DCP 100
Digital Controller Programmer

Operator's Manual

Honeywell

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PREFACE

This manual is intended for use in support of day-to-day operation of the Honeywell DCP 100 Digital Controller Programmer. For information on installation, commissioning, configuration etc., refer to the associated Installation Manual (see below).

Associated Documents

Title	Document No.
DCP 100 Digital Controller Programmer Installation Manual	EN1I-6173

In normal operation, the operator must not remove the controller from its housing or have unrestricted access to the rear terminals, as this would provide potential contact with hazardous live parts.

Installation and configuration *must be undertaken by technically competent servicing personnel*. This is covered in the Installation Manual (see above).

Contents

Illustrations

1   INTRODUCING THE DIGITAL CONTROLLER PROGRAMMER

The DCP 100 Digital Controller Programmer is a powerful, easy-to-use ¼-DIN setpoint programmer with full PID control capability (complete with Self-Tune and Pre-Tune facilities). Its standard features are:

*   Up to eight programs of up to 16 free-format (e.g. dwell, ramp, join or end) segments each.

*   Facility to join programs to one another in any sequence (maximum program length 121 segments).

*   User can change currently-running program segment.

*   Delayed Start of Program facility.

*   End of Program relay output.

*   Universal input - thermocouple, RTD (Pt100) or DC linear
    - user- selectable).

*   Universal power supply (90 - 264V ac 50/60Hz).

*   Configurable from front panel.

*   Comprehensive front panel displays.

*   Front panel sealing to NEMA 4 standard.

*   Behind-panel depth only 100mm.

Optional features include:

*   Remote control and selection of program (plug-in option).

*   Up to four Event relay outputs (plug-in option).

*   Second control output.

*   Recorder output (setpoint or process variable).

*   RS485 serial communications.

*   User-definable program tag names

*   Support software (Off-Line Configurator, On-Line Graphic Program Editor) - operates via RS485 communications link.

The Digital Controller Programmer has four operating modes:

Base Mode: Day-to-day PID control operations with no program running. In this mode, a program may be selected to run.

Program Run Mode: A selected program is running, held or waiting for a pre-defined delay before starting. In this mode, the operator can view status and program information.

Program Define Mode [1]: Used to view/create/edit programs. This mode is entered either from Base Mode (selected program may be edited/created) or from Program Run Mode (currently-running program may be edited).

Controller Define Mode [2]: Used to define the Controller characteristics.

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1   *Entry via Lock Code; also optional Program Lock prevents changing of program definitions while a program is running.*

2   *Entry via a Lock Code.*

2 FRONT PANEL CONTROLS, INDICATORS AND DISPLAYS

2.1 CONTROLS

MODE key	Program key
MODE Changes mode of instrument.	**PROG** Cycles through Program Numbers.
SET UP key	Run/Hold key:
SET UP Displays the next parameter in sequence (indicated by Message display - see Subsection 2.3).	**RUN HOLD** Runs, holds or aborts current program.
Down key	Up key
▼ Decrements displayed parameter value/cycles through options.	▲ Increments displayed parameter value/cycles through options.
▲ **+** MODE Selects/de-selects Self-Tune and Pre-Tune (when Message Display shows appropriate message).	▲ **+** PROG Jumps to next segment, when a program is running.
SET UP **+** MODE Selects/de-selects Manual Control (see Section 7).	▲ **+** ▼ Sets a segment to Soak when defining a program.

Figure 2-1   Front Panel Controls

2.2   INDICATORS

	Control Status Indicators	
● AT	**AT**	ON when Self-Tune is active; flashes when Pre-Tune is active.
● ALM	**ALM**	Flashes when any alarm is active.
● OUT1	**OUT1**	ON when primary control output is active.
● OUT2	**OUT2**	ON when secondary control output (if fitted) is active.
● MAN	**MAN**	ON when Manual Control is selected.

	Run Status Indicators	
RUN ●	**RUN**	ON - Program running or (if **HLD** ON also) held Flashing - Program in Delayed state
HLD ●	**HLD**	ON - Program held Flashing - Program in Guaranteed Soak
x60 ●	**x60**	OFF - timebase = hours/minutes ON - timebase = minutes/seconds

	Event Indicators
EV1 ●	Each indicates the status (active or inactive) of a user-defined event (OFF = inactive, ON = active).
EV2 ●	
EV3 ●	
EV4 ●	

	Mode Indicators	
SET ●	**SET**	ON when Controller Define Mode or Program Define Mode is entered; flashes when viewing parameters in Controller Define Mode or Program Define Mode after entry from Base Mode.
PRG ●	**PRG -**	ON when Program Define Mode is entered.

Figure 2-2   Front Panel Indicators

2.3   DISPLAYS

Lower Display
Setpoint value or value/setting of parameter being viewed/edited.

Upper Display
Process Variable value.

Message Display

Honeywell

● AT
● ALM
● OUT1
● OUT2
○ MAN

1998

200.0

Setpoint

EV1 ●
EV2 ●
EV3 ●
EV4 ●

RUN ●
HLD ●
x60 ●

PRG   SEG

SET ●
PRG ○

3   *12*   ▲

┌ MAN ┐

▼   ▲   SET UP   MODE   PROG   RUN HOLD

└─── ADVANCE ───┘   SEG ABORT

Program Number
Number of currently-selected program

Segment Number
Number of current segment

Current Ramp State

△   = Up ramp
▽   = Down ramp
Both ON   = Soak
Both flashing   = In Manual Control while program is running.

Figure 2-3   Front Panel Displays

2.4   ALARM STATUS INDICATION

When any alarm is active, the **ALM** indicator will flash. To view the alarm status in the Message Display, press the **SET UP** key until a display appears of the form:

Appears only if Alarm 1 is active ——————

Appears only if Alarm 2 is active ——————————

Appears only if the Loop Alarm is active ——————————————

Figure 2-4   Alarm Status Display

2.5   VIEWING PROGRAM AND CONTROLLER PARAMETERS

In Base Mode (i.e. with no program currently running or held), the **MODE** key gives "view only" access to Program Define Mode and Controller Define Mode:

VIEW ONLY   VIEW ONLY

BASE MODE   [MODE]→   PROGRAM DEFINE MODE   [MODE]→   CONTROLLER DEFINE MODE

See Section 8   See Section 9
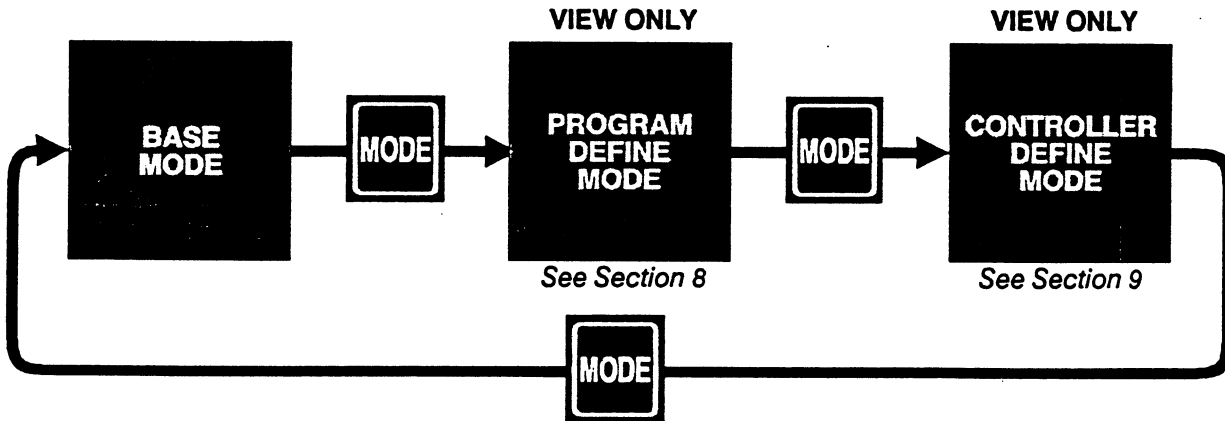
[MODE]

3   PROGRAMS

3.1   SELECTING AND RUNNING A PROGRAM

When no program is running, the Digital Controller Programmer is in Base Mode and the **RUN** and **HLD** indicators are OFF. In this mode, select a program as follows:

> 1. Hold down the **PROG** key until the required program number is displayed.
>
> 2. Press the Run/Hold key once to start the program. The **RUN** indicator will then go ON; the Digital Controller Programmer is now in Program Run Mode.

3.2   CHANGING THE PROGRAM TIMEBASE

Whilst a program is running, the normal timebase is hours/minutes. To change to a timebase of minutes/seconds (i.e. select the x60 facility), press the Up key for more than five seconds, whereupon the **x60** indicator will go ON. To cancel operation on the x60 timebase, press the Down key for more than five seconds, whereupon the **x60** indicator will go OFF.

3.3   HOLDING A PROGRAM MANUALLY

The operator may hold or freeze a program by momentarily pressing the Run/Hold key. The **HLD** indicator will then go ON (the **RUN** indicator staying ON) and the program will stop execution. The progam may subsequently be restarted by momentarily pressing the Run/Hold key again.

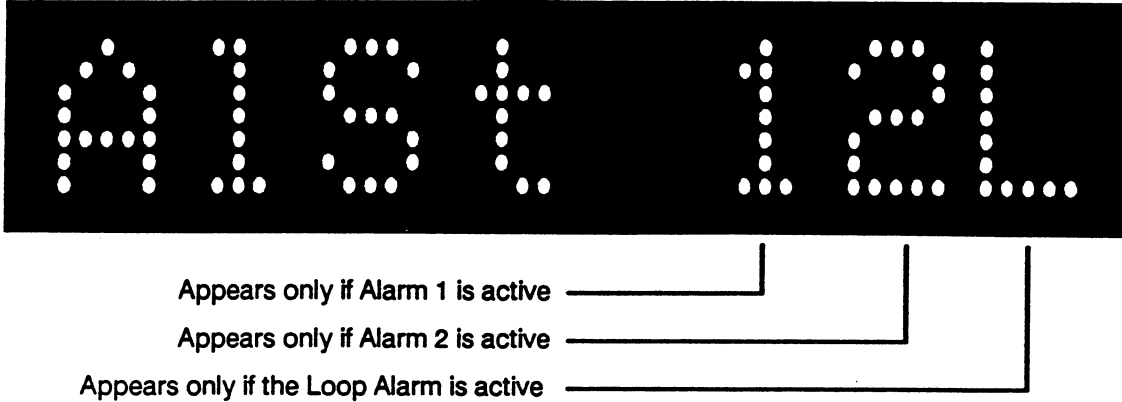> **HLD INDICATOR FLASHING:** If, before the operator holds the program manually, the **HLD** indicator starts flashing, this indicates that the program is currently subject to a Guaranteed Soak (see Subsection 8.3). If the Run/Hold key is pressed (for a manual Hold), the **HLD** indicator will go ON continuously. When the operator removes the manual Hold (by pressing the Run/Hold key again), the **HLD** indicator will either flash (indicating that the Guaranteed Soak conditions still prevail) or go OFF (indicating that the Guaranteed Soak conditions no longer exist).
>
> **RUN INDICATOR FLASHING:** This indicates that the program is in a Delay state i.e. is timed to start after a user-defined delay has elapsed. When the delay period has elapsed, the program will run and the **RUN** indicator will come on continuously.

3.4   JUMPING TO THE NEXT SEGMENT

At any time during a program's execution, the operator may jump forward to the next segment by simultaneously pressing the **PROG** and Up keys.

Note that, since programs may be joined or set to cycle, jumping past the last segment in a program may result in changes in the Program Number and Cycle Count.

3.5 VIEWING PROGRAM PROGRESS/STATUS

In Program Run Mode, a number of displays are made available to the operator (in the Message Display area) which indicate program progress/status. Whilst the current program is running, held or delayed, press the **SET UP** key to cycle through a sequence of program status displays with the following legends in the Message Display:
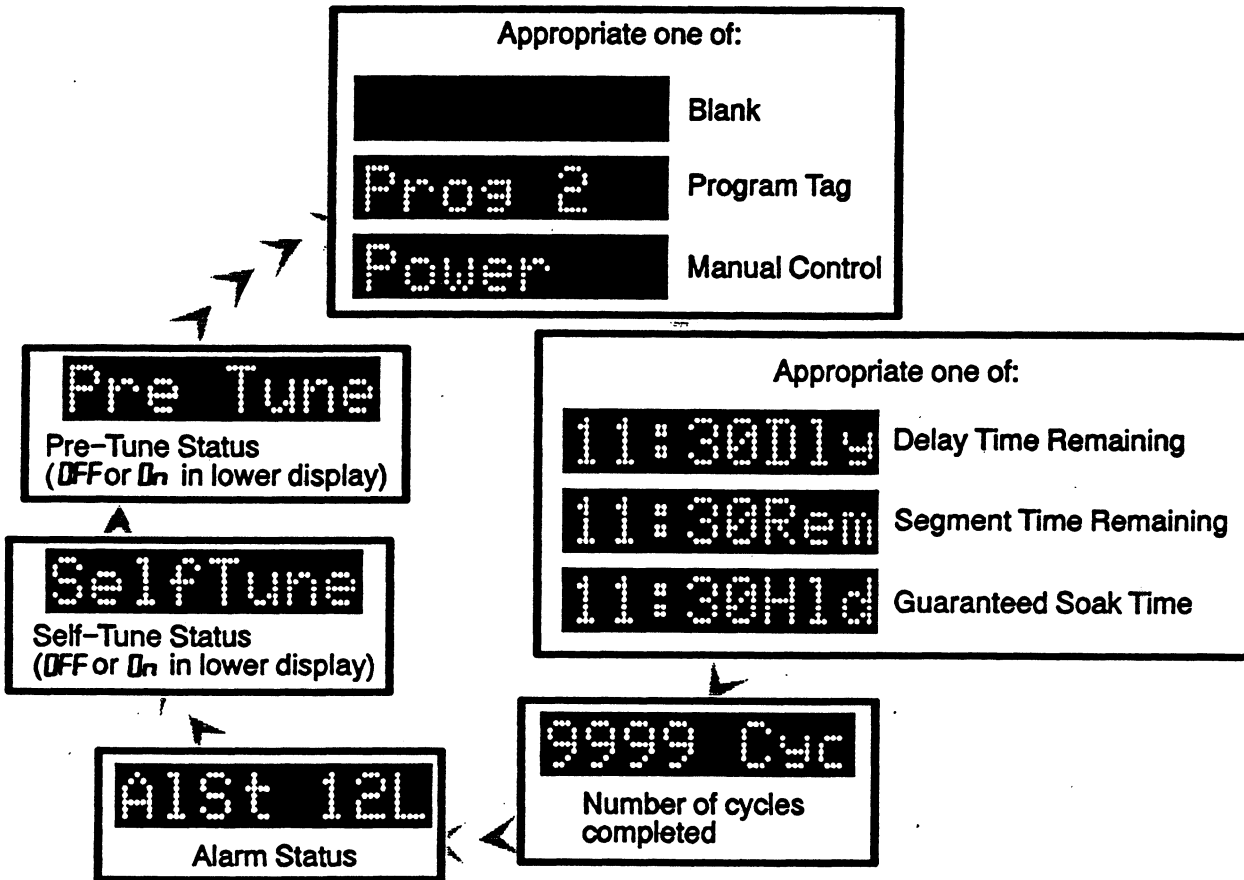
In the case of Segment Time Remaining or Guaranteed Soak Time display, the time is in hours/minutes (if the x60 indicator is OFF) or minutes/seconds (if the x60 indicator is ON). The Delay Time display is *always* in hours/minutes.

> NOTE: If the **SET UP** key is held for two seconds or longer, the Digital Controller Programmer will auto-scroll through the above display cycle (with the exception of the Self-Tune and Pre-Tune displays). To stop the Auto-scroll, press any key other than the **SET UP** key.

After all applicable program status/progress displays have been shown, press the **SET UP** key to return to the Base Mode displays.

3.6 ABORTING A PROGRAM

The operator may abort (i.e. terminate) the current program by holding down the Run/Hold key for more than five seconds. When the program is aborted, a return is made to the Base Mode and the Message Display will show:

```
Aborted
```

This message will be removed by the next keypress.

3.7 "END OF PROGRAM" INDICATION

When the program has reached its End Marker, the Message Display shows:

```
at End
```

and a return is made to Base Mode.

3.8 VIEWING PROGRAM AND CONTROLLER PARAMETERS

In Program Run Mode (i.e. with a program currently running or held), the **MODE** key gives "view only" access to Program Define Mode and Controller Define Mode:

VIEW ONLY   VIEW ONLY

PROGRAM RUN MODE → MODE → PROGRAM DEFINE MODE → MODE → CONTROLLER DEFINE MODE

See Section 8   See Section 9
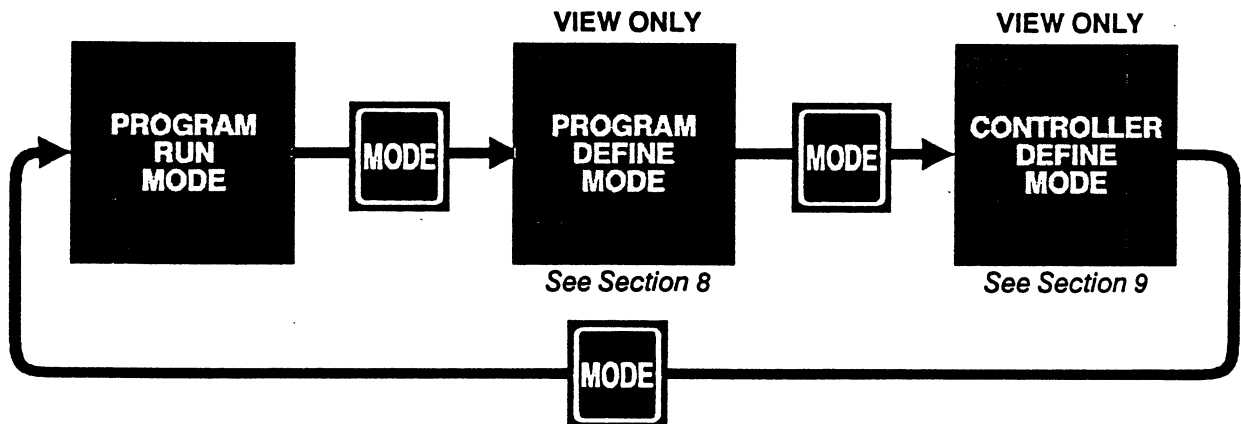
MODE

4   ADJUSTING THE SETPOINT

With the Digital Controller Programmer in Base Mode (i.e. with the **RUN, HLD, SET** and **PRG** indicators OFF), the two main displays will show the process variable value (upper display) and the setpoint value (lower display - Read Only). To change the setpoint value:

   1. Press the **SET UP** key; the Message Area will display:

   Cont. SP

   2. Use the Up and Down keys to change the setpoint value (in the lower display) as required.

   3. When the setpoint value is set as desired, press the **SET UP** key again to return to the initial display.

5   USING THE SELF-TUNE FACILITY

The Self-Tune facility is used to optimise tuning whilst the Controller part of the Digital Controller Programmer is operating. Self Tune may be activated as follows:

> 1. With the Digital Controller Programmer in Base Mode (with the **RUN** and **HLD** indicators OFF), press the **SET UP** key until the Message Display shows:

> **SelfTune**

> and the lower Main Display shows:

> **OFF**

> 2. Press the **MODE** and Up keys to change the lower Main Display to:

> **On**

> indicating that the Self-Tune facility is now activated.

To de-activate the Self-Tune facility, press the **SET UP** key to obtain the same Message Display as above; then press the **MODE** and Up keys simultaneously to change the lower Main Display from **On** to **OFF**.

6   USING THE PRE-TUNE FACILITY

The Pre-Tune facility is used to set the Digital Controller Programmer's PID control parameters to values which are approximately correct in order to provide a base from which the Self-Tune facility may subsequently optimise tuning. Pre-Tune may be activated as follows:

> 1. With the Digital Controller Programmer in Base Mode (with the **RUN** and **HLD** indicators OFF), press the **SET UP** key until the Message Display shows:

> and the lower Main Display shows:

> 2. Press the **MODE** and Up keys to change the lower Main Display to:

> indicating that the Pre-Tune facility is now activated.

> NOTES

> 1. If the process variable is within 5% of the input span from the setpoint, the Pre-Tune facility cannot be activated and any attempt to do so will have no effect.

> 2. Since the Pre-Tune facility is a single-shot operation, it will automatically de-activate itself once the operation is complete.

To de-activate the Pre-Tune facility manually (with the Digital Controller Programmer in Base Mode), press the **SET UP** key to obtain the same Message Display as above; then press the **MODE** and Up keys to change the lower Main Display from **On** to **OFF**.

7   MANUAL CONTROL

In any mode except Configuration Mode or Calibration Mode, the operator may select manual control of the process by simultaneously pressing the **SET UP** and **MODE** keys. The Digital Controller Programmer will then enter Base Mode or (if a program is currently running) Program Run Mode with the program held. The Message Display will show:

and the lower Main Display will show the power output value, which may then be adjusted using the Up and Down keys. Whilst manual control is being exercised, the power output display is included in the displays available in Base Mode and Program Run Mode.

To cancel manual control, press the **SET UP** and **MODE** keys simultaneously, whereupon the power out value display and the **Power** Message Display will disappear and the Digital Controller Programmer will remain in whatever mode prevailed when manual control was cancelled (if this is Program Run Mode, the currently-running program will be resumed from the point at which it was held).

8 DEFINING AND VIEWING A PROGRAM (PROGRAM DEFINE MODE)

The Digital Controller Programmer may be put into Program Define Mode from either Base Mode or Program Run Mode (i.e. with a program currently running).

8.1 ENTRY INTO PROGRAM DEFINE MODE

1. Press the **SET UP** and Up keys simultaneously. The lower Main Display will show **0** and the Message Display will show:

2. Use the Up and Down keys to set the value in the lower Main Display to the Lock Value (defined by the user in Controller Define Mode) and press the **SET UP** key.

The Digital Controller Programmer will enter Program Define Mode, the **SET** and **PRG** indicators will go ON and the operator will be able to edit programs and segments. The **MODE** key can then be used (a) to switch to Controller Define Mode (see Section 9), and then (b) to show a Message Display:
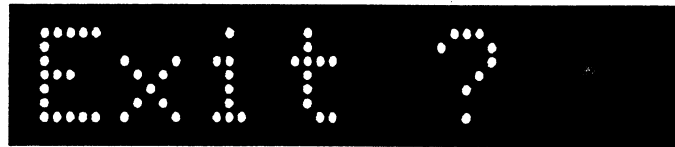
To return to Program Define Mode (and re-start the Program Define/Controller Define/**Exit?** display cycle), press the **MODE** key; to return to Base Mode, press the **SET UP** key.

If an incorrect lock value is entered, the Digital Controller Programmer will return to Base Mode.

Program parameters are divided into three categories:

(a) Those common to all programs - global parameters
(b) Those common to all segemnts in a specific program
(c) Those relevant to a specific segment in a specific program

Upon entry into Program Define Mode, the operator will be presented with the first of a sequence of parameter displays (see following Subsections). The operator may then step through the sequence, using the **SET UP** key. The displayed Program Number may be changed using the **PROG** key and the displayed Segment Number may be changed using the Run/Hold key.

> NOTE: If entry is made from Program Run Mode and Program Lock is On, only Controller Define Mode will be accessible.

8.2 PARAMETERS COMMON TO ALL PROGRAMS (GLOBAL)

Program Number = A ⟶ [A] ⟵ Segment Number = Blank

Parameter	Message Display	Function	Available Settings (Lower Main Display)	
Start On	Start on	Defines setpoint value at start of each program	SEtP	Current setpoint value
			Proc	Current process variable value
End On	End on	Defines setpoint value at end of each program	F_SP	End on Final SP value [1]
			SEtP	End on Controller SP value
Delay Time	Delay	Defines delay (in hours/minutes) between initiating the program and the program actually starting	Numerical value, with the decimal point acting as the de-limiter between the two units (hours/minutes)	
Program Lock	ProgLock	Defines whether the operator is permitted to change program definitions whilst a program is running/held	On	No changes permitted
			OFF	Changes permitted
Power Fail Recovery	Recovery	Defines response to restoration of power after power failure	0.00 or 1.00 if no Real Time Clock. 0.00 or time (0.01 - 24.00) if Real Time Clock fitted. 0.00 = Cold Start [2] 1.00 or time = Warm Start [3]	
RTC Time [4]	RTC Time	Defines Real Time Clock initial setting (hours.minutes)	0.10 - 24.00	
RTC Day [4]	RTC Day	Defines Real Time Clock initial setting (day of week)	Sun, Mon, tuE, WEd, thu, Fri or SAt	
External Selection	Ext. Sel	Defines functions which may be controlled externally	nonE	No external selection
			SEL	Program selection only
			run	Only Run, Hold, Abort and x60 functions
			both	All program selection and run control functions

1. The Final Setpoint value for the End Marker of each program - see Subsection 8.4.

2. Cold Start = Base Mode with Program No. as when power failed and Segment No. blank.

3. Warm Start = resumption from point when power failed (with RTC, if Time has not expired, otherwise Cold Start).

4. Available only if Real Time Clock option fitted.

8.3 PARAMETERS WHICH APPLY TO A SPECIFIC PROGRAM AS A WHOLE

Program Number = 1 to 8 ➡️ `[ 1 ][ ]` ⬅️ Segment Number = Blank

Parameter	Message Display	Function	Available Settings (Lower Main Display)	
Cycle Count	`Cycles`	Defines the number of times a program will be repeated	0 - 9999	Program will repeat the set number of times.
			`inF`	Program will repeat indefinitely
Guaranteed Soak	`G. Soak`	Selects operation of Guaranteed Soak facility (relative to setpoint) - see Figure 8-1	`OFF`	No Guaranteed Soak
			`H_SP`	Guaranteed Soak above setpoint only
			`L_SP`	Guaranteed Soak below setpoint only
			`both`	Guaranteed Soak above and below setpoint
Guaranteed Soak Band	`G.S.Band`	Defines the width of the Guaranteed Soak Band - see Figure 8-1	Numerical value (0 to span)	
Guaranteed Soak On	`G.S. on`	Defines whether the Guaranteed Soak facility is used on ramps only, on soaks only or on both ramps and soaks	`S_r`	Guaranteed Soak on ramps and soaks
			`S`	Guaranteed Soak on soaks only
			`r`	Guaranteed Soak on ramps only
Pre-x60	`Pre-x60`	Defines functions whether the timebase for the program is pre-selected to be hours/minutes or minutes/seconds (NOTE: This parameter setting is over-ruled by the external "x60" input).	`nonE`	No pre-selection
			`On`	Minutes/seconds
			`OFF`	Hours/minutes
Timer (RTC only)	`Timer`	Selects/de-selects timer control of program.	`On` or `OFF`	
Start Hour (Timer On)	`Start Hr`	Defines start time for program.	24.00 (0.00) - 23.59	
Star Day (Timer On)	`StartDay`	Defines day(s) for program to be run.	Sun, Mon, tuE, WEd, thu, Fri, SAt, 5 dY (Mon - Fri), 6 dY (Mon - Sat) or ALL (all 7 days of the week).	

This sequence may be viewed/edited for any program by changing the Program Number with the **PROG** key, then stepping through the parameters with the **SET UP** key.
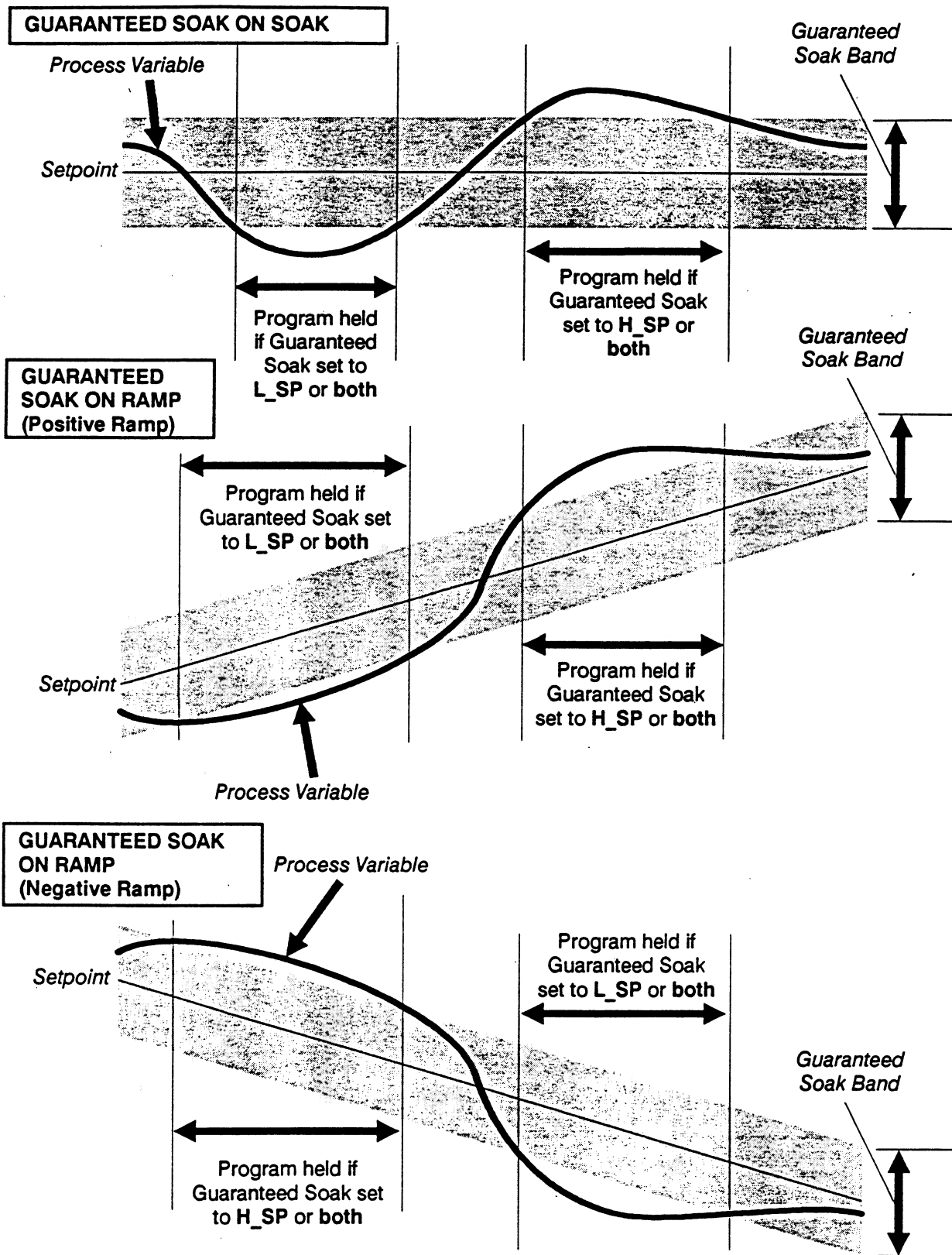
GUARANTEED SOAK ON SOAK

Process Variable

Guaranteed Soak Band

Setpoint

Program held
if Guaranteed
Soak set to
L_SP or **both**

Program held if
Guaranteed Soak
set to **H_SP** or
both

**GUARANTEED
SOAK ON RAMP
(Positive Ramp)**

Guaranteed Soak Band

Program held if
Guaranteed Soak set
to **L_SP** or **both**

Setpoint

Program held if
Guaranteed Soak
set to **H_SP** or **both**

Process Variable

**GUARANTEED SOAK
ON RAMP
(Negative Ramp)**

Process Variable

Program held if
Guaranteed Soak
set to **L_SP** or **both**

Setpoint

Guaranteed Soak Band

Program held if
Guaranteed Soak set
to **H_SP** or **both**

Figure 8-1   Guaranteed Soak Operation

8.4 PARAMETERS IN ANY/EACH SEGMENT IN A SPECIFIC PROGRAM

Program Number = 1 to 8 ➡ **| 1 | 1 |** ⬅ Segment Number = 1 to 16

Parameter	Message Display	Function	Available Settings (Lower Main Display)
Final Setpoint Value	`Final SP`	Defines the final setpoint value for this segment, selects a Soak segment or indicates a Join, Repeat or End Marker	Numeric value (limited by SPHi and SPLo) or (by pressing the Up and Down keys simultaneously) indicates a Soak segment with: [▬ ▬ ▬ ▬] or, if the segment is already a Join, Repeat or End Marker, as shown below.
Segment Time or Ramp Rate as selected in Configuration Mode (see Site Manual	`Time` or `RampRate` as appropriate	Defines the duration or ramp rate of the segment or whether it is a Join Marker, Repeat Marker or End Marker *	Four-digit number in the form nn.nn (hours.minutes or minutes.seconds) or negative values as follows: J01 Join to Program 1 J02 Join to Program 2 J03 Join to Program 3 J04 Join to Program 4 J05 Join to Program 5 J06 Join to Program 6 J07 Join to Program 7 J08 Join to Program 8 REP Repeat Marker End End Marker
Event [†]	`Event`	Defines the states of the four event outputs for this segment	Four-bit binary number (0 = inactive, 1 = active): [▮▮▮▮] ├── Event 1 ├── Event 2 ├── Event 3 └── Event 4

* If a segment is set to be a Join Marker, a Repeat Marker or an End Marker, the next depression of the **SET UP** key will set the Segment Number to A and the first parameter common to the whole program (Cycle Count - see Subsection 8.3) will be displayed. Otherwise, the next depression of the **SET UP** key will display the next segment parameter - Event (for the current segment) if the Event Output hardware is fitted.

† This parameter appears in the sequence only if the Event Output hardware is fitted, in which case this parameter will be followed by the Final Setpoint Value parameter for the next segment. If the Event Output hardware is not fitted, this parameter will be omitted from the sequence and the Segment Number will be advanced, causing the Final Setpoint Value parameter for the next segment to appear immediately.

CANCELLING JOIN, REPEAT OR END MARKERS

To cancel a Join, Repeat or End Marker:

> (a) at the Final Setpoint Value parameter, press the Up and Down keys simultaneously to produce a Soak segment, or

> (b) at the Segment Time/Ramp Rate parameter, increment the value to 0 or a positive value.

## 8.5 USING JOIN, REPEAT AND END MARKERS AND CYCLING PROGRAMS

By default, the Digital Controller Programmer has eight programs, each 16 segments long (all 16 segments are active and, at the end of Segment 16 is an implicit End Marker). These programs can be made shorter (using End Markers) or longer (by creating program sequences with Join, Repeat and End Markers). The only limit to the size of a program sequence is a maximum length of 121 active segments plus seven Join Markers plus one End Marker (i.e. all eight programs joined to make one program sequence).

Segments follow a free format in that ramp or dwell can be followed by dwell or ramp, completely as desired.

Consider two example programs:

PROGRAM 1
(5 active segments, 1 End Marker)

PROGRAM 2
(3 active segments, 1 End Marker)
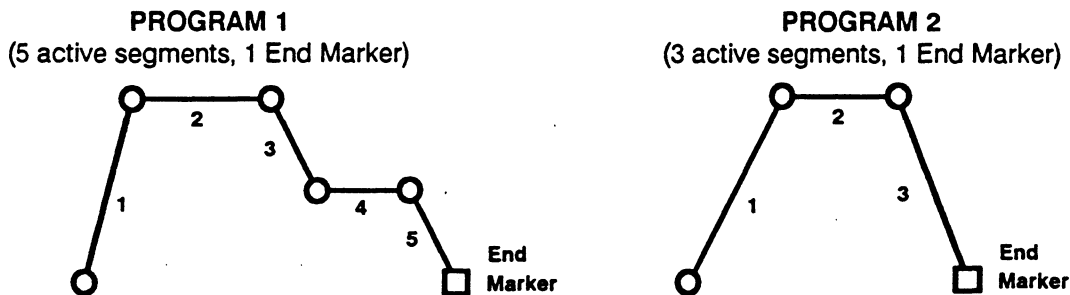
To join the two programs to form a program sequence, change the End Marker of Program 1 to a Join Marker (Segment Time/Ramp Rate set to **J02** - Join Program 2):

PROGRAM 1
(5 active segments, 1 Join Marker)
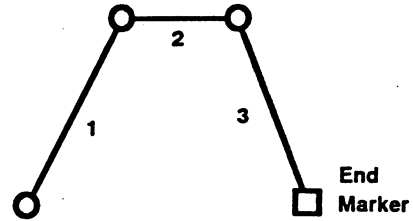
PROGRAM 2
(3 active segments, 1 End Marker)
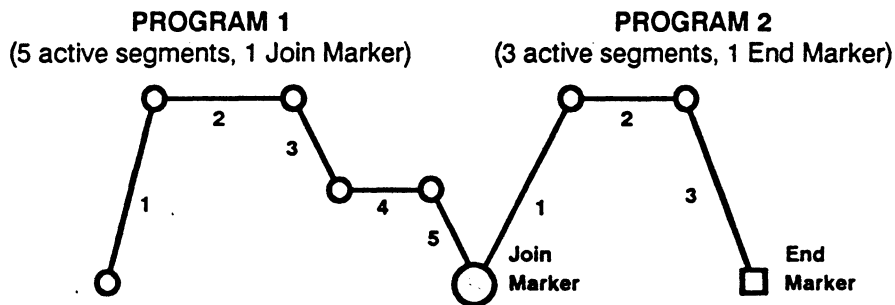
There are no restrictions on joining programs; several programs can be joined to one program (e.g. to provide user-selectable warm-up programs, depending upon which program is run first).

The Cycle feature can be used to make more complex program sequences. Consider the two simple example programs previously described:
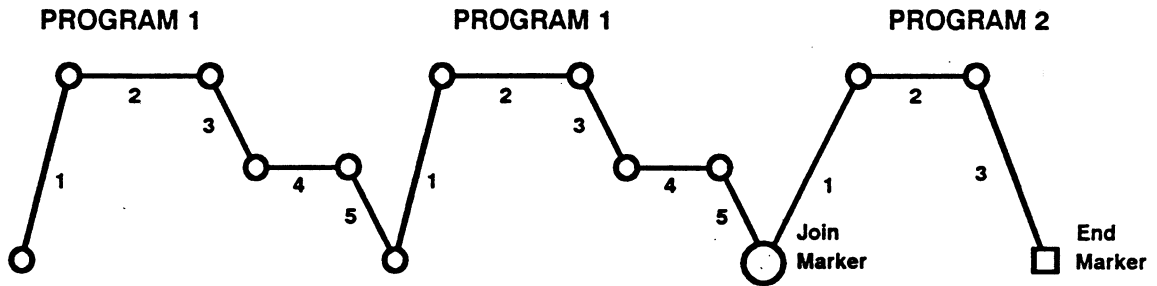
PROGRAM 1
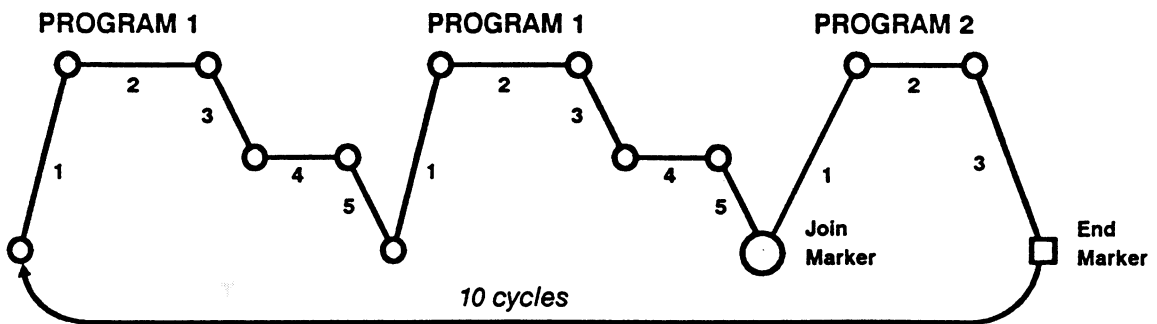(5 active segments, 1 End Marker)
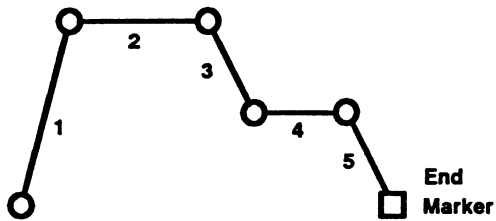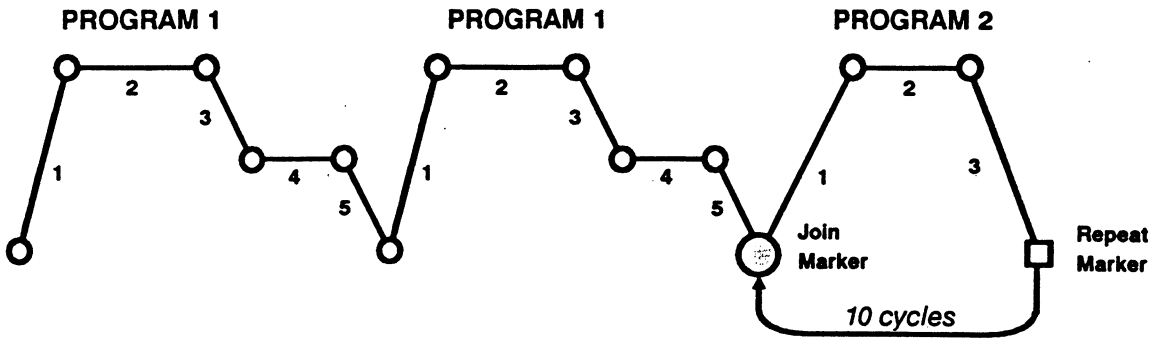
PROGRAM 2
(3 active segments, 1 End Marker)

and consider the case in which Program 1 is set to perform two cycles and is joined to Program 2. When Program 1 is run, the result would be:

PROGRAM 1   PROGRAM 1   PROGRAM 2

If Program 2 were now set to perform ten cycles, the result would be:

PROGRAM 1   PROGRAM 1   PROGRAM 2

10 cycles

Now, with Program 2 set to perforn ten cycles, if the the End Marker of Program 2 were changed to a Repeat Marker (Segment Time/Ramp Rate set to **REP**), the result would be:

PROGRAM 1   **PROGRAM 1**   **PROGRAM 2**

10 cycles

At the end of the tenth cycle of Program 2, the program sequence would end.

8.6   BASIC RULES TO REMEMBER

In any program sequence:

 * A program ending in a Join Marker will perform the required number of cycles *of itself* before joining the new program.

 * A program ending in a Repeat Marker (hence, by definition, the last program in the sequence) will perform the required number of cycles *of itself* before ending the sequence.

 * A program ending in an End Marker (hence, by definition, the last program in the sequence) will perform its cycle count on *the entire program sequence* before ending that sequence.

8.7   EXITING PROGRAM DEFINE MODE

The operator may exit from Program Define Mode by pressing the **MODE** key until the **Exit ?** prompt appears in the Message Display, then pressing the **SET UP** key, which will cause a return to the mode from which entry was made.

NOTE

An automatic return is made if there is no key activity in Program Define Mode for five minutes.

9   DEFINING THE CONTROLLER PARAMETERS (CONTROLLER DEFINE MODE)

Entry can be made into this mode from Program Define Mode, Program Run Mode or Base Mode.

To enter from Base Mode or Program Run Mode:

    1. Press the **SET UP** and Up keys simultaneously. The lower Main Display will show 0 and the Message Display will show:

    2. Use the Up and Down keys to set the value in the lower Main Display to the correct Lock Code Value (defined by the user in Controller Define Mode) and press the **SET UP** key. The Digital Controller Programmer is now in Program Define Mode.

    NOTE: If an incorrect Lock Code Value is entered, the Digital Controller Programmer will return to its original mode (i.e. Base Mode or Program Run Mode).

    3. Press the **MODE** key.

The Digital Controller Programmer is now in Controller Define Mode.

To enter from Program Define Mode press the **MODE** key.

Upon entry into Controller Define Mode, the **SET** indicator will come ON and the first of the Controller parameters (Input Filter Time Constant) will be presented for editing/viewing. Using the **SET UP** key, step through the sequence of Controller parameters, editing as required (using the Up/Down keys).

9.1 CONTROLLER PARAMETERS

The Controller parameters appear in the following sequence:

Parameter	Message Display	Function	Available Settings/Values (Lower Main Display)
Input Filter Time Constant	`Filter`	Defines time constant for input filter (removes extraneous impulses from the process variable input).	0.0 seconds (filter OFF) to 100.0 seconds in 0.5-second increments. Default = 2.0 seconds.
Process Variable Offset [1]	`Offset`	Modifies actual PV value: Offset PV + actual PV = PV value used	For linear input, limited by Scale Range Maximum and Scale Range Minimum. Default = 0.
Output 1 Power	`Out1`	Indicates current Output 1 power level.	Not adjustable - "read only".
Output 2 Power [2]	`Out2`	Indicates current Output 2 power level.	Not adjustable - "read only".
Proportional Band 1 (PB1)	`P.Band 1`	Defines portion of input span in which the Output 1 power level is proportional to the (offset) process variable value (see Figure 9-1).	0.0% (ON/OFF Control) to 999.9% of input span. Default = 10.0%.
Proportional Band 2 (PB2)	`P.Band 2`	Defines portion of input span in which the Output 2 power level is proportional to the (offset) process variable value (see Figure 9-1).	0.0% (ON/OFF Control) to 999.9% of input span. Default = 10.0%.
Reset [3]	`Reset`	Integral Time Constant	1second to 99 minutes 59 seconds
Rate [3]	`Rate`	Derivative Time Constant	00 seconds to 99 minutes 59 seconds
Overlap or Deadband [4]	`Overlap`	Defines the portion of the Proportional Band (PB1 + PB2) over which both outputs are active (Overlap) or neither output is active (deadband) - see Figure 9-1.	−20% to +20% (negative value = deadband, positive value = overlap). Default = 0%.
Bias (Manual Reset) [3]	`Bias`	Bias applied to output power, expressed as a percentage of output power.	0% to 100% (Output 1 only) −100% to +100% (Output 1 & Output 2) Default = 25%
ON/OFF Differential [5]	`Diff 1` `Diff 2` `Diff`	Switching differential for one output (Diff 1 or Diff 2) or both outputs (Diff) set to ON/OFF control (PB1, PB2 or both = 0%)	0.1% to 10% of input span. Default = 0.5%

Continued overleaf ⇒ ⇒ ⇒ ⇒

Parameter	Message Display	Function	Available Settings/Values (Lower Main Display)
Setpoint High Limit [6]	`SP High`	The maximum limit for setpoint adjustment. **Should be set to a value which prevents setpoint values causing damage to the process.**	Current setpoint value to Input Range Maximum. Default = Input Range Maximum.
Setpoint Low Limit [6]	`SP Low`	The minimum limit for setpoint adjustment. **Should be set to a value which prevents setpoint values causing damage to the process.**	Input Range Minimum to current setpoint value. Default = Input Range Minimum.
Recorder Output Scale Maximum [7]	`Rec High`	The value of the process variable or setpoint (as applicable) for which the recorder output is a maximum.	−1999 to 9999 (decimal point as for the process variable input range). Default = Input Range Maximum.
Recorder Output Scale Minimum [7]	`Rec Low`	The value of the process variable or setpoint (as applicable) for which the recorder output is a minimum.	−1999 to 9999 (decimal point as for the process variable input range). Default = Input Range Minimum.
Output Power Limit [3]	`Out High`	Limits the power level of Output 1 (used to protect the process).	0% to 100%.
Output 1 Cycle Time [8]	`CycTime1`	Limits the frequency of operation of output relay to maximise relay life.	0.5, 1, 2, 4, 8, 16, 32, 64, 128, 256 or 512 seconds. Default = 32 seconds.
Output 2 Cycle Time [8]	`CycTime2`	Limits the frequency of operation of output relay to maximise relay life.	0.5, 1, 2, 4, 8, 16, 32, 64, 128, 256 or 512 seconds. Default = 32 seconds.
Process High Alarm 1 value	`HiAlarm1`	If Alarm 1 is a Process High Alarm, the value of the process variable at or above which Alarm 1 will be active (see Figure 9-2).	Input Range Maximum to Input Range Minimum. Default = Input Range Maximum.
Process Low Alarm 1 value	`LoAlarm1`	If Alarm 1 is a Process Low Alarm, the value of the process variable at or below which Alarm 1 will be active (see Figure 9-2).	Input Range Maximum to Input Range Minimum. Default = Input Range Minimum.
Band Alarm 1 value	`BaAlarm1`	If Alarm 1 is a Band Alarm, the band of process variable values (centred on the setpoint) outside which the process variable will cause this alarm to be active (see Figure 9-2).	±(input span) from setpoint. Default = 5 input units.

Continued overleaf ⇒⇒⇒⇒

Parameter	Message Display	Function	Available Settings/Values (Lower Main Display)
Deviation (High/Low) Alarm 1 value	`DeAlarm1`	If Alarm 1 is a Deviation High/Low Alarm, gives a value above (positive value) or below (negative value) the setpoint. If the process variable deviates from the setpoint by a margin greater than this value, the alarm becomes active (see Figure 9-2).	±(input range) from setpoint. Default = 5 input range units.
Alarm 1 Hysteresis value	`Al1 Hyst`	Defines a hysteresis band on the "safe" side of the Alarm 1 value (see Figure 9-3).	1 LSD to 10% of input span (0 is an invalid value).
Process High Alarm 2 value	`HiAlarm2`	If Alarm 2 is a Process High Alarm, the value of the process variable at or above which Alarm 2 will be active (see Figure 9-2).	Input Range Maximum to Input Range Minimum. Default = Input Range Maximum.
Process Low Alarm 2 value	`LoAlarm2`	If Alarm 2 is a Process Low Alarm, the value of the process variable at or below which Alarm 2 will be active (see Figure 9-2).	Input Range Maximum to Input Range Minimum. Default = Input Range Minimum.
Band Alarm 2 value	`BaAlarm2`	If Alarm 2 is a Band Alarm, the band of process variable values (centred on the setpoint) outside which the process variable will cause this alarm to be active (see Figure 9-2).	±(input span) from setpoint. Default = 5 input units.
Deviation (High/Low) Alarm 2 value	`DeAlarm2`	If Alarm 2 is a Deviation High/Low Alarm, gives a value above (positive value) or below (negative value) the setpoint. If the process variable deviates from the setpoint by a margin greater than this value, the alarm becomes active (see Figure 9-2).	±(input range) from setpoint. Default = 5 input range units.
Alarm 2 Hysteresis value	`Al2 Hyst`	Defines a hysteresis band on the "safe" side of the Alarm 2 value (see Figure 9-3).	1 LSD to 10% of input span (0 is an invalid value).
Loop Alarm Enable	`Loop Alm`	Enables/disables Loop Alarm (see Subsection 9.3)	0 (Disabled), 1 (Enabled). Default = 0 (Disabled)

Continued overleaf ⇒⇒⇒⇒

Parameter	Message Display	Function	Available Settings/Values (Lower Main Display)
Loop Alarm Time	`LpAtime`	If ON/OFF control is selected (i.e. PB1 = 0) and Loop Alarm is enabled, this defines the duration of the saturation condition after which the Loop Alarm is activated (see Subsection 9.3)	1 second to 99 minutes 59 seconds Default = 99 minutes 59 seconds
Scale Range Decimal Point [9]	`Range Pt`	For linear inputs, defines the decimal point position.	0 XXXX 1 XXX.X (default) 2 XX.XX 3 X.XXX
Scale Range Maximum [9]	`Range Hi`	For linear inputs, defines the scaled input value when the process variable input is at its maximum value.	−1999 to 9999 (decimal point as defined by Scale Range decimal Point parameter). Default = 100.0
Scale Range Minimum [9]	`Range Lo`	For linear inputs, defines the scaled input value when the process variable input is at its minimum value.	−1999 to 9999 (decimal point as defined by Scale Range decimal Point parameter). Default = 0.0
Auto Pre-Tune Enable/Disable	`Auto PT`	Determines whether the Pre-Tune facility is automatically activated on power-up.	OFF = Disabled On = Enabled Default = OFF
Manual Control Enable/Disable	`A/M Enab`	Enables/disables operator selection of manual control.	OFF = Disabled On = Enabled Default = OFF
Communications Write Enable/Disable [10]	`ComWrite`	Enables/disables changing of parameter values or settings via the RS485 Communications link.	OFF = Disabled On = Enabled Default = OFF
Lock value	`Lock`	Defines the four-digit code required to enter Program Define Mode or Controller Define Mode.	0 to 9999. Default = 10.

NOTES ON CONTROLLER DEFINE MODE PARAMETERS

1. The Process Variable Offset value should be chosen with care. Any adjustment to this parameter is, in effect, a calibration adjustment. Injudicious application of values to this parameter could lead to the displayed process variable value bearing no meaningful relationship to the actual process variable value. **There is no front panel indication when this parameter is in effect (i.e. has been set to a non-zero value).**

2. These parameters are applicable only if the secondary control (COOL) output is fitted.

3. These parameters are not applicable if Proportional Band 1 is set to 0 (i.e. ON/OFF control).

4. This parameter is not applicable if Proportional Band 1 is set to 0 or if Output 2 (COOL) is not fitted.

5. The Message Display will show **Diff 1** for ON/OFF control on Output 1 only, **Diff 2** for ON/OFF control on Output 2 only or **Diff** for ON/OFF control on both Output 1 and Output 2.

6. Internal software prevents (a) the Setpoint High Limit being given a value less than any setpoint value contained in currently-resident programs, and (b) the Setpoint Low Limit being given a value greater than setpoint value contained in currently-resident programs.

7. These parameters are not applicable if the Recorder Output option is not fitted.

8. Output 1 Cycle Time is not applicable if Proportional Band 1 is set to 0 or if Output 1 is a DC linear output. Output 2 Cycle Time is not applicable if Proportional Band 1 is set to 0, if Proportional Band 2 is set to 0, if Output 2 is not fitted or if Output 2 is a DC linear output.

9. These parameters are applicable only if a linear input is fitted.

10. Applicable only if the RS485 Communications option is fitted.
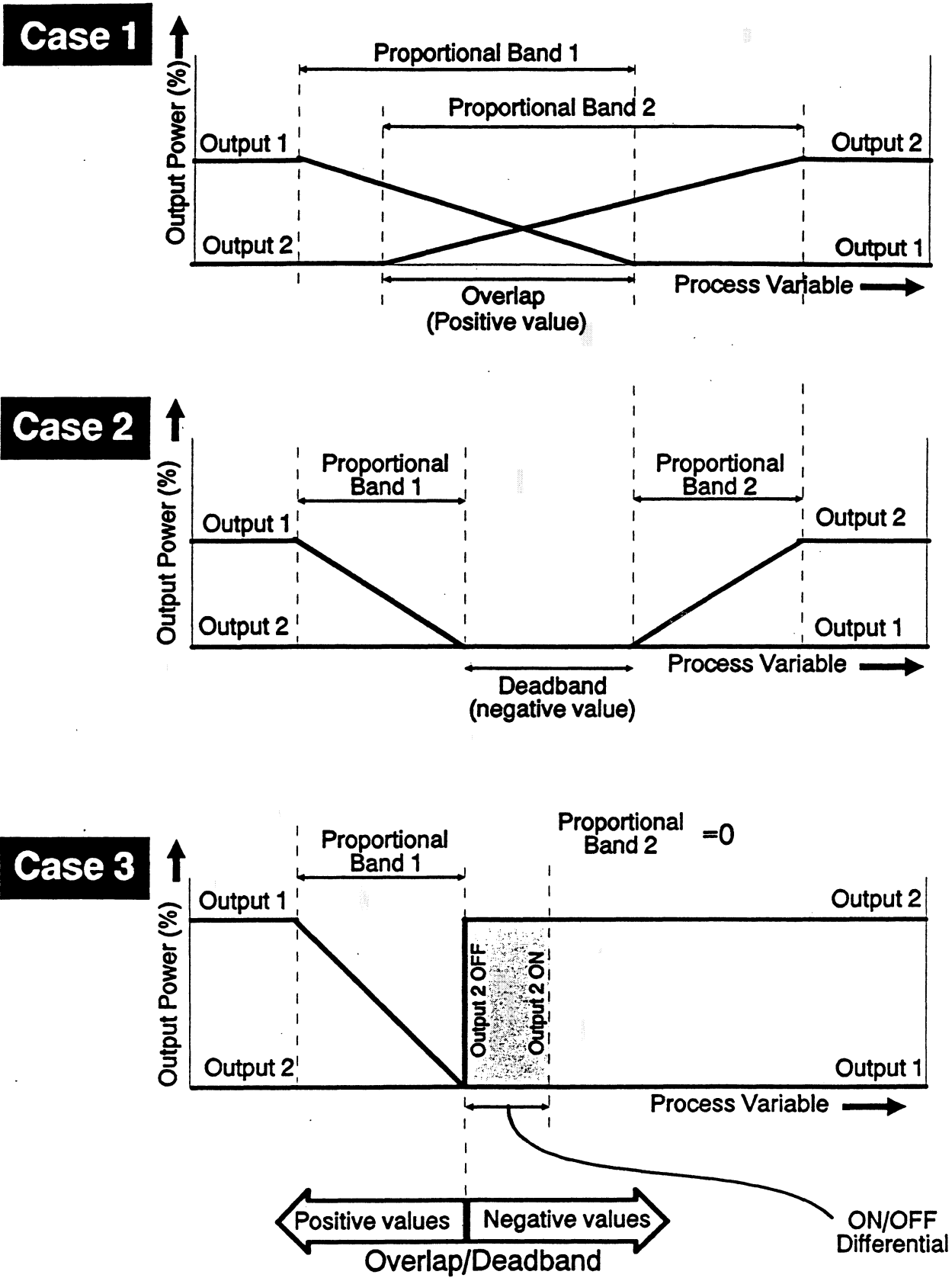
Figure 9-1   Proportional Band and Deadband/Overlap

Figure 9-2   Alarm Operation

The labels along the left side of the figure:

Process High Alarm direct-acting

Process High Alarm reverse-acting

Process Low Alarm direct-acting

Process Low Alarm reverse-acting

Band Alarm direct-acting

Band Alarm reverse-acting

Deviation High Alarm direct-acting (positive value)

Deviation Low Alarm direct-acting (negative value)

Deviation High Alarm reverse-acting (positive value)

Deviation Low Alarm reverse-acting (negative value)

Process Variable below Setpoint   Setpoint   Process Variable above Setpoint

NOTE

The "Relay On/Off" statements apply only if the alarm is connected to an output.

Process High Alarm

Alarm Value
Process Variable
Hysteresis Band

Alarm Inactive — Alarm Active — Alarm Inactive

Process Low Alarm

Alarm Inactive — Alarm Active — Alarm Inactive

Hysteresis Band
Alarm Value
Process Variable

Band Alarm

Process Variable
Hysteresis Band
Alarm Value
Setpoint
Alarm Value
Hysteresis Band

Alarm Inactive — Alarm Active — Alarm Inactive — Alarm Active — Alarm Inactive

Deviation High Alarm

Hysteresis Band
Alarm Value
Process Variable
Setpoint

Alarm Inactive — Alarm Active — Alarm Inactive

Deviation Low Alarm

Setpoint
Alarm Value
Process Variable
Hysteresis Band

Alarm Inactive — Alarm Active — Alarm Inactive

Figure 9-3   Alarm Hysteresis Operation

9.2   BASE MODE DISPLAYS

Once the complete cycle of Controller Define Mode parameters has been displayed, the user may then step through the Base Mode displays (controller setpoint - alarm status - Self Tune - Pre-Tune), making adjustments where required, before re-starting the Controller Define Mode parameter cycle.

9.3   LOOP ALARM AND LOOP ALARM TIME

The Loop Alarm is a special alarm which detects faults in the control feedback loop by continuously monitoring process variable response to the control output(s).

The Loop Alarm facility, when enabled, repeatedly checks the control output(s) for saturation i.e. either or both outputs being at the maximum or minimum limit. If an output is found to be in saturation, the Loop Alarm facility starts a timer; thereafter, if the saturated output has not caused the process variable to be corrected by a pre-determined amount V after a time T has elapsed, the Loop Alarm goes active. Subsequently, the Loop Alarm facility repeatedly checks the process variable and the control output(s). When the process variable starts to change value in the correct sense or when the saturated output comes out of saturation, the Loop Alarm is de-activated.

For PID control, the Loop Alarm Time T is always set to twice the value of the Reset (Integral Time Constant) parameter. For On/Off control, the user-defined value of the Loop Alarm Time parameter is used.

The value of V is dependent upon the input type:

$^{\circ}$C ranges: 2°C or 2.0°C

$^{\circ}$F ranges: 3°F or 3.0°F

Linear ranges: 10 least significant display units

For single output Controllers, the saturation limits are 0% and Output Power Limit. For dual output Controllers, the saturation limits are –100% and Output Power Limit.

> NOTES
>
> 1. Correct operation of the Loop Alarm depends upon reasonably accurate PID tuning.
>
> 2. The Loop Alarm is automatically disabled during Manual Control Mode and during execution of the Pre-Tune facility. Upon exit from Manual Control Mode or after completion of the Pre-Tune routine, the Loop Alarm is automatically re-enabled.

When full ON/OFF control is selected (i.e. Proportional Band 1 is set to 0) and Loop Alarm is enabled, the Loop Alarm Time parameter determines the duration of the saturation condition after which the Loop Alarm will be activated. It may be adjusted within the range 1 second to 99minutes 59 seconds. This parameter is omitted from the display sequence if ON/OFF control is not selected or Loop Alarm is disabled. The default setting is 99:59.

9.4   EXITING CONTROLLER DEFINE MODE

The operator may exit from Controller Define Mode by pressing the **MODE** key until the **Exit ?** prompt appears in the Message Display, then pressing the **SET UP** key, which will cause a return to the mode from which entry was made.

> NOTE: An automatic return is made if there is no key activity in Controller Define Mode for five minutes.

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