Certifier™ Plus Flow Analyzer

Models 4089, 4081, 4082

Quick Start Guide

P/N 6016478, Revision D
May 2023



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Certifier™ Plus Instrument Components

Model 4089 Certifier™ Plus Interface Module Kit*

Material Description	Replacement Part
Certifier™ Plus Interface Display Module	4089
Cable, flow module, coiled, REDEL® straight plug to 4-pin mini-DIN	130384
Carrying case, hybrid (13.8 x 9.5 x 8.1 inches)	130389
Power supply 100/240 VAC to +12 VDC 2.1 mm, includes plug set with NA, UK, EU, CN, SAA	130400

Model 4081 Certifier™ Plus High Flow Module Kit*

Material Description	Replacement Part
Certifier Plus High Flow Module	4081
Inlet Filter, HEPA, 22 mm x 22 mm male/female	1602341
Adapter, 15 mm ID x 22 mm OD	1102093
Airway pressure fitting with screen	1611330
Pressure tubing, silicone, 1/8 in. ID x 1/4 in. OD x 48 in.	3002053
Velcro® strap for use on High Flow Module	2913110

* Model 4089 and 4081 kits make up the model 4080-S Certifier™ Plus System.

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Model 4082 Certifier™ Plus Low Flow Module Kit

Material Description	Replacement Part
Certifier™ Plus Low Flow Module	4082
Inlet Filter, HEPA, 3/8 to 1/2 in. barb	1602342
Coupling, 3/8 to 5/16 in. push-to-connect, straight	1601180
Adapter, 3/8 in. tube to 3/8 in. barb	1601179

Certifier™ Plus Accessories

Material Description	Part Number
Oxygen Sensor Kit	4073
Test Lung, Adult, 1 L	130393
Test Lung, Pediatric, 0.5 L	130396
Deluxe Carrying Case, Fitted (13.8 x 9.5 x 8.1 in.)	130393
Computer Cable, RS232, USB-A to 9-pin D-sub (includes null modem converter)	130379
Computer Cable, USB-C to USB-A, Screw Lock	130382
Certifier Connector Kit (various fittings and adapters)	130391
Flow Resistor Kit, calibrated resistors (Rp5, Rp20, Rp50)	130395

RAM Mounting Kits



Material Description	Part Number
RAM Mounting Kit, for 4089 Interface Module	130398
RAM Mounting Kit, for 4089 Interface Module plus 4081 High Flow or 4082 Low Flow Module (kit shown above)	130399

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Instrument Overviews

Model 4089 Interface Display



1. Flow Module Connector (A)	6. USB-C Communications Output
2. Flow Module Connector (B)	7. Screw hole for USB-C cable lock
3. DC Power Input	8. Tilt Stand
4. Power Button (On/Off)	9. Cable Retainer
5. USB-A Connectors (2)	10. Mounting holes (2), threaded M4

Model 4081 High Flow Module



1. Interface Module Connector	4. Mounting Holes (2), threaded #8-32
2. Oxygen Sensor Input	5. High Pressure Port (150 PSIG max)
3. TTL Trigger Input	6. Low Pressure Ports (±150 cmH_2O)

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Model 4082 Low Flow Module



1. Interface Module Connector	2. Mounting Holes (2), threaded #6-32

To remove a push-to-connect coupling from the 4082, press or pry the ring toward the coupling body with a small screwdriver while pulling the coupling away from the flow module (as shown below).



4073 Oxygen Sensor Kit



NOTICE

The oxygen sensor connects to High Flow Modules only.

1. O_2 Sensor (P/N 2917019)
2. Coupling (P/N 1313118)
3. Sensor Cable (P/N 1303741)

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Available Measurement Parameters

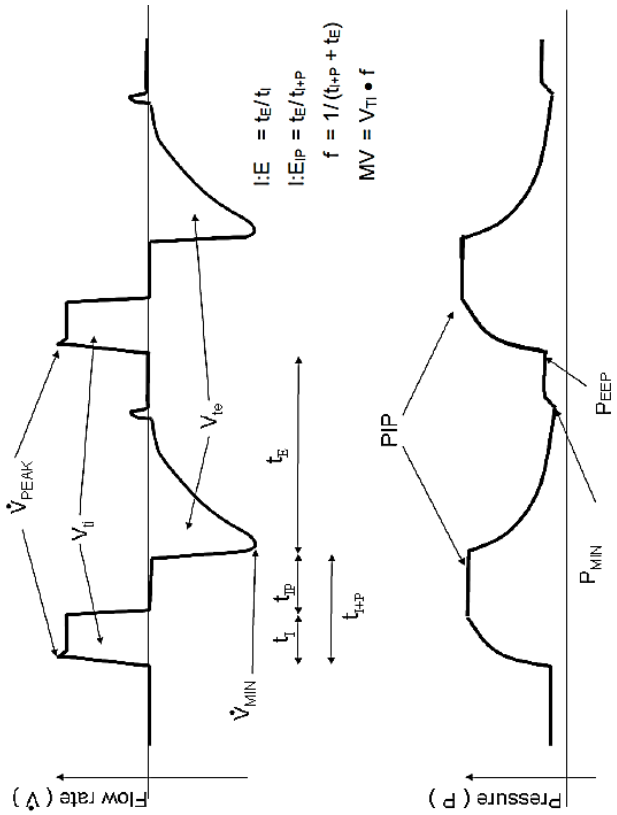
The actual measurement parameters available from the Certifier™ Plus Flow Analyzer are dependent on the model of the connected flow module.

Symbol	Description	Symbol	Description
$\dot{V}$	Flow rate	LR	Leak rate – change in low pressure over the set Average Time
$\dot{V}_{PEAK}$	Peak flow rate – Peak inhaled flow rate	P_{Δ}	Delta low pressure – Delta airway pressure (4081 only)
V_{MIN}	Minimum flow rate	P_{PLAT}	Plateau pressure
$\dot{V}\Delta$	Flow rate delta – the numerical difference in flow rates.	P_{HIGH}	High pressure (4081 only)
$\dot{V}\Delta\%$	Flow rate delta % – the difference in flow rates by %.	P_{ABS}	Absolute pressure, equals barometric pressure if flow tube open to atmosphere.
V_{TI}	Inhaled tidal volume	f	Breath frequency
V_{TE}	Exhaled tidal volume	t_I	Inspiratory time
V	Real-time volume	t_{IP}	Inspiratory pause time
MV	Inhaled minute tidal volume	t_{I+P}	Inspiratory time including pause time
O_2	Oxygen concentration (4081 with 4073 only)	t_R	Inspiratory rise time
T	Temperature	t_E	Expiratory time
P	Low pressure measurement (4081 only)	I:E	Inspiratory to Expiratory ratio
PIP	Peak inspiratory pressure (4081 only)	$I:E_{IP}$	Inspiratory to Expiratory ratio including pause time
P_{EEP}	Peak end expiratory pressure (4081 only)	C_{STAT}	Static compliance
P_{MAP}	Mean airway pressure (4081 only)	🕓	Time of day
P_{MIN}	Minimum low pressure (4081 only)		

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Measurement Parameter Definitions

Refer to the Certifier™ Plus User Manual for more detailed definitions of the measurement parameters.



Setup and Pre-Test Checks

Power and Warmup

The Certifier™ Plus Flow Analyzer can be operated through AC power or on battery power. With AC power applied, the battery will automatically recharge. Upon startup, allow 1 minute for the Certifier™ Flow Analyzer's flow sensor and pressure transducers to warm up.

Connect/Disconnect Flow Modules

Connect high flow or low flow modules to either port (A or B) located at the top of the Certifier™ Plus Interface Module. Flow modules may be

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connected or removed at any time. The interface display will reboot the application automatically upon a change in connected flow modules.

Connect Inlet Filter

TSI® Certifier™ Flow Analyzers measure utilizing an exposed thermal flow sensor that is highly sensitive to foreign matter and particles within the gas flow. TSI® supplies inlet filters for both the high flow and low flow modules and recommends that an inlet filter be used at all times when operating the Certifier™ instrument.

Pre-Test Checks

Calibration Date: Confirm that the calibration date for the Certifier™ Plus flow module is valid. TSI® recommends an annual calibration to ensure the most accurate flow, pressure, and temperature measurements.

Low/High Pressure: Disconnect any pressure tubing from the low and high pressure ports on the 4081 High Flow Module to expose the sensors to ambient air. Press the zero icon on the Certifier Plus display to access the Zero Pressure Sensors screen and perform the zeroing.

Flow Module Self-Check: Connect two of the same model Flow Modules inline to compare real-time measurements against each other.

Connect Low Pressure Measurement

Low pressure is available on the 4081 High Flow Module only. Connect the airway pressure fitting with screen (1) to the outlet of the flow module. Cut a length of tubing (2) and connect it from the airway pressure fitting barb to the (+) port on the flow module.



Connect Oxygen Sensor

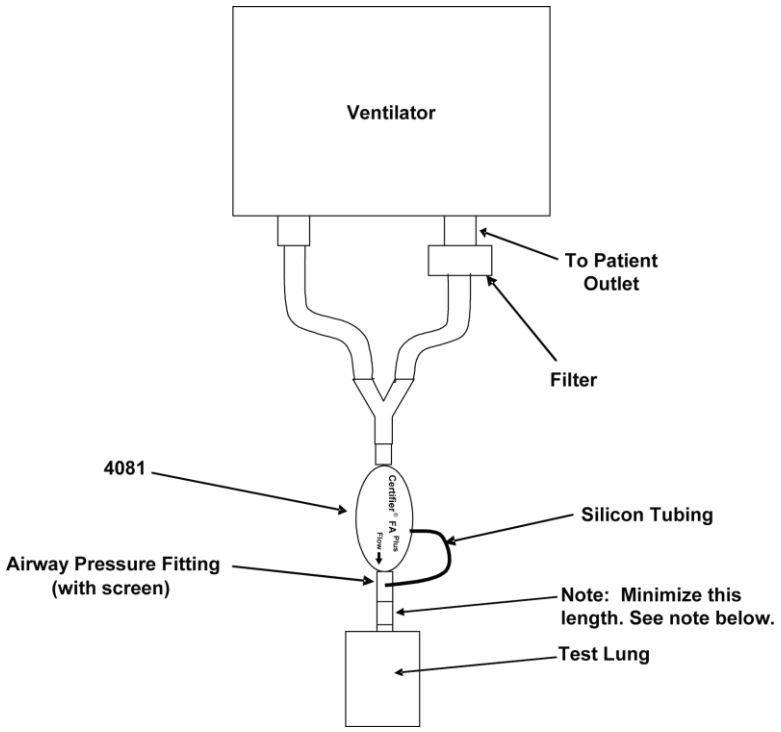
The oxygen sensor can be connected to High Flow modules only. You can connect or disconnect an oxygen sensor at any time without interrupting the operation of the instrument. Oxygen sensors should be field calibrated daily when in use and following a change in altitude.

To connect an oxygen sensor, unpackage the O_2 cell and screw it into the airway coupling. Connect the airway coupling to the outlet of the flow module and insert one end of the sensor cable into the top of the

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O_2 sensor cell. Connect the other end of the sensor cable to the input labeled “O2 Sensor” located on the top of the high flow module.

Test Circuit for Bi-directional Flow



NOTICE

If using a test lung with a built-in restrictor, place the airway pressure fitting with less than 15 cm length of the 22 mm tubing between the restrictor and the flow module. If this is not done, the flow direction sensor may not work properly.

Touchscreen Operation

The Certifier™ Plus Interface Module utilizes a 5-inch capacitive touchscreen display. The display interface is designed to be operated using your fingers, press lightly on the display for optimum touchscreen operation. TSI® offers a capacitive-touch stylus (TSI® P/N 130370) that can be used as an alternative to finger presses.

Operate the Certifier™ Flow Analyzer by touching any on-screen element that you would like to change. Up to 18 measurement parameters can be displayed on screen at one time, and the display

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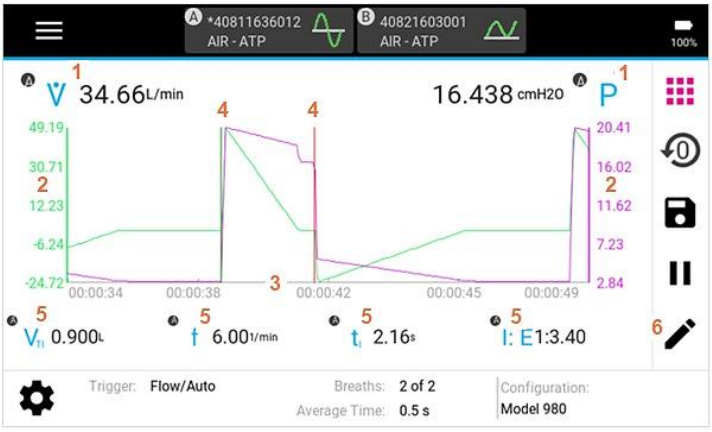
will automatically adjust the font size and positioning based on the number of selected measurements.

Parameter Screen



1. Menu	8. Parameter/Graph Screen Toggle
2. Module Cards	9. Zero Pressure Sensors
3. Module Indicators	10. Save Data and/or Snapshots
4. Battery Indicator	11. Pause/Play Display
5. Measurement and Units	12. Edit Measurements and/or Units
6. Triggers / Averaging Settings	13. Warnings & Errors Notifications
7. User Configurations	

Graph Screen

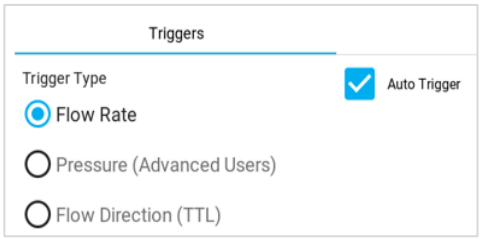


1. Plotted Measurements	4. Breath Trigger Indicators
2. Y-Axis (primary and secondary)	5. Real-Time Measurements
3. X-Axis	6. Edit Graph

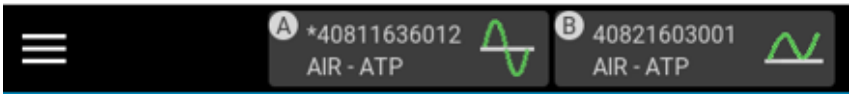
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Breath Triggers

Triggers are used to detect the start of the inspiratory and expiratory breath cycles. Triggers can be based on the flow rate, pressure, or driven from a TTL voltage signal. The Certifier™ Plus flow analyzer can automatically detect the breath using the flow rate, or you can manually set your own start and end trigger values using the flow rate or low pressure. In most circumstances, it is recommended to use the Auto Trigger setting.



When more than one flow module is connected, the breath triggering is controlled from the flow module connected to channel A of the Certifier™ Plus Interface Module. The flow module that is controlling the breath triggers will be indicated on the screen with an asterisk (*) displayed in the module card before the serial number.



Breath Averaging

The number of breaths specifies the maximum number of breaths over which to average breath parameter measurements. The averaging time sets the rate at which real-time values are averaged and updated on the Certifier™ Plus display. Real-time values include measurements for flow rate, low pressure, high pressure, absolute pressure, oxygen concentration (if connected), and temperature.



Certifier™ Flow Analyzer Configurations

A Certifier™ Flow Analyzer configuration is a saved collection of settings for the measurements, units, gas type and conditions, triggering, and graphing that you have selected. Any Certifier™ Flow Analyzer setup can be saved as a configuration and later recalled. Configurations can be saved for testing various types of equipment or to optimize test setups to conform with organizational standards or personal preference.

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Up to 20 different user configurations can be stored in the internal memory of the 4089 Certifier™ Plus Interface Module and can be exported from either USB-A port on the 4089 to a USB mass storage device. Exported user configurations can then be imported onto other model 4089 Certifier™ Plus or model 4090 Certifier™ Pro instruments. Exported configurations can also be sent as email attachments.

Data Acquisition

The Certifier Plus flow analyzer is capable of logging measurement data and capturing screenshots. Data can be saved from either the Parameter or Graph screen, and files are saved to the internal memory of the Certifier Plus Interface Module.

Snapshots save a screenshot image as well as the data currently displayed on screen. Continuous logging captures data for all measurements selected on screen at sample rate of 1 sec to 10 mins and test length from 15 secs to up to 5 days. Waveform logging records raw sensor data at a rate of 1000 Hz for a length of 15 to 60 seconds.

Data Export

Saved screenshots and data log files can be exported from either of the two USB-A ports located on the top side of the 4089 Certifier Interface Module. Snapshots are exported as .png image files and data is exported as .csv files. The delimiter for data export can be set as comma, pipe, semicolon, or tab delimited. You can select the Export Delimiter in the General Settings page of the Settings menu option.

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