# Lorox™ Controller

## INSTALLATION & OPERATIONS MANUAL

Part # F200082



Revised:

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|---|---|
| Revision 1.0 | March 13, 2002 |
| Revision 1.1 | March 22, 2002 |
| Revision 1.2 | April 2, 2002 |

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# Introduction

The Lorox™ utilizes high-performance Lorox Probe technology to provide cost-effective and reliable oxygen sensing and control in low process temperature applications.

Your Lorox™ system is covered by a one-year conditional warranty as described on the enclosed Warranty Card. Please be sure to complete and return your Warranty Registration card so that Marathon can provide you will the most responsive service and support.

# Package Contents

Please verify that you have received the following:

1. Lorox™ controller enclosure with Dualpro™ controller
2. System wiring and piping diagrams
3. Dualpro Operation Manual F200001
4. Dualpro Programming and Basic Language Handbook F200043
5. Lorox Installation and Operations Manual F200081
6. Lorox Controller Installation and Operations Manual F200082

If your shipment is missing any of these items please contact Marathon Sensors immediately.

# Installation

## *Location*

Choose a location for installation of the Lorox™ enclosure where the ambient temperatures will not exceed 130°F. Optional air conditioning or vortex cooling systems can be added to the package if required.

The Lorox™ control package requires ventilation in order to maintain adequate reference air when using an internal pump. Do not position the enclosure where process or combustion exhaust can be pulled into system enclosure.

The system can also be configured for instrument air. It is necessary to use shop instrument air for probe reference air if an air conditioning unit is installed.

## *Electrical Connections*

Following the enclosed wiring diagram, attach a 115VAC power source to the incoming power terminals. The power source to the enclosure should not share power with heavy motors, pumps, welding equipment, or inductive loads. An isolated 115VAC transformer for instrument power is preferred.

The following diagram shows the basic electrical connections and signal connections between the Lorox sensor and the control panel.

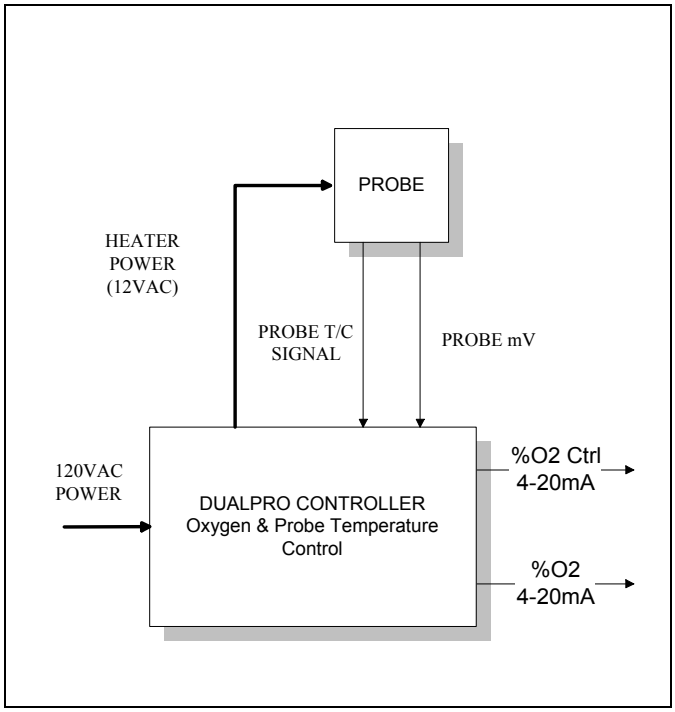



**Figure 1 Basic Lorox Connections**

The measurement part of the system consists of a self-heating Lorox probe and the Dualpro, a dual loop programmable controller. The power to the probe's internal heater is controlled by the first control loop of the Dualpro. This control is accomplished by monitoring the probes internal thermocouple. This temperature reading and the probe's millivolt signal are used to calculate the oxygen level in the process. This value can be used to control the process oxygen using the one for two 4-20mA loops or control contract on the controller.

The probe temperature sensor is a type "K" thermocouple. The Dualpro measures this signal with cold junction compensation. This temperature input is used to calculate the oxygen level and control the probe's internal heater. The millivolt signal from the probe can be adjusted manually or automatically when a zero and span cal gas are used to calibrate and check the Lorox probe. Refer to the section on calibration for more information on this feature.

### *AC Power Connections*

All the electrical connections for the system are made on the terminal blocks located inside the Lorox enclosure. The AC power connections are located on the upper right-hand side of the enclosure subpanel. There is a single fused AC power ladder. The terminals labeled as A1000 (Line), A1020 (Neutral) feed the control and alarm circuits. The terminals labeled A1001 (Line) and A1021 (Neutral) feed the instrument power circuit. There is a subpanel jumper, 119JP, that provides a power disconnect to the rear panel of the Dualpro. There are additional 1.0A fuses for the instrument's alarm, event, and control circuits. Removing the jumper will remove all power to the rear of the instrument.

A separate 4.0 Amp fuse protects the probe heater circuit. This power is applied to the probe heater through a relay under the control of the Dualpro.

### *DC Signal Connections*

Separate DC signal terminal blocks are located on the left-hand side of the subpanel. Terminal blocks are provided for field wiring to the 4-20mA control loops and the probe millivolt signal. The thermocouple wire should be connected directly to the instrument using K type extension wire. There are several considerations when running signal wire for this or any measurement system;

- All signal wiring should be kept separate from any AC power cabling.
- Do not run DC signal wiring closely bundled or in parallel with power cables.
- Use shielded cable for the signals.
- Tie the shield to a single ground point at one end of the cable, preferably at the controller ground.

### *Dualpro Connections*

The Dualpro reads the signal inputs from the Lorox probe. From these inputs it calculates the process oxygen potential and controls the probe's internal heater. The Dualpro also has the capability of controlling the trim air for the process with either a control contract #2 or a 4-20mA loop. The following are typical connections for the Dualpro;

Control Connections

- Control 1 – Probe heater (Loop 1)
- Control 2 – Available for oxygen control (Loop 2)
- Analog 1 – Scaled for 0-25% oxygen (4-20mA)
- Analog 2 – Available for process control
- Event 0 – Zero cal gas flow control
- Event 1 – Span cal gas flow control

Input Connections

- Input 1 – Probe type K thermocouple
- Input 2 – Probe millivolt signal
- Input 3 – Not used

If control contract #2 is being used, the two 4-20mA loops can be configured to provide retransmission of the oxygen and temperature levels of the probe.

The instrument also has four internal events numbered event 0, 1, 2, and 3. Event 0 is used to control the zero gas (air) and event 1 is used to control the span gas (typically 1% - 2% oxygen).

## *Gas Sampling Connections*

Connect the incoming zero and span gases to the inlets on the top left side of the enclosure. The connections for the span and zero gasses are ¼" CPI fitting with nut and ferrule included. These sources should have a maximum pressure of 5PSI and a flow of 5 – 10 SCFH.

The connection of reference air (shop air option installed) is a ¼" female NPT on the top left side of the panel. This air supply should have a maximum pressure of 150 PSI. Adjust the internal pressure gauge/filter assembly for a pressure of <10 PSI with a flow rate of 2 SCFH

The gas and reference air exits at the top right side of the enclosure through ¼" CPI fittings. It is recommended that continuous metal tubing be used to connect the cal and reference gasses to the Lorox probe junction box.

The following diagram shows a typical sample gas installation.

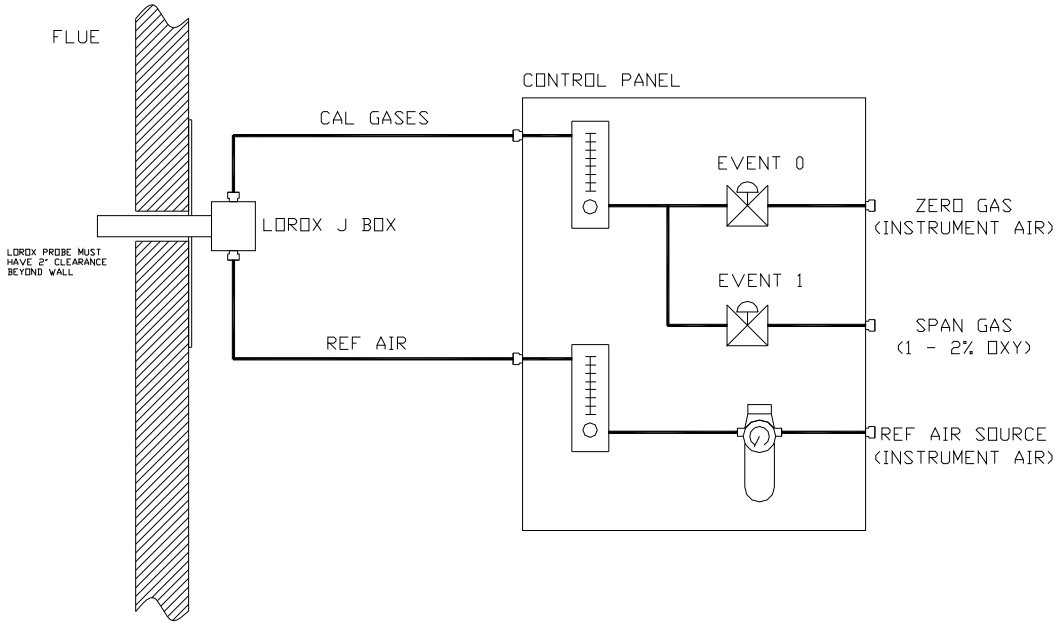



**Figure 2 Typical Gas Line Connections**

The reference air rotometer on the left side of the enclosure should be adjusted for a 1.0 SCFH (mid-scale) reading.

Adjust the calibration gas rotometer on the right side to 5 SCFH (mid-scale). See the System Operation section for instructions on how to manually operate the calibration gas events.

The term zero gas for air (20.9% oxygen) is used here because when air is injected at the face of the probe it should produce a 0 mV output. When the span gas (1-2% oxygen) is injected at the face of the probe it should produce a positive millivolt output. Therefore the terms zero and span refer to the resulting millivolt output of the probe not the levels of oxygen used to generate these levels.

## System Operation

### *Normal Operation*

During normal operation the Dualpro will display the probe temperature (Loop 1) and the process oxygen (Loop 2). The Dualpro is configured to control probe temperature using control contact 1. It can also be configured to control the oxygen level of the measured process by using control contact 2 or one of two 4-20mA signal loops. Refer to the Dualpro manual F200001 for a detailed description of the instrument's control capabilities. Also refer to the Lorox system drawings to see where the required connections points are for your Lorox application.

### *Automatic Loop Control*

The Dualpro controls the probe temperature and process oxygen automatically using the standard automatic control features of the instrument. In Automatic Mode the measured process value is displayed in the PROCESS display and the set point is displayed in the SET display. Any control action is computed based upon the PID parameters and changes in the Lorox probe temperature and millivolt levels. Pressing and holding the [Left Arrow] key will cause the SET display to show the percent output control action for either loop when that loop is actively displayed.

The loop displays correspond with the LED indicators on the right and left side of the SETPOINT and PROCESS displays. The LOOP 1 LED is lit when the loop 1 process and set point displays are shown. The LOOP 2 LED is lit when the loop 2 process and set point displays are shown.

Pressing [Shift] key shifts the display representation from one loop to the other as indicated by the loop LED's. Loop1 is set to control the probe temperature, loop 2 is set to control the oxygen level of the process.

Refer to the following figure for locations of the keys and indicators on the Dualpro.

### *Conditional Tests of the Lorox System*

The Lorox program running on the Dualpro tests a number of conditions during normal operations. This program is running in the background at all times. It performs the following tasks:

- Works in conjunction with the Basic program to calculate in floating point, the required slope settings for the millivolt input.
- Initiates a calibration sequence for zero and span when a operator request is made or when the time setting matches the instrument's real time clock.
- Automatically operates the zero (air) gas and span gas solenoids during calibration.
- Monitors alarm conditions for probe heating, calibration value limits, and program operation. (See System Alarms for details)

### *System Alarms*

The system can generate a series of alarms and displays these as PAL's (Program ALarms). The following list explains these PAL codes. Refer to the troubleshooting section for help in resolving problems that may occur.

It is possible to clear these program alarms by pressing the [Enter] key. Some alarms such as the PROBE TOO HOT or PROBE NOT HEATING alarm will not clear until the fault condition is corrected. During an alarm condition, the calibration offset and slope values are set to default values of 0.0 offset and 1.00 slope.

**Table 1 Program Alarm Codes**

| PAL Code | Alarm Description | Condition | Cause |
|---|---|---|---|
| 201 | PROBE NOT HEATING | Occurs if the probe does not achieved the required temperature set point (750°C) once the set point has been entered. A fixed time limit of 30 minutes is set once the set point is entered. This alarm will also occur if the probe temperature drops 50° below set point during normal operation. It will continue to appear if acknowledged until the heat reaches normal levels. | • The probe heater has failed.<br>• The fuse for the probe heater circuit has opened.<br>• The heater circuit relay has failed open.<br>• The control contact in the Dualpro has failed open or the control parameters for Loop 1 have been changed. |
| 202 | PROBE TOO HOT | Occurs if the probe temperature rises 50° above set point. It will continue to appear if acknowledged until the heat reaches normal levels. | • Loop 1 has been left in manual mode at 100% output.<br>• Control relay of heater circuit has failed closed. |
| 205 | CAL OFFSET TOO LOW | Appears if the probe millivolt level measured during the offset cycle is less than –50mV. While the alarm is active, the default offset and slope numbers are used. The system will initialize all calibration values and stop the calibration sequence when this alarm is acknowledged. | Span gas has been switched with the probe's reference air. This would cause a polarity change in the probe output during a zero calibration. |
| 206 | CAL OFFSET TOO HIGH | Appears if the probe millivolt level measured during the offset cycle is greater than 50mV. While the alarm is active, the default offset and slope numbers are used. The system will initialize all calibration values and stop the calibration sequence when this alarm is acknowledged. | • Zero gas is not available<br>• Zero gas solenoid has failed to function, leaving the process gas in the probe.<br>• An improper span value has been entered in N1. |
| 207 | CAL SPAN TOO LOW | Appears if the slope calculation does not compare to the value in the Basic program (data transfer problem) or if the calculated slope is less than –1.999. | • Span gas is not available<br>• Span gas solenoid has failed to function, leaving the process gas in the probe |

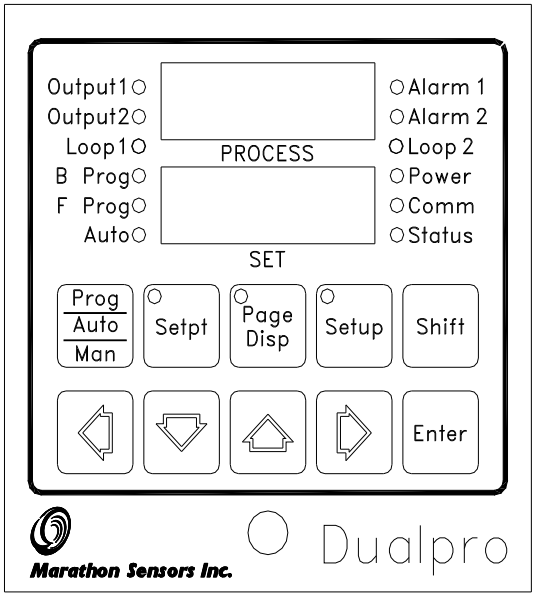
| | | | |
|---|---|---|---|
| | | | • An improper span value has been entered in N1. |
| 208 | CAL SPAN TOO HIGH | Set if the probe millivolt level is higher than 409mV or the slope calculation is greater than 1.999. | |
| 300 | BASIC PROGRAM STOP | Set if the Basic program has stop and has not reset the 120 second watchdog timer running in the Lorox program. In most situations the program will restart the Basic program. | • Span gas is not available<br>• Span gas solenoid has failed to function, leaving the process gas in the probe<br>• An improper span value has been entered in N1. |

The system can also be configured for a process alarm. This function is wired to Alarm 1 contact through relay 119CR in the system enclosure. The alarm can be setup for deviation, band, or high/low limit alarms associated with the oxygen set point. See the Alarms section of the Dualpro manual for more information on how to configure these alarms. Normally open and normally closed contracts are available on relay 119CR.

### *The Dualpro Front Panel*

Refer to the following figure during references to the DUALPRO'S indicators and keys.

**Figure 3 Dualpro Front Panel**



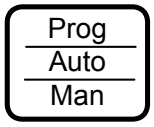

All information entered into the instrument is stored in non-volatile memory. All the setups are entered using the [Setup] key. Some of the parameters opened by the [Setup] key can be password protected. The DUALPRO is shipped from the factory without a password.

The DUALPRO front panel consists of an upper and lower segment Light Emitting Diode (LED) display, twelve LED indicators, and ten membrane keypads (keys). The upper segmented display shows the process value in normal operation and is referred to as the PROCESS window. When entering parameters, this display will show a message identifying the parameter being entered. The lower display in normal operation will show the process setpoint when in auto and the control percent output when in manual. It is referred to as the SET window. When entering parameters, this display will show the value of the parameter being entered. This display will temporarily show other data dependent on certain keys being held down as described in the keypad section.

The twelve LED indicators provide information on the operation of the DUALPRO as follows:

### *The Dualpro Keypad*

The functions of the ten membrane keys may change when the DUALPRO is placed into different modes. This describes the keys if activated from the normal mode of operation. The descriptions of the various modes will describe how the keys are used in that mode.

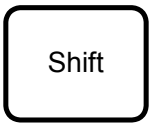



The [Prog|Auto|Man] key provides control of the foreground program, background program, Loop 1, and Loop 2. The foreground and background programs may be separately stopped, viewed, run, continued, or placed in hold. Loop 1 and Loop 2 may be separately placed in either manual or automatic mode. Press this key twice to reach the other options for the background program start or loop control.


The [Setpt] key allows the user to edit the setpoint (SP1, SP2), reference number (RN), and operator-input numbers (N1 - N15). The operator-input numbers have special assignments for the Lorox application. See the section on Automatic Lorox Probe Calibration of a list of these special assignments.

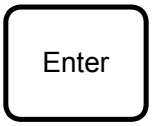

The [Page Disp] key allows the status display page to be viewed and allows a limited number of features to be edited. See the Display Menu section for an explanation of these menus.


Pressing the [Setup] key places the DUALPRO into the parameter entry mode for all setup parameters. See the Setup Menu section for an explanation of these menus.

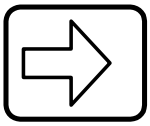



Pressing the [Shift] key shifts the display representation from one loop to the other as indicated by the loop LED's. It also performs as the second key for most dual key operations. The [Shift] key also can be used to cycle through the parameters of other keys in a reverse direction. In

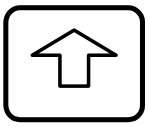
multi-key operations, always press and hold the [Shift] key then press the other keys.



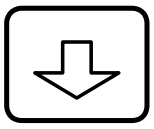

The [Enter] key has no function by itself under normal operation. However, it is used to cycle through, in a forward direction, the parameters of the other keys.



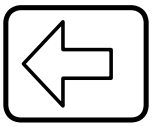
The [Right Arrow] is only used when in manual mode or parameter entry mode. Each press of the [Right Arrow] key will cause the percent output of the displayed loop to increase by approximately 10% when the loop is in Manual mode.



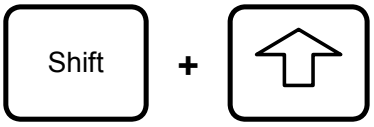
The [Up Arrow] is used to increase the edited digit in parameter entry mode and to manually adjust the percent output in the manual control mode. Each press of the [Up Arrow] key causes the percent output of the displayed loop to increase by 1%.



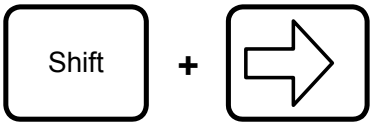
The [Down Arrow] is used to decrease the edited digit in parameter entry mode and to manually adjust the percent output in the manual control mode. Each press of the [Down Arrow] key causes the percent output of the displayed loop to decrease by 1%



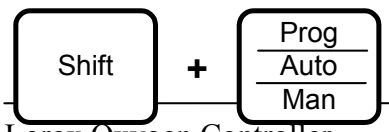
The [Left Arrow] is only used when in manual mode or parameter entry mode. Each press of the [Left Arrow] key will cause the percent output of the displayed loop to decrease by approximately 10%.




Pressing [Shift]+[Up] two key combination performs an LED test whereby every segment and decimal point of the fourteen segment displays and every LED is illuminated. Should an LED not light up, it is defective. If any part of the display does not light during this test, it is defective.

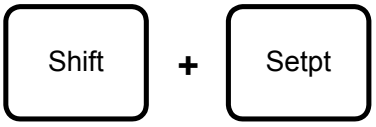



The [Shift]+[Right] two key combination determines how the two control loops will be displayed. Pressing [Page Disp] key in this mode allows the display to either scan between Loop 1 and Loop 2, or to display only the loop placed in hold. The loop to be placed in hold may be determined by pressing the [Shift] key. The appropriate loop LED will flash while it is placed in hold mode.

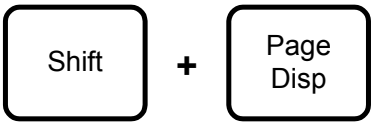



The [Shift]+[Prog|Auto|Man] two key combination sets up

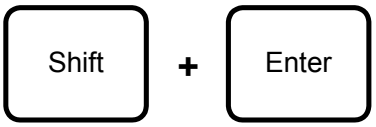
the cold junction trim. The cold junction temperature can then be adjusted with the [Down] or [Up] keys. Exit by pressing [Enter].



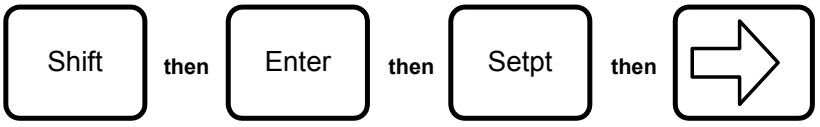

The [Shift]+[Setpt] two key combination opens the program editor option.



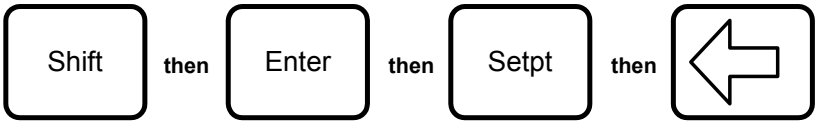

The [Shift]+[Page Disp] two key combination sets up the password. Any order of keys except for [Shift] or [Enter] can be used as passwords. Up to nine key presses can be used. Press [Enter] to save a newly set password. The number in the SET display will count the number of keys entered. Pressing [Enter] without pressing any other key (i.e.: SET display = 0) will enter "no" password. The lock level setting and the lock level required for each parameter determine whether or not a password is needed on each parameter. The lock levels for each parameter are listed in the Dualpro Operators Manual. A lock level of 0 is the most restrictive. A lock level of 3 is the most open.



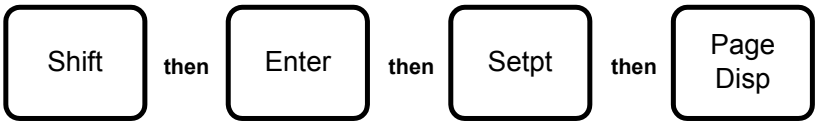

The [Shift]+[Enter] two key combination will start the probe maintenance routine, if it is enabled. This function is automatically disabled in the Lorox application.




The [Shift] then [Enter] then [Setpt] then [Right] four-key sequence will set the memory of the instrument to default settings. If the lock level is less then 3, a password will be required to execute this function. **Do not** set the CLR PG (Clear Program) option to Yes. This will clear the Lorox background program necessary to run the Lorox application.




The [Shift] then [Enter] then [Setpt] then [Left] four-key sequence will test the memory. If the lock level is less then 3, a password will be required to execute this function.



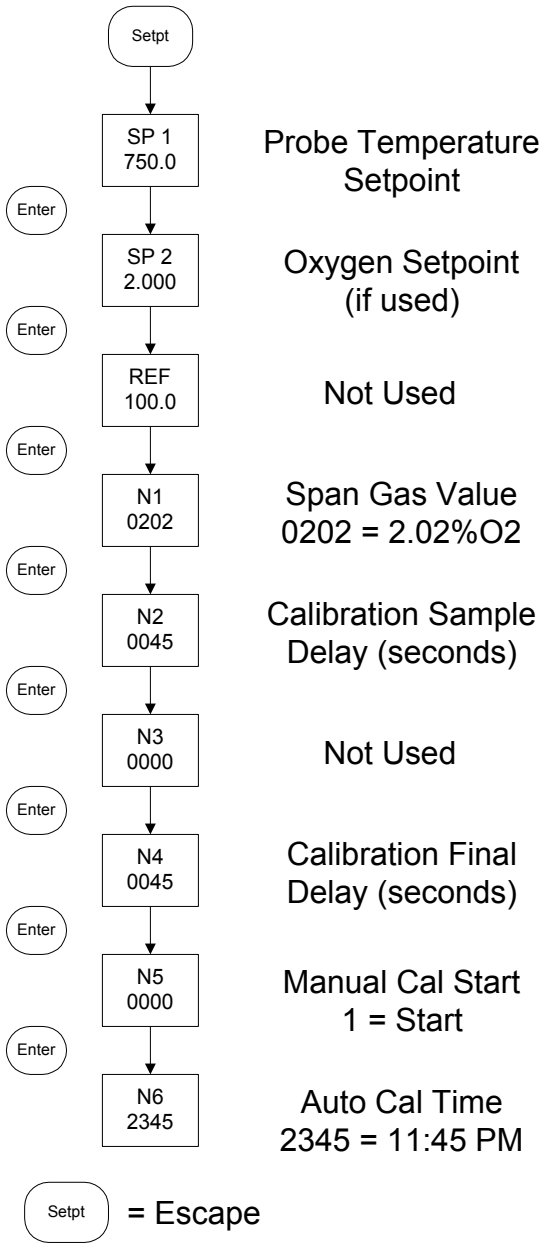

The [Shift] then [Enter] then [Setpt] then [Page Disp]

four-key sequence will place the Dualpro in INPUT CALIBRATION MODE. If the lock level is less then 3, a password will be required to execute this function.

### *Setpoint Key*

The [Setpt] is important in the operation of the Lorox because the parameters in this key's menu control the probe operating temperature, calibration sample and delay times, and calibration start times. It is also possible to start a calibration manually using the N5 parameter in the [Setpt] key menu. The following figure explains the parameter assignments for the Lorox application.

**Figure 4 Setpt Key Menu**




*Entering Loop Set Points*

To start the measurement process it is necessary to enter the set point for the probe's internal heater. Follow the above figure and enter the set point by doing the following;

- Press the [Setpt] key

- The PROCESS display shows SP1, the SET display shows the loop 1 set point in degrees Celsius.
- Press the [LEFT] key to move the flashing cursor to the digit to change.
- Press the [UP] or [DOWN] key to change the flashing digit value.
- Enter the required temperature of 750°C or 1382°F. (Celsius is the default)
- Press [Setpt] again to exit.

If the Auto LED indicator is not light while the display shows the Loop 1 process, it will be necessary to set Loop 1 to automatic control mode. Place Loop 1 in automatic mode by doing the following;

- Press the [Prog/Auto/Man] key twice, the upper display will indicate FPROG
- Press the [Enter] key once, the display will indicate BPROG
- Press the [Enter] key once, the display will indicate LP 1
- Press the [UP] key to change MAN to AUTO.
- Press the [Prog/Auto/Man] key to exit

The LOROX probe will take about 20 minutes to heat from an ambient temperature to an operating temperature of 750°C (1380°F). The oxygen display in loop 2 is always active but this value is not valid until the probe has reached the required temperature set point.

A timer (timer TD) starts running as soon as the set point for Loop 1 has changed to 750°C. If the probe does not achieve set point within 30 minutes an alarm 201 (probe not heating) is set. If the probe achieves the required temperature within the time limit the system will continue to control probe temperature and look for calibration requires. See the Display Parameters section for an explanation of the timer menu.

Both the analog outputs can be configured to retransmit the process values or transmit percent output levels for process control. A set point has to be entered for Loop 2 if control of the oxygen process is required. Both analog outputs will provide a 4-20mA output proportional to 0-100% control output or a process range such as 0 to 21% oxygen. The system default settings are oxygen 0-25% on analog output channel 1 and probe temperature 0-1000°C.

## Display Parameters

The following figures show the structure of the Display menu. This menu is accessed by pressing the [Page Disp] key on the Dualpro front panel. Most of the parameters shown in these menus are for display purposes only. There are a few special cases that allow you to manually control some features of the instrument such as the digital events, both internal and external (if connected). A detailed explanation follows these figures.

Any menu page heading maybe displayed when you press the [Page Disp] key. This depends on the last page you were viewing. It is possible to advance to the next menu parameter by pressing [Down] key. It is possible to move forward or backward in the menu headings by pressing the [Right] or [Left] arrow keys. Pressing the [Page Disp] key again exits from the Setup menu.

**Figure 5 Display Parameters**

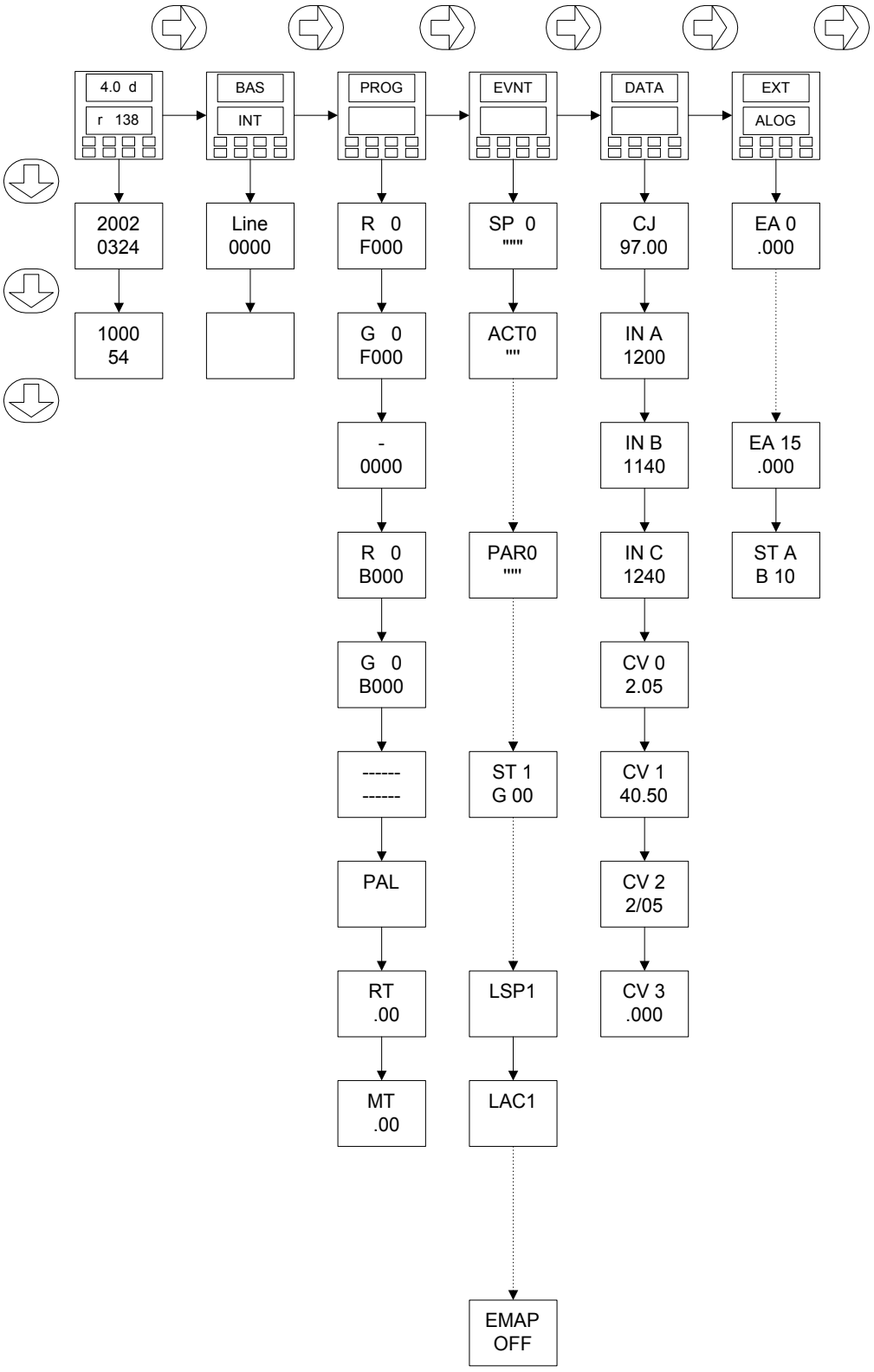
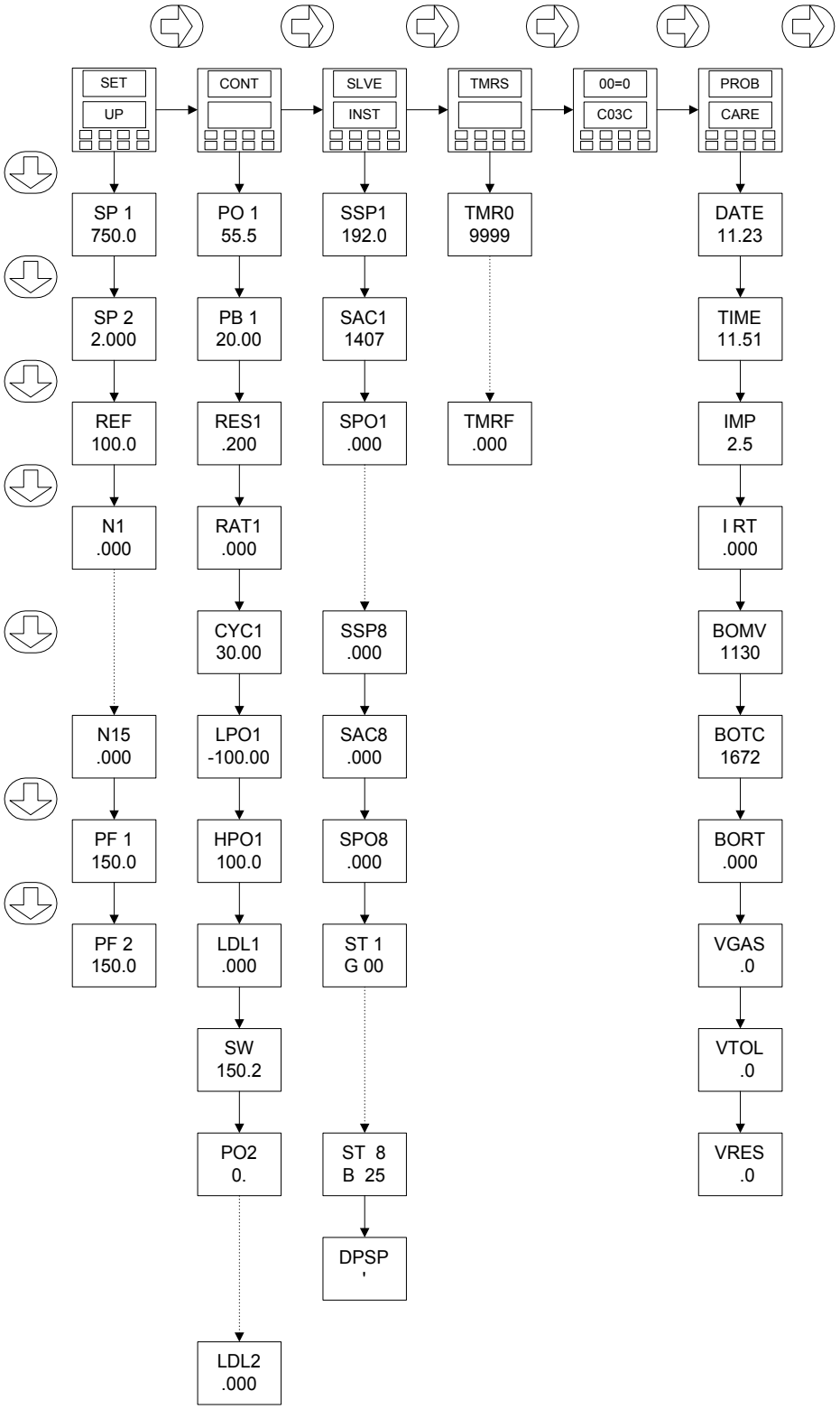


**Figure 6 Display Parameters (continued)**



The following tables are detailed descriptions of each menu item in the Display menu tree.

| VERSION Display Page | Description |
|---|---|
| 4.0 d<br>r 138 | Displays the firmware revision as Version 4.0 Dualpro revision 138 |
| 2002<br>0404 | Displays the year, month, and date. The time and date can be changed at this point by pressing [Shift]+[Setpt] |
| 1428<br>38 | Displays the hour (military time), minutes and seconds. |

| BASIC PROGRAM Display Page | Description |
|---|---|
| BAS<br>INT | Internal Basic program display menu heading |
| Line<br>0120 | Indicates the line number being executed by the Basic program area of the Dualpro. The Lorox application uses Basic to calculate equivalent millivolts and slopes for the calibration routine |
| | PM0$ program display window (usually blank) |
| | PM1$ program display window (usually blank) |

| PROGRAM Display Page | Description |
|---|---|
| PROG | Program display menu heading |
| R 0<br>F000 | Displays the running line number (R) and the foreground program number (F). The foreground program is typically used of recipes |
| G 0<br>F000 | Displays the subroutine (G) and the calling program number (F) of a running foreground program |
| -<br>0000 | Indicates the op code and data of the currently executing program line in an active foreground program |
| R 0<br>B000 | Displays the running line number (R) and the background program number (B). A background program running in the Lorox application |
| G 0<br>B000 | Displays the subroutine (G) and the calling program number (B) of a running background program |
| CP.ZE<br>0001 | Indicates the op code and data of the currently executing program line in the background program |
| PAL | Displays any active Program Alarms. This display pops up when an alarm occurs. |
| RT<br>.00 | Displays remaining time in a foreground recipe step. It is possible to edit this time while the recipe is running by pressing [Shift]+[Setpt] |
| MT<br>.00 | Displays the Master timer used in V3.5* recipes. This time is displayed as hours.minutes and is set by the “T” recipe opcode. |

| EVENTS Display Page | Description |
|---|---|
| EVNT | Event display menu heading |
| SP 0<br>\|\|\|\| | Displays the set point request for the internal events of the Dualpro. These events can be turned on/off manually by pressing [Shift]+[Setpt] and then the arrow keys to select the event or turn it on/off. Only event numbers 0 – 3 are valid. |
| ACT0<br>\|\|\|\| | Displays the active events that are being monitored by the instrument and confirmed as on. An on state is indicated by a tick mark for each event. |
| SP 1<br>\|\|\|\| | Displays the set point request for the first external OPTO events board connected to the Dualpro. These events can be turned on/off manually by pressing [Shift]+[Setpt] and then the arrow keys to select the event or turn it on/off. Valid events can be 0 – 3, 7, or 15 depending on the size of the attached event board. |
| ACT1<br>\|\|\|\| | Displays the active events that are being monitored by the instrument and confirmed as on. An on state is indicated by a tick mark for each event. |
| SP 2<br>\|\|\|\| | Displays the set point request for the second external OPTO events board connected to the Dualpro. These events can be turned on/off manually by pressing [Shift]+[Setpt] and then the arrow keys to select the event or turn it on/off. Valid events can be 0 – 3, 7, or 15 depending on the size of the attached event board. |
| ACT2<br>\|\|\|\| | Displays the active events that are being monitored by the instrument and confirmed as on. An on state is indicated by a tick mark for each event. |
| SP 3<br>\|\|\|\| | Displays the set point request for the third external OPTO events board connected to the Dualpro. These events can be turned on/off manually by pressing [Shift]+[Setpt] and then the arrow keys to select the event or turn it on/off. Valid events can be 0 – 3, 7, or 15 depending on the size of the attached event board. |
| ACT3<br>\|\|\|\| | Displays the active events that are being monitored by the instrument and confirmed as on. An on state is indicated by a tick mark for each event. |
| SP 4<br>\|\|\|\| | Displays the set point request for the fourth external OPTO events board connected to the Dualpro. These events can be turned on/off manually by pressing [Shift]+[Setpt] and then the arrow keys to select the event or turn it on/off. Valid events can be 0 – 3, 7, or 15 depending on the size of the attached event board. |
| ACT4<br>\|\|\|\| | Displays the active events that are being monitored by the instrument and confirmed as on. An on state is indicated by a tick mark for each event. |
| PAR0<br>\|\|\|\| | Displays the event partition of the internal events. A tick mark indicates the event is set as an output. This state is set in the Events Setup Page. |
| PAR1<br>\|\|\|\| | Displays the event partition of the events on the first external events board. A tick mark indicates the event is set as an output. This state is set in the Events Setup Page. |
| PAR2<br>\|\|\|\| | Displays the event partition of the events on the second external events board. A tick mark indicates the event is set as an output. This state is set in the Events Setup Page. |
| PAR3<br>\|\|\|\| | Displays the event partition of the events on the third external events board. A tick mark indicates the event is set as an output. This state is set in the Events Setup Page. |

| | |
|---|---|
| PAR4<br>\|\|\|\| | Displays the event partition of the events on the fourth external events board. A tick mark indicates the event is set as an output. This state is set in the Events Setup Page. |
| ST 1<br>G 00 | Indicates good (G) communications status of bad (B) status with the first external board. A "B" is show if no board is attached. |
| ST 2<br>B 00 | Indicates good (G) communications status of bad (B) status with the second external board. A "B" is show if no board is attached. |
| ST 3<br>B 00 | Indicates good (G) communications status of bad (B) status with the third external board. A "B" is show if no board is attached. |
| ST 4<br>B 00 | Indicates good (G) communications status of bad (B) status with the fourth external board. A "B" is show if no board is attached. |
| LSP1 | Indicates if any logical events are set. This feature is not used for Lorox. |
| LAC1 | Indicates if any logical events are on. This feature is not used for Lorox. |
| LSP2 | Indicates if any logical events are set. This feature is not used for Lorox. |
| LAC2 | Indicates if any logical events are on. This feature is not used for Lorox. |
| LSP3 | Indicates if any logical events are set. This feature is not used for Lorox. |
| LAC3 | Indicates if any logical events are on. This feature is not used for Lorox. |
| LSP4 | Indicates if any logical events are set. This feature is not used for Lorox. |
| LAC4 | Indicates if any logical events are on. This feature is not used for Lorox. |
| EMAP<br>OFF | This display indicates if the event mapping features of the Dualpro are turned on or off. The Lorox program turns this feature off automatically. |

| DATA<br>Display Page | Description |
|---|---|
| DATA | DATA display menu heading |
| CJ<br>39.00 | Cold junction reading in °C. It can also be used to measure the internal cabinet temperature of the system. |
| IN A<br>750.0 | This is the measured temperature of the Lorox probe. This reading is used to control the probe heater as well as calculate the oxygen level. |
| IN B<br>67.50 | This is the measured millivolt reading from the Lorox probe. This reading is used to calculate the oxygen reading along with the temperature reading. |
| IN C<br>3500 | This is the measured value at input C. This input is turned off in the Lorox application. |
| CV 0<br>1.010 | Calculated value 0 displays the actual oxygen level measured by the Lorox probe. |
| CV 1<br>.000 | Calculated value 1 is not used in this application. |
| CV 2<br>1.010 | Calculated value 2 displays the same as CV 0. |
| CV 3<br>66.59 | Calculated value 3 displays the equivalent millivolt reading expected from the Lorox probe based in the span gas value entered in N1 and the actual probe temperature from IN A. This value is calculated by the Basic program. |

| EXTERNAL ANALOG Display Page | Description |
|---|---|
| EXT<br>ALOG | External Analog display menu heading |
| EA 0<br>through EA 15 | These displays indicate the measured values from each of possibly sixteen input modules of an external analog input board. |
| ST A<br>B 10 | Indicates the communication status of the external OPTO analog input board. "G" indicates good status, "B" indicates bad status or no board attached. |

| SET UP Display Page | Description |
|---|---|
| SET<br>UP | Set Up display menu heading |
| SP 1<br>750.0 | Set point for loop 1. This is the probe temperature set point in the Lorox application. |
| SP 2<br>1.000 | Set point for loop 2. This is set point is unassigned in the Lorox application but is shown here as an oxygen set point. |
| REF<br>200.0 | Reference Number, set in the [Setpt] key menu |
| N1 through N15 | Values of N1 through N15. These numbers are set in the [Setpt] key menu. Some of these numbers have particular meanings in the Lorox application. See section on Automatic Lorox Probe Calibration of a detailed explanation of these settings. |
| PF 1<br>150.0 | Process factor 1 for carbon control. The default for this number is 150. |
| PF 2<br>150.0 | Process factor 2 for dew point control. The default for this number is 150. |

| CONTROL Display Page | Description |
|---|---|
| CONT | Control display menu heading |
| PO 1<br>0100 | Actual percent output of loop 1. The same value can be seen by pressing the [Left] key while viewing the loop 1 process display. |
| PB 1<br>20.00 | Proportional band setting for loop 1. This number is used by the tuning algorithm for loop 1. Display is in loop 1 process units (°C) |
| RES 1<br>.200 | Reset setting for loop 1. This number is used by the tuning algorithm for loop 1 |
| RAT1<br>.000 | Rate setting for loop 1. This number is used by the tuning algorithm for loop 1 |
| CYC1<br>30.00 | Cycle time in seconds for the control contract assigned to loop 1. |
| LPO1<br>.000 | Low percent output for loop 1. Usually set to 0. |
| HPO1 | High percent output for loop 1. Usually set to 100 |

| | |
|---|---|
| 100.0 | |
| LDL1<br>.000 | Load line display for loop 1. Not used in this application |
| SW<br>150.3 | Slidewire reading from Input C. Not used in this application. |
| PO 2<br>0100 | Actual percent output of loop 2. The same value can be seen by pressing the [Left] key while viewing the loop 2 process display. |
| PB 2<br>20.00 | Proportional band setting for loop 2. This number is used by the tuning algorithm for loop 2. Display is in loop 2 process units. |
| RES 2<br>.200 | Reset setting for loop 2. This number is used by the tuning algorithm for loop 2. |
| RAT2<br>.000 | Rate setting for loop 2. This number is used by the tuning algorithm for loop 2. |
| CYC2<br>30.00 | Cycle time in seconds for the control contract assigned to loop 2. |
| LPO2<br>.000 | Low percent output for loop 2. Usually set to 0. |
| HPO2<br>100.0 | High percent output for loop 2. Usually set to 100 |
| LDL2<br>.000 | Load line display for loop 2. Not used in this application |

| SLAVE INSTRUMENT Display Page | Description |
|---|---|
| SLVE<br>INST | Slave Instruments display menu heading |
| SPP1 through SPP8 | Shows the set point requests being sent by the Dualpro to any attached slave controllers. A maximum of eight slaves are allowed. |
| SAC1 through SAC8 | Shows the actual set points being sent to the Dualpro from any attached slave controllers. A maximum of eight slaves are allowed. |
| SPO1 through SPO8 | Shows the percent output of each slave sent to the Dualpro by any attached slave controllers. A maximum of eight slaves are allowed. |
| ST 1 through ST8 | Shows the communications status of any attached slave controllers. A maximum of eight slaves are allowed. |
| DPST<br>\|\|\|\|\|\|\| | Shows the activity of any attached controllers on the Dualpro's Auxiliary bus port. Up to fifteen instruments are allowed in certain port settings. |

| TIMERS Display Page | Description |
|---|---|
| TMRS | Timers display menu heading |
| TMR0 through TMR15 | Displays the timer settings for each of sixteen timers available in the Dualpro. Timer values can be changed by pressing [Shift]+[Setpt] at the particular timer display. See "Can I change the calibration timers during a calibration?" in the Troubleshooting section of this manual for a detail of the timer definitions. |

| MEMORY MAP Display Page | Description |
|---|---|
| 00=0<br>C13C | Memory Map display menu heading. This display is for advanced users only. Do not attempt to change any values here unless you know what they are. |

| PROBE CARE Display Page | Description |
|---|---|
| PROB<br>CARE | Probe Care display menu heading. This feature is disabled in the Lorox application. |
| DATE<br>.00 | Date when last probe care test was run. |
| TIME<br>.00 | Time when last probe care test was run. |
| IMP<br>.0 | Probe impedance measurement made during last probe care test. |
| I RT<br>.000 | Probe recovery time in seconds during the last probe care test. |
| BOMV<br>.000 | Actual millivolt reading during probe burn off cycle. |
| BOTC<br>.000 | Actual temperature reading from probe during burn off cycle. |
| BORT<br>.000 | Recovery time in seconds for probe following the burn off cycle. |
| VGAS<br>.0 | Verification gas value (%O2) used during the last oxygen probe test. |
| VTOL<br>.0 | Verification test tolerance (%O2) during the last oxygen probe test. |
| VRES<br>.0 | Verification gas measured (%O2) during the last oxygen probe test. |

## Setup Parameters

The following figures show the structure of the Setup menu tree. These menus are accessed by pressing the [Setup] key on the Dualpro front panel. The parameters are grouped by function under specific menu headings. Some or these functions are not required in this application. Some parameters are pre-set by the Lorox program. These are indicated in the following figures as gray blocks. The values shown are not necessarily the values required in your application. Make sure you have filled out the setup parameter work sheet in Appendix C of this manual to document the actual setup parameters in your application. A detailed explanation follows these figures.

Any menu page heading may be displayed when you press the [Setup] key. This depends on the last page you were viewing. It is possible to advance to the next menu parameter by pressing [Enter]. It is possible to move forward or backward in the menu headings by pressing the [Right] or [Left] arrow keys. Pressing the [Setup] key again exits from the Setup menu.

Menu parameters are changed by moving the flashing cursor through the parameter number by pressing [Right] or [Left]. The value of the flashing digit can be changed by pressing the [Up] or [Down] keys. Some parameters provide a selection list that can be changed with the [Up] or [Down] keys. The changed value is entered into the instrument when the [Enter] key is pressed.

Repeat functions are shown as dotted lines in the following figures. For example there are three inputs for the instrument. Similar parameters are available for all three inputs, so these functions are shown for input A (IN A), and implied for inputs B and C.

**Figure 7 Setup Menu**

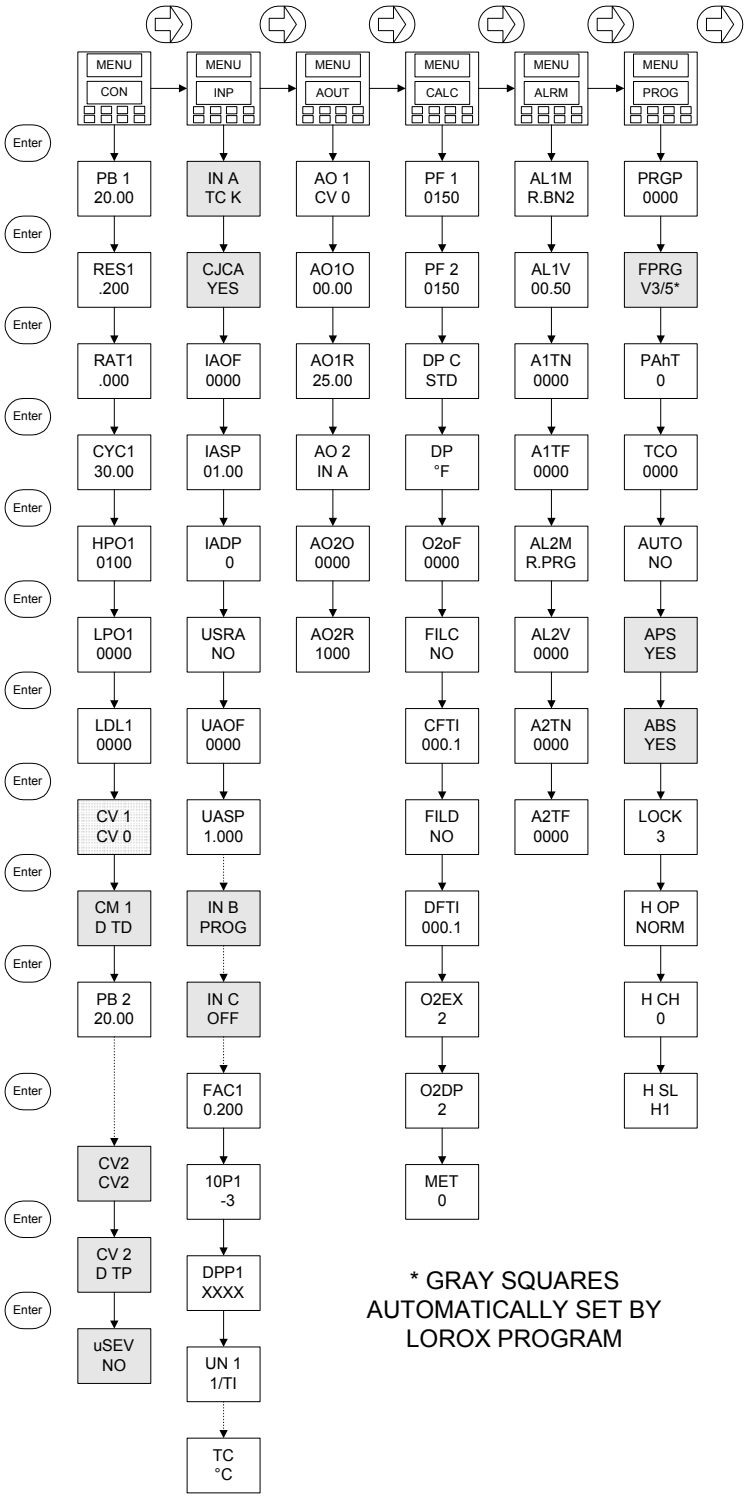
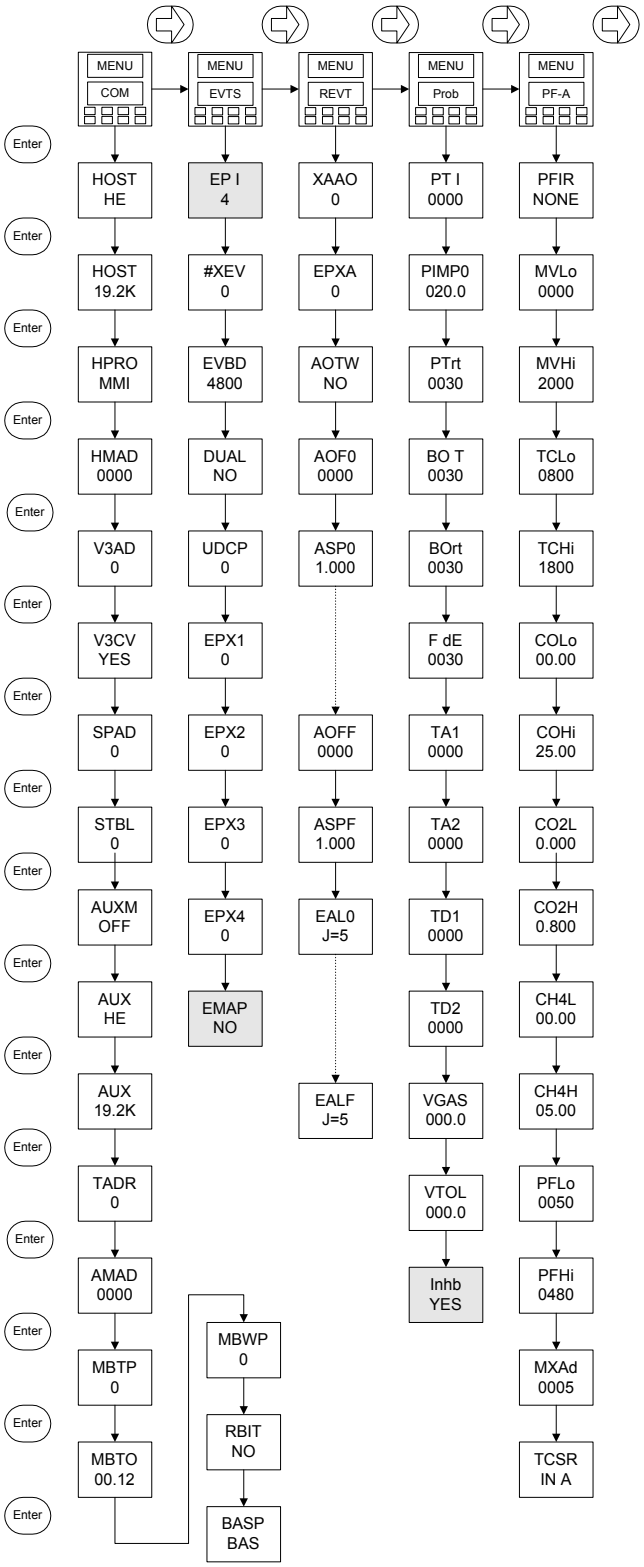


**Figure 8 Setup Menu (continued)**



| CONTROL Setup Page | Description |
|---|---|
| MENU CONT | Control setup menu heading |
| PB 1 0020 | Proportional band setting for loop 1. This number is used by the tuning algorithm for loop 1. Display is in loop 1 process units (°C) |
| RES 1 00.20 | Reset setting for loop 1. This number is used by the tuning algorithm for loop 1 |
| RAT1 00.00 | Rate setting for loop 1. This number is used by the tuning algorithm for loop 1 |
| CYC1 0030 | Cycle time in seconds for the control contract assigned to loop 1. |
| HPO1 0100 | High percent output for loop 1. Set to 100 in the Lorox application. |
| LPO1 0000 | Low percent output for loop 1. Set to 0 in the Lorox application. |
| LDL1 0000 | Load line display for loop 1. Not used in this application |
| CV 1 IN A | Selects Input A, probe temperature, as the control parameter for Loop 1 |
| CM 1 D TP | Control mode for Loop 1 is selected to be Direct, Time Proportioning. This mode uses Control Contract 1 to regulate the probe heater. |
| PB 2 0020 | Proportional band setting for loop 2. This number is used by the tuning algorithm for loop 2. Display is in loop 2 process units. |
| RES 2 00.20 | Reset setting for loop 2. This number is used by the tuning algorithm for loop 2. |
| RAT2 00.00 | Rate setting for loop 2. This number is used by the tuning algorithm for loop 2. |
| CYC2 0300 | Cycle time in seconds for the control contract assigned to loop 2. |
| HPO2 0100 | High percent output for loop 2. Usually set to 100 |
| LPO2 0000 | Low percent output for loop 2. Usually set to 0. |
| LDL2 0000 | Load line display for loop 2. Not used in this application |
| CV 2 CV 2 | Selects the measured oxygen level as the control parameter for Loop 2 |
| CM 1 D TP | Control mode for Loop 2 is selected to be Direct, Time Proportioning. This mode uses Control Contract 2 to regulate the process oxygen. |
| uSEV NO | Set to not use any internal events for control. This selection determines if event outputs 2 and 3 would be used for control based on the output contact selection. This selection is set to NO by the Lorox application. |

| INPUT Setup Page | Description |
|---|---|
| MENU INP | Input setup menu heading. |
| IN A TC K | Input type selection for Input A. This selection is automatically set by the Lorox application and is used to measure the probe temperature. |
| CJCA YES | Cold junction for Input A. Automatically set to Yes because a thermocouple is connected to the Dualpro |
| IAOF 0000 | Input A offset. Only used of PROG was selected for input type. |
| IASP 0100 | Input A span adjustment. Only used of PROG was selected for input type. |
| IADP 0 | Input A decimal point location. Selected to show a full four digit temperature display with no fractional degrees. |
| USRA NO | User scaling selected. Not used in this application. |
| UAOF 0000 | User scaling offset. Not used in this application. |
| UASP 1.000 | User scaling span. Not used in this application. |
| IN B PROG | Input type selection for Input B. This selection is automatically set by the Lorox application and is used to measure the probe millivolts. This setting assumes the input is a linear value with an input range of 0 – 2000 mV. |
| CJCB NO | Cold junction for Input B. Automatically set to NO. |
| IBOF 0000 | Input B offset. Calculated by the Lorox program to offset any millivolt level measured during the zero calibration sequence. The default value is 0. |
| IBSP 01.00 | Input B span adjustment. Calculated by the Lorox program to adjust the signal slope at full scale. This value is calculated during the span calibration sequence. The default value is 1.00. |
| IBDP 0 | Input B decimal point location. Selected to show a full four digit millivolt display with no fractional millivolts. |
| USRB NO | User scaling selected. Not used in this application. |
| UBOF 0000 | User scaling offset. Not used in this application. |
| UBSP 1.000 | User scaling span. Not used in this application. |
| IN C OFF | Input type selection for Input C. This selection is automatically set by the Lorox application. |
| CJCC NO | Cold junction for Input C. |
| ICOF 0000 | Input C offset. Only used of PROG was selected for input type. |
| ICSP | Input C span adjustment. Only used of PROG was selected for input |

| | |
|---|---|
| 01.00 | type. |
| ICDP<br>0 | Input C decimal point location. Selected to show a full four digit temperature display with no fractions degrees. |
| UCRA<br>NO | User scaling selected. Not used in this application. |
| UCOF<br>0000 | User scaling offset. Not used in this application. |
| UCSP<br>1.000 | User scaling span. Not used in this application. |
| FAC 1<br>through 3 | Factor setting for pulse input on inputs A, B, or C. Not used in this application. |
| 10P1 through<br>10P3 | Exponent power setting for pulse inputs on A, B, or C. Not used in this application. |
| DPP1 through<br>DPP3 | Display decimal point setting for inputs A, B, or C when used with a pulse input. Not used in this application. |
| UN 1 through<br>UN 3 | Time or frequency unit selection for inputs A, B, or C. Not used in this application. |
| TC<br>°C | Selects either F (Fahrenheit) or C (Celsius). Celsius is used in the Lorox application. |

| Analog Outputs Setup Page | Description |
|---|---|
| MENU<br>AOUT | Analog Outputs setup menu heading |
| AO 1<br>CV 0 | Analog channel 1 is selected to re-transmit the oxygen process in this example. Other selections can be made such as IN A (temperature), or IN B (probe millivolts |
| AO1O<br>00.00 | Analog channel 1 offset scales the 4.0 mA output level to the minimum value of the process selected in AO 1. The absolute process minimum does not have to be used. Sections of the process response can be used to improve output resolution. |
| AO1R<br>20.95 | Analog channel 2 range scales the 20 mA output level to the maximum value of the process selected in AO 1. The absolute process maximum does not have to be used. Sections of the process response can be used to improve output resolution. |
| AO 2<br>IN A | Analog channel 2 is selected to re-transmit the probe heater temperature in this example. Other selections can be made. |
| AO2O<br>0000 | Analog channel 2 offset scales the 4.0 mA output level to the minimum value of the process selected in AO 2. The absolute process minimum does not have to be used. Sections of the process response can be used to improve output resolution. |
| AO2R<br>1000 | Analog channel 2 range scales the 20 mA output level to the maximum value of the process selected in AO 2. The absolute process maximum does not have to be used. Sections of the process response can be used to improve output resolution. |

| Calculation Setup Page | Description |
|---|---|
| MENU<br>CALC | Calculation setup menu heading |
| PF 1<br>150.0 | Process factor 1 for carbon control. The default for this number is 150. Not used in the Lorox application |
| PF 2<br>150.0 | Process factor 2 for dew point control. The default for this number is 150. Not used in the Lorox application |
| DP C<br>STD | Std/PIC standard or piccolo probe based. Use the piccolo option only if non-air reference gas is used. Not used in the Lorox application |
| DP<br>°F | Choice of dewpoint calculations done in Centigrade or Fahrenheit. Not used in the Lorox application. |
| O2Of<br>0000 | This offset is added to the probe millivolt reading (input B) before it is used in calculating percent Carbon or dewpoint. Not used in the Lorox application. |
| FILC<br>NO | If no, then the display and datalogged % carbon values are instantaneous. If yes then the display and datalogged % carbon values are an average over the specified filter time. The instantaneous values are always used for control.<br>Not used in the Lorox application. |
| CFTI<br>000.1 | A sliding window average of the % values is computed over the specified time. Not used in the Lorox application. |
| FILD<br>NO | If no, then the display and datalogged dewpoint values are instantaneous. If yes then the display and datalogged dewpoint values are an average over the specified filter time. The instantaneous values are always used for control.<br>Not used in the Lorox application. |
| DFTI<br>000.1 | A sliding window average of the dewpoint values is computed over the specified time. Not used in the Lorox application. |
| O2EX<br>2 | Oxygen exponent (0 to 31). When the oxygen calculation is selected this setup determines the units. A value of 2 represents 10″ therefore the units are percent. A value of 6 would have units of ppm (parts per million).<br>This parameter is automatically set by the Lorox application. |
| O2DP<br>2 | Oxygen Decimal Place. When the Oxygen calculation is selected this value determines the resolution to which the calculated value is displayed. For example by changing the decimal place the %O in the atmosphere could be displayed as 21, 20.9, or 20.95. This parameter is automatically set by the Lorox application. |
| MET<br>0 | This value selects the metal contents for the redox calculation.<br>Not used in the Lorox application. |

| Alarms Setup Page | Description |
|---|---|
| MENU ALRM | Alarms setup menu heading |
| AL1M R.BN2 | Alarm 1 Mode, shows BN2 for band detection above and below the loop 2 set point. If the band set by the alarm value is 0.50% oxygen and the SETPOINT is 2.0% then alarm will trigger at 2.5% and 1.5% . The "R." indicates that the contact closure is reversed, where it opens when the alarm occurs. |
| AL1V 00.50 | Alarm 1 Value, sets the alarm trip point. Alarm value is consistent with the process variable selected in AL1M. |
| A1TN 0000 | Alarm 1 Turn On Delay, 0000 to 0250 seconds. Sets a delay period between alarm condition and alarm activation. |
| A1TF 0000 | Alarm 1 Turn Off Delay, 0000 to 0250 seconds. Sets a delay period between alarm condition and alarm deactivation. |
| AL2M R.PRG | Alarm 2 Mode, shows PROG for program alarm. This alarm will react to any program alarms generated by the Lorox program. These alarms will also be displayed as PAL XXX, where XXX is the PAL alarm code. See the section on System Alarms for more information about PAL alarms. |
| AL2V 1000 | Alarm 2 Value, sets the alarm trip point. Alarm value is consistent with the process variable selected in AL2M. Since PROG is selected any process number entered here will have no effect. |
| A2TN 0000 | Alarm 2 Turn On Delay, 0000 to 0250 seconds. Sets a delay period between alarm condition and alarm activation. |
| A2TF 0000 | Alarm 2 Turn Off Delay, 0000 to 0250 seconds. Sets a delay period between alarm condition and alarm deactivation. |

| Program Setup Page | Description |
|---|---|
| MENU PROG | Program setup menu heading |
| PRGP 0000 | Program Partition, if 0000 the feature is deactivated. If 1 to 200, the number set will represent the partition between background and foreground programs. Programs whose numbers are above the partition may only be run in the foreground and programs whose numbers are below the partition may only be run in the background. This setting applies if the FPRG parameter is set to VER4. |
| FPRG VER3.5* | Foreground Program Type, If set to VER4 then the foreground programmer uses a standard LOGIC language program. (The same as the background program.) If set to V3.5* then the foreground program is a RECIPE type language program. |
| PAHT 0 | Program Alarm Hold Time, sets the "Hold Time" to latch a PAL (Program Alarm) for HOLD TIME Data-logging purposes. An alarm will be held in the internal alarm stack for the time specified, after which the oldest PAL will be cleared. The delay time set should be based on the scan time of the |

| | |
|---|---|
| | data-logging system attached to the instrument. This setting will have no visual effect on front panel operations. Selections are 0, 10, 30, 60, 90, 120, 180 seconds. |
| TCO<br>0000 | Thermocouple Offset. This parameter is related to Alarm 85 function available in V3.5 recipes. It sets the allowed temperature deviation between the probe thermocouple (input A) and the temperature control thermocouple (input C) when Alarm 85 is activated in a recipe. |
| AUTO<br>NO | Recipe Program Auto Continue. If YES, allows for the automatic continuation of a recipe that was running when the instrument lost power for a period of more than 10 seconds. If NO, does not continue the recipe when power is reapplied. Note: Recipes will auto-start regardless of selection if power loss is less than 10 seconds. |
| APS<br>YES | Background Program Auto Continue. Yes forces the background program to restart at program 1, step 1, whether it was running or not, when power is reapplied after a power loss. No does not force the background program to start when power is reapplied. This parameter is automatically set by the Lorox program the first time it is run. |
| ABS<br>YES | Auto Background Program Start. If YES, the background (logic) program is started at program 1 step 1 even if the background program has been manually stopped or stopped for more then 5 seconds. ABS is automatically set to YES by the Lorox program since the background program is necessary to control this application. |
| LOCK<br>3 | Lock Level, Requires a password entry for access.<br>LOCK LEVEL DEGREE OF ACCESS<br>0 NO ACCESS (lowest level)<br>1 LIMITED ACCESS<br>2 SOME RESTRAINTS / RECIPE EDIT<br>3 FULL ACCESS (highest level) |
| H OP<br>NORM | H Opcode Redirection, selects whether or not to activate the temperature redirection option. If '**NORM**' is selected it is assumed the temperature set point command in a recipe is directed to an internal loop of the Dualpro. If '**DIR** ' is selected, the set point command is directed to an attached temperature slave instrument. |
| H CH<br>0 | H Opcode Channel, selects the channel number of the slave instrument where the temperature setpoint is to be directed. 0 refers to the master Dualpro, numbers 1 through 15 refer to other attached Dualpro controllers. |
| H SL<br>H1 | H Opcode Slave Channel, selects the slave temperature controller that is attached to the selected H CH instrument. This allows a temperature set point to be passed through attached Dualpros and directed to a slave instrument of the specified Dualpro. |

| Communication Setup Page | Description |
|---|---|
| MENU<br>COM | Communications setup menu heading |
| HOST | Host Port Parity, selections include HE = Half Duplex Even Parity |

| | |
|---|---|
| HE | HN = Half Duplex No Parity, FE = Full Duplex Even Parity, FN = Full Duplex No Parity |
| HOST<br>19.2K | Host Port Baud Rate, selections include 1200, 2400, 4800, 9600, 19.2K, 38.4K, 76.8K. |
| HPRO<br>MMI | Host Protocol, selections include, MMI = Marathon Proprietary Protocol, and MOD = MODBUS RTU Protocol |
| HMAD<br>0000 | Host Modbus Address, address used if Modbus protocol is selected. If set to 0 then the dipswitch SW2 address setting is used. |
| V3AD<br>0 | Version 3 Address, Setting 0 uses the SW2 dipswitch settings. Settings 1 through 15 respond to the numbered address.<br>The version 3 address is used when a Dualpro is replacing a Version 3 Carbpro connected to a Process Master 5.x system. The Dualpro will evaluate a Version 3 Carbpro at the specified address but will also respond to Version 4 requests at the dipswitch address. |
| V3CV<br>YES | Version 3 Program Conversion, YES translates the version 3 recipe programs in version 3 mode. NO passes the program through without conversion utilities. If a Dualpro replaces a version 3 instrument, the programs must be converted. |
| SPAD<br>0 | Secondary Port Address, if set to 0 then the secondary port is inactive. This feature sets a second address at which the instrument will respond on the host port. The secondary port table parameter selects which parameter table will be set for block reads. |
| STBL<br>0 | Secondary Port Table, sets table 0 to 31 to be used with the secondary port address. |
| AUXM<br>OFF | Aux Port Mode, selects the auxiliary ports mode of operation; BRoaDcast, TEMperature buss, network MASter, OFF, LISten, UDC, or TOKen. |
| AUX<br>HE | Aux Parity, selects the auxiliary port parity setting; HE = Half Duplex Even Parity, HN = Half Duplex No Parity, FE = Full Duplex Even Parity, FN = Full Duplex No Parity |
| AUX<br>19.2K | Aux Baud Rate, selections include 1200, 2400, 4800, 9600, 19.2K, 38.4K, 76.8K. |
| TADR<br>0 | Token Ring Address, determines which token address the instrument uses when the Aux port is in token mode. When set to 0, the instrument responds to the dipswitch settings. When set to 1 through 15, the instrument responds to that address. This allows address assignments independent of the HOST port address. |
| AMAD<br>0000 | Aux Modbus Address, if the Aux Port Mode is set to 'MOD,' this parameter determines the Modbus slave address to which the instrument will respond. If this value is 0 then the HOST dipswitch address will be used. |
| MBTP<br>0 | Master Bus Time Out Partition, used only when the Aux port is in Master or Token mode. Selects the channel number at or above which the MBTO value is used instead of the normal time out value. This feature is disabled if set to 0. This feature is used when a slower device (such as a PLC) is connected to the MSI network |

| | |
|---|---|
| | and emulating a MSI instrument. |
| MBTO<br>00.12 | Master Bus Time Out Value, when the MBTP is non-zero, this value is used as the bus time out value when attempting to communicate with channels equal to MBTP and above. |
| MBWP<br>0 | Master Bus Write Partition, used to define unused slave channels that can be used by the programmer for additional memory space. Indirect writes to channel numbers equal to or above the MBTP (if active) will be stored into memory allocated for these channels. These values can later be read by with indirect reads. |
| RBIT<br>NO | Local Mode Slave Indicator, selects whether the local mode indicator of the slave temperature controller should use BIT 12 of the actual setpoint. Use YES for compatibility with old applications. Select NO for most new ones. |
| BASP<br>BAS | Basic Port Mode, when set to BAS, Basic programs may be run and the basic port is used only for BASIC communications. When set to TEMP, Basic programs may not be run and the port is then used as a temp buss at 4800 BAUD. This is allowed only if the Aux port is not set to UDC or TEMP. TEMP allows the instrument to operate a Master Network on the Aux bus and a temp instrument network on the Basic bus. This setting should be set to BAS for the Lorox application. |

| Events Setup Page | Description |
|---|---|
| MENU<br>EVTS | Events setup menu heading |
| EP I<br>4 | Internal Event Partition, where 0 configures all the internal events as inputs and 4 sets them all to outputs. A 1 will represent 1 output and 3 inputs, and so on until when at 4 all outputs are set. The Lorox program automatically sets this parameter to 4. |
| #XEV<br>0 | Number of External Event Boards, representing the number of digital, event boards attached to the Dualpro. No external events boards are used in the Lorox application. |
| EVBD<br>4800 | External Events Baud Rate, can be set to 1200 (for 1200 BAUD) or 4800 (for 4800 BAUD). Not used in the Lorox application. |
| DUAL<br>NO | Dual Bus Mode, YES or NO. If yes and the Basic port is not temp and the Aux port is not temp or UDC, the events buss is used for both events boards and temperature controllers. Not used in the Lorox application. |
| UDCP<br>0 | UDC Partition, 0 to 8. Sets the number of UDC instruments that are installed on the Events port in dual buss mode. The UDC's use the high address numbers in the range 1-8. Not used in the Lorox application. |
| EPX1<br>0 | External Event Brd 1 Partition, 0-15. 0 implies all inputs, and 15 implies 15 outputs and 1 input for the first digital events board. 5 implies 5 outputs and 11 inputs; and so on. Not used in the Lorox application. |
| EPX2<br>0 | External Event Brd 2, 0-15. 0 implies all inputs, and 15 implies 15 outputs and 1 input for the second digital events board. 5 implies 5 outputs and |

| | |
|---|---|
| | 11 inputs; and so on. Partition Not used in the Lorox application. |
| EPX3<br>0 | External Event Board 3 Partition, 0-15. 0 implies all inputs, and 15 implies 15 outputs and 1 input for the third digital events board. 5 implies 5 outputs and 11 inputs; and so on. Not used in the Lorox application. |
| EPX4<br>0 | External Event Board 4 Partition, 0-15. 0 implies all inputs, and 15 implies 15 outputs and 1 input for the forth digital events board. 5 implies 5 outputs and 11 inputs; and so on. Not used in the Lorox application. |
| EMAP<br>NO | Events Mapping, YES / NO. Yes activates logical events mapping. Refer to the programmer's manual for complete information on logical event mapping. The Lorox program automatically sets this parameter to NO. |

| Remote Events Setup Page | Description |
|---|---|
| MENU<br>AEVT | Analog (external) events setup menu heading |
| XAAO | External Analog Address Offset, normally set to 0 and the Analog OPTOMUX board connected to the instrument has an address of FC hex. When 1, then the Analog OPTOMUX used by the instrument is at address FD hex. Likewise, when 2, the address is FE hex, and 3 produces an address of FF hex. This is used when more than one Analog OPTOMUX is connected to the instrument. Not used in the Lorox application. |
| N/A | All other parameters are not applicable to the Lorox program. |

| Probe Setup Page | Description |
|---|---|
| MENU<br>Prob | Probe Maintenance setup menu heading |
| PT I<br>0000 | Probe Test Interval, Not used in the Lorox application. |
| PIMP<br>020.0 | Maximum Probe Impedance, Not used in the Lorox application. |
| Ptrt<br>0030 | Probe Test Recover Time, Not used in the Lorox application. |
| BO T<br>0030 | Probe Burnoff Time, Not used in the Lorox application. |
| Bort<br>0030 | Probe Burnoff Recover Time, Not used in the Lorox application. |
| F De<br>0030 | Final Delay, Not used in the Lorox application. |
| TA1<br>0000 | Verification Time 1 Average, Not used in the Lorox application. |
| TA2<br>0000 | Verification Time 2 Average, Not used in the Lorox application. |
| TD1 | Time 1 Delay, Not used in the Lorox application. |

| | |
|---|---|
| 0000 | |
| TD2<br>0000 | Time 2 Delay, Not used in the Lorox application. |
| VGAS<br>000.0 | Verification Gas Value, Not used in the Lorox application. |
| VTOL<br>000.0 | Verification Test Tolerance, Not used in the Lorox application. |
| Inhb<br>YES | Inhibit Test? The Lorox program automatically sets this parameter to YES. |

| Process Factor Adjust Setup Page | Description |
|---|---|
| MENU<br>PF-A | Process Factor Adjust setup menu heading |
| PFIR<br>NONE | Process Factor IR Adjustment mode, selects the type of interaction possible if an IR 3 gas measurement system. NONE turns of IR functions. ICCO accepts a linear input on IN C that is proportional to the CO level. IRCO accepts the CO level from the IR system using the Token bus. IRMO monitors the gases measured by an IR system via the Token bus. IRPF provides full control of the process factor using the carbon calculation from the IR system. Not used in the Lorox application. Leave this parameter set to NONE for the Lorox application. |
| MVLo<br>0000 | Probe millivolt Minimum Limit is the minimum millivolt level of the furnace probe that must be achieved to allow IR sampling. Not used in the Lorox application. |
| MVHi<br>2000 | Probe millivolt Maximum Limit is the maximum millivolt level of the furnace probe that must be achieved to allow IR sampling. Not used in the Lorox application. |
| TCLo<br>0800 | Temperature Minimum Limit, Not used in the Lorox application. |
| TCHi<br>1800 | Temperature Maximum Limit, Not used in the Lorox application. |
| COLo<br>00.00 | CO Minimum Limit sets the minimum allowed CO level measured by IR system with a range of 0.0%CO to 30.0%CO. This level also applies for the CO Compensation options. Not used in the Lorox application. |
| COHi<br>25.00 | CO Maximum Limit sets the maximum allowed CO level measured by IR system with a range of 0.0%CO to 30.0%CO. This level also applies for the CO Compensation options. Not used in the Lorox application. |
| CO2L<br>0.000 | CO2 Minimum Limit sets the minimum allowed $CO_2$ level measured by IR system with a range of 0.0%$CO_2$ to 5.0%$CO_2$. Not used in the Lorox application. |
| CO2H | CO2 Maximum Limit sets the maximum allowed $CO_2$ level |

| | |
|---|---|
| 0.800 | measured by IR system with a range of 0.0%$CO_2$ to 5.0%$CO_2$. Not used in the Lorox application. |
| CH4L<br>00.00 | Methane Minimum Limit sets the minimum allowed $CH_4$ level measured by IR system with a range of 0.0%$CH_4$ to 20.0%$CH_4$. Not used in the Lorox application. |
| CH4H<br>05.00 | Methane Maximum Limit sets the maximum allowed $CH_4$ level measured by IR system with a range of 0.0% $CH_4$ to 20.0%$CH_4$. Not used in the Lorox application. |
| PFLo<br>0050 | Process Factor Minimum Limit sets the maximum allowed $CH_4$ level measured by IR system with a range of 0.0% $CH_4$ to 20.0%$CH_4$. Not used in the Lorox application. |
| PFHi<br>0480 | Process Factor Maximum Limit sets the maximum limit of the Process Factor value with a range of 000 to 999. This parameter also applies for the CO Compensation options. Not used in the Lorox application. |
| MXAd<br>0005 | Maximum PF adjustment sets maximum allowable Process Factor adjustment per IR sample that the instrument can make with a range of 000 to 100. This parameter also applies for the CO Compensation options. Not used in the Lorox application. |
| TCSR<br>IN A | Thermocouple Source Where IN A, IN C, or IR can be selected. If input A or C are selected these temperature values are transmitted to the IR system and used as the default temperature values for that point at the IR system. If IR is selected the manually entered default temperature at the IR system for that point is use. Not used in the Lorox application. |

# Calibration Procedures

## *Lorox Probe Calibration*

The Lorox controller can perform an automatic calibration on the Lorox probe by change N5 to 1 or by setting N6 to the required time at which a calibration should be done. It is also possible to perform a manual calibration by manually turning on/off the zero and span gas events.

Before the controller can be used to calibrate in automatic mode it is necessary to know what the required delay times for zero process, the span process, and the amount of time required to return to the normal process level. The calibration program uses the same time for the zero and span delays (seconds), so the maximum time of either process will be used. The final delay time is the time (seconds) required for the probe to start to correctly register the process gas following the calibration cycle.

### *Manual Lorox Probe Calibration*

**Warning**

When the Lorox probe is calibrated manually, the analog output channels are **not** frozen. The analog output 4-20mA loops will react to the zero and span gases as if they were changes in the process gas. Automatic calibration through either N5 or N6 will freeze the analog output channels.

**Warning**

Insure that any system interlocks connected through the Dualpro will not be tripped during manual calibration of the Lorox probe or during calibration of the Dualpro analog inputs or outputs.

Three display menus will be used during this calibration process; the EVENT and DATA displays under the [Page Disp] key, and the INPUT menu under the [Setup] key. Refer to the section on the [Page Disp] menus for more information. The procedures for viewing and setting the required parameters follows the manual calibration procedure.

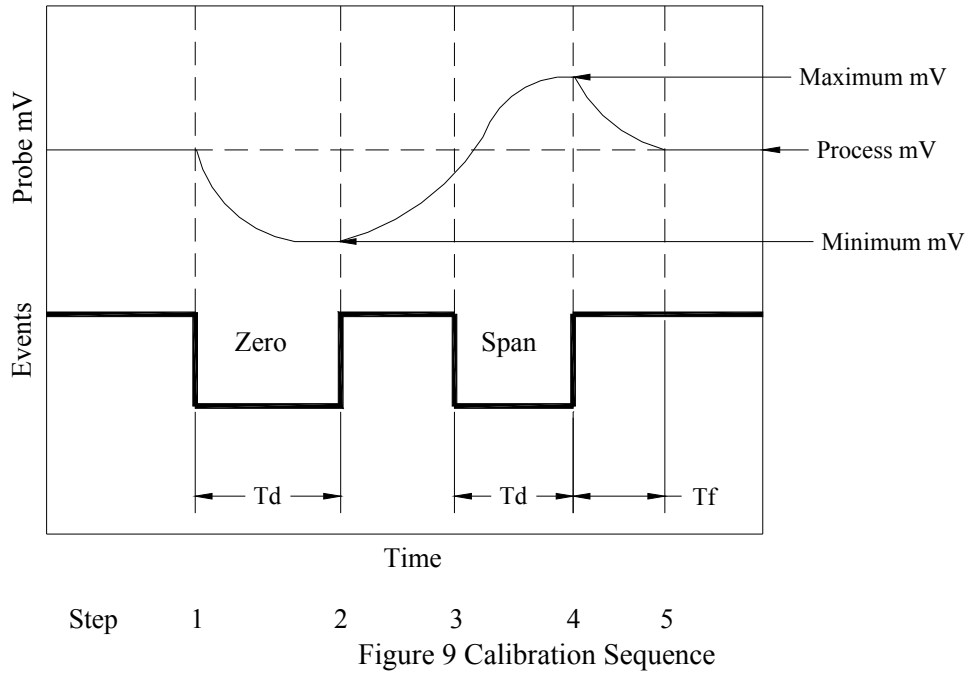



Figure 9 Calibration Sequence

Step 1
- Note average process value (mV)
- Turn on the zero event (EV0) and note start time
- Check and adjust zero cal gas flow for 5 SCFH minimum
- Verify that that the probe millivolt level drops

Step 2
- Note elapsed time for a stable minimum reading, this is the Zero Time Delay
- Note the minimum millivolt level, this is the Zero Offset Value
- Turn off the zero event (EV0)

Step 3
- Turn on the span event (EV1) and note time
- Verify a span gas flow of 5 SCFH minimum
- Verify that the probe millivolt level increases

Step 4
- Note the elapsed time for a stable maximum reading, this is the Span Time Delay
- Note the maximum millivolt level, this is the Span Value
- Turn off the span event (EV1)
- Note start time

Step 5
- Note elapsed time when the millivolt level returns to the normal process range, this is the Final Delay Time

### *Turning on the Events*

The events on the Dualpro can be turned on by:

- Pressing the [Page Disp] key
- Press the [RIGHT] key until EVNT is displayed
- Press the [DOWN] key once to display SP 0
- Press the [Shift] + [Setpt] keys at the same time.
- Select 0oF (if not displayed) by pressing the [UP] or [DOWN] keys
- Turn EV0 on (of off) by pressing the [RIGHT] (or [LEFT]) keys
- Press [Page Disp] to exit

Event 1 operates the same why when it is selected using the same procedure. It is displayed as 1oF or 1on when selected.

### *Viewing the Probe Data*

A number of process values are displayed in the DATA menu screen. Press the following keys to view this information.

Press the [Page Disp] key
Press the [RIGHT] key until DATA is displayed
Press the [DOWN] key to view system data.

| | |
|---|---|
| CJ | Instrument cold junction temperature |
| IN A | Probe temperature (C or F) |
| IN B | Probe millivolts |
| IN C | Not used |
| CV0 | % Oxygen |
| CV1 | Not used |
| CV2 | % Oxygen |
| CV3 | Calculated span millivolts based on probe temp and value in N1 |

### *Entering the Offset and Span Correction Values*

The offset and span correction values from the work sheet in Appendix D are entered using the following steps;

- Press the [Setup] key
- Press the [RIGHT] key until the MENU INP is displayed
- Press the [Enter] key until IN B is displayed, verify PROG is set
- Press the [Enter] key to display IBOF
- Enter the Offset number as a whole number integer, i.e. if the actual millivolt reading was 16.67 millivolts, enter 17.
- Press the [Enter] key to display IBSP
- Enter the calculated span value from the worksheet

You can initiate another span calibration cycle and verify that the oxygen reading is the same as the span gas value. Otherwise the probe has been calibrated to the span gas.

### *Automatic Lorox Probe Calibration*

There are a number of parameters that must be set to perform an automatic calibration. These parameters are set by entering the [Setpt] menu. Press the [Setpt] key and enter the following values that were obtained from the worksheet in Appendix D.

**Table 2 System Set Points and Registers**

| Process Display | Setpt Display | Action Required |
|---|---|---|
| SP1 | Loop 1 set point value | Press [Enter] for next |
| SP 2 | Loop 2 set point value | Press [Enter] for next |
| RN | Reference Number | Press [Enter] for next |
| N1 | Span Gas value i.e. 200 = 2.00% oxygen | Set value and press [Enter] for next |
| N2 | Calibration Sample Delay Time (seconds) | Set time for the zero and span delay time. Press [Enter] for next |
| N3 | Not used | Press [Enter] for next |
| N4 | Calibration Final Delay Timer (seconds) | Set time required for the process to return to normal. Press [Enter] for next |
| N5 | Manual Cal request, 0 = no request, 1 = manual request | Press [Enter] for next |
| N6 | Calibration Start Time i.e. 0800 = 8:00am or 1600 = 4:00pm. 0000 turns off auto-cal function | Set time for automatic cal to start. Press [Setpt] to exit. (Check Real Time Clock to make sure time is correct) |

When a Calibration Start Time is reached or if N5 is changed to 1, the automatic calibration function is activated. A manual request (N5) generates an immediate calibration. The Start Time in N6 is compared to the instrument's Real Time Clock. A calibration cycle starts if the time entered in N6 equals the Real Time Clock. The following chart shows examples of time entries.

**Table 3 Calibration Interval Setting**

| Desired Start Time | Number in N6 | Comments |
|---|---|---|
| 08:00 am | 800 | Enter 800 for 8:00 |
| 6:30 pm | 1830 | Enter 1830 for 6:30 |
| 12:00 pm | Not valid | 0000 turns off auto-cal function. Use 2359 or 0001 for midnight. |
| 12:00 am | 1200 | Enter 1200 for 12:00 |

## *Dualpro Calibration*

Refer to the Dualpro Operations Manual chapter on calibration for information about calibrating the Dualpro instrument analog inputs and outputs.

The Dualpro that is used in the Lorox has a standard T/C, MV, T/C configuration. Refer to the Dualpro Operations Manual Calibration sections for the thermocouple and probe millivolt inputs.

**Warning**

During Dualpro calibration, the analog output channels (4-20mA) will slew from zero (4mA) to span (20mA) levels during the zero and span settings for any of the three input channels.

# Maintenance

## *Lorox Probe*

The probe is a self-heated device that is mounted into the process flue with a flange interface. The probe is internally heated to an operating temperature of 750°C with the application 120VAC power. It is necessary to secure this power source before any service is attempted. It is important to remove power from the probe and allow the probe to cool before any component replacement is attempted.

Power can be removed from the circuit by pulling fuse 128FU.

Refer to the Lorox Sensor Manual for details on how to disassemble and reassemble the sensor.

## *Dualpro*

The Dualpro is easily serviced in the field with the ability to replace function specific cards located behind the front panel. To access these circuit boards, unscrew the panel screw at the bottom of the keyboard.

Remove the keyboard panel and turn off the toggle switch on the right hand board. Remove the keyboard panel by unplugging the ribbon cable connector.

The circuit boards are laid out from right to left as:

- Triac board
- Interface board (display / keyboard plug)
- CPU board
- Communication board
- Analog Output board
- Analog Input board

**Warning**

Do not remove the Triac board unless all power is removed from the rear panel of the instrument. See panel jumper 119JP. All other boards can be removed when the power toggle switch on the Triac board is turned off.

Contact Marathon Sensor Inc. for any questions regarding the operation of this product. Refer to the Dualpro Operations Manual for more details about each circuit board and how to configure the instrument.

## Appendix A – mV to Percent Oxygen Chart

| Probe MV | Probe Temp deg C | Process %O2 | Probe MV | Probe Temp deg C | Process %O2 |
|---|---|---|---|---|---|
| 0 | 750 | 20.95% | 41 | 750 | 3.25% |
| 1 | 750 | 20.02% | 42 | 750 | 3.10% |
| 2 | 750 | 19.13% | 43 | 750 | 2.97% |
| 3 | 750 | 18.28% | 44 | 750 | 2.83% |
| 4 | 750 | 17.47% | 45 | 750 | 2.71% |
| 5 | 750 | 16.69% | 46 | 750 | 2.59% |
| 6 | 750 | 15.95% | 47 | 750 | 2.47% |
| 7 | 750 | 15.24% | 48 | 750 | 2.36% |
| 8 | 750 | 14.56% | 49 | 750 | 2.26% |
| 9 | 750 | 13.92% | 50 | 750 | 2.16% |
| 10 | 750 | 13.30% | 51 | 750 | 2.06% |
| 11 | 750 | 12.71% | 52 | 750 | 1.97% |
| 12 | 750 | 12.14% | 53 | 750 | 1.88% |
| 13 | 750 | 11.60% | 54 | 750 | 1.80% |
| 14 | 750 | 11.09% | 55 | 750 | 1.72% |
| 15 | 750 | 10.59% | 56 | 750 | 1.64% |
| 16 | 750 | 10.12% | 57 | 750 | 1.57% |
| 17 | 750 | 9.67% | 58 | 750 | 1.50% |
| 18 | 750 | 9.24% | 59 | 750 | 1.43% |
| 19 | 750 | 8.83% | 60 | 750 | 1.37% |
| 20 | 750 | 8.44% | 61 | 750 | 1.31% |
| 21 | 750 | 8.06% | 62 | 750 | 1.25% |
| 22 | 750 | 7.71% | 63 | 750 | 1.20% |
| 23 | 750 | 7.36% | 64 | 750 | 1.14% |
| 24 | 750 | 7.04% | 65 | 750 | 1.09% |
| 25 | 750 | 6.72% | 66 | 750 | 1.04% |
| 26 | 750 | 6.43% | 67 | 750 | 1.00% |
| 27 | 750 | 6.14% | 68 | 750 | 0.95% |
| 28 | 750 | 5.87% | 69 | 750 | 0.91% |
| 29 | 750 | 5.61% | 70 | 750 | 0.87% |
| 30 | 750 | 5.36% | 71 | 750 | 0.83% |
| 31 | 750 | 5.12% | 72 | 750 | 0.79% |
| 32 | 750 | 4.89% | 73 | 750 | 0.76% |
| 33 | 750 | 4.67% | 74 | 750 | 0.72% |
| 34 | 750 | 4.47% | 75 | 750 | 0.69% |
| 35 | 750 | 4.27% | 76 | 750 | 0.66% |
| 36 | 750 | 4.08% | 77 | 750 | 0.63% |
| 37 | 750 | 3.90% | 78 | 750 | 0.60% |
| 38 | 750 | 3.72% | 79 | 750 | 0.58% |
| 39 | 750 | 3.56% | 80 | 750 | 0.55% |
| 40 | 750 | 3.40% | 81 | 750 | 0.53% |

# Appendix B – Troubleshooting

### *There is no millivolt output from the probe.*

Verify the millivolt output level from the probe by checking the display INPUT menu for IN B. This millivolt reading should agree with the measured value at the probe signal terminals. If these readings agree but are still low, check to flow meter to verify that reference air is flowing to the sensor.

Verify that power is applied to the enclosure and that the temperature of the probe is being controlled to 750°C ± 5°.

If the temperature has dropped, verify that the fuse for the probe heater (128FU) is good. If the fuse is blown, remove and measure the resistance between terminals 1281 and 1020. There should be at least 50 ohms present. If this point reads as a short or an open, it may be necessary to replace the probe heater. Refer to the Lorox Probe manual for disassembly.

### *How come the Calibration routine does not run?*

If the probe temperature set point is not set to 750°C or the probe temperature is not actually able to achieve the set point level, then the calibration routine will not run.

Make sure the set point of loop 1 is set to 750. Verify that the probe temperature (Input A) is correct and that the probe is actually heating. If the set point is correct and the Dualpro is providing power to the probe heater but the probe is not coming to temperature, then it is possible the probe heater has failed or the fuse for the probe heater is blown.

### *How come I can't set the probe temperature set point higher than 750°C?*

The Lorox program monitors the set point for the probe's internal heater to make sure it can not exceed 750°C. Normal operation or calibration is not possible if the temperature set point is lower than 750°C.

### *How Do I Know if the Background Program is Running?*

The Background program is running if the LED next to B Prog on the Dualpro front panel is lit. If this LED is not lit;

- Press the [Prog/Auto/Man] key twice.
- Press the [Enter] key once to display BPRG in the top display.
- Press the [DOWN] arrow key to change the lower display to RUN.
- Press [Enter]
- Use the arrow keys to change the number that is displayed to 0001.
- Press [Enter] again. The display will change to STEP.
- Use the arrow keys to change the number to 0001
- Press [Enter].
- The BPROG LED should now be lit.
- Press [Prog/Auto/Man] to exit

### *Can I change the calibration timers during a calibration?*

All the instrument's timers can be accessed through the [Page Disp] TMRS (Timers) menu under the [Page Disp].

There are sixteen timers available in the Dualpro. The following timers are used in this application.

**Table 4 Instrument Timer Definitions**

| Timer Name | Timer Function |
|---|---|
| T4 | CAL SAMPLE DELAY TIMER (second down counter) |
| T5 | T5 Not used |
| T6 | CAL FINAL DELAY TIMER (second down counter) |
| T7 | BASIC WATCHDOG TIMER, SET BY BASIC PROGRAM (second down counter) |
| TD | HEATER TIMER, TIME LIMIT FOR LOROX HEATER TO COME TO TEMP (minute down counter) |

To change any timer, do the following;

- Press the DISP PAGE key
- Press the [RIGHT] key until TMRS is displayed
- Press the [Enter] key until TMR X is displayed, where X is the timer number
- Press the [Shift] + [Setpt] key at the same time
- Use the arrow keys to change the time to desired number
- Press the [Page Disp] key to exit

### *How do I set the REAL TIME CLOCK?*

Press [Page Disp]
Select the VERSION page by pressing the [right] or [left] arrow keys.
Press the [down] key to display the date.
Press and hold [Shift] press [Setpt] with it to get a display that reads:

| | |
|---|---|
| MODE<br>XXAB | This allows the clock flexibility in keeping dates accurate. The formula for mode is based on the "A" place being the number of years since the last leap year. The one's place is used for a numeric value for the day of the week. The "A's" values are only 0 to 3; the "B's" values are Sunday = 1 through Saturday = 7. |
| YEAR<br>XXXX | Year can be from 1980 to 2079 |
| MNTH<br>XXXX | The month can be set to<br>0001 through 0012 |
| DAY<br>XXXX | Day is set as date value<br>0001 through 0031 |
| HOUR<br>XXXX | The hour is set in military time<br>0000 (midnight) to 23(11 P.M.) |
| MIN<br>XXXX | Minutes are set from 0 to 59. If greater accuracy is needed, set the DUALPRO to the next minute and press the [Enter] key when your external time reference seconds are equal to zero. |

# Appendix C – Dualpro Setup

## DUALPRO SETUP PARAMETERS

Firmware Version 130 or higher

DIP Switch Settings

| |
|---|
| SW1: ON – 2<br>OFF – ALL OTHERS |
| SW2: 1 2 3 4 N/A |

| CONTROL MENU | | Default | New Setting |
|---|---|---|---|
| Parameters | Description | | |
| PB 1 | Proportion Band Loop 1 | 20 | |
| RES 1 | Reset Loop 1 | 0.20 | |
| RAT 1 | Rate Loop 1 | 0.00 | |
| CYC 1 | Cycle Time Loop 1 | 30 | |
| HPO1 | High output Loop 1 | 100 | |
| LPO1 | Low output Loop 1 | 0 | |
| LDL1 | Load line Loop 1 | 0 | *** |
| CV 1 | Control Variable Loop 1 | IN A | IN A |
| CM 1 | Control Mode Loop 1 | D TP | D TP |
| PB 2 | Proportion Band Loop 2 | 20 | |
| RES 2 | Reset Loop 2 | 0.20 | |
| RAT 2 | Rate Loop 2 | 0.00 | |
| CYC 2 | Cycle Time Loop 2 | 30 | |
| HPO 2 | High output Loop 2 | 100 | |
| LPO 2 | Low output Loop 2 | 0 | |
| LDL 2 | Load line Loop 2 | 0 | *** |
| CV 2 | Control Variable Loop 2 | CV 2 | CV 2 |
| CM 2 | Control Mode Loop 2 | D TP | D TP |
| uSEV | Use Events for Control? | NO | NO |

- GRAY BLOCK INDICATES PARAMETERS AUTOMATICALLY SET BY THE LOROX APPLICATION PROGRAM
- *** INDICATES NO APPLICATION TO LOROX PROGRAM

| INPUT MENU | | Default | New Setting |
|---|---|---|---|
| Parameters | Description | | |
| IN A | Input A Input Selection | TC K | TC K |
| CJCA | Input A Cold Junction compensation? | YES | YES |
| IAOF | Input A Offset | 0000 | *** |
| IASP | Input A Span | 01.00 | *** |
| IADP | Input A Decimal Point | 0 | *** |
| USRA | Input A User Offset? | NO | NO |
| UAOF | Input A User Offset | 0000 | *** |
| UASP | Input A User Span | 1.000 | *** |
| IN B | Input B Input Selection | PROG | PROG |
| CJCB | Input B Cold Junction compensation? | NO | NO |
| IBOF | Input B Offset | 0000 | |
| IBSP | Input B Span | 1.000 | |
| IBDP | Input B Decimal Point | 0 | |
| USRB | Input B User Offset? | NO | NO |
| UBOF | Input B User Offset | 0000 | *** |
| UBSP | Input B User Span | 1.000 | *** |
| IN C | Input C Input Selection | OFF | OFF |
| CJCC | Input C Cold Junction compensation? | NO | NO |
| ICOF | Input C Offset | 0000 | *** |
| ICSP | Input C Span | 1.000 | *** |
| ICDP | Input C Decimal Point | 0 | *** |
| USRC | Input C User Offset? | NO | *** |
| UCOF | Input C User Offset | 0000 | *** |
| UCSP | Input C User Span | 1.000 | *** |
| FAC 1 | Input A Pulse Factor | 0.200 | *** |
| 10P 1 | Input A Pulse Power of 10 | -3 | *** |
| DPP 1 | Input A Pulse Decimal Place | XXXX | *** |
| UN 1 | Input A Pulse Units | 1/TI | *** |
| FAC 2 | Input B Pulse Factor | 0.200 | *** |
| 10P 2 | Input B Pulse Power of 10 | -3 | *** |
| DPP 2 | Input B Pulse Decimal Place | XXXX | *** |
| UN 2 | Input B Pulse Units | 1/TI | *** |
| FAC3 | Input C Pulse Factor | 0.200 | *** |
| 10P 3 | Input C Pulse Power of 10 | -3 | *** |
| DPP 3 | Input C Pulse Decimal Place | XXXX | *** |
| UN 3 | Input C Pulse Units | 1/TI | *** |
| TC | F or C? | °C | |

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| ANALOG OUTPUT MENU | | Default | New Setting |
|---|---|---|---|
| Parameters | Description | | |
| AO 1 | Analog 1 Function | CV 0 | |
| AO1O | Analog 1 Offset | 00.00 | |
| AO1R | Analog 1 Range | 25.00 | |
| AO 2 | Analog 2 Function | IN A | |
| AO2O | Analog 2 Offset | 0000 | |
| AO2R | Analog 2 Range | 1000 | |

| CALCULATIONS MENU | | Default | New Setting |
|---|---|---|---|
| Parameters | Description | | |
| PF 1 | Process Factor of Carbon | 0150 | *** |
| PF 2 | Process Factor of Dewpoint | 0150 | *** |
| DP C | Dewpoint Type | STD | *** |
| DP | Dewpoint F of C? | °F | *** |
| O2oF | Probe mV Offset | 0000 | *** |
| FILC | Filter Carbon Display? | NO | *** |
| CFTI | Carbon Filter Averaging Time | 000.1 | *** |
| FILD | Filter Dewpoint Display? | NO | *** |
| DFTI | Dewpoint Filter Averaging Time | 000.1 | *** |
| O2EX | Oxygen Exponent | 2 | 2 |
| O2DP | Oxygen Decimal Point | 2 | 2 |
| MET | Redox Metal Number | 0 | *** |

| ALARM MENU | | Default | New Setting |
|---|---|---|---|
| Parameters | Description | | |
| AL1M | Alarm 1 Mode | R.BN2 | |
| AL1V | Alarm 1 Value | 00.50 | |
| A1TN | Alarm 1 Turn On Delay | 0000 | |
| A1TF | Alarm 1 Turn Off Delay | 0000 | |
| AL2M | Alarm 2 Mode | D.PRG | |
| AL2V | Alarm 2 Value | 1000 | |
| A2TN | Alarm 2 Turn On Delay | 0000 | |
| A2TF | Alarm 2 Turn Off Delay | 0000 | |

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| PROGRAM MENU | | Default | New Setting |
|---|---|---|---|
| Parameters | Description | | |
| PRGP | Program Partition | 0000 | 0000 |
| FPRG | Foreground Program Type | VER3.5* | VER3.5* |
| PAHT | Program Alarm Hold Time | 0 | 0 |
| TCO | Thermocouple Offset | 0000 | 0000 |
| AUTO | Recipe Program Auto Continue? | NO | NO |
| APS | Background Prog Auto Continue? | YES | YES |
| ABS | Auto Background Prog Start? | YES | YES |
| LOCK | Lock Level | 3 | |
| H OP | H Opcode Redirection | NORM | *** |
| H CH | H Opcode Channel | 0 | *** |
| H SL | H Opcode Slave Channel | H1 | *** |

| COMMUNICATIONS MENU | | Default | New Setting |
|---|---|---|---|
| Parameters | Description | | |
| HOST | Host Parity | HE | *** |
| HOST | Host Baud Rate | 19.2K | *** |
| HPRO | Host Protocol | MMI | *** |
| HMAD | Host Modbus Address | 0000 | *** |
| V3AD | Version 3 Address | 0 | *** |
| V3CV | Version 3 Program Conversions? | YES | *** |
| SPAD | Secondary Port Address | 0 | *** |
| STBL | Secondary Port Table | 0 | *** |
| AUXM | Aux Port Mode | OFF | *** |
| AUX | Aux Parity | HE | *** |
| AUX | Aux Baud Rate | 19.2K | *** |
| TADR | Token Ring Address | 0 | *** |
| AMAD | Aux Modbus Address | 0000 | *** |
| MBTP | Master Bus Time Out Partition | 0 | *** |
| MBTO | Master Bus Time Out Value | 00.12 | *** |
| MBWP | Master Bus Write Partition | 0 | *** |
| RBIT | Local Mode Slave Indicator | NO | *** |
| BASP | Basic Port Mode | BAS | BAS |

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| DIGITAL EVENTS MENU | | Default | New Setting |
|---|---|---|---|
| Parameters | Description | | |
| EP I | Internal Event Partition | 4 | 4 |
| #XEV | # of External Event Boards | 0 | *** |
| EVBD | Events Baud Rate | 4800 | *** |
| DUAL | Dual Bus Mode? | NO | *** |
| UDCP | UDC Partition | 0 | *** |
| EPX1 | External Event Brd 1 Partition | 0 | *** |
| EPX2 | External Event Brd 2 Partition | 0 | *** |
| EPX3 | External Event Brd 3 Partition | 0 | *** |
| EPX4 | External Event Brd 4 Partition | 0 | *** |
| EMAP | Events Mapping? | NO | NO |

| ANALOG EVENTS MENU | | Default | New Setting |
|---|---|---|---|
| Parameters | Description | | |
| XAAO | External Analog Address Offset | 0 | *** |
| N/A | All other parameters are not applicable | N/A | *** |

| PROBE MENU | | Default | New Setting |
|---|---|---|---|
| Parameters | Description | | |
| PT I | Probe Test Interval | 0000 | *** |
| PIMP | Maximum Probe Impedance | 020.0 | *** |
| Ptrt | Probe Test Recover Time | 0030 | *** |
| BO T | Probe Burnoff Time | 0030 | *** |
| Bort | Probe Burnoff Recover Time | 0030 | *** |
| F dE | Final Delay | 0030 | *** |
| TA1 | Verification Time 1 Average | 0000 | *** |
| TA2 | Verification Time 2 Average | 0000 | *** |
| TD1 | Time 1 Delay | 0000 | *** |
| TD2 | Time 2 Delay | 0000 | *** |
| VGAS | Verification Gas Value | 000.0 | *** |
| VTOL | Verification Test Tolerance | 000.0 | *** |
| Inhb | Inhibit Test? | YES | YES |

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- *** INDICATES NO APPLICATION TO LOROX PROGRAM

| PF-IR ADJUST MENU | | Default | New Setting |
|---|---|---|---|
| Parameters | Description | | |
| PFIR | Process Factor IR Adjustment mode; NONE, ICCO, IRCO, IRMO, IRPF | NONE | NONE |
| MVLo | Probe millivolt Minimum Limit | 0000 | *** |
| MVHi | Probe millivolt Maximum Limit | 2000 | *** |
| TCLo | Temperature Minimum Limit | 0800 | *** |
| TCHi | Temperature Maximum Limit | 1800 | *** |
| COLo | CO Minimum Limit | 00.00 | *** |
| COHi | CO Maximum Limit | 25.00 | *** |
| CO2L | CO2 Minimum Limit | 0.000 | *** |
| CO2H | CO2 Maximum Limit | 0.800 | *** |
| CH4L | Methane Minimum Limit | 00.00 | *** |
| CH4H | Methane Maximum Limit | 05.00 | *** |
| PFLo | Process Factor Minimum Limit | 0050 | *** |
| PFHi | Process Factor Maximum Limit | 0480 | *** |
| MXAd | Maximum PF adjustment | 0005 | *** |
| TCSR | Thermocouple Source | IN A | *** |

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Appendix D – Calibration Work Sheet

| | | | |
|---|---|---|---|
| Average process value | (DATA INPUT B) | | _____(mV) |
| Zero Offset Value (Eo) | (DATA INPUT B) | | _____(mV) |
| Zero Time Delay | | | _____(sec) |
| Span Value (Es) | (DATA INPUT B) | | _____(mV) |
| Span Time Delay | | | _____(sec) |
| Final Time Delay | | (N4) | _____(sec) |
| IBSP span correction value<br>(*see below for calculation) | | | _____ |
| Greater number of Zero Delay or Span Delay | | (N2) | _____(sec) |

***Calculate equivalent span millivolt value**

Perform the following to calculate the required IBSP (Input B span in INPUT Menu). Look up the equivalent millivolt when the span gas is flowing as shown in Appendix A if the actual temperature is 750°C or calculate using equation;

$$Eq = 0.0215 * Tk * LN( 20.95/Span\% )$$

Where:

Tk = Actual Temp (°C) + 273.15
LN = Natural Log function
Span% = Span gas oxygen % value
Eq = Equivalent millivolt value

**Calculate Input B span value correction**

Use the following equation to calculate the input span value correction;

$$Ibsp = Eq / (Es + Eo)$$

Where:

Ibsp = the IBSP span correction of input B
Eq = the equivalent millivolt from the previous equation
Es = Span millivolt from work sheet
Eo = Offset millivolt from work sheet