USER OPERATION

MANUAL

FOR

M-TRAC4

DIRECT 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

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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.

www.engineeredair.com

M-TRAC4

The M-TRAC4 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.

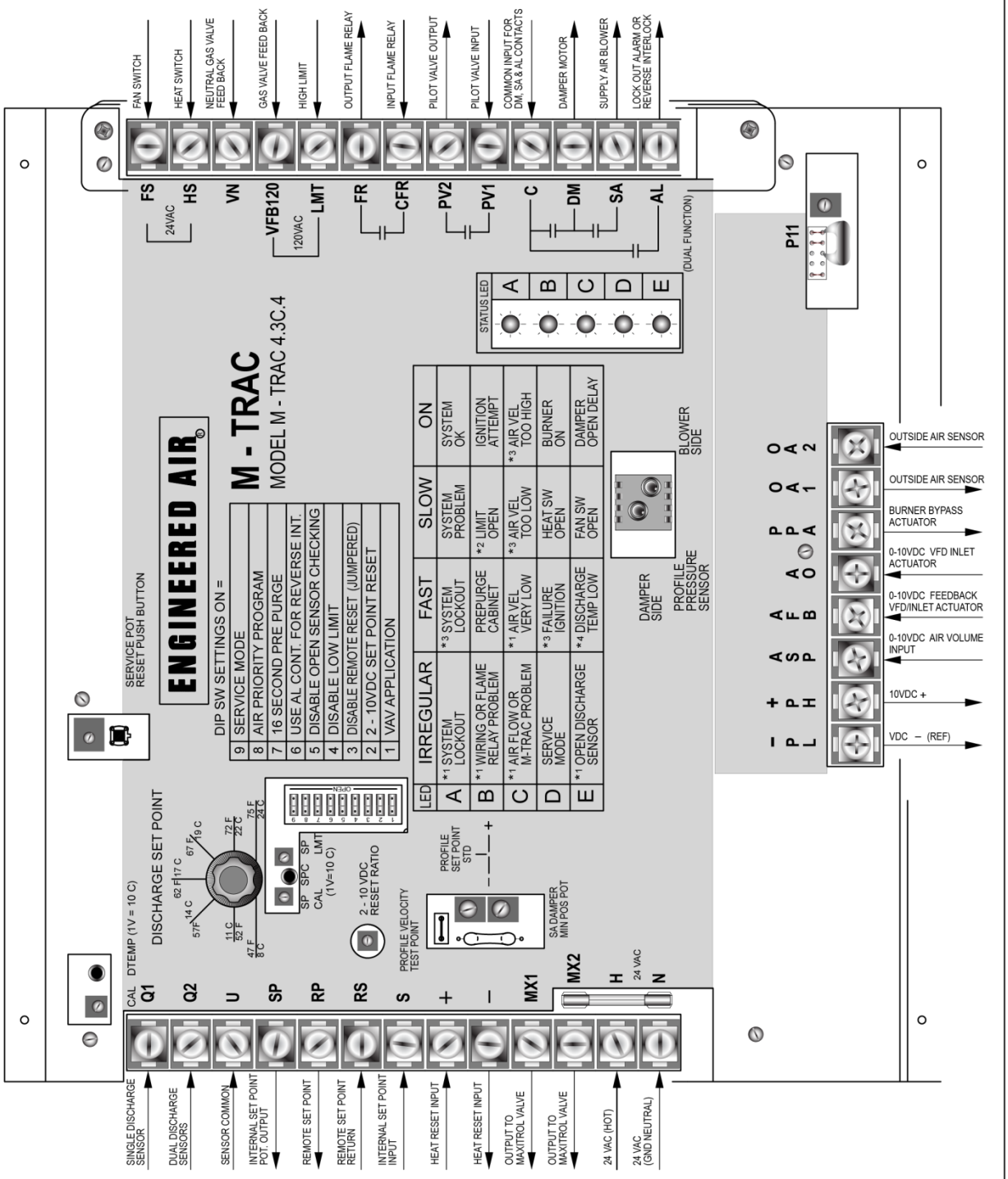
To ensure warranty is honored, only qualified personnel should be employed for service and troubleshooting. If further information is required please contact the nearest Engineered Air office.

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 is 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.**



M-TRAC 4.3C.4 CONTROLLER

EngA ENGINEERED AIR

REVISIONS: APRIL 02 2015			
DATE:	DRN.BY:	CHKD.BY:	DRWG.No.:
MAY 06 2008	MA	DW	M-TRAC-4.3C.4

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INTRODUCTION

The M-TRAC4 is a discharge air temperature controller of variable volume direct-fired Engineered Air equipment. The M-TRAC4 maintains the required burner airflow by modulating the burner profile bypass damper (or return air damper on RE style equipment).

The information used in this manual should be used in conjunction with the unit function sheet(s) and the HE (or RE) series Installation, Operation, and Maintenance manual.

The M-TRAC4 is designed to control only Engineered Air equipment.

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

Various upgrades and improvements have been made over time. Always include any suffix letters and numbers for trouble shooting or replacement. All M-TRAC4 models are backwards compatible; however some additional wiring may be required.

CONTROLLER RATINGS

Power requirements: 24 Vac, 40 VA.
Contact Rating: 120V 3A inductive
2-10 Vdc input impedance: 2 kΩ
Environment: -40 to 120°F (-40 to 50°C) non-condensing.
Fuse Rating: 1.25 GDC slow-blow

CONTROLLER DESCRIPTION

TERMINALS

TABLE 1

Terminal	Description
Q1	Input terminal for single discharge sensor
Q2	Input terminal for two discharge sensors wired in series
U	Sensor common
SP	Output from the built in set point POT.
RP	Positive supply for a remote set point POT.
RS	Return from the remote set point POT.
S	Setpoint enable
+ / -	2 to 10 Vdc temperature reset input
H	24 Vac hot
N	24 Vac neutral (ground)
FS	Fan switch input
HS	Heat switch input
LMT	Input from safety limit (high limit)
VN	Neutral for the 120 Vac Main gas valve feedback
VFB 120	Hot for the 120 Vac Main gas valve feedback
FR	Flame relay control
CFR	Flame relay control common
PV1 / PV2	Pilot Valve control contacts
C	Input power supply to feed DM, SA and AL outputs
DM	Damper enable output
SA	Supply blower output
AL	Alarm output or Reverse interlock control output
MX1 / MX2	Maxitrol valve output.
AO	Output to air volume controller.
AFB	Air volume feedback input.
PPA	Burner bypass actuator output.
ASP	Air setpoint (volume) input.
PH	Fixed 10Vdc output (+).
PL	Reference 10Vdc output (-).
OA1 / OA2	Outside air temperature sensor.

DIP SWITCHES

The M-TRAC4 options are configured by DIP switch selection and/or wiring connections. DIP switch settings are noted on the internal wiring diagram, and should not be altered.

TABLE 2

DIP SW	Description
9	Service Mode. Enable to manually control the firing rate.
8	Air Priority Program. See Blower Control.
7	16 Second Pre-purge. Heating will delay on after fan starts.
6	Alarm contact to be used for reverse interlock. See Reverse Interlock.
5	Disable Open Sensor Checking. See Discharge Air Setpoint.
4	Disable Low Limit. See Low Limit.
3	Disable remote reset of failure codes.
2	2-10 Vdc Set Point Reset. See Temperature Reset.
1	VAV application.

INDICATION AND DIAGNOSTIC LIGHTS

There are 5 status lights on the M-TRAC4 labeled A to E. They operate in 4 patterns: an irregular flash (.. __ .. __ ..), fast flash (…….), slow flash (. . .), or constantly on (_____).

TABLE 3

IRREGULAR	FAST	SLOW	ON	LIGHT
System Lockout	System Lockout	System Problem	System Ok	A – GREEN
Wiring Or Flame Relay Problem	Prepurge Cabinet	Limit Open	Ignition Attempt	B – RED
Air Flow Or M-TRAC Problem	Air Velocity Very Low	Air Velocity Too Low	Air Velocity Too High	C – RED
Service Mode	Ignition Failure	Heat Switch Open	Burner On	D – RED
Open Discharge Sensor	Discharge Temp Low	Fan Switch Open	Damper Open Delay	E – RED

ADJUSTMENT POTS

There are a number of setting and calibration potentiometers (POT's) located on the face of the M-TRAC4. Modifications to these should only be performed by experienced and qualified personnel.

TABLE 4

POT	Description
SP LMT	Limits the maximum discharge temperature set point.
CAL DTEMP	Discharge air sensor temperature calibration.
SP CAL	Setpoint dial calibration.
SERVICE POT	Manually sets burner firing rate for service. Located just above the centre. When the service switch is on, this POT can be used to adjust the modulating gas valve from low to high fire. When the service DIP switch is on, light 'D' blinks irregularly.
2-10 Vdc RESET RATIO	Sets the reset temperature range. This adjusts the amount of reset range the 2-10 Vdc room thermostat will have. This allows an adjustment band between 5°F and 50°F (3°C and 28°C).
PROFILE VELOCITY	Allows a narrow adjustment for Profile pressure set point.
SA DAMPER MIN POS	Adjusts the minimum output to the air volume controller (terminal AO).

MULTIMETER TEST POINTS

The M-TRAC4 has readout test points for discharge air temperature, discharge set point and profile plate velocity status. **Temperature readings are indicated by Vdc referenced to ground.**

MAXIMUM DISCHARGE SET POINT LIMIT SETUP (SP LMT)

Regulations, design or authorities having jurisdiction may require limiting the maximum discharge air temperature the appliance is allowed to reach. This may be set by the potentiometer SP LMT, which is located below and to the right of the M-TRAC4 discharge set point knob. Vdc readout = °C / 10. See Table 5.

CALCULATED SETPOINT (SPC)

The SPC measurement point is located just below the M-TRAC4 set point knob. This temperature is the current operating set point after all applicable temperature resets have been applied to primary or base set point. Vdc readout = °C / 10. See Table 5.

DISCHARGE TEMPERATURE (DTEMP)

The DTEMP measurement point is located on the top left corner of the M-TRAC. The voltage reading relates to the actual temperature of the discharge sensor. Vdc readout = °C / 10. See Table 5.

Table 5

Voltage (Vdc)	˚C	˚F
1	10	50
1.5	15	59
2	20	68
2.5	25	77
3	30	86
3.5	35	95
4	40	104

NOTE: Sensor accuracy is diminished at temperatures greater than those noted in table 5.

PROFILE PLATE VELOCITY

The profile plate has been factory set for the airflow shown in the submittal record.

The profile plate air velocity status can be determined by reading the DC volts measured between the profile measurement point (located close to terminal S) and terminal N. When the profile velocity is optimum, the reading is 4.8 Vdc at high fire and full speed. 50% volume should read 3.5 Vdc, and 33% should read 3.3 Vdc.

Note that if the airflow is reduced below safe operating conditions there are delays built into the M-TRAC4 that will shut off the unit within 45 seconds.

TABLE 6

Test Point Reading at high fire	Status	Result
Below 0.8 volts	Very low or no airflow	Unit lockout
Between 0.8 and 3.0 volts	Low airflow	If the burner is already off it is disabled. If the burner is on, variable timed lockout.
Between 3.0 and 5.2 volts	Operating range	Normal
Over 6.0 volts	High airflow	If the burner is already off it is disabled. If the burner is on, variable timed lockout.

LOCKOUT RESET

To reset the M-TRAC4 from a lockout condition push the “Reset Push Button” located just above and to the right of the DIP switch block. If the M-TRAC4 loses line power while locked out, the status codes (reason for the lockout) will be lost. When power is resumed the M-TRAC4 will remain locked out, with only the green LED flashing irregularly.

CONTROL

SYSTEM TIMING

Blower startup: 54 seconds after terminal FS is energized.
Low Limit bypass: 4.5 minutes from initial startup, 50 seconds nuisance timer.
Trial for ignition: 30 sec.

DISCHARGE AIR SETPOINT

The M-TRAC4 is a discharge air temperature controller with a built in face mounted set point knob (that is activated by connecting terminal S to SP). Optionally, the M-TRAC4 is available with a remote set point, with varying set point ranges. When a remote setpoint is provided, the M-TRAC4 face mounted set point will have no effect.

Additional methods of resetting the discharge air temperature setpoint may be used. Refer to the unit function and electrical drawing.

DISCHARGE AIR SENSOR

The M-TRAC4 is designed to use either a single or dual discharge sensors, wired in series. Dual sensors are always used in equipment with temperature rise over 100˚F (55°C) or with dual fans. In most applications the discharge air sensor(s) is located in the supply blower outlet.

The discharge air sensor also serves as a low limit (or freeze protection) sensor.

The M-TRAC4 automatically checks the discharge air sensor(s). If the M-TRAC4 reads an open sensor it will disable temperature control and reduce the firing rate to low fire, then shutdown the appliance. Open sensor checking may be disabled by switching on DIP switch #5.

LOW LIMIT

The M-TRAC4 control is typically configured so that the discharge air temperature sensor also performs the function of a low limit or freeze stat. If DIP switch 4 is ‘off’ the low limit function is enabled. If the discharge temperature falls below 40˚F (4°C) the appliance will shut down and the LED for low discharge temperature will begin flashing. On initial startup the M-TRAC4 will internally bypass the low limit for 4.5 minutes. After this time, the low limit discharge temperature must be below the low limit setpoint (40°F / 4°C) for 4 minutes before the M-TRAC4 will shut the appliance off.

If DIP switch 4 is ‘on’, the low limit safety function is disabled.

DAMPER CONTROL

The inlet damper actuator(s) is enabled through output terminal DM. The M-TRAC4 allows time for the dampers to open prior to starting the supply blower.

BLOWER CONTROL

The M-TRAC4 uses output terminal SA to control the supply air fan. There are, however, a number of internal and/or external components that may be required to be functional prior to starting the blower. Proof of air flow is confirmed by the profile pressure sensor.

In some applications continuous airflow is more important than temperature control. The M-TRAC4 has two blower control program options. They are referred to as **airflow** priority, and **comfort** priority. See Table 7 for the differences between the two priorities. Priority type is selected by DIP switch 8.

For the comfort priority program, minimum airflow is defined as 60% of required airflow. Airflow priority is defined as 40% of required airflow.

TABLE 7

	Priority Level	
Status	**Comfort**	**Air Flow**
Heat switch off. Low airflow	Lock out in 50 seconds.	Blower will remain on until the discharge air temperature falls below 40˚F (4°C).
Flame failure, with discharge temperature greater than 40°F (4˚C).	Burner and blower off.	Burner off, blower continues to run.
Heat on, but sensing a high air velocity condition.	Unit will shutdown after 60 seconds.	Burner will lockout after 60 seconds. Blower will remain on until the discharge air temperature falls below 40˚F (4°C).
Heat on, with the high limit control open.	Unit will shutdown after 4 seconds.	Burner will lockout after 4 seconds. Blower will remain on until the discharge air temperature falls below 40˚F (4°C).

BURNER CONTROL

The M-TRAC4 outputs a 2 to 16 Vdc signal to a Maxitrol valve to control and maintain a defined discharge air temperature setpoint.

PROFILE PLATE VELOCITY SENSING SYSTEM

The M-TRAC4 has a built in profile pressure sensor to prove and monitor air flow across the burner. This allows the burner to operate safely and efficiently by proving the airflow is within proper air velocity limits.

The profile pressure sensor has three non-adjustable air settings: 40, 60 and 120% of normal airflow. These perform the equivalent function of the high (120%) and low (60%) velocity air switches while providing an additional very low (40%) velocity for use in process applications, when providing air is more crucial than temperature control.

The normal profile plate pressure drop is 0.48”w.c.

TEMPERATURE RESET

MAKE / BREAK THERMOSTAT

The set point can be configured for two-level discharge air temperature control, initiated by a override contact or space mounted, single stage thermostat, with the second (upper) level adjustable from 75˚(24°C) to 160˚F (71°C) by the SP LMT POT.

2 – 10 Vdc SIGNAL (BMS)

The set point can be adjusted linearly upwards from 5°F to 50 °F (3°C to 28°C) from a 2-10 Vdc BMS input on terminals - and +. When equipped with a 2 to 10 Vdc room thermostat, this option becomes a linear room reset. The discharge set point dial, either face mounted or remote mounted, is the minimum set point. The maximum reset amount is adjusted by the 2-10VDC RESET RATIO POT located beside terminals RS and RP.

RESET EXAMPLE

SP LMT set at 95˚F, Dial set point set at 50˚F.
2-10 Vdc reset ratio POT adjusted to give 30˚F reset at 10 Vdc.
The resulting control will be:
At 0-2 Vdc = 50˚F discharge
At 6 Vdc = is ½ of the reset authority. Half of 30˚F equals 15˚F, therefore the discharge setpoint will be at 65˚F (50° + 15° = 65°). At 10 Vdc = full reset. Discharge will be at 50° + 30° = 80˚F. This will not be limited by the SP LMT (at 95°F), unless the setpoint dial is turned up more than 15°F.

OPERATION

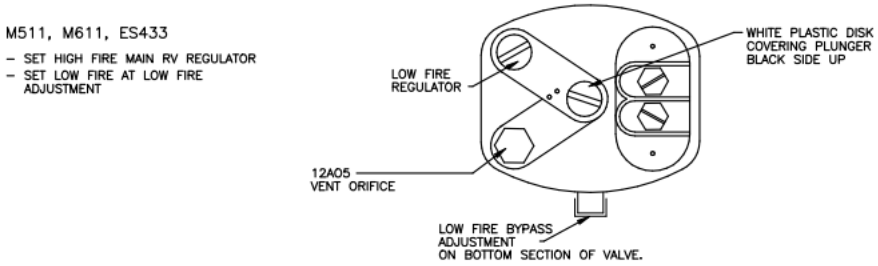
EXHAUST FAN INTERLOCKING

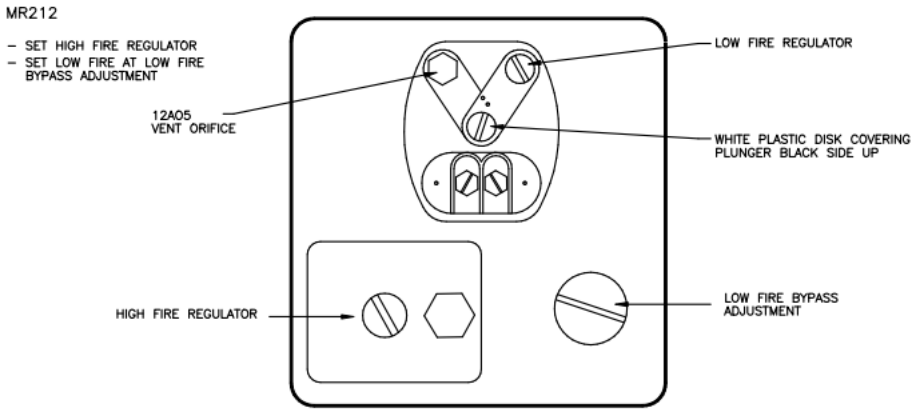
There are a number of different exhaust interlocking options available. Always refer to the wiring diagram and unit function sheet to determine the exact type of interlocking used. The AL output contact may be switched from an alarm output to a exhaust fan enable output contact for control of reverse interlock control systems (DIP sw #6). In this mode terminal AL will close on proof of supply air flow.

LOW FIRE

The M-TRAC4 low fire is set at the modulating valve. With the air flow at maximum and the output to the Maxitrol modulating valve at 0 Vdc, low fire should be set to just ensure a continuous and stable flame exists along the entire length of the burner.

Adjust the low fire regulator on M, ES and MR Maxitrol modulating valves to minimum (fully counter-clockwise) and locked in place by the locking cap. Locate the low fire bypass adjustment on the valve and turn to set minimum fire. Turning the bypass adjustment clockwise will reduce the low fire.





CALIBRATION

While the burner and M-TRAC4 is factory tested and calibrated, field conditions may affect airflow and sensor readings.

After making any calibration adjustment, it may take a few minutes for the M-TRAC4 to reflect the changes. After this time, turn the appliance off for a few seconds, then back on. Re-confirm the calibration.

SETPOINT (SPC)

Check the wiring diagram to determine if the M-TRAC4 is using the face mounted setpoint dial or an optional remote mounted setpoint dial. The most commonly used remote control panel includes fan and heat on/off switches and a setpoint dial. A jumper will be installed across terminals S and SP if the M-TRAC4 is using its built in setpoint dial.

1. Disable any external temperature resets (DIP switch #2 off) or lower the room thermostat settings so there is no call for additional heat.
2. Use a voltmeter to measure the Vdc output on the SPC measurement point.
3. Compare to the Setpoint dial and adjust the SP CAL POT (located near the face mounted setpoint dial) so they match (1 Vdc = 10°C).
4. Turn DIP switch 1 on, or return the room thermostat to its normal position.

Note: If the adjustments have no effect on the discharge temperature, the set point may be under the authority of the maximum set point limiting POT (SP LMT).

DISCHARGE AIR TEMPERATURE (DTEMP)

The discharge sensor must be located so that its temperature remains stable. Due to the nature of direct fired appliance, the air temperature leaving the supply blower is often very stratified. It is important to understand that the supply blower does not significantly mix the air. As well, the stratification pattern will change with different firing rates, wind conditions, ducting and blower configurations.

Field conditions may result in differences between the sensed temperature and the actual temperature. Adjusting the location of the discharge sensor a few inches will often correct temperature differences. If a section of duct is connected to the discharge opening, the sensor may be moved downstream up to 10 ft. (3 meters). Moving the sensor too far downstream may result in sensing lag, which could compound control error.

1. Accurately measure the temperature at the discharge air sensor.
2. Compare the temperature to the DTEMP test point voltmeter reading.
3. Match the readings by adjusting the CAL DTEMP POT (located near terminal Q1).

PROFILE VELOCITY

Profile velocity test point readings outside the 3.0 - 6.0 Vdc range generally indicate improper airflow through the burner. Before attempting to adjust the profile velocity ensure the heater is operating at the required nameplate air volume.

The Profile Velocity POT is typically set to the '12' o'clock position. Outside air temperature will affect the pressure drop across the burner.

2-10 VDC RESET SET UP

1. The 2-10 VDC RESET RATIO POT is located beside terminal RS.
2. Turn off DIP switch 1 and turn the discharge set point knob (face mounted or remote) to the minimum required set point.
3. Set the voltage across terminals + and – to maximum (10 volts).
4. Calculate the maximum required discharge temperature (°C) and divide by 10.
5. Turn on DIP switch 1 and adjust 2-10 Vdc reset POT ratio until the SPC voltage is equal to the number calculated in the above step.
6. Adjust SP LMT until the voltage reading is the same as was recorded in step 5.

SERVICE

SERVICE MODE

Placing the M-TRAC4 into service mode allows for direct control of the burner firing rate. Once the burner has started, the M-TRAC4 can be placed into the service mode by turning on DIP switch #9. The service POT, located above the reset push button, will control the position of the modulating valve to any position from low to high fire.

Note: the service mode does not bypass any safeties, heat or fan switches.

SETTING HIGH CAPACITY

Ensuring that operation at high capacity is correct is critical to the operation of the appliance at all other firing rates.

Set the M-TRAC4 and any related controls to high capacity. Ensure the bypass damper is fully open, and approximately 9 Vdc is measured at terminal PPA, and the profile pressure test points read 4.8 Vdc.

SETPOINT REMOTE WIRING

Impedance from long wiring runs may cause the setpoint to be out of calibration. Refer to the setpoint calibration section if adjustment is required.

AIR PRESSURE SENSOR

The M-TRAC4 has an internally mounted air pressure sensor. Do not blow onto the pressure ports – too much air pressure will damage it. The ports are fragile and can easily break.

During initial startup, the space the appliance is feeding may be under negative or positive pressure. To accurately check the M-TRAC4 pressure sensor, remove the sensing tubes from the M-TRAC4, while the fan is on, and the reading should be 0 Vdc.

The M-TRAC4 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.

Before making any modifications to the profile opening contact Engineered Air.

INPUT CONTACTS BY OTHERS

Input contacts, such as HS and FS must use mechanical relay (dry) input contacts. The use of solid state relay's (SSR's) may cause the M-TRAC4 to malfunction due to reverse leakage current when 'open'.

BMS SENSOR LOCATION

If there is a BMS sensor located in the discharge duct, that sensor must be mounted within ½ inch of the Engineered Air sensor.

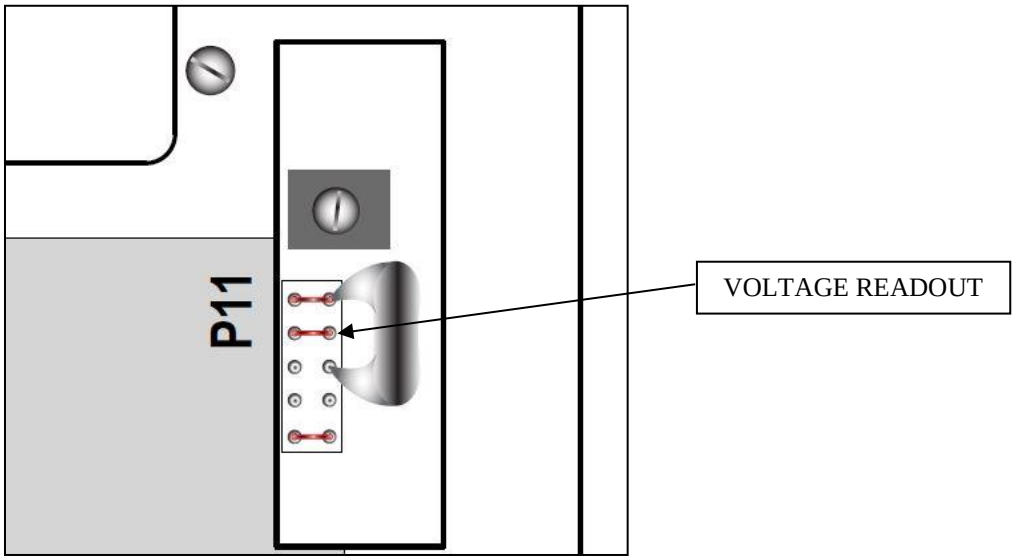
Note: BMS (Building Management System) discharge air temperatures should never be used to reset the temperature of the heater. Only use space or room mounted sensors.

VFD FEEDBACK ADJUSTMENT

Factory setting of the variable frequency drive feedback cannot anticipate every eventuality after the appliance has been installed in the field. Nuisance temperature over/under shooting and limit failures at mid and low firing rates can often be attributed to the incorrect setting of the VFD feedback. Field tuning will be required on all equipment when the VFD is supplied and installed by others.

The feedback voltage from the VFD to terminal AFB should be a fair representation of the actual air volume output to AO terminal. When using a VFD, the output signal feeding into AFB should provide 10 VDC at high volume, 5 VDC at 50% and 3.3 VDC at 33%. The P11 pot sets the starting point of the internal temperature control reset curve. (This is the reset curve that collects signal input from OA sensor, AFB feedback and DA sensor to best control the modulating gas valve due to an equally proportional rise in the total temperature rise. At half the volume the heat rise is doubled)

Ensure that the AFB terminal is receiving proper signal as mentioned above, then switch the speed reference signal to the lowest as per the unit function (typically 33% or 50%). It should be adjusted such that when the VFD is at minimum volume, the voltage to the second jumper from the P11 pot should be at minimum. Carefully connect a DC voltmeter from the second jumper to ground. While watching the meter, gradually turn pot P11 just until the voltage stops falling. Do not set past this point.



This adjustment ensures that the internal temperature control reset curve starts just as the VFD begins to ramp up. The internal reset signal will be at maximum when the AFB voltage has increased by 6 VDC greater than the minimum volume voltage. If the minimum input voltage is greater than 4 VDC the amount of the internal temperature reset is reduced.

Ensure that the spring activated low fire adjustment on the Maxitrol modulating valve is at minimun turned fully counter clockwise and locked in place by the locking cap. This is because the MTRAC-4.3C.4 has 2 to 16 VDC on MX1 and MX2.

M-TRAC4 LOCK OUT DESCRIPTION

Table 8

LED Code	Reasons
B Irregular	Faulty flame relay or wiring error. Ignition control and safety shut off valve should be off (FR and CFR contact 'open', but receiving power to VFB120 indicating valve is still on.
	Faulty flame relay or wiring error. FR and CFR contacts closes, but feedback from safety shut off valve to VFB120 happening too fast.
B Slow	High limit open.
C Fast	Very low air flow. Sensed air flow is below 40%.
C Slow	Low air flow. Sensed air flow is below 60%.
C On	High air flow. Sensed air flow is over 120%.
D Fast	Ignition failure.
E Irregular	Open discharge air sensor. Sensor resistance should not exceed 1940, or 3450 Ω for dual sensors.
E Fast	Low limit. Discharge temperature has fallen below 40°F (4°C).

SENSOR TABLE

Sensor Resistance Chart for TE600EA3.

Table 9

˚C	˚F	Resistance Ω	˚C	˚F	Resistance Ω	˚C	˚F	Resistance Ω
-40	-40	602	4.4	40	881	48.9	120	1234
-34.4	-30	633	10	50	921	54.4	130	1269
-28.9	-20	665	15.6	60	963	60	140	1333
-23.3	-10	698	21.1	70	1005	65.6	150	1365
-17.8	0	732	26.7	80	1048	71.1	160	1437
-12.2	10	768	32.2	90	1092	76.7	170	1491
-6.6	20	804	37.8	100	1139	82.2	180	1546
-1.1	30	842	43.3	110	1186	87.8	190	1602

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