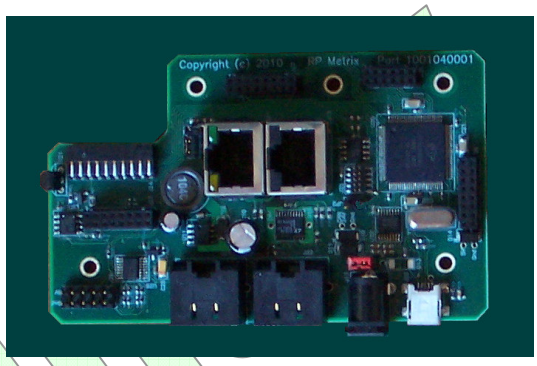
RP Metrix

LASOM2 Controller Module	LASOM2.C1

Controller Module for a LASOM2 Scalable Olfactometer Module

- 14 odor sources per module
- Scalable to 15+ module, 210+ odor system
- Hosts 2 Digital or 3 Analog Mass Flow Controllers
- USB control interface
- CAN BUS slave module interface with terminator
- Field upgradeable firmware and logic
- Microsoft Windows ® Win32 driver and control program
- Supports 24 VDC Valves
- In Rush Current Limiter
- Detachable Valve Driver Board
- Analog Expansion Port
- Three Mixed Signal Expansion Ports
- LASOM1 compatible Sequencer



Ordering Information

Configuration	Part Number
Scalable Olfactometer Module LASOM2[1]	LASOM2
Olfactometer Module Control Board, Type 1	LASOM2.C1
Olfactometer Module Valve Driver Board, Type 1	LASOM2.V1
Replacement external 24 VDC adapter[2]	LAPDC24-1

[1] LASOM2 is a joint development of RP Metrix and the Howard Hughes Medical Institute Janelia Farm Research Campus

[2] Elpac Power Systems FW1824-760F (Digi-Key EPS334-ND) or equivalent.

Absolute Maximum Ratings _____

Characteristic	Symbol	Min	Typ	Max	Unit
Input DC Supply Voltage	V_{DC}	-0.3	24.0	24.5	V
Input DC Supply Isolation to Ground	V_{SISO}	700			V
Valve Circuit Current	I_{VALVE}	0		500	mA
Valve Circuit Voltage	V_{VALVE}	0	24	24	V
Output Short-Circuit to Ground Duration	t_{SC}			∞	sec
Operating Temperature	T_A	0		70	°C
Storage Temperature	T_S	-40		85	°C
USB VBus[3]	V_{VBUS}	-0.3	5.0	5.5	V
USB D+, D-	V_{USBD}	-0.5		5.25	V
Ext Digital I/O Input Voltage	V_{DIO}	-0.5		5.5	V
Ext Digital I/O Output Current	I_{DIO}	-50		11	mA
Ext Digital I/O Clamp Current (V_{DIO} < 0)	I_{DIOK}	-50			mA

Specifications _____

At T_A = +25°C, V_{DC} = 5V, unless otherwise noted.

Characteristic	Symbol	Min	Typ	Max	Unit
Input DC Supply Voltage (in operation)	V_{DC}	4.5	5.0	5.5	V
Operating Supply Current	I_S		750	1500	mA
Ext Digital High Level Output Voltage	V_{OH}		3.3		V
Ext Digital Low Level Output Voltage	V_{OL}		0.4		V
Ext Digital High Level Input Voltage	V_{IH}	2.0			V
Ext Digital Low Level Input Voltage	V_{IL}			0.8	V
Purge gas (air[4])					
Inlet pressure		48		70	kPa
Flow rate range		10	900	1000	ml/min
Flow rate step size			1.0		ml/min
Flow rate accuracy			10.0		ml/min
Carrier gas (nitrogen[5])					
Inlet pressure		48		70	kPa
Flow rate range		10	100	100	ml/min
Flow rate step size			0.1		ml/min
Flow rate accuracy			1.0		ml/min
Odor select valve activation delay		3	4	5	ms
Odor select valve deactivation delay		5	6	7	ms
Board Length			101.60		mm
Board Width			61.72		mm

[3] Module interface power only, valve current load exceeds USB specifications for bus powered devices.
[4] Default purge gas calibration is for air. Other gases can be configured by special order.
[5] Default carrier gas calibration is for nitrogen. Other gases can be configured by special order.

Description _____

The LASOM2 Scalable Olfactometer Module is a plug mount module that connects to clean gas sources and delivers an odorized gas flow to an olfaction experiment. The output flow contains a controlled concentration of odorant selected electronically from one of fourteen user supplied odor source vials mounted in the module. The module can support an experiment requiring up to 14 odors as is, or can be plugged into one slot of one or more multi-slot module bins available from your supplier. Up to fifteen modules may be combined to construct a 210-odor system. A single USB connection is used to connect a single or multi-module system to a host computer for automated management of the odor selections.

Two integrated independent mass flow controllers permit precise control of purge and odorized carrier gas flows. Clean gas is supplied to both flow controllers. The non-odorized purge gas flow making up the bulk of the flow during a trial is delivered to the subject between trials. The odorized flow is created by routing clean carrier gas through its flow controller and through a selected odor vial during a trial. This combines with clean purge gas which makes up the bulk of the flow. The net olfactometer output flow rate matches an externally managed background flow.

During a trial, external valves swap the balanced background and odorized flows near the subject.

Between trials, the external valves and odor select valves are deactivated. The clean purge gas clears the olfactometer and flows externally to exhaust. The clean background gas flow is directed to the subject.

The on/off valves used to select odors are easily replaceable by the user if necessary. Wetted components can easily be removed, cleaned with solvent, baked, and reinstalled. The valves are powered by an external DC power supply, which permits one module to support one set of 24 VDC valves.

The controller has a USB 2.0 Type B jack for use with the user supplied host computer. A 5-meter USB 2.0 Type A to Type B cable is supplied with the LASOM. A CDROM supplied with the LASOM contains software for installation in a user supplied PC running Microsoft Windows ® 2000, Windows ® XP, or a compatible operating system. USB driver and user application programs are included.

Additional slave LASOM2 modules may be attached to the master (USB connected) module via the integrated CAN BUS connectors and standard CAT5-type 8-wire RJ-45 terminated cables. The cable carries power and data to the other modules, so that typically only one 24VDC power module is needed. An external power supply connected to J13, and enabled via jumper JP1, is diode mixed to the CAN 24V bus circuit. Each control board routes power from this circuit through its on-board in rush current limiter to power the rest of the module.

Connectors

Designator	Description	Type
J11	CAN BUS Interface	RJ-45 jack, vertical, with LEDs
J12	CAN BUS Interface	RJ-45 jack, vertical
J13	24 VDC Power Input	5.8 mm jack
J20	USB Host Connector	USB type mini-B jack
J21	MFC 1 Control	RJ-45 jack, right angle
J22	MFC 2 Control	RJ-45 jack, right angle
J23	MFC 3 Control	16-pin 2mm receptacle
J24	Valve Driver Interface	20-pin 2mm receptacle
J25	SWD Debug Interface	10-pin 0.050” header
J26	PSOC Expansion Port	16-pin 2mm receptacle
J27	PSOC Expansion Port	16-pin 2mm receptacle
J28	PSOC Expansion Port	12-pin 2mm receptacle
J29	Analog Expansion Port	10-pin 0.100” header
JP1	Input Power Enable	2-pin 0.100” header
JP2	PSOC Reset	2-pin 0.100” header
JP3	CAN BUS Termination	2-pin 0.100” header
JP4	CAN BUS DC Reference	2-pin 0.100” header

JP1 enables current flow from the J13 24V DC power input to the 24V CAN circuit.
JP2 connected momentarily resets the on-board microcontroller.
JP3 must be installed at each end of the CAN BUS to terminate the bus differential pair.
JP4 must be installed at one or more nodes to set the mid point DC reference to 2.5V.

J11,J12 (RJ-45) 8-Pin CAN BUS Interface Connector

Pin #	Signal	Input/Output
1	CAN_H	Bidirectional
2	CAN_L	Bidirectional
3	Ground	--------
4	No Connection	
5	No Connection	
6	CAN Shield	--------
7	Ground	--------
8	CAN 24V	Bidirectional
Shield	CAN Shield Wrap	

CAN Shield Wrap connects to ground via a 10 MOhm resistor and a 4.7 nF capacitor.

J13 (5.8 mm Jack[6]) 2-Pin DC Power Jack

Pin #	Signal	Input/Output
1 (center)	V_{DC} Supply (24V)	Input
2 (barrel)	V_{DC} Return (Gnd)	Input

J20 (USB Type mini-B) 5-Pin USB Host Interface Connector

Pin #	Signal	Input/Output
1	VBUS (5V)	Input
2	D-	Input
3	D+	Input
4	No Connection	
5	Ground	--------
Shield	USB Shield	

USB VBUS supplies power to low voltage control board components, when CAN 24V is not present from either J13 or a remote CAN device. This can be used to power the board for software development.

USB Shield connects to ground via a 10 MOhm resistor and a 4.7 nF capacitor.

[6] CUI, Inc., PJ-005B

J21,J22 (RJ-45) 8-Pin MFC Digital/Analog Interface Connector

Pin #	Signal	Input/Output
1	RX RS232	Input
2	MFC Analog Out	Input
3	MFC Analog In	Output
4	Ground	--------
5	MFC Valve Out	Input
6	TX RS232	Output
7	Module 24V	Output
8	Ground	--------

J21 and J22 support Bronkhorst-type MFCs. Typically, only the digital RS232 interface is used. Analog circuits are also provided to support an analog interface MFC.

J23 (16-pin 2mm pitch header[7]) 16-Pin MFC Analog Interface Connector

Pin #	Signal	Input/Output	Pin #	Signal	Input/Output
1	Ground	--------	2	No Connection	
3	MFC Flow Signal	Input	4	Ground	--------
5	Ground	--------	6	No Connection	
7	MFC Purge	Output	8	MFC Valve Off	Output
9	Ground	--------	10	Module 24V	Output
11	No Connection		12	No Connection	
13	Module 24V	Output	14	MFC Chassis Ground	--------
15	MFC Analog In	Output	16	No Connection	

J23 supports a third Aalborg-type MFC. Although the pins are numbered in pairs, signals are assigned to the connector so that the column starting at pin 1 corresponds to pins 1..8 of the Aalborg DB-15 pin out, and the other column starting at pin 2 corresponds to pins 9..15 of the DB-15.

[7] Hirose Electric DF11-16DS-2DSA(06), Digi-Key H10188-ND. Example mate: DF11-16DEP-2C housing and Digi-Key H3AXG-10108-B6-ND 8" round wire jumper to DF11 pin.

J24 (20-pin 2mm pitch receptacle) 20-Pin Valve Driver Interface Connector

Pin #	Signal	Input/Output	Pin #	Signal	Input/Output
1	Ground	--------	2	Ground	--------
3	5V Logic Power	Output	4	VD_nFAULT	Input
5	5V Logic Power	Output	6	VD_nRESET	Output
7	No Connection		8	VC_RCLK	Output
9	Module 24V	Output	10	VC_nCLR	Output
11	Module 24V	Output	12	VC_nSRCLR	Output
13	Module 24V	Output	14	VC_SDO	Input
15	1_Wire_BUS	Bidirectional	16	SPI_TO_DEV	Output
17	VC_LED_ENA	Output	18	SPI_CLK	Output
19	Ground	--------	20	Ground	--------

J25 (10-pin 0.050" pitch header) 10-Pin SWD Debug Interface Connector

Pin #	Signal	Input/Output	Pin #	Signal	Input/Output
1	5V Logic Power	--------	2	SWDIO_TMS	Bidirectional
3	Ground	--------	4	SWDCK_TCK	Input
5	Ground	--------	6	TDO	Output
7	Ground	--------	8	TDI	Input
9	Ground	--------	10	XRES	Input

J25 mates with a Cypress Semiconductor MiniProg3 Programing and Debug device.

J26, J27 (16-pin 2mm pitch header[8]) 16-Pin PSOC Expansion Interface Connector

Pin #	Signal	Input/Output	Pin #	Signal	Input/Output
1	PSOC I/O	--------	2	PSOC I/O	--------
3	PSOC I/O	--------	4	PSOC I/O	--------
5	PSOC I/O	--------	6	PSOC I/O	--------
7	PSOC I/O	--------	8	PSOC I/O	--------
9	PSOC I/O	--------	10	PSOC I/O	--------
11	PSOC I/O	--------	12	PSOC I/O	--------
13	PSOC I/O	--------	14	PSOC I/O	--------
15	Ground	--------	16	5V Logic Power	Output

J28 (12-pin 2mm pitch header[9]) 12-Pin PSOC Expansion Interface Connector

Pin #	Signal	Input/Output	Pin #	Signal	Input/Output
1	PSOC I/O	--------	2	PSOC I/O	--------
3	PSOC I/O	--------	4	PSOC I/O	--------
5	PSOC I/O	--------	6	PSOC I/O	--------
7	PSOC I/O	--------	8	PSOC I/O	--------
9	PSOC I/O	--------	10	PSOC I/O	--------
11	Ground	--------	12	5V Logic Power	Output

J26, J27, and J28 connect directly to the on-board Cypress Semiconductor PSoC3 microcontroller. Each PSOC I/O pin can be respectively programmed as a digital or analog input or output.

[8] Hirose Electric DF11-16DS-2DSA(06), Digi-Key H10188-ND. Example mate: DF11-16DEP-2C housing and Digi-Key H3AXG-10108-B6-ND 8" round wire jumper to DF11 pin.
[9] Hirose Electric DF11-12DS-2DSA(06), Digi-Key H10186-ND.

J29 (10-pin 0.100" pitch header) 10-Pin Analog Expansion Interface Connector

Pin #	Signal	Input/Output	Pin #	Signal	Input/Output
1	DAC Out C	Output	2	DAC Out A	Output
3	DAC Out D	Output	4	DAC Out B	Output
5	ADC IN 4	Input	6	ADC IN 1	Input
7	ADC IN 3	Input	8	ADC IN 2	Input
9	5V Logic Power	Output	10	Ground	--------

These analog signals are supported by an IC which provides 4 DAC channels and 4 ADC channels (Analog Devices ADT7516). These signals are also connected to the MFC connectors J21, J22, and J23 as detailed below. The DAC channels are directly wired to MFC pins. The ADC channels are wired from voltage dividers, so that each ADC channel samples a fraction of its respective MFC analog output. The voltage dividers all use 5.11K ohm resistors in the bottom, grounded portion of the divider. The MFC pins feed the top resistors, with are either 5.11K ohm or 25.5K ohm resistors, resulting in the attenuation factor noted in the table below. ADC input 4 is shared between two MFC connectors – only one of these connector pins should be wired to a source.

MFC Analog Signal Routing

Pin #	Signal	MFC Pin #	MFC Signal	Attenuation
2	DAC Out A	J21-3	MFC Analog In 1	--------
4	DAC Out B	J22-3	MFC Analog In 2	--------
1	DAC Out C	J23-15	MFC RemoteSetPoint 3	--------
3	DAC Out D	--------	--------	--------
6	ADC IN 1	J22-2	MFC Analog Out 2	0.50
8	ADC IN 2	J21-2	MFC Analog Out 1	0.50
7	ADC IN 3	J21-5	MFC Valve Out 1	0.167
5	ADC IN 4	J22-5	MFC Valve Out 2	0.167
		J23-3	MFC Flow Signal Output 3	0.50

LASOM1 Behavioral I/O _____

LASOM2 emulates the LASOM1 behavioral subsystem inputs and outputs via the J27 and J28 expansion connectors. Although LASOM2 does not provide the buffered interfaces for Strobe or Leaf functions, equivalent TTL level support is provided which maps in firmware to the equivalent LASOM1 signals. This permits comparable sequencer and API access to these signals.

The table below describes the mapping.

LASOM1 Signal	LASOM2 Connector-Pin	Input/Output
Beam 1	J28-1	Input
Beam 2	J28-2	Input
Beam 3	J28-3	Input
Dig In 1	J28-4	Input
Dig In 2	J28-5	Input
Dig In 3	---------	---------
Cue 1	J28-6	Output
Cue 2	J28-7	Output
Cue 3	J28-8	Output
Dig Out 1	J28-9	Output
Dig Out 2	J28-10	Output
Dig Out 3	---------	---------
Xlogic 1	J27-1	Input
Xlogic 2	J27-2	Input
Xlogic 3	J27-3	Input
Xlogic 4	J27-4	Input
Xlogic 5	J27-5	Output
Xlogic 6	J27-6	Output
Xlogic 7	J27-7	Output
Xlogic 8	J27-8	Output
Strobe In	J27-9	Input
Strobe Out	J27-10	Output
Beam Monitor 1	J27-11	Output
Beam Monitor 2	J27-12	Output
Beam Monitor 3	J27-13	Output
Strobe Out	J27-14	Output

Software Installation _____

Included with the LASOM2 is a software installation CDROM. Check the RP Metrix web site (www.rpmetrix.com) for information about the latest software, which may be newer than the version described in this document. The top-level folder "RP Metrix" contains these items:

File Name	Description
RedPill.inf	Windows USB driver information
RedPill.sys	Windows USB driver
LASOM_LV.dll	Windows DLL supporting LabView, etc.
LASOMX.ocx	Windows ActiveX control supporting MatLab, etc.
Firmware	Folder for maintenance program and backup copy of firmware
Doc	Folder containing documentation files
Example	Folder containing example Sequencer and API scripts

This software is designed for use on a PC running Windows ® 2000 or Windows ® XP.
This software cannot be used with Windows ® 98, Me, NT or earlier versions of Windows.
Only Administrators can install the USB driver. After that, any user can operate the module with SOPlayer.exe.

When the LASOM2 is first connected to a PC USB port, the operating system will detect a new unrecognized device. Depending on the type of Windows ® operating system, you will be prompted by the Found New Hardware Wizard to install the new driver. The steps listed below are for Windows 2000. Follow the wizard prompts to:

- Search for a suitable driver for my device.
- Specify a location.
- Browse to the CDROM (or a copy), browse into the RP Metrix folder, then select RedPill.inf and click Open.
- Confirm that windows found RedPill.inf in the proper folder and click Next.
- If a Digital Signature Not Found window pops up for "RP Metrix LASOM2 USB device", click Yes to continue the installation.
- Close the wizard by clicking Finish.

You should now be able to run the application programs.

Upgrading Firmware with LoadBoard _____

After the USB driver is installed, the LoadBoard.exe program can be used upgrade the firmware in the LASOM2, if necessary. This program can also make the LASOM2 unusable, so use this program only as directed by your technical support representative.

Controlling Modules with LoadBoard _____

After the USB driver is installed, the LoadBoard.exe program can be used to control modules via the LASOM2. This program contains basic test support for RP Metrix devices. Click “Get ID”, then “Test Inst” to bring up the top level test dialog for a particular device.