Optimode

User manual



SRA INSTRUMENTS

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1. Description

1.1 Presentation



The Optimode is a modulation controller used in two-dimensional chromatography (GCxGC), developed by SRA Instruments. It is the heart of your 2D chromatography system because it controls the injection of gases from the first column into the second column. The Optimode controls a mass flow meter that regulates the flow of the cold air jet and thus ensures the adsorption of chemical species in the intermediate zone. Their desorption occurs periodically by the hot air jet pulse controlled by an electrovalve also controlled by the Optimode. For 2D imaging, it is essential to keep this period (modulation) repeatable.

The Optimode offers the following possibilities for the GCxGC:

- Good accuracy and repeatability of modulation time.
- A multi-modulation management allowing to adapt the modulation time during the analysis.
- An intuitive web programming interface, without the need for additional software.
- A control by network connection (Ethernet) like the rest of the GC installation.

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1.2 Front and back panels

1.2.1 Front panel



The 6 LEDs on the front panel provide information on the system status:

- POWER : this light is on when the system is powered and operational.
- IDLE : this light is on if the system is waiting for instructions.
- CYCLE : this light indicates that the system is in use.
- SPECIAL : this light indicates that a special action is in progress (configuration, cooling).
- START IN : this light is on when the Optimode receives the Start from the GC.
- HOT JET : this light indicates that the hot jet signal is activated.

1.2.2 Back panel



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1.3 Embedded web server

The Optimode interface is fully integrated because the module hosts an embedded server. This provides the necessary web pages to control the settings. Access to this interface requires only a LAN connection and a web browser. By default, the address is: 10.1.1.1.111

The home page looks like this:

Menu	Simple I	Run					
OVERVIEW	From this page, y jet control, and t	you can set the paramete he aperture of an analog	ers of a simple (ic mass-flow co	cycle and run it. The Optimod ntroller via a 4mA-20mA or 0	le provide a 0V-24V pulse for hot -10V signal.	0,9 -	
SIMPLE-MODULATION	As seen on this g t ₀ . The Modulatio START contact on, the mass-flow is	raph, a start (via the coi n starts right ahead wit the cycle shall be runnin kept to the idle value. If	rresponding GC th a hot jet pul ng right now. U t ₁ = 0 s (strong	contact or the START button lse in less than 2 ms. If you r Intil t ₁ ,the first time coordina gly advised), the first mass-flo	on this page) launch the cycle at eset the SRA-Optimode with the ate of the mass-flow, is reached, ow value is set at the same time	0.8 - 0.7 - 0.6 -	Mass Flow
MULTI-MODULATION	as the first mod coordinate, is re modulation is sto to the Idle Cycle.	dulation. The mass-flow eached, the system ente pped. A STOP(via the corr	signal is linear er an "End" cyc responding butt	r with time between coord de. the mass-flow is kept to ton or the GC contact on a sh	inates. When t _N , the last time o its last known value, and the ift down) is required to go back	0,3 0,4 0,3 0,2	
MAINTENANCE	The mass-flow an account if the sy mass-flow time p approvimately 5	nd modulation paramete stem is currently runnin arameters must be sorte The mass-flow apertur	ers can be mod ng. The number ed from smalles	tified with the following form of mass-flow coordinate can st (0s advised) to longest. The encentage with a built in pro-	mulary. Data won't be taken in n be set between 1 and 10. The ere is a 1 s time precision, up to erision of 0.396 and thus a 0.16	0,1 t ₀ 0 10	t1 20 30 40 50 60
P CONFIGURATION	step in entry. The time must be str	e hot jet time, correspon ictly superior to the hot	jet. Both hot je	t pulse, must be strictly super et and modulation are defined	rior to 0 ms, and the modulation with a 1 ms precision, up to a h	undred hour.	
	if you enter an in	correct parameter, no v	alue will be tak	en in account in the program	n. The current parameters appea	r above the entries.	
SPECIFICATIONS	Black me Green me	ans the values are synchr	ronized and you	ur parameters have been accord	ounted for.	withe current para	nators used
	Red als	o indicates parameters v	which haven't be	een taken in account, but are	not part of the current cycle. (T	hey are default value	s stored for further use)
tatus : Stand By	All values are har	d-saved only once the wh	nole formulary i	is correct.			
-							
urrent Cycle	Configu	ration					
urrent Cycle tand By	Configu	ration		ME Chack Baiate	Idle Mars Flow		
urrent Cycle tand By ext Cycle	Configur	ration	1	MF Check Points	Idle Mass Flow	I	Download
urrent Cycle tand By ext Cycle ain Cycle C Contact off	Configu Hot Jet Modulation (s)	20	00m20s000	MF Check Points	Idle Mass Flow Mass Flow Idle (%)	▲] 3	Download
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Current Cycle tand By lext Cycle tain Cycle C Contact off kodulation off lass Flow Value 3 lapsed Time lot Initialized tart	Configu Hot Jet Modulation (s) HotJet (s) Mass Flow Time (s) Mass Flow (%)	20 € [0.5] € oohoomoo 0 0 € 70 €	00m20s000 00m00s500 00h15m00 900 35 35 35	MF Check Points	Idle Mass Flow Mass Flow Idle (%) 3	▲] 3	Download

The Optimode can also be used offline with predefined settings after configuration with the web interface.

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1.4 Accessories supplied with the device



The Optimode can be supplied with a thermal mass flow meter, range 0.8 to 40 ln/min and the electro-valve which controls the supply of the hot air jet.

1.5 Installation

The Optimode is generally used with Zoex GC Image GCxGC software. The mass flow meter is mounted on the cold air inlet before the chromatograph and the electro-valve is mounted above the GC on the hot air inlet.



Overview of the top of the GC

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2. Principle of operation

On power-up, the Optimode is in Stand By mode. Modulation is disabled and the mass flow rate is maintained at an initial value, set in the **Simple Modulation** menu with the **Idle Mass Flow** parameter. The 'Idle' LED is lit.

There are two operating cycles:

- Simple modulation
- Multi modulation

Whatever the cycle defined, it is activated either by pressing the **Start** button on the web page or by receiving the Start from the GC. The 'Cycle' LED is lit for its entire duration. At the level of the Web interface, it is possible to track the actions performed and the time elapsed. At the end of the cycle, the Optimode remains in state and it is necessary to press the **Stop** button to return to Stand By mode. During the cycle, pressing the **Pause** button temporarily interrupts the cycle and the flow rate remains unchanged. Pressing the **Continue** button restarts the cycle from where it was at the time of the pause. Pressing the **New** button restarts a new cycle.

2.1 Simple modulation

In this mode, the modulation and duration of the Hot Jet are fixed. Up to 10 mass flow changes (MF Check Points) can be programmed during the cycle.

2.2 Multi modulation

In this mode, it is possible to change the modulation and duration of the Hot Jet up to 10 times (HJ Check Points). As in the Simple Modulation cycle, it is possible to program mass flow changes.

2.3 Initialization of parameters and module

- In the case of normal power-up, the last saved settings are restored. The LEDs blink quickly at the same time.
- If the Reset button is held down during power-up, all settings are reset to factory settings. The 'Cycle' LED then blinks to indicate the success of the operation.
- In the event of memory loss or damaged data, the factory settings are also loaded. The 'Idle' and 'Special' LEDs blink together.

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3. Web interface

The Web interface is accessible by entering the IP address or host name (if DHCP is supported) in the address field of the web browser. By default, the Optimode address is **10.1.1.101**. By default, the *Simple Modulation* page is displayed.

3.1 Web interface architecture

The interface is intuitive and divided into 6 pages, each dedicated to a specific mode of use:

- Overview
- Simple modulation
- Multi modulation
- Maintenance
- IP configuration
- Specifications

The *Overview* and *Specifications* pages only display information and do not change the current cycle. The *Maintenance* page includes several functions such as cooling and recovering factory settings. The *IP configuration* page allows you to change the IP address of the module, its name at domain level and to validate or not the use of DHCP (Dynamic Host Configuration Protocol) which manages the IP address. If the IP configuration is changed, the system is automatically reset with the new settings.

3.2 Web page architecture

Each page of the interface is built on the same model and divided into 3 parts.

• The left part includes the navigation bar (MENU), the status section (STATUS) and the software start button (START).



Current Cycle	
Stand By	
Next Cycle	
Main Cycle	
GC Contact	off
Modulation	off
Mass Flow Value	3
Elapsed Time	
Not Initialized	

Start	
Start	

The information displayed in the **Status** section is about the cycle status (*Current cycle*), the next step (*Next cycle*) and the elapsed time (*Elapsed time*). The *GC Contact* information displays the status of the chromatograph's external Start input, *Modulation* indicates the state of modulation (On/Off) and *Mass Flow Value* displays the scale percentage of the mass flow.

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The *Status* information indicates the status of the Optimode (Stand By), or indicates the type of cycle in progress (Main Cycle for simple modulation or Multi Modulation).

The **Start** section includes two buttons. The name of these buttons can change depending on the state of the Optimode cycle.

• **The upper central part** provides information on the current page, the cycle to be started and the interface.

Simple Run	
From this page, you can set the parameters of a simple cycle and run it. The Optimode provide a OV-24V pulse for hot jet control, and the aperture of an analogic mass-flow controller via a 4mA-20mA or 0-10V signal. As seen on this graph, a start (via the corresponding GC contact or the START button on this page) launch the cycle at t_0 . The Modulation starts right ahead with a hot jet pulse in less than 2 ms. If you reset the SRA-Optimode with the START contact on, the cycle shall be running right now. Until t_1 , the first time coordinate of the mass-flow, is reached, the mass-flow is kept to the idle value. If $t_1 = 0$ s (strongly advised), the first mass-flow value is set at the same time coordinate, is reached, the system enter an "End" cycle. the mass-flow is kept to its last known value, and the modulation is stopped. A STOP[via the corresponding button or the GC contact on a shift down) is required to go back	1 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.3 0.4 0.3 0.5 0.4 0.5 0.4 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5
The mass-flow and modulation parameters can be modified with the following formulary. Data won't be taken in account if the system is currently running. The number of mass-flow coordinate can be set between 1 and 10. The mass-flow time parameters must be sorted from smallest (0s advised) to longest. There is a 1 s time precision, up to approximately 5h. The mass-flow aperture is given in percentage, with a built in precision of 0.39%, and thus a 0.1% step in entry. The hot jet time, corresponding to the hot pulse, must be strictly superior to 0 ms, and the modulation time must be strictly superior to the hot jet. Both hot jet and modulation are defined with a 1 ms precision, up to a hur	$\begin{array}{c} 0.3 \\ 0.1 \\ 0 \\ 0 \\ 10 \\ 20 \\ 30 \\ 40 \\ 50 \\ 60 \\ 60 \\ 60 \\ 60 \\ 60 \\ 60 \\ 6$
if you enter an incorrect parameter, no value will be taken in account in the program. The current parameters appear Black means the values are synchronized and your parameters have been accounted for. Green means the parameters haven't been updated due to a mistake somewhere in the formulary, and show you Red also indicates parameters which haven't been taken in account, but are not part of the current cycle. (The 	above the entries. I the current parameters used. By are default values stored for further use)
All values are hard-saved only once the whole formulary is correct.	

• **The lower central part** allows you to enter the parameters. It is linked to the displayed web page. The information is sent via the **Download** button. The parameters are displayed as a default value for entry and as a text code. This redundancy is used to convert the input from seconds to explicit time and to highlight errors found in the submitted parameters.

The text parameters displayed in **black** are in accordance with the values submitted. The **green** text indicates the actual value used by the software. The **red** text is used to show that the displayed value is not relevant.

The parameters are stored in the internal memory only if they are correct. The parameters cannot be changed during system operation.

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HotJet (s) 30 00m00s500 Mass Flow Time (s) 00h00m00 00h15m00 02h31m00 00h00m00 0 0 0 00h15m00 02h31m00 00h00m00 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Hot Jet Modulation (s)	20	00m20s	۲ 5000 4	NF Check	Points	Idle Mass Flor Mass Flow Idle	w e (%) 3	3	send
Mass Flow 00h00m00 00h15m00 02h31m00 00h00m00 Time (s) 0 9 9 0 0 0 50 35 5 0 0 0 0 Mass Flow (%) 50 35 5 0 0 0	HotJet (s)	30	00m00:	500						
50 35 5 0 Mass Flow (%) 50 35 5 0	Mass Flow	00h00m00	00h15m00	02h31m00 9 060 🚔	00h00m	00				
Mass Flow (%) 50 🔄 35 🜩 5 💭 0	(-)	50	35	5	0					
	Mass Flow (%)	50 🚖	35 🚖	5 🔶	0	÷				

In the example above, the modulation parameter is correct, but not the hot jet (it must be shorter than the modulation). The hot jet used by the software, 0.5 second, is displayed in green. The number of mass flow steps has just been increased from 3 to 4, the 4th step parameter group is in red to indicate that the entered parameters are not correct (0) while the time of the previous step is at 2h31. In this case, only the first 3 groups of parameters are taken into account by the program. The hot jet and mass flow settings must be correct before the data is stored in the internal memory.

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3.3 Overview page

This page contains information about:

- The different web pages corresponding to the menu sections, presented below.
- It presents the different states of the system:



- <u>Stand By</u>: This is the default state of the device. Modulation is disabled and the mass flow rate is maintained at the initial value (Idle Mass Flow). The 'Idle' LED is lit. The Optimode switches to Stand By cycle automatically when the board is reset. If the "Start" input is closed (the status of the input can be controlled by the "GC Contact" information). A downward front on the GC connector or the "Stop" button also activates Stand By mode.
- <u>Main Cycle</u>: It is a simple cycle with fixed modulation and mass flow control. The 'Cycle' LED lights up during the operation. This cycle switches to **Stand By** mode in case of stop (connector software button), or to **End** phase at the end of the cycle. The time elapsed since the beginning of the cycle is displayed together with the mass flow value in real time. The Hot Jet control is also displayed in real time.
- <u>Multi-modulation</u>: This cycle is similar to the **Main Cycle**, but allows multi-modulation. It is launched from the appropriate web page (Multi-Modulation). If "Special cycle" appears in the Next cycle field instead of "Main cycle", reload the current web page with the "Main Cycle" link in the navigation bar.

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- <u>End</u>: This is the step that takes place after the cycle (Main or Multi). In this state, modulation is disabled and the mass flow rate is maintained at the last known value. To exit this state, you must request a stop (software or GC Start downward front), and switch to Stand By mode. When the system enters this cycle, a "Press Stop" message is displayed on the interface.
- <u>Pause</u>: The Optimode goes into this simple state after pressing the Pause button, it goes into standby. To continue the cycle, simply press the *Continue* button and the cycle starts again. The 'Idle' LED lights up during the pause. Pause is not available from the **Stand By** state.
- <u>Cold Up</u>: This is a special function available at the beginning of your experiment. Thanks to a short sequence of hot pulses (5) at an opening of 50% of the mass flow rate, the system is placed in optimal conditions. All the ice at the end of the nozzle is removed by the hot jet and the mass flow inlet is cooled. Cooling automatically ends in **Stand By** mode. The 'Special cycle' LED lights up during operation. Cold Up is available on the maintenance web page.
- <u>Mass Flow</u>: This button is also available in the maintenance page. It lights the 'Special' LED. It allows the fine adjustment and testing of the mass flow controller and the hot jet. This function is used at the factory to set the 4 mA 20 mA output potentiometers.
- *Factory Cycle* sets the device parameters to their initial value. The IP configuration is not changed in the meantime.

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3.4 Simple modulation page

Simple modulation allows cycles to be performed with a fixed modulation period. However, it is possible to program several mass flow steps (1 to 10).

From this page, you can define the parameters of a simple cycle and execute it. The Optimode provides a 0-24 V pulse for hot jet control, and controls the mass flow meter via a 4-20 mA or 0-10 V analog signal.

		SKA Releas Compi	Uptimo e version: ling Date :	3.00 Oct 1 2018 10:15:27	TCP/IP Version: Serial Number :	v5.36 2013		
enu	Simple	Run						
	From this page, jet control, and	you can set the parame the aperture of an analo	ters of a simple gic mass-flow co	cycle and run it. The Optim ontroller via a 4mA-20mA c	mode provide a OV-24V or O-10V signal.	pulse for hot	10000	
VERVIEW	As seen on this g	raph, a start (via the c	or responding GC	contact or the START but	ton on this page) launci	the cycle at	0,9 - 0,8 -	Hot Set
IMPLE-MODULATION	START contact on the mass-flow is as the first mo	i, the cycle shall be runn kept to the idle value. I dulation. The mass-flow	ing right now. U f t ₁ = 0 s (strong signal is linea	Intil t ₁ , the first time coor gly advised), the first mas r with time between co de the mass flow is keen	dinate of the mass-flow s-flow value is set at the cordinates. When t_N , t	, is reached, he same time he last time	0,7 - 0,6 - 0,5 - 0,4 -	
ULTI-MODULATION	to the Idle Cycle.	opped. A STOP(via the co	rresponding but	ton or the GC contact on	a shift down) is require	id to go back	0.3 -	
AINTENANCE	The mass-flow a account if the sy mass-flow time p	nd modulation parame stem is currently runn parameters must be sor	ers can be mot ing. The number ted from smalle	dified with the following r of mass-flow coordinate st (0s advised) to longest.	formulary. Data won't can be set between 1 There is a 1 s time pro-	be taken in and 10. The ecision, up to	0,1 t ₀ 0 10	20 30 40 50 64
CONFIGURATION	step in entry. Th	e hot jet time, corresp	anding to the hol	t pulse, must be strictly su	uperior to 0 ms, and th	e modulation	deed have	
ECIFICATIONS	if you enter an i • Black me	ncorrect parameter, no eans the values are sync	value will be tak pronized and you	ken in account in the prog ur parameters have been	ram. The current para accounted for.	ion, up to a hur neters appear	above the entrie	5.
PECIFICATIONS Catus : Stand By arrent Cycle	time must be sti if you enter an i Oreen m Red ab All values are ha	netry superior to the no neorrect parameter, no eans the values are sync eans the parameters ha so indicates parameters rd-saved only once the v ration	value will be tak hronized and you ven't been updat which haven't b whole formulary	ken in account in the prog ur parameters have been ed due to a mistake some een taken in account, but is correct.	ram. The current paral accounted for, where in the formulary are not part of the cur	ion, up to a nur meters appear , and show you rent cycle. (The	the current part y are default value	s. ameters used, ues stored for further use)
PECIFICATIONS Catus: Stand By arrent Cycle and By wt Cycle	time must be sti if you enter an i • Black m • Green m • Red al All values are ha Configu	rectly superior to the no ncorrect parameter, no eans the values are sync eans the parameters ha so indicates parameters rd-saved only once the v ration	value will be tak hronized and you ren't been updat which haven't b rhole formulary	er and modulation are den ken in account in the prog ur parameters have been ed due to a mistake some een taken in account, but is correct.	ram. The current para accounted for. where in the formulary are not part of the cur idle Mass Flow	ion, up to a nur neters appear , and show you rent cycle. (The	the current par-	s. ameters used, ues stored for further use)
PECIFICATIONS Eatus: Stand By arrent Cycle and By ext Cycle sin Cycle	time must be st if you enter an i Black m Red at All values are ha Configu Hot Jet Modulation (s)	Incorrect parameter, no noorrect parameter, no sans the values are sync assis the parameters ha so indicates parameters rd-saved only once the v ration	value will be tak hronized and you ren't been updat which haven't b hole formulary	And modulation are den ken in account in the prog ur parameters have been ed due to a mistake some een taken in account, but is correct.	Idle Mass Flow Idle (16)	ion, up to a num meters appear , and show you rent cycle. (The	the current par. the current par. y are default vali	5. ameters used. uses stored for further use) Download
PECIFICATIONS Eatus : Stand By Frent Cycle and By Status Cycle Contact off Cycle	time must be st if you enter an i e Black mi Green m Red ab All values are ha Configu Hot Jet Modulation (s) HotJet (s)	Incorrect parameter, no neor rect parameter, no sans the values are sync ass the parameters ha so indicates parameters red-saved only once the v ration	value will be tak hronized and you ren't been updat which haven't b hole formulary	And modulation are den ken in account in the prog ur parameters have been ed due to a mistake some een taken in account, but is correct.	ram. The precision of the current parameter of the current parameter of the current parameter of the current part of the current part of the current of the	ion, up to a num meters appear , and show you rent cycle. (The) 3	above the entrie the current part y are default value	5. ameters used. ues stored for further use) Download
PECIFICATIONS Eatus: Stand By arrent Cycle and By status: Cycle in Cycle Contact off odulation off ass Flow Value 3	time must be st if you enter an i Black mi Green m Red ab All values are ha Configu Hot Jet Modulation (s) HotJet (s) Mass Flow	Inclus superior to the no ncorrect parameter, no sans the values are sync ass the parameters ha so indicates parameters indicates parameters radiated only once the v ration	yalue will be tak hronized and you ren't been updat which haven't b hole formulary]] 00m205000 [] 00m005500	An in account in the prog ur parameters have been ed due to a mistake some een taken in account, but is correct. MP Check Points 2	ram. The current paras ram. The current paras where in the formulary are not part of the cur idle Mass Flow Mass Flow idle (s	ion, up to a num meters appear , and show you rent cycle. (The	above the entrie the current par- y are default vali	5. ameters used. ues stored for further use) Download
PECIFICATIONS atus : Stand By arrent Cycle and By xt Cycle in Cycle Contact off odulation off ss Flow Value 3 apsed Time	time must be st if you enter an i e Black mi e Red ab All values are ha Configu Hot Jet Modulation (s) HotJet (s) Mass Flow	Incorrect parameter, no neor rect parameter, no sans the values are sync assis the parameters ha so indicates parameters indicates parameters radiaved only once the v ration	(per. both hot is value will be tak value will be tak vent been updat which haven't b hole formulary () 00m20s000 () 00m00s500 00h15m00	And modulation are den ken in account in the prog ur parameters have been ed due to a mistake some een taken in account, but is correct.	Idle Mass Flow Idle (1)	ion, up to a num meters appear , and show you rent cycle. (The	above the entrie the current par- y are default val	5. ameters used. ues stored for further use) Download
PECIFICATIONS PECIFICATIONS Catus: Stand By arrent Cycle and By ext Cycle sin Cycle Contact off dduation off ass Flow Value 3 apped Time ot Initialized	time must be st if you enter an i Black mi Red at All values are hai Configu Hot Jet Modulation (s) HotJet (s) Mass Flow Time (s)	Incur superior to the no ncorrect parameter, no sans the values are sync asis the parameters ha so indicates parameters rad-saved only once the v ration	type: both hot is value will be tak intronized and you venit been updat which haven't b hole formulary if 00m20s000 if 00m00s500 00h15m00 if 900	An in modulation are den ken in account in the prog ur parameters have been ed due to a mistake some een taken in account, but is correct.	Idle Mass Flow Idle (9 Mass Flow Idle (9 Mass Flow Idle (9 Mass Flow Idle (9	ion, up to a nur neters appear , and show you rent cycle. (The	above the entrie the current par- y are default val	5. ameters used. uses stored for further use) Download
PECIFICATIONS PECIFICATIONS Catus : Stand By arrent Cycle and By ext Cycle ain Cycle Contact off dduation off ass Flow Value 3 apped Time ot Initialized cart	time must be st if you enter an i Black m Red at All values are ha Configu Hot Jet Modulation (s) HotJet (s) Mass Flow Time (s)	Incorrect parameter, no neor rect parameter, no sans the parameters ha so indicates parameters rad-saved only once the v ration	value will be tak value will be tak	MF Check Points	Idle Mass Flow Idle (5 Mass Flow Idle (5 Mass Flow Idle (5	ion, up to a mum meters appear , and show you rent cycle. (The	above the entrie the current par. y are default val	s. ameters used. ues stored for further use) Download
PECIFICATIONS PECIFICATIONS Catus : Stand By arrent Cycle and By ext Cycle sin Cycle Contact off dduation off ass Flow Value 3 apped Time at Initialized cart	time must be st. if you enter an i Black m Red at All values are ha Configu Hot Jet Modulation (s) HotJet (s) Mass Flow Time (s) Mass Flow (k)	Incorrect parameter, no ncorrect parameter, no nass the values are sync easis the parameters has to indicates parameters disaved only once the v ration	iper. both hot is value will be tak incontext and your	MF Check Points WF Check Points	Idle Mass Flow Idle (5 Mass Flow Idle (5 Mass Flow Idle (5	ion, up to a mum meters appear , and show your rent cyde. (The	above the entrie the current par. y are default val	s. ameters used. ues stored for further use) Download
PECIFICATIONS PECIFICATIONS tatus : Stand By arrent Cycle and By ext Cycle sin Cycle Contact off odulation off ass flow Value 3 apsed Time t Initialized cart Start	time must be st if you enter an i e Black mu e Green m Red at All values are ha Configu Hot Jet Modulation (s) HotJet (s) Mass Flow Time (s)	Inclus superior to the no ncorrect parameter, no eans the values are sync ass the parameter's ha so indicates parameters rd-saved only once the v ration	iper. both hot is value will be tak intronized and your intronized and your which havent b which havent b intronized and your intronized and your </td <td>A min modulation are den ken in account in the prog ur parameters have been ed due to a mistake some een taken in account, but is correct.</td> <td>Idle Mass Flow Idle (9</td> <td>on, up to a mum meters appear , and show you rent cycle. (The</td> <td>above the entrie the current par- y are default vali</td> <td>5. ameters used. ues stored for further use) Download</td>	A min modulation are den ken in account in the prog ur parameters have been ed due to a mistake some een taken in account, but is correct.	Idle Mass Flow Idle (9	on, up to a mum meters appear , and show you rent cycle. (The	above the entrie the current par- y are default vali	5. ameters used. ues stored for further use) Download

As you can see on the graph above, a start (via the GC Contact input or the START button on this page) starts the cycle at t0. The modulation starts directly with a hot jet pulse in less than 2 ms. If you reset the Optimode by opening the START contact, the cycle is started immediately. Until time t1 of the first stage, the mass flow rate is maintained at the initial value. If time t1 is 0 s, strongly recommended, the mass flow value is set at the same time as the first modulation. The mass flow signal is linear with time between the stages. When the time tN of the last level is reached, the system switches to "End" mode. The mass flow rate is maintained at the last set value and modulation is stopped. A STOP (via the corresponding button or the GC contact during a downward front) is required to return to the Stand By cycle.

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The mass flow and modulation parameters can be modified using the form on the page. The data will not be taken into account if the system is in the running cycle. The number of mass flow steps can be set between 1 and 10. The mass flow time parameters must be sorted from the smallest (0 s recommended) to the longest. There is a time accuracy of 1 s, up to about 5 h. The mass flow opening is given in percentage, with an integrated accuracy of 0.39%, and therefore a step of 0.1% at the input. The hot jet time, corresponding to the hot pulse, must be strictly greater than 0 ms, and the modulation time must be strictly greater than the hot jet time. The hot jet and modulation are defined with an accuracy of 1 ms, up to a hundred hours.

If you enter an incorrect parameter, no value will be taken into account in the program. The current settings appear above the inputs.

- **Black** means that the values are synchronized and your settings have been taken into account. •
- Green means that the settings have not been updated due to an error somewhere in the form, and • shows you the current settings used.
- Red also indicates parameters that have not been taken into account, but are not part of the • current cycle. (These are default values stored for later use).

All values are only saved in internal memory when all parameters are correct.

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3.5 Multi-modulation page

The multi-modulation mode is used for more complex experiments with different modulation and hot jets periods during the same analysis.

	SRA Optimode Release Version: 3.00 TCP/IP Version: v5.36 Compiling Date : Oct 1 2018 10:15:27 Serial Number : 2013
Menu	Multi-Modulation
OVERVIEW	Multi-Modulation is a new feature in this optimode. The modulation and hot Jet are dynamically adjustable to your analysis. Like the mass-flow controller, you can enable up to 10 successive steps with different modulation parameters. The new modulation parameters are changed at the time associated. The modulation doesn't start directly parameters are stored in memory, and become effective at the next automatic update which 0,8
SIMPLE-MODULATION	occurs at the end of each complete modulation. As a result, the different sections of a multi-modulation all share the same time shift. If you set the first modulation at time = 0 s, this offset is null, within the 2 ms precision. The multi-modulation mode is similar to the simple modulation : it starts and stops in the same conditions, and the 0.5
MULTI-MODULATION	behavior of the mass-flow controller is the same. If the last mass-flow time parameter is smaller than the last modulation one, the mass-flow is kept at the same value until the (yede finish and enters 'Ending' mode. If the mass- flow time is longer, the last modulation and pube parameters are kept until the 'Ending' Cycle. Also, the parameters are only updated and aswed on hard memory once the whole formulary is correct.
MAINTENANCE	The modulation can be disabled until next modulation time with the checkbox next to the time entry. When disabled, the modulation and pulse parameters are irrelevant, and are therefore not displayed. The next modulation shall start at the precise time set. When the Modulation is albed in the program, no values (***) is displayed. However, the out a start of the start
IP CONFIGURATION	parameters are still available in memory for further use. Configuration
SPECIFICATIONS	
Status : Stand By	Disabled 00h00m00
Current Cycle Stand By	Time (s) 0 0
Next Cycle Multi Modulation	Modulation (s) 20
GC Contact off Modulation off	Hot Jet (s) 0,5
Mass Flow Value 3 Elapsed Time	Mass Flow MF Check Points 2
Not Initialized	Time (s) 0 900
Start	70 35 Mass Flow (k) [70] [35]
Start	
SRA Instruments 150, rue des Tel. +33 04 7844 2947 I Fax +3 Siege Social: 150, rue des Sour SA a Directoire et a Conseil de	Sources I 69280 Marcy I Etaile I France 3 04 7844 2962 I info@sra-instruments.com I www.sra-instruments.com ces , 69280 Marcy IEtaile e Surveillance au capital de 150 000 Euros

Multi-modulation is a new feature of the Optimode. The modulation and hot jet are dynamically adjustable according to the analysis. As with the mass flow controller, you can choose up to 10 successive steps with different modulation parameters. The new modulation parameters are modified at the associated time. Modulation does not start directly anyway: the parameters are stored in memory, and become effective at the next automatic update which takes place at the end of each complete modulation. Therefore, the different sections of a multi-modulation all share the same time shift. If you set the first modulation time = 0 s, this offset is zero, with an accuracy of 2 ms.

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The multi-modulation mode is similar to simple modulation: it starts and stops under the same conditions, and the behavior of the mass flow controller is the same. If the last mass flow time parameter is lower than the last modulation parameter, the mass flow is maintained at the same value until the end of the cycle and switches to "End" mode. If the mass flow time is longer, the last modulation and pulse parameters are retained until the "End" cycle. In addition, the parameters are only updated and saved in internal memory when all the parameters are correct.

The modulation can be deactivated until the next modulation by using the checkbox next to the time entry. When disabled, the modulation and pulse parameters are not relevant and are therefore not displayed. The next modulation starts at the precise time set. When modulation is disabled in the program, no value (***) is displayed. However, the settings are still available in memory for later use.



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3.6 Maintenance page

This page is a technical section where you can fine-tune the Optimode internal clock, start a defrost initiation cycle, test the mass flow rate and hot jet valve, and restore factory settings.

Menu	Maintenance Section	
OVERVIEW SIMPLE-MODULATION MULTI-MODULATION MAINTENANCE IP CONFIGURATION SPECIFICATIONS Status : Stand By	 Asas FLow and Hot Jet Set is used in factory for testing and hardware configuration. The system special mode when the formulary is submitted. The state of the hot jet and the mass-flow value can submitted. The state of the hot jet and the mass-flow value can use the system in optimal conditions. The mass-flow value can subspace in percentage, in 3-bits binary (the numerical vamas-flow), on a 0 - 10 V scale, and on a 4 - 20 mA scale, for direct control. The mass-flow value has incidence on the idle value. Cold Up is a special cycle used to put the system in optimal conditions. The mass-flow is set to 50 M, and successive 1 s long modulation and hot jet pulse are triggered. We can therefore de-ice the cold cold the ir entry. The parameters of this special cycle are factory written in hard memory, and can ange. Timer shift enables the tuning of the SRA-Optimode internal dock. 1 ms is initially defined as 4.000 or timer, in accordance with a 80 MHz builtin quartz. As seen in the following figure, the span differeme the Optimode dock and your GC can lead to a difference in the modulation period, and to a pulse over time. We can observe, by example, a 5 shift vor the course of 1h30. After characteriz time shift and the total time, enter the required correction in the time shift formular to synchronic dock. The same unit (to your choice) is required, with relative integers ordy. The final module is used for memory save and recovery. Farameters are automatically save afte different parameters : the timer definition of 1 ms, The ide level of the mass-flow, the Hot Jet para different parameters : the timer definition of 1 ms, The ide level of the mass-flow, the Hot Jet parameters is the time of the integer of the mass-flow integer of the formulation is the spece of the mass-flow is the specee of the mass-flow is the specee of the mass-flow is the specee of the mass-flow is the spec	n enters a be able of the ino aperture, dift, and ant be 23 00 cycle on a shift in 23 10 min 50 min 50 min 70 min 90 ameters, and the mass-flow parameters.
Jurrent Cycle itand By exst Cycle Config MF GC Contact off Aodulation off Aass Flow Value 3 Bapsed Time Not Initialized	Mass Flow Shift Timer Cold Up 3 Image: Mass Flow (%) 0 Image: Time flow (%) 0 8 Bits encoding 00001000 Image: Time flow (%) 0 Image: Time flow flow (%) 0 4.000-200.00 mk 4501 Current countdown for a ms 0000 Image: Time flow flow flow flow flow flow flow flow	Factory Hot Jet Mass Flow Save Parameters Timer Load Parameters MF idle

The maintenance section is composed of 4 different functions:

- Mass flow and Hot Jet: Mass flow and hot jet are used in the factory for testing and hardware configuration. The system switches to special mode when these values are submitted. The hot jet status and mass flow rate value can be configured as required. The mass flow value is displayed in percentage, in 8-bit binary (digital mass flow value), on a scale of 0-10 V, and on a scale of 4-20 mA, for direct control. The mass flow value has no effect on the idle value.
- **Cold up** is a special cycle used to put the system in optimal conditions. The mass flow rate is set to an opening of 50%, and a successive modulation of 1 s and a hot jet pulse are triggered. The parameters of this special cycle are stored in the factory and cannot be changed. It is therefore possible to defrost the cold jet and cool the air inlet after nitrogen filling, for example, with a high flow rate.

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Shift Timer allows the internal clock of the Optimode to be set. 1 ms is initially defined as 40,000 cycles on our timer, in accordance with an integrated 80 MHz quartz. As shown in the following figure, the difference in scale between the Optimode clock and your GC can cause a difference in the modulation period and a time shift of a pulse. For example, we can observe a delay of 5 s over a period of 1 h 30. After characterizing the time difference and total time, enter the required correction in the time difference form to synchronize your clocks. The same unit (of your choice) is required, with relative integers only.



• **Factory** is used for in-memory backup and data recovery. The parameters are automatically saved after a correct entry, and this section allows you to retrieve different factory parameters: the 1 ms timer definition, the mass flow idle level, the hot jet parameters, and the mass flow parameters.

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3.7 IP Configuration page

	SRA Optimode Release Version: 3.00 TCP/IP Version: V5.36 Compiling Date : Oct 1 2018 10:15:27 Serial Number : 2013
Menu OVERVIEW SIMPLE-MODULATION MULTI-MODULATION	IP Configuration This page allows the configuration of the board's network settings. Be very careful, once you've submitted the new settings, the board may loose connectivity with the network As soon as new settings are input, the board ball reset itself, resulting in the 3 status Led Blinking, Recovery options will be provided on the next page. The DHCP option is useful if you want the board to synchronize with your DHCP server. The AutoP option (overrun by the DHCP) attributes a random IP to your board if it cant achieve connection.
MAINTENANCE IP CONFIGURATION SPECIFICATIONS Status : Stand By Current Cycle Stand By Next Cycle Config MF GC Contact off Modulation off Mass Flow Value 3 Elapsed Time Nah Infibience	Host Name: SRAOPTI-2013 IP Address: 10.1.1.11 Gateway: 10.1.1.1 Subnet Mask: 255.255.0 Primary DNS: 10.1.1.1 Secondary DNS: 0.0.0.0 MAC Address: 00:04:A3:48:68:00 Enable DHCP Enable DHCP Save Config
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This page allows you to configure the network settings of the board. Be very careful, once you have submitted the new settings, the board may no longer be connected to the network. As soon as new settings are entered, the board resets itself, causing all 3 status LEDs to blink. Recovery options are provided on the next page. The DHCP option is useful if you want the board to synchronize with your DHCP server. The AutoIP option (disabled by DHCP) assigns a random IP address to your board if it can't connect.

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3.8 Specifications page

This page presents the specifications of the various system parameters.

You can find them in Chapter 5 - Appendix B of this manual.

۸enu	Specifications						
OVERVIEW							
SIMPLE-MODULATION	Specification Name	Specification Value	Т.				
MULTI-MODULATION	Hot Jet Modul Modulation resolution (Mean) Hot Jet resolution (Mean)	lation 0.1 µs 0.1 µs		•	Hot Jet Si	gnal (2D)	
MAINTENANCE	Modulation repeatibility (Variance) Hot Jet repeatibility (Variance) Modulation Step	12.5 ns 12.5 ns 1 ms		+			
IP CONFIGURATION	Hot Jet Step Modulation Lenght Multi-Modulation steps	1 ms 2 ms to 1 h 40					
SPECIFICATIONS	Multi-Modulation steps Multi-Modulation time parameter Initialisation delay at "Start" command	up to 100 h between 1 ms and 2 ms.		1:			
Senter of Canada Day	Mass Flow Con	troler		+			
Status : Stand by	Mass Flow time parameter	up to 5h30 between each step up to 100h					
Current Cycle	Mass-Flow steps	10			+		
Stand By	Internal Clo	ick .		10 min	30 min	50 min	70 min
Next Cycle	maximum clock drift (after correction)	9 ms per hour.		1011111	3011111	5011111	/011111
Contig MF	-		-				
GC Contact off							
Mass Flow Value 3							
Flansed Time							
Not Initialized							
Not micialized							
Start							
ocur c							
Start							

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4. Using the Optimode with an Agilent GC

When using the Optimode with an Agilent GC, the valve 5 of the GC must be used to control the Optimode (pin 1 and 4 of the GC External Event connector).

5. Specifications

Hot Jet Modulation					
Modulation and Hot Jet resolution	0.1 µs				
Modulation and Hot Jet variance	12.5 ns				
Modulation and Hot Jet input step	1 ms				
Modulation and Hot Jet maximum span	1 h 40				
Number of modulation phases	10				
Phase duration	Up to 100 h				
Délai on Start contact	2 ms ± 1 ms				
Mass Flow Controller					
Mass flow resolution	0.39 %				
Number of mass flow interpolation coordinates	10				
Max. time between mass flow coordinates	5 h 50				
Horloge					
Internal clock variation	9 ms per hour				
Dimensions					
Length x Base x Height	230 mm x 125 mm x 90 mm				

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