EngA ENGINEERED AIR

CenCon

Technical Manual

Manual Revision 2.2.0

RECOGNIZED COMPONENT
C ETL LISTED US
Intertek

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

INTRODUCTION

This technical manual is intended for technicians and factory personnel already familiar with the operation of Engineered Air equipment, control strategies and combustion setup.

The CenCon and expansion modules have been certified by Intertek (ETL) 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.

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

To ensure the 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.

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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 CenCon is a configurable controller. Its operation on one appliance of equipment may not mimic another.

⚠ CAUTION:

CenCon 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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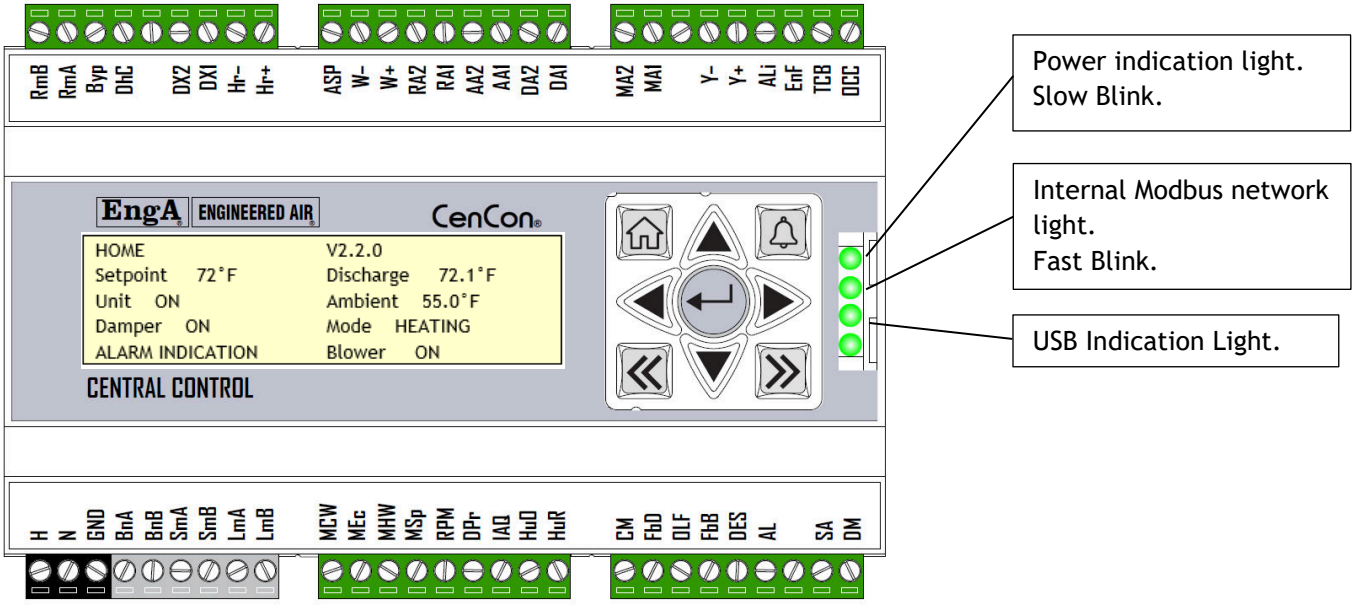
GENERAL OVERVIEW



The Engineered Air CenCon controller is the primary operational component for the majority of custom manufactured Engineered Air HVAC equipment. Various expansion modules (-XM) may be added to extend the operational capabilities to gas fired heating, cooling, humidification, and energy recovery systems.

Notice:

⚠ There is approximately a 1-minute delay before operation can commence on initial power up. The time varies depending on the complexity of the equipment it is controlling.

HARDWARE INFORMATION

Control Voltage	24Vac 60Hz
Digital Output Rating	120V 10A
Digital Input	24 - 120Vac[1]
Analog Output	0-10Vdc
Analog Input	0-10Vdc and 4-20mA[2,3]
Analog In Impedance	7.5kΩ
Temperature Rating	-40 – 150°F (65°C)
Temperature Sensor	10k Type 2 NTC

Apparent Power Ratings

CenCon	10 VA
J-XM, G-XM, M-XM, S-XM, ER-XM	30 VA
C-XM	20 VA
XP-XM	12 VA
CD-XM	5 VA
P-XM	5 VA

[1] Digital input connection to the CenCon or any of the expansion modules cannot use Mosfet solid state switches. Input switching must be mechanical.

[2] If using 4-20mA, add a 500Ω resistor across the input terminals.

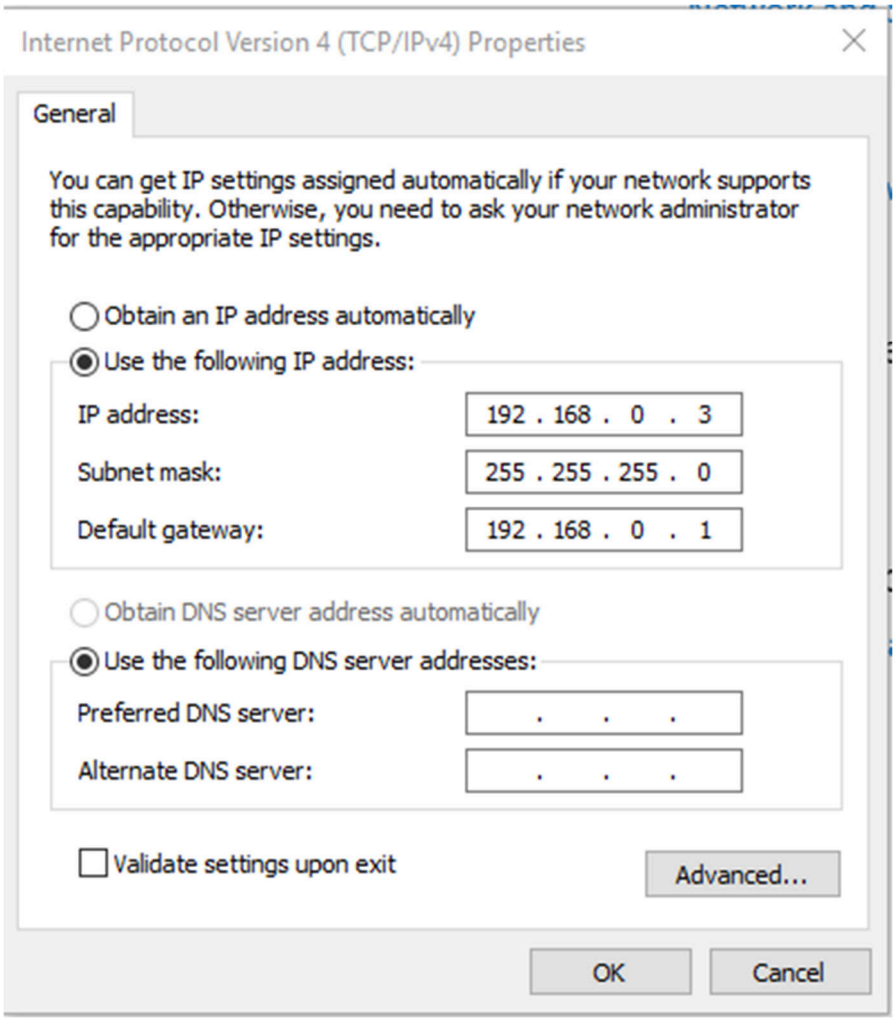
[3] Analog inputs will trigger 10Vdc 'high' if using 24Vac input and a series Diode (1N400x).

COMPUTER CONNECTION

Direct connection may be made to a computer or tablet that has the ability to connect to a static IP address. To gain access to the CenCon testing interface connect using a Cat.5 Ethernet cable to the CenCon, near the top right of the controller. Tablets may require a USB to Ethernet adapter. Any web browser should work.

To set the correct IP address in Windows (10, 11): right-click the Start Button and select Search. Type and select "Control Panel" to open the control panel window. Find and select Network and Sharing Center. Click Change Adapter Settings and then the Ethernet icon, which will open a status page. Click the Properties button, then double-click the Internet Protocol Version 4 (TCP/IPv4) located in the list box.

Set the static IP address with the following settings:



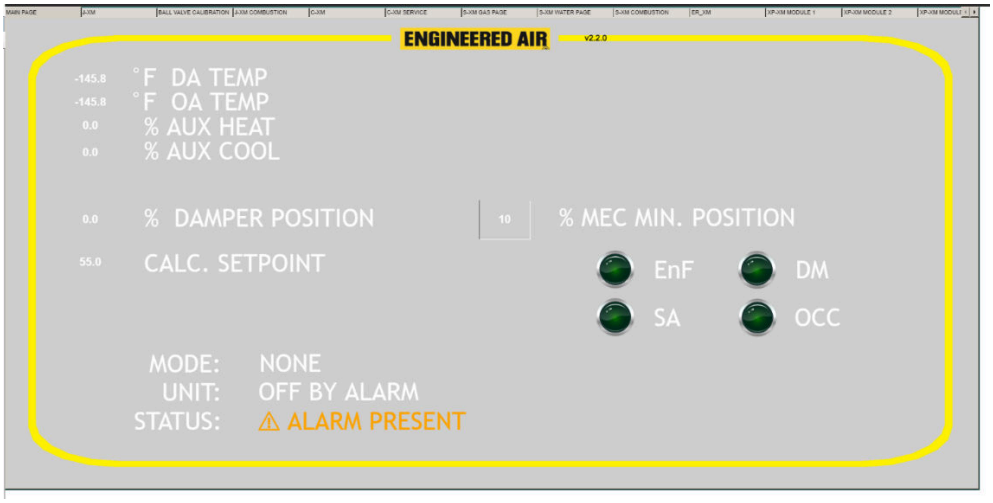
Click OK to accept, and then open a web browser and type in the following address to gain access to the controller interface:

192.168.0.10:8080/webvisu.htm

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

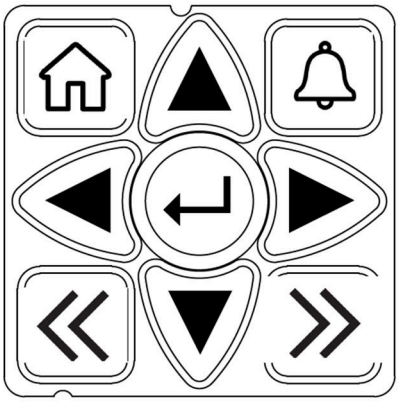
INTERFACE SCREENS

The interface display should appear, similar to the following. Note the tabs along the top:



KEYPAD

The 9-button keypad has been configured to easily manipulate any user variables available for modification. Typically, this would include the temperature setpoint(s) and outside air minimum position.



The home button displays the main page.

Pressing the alarm button changes the display to the alarm page.

The left and right double arrow keys increment the display to the next page.

Use the left and right arrows to navigate the location of the cursor within each page.

Press the enter key once the cursor is located at the variable to be changed.

The up and down arrows change the value of the indicated variable. *

*Changing a variable is 'live'. Pressing enter is not required to set the value.

DISPLAY SCREENS

The CenCon display can show a variety of input and output conditions as shown in the examples below, in addition to the current operating variables. Additional screens become available as expansion modules (-XM) are added to the system. The display screen-saver will automatically go blank after 5 minutes. Pressing any key will reactivate the screen and return to the home page.

HOME SCREEN

The Home screen ⌂ displays the required setpoint, actual discharge temperature, and various active modes of operation. Note the version number in the upper right area.

HOME	V2.2.0
Setpoint 72°F	Discharge 72.1°F
Unit ON	Ambient 55.0°F
Damper ON	Mode HEATING
ALARM	Blower ON

Pressing the right page advance » changes the display to the next status page(s). Note the top right corner describes which module the variables relate to. The sample list that follows may or may not be present in the particular appliance using the CenCon.

HEATING

HEATING			G-XM
Setpoint	90 °F	Discharge	89.3 °F
Demand	16.9 %	Aux. Heat	0.0 %
Burner Sequence		①②③④❺⑥⑦	
ALARM			

Burner sequence

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

ECONOMIZER

ECONOMIZER			CENCON
Mixed Air	59.3 °F	Discharge	53.8 °F
Ambient Air	72.5 °F	Return Air	75.8 °F
Min. Position	20.0 %	Damper	34.5 %
ALARM			

COOLING

Showing stages 1 to 3 enabled, out of 6 total. Total number will always display 6 regardless of number of compressors configured.

COOLING			C-XM
Setpoint	55 °F	Discharge	57.1 °F
Demand	16.9 %	Aux. Cool	0.0 %
Compressors	❶❷❸④⑤⑥		
ALARM			

Compressor Stages

- ❶ Stage #1 On
- ❷ Stage #2 On
- ❸ Stage #3 On
- ④ Stage #4 Off
- ⑤ Stage #5 Off
- ⑥ Stage #6 Off

CENCON ANALOG I/O

ANALOG I/O					CENCON
MEc	7.2 V	MHW	0.0 V	MCW	0.0 V
MSp	0.0 V	IAQ	0.0 V	RPM	0.0 V
HuO	0.0 V	HR +/-	0.0 V	FbD	0.0 V
ASP	0.0 V	W +/-	0.0 V	Y +/-	0.0 V

CENCON DIGITAL I/O

DIGITAL I/O					CENCON
SA	☑	DM	☑	AL	☐
OLF	☐	FbB	☐	DES	☐
EnF	☑	OCC	☐		
BAL	☐	DhC	☐		

HEATING ANALOG I/O

ANALOG I/O				G-XM
MBV	4.41 V	CP	24.4 kΩ	
FbG	4.39 V			
MCA	3.74 V			
FbA	3.71 V			

HEATING DIGITAL I/O

DIGITAL I/O					G-XM
EnH	☑	SR	☑	CAS	☑
FbV	☑	FR	☑		
HL	☑	PV	☐		
BFS	☑	CB	☑		

SETTINGS

SETTINGS	
IP Address	192.168.0.10
Read Settings	No
Save Settings	No

ALARMS

ALARMS		
Unit: No alarms	Reset	NO
Heating: No alarms		
Cooling: No alarms		
Communication: No alarms		

TERMINAL DESCRIPTION

Terminal	Type	Name	Description	Value
H N		Power Supply		24 Vac
GND		Ground	Connect to chassis.	
LmA B		Modbus	Internal network.	
BmA,B		BACnet	BACnet network slave.	
SmA,B		Modbus	Modbus network slave.	
MCW	AO	Modulating cooling	Chilled water coil valve actuator. 0V=off.	0-10 Vdc
MEc	AO	Modulating economizer	Economizer / Mix box actuator. 0V=closed.	0-10 Vdc
MHW	AO	Modulating heating	Hot water coil valve actuator. 0V=off.	0-10 Vdc
MSp	AO	VFD command speed	VFD control signal.	0-10 Vdc
RPM	AI	VFD feedback speed	Confirmation of VFD speed.	0-10 Vdc
DPr	AI	Supply duct pressure	Duct pressure sensor signal.	0-10 Vdc
HuO	AI	Outside humidity	Outside / ambient air humidity.	0-10 Vdc
CM		Relay common	Common power to output relays.	24 Vac
FbD	AI	Damper feedback	Damper actuator position feedback signal.	0-10 Vdc
OLF	DI	VFD fault	Motor overload or VFD fault input.	24 Vac
FbB	DI	Air proving switch	Supply blower air proving switch.	24 Vac
DES	DI	Damper end switch	Mechanical damper end switch.	24 Vac
AL	DO	Alarm	Alarm contact for annunciation.	24 Vac
SA	DO	Supply air	Blower enable contact.	24 Vac
DM	DO	Damper actuator enable	Two position actuator control.	24 Vac
OCC	DI	Occupied / Unoccupied	Enable occupied mode when powered.	24 Vac
TCB	DI	Time clock bypass	Momentary push button (future).	24 Vac
EnF	DI	Enable Fan	Occupied mode start.	24 Vac
ALi	DI	Secondary Bacnet alarm	Spare alarm input for BACnet annunciation.	24 Vac
Y+-	AI	Various functionality	Cooling demand setpoint.	0-10 Vdc
MA1,2	AI	Mixed air temperature	10k Type 2 thermistor.	Ohms (Ω)
DA1,2	AI	Discharge temperature	10k Type 2 thermistor.	Ohms (Ω)
AA1,2	AI	Ambient air temperature	10k Type 2 thermistor.	Ohms (Ω)
RA1,2	AI	Return / room temperature	10k Type 2 thermistor.	Ohms (Ω)
W+-	AI	Modulating heating thermostat	Independent heating demand signal.	0-10 Vdc
ASP	AI	Remote VFD setpoint	VFD speed input demand signal.	0-10 Vdc
Hr+-	AI	Modulating humidity	Return or Room humidity demand signal.	0-10 Vdc
DX1,2	AI	DX temperature	10k Type 2 thermistor.	Ohms (Ω)
DhC	DI	Dehumidification.	Dehumidification call input.	24 Vac
Byp	DI	VFD Bypass	VFD bypass input.	24 Vac
RmA,B		Modbus Room	Modbus room thermostat (Future).	

OPERATION

MODE SELECTION

The CenCon can operate under up to 4 distinct modes: heating, economizer, ventilation and cooling, in addition to combination modes, such as dehumidification. There is a delay between changing from one mode to another in order to prevent cycling of the equipment. Mode selection is determined by the demand call and the ambient temperature. The CenCon must have an ambient sensor installed either within the appliance, or remotely located to measure the ambient temperature.

OCCUPIED / UNOCCUPIED

During night, or unoccupied, operation, when the modulating room thermostat is calling for more than 60% heating demand, the heater will operate at the maximum discharge setpoint of 120°F until the room thermostat demand falls below 20%.

FAN CONTROL

VARIABLE AIR VOLUME

On a blower start signal, and before the blower is started, the VFD feedback signal is checked for a false signal. If a false feedback signal is detected the unit will go into alarm and not start. If the signal remains above the VFD minimum speed (%) for 30 seconds, the Air Proving fault alarm is set. After the blower is started, the feedback signal must rise above the VFD minimum speed (%). If it does not, after 30 seconds the Low Airflow alarm is set and the equipment shuts down.

VFD minimum speed should not be set to 0%. The design minimum is typically 35%, or 3.5Vdc. Confirm with the unit function what the specific design minimum is. The feedback signal should not be scaled, and must send a 3.5 to 10.0Vdc signal to the CenCon. Confirm the feedback signal generates a full signal range to the base. Adjust the output range to compensate if unable to meet 10.0Vdc minimum. The feedback output on the ACH-580 drive is typically set to 10.6Vdc at maximum to ensure 10.0Vdc at the base. Confirm the feedback display reads 100% on the computer or the keypad display.

AIR PROVING SWITCH

On a blower start signal the air proving switch must be in the open position. If a closed position is detected, the fan is not allowed to start and a 30 second alarm timer is initiated. The alarm will automatically clear if the switch opens within 30 seconds.

If the flow proving switch is open, the blower can start normally. After the blower starts, the CenCon needs to see the air switch close (prove) within 30 seconds. If the switch does not close, the low air flow alarm is triggered. If during normal operation, the flow proving opens, a 15 second low air flow lock out timer is started. During this time, compressors and heat exchanger style burners are allowed to stay running. Once the 15 second timer has elapsed, the equipment will shut down on low air flow alarm.

WARMUP/COOLDOWN

A blower warmup/cooldown delay may be required to preheat or cool down the heat exchanger. For DG and DJ style heat exchangers a full heat exchanger warm up delay is required when the ambient temperature is

below the low limit set point or when the ambient temperature is 8°F or colder than the discharge set point but above the full warmup required ambient.
The blower delay off time is automatically set according to the application and type of heating device, according to the table below.

Application	* Damper delay	Exchanger Warm up delay	Cool down delay
MUA	On 90 sec Off 20 sec	DJ: 75 sec DG/DJX: 75 sec Other: 0 sec	DJ: 90 sec DG: 90 sec DJX : 90 sec HE: 8 sec Other: 30 sec
Mixbox	On 10 sec Off 10 sec	DJ: 75 sec DG: 75 sec Other: 0 sec	

*The damper off delay starts when the blower is shut off

DAMPER CONTROL

MAKE UP AIR

Make up air equipment will normally use a 2 position actuator to open or close the inlet dampers.

DAMPER END SWITCH

A damper end switch is a mechanical device used to prove the dampers have opened. The switch may be independent, or an auxiliary contact from the damper actuator. If used, when the damper end switch 'makes' and inputs 24Vac to terminal DES, the fan delay timer is set to zero, and the fan will start.

AMBIENT COMPENSATION

On blow through heat exchangers, the blower sees greatly varying inlet temperatures. As the air temperature changes, so does the air density and volume. The blower delivers a constant volume of 'cold' air. As this air is warmed by the heat exchanger, it expands causing the outlet air volume to increase. With the extra air volume, the temperature rise falls and there may not be enough heat on a design day.

The ambient compensation attempts to correct this by partially closing the inlet damper enough to add enough system static to compensate for the expansion effect. The compensation starts to reduce the damper opening at 30°F and reaches maximum effect at -40°F. The low limit operation has no effect on the ambient compensation package. This option requires a modulating damper actuator and opposed blade dampers.

ECONOMIZER

Economizer damper control will mix the return and outside air streams to achieve the required discharge air temperature. The CenCon may also be configured to employ an additional mixed air sensor downstream of the mixing dampers.

It is possible for the economizer to operate while in heating or cooling mode. While the display will show either heating or cooling, the analog output to the economizer will be active and show a value greater than the minimum position.

Applications may require economizer damper control 'by others'. This requires the CenCon to be programmed as a MUA and uses the FbD (Outside Air Feedback Damper) input to allow the CenCon to adjust and reset the low limit bypass timer if required during a significant increase in cold outside air.

DIFFERENTIAL ENTHALPY ECONOMIZER

Differential economizer damper control calculates the outside air enthalpy and compares it to the return air enthalpy. If the outside air calculation is less than the return air calculation the damper control will mix the return and outside air streams to achieve the required discharge air temperature. If the outside air calculation is greater than the return air calculation, the dampers will revert to minimum position. The CenCon may also be configured to employ an additional mixed air sensor downstream of the mixing dampers.

MINIMUM POSITION

The minimum position setting may be adjusted using the display keypad, a computer interface, Modbus or BACnet. The IAQ terminal can be used to reset the damper minimum position by supplying a 0-10vdc signal which corresponds to 0-100% position of the damper. If this input is less than the minimum position setting in the controller the higher setting will be used. This setting corresponds to the actuator output signal, not the actual air volume.

CALIFORNIA BUILDING ENERGY EFFICIENCY - TITLE 24

This standard requires that the economizer must be monitored and prove the mechanical operation of the dampers. Whenever the economizer is in the full open position, a damper end switch is activated to indicate that the dampers are operating correctly. A mixed air sensor must be installed to give feedback on the effectiveness of the mixing section and to act as a mixed air low limit.

HIGH AMBIENT LOCKOUT

This feature is required to disable the economizer if there is no cooling available from the ambient air.

This can be performed by two different methods. Differential temperature is generally the method used and compares the ambient temperature to the return temperature. A second method is differential enthalpy. Humidity sensors are installed in the return and outside air, and enthalpy is calculated based on the humidity and temperature readings.

DAMPER CONTROL BY OTHERS

The CenCon will enable power to the dampers when the unit is enabled and requested to run. The dampers will then be controlled from a signal by others with a field installed mixed air sensor. The minimum position must be set by others.

LOW LIMIT

Low limit, or freeze protection, may be enabled or disabled depending on application. Based on discharge air temperature sensing, the low limit will disable unit operation if the temperature falls below 40°F (4°C). The

setpoint is not adjustable. The low limit bypass has 2 timers, the main bypass timer that occurs at initial startup of the supply fan, and an anti-nuisance timer. The anti-nuisance timer has a duration of 30 seconds and resets once the discharge temperature rises above the low limit setpoint. The main bypass time is 4 minutes for all types of equipment.

On variable air volume systems, the main low limit bypass time is reset if the economizer minimum position is suddenly increased by over 15%, or if the VFD speed increases by over 20%, both within 10 seconds.

The bypass time is reduced to 2 minutes if the heating has been disabled. The low limit is not active in cooling mode.

HEATING

The CenCon may control simple fluid based heating devices from the auxiliary heating 0-10Vdc output. Expansion modules are necessary for gas fired heating to monitor and control the increased complexity and safety requirements of gas fired equipment.

The MHW (Modulating Hot Water) output is a 0-10Vdc signal, with 0V=no heat and 10V=max heat, typically associated with a hot water coil. Reversing function must be done at the actuator. A spring return actuator would be required for applications desiring full open, full closed or full bypass when the equipment is off.

GAS FIRED HEATING

Commands to heating expansion modules are done via the internal Modbus network. Refer to the appropriate expansion module section for more information.

COOLING

The CenCon may control simple fluid based cooling devices (chilled water or glycol) from the auxiliary cooling 0-10Vdc output. Expansion module(s) for mechanical cooling are necessary for staged or modulating mechanical cooling. Refer to the C-XM cooling expansion module section.

The MCW (Modulating Chilled Water) output is a 0-10Vdc signal, with 0V=no cool and 10V=max cool, typically associated with a chilled water coil. Reversing function must be done at the actuator. A spring return actuator would be required for applications desiring full open, full closed, or full bypass when the equipment is off.

ENERGY RECOVERY

Appliances equipped with energy recovery systems (ER-XM) will control the discharge minimum setpoint. Additional heating will be enabled to control to the calculated discharge setpoint.

DEHUMIDIFICATION

If DhC is powered and the humidity sensor reading is above the humidity setpoint, the unit will enter dehumidification mode. In this mode auxiliary heat may be utilized to meet the discharge setpoint demand.

GENERAL TIMING

Mode Change time	1 minute
Damper delay off	20 seconds
Supply low airflow alarm	30 seconds
Shorted Damper End Switch	1 second
Supply air shorted air switch alarm	30 seconds
Low limit bypass (with heating)	4 minutes + 30 second anti-nuisance
Low Limit bypass (without heating)	2 minutes + 30 second anti-nuisance

TEMPERATURE CONTROL

The CenCon is a discharge air temperature controller. The discharge setpoint is adjusted from the CenCon display and keypad, between maximum and minimum limits determined by design.

There are several methods to change, or 'reset' the discharge temperature to what the space requires.

ROOM OR RETURN THERMOSTAT

The thermostat can output the demand signal into terminals W+/-. The demand signal modifies the discharge temperature between the upper and lower maximum temperature values. Refer to the field wiring diagram included with the appliance for wiring connections.

Mounting locations:

- Do not install on an exterior wall.
- Do not install near any heat source.
- Should not be installed near an air discharge opening.
- Should not be affected by direct sunlight.
- Must be open to air circulation around the thermostat.

REMOTE SETPOINT

A Belimo SGF24 (0-10Vdc) with a calibrated temperature dial may be used to directly change the discharge temperature (W+/-).

BMS SETPOINT

This method uses a single 0-10Vdc input (W+/-) to modify the discharge temperature between the upper and lower maximum temperature values.

ALARM DESCRIPTIONS

The last alarm event will be shown on the main page of the CenCon display. A more detailed list can be found by pressing the alarm keypad button 🔔. Additional alarms specific to the system are detailed by expansion module type.

Low limit	The discharge air temperature has fallen below low limit setpoint. The low limit setpoint is 40°F (4°C).
Air Proving Fault	VFD Feedback is greater than the minimum VFD speed for more than 30 seconds with the supply fan output off.
Shorted Air Proving	Air Proving switch detects flow before blower starts.
Low airflow	Air Proving switch opens during operation for 30 seconds or the VFD feedback drops below the minimum speed for 30 seconds.
Discharge Air Sensor Failure	Discharge Air sensor is outside of its range (-60°F to 220°F) for 10 seconds or more.
Ambient Air Sensor Failure	Outdoor Ambient sensor is outside of range (-60°F to 220°F) for 10 seconds or more.
Damper End Switch Warning	Shorted damper end switch. Meaning the damper end switch is made before energizing the damper output.
Damper Mechanical Alarm	End switch enabled codex is true and end switch is not made after energizing damper output.
Communication Error	Triggered on loss of communication with application modules.

ALARM RESET

To reset from the computer screen, press the Alarm Reset button on the main screen. To reset from the CenCon keypad, press the 🔔 button, then ↵ to move the cursor to the reset area. Then press ▲.

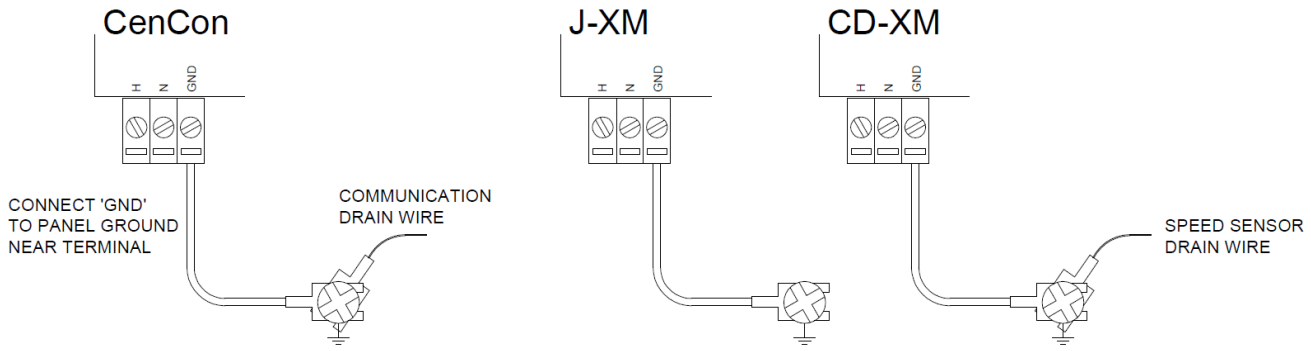
WIRING CONCERNS

For purposes of unit wiring to chassis in this manual, grounding and bonding reference the same thing and may be used interchangeably. Shielded cables always include an uninsulated ground connection wire, called a 'drain' wire.

MODULE GROUNDING

The CenCon and all expansion modules have a black power connection termination that includes Hot (H), Neutral (N), and Ground (GND). The GND terminal must be connected to a short green wire securely fastened to unpainted metal directly below the termination of each expansion module.

As shown in the example below, the DJ speed sensor wire shield drain wire must connect to the same unpainted ground connection used by the CD-XM input power. The communication wire ground should only connect to the CenCon unpainted ground connection.



COMMUNICATION WIRING

NOTICE: **Correctly wiring the internal Modbus communication network is critical to ensuring stable operation. Maintain the wiring at least 8" (200mm) away from any high power wiring, motors, transformers or VFD's.**

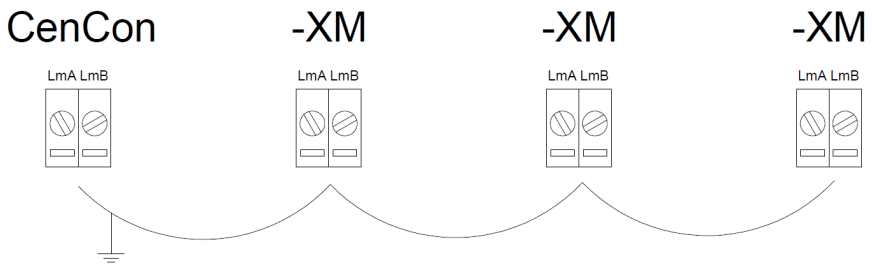
The CenCon communicates with expansion modules via an internal Modbus communication protocol. The wire is specific for Modbus communication: ASTM B33, Twisted pair, 22ga. fully shielded with drain wire, and plenum rated jacket. An end of line resistor (EOL termination) should not be required due to the relatively short length of the internal Modbus wiring. Care must be taken to ensure correct polarity between modules.

NOTICE: **For consistency, always wire: Red to LmA, and Black to LmB.**

Starting at the CenCon, wiring must be routed in series, or 'daisy chained' as shown below. There should never be more than 2 communication wires at any LmA/LmB terminal.

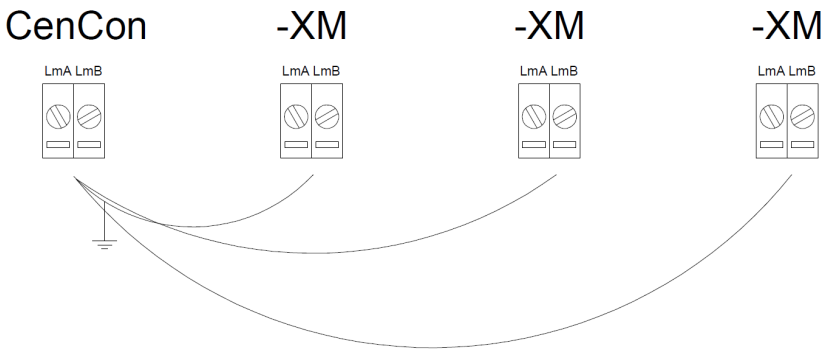
Correct

'Daisy Chain Connection'



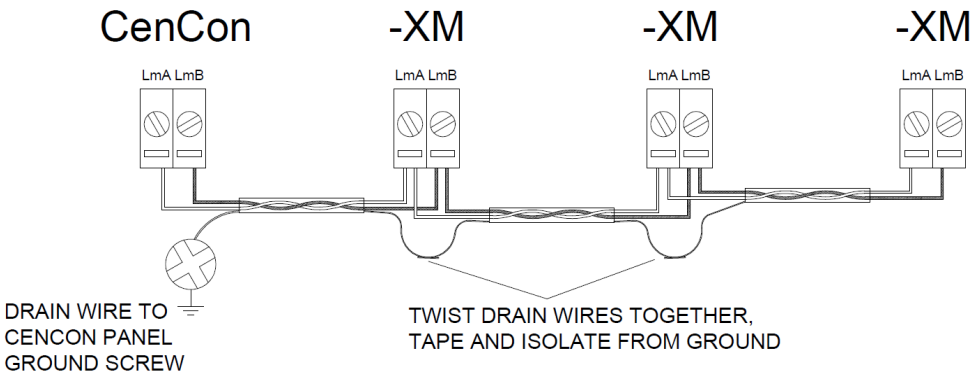
Wrong

'Star Connection'



COMMUNICATION WIRE GROUNDING

The communication wire drain should be connected only at the same unpainted ground termination used by the CenCon panel ground. All expansion module intermediate drain wires must be twisted together tightly and taped to secure together and isolate from ground. A wire nut or insulated splice connector may also be used. It is important that these must not be grounded anywhere except at the CenCon ground connection.



EXPANSION MODULES (XM)

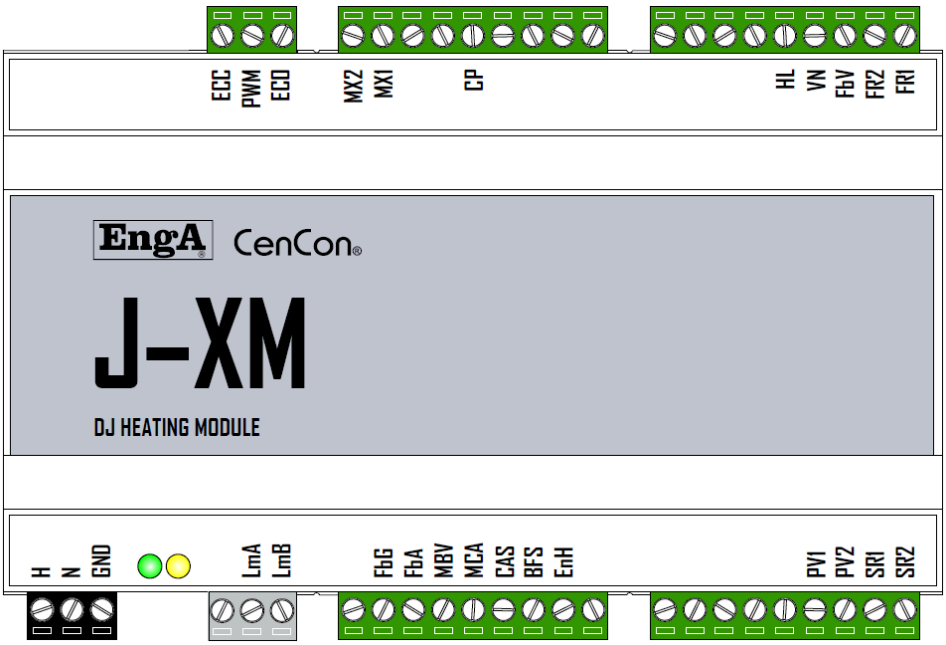
The CenCon controller can be connected to any Engineered Air expansion module. The expansion module provides the required wiring terminals for each additional appliance it is controlling.

All expansion modules have (2) lights. The Green light is an indication of power, and the blinking yellow light is to show the module is connected and communicating to the CenCon.

Expansion Module	Engineered Air Appliance Type
J-XM	DJ (E,S,X) style indirect fired heating up to size 140.
G-XM	DG, and DJX indirect fired gas burners, sizes 200 and 300.
M-XM	HE direct fired gas heating.
H-XM	K binary staged electric heating.
C-XM	FW, CU, UPW staged mechanical cooling.
ER-XM	Energy recovery Wheel, Pipe and Plate style energy recovery systems.
S-XM	SH and SHX gas fired humidification.
XP-XM	BACnet IO board used for additional points.
CD-XM	In addition to J-XM for DJ (E, S, X) burners up to size 140, and SH(X) sizes 120-650
P-XM	Static pressure sending, in addition to M-XM for profile pressure sensing module on direct fired burners.

J-XM

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



BASIC OPERATION

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 J-XM will disable the pilot valve. The burner is allowed to operate to maintain the requested discharge air temperature from the CenCon 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 J-XM burner expansion module can control either a Maxitrol magnetic style modulating valve or a 0-10Vdc actuator.

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

TERMINAL DESCRIPTION

Terminal	Type	Name	Description	Value
H N		Power Supply		24 Vac
GND		Ground	Connect to chassis.	
LmA B		Modbus	Internal Network	
FbG	AI	Feedback Gas	Compares the ball valve actuator feedback signal to the demand signal.	0-10 Vdc
MBV	AO	Modulating ball valve	Modulating gas valve actuator output.	0-10 Vdc
CAS	DI	Combustion air switch	Optional proof of combustion air flow.	24 Vac
BFS	DI	Blocked flue switch	Normally closed, opens on blocked flue.	24 Vac
EnH	DI	Enable heat	24V must be applied to allow heating function.	24 Vac
PV1, PV2	DO	Pilot valve	Disables the pilot flame once the main burner has been established.	24/120 Vac
SR1, SR2	DO	Safety relay	Secondary safety lockout contacts	24/120 Vac
FR1, FR2	DO	Flame relay	Flame relay enable contacts.	24/120 Vac
FbV	DI	Feedback valve	Feedback signal from the safety shut off valve (SSOV). Wired directly to valve.	24/120 Vac
VN		Valve neutral	Neutral feedback signal from the safety shut off valve (SSOV).	
HL	DI	High limit	Normally closed, opens on high temperature.	24 Vac
CP	AI	Condensate probe	Condensate probe sensor input.	Ohms (Ω)
MX1, MX2	AO	Maxitrol Valve	DC current output to the Maxitrol modulating valve.	mAdc
ECO	AO	ECM Demand	Electronically Commutated burner motor control output signal.	0-10 Vdc
PWM	PWM	ECM rpm feedback	Pulse width modulation feedback signal from Electronically Commutated burner motor.	PWM
ECC		ECM Neutral	Neutral reference to ECO output signal.	

J-XM / CD-XM TIMING

Prepurge	60 seconds
Post purge	5 minutes
Flame failure	15 seconds lockout on ignition control and 60 seconds on burner
Pilot opening time	8 seconds
Open combustion air proving	30 seconds
RPM out of range	60 seconds
Improper gas valve wiring	5 seconds
Blocked condensate	5 minutes
Blocked flue	10 seconds trip and 1 minute to alarm
Heat exchanger cool down	90 seconds if the discharge air is above 50° (10°C), else none.
Heat exchanger warm up fan delay	75 seconds if ambient air is less than 40°F (4°C) and discharge temperature less than 90°F (32°C), else no warm up.
Burner cool down	90 seconds if the burner has been on for more than 30 seconds, else no burner cool down

J-XM COMBUSTION SETUP

Combustion setup may only be done using a computer. Refer to the combustion values and setup sheets at the end of this manual. Refer to the tabs along the top of the service screens to access noted sections.

NOTICE:

Always allow the heat exchanger temperatures to stabilize before accepting combustion values.

GAS ACTUATOR CALIBRATION

WARNING:

If using a ball valve and actuator for gas, it must be pre-calibrated before attempting to set combustion offsets. This is normally completed at initial factory setup but will also need to be verified if the actuator is replaced.

For field service, record all offset values, and then set all values to zero. Enter calibration screen and perform calibration setup. Return and re-set offset values.

WARNING:

Before performing the calibration procedure, turn Off the appliance gas supply.

Power the CenCon, leave the heat switch and fan switch off.

Switch to the Ball Valve Actuator Calibration Tab.

Press: **Start Setup**, then **Closed (0%)**

The fuel actuator will move to fully closed (90°) position, and read 2V. Set the ball valve to fully closed mechanically and tighten linkage. The feedback must be at or very near 2V. Enter the actual feedback value into the space provided.

Press in sequence from low to high fire. At each stage enter the feedback value for the gas actuator once stabilized.

Once complete, press **Start Setup** to release.

COMBUSTION OFFSETS

Turn on the appliance gas supply.

To continue, enable the fan and heat switch. The technician must ensure that there is adequate air flow across the heat exchanger.

Select the Combustion Setup tab.

For initial testing, to avoid high levels of CO overloading the analyzer at high fire, increase the 'PacMan' opening to near fully open before starting.

Press Service Mode and set Service Override to 100%.

The burner will be enabled to prepurge and ignition. Allow the heat exchanger to warmup a few minutes.

CAUTION:

Be aware of high discharge temperatures.

Adjust regulator to achieve design manifold pressure.

Connect analyzer to flue.

Adjust the 'PacMan' to achieve a high fire air. **Refer to the combustion Value Table in Appendix G.**

Calculate and clock the high fire gas flow. Adjust regulator as required and re-clock. Once set, lock the 'PacMan' in place with the slider set-screw.

Follow the combustion setup sequence noted in appendix H.

Once the above values have been confirmed and set, return to high fire and allow combustion levels to stabilize. Set Service Override to low fire and observe combustion values to ensure clean combustion throughout the operating range.

Low fire combustion blower speed must not be lower than 950 rpm.

Navigate to the Save Load tab and press **Save Settings**.

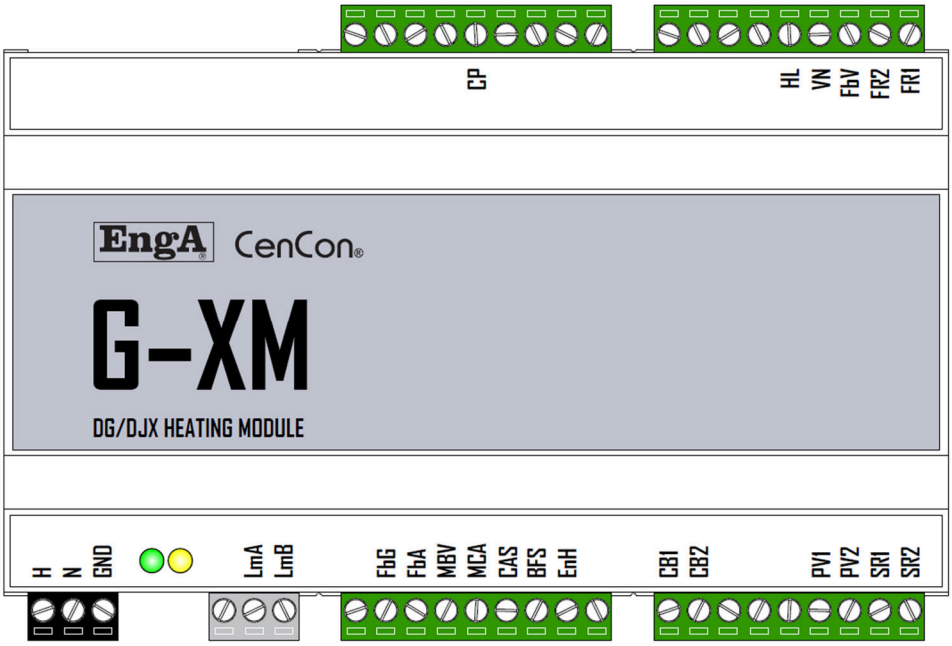
Combustion setup is now complete.

ALARM DESCRIPTIONS

Gas Valve Wiring	Gas valve feedback has power before the FR and SR contact are energized.
Shorted Air proving	Combustion blower feedback exceeds 500 rpm for more than 60 seconds when there is no demand.
Open Air Proving	Combustion blower does not exceed 3000 rpm during purge.
60 Hz	Combustion blower frequency has exceeded 60 Hz (3590 RPM)
Plugged Condensate	Blocked condensate sensor reads less then 7kΩ for more than 5 minutes.
Blocked Flue	Blocked flue input has been enabled for 3 minutes or more.
Flame Relay Wiring	Received a gas valve feedback within 500ms of activating the flame relay output.
Flame Failure	Gas valve feedback has no power after 1 minute of enabling the Flame relay output.
Gas Valve out of range	When ball valve is enabled this alarm occurs if the gas actuator feedback is greater or less then the demand by 10% for more than 90 seconds.

G-XM

For indirect heating appliances with DG and DJX200/300.



BASIC OPERATION

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 pilot flame. Once ignition is proven, it will then open the main safety valve (SSOV). Once the pilot flame has proven and the main flame is established, the G-XM will then disable the pilot valve. The burner is allowed to operate to maintain the requested discharge air temperature from the CenCon 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.

G-XM TIMING

Prepurge	60 seconds
Post purge	5 minutes
Flame failure	15 seconds lockout on ignition control and 60 seconds on burner
Pilot opening time	8 seconds
Open combustion air proving	60 seconds
Improper gas valve wiring	5 seconds
Blocked condensate trip	5 minutes
Blocked flue	10 seconds trip and 1 minute burner alarm
Heat exchanger cool down	90 seconds if the discharge air is above 50° (10°C), else none.
Heat exchanger warm up fan delay	75 seconds if ambient air is less than 40°F (4°C) and discharge temperature less than 90°F (32°C), else warm up is not required.
Burner cool down	90 seconds

TERMINAL DESCRIPTION

Terminal	Type	Name	Description	Value
H N		Power Supply		24 Vac
GND		Ground	Connect to chassis.	
LmA B		Modbus	Internal Network.	
FbG	AI	Feedback Gas	Compares the ball valve actuator feedback signal to the demand signal.	0-10 Vdc
FbA	AI	Feedback Air	Compares the combustion air actuator feedback signal to the demand signal.	0-10 Vdc
MBV	AO	Modulating ball valve	Modulating gas valve actuator output.	0-10 Vdc
MCA	AO	Modulating combustion air	Modulating combustion air actuator output.	0-10 Vdc
CAS	DI	Combustion air switch	Optional proof of combustion air flow.	24 Vac
BFS	DI	Blocked flue switch	Normally closed, opens on blocked flue.	24 Vac
EnH	DI	Enable heat	24V must be applied to allow heating function.	24 Vac
CB1, CB2	DO	Combustion blower	Start contact for the combustion air motor contactor.	24/120 Vac

PV1, PV2	DO	Pilot valve	Disables the pilot flame once the main burner has been established.	24/120 Vac
SR1, SR2	DO	Safety relay	Secondary safety lockout contacts.	24/120 Vac
FR1, FR2	DO	Flame relay	Flame relay enable contacts.	24/120 Vac
FbV	DI	Feedback valve	Feedback signal from the safety shut off valve (SSOV). Wired directly to valve.	24/120 Vac
VN		Valve neutral	Neutral feedback signal from the safety shut off valve (SSOV).	
HL	DI	High limit	Normally closed, opens on high temperature.	24 Vac
CP	AI	Condensate probe	Condensate probe sensor input.	Ohms (Ω)

G-XM COMBUSTION SETUP

Combustion setup may only be done using a computer. Refer to the combustion values and setup sheets at the end of this manual. Refer to the tabs along the top of the service screens to access noted sections.

NOTICE:

Always allow the heat exchanger temperature to stabilize before accepting combustion values.

A set of full clocking data must be completed in factory to generate a data base of combustion fuel curves.

GAS AND AIR ACTUATOR CALIBRATION

WARNING:

If using a ball valve and actuator for gas or air, it must be pre-calibrated before attempting to set combustion offsets. This is normally completed at initial factory setup but will also need to be verified if the actuator is replaced.

For field service, record all offset values, and then set all values to zero for both the gas and air actuators. Enter calibration screen and perform calibration setup. Return and re-set offset values.

WARNING:

Before performing the calibration procedure, turn Off the appliance gas supply.

Power the CenCon, leave the heat switch and fan switch off. **Turn off the gas supply to the appliance.**

Switch to the Ball Valve Actuator Calibration Tab.

Press: **Start Setup**, then **Closed (0%)**

Both actuators will move to fully closed (90°) position, and read 2V. Set the ball valve and combustion air damper to fully closed mechanically, and tighten linkage. The feedbacks must be at or very near 2V. Enter the actual feedback values into the spaces provided.

Press in sequence from low to high fire. At each stage enter the feedback values for both the gas and air actuators once stabilized.

Once complete, press **Start Setup** to release. Turn the gas supply back ON.

COMBUSTION OFFSETS

To continue, enable the fan and heat switch. The technician must ensure that there is adequate air flow across the heat exchanger.

Select the Combustion Setup tab.

Press Service Mode and set Service Override to 100%.

The burner will be enabled to prepurge and ignition. Allow the heat exchanger to warm up a few minutes.

From this point begin setup.

CAUTION:

⚠ Be aware of high discharge temperatures. High limit failure may occur.

Adjust regulator to achieve design manifold pressure.

Connect analyzer to flue.

Adjust the High Fire Air Offset value to achieve combustion values listed in the table in **Appendix G**.

Calculate and clock the high fire gas flow. Adjust regulator as required and re-clock.

Follow the combustion setup sequence noted in Appendix H.

Use the air offset and gas offset to achieve the desired combustion values.

Once the above values have been confirmed and set, return to high fire and allow combustion levels to stabilize. Set Service Override to low fire and observe combustion values to ensure clean combustion throughout the operating range.

Press: **Setup Complete.**

Press to disable **Service Mode.**

Navigate to the Save Load tab and press **Save Settings**. Combustion setup is now complete.

NOTICE:

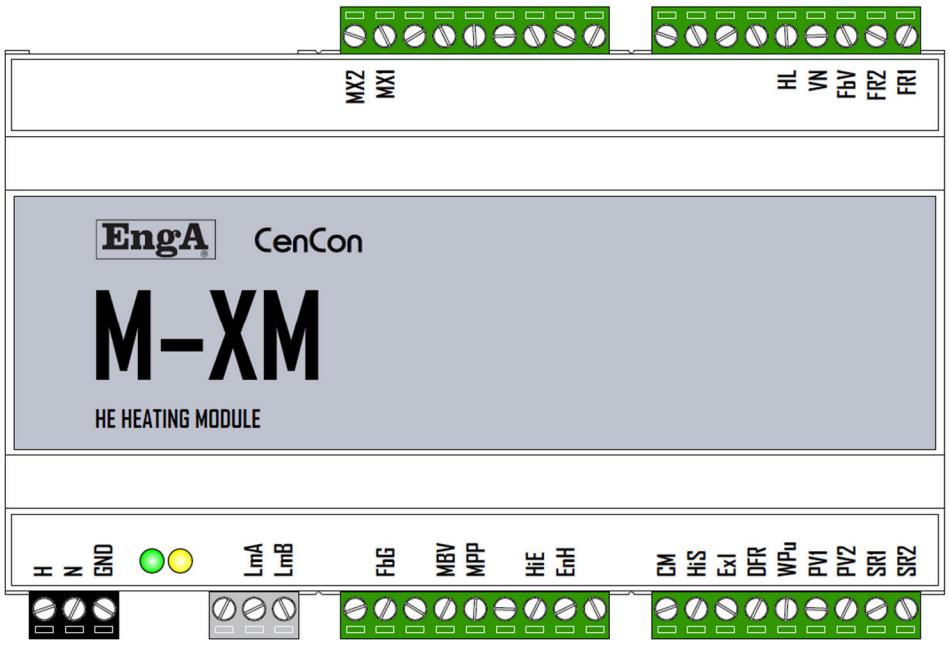
⚠ The **Tracking Okay** light indicates the stroke time of the actuators are in sync, within 5%. If not illuminated, one actuator is waiting for the other to catch up.

ALARM DESCRIPTION

Gas Valve out of range	Gas valve actuator feedback is greater or less then the demand . Tolerances and timing depending vary on mode of operation.
Air Actuator Out of range	Air Actuator Feedback Is greater or less then the demand. Tolerances and timing vary depending on mode of operation.
Shorted Air Proving	Combustion blower air switch input has power for 10 seconds before the combustion blower has been commanded on.
Open Air Proving	Combustion blower air switch input 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
Plugged Condensate	Blocked condensate sensor reads less than 7kohms for more than 5 minutes.
Blocked Flue	Blocked flue input has been enabled for 1 minute or more.
Flame Relay Wiring	Received a gas valve feedback within 500ms of activating the Flame relay output.
Flame Failure	Gas valve feedback has no power after 1 minute of enabling the Flame relay output.
Gas Valve Wiring	Gas valve feedback has power before the FR and SR contact are energized.

M-XM

For direct fired HE style direct fired heaters.



BASIC OPERATION

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 to maintain the requested discharge air temperature from the CenCon by modulating the control valve.

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.

M-XM / P-XM TIMING

Flame failure alarm	15 seconds lockout on ignition control 60 seconds on burner
Pilot opening time	10 seconds
Mode change time	60 seconds
Damper delay off	20 seconds
Improper gas valve wiring alarm	5 seconds
Supply air low airflow alarm	30 seconds
Shorted damper end switch alarm	1 second
Supply air shorted air switch alarm	30 seconds

TERMINAL DESCRIPTIONS

Terminal	Type	Name	Description	Value
H N		Power Supply		24 Vac
GND		Ground	Connect to chassis.	
LmA B		Modbus	Internal Network	
FbG	AI	Feedback Gas	Compares the ball valve actuator feedback signal to the demand signal.	0-10 Vdc
MBV	AO	Modulating ball valve	Modulating gas valve actuator output.	0-10 Vdc
MPP	AO	Profile pressure	Modulating profile pressure damper actuator output	0-10 Vdc
HiE	DI	High Speed Enable	Initiate high speed operation.	24 Vac
EnH	DI	Enable heat	24V must be applied to allow heating function.	24/120 Vac
CM	COM	Relay Common	Relay input power common to digital outs	24/120 Vac
HiS	DO	High Speed	High speed fan start contact	24/120 Vac
Exl	DO	Exhaust fan low	Single or low speed exhaust fan start contact	24/120 Vac
DFR	DO	Dual Flame Rod	Relay output to switch flame rods.	24/120 Vac
WPu	DO	Water Pump	Enable evaporative ‘swamp’ cooler water pump.	24/120 Vac

PV1, PV2	DO	Pilot valve	Disables the pilot flame once the main burner has been established.	24/120 Vac
SR1, SR2	DO	Safety relay	Secondary safety lockout contacts	24/120 Vac
FR1, FR2	DO	Flame relay	Flame relay enable contacts.	24/120 Vac
FbV	DI	Feedback valve	Feedback signal from the safety shut off valve (SSOV). Wired directly to valve.	24/120 Vac
VN		Valve neutral	Neutral feedback signal from the safety shut off valve (SSOV).	
HL	DI	High limit	Normally closed, opens on high temperature.	24 Vac
MX1, MX2	AO	Maxitrol Valve	DC current output to the Maxitrol modulating valve.	mA

M-XM BURNER SETUP

Combustion setup may only be done using a computer. Refer to the combustion values and setup sheets at the end of this manual. Refer to the tabs along the top of the service screens to access noted sections.

MAXITROL VALVE

Power the CenCon and enable the fan switch. Connect computer to CenCon.

Set airflow as required. Confirm profile pressure drop is within proper range. If using a Belimo gas valve actuator, perform the **Ball Valve Actuator Calibration** first.

Select the HE setup tab. Enable the heat switch.

Follow the combustion setup sequence noted in appendix H.

Press **Service Mode**, set Service Override to 100%. The burner will initiate the ignition sequence.

Adjust the service regulator to achieve design manifold pressure. Clock the gas flow and adjust as necessary.

Set Service Override to 4%. Set low fire using the mechanical bypass on the Maxitrol valve. The flame should be as small as possible while still maintaining a stable flame across the entire burner.

Press **Setup Complete**.

Return to the home screen and allow the unit to operate independently.

GAS ACTUATOR CALIBRATION

WARNING: ⚠	If using a ball valve and actuator for gas it must be pre-calibrated before attempting to set combustion offsets. This is normally completed at initial factory setup but will also need to be verified if the actuator is replaced. For field service, record all offset values, and then set all values to zero for both the gas and air actuators. Enter calibration screen and perform calibration setup. Return and re-set offset values.

WARNING:

Before performing the calibration procedure, turn Off the appliance gas supply.

Power the CenCon, leave the heat switch and fan switch off. **Turn off the gas supply to the appliance.**

Press the **UP** arrow to enter the actuator calibration screen.

Press: **Start Setup**, then **Closed (0%)**

The gas actuator will move to fully closed (90°) position, and read 2V. Set the ball valve to fully closed mechanically, and tighten linkage. The feedback must be at or very near 2V. Record the feedback in the space provided.

Press in sequence from low to high fire. At each stage enter the feedback values for the gas actuator.

Once complete, press **Start Setup** to release, and navigate to the Burner setup tab

Enable the heat switch. Press **Service Mode**, then set **Service Override to 100%**.

The ball valve will move to 100% open. Adjust the appliance regulator to achieve the design manifold pressure. Clock the gas flow and adjust as necessary.

Set **Service override to 4%**. Set low fire by adjusting the gas offset valve next to the Low Fire window, under **Gas Offsets**. The flame should be as small as possible while still maintaining a stable flame across the entire burner.

Press: **Setup Complete.**

Press to disable **Service Mode.**

Navigate to the Save Load tab and press **Save Settings**.

Combustion setup is now complete.

NOTICE:

The **Tracking Okay** light indicates the stroke time of the actuators are in sync, within 5%. If not illuminated, one actuator is waiting for the other to catch up.

ALARM DESCRIPTIONS

Flame Failure	Gas valve feedback has no power after 1 minute of enabling the Flame relay output.
Gas Valve Wiring	Gas valve feedback has power before the FR and SR contact are energized.
Flame Relay Wiring	Received gas valve feedback signal within 500ms of activating the Flame relay output.
Gas Valve out of range	When ball valve is enabled this alarm occurs if the gas actuator feedback is greater or less then the demand by 10% for more then 60 (Default is currently variable) seconds.
Low Velocity Air Switch	Occurs if the pressure drops below the low pressure setpoint during modulation for more than 40 seconds
High Velocity Air Switch	Occurs if the pressure goes above the High pressure setpoint during modulation for more than 90 seconds
Air Tube	Unexpected sensing. Typically reversed sensor connections.
Low Pressure	Alarm occurs if the pressure is less than the low pressure setpoint plus 0.05" wc after the damper is opened and the blower has been commanded to start for a minute. This alarm will not be triggered if the sequence has already passed the purge status and has lit. See “Low Velocity Air Switch” alarm
Low Pressure Sensor	If the pressure is greater than the Very low pressure setpoint before the damper is opened for more than 1 minute.
Very Low Pressure	Occurs if the pressure drops below the very low pressure setpoint after the purge has been completed.
Far Sensor Flame Failure	Occurs if a secondary flame rod is enabled and we lose flame sensing in less than 20 seconds after the pilot valve drops out on consecutive attempts.

Profile Pressure Setpoint

Non-adjustable trip setpoints noted in the table below, measured as in.wc. (Pa). If the unit is designed for variable air volume, the pressure trip points are scaled slightly to allow the profile damper actuator time to move and rebalance the profile pressure drop.

	Natural Gas	Propane
Very Low	0.12 (30)	0.17 (42)
Low	0.18 (45)	0.25 (62)
High	0.75 (187)	1.00 (249)

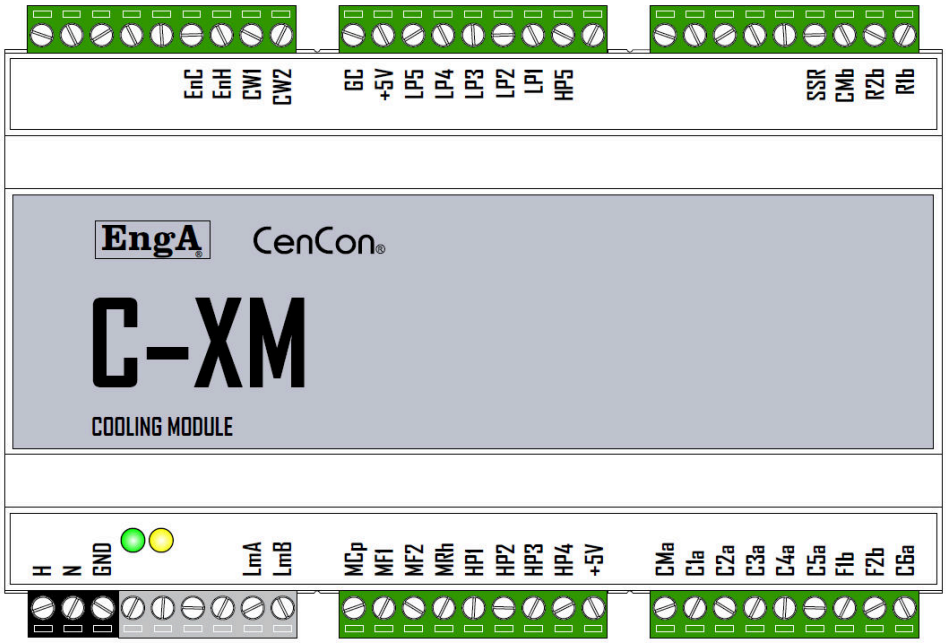
Time to trip on failures:

Heating Enabled	Response Time
Actual less than Very Low	1 Second
Actual less than Low	40 Seconds
Actual greater than High	90 Seconds

No Heat (Ventilation)	Response Time
Actual less than Very Low	1 Minute
Actual less than Low	1 Minute
Actual greater than High	No failure

C-XM

For direct expansion mechanical cooling operation, including FW, UPW and CU style equipment.



BASIC OPERATION

For staged compressor operation the C-XM will sequence on and off compressor stages to attempt 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. The C-XM can stage up to 6 compressors. A second C-XM may be added for equipment with more than 6 stages.

C-XM TIMING

Anti-cycle time	5 minutes
Inter-stage time	5 minutes

TERMINAL DESCRIPTIONS

Terminal	Type	Name	Description	Value
H N		Power Supply	24Vac Grounded Neutral.	24 Vac
GND		Ground	Connect to chassis.	
LmA B		Modbus	Internal Network.	

MCp	AO	Modulating compressor	Analog output to modulating compressor.	0-10 Vdc
MF1	AO	Modulating condenser fan #1	Analog output to variable speed condenser fan.	0-10 Vdc
MF2	AO	Modulating condenser fan #2	Analog output to variable speed condenser fan.	0-10 Vdc
MRh	AO	Modulating reheat output	Modulating hot gas reheat output.	0-10 Vdc
HP1	AI	High pressure sensor #1	Analog discharge pressure transducer, circuit #1.	0-10 Vdc
HP2	AI	High pressure sensor #2	Analog discharge pressure transducer, circuit #2.	0-10 Vdc
HP3	AI	High pressure sensor #3	Analog discharge pressure transducer, circuit #3.	0-10 Vdc
HP4	AI	High pressure sensor #4	Analog discharge pressure transducer, circuit #4.	0-10 Vdc
+5V		+5 Vdc	DC 5V power source.	
CMa	COM	Common to output set ‘a’	Common power relays ‘a’.	24/120 Vac
C1a	DO	Cooling stage #1	Output stage #1 cooling, powered from common ‘a’.	24/120 Vac
C2a	DO	Cooling stage #2	Output stage #2 cooling, powered from common ‘a’.	24/120 Vac
C3a	DO	Cooling stage #3	Output stage #3 cooling, powered from common ‘a’.	24/120 Vac
C4a	DO	Cooling stage #4	Output stage #4 cooling, powered from common ‘a’.	24/120 Vac
C5a	DO	Cooling stage #5	Output stage #5 cooling, powered from common ‘a’.	24/120 Vac
F1b	DO	Condenser fan stage #1	Ambient temperature based condenser fan #1 enable.	24/120 Vac
F2b	DO	Condenser fan stage #1	Ambient temperature based condenser fan #2 enable.	24/120 Vac
C6a	DO	Cooling stage #6	Output stage cooling, stage #6, powered from common ‘a’.	24/120 Vac
R1b	DO	Stepped reheat stage #1	Stepped reheat output, stage 1, powered from common ‘b’.	24/120 Vac
R2b	DO	Stepped reheat stage #2	Stepped reheat output, powered from common ‘b’.	24/120 Vac
CMb	COM	Common to output set ‘b’	Common power relays ‘b’.	24/120 Vac
SSR	DO	Digital output	Solid state relay for digital compressors.	
HP5	AI	High pressure sensor #5	Analog discharge pressure transducer, circuit #5.	0-10 Vdc
LP1	AI	Low pressure sensor #1	Analog suction pressure transducer, circuit #1.	0-10 Vdc
LP2	AI	Low pressure sensor #2	Analog suction pressure transducer, circuit #2.	0-10 Vdc
LP3	AI	Low pressure sensor #3	Analog suction pressure transducer, circuit #3.	0-10 Vdc

LP4	AI	Low pressure sensor #4	Analog suction pressure transducer, circuit #4.	0-10 Vdc
LP5	AI	Low pressure sensor #5	Analog suction pressure transducer, circuit #5.	0-10 Vdc
+5V		+5 Vdc	DC +5 power source.	5 Vdc
GC		DC common	DC common.	
EnH	DI	Enable reheat ovveride	Enable hot gas reheat override to 100%.	24 Vac
EnC	DI	Enable cooling	Enable / disable mechanical cooling.	24 Vac
CW1,2	AI	Chilled Water sensor	10k Type 2 thermistor.	Ohms (Ω)

STAGED COMPRESSORS

On a call for cooling, the compressors will stage on from 1 to 6. The CenCon cooling programming does not allow for random start, only sequential. Inter-stage and anti-cycle timing is built into the CenCon program and is not adjustable.

On the initial call for cooling only, the inter-stage time of the first 2 stages is decreased.

AMBIENT CONDENSER FANS

The CenCon may incorporate up to 2 ambient temperature based condenser fan (or ambient based compressors) enable contacts.

LOW AMBIENT LOCKOUT

Mechanical cooling is disabled below the design low ambient lockout setpoint, typically set at 50˚F (10˚C), and 58˚F (14˚C) for makeup air appliances.

CONDENSER REHEAT

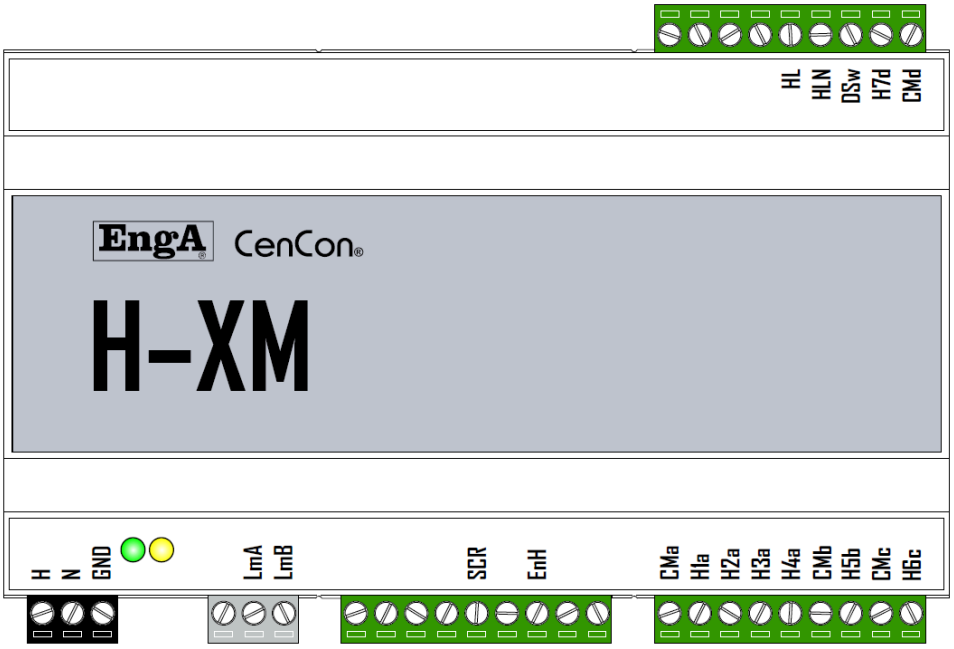
When dehumidification is enabled (digital input) and there is a call for dehumidification from the return or room air humidistat, the CenCon will enable the condenser reheat controller (Carel CRC) and stage on compressors to obtain the (DX) leaving temperature. The CenCon will modulate the output signal to the CRC to operate the reheat valve to maintain the requested discharge set point.

Appliances may have an added auxiliary heat option that will allow the main source of heat to be enabled if reheat is at 100% or EnH is enabled and the desired discharge setpoint cannot be attained.

The compressor oil return cycle is managed by the CRC. Refer to the Engineered Air Carel Condenser Reheat manual.

H-XM

For control of staged electric heat (LMK and /K) appliances.



BASIC OPERATION

For staged electric heater operation the H-XM will sequence stages of electric heat to attempt to maintain the discharge temperature setpoint. As with all staged systems, expect the discharge temperature to fluctuate from setpoint as stages are turned on and off. The H-XM can control up to 5 stages of electric heat, in addition to 2 ambient temperature-based stages.

TERMINAL DESCRIPTIONS

Terminal	Type	Name	Description	Value
H N		Power Supply	24Vac Grounded Neutral	24 Vac
GND		Ground	Connect to chassis.	
LmA B		Modbus	Internal Network	
SCR	AO	Modulating output	Modulating output to external SCR controller.	0-10 Vdc
EnH	DI	Enable heat	24V must be applied to allow heating function.	24/120 Vac
CMa	COM	Common to output ‘a’.	Common power relays ‘a’.	24/120 Vac
H1a	DO	Heating stage #1	Output stage #1 heating, powered from common ‘a’.	24/120 Vac
H2a	DO	Heating stage #2	Output stage #2 heating, powered from common ‘a’.	24/120 Vac
H3a	DO	Heating stage #3	Output stage #3 heating, powered from common ‘a’.	24/120 Vac

H4a	DO	Heating stage #4	Output stage #4 heating, powered from common ‘a’.	24/120 Vac
CMb	COM	Common to output set ‘b’	Common power relays ‘b’.	24/120 Vac
H5b	DO	Heating stage #5	Output stage #5 heating, powered from common ‘b’.	24/120 Vac
CMc	COM	Common to output set ‘c’	Common power relays ‘c’.	24/120 Vac
H6c	DO	Ambient stage #1	Output ambient stage #1 heating, powered from common ‘c’.	24/120 Vac
CMd	COM	Common to output set ‘d’	Common power relays ‘d’.	24/120 Vac
H7d	DO	Ambient stage #2	Output ambient stage #2 heating, powered from common ‘c’.	24/120 Vac
DSw	DI	Door Switch	External safeties input.	24/120 Vac
HLN		High limit neutral	External safeties input neutral.	24/120 Vac
HL	DI	High Limit	Normally closed, opens on high temperature.	24/120 Vac

STAGED HEATING

Inter-stage timing is non-adjustable; however the timers may be truncated on initial startup depending on the level of temperature demand.

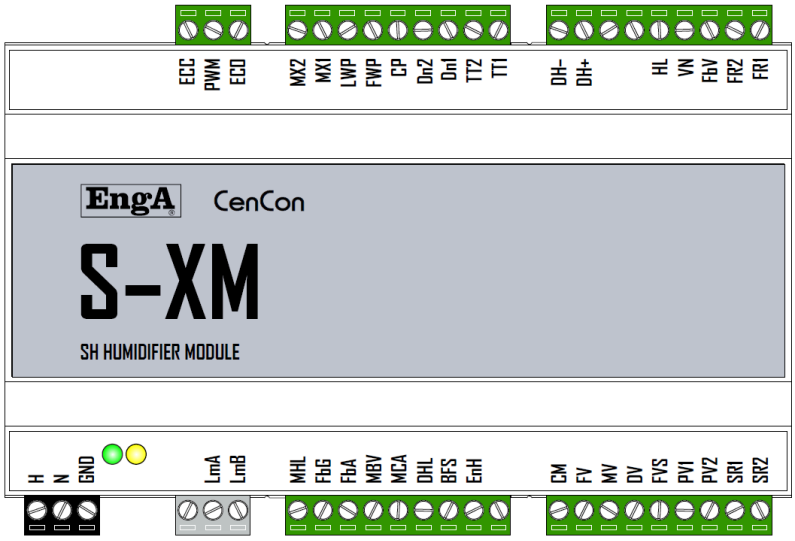
Ambient stage cut-in setpoints are adjustable.

HIGH AMBIENT LOCKOUT

Electric heating is disabled above the design high ambient lockout setpoint.

S-XM

For control of gas fired SH and SHX humidifiers.



BASIC OPERATION

The S-XM expansion module controls the operation of SH and SHX series gas fired humidifiers. This includes tank water fill and drain and burner control. 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. The water quality setting determines maximum total boiling time before it cycles a full drain event. Drain temperature is monitored and cooled with the supply water if required. SHX have a secondary side tank for improved efficiency. These use an additional fill valve for the side tank.

Control may be independent, with an internal setpoint (viewed from the interface screen) that may be adjusted to the desired relative humidity setpoint (RH%). The CenCon may also accept a 0-10Vdc control signal into terminals W+/-. This input signal may be factory configured to be either setpoint only (0-100%), or a direct command signal to enable the gas section of the humidifier to fire from 0 to 100% (full output). Input signal below 0.4Vdc will disable humidification.

Direct control should only be used in conjunction with a front-end control system that has an existing humidity sensing system.

On initial startup, with a demand for humidity, the SH will go to high fire for a timed event to raise the water temperature to at or near the boiling point.

Never install the RH sensor in the discharge duct of an appliance. Relative humidity is relative to the surrounding air temperature, which must be stable. Only install RH sensors in the return duct or in the room being served.

S-XM TIMING

Dump/drain Schedule (ppm of calcium carbonate – pre-programmed)	0 ppm = No dump unless triggered by input (below). Less than 60 ppm = 30 hours 60 – 119 ppm = 20 hours 120 – 179 = 15 hours 180 or greater = 10 hours
Drain initiation contact (OCC) or EnH.	Drain initiated 30 seconds after terminal power loss
Drain time	SH(X)240 and smaller = 20 minutes SH(X)400 and larger = 40 minutes
Fill time	30 – 60 minutes
Tank warm up time	15 minutes at 100% firing rate
Pilot opening time	10 seconds
Improper gas valve wiring alarm	5 seconds
Tank warm up	15 minutes

OPERATION NOTES

The S-XM can control both the large (120-650) and small (35-90) sizes of humidifiers. The large sizes use a DJ style burner and require the addition of a J-XM and CD-XM expansion module.

TERMINAL DESCRIPTIONS

Terminal	Type	Name	Description	Value
H N		Power Supply	24Vac Grounded Neutral	24 Vac
GND		Ground	Connect to chassis.	
LmA B		Modbus	Internal Network	
MHL	AI	Modulating High Limit	Optional analog input for duct mounted high humidity sensing.	0–10 Vdc
FbG	AI	Feedback Gas	Compares the ball valve actuator feedback signal to the demand signal.	0-10 Vdc
MBV	AO	Actuator Modulating Valve	Future	0-10 Vdc
BFS	DI	Blocked Flue Switch	Normally closed, opens on blocked flue.	24 Vac
EnH	DI	Enable Heat/Humidity	24V must be applied to allow heating function.	24 Vac
CM	COM	Relay Common	Relay input power common to valve outputs.	24/120 Vac
FV	DO	Fill Valve	Enable water fill valve.	24/120 Vac
MV	DO	Mixing Valve	Enable drain water tempering valve.	24/120 Vac
DV	DO	Drain Valve	Enable primary drain valve.	24/120 Vac
FVS	DO	Fill Valve Side	Enable side tank (SHX) fill valve.	24/120 Vac
PV1, PV2	DO	Pilot valve	Disables the pilot flame once the main burner has been established.	24/120 Vac
SR1, SR2	DO	Safety relay	Secondary safety lockout contacts	24/120 Vac
FR1, FR2	DO	Flame relay	Flame relay enable contacts.	24/120 Vac

FbV	DI	Feedback valve	Feedback signal from the safety shut off valve (SSOV). Wired directly to valve.	24/120 Vac
VN		Valve neutral	Neutral feedback signal from the safety shut off valve (SSOV).	
HL	DI	High limit	Normally closed, opens on high temperature.	24 Vac
DH+,DH-	AI	Direct Humidity	Input for direct control of humidifier output control. Below 0.4Vdc disables humidification.	0-10 Vdc
Dn1, Dn2	AI	Drain Sensor	Drain probe sensor input.	Ohms (Ω)
CP	AI	Condensate probe	Condensate probe sensor input.	Ohms (Ω)
FWP	AI	Water probe	Fill water level sensor	Ohms (Ω)
LWP	AI	Water probe	Low water level sensor	Ohms (Ω)
MX1, MX2	AO	Maxitrol Valve	DC current output to the Maxitrol modulating valve.	mA
ECO	AO	ECM Demand	Future	0-10 Vdc
PWM	PWM	ECM rpm feedback	Future	PWM
ECC		ECM Neutral	Future	

LARGE SH(X) COMBUSTION SETUP

Combustion setup may only be done using a computer. Refer to the combustion values and setup sheets at the end of this manual. Refer to the tabs along the top of the service screens to access noted sections.

WARNING: ⚠ Always allow the heat exchanger temperatures to stabilize before accepting combustion values.

GAS ACTUATOR CALIBRATION

WARNING: ⚠ If using a ball valve and actuator for gas, it must be pre-calibrated before attempting to set combustion offsets. This is normally completed at initial factory setup but will also need to be verified if the actuator is replaced.

For field serviced, record all offset values, and then set all values to zero. Enter calibration screen and perform calibration setup. Return and re-set offset values.

WARNING: ⚠ Before performing the calibration procedure, turn Off the appliance gas supply.

Power the Cencon, leave the heat switch and fan switch off. **Turn off the gas supply to the appliance.**

Switch to the Ball Valve Actuator Calibration Tab.

Press: **Start Setup**, then **Closed (0%)**

The fuel actuator will move to fully closed (90°) position and read 2V. Set the ball valve to fully closed mechanically and tighten linkage. The feedback must be at or very near 2V. Enter the actual feedback value into the space provided.

Press in sequence from low to high fire. At each stage enter the feedback value for the gas actuator once stabilized.

Once complete, press **Start Setup** to release.

COMBUSTION OFFSETS

To continue, enable the fan and heat switch. The technician must ensure that there is adequate air flow across the heat exchanger.

Select the Combustion Setup tab.

For initial testing, to avoid high levels of CO overloading the analyzer at high fire, increase the 'PacMan' opening to near fully open before starting.

Press Service Mode and set Service Override to 100%.

The burner will be enabled to prepurge and ignition. Allow the heat exchanger to warm up for a few minutes.

WARNING:

⚠ Be aware of high discharge temperatures.

Adjust regulator to achieve design manifold pressure.

Connect analyzer to flue.

Adjust the 'PacMan' to achieve a high fire air. **Refer to the combustion Value Table in Appendix G**.

Calculate and clock the high fire gas flow. Adjust regulator as required and re-clock. Once set, lock the 'PacMan' in place.

Follow the combustion setup sequence noted in appendix H.

Once the above values have been confirmed and set, return to high fire and allow combustion levels to stabilize. Set Service Override to low fire and observe combustion values to ensure clean combustion throughout the operating range.

Low fire combustion blower speed must not be lower than 950 rpm.

Navigate to the Save Load tab and press **Save Settings**.

Combustion setup is now complete

SMALL SH(X) BURNER SETUP

Combustion setup may only be done using a computer. Refer to the Large SH(X) burner setup for SH and SHX humidifiers sizes 120 – 650. The following is for the small versions sizes 35-90 which have a turndown of 3:1.

Power the CenCon and enable the fan switch. Connect computer to CenCon.

Select the Combustion Setup tab.

Enable the heat switch.

Follow the combustion Values noted in appendix G.

Press **Service Mode**, then set **Service Override to 100%.**

The burner ignition module will be enabled to start the ignition sequence and monitor the air proving switch.

Adjust the service regulator to achieve design manifold pressure. Clock the gas flow and adjust as necessary.

Follow the combustion setup sequence noted in appendix H.

Adjust high fire air with the combustion air blower inlet slider. Re-clock gas flow and screw the inlet slider in place.

Set **Service Override to 100%**. Low fire gas pressure is set by using the mechanical bypass on the Maxitrol valve. Air flow is not adjustable.

Press: **Setup Complete.**

Press to disable **Service Mode.**

Return to the home screen by pressing the **Left** arrow key, and then press **Save User Settings**.

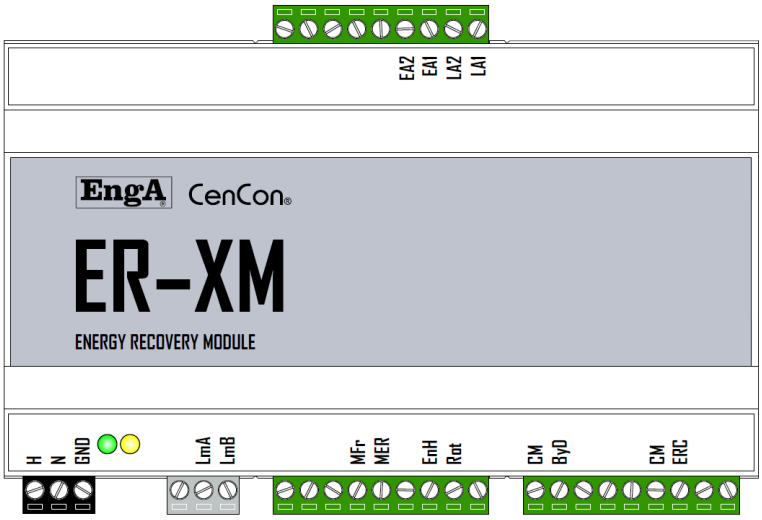
ALARM DESCRIPTION

Drain Sensor Failure	Sensor reads <30˚F or >212˚F for more than 10 seconds.
Tank High Pressure Overflow	Unexpected hot water reading at drain sensor. Drain temperature has been >110˚F after the burner has been on for more than 5 minutes.
Fill Valve Stuck Open	Unexpected hot water reading at drain sensor. Drain temperature is >110˚F, both LWP and FWP probes are covered, and SH status is OFF.
Hot Drain Lockout	Drain tempering valve appears to not function. Drain temperature senses >130˚F for more than 1 minute. Attempts to drain 15 times, then locks out for 2 hours before retrying drain attempt.
Foaming Alarm	If during steam production the low water probe (LWP) is uncovered in the first 2 minutes of the fill valve being turned on, after the burner has been on for longer than 10 minutes.
Water Probe Sequence	During fill, if the FWP is made before the LWP.
Failure to Drain	The drain valve has been enabled for more than 1 hour and the LWP is still covered.

Tank High Limit	Tank high limit temperature switch open. Manual reset.
Failed Water Supply	On initial fill, if the LWP is not covered within the full fill time. During normal steam production, alarm occurs if FWP is not covered after 5 minutes of fill command.

ER-XM

For control of energy recovery systems, including wheels, pipes and plates.



BASIC OPERATION

On a call for energy recovery, with the enable contact closed, the ER-XM will command the energy recovery method to try and achieve control (heat wheel motor speed, heat pipe tilt actuator, heat plate damper actuator) to discharge setpoint. Exhaust temperature is monitored for performance and frost protection.

The leaving air temperature is primarily for independent heat wheel systems. In a packaged unit the discharge sensor is used for control. In a packaged unit the leaving air sensor is for calculating performance.

An optional rotational sensor can be added to the heat wheel for indication of rotation and speed.

BYPASS MODE

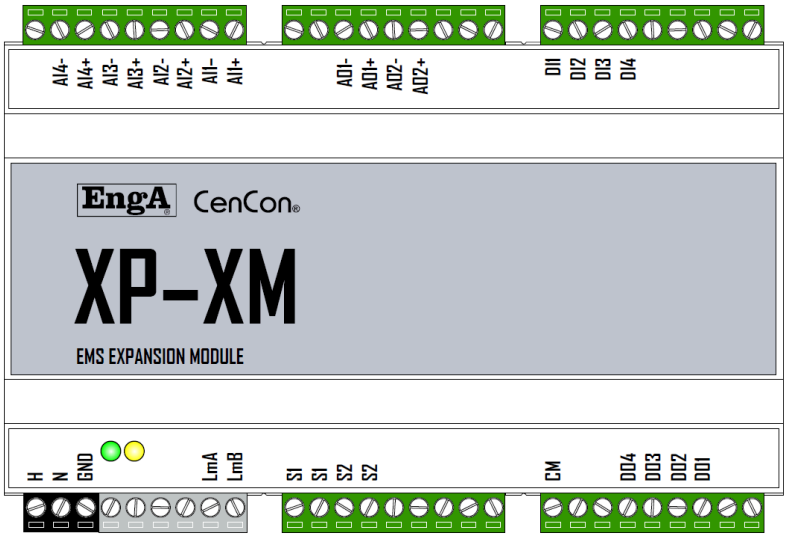
If bypass dampers are incorporated into the appliance they are enabled to open/modulate for frost control. The bypass dampers will also open when no energy recovery is available to reduce pressure drop and increase energy savings.

TERMINAL DESCRIPTION

Terminal	Type	Name	Description	Value
H N		Power Supply		24 Vac
GND		Ground	Connect to chassis.	
LmA B		Modbus	Internal Network	
MFr	AO	Modulating Bypass Damper Demand	Modulating output to bypass damper actuator.	0-10 Vdc
MER	AO	Drive Motor Speed Signal	Modulating output to heat wheel drive motor, heat pipe tilt actuator, or heat plate damper actuator.	0-10 Vdc
EnH	DI	Enable energy recovery	Enable energy recovery operation.	24 Vac
Rot	DI	High Speed Enable	Input from rotation sensor.	24 Vac
CM / ByD	DO	Bypass Damper	Dry contact enable bypass damper.	24/120 Vac
CM / ERC	DO	Relay Common	Dry contact enable wheel motor starter.	24/120 Vac
LA1,2	AI	Leaving (Supply) Air Temperature	10k Type 2 thermistor	Ohms (Ω)
EA1,2	AI	Exhaust Air Temperature	10k Type 2 thermistor	Ohms (Ω)

XP-XM

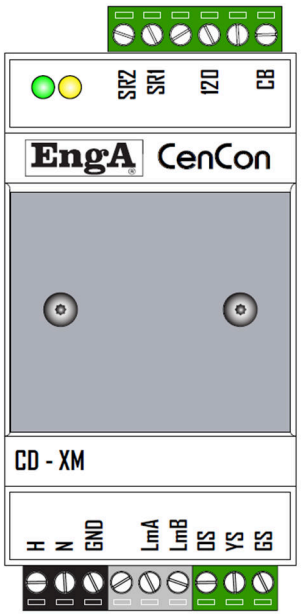
An expansion module was developed primarily to allow the addition of BACnet (EMS) points not currently available on the CenCon. These points are for monitoring only, or command points from the front end BACnet system. Up to a maximum of (4) XP-XM expansion modules may be used on a single system. Custom programming for functional operation of these points is not available.



Terminal	Type	Name	Description	Value
H N		Power Supply	24Vac Grounded Neutral	24 Vac
GND		Ground	Connect to chassis.	
LmA B		Modbus	Internal Network	
S1	AI	Sensor 1	10k Type 2 thermistor	Ohms (Ω)
S2	AI	Sensor 2	10k Type 2 thermistor	Ohms (Ω)
AI1+/-	AI	Analog Input 1	Analog input, high common mode	0-10 Vdc
AI2+/-	AI	Analog Input 2	Analog input, high common mode	0-10 Vdc
AI3+/-	AI	Analog Input 3	Analog input, high common mode	0-10 Vdc
AI4+/-	AI	Analog Input 4	Analog input, high common mode	0-10 Vdc
DI1	DI	Digital Input 1	Normally open input contacts	24 Vac
DI2	DI	Digital Input 2	Normally open input contacts	24 Vac
DI3	DI	Digital Input 3	Normally open input contacts	24 Vac
DI4	DI	Digital Input 4	Normally open input contacts	24 Vac
AO1+/-	AO	Analog Output 1	Analog output	0-10 Vdc
AO2+/-	AO	Analog Output 1	Analog output	0-10 Vdc
CM	COM	Relay Common	Relay input power common to digital outputs	24 Vac
DO1	DO	Digital Output 1	Normally open output contacts	24 Vac
DO2	DO	Digital Output 2	Normally open output contacts	24 Vac
DO3	DO	Digital Output 3	Normally open output contacts	24 Vac
DO4	DO	Digital Output 4	Normally open output contacts	24 Vac

CD-XM

TRIAC combustion motor speed drive. The 120V and CB terminals as separated to accept heavy insulation wire from the combustion blower motor. The CD-XM will be mounted in the electrical panel on 'standard' equipment. The CD-XM must always be mounted such that the speed sensor wire does not need to be extended, therefore it may be mounted inside the burner cabinet in equipment that has the burner control panel mounted farther away. If so, keep at least 6" (150mm) away from the ignition control.



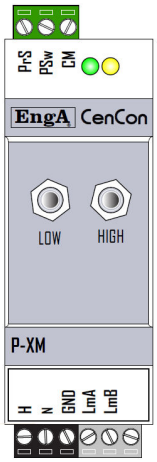
BASIC OPERATION

The Chopper Drive module will control the combustion motor speed on DJ and large SH indirect fired burners in conjunction with the J-XM heating module. A 3 wire feedback signal from the Engineered Air hall-effect speed sensor is used to prove the actual blower speed.

Terminal	Type	Name	Description	Value
H N		Power Supply	24Vac Grounded Neutral	24 Vac
GND		Ground	Connect to chassis.	
LmA B		Modbus	Internal Network	
OS	AI	Tachometer +	Engineered Air DJ speed sensor Red wire.	0-10 Vdc
YS	AI	Tachometer -	Engineered Air DJ speed sensor Yellow wire.	0-10 Vdc
GS	AI	Tachometer reference	Engineered Air DJ speed sensor Green wire.	0-10 Vdc
CB	AO	TRIAC output	Output to combustion blower motor.	120 Vac
120		120V line in	120V Hot input	120 Vac
SR1,2	DO	Safety relay	Normally open output contacts	24/120 Vac

P-XM

The pressure sensing module is used for monitoring the direct fired burner profile pressure drop. The P-XM can also output either a dry on/off contact or a modulating 0-10Vdc output to provide filter monitoring or differential pressure readings. The CenCon can monitor up to (7) P-XM modules.



BASIC OPERATION

P-XM has an internally mounted air pressure sensor rated at an output of 0-10mbar (0-4”wc).

CAUTION:

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

At power start up, the P-XM will perform a check of the pressure sensor (near 0.0 pressure differential), primarily for testing for kinked or blocked tubing. If any pressure is present at the sensor the yellow light will turn on solid for 2 seconds, then revert to normal operation. It then ignores the pressure sensing output until after the supply blower starts. It then ensures the pressure differential across the profile is within operating range before allowing the heat to be enabled.

The CenCon air pressure monitoring system performs a time weighted calculation based on severity of change to provide some protection against nuisance lock outs from various sources, such as wind gusts. Once the airflow has stabilized, the timer is reset. For timing values refer to the M-XM alarm list.

Terminal	Type	Name	Description	Value
H N		Power Supply	24Vac Grounded Neutral	24 Vac
GND		Ground	Connect to chassis.	
LmA B		Modbus	Internal Network	
CM		Relay Common	Common contact input to Pressure Switch	24/120 Vac
PSw	DO	Pressure Switch	Output contact	24/120 Vac
PrS	AO	Pressure Sensor	Pressure sensor output 0-4”w.c.	0-10 Vdc

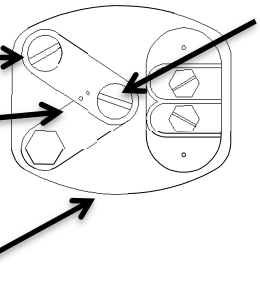
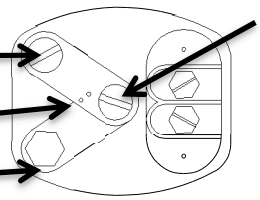
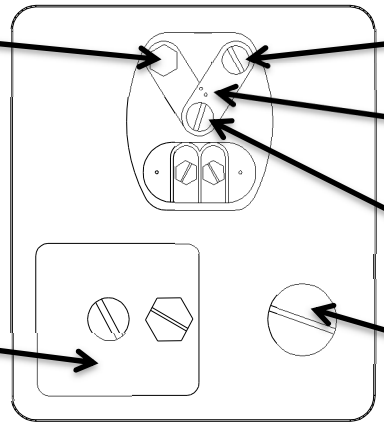
Appendix A - Thermistor Output Table

°F	°C	Ω
-39	-39.4	323839
-37	-38.3	300974
-35	-37.2	279880
-33	-36.1	260410
-31	-35.0	242427
-29	-33.9	225809
-27	-32.8	210443
-25	-31.7	196227
-23	-30.6	183068
-21	-29.4	170775
-19	-28.3	159488
-17	-27.2	149024
-15	-26.1	139316
-13	-25.0	130306
-11	-23.9	121939
-9	-22.8	114165
-7	-21.7	106939
-5	-20.6	100218
-3	-19.4	93909
-1	-18.3	88090
1	-17.2	82670
3	-16.1	77620
5	-15.0	72911
7	-13.9	68518
9	-12.8	64419
11	-11.7	60592
13	-10.6	57017
15	-9.4	53647
17	-8.3	50526
19	-7.2	47606
21	-6.1	44874
23	-5.0	42317
25	-3.9	39921
27	-2.8	37676
29	-1.7	35573
31	-0.6	33599
33	0.6	31732
35	1.7	29996
37	2.8	28365
39	3.9	26834
41	5.0	25395
43	6.1	24042
45	7.2	22770
47	8.3	21573
49	9.4	20446
51	10.6	19376
53	11.7	18378
55	12.8	17437
57	13.9	16550
59	15.0	15714
61	16.1	14925
63	17.2	14180
65	18.3	13478
67	19.4	12814
69	20.6	12182
71	21.7	11590
73	22.8	11030
75	23.9	10501
77	25.0	10000
79	26.1	9526
81	27.2	9078
83	28.3	8653
85	29.4	8251
87	30.6	7866
89	31.7	7505
91	32.8	7163
93	33.9	6838
95	35.0	6530
97	36.1	6238
99	37.2	5960
101	38.3	5697
103	39.4	5447
105	40.6	5207
107	41.7	4981
109	42.8	4766
111	43.9	4561
113	45.0	4367
115	46.1	4182
117	47.2	4006
119	48.3	3838
121	49.4	3679
123	50.6	3525
125	51.7	3380
127	52.8	3242
129	53.9	3111
131	55.0	2985
133	56.1	2865
135	57.2	2751
137	58.3	2642
139	59.4	2538
141	60.6	2438
143	61.7	2343
145	62.8	2252
147	63.9	2165
149	65.0	2082
151	66.1	2003
153	67.2	1927
155	68.3	1855
157	69.4	1785
159	70.6	1718
161	71.7	1655
163	72.8	1594
165	73.9	1536
167	75.0	1480
169	76.1	1427
171	77.2	1375
173	78.3	1326
175	79.4	1279
177	80.6	1234
179	81.7	1190
181	82.8	1149
183	83.9	1109
185	85.0	1070
187	86.1	1034

Appendix B - Maxitrol Valve Adjustments

The ES345D-L has a built in regulator for high fire. For M and MR series, adjust high fire with the upstream main regulator.

On DJ style burners, the top of the valve is piped into the burner box to provide a pressure to the top of the control valve regulator, extending its operating range and overcoming pressure differences due to the varying combustion blower speed. This is called Top Loading. When setting combustion on a top loaded valve, temporarily plug the small vent holes when the cover cap is removed to allow top loading to function during setup. Remove plug once setup is complete and reinstall the cap cover.

Valve Model	Adjustment	Top View Gas Flow
M420 M520 M620	Low fire adjustment. Vent hole (plug if top loaded) Low fire bypass (bottom side of valve)	 White plastic disk covering plunger, black side up.
MR410 MR510 MR610 M411 M511 M611 ES433	Low fire adjustment Vent hole (plug if top loaded) Vent orifice	 Brass disk covering plunger, black side up.
ES345D-L MR212	Vent orifice, or top loading connection High fire regulator	 Low fire adjustment. Vent hole (plug if top loaded) White plastic disk covering plunger, black side up. Low fire bypass adjustment.

Appendix C – Startup Checks

1. Check and confirm all hardware connections
   a. Terminal Plugs firmly attached.
   b. Wiring connections.
2. Confirm ground bonding is correct and firmly fastened.
3. Confirm shielded grounds are correct.
4. Confirm internal Modbus wiring is correct (LmA and LmB).
5. Check all field electrical connections are intact and correct.

Appendix D – Address Settings

The expansion modules must have the rotary address pot in the back of the PCB selected to correctly function. These are normally set from the PCB manufacturer, however in appliances with multiple modules of the same type it will need to be factory adjusted. The settings are also noted on the electrical diagram.

Expansion Module	Operation	Switch Setting
C-XM	Standard	0
J-XM	Standard	0
G-XM	Standard	2
M-XM	Standard	4
S-XM	Standard	6
H-XM	Standard	8
ER-XM	Standard	A
CD-XM	Standard DJ	0
	SH	1
	DJ #2	2
XP-XM	Standard	0
	XP #2	1
	XP #3	2
	XP #4	3
P-XM	Direct Fired	0
	P-XM #1	1
	P-XM #2	2
	P-XM #3	3
	P-XM #4	4
	P-XM #5	5
	P-XM #6	6
	P-XM #7	7

Appendix E - Service Issues

READ AND SAVE FEATURES

The majority of software settings are specified at the time of the appliance design. Some settings can be field adjusted with a computer interface, including temperature and humidity setpoints, minimum damper position, combustion settings, etc.

The READ SETTINGS function references a configuration file located within the CenCon permanent memory and writes the data values from that table into the relevant parameters on the live system. Any changes to values on the system that were not previously saved will be overwritten.

The SAVE SETTINGS function writes data values from the live system to the permanent memory. This process will overwrite any previously saved data and will become the new configuration file when the controller is powered up.

CAUTION:

⚠ Do not power cycle during Read/Save process.

COMMUNICATION ALARM

Check and confirm with correct communication wiring on the internal Modbus network wiring and connections.

ERRATIC BEHAVIOR

During shipping, it is possible for the terminal connectors that plug into the CenCon or expansion modules to come loose and separate from the controller. When performing the initial start-up of the appliance always confirm the terminals are firmly embedded into the controller. In addition, check the tightness of all wiring connections.

HARD RESET BUTTON

Near the edge of the left side face of the CenCon face is a small button which is the hard reset button. If not correctly aligned with the cover plate, it is possible the button could be constantly depressed. In this circumstance the display will be blank, the 4 lights on the right side will not be lit, and the controller will be unresponsive to all commands.

Miscellaneous

COMBUSTION ANALYSIS

Indirect heaters should be annually checked for quality of combustion.

POOR PILOT SENSING

Check the condition of the pilot assembly. Check for damaged or dirty ceramics, and the condition of the gasket. Ensure the pilot air tube is free of debris and blockages. Note that on DJ's and DG's there is an orifice

where the pilot gas line is connected to the pilot air tube. It must be free of dirt and burrs to operate properly. Pilot pressure is between 3 – 5”wc.

REGULATOR RESPONSE

On some indoor units the vent orifice fitting on the RV appliance regulator is to be vented to atmosphere. The field installed vent line must be sized in accordance with the requirements of the gas code in force.

Some DJ unit manifolds have RV appliance regulators with a vent-limiting orifice, usually a brass orifice marked ‘12A06’. Ensure that this tiny orifice is free of dirt or debris. A plugged orifice will impede regulators opening flow and cause improper air/fuel mixtures.

WATER AND ICE FROM COMBUSTION

Water is one of the major products of combustion. As the flue temperature drops, and the efficiency increases, the amount of water condensing to liquid will also increase. Extended chimneys can contribute to condensation problems. Increasing the excess air is a method of reducing the amount of water condensate. Increasing excess air by 1-2% will assist in keeping the flue gases drier.

MANIFOLD PRESSURE

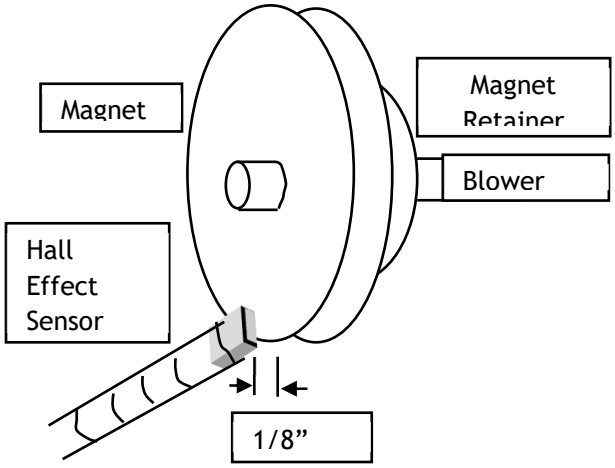
Manifold pressure settings that the unit was tested and clocked at in the factory are recorded on the unit rating plate. Any attempt to clock a unit in the field should be done with care. Corrections for density *(altitude and station pressure)*, temperature, and the correction factor for the meter are often overlooked, thus leading to an incorrect conclusion.

CUSTOMER INSTALLED SENSORS

If there is a temperature sensor to be installed in the discharge, that sensor must be mounted within ½ inch of the Engineered Air sensor. BMS (Building Management System) discharge air temperature sensors should never be used to reset the temperature of the heater. Only use space or room mounted sensors.

Humidity sensing should never sense discharge air. During normal operation the RH% will vary as the sensible and latent temperatures change due to heating and cooling. Only use return air or room sensing for humidity control.

HALL EFFECT SPEED SENSOR



With a digital AC voltmeter, measure the AC volts present on terminals “YS to GS”. When the combustion blower is running there should be 4 to 6 Vac present. If the AC voltage is not present, confirm the tachometer sensor is located near the circumference of the magnet, with a 1/16 to 1/8” (2-3mm). Ensure speed sensor wire is routed at least 8” (200mm) away from any power wiring.

TOP LOADING

Ensure the top loading tube from the modulating valve is located is not pointed directly UP. Ideally it enters from the bottom and is located at either side of the burner box and bent to a 90° angle pointed towards the heat exchanger. This location was chosen to obtain reasonably constant pressure readings not affected by air velocity.

AIR BALANCING

Installation and air balancing is often done during warmer weather than that experienced in the cold of winter. If the air balance did not account for ambient temperature, the appliance could be having lower than expected temperature rise in cold weather conditions. As the fan is a constant volume device and as it is located before the heat exchanger, air will expand as it is heated. The amount of change could be up to a 20% increase in air volume from -30°F to +70°F.

Appendix F – BACnet / Modbus

The CenCon supports BACnet MS/TP RS-485 and BACnet/IP. The Baud rate is fixed at 38400 for MS/TP networks. For detailed information refer to the CenCon Communication Manual for Modbus and BACnet at https://www.engineeredair.com/manuals/.

Wiring

The CenCon can be connected to either a BACnet® RS-485 network or to a BACnet® Ethernet/IP network. The BACnet MS/TP RS-485, & BACnet/IP communication cables must conform to BACnet specifications.

RS485

The CenCon has a gray terminal strip that is used for all RS-485 communication connections. Terminals BnA and BnB have been designated and must be used to connect to the RS-485 BACnet network. The RS-485 communication cable to the CenCon should be a 24awg shielded twisted pair (STP) with a shunt capacitance of 16pF per foot and 100 ohm characteristic impedance.

Ethernet

The CenCon is equipped with a standard RJ45 Ethernet port located on the top of the controller. The Ethernet port is designed to be incorporated with a BACnet® over IP network that is used to communicate with the building EMS.

Appendix G – Fuel Curve Development

Clocking notes:

- Correct values for Altitude.
- **Ensure inlet pressure is correct at each stage.**
- All clocked values should be within 5% of the calculated value.
- Offset values are set by 0.1Vdc increments. If results at low fire are not exact, and either too little or too much gas, use too much so as not to exceed maximum turn down.
- Where possible, use a small meter to improve clocking times at lower firing rates.

Whenever possible at each stage, allow a few minutes for the heat exchanger temperature to stabilize before finalizing combustion values.

> ⚠ **CAUTION:**
> Although the setup sequence is non-linear, ensure firing rates and combustion air values increase as the combustion range increases from low to high fire. For example, do not have the clocked Near Low Fire rate less than the Low Fire value. The pressure must be more than the Low Fire value.

1. High Fire. Adjust inlet regulator to achieve correct clocking, while adjusting Pac-Man (DJ) or DG Air Offset for clean burn.
2. Near High Fire. Multiply High Fire clocking by Ratio (X 1.1), and re-clock. Adjust gas and/or air offset values if required. Record new clocking value, manifold pressures, burn, and Air and Gas offsets.
3. Low Fire. Multiply High Fire clocking by Ratio, and re-clock.
    a. Adjust bypass orifice and/or air offset if required on DJ. Record new values.
    b. Adjust gas and/or air offset values if required on DG. Record new values.
4. Continue same process with Near Low Fire, Medium Fire 1, and Medium Fire 2.
5. Set to High Fire and confirm correct inlet pressure.
6. Set to Low Fire to confirm clean burn throughout range.
7. Finished combustion setup. Save values.
8. Shut down and restart heat to confirm good ignition.
9. Allow heating to run on automatic for a few minutes.

Example #1: high fire clocking is 10 seconds
Example #2: high fire clocking is 30 seconds

				Calculated	
Name	% Fire	Ratio		Example #1	Example #2
High Fire	100	1.0		10	30
Near High Fire	90	1.1		11	33
Medium Fire 2	55	1.8		18	54
Medium Fire 1	25	4.0		40	120
Near Low Fire	10	10.0		100	300
Low Fire - DJ	6.6	15.0		150	450
Low Fire - DG	4	20.0		200	600

Typical Combustion Values

Review the appliance nameplate for the model number of the heater, the fuel type, and the turndown (maximum input btuh / minimum input btuh). Values noted are approximate. CO values should be very low. The maximum acceptable quantity of CO is 200 ppm. Any unit that emits more CO than 200 ppm at any point in its combustion curve must be corrected.

Contact Service for combustion setup assistance of DJ20 Propane appliances.

DJ(X,E,S) and Large SH with 15:1 turndown

Position	Natural Gas O_2 (%)	Propane O_2 (%)
High Fire (100%)	3.5 - 4.5	4.5 - 5.5
Near High Fire (90%)	3.8 - 4.8	6.0 - 7.0
Medium Fire 2 (55%)	7.0 - 8.5	8.0 - 9.0
Medium Fire 1 (25%)	10.5 - 12.5	11.0 - 13.0
Near Low Fire (10%)	15.0 - 16.0	15.0 - 16.0
Low Fire (6-7%)	16.8 - 17.3	16.0- 17.0

DG-HT Series 20:1 turndown (Natural Gas only)

Position (Fire rate)	Natural Gas O_2 (%)
High Fire (100%)	3.5 - 4.5
Near High Fire (90%)	3.8 - 4.8
Medium Fire 2 (55%)	7.0 - 8.5
Medium Fire 1 (25%)	10.5 - 12.5
Near Low Fire (10%)	15.0 - 16.0
Low Fire (4%)	16.8 - 17.5

DG Series 4:1 turndown (GP Burner - Propane only)

Position (Fire rate)	Propane O_2 (%)
High Fire (100%)	4.5 - 5.5
Near High Fire (90%)	4.8 - 5.8
Medium Fire (55%)	8.0 - 9.5
Low Fire (25%)	10 - 12

Small SH Series (35, 60, 90) 3:1 turndown

Position (Fire rate)	Natural Gas O_2 (%)
High Fire (100%)	3.5 - 4.5
Low Fire (33%)	9.0 - 12.0

Appendix H - Combustion Records

The following documents are to assist factory and field combustion setup. As noted, always ensure there are increased values set for both fuel pressure and combustion air (either the Vdc or Maxitrol mA output) as the firing rate increases from low fire to high fire.

Caution:

The combustion setup sequence noted on the combustion records be followed.

DJ(X,E,S)/Large SH Series 15:1 turndown

Caution:

High fire gas and air offsets should be set to zero. Use the PacMan to set air and the appliance regulator to set gas.

Serial and Tag#		Date	
Model #		Technician	
Job Name		Location	

Sequence	1	2	3	4	5	6
Name	High Fire	Near High Fire	Low Fire	Near Low Fire	Medium Fire 1	Medium Fire 2
% Fire	100	90	6.7	10	25	55
Man. Press.						
Oxygen - O_2						
CO						
RPM						
Air Offset	0					
Gas Offset	0					
Gas mA/Vdc						
FACTORY CLOCKING						
Clocking						
Calculated						
Clock Ratio	1.0	1.1	15.0	10.0	4.0	1.8

Low fire is set on valve mechanical bypass. Only adjust offset if unable to achieve clocking with the bypass.

Setup Comments:

DG-HT Series 20:1 turndown

Caution:

⚠ High fire gas offset should be set to zero. Use the appliance regulator to set.

Serial and Tag#		Date	
Model #		Technician	
Job Name		Location	

Sequence	1	2	3	4	5	6
Name	High Fire	Near High Fire	Low Fire	Near Low Fire	Medium Fire 1	Medium Fire 2
% Fire	100	90	5	10	25	55
Man. Press.						
Oxygen - O_2						
CO						
Air Offset						
Air Vdc						
Gas Offset	0					
Gas Vdc	10					
FACTORY CLOCKING						
Clocking						
Calculated						
Clock Ratio	1.0	1.1	20.0	10.0	4.0	1.8

Setup Comments:

DG Series with 4:1 turndown

GP Burner Propane

Caution:

High fire gas offset should be set to zero. Use the appliance regulator to set. This series uses a modified program due to the limited turndown.

Serial and Tag#		Date	
Model #		Technician	
Job Name		Location	

Sequence	1	2	3	6
Name	High Fire	Near High Fire	Low Fire	Medium Fire
% Fire	100	90	25	55
Man. Press.				
Oxygen - O_2				
CO				
Air Offset				
Air Vdc				
Gas Offset	0			
Gas Vdc	10			
Factory Clocking				
Clocking				
Calculated				
Clock Ratio	1.0	1.1	4.0	1.8

Setup Comments:

Small SH (3:1) Series

This style equipment uses hot surface ignition with constant combustion air. Combustion setup is for high and low fire only.

Caution:

High fire gas and air offsets should be set to zero. Use the PacMan to set air and the appliance regulator to set gas.

Serial and Tag#		Date	
Model #		Technician	
Job Name		Location	

Sequence	1	2
Name	High Fire	Low Fire
% Fire	100	33.3
Man. Press.		
Oxygen - O_2		
CO		
Gas mA		
Factory Clocking		
Clocking		
Calculated		
Clock Ratio	1.0	3.0

Setup Comments:

HE Series

Caution:

⚠ High fire gas offset should be set to zero. Use the appliance regulator to set.

Serial and Tag#		Date	
Model #		Technician	
Job Name		Location	

1. Set profile pressure drop to 0.7”wc by blocking the discharge. If unable, then evenly block off inlet.
2. High Fire. Adjust inlet regulator to achieve correct clocking.
3. Observe high fire flame for burn quality.
4. Reduce to low fire and set flame length. Clocking not required. Note values below on factory spreadsheet.
5. Finished combustion setup. Save values.
6. Shut down and restart heat to confirm good ignition.
7. Allow heating to run on automatic for a few minutes.

Sequence	**1**	**2**
Name	**High Fire**	**Low Fire**
Manifold Pressure		
Gas Offset	0	
Gas mA/Vdc		
FACTORY CLOCKING		
Clocking		
Calculated		

Low fire is set on valve mechanical bypass. Only adjust offset if unable to achieve clocking with the bypass.

Setup Comments: