

Discover



Operation
Manual

**Copyright 2005 by CEM Corporation
All Rights Reserved**

**This manual contains proprietary information, which shall not
be reproduced or transferred to other documents or disclosed to others
without prior written permission of CEM Corporation.**

**CEM is a registered trademark of CEM Corporation.
Discover is a registered trademark of CEM Corporation.**

Patents Pending

**CEM Corporation
POB 200
3100 Smith Farm Road
Matthews, North Carolina 28106-0200
(704) 821-7015 (phone)
704-821-7894 (fax)
info@cemsynthesis.com (email)
www.cem.com (web site)**

Manufactured in the
United States of America

600155
Rev. 6
2/07

Operating Precautions

The Discover® System must be grounded. In the event of an electrical short circuit, grounding reduces the risk of electric shock by providing an escape wire for electric current. This instrument is equipped with a cord having a grounding wire with a grounding plug. The plug must be plugged into an outlet that is properly installed and grounded. Consult a qualified electrician or service technician if the grounding instructions are not completely understood or if doubt exists as to whether the instrument is properly grounded. If it is necessary to use an extension cord, use only a 3-wire extension cord that has a 3-blade grounding plug and a 3-slot receptacle that will accept the plug from the instrument. The marked rating of the extension cord must be equal to or greater than the electrical rating of the instrument.

The possibility of instrument-induced electromagnetic interference (EMI) is minimal if the instrument is operated as outlined in this manual. The instrument should not be placed close to any electrical device susceptible to EMI. The manufacturer suggests that the user post a sign warning pacemaker wearers that a microwave device is in operation. If the instrument is suspected of inducing EMI, a microwave leakage measurement should be performed as outlined on pages 45-46. Leakage measured above the legal limit of 5 mW/cm² should be reported to the CEM Service Department.

Cardiac pacemakers require magnets to control their operation during checkout. If the instrument is equipped with an optional magnetic sample stirrer, which contains very high static magnetic fields, some danger exists if a pacemaker is positioned in close proximity of the instrument cavity. If the instrument is suspected of interfering with the operation of a pacemaker, the instrument should be turned off or the pacemaker wearer should move away from the instrument.

This instrument utilizes high voltages and microwave radiation. Only those trained in repair and maintenance of high voltage and microwave power systems should perform instrument service and repair.

Use of the Discover instrument in any manner not specified by CEM Corporation could render the instrument operation unsafe for the operator.

This instrument complies with United States Code of Federal Regulations 21CFR Part 1030.10 (C) for microwave leakage. A verification report is on file. This instrument complies with FCC Requirements in the United States Code of Federal Regulations (47CFR Part 18) – Industrial, Scientific and Medical (ISM) Equipment – emissions requirements. A verification report is on file.

Table of Contents

Warnings and Cautions	5
Introduction	6
System Installation	8
Installation Site	8
Unpacking	8
Accessories	10
Instrument Description	11
Temperature Control System Options	14
Infrared Temperature Control System	14
Fiber Optic Temperature Control System	14
IntelliVent Pressure Control System	15
BenchMate Option	15
Sample Stirrer	16
Cooling	16
User Interface	16
Method Control Options	17
Standard Control	17
Power-Time Control	17
SPS Control	17
Speed Set	18
Quick Test	19
Create New Method/Edit Method	21
Standard Control	21
Power-Time Control	24
SPS Control	27
Load Method	30
Perform Method	31
System Setup	32
Temperature	32
Enter Previous Calibration Values	32
Calibrate Temperature Sensor	32
Select Alternate	33
Pressure	34
Enter Previous Calibration Values	34
Calibrate Pressure Sensor	34
Peripheral Settings	35
System Options	35
Set Clock	36
Pressure Units	36
Cool Down Time	36
Release Limits	37
Ethernet Settings	38
Pre Cool Temp	39
PS EEPOT Settings	39
Method Defaults	39
Stirrer Speed	40
Open Vessel	40
System Info	41
Delete Method	41
Flow Valve	42

Table of Contents (Continued)

Maintenance, Troubleshooting and Service	43
Routine Maintenance and Cleaning	43
Microwave Leakage Measurement	43
Microwave Power Measurement	44
Troubleshooting Guide	45
Repair and Service	46
Cavity Liner Cleaning/Replacement	47
Spill Tray Cleaning	48
Ordering Information	49
Specifications	50
Warranty	51

Warnings and Cautions

Warnings, cautions and notes are included throughout this manual and should be read thoroughly and strictly followed.

WARNING: *A warning is inserted for essential information used to emphasize dangerous or hazardous conditions to the operation, cleaning and maintenance of the instrument which may result in personal injury.*

CAUTION: *A caution is inserted for essential information used to emphasize procedures which, if not strictly followed, may result in damage or destruction to the instrument or improper instrument operation.*

NOTE: *A note is inserted for emphasis of procedures or conditions that may otherwise be misinterpreted or overlooked and to clarify possible confusing situations.*

WARNING

If damage to the instrument is noted upon receipt, do not attempt to operate the instrument.

This instrument utilizes high voltages and microwave radiation. Only technicians trained in repair and maintenance of high voltage and microwave power systems should perform instrument service and repair.

Proper precautions must be taken to avoid contact with solvents or solvent vapors. Protective gear should be worn as outlined in the user's safety program for hazardous materials and the reagent manufacturer's material safety data sheet. Refer to these guidelines for proper handling and disposal of reagents.

Never modify the attenuator access port or insert metallic objects such as wire into the port. Serious microwave leakage and/or electrical shock may result. The access port of the Discover is electrically grounded to the microwave cavity and is designed to prevent leakage of microwave energy.

Cardiac pacemakers require magnets to control operation during checkout. If the Discover System is equipped with an optional sample stirrer, some danger exists if a pacemaker is positioned in close proximity to the instrument cavity. If the instrument is suspected of interfering with the operation of a pacemaker, the instrument should be turned off or the pacemaker wearer should move away from the instrument.

Refer to the manufacturer's safety data sheet and the user's safety program for proper handling and disposal procedures for any solvent used.

To prevent the possibility of severe burns, ensure that insulated gloves and protective gear as outlined in the user's safety program are worn during instrument operation.

Prior to each use of the 80 mL vessel, ensure that the fittings at the vessel cap are properly tightened. Failure to tighten these fittings may allow the vessel to leak.

Disconnect the instrument from the AC power source prior to performing any service procedure.

CAUTION

The pressure control systems are usable only with CEM supplied 10mL reaction vessels and septa.

Prior to using any cleaning or decontamination method except those recommended by the equipment manufacturer, the user should check with the manufacturer that the proposed method will not damage the equipment.

Introduction

The CEM Focused Microwave™ Synthesis System, Model Discover, is designed to enhance the ability to perform chemical reactions under controlled conditions on a laboratory scale. The System facilitates either homogeneous or heterogeneous solution phase chemistry, solid phase chemistry or chemistry conducted on solid supports. It accommodates vessels ranging in volume from 5mL to 125mL for reactions performed under atmospheric conditions and a 10mL vessel with septa for reactions performed at elevated temperatures and pressures. Primary uses of the Discover are in the discovery and lead optimization phases of the new product development process.

Microwave energy is applied to the vessel contents (reactants, catalysts, salts, solvents and/or solid supports) to accelerate the chemical reaction. The microwave absorption properties of some liquid and solid materials, due to their polar and ionic characteristics, have the capability to significantly enhance chemical reactions relative to traditional energy application (heating) techniques. The microwave interaction properties with the reactants, intermediates, catalysts, solid supports and salts provide unique opportunities for the synthetic chemist.

The Discover System consists of:

- A continuous microwave power delivery system with operator selectable power output from 0 - 300 watts (+/- 30 watts) programmable in 1-watt increments.
- A self-adjusting, single mode microwave cavity that is manually accessed via multiple attenuator ports (both ports are included).
- A 4-line x 20-character vacuum fluorescent display with alphanumeric keypad and on-board computer for programming and operational control of the system. The memory will store and recall up to 20 methods.
- 3 safety interlocks and an interlock monitoring system to prevent microwave emission when the attenuator port is not properly installed.
- Two serial ports for computer interface and optional feature connections.
- An ethernet port for network connection (optional configuration).
- An accessory kit.

Optional features include:

- **Infrared Temperature Control System** – This temperature control system uses a non-contact, infrared sensor to measure temperature. It is located below the microwave cavity floor and measures the temperature on the bottom of the vessel. The sensor is vessel volume independent and is used in a feedback loop with the on-board computer to control the temperature rise rate and control point of the vessel contents. Temperature is programmable from 25 - 250 °C.
- **Fiber Optic Temperature Control System** – This optional temperature control system, for use with large volume, open vessel applications, uses a fiber optic temperature probe for temperature measurement and control of the vessel contents. This is an “invasive” measurement technique and thus requires access to the reaction container from the external environment. It connects to the instrument through the second serial port at the rear of the instrument. When connected, the Discover system automatically detects the temperature sensor and defaults to use this sensor for temperature measurement and control. Temperature is programmable from -80 °C to 250 °C.

NOTE

The Direct Pressure Control System is no longer offered as an option for the Discover instrument. The information below is for customers with instruments purchased when this option was available.

- **Direct Pressure Control System** – This pressure control system uses a load cell for a direct pressure measurement of the reaction vessel contents. The load cell is connected to a 10mL vessel via a 22-gauge needle, which penetrates just below the septum surface (the septum is positioned outside the microwave field.). The sensor provides very accurate low-end pressure measurements and is used in a feedback control loop with the on-board controller to control the pressure rise rate and control point of the vessel contents. Pressure is programmable from 0 – 300 psi (0 – 21 bar).

- **IntelliVent™ Pressure Control System** – This pressure control system uses a load cell for an indirect measurement of the reaction vessel contents. The load cell is connected to a 10mL vessel and senses changes in the external deflection of the septa on top of the sealed pressure vessel. The sensor housing incorporates a capture and release mechanism to secure the reaction in the cavity. Pressure is programmable from 0 - 300 psi (0 - 21 bar).

CAUTION

The pressure control systems are usable only with CEM supplied 10mL reaction vessels and septa.

- **Stirring Option** - The stirring option consists of a rotating magnetic plate located below the floor of the microwave cavity. “Stirring” occurs when the rotating magnetic field couples with a stir bar in the vessel. The method setup enables the stirring feature. Standard stir bars or “fleas” are used (not included).
- **Cooling Option** – The cooling option consists of necessary valves and ports to direct a cooling gas (either nitrogen or “clean” air) onto the vessel in the system cavity. This option will decrease the temperature of a 2mL solution in a 10mL Pyrex reaction vessel from ~150 °C to ~40 °C in less than 120 seconds. Method setup enables the cooling feature. The gas is user supplied at a minimum pressure level of 20 psi (~1.5 bar) and a flow rate of 25 liters/min.
- **80 mL Vessel Option** – The 80 mL sealed vessel option permits batch scale-up of reactions performed in the 10 mL sealed vessel. The vessel has an internal volume of 80 mL with a working volume of 50 mL. It has a maximum operating temperature of 220 °C and a maximum operating pressure of 200 (psi (13.789 bar). It can be used with the standard infrared temperature sensor or with the optional fiber optic temperature sensor. For large volume temperature-critical applications, CEM recommends use of the fiber optic sensor with the 90 mL vessel.

System Installation

Installation Site

The Discover System may be installed in a laboratory fume hood or on a laboratory bench with proper ventilation. Choose a location that

- provides at least 8 in (20 cm) open space on each side and 6 in (15 cm) open space in the rear of the instrument for ventilation,
- is free from vibration of large equipment and/or excessive walk-through traffic,
- provides a temperature range of 41°F (5°C) to 104°F(40 °C) and a humidity range of 10-85% relative humidity,
- provides adequate space for sample handling (and computer placement if applicable), and
- permits the system to be connected to a dedicated, grounded 120 or 240 VAC outlet. The Discover System should be operated on a stabilized, constant voltage AC power supply. To operate properly, the voltage must be within $\pm 10\%$ of the specified level.

Unpacking

Following the instructions provided in the packing carton, carefully remove the Discover System from its shipping carton and place it in an appropriate location in the fume hood.

NOTE

Retain all packing material for use if returning the system to the manufacturer, subsidiary or distributor for service.

Inspect the instrument for shipping damage such as cracks, dents or warping.

WARNING

If damage is noted, do not attempt to operate the instrument.

If the instrument has been damaged in shipping, contact the freight carrier to report the damage and to file a damage report. Contact the CEM Service Department or the local subsidiary or distributor to report damage and to request service information.

CEM Corporation Contact Information:

Corporate Headquarters

CEM Corporation
Service Department
PO Box 200
3100 Smith Farm Road
Matthews, NC 28106-0200 USA

800.726.5551 (phone within USA)
01.704.821.7015(phone outside of US)
01.704.821.4369 (fax)
service@cem.com (email)
www.cem.com (Web Site)

United Kingdom Subsidiary

CEM Microwave Technology Ltd.
2 Middle Slade
Buckingham Industrial Park
Buckingham MK18 1WA
United Kingdom
44.1.280.822873 (phone)
44.1.280.822342 (fax)

German Subsidiary

CEM GmbH
Carl-Friedrich-Gauss Strasse 9
47475 Kamp-Lintfort
Germany
49.2842.96440 (phone)
49.2842.964411 (fax)

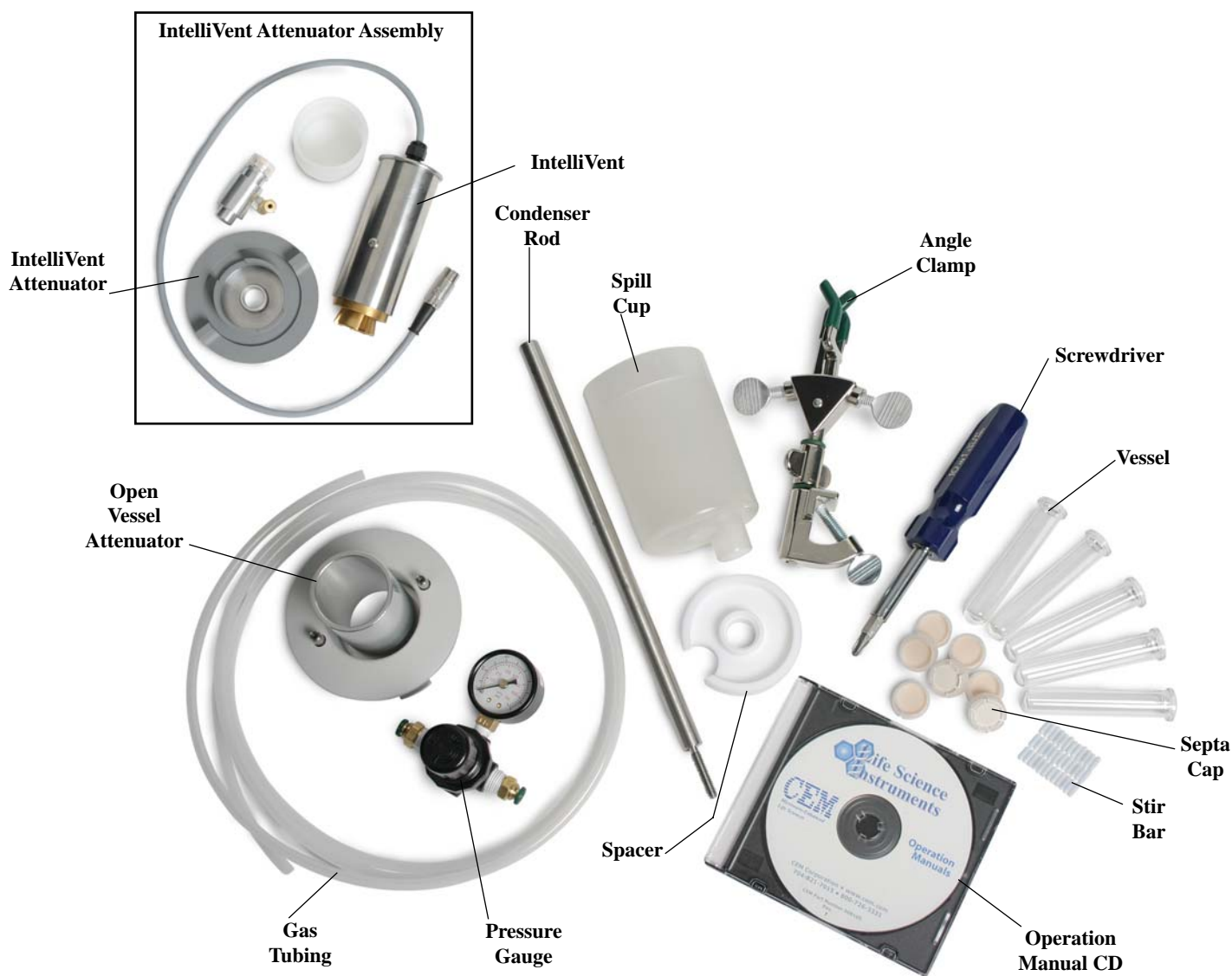
Italian Subsidiary

CEM S.r.l.
Via Dell' Artigianato, 6/8
Italy
39.35.896224 (phone)
39.35.891661 (fax)

Accessories

Verify that all accessories listed below and illustrated below plus any optional items (if ordered) have been included:

- Detachable Power Cord - based on instrument voltage (Not illustrated)
- 10-mL thick walled Pyrex reaction vessels (100)
- Septa caps (100)
- Stir Bar (100)
- Spill Cup
- IntelliVent Attenuator Assembly– This attenuator has an access port with a 0.65 in. (1.65 cm) inside diameter and RF stub height of 0.77 in(1.95 cm).
- Open Vessel Attenuator – This attenuator has an access port with a 1.5 in. (4.0 cm) inside diameter and RF stub height of 2.17 in(5.5 cm). It will accept ground glass joints up to a size of 24/40.
- IntelliVent Pressure Sensor Assembly
- Vessel Spacer (Teflon)
- Gas Tubing – 8 ft. (2.44 m) of 1/4 in. (x.xx m) diameter
- Pressure Gauge
- Screwdriver
- Operation Manual CD



Instrument Description



Discover System - Front View

- **Display** – displays menus, method parameters and instrument status on a 4 line x 20 character vacuum fluorescent display.
- **Keypad** – allows the operator to create, edit, store and recall methods, start and stop methods and change programmed parameters during operation.
- **Attenuator** – provides access to the instrument cavity while preventing microwave leakage during operation. The attenuator can be installed or removed with a “twist-lock” action (no tools required).

WARNING

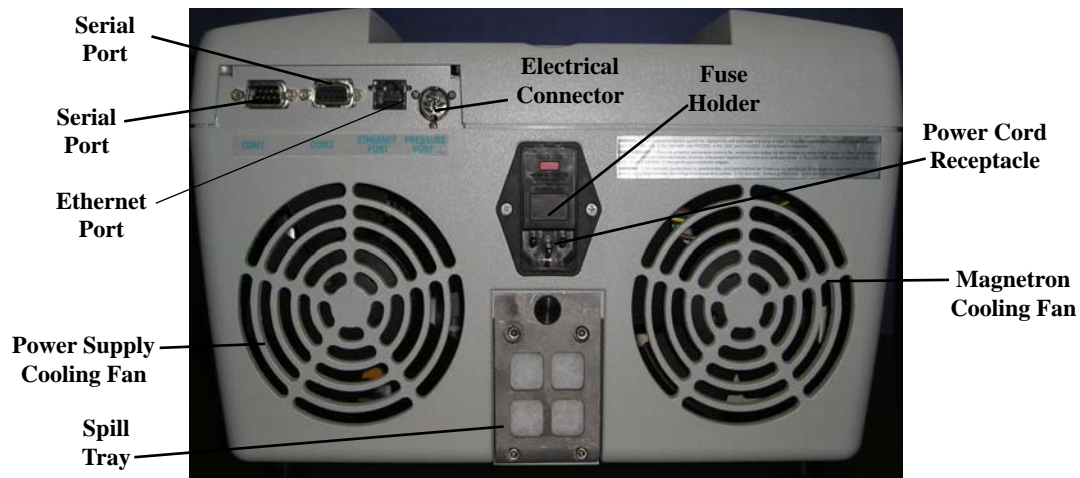
Never modify the attenuator access port or insert metallic objects such as wire into the port. Serious microwave leakage and/or electrical shock may result. The access port of the Discover is electrically grounded to the microwave cavity and is designed to prevent leakage of microwave energy.

- **Interlock Assembly** – monitors mating of the attenuator to the cavity. If the attenuator is not installed properly, the instrument will not deliver microwave power nor permit the system to operate.



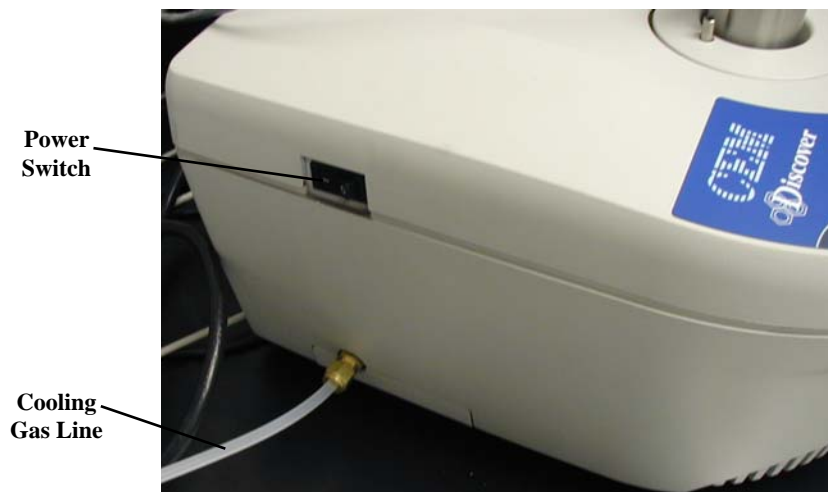
Discover System Keypad

- **Edit** – Press to access the System Setup options such as sensor configuration and calibration or system parameters.
- **Home** – Press to return to the main screen from any menu in the software. Within the System Setup portion of the software, press this key to return to the previous menu.
- **File** – Press to access the programming options in the software. These options include; Quick Test, New Method, or a list of methods from the method library.
- **C/CE** – Press to clear a key entry or delete a method from the method library when using the delete method function.
- **Enter** – Press to accept entries while editing or creating a method or in System Setup.
- **0-9** – Press to enter method parameter values such as power, temperature, pressure, ramp time, run time and hold time.
- **Start/Pause** – Press to start the current method or press during method operation to pause or suspend operation. Pressing the key again will restart the method from the paused point.
- **Stop** – Press to stop any process. Pressing this key when performing a method will stop system operation and launch the cooling function. Pressing this key during the cooling cycle will abort the cooling cycle and return the system to the home screen.
- **Arrows** – Press these keys to navigate through method programming or System Setup steps.
- **Power** – Press this key followed by the appropriate numeric keys to change the maximum applied microwave power setting. This does not stop or pause a method but updates the setting in real time. The updated setting is not captured as part of the saved method file in the method library.
- **Temperature** - Press this key followed by the appropriate numeric keys to change the temperature setpoint before or during a method. This does not stop or pause a method but updates the setting in real time. The updated setting is not captured as part of the saved method file in the method library.
- **Time** – Press this key followed by the appropriate numeric keys to change the time value during or after a method. Pressing during the Run Time cycle allows for real time changes to this value. Pressing during the Hold Time cycle allows for real time changes to this value. This does not stop or pause a method but updates the setting in real time. The updated setting is not captured as part of the saved method file in the method library.
- **Pressure** – Press this key followed by the appropriate numeric keys to change the pressure set point during a method. This does not stop or pause a method but updates the setting in real time. The updated setting is not captured as part of the saved method file in the method library. This key can also be pressed when the instrument is idle to open or close the IntelliVent.
- **Cooling** – Press this to perform the cooling function during a method. This does not stop or pause a method but updates the setting in real time. The updated setting is not captured as part of the saved method file in the method library. The cooling key can also be pressed prior to beginning a method to turn Power Max “on” or “off.”
To cool a vial when a method is not in progress, from the Main Menu, press the “Home” key; then from the temperature screen, press the cooling key.



Discover System - Rear View

- **Power Cord Receptacle** – Receives the female end of the power cord.
- **Magnetron Cooling Fan** – Draws room air past the magnetron for cooling purposes.
- **Power Supply Cooling Fan** – Draws room air past the power supply for cooling purposes.
- **Fuses** – Prevent electrical power overload.
- **7-pin Electrical Connector** – Connects load cell (pressure measurement device) to the main CPU (controller) board.
- **Serial Ports** – Communications port #1 allows connection and communication with an external computer for data collection. Communications port #2 allows connection and communication with the optional fiber optic temperature control system.
- **Spill Tray** – Removable collection tray for cavity contents in case of a vessel failure.
- **Ethernet Port** – Allows communication and connection to a local area network (LAN) or the Internet. (Optional).



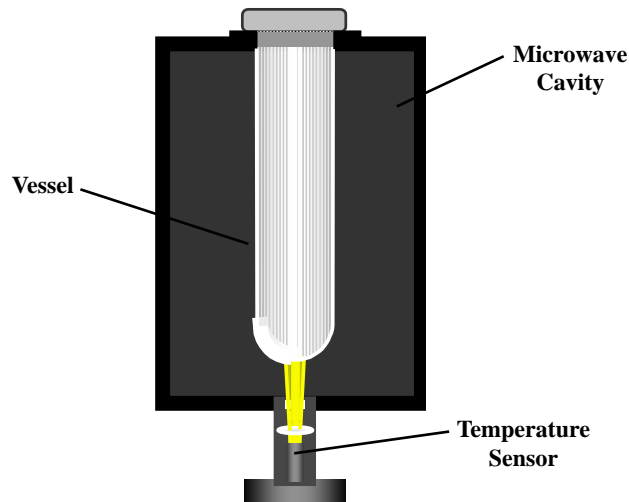
Discover System - Side View

- **Power Switch** – Turns AC power on and off to the instrument.
- **Cooling Gas Line** – Connects cooling gas supply to instrument
- **Hose Connector** – Provides a hose connection for the cooling gas source.
- **Nameplate** – Lists the model, serial number, operating voltage, frequency and current of the instrument.

Temperature Control System Options

Infrared Temperature Control System

The standard temperature control system for the Discover System consists of a non-contact infrared sensor which monitors and controls the temperature conditions of the reaction vessel located in the instrument cavity. The temperature sensor is centrally located beneath the cavity floor and “looks” up at the bottom of the vessel. A lens is positioned between the sensor and the cavity floor to protect the sensor. The temperature sensor data is set up in a feedback control loop with the magnetron to regulate the power output to maintain the temperature set-point through the onboard processor. The instrument software is designed so that the magnetron provides the lowest power output to maintain the set-point, thus maximizing the “on” time of the microwave energy input.



Cutaway View of Infrared Temperature Sensor

Fiber Optic Temperature Control System

The optional fiber optic temperature control system is recommended for use with large volume, open vessel applications. It consists of a fiber optic temperature probe that monitors and controls the temperature conditions of the reaction vessel while it is located in the instrument cavity. This temperature system requires access to the reaction container from the external environment and connects to the Discover System through communications port #2 located on the rear of the instrument. The temperature sensor data is set up in a feedback control loop with the magnetron to regulate the power output to maintain the temperature set-point through the onboard processor.

The fiber optic temperature control system can be turned “on” or “off” by pressing EDIT with the Main Menu displayed, Select “Temperature.” Choose “Select Alternate.”

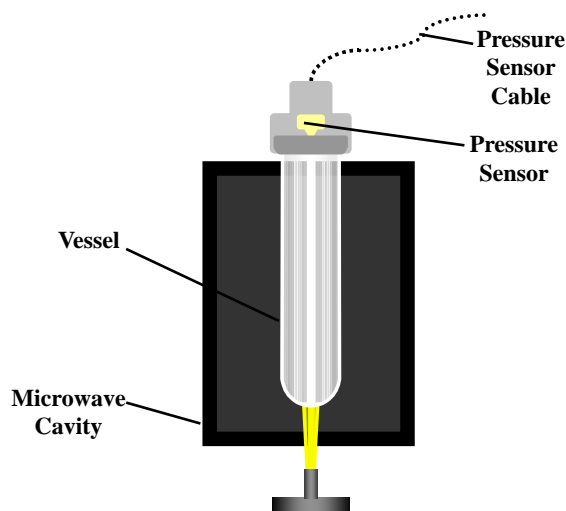
IntelliVent Pressure Control System

This pressure control system consists of a load cell to enable pressure measurement and control of the reaction environment that senses changes in the external deflection of the septa on top of the sealed pressure vial. The sensor housing incorporates a capture and release mechanism that secures the reaction vessel in the cavity. This sensor system cannot be used simultaneously with the direct pressure measurement system.

The pressure sensor data is set up in a feedback control loop with the magnetron to regulate the power output to maintain the pressure set-point if this value is reached prior to reaching the temperature set-point. The instrument software is designed to have the magnetron provide the lowest power output to maintain the set-point - thus maximizing the “on” time of the microwave energy input.



IntelliVent Pressure Sensor Assembly



Cutaway View of IntelliVent Pressure Sensor

1. Plug the IntelliVent sensor into the 7-pin connector located on the back of the Discover instrument.

NOTE

During routine use, the pressure sensor should remain connected to the 7-pin connector located on the back of the Discover.

2. Place the IntelliVent on top of the attenuator.
3. Press START. The IntelliVent closes.
4. Once the reaction is complete and the release limits are met, the IntelliVent releases itself from the attenuator.

BenchMate Option

NOTE

The BenchMate maintains pressure, but does not measure pressure.

During routine use, the BenchMate should remain connected to the 7-pin connector located on the back of the Discover.

1. Plug the BenchMate into the 7-pin connector located on the back of the Discover instrument.
2. Place the BenchMate on top of the BenchMate attenuator, ensuring that the notches on the BenchMate are aligned with the slits on the attenuator. Lock the BenchMate onto the attenuator by pushing down on the sides of the BenchMate.
3. Tighten the BenchMate by turning the top of the BenchMate clockwise until resistance is felt.

Sample Stirrer

Based on system design, the sample stirrer is a rotating plate containing either electromagnetic coils or permanent magnets positioned beneath the instrument cavity floor. It works in conjunction with stirring bars or “fleas” placed in the reaction vessel to affect stirring and ensure a homogeneous sample. An initial supply of magnetic stir bars or “fleas” are provided. Additional stir bars can be purchased from CEM Corporation. Any commercially available magnetic stir bars or “fleas” are acceptable for use with the Discover System

NOTE

The stir bars are Teflon[®]-coated iron oxide bars. When placed in the microwave field, the iron oxide bars will reflect the microwave energy without harming the instrument.

WARNING

Cardiac pacemakers require magnets to control operation during checkout. If the Discover System is equipped with a sample stirrer, some danger exists if a pacemaker is positioned in close proximity to the instrument cavity. If the instrument is suspected of interfering with the operation of a pacemaker, the instrument should be turned off or the pacemaker wearer should move away from the instrument.

Cooling

The cooling feature directs a gas source onto the outside wall of the reaction vessel. This provides the ability to rapidly cool (quench) a reaction after the application of microwave energy. The cooling feature is either “on or off” and is part of the method.

The feature consists of

- “plumbing” to direct the gas from the inlet point of the Discover to the reaction vessel in the cavity, a solenoid valve connected to the CPU (controller) board to turn the gas flow on and off,
- a hose fitting to connect the Discover to the gas source via a hose,
- 8 feet (2.44 meters) of ¼ inch (6.35 mm) inside diameter air hose.

The gas source is user supplied. CEM Corporation recommends either nitrogen or “clean” air at a minimum pressure of 20 psig (~ 1.5 bar). This will provide a flow rate of 25 liters per minute and will cool a 5mL volume of propylene glycol in a 10mL reaction vessel from 150 °C to less than 40 °C in less than 2 minutes.

User Interface

The user interface consists of the keypad, LCD display, and two serial ports. This provides the means for the user to input information into and output information from the Discover System.

The input functions are performed with the keypad and provide the ability to

- create new methods and edit existing methods,
- recall and delete methods,
- change operating parameters during method operation in real time,
- start, pause and stop operation,
- set up a computer, and
- configure the sensor options and system options.

The output functions are obtained from the LCD Display and computer port. The LCD display provides visual information of the keypad entry and permanently stored instrument information. The computer port provides the option of using an off-board PC to program the system and to collect data.

Method Control Options

The Discover System has four (4) control options for programming a method – Standard Control, Power-Time Control and SPS Coupling and SPS Deprotection Control. These options permit the user to control how the system applies the microwave energy to the reaction. In all control options, the user inputs control parameters to create the method. The user enters more control information as the level of control increases from the Power-Time Control to the Standard Control to SPS Control.

Note: Standard Control is the recommended control technique for routine operation and the default control technique used when programming a Quick Test method.

Standard Control

The Standard Control option provides more flexibility in how the user programs a reaction method and makes greater use of the feedback control data from the temperature and pressure systems. It applies a specified amount of power, defined by the user, to reach the control point. It modulates this set power automatically, based on the sensor feedback data, to ensure the control point is reached rapidly, but with limited error (temperature or pressure “overshooting”). The user programs

1. the maximum amount of microwave power that can be applied to the method,
2. a temperature control point,
3. a pressure control point,
4. a run time (the maximum run time for the method for situations where the control point is not reached)
5. a hold time (the time the system maintains the control parameters),
6. optional stirring function, and
7. optional cooling function.

The Standard Control option can be programmed for five (5) stages for multiple irradiation steps and is a general control method for maintaining critical control points.

Power-Time Control

The Power-Time Control option is the simplest programming option. It provides the user the most direct method to energize reaction systems. This option applies a specified amount of energy for a specified amount of time. Maximum temperature and pressure limits stop instrument operation if either is reached. The user programs

1. the amount of microwave power applied,
2. a maximum run time (the total time the system applies microwave energy),
3. a maximum temperature (a temperature above which the system will not apply microwave energy),
4. a maximum pressure (a pressure above which the system will not apply microwave energy),
5. optional stirring function, and
6. optional cooling function.

The Power-Time Control option can be programmed for five (5) stages for multiple irradiation steps. It does not provide the flexibility to maintain critical control points; thus, it provides the least amount of control.

SPS Control

The SPS Control option is the control for the solid phase peptide synthesis applications which will irradiate at the defined power to bring the reaction mixture to the control temperature, then cycles the power on and off for the remainder of the run time as the temperature varies between the control temperature and a user defined deviation - usually 5 °C below the control temperature. The user programs

1. the input power level when the magnetron is on,
2. a control temperature (the temperature at which the magnetron will turn off),
3. a run time (the maximum run time for a stage of the method),
4. a delta temperature (the maximum that the temperature can fall below the control temperature before the magnetron will turn on),
5. optional stirring function, and
6. optional cooling function.

Speed Set

DISCOVER	STD
XXXXXXXX	1/1
TEMP = XXX	POWER = XXX
TIME = XX:XX	Pmax = XXX

1. With the main menu displayed, press any of the “hot” keys to change the method parameters.
 - Press the “μWave Power” (Microwave Power) key to revise the power parameter.
 - Press the “T °” (Temperature) key to revise the temperature parameter.
 - Press the “⌚” (Time) key to revise the time parameter. Use the numeric keypad to enter the time (mm:ss). Press ENTER.
 - Press the “*” key to toggle “Power Max” on or off. Press ENTER.
2. Once all desired parameters have been revised, press START to begin the method.

Quick Test

```
DISCOVER          STD
XXXXXXXXX         1/1
TEMP = XXX        POWER = XXX
TIME = XX:XX      Pmax = XXX
```

1. With the main menu displayed, press the “file” key.

```
Select Method
→Quick Test
New Method
XXXXXXXXX
```

2. Using the left arrow key, toggle and select “Quick Test.” Press the ENTER key.

```
QUICK TEST
NAME = <QUICK TEST>

Temperature = XXX
```

3. Using the numeric keypad, enter the temperature control point (from 0 - 300 °C). Press the ENTER key.

```
QUICK TEST
NAME = <QUICK TEST>

Hold Time = XX:XX
```

4. Using the numeric keypad, enter the hold time (from 0 to 60 minutes). Press the ENTER key.

```
Save Method = <N>
```

5. Using the arrow key(s), toggle and select “Y - yes” or “N - no” to save and name the method in the instrument directory (maximum 20 methods). Press the ENTER key.

```
Name:
A B C D E F G H I J K L M N O P Q R
S T U V W X Y Z 1 2 3 4 5 6 7 8 9
Exit → “ “
```

6. Using the arrow keys, highlight the first letter of the method name. Press the ENTER key. Continue to use the arrow key(s) and the ENTER key to complete the name of the method (12 characters maximum). When the name is completed, use the arrow key(s) to highlight “Exit.” Press the ENTER key. **Note:** Use the “C/CE” key to erase a character. Use the “ “ to add a space in the name. When using numbers to identify the method, use the keypad to enter the numbers and press the ENTER key.

7. Once the method name is selected, press the ‘Home’ key.

```
DISCOVER
XXXXX           1/1
TEMP = XXX      POWER = XXX
TIME = XX:XX    Pmax = XXX
```

XXXXX
1 of 1 XXXW T = XXX°
XX:XX XX °C XXXX PSI

14. The instrument will count down the programmed time for the reaction.

Note: During the Quick Test, the keys on the left side of the instrument may be pressed to change the parameters during the method – power, temperature, time, pressure, stirring speed and cooling. For example, if the “temperature” key is pressed, the following screen will appear. Use the numeric keys to enter the new parameter.

Temperature = XXX
1 of 1 XXXW T = XXX°
XX:XX XX °C XXXX PSI

Note: At the end of the Quick Test, the cool down time begins.

Note: The length of cool down time is programmed in System Setup.

COOL DOWN
X:XX
XXX C XXXXPSI
Vessel May be Hot

15. At the end of the cool down time, the instrument will produce several audible beeps.

WARNING

To prevent the possibility of severe burns, ensure that insulated gloves and protective gear as outlined in the user’s safety program are worn.

16. Press the “Home” key to return to the instrument main manu.

DISCOVER

XXXXX	1/1
TEMP = XXX	POWER = XXX
TIME = XX:XX	Pmax = XXX

Note: To perform additional reaction(s) using the same Quick Test method, press the “Start” key.

Create New Method/Edit Method

Standard Control

DISCOVER	STD
XXXXX	1/1
TEMP = XXX	POWER = XXX
TIME = XX:XX	Pmax = XXX

1. With the main menu displayed, press the “file” key.

Select Method
Quick Test
→New Method
POWER TEST

2. Using the left arrow key, toggle and select “New Method” to create a method or select the method to be edited. Press the ENTER key.

Edit Method
Name <UNTITLED>
Stage = 1
Mode = Standard

3. Using the right arrow key, toggle and select “Standard.” Press the ENTER key. The instrument is now prepared to edit or create stage #1 of a method using the “standard” control option.

Edit Method
Name <UNTITLED>
Stage = 1
Power = 000 Watts

4. Using the numeric keypad, enter the power for the method (from 1 to 300 watts). Press the ENTER key.

Edit Method
Name <UNTITLED>
Stage = 1
Temperature = 000

5. Using the numeric keypad, enter the temperature (from ambient to 300 °C). Press the ENTER key.

Edit Method
Name <UNTITLED>
Stage = 1
Pressure = 000 Psi

6. Using the numeric keypad, enter the pressure (from 0 to 300 psi [21 bar]). Press the ENTER key.

Edit Method
Name <UNTITLED>
Stage = 1
Run Time = 00:00

7. Using the numeric keypad, enter the run time (from 0 to 60 minutes). Press the ENTER key.

Edit Method
Name <UNTITLED>
Stage = 1
Hold Time = 00:00

8. If applicable, using the numeric keypad, enter the hold time (from 0 to 60 minutes). Press the ENTER key.

Edit Method Name <UNTITLED> Stage = 1 Stirrer Speed = <OFF>
--

9. If the instrument is equipped with the stirring option, use the right arrow key to toggle and select “Off,” “Low,” “Medium” or “Hi” stirring speed. Press the ENTER key.

Edit Method Name <UNTITLED> Stage = 1 Cooling = <OFF>
--

10. If the instrument is equipped with the cooling option, use the right arrow key to toggle and select “Off” or “On” to indicate if the cooling option is to be used for the method. Press the ENTER key.

Note: The length of cooling time is programmed in System Setup.

Edit Method Name <UNTITLED> Stage = 1 Next Stage = <N>

11. Using the arrow key(s), toggle and select “Y - yes” or “N - no” to advance to programming and entering parameters for additional stages (5 maximum). Press the ENTER key.

Note: The previous parameter screens will be repeated for each stage selected (1 - 5).

Edit Method Name <UNTITLED> Stage = 1 Print Data = <N>

12. Using the arrow key(s), toggle and select “Y - yes” or “N - no” to send method data to a PC for printing. Press the ENTER key.

Save Method = <N>

13. Using the arrow key(s), toggle and select “Y - yes” or “N - no” to save the method name in the instrument directory. Press the ENTER key. Note: If “no” is selected, the instrument main screen will appear with the method titled “untitled.” If “yes” is selected, proceed with step 14.

Name: <UNTITLED> A B C D E F G H I J K L M N O P Q R S T U V W X Y Z 1 2 3 4 5 6 7 8 9 Exit → “ “

14. Using the arrow keys, highlight the first letter of the method name. Press the ENTER key. Continue to use the arrow key(s) and the ENTER key to complete the name of the method (12 characters maximum). When the name is completed, use the arrow key(s) to highlight “Exit” Press the ENTER key. **Note:** Use the “C/CE” key to erase a character. Use the “ ” to add a space in the name.

Note: When using numbers to identify the method, use the keypad to enter the numbers and press the ENTER key.

15. Once the method name is selected, press the ‘Home’ key.

Note: If the name entered exists in the method directory, the following screen will appear.

<p style="text-align: center;">File Name Already Exists.</p> <p style="text-align: center;">1: Overwrite 2: Edit Name</p>
--

Note: If the above screen appears, press “1” to overwrite the method with the same name or “2” to edit the method name. If the name is to be edited, the above screen will appear for naming the method.

DISCOVER	STD
XXXXX	1/1
TEMP = XXX	POWER = XXX
TIME = XX:XX	Pmax = XXX

16. Press the “Start” key to begin the programmed method.

Power-Time Control

DISCOVER	P/T
XXXXX	1/1
TEMP = XXX	POWER = XXX
TIME = XX:XX	Pmax = XXX

1. With the main menu displayed, press the “file” key.

Select Method
Quick Test
→New Method
POWER TEST

2. Using the left arrow key, toggle and select “New Method” to create a method or select the method to be edited. Press the ENTER key.

Edit Method
Name <UNTITLED>
Stage = 1
Mode = Power Time

3. Using the right arrow key, toggle and select “Power Time.” Press the ENTER key. The instrument is now prepared to edit or create stage #1 of a method using the “power time” control option.

Edit Method
Name <UNTITLED>
Stage = 1
Power = 000 Watts

4. Using the numeric keypad, enter the power for the method (1 - 300 watts). Press the ENTER key.

Edit Method
Name <UNTITLED>
Stage = 1
Run Time = 00:00

5. Using the numeric keypad, enter the run time (0 - 60 minutes). Press the ENTER key.

Edit Method
Name <UNTITLED>
Stage = 1
Max Temp. = 000

6. Using the numeric keypad, enter the maximum temperature (temperature at which instrument ceases to apply microwave power). Press the ENTER key.

Edit Method
Name <UNTITLED>
Stage = 1
Max Press. = 000

7. Using the numeric keypad, enter the maximum pressure (pressure at which instrument ceases to apply microwave power). Press the ENTER key.

Edit Method
Name <UNTITLED>
Stage = 1
Stirrer Speed = <Off>

8. If the instrument is equipped with the stirring option, use the right arrow key to toggle and select “Off,” “Low,” “Medium” or “Hi” stirring speed. Press the ENTER key.

```

Edit Method
Name <UNTITLED>
          Stage = 1
Cooling = <Off>

```

9. If the instrument is equipped with the cooling option, using the arrow key(s), toggle and select “Off” or “On” to indicate if the cooling option is to be used for the method. Press the ENTER key.

Note: The length of cool down time is programmed in System Setup>

```

Edit Method
Name <UNTITLED>
          Stage = 1
Next Stage = <N>

```

10. Using the arrow key(s), toggle and select “Y - yes” or “N - no” to advance to programming and entering parameters for additional stages (5 maximum). Press the ENTER key.

Note: The previous parameter screens will be repeated for each stage selected (1 - 5).

```

Edit Method
Name <UNTITLED>
          Stage = 1
Print Data = <N>

```

11. Using the arrow key(s), toggle and select “Y - yes” or “N - no” to send method data to a PC for printing. Press the ENTER key.

```

Save Method = <N>

```

12. Using the arrow key(s), toggle and select “Y - yes” or “N - no” to save the method name in the instrument directory. Press the ENTER key.

```

Name: <UNTITLED>
A B C D E F G H I J K L M N O P Q R
S T U V W X Y Z 1 2 3 4 5 6 7 8 9
Exit  →    “  “

```

13. Using the arrow keys, highlight the first letter of the method name. Press the ENTER key. Continue to use the arrow key(s) and the ENTER key to complete the name of the method (12 characters maximum). When the name is completed, use the arrow key(s) to highlight “Exit” Press the ENTER key. **Note:** Use the → key to erase a character. Use the “ “ to add a space in the name.

Note: When using numbers to identify the method, use the keypad to enter the numbers and press the ENTER key.

14. Once the method name is selected, press the ‘Home’ key.

Note: If the name entered exists in the method directory, the following screen will appear.

```

File Name Already Exists.

1: Overwrite
2: Edit Name

```

Note: If the name entered exists in the method directory, the following screen will appear.

<p style="text-align: center;">File Name Already Exists.</p> <p style="text-align: center;">1: Overwrite 2: Edit Name</p>
--

Note: If the above screen appears, press “1” to overwrite the method with the same name or “2” to edit the method name. If the name is to be edited, the above screen will appear for naming the method.

DISCOVER	PT
XXXXX	1/1
TEMP = XXX	POWER = XXX
TIME = XX:XX	Pmax = XXX

25. Press the “Start” key to begin the programmed method.

SPS Control

DISCOVER	SPS
XXXXX	1/1
TEMP = XXX	POWER = XXX
TIME = XX:XX	Pmax = XXX

1. With the main menu displayed, press the “file” key.

Select Method
Quick Test
→New Method
POWER TEST

2. Using the left arrow key, toggle and select “New Method” to create a method or select the method to be edited. Press the ENTER key.

Edit Method
Name <UNTITLED>
Stage = 1
Mode = SPS

3. Using the right arrow key, toggle and select “SPS.” Press the ENTER key. The instrument is now prepared to edit or create stage #1 of a method using the “SPS” control option.

Edit Method
Name <UNTITLED>
Stage = 1
Power = 000 Watts

4. Using the numeric keypad, enter the power for the method (1 - 300 watts). Press the ENTER key.

Edit Method
Name <UNTITLED>
Stage = 1
Temperature = 000

5. Using the numeric keypad, enter the temperature (from ambient to 300 °C). Press the ENTER key.

Edit Method
Name <UNTITLED>
Stage = 1
Pressure = 000 Psi

6. Using the numeric keypad, enter the pressure (from 0 to 300 psi [21 bar]). Press the ENTER key.

Edit Method
Name <UNTITLED>
Stage = 1
Run Time = 00:00

7. Using the numeric keypad, enter the run time (from 0 to 60 minutes). Press the ENTER key.

Edit Method
Name <UNTITLED>
Stage = 1
Delta Temp = XX

8. Using the numeric keypad, enter the delta temperature (from 0 to 50 °C). Press the ENTER key.

```

Edit Method
Name <UNTITLED>
      Stage = 1
Stirrer Speed = <OFF>

```

9. If the instrument is equipped with the stirring option, use the right arrow key to toggle and select “Off,” “Low,” “Medium” or “Hi” stirring speed. Press the ENTER key.

```

Edit Method
Name <UNTITLED>
      Stage = 1
Cooling = <OFF>

```

10. If the instrument is equipped with the cooling option, use the right arrow key to toggle and select “Off” or “On” to indicate if the cooling option is to be used for the method. Press the ENTER key.

Note: The length of cooling time is programmed in System Setup.

```

Edit Method
Name <UNTITLED>
      Stage = 1
Next Stage = <N>

```

11. Using the arrow key(s), toggle and select “Y - yes” or “N - no” to advance to programming and entering parameters for additional stages (5 maximum). Press the ENTER key.

Note: The previous parameter screens will be repeated for each stage selected (1 - 5).

```

Edit Method
Name <UNTITLED>
      Stage = 1
Print Data = <N>

```

12. Using the arrow key(s), toggle and select “Y - yes” or “N - no” to send method data to a PC for printing. Press the ENTER key.

```

Save Method = <N>

```

13. Using the arrow key(s), toggle and select “Y - yes” or “N - no” to save the method name in the instrument directory. Press the ENTER key.

```

Name: <UNTITLED>
A B C D E F G H I J K L M N O P Q R
S T U V W X Y Z 1 2 3 4 5 6 7 8 9
Exit   →     “ ”

```

14. Using the arrow keys, highlight the first letter of the method name. Press the ENTER key. Continue to use the arrow key(s) and the ENTER key to complete the name of the method (12 characters maximum). When the name is completed, use the arrow key(s) to highlight “Exit” Press the ENTER key. **Note:** Use the “C/CE” key to erase a character. Use the “ ” to add a space in the name.

Note: When using numbers to identify the method, use the keypad to enter the numbers and press the ENTER key.

15. Once the method name is selected, press the ‘Home’ key.

Note: If the name entered exists in the method directory, the following screen will appear.

<p style="text-align: center;">File Name Already Exists.</p> <p style="text-align: center;">1: Overwrite 2: Edit Name</p>
--

Note: If the above screen appears, press “1” to overwrite the method with the same name or “2” to edit the method name. If the name is to be edited, the above screen will appear for naming the method.

DISCOVER	SPS
XXXXX	1/1
TEMP = XXX	POWER = XXX
TIME = XX:XX	Pmax = XXX

16. Press the “Start” key to begin the programmed method.

Load Method

Note: Prior to performing a method, the method must be loaded (selected) from the method directory.

DISCOVER	SPS
XXXXX	1/1
TEMP = XXX	POWER = XXX
TIME = XX:XX	Pmax = XXX

1. With the main menu displayed, press the “file” key.

Select Method
Quick Test
New Method
→XXXXXXXXXX

2. Using the arrow keys, toggle and select the method to be loaded into the software for performing a reaction.
3. Press the ENTER key.

DISCOVER	SPS
XXXXX	1/1
TEMP = XXX	POWER = XXX
TIME = XX:XX	Pmax = XXX

Note: The selected method is displayed. To begin the method, press the “Start” key.

Perform Method

DISCOVER	STD
XXXXX	1/1
TEMP = XXX	POWER = XXX
TIME = XX:XX	Pmax = XXX

WARNING

Refer to the manufacturer's safety data sheet and the user's safety program for proper handling and disposal procedures for the selected solvent.

1. Prepare the reaction component(s). Place the vessel in the instrument and secure the pressure sensor into position.
2. Ensure that the method to be performed is loaded and displayed on the main menu.
3. Press the "Start" key to begin the method.

XXXXXXXX
1 of X XXXW T =XXX° *
XX:XX XX °C XXX PSI

4. The instrument will count down the programmed time for stage #1 of the reaction.

Note: If pressure exceeds 300 psi during the reaction, the cooling gas turns on and the reaction is terminated.

Note: During the reaction, the keys on the left side of the instrument ("hot" keys) may be pressed to change the parameters – power, temperature, time, pressure and cooling. For example, if a pressure device is installed and the "pressure" key is pressed, the following screen will appear. Use the numeric keys to enter the new parameter. The arrow keys can be used to set the stirring option at "Hi," "Med," "Low" or "Off." If parameter are edited using the "hot" keys, the instrument will prompt the user to either save or not save the changes.

Pressure = XXX
1 of 1 XXXW T = XXX°
XX:XX XX °C XXXX PSI

Note: At the end of the reaction, the cool down time begins.

COOL DOWN
X:XX
XXX C XXXXPSI
Vessel May be Hot

5. At the end of the cool down time, the instrument will produce several audible beeps and return to the Main Menu.

Note: If more than one (1) stage is programmed for the reaction, the method will continue with each stage as programmed.

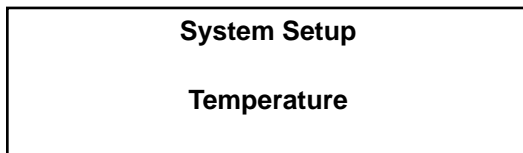
WARNING

To prevent the possibility of severe burns, ensure that insulated gloves and protective gear as outlined in the user's safety program are worn.

Note: To perform additional reaction(s) using the same method, press the "Start" key.

System Setup

1. With the main menu displayed, press the EDIT key.

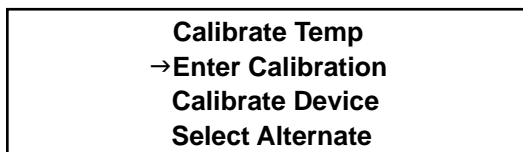


Note: Use the arrow keys to toggle and select the system setup menu items – Temperature, Pressure, System Options, Open Vessel, System Info, Delete Methods and Flow Valve.

Temperature

The Discover instrument is factory calibrated. If software is corrupted or if new software is installed, the temperature calibration data must be re-entered into the system setup information. If a new temperature sensor or cavity liner is installed, calibration of the sensor is required.

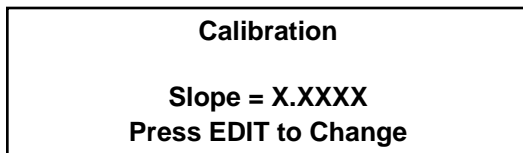
2. Press the ENTER key.



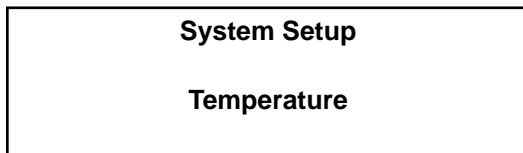
Enter Previous Calibration Values

3. To enter previous calibration information, use the arrow key(s) and select “Enter Calibration.” Press the ENTER key.

Note: The calibration values can be found either on the temperature sensor or on the calibration certificate provided with the sensor.



4. Press the EDIT key to highlight the slope calibration data. Using the numeric keypad, enter the previous slope constant. Press the ENTER key.



Calibrate Temperature Sensor

5. Use the arrow key(s) and select “Calibrate Device.” Press the ENTER key.



6. Place 50mL of dimethyl formamide, ethylene glycol or another high-boiling-point (greater than 130 °C) solvent in a round bottom flask with a stir bar. Disconnect the cooling supply line. Using Power-Time control, program the system to irradiate the solvent at 300W for 30 seconds (approximately 150 °C).

7. Press the ENTER key. The following screen will be displayed.

Input Temperature
Actual = XXXX
Current = XXXX °C

8. Place a thermometer in the vessel and stir the solvent (2 - 3 seconds). Wait until the temperature is no longer rising and reaches a stable value. Measure the temperature of the solvent. Using the numeric keys, enter the actual temperature of the solvent.

9. Press the ENTER key. The following screen will be displayed.

CALIBRATED
Slope = X.XXXX
Current = XXX °C
Press Any Key

10. Press the HOME key to return to the temperature calibration screen.

Calibrate Temperature
→Enter Calibration
Calibrate Device
Select Alternate

11. Press the HOME key to return to the System Setup screen.

System Setup
Temperature

Select Alternate

12. Use the arrow key(s) and select “Select Alternate.” Press the ENTER key.

Select Temp Device
Device: XXXXXXXXX

13. Use the arrow key(s) to toggle and select the proper temperature device - “Infrared” or “Fiber Optic.”

14. Press the ENTER key.

Note: Since the Fiber Optic sensor is optional, if “Fiber Optic” is selected, but a fiber optic sensor is not installed, the following screens will appear.

Select Temp Device
No Fiber Optic Found

Fiber Optic Error
No Response
1: Reset Device
9: Alternate Device

Note: Press the HOME key to return to the instrument main menu.

Pressure

System Setup
Pressure

The Discover instrument is factory calibrated. If software is corrupted or if new software is installed, the pressure calibration data must be re-entered into the system setup information. If a new pressure sensor is installed, calibration of the sensor is required.

15. Press the ENTER key.

Calibrate Pressure
→Enter Calibration
Calibrate Device

Enter Previous Calibration Values

16. To enter previous calibration information, use the arrow key(s) and select “Enter Calibration.” Press the ENTER key.

Note: Calibration values can be found either on the temperature sensor or on the calibration certificate provided with the sensor.

Calibration
Slope = X.XXXX
Intercept = XX.X

17. Press the EDIT key to highlight the slope calibration data. Using the numeric keypad, enter the previous value for the slope of the pressure curve. Press the ENTER key. The instrument highlights the intercept data.
18. Using the numeric keypad, enter the previous value for the intercept of the pressure curve. Press the ENTER key.

Calibrate Pressure
→Enter Calibration
Calibrate Device

Calibrate Pressure Sensor

19. To calibrate the instrument pressure sensor, use the arrow key(s) and select “Calibrate Device.” Press the ENTER key.

Calibrate Pressure
Press ENTER
To Begin

20. Ensure that there is no pressure applied to the pressure assembly. Press the ENTER key.

Closing Device
Please Wait

Waiting
XXX

Note: The instrument closes the pressure device and counts down sixty (60) seconds to ensure that no pressure is applied.

Zero Pressure
Press Enter

21. Press the ENTER key.

Apply Pressure.
Press ENTER
XXXX
XXXX

22. Apply a pressure source with a known pressure value to the pressure sensor assembly (maximum pressure 300 psi or 21 bar). Using the numeric keys, enter the applied pressure value. Press the ENTER key. The pressure sensor is calibrated.

23. Press the HOME key to return to the System Setup screen.

Note: If the instrument is not equipped with a pressure sensor and “Calibrate Device” is selected, the following screen will appear.

Calibrate Error
No Pressure Device

Press ENTER

System Options

24. Using the arrow keys, toggle and select “System Options.

System Setup

System Options

25. Press the ENTER key.

System Options

Peripheral Settings

Note: Use the arrow keys to toggle and select the System Options menu items – Peripheral Settings, Set Clock, Pressure Units, Cool Down Time, Release Limits, Ethernet Settings, Pre Cool Temp, PS EEPOT Settings, Method Defaults and Stirrer Speed.

Peripheral Settings

26. Press the ENTER key.

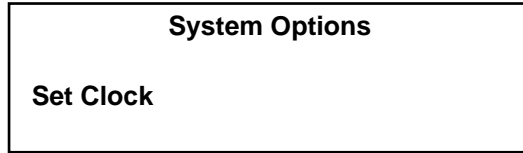
Set Peripherals

Mode = XXXXXXXX

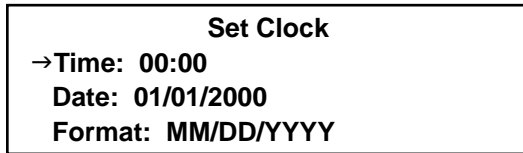
Note: Peripheral settings include system options. Use the arrow keys to toggle and select the Peripheral Settings menu items – None, Fiber Optic, Explorer, Voyager, and CoolMate. If an Explorer, Voyager or CoolMate module is to be utilized in conjunction with the Discover module, select the proper option setting. Refer to the appropriate module operation manual for system operation. If Voyager, Explorer or CoolMate is selected, and the option is not installed, an error message will be displayed.

Note: If a fiber optic temperature sensor is installed, select “Fiber Optic.” To operate the Discover with a standard infrared temperature sensor, select “None.”

Set Clock



27. Press the ENTER key.

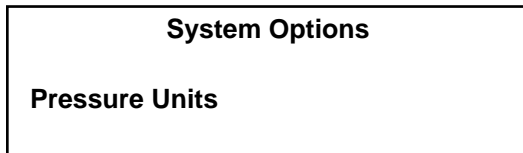


28. Using the arrow key(s), position the “arrow” on the item to be entered or edited. Press the EDIT key. Using the numeric keypad, enter the appropriate time (24-hour basis) and/or date and press the ENTER key. To edit the date format, position the “arrow” beside “Format.” Press the EDIT key to highlight the date format. Press the ENTER key to toggle and select either “MM/DD/YYYY” (Month/Day/Year) or “DD/MM/YYYY” (Day, Month, Year).

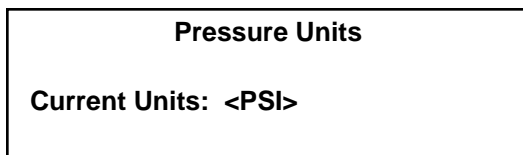
29. Press the “Home” key to return to the System Options screen.

Pressure Units

30. Press the arrow key(s) to toggle and select “Pressure Units.”



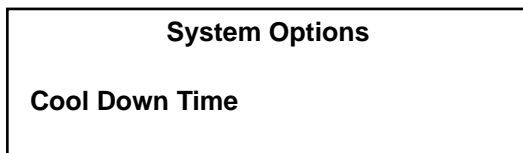
31. Press the ENTER key.



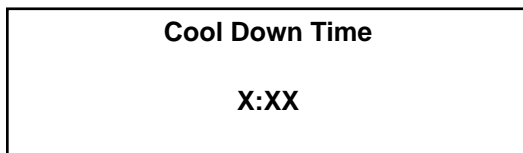
32. Using the arrow key(s), toggle and select the units in which pressure will be displayed – PSI or BAR. Press the ENTER key to return to the System Options screen.

Cool Down Time

33. Press the arrow key(s) to toggle and select “Cool Down Time.”



34. Press the ENTER key.



Note: The post-reaction cool down time appears at the end of a reaction and counts down to permit sufficient cool down time prior to removing the vessel from the instrument. Cool down time can be set from 0 - 99 minutes and 99 seconds. The default cool down time is five (5) minutes. CEM Corporation recommends that a minimum of one (1) minute cool down time be used for any reaction.

35. Using the numeric keypad, enter the desired cool down time. Press the ENTER key.

<p style="text-align: center;">System Options</p> <p>Set Clock</p>
--

36. Press the “Home” key to return to the System Setup screen.

Release Limits

Note: Pressure and Temperature release limits are the pressure and temperature at which the post reaction cooling ends.

37. Press the arrow key(s) to toggle and select “Release Limits.”

<p style="text-align: center;">System Options</p> <p>Release Limits</p>

38. Press the ENTER key.

<p style="text-align: center;">Release Limits</p> <p>Release Pressure Release Temperature</p>
--

39. Use the arrow key(s) to toggle and select “Release Pressure.”

<p style="text-align: center;">Release Pressure</p> <p style="text-align: center;">XX.X PSI</p>

40. Using the numeric keypad, enter the desired pressure (0 - 300 PSI or 0 - 20.7 BAR) . Press the ENTER key.

<p style="text-align: center;">Release Limits</p> <p>Release Pressure Release Temperature</p>
--

41. Use the arrow key(s) to toggle and select “Release Temperature.”

<p style="text-align: center;">Release Temperature</p> <p style="text-align: center;">XXX° C</p>
--

42. Using the numeric keypad, enter the desired pressure (0 - 300° C) . Press the ENTER key.

<p style="text-align: center;">Release Limits</p> <p>Release Pressure Release Temperature</p>
--

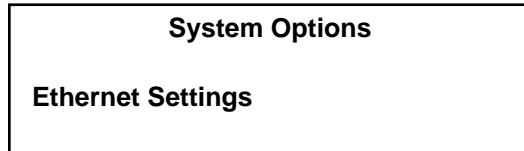
Ethernet Settings

Note: The ethernet settings menu should be used only when communicating via the ethernet port. If the Discover is connected to the internet or a wireless router, the default IP address must be edited since only one unique IP address can be exposed to the network.

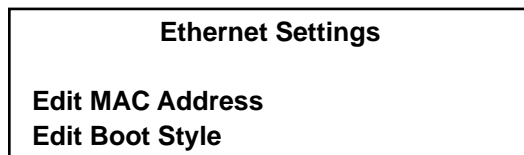
CAUTION

If the Discover is not communicating via the ethernet port, **do not** continue with the “Ethernet Settings” menu.

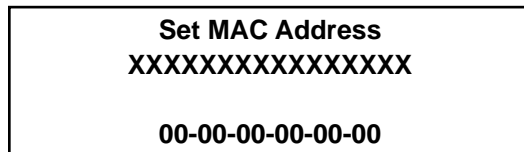
43. Press the arrow key(s) to toggle and select “Release Limits.”



44. Press the ENTER key.



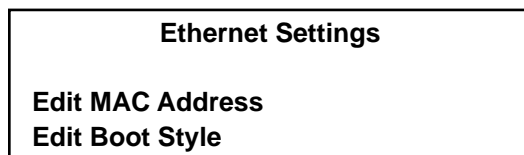
45. Use the arrow key(s) to toggle and select “Edit MAC Address.” Press the ENTER key.



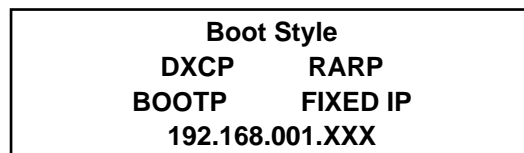
46. Press the EDIT key.

47. Using the numeric keypad, enter the following numbers: 00-08-79-01-XX-XX (X's indicate the serial number of the instrument.) i.e. For serial number DU1234, enter “12-34.”

48. Press the “Home” key to save the new number.



49. Use the arrow key(s) to toggle and select “Edit Boot Style.” Press the ENTER key.



50. Press the EDIT key.

51. Using the numeric keypad, enter the following numbers: 192.168.001.XXX. (XXX is a unique number between 5 and 100. The instrument default is “60.”)

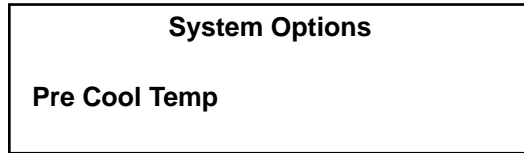
52. Press the ENTER key. Press the “Home” key to return to the “System Options” screen.

53. Reboot the Discover system by turning the instrument off, then on.

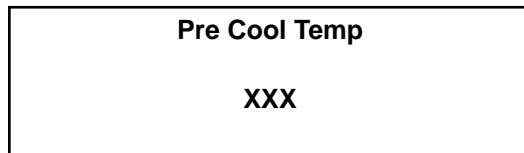
Pre Cool Temp

Note: Pre Cool Temp is utilized only with the CoolMate option. To utilize this setting, refer to the appropriate operation manual.

54. Press the arrow key(s) to toggle and select “Pre Cool Temp.”

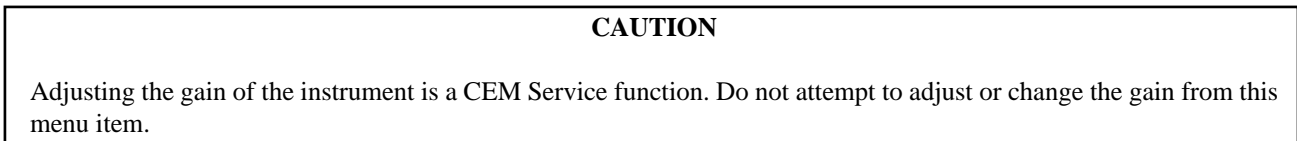


55. Press the ENTER key.



56. Using the numeric keypad, enter the desired pre-cool temperature (-80 to 54). Press the ENTER key. **Note:** The temperature key can be pressed to toggle between “-” and “+” temperatures.

PS EEPOT Settings

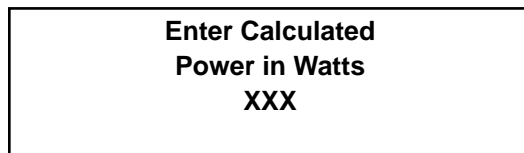


Note: Power supply EEPOT setting requires performance of a power test to enter the calculated instrument wattage. Prior to selection of this menu item, perform a power test as outlined in this manual.

57. Press the arrow key(s) to toggle and select “PS EEPOT Settings.”



58. Press the ENTER key.

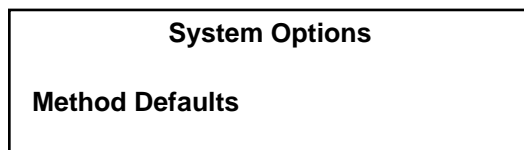


59. Using the numeric keypad, enter the calculated wattage from the power test.

Method Defaults

Note: Method Defaults is used to enter the default delta temperature in the SPS mode.

60. Press the arrow key(s) to toggle and select “Method Defaults.”



61. Press the ENTER key.

Method Defaults
Delta Temp XX
(1 - 50)

62. Using the numeric keypad, enter the delta temperature (1 - 50° C).

Stirrer Speed

63. Press the arrow key(s) to toggle and select “Stirrer Speed.”

System Options
Stirrer Speed

64. Press the ENTER key.

Edit Stirrer Speed
Stirrer HI = XXX
Stirrer MED = XXX
Stirrer LOW = XXX

65. Using the right arrow key, toggle to select either “Hi,” “Med” or “Low.”

66. Using the numeric keypad, enter the desired stirrer speed (percentage) from 0 - 100. Default percentages are 40 (Low), 65 (Med) and 100 (High).

67. Press the ENTER key.

68. Press the “Home” key two times to return to the “System Setup” screen.

Open Vessel

69. Using the arrow keys, toggle and select “Open Vessel.”

System Setup
Open Vessel

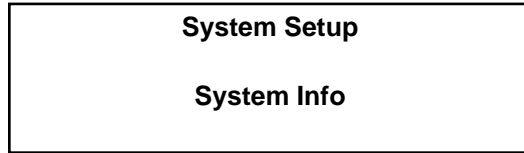
70. Press the ENTER key.

Open Vessel
Run Open Vessel: No
Arrow to Choose
Enter to Select

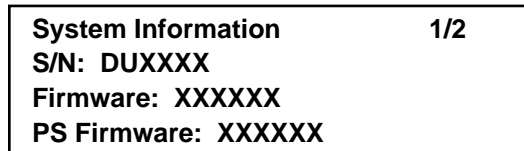
71. Press the arrow key(s) to toggle and select “Yes” or “No.” Press the ENTER key.

System Info

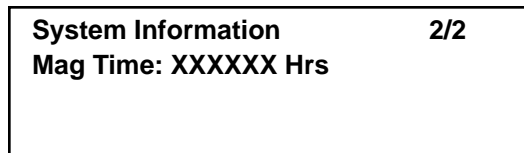
72. Press the arrow key(s) to toggle and select “System Info.”



73. Press the ENTER key.



74. Press the arrow key(s) to toggle and select the second System Information screen (2/2).



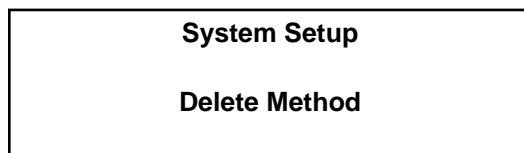
Note: The System Information screens display the instrument serial number, the firmware version, the PS firmware version and the magnetron operation time. The instrument serial number and the firmware number require re-entry immediately following an instrument cold start. If the instrument is cold started, immediately access this screen, and using the numeric keypad, reenter the instrument serial number and the software version. The PS firmware number and the mag time can not be edited.

75. Press the “Home” key to return to the System Setup screen.

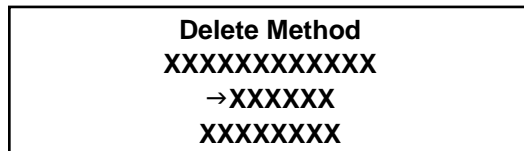
Delete Method

Note: The Discover software permits deletion of a method by two techniques - by menu screens in the System Setup or after accessing the method library. The following instructions are for the System Setup technique.

76. Press the arrow key(s) to toggle and select “Delete Method.”

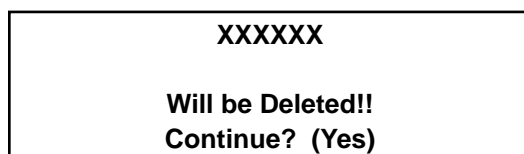


77. Press the ENTER key.



78. Using the arrow key(s), toggle and place the arrow beside the method to be deleted.

79. Press the ENTER key.



80. Using the arrow key(s), toggle and select “yes” to continue the method deletion.

Note: Select “no” to abort the deletion process.

81. Press the ENTER key. The method is deleted from the library and the Select Method screen appears.

Select Method
XXXXXXXXXXXX
→XXXXXXXX
XXXXXXXX

Note: With the above screen displayed, the C/CE key can be pressed to begin the method deletion process. This process will follow the same procedures as outlined above.

Flow Valve

Note: The Discover software permits deletion of a method by two techniques - by menu screens in the System Setup or after accessing the method library. The following instructions are for the System Setup technique.

82. Press the arrow key(s) to toggle and select “Flow Valve.”

System Setup

Flow Valve

83. Press the ENTER key.

Flow Valve
Valve Installed: No
Arrow to Choose
Enter to Select

84. Press the arrow key(s) to toggle and select “Yes” or “No.” Press the ENTER key. The “System Setup” screen will appear.

85. If “Yes” is selected, press the arrow key(s) to toggle and select “PowerMax Level.”

System Setup

PowerMAX Level

86. Press the ENTER key.

PowerMAX at HIGH
PowerMAX at MED
PowerMAX at LOW
Press ENTER to Save

87. Press the arrow key(s) to toggle and select “High,” “Medium” or “Low.” Press the ENTER key.

Maintenance, Troubleshooting and Service

This section covers routine maintenance, troubleshooting and minor parts replacement. For service and repair, contact the CEM Service Department or local CEM subsidiary or distributor. A routine preventive maintenance program is recommended to ensure optimum performance of the Discover System.

WARNING

This instrument utilizes high voltages and microwave radiation. Only technicians trained in repair and maintenance of high voltage and microwave power systems should perform instrument service and repair.

WARNING

Proper precautions must be taken to avoid contact with solvents or solvent vapors. Protective gear should be worn as outlined in the user's safety program for hazardous materials and the reagent manufacturer's material safety data sheet. Refer to these guidelines for proper handling and disposal of reagents.

Routine Maintenance and Cleaning

Interlocks – Weekly, examine the cavity edge and attenuator interlocks to verify that they are clean and working properly.

Cavity – Weekly, wipe the cavity liner with an alcohol wipe or equivalent.

Microwave Leakage Measurement

The attenuator and cavity of the Discover are durable and are designed for reliable operation under severe laboratory conditions. External radiation checks are performed on the Discover System at several points in the manufacturing process, ensuring that leakage from the finished instrument is only a fraction of that allowed by U.S. law (5 mW/cm²).

The attenuator is equipped with a safety interlock system to stop the generation of microwave energy when the attenuator is opened or ajar. If the interlock system fails, a monitoring mechanism will blow the fuse(s) through which power is supplied to the magnetron, rendering the microwave power system inoperable.

To verify that seals and interlocks are working properly, the Discover System should be tested periodically for microwave leakage. Use the following procedure to measure microwave leakage:

1. Create a standard method using 300 watts of power, 2 minutes run time, 95 °C temperature set-point and 1-minute hold time.
2. Place a round bottom flask containing 50mL of demonized water into the cavity.
3. Attach the attenuator with RF stub to accept a 24/40 ground glass joint.
4. Load the created method and press “Start” to begin the method.
5. Use a suitable RF field strength meter (microwave detector) such as the Holaday Model HI-1500 (available from CEM Corporation, P/N 300500). Slowly move the RF probe around the attenuator perimeter and around the fan grills to check for microwave leakage.

NOTE

CEM does not recommend use of meters available in electronics stores because they are prone to give erroneous readings and lack the necessary sensitivity to properly test an instrument for microwave leakage.

The U.S. Government defines excessive microwave leakage as 5 mW/cm². If the instrument shows excessive microwave leakage, do not attempt further operation. Contact the CEM Corporation Service Department or the local CEM subsidiary or distributor for further instructions.

Microwave Power Measurement

Use the following procedure to determine actual power output in watts for a 300-watt setting.

1. Remove the 10mL attenuator (access) port.
2. Place the Teflon spacer on the floor of the cavity.
3. Create a power and time method using 300 watts of power and a run time of 60 seconds.
4. Place 100 mL of ambient temperature (18-22 °C) deionized water and stirring bar, if available, in a 100 mL round bottom flask (with a ground glass joint of a size less than or equal to 24/40).
5. Using a thermometer with 0.1 °C gradations. Stir the water for at least 15 seconds, then measure and record the initial water temperature, T_i . Ensure that the thermometer is immersed to its indicated immersion line prior to reading the temperature.
6. Remove the thermometer from the flask. Carefully place the flask into the cavity.
7. Attach the attenuator with RF stub to accept a 24/40 ground glass joint.
8. Load the method created in step 1, and press “Start” to begin the method.
9. At the end of the programmed time (60 sec), stir the water thoroughly for 10 seconds, then quickly measure and record the peak temperature reading. This is the final temperature, T_f .
10. The microwave power output is calculated as follows:
$$\text{Power in Watts} = 6.97 (T_f - T_i)$$
11. If the measured power is below 270W, repeat the microwave power measurement. If the power remains less than 270W, the instrument is not producing adequate microwave power at the 300W selection.

If the instrument is not producing sufficient wattage, refer to the Troubleshooting Guide in this manual.

Troubleshooting Guide

Condition	Possible Cause
Instrument Inoperative	Instrument not plugged into electrical outlet Power switch not in "on" position Blown fuse Loose connection to power switch Faulty power switch Faulty DC power switch
No Microwave Power	Instrument attenuator ajar Zero wattage selected Interlock(s) not properly adjusted or faulty Faulty controller board Faulty thermal switch Faulty high voltage component
Low Microwave Power	Low line voltage Incorrect wattage selected Faulty high voltage relay(s) Faulty high voltage component
Fuse Blows When Attenuator Is Opened	Interlock(s) not properly adjusted Faulty interlock(s)
Fuse Blows Repeatedly During Operation	Low line voltage Faulty high voltage component Faulty DC power supply Faulty controller board Faulty continuous power supply
No Display	Loose or broken wiring connections Loose or faulty interface cable Faulty display Faulty controller board
Inoperative Keyboard	Loose or faulty interface cable Faulty keyboard Faulty controller board
Inoperative Vessel Stirring Motor	Loose or broken stirring motor belt Faulty stirring motor
Erratic Pressure	Faulty coil Incorrect A/D setting Leakage from vessel Loose connector Improper grounding connection Faulty load cell Faulty pressure transducer
Erratic Temperature	Lens blocked Faulty IR sensor Faulty controller board
Microwave Leakage	Damaged attenuator Pressure sensor unattached or faulty
No Rise in Temperature	Sample does not absorb microwave energy Faulty infrared temperature sensor Incorrect temperature calibration

Repair and Service

WARNING

This instrument utilizes high voltages and microwave radiation in its operation. Only technicians trained in repair and maintenance of high voltage and microwave power systems should undertake instrument service and repair.

WARNING

Proper precautions must be taken to avoid contact with solvents or solvent vapors. Protective gear should be worn as outlined in the user's safety program for hazardous materials and the reagent manufacturer's material safety data sheet. Refer to these guidelines for proper decontamination, handling and disposal of reagents or any hazardous materials.

The Discover System is constructed in modular form to facilitate troubleshooting and repair. It is recommended that troubleshooting and repair by the user be limited to identifying and replacing parts such as printed circuit boards, fans, lamps, or motors.

WARNING

Disconnect the instrument from the AC power source prior to performing any service procedure.

Prior to any troubleshooting or service procedures in the high voltage section or area, bridge the contacts of the high voltage capacitor using the metal shaft of a well-insulated screwdriver to discharge the residual voltage in the capacitor. This will prevent exposure to high voltage discharge during troubleshooting or service.

Before replacing the high voltage plate assembly after any service procedure involving the microwave generating components, visually check the magnetron, transformers, triac, and high voltage capacitor to ensure that the electrical connections are secure.

Any service to or inspection of the Discover™ System that requires

- removal of the power supply assembly or
- replacement of components in the
 - interlock mechanism,
 - microwave generation system, or
 - microwave transmission system

should be followed by a microwave leakage measurement to verify that leakage is less than 5 mW/cm².

CAUTION

Prior to using any cleaning or decontamination method except those recommended by the equipment manufacturer, the user should check with the manufacturer that the proposed method will not damage the equipment.

Cavity Liner Cleaning or Replacement

The Discover System is equipped with a replaceable cavity liner positioned inside the circular cavity of the instrument. It protects the temperature sensor from debris in case of a vessel failure. If a vessel failure occurs, the cavity liner should be removed and cleaned or replaced if it is damaged.

WARNING

Proper precautions must be taken to avoid contact with solvents or solvent vapors. Protective gear should be worn as outlined in the user's safety program for hazardous materials and the reagent manufacturer's material safety data sheet. Refer to these guidelines for proper handling and disposal of reagents.

1. Carefully remove the cavity liner by grasping it and pulling it up and out of the cavity, using caution to prevent spillage through the opening.
2. Rinse the liner with an appropriate solvent to remove all debris.
3. Inspect the liner for damage. If the liner is damaged, especially the lens area, replace the liner.
4. Install the liner into the cavity, ensuring that the spout is positioned into the spill channel. **Note:** If the liner is not seated properly, the attenuator cannot be installed properly.
4. If the cavity liner is replaced, calibrate the temperature sensor as outlined in the System Setup section of this manual.



Figure 10. Cavity Liner

Spill Tray Cleaning

WARNING

Proper precautions must be taken to avoid contact with solvents or solvent vapors. Protective gear should be worn as outlined in the user's safety program for hazardous materials and the reagent manufacturer's material safety data sheet. Refer to these guidelines for proper handling and disposal of reagents.

1. Remove the screw securing the spill tray to the back of the instrument cover.
2. Carefully slide the spill tray out of the instrument.
3. Properly dispose of the contents of the tray.
4. Rinse the tray with an appropriate solvent.
5. Install the spill tray and secure it to the instrument with the screw.



Figure 11. Spill Tray

Ordering Information

For assistance and pricing of replacement parts and accessories, please CEM Corporation or the local subsidiary or distributor..

CEM Corporation Contact Information:

1. **Corporate Headquarters**

CEM Corporation
Customer Service Department
P.O. Box 200
3100 Smith Farm Road
Matthew, NC 28106-0200 USA
800.726.3331 (phone within US)
01.704.821.7015(phone outside US)
704.821.4369 (fax)
info@cemsynthesis.com (email)
www.cem.com (web site)

2. **United Kingdom Subsidiary**

CEM Microwave Technology Ltd.
2 Middle Slade
Buckingham Industrial Park
Buckingham MK18 1WA
United Kingdom
44.1.280.822873 (phone)
44.1.280.822342 (fax)

3. **German Subsidiary**

CEM GmbH
Carl-Friedrich-Gauss Strasse 9
47475 Kamp-Lintfort
Germany
49.2842.96440 (phone)
49.2842.964411 (fax)

4. **Italian Subsidiary**

CEM S.r.l.
Via Dell' Artigianato, 6/8
Italy
39.35.896224(phone)
39.35.891661(fax)

Specifications

Electrical Requirements	120 VAC (90-140 VAC), 60 Hz, 10A @ 120 VAC; 220/240 VAC (202-250 VAC), 50 Hz, 5A @ 240VAC; Detachable Power Cord with U.L., CSA & CE approvals; Variance in line voltage can affect microwave power output.
Safety Features	Three independent safety interlocks, including interlock monitoring system, plus two independent thermal switches used in each instrument to prevent instrument operation and microwave emissions in case of improper attenuator closure or misalignment. Instrument complies with HHS standards under 21 CFR, Part 1030.10, Subparts (C)(1), (C)(2), and (C)(3).
Magnetron Frequency	2455 MHz
Power Output	300 watts \pm 10%
Magnetron Protection	Wave Guide Design (Patent Pending) to protect magnetron from reflected energy, ensuring constant power output.
Microwave Cavity	Heavy-duty, multi-layer stainless steel
Dimensions (Overall)	16-3/4" x 14" x 8-1/2" (42.5 cm x 35.5 cm x 22.2 cm) -D x W x H
Weight	28 lbs. or 12.6 kg (Shipping Wt. 50 lbs. or 22.7 kg)
Computer Compatibility	80C188 on-board computer controls all system functions. System can perform all functions with or without connection to external PC. RS 232, 9-Pin, IBM PC compatible.
Internal Diagnostic Software	BITS System (Built-In Test System) Checks/monitors line voltage, magnetron life, temperature control, status/operation, safety interlocks.
Pressure Control System	Inboard pressure control system to monitor and control System equilibrium/reaction pressure. Pressure sensed 200 times per minute. Internal pressure control system able to monitor and control vessel pressures up to 300 psi (21 bar).
Temperature Control System	Non-contact sensor for temperature measurement of vessel contents. Temperature sensor independent of vessel volume. Temperature measurement range from 15°C to 430 °C with an upper control limit of 250 °C.
Service Accessibility	One panel access to system main circuitry for convenient service and upgrading capability.
Fuses	10 AMP Fuse (F10A - 250V, 1-1/4" Type, Littlefuse #312010, CEM #BR188270) 5 AMP Fuse (F5A-250V, 1-1/4" Type, Littlefuse #312005, CEM #BR188280) Surgeboard (Slow-blo T3/8A - 250V, Littlefuse 326.375, CEM #BR198049)
Patents	CEM Microwave Systems may be covered by any one of the following U.S. patents: 04835354, 04080168, 05369034, 04672996, RE034373, 05230865, 04877624, 04672996, 05206479, 05427741. Other patents pending.

Warranty

What Is Covered:

CEM Corporation warrants that the instrument will be free of any defect in parts or workmanship and will, at its option, replace or repair any defective part (excluding consumables) or instrument.

For How Long:

This warranty remains in effect for 365 days from date of delivery to the original purchaser.

What Is Not Covered:

This warranty does not cover parts or workmanship which have been damaged due to:

- Neglect, abuse or misuse,
- Damage caused by or to test samples,
- Damage incurred during instrument relocation,
- Damage caused by or to any attached equipment,
- Use of incorrect line voltages or fuses,
- Fire, flood, "acts of God" or other contingencies beyond the control of CEM Corporation,
- Improper or unauthorized repair, or
- Any other damage caused by purchaser or its agents.

Responsibilities of Purchaser:

To ensure warranty coverage, purchaser must:

- Use the instrument according to directions,
- Connect the instrument properly to a power supply of proper voltage,
- Replace blown fuses,
- Replace consumables and
- Clean the instrument as required.

How to Get Service:

Purchaser should contact the Service Department of CEM Corporation or his distributor for return authorization and for proper crating and shipping instructions to return instrument, freight prepaid, for service. On-site repairs by an authorized service technician are available through the CEM Service Department. Travel costs will be charged to the purchaser for on-site repairs.

CEM Corporation
3100 Smith Farm Rd.
Matthews, NC 28105
800.726.5551 (telephone within the US)
01.704.821.7015 (telephone outside the US)
01.704.821.7894 (Fax)
service@cem.com (E-mail)

Warranty Disclaimer:

CEM Corporation hereby excludes and disclaims any warranty of merchantability or fitness for any particular purpose. No warranty, express or implied, extends beyond the face hereof. CEM Corporation shall not be liable for loss of use of instrument or other incidental or consequential costs, expenses or damages incurred by the purchaser or any other user.

Purchaser's Rights Under State Law:

This warranty gives the purchaser specific legal rights, and the purchaser may also have other rights which vary from state to state.