

# **GB5 TEMPERATURE CONTROLLER**

## **INSTRUCTION MANUAL**

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Describes GB5s in rectangular cases  
produced since 2016



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# Chapter 1

## Overview of the GB5

### 1.1 Introduction

This manual introduces you to your GB5 Programmable Temperature Controller. You do not need prior experience with temperature controllers or computers. Just read and follow the simple instructions for programming your GB5.

From time-to-time, we will refer to each of the units your are controlling with the GB5 as an “oven”, regardless of whether it is a lehr, annealer, furnace, or what-have-you.

Chapter 1 introduces you to the features and benefits of your GB5. The function of each operating mode, indicator light, LED display and keypad button on the face of the GB5 is explained.

Chapter 2 teaches you how to program your GB5. The GB5 is easy to program once you are familiar with the layout of its controls, explained in Chapter 1. The chapter contains a sample profile that you may want to enter to become comfortable programming the unit.

Chapter 3 explains the special features of the GB5, including how it behaves when power failures occur.

### 1.2 Capabilities

The GB5 has many capabilities and features that make it ideal for complex processes involving automatic temperature control, including glass, ceramics, metalwork, casting, etc. Its great versatility gives it a wide range of applications, and its ease of programming and simplicity of operation make it a favorite of users at all levels of technical proficiency.

- Simultaneous independent control of up to five ovens.
- User-programmable profiles.
- Up to fifteen setpoints per profile.
- Automatic ramping between setpoints.
- Maximum time of over three weeks per step, allowing over eleven months per profile.
- Automatic hold when temperature lags profile.
- Manual control when needed:
  - skip-to-next-step and
  - keypad hold with instant setpoint to allow the hold temperature to be altered.
- Looping back to beginning of program.
- Delayed start of program.
- Full 16-button keypad, allowing direct entry of times and temperatures without scrolling.
- Separate, large, bright LED displays for temperature and time.
- Retention of all profiles during power failures.
- Intelligent recovery from power failures and brown-outs.

The GB5 can be enhanced with several optional features.

- Remote temperature readouts, both standard and large size, permitting monitoring ovens from various convenient sites.
- Power sharing, allowing multiple ovens to share limited power.
- PC connectivity.
  - Graphing (chart recorder) of actual and programmed temperatures.
  - Data logging, giving a permanent record.
  - Remote monitoring for viewing progress of a profile at the PC, even over the Internet or using dial-up networking, for appropriately configured systems.
  - Entering profiles on the PC by typing at the keypad, with a graph of the result.



- Archiving profiles on the PC; keep an almost unlimited library of profiles for various kinds of work.
- Copying profiles from the GB5 to the PC, for inspection, editing, and long-term storage.
- Loading profiles from PC to the GB5; enter new profiles or use profiles previously stored on the PC.
- Control of GB5 from PC; clear errors, stop, and even start an oven from the PC, even over the Internet or using dial-up networking, for appropriately configured systems.
- Phone notification of events, such as errors and advancing from one step to the next.
- Adjusting the parameters of the GB5, both global, such as whether it uses Fahrenheit or Celsius, and per-channel, such as whether a given oven has a Type K, R, or S thermocouple.

A diagram of the face of the GB5 is on the following page.

## 1.3 Modes

There are two modes of operation for your GB5: MONITOR and PROGRAM. During standard operations, the GB5 usually is in the MONITOR MODE. When entering, changing or examining temperature profiles, the GB5 must be in PROGRAM MODE.

For those channels that support proportional output, the MONITOR mode has two display choices: time display showing either remaining time or power level. Added to the PROGRAM mode, these two MONITOR displays may give the user the impression that there are three modes.

## 1.4 Status Indicator Lights

There are two groups of indicator lights on the face of the GB5. The MODE lights are directly above the keypad on either side of the STEP display. The four status indicator lights are to the left of the keypad, directly beneath the TIME display.

**MONITOR MODE:** When the green MONITOR light is on, the GB5 is ready to display the temperature and either the time remaining or the power level of a given unit. Your units are constantly monitored by the GB5, even when the MONITOR light is not lit.

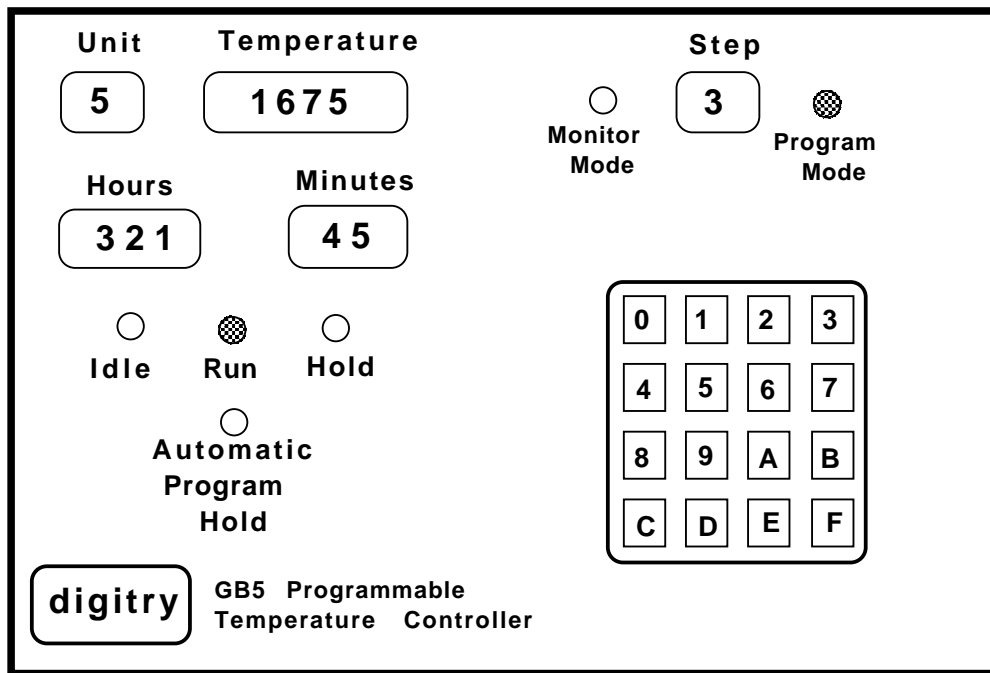


Figure 1.1: GB5 Face

**PROGRAM MODE:** When the red PROGRAM light is on, the GB5 is ready to enter, examine, or change temperature profiles. Note that any programs that have already been started will continue to execute; working with one program has no effect on the others.

Button B on the keypad is used to switch modes. See section 1.6, page 7, for details.

**IDLE:** The red IDLE light indicates that the control power to a selected unit is off and the unit timer is not running. Therefore, that unit is ready to begin STEP #1 of your program. Once the program has completed its cycle, the GB5 automatically returns the unit to IDLE. Resetting the unit using Button F (as described in section 1.6, page 7) also forces the GB5 into IDLE.

**RUN:** The green RUN light indicates that your unit has been activated. This means that the unit is following your program.

**HOLD:** The yellow HOLD light indicates that your program has reached an indefinite, programmed hold or that Button D has been pushed (also placing the unit in an indefinite hold). In either case, the unit timer stops running and the unit maintains the preset temperature.

**AUTO-HOLD:** The yellow AUTO-HOLD light indicates that the actual unit temperature is far below or above the calculated program temperature. This situation occurs when the programmed slope (calculated automatically according to the time and temperature setpoints you entered into your program) is too steep to be achieved by your unit's capability to heat up or cool down. This light also comes during the last minute of any step until the programmed temperature is achieved. Whenever this light appears, the unit timer stops and remains stopped until the unit reaches the required temperature.

## 1.5 Numerical Displays

There are four numerical LED displays on the face of the GB5: one digit each for the UNIT and the STEP, four digits for the TEMPERATURE, and five digits for the TIME. Under most circumstances, each indicates information either about a profile being entered or about an oven being controlled. At other times, power level or error messages may appear in the TIME and TEMPERATURE displays. These are described in other sections of this manual.

**UNIT:** This display indicates the unit (i.e., oven, kiln, lehr or furnace) that currently is being monitored or programmed.

**TEMPERATURE:** This display indicates temperature. In MONITOR MODE, this is the reading from your thermocouple; in PROGRAM MODE, it is the final temperature of a given step.

In MONITOR MODE, if no Sending Unit is attached to a Type K channel, this display will be 32° Fahrenheit (blank for Celsius). If the Sending Unit is attached to the GB5 but the thermocouple is not connected or is burnt out, the TEMPERATURE display will read extremely high, typically above 2350°F (1290°C), the alarm on the Sending Unit will sound (“buzz” or squeal) if it is a Type K Sending Unit.

**TIME:** This display shows the time for the current step. The time indicated when the GB5 is in PROGRAM MODE denotes the length the step. When programming, “HHH HH” will be displayed to indicate a programmed hold, i.e., a soak of indefinite length, and “LLL LL” will be displayed to indicate a loop back to the beginning of the program.

Even more esoteric is the LL-LL and the LS-LS for copying and exchanging programs, which are described in Section 2.4, page 19.

In MONITOR MODE, the display shows the remaining time of the current step, and diminishes as the step proceeds. The timer is running whenever the green RUN light is on unless the HOLD or AUTO-HOLD light is on. The timer stops when your oven is IDLE. When the timer is stopped, the displayed time does not change. However, since a programmed hold has no time associated with it, the display shows “HHH HH”.

For proportional control channels of the GB5, the MONITOR MODE has two different displays, which differ only in what is shown in the bottom LEDs. The first display mode is the normal one described above. The second one replaces the time with a power level display. A 3-digit number representing the current power level (as a percent) is followed by the letters “PL” (for Power Level). This power level is automatically determined and is not user adjustable.

**STEP:** In MONITOR MODE, the number displayed directly above the keypad indicates the current step of the program you are executing. In PROGRAM MODE, this LED display indicates the step you are entering or reviewing. The steps are indicated by the numbers “1” through “9”, and then “A” for the tenth step, “B” for the eleventh step, and so forth, up to “F” for the fifteenth step (the maximum number that can be programmed for any one unit). A horizontal bar “— — — —” will appear in the TIME and TEMPERATURE displays if you try to enter more than 15 steps per unit or if you try to view a step after a Loop “LLL LL”.

## 1.6 Keypad

The keypad on the face of the GB5 consists of 16 buttons. There are 10 numerals, 0–9, and six special function buttons, A–F. The functions performed by the A–F buttons are printed to the right of the keypad. The chart in Figure 1.2 summarizes the functions performed in each operating mode.

**Button A—Pick Unit:** Button A is used to select the unit that will appear in the display, i.e., the unit you will be monitoring or programming. Simply push Button A and then push the number of the unit (from 1–9) you wish to view. (If you don't push the number of the unit within several seconds, the action of button A will be cancelled.) The unit number appears in the upper left hand corner of the GB5, below the word UNIT. Selecting a unit automatically invokes MONITOR MODE.

In addition to the five ovens that you can actually control, there are four units that are not connected to any temperature reading inputs or control outputs. These units, 6–9, are for storing programs that you may wish to use later. These “extra” programs may be either punched in directly, in the same way as with units 1–5, or exchanged or copied from other units, as will be explained shortly. Since units 6–9 do not correspond to real ovens, there is no monitor mode for them. They will always appear in the PROGRAM MODE.

Another, less frequent use of Button A is in copying and exchanging programs. For this use, you must be in PROGRAM MODE. Pushing Button A twice will call up LS-LS or LL-LL, prompting you to specify a program number to exchange or copy, respectively. This is explained in section 2.4, page 19.

**Scan Function:** The GB5 has a special SCAN FUNCTION, where it monitors all five units and displays each unit's time and temperature for a few seconds. This allows you to monitor all your ovens without having to step through them manually. To select the SCAN FUNCTION, press Button A followed by Button 0. The SCAN FUNCTION automatically sets the GB5 to MONITOR MODE. To return to the normal control mode (and reactivate the keypad), select any unit or program for display by pressing Button A followed by a digit. No buttons other than A are active while Scanning.

Note that whenever the GB5 resets, it automatically invokes the SCAN FUNCTION. In particular, if there has been a power outage, the GB5 will commence Scanning upon the return of power. Other events that will trigger the SCAN FUNCTION are the occurrence of an error related to a specific oven (such as Cold, BAD1, etc.) or the receipt of a command from a PC through the serial communications connector, if you have the optional communications software. As above, the

Button	In PROGRAM MODE	In MONITOR MODE
<b>A (Pick Unit)</b> (pushed once followed by digit 1–9)	Selects profile for viewing or changing	Selects profile for viewing or changing
(pushed once followed by digit 0)	Selects SCANNING FUNCTION	Selects SCANNING FUNCTION
(pushed once followed by ENTER)	Backs up to previous step	
(pushed once followed by MODE)		Displays current target temperature
(pushed twice)	Prompts for copying or exchanging programs	
<b>B<sup>1</sup> (Mode)</b>	Selects MONITOR MODE	Selects PROGRAM MODE
<b>C (Clear)</b>	Clears entries so changes can be made	Clears errors; temporarily disables BAD1 and BAD2
<b>D (Hold)</b> (pushed once)	Denotes a hold, or soak, at a specified temperature	Holds oven at current temperature <sup>2</sup>
(pushed twice)	Programs looping feature	
<b>E (Start/Skip or Enter)</b>	Enters or reviews a program	Starts, restarts or skips steps in a program selected by digit <sup>3</sup>
<b>F (Cancel or Erase Pgm)</b> followed by digit <sup>3</sup>	Erases the entire program	Cancels a profile and returns to IDLE

NOTE: All units can be operating simultaneously regardless of which unit operations are being displayed or which unit is being programmed.

<sup>†</sup>Proportioning GB5s have two monitor modes, one that displays power level and one that displays time. Pressing MODE advances along the cycle PROGRAM MODE → MONITOR TIME MODE → MONITOR POWER LEVEL MODE → PROGRAM MODE → . . . .

<sup>‡</sup>This digit is required by the Confirmation Sequence; see section 1.6, page 12.

Figure 1.2: Keypad Functions

keypad will be mostly disabled; you will have to select a specific unit or program before you can do anything else, including clearing an error.

**Target Temperature Display:** While in MONITOR MODE, if the oven is running, you can display its target temperature by pressing Button A followed by Button B (Mode). The target temperature is calculated minute-by-minute to move evenly from the temperature at the start to the temperature at end of the current step; i.e., the target temperature follows the ramp up or down between the beginning and end of the step.

When displaying the target temperature, the temperature will flash to indicate that this is a calculated temperature and not the actual temperature of the kiln. To revert back to the normal display, you may press any key, or you may simply wait a few seconds.

While the target temperature is flashing, the elapsed time of the current step will be shown, as opposed to the usual display of the remaining time for the step<sup>1</sup>. In the case of a HOLD, this will be the time that the HOLD has been in effect. Time while the AUTOHOLD light is on is not counted.

If a keypad hold has been invoked (see section 1.6, page 10) the time shown will be the time that has elapsed since the last time the HOLD button was pushed.

**Button B—Mode:** Button B is used for switching between MONITOR and PROGRAM MODE. The mode you select is indicated by a light on either side of the STEP LED: red for PROGRAM MODE, green for MONITOR MODE.

For channels with proportional control, there are two MONITOR MODEs, one showing the power level instead of the remaining time (see section 1.5, page 6).

MONITOR MODE is used for observing the status of any of your five units. A unit must be in MONITOR MODE to perform any of the following functions:

- Display the current settings and status of the unit.
- Start a program (see “Button E”).
- Initiate a non-programmed hold (see “Button D”).
- Skip a step in the program that is running (see “Button E”).
- Cancel the cycle (see “Button F”).

When the GB5 is in PROGRAM MODE, you can enter, review or change the times and temperatures (which constitute your temperature profile) for the currently

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<sup>1</sup>For GB5s configured to work with cumulative time, the usual display is not the remaining time, but the total elapsed time of the program.

displayed unit. As you enter times and temperatures into the profile, the step you are modifying is displayed in the STEP LED. You may review or change a program even while it is running, except that you cannot modify the step that is currently executing. Simply press Button B twice to review the program for the unit currently being displayed. See section 2.3, page 18, for details on changing time and temperature settings.

**Button C—Clear:** Button C is most commonly used when the GB5 is in PROGRAM MODE to allow entries to be changed. In MONITOR MODE, Button C is used to clear or retard various error indications.

In PROGRAM MODE, Button C is used to clear entries that you need to change. If only a time has been entered, then pushing Button C clears it. If both a time and a temperature have been entered in a step, pushing Button C once will clear only the temperature. If you do not want to change the time, you then can enter a new temperature setting. If you do want to clear both the existing time and temperature setting, push Button C twice; the first time to clear the temperature, the second to clear the time. You then can enter your new settings. While altering a profile during review, there is no way to clear the time without first clearing the temperature.

NOTE: If your display reads all “E”s (error in entry), you must push Button C in order to proceed. (See section 2.2, page 17, for a further explanation.)

In MONITOR MODE, pressing Button C when an error is present simply clears the error. However, pressing Button C when no error is present disables abnormal temperature warnings (BAD1, BAD2) for 45 minutes from the last time it was pushed. This allows you to open your oven and insert a piece or “crash cool” without unnecessarily triggering an error message. This is discussed in more detail in section 3.5, page 31. When you press Button C in MONITOR MODE, both the TIME and TEMPERATURE displays momentarily show a series of dashes “— — — —” to acknowledge the button press.

**Button D—Hold:** While in PROGRAM MODE, Button D programs a hold (also known as a “soak”) at a specified temperature for an undetermined time. Once the button is pushed, the programmed hold is indicated by “HOLd” in the TIME display. The temperature is specified in the normal manner (see section 2.2, page 17). When the HOLD is encountered in the course of running the profile, the unit will continue to hold forever or until you release it by pushing the enter sequence (whichever comes first)! When a programmed hold step is reached, the TIME display will show “HOLd”.

Do not use this button for a timed soak (see section 2.1, page 17).



You can start a program with HOLD. You then can attend to other business while your unit reaches working temperature. Once you load the unit, push Button E followed by the unit number, and the GB5 continues with the rest of the curing cycle for that unit. Of course, it has continued to monitor and control all running units during this time.

Button D also is used to program the special looping feature. Simply push Button D twice in succession while in the PROGRAM MODE. (See section 2.5, page 20, for a more complete description of the looping feature.)

In MONITOR MODE, pushing Button D does nothing if the GB5 is IDLE; however, if the GB5 is running, Button D immediately initiates a hold at the current temperature of the oven. We call this a “keypad hold” to distinguish it from the programmed hold described above. As with any hold, the internal clock stops, so the GB5 temporarily acts like a setpoint controller.

If you would like to know how long the HOLD has been in effect, while holding you can use the Button A – Button B sequence, described in section 1.6, page 9.

When a keypad hold is started, the yellow HOLD light will come on. To exit a keypad hold and resume normal operation, push Button E immediately followed by the profile number. The program will resume from the point at which you began the keypad hold.

The keypad hold is particularly useful in fusing and slumping, or indeed any procedure where you are waiting for the glass to behave in a certain way. For example, if a slump is not happening when expected, you can extend the step manually using the keypad hold.

Some processes need even more flexibility, so in addition to stretching out the time by stopping the internal clock, you can also temporarily alter the temperature at which the oven will hold. This means you have an *adjustable* instant setpoint.

If you do not wish to change the holding setpoint temperature, you need do nothing until you want to end the keypad hold.

However, to change the setpoint temperature, proceed as follows:

1. Press the Button B once (or twice if your GB5 is configured for PID and shows the Power Level) until PROGRAM MODE lights. At this point, the TIME display will become blank (because the keypad hold continues indefinitely until you end it) and the TEMPERATURE display will display the setpoint target temperature.
2. To change the setpoint target temperature, you must first clear it with Button C, and then

3. use digit keys to specify the desired setpoint target temperature. Digit keys pressed before the temperature is cleared are simply ignored.
4. Once you have specified the desired temperature, press Button E to enter that temperature. The MONITOR MODE will light, and the kiln will use the entered temperature as its target.

Until you actually enter the new temperature in step 4, the GB5 will continue to use the original setpoint as its target temperature.

If you don't complete entering the new setpoint target temperature (i.e., if you don't press Button E, step 4), after a few seconds, the GB5 will revert to MONITOR MODE. The keypad hold will still be in effect, using the original setpoint target temperature. This means if you key in a new target setpoint temperature but neglect to push Button E, after a few seconds the GB5 will show the current temperature and ignore the attempted change to the setpoint temperature, because the entry was not completed. You can always check the setpoint target temperature using the Button A – Button B sequence, as shown in section 1.6, page 9.

*Tip:* If you decide you don't want to change the temperature after you press Button C in step 2 above, you can return to monitoring the keypad hold by pressing Button B or by doing nothing for several seconds. The setpoint target temperature will not have been changed. However, once you have cleared the temperature, if you press Button E to return to MONITOR MODE, you will cause the displayed temperature to become the target temperature, even if it is zero. If this is not what you want, press Button D again to restart the keypad hold at the current temperature.

Each time you press Button D, you restart the keypad hold, which will hold at the then current temperature and zero the timer that records how long the hold has been in effect. You can see this time, using the Button A – Button B sequence, described in section 1.6, page 9.

### Confirmation Sequence

The functions described below, activated by Buttons E and F, are used to start your units, skip steps in your programs, erase your programs, or reset your units to STEP #1. Because of the importance of these functions, a special sequence called the *Confirmation Sequence* is incorporated to avoid accidental use. After pressing Button E or F, you must push the number of the unit currently displayed. Pushing any other button after Button E or F will violate the Confirmation Sequence and thus prevent the action. For Button E, the Confirmation Sequence is required only when the GB5 is in MONITOR MODE. For Button F, the Confirmation Sequence is always required whether the GB5 is in MONITOR or PROGRAM MODE.

**Button E—Enter/Start:** Button E serves a different function depending on the mode of the GB5: in MONITOR MODE, Button E is the start/skip-step button; in PROGRAM MODE, it serves as the enter button.

Before starting your programmed profile, make sure the red IDLE and the green MONITOR MODE lights are lit and you have entered your program. Then, push Button E and press the number of the unit displayed in the upper left corner (UNIT). The red IDLE light will go out and the green RUN light will come on, showing that your program has started.

At any time during the cycle you may cancel a given step and go on to the next step (this is called “skip-step” capability). Push Button E and then press the number of the unit displayed. The GB5 will skip to the next programmed step. Once you have skipped a step, there is no direct way to back up. However, you can always cancel the whole program (Button F), restart the program and skip to the beginning of any step.

Button E also is used to continue your program from HOLD. Leaving a programmed HOLD is, after all, nothing more than skipping to the next step.

Recall that the GB5 also has a second kind of HOLD, the keypad hold, which you can recognize because the yellow HOLD light will be on, but the TIME display will not show “HHH HH” but rather it will be stopped at the time you invoked the keypad hold. Pushing Button E followed by the unit number will simply cause the program to continue from where it was stopped: the HOLD light will go out and the time will resume counting down.

When the GB5 is in PROGRAM MODE, Button E is used to enter the times and temperatures you select for your program. The Confirmation Sequence feature is not in effect in this mode. After selecting any time or temperature, you must press Button E to record your entry into the GB5’s memory. Then, proceed to your next entry.

Button E also is used to review your program. Each time you push Button E, the next time and temperature setpoints appear in the LED displays. Pushing Button A followed by Button E backs up to the previous step. See section 2.3, page 18, for further information on reviewing a program.

**Button F—Cancel:** Button F either cancels or erases a program, depending on the mode. In MONITOR MODE, it is used to cancel a program and return the GB5 to IDLE. This does not erase your program; it shuts the displayed unit off, leaving the UNIT showing the last step attained.

In PROGRAM MODE, Button F erases your entire program.

In both MONITOR and PROGRAM MODE, once you press Button F, remember to follow this by entering the number of the unit displayed, as required by the Confirmation Sequence feature.

# Chapter 2

## Programming

### 2.1 Introduction

A profile for the GB5 may be thought of as a series of points, with each point consisting of a time and a temperature. When these points are connected by straight lines, they form a continuous graph. This graph represents the temperature profile you want your oven to follow. You program your GB5 by entering these time-temperature points. The time you enter is always the length of the step; the temperature is in degrees. Your GB5 automatically calculates the rate (“ramp”) at which the temperature rises or falls between successive time-temperature points.

Some people are used to being forced to describe temperature profiles in terms ramp rates up and down, expressed as degrees per minute, and in terms of timed soaks. The GB5 relieves you of the calculations required to specify profiles in this arcane manner.

For example, your oven is at 100°. In 2 hours, you want it to reach 500°. Then, in 3 more hours you want your oven to be at 650°. The only information you must enter is the two time-temperature points: 2 hours, 500°; and 3 hours, 650°. The GB5 then calculates and executes the ramp up between 100° and 500° in 2 hours, as well as a different ramp rate up from 500° to 650° in 3 hours.

A profile may consist of up to 15 such points, each of which is called a *step*. If you wish to hold a specific temperature for an indefinite period of time, you can use HOLD (see page 10). The HOLD acts as a substitute for a time setting. During a HOLD, the timer does not run, so there is no remaining time period to display. Instead, the GB5 displays “HHH HH”. When you are ready to continue with the program, you have to advance the GB5 to the next step manually (see page 13). A programmed HOLD counts as one step.

The typical use of HOLD is to keep an annealing oven at a fixed temperature while a batch of work is completed. When each piece is finished, it is placed into the annealer,

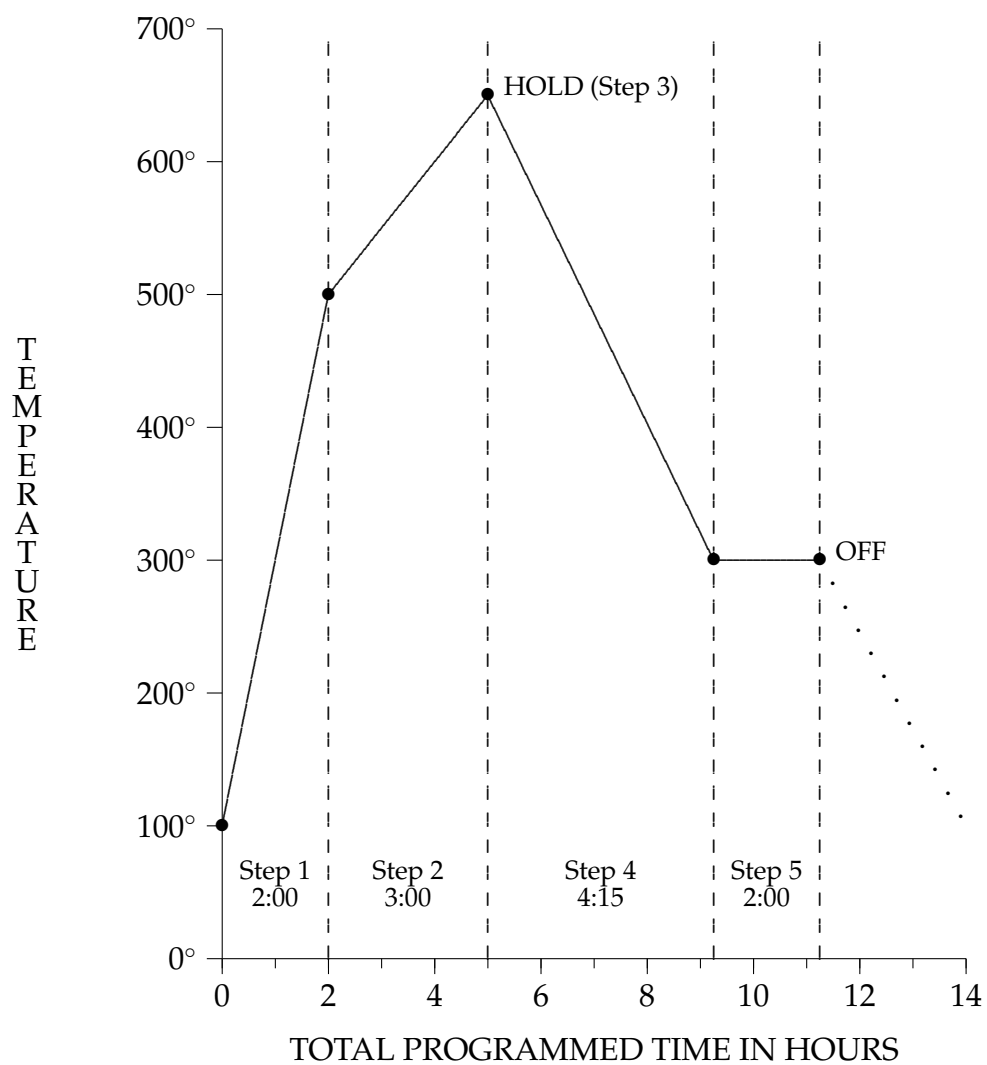


Figure 2.1: Simple Profile

which is maintaining a constant temperature. When all the pieces are finished (or the annealer is full), then the rest of the annealing cycle can commence. This is when you leave the HOLD step and proceed with the rest of the profile. Since you don't know in advance how long it will take to make the pieces, it is more appropriate to use a HOLD than a timed soak. That way, you will not be working against the clock.

If you wish to maintain a certain temperature for a specific time (a "timed soak"), you simply program it in the standard manner, using the same temperature for two consecutive setpoints. For example, the following program ramps up to 950° over an eight hour period and then soaks at 950° for two hours before shutting off.

```

800  Button E (ENTER/START)  (eight hours)
950  Button E (ENTER/START)  (950°)

200  Button E (ENTER/START)  (two hours)
950  Button E (ENTER/START)  (950°)

```

As you can see, you should not use the HOLD button for a timed soak.

Now that you are familiar with the HOLD function, let's add three more steps to the previous example. Your third step is to HOLD at 650° for an indefinite amount of time. Then, cool off to 300° in 4 hours and 15 minutes. Finally, hold at 300° for 2 hours. The third step would then have "H" for time and 650° for temperature. The fourth step would have 4 hours and 15 minutes for time, and 300° for temperature. The last step would have 2 hours for time and 300° for temperature.

The graph in Figure 2.1, illustrates the profile corresponding to this simple program.

A second sample profile is shown in the graph of Figure 2.3. Figure 2.4 shows you just how easy it is to program your GB5 to follow this profile.

## 2.2 Entering a Program

First, select the unit to be programmed by pressing Button A and the unit number (from 1–9) on the keypad. For units 6–9, the GB5 automatically switches to PROGRAM MODE. For units 1–5, you must put your GB5 into PROGRAM MODE using Button B.

At this point, the STEP display will read "1" and the TIME display will read "0". Now, punch in the time (in hours and minutes) on the keypad. Then press Button E to enter the time. At this point, "0" will appear in the TEMPERATURE display. If you wish to change the time, or if you have made an error, press Button C (Clear). The TEMPERATURE will become blank and the TIME will read "0". You can now enter a

new time. Then, punch in a temperature<sup>1</sup>After pushing button E, the TIME will read "0" and the TEMPERATURE will be blank. The STEP will read "2".

You now are ready to enter the second point in your program. This process is repeated until you have entered your entire program. Remember, you have as many as 15 steps to work with for each unit. If you enter fewer than 15 steps, your program will terminate upon reaching the first unfilled step (zero time).

NOTE: When your profile has finished running, the GB5 will go into IDLE MODE and, to indicate that the profile has finished, the STEP display will show one more than the last step of your profile, and the TIME display will show zero time remaining. For example, when a profile with 5 steps has completed, the IDLE light goes on, the STEP display shows "6", and the TIME display shows "0". Similarly, when a profile with ten steps has completed, the IDLE light goes on, the STEP display shows "b" (which looks similar to a "6"), and the TIME display shows "0". If you press Button F, the display will change to show a STEP of "1", with the TIME replaced by dashes.

## 2.3 Reviewing a Program

Switching from PROGRAM MODE to MONITOR MODE, and back to PROGRAM MODE (by pressing Button B), automatically sets the STEP display to Step # 1. The time and temperature settings you selected for the first step now will be displayed. Pushing Button E (Enter) advances you through the succeeding steps of your program. Pushing Button A followed by Button E backs up to the previous step. You may review your program in this manner even while the program is running.

At any time during your review, you may make changes to your program by first clearing and then reentering new times and temperatures. However, it is generally not advisable to change the program for a unit that is currently running. If you choose to do so, be sure you do not change the time of the step that is currently being executed. This is because changing a time entails returning the time to zero which, in turn, will terminate your program and put the GB5 into IDLE for that unit.

NOTE: To change the time setting in your program, you first must clear the temperature by pressing Button C once. Then you can clear the time by pressing Button C again. This step of your program now is ready to enter a new time and temperature. If you want to change only the temperature, just push Button C once and the time will remain unchanged.

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<sup>1</sup>The maximum temperature for Type K thermocouples is set to 2350°F (1250°C); for Type R and Type S thermocouples, the maximum temperature is set to 3000°F (1650°C). Attempting to enter a temperature above the maximum causes E's to appear, indicating an error. If this happens, push CLEAR to proceed.



## 2.4 Copying and Exchanging Programs

As mentioned in section 1.6, page 7, units 6, 7, 8, and 9 have no hardware attached to them; you may think of them as “phantom ovens”. However, they may be programmed just as the ovens 1–5 are. Since there are no temperature inputs or relay outputs for these phantom ovens, you cannot run them. There is nothing for them to do except to store extra programs for future use. The programs in 6–9 are entered, reviewed and edited (changed) just as those in one through five. To use one of these programs, you must copy it into unit 1, 2, 3, 4, or 5 as described in the following paragraphs. To simplify the language in what follows, we will call the program for unit 1, “program 1”, etc.

You can exchange any two programs with just a few button pushes. You can also copy (replicate) a program into a completely blank program. You will be notified whether a copy or exchange is to occur by the symbols in the TIME display: “LS-LS” for exchange or “LL-LL” for copy.<sup>2</sup> With regard to copying and exchanging, all programs 1–9 are on equal footing. You may copy (or exchange) from any one to any other.

Now for the details:

- First select your target program with Button A as usual. Put unit in program mode if it is one of 1–5. (Units 6–9 will automatically be in program mode.)
- If you want to copy another program into the target (as opposed to exchanging another program with the target program), you must first completely clear the target program. This means that all 15 steps must be zero. If only the first few steps have been cleared, the program may seem empty without being so. If you get the LS-LS symbol, you can be sure that one of the 15 steps has data in it. Using Button F, you can clear all steps without having to explicitly find the non-zero steps. If your target is not totally cleared, it will be exchanged with the source program. In other words, if you are not careful here, you will find that the source program has changed when you did not expect it to do so.
- Now push Button A twice in a row. The appropriate symbol, LL-LL or LS-LS, will appear in the TIME display and a dash will appear in the TEMPERATURE display. This dash will turn into the source program you wish to load or copy from when a digit (1–9) is pressed. If any other button is pushed, you will get an error (“E”s will appear in the TIME display), and then you need to push Button C (Clear Entry) and start again. You may change the number without first clearing it; just push a different one.

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<sup>2</sup>While these may not be the most obvious symbols, bear in mind that only a limited number of possible characters exist for the display. It may help to think of the exchange symbol as “load and store” and the copy symbol as “load”.

- After having chosen the source program, push the enter key. Voilà... the exchange or copy will take place! Note that when you do two exchanges in a row, you will be back to where you started. If you do a copy, the source program will remain where it is and also be replicated in the target program. We note the obvious fact that if you exchange two programs which are exactly the same, it is equivalent to having done absolutely nothing!
- Also note that it is impossible for one program to overwrite another—they merely interchange themselves. If you want to overwrite the target, you must first wipe it out with Button F and then copy over the blank program.

### Summary

- Target program completely empty means you will replicate the source program into the target. The symbol is “LL-LL”.
- Target program not completely empty means the source and target will be exchanged. The symbol is “LS-LS”.

## 2.5 Looping

Many people use a Type S channel to control a furnace. Unlike an annealer, a furnace usually runs on a repetitive, continuous cycle. To accommodate such use, the GB5 contains a loop command which allows indefinite repetition of a temperature profile. After reaching the last programmed step, the program immediately will return to Step #1. When the repeat feature is operational, the program will never stop by itself. The repeat can be cancelled by pressing Button F followed by the unit number or removed by changing your program.

The loop command can be used only once in a program. It always sends the program back to the very beginning. It is invoked from the PROGRAM MODE by pushing Button D twice in succession. The “H”s and blanks in the TIME and TEMPERATURE displays will change. The TEMPERATURE display will read “LOOP” and the TIME will have dashes. When this occurs, press Button E. (Failure to do this will result in an error. You then must clear the step by pressing Button C and start this step over again.)

When Button E is pushed, the display will show all horizontal bars indicating that no further program steps may be entered, regardless of what the STEP display reads. This is because the loop is always the last thing you do. Pushing Button E at this point will have no effect. You can gain access to the remaining program segments by clearing “LOOP” (press Button C). If you push Button E after pushing Button D just once, the

GB5 will assume that it is a HOLD. In this case, a subsequent push of Button D will be ignored, since the GB5 is expecting a temperature. In short, the sequence of buttons to be pressed is:

For a HOLD: D, E, (temperature)

For a LOOP: D, D, E

When set on a 24-hour cycle, the times may slowly “creep” over a period of days. A unit set to come on at 8:00 a.m. gradually will come on later in the day. There are several reasons for this. First, due to technical constraints, the GB5’s internal clock is off by about 15 seconds a day. Although this amounts to only about 2 minutes a week, it eventually will add up. Second, anything that stops the timer, such as power failures (which may well go unnoticed because of the GB5 Memory Back-up) or pushing Button D (HOLD), will delay the cycle. Third, if the unit goes into AUTO-HOLD for any reason, the cycle will be delayed.

When using the looping feature, the current unit temperature is read as the starting point for calculating the temperature slope on the first segment of the profile. Thus, if your unit temperature is hotter during the second run of the cycle, there will be a less steep ramp than the first time.

For example, assume your first step is to raise the temperature to 700°F (371°C) in one hour, then go to 1100°F (593°C) in 3 hours before entering the looping feature. The second time around, your unit will start out at 1100°F and the GB5 will take it down evenly to 700°F in one hour. This may or may not be what you intended.

If you want the repeat to start from some cool point, you must specifically put that into your program. For example, if you want your cycle to always ramp up to 700°F from a maximum of 300°F (149°C), you must enter a cooling off segment in the program before the loop. If this segment is too short for the unit to cool down within the allotted time, then AUTO-HOLD will come on, changing your total cycle time.

## 2.6 Delayed Start

The GB5 has a *delayed start* feature. The main use of this is to have your oven waiting for you at working temperature when you arrive at your studio in the morning. With the GB5, you do not have to leave the oven on all night to accomplish this, thus saving on your fuel bill and your time. All you have to do is set the first step of your profile to zero temperature and set the time to indicate the amount of time that should elapse before the oven should begin to heat.<sup>3</sup> Then set the second step to HOLD at the desired

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<sup>3</sup>Whenever the programmed temperature is set to zero, the GB5 will run its clock without turning on the oven and without engaging AUTO-HOLD.

morning temperature. Be sure to start the HOLD soon enough to allow the oven to attain desired temperature before you need to use it.

For example, if it is 7:30 p.m. and you are ready to go home, but you want your unit to come on at 7 a.m. the next morning so that it will be nicely hot (say 950°) by 9 and then hold that temperature, you could enter a three-step program:

Step	Time	Temperature	Comment
1	11:30	0°	11:30 hours from 7:30 p.m. is 7:00 a.m.
2	2:00	950°	2:00 hours from 7:00 a.m. is 9:00 a.m.
3	HOLD	950°	

Alternatively, you could heat up as quickly as possible to 950° starting at 8:00 a.m. by entering the following slightly simpler program:

Step	Time	Temperature	Comment
1	12:30	0°	12:30 hours from 7:30 p.m. is 8:00 a.m.
2	HOLD	950°	AUTO-HOLD will come on while the kiln heats up to 950°.

## 2.7 Sample Program

To end this chapter, we include an example of a typical program. A sample profile is shown in the graph of Figure 2.3. This profile shows the unit starting at room temperature (around 70°F) and ramping up to 650°F in 2 hours 45 minutes. It then soaks for three hours and then ramps up to 1050°F over the next seven hours, where it soaks for two hours 15 minutes. After that, it ramps up to 1200°F over one hour and then immediately ramps down to 350°F over the next seven hours. This ends the program, so the unit will then shut off and coast down to room temperature. Figure 2.2 shows this program filled in on a Digitry GB5 Programming Form. Blank forms may be found at the end of this manual or obtained from Digitry Company, Inc.

The sample program in Figure 2.4 shows you just how easy it is to program your GB5 to follow this profile for unit #5. By pushing the buttons indicated, you can enter this program into your GB5.



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Use Genuine Digitry Controllers*

## Digitry GB5 Programming Form

Oven # \_\_\_\_\_ 5

Date \_\_\_\_\_ 12/27/2016

Use \_\_\_\_\_ *Sample Profile*

Author \_\_\_\_\_ *Leslie Cooper*

	Step 1	Step 2	Step 3	Step 4	Step 5
Temp	650	650	1050	1050	1200
Time	2:45	3:00	7:00	2:15	1:00

	Step 6	Step 7	Step 8	Step 9	Step A
Temp	350				
Time	7:00				

	Step B	Step C	Step D	Step E	Step F
Temp					
Time					

Notes:

Figure 2.2: Filled In Programming Form

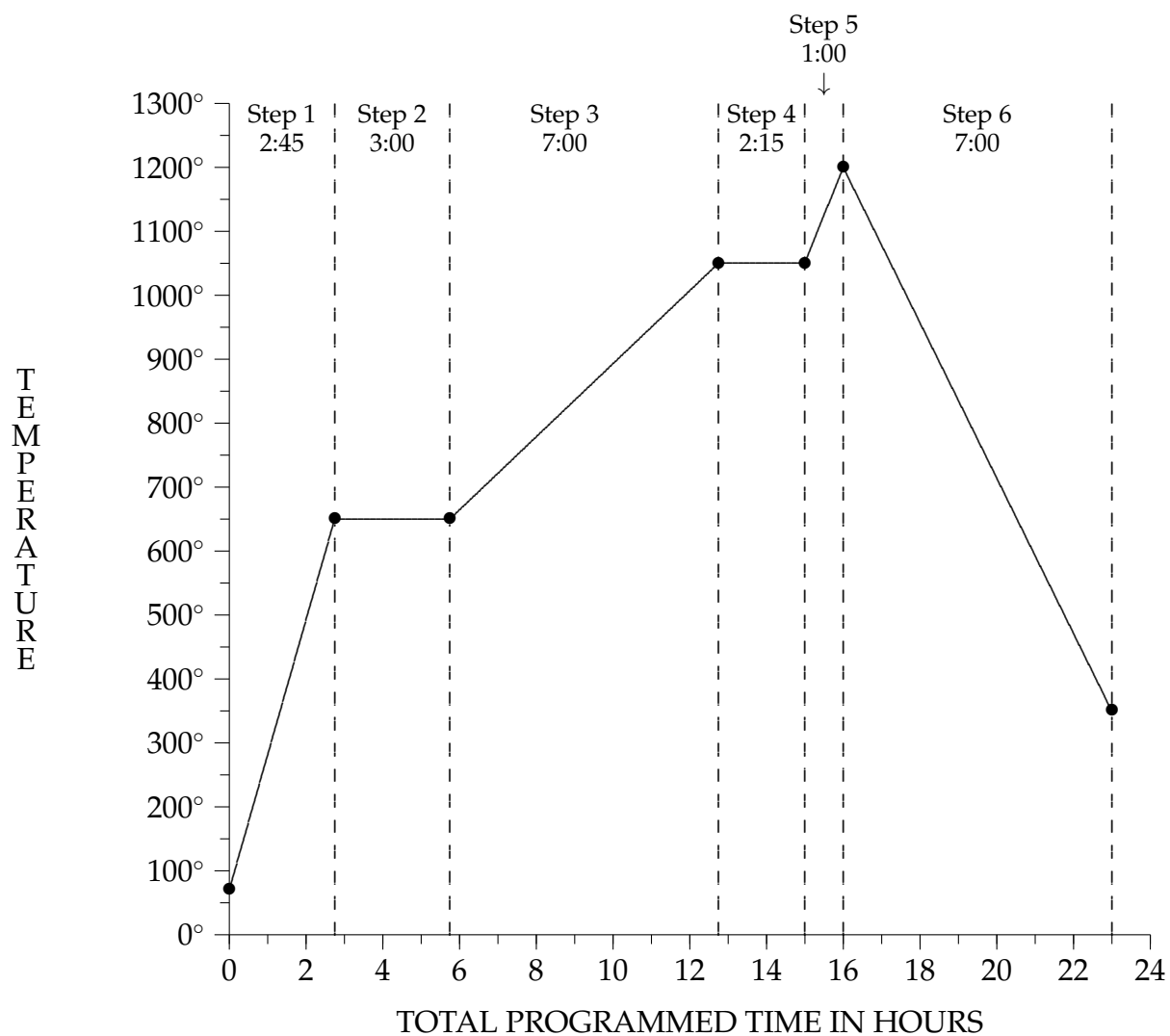


Figure 2.3: Sample Profile Graph

Press:	To:
A 5	Let the GB5 know you want to program unit #5.
B	Put the GB5 into PROGRAM MODE.
245 E 650 E	Program unit #5 to ramp up evenly to 650°F in 2 hours and 45 minutes. This is Step #1.
300 E 650 E	Soak at 650°F for 3 hours. This is Step #2.
700 E 1050 E	Ramp up to 1050°F in 7 hours. This is Step #3.
215 E 1050 E	Soak at 1050°F for 2 hours and 15 minutes. This is Step #4.
100 E 1200 E	Ramp up to 1200°F in 1 hour. This is Step #5.
700 E 350 E	Ramp down to 350°F in 7 hours. This is Step #6.
	The program is now entered.
B	Return to MONITOR MODE.
E 5	Start unit #5 running.

Figure 2.4: Sample Profile





# Chapter 3

## Special Features of the GB5

The GB5 is designed with several special features to enhance its ease of use and reliability. These include

- automatically stretching the length of steps to accommodate the capabilities of your oven — “AUTO-HOLD”.
- warnings of common external failures (thermocouple burn-out, contactor lock-up, etc.),
- preservation of your programs in the event of a power failure,
- monitoring of memory integrity, and
- a serial port for communicating with a PC.

### 3.1 Automatic Hold

Using the program you entered, the GB5 calculates a temperature for each minute of the cycle. It bases its decision about automatic holding on this temperature. Essentially, if your unit is not able to keep up with the temperature changes you requested, the GB5 clock for this unit will be stopped until the unit catches up.

On heating steps (ramping up), the AUTO-HOLD light will come on if the unit temperature is more than 40°F (20°C) below the calculated temperature for the current minute. On cooling or soak steps, the AUTO-HOLD light will come on whenever the unit temperature exceeds the calculated temperature for the current minute by more than 40°F (20°C).

Once the AUTO-HOLD is engaged, it keeps the clock stopped until the temperature calculated for the current minute is actually achieved.

Under normal circumstances, AUTO-HOLD is usually thought of as something that compensates for unusual demands placed on your oven's ability to follow a profile. However a creative use of AUTO-HOLD allows you to program your oven to ramp up to a given temperature as quickly as possible. Simply program the time for the step to be one minute. The GB5 then will go into AUTO-HOLD until the desired temperature is reached and then go on to the next step.

AUTO-HOLD can be disabled on a channel-by-channel basis using the GB Tech software.

## 3.2 Zones

Normally, each oven works independently, but in special situations, you may want to have several channels of the GB5 acting as separate zones in the same oven. The programs for these channels are all generally the same (but they need not be). Because they are controlling the same oven, it is important that these channels function together, using synchronized clocks. If AUTO-HOLD were to occur for one of these channels but not the others, its clock would fall behind the others, destroying the required synchronization. Placing the channels into the same zone group causes them all to enter and leave AUTO-HOLD at the same time.

A GB5 can support a maximum of two separate zone groups. Setting up zones is accomplished using the GB Tech software.

## 3.3 Guaranteed Temperatures

Sometimes it is very important that the final temperature of a ramp be attained before going on to the next step of the profile. So, at the end of each step, the GB5 guarantees that the oven actually reaches the programmed temperature before allowing it to go on to the next step. When necessary, the clock will be stopped during the last minute of a step to allow the oven to reach this temperature. The AUTO-HOLD light will come on while the clock is stopped.

## 3.4 Error Messages

There are certain serious problems that could cause improper temperature readings or overheating of a unit. When one of these happens, an error code of the form "BAD?" or "ERR??" will appear in the display to identify the problem. The difference between a

BAD and an ERR message is this: BAD refers to a problem with a specific channel while ERR concerns a problem that affects all channels.

Other serious but very rare conditions can cause unusual displays to occur: flashing P's to indicate a memory failure (see section 3.8, page 33), and "Lo Pr" to indicate that the voltage supplied to the GB5 has fallen below an acceptable threshold, which is set at three-fourths of full voltage (see section 3.6, page 31).

The "BAD?" or "ERR?" display is made up of unusual-looking characters. "BAD" is a lower-case b, an upper-case A, a lower-case d, and then a single digit. "ERR" is an upper-case E, two large but lower-case r's, and then two digits. We mention all this because the messages can be very confusing when first seen, and we hope you see them seldom enough that you never get used to them!

When it detects an error specific to a given channel (one of the "BAD" messages), the GB5 will attempt to shut down the corresponding unit by turning off its contactor<sup>1</sup>. It will also start the special SCAN FUNCTION (see section 1.6, page 7), to guarantee that the affected unit will show up in the display.

Switch to the unit by pressing Button A, followed by the unit number, and then press the CLEAR key, Button C. This will clear the BAD message and allow the GB5 to resume the corresponding program. However, if the condition has not been corrected, the error message will be reactivated as soon as the condition is again detected. This can take anywhere from one second to twenty minutes, depending on the cause of the problem. Of course if the error messages have been disabled, as discussed below, then BAD1 and BAD2 are prevented from occurring for at least 45 minutes.

These are the various error messages and their interpretations.

**BAD1:** The temperature does not appear to be increasing, even though the GB5 is calling for heat. This error message latches on until the CLEAR key, Button C, is pushed. Likely causes of BAD1 are

1. The thermocouple has come out of the oven.
2. There is a bad fuse in GB5 output module circuit.
3. The contactor is bad (its coil has probably burned out).
4. There is a fault in the oven itself that prevents it from heating adequately.
5. There is an internal problem in the GB5.

Some ovens heat so slowly, especially at high temperatures, that they trigger a BAD1 error, even though they are still heating. To account for this, we set a maximum temperature at which we check for the BAD1 condition, called the "Bad1

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<sup>1</sup>Depending on the problem, the GB5 may not be able to shut off the contactor. For example, the underlying problem may be that the contactor itself has failed in the "on" position.

Cutoff". It may be different for each oven, but its default values are 400°F and 200°C. It can be changed via a PC using the GB5 Tech program. It must be between 125° and 2000° Fahrenheit (50° and 1000° Celsius).

**BAD2:** There has been a significant temperature increase even though the GB5 is not calling for heat. This error message latches on until the CLEAR key, Button C, is pushed. Likely causes of BAD2 are

1. The contactor is bad (it has become stuck or shorted).
2. There is a short circuit in the wiring between the GB5 and the contactor.
3. There is an internal problem in the GB5.

BAD2 can be disabled on a channel-by-channel basis using the PC Tech software.

**ERR10, ERR24, ERR28:** The GB5's internal circuitry has detected an evanescent error, probably caused by environmental electrical noise. If this happens repeatedly, you may need a power line conditioner.

**ERR21, "Lo Pr"** The line voltage has dropped below that required for reliable operation of the GB5. The GB5 will shut itself down until the line voltage is restored.

**ERR4?** This error occurs when there is a timing problem in the serial communication.

**ERR5?, ERR60, ERR70:** These all correspond to internal errors internal problems with the analog to digital converter. If the first digit is 5, the second digit helps Dig- itry locate the cause of the difficulty. However, the error can also be caused if the temperature appears to be over the maximum the GB5 is capable of reading (ap- proximately 2385°F for Type K). This warning remains active only so long as the problem is detected; once the problem disappears, the error clears itself.

Note that the error messages BAD1 and BAD2 "latch on" and will only reset when CLEAR is pressed. The other error messages are self-clearing, but if the problem recurs frequently, they will appear to latch on.

Another form of error message is the "buzz" that a sending unit for a Type K ther- mocouple makes when either the thermocouple burns out or is disconnected. Note that it is normal for thermocouples to burn out after a certain amount of use. If you are using a Type K thermocouple, the Sending Unit will buzz when this happens. As described in the troubleshooting section 4.1, page 36, you should try connecting a plain piece of wire from the red to the yellow terminals where the thermocouple attaches. If this stops the buzzing, then the GB5 is functioning correctly, and you should replace your old thermo- couple. Of course, you should remove the wire used during testing when you connect a thermocouple.

## 3.5 Disabling Error Messages

BAD1 and BAD2 signify temperature changes not initiated by the GB5. Under normal circumstances these work as expected. However whenever external events cause abrupt temperature changes, these errors may falsely trigger. This could happen when you place a large, hot casting into the oven; it might raise the temperature without the GB5's calling for heat, thus triggering a BAD2. Similarly, opening the oven door to place a piece into the kiln or keeping it open to "crash cool" a piece could trigger a BAD1. Under these circumstances, it is desirable to be able to disable the error messages before they alarm you and disrupt your work!

Pressing the CLEAR key while the GB5 is in MONITOR MODE has the effect of disabling the BAD1 and BAD2 error messages for 45 minutes. Any time it is pushed, the 45 minute delay begins afresh; pushing it twice does not give 90 minutes — just 45 minutes from the second push. The key is acknowledged by momentarily displaying a horizontal bar "—" in both the TIME and TEMPERATURE displays. In general, there is no way to cancel this delay but the passage of time.

## 3.6 Behavior During Power Failures

Special components and circuitry are used within the GB5 to preserve its memory during power failures. The GB5 will remember:

- which units were running and which were idle when the power failed,
- the program step and time of each running unit when the outage occurred, and
- the last temperature reading of each running unit at the time of the power failure.

Whenever the GB5 detects that the voltage being supplied by the electric company has dropped to an unacceptable level, below 3/4 of full voltage, it will display "Lo Pr". Generally, you won't notice this if power is failing, but you may notice this during a "brown out", when power remains low for an extended period. While this is displayed, all ovens are turned off, because the GB5 may not be able to function reliably with the available low voltage. If the electric company restores full voltage without failure, the GB5 will enter its normal power-up sequence described in the next paragraph.

During the power failure, the face of the GB5 will look blank. When power is restored, "8"s will appear in the TIME and TEMPERATURE displays while the GB5 takes new, reliable temperature readings. Concurrently, the UNIT display counts down from five to one<sup>2</sup>.

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<sup>2</sup>It is important to realize that many power failures are extremely short, so short that you may not even notice them. As a consequence, from time-to-time your GB5 may appear to count down spontaneously.

The GB5 then evaluates the temperature loss of each unit from the time the power failed to the time it was restored. If the actual temperature loss is less than 200°F (or 100°C for Celsius models), that unit will continue as if the power failure had not occurred. Since the vast majority of power failures are quite short (under one minute), the unit temperature drop is insignificant and the unit thus will continue running according to your original program.

If a unit cools more than 200°F<sup>3</sup> during a power failure, the temperature of the unit when power is restored will be maintained. The TIME and TEMPERATURE displays for that unit will read “Cold”. This procedure should protect your unit and its contents from reheating rapidly without your knowledge. When you check the unit and notice this condition, you then have the opportunity to decide the most appropriate course of action from this point (as described in the following section).

After the GB5 has measured the temperature of all units to determine whether the unit should continue running or be maintained at its current temperature, the SCAN FUNCTION will be triggered (see section 1.6, page 7). Note that even a very short power failure will cause the SCAN FUNCTION to be activated.

### 3.7 “Cold” Readings

As noted above, if a power failure has lasted long enough that one of your units has cooled more than 200°F (100°C) during the outage, its TIME and TEMPERATURE displays will read “Cold”. The current unit temperature will be maintained, and the SCAN FUNCTION will be activated so the “Cold” will be seen whenever that unit is scanned.

For each unit that is “Cold”, push Button A and the number of that unit. The GB5 will go into MONITOR MODE and “Cold” will be displayed. Push Button C to clear the “Cold” display. The GB5 will then resume running its profile. As the unit lost more than 200°F during the power failure, the unit will begin heating. If the unit was ramping up when the power failed, AUTO-HOLD will go into effect until the unit reaches the programmed temperature.

If you want to cancel your program and restart the unit, push Button F and the unit number. The GB5 will then be in IDLE. This may be the best course, because otherwise the unit will be heating as quickly as it possibly can, which may have an adverse effect on your work. If you wish to reprogram the unit to follow a temporary program, consider using one of the auxiliary ovens (6 – 9) and then exchanging that program with the original program. Once the temporary program has completed, you can again exchange it with the original program, so you won’t have to enter it from scratch.

Follow the procedures above for each unit that is marked “Cold”.

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This is invariably a result of power difficulties of some sort.

<sup>3</sup>This value can be altered via a PC using the GB5 Tech program as described at the end of this section.

## 3.8 Memory Failure

Your GB5 continually checks its internal memory for accuracy. In case of a memory failure, the green and red MODE lights alternately will light about every one-half second and “P”s (for “Problem”) will flash across the TIME and TEMPERATURE displays.

In the event of a memory failure, the GB5 is designed to protect your work and units by running the following sequence. First, it will turn off all units for about one minute to allow the temperature readings to stabilize. Then, it will read the current temperature of each unit and hold at that temperature until you reprogram the GB5.

When the GB5 signals a memory failure, pushing any button on the keypad will reset it. It then will stop flashing, display UNIT #1, clear all memories and set all units to IDLE. If you do not reprogram the GB5, your units will begin to cool down.

Fortunately, memory failure is quite unusual. It can usually be traced to one of two causes:

- A voltage transient so fast and so powerful that it swamps the GB5’s protective circuitry and modifies program memory. Digitry’s memory assurance scheme is so sensitive that it will detect the alteration of even a single digit.
- Power failure while you are entering a program. In this case, the memory assurance scheme may detect inconsistent information.

If flashing “P”s recur immediately, or if they start occurring frequently, your internal memory has suffered electrical damage and must be replaced. Return your GB5 to Digitry for service.

**IMPORTANT:** In the rare case that your GB5 experiences a memory failure, any customization set at the factory or that you have set via the PC using the PC Tech software may be lost. Whether it loses the customization parameters depends on what part of the memory failed — the part that saves your programs, or the part that saves the customization parameters. As part of recovering from the memory failure, all programs are cleared, but the parameters are set to default values only if that part of the memory is determined to have been corrupted. If the customization parameters are reset, then if you have chosen the Celsius temperature scale, the GB5 will revert to Fahrenheit; any channels that were set to use a Type R or Type S thermocouple will revert to Type K, etc. If you have never thought about customizing your unit, then it is almost surely unnecessary to make any adjustments, unless it was calibrated in Celsius or any channel used a Type S or Type R thermocouple. If your GB5 had any customization, either by you or at the factory, connect your GB5 to a PC running the Digitry PC Tech software to check that your parameters are correct and adjust them if necessary. If you cannot gain access to a PC running the GB5 Tech program, contact Digitry to arrange to return your GB5 to the factory to have it reset to your specifications.





# Chapter 4

## Reference

### 4.1 Troubleshooting

Symptom	Likely Cause	Suggested Actions
GB5 appears dead	No Power to GB5	1. Check that GB5 is plugged in to a live circuit. 2. Check power fuse located in small drawer in AC inlet. Remove power cord to gain access, and slide tab out.
One channel reads 32°F	Defective sending unit or wires to sending unit broken or disconnected	1. Try exchanging the sending unit with another that is known to work. 2. Try using new wire to connect the sending unit to the GB5. Send defective sending unit to Digitry.
All channels read 32°F	Power for all sending units has failed	Send GB5 and sending units to Digitry for repair.

Symptom	Likely Cause	Suggested Actions
All channels read approximately 33–38°F	Short circuit between blue and orange wires or defective sending unit.	Remove all sending units. Add back one at a time until all have been tested. If one or more appear bad, send them to Digitry for repair. If all appear bad, send GB5 and sending units to Digitry for repair.
Sending unit buzzes	Burnt out or defective thermocouple, defective sending unit, or short circuit between green and orange wires	<ol style="list-style-type: none"> <li>1. Try exchanging sending unit with another that is known to work.</li> <li>2. Try replacing thermocouple with one known to be good.</li> <li>3. Try replacing thermocouple with short piece of wire. GB5 should display approximate room temperature, and sending unit should stop buzzing. If this happens, your thermocouple is bad; replace it with a good one (don't forget to remove the short piece of wire). If it doesn't, send defective sending unit to Digitry for repair.</li> <li>4. Disconnect both the GB5 and the sending unit from their wires. Then attach the GB5 to the sending with short lengths of wire, where you can see that they don't short out. If this stops the buzzing, the problem is in your wiring.</li> </ol>
Erratic temperature readings for one or more units	Defective A2D converter chip	Contact Digitry.
A unit does not heat	Defective contactor or internal GB5 fuse has blown	Try actuating the contactor manually (carefully short out connectors at back of GB5—WARNING: electrical shock hazard). If unit begins to heat, check internal micro-fuse for that channel (if necessary, swap fuse with working channel). If fuse is bad, obtain replacements from Digitry; they are hard to find locally. If fuse is OK, return GB5 to Digitry for repair. If unit does not heat, check wiring or replace contactor.

## 4.2 GB5 Specifications

The GB5 Programmable Temperature Controller, standard model, is equipped with 2–5 Sending Units for use with Type K thermocouples. Sending Units calibrated for Platinum thermocouples (Types R and S), key lock security, and customized hardware and software are optional.

**Power Requirements:** 10 watts at 110–120 volts AC, 60 cycle, grounded outlet (220–240 volts, 50 cycle available).

**Temperature Measurement Range:** 5 channels, 32° to 2370°F (0° to 1300°C) with automatic cold junction compensation; 32° to 3200°F (0° to 1760°C) for Type S.

**Resolution:** 1 part in 4000.

**Repeatability:** 1°F.

**Timing:** crystal controlled.

**Common Mode Rejection Ratio:** at 60 Hz (at thermocouple) for Type K, 126 dB minimum; for Type S, 148 dB minimum.

**Output:** 5 channels

- ON/OFF control via internal solid state relays with zero crossing detection: 1.5 amps at 24–280 volts AC, fused internally, optically isolated to 3750 volts.
- Pulse-width Modulated Proportional Control: approximately 12 volts DC to control Digitry plug boxes or user-supplied solid state relays.

**Programming:** 9 programs; 15 setpoints per program; maximum of 543 hours in one minute increments for each step (total of 203 days, 15 hours).

**Dimensions (H×W×D):**  $7\frac{1}{4}'' \times 10\frac{1}{4}'' \times 3\frac{3}{4}''$

**Shipping Weight:** approximately 8 lbs.

**Operator Interface:**  $\frac{1}{2}''$ , 7-segment, red LED; 16-position sealed keypad (dust and moisture resistant).

### 4.3 Accuracy

While the absolute accuracy of the GB5 is limited to about 1%, the resolution always is at least 0.5°F. This yields more than 0.025% of full scale reading. With a given GB5 and fixed thermocouple location, your temperature profiles are repeatable to an extremely high degree of accuracy. More variation will be introduced by the way you load your unit than by the accuracy of your readings.

To help ensure this repeatability, all Digitry Sending Units are equipped with automatic cold junction compensation to account for variations in room temperature. Such variations ordinarily would appear as an error in the temperature reading. This is because a thermocouple measures the difference in temperature between the hot end and the point where it attaches to the Sending Unit, *not* the absolute temperature. With cold junction compensation, these errors are eliminated.

It is important to realize that because of the resolution of the GB5 temperature measurement, you will note swings in the temperature of your unit that would go unnoticed with a standard, meter type pyrometer. These swings are to be expected. They were always there, you just could not see them. You should notice that the more material you place in your unit, the less severe the swings.

### 4.4 Sales and Service

The main offices of Digitry Company, Inc., are located at:

449 Forest Avenue, Suite 9  
Portland, ME 04101  
USA  
Phone +1-207-774-0300  
Email [info@digitry.com](mailto:info@digitry.com)  
Internet [www.digitry.com](http://www.digitry.com)

Write or call for all sales, service, or technical information.

### 4.5 Loaner Program

If your GB5 should ever malfunction, you can return the GB5 to Digitry for repair.

Realizing that the GB5 will become an indispensable part of your production facility, Digitry will, upon request, immediately send a GB5 “loaner” for the duration of the repair. Please call the Maine office for the current cost of the loaner and the deposit amount.

## **4.6 Warranty Information**

DIGITRY COMPANY, INC., (“SELLER”) WARRANTS THAT THE PROGRAMMABLE TEMPERATURE CONTROLLER (“PRODUCT”) SOLD TO PURCHASER SHALL BE OF STANDARD QUALITY OF SELLER. SELLER’S OBLIGATION AND LIABILITY UNDER THIS WARRANTY IS EXPRESSLY LIMITED TO REPAIRING OR REPLACING, AT SELLER’S OPTION, A PRODUCT NOT OF SELLER’S STANDARD QUALITY FOR A PERIOD OF NINETY (90) DAYS FROM THE DATE OF DELIVERY. SELLER MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, AND MAKES NO WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR ANY PARTICULAR PURPOSE. SELLER’S OBLIGATION UNDER THIS WARRANTY SHALL NOT INCLUDE ANY TRANSPORTATION CHARGES OR COSTS OF INSTALLATION OR ANY LIABILITY FOR DIRECT, INDIRECT OR CONSEQUENTIAL DAMAGES, DELAY OR LOSS OF PROFITS, EVEN IF SELLER HAS BEEN INFORMED BY PURCHASER OF THE POSSIBILITY OF SUCH DAMAGES.

IF REQUESTED BY SELLER, A PRODUCT ON WHICH A WARRANTY CLAIM IS MADE SHALL BE RETURNED TRANSPORTATION PREPAID TO SELLER’S PRINCIPAL PLACE OF BUSINESS. ANY IMPROPER USE, OPERATION, SUBSTITUTION OF PARTS, OR ALTERATION OR REPAIR BY OTHERS IN SUCH A MANNER AS IN SELLER’S JUDGMENT AFFECTS A PRODUCT MATERIALLY AND ADVERSELY SHALL VOID THIS WARRANTY. NO EMPLOYEE OR REPRESENTATIVE OF SELLER IS AUTHORIZED TO CHANGE THIS WARRANTY IN ANY WAY OR TO GRANT ANY OTHER WARRANTY.