are from 65 to 83 degrees Fahrenheit. The unit can be placed into "Occupied Mode" (default state). The "Application Mode" can also be changed from "Automatic" to "Off." "Automatic" mode provides normal operation. "Off" mode sets the thermal load to 0% so the compressor turns off. The fan will continue to operate since it is continuous and the reversing valve will remain in its current state. Readouts from the controller include fan, reversing valve, compressor, and heating and cooling statuses. The "Thermal Load" and "Active Setpoint" are displayed. Also "Occupancy", "Application", and "Emergency" mode states are shown. Each interface will only operate the individual heat pump. Upon start up some of the mode readouts may appear anomalous since the memory address upon start up will read "FF" in hexadecimal, Fix32 does not always display this value correctly. Use the "Occupied", and "Automatic" buttons to send "00" to the address locations and correct the display. Note that the controller will still be in "Automatic" and "Occupied" modes upon start up with "FF" in the memory address, since that is how the controller interprets the data.

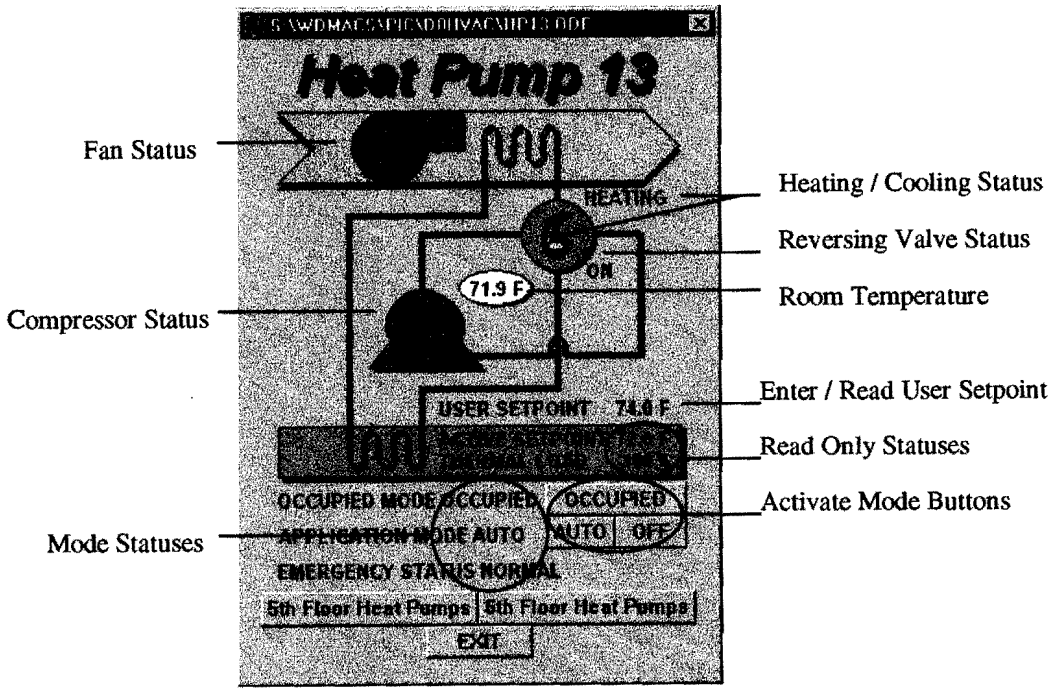

Figure 1: Heat Pump Interface

Additional Programming Suggestions

At some point in the future additional control over certain heat pump controller operations may be desired. Tables 10-11 contain information for additional poll records, database blocks, and script programming for other functions, which might be used within our system. Note that the address locations for some of these variables will be different for each heat pump. Also not everything presented will function with a 100% guarantee. Functions, which still require more work, are the "Override" command, and "Economy Mode." The proper signal conditioning for the "Override" command has not been found yet. The only information to date is that for variables with 2 bytes of memory, such as the "Override" command, a "C8 01" in hexadecimal must be written to the memory address to activate the function and "00 00" in hexadecimal to deactivate the function. The "Poll Network Variable" and "Update Input Network Variable" commands in NodeUtility can be used to see the current contents of the NV memory addresses as well as write to them. The results can be viewed using the Intelligent Stat. This can be used to find the proper signaling. Then Fix32 must be setup to produce the same effect, most likely using a script program. The script file for Economy Mode in Table 9 changes the "Occupancy Mode" on the Intelligent Stat to "2", which according to the manual, is "Economy Mode". However, the display will read "Override", but the "Override" state in the setpoints will still be off. It still must be determined if the controller is in an override state or economy state when using this command. Also note that the "Local Emergency" command can be sent via the network however without a direct wired connection commanding a "Local Emergency" the controller will override the network signal after approximately ten seconds restoring normal operation.

Table 10: Fix32 Driver Poll Table Programming For Extra Heat Pump Controls

NV	Name	NV Name	Direction	NV Selector		Length	Poll Time	Access Time	Exception Type
				HEX	*DEC*	*(Bytes)*	*(Sec.)*	*(Sec.)*	
24	Manual Override Command	OVER-CMD	OUT	3FE7	16359	2	5.0	300.0	DISABLED
25	Manual Override Status	OVER-STAT	IN	3FE6	16358	2	5.0	300.0	DISABLED
30	Local Emergency Command	LOC-EM-CMD	OUT	Varies	Varies	2	5.0	300.0	DISABLED
31	LON Emergency Command	LON-EM-CMD	OUT	3FE0	16352	1	5.0	300.0	DISABLED
38	Manual Override Command	MAN-OVER-CMD	OUT	3FD9	16345	5	5.0	300.0	DISABLED
42	Fan Command	FAN-CMD	IN	Varies	Varies	2	5.0	300.0	DISABLED
43	Reversing Valve Command	REV-VL-CMD	IN	Varies	Varies	2	5.0	300.0	DISABLED
44	Compressor Stage Command	COMP-STG-CMD	IN	3FD3	16339	2	5.0	300.0	DISABLED
45	Compressor Stage 1 Command	COMP1-CMD	IN	Varies	Varies	2	5.0	300.0	DISABLED

Table 11a: Digital Register Database Block Programming For Extra Heat Pump Controls

Tag Name		COMP-STG-CMD-HP*	COMP1-STG-CMD-HP*	EM-STAT-HP*
Description		Heat Pump * Compressor Stage Command	Heat Pump * Compressor Stage 1 Command	Heat Pump * Emergency Status
Hardware Specifications	*Device*	LNI	LNI	LNI
	Hardware Options	BIT:1	BIT:1	BIT:0
	Address Type	DECIMAL	DECIMAL	DECIMAL
	I/O Address	HP-*:COMP-STG-CMD:0	HP-*:COMP1-CMD:0	HP-*:EMER-STAT:0
Output	*Output Enable*	NO	NO	NO
	Event Msg.	NO	NO	NO
	Invert Output	NO	NO	NO
Labels	*Open*	OFF	OFF	NORM
	Close	ON	ON	EMERG
Security Areas	*1*	D0 HVAC	D0 HVAC	D0 HVAC
	2	NONE	NONE	NONE
	3	NONE	NONE	NONE

Table 11b: Digital Register Database Block Programming For Extra Heat Pump Controls

Tag Name		FAN-CMD-HP*	LOC-EM-CMD-HP*	LON-EM-CMD-HP*
Description		Heat Pump * Fan Command	Heat Pump * Local Emergency Command	Heat Pump * LON Emergency Command
Hardware Specifications	*Device*	LNI	LNI	LNI
	Hardware Options	BIT:1	BIT:0	BIT:0
	Address Type	DECIMAL	DECIMAL	DECIMAL
	I/O Address	HP-*:FAN-CMD:0	HP-*:LOC-EM-CMD:0	HP-*:LON-EM-CMD:0
Output	*Output Enable*	NO	YES	YES
	Event Msg.	NO	NO	NO
	Invert Output	NO	NO	NO
Labels	*Open*	OFF	DEACT	DEACT
	Close	ON	ACT	ACT
Security Areas	*1*	D0 HVAC	D0 HVAC	D0 HVAC
	2	NONE	NONE	NONE
	3	NONE	NONE	NONE

Table 11c: Digital Register Database Block Programming For Extra Heat Pump Controls

Tag Name		MANOCC-STAT-HP*	MANOVER-CMD-HP*	MANOVER-STAT-HP*
Description		Heat Pump * Manual Occupancy Status	Heat Pump * Manual Override Command	Heat Pump * Manual Override Status
Hardware Specifications	*Device*	LNI	LNI	LNI
	Hardware Options	BIT:0	BIT:0	BIT:1
	Address Type	DECIMAL	DECIMAL	DECIMAL
	I/O Address	HP-*:MAN-OCC-STAT:0	HP-*:OVER-CMD:0	HP-*:OVER-STAT:0
Output	*Output Enable*	NO	YES	NO
	Event Msg.	NO	NO	NO
	Invert Output	NO	NO	NO
Labels	*Open*	OCCUP'D	DEACT	NORM
	Close	UNOCCUP	ACT	OVER
Security Areas	*1*	D0 HVAC	D0 HVAC	D0 HVAC
	2	NONE	NONE	NONE
	3	NONE	NONE	NONE

Replace "" with the node number of the heat pump controller.*

Table 11d: Digital Register Database Block Programming For Extra Heat Pump Controls

Tag Name		REV-VL-CMD-HP*
Description		Heat Pump * Reversing Valve Command
Hardware Specifications	*Device*	LNI
	Hardware Options	BIT:1
	Address Type	DECIMAL
	I/O Address	HP-*:REV-VL-CMD:0
Output	*Output Enable*	NO
	Event Msg.	NO
	Invert Output	NO
Labels	*Open*	OFF
	Close	ON
Security Areas	*1*	D0 HVAC
	2	NONE
	3	NONE

Replace "" with the node number of the heat pump controller.*