USER OPERATION

MANUAL

FOR

DJM3

INDIRECT FIRED HEATING CONTROLLER

RECOGNIZED COMPONENT
C ETL LISTED
Intertek

RECOGNIZED COMPONENT
ETL LISTED US
Intertek

UNIT MODEL NO. _____
UNIT SERIAL NO. _____
SERVICED BY: _____
TEL. NO: _____

CANADIAN HEAD OFFICE AND FACTORY

1401 HASTINGS CRES. SE
CALGARY, ALBERTA
T2G 4C8
Ph: (403) 287-2590
Fax: 888-364-2727

USA HEAD OFFICE AND FACTORY

32050 W. 83rd STREET
DESOTO, KANSAS
66018
Ph: (913) 583-3181
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CANADIAN EASTERN FACTORY

1175 TWINNEY DRIVE
NEWMARKET,
ONTARIO
L3Y 5V7
Ph: (905) 898-1114
Fax: (905) 898-7244

SALES OFFICES ACROSS CANADA AND USA

Retain instructions with unit and maintain in a legible condition.
Please give model number and serial number when contacting factory for information and/or parts.

DJM3

The DJM3 has been certified by Intertek (ETL) for use with Engineered Air appliances only. It has been evaluated to CSA C22.2 No. 24 Temperature-Indicating and Regulating Equipment and UL 873 UL Standard for Safety Temperature-Indicating and Regulating Equipment. This is a User Operation Manual and therefore not subject to evaluation.

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

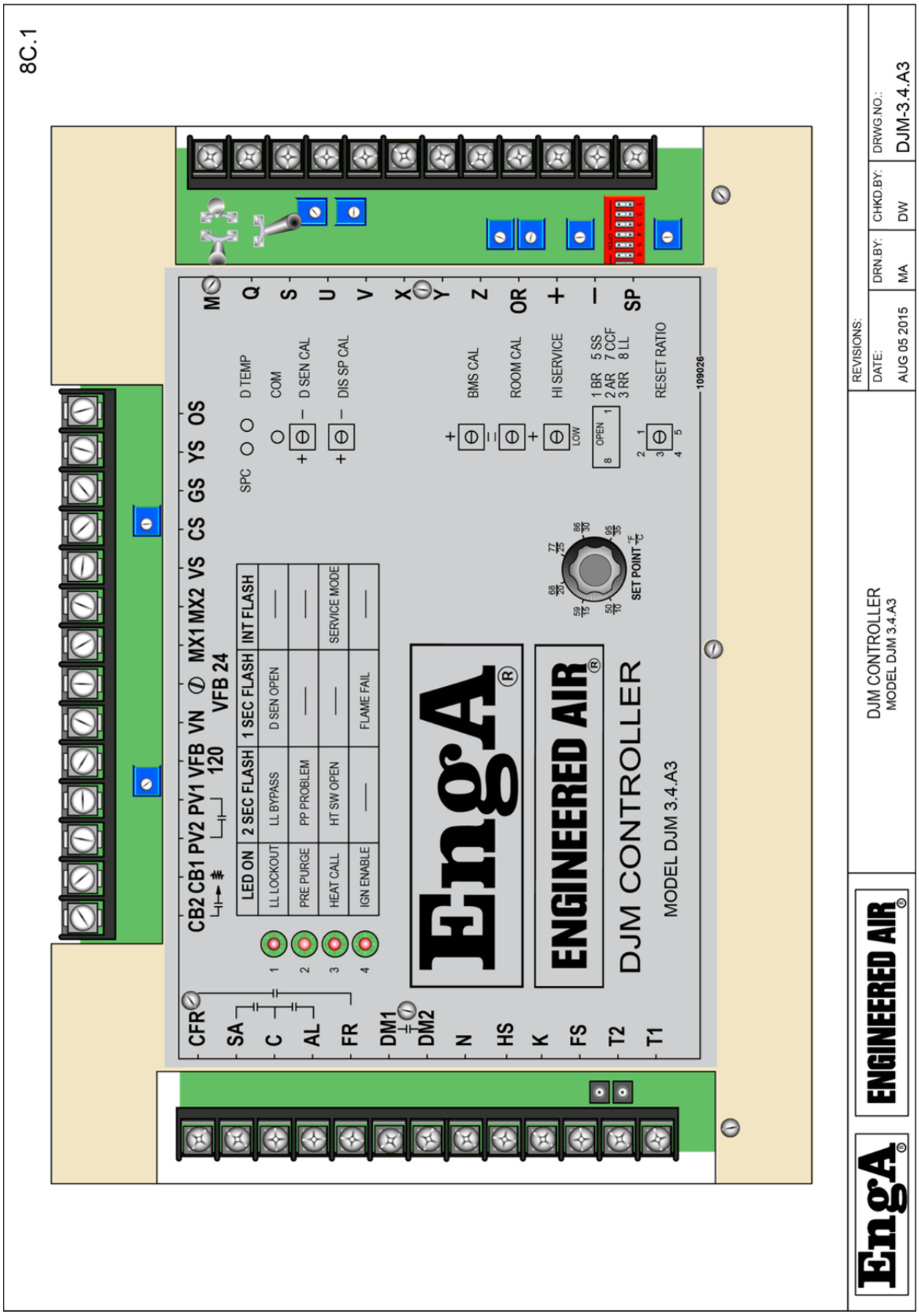
To ensure warranty is honored, only qualified personnel should be employed for service and troubleshooting. If further information is required please contact the nearest Engineered Air office.

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

Please report any omissions to the national service manager.

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

Warning: ⚠ ⚠	**This unit is connected to high voltages. Electrical shock or death 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 should 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.**


8C.1
CB2 CB1 PV2 PV1 VFB VN MX1 MX2 VS CS GS YS OS
120
VFB 24
LED ON
2 SEC FLASH
1 SEC FLASH
INT FLASH
LL LOCKOUT
LL BYPASS
D SEN OPEN
PRE PURGE
PP PROBLEM
HEAT CALL
HT SW OPEN
SERVICE MODE
IGN ENABLE
FLAME FAIL
CFR
SA
C
AL
FR
DM1
DM2
N
HS
K
FS
T2
T1
M
Q
S
U
V
X
Y
Z
OR
+
–
SP
SPC
D TEMP
COM
D SEN CAL
DIS SP CAL
BMS CAL
ROOM CAL
HI SERVICE
LOW
OPEN
1 BR 5 SS
2 AR 7 CCF
3 RR 8 LL
RESET RATIO
SET POINT °F °C
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ENGINEERED AIR
DJM CONTROLLER
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INTRODUCTION

The DJM3 is an independent controller for Engineered Air DJ style gas fired heating equipment designed to provide the majority of control requirements. The DJM3 modulates a variable speed combustion blower in conjunction with an modulating gas valve. The combustion blower speed and the gas valve flow rate are both modulated to maintain the required discharge air temperature.

The information used in this manual should be used in conjunction with the unit function sheet(s) and the DJ(E,S) & DG or DJX series Installation, Operation, and Maintenance manuals.

The DJM3 is designed to control only Engineered Air equipment. Various upgrades and improvements have been made over time. Always include any suffix letters and numbers for troubleshooting and/or replacement.

Note: It is necessary that all of the remote wiring and controls be complete and operational before starting the appliance.

CONTROLLER RATINGS

Power requirements: 24 Vac, 40 VA.
Contact Rating: 120V 5A inductive
0-10 Vdc input impedance: 2 kΩ
Environment: -40 to 120°F (-40 to 50°C) non-condensing.
Fuse Rating: 1.5 GDC slow-blow

CONTROLLER DESCRIPTION

TERMINALS

TABLE 1

Terminal	Description
T1	Board power supply. (HOT) 24 Vac isolated.
T2	Board power supply. (NEUTRAL) 24 Vac isolated.
FS	Fan switch (or Day mode) enable input (24 Vac).
K	Night (unoccupied) mode enable input (24 Vac).
HS	Heat enable input (24 Vac).
N	Grounded 24 Vac neutral (reference to FS, K, HS).
DM1, DM2	Damper motor output contacts (dry).
FR, CFR	Flame relay output contacts (dry).
AL	Alarm output.
C	Contact common input power (to AL and SA).
SA	Supply air fan enable output.
CB1	Combustion blower motor input.
CB2	Combustion blower motor speed control output.
PV1, PV2	Pilot valve disable contact (dry).
VFB120	Main gas valve feedback (SSOV) hot input for 120V valves.
VFB24	Main gas valve feedback (SSOV) hot input for 24V valves.
VN	Main gas valve feedback (SSOV) neutral input.
MX1, MX2	Modulating valve output. (DC volts)
VS	Legacy input. Not used.
OS, GS, YS	Combustion blower speed sensor input.
Q, U	Discharge air temperature sensor input.
S SP M	Internal (jumpered) or external discharge setpoint inputs.
V X Y Z	Modulating (resistive) room / return air thermostat inputs.
OR	Single stage heat thermostat input.
+ / -	0-10 Vdc (4-20 mA) temperature reset input.

DIP SWITCHES

The DJM3 options are configured by DIP switch selection and/or wiring connections.

TABLE 2

DIP SW	Description
1	Enable Vdc or mA temperature reset if ON.
2	Enable ambient reset if ON.
3	Enable room/return temperature reset if ON.
4	Not used.
5	Service mode (must be left OFF for normal operation).
6	Not used.
7	Constant combustion air purge mode if ON.
8	Enable low limit discharge temperature sensing if ON

Note: The DJM3 will only accept one type temperature reset signal.

INDICATION AND DIAGNOSTIC LIGHTS

There are 4 status lights on the DJM3 labeled 1 to 4. They operate in 4 patterns: constant on, 2 second flash (on for 1 second, off for 1 second), 1 second flash (on for ½ second, off for ½ second) and an irregular flash (flashes twice, then off, repeat).

TABLE 3

LIGHT	LED ON	2 SEC FLASH	1 SEC FLASH	INT FLASH
1	LL LOCKOUT	LL BYPASS	D SEN OPEN	----------
2	PRE PURGE	PP PROBLEM	----------	----------
3	HEAT CALL	HT SW OPEN	----------	SERVICE MODE
4	IGN ENABLE	----------	FLAME FAIL	----------

1	ON	The appliance has been shut down due to low limit failure and lockout. (discharge temperature below 4°C (40°F)) Reset with the service switch. Normal operating status: OFF.
1	2 SEC	Unit has low discharge temperature and is timing out. If the temperature does not recover to above 4°C (40°F) it will shut down and lockout. Normal operating status: OFF, or waiting for the discharge temperature to rise above 4°C (40°F).
1	1 SEC	The discharge sensor circuit is open (sensor range must be between 880 and 4000Ω). Normal operating status: OFF.
2	ON	The combustion blower is purging the exchanger as a preliminary to ignition. Normal operating status: EITHER ON or OFF.
2	2 SEC	Pre Purge problem. The DJM3 is not receiving a correct signal from the hall effect tachometer sensor, into terminals YS, OS, GS. Normal operating status: OFF.

3	ON	The discharge sensor is below calculated setpoint (SPC) and the DJM3 has initiated the heating sequence. Normal operating status: ON for heating.
3	2 SEC	There is a call for heating, however the heating has been disabled from no input into terminal HS (24Vac). Normal operating status: OFF.
3	INT FLASH	Unit is in service mode, allowing the technician to manually set the heating from low to high fire with the service pot. Normal operating status: OFF.
4	ON	FR and CFR contacts have closed, enabling the ignition control to fire the burner. Normal operating status: ON for heating.
4	1 SEC	Burner ignition was unsuccessful. The DJM3 did not receive a main gas valve (SSOV) feedback signal into terminals VFB24 or VFB120. Normal operating status: OFF.

ADJUSTMENT POTS

There are a number of setting and calibration potentiometers (POT's) located on the front of the DJM3. Modifications to these should only be done by experienced and qualified personnel.

TABLE 4

POT	Description
D SEN CAL	Discharge sensor calibration.
DIS SP CAL	Discharge setpoint calibration.
BMS CAL	BMS (0-10Vdc or 4-20 mA) reset calibration.
ROOM CAL	Room sensor calibration.
SERVICE	Service mode pot.
RESET RATIO	Temperature reset range adjustment.
LOW FIRE*	Low fire speed RPM adjustment pot (near terminal PV1).
CURVE MATCHING*	Valve curve matching RPM adjustment pot (near terminal CS).
SETPOINT	If used, the on-board discharge setpoint dial.

* These pots should only be adjusted when used with a combustion analyzer.

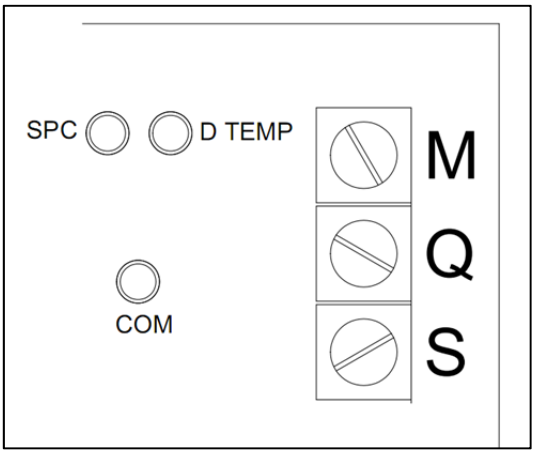
MULTIMETER TEST POINTS

The DJM3 has readout terminals for measuring the discharge sensor temperature and the calculated discharge setpoint. These 3 test points are located near the M and Q terminals.

Measurements are made using a Vdc multimeter using a scale of 1Vdc = 10°C. For example, a reading of 2.1Vdc = 21°C (or 70°F). Refer to the table below for Celsius to Fahrenheit conversion.

TABLE 5

Voltage Reading (Vdc)	°C	°F
1.0	10	50
1.5	15	59
2.0	20	68
2.5	25	77
3.0	30	86
3.5	35	95
4.0	40	104



SYSTEM TIMINGS

The times listed are general, and may be affected by external time delay devices.

TABLE 6

Pre-purge	45 seconds
Post purge	4 minutes (day mode) 1 minute (night mode)
Fan delay	30 seconds
Warm up time	30 seconds
Cool down time	60 seconds
Low limit bypass	5 minutes
Flame Failure	90 seconds

TEMPERATURE CONTROL

CALCULATED SETPOINT (SPC)

The DJM3 is designed to be a discharge air temperature control. The base discharge air temperature setpoint is typically set from the control pot located on the face of the DJM3. The base discharge air temperature is normally modified from a remote signal to maintain the desired temperature of the supplied space. This is called reset. The DJM3 discharge setpoint can be reset from a variety of sources such as ambient air temperature, modulating or staged room thermostats, return air temperature, or a BMS signal (0-10Vdc or 4-20mA).

Without any temperature reset method the base setpoint (either face mounted or remote mounted) is the calculated setpoint that the DJM3 will attempt to maintain the discharge temperature at.

Setpoint Calculation (SPC) = Discharge Setpoint + Reset

The DJM3 is designed to use either of the following as a setpoint:

- The setpoint mounted on the face of the DJM3 (range of 50-95°F (10-35°C)). If the DJM3 face mounted set-point is used, terminals “SP and S” must be jumpered; or
- The Johnson Controls TE 6100-960 set-point (range of 50-85°F (10-29°C)). If the TE 6100-960 is used as a set-point, “S to SP” is not jumpered and the TE 6100 must be wired:

TABLE 7

TE 6100 Wires	DJM3 Terminals
Violet (not used)	-
Red (not used)	-
Grey	Wired to terminal U
Blue	Wired to terminal M
Orange	Wired to terminal S

DISCHARGE TEMPERATURE SENSOR (D TEMP)

The DJM3 uses the discharge sensor for both temperature control and low limit. Because of this, the DJM3 will not operate with a faulty discharge sensor. If the discharge sensor resistance is greater than 4000-ohms or less than 880-ohms, the unit will lock out either on low limit or bad temperature sensor.

MODULATING ROOM RESET (continuous blower operation only)

DIP switch 3 must be "on". This option also requires a TE 6100 wired:

TABLE 8

TE 6100 Wires	DJM3 Terminals
Red (not used)	-
GREY	Wired to terminal V
VIOLET	Wired to terminal X
ORANGE	Wired to terminal Y
BLUE	Wired to terminal Z

If DIP switch 3 is on and the TE 6100 is not wired to the correct DJM3 terminals, the DJM3 will reset the discharge temperature down as it thinks that the room sensor is very warm. The room temperature requirements can increase or decrease (reset) the calculated discharge air set-point.

Note: If room reset calling, the “calculated” discharge temperature setpoint will vary from the setting of “master” setpoint.

- The room-reset feature is activated by DIP switch 3.
- Room sensor calibration pot is Room Cal Pot.
- Room reset band is ±3°F (fixed).

The “room reset band” means a room temperature error of just 3°F will result in a maximum reset of the discharge air set point. The actual amount reset (in degrees) varies as per both the setting of Pot Reset Ratio and the discharge set point. The calculated discharge air set point (dial setting + reset) is limited between 48 and 120°F.

To determine the amount of reset available refer to Table 9.

EXAMPLE: DJM3 setpoint 70°F; pot #5 set at 3; room thermostat set 75°F.

- If room thermostat sensor is at 75°F - no reset, discharge at 70°F.
- If room sensor is 3°F cold (72°F), discharge is reset up full amount of its authority (+20) to 90°F. If room thermostat was at 73°F then β of the reset would be used (β * 20 is approx. 14°F), added on to the set-point of 70°F giving discharge of 84°F.
- If room sensor is 3°F hot (78°F) full reset down will lower the discharge 13° (57°F discharge).

Multiple Room Sensors

Four sensors can be wired to give an average reading of room temperatures to the DJM3 control. They must be wired in a series/parallel arrangement. Refer to main or field electrical diagram for appropriate wiring.

ROOM RESET AUTHORITY TABLE

TABLE 9

Discharge Set-Point	Reset Ratio Pot	Maximum Temp. °C	Minimum Temp. °C	Reset Band Width °C	Maximum Temp. °F	Minimum Temp. °F	Reset Band Width °F
15.5°C 60°F	1	25 (+9.5)	12 (-3.5)	13	77 (+17)	54 (-6)	23
	2	26 (+10.5)	11.5 (-4)	14.5	79 (+19)	53 (-7)	26
	3	28 (+12.5)	10.5 (-5)	17.5	82 (+22)	51 (-9)	31
	4	33 (+17.5)	9 (-6.5)	24	91 (+31)	48 (-12)	43
	5	38 (+22.5)	9 (-6.5)	29	100 (+40)	48 (-12)	52
21°C 70°F	1	29 (+8)	16 (-5)	13	84 (+14)	61 (-9)	23
	2	30 (+9)	15 (-6)	15	86 (+16)	59 (-11)	27
	3	32 (+11)	14 (-7)	18	90 (+20)	57 (-13)	33
	4	37 (+16)	11 (-10)	26	99 (+29)	52 (-18)	47
	5	40.5 (+19)	9 (-12)	31.5	105 (+35)	48 (-22)	57
27°C 80°F	1	33 (+6)	21 (-6)	12	91 (+11)	70 (-10)	21
	2	34 (+7)	19 (-8)	15	93 (+13)	66 (-14)	27
	3	35.5 (+8)	18 (-9)	17.5	96 (+16)	64 (-16)	32
	4	39 (+12)	15 (-12)	24	103 (+23)	59 (-21)	44
	5	44 (+17)	11 (-16)	33	111 (+31)	52 (-28)	59
32°C 90°F	1	38 (+6)	25 (-7)	13	100 (+10)	77 (-13)	23
	2	38 (+6)	23 (-9)	15	101 (+11)	74 (-16)	27
	3	40 (+8)	22 (-10)	18	104 (+14)	72 (-18)	32
	4	44 (+12)	18 (-14)	26	111 (+21)	64 (-26)	47
	5	47 (+15)	13 (-19)	34	116 (+26)	56 (-34)	60

NOTE: The above table is not linear and reset up and down is equal at a set-point of about 82°F

BMS RESET (continuous blower operation only)

DIP switch one must be on to activate BMS reset. This option requires an analog voltage or current signal to be wired to the optically isolated + and - terminals. The analog input signal proportionally increases the calculated discharge air set-point. The calculated discharge set-point equals the dial discharge set-point plus the input signal multiplied by a reset ratio factor.

The maximum amount of reset is adjustable from 15°F (8°C) to 60°F (33°C). The maximum discharge temperature (dial set-point plus reset) is limited to 120°F (49°C). The BMS reset option is activated by DIP switch 1.

Note: As standard, the DJM3 is designed to operate with 4-20 mA or 2-10 Vdc into a 500-ohm input impedance. Some BMS devices may not have enough power (Volt-Amps) to provide a full 10 VDC when connected to a 500-ohm load. The input resistance for this operation can be increased to 1500 ohms by cutting resistor R43. To cut this resistor you must turn the board over. It is located on the back of the larger board, just below the DIP switch block and beside Pot Reset Ratio. This is a 1-watt, 680-ohm resistor colours blue, grey, brown, gold.

BMS reset is not truly linear. Reset will usually begin at about 4 volts. Following, is an example of reset from one application that gives a 13°C or 24°F reset.

CALCULATED SETPOINT FROM BMS RESET APPLIED TO + AND –

TABLE 10

Current Reset	Voltage Reset	Calculated Setpoint	
mA	Vdc	°C	°F
-	0	13	55
3	3	13.5	56
5	4	14.5	58
12	6	16	61
-	7	18	65
16	8	20	68
-	9	23	75
20	10	26	79

AMBIENT RESET (continuous blower operation only)

This option requires DIP switch 2 to be on and an ambient sensor (Johnson Controls TE 6000-960) wired to terminals X and Z. The discharge air set-point will be reset upwards based on the ambient temperature. Ambient temperatures below 70°F (21°C) will gradually increase the calculated discharge air set-point. The maximum increase in the discharge temperature will be reached when the ambient falls to 20°F (-7°C). The amount of reset is dependent on the position of Reset Ratio Pot and the discharge set-point as set on the dial.
(The discharge set-point will be reset below master set-point if ambient is above 70°F (21°C). In most cases when the outside ambient is above 70°F (21°C), the heat will be off.)

It is possible to obtain an extended temperature range by placing a 120-ohm resistor in series with the ambient temperature sensor.

Note: With this resistor the discharge temperature will be at its maximum when ambient is at -15°F. With this resistor, the calculated discharge air set-point equals the dial set-point at 35°F (different from above). Above 40°F the calculated discharge air temperature will be below the dial set-point.

TABLE 11

Reset Ratio Pot Setting	Reset Amount °F (no resistor)	Reset Amount °F (with a 120 ohm resistor in series)
1	10	18
2	11	20
3	13	24
4	16	30
5	21	37

MAKE/BREAK RESET and OVERRIDE

"OR" and "V" Override (Day Operation only)

To activate this feature DIP switch 3 must be off. If a thermostat or contact is closed across terminals "OR" and "V", the discharge temperature is set at 120°F (49°C). When thermostat or contact is open, the discharge temperature is set at the dial setpoint plus any other resets being used.

"X" and "Z" Override (Day and Night Operation)

To activate this feature DIP switch 3 must be on. During day operation, if a thermostat or contact is closed across terminals "X" and "Z", the discharge temperature is set at the dial setpoint plus the maximum amount of reset upwards. When the thermostat or contact is open across terminals "X" and "Z", the discharge temperature is set at the dial setpoint less the maximum amount of reset downwards.

During Night operation, if a thermostat or contact is closed across terminals "X" and "Z", the discharge temperature is set at 120°F (49°C). When the thermostat or contact is open across terminals "X" and "Z", heat is off.

OPERATION

DAY / NIGHT OPERATION

The DJM3 supports a variety of fan, damper, and temperature control operating schemes. The exact operation depends on the status of terminals “FS, HS”, and “K”. Night operation is not suitable for 100% make-up air applications, due to the equipment having to open outside air dampers and heat outside air. To operate in Night mode, a room thermostat or make/break reset must be used.

TABLE 12

Terminal Status			Blower Operation	Damper Operation	Control Source	Control Mode
HS	FS	K				
XXX XXX	Off On	Off Off	Off Constant	Off Powered	N/A Discharge/Room/BMS	Off Day
Off On On	XXX Off On	On On On	Off Intermittent Constant	Off Off Off	N/A Room Discharge w/Room Reset	Off Night Night

XXX = Switch (SW.) can be "ON" or "OFF"

FAN CONTROL

In day mode, the supply air fan should run continuously (unless just starting the morning warm-up or tripped on low limit.). For supply fan operation, the discharge sensor must be operating correctly as it is also used as the low limit sensor. If the discharge sensor resistance is too high (or open circuit), the DJM3 perceives a low limit fault and locks off DJM3.

DAMPER CONTROL

The inlet damper actuator(s) is enabled through output terminal DM2. The DJM3 has a delayed supply blower start to allow time for the dampers to open.

BURNER CONTROL

Burner is enabled when a valid heat call is made and terminal “HS” is powered. The DJM3 will enter a heat exchanger purge cycle. When the purge cycle is complete, the DJM3 will run combustion blower at light-off speed and enable the ignition control to start the pilot. When the ignition control proves pilot light-off it will enable the main gas valve. Once the main flame is established and the DJM3 receives a feedback signal to terminals VFB24 or VFB120 and VN the control will modulate the gas valve and combustion blower to satisfy the heat call. If the DJM3 does not receive the feedback signal the alarm contact, terminal “AL”, will be activated.

When heat call is satisfied the DJM3 will cycle off the burner. The combustion blower will continue to run for several minutes after heat call is open to maintain purge and cool off the burner and heat exchanger.

LOW LIMIT

The low limit set point is fixed at 40°F. There are two low limit bypass timers, start-up and anti-noise. The start-up auto bypass low limit timer is started every time terminal “K”, “SA” or “FS” energized status changes (on/off). The start-up timer will bypass the low limit for 5 minutes. After the 5 minute start up bypass, a 30-second anti-noise low limit bypass timer is started every time a low limit condition is detected. This timer is designed to prevent nuisance trips caused by any electrical noise picked up by the discharge sensor. If the low limit condition exists for more than 30 seconds, a low limit lockout will occur. This will activate the alarm contact on the DJM3, terminal “AL”.

Resetting Low Limit

To reset the low limit, cycle power to the DJM3 control terminals "T1" and/or "T2"; or interrupt power to terminals "FS, HS, and K" all at the same time.

SERVICE

SERVICE MODE

Placing the DJM3 into service mode allows for direct control of the burner firing rate. DIP switch 5 will activate service mode and enable the heat immediately. The service POT, located to the right of the setpoint dial, will manually set the burner to any firing rate. When in service mode, the supply air fan may need to be activated manually.

Note: DO NOT leave DJM3 in service mode, burner will not cycle off. Service mode should only be used for combustion set-up and operational checks.

BURNER SET UP

Service Pot

This pot is designed to allow a service technician to manually set the burner to any firing rate he chooses. If the service switch (dipswitch 5) is on and the blower switch (terminal FS) is powered, the burner firing rate is controlled by the Service Pot. The Service Pot is located close to the “+" terminal and above the dipswitches. Rotating this pot will allow the firing rate to be set at any rate between low and high fire.

Low Fire Pot

The low fire pot is located below the PV1 terminal. The low fire pot is used to adjust the combustion air at low fire. The low fire speed is adjustable from 1150 to 1400 RPM (high turndown) or 1800 to 2000 (standard burner). The low fire pot is to be adjusted by a qualified service technician only.

Curve Matching Pot

The curve matching pot is located below the CS terminal. The DJM3 can be used with several different Maxitrol valves. Each of these valves has a slightly different opening curve. The Curve Matching Pot is to be adjusted by a qualified service technician only.

Burner Selection

The DJM3 is designed to operate with both the standard (round burner plate) and high turndown (rectangular) burners. The selection is made by cutting a jumper wire R100 which is located on the small board. (The DJM3 must be turned over to access the jumper wire.)

NOTE: Jumper wire R100 is cut only for the high turndown burner operation. Caution – do not cut resistor R100 on the large board.

NOTE: Do not adjust any other pots located on the small board, which are not accessible from the front of the DJM3

Combustion Set Up

When measuring combustion gases, ensure probe of analyser inserts fully into the flue connection to the heat exchanger**.** Measuring at the flue outlet may be a diluted reading due to air mixing into the flue.

NOTE: If combustion is not set correctly it can result improper burning which may produce products of combustion that smell, carbon and or an excessive amount of water in the flue. Care should be taken to set burners up properly. Note that temperature of the air and fuel may have a great affect on the set up selected. If both the combustion air and the fuel are at a constant temperature throughout the heating season, once combustion is set it should remain similar through the season.

High Turndown (Rectangular) Burner

Most high turndown DJ units will employ on of the following Maxitrol modulating DC volt gas valves.

Series 20 420, M520, M620. These valves do not have high fire regulators. High fire pressure is set up at the appliance regulator.

Series 50 550, M650, ES350. These valves do not have high fire regulators. High fire pressure is set up at the appliance regulator

ES345D-L This valve has a built in high fire regulator. Typically used on DJ140 models.

The above valves differ from each other in size, configuration, BTU capacity, physical layout, and low fire set up.

Check the equipment to verify what type of modulating gas valve you have to ensure the correct combustion set up method is used.

High Fire Set Up

1. Turn on the service switch (dipswitch 5).
2. Set the Service Pot to high fire. Adjust the high fire input to the correct clocked rate. Adjust combustion air slider or inlet damper until the high fire O_2 reading is between 3.5 and 4.2%.

Low Fire Set Up

Ensure that there is aluminium tubing connected from the top of the modulating gas valve vent connection to the burner box. This is to guarantee that the varying burner box air pressure allows the proper gas flow rate through the modulating gas valve. Also ensure that the small vent hole under the oval shaped cover is sealed off with silicone or Tremco tape. When doing combustion analysis it is important that the top of the valve be sealed by either reinstalling the cap after each adjustment, or placing your finger fully over the top to seal the open top on the valve. The reason for this requirement is that the valve is "top loaded" which means that the valve is having pressure from the combustion fan added to the top of the valve's diaphragm thus increasing the gas flow through the valve, especially at higher flow.

Series 20/M420, M520 and M620 (High Turndown Burner)

These valves have 2 low fire adjustments the following procedure should be followed carefully.
Once the high fire pressure and combustion has been set up, turn the Service Pot fully counter-clockwise to achieve low fire. Adjust the Low Fire Pot until the low fire speed on the combustion fan motor is 1250 RPM ±10 RPM (20.8 Hz) for 10:1 set up or 1195 RPM ±5 (19.91 Hz) for 15:1 turndown.
At this point the DC voltage reading at the modulating gas valve terminals should be 0 VDC.
Under the cover on the Maxitrol series 20 valve is an adjustment screw (brass or silver) that has a lock ring which uses a special tool (two very small holes) to loosen it.

1. The lock ring needs to be loosened first. Turn it fully CCW (up) now turn the slot screw in the centre of the lock ring (spring activated low fire adjustment) full CCW (up).

   Caution: Do not over torque this screw at the top or bottom of its adjustment or it will break the "c-clip" inside the valve, thus allowing the spring to ride free.

2. Adjust the low fire bypass screw at the bottom side of the valve body until the O_2 reading is between 16.0% to 16.5%. (16.5 to 17.5% oxygen for 15:1 turndown.) At these settings the turndown will be very close to 10:1. The maximum CO at low fire is 80 PPM.
3. Adjust the Service Pot up very slowly until the DC volts at the modulating gas valve terminals are about 2.25 VDC. If the voltage rises over 2.25 VDC while adjusting the manual pot, turn it down and start again from less than 1.5 VDC until 2.25 VDC is reached.
4. Check the O_2 reading again at this point. If the O_2 has increased, adjust the spring activated low fire adjustment on top of the valve until the O_2 reading is same as the low fire reading at 0 VDC.

5. **Curve Matching Procedure**
   Turn Service Pot to high fire (approximately 3450 RPM or 57.5 Hz) for 1 minute. Adjust the Service Pot down very slowly until the combustion motor speed is about 3060 RPM (51 Hz). If the pot is adjusted below 51Hz return to high fire and attempt to lower without passing 51Hz. Let the burner stabilize for 2 minutes, then re-check O_2 reading. If O_2 has dropped to less than the original high fire O_2 reading, adjust the Curve Matching pot. Adjusting CCW increases the O_2 reading by reducing the voltage to the Maxitrol modulating gas valve. The Curve Matching pot only changes the voltage to the gas valve; it does not affect fan speed.

   If the curve matching pot is adjusted to the fully CCW position and the O_2 reading is still not within 10% of the original high fire O_2 reading, add a 180-ohm 2 watt resistor across the modulating gas valve terminals; repeat above test until proper curve matching is achieved. (A 150-ohm, 2-watt resistor may have to be used if O_2 level still does not rise to within 10% of original high fire O_2 reading.)

   Switch burner to low fire again and re-check low fire, both at 0 VDC and 2.25 VDC. (An addition of a resistor above may have changed the low fire setting, if it was needed.)

   Lock the locking ring on the spring activated low fire adjustment screw (from step 1). Failure to lock it may cause the screw to vibrate loose allowing low fire gas pressure to increase. This can create sooting of burner parts and the heat exchanger. If the locking ring is missing, drop one drop of Loctite thread locker onto the brass screw threads.

Series 50/M550, M650 AND ES350 (High Turndown Burner)

These valves have only 1 low fire adjustment (spring activated low fire).

1. The combustion set up is similar to the above except there is no low fire bypass adjustment on the bottom of these valves. Therefore simply set up low fire by turning the manual firing Pot Reset Ratio to the low fire position - 1250 RPM ±10 RPM 20.8 Hz. (15:1 turndown set at 1195 RPM, 19.91 Hz.) Voltage to the series 50 valve should be near 0 volts DC. Adjust the spring activated low fire adjustment at the top of the modulating gas valve (small screw) until an O_2 reading of 16.8% to 17.5% is achieved.
2. Lock the low fire adjustment screw as described in point 7 above and then adjust the curve matching pot as in point 5 above.

Type ES345D-L (High Turndown Burner)

As this valve has 2 low fire adjustments the following procedure should be applied.

1. Bring the unit to low fire using the service firing pot fully CCW. Adjust Pot Low Fire until the combustion fan is turning 1250 RPM ±10 RPM (20.8 Hz). (15:1 turndown is 1195 RPM, 19.91 Hz.) Voltage to the ES valve should be near 0 volts DC. The low fire bypass adjustment on this valve is under the top cover on the large port and the adjustment inside it is marked:

   Increase ←→Decrease

   After removing the cover, loosen the locking screw first before making adjustment. This should be done at 0 VDC to the modulating gas valve terminals and the **spring activated low fire brass screw** turned fully CCW and the locking ring loosened off.

2. Bring voltage to gas valve at 2.25 VDC and adjust the **spring activated low fire** adjustment located in the head with the electric modulator (smaller screw under cap) to achieve the same O_2 reading as the one achieved at 0 VDC (16.8% to 17.5% O_2). After this is complete then adjust the Curve Matching pot as described in point 5 above.

Pilot Set Up (High Turndown Burner)

1. On high turndown units, ensure air tube to pilot is free of debris and blockages and then set pilot pressure to 3.5" WC.
2. Pilot set up is not as critical on the high turndown burner as there is not as much heat on it as on the regular burner.

Standard (Round) Burner

Most standard turndown DJ units will employ one of the following Maxitrol modulating DC volt gas valves.

Series 20 M520, M620	These valves do not have high fire regulators. High fire pressure is set up at the appliance regulator. If used on the standard burner, the low fire adjustment located on the bottom side of the valve is to be adjusted fully clockwise (no bypass).
Series 50 M550, M650, ES350	These valves do not have high fire regulators. High fire pressure is set up at the appliance regulator. This series of valve has been replaced with the M520/620 series.
ES345D-L	This valve has a built in high fire regulator.

High Fire Set Up

1. Turn on the service switch (dipswitch 5).
2. Set manual firing Pot Hi Service (located next to the + terminal) to high fire. Adjust the high fire input to the correct clocked rate. Adjust the combustion air slider or inlet damper until the high fire O_2 reading is between 3.5 and 4.2%.

Low Fire Set Up

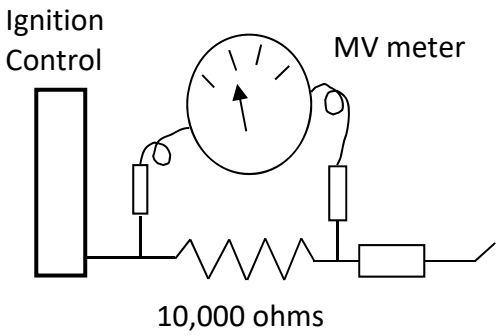
Low fire blower input is 40% of high fire blower input.

The low fire procedure set up is similar to that for the high turndown burners noted above. The difference is the maximum allowable CO at low fire is 200 PPM. The low fire O_2 reading should be between 10.9% to 11.3%. The combustion slider is different than the high turndown slider. It is a plate that slides between the blower outlet and the burner box. The low fire RPM is adjusted using Low Fire Pot to 1850 $\pm$10 RPM (30.5 Hz).

After setting up the low fire, adjust the curve matching pot as described in point 5 above.

Pilot Set Up (Standard Burners)

Do not set up pilot until you are confident the burner is operating with correct air/fuel mixture. Ensure the pilot tube is free of debris and blockages. On standard round burners, set pilot as per the following procedure.



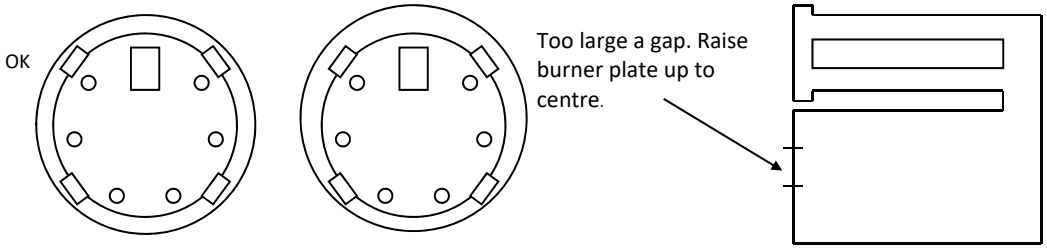
1. Install a 10,000-ohm resistor in series with the flame rod circuit.
2. Connect a DC voltmeter across the resistor.
3. The reading will be in millivolts if your meter does not auto scale.
4. Connect a manometer to the pilot line.
5. Run the burner on main flame for a few minutes to have the burner plate warm.
6. Leave the pilot on but turn the main gas off. You will have to jumper the DJM3 terminals PV1 and PV2 to do this and remove the wire from terminal VFB 120 or VFB 24 (depending on valve voltage).
7. As low pilot gas pressure can damage the ceramics, reduce the pilot gas pressure to 2.5 inches and immediately return it to a higher pressure. This is to ensure the pilot gas regular responds properly.
8. Adjust the pilot valve regulator to a pressure in excess of 4.5 inches pressure.
9. Slowly reduce the pilot gas pressure while watching both the pressure and the voltmeter. The millivolt reading should be increasing. At the point where it begins to fall you should stop reducing pressure and return to the high spot.

NOTE: The fall in pressure could only be as small as a couple of millivolts. This point should be between 4.5 and 2.5 inches pilot pressure.

NOTE: Some smaller burners (DJ40 250,000 BTUH and smaller), may need to have a screw placed through the pilot air tube to reduce the amount of air to the pilot.

10. This reading is used to determine the adjustment that will usually give the best pilot lighting and proving strength. However, care must be taken to not adjust the reading for pilot gas pressure below 2.5 inches water column pressure or you will break the pilot ceramics.

11. Next, visually observe the pilot flame. It should be visible at a minimum of 3 of the holes around the pilot. If the pilot cannot be seen then it is likely burning too deep into the pilot box. If this is occurring check that the gasket on the pilot assembly is forming a tight seal. Also ensure that the burner is located in the center of the burner tube. If it is mounted too low then too much air can flow over the top of the burner and affect the pilot.



NOTE: After set up is complete make sure to turn off dipswitch 5.

Propane Gas

Combustion set up for propane fuels for either the high turndown or the standard burner are similar to the above. The only modification suggested is it may be desirable to increase the oxygen settings by 1% to 1.5% above those for natural gas.

Due to the quantity of fuel that can be drawn off a propane tank, it is often necessary to equip a propane fuel system with a vaporizer. The usual sign that a vaporizer is required is that the equipment fuel supply falls off as the line “freezes”. The following could be observed:

- Lack of temperature rise,
- Rumbling or shaking burner due to air/fuel mix,
- After turning the unit off for a period of time the fuel line thaws and restarting it, all appears to be normal.

High turndown burners operating on propane fuel will generally exhibit the following:

High Fire At 3.5% O_2 will appear yellow from behind the burner. However, if you could view it from the other side of the burner you would see blue as the flame lengthens out.

Low Fire At 16% O_2 the flame will likely be yellow. At 17% O_2 the flame will likely be blue and yellow.

Inlet/Manifold Pressure Settings

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 as corrections for density (altitude and station pressure), temperature, and for the meter are often overlooked, thus leading to an incorrect conclusion.

Inlet gas pressures are recorded on the unit label. At high fire inlet gas pressure to the unit should not fall below 6.25" on units designed for 7" inlet pressure. If design is for 14" pressures should not fall below 12".

If design is for 11" propane gas, then inlet pressures should not fall below 10". Note that with propane fired units it may be necessary to equip the propane system with a properly sized vaporizer.

TEMPERATURE CONTROL

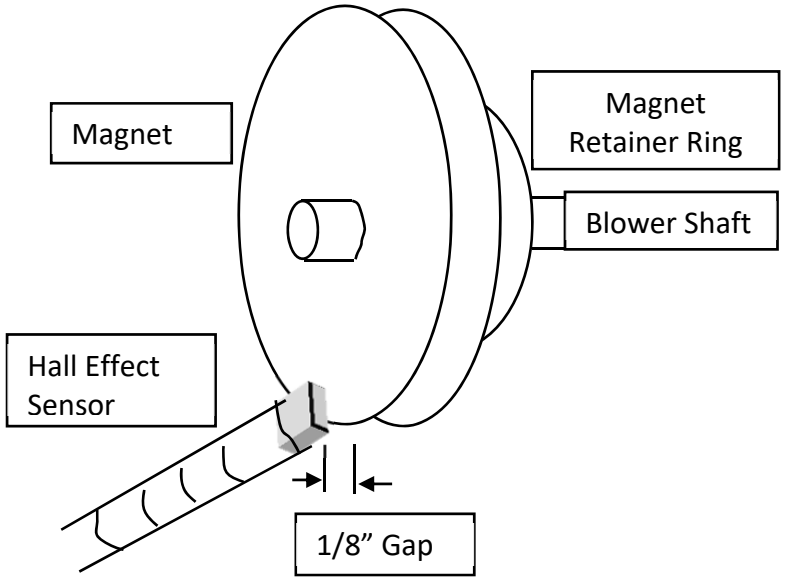
Modulation of the firing rate is gradually made until the discharge air temperature is within ±1.5°F of the "calculated" set-point. When the heat load is light and the burner is cycling between low fire and off there will be small temperature swings.

AIR BALANCING

Installation and air balancing is often done during warmer weather than that experienced in the cold of winter. If the air balancer did not allow for the changes that will occur in air volume in cold weather then the unit will appear to be short of temperature rise. 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 will be about 20% increase in air volume from -30°F to +70°F.

PRE-PURGE PROBLEM

If a Pre-Purge problem is found, typically the DJM3 is receiving a signal from the tachometer sensor (Hall Effect sensor) that is not consistent with the combustion blower status. If there is a call for heat and the combustion blower is not running the DJM3 has likely detected a false or grounded tachometer signal. Remove all three wires to terminals O, YS, and G. If the combustion blower fails to start, check the combustion motor and or motor wiring.



If the combustion blower is running and the tachometer signal is absent, weak, or grounded. With a digital AC voltmeter, measure the AC volts present on terminals "YS to G". 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.

INDUCED VOLTAGE ON REMOTE CONTROL WIRING

The DJM3 control is calibrated at the factory and this calibration will satisfy most applications. Occasionally impedance from long wiring runs or induced voltage on the remote wiring cause it to be out of calibration. To recalibrate refer to the following section. To check for induced voltages, disconnect all of the field wiring in question from the DJM3.2 while the unit is left operating, and check for AC volts across each questionable wire and ground.

CALIBRATION

Discharge Sensor

1. Accurately measure the discharge air temperature at the temperature sensor in °C.
2. Read the DJM3 discharge temperature by reading the voltage at multimeter test point DTEMP. Using a DC voltmeter
3. If a difference is found adjust the D SEN CAL Pot to match to the two values

Discharge Setpoint Calibration

1. Record the settings of DIP switches 1, 2, and 3. Turn off DIP switches 1, 2, and 3. If the "OR" terminal is used, the wire to terminal "OR" must be removed.
2. Depending on which setpoint control method is used:
   a) Johnson Controls TE 6100
      i) Set Johnson Controls TE 6100 setpoint to 21°C
      ii) Read the DJM3 Discharge setpoint at multimeter test point SPC using a DC voltmeter.
      iii) Adjust the DIS SP CAL POT to match the reading.
   b) DJM3 Built in Dial
      i) Turn setpoint dial to 21°C.
      ii) Read the DJM3 Discharge setpoint at multimeter test point SPC using a DC voltmeter.
      iii) Loosen the set-screw on the setpoint knob and move the knob marker to match with the measured value.
      iv) Tighten set-screw.

For either of the above:

3. Return the DIP switches to their normal position.

Room Sensor Calibration

1. Accurately measure the room or return air in °C and set the room setpoint dial to the measured value.
2. Record the settings of DIP switches 1, 2, and 3. Turn off DIP switches 1, 2, and 3.
3. Read the DJM3 Discharge setpoint at multimeter test point SPC using a DC voltmeter.
4. Turn DIP switch3 on
5. Read the DJM3 Discharge setpoint again and adjust the ROOM CAL Pot to match the same voltage measured in step 3.
6. Return the DIP switches to their normal position.

BMS Signal Calibration

1. Apply 100% mA or Vdc signal to the DJM3 "+" and "-" terminals (i.e. 10 Vdc or 20 mA).
2. Record the settings of DIP switches 1, 2, and 3. Turn off DIP switches 1, 2, and 3.
3. Measure the DJM3 calculated setpoint at multimeter test point SPC using a DC voltmeter.
4. Turn DIP switch 1 on.
5. Measure the DJM3 calculated set-point DC voltage again and adjust the BMS CAL Pot until the voltage is equal to the number of °C maximum reset.
6. Return the DIP switches to their normal position.

SENSOR TABLE

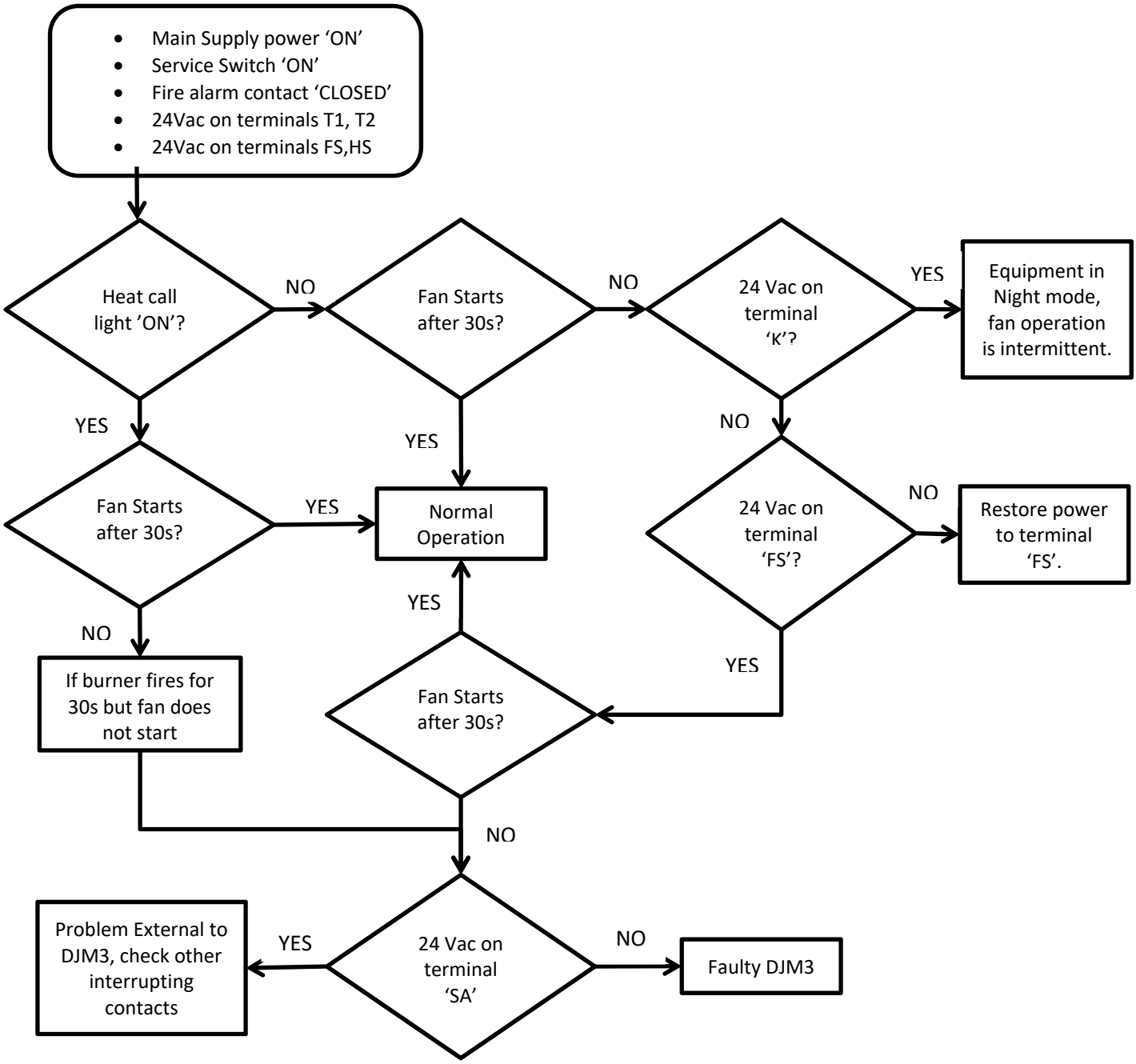
Sensor Resistance Chart for TE 6100-960 and TE6000EA3.

Table 13

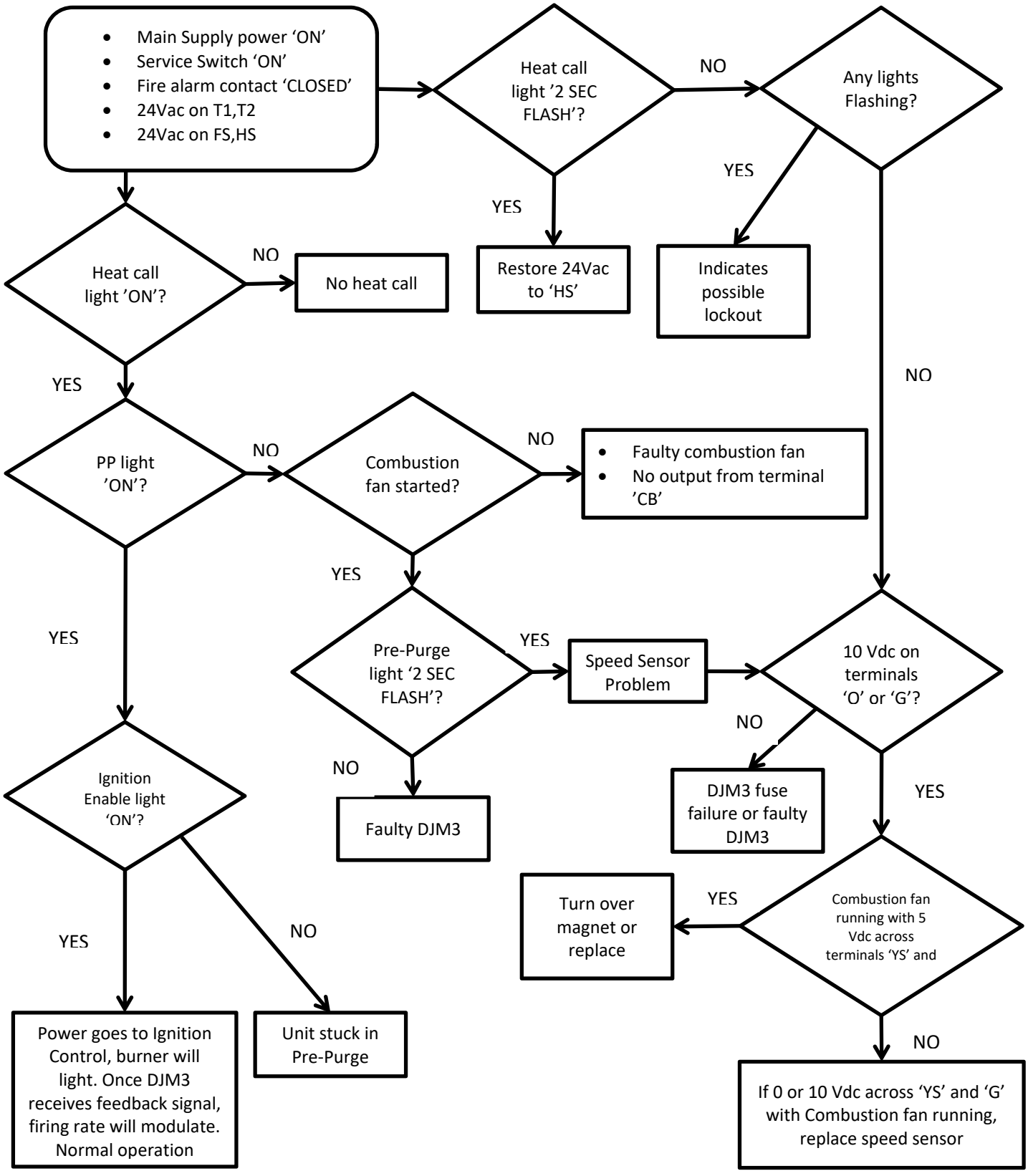
˚C	˚F	Resistance Ω	˚C	˚F	Resistance Ω	˚C	˚F	Resistance Ω
-40	-40	597	4.4	40	877	48.9	120	1229
-34.4	-30	629	10	50	916	54.4	130	1279
-28.9	-20	661	15.6	60	958	60	140	1329
-23.3	-10	694	21.1	70	1000	65.6	150	1381
-17.8	0	728	26.7	80	1043	71.1	160	1433
-12.2	10	763	32.2	90	1088	76.7	170	1487
-6.6	20	800	37.8	100	1134	82.2	180	1542
-1.1	30	838	43.3	110	1181	87.8	190	1599

Note: Reference resistance is 1035 ohms at 77˚F. Resistance tolerances are ±0.05 to 0.15% at 77˚F.

FAN OPERATION FLOWCHART



HEAT OPERATION FLOWCHART

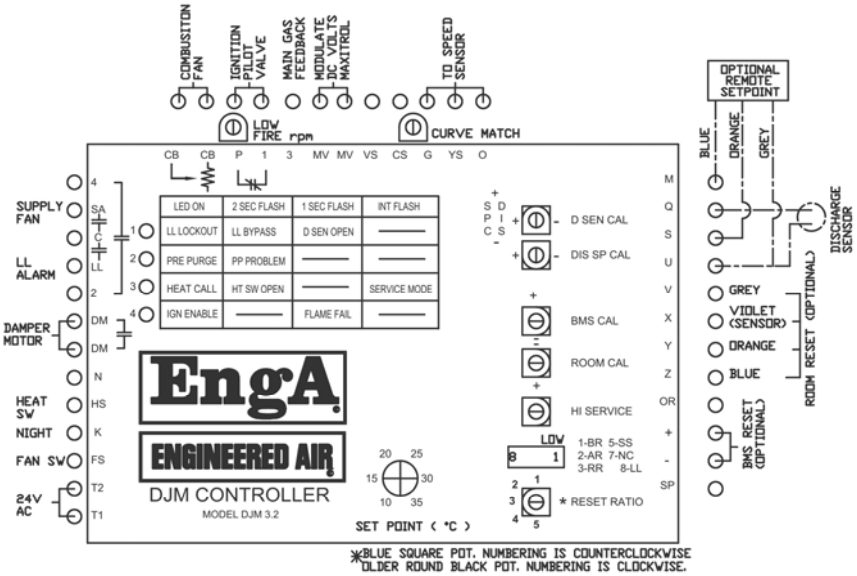


UPGRADING DJM3.2 OR 3.3 to DJM3.4

ORIGINAL DJM-3.2 OR 3.3 WIRING

Note:
Terminal 3 is the feed back wire from the gas valve/ignition control circuit.

If you have one of these controllers and are replacing it with a DJM-3.4 note instruction below.



NEW DJM-3.4

1) Some terminal designations have been changed. The function is the same.
2) The wire that was on terminal 3 of the above DJM, should be taped off. If there were 2 wires on that terminal, they should be marretted together.
3) In place of the wire that was on terminal 3 for the DJM 3.4 you must run 2 wires directly from the main blocking valve to the valve feed back terminals

VN for neutral.
VFB24 if its 24v valve.
VFB120 if its 120v valve.