

GC × GC Modulation Control

User's Guide

Version 1.0

InfoMass *LLC*

www.infomassllc.com

Revision History

Version	Date	Description
1.0	2026	Initial Release

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1. Introduction

GC × GC Modulation Control is a Windows-based software application developed by InfoMass LLC for operation of GC×GC thermal modulation systems.

The software provides complete control of modulation system operating parameters, including:

- Hot Jet Temperature
- Hot Jet Gas Control
- Cold Jet Gas Control
- Cold Jet Flow Control
- Modulation Period
- Hot Jet Duration
- Automated GC-Triggered Operation
- Manual Operation
- Method Management
- Real-Time System Monitoring

The software operates independently of the gas chromatograph and may be used with a variety of GC platforms capable of providing a suitable start signal.

GC × GC Modulation Control allows users to create, save, load, and execute modulation methods while continuously monitoring actual operating conditions reported by the controller.

The software supports both automated operation initiated by a GC Start signal and manual operation initiated directly by the user.

2. System Requirements

2.1 Computer Requirements

The software is designed for operation on Microsoft Windows systems.

Supported operating systems:

- Windows 10
- Windows 11

Recommended hardware:

- Intel Core i5 processor or higher
 - 8 GB RAM or greater
 - 1920 × 1080 screen resolution or higher
 - Available USB port
-

2.2 Controller Connection

Communication between the PC and the modulation controller is established through a USB connection.

A stable USB connection is required for reliable operation.

2.3 Recommended Power Management Settings

To prevent communication interruptions during long analytical runs, InfoMass LLC recommends:

- Disable Sleep mode
- Disable Hibernation
- Disable USB Selective Suspend
- Disable USB Hub Power Saving

Detailed configuration instructions are provided in Section 13.

Failure to configure these settings may result in unexpected communication interruptions during operation.

3. Installation

3.1 Software Installation

The software is distributed as a Windows installer package.

Installer filename:

GCxGC_Modulation_Control_Setup_v1.0.exe

To install the software:

1. Locate the installer package.
2. Double-click the installer.
3. Follow the on-screen installation instructions.
4. Complete the installation process.

Administrative privileges may be required depending on local computer security policies.

3.2 First-Time Startup

After installing the software:

1. Connect the modulation controller to the PC using a USB cable.
2. Apply power to the controller.
3. Launch GC × GC Modulation Control.

Immediately after startup, communication with the controller has not yet been established.

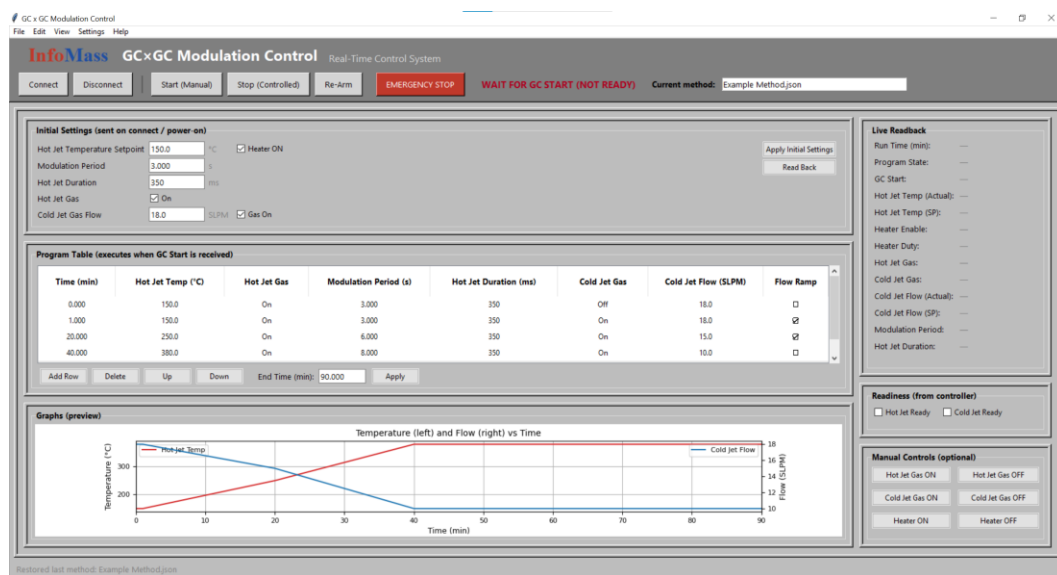


Figure 1. Software startup condition immediately after launch.

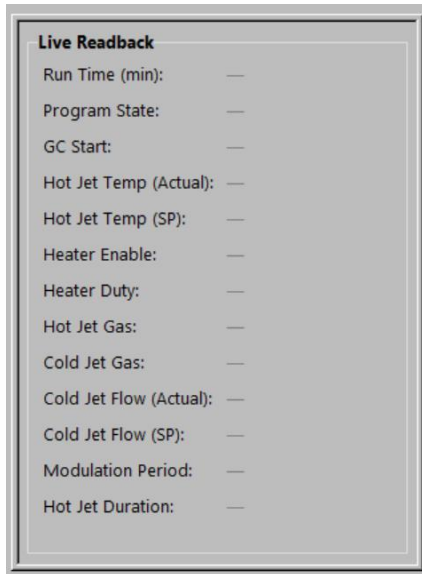


Figure 2. Startup Live Readback panel.

At startup, the Live Readback panel displays:

Program State = "-"

indicating that communication with the controller has not yet been established.

Communication is established after the Connect button is pressed.

3.3 PC Power Status Verification

During startup, the software may check selected Windows power-management settings.

If potentially problematic settings are detected, a warning message may be displayed.

Users should review the recommended power-management settings described in Section 13 before operating the modulation system.

4. User Interface Overview

The GC × GC Modulation Control main window provides access to all operating functions required for method development, system operation, and monitoring.

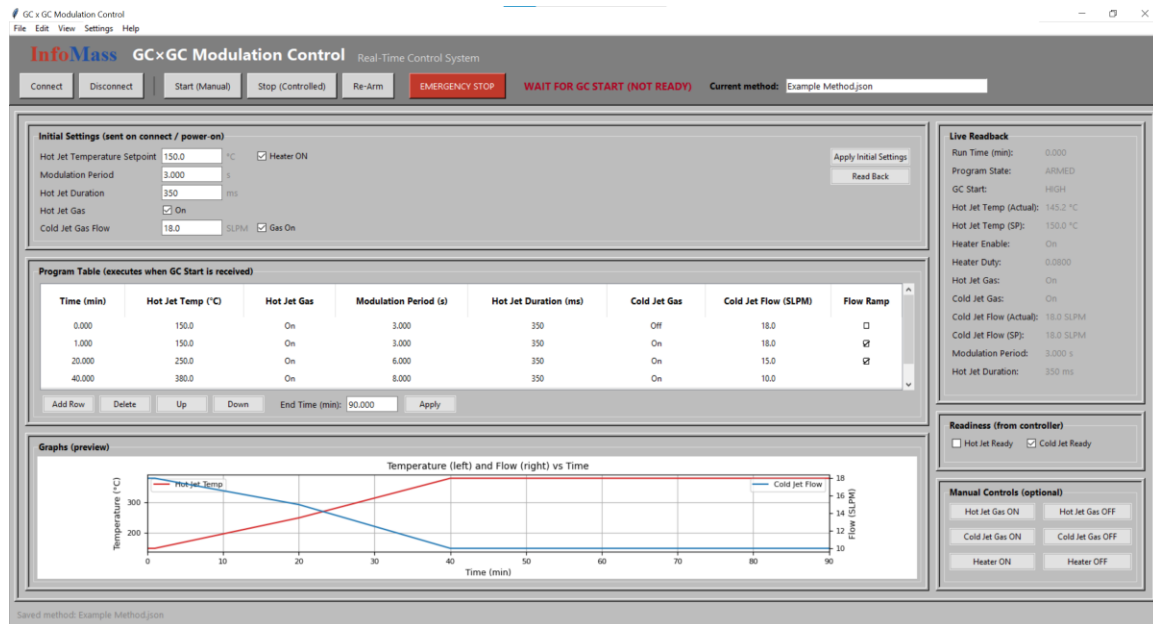


Figure 3 .Main GC × GC Modulation Control window.

The user interface consists of the following major areas:

1. Menu Bar
2. Header Ribbon
3. Initial Settings Panel
4. Program Table
5. Graph Display
6. Live Readback Panel
7. Readiness Indicators
8. Manual Controls
9. Status Bar

4.1 Menu Bar

The Menu Bar provides access to software functions.

Available menus include:

- File
- Edit
- View
- Settings
- Help

These menus provide access to method management, display options, communication settings, documentation, and software information.

4.2 Header Ribbon

The Header Ribbon contains the primary operating buttons used during routine operation.

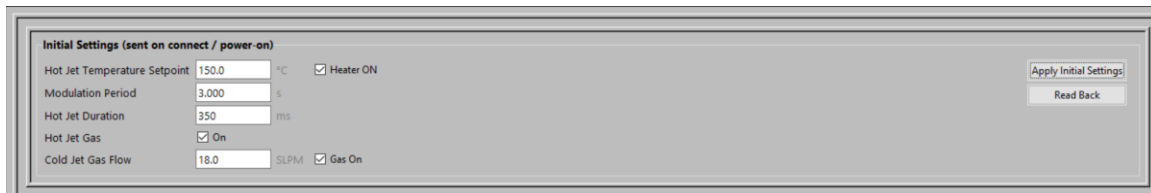
Typical functions include:

- Connect
- Disconnect
- Start (Manual)
- Stop (Controlled)
- Re-Arm
- Apply Initial Settings
- Read Back
- Emergency Stop

These controls provide direct access to the most frequently used operating functions.

4.3 Initial Settings Panel

The Initial Settings panel defines the baseline operating conditions of the modulation system.



The screenshot shows a software interface titled "Initial Settings (sent on connect / power-on)". It contains several input fields and checkboxes for configuring the system. The settings are as follows:

Parameter	Value	Unit	Checkbox	Label
Hot Jet Temperature Setpoint	150.0	°C	☒	Heater ON
Modulation Period	3.000	s		
Hot Jet Duration	350	ms		
Hot Jet Gas	☒			On
Cold Jet Gas Flow	18.0	SLPM	☒	Gas On

On the right side of the panel, there are two buttons: "Apply Initial Settings" and "Read Back".

Figure 4. Initial Settings panel.

Initial Settings serve two important purposes:

1. Define the baseline operating conditions maintained by the controller.
2. Allow the modulation system to reach run-ready conditions before analytical runs begin.

Because the hot jet heater requires warm-up time, users will typically set the Initial Hot Jet Temperature equal to the starting temperature used in the Program Table.

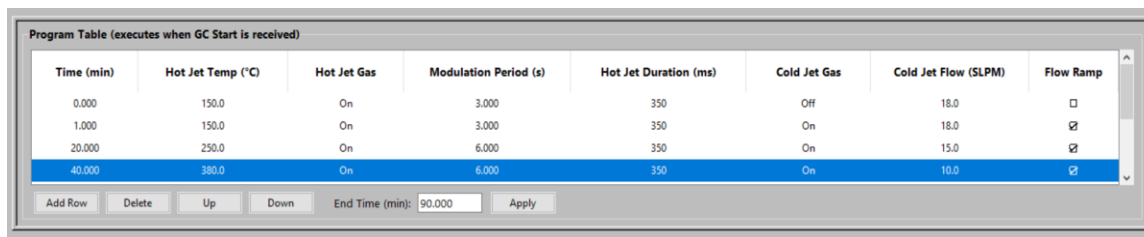
When Connect is executed, the Initial Settings are automatically transmitted to the controller.

The Apply Initial Settings button may be used at any time to manually resend the current Initial Settings values to the controller.

The Read Back button requests the current controller settings and updates the Initial Settings panel with the values currently stored in the controller.

4.4 Program Table

The Program Table defines time-dependent operating conditions during a run.



Program Table (executes when GC Start is received)

Time (min)	Hot Jet Temp (°C)	Hot Jet Gas	Modulation Period (s)	Hot Jet Duration (ms)	Cold Jet Gas	Cold Jet Flow (SLPM)	Flow Ramp
0.000	150.0	On	3.000	350	Off	18.0	☐
1.000	150.0	On	3.000	350	On	18.0	☒
20.000	250.0	On	6.000	350	On	15.0	☒
40.000	380.0	On	6.000	350	On	10.0	☒

Buttons: Add Row, Delete, Up, Down, End Time (min): 90.000, Apply

Figure 5. Program Table example.

Each row specifies the operating setpoints that become active at the programmed time.

Programmed values remain active until the next row becomes active.

The Program Table allows programming of:

- Hot Jet Temperature
- Hot Jet Gas State
- Modulation Period
- Hot Jet Duration
- Cold Jet Gas State
- Cold Jet Flow
- Cold Jet Flow Ramping

Additional details regarding Program Table operation are provided in Section 7.

4.5 Graph Display

The Graph Display provides a graphical representation of the programmed method.

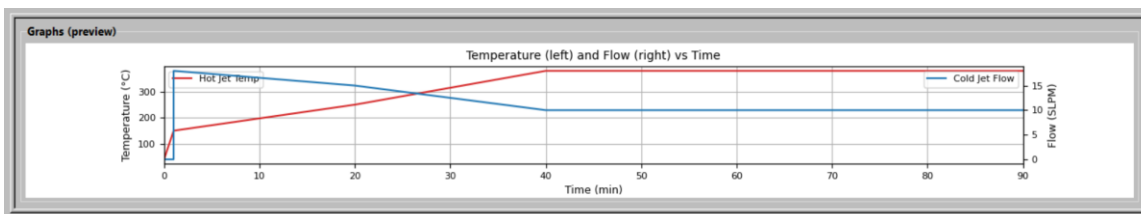


Figure 6. Program Graph Display.

The displayed curves are calculated from the Program Table and are intended to assist method development and review.

The Graph Display does not represent live measured values from the controller.

4.6 Live Readback Panel

The Live Readback panel displays real-time information reported by the controller.

Displayed information includes:

- Run Time
- Program State
- GC Start Status
- Hot Jet Temperature
- Hot Jet Temperature Setpoint
- Heater Enable Status
- Heater Duty Cycle
- Cold Jet Flow
- Cold Jet Flow Setpoint
- Modulation Period
- Hot Jet Duration

The Live Readback panel allows users to verify actual operating conditions during operation.

4.7 Readiness Indicators

The software displays readiness indicators for:

- Hot Jet Ready
- Cold Jet Ready

These indicators provide information regarding current operating conditions.

The readiness indicators are informational only and do not prevent operation.

An automated run will begin whenever:

- Program State = ARMED
- A valid GC Start signal is received

even if one or both readiness indicators indicate NOT READY.

4.8 Manual Controls

Manual Controls provide direct control of selected hardware functions.

These controls are intended primarily for:

- Setup
- System Checkout
- Troubleshooting
- Method Development

Manual Controls should normally not be used while a programmed run is in progress.

Additional details are provided in Section 10.

4.9 Status Bar

The Status Bar displays software status messages and operational notifications.

Examples include:

- Connection status
- Method file operations
- CSV export confirmation
- Warning messages

- Error messages

Users should periodically review Status Bar messages during operation.

5. Connection and Run Initiation

This section describes the procedures used to establish communication with the controller and initiate program execution.

5.1 Startup Condition

Immediately after launching GC × GC Modulation Control, communication with the controller has not yet been established.

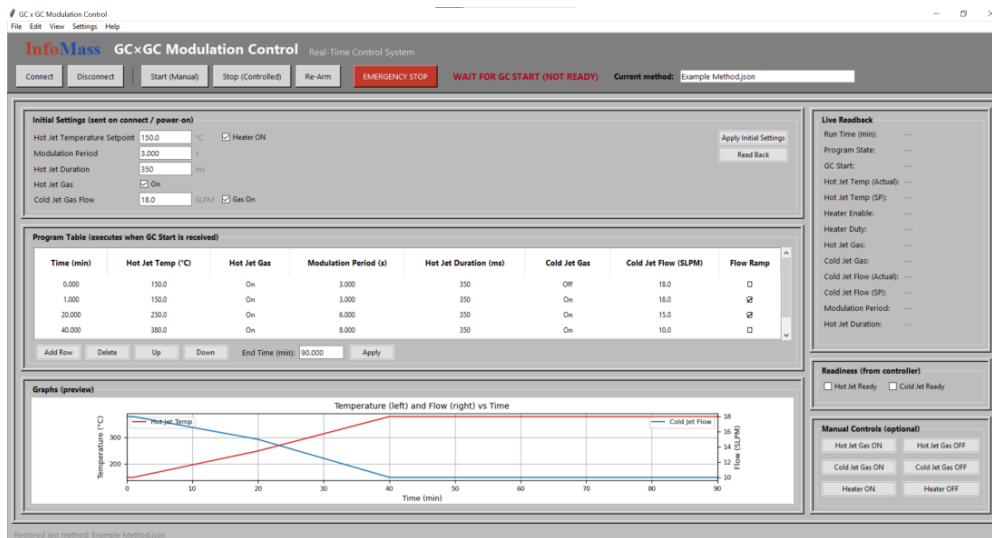


Figure 1. Software startup condition immediately after launch.

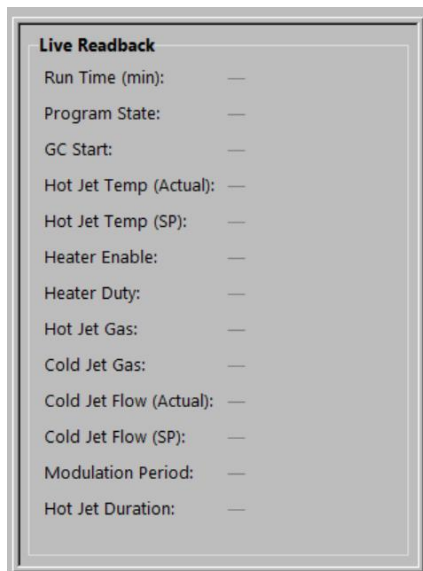


Figure 2. Startup Live Readback panel.

At startup, the Live Readback panel displays:

Program State = "-"

indicating that communication with the controller has not yet been established.

The software remains in this condition until the Connect button is pressed.

5.2 Establishing Communication

Before connecting:

1. Connect the controller to the PC using a USB cable.
2. Apply power to the controller.
3. Launch GC × GC Modulation Control.

Communication settings may be reviewed or modified using:

Settings → Connection Settings



Figure 7. Connection Settings dialog.

The Connection Settings dialog allows selection of the communication port used by the controller.

The correct COM port is typically assigned automatically by Windows when the controller is connected.

To establish communication:

1. Verify the correct COM port is selected.
2. Click Connect.

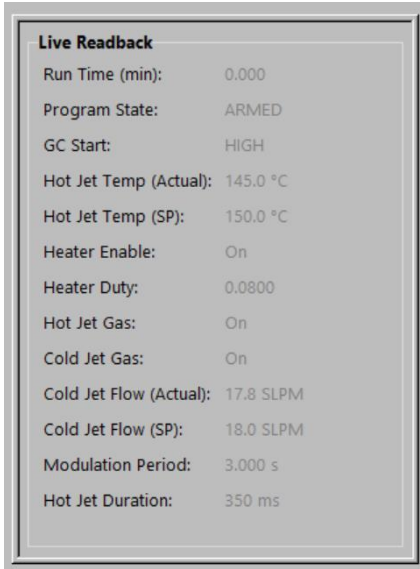
When Connect is executed:

- Communication with the controller is established.
- Initial Settings are automatically transmitted to the controller.
- Program State changes to ARMED.

The system is then ready to respond to a GC Start signal.

5.3 ARMED State

The ARMED state indicates that the software is prepared to begin an automated run when a GC Start signal is received.



Live Readback	
Run Time (min):	0.000
Program State:	ARMED
GC Start:	HIGH
Hot Jet Temp (Actual):	145.0 °C
Hot Jet Temp (SP):	150.0 °C
Heater Enable:	On
Heater Duty:	0.0800
Hot Jet Gas:	On
Cold Jet Gas:	On
Cold Jet Flow (Actual):	17.8 SLPM
Cold Jet Flow (SP):	18.0 SLPM
Modulation Period:	3.000 s
Hot Jet Duration:	350 ms

Figure 8. ARMED state awaiting GC Start signal.

When Program State indicates ARMED:

- Communication with the controller is active.
- Initial Settings have been transmitted to the controller.
- The software is monitoring for a GC Start signal.
- The next valid GC Start signal will initiate an automated run.

Important

An automated run will begin whenever:

- Program State = ARMED
- A valid GC Start signal is received

even if the readiness indicators display:

WAIT FOR GC START (NOT READY)

The readiness indicators are informational only and do not prevent an automated run from starting.

5.4 Read Back

The Read Back button requests the current controller settings and updates the Initial Settings panel with the values currently stored in the controller.

The Read Back function may be used to:

- Verify communication
- Confirm controller settings
- Synchronize the Initial Settings panel with the controller

The values returned by Read Back replace the values currently displayed in the Initial Settings panel.

5.5 Start (Manual)

Start (Manual) immediately begins execution of the programmed method without requiring a GC Start signal.

When Start (Manual) is executed:

- Program execution begins immediately.
- Program State changes to RUNNING.
- A GC Start signal is not required.

Start (Manual) may be executed when Program State is:

- ARMED
- IDLE

Typical Applications

Start (Manual) is intended primarily for:

- Method development
- System checkout
- Troubleshooting
- Demonstrations

Important

Start (Manual) does not require the system to be in a Ready state.

A run will begin even if:

- Hot Jet Ready = No
- Cold Jet Ready = No

Users should verify that the modulation system is in the desired operating condition before initiating a manual run.

5.6 Stop (Controlled)

Stop (Controlled) is the normal method for terminating a run.

When Stop (Controlled) is executed:

- Program execution stops.
- Initial Settings are restored.
- Program State changes to IDLE.

Live Readback	
Run Time (min):	0.000
Program State:	IDLE
GC Start:	HIGH
Hot Jet Temp (Actual):	29.6 °C
Hot Jet Temp (SP):	150.0 °C
Heater Enable:	On
Heater Duty:	0.3500
Hot Jet Gas:	On
Cold Jet Gas:	On
Cold Jet Flow (Actual):	0.0 SLPM
Cold Jet Flow (SP):	18.0 SLPM
Modulation Period:	3.000 s
Hot Jet Duration:	350 ms

Figure 9. IDLE state.

After Stop (Controlled), automated operation is disabled until the system is re-armed.

To return the software to the ARMED state:

1. Click Re-Arm.
2. Verify that Program State indicates ARMED.

The system is then ready to respond to the next GC Start signal.

6. Initial Settings

The Initial Settings panel defines the baseline operating conditions of the modulation system.



Initial Settings (sent on connect / power-on)	
Hot Jet Temperature Setpoint	150.0 °C
Modulation Period	3.000 s
Hot Jet Duration	350 ms
Hot Jet Gas	☒ On
Cold Jet Gas Flow	18.0 SLPM
	☒ Gas On

Figure 4. Initial Settings panel.

Initial Settings serve two important purposes:

1. Define the baseline operating conditions maintained by the controller.
2. Allow the modulation system to reach run-ready conditions before analytical runs begin.

Because the hot jet heater requires warm-up time, users will typically set the Initial Hot Jet Temperature equal to the starting temperature used in the Program Table.

When Connect is executed, the Initial Settings are automatically transmitted to the controller.

When a run finishes normally or when Stop (Controlled) is executed, the controller returns to the Initial Settings.

6.1 Hot Jet Temperature Setpoint

Defines the desired initial operating temperature of the hot jet heater.

The controller regulates heater power to maintain the specified temperature.

6.2 Heater Enable

Enables or disables heater operation.

When Heater Enable is OFF, heater power is removed regardless of the programmed temperature setpoint.

6.3 Modulation Period

Defines the modulation period in seconds.

The modulation period determines the time interval between successive modulation events.

6.4 Hot Jet Duration

Defines the duration of the hot jet pulse in milliseconds.

This parameter determines how long the hot jet pulse is applied during each modulation event.

6.5 Hot Jet Gas

Turns Hot Jet Gas ON or OFF.

6.6 Cold Jet Flow Setpoint

Defines the desired cold jet flow rate.

Flow is expressed in standard liters per minute (SLPM).

6.7 Cold Jet Gas

Turns Cold Jet Gas ON or OFF.

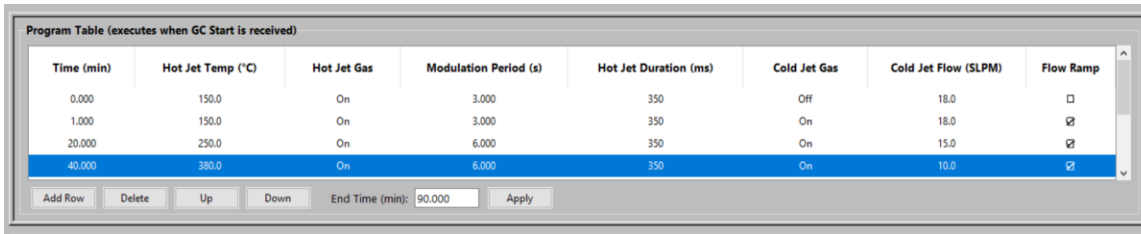
6.8 Apply Initial Settings

Apply Initial Settings manually transmits the current Initial Settings values to the controller.

This function may be used whenever Initial Settings have been modified and should be immediately applied.

7. Program Table

The Program Table defines time-dependent operating conditions during a run.



Time (min)	Hot Jet Temp (°C)	Hot Jet Gas	Modulation Period (s)	Hot Jet Duration (ms)	Cold Jet Gas	Cold Jet Flow (SLPM)	Flow Ramp
0.000	150.0	On	3.000	350	Off	18.0	☐
1.000	150.0	On	3.000	350	On	18.0	☒
20.000	250.0	On	6.000	350	On	15.0	☒
40.000	380.0	On	6.000	350	On	10.0	☒

Add Row Delete Up Down End Time (min): 90.000 Apply

Figure 5. Program Table example.

Each row specifies the operating setpoints that become active at the programmed time.

The programmed values remain active until the next programmed row becomes active.

7.1 Time Column

The Time column specifies the time at which the programmed row becomes active.

Time values are expressed in minutes.

7.2 Hot Jet Temperature

Defines the Hot Jet Temperature setpoint that becomes active at the specified time.

Temperature transitions are linearly ramped between programmed values.

7.3 Hot Jet Gas

Determines whether Hot Jet Gas is ON or OFF.

7.4 Modulation Period

Defines the modulation period active during the interval.

7.5 Hot Jet Duration

Defines the Hot Jet Duration active during the interval.

7.6 Cold Jet Gas

Determines whether Cold Jet Gas is ON or OFF.

7.7 Cold Jet Flow

Defines the Cold Jet Flow setpoint active during the interval.

7.8 Cold Jet Flow Ramp

When Cold Jet Flow Ramp is enabled in a row, Cold Jet Flow transitions linearly from the value in that row to the value specified in the next row.

When Cold Jet Flow Ramp is disabled, Cold Jet Flow changes immediately at the programmed time.

The final Program Table row cannot use Cold Jet Flow Ramp because no subsequent row exists.

7.9 Understanding Program Rows

Each row defines the operating setpoints that become active at the programmed time.

For example:

Time	Temp	HJ Gas	Mod Period	HJ Duration	CJ Gas	CJ Flow	Ramp
1.000	150	On	3.000	350	On	18.0	✓

At 1.000 minutes:

- Hot Jet Temperature becomes 150 °C and begins ramping toward the temperature specified in the next row.
- Hot Jet Gas turns ON.
- Modulation Period becomes 3.000 seconds.
- Hot Jet Duration becomes 350 ms.
- Cold Jet Gas turns ON.
- Cold Jet Flow becomes 18.0 SLPM and begins ramping toward the value specified in the next row because Flow Ramp is enabled.

These conditions remain active until the next programmed row becomes active.

7.10 End Time

End Time defines the total duration of the programmed run.

When Run Time reaches End Time:

- Program execution ends.
- Initial Settings are restored.
- Program State automatically returns to ARMED.

The system is then ready for the next GC-triggered run.

7.11 Hot Jet Temperature Ramp Rate Limit

GC × GC Modulation Control enforces a maximum Hot Jet Temperature ramp rate of 30 °C/min.

When editing the Program Table, the software automatically calculates the required ramp rate between consecutive rows.

If a programmed temperature change would require a ramp rate greater than 30 °C/min:

- The entered value is rejected.
- The Program Table is not updated.
- The user must enter a value that results in a ramp rate of 30 °C/min or less.

This limit applies to all programmed Hot Jet Temperature transitions.

7.12 Modulation Period Rule

The duration between two consecutive Program Table rows must be an exact integer multiple of the modulation period active during that interval.

Examples:

- A 3.000-second modulation period permits interval durations of 3, 6, 9, 12, 15 seconds, etc.
- A 7.000-second modulation period permits interval durations of 7, 14, 21, 28, 35 seconds, etc.

If a programmed time interval is not compatible with the modulation period:

- The software automatically adjusts the affected time value to satisfy the modulation period rule.
- The user is notified whenever a time adjustment is made.
- Export validation prevents generation of invalid CSV files.
- Invalid timing relationships are reported to the user.

This rule ensures consistent modulation timing throughout the run.

7.13 Program Execution Rules

Program Table rows are executed in chronological order based on the Time column.

Each row becomes active when the programmed time is reached.

Programmed values remain active until the next row becomes active.

The final row remains active until End Time is reached.

At End Time:

- Initial Settings are restored.
- Program State returns to ARMED.

8. Operation Modes

GC × GC Modulation Control operates using several distinct operating states.

8.1 ARMED

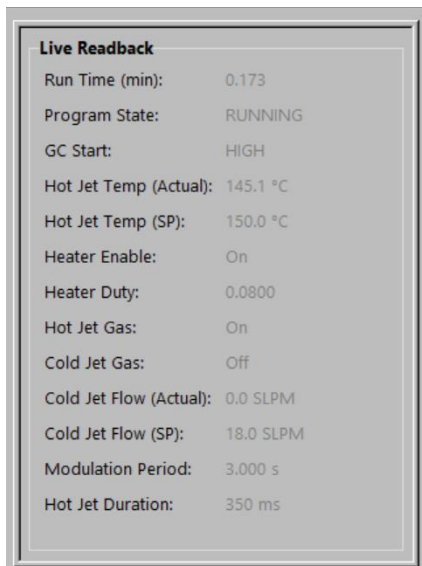
The ARMED state indicates that the software is ready to respond to a GC Start signal.

The ARMED state occurs after:

- Connect
 - Re-Arm
 - Normal completion of a run
-

8.2 RUNNING

The RUNNING state indicates that a programmed method is actively executing.



Live Readback	
Run Time (min):	0.173
Program State:	RUNNING
GC Start:	HIGH
Hot Jet Temp (Actual):	145.1 °C
Hot Jet Temp (SP):	150.0 °C
Heater Enable:	On
Heater Duty:	0.0800
Hot Jet Gas:	On
Cold Jet Gas:	Off
Cold Jet Flow (Actual):	0.0 SLPM
Cold Jet Flow (SP):	18.0 SLPM
Modulation Period:	3.000 s
Hot Jet Duration:	350 ms

Figure 10. RUNNING state

During operation, programmed values are transmitted to the controller according to the Program Table.

When a run finishes normally:

- Initial Settings are restored.
- Program State returns to ARMED.

No Re-Arm operation is required after normal completion.

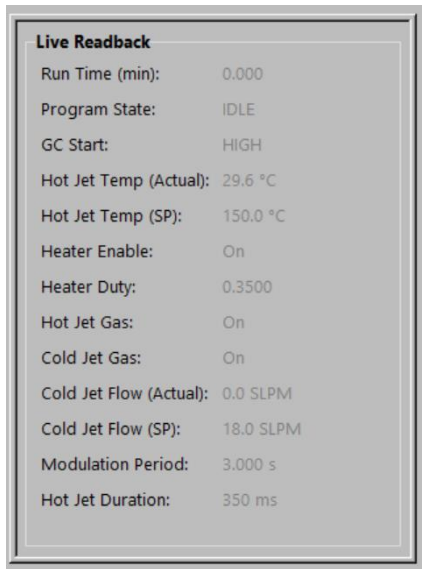
8.3 Start (Manual)

Start (Manual) provides a method of entering the RUNNING state without requiring a GC Start signal.

Additional details are provided in Section 5.5.

8.4 IDLE

The IDLE state most commonly occurs after Stop (Controlled).



Live Readback	
Run Time (min):	0.000
Program State:	IDLE
GC Start:	HIGH
Hot Jet Temp (Actual):	29.6 °C
Hot Jet Temp (SP):	150.0 °C
Heater Enable:	On
Heater Duty:	0.3500
Hot Jet Gas:	On
Cold Jet Gas:	On
Cold Jet Flow (Actual):	0.0 SLPM
Cold Jet Flow (SP):	18.0 SLPM
Modulation Period:	3.000 s
Hot Jet Duration:	350 ms

Figure 9. IDLE state.

While in IDLE, automated operation is disabled.

To enable automated operation, click Re-Arm.

8.5 Re-Arm

The Re-Arm button places the software into the ARMED state.

Re-Arm is required after execution of Stop (Controlled).

Re-Arm is not required:

- After Connect
- After normal completion of a run

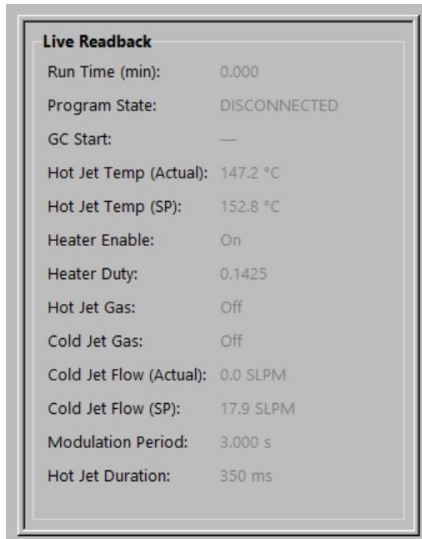
When Re-Arm is executed:

- Program State changes to ARMED.

- The software is ready to respond to the next GC Start signal.

8.6 DISCONNECTED

The DISCONNECTED state indicates that communication with the controller has been lost or terminated.



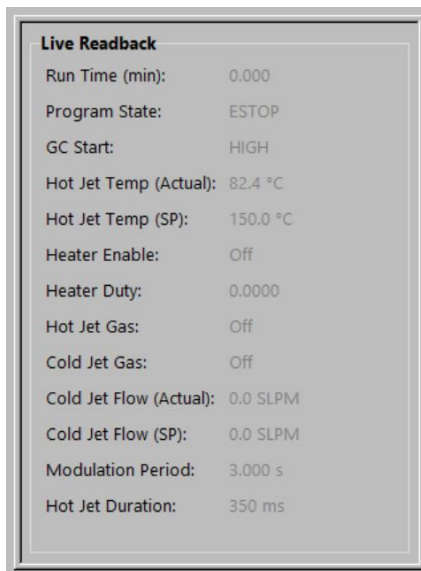
Live Readback	
Run Time (min):	0.000
Program State:	DISCONNECTED
GC Start:	—
Hot Jet Temp (Actual):	147.2 °C
Hot Jet Temp (SP):	152.8 °C
Heater Enable:	On
Heater Duty:	0.1425
Hot Jet Gas:	Off
Cold Jet Gas:	Off
Cold Jet Flow (Actual):	0.0 SLPM
Cold Jet Flow (SP):	17.9 SLPM
Modulation Period:	3.000 s
Hot Jet Duration:	350 ms

Figure 11. DISCONNECTED state.

No controller commands can be executed while in this state.

8.7 ESTOP

Emergency Stop places the system into a safe state and immediately terminates operation.



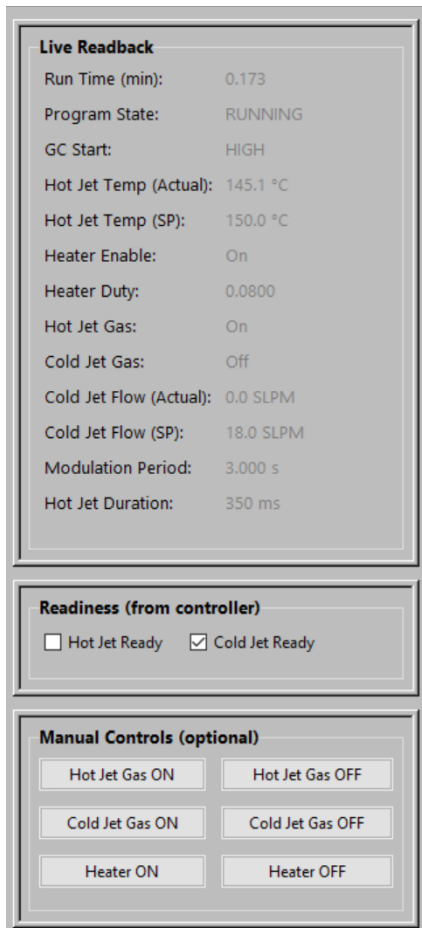
Live Readback	
Run Time (min):	0.000
Program State:	ESTOP
GC Start:	HIGH
Hot Jet Temp (Actual):	82.4 °C
Hot Jet Temp (SP):	150.0 °C
Heater Enable:	Off
Heater Duty:	0.0000
Hot Jet Gas:	Off
Cold Jet Gas:	Off
Cold Jet Flow (Actual):	0.0 SLPM
Cold Jet Flow (SP):	0.0 SLPM
Modulation Period:	3.000 s
Hot Jet Duration:	350 ms

Figure 12. ESTOP state.

Additional details are provided in Section 11.

9. Real-Time Monitoring

The Live Readback panel provides real-time information reported by the controller.



The screenshot shows a software interface with three stacked panels. The top panel, titled 'Live Readback', contains a list of system parameters and their current values. The middle panel, titled 'Readiness (from controller)', shows two checkboxes: 'Hot Jet Ready' (unchecked) and 'Cold Jet Ready' (checked). The bottom panel, titled 'Manual Controls (optional)', contains six buttons arranged in a 3x2 grid: 'Hot Jet Gas ON', 'Hot Jet Gas OFF', 'Cold Jet Gas ON', 'Cold Jet Gas OFF', 'Heater ON', and 'Heater OFF'.

Live Readback	
Run Time (min):	0.173
Program State:	RUNNING
GC Start:	HIGH
Hot Jet Temp (Actual):	145.1 °C
Hot Jet Temp (SP):	150.0 °C
Heater Enable:	On
Heater Duty:	0.0800
Hot Jet Gas:	On
Cold Jet Gas:	Off
Cold Jet Flow (Actual):	0.0 SLPM
Cold Jet Flow (SP):	18.0 SLPM
Modulation Period:	3.000 s
Hot Jet Duration:	350 ms

Readiness (from controller)

☐ Hot Jet Ready ☒ Cold Jet Ready

Manual Controls (optional)

Hot Jet Gas ON	Hot Jet Gas OFF
Cold Jet Gas ON	Cold Jet Gas OFF
Heater ON	Heater OFF

Figure 10. RUNNING state

The Live Readback panel allows users to verify actual operating conditions during a run and to monitor controller performance.

9.1 Run Time

Run Time displays the elapsed time since the current run began.

Time is displayed in minutes.

Run Time resets when a new run is initiated.

9.2 Program State

Program State indicates the current operating state of the software.

Possible states include:

- ARMED
- RUNNING
- IDLE
- DISCONNECTED
- ESTOP

The Program State display allows users to quickly determine the current operating condition of the system.

9.3 Actual and Setpoint Values

The Live Readback panel displays both actual values and commanded setpoints where available.

Examples include:

- Hot Jet Temperature (Actual)
- Hot Jet Temperature Setpoint
- Cold Jet Flow (Actual)
- Cold Jet Flow Setpoint

Temporary differences between actual values and setpoints may occur while the system is approaching a new operating condition.

9.4 GC Start Status

GC Start displays the current state of the GC Start input.

The displayed status will be either:

- HIGH
- LOW

Under normal conditions, the GC Start input remains HIGH.

When a valid GC Start signal is received from the gas chromatograph, the input transitions to LOW.

When Program State is ARMED, a LOW GC Start signal initiates an automated run.

The GC Start indicator is useful for:

- System installation
- Hardware testing
- Verification of GC Start wiring
- Troubleshooting communication between the gas chromatograph and the modulation controller

9.5 Heater Duty Cycle

Heater Duty Cycle displays the percentage of heater power currently being applied by the controller.

This value may vary continuously as the controller regulates temperature.

Higher values typically occur during:

- System warm-up
- Large temperature increases

Lower values typically occur when the temperature has stabilized near the desired setpoint.

9.6 Readiness Indicators

The software provides two readiness indicators:

- Hot Jet Ready
- Cold Jet Ready

These indicators provide information regarding the current operating condition of the modulation system.

The readiness indicators are informational only.

An automated run will begin whenever:

- Program State = ARMED
- A valid GC Start signal is received

even if one or both readiness indicators indicate NOT READY.

Users are encouraged to verify readiness before beginning routine analyses.

10. Manual Controls

The Manual Controls section provides direct control of selected hardware functions.

Manual Controls are intended primarily for:

- System setup
- Hardware verification
- Troubleshooting
- Method development

Manual Controls should normally not be used while a programmed run is in progress.

10.1 Hot Jet Gas Controls

The Hot Jet Gas controls allow manual activation and deactivation of Hot Jet Gas.

These controls may be used to:

- Verify valve operation
 - Confirm gas connections
 - Troubleshoot gas delivery systems
-

10.2 Cold Jet Gas Controls

The Cold Jet Gas controls allow manual activation and deactivation of Cold Jet Gas.

These controls may be used to:

- Verify valve operation
 - Confirm gas delivery
 - Troubleshoot gas flow issues
-

10.3 Heater Controls

The Heater controls allow manual enabling and disabling of heater operation.

These controls may be useful during:

- Initial system checkout
- Heater verification

- Troubleshooting

Caution

Manual heater operation should be performed only by trained personnel familiar with normal system operation.

Users should verify appropriate operating conditions before enabling heater operation.

11. Stop Functions

GC × GC Modulation Control provides two methods for terminating operation:

- Stop (Controlled)
 - Emergency Stop
-

11.1 Stop (Controlled)

Stop (Controlled) is the normal method for terminating a run.

A detailed description of Stop (Controlled), including state transitions and Re-Arm requirements, is provided in Section 5.6.

In summary:

- Program execution stops.
- Initial Settings are restored.
- Program State changes to IDLE.
- Re-Arm is required before the next automated run.

Stop (Controlled) should be used whenever routine termination of a run is desired.

11.2 Emergency Stop

Emergency Stop immediately places the controller into a safe state.

Emergency Stop should be used only when immediate termination of operation is required.

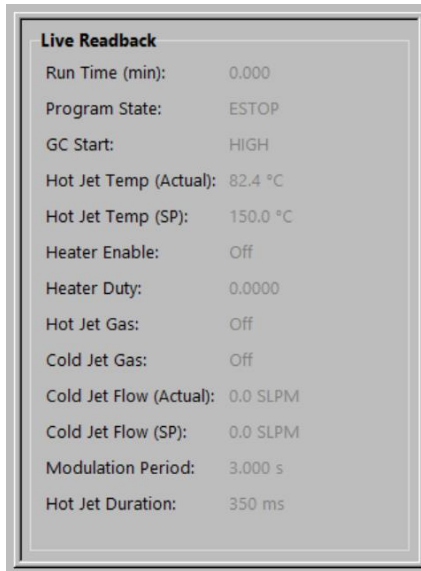


Figure 12. ESTOP state.

When Emergency Stop is executed:

- Heater output is disabled.
- Hot Jet Gas is turned OFF.
- Cold Jet Gas is turned OFF.
- Program execution terminates immediately.
- Program State changes to ESTOP.

Difference Between Stop (Controlled) and Emergency Stop

Stop (Controlled)	Emergency Stop
Controlled shutdown	Immediate shutdown
Restores Initial Settings	Does not perform controlled restoration
Program State → IDLE	Program State → ESTOP
Intended for routine operation	Intended for emergency situations
Re-Arm required	Disconnect and reconnect required

11.3 Recovery from Emergency Stop

To recover from Emergency Stop:

1. Correct the condition that caused the Emergency Stop.
2. Click Disconnect.
3. Click Connect.
4. Verify communication with the controller.

When Connect is executed:

- Initial Settings are automatically transmitted to the controller.
- Program State returns to ARMED.

The system is then ready for automated operation.

12. Method Management

GC × GC Modulation Control allows methods to be created, saved, loaded, and exported.

12.1 New Method

File → New Method

Creates a new method and clears the current method information.

Users should save any desired information before creating a new method.

12.2 Open Method

File → Open Method

Loads a previously saved method file.

All Initial Settings and Program Table information contained within the selected method file are restored.

After a method is loaded:

- The Initial Settings panel is updated.
- The Program Table is updated.
- The loaded Initial Settings are displayed in the software.

Loading a method does not automatically transmit the Initial Settings to the controller.

If the user wishes to apply the loaded Initial Settings to the controller, the Apply Initial Settings button must be executed after the method is loaded.

12.3 Save Method

File → Save Method

Saves the current method using the existing filename.

12.4 Save Method As

File → Save Method As

Saves the current method using a new filename.

This function is useful when creating method variations while preserving the original method.

12.5 JSON Method Files

Methods are stored as JSON files (.json).

JSON (JavaScript Object Notation) is a text-based file format used to store structured information.

Method files preserve:

- Initial Settings
- Program Table information
- End Time
- Additional method parameters

Users normally do not need to edit JSON files manually.

12.6 Export Method to CSV

File → Export Method to CSV

Exports the current method to a CSV file.

Prior to export, the software validates Program Table timing relationships and reports any errors that would prevent successful export.

The exported file contains:

- Initial Settings
- Program Table information

This export format is intended primarily for use with GC Image data processing software.

GC Image uses the Time and Modulation Period information to construct modulation timing tables.

Successful export is confirmed in the Status Bar.

12.7 CSV Export Validation

Before a CSV file is generated, the software verifies:

- Program timing relationships

- Modulation Period Rule compliance
- Export data consistency

If invalid timing relationships are detected:

- CSV export is prevented.
- The user is notified of the specific issue.
- The Program Table must be corrected before export can proceed.

This validation helps ensure that exported methods are compatible with downstream data-processing workflows.

13. PC Power Management Settings

For reliable communication between the controller and the PC, Windows power-saving features should be configured appropriately.

Failure to configure these settings may result in:

- Communication interruptions
 - Unexpected disconnections
 - Interrupted analytical runs
-

13.1 Disable Sleep and Hibernation

During operation, the computer should not enter Sleep or Hibernation mode.

To configure these settings:

1. Open Control Panel.
2. Select Power Options.
3. Click Change Plan Settings.
4. Set:

Put the computer to sleep → Never

5. Click Save Changes.
6. Click Change Advanced Power Settings.
7. Expand Sleep.
8. Set:

Sleep after → Never

Hibernate after → Never

9. Click Apply.
 10. Click OK.
-

13.2 Disable USB Selective Suspend

USB Selective Suspend allows Windows to temporarily disable USB devices to conserve power.

This feature should be disabled for reliable controller communication.

To disable USB Selective Suspend:

1. Open Control Panel.
2. Select Power Options.
3. Click Change Plan Settings.
4. Click Change Advanced Power Settings.
5. Expand USB Settings.
6. Expand USB Selective Suspend Setting.
7. Set:

On Battery → Disabled

Plugged In → Disabled

8. Click Apply.
9. Click OK.

13.3 Disable USB Hub Power Saving

Windows may automatically disable USB hubs to conserve power.

This feature should be disabled.

To disable USB Hub Power Saving:

1. Open Device Manager.
2. Expand Universal Serial Bus Controllers.

For each USB Root Hub and Generic USB Hub:

1. Right-click the device.
2. Select Properties.
3. Select the Power Management tab.
4. Uncheck:

Allow the computer to turn off this device to save power

5. Click OK.

Repeat this procedure for all USB Root Hub and Generic USB Hub entries.

13.4 Verify PC Power Settings

The software provides a PC Power Status check.

Access this feature using:

Settings → Check PC Power Status

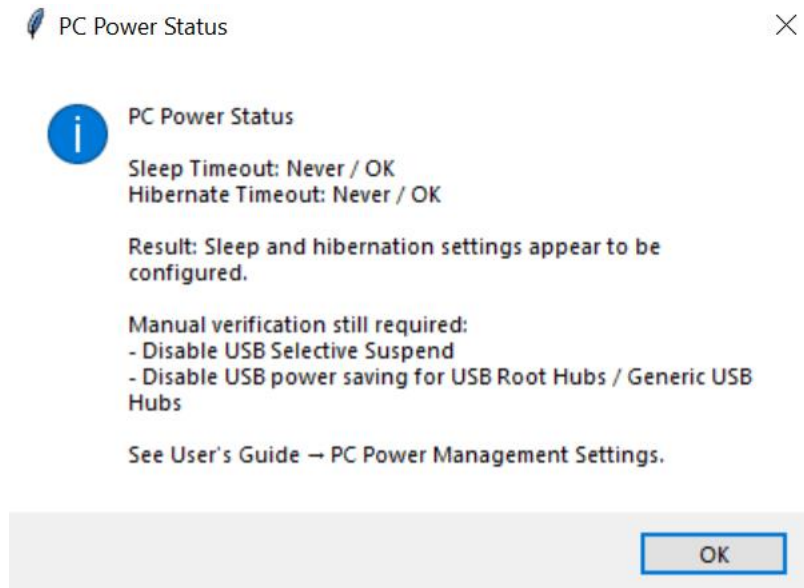


Figure 13. PC Power Status window.

The PC Power Status check verifies selected Windows power-management settings and reports potential issues.

Important

The PC Power Status feature only checks the current Windows settings.

The software does not automatically modify any Windows power-management settings.

If a problem is reported, the user must manually update the corresponding Windows settings as described in Sections 13.1 through 13.3.

Users should correct any reported issues before operating the modulation system.

14. Troubleshooting

This section describes common operating problems and recommended corrective actions.

14.1 Connection Failure

Symptoms

- Unable to connect to the controller
- Program State does not enter ARMED after Connect
- Communication errors are reported

Possible Causes

- Controller power is OFF
- USB cable is disconnected
- Incorrect COM port selected
- Controller firmware is not responding

Corrective Actions

1. Verify controller power.
 2. Verify USB cable connection.
 3. Verify communication settings.
 4. Disconnect and reconnect the USB cable if necessary.
 5. Power cycle the controller.
 6. Restart GC × GC Modulation Control if necessary.
-

14.2 Automated Run Fails to Start

Symptoms

- GC injection occurs
- Program does not begin running

Possible Causes

- Program State is IDLE
- Program State is ESTOP

- GC Start signal is not being received
- GC Start wiring is incorrect

Corrective Actions

1. Verify Program State indicates ARMED.
 2. If Program State indicates IDLE, click Re-Arm.
 3. Verify GC Start wiring.
 4. Verify GC Start Status changes from HIGH to LOW when the GC start signal is issued.
 5. Verify communication with the controller.
-

14.3 Controller Connected but Not Responding

Symptoms

- Program State does not update correctly
- Read Back does not return expected values
- Live Readback values do not change
- Commands appear to have no effect

Possible Causes

- Controller communication has stalled
- USB communication problem
- Controller firmware is not responding

Corrective Actions

1. Verify controller power.
2. Verify USB cable connection.
3. Power cycle the controller.
4. Disconnect and reconnect.
5. Restart GC × GC Modulation Control if necessary.

15. Help Menu

The Help menu provides access to software documentation and version information.

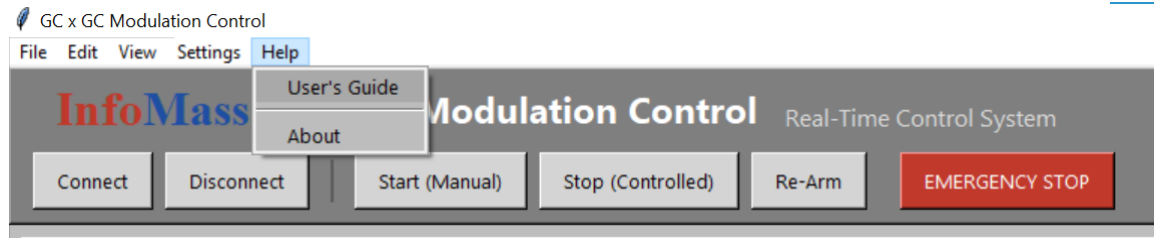


Figure 14. Help menu.

Available functions include:

- User's Guide
- About

15.1 User's Guide

Help → User's Guide

Opens the GC × GC Modulation Control User's Guide.

The User's Guide provides installation instructions, operating procedures, troubleshooting information, and system documentation.

15.2 About

Help → About

Displays software version and developer information.

Additional details regarding the About window are provided in Section 16.

16. About

The About window provides software identification and support information.

Displayed information includes:

- Software Name
- Software Version
- Developer Information
- Support Contact Information
- Copyright Information

Current About information:

GC × GC Modulation Control

Version 1.0

Developed by InfoMass LLC

Control software for GC×GC modulation systems, including hot jet temperature programming, cold jet flow control, modulation timing control, and live system readback.

Support: info@infomassllc.com

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Appendix A – Loop Winding Video

A loop winding demonstration video is available on YouTube.

Loop Winding Video:

<https://www.youtube.com/watch?v=MomxYD4lnw0>

The video demonstrates the proper procedure for winding a capillary loop in the loop holder.

The loop holder design maintains loop alignment by geometry and allows the loop to be secured using finger-tight fastening without requiring alignment adjustments.

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