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WATERS CHROMATOGRAPHY DIVISION

PRODUCT PERFORMANCE SPECIFICATION

MODEL NAME: TEMPERATURE CONTROL MODULE

MODEL NUMBER:

WATERS SYSTEM PART NUMBER: 038000

PROJECT MANAGER: Richard Harris

PREPARED BY: Richard Harris/Tony Lymneos DATE: 8/16/85

APPROVED BY: *B. Choquette* DATE:

CONTROL NO.: 38001 REV: 0

EN: DRN0336-1

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## 1.0 PRODUCT CHARACTERIZATION

### 1.1 Generic Categorization

The Temperature Control Module (WA P/N 38000) is a stand-alone device capable of independent and simultaneous control of up to three controlled devices. \*Each device can be identical, such as three column heaters, or different, such as a column heater and a heated detector cell. Connections to each device are made through any of three 9-pin "D" connectors on the back of unit. These connectors are signal level only (low power) and do not carry A.C. power. Each controlled device must have its own power source.

### 1.2 General Description

The Temperature Control Module (TCM) is a microprocessor based controlling unit that maintains precise, consistent temperatures from ambient to 150C. The system can control and simultaneously regulate up to three ancillary devices. Each device connected may be set to a different temperature. The TCM is intended for applications where elevated and/or stable temperatures are required for accurate chromatographic performance.\*

### 1.3 Physical Description

|                           |                              |
|---------------------------|------------------------------|
| Height: 9.12 in (23.18cm) | Width: 5.0 in (12.5cm)       |
| Length: 14.5 in (36.83cm) | Weight: 11.61 lbs. (25.52Kg) |

## 2.0 APPLICABLE DOCUMENTS

| <u>Document #</u> | <u>Title</u>                                 |
|-------------------|----------------------------------------------|
| 38180             | Performance Spec. Temperature Control System |
| 38179             | Test Spec. Temperature Control Module        |

\*The controller design allows future compatibility with cooling devices designed by Waters.

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### 3.0 PRODUCT FUNCTIONS

#### 3.1 Operation

The control element within the TCM is a program in a microprocessor (firmware). It is a coupled data feedback system. The output is a time modulated TTL compatible signal which is proportional to the magnitude of, and integral of the difference between the desired temperature and the actual temperature, sometimes known as proportional control and lag compensation.<sup>1</sup>

An additional feed forward compensation is provided for power line voltage fluctuations.

##### 3.1.1 Control Mode

Control mode occurs whenever the keyboard is not being used for programming. When the TCM is in CONTROL MODE, the firmware scans the current internal temperature of each external device connected. It displays the temperature of each external device in sequence and illuminates the corresponding LED.

##### 3.1.2

Input mode is used to set the temperature and the over and under limits on each external device used. the external devices continue to operate while the TCM is in this mode. The temperature display shows temperature selected for changing. Each key chirps once when pressed. If you make an illegal entry, the TCM chirps twice, then displays the previous value.

### 4.0 PRODUCT REQUIREMENTS

#### 4.1 Environmental Conditions

4.1.1 Storage Temperature:  $-40^{\circ}\text{C}$  to  $75^{\circ}\text{C}$

4.1.2 Operating Temperature:  
Lab Environment:  $10^{\circ}\text{C}$  to  $40^{\circ}\text{C}$

4.1.3 Humidity: 10% to 90%

Non-condensing with adequate protection against environmental condensation during shipping and storage.

<sup>1</sup>Linear Control System Analysis and Design, D'Azzo and Houpes, McGraw Hill.

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#### 4.2 Power

##### 4.2.1 Voltage/Frequency/Fuse Rating

| Voltage AC    | Frequency    | Fuse |
|---------------|--------------|------|
| 115 (90-132)  | 60Hz (57-63) | 1.0A |
| 220 (198-264) | 50Hz (47-53) | .5A  |

##### 4.2.2 Power Consumption: 20VA (worst case)

### 5.0 PRODUCT FEATURES

#### 5.1 Product Status Indicators/Alarms

- o Display: One 7-segment, 4-character LED with fixed 1 place decimal. Purpose: Temperature display
- o Seven LED function indicators. Purpose: CHANNEL 1, CHANNEL 2, CHANNEL 3, REMOTE (future IEEE 488 use), OVER temperature, SET temperature and UNDER temperature.
- o Alarm: 1) 1 "CHIRP" for any keyboard key depressed.  
2) 2 "CHIRPS" for erroneous entries.  
3) OVER and UNDER temperature alert.

#### 5.2 Operating Controls

##### 5.2.1 Internal Control

- o Keypad: 16-key, numbers arranged by "Telephone Standard." Separate function keys for OVER, UNDER, SET, ENTER, SELECT and CLEAR.
- o Power Switch: Instrument main power
- o Line Select Switch: 115V/220V Operating Voltage
- o Address Switch: For future IEEE 488 use

##### 5.2.2 External Control

- o Connector (1, 2 & 3): Input/Output signal lines.
- o Connector: For future IEEE 488 use

##### 5.2.3 Channels Input/Output

- o Channels: 3 Input/Output
- o Remote: Future IEEE 488 use

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#### 5.2.4 Firmware

- o Power "ON" Self Test
- o OVER temperature setpoint default: 150C
- o UNDER temperature setpoint default: 0C
- o OPERATING temperature default: OFF
- o No devices connected; display: UC
- o Device connected; display: Temperature C

### 6.0 PRODUCT SAFETY FEATURES

#### 6.1 Site Selection

Install the TCM in an area free from extremes of temperature, humidity, appreciable shock and vibration. Make sure the TCM is located near a properly grounded power source that is free of transients and fluctuations.

#### 6.2 Operator/Product Safety

##### 6.2.1 Ground Resistance/Leakage Compliance

- o Ground Resistance:  $\leq .1$  ohms
- o Ground Leakage:  $\leq 1000$  microamps

##### 6.2.2 Hi-Pot compliance: 60 sec at 1500 VAC

##### 6.2.3 Fuse Protection

A single fuse is located at the rear of the TCM. A second fuse mounting hole is provided for an additional fuse in countries requiring both sides fused.

##### 6.2.4 Grounding

Safety ground wire is green/yellow direct to chassis per UL1262.

##### 6.2.5 Firmware Over/Under Temperature Protection

TCM controlled OVER and UNDER temperature limits can be entered to the TCM front panel.

- o OVER temperature default:  $150^{\circ}\text{C}$ .
- o UNDER temperature default:  $0^{\circ}\text{C}$ .

If the OVER limit is exceeded, the TCM will flash the channel LED and sound an alarm.

##### 6.2.6 Audible Alarm/Indicator

An audible alarm will chirp if either OVER or UNDER

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temperature limits are exceeded. The chirping will continue even if the condition rectifies itself.

To reset: Enter new set temperature.

#### 6.2.7 Power Fail Considerations

In the event of a power failure, all channels are turned OFF and all programmed values are lost.