

# base

## User Manual

Manual Revision 1.05



These instructions are intended as an aid to qualified, licensed installers and service personnel for proper installation, adjustment and operation of this unit. Read and understand these instructions thoroughly before attempting installation or operation. Failure to follow these instructions may result in improper installation, adjustment, service or maintenance possibly resulting in fire, electrical shock, carbon monoxide poisoning, explosion, personal injury or property damage.

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[www.engineeredair.com](http://www.engineeredair.com)

## INTRODUCTION

Read this manual thoroughly before operating or servicing this unit.

The Engineered Air base and CD-XM expansion module have been certified by Intertek (ETL) as a recognized component for use with Engineered Air appliances only, evaluated to CSA 22.2 No. 24 Temperature Indicating and Regulating Equipment and UL873 Standard for Safety Temperature Indicating and Regulating Equipment. This is a User Operation Manual and therefore not subject to evaluation.

If any errors or omissions are noted please contact the nearest Engineered Air Technical Service Department.

To ensure warranty is honored, only qualified personnel should be employed for service or troubleshooting. If further information is required please contact the nearest Engineered Air sales office.

There are two sets of electrical drawings and function sheets provided with the appliance. One set is in an envelope which also contains the Operation, Installation and Maintenance manual(s). This package is for copying, then should either be returned to the appliance or stored in a safe place. The other set is attached to the control panel door and should never be removed.

This User Manual and the CenCon Technical Manual is available on the Engineered Air website.

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## WARNINGS, CAUTIONS AND NOTICES

Warning, Caution and Notice statements are used throughout this manual to emphasize important and critical information. You must read these statements to help ensure safety and to prevent damage.

### WARNING:

Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

### CAUTION:

Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

### NOTICE:

Indicates information considered important but not hazard related.

### CAUTION:

If capable of heating, this appliance can discharge at high temperatures. Operate with caution as excessive heat could potentially cause damage. Fire alarms, smoke and heat detectors, sprinklers, fire dampers, etc. could activate.

Combustion setup and any service over-rides should be done with caution, and at cooler inlet temperatures. Refer to the appliance rating plate for the marked temperature rise of the appliance prior to commissioning or combustion setup.

### WARNING:

Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death. Read the installation, operation and maintenance instructions thoroughly before installing or servicing this equipment.

### WARNING:

This unit is connected to high voltages. Electrical shock could occur if instructions are not followed. This equipment contains moving parts that can start unexpectedly. Injury or death could occur if instructions are not followed. All work must be performed by a qualified technician. Always disconnect and lock out power before servicing. DO NOT bypass any interlock or safety switches under any circumstances.

### CAUTION:

All the remote wiring must be complete and functional before attempting to start the appliance.

### CAUTION:

It is important that the service technician understands the base is a configurable controller. Its operation on one appliance of equipment may not mimic another.

### CAUTION:

Adding a variable air volume system to equipment originally designed with constant air flow will void warranty, unless approved and recorded by Engineered Air.

### CAUTION:

The base is specifically programmed for this specific appliance. Do not replace with another controller without confirming its program suitability with Engineered Air.

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## OVERVIEW

The Engineered Air base controller is the primary operational component of Engineered Air heating equipment, with and without cooling. Functions include:

- Outdoor, discharge and room temperature monitoring.
- Single and variable speed fan control.
- Analog heating and cooling outputs.
- Damper and economizer control.
- Alarm annunciation.
- Freeze protection.
- Night mode for Mixbox applications.

Each base controller is factory programmed specifically for the equipment installed. Refer to the appliance function description for additional details.

## HARDWARE INFORMATION

Control Voltage	24Vac 60Hz
Digital Output Rating	120Vac 10A
Digital Input	24-120Vac
Analog Output	0-10Vdc
Analog Input	0-10Vdc or 4-20mA
Temperature Rating	-40 - 150°F (65°C)
Temperature Sensor	10k Type 2 NTC
Terminations	#14 awg max.

### ⚠ NOTICE:

Digital inputs connections to the base or any of the expansion modules cannot use mosfet solid state switches. Input switching must be mechanical.

## COMMUNICATION

Direct connection may be made to a laptop computer using a Cat.5 cable. Once connected and correctly configured, a web page will appear showing the various operational conditions and settings.

## COMPUTER CONNECTION

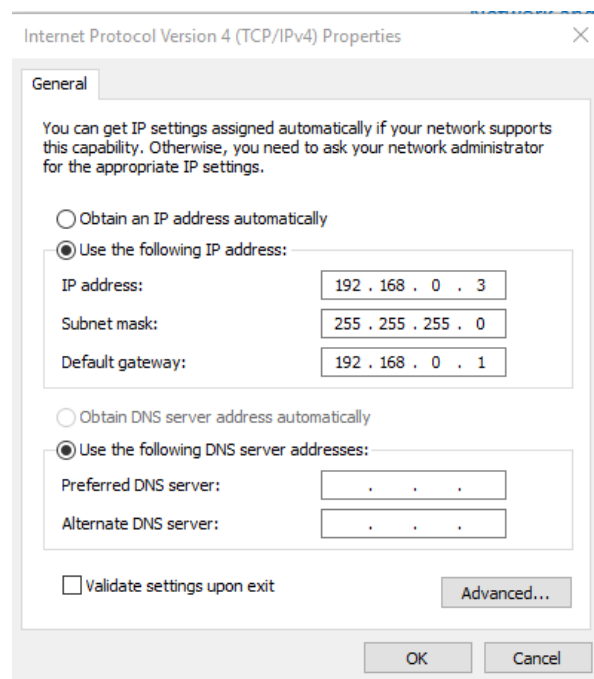
### ⚠ Notice:

The base requires a connection to a computer for detailed information beyond what is indicated on the LED displays.

Direct connection may be made to a Windows 10 OS computer or tablet. To gain access to the base display interface connect using a Cat.5 Ethernet cable to the base, near the top right of the controller. Tablets may require a USB to Ethernet adapter. Any Windows based web browser should work.

To set the correct IP address, click the Start button, then Settings, then Network and Internet. Then, click Ethernet (on the left side), then Change Adapter Options. Click the Ethernet icon and a status page should open. Press Properties, then Ethernet, then select Internet Protocol Version, and then Properties.

Set a static IP address on the computer with the following settings:

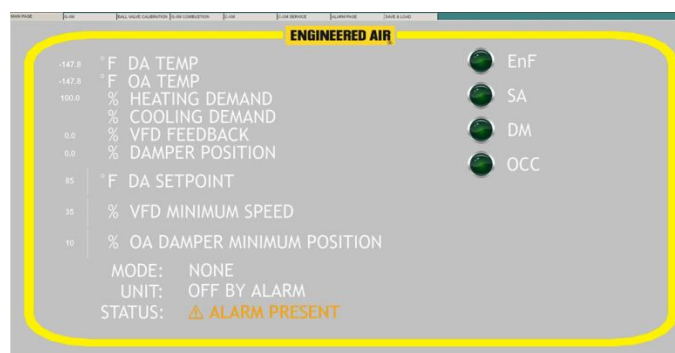


Click OK to accept, and then open a web browser and type in the following address to gain access to the display interface:

**192.168.0.10:8080/webvisu.htm**

To simplify connections, make this a bookmark in the web browser for future connections.

The display interface should appear, similar to the following. Note the tabs along the top for access to additional information screens.



Changes made to adjustable values are 'live'. Pressing ENTER or SAVE is not required.

### Heating and Cooling Display Sequence Definitions

The display screens specific to gas fired heating and mechanical cooling have a number sequence included to describe the current operating mode.

#### Burner sequence

①	Move to purge
②	Purge
③	Move to ignition
④	Ignition / pilot
⑤	Main valve
⑥	Post purge
⑦	Shutdown

#### Compressor Stages

①	Stage #1 On
②	Stage #2 On
③	Stage #3 On
④	Stage #4 Off
⑤	Stage #5 Off

## ALARM RESET

Alarms may be reset either from the laptop computer alarm screen or the red reset button near the top left.

## LED LIGHTS

Light	Description	Function
Green	Power	ON=Powered OFF=No Power to H&N
Yellow	Communication	BLINK=Comm to CD-XM ON=Internal Comm. OFF=Failure
Red	Alarm	ON=Alarm Condition OFF=No alarm present

## SEVEN SEGMENT DISPLAY

Left is mode indication

- 4: Cooling
- 3: Heating
- 2: Economizer
- 1: Ventilation

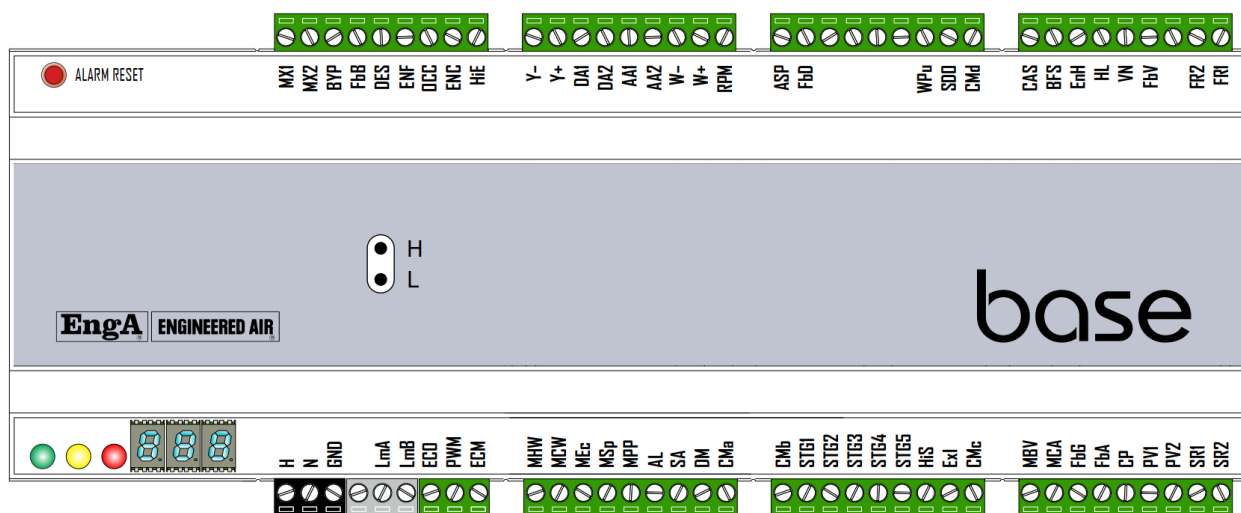
Right 2 Displays: Alarm value

See ALARMS

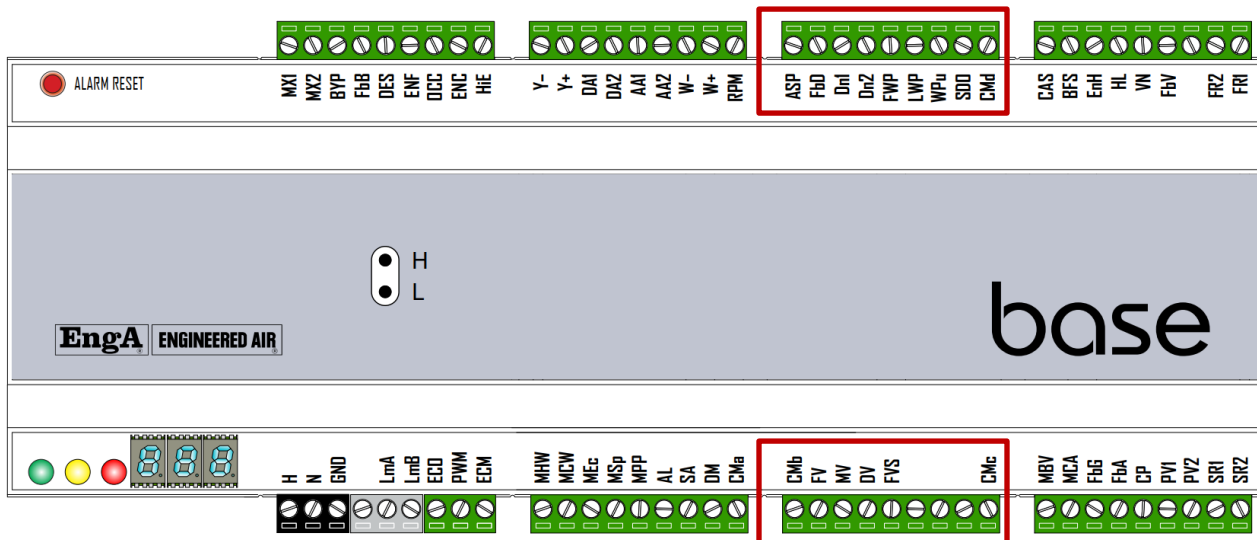
#### ⚠ NOTICE:

The mode indication is indicative of the current mode and not what the mode was when an alarm occurred.

## Standard Version

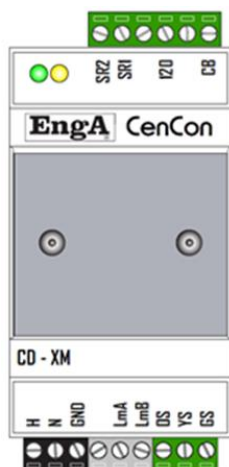


## Humidifier Version



## CD-XM EXPANSION MODULE

A TRIAC driver slave connected via Modbus communication to the base, this module controls the combustion motor speed on DJ indirect fired heaters. A 3 wire feedback signal is returned to the module to confirm the blower speed.



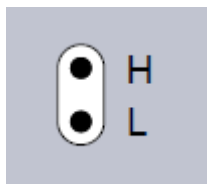
## PRESSURE PORTS

Marked as H (high side) and L (low side) for use on direct fired appliances.

Pressure ports may not be included on appliances that do not require them.

### **CAUTION:**

Do not blow onto the pressure ports. Excessive pressure and moisture will damage it. The ports are fragile and should not be tampered with.



## TERMINAL DESIGNATIONS

Terminals **indicated** change on the humidifier version.

H N		Power Supply
GND		Ground
LmA,B		Local Modbus
ECO	AI	EC Motor Common
PWM	AI	EC Motor Running Speed
ECM	AO	EC Motor Demand
MHW	AO	Modulating Heating
MCW	AO	Modulating Cooling
MEc	AO	Modulating economizer
MPP	AO	Profile Plate Actuator
AL	DO	Alarm
SA	DO	Supply air
DM	DO	Damper actuator enable
CMa	DO	Relay 'a' Common
CMb	DO	Relay 'b' Common
STG1	DO	Cooling Stage 1
STG2	DO	Cooling Stage 2
STG3	DO	Cooling Stage 3
STG4	DO	Cooling Stage 4
STG5	DO	Cooling Stage 5
HiS	DO	High Speed Exhaust Fan Start
Exl	DO	Low Speed Exhaust Fan Start
CMc	DO	Relay 'c' Common
MBV	AO	Modulating Ball Valve
MCA	AO	Modulating Air Actuator
FbG	AI	Modulating Gas Valve Feedback
FbA	AI	Modulating Air Feedback
CP	AI	Condensate Probe
PV1,2	DO	Pilot Valve
SR1,2	DO	Safety Relay
FR1,2	DO	Flame Relay
FbV	DI	Feedback Gas Valve
VN	DI	Feedback Gas Valve Neutral
HL	DI	High Limit
EnH	DI	Enable Heat
BFS	DI	Blocked Flue Switch
CAS	DI	Combustion Air Switch
CMd	DO	Relay 'd' Common
SDO	DO	(HE) Dual Flame Rod
SDO	DO	(DG) Combustion Blower Start
WPU	DO	Water Pump



FbD	AI	Outside Air Damper Feedback
ASP	AI	Remote VFD setpoint
RPM	AI	VFD Feedback Speed
W+/-	AI	Modulating heating thermostat
AA1,2	AI	Ambient / Outside temperature
DA1,2	AI	Discharge temperature
Y+-	AI	Modulating cooling thermostat
HiE	DI	High Speed Enable
ENC	DI	Enable Cooling
OCC	DI	Occupied / unoccupied mode
EnF	DI	Enable Fan
DES	DI	Damper end switch
FbB	DI	Air proving switch
BYP	DI	VFD Bypass
MX1,2	AO	Maxitrol Modulating Valve

#### Humidifier Version Terminals

FV	DO	Fill Valve
MV	DO	Mixing Valve
DV	DO	Drain Valve
FVS	DO	Second Fill Valve
LWP	CI	Low Water Probe
FWP	CI	Fill Water Probe
DN1,2	AI	Drain Water Temperature

#### CD-XM Terminals

H N		24Vac Power Supply
GND		Ground
LmA,B		Internal Modbus
OS	AI	Tachometer +
YS	AI	Tachometer -
GS	AI	Tachometer reference
CB	AO	TRIAC output
120		120Vac input
SR1,2	DO	Safety relay

## APPLIANCE TYPES

### DJ STYLE INDIRECT FIRED

For indirect fired equipment with DJ (E, S, X) style burners up to size 140.

On a call for heating the combustion blower will be enabled to full speed to prepurge the heat exchanger. Once the prepurge time has elapsed the combustion blower speed will reduce to ignition speed and then enable the ignition control to start and prove pilot flame, then open the main safety valve (SSOV). After a time delay the pilot valve IS disabled. The burner is allowed to operate from low fire to high fire at a 15:1 turndown ratio to maintain the requested discharge air temperature by modulating the control valve and the combustion blower speed. If heating is not required the burner will be disabled and the combustion blower will enter a post purge time, and then shut down.

The base can control either a Maxitrol magnetic style modulating valve or an actuator and ball valve combination.

Combustion air blower modulation is controlled by either the CD-XM expansion module. If using an electronically commutated motor (ECM) modulation is directly controlled from the base.

### DG STYLE INDIRECT FIRED

For indirect fired equipment, DJX sizes 200 and 300, and all DG sizes. These use actuator controlled air flow control damper and gas ball valves.

On a call for heating the combustion blower will be enabled and the air actuator will open to the prepurge setpoint to purge the heat exchanger. Once the prepurge time has elapsed the gas and air actuators will move to ignition position and then enable the ignition control to start and prove pilot flame, then open the main safety valve (SSOV). Once the pilot flame has proven and the main flame is established, the base will then disable the pilot valve. The burner is allowed to operate from

high fire to low fire at a 20:1 turndown ratio to maintain the requested discharge air temperature by modulating the gas and air actuators. If heating is not required the burner will be disabled and the combustion blower will enter a post purge time, and then shut down.

## HE DIRECT FIRED

For direct fired HE style direct fired heaters.

On a call for heating, and with the supply blower enabled, the ignition control will be enabled to start and prove pilot flame, then open the main safety valve (SSOV). Once the pilot flame has proven and the main flame is established, the M-XM will then disable the pilot valve. The burner is allowed to operate from low fire to high fire to maintain the requested discharge air temperature by modulating the fuel control valve. The heating will remain on as long as the heating enable circuit is energized.

Cycling a direct fired burner will often cause undesirable fuel odorants to enter the occupied space. When in heating mode, direct fired appliances rely on a high turndown ratio of fuel control to maintain the discharge air temperature setpoint. The heating may be disabled by either a predetermined ambient lock out setpoint, or external contacts or switches connected to terminal EnH. The default ambient heating lockout setpoint (typically 65°F) is field adjustable only through a computer connection service interface.

The base can control either a Maxitrol magnetic style modulating valve or an actuator and ball valve combination.

Variable air volume systems include a burner bypass damper which modulates to maintain the correct burner profile pressure drop.

## STAGED COOLING

For staged compressor operation the base will sequence on and off up to 5 compressor stages to maintain the discharge temperature setpoint. As with all staged systems, expect the discharge

temperature to fluctuate from setpoint as compressors are turned on and off.

## SH(X) HUMIDIFIER

SH and SHX series gas fired humidifiers are controllable using the humidifier version of the base controller.

SHX models use a second fill valve for the side tank.

On a call for humidification the tank first fills with water, then the burner gas-fired heat is enabled to produce steam. Water level is controlled by the water level probes. Water quality dictates the minimum tank drain cycle times. Drain temperature is monitored and cooled with the supply water if required.

Direct burner control is available by sending a 0-10vdc to the controller which will set the firing rate between 4-100%.

Drain cycle times are preprogrammed based on water quality, or may be initiated by a time clock contact.

Large SH(X) sizes (120-650) use DJ style burner for the gas fired portion.

## ALARMS

LED	Name	Description
<b>General Alarms</b>		
<b>01</b>	Low limit	The low limit setpoint is the lower of 40°F or 15°F below the discharge air setpoint. 4 minute bypass time.
<b>02</b>	Air Proving Fault	VFD Feedback is greater than the minimum VFD speed for more than 30s with the supply fan output off.
<b>03</b>	Shorted Air Proving	Air SA Proving switch shorted on start up.
<b>04</b>	Low airflow	Air Proving switch opens during operation for 30s or the VFD feedback drops below the minimum speed for 30 seconds.
<b>05</b>	Discharge Air Sensor Failure	Discharge Air sensor is outside of its range for 10s.
<b>06</b>	Ambient Air Sensor Failure	Outdoor Ambient sensor is outside of range for 10s.
<b>07</b>	Damper End Switch Short	The damper end switch is made before energizing the damper output.
<b>08</b>	Damper End Switch Open	Indication damper end switch not made after actuator is energized.
<b>09</b>	Communication	Loss of communication to CD-XM (if used).
<b>Heating Alarms</b>		
<b>80</b>	Gas Valve Wiring	Gas valve feedback has power before the FR and SR contact are energized.
<b>81</b>	Gas Valve out of range	Gas valve actuator feedback is greater or less than the demand. Timed event.
<b>86</b>	High Limit	High limit safety tripped due to excessively high temperature.
<b>87</b>	Flame Relay Wiring	Received a gas valve feedback within 500ms of activating the Flame relay output.
<b>88</b>	Flame Failure	Gas valve feedback has no power after 1 minute of enabling the Flame relay output.
<b>DJ/SH(X) Alarms</b>		
<b>82</b>	RPM out of range	Combustion blower motor RPM is greater or less then the demand. Timed event.
<b>83</b>	Open Air Proving	Combustion blower does not exceed 3000 rpm during purge.
<b>84</b>	Combustion Air Proving	Combustion rpm speed sensor has a value greater than 500 rpm for 60 seconds before the combustion blower has been commanded on.
<b>85</b>	Plugged Condensate	Blocked condensate sensor reads less then 7kΩ for more than 5 minutes.
<b>89</b>	Blocked Flue	Blocked flue input is open for more than 1 minute.
<b>90</b>	60 Hz	Combustion blower frequency has exceeded 60 Hz ( 3590 RPM)

DG Alarms		
82	Air Actuator Out of range	Air Actuator Feedback Is greater or less then the demand. Tolerances and timing vary depending on mode of operation.
83	Open Air Proving	Combustion blower air switch input (CB) has no power for 60 seconds after commanding the combustion blower on / Combustion blower air switch input has no power for 2 seconds during main flame.
84	Shorted CB Air Proving	Combustion blower air switch input has power for 10 seconds before the combustion blower has been commanded on.
85	Plugged Condensate	Blocked condensate sensor reads less than 7kohms for more than 5 minutes.
86	High Limit	High limit safety tripped due to excessively high temperature.
89	Blocked Flue	Blocked flue input has opened for more than 1 minute.
HE Alarms		
91	Low Velocity Air Switch	Occurs if the pressure drops below the low pressure setpoint during modulation for more than 40 seconds
92	High Velocity Air Switch	Occurs if the pressure goes above the High pressure setpoint during modulation for more than 90 seconds
94	Low Pressure	Air flow too low to enable heating.
95	Low Pressure Sensor	Unable to zero the pressure before the damper has opened.
96	Very Low Pressure	Occurs if the pressure drops below the very low pressure setpoint after the purge has been completed.
97	Far Sensor Flame Failure	Occurs if a secondary flame rod is enabled and flame sensing is lost in less than 20 seconds after the pilot valve drops out on consecutive attempts.
SH(X) Water Alarms		
61	Tank High Pressure Overflow	SH is in normal operating mode and the drain temperature is greater than 110 deg F for longer than 10 seconds.
62	Water Foaming	Low water probe made and fill valve open for less than 2 minutes during normal operation.
63	Failed Water Supply	The fill valve stay open longer than the required time (varies on current mode: Normal operation: 5m; Complete fill: 1hr).
64	Failure to Drain	Low water probe covered and drain valve open for longer than 1 hour.
65	Water Probe Sequence	Fill water probe is covered before the low water probe.
66	Duct High Limit Trip	Duct humidity has tripped the mechanical high limit.
67	Drain Sensor Failure	Drain sensor is out of range (less than 30° or greater than 212°F) for 10 seconds.
68	Fill Valve Stuck Open	Fill water probe and low water probes are covered and the drain temperature is greater than 110°F for longer than 10 seconds when the SH is off and no drain is required.

