

DX-9100 Applications from Engineering Services

Introduction	Page	3
• <i>Overview</i>		3
Air Handling Unit Applications		5
• <i>100%.dxs</i>		5
• <i>100PHT.dxs</i>		5
• <i>AHU-ROOM.dxs</i>		6
• <i>CNST-SAT.dxs</i>		6
• <i>HUMIDITY.dxs</i>		7
• <i>MASP-SEQ.dxs</i>		7
• <i>MIX-1-1.dxs</i>		7
• <i>MIX-1-2.dxs</i>		8
• <i>MIX-2-1.dxs</i>		8
• <i>MIX-2-2.dxs</i>		8
• <i>MIX-3-0.dxs</i>		8
• <i>MIX-3-1.dxs</i>		9
• <i>MIX-3-2.dxs</i>		9
• <i>MIX-3-3.dxs</i>		9
• <i>MIX-3-4.dxs</i>		9
• <i>MIX-4-0.dxs</i>		10
• <i>MIX-4-1.dxs</i>		10
• <i>STATIC.dxs</i>		10

Central Plant Applications	Page	11
• <i>3CHILSEQ.dxs</i>		11
• <i>BLR-1-1.dxs</i>		11
• <i>BOILER.dxs</i>		12
• <i>PUMP.dxs</i>		12
• <i>TOWER.dxs</i>		12
Special Applications		13
• <i>FAN-SEQ.dxs</i>		13
• <i>ILC.dxs</i>		13
• <i>NOPMPROP.dxs</i>		13
• <i>OA-RESET.dxs</i>		14
• <i>PWRFAIL.dxs</i>		14
• <i>STASTOXP.dxs</i>		14
• <i>VERNIER.dxs</i>		14

Introduction

Overview

This document describes application files that you can use as a starting point for DX-9100 Extended Digital Controller applications. All the files are located under the DX-9100 Conference in two places: the Johnson Controls Bulletin Board System (Engineering Services BBS) and the Johnson Controls Advisor. Using your computer and a modem, you can connect to the BBS or Advisor, join the DX-9100 Conference, select Applications, and download these files to your computer.

The DX-9100 application files are self-extracting files with an .EXE extension. Typing the full name of the file (including the .EXE extension) at the DOS prompt and pressing Enter will extract the files. For example, if the downloaded file is called 100%.EXE, you would type the following at the DOS prompt on your computer:

100%.EXE <Press Enter>

When the file is extracted, three files are created: a .DXS, .DOC, and .TXT. The file with the .DXS extension is a GX-9100 program file that the GX-9100 software tool can use. The file with the .DOC extension is a Microsoft® Word 6.0 file that explains the application. The .TXT file is the same file as the .DOC file, but in text format that can be read by any text editor. *These and all files taken off the BBS or Advisor are company confidential.*

Note: The entire set of DX-9100 applications explained in this document are also available in one self-extracting file called **HVACAPPS.EXE**, also on the BBS or Advisor under the DX-9100 Conference.

This document lists the files available at the time of printing. The content and number of files may change without notice.

The DX-9100 Controller is very similar to the Lab and Central Plant (LCP) Controller when it comes to the hardware functionality and some of the software configurations. For some applications, you can use the LCP examples given in the *LCP Examples Technical Bulletin (LIT-6362069f)* of this manual. Then, modify them to apply them to a DX-9100, such as:

- Analog Input Calibration
- Analog Output Calibration
- Square Root Calculations
- Metastat™ Input (remote setpoint)

Please refer to the *LCP Examples Technical Bulletin (LIT-6362069f)* for more information.

The DX-9100 applications described in this document are grouped into three categories:

- Air Handling Unit Applications
- Central Plant Applications
- Special Applications

Note: Most of the applications described here have only been tested on a DX demonstration panel. Please verify proper operation before loading programs into an operating system. Also, these programs are examples only, and should be modified to fit your particular applications.

Air Handling Unit Applications

The following are the names and brief highlights of the DX-9100 Air Handling Unit applications available on the BBS.

100%.dxs

100% Outdoor Air System with Preheat and Cooling Control

- Occupied mode will be commanded from a Facility Management System (FMS). When occupied is On, the fan will be commanded to start and the discharge and outdoor air dampers will be ramped from 0 to 100% open.
- On a call for heating, the controller will modulate the hot water valve open.
- On a call for cooling, the controller will first modulate the hot water valve closed, then modulate the chilled water valve open.
- Whenever the outdoor air temperature is less than 40°F, the controller will start the hot water recirculation pump.
- The controller will monitor a differential pressure switch for dirty filter status, low limit thermostat status, and supply duct smoke detector status.

100PHT.dxs

100% Outdoor Air with Preheat/Bypass

- 100% outdoor air
- Face/bypass damper/valve
- Constant discharge air
- Variable speed drive for static control
- Dehumidification
- Humidification with high discharge air humidity override of humidity valve

AHU-ROOM.dxs**Mixed Air Unit with Room Reset**

- Mixed air unit/room reset of discharge air heating and cooling setpoints/sequence of heating valve and outdoor air damper
- On a signal for air handling unit to start, the return and outdoor air dampers shall open to 50 percent (minimum outdoor air position).
- Room temperature shall reset the discharge air temperature setpoint to maintain the desired room conditions. Room setpoints shall be 68.0°F for heating and 80.0°F for cooling.
- On a call for heating, the controller shall modulate the preheat valve open to maintain discharge air temperature setpoint.
- On a call for cooling, the controller shall modulate the outdoor air damper open above minimum position to maintain discharge air temperature setpoint.
- The controller shall sequence the hot water preheat valve and the outdoor air dampers to eliminate simultaneous heating and cooling.
- Any time the outdoor air temperature is below 40.0°F, the hot water recirculating pump shall start.

CNST-SAT.dxs**Constant Discharge Air Control**

- The heating valve, dampers, and cooling valve are sequenced such that no two are on at the same time.
- The damper has two features: mixed air low limit and ramp on startup.
- The air handler will be controlled to maintain a constant discharge air temperature.
- The mixed air chamber will be controlled such that dampers may be overridden from minimum position to prevent a freeze condition.
- At startup, the dampers will be ramped to their commanded position.
- The air handler will operate based on a weekly schedule.
- During the unoccupied mode, the air handler will be started with the dampers closed if the zone temperature drops below the night setback temperature.
- During the unoccupied mode, the air handler will be started and the dampers allowed to modulate if the zone temperature rises above the night setup temperature.
- In the unoccupied mode, the heating valve will be at 100% open unless locked out by the outdoor air temperature; the cooling valve will be closed.

HUMIDITY.dxs**Humidity Control with Discharge High Limit**

- The discharge air humidity setpoint will be reset by return air humidity to maintain return humidity setpoint. This is applicable to any modulating device, such as steam valve or electric humidifier.
- The operation should be enabled when fan status is on, occupied mode is on, and winter mode is on.
- Occupied mode should be based on a time schedule.
- Winter mode will be set when outdoor air temperature is below 40.0°F.
- The discharge air humidity shall be maintained at setpoint by modulating the humidifier on a PI control type. The discharge air humidity setpoint will be reset between 10 and 85% RH based on return air humidity. The return air humidity setpoint will be at 30% RH (adjustable).

MASP-SEQ.dxs**Mixed Air Single Path (MASP)**

- This system is a mixed air single path, with constant discharge air temperature control.
- The discharge air temperature is controlled by modulating in sequence the heating valve, outdoor air damper, and the cooling valve.
- The fan control is constant discharge pressure.
- A mixed air sensor will override the signal to the outdoor air dampers to prevent the mixed air temperature dropping below 45°F.

MIX-1-1.dxs**MASP, Heating, Cooling, Static Pressure, and Humidification (Mixed Air Control)**

- Mixed air control at discharge air setpoint; economizer control with Outdoor Air (OA) dry bulb
- Heating coil proportional control at discharge air setpoint; heating lockout with common OA heating/cooling setpoint
- Cooling coil proportional control at discharge air setpoint; cooling lockout with common OA heating/cooling setpoint
- Static pressure control at discharge static pressure setpoint
- Humidification proportional control at the return air humidification setpoint

MIX-1-2.dxs**MASP, Heating, Cooling, Static Pressure, Humidification, and Dehumidification (Mixed Air Control)**

- Mixed air control at discharge air setpoint; economizer control with OA dry bulb
- Heating coil proportional control at discharge air setpoint; heating lockout with common OA heating/cooling setpoint
- Cooling coil proportional control at discharge air setpoint; cooling lockout with common OA heating/cooling setpoint
- Static pressure control at discharge static pressure setpoint
- Humidification proportional control at the return air humidification setpoint
- Dehumidification proportional control at the return air dehumidification setpoint

MIX-2-1.dxs**MASP, Heating, Cooling, and Humidification (Room Control)**

- The heating valve, mixing dampers, and the cooling valve operate in sequence to maintain the room temperature at the room temperature setpoint.
- Humidification proportional control at the return air humidification setpoint

MIX-2-2.dxs**MASP, Heating, Cooling, Humidification, and Dehumidification (Room Control)**

- The heating valve, mixing dampers, and the cooling valve operate in sequence to maintain the room temperature at the room temperature setpoint.
- Humidification proportional control at the return air humidification setpoint
- Dehumidification proportional control at the return air dehumidification setpoint

MIX-3-0.dxs**MASP, Heating and Cooling (Discharge Air Control)**

- The heating valve, mixing dampers, and the cooling valve operate in sequence to maintain the discharge air temperature at the discharge air temperature setpoint.

MIX-3-1.dxs**MASP, Heating, Cooling, and Humidification (Discharge Air Control)**

- The heating valve, mixing dampers, and the cooling valve operate in sequence to maintain the discharge air temperature at the discharge air temperature setpoint.
- Humidification proportional control at the return air humidification setpoint

MIX-3-2.dxs**MASP, Heating, Cooling, Humidification, and Dehumidification**

- The heating valve, mixing dampers, and the cooling valve operate in sequence to maintain the discharge air temperature at the discharge air temperature setpoint
- Humidification proportional control at the return air humidification setpoint
- Dehumidification proportional control at the return air dehumidification setpoint

MIX-3-3.dxs**MASP, Heating, Cooling, Humidification, Dehumidification, and Static Pressure**

- The heating valve, mixing dampers, and the cooling valve operate in sequence to maintain the discharge air temperature at the discharge air temperature setpoint.
- Humidification proportional control at the return air humidification setpoint
- Dehumidification proportional control at the return air dehumidification setpoint
- Static pressure proportional control at the discharge air static pressure setpoint

MIX-3-4.dxs**MASP, Heating, Cooling, Humidification, Dehumidification, Static Pressure, and Volume Matching**

- The heating valve, mixing dampers, and the cooling valve operate in sequence to maintain the discharge air temperature at the discharge air temperature setpoint.
- Humidification proportional control at the return air humidification setpoint
- Dehumidification proportional control at the return air dehumidification setpoint
- Static pressure proportional control at the discharge air static pressure setpoint
- Supply fan/return fan volume matching control

MIX-4-0.dxs**MADP, Hot Deck Heating Coil and Cold Deck Cooling Coil**

- The mixing dampers and the cold deck cooling valve operate in sequence to maintain the cold deck temperature at the cold deck air temperature setpoint.
- The hot deck heating valve modulates to maintain the hot deck temperature at the calculated hot deck setpoint based on an outdoor air temperature reset schedule.

MIX-4-1.dxs**MADP, Hot Deck Heating Coil and Cold Deck Cooling Coil**

- The mixing dampers and the cold deck cooling valve operate in sequence to maintain the cold deck temperature at the cold deck air temperature setpoint.
- The hot deck heating valve modulates to maintain the hot deck temperature at the calculated hot deck setpoint based on an outdoor air temperature reset schedule.
- This application includes face/bypass outputs for valve and damper.

STATIC.dxs**Static Pressure Control**

- This program shows how to configure a Totalizer block to be used as a Ramp function on a PID loop.
- The DDC controller shall modulate the variable speed drive such that it maintains a 1 in. static pressure setpoint.
- The air handler will operate on a weekly schedule that will be defaulted to a 6:00 a.m. start time and a 6:00 p.m. stop time.
- When the air handler is commanded to start, the static pressure control will be ramped.
- If air flow is not detected, the air handler will be shut down.

Central Plant Applications

The following are the names and brief highlights of the DX-9100 Central Plant applications available on the BBS.

3CHILSEQ.dxs

Three Chiller Application

- Staging of three chillers and three pumps from the Chilled Water (CHW) return temperature
- Uses equal runtime
- Operate any chiller with any pump
- CHW bypass valve control
- Each chiller shall have its own factory mounted temperature controller set to maintain 45°F chilled water supply temperature.
- Once a chiller is disabled, its chilled water pump shall continue to run for two minutes while the chiller is in the pump down cycle.
- Each chiller shall be capable of being taken out of the rotational (equal run) sequence for maintenance, breakdown, etc.
- The controller shall modulate a Normally Closed (N.C.) CHW bypass valve to maintain a differential setpoint.

BLR-1-1.dxs

Boiler Configuration: Two Hot Water Boilers And Two Pumps

- The boilers will operate based on occupancy and the outdoor air temperature.
- Maintain hot water return temperature by cycling the boilers as required with minimum on and off times.
- The lead boiler and pump will change based on runtime.

BOILER.dxs**Boiler Control Examples**

- Controls two 2-stage boilers in sequence to maintain a hot water setpoint that is reset based on outdoor air temperature.
- Pumps with a single flow switch for proof of flow
- The lead boiler is selectable via a toggle switch mounted on the front panel.
- The boilers are enabled only when there is proof of flow.
- The pumps run continuously when the outdoor air is below 60°F.
- The pumps cycle every 24 hours; the pump with the least amount of runtime starts.
- Should the pump fail for any reason, the system starts the second pump.

PUMP.dxs**Two Pumps Lead/Lag and One Flow Switch Control**

- This program solves the problem of controlling two pumps using one flow switch.
- The DX-9100 Controller shall turn On or Off either pump based on the position of a lead switch and the detection of flow.
- The lead pump will turn On when outdoor air temperature is greater than 65°F, and Off when the temperature rises above 68°F.
- Should the flow switch detect loss of flow for 15 seconds, the lag pump will be activated and an alarm will be sounded.

TOWER.dxs**Cooling Tower Fan Control**

- This is a cooling tower program that will control four 2-speed fans based on the condenser water supply temperature.
- As the condenser water supply temperature rises above the condenser water setpoint, the proportional output command will be used to start the cooling tower fans.
- When the condenser water temperature begins to exceed the setpoint, the fans will first be started at their low speeds.
- If the Condenser Water Supply (CWS) continues to rise even with the low speeds on, the high speeds will be commanded to start. The high speed fan command will stop the low speed of the respective fan.
- If the condenser water pump is off, all of the fans will be disabled.

Special Applications

The following are the names and brief highlights of the DX-9100 Special applications available on the BBS.

FAN-SEQ.dxs

Fan Sequencer

- This application was originally built for a horse barn where the ventilation requirements increase as the outdoor air temperature rises. The requirement was for rotational cycling of one to nine fans.
- A group of nine ventilation fans will be cycled on a rotational basis every 15 minutes.
- At least one fan is to be running at all times.
- As the outdoor air temperature rises, more fans will be turned on at a time, until all fans are running continuously. The number of fans to run will be determined by an outdoor air schedule.
- Every 15 minutes, one fan (which has been on the longest) will be turned off, and the next fan in sequence will be turned on.

ILC.dxs

Lighting Control - Blink Feature

- This program shows how to configure a DX controller into an Intelligent Lighting Controller (ILC) with up to eight zones if additional XTs and XPs are added. This program will show how to do one zone with the other seven being similar.
- During occupied mode, the controller will turn on the lights and the customer will have the ability to turn off the lights from a local wall switch. At the end of occupied mode, the lights will turn off.
- During the unoccupied mode, the customer will have the ability to turn on or off the lights from a local wall switch.
- Near the end of the time period, the lights will blink once to let the customer know the time period has almost expired. To reactivate the time period, the customer will push the On switch.

NOPMPROP.dxs

Proportional Control without a PM Module

- In this application proportional only control can be performed without the use of a PM block. This cannot be used on the XP-9102 modules since they don't have the AI% connections.

OA-RESET.dxs**Outdoor Air Reset - Front Panel**

- This program shows how to have an adjustable reset schedule at the front panel for standalone applications.

PWRFAIL.dxs**Power Fail Restart Application**

- This application shows how to implement a power fail restart process when starting and stopping multiple loads from a DX-9100.
- AHU 1 through 6 shall be weekly scheduled to start and stop from the Metasys® Companion™ system or the Network Control Unit (NCU). After a power failure occurs, the AHUs shall sequentially restart with a 10 second delay between start commands.

STASTOXP.dxs**Momentary STA/STO to Lighting Relay**

- This program shows two methods to use XP digital outputs as momentary start/stop points.

VERNIER.dxs**Vernier Control With One to Eight Stages**

- This program shows how to control stages within a modulating device. A good example is electric heat stages plus a modulating Silicon Controlled Rectifier (SCR).
- The operation should be enabled when fan status is on and winter mode is on.
- Winter mode will be set when outdoor air temperature is below 50.0°F.
- The discharge air temperature shall be maintained at setpoint by modulating the SCR and the four stages on a PI control type.

Notes

Notes



Controls Group
507 E. Michigan Street
P.O. Box 423
Milwaukee, WI 53201

FAN 636.4
System 9100 Technical Manual
Printed in U.S.A.