PARTICLE INSTRUMENTS

Mass Flowmeters

TSI® Model 3063
Thermal Mass Flowmeter

Operation and Service Manual

1930101, Revision D
August 2010

TRUST. SCIENCE. INNOVATION.

Start Seeing the *Benefits* of Registering Today!

Thank you for your TSI instrument purchase. Occasionally, TSI releases information on software updates, product enhancements and new products. By registering your instrument, TSI will be able to send this important information to you.

http://register.tsi.com

As part of the registration process, you will be asked for your comments on TSI products and services. TSI's customer feedback program gives customers like you a way to tell us how we are doing.

TSI Incorporated

USA **Website:** www.tsi.com
Germany **Website:** www.tsiinc.de
Singapore **E-mail:** tsi-singapore@tsi.com

UK **Website:** www.tsiinc.co.uk
France **Website:** www.tsiinc.fr

Manufacturer of TSI®, AIRFLOW™ Instruments, and Alnor® products.

P/N 2980174 Rev F

Part Number
1930101

Address
TSI Incorporated / 500 Cardigan Road / Shoreview, MN 55126 / USA

Fax Number
651-490-3824

LIMITATION OF WARRANTY AND LIABILITY. Seller warrants the goods sold hereunder, under normal use and service as described in the operator's manual, shall be free from defects in workmanship and material for (12) months, or the length of time specified in the operator's manual, from the date of shipment to the customer. This warranty period is inclusive of any statutory warranty. This limited warranty is subject to the following exclusions:

a. Hot-wire or hot-film sensors used with research anemometers, and certain other components when indicated in specifications, are warranted for 90 days from the date of shipment.

b. Parts repaired or replaced as a result of repair services are warranted to be free from defects in workmanship and material, under normal use, for 90 days from the date of shipment.

c. Seller does not provide any warranty on finished goods manufactured by others or on any fuses, batteries or other consumable materials. Only the original manufacturer's warranty applies.

d. Unless specifically authorized in a separate writing by Seller, Seller makes no warranty with respect to, and shall have no liability in connection with, goods which are incorporated into other products or equipment, or which are modified by any person other than Seller.

The foregoing is IN LIEU OF all other warranties and is subject to the LIMITATIONS stated herein. **NO OTHER EXPRESS OR IMPLIED WARRANTY OF FITNESS FOR PARTICULAR PURPOSE OR MERCHANTABILITY IS MADE**.

TO THE EXTENT PERMITTED BY LAW, THE EXCLUSIVE REMEDY OF THE USER OR BUYER, AND THE LIMIT OF SELLER'S LIABILITY FOR ANY AND ALL LOSSES, INJURIES, OR DAMAGES CONCERNING THE GOODS (INCLUDING CLAIMS BASED ON CONTRACT, NEGLIGENCE, TORT, STRICT LIABILITY OR OTHERWISE) SHALL BE THE RETURN OF GOODS TO SELLER AND THE REFUND OF THE PURCHASE PRICE, OR, AT THE OPTION OF SELLER, THE REPAIR OR REPLACEMENT OF THE GOODS. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY SPECIAL, CONSEQUENTIAL OR INCIDENTAL DAMAGES. SELLER SHALL NOT BE RESPONSIBLE FOR INSTALLATION, DISMANTLING OR REINSTALLATION COSTS OR CHARGES. No Action, regardless of form, may be brought against Seller more than 12 months after a cause of action has accrued. The goods returned under warranty to Seller's factory shall be at Buyer's risk of loss, and will be returned, if at all, at Seller's risk of loss.

Buyer and all users are deemed to have accepted this LIMITATION OF WARRANTY AND LIABILITY, which contains the complete and exclusive limited warranty of Seller. This LIMITATION OF WARRANTY AND LIABILITY may not be amended, modified or its terms waived, except by writing signed by an Officer of Seller.

Service Policy

Knowing that inoperative or defective instruments are as detrimental to TSI as they are to our customers, our service policy is designed to give prompt attention to any problems. If any malfunction is discovered, please contact your nearest sales office or representative, or call TSI at 1-800-861-7032 (USA) or +1-651-765-3797 (International).

CONTENTS

Chapters

(This page intentionally left blank)

Chapter 1

Unpacking and Parts Identification

Carefully unpack the instrument and accessories from the shipping container. Check the individual parts against the list of components in Table 1. If any parts are missing or damaged, notify TSI immediately.

Table 1. List of Components

Qty	Item Description	Part/Model
1	Model 3063 Mass Flowmeter	3063
1	Computer cable	1303583
1	Analog cable	1303584
1	Filter	1602300
1	AC Adapter	
	120 V, North America, ungrounded	8918-US
	100-240 V, NEMA 5-15 plug, grounded	8918-NA
	100-240 V, Europlug, CEE 7/16, grounded	8918-EC
	100-240 V, Great Britain, grounded, fused	8918-GB
	100-240 V, Australia/NZ	8918-AT
1	Operation and Service Manual	1930101
1	RS-232 Serial Command Manual	1930102
1	Carrying case	1319176
1	½" tube to ⅜ FNPT fitting	1601738
2	3½" diskettes containing LabVIEW® software	1036161

LabVIEW® is a registered trademark of National Instruments Corporation.

Parts Identification

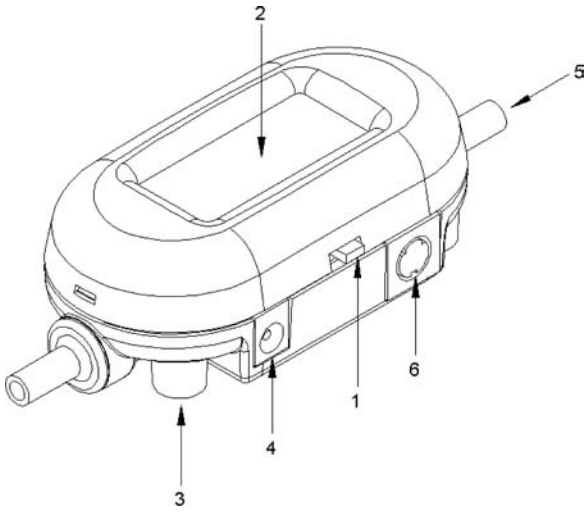


Figure 1-1 Model 3063 Mass Flowmeter

1. On/Off Switch
2. Display
3. Mounting Inserts (2)
4. DC Power Input
5. Flow Inlet
6. Computer Serial Interface and Analog Output and Optional Power Input Connector

Chapter 2

Setting Up

Supplying Power

The flowmeter can be powered in one of two ways: through the power jack using the supplied AC adapter or through the mini-DIN connector. The DC power input connector is shown below along with the power requirements.

Power Supply: 7.5 VDC ± 1.5 V, 300 mA maximum

When supplying power through the TSI-supplied interface cable, line up the arrow on the connector with the bottom side of the flowmeter. Flowmeter connector pin-out designations are shown below.

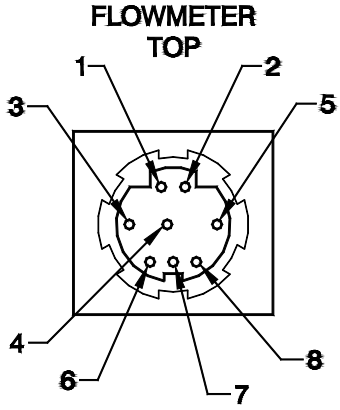
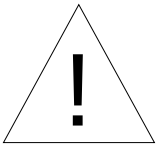


Table 2. List of Connector Pin-Outs and Cable Color Code Designations

Pin	Function	Cable Color Code (TSI)
1	Power Input (+)	Black
2	Power Ground (-)	Green
3	Analog Output (+)	Red
4	Analog Ground (-)	Brown
5	(no connection)	Blue
6	RS-232 Receive (in)	White
7	RS-232 Transmit (out)	Yellow
8	Logic Ground	Gray

Connecting Filter and Flow Tubes

The Model 3063 has an exposed thermal flow sensor, which must be protected from foreign matter and particles in the gas flow. TSI has supplied a filter, which should be connected to the inlet of the flowmeter. However, any filter will work as long as it has a minimum efficiency of 99.9%.



CAUTION

Always use a filter on inlet of flowmeter. Failure to filter the gas flow may change the calibration and/or permanently damage the sensor.

Note: *Flow direction is identified by the large arrow printed on the bottom side of the flowmeter.*

After attaching the filter, connect the flow tube to the inlet of the filter. Connecting a tube to the outlet of the flowmeter will create back pressure. See Appendix A for flowmeter accuracy specifications when operating at various pressures. In general, minimize back pressure on the flowmeter to maintain higher accuracy.

Configuring Flowmeter Through Serial Port

The following flowmeter operating parameters can be configured through the serial interface using the serial interface cable and a simple terminal program. Refer to the Model 3063 RS-232 Serial Command Set Manual for detailed description on the command syntax.

Table 3. List of Operating Parameters

Function	Command
Select Standard or Volumetric Flow Measurement	SU
LCD Display Update Rate	SUR
Select Data Update Rate for Analog Output	SSR

Use a terminal program (supplied with most computers) to write and read data from the Model 3063 flowmeter. The serial interface protocol is as follows.

Type..... RS-232 Serial
Baud Rate 38,400
Data Bits..... 8
Parity ..... None
Stop Bits 1
Flow Control ..... None

Chapter 3

Operation

Overview
The Model 3063 Mass Flowmeter measures mass flowrate, temperature, and absolute pressure of the gas inside the flow tube. All measurements made by the Model 3063 are traceable to NIST.

ON/OFF Switch
Slide the switch to the ON position. The power switch is marked in the international symbols '|' for *on* and 'O' for *off*. The flowmeter will begin to simultaneously display flowrate, temperature and pressure.

Flowrate Measurement
Flowrate data can be obtained, from the Model 3063, through the LCD display, RS-232 serial port, or the linearized analog output. The analog output is a 0 to 10 volt DC linear signal representing 0 to 200 Std L/min. Refer to the RS-232 Serial Command Set Manual for instructions on how to obtain flow data through the serial port.

Flow can be displayed in units of standard liters per minute (Std L/min[*]) or in volumetric units of liters per minute (L/min). Refer to Appendix B for a description between the two measurements. Selecting between the two measurements is accomplished through the serial port. Refer to the RS-232 Serial Command Set Manual for instructions on how to select between flow units.

Temperature Measurement
The Model 3063 has an independent temperature transducer in the flow tube to measure the gas temperature. The temperature sensor is used for temperature compensation of flowrate and for converting flow from standard to volumetric units. Temperature is displayed on the LCD and is available through the RS-232 serial port, in the units of degrees Celsius (°C).

***Note**: At low flowrates, the temperature inside of the flow tube will increase because of the heat generated by the thermal flow sensor. This effect is normal and the temperature of the incoming gas will be measured once flow resumes.*

[*]TSI defines standard conditions as 21.1°C (70° F) and 101.4 kPa (14.7 psia, 1 bar).

Pressure Measurement

The Model 3063 measures absolute pressure near the outlet of the flowmeter, in the SI units of kilo-Pascals (kPa). Pressure measurements are required when converting from standard to volumetric flow. Absolute pressure measurements are displayed, on the LCD display, and are available through the RS-232 serial port.

Volume Measurement

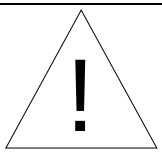
The Model 3063 measures total volume by integrating flow over time. This is a calculated measurement performed by the flowmeter and is only available using the RS-232 serial port. Volume is not displayed on the LCD display. Refer to the Model 3063 RS-232 Serial Command Set Manual for instructions on using the volume function.

Chapter 4

Maintenance

Flow Sensor

Periodically inspect the flow sensor by looking into the outlet of the flowmeter. Remove dust, particles, and fibers from the sensor with clean, dry compressed air. The flow sensor will break if touched. Never run liquids through the flowmeter and never touch the sensor with a brush. Dust or other deposits on the flow sensor will degrade the 3063's flow accuracy.



CAUTION

The flowmeter must be switched off for cleaning. Only use clean, dry, compressed air when attempting to remove contamination from the sensor.

Re-certification

To maintain a high degree of confidence in the measurements made by the Model 3063, TSI recommends that you return the instrument to TSI every 12 months for re-certification. For a nominal fee, we will recalibrate the unit and return it to you with a certificate of calibration and US National Institute of Standards Technology (NIST) traceability. This 'annual checkup' assures you of consistently accurate readings; it is especially important in applications where strict calibration records must be maintained.

Cases

If the instrument case or storage case needs cleaning, wipe it off with a soft cloth dipped in isopropyl alcohol or mild detergent. Never submerge the flowmeter.

Storage

When storing the flowmeter, always cover the ends of flow tubes with the provided caps to prevent dust or other foreign matter from entering the tube.

(This page intentionally left blank)

Chapter 5

Troubleshooting

Table 4 lists the symptoms, possible causes, and recommended solutions for common problems encountered with the flowmeter. If your symptom is not listed, or if none of the solutions solves your problem, please contact TSI.

Table 4. Troubleshooting

Symptom	Possible Causes	Corrective Action
No display	Unit not switched on	Switch on the unit.
	No power to instrument	Plug in AC adapter or check power source on mini-DIN connector.
Temperature reads high at low or zero flows	Temperature sensor is being heated from the flow sensor	This is normal. Once flow exceeds 1 Std L/min, the temperature will track the flowing gas temperature.
Flow readings fluctuate badly	The flow is fluctuating	Improve inlet conditions or increase display averaging time.
Display shows flows over-range with no flow passing through flow tube	The sensor may be damaged or broken	Return flowmeter to TSI for service.

(This page intentionally left blank)

Appendix A

Specifications

	Model 3063
Flow Measurement	
Measurement Range	0 to 200.0 Std L/min (0 to 7.06 cfm) in air.
Accuracy	2% of reading or 0.05 Std L/min, whichever is greater, at standard conditions (21.1°C and 101.3 kPa) See notes **1** through **5** below.
Resolution (Display)	0.01 Std L/min between 0 and 90 Std L/min 0.1 Std L/min between 90 and 200 Std L/min
Response	Less than 4 msec, 63% of final value at full scale flow
Temperature Measurement	
Measurement Range	0 to 50°C (0 to 122°F)
Accuracy	±1°C, at flows greater than 1 L/min. See note **2** below.
Resolution (Display)	0.1°C
Response	Less than 75 msec, 63% of final value for 20°C (68°F) step change in temperature at full scale flow
Static Pressure Measurement	Measured inside flow tube near the exit
Measurement Range	50 to 199 kPa (7.2 to 28.9 psi) absolute
Accuracy	±1 kPa, See note **6** below
Resolution (Display)	0.1 kPa
Response	Less than 4 msec. 63% of final value for 30 kPa step change
Over Pressure	620 kPa (89.9 psi)
Burst Pressure	Tested to 690 kPa without rupture. Do not exceed 690 kPa.
Pressure Drop	See chart labeled “Pressure Drop Across Model 3063 Flowmeter” later in this section.
Volume	
Measurement Range	0.01 to 99.9 L (0.00035 to 3.53 ft^3)
Accuracy	2% of Reading at flows greater than 2.5 Std L/min See notes **1** through **5** below.
Instrument Temp. Range	
Operation, Ambient	0 to 50°C (0 to 122°F)
Storage, Ambient	-20 to 60°C (–4 to 140°F)
Gas Calibration	Air

	Model 3063
Physical Dimensions	
External Dimensions	See diagram on page 13.
Tube Adapters	½" tube, inlet and outlet
Weight	180 grams (0.4 lb)
Flow Body Material	PolyCarbonate
Computer Interface	Connector 8 pin mini-DIN Type RS-232 Serial Baud Rate 38,400 Data Bits 8 Parity None Stop Bits 1 Flow Control None
Analog Output (Flow Only)	
Range	0 to 10 V
Resolution	13 bit
Flow Accuracy	2% of Reading or 0.1 Std L/min, whichever is greater See notes **1** through **5** below.
Maximum Current	10 ma
Power	AC adapter or power supplied through mini-DIN 7.5 VDC ± 1.5 V, 300 mA maximum

Notes:

1 Accuracy stated at standard conditions of 21.1°C and 101.3 kPa.

- Add an additional 0.075% of reading per 1°C away from standard conditions when operating within the range of 0°C to 50°C.
- Add an additional 0.015% of reading per 1 kPa above 101.3 kPa or
- Add an additional 0.022% of reading per 1 kPa below 101.3 kPa when operating within the pressure range of 70 kPa to 170 kPa.

2 Accuracy stated with gas temperature and flow body temperature within ±10°C of one another.

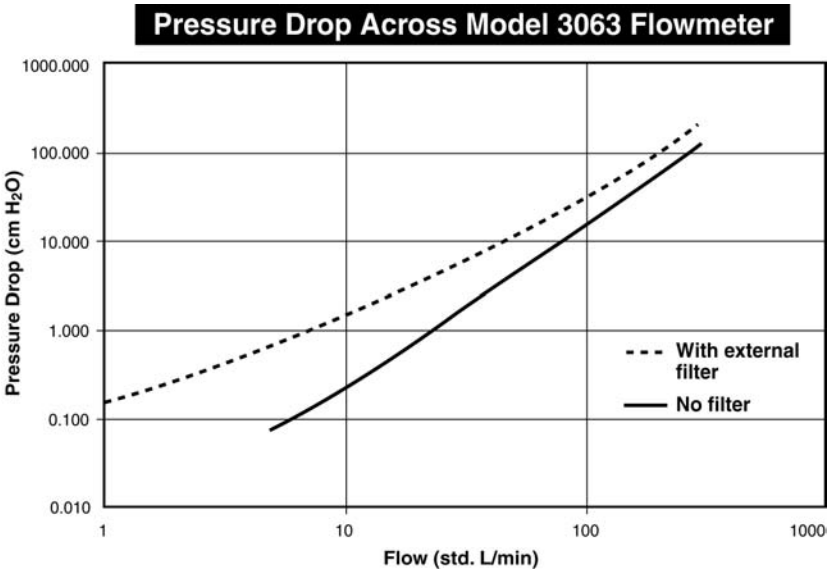
3 Accuracy stated measuring dry gas (less than 10% R.H.).

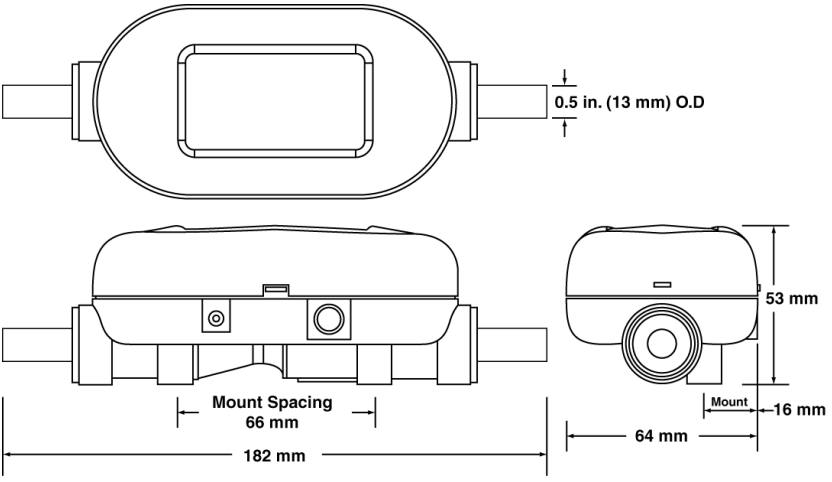
4 Includes ±0.5% of reading repeatability.

5 Volumetric flowrate is calculated from the mass flow measurement. Add an additional 0.25% of reading to the flow accuracy to account for the uncertainty in measuring gas temperature and pressure.

6 Add uncertainty of 0.2 kPa for every 10°C away from 21.1°C.

Specifications subject to change without notice.


Pressure Drop Across Model 3063 Flowmeter
1000.000
100.000
10.000
1.000
0.100
0.010
Pressure Drop (cm H_2O)
1
10
100
1000
Flow (std. L/min)
With external filter
No filter


0.5 in. (13 mm) O.D
53 mm
Mount Spacing
66 mm
182 mm
Mount
16 mm
64 mm

(This page intentionally left blank)

Appendix B

Standard Flowrate vs. Volumetric Flowrate

Because thermal flow sensors are sensitive to changes in air density and air velocity, all thermal flowmeters indicate flowrates with reference to a set of standard conditions. For TSI instruments, standard conditions are defined as 21.1° C (70° F) and 101.4 kPa (14.7 psia). Other manufacturers may use different values.

Standard flowrate is the flowrate the air would be moving if the temperature and pressure were at standard conditions. It is usually the most useful measure of airflow because it defines the heat-carrying capacity of the air.

Volumetric flowrate is the true volume flow of the gas exiting the flowmeter.

In some instances, volumetric flowrate rather than standard flowrate may be of interest. To display volumetric flowrate, the Model 3063 will multiply the standard flow measurement by the following density correction factor:

$$VolumetricFlow = (StdFlow)\left[\frac{273.15 + T_m}{273.15 + 21.11}\right]\frac{101.3}{P_m}$$

Where

T_m = Gas temperature measured in flow tube in units of degrees Celsius

P_m = Absolute pressure measured in flow tube in units of kPa

To demonstrate the difference in output, consider the following.

Measured flow displays 100 Std L/min at 15°C and 117 kPa. The volumetric flow as calculated by the Model 3063 would be as follows.

$$VolumetricFlow = (100)\left[\frac{273.15 + 15}{273.15 + 21.11}\right]\frac{101.3}{117} = 84.78 L/\min$$

(This page intentionally left blank)

TSI Incorporated – 500 Cardigan Road, Shoreview, MN 55126 U.S.A

USA	Tel: +1 800 874 2811	E-mail: particle@tsi.com	Website: www.tsi.com
UK	Tel: +44 149 4 459200	E-mail: tsiuk@tsi.com	Website: www.tsiinc.co.uk
France	Tel: +33 491 11 87 64	E-mail: tsifrance@tsi.com	Website: www.tsiinc.fr
Germany	Tel: +49 241 523030	E-mail: tsigmbh@tsi.com	Website: www.tsiinc.de
India	Tel: +91 80 41132470	E-mail: tsi-india@tsi.com	
China	Tel: +86 10 8251 6588	E-mail: tsibeijing@tsi.com	
Singapore	Tel: +65 6595 6388	E-mail: tsi-singapore@tsi.com	

Contact your local TSI Distributor or visit our website www.tsi.com for more detailed specifications.

P/N 1930101 Rev D Printed in U.S.A.