ROBD2

Reduced Oxygen Breathing Device 2

Programming and Technical Guide

Maintenance Manual

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ROBD2 Programming and Technical Guide changes

Manual Revision #	Software Revision #	Manual Release Date	Enhancements
1	0.96-XX	02/08/06	Initial release
2	0.96-XX	02/09/06	Minor changes for typographical errors
3	0.96-XX	1/02/07	New pulse oximeter power supply. Changes to appendices A3, B1, B9, D, E
4	0.97-XX	5/10/10	Added new flight simulator remote mode commands

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LIST OF ABBREVIATIONS / ACRONYMS

AC	Alternating Current
EMI	Electromagnetic Interference
FSO	Full Scale Operation
FNPT	Female National Pipe Thread
HZ	Hertz
LCD	Liquid Crystal Display
LPM	Liters Per Minute
MFC	Mass Flow Controller
NAG	Nitrogen and Air Generator
P&ID	Piping and Instrument Diagram
PWM	Pulse Width Modulation
PSIG	Pounds Per Square Inch Gauge
RFI	Radio Frequency Interference
STP	Standard temperature and pressure
SUT	Subject Under Test
VAC	Volts, Alternating Current
VDC	Volts, Direct Current

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OVERVIEW

Congratulations on your purchase of the second generation Environics' reduced oxygen breathing device ROBD2.

This manual includes information on using the restricted modes of the instrument, programming the ROBD2, communicating remotely via the RS232 port, troubleshooting, parts lists and diagrams. For information on how to run subjects on the instrument for hypoxia testing and operating the pulse oximeter, refer to the operator's guide.

There are two levels of visible menus on the front panel display. The instrument always powers up into the default OPERATORS menu. This menu is limited to the functions of running programs on subjects and prevents access to programming steps, making changes to existing programs and other modes where system configuration can be changed. The second menu is the ADMIN menu for administrator access. This mode includes all the functionality of the operators menu but does not limit access for programming and other functions. The ADMIN mode is password protected.

The program mode is considered an administrator function and is therefore password protected. This prevents the operator from changing the program and potentially putting the subject under test at risk of becoming hypoxic prematurely or being exposed to levels of O_2 below those planned for the profile setup to run for particular individuals.

The remote communication protocol (RS232) allows the ROBD2 to run remotely from a host computer. The operation of the ROBD2 can be controlled as part of an overall process/program consisting of multiple tasks. For example, the ROBD2 could be run along with a flight simulator, the functions of both being controlled by a program on the host computer.

The flexibility of the ROBD2 allows it to run independent of a computer. Its basic menu driven display allows for simple navigation of the modes on a 4 line by 20 character display. All user entered program information is retained in the system by battery backup. Also, all the user settings of the integrated pulse oximeter are backed up.

Before reading this manual, Environics recommends reading the operator's guide and having a complete understanding of how to operate the unit, even if it is done so without a subject under test. This allows non qualified operators to run and understand the unit.

IMPORTANT: The ROBD2 operator should be certified in first-aid and CPR and have access to communication in the event of an emergency.

Prior to participation in ROBD2 training or research, the subject under test should have the equivalent to a FAA physical of any class or military flight physical and be screened for current health status prior to the run.

IMPORTANT: For the most part, the ROBD2 is fairly maintenance free. Other than some yearly maintenance and calibration, the system should run trouble free for the full period in between. If some type of failure does occur, and parts or assemblies need to be replaced, it is important to note that all of the components that come in contact with 100% oxygen have been cleaned for oxygen service or built as oxygen compatible parts. The goal is to prevent any contamination, including the oils on the skin, from getting onto the wetted surfaces of the gas path. Use some type of rubber or cloth gloves when working on these components. This is for the protection of the operator, subject under test and anyone else in close vicinity to the unit.

THEORY OF OPERATION

System layout

Listed below are the major components of the system. Refer to the top view illustration showing each numbered part. Also, refer to the P&ID at the end of this document.

1. PC401/PC412-ROBD2 assembly number A194. The PC401 (1a) is the main micro-controller board and the PC412-ROBD2 is the analog interface board for the analog devices such as the MFCs, pressure transducer and oxygen sensor. For a parts breakdown of this assembly, refer to appendix A.

2. The breathing bag port. The breathing bag is removed for shipping. This bag allows blended gas to collect and be used for individuals with larger than average lung capacity and breath rate.

3. Part number E615-6103, RS232 interface ribbon cable. This cable interconnects the main micro-controller board PC401 to the rear panel RS232 port and to the pulse oximeter PC board on front panel assembly A214 (item # 8). For a detailed illustration drawing of this cable, refer to appendix B.

4. Rear panel assembly number A215. For a parts breakdown of this assembly, refer to appendix A. Referring to the P&ID, parts labeled PS1, FIL-1 and FIL-2 are part of the A215 assembly.

5. Pulse oximeter power supply part number A205. Connects to front panel mounted pulse oximeter via electrical cable E628.

6. Optional pressure control valve assembly number A211. This valve is labeled NV1 in the P&ID

7. Electrical terminal block assembly A206. This terminal block is used to distribute alike voltage signals +24 VDC and Ground to multiple sources.

8. Front panel assembly number A214.

9. Optional bypass valve number A210. This item as well as item # 6 make up the option to control pressure in the FSHT, OSFT and PPT modes of operation. For basic hypoxia training, as with the HRT mode of operation, these parts are not used. This valve is labeled V2 in the P&ID.

10. Crossover valve number A209. This valve is used to direct air to the MFC normally running Nitrogen. Certain steps of a program and other operating modes in the system require both MFCs to run with air. This valve is labeled V3 in the P&ID.

11. Air mass flow controller MFC1, part number MAB1-005-25000.

12. Mask particle filter part number A221. This filter prevents particles from getting up into the breathing mask. This part is labeled FIL-3 in the P&ID.

13. Oxygen dump valve part number A208. This valve interrupts the flow of mixed gas, when the O_2 dump valve is activated, and provides 100% oxygen to the mask. This part is labeled V1 on the P&ID.

14. Input particle filter number VA-FIL-004. The air port and N2 port are filtered to prevent any particles from entering the system. These parts are labeled FIL-1 and FIL-2 on the P&ID.

15. Nitrogen mass flow controller MFC2, part number MAB1-005-77000.

16. Back pressure regulator assembly A212. This regulator provides stability on the outputs of the MFCs to prevent the pressure fluctuations, of breathing off the mask, from affecting the controlled flow rates. This regulator also serves to control the pressure on the oxygen sensor filtered orifice, to accurately control 150 SCCM of flow into the sensor. This part is labeled BPR1 on the P&ID.

17. Data interface cable, part number E609-ROBD2. This flat ribbon cable carries data to and from the PC401 microcomputer board, the PC406 display board, the PC412-ROBD2 analog interface board and the PC416 solenoid driver I/O board. Refer to appendix B for details of this cable.

18. Oxygen interface PCB, part number SK10-001-PCB, This board conditions the signal from the oxygen sensor, linearizes it and converts it to a voltage scale which is sent to the PC412-ROBD2 analog interface board. A calibration curve is then applied by the software in the system and the result is displayed as an oxygen percentage in various operating modes of the system.

19. Power cable, part number E613-ROBD2. This cable carries the DC voltage power from the system power supply, item 23, to the analog interface board, PC412-ROBD2. A large power resistor has been added to the side panel to ensure proper loading requirements on the power supply to get well regulated voltages.

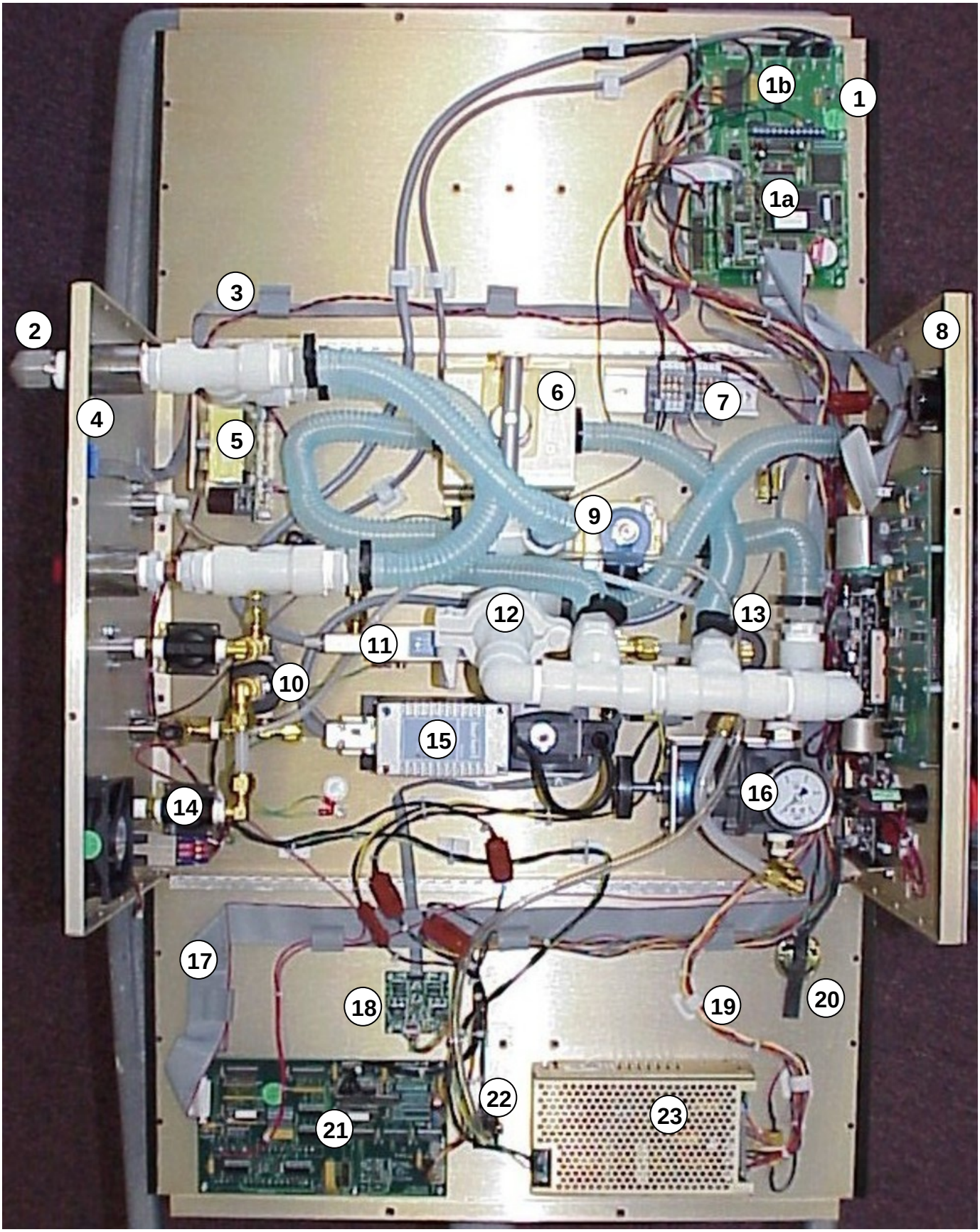
20. Pulse oximeter speaker, part number AK01-002. This speaker sounds the pulse oximeter alarm features which are configurable from the pulse oximeter key controls on the front panel of the system. The pulse tone and alarms are separately configurable; see the operator’s manual for more details.

21. Solenoid valve driver and I/O board, part number PC416. This board interfaces with the oxygen dump switch, the low oxygen pressure switch on the oxygen port and the solenoid valves used to isolate and direct the gas flow. This board also powers the fan and has additional I/O for future expansion and options.

22. Breathing loop pressure transducer, part number A215. This sensor monitors the pressure of the gas in the breathing loop which is displayed in various operating modes. This part is labeled PX1 on the P&ID.

23. System power supply, part number PJ02-14-004. This quad output power supply generates the +5 VDC, +/- 15 VDC and 24 VDC voltages necessary to power all the electrical components in the system.

Instrument illustration drawing



Functional description

Gas inputs

There are three gas inputs on the rear panel of the ROBD2. On the standard instrument, without the hose and regulator option, these inputs are ¼" FNPT.

Environics offers a hose and regulator option. With this option, each gas input has a keyed and colored quick connect fitting both on the back of the instrument and on each gas regulator. The Oxygen port (green) requires 20 PSIG input pressure. The Nitrogen port (black) requires 40 PSIG input pressure. The Air port (yellow) requires 40 PSIG input pressure. These pressures are the same without the hose and regulator option. The gas lines, provided as part of this option, are ten foot 316 stainless steel flexible braided hoses. The pressure regulators provided are dual stage and have the CGA connectors for breathing air (CGA 346), medical grade nitrogen (CGA 580) and medical grade oxygen (CGA 540). When ordering the option, specify HOSE-REG-OPT. To order 20 foot hoses, specify HOSE-REG-OPT-20

Gas flow and blending **(refer to P&ID at the end of this document)**

Through the rear panel, pressurized air and nitrogen enter each respective port and flow into individual particle filters. These filters remove any condensate and particles larger than .0002". The individual gases then flow through thermal mass flow controller one (MFC1 for air) and two (MFC2 for nitrogen). Dependent upon the programmed altitude, the system will produce the correct ratio of air to nitrogen flow to produce the correct sea level equivalent oxygen content for that altitude, refer to appendix H. As the programmed altitude increases, the volume of gas delivered to the mask will increase. This increase in flow is in response to increased lung capacity and breaths per minute as the subject under test is deprived of oxygen; reference appendix H.

The gas exits each MFC and mixes in the zone between the outputs of the MFCs and the input to the back pressure regulator (BPR1). BPR1 serves two purposes. The primary function is to control the pressure to the oxygen sensor fixed orifice. At 5 PSIG, the orifice controls the flow to approximately 150 SCCM into the oxygen sensor at all times, regardless of the total flow delivered to the breathing loop. The second purpose of the BPR1 is to control the pressure differential across the MFCs, which buffers the MFCs from the pressure disturbances of the inspiratory and expiratory cycle of the subject under test. Pressure gauge G1 reads the pressure upstream of BPR1 and should always read 5 PSIG. This pressure regulator and pressure gauge are located inside the system. Adjustments to this regulator are rarely needed. The pressure gauge is mainly there for setup, troubleshooting and verification purposes. All gas connections exiting the back pressure regulator are considered to be part of the breathing loop. All of the components in the breathing loop are in direct pneumatic connection with the output port that connects to the pilots mask. Note, the breathing loop is highlighted in red on the attached P&ID.

Solenoid valve V3, on the input of MFC2, allows certain operating modes to use both MFCs with air only. For instance, the PPT mode provides 95 LPM air to the mask at a pressure of 10" H_2O. Since this cannot be accomplished with one MFC, both are used together to provide the high flow rate of air. Also, whenever a sea level (zero altitude) step is used in a program, both MFCs are used with air.

Solenoid valve V1 is used to direct either the mix of gases, produced by the MFCs, or 100% oxygen to the breathing loop and breathing mask. 100% O_2 is used for the calibration of the O_2 sensor and when the O_2 dump switch is activated. 100% O_2 is also sent to the mask when certain safety features are violated; see safety features below. This valve is also referred to as the oxygen dump valve.

The oxygen pressure switch (PS1), on the input of the oxygen port, is used to detect low O_2 tank pressure; see safety features below.

The breathing loop pressure port, on the rear panel of the system, can be used to connect a mechanical pressure gauge or pressure transducer for monitoring breathing loop pressure. This port will normally be plugged when the system is operating and has mainly been installed for troubleshooting and verification purposes. The system has a built In breathing loop pressure transducer. If the plug is not installed during normal operation, then the positive pressure option will not function correctly.

The standard system has been designed to work with a sealed breathing mask. This means that the flow of gas cannot be sent directly to the mask without venting some portion of that flow. The venting portion of the plumbing path allows the breathing loop pressure to remain close to 0" H_2O during basic hypoxia recognition testing or training (HRT mode). This is accomplished by building up enough pressure internally to inflate the breathing bag. The breathing bag acts as a reserve to accommodate those with larger lung capacities or someone breathing at a higher rate than normal. Once the breathing bag inflates, the excess flow is driven out of the vent port on the rear panel of the system. The inflation of the breathing bag is dependent upon the subject under test having the mask secured to the face.

Check valve CHV1 prevents the breathing loop from ever exceeding 1 PSIG (27" H20).

Positive pressure option

Needle valve adjustment NV1 allows each individual system to be setup to produce the positive pressure breathing requirements of the FSHT (Flight Simulator Hypoxia Training), OSFT (Oxygen System Failure Training) and PPT (Positive Pressure Training) modes of the system; see appendix F. These modes are primarily used for training US NAVY fighter pilots.

The pressures generated are consistent with those produced in the pilot's mask at high altitudes. At a high enough altitude, the partial pressure of the ambient oxygen is insufficient to drive oxygen into the bloodstream from the lungs even if the pilot is breathing 100% oxygen. The application of positive pressure is supplemental to help drive the oxygen from the lungs at high altitudes.

Bypass valve V2 closes for the positive pressure requirements of these modes and opens for the HRT (Hypoxia Recognition Training) mode. When bypass valve V2 is open in the HRT mode, it minimizes the pressure in the breathing loop to approximately 0-2" H_2O, altitude dependent. The requirements of the HRT mode are to keep the breathing loop pressure as close to 0" H_2O as possible. The large orifice bypass valve accomplishes this goal during the HRT mode. By closing V2 for the positive pressure modes, it forces all flow through needle valve NV1. NV1 is set to provide slight positive pressure, in the breathing loop, with increasing altitudes above 28,000 feet.

The 3 liter breathing bag is externally mounted. This breathing bag satisfies the short, deep breaths that the system flow cannot satisfy alone. The vent port will exhaust the gas flow that is not used during the expiratory part of the breathing cycle.

Oxygen dump feature

Valve V1 controls the flow of 100% oxygen to the pilots mask during an oxygen dump. An oxygen dump is performed when the system operator engages the emergency dump switch on the front panel. This will normally be done when the operator has determined that the subject under test has become hypoxic and needs to recover. The mixing action of the MFCs will stop and the output of the MFCs will be isolated from the pilot's mask. The .070" orifice will control the flow of 100% oxygen to the pilots mask.

Safety features

There are several built-in safety features to either alert the operator or stop the operation of the system and go to a “safe” mode of operation.

Oxygen pressure switch PS1

The oxygen pressure switch monitors the input pressure on the oxygen port. If this pressure is less than 10 PSIG, the system will not allow the START mode (pilot test menu) to be used. This pressure should normally be set at 20 PSIG. Once the pressure on the oxygen port is restored to above approximately 13 PSIG, the system can be used as normal.

Oxygen alarm

The O_2 alarm will sound for two different scenarios. After pressing the emergency oxygen dump switch, if the O_2 has not reached 90% in 5 seconds, the alarm sounds. The alarm will remain active until the emergency switch is turned off. Also, if during an O_2 dump, the oxygen content drops below 90%, the alarm will sound. The O_2 content, as read by the internal oxygen sensor, is displayed during the oxygen dump routine.

Oxygen analysis

Using the onboard oxygen sensor, if the oxygen content in any pilot test mode drops below 3.8%, the system will automatically turn on the oxygen dump and display a warning message. 3.8% was selected because the lowest O_2 content produced during normal operation is 4.4% at 34,000 feet.

Overpressure detect

Using the onboard pressure sensor, if the pressure in the breathing loop rises above 20” H_20, the system will turn on the oxygen dump and open the bypass valve, bringing the breathing loop pressure down to zero.

Pressure relief valve

As a back up to the over pressure detect, this mechanical pressure relief valve prevents the pilot’s mask from exceeding 27” H_20 or 1 PSIG.

Low air flow detect

The air MFC (MFC1) has an alarm signal that activates if the internal MFC valve opens to maximum capacity. This generally indicates that there is not enough pressure on the MFC to satisfy the required flow rate. This would lead to elevated N2 levels in the breathing loop during normal operation. This feature uses the MFC alarm signal to stop flow and provide 100% oxygen to the breathing loop. A message appears indicated the failure.

ADMINISTRATIVE MODE (ADMIN mode)

The Administrative mode is a limited access mode and is password protected. Access to this mode allows for changing program information, calibration data, and accessing troubleshooting features.

When the system is in the normal operator's mode (READY screen), the only two menu items, as seen on the bottom line of the display, are START and OPTION. When the system is in the ADMIN mode, a secondary menu appears in the READY screen. The two menu selections are Program (PROG) and System. Toggle back and forth between the operator's menu and the Admin menu by pressing the MENU key.

Each time the instrument is powered off and on, and the self tests are run, the system automatically enters the operator's menu. To enter the ADMIN mode, perform the following:

1. From the ready screen or operator's menu (seen below), select OPTION.

2. Select OPTION (F3), arrow down to ADMIN mode and press ENTER.

3. Enter the 4 digit numeric password, factory default 1234. This password can be changed once in the ADMIN mode, refer to SYSTEM mode in the index.

4. Once the 4 digit password has been entered, the screen will display ADMIN MODE ENABLED and automatically exit back out to the ready screen. The display will now appear in the ADMIN mode, see below.

Once in the ADMIN mode, access is granted to two other menu items. Press the MENU key to display the following screen.

Programming the instrument (PROG mode)

The program mode is used to create a sequence of up to 99 steps, which later run automatically when selected in the RUNPRG mode. The RUNPRG mode is part of the PILOT TEST menu within the START menu. The system can store up to 20 programs with up to 99 steps each.

Each step can be programmed as either a HOLD or CHANGE step. For a HOLD step, the system will hold at the specified altitude for the specified amount of time, up to 60 minutes in 1 minute increments, and produce the equivalent oxygen content for that altitude. When programming two HOLD steps in a row, the system jumps instantaneously from one altitude to another. To program a hold step for more than 60 minutes, simply insert a second hold step at the same altitude. For a change step, the system decreases or increases the equivalent 02 content, at the specified ascent or descent rate. Using this information, the system determines total step run time for display purposes in the RUN mode.

For a HOLD step, the user must specify the altitude and hold time in seconds.

For a change step, the user must specify the new altitude and rate of change. If a change step is specified as the first step in a program, the system assumes starting at sea level.

Perform the following steps to enter a program of altitudes.

1. Select PROG (F1)

2. A right pointing arrow in the farthest left column will align with the current program number.

3. To create a new program or to select a program to edit, arrow down to the program number (1-20) and select EDIT (F1).

4. To create or edit the program name, use the up and down arrow keys to select the letters/numbers/characters and the right and left arrow keys to select the character position within the program name. Each program can have up to 11 characters, including spaces.

5. Press **ENTER** to accept the program name.

6. Use the **TOGGLE** key to select the program mode of operation. HRT (Hypoxia Recognition Training), FSHT (Flight Simulator Hypoxia Training) or OSFT (Oxygen System Failure Training) and select OK(F3).

   HRT – The basic **H**ypoxia **R**ecognition **T**raining mode of operation runs altitudes without adjusting the breathing loop pressure, but provides the sea level equivalent 0_2 for the programmed altitude. The pressure in the breathing loop is maintained close to 0" H_20. Hold and change altitudes can be programmed. Hold altitudes require a hold time in minutes, change (CHGALT) altitudes require an ascent/descent rate in feet/minute (60000 ft/min max.).

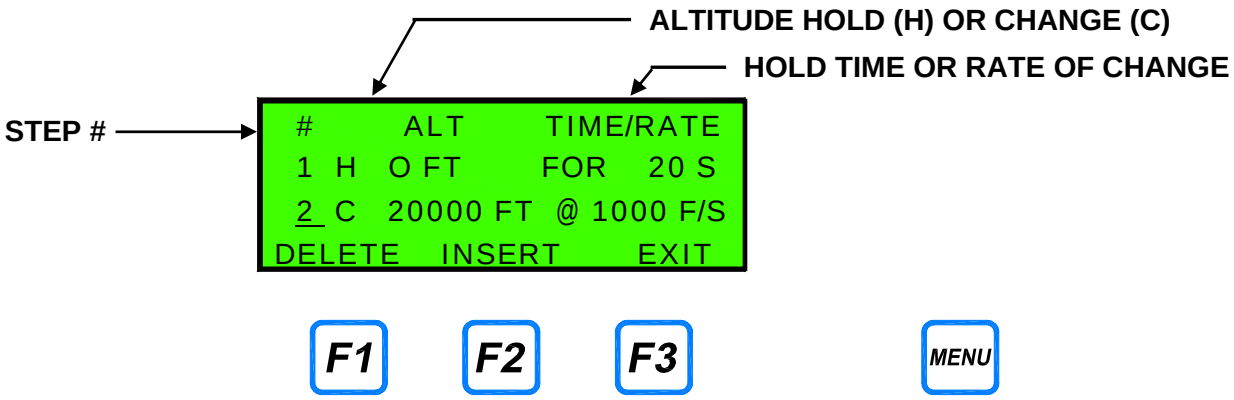
   FSHT – Runs altitudes while adjusting breathing loop pressure above 28,000 feet; reaching a ceiling of 34,000 feet at approximately 4" H_20. The sea level 0_2 equivalent is also adjusted while altitude increases as with HRT. Hold and change altitudes can be programmed. Hold altitudes require a hold time in minutes, change (CHGALT) altitudes require an ascent/descent rate in feet/minute (60000 ft/min max.).

   OSFT – Runs altitudes while adjusting breathing loop pressure above 28,000 feet; reaching a ceiling of 34,000 feet. 0_2 content remains at 21% until the **02FAIL** key is pressed while in the pilot test mode. Once **02FAIL** is pressed in the pilot test mode, the 0_2 content will adjust to the sea level equivalent for that altitude while maintaining pressure above 28,000 feet. Hold and change altitudes can be programmed. Hold altitudes require a hold time in minutes, change (CHGALT) altitudes require an ascent/descent rate in feet/minute (60000 ft/min max.).

   Refer to appendix F for the altitude to pressure curve for the FSHT and OSFT modes.

7. When on the row for a program step, the step can either be deleted or a new step can be inserted. Pressing the right arrow key will bring up the edit menu to select hold or change selections. After selecting the hold or change step and altitude, pressing the right arrow key will advance the cursor to the time/rate column.

SAMPLE SCREEN IN PROGRAM MODE:



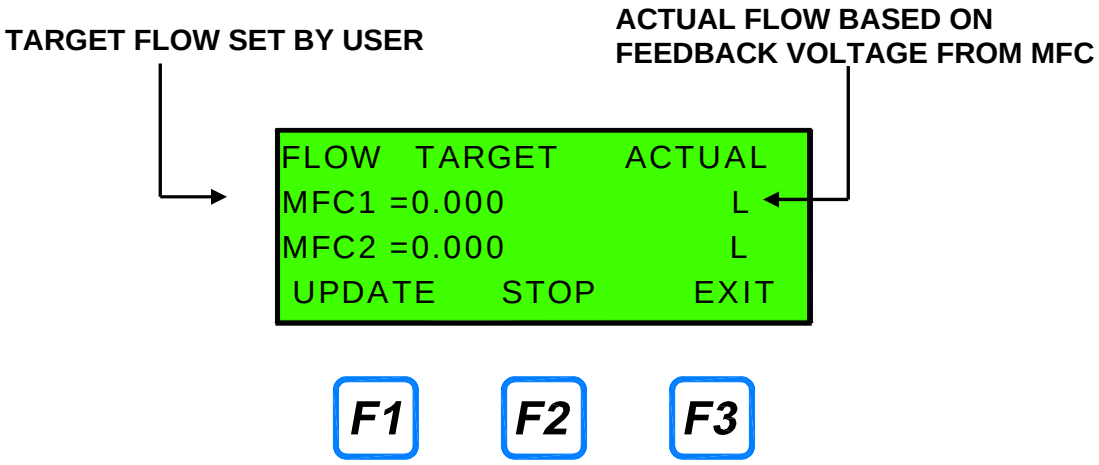
System mode

The system mode contains features that are used by Environics when calibrating the system. Some of these features can be used for advanced troubleshooting under the direction of technical staff. The ADMIN mode password can also be changed in this mode. When troubleshooting a problem, the warm up time and self test routine can be bypassed in this mode.

Test flow mode

The TEST FLOW mode is used to individually flow each MFC at a particular flow rate. The flow rate is user selectable within the full range of the MFC. This mode is used by the factory for verifying the accuracy of the MFC calibration and can be used as a troubleshooting tool as well. The test flow mode uses the MFC calibration data to provide a corrected accurate flow rate for an STP of 0°C and 14.7 PSIA.

To enter the TEST FLOW mode, select the SYSTEM mode, arrow down to the TEST FLOW menu item and press the ENTER key. The following screen will appear.



Enter the desired flow rates for one or both MFCs into the target column. Enter the flow rate in LPM. Pressing the update key will begin the flow of gas. MFC1 will flow the gas connected to the AIR port and MFC2 will flow the gas connected to the N2 port. The target flows can be updated while running, without stopping and starting the system. Once flow has stabilized, the flow in the actual column should equal the target flow. The display of actual flow is a function of the feedback voltage from the MFC. The MFC command and response voltages can be monitored on the PC412-ROBD2, refer to the section containing the PCB layout drawings and PCB function and test point section as well.

WARNING: Never use this mode when a subject is breathing off the mask. 100% N2 will be sent to the breathing loop when flowing MFC2.

Bypass warmup time

The 10 minute warm up time, that counts down after power is applied to the system, can be disabled for trouble shooting purposes.

1. From the system menu, arrow down to BYPASS WARMUP TIME and press the ENTER key.

2. Select YES (F1).

3. This will bypass the warm up time while the instrument is powered on. This procedure needs to be performed each time the system is powered off and on.

Bypass self tests

Like the Bypass warmup time feature, this feature allows the service technicians to bypass the self test feature for troubleshooting purposes. This feature will disable self tests as long as the instrument is powered on. Once the power is turned off and on again, the feature resets and will need to be disabled again.

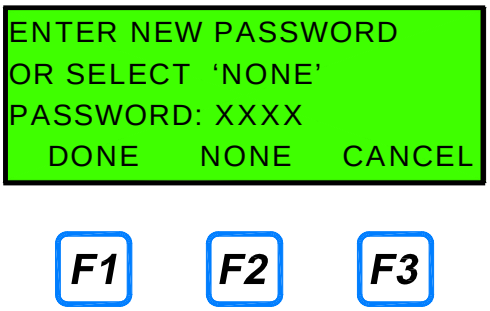
1. From the system menu, arrow down to BYPASS SELF TESTS and press the ENTER key.

2. Select YES (F1).

Password protection (change password)

The system mode can be password protected, as this mode contains all the data that impacts the accuracy of the system. The system is shipped with the password set to 1234. A four character numeric password is set within the SYSTEM mode. Upon any attempts to reenter the system mode, after setting a password, the user will be prompted to enter the password to gain entry. Be sure to record this password and keep it in a safe and secure location.

1. Select the SYSTEM mode.
2. Arrow down to CHANGE PASSWORD and press the ENTER key.
3. Enter the 4 digit numeric password and press DONE.
4. EXIT back out of the SYSTEM mode and press the SYSTEM key. A prompt should appear for a password entry.
5. Enter the previously selected 4 digit numeric password to verify the process.



Calibrate MFC, Calibrate ADC, Edit Alt flow tbl, Edit alt press tbl and Edit prs ctrl tbl.

The latter three modes, within the SYSTEM menu, are currently used by Environics only. However, at some point, as directed by Environics, technical personnel may be directed to enter these modes for advanced troubleshooting. Please refrain from entering these modes, unless under direction from Environics. If data is changed within these modes, system accuracy is compromised. Calibrate MFC mode is covered in the MFC calibration section.

REMOTE COMMUNICATIONS

The system has a remote communications port, which allows it to be controlled remotely by a host computer. The host computer communicates with the system through the RS232 port located on the rear panel.

The system will respond to commands issued by the host computer, but will not issue any unsolicited messages to the host, except to acknowledge a command or to return an error code.

Interface Specification

The communication interface is a standard RS-232C serial interface, connected via a Male DB-9 connector. The system operates as a DTE (Data Terminal Equipment) device, requiring a null modem cable to connect to a PC

Communication port parameters are: 1 Start bit, 8 data bits, 1 Stop bit, No parity bit. The speed of the communications port is fixed at 9600 baud.

Data Format

All remote communications use standard ASCII characters. Commands are terminated with either (or both) of these single byte ASCII codes:

<CR> Carriage Return (ASCII Code 0x0D)
This is used to indicate the end of a command.

<LF> Linefeed (ASCII Code 0x0A)
This is used to indicate the end of a command.

Command Format

Commands sent to the system must be formatted a follows:

COMMAND FORMAT: **COMMAND <CR><LF>**

The system recognizes the end of the command when it sees a <CR> and/or <LF> character. Commands are not case sensitive.

For each command sent, be sure to wait for a valid response from the system before sending a new command.

Reply Format

All replies from the system to the host computer will be formatted with one of three formats shown, depending on the type of response required.

COMMAND ACCEPTED — If the command received requires no data to be returned, the system will acknowledge that it successfully received and performed the command. This will be indicated by:

RESPONSE: **OK**<CR><LF>

DATA RETURNED — For commands that require data to be returned, the data will be formatted as follows. If the data consists of a list of values, each value will be separated with a comma.

RESPONSE: data<CR><LF>

EXAMPLE: 5000.0<CR><LF>

ERROR RETURNED — If the command received contains errors, or cannot be performed by the system, an error code will be returned. The error message is formatted as:

RESPONSE: **ERR**(error code)<CR><LF>

EXAMPLE: ERR12<CR><LF>

Format Of Numeric Data

All numerical values for physical parameters such as Altitude, Pressure, etc. are formatted as floating point values. These values are indicated by the format "**x.xxx**"

Whole number values (for specifying program step, etc.) must be specified without a decimal point. These values are indicated by the format "**n**"

Remote Command List

ROBD2 PROGRAMMING COMMANDS

These commands are used to set up and review the ROBD2 program steps. A total of 20 programs can be created, each with up to 99 steps.

COMMAND	DESCRIPTION
PROG n **NAME** progname	**Assign program name**
PROG n **NAME ?**	**Get name of program**
PROG n **MODE** progmode	**Assign program operating mode**
PROG n **MODE ?**	**Get program operating mode**

Command parameters:

n = Program # (1-20)
progname = Name of program (10 characters max.)
progmode = Program operating mode:
0 for HRT mode, 1 for FSHT mode, 2 for OSFT mode

PROG n s mode alt value	**Create a program step**.
PROG n s **?**	**Display program step parameters**.

Data is returned as: mode alt value

Command parameters:

n = Program # (1-20)
s = Step # 1-98) (Step 99 is always END and cannot be changed)
mode = HLD (hold), CHG (change), or END (end of program)
alt = Target Altitude (in feet)
value = Hold Time (in minutes) for a HLD step, -or-
Rate Of Change (in ft/min) for CHG step.

ROBD2 OPERATING COMMANDS

These commands are used to control the ROBD2.

COMMAND	DESCRIPTION
RUN READY	**Enter PILOT TEST mode** Put software into the Pilot Test mode. Equivalent to pushing START from the Main Menu.
RUN EXIT	**Exit PILOT TEST mode** Exit from the Pilot Test mode. Equivalent to pushing EXIT from the Pilot Test Menu.

The following RUN commands require the software to be in the Pilot Test mode

RUN n	**Run the specified program** n = program # to run (from 1 to 20)
RUN NEXT	**Advance to next program step** While running a program, this advances the program to the next step. This is equivalent to pressing the ADVANCE key from the front panel.
RUN PPT IDLE	**Enter POSITIVE PRESSURE TEST Mode** Enter the Positive Pressure Breathing test menu. This command is equivalent to pressing PPT from the Pilot Test menu.
RUN PPT START	**Start POSITIVE PRESSURE TEST** Start the Positive Pressure Breathing Test. Flow air to mask at 95 LPM, at a pressure of 10 in. H20.
RUN PPT STOP	**Stop POSITIVE PRESSURE TEST** Stop the Positive Pressure Breathing Test. Mask pressure is reduced back to 0 in. H20, and flow is reduced back to approximately 16 LPM

RUN O2FAIL — **Toggle the O_2 Failure state**

For programs configured for OSFT mode, this command toggles the state of the O_2 Failure simulation. This is equivalent to pressing the O2FAIL button from the menu while a program is running. Refer to the RUN PROGRAM section of the manual for more information.

RUN ABORT — **Abort current test**

Abort the current program or test, and return to the Pilot Test menu.

SET O2DUMP n — **Set the Oxygen Dump state.**

n=1, turns the Oxygen Dump ON
n=0, turns the Oxygen Dump OFF.

This command has the same effect as pressing/releasing the O_2 Dump switch on the front panel.

ROBD2 STATUS COMMANDS

These commands are used to get ROBD2 status information.

NOTE: SpO2 and Pulse data is valid only after entering PILOT TEST MODE
Altitude and Elapsed/Remaining Time are valid only while running a Program

COMMAND	DESCRIPTION
GET RUN O2CONC	Get the O_2 Concentration in the breathing loop
GET RUN BLPRESS	Get the Breathing Loop Pressure
GET RUN SPO2	Get SpO2 reading from Pulse Oximeter
GET RUN PULSE	Get Pulse reading from Pulse Oximeter
GET RUN ALT	Get the Current Altitude for the current step
GET RUN FINALALT	Get the Final Altitude for the current step
GET RUN ELTIME	Get the Elapsed Time of the current step
GET RUN REMTIME	Get the Remaining Time for the current step
GET RUN ALL	Get all run data. Data format is:

mm-dd-yy hh-mm-ss, program#, current alt ,final alt, o2conc, breathing loop pressure, elapsed time, remaining time, spo2, pulse<cr><lf>

GET INFO	Returns the system model number, software revision and serial number
GET MFC n	Get the current flow rate for MFC n
GET ADC n	Get the voltage for ADC device n
GET O2 STATUS	**Get the 100% O2 source status**. Returns "1" if the 100% O_2 source pressure is OK. Returns "0" if the 100% O_2 source pressure is LOW,

GET STATUS Returns a 1 if system is not ready (warmup time not expired, low O2 pressure, or self tests not completed) Returns a 0 if system is ready.

FLIGHT SIMULATOR COMMANDS

RUN FLSIM Puts the system into Flight Simulator Tracking mode. You must first issue the "RUN READY" command, just as you would when you want to run any other mode, then RUN FLSIM. When in Flight Simulator mode, the screen will display FLIGHT SIM TRACKING along with the current altitude, o2 conc, and breathing loop pressure. No keyboard commands are accepted. To exit from this mode, use the "RUN ABORT" command, like you normally would for other run modes.

SET FSALT nnnnn Sets the Flight Sim Altitude to nnnnn. Value must be <= 34000 Sending too many SET FSALT commands will return an ERR99, which means you've overflowed the command buffer for the flight simulator mode. The software will store the last 5 altitude commands, but since it updates the MFCs only once per second, you shouldn't need to send this command more often than that anyhow.

When in the Flight Sim mode, the GET RUN ALL command will behave as normal, with the following changes:

Program # will be 99, to indicate Flight Sim mode
Elapsed time will reset to 0 each time you give a new SET FSALT command
Remain time will always be 1 second.

Remote Command example:

The following example shows how to program and operate the ROBD2. Commands are shown first with a description of each command. The response from the ROBD2 is shown indented below each command

`PROG 1 NAME TEST001`	Assign name “TEST001” to Program 1
`  OK`	
`PROG 1 MODE 0`	Set Program mode to HRT mode
`  OK`	
`PROG 1 1 HLD 0 1`	Prog 1, Step 1: Hold at 0 feet for 1 min.
`  OK`	
`PROG 1 2 CHG 5000 5000`	Step 2: Change to 5000 feet at 5000 ft/min.
`  OK`	
`PROG 1 3 HLD 5000 2`	Step 3: Hold at 5000 feet for 2 min.
`  OK`	
`PROG 1 4 CHG 30000 10000`	Step 4: Change to 30000 feet at 10000 ft/min.
`  OK`	
`PROG 1 5 END`	Step 5: End of program.
`  OK`	
`PROG 1 2 ?`	Display Prog 1, Step 2 information.
`  CHG 5000 5000`	> Change to 5000 ft at 5000 ft/min
`GET O2 STATUS`	Get status of 100% O_2 source
`  1`	> O_2 pressure is OK
`RUN READY`	Enter Pilot Test mode (required to run a program)
`  OK`	
`RUN 1`	Start running Program 1.
`  OK`	
`GET RUN ALL`	Get Status information
`  12-31-05 17:55:49,1,0,0,21.04,3.12,3,57,99.2,68`	
`RUN NEXT`	Advance to the next step
`  OK`	
`GET RUN ALL`	Get Status information
`  12-31-05 17:56:05,1,975,5000,20.98,3.09,9,51,99.2,67`	
`RUN ABORT`	Abort program
`  OK`	
`RUN EXIT`	Exit Pilot Test Mode
`  OK`	

Remote Error Codes

ERROR	DESCRIPTION
4	**COMMAND OVERFLOW** The input command is too long. Commands are limited to 79 characters.
12	**UNKNOWN COMMAND** An unknown command was received.
18	**COMMAND ERROR** Specified command is recognized but does not match the required format.
19	**TOO MANY TOKENS** Command contained too many data elements to be processed.
53	**VALUE OUT OF RANGE** One of the specified values is out of range.
60	**UNKNOWN PROG STEP** Unknown program step type. Must be HLD, CHG or END

ROUTINE MAINTENANCE

Visual inspection before power up

Items to check after removing the instrument and supplemental parts from the transport case. This would be either when receiving the instrument from Environics or during shipment from one location to another.

- Make sure the breathing bag has no rips of punctures.
- Make sure the finger probe has not been damaged.
- Remove the cover from the system and make sure (visually) that all assemblies, electrical cables and tubing connections are secure.
- Make sure that the regulator fittings are clean and free of any packing material.

During power up, the self tests will catch any potential problems. Once the self tests and self calibrations have run, and the system enters the ready mode, plug in the pulse oximeter probe and make sure no errors appear on the pulse oximeter. The finger probe icon should disappear once the probe is connected to the system and placed on the finger. Once removed from the finger, the alarm will sound. Refer to the operator's guide for pulse oximeter operation.

Packing the system for shipment

- Pulse oximeter probe should be placed in original package when shipped.
- Regulators should be placed in individual plastic bags for shipping.
- Hose fittings and rear panel fittings should be plugged or capped.
- System should be placed in original plastic bag.
- Breathing bag should be placed in plastic bag.

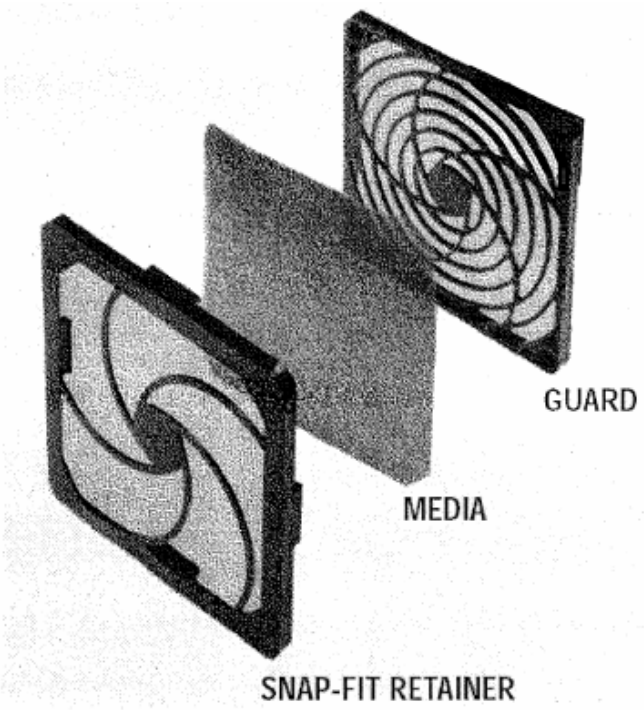
Yearly Maintenance

Environics' Part Number	Description	Replacement Frequency
FB07-002-FM	Fan filter media, 45 PPI (replace or clean)	1 year
MA04-003-005	Filtered orifice, .005", replace with SK10-001	2 years
PA04-02-001	Viton tube, Oxygen sensor, replace with SK10-001	2 years
SK10-001	Oxygen sensor	2 years
VA-FIL-004-E	Filter elements, 5 micron, for input gas filters	1 year
RECAL AND TUNE UP	Mfc 21 pt calibration, system performance test	1 year

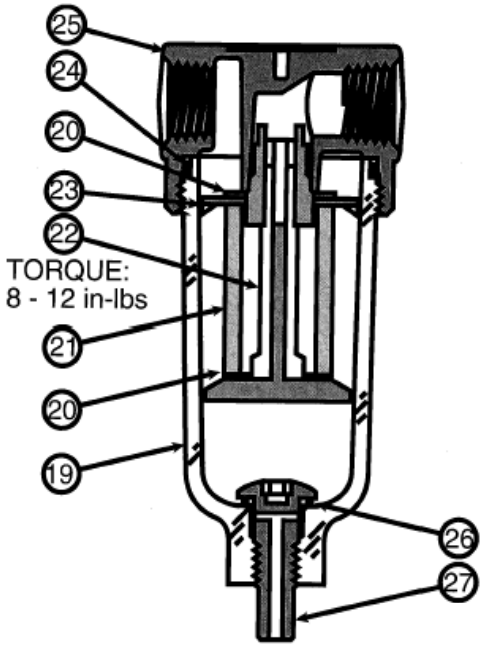
Cleaning the fan filter

The fan filter should be removed for cleaning at least once per year (more often if it is visibly dirty.) Proceed as follows:

1. Gently pry off the retainer with a screwdriver. **Do not unscrew the mounting screws in the guard.**
2. Carefully pull out the filter media. You may either vacuum it clean, or wash it gently in warm sudsy water. Be careful not to tear the filter.
3. If the filter has been washed, blot it well between sheets of paper towels, then allow it to dry.
4. Reinstall the filter by holding it in place over the fan opening, then snapping the retaining grid in place.



Replacing the particle filter element



Filter Parts Identification List

Item#	Description
19	Bowl
20	Gasket (2)
21	Filter Element
22	Filter Holder
23	Deflector
24	O-ring (body to bowl)
25	Body
26	O-ring (drain to bowl)
27	Manual Drain (twist style)

Caution: Shut off air supply and exhaust the primary and secondary pressure before dis-assembling the unit. (Units may be serviced without removing them from the air and nitrogen lines.)

Replacing Filter Element (VA-FIL-004-E)

1. Unscrew the threaded bowl (19) and filter holder (22). The filter element (21), deflector (23) and at least one gasket (20) will drop out with the filter holder.

2. Remove large o-ring (24), deflector (23), filter element (21), and two gaskets (20). Note, top gasket (20) and o-ring (24) may not come out when removing the threaded filter element holder. They may be stuck from compression inside the cap body (25). The gasket (20) and o-ring (24) will be visible up inside the body and can be removed easily.

3. If necessary, clean the bowl (19) before re-assembling the unit. Use a mild soap solution and water only. DO NOT use cleansing agents such as acetone, benzene, carbon tetrachloride, gasoline, toluene, etc., which are damaging to this plastic.

4. Install new deflector, filter element, and new gaskets onto filter holder.

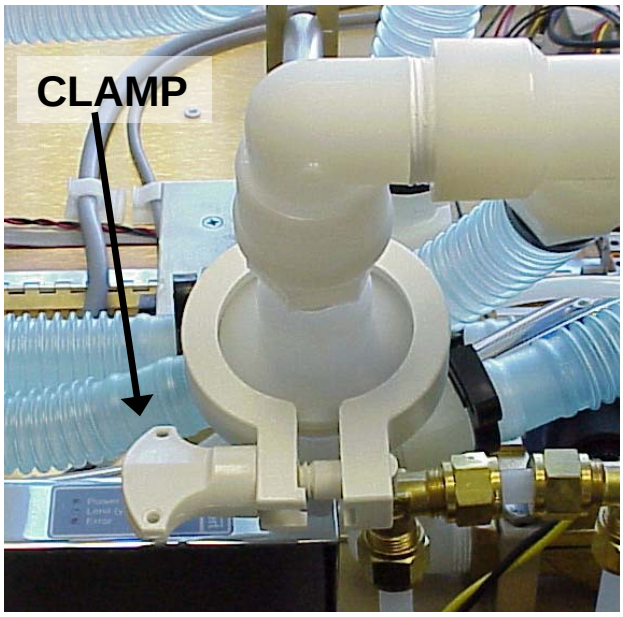
5. Attach element holder to body. Torque from (8 to 12 in-lbs).

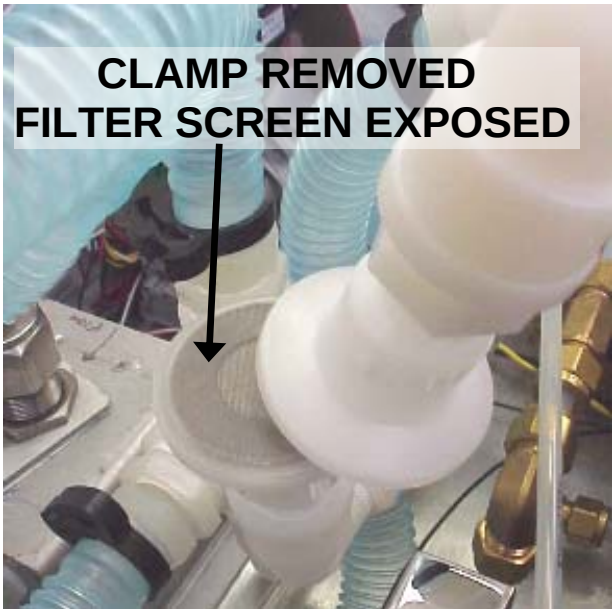
6. Replace o-ring (24) onto bowl top. To assist with retaining bowl's o-ring while installing bowl, lubricate the o-ring with Dupont Krytox lubricant for oxygen compatible parts. Place the o-ring in the outer diameter grove at the very top of the bowl. Do not use the lubricant that comes with the filter element kit.

Cleaning or replacing the final filter (A221)

The final filter is meant to capture any particles that may have entered the system during assembly, or during the replacement of a part, and prevent them from entering the breathing mask. The input filters catch any particles entering the system. As a result, this filter should last indefinitely and should only require yearly inspection. An indication that the filter is clogged to the point where it should be cleaned or replaced is that it gets harder and harder to breathe through the mask via the vent port. This can be observed by simply breathing through the mask with the system in the ready mode or powered off altogether.

1. Reference the A221 drawing in Appendix A, page A16. Remove clamp item 10.
2. This will expose the screen filter item 50.
3. Remove the screen filter and inspect.
4. Blow out the filter with compressed air or clean it with a mild soap solution. If necessary, replace the filter. Be sure the filter is dry before reinstalling.
5. Making sure it is properly aligned, reinstall the filter screen and the clamp to the tightness observed in the step 1.





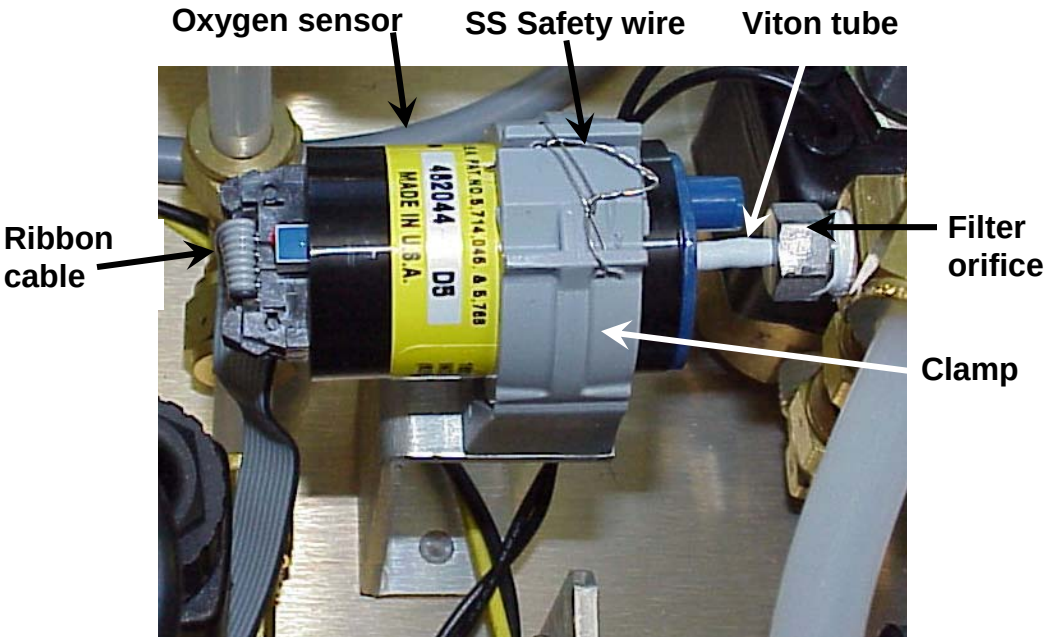
A221

Replacing the oxygen sensor

The average replacement period for the oxygen sensor (Environics' part number SK10-001) is 2 years. However, an indicator that the oxygen sensor has deteriorated to the point that it needs to be replaced is that the system will not pass the oxygen sensor calibration; refer to the Operator's Guide section titled Self Calibration operations, oxygen sensor calibration. When replacing the oxygen sensor, Environics highly recommends replacing the filter orifice fitting. This fitting controls the flow into the oxygen sensor at 150 SCCM. This fitting has a built in mesh filter to prevent particles from clogging the orifice of the fitting. Over time, the filter itself can become clogged by particles. The instructions to replace this fitting are part of the following procedure.

1. Remove the flat ribbon cable from the end of the oxygen sensor, see illustration on the next page.
2. Referencing Appendix A, assembly number A207, locate the two Kept nuts (item 40) on the bottom side of the instrument and remove.
3. Remove the A207 assembly. As the A207 is removed, slide the Viton tube off the blue barbed fitting on the oxygen sensor.
4. Remove the stainless steel safety wire with needle nose pliers or diagonal cutters if it will be replaced.
5. Open the clamp that holds the oxygen sensor in place and remove the oxygen sensor.
6. Referring to appendix A, A207 parts list, tighten the clamp screw (item 20) if necessary.
7. Install the new oxygen sensor in the same orientation as the one that was removed, making sure the blue barb fittings is located in the same orientation.
8. Close the clamp. If necessary, add one or two revolutions of electrical tape onto the sensor to make sure the O_2 sensor is held firmly in place.
9. Reattach the safety wire. The installation of the safety wire can be simplified by using a safety wire twisting tool, reference www.mcmaster.com part number 5649A2. The wire can be ordered from Environics using part number RB02-00-00015, specify the number of inches.
10. Place the 02 sensor assembly aside and proceed with replacing the filter-orifice fitting.
11. Using an adjustable or closed end wrench, remove the filter fitting shown in the illustration on the next page.
12. Be sure to remove all Teflon tape fragments from the mating part after the fitting has been removed.

13. Apply Teflon tape to the new filter fitting (Environics part number MA04-003-005) and screw it into place. Reference the procedure for applying Teflon tape to pipe fittings in this section of the manual. NOTE: this fitting has 1/8” NPT thread and should use 1/8” wide Teflon tape as indicated in the table on the next page.
14. Replace the Viton tube, Environics part number PA04-02-001.
15. Reinstall the oxygen sensor assembly and connect the Viton tube to both the filter fitting and the oxygen sensor.
16. Reinstall the Kept nuts on the bottom panel of the system
17. Reconnect the flat ribbon cable to the oxygen sensor.
18. Once the system is powered back on and the self tests/ self calibrations are performed, the system will automatically calibrate the new sensor.



Oxygen sensor assembly A207

Applying Teflon tape to pipe fittings

Thread tape acts as a lubricant allowing more thread engagement, preventing galling, and filling the gap between the crests and roots of mating taper threads in order to prevent formation of a spiral leak path. Always apply TFE tape to the male taper threaded end. Wrap the tape in the direction of the thread. All ROBD2 fittings are right hand style, meaning the tape must be applied in a clockwise direction. Draw the tape tightly around the thread; be sure the tape does not overhang the first thread otherwise the tape could deteriorate and contaminate the piping system. On stainless steel a double wrap is recommended to minimize any possible galling, while providing a good seal. As shown in the chart below, also ensure that the appropriate minimum number of threads have been wrapped. Press tape firmly into threads, particularly in the overlap area. The taped thread is then ready to assemble to a female thread.

Caution: Use latex type gloves to press tape into threads and also during assembly and disassembly. Most pipe fittings in the ROBD2 have been cleaned for oxygen service. The goal is to prevent any grease, including the oils from the skin, from getting onto the wetted surfaces of the gas path.

NOMINAL PIPE SIZE	TAPE WIDTH	EFFECTIVE THREAD LENGTH (EXTERNAL)	APPROX. # OF THREADS
1/8	1/8–1/4	1/4	7
1/4	1/4	3/8	7 1/3
3/8	1/4	3/8	7 1/2
1/2	1/4–1/2	1/2	7 1/2
3/4	1/4–1/2	9/16	7 2/3
1	1/4–1/2	11/16	8

Calibrating the Mass Flow Controllers

Equipment Specification and setup (reference illustration on next page)

1. The gas source: Bottle air or clean dry oil-free air from a compressor system can be used for calibration. The input pressure setting for the calibration is the same as the operating pressure, 40 PSIG. Although MFC2 is used for Nitrogen, the properties of air (K factor) allow it to be used as a surrogate gas for calibration. Environics uses air to calibrate both MFCs. However, nitrogen can be used on MFC2.

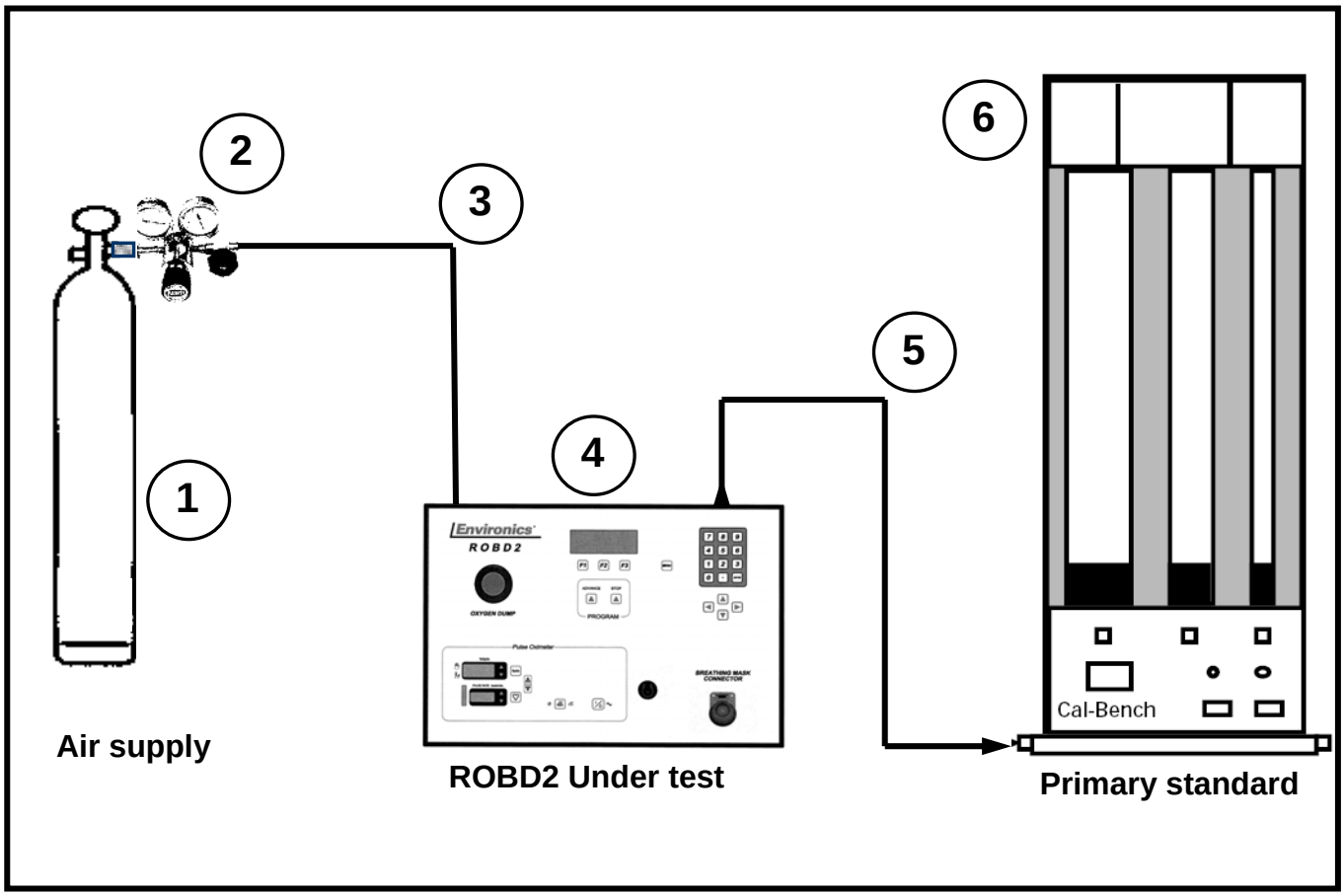
2. The pressure regulator: Environics uses and recommends the use of dual stage regulators. This is most important if using air from a compressor, to eliminate pressure fluctuations and maintain a drift-free pressure setting.

3. The air feed line to the ROBD2: This line should have minimum I.D. of ¼" and a length no longer than 20 feet. At the maximum calibrated flow of 77 LPM N2, this hose will drop 3 PSIG pressure with a starting pressure of 40 PSIG.

4. ROBD2: Outlined in the following procedure, the input gas connects to each respective port for calibrating the air MFC (MFC1) and the nitrogen MFC (MFC2). Although the normal input ports are used for calibrating the MFCs, the breathing loop is isolated during calibration by interrupting the plumbing of the ROBD2. This is necessary to insure that cumulative minor leaks in the breathing loop do not impact the calibration of the MFCs.

5. Output hose connection: The minimum I.D. of this hose should be ¼". It is important to keep this length of hose as short as possible. Running at approximately ambient pressure, this hose will drop more pressure than the equivalent hose running at 40 PSIG, as with the input hoses. The same 20 foot hose will drop 5.5 PSIG with running at ambient pressure.

6. The calibration equipment: The measuring device used for flow calibrating the ROBD2, should be a National Institute for Standards and Technology (NIST) traceable primary standard with and accuracy better than .25% of reading. This calibration procedure assures the best possible precision error, and through traceability, minimizes bias or systematic error, which are more common with secondary or transfer standards. Environics uses a piston prover primary standard flow calibration system Sierra model 101. Environics has three cal benches that are periodically certified and correlated to one another. In addition, Environics cross correlates the benches between certifications to insure accuracy. The STP of the equipment must be set or corrected for 70°F and 29.92 "HG. These are the standard settings Environics uses and adjusts to during MFC calibration in the ROBD2.



Typical calibration setup

Removing the MFCs

At some point, it may be more cost effective to remove the MFCs and have them calibrated in an ROBD2 at a central location or by Environics. This will save on shipping charges.

1. Unplug the power cord.

2. Remove the cover from the system.

3. Turn the unit on it side and remove the six screws that hold the MFCs in place. The screws that hold the air flow controller (MFC1) in place are Environics part number HA0113-M400D8MM (4). The screws that hold the nitrogen flow controller (MFC2) in place are Environics part number HA0113-M40012M (2).

4. Turn the unit upright.

5. Unplug the cooling fan from the PC416 and remove the screws in the left side panel.

6. Drop the left side panel. Note never allow the panels to drop to an angle greater than -90 or +90 degrees for the left and right panel respectively. In other words, the panels should always drop to a flat surface that is parallel to the bottom of the system, as shown in the system illustration drawing.

7. Using an open ended or adjustable wrench, disconnect the compression fittings from the plumbing connected to the MFCs. Note, the fittings on the MFCs are not directly accessible, move up or downstream to the most accessible fittings.

8. Remove the MFCs to the point where the MFC cable screws are accessible and remove the cables.

9. Remove the MFCs from the system chassis.

10. Remove any remaining plumbing from the MFC, excluding the brass fittings in the base of the MFC. Loosely assemble the plumbing back into the system, so it does not get misplaced.

11. Acquire and install threaded caps onto the 3/8” MFC compression fittings. Caplug # CD-6 will work.

12. When packing the MFCs, be sure to use plenty of cushion in the shipping box.

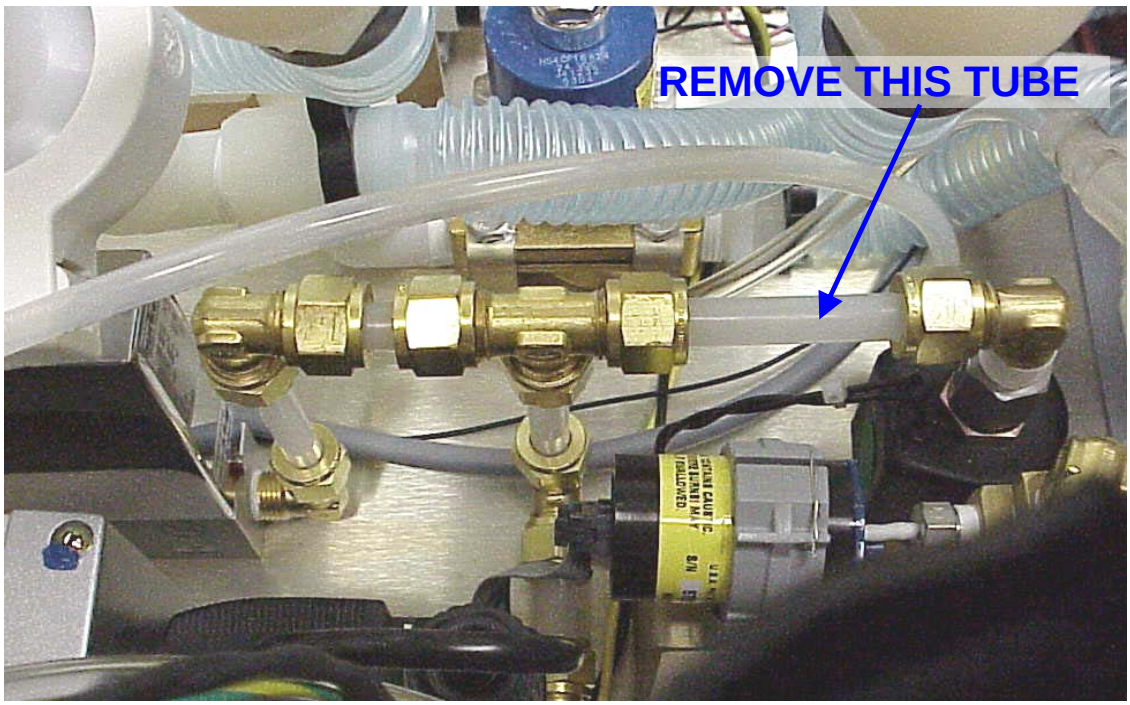
13. When the calibrated MFCs return, a calibration certificate should be included. Appendix P illustrates the certificate that will be received from the Environics 21 point calibration.

14. Reinstall the MFCs, using this procedure in reverse order.

Calibrating the MFCs in the ROBD2

1. Power the system down, disconnect the power cord and remove the cover from the system.

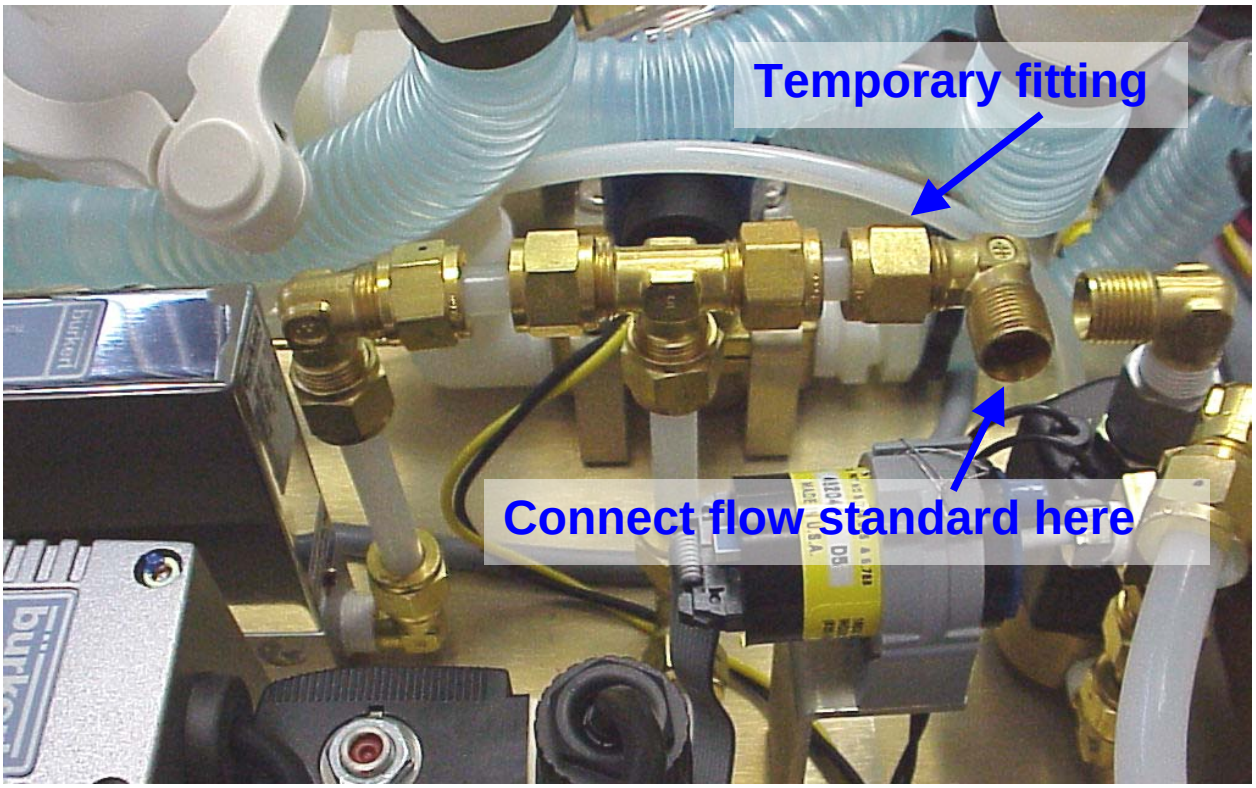
2. Locate the series of fittings shown in the illustration below, and remove the tube that is called out. These are the fittings that connect to the output or downstream side of the MFCs.



3. A temporary fitting and tube combination will need to be constructed (see below) to connect to the primary standard. The 3/8" union fitting must be a compression fitting (Gyrolok or Swagelok compatible). The ROBD2 uses Gyrolok (Hoke) brass compression fittings. These parts can be ordered from Environics. The union elbow is Environics part number FA110-01-B06 and the 3/8" tube is Environics part number PA15-06-001. The tube must be cut as short as possible. The nuts and ferrules come with the fitting.

Temporary fitting

4. Install the temporary fitting as shown below. This replaces the tube that was removed in step 2. Rotate the union elbow as required for accessibility to the primary standard connection.



5. Connect the Primary standard to the union elbow as called out above.

6. Plug in the power cord and power the system on. Allow the 10 minute warm up time to elapse.

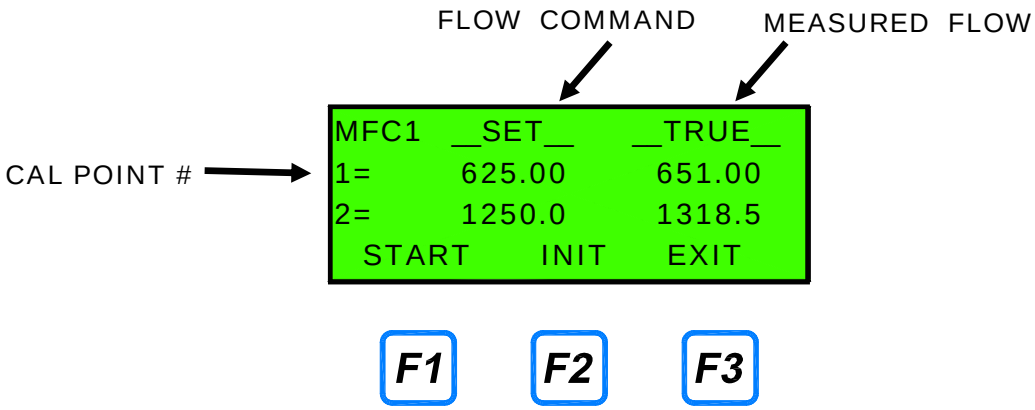
7. Place the system in the ADMIN mode and enter the SYSTEM mode.

8. Arrow down to CALIBRATE MFC and press ENTER.

9. Enter the MFC number to be calibrated, MFC1 for air (25 LPM full scale) or MFC2 for N2 (77 LPM full scale).

10. Enter the corresponding port number for the MFC. Port 1 for MFC1 and port 2 for MFC2.

11. The system will automatically enter the calibration table/mode. This mode is used to both enter the measured flow rates for 21 individual points and is also used to generate uncalibrated (raw) voltages to the MFC from zero to 100% in 5% increments including 2.5% FSO. This mode is used to generate the flows while they are being measured real time. The following screen is an example of what will be displayed dependent upon the MFC selected and the TRUE (measured) flow data resident in the table.



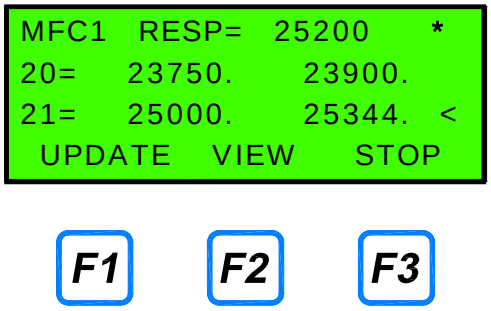
12. Because of the display limitations, only two calibration points (rows) are shown simultaneously. To navigate the table, use the up and down arrow keys for the individual points and the right and left arrow keys to move back and forth between the set and true flow columns. The cursor will move as the arrow keys are depressed.

13. The start key (F1) energizes the MFC, for the respective flow rate, and starts flowing to the primary standard. The init key (F2) initializes the calibration table to the values outlined in step 11. The set point values can be changed independently. It is not necessary to press the init key unless these set point values have been manipulated and it is desireable to recover the factory initialized values of 2.5%, 10-100% in 5% increments. The exit key (F3) exits the calibration mode. If any data has changed, you will be prompted to perform a save or no save data operation. No save will not save the changes that have been made.

14. The next step is where the control of flow actually starts. Insure that the system is plumbed as outlined in the typical calibration setup illustration above.

15. Arrow down to point number 21, which is 100% FSO for the MFC.

16. Select start (F1). Gas will start flowing to the primary standard and the following screen (example) will appear. The top line of the display will now show the interpreted flow rate based on the response voltage of the MFC. Since the valves in the MFC use PWM, the response field may fluctuate more at some flow rates than others. The modulation is at a frequency that the flow averages out and these fluctuations are undetectable in the mix. A blinking asterisk in the upper right hand corner identifies that the MFC has been energized. Pressing the view key (F2) will toggle the top line between a set and true flow label to the MFC response. The update key is used after moving the cursor to another row (set point) to update the flow rate consistent with the selected point. The stop key, of course, stops flow and puts the system into the mode shown above. A left pointing arrow in the far right hand column will identify the active row.



17. Take several readings on the primary standard to ensure that the flow rate is not drifting. Drifting flow will sometimes indicate that the MFC has not had ample warm up time. It is only necessary to take multiple readings at this point to insure stability. Once flow has stabilized, take a final measurement and enter that flow rate into the true column opposite the set flow rate. For the example above, a primary standard measurement of 25344 SCCM was measured for an ROBD2 setting of 25000 SCCM.

18. Move the cursor up to the next point and select update (F1). The left facing arrow should move up one row. Allow one minute or so and take a reading. Enter the measured flow rate into the true flow column.

19. Repeat step 18 for all 21 calibration points.

20. After the last calibration point has been recorded, press stop (F3).

21. Scroll the table and insure all data has been entered correctly.

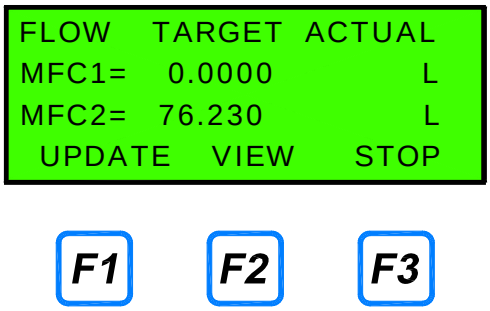
22. Press exit (F3) and then save (F1). The data has now been saved and this look up table, along with linear interpolation, will be used by the system when running programs.

23. Start at step 8 to calibrate another flow controller, or move onto verifying the flow calibration.

Verifying the flow calibration

1. While in the system mode, arrow up to the top line item, TEST FLOW, and press the ENTER key.

2. Cursor down to the MFC to verify, first making sure that the target flow setting for the other MFC is set to zero, and enter the flow rate to verify. Refer to Appendix P for the 5 flow rates that Environics uses for its flow verification. Reference sample display below.



3. Select update (F1). The system will once again start delivering flow to the primary standard, the difference being that the calibration table is being used to correct the flow. The flow measured by the primary standard should be +/- .5% of the targeted flow rate. The screen will also display the flow rate based on the response voltage from the MFC.

4. Once both MFCs have been calibrated and verified, exit out to the ready mode and power down.

5. Replace the tube taken out in the calibration procedure if the MFCs were calibrated in the unit.

6. If the MFCs were calibrated at an outside source, then the calibration table must be changed to reflect the new data.

PCB function and TEST POINTS

PC401 function (Microcomputer board)

The PC401 is the microcomputer board. It contains the system EPROM and battery backed up RAM for the storage of all system configuration, calibration and user data. Reference appendix A, assembly A194. This PCB is not field serviceable and should be replaced in the event of failure.

PC403 and PC404 function (pulse oximeter PCBs)

The PC403 is the main pulse oximeter board containing the display, keypad interface and microprocessor/memory. The PC404 is the RS232 interface card and is connected directly to the PC403. Reference appendix A, assembly A214 (front panel assembly). These PCBs are not field serviceable and should be replaced in the event of failure.

PC406 function (keypad interface and display PCB)

The PC406 decodes the information entered on the keypad and displays information sent by the microcomputer board, on the front panel 4 line by 20 character LCD display. Also, this PCB contains the beeper circuit for an audible confirmation of keypad data entry. Reference appendix A, assembly A214 (front panel assembly)

PC406 test points

TP#	VALUE
TP1	5 VDC Steady state
TP2	GND Meter or oscilloscope reference
TP3	.25 to 1.8 VDC as display contrast is adjusted in PREFS mode
TP4	See waveform "PC406 TP4" on page 45.

PC412-ROBD2 FUNCTION (ANALOG BOARD)

This PCB is an interface between all system analog control/feedback components and the microcomputer board (PC401). The analog components include 02 sensor feedback, breathing loop pressure transducer and mass flow controllers (MFCs). This PCB uses 12-bit A/D and D/A converters for high resolution control and read back of the analog devices. Reference appendix A, assembly A194

PC412-ROBD2 test points

TP#	VALUE
TP1	Command voltage for MFC1; this test point should measure approximately .5 VDC to 5.0 VDC for MFC1 commands between 10 and 100% full-scale flow. This range is approximated due to the MFC calibration table having an affect on the command voltage.
TP2	Response voltage for MFC1; this test point should measure approximately -.015 to +.015 VDC with a no flow command or a flow command of zero. When commanding flow, the measurement of this test point should equal TP1 as long as the MFC is flowing and controlling properly.
TP3	Command voltage for MFC2; this test point should measure approximately .5 VDC to 5.0 VDC for MFC1 commands between 10 and 100% full-scale flow. This range is approximated due to the MFC calibration table having an affect on the command voltage.
TP4	Response voltage for MFC2; this test point should measure approximately -.015 to +.015 VDC with a no flow command or a flow command of zero. When commanding flow, the measurement of this test point should equal TP3 as long as the MFC is flowing and controlling properly.

PC412-ROBD2 TEST POINTS (CONTINUED)

TP#	VALUE
TP5	Command voltage for optional MFC3; this test point should measure approximately .5 VDC to 5.0 VDC for MFC1 commands between 10 and 100% full-scale flow. This range is approximated due to the MFC calibration table having an affect on the command voltage.
TP6	Response voltage for optional MFC3; this test point should measure approximately +.005 to +.015 VDC with a no flow command or a flow command of zero. When commanding flow, the measurement of this test point should equal TP5 as long as the MFC is flowing and controlling properly.
TP7(VREF)	+5.00 VDC steady state.
TP8(AGND)	Analog ground test point for negative (black) meter lead.
TP9(+5A)	+5 VDC steady state.
TP10(-5)	-5 VDC steady state.
TP11(-12)	-12 VDC steady state.
TP12(+12)	+12 VDC steady state.
TP13(AGND)	Analog ground test point for negative (black) meter lead.
TP14(-15)	-15 VDC steady state.
TP15(+15)	+15 VDC steady state.
TP16(+5)	+5 VDC steady state.
TP17(GND)	Ground test point for negative (black) meter lead when measuring TP16.
TP18(PGND)	Ground test point for negative (black) meter lead when measuring TP19.
TP19(+24)	+24 VDC steady state.

() Values in parenthesis are as seen on the PCB silkscreen.

PC416 FUNCTION (SOLENOID VALVE DRIVER AND STATUS I/O BOARD)

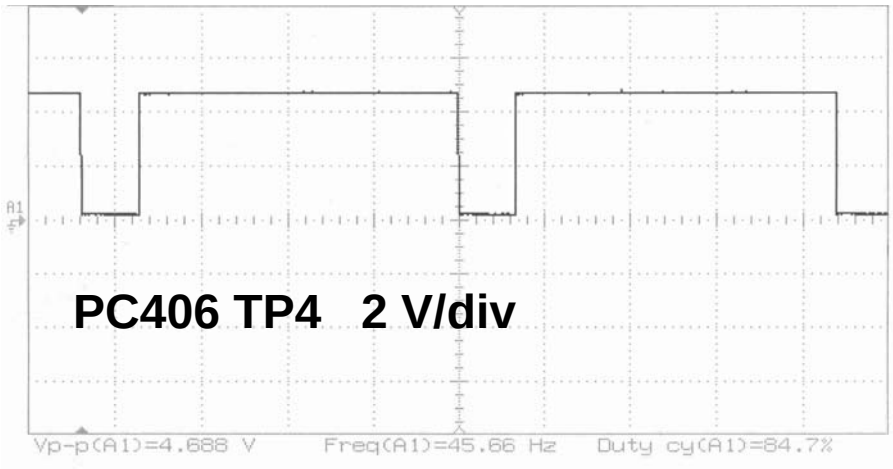
This PCB is used to activate the solenoid valves used to isolate the gases on the input gas ports. These valves are turned on with 24 VDC and then run at 30% duty cycle or 1/3 power. This allows more efficient use of the internal 24 VDC power supply. This board also controls the input and output status lines currently used to read the low pressure oxygen switch and the emergency dump switch.

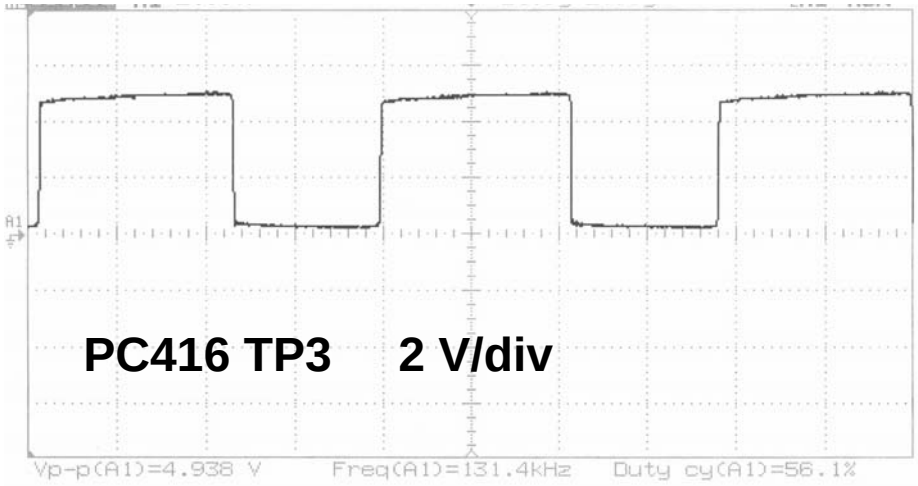
PC416 test points

TEST POINT WAVEFORMS

TP#	VALUE
TP1(+5)	5 VDC Steady state
TP2(GND)	GND meter reference for TP1.
TP3(100KHZ)	See waveform "PC416 TP3" on page 45.
TP4(PGND)	This is the power (+24VDC) ground test point for the negative (black) meter lead when measuring the +24 VDC test point TP5.
TP5(+24)	+24 VDC steady state.

() Values in parenthesis are as seen on the PCB silkscreen.


A1
PC406 TP4 2 V/div
Vp-p(A1)=4.688 V
Freq(A1)=45.66 Hz
Duty cy(A1)=84.7%


A1
PC416 TP3 2 V/div
Vp-p(A1)=4.938 V
Freq(A1)=131.4kHz
Duty cy(A1)=56.1%

TROUBLESHOOTING GUIDE

Troubleshooting system problems

POWER PROBLEM SYMPTOMS	ACTION/SOLUTION
System display does not light up **Solenoid valves do not actuate** **Fan does not run** **Self tests fail** **Oxygen dump does not activate**	• Check power cord connection and power source voltage. Environics recommends the use of a power conditioner. • Check fuses in the power entry module on rear panel and replace if necessary. Refer to procedure at the end of this guide. • Check all steady state test points on the PC412-ROBD2 ▪ In the absence of voltage at TP14, TP15, TP16 or TP19, check power supply voltages with power cable disconnected from PC412-ROBD2 J7. See power cable wiring diagram on page 53 of this manual. If any of the power supply voltages are absent, replace power supply. If all power supply voltages are present, identify the PCB or component drawing down by disconnecting cables attached to the PC412-ROBD2. Be sure to power off and on again when disconnecting cables. • In the absence of any voltages of other steady state test points, replace PC412-ROBD2 • If the problem is not found by following the directions above, and the problem is not consistent with any other symptom in the troubleshooting guide, contact Environics technical services.

FLOW/BLENDING PROBLEM SYMPTOMS	ACTION/SOLUTION
Zero or low flow from one or more mfcs. NOTE: For all flow related problems, always check the steady state test point values on the PC412-ROBD2 first. If there is a problem with TP14, 15, 16 or 19, follow the instructions in the POWER PROBLEM section above. NOTE: The command test points are found on the PC412-ROBD2, see PCB function and test points HINT: use the test flow mode to trouble shoot flow related problems. The DC command voltage measured should be approximately the same percentage of 5 VDC as the commanded flow is a percentage of the full scale flow rate of the MFC. MFC1 for air is 25 LPM and MFC2 for N2 is 77 LPM.	▪ Make sure the input pressures are as prescribed ▪ If the command voltage for the respective MFC seems correct for the flow rate being commanded, measure corresponding MFC response test point on the PC412-ROBD2. If the response voltage is low or 0, there may either be a problem with the MFC cable, +/- 15 VDC steady state power supply , or the MFC. Try checking the PC412-ROBD2 test points for +/- 15 VDC and swapping the MFC cable. ▪ If the command voltage is not present, check the calibration data for the MFC in the system mode to ensure that the values have not changed from the last calibration. Environics sends a hardcopy of all data for reference. These values may be slightly different if a follow-up calibration has been done outside Environics. Check TP7 on PC412-ROBD2. This is the reference voltage (+5 VDC) used by the MFC ADC and DAC. ▪ If these things fail to fix the problem, contact Environics technical services.

FLOW/BLEND PROBLEMS (CONT.)	ACTION/SOLUTION
Blend or flow is unstable as Displayed on the front panel.	• Measure the MFC response voltage on the PC412-ROBD2. • If the response voltage is changing at the same rate as the instability of the blend, Verify input pressure stability. • Confirm the stability of the command voltage for the MFC. • Replace the MFC. • Check the O_2 sensor feedback when running sea altitude only. This will confirm the stability of the O_2 sensor
Flow rate is saturated, regardless of command. INDICATIONS: O_2 concentration is too low (MFC2 saturated) or concentration is to high (MFC1 saturated).	• This normally indicates a failure within the MFC. However, first check all PC412-ROBD2 steady state voltages. Follow previously recommended procedure (in POWER PROBLEM section) if voltages are not correct. • Replace MFC.
Displayed O2 value is not consistent with the altitude **Self calibration fails for test altitudes**	• Run an O_2 sensor calibration and reconfirm. • Run sea level altitude, O_2 value should be approximately 21% on display. • The voltage read between pins 2 and 3 of SK10-001-PCB should be approximately .7 to .8 VDC for sea level altitude, 21% O2. See appendix E. • Confirm the +/- 15 VDC power is being supplied to the SK10-001-PCB using appendix E as a guide. • Replace O_2 sensor or O_2 sensor PCB

FLOW/BLEND PROBLEMS (CONT.)	ACTION/SOLUTION
100% oxygen does not flow to the mask when the emergency dump switch is activated. **Dump switch self tests fail** Hint: The oxygen dump switch is wired to on of the PC416 input lines. The software polls this line frequently looking for the closure of the switch. When the software detects a closure, it activates the oxygen dump valve to provide oxygen to the front panel mask port. Notes: if the positive pressure option is installed, the bypass valve and oxygen dump valve activate together to provide positive pressure O_2	• If the dump switch does not illuminate, the internal contacts of the switch may be defective. Use appendix E, point to point wiring, to trace the problem. • When pressing the dump switch, audible clicking should be heard from the oxygen dump valve V1 and the bypass valve (if installed) V2. Power is sent to these valves via electrical harness E627 from PC416. Refer to appendix B and E for details. • Replace the defective component based on the results of monitoring the control signals from the dump switch to the solenoid valves via the PC416.
Gas flow is heard immediately upon turning the system power on.	• Make sure the oxygen dump switch is not activated • Measure the command voltage to the MFCs at PC412-ROBD2 test points. If other than zero volts, PC412-ROBD2 may be defective, replace. • If command voltage is zero, MFC or MFC cable may be defective, replace.

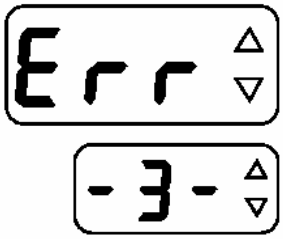
MISCELLANEOUS PROBLEMS	SOLUTION
Memory loss	• Battery on PC401 is low. Battery should be 3 VDC and no less than 2 VDC.
Low O_2 message appears when pressure is greater than 15 PSIG.	• Adjust the pressure switch to close when pressure drops to 10 PSIG. Pressure switch should open when pressure rises to approximately 13 PSIG. See procedure below. • Replace oxygen pressure sensor
BLP sensor pressure is not consistent with the normal operating BLP pressure	• Trouble shoot the pressure snsor feedback using appendix E, cable E626. • Replace BLP sensor A215 if necessary

Troubleshooting notes:

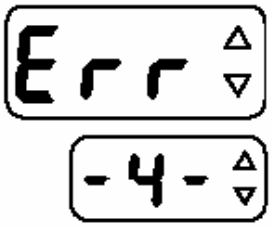
1. Be sure to use an ESD wrist strap or other static control, when handling electronics.
2. Refer to Appendix E for point to point wiring.
3. Refer to appendix B for complete list of detailed cable drawings and other electrical illustrations.
4. There are other appendices which may be useful for troubleshooting purposes, see list of appendices
5. If the symptoms are not listed in the troubleshooting guide, contact Environics' technical services
6. IMPORTANT: When lowering the left side panel for troubleshooting, be sure to unplug the fan first. This is the only component that does not have a long enough cable to fully extend.
7. IMPORTANT: When disconnecting and working with plumbing parts downstream of the oxygen dump valve and on the oxygen input line, be sure to where latex type gloves to keep oils off of the wetted surfaces.

Troubleshooting pulse oximeter problems

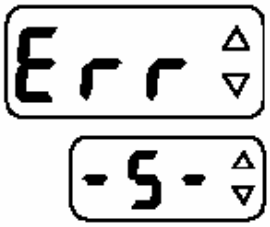
Certain conditions may generate special messages in the saturation and pulse rate displays. These displays and the conditions are listed below. Note that “Err” stands for error, but does not necessarily indicate a malfunction. Also, error conditions one and two are internal only, and are not displayed.



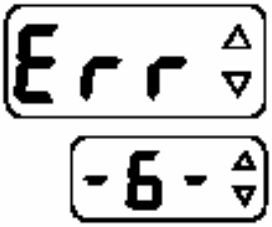
Low signal strength. Pulse strength as detected by the sensor is too small for proper monitor operation. This message will disappear when the problem is corrected.



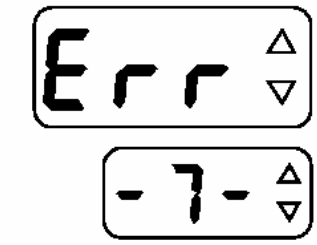
Insufficient light. Sensor is placed on a site too thick (or opaque) for adequate light transmission. This message will disappear when the problem is corrected.



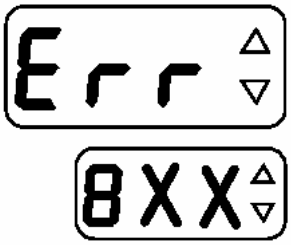
Pulse out of range. Pulse must be within 30 -250 beats per minute inclusive. This message will disappear when the problem is corrected.



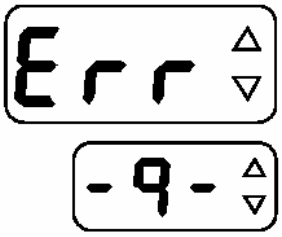
Light interference. Ambient light source (sunlight, warming lights, etc.) are interfering with sensor operation. Shield sensor from these light sources. This message will disappear when the problem is corrected.



Sensor faulty. Remove sensor from use and replace.



Monitor faulty. Record the error number that appears in the pulse rate display (XX will vary, depending upon the fault). Remove the monitor from use and contact qualified service personnel (report the number that appears in the pulse rate display).



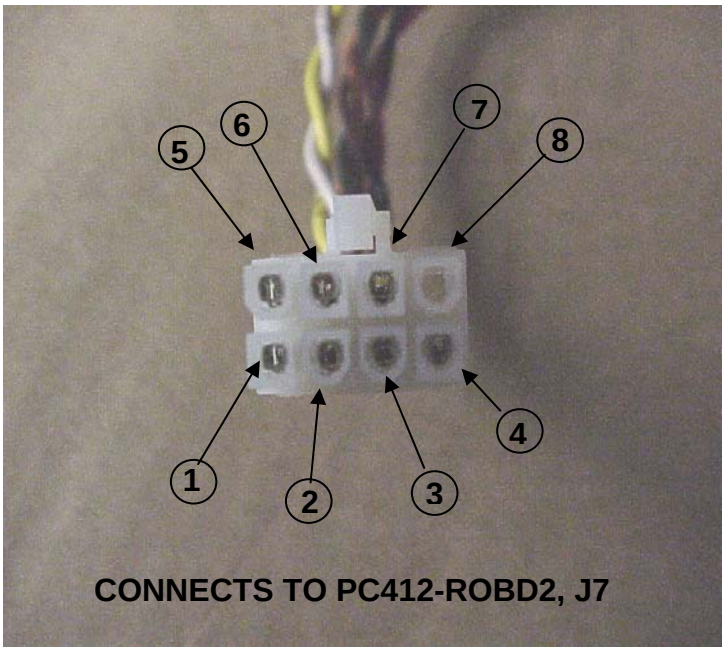
Bad Signal. Monitor not receiving valid signals from sensor. May be caused by excessive motion, cardiac arrhythmia or other situations leading to poor signal. Check subject status, reposition sensor. This message will disappear when the problem is corrected.

If the pulse oximeter will not power on and all other functions of the ROBD2 are working, then the problem may be the pulse oximeter power supply assembly A205, see appendix A.

For a point to point wiring diagram of the A205 power supply, see the wiring diagram, appendix E. The power supply contains its own fuse F302. Check the continuity of this fuse with the power cord of the system disconnected.

The pulse oximeter gets its power directly from the power entry module. It generates 12 VDC which is sent to the pulse oximeter board via cable E628.

Main DC power cable pinout



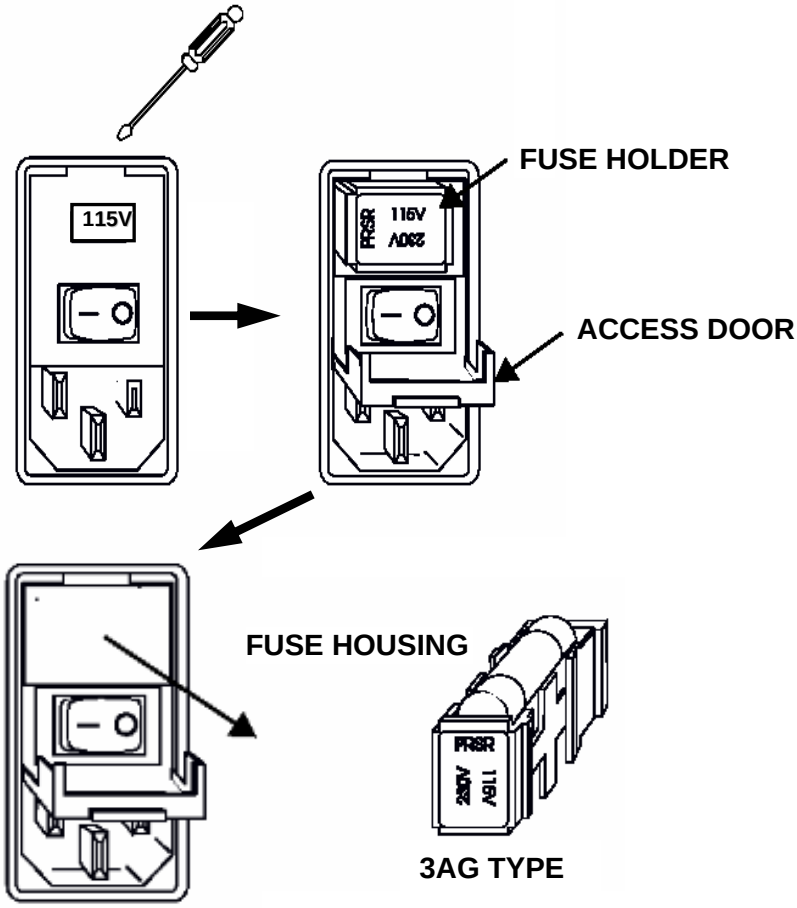
PIN NUMBER	VOLTAGE
1	+15 VDC
2	-15 VDC
3	GND
4	GND
5	GND
6	+5 VDC
7	+24 VDC
8	NC

E613-ROBD2 POWER CABLE DIAGRAM

REPLACING FUSES

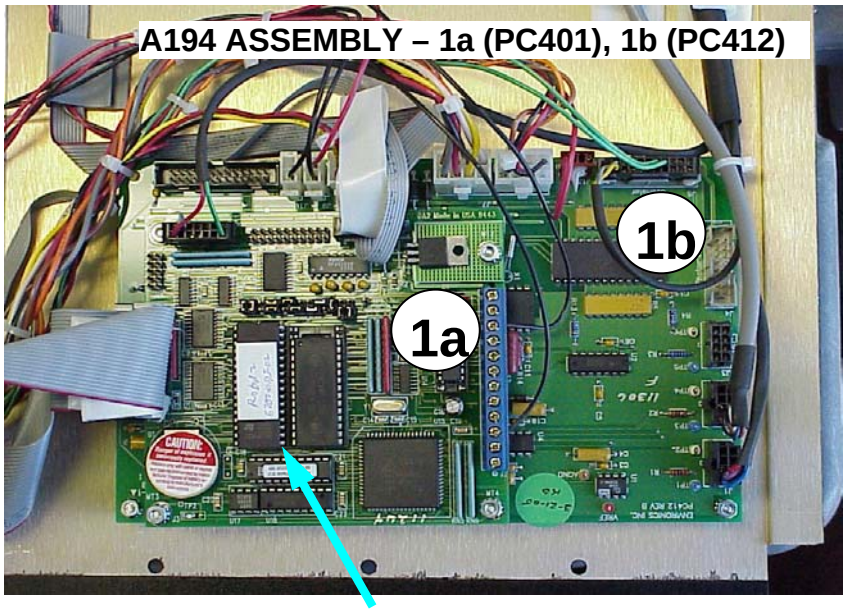
Using the troubleshooting guide, for a power related problem, the result may lead to this procedure.

1. Locate the power entry module on the rear panel and turn the power switch off.
2. Remove the power cord from the power entry module.
3. Take note of the voltage indicator position (normally 115 VAC). This module will be removed as part of this procedure and it is very important to reinstall it in the correct orientation.
4. Using a small flathead screwdriver, open the power entry module as shown below.
5. Gently pry out the red fuse holder.
6. Replace the defective fuse(s), reinstall the fuse holder and close the power entry module access door.
7. Reconnect the power cord and power the instrument on.

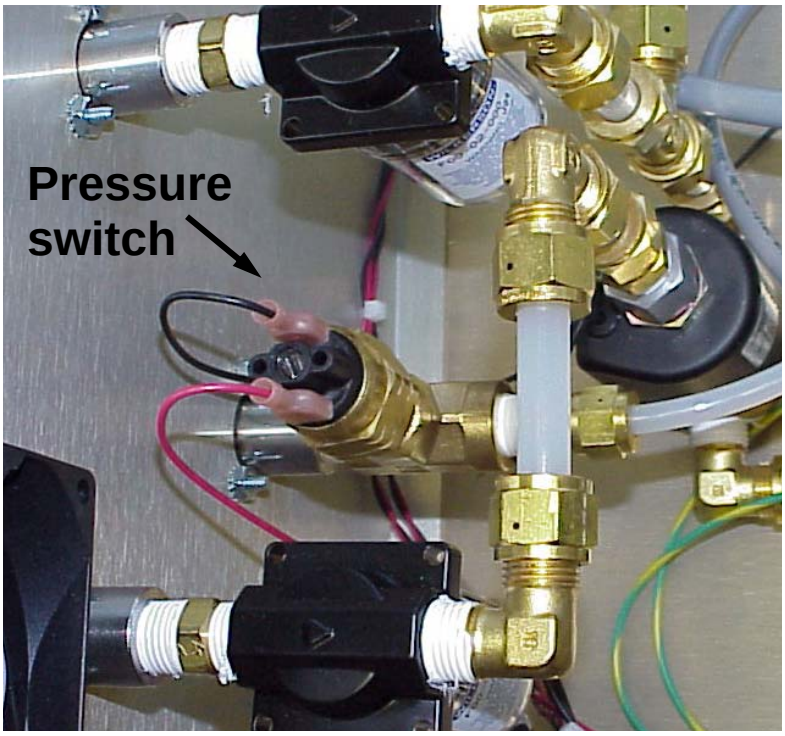


Replacing or updating software

1. Locate the power entry module on the rear panel and turn the power off.
2. Remove the power cord from the power entry module.
3. Remove the screws from the instrument cover and remove the cover. Remove the six screws from the right side panel of the instrument.
4. Lower the right side panel so it is parallel to the base of the unit; resting on a table top.
5. Locate the A194 shown in the system illustration drawing at the beginning of this manual. The software is in the PCB labeled 1a in that illustration (PC401). Below is an enlarged view of that part of the illustration drawing.
6. Use an ESD wrist strap when working with electronics. Using a small flat head screwdriver, remove the old software IC, paying close attention to the orientation of the EPROM IC in the socket.
7. The new software chip revision should contain a higher number than the last. Currently, as of the original release date of this manual, the software revision is 0.96-01.
8. Making sure that the pins are even and properly aligned with the socket, press in the new software IC.
9. Return the side panel to its original upright position and screw it into place.
10. Place the cover back onto the instrument and power the unit on, making sure the new software revision has been recognized in the startup screen.
11. Screw the cover into place.



Adjusting the low oxygen pressure switch

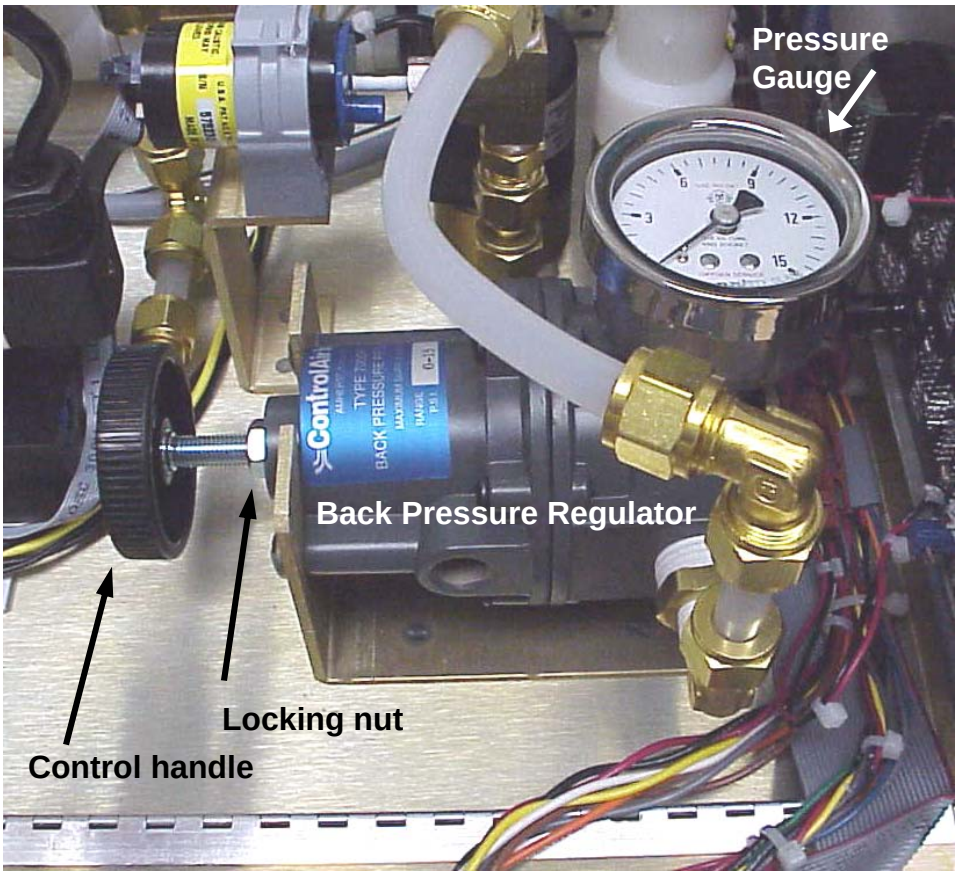


SETTING THE O_2 PRESSURE SWITCH TO 10 PSIG FALLING

1. Remove the two terminal connections on the O_2 pressure switch (black and red wires). The pressure switch is connected to the rear panel by a series of fittings. Refer to assembly A213 in appendix A and the illustration above.
2. Connect an ohm meter across the two terminals of the pressure switch.
3. Using an accurate pressure test gauge and pressure relieving regulator, connect oxygen (or air) to the Oxygen port at approximately 10 PSIG. Important: Only use oxygen if the pressure relieving regulator is O_2 compatible.
4. Adjust the pressure switch slotted adjustment (top) until the pressure switch turns on (zero ohms) when falling below 10 PSIG and turns off when rising above approximately 12 to 15 PSIG. The key setting is 10 PSIG falling pressure. The 12 to 15 PSIG range is controlled by the dead-band of the pressure switch. Once it is set, adjust the pressure a few times to insure the repeatability of the switch. This adjustment does not lock.

Adjusting the internal back pressure regulator A212

1. Confirm that with the system in standby mode (no flow) the pressure gauge reads zero.
2. In the TEST FLOW mode in the SYSTEM mode, command 25 LPM for MFC1 and press enter.
3. On the internal pressure gauge (G1), make sure BPR1 is set to read 5 PSIG.
4. To adjust, loosen the locking nut on the shaft of the handle and turn the control handle clockwise to increase and counterclockwise to decrease the pressure.
5. Lock down the nut on the shaft of the BPR1.
6. Stop and start MFC1 flow a few times to insure the setting is repeatable.
7. Exit the TEST FLOW mode.



A212, BPR1

Adjusting needle valve assembly A211

Three of four primary operating modes supply varying amounts of pressure to the pilot under test, dependent upon the simulated altitude. This procedure will use one of those modes, the PPT (Positive Pressure Training) mode, to set and lock down the needle valve. The needle valve produces back pressure to the mask in the operating modes.

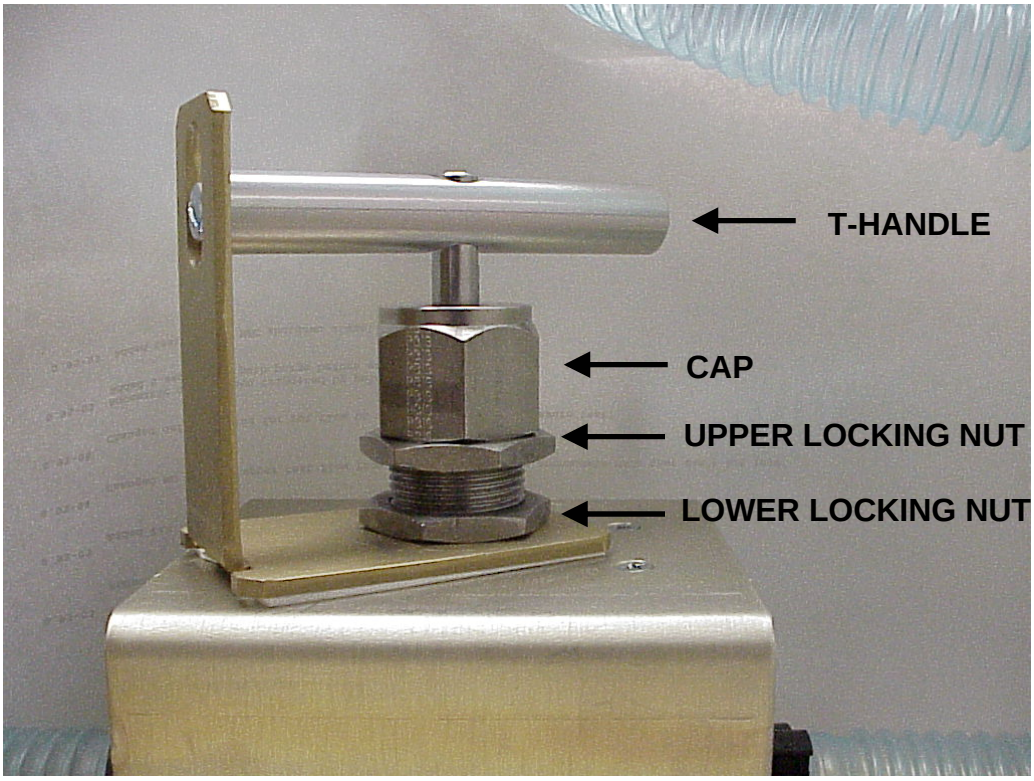
To run this test, the SELF TEST and SELF CALIBRATION procedure must be completed and the system must be in the ready mode. Gases must be connected and pressurized. Because this test consumes 95 LPM air; clean, dry, oil free air from a compressor system can also be used to conserve bottled breathing air.

1. Remove the cap from the breathing bag port and install the 3 liter breathing bag and breathing bag clamp.

2. With a rubber plug (reference www.mcmaster.com, part number 9545K16) plug the breathing mask connector on the front panel.

3. Make sure the breathing loop pressure port, on the rear panel of the system, is plugged and the plug is removed from the VENT port.

4. If this is a first time adjustment, because the assembly has been replaced, loosen the lower locking nut on the A211 so the T handle moves freely, see diagram below. If this is a readjustment, proceed to step 6.



5. Turn the handle counterclockwise to decrease the adjustment. This prevents overpressure for the next step. This is usually only required for first time adjustment.

6. From the main menu, select **START**. The system will purge with air for a few seconds.

7. Enter the **PPT** mode; air will start flowing. The O2 reading on the screen should be approximately 21% and the BLP (Breathing Loop Pressure) should be approximately .5 to .8; BLP is in "H_2O.

8. Select **START.** The system will now flow 95 LPM air. The O2 reading should remain at 21%. If the needle valve is not decreased enough, the system may shutdown and provide 100% O2. This is a built in safety feature to prevent the BLP from getting to high. If this happens, select OK to stop the flow of O2 and rerun steps 5-9.

9. While running 95 LPM in the PPT mode, make sure the command and response voltages to the MFCs are consistent, these voltages can be measured at the PC412. This ensures that the system is delivering the right amount of flow for the needle valve adjustment. The adjustment is very sensitive and can be impacted by varying flow rates. To put it in perspective, once the adjustment is made, the needle valve will produce 10" H2O or .36 PSI back pressure at 95 LPM flow.

10. Increase the needle valve adjustment until the BLP reads between 10 and 10.5 within 5 seconds after pressing **START**. The pressure should not rise above 11.5" within 1 minute after pressing **START**. This pressure should remain stable and not fluctuate. Some reasons for fluctuating readings could be a leaking bypass valve (large blue solenoid valve) or an improperly installed A211 (backwards).

11. Tighten the lower locking nut while running. Stop and start the PPT mode a few times to ensure the adjustment generates consistent results.

12. The upper locking nut should be tight against the cap, as provided by the manufacturer.

Testing the pulse oximeter and battery backup

1. Power on the pulse oximeter.
2. After it has gone through its self-test routine, both the pulse oximeter displays will show 3 dashes.
3. Press the Sp02 key and then the down arrow key once to change the factory default setting from 100 to 99.
4. Press the Sp02 key again and then the up arrow key once to change the factory default setting from 85 to 86.
5. Press the Sp02 key a third time to put the pulse oximeter in the ready mode.
6. Press the pulse rate key ( ) and then the down arrow key once to change the factory default setting from 150 to 149.
7. Press the pulse rate key again and then the up arrow key once to change the factory default setting from 40 to 41.
8. Press the pulse rate key a third time to put the pulse oximeter back into the ready mode.
9. Turn power to the ROBD2 off for approximately one minute.
10. Turn the ROBD2 power back on.
11. Turn the pulse oximeter power on.
12. After the self test routine, press the SpO2 button once and again to verify the retention of the values 99 and 86.
13. Press the pulse rate key once and again to verify the retention of the values 149 and 41.
14. Press the pulse rate key a third time to put the pulse oximeter back into ready mode.
15. Plug in pulse oximeter finger probe (Environics # XJ007) and attach to pointer finger.
16. Values should appear on the two displays of the pulse oximeter display. The SpO2 number should be in the high 90s and the pulse value will be resting pulse rate.
17. Disconnect the finger probe from the pointer finger and the pulse oximeter alarm should sound.
18. Press the mute ( ) key once to mute the alarm.

Checking the pressure sensor and O2 sensor ADC

1. Power the unit on and press the CYL key.
2. Select the OPTION mode.
3. Arrow down to the ADMIN mode and press the ENTER key. The message "admin mode enabled" should appear on the top row. If prompted for a password, enter the factory default 1234.
4. Exit and press the MENU key.
5. Enter the SYSTEM mode, arrow down to CALIBRATE ADC and press ENTER.
6. Enter the number 12.
7. On the top line of the calibration table, the "RESP =" value should be in approximate range of .75 and .81 V. This is the Oxygen sensor ADC. This is the voltage read back from the oxygen sensor for 21% O2 (or air).
8. Exit and enter Calibrate ADC again.
9. Enter the number 11.
10. On the top line of the calibration table, the "RESP =" value should be approximately 2.25 V. This is the pressure transducer ADC. The pressure transducer reads back 2.25 VDC for 0" H20.

Calibrating adc 11 (pressure sensor)

1. Remove the cap from the breathing bag port if present.
2. In ADC 11 cal table, add .003 to the value read in step 10 and enter that value into column 1 of line one in ADC 11. Also, record this value for the ADC calibration sheet for this device. Line two should always have 4.250 and 30.0 entered into columns one and two respectively. These are the only two lines with data. Exit and save the new data.

SAMPLE ADC 11 CAL TABLE:

ADC 11	RESP = 2.2520V
1 = 2.2550	0.0000
2 = 4.2500	30.000

NOTE: CALIBRATION OF ADC 12 IS PERFORMED BY THE SYSTEM IN THE SELF CALIBRATION ROUTINE. THIS IS DONE IN THE POST CALIBRATION PROCEDURE

Leak test

Physical setup

1. Remove the ROBD2 cover, unplug fan, remove the screws from the side panels and fold down both hinged side panels.
2. Connect a back pressure regulator to the vent port as shown in diagram 1, no Teflon tape required. This assembly can be purchased from Environics, or acquire a back pressure regulator that has a range of 0 to 2 PSIG. This type of regulator can be purchased from Control Air Inc. The gauge must read "H_20.
3. Connect the red shipping cap to breathing bag port as shown in diagram 1.
4. Insert black tapered rubber plug (reference www.mcmaster.com, part number 9545K16) into the breathing mask port as shown in diagram 2.
5. Ensure the metal plug is installed into the breathing loop pressure port, see diagram 3.
6. Make sure the external back pressure regulator is decreased all the way.
7. Install temporary fittings into the air, N2 and oxygen ports and supply air to all three at 30-40 PSIG. Diagram 4 shows a sample setup used by the factory. If the hose and regulator option has been installed onto the system being leak tested, extra fittings can be purchased from Environics for leak testing.

Performing the leak test

1. Power the unit on and select CYL from front panel menu.
2. Put the system into the ADMIN mode
3. Exit back to the READY mode.
4. Press the menu key until the SYSTEM mode appears.
5. Enter the SYSTEM mode (F3), arrow to TEST FLOW and press ENTER.
6. Enter 5 LPM for MFC1 and press UPDATE (F1).
7. Adjust the external BPR for 10" H20.
8. Use leak test formula 300 for oxygen systems to ensure bubble tight connections for all threaded fittings and tubing connections. Shake the formula until the top of the bottle fills with bubbles. Pull out the applicator tube until the inside end of the tube is within the envelope of the bubble chamber in top of the bottle. Apply bubbles, not liquid to all plumbing connections. Refer to diagram 5; some parts of the system are at 40 PSIG, others are at 5 PSIG and the remaining parts in the breathing loop are at 10" H20. When using the solution over electrical connections, be sure to use absorbent paper towels to catch any drip. When finished with a connection, wipe away any remaining bubbles.

DIAGRAM 1

DIAGRAM 2

DIAGRAM 3

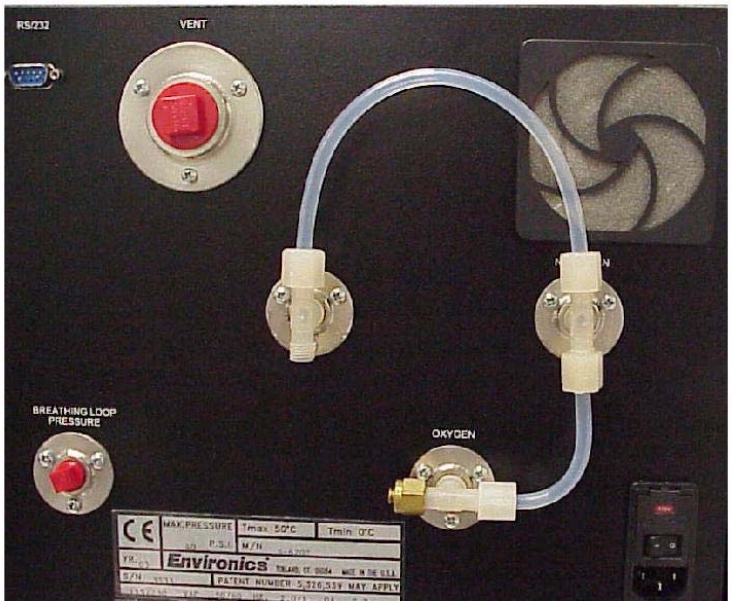


DIAGRAM 4

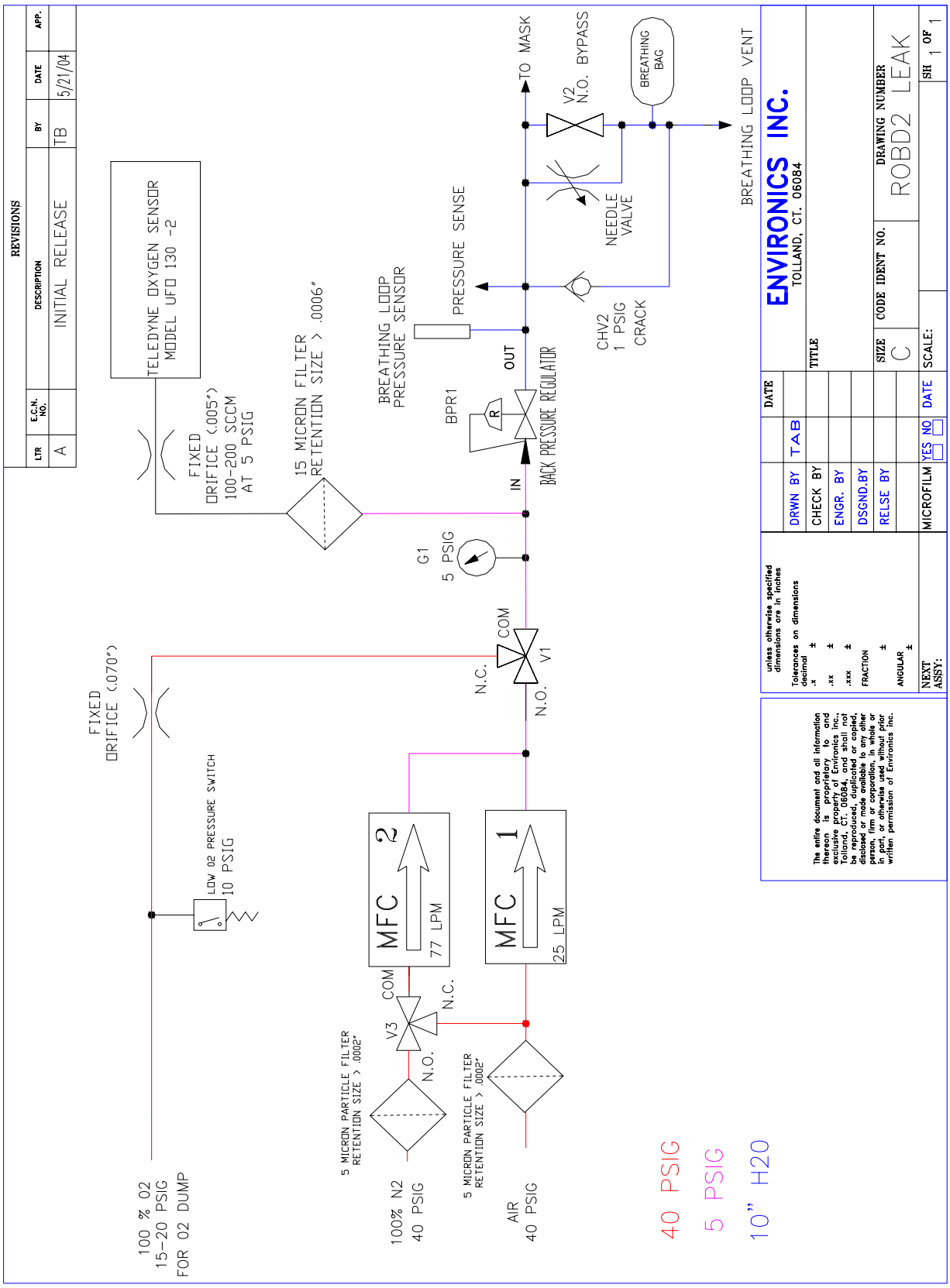

REVISIONS
LTR
E.C.N. NO.
DESCRIPTION
BY
DATE
APP.
A
INITIAL RELEASE
TB
5/21/04
TELEDYNE OXYGEN SENSOR
MODEL UFO 130 -2
FIXED
ORIFICE (.005")
100-200 SCCM
AT 5 PSIG
15 MICRON FILTER
RETENTION SIZE > .0006"
BREATHING LOOP
PRESSURE SENSOR
PRESSURE SENSE
TO MASK
V2
N.O. BYPASS
BREATHING
BAG
BREATHING LOOP VENT
NEEDLE
VALVE
CHV2
1 PSIG
CRACK
BPR1
R
OUT
IN
BACK PRESSURE REGULATOR
G1
5 PSIG
COM
V1
N.C.
N.O.
FIXED
ORIFICE (.070")
LOW O2 PRESSURE SWITCH
10 PSIG
MFC 2
77 LPM
MFC 1
25 LPM
COM
V3
N.C.
N.O.
5 MICRON PARTICLE FILTER
RETENTION SIZE > .0002"
5 MICRON PARTICLE FILTER
RETENTION SIZE > .0002"
100 % O2
15-20 PSIG
FOR O2 DUMP
100% N2
40 PSIG
AIR
40 PSIG
40 PSIG
5 PSIG
10" H20
ENVIRONICS INC.
TOLLAND, CT. 06084
TITLE
DRAWING NUMBER
ROBD2 LEAK
SIZE
C
CODE IDENT NO.
SCALE:
SH 1 OF 1
DATE
DRWN BY
TAB
CHECK BY
ENGR. BY
DSGND.BY
RELSE BY
MICROFILM
YES NO
DATE
unless otherwise specified
dimensions are in inches
Tolerances on dimensions
decimal
.x ±
.xx ±
.xxx ±
FRACTION
±
ANGULAR
±
NEXT
ASSY:
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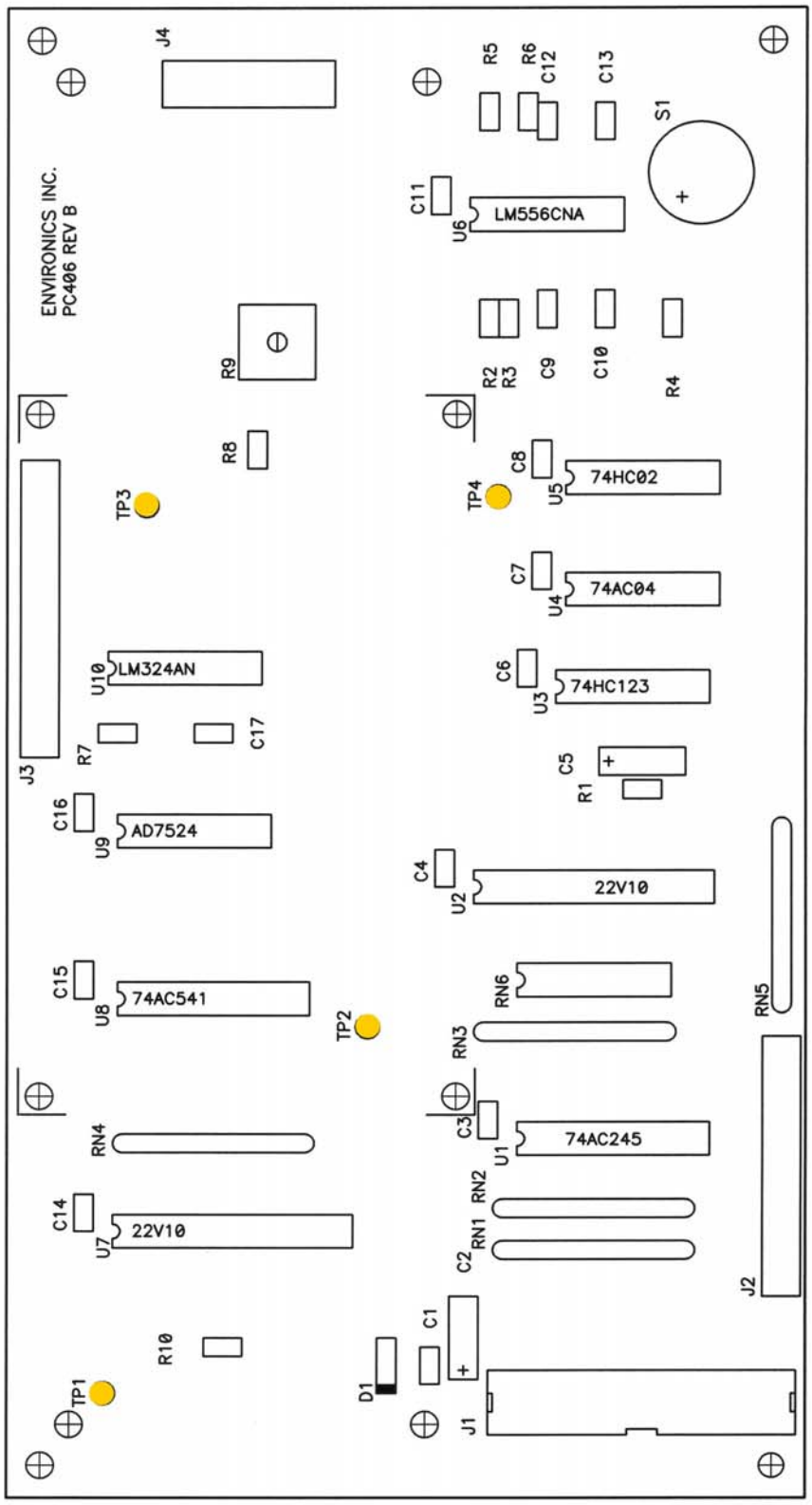
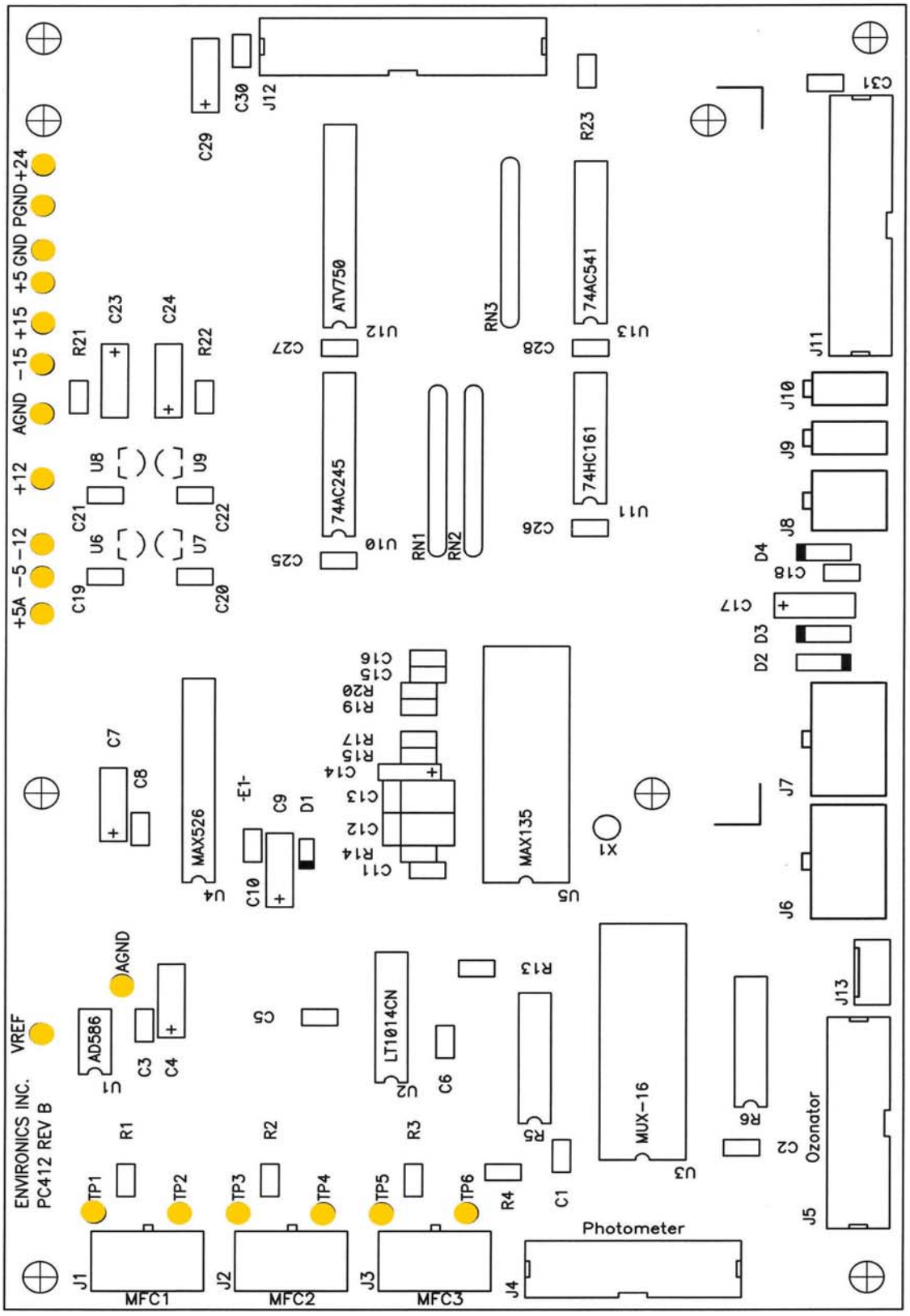
DIAGRAM 5

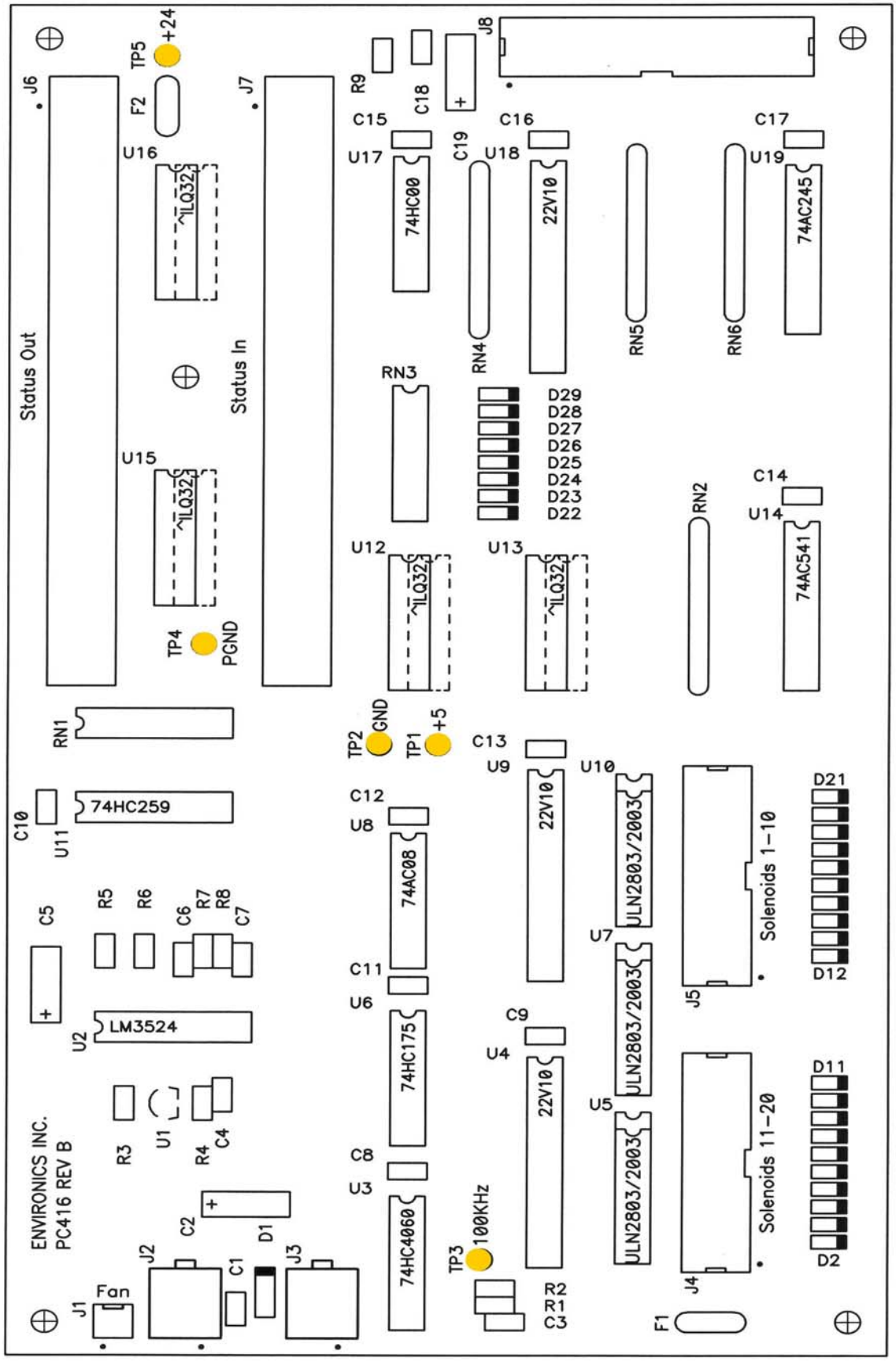
PCB assembly drawings



PC406

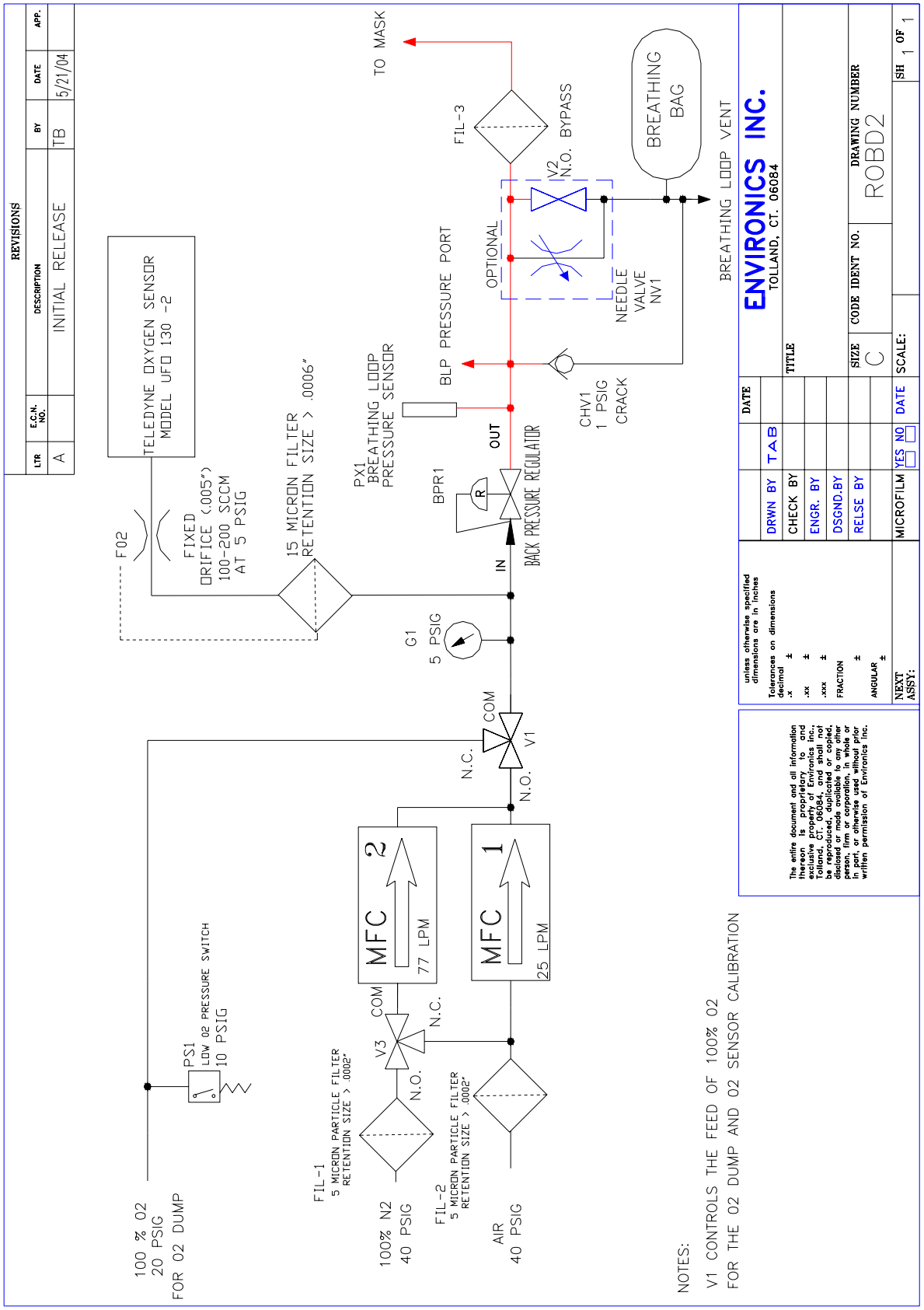

+5A -5 -12 +12 AGND -15 +15 +5 GND PGND +24
ENVIRONICS INC.
PC412 REV B
VREF
AGND
AD586
MAX526
LT1014CN
MAX135
MUX-16
ATV750
74AC245
74AC541
74HC161
Photometer
Ozonator
MFC1
MFC2
MFC3
J1
J2
J3
J4
J5
J6
J7
J8
J9
J10
J11
J12
J13
TP1
TP2
TP3
TP4
TP5
TP6

PC412-ROBD2


ENVIRONICS INC.
PC416 REV B
Status Out
Status In
Fan
Solenoids 1-10
Solenoids 11-20
74HC259
LM3524
74AC08
74HC175
74HC4060
74HC00
22V10
ULN2803/2003
74AC245
74AC541
100KHz
PGND
GND
+5
+24

PC416

P&ID


REVISIONS
LTR
E.C.N. NO.
DESCRIPTION
BY
DATE
APP.
A
INITIAL RELEASE
TB
5/21/04
TELEDYNE OXYGEN SENSOR
MODEL UFO 130 -2
FIXED
ORIFICE (.005")
100-200 SCCM
AT 5 PSIG
F02
15 MICRON FILTER
RETENTION SIZE > .0006"
PX1
BREATHING LOOP
PRESSURE SENSOR
BLP PRESSURE PORT
OPTIONAL
TO MASK
FIL-3
V2
N.O. BYPASS
BREATHING
BAG
BPR1
R
OUT
IN
BACK PRESSURE REGULATOR
CHV1
1 PSIG
CRACK
NEEDLE
VALVE
NV1
BREATHING LOOP VENT
G1
5 PSIG
COM
N.C.
N.O.
V1
MFC 2
77 LPM
MFC 1
25 LPM
V3
COM
N.C.
N.O.
FIL-1
5 MICRON PARTICLE FILTER
RETENTION SIZE > .0002"
FIL-2
5 MICRON PARTICLE FILTER
RETENTION SIZE > .0002"
PS1
LOW 02 PRESSURE SWITCH
10 PSIG
100 % 02
20 PSIG
FOR 02 DUMP
100% N2
40 PSIG
AIR
40 PSIG
NOTES:
V1 CONTROLS THE FEED OF 100% 02
FOR THE 02 DUMP AND 02 SENSOR CALIBRATION
unless otherwise specified
dimensions are in inches
Tolerances on dimensions
decimal
.x ±
.xx ±
.xxx ±
FRACTION
±
ANGULAR ±
DRWN BY TAB
CHECK BY
ENGR. BY
DSGND.BY
RELSE BY
DATE
NEXT ASSY:
MICROFILM YES NO
DATE
SCALE:
SIZE
C
CODE IDENT NO.
DRAWING NUMBER
ROBD2
SH 1 OF 1
TITLE
ENVIRONICS INC.
TOLLAND, CT. 06084
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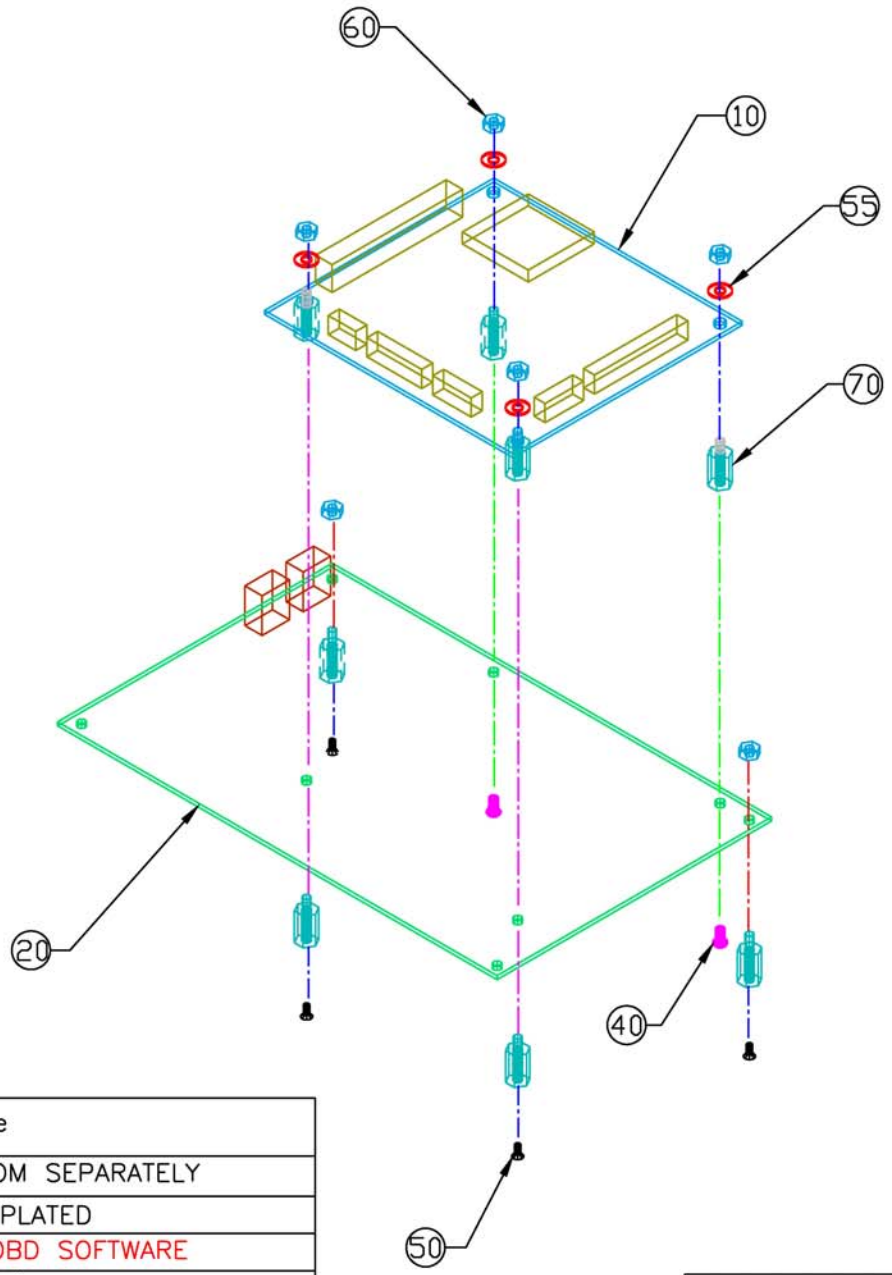
APPENDIX A: Assembly parts list and illustration drawings

A1: A194, PC412-ROBD2 and PC401-1D PC boards
A2: A204, pulse oximeter battery backup
A3: A222, pulse oximeter power supply
A4: A206, terminal strip assembly
A5: A207, Oxygen sensor assembly
A6: A208, Oxygen dump valve assembly (V1 in P&ID)
A7: A209, Crossover valve assembly (V3 in P&ID)
A8: A210, Bypass valve assembly (option, V2 in P&ID)
A9: A211, Needle valve assembly (option, NV1 in P&ID)
A10: A212, Back pressure regulator assembly (BPR1 in P&ID)
A11: A213, Rear panel assembly
A12: A213 parts list
A13: A214, Front panel assembly
A14: A214 parts list
A15: A215, BLP pressure transducer (PX1 in P&ID)
A16: A221, mask particle filter assembly (FIL-3 in P&ID)

A194 PARTS LIST



NOTES:

1. ITEM 30 NOT SHOWN
2. ITEM 50 MOUNTS THROUGH CHASSIS TO ITEM 70.

Item	Qty	Environics' #	Description	Note
10	1	PC401-1C	MICRO-COMPUTER PCB	ORDER EPROM SEPARATELY
20	1	PC412-ROBD2	ANALOG INTERFACE PCB	6-32 ZINC PLATED
30	1	UK18-009*	BLANK EPROM	*SPECIFY ROBD SOFTWARE
40	2	HA0113-0440C04	PHILLIPS PAN HEAD SCREW	4-40 X 1/4", ZINC PLATED
50	4	HA0115-0440B04	PHILLIPS FLAT HEAD SCREW	4-40 X 1/4", BLACK OXIDE
55	4	HA0699-0800C03	PLASTIC ISOLATION WASHER	.14" I.D., 5/16" O.D., 1/32" THICK
60	6	HA0799-0440C00	KEPT NUT, 4-40	ZINC PLATED
70	8	HA08-0440A8	STANDOFF, MALE FEMALE	4-40 X 1/2" ALUMINUM

Environics Inc
TOLLAND, CT 06084-2805

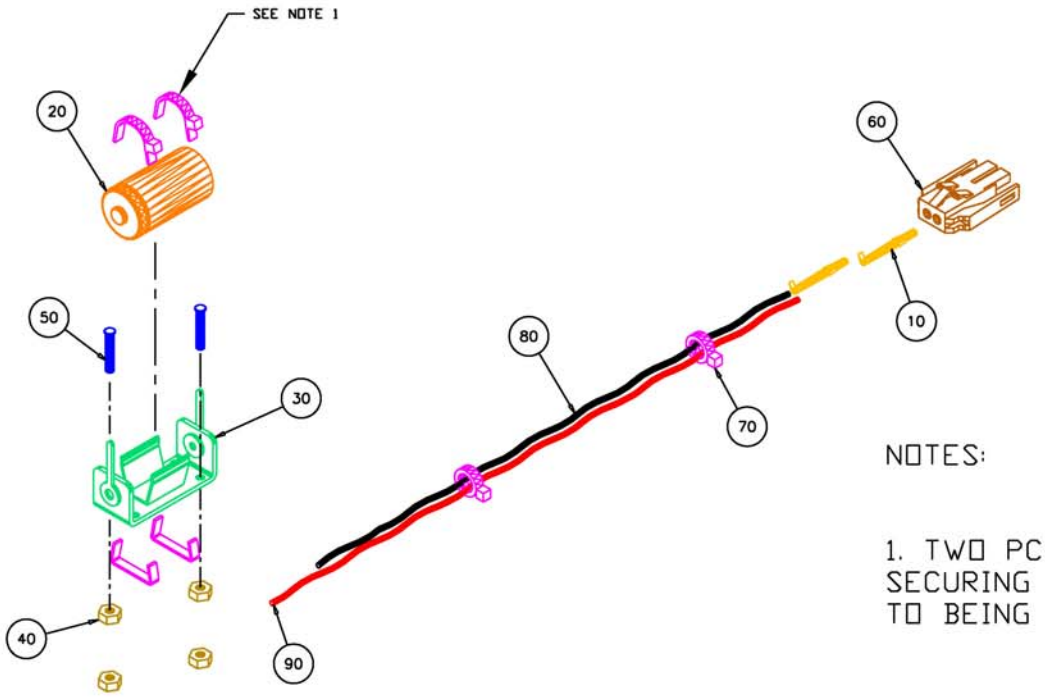
TITLE
PC401 TO PC412
SUB ASSEMBLY
FOR S6100/S6103

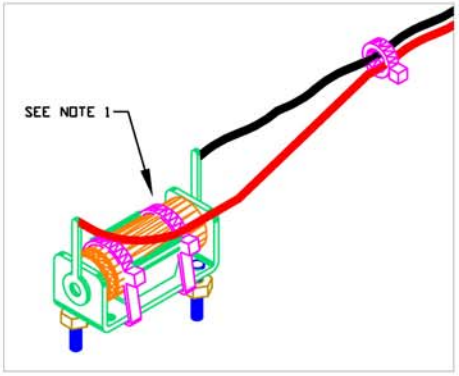
SIZE B | REVISION B | DWG NO A194

SCALE NONE | WEIGHT | SHEET 1 OF 1

A204 PARTS LIST

A2





NOTES:

1. TWO PCS. OF ITEM 70 TO BE USED FOR SECURING BATTERY TO BATTERY HOLDER PRIOR TO BEING PLACED IN SYSTEM.

Item	Qty	Environics' #	Description	Note
10	2	AJ06-001-GF31	CONTACT, SOCKET	
20	1	BK05-002	BATTERY LITHIUM 3V	2/3 A
30	1	CJ001	BATTERY HOLDER	
40	4	HA0799-0440C00	4-40 KEPT NUT	ZINC PLATED
50	2	HA0899-0440D06	4-40 PEM STUD	3/8" LONG, SS
60	1	HJ08-003-M02	HOUSING, SOCKET 2P	
70	4	WA01-01-040	WIRE TIE TYPE 1	CLASS 1 (4" LG)
80	1	WJ03-G1-A	WIRE LEAD 22 AWG BLK	11 INCHES LONG
90	1	WJ03-G1-C	WIRE LEAD 22 AWG RED	11 INCHES LONG

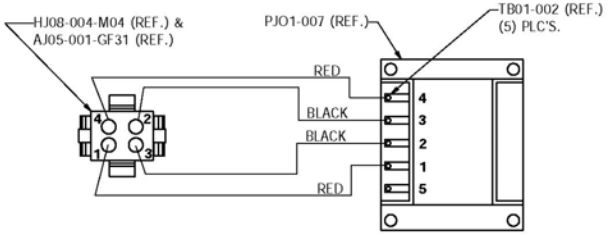
Environics Inc
TOLLAND, CT 06084-2805

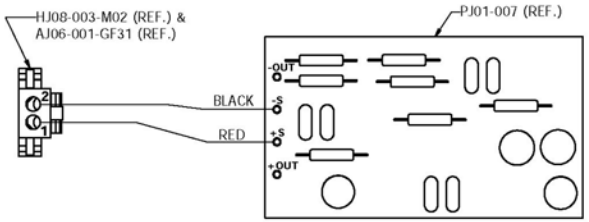
TITLE
BATTERY HOLDER
SUB ASSY
ROBD2

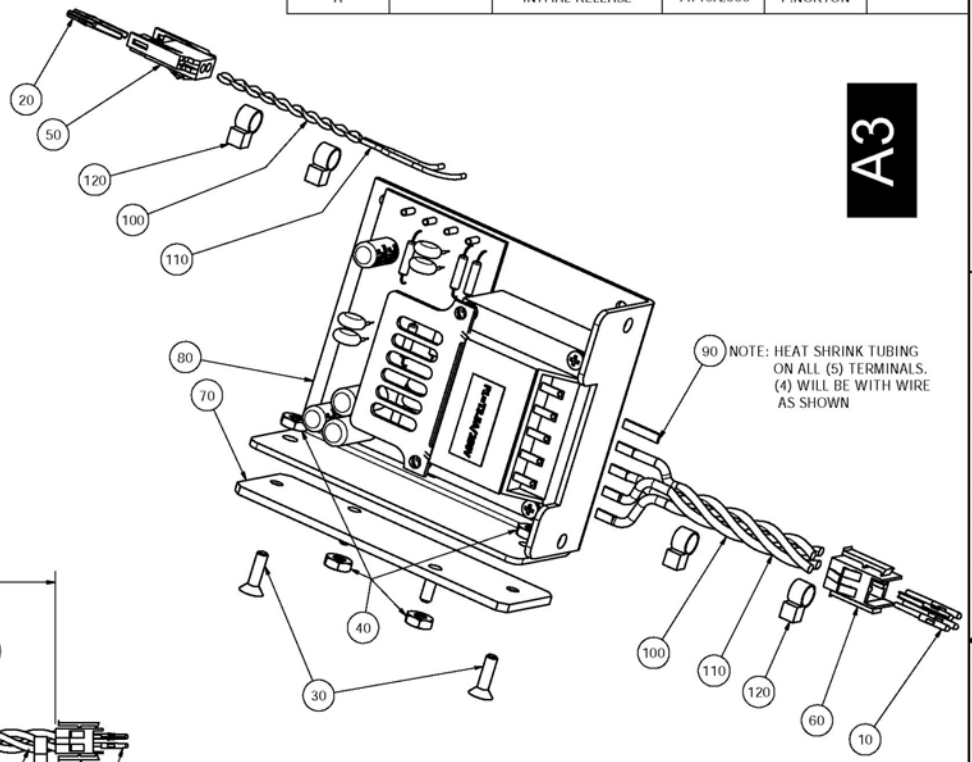
SIZE	REVISION	DWG NO
B	A	A204

SCALE NONE | WEIGHT | SHEET 1 OF 1

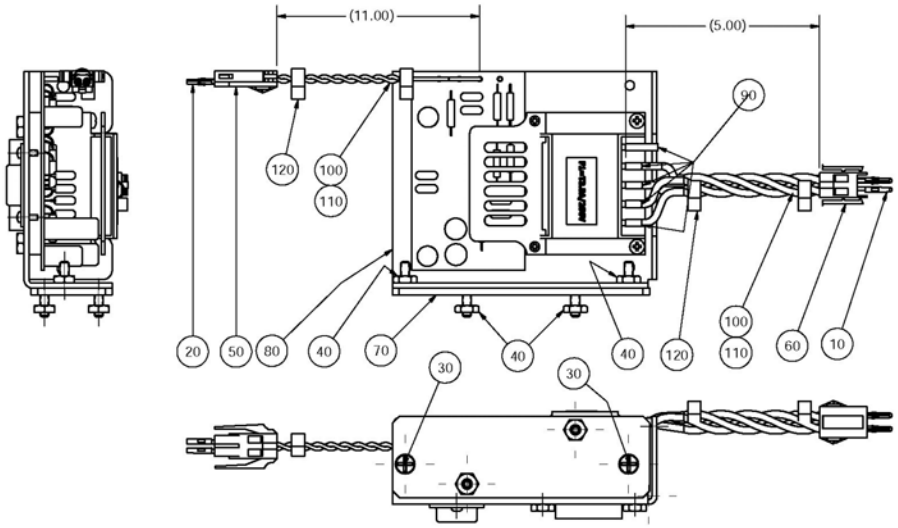
REVISION HISTORY					
REV	ECN#	DESCRIPTION	DATE	DFT'R.	APPROVED
A	·	INITIAL RELEASE	11/16/2006	P.NORTON	·







A3



ITEM	QTY	PART NUMBER	DESCRIPTION
120	4	WA01-01-040	TIE DOWN
110	2 FT.	WJ03-G1-C	WIRE RED
100	2 FT.	WJ03-G1-A	WIRE BLACK
90	5	TB01-002	HEAT SHRINK TUBBING
80	1	PJ01-007	POWER SUPPLY
70	1	M0532	MOUNT PLATE
60	4	HJ08-004-M04	CONNECTOR
50	2	HJ08-003-M02	CONNECTOR
40	4	HA0799-0832C00	ZINK PLATE
30	2	HA0115-0832C08	FLAT HD. SCR.
20	2	AJ06-001-GF31	PIN FEMALE
10	4	AJ05-001-GF31	PIN MALE

Parts List

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UNLESS OTHERWISE SPECIFIED
DIMENSION ARE IN INCHES
TOLERANCE ON

FRACTION	DECIMALS	ANGLES
± 1/8	.X ± .020	± 1°
	.XX ± .010	
	.XXX ± .005	

DRAWN pnorton	DATE 11/16/2006	
APPROVED	DATE	
MATERIAL: AS NOTED		
S/N		

Environics Inc.®
TOLLAND CT. 06084-2805 (860) 872-1111

TITLE
SUB ASS'Y.
OXIMETER PWR. SUPPLY
ROBD 2

SIZE	DWG NO	REV
C	A222	A

SCALE | SHEET 1 OF 1

A4

A206 PARTS LIST

REVISIONS						
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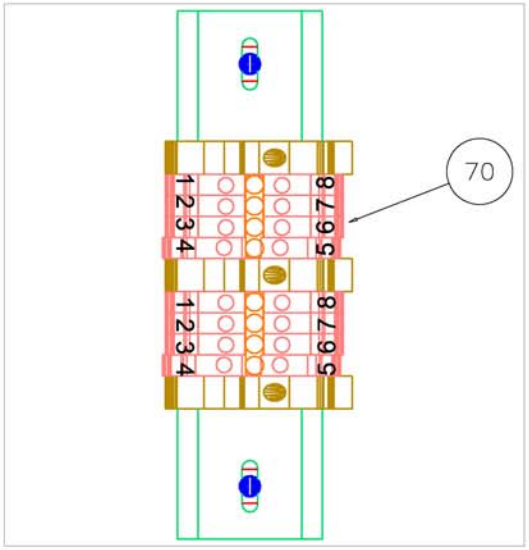
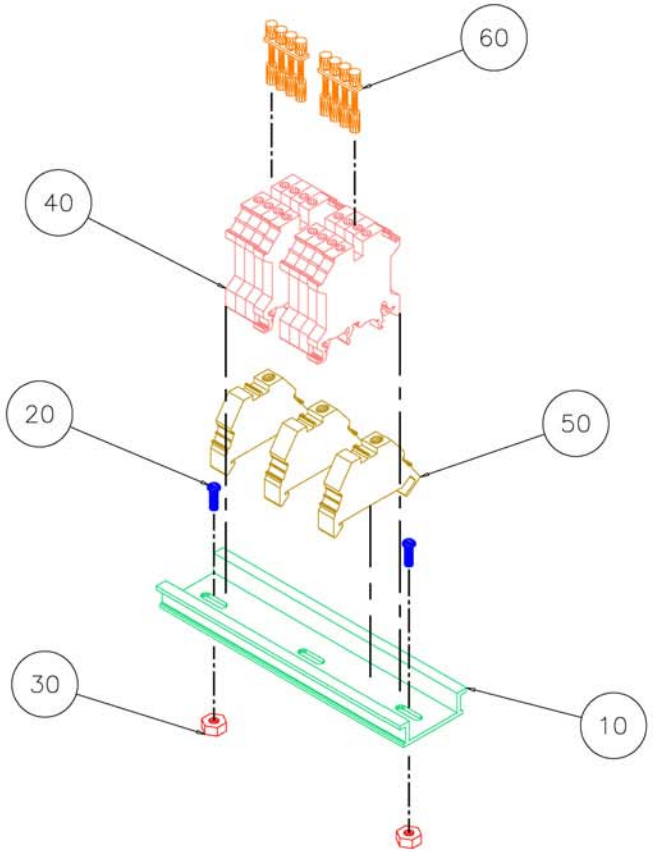
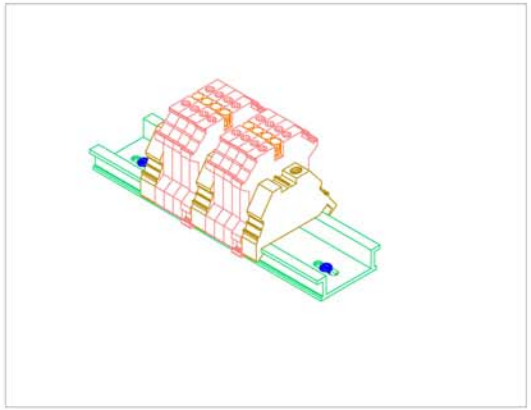
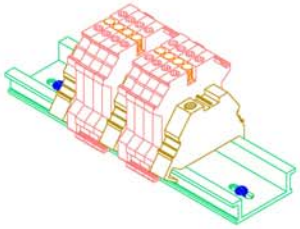




LEFT FRONT ISO VIEW



RIGHT REAR ISO VIEW



Item	Qty	Environics' #	Description	Note
10	1	EA09-032	ALUMINIUM DIN RAIL	5 INCHES LONG
20	2	HA0101-0632C06	PAN HEAD SCREW	6-32 ZINC PLATED
30	2	HA0718-0632C00	KEPT NUT	6-32 ZINC PLATED
40	8	HJ22-001-002	TERMINAL BLOCK	FEED THRU
50	3	HJ22-001-ES	TERMINAL BLOCK	END STOP
60	2	HJ22-001-JUMP	TERM.BLOCK JUMPER	FOUR POLE
70	20	HJ22-001-LAB	TERM.BLOCK LABEL	1-10

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ±1/8 | DECIMALS .X ±0.100 .XX ±0.010 .XXX ±0.005 | ANGLES ±1°

MATERIAL:

FINISH:

SIGNATURES | DATE
DRAWN BY: C.SHAW | 2/4/04
CHECKED BY:
APPROVED BY:
CUST.NAME & NO.

Environics Inc
TOLLAND, CT 06084-2805

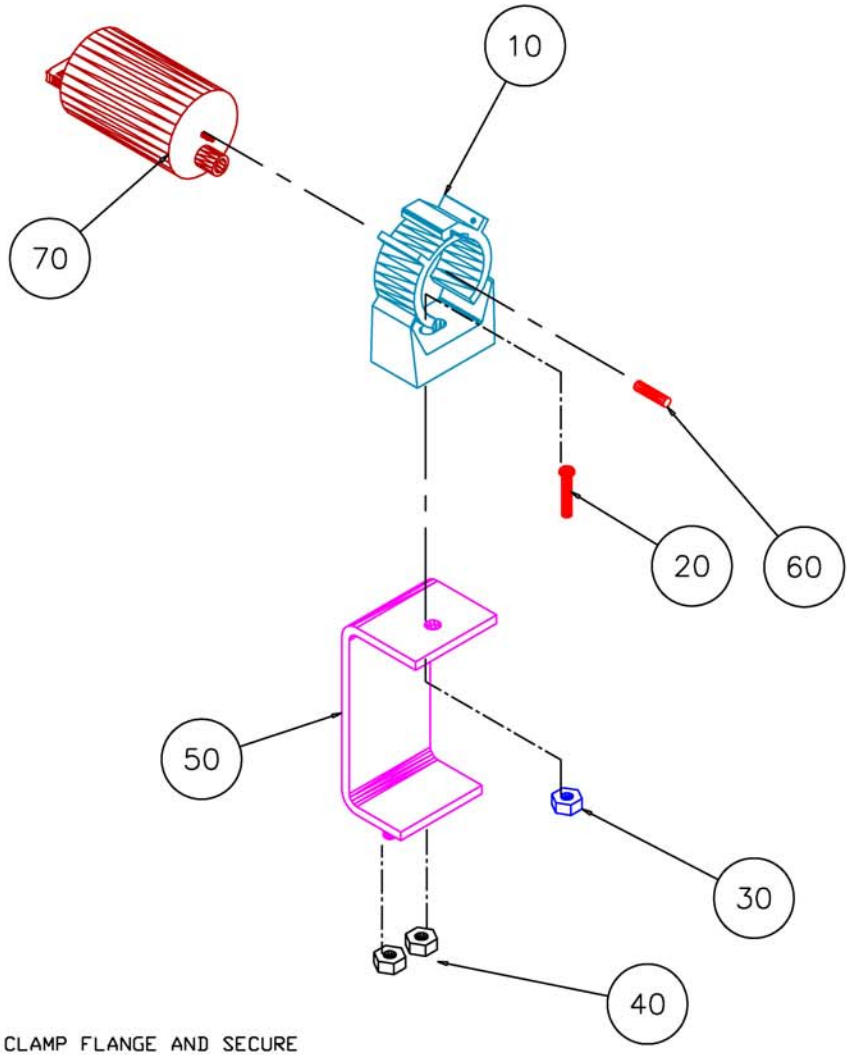
TITLE
TERMINALS, DIN RAIL MOUNT
SUB ASSY
ROBD2

SIZE	REVISION	DWG NO
B	A	A206

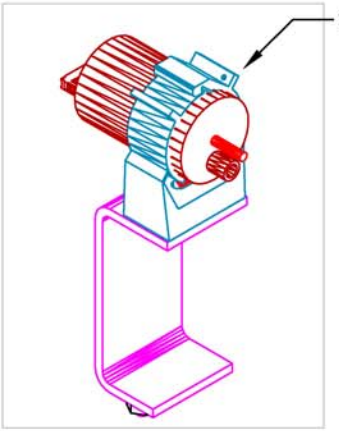
SCALE NONE | WEIGHT | SHEET 1 OF 1

A207 PARTS LIST

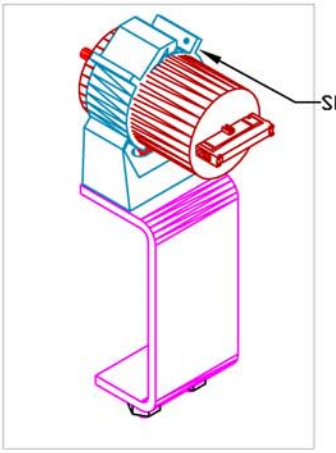
A5



LEFT FRONT ISO VIEW



RIGHT REAR ISO VIEW



NOTES:

DRILL .062 DIA. HOLE 2 PLCS. IN CLAMP FLANGE AND SECURE WITH RB02-00-00015 (STAINLESS STEEL SAFETY WIRE).

Item	Qty	Environics #	Description	Note
10	1	CA01-001-19	NYLON CLAMP	
20	1	HA0113-0632C10	PHILLIPS HEAD SCREW	6-32 X 5/8" ZINC PLATED
30	1	HA0718-0632C00	6-32 NUT KEPT	ZINC PLATED
40	2	HA0799-0832C00	8-32 KEPT NUT	ZINC PLATED
50	1	M0475	MOUNTING BRACKET	
60	1	PA04-02-001	VITON TUBE	1/2" TO 1" LONG
70	1	SK10-001	OXY SENSOR 0-100%	

Environics Inc
TOLLAND, CT 06084-2805

TITLE
SENSOR OXYGEN
SUB ASSY
ROBD2

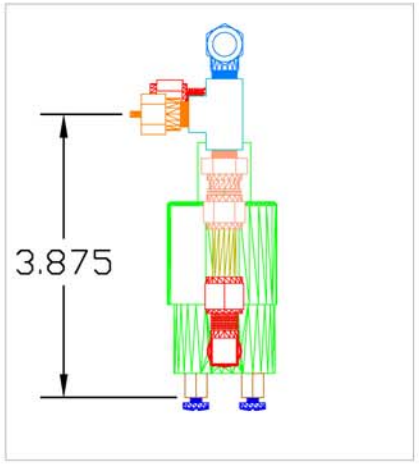
SIZE	REVISION	DWG. NO
B	A	A207

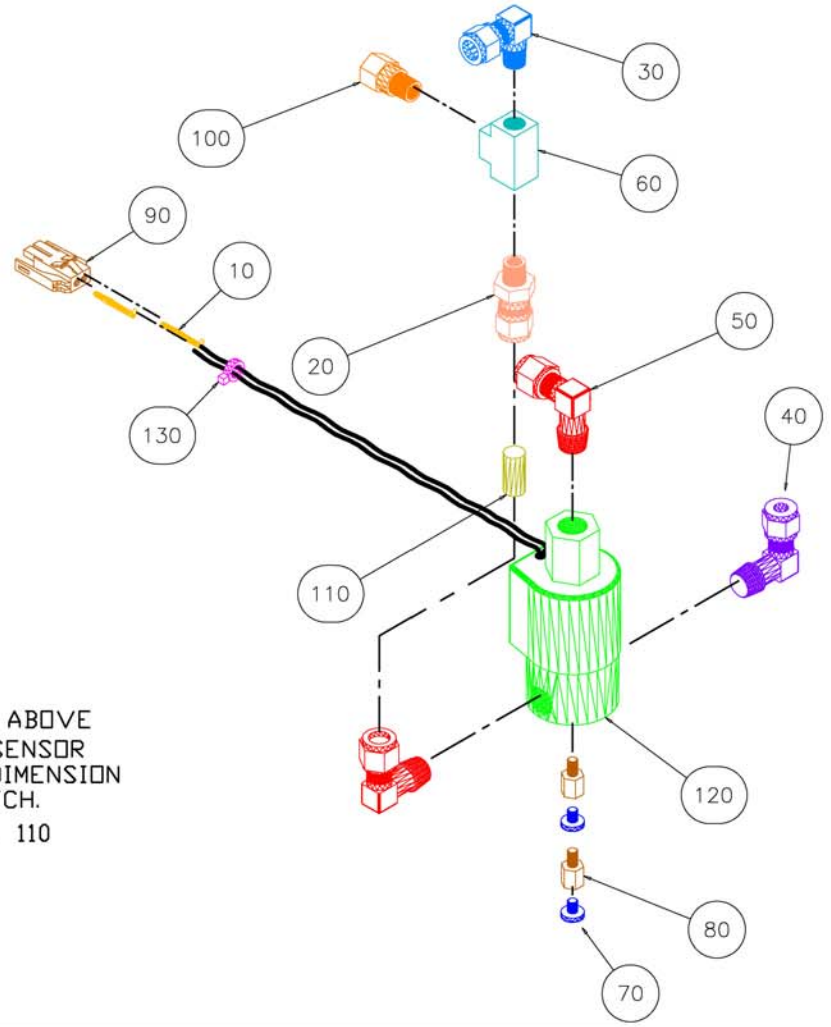
SCALE NONE | WEIGHT | SHEET 1 OF 1

A208 PARTS LIST

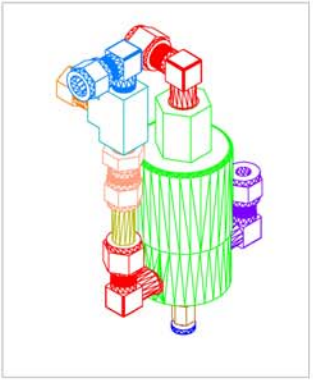
A6

RIGHT SIDE VIEW

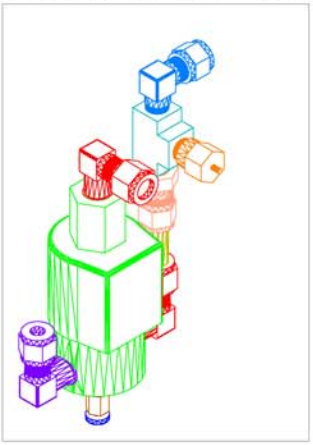




LEFT FRONT ISO VIEW



RIGHT REAR ISO VIEW



NOTES:

1. DIMENSION SHOWN IN RIGHT SIDE VIEW ABOVE IS CRITICAL FOR ALIGNMENT WITH O2 SENSOR SUB ASSY CONNECTION (A207) ADJUST DIMENSION (REF. 1.678" LONG) FOR DET. 110 TO MATCH.
2. DO NOT PERMANENTLY INSTALL DETAIL 110 UNTIL FINAL SYSTEM ASSEMBLY.

Item	Qty	Environics' #	Description	Details
10	2	AJ05-001-GF31	TERMINAL GOLD PIN	
20	1	FA101-00-B0602	BRASS MALE TUBE FITTING	1/8" MNPT x 3/8" TUBE, O2 CLEANED
30	1	FA102-00-B0602	BRASS ELBOW TUBE FITTING	1/8" MNPT X 3/8" TUBE, O2 CLEANED
40	1	FA102-02-B04	BRASS ELBOW TUBE FITTING	1/4" MNPT x 1/4" TUBE, O2 CLEANED
50	2	FA102-02-B0604	BRASS ELBOW TUBE FITTING	1/4" MNPT x 3/8" TUBE, O2 CLEANED
60	1	FA114-03-B02	BRASS FEMALE PIPE FITTING	1/8" FNPT TEE, O2 CLEANED
70	2	HA0101-1032C04	SLOTTED PAN HEAD SCREW	10-32 X 1/4", ZINC PLATED
80	2	HA08-1032A6	MALE/FEMALE STANDOFF	10-32 X 3/8" ALUMINUM
90	1	HJ08-004-M02	HOUSING, PIN 2 PIN	
100	1	MA04-003-005	ORIFICE, .005", SS, FILTERED	1/8" MNPT X BARB (1/16" I.D. TUBE)
110	.25	PA09-06-001	3/8" BRASS TUBE	2", O2 CLEANED
120	1	SA06-010-02	3-WAY, BRASS SOLENOID VALVE	1/4" FNPT, O2 CLEANED
130	1	WA01-01-040	WIRE TIE TYPE 1	CLASS 1 (4" LG)

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ±1/8 DECIMALS .X ±.030 .XX ±.010 .XXX ±.005 ANGLES ±1°

MATERIAL:

FINISH:

SIGNATURES DATE
DRAWN BY: C.SHAW 12/6/04
CHECKED BY:
APPROVED BY:
CUST.NAME & NO.

Environics Inc
TOLLAND, CT 06084-2805

TITLE
V1 VALVE
SUB ASSEMBLY
ROBD2

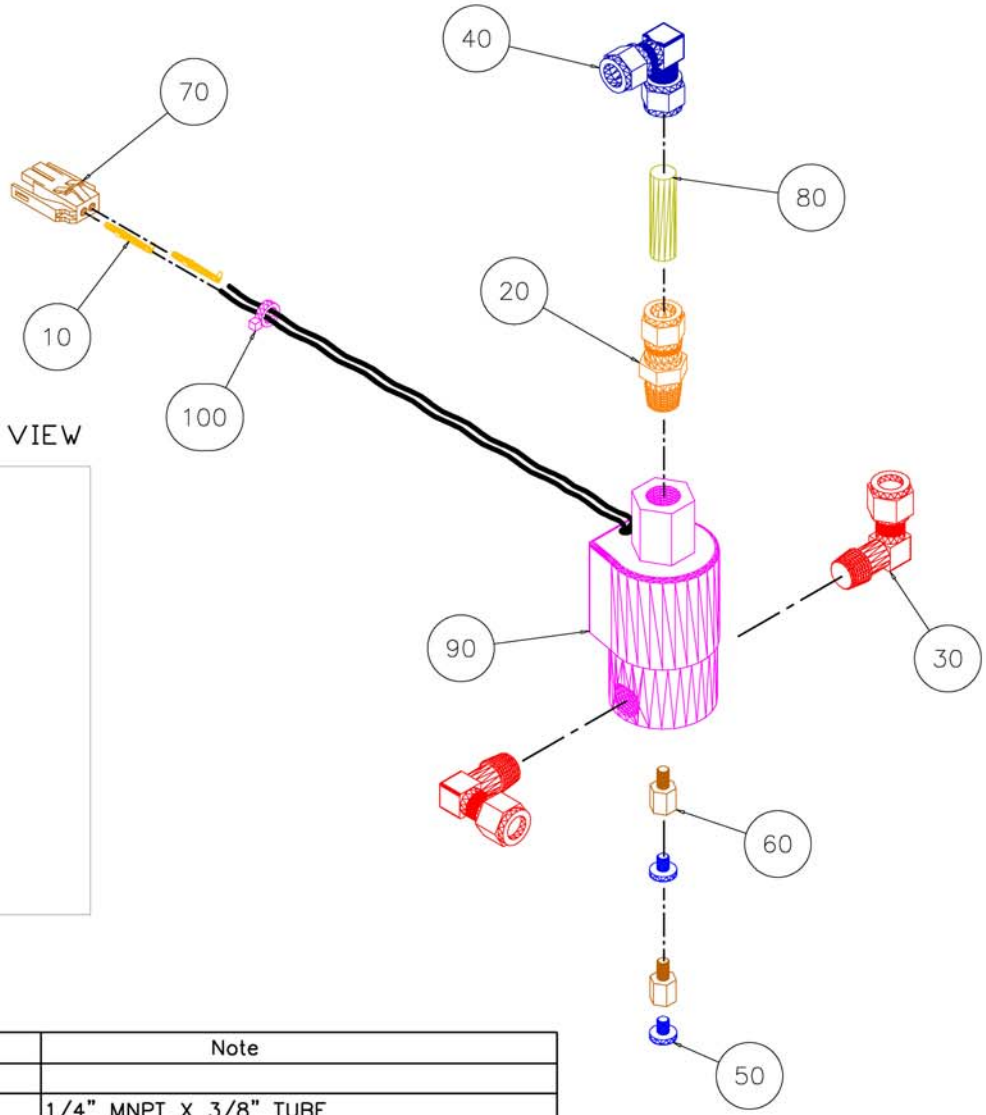
SIZE B | REVISION B | DWG NO A208

SCALE NONE | WEIGHT | SHEET 1 OF 1

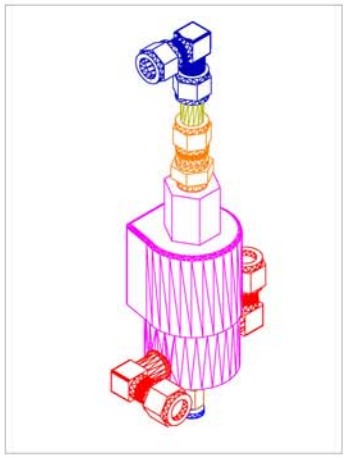
8 7 6 5 4 3 2 1

A209 PARTS LIST

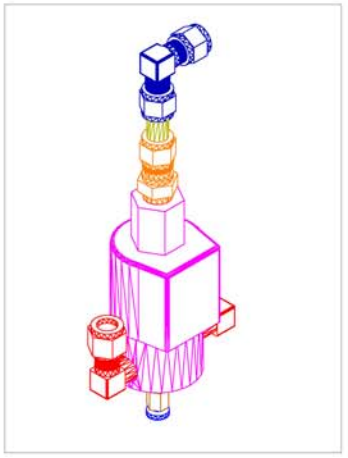
A7



LEFT FRONT ISO VIEW



RIGHT REAR ISO VIEW



Item	Qty	Environics #	Description	Note
10	2	AJ05-001-GF31	TERMINAL GOLD PIN	
20	1	FA101-01-B0604	BRASS MALE TUBE FITTING	1/4" MNPT X 3/8" TUBE
30	2	FA102-02-B0604	BRASS ELBOW TUBE FITTING	1/4" MNPT X 3/8" TUBE
40	1	FA110-01-B06	BRASS UNION ELBOW FITTING	3/8" TUBE X 3/8" TUBE
50	2	HA0101-1032C04	PAN HEAD SLOTTED SCREW	10-32 X 1/4", ZINC PLATED
60	2	HA08-1032A6	M/F STANDOFF	10-32 X 3/8", ALUMINUM
70	1	HJ08-004-M02	HOUSING, PIN 2P	
80	.15	PA15-06-001	3/8" KYNAR TUBE	1.687" LENGTH
90	1	SA06-010	3-WAY BRASS SOLENOID VALVE	1/4" FNPT, 24 VDC
100	1	WA01-01-040	WIRE TIE TYPE 1	CLASS 1 (4" LG)

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ±1/8 DECIMALS .X ±.030 .XX ±.005 .XXX ±.005 ANGLES ±1°
MATERIAL:
FINISH:
SIGNATURES DATE
DRAWN BY: C. RYAN 12/6/04
CHECKED BY:
APPROVED BY:
CUST. NAME & NO.

Environics Inc
TOLLAND, CT 06084-2805

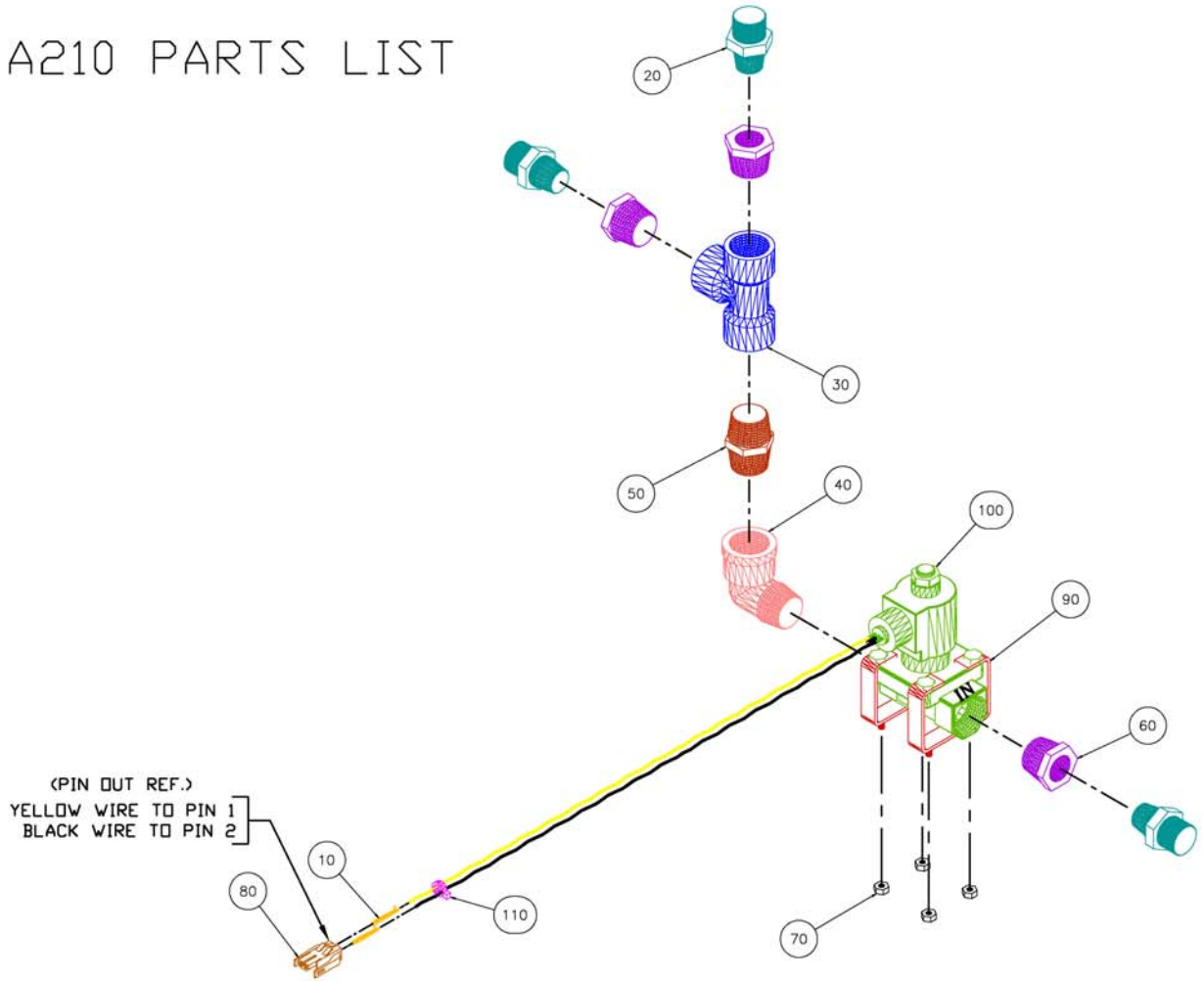
TITLE
V3 VALVE
SUB ASSY
ROBD2

SIZE B | REVISION A | DWG NO A209
SCALE NONE | WEIGHT | SHEET 1 OF 1

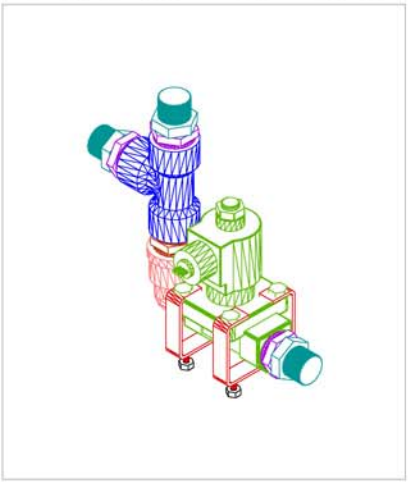
A210 PARTS LIST

REVISIONS						
ZONE	LTR	ECN#	DESCRIPTION	DATE	BY	APPV'D BY
-	A		INITIAL RELEASE	2/1/05	C.J.A.	J.A.B.

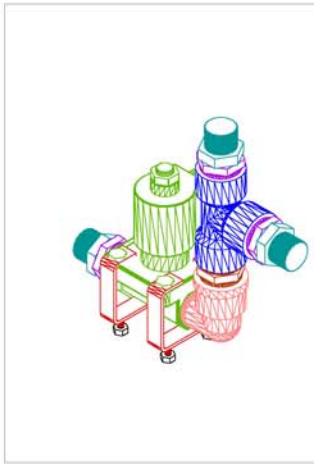
A8



FRONT LEFT ISO VIEW



RIGHT REAR ISO VIEW



Item	Qty	Environics' #	Description	Details
10	2	AJ05-001-GF31	TERMINAL GOLD PIN	
20	3	FA101-01-K1008	KYNAR MALE TUBE FITTING	1/2" MNPT x 5/8" TUBE, O2 CLEANED
30	1	FA114-00-N12	NYLON TEE FITTING	3/4" FNPT, O2 CLEANED
40	1	FA122-00-N12	NYLON ELBOW FITTING	3/4" MNPT x 3/4" FNPT, O2 CLEANED
50	1	FA140-00-N12	NYLON HEX NIPPLE FITTING	3/4" MNPT, O2 CLEANED
60	3	FA162-00-N1208	NYLON REDUCING BUSHING	3/4" MNPT x 1/2" FNPT, O2 CLEANED
70	4	HA0799-0832C00	8-32 KEPT NUT	ZINC PLATED
80	1	HJ08-004-M02	HOUSING, PIN 2 PIN	
90	2	M0502	MOUNTING BRACKET	
100	1	SA01-012	BRASS SOLENOID VALVE	FNPT, N.O., O2 CLEANED
110	1	WA01-01-040	WIRE TIE TYPE 1	CLASS 1 (4" LG)

Environics Inc
TOLLAND, CT 06084-2805

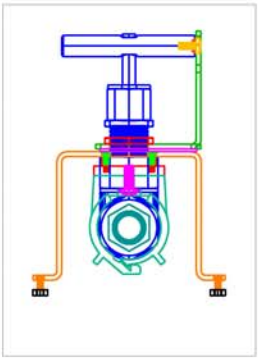
SIGNATURES | DATE
DRAWN BY: C.SHAW | 2/1/05
CHECKED BY:
APPROVED BY:
CUST.NAME & NO.

TITLE
V2 VALVE (BYPASS)
SUB ASSY
ROBD2

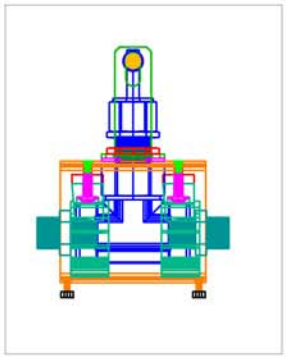
SIZE C | REVISION A | DWG NO A210
SCALE NONE | WEIGHT | SHEET 1 OF 1

A9

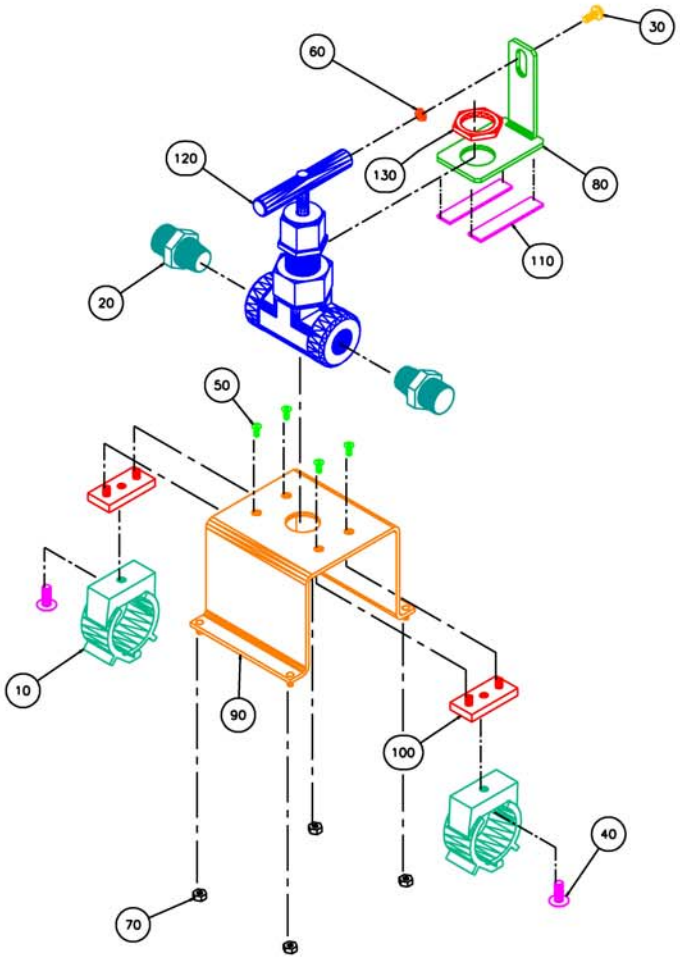
A211 PARTS LIST



FRONT VIEW



RIGHTSIDE VIEW



Item	Qty	Environics #	Description	Note
10	2	CA01-001-27	CLAMP	THERMAL PLASTIC
20	2	FA101-01-K1008	MALE TUBE FITTING	NYLON, O2 CLEANED
30	1	HA0109-1032C06	SCREW, BINDING HEAD	10-32 x 3/8", ZINC PLATED
40	2	HA0110-2520-C10	SCREW, TRUSS HEAD	1/4-20 x 5/8", ZINC PLATED
50	4	HA0115-0632C06	SCREW, PHILLIPS FLAT HEAD	6-32 X 3/8", ZINC PLATED
60	1	HA0499-1032E01	PEM NUT, FLUSH HEAD	
70	4	HA0799-0832C00	8-32 KEPT NUT	ZINC PLATED
80	1	M0511	LOCKING PLATE	
90	1	M0512	VALVE MOUNT	
100	2	M0513	VALVE MOUNT	
110	2	TA01-001-500	GASKET TAPE	2 1/2" LONG
120	1	VA-N-001	NEEDLE VALVE, SS	O2 CLEANED
130	1	VA-N-001-PN	PANEL NUT	

REVISIONS

ZONE	LTR	ECN#	DESCRIPTION	DATE	BY	APPV'D BY
-	A		INITIAL RELEASE	2/1/05	C.J.S.	J.A.B.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON

FRACTIONS	DECIMALS	ANGLES
±1/8	.X ±.020 .XX ±.010 .XXX ±.005	±1°

MATERIAL:

FINISH:

SIGNATURES	DATE
DRAWN BY: C.SMAN	2/1/05
CHECKED BY:	
APPROVED BY:	

CUST.NAME & NO.

Environics Inc
TOLLAND, CT 06084-2805

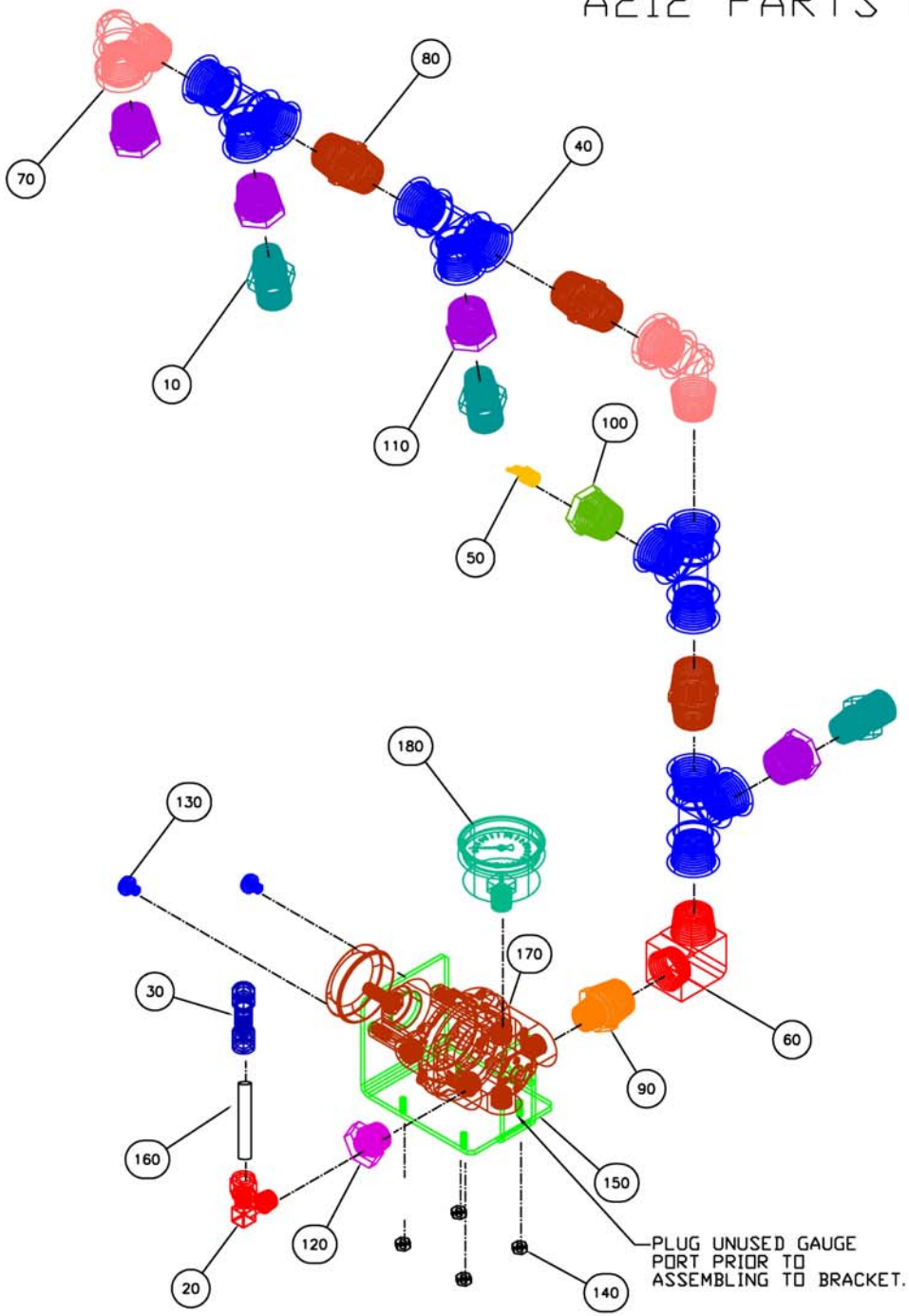
TITLE
VALVE NEEDLE
SUB ASSY
ROBD2

SIZE	REVISION	DWG. NO
D	A	A211

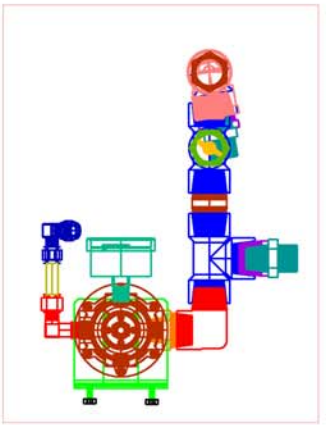
SCALE NONE | WEIGHT | SHEET 1 OF 1

A10

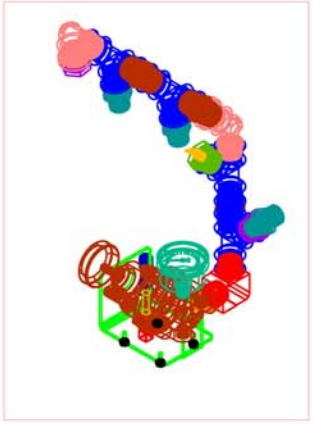
A212 PARTS LIST



FRONT VIEW



ISO VIEW



Item	Qty	Environics #	Description	Note
10	3	FA101-01-K1008	NYLON MALE TUBE FITTING	O2 CLEANED
20	1	FA102-02-B0604	3/8" BRASS MALE ELBOW	O2 CLEANED
30	1	FA110-01-B06	3/8" BRASS UNION ELBOW	O2 CLEANED
40	4	FA114-00-N12	NYLON UNION TEE FITTING	O2 CLEANED
50	1	FA115-00-N0402	NYLON BRANCH TEE FITTING	O2 CLEANED
60	1	FA122-00-B12	BRASS ELBOW ADAPTER	O2 CLEANED
70	2	FA122-01-N12	NYLON ELBOW ADAPTER	O2 CLEANED
80	3	FA140-00-N12	NYLON HEX NIPPLE	O2 CLEANED
90	1	FA144-00-B1208	BRASS REDUCING NIPPLE	O2 CLEANED
100	1	FA162-00-N1202	NYLON REDUCING BUSHING	O2 CLEANED
110	4	FA162-00-N1208	NYLON REDUCING BUSHING	O2 CLEANED
120	1	FA162-01-B0804	BRASS REDUCING BUSHING	O2 CLEANED
130	2	HA0113-2520D05	PAN HEAD SCREW, S.S.	1/4-20 X 5/16"
140	4	HA0799-0832C00	8-32 KEPT NUT	ZINC PLATED
150	1	M0501	MOUNTING BRACKET	
160	1	PA15-06-001	3/8" KYNAR TUBING, 2.187"	O2 CLEANED
170	1	VA-BPR-3	BACK PRESSURE REGULATOR	O2 CLEANED
180	1	VA-G-005	PRESSURE GAUGE, 0-15	O2 CLEANED

Parts List

Environics Inc
TOLLAND, CT 06084-2805

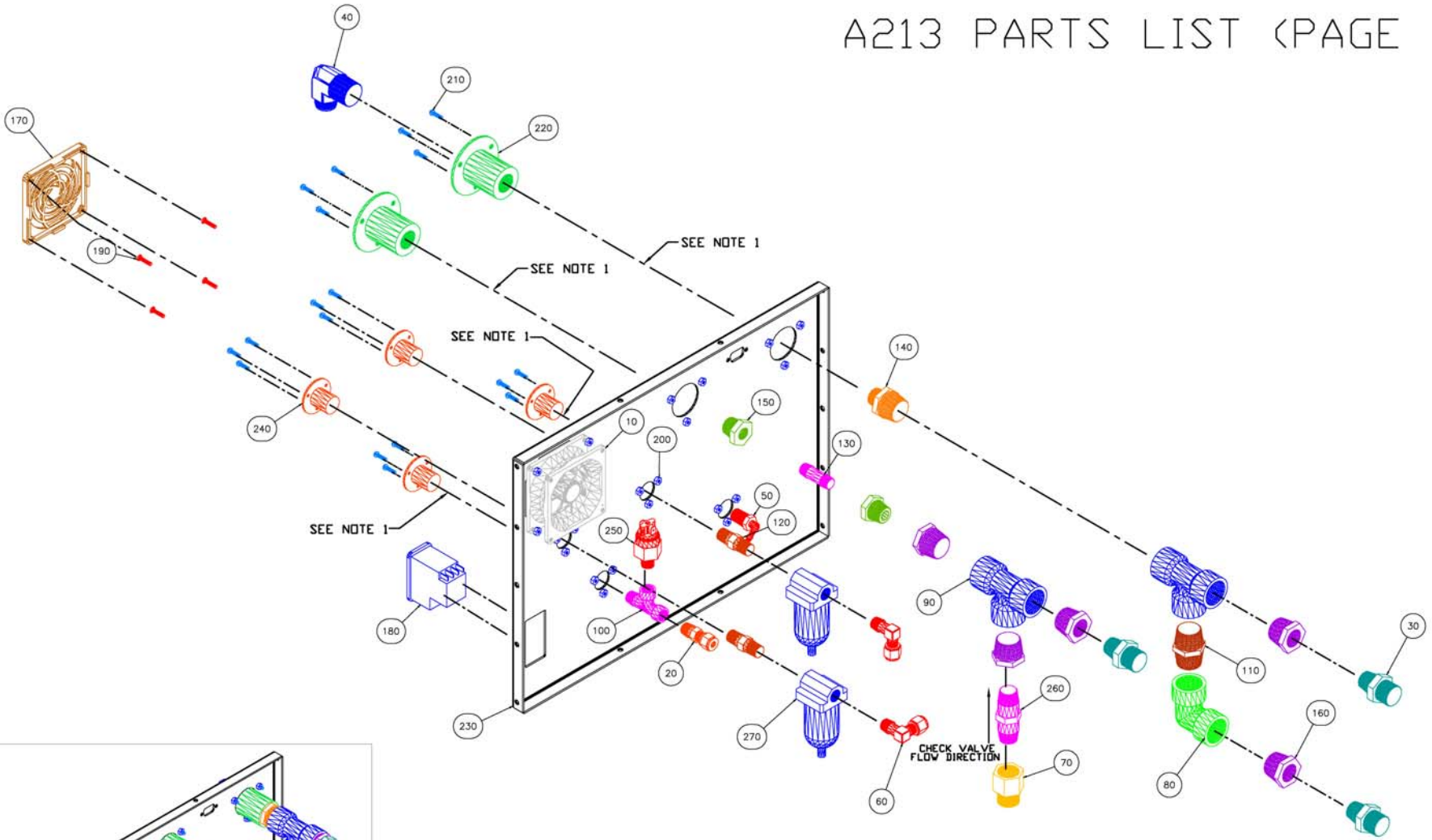
TITLE
REGULATOR
SUB ASSEMBLY
ROBD2

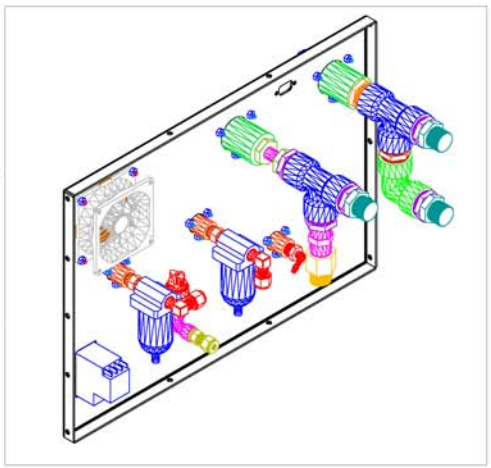
SIZE	REVISION	DWG NO
D	B	A212

SCALE NONE | WEIGHT | SHEET 1 OF 1

A213 PARTS LIST (PAGE 1)

A11





NOTES:
1. ALL FLOW COMPONENTS IN THESE GROUPINGS TO BE CLEANED FOR OXYGEN SERVICE.

Environics Inc
TOLLAND, CT 06084-2805

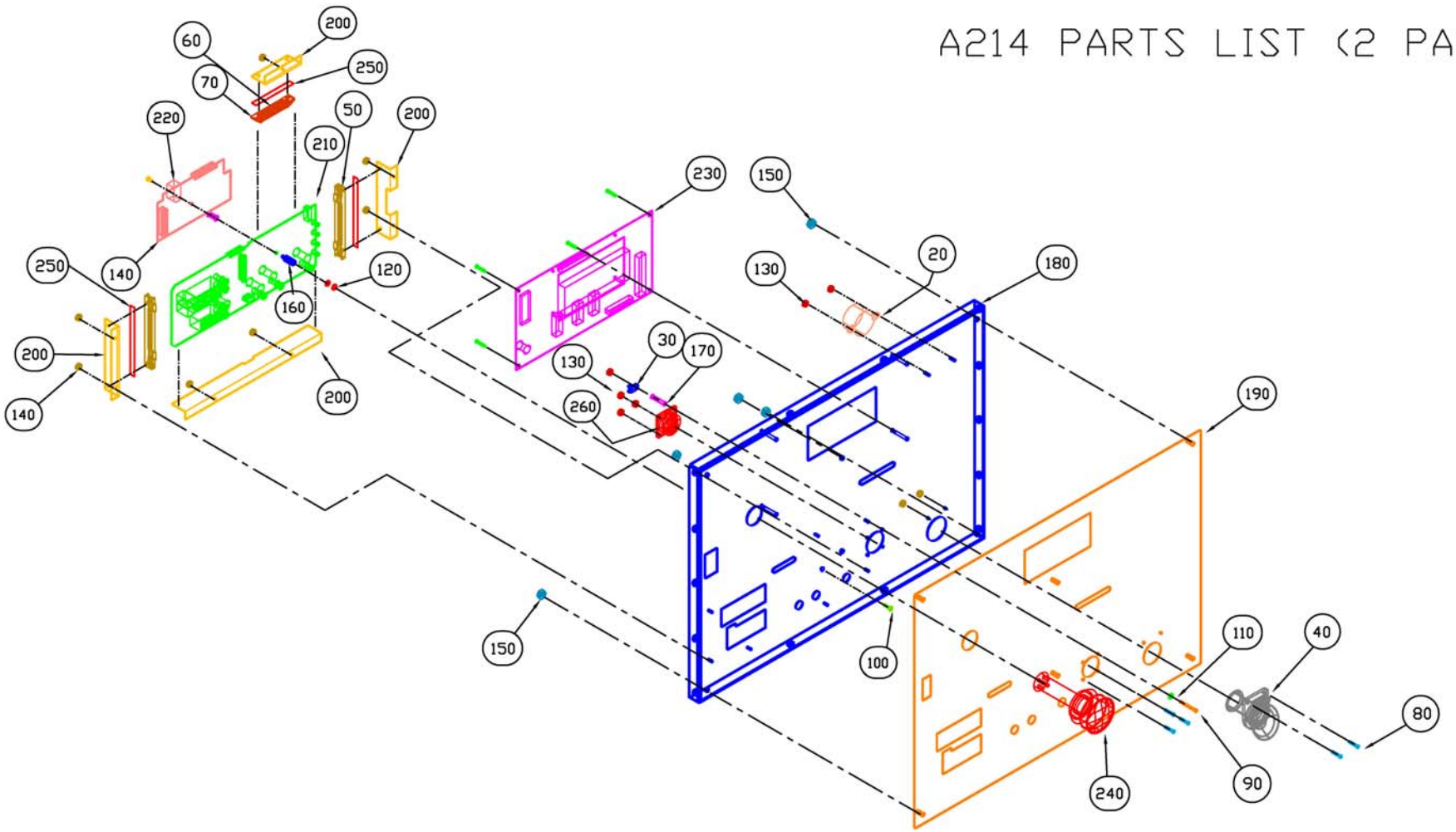
TITLE		
REAR PANEL SUB ASSY ROBD2		
SIZE: D	REVISION: A	DWG NO: A213
SCALE: NONE	WEIGHT:	SHEET 1 OF 1

A213 PARTS LIST (PAGE 2)

Item	Qty	Environics #	Description	Note
10	1	A183	FAN ASSMEBLY	INCLUDES CONNECTOR
20	1	FA101-01-B04	BRASS MALE FITTING	1/4" MNPT X 1/4" TUBE, O2 CLEANED
30	3	FA101-01-K1008	NYLON MALE FITTING	1/2" MNPT X 5/8" TUBE, O2 CLEANED
40	1	FA102-00-S1012	SS ELBOW FITTING	3/4" MNPT X 5/8" TUBE, O2 CLEANED
50	1	FA102-01-N0403	NYLON BARB ELBOW FITTING	1/4" MNPT X 3/16" TUBE BARB, O2 CLEANED
60	2	FA102-02-B0604	BRASS ELBOW FITTING	1/4" MNPT X 3/8" TUBE
70	1	FA105-01-K1008	NYLON FEMALE FITTING	1/2" FNPT X 5/8" TUBE, O2 CLEANED
80	1	FA110-00-N12	NYLON UNION ELBOW FITTING	3/4" FNPT, O2 CLEANED
90	2	FA114-00-N12	NYLON UNION TEE FITTING	3/4" FNPT, O2 CLEANED
100	1	FA117-02-B04	BRASS STREET TEE FITTING	1/4" NPT, O2 CLEANED
110	1	FA140-00-N12	NYLON HEX NIPPLE	3/4" NPT, O2 CLEANED
120	2	FA140-01-B04	BRASS CLOSE NIPPLE	1/4" NPT X 1-3/8"
130	1	FA140-02-B04	BRASS CLOSE NIPPLE	1/4" NPT X 1-1/2", O2 CLEANED
140	1	FA144-00-N1208	NYLON REDUCING NIPPLE	3/4" NPT X 1/2" NPT, O2 CLEANED
150	2	FA162-00-N0804	NYLON REDUCING BUSHING	3/4" MNPT X 1/4 FNPT" NPT, O2 CLEANED
160	5	FA162-00-N1208	NYLON REDUCING BUSHING	3/4" MNPT X 1/2 FNPT" NPT, O2 CLEANED
170	1	FB07-002	FAN FILTER	45 PORE PER INCH
180	1	E402-ROBD2	POWER ENTRY MODULE	ELECTRICAL HARNESS INCLUDED
190	4	HA0115-0632C10	PHILLIPS FLAT HEAD SCREW	6-32 X 5/8", ZINC PLATED
200	22	HA0718-0632C00	KEPT NUT	6-32, ZINC PLATED
210	18	HA113-0632C08	PHILLIPS PAN HEAD SCREW	6-32 X 1/2", ZINC PLATED
220	2	M0434	COUPLING, WELDED FLANGE	3/4" FNPT X 1/2" FNPT, 316 SS, O2 CLEANED
230	1	M0476	SILKSCREENED REAR PANEL	
240	4	M0479	COUPLING, WELDED FLANGE	1/4" NPT, 316 SS, O2 CLEANED
250	1	SK11-001G010	O2 PRESSURE SWITCH	SPECIFY 10 PSIG SETTING WHEN ORDERING
260	1	VA-CH-5	BRASS SAFETY CHECK VALVE	27" H2O CRACKING PRESSURE, O2 CLEANED
270	2	VA-FIL-004	PARTICLE FILTER	5 MICRON FOR N2 AND AIR PORTS

A13

A214 PARTS LIST (2 PAGES)



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TOLERANCES ON
FRACTIONS ±1/8 | DECIMALS .X ±.005, .XX ±.010, .XXX ±.005 | ANGLES ±1°

SIGNATURES	DATE
DRAWN BY: C.CHIN	7/1/02
CHECKED BY:	
APPROVED BY:	

MATERIAL:

FINISH:

CUST.NAME & NO.

XXXX	XXXX
USED ON	NEXT ASSY
APPLICATION	

Environics Inc
TOLLAND, CT 06084-2805

TITLE
PANEL FRONT
SUB ASSEMBLY
ROBD2

SIZE	REVISION	DWG NO
D	C	A214

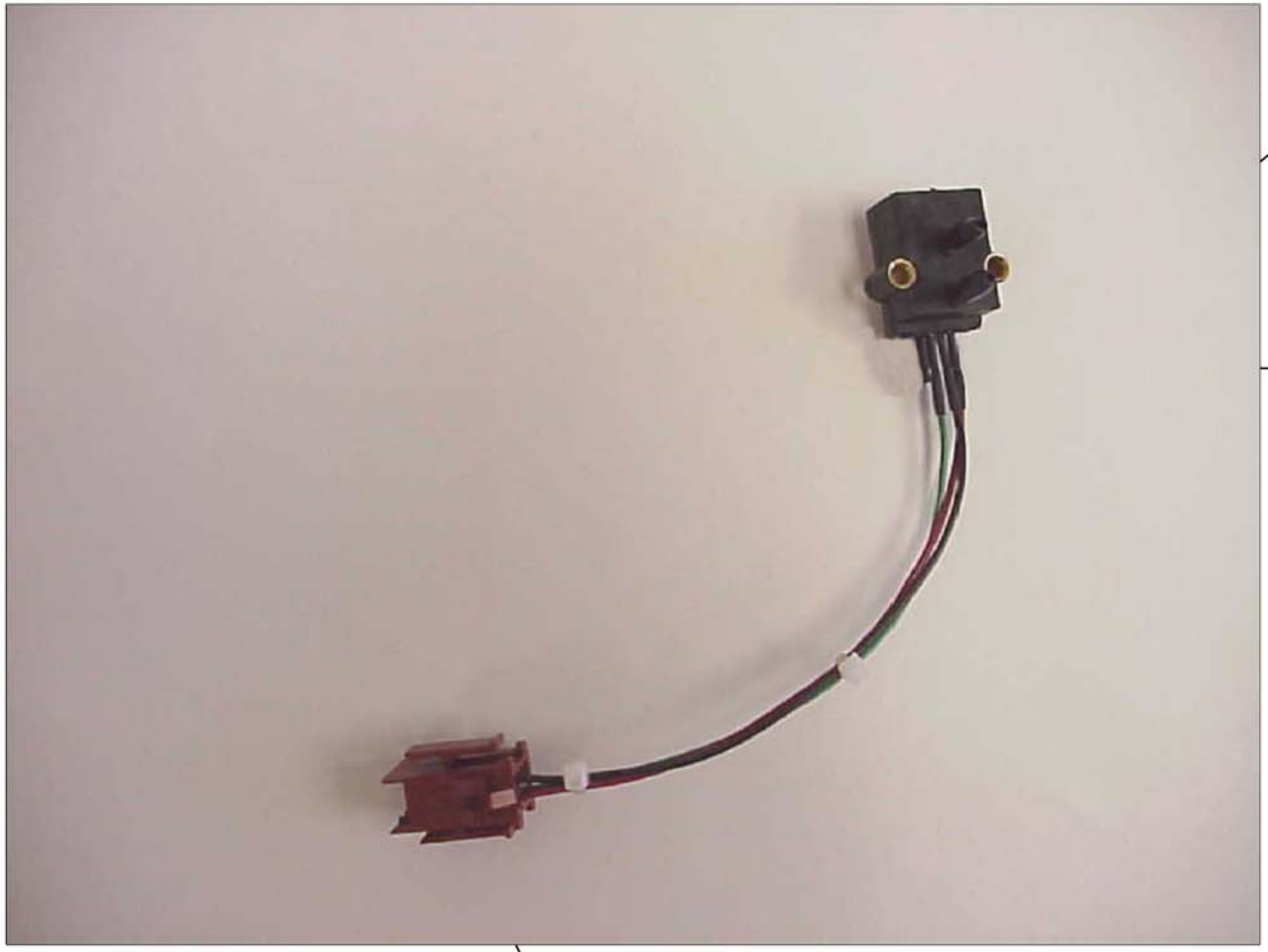
SCALE NONE | WEIGHT | SHEET 1 OF 1

PARTS LIST FOR FRONT PANEL ASSEMBLY A214

Item	Qty	Environics' #	Description	Details
20	1	A216	ALARM ASSEMBLY	
30	1	CA01-001-02	PULSE OX. CABLE CLAMP	
40	1	FA122-00-SM9	MASK CONNECTOR	OXYGEN CLEANED
50	2	GK003	SNAP IN CARD GUIDE	
60	1	GK004	CARD GUIDE CHANNEL	1.375" LONG
70	2	GK004-E	CARD GUIDE CHANNEL END	
80	5	HA0105-0440C08	PAN HEAD SCREW/WASHER	PHILLIPS 4-40 x 1/2", ZINC PLATED
90	1	HA0113-0440D24	PAN HEAD SCREW/WASHER	PHILLIPS 4-40 x 1.5", 18-8 SS
100	1	HA0115-0440B06	FLAT HEAD SCREW	PHILLIPS 4-40 x 3/8"", BLACK FINISH
110	1	HA0602-C04-01	INT. TOOTH LOCK WASHER	FOR #4 SCREW, ZINC PLATED
120	2	HA0699-0800C01	FLAT WASHER	1/8" I.D., 5/16" O.D., ZINC PLATED
130	6	HA0714-C0440	NYLOK NUT	4-40, ZINC PLATED
140	9	HA0799-0440C00	KEPT NUT	4-40, ZINC PLATED
150	6	HA0799-0832C00	KEPT NUT	8-32, ZINC PLATED
160	1	HA08-0440A8	STANDOFF MALE/FEMALE	4-40 x 1/2", ALUMINUM
170	1	HA0901-AD071656	SPACER, ROUND NYLON	.115" I.D., .25" O.D., 7/8" LONG
180	1	M0477	FRONT SUB PANEL	
190	1	M0478	ALUMINUM BACKER PANEL	SWITCH MEMBRANE ATTACHED
200	1	M0506	MOUNTING BRACKETS	PULSE OXIMETER (4 BRACKETS)
210	1	PC403-1D	PULSE OXIMETER PCB	MAIN BOARD
220	1	PC404-1D	PULSE OXIMETER PCB	ANALOG/RS232 MOUNTING HARDWARE INC. MANUFACTURER
230	1	PC406-1D	DISPLAY/KEYPAD PCB	
240	1	SJ04-001-351	EMERGENCY SWITCH	OXYGEN DUMP
250	1	TA06-001-250	DOUBLE SIDED TAPE	1 PIECE FOR ITEM 60 2 PIECES FOR ITEM 50
260	1	XJ006	PROBE HARNESS	PULSE OXIMETER

A15

REVISIONS					
LTR	ECN#	DESCRIPTION	DATE	BY	APPV'D BY
A	-	INITIAL RELEASE	4/25/05	C.J.S.	J.A.G.



TB01-001 (3X 3/4" LG.)
FOR WIRE CONNECTIONS

WJ03-G1-A (6" LG.)
WJ03-G1-C (6" LG.)
WJ03-G1-F (6" LG.)

HJ08-004-M06

SK0401-0011030

1	RED	1
3	GREEN	3
2	BLACK	2

HJ08-004-M06

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DIMENSIONS ARE IN INCHES
TOLERANCES ON

FRACTIONS	DECIMALS	ANGLES
±1/8	.X ±.020 .XX ±.010 .XXX ±.005	±1°

SIGNATURES		DATE
DRAWN BY:	C.SHAW	4/25/05
CHECKED BY:		
APPROVED BY:		
CUST.NAME & NO.		

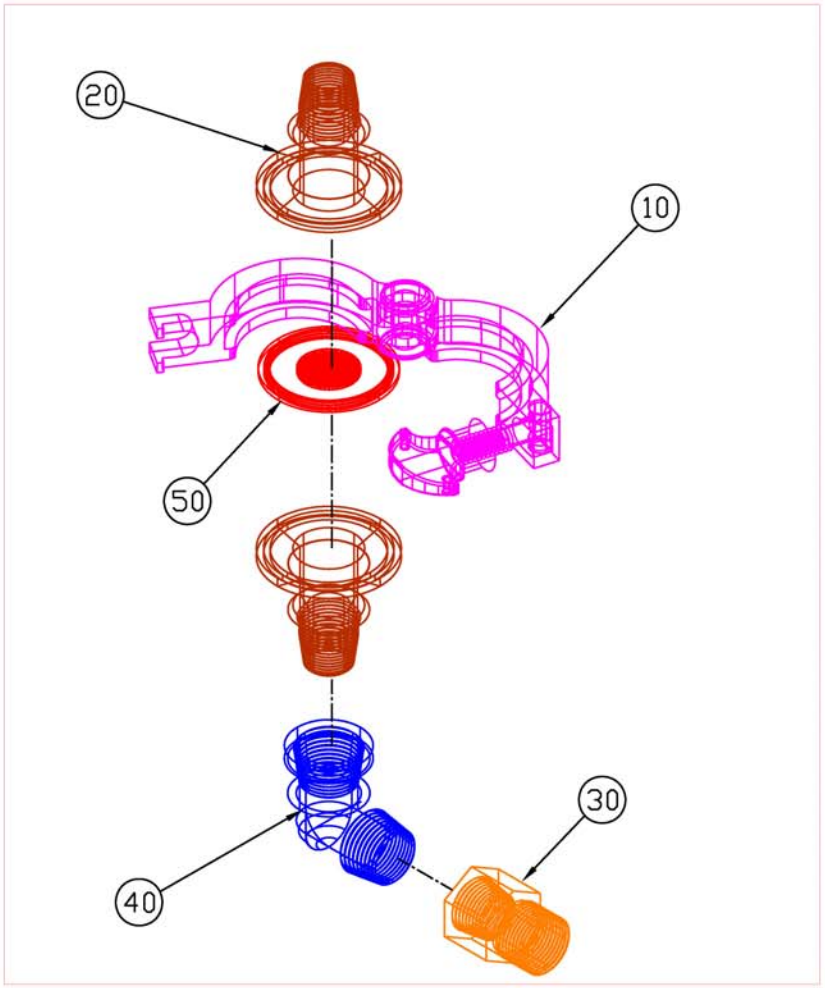
Environics Inc
TOLLAND, CT 06084-2805

TITLE
SENSOR
PRESSURE
ROBD2

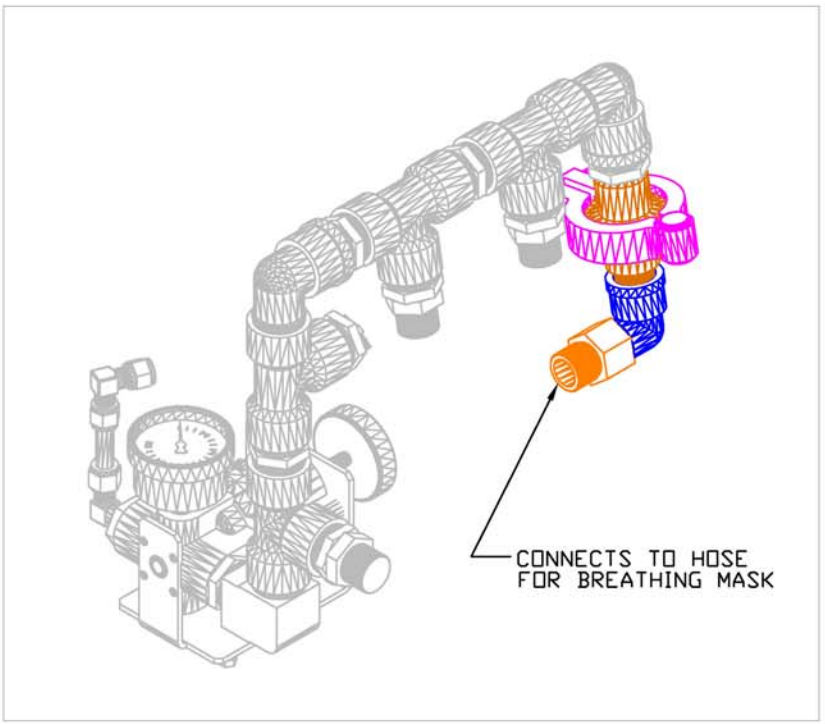
SIZE	REVISION	DWG NO	
A	A	A215	
SCALE NONE	WEIGHT	SHEET 1	OF 1

REVISIONS						
ZONE	LTR	ECN#	DESCRIPTION	DATE	BY	APPV'D BY
-	A		INITIAL RELEASE	10/21/05	C.J.A.	J.A.R.

A16



LOCATION OF FILTER



A221 PARTS LIST

Item	Qty	Environics' #	Description	Note
10	1	CA01-002-16	FILTER CLAMP	
20	2	FA022-01-P1608	FILTER HOUSING	O2 CLEANED
30	2	FA105-01-K1008	ADAPTER FITTING	O2 CLEANED
40	8	FA122-01-P08	ELBOW ADAPTER FITTING	O2 CLEANED
50	3	FB004	60 MESH SS FILTER	O2 CLEANED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ±1/8 DECIMALS .X ±.100 .XX ±.010 .XXX ±.005 ANGLES ±1°
MATERIAL:
FINISH:
SIGNATURES DRAWN BY: C.SHAW DATE 10/21/05
CHECKED BY:
APPROVED BY:
CUST. NAME & NO.

QTY REQ'D	ITEM NO.	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL OR NOTE
			PARTS LIST	

Environics Inc
TOLLAND, CT 06084-2805

TITLE
FILTER, FINAL
BREATHING MASK PORT
ROBD2

SIZE	REVISION	DWG NO
C	A	A221

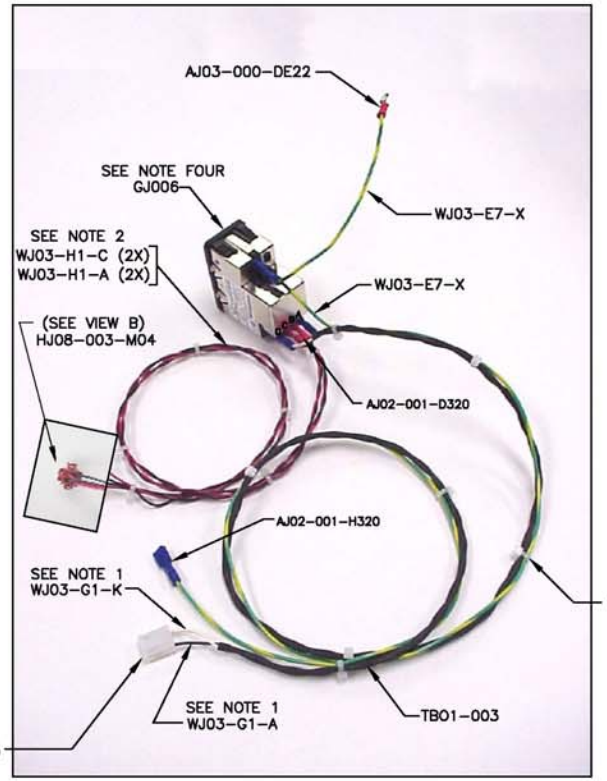
SCALE NONE WEIGHT SHEET 1 OF 1

APPENDIX B: Electrical harnesses and diagrams

B1: E402-ROBD2-1, AC power entry cable
B2: E609-ROBD2, data interface ribbon cable
B3: E613-ROBD2, power supply cable, low voltage DC
B4: E615-ROBD2, RS232 interface cable
B5: E616-ROBD2, PC416 power interconnect cable
B6: E625, Oxygen dump switch cable
B7: E626, Oxygen and pressure sensor cable
B8: E627, Solenoid valve cable
B9: E628-1, Pulse oximeter power supply cable
B10: E629, PC412-ROBD2 misc. power cables
B11: E630, Oxygen alarm cables
B12: E631, E625 interface to terminal block
B13: E633, MFC2 (N2) signal cable
B14: I418, MFC1 signal and power cable
B15: I417, MFC2 power cable
B16: I397 Sheet 1, Terminal block wiring diagram
B17: I397 Sheet 2, Oxygen pressure switch wiring diagram
B18: A216, low oxygen alarm

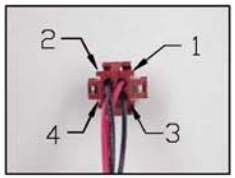
B1

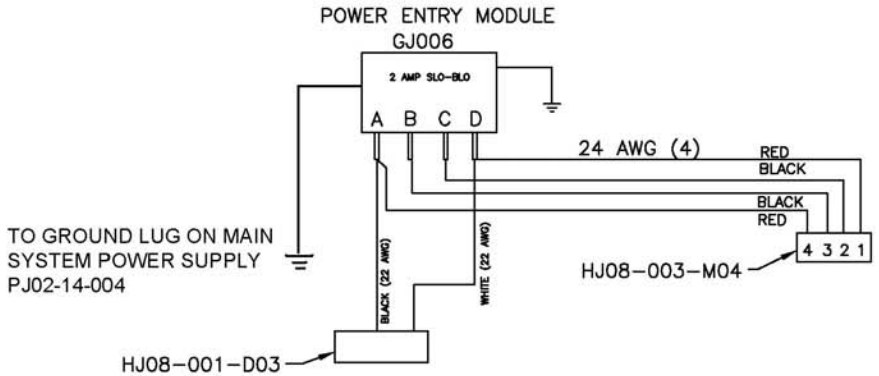
REVISIONS						
ZONE	LTR	ECN#	DESCRIPTION	DATE	BY	APPV'D BY
-	A		INITIAL RELEASE	12/14/06	P.W.B.	T.P.



VIEW A

VIEW B





NOTES:

1. TWIST TOGETHER (APPROX. 1 TWIST PER INCH) & COVER WITH TB01-003.
2. TWIST TOGETHER IN PAIRS (BLACK & RED) APPROX. 1 TWIST PER INCH)
3. INSTALL WA01-01-040 EQUALLY SPACED, TIE WRAPS AT ENDS SHOULD NOT PUT ANY STRAIN ON CONNECTORS OR WIRES.
4. VIEWED FROM BOTTOM, REVERSE FOR INSTALLATION IN REAR PANEL.

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TOLERANCES ON
FRACTIONS ±1/8 | DECIMALS .X ±.100 .XX ±.010 .XXX ±.005 | ANGLES ±1°

MATERIAL:

FINISH:

USED ON | NEXT ASS'Y
APPLICATION

	SIGNATURE	DATE
DRAWN BY	PINGRYON	12/14/06
CHECKED BY	T.P.	12/14/06
APPROVED BY		

COMPLIANCE # NO.

Environics Inc
TOLLAND, CT 06084-2805

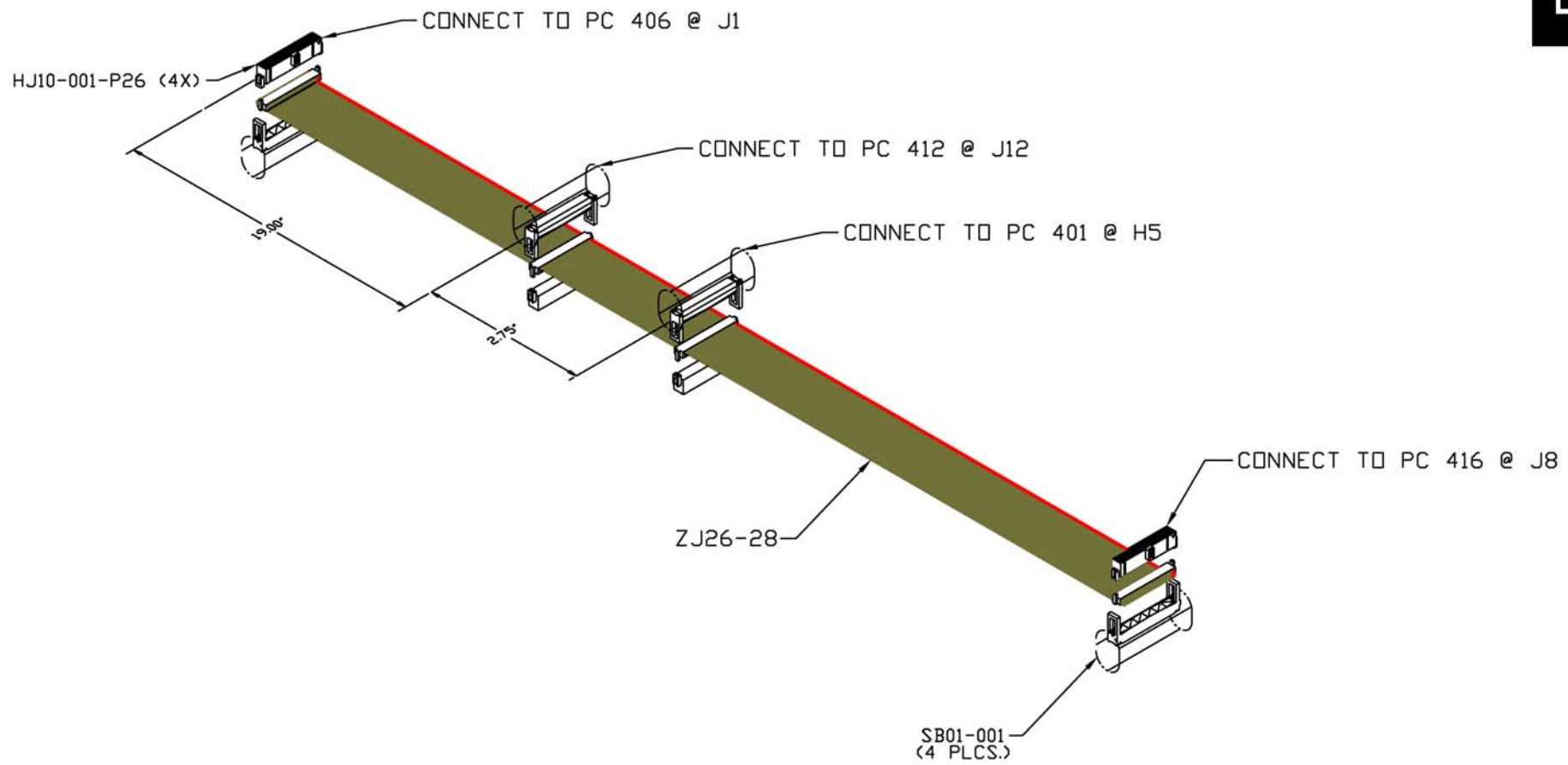
TITLE
HARNESS
POWER ENTRY MODULE
ROBD2

SIZE	REVISION	DWG NO
C	A	E402-ROBD2-1

SCALE NONE | WEIGHT | SHEET 1 OF 1

REVISIONS						
ZONE	LTR	ECN#	DESCRIPTION	DATE	BY	APPV'D BY
-	A		INITIAL RELEASE	4/26/05	C.J.A.	T.A.B.

B2



LENGTH OF ZJ26-28 IS 77.0"

QTY REQ'D	ITEM NO.	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL OR NOTE

PARTS LIST

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FRACTIONS ±1/8 | DECIMALS .X ±.100, .XX ±.010, .XXX ±.005 | ANGLES ±1°

MATERIAL:

FINISH:

6100
USED ON | NEXT ASSY
APPLICATION

SIGNATURES | DATE
DRAWN BY: C.SHAW 1/11/00
CHECKED BY:
APPROVED BY:
CUST. NAME & NO.

Environics Inc
TOLLAND, CT 06084-2805

TITLE
HARNESS, PC406 TO PC412 TO PC401 TO PC416 FOR ROBD2

SIZE	REVISION	DWG NO
C	A	E609-ROBD2

SCALE NONE | WEIGHT | SHEET 1 OF 1

TWIST TOGETHER BLACK & RED WIRES,
WHITE & YELLOW, ORANGE & GRAY & BROWN.
AFTER TWISTING WIRES FINISHED LENGTH IS APPROX. 47.00"

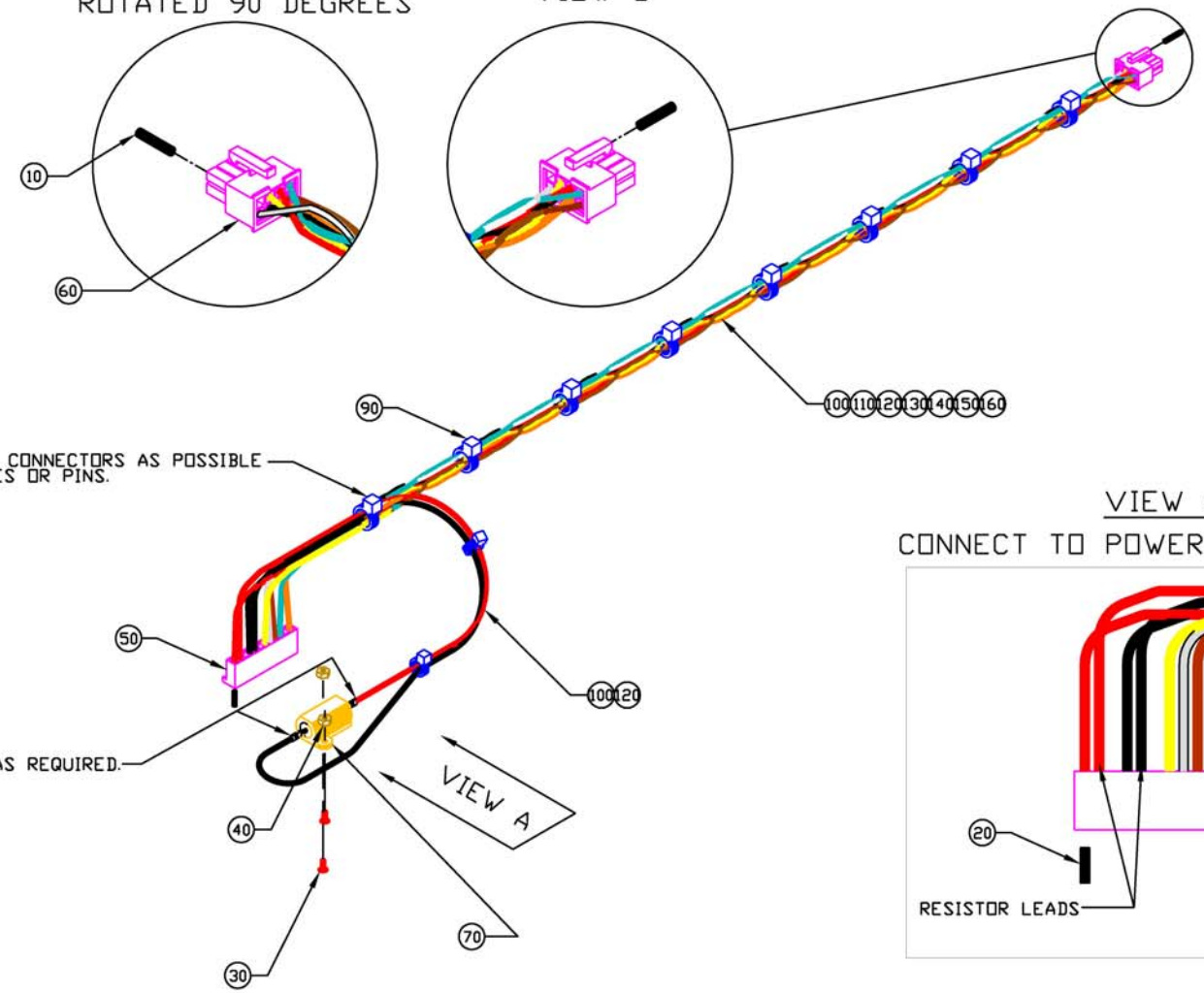
REVISIONS					
ZONE	LTR	ECN#	DESCRIPTION	DATE	BY	APPV'D BY
-	A		INITIAL RELEASE	2/2/05	CJA	ZAR

B3

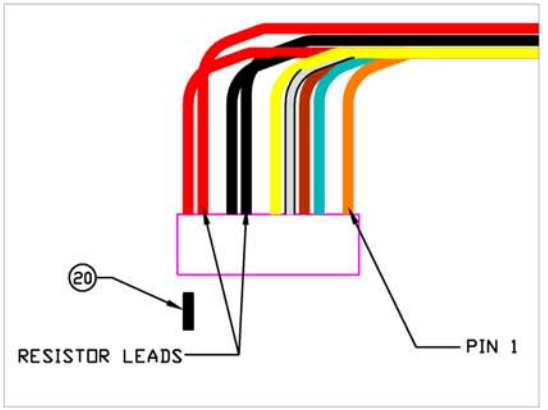
VIEW B
ROTATED 90 DEGREES

VIEW B

CONNECT TO PC412 @ J2
SEE VIEW B



VIEW A
CONNECT TO POWER SUPPLY @ J2



COLOR LEGEND

- = BLACK
- = BROWN
- = GRAY
- = ORANGE
- = RED
- = WHITE
- = YELLOW

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TOLERANCES ON
FRACTIONS ±1/8 | DECIMALS .X ±.020, .XXX ±.005 | ANGLES ±1°

MATERIAL:

FINISH:

6100
USED ON | NEXT ASS'Y
APPLICATION

SIGNATURES | DATE
DRAWN BY: C.SHAW 2/2/05
CHECKED BY:
APPROVED BY:
CUST.NAME & NO.

Environics Inc
TOLLAND, CT 06084-2805

TITLE
HARNESS PWR SUPPLY
TO PC 412
FOR ROBD2

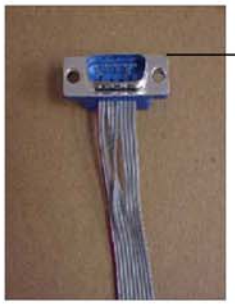
SIZE C | REVISION A | DWG NO E613-ROBD2
SCALE NONE | WEIGHT | SHEET 1 OF 1

REVISIONS						
ZONE	LTR	ECN#	DESCRIPTION	DATE	BY	APPV'D BY
-	A		INITIAL RELEASE	2/16/05	CJS	JAB

B4

VIEW A

HJ11-001-P09



VIEW B

HJ10-001-P10

VIEW C

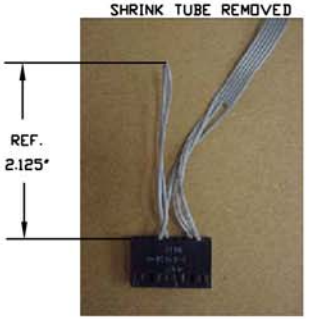
HJ10-001-P10
OPPOSITE SIDE

VIEW D

HJ10-002-P20

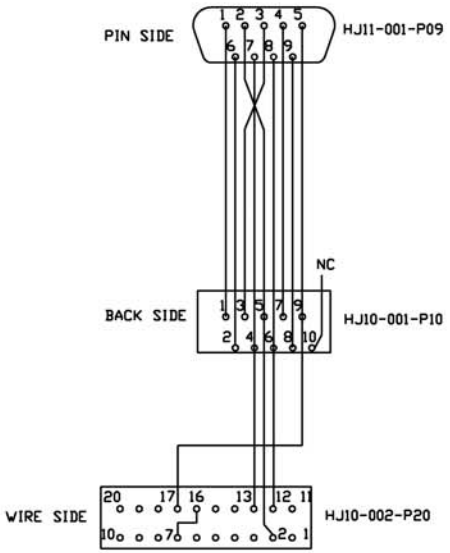
VIEW E

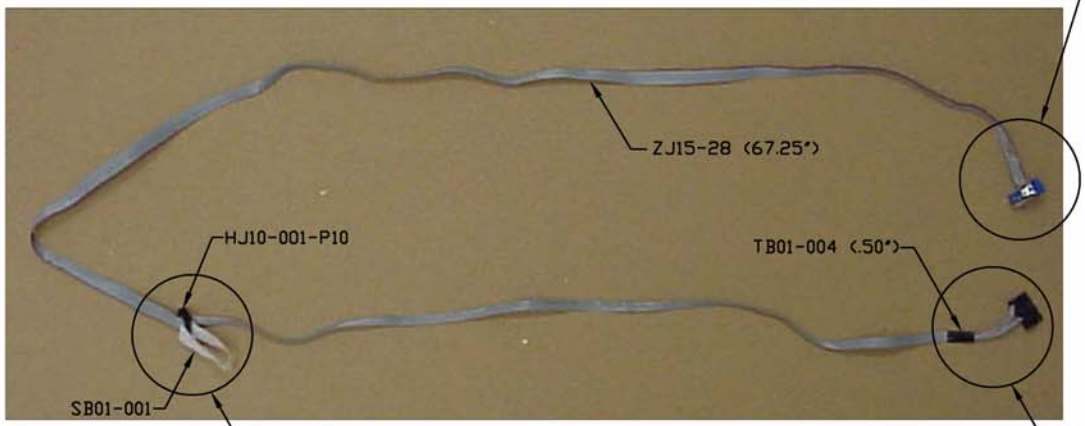
VIEW D
SHRINK TUBE REMOVED



SPLIT OUT 3,4 AND 5 TOGETHER AND TWIST
1" FROM HJ11-001-P09 (SEE VIEW A)

PINS 7 & 8 MUST BE REMOVED
FROM D CONNECTOR PRIOR TO ASSEMBLY.
REMOVE FROM BACK OF CONNECTOR,
UNCLIP RETAINING PIECE





ADD ADDITIONAL PINS (AJ05-B713) FOR SUPPORT AT LOCATIONS: 1,9,10,11,19,20

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TOLERANCES ON
FRACTIONS ±1/8 | DECIMALS X ±.030, .XX ±.010, .XXX ±.005 | ANGLES ±1°

MATERIAL:

FINISH:

6100
USED ON | NEXT ASSY
APPLICATION

SIGNATURES | DATE
DRAWN BY: C.STAV | 2/16/05
CHECKED BY:
APPROVED BY:

CUST.NAME & NO.

Environics Inc
TOLLAND, CT 06084-2805

TITLE
HARNESS
RS 232
ROBD2

SIZE C | REVISION A | DWG NO E615-ROBD2

SCALE NONE | WEIGHT | SHEET 1 OF 1

REVISIONS						
ZONE	LTR	ECN#	DESCRIPTION	DATE	BY	APPV'D BY
-	A		INITIAL RELEASE	4/26/05	C.J.A.	T.A.B.

B5

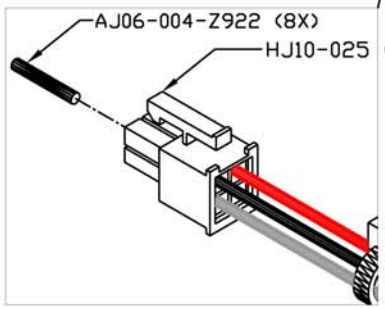
CONNECT TO PC412 @ J8

INSTALL WA01-01-040 (12X)
PER ECN 1073

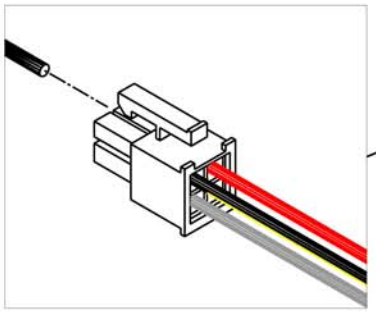
WJ03-G1-A (53.5")
WJ03-G1-C (53.5") TWIST IN PAIRS: YELLOW & GRAY, RED & BLACK
WJ03-G1-E (53.5") THEN TWIST PAIRS TOGETHER
WJ03-G1-J (53.5")

CONNECT TO PC416 @ J2

VIEW A



VIEW B
ROTATED 180°



COLOR LEGEND

= BLACK

= GRAY

= RED

= YELLOW

QTY REQ'D	ITEM NO.	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL OR NOTE

PARTS LIST

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FRACTIONS ±1/8 | DECIMALS .X ±.020, .XX ±.010, .XXX ±.005 | ANGLES ±1°

MATERIAL:

FINISH:

6100	
USED ON	NEXT ASSY
APPLICATION	

Environics Inc
TOLLAND, CT 06084-2805

SIGNATURES	DATE
DRAWN BY: C.J.A.	4/26/05
CHECKED BY:	
APPROVED BY:	

CUST. NAME & NO.

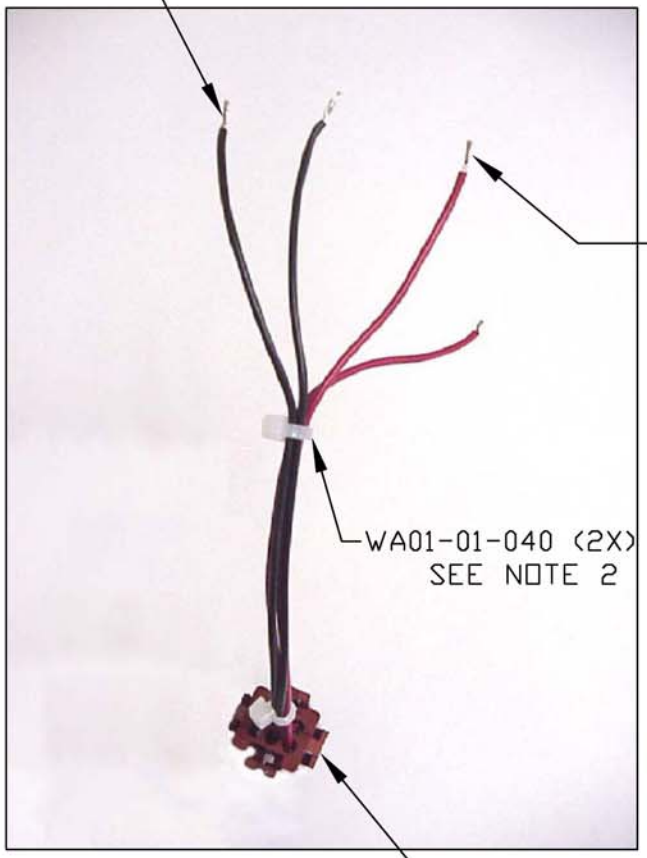
TITLE
HARNESS
PC416 TO PC412
FOR ROBD2

SIZE	REVISION	DWG. NO
C	A	E616-ROBD2

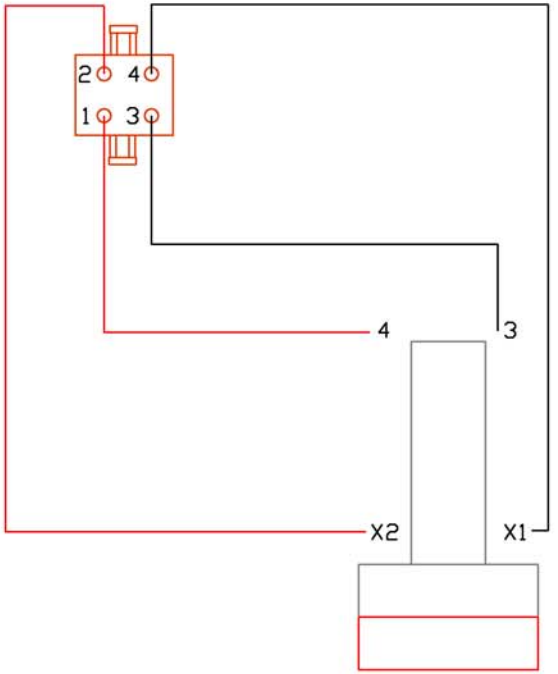
SCALE NONE | WEIGHT | SHEET 1 OF 1

B6

REVISIONS					
LTR	ECN#	DESCRIPTION	DATE	BY	APPV'D BY
A	-	INITIAL RELEASE	4/1/05	C.J.S.	J.A.B.



HJ08-004-M04
PIN REFERENCE



SJ04-001-351
REFERENCE

NOTES:

1. DO NOT CONNECT WIRING TO SWITCH UNTIL SWITCH IS MOUNTED TO FRONT PANEL ASSY.
2. TIE WRAPS AT ENDS SHOULD NOT PUT ANY STRAIN ON CONNECTORS OR WIRES.
3. TIN WIRE ENDS (4X)

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TOLERANCES ON

FRACTIONS	DECIMALS	ANGLES
±1/8	.X ±.020 .XX ±.010 .XXX ±.005	±1°

SIGNATURES		DATE
DRAWN BY:	C.SHAW	4/1/05
CHECKED BY:		
APPROVED BY:		
CUST.NAME & NO.		

Environics Inc
TOLLAND, CT 06084-2805

TITLE
HARNESS
D2 DUMP SWITCH
ROBD2

SIZE	REVISION	DWG. NO	
A	A	E625	
SCALE NONE	WEIGHT	SHEET 1	OF 1

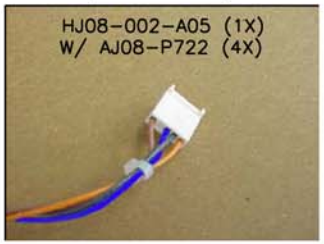
REVISIONS						
ZONE	LTR	ECN#	DESCRIPTION	DATE	BY	APP'D BY
-	A		INITIAL RELEASE	5/9/05	C.J.A.	J.A.B.

NOTES:

1. BLUE & GREEN WIRES TO EXTEND 8" FROM TIE WRAP, HJ10-027 TO EXTEND 8 1/2" FROM TIE WRAP.
2. INSTALL WA01-01-040 (4X) AT CONNECTOR ENDS & NOTE 1 REF.
3. 22 AWG NUMBER REFERENCES:
   - WJ03-G1-A (BLACK)
   - WJ03-G1-B (BROWN)
   - WJ03-G1-C (RED)
   - WJ03-G1-D (ORANGE)
   - WJ03-G1-F (GREEN)
   - WJ03-G1-G (BLUE)
   - WJ03-G1-J (GRAY)

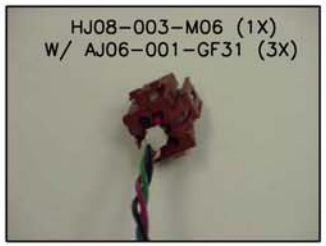
VIEW B

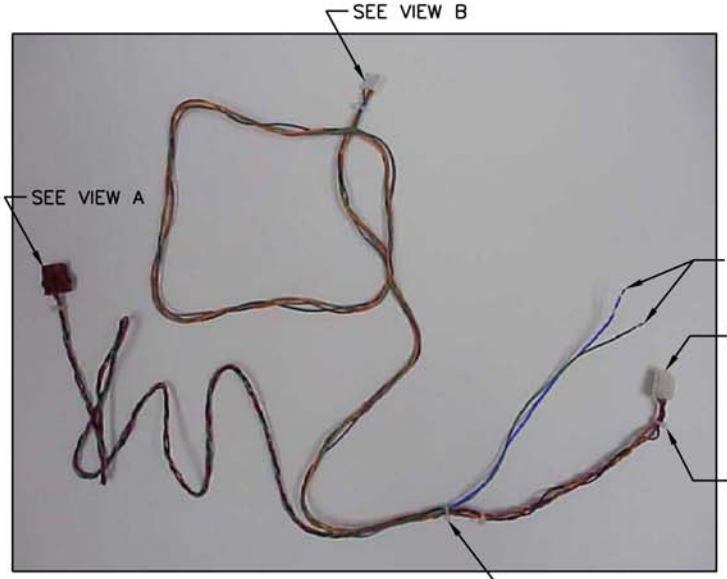
HJ08-002-A05 (1X)
W/ AJ08-P722 (4X)



VIEW A

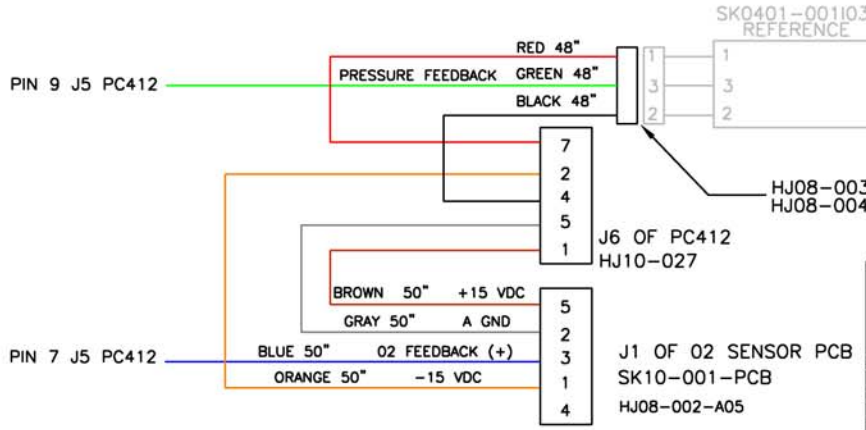
HJ08-003-M06 (1X)
W/ AJ06-001-GF31 (3X)





VIEW C

HJ10-027 (1X)
W/ AJ06-004-Z922 (5X)



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TOLERANCES ON
FRACTIONS ±1/8 | DECIMALS .X ±.100 .XX ±.010 .XXX ±.005 | ANGLES ±1°

MATERIAL:
FINISH:
XXXX USED ON | XXXX NEXT ASSY
APPLICATION

SIGNATURES | DATE
DRAWN BY: C.SHAW 5/9/05
CHECKED BY:
APPROVED BY:
CUST.NAME & NO.

Environics Inc
TOLLAND, CT 06084-2805

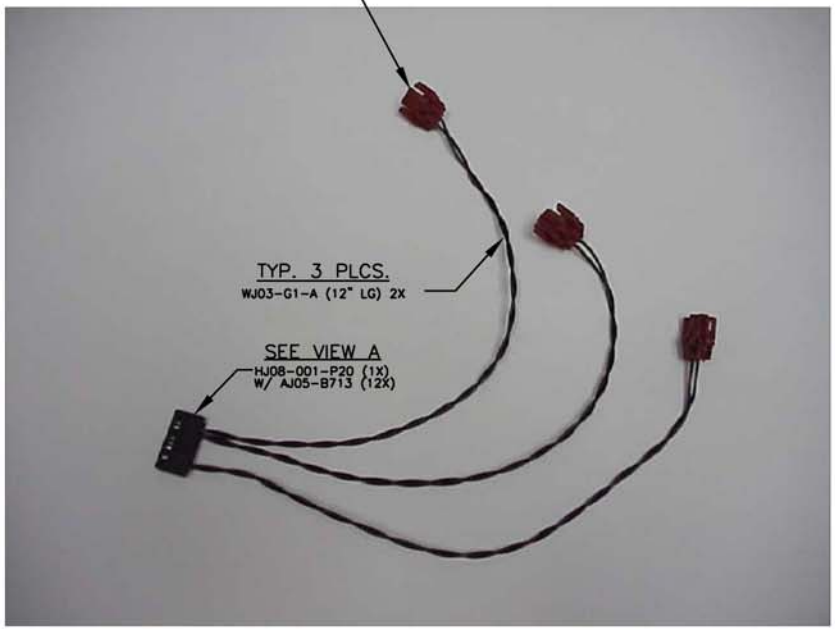
TITLE
HARNESS, 02 PCB SENSOR & PRESSURE SENSOR FOR ROBD2

SIZE C | REVISION A | DWG NO E626
SCALE NONE | WEIGHT | SHEET 1 OF 1

B8

REVISIONS						
ZONE	LTR	ECN#	DESCRIPTION	DATE	BY	APPV'D BY
-	A		INITIAL RELEASE	5/9/05	C.J.A.	J.A.B.

TYP. 3 PLCS.
HJ08-003-M02 (1X)
W/ AJ06-001-GF31 (2X)



VIEW A

NOTE: MARK CONNECTORS (HJ08-003-M02) V1,V2,V3 FOR IDENTIFICATION.

SOLENOID VALVE #8
PINS 15&16 OF J5 PC416
V1

HJ08-003-M02 & HJ08-004-M02

SOLENOID VALVE #9
PINS 17&18 OF J5 PC416
V2
TRIM GREEN WIRE

HJ08-003-M02 & HJ08-004-M02

SOLENOID VALVE #2
PINS 3&4 OF J5 PC416
V3

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FRACTIONS ±1/8 | DECIMALS .X ±.030, .XX ±.010, .XXX ±.005 | ANGLES ±1°

MATERIAL:
FINISH:
XXXX | XXXX
USED ON | NEXT ASS'Y
APPLICATION

SIGNATURES	DATE
DRAWN BY: C.SHAW	5/9/05
CHECKED BY:	
APPROVED BY:	
CUST.NAME & NO.	

Environics Inc
TOLLAND, CT 06084-2805

TITLE
HARNESS
V1,V2,V3
FOR ROBD2

SIZE	REVISION	DWG NO
B	A	E627

SCALE NONE | WEIGHT | SHEET 1 OF 1

REVISIONS						
ZONE	LTR	ECN#	DESCRIPTION	DATE	BY	APPV'D BY
–	A		INITIAL RELEASE	12/14/06	P.W.N.	T.P.

B9

WA01-01-040 (2X)

HJ08-004-M02 (1X)

OVERALL CABLE LENGTH 34"

HJ08-004-M02

HJ08-001-A04
TO J404 ON PC403-1C

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TOLERANCES ON
FRACTIONS ±1/8 | DECIMALS X ±.030, .XX ±.010, .XXX ±.005 | ANGLES ±1°

MATERIAL:

FINISH:

XXXX	XXXX
USED ON	NEXT ASS'Y
APPLICATION	

SIGNATURES	DATE
DRAWN BY: P.W.N.	12/14/06
CHECKED BY: T.P.	12/14/06
APPROVED BY:	

CUST.NAME & NO.

Environics Inc
TOLLAND, CT 06084-2805

TITLE
HARNESS, PULSE OXIMETER
POWER SUPPLY
FOR ROBO2

SIZE	REVISION	DWG NO
B	A	E628-1

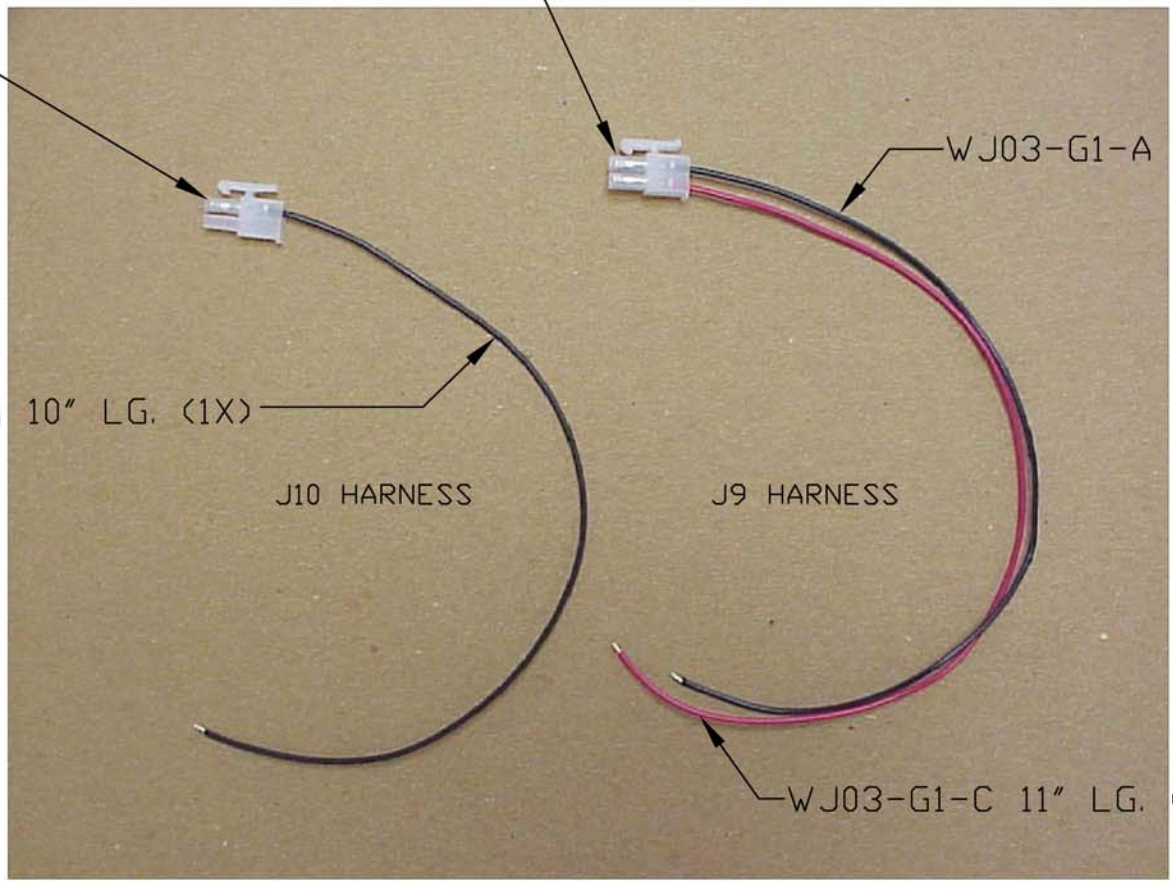
SCALE NONE | WEIGHT | SHEET 1 OF 1

REVISIONS					
LTR	ECN#	DESCRIPTION	DATE	BY	APPV'D BY
A	-	INITIAL RELEASE	5/9/05	C.J.S.	T.A.B.

B10

HJ10-018 (1X)
W/ AJ06-004-Z922 (1X)

HJ10-018 (1X)
W/ AJ06-004-Z922 (2X)



GND — 22 AWG BLACK — 2
+24 VDC — 22 AWG RED — 1
J9 OF PC412

GND — 22 AWG BLACK — 2
J10 OF PC412

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TOLERANCES ON

FRACTIONS	DECIMALS	ANGLES
±1/8	.X ±.020 .XX ±.010 .XXX ±.005	±1°

SIGNATURES		DATE
DRAWN BY:	C.SHAW	5/9/05
CHECKED BY:		
APPROVED BY:		
CUST.NAME & NO.		

Environics Inc
TOLLAND, CT 06084-2805

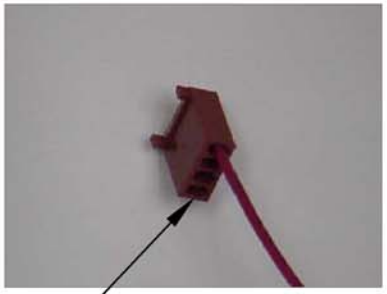
TITLE
HARNESS J9-J10
PC412
FOR ROBD2

SIZE	REVISION	DWG. NO	
A	A	E629	
SCALE NONE	WEIGHT	SHEET 1	OF 1

REVISIONS					
LTR	ECN#	DESCRIPTION	DATE	BY	APPV'D BY
A	-	INITIAL RELEASE	5/9/05	C.J.S.	T.A.C.

B11

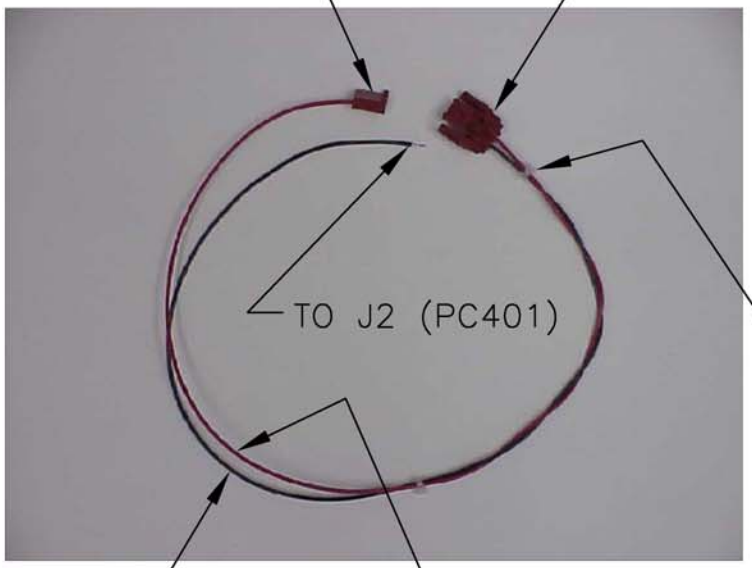
HJ11-012 (1X)
W/ AJ08-P722 (2X)



LOCATION FOR SECOND PIN

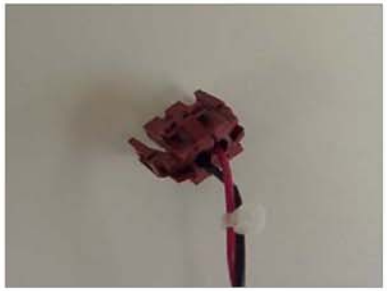
TO CONNECTOR ON A216

TO J13 (PC412)



TO J2 (PC401)

HJ08-003-M02 (1X)
W/ AJ06-001-GF31 (2X)



WA01-01-040 (2X)

WJ03-G1-A (18" 1X)

WJ03-G1-C (18" 1X)

PIN 4 OF J13 (PC412)

ALARM
AK02-002

PIN 3 OF J2 (PC401)

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DIMENSIONS ARE IN INCHES
TOLERANCES ON

FRACTIONS	DECIMALS	ANGLES
±1/8	.X ±.020 .XX ±.010 .XXX ±.005	±1°

SIGNATURES		DATE
DRAWN BY:	C.SHAW	5/9/05
CHECKED BY:		
APPROVED BY:		
CUST.NAME & NO.		

Environics Inc
TOLLAND, CT 06084-2805

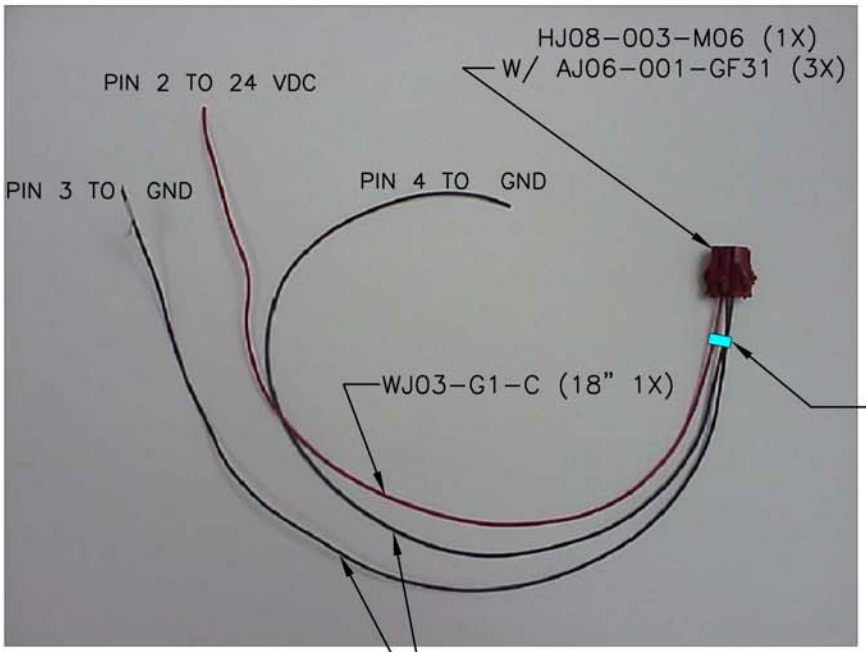
TITLE
HARNESS
BEEPER ALARM
FOR ROBD2

SIZE	REVISION	DWG NO
A	A	E630

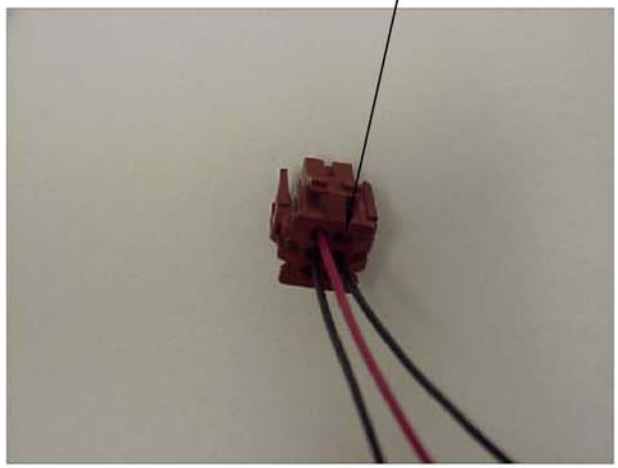
SCALE NONE | WEIGHT | SHEET 1 OF 1

B12

REVISIONS						
ZONE	LTR	ECN#	DESCRIPTION	DATE	BY	APPV'D BY
-	A		INITIAL RELEASE	5/9/05	C.J.L.	J.A.R.



REF. FOR RED WIRE (WJ03-G1-C)
FROM PIN 1 ON STATUS INPUT
CONNECTOR J7 SOLDER SIDE PC416



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TOLERANCES ON

FRACTIONS	DECIMALS	ANGLES
±1/8	.X ±.030 .XX ±.010 .XXX ±.005	±1°

MATERIAL:

FINISH:

XXXX	XXXX
USED ON	NEXT ASS'Y
APPLICATION	

SIGNATURES	DATE
DRAWN BY: C.SHAW	5/9/05
CHECKED BY:	
APPROVED BY:	

CUST.NAME & NO.

Environics Inc.
TOLLAND, CT 06084-2805

TITLE
HARNESS, E625
TO TERMINAL BLOCK
FOR ROBD2

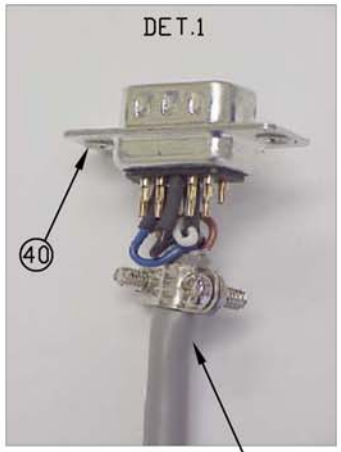
SIZE	REVISION	DWG. NO
B	A	E631

SCALE NONE | WEIGHT | SHEET 1 OF 1

B13

REVISIONS						
ZONE	LTR	ECN#	DESCRIPTION	DATE	BY	APPV'D BY
-	A		INITIAL RELEASE	10/11/05	[illegible]	[illegible]

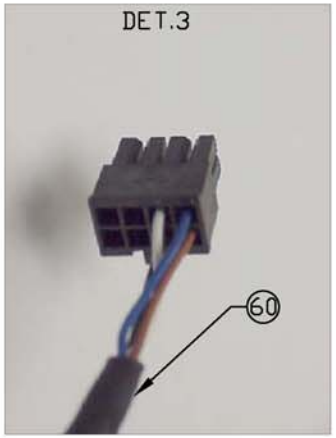
DET.1



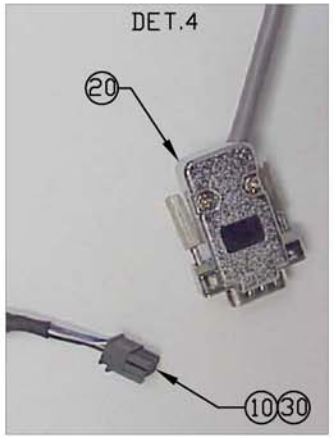
DET.2

SEE NOTE 1

DET.3

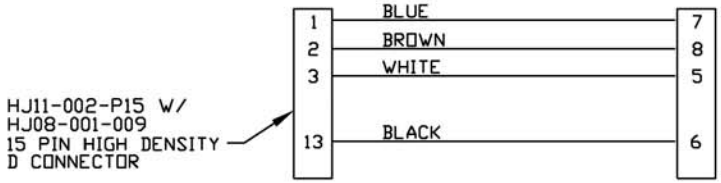


DET.4

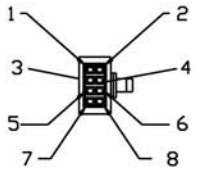


(E633) SIGNAL CABLE FOR MFC 2

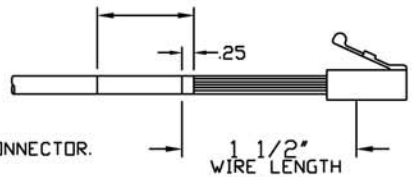
HJ11-002-P15 W/
HJ08-001-009
15 PIN HIGH DENSITY
D CONNECTOR



HJ08-002-Z08
PIN SIDE VIEW



1" LONG HEAT SHRINK TUBING



NOTE:

1. STRIP CASING BACK 3/4" TO EXPOSE WIRES FOR "D" CONNECTOR.

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TOLERANCES ON
FRACTIONS ±1/8 | DECIMALS .X ± 0.100, .XX ± 0.010, .XXX ± 0.005 | ANGLES ±1°

MATERIAL:

FINISH:

XXXX USED ON | XXXX NEXT ASSY
APPLICATION

SIGNATURES	DATE
DRAWN BY: C.STAN	10/11/05
CHECKED BY:	
APPROVED BY:	

CUST.NAME & NO.

Environics Inc
TOLLAND, CT 06084-2805

TITLE
CABLE, SIGNAL
MFC2 77L
ROBD2

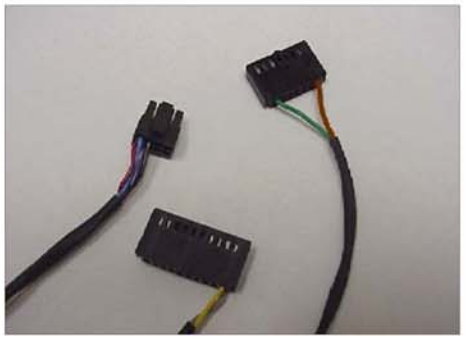
SIZE	REVISION	DWG NO
B	A	E633

SCALE: NONE | WEIGHT | SHEET 1 OF 1

B14

REVISIONS						
ZONE	LTR	ECN#	DESCRIPTION	DATE	BY	APPV'D BY
-	A		INITIAL RELEASE	3/29/05	C.J.L.	T.A.B.
-	B	1652	ADDED LOW AIR PRES. MOD.	11/8/05	C.J.L.	T.A.B.

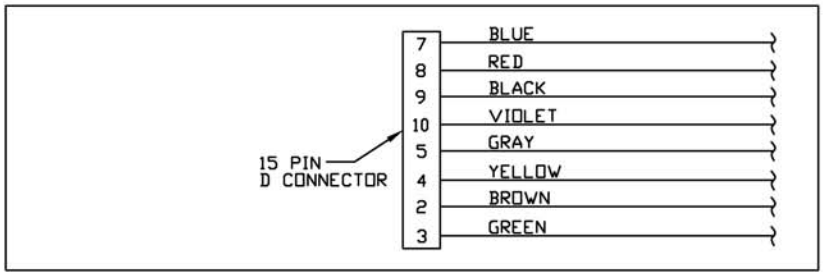
CONNECTOR DETAILS

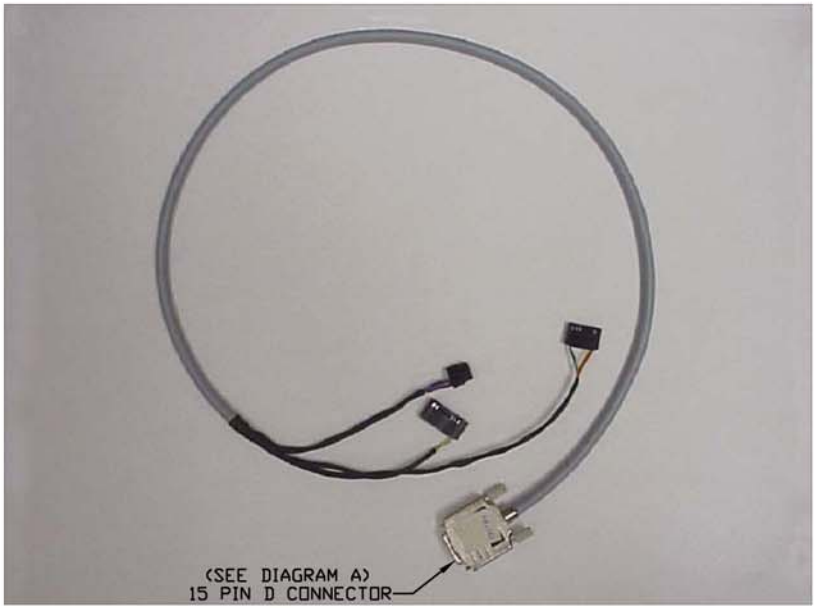


CONNECTOR DETAIL END VIEWS

GROUND CABLE

DIAGRAM A





FOR WIRING INFORMATION, REFER TO E205

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FRACTIONS ±1/8 | DECIMALS .X ±.100 .XX ±.010 .XXX ±.005 | ANGLES ±1°

SIGNATURES	DATE
DRAWN BY: C.SHAW	3/29/05
CHECKED BY:	
APPROVED BY:	

MATERIAL:
FINISH:
CUST.NAME & NO.

XXXX	XXXX
USED ON	NEXT ASS'Y
APPLICATION	

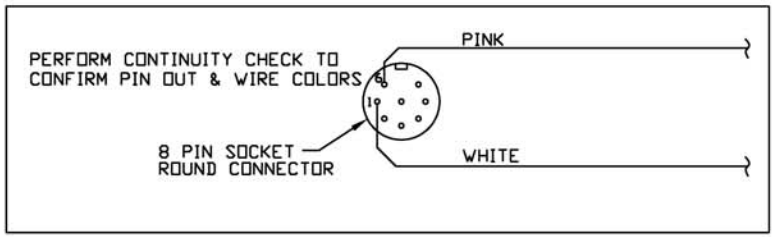
Environics Inc
TOLLAND, CT 06084-2805

TITLE
CABLE, MFC1
25 L
ROBD2

SIZE	REVISION	DWG NO
C	B	1418

SCALE NONE | WEIGHT | SHEET 1 OF 1

B15



GROUND CABLE

NOTES:

WHITE WIRE CONNECTS TO +24V ON TERMINAL BLOCK.
PINK WIRE CONNECTS TO GROUND ON TERMINAL BLOCK.
REFER TO I397 FOR TERMINAL BLOCK CONNECTION

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TOLERANCES ON
FRACTIONS ±1/8 | DECIMALS .X ±.005 .XX ±.010 .XXX ±.005 | ANGLES ±1°

MATERIAL:

FINISH:

XXXX	XXXX
USED ON	NEXT ASS'Y
APPLICATION	

SIGNATURES | DATE
DRAWN BY: C.SEAN 5/29/02
CHECKED BY:
APPROVED BY:
CUST.NAME & NO.

Environics Inc
TOLLAND, CT 06084-2805

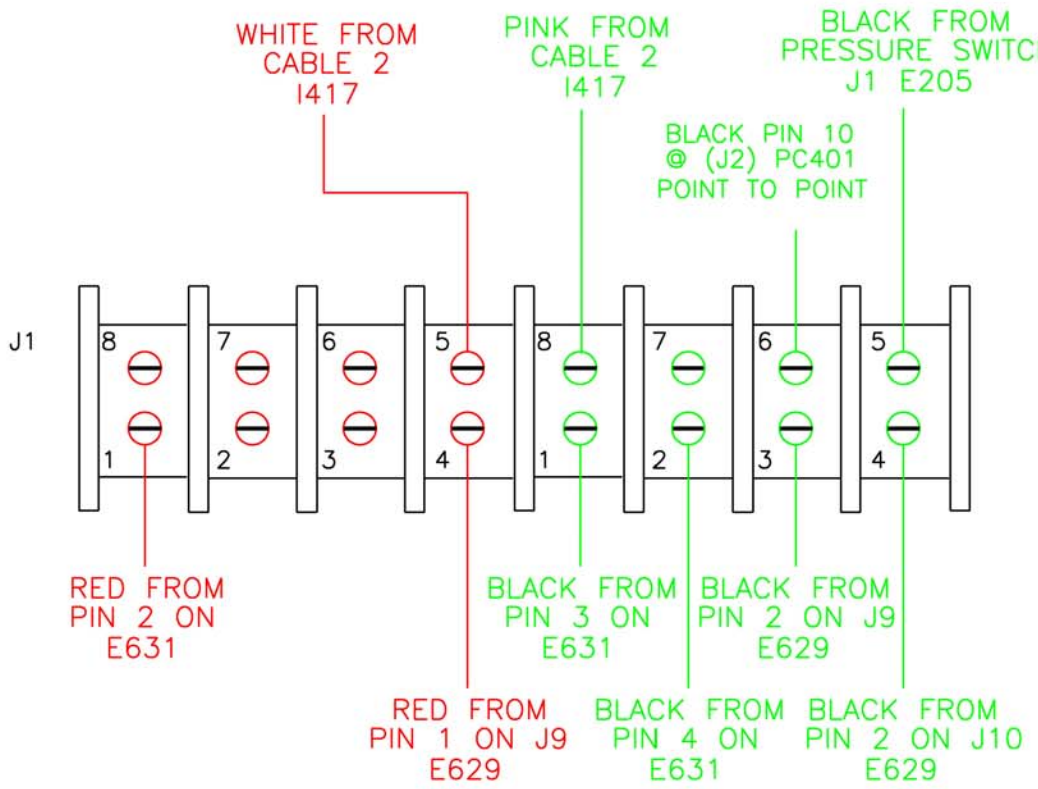
TITLE
CABLE, POWER
MFC2 77 L
ROBD2

SIZE	REVISION	DWG NO
C	B	I417

SCALE NONE | WEIGHT | SHEET 1 OF 1

LTR	ECN#	DESCRIPTION	DATE	BY	APPV'D BY
A	-	INITIAL RELEASE	5/10/05	C.J.S.	T.A.C.
C	1645	CHANGE TO SHT'S 1-5	5/10/05	C.J.S.	T.A.C.

B16



A206 SUB

+24 VDC TERMINAL BLOCK GND

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TOLERANCES ON

FRACTIONS	DECIMALS	ANGLES
±1/8	.X ±.020 .XX ±.010 .XXX ±.005	±1°

SIGNATURES		DATE
DRAWN BY:	C.SHAW	5/10/05
CHECKED BY:		
APPROVED BY:		
CUST.NAME & NO.		

Environics inc
TOLLAND, CT 06084-2805

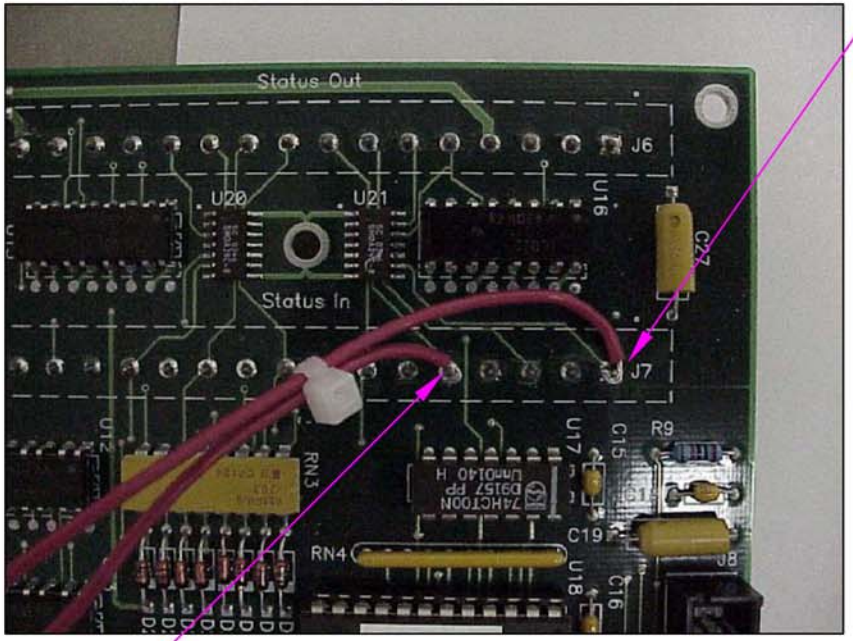
TITLE
TERMINAL BLOCK
CONNECTION DETAILS
ROBD2

SIZE	REVISION	DWG NO	
A	C	I397	
SCALE NONE	WEIGHT	SHEET 6 OF 7	

B17

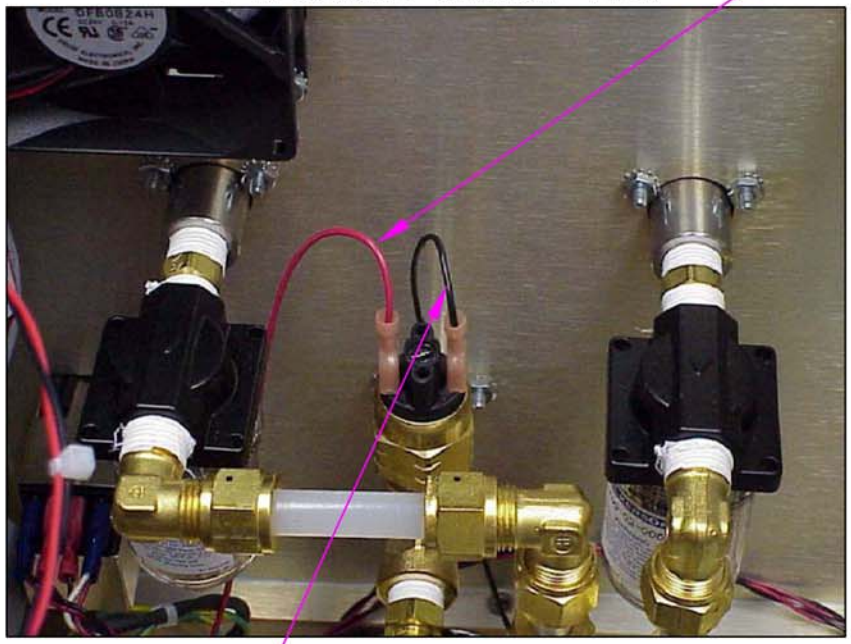
RED WIRE FROM PIN 1 OF E631
SOLDERED TO PIN 1 @ J7 SOLDER SIDE PC416

PC416 VIEW



CONNECTS TO PIN 5 @ J7
SOLDER SIDE PC416

PRESSURE SWITCH VIEW



RED WIRE
FROM OXYGEN PRESSURE SWITCH

CONNECT TO GND @
TERMINAL BLOCK.

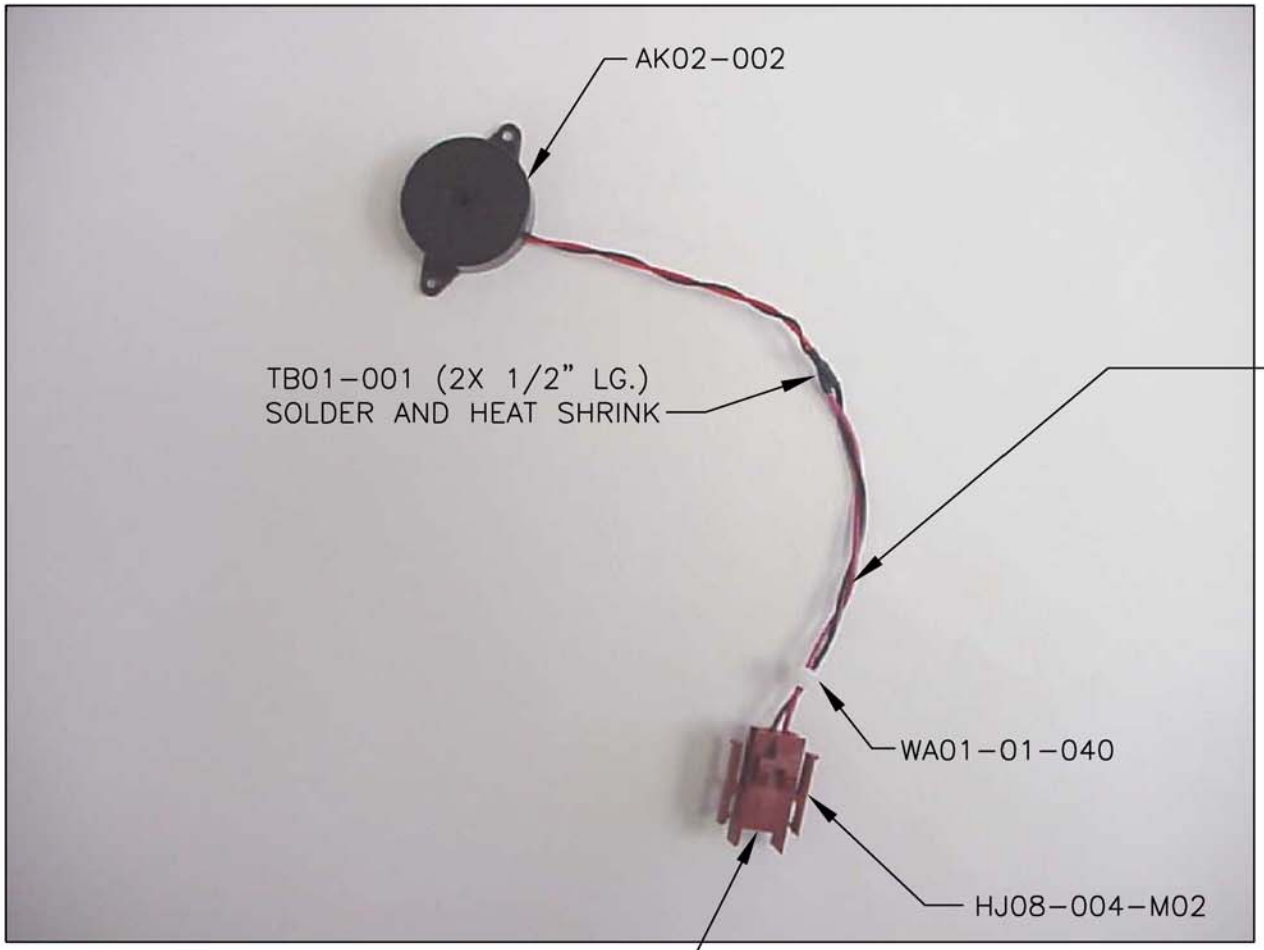
Environics Inc TOLLAND, CT 06084-2805			
TITLE WIRING, PRESSURE SWITCH TO E631 & PC416 ROBD2			
SIZE A	REVISION C	DWG NO I397	
SCALE NONE	WEIGHT	SHEET 7	OF 7

REVISIONS					
LTR	ECN#	DESCRIPTION	DATE	BY	APPV'D BY
A	-	INITIAL RELEASE	4/25/05	C.J.S.	T.A.B.

B18

NOTES:

1. EXTEND EXISTING WIRES AS SHOWN.
2. MOUNTS TO FRONT PANEL WITH TWO PCS. HA0799-0440C00 FROM A214.



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UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON

FRACTIONS	DECIMALS	ANGLES
±1/8	.X ±.020 .XX ±.010 .XXX ±.005	±1°

SIGNATURES		DATE
DRAWN BY:	C.SHAW	4/25/05
CHECKED BY:		
APPROVED BY:		
CUST.NAME & NO.		

Environics Inc
TOLLAND, CT 06084-2805

TITLE
BEEPER
ALARM
ROBD2

SIZE	REVISION	DWG. NO	
A	A	A216	
SCALE NONE	WEIGHT	SHEET 1	OF 1

APPENDIX C: ROBD2 RECOMMENDED SPARE PARTS LIST

PRICES EFFECTIVE: 2/24/2006
REVISION: 1

ITEM #	QUANTITY PER 10 ROBD2	ENVIRONICS #	DESCRIPTION	UNIT PRICE
1	1	A204	BATTERY BACKUP ASSEMBLY	
2	1	A222	PULSE OXIMETER POWER SUPPLY ASSEMBLY	
3	1	A209	3-WAY SOLENOID VALVE ASSEMBLY, MFC CROSSOVER	
4	1	A210	2-WAY BYPASS VALVE ASSEMBLY (LARGE BLUE SOLENOID)	
5	1	A215	BREATHING LOOP PRESSURE SENSOR WITH HARNESS	
6	1	A216	O2 ALARM WITH HARNESS	
7	1	A221	FILTER, SS WIRE, 60 MESH, 02 CLEANED	
8	2	AK01-002	PULSE OXIMETER SPEAKER (TAPE NOT INCLUDED)	
9	5	CA01-001-16	BREATHING HOSE AND BREATHING BAG CLAMPS	
10	1	FB07-002-FM	FAN FILTER MEDIA, 45 PPI	
11	2	FB09-002	3 LITER BREATHING BAG	
12	10	FJ02-002-0022	FUSE, SLO-BLO, 2.0 AMP 250 VAC (2 PER ROBD)	
13	2	MA04-003-005	FILTERED ORIFICE, .005", OXYGEN SENSOR FLOW CONTROL	
14	2	MAB1-005-25000	AIR MASS FLOW CONTROLLER FACTORY CALIBRATED W/CERT	
15	2	MAB1-005-77000	N2 MASS FLOW CONTROLLER FACTORY CALIBRATED W/CERT	
16	10	PA00-16-001	BREATHING HOSE (7.5 FEET PER ROBD2)	
17	1	PA04-02-001	VITON TUBE, OXYGEN SENSOR, REPLACED WITH SK10-001	
18	1	PC401-1C	MICROCOMPUTER PC BOARD (DOES NOT INCLUDE EPROM)	
19	1	PC403-1D	MAIN PULSE OXIMETER PC BOARD	
20	1	PC404-1D	PULSE OXIMETER PC BOARD, ANALOG/RS232	
21	1	PC406-1D	KEYBOARD/DISPLAY INTERFACE PC BOARD	
22	1	PC412-1D	ANALOG INTERFACE PC BOARD	
23	1	PC416-1D	SOLENOID VALVE DRIVER PC BOARD	
24	1	PJ02-14-004	MAIN POWER SUPPLY W/O COVER	
25	1	SA06-010-02	3-WAY OXYGEN DUMP SOLENOID VALVE (W/O PINS)	
26	1	SJ04-001-351	OXYGEN DUMP SWITCH	
27	1	SK10-001	OXYGEN SENSOR	
28	1	SK10-001-PCB	OXYGEN SENSOR PC BOARD	
29	1	SK11-001G010	OXYGEN PRESSURE SWITCH, 0-10 PSIG, PRESET FOR 10 PSIG	
30	1	UK18-009	EPROM FOR PC401 (MUST BE PROGRAMMED BY FACTORY)	
31	4	VA-FIL-004-E	FILTER ELEMENTS, 5 MICRON, FOR INPUT GAS FILTERS	
32	1	VA-G-005	PRESSURE GAUGE, 0-15 PSIG, O2 CLEANED	
33	1	VA-PRR-001	OPTIONAL PRESSURE REGULATOR FOR AIR	
34	1	VA-PRR-002	OPTIONAL PRESSURE REGULATOR FOR NITROGEN	
35	1	VA-PRR-003	OPTIONAL PRESSURE REGULATOR FOR OXYGEN	
36	2	XJ007	PULSE OXIMETER FINGER PROBE	

Appendix D

GE RTV 167 FOR ROBD2 CONNECTORS

Application: 1/8" dab of RTV on center of connectors. Any connectors having more than 10 pins, apply 2 dabs, one at each end. In hard to reach locations, first apply dab to tie wrap end then to connectors. Be sure to cover both mating connectors. 14 total connections

PC401- Micro-controller Board
Connectors H1 (inputs), H3 (RS232) and H5 (Data bus).

PC403 – Main Pulse Oximeter Board
Connectors J402 (keypad), J404 (power in) and J407 speaker.

PC404 – Secondary Pulse Oximeter Board (smaller).
J401 (RS232 cable)

PC406 – Front panel
J2 (keypad)

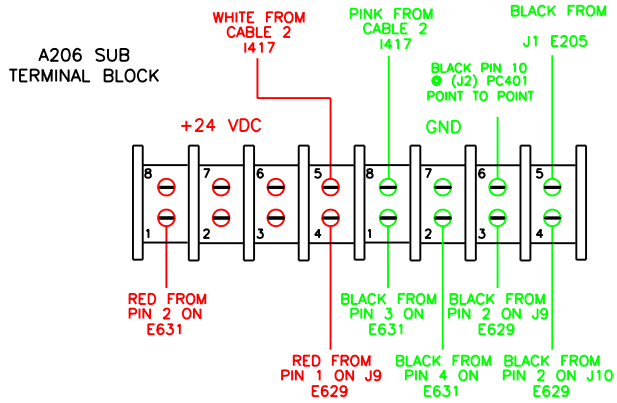
PC412 – Analog Board
Connectors J5 and J13

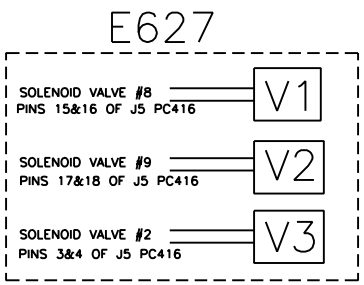
PC416 – Status/solenoid valve driver PCB
J5 (solenoid valves)

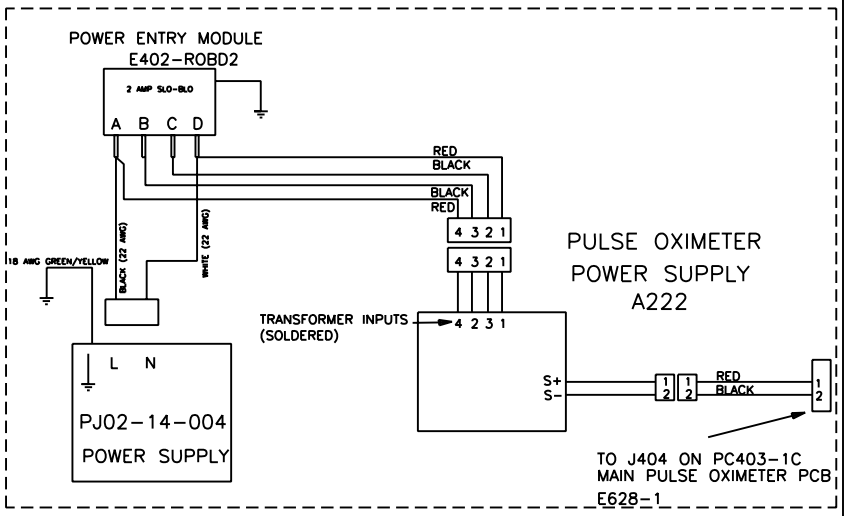
Main power supply
Connector TB1 (power input)

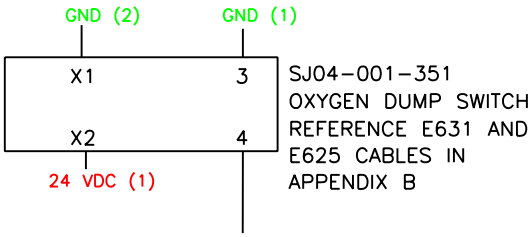
SK10-001-PCB – Oxygen sensor PCB
J1

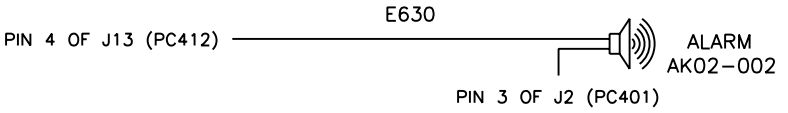
APPENDIX E

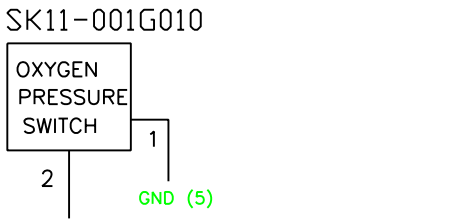


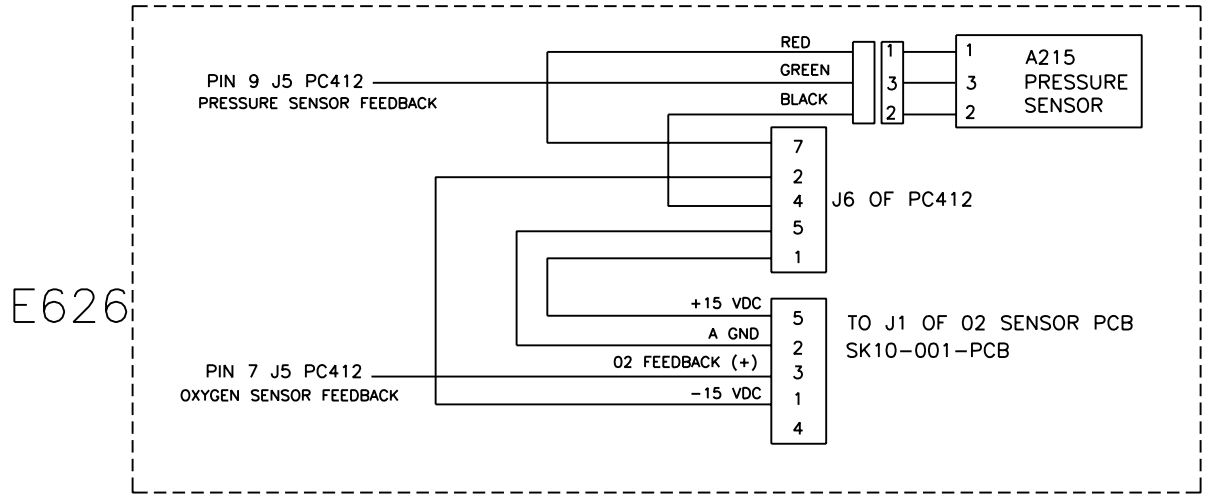


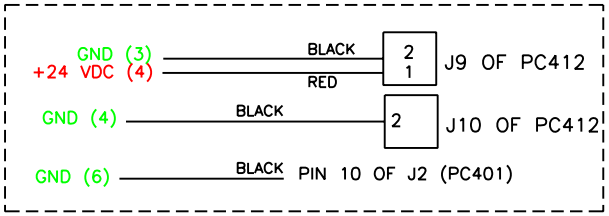












NOTES:

FOR REFERENCES TO AXXX AND EXXX NUMBERS
REFER TO APPENDICES A AND B RESPECTIVELY

Environics inc
TOLLAND, CT 06084-2805

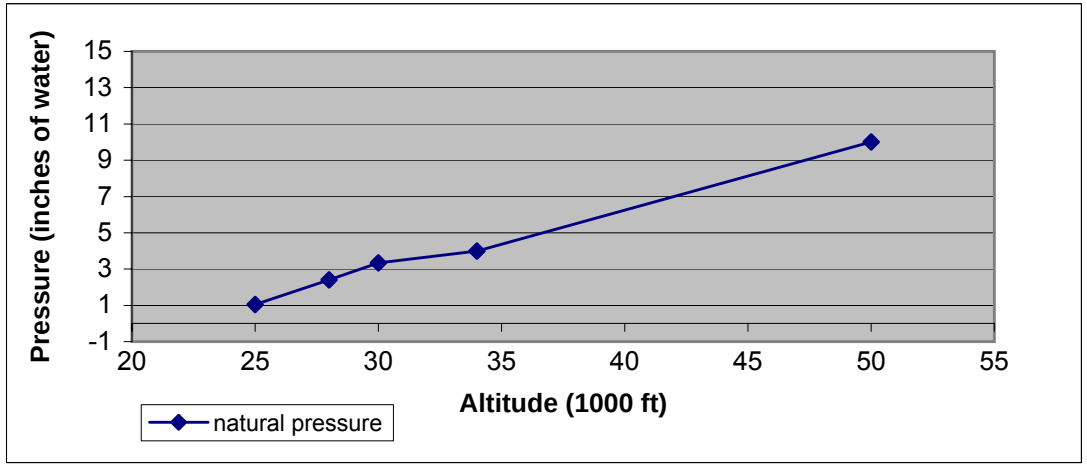
TITLE
ROBD2 POINT TO POINT
WIRING DIAGRAM

SIZE	REVISION	DWG NO
		E205 (manual version)

SCALE NONE | WEIGHT | SHEET 1 OF 1

APPENDIX F: ALTITUDE VERSUS PRESSURE CURVE FOR FSHT, OSFT AND PPT MODES

Altitude (X1000 Ft)	Pressure (inH2O)	
25	**1.04**	
28	**2.4**	
30	**3.34**	
34	**4**	
50	**10**	← **PPT test**

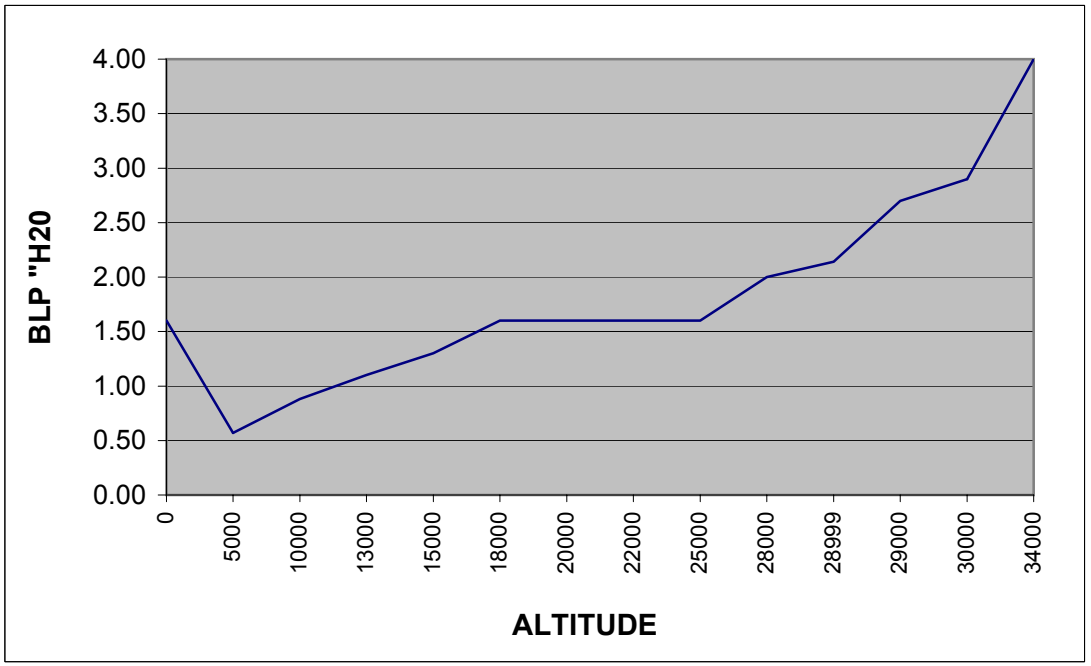


Note: The system can only be programmed to ascend to a ceiling of 34000 feet max.

APPENDIX G: NAVALSURVIVAL TRAINING INSTITUTE (NSTI/ASTC) FLOW, ALTITUDE PRESSURE CURVE FOR FSHT AND OSFT MODES

FSHT AND OSFT MODES OF OPERATION

ALTITUDE	MASK FLOW LPM	BLP ("H20)
0	50.0	1.60
5000	30.0	0.57
10000	37.0	0.88
13000	42.0	1.10
15000	46.0	1.30
18000	50.0	1.60
20000	50.0	1.60
22000	50.0	1.60
25000	50.0	1.60
28000	56.0	2.00
28999	59.0	2.14
29000	50.0	2.70
30000	52.0	2.90
34000	56.0	4.00



Appendix H: Respiratory physiology and ROBD2 flow rate parameters

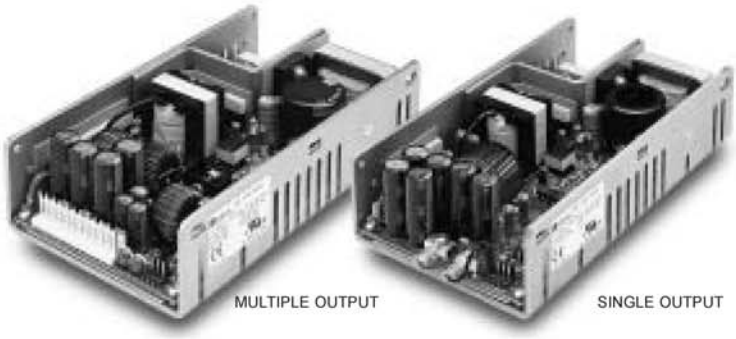
% O_2	ALTITUDE	TIDAL VOLUME (ml)	BREATHS/MIN	MASK FLOW LPM	AIR MFC LPM	N2 MFC LPM
21	0	500	14	30.0	30.0	0.0
17.28	5000	500	14	30.0	24.7	5.3
14.08	10000	536	14	30.0	20.1	9.9
12.43	13000	536	14	30.0	17.8	12.2
11.38	15000	536	14	30.0	16.3	13.7
9.96	18000	593	14	30.0	14.2	15.8
9.09	20000	700	15	30.0	13.0	17.0
8.24	22000	800	16	30.0	11.8	18.2
7.11	25000	825	19	31.4	10.6	20.7
6.09	28000	850	23	39.1	11.3	27.8
5.43	30000	900	27	48.6	12.6	36.0
4.4	34000	933	30	56.0	11.7	44.3

Appendix I: Power supply data sheet

CE-150 SERIES

Features

- Universal 85-264 VAC Input
- Harmonic Current per EN 61000-3-2
- Compact 4" X 7" X 1.75" Size
- Standard "U" Shaped Chassis
- Optional Perforated Cover
- Optional Remote On/Off
- Class B Conducted Emissions Per EN 55022,11
- EMC Compliant to EN 61000-4-2, 3, 4, 5, 6 & 11 and EN 60601-1-2
- Optional Power Fail Signal
- 2 Year Warranty
- EN 60950 ITE Certification
- EN 60601-1 Medical Cert.



MULTIPLE OUTPUT SINGLE OUTPUT

SAFETY SPECIFICATIONS

General	Protection Class:	I
	Voltage Category:	II
	Pollution Degree:	2
cULus	Underwriters Laboratories File E137708	UL1950 Third Edition UL2601-1 Second Edition CB Report per IEC 950 (1991) Second Edition, A1, A2, A3, A4 All EN 60950 Deviations CB Report Per IEC 601-1 (1988) First Edition A1, A2
cULus	UL Recognition Mark For Canada File E137708	CAN/CSA-C22.2 No. 950-M95 CAN/CSA-C22.2 No. 601-1-M90
TUV	TUV	EN 60950/A4:1997 EN 60601-1/A2:1995
CE		Low Voltage Directive

MODEL LISTING

MODEL	OUTPUT 1	OUTPUT 2	OUTPUT 3	OUTPUT 4
CE-150-4001	+3.3/15A	+5V/5A	+12V/2A	-12V/2A
CE-150-4002	+5V/15A	+3.3V/5A	+12V/2A	-12V/2A
CE-150-4003	+5V/15A	+3.3V/5A	+15V/2A	-15V/2A
CE-150-4004	+5V/15A	-5.2V/5A	+12V/2A	-12V/2A
CE-150-4005	+5V/15A	-5.2V/5A	+15V/2A	-15V/2A
CE-150-4006	+5V/15A	+12V/5A	+12V/2A	-12V/2A
CE-150-4007	+5V/15A	+12V/5A	+15V/2A	-15V/2A
CE-150-4101	+5V/15A	+24V/5A	+12V/2A	-12V/2A
CE-150-4102	+5V/15A	+24V/5A	+15V/2A	-15V/2A
CE-150-3001	+5V/15A	+12V/5A		-12V/2A
CE-150-3002	+5V/15A	+15V/5A		-15V/2A
CE-150-3003	+15V/5A	-15V/5A	+5V/2A	
CE-150-2001	+12V/7.5A	-12V/5A		
CE-150-2002	+15V/5A	-15V/5A		
CE-150-2003	+5V/15A	+12V/6A		
CE-150-2101	+5V/15A	+24V/5A		
CE-150-1001	3.3V/30A(5)			
CE-150-1002	5V/30A(5)			
CE-150-1003	12V/12.5A			
CE-150-1004	15V/10A			
CE-150-1005	24V/6.25A			
CE-150-1006	28V/5.4A			
CE-150-1007	48V/3.1A			

All specifications are maximum at 25°C unless otherwise stated and are subject to change without notice.

OUTPUT SPECIFICATIONS

Total Output Power	100W Convection Cooled 125W Convection Cooled W/ 1 Sq. Ft. Baseplate 150W 300 LFM Forced Air
Output Voltage Centering	Output 1: ± 0.25% Output 2: ± 0.25% (X0XX) (All Outputs 50% Load) Output 2: ± 3.0% (X1XX) Output 3: ± 2.0% Output 4: ± 2.0%
Source Regulation	Outputs 1-4: 0.5%
Load Regulation	Output 1: 0.5% (0-100% Load Change) Output 2: 0.5% (X0XX Models, 0-100%) 3.0% (X1XX Models, 10-100%) Output 3-4: 2.0% (0-100% Load Change)
Cross Regulation	Output 2: 0.2% (X0XX) (Output 1 load varied 50-100%) Output 2: 5.0% (X1XX) Output 3-4: 2.0%
Output Voltage Adjust Span	Output 1-2: 95-105% (X0XX Models) Output 1: 95-105% (XIXX Models) Output 1: 85-105% (1001, 4001) Output 2: 85-105% (4002, 4003)
Resolution	1%
Output Noise Source Freq. Switching Freq. Total (20MHz)	(Output under test at 100% rated load) Outputs 1-4: 0.5% Outputs 1-4: 1% Outputs 1-4: 1%
Turn On Overshoot	None
Transient Response Voltage Dev. Recovery Time Load Change	Outputs 1-4 5% 500 µS 50% To 100%
Output Overvoltage Protection (Optional)	Output 1: 110% To 150% Shuts down all outputs. Cycle input to restart
Output Overpower Protection	165 Watts Min.,Outputs 1 and 2 Outputs cycle on/off, auto recovery
Output Overcurrent Protection	110% Min. Outputs 3 And 4
Hold Up Time	20 mS Min., 150W Output 120V Input
Start Up Time	3 Seconds

INPUT SPECIFICATIONS

Source Voltage	85 - 264 Volts AC
Frequency Range	47-63 Hz
Source Current True RMS Peak Inrush Peak Repetitive Harmonic Distortion	 3A at 85V Input 30A 4.25A at 85V Input 0.05
Efficiency	.68 -.80 (Varies by model)
Power Factor	0.90 (150 watts, 230V)

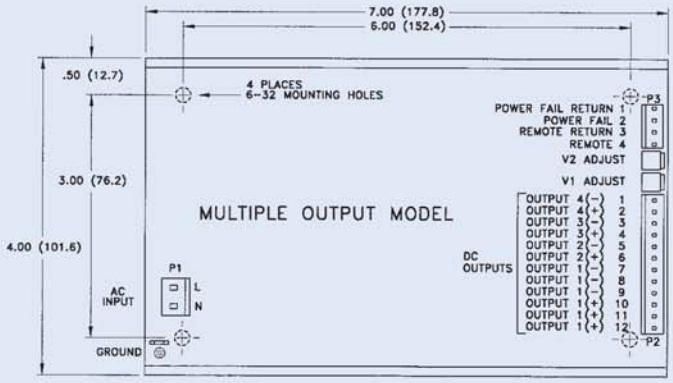
ENVIRONMENTAL SPECIFICATIONS

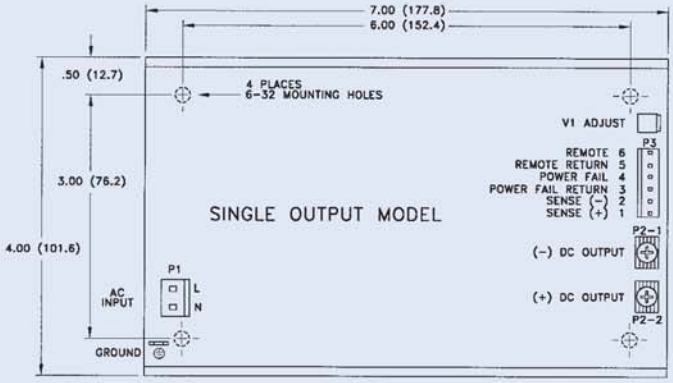
Ambient Operating Temperature Range	0° C to +70° C Derating: See Power Rating Chart
Ambient Storage Temperature Range	-40° C To +85° C
Temperature Coefficient	Outputs 1-4: 0.02%/°C
Vibration	MIL-STD-810E, Method 514.4 Category 1
Shock	Transit Drop per MIL-STD-810E Method 516.4 Procedure IV

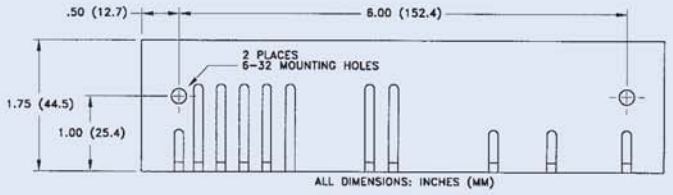
GENERAL SPECIFICATIONS

Dielectric Strength	5656 VDC, Primary to Secondary, 1 Sec. 2121 VDC, Primary to Ground, 1 Sec. 707 VDC, Secondary to Ground, 1 Sec.
Leakage Current	<300 µA Earth Leakage Current <100 µA Patient Leakage Current
Remote On/Off (Optional)	Contact closure shuts off all outputs
Power Fail Signal (Optional)	Logic low with input power failure 10 mS minimum prior to output one dropping 1%
Remote Sense (Single Output Models Only)	250mV compensation of output cable losses
Mean-Time Between Failures	150,000 Hours min., MIL-HDBK-217F, 25° C, GB
Weight	2.0 Lbs.

CE-150 SERIES MECHANICAL SPECIFICATIONS







AC Input Connector P1:

- .156 inch friction lock header mates with Molex 09-50-3031 or equivalent crimp terminal housing with Molex 08-50-0189 or equivalent crimp terminal.

DC Output Connector P2: (Single Output)

- 6-32 screw down terminal mates with # 6 ring tongue terminal.

DC Output Connector P2: (Multi Output)

- .156 inch friction lock header mates with Molex 09-50-3121 or equivalent crimp terminal housing with Molex 08-50-0189 or equivalent crimp terminal.

Ground Connector ⏚:

- Ground mates with .187 inch quick disconnect terminal.

Option/Sense Connector P3: (Single Output)

- .100 inch friction lock header mates with Molex 22-01-2067 or equivalent crimp terminal housing with Molex type 6459 or equivalent crimp terminal.

Option Connector P3: (Multi Output)

- .100 inch friction lock header mates with Molex 22-01-2047 or equivalent crimp terminal housing with Molex type 6459 or equivalent crimp terminal.

Optional cover increases height dimension from 1.75 to 1.92 inches.

ELECTROMAGNETIC COMPATIBILITY SPECIFICATIONS

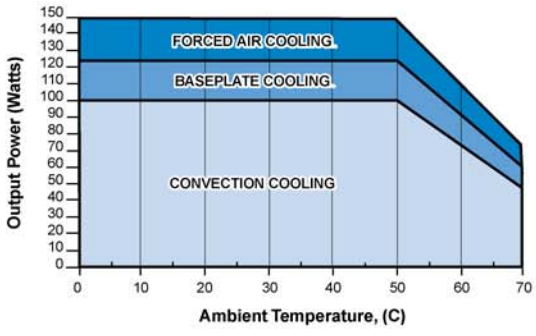
Electrostatic Discharge	EN 61000-4-2	6kV Contact Discharge
Radiated Electromagnetic Field	EN 61000-4-3	3V/M, 26-1000 MHz
EFT/Bursts	EN 61000-4-4	2kV
Surges	EN 61000-4-5	1kV Differential Mode 2 kV Common Mode
Conducted Immunity	EN 61000-4-6	3V,150KHz-80MHz
Voltage Dips	EN 61000-4-11	30% Reduction, 10mS 60% Reduction, 100mS
Voltage Interruptions	EN 61000-4-11	95% Reduction, 5000mS
Radiated Emissions	EN 55011 EN 55022	Class B Class B
Conducted Emissions	EN 55011 EN 55022	Class B Class B
Harmonic Current Emissions	EN 61000-3-2	

Specifications are typical across product line and may vary by model.

APPLICATIONS INFORMATION

1. Consult factory for alternate output configurations.
2. Consult factory for positive, negative, or floating outputs.
3. Specify optional overvoltage protection, remote on/off, power fail signal or cover when ordering.
4. Each output can deliver its rated current but total output power must not exceed 100, 125 or 150 watts as determined by the cooling method.
5. Rated 20 amps maximum when convection cooled only.
6. Free air convection cooling, 100 watts maximum output power.
7. Base plate cooled rating of 125 watts requires a one square foot .09" thick aluminum area attached to bottom four mounting holes.
8. Forced air cooling rating of 150 watts requires an air speed of 300 linear feet per minute flowing past a point one inch above the main isolation transformer.
9. This product is intended for use as a professionally installed component within medical and information technology equipment.
10. A minimum load of 10% is required on output one to ensure proper regulation of remaining outputs.
11. Remote sense terminals (Figure 1) may be used to compensate for cable losses up to 250mV (single output models only). The use of a twisted pair is recommended as well as a decoupling capacitor C_D (0.1-10µF) and a capacitor C_L of 100µF/Amp connected across the load side.
12. Peak to peak output ripple and noise is measured directly at the output terminals of the power supply, without the use of the probe ground lead or retractable tip, 20 MHz bandwidth.
13. This power supply has been safety approved and final tested using a DC dielectric strength test. Please consult factory before performing an AC dielectric strength test.
14. The input circuit includes only one fuse in the "line" conductor. In consideration to paragraph 57.6 of UL 2601-1, when used in medical applications, a fuse should be added to the "neutral" conductor in the end product.
15. Maximum screw penetration into chassis mounting holes is .250 inches.

Maximum Output Power vs. Ambient Temperature



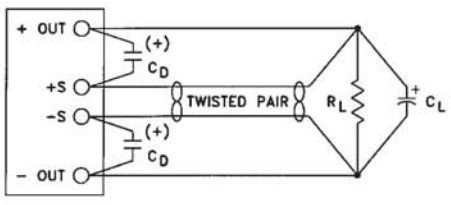
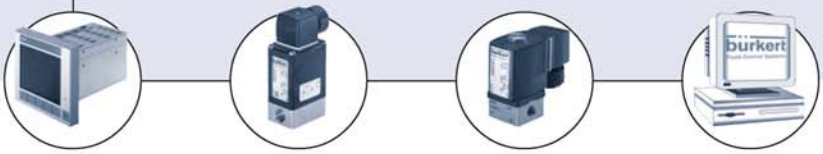


Figure 1 - Output sense connections

APPENDIX J MFC1

- Bypass MFC with semiconductor sensor technology for nominal flow rates from 20 ml_N/min to 50 l_N/min
- High accuracy
- Fast settling time

Type 8711 can be combined with...



Type 1150
Multi-channel programme controller

Type 0330
3/2 or 2/2-way valve

Type 6013
2/2-way valve

MFC
Configuration software

Type 8711 is a unit for the control of the mass flow of gases that is relevant for most applications in Process Technology. The measured value provided by the sensor (see the description on page 2) will be compared in the digital regulation electronics with the predefined set point according to the signal; if a control difference is present, the control value output to the proportional valve will be modified using a PI-control algorithm. Due to the fact that the sensor is directly in the bypass channel a very fast settling time of the MFC is reached. In this way, the mass flow can be maintained at a fixed value or a predefined profile can be followed, regardless of pressure variations or other changes in the system. Type 8711 can optionally be calibrated for two different gases, the user is able to switch between these two gases. As the control element, a proportional valve working at low friction guarantees a high sensitivity and a good control characteristics of the unit. Typical application areas are gas dosing or rather the production of gas mixtures in:

- Process technology
- Packaging and foodstuff industry
- Environmental technology
- Surface treatment
- Material coating
- Burner controllers
- Fuel cell technology

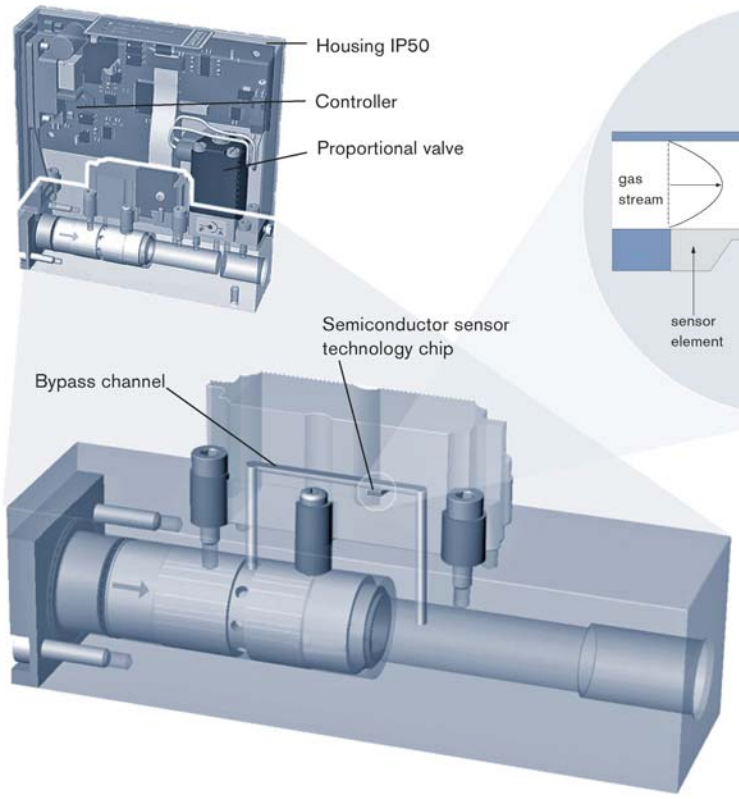
Technical data	
Full scale ranges[1] (Q_{nom})	0.02 to 50 l_N/min N_2 equivalent
Operating media	neutral, non-contaminated gases, other gases on request
Max. operating pressure (inlet pressure)	10 bar (145 psi) depending on the orifice of the valve
Calibration medium	operating gas or air with conversion factor
Medium temperature	-10 to +70°C
Ambient temperature	-10 to +50°C
Accuracy (after 1 min. warm up time)	± 0.8% of Rdg. ± 0.3% F.S.
Linearity	± 0.1% F.S.
Repeatability	± 0.1% F.S.
Control range	1:50, 1:500 on request
Settling time ($t_{95\%}$)	< 300 ms
Body material	aluminium or stainless steel 1.4305
Electr. housing material	chromium plated steel sheet
Sealing material	FPM, EPDM, others on request
Port connections	NPT 1/4, G 1/4, screw-in fitting or sub-base, others on request
Control valve (proportional valve) valve orifice k_{vs}-value	valve is closed when power is off 0.05 to 1.6 mm 0.0002 to 0.05 m^3/h
Electr. connection	15-pin sub-D plug

Power supply	24V DC
Voltage tolerance	± 10%
Residual ripple	< 5%
Power consumption	max. 400 mA at 24V DC
Set point Feed impedance	0-5 V, 0-10 V, 0-20 mA or 4-20 mA > 20 kΩ (voltage), < 300 Ω (current)
Output signal Max. current, volt. output Max. load, current output	0-5 V, 0-10 V, 0-20 mA or 4-20 mA 10 mA 600 Ω
Digital communication	RS232 or RS485, adapter needed
Protection class	IP50
Dimensions [mm] (without fitting)	107 x 114 x 28 mm
Total weight	ca. 1000 g (aluminium body)
Mounting position	horizontal or vertical
Light emitting diode display (default, other allocations possible)	indication for Power, Limit, Error
Binary input (default, other functions possible)	two 1. start autotune 2. not assigned
Binary output (default, other functions possible)	one relay-output for 1. setpoint not reached max. load: 25V, 1A, 25VA
Certification (see operating instructions)	various environmental testing, electromagnetic compatibility

[1] at standard conditions 1.013 bar(a) and 273 K

APPENDIX J MFC1

Measurement principle



Functinal principle of the registration of the measured value

The actual flow rate is detected by a sensor. This operates according to a thermal principle which has the advantage of delivering the mass flow without any corrections for the required pressure or temperature.

A small part of the total gas stream is diverted into a small, specifically designed bypass channel, that ensures laminar flow conditions. The sensor element is a chip immersed into the wall of this channel. The chip, produced in CMOS technology, contains a heating resistor and two temperature sensors (thermopiles) which are arranged symmetrically upstream and downstream of the heater. The differential voltage of the thermopiles is a measure of the mass flow rate passing this bypass channel. The calibration procedure effectuates a unique assignment of the sensor signal to the total flow rate passing the device.

Notes regarding the selection of the unit

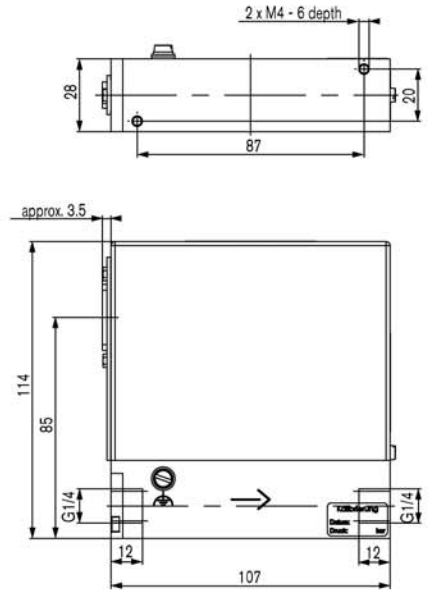
For the proper choice of the actuator orifice within the MFC, not only the required maximum flow rate Q_{nom}, but also the pressure values *directly* before and after the MFC (p_1, p_2) at this flow rate Q_{nom} should be known. In general, these pressures are not the same as the overall inlet and outlet pressures of the whole plant, because usually there are additional flow resistors (tubing, additional shut-off valves, nozzles etc.) present both before and after the controller.
Please use the request for quotation form on p. 4 to indicate the pressures *directly* before and after the MFC. If these should be unknown or not accessible to a measurement, estimates are to be made by taking into account the approximate pressure drops over the flow resistors before and after the MFC, respectively, at a flow rate of Q_{nom}.
In addition, please quote the maximum inlet pressure p_{1max} to be encountered. This data is needed to make sure the actuator is able to provide a close-tight function within all the specified modes of operation.

The request for quotation form on page 4 contains the relevant fluid specification. Please use in this way the experience of Bürkert engineers already in the design phase and provide us with a copy of the request containing the data of your application together with your inquiry or order.

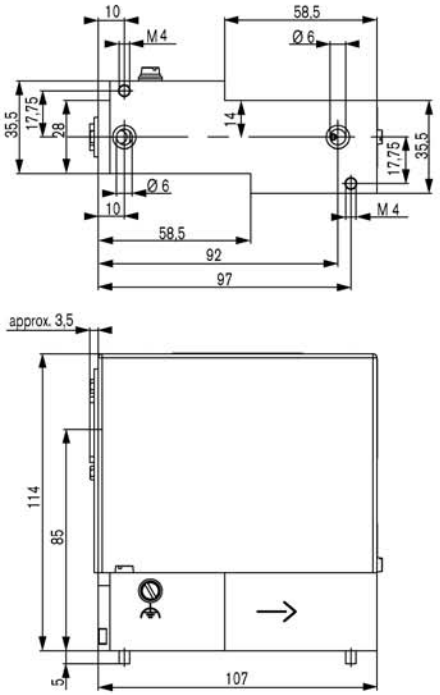
APPENDIX J MFC1

Dimensions [mm]

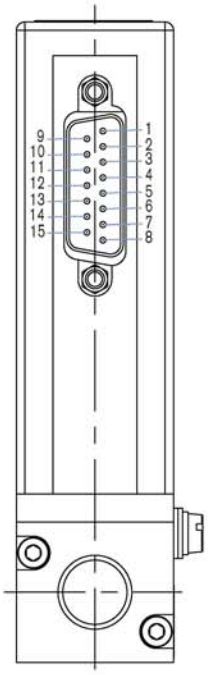
Standard version



Sub-base version



PIN configuration



15-pin sub-D plug

Pin	Connection
1	relay, NC contact
2	relay, NO contact
3	relay, C contact
4	GND 24V-supply and binary inputs
5	supply +24V
6	8V output (only internal company use)
7	set-value input GND
8	set-value input +
9	actual value output GND
10	actual value output +
11	DGND (for RS232)
12	binary input 1
13	binary input 2
14	RS232 RxD (without driver)
15	RS232 TxD (without driver)

APPENDIX J MFC2

PRODUCTINFORMATION

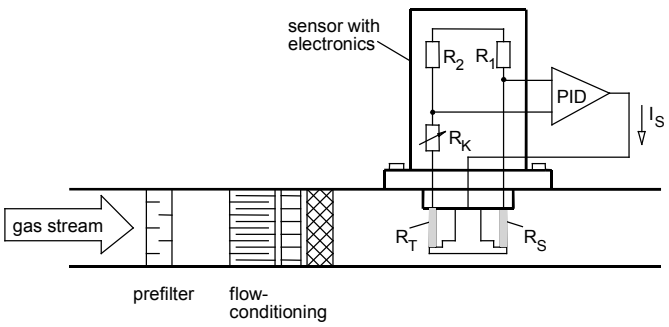
TECHNICAL DATA

Full scale ranges [1] (Q_{nom})	25 to 1500 l_N/min N_2 equivalent
Operating media	neutral, non-contaminated gases, other gases on request
Max. operat. press.	max. 10 barg, depending on the orifice of the valve
Calibration medium	operating gas or air with conversion factor
Medium temperature	-10 to +70 °C
Ambient temp.	-10 to +45 °C
Accuracy (after 15min. warm up time)	±1,5% of rate ±0,3% F.S.
Linearity	±0,25% F.S.
Repeatability	±0,1% F.S.
Control range	1:50
Settling time ($t_{95\%}$)	< 500 ms
Body material	anodised aluminium or stainless steal 1.4305
Electr. housing material	aluminium (coated)
Sealing material	FPM, EPDM others on request
Port connection	G 1/4, 3/8, 1/2, 3/4, NPT 1/4, 3/8, 1/2, 3/4
Control valve (proportional valve)	normally closed, N.C.
valve orifice	0,8 bis 12 mm
k_{VS}-value	0,02 bis 2,8 m^3/h
Electr. connection	
round socket	8-pin
sub-HD socket	15-pin
Fieldbus comm.	9-pin sub-D socket

[1] at reference conditions 1,013bar(a), 0°C

Power supply	24 V DC
Voltage tolerance	±10 %
Residual ripple	< 5 %
Power consumption	20 W – max. 50 W (depending on specification)
Set point	0-5 V, 0-10 V, 0-20 mA or 4-20mA
Feed impedance	> 20 kΩ (voltage) < 300 Ω (current)
Output signal	0-5 V, 0-10 V, 0-20 mA or 4-20mA
Max. current, voltage output	10 mA
Max. load, current output	600 Ω
Fieldbus communication	Profibus-DP, DeviceNet, others on request
Protection class	IP 65
Dimensions [mm]	see drawings p. 2-4
Total weight (examples)	1,8 kg (Al, 10 W valve) 4,0 kg (VA, 14 W valve)
Mounting position	horizontal or vertical
Light emitting diodes (Default, other allocations possible)	indication for Power, Communication, Limit, Error
Binary input (Default, other functions possible)	three 1. start autotune 2. not assigned 3. not assigned
Binary output (Default, other functions possible)	two relay-outputs for 1. set point not reached 2. error (e.g. sensor fault) max. load: 60V, 1A, 60VA
Certification (see operating instructions)	various environmental testing, electromagnetic compatibility

Functional principle of the registration of the measured values



This sensor utilises the hot-film-anemometer principle in the so called Constant Temperature Anemometer mode. There are two resistances with precisely specified temperature coefficients directly in the gas stream as well as three resistances outside the gas stream interconnected to a bridge.
The first resistance (RT) in the gas stream measures the temperature of the medium, the second resistance (RS) with low impedance is so far heated that it is held on a fix given over-temperature to the medium temperature. The filament current which is necessary for that is a measure for the heat dissipation by the flowing gas and represents the primary measured variable.
The calibration with a high-quality flow-normal guarantees as well as an adequate flow conditioning within the MFC that from the primary signal the mass of gas , flowing through per time unit, can be derived with a high accuracy.

SHORT DESCRIPTION

Bürkert's compact 8626 Mass Flow Controller precisely controls gas flows independently of disturbances such as pressure variation.
The MFC fuses three distinct components: flow sensor, intelligent control electronics and a precision control valve.
The flow sensor utilises the hot-film anemometer principle. As mass flow changes the filament current adapts to hold a constant temperature. The current required to keep the filament temperature constant is proportional to the actual mass flow though the apparatus. (see description alongside)
The 8626 exhibits excellent dynamics as it measures gas flows in the main stream. It is because of this mainstream measurement that the sensor portion of the system is also less sensitive to contamination.
Processing of the flow data is carried out by digital microprocessor electronics. Signals from the sensor are converted, with the aid of a calibration curve stored in the EEPROM, into a exact and instaneous mass flow rate.
The MFC's microprocessor contains elements of proportional and integral (P,I) control algorithms. Using the autotune function allows the user to achieve optimal control and extremely high accuracy.
Tight shut off is assured as a function of the control valve eliminating the normal requirement for additional on-off valves.
Bürkert's modular concept allows timely construction of tailor-made mass flow solutions.
Typical application areas are gas metering or rather the production of gas mixtures in

- process technology,
- packaging and foodstuff industry,
- environmental technology,
- surface refinement,
- material coating,
- burner controllers and
- fuel cell technology.

bürkert

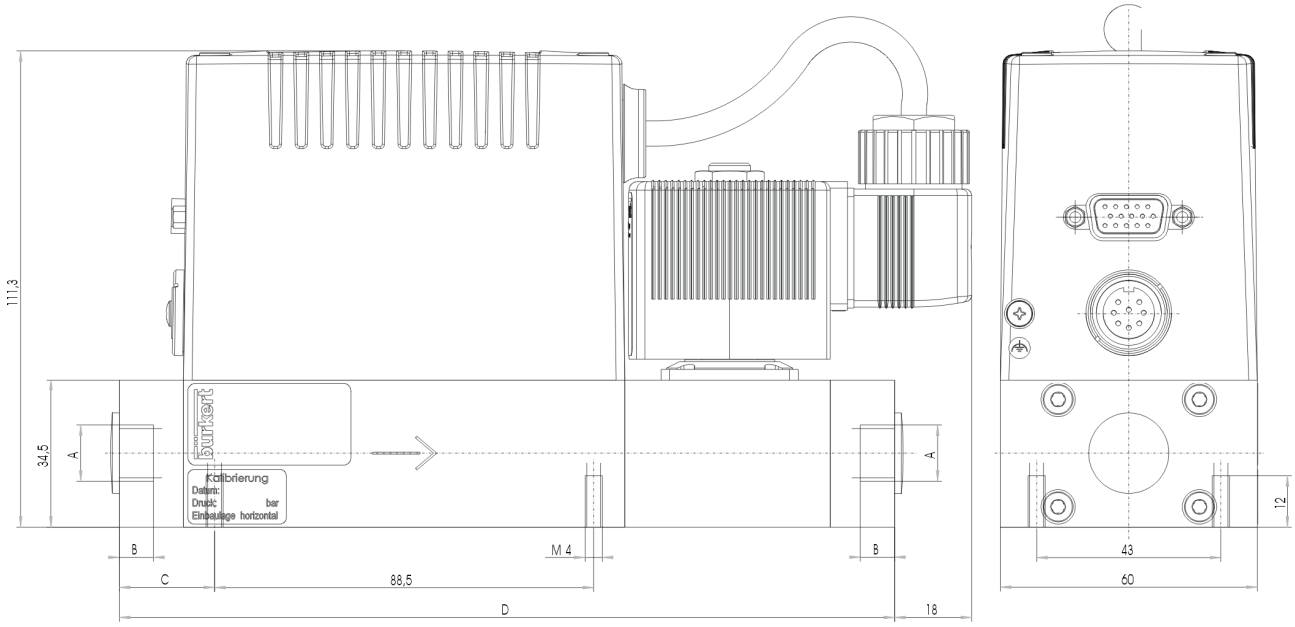
APPENDIX J MFC2

Notes regarding the selection of the unit

For the proper choice of the actuator orifice within the MFC, not only the required maximum flow rate Q_{nom} , but also the pressure values *directly* before and after the MFC (p_1, p_2) at this flow rate Q_{nom} should be known.
In general, these pressures are not the same as the overall inlet and outlet pressures of the whole plant, because usually there are additional flow resistors (tubing, additional shut-off valves, nozzles etc.) present both before and after the controller.
Please use the specification sheet (p. 6) to indicate the pressures *directly* before and after the MFC. If these should be unknown or not accessible to a measurement, estimates are to be made by taking into account the approximate pressure drops over the flow resistors before and after the MFC, respectively, at a flow rate of Q_{nom}.
In addition, please quote the maximum inlet pressure p_{1max} to be encountered. This data is needed to make sure the actuator is able to provide a close-tight function within all the specified modes of operation.

The questionnaire on page 6 contains the relevant fluid specification. Please use in this way the experience of Burkert engineers already in the design phase and provide us with a copy of the questionnaire containing the data of your application together with your inquiry or order.

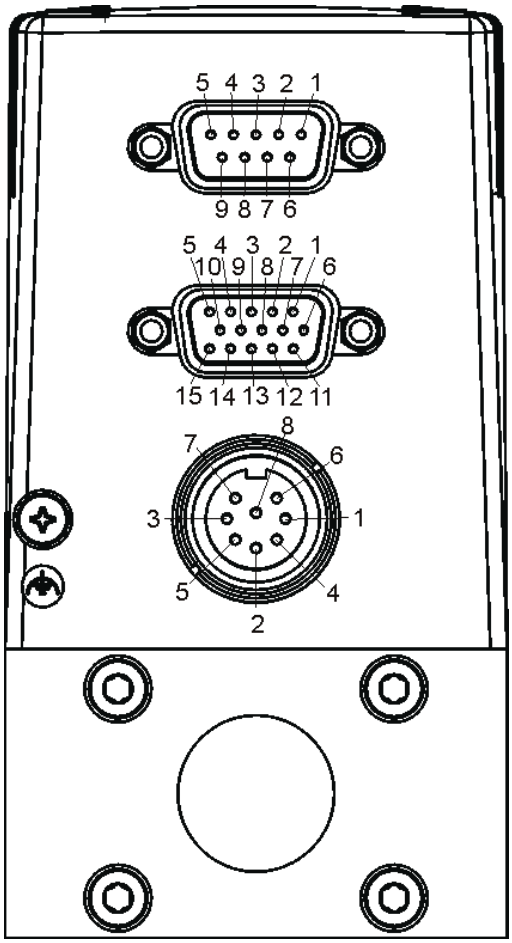
Dimensions [mm]



A	B	C	D
G 3/4; NPT 3/4	14	27,25	191
G 1/2; NPT 1/2	13		
G 3/8; NPT 3/8	10	22,25	181
G 1/4; NPT 1/4			

MFC 8626 valve type 6022 (10W coil)

APPENDIX J MFC2



9-pin Sub-D socket:

with Profibus-DP

Pin	Connection
1	shield
2	not used
3	RxD/ TxD – P (B-line)
4	RTS (control signal for repeater)
5	GND
6	VDD
7	not used
8	RxD/ TxD – N (A-line)
9	not used

with DeviceNet

Pin	Connection
1	shield
2	CAN_L
3	GND
4	not used
5	not used
6	not used
7	CAN_H
8	not used
9	not used

15-pin Sub-HD socket:

Pin	Connection
1	signal input +
2	signal input GND
3	signal output +
4	binary input 2
5	12V-output (only company internal use)
6	RS232 TxD (direct connection to PC)
7	binary input 1
8	DGND (for binary inputs)
9	only company internal use (do not connect!)
10	12V-output (only company internal use)
11	12V-output (only company internal use)
12	binary input 3
13	signal output GND
14	RS232 RxD (direct connection to PC)
15	DGND (for RS232)

(with bus version 1-3 and 13 not used)

8-pin socket round:

Pin	Connection
1	supply 24V +
2	relay 1 – middle contact
3	relay 2 – middle contact
4	relay 1 – opener
5	relay 1 – closer
6	supply GND
7	relay 2 – closer
8	relay 2 – opener

Ordering table for accessories (connectors are not included in the delivery)

Article	Ordering-No.
Round plug 8-pin Binder (solder termination)	918 299
Round plug 8-pin with 5m - cable, on one side prefabricated	787 733
Round plug 8-pin with 10m - cable, on one side prefabricated	787 734
SUB-HD-plug 15-pin with 5m - cable, on one side prefabricated	787 735
SUB-HD-plug 15-pin with 10m - cable, on one side prefabricated	787 736
RS232-adapter - for connection to a PC	654 757
Cable for RS232 9-pin socket/plug 2m	917 039

APPENDIX K: PULSE OXIMETER DATA SHEET

Specifications

Below are specifications for the Respironics Novametrix Model 515B Pulse Oximeter. These specifications are listed for informational purposes only, and are subject to change without notice.

Pulse Oximeter

Principle of Operation

- Red/Infrared absorption

SpO_2 (Oxygen Saturation)

- Range: 0-100%
- Accuracy: (for 1 standard deviation or 68% of sample distribution)
  ± 2% SpO_2 (for 80-100% SpO_2)
  unspecified for 0-79%
- Display Resolution: 1%
- Averaging: 8 seconds
- Audio: Pitch of pulse tone varies with SpO_2 value

Pulse Rate

- Range: 30-250 beats per minute (bpm)
- Accuracy: ± 1% of full scale (for 1 standard deviation or approximately 68% of readings)
- Display Resolution: 1 bpm
- Averaging time: 8 seconds

Sensors

- Reusable Y-Sensor™ (can be disinfected and used with all patient populations) and reusable adult finger sensor
- Neonatal/Pediatric and Pediatric/Adult Single Patient Use SpO_2 Sensors

General Specifications

Alerts

- Limits: Automatic and adjustable limits for SpO_2 and Pulse Rate. Values are retained in memory when the monitor is turned off, or can be reset to factory defaults when the monitor is turned on.
- Audio: Adjustable volume, 2-minute silence or OFF (LED indicators)
- Visual: Flashing numerics for violated limit(s) and red "Alert Bar" with limit (high or low) violation indicator.

- Messages: Icons for sensor disconnected, sensor off patient. Numeric codes for low signal, insufficient light, light interference, pulse out of range, sensor faulty, monitor faulty, bad signal.

Display

- Numerics: 7-Segment LED's

Teledyne Analytical Instruments

Appendix L

UFO-130-2 Oxygen Sensor

2x2 inch
PC Board

Ultra-Fast Oxygen Sensor (UFO)

Teledyne Analytical Instruments has a long history of developing unique solutions for challenging applications.

The 2-year Ultra Fast Oxygen sensor (UFO-130-2) is a prime example of this capability. Specifically developed as a reliable and economical alternative to expensive paramagnetic and optical sensors, the Teledyne UFO utilizes fuel cell technology which is inherently rugged and forgiving.

Unlike other sensors, the UFO is insensitive to shock, vibration, and position, and will withstand repeated exposure to water without damage. With an average response time of 100 milliseconds, the UFO is one of the fastest sensors ever developed for this application.

Ideally suited for use in Metabolic and Critical Care Monitors, the UFO is also a welcome addition to Clinical Exercise and Sports Medicine as well as other applications where Breath by Breath analysis is critical.

Available with a 2 x 2 inch PC board and weighing only 4.0 ounces, the UFO can be mounted in almost any location.

Since the UFO already meets ISO 7767 (1997), ASTM F1462-93, and CE Medical Devices Directives, very little additional work is needed to integrate the sensor into new or existing products.

For additional information on this or other Teledyne oxygen sensors, please contact us using the information noted on this data sheet.

Built for reliability and performance

UFO-130-2 Specifications

Output: 3.4 – ±0.4V at 100% oxygen, 1 ATM

Range: 1 – 100% oxygen

Accuracy: Less than ±1.0% oxygen at constant temperature and pressure, when calibration in air and 100% oxygen

Resolution: 0.1 oxygen

Response time:

10 – 90% OS step change in <130 MS (@200 ±100 cc / min gas flow rate)

Response time will degrade at slower flow rate.

Cross interference:

Referenced to ISO7767 (May, 1997) ASTM-F1462/93

Operating humidity:

0 – 99% RH (non-condensing)

Operating ambient pressure:

550 – 800 mmHg

Operating relative pressure:

Continuous: -100 to +100 mmHg to ambient pressure

Intermittent: Up to -200 mmHg for less than 5 seconds

Operating temperature:

Continuous: 15 – 40°C

Intermittent: Up to 50°C for less than 2 hours per day

Power supply:

+11.8 VDC to +16.0 VDC

-11.8 VDC to -16.0 VDC

Power consumption: Less than 200 mW

Weight:

Sensor: <2.5 oz

Electronics board: <1.5 oz

Dimensions:

Sensor: 2 5/8" L x 1 3/16" W

Electronics Board: 2" x 2"

Sensor life expectancy:

24 months in air @ 25°C 50% RH

Sensor storage temperature: 0 – 40°C

Gas inlet connection: 1/16" OD tube

Gas outlet connection: Luer connector

Standard: Meets ISO7767 (May, 1997) ASTM F1462/93

TELEDYNE
ANALYTICAL INSTRUMENTS
A Teledyne Technologies Company
16830 Chestnut Street
City of Industry, California 91748, USA

TEL: 626-934-1500 FAX: 626-934-1651
TOLL FREE: 888-789-8168

Visit Our Web Site at:
www.teledyne-ai.com

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Warranty

Sensor is warranted for 2 years against defects in material or workmanship

NOTE: Specifications and features will vary with application. The above are established and validated during design, but are not to be construed as test criteria for every product. All specifications and features are subject to change without notice.

CERTIFIED
ISO 9001 : 2000

Accredited by the Council for Accreditation (RvA)

INTERTEK CERTIFICATION

ANSI-RAB QMS ACCREDITED
National Accreditation Program

APPENDIX M: BLANK PERFORMANCE DATA SHEET

SERIAL NUMBER _____ DATE _____

ROBD PERFORMANCE TESTING NA

STEP #	ALTITUDE (FEET)	DESIRED % O_2	ACTUAL % O_2	ERROR %	O_2 RANGE ALLOWED	BLP ("H_20)
1	0	20.947			20.9 TO 21.1	
2	5000	17.28			16.9 TO 17.5	
3	10000	14.08			13.8 TO 14.3	
4	13000	12.43			12.3 TO 12.5	
5	15000	11.38			11.2 TO 11.5	
6	18000	9.96			9.80 TO 10.1	
7	20000	9.09			8.90 TO 9.25	
8	22000	8.24			8.10 TO 8.40	
9	25000	7.11			6.95 TO 7.25	
10	28000	6.09			5.95 TO 6.20	
11	30000	5.43			5.30 TO 5.55	
12	34000	4.4			4.30 TO 4.50	

STEP 1: Select program 20 or program the instrument with the altitudes identified above for FSHT mode.
STEP 2: Plug the mask port.
STEP 3: Run an oxygen sensor calibration
STEP 4: Run program 20 and record the oxygen and pressure data.

NOTE: The breathing bag must be connected

Appendix N

Honeywell

DC030NDR4

Pressure Sensors: Measurement Type: Bidirectional Gage, Differential; Signal Conditioning: Amplified; Pressure Range: ± 30.0 in H_2O; Port Style: Barbed

Features

- Ultra Low Pressure Sensing, down to 1" H_20
- ASIC Enhanced
- Available in Gage and Differential Pressure Ranges
- Available in Ratiometric and Regulated
- Temperature Compensated over 0 °C to 50 °C [32 °F to 122 °F]
- Combined Linearity and Hysteresis error <±0.25% Span

Typical Applications

- Medical Instrumentation
- HVAC
- Environmental Controls
- Portable Monitors

Description

The DC pressure sensor combines our SURSENSE™ precision high sensitivity silicon sensing capabilities with the latest in ASIC technology to produce one of the most precise, reliable pressure sensors in the market. The SURSENSE technology provides Dynamic Self Compensation which substantially reduces offset errors due to changes in temperature, stability to warmup, long term instability and position sensitivity. When operated with a fixed 5.0 Vdc supply the DC sensors provides a ratiometric 0.25 Vdc to 4.25 Vdc output (4.0 Vdc span). Regulated voltage units are also available for applications involving variable supply voltages (see electrical specifications).

Honeywell

DC030NDR4

Pressure Sensors: Measurement Type: Bidirectional Gage, Differential; Signal Conditioning: Amplified; Pressure Range: ± 30.0 in H_2O; Port Style: Barbed

Product Specifications	
Measurement Type	Differential, Bidirectional Gage
Signal Conditioning	Amplified
Pressure Range	± 30.0 in H_2O
Maximum Overpressure	450 in H_2O
Supply Voltage	7.0 Vdc to 30.0 Vdc
Compensated	Yes
Output Calibration	Yes
Termination	PCB
Port Style	Barbed
Package Style	Honeywell DI-DC
Typical Sensitivity	0.133 V/in H_2O
Full Scale Span	± 2.0 V typ.
Null Offset	2.25 Vdc typ.
Offset Position Sensitivity	± 1 mV
Total Error (% Full Scale)	± 1.0 % typ., ± 2.0 % max. (See Note 1)
Accuracy (% Best Fit Straight Line)	± 0.25 % (See Note 2)
Operating Temperature Range	-25 °C to 85 °C [-13 °F to 185 °F]
Compensated Temperature Range	0 °C to 50 °C [32 °F to 122 °F]
Storage Temperature Range	-40 °C to 125 °C [-40 °F to 257 °F]
Media Compatibility	P1 port: DRY GASES ONLY: Media must be compatible with epoxy based adhesive. P2 port: Wetted materials; Media must be compatible with nylon housing, epoxy adhesive and silicon.

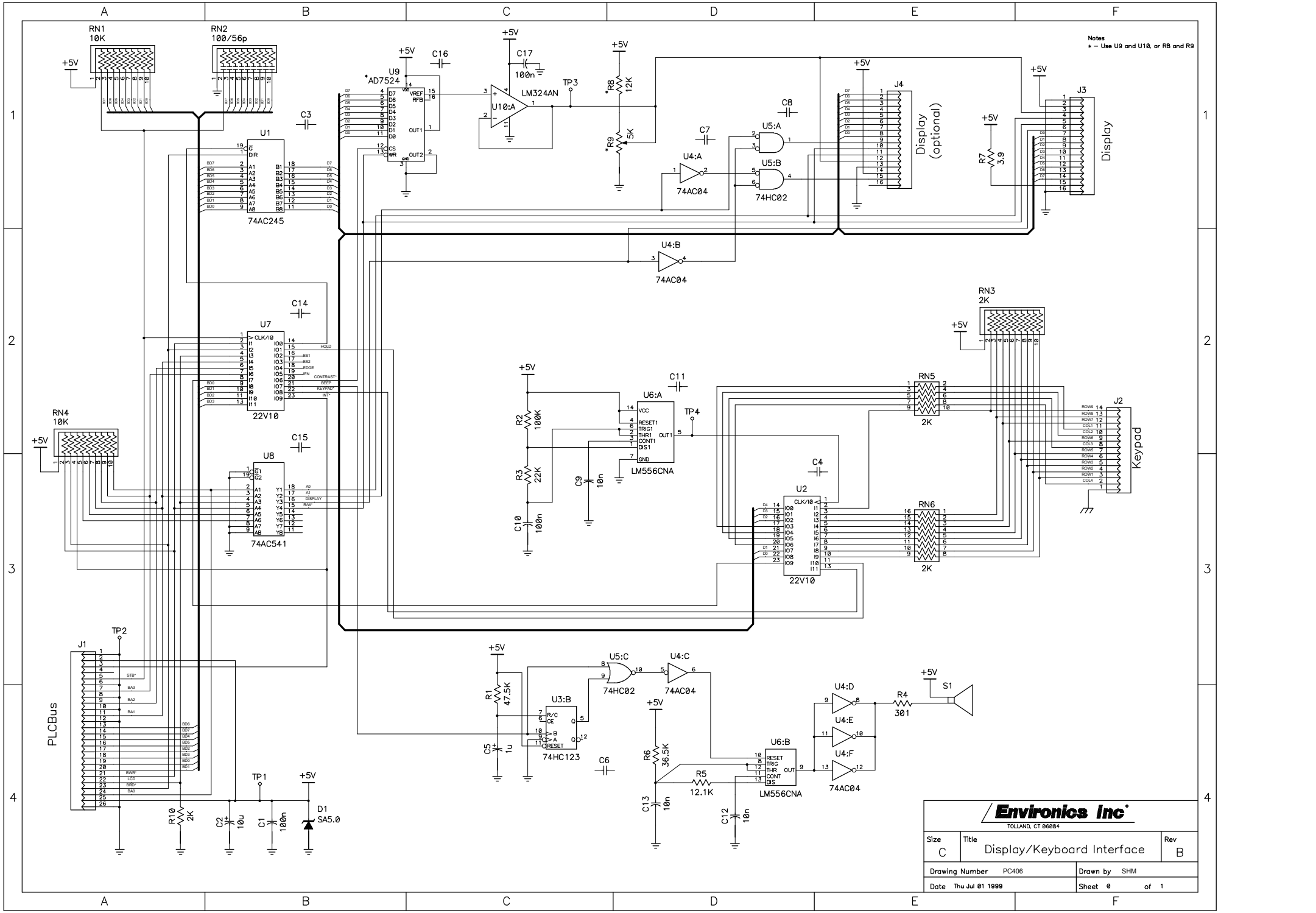
Appendix O: PCB Schematics

ROBD2 specific signals
PC406
PC412 sheet 1
PC412 sheet 2
PC416 sheet 1
PC416 sheet 2

ROBD2 SPECIFIC PCB SIGNAL CONNECTION POINTS

SIGNAL ORIGINATES					SIGNAL TERMINATES			
PART	J#	PIN#	CABLE	FUNCTION	PART	J#	PIN#	CABLE
PC416	J5	15&16	E627	V1, O2 DUMP VALVE	V1 (A208)	N/A	N/A	E627
PC416	J5	17&18	E627	V2, BYPASS VALVE	V2 (A210)	N/A	N/A	E627
PC416	J5	3&4	E627	V3, CROSSOVER VALVE	V3, (A209)	N/A	N/A	E627
A206	N/A	GND 2	E631[1]	GND SIGNAL FOR O2 DUMP SWITCH LAMP	SJ04-001-351	N/A	X1	E625[1]
A206	N/A	GND 1	E631	GND SIGNAL FOR O2 DUMP SWITCH	SJ04-001-351	N/A	3	E625
A206	N/A	+24VDC 1	E631	+24 VDC SIGNAL FOR O2 DUMP SWITCH LAMP	SJ04-001-351	N/A	X2	E625
SJ04-001-351	N/A	4	E631	GROUNDS THE INPUT LINE ON PC416, O2 DUMP	PC416	J7[2]	1	E625
A206	N/A	GND 5	N/A	GND SIGNAL SUPPLY TO O2 PRESSURE SWITCH	SK11-001G010	N/A	1[3]	N/A
SK11-001G010	N/A	2[3]	N/A	GROUNDS INPUT LINE ON PC416, LOW O2 PRESSURE	PC416	J7[2]	5	N/A
PC412	J9	1	E629	+24 VDC SUPPLY WIRE TO TERMINAL BLOCK A206	A206	N/A	+24VDC 4	E629
PC412	J9	2	E629	GND SUPPLY WIRE TO TERMINAL BLOCK A206	A206	N/A	GND 3	E629
PC412	J10	2	E629	2ND GND SUPPLY WIRE TO TERMINAL BLOCK A206	A206	N/A	GND 4	E629
A206	N/A	GND 6	N/A	GND WIRE FOR PC401 HIGH CURRENT DRIVERS	PC401	J2	10	N/A
PC412	J13	4	E630	+15 VDC SUPPLY FOR A216 OXYGEN ALARM[4]	A216	N/A	1	E630
PC401	J2	3	E630	PULLED TO GND VIA PC401 HIGH CURRENT DRIVERS	A216	N/A	2	E630
PC412	J6	1	E626	+15 VDC SUPPLY VOLTAGE FOR SK10-001-PCB	SK10-001-PCB	J1	5	E626
PC412	J6	2	E626	-15 VDC SUPPLY VOLTAGE FOR SK10-001-PCB	SK10-001-PCB	J1	1	E626
PC412	J6	4	E626	GND SIGNAL FOR PRESSURE SENSOR A215	A215	N/A	2[5]	E626[5]
PC412	J6	5	E626	ANALOG GND FOR SK10-001-PCB	SK10-001-PCB	J1	2	E626
PC412	J6	7	E626	+24VDC FOR PRESSURE SENSOR A215	A215	N/A	1	E626
A215	N/A	3	E626	PRESSURE SENSOR ANALOG OUTPUT SIGNAL	PC412	J5	9	E626
SK10-001-PCB	J1	3	E626	OXYGEN SENSOR OUTPUT SIGNAL	PC412	J5	7	E626
PC412	J5	19	I418[6]	+24 VDC POWER TO MFC1	MFC1	N/A	5	I418[6]
PC412	J5	20	I418	GND WIRE FOR MFC1	MFC1	N/A	4	I418
PC401	H1	13	I418	GND SIGNAL FOR MFC LIMIT ERROR RELAY	MFC1	N/A	3	I418
MFC1	N/A	2	I418	GROUNDS INPUT PIN ON PC401 I/O CONNECTOR H1	PC401	H1	1	I418

1. E631 INTERCONNECTS WITH E625, REFERENCE APPENDIX B FOR ELECTRICAL DRAWINGS.
2. SOLDER SIDE OF J7 ON PC416, REFER TO APPENDIX B, PAGE B17
3. PART HAS NO PIN NUMBERS, REFER TO APPENDIX B, PAGE B17 FOR CONNECTIONS
4. FOR A216, LOW OXYGEN ALARM, REFERENCE APPENDIX B, PAGE B19. A216 CONNECTS TO E630.
5. A215 CONNECTS TO E626 WITH INTERCONNECT PIN NUMBERS FOR A215 REFER TO THE 6-PIN INTERCONNECT.
6. ILLUSTRATION DRAWING I418 (PAGE B14 OF APPENDIX B) SHOWS MFC1 WIRING WITH RESPECT TO THESE SPECIFIC SIGNALS
7. FIELDS FOR ALIKE OR GROUPED WIRES/SIGNALS ARE SHADED
8. REFERENCE APPENDIX E FOR POINT TO POINT WIRING DIAGRAM E205
9. +24 VDC AND GND ARE CONNECTIONS ON THE A206 TERMINAL BLOCK ASSEMBLY. THESE COLORS ARE REFERENCES FROM APPENDIX E POINT TO POINT WIRING DIAGRAM.


Notes
* – Use U9 and U10, or R8 and R9
RN1
10K
RN2
100/56p
U1
74AC245
U9
*AD7524
C16
C17
100n
U10:A
LM324AN
TP3
*R8
12K
*R9
5K
C3
C7
C8
U4:A
74AC04
U5:A
U5:B
74HC02
J4
Display
(optional)
J3
Display
R7
3.9
U4:B
74AC04
RN3
2K
RN5
2K
RN6
2K
J2
Keypad
RN4
10K
U7
22V10
C14
C15
U8
74AC541
C11
U6:A
LM556CNA
TP4
R2
100K
R3
22K
C9
10n
C10
100n
C4
U2
22V10
TP2
J1
PLCBus
TP1
D1
SA5.0
R10
2K
C2
10u
C1
100n
U5:C
74HC02
U4:C
74AC04
R1
47.5K
U3:B
74HC123
C5
1u
C6
R6
36.5K
R5
12.1K
U6:B
LM556CNA
C13
10n
C12
10n
U4:D
U4:E
U4:F
74AC04
R4
301
S1
Environics Inc
TOLLAND, CT 06084
Size
C
Title
Display/Keyboard Interface
Rev
B
Drawing Number
PC406
Drawn by
SHM
Date
Thu Jul 01 1999
Sheet
0
of
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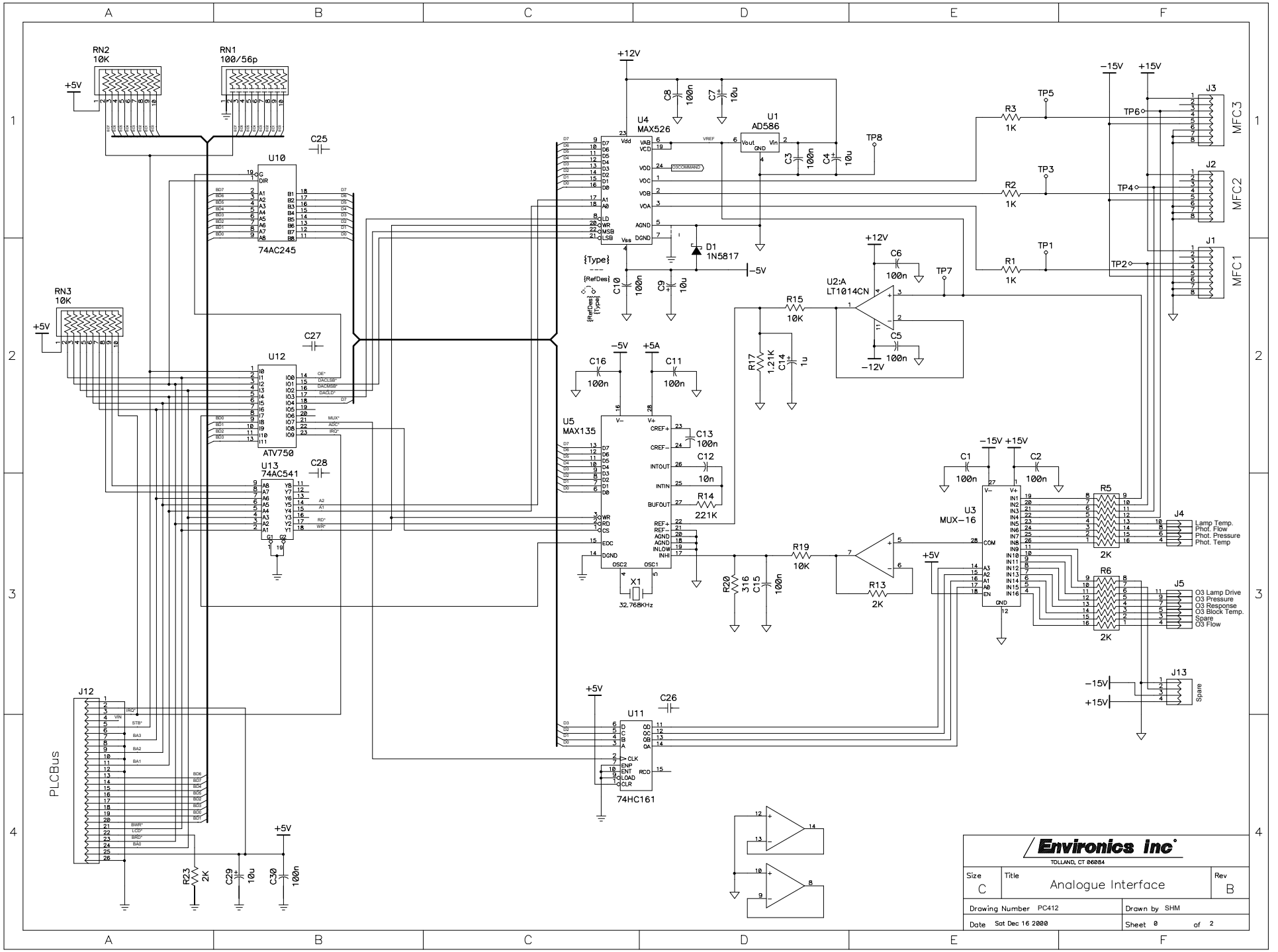
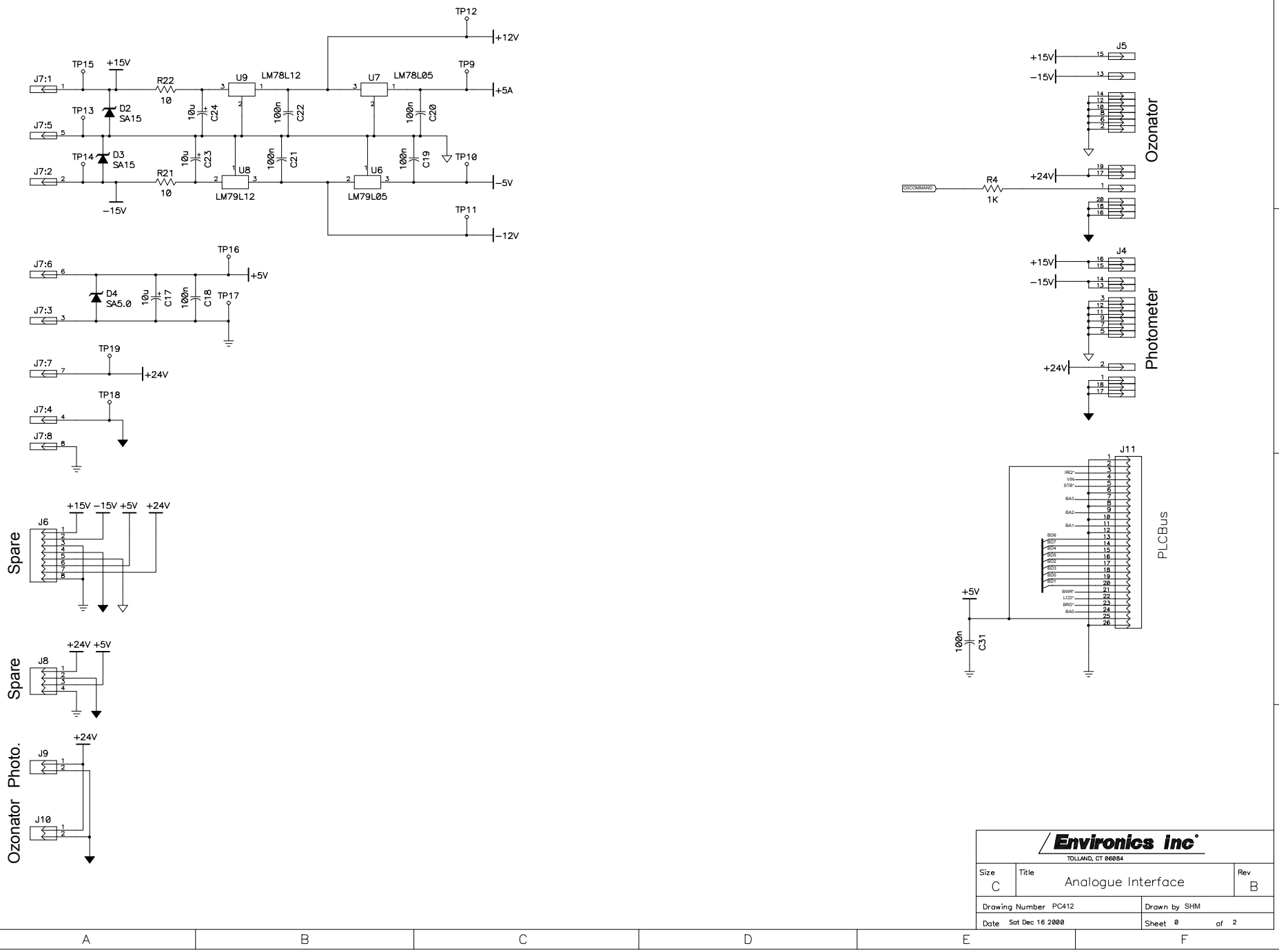
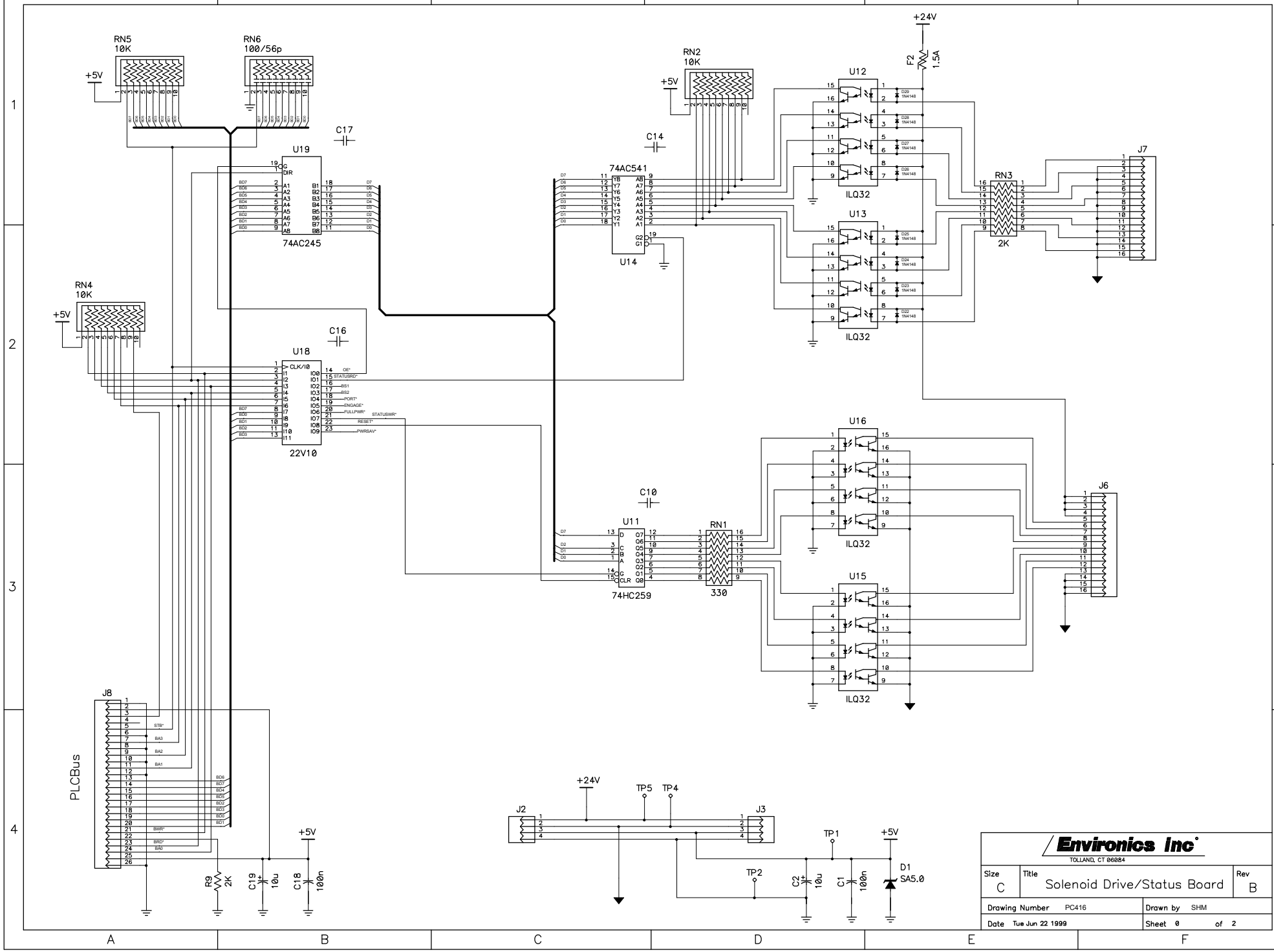

RN2
10K
RN1
100/56p
+5V
C25
U10
74AC245
RN3
10K
C27
U12
ATV750
U13
74AC541
C28
J12
PLCBus
R23
2K
C29
10u
C30
100n
+12V
C8
100n
C7
10u
U4
MAX526
U1
AD586
C3
100n
C4
10u
TP8
D1
1N5817
-5V
{Type}
{RefDes}
C10
100n
C9
10u
TP5
TP6
TP3
TP4
TP1
TP2
R3
1K
R2
1K
R1
1K
J3
MFC3
J2
MFC2
J1
MFC1
-15V
+15V
U2:A
LT1014CN
C6
100n
C5
100n
TP7
R15
10K
R17
1.21K
C14
1u
C16
100n
C11
100n
+5A
U5
MAX135
C13
100n
C12
10n
R14
221K
X1
32.768KHz
R20
316
C15
100n
R19
10K
R13
2K
C1
100n
C2
100n
U3
MUX-16
R5
2K
R6
2K
J4
Lamp Temp.
Phot. Flow
Phot. Pressure
Phot. Temp
J5
O3 Lamp Drive
O3 Pressure
O3 Response
O3 Block Temp.
Spare
O3 Flow
J13
Spare
U11
74HC161
Environics Inc
TOLLAND, CT 06084
Size
C
Title
Analogue Interface
Rev
B
Drawing Number PC412
Drawn by SHM
Date Sat Dec 16 2000
Sheet 0 of 2

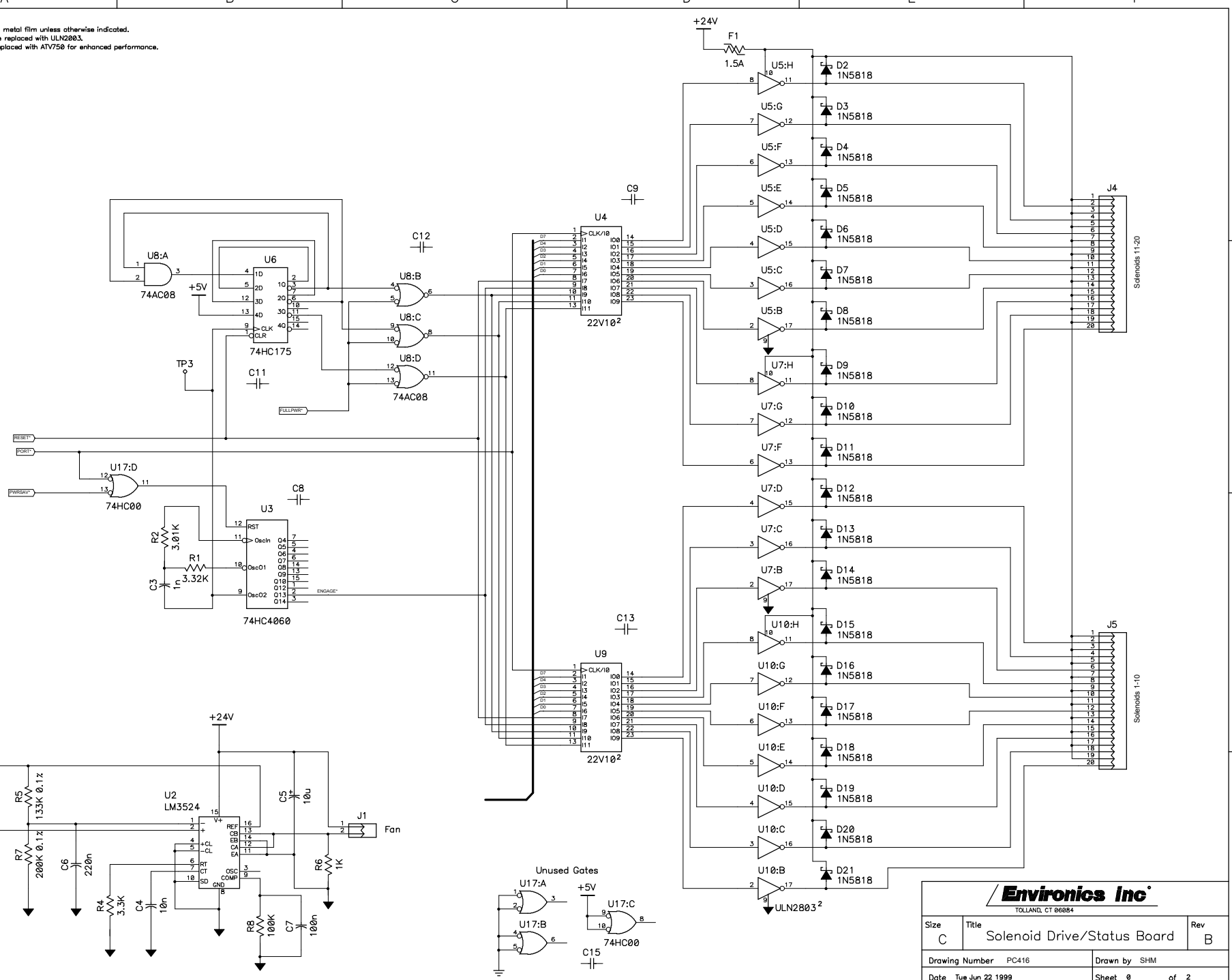

TP12
+12V
TP15
+15V
J7:1
R22
10
U9
LM78L12
U7
LM78L05
TP9
+5A
TP13
D2
SA15
J7:5
10u
C24
100n
C22
100n
C20
TP14
D3
SA15
J7:2
R21
10
10u
C23
100n
C21
100n
C19
TP10
U8
LM79L12
U6
LM79L05
-5V
-15V
TP11
-12V
TP16
J7:6
+5V
D4
SA5.0
10u
C17
100n
C18
TP17
J7:3
TP19
J7:7
+24V
TP18
J7:4
J7:8
Spare
J6
+15V -15V +5V +24V
Spare
J8
+24V +5V
Ozonator Photo.
J9
+24V
J10
J5
+15V
-15V
Ozonator
OSCOMMAND
R4
1K
+24V
J4
+15V
-15V
Photometer
+24V
J11
PLCBus
+5V
100n
C31
Environics Inc
TOLLAND, CT 06084
Size
C
Title
Analogue Interface
Rev
B
Drawing Number PC412
Drawn by SHM
Date Sat Dec 16 2000
Sheet 0 of 2



Environics Inc TOLLAND, CT 06084		
Size C	Title: Solenoid Drive/Status Board	Rev B
Drawing Number PC416		Drawn by SHM
Date Tue Jun 22 1999		Sheet 0 of 2

NOTES:

1. All resistors are 1% metal film unless otherwise indicated.
2. U5, U7, U10, can be replaced with ULN2003.
3. U4 an U5 can be replaced with ATV750 for enhanced performance.



Environics Inc
TOLLAND, CT 06084

Size	Title	Rev
C	Solenoid Drive/Status Board	B
Drawing Number PC416		Drawn by SHM
Date Tue Jun 22 1999		Sheet 0 of 2

Appendix P

ROBD2 FLOW CALIBRATION SHEET (CALIBRATION EQUIPMENT S/N #_____)

ROBD2 SERIAL# _____ SYSTEM MODEL# ROBD2

DATE: _____ STP 70°F, 29.92"HG ROBD2 SOFTWARE REVISION: _____

MFC1 : 25 SLPM SERIAL#: _____ MFC2: 77 SLPM SERIAL#: _____

SET FLOW RATE		MEASURED FLOW RATE	SET FLOW RATE		MEASURED FLOW RATE
100%	25000		100%	77000	
95%	23750		95%	73150	
90%	22500		90%	69300	
85%	21250		85%	65450	
80%	20000		80%	61600	
75%	18750		75%	57750	
70%	17500		70%	53900	
65%	16250		65%	50050	
60%	15000		60%	46200	
55%	13750		55%	42350	
50%	12500		50%	38500	
45%	11250		45%	34650	
40%	10000		40%	30800	
35%	8750		35%	26950	
30%	7500		30%	23100	
25%	6250		25%	19250	
20%	5000		20%	15400	
15%	3750		15%	11500	
10%	2500		10%	7700	
5%	1250		5%	3850	
2.5%	625		2.5%	1925	

CAL DATE: _____ BY: _____ CAL DATE: _____ BY: _____

VERIFICATION OF MFC CALIBRATION (ACCEPTABLE TOLERANCE OF 0.5% SET POINT)

SET FLOW RATE		MEASURED FLOW RATE	SET FLOW RATE		MEASURED FLOW RATE
99%	24750		99%	76230	
85%	21250		85%	65450	
55%	13750		55%	42350	
25%	6250		25%	19250	
10%	2500		10%	7700	
5%	1250		5%	3850	

MFC FLOW VERIFICATION DATE: _____. MFC FLOW VERIFICATION DATE: _____