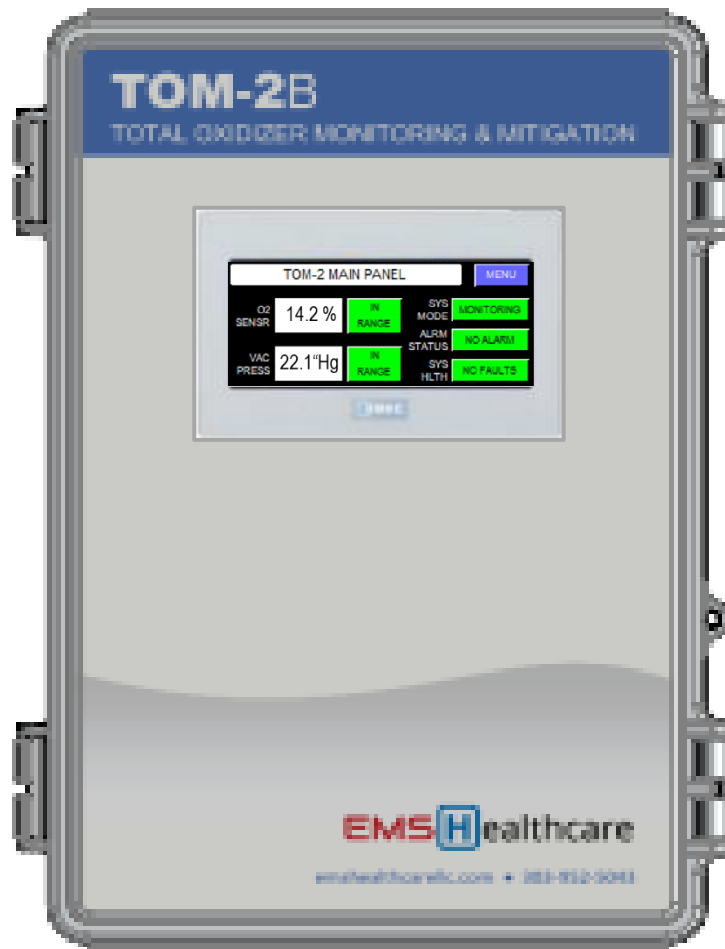


TOM-2 Total Oxidizer Monitor w/Mitigation

Operators Manual

For Part Number TOM-2095B



TOM-2 Operators Manual

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System Overview

With the introduction of NFPA 99 2012 edition came an entirely new requirement for medical-surgical vacuum systems that are also used for Waste Anesthetic Gas Disposal (WAGD). For these combined-use systems, the NFPA now requires the total concentration of oxidizers (oxygen and nitrous oxide) be maintained below 23.6 percent or the materials, lubricants, and sealants within the vacuum pump be inert to these oxidizers for new installations (reference section 5.1.3.8.1.2. (2)). The NFPA 99 2018 edition imposes this requirement on all (existing and new) combined-use vacuum systems and the 2021 edition removes nitrous oxide from the requirement.

The **TOM-2** Total Oxidizer Monitor (patent pending) from EMS Healthcare, LLC is a gas monitoring and mitigation system that's ideal for the continuous regulation of oxygen below the limit of 23.6 percent in combined-use vacuum systems. The heart of the monitoring & mitigation system is a PLC that interfaces to an oxygen sensor, a vacuum transducer, and a control valve. The unit monitors oxygen concentration and vacuum pressure and takes appropriate action based on these input parameters. The PLC will operate a valve plumbed to a regulated gas source (e.g., carbon dioxide or nitrogen) or ambient air to maintain levels below the critical threshold of 23.6%. Maintaining system vacuum pressure is always prioritized over oxygen levels; as long as vacuum pressure remains acceptable, increasing oxygen levels to the vacuum pump inlet will be mitigated.

Model Features

The **TOM-2B** (part number TOM-2095B) performs both oxygen monitoring and mitigation and is recommended for use in both in-patient and out-patient facilities where oxygen concentrations may exceed the NFPA 99 threshold of 23.6%. The TOM-2B continuously monitors and logs total oxygen concentration in order to provide periodic reports for compliance purposes.

The TOM-2B features a zirconium oxide O₂ sensor with a life span of 10 years of continuous operation. Sensor behavior is very stable under nominally changing environmental conditions of temperature, pressure, and humidity. Because of its stability, the sensor requires only periodic testing to verify the sensor remains calibrated for accuracy.

The system also features an alarm output relay that is triggered if the oxygen level exceeds the limit of 23.6 percent. This alarm output can be wired to the master alarm panel if a facility requires this.

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System Specifications

Part Number		TOM-2095B
Description		Oxygen monitoring and mitigation, vacuum pressure monitoring, alarm relay output, data logging
Performance	Response Time	Within 1 second of any change in oxygen levels
	Accuracy	± 0.5% of FS
	Repeatability	± 1% of reading
	Operating Temp	-40° to 122°F (-40° to +50°C)
	Humidity	0 – 98% RH, non-condensing
	Data Logging	Oxygen concentration and Vacuum Pressure readings logged every 10 seconds
	Alarm Output	2-wire dry contact, normally open relay commanded closed during normal operation (opens on alarm of 23.6% O ₂ or loss of power)
Oxygen Monitoring	Range	0 – 95% oxygen concentration
	Sensor Gas Interface	1/2" NPT male threaded connection
	Sensor Electrical Interface	M8 4-pole connector with keyway (5m connectorized cable included with unit)
Vacuum Pressure Monitoring	Range	0 – 30 in Hg, vacuum range
	Sensor Gas Interface	1/4" NPT male threaded connection
	Sensor Electrical Interface	M12 4-pole connector with keyway (5m connectorized cable included with unit)
Gas Mitigation	Gas Type	Carbon dioxide, nitrogen or ambient air (with included muffler)
	Gas Pressure	5 – 10 psig (operating pressure range at valve inlet port)
	Gas Interface	1/2" NPT female threaded connection
	Valve Power	24VDC power is supplied by control unit (5m 3-wire cable included with unit)
Electrical	Voltage Source	110-120 VAC, 60 Hz
	Power (max)	23 Watts including solenoid valve and transducers
Physical (Control Unit)	Dimensions	8" (W) x 12" (H) x 6" (D)
	Weight	10.0 pounds (4.5 kg) including solenoid valve, transducers, and wiring
	Enclosure Type	NEMA 1,2,4,4X rated, polycarbonate, indoor/outdoor use

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System Equipment

When a TOM-2095B is purchased from EMS Healthcare LLC, the following materials are included in the delivered package to support system installation.

Manufacturer	Part Number	Part Description	Qty
EMS Healthcare	TOM-2095-B	Programmed PLC with dry contact alarm relay, 24VDC power supply, 1A circuit breaker, terminal blocks with internal wiring, O2 sensor cable with female M8 screw-on connector, vacuum pressure sensor cable with female M12 screw-on connector, and solenoid valve 3-wire cable with unterminated leads (all cables are 5m length) assembled within a polycarbonate wall mount enclosure.	1
Angst+Pfister	FCX-TR0095	Oxygen concentration sensor with male M8 connector	1
ProSense	PTD25-10-VH	Vacuum pressure sensor with male M12 connector	1
Asco	8210G002-24V	24VDC solenoid valve with ½” NPT female connections and unterminated wire leads	1
various	various	Filter/muffler with ½” NPT male connection	1
various	various	½” PVC or metal LB junction box for solenoid valve	1
various	various	½” close nipple for LB junction box and valve	2
various	various	½” straight to NPT brass adapter for O2 sensor	1
various	various	Wire nuts for solenoid wire terminations	3

In addition to this material list, the installer will need to provide all the necessary tools along with materials specific to the facility where the installation will occur in order to complete the installation. These additional materials are detailed in the System Installation section of this manual.

System Installation

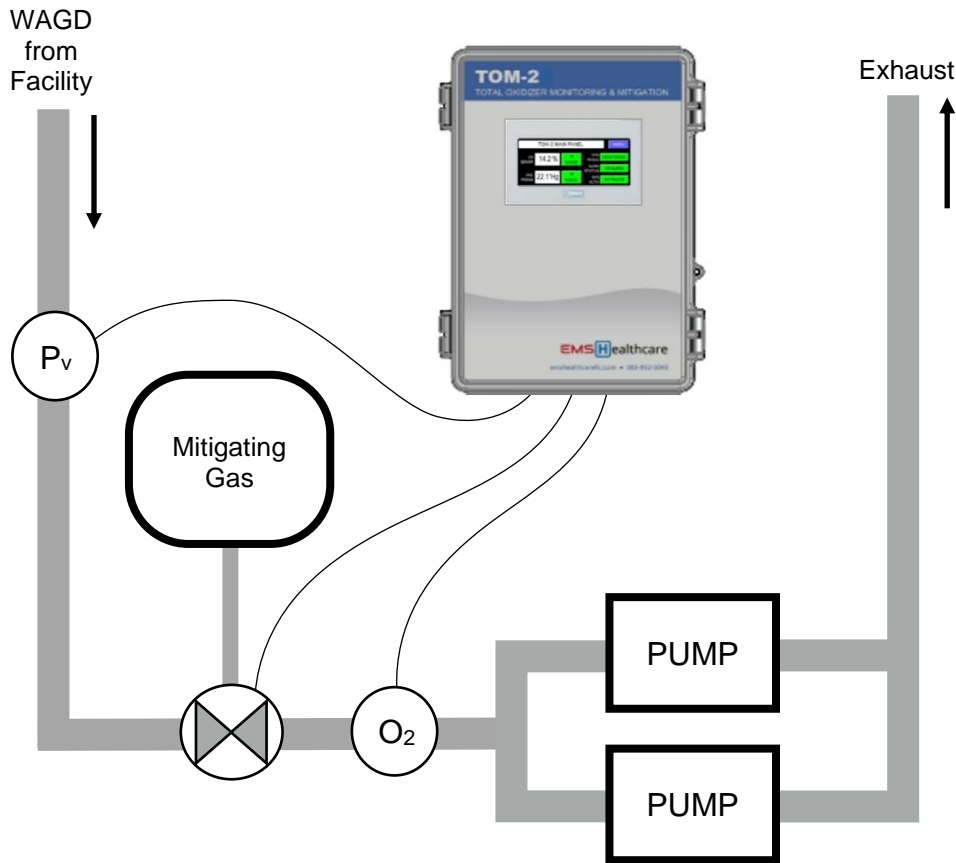
TOM-2 Unit Installation

TOM-2B installation must be performed by a qualified technician trained by EMS Healthcare LLC.

The TOM-2B enclosure should be mounted vertically on or near the vacuum pump skid to allow installation of the sensors and valve into the facility vacuum system as indicated in the diagram below. The enclosure is supplied with 4 metal standoff brackets and screws that attach these to the rear of the enclosure. The installer must provide any additional hardware (e.g. Unistrut or superstrut, mounting hardware, washers, etc.) needed to mount the enclosure to the vacuum pump skid. See Specifications for enclosure dimensions.



ACTUAL INSTALLATION PHOTO



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TOM-2 Sensor and Valve Installation

The TOM-2B unit comes pre-wired with connectorized 5-meter cables for the O₂ sensor and vacuum pressure sensor and a 3-wire 5-meter cable with unterminated leads for the solenoid valve.

NOTE: The installer will need to provide pipe fitting T's, nipples, and/or reducers appropriate to the facility pipe configuration to complete installation of the sensors and valve. Use Teflon tape or equivalent at all piping connections. Secure all wiring using zip-ties and coil/secure any excess wiring near the unit. If there are questions during installation, contact EMS Healthcare at 303-952-5043 for guidance.

CAUTION: ensure electrical power to the TOM-2B is OFF before electrical connections are mated/demated at the sensors and valve.

1. **O₂ Sensor** – The TOM-2B is supplied with an Angst+Pfister FCX-TR0095 O₂ sensor that has 0.5” straight-threaded gas interface and M8 4-pole electrical connector interface. A brass adapter is also supplied to adapt the straight-thread to 0.5” NPT. Install the O₂ sensor in the common inlet piping closest to the vacuum pump inlets so that it can sense gases going into all pumps, including the gas from the mitigation valve. Once the O₂ sensor is installed in the piping system, route the pre-wired O₂ sensor cable with the M8 connector from the TOM-2B unit over to the O₂ sensor and mate the connector to the sensor.



2. **Mitigation Solenoid Valve** – The TOM-2B is supplied with an Asco 8210G002-24VDC solenoid valve with 0.5” NPT gas interfaces for controlling mitigating gas. A brass filter/muffler is also supplied and should be mated to the inlet side of the valve if room air is to be used for mitigating gas. Install the valve in the system upstream of where the O₂ sensor is located so that the O₂ sensor can measure the effects of mitigating gas when the valve is opened. Adequate gas mixing must be assured before vacuum system gases pass by the O₂ sensor. Once the valve is installed in the piping system, route the 3-wire (RED, BLACK, WHITE) unterminated solenoid wires to the valve location. A type-LB conduit body and wire nuts are supplied for completing wiring terminations at the solenoid valve electrical interface. The solenoid valve operates with 24VDC so the RED (V+) and BLACK (V-) wires from the TOM-2B unit should be connected to the RED wires at the solenoid. The WHITE wire from the TOM-2B is a grounding wire and should be connected to the GREEN wire at the solenoid interface.



3. **Vacuum Pressure Sensor** – The TOM-2B is supplied with a ProSense PTD25-10-VH Vacuum Pressure sensor that has 0.25” NPT gas interface and M12 4-pole electrical connector interface. Install the Vacuum Pressure sensor in the common pipe preferably upstream of the solenoid valve so that it can sense patient-side vacuum level effects when the valve is opened. If this is not possible, install the sensor adjacent to the vacuum sensor port that is used to sense vacuum levels by the vacuum pump control panel. Once the sensor is installed in the piping system, route the pre-wired vacuum sensor cable with the M12 connector from the TOM-2B unit over to the sensor location and mate the connector to the sensor.

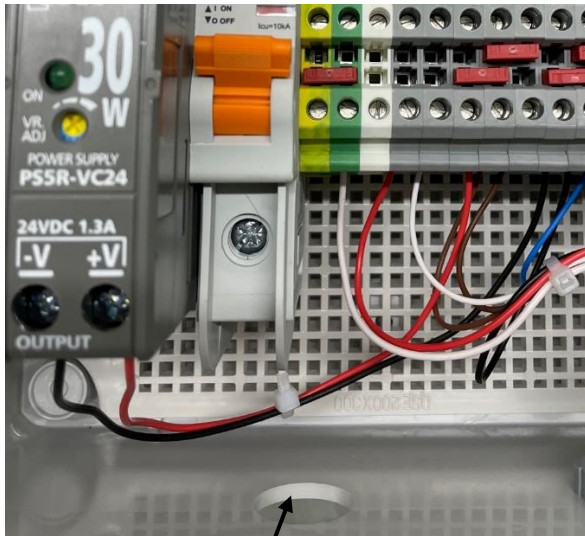


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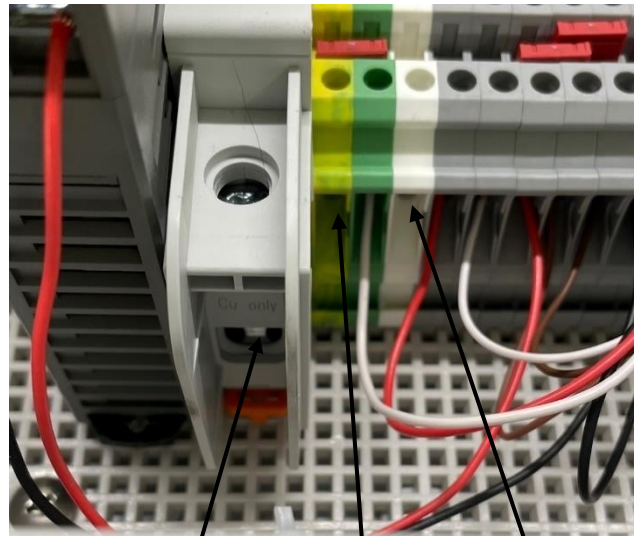
Facility Interface Wiring

Electrical installation must be performed by a qualified electrician.

1. **Power Input** - The TOM-2B requires 110VAC electrical power (2-conductor plus ground) wired into it. The power input connections are to be made at terminal blocks inside the unit enclosure. The installer must provide all necessary wiring to interface this TOM-2B power input with an appropriate power source (typically connected to 1A source in the vacuum pump control panel).



Insert 110VAC armored cable (or equivalent) wiring thru left wiring port

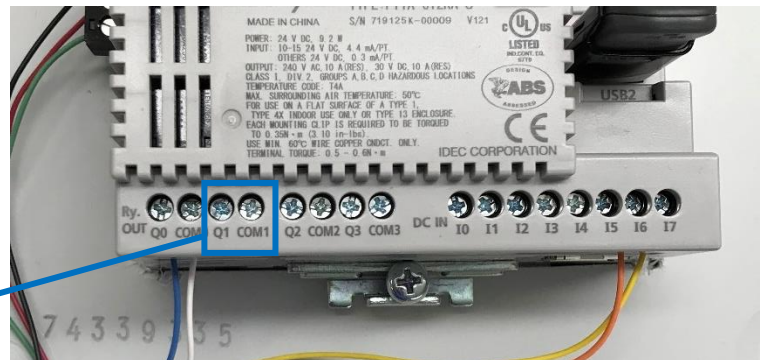


Hot/Black Wire to Circuit Breaker input

Neutral/White Wire to White Terminal

Ground/Green Wire to Green/Yellow Ground Terminal

2. **O2 Alarm Relay Output** – The TOM-2B includes an O2 Alarm relay output (2-wire dry contact, normally open) that can be wired to the facility master alarm panel. This relay output is commanded closed for normal operation and will open when an O2 Alarm is indicated (23.6% O2 is exceeded) or when a loss of 110VAC power to the unit occurs. See below for where these connections can be found within the TOM-2B enclosure. The installer must provide all necessary wiring to interface this TOM-2B alarm output with the facility’s master alarm panel.



Q1 and COM1 are the O2 Alarm relay output

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Mitigating Gas

The mitigation of high oxygen levels can be implemented with ambient air, carbon dioxide gas, or nitrogen gas.

For in-patient facilities, the combined WAGD systems typically have large system volumes such that, when oxygen is introduced into the system, its contribution to the overall percentage of gases is small and easily mitigated by dilution in the total system volume or by introduction of a small amount of mitigating gas. Therefore, ambient air is suggested as the initial mitigating gas for these in-patient facilities. The TOM-2B comes equipped with an air inlet filter/muffler on the solenoid valve for installations where ambient air will be used. After installation, if the system shows recurring O₂ alarms with ambient air mitigation, carbon dioxide or nitrogen may be required as a mitigating gas.

For out-patient facilities and surgery centers, the rise rate and peak level of oxygen concentration in the system during facility use can be much higher than what is seen in an in-patient facility due to smaller system volumes. Therefore, it is suggested that these facilities use carbon dioxide or nitrogen as a mitigating gas to more rapidly respond to increasing oxygen levels detected by the TOM-2B. See the Specifications page for gas connection sizing and acceptable pressure input levels if carbon dioxide or nitrogen gas will be used.

The mitigating gas valve should be installed at a point where all vacuum system input is consolidated to one line upstream of the vacuum pumps. Larger valve sizes (3/4" and 1") are available if the vacuum pump system requires higher flow.

Initial Power Application

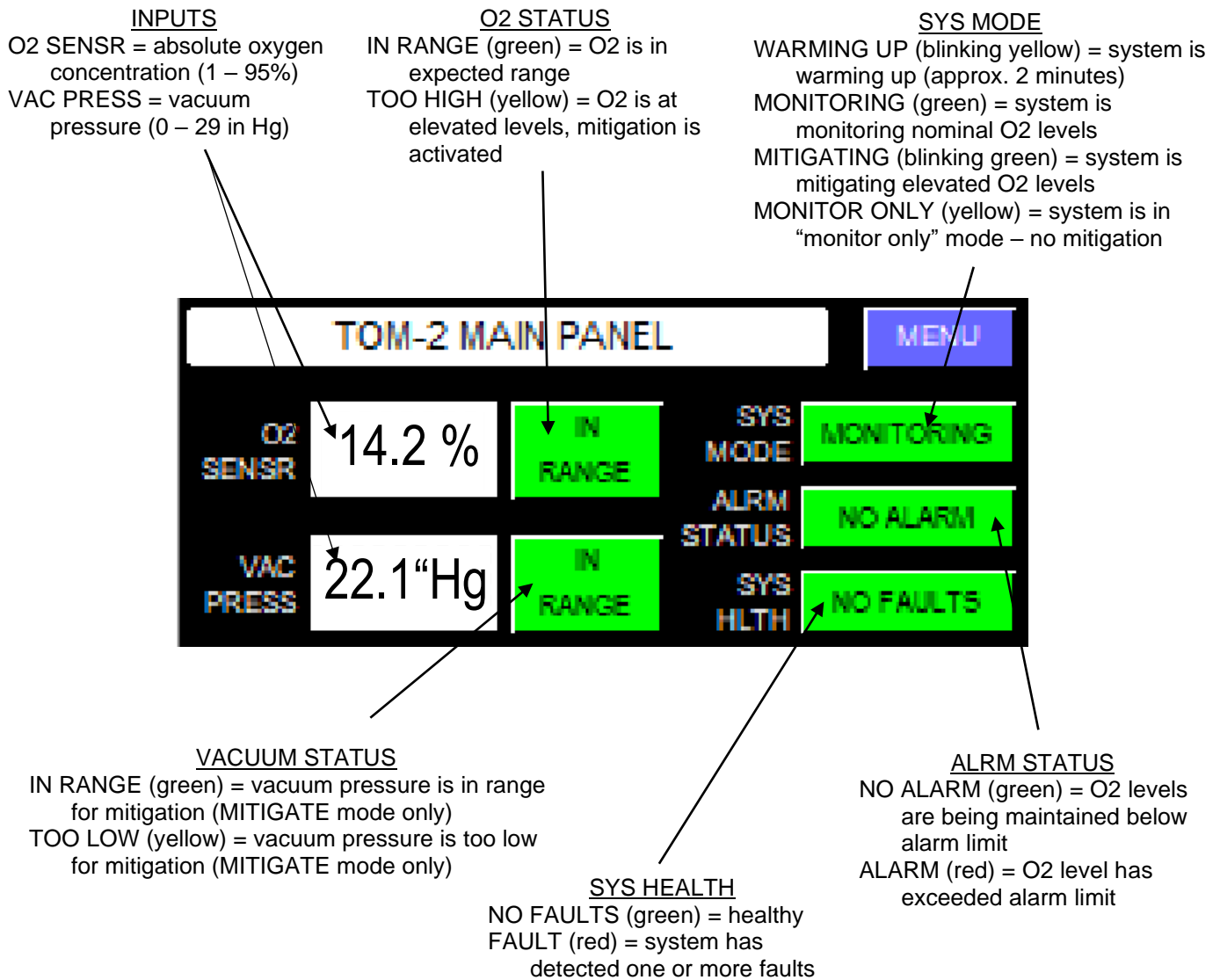
On initial application of 110VAC power following system installation, the system will power up with initial settings entered from the factory. The touch screen on the front cover of the unit will power on and show the TOM-2B MAIN PANEL. Verify that the following steps occur automatically:

1. Initial System Mode indicates "WARMING UP" and then transitions to "MONITORING" after about 2 minutes.
2. Once System Mode indicates "MONITORING", O₂% and Vacuum Pressure readings are displayed.

Once the unit is operational, the installer should baseline the O₂ sensor concentration for the facility location and altitude. This is done by exposing the sensor to ambient air for at least 2 minutes and recording the concentration reading. This baseline reading can then be used to ensure the O₂ sensor is not drifting during annual maintenance checks. Refer to "Periodic Sensor Calibration" under the **System Maintenance** section in this manual for the calibration process.

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TOM-2B MAIN Screen

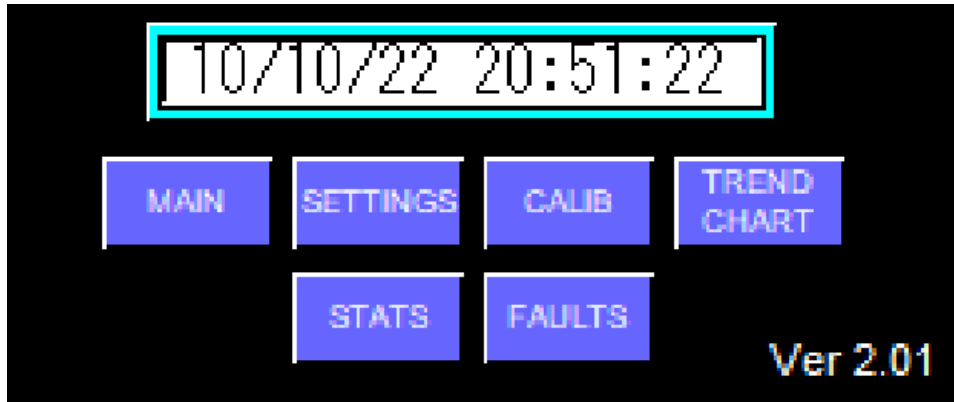


System Operation

System Configuration

The TOM-2B provides a touch screen display interface that allows the user to monitor system operations and adjust configuration settings as needed. The MAIN screen (as shown above) allows access to Settings, Calibrations, real-time data trending, system statistics, and system faults by pressing MENU on the display. The MENU screen (shown below) also displays the date/time and the software version loaded into the PLC.

MENU Screen



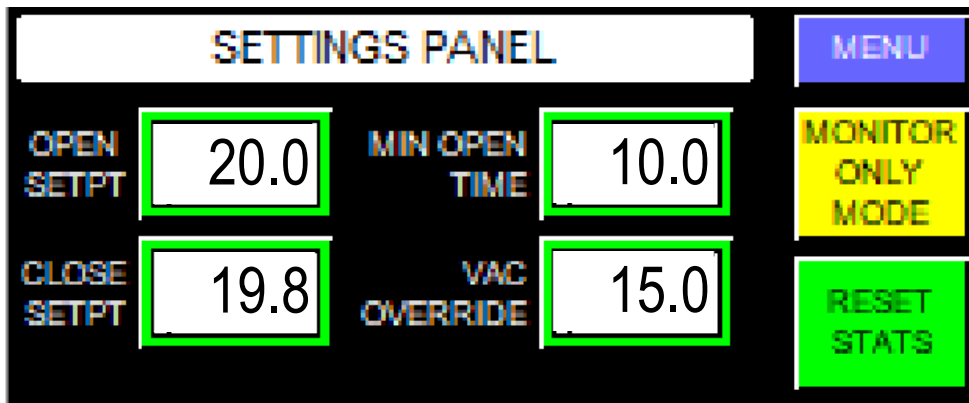
Settings

Access to this screen is password protected to prevent unauthorized personnel from changing system settings after initial system installation.

The Settings screen (below) enables the operator to modify settings for the mitigation solenoid valve operation setpoints and vacuum override as well as change the TOM-2B mode (monitor only or mitigate) and reset system statistics.

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SETTINGS Screen



1. Limits – This section describes the limits and recommended settings based on the type of facility the unit is installed in. All settings will remain active even after a power reset.
 - a. O2 Monitoring
 - i. The TOM-2B continuously monitors O2% levels against the alarm limit thresholds.
 1. O2% - This measurement shows instantaneous O2 concentration values and is used by the PLC to determine when mitigation is required. This measurement is shown on the MAIN screen and on the TREND CHART screen. Min/max values can be found on the STATS screen.
 2. O2% Filtered – This measurement is generated by averaging O2% values over a 60 second period and is used to determine when to trigger the O2 alarm. This measurement is shown on the TREND CHART screen and min/max values can be found on the STATS screen.
 - ii. If the system detects an O2% above the O2 Alarm limit for a sustained period of time (O2% Filtered), the system will open the O2 Alarm relay, sending an indication to the Master alarm panel if this relay output is wired to the facility panel. If this situation occurs, the facility should develop a procedure to physically monitor the vacuum system pumps, inspect the O2% reading on the TOM-2B and, if the reading is below the O2 alarm limit of 23.6%, reset the O2 alarm. Then contact the TOM-2B installation agency for further evaluation of the system to understand the cause and determine whether TOM-2B setting adjustments are required.
 - b. O2 Mitigation settings (Mitigation mode only)
 - i. O2 Mitigation is only enabled when vacuum system pressure is above the Vacuum Override limit (factory default setting is 15.0 in Hg). The operator can adjust mitigation valve Open Setpoint, Close Setpoint, and Min Open Time settings based on facility vacuum system design. These settings should be adjusted to provide sufficient time for the mitigation process to affect the oxygen levels and avoid an O2 alarm situation. The factory default settings have been evaluated under test and should be acceptable for use in most facilities.

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- ii. The initial Open Time is set at 10 seconds. This setting can be modified by touching the value window (a pop-up window will appear to adjust the value; once a new value is input, press ENTER).
 - iii. Initial Open Setpoint is 20.0% O₂ concentration and can be adjusted by operator. This setting can be modified by touching the value window (a pop-up window will appear to adjust the value; once a new value is input, press ENTER).
 - iv. Initial Close Setpoint is 19.8% O₂ concentration and can be adjusted by the operator. This setting can be modified by touching the value window (a pop-up window will appear to adjust the value; once a new value is input, press ENTER).
 - v. Mitigation operation - when the Open Setpoint is exceeded (O₂% value is higher than setpoint), System Mode on the MAIN screen will indicate MITIGATING in blinking green; otherwise, it displays MONITORING in solid green.
 - 1. Solenoid valve output is activated for a time period specified by the Open Time setting.
 - 2. Once the Open Time expires and the O₂% is confirmed to be below the Close Setpoint, the valve is closed.
 - 3. If O₂% level remains above the Open Setpoint after the Open Time expires, the valve will remain open until the O₂% level drops below the Close Setpoint.
 - 4. If vacuum pressure level falls below the minimum vacuum level setting when O₂ mitigation is active, the solenoid valve output will be immediately deactivated and remain deactivated until vacuum level rises above the minimum limit (plus 0.5 in Hg for valve on/off hysteresis).
- c. Vacuum Override setting (Mitigation mode only)
- i. Vacuum Override is used internally by the O₂ mitigation algorithm in order to prioritize vacuum system pressure over O₂ mitigation. If the vacuum system pressure falls below this minimum pressure limit, all O₂ mitigation activity will be disabled until vacuum pressure returns to a value above the minimum limit. There is no alarm output from the device for this indication because the vacuum system controller already has such an alarm.
 - ii. Initial value for the alarm is 15.0 in Hg and can be adjusted by the operator. This setting can be modified by touching the value window (a pop-up window will appear to adjust the value; once a new value is input, press ENTER).
 - iii. When the vacuum override setting is exceeded (pressure falls BELOW the limit), System Mode on the MAIN screen will display MONITORING; otherwise, it displays MITIGATING in blinking green when mitigation is active and vacuum pressure is within limits.
2. Monitor/Mitigate Mode - The system operates in monitor only or mitigation modes. The Settings screen shows Monitor Only Mode or Mitigate Mode depending on the setting.
- a. Press MONITOR ONLY MODE to change setting to MITIGATE MODE; likewise, press Mitigate Mode to change back to Monitor Only Mode. The selected setting will remain active even after a power reset.
 - b. In MONITOR ONLY MODE, the system continuously monitors oxygen levels and provides O₂ alarm indications. In this mode, only the O₂ sensor input is required.

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- c. In MITIGATE MODE, the system monitors oxygen and vacuum pressure levels and mitigates elevated O2 levels by opening a mitigating gas valve. In this mode, the O2 sensor input, vacuum pressure input, and solenoid valve output are required. Once selected, MITIGATE MODE will remain selected even after a power reset.
3. Reset Statistics – The system generates statistical operating data which is displayed on the STATS screen. Press the RESET STATS button to clear all existing statistics from memory and begin generating new data.
 - a. This button should only be pressed when the operator knows existing statistics contain data generated during events NOT representative of normal facility operations, like initial system installation and checkout, or power interruption, or sensor calibration.

CAUTION: once RESET STATS is pressed, all existing statistical data is erased and can no longer be retrieved

Sensor Calibration

Access to this screen is password protected to prevent unauthorized personnel from changing system settings after initial system installation.

The Calibration screen (below) enables the operator to add/modify value offsets for the O2 sensor and the Vacuum pressure sensor.

CALIBRATION Screen

The screenshot shows a black background with a white title bar at the top left that reads "CALIBRATION PANEL" and a blue "MENU" button at the top right. Below the title bar, there are four data fields arranged in a 2x2 grid. The top row contains "O2 SENSOR" with a value of "14.2" and "VAC PRESS" with a value of "22.1". The bottom row contains "O2 OFFSET INPUT" with a value of "0.0" and "VAC OFFSET INPUT" with a value of "0.0". The "0.0" values in the bottom row are enclosed in a bright green rectangular border.

1. O2 Sensor Offset Input
This field allows for O2 sensor reading adjustment as part of regular TOM-2B system maintenance. Adjustment should only be performed by qualified personnel trained by EMS Healthcare LLC.
 - a. O2 sensor OFFSET can be adjusted up/down from default of 0.0

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2. Vacuum Pressure Offset Input

This field allows for vacuum pressure sensor adjustment as part of regular TOM-2B system maintenance. Adjustment should only be performed by qualified personnel trained by EMS Healthcare LLC.

- a. Vacuum pressure sensor OFFSET can be adjusted up/down from default of 0.0

Statistics

The Statistics screen (below) enables the operator to review system statistics that are generated during nominal facility operations.

STATS Screen

STATS PANEL			MENU
	O2%	O2% FLTR	VAC PRES
MIN	3.5%	6.2%	15.3"Hg
MAX	21.2%	20.6%	26.5"Hg
MITIGATION CYCLES		15	O2 AMB MAX 16.1%
			O2 RATE MAX 1.2%/sec

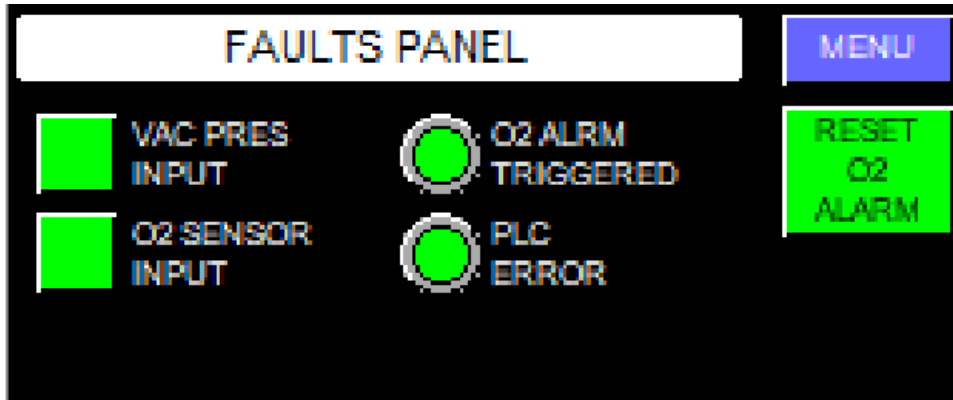
1. O2% Minimum and Maximum readings – these values represent the lowest and highest system readings for O2% values since the system was started or the STATS RESET button was last pressed.
2. O2% Filtered Minimum and Maximum readings – these values represent the lowest and highest system readings for O2% filtered values since the system was started or the STATS RESET button was last pressed.
3. Vacuum Pressure Minimum and Maximum readings – these values represent the lowest and highest readings for Vacuum Pressure values since the system was started or the STATS RESET button was last pressed.
4. O2% Ambient Maximum – this value represents the highest reading for O2% generated during the three hours from midnight to 3am. For a surgery center, O2% Ambient Maximum represents the highest level of ambient O2 levels in the vacuum system when the facility is not being used for patient procedures. This value is currently not used by the mitigation algorithm and is only collected for facility diagnostics.
5. O2% Rate Maximum – this value represents the highest increasing rate of O2% that the system detected. This value is currently not used by the mitigation algorithm and is only collected for facility diagnostics.

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Faults

The Faults screen (below) enables the operator to evaluate system faults and alarms that are generated during facility operations.

FAULTS Screen



1. **Vacuum Pressure Input** – this indicator is GREEN as long as the sensor and interfacing cabling is healthy. If the PLC detects an issue with the sensor or cabling, this indicator will change to RED. If the indicator is RED, press the RED square to see the status word for this fault. If the indicator is RED, use of the mitigation valve is disabled until the indicator is restored to GREEN.

Status	Description	Analog Input Value
0	Operating normally	Current analog input value
1	Converting data	Undefined value
2	Initializing	0
3	Parameter setting error	Correct value before the error occurred
4	Reserved	-
5	Wiring fault (out of max range)	Maximum value
6	Wiring fault (out of min range)	Minimum value

2. **O2 Sensor Input** – this indicator is GREEN as long as the sensor and interfacing cabling is healthy. If the PLC detects an issue with the sensor or cabling, this indicator will change to RED. If the indicator is RED, press the RED square to see the status word for this fault. If the indicator is RED, use of the mitigation valve is disabled until the indicator is restored to GREEN.

Status	Description	Analog Input Value
0	Operating normally	Current analog input value
1	Converting data	Undefined value
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3	Parameter setting error	Correct value before the error occurred
4	Reserved	-
5	Wiring fault (out of max range)	Maximum value
6	Wiring fault (out of min range)	Minimum value

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3. O2 Alarm Triggered

- a. The O2 alarm limit is set at 23.6% as dictated by NFPA 99 and cannot be adjusted by the operator.
- b. When the alarm limit is exceeded with persistence (value is higher than limit for a sustained period of time), ALARM in red is set on the MAIN screen and O2 ALRM TRIGGERED will change from green to red on the FAULTS screen.
- c. When O2 ALRM TRIGGERED is indicated, the O2 Alarm relay output will remain latched ON (relay is open) until the operator resets it.

4. PLC Error

- a. This error indicates that invalid data was found during program execution in the PLC. If this error occurs, contact the installation agency for further troubleshooting.

5. Reset O2 Alarm

- a. To reset the O2 Alarm, first ensure O2% is reading below 23.6%. If O2% is reading nominally, then press RESET O2 ALARM. Then press MENU and select MAIN to return to the main screen and verify that the ALARM STATUS indicator now shows NO ALARM in green.

Data Trend

From the MAIN screen, press MENU and then press TREND CHART to view O2% for the system in a graphical plot. The screen will show a graph of O2%, O2% Filtered, and Vacuum Pressure data from the data log. After 60 seconds, the screen will revert back to the MAIN screen automatically. The operator can scroll through previous data using the arrows provided.

Data Logging

The TOM-2B system utilizes a real-time logging function that writes data directly to an attached thumb drive (provided with the unit) containing sufficient memory to record more than one year's worth of data. O2 level, Vacuum Pressure level, O2 Filtered, and System Mode data are logged every ten (10) seconds to provide a time history of the TOM-2B operation for review.

The data stored in the thumb drive can be reviewed by removing the thumb drive from the unit, inserting the drive into the USB port of a laptop computer, and importing the data as a CSV file into a spreadsheet application. Some manipulation of the data may be required.

The TOM-2B produces two separate data logging files: LOGA1 and LOGA2. The LOGA1 file contains O2 level, Vacuum Pressure level, O2 Filtered, and System Mode data. The LOGA2 file contains the mitigation valve relay output data (0 = closed, 1 = open).

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LOGA01 Data Table - Example

Sampling Time	O2 Lvl	Vac Lvl	O2 Filt	Sys Mode
06/23/2022 13:16:21	168	204	172	1
06/23/2022 13:16:31	158	212	163	1
06/23/2022 13:16:41	149	218	152	1

All O2 and Vacuum Pressure readings have an implied decimal point 1 digit from the right. In the above example, an O2 level of 168 is 16.8%. Similarly, the vacuum pressure level of 204 is 20.4 “Hg. The System Mode values are interpreted as follows:

- 0 = WARMING UP
- 1 = MONITORING
- 2 = MITIGATING
- 3 = MONITOR ONLY

LOGA02 Data Table - Example

Sampling Time	Outputs
06/23/2022 13:16:21	2
06/23/2022 13:16:31	2
06/23/2022 13:16:41	2

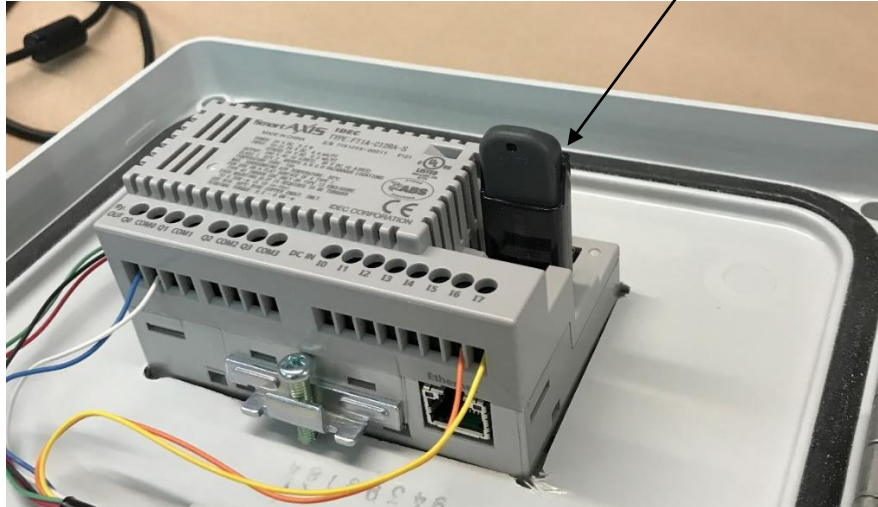
Under normal conditions, a value of “2” is expected for Outputs (see table below for interpreting this value). During elevated O2 conditions, a value of “3” is expected if mitigation demand is sufficient for the elevated levels of O2. If mitigation cannot keep up with the elevated O2 levels, then a value of “1” may be recorded if the O2 level exceeds the alarm limit.

Since the O2 Alarm relay is latched, once it is set it will remain set. Therefore, once normal conditions return, a value of “0” will be recorded instead of “2” until the O2 Alarm is manually reset (see “O2 Alarm Reset”)

Outputs Value	TOM-2 State	Not Applicable (Relay 3)	Not Applicable (Relay 2)	O2 Alarm (Relay 1)	Mitigation Valve (Relay 0)
3	Elevated O2 levels, mitigation is active	0	0	1	1
2	Normal O2 levels, mitigation is not active	0	0	1	0
1	Alarm limit exceeded, O2 level is back to normal, mitigation remains active	0	0	0	1
0	Alarm limit exceeded, O2 level is back to normal, mitigation is not active	0	0	0	0

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Thumb drive



System Maintenance

Annual Compliance Reporting

EMS Healthcare recommends downloading the time history log from the thumb drive on an annual basis to provide the facility a report of oxygen concentration compliance to the NFPA 99 requirement.

Periodic Sensor Check

EMS Healthcare recommends checking the O₂ sensor on an annual basis to verify sensor accuracy. This check can be conducted during the same visit when the time history log is downloaded from the unit.

To check the O₂ sensor, remove the sensor from the vacuum system by unscrewing the sensor from its port.

CAUTION: do NOT unplug the sensor cable unless power to the unit has been shut off first

Leave the sensor in ambient air for at least 2 minutes and then verify the O₂% is reading the same as the baseline reading taken at initial system startup (refer to Initial Power Application under System Installation). If the sensor is not at this value, adjust the O₂ sensor offset value (refer to O₂ Sensor Calibration under System Operation) to re-calibrate it.

Once the O₂ sensor has been verified, it should be re-installed into the sensor port.

O₂ Concentration at Vacuum Pressure

The O₂ sensor is designed to measure O₂ concentrations relative to sea-level ambient pressure of 14.7 psia. When exposed to lower pressures due to vacuum conditions, the sensor will count fewer O₂ molecules and produce an O₂ concentration relative to sea-level pressure. While the fractional oxygen content in the local ambient gas remains relatively constant (e.g., 20.9% relative to other gases in the local ambient air), the O₂ concentration being reported by the sensor will decrease at ambient pressures lower than sea-level and increase at ambient pressures higher than sea-level as it measures absolute oxygen molecule content relative to sea-level.

Password Screen

To enter the password, use the arrow keys to move the cursor to the alpha-numeric character and then press “enter” to add the character to the sequence. Do this to enter every character in the sequence. Once the password has been entered, move the cursor to the “OK” key and press “enter” to accept the password. Once the password has been accepted, all screens that require the password will be open to the operator. After 10 minutes of inactivity on the PLC, the password-protected screens will require the password to be re-entered.

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Schematic Diagram

TOM-2B SCHEMATIC

