HCR INCORPORATED
A DIVISION OF JAMISON DOOR COMPANY

INSTRUCTION BOOKLET

Model CAC AIR CURTAIN

CONTENTS

HCR® INCORPORATED
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HCR SAFETY INFORMATION

1. **NOTICE! Read and follow all safety information on this page before attempting to install, start-up, service or do other work on this HCR door.**
2. **NOTICE! All individuals working on this HCR door should become familiar with this instruction manual before doing installation, service or adjustment of the door. If you have any questions concerning these safety instructions, please contact a HCR service person at 1-800-326-7700, your supervisor or any service personnel who has received training from a HCR factory representative before attempting to work on the equipment.**
3. **NOTICE! Follow all HCR recommended Preventative Maintenance Procedures at least as often as suggested and more often if needed.**
4. **NOTICE! Follow all safety decals and warning labels located on the equipment and replace any labels or decals that are no longer legible or have been removed. HCR will be glad to supply any necessary replacement safety/warning labels or decals.**
5. **NOTICE! Keep a copy of this instruction/installation manual with the unit at all times. HCR recommends keeping a manual in the door pocket of the electrical remote/power-control box. Please contact HCR if additional manuals are needed.**
6. **NOTICE! Do not continue to operate the door if it is broken or is not operating correctly. If service personnel are unable to fix the door, contact HCR for assistance at 1-800-326-7700.**
7. **WARNING! If the unit has swinging arms, verify that they are electrically and mechanically locked before performing adjustment or service work.**
8. **WARNING! Do not operate equipment without safety shields in place. Replace any missing or defective shields before putting the equipment back in service.**
9. **WARNING! If working on equipment off the ground, follow all applicable OSHA regulations including but not limited to safety harnesses, safety cages/lifts, hard hats, etc.**
10. **WARNING! Do not operate this door except as described in the "Operation Instruction" page(s) in this manual or an unsafe/hazardous condition may occur resulting in damage to equipment or injury to personnel.**
11. **WARNING! On HCR door products that have condenser heat reclaim coils, it is important to protect the heat reclaim coil and piping from damage by forklifts or other equipment to prevent a hazardous gas spill! Protection of the door equipment and piping is the responsibility of the owner of the equipment.**
12. **WARNING! Keep electrical remote/power-control box locked and the key in a safe place where only qualified and authorized personnel have access to it.**
13. **DANGER! Any electrical service work done on energized equipment should be done by a OSHA defined qualified and authorized individual who is trained in following all applicable Lock-Out/Tag-Out safety standards as set forth in OSHA Regulations (Standards – CFR 1910.331-5). Follow all applicable local, state and national electrical codes.**
14. **DANGER! 480 Volts is present for door operation and should be shut-off at the disconnect supplying power to the equipment before any service work or adjustment is done. If the unit needs to be energized for the work or adjustment, see #12 above.**

MODEL CAC DESCRIPTION

The HCR Model CAC conditioned air curtain provides a completely unrestricted passageway for large cold rooms while reducing doorway refrigeration loss. The airstream is **horizontally** directed and **curvilinear** in shape to produce counterflow forces against infiltration and exfiltration at the doorway. The CAC is **recirculatory** to provide inherent stability and to permit treatment of entrained moist air. Having captured whatever warm, moist air occurs, heat is utilized to condition the air to a non-fogging, non-frost-producing level. The Model CAC can be used as a stand-alone unit or it can be added to other doors such as a Model ECAV (ECAV/CAC) or fast acting door (Hybrid Door) to increase the efficiency of the door under adverse conditions; i.e., high humidity, increased pass-thrus, etc.

The HCR Model **CAC with optional temperature transmitter** is commonly used where the warm side temperature varies more than 10-15 degrees to ramp up and down the velocity of the airstream as the temperature varies on the warm-side of the opening.

Model CAC conditioned air curtains have been designed for swift field erection, electrical connection and start-up.

Although all units are test-run before shipment, proper start-up procedure includes checking adjustments in accordance with instructions.

Customer supplied disconnect, branch circuit protection and field wiring for the unit is to be done by an electrician following all applicable NEC and local electrical codes.

PHYSICAL DATA DRAWING

DATE: R11/02/17

HCR INCORPORATED
HIGHWAY 87 WEST
LEWISTOWN, MT 59457
1-406-538-7781

JOB: AMAZON FRESH

DOORWAY: 7-ft by 10-ft Doorway
-10°F to 38°F Max

APPROVED BY: **DATE:**

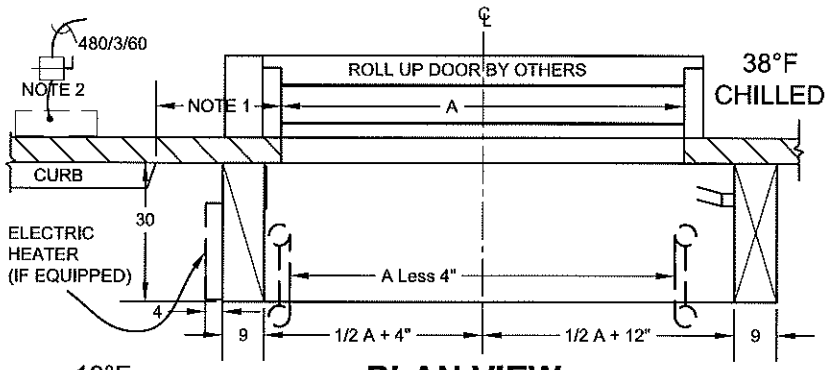
Model CAC Conditioned Air Curtain

(Type - 4)

DIMENSIONS:	A	B	C	D	E	F	G	H
[X] INCHES	84	120						
[ ] MM	I	J	K	L	M	N	O	P

[X] PRELIMINARY DRAWING
[ ] FACTORY CERTIFIED DRAWING
BY MEL

NOTES:
1. 30" MINIMUM CURB TO DOORWAY CLEARANCE REQUIRED.
2. DISCONNECT SWITCH NOT PROVIDED.
3. ALL INTERCONNECT AND POWER WIRING BY OTHERS. PLEASE CONTACT HCR FOR WIRING DETAILS.



PLAN VIEW

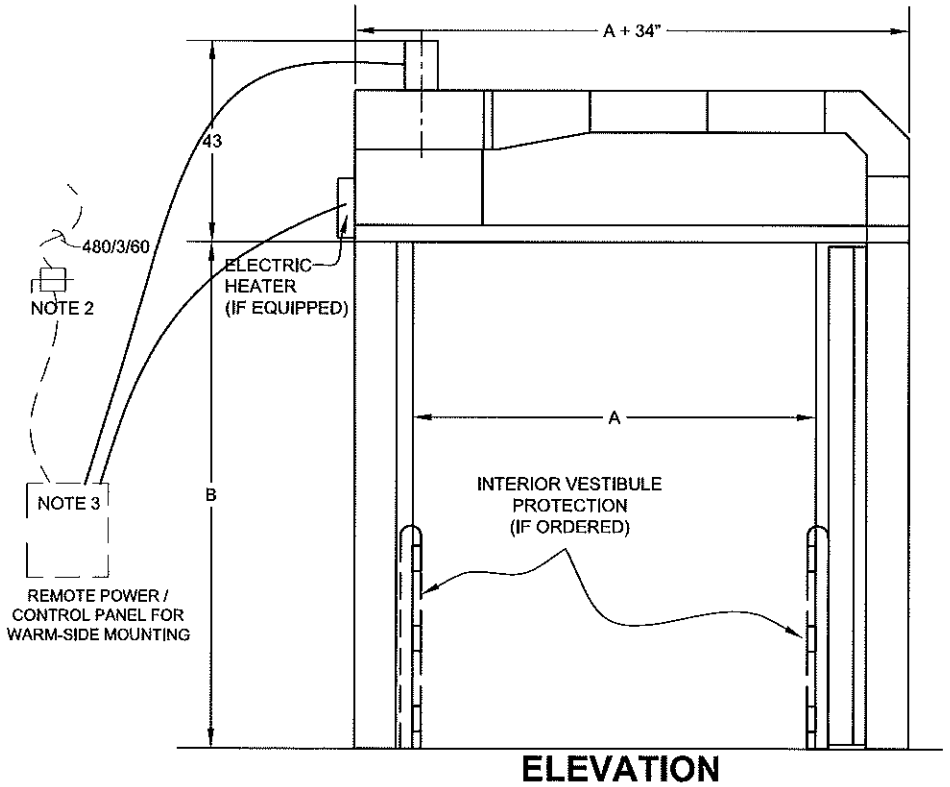
SPECIFICATIONS

[X] POWDER COAT [ ] STAINLESS STEEL
[X] EH ..... ELECTRIC HEAT 33 KW
[X] CS [ ] WS ..... INSTALLATION
UNIT CLEARANCE 80 x 120

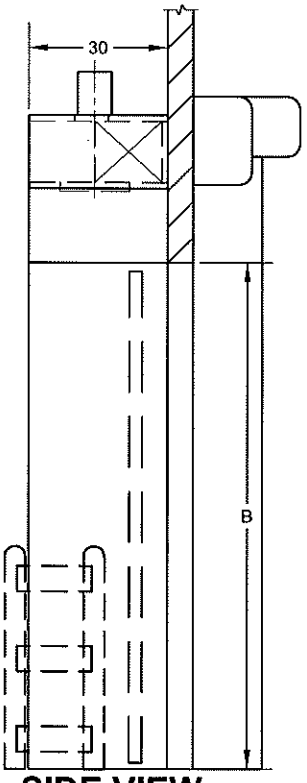
COLD SIDE	-10 °F	°C	90	%RH
WARM SIDE	38 °F	°C	90	%RH

[X] INTERNAL BOLLARDS BY HCR
[ ] INTERNAL BOLLARDS BY OTHERS

POWER	480 V	3 PH	60 HZ	
BLOWER:	3 HP		4.3	FLA
HEATER:	33 KW		39.8	FLA
CONTROL:	.2 KVA		.4	FLA
COMPLETE UNIT			44.5	FLA



ELEVATION



SIDE VIEW

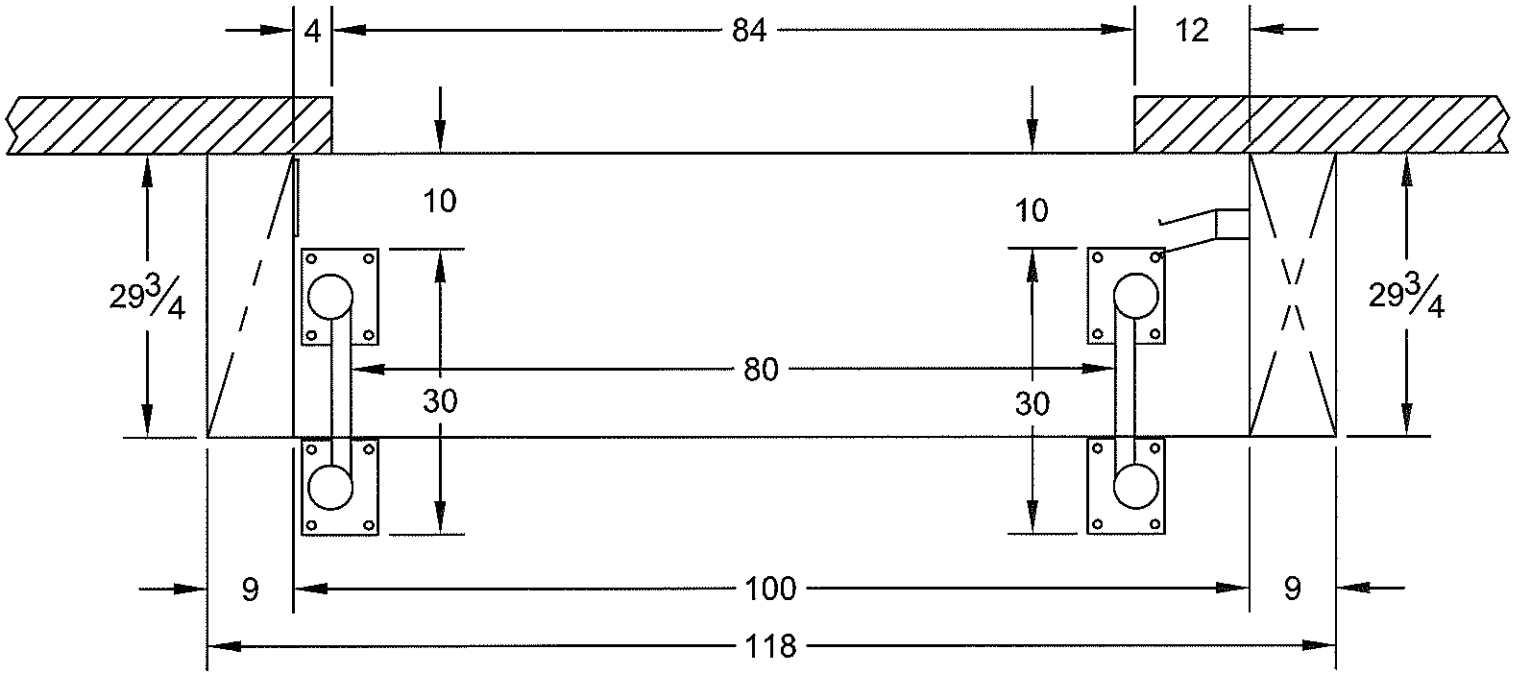
FACTORY NUMBER: CAC-T4-EH-CS-84/120-M10/P38-33-480/3/60

JOB #:

PROJECT #:

ACTIVITY #:

38° CHILLED



-10° FREEZER

AMAZON FRESH
BETHPAGE, NY.

141299101

FOOTPRINT

MODEL CAC INSTALLATION / START-UP INSTRUCTIONS

INSTALLATION INSTRUCTIONS

The Model CAC is shipped for field erection as follows: top equipment cabinet/ductwork assembly, discharge plenum, intake plenum, remote-power/control panel and miscellaneous parts package. The installation sequence is as follows:

1. Inspect the doorway for any obstructions in accordance with the factory PD (Physical Data) drawing. Make a door centerline mark on the bottom of the doorway header.

2. Install encapsulation stand-off panels if a Hybrid unit is being created as shown on PD. Mark centerline of stand-off panels if used for Hybrid.

3. After inserting the forklift forks under the top equipment assembly, raise the assembly above the door by approximately 4" while aligning the unit with the centerline of the doorway or stand-off panels using PD drawing.

4. Stand intake and discharge plenum assemblies in place **on the correct side as shown on PD and verified by looking in cabinet or at exposed ductwork (ductwork from blower should go to discharge plenum side)**.

5. Carefully lower the top equipment assembly until it is seated on the intake and discharge plenums. Secure with the screws provided. For ease of installation, plenums may be installed one at a time.

6. Make sure the unit is plumb, square and flush-to-the-wall or stand-off panels.

7. Use trim angle to secure the discharge and intake plenums to the wall or stand-off panels unless the unit comes with optional insulation and cladding. Use the flange(s) of insulation cladding to secure the unit if it comes with insulation and cladding. Use floor clips to secure the plenums to the floor.

8. After securing the top equipment assembly to the wall or stand-off panels using studs, thru-bolts, etc., lower the forklift.

9. Install the stem thermometers from the Misc. Parts Box in the face of discharge and intake plenums being careful not to over-tighten.

10. Mount remote-power/control panel, if applicable, on the **warm** side of doorway. Connect all power and interconnect wiring.

11. If a CH condenser heat unit connect refrigeration piping and controls to the coil flanges.

12. Use caulk or foam to fill any cracks between wall and equipment.

13. **Install interior and exterior doorway protection immediately.**

START-UP INSTRUCTIONS

Note: All the settings and adjustments information needed below is found on Form 48C-H37.

1. Bump ON/OFF switch or disconnect and verify correct blower rotation. Record motor amp draw on Form HCR 48C-H37a "Settings and Adjustments".

2. With unit running, lower temperature or humidity control set point(s) to verify all steps/stages of heat are functioning. Discharge and intake plenum air temperatures and amp draw of heater steps should be recorded on Form 48C page 1 of 4 during this step.

3. Check the air-curtain discharge nozzle blade spacing and the angle adjustments.

4. Balance the airflow using the enclosed air velocity meter so it has the same velocity reading at 12" up from the floor and 12" down from the ceiling by adjusting the slide damper behind the nozzle on the discharge plenum. The balanced airflow velocity should be close to the factory suggested values on 48C-H37a (with optional temperature transmitter the velocity will vary with the temperature on the warm-side of the door); if not, adjust potentiometer knob mounted on face of VFD to achieve the desired velocity. Record discharge velocities on Form 48C-H37a.

5. Check the discharge airstream using flagging tape or tissue as described in "Operating Instructions". Reset all set points and make any changes in accordance with Form 48C-H37a.

6. Consult factory @ (800) 326-7700 with the above recorded values and for help if needed.

MODEL CAC INSTALLATION / START UP CHECKOFF SHEET

JOB NAME:	SERIAL NO.:_____

INSTALLATION / START UP CHECKOFF	
Using this Instruction Manual familiarize yourself with the PD (Physical Data) drawing and the "Installation/Startup Instructions" before starting installation.	
INSTALLATION	☑
1. Centerline on door opening and overhead equipment located according to PD.	
2. Intake and discharge plenums located on correct side of opening according to PD.	
3. Top equipment cabinet fastened onto plenums with Tek screws.	
4. CAC unit is plumb, square and flush to the wall.	
5. CAC cabinet fastened to wall with thru bolts.	
6. Plenums fastened to floor with floor clips.	
7. CAC caulked and/or foamed to eliminate any cracks between wall and equipment.	
8. Wall trim angle fastened to outer plenum and overhead equipment surfaces.	
9. Stem thermometers installed in plenums (electric heat models only).	
10. Internal bollards located according to PD.	
11. Exterior goalpost bollards located according to customer or PD?	
12. Remote electrical control panel installed and wired by electrician.	
START-UP	
1. **Inside of remote electrical box must be pre-warmed to 32° F before power is applied if equipped with VFD(s).**	
2. Electrician verified correct voltage at remote electrical panel.	
3. Electrician verified correct fan motor rotation (air blowing out discharge plenum).	
4. Correct nozzle blade and angle adjustment settings per Form HCR 48C-CAC-H37.	
5. Airflow balanced top to bottom to velocity values on Form HCR 48C-CAC-H37.	
6. Air curtain discharge angle adjustment with flagging tape per "Operating Instructions".	
7. Heater steps brought on by humidistats, t'stats, etc. Temperature rise/FLAs recorded.	
8. Fan motor FLA reading on VFD is within nameplate specifications.	
9. Start-up data recorded on Form HCR 48C-CAC-H37 "Settings and Adjustments" page.	
10. Local maintenance/service personnel trained in adjustment of unit if appropriate.	
11. Perform miscellaneous touch-up of CAC and cleanup area to customer's satisfaction.	

INSTALLING CONTRACTOR AND CUSTOMER SIGN OFF			
Installer Signature(s):		Date:	
Customer Signature(s)		Date:	

MODEL 'AIR CURTAIN' HYBRID OPERATING INSTRUCTIONS

On/Off Switches or Disconnect Switch:

The HCR air curtain(s) are controlled with their own ON/OFF switch and control panel or by the power supply Disconnect Switch. The fast acting door is also controlled with its own ON/OFF switch and control panel or by a Disconnect Switch. They may be interconnected as described below.

Interconnection:

Interconnection of fast acting door panel or door switch with the HCR control panel terminals is the responsibility of the installing electrician.

The HCR air curtain(s) electrical panel is supplied with interconnect terminals that need to be interconnect wired to the fast acting door control board terminals or door switch. The door switch or terminals should be wired to be normally open with the fast acting door in the open position and closed when the fast acting door is in the closed position. When the door starts opening, the fan VFD either comes back up to full speed or comes ON to a pre-determined speed. A time delay relay may also be part of the control system to shut the air curtain OFF after a preset time delay when the fast acting door shuts and back ON when the fast acting door starts to open. **The fast acting door must be used with each pass thru for proper 'Hybrid Operation'.**

Heater Controls:

Electric heat HCR air curtain(s) are controlled by humidity or temperature control(s) located on the warm side of the doorway in the remote electrical panel. The controls make on humidity or temperature rise and bring on additional step(s) of heat but only while the hard door is open. The humidity or temperature control(s) should be set initially in accordance with "Model Settings & Adjustments," Form HCR-48 of this booklet.

Condenser heat HCR air curtain(s) are supplied with a spring return damper motor in the re-circulatory air stream that controls the condenser heat contribution to the air stream temperature. The damper motor springs open to allow full heat while the fast acting door is open and drives closed after the fast acting door shuts.

With HCR air curtain cold side mounting one step of electric heat left ON or a partial open damper to condenser coil will prevent air curtain equipment from cold soaking.

Temperature/Velocity Control (if so equipped):

Air curtain velocity varies as warm room temperature varies. Please follow instructions on Variable Frequency Drive Settings and Adjustment page for adjustment.

Evaluating Discharge Airstream:

For maximum efficiency and good air curtain performance, do not discharge air at a higher velocity than necessary to maintain an intact airstream the full width of the doorway. As discharge velocity increases, airstream turbulence and secondary induction also increase and the result is decreased efficiency. Airstream velocity is controlled either by a damper in the discharge duct or, if so equipped, by the potentiometer knob on the front of the fan VFD in the control box or the (optional) temperature transmitter.

With an (optional) temperature transmitter control the velocity of the airstream will vary dependent on the temperature of the warm-side room. Instructions to adjust the velocity of the airstream equipped with the (optional) temperature transmitter control are included on the bottom of the Instruction Booklet Variable Frequency Drive Settings & Adjustments" page.

The correct discharge airstream occurs when airflow observed at the intake assembly is as shown in figure 1 (see page 3, Form 48D that follows). Incorrect discharge airstreams are shown in figures 2 and 3 together with suggested corrective measures.

To evaluate for a proper discharge nozzle angle adjustment: fasten flagging tape (cut to the width of the door) to the inside of the discharge nozzle at 3-4 feet off the floor, one foot down from the ceiling panel and approximately every 2-3 feet in-between. If the flagging tape is sucked into the intake screen on the opposite side of the door opening, the nozzle angle is set correctly. However, if the tape is blown to one side or the other of the intake screen, adjust the angle of the nozzle to bring the tape back in line such that it is sucked into the intake screen.

An alternative method is to introduce a 3-4 foot long strip of tissue (toilet paper) into the air-stream at the discharge nozzle (2-3 feet off the floor and 1-2 feet down from the ceiling) and walk across the door to the intake plenum keeping the tissue floating in the strongest part of the airstream. If the tissue floats into the air intake and equally to each side, the nozzle angle setting is correct. If drag differs as in Figure 2 or Figure 3, one or more of the suggested corrective measures should be taken.

If either the flagging tape or tissue, while floating in the airstream, falls towards the floor, the air-stream velocity needs to be increased by opening the damper quadrant located in the discharge duct, adjusting the potentiometer dial knob on the face of the VFD or the temperature transmitter.

Note: A negative pressure condition will have a similar effect to Figures 2 and 3 and should be eliminated prior to airstream adjustment.

Troubleshooting:

Haze entering the freezer or fog entering the warm-side room may be the result of:

1. The humidity or temperature controller(s) are not properly bringing on the steps of electric heat or controlling the damper motor. Compare control settings to factory suggested settings contained in this manual. There are instruction manuals for the humidity or temperature control(s) in this booklet.
2. The electric heater has failed partially or fully. Check for the correct amp reading on all heater legs; replace fuses, contactors and/or heater as needed.
3. The condenser coil may not have the proper temperature gas flowing thru it or it may not be properly set-up to act as a condensing coil. Hot gas should always be available.
4. The DOT (door open time) per hour of fast acting door may be higher than design. Design is usually < 10% DOT.
5. The door pass thru time per opening may be longer than design. Usually design is < 12 seconds per pass thru from fully closed to open to fully closed again. The pass thru time is usually adjustable in its control panel. If motion detector or floor loop activation is used, they may have to be adjusted to reduce total DOT and/or door pass thru time per pass thru.
6. Air curtain may need to be re-adjusted. Procedure is given in this manual.

Call HCR at 1-800-326-7700 and ask for Tim if further help is needed.

MODEL CAC-EH SETTINGS AND ADJUSTMENTS

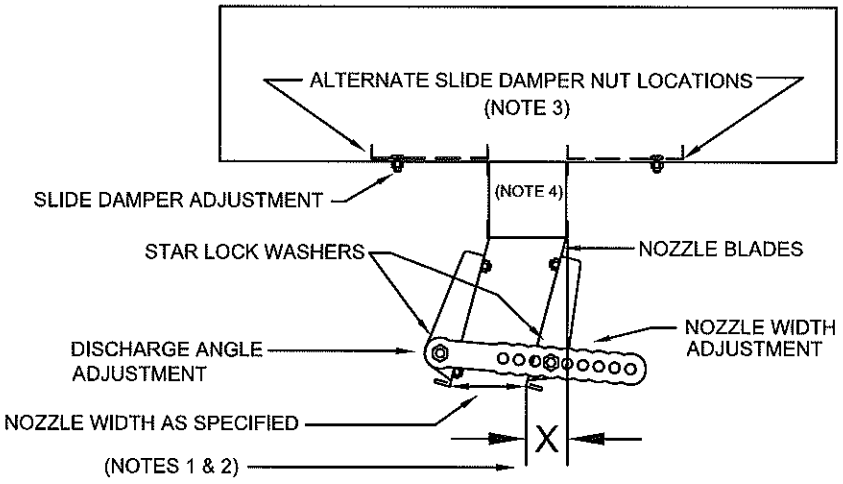
Job Name: Amazon Bethpage, NY **Serial No.:** 141299-101
Model No.: CAC-EH-CS-84/120-M10/38-33.0-480/3/60

AIR CURTAIN PHYSICAL DATA					
Air Quantity (Design)	cfm	3300			
Blower Size	model/make	NYB/151			
Motor Size	hp/volts	3.0/480			
Discharge Nozzle Adjustments		Top	Ctr.	Btm.	
Discharge Angle	(°)	15	0	15	
Dimension "X"	in.	1.5	---	1.5	
Nozzle Width	in.	3.0	.75	3.0	
Discharge Toward (Note 1)	TWS/TCS	TWS	---	TCS	
Nozzle Velocity (Design)	fpm	2200	---	2200	
Actual (Notes 2 & 4)	fpm	*	---	*	
Electric Heater	kw	33.0			
Total FLA (39.8) Actual	amps	*			
FLA per Step (13.3) Actual	amps	*			
Steps of Heat	#	3			
Temp Rise/Step (8.5) Actual	°F	*			
Total Temp. Rise (25.0) Actual	°F	*			
Motor FLA (3.9) Actual	amps	*			
Humidistat(s) H-1 / H-2	%	30/60			

Notes:

1. "TCS" denotes discharge toward the cold side of the doorway, "TWS" toward the warm side.
2. The fan VFD(s) are used to assist in discharge velocity adjustment. Use factory suggested velocity settings as a starting point.
3. Design conditions are -10°F, 90% RH freezer and 38°F, 90% RH outer room. Required heat output increases substantially as relative humidity and/or temperature rises above the design conditions on either side of the opening.
4. Items marked with an (*) are to be recorded during start-up.

DISCHARGE PLENUM NOZZLE (PLAN VIEW)



PROCEDURE FOR ADJUSTMENT OF DISCHARGE NOZZLE

Notes:

1. Proper procedure is to first adjust nozzle width then discharge dimension "X" . Dimension "X" will change as nozzle discharge angle is altered to direct the air stream to the intake plenum as illustrated in figure 1 on the following page.
2. Discharge nozzle angle of deflection is towards the cold side at the floor and towards the warm side at the top unless a negative airflow is present; in which case the entire nozzle will be deflected in one direction to oppose this flow.
3. Adjust slide damper (behind nozzle) open or closed to obtain design discharge velocity at top and bottom. All adjustment bolts will have to be loosened before damper will slide for proper adjustment.
4. Nozzle may be located in center or at either edge of discharge plenum. Nozzle shown in center of plenum.
5. **Star lock washers must be used to lock adjustments in place!**

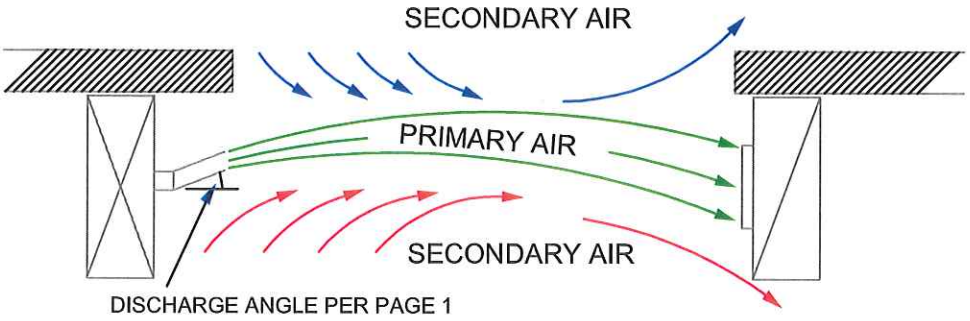


FIG. 1: SECONDARY AIR CORRECTLY EXITS TO EACH SIDE OF THE PRIMARY AIR STREAM.

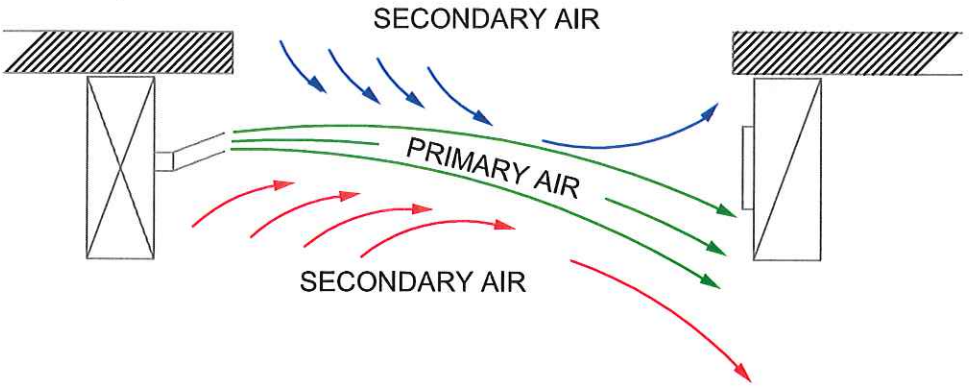


FIG. 2: DISCHARGE VELOCITY AND/OR ANGLE TOO SMALL.
POSSIBLE CORRECTIVE ACTION:
1. INCREASE AIR VELOCITY WITH HAND DAMPER OR FAN VFD.
2. INCREASE DISCHARGE ANGLE.
3. REDUCE NOZZLE WIDTH.

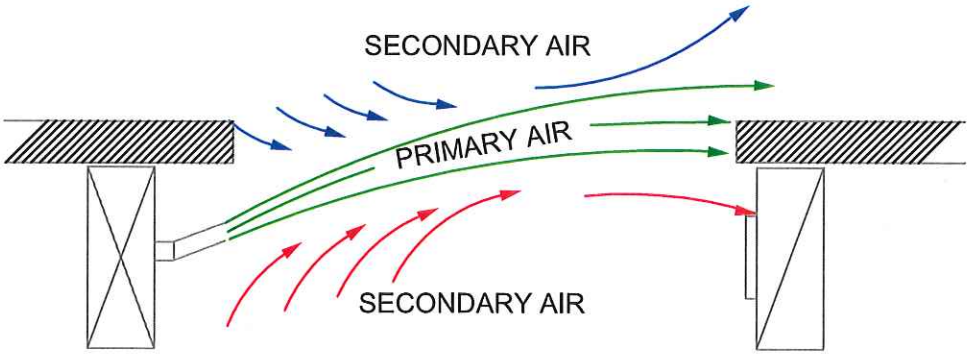
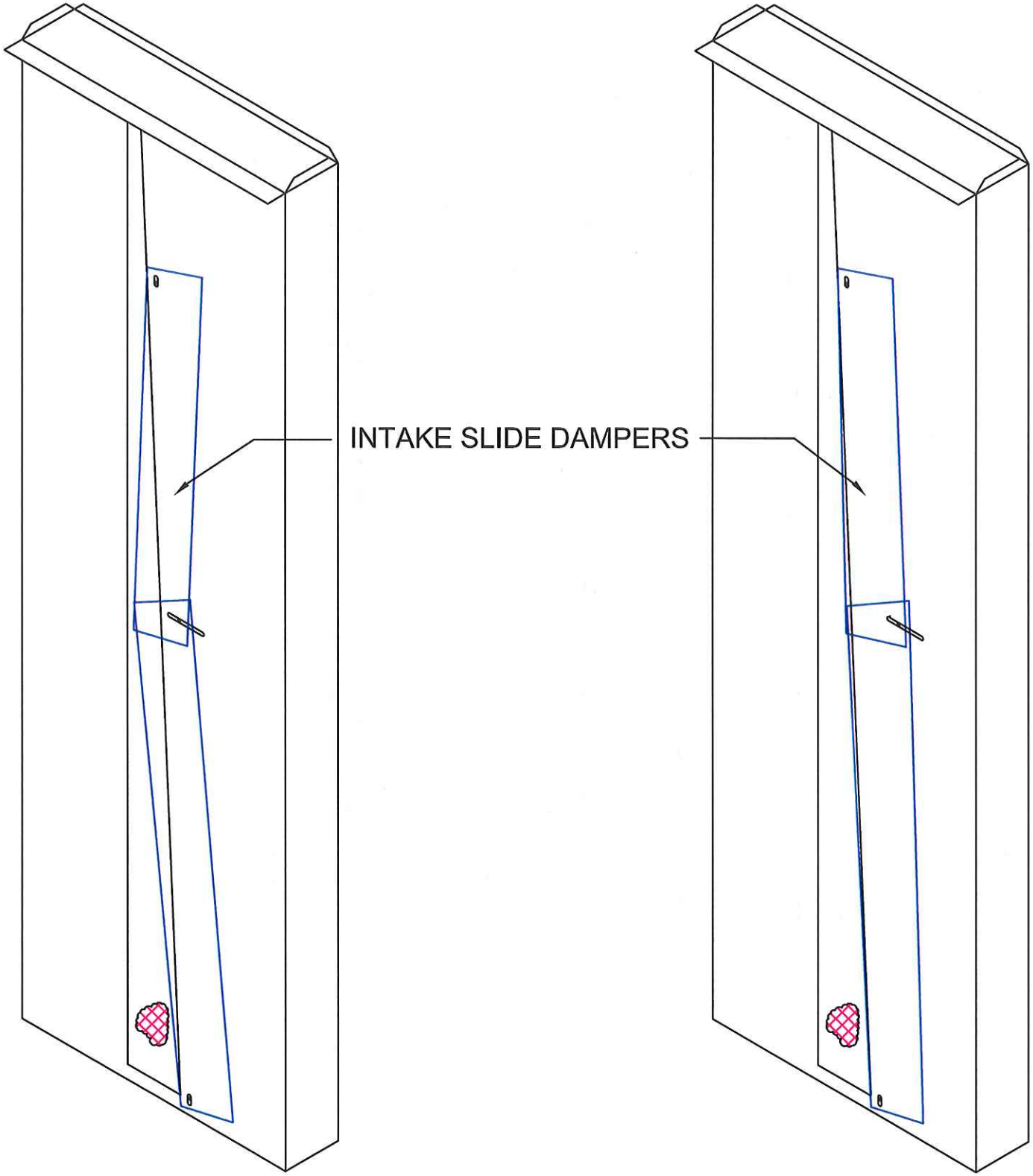


FIG. 3: DISCHARGE VELOCITY AND/OR ANGLE TOO LARGE.
POSSIBLE CORRECTIVE ACTION:
1. REDUCE VELOCITY WITH HAND DAMPER OR FAN VFD.
2. REDUCE DISCHARGE ANGLE.
3. INCREASE NOZZLE WIDTH.

INTAKE PLENUM ADJUSTMENT DETAIL

NEW DESIGN INTAKE PLENUMS HAVE NO SLIDE DAMPER ADJUSTMENT.



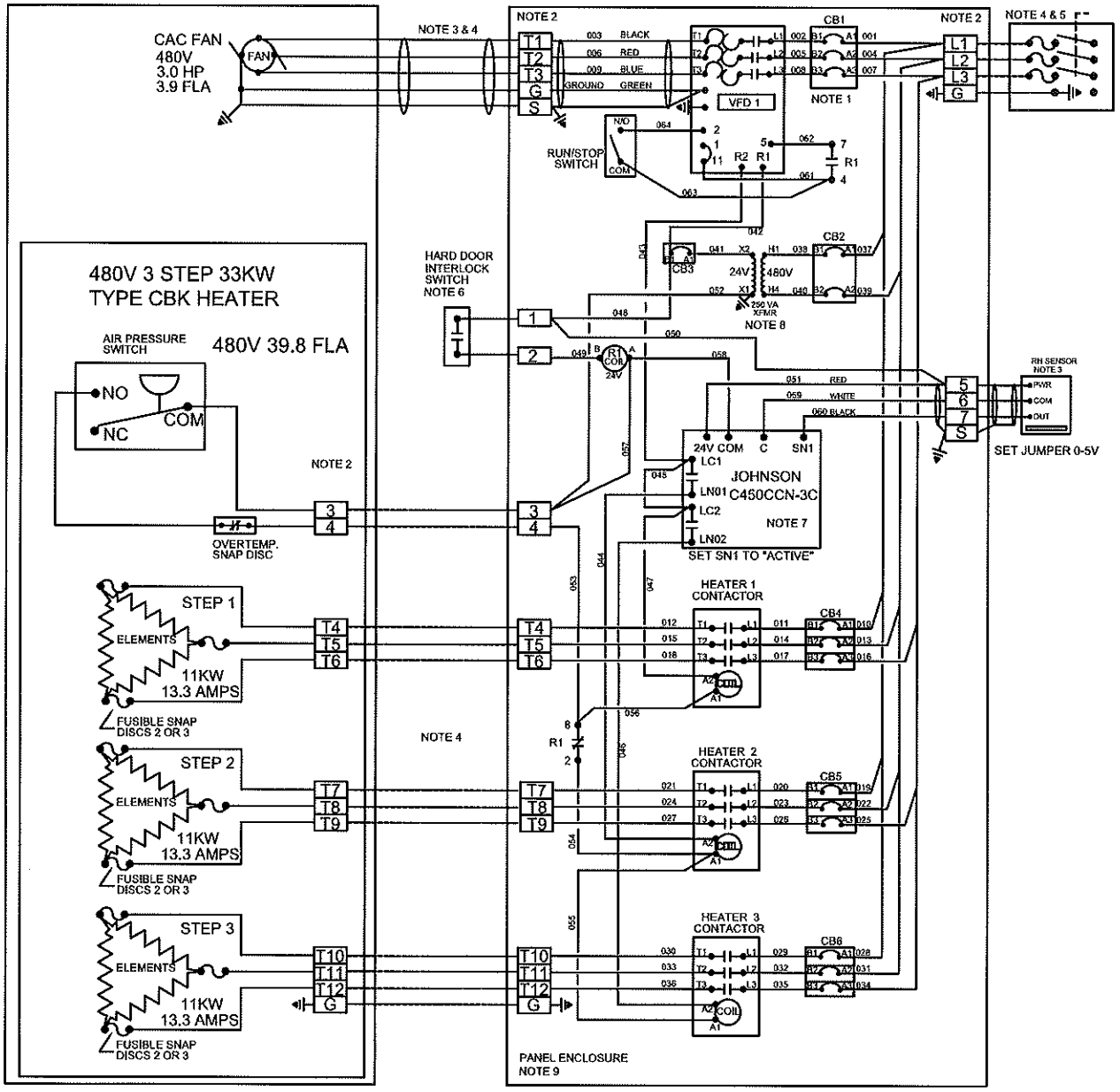
Adjust intake slide damper as illustrated above left on all Air Curtains except Model NPAC which should have slide damper wide-open top to bottom as illustrated above right.

MODEL CAC-EH WIRING DIAGRAM

AMAZON
BETHPAGE, NY
141299-101
CAC-EH
480/3/60
12/18/2017

TYPE4 CAC UNIT

REMOTE-POWER / CONTROL PANEL



WIRE ROUTING TABLE		
TERMINAL	WIRE #	TERMINAL
L1	001	CB1 A1
CB1 B1	002	VFD1 L1
VFD1 T1	003	T1
L2	004	CB1 A2
CB1 B2	005	VFD1 L2
VFD1 T2	006	T2
L3	007	CB1 A3
CB1 B3	008	VFD1 L3
VFD1 T3	009	T3
L1	010	CB4 A1
CB4 B1	011	CTC1 L1
CTC1 T1	012	T4
L2	013	CB4 A2
CB4 B2	014	CTC1 L2
CTC1 T2	015	T5
L3	016	CB4 A3
CB4 B3	017	CTC1 L3
CTC1 T3	018	T6
L1	019	CB5 A1
CB5 B1	020	CTC2 L1
CTC2 T1	021	T7
L2	022	CB5 A2
CB5 B2	023	CTC2 L2
CTC2 T2	024	T8
L3	025	CB5 A3
CB5 B3	026	CTC2 L3
CTC2 T3	027	T9
L1	028	CB6 A1
CB6 B1	029	CTC3 L1
CTC3 T1	030	T10
L2	031	CB6 A2
CB6 B2	032	CTC3 L2
CTC3 T2	033	T11
L3	034	CB6 A3
CB6 B3	035	CTC3 L3
CTC3 T3	036	T12
L1	037	CB2 A1
CB2 B1	038	XFMR1 H1
L2	039	CB2 A2
CB2 B2	040	XFMR1 H4
XFMR1 X2	041	CB3 A1
CB3 B1	042	VFD1 R1
VFD1 R2	043	CTRL1 LC1
CTRL1 LNO1	044	CTC2 A2
CTRL1 LC1	045	CTRL1 LC2
CTRL1 LN02	046	CTC3 A2
CTRL1 LC2	047	CTC1 A2
CB3 B1	048	1
2	049	R1COIL B
1	050	5
CTRL1 24V	051	5
XFMR1 X1	052	3
4	053	R1 8
R1 2	054	CTC2 A1
CTC2 A1	055	CTC3 A1
R1 8	056	CTC1 A1
3	057	R1COIL A
R1COIL A	058	CTRL1 COM
CTRL1 C	059	6
CTRL1 SN1	060	7
VFD1 11	061	R1 4
R1 7	062	VFD1 5
R1 4	063	SW1 COM
SW1 N/O	064	VFD1 2

HCR INCORPORATED
A DIVISION OF JAMISON DOOR COMPANY

AMAZON
BETHPAGE, NY
141299-101
CAC-EH Wiring Diagram Notes
12/18/2017

CAC-EH WIRING DIAGRAM NOTES

1. Circuit Breakers CB1-CB6 are sized according to NEC guidelines. The amp rating is listed below.

2. Terminal block L1-L3 is rated 115A/600V and recommended tightening torque is 10-16.7 LB.-IN. Terminals T1-T12, S and G are 600V/65A rated with a recommended tightening torque of 10.6-21.2 LB.-IN. Terminals 1-7 and S are 600V/25A rated with a recommended tightening torque of 3.5-7.1 LB.-IN.

3. Shielded cable should be used between VFD and fan motor terminals T1-T3 & G with drain wire connected to terminal S at both ends, and also between terminals 5-7 and humidity sensor with drain connected to terminal S. (Cable supplied with sensor). Mount sensor on warm side wall away from freezer door.

4. All field interconnect wires should be copper with 105° centigrade minimum rated insulation.

5. A 100 amp fused disconnect using appropriately sized class J,T, RK1 or RK5 fuses and branch circuit protection for unit power supply and field wiring not to exceed #2AWG to be done by an electrician following all applicable NEC and local electrical codes. Unit FLA is 44.0 amps.

6. Roll up door interlock switch should be wired to be normally open with the door in the open position so the switch closes when the door is closed. Unit will ramp down to factory pre-set speed when hard door is closed.

7. Step 1 of heat will come on with fan, steps 2 & 3 will come on when humidistat set points are not satisfied. Steps 2 and 3 will drop out when roll up door is closed.

8. Neutral of power transformer(s) is bonded to ground.

9. Any field perforations of the control panel enclosure must be occupied by fixtures designed to maintain the NEMA rating stated on the HCR enclosure labeling.

CIRCUIT BREAKER CHART

CB1	**15**	**amps**
CB2	**1.6**	**amps**
CB3	**10**	**amps**
CB4	**30**	**amps**
CB5	**30**	**amps**
CB6	**30**	**amps**

CAC-EH Variable Frequency Drive Settings & Adjustments

BASIC PARAMETERS	POWER FLEX 4 SETTINGS
P033 MOTOR FLA	3.9 AMPS
P034 MINIMUM FREQUENCY	*30 HZ
P035 MAXIMUM FREQUENCY	*75 HZ
P036 START SOURCE	#2 TWO WIRE
P039 ACCELERATION TIME	5 SECONDS
P040 DECELERATION TIME	50 SECONDS
A055 RELAY OUT SELECT	#6 ABOVE FREQUENCY
A056 RELAY OUT LEVEL	20HZ
A092 AUTO RSTRT TRIES	4
A093 AUTO RSTRT DELAY	10
A094 START AT POWERUP	1
A095 REVERSE DISABLE	1
A096 FLYING START	1
A101 PROGRAM LOCK	1
* These may be altered after initial setup.	

NOTES: [***See Instruction Manual for detailed instructions on programming of VFDs***]

1. ***WARNING!*** ***UNIT IS PROGRAMMED (A092, A093, & A094) TO AUTO RESTART AFTER POWER FAILURE OR OTHER POWER INTERRUPTION!***
2. **Before programming of parameters can occur: Parameter A101 'Program Lock' must be set to '0' to unlock program lock. Reset A101 to '1' after re-programming to prevent unauthorized parameter changes, if desired.**
3. **Stop drive motor to change the following parameters: P035, P036, P041, A094, & A095.**
4. **To clear a fault code press the STOP button on face of VFD and/or cycle power using ON/OFF switch or unit disconnect. Identify fault code and correct fault before restarting VFD.**
5. To increase or decrease airflow use potentiometer knob on face of VFD. Verify unit is not exceeding its' FLA rating by checking d001 parameter if P035 is changed. Do not change P034 without verifying sufficient airflow over heater elements.
6. To re-program VFD(s) to original factory settings:
   a. use "viewing and editing parameters" page in Instruction Manual to **set**:
      i. A101 to "0" (this unlocks the program)
      ii. P041 to "1" (this sets all parameters to factory default settings)
      iii. Change basic parameters to table values for each drive, as suggested above.

Quick Start

PowerFlex 4 Adjustable Frequency AC Drive

FRN 4.xx

This Quick Start guide summarizes the basic steps needed to install, start-up and program the PowerFlex 4 Adjustable Frequency AC Drive. **The information provided Does Not replace the User Manual and is intended for qualified drive service personnel only.**
For detailed PowerFlex 4 information including EMC instructions, application considerations and related precautions refer to the PowerFlex 4 *User Manual*, Publication 22A-UM001… on the CD supplied with the drive or at **www.rockwellautomation.com/literature.**

General Precautions

ATTENTION: The drive contains high voltage capacitors which take time to discharge after removal of mains supply. Before working on drive, ensure isolation of mains supply from line inputs [R, S, T (L1, L2, L3)]. Wait three minutes for capacitors to discharge to safe voltage levels. Failure to do so may result in personal injury or death.

Darkened display LEDs is not an indication that capacitors have discharged to safe voltage levels.

ATTENTION: Equipment damage and/or personal injury may result if parameter A092 [Auto Rstrt Tries] or A094 [Start At PowerUp] is used in an inappropriate application. Do not use this function without considering applicable local, national and international codes, standards, regulations or industry guidelines.

ATTENTION: Only qualified personnel familiar with adjustable frequency AC drives and associated machinery should plan or implement the installation, start-up and subsequent maintenance of the system. Failure to comply may result in personal injury and/or equipment damage.

ATTENTION: This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, reference A-B publication 8000-4.5.2, "Guarding Against Electrostatic Damage" or any other applicable ESD protection handbook.

ATTENTION: An incorrectly applied or installed drive can result in component damage or a reduction in product life. Wiring or application errors, such as, undersizing the motor, incorrect or inadequate AC supply, or excessive ambient temperatures may result in malfunction of the system.

Mounting Considerations

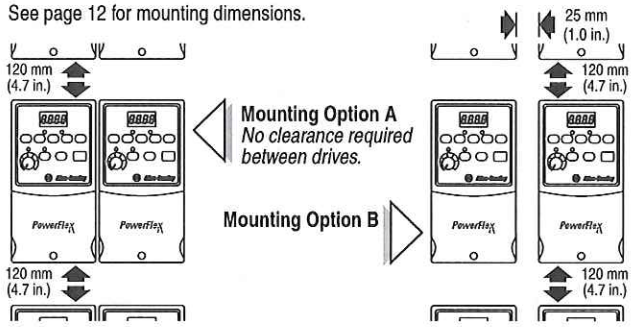
- Mount the drive upright on a flat, vertical and level surface.

Min. Panel Thickness	Screw Size	Screw Torque	DIN Rail
1.9 mm (0.0747 in.)	M4 (#8-32)	1.56-1.96 N-m (14-17 lb.-in.)	35 mm

- Protect the cooling fan by avoiding dust or metallic particles.
- Do not expose to a corrosive atmosphere.
- Protect from moisture and direct sunlight.

Minimum Mounting Clearances

See page 12 for mounting dimensions.



Ambient Operating Temperatures

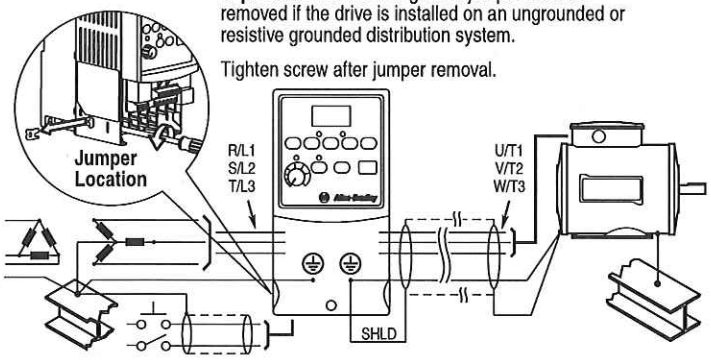
Ambient Temperature		Enclosure Rating	Minimum Mounting Clearances
Minimum	Maximum		
-10°C (14°F)	40°C (104°F)	IP 20/Open Type	Use Mounting Option A
		IP 30/NEMA 1/UL Type 1[1]	Use Mounting Option B
	50°C (122°F)	IP 20/Open Type	Use Mounting Option B

(1) Rating requires installation of the PowerFlex 4 IP 30/NEMA 1/UL Type 1 option kit.

General Grounding Requirements

Important: The MOV to ground jumper must be removed if the drive is installed on an ungrounded or resistive grounded distribution system.

Tighten screw after jumper removal.



CE Conformity

Refer to the PowerFlex 4 *User Manual* on the CD supplied with the drive for details on how to comply with the Low Voltage (LV) and Electromagnetic Compatibility (EMC) Directives.

Specifications, Fuses and Circuit Breakers

Drive Ratings

Catalog Number	Output Ratings		Input Ratings			Branch Circuit Protection			Power Dissipation
	kW (HP)	*Amps*	*Voltage Range*	*kVA*	*Amps*	*Fuses*	*140M Motor Protectors*[2]	*Contactors*	*IP20 Open Watts*
100 - 120V AC (±10%) – 1-Phase Input, 0 - 230V 3-Phase Output									
22A-V1P5N104	0.2 (0.25)	1.5	90-126	0.75	6.0	10	140M-C2E-C10	100-C09	32
22A-V2P3N104	0.4 (0.5)	2.3	90-126	1.15	9.0	15	140M-C2E-C16	100-C12	40
22A-V4P5N104	0.75 (1.0)	4.5	90-126	2.25	18.0	30	140M-D8E-C20	100-C23	55
22A-V6P0N104	1.1 (1.5)	6.0	90-126	3.0	24.0	40	140M-D8E-C25	100-C37	80
200 - 240V AC (±10%) – 1-Phase[1] Input, 0 - 230V 3-Phase Output, NO BRAKE									
22A-A1P4N103	0.2 (0.25)	1.4	180-265	0.7	3.2	6	140M-C2E-B40	100-C09	32
22A-A2P1N103	0.4 (0.5)	2.1	180-265	1.05	5.3	10	140M-C2E-B63	100-C09	40
22A-A3P6N103	0.75 (1.0)	3.6	180-265	1.8	9.2	15	140M-C2E-C16	100-C12	55
22A-A6P8N103	1.5 (2.0)	6.8	180-265	3.4	14.2	25	140M-C2E-C16	100-C16	85
22A-A9P6N103	2.2 (3.0)	9.6	180-265	4.8	19.6	30	140M-D8E-C25	100-C23	125
200 - 240V AC (±10%) – 1-Phase[1] Input, 0 - 230V 3-Phase Output									
22A-A1P5N104	0.2 (0.25)	1.5	180-265	0.75	5.0	10	140M-C2E-B63	100-C09	32
22A-A2P3N104	0.4 (0.5)	2.3	180-265	1.15	6.0	10	140M-C2E-B63	100-C09	40
22A-A4P5N104	0.75 (1.0)	4.5	180-265	2.25	10.0	15	140M-C2E-C16	100-C12	55
22A-A8P0N104	1.5 (2.0)	8.0	180-265	4.0	18.0	30	140M-D8E-C20	100-C23	85
200 - 240V AC (±10%) – 3-Phase Input, 0 - 230V 3-Phase Output									
22A-B1P5N104	0.2 (0.25)	1.5	180-265	0.75	1.8	3	140M-C2E-B25	100-C09	32
22A-B2P3N104	0.4 (0.5)	2.3	180-265	1.15	2.5	6	140M-C2E-B40	100-C09	40
22A-B4P5N104	0.75 (1.0)	4.5	180-265	2.25	5.2	10	140M-C2E-C10	100-C09	55
22A-B8P0N104	1.5 (2.0)	8.0	180-265	4.0	9.5	15	140M-C2E-C16	100-C12	85
22A-B012N104	2.2 (3.0)	12.0	180-265	5.5	15.5	25	140M-C2E-C16	100-C16	125
22A-B017N104	3.7 (5.0)	17.5	180-265	8.6	21.0	30	140M-F8E-C25	100-C23	180
380 - 480V AC (±10%) – 3-Phase Input, 0 - 460V 3-Phase Output									
22A-D1P4N104	0.4 (0.5)	1.4	340-528	1.4	1.8	3	140M-C2E-B25	100-C09	35
22A-D2P3N104	0.75 (1.0)	2.3	340-528	2.3	3.2	6	140M-C2E-B40	100-C09	50
22A-D4P0N104	1.5 (2.0)	4.0	340-528	4.0	5.7	10	140M-C2E-B63	100-C09	70
22A-D6P0N104	2.2 (3.0)	6.0	340-528	5.9	7.5	15	140M-C2E-C10	100-C09	100
22A-D8P7N104	3.7 (5.0)	8.7	340-528	8.6	9.0	15	140M-C2E-C16	100-C16	150

Input/Output Ratings

Output Frequency: 0-240 Hz (Programmable)

Efficiency: 97.5% (Typical)

Approvals

UL508C, CSA 22.2, US No. 14 — CE: EMC Directive 89/336/EEC, LV Dir. 73/23/EEC; UL: EN 50178; EMC: EN 61800-3

Digital Control Inputs (Input Current = 6mA)

SRC (Source) Mode:	SNK (Sink) Mode:
18-24V = ON	0-6V = ON
0-6V = OFF	18-24V = OFF

Analog Control Inputs

4-20mA Analog: 250 ohm input impedance

0-10V DC Analog: 100k ohm input impedance

External Pot: 1-10k ohms, 2 Watt minimum

Control Output (Programmable Output, form C relay)

Resistive Rating: 3.0A at 30V DC, 125V AC and 240V AC *Inductive Rating:* 0.5A at 30V DC, 125V AC, and 240V AC

Recommended Fuses and Circuit Breakers

Fuse: UL Class J, CC, T or Type BS88; 600V (550V) or equivalent. *Circuit Breakers:* HMCP or Bulletin 140U or equivalent.

Protective Features

Motor Protection: I^2t overload protection - 150% for 60 Secs, 200% for 3 Secs (Provides Class 10 protection)

Overcurrent: 200% hardware limit, 300% instantaneous fault

Over Voltage:
100-120V AC Input – Trip occurs at 405V DC bus voltage (equivalent to 150V AC incoming line)
200-240V AC Input – Trip occurs at 405V DC bus voltage (equivalent to 290V AC incoming line)
380-460V AC Input – Trip occurs at 810V DC bus voltage (equivalent to 575V AC incoming line)

Under Voltage:
100-120V AC Input – Trip occurs at 210V DC bus voltage (equivalent to 75V AC incoming line)
200-240V AC Input – Trip occurs at 210V DC bus voltage (equivalent to 150V AC incoming line)
380-480V AC Input – Trip occurs at 390V DC bus voltage (equivalent to 275V AC incoming line)

Control Ride Through: Minimum ride through is 0.5 Secs - typical value 2 Secs

Faultless Power Ride Through: 100 milliseconds

Dynamic Braking

Internal brake IGBT included with all ratings except No Brake versions. Refer to Appendix B of the PowerFlex 4 *User Manual* on CD for ordering information.

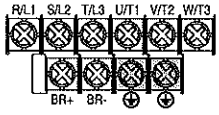
(1) 200-240V AC - 1-Phase drives are also available with an integral EMC filter. Catalog suffix changes from N103 to N113 and N104 to N114.

(2) Refer to the Bulletin 140M Motor Protectors *Selection Guide*, publication 140M-SG001... to determine the frame and breaking capacity required for your application.

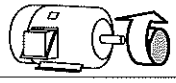
Power Wiring

Power Wire Rating	Recommended Copper Wire
Unshielded 600V, 75°C (167°F) THHN/THWN	15 Mils insulated, dry location
Shielded 600V, 75°C or 90°C (167°F or 194°F) RHH/RHW-2	Belden 29501-29507 or equivalent
Shielded Tray rated 600V, 75°C or 90°C (167°F or 194°F) RHH/RHW-2	Shawflex 2ACD/3ACD or equivalent

Power Terminal Block (A Frame Shown)



Terminal	Description
R/L1, S/L2	1-Phase Input
R/L1, S/L2, T/L3	3-Phase Input
U/T1	To Motor U/T1
V/T2	To Motor V/T2
W/T3	To Motor W/T3
BR+, BR-	Dynamic Brake Resistor Connection (0.75 kW (1 HP) ratings and higher)
⏚	Safety Ground - PE

= 

Switch any two motor leads to change forward direction.

Power Terminal Block Specifications

Frame	Maximum Wire Size [1]	Minimum Wire Size [1]	Torque
A	3.3 mm² (12 AWG)	0.8 mm² (18 AWG)	1.7-2.2 N-m (16-19 lb.-in.)
B	5.3 mm² (10 AWG)	1.3 mm² (16 AWG)	

(1) Maximum/minimum sizes that the terminal block will accept - these are not recommendations.

Input Power Conditions

Input Power Condition	Corrective Action
Low Line Impedance (less than 1% line reactance)	• Install Line Reactor[2] • or Isolation Transformer
Greater than 120 kVA supply transformer	
Line has power factor correction capacitors	
Line has frequent power interruptions	
Line has intermittent noise spikes in excess of 6000V (lightning)	
Phase to ground voltage exceeds 125% of normal line to line voltage	• Remove MOV jumper to ground. • or Install Isolation Transformer with grounded secondary if necessary.
Ungrounded Distribution System	

(2) Refer to Appendix B of the PowerFlex 4 *User Manual* on CD for accessory ordering information.

I/O Wiring Recommendations[3]

Wire Type(s)	Description	Minimum Insulation Rating
Belden 8760/9460 (or equiv.)	0.8 mm² (18 AWG), twisted pair, 100% shield with drain.	300V 60 degrees C (140 degrees F)
Belden 8770 (or equiv.)	0.8 mm² (18 AWG), 3 conductor, shielded for remote pot only.	

(3) If the wires are short and contained within a cabinet which has no sensitive circuits, the use of shielded wire may not be necessary, but is always recommended.

I/O Terminal Block Specifications

Maximum Wire Size [4]	Minimum Wire Size [4]	Torque
1.3 mm² (16 AWG)	0.13 mm² (26 AWG)	0.5-0.8 N-m (4.4-7 lb.-in.)

(4) Maximum / minimum that the terminal block will accept - these are not recommendations.

Refer to the PowerFlex 4 *User Manual* on CD for maximum power and control cable length recommendations

Control Terminal Block

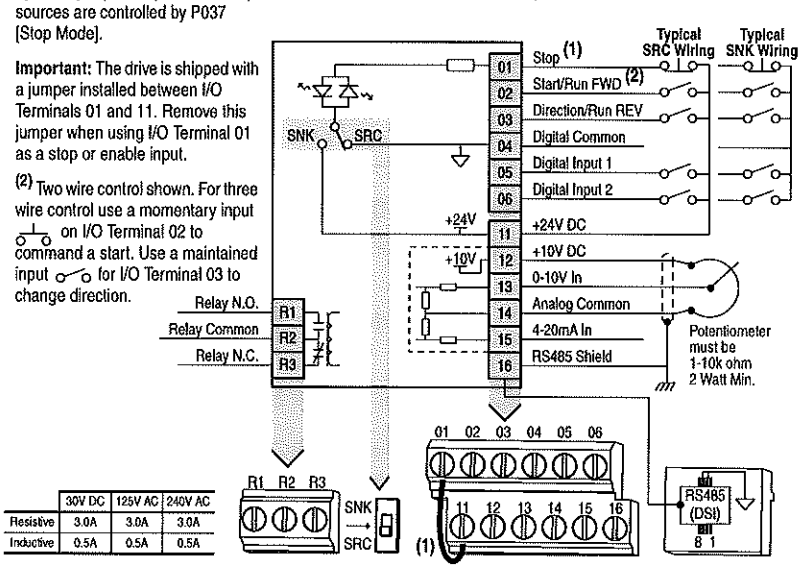
(1) **Important:** I/O Terminal 01 is always a coast to stop input except when P036 [Start Source] is set to "3-Wire" control. In three wire control, I/O Terminal 01 is controlled by P037 [Stop Mode]. All other stop sources are controlled by P037 [Stop Mode].

P036 [Start Source]	Stop	I/O Terminal 01 Stop
Keypad	Per P037	Coast
3-Wire	Per P037	Per P037
2-Wire	Per P037	Coast
RS485 Port	Per P037	Coast

Important: The drive is shipped with a jumper installed between I/O Terminals 01 and 11. Remove this jumper when using I/O Terminal 01 as a stop or enable input.

(2) Two wire control shown. For three wire control use a momentary input on I/O Terminal 02 to command a start. Use a maintained input for I/O Terminal 03 to change direction.

Refer to the PowerFlex 4 *User Manual* on CD for detailed I/O wiring examples.



	30V DC	125V AC	240V AC
Resistive	3.0A	3.0A	3.0A
Inductive	0.5A	0.5A	0.5A

No.	Signal	Default	Description	Param.
R1	Relay N.O.	Fault	Normally open contact for output relay.	A055
R2	Relay Common	–	Common for output relay.	
R3	Relay N.C.	Fault	Normally closed contact for output relay.	A055
Sink/Source DIP Switch		Source (SRC)	Inputs can be wired as Sink (SNK) or Source (SRC) via DIP Switch setting.	
01	Stop(1)	Coast	The factory installed jumper or a normally closed input must be present for the drive to start.	P036(1)
02	Start/Run FWD	Not Active	Command comes from the integral keypad by default. To disable reverse operation, see A095 [Reverse Disable].	P036, P037
03	Direction/Run REV	Not Active		P036, P037, A095
04	Digital Common	–	For digital inputs. Electronically isolated with digital inputs from analog I/O.	
05	Digital Input 1	Preset Freq	Program with A051 [Digital In1 Sel].	A051
06	Digital Input 2	Preset Freq	Program with A052 [Digital In2 Sel].	A052
11	+24V DC	–	Drive supplied power for digital inputs. Maximum output current is 100mA.	
12	+10V DC	–	Drive supplied power for 0-10V external potentiometer. Maximum output current is 15mA.	P038
13	0-10V In(3)	Not Active	For external 0-10V input supply (input impedance = 100k ohm) or potentiometer wiper.	P038
14	Analog Common	–	For 0-10V In or 4-20mA In. Electronically isolated with analog inputs from digital I/O.	
15	4-20mA In(3)	Not Active	For external 4-20mA input supply (input impedance = 250 ohm).	P038
16	RS485 (DSI) Shield	–	Terminal should be connected to safety ground - PE when using the RS485 (DSI) communications port.	

(3) Only one analog frequency source may be connected at a time. If more than one reference is connected at the same time, an undetermined frequency reference will result.

Prepare For Drive Start-Up

ATTENTION: Power must be applied to the drive to perform the following start-up procedures. Some of the voltages present are at incoming line potential. To avoid electric shock hazard or damage to equipment, only qualified service personnel should perform the following procedure. Thoroughly read and understand the procedure before beginning. If an event does not occur while performing this procedure, **Do Not Proceed. Remove All Power** including user supplied control voltages. User supplied voltages may exist even when main AC power is not applied to the drive. Correct the malfunction before continuing.

Before Applying Power to the Drive

❑ **1.** Confirm that all inputs are connected to the correct terminals and are secure.

❑ **2.** Verify that AC line power at the disconnect device is within the rated value of the drive.

❑ **3.** Verify that any digital control power is 24 volts.

❑ **4.** Verify that the Sink (SNK)/Source (SRC) Setup DIP Switch is set to match your control wiring scheme. See page 5 for location.

Important: The default control scheme is Source (SRC). The Stop terminal is jumpered (I/O Terminals 01 and 11) to allow starting from the keypad. If the control scheme is changed to Sink (SNK), the jumper must be removed from I/O Terminals 01 and 11 and installed between I/O Terminals 01 and 04.

❑ **5.** Verify that the Stop input is present or the drive will not start.

Important: If I/O Terminal 01 is used as a stop input, the jumper between I/O Terminals 01 and 11 must be removed.

Applying Power to the Drive

❑ **6.** Apply AC power and control voltages to the drive.

❑ **7.** Familiarize yourself with the integral keypad features (see next page) before setting any Program Group parameters.

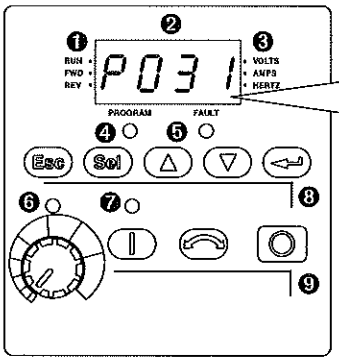
Start, Stop, Direction and Speed Control

Factory default parameter values allow the drive to be controlled from the integral keypad. No programming is required to start, stop, change direction and control speed directly from the integral keypad.

Important: To disable reverse operation, see A095 [Reverse Disable].

If a fault appears on power up, refer to page 11 for an explanation of the fault code. For complete troubleshooting information, refer to the PowerFlex 4 *User Manual* on the CD supplied with the drive.

Integral Keypad



Menu	Description
d	**Display Group (View Only)** Consists of commonly viewed drive operating conditions.
P	**Basic Program Group** Consists of most commonly used programmable functions.
A	**Advanced Program Group** Consists of remaining programmable functions.
F	**Fault Designator** Consists of list of codes for specific fault conditions. Displayed only when fault is present.

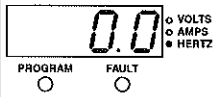
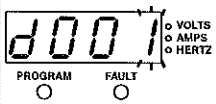
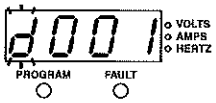
No.	LED	LED State	Description
❶	Run/Direction Status	Steady Red	Indicates drive is running and commanded motor direction.
		Flashing Red	Drive has been commanded to change direction. Indicates actual motor direction while decelerating to zero.
❷	Alphanumeric Display	Steady Red	Indicates parameter number, parameter value, or fault code.
		Flashing Red	Single digit flashing indicates that digit can be edited. All digits flashing indicates a fault condition.
❸	Displayed Units	Steady Red	Indicates the units of the parameter value being displayed.
❹	Program Status	Steady Red	Indicates parameter value can be changed.
❺	Fault Status	Flashing Red	Indicates drive is faulted.
❻	Pot Status	Steady Green	Indicates potentiometer on Integral Keypad is active.
❼	Start Key Status	Steady Green	Indicates Start key on Integral Keypad is active. The Reverse key is also active unless disabled by A095 [Reverse Disable].

No.	Key	Name	Description
❽	Esc	Escape	Back one step in programming menu. Cancel a change to a parameter value and exit Program Mode.
	Sel	Select	Advance one step in programming menu. Select a digit when viewing parameter value.
	△ ▽	Up Arrow Down Arrow	Scroll through groups and parameters. Increase/decrease the value of a flashing digit.
	↵	Enter	Advance one step in programming menu. Save a change to a parameter value.
❾		Potentiometer	Used to control speed of drive. Default is active. Controlled by parameter P038.
		Start	Used to start the drive. Default is active. Controlled by parameter P036.
		Reverse	Used to reverse direction of the drive. Default is active. Controlled by parameters P036 and A095.
		Stop	Used to stop the drive or clear a fault. This key is always active. Controlled by parameter P037.

Viewing and Editing Parameters

The last user-selected Display Group parameter is saved when power is removed and is displayed by default when power is reapplied.

The following is an example of basic integral keypad and display functions. This example provides basic navigation instructions and illustrates how to program the first Program Group parameter.

Step	Key(s)	Example Displays
1. When power is applied, the last user-selected Display Group parameter number is briefly displayed with flashing characters. The display then defaults to that parameter's current value. (Example shows the value of d001 [Output Freq] with the drive stopped.)		
2. Press Esc once to display the Display Group parameter number shown on power-up. The parameter number will flash.	Esc	
3. Press Esc again to enter the group menu. The group menu letter will flash.	Esc	
4. Press the Up Arrow or Down Arrow to scroll through the group menu (d, P and A).	▲ or ▼	
5. Press Enter or Sel to enter a group. The right digit of the last viewed parameter in that group will flash.	↵ or Sel	
6. Press the Up Arrow or Down Arrow to scroll through the parameters that are in the group.	▲ or ▼	
7. Press Enter or Sel to view the value of a parameter. If you do not want to edit the value, press Esc to return to the parameter number.	↵ or Sel	
8. Press Enter or Sel to enter program mode to edit the parameter value. The right digit will flash and the Program LED will illuminate if the parameter can be edited.	↵ or Sel	
9. Press the Up Arrow or Down Arrow to change the parameter value. If desired, press Sel to move from digit to digit or bit to bit. The digit or bit that you can change will flash.	▲ or ▼	
10. Press Esc to cancel a change. The digit will stop flashing, the previous value is restored and the Program LED will turn off. Or Press Enter to save a change. The digit will stop flashing and the Program LED will turn off.	Esc ↵	
11. Press Esc to return to the parameter list. Continue to press Esc to back out of the programming menu. If pressing Esc does not change the display, then d001 [Output Frequency] is displayed. Press Enter or Sel to enter the group menu.	Esc	

Display Group Parameters

No.	Parameter	Min/Max	Display/Options			
d001	[Output Freq]	0.0/[Maximum Freq]	0.1 Hz			
d002	[Commanded Freq]	0.0/[Maximum Freq]	0.1 Hz			
d003	[Output Current]	0.00/(Drive Amps × 2)	0.01 Amps			
d004	[Output Voltage]	0/Drive Rated Volts	1 VAC			
d005	[DC Bus Voltage]	Based on Drive Rating	1 VDC			
d006	[Drive Status]	0/1 (1 = Condition True)	Bit 3 Decelerating	Bit 2 Accelerating	Bit 1 Forward	Bit 0 Running
d007- d009	[Fault x Code]	F2/F122	F1			
d010	[Process Display]	0.00/9999	0.01 – 1			
d012	[Control Source]	0/9	Digit 1 = Speed Command (See P038; 9 = "Jog Freq")		Digit 0 = Start Command (See P036; 9 = "Jog")	
d013	[Contrl In Status]	0/1 (1 = Input Present)	Bit 3 Reserved	Bit 2 Stop Input	Bit 1 Dir/Run REV	Bit 0 Start/Run FWD
d014	[Dig In Status]	0/1 (1 = Input Present)	Bit 3 Reserved	Bit 2 Reserved	Bit 1 Digital In2 Sel	Bit 0 Digital In1 Sel
d015	[Comm Status]	0/1 (1 = Condition True)	Bit 3 Fault Occurred	Bit 2 RS485 Option	Bit 1 Transmitting	Bit 0 Receiving
d016	[Control SW Ver]	1.00/99.99	0.01			
d017	[Drive Type]	1001/9999	1			
d018	[Elapsed Run Time]	0/9999 Hrs	1 = 10 Hrs			
d019	[Testpoint Data]	0/FFFF	1 Hex			
d020	[Analog In 0-10V]	0.0/100.0%	0.1%			
d021	[Analog In 4-20mA]	0.0/100.0%	0.1%			
d024	[Drive Temp]	0/120 degC	1 degC			

Smart Start-Up with Basic Program Group Parameters

[O] = Stop drive before changing this parameter.

No.	Parameter	Min/Max	Display/Options		Default
P031	[Motor NP Volts]	20/Drive Rated Volts	1 VAC		Based on Drive Rating
[O]	Set to the motor nameplate rated volts.				
P032	[Motor NP Hertz]	10/240 Hz	1 Hz		60 Hz
[O]	Set to the motor nameplate rated frequency.				
P033	[Motor OL Current]	0.0/(Drive Rated Amps×2)	0.1 Amps		Based on Drive Rating
	Set to the maximum allowable motor current.				
P034	[Minimum Freq]	0.0/240.0 Hz	0.1 Hz		0.0 Hz
	Sets the lowest frequency the drive will output continuously.				
P035	[Maximum Freq]	0/240 Hz	1 Hz		60 Hz
[O]	Sets the highest frequency the drive will output.				
P036	[Start Source]	0/5	0 = "Keypad"(1) 1 = "3-Wire" 2 = "2-Wire"	3 = "2-W Lvl Sens" 4 = "2-W Hi Speed" 5 = "Comm Port"	0
[O]	Sets the control scheme used to start the drive.				
	(1) When active, the Reverse key is also active unless disabled by A095 [Reverse Disable].				
P037	[Stop Mode]	0/7	0 = "Ramp, CF"(1) 1 = "Coast, CF"(1) 2 = "DC Brake, CF"(1) 3 = "DCBrkAuto,CF"(1)	4 = "Ramp" 5 = "Coast" 6 = "DC Brake" 7 = "DC BrakeAuto"	0
	Active stop mode for all stop sources [e.g. keypad, run forward (I/O Terminal 02), run reverse (I/O Terminal 03), RS485 port] except as noted below.				
	Important: I/O Terminal 01 is always a coast to stop input except when P036 [Start Source] is set for "3-Wire" control. When in three wire control, I/O Terminal 01 is controlled by P037 [Stop Mode].				
	(1) Stop input also clears active fault.				
P038	[Speed Reference]	0/5	0 = "Drive Pot" 1 = "InternalFreq" 2 = "0-10V Input"	3 = "4-20mA Input" 4 = "Preset Freq" 5 = "Comm Port"	0
	Sets the source of the speed reference to the drive.				
	Important: When A051 or A052 [Digital Inx Sel] is set to option 2, 4, 5, 6, 13 or 14, and the digital input is active, A051 or A052 will override the speed reference commanded by this parameter. Refer to Chapter 1 of the PowerFlex 4 *User Manual* on CD for details.				
P039	[Accel Time 1]	0.0/600.0 Secs	0.1 Secs		10.0 Secs
	Sets the rate of accel for all speed increases.				
P040	[Decel Time 1]	0.1/600.0 Secs	0.1 Secs		10.0 Secs
	Sets the rate of decel for all speed decreases.				
P041	[Reset To Defalts]	0/1	0 = "Idle State" 1 = "Reset Defaults"		0
[O]	Resets all parameter values to factory defaults.				
P043	[Motor OL Ret]	0/1	0 = "Disabled"	1 = "Enabled"	0
	Enables/disables the Motor Overload Retention function.				

Advanced Group Parameters

No.	Parameter	Min/Max	Display/Options	Default
A051 A052 [O]	[Digital In1 Sel] *I/O Terminal 05* [Digital In2 Sel] *I/O Terminal 06*	0/26	0 = "Not Used" 1 = "Acc 2 & Dec 2" 2 = "Jog" 3 = "Aux Fault" 4 = "Preset Freq" 5 = "Local" 6 = "Comm Port" 7 = "Clear Fault" 8 = "RampStop,CF" 9 = "CoastStop,CF" 10 = "DCInjStop,CF" 11 = "Jog Forward" 12 = "Jog Reverse" 13 = "10V In Ctrl" 14 = "20mA In Ctrl" 26 = "Anlg Invert"	4
A055	[Relay Out Sel]	0/21	0 = "Ready/Fault" 1 = "At Frequency" 2 = "MotorRunning" 3 = "Reverse" 4 = "Motor OverId" 5 = "Ramp Reg" 6 = "Above Freq" 7 = "Above Cur" 8 = "Above DCVolt" 9 = "Retries Exst" 10 = "Above Anlg V" 20 = "ParamControl" 21 = "NonRec Fault"	0
A056	[Relay Out Level]	0.0/9999	0.1	0.0
A067	[Accel Time 2]	0.0/600.0 Secs	0.1 Secs	20.0 Secs
A068	[Decel Time 2]	0.1/600.0 Secs	0.1 Secs	20.0 Secs
A069	[Internal Freq]	0.0/240.0 Hz	0.1 Hz	60.0 Hz
A070 A071 A072 A073	[Preset Freq 0][1] [Preset Freq 1] [Preset Freq 2] [Preset Freq 3]	0.0/240.0 Hz	0.1 Hz	0.0 Hz 5.0 Hz 10.0 Hz 20.0 Hz

[1] To activate [Preset Freq 0] set P038 [Speed Reference] to option 4.

Input State of Digital In 1 (I/O Terminal 05)	Input State of Digital In 2 (I/O Terminal 06)	Frequency Source	Accel / Decel Parameter Used [2]
0	0	[Preset Freq 0]	[Accel Time 1] / [Decel Time 1]
1	0	[Preset Freq 1]	[Accel Time 1] / [Decel Time 1]
0	1	[Preset Freq 2]	[Accel Time 2] / [Decel Time 2]
1	1	[Preset Freq 3]	[Accel Time 2] / [Decel Time 2]

[2] When a Digital Input is set to "Accel 2 & Decel 2", and the input is active, that input overrides the settings in this table.

A078	[Jog Frequency]	0.0/[Maximum Freq]	0.1 Hz			10.0 Hz
A079	[Jog Accel/Decel]	0.1/600.0 Secs	0.1 Secs			10.0 Secs
A080	[DC Brake Time]	0.0/90.0 Secs	0.1 Secs			0.0 Secs
A081	[DC Brake Level]	0.0/(Drive Amps × 1.8)	0.1 Amps			Amps × 0.05
A082 [O]	[DB Resistor Sel]	0/99	0 = Disabled 1 = Normal RA Res	2 = NoProtection 3-99 = % of Duty Cycle		0
A083	[S Curve %]	0/100%	1%			0% (Disabled)
A084	[Start Boost]	1/14	Settings in % of base voltage. Variable Torque 1 = "30.0, VT" 2 = "35.0, VT" 3 = "40.0, VT" 4 = "45.0, VT" Constant Torque 5 = "0.0, no IR" 6 = "0.0" 7 = "2.5, CT" 8 = "5.0, CT" 9 = "7.5, CT" 10 = "10.0, CT" 11 = "12.5, CT" 12 = "15.0, CT" 13 = "17.5, CT" 14 = "20.0, CT"			8 7 (5 HP Drives)
A088	[Maximum Voltage]	20/Rated Volts	1 VAC			Rated Volts
A089	[Current Limit]	0.1/(Drive Amps × 1.8)	0.1 Amps			Amps × 1.5
A090	[Motor OL Select]	0/2	0 = "No Derate"	1 = "Min Derate" 2 = "Max Derate"		0
A091	[PWM Frequency]	2.0/16.0 kHz	0.1 kHz			4.0 kHz
A092	[Auto Rstrt Tries]	0/9	1			0
A093	[Auto Rstrt Delay]	0.0/300.0 Secs	0.1 Secs			1.0 Secs
A094 [O]	[Start At PowerUp]	0/1	0 = "Disabled"	1 = "Enabled"		0
A095 [O]	[Reverse Disable]	0/1	0 = "Rev Enabled"	1 = "Rev Disabled"		0
A096	[Flying Start En]	0/1	0 = "Disabled"	1 = "Enabled"		0
A097	[Compensation]	0/3	0 = "Disabled" 1 = "Electrical"	2 = "Mechanical" 3 = "Both"		1
A098	[SW Current Trip]	0.0/(Drive Amps × 2)	0.1 Amps			0.0 (Disabled)
A099	[Process Factor]	0.1/999.9	0.1			30.0
A100 [O]	[Fault Clear]	0/2	0 = "Ready/Idle"	1 = "Reset Fault" 2 = "Clear Buffer"		0
A101	[Program Lock]	0/1	0 = "Unlocked"	1 = "Locked"		0
A102	[Testpoint Sel]	0/FFFF	1 Hex			400

No.	Parameter	Min/Max	Display/Options		Default
A103	[Comm Data Rate][3]	0/5	0 = "1200" 1 = "2400" 2 = "4800"	3 = "9600" 4 = "19.2K" 5 = "38.4K"	3
A104	[Comm Node Addr][3]	1/247	1		100
A105	[Comm Loss Action]	0/3	0 = "Fault" 1 = "Coast to Stop"	2 = "Stop" 3 = "Continu Last"	0
A106	[Comm Loss Time]	0.1/60.0	0.1		5.0
A107	[Comm Format][3]	0/5	0 = "RTU 8-N-1" 1 = "RTU 8-E-1" 2 = "RTU 8-O-1"	3 = "RTU 8-N-2" 4 = "RTU 8-E-2" 5 = "RTU 8-O-2"	0
A110 [O]	[Anlg In 0-10V Lo]	0.0/100.0%	0.1%		0.0%
A111 [O]	[Anlg In 0-10V Hi]	0.0/100.0%	0.1%		100.0%
A112 [O]	[Anlg In4-20mA Lo]	0.0/100.0%	0.1%		0.0%
A113 [O]	[Anlg In4-20mA Hi]	0.0/100.0%	0.1%		100.0%
A114	[Slip Hertz @ FLA]	0.0/10.0 Hz	0.1 Hz		2.0 Hz
A115	[Process Time Lo]	0.00/99.99	0.01		0.00
A116	[Process Time Hi]	0.00/99.99	0.01		0.00

[3] Power to drive must be cycled before any changes will affect drive operation.

Fault Codes

To clear a fault, press the Stop key, cycle power or set A100 [Fault Clear] to 1 or 2.

No.	Fault	Description
F2	Auxiliary Input[1]	Check remote wiring.
F3	Power Loss	Monitor the incoming AC line for low voltage or line power interruption.
F4	UnderVoltage[1]	Monitor the incoming AC line for low voltage or line power interruption.
F5	OverVoltage[1]	Monitor the AC line for high line voltage or transient conditions. Bus overvoltage can also be caused by motor regeneration. Extend the decel time or install dynamic brake option.
F6	Motor Stalled[1]	Increase [Accel Time x] or reduce load so drive output current does not exceed the current set by parameter A089 [Current Limit].
F7	Motor Overload[1]	An excessive motor load exists. Reduce load so drive output current does not exceed the current set by parameter P033 [Motor OL Current].
F8	Heatsink OvrTmp[1]	Check for blocked or dirty heat sink fins. Verify that ambient temperature has not exceeded 40°C (104°F) for IP 30/NEMA 1/UL Type 1 installations or 50°C (122°F) for Open type installations. Check fan.
F12	HW OverCurrent[1]	Check programming. Check for excess load, improper DC boost setting, DC brake volts set too high or other causes of excess current.
F13	Ground Fault	Check the motor and external wiring to the drive output terminals for a grounded condition.
F33	Auto Rstrt Tries	Correct the cause of the fault and manually clear.
F38	Phase U to Gnd	Check the wiring between the drive and motor. Check motor for grounded phase. Replace drive if fault cannot be cleared.
F39	Phase V to Gnd	
F40	Phase W to Gnd	
F41	Phase UV Short	Check the motor and drive output terminal wiring for a shorted condition. Replace drive if fault cannot be cleared.
F42	Phase UW Short	
F43	Phase VW Short	
F48	Params Defaulted	The drive was commanded to write default values to EEPROM. Clear the fault or cycle power to the drive. Program the drive parameters as needed.
F63	SW OverCurrent[1]	Check load requirements and A098 [SW Current Trip] setting.
F64	Drive Overload	Reduce load or extend Accel Time.
F70	Power Unit	Cycle power. Replace drive if fault cannot be cleared.
F71	Net Loss	The communication network has faulted.
F81	Comm Loss	If adapter was not intentionally disconnected, check wiring to the port. Replace wiring, port expander, adapters or complete drive as required. Check connection. An adapter was intentionally disconnected. Turn off using A105 [Comm Loss Action].
F100	Parameter Checksum	Restore factory defaults.
F122	I/O Board Fail	Cycle power. Replace drive if fault cannot be cleared.

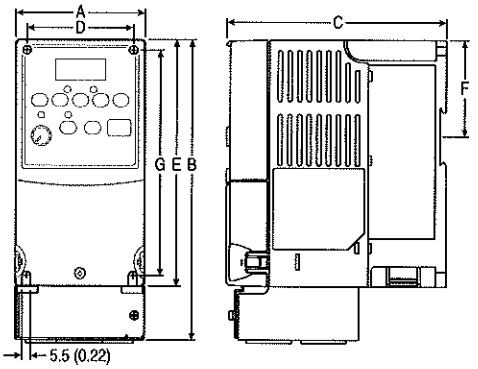
[1] Auto-Reset/Run type fault. Configure with parameters A092 and A093.

Drive Dimensions

PowerFlex 4 Panel Mount Drives – Ratings are in kW and (HP)

Frame	120V AC – 1-Phase	240V AC – 1-Phase No Brake	240V AC – 1-Phase	240V AC – 3-Phase	480V AC – 3-Phase
A	0.2 (0.25) 0.37(0.5)	0.2 (0.25) 0.37 (0.5) 0.75 (1.0)	0.2 (0.25) 0.37 (0.5) 0.75 (1.0)	0.2 (0.25) 0.37 (0.5) 0.75 (1.0) 1.5 (2.0)	0.37 (0.5) 0.75 (1.0) 1.5 (2.0)
B	0.75(1.0) 1.1 (1.5)	1.5 (2.0) 2.2 (3.0)	1.5 (2.0)	2.2 (3.0) 3.7 (5.0)	2.2 (3.0) 3.7 (5.0)

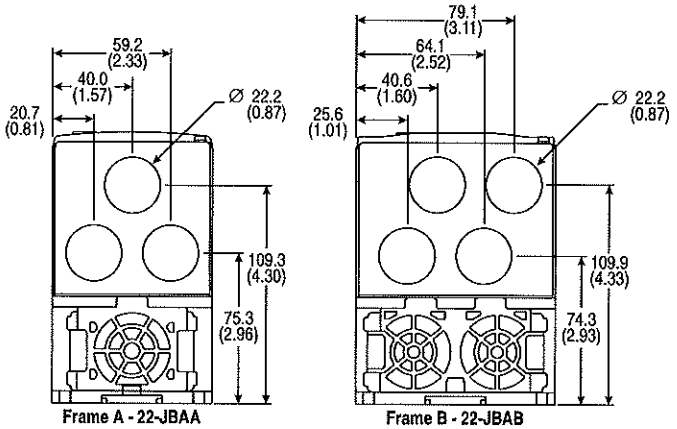
PowerFlex 4 Panel Mount Drives (1) – Dimensions are in millimeters and (inches). Weights are in kilograms and (pounds).



Frame	A	B (2)	C	D	E (3)	F	G	Shipping Weight
A	80 (3.15)	185 (7.28)	136 (5.35)	67 (2.64)	152 (5.98)	59.3 (2.33)	140 (5.51)	1.4 (3.1)
B	100 (3.94)	213 (8.39)	136 (5.35)	87 (3.43)	180 (7.09)	87.4 (3.44)	168 (6.61)	2.2 (4.9)

(1) Flange Mount drives are also available. Refer to the PowerFlex 4 *User Manual* on CD for information.
(2) Overall height of drive with IP 30/NEMA 1/UL Type 1 option kit installed.
(3) Overall height of standard IP 20/Open Type drive.

IP 30/NEMA 1/UL Type 1 Option Kit – Dimensions are in millimeters and (inches)



Frame A - 22-JBAA **Frame B - 22-JBAB**

U.S. Allen-Bradley Drives Technical Support
Tel: (1) 262.512.8176, Fax: (1) 262.512.2222, Email: support@drives.ra.rockwell.com, Online: www.ab.com/support/abdrives

Rockwell Automation

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System 450™ Series Control Modules with Relay Outputs Installation Instructions

C450CBN-4
C450CCN-4

Part No. 24-7664-3205, Rev. A
Issued May 2017

Refer to the QuickLIT website for the most up-to-date version of this document.

Application

IMPORTANT: Use this System 450™ Series Control Module with Relay Outputs only as an operating control. Where failure or malfunction of the System 450™ could lead to personal injury or property damage to the controlled equipment or other property, additional precautions must be designed into the control system. Incorporate and maintain other devices, such as supervisory or alarm systems or safety or limit controls, intended to warn of or protect against failure or malfunction of the System 450™.

IMPORTANT : Utiliser ce System 450™ Series Control Module with Relay Outputs uniquement en tant que dispositif de contrôle de fonctionnement. Lorsqu'une défaillance ou un dysfonctionnement du System 450™ risque de provoquer des blessures ou d'endommager l'équipement contrôlé ou un autre équipement, la conception du système de contrôle doit intégrer des dispositifs de protection supplémentaires. Veiller dans ce cas à intégrer de façon permanente d'autres dispositifs, tels que des systèmes de supervision ou d'alarme, ou des dispositifs de sécurité ou de limitation, ayant une fonction d'avertissement ou de protection en cas de défaillance ou de dysfonctionnement du System 450™.

System 450™ is a family of modular, digital electronic controls that is easily assembled and set up to provide reliable temperature, pressure, and humidity control for a wide variety of HVACR and commercial and industrial process applications.

The System 450 control modules allow you to configure custom application-specific control systems with up to three input sensors and ten (relay, analog, or both) outputs, including control systems that can monitor and control temperature, pressure, and humidity applications simultaneously.

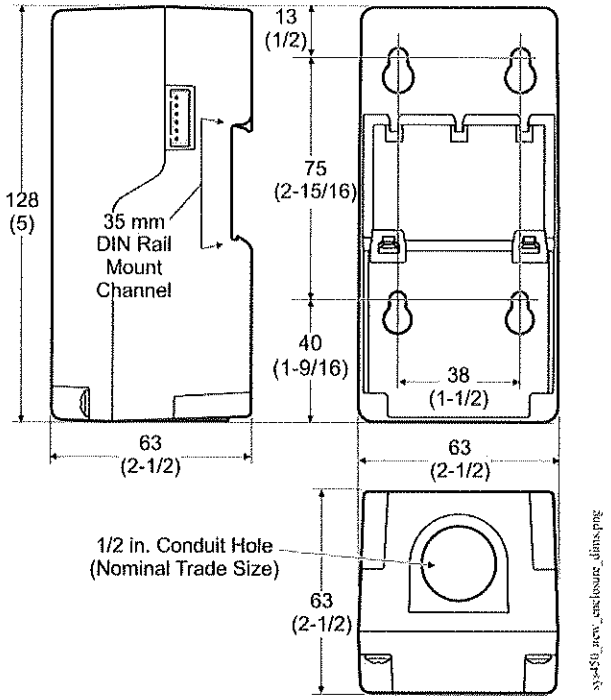
You can easily install and quickly configure a stand-alone System 450 control module and sensor in the field as a replacement control for almost any temperature, pressure, and humidity control.

C450CBN-4 and C450CCN-4 models are relay output control modules with LCD and four-button touchpad user interface (UI) that allows you to set up a System 450 control system. C450CBN-4 models provide one relay output, and C450CCN-4 models provide two relay outputs.

Refer to the *System 450™ Series Modular Control Systems with Standard Control Modules Technical Bulletin (LIT-12011459)* for more detailed information on designing, installing, setting up, and troubleshooting System 450 Series control systems. The System 450 technical bulletin can be accessed and downloaded on the Johnson Controls® *QuickLIT* Product Literature website.

Installation

Figure 1: System 450 Module Dimensions, mm (in.)



Location Considerations

Observe the following System 450 location guidelines:

- Ensure that the mounting surface can support the module assembly, mounting hardware, and any (user-supplied) panel or enclosure.
- Mount the modules upright and plugged together in a horizontal row where possible (Figure 3). DIN rail mounting is highly recommended.
- Mount modules on flat, even surfaces.
- Allow sufficient space for wires and connections.
- Mount the modules in locations free of corrosive vapors and observe the ambient operating conditions listed in the *Technical Specifications* on page 28.
- Do not mount the modules on surfaces that are prone to vibration or in locations where radio frequency or electromagnetic emissions may cause interference.
- Do not install the modules in airtight enclosures.
- Do not install heat-generating devices in an enclosure with the modules that may cause the temperature to exceed the ambient operating limit.

Mounting

Mount System 450 modules on 35 mm DIN rail (recommended) or directly onto an even wall surface. To mount modules on DIN rail:

1. Provide a section of 35 mm DIN rail that is longer than the module assembly width, and mount the DIN rail horizontally in a suitable location using appropriate mounting hardware or fasteners.
2. Clip the control module on the rail, position the upper DIN rail clips on the top rail, and gently snap the lower clips onto the rail.

3. Clip the remaining power and expansion modules to the right of the control module on to the DIN rail and plug the 6-pin module connectors together (Figure 3).

Notes:

- DIN rail end clamps can be used to prevent the module assembly from sliding off the DIN rail.
- If your System 450 control system uses a power module, the power module **must** be plugged into the right-hand side of the control module.

To direct-mount modules to wall surfaces:

1. Plug the modules together, remove the module covers, place the assembly against wall surface horizontally in a suitable location, and mark the mount hole locations on the surface (Figure 1).
2. Install appropriate screw fasteners, leaving screw heads approximately one to two turns away from flush to the surface.
3. Place the assembly over screw heads on the mounting slots, and carefully tighten the mounting screws.

   Note: If you mount the modules on an uneven surface, do not damage the housings when tightening mounting screws. Use shims or washers to mount the module assembly evenly on the surface.

Refer to the control sensor installation instructions for information on locating and mounting control sensors.

Wiring

See Figure 2 and Table 1 for electrical termination locations and wiring information. See *Technical Specifications* on page 28 for electrical ratings.

⚠ WARNING

Risk of Electric Shock.
Disconnect or isolate all power supplies before making electrical connections. More than one disconnection or isolation may be required to completely de-energize equipment. Contact with components carrying hazardous voltage can cause electric shock and may result in severe personal injury or death.

⚠ ADVERTISSEMENT

Risque de décharge électrique.
Débrancher ou isoler toute alimentation avant de réaliser un branchement électrique. Plusieurs isolations et débranchements sont peut-être nécessaires pour -couper entièrement l'alimentation de l'équipement. Tout contact avec des composants conducteurs de tensions dangereuses risque d'entraîner une décharge électrique et de provoquer des blessures graves, voire mortelles.

IMPORTANT: Use copper conductors only. Make all wiring connections in accordance with local, national, and regional regulations.

IMPORTANT: Do not exceed the System 450 module electrical ratings. Exceeding module electrical ratings can result in permanent damage to the modules and void any warranty.

IMPORTANT: Run all low-voltage wiring and cables separate from all high-voltage wiring. Shielded cable is strongly recommended for input (sensor) and analog output cables that are exposed to high electromagnetic or radio frequency noise.

IMPORTANT: Electrostatic discharge can damage System 450 modules. Use proper Electrostatic Discharge (ESD) precautions during installation and servicing to avoid damaging System 450 modules.

IMPORTANT: Do not apply power to a C450Y Power Module or the 24 VAC/VDC power source for the System 450 modules before finishing wiring and checking all wiring connections. Short circuits or improperly connected wires can result in damage to the modules and void any warranty.

IMPORTANT: A System 450 control module and module assembly can be connected to an internal power source (a System 450 power module) **or** an external power source (24 VAC/VDC power connected to the 24 V and COM terminals on the control module), but must **not** be connected to both power sources simultaneously. Connecting a control module to both internal and external power sources can damage the modules and void any warranty.

IMPORTANT: When connecting System 450 compatible sensors with shielded cable to a System 450 control module, connect the cable shield drain lead to one of the C (common) terminals on the input sensor terminal block. Do not connect the shield at any other point along the cable. Isolate and insulate the shield drain at the sensor end of the cable. Connecting a cable shield at more than one point can enable transient currents to flow through the sensor cable shield, which can cause erratic control operation.

Figure 2: C450CxN-4 Wiring Terminals

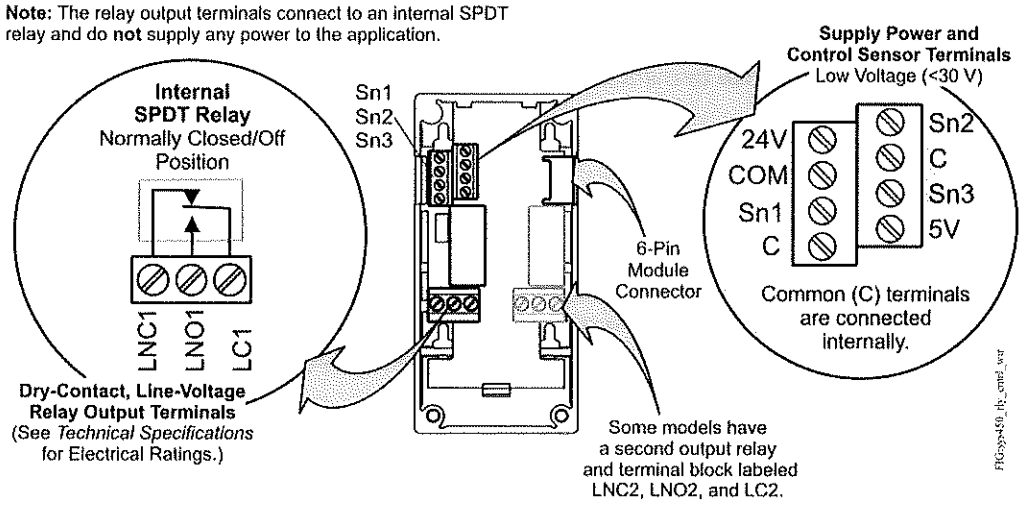
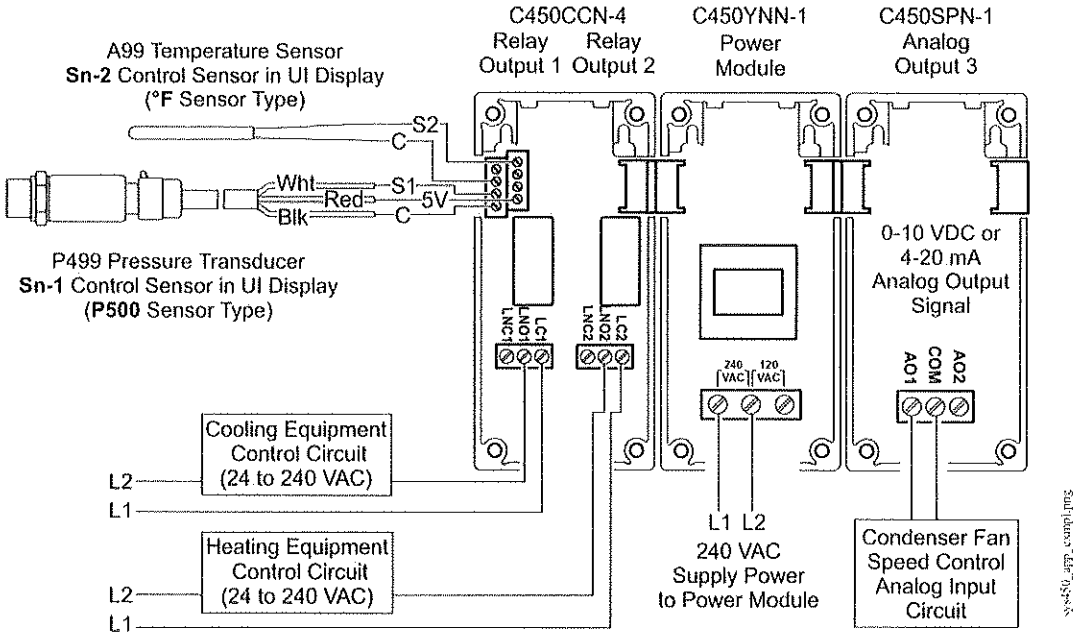


Table 1: System 450 Relay Output Control Module Terminal Wiring Information

Label	Terminal Function	Wire Sizes
24V	Accepts 24 VAC/VDC supply power when a C450YNN power module is **not** connected, and provides a power terminal for 24 V sensors.	0.08 mm^2 to 1.5 mm^2 28 AWG to 16 AWG
5V	Provides 5 VDC power for active sensors.	
Sn-1, Sn-2, Sn-3	Accepts passive or active (0–5 VDC) input signals from control sensors. The control automatically selects a passive or active sensor circuit for each input based on the sensors selected in the setup screens.	
COM	Provides a connection for the 24 VAC/VDC supply common input.	
C (Two Terminals)	Provides low-voltage circuit Common connections for passive or active sensors that are connected to the 5V, Sn1, Sn2, and Sn3 terminals.	
LNC1, LNC2	Connects the control circuit to the Line Normally Closed (LNC) contact on the single-pole, double-throw (SPDT) relay.	0.08 mm^2 to 2.5 mm^2 28 AWG to 14 AWG
LNO1, LNO2	Connects the control circuit to the Line Normally Open (LNO) contact on the SPDT relay.	
LC1, LC2	Use to connect Line (power) to the Common terminal on the SPDT relay.	

Figure 3: System 450 Heat/Cool System with Condenser Fan Speed Control Example



Note: In 120 VAC applications, L1 wire is connected to L2 terminal and Common wire must be connected to the COM terminal.

Setup and Adjustments

System 450 Component Requirements

A System 450 control system consists of one control module, one to three control sensor inputs, and one to ten outputs that provide On/Off control or analog control. Figure 3 shows an example System 450 module assembly with two sensors and three outputs (two analog outputs and one relay output).

Setting Up a System 450 Module Assembly

1. Determine the controlled conditions, sensor types, and value ranges that are required for your application, and select the appropriate System 450 sensor types.
2. Determine the number and type (relay or analog) of outputs required to control your application, and select the appropriate System 450 control module and expansion modules to provide the outputs.
3. Assemble the control and expansion modules in the proper order, starting with the control module on the left.

Notes:

- If you use a C450YNN-1 power module, it must be plugged into the control module. Plug in any expansion modules (for your control system) to the right of the power module.
- After you power on your module assembly, you can set up your control system in the control module UI before wiring the sensors or outputs to your assembly. If the sensors are set up in the UI but not connected, the LCD displays an SNF Sensor Failure.

Setting Up a Control System in the User Interface

System 450 control modules have a backlit LCD and a four-button touchpad UI (Figure 4 and Table 2) that enable you to set up your control system. To set up a control system in the System 450 UI:

1. Build your control system module assembly and connect it to power. See *Setting Up a System 450 Module Assembly*.

Note: Every time a module assembly is powered ON, the control module polls all of the modules to identify output type (relay or analog) and assigns a sequential output number (1 to 9 [0 = 10]) to each output starting with the control module output on the left. The output numbers identify each output's setup screens in the UI. (See Figure 4 and Table 2.)

2. Access the System 450 setup screens in the UI. See *Accessing the System 450 Setup Start Screens* on page 9.
3. Set up the control system inputs or sensors in the UI. See *Setting Up System 450 Sensors* on page 9.
4. Set up the control system outputs in the UI. See *Setting Up System 450 Outputs* on page 15.

IMPORTANT: Do not change the module positions after a System 450 control system is set up in the UI. System 450 control logic is set up in the UI according to the Sensor Types, the output types, and the output numbers. Changing modules or module positions in a module assembly that is already set up in the UI can change the output numbers, output types, and the setup values of the assembly outputs, which requires setting up the outputs again.

Figure 4: System 450 Control Module Output Relay LEDs, LCD, Four-Button Touchpad User Interface

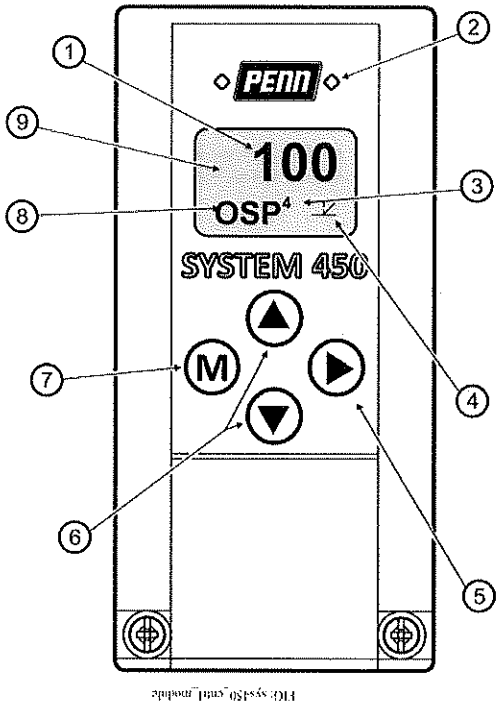


Table 2: System 450 Control Module Output Analog LEDs, LCD, Four-Button Touchpad User Interface

Callout	Feature	Description
1	Status or Setup Value	Displays the current input status, output status, or setup parameter value for the displayed input sensor, output, or setup parameter. Press ▲ or ▼ to select a different parameter value when the value is flashing. (Here, 100 = 100%)
2	LED	Green LEDs on Relay Control Module and Relay Expansion Modules (only) indicate if the associated relay output is on or off.
3	Output Number	Displays a numerical value that identifies the output associated with the status or setup value shown on the screen. Output numbers are automatically determined by the outputs' physical positions (left to right) in the module assembly. (Here, 4 = Output 4)
4	Control Ramp Icon	Displays whether an analog output (only) is set as direct-acting or reverse-acting, and whether the output signal strength is at minimum or maximum when the sensed property is at Setpoint. The control ramp icon displayed is determined by the output's SP, EP, OSP, and OEP setup values.
5	Next Button	In the Main screens, press ▶ to scroll through the system status screens. In a setup screen, press ▶ to save the (flashing) setup value and go to the next setup screen.
6	Up and Down Buttons	Press ▲ or ▼ to select a different value for any flashing value in the setup value field. In the Main (sensor status) screens, press and hold both ▲ and ▼ for 5 seconds to access the setup Start screens.
7	Menu Button	Press M to move through the sensor and output setup start screens. When moving through the status or setup screens, press M to return to the status start screen or setup start screen.
8	Status or Setup Identifier	Displays the unit of measurement, output, sensor number, **or** setup parameter for the displayed status or setup value. (Here, the setup identifier OSP represents % output signal strength at setpoint.)
9	LCD	Backlit LCD screen. The LCD brightness is adjustable. During normal operation, the LCD displays the Main screens.

Viewing the Startup, Main, and System Status Screens

Every time you connect power to a System 450 control module, the Startup screen appears for several seconds before the Main screens appear. The Startup screen displays the current firmware version for the module. See Table 3 and *System 450 Firmware Versions* for more information.

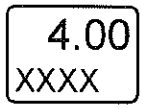
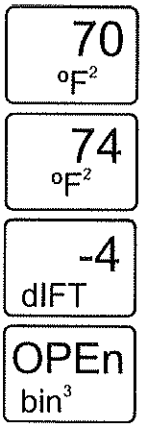
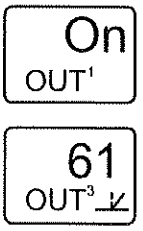
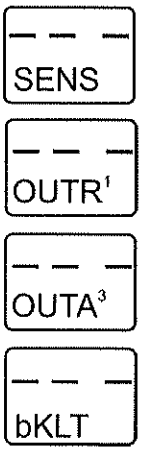
After you install, wire, power on, and set up your control system in the UI, the Main screens appear on the LCD, immediately after the Startup screen. During normal operation, the Main screens automatically scroll through the current status of each sensor in your control system and the backlight low level setting is applied. See Table 3 for more information.

The System Status screens display the current status of each input and output in your control system. With the Main screen displayed, press any key to exit idle mode, then press ▶ repeatedly to scroll through and view all of the status screens in your control system. See Table 3 for more information about the System Status screens.

System 450 Firmware Versions

The System 450 firmware versions identify the control features that are available. Standard System 450 control modules with Version 2.00 firmware and later include the High Input-Signal Selection and Differential Control features. See *High Input-Signal Selection* on page 13 and *Differential Control* on page 14 for more information.

Table 3: System 450 Startup Screen, Main Screens, Status Screens, and Setup Start Screens Information and Procedures

LCD Screen	Name, Description/Function, User Action, and Example
	**Startup Screen:** When you power on a System 450 control module, the LCD displays the control module's current firmware version for approximately five seconds before it displays the Main (Input Status) screen. The screen example shows System 450 firmware version number **4.00** on the top of the screen. The number on the bottom of the screen (indicated in this example with xxxx) identifies the Johnson Controls firmware.
	**Main (Input Status) Screens:** During normal operation, the Main screens automatically scroll through the current status of each input sensor in your control system and display the sensor number, the unit of measurement, and the sensed condition value. **Note:** Main screens are view-only; selections are not made in Main screens. The Main screens are the System 450 default screens. After 2 minutes of inactivity in any screen, the UI returns to the Main screens. **While the Main screens are scrolling, you can press ▶ repeatedly to scroll through and view the System Status screens for all inputs and outputs in your control system.** **While the Main Screens are scrolling, you can press and hold ▲ and ▼ for 5 seconds to access your control system's Setup Start screens.** The top two screen examples show **Sensor 1** sensing **70°F** and **Sensor 2** sensing **74°F.** The third screen example shows a **Temperature Differential Sensor** that is sensing a **-4** degree differential. The bottom screen shows **Sensor 3** set up as a **Binary Input** and the input is **open**.
	**System Status Screens:** The System Status screens display the current status of all inputs **and** outputs in your control system. System Status screens are view-only. Relay output status screens display output number and relay status (On/Off). Analog output status screens display output number, signal strength, and control ramp icon. **Press ▶ repeatedly to scroll and view the System Status screens for the inputs and outputs in your control system. When you stop pressing ▶, the displayed Status screen refreshes its value and remains displayed for 2 minutes before returning to the Main Screens.** The screen examples show that the **Output 1** relay is **On** and the signal strength of **Output 3** is **61%** of the total signal strength. The control ramp icon in the bottom screen example indicates that the Analog Output is set up with SP<EP and OSP<OEP. See *Setting Up an Analog Output* for information about ramp icons.
	**Setup Start Screens:** Setup Start screens are view-only screens, from which you can access the setup screens for the sensors, the displayed output, or the backlight brightness. The Sensor Setup Start screen is the first screen displayed when you access the System 450 setup screens. **Note:** The numerical order and type of Output Setup Start screens are determined by the modules that are selected for your System 450 control system and their physical order in the control system module assembly. See *Setting Up a Control System in the User Interface* on page 5 for more information. **From the Sensor Setup Start screen, press M repeatedly to scroll through the Output Setup Start screens for all of the outputs in your control system. When a Setup Start screen is displayed, press ▶ to go to the setup screens for the sensors or the output displayed in the screen.** **Note:** In any Setup Start screen, you can return to the Main screens by pressing both ▲ and ▼ simultaneously. Also, the UI returns to the Main screen after 2 minutes of inactivity in any screen. The screen examples show the **Sensor, Relay Output 1, Analog Output 3,** and **LCD Backlight Brightness** Setup Start screens.

Accessing the System 450 Setup Start Screens

Access the System 450 Setup Start screens from the Main screen. See Table 3 for more information about the Setup Start screens.

To access the System 450 setup screens:

1. Power on the module assembly. After the **Startup** screen appears briefly (displaying the control module firmware version), the **Main** screen appears on the LCD.
2. With the **Main** screen displayed, press any key to exit idle mode, then press and hold ▲ and ▼ simultaneously for 5 seconds to access the setup screens and go to the **Sensor Setup Start** screen.
3. Press M repeatedly to scroll through the **Output Setup Start** screens. See Figure 6.

   Note: The UI returns to the Main screens after 2 minutes of inactivity in any screen in the UI.

Setting Up System 450 Sensors

You must set up the input sensors for your control system before you can set up any outputs. To set up the input sensors, you must access the setup screens.

The Sensor Setup Start screen is the first screen displayed when you access the system setup screens.

Table 4 provides information about System 450 sensors, Sensor Types, parameter values, and specified sensor or transducer product code numbers. Table 5 provides sensor setup information, procedures, and example screens. Figure 6 on page 26 provides a System 450 UI setup example.

Table 4: System 450 Sensor Types, Setup Values, and Sensor or Transducer Product Codes (Part 1 of 2)

Sensor Type	Unit of Measurement Code (Condition/Units)	Effective Sensing Range	Range of Usable Values[1]	Resolution Increment Value	Minimum Proportional or Control Band	Sensor Product Type Number[2]
°F	°F (Temperature/degrees)	-46 to 255	-40 to 250	1	1	A99x-xxx
°C	°C (Temperature/degrees)	-43 to 124	-40 to 121	0.5	0.5	A99x-xxx
rH	% (Humidity/%RH)	1 to 100	10 to 95	1	2	HE-67Sx-xxxxx HE-67Nx-xxxxx HE-68Nx-0N00WS
P 0.25	INWC (Pressure/in. W.C.)	-0.250 to 0.250	-0.225 to 0.250	0.005	0.01	DPT2650-R25B-AB
P 0.5	INWC (Pressure/in. W.C.)	0 to 0.5	0.025 to 0.5	0.005	0.01	DPT2650-0R5D-AB
P 2.5	INWC (Pressure/in. W.C.)	0 to 2.5	0.1 to 2.5	0.02	0.1	DPT2650-2R5D-AB
P 5	INWC (Pressure/in. W.C.)	0 to 5.0	0.25 to 5.0	0.05	0.25	DPT2650-005D-AB
P 8	bAR (Pressure/bar)	-1 to 8	-1 to 8	0.05	0.1	P499RCP-401C P598RCPSN401C
P 10	INWC (Pressure/in. W.C.)	0 to 10	0.5 to 10	0.05	0.2	DPT2650-10D-AB
P 15	bAR (Pressure/bar)	-1 to 15	-1 to 15	0.1	0.2	P499RCP-402C P598RCPSN402C
P 30	bAR (Pressure/bar)	0 to 30	0 to 30	0.1	0.4	P499RCP-404C P598RCPSN404C
P 50	bAR (Pressure/bar)	0 to 50	0 to 50	0.2	0.4	P499RCP-405C P598RCPSN405C

Table 4: System 450 Sensor Types, Setup Values, and Sensor or Transducer Product Codes (Part 2 of 2)

Sensor Type	Unit of Measurement Code (Condition/Units)	Effective Sensing Range	Range of Usable Values[1]	Resolution Increment Value	Minimum Proportional or Control Band	Sensor Product Type Number[2]
P 100	**PSI** (Pressure/psi)	0 to 100	0 to 100	0.5	1	P499RAP-101C P499RAP-101K P499RCP-101C P499RCP-101K P598RAPSN101C P598RAPSN101K P598RCPSN101C P598RCPSN101K
P 110[3]	**InHg/PSI** (Pressure in.Hg/ psi)	-10 to 100	-10 to 100	0.5	1	P499RAPS-100C P499RAPS-100K P499RCPS-100C P499RCPS-100K P598RAPSN100C P598RAPSN100K P598RCPSN100C P598RCPSN100K
P 200	**PSI** (Pressure/psi)	0 to 200	0 to 200	1	1	P499RAP-102C P499RAPS102C P499RAPS102K P499RCPS102C P499RCPS102K P598RAPSN102C P598RAPSN102K P598RCPSN102C P598RCPSN102K
P 500	**PSI** (Pressure/psi)	0 to 500	90 to 500	1	5	P499RAP-105C P499RAP-105K P499RCP-105C P499RCP-105K P598RAPSN105C P598RAPSN105K P598RCPSN105C P598RCPSN105K
P 750	**PSI** (Pressure/psi)	0 to 750	150 to 750	2	6	P499RAP-107C P499RAP-107K P499RCP-107C P499RCP-107K P598RAPSN107C P598RAPSN107K P598RCPSN107C P598RCPSN107K
HI°F	**°F** (Temperature/degrees)	-50 to 360	-40 to 350[4]	1	1	TE-631x, TE-6000-x, TE-68NT-0N00S
HI°C	**°C** (Temperature/degrees)	-45.5 to 182	-40 to 176[4]	0.5	0.5	TE-631x-x TE-6000-x TE-68NT-0N00S
bin	Open or Closed[5] (Dry Contacts)	N/A	N/A	N/A	N/A	N/A

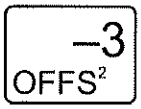
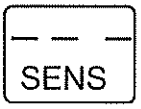
1. See *Differential Control* on page 14 for information on setting up the System 450 Differential Control feature.

2. Refer to the *System 450 Series Modular Controls Product Bulletin (LIT-12011458)*, *Catalog Page (LIT-1900549)*, or the *System 450 Series Controls Systems Technical Bulletin (LIT-12011459)* for additional ordering information for System 450 compatible sensors and transducers.
3. See *Setting Up Outputs That Reference a P110 Sensor* on page 12 for information on setting up System 450 outputs that reference the P110 Sensor Type.
4. Many of the temperature sensors that can be set up as HI°F or HI°C Sensor Types are not designed for use across the entire range of usable values for HI°F and HI°C Sensor Types. Refer to the Technical Specifications for the sensor you intend to use to determine the ambient temperature range that the sensor is specified to operate in. The TE-6000-6 Nickel Sensor is the only sensor designed for use over the entire temperature range.
5. Selecting the **bin** Sensor Type for a sensor (Sn-1, Sn-2, or Sn-3) sets up the input to control relay outputs (only) based on the state of the binary input contacts (open or closed) connected to the sensor input (Sn1, Sn2, or Sn3). See *Binary Input Control for Relay Outputs* on page 13 for more information. Can only be used for relay outputs.

Table 5: System 450 Sensor Setup Screen Information and Procedures (Part 1 of 2)

LCD Screen	Name, Description/Function, User Action, and Example
— — — SENS	**Sensor Setup Start Screen:** The Sensor Setup Start screen is the first screen that is displayed when you access the System 450 setup screens. From the Sensor Setup Start screen, you can navigate to the Output Setup Start screens or the Sensor Setup screens. See Figure 6. **Note:** You must set up the input sensors before you can set up the control system outputs. The Sensor Setup Start screen is view-only; selections are not made in Setup Start screens. 1. **In the Sensor Setup Start screen, press ▶ to go to the first Sensor Type Selection screen (Sn-1) and begin setting up the sensors in your control system.** The screen example shows the **Sensors** Setup Start screen with flashing dashes.
P500 Sn–1 °F Sn-2 — — Sn-3	**Sensor Type Selection Screens:** The Sensor Type that you select for an input sensor automatically determines the setup parameters and values for each output that is set up to reference that sensor. See Table 4 for information about System 450 sensors/transducers, Sensor Types, condition type, units of measurement, minimum control band or proportional band, setup values, value ranges, and product code numbers. **Note:** For outputs to operate properly, the selected Sensor Type must match the sensor/transducer model wired to the control module, and the sensor/transducer must be wired to the proper control module input terminals. 2. **In the Sn-1 Sensor Type Selection screen, press ▲ or ▼ to select a Sensor Type. Press ▶ to save your selection and go to the Sn-2 Sensor Type Selection screen.** 3. **In the Sn-2 Sensor Type Selection screen, press ▲ or ▼ to select a Sensor Type. Press ▶ to save your selection and go to the Sn-3 Sensor Type Selection screen.** **Note:** If your control system does not use three input sensors, simply press ▶ while the two dashes are flashing in a Sensor Type Selection screen to save **no Sn-3** Sensor Type and go to the next setup screen. 4. **In the Sn-3 Sensor Type Selection screen, press ▲ or ▼ to select a Sensor Type. Press ▶ to save your selection and either:** • **go to the Temperature Offset Setup screen for the first temperature sensor in your system.** • **return to the Sensor Setup Start Screen, if your control system has no temperature sensors.** **Note:** Beginning with firmware Version 2.00, if you select the same Sensor Type for Sn-1 and Sn-2, two additional functional sensors (Sn-d and HI-2) are available for selection when you set up the control system outputs. If you select the same Sensor Type for Sn-1, Sn-2, and Sn-3, then functional sensor HI-3 is also available for selection when you set up outputs. See *High Input-Signal Selection* on page 13 and *Differential Control* on page 14 for more information. The screen examples show **Sn-1** with the **P500** Sensor Type selected, **Sn-2** with the **°F** Sensor Type selected, and **Sn-3** with the **no** Sensor Type selected.

Table 5: System 450 Sensor Setup Screen Information and Procedures (Part 2 of 2)

LCD Screen	Name, Description/Function, User Action, and Example
	**Temperature Offset Selection Screens:** Select a temperature offset for the temperature inputs (only) in your control system. Sensor Type **°F** enables an offset of +/- 5°F in 1 degree increments. Sensor Type **°C** enables an offset of +/- 2.5°C in 0.5 degree increments. **Note:** The temperature offset changes the displayed temperature value by the selected offset value. **5. Press ▲ or ▼ to select a temperature offset value. Press ▶ to save your selection and either:** • **go to the next Temperature Offset Selection screen (if there are additional temperature sensors in your control system) and repeat this step for each temperature sensor.** • **return to the Sensor Setup Start screen.** The screen example shows an **OFFS** value of **-3** (°F) for Sensor **2**. Therefore a sensed temperature value of 75 (°F) at Sensor 2 is displayed as 72 (°F).
	**Sensor Setup Start Screen:** When you have finished setting up all of the sensors for your control system, the display returns to the Sensor Setup Start screen. **Note:** You can edit the sensor setup values at any time, if required. However, changing the Sensor Type for a sensor that is referenced by an output requires setting up the output again to the new Sensor Type values. **After the sensors are set up for your control system, you can:** • **press M to scroll through the Output Setup Start screens and begin setting up your system outputs.** • **press ▲ and ▼ simultaneously to return to the Main screens.** The screen example shows **Sensors** Setup Start screen with flashing dashes.

Setting Up Outputs That Reference a P110 Sensor

The P110 Sensor Type can monitor negative pressure down to 20 InHg (-10 psi). When referencing a P110 sensor, System 450 displays negative pressure values in InHg on the Main and System Status screens.

But when you set up an output that references a P110 sensor and the setup value is a negative pressure value, you must select a pressure value in negative psi.

Use Table 6 to determine the negative psi setup value that corresponds to your InHg target value. For example, if you want a relay output to go off when the sensed pressure reaches 7 InHg, you select the value -3.5 (psi) in the output's Relay OFF Selection screen.

Table 6: InHg Target Values/PSI Setup Values

InHg Value	psi Setup Value	InHg Value	psi Setup Value
1	-0.5	**11**	-5.5
2	-1.0	**12**	-6.0
3	-1.5	**13**	-6.5
4	-2.0	**14**	-7.0
5	-2.5	**15**	-7.5
6	-3.0	**16**	-8.0
7	-3.5	**17**	-8.5
8	-4.0	**18**	-9.0
9	-4.5	**19**	-9.5
10	-5.0	**20**	-10.0

Note: When an output references the P110 Sensor Type and the output is set up for Differential Control (Sn-1 and Sn-2 are P110 Sensor Type), the negative pressure values displayed in the differential pressure System Status screen (dIFP) are displayed as negative psi values, not InHg values. See *Differential Control* on page 14 for more information.

Binary Input Control for Relay Outputs

You can connect a binary input (dry contacts) to any of the three System 450 control module inputs (Sn1, Sn2, or Sn3) and control the output relays in your control system based on the binary input's state (open or closed).

An input (Sn-1, Sn-2, or Sn-3) that is set up as a binary input can only be referenced by a relay output. Inputs set up as binary inputs are not available for selection on analog outputs.

When a relay output references a sensor that is set up as a binary input, the **On** and **OFF** parameter screens are not available as you set up the output. The relay output's On/Off state is controlled by the binary input's Closed/Open state, respectively, **and** any of the timer parameters (ONT, OFFT, ONd, or OFFd) that you set up for the relay output. Refer to the Binary Input Control for Relay Outputs section of the *System 450™ Series Modular Control Systems with Standard Control Modules Technical Bulletin (LIT-12011459)* for more information.

High Input-Signal Selection

The High Input-Signal Selection feature enables a System 450 control system to monitor a condition (temperature, pressure, or humidity) with two or three sensors (of the same type) and control relay, analog, or both outputs based on the highest condition value sensed by the two or three referenced sensors.

In two sensor applications (HI-2), Sn-1 and Sn-2 must be the same Sensor Type. In three sensor applications (HI-3), Sn-1, Sn-2, and Sn-3 must be the same Sensor Type.

A System 450 control system that uses High Input-Signal Selection can monitor the outlet pressures of two condenser coils in a multi-circuit condensing unit using two pressure sensors of the same type—one connected to each coil outlet.

If the multi-circuit condensing unit has single-speed fan motors, multiple relay outputs can be set up to reference the high input-signal and System 450 can stage the fans on and off, based on the pressure sensed at the coil with the highest pressure.

If the multi-circuit condensing unit has variable speed fan motors, one or more analog outputs can be set up to reference the high input-signal and control the fan motor speeds based on the pressure sensed at the coil with the highest pressure.

Differential Control

System 450 control modules include a Differential Control feature. Differential control is used to monitor and maintain a given difference in a condition (temperature, pressure, or humidity) between two sensor points within a system, process, or space.

The Differential Control feature enables a System 450 control system to monitor the temperature, pressure, or humidity differential between two sensors of the same type (Sn-1 and Sn-2) and control relay or analog outputs based on the sensed differential value relative to user-selected differential values (dON, dOFF, dSP, and dEP).

When a Differential Control sensor (Sn-d) is set up, the displayed differential sensor value is a calculated variable value: (Sn-d) = (Sn-1) – (Sn-2).

The Sn-d value appears in the System Status screens as either a temperature differential value (dIFT), pressure differential value (dIFP), or humidity differential value (dIFH). The unit of measurement associated with the displayed differential value is determined by the Sn-1 and Sn-2 Sensor Type. See Table 4 on page 9 for Sensor Types and their units of measurement.

The relay output setup values dON and dOFF are condition differential values. When a relay output is set up for differential control, System 450 controls the relay state (On or Off) based on the difference between Sn-1 and Sn-2 (Sn-d) relative to the user-selected differential On (dON) and differential Off (dOFF) values.

When an analog output is set up for differential control, System 450 controls the analog signal strength based on the difference between Sn-1 and Sn-2 (Sn-d) relative to the user-selected differential setpoint (dSP) and differential endpoint (dEP) values.

Differential Sensor Range of Usable Values

The System 450 Differential Control sensor (Sn-d) value is always equal to Sn-1 minus Sn-2. Depending on the intended control action of the output, the differential value may be either a positive or negative value. Therefore, the range of usable values is twice as large as a single sensor, and each Sensor Type has an equal number of positive and negative values. See Table 7 for the range of usable values when an output references Sn-d.

Note: Binary Inputs cannot be set up as a Differential Sensor.

Table 7: Ranges of Usable Values for Sensor Types in Differential Control Applications

Sensor Type	Sn-d Range of Usable Values	Sensor Type	Sn-d Range of Usable Values
°F	-290 to 290	P 30	-30.0 to 30.0
°C	-161.0 to 161.0	P 50	-50.0 to 50.0
rH	-95 to 95	P 100	-100.0 to 100.0
P0.25	-0.500 to 0.500	P 110	-110.0 to 110.0
P 0.5	-0.500 to 0.500	P 200	-200 to 200
P 2.5	-2.50 to 2.50	P 500	-500 to 500
P 5	-5.00 to 5.00	P 750	-750 to 750
P 8	-9.00 to 9.00	HI°F	-380 to 380
P 10	-10.00 to 10.00	HI°C	-210.0 to 210.0
P 15	-16.0 to 16.0	--	--

Setting Up System 450 Outputs

After you build and connect power to your control system module assembly, the output numbers and output types for your control system are automatically assigned in the UI.

Note: You must set up the input sensors for your control system before you can set up the outputs. See *Setting Up System 450 Sensors* on page 9 for more information.

To set up System 450 outputs in the UI:

1. Apply power to your module assembly. After the **Startup** screen appears briefly (displaying the control module firmware version), the **Main** screen appears on the LCD.
2. In the **Main** screen, press any key to exit idle mode, then press and hold ▲ and ▼ simultaneously for 5 seconds to access the setup screens and to go to the **Sensor Setup Start** screen.
3. At the **Sensor Setup Start** screen, press M repeatedly to scroll through and select the desired **Output Setup Start** screen. The Output Setup Start screen indicates the output number and the output type for the selected output.
4. To set up relay outputs, see *Setting Up a Relay Output* and Table 8 for setup information and procedures.
5. To set up analog outputs, see *Setting Up an Analog Output* and Table 10 for setup information and procedures.
6. To set up the backlight brightness, see *Setting Up the LCD Backlight Brightness* and Table 11 for setup information and procedures.

Setting Up a Relay Output

Table 8 provides information, procedures, guidelines, and screen examples for setting up relay outputs on System 450 control modules. See Figure 6 on page 26 for example menu flow of the Relay Output 1 setup in Table 8.

Note: The differential sensor, Sn-d, is used to set up analog and relay outputs for Differential Control. See *Differential Control* on page 14 for more information.

Table 8: System 450 Setup Screen Information and Procedures for Relay Outputs (Part 1 of 4)

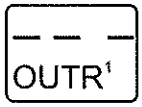
LCD Screen	Name, Description/Function, User Action, and Example
	**Relay Output Setup Start Screen:** The output numbers and the output type (relay or analog) are determined by the module types and configuration of your control system's module assembly and are automatically assigned when you connect power to the module assembly. (See *Setting Up a Control System in the User Interface* on page 5.) **Note:** You must set up the control system input sensors before you can set up the outputs. **1. In the Relay Output Setup Start screen, press ▶ to go to the output's Sensor Selection screen.** The screen example shows a **Relay** Output Setup Start screen for **Output 1**.

Table 8: System 450 Setup Screen Information and Procedures for Relay Outputs (Part 2 of 4)

LCD Screen	Name, Description/Function, User Action, and Example
— — — SENS[1] Sn–2 SENS[1] Hi–2 SENS[1] Sn–d SENS[1] bin SENS[1]	**Sensor Selection Screen:** The sensor you select here determines the output's setup parameters and values, including condition type, unit of measurement, minimum control band, default setup values, and setup value ranges for several of the remaining output setup screens. If a sensor is not selected, the remaining output setup screens do not appear. If a sensor is already selected for this output, the Sensor Selection screen does not appear here and the Relay ON Selection (ON or dON) screen appears instead. **Notes:** • You must select a sensor in this Sensor Selection screen **and** the selected sensor must be already set up in the System 450 UI. (See *Setting Up System 450 Sensors*.) • On System 450 control modules, the functional sensors Sn-d and HI-2 are available, if Sn-1 and Sn-2 are the same Sensor Type. If Sn-1, Sn-2, and Sn-3 are the same Sensor Type, the functional sensor HI-3 is also available. **2. Press ▲ or ▼ to select the sensor that this output references:** • **For standard control action, select Sn-1, Sn-2, or Sn-3.** • **For standard control action with High Input-Signal Selection, select HI-2 or HI-3.** • **For differential control action, select Sn-d.** • **For binary input control of Relay Outputs, select bIn.** **Then, press ▶ to save your sensor selection and go to the Standard Relay ON Selection screen or the Relay dON Selection.** The top screen example shows the initial **Sensor** Selection screen for Relay Output **1** before a sensor is selected. The remaining screen examples show some of the sensors that may be available for selection. For the Output Relay example, **Sn-2** is selected as the **Sensor** for Output 1 as shown in the second screen.
78 ON[1] OR 30.0 dON[1]	***When a relay output references Sn-1, Sn-2, Sn-3, HI-2, or HI-3, the Standard Relay ON Selection screen appears.*** **Standard Relay ON Selection Screen:** Select the value at which the relay turns on. Relay **ON** is defined as relay LED On (lit), relay contacts N.O. to C are closed, and N.C. to C contacts are open. **Note:** The value ranges and minimum control band are determined by the Sensor Type selected for the sensor that the output references and are enforced in the Relay ON and Relay OFF Selection screens. **3. Press ▲ or ▼ to select the value at which the output relay turns on, then press ▶ to save your selection and go to Relay OFF Selection screen.** The screen example shows an **ON** value of **78** (°F) selected for Relay Output **1**. ***When a relay output references Sn-d, the Differential Relay dON Selection screen appears.*** **Differential Relay dON Selection Screen:** Select the dON value at which the relay turns on. The dON value is a differential value that represents the intended difference in the condition (temperature, pressure, or humidity) between Sn-1 and Sn-2 (Sn-1 minus Sn-2) at which the relay is turned on. Depending on the intended control action and the physical location of Sn-1 and Sn-2 sensors in the condition process, dON may be a positive or negative value. **Note:** The unit of measurement, resolution increment, minimum control band, and range of usable values for dON and dOFF are determined by the Sensor Type selected for Sn-1 and Sn-2. (See Table 4 and Table 7 for more information.) **3. Press ▲ or ▼ to select the differential value at which the output relay turns on. Press ▶ to save your selection and go to Relay dOFF Selection Screen.** The screen example shows a **dON** value of **30** (psi) selected for Relay Output **1**. ***When a relay output references a hard-wired sensor (Sn-1, Sn-2, or Sn-3) that is set up with the bIn (binary input) Sensor Type, the ON and OFF screens are not available. If you select and save a sensor set up as a binary input in Step 2, the ON Delay (ONd) screen appears. Go to Step 5.*** **Binary Input Control:** Relay outputs that reference sensors set up with the **bIn** Sensor Type are controlled by the binary input contacts state (open or closed). The ON and OFF values are not used to control relay outputs that reference a binary input sensor.

Table 8: System 450 Setup Screen Information and Procedures for Relay Outputs (Part 3 of 4)

LCD Screen	Name, Description/Function, User Action, and Example
75 OFF[1] OR 32.0 dOFF[1]	***When a relay output references Sn-1, Sn-2, Sn-3, HI-2, or HI-3, the Standard Relay OFF Selection screen appears.*** **Standard Relay OFF Selection Screen:** Select the value at which the relay turns off. Relay **OFF** is defined as relay LED Off, relay contacts N.C. to C are closed, and N.O. to C contacts are open. **Note:** The value ranges and minimum control band are determined by the Sensor Type selected for the sensor that the output references and are enforced in the Relay ON and Relay OFF Selection screens. **4. Press ▲ or ▼ to select the value at which output relay turns off, then press ▶ to save your selection and go to Relay-ON Delay Time Selection screen.** The screen example shows an **OFF** value of **75** (°F) selected for Relay Output 1.
	When a relay output references Sn-d, the Differential Relay dOFF Selection screen appears. **Differential Relay dOFF Selection Screen:** Select the dOFF value at which the relay turns on. The dOFF value is a differential value that represents the intended difference in the condition (temperature, pressure, or humidity) between Sn-1 and Sn-2 (Sn-1 minus Sn-2) at which the relay is turned off. Depending on the intended control action and the physical location of Sn-1 and Sn-2 sensors in the condition process, dOFF may be a positive or negative value. **dOFF** is defined as relay LED Off, relay contacts N.C. to C are closed, and N.O. to C contacts are open. **Note:** The unit of measurement, resolution increment, minimum control band, and range of usable values for dON and dOFF are determined by the Sensor Type selected for Sn-1 and Sn-2. (See Table 4 and Table 7 for more information.) **4. Press ▲ or ▼ to select the differential value at which output relay turns off. Press ▶ to save your selection and go to the Relay-ON Delay Time Selection Screen.** The screen example shows a **dOFF** value of **32** (psi) selected for Relay Output 1.
	When a Relay Output references a hard-wired sensor (Sn-1, Sn-2, or Sn-3) that is set up with the bin (binary input) Sensor Type, the ON and OFF screens are not available. If you select and save a sensor set up as a binary input in Step 2, the ON Delay (ONd) screen appears. Go to Step 5. **Binary Input Control:** Relay outputs that reference a sensor set up with the **bin** Sensor Type are controlled by the binary input contacts state (open or closed). The ON and OFF values are not used to control relay outputs that reference a binary input sensor.
30 ONd[1]	**Relay-On Delay Time Selection Screen:** Select the value (in seconds) that you want output relay to delay turning ON after the condition reaches and maintains the Relay-On value. The Relay-On Delay time range is 0 to 300 seconds. **Note:** Beginning with firmware Version 4.00, the Relay-On Delay feature can be used to delay the output relay from going to the On state after the On value is reached at the referenced input sensor. The condition change must reach or exceed the output's Relay-On value for the entire duration of the Relay-On Delay, before the output relay goes On. This feature can be used to prevent controlled equipment such as actuators from being exercised every time the condition momentarily spikes to the Relay-On value, reducing wear on the controlled equipment. **5. Press ▲ or ▼ to select the time value (in seconds) that the output relay delays turning on after the process condition reaches the Relay-On value, then press ▶ to save your selection and go to the Relay-On Delay Time Selection Screen.** The screen example shows an **ONd** value of **30** (seconds) selected for Output 1.
0 OFFd[1]	**Relay-Off Delay Time Selection Screen:** Select the value (in seconds) that you want output relay to delay turning Off after the condition reaches and maintains the Relay-Off value. The Relay-Off Delay time range is 0 to 300 seconds. **Note:** Beginning with firmware Version 4.00, the Relay-Off Delay feature can be used to delay the output relay from going to the Off state after the Off value is reached at the referenced input sensor. The condition change must reach or exceed the output's Relay-Off value for the entire duration of the Relay-Off Delay, before the output relay goes Off. This feature is used to prevent controlled equipment such as actuators from being exercised every time the condition momentarily spikes to the Relay-Off value, reducing wear on the controlled equipment. **6. Press ▲ or ▼ to select the time value (in seconds) that the output relay delays turning off after the process condition reaches the Relay-Off value, then press ▶ to save your selection and go to the Relay-Off Delay Time Selection Screen.** The screen example shows an **OFFd** value of **0** (seconds) selected for Output 1.

Table 8: System 450 Setup Screen Information and Procedures for Relay Outputs (Part 4 of 4)

LCD Screen	Name, Description/Function, User Action, and Example
0 ONT[1]	**Minimum Relay ON Time Selection Screen:** Select the minimum time that the output relay is required to stay on after it turns on. The minimum ON Time range is **0** to **300** seconds. **7. Press ▲ or ▼ to select the minimum time that the output relay remains on after reaching the Relay ON value, then press ▶ to save your selection and go to the Minimum Relay OFF Time Selection screen.** The screen example shows an **ONT** value of **0** (seconds) selected for Output **1**.
120 OFFT[1]	**Minimum Relay OFF Time Selection Screen:** Select the minimum time that the output relay is required to stay Off after it turns Off. Minimum OFF Time range is **0** to **300** seconds. **8. Press ▲ or ▼ to select the minimum time that this output relay remains off after reaching the Relay OFF value. Press ▶ to save your selection and go to the Sensor Failure Mode Selection screen.** The screen example shows an **OFFT** value of **120** (seconds) selected for Output **1**.
OFF SNF[1]	**Sensor Failure Mode Selection Screen:** Select the output's mode of operation if a referenced sensor or sensor wiring fails. For outputs that reference functional sensors HI-2, HI-3, or Sn-d, the failure of any of the referenced hard-wired sensors results in a functional sensor failure condition. The output operates in the selected Sensor Failure mode until the failure is remedied. Sensor Failure mode selections for relay outputs include: • **ON** = Output relay remains on during sensor failure. • **OFF** = Output relay remains off during sensor failure. **9. Press ▲ or ▼ to select this output's mode of operation if the sensor or sensor wiring fails. Press ▶ to save your sensor failure mode selection and go to the Edit Sensor screen.** The screen example shows **OFF** selected as the **Sensor Failure** mode for Output **1**.
Sn–2 SENS[1]	**Edit Sensor Screen:** This screen displays the sensor that this output currently references. Typically, no action is taken in this screen. But if you need to change the sensor that this output references, you can select a different sensor for this output in this screen. **Note:** If you change the sensor that an output references to a sensor with a different Sensor Type, the default setup values for the output change, and you must set the output up again. **10. If you do not need to change this output's sensor, simply press ▶ to save the current sensor selection and return to the Relay Output Setup Start screen.** **To change the sensor this output references, press ▲ or ▼ to select the new sensor that this output references. Then press ▶ to save the new sensor selection and return to the Relay ON Selection screen (ON or dON). If the new sensor has a different Sensor Type from the previously referenced sensor, repeat the output setup procedure for this output.** This relay output is now set up in the System 450 UI. The screen example shows **Sn-2** is selected **Sensor** for Output **1**.
— — — OUTR[1]	**Relay Output Setup Start Screen** After you have set up this relay output, you can go to another Output Setup Start screen, the Sensor Setup Start screen, or return to the Main screens. **11. Press M to scroll through the remaining Output Setup Start screens and return to the Sensor Setup Start screen, or press ▲ and ▼ simultaneously to return to the System 450 Main screens.** The screen example shows a **Relay** Output Setup Start screen for **Output 1**.

Setting Up an Analog Output

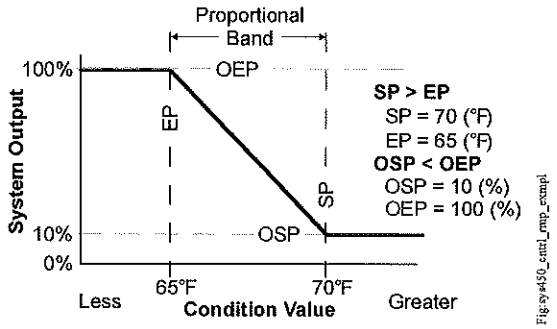
Analog outputs provide an analog signal to control equipment in your application based on the input from a standard fixed setpoint sensor (Sn-1, Sn-2, or Sn-3) or a High Input Signal Selection sensor (HI-2 or HI-3).

Note: The differential sensor, Sn-d, is used to set up analog and relay outputs for Differential Control. See *Differential Control* on page 14 for more information.

Analog outputs provide an auto-selecting analog signal that is proportional to the sensed input condition. The System 450 analog output senses the impedance of the controlled equipment's analog input circuit and automatically delivers either a 0–10 VDC or 4–20 mA signal to the controlled equipment.

Figure 5 shows an example of the analog output setup values and the resulting output signal in a typical space heating application (SP > EP and OSP < OEP).

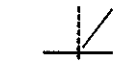
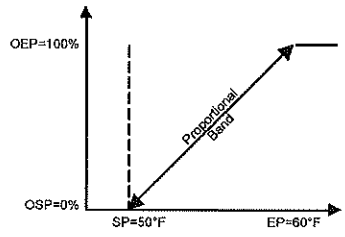
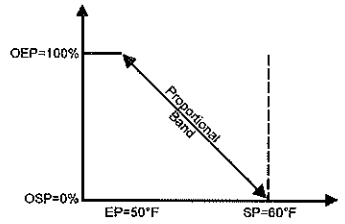
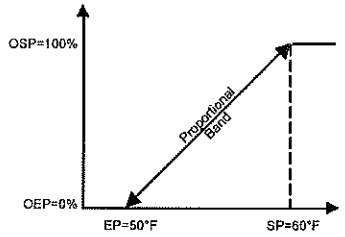
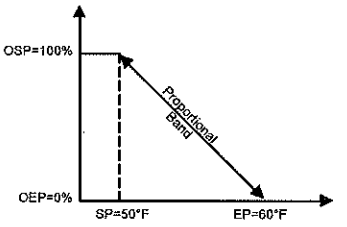
Figure 5: Control Ramp Example for a Typical Heating Application (SP > EP and OSP < OEP)



The control action between the input signal and the output signal can be set up four ways, depending on the values selected for the Setpoint (SP), End Point (EP), Percent Output Signal Strength at Setpoint (OSP), and Percent Output Signal Strength at End Point (OEP). The LCD displays different Control Ramp icons for the four control actions.

Table 9 shows the four Control Ramp icons and the associated analog output setup value relationships.

Table 9: Analog Output Control Ramp Icons

Control Ramp Displayed on LCD	Control Action	Set the Analog Output Value Relationships for the Desired Control Action and Control Ramp
 Output Minimum at SP		**SP < EP** **OSP < OEP**
 Output Minimum at SP		**SP > EP** **OSP < OEP**
 Output Maximum at SP		**SP > EP** **OSP > OEP**
 Output Maximum at SP		**SP < EP** **OSP > OEP**

Setting Up the Integration Constant, Update Rate, and Output Deadband

The System 450 Integration Constant (I-C), the Update Output Signal Rate (UP-R), and the Output Signal Strength Deadband (bNd) are powerful tools for controlling the analog outputs and your application's process loops.

Depending on your control system application, setting up the I-C, UP-R, or bNd values to those other than the factory-default values can significantly change the behavior of an analog output. Refer to the *System 450™ Series Modular Control Systems with Standard Control Modules Technical Bulletin (LIT-12011459)* for more information.

IMPORTANT: If you set the I-C, UP-R, or bNd values to something other than the default value, you should operate and observe the affected analog outputs and process loops through the entire range of control. Failure to observe and adjust an analog output set up to use the I-C, UP-R, or bNd features can result in unexpected behavior and out of range conditions in the affected process loops.

Table 10 provides information, procedures, guidelines, and screen examples for setting up analog outputs on System 450 control modules.

See Figure 6 on page 26 for example menu flow of the Analog Output 3 set up in Table 10.

Table 10: System 450 Setup Screen Information and Procedures for Analog Output (Part 1 of 4)

LCD Screen	Name, Description/Function, User Action, and Example
— — — OUTA[3]	**Analog Output Setup Start Screen:** The output numbers and the output type (relay or analog) are determined by the module types and configuration of your control system's module assembly and are automatically assigned when you connect power to the module assembly. (See *Setting Up a Control System in the User Interface* on page 5.) **Note:** You must set up the system's sensors before you can set up the outputs. **1. Press ▶ to go to this output's Sensor Selection screen.** The screen example shows the **Analog** Output Setup Start screen for **Output 3**.
— — — SENS[1] Sn–2 SENS[1] Hi–2 SENS[1] Sn–d SENS[1]	**Sensor Selection Screen:** The selected sensor determines this output's setup parameters and values, including condition type, unit of measurement, minimum proportional band, default setup values, and setup value ranges for several of the remaining output setup screens. If a sensor is not selected here, this output's remaining setup screens do not appear. If a sensor is already selected for this output, the Sensor Selection screen does not appear here, and the Setpoint Selection (SP or dSP) screen appears instead. **Notes:** • You must select a sensor in this Sensor Selection screen **and** the selected sensor must be already set up in the System 450 UI. (See *Setting Up System 450 Sensors*.) • On System 450 control modules, the functional sensors Sn-d and HI-2 are available if Sn-1 and Sn-2 are the same Sensor Type. If Sn-1, Sn-2, and Sn-3 are the same Sensor Type, the functional sensor HI-3 is also available. The Binary Input sensor is not available for analog outputs. **2. Press ▲ or ▼ to select the sensor that this output references:** • **For standard control action, select Sn-1, Sn-2, or Sn-3.** • **For standard control action with High Input-Signal Selection, select HI-2 or HI-3.** • **For differential control action, select Sn-d.** **Then press ▶ to save your sensor selection and go to the Setpoint Selection screen.** The top screen example shows the initial **Sensor** Selection screen for Analog Output **3** before a sensor is selected. The remaining screen examples show some of the sensors that may be available for selection. For the analog output example, **Sn-1** is the selected **Sensor** for Output **3** as shown in the second screen.

Table 10: System 450 Setup Screen Information and Procedures for Analog Output (Part 2 of 4)

LCD Screen	Name, Description/Function, User Action, and Example
225 SP3 OR 30.0 dSP3	***When an analog output references Sn-1, Sn-2, Sn-3, HI-2, or HI-3, the Standard Setpoint Selection screen appears.*** **Setpoint Selection Screen:** Setpoint is the target value that the controlled system drives toward and, along with End Point, defines this output's proportional band. **Note:** An output's minimum proportional band (between Setpoint and End Point) is automatically enforced in the output's Setpoint and End Point Selection screens. **3. Press ▲ or ▼ to select this output's Setpoint value. Press ▶ to save your Setpoint value selection and go to the End Point Selection screen.** The screen example shows a **Setpoint** value of **225** (psi) selected for Output **3**.
	When an analog output references Sn-d, the Differential Setpoint Selection screen appears. **Differential Setpoint Selection Screen:** Differential Setpoint (dSP) is the target value that the controlled system drives toward, and along with Differential End Point (dEP), defines this output's proportional band. The dSP value is a differential value that represents a (selected) difference in the condition (temperature, pressure, or humidity) between Sn-1 and Sn-2 (Sn-1 minus Sn-2). Depending on the intended proportional control action and the physical location of Sn-1 and Sn-2 sensors in the condition process, dSP may be a positive or negative value. **Note:** The unit of measurement, resolution increment, minimum proportional band, and range of usable values for dSP and dEP are determined by the Sensor Type selected for Sn-1 and Sn-2. (See Table 4 and Table 7 for more information.) The output's minimum proportional band (between dSP and dEP) is automatically enforced in the output's Setpoint and End Point Selection screens. **3. Press ▲ or ▼ to select this output's Differential Setpoint value. Press ▶ to save your Differential Setpoint value selection and go to the End Point Selection screen.** The screen example shows a **dSP** value of **30** (psi) selected for Output **3**.
235 EP3 OR 25.0 dEP3	***When the analog output references Sn-1, Sn-2, Sn-3, HI-2, or HI-3, the Standard End Point Selection screen appears.*** **End Point Selection Screen:** End Point is the value that the controlled system drives away from (toward Setpoint) and, along with Setpoint, defines this output's proportional band. **Note:** An output's minimum proportional band (between Setpoint and End Point) is automatically enforced in the output's Setpoint and End Point Selection screens. **4. Press ▲ or ▼ to select this output's End Point value. Press ▶ to save your End Point value selection and go to the %Output Signal Strength at Setpoint Selection screen.** The screen example shows an **End Point** value of **235** (psi) selected for Output **3**.
	When the analog output references Sn-d, the Differential End Point Selection screen appears. **Differential End Point Selection Screen:** Differential End Point (dEP) is the target value that the controlled system drives away from (toward Differential Setpoint) and along with Differential Setpoint (dSP), defines this output's proportional band. The dEP value is a differential value that represents a (selected) difference in the condition (temperature, pressure, or humidity) between Sn-1 and Sn-2 (Sn-1 minus Sn-2). Depending on the intended proportional control action and the physical location of Sn-1 and Sn-2 sensors in the condition process, dEP may be a positive or negative value. **Note:** The unit of measurement, resolution increment, minimum proportional band, and range of usable values for dSP and dEP are determined by the Sensor Type selected for Sn-1 and Sn-2. (See Table 4 and Table 7 for more information.) The output's minimum proportional band (between dSP and dEP) is automatically enforced in the output's Setpoint and End Point Selection screens. **4. Press ▲ or ▼ to select this output's Differential End Point value. Press ▶ to save your Differential End Point value selection and go to the %Output Signal Strength at Setpoint Selection screen.** The screen example shows a **dEP** value of **25** (psi) selected for Output **3**.
10 OSP3	**Output Signal Strength at Setpoint Selection Screen:** Select the strength of the signal that this output generates when the sensed condition is at the Setpoint value. The signal strength range is **0** to **100** (%). **5. Press ▲ or ▼ to select this output's %Output Signal Strength at Setpoint (OSP) value. Press ▶ to save your selection and go to the %Output Signal Strength at End Point Selection screen.** The screen example shows an **OSP** value of **10** (%) selected for Output **3.** Therefore, Output 3 generates 10% of the total signal strength (1 V or 5.6 mA) when the input is at the Setpoint value of 200 (psi).

Table 10: System 450 Setup Screen Information and Procedures for Analog Output (Part 3 of 4)

LCD Screen	Name, Description/Function, User Action, and Example
90 OEP³	**Output Signal Strength at End Point Selection Screen:** Select the strength of the signal that this output generates when the sensed condition is at the End Point value. The signal strength range is **0** to **100** (%). **6. Press ▲ or ▼ to select this output's %Output Signal Strength at End Point value. Press ▶ to save your selection and go to the Integration Constant Selection screen.** The screen example shows an **OEP** value of **90** (%) selected for Output **3.** Therefore Output 3 generates 90% of the total signal strength (9 V or 18.4 mA) when the input is at the End Point value of 250 (psi).
0 I-C³	**Integration Constant Selection Screen:** An integration constant allows you to set up proportional plus integral control for this analog output. Proportional plus integral control can drive the load closer to Setpoint than proportional only control. **Note:** Initially, you should select the I-C value of **0** (zero) for no integration constant. Refer to the *System 450 Series Technical Bulletin (LIT-12011459)* for more information on proportional plus integral control and setting an integration constant in the System 450 UI. **7. Press ▲ or ▼ to select this output's Integration Constant for proportional plus integral control. Press ▶ to save your selection and go to the Output Update Rate Selection screen.** The screen example shows an **I-C** value of **0** (zero) selected for Output **3**.
1 UP-R³	**Output Signal Update Rate Selection Screen:** Select the time interval in seconds at which the output updates the output signal strength. The selected Output Signal Update Rate is the minimum time that the output maintains a constant signal strength (regardless of the input signal) before updating the output signal in response to the referenced input signal. The Output Signal Update Rate value range is 1 to 240 (seconds). **Note:** Beginning with firmware Version 4.00, the Output Update Rate is used to reduce excessive cycling or repositioning of controlled equipment, such as valve and damper actuators. The Output Signal Update Rate feature can be used in conjunction with the Output Signal Deadband feature. **8. Press ▲ or ▼ to select this output's Output Signal Update Rate. Press ▶ to save your selection and go to the Output Signal Deadband Selection screen.** The screen example shows an Output Update Rate value of 1 (second), which is the default and lowest update rate you can select.
0 bNd³	**Output Signal Deadband Selection Screen:** Select the Output Signal Deadband value (as a percent of the output signal strength range) to establish a deadband around the analog output signal strength. The analog output responds to a changing input signal and updates the output signal strength whenever the input signal moves outside of the selected Output Signal Deadband. At each update of the output signal, the control determines if the calculated (input-induced) output signal strength is within the selected Output Signal Deadband or not. If the input-induced change of the output signal strength is within the selected Output Signal Deadband, the output signal strength is not updated and remains unchanged. If the input-induced change of the output signal falls outside the Output Signal Deadband, the output signal strength is updated to the new signal strength value and the selected Output Signal Deadband is applied to the new signal strength value. The Output Signal Deadband range is 0 to 50% of the OSP to OEP range. **Note:** Beginning with firmware Version 4.00, the Output Signal Deadband is used to reduce excessive cycling or repositioning of controlled equipment, such as valve and damper actuators.The Output Signal Deadband feature can be used in conjunction with the Output Signal Update Rate feature. **9. Press ▲ or ▼ to select this output's Output Signal Deadband. Press ▶ to save your selection and go to the Sensor Failure Mode Selection screen.** The screen example shows an Output Deadband value of 0 (%), which is the default value and disables the Output Deadband feature.

Table 10: System 450 Setup Screen Information and Procedures for Analog Output (Part 4 of 4)

LCD Screen	Name, Description/Function, User Action, and Example
OFF SNF[3]	**Sensor Failure Mode Selection Screen:** Select the output's mode of operation if a referenced sensor or sensor wiring fails. For outputs that reference functional sensors HI-2, HI-3, or Sn-d, the failure of any of the referenced hard-wired sensors results in a functional sensor failure condition. The output operates in the selected Sensor Failure mode until the failure is remedied. Sensor Failure mode selections for analog outputs include: • **ON** = Output generates the selected OEP signal strength during sensor failure. • **OFF** = Output generates the selected OSP signal strength during sensor failure. **10. Press ▲ or ▼ to select this output's mode of operation if the sensor or sensor wiring fails. Press ▶ to save your selection and go to the Edit Sensor Selection screen.** The screen example shows **OFF** selected as the **Sensor Failure** mode for Output 3.
Sn–2 SENS[3]	**Edit Sensor Selection Screen:** This screen displays the sensor that this output currently references. Typically, no action is taken in this screen. But if you need to change the sensor that this output references, you can select a different sensor for this output in this screen. **Note:** If you change the sensor that an output references to a sensor with a different Sensor Type, the default setup values for the output change, and you must set the output up again. **11. If you are not changing this output's sensor, simply press ▶ to save the current sensor selection and return to the Analog Output Setup Start screen.** **To change the sensor this output references, press ▲ or ▼ to select the new sensor that this output references. Then press ▶ to save the new sensor selection and return to the Setpoint Selection screen (SP or dSP). If the new sensor has a different Sensor Type from the previously referenced sensor, repeat the output setup procedure for this output.** The screen example shows **Sn-2** as the selected Sensor for Output 3.
– – – OUTA[3]	**Analog Output Setup Start Screen:** After you have set up this analog output, you can go to another Output Setup Start screen, the Sensor Setup Start screen, or return to the Main screens. **12. Press M to scroll through the remaining Output Setup Start screens and return to the Sensor Setup Start screen, or press ▲ and ▼ simultaneously to return to the System 450 Main screens.** The screen example shows the Analog Output Setup Start screen for Output 3.

Setting Up the LCD Backlight Brightness

Beginning with firmware Version 4.00, the LCD backlight brightness can be adjusted in the UI. Table 11 provides information, procedures, guidelines, and screen examples for setting up the backlight brightness on System 450 control modules. See Figure 6 on page 26 for an example menu flow of the backlight set up in Table 11.

Table 11: System 450 Setup Screen Information and Procedures for Backlight Brightness (Part 1 of 2)

LCD Screen	Name, Description/Function, User Action, and Example
– – – bKLT	**Backlight Setup Start Screen:** The Backlight Brightness level feature allows you to adjust the LCD backlight intensity. The selected backlight low level value is applied when the control is in idle mode. When you enter the programming menus to set up the control or press any key, the LCD automatically goes to the selected backlight high level value. **1. Press ▶ to go to the Edit Backlight Low Level screen.** The screen example shows the Backlight Setup Start screen.
OFF bKLL	**Backlight Low Level:** The backlight low level defines the brightness of the backlight during regular or idle mode, when you are not making adjustments to the control. **2. Press ▲ or ▼ to select the backlight brightness low level value. Press ▶ to save your selection and go to the Edit Backlight High Level screen.** The screen example shows the Backlight low level set to OFF.
10 bKLH	**Backlight High Level:** The high level defines the brightness when you are making configuration changes to the control and interacting with the UI. The backlight high level can be set to values 1–10; it cannot be turned completely off. **3. Press ▲ or ▼ to select the backlight brightness high level value. Press ▶ to save your selection and return to the Backlight Setup Start screen.** The screen example shows the Backlight high level set to 10.

Table 11: System 450 Setup Screen Information and Procedures for Backlight Brightness (Part 2 of 2)

LCD Screen	Name, Description/Function, User Action, and Example
	**Backlight Setup Start Screen** After you have set up the backlight brightness level, you can go to the Sensor Setup Start screen, or return to the Main screens. **4. Press M to return to the Sensor Setup Start screen, or press ▲ and ▼ simultaneously to return to the System 450 Main screens.** The screen example shows the Backlight Setup Start screen.

Figure 6: System 450 Status Screens, Setup Screens, and Menu Flow Example

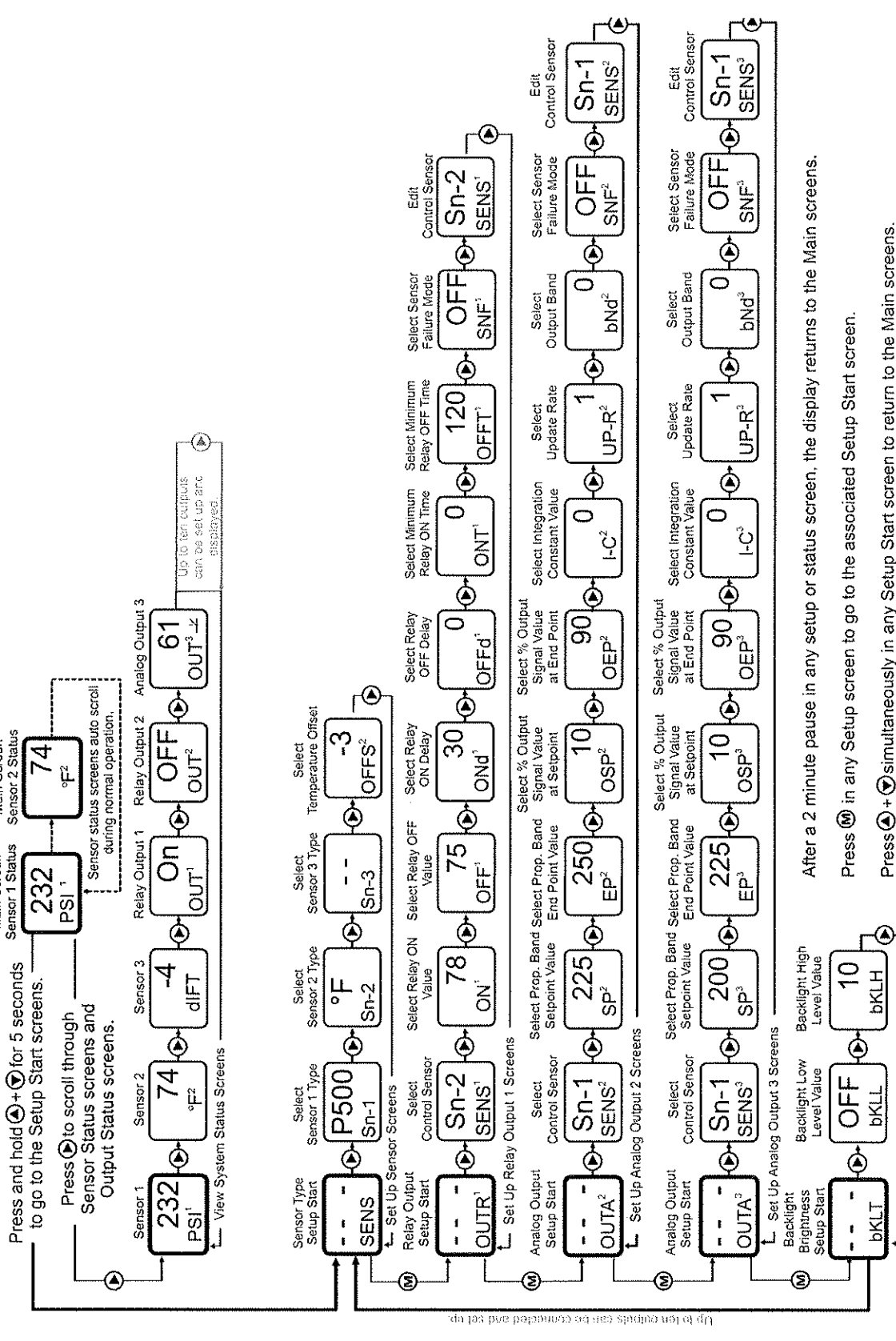
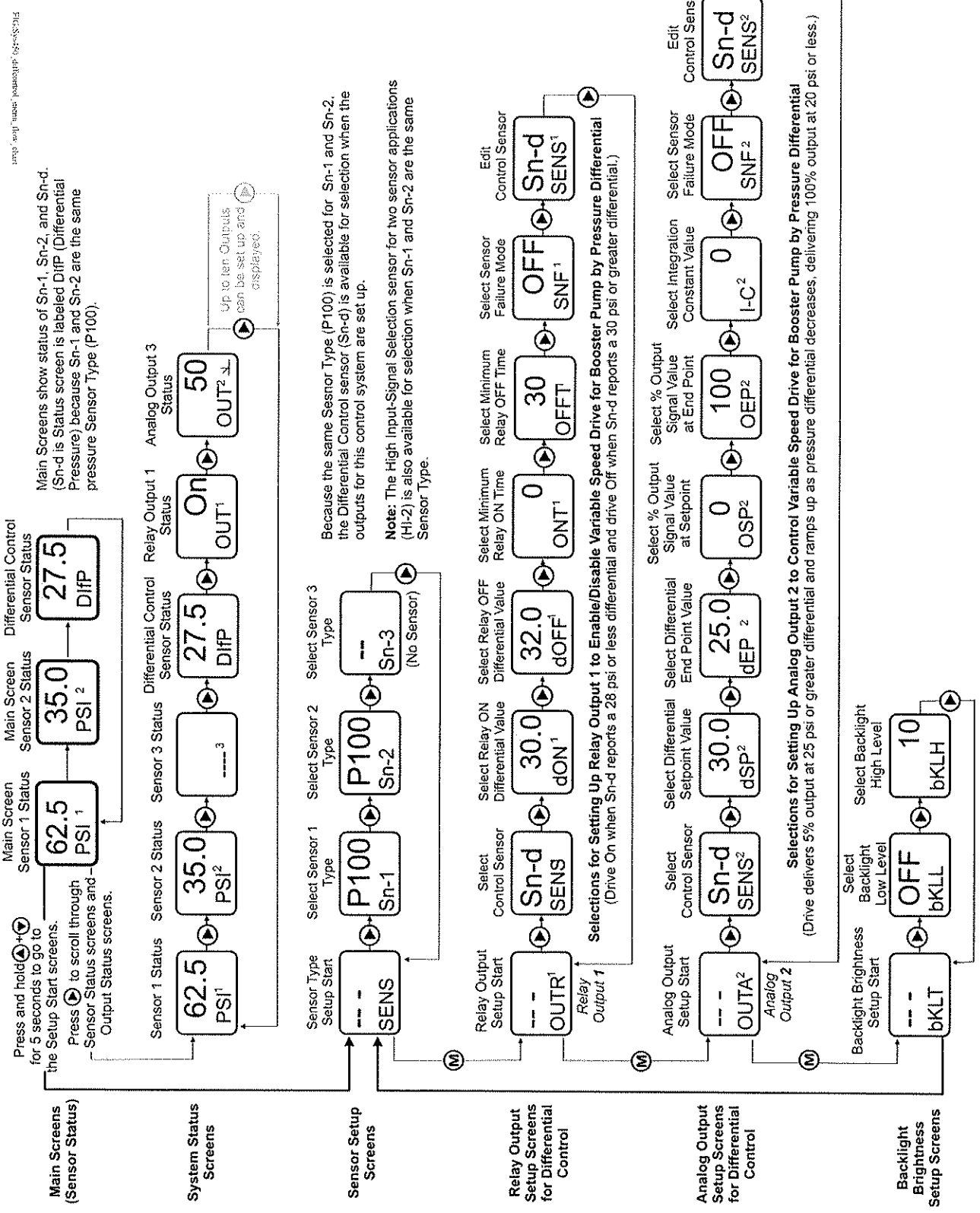


Figure 7: System 450 Status Screens, Setup Screens, and Menu Flow Example for Differential Control



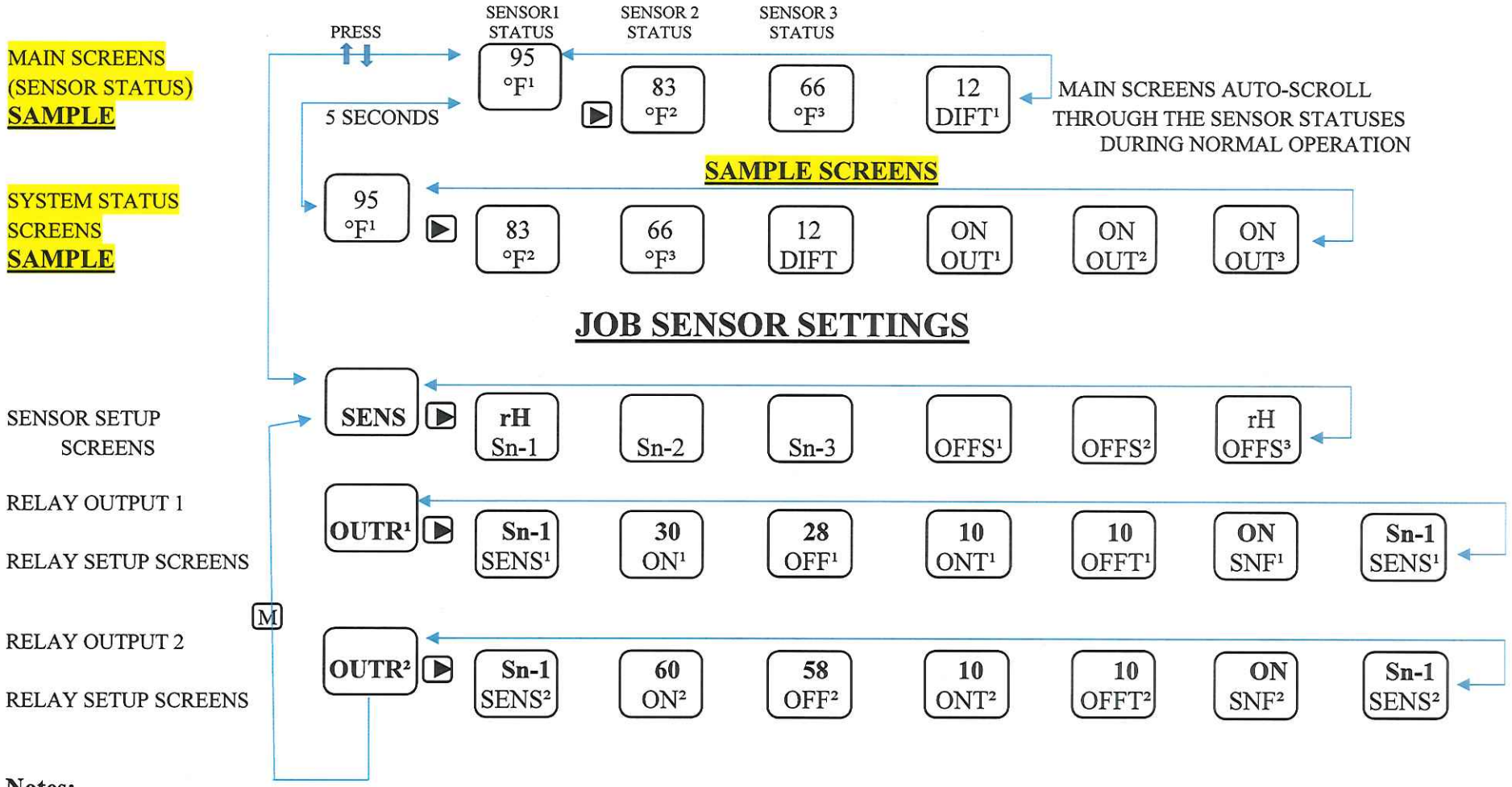
Technical Specifications

C450CxN Control Modules with Analog Outputs

Product	**C450CxN:** System 450 Control Modules are sensing controls and operating controls with LCD, four-button touchpad, and On/Off relay output. **C450CBN-4:** Control Module with one SPDT output relay **C450CCN-4:** Control Module with two SPDT output relays
Supply Power	C450YNN-1 Power Supply Module, or 24 (20-30) VAC Safety Extra-Low Voltage (SELV) (Europe) Class 2 (North America), 50/60 Hz, 10 VA minimum, or 20–30 VDC, 2 Watts minimum for control, then 1 Watt additional for each output attached. **Note:** A System 450 Control Module must only be connected to one power source.
Ambient Operating Conditions	**Temperature:** -40 to 66°C (-40 to 150°F) **Humidity:** Up to 95% RH Non-condensing; Maximum Dew Point 29°C (85°F)
Ambient Shipping and Storage Conditions	**Temperature:** -40 to 80°C (-40 to 176°F) **Humidity:** Up to 95% RH Non-condensing; Maximum Dew Point 29°C (85°F)
Input Signal	0–5 VDC; 1,035 ohms at 25°C (77°F) for an A99 PTC Temperature Sensor
Output Relay Contacts	**General:** 1/2 HP at 120/240 VAC, SPDT
	Specific: AC Motor Ratings — 120 VAC — 208/240 VAC AC Full-Load Amperes: 9.8 A 4.9 A AC Locked-Rotor Amperes: 58.8 A 29.4 A 10 Amperes AC Non-Inductive at 24/240 VAC Pilot Duty: 125 VA at 24/240 VAC
Enclosure	Type 1 (NEMA), IP20 High-Impact Thermoplastic
Dimensions (H x W x D)	127 x 61 x 61 mm (5 x 2-3/8 x 2-3/8 in.)
Weight	**C450CBN-4:** 209 gm (0.46 lb) **C450CCN-4:** 222 gm (0.49 lb)
Compliance CE	**United States:** cULus Listed; UL 60730-1, File E27734; FCC Compliant to CFR47, Part 15, Subpart B, Class B
	Canada: cULus Listed; CAN/CSA-E60730-1, File E27734; Industry Canada (IC) Compliant to Canadian ICES-003, Class B limits
	Europe: CE Mark - Johnson Controls declares that this product is in compliance with the essential requirements and other relevant provisions the EMC Directive.
	Australia and New Zealand: RCM mark, Australia/NZ Emissions Compliant

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult Johnson Controls Application Engineering at (414) 524–5535. Johnson Controls shall not be liable for damages resulting from misapplication or misuse of its products.

450 SENSOR SETTINGS **Heater-2 Step**



Notes:

Press and hold up or down arrow for 5 seconds to go to the Setup Start screens.
Press side arrow to scroll through Sensor Status screens and Output Status screens.
After a 2 minute pause in any setup or status screen, the display returns to the Main Screens.
Press 'M' in any Setup screen to go to the associated Setup Start screen.
Press up and down arrows simultaneously in any Setup Start screen to return to the Main screens.

MODEL CAC
PREVENTIVE MAINTENANCE

DAILY:

1. Check for ice or haze in or on vestibule. See "HCR Freezer Door Troubleshooting." or "Operating Instructions".
2. Remove debris accumulation from intake screens of intake plenum(s).

AFTER INITIAL 50 TO 100 HOURS OF OPERATION:

1. Inspect all bearing collar set screws and tighten as necessary to a minimum of 6 ft./lbs. or advised by blower manufacturer.
2. If blower(s) are belt drive, check tension. **Inspect/clean blower wheel for debris.**

MONTHLY:

1. If applicable, check belt(s) tension and grease bearings. **Inspect/clean blower wheel(s) as necessary. Clean-out door on blower(s) may be provided – failure to clean blower wheel can lead to an unbalanced blower that will fail!**

YEARLY:

1. Replace blower belts, if present, and check blower wheel(s) for foreign material accumulation.
2. Check electric heater elements and contactor(s) (if applicable) performance.
3. Clean hot-gas coil (if applicable) and check for the correct heat output.
4. Verify that humidistats, PLC's, t'stats, heater relay and/or temperature controller works.