EngA ENGINEERED AIR

base

Technical Manual

Manual Revision 1.04

RECOGNIZED COMPONENT
ETL LISTED c 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.

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 base and CD-XM expansion module 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 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.

⚠ WARNING:

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

⚠ ⚠ WARNING:

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

⚠ CAUTION:

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

⚠ CAUTION:

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

⚠ CAUTION:

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

⚠ 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.

TABLE OF CONTENTS

GENERAL OVERVIEW

UNIT TYPE

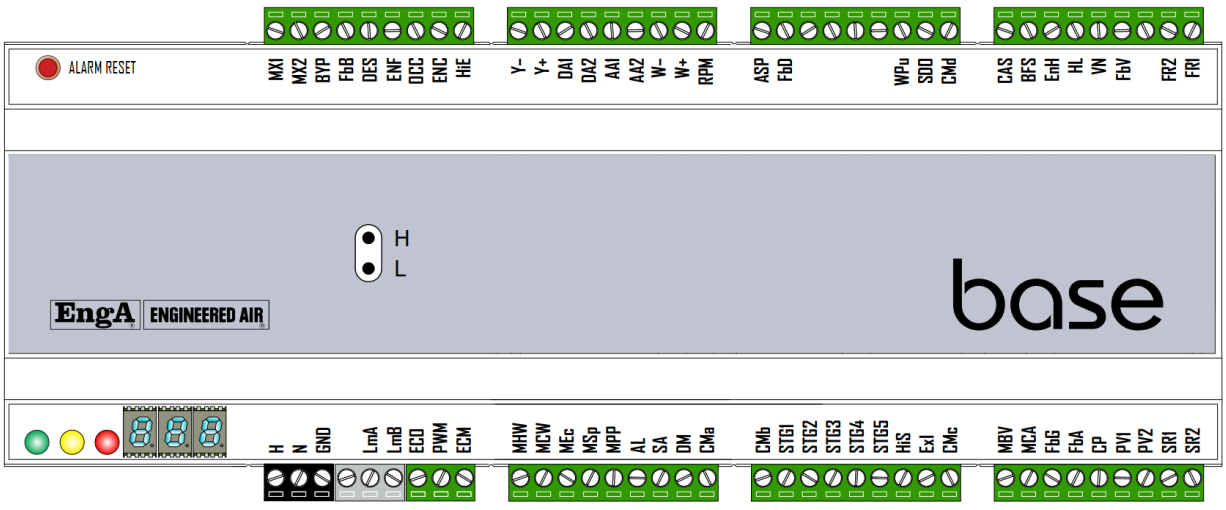
The base may be configured for use with a variety of heating appliances, with and without cooling. A second version specific to the Engineered Air SH(X) type humidifier has 2 distinct terminal sets that differ from the heating version.

SELECTOR SWITCH

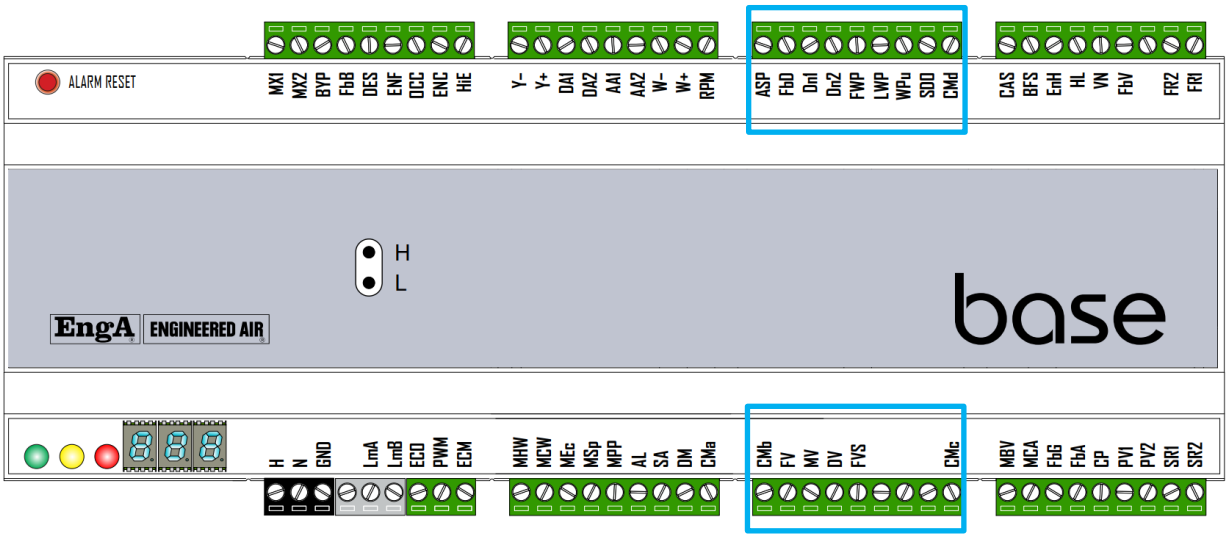
A small rotary selector switch is located on the back of the board. Some modules may require the back plate to be carefully removed for adjustment. All modules and expansion boards have been set at the time of manufacture.

Module Type	Switch Setting
BASE (All types)	0
CD-XM (DJ)	0
CD-XM (SH)	1
P-XM (Filter Monitoring)	1-7 based on designation

HEATING AND COOLING – DJ, DG, HE



HUMDIFIER VERSION – SH



The Engineered Air base controller is the primary operational component for custom manufactured Engineered Air HVAC equipment. Engineered Air DJ style burners on SH(X) sizes 120-650, use the CD-XM expansion module for burner motor speed control.

Green Light: 24Vac to H and N.
Yellow Light: Communication.
Red Light: Alarm indication.
7 segment displays: Left: Mode status, right 2 LED's: Alarm reference number.

> ⚠ **Notice:**
>
> There is approximately a 1 minute delay before operation can commence on initial power up. The base has to load parameters and configurations prior to operation.

HARDWARE INFORMATION

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

[1] Digital input connection to the base 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).

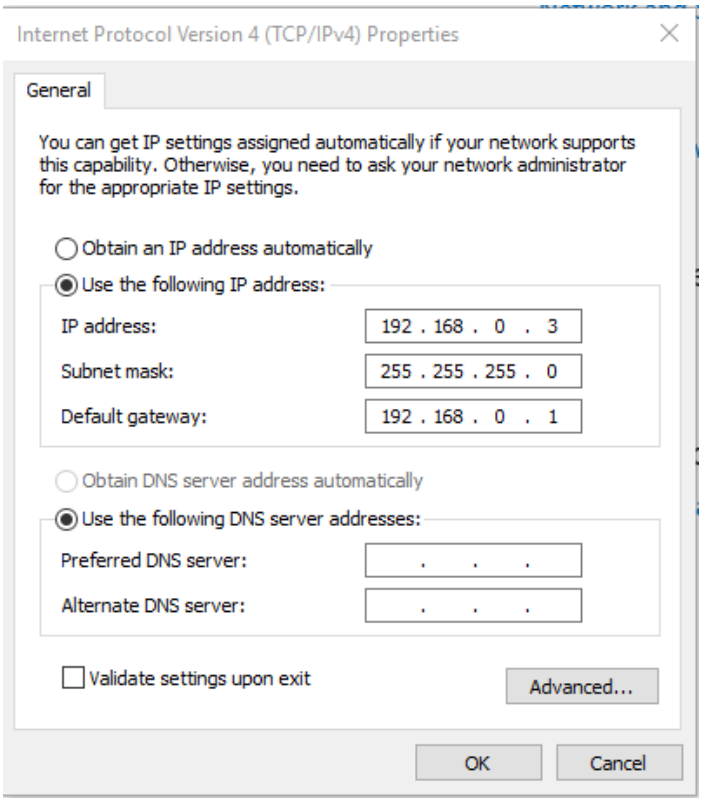
COMPUTER CONNECTION

> ⚠ **Notice:**
> The base requires a connection to a computer for detailed information beyond what is indicated on the LED displays.

Direct connection may be made to a computer or tablet. To gain access to the base testing interface connect using a Cat.5 Ethernet cable to the base, near the top right of the controller. Tablets may require a USB to Ethernet adapter. .

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

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

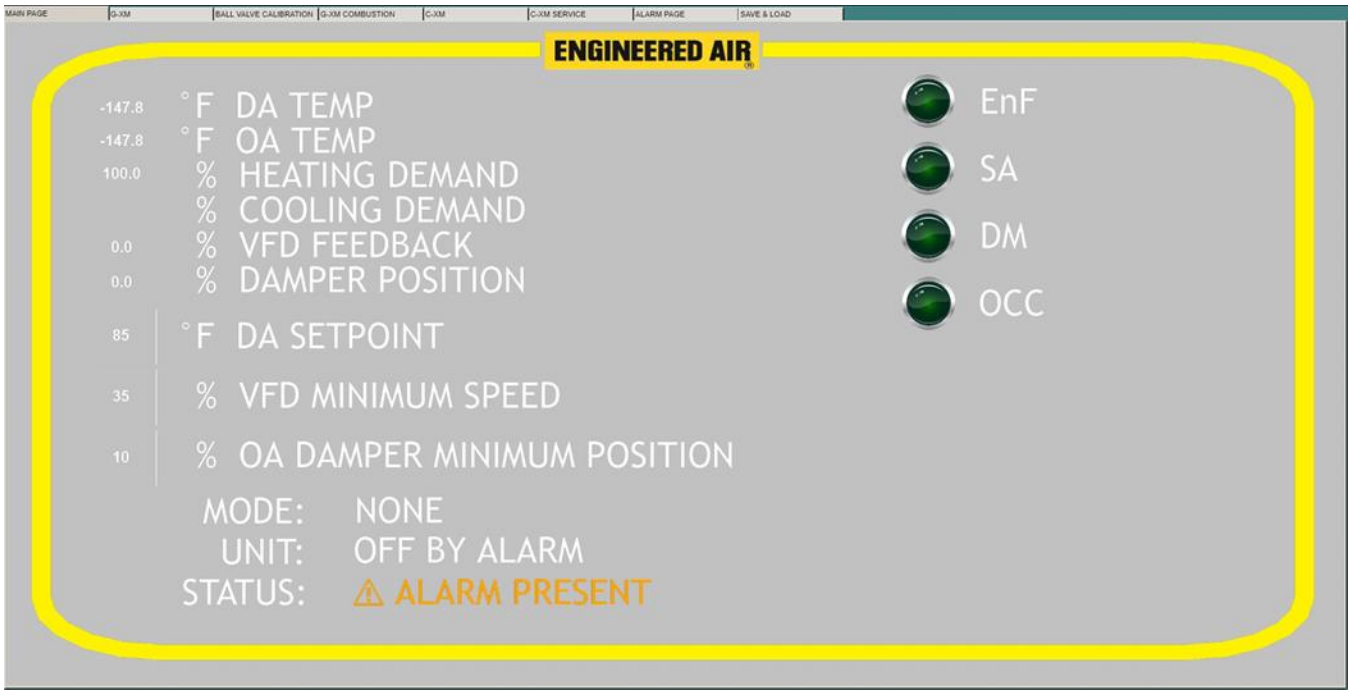


Click OK to accept, and then open a web browser and type in the following address to gain access to the testing interface:

192.168.0.10:8080/webvisu.htm

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

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



WiFi Connection

A USB Wi-Fi adapter may be plugged into the base controller for temporary communication to a laptop, tablet or phone. It is intended as a replacement to the cumbersome wired connection for service and maintenance. Contact Technical Service to purchase the WiFi adapter with instructions on how to configure the specific device attempting to connect.

TERMINAL DESCRIPTION

HEATING COOLING VERSION

Terminal changes when using SH(X) humidifier version are indicated.

Terminal	Type	Name	Description	Value
H N		Power Supply		24 Vac
GND		Ground	Connect to chassis.	
LmA B		Modbus	Internal network	
ECO	AO	ECM Motor Output	ECM motor output controls signal	0-10 Vdc
PWM		ECM Motor Feedback	ECM motor speed feedback signal	PWM
ECM		ECM Common	ECM output signal common	0-10 Vdc
MHW	AO	Modulating heating	Hot water coil valve actuator. 0V=off.	0-10 Vdc
MCW	AO	Modulating cooling	Chilled water coil valve actuator. 0V=off.	0-10 Vdc
MEc	AO	Modulating economizer	Economizer / Mixbox actuator. 0V=closed.	0-10 Vdc
MSp	AO	VFD command speed	VFD control signal.	0-10 Vdc
MPP	AO	Profile pressure	Modulating profile pressure damper actuator output	0-10 Vdc
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
CMa	COM	Common to output set ‘a’	Common power relays ‘a’, above.	24/120 Vac
CMb	COM	Common to output set ‘b’	Common power relays ‘b’, below.	24/120 Vac
STG1	DO	Cooling stage #1	Output stage #1 cooling, powered from common ‘b’.	24/120 Vac
STG2	DO	Cooling stage #2	Output stage #2 cooling, powered from common ‘b’.	24/120 Vac
STG3	DO	Cooling stage #3	Output stage #3 cooling, powered from common ‘b’.	24/120 Vac
STG4	DO	Cooling stage #4	Output stage #4 cooling, powered from common ‘b’.	24/120 Vac
STG5	DO	Cooling stage #5	Output stage #5 cooling, powered from common ‘b’.	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
CMc	COM	Common to output set ‘c’	Common power relays ‘c’, below.	24/120 Vac
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
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

CP	AI	Condensate probe	Condensate probe sensor input.	Ohms (Ω)
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
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	AI	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
BFS	DI	Blocked flue switch	Normally closed, opens on blocked flue.	24 Vac
CAS	DI	Combustion air switch	Optional proof of combustion air flow.	24 Vac
CMd	COM	Common to output set ‘d’	Common power relays ‘d’, above.	24/120 Vac
SDO	DO	Multipurpose output.	HE dual flame sensing switchover and Combustion blower start output for DG.	
WPu	DO	Water Pump	Enable evaporative ‘swamp’ cooler water pump.	24/120 Vac
FbD	AI	Damper Feedback	Modulating damper actuator feedback.	0-10 Vdc
ASP	AI	Remote VFD Setpoint	VFD speed input demand signal.	0-10 Vdc
RPM	AI	VFD feedback speed	VFD output speed feedback	0-10 Vdc
W+-	AI	Modulating heating thermostat or control for humidification on SH version	Independent heating demand or SH humidity signal.	0-10 Vdc
AA1,2	AI	Ambient air temperature	10k Type 2 thermistor	Ohms (Ω)
DA1,2	AI	Discharge temperature	10k Type 2 thermistor	Ohms (Ω)
Y+-	AI	Modulating cooling thermostat	Independent cooling demand signal.	0-10 Vdc
HiE	DI	High Speed Enable	Initiate high speed operation.	24 Vac
EnC	DI	Enable cooling	Enable / disable mechanical cooling.	24 Vac
OCC	DI	Occupied / Unoccupied	Enable occupied mode when powered.	24 Vac
ENF	DI	Enable Fan	Occupied mode start	24 Vac
DES	DI	Damper End Switch	Mechanical damper end switch input	24 Vac
FbB	DI	Air Proving Switch	Supply blower air proving switch	24 Vac
BYP	DI	VFD Bypass	VFD bypass input.	24 Vac
MX1, MX2	AO	Maxitrol Valve	DC current output to the Maxitrol modulating valve.	mAdc

SH(X) HUMIDIFIER VERSION

CMb	COM	Common to output set 'b'	Common power relays 'b', below.	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	Side Tank Fill Valve	Enable side tank (SHX) fill valve.	24/120 Vac
Dn1,2	AI	Drain sensor	Drain temperature sensor probe input	Ohm (Ω)
FWP	AI	Fill water probe	Fill water level sensor	Ohm (Ω)
LWP	AI	Low water probe	Low level water sensor	Ohm (Ω)

OPERATION

MODE SELECTION

The base can operate under up to 4 distinct modes; heating, economizer, ventilation and cooling. 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 base must have an ambient sensor installed either within the appliance, or remotely located to measure the ambient temperature.

The first (left) seven segment LED describes the current operating mode, as:

1 = Ventilation
2 = Economizer
3 = Heating
4 = Cooling

The two seven segment LED on the right side show the current alarm reference number.

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 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 trip set point for 30 seconds, the SA flow alarm is set. After the blower is started, the feedback signal must rise above the low flow trip point. If it does not, after 30 seconds the SA flow alarm is set and the equipment shuts down.

Compressors or direct fired burners are not allowed to run until the air flow is above minimum feedback. While the blower is normally operating and the feedback drops 5% below the low air flow set point, a low air flow warning is displayed and the 15 second alarm timer is started. If the air flow rises above the low flow set point within 15 seconds, the low flow timer resets and the unit reverts to normal operation. During this 15 sec time delay, compressors and heat exchanger style burners are allowed to stay running.

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 base 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 more colder than the discharge set point but above the full warmup required ambient.

The base 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

Used with a 2 position damper actuator, the damper end switch input is for 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 truncates 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.

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 until there is a heating (or cooling) demand.

MINIMUM POSITION

The minimum position setting is preset in factory, and may be adjusted using a computer interface.

HIGH AMBIENT LOCKOUT

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

LOW LIMIT

Freeze protection 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. Low limit, or freeze protection, may be enabled or disabled. 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 base can directly control direct fired (HE) and indirect fired burners (DJ and DG). DJ burners will require the CD-XM burner motor speed controller expansion module connected via an internal Modbus network.

COOLING

The base can control up to 5 stages of mechanical cooling and 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.

Interstage and anticycle timing is 5 minutes, non-adjustable.

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.

PRESSURE SENSING

The internal pressure sensor will measure the required variable flow in a direct fired heater. The sensor is rated at 0-10mbar (0-4"wc).

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

At power start up, the base will perform a check of the pressure sensor. Primarily for testing for kinked tubing, if any pressure is present at the sensor the yellow light will turn on solid for 2 seconds then revert to normal operation.

The 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.

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	4 minutes + 30 second anti-nuisance

TEMPERATURE CONTROL

The base is a discharge air temperature controller. The discharge setpoint may be adjusted, or reset, by a variety of methods, typically using a modulating room sensor. The reference setpoint is preprogrammed and can only be changed from a computer connection.

ROOM OR RETURN THERMOSTAT

The thermostat may have independent 0-10Vdc outputs for heating, cooling, or both. The selected room thermostat is the Viconics VT7200F5031. This thermostat has (2) distinct 0-10Vdc analog outputs, for heating (W+/-) and cooling (Y+/-). Refer to the field wiring diagram included with the appliance for wiring connections. This can also operate as a single 0-10Vdc input (W+/-) to modify the discharge temperature between the upper and lower maximum temperature values.

A remote wall sensor (S3010W1000) is available for various single or averaging room sensor arrangements. Further information can be found at www.viconics.com.

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.

2 STAGE ROOM THERMOSTAT

The thermostat may have independent contacts for heating, cooling, or both. A Belimo SGF24 (0-10Vdc) with a calibrated temperature dial will be used to directly change the discharge temperature (W+/-) to the high fire position when the heating contact closes.

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 RESET

To reset, press the Red Alarm Reset button on the corner of the base, or from the computer interface.

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 a ground connection wire, uninsulated, called a 'drain' wire. This wire should be connected to ground only at one end, not both.

MODULE GROUNDING

The base and CD-XM 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 and every expansion module.

On the CD-XM, 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 base unpainted ground connection.

COMMUNICATION WIRING

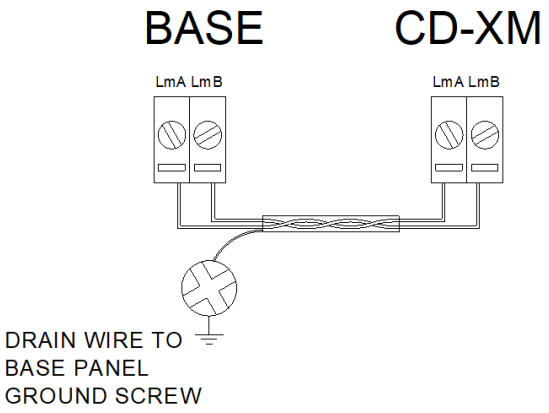
> ⚠ **NOTICE:**
> **Correctly wiring the internal Modbus communication network is critical to ensuring stable operation. Maintain the wiring at least 6" (150mm) away from any high power wiring, motors, transformers or VFD's.**

The base communicates with the CD-XM expansion module via an internal Modbus communication protocol. The (pink jacket) 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.

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

COMMUNICATION WIRE GROUNDING

The communication wire drain should be connected only at the same unpainted ground termination used by the base 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 base ground connection.



DJ/SH(X) INDIRECT FIRED

For indirect fired equipment with DJ (E, S, X) style burners up to size 140. Large sizes (120-650) of SH(X) use the DJ burner.

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 base will disable the pilot valve. The burner is allowed to operate to maintain the requested discharge air temperature from the base by modulating the control valve and the combustion blower speed. If heating is not required the burner will be disabled and the combustion blower will enter a post purge time, and then shut down.

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

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

DJ / 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	2 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

DJ/SH(X) COMBUSTION SETUP

Combustion setup may only be done using a computer.

> ⚠ **NOTICE:**
> Always allow the heat exchanger temperatures to stabilize before accepting combustion values.

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

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.**

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

Press the **UP** arrow to enter the Actuator Calibration Screen.

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

Access the Combustion Setup page by pressing the **Right** arrow key on the computer.

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.

For low fire, there is a risk of excessive levels of CO produced. To avoid potential high levels of CO, reduce the gas offset on all remaining combustion settings (55, 25 and 10%). If using a Maxitrol modulating valve, reduce by approximately 20-30mA.

Connect analyzer to flue. Enable the fan and heat switch.

Press: **Service Mode** and **High Fire.**

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

> ⚠ **CAUTION:**
> Be aware of high discharge temperatures.
> High limit failure may occur.

Adjust regulator to achieve design manifold pressure. Adjust the 'PacMan' to achieve a high fire air level between 3.5 – 4.5% O_2.

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

Follow the sequence noted below exactly and set to the approximate O_2 values noted by adjusting the air and gas offsets as required. Recalculate and record clocking value to match percentage of fuel at each level.

> ⚠ **NOTICE:**
> Important: remember to un-click the previous gas position button once you have clicked on the next position.

Position	**%O_2**
Near High Fire 90%	3.8 – 4.8
Low Fire 4%	16.8 – 17.3
Near Low Fire 10%	15.0 – 16.0
Medium Fire 1 25%	10.5 – 12.5
Medium Fire 2 55%	7.0 – 8.5

Once the above values have been confirmed and set, again press **High Fire** button, and allow O_2 levels to stabilize. Press **Low Fire**, and release the **High Fire** button. As the burner reduces to low fire, observe O_2 levels to ensure they do not drop below the high fire O_2 setting by more than 0.3. If this occurs there is air fuel curve error and must be reset with the above steps.

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

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.

Combustion setup is now complete.

DG INDIRECT FIRED

For indirect heating appliances with DG, and DJ (X) style burners size 200 and above.

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

DG 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	2 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 no warm up.
Burner cool down	90 seconds

DG COMBUSTION SETUP

Combustion setup may only be done using a computer.

> ⚠ **NOTICE:**
> Always allow the heat exchanger temperature to stabilize before accepting combustion values.

A set of full clocking data must be completed in test bay 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 serviced, 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.**

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

Press the **UP** arrow to enter the Actuator Calibration screen.

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.

COMBUSTION OFFSETS

Access the combustion setup page by pressing the **Right** arrow key on the computer.

Connect analyzer to flue.

Enable the fan and heat switch.

Press: **Service Mode** and **High Fire.**

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 and suggested oxygen levels of 3.5 -4.5%. Once stabilized clock input. Readjust regulator or air offset if required.

To adjust the high fire air use **High Fire Air Offset** value.

Follow the sequence noted below exactly and set to the approximate O_2 values noted by adjusting the air and gas offsets as required. Recalculate and record clocking value to match percentage of fuel at each level.

Important: remember to un-click the previous gas position button once you have clicked on the next position.

Position	**%O_2**
Near High Fire 90%	3.8 – 4.8
Low Fire 4%	16.8 – 17.3
Near Low Fire 10%	15.0 – 16.0
Medium Fire 1 25%	10.5 – 12.5
Medium Fire 2 55%	7.0 – 8.5

Once the above values have been confirmed and set, again press **High fire** button and allow O_2 levels to stabilize. Press **Low Fire**, and release the **High fire** button. As the burner reduces to low fire, observe O_2 levels to ensure they do not drop below the high fire **O_2** setting by more than 0.3. If this occurs there is air fuel curve error and must be reset with the above steps.

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.

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.

HE DIRECT FIRED

For direct fired HE style direct fired heaters.

On a call for heating, and with the supply blower enabled, the ignition control will be enabled to start and prove pilot flame, then open the main safety valve (SSOV). Once the pilot flame has proven and the main flame is established, the base will then disable the pilot valve. The burner is allowed to operate to maintain the requested discharge air temperature from the base by modulating the control valve. If heating is not required the burner will be disabled, and then shut down.

HE 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	2 seconds
Supply air low airflow alarm	30 seconds
Shorted damper end switch alarm	1 second
Supply air shorted air switch alarm	30 seconds

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

HE BURNER SETUP

Combustion setup may only be done using a computer.

MAXITROL VALVE

Power the base and enable the fan switch.

Connect computer to base.

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.

Access the burner setup screen by pressing the **Right** arrow computer key.

Enable the heat switch.

Press **Service Mode**, then **High Fire**.

The burner will initiate the ignition sequence.

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

Press **Low Fire**. 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 serviced, record all offset values, and then set all values to zero for the gas 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 then press the **Down** arrow.

Enable the heat switch.

Press **Service Mode**, then **High Fire**.

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.

Press **Low Fire**.

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.**

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

Burner setup is now complete.

SH / SHX HUMIDIFIER

BASIC OPERATION

The base SH(X) humidifier controller version 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. Water quality dictates the minimum tank drain cycle times. 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 base 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).

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

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.

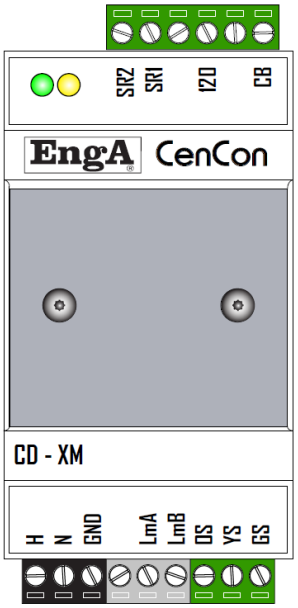
S-XM TIMING

Dump Schedule (ppm of calcium carbonate – pre-programmed)	Less than 60 ppm = 30 hours 60 – 119 ppm = 20 hours 120 – 179 = 15 hours 180 or greater = 10 hours
Drain initiation contact (OCC) confirm delay time	30 seconds
Drain time	SH_240 and smaller = 20 minutes SH_400 and larger = 40 minutes
Fill time	30 – 60 minutes
Pilot opening time	10 seconds
Improper gas valve wiring alarm	2 seconds

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) aware from the ignition control.

The CD-XM has (2) lights. The Green light is indication of power, and the blinking yellow light is to show communication to the base is connected.



BASIC OPERATION

The Chopper Drive module will control the combustion motor speed on DJ indirect fired appliances. A 3 wire feedback signal from the Engineered Air DJ 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

ALARMS

When an alarm condition exists the base will flash the RED LED and show a number on the right 2 seven segment displays. The first (left) seven segment LED describes the current operating mode, as:

1 = Ventilation
2 = Economizer
3 = Heating
4 = Cooling

The two seven segment LED on the right side show the current alarm reference number.

LED	Name	Description
General Alarms		
01	Low limit	The low limit setpoint is the lower of 40°F or 15°F below the discharge air setpoint.
02	Air Proving Fault	VFD Feedback is greater than the minimum VFD speed for more than 30 seconds with the supply fan output off.
03	Shorted Air Proving	Air SA Proving switch shorted on startup.
04	Low airflow	Air Proving switch opens during operation for 30 seconds or the VFD feedback drops below the minimum speed for 30 seconds.
05	Discharge Air Sensor Failure	Discharge Air sensor is outside of its range (-60°F to 220°F) for 10 seconds or more.
06	Ambient Air Sensor Failure	Outdoor Ambient sensor is outside of range (-60°F to 220°F) for 10 seconds or more.
07	Damper End Switch Warning	Shorted damper end switch. Meaning the damper end switch is made before energizing the damper output.
08	Damper Mechanical Alarm	End switch enabled codex is true and end switch is not made after energizing damper output.
09	Communication	Loss of communication between base and CD-XM expansion module.
DJ Alarms		
80	Gas Valve Wiring	Gas valve feedback has power before the FR and SR contact are energized.
81	Gas Valve out of range	Gas valve actuator feedback is greater or less then the demand. Tolerances and timing vary depending on mode of operation.
82	RPM out of range	Combustion blower motor RPM is greater or less then the demand. Tolerances and timing vary depending on mode of operation.
83	Open Air Proving	Combustion blower does not exceed 3000 rpm during purge.
84	Combustion Air Proving	Combustion rpm speed sensor has a value greater than 500 rpm for 60 seconds before the combustion blower has been commanded on.
85	Plugged Condensate	Blocked condensate sensor reads less then 7kΩ for more than 5 minutes.
86	High Limit	High limit safety tripped due to excessively high temperature.
87	Flame Relay Wiring	Received a gas valve feedback within 500ms of activating the flame relay output.
88	Flame Failure	Gas valve feedback has no power after 1 minute of enabling the Flame relay output.

89	60 Hz	Combustion blower frequency has exceeded 60 Hz (3590 RPM)
DG Alarms		
80	Gas Valve Wiring	Gas valve feedback has power before the FR and SR contact are energized.
81	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.
82	Air Actuator Out of range	Air Actuator Feedback Is greater or less then the demand. Tolerances and timing vary depending on mode of operation.
83	Open CB 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
84	Shorted CB Air Proving	Combustion blower air switch input has power for 10 seconds before the combustion blower has been commanded on.
85	Plugged Condensate	Blocked condensate sensor reads less than 7kohms for more than 5 minutes.
86	High Limit	High limit safety tripped due to excessively high temperature.
87	Flame Relay Wiring	Received a gas valve feedback within 500ms of activating the Flame relay output.
88	Flame Failure	Gas valve feedback has no power after 1 minute of enabling the Flame relay output.
89	Blocked Flue	Blocked flue input has been enabled for 1 minute or more.
HE Alarms		
80	Gas Valve Wiring	Gas valve feedback has power before the FR and SR contact are energized.
81	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.
86	High Limit	High limit safety tripped due to excessively high temperature.
87	Flame Relay Wiring	Received a gas valve feedback within 500ms of activating the Flame relay output.
88	Flame Failure	Gas valve feedback has no power after 1 minute of enabling the Flame relay output.
91	Low Velocity Air Switch	Occurs if the pressure drops below the low pressure setpoint during modulation for more than 40 seconds
92	High Velocity Air Switch	Occurs if the pressure goes above the High pressure setpoint during modulation for more than 90 seconds
94	Low Pressure	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 we have already passed the purge status and have lit. See Low velocity air Switch alarm
95	Low Pressure Sensor	If the pressure is greater than the Very low pressure setpoint before the damper is opened for more than 1 minute.
96	Very Low Pressure	Occurs if the pressure drops below the very low pressure setpoint after the purge has been completed.
97	Far Sensor Flame Failure	Occurs if a secondary flame rod is enabled and we lose flame sensing in less than 20 seconds after the pilot valve drops out on consecutive attempts.
SH(X) Alarms		
61	Tank High Pressure	SH is in normal operating mode and the drain temperature is greater than 110 deg F for longer than 10 seconds

	Overflow	
62	Water Foaming	Low water probe made and fill valve open for less than 2 minutes during normal operation
63	Failed Water Supply	The fill valve stay open longer than the required time (varies on current mode: Normal operation: 5m; Complete fill: 1hr)
64	Failure to Drain	Low water probe covered and drain valve open for longer than 1 hour
65	Water Probe Sequence	Fill water probe is covered before the low water probe
66	Duct High Limit	Duct humidity has tripped the mechanical high limit
67	Drain Sensor Failure	Drain sensor is out of range (less than 30° or greater than 212°F) for 10 seconds
68	Fill Valve Stuck Open	Fill water probe and low water probes are covered and the drain temperature is greater than 110°F for longer than 10 seconds when the SH is off and no drain is required.

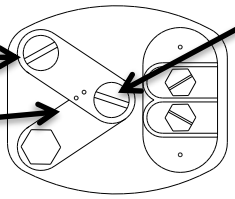
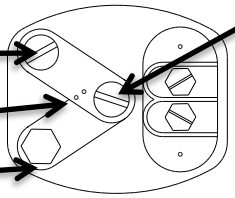
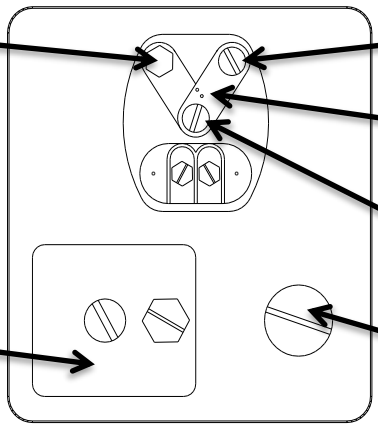
Appendix A - Thermistor Output Table

°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. 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 - Service Issues

READ AND SAVE FEATURES

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

The READ USER SETTINGS function references a configuration file located within the base 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 USER 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.

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 base or CD-XM expansion module 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.

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

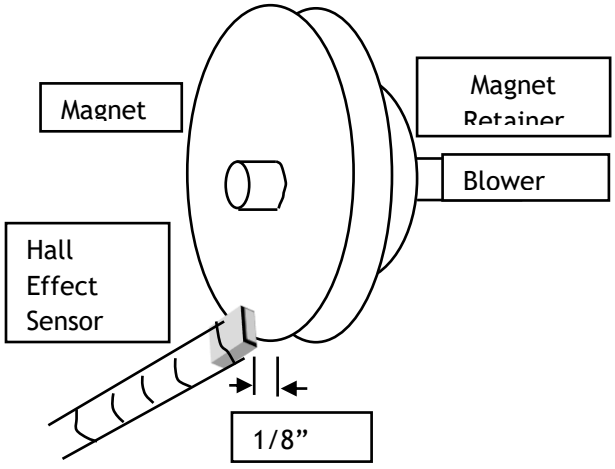
Manifold pressure settings that the unit was tested and clocked at in the factory are recorded on the unit rating plate. Any attempt to clock a unit in the field should be done with care. Corrections for density *(altitude and station pressure)*, temperature, and the correction factor for the meter are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

SPEED SENSOR – DJ



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, check the tachometer sensor to magnet gap. It should be 1/16 to 1/8 inch. If the gap is satisfactory, attempt to repair by flipping the

magnet over, then flipping the tachometer sensor over, before replacing the tachometer sensor to correct the problem. Note: No part of the speed sensor's sensing element should be located over the end of blower motor shaft.

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 E – DJ/DG 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.

⚠	**Ensure firing rates increase as the combustion range increases from low to high fire. For example, do not have the clocked Near Low Fire rate <u>less</u> 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	6.67	15.0		150	450
Low Fire - DG	5	20.0		200	600

Combustion Record – DJ/SH(X) base

⚠ **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	6.67	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

* Set to zero when using Maxitrol. Low fire is set on valve mechanical bypass. Only adjust offset if unable to achieve clocking with the bypass.

Setup Comments:

Combustion Record - DG base

⚠ **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:

Combustion Record – HE base

⚠ **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 testbay 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		

* Set to zero when using Maxitrol. Low fire is set on valve mechanical bypass.

Setup Comments: