Dualpro
Operations Manual

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MARATHON MONITORS INC

United
PROCESS CONTROLS

AFFILIATED MEMBERS

| Furnace Control Corp. | Marathon Monitors Inc. | Process-Electronic | Waukee Engineering Co. |

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This manual covers instrument revisions up to 4.130.

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Commonly Asked Questions

How do I set the measurement for carbon or dewpoint?

In the top bank of 8 switches, switch 1 ON and switch 2 OFF will store the calculated %C in CV-0 and the dewpoint in CV-1. Use Input A for the temperature used in calculating the dewpoint, Carbon, REDOX or $\%O_2$. This is usually the probe thermocouple. Input B is used for probe millivoltage. Pick the loop you want to use to control. Set the control variable. Set to CV 1 the instrument control for dewpoint. Set to CV 0 control for Carbon. Process Factors and CO compensation setting will also have an impact on your setting. See Setup and Configuration for more information.

How do I do a Probe test?

There is an automated probe test that can be programmed in the setup menu system. Press the [Setup] key and select the probe menu. Press [Enter] to move to the Probe Test Interval (PT I). This sets the time between tests. If it is set to 0 the automatic feature of the probe testing is off. Set a time, in minutes, for the probe interval if an automated sequence is wanted. Press [Shift] and [Enter] together to start a probe maintenance cycle manually.

> **WARNING**
> **If you have a Piccolo probe, burn off should be disabled. Piccolo probes should not be burned off.**

If you have a Piccolo probe and do not know if burn off is disabled, do not run a probe test. Contact MMI for programming information regarding Piccolo probes.

In a 1,2,1 configuration, how do I set up my thermocouple and my over temperature controller inputs?

You should connect the thermocouple from the oxygen probe to the input A terminals on the Dualpro. Input C is typically used for furnace temperature control or quench temperature control on the second control loop. Never share the over temperature control thermocouple with any other device. The over temperature controllers should always have an independent and isolated thermocouple.

Does it matter which temperature input I use?

The "1" shows a board specified to measure temperature from a thermocouple. Usually, you want to get a reading that will tell you something besides temperature in your furnace or generator. If the DUALPRO is to calculate % C, % O_2, dewpoint definite thermocouple connections are needed. The probe thermocouple **must** be connected to Input A. The millivolts, to input B (your 2 board). A reference thermocouple or the furnace temperature t/c is usually on Input C.

See the manual for a complete list of board numbers and applications. The other board for reading temperature is 6: a resistive temperature device (RTD) board. This board is preferable if you are measuring low temperatures because the accuracy is better in the low ranges. However, its upper working limit makes it impractical for most high temperature applications.

Why doesn't my temperature read correctly?

Check your thermocouple setting.
Refer to the setup menu under "MENU INP." The input A
(IN A) first setting is usually thermocouple (TC X). Does
the thermocouple type match the thermocouple you have
installed?

*Is the thermocouple installed with the red wire in the
negative position?*

*Is the thermocouple wire run in conduit with any other
wire?*
If it is not, is there any disruptive activity such as welding
going on near the panel?

*Is the thermocouple input coupled to another device such
as a recorder?*
Some recorders generate and offset or pulse to detect an
open thermocouple condition. It might be possible to turn
this function off at the recorder. If it is not then you will
have to isolate the controller from the recorder by using
different thermocouples or use one of the analog output
signals from the Dualpro to drive a linear input of the
recorder for an equivalent temperature signal.

As a last resort, disconnect any input sensor and drive
the input channel with a know good calibration source. If
the input does not match the input display, then the
instrument must be run through a calibration process.

Depending upon your application there may be other
factors. Tables of data are involved in some cases in
others there are setup parameters besides the input that
have an impact on the temperature reading. See setup
and Configuration for more information.

**Is there a simple way to calibrate the instrument?
How do I reconfigure it?**

There is a step by step method of Setup and
Configuration built into the DUALPRO. When you set
your instrument up the first time be sure to record all
the parameter settings for each instrument in an
installation on the SETUP SHEET at back of the
manual. Make copies if there are more than four
instruments in a setting. Keep these SETUP SHEETS
in a safe place where you can find them to recalibrate
or reset an instrument if necessary. See Setup and
Configuration for details.

If after you review the manual section on setups you still
have problems please call Marathon Monitors for help. To
get an instrument calibrated outside your installation you
may return it to Marathon for calibration service. This
requires calling, scheduling the return, shipping and being
without your DUALPRO for at least one week. You could
also schedule a paid service call.

How do I set the clock?

Check the operator's quick reference to confirm how
to change a value with the arrow keys.

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   This allows the clock flexibility in keeping dates
x x A B   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

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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 can be from 1980 to 2079

YEAR
XXXX

The month can be set to
MNTH   0001 through 0012
XXXX

Day is set as date value
DAY   0001 through 0031
XXXX

The hour is set in military time
HOUR   0000 (midnight) to 23(11 P.M.)
XXXX

Minutes are set from 0 to 59. If greater
MIN   accuracy is needed, set the DUALPRO to the
XXXX   next minute and press the [Enter] key when
        your external time reference seconds are equal
        to zero.

DESCRIPTION

The MMI DUALPRO Controller/Programmer
represents the state of the art in microprocessor-based
process control technology. By combining the flexibility
of Proportional, Integral, Derivative (PID) control with
the features common in programmable controllers, the
DUALPRO can tackle even the most complex
systems.

The following features have been included to allow use
of the instrument in many applications:

CONTROL
   Is fully site-configurable for single or dual loop
   control with a variety of simple or complex control
   variables.

PROGRAMMING
   Offers a selectable option that allows programs to be
   entered and edited in the MMI industry standard
   Recipe language programmer or the Logic language
   programmer. This gives the ability to let the
   operators work with an easy to use procedural
   program language.

   A powerful process/logic programmer that can store
   up to two-hundred (200) Recipe language programs,
   consisting of nineteen (19) steps, each, and 200
   Logic language programs consisting of twenty-four
   (24) steps, each. It allows multiple tasks, foreground
   and background tasks, subroutine calls,
   test-and-branch capability, and full access to all
   instrument parameters.

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Onboard, MMIBASIC Interpreter can reach all instrument parameters in a high-level language format separate from the process/logic programmer.

ANALOG INPUTS

The DUALPRO allows for three analog inputs that can be configured for various input types based on the type of "daughter boards" located on the analog input board. The standard connection, at TB D, will have the first input as a thermocouple on TB D positions 1 and 2. The second input is usually the probe millivolt input at TB D positions 4 and 5. The last input is usually another thermocouple input at TB D positions 7 and 8.

Up to three (3) fully isolated analog inputs, each separately configurable for thermocouple, RTD, voltage, or current. The total number of inputs can be expanded to 67 inputs with external analog boards.

ANALOG OUTPUTS

Two (2) fully isolated analog output contacts, each separately configurable for voltage or current output. Internal outputs can be adjusted to 0 to 5 V dc or 0 to 22 mA. The standard setting for both channels is 4 to 20 mA outputs. The change from V dc to mA is made through a DIP switch setting on the analog output board. Calibration adjustments are made via on-board potentiometers.

Additional external analog outputs can be added with an external analog board.

ALARM OUTPUTS

Two (2) configurable alarm contacts, programmable as process, deviation, program, or fault alarms.

CONTROL OUTPUTS

Two (2) configurable control output triacs allowing dual control on both loops.

DISCRETE INPUTS and OUTPUTS

Four (4) programmer events. These events can be partitioned as discrete inputs or outputs. Outputs are always grouped as the lower set, inputs as the upper set. The number of discrete events can be expanded to 68 I/O with external event boards.

COMMUNICATIONS

Four communication ports are at TB C. They use RS-422 / RS485 full or half duplex protocol for all ports. Typically, the HOST port will connect to a host computer; the AUXILIARY port to other slave instruments, the EVENTS PORT to OPTOMUX I/O devices, and the BASIC TERMINAL PORT to a remote terminal or other programmable device.

A number of protocol selections are possible including, Marathon Protocols for block transfer, slaves, master, token ring, and Modbus.

PROBE CARE

Automatic probe testing is available and can be initiated during setup by entering the time between tests. Automatic probe burnoff can be setup by entering the time between burnoffs and the time for burnoff. See the specific probe's documentation for details.

OPERATION

Once installation and setup and configuration are complete, the day to day operation needs of the DUALPRO depend upon the application. The basics are found in the Quick Reference Guide.

HOW TO RESPOND TO ALARM MESSAGES:

Note the alarm and determine what caused the alarm.

Press [Enter] once to deactivate (silence) alarm relay contact and continue program execution.

After acknowledging the alarm, one of the following actions may be appropriate:

> ➢ Abort the program by pressing the [Prog/Auto/Man] key.
> ➢ In the case of a timed-out LIMIT statement (message #93), it is normally desirable to continue the program by re-executing the offending LIMIT statement to be sure it is satisfied. This is done automatically when the [Enter] key is pressed to acknowledge the alarm. If you do not want to re-execute the LIMIT statement, press the [Setpt] key instead of the [enter] key. This will cause the LIMIT statement to be skipped and the program to continue to the next STEP.

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CHANGING THE SETPOINT AND THE REFERENCE NUMBER

[Setpt] is used to enter the setpoints for Loop 1, Loop 2, the Reference Number, and the Operator Inputs. The first press of [Setpt] will allow the arrow keys to adjust the value of the setpoint for Loop 1; pressing [Enter] allows the setpoint of Loop 2 to be changed. Pressing [Enter] again allows the Reference Number to be changed. Pressing [Shift] at any time allows the operator to "back up"to the to the step before [Enter] was pressed. Each additional press of [Enter] allows operator Inputs 1 - 15 to be changed. The next press of [Enter] will cycle back to the setpoint for Loop 1. Anytime during the setting of values [Setpt] may be pressed to save the value and exit.

All the parameters in this group have a lock level of 3.

SETPOINT PARAMETERS

Table 1 Setpoint Parameters

Parameters	Description
SP 1 SETPOINT 1	The set line represents the basic parameter for Loop 1 that the process needs for control.
SP 2 SETPOINT 2	The Set line represents the basic parameter for Loop 2 that the process needs for control.

REF Reference Number	Assigns a number to a program for future reference, different applications include 1. Part number. 2. Loop control for the Programmer.
Nn OPERATOR INPUT (n = 1-15)	Allows the operator to enter information that may be needed by a program. These inputs may be used similar to the reference number.

PROG/AUTO/MAN

Loop operation modes and the control of both the foreground and background programs are selected by the [Prog/Auto/Man] key. The first selection, after pressing [Prog/Auto/Man], allows for control of the foreground program to be entered. The key presses that follow it depend upon the state of the program. If a program is running in both the foreground and background, a press of [Enter] allows for control of the background program to be selected.

Another press of [Enter] allows for the operation mode (auto or manual) of loop 1 to be selected, and another press allows for the operation mode of loop 2 to be selected.

Any further presses of [Enter] will cycle back through these selections. If a program is not running see Running A Program below.   Anytime during the selection process [Prog/Auto/Man] may be pressed to exit the selection process. All of the parameters under this key have a Lock Level of 3.   The background program is the exception with a Lock Level of 2.

MANUAL MODE

In Manual mode the process variable is displayed in the PROCESS display, the SET display shows the appropriate control value, and no control action is computed. The arrow keys can also be used to activate the control output.

Either the percent ON time (time-proportion) or valve position (position proportion) is displayed in the SET window. For single control mode operation this number is always positive (0/50/100). The [Up Arrow] and the [Down Arrow] keys increase or decrease the percent ON time or the valve position toward its fully opened or closed positions by approximately 1%. This continues for as long as the key is pressed. The [Right Arrow] and [Left Arrow] keys force the CONTROL OUTPUTs to increase or decrease the percent output by approximately 10%.

AUTOMATIC MODE

 In Automatic Mode the process variable is displayed in the PROCESS display, the SETPOINT is displayed in the SET display, and control action is computed based upon the PID parameters and the input(s). Pressing and holding the [Left Arrow] key will cause the SET display to show the control action as described previously in "Manual Mode."

RUNNING A PROGRAM

To run a program,
> ➤ Press [Prog/Auto/Man].

Foreground program:

> ➤ If FPRG STOP is displayed.
> ➤ Use the arrow keys to select RUN.
> ➤ Press [Enter]
> ➤ Enter the program number to be run.
> ➤ Press:
>> ➤ [Shift], to start the program at step 1, or
>> ➤ [Enter], to pick the step number to start after entering the starting step number, press [Enter]

> ➤ If FPROG RUN
> ➤ Press [prog/auto/man] for FPRG CONT
> ➤ Use the arrow keys to set program number.
> ➤ Press either
>> ➤ [Shift] to start at step one or
>> ➤ [Enter] to pick the starting step, then press [Enter] again.

Background program:

> ➤ If FPRG STOP
> ➤ Press [Enter] to get BPRG STOP
> ➤ Use the arrow keys to pick RUN
> ➤ Press [Enter] to get BPRG
> ➤ Use the arrow keys to pick the program number
> ➤ Press either
>> ➤ [Shift] to start at step 1 or
>> ➤ [Enter] to pick the step number; press

[enter] again.

> If FPRG RUN
> Press [Prog/Auto/Man] to get FPRG CONT.
> Press [Enter] to get BPRG STOP.
> Use arrow keys to pick RUN.
> Press [Enter].
> Use the arrow keys to pick the step number.
> Press either
> > [Shift] to start at step 1 or
> > [Enter] to pick the step, use arrow keys to pick; press [Enter] again.

STOPPING A PROGRAM

To stop a program,

> Press [Prog/Auto/Man.
> Select FPRG to stop a foreground program or BPRG to stop a background program.
> Use the arrow keys to select STOP.
> Press [Prog/Auto/Man] to exit the selections.

NOTE
This is different from HOLDing or pausing a program.

PLACING A PROGRAM IN HOLD

To hold or pause a program,
> Press [Prog/Auto/Man.
> Select FPRG to hold a foreground program or BPRG to hold a background program.
> Use the arrow keys to select HOLD.
> Press [Prog/Auto/Man] to exit the selections

NOTE

This is different from stopping a program. Placing a program in hold stops the program execution at the program line that was executing. The B Prog or F Prog LED will flash, indicating which program is in hold. The program can be continued by selecting the CONT option and pressing [Enter].

RESTARTING A PROGRAM FROM HOLD

To restart a program after holding or pausing,
- ➢ Press [Prog/Auto/Man].
- ➢ Select FPRG to continue a foreground program or BPRG to continue a background program.
- ➢ Use the arrow keys to change the selection from HOLD to CONT.
- ➢ Press [Prog/Auto/Man] to exit the selections.

NOTE

If the selection displays CONT, then a program is currently running. A press of either [Enter] or [Shift] will continue to the next or previous selection without interrupting the running program.

PROBE CARE

Probe Care is a combination of several functions that can be performed on the oxygen sensor connected to the Dualpro. These functions make determine the viability of the probe as a sensing device and perform burn off maintenance cycles.

Probe life can be estimated by tracking the impedance of the probe over its operation life. A new probe will have an impedance of around 1 Kohm. This impedance will increase over time based on how quickly the sensor electrodes are affected by the reducing atmosphere in the furnace. As a probes impedance approaches 20 Kohms it may be time to consider a replacement. These is why the standard default test impedance value is typically set to 20. From this point the probe will degrade more rapidly. The probe should be replaced if it reaches 50 Kohms before failing.

This probe impedance cannot be measured with an Ohm meter. It is determined by calculating the internal source impedance of the probe by shunting the output with a know resistance. See the detail explanation in the Probe Impedance section below.

The impedance test also measures the recovery time of the probe signal level once the shunt resistor is removed. This is another quality measurement. A healthy probe should recover to full signal output in less than 45 seconds. This is an additional limit that can be set to monitor and alarm if the recovery time exceeds a normal recovery time.

If Probe Care is enabled in the Probe Care menu the Dualpro will run and record the probe impedance, burn off parameters and recovery times.

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The Bank 1 dip switches on the Interface board must have a process selection enabled for these functions work.   See the Setup and Configuration Section for an explanation of these switch settings.

To manually start a probe maintenance program

> Press [Shift] +[Enter]

CAUTION

IF PROBE CARE IS **INHIBITED** DO NOT ENABLE IT UNLESS YOU ARE SURE THE PROBE HAS BURNOFF CAPABILITY! SOME PROBES SUCH AS THE PICOLLO PROBE CAN BE DAMAGED BY BURNOFF PROCEDURES.   CHECK WITH SUPERVISORY PERSONNEL OR MARATHON PERSONNEL BEFORE STARTING A DISABLED PROGRAM.

Probe Impedance Test

The probe impedance test is performed only if dip switch bank 1 has enabled a process function. The probe impedance test is performed by measuring the open circuit voltage of the probe, then applying a known shunt resistor across the probe signal and measuring the shunted value. The value of the shunt resistor is 10kohm for carbon or dewpoint calculations or 10 ohm for the oxygen calculation. The impedance is calculated as:

$$Rx = (Eo/Es-1)*Rs$$

Where Rx = probe impedance, Eo = open circuit voltage, Es = shunted voltage, and Rs = shunt resistor.

Since the voltage units drop out, the voltage could be in volts, millivolts, or A/D counts. The units of Rx are the same as Rs; therefore, the calculation is the same for Rs = 10 kohm or Rs = 10 ohm.

The following table outlines the steps taken by the instrument during an impedance test.

Table 2 Probe Impedance Sequence

Sequence #	Description
1	Inhibit process variable calculations.
	Freeze alarms at last state except clear any previous probe test failure alarm.
	Store present probe millivolt reading
	Apply shunt resistor across probe
2	Wait for impedance test timer, fixed time of 30 seconds
3	Compute impedance of probe and remove shunt resistor.
	If impedance is greater than maximum allowed then set probe test failure alarm.
4	Wait for probe to recover to >=99% of original millivolts.
	Maximum wait time for recovery is set by operator.
	If recovery time is greater than maximum time then set probe test failure alarm.
	Store recovery time (or max value)
5	If burn off is to be performed then go to step 1 of burn off sequence, otherwise wait 30 seconds.
6	Resume normal operation of all instrument functions.

Probe Burn Off

A probe burn off cycle consists of pumping a high flow of reference air into the probe to cause the accumulated carbon to ignite and 'burn off' the end of a carbon probe. This is not a feature of an oxygen probe.

Table 3 Probe Burn Off Sequence

Sequence #	Description
1	Inhibit process variable calculations.
	Freeze alarms at last state.
	Turn on the output contact to start probe burn-off.
2	Wait for probe burn-off timer, value set by operator.
	Store probe temperature and millivolts at end of burn-off time.
3	Turn off output contact to end burn-off
4	Wait for probe to recover to >=99% of original millivolts
	Maximum wait time for recovery is set by operator.
	Store recovery time (or max value).
5	Wait 30 seconds (final delay)
6	Resume normal operation of all instrument functions.

TO CHANGE THE LOOP DISPLAYED

➢ Press [Shift]

TO PLACE A LOOP IN HOLD

➢ Press [Shift]+[Right Arrow]

➢ Press [Page Disp] to return to scan or to shift between scan and hold.

CHANGING PARAMETERS

All of the DUALPRO parameters, program numbers, OPCODES, and data values can be altered using the following procedure:

➢ Press [setup]. The word MENU will appear in the PROCESS window. The Parameter group will appear in the SET window. Use the [right] arrow key or the [left] arrow key to select the desired parameter group. Press [Enter]. The symbol for the parameter is displayed in the PROCESS window while the current alterable data is shown in the SET window. The flashing character is the one that can be altered.

➢ Use the [Left Arrow] or [Right Arrow] keys to select the character to be altered.

➢ Once the character to be changed is flashing, use the [Up Arrow] or [Down Arrow] keys to select the desired number or symbol.

➢ After all characters are as wanted, press the [Setup] key to place the value in memory and exit,

or

press [Enter] to save the value and continue (forward) editing other parameters,

or

[Shift] to save the value and continue (back) editing other parameters.

NOTE

If an entered number value is not within the acceptable data range, the maximum/minimum value will flash in the SET display. Repeat the above procedure until an acceptable value has been entered.

VIEWING A PROGRAM WHILE IT IS RUNNING

To view any part of the program while its running press [Page Disp.] this will open the Status Display Page. To navigate the indexing of the Status Display, think of the items that show up in the Process and Set displays of the instrument as paragraphs of various pages. As a page is reached, the first paragraph identifies the page.

- To travel through a page the [up arrow] or [down arrow] keys will move the display from paragraph to paragraph.
- To "turn pages" the [left arrow] or [right arrow] keys will move the display from page to page.

The last paragraph viewed on a page is stored in memory. When returning to a page to see the last viewed paragraph press the [Setpt] key. To stop viewing any time press the [Page Disp] key. This will return the display to operating mode. The following items are intended to provide a complete definition and layout of the status display.

Status Display Operations

The Status Display consists of eleven (11) pages containing between three (3) and 255 paragraphs each. Pages with repetitive or sequential paragraphs are generally shown as having the beginning and ending paragraphs separated by three dots (indicative of missing paragraphs). The eleven pages will be defined as shown below:

PAGE	TITLE	DESCRIPTION
0	4.0 d	Displays the Version number of the installed unit and the current date and time.
1	BAS	Displays the line being executed and the two user- created messages
2	PROG	Displays the STEP/PROGRAM of the current, calling, and background programs; the executing OPCODE and any alarms that are present.
3	EVNT	Contains "tick mark" indicators of the Digital Events Setpoint, Actual States, and OPTOMUX Port communication status.

4	DATA	Contains the process variables including thermocouple, cold junction, and calculated values.
5	EXT ALOG	Displays the data of the external Analog channels 0 through 15, and the Analog Communications Status.
6	SET UP	Displays the values for the Setpoints, the Process Factors, and the Reference Number, and the operator inputs.
7	CONT	Displays various control parameters such as: Proportional Band, Reset, Rate, Cycle Time, Process Factor, and Percent Output.
8	SLAVE INST	Displays the slave instrument's setpoint and actual data for instrument 1 through 8 and communications status of each instrument..
9	TMRS	Displays current displacement of timers 0 through F (15 in decimal).

10	00=0	Displays the parameters and their present values (in hex).
11	PROB CARE	Displays the data associated with the last probe maintenance cycle.

NOTES to the following Status Display table

EVNT DISPLAY
? = 0 through 4: This is a repetitive screen sequence of SP (setpoint) and ACT (actual) followed by PAR (parameter) each being a number 0 through 4.

It is possible to manual turn on or off individual events by selecting the set point (SP ?) display where ? is the event board to change. SP 0 indicates the instrument's internal events. SP 1 through SP 4 indicates external OPTO event boards. To turn an event on/off while SP ? is shown, press the [Shift] + [Setpt] keys at the same time.   The display will change to ESP? 0oF. Press the [Right] or [Left] keys to turn the event on/off. Press the [Up] or [Down] keys to select another event. Only events 0 through 3 are valid for the internal events (SP 0).

EXT ALOG DISPLAY
? = 0 through 15 EA (external analog) events 0 - 15 are displayed here.

SETUP DISPLAY
? = 1 THROUGH 15: This is a repetitive screen showing the 16 "N" numbers or program registers that can be used at operator inputs to control instrument programs.

CONTROL DISPLAY
? = 1 OR 2. The control menu cycles through the shown

set of screens to indicate either Loop 1 or Loop 2 control parameters.

SLAVE DISPLAY
? = Slave instrument number. Slave instrument screens cycle through as a set from 1 to 8. SSP (slave setpoint), SAC (slave actual), and SPO (slave percent out) are the first set of screens.

TIMERS DISPLAY
? = Timer number
Timers are numbered in hex from 1 through F (15) and the screens repeat accordingly.

GENERIC DISPLAY

The instrument's parameter tables are shown in this display. This page should be avoided by operators. The upper display XX = Y indicates the parameter number and table where XX is the parameter number in hexadecimal and Y is the table. The instrument has 31 tables number 0 through V. It is possible to advance through these tables by pressing the [Setup] key. Each table has 256 parameters number from 00 to FF. It is possible to advance through these parameters ten at a time by pressing the [Enter] key. Pressing the [Up] or [Down] keys allows you to move up or down through the table parameters.

Status Display chart

4.0 d r138	BAS INT	PROG	EVNT	DATA	EXT ALOG
2002 0324	Line 0000	R 0 F000	SP ? ''''	CJ 93.00	EA ? 000
1000 54		G 0 F000	ACT ? ''''	IN A 3500	ST ? B 10
		- 0000	PAR? ''''	IN B 2504	
		R 0 B000	ST ? G 00	IN C 2410	
		G 0 B000	LSP?	CV 0 2.550	
		---- ----	LAC?	CV 1 -100	
		PAL	EMAP OFF	CV 2 .000	
		RT .00		CV 3 .000	
		MT .00			

Status Display cont.

SET UP	CONT	SLVE INST	TMRS	00=0 C03C	PROB CARE
SP 1 1000.	PO ? 0.0	SSP? .000	TMR? 9999		DATE 11.23
SP 2 2000.	PB ? 20.0	SAC? .000			TIME 6.00
REF 100.0	RES? .200	SPO? .000			IMP 2.5
N? 1.000	RAT? .000	ST ? B 25			I RT .000
PF 1 150.0	CYC? 10.00	DPST '			BOMV 1130
PF 2 150.0	LPO? .000				BOTC 1672
	HPO? 100.0				BORT .000
	LDL? .000				VGAS .0
	SW 250.4				VTOL ,0
					VRES .0

Table of abbreviations :

abbreviation	definition
ac	Alternating current
ao	analog output location also called analog outputs
C	centigrade
CV	calculated value or control variable *
dc	direct current
Dim	dimensioning statement
F	Fahrenheit
Hz	Hertz
I/O	input <u>or</u> output
mA	milliampere(s) also called milliamps
mV dc	millivolt direct current
PF	Process Factor
Rev	Revision
RTD	Resistive Temperature Device
SCSP	Supervisory Computer Software system

abbreviation	definition
TB	Terminal Block
T/C	Thermocouple
V	volts
V ac	Volts alternating current
V dc	Volts direct current
v	version
#	number
"	inches

* This is situation dependant. CV is used in display space
to indicate a value to be entered in a program slot.

INSTALLATION

The DUALPRO instrument is designed for .125" thick panel mounting in a quarter DIN standard opening of 5.43" square (adapter panels available by special order). Required rear clearance is 10.5" to allow for wiring.

As with all solid state equipment, the controller should be away from excessive heat, humidity, and vibration. Since the unit uses red LED display devices, it should also be so that direct sunlight will not interfere with the display's visibility. The instrument requires 100/120/200/240 V ac (jumper selectable on power interconnect board inside the REAR PANEL) 50/60 Hz and should not be on the same circuit with other electrical noise producing equipment such as induction machines, large electrical motors, etc. All instrument wiring must be run separate from all control wiring. Noise suppression must be employed. Commercial noise suppression equipment is available. MMI can provide recommended parts or numbers for transient noise suppression from solenoid valves or similar equipment.

PANEL MOUNTING/REMOVAL

Because the instrument uses a ventilated enclosure, it is not dust tight. It should always be mounted in a sealed control panel.

To mount the instrument in a control panel, cut a 5.43" square hole in the necessary location on the panel. The following procedure should be followed to mount the DUALPRO in the panel.

  1. INSERT the unit into 5.43" square cut out in the panel.
  2. While supporting the unit, insert one, slotted, clamping bracket into the small rectangular cutout on the side of the unit.

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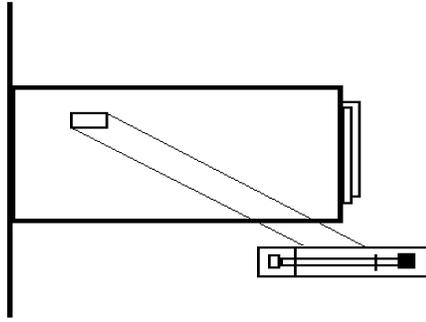
3. Repeat step 2 for the opposite side of the unit.
4. With a 7/16" socket or wrench, alternately tighten bolts on either side of the instrument until the springs are compressed halfway to ensure rigidity of mounting.
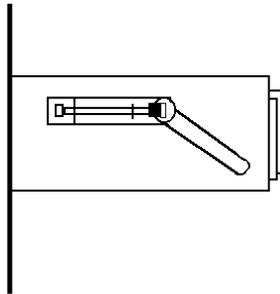
CAUTION

To prevent damage or warping of the unit's case, **do not** over tighten the clamp bolts.

To remove the unit, loosen the side clamping brackets and reverse steps 1 through 3 above.

On subsequent removals and installations the rear panel can be removed (4 screws) and the wiring does not have to be disturbed.

WARNING

ALL CONNECTIONS, REAR PANEL INSTALLATIONS AND REMOVALS; AS WELL AS TRIAC BOARD INSTALLATIONS AND REMOVALS MUST BE DONE WITH POWER REMOVED FROM TERMINAL BLOCK A (TBA) AND TERMINAL BLOCK B (TBB). ALL OTHER (PC) BOARDS SHOULD ONLY BE REMOVED OR INSTALLED WHEN INSTRUMENT POWER IS TURNED OFF VIA THE TOGGLE SWITCH ON THE TRIAC BOARD. OTHERWISE, SERIOUS PERSONAL AND/OR EQUIPMENT DAMAGE CAN OCCUR.

THERMOCOUPLES AND OTHER SIGNAL WIRES

The wiring used to connect the signal wires to the instrument should be run in conduit, separate from any AC lines in the area. This provides noise immunity and physical protection. Thermocouples should be wired with the appropriate alloy extension wire with no termination other than at the instrument. As with all cold junction compensating instruments, EXTREME CARE should be used when an existing thermocouple is to be used for both the Controller and another instrument at the same time.

CHART RECORDERS

If a chart recorder is to be used, it must have input specifications within 0 to 5 V dc, and 4 to 20 mA. The ideal location of the recorder is adjacent to the instrument but it may be located remotely if the connecting wires are properly shielded. Long wiring runs from the chart recorder outputs may require resistive termination (2 K ohms or so) at the remote end to decrease the effects of electrical noise. For best results, the chart recorder input(s) should be isolated from ground. Another possible configuration is to calibrate the Analog output to 0-20 mA and use a terminating resistor to get the required voltage at the chart recorder. This setup will help reduce noise at the chart recorder.

ALARMS

Two user programmable alarm contacts are available for connection at the DUALPRO rear panel. The system design for alarm usage will determine the alarm wiring and configuration.

Electrical connections

TB A		TB B		TB C		TB D	
1	LINE	1	NEUTRAL	1	RX +	1	INPUT # 1+
2	LINE	2	NEUTRAL	2	RTX -	2	INPUT # 1 -
3	GROUND	3	GROUND	3	TX +	3	INPUT # 1 V
4	EVENT POWER	4	EVENT NEUTRAL	4	TX -	4	INPUT # 2 +
5	EVENT # 0	5	EVENT # 1	5	RTX +	5	INPUT #2 -
6	EVENT # 2	6	EVENT # 3	6	RTX -	6	INPUT # 2 V
7	CONTROL # 1 - COM	7	CONTROL # 1 N.O.	7	TX +	7	INPUT #3 +
8	CONTROL # 2 -COM	8	CONTROL # 2 N.O.	8	TX -	8	INPUT # 3 -
9	ALARM # 1-COM	9	ALARM # 1 N.O.	9	RTX +	9	INPUT # 3 V
10	ALARM # 2 - COM	10	ALARM # 2 N.O.	10	RTX -	10	
				11	TX+	11	
				12	TX -	12	
				13	RTX +	13	ANALOG +
				14	RTX -	14	OUT # 1
				15	TX +	15	ANALOG +
				16	TX +	16	OUT # 2
				17		17	CAL EN +
				18		18	CAL EN -

Connections to the unit are made via four terminal blocks, located on the REAR PANEL, labeled TBA, TBB, TBC, and TBD. Positions are numbered from top to bottom. AC power, event, control, and alarm connections are made on TBA and TBB. All communications are located on TBC and all analog I/O signals are located on TBD. Refer to your installation drawings for a complete layout of the electrical connections.

AC POWER

The DUALPRO requires 100/120/200/240 V ac at ¼ AMP. Be sure the jumpers on the power connection are correct for the voltage supplied.

CONTROL CONTACTS

Eight control contacts are located on TBA and TBB. Be certain to isolate the instrument with a relay (MMI part

number F921702).

COMMUNICATIONS

Four communication busses are located at TBC and use RS-422 full or half duplex protocol for all ports. Typically, the HOST port will connect to a host computer; the AUXILIARY BUSS to other instruments (including those in the PRO series); the EVENTS PORT to OPTOMUX I/O devices; and the BASIC TERMINAL PORT to a remote terminal or other programmable devices

ANALOG INPUTS

The DUALPRO allows for three analog inputs with their individual functions determined by "daughter boards" located on the analog input board inside the unit. The standard connection, located at TBD, will have the first input as a thermocouple. The other two inputs are used optionally to input voltage or milliamp signals with resistor .

ANALOG OUTPUTS

Two separate and isolated analog outputs are provided on TBD and can be adjusted to any upper and lower limit within the ranges given: 0 to 5 Vdc or 0 to 20 mA to include the standard settings of 4 to 20 mA or 0 to 5 Vdc output. The change from V dc to mA is made through a DIP switch setting on the analog output board. Adjustments are made via on board potentiometers. See Maintenance and Troubleshooting for details of settings.

OUTPUT CONTACT

To allow for full dual loop control, with two control contacts available for each loop, an "as needed" scheme is used. This calls for event contacts 2 and 3 to be attached as third and fourth control contacts when the setup requires it. If they are not needed they remain as events. See THEORY

of OPERATION for complete definitions of the control
modes indicated below.

LOOP 1 CONTROL MODE					
LOOP 2 CONTROL MODE	Control Function	TP/OF	TC/OC	TD/OD	MS/PP
TP/OF	Lp 1 fwd Lp 1 rev Lp 2 fwd Lp 2 rev	Ctrl 1 - - - - Ctrl 2 - - - -	Ctrl 1 Evt 3 Ctrl 2 - - - -	Ctrl 1 Ctrl 2 Evt 3 - - - -	Ctrl 1 Ctrl 2 Evt 3 - - - -
TC/OC	Lp 1 fwd Lp 1 rev Lp 2 fwd Lp 2 rev	CTRL 1 - - - - - Ctrl 2 Evt 3	Ctrl 1 Evt 3 Ctrl 2 Evt 2	Ctrl 1 Ctrl 2 Evt 3 Evt 2	Ctrl 1 Ctrl 2 Evt 3 Evt 2
TD/OD	Lp 1 fwd Lp 1 rev Lp 2 fwd Lp 2 rev	Ctrl 1 - - - - - Ctrl 2 Evt 3	Ctrl 1 Evt 3 Ctrl 2 - - - -	Ctrl 1 Ctrl 2 Evt 3 Evt 2	Ctrl 1 Ctrl 2 Evt 3 Evt 2
MM (note 1)	Lp 1 fwd Lp 1 rev Lp 2 fwd Lp 2 rev	Ctrl 1 - - - - - Note 2 Ctrl 2	Ctrl 1 Ctrl 2 Evt 3 note 3	Ctrl 1 Ctrl 2 - - - - - - -	Ctrl 1 Ctrl 2 - - - - - - -
PP	Lp 1 fwd Lp 1 rev Lp 2 fwd Lp 2 rev	Ctrl 1 - - - - Ctrl 2 Evt 3	Ctrl 1 Evt 3 Ctrl 2 Evt 2	Ctrl 1 Ctrl 2 Evt 3 Evt 2	Ctrl 1 Ctrl 2 Evt 3 Evt 2

NOTES:

Continued on next page

1. MM (Multi Mode) for loop 2 is dual mode (-100% to 100%) when loop 1 is in TP, OF or OC. Otherwise it is a single mode (0 to 100 %)

2. ANALOG OUTPUT 1, if set to PO2, will be zero to full scale for 0 to 100% if loop 2 is in MM and loop 1 is in TP, OF, TC or OC.

3. ANALOG OUTPUT 2 if set to PO2 will be zero to full scale for 0 to -100% if loop 2 is in MM and loop 1 is in TP, OF, TC or OC.

4. Only one analog output needs to be set to PO 2 for notes 2 and 3 to apply.

SETUP & CONFIGURATION

DIP SWITCH SETTINGS
The user has a number of options that can be specified using the Dual Inline Packaging (DIP) switches located on the INTERFACE BOARD inside the DUALPRO.

To gain access to the DIP switches, loosen the black knurled knob on the FRONT PANEL by turning in a
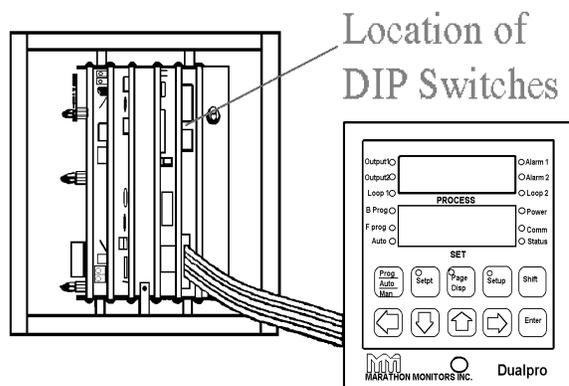
counter-clockwise direction. Carefully remove the FRONT PANEL, but DO NOT remove the ribbon cable connecting the FRONT PANEL to the INTERFACE BOARD. Safely support the FRONT PANEL near the instrument. Adjust DIP switches for the desired operating mode. When switch adjustments are complete, replace FRONT PANEL to prevent contamination.

Locate the appropriate switches as shown in the figure below. Switches pushed to the left are ON pushed to the right are OFF.
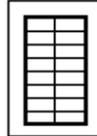
SW1

DIP Switch Bank 1

SWITCH | FUNCTION

Switch 1 & 2 select the calculation mode. If both are off then no calculation is preformed.

1   2   If sw1 is on and sw2 is off then %C is calculated and stored in cv-0 and dewpoint is calculated and stored in cv-1. If sw1 is off and sw2 is on then %O is calculated and stored in both cv-0 and cv-1. If both are on and the REDOX value is calculated and stored in cv-0

3   4   5   Slidewire deadband values assigned as follows:

5	4	3	Dead band value
OFF	OFF	OFF	0.2
OFF	OFF	ON	0.4
OFF	ON	OFF	1.0

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OFF	ON	ON	2.0
ON	OFF	OFF	3.4
ON	OFF	ON	5.2
ON	ON	OFF	7.4
ON	ON	ON	10.0

6	Not Assigned.
7	Service 1
8	Service 2

Each DUALPRO connected to a master instrument or supervisory Computer system must have a unique address for proper communications, use the table below to select the address setting for an individual instrument. The Host Address is the address that identifies the DUALPRO and makes it unique . 0 is rarely used in computer supervisory control systems for instruments. 0 is assumed to be the Master Address, a role the supervisory computer takes in a networked system.

Dualpro in a network

Find the DIP switch bank 2, with 4 switches in it, to set the host address. This bank resembles the figure below. Use the following table to set the switches for the correct address.
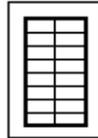
Switches pushed to the left are ON, to the right are OFF.
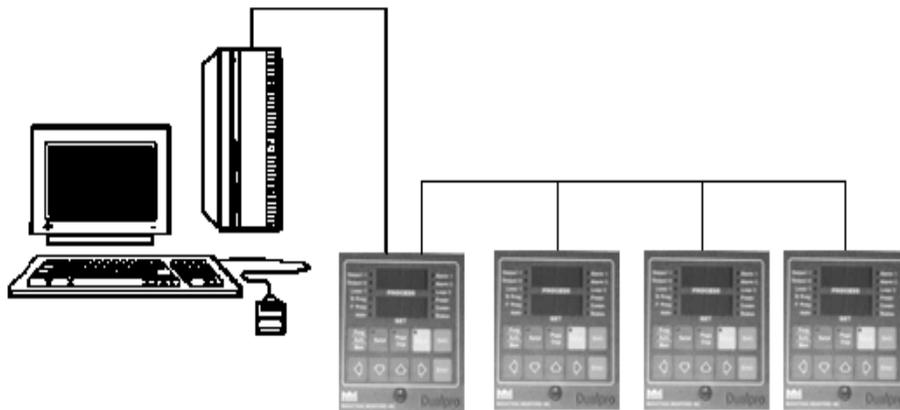
HOST address settings

DEC	HEX	1	2	3	4
0	0	OFF	OFF	OFF	OFF
1	1	ON	OFF	OFF	OFF
2	2	OFF	ON	OFF	OFF
3	3	ON	ON	OFF	OFF
4	4	OFF	OFF	ON	OFF
5	5	ON	OFF	ON	OFF
6	6	OFF	ON	ON	OFF
7	7	ON	ON	ON	OFF
8	8	OFF	OFF	OFF	ON
9	9	ON	OFF	OFF	ON
10	A	OFF	ON	OFF	ON
11	B	ON	ON	OFF	ON
12	C	OFF	OFF	ON	ON
13	D	ON	OFF	ON	ON
14	E	OFF	ON	ON	ON
15	F	ON	ON	ON	ON

ANALOG OUTPUT MODE
Analog output selector switches are located on the analog output board. The selection choices are between Voltage and current. The DIP switch pointing up is Voltage mode and pointing down is current mode.   If the instrument is switched from one mode to the other, the analog output must be recalibrated. See Maintenance and Troubleshooting for how to calibrate.

Output Type

Voltage   Current

Gain Potentiometer
Offset Potentiometer
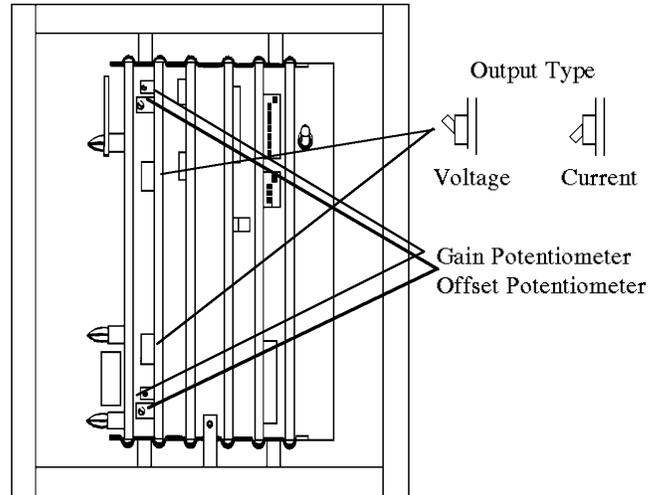
THERMOCOUPLE BURNOUT SELECTION.
The thermocouple jumper selects either a full upscale or a full down scale reaction to take place when a thermocouple fails or becomes open. The thermocouple daughter board has a default setting of full upscale reaction to take place when a thermocouple fails or opens. If full scale downwards is desired cut the solder track from the + to the C and then jumper from the - to the C.

Connector

+ C -

Standoff
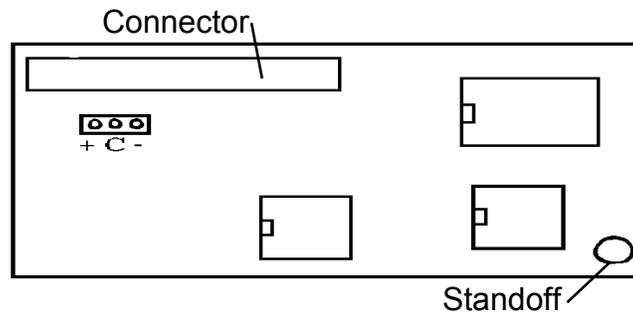
DAUGHTER BOARD TYPES
The user can specify at purchase several different daughter

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board configurations.

Options include

- 1 = thermocouple (T/C)   MMI Part # A810077
- 2 = auxiliary or O_2 Mv   MMI Part # A810076
- 3 = slidewire feedback   MMI Part # A810095
- 4 = 0 - 10 V linear   MMI Part # A810147
- 5 = 4 - 20 m A   MMI Part # A810168
- 6 = RTD *   MMI Part # A810115
- 7 = combustion O_2 probe   MMI Part # A810190
- 8 = pulse input   MMI Part # A810145

*(Resistive Temperature Device)

The standard factory setup is a 1, 2, 1.
If a daughter board is changed even with the same type,
that input must be recalibrated.

THE FRONT PANEL

The DUALPRO can be set to do specific jobs by entering information through the front panel keyboard. Information entered is stored in non-volatile memory. All the setups are entered using the [Setup] key. Some of the parameters opened by the [Setup] key require a password for entry, in order to be sure that unauthorized or accidental changes are not made. The DUALPRO is shipped from the factory without a password; so, pressing [Enter] will by-pass the password.
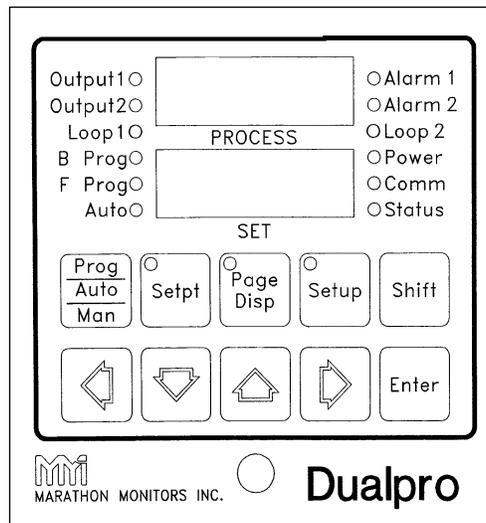
The DUALPRO front panel consists of an upper and lower segment Light Emitting Diode (LED) display, twelve LED indicators, and ten membrane keypads (keys). The upper segmented display shows the process value in normal operation and is referred to as the PROCESS window. When entering parameters, this display 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

State of the Alarm triacs; if either LED is on, then, the matching triac is ON.

Display is for Control Loop 2.

Internal 5V Power Supply is Working.

DualPro transmitting over the host RS-485/422.

User programmable. See Parameter table for details.

◌ Alarm 1
◌ Alarm 2
◌ Loop 2
◌ Power
◌ Comm
◌ Status
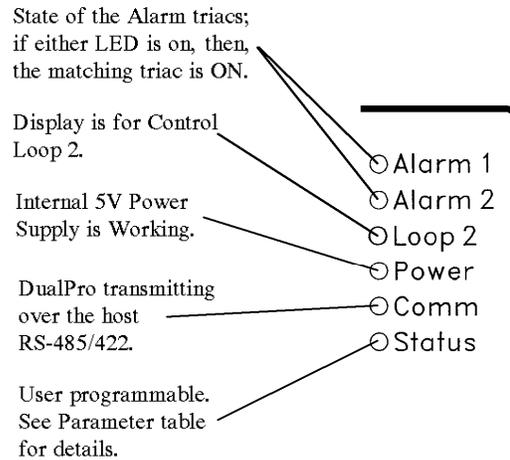
operation of the DUALPRO as follows:

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State of the control triacs.
If either of the LED's is
on then the matching
output triac is ON.

Display is for Control
Loop 1

Output1 ⊘
Output2 ⊘
Loop1 ⊘
B Prog ⊘
F Prog ⊘
Auto ⊘

If on Background
Program Running.
If flashing Background
Program in Hold.

If on Foreground Program
Running.
If flashing Foreground
Program in Hold.

If on Loop is in
Automatic.
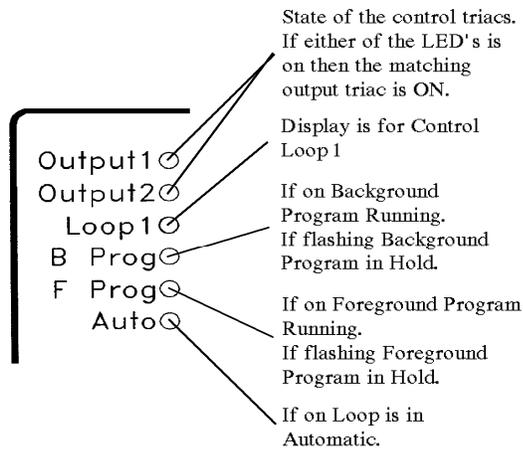
The keypad

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.

| Prog |
| Auto |
| Man |

This key displays messages concerning
the operation of the foreground program,
background program, Loop 1, and Loop
2. The foreground and background
programs may separately be stopped,
viewed, run, continued, or placed in hold.
Loop 1 and Loop 2 may be separately placed in
either manual or automatic mode.

○
Setpt

Pressing this key allows the user to
edit the setpoint (SP1, SP2), reference
number (RN), and operator-input
numbers (N1 – N15)

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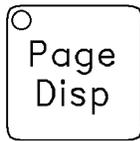
Page Disp

This key allows the status display page to be viewed, and allows a limited number of features to be edited.
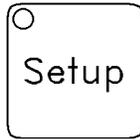
Setup

Pressing this key places the DUALPRO into parameter entry mode for all setup parameters.

Shift

Pressing this 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.

Enter
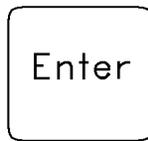
This key has no function by itself under normal operation. However, it is used to cycle through, in a forward direction, the parameters of the other keys.
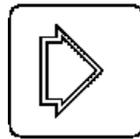
The [Right Arrow] is only used when in manual mode or parameter entry mode. Each press of the [Right Arrow] key will cause the percent output of the displayed loop to increase by approximately 10% when the loop is in Manual mode.
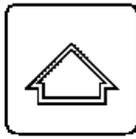
The [Up Arrow] is used to increase the edited digit in parameter entry mode and to manually adjust the percent output in the manual control mode. Each press of the [Up Arrow] key causes the percent output of the displayed loop to increase by 1%.
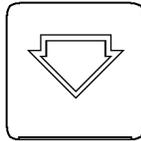
The [Down Arrow] is used to decrease the edited digit in parameter entry mode and to manually adjust the percent output in the manual control mode. Each press of the [Down Arrow] key causes the percent output of the displayed loop to decrease by 1%
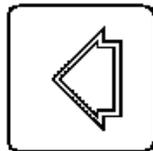
The [Left Arrow] is only used when in manual mode or parameter entry mode. Each press of the [Left Arrow] key will cause the percent output of the displayed loop to decrease by approximately 10%.

+

Shift

This 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.

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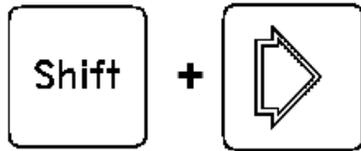
This two key combination determines how the two control loops will be displayed. Pressing [Page Disp] key in this mode allows the display to either scan between Loop 1 and Loop 2, or to display only the loop placed in hold. The loop to be placed in hold may be determined by pressing the [Shift] key.
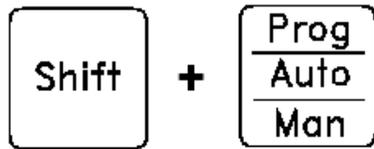
This two key combination sets up the cold junction trim.
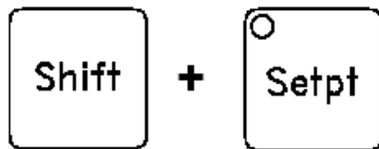
This two key combination opens the program editor option.
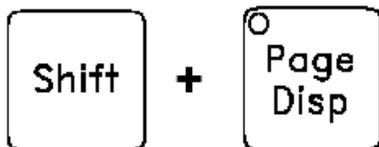
This two key combination sets up the password. Any order of keys except for [shift] or [Enter] can be used as passwords. Up to nine key presses can be used. Press [Enter] to save a newly set password. The number in the SET display will count the number of keys entered. Pressing [Enter] without pressing any other key (i.e.: SET

display = 0) will enter "no" password. Whether or not a password is needed on each parameter is determined by the lock level setting and the lock level required for each parameter. The lock level which affects each parameter will be listed at the end of each parameter description as LL-X (X=0 to 3).

Shift + Enter
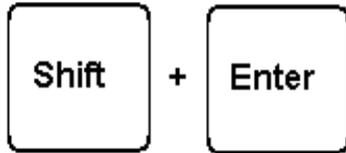
These two key combinations will start the probe maintenance routine, if it is enabled.

Shift then Enter then Setpt then ▷
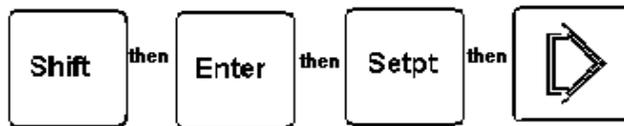
This is a four-key sequence that will set up the memory of the instrument. If the lock level is less then 3, a password will be required to execute this function.

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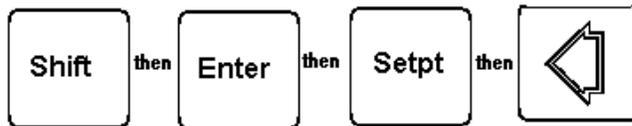
This is a four-key sequence will test the memory. If the lock level is less than 3, a password will be required to execute this function.

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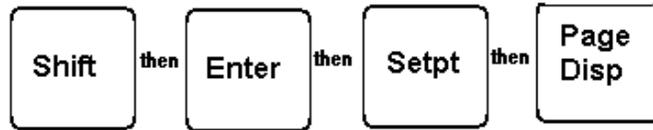
This is a four-key sequence will place the Dualpro in INPUT CALIBRATION MODE. If the lock level is less than 3, a password will be required to execute this function.

INSTRUMENT SETUP

The [Setup] key allows for setup parameter options to be changed/set. These options exist in "groups". They are displayed as "menu" choices after [Setup] is pressed. Press [Enter] to step forward in any option, or [Shift] to back up to a previous option. The arrow keys are used to change the option within its limits. Pressing [Setup] at any time will exit from this option setup sequence.
Options are saved as they are changed. To move from menu column to menu column press ◁ or ▷ when menu is displayed. To move from selection to selection in a column press [Enter] to go forward and [Shift] to go backward.

Control Parameters - Loops 1 and 2

Proportional Band

| PBn
XXXX | The proportional Band range is 0001 to 9999. If the proportional band is set at 10% and the error is 100 (10% of the total range) then the output would be 100% presuming a reset of 0 |

The n = 1 for loop 1 or 2 for loop 2. With Simple ON/OFF control Proportional Band is used to set the dead-band. Lock Level (LL)=2.

Reset 1

| RESn
XX.XX | The Reset setting is in repeats per minute. The range is 00.00-99.99 (=XXXX) resets per minute in .01 increments. The n=1 (for Loop 1) or 2 (for Loop 2). LL=2 |

Rate

| RATn
XX.XX | The Rate setting is in minutes and can range |

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from 00.00-09.99 (=XX.XX) minutes in .01 increments. The n=1 (for Loop 1) or 2 (for Loop 2). Refer to Appendix on PID control for more information on Setting up the PB, rate, and reset. LL=2.

Cycle Time

| CYCn XXXX | The cycle time is in seconds. The range is 0001 - 0250 (=XXXX). The n=1 (for Loop 1) or 2 (for Loop 2). LL=2. |

Maximum %

| HPOn XXXX | Maximum percent output loop 1 (set > LPO1) |

Minimum %

| LPOn XXXX | Minimum percent output loop 1 (set < HPO1) CAUTION: Unknown results can occur if LPO is set above HPO. |

Load Line

| LDLn XXXX | Is a manual offset to the control output (manual reset). The LOAD LINE can be set from (-100) to 0100 (=XX- XX). LOAD LINE must be set to zero when using ON/OFF |

control. The n=1 (for Loop 1) or 2 (for Loop 2). LL=2

Control Variable

| CV n XXXX | n = 1 (for Loop 1) or 2 (for Loop 2). XXXX = inputs A (IN A),B (IN B), or C (IN C) and Calc Value 0 (CV 0),1 (CV 1),2 (CV 2), 3 |

(CV 3) or Not Applied (N/A). The input type selected by this parameter determines the process variable to be controlled by the respective loop. The setpoint units and control calculation are also based on this selection. LL=1

Control Mode

| CM n
XXXX | n = 1 for (Loop 1) or 2 (for Loop 2). The control mode setting determines the type of control action that will occur when the difference between the actual process |

variable value and the setpoint that value becomes great enough to warrant corrective action by the control loop. i.e.: with temperature as the process variable and a setpoint of 1600¦. When the actual temperature drops below 1600 the control loop should respond by applying heat. The control mode setting determines what form that application will take. (i.e.: a control contact turning on, or an increase in a 0- 5 V dc signal.) The left most X (of XXXX) represents direct (D) or reverse (R), and the remaining X's =:

TP = TIME PROPORTIONING
TC = TIME PROPORTIONING WITH COMPLEMENT
TD = TIME PROPORTIONING DUAL
MS = MOTOR WITH SLIDEWIRE FEEDBACK (Loop 1 only)
OF = OFF / ON CONTROL OC = OFF/ON CONTROL WITH COMPLIMENT
OD = OFF / ON CONTROL DUAL
PP = POSITIONING PROPORTIONING
MM = MULTIMODE (loop 2 only) (See theory of operation for definitions of these terms)
LL = 1

Use Events for Control

| uSEV
XXXX | xxxx = yes or no
use events for control. This selection |

determines if event outputs 2 and 3 would be used for control based on the output contact selection chart (page 34). yes = use events, no = don't LL=1

Input Setups - Inputs A, B, and C

Input Selection

| IN n |
| XXXX |

n = A (for input A), B (for input B), or C (for input C). XXXX = LINear; thermocouple (TC): B, C, E, J, K, N, NM, R, S, or T; U1 for user defined linearization curves.

PUL – For pulse input.
OFF - Turns input off and stops update of corresponding input parameters.
PROGram - Linear inputs can be scale the displayed engineering units using the offset and span values.
RTD - For RTD connection. LL=1

Cold Junction

| CJC n |
| XXXX |

n = A (for input A), B (for input B), or C (for input C). COMPENSATION XXX = YES, to select cold junction compensation, or NO to not select cold junction compensation. LL=1

Input Offset

| InOF |
| XXXX |

n = A (for input A), B (for input B) or C (for input C). Selects the amount of offset for the programmable input function. (See Setup and Calibration for more details.) XXXX = (-999) to 0999. With farthest left digit flashing the [Up Arrow] key selects the decimal position and the [Down Arrow] key selects positive or negative. LL=2

Input Span

| InSP
XXXX | n = A (for input A), B (for input B) or C (for input C). Selects the amount of span for the programmable input function. (See Setup and Calibration for more details.) XXXX = |

(-999) to 0999. With farthest left digit flashing the [Up Arrow] key selects the decimal position and the [Down Arrow] key selects positive or negative. LL=2

Input Decimal Point

| InDP
XXXX | X = 0-3. Selects the number of decimal places displayed in programmed input display. LL=2 |

User Active

| USRn
XXXX | user offset and multiplier active where n = a, b, or c. (x= y (yes) or x= n(no)) LL=2
These selection enables (yes) or disables the user offset and user multiplier for the selected input (a, b , or c). This allows the |

input calibration to be trimmed without changing the actual calibration release.

User Offset

| UnOF XXXX | user offset where n = a, b, or c (xxxx = -500 to 500) LL= 2 |
| | If user active (yes), then this offset value is added to the linear input value |

User Multiplier

| UnSP XXXX | User Multiplier where n = a, b, or c (xxxx = 0.9000 to 1.100) LL=2 |
| | if active is yes, then this multiplier is used to scale the input value after the user offset is added. |

Pulse Factor

| FACn XXXX | Pulse Factor where n = 1, 2, or 3 (xxxx = 0.200 to 9.999) LL=2 |
| | When the input type is pulse, then the factor is a multiplier to compute the input value. |

Pulse Power

| 10Pn XXXX | Pulse Power of 10 where n = 1,2or3 (xx=-3 to 4) LL=2. |
| | When the input type is pulse, the power of ten is used with the factor to compute the input value. A power of ten value of 2 |

multiplier by 100.

Pulse Decimal Place

| DPPn XXXX | Pulse decimal place where n = 1,2,3 (xxxx include decimal location)LL=2. |
| | Determines the decimal place in the input value when pulse type is selected. |

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Pulse Units

| UN n
XXXX | Pulse Units where n = 1,2, or 3 (xxxx = time or 1/TI) LL=2 When pulse input type is selected, the units of the input value is time or per time. Time units can be seconds, minutes, or hours. Units per time can be |

revolutions per minute (RPM), feet per second, or whatever.

Thermocouple Display

| TC
XX | XX = ºF or ºC. Selects the units in which the thermocouple temperatures are displayed and stored: degrees in Fahrenheit or degrees Celsius,. LL=2 |

Analog Output Setups - Analog Outputs 1 and 2

Analog Output

AO n XXXX

n = 1 (for analog output 1) or 2 (for analog output 2). XXXX = Calculated Value 0, or 1; Percent Out 1, or 2; Programmed; or INput A, B, or C. This selection is used to determine which of the above variables the Analog Output will represent. The minimum (offset) and maximum (range) values are set for the input variable so that it can be scaled to the output based on its' minimum and maximum. i.e.: if the input is "IN A" and the analog output is set for 0-5 V dc; with the offset at "0000" and the range at "1000" (for a total of 1000¦ {0-1000}). If input A were at 500¦ the output would be 2.5 V dc. With the offset at "1000" and the range at "1000" (for a total of 1000¦ {1000-2000}). If input A was 1500 the output would be 2.5 V dc.

Program mode allows the analog output value to be assigned directly from the program. LL=1

Analog Output Offset

AOnO XXXX

n = 1 (for analog output 1) or 2 (for analog output 2). offset The analog output zero starting value can be a value from -999 to 4000. This is used to scale the process variable output range. This value is not used when either control percent output or program outputs is selected as the Analog output variable. LL=2

Analog Output Range

| AO n XXXX | n = 1 (for analog output 1) or 2 (for analog output 2). range The analog output range is set by this parameter from 0 to 4000. This value is not used when either control percent output or program output is selected as the |

Analog output variable. LL=2

Calculations Setups

Process Factor (1 or 2)

```
┌──────────┐
│  PF n    │
│  XXXX    │
└──────────┘
```

XXXX = 0000-0999. Process factors 1 and 2 are independent of the loops and are used in the calculation of percent Carbon and dewpoint. PF1 is used when percent carbon is calculated and PF2 is used when dewpoint is calculated. If Piccolo (PIC) dewpoint mode is selected, the PF1 and PF2 are both used to calculate dewpoint and percent carbon is not computed.

CO Compensation

```
┌──────────┐
│  COmP    │
│  XXXX    │
└──────────┘
```

XXX = YES OR NO. If Yes, then CV3 is interpreted as % CO from an IR analyzer. The value is used in calculating % Carbon by effectively modifying the process factor.   An input of 0-2000mV is scaled as 0-30% CO.

LL=1

Dewpoint Type

```
┌──────────┐
│  dPC     │
│  XXXX    │
└──────────┘
```

Std/PIC standard or piccolo probe based.LL=1
The piccolo option is used when a non air reference gas is used. The %C is not calculated and CV0 is not changed. PF1 is use to input the equivalent mV.

Dewpoint

| dP
XX | ° F or °C   Choice of dewpoint calculations done in Centigrade or Fahrenheit. LL=2 |

Oxygen Millivoltage Offset

| O2oF
XXXX | This offset is added to the probe millivoltage reading (input B) before it is used in calculating percent Carbon or dewpoint. LL=2 |

Filter Carbon

| FILC
XXX | % carbon filter; no = off, yes = on LL=2 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.

Carbon filter Time

| CFTI
XXX.X | % carbon filter time in minutes ; 0 to 60.0 A sliding window average of the % values is computed over the specified time. LL=2 |

Filter Dewpoint

| FILD
XX | Dewpoint filter: no = off, yes = on. 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.

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Dewpoint Filter Time

```
DFTI
XXX.X
```

Dewpoint filter time in minutes 0 to 60.0.
A sliding window average of the dewpoint
values is computed over the specified time.
LL=2

Oxygen exponent

```
O2Ex
  XX
```

Oxygen exponent (xx = 0 to 31) LL=2. 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) but most
sensors are only able to measure ppm to about 100ppm.
Lower oxygen levels are subject to other reducing forces
besides oxygen partial pressure

Oxygen Decimal Place

```
O2dP
XXXX
```

Oxygen Decimal Place (where xxxx = where
the decimal place is). LL=2. 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. The setting
effects the O2 display if oxygen is set to CV0 via the DIP
switch settings.

Redox Metal

```
┌─────────┐
│  MET    │
│         │
│   XX    │
└─────────┘
```

(xx = 0 to 29) LL=2
This value selects the metal contents for the redox calculation. The default metals loaded into the Dualpro are shown below.

REACTION	MET #	REF	A	B	C
4/3Al+O2=2/3Al2O3	0	AL	-.0026	5.214588	0
2Ca+O2=2CaO	1	Ca	-.00278	5.837392	0
2Co+O2=2CoO	2	Co	-.00104	2.008383	0
4/3Cr+O2=2/3CrO3	3	Cr	-.00168	3.405068	0
4Cu+O2=2Cu2O	4	Cu	-.00089	1.451836	0
2Fe+O2=2FeO	5	Fe	-.00075	1.787298	0
4Fe3O4+O2=6Fe2O3	6	Fe23	-.00101	1.637716	0
6FeO+O2=2Fe3O4	7	Fe34	-.00101	2.016779	0
2Mg+O2=2MgO	8	Mg	-.00316	5.887252	0
2Mn+O2=2MnO	9	Mn	-.00169	3.502102	0
2Ni+O2=2NiO	10	Ni	-.00106	1.957724	0
2Si+O2=2SiO	11	Si	-.00024	1.117118	0
2Ti+O2=2TiO	12	Ti	-.0043	10.50107	0
2V+O2=2VO	13	V	-.00279	5.24182	0
2Zn+O2=2ZnO	14	Zn	-.0128	9.626133	0

MET # is the metal selection number used in the AACC 2300, Dualpro, and Multipro.
REF is the 4-character metal selection message for the Multipro Redox Metals Page.

Alarm Setups - Alarms 1 and 2

Alarm Mode

AL1m

XXXX

The far left X = R (for Reverse operation of actuation), or D (for Direct operation). These operations work as follows:

R - REVERSE operation (opposite of NORMAL) for ALARM   actuation (i.e.: the ALARM contact is normally closed until it   reaches the trigger limit specified by the Alarm Value, then the contact opens).

D - This is DIRECT operation for ALARM actuation (i.e.: the contact is normally open until it reaches the trigger limit specified by the Alarm Value, then the contact closes).

The XXX located to the right of the decimal point indicates the variable upon which actuation is based. These variables are as follows:

PVn - PROCESS control mode. Alarm actuation is based on the PROCESS VARIABLE exceeding the limit set in the alarm values. n = 1 for Loop 1 or 2 for Loop 2.

BNn - ALARM actuation uses BAND WIDTH control above and Alarm Mode (cont.) below the loop SETPOINT. I E: If the band set by the alarm value is 100° and the SETPOINT is at 1000°, the alarm will trigger at 1100° and 900°). n = 1 for Loop 1 or 2 for loop 2.

DEn - Alarm actuation uses DEVIATION BAND control above or below the loop SETPOINT. The + and - symbols determine if the deviation is allowed above (+) the SETPOINT or below (-) it. (i.e.: If a deviation of 100° is set in the alarm values and 1000° is the SETPOINT the alarm will trigger at 1100° or 900°, for -100°). n = 1 for Loop 1 or 2 for Loop 2.

POn - Alarm actuation is based on the PERCENT OUTPUT exceeding the limit as set in the alarm values. n = 1 for Loop 1 or 2 for Loop 2.

INB - ALARM actuation is based on the analog signal at Input B input exceeding the limit set by the alarm values. Input B input is physically located at Terminal Board D-4, D-5, and D-6 on the unit's rear connectors.

INC - ALARM actuation is based on the analog signal at Input C exceeding the limit set by the alarm values. Input C is physically located at TBD-7,   TBD-8 and TBD-9 on the unit's rear connectors.

PRG - An INTERNAL program will actuate the ALARM. The alarm value setting is ignored.

FLT - An input FAULT, or an internal program is to be used as basis for the actuation. The alarm value setting is ignored.

Cvn - Alarm actuation is based upon one of the calculated values (n = 0, 1, 2, or 3) exceeding the limit set by the alarm values..

AAL - Alarm actuation is based upon an alarm set in one of the active alarm words.

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Alarm Value 1

AL1V

XXXX

-999 to 9999. Sets the alarm trip point. LL=2

Alarm Turn On Delay 1

A1TN

XXXX

0000 to 0250 seconds. Sets a delay period between alarm condition and alarm activation. LL=2

Alarm Turn Off Delay 1

A1TF

XXXX

0000 to 0250 seconds. Sets a delay period between alarm condition and alarm deactivation. LL=2

Alarm Mode

AL2M

XXXX

The far left X = R (for Reverse operation of actuation), or D (for Direct operation). These operations work as follows:

R - REVERSE operation (opposite of NORMAL) for ALARM   actuation (i.e.: the ALARM contact is normally closed until it   reaches the trigger limit specified by the Alarm Value, then the contact opens).

D - This is DIRECT operation for ALARM actuation (i.e.: the contact is normally open until it reaches the trigger limit specified by the Alarm Value, then the contact closes).

The to XXX located to the right of the decimal point indicates the variable upon which actuation is based. These variables are as follows:

PVn - PROCESS control mode. Alarm actuation is based on the PROCESS VARIABLE exceeding the limit set in the alarm values. n = 1 for Loop 1 or 2 for Loop 2.

BNn - ALARM actuation uses BAND WIDTH control above and below the loop SETPOINT. I E: If the band set by the alarm value is 100° and the SETPOINT is at 1000°, the alarm will trigger at 1100° and 900°). n = 1 for Loop 1 or 2 for loop 2.

DEn - Alarm actuation uses DEVIATION BAND control above or below the loop SETPOINT. The + and - symbols determine if the deviation is allowed above (+) the SETPOINT or below (-) it. (i.e.: If a deviation of 100° is set in the alarm values and 1000° is the SETPOINT the alarm will trigger at 1100° or 900°, for -100°). n = 1 for Loop 1 or 2 for Loop 2.

POn - Alarm actuation is based on the PERCENT OUTPUT exceeding the limit as set in the alarm values. n = 1 for Loop 1 or 2 for Loop 2.

The XXX located to the right of the decimal point indicates the variable upon which actuation is based. These variables are as follows:

INB - ALARM actuation is based on the analog signal at Input B input exceeding the limit set by the alarm values. Input B input is physically located at Terminal Board D-4, D-5, and D-6 on the unit's rear connectors.

INC - ALARM actuation is based on the analog signal at Input C exceeding the limit set by the alarm values. Input C is physically located at TBD-7,   TBD-8 and

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TBD-9 on the unit's rear connectors.

PRG - An INTERNAL program will actuate the ALARM.The alarm value setting is ignored.

FLT - An input FAULT, or an internal program is to be used as basis for the actuation. The alarm value setting is ignored.

Cvn - Alarm actuation is based upon one of the calculated values (n = 0, 1, 2, or 3) exceeding the limit set by the alarm values. LL=1

AAL - Alarm actuation is based upon an alarm set in one of the active alarm words.

Alarm Value

AL2V
XXXX
alarm value 2
-999 to 9999. Sets the alarm trip point. LL=2

Alarm Turn On Delay
A2TN
XXXX

Alarm 2 on delay
0000 - 0250 seconds. Sets a delay period between alarm condition and alarm activation. LL=2

Alarm Turn Off Delay
A2TF
XXXX
0000 to 0250 seconds. Sets a delay period between end of

alarm condition and alarm deactivation. LL=2

Program Menu

Program Partition
PRGP
XXXX

If XXX = 0 the feature is deactivated. If XXX = 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. LL=1

Foreground
FPRG
XXXX

If XXXX = VER4 then the foreground programmer uses a standard LOGIC language program. (The same as the background program.) If XXXX = v3.5 then the foreground program is a RECIPE language program. LL=1

Program Alarm Hold Time
PAHT
XXXX

Selects the "Hold Time" to latch a PAL (Program Alarm) for HOLD TIME Datalogging 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 Process Master for this instrument. This setting will have no visual effect on front panel operations. XXX = 0, 10, 30, 60, 90, 120, 180 sec. LL=1

Thermocouple Offset

TCO
XXXX

Alarm 85 function. 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. (See programming section for alarm codes and details) LL=2

Auto Continue
AUTO
XXXX

XXX = YES OR NO. Yes allows for the automatic continuation of a program that was running when the instrument lost power for a period of more than 10 seconds. No does not continue the program when power is reapplied. Note: Program will auto start regardless of selection if power loss is less than 10 seconds. LL=1

Auto Program Start
APS
XXXX

X = YES OR NO. Yes forces the background program No. 1 to start at step No. 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. LL=1

ABS
XXXX

Auto background start. Where x = yes or no. If yes the background (logic) program is started at program 1 step 1 if stopped for more than 5 seconds. LL=1.

Lock Level
LOCK
X

Requires PasSWorD entry for access. X = 0-3 where 3 is unlocked.

LOCK LEVEL DEGREE OF ACCESS
0   NO ACCESS (lowest level)
1   LIMITED ACCESS
2   SOME RESTRAINTS / RECIPE EDIT
3   FULL ACCESS (highest level)

To unlock a locked keyboard the password must be entered when requested. Requests are made on a parameter to parameter basis. Once a password is used to unlock a parameter, full access is given to any parameter (under the same function key) with a Lock Level equal to or higher than the parameter just unlocked. If a parameter with a lower Lock Level is encountered, the password must be entered for access, or pressing the [Enter] key will proceed to the next parameter. (Likewise the [Shift] key will proceed to the next parameter in reverse order.) i.e.: the lock level parameter has LL=0, if the password is used to unlock this parameter, all other parameters are open while still operating in the [Setup] key function. If the password is used to unlock the Proportional Band parameter (LL=2), only parameters of Lock Levels 2 and 3 may be accessed without password entry (while still under the same function key). LL = 0

H OPCODE Redirection

HOP
XXXX

Selection is whether or not to activate the redirection. The lower display can be toggled between '**NORM**' and '**DIR** '. These messages refer to normal or directed mode. (See programming section for details.)
LL=1

H OPCODE Channel

HCH
XX

0 to 15: selection is the channel number where 0 refers to the master DUALPRO and numbers 1 through 15 its slave Dualpros. (See programming section for details.)
LL = 1

HSL
XXX

The selection is the slave temperature controller of the selected channel. Since the slave DUALPRO may be a Protocol Converter, the selection allows for sixteen temperature slaves. (See programming section for details.)
 LL = 1

Communications

Host Port
HOST
XX

HE = Half Duplex Even Parity
HN = Half Duplex No Parity
FE = Full Duplex Even Parity
FN = Full Duplex No Parity
LL=1

Host Baud
HOST
XXX

1200	19.2K
2400	38.4K
4800	76.8K
9600	LL=1

Host Protocol
HPRO

MMI = Marathon Proprietary Protocol
MOD = MODBUS RTU Protocol

Host Modbus Address
HMAD
XXXX

XXXX = 0 to 247
Address used if Modbus protocol selected. If set to 0 then
dipswitch. Host address value is used.

Version 3 Address
V3AD
XXX

Setting 0 uses the DIP switch settings.
Settings 1 through 15 respond to the numbered address.
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 and still respond to version 4
requests at the DIV switch address.

Version 3 conversion
V3CV
XXX

YES translates the version 3 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. LL = 1

Secondary Port Address
SPAD
XXX

xx = 0 to 15; if 0 secondary port is inactive. This feature sets an 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. LL=1

Secondary Port Table
STBL
XX

xx = table # 0 to 31 which is used with the secondary port address. LL=1

Aux
Port Mode
AUXM
XXX

Selects the auxiliary ports mode of operation. XXX = BRoaDcast, TEMperature buss, network MASter, OFF, LISten, UDC, or TOKen. LL=1

Broadcast: continuously sends setpoint 1 in 10 pro mode using the broadcast address character "?".

Temperature: sequentially accesses addresses 1 through 8 in 10pro mode requesting the setpoint, process variable , percent output, and operating mode. Also sends the setpoint if requested.

Network Master: sequentially accesses addresses 1 through 15 in block mode and string the information in tables 1 through 15 respectively.

Off: No active requests, but will respond as a MODBUS slave.

List: drivers are off, but all valid block responses on the buss are stored in their respective tables.

UDC: same as temperature mode except uses Honeywell UDC 3000 communications.

Token: A combustion of Master and Listen mode. The instrument remains in listen mode until receiving the token. Then it is the Master for one cycle though all 15 addresses. The token is then sent to the instrument.
MODBUS: MODBUS RTU Protocol Master.

Auxiliary Port Communications

aux
XXX

Selects the auxiliary ports communications information as follows:
HE = Half Duplex Even Parity
HN = Half Duplex No Parity
FE = Full Duplex Even Parity
FN = Full Duplex No Parity
LL=1

Auxiliary Baud

aux
XXX

1200	19.2K
2400	38.4K
4800	76.8K
9600	
LL=1	

Token Address
TADR
XX

This parameter determines which token address the instrument used when the aux port is in token mode. Set to 0 the instrument responds to the DIP switch settings. Set to 1 through 15 the instrument responds to the number's address. LL=1

Aux Port MODBUS Address
AMAD
XXXX

XXXX = 0 to 247; if the Aux Port Mode is 'MOD,' this parameter determines the Modbus slave address to which it will respond. If this value is 0 then the host dipswitch address will be used.

Master Buss Time Out Partition
MBTP
XXX

XX = 0-15. Used only when the AUX port is in master or token mode. Selects the channel number at and above which the MBTO value is used instead of the normal time out value. IF XX=0 this feature is disabled. This feature is used when a device (such as a PLC) is connected to the MMI network emulating a MMI instrument. LL=1

Master Buss Time Out Value
MBTO
XXXX

XX.XX = 00.10 to 02.55 seconds. When the MBTP is non-zero, this value is used as the BUSS time out value when attempting to communicate with channels equal to MBTP and above. LL=1

Master Buss Write Partition
MBWP
XX

XX = 0-15. Used to define unused slave channels so that the memory space can be used by the programmer. 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 indirect reads.

If XX=0, then this feature is inactive. The MBTP takes precedence over MBWP; therefore, if MBWP is set equal to or greater than the MBTP (except if 0), the MBWP is effectively MBTP - 1. LL=1

Remote Local Bit For Slave
RBIT
XXX

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. LL = 1

Basic Port
BASP
XXXX

XXX = BAS, TEMP or HOST
BAS = Basic programs may be run and the basic port is used only for BASIC communications.

TEMP = Basic programs may not be run and the port is then used as a temp buss at 4800 BAUD. This occurs if the Aux port is not set to UDC or TEM. This allows an instrument to have a Master Network (see AUXM description) and a temp instrument network at the same time.

HOST = Basic programs may not be run and the port is then used as a second host buss at 4800 BAUD. LL = 1

DIGITAL EVENTS

Events Partition Internal

EPI

X

      X = 0-4, where 0 is all inputs and 4 is all outputs. A 1 will represent 1 output and 3 inputs, and so on until when at 4 all outputs are set. LL=1

Number Of External Events

BXEV

X

      X = 0-4 representing the number of digital, event boards. LL=1

Events Baud Rate

EVBD

XXXX

XXXX = 1200 (for 1200 BAUD) or 4800 (for 4800 BAUD) LL=1

 Dual Buss Mode

DUAL

XXXX

      xxx = yes or no. If yes and the basic port is not temp and the aux buss is not temp or UDC, the events buss is used for both events boards and temperature controller. LL=1

UDC Partition

UDCP
X

x = 0 to 8, set the number of UDC instruments that are installed on the events buss in dual buss mode. The UDC's use the high address numbers in the range 1-8. LL=1

Events Partition

EPXn
XX

X = 0-15, and n is the external board number (1-4). X = 0 implies all inputs, and X = 15 implies 15 outputs and 1 input.   X = 5 implies 5 outputs and 11 inputs; and so on. The partition should be selected for each external board. LL=1)

Events Mapping

EMAP
XXX

YES / NO , yes activates logical events mapping. Refer to the programmers manual for complete information on logical event mapping. LL=1

ANALOG EVENTS

AEVT
External Analog Address Offset

XAAO
X

 X = 0-3.

 Normally X is set to 0 and the Analog OPTOMUX board connected to the instrument has an address of FC hex. When X=1, then the Analog OPTOMUX used by the instrument is at address FD hex. Likewise, when X=2, the address is FE hex, and X=3 produces an address of FF hex. This is used when more than one Analog OPTOMUX is connected to the instrument. LL=1

Events Partition Analog

EPXA
XX

n = X.

 XX = 0-15 which selects the partitioning of the events on the external analog board. Partitioning described in the events partition. X=0 implies all inputs, and X=15 implies 15 outputs and 1 input. X=5 implies 5 outputs and 11 inputs; and so on. LL=1

Analog Opto Tweaking

AOTW
XXX

 YES / NO This is a way of calibrating the OPTO board reading for DUALPRO use. LL=1

Analog Output Offset
AFOn
XXXX

  0 to F used in Tweaking operation. Range: +/- 999
LL=1

Analog Output Span
ASPn
XXXX

  0 - F used in Tweaking operation. Range from .900
to 1.1 LL=1

Ext Analog Tc Types
EALn
XXXX

n = 0-9, and A-F, the external inputs.
  XXXX = J, K, R, S, T, N/A, LINEARIZATION or
PROG the thermocouple types. The thermocouple type
should be selected for each external input.
  When PROG is selected, N3 determines which
standard curve will be used and which analog input is used
as cold junction compensation. N3's usage is divided as
follows: The high byte is used to determine which module
of the available 16 is used as the Cold Junction module.
The low byte is used to determine which thermocouple type
is used for the remaining 15 modules: linear, prog, J = 5,
K= 8, R=17, S=17, T=18, N/A. LL=1

PROB MENU

Prob

Probe test Interval

PTI

XXXX

Probe test Interval (time in minutes, between automatic test). LL=1
xxxx = 0 to 9999

Probe Impedance

PIMP
XXXX

Max Probe Impedance allowed for no probe fault.
xxxx = 000.0 to 999.9 LL=2

Probe Test Recovery

PTRT
XXXX

Max Probe Test Recovery in seconds
xxxx = 0 to 999 LL=2

Burn Off Timer

BOT
XXXX

length of burn off time in seconds
xxxx = 0 to 999.LL=2

Burn Off Timer Recovery
BORT
XXXX

Max Burn Off Timer Recovery in seconds
xxxx = 0 to 3600. LL=2

Final Delay
FDE
XXXX

Final Delay time in seconds.
Xxxx = 0 to 999. LL=2

Time average 1
TA1
XXXX

Time average 1 for O_2 probe verification.
Xxxx= 0 to 255 minutes. LL=2

Time average 2
TA2
XXXX

Time average 2 for O_2 probe verification.
Xxxx= 0 to 255 minutes. LL=2

Time Delay 1
TD1
XXXX

Time average 1 for O_2 probe verification.
Xxxx= 0 to 255 seconds. LL=2
Time Delay 2

TD2

XXXX

Time average 2 for O_2 probe verification.
Xxxx= 0 to 255 seconds. LL=2

Verification gas value

VGAS

XXXX

Verification gas value for O2 probe verification.
Xxxx = 0 to 100.0. LL=2

Verification Tolerance

VTOL

XXXX

Verification tolerance for O2 probe verification.
Xxxx = 0 to 10.0. LL=2

Inhibit

INHB

XXXX

Inhibit probe maintenance yes/no. if yes then no maintenance cycle (impedance test or burn off) can be started or run. LL=1

Process Factor Adjustment

Process Factor IR

Millivolts Low

Millivolts High

TC Low

TC High

CO Low

CO High

CO2 Low

CO2 High

CH4 Low

CH4 High

PF Low

PF High

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Maximum Adjustment

TC Source

Maintenance and Troubleshooting

PASSWORD PROTECTION BYPASS

To bypass the password, press [Enter]. If you are locked out because you forgot the password, you will have to remove the front panel. Find DIP switch 8 in the top bank. Turn it to ON.. Press [Shift][Page Disp] and [Enter][Enter] to create "enter" as a new password. Turn switch 8 in the top bank OFF. Replace the front panel. The new password is in effect. See Setup and Configuration for more details.

CALIBRATION

The DUALPRO instrument is shipped completely pre-calibrated. The drift characteristics of the input circuits are excellent but from time to time adjustment may be necessary to maintain a high degree of accuracy.

ANALOG INPUT CALIBRATION.

There are three analog inputs and a cold junction compensation sensor on the DUALPRO. The input level and input features for each input are determined by changeable daughter boards that are mounted piggy back on the analog input board. There are several types of input daughter boards: thermocouple input, auxiliary input, 4 to 20 mA input, 0 to 10 V linear, RTD, and slide wire input.

The standard factory configuration is for input A to be a thermocouple input, input B to be an Oxygen probe input(auxiliary input) board, and input C to be another thermocouple input. If the instrument to be calibrated does not have the standard factory configuration, then identifying the configuration is necessary so that the proper procedure for each input board can be followed. For daughter board

types see the SETUP & CONFIGURATION section.

CALIBRATION DISPLAYS AND KEYBOARD
When operating in the calibration mode, the displays and front panel keys take on special assignments. The PROCESS display shows the value of the input being calibrated with a flashing digit. This flashing digit shows the relative sensitivity of the arrow keys, as described following the key descriptions. The SET display shows which input is being calibrated and whether the zero value or the span value is being modified.
The SET display messages are shown below:

Message	Description
Z-A	Zero input A
Z-B	Zero input B
Z-C	Zero input C
Z-SW	Zero slide wire (from input C)
S-A	Span input A
S-B	Span input B
S-C	Span input C
S-SW	Span slide wire (from input C)

NOTE

It is very important to be sure the SET display is showing the proper mode before making an adjustment or the wrong value will be changed.

ADJUSTMENT SENSITIVITY

The adjustment sensitivity works in the following manner. If the digit farthest right in the process display is flashing, then each press of the [Up Arrow] or [Down Arrow] key will change the calibration value shown by one unit. This is the least sensitive position. If the digit farthest left is flashing, then each press of the [Up Arrow] or [Down Arrow] key will change the calibration value by a thousand units. The middle digits will show sensitivities of a hundred and ten units respectively. It is not important to know the relative worth of one calibration unit. Understanding that the location of the flashing digit affects change that one key press will make on the calibration value is necessary. By observing the degree of sensitivity one key press makes at each flashing digit location, you can quickly see how to use this feature. Enter calibration mode by using the 4 key sequence or jumper terminals 17 & 18.

PREPARING FOR CALIBRATION
THERMOCOUPLE DAUGHTER BOARD CALIBRATION

PARTS REQUIRED
1. 1 - 0-50 milivolt dc power supply. (for input voltage simulation)
2. 1- set of twisted pair copper wire. (for input voltage simulation)
3. 1- jumper (to short out the input)
4. 1- digital volt meter. (to determine the amount of input voltage)
5. 1- piece of thermocouple extension wire same as being used on instrument.   (to calibrate the cold junction compensation)
6. 1- thermocouple input simulator. (to simulate the thermocouple input readings)

SETUP FOR LINEAR CALIBRATION NOTE : for simplicity the following procedure will be referring to input 1, this may not apply to all instrument configuration. (please substitute the appropriate input for this procedure)
1. determine which inputs are thermocouple inputs, the part number should let you know. (example a fdp121-4.0 has a thermocouple input on input 1 and input 3.)
2. set the thermocouple input type to linear for all thermocouple board(s).

LINEAR CALIBRATION PROCEDURE
1. place the jumper from pins 1 and 2 on t.b. d. (shorting out input 1)
2. place the dualpro in calibration mode, by using the following key sequence: **shift, enter, setpt, and page disp.**
3. verify **z-a** is displayed in the **set window.** (if **a** is not displayed press the **shift** key until it is displayed, if **z** is not displayed press the **enter** key until it is displayed.)

4. adjust the value in the **process window** to read zero (0) , by using the up and down, left and right arrow keys. (the flashing digit determine the amount of adjustment. the right most digit is the least coarse, and the farther left the digit is the more coarse the adjustment will get.)
5. once zero (0) is achieved press the **enter** key once to store the value, and go to **s-a**.
6. remove the jumper, connect the twisted pair copper wire to the voltage simulator and connect to the instrument where the jumper was.
7. set the simulator to 50 milivolts.
8. adjust the value in the **process window** to read 2500 , by using the up and down, left and right arrow keys. (the flashing digit determine the amount of adjustment. the right most digit is the least coarse, and the farther left the digit is the more coarse the adjustment will get.)
9. once 2500 is achieved press the **enter** key once to store the value, and go to **z-a**.
10. follow this procedure until the input reads correctly and for any other inputs.
11. exit calibration mode by pressing the **setup** key.

SETUP FOR COLD JUNCTION COPMENSATION CALIBRATION
1. determine which inputs are thermocouple inputs, the part number should let you know. (example a fdp121-4.0 has a thermocouple input on input 1 and input 3.)
2. set the input to the correct thermocouple type(s) for the specific board(s).
3. turn on the cold junction compensation for the input(s).

COLD JUNCTION COMPENSATION CALIBRATION PROCEDURE
1. connect the correct thermocouple extension wire to the thermocouple input simulator and the dualpro. (t.b. d pins 1 and 2)
2. set the simulator for a zero value. (see table in manual)

3. place the dualpro in calibration mode, by using the following key sequence: **shift, enter, setpt, and page disp.**
4. verify **z-a** is displayed in the **set window.** (if**a** is not displayed press the **shift** key until it is displayed, if **z** is not displayed press the **enter** key until it is displayed.)
5. adjust the value in the **process window** to read the zero value , by using the up and down, left and right arrow keys. (the flashing digit determine the amount of adjustment. the right most digit is the least coarse, and the farther left the digit is the more coarse the adjustment will get.)
6. once the zero value is achieved press the **enter** key once to store the value, and go to   **s-z**.
7. set the simulator for a span value (see table in manual)
8. adjust the value in the **process window** to read the span value selected, by using the up and down, left and right arrow keys. (the flashing digit determine the amount of adjustment. the right most digit is the least coarse, and the farther left the digit is the more coarse the adjustment will get.)
9. once the span value is achieved press the **enter** key once to store the value, and go to   **z-a**.
10. follow this procedure until the input reads correctlyand for any other inputs.
11. exit calibration mode by pressing the **setup** key.

Thermocouple type	Zero °F	Span°F
B	200	3000
C	32	3000
E	32	1300
J	32	1300
K	32	2300
N	32	2300
NNM	32	2000
R	300	3000

Thermocouple type	Zero °F	Span°F
S	300	3000
T	32	700

The usable ranges of the thermocouple types are shown in The table above. If having a high accuracy over a specific operating range is desirable then the input should be calibrated over that range. Follow the calibration procedure for normal calibration with the following changes. Use the low end of the desired range as the zero value and the high end as the span value. There will be more interaction between zero and span with this method. The desired operating range must fit with the limits of the table.

O2 AUXILLARY INPUT DAUGHTER BOARD CALIBRATION

PARTS REQUIRED
1. 1 - 0-2volt dc power supply. (for input voltage simulation)
2. 1- set of twisted pair copper wire. (for input voltage simulation)
3. 1- jumper (to short out the input)
4. 1- digital volt meter. (to determine the amount of input voltage)

setup for calibration
note : for simplicity the following procedure will be referring to input 2, this may not apply to all instrument configuration. (please substitute the appropriate input for this procedure)
1. determine which inputs are auxiliary inputs, the part number should let you know. (example a fdp121-4.0 has an auxiliary input on input 2.)
2. set the input type to linear for the board(s).

CALIBRATION PROCEDURE
1. place the jumper from pins 4 and 5 on t.b. d. (shorting out input 2)

2. place the dualpro in calibration mode, by using the following key sequence: **shift, enter, setpt, and page disp.**
3. verify **z-b** is displayed in the **set window.** (if **b** is not displayed press the **shift** key until it is displayed, if **z** is not displayed press the **enter** key until it is displayed.)
4. adjust the value in the **process window** to read zero (0) , by using the up and down, left and right arrow keys. (the flashing digit determine the amount of adjustment. the right most digit is the least coarse, and the farther left the digit is the more coarse the adjustment will get.)
5. once zero (0) is achieved press the **enter** key once to store the value, and go to **s-b**.
6. remove the jumper, connect the twisted pair copper wire to the voltage simulator and connect to the instrument where the jumper was.
7. set the simulator to 1.5volts dc.
8. adjust the value in the **process window** to read 1500 , by using the up and down, left and right arrow keys. (the flashing digit determine the amount of adjustment. the right most digit is the least coarse, and the farther left the digit is the more coarse the adjustment will get.)
9. once 1500 is achieved press the **enter** key once to store the value, and go to **z-a**.
10. follow this procedure until the input reads correctly and for any other inputs.
11. exit calibration mode by pressing the **setup** key.

SLIDEWIRE FEEDBACK INPUT DAUGHTER BOARD CALIBRATION

PARTS REQUIRED
1. 1 - 0-2volt dc power supply. (for input voltage simulation)
2. 1- set of twisted pair copper wire. (for input voltage simulation)
3. 1- jumper (to short out the input)

4. 1- digital volt meter. (to determine the amount of input voltage)

SETUP FOR CALIBRATION
note : for simplicity the following procedure will be referring to input 3, this may not apply to all instrument configuration. (please substitute the appropriate input for this procedure)
1. determine which inputs are slidewire feedback input(s), the part number should let you know. (example a fdp123-4.0 has a slidewire feedback input on input 3.)
2. set the input type to linear for the board(s).

CALIBRATION PROCEDURE
1. place the jumper from pins 7 and 8 on t.b. d. (shorting out input 3)
2. place the dualpro in calibration mode, by using the following key sequence: **shift, enter, setpt, and page disp.**
3. verify **z-c** is displayed in the **set window.** (if **c** is not displayed press the **shift** key until it is displayed, if **z** is not displayed press the **enter** key until it is displayed.)
4. adjust the value in the **process window** to read zero (0) , by using the up and down, left and right arrow keys. (the flashing digit determine the amount of adjustment. the right most digit is the least coarse, and the farther left the digit is the more coarse the adjustment will get.)
5. once zero (0) is achieved press the **enter** key once to store the value, and go to **s-c**.
6. remove the jumper, connect the twisted pair copper wire to the voltage simulator and connect to the instrument where the jumper was.
7. set the simulator to 1.5volts dc.
8. adjust the value in the **process window** to read 1500 , by using the up and down, left and right arrow keys. (the flashing digit determine the amount of adjustment. the right most digit is the least coarse, and the farther left the digit is the more coarse the adjustment will get.)

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9. once 1500 is achieved press the **enter** key once to store the value, and go to **z-c**.
10. follow this procedure until the input reads correctly and for any other inputs.
11. exit calibration mode by pressing the **setup** key.

0-10 VOLT LINEAR DC INPUT DAUGHTER BOARD CALIBRATION

PARTS REQUIRED
1. 1 - 0-10volt dc power supply. (for input voltage simulation)
2. 1- set of twisted pair copper wire. (for input voltage simulation)
3. 1- jumper (to short out the input)
4. 1- digital volt meter. (to determine the amount of input voltage)

SETUP FOR CALIBRATION
note : for simplicity the following procedure will be referring to input 3, this may not apply to all instrument configuration. (please substitute the appropriate input for this procedure)
1. determine which inputs are 0-10 volt dc linear input(s), the part number should let you know. (example a fdp124-4.0 has a 0-10 volt dc linear input on input 3.)
2. press the **setup** key once.
3. use the up or down arrow keys to display **inp** in the set window
4. press the **enter** key until **in c** is displayed in the process window
5. set **in c** to **prog.** by using the up or down arrow keys.
6. press the **enter** key until **cjcc** is displayed in the process window
7. set **cjcc** to **no.**
8. press the **enter** key until **icof** is displayed in the process window
9. set **icof** to **0000**.

10. press the **enter** key until **icsp** is displayed in the process window
11. set **icsp** to **01.00**
12. press the **enter** key until **icdp** is displayed in the process window
13. set **icdp** to **2**

CALIBRATION PROCEDURE

1. place the jumper from pins 7 and 8 on t.b. d. (shorting out input 3)
2. place the dualpro in calibration mode, by using the following key sequence: **shift, enter, setpt, and page disp.**
3. verify **z-c** is displayed in the **set window.** (if **c** is not displayed press the **shift** key until it is displayed, if **z** is not displayed press the **enter** key until it is displayed.)
4. adjust the value in the **process window** to read zero (00.00) , by using the up and down, left and right arrow keys. (the flashing digit determine the amount of adjustment. the right most digit is the least coarse, and the farther left the digit is the more coarse the adjustment will get.)
5. once zero (00.00) is achieved press the **enter** key once to store the value, and go to **s-c**.
6. remove the jumper, connect the twisted pair copper wire to the voltage simulator and connect to the instrument where the jumper was.
7. set the simulator to 10 volts dc.
8. adjust the value in the **process window** to read 10.00 , by using the up and down, left and right arrow keys. (the flashing digit determine the amount of adjustment. the right most digit is the least coarse, and the farther left the digit is the more coarse the adjustment will get.)
9. once 10.00 is achieved press the **enter** key once to store the value, and go to **z-c**.
10. follow this procedure until the input reads correctly and for any other inputs.
11. exit calibration mode by pressing the **setup** key.

4-20 MILIAMP DC INPUT DAUGHTER BOARD CALIBRATION

PARTS REQUIRED
1. 1 - 4-20 miliamp dc power supply. (for input current simulation)
2. 1- set of twisted pair copper wire. (for input current simulation)
3. 1- digital volt meter. (to determine the amount of input current)

SETUP FOR CALIBRATION
note : for simplicity the following procedure will be referring to input 3, this may not apply to all instrument configuration. (please substitute the appropriate input for this procedure)
1. determine which inputs are 4-20 miliamp dc input(s), the part number should let you know. (example a fdp125-4.0 has a 4-20 miliamp dc input on input 3.)
2. set the input type to linear for the board(s).

CALIBRATION PROCEDURE
1. connect the twisted pair copper wire to the current simulator and connect to t.b. d pins 7 and 8 of the dualpro.
2. set the simulator to 4.0 miliamps dc.
3. place the dualpro in calibration mode, by using the following key sequence: **shift, enter, setpt, and page disp.**
4. verify **z-c** is displayed in the **set window.** (if **c** is not displayed press the **shift** key until it is displayed, if **z** is not displayed press the **enter** key until it is displayed.)
5. adjust the value in the **process window** to read zero (0) , by using the up and down, left and right arrow keys. (the flashing digit determine the amount of adjustment. the right most digit is the least coarse, and the farther left the digit is the more coarse the adjustment will get.)

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6. once zero (0) is achieved press the **enter** key once to store the value, and go to **s-c**.
7. set the simulator to 20 miliamps dc.
8. adjust the value in the **process window** to read 2000 , by using the up and down, left and right arrow keys. (the flashing digit determine the amount of adjustment. the right most digit is the least coarse, and the farther left the digit is the more coarse the adjustment will get.)
9. once 2000 is achieved press the **enter** key once to store the value, and go to **z-c**.
10. follow this procedure until the input reads correctly and for any other inputs.
11. exit calibration mode by pressing the **setup** key.

RTD DC INPUT DAUGHTER BOARD CALIBRATION

PARTS REQUIRED
1. 1 - rtd simulator. (for input simulation)
2. 1- set of twisted copper wire, 3 conductor. (for input simulation)

SETUP FOR CALIBRATION
note : for simplicity the following procedure will be referring to input 1, this may not apply to all instrument configuration. (please substitute the appropriate input for this procedure)
1. determine which inputs are rtd input(s), the part number should let you know. (example a fdp623-4.0 has a rtd input on input 1.)
2. set the input type to rtd for the board(s).

CALIBRATION PROCEDURE
1. connect the twisted copper wire 3 conductor to the rtd simulator and connect to t.b. d pins 1, 2 and 3 of the dualpro.
2. set the simulator to -100 degrees

3. place the dualpro in calibration mode, by using the following key sequence: **shift, enter, setpt, and page disp.**
4. verify **z-a** is displayed in the **set window.** (if **a** is not displayed press the **shift** key until it is displayed, if **z** is not displayed press the **enter** key until it is displayed.)
5. adjust the value in the **process window** to read -100, by using the up and down, left and right arrow keys. (the flashing digit determine the amount of adjustment. the right most digit is the least coarse, and the farther left the digit is the more coarse the adjustment will get.)
6. once -100 is achieved press the **enter** key once to store the value, and go to **s-a**.
7. set the simulator to 100.
8. adjust the value in the **process window** to read 100 , by using the up and down, left and right arrow keys. (the flashing digit determine the amount of adjustment. the right most digit is the least coarse, and the farther left the digit is the more coarse the adjustment will get.)
9. once 100 is achieved press the **enter** key once to store the value, and go to **z-a**.
10. follow this procedure until the input reads correctly and for any other inputs.
11. exit calibration mode by pressing the **setup** key.

O2 FOR OXYGEN INPUT DAUGHTER BOARD CALIBRATION

PARTS REQUIRED
1. 1 - 0-100 milivolt dc power supply. (for input voltage simulation)
2. 1- set of twisted pair copper wire. (for input voltage simulation)
3. 1- jumper (to short out the input)
4. 1- digital volt meter. (to determine the amount of input voltage)

SETUP FOR CALIBRATION

<u>**note :**</u> for simplicity the following procedure will be referring to input 2, this may not apply to all instrument configuration. (please substitute the appropriate input for this procedure)

1. determine which inputs are auxiliary inputs, the part number should let you know. (example a fdp171-4.0 has an o2 for oxygen input on input 2.)
2. set the input type to linear for the board(s).

CALIBRATION PROCEDURE

1. place the jumper from pins 4 and 5 on t.b. d. (shorting out input 2)
2. place the dualpro in calibration mode, by using the following key sequence: **shift, enter, setpt, and page disp.**
3. verify **z-b** is displayed in the **set window.** (if **b** is not displayed press the **shift** key until it is displayed, if **z** is not displayed press the **enter** key until it is displayed.)
4. adjust the value in the **process window** to read zero (0) , by using the up and down, left and right arrow keys. (the flashing digit determine the amount of adjustment. the right most digit is the least coarse, and the farther left the digit is the more coarse the adjustment will get.)
5. once zero (0) is achieved press the **enter** key once to store the value, and go to **s-b**.
6. remove the jumper, connect the twisted pair copper wire to the voltage simulator and connect to the instrument where the jumper was.
7. set the simulator to 100milivolts dc.
8. adjust the value in the **process window** to read 100 , by using the up and down, left and right arrow keys. (the flashing digit determine the amount of adjustment. the right most digit is the least coarse, and the farther left the digit is the more coarse the adjustment will get.)
9. once 100 is achieved press the **enter** key once to store the value, and go to **z-a**.
10. follow this procedure until the input reads correctly and for any other inputs.

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11. exit calibration mode by pressing the **setup** key.

ANALOG OUTPUT CALIBRATION

The two Analog Output signals can be configured for the following ranges: 0 to 5 V or 4 to 20 mA. The output mode for each of the Analog Outputs are determined by the two separate Dip switches on the ANALOG OUTPUT board. Any time the mode of operation is switched between current and voltage, the outputs must be recalibrated. The outputs do not have to be recalibrated when switching between signal types i.e.: if the output is calibrated for 0 to 5 volts, and it is needed to change from Process Variable to Proportional Output 1, no recalibration is necessary (5 volts will be equal to 100%).

Output Type

Voltage   Current

Gain Potentiometer
Offset Potentiometer
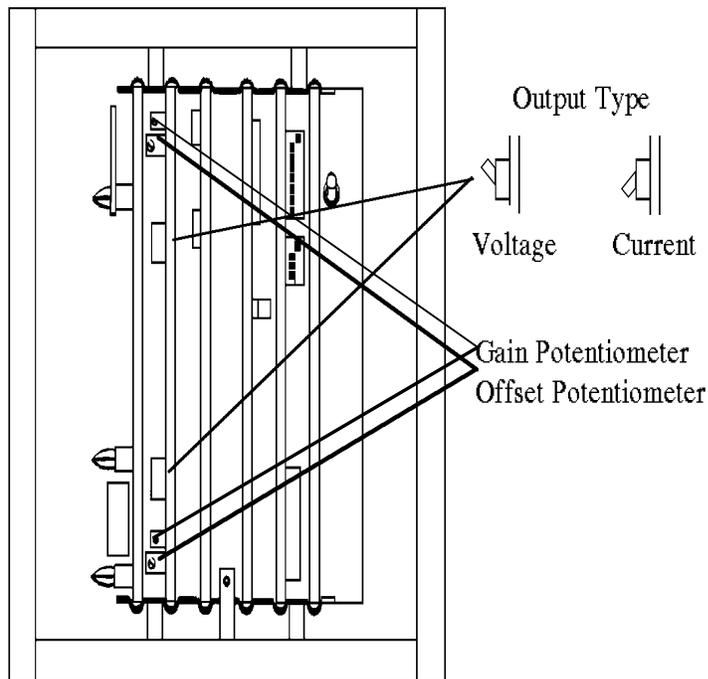
PREPARING FOR CALIBRATION

To set the desired mode, find the proper switch that corresponds to the output to be used. Select the voltage mode by pushing the rocker switch down at the bottom edge of the switch. Select the current mode by pushing the rocker switch down at the top of the switch. Repeat procedure for the other output.

CALIBRATING THE OUTPUTS

To calibrate the Analog Outputs:
        • Consideration must be made at this time about which type output, current or voltage, is to be used. Check the two rocker switches on the Analog Output board to confirm that the desired mode is selected for each output.

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The easiest way to adjust the current output for 4 mA, is to put the instrument in Manual Mode by using the [Prog/Auto/Man] key.

• next, remove the FRONT PANEL by loosening the black knurled knob in the counterclockwise direction. Remove the panel from the chassis and support it near the instrument.

• To calibrate the outputs using the following method, both Analog Outputs must be set to the Proportional Output (PO1) control mode. This is done by:

i. Pressing [Setup] and selecting AOUT from the menu. Press [Enter] to move forward through the menu.

ii. At the AO 1 display, change the control mode in the lower window to PO 1.

iii. Press [Enter] repeatedly.

iv. At the AO 2 display, change the control mode in the lower window to PO 1.

v. Press [Setup] to exit the menu.

*•Remove any wires at the Analog Output terminals (TBD-13, TBD-14, TBD-15 and TBD-16).

*• Attach the leads of a digital multi-meter(DMM) to the terminals that correspond to the output to be calibrated (TBD-13(+) and TBD-14(-) for Analog Output #1. TBD-15 (+) and TBD-16(-) for Analog Output #2).

*• Set the Percent Output to 0% using the [Left Arrow] key.

*• Find the OFFSET POT for the output to be adjusted. Adjust the pot until the DMM reads 4 mA current output or 0 V.

• Repeat * steps for the other output.

• To get the full SPAN output value, press the [right arrow] until 100 is displayed in the PROCESS Window indicating 100 percent is being applied.

• With the DMM connected at the proper output terminal connection, adjust the GAIN pot of the corresponding output until the DMM reads the required

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output (5 V max) or 20 mA).

       • Move the meter leads to the other Analog Output and repeat the previous step for the SPAN output.

       • Repeat the Zero and Span process until no further adjustment is required.

       • Reset PO1 to its original setting, if it was changed in the *I offset pot step above, to their desired values. Reattach any wires removed from the Analog Output terminals.

       • Reattach the units FRONT PANEL to the chassis. The Analog Output Calibration procedure is now complete.

Analog OPTO Tweaking

The analog OPTO tweaking feature of the DUALPRO allows the operator to adjust the zero and span of each module on the analog OPTO rack. This is similar to calibration except that the operation is done in the DUALPRO after the digital data is received from the OPTO rack. The purpose of the tweaking feature is to provide a means of fine tuning the readings from the OPTO board. For example, if a thermocouple attached to the appropriate module is reading a few degrees high or low the tweaking feature can be used to adjust for this error.

To use the analog OPTO tweaking feature it must be activated. This is done under the **Setup** key '**AEVT**' menu. When the process display shows '**AOTW**', the tweaking feature is activated by selecting yes in the set display. The tweaking feature applies to all sixteen modules on the rack. Be sure that the offset is set to 0000 and the span to 1.000 on any modules you do not wish to adjust. The offset and span effect the digital data received from the OPTO rack before any linearization is applied. The range of the offset number is + or - 999 counts. The full scale range of the data from the OPTO module is 4095 counts regardless of the type of module. For example a 0 to 5 volt module full scale is 4095 counts therefore each counts is 1.22 millivolts.

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The tweaking offset can therefore adjust the offset (zero) of the approximately 24%.The range of the span adjustment is 0.900 to 1.100. This allows a + or - 10% adjust to the gain. Since the span multiplier occurs on the non-linearized data, an error of 2% may need a slightly higher or lower multiplier than 2%.

The best way to use the tweaking feature is the same way a calibration would be done. First apply a zero or near zero signal, and adjust the offset for a correct reading. then apply a full scale signal and adjust the span for a correct reading. Repeat the zero and span processes until there is no interaction. For greater accuracy over a know operating range, use the low end of the range for the zero and the high end of the range for the span. The disadvantage of this technique is that there will be more interaction between the zero and the span.

The sophisticated DUALPRO user might be using the analog OPTO address offset feature to have more than one analog OPTO rack on the DUALPRO. The tweaking feature can not distinguish which board is active and would apply the tweaking factors to all the data. Since the logic programmer is probably being used to switch between the boards, the logic programmer could also turn on the tweaking feature for the desired board and turn it off when selecting the other board(s). This would allow the tweaking feature to be used on a critical board without affecting the data from the other boards.

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HOW TO CHANGE BOARDS FUSES AND ELECTRONICS SAFELYHOW TO CHANGE BOARDS FUSES AND ELECTRONICS SAFELY

Boards

Observe all electrical safety standards when handling the DUALPRO. Turn off or remove the power connection before handling any of the boards and work on a grounded surface with electrostatic defusion equipment. Use the following chart to identify the location of your boards. To troubleshoot a malfunction it is often necessary to exchange (swap) boards. Using proper grounding precautions, open the front panel using the knob at the bottom. Turn off the power. Turn off the triac board switch.
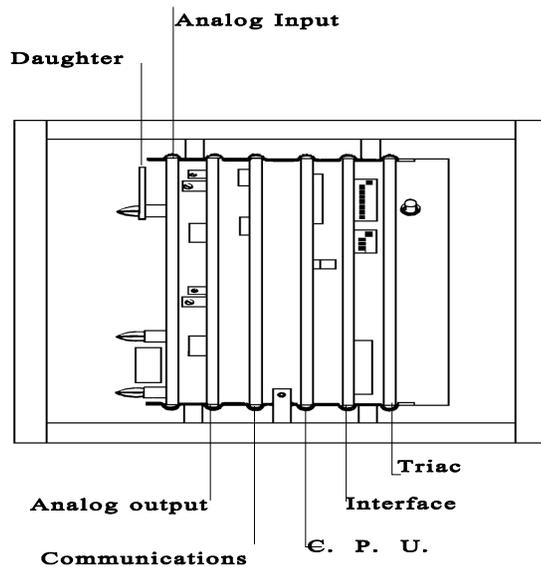
Remove the board that may be causing the problem and exchange it for a new one. **Note : If removing or**

replacing the triac board , be sure all power connected to the back of the instrument is off.

FUSES

If the problem involves an event, alarm, control or power to the instrument itself, first check that the instrument is connected to the power source correctly. If that is not the problem, then check the fuses on the Triac board. The figure below will help identify the possible fuse causing the problem with older versions of the Dualpro Triac board.

WARNING
Remove all AC Power (Instrument, Alarms, Events) from the rear of the instrument before removing the Triac board.

```
Fuses
F6: Instrument
F5: Event


F1: Control 1
F2: Control 2
F3: Alarm 1
F4: Alarm 2
```
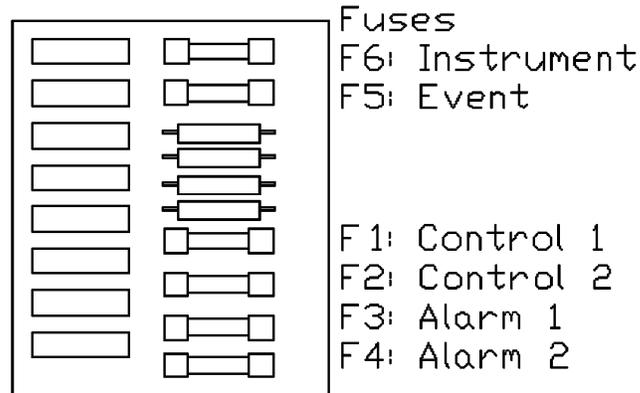
Nearer versions of the Dualpro have only a main fuse for the instrument. Event, Alarms, and Control sources should be fused externally in the control panel.

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SPARE PARTS LIST

Marathon recommends that customer's purchase a second unit as a back up so that service remains uninterrupted. If that is not possible then at least purchase the following items:

• MFU-1.0GMA 1 AMPERE FUSES
• A810151 - fast analog output board
• A810071 - analog output board
• A810070 - communications board
• A810153 - Turbo CPU board
• A810073 - interface board
• A810074 - Triac board
• A810052 - display board
• K810122 - DUALPRO faceplate

and the corresponding daughter boards for your configuration from the following list

• A810076 Auxiliary / O2 mV
• A810077 Thermocouple
• A810095 Slidewire Feedback
• A810115 Resistive Temperature Device
• A810147 0 to 10 V Linear
• A810168 4 to 20 mA
• A810190 combustion O▤ probe

Theory of Operation

The Proportional Integral and Derivative (PID) control in the DualPro is based on the theories first developed by Ziegler and Nichols in 1942. For a detailed explanation of these theories see: David W. St. Clair <u>Controller Tuning and Control Loop Performance</u>; 1990: Straight Line Control Company, 3 Bridlebrook Lane, Newark, De 19711.

The DUALPRO has two distinct programming languages: the logic language called version 4 language and the recipe language called version 3.5 language. Originally, the DUALPRO did not have recipe language. It was added to the DUALPRO because of customer requests. The recipe language is a derivative of the version 3 UNIPRO /CARBPRO language. Consequently, it looks like version 3 UNIPRO / CARBPRO, version 3.5 CARBPRO and MULTICARB languages to the user with a few minor exceptions.

The background "logic" language has four purposes:

> • to allow the same instrument to be used for several specific applications that require custom operation codes
> • to be able to move and manipulate data for scaling, data logging, alarm testing
> • to handle bit logic and sequencing operations
> • to communicate with and concentrate data from many sources

The foreground "recipe" language has two purposes:

> • to give the user a familiar framework to run their recipes for heat treating
> • to provide a method by which the logic language can work with these programs to add increased flexibility with the use of flags and waits

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Note that the logic language can operate either in the background or the foreground but the recipe language can only operate in the foreground. When the instrument is set up, the installer has the option of setting the foreground language to Ver4 or Ver3.5. Thus, no version 4 programming capabilities are lost! The DUALPRO can run version 3.5 programs without any logic program running but this reduces the DUALPRO to a version 3.5 CARBPRO.

The programming languages of this instrument are meant to work seamlessly with each other. While the foreground program is accessible to the metallurgist or the highly skilled floor operator for the entry of recipes, the background language is intended to remain invisible after installation

The Dual loop control allows greater flexibility in programming and upward expandability of a system controlled by the DualPro. This same dual loop control allows simultaneous control of two process variables.

DualPro is one of the few if not the only instrument with four communications ports. The four communications ports allow varied communication between the DualPro and other instruments. This allows the use of simultaneous control and communications features.

Control Mode Definitions

Time Proportioning (TP)

Time proportioning adjusts the duty cycle of the control device to maintain control. This is usually done with solenoid valves controlling the flow of a critical material to the process. The control loop percent output is the ON time percentage of the value. The cycle time parameter determines the total cycle time, ON time plus OFF time. For example if the control loop percent output is 34% and the cycle time is 10 seconds, then the ON time would be 3.4 seconds and the OFF time would be 6.6 seconds. The selection of the proper cycle time is a trade off between excess wear and tear on the solenoid valve with short cycle times and rough (pulsing) flow of the control material with long cycle times. Only one control output triac is used in this mode.

Time Proportioning with Complement (TC)

This mode is identical to the time proportioning mode except that two control output triacs are used. The second control output is the complement of the first, that is when the first output is ON the second is OFF and vice versa. This mode is used with single action motorized valves that open quickly when a voltage is applied to one terminal and close quickly when voltage is applied to the other terminal.

Time Proportioning Dual (TD)

This mode is used when there is two process materials to control which have complementary effects; like gas and air in a heat treating furnace. If the carbon potential is too low then more gas is required. If the carbon potential is too high then once the gas flow has been shut off air is required. The time proportioning dual mode uses two control output

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triacs; one for gas and one for air. There is never a time when both outputs are on simultaneously. The control loop computes a percent output from -100 to +100%. When positive, the proportioning action applies to the forward (gas) output. When negative the proportioning action applies to the reverse (air) output.

Motor with slidewire (MS)

This mode is used for motorized valves that have a slidewire feedback. This mode requires a slidewire board for input C of the DUALPRO. MS mode can only be selected for loop 1 of the DUALPRO. The motor slidewire is then wired to this input. This mode uses two control output triacs; one to drive the motor forward (open) and the other to drive it reverse (closed). This mode is effectively a control loop within a control loop. The main control loop computes a desired output percentage. The secondary loop then drives the motor (forward or reverse) until the slidewire indicates that the valve is open the proper percentage. To prevent the motor from "hunting" a deadband can be set using the DIP switches. This value can be set from .2 % to 10%. In most applications the motor with slidewire does not provide any better control than position proportioning (see below).

Position Proportioning (PP)

This mode is used with motorized valves that do not have slidewire feedback. This mode is sometimes referred to as the "bump" mode because it "bumps" the valve slightly more open or closed. This mode uses two control output triacs; one to drive the motor forward (open) and the other to drive it reverse (closed). For each computation of the control this mode computes the difference between the new percent output and the last percent output. If the difference is positive than the valve motor is driven open for that percentage of the cycle. If negative it is driven closed

by that percentage of the cycle time. For example if the new percent out is 60% and the old was 45% then the motor is driven open for 15% of the cycle time. If the cycle time is set to the time that the motor takes to move from fully closed to fully open, then the flow is theoretically increased by 15%. Two special cases exist. If the control output is computed at 100% then the motor is driven continuously in the open direction. Likewise if the control output is computed as 0% then the motor is driven continuously closed.

ON/OFF (OF)

ON/OFF control is exactly what it implies, the control action is either ON or OFF. With true ON/OFF control the control output triac is ON whenever the process is below the setpoint value and OFF when the process is at or above the process value. In many real world applications this simple control method will cause "contact chatter" because of noisy signals which will switch the ON and OFF states rapidly. Also since the control action does not turn OFF until the setpoint is reached, the process will overshoot due to lags in the control action. Marathon controllers incorporate two features which prevent this problems from occurring; hysterisis and deadband. Hysterisis provide a gap between the process turn on point and the turn off point. With this gap noise will not cause the control output to "chatter". Deadband allows the process to deviate away from the setpoint by the width of the deadband before any control action occurs. The deadband on the DUALPRO is adjusted with the proportion band setup (the reset and rate must be set to 0 for ON/OFF control). For temperature control a proportional band of 10 would represent a deadband of 10 degrees. A proportional band of 5 would represent 5 degrees of deadband, etc. This is accomplished by allowing the PID control loop to calculate in a normal fashion. The percent output is then used to determine when the output should be turned on or off. The output is turned on when the percent output reaches 10%.

Hysterisis is added by not turning off the output until the percent output drops to 2%. With the temperature control example where the proportion band is set at 10, the output would turn on when the process dropped to 10 degrees below the setpoint and turn off when the temperature reached 2 degrees below the setpoint. With a proportional band of 1 these points would be 1 degree and 0.2 degrees respectively.

ON/OFF with Complement (OC)

This mode is exactly like ON/OFF control with the addition of a second control output triac. The second triac would be ON when the first is OFF and vice versa.

ON/OFF Dual (OD)

This mode is similar to time proportioning dual in that two control output triac are used such as in a heat/cool application. The forward (heat) output would act as described in the ON/OFF description above. The reverse (cool) output would respond when the process is above the setpoint. To facilitate this process the PID control loop computes a percent output from -100 to +100%. The plus values mean the process is below setpoint and the minus values mean the process is above setpoint. The forward contact would turn on when the percent output reaches 10% or above. It would not turn off until the percent output dropped to 2% or below. In a similar fashion, the reverse contact would turn on when the percent output dropped to -10% or lower (more negative). It would turn off when the percent output rose to -2% or higher (more positive). For the temperature example with a proportional band of 10, the heat contact would turn on when the temperature was 10 degree or more below the setpoint and would turn off when it came within 2 degrees of the setpoint. Likewise the cool contact would turn on when the temperature rose 10

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degrees above the setpoint and would turn off when it dropped to within 2 degrees of the setpoint.

Multi Mode (MM)

Multi Mode is a control mode on the DUALPRO that deals with output resource assignment. Multi Mode can only be selected for loop 2 of the DUALPRO. Multi Mode is either time proportioning single or dual depending on the setup of the DUALPRO. The simplest form of Multi Mode occurs when loop 1 is set for TD, OD, MS, or PP. In this case Multi Mode is time proportioning single and has no output triacs. Therefore one of the analog outputs must be assigned to PO2 (loop 2, percent output) for loop 2 to have any output resource. For other assignments of loop 1, Multi Mode makes loop 2 a dual time proportion loop. However, loop 2 only has one output triac assigned to it. If loop 1 is set for TP or OF, the control output 2 is assigned to loop 2. This triac will be the reverse output of the dual loop. If loop 1 is set for TC or OC, the event output 3 is assigned to loop 2. This triac will be the forward output of loop 2. The two analog outputs have special functions if assigned to PO2 when loop 2 is in MM and loop 1 is either TP, OF, TC, or OC. If analog output 1 is assigned to PO2, it will be zero to full scale for 0 to +100% output of loop 2. If analog output 2 is assigned to PO2, it will be zero to full scale for 0 to -100% output of loop 2. Only one of the analog outputs need be assigned to PO2 for this to occur.

Recipe Error Codes:

01…79	Programmed alarm
80	Turns off 81
81	Temperature deviation band alarm
82	Turns off 83
83	%C (dewpoint or mV) deviation band alarm.
84	not assigned
85	Deviation alarm between probe TC and temperature controller.
86…90	not assigned
91	Temperature buss error
92	OPTOMUX buss error
93	LIMIT statement time-out
94	not assigned
95	Illegal RAMP
96	Auto restart after power failure
97	Illegal subroutine call
98	Illegal JUMP attempted
99	not assigned

Programmer System Error codes:

Note : * = Program Halt

Foreground Program	Background Program	Description
*100	101	Bad load on executing jump
*104	105	Step too big in jump
*106	107	Program number too big in jump
*110	111	Bad load in executing gosub
*112	113	Gosub too deep
*114	115	Step too big in gosub
*116	117	Program # too big in gosub
*118	119	Bad load on return from gosub
*120	121	Bad load running background
*124	125	Step too big running background
*126	127	Program number too big running background
130	131	Read indirect too big
132	133	Write indirect too big or requests que full
134	135	Sync out but not master unit
136	137	Send program to slave but not master unit
138	139	Start program in slave but not master unit
140	141	Program send value not valid
142	143	Data stack pushed too deep
144	145	Data stack empty on pop
146	147	Block specification incorrect
148	149	Block send but not master or que full
*252	253	Bad load when restoring a program on a power fail restore
*254	255	Bad load of prog 1 on auto prog start

Specifications:

Alarm output 2 user selectable Triac outputs for process alarms.

Ambient temperature   0 to 130 ° F

Analog output   adjustable Voltage (0 to 10 V dc or milliamperage (2 to 22) based on various selectable sources.

Auxiliary and Slide Wire input impedance   44 M ohm

Auxiliary and Slidewire input range   -50 to 2000 mV dc

Control Outputs   2 configurable output Triacs allowing dual control on both loops for ON / OFF, Time-proportioning or position-proportioning control.

Serial interface:
    Host   RS-422 1200/4800/ 9600 / 19200 / 38.4K / 76.8K BAUD Full / Half duplex, Even / no   parity, MMI protocol
    Auxiliary RS-422 1200 /4800 / 9600 / 19200 BAUD, Full /Half duplex, Even No/ Parity, 1 stop bit, Multiple modes.
    OPTOMUX RS-422 1200 / 4800 BAUD, 8 Bit, no parity, 1 stop Bit Full Duplex, 2 pass OPTOMUX protocol.

BASIC terminal PortRS-422 4800 BAUD, Full duplex, for BASIC interpreter

Dimensions   5.75" height, 5.75" width, 10.5" length
Event Output   4 events configured for in or out.

Control/alarms   4 Triac contact closure combination for output and or input available to

process programmer. 1 amp rating

Inputs	3 inputs
Humidity	0 to 85% noncondensing
Input linear	10 thermocouple types (See the list under thermocouple) 2 user definable curves 1 programmable offset and span 1 RTD, 10 ohm platinum, Alpha = .00385 (DIN 43 760)
Line voltage	85 to 140 V ac, 50 / 60 Hz. 190 to 250 V ac, 50 /60 Hz
Output	Triacs fused at 1 Amp 125/240 maximum.
Panel cut out	5.43" X 5.43" square
Programs	logic = 200, 24 steps each. Recipe = 200 , 19 steps each. 55 on internal ROM.
PID Constants	Proportional Band 1 to 9999 Reset 0 to 99.99 RPM Rate 0 to 9.99 minutes Cycle Time 0 to 250 seconds Load Line -100 to 100 % High limit 0 to 100 % Low limit -100 to 100 %
Setpoints	-999 to 9999
Signal display range	- 300 to 3500 ($\pm$4) Depending upon thermocouple type. - 999 to 9999 for programmed values

Thermocouple board

Signal input range	-10 to +64 mV
Thermocouple	B: Platinum 30% Rhodium vs. Platinum 6% Rhodium C: Tungsten 5% Rhenium vs. Tungsten 26% Rhenium E: Chromel-Constantan J: Iron-Constantan K: Chromel-Alumel N: Nickel 14.2% Chromium 1.4% Silicon vs. Nickel 4.4% Silicon 0.1% Magnesium NNM: Nickel vs. Nickel 18% Molybdenum R: Platinum vs Platinum 13% Rhodium S: Platinum vs Platinum 10% Rhodium T: Copper-Constantan
Weight	Approximately 11 pounds

USING THE DUALPRO IN OXYGEN APPLICATIONS

Versions 4.124 and up.

Introduction

This application note will describe the setups needed to use the Dualpro in per cent oxygen applications. The **Process** display will show the percent oxygen (and the temperature if SCAN mode is used). Page display will show the oxygen sensor temperature, recent sensor tests, etc. Also, the analog output 2 will retransmit percent oxygen as a 4 to 20 mA signal equal to 0 to 25% O_2. Analog output 1 will retransmit temperature as a 4 to 20 mA signal equal to 0 to 3000 ^{o}F (or 0 to 1500 ^{o} C).

Instrument setup

Dip switches

Set Bank 1 (top) dip switch #2 to **ON** and dip switch #1 to **OFF**. This will enable the percent oxygen calculation

Analog output mode

Verify that the Analog Output board is in current mode for both channels. If not, then switch to current mode and recalibrate the analog outputs. (See section 9-1 of the main Dualpro manual for help)

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Display mode

The display mode must be placed into either **HOLD** or **SCAN**. To do this, press the **Shift + right arrow** together. The Process display will show either HOLD or SCAN.

Parameter Setups

Press **Setup** to display the setup menu. The chart below shows which parameters under each menu heading must be setup.

Menu Heading	Parameter (Process Window)	Setup (Set Window)
CON	CV 1	CV 2
	CV 2	IN A
INP	IN A	T/C B
	CJCA	YES
	IN B	LIN
	CJCB	NO
	TC	Deg F (or Deg C)
AOUT	AO 1	IN A
	AO1O	0
	AO1R	3000 (or 1500 for deg C)
	AO 2	CV 0
	AO2O	0000
	AO2R	25.00

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PROB	PT I	480(Note: minutes)
	PIMP	020.0
	Ptrt	30 (Note: seconds)
	BO T	0000

(Note: No probe burnoff)

	BorT	0000

(Note: No recovery time)

	F dE	30 (Note: seconds)
	TA1	0003
	TA2	0003
	TD1	0120
	TD2	0090
	VGAS	Set to value of reference gas
	VTOL	002.0
	Inhb	NO

(Yes=NO probe tests)

CALC	O2EX	2
	O2DP	1

Wiring

Connect the probe thermocouple to TBD-1 (+) and TBD-2 (-).

Connect the probe mv output to TBD-4 (+) and TBD-5 (-).

Connect the temperature recorder to TBD-13 (+) and TBD-14 (-).

Connect the percent oxygen recorder to TBD-15 (+) and TBD-16 (-).

Connect the verification 3-way solenoid to TBA-5 and TBB-2.

Connect a jumper from TBA-2 to TBA-4.

Connect a jumper from TBB-2 to TBB-4.

Connect 115 VAC 60 Hz power to TBA-1 (Line), TBB-1 (Neutral), and TBA-3 (Ground).

Instrument Operation

Manual sensor impedance and verification test

A sensor impedance and verification test may be manually started by pressing the **Shift + Enter** keys simultaneously. Display will show test in progress. Please wait until test is completed to view date from the sensor test using next section (Viewing sensor test date).

Viewing sensor test data

The data from the most recent sensor test can be viewed on the instrument page display. Press the **Page Disp** key. Use the **left arrow** key or **right arrow** key to find the message **PROB CARE.** Use the **down arrow** or **up arrow** key to display the test data described in the table.

Process display	**Description of data**
DATE (mm.dd)	The month and day of the last test
TIME (hh.mm)	The hour and minute of the last test
IMP	The sensor impedance in kilo-ohms
IRT seconds	Impedance test recovery time in
BOMV & BORT	Ignore, not used in %O2 applications
BOTC	Ignore, not used in %O2 applications
VGAS	Reference gas Value for verification
VTOL	Verification tolerance
VRES	Verification result

Changing the automatic test interval

The automatic sensor test interval may be set to any value from 0 to 9999 minutes. Setting the value to 0 disables the automatic test feature. Values less than 60 minutes are not recommended. The parameter to change for the automatic sensor test interval is **PT I**. This is accessed by the **Setup** key under the **PROB** menu.

Calibration of the Dualpro for Oxygen Tools Required

        1 - Small flat blade screwdriver
        1 - Temperature source (to emulate oxygen sensor
         thermocouple)
        1 - Piece of thermocouple extension wire
        1 - MilliVolt source (To emulate oxygen sensor)
        1 - Twisted pair of copper wire

NOTE

Both a millivolt and temperature source is required. RONAN Engineering, Model X-88 Calibrator or similar is required (800-327-6626).

Thermocouple Input A Calibration

1. Place the Dualpro into calibration mode by pressing the following keys (SHIFT, ENTER, SETPT, AND PAGE DISP.) or by placing a jumper between Terminal block "D" # 17 & # 18

2. Connect the thermocouple extension wire to the temperature source and to the Dualpro terminal block "D" # 1 & # 2.

3. Using the temperature source, "ENTER" the correct "zero" value indicated for the thermocouple wire selected (Generally a "B" type T/C) (refer to the Dualpro manual for proper zero values for the thermocouple wire selected).

4. Verify that the Dualpro display has Z-A in the SET (Lower Window of the Dualpro) WINDOW, and a value in the PROCESS (Upper Window of the DualPro) WINDOW with one of the digits flashing. (the flashing digit represents the sensitivity of the adjustment needed. The right most digit is the finest adjustment and the left most digit is the most coarse adjustment. The middle two digits are between the fine and coarse adjustments).

5. If the Dualpro is not displaying Z-A in the SET (Lower Window of the Dualpro) WINDOW press the "ENTER" key to change the first letter, or press the shift key to change the second letter.

6. Use the up and down arrow keys to make any changes to the value and the left and right arrow keys to change the sensitivity of the adjustment.

7. Change the value on the Dualpro to match the

value on the calibrator.

8. Once the correct zero value is displayed press the enter key. (This will save the zero calibration value and also prepare the instrument for the span calibration)

9. "ENTER" a span value (refer to the Dualpro manual for proper zero and span values for the t/c wire selected).

10. Verify that the Dualpro display has S-A in the SET (Lower Window of the Dualpro) WINDOW.

11. Use the up and down arrow keys to make any changes to the value and the left and right arrow keys to change the sensitivity of the adjustment.

12. Once the correct span value is displayed press the enter key. (This will save the span calibration value)

13. Repeat steps 3-12 until the calibration values are correct.

Oxygen Input B Calibration:

1. Place the Dualpro into calibration mode by pressing the following keys (SHIFT, ENTER, SETPT, AND PAGE DISP.) or by placing a jumper on Terminal block "D" # 17 & # 18

2. Connect the twisted pair of copper wires to the calibrator and to the Dualpro terminal block "D", # 4 & # 5.

3. "ENTER" a zero value, 0 (zero) mV.

4. Verify that the Dualpro display has Z-B in the SET

(Lower Window of the Dualpro) WINDOW, and a value in the PROCESS (Upper Window of the DualPro) WINDOW with one of the digits flashing. (the   flashing digit represents the sensitivity of the adjustment needed. The right most digit is the finest adjustment and the left most digit is the most coarse adjustment. The middle two digits are between the fine and coarse adjustments).

5. If the Dualpro is not displaying Z-B in the SET (Lower Window of the Dualpro) WINDOW press the enter key to change the first letter, or press the shift key to change the second letter.

6. Use the up and down arrow keys to make any changes to the value and the left and right arrow keys to change the sensitivity of the adjustment.

7. Change the value on the Dualpro to match the value on the calibrator.

8. Once the correct zero value is displayed press the enter key. (This will save the zero calibration value and also prepare the instrument for the span calibration)

9. "ENTER" a span value, 300 mV

10. Verify that the Dualpro display has S-B in the SET (Lower Window of the Dualpro) WINDOW.

11. Use the up and down arrow keys to make any changes to the value and the left and right arrow keys
        to change the sensitivity of the adjustment.

12. Once the correct span value is displayed press the enter key. (This will save the span calibration value).

13. Repeat steps 3-12 until the calibration values are correct.

Thermocouple Input C Calibration:

1. Place the Dualpro into calibration mode by pressing the following keys (SHIFT, ENTER, SETPT, AND PAGE DISP.) or by placing a jumper on Terminal block "D" # 17 & # 18

2. Connect the thermocouple extension wire to the temperature calibrator and to the Dualpro Terminal block "D" # 7 & # 8

3. "ENTER" a zero value (refer to the Dualpro manual for proper zero values for the thermocouple wire selected).

4. Verify that the Dualpro display has Z-C in the SET (Lower Window of the Dualpro) WINDOW, and a value in the PROCESS (Upper Window of the DualPro) WINDOW with one of the digits flashing. (the flashing digit represents the sensitivity of the adjustment needed. The right most digit is the finest adjustment and the left most digit is the most coarse adjustment. The middle two digits are between the fine and coarse adjustments).

5. If the Dualpro is not displaying Z-C in the SET (Lower Window of the Dualpro) WINDOW press the enter key to change the first letter, or press the shift key to change the second letter.

6. Use the up and down arrow keys to make any changes to the value and the left and right arrow keys to change the sensitivity of the adjustment.

7. Change the value on the Dualpro to match the value on the calibrator.

8. Once the correct zero value is displayed press the enter key. (This will save the zero calibration value and also prepare the instrument for the span calibration)

9. "ENTER" a span value (refer to the Dualpro manual for proper zero and span values for the t/c wire selected).

10. Verify that the Dualpro display has S-C in the SET (Lower Window of the Dualpro) WINDOW.

11. Use the up and down arrow keys to make any changes to the value and the left and right arrow keys to change the sensitivity of the adjustment.

12. Once the correct span value is displayed press the enter key. (This will save the span calibration value).

13. Repeat steps 3-12 until the calibration values are correct.

Glossary

Anything in block capitals (ANSI, BYTE, BAUD) is an acronym or abbreviation.

Manufactured terms: Technical Jargon for which there is no satisfactory substitute term in common English as spoken in the United States of America.

The definitions provided here are those in common usage at Marathon Monitors. While some may be industry standard others are specialized to Marathon usage.

Glossary:

ANSI (acronym): American National Standard Institute. Organization for setting standards of performance, hardness, safety or other measurable feature. Their standards are used in laws and codes for product safety and reliability.

ASCII (acronym): American Standard Code for Information Interchange. Its use here usually refers to the standard code for serial communications of alphanumeric and control characters.

Asynchronous a communication method where data is sent when it is ready without reference to a timing clock or waiting until the receiver signals it is ready to receive it.

BASIC (n): Beginners All-purpose Symbolic Instruction Code. A programming language developed at Dartmouth College as a learning tool.

BAUD rate (n): standard information exchange speeds that are used by telephone data exchange equipment (modem, fax = facsimile, two-way video conferencing and the like)

equal to number of signal events or BITS per second used.

Binary (n): The basic coding system of all computer languages consisting of 1's and 0's indicating either an off or on position for a switch.

BIT (n): a single minute piece of binary data represented by either a 1 or a 0. A 1 = on, a 0 = off. These on or off positions are grouped into a block of 8 BITS to make up the basic building blocks of data processing memory storage and retrieval.

Block diagram (n): a shortened, graphical representation of the cause and effect relationship between the input and output of the physical system.

Block mapping (g): a method of moving and retrieving stored data that resides in specific memory locations called blocks.

BYTE (N): an eight BIT piece of memory storage and retrieval data.

Buss (n): paralell lines for transfer signals between devices or components.

Character (n): a letter, digit, or other symbol used as a representation of data.
_____String (n): a connected sequence of characters.
Control_____ (n): a character whose appearance in a particular context starts, stops, or modifies an operation that effects the recording, transmission, interpretation or processing of data.

Closed loop (n): a control system in which the control action is dependant on the output in some way.

Control loop (n): The continuous comparison of a process

output to its setpoint ; adjusting the inputs to the process to achieve and maintain that setpoint.

Controlled output (n): The quantity or condition of the item which is controlled.

Controller (n): A device with a transfer function especially tailored to improve the dynamics of a system.   In practice, it is a mechanism, with adjustable parameters, designed to receive a setpoint and feedback signals and to send an output signal to activate a final control element such as a valve.

Control system (n): an arrangement of Physical components organized in a way that allows it to command, direct, regulate itself or another system.

Control signal(n): the quantity or condition which is applied to the item being controlled.

Datalogging (v): recording of historical data about a furnace operation on a computer; to record process parameters.

Decimal (n): base ten number system using the characters 0 through 9 to represent values.

Derivative (n): A function within the a P. I. D. controller which produces an output proportional to the rate of change of the input variable.

Digital Control System (n): a system in which the components are discrete time devices and are exposed to pulsed rather than continuous signals.

DIP switch (acronym) "dual inline package" switch: pre formed micro switch packets which allow the operator to "permanently" preset a single programmable item such as

the address of an instrument in a daisy chain. DIP
switches produce a rudimentary binary message
dependant upon the wiring formation and if they are "read"
by some computer based communications system.

DIN (acronym): an abbreviation for the German national
standards organization, sets exacting standards for
industrial openings in cabinet faces, camera lenses, etc.
Also sets sizes for laboratory glassware, film speeds. used
here in relation to size of opening standard.

Disturbance (n): an undesired input signal which affects the
value of the controlled output. If this is an electronic signal
it is also referred to as "Noise".

DPR = digital process recorder: Honeywell trademarked
name portion as in DPR100, DPR3000 for a chart recorder.
 These recorders range from single pen strip recorders to
multipen circular ones.

Error (n) : the difference between the setpoint of a
controller and its measured variable

Event (n): a binary input or output bit (of data) usually
switch or contact data.
Event mapping (g): the ability of a programmer to place a
bit of information in a specific location where it can then be
retrieved by a program for use.

Feedback (n): the property of a closed loop system which
permits a control variable to be compared with the input so
that the appropriate control action may be formed as a
function of the output and input.

Filter (n): a transducer whose frequency response
characteristics are chosen so that signals within a certain

frequency range are faithfully transmitted with little of other frequencies passing through.

Frequency (n): the number of complete cycles per unit of time that a sinusoidal (or any regular) oscillation occurs.

Gain (n): a number which represents the ratio of the output device to its input.

Gap (n): the space in the flow of processing between groups of parts. In most recipes gaps are expressed as time measurements.

Half duplex (n): a one way at a time data communication; both devices can send and receive data only one at a time.

Handshake (n):   An interface procedure that is based on status/data signals; that assures an orderly data transfer as opposed to an asynchronous exchange.

Hertz (n): An electrical term; a unit of frequency equal to one cycle pre second.

Hexadecimal (n): A base sixteen number system using the characters 0 through 9 and A through F to represent the values. Often abbreviated as HEX.

Host (n): the primary or controlling instrument in a multipart system.

Hystersis (n): The difference in output when a setpoint is first approached with increasing and then decreasing value. Expressed in terms of percent full scale during any one calibration cycle, similar to back-lash in a gear train cycle.

Input (n): a signal or other excitation applied to a control

system from an external source to produce a specific response from the control system.

Integral (adj): the I in P. I. D. control, a function which produces an output which is proportional to the integral of the error signal. When the error is zero the integral is a constant; when the error is a constant, the integral is a ramp function.

Interface (n): the means by which two systems or devices are connected and communicate with each other.

Interpreter (n): a system program that converts and executes each instruction of a high level language program into machine code as it runs before going on to the next instruction.

Interrupt (n): a program device which stops a process or program in such a way that it can be resumed.

Load tracking (n): the record of a group of parts through the processing set for them.

Leading edge (n): the first part of group of parts going through processing.

LED = light emitting diode (n) : abbreviation for a diode functioning as a lamp usually in a digital data display.

Linearize (a verb manufactured from a noun): with a particular, limited range of variables; substitution of a linear function for a non linear one. This linear function gives approximately the same relationships.

Loop (n) a closed path in a feedback control system.

Manipulated variable (n) the process variable that is

changed by the controller in order to effect corrections, the control signal.

Measured variable (n): the process parameter which is being controlled.

Menuing (manufactured verb from the noun menu) options (g) a term adopted by Marathon engineers to name the process of reading menu selections from the screen of a DUALPROÔ or other Marathon instrument with that option in its program.

Noise(n): electronic interference that conceals or causes unwanted fluctuations in the variable or the signal it is supposed to represent. See also Disturbance.

Nominal part density (n) : a predetermined or premeasured quantity of parts concentrated on a given location of a belt in a belt furnace.

Octal (n): a base eight number system using the characters 0 through 7 to represent values.

Offset (n): the steady state error in a control loop stemming from proportional only control action.

ON/OFF control, also called binary or logic control (n) : the control system in which the final control device has only two possible positions or states.

Open loop system: one in which the control is independent of the output.

Operator Interface: (n) the point at which human beings and system instruments connect. This can be a faceplate keyboard, a computer touch screen, or a computer keyboard and monitor. Other "interfaces" include switches, controlling leavers, Non system faceplates, buttons,

monitors and keyboards.

Output: the actual response from the control system.

Overshoot: the difference between the final steady state value and the value of the first reading. Often expressed as a fraction of the difference between the initial and final values.

Parameter: Marathon Monitors uses the term to define a value that occupies a 16 bit binary word. This can consist of signed or unsigned values and the location can be used for one or more values depending on the size of the code required to store the value.

Parameter table: a group of 240 of these data.

PI (acronym) : the Marathon Monitors Inc. version of the predefined constant p.

PLC (abbreviation) = programmable logic controller: a sophisticated piece of equipment capable of communicating with a programming unit--(DUALPRO, Process Master, 10PULSE) and equipment --(solenoid valves, drive belts) with the ability to get work done by the equipment that the programming unit calls for, such as, increasing gas flow to the furnace, moving parts through the furnace, or opening or closing the furnace door. A PLC can store programs and do its own programs as well as those of the control unit. It's response time is shorter than most programming units when relating to switches and controls of the solenoid type.

Proportional (adj): the P in P. I. D.; in a PID controller, the function which produces an output in proportion to the error signal.

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Realrun* screens (n) a display on a computer monitor usually the Process Master file server computer monitor or a node (OVERVIEW 8600) at an operator work station. These screens are used to show current Data in the master DUALPRO* in organized, easy to see format. Realrun* can be used to display limited amounts of computer Data information such as an in process part or job number.

Recipe, (n) a sequential list of setpoints, event action and soak times to be used for every control loop in a system. Setpoints for every control loop in the line of a Beltpro* system.

Reference input (n) :an external signal applied to a feedback control system in order to command a specified action; often representative of ideal behavior.

Regulator (n) : a controller with the primary objective of maintaining an output constant in spite of load variations.

Setpoint (n): The desired value of a measured variable ; the controller acts to make the measured variable match the setpoint.

Settling time (n) : amount of time required to reach 2 to 5 % of the final value.

Stable (n): a state of being, a system that will stay at rest unless excited by an external source and will return to rest in external excitements are removed.

Three mode controller (n) : a P. I. D. controller.

Time constant (n) : the time needed for the output to change from a given value to within 63% of the total change when a step input is made. The Greek letter tau or t in formulas represents this.

Toggle (v) from the noun toggle switch: to move between two preset states -- "to toggle between off and on" for example.

Trailing edge (n) the last of a group of parts going through processing.

Transducer (n) a device that converts one energy form into another.

UDC (abbreviation) = universal digital controller: HoneywellÔ trademarked temperature control devices as in UDC2000, UDC3000 etc.

WORD(n): a two BYTE piece of binary memory storage and retrieval data.

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