

Brooks® Model 5850TR

TR series MFC

+/- 15 Vdc



Model 5850 TR

Dear Customer,

The Brooks Instrument mass flow controller you have just received is of the highest quality available, offering superior performance to the user. This controller provides the finest degree of accuracy, repeatability, and widest operating parameters available for extremely reliable gas measurement and control of mass flow rate.

Because of the wide variety of applications for mass flow controllers, we have expressly designed this instrument to provide user selectable functions in a single instrument to meet ever changing process conditions. Additionally, this "state-of-the-art" design has been packaged and materials selected to permit application to a variety of often corrosive and hostile conditions.

To realize the full potential of the inherent design flexibility and ease of maintenance, may we suggest you review this manual in its entirety.

Should you need additional information concerning the 5850 series mass flow controllers, please feel free to contact your local Brooks sales office.

We are pleased to have this opportunity of servicing you for your gas measurement and control needs.

Sincerely,

BROOKS INSTRUMENT B.V.

CAUTION

It is recommended that this publication be read in its entirety before performing any operation. Failure to understand and follow these instructions could result in serious personal injury and/or damage to the equipment.

CAUTION

This instrument contains electronic components that are susceptible to damage by static electricity. Proper handling* procedures must be observed during the removal, installation, or other handling of internal circuit boards or devices.

*** Handling procedure:**

1. Power to unit must be removed.
2. Personnel must be grounded, via a wrist strap or other safe, suitable means before any printed circuit card or other internal device is installed, removed or adjusted.
3. Printed circuit cards must be transported in a conductive bag or other conductive container. Boards must not be removed from protective enclosure until the immediate time of installation. Removed boards must be placed immediately in protective container for transport, storage, or return to factory.

COMMENTS

This instrument is not unique in its content of ESD (electrostatic discharge) sensitive components. Most modern electronic designs contain components that utilize metal oxide technology (NMOS, CMOS, etc.). Experience has proven that even small amounts of static electricity can damage or destroy these devices. Damaged components, even though they appear to function properly, exhibit early failure.

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Section 1 INTRODUCTION

1-1 PURPOSE

The Brooks Model 5850TR mass flowmeter / mass flow controller is a mass flow measuring device, designed for accurately measuring and rapidly controlling flows of gases.

1-2 DESCRIPTION

The Brooks Model 5850TR mass flow controller (M.F.C.) provides "state-of-the-art" mass flow measurement and P.I. control.

The Brooks Model 5850TR M.F.C. is used widely in the semiconductor industry as well as many others, where manual, electronic or computer controlled gas handling occurs.

The Model 5850TR consists of three basic units: a flow sensor, a control valve and an integrated electronic control system.

This combination produces a stable gasflow, selectable overshoot protection and eliminates the need for continuous monitoring and re-adjustment of gas pressures.

1-2-1 Standard user selectable features includes:

- **Soft start** provides a flow ramping function that effectively reduces gas flow over-/undershoot to a neglectable value. Refer to section 2-4-2.
- **Remote programming** permits the user to program the mass flow controller with an external 0-5Vdc, or 0-10Vdc command voltage in lieu of the command potentiometer. Refer to section 2-4-3.
- **Valve override** permits the user to fully open and close the control valve independent of the command setting. Refer to section 2-4-4.
- **External valve control** permits the user flexibility to provide an external valve control source independent of the standard control incorporated within this mass flow controller. Refer to section 2-4-5.

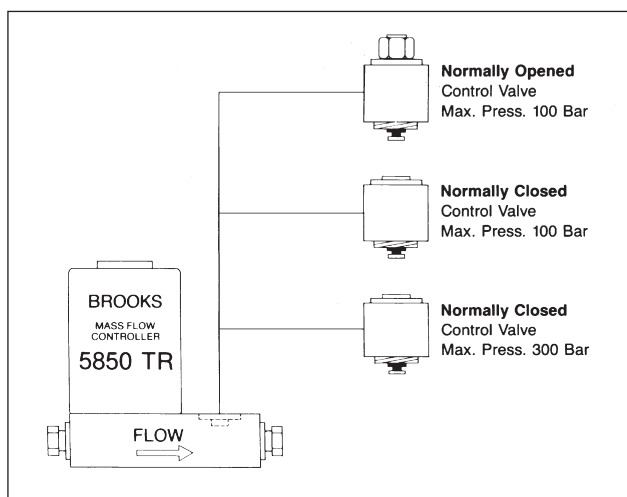


Figure 1-1. Control valve types

The 5850TR M.F.C. can be supplied with three different type control valves:

- Normally opened, max. 100 Bar operating pressure.
- Normally closed, max. 100 Bar operating pressure (std).
- Normally closed, max. 300 Bar operating pressure.

1-3 RECEIPT OF EQUIPMENT

When the equipment is received, the outside packing case should be checked for any damage incurred during shipment.

If the packing case is damaged, the local carrier should be notified at once regarding his liability.

A report should be submitted to the product service department, Brooks Instrument / Rosemount. Refer to the cover for full address.

Remove the envelope containing the shipping list. Carefully remove the equipment from the packing case. Make sure spare parts are not discarded with the packing material.

1-4 RETURN SHIPMENT

Do not return any assembly or part without a return material report. The return material report is available from all district sales offices and the product service department.

Information describing the problem, corrective action, if any, and the work to be accomplished at the factory must be included.

1-5 RECOMMENDED STORAGE PRACTICE

If intermediate or long term storage is required for equipment, as supplied by Brooks Instrument B.V., it is recommended that said equipment be stored in accordance with the following:

1. Within the original shipping container.
2. Stored in a sheltered area, preferably a warm, dry, heated warehouse.
3. Ambient temperature (21°C Nominal, 32°C max. / 7°C min.)
4. Relative humidity 45% Nominal (60% max., 25% min.)

Upon removal from storage, a visual inspection should be conducted to verify the condition of equipment is "as received".

If the equipment has been in storage for an excess of ten (10) months or in conditions in excess of those recommended, all pressure boundary seals should be replaced and the device subjected to a pneumatic pressure in accordance with the applicable vessel codes.

1-6 SPECIFICATIONS

Certification EMC directive (89/336/EEC)
 EN 61326-1:1997+ A1:1998
 Certified for Zone II environment according to:
 KEMA 03ATEX1531 X per EN 60079-15:2003



II 3 G EEx nA II T4

Performance

Accuracy $\pm 1\%$ full scale including linearity measured at calibrated conditions

Repeatability $\pm 0.25\%$ full scale

Rangeability 50 to 1

Temperature coefficient 0.1% full scale/ $^{\circ}\text{C}$

Mounting attitude sensitivity $\pm 0.5\%$ full scale maximum deviation from specified accuracy

Flow ranges Any full scale range from 10 ml_n/min. to 20 l_n/min. Based on Nitrogen equivalent.

Flow output/setpoint input 0-5 Vdc, min. load: 1000 Ohm

Ratings

Max. operating pressure 100/300 bar versions

Temperature Ambient/gas 0-65 $^{\circ}\text{C}$

Leak integrity Outboard: 1×10^{-6} mbar.l/s Helium

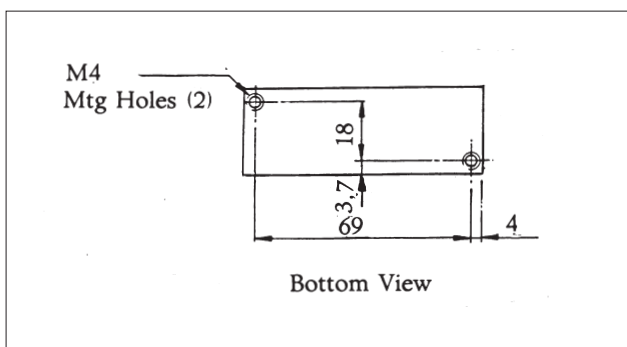
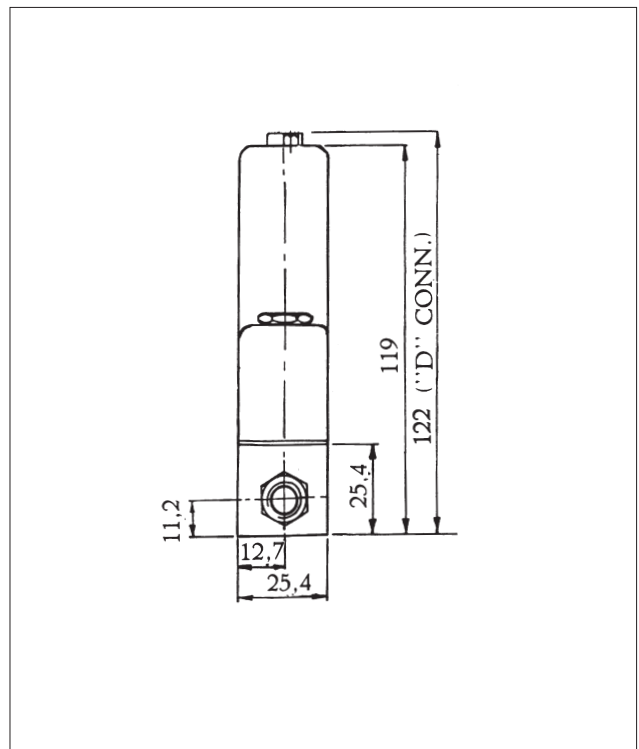
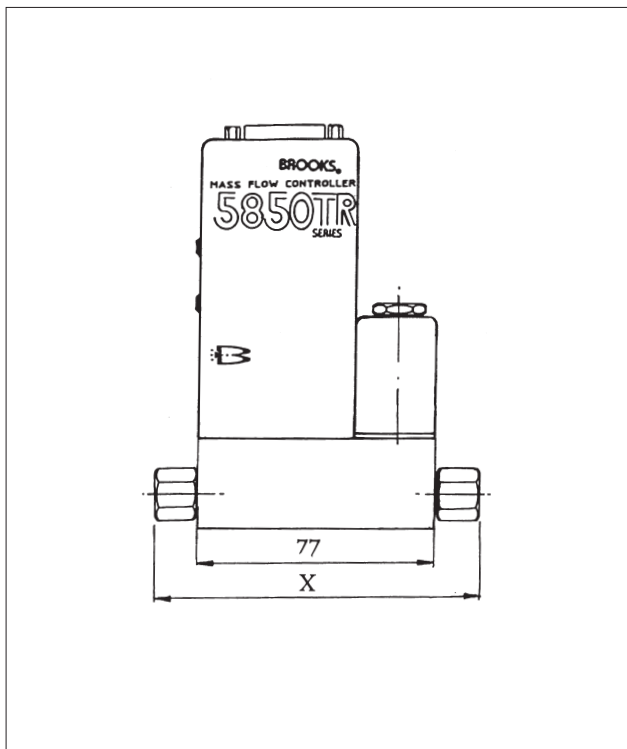
Power requirements + 15 Vdc ($\pm 5\%$) at 25 mA and - 15 Vdc ($\pm 5\%$) at 180 mA

Materials of construction Wetted parts stainless steel with Viton®, PTFE, Buna-N® or Kalrez®

Mechanical connections Standard fittings: 1/4" VCR, 1/4" VCO, 1/4" NPT, 1/8" or 1/4" tube compression

Electrical connection Sub-D-type connector (goldplated contacts) with 3 m or 6 m cable

DIMENSIONS



Connections	Dim.X
9/16" - 18 UNF	77
1/4" TB COMPR.	129
1/8" TB COMPR.	124
1/4" VCR	125
1/4" VCO	117
1/4" NPT	118
6 mm TB COMPR.	129

Figure 1-6.

Note: Dimensions are in mm.

1-7 STANDARD MANUFACTURING PROCEDURES

Brooks Instrument warrants the supply of very high quality flow measurement and control equipment. Upon receipt of incoming materials, till shipment of instruments, fabrication of the BROOKS MASS FLOW CONTROLLERS are monitored at every production stage.

Pressure test, each mass flow controller is pressure tested at 1,5 times the maximum working pressure.

Burn-in test, each instrument undergoes a temperature burn-in test for 16 hours. In this time the instruments are continuously tested under severe conditions.

Calibration, in our calibration department the instruments are calibrated in accordance with the customers requirements.

Brooks Instrument uses their patented VOL-U-METER, and BELL PROVER calibration equipment, which are used as a **primary standard**, certified by the National Bureau of Standards.

Helium leak-test, when the mass flow controllers have been calibrated, the instruments are subject to a leak test, using a Helium leak detector. Sensitivity: 1×10^{-11} ml/sec. He.

For model 5850TR, Brooks warrants an inboard outboard leak integrity: 1×10^{-6} m.bar. l/sec. of Helium.

Final inspection, The instruments are visually inspected, identified for serial control and completed with a calibration certificate.

E.S.D. package, each mass flow controller is carefully packed in a specially designed electro static discharge box, provided with a sticker for serial control.

Section 2 INSTALLATION

2-1 GAS CONNECTIONS

Standard inlet and outlet connections supplied with Model 5850TR are 1/4" tube compression fittings, for flowrates up to 10 l/min. and 3/8" tube compression fittings for higher flowrates, 6 mm tube compression fittings, 1/4"-VCO, 1/4"-VCR, 1/4"-NPT, or 1/8" tube compression fittings are available upon request.

Prior to installation, make certain all piping is clean and free of obstruction. Install the piping in such a manner that permits easy removal if the instrument has to be removed for cleaning, or bench troubleshooting.

2-2 IN-LINE FILTER

It is recommended an in-line filter be installed upstream and sometimes downstream from the flowsensor to prevent the possibility of any foreign material entering the mass flow sensor or controller. The filter element should be periodically replaced or may be ultrasonically cleaned.

Refer to table: 2-2

Maximum Flow Rate	Recommended Filter Size
100 ml _n /min.	1 micron
500 ml _n /min.	2 micron
1 or 5 l _n /min.	7 micron
10 or 20 l _n /min.	15 micron

Table 2-2. Recommended filter size

2-3 INSTALLATION

CAUTION: When installing the controller, care should be taken that no foreign materials enter the inlet or outlet of the instrument. Do not remove the protective end caps until time of installation.

Recommended installation procedures:

- The Model 5850TR should be located in a clean dry atmosphere relatively free from shock and vibration.
- Leave sufficient room for access to the electrical components.
- Install in such a manner that permits easy removal if the instrument requires cleaning.

CAUTION: When used with a reactive (sometimes toxic) gas, contamination or corrosion may occur as a result of plumbing leaks or improper purging. Plumbing should be checked carefully for leaks and the controller purged with dry Nitrogen before use.

- The Model 5850TR mass flow controller can be installed in any position.

However, mounting orientations other than the original factory calibration (see data sheet) will result in a $\pm 0,25\%$ maximum full scale shift.

NOTE: The control valve in the Model 5850TR provides precision control and is not designed for positive shut off. If positive shut off is required, it is recommended that a separate shut-off valve be installed in-line.

CAUTION: Since the Model 5850TR control valve is not a positive shut-off, a separate solenoid valve may have been installed for that purpose. It should be noted that a small amount of gas may be trapped between the downstream side of the mass flow controller and the solenoid resulting in a surge upon actuation of the controller. This surge can be reduced in magnitude by locating the controller and solenoid valve close to gether or by moving the solenoid valve upstream of the controller.

2-4 ELECTRICAL CONNECTION

(Refer to figures 2-4 and 2-5)

The 5850TR can be supplied with a 15-pins "D"-connector suitable for round cable connections.

The Brooks (electrical/electronic) equipment bearing the CE mark has been successfully tested to the regulations of the Electro Magnetic Compatibility (EMC directive 89/336/EEC).

Special attention however is required when selecting the signal cable to be used with CE marked equipment.

Quality of the signal cable and cable connectors:

- Brooks standard supplies high quality cable(s) which meets the specifications for CE certification.
- If you provide your own signal cable you should use a cable which is overall completely screened with at least an 100% shield.

Cable connectors used should be made from metal and cable glands should either be metal or metal shielded.

The cable screen should be connected to the metal connector or gland and shielded at both ends over 360 degrees.

For pin configuration; please refer to figure 2-5.

2-4-1 Setpoint

The command potentiometer (if used) may be furnished with the instrument or may be supplied by the user. The potentiometer should be a 1 K-ohm or 5 K-ohm 10-turn precision potentiometer with 0,25% linearity. (Beckman 7240 Series or equivalent.)

"D" connections : refer to figures 2-4 and 2-5.

2-4-2 Soft Start (standard option, for controller only)

To enable Soft-Start: connect pin 15 to pin 3 or 9.

To disable Soft-Start: disconnect pin 15 from pin 3 or 9.

2-4-3 Remote Programming

If the controller is to be programmed for an external 0-5 Vdc command voltage, the command potentiometer is not used.

The external command voltage (+) is applied to the command signal and (-) to the command signal return.

refer to figure 2-5: command signal to pin 8

command signal return to pin 1.

2-4-4 Valve Override

It is possible to drive the control valve fully open or close, independent of the controller position.

Control valve normally closed	Opened	Closed
Sub "D" p.v.v., pin 12	+15 Vdc	-15 Vdc
Sub "D" n.v.v., pin 12	-15 Vdc	+15 Vdc

Control valve normally opened	Opened	Closed
Sub "D" p.v.v., pin 12	-15 Vdc	+15 Vdc
Sub "D" n.v.v., pin 12	+15 Vdc	-15 Vdc

2-4-5 External valve control

It is possible to drive the valve with an external P.I. controller. This can be enabled by removing Jumper J2 a-b and inserting Jumper J2 a-c.

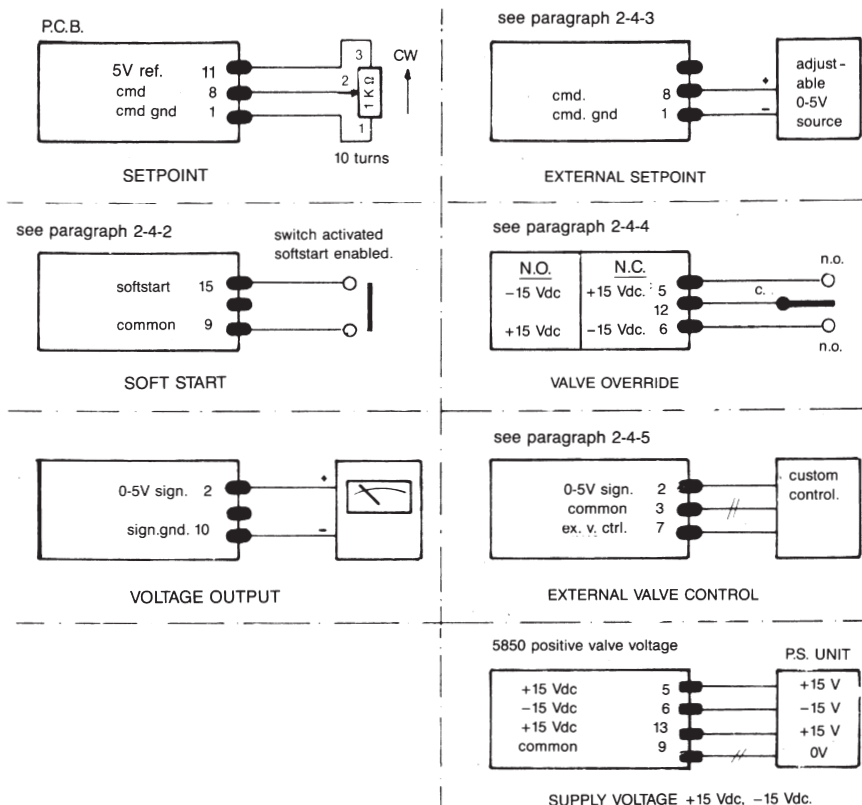
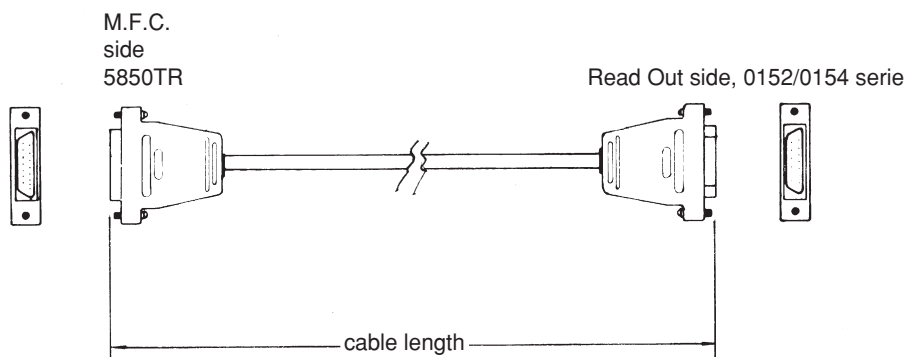


Figure 2-4. 5850TR Hook-up diagrams 15 pins sub "D"-connector



"D"-CONNECTOR 15-pins		COLOR	FUNCTION
M.F.C. pin. no	readout side pin. no		
female	male		
1	6	BROWN	Command return
2	10	WHITE	0-5V out
3	9	GREY/PINK	Common valve
4	2	RED/BLUE	Not used
5	13	RED	+ 15 Vdc
6	14	YEL/WHITE	- 15 Vdc
7	3	VIOLET	Ext. valve control
8	5	GREY	Command
9	12	BLACK	Common supply
10	8	PINK	Signal return
11	4	YELLOW	5V reference
12	7	GREEN	Valve override
13	1	WHITE/GRN	+ 15Vdc valve
NC	11	SHIELD	No function
15	15	BWN/GRN	Soft start
Housing	Housing	Shield	Shielding

Figure 2-5. 5850TR connections diagram "D"-connector

Section 3 OPERATION

3-1 THEORY OF OPERATION

The thermal mass flow sensing technique used in the 5850TR works as follows:

A precision power supply provides a constant power heat input (P) at the heater, which is located at the midpoint of the sensor tube. Refer to figure 3-1. At zero, or no flow conditions the heat reaching each temperature sensor is equal. Therefore the temperatures T1 and T2 are equal. When gas flows through the tube the upstream sensor is cooled and the downstream sensor is heated, producing a temperature difference. The temperature difference T2-T1, is directly proportional to the gas mass flow. The equation is: $\Delta T = A * P * C_p * m$

Where:

ΔT = Temperature difference T2-T1 (K)

C_p = Specific heat of the gas at constant pressure (kJ .kg⁻¹ . K⁻¹)

P = Heater power (kJ/s)

m = Mass Flow (kg/s)

A = Constant of proportionality (S²-K²/kJ²)

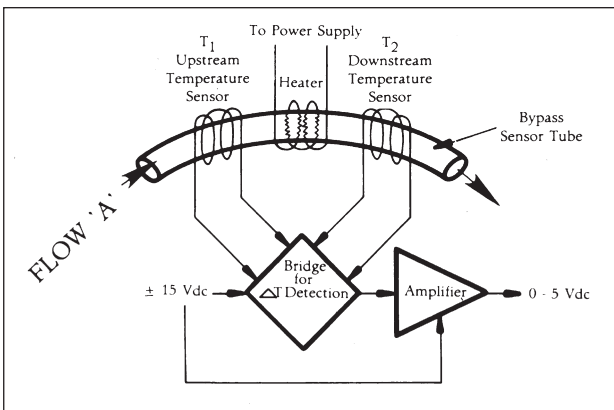


Figure 3-1. Flow sensor operational diagram

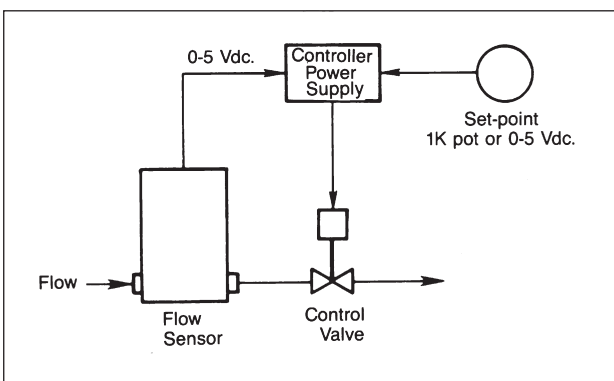


Figure 3-2. Control system block diagram

A bridge circuit interprets the temperature difference and a differential amplifier generates a linear 0-5 Vdc signal directly proportional to the gas **mass flow rate**. A flow restrictor performs a ranging function similar to a shunt resistor. This restrictor provides a pressure drop that is linear with flow rate. The sensor tube has

the same linear pressure drop/flow relationship. The ratio of the restrictor flow to the sensor tube flow remains constant over the range of the meter. Different restrictors have different pressure drops and produce meters with different full scale flow rates. The span adjustment in the electronics affects the fine adjustment of the meters full scale flow.

The printed control board offers you the following features:

- soft start
- valve override and a setpoint input for 0-5Vdc or 0-10 Vdc signal, or a command potentiometer.
- precision reference voltage is provided to drive the command potentiometer.

The voltage is presented to the wiper by the voltage divider action and is applied to the command input of the controller.

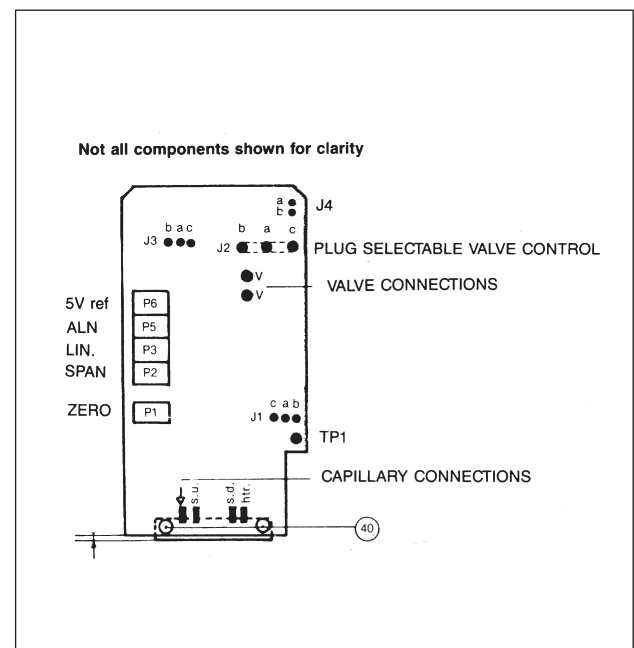
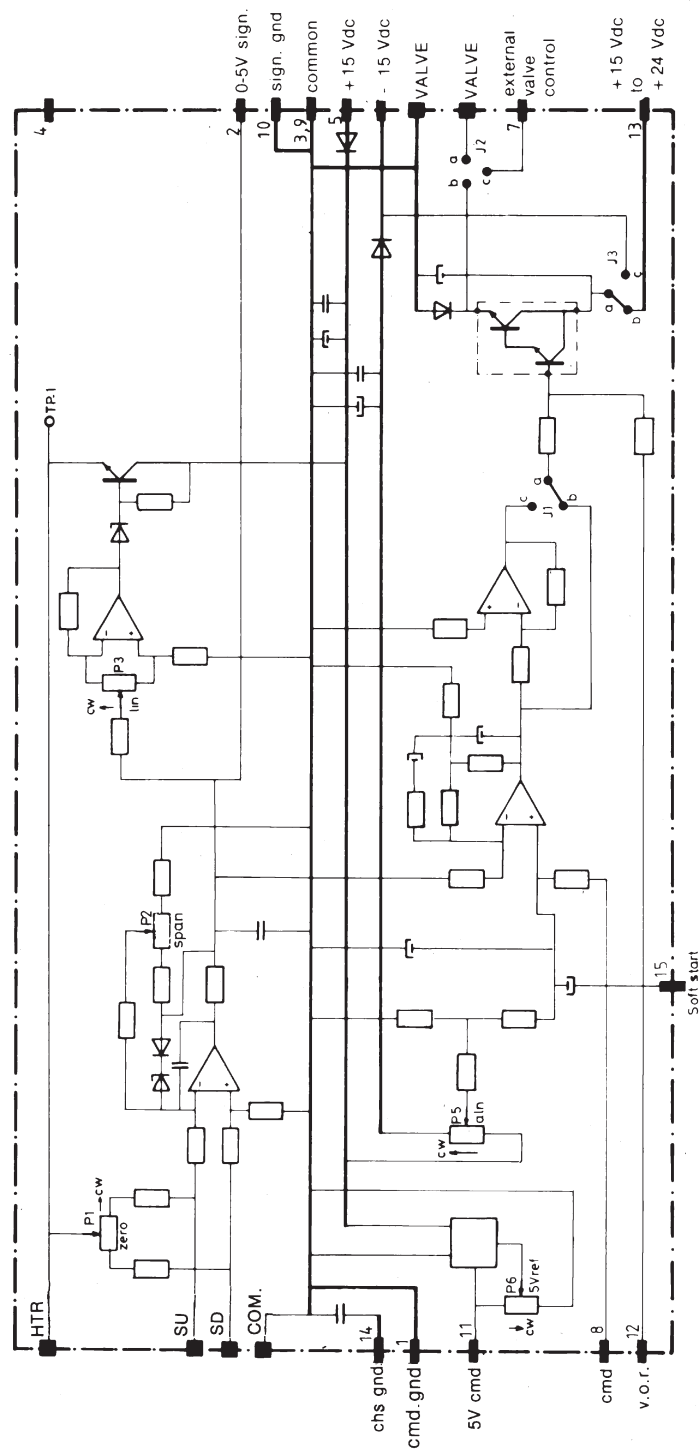


Figure 3-3. Printed circuit board assembly "D"-connector



- The soft start may be used by connecting pin 15 to pin 3.9.
- For internal valve control insert jumper J2a-b.
- For external valve control insert jumper J2a-c.
- Represents D-connector terminals.

Figure 3-4. Schematic diagram 5850TR electronics with "D"-connector

3-2 OPERATING PROCEDURE (refer to figures 2-2 to 2-5 customer hook-up diagram).

- A. Apply power to the M.F.C. and allow approximately 45 minutes for the instrument to warm up and stabilize.
- B. Turn on gas supply.
- C. Command 0% flow and observe the controllers output signal.
The output should be slightly positive: + 15 mVdc for the N.C. Valve and + 100 mVdc for the N.O. Valve.
- D. Set command for desired flowrate to assume normal operation.

3-3 ZERO ADJUSTMENT

Each 5850TR is factory adjusted to provide a + 15 mVdc signal at zero flow. The adjustment is made in our calibration laboratory which is temperature controlled. After initial installation and warm-up in the gas system the zero flow indication may be other than the factory setting. This is primarily caused by changes in temperature between our calibration laboratory and the final installation. The zero flow reading can also be affected to a small degree by changes in line pressure and mounting attitude. To check zero always mount the controller in its final configuration and allow a minimum of 20 minutes for the temperature of the controller and its environment to stabilize. Use a suitable voltmeter check the controller output signal. If it differs from the factory setting adjust it by removing the lower pot hold plug, which is located closest to the controller body. Adjust the zero potentiometer (refer to figure 3-3) until the desired output signal is obtained.

3-4 CALIBRATION PROCEDURE (refer to figures 3-3 to 3-6).

NOTE:

Calibration of the 5850TR mass flow controller requires the use of a digital voltmeter (DVM) and a primary flow standard calibrator such as the Brooks Vol-U-meter®.

It is recommended that the calibration should be performed only by trained and qualified service personnel.

If the mass flow controller is to be used on a gas other than the calibration gas, apply the appropriate sensor conversion factor. Size the orifice for actual operating conditions.

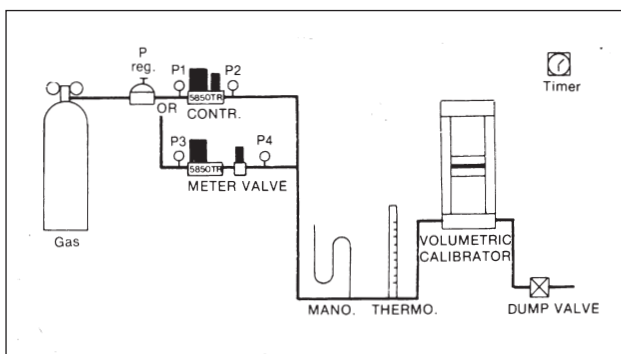


Figure 3-5. Typical calibration installation

The calibration procedure is written for all M.F.C. models, please refer only to those chapters which are applicable.

With the meter installed in an unpressurized gas line, apply power and allow approximately 45 minutes for warming up. Adjustment and calibration check procedures do not allow the control valve to open when gas flow is not present. This situation is not a normal operation mode, it will cause the control valve to heat up abnormally. A meter with an abnormally warm valve will be difficult to calibrate. This situation can be prevented by switching the valve override "closed" when there is no gas flow. Also avoid unnecessary periods with the valve override "open".

1-Reference, P6

Ref. adjustment. -Connect D.V.M. positive lead to the command potentiometer terminal CW.

- Pin 11 and negative to command pin 1.
Adjust Ref P6 for 5.000 V.

2-Zero, P1

ZERO adjustment - Connect DVM positive to the output and DVM negative to the signal common.
Adjust Zero, P1 for + 15 mV \pm 2 mV.

3-Alignment, P5

ALN. adjustment- Set command potentiometer to 100%. Adjust ALN P5 for 5.000V flow output.

- Connect positive lead to the output pin 2 and negative to pin 10.

4-Total Error

Set the command potentiometer to 10% of ref. voltage (0,500V)

Check and record output reading. The difference (in millivolts) between the command and output is "total error".

5-Alignment, P5

ALN adjustment, P5 to minus one-half of error.

6-Linear, P3

LIN adjustment. -Set command potentiometer to 100%, with DVM connected to TP1, adjust LIN (P3) for 11,0V.

7-Span, P2

SPAN adjustment -With command potentiometer at 100%, using suitable volumetric calibration equipment, adjust SPAN P2 for proper full scale flow.

8-Zero, P1

Set command potentiometer to 0% of flow. Connect DVM positive to output and readjust zero (P1) for 15mV \pm 2 mV.

9-LIN adjustment

Set command potentiometer to 50% of flow and measure the flow rate using suitable volumetric calibration equipment.
Calculate the error as a percentage of full scale.

$$\text{Full scale error} = \frac{100\% (\text{measured flow rate} - \text{desired flow rate})}{\text{F.s. flow rate}}$$

Example:

What is the percent of full scale error when
F.s. = 100 ml_n/min.

Measured flow rate = 51,5 ml_n/min.

Desired flow rate = 50,0 ml_n/min.

$$\text{Full scale error} = \frac{100 (51,5 - 50)}{100} = 1,5\%$$

Note:

If the result of the percentage of error calculation is negative, be sure the "negative" percentage of error is used when calculating the TP1 voltage.

10-

Set command potentiometer to 100% of flow.
Note the voltage at TP1.
Calculate the new TP1 voltage: (the error from step 9) times (-0,178 V/%).

Example:

If step 9 error = 1,5%

and TP1 voltage = 11,000V

$$\begin{aligned}\text{Then the new TP1} &= 1,5\% \times (-0,178 \text{ V}/\%) + 11\text{V} \\ &= -0,267 \text{ V} + 11\text{V} \\ &= 10,733 \text{ V}\end{aligned}$$

*A linearity adjustment factor units = volts/percent.

11-

Adjust LIN (P3) for new TP1 voltage.

12-

Repeat steps 7, 8 and 9. If the error from step 9 is less than 0,5% then calibration is complete.
If not, then repeat steps 10, 11 and 12.

3-5 SIZING OF CONTROL VALVE

When a change of the flow conditions is required; it may be necessary to change the flow restrictor (refer to par. 4-4) and orifice size.

When calculating the Kv-value following information is required.

For proper sizing following information is required:

Upstream pressure P1 (Abs) Bar

Downstream pressure P2 (Abs) Bar

Gas temperature T (Kelvin)

Maximum flow Q (m3n/h)

Gas density φ (kg/m3n)

Depending on the ratio between P1 and P2, we have to make different calculations:

- Over critical, when $\frac{P_2}{P_1} > 0,5$

$$K_v = \frac{Q \text{ max.}}{514} \times \sqrt{\frac{\varphi \times T}{(P_1 - P_2) \times P_2}}$$

- Under critical, when $\frac{P_2}{P_1} \leq 0,5$

$$K_v = \frac{Q \text{ max.}}{257 \times P_1} \times \sqrt{\varphi \times T}$$

The table 3-5-1 refers to the Kv-values and appropriate orifice sizes.

The next largest orifice size should be selected in case of interpolation.

3-5-1- Kv-Values and max. Acceptable Pressure Drop over the Valve

Kv value (m3n/h)	Orifice diameter (inch)	Max. ΔP (Bar)	Partnumber
5×10^{-6}	0,0013"	500	577-Z-363-BMT
2×10^{-5}	0,002"	500	577-Z-364-BMT
5×10^{-5}	0,003"	350	577-Z-365-BMT
11×10^{-5}	0,004"	230	577-Z-366-BMT
18×10^{-5}	0,005"	160	577-Z-367-BMT
4×10^{-4}	0,007"	100	577-Z-368-BMT
9×10^{-4}	0,0010"	60	577-Z-369-BMT
2×10^{-3}	0,0014"	36	577-Z-401-BMT
$4,7 \times 10^{-3}$	0,0020"	22	577-Z-370-BMT
$1,05 \times 10^{-2}$	0,0028"	13	577-Z-371-BMT
$1,4 \times 10^{-2}$	0,0032"	11	577-Z-372-BMT
$3,3 \times 10^{-2}$	0,0048"	6	577-Z-137-BMT

Section 4 MAINTENANCE

4-1 GENERAL

No routine maintenance is required on the model 5850 TR other than an occasional cleaning. If an in-line filter is used, the filtering element should periodically be replaced or ultrasonically cleaned.

4-2 CONTROL VALVE (refer to figure 5-1)

The control valve may be disassembled in the field by the user for cleaning or servicing. Disassemble the valve as follows:

1. remove the jam nut (14) on top of the valve assembly.
2. remove the screw (5) and cover (3) of the controller.

3. remove the coil housing (13), (including item 12 and 11).
4. carefully remove the stem assembly (1) as not to bend the lower guide spring (9).
5. remove plunger assembly (16).
6. remove orifice (19).

Clean the parts and carefully assemble in reverse of the above procedure.

O-ring seals should be inspected and may need to be replaced during the maintenance procedure.

O-ring seals must be lubricated with HALO-CARBON 25-10M grease prior to installation.

NO LUBRICATION SUBSTITUTE IS RECOMMENDED.

Trouble	Possible cause	Check corrective action
NO OUTPUT	No power in	1. Check for + 15 Vdc power supply
	Obstruction in sensor	1. Flush sensor in both directions with non-residuous solvent. Air dry thoroughly. Do not attempt to service or disassemble sensor. 2. Return to factory
	P.C. Board failure	1. Return to factory.
	Gas leak	1. Check downstream gas connection 2. Return to factory
	P.C. Board failure	1. Return to factory.
	Gas leak	1. Check all gas connections
	Dirty sensor	1. Flush with non-siduous solvent Air dry thoroughly. Do not attempt to service or disassemble sensor 2. Return to factory.
	Change in composition of metered gas	1. Refer to table 4-4-1 for conversion factor 2. Return to factory.
	P.C. Board failure	1. Return to factory.
	Clogged restrictor	1. Ultrasonically clean. 2. Replace restrictor.

If any of the above services are performed, it is recommended calibration of the unit be verified using suitable volumetric calibration equipment.

4-3 TROUBLE SHOOTING

CAUTION: *It is important that this instrument be serviced only by properly trained and qualified personnel.*

System Checks

The 5850TR is generally used as a component in gas handling systems which can be quite complex. This can make the task of isolating a malfunction in the system a difficult one. An incorrectly diagnosed malfunction can cause many hours of unnecessary downtime. If possible, make the following system checks before removing a suspected defective mass flow controller for bench troubleshooting or return, especially if the system is new:

1. Verify that the process gas fittings have been correctly connected and leak checked.
2. If the mass flow controller appears to be functioning but cannot achieve set-point, verify that sufficient inlet pressure and pressure drop are available at the controller to provide the required flow.

WARNING:

If it becomes necessary to remove the controller from the system after exposure to toxic, pyrophoric, flammable, or corrosive gas, purge the controller thoroughly with dry inert gas such as Nitrogen, before disconnecting the gas connections. Failure to correctly purge the controller could result in fire, explosion, or death. Corrosion or contamination of the mass flow controller upon exposure to air may also occur.

4-4 USE OF THE CONVERSION TABLES

If a Mass Flow Meter or Controller is operated on a gas other than the gas it was calibrated with, a scale shift will occur in the relationship between the output signal and the mass flow rate as a result of the difference in heat capacities between the two gases.

This scale shift can be calculated by using the ratio of the molar specific heat of the two gases, or the sensor conversion factor.

The gasconversion table is available at Brooks Instrument under document no.: J-836-D-508.

USE OF A MFC/M FOR A DIFFERENT GAS THAN IT IS CALIBRATED FOR:

For use with a different gas type, multiply the output reading by the ratio of the gas factor of the desired gas and the gas factor of the calibrated gas.

$$\text{Actual gas Flow rate} = \frac{\text{Output Reading} \times \text{factor of the new gas}}{\text{factor of the calibrated gas}}$$

Example:

The controller is calibrated for nitrogen:

1000ml_n/min full scale.

The desired gas is carbon dioxide.

Multiply the output reading by 0.773 to calculate the flow of carbon dioxide.

When the output reading is 750 ml_n/min, the flow rate for carbon dioxide

is $750 \times 0.773 = 579.75 \text{ ml}_n/\text{min}$.

CALCULATE GAS FACTOR FOR MIX GASSES:

In order to calculate the conversion factor for a gas mixture the following formula should be used:

$$\text{Sensor conversion factor for Mixture} = \frac{100}{\frac{P1}{\text{sensor conversion factor 1}} + \frac{P2}{\text{sensor conversion factor 2}} + \frac{Pn}{\text{sensor conversion factor n}}}$$

Where P1 = percentage (%) of gas 1 (by volume)
P2 = percentage (%) of gas 2 (by volume)
Pn = percentage (%) of gas n (by volume)

Example:

The desired gas is 20% Helium (He) and 80% Chlorine (Cl₂) by volume. The desired full-scale flow rate of the mixture is 20 l_n/min.

Sensor conversion factor for the mixture is:

$$\text{Mixture Factor} = \frac{100}{\frac{20}{1.386} + \frac{80}{0.876}} = 0.946$$

N₂ equivalent flow = $20/0.946 = 21.14 \text{ l}_n/\text{min}$.

NOTE:

It is generally accepted that the mass flow rate derived from this equation is only accurate to $\pm 5\%$. The table below lists the conversion factors for various gases with respect to nitrogen. The conversion table is used to determine the flow rate for gases other than the pre-selected gas. The flow meter is factory set to a pre-selected gas, pressure and flow range.

	Formula	Gasfactor	Orifice factor	Density (kg/m3)
Acetylene (Ethyne)	C2H2	0,615	0,970	1,173
Air	Mixture	0,998	1,018	1,293
Allene	C3H4	0,478	1,199	1,787
Ammonia	NH3	0,786	0,781	0,771
Argon	Ar	1,395	1,195	1,784
Arsine	AsH3	0,754	1,661	3,478
Boron Trichloride	BCL3	0,443	2,044	5,227
Boron Trifluoride	BF3	0,579	1,569	3,025
Bromine Pentafluoride	BrF5	0,287	2,502	7,806
Bromine Trifluoride	BrF3	0,439	2,214	6,108
Bromotrifluoroethylene	C2BrF3	0,326	2,397	7,165
Bromotrifluoromethane (f-13B1)	CBrF3	0,412	2,303	6,615
1,3-Butadiene	C4H6	0,354	1,413	2,491
Butane	C4H10	0,257	1,467	2,593
1-Butene	C4H8	0,294	1,435	2,503
CIS-2-Butene	C4H8	0,320	1,435	2,503
Trans-2-Butene	C4H8	0,291	1,435	2,503
Carbon Dioxide	CO2	0,773	1,255	1,977
Carbon Disulfide	CS2	0,638	1,650	3,393
Carbon Monoxide	CO	0,995	1,000	1,250
Carbon Tetrachloride	CCL4	0,344	2,345	6,860
Carbon Tetrafluoride (f-14)	CF4	0,440	1,770	3,926
Carbonyl Fluoride	COF2	0,567	1,555	2,045
Carbonyl Sulfide	COS	0,680	1,463	2,680
Chlorine	CL2	0,876	1,598	3,214
Chlorine Dioxide	CLO2	0,693	1,554	3,011
Chlorine Trifluoride	CLF3	0,433	1,812	4,125
Chlorodifluoromethane (f-22)	CHCLF2	0,505	1,770	3,906
Chloroform (Trichloromethane)	CHCL3	0,442	2,066	5,340
Chloropentafluoroethane (f-115)	C2CLF5	0,243	2,397	7,165
Chlorotrifluoroethylene	C2CLF3	0,337	2,044	5,208
Chlorotrifluoromethane (f-13)	CCLF3	0,430	1,985	4,912
2-Chlorobutane	C4H9CL	0,234	1,818	4,134
Cyanogen	(CN)2	0,498	1,366	2,322
Cyanogen Chloride	CLCN	0,618	1,480	2,730
Cyclobutane	C4H8	0,387	1,413	2,491
Cyclopropane	C3H6	0,505	1,224	1,877
Deuterium	D20,995	0,379	0,177	
Diborane	B2H6	0,448	1,000	1,235
Dibromodifluoromethane (f-12B2)	CBr2F2	0,363	2,652	8,768
1,2-Dibromotetrafluoroethane (f-114B2)	C2Br2F4	0,215	2,905	10,530
Dichlorodifluoromethane (f-12)	CCL2F2	0,390	2,099	5,492
Dichlorofluoromethane (f-21)	CHCL2F	0,456	1,985	4,912
Dichlorosilane	SiH2CL2	0,442	1,897	4,506
Diedthylsilane	C4H12Si	0,183	1,775	3,940
2,2 Dichloro- 1,1,1- Trifluoroethane	C2HCL2F3	0,259	2,336	6,829
1,2-Dichloroethane (Ethylene dichloride)	C2H4CL2	0,382	1,879	4,419
1,2-Dichlorotetrafluoroethane (f-114)	C2CL2F4	0,231	2,449	7,479
1,1-Difluoro-1-Chloroethane	C2H3CLF2	0,341	1,957	4,776
1,1-Difluoroethane	CH3CHF2	0,415	1,536	2,940
1,1-Difluoroethylene	CH2:CF2	0,458	1,512	2,860
Difluoromethane (f-32)	CF2H2	0,627	1,360	2,411
Dimethylamine	(CH3)2NH	0,370	1,269	2,013
Dimethylether	(CH3)2O	0,392	1,281	2,055
2,2-Dimethylpropane	C(CH3)4	0,247	1,613	3,244
Disilane	Si2H6	0,332	1,493	2,779
Ethane	C2H6	0,490	1,038	1,357
Ethanol	C2H6O	0,394	1,282	2,057
Ethylacetylene	C4H6	0,365	1,384	2,388
Ethyl Chloride	C2H5CL	0,408	1,516	2,879
Ethylene	C2H4	0,619	1,000	1,261
Ethylene Oxide	C2H4O	0,589	1,254	1,965
Fluorine	F20,924	1,163	1,695	
Fluoroform (f-23)	CHF3	0,529	1,584	3,127
Germane	GeH4	0,649	1,653	3,418
Germanium Tetrachloride	GeCL4	0,268	2,766	9,574
Halothane	C2HBrCLF3	0,257	2,654	8,814
Helium	He1,386	0,378	0,178	
Hexafluoroacetone	C3F6O	0,219	2,434	7,414
Hexafluorobenzene	C6F6	0,632	2,577	8,309
Hexafluoroethane (f-116)	C2F6	0,255	2,219	6,139
Hexafluoropropylene (HFP)	C3F6	0,249	2,312	6,663
Hexamethyldisilane (HMDS)	(CH2)6Si2	0,139	2,404	7,208
Hexane	C6H14	0,204	1,757	3,847

Hydrogen	H2	1,008	0,269	0,090
Hydrogen Bromide	HBr	0,987	1,695	3,645
Hydrogen Chloride	HCL	0,983	1,141	1,639
Hydrogen Cyanide	HCN	0,744	0,973	1,179
Hydrogen Fluoride	HF	0,998	0,845	0,893
Hydrogen Iodide	HI	0,953	2,144	5,789
Hydrogen Selenide	H2Se	0,837	1,695	3,613
Hydrogen Sulfide	H2S	0,850	1,108	1,539
Iodine Pentafluoride	IF 5	0,283	2,819	9,907
Isobutane	C4H10	0,260	1,440	2,596
Isobutene	C4H8	0,289	1,435	2,503
Isopentane	C5H12	0,211	1,605	3,222
Krypton	Kr	1,382	1,729	3,708
Methane	CH4	0,763	0,763	0,717
Methylacetylene	C3H4	0,473	1,196	1,782
Methyl Bromide	CH3Br	0,646	1,834	4,236
3-Methyl-1-butene	C5H10	0,252	1,584	3,127
Methyl Chloride	CH3CL	0,687	1,347	2,308
Methyl Fluoride	CH3F	0,761	1,102	1,518
Methyl Mercaptan	CH4S	0,588	1,313	2,146
Methyl Silane	CH6Si	0,393	1,283	2,061
Methyl Trichlorosilane	CH3CL3Si	0,267	2,310	6,675
Methyl Vinyl Ether	C3H6O	0,377	1,435	2,567
Monoethanolamine	C2H7NO	0,305	1,477	2,728
Monoethylamine (CH3CH2NH2)	C2H7	0,359	1,269	2,013
Monomethylamine	CH3NH2	0,565	1,067	1,420
Neon	Ne	1,398	0,847	0,902
Nickel Carbonyl	Ni(CO)4	0,212	2,371	7,008
Nitric Oxide	NO	0,995	1,030	1,339
Nitrogen	N2	1,000	1,000	1,251
Nitrogen Dioxide	NO2	0,758	1,713	2,052
Nitrogen Trifluoride	NF3	0,501	1,598	3,168
Nitrogen Trioxide	N2O3	0,443	1,649	3,389
Nitrosyl Chloride	NOCL	0,644	1,529	2,913
Nitrous Oxide	N2O	0,752	1,259	1,964
Octofluorocyclobutane	C4F8	0,169	2,672	8,933
Oxygen	O2	0,988	1,067	1,429
Oxygen Difluoride	OF2	0,672	1,388	2,402
Ozone	O3	0,738	1,310	2,138
Perchloryl Fluoride	CLO3F	0,448	1,905	4,571
Perfluorobutane	C4F10	0,738	2,918	10,610
Perfluoro-2-Butene	C4F8	0,268	2,672	8,933
Perfluoromethyl-vinylether (PMVE)	PMVE	0,296	2,029	5,131
Perfluoropropane	C3F8	0,179	2,591	8,396
Pentane (n-Pentane)	C5H12	0,212	1,605	3,222
Pentafluoroethane	C2HF5	0,287	2,070	5,360
Phosgene	COCL2	0,504	1,881	4,418
Phosphine	PH3	0,783	1,100	1,517
Phosphorous Pentafluoride	PF5	0,346	2,109	5,620
Phosphorous Trifluoride	PF3	0,495	1,770	3,906
Propane (same as CH3CH2CH3)	C3H8	0,343	1,274	2,008
Propylene (Propene)*	C3H6	0,401	1,234	1,875
Rhenium Hexafluoride	ReF6	0,230	3,279	13,410
Silane	SiH4	0,625	1,070	1,440
Silicon Tetrachloride	SiCL4	0,310	2,462	7,579
Silicon Tetrafluoride	SiF4	0,395	1,931	4,648
Sulfur Dioxide	SO2	0,728	1,529	2,858
Sulfur Hexafluoride	SF6	0,270	2,348	6,516
Sulfur Tetrafluoride	SF4	0,353	1,957	4,776
Sulfur Trioxide	SO3	0,535	1,691	3,575
Sulfuryl Fluoride	SO2F2	0,423	1,931	4,648
Tetrachloromethane	CCL4	0,344	2,345	6,858
Tetrafluoroethylene (TFE)	C2F4	0,361	1,905	4,526
Tetrafluorohydrazine	N2F4	0,367	1,926	4,624
Trichlorofluoromethane (f-11)	CCL3F	0,374	2,244	6,281
Trichlorosilane	SiHCL3	0,329	2,201	6,038
Trimethyloxyborane (TMB)	B(OCH3)3	0,300	1,929	4,638
1,1,2-Trichloro-1,1,2-Trifluoroet (f-113)	C2CL3F3	0,231	2,520	7,920
Trimethylamine	(CH3)3N	0,316	1,467	2,639
Tungsten Hexafluoride	WF6	0,227	3,264	13,280
Uranium Hexafluoride	UF6	0,220	3,548	15,700
Vinyl Bromide	C2H3Br	0,524	1,985	4,772
Vinyl Chloride	C2H3CL	0,542	1,492	2,788
Vinyl Fluoride	C2H3F	0,576	1,281	2,046
Water Vapor	H2O	0,861	0,802	0,804
Xenon	Xe1,383	2,180	5,851	

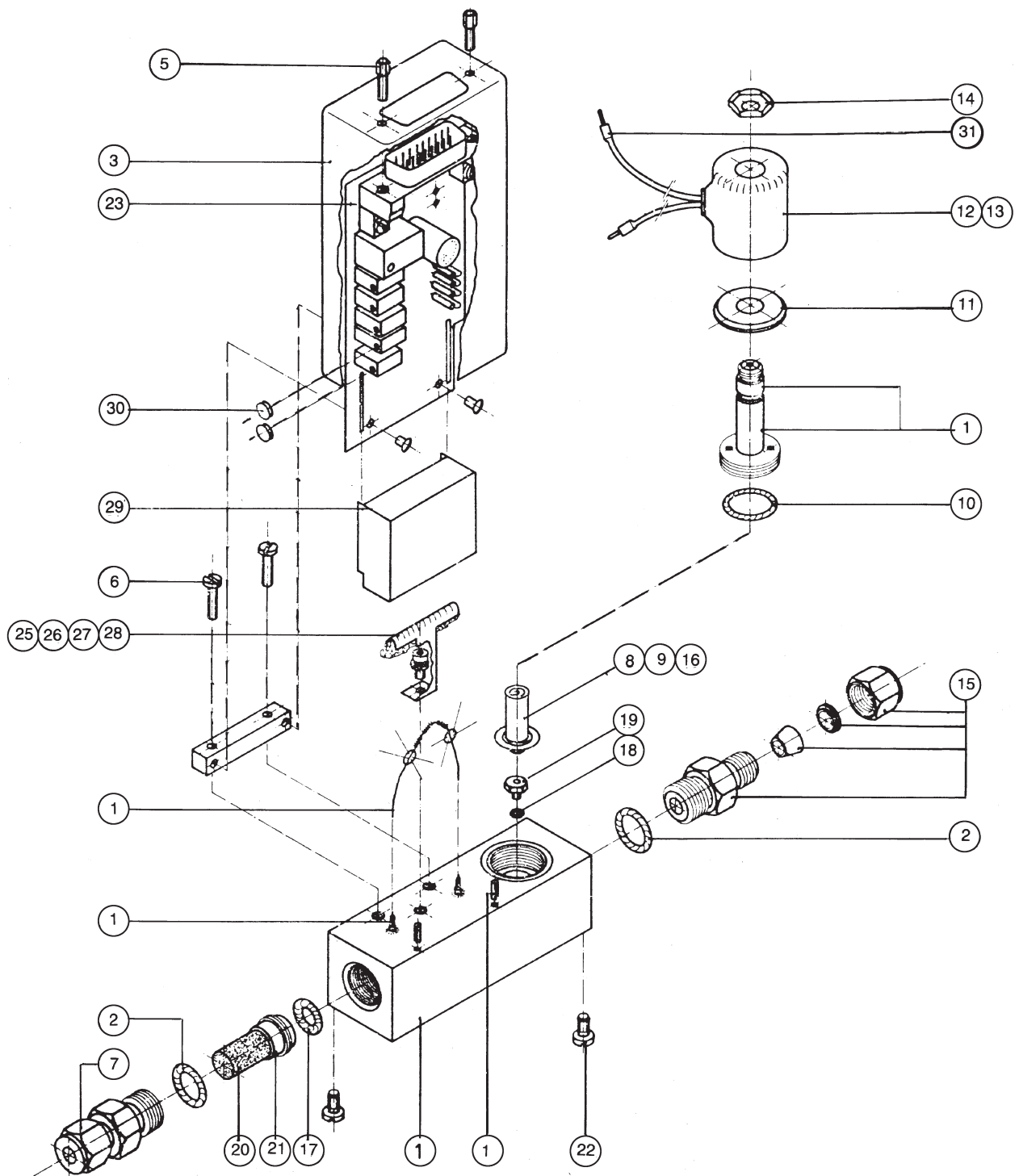


Figure 5-1. Exploded view 5850TR

5-1 RECOMMENDED SPARE PARTS 5850TR WITH N.C. VALVE, 100 BAR

Ref. no.	Quantity required	Description	Part number
1	1	Transducer body M.F.C. Sensor	092-B-033-BMA 092-B-036-BMA
2	2	O-ring for adapters Viton Teflon Buna-N	375-B-906-QTA 375-B-906-QMA 375-B-906-SUA
3	1	Housing cover Card Edge connection sub "D"-connection sub "D"-connection (sensor)	219-Z-190-EAA 219-Z-241-EAA 219-Z-243-EAA
5	2 1	Cil. screw Card Edge connection Mounting set sub "D"-connection	753-G-267-AAA 760-Z-037-ACS
7	1	Inlet Adapters (incl. filter) 1/4" tube comp. fittings 1/8" tube comp. fittings 1/4" VCR 1/4" NPT 6 mm tube comp. fittings 3/8" tube comp. fittings	320-B-080-BMA 320-B-083-BMA 014-Z-358-BMA 014-C-203-BMA 320-B-092-BMA 320-B-085-BMA
8	1	Seat assembly Viton Teflon Kalrez Buna-N	715-Z-245-AAA 715-Z-041-AAA 715-Z-162-AAA 715-Z-246-AAA
9	1	Lower guide spring	820-Z-073-BBA
10	1	O-ring valve seal Viton Teflon Buna-N	375-B-016-QTA 375-B-016-QMA 375-B-016-SUA
11	1	Filflix plate	613-E-444-ACJ
12	1	Coil	185-Z-128-AAA
13	1	Coil housing	441-Z-180-AAA
14	1	Nut	575-Z-011-ACJ
15	1	Outlet adapters 1/4" tube comp. fittings 1/8" tube comp. fittings 1/4" VCR 1/4" NPT 6 mm tube comp. fittings 3/8" tube comp. fittings	320-B-079-BMA 320-B-082-BMA 014-Z-357-BMA 014-C-202-BMA 320-B-091-BMA 320-B-150-BMA
16	1	Plunger assy	622-Z-108-AAA
17	1	O-ring filter bushing Viton Teflon Buna-N	375-B-109-QTA 375-B-109-QMA 375-B-109-SUA
18	1	O-ring under orifice Viton Teflon Buna-N	375-G-042-QTA 375-G-042-QMA 375-G-042-SUA
19	1	Orifice 0,0013" 0,002" 0,003" 0,004" 0,007" 0,010" 0,014" 0,020" 0,028" 0,032" 0,048" 0,052" 0,067"	577-Z-363-BMT 577-Z-364-BMT 577-Z-365-BMT 577-Z-366-BMT 577-Z-368-BMT 577-Z-369-BMT 577-Z-401-BMT 577-Z-370-BMT 577-Z-371-BMT 577-Z-372-BMT 577-Z-137-BMT 577-Z-138-BMA 577-Z-139-BMA

5-1 RECOMMENDED SPARE PARTS 5850TR WITH N.C. VALVE, 100 BAR (continued)

		Min. full scale		Max. full scale	
20 + 21	1	Restrictor assy	6,1	8,7 ml _n /min	110-Z-159-BMA
		Restrictor assy	8,6	12,1 ml _n /min	110-Z-160-BMA
		Restrictor assy	12,0	17,0 ml _n /min	110-Z-161-BMA
		Restrictor assy	16,9	23,9 ml _n /min	110-Z-162-BMA
		Restrictor assy	23,6	33,4 ml _n /min	110-Z-163-BMA
		Restrictor assy	33,1	46,9 ml _n /min	110-Z-164-BMA
		Restrictor assy	46,3	65,6 ml _n /min	110-Z-165-BMA
		Restrictor assy	64,8	91,7 ml _n /min	110-Z-166-BMA
		Restrictor assy	90,8	129 ml _n /min	110-Z-167-BMA
		Restrictor assy	127	180 ml _n /min	110-Z-168-BMA
		Restrictor assy	178	252 ml _n /min	110-Z-169-BMA
		Restrictor assy	249	352 ml _n /min	110-Z-170-BMA
		Restrictor assy	349	494 ml _n /min	110-Z-171-BMA
		Restrictor assy	488	691 ml _n /min	110-Z-231-BMA
		Restrictor assy	683	967 ml _n /min	110-Z-232-BMA
		Restrictor assy	958	1360 ml _n /min	110-Z-233-BMA
		Restrictor assy	1340	1890 ml _n /min	110-Z-234-BMA
		Restrictor assy	1870	2650 ml _n /min	110-Z-235-BMA
		Restrictor assy	2620	3710 ml _n /min	110-Z-236-BMA
		Restrictor assy	3670	5200 ml _n /min	110-Z-237-BMA
		Restrictor assy	5140	7300 ml _n /min	110-Z-238-BMA
		Restrictor assy	7200	10200 ml _n /min	110-Z-239-BMA
		Restrictor assy	10100	14300 ml _n /min	110-Z-228-BMA
		Restrictor assy	14100	20000 ml _n /min	110-Z-226-BMA
		Restrictor assy	19800	28000 ml _n /min	110-Z-224-BMA
23	1	P.C. Board N.C.; neg. valve volt, Card Edge conn. 0-5Vdc			097-B-107-ZZZ
		P.C. Board N.C.; pos. valve volt, sub. "D"-conn. 0-5Vdc			097-B-115-ZZZ
		P.C. Board N.O.; neg. valve volt, Card Edge conn. 0-5Vdc			097-B-151-ZZZ
		P.C. Board N.O.; pos. valve volt, sub "D"-conn. 0-5Vdc			097-B-156-ZZZ
30	2	Cap for trimpots			620-Z-434-SXA

5-1-1 RECOMMENDED SPARE PARTS 5850TR WITH N.O. VALVE, 100 BAR

Ref. no.	Quantity required	Description	Part number
1	1	Transducer body	092-B-063-BMA
23	1	P.C. Board neg. valve volt. Card Edge conn. pos valve volt. Card Edge conn. pos valve volt. sub "D" conn.	097-B-151-ZZZ 097-B-152-ZZZ 097-B-156-ZZZ
40	1	Nut	573-Q-074-ACD
41	1	O-ring sleeve seal Viton Teflon	375-B-012-QTA 375-B-012-QMA
42	1	Plunger extension	830-Z-045-BMA
43	1	Ring	724-Z-202-AAA
44	1	Seat assembly - Kalrez	715-Z-197-AAA
45	1	Plunger assy	622-Z-110-CEA
46	1	Spacer 0,05 mm	810-A-303-BMA
47	1	Spacer 0,2 mm	810-A-304-BMA

5-1-2 RECOMMENDED SPARE PARTS 5850TR WITH N.C. VALVE, 300 BAR

Ref. no.	Quantity required	Description	Part number
1	1	Transducer body	092-B-064-BMA
11	1	Filflix Plate	613-E-452-ACJ
16	1	Plunger assy	622-Z-111-AAA

5-1-3 SERVICE TOOLS

Quantity required	Description	Part number
1	5850 M.F.C. toolkit	778-D-017-AAA
1	Stem removal tool	908-Z-048-AAA
1	Orifice removal tool	908-Z-035-AAA

SECTION 6 MODELLISTING

THERMAL MASS			BROOKS INSTRUMENT B.V.		
5850TR - METERS & CONTROLLERS					
BASE MODEL NUMBER			DESCRIPTION		
5850TR/F			MASS FLOW METER & CONTROLLER FULL SCALE RANGES FROM 10 mln/min UPTO 20 ln/min N2		
			O-RING/VALVE SEAT MATERIAL		
A			VITON		
B			BUNA		
C			TEFLON/KALREZ (KALREZ ONLY FOR THE VALVE SEAT)		
D			KALREZ (INCLUDING ADAPTERS)		
E			TEFLON		
Z			SPECIFY		
			VALVE TYPE		
	0		NONE (METER ONLY) (300 BAR RATING)		Deduct:
	1		NORMALLY CLOSED (100 BAR RATING)		
	2		NORMALLY OPENED (100 BAR RATING)		
			ELECTRICAL CONNECTIONS		
		C	0-5 VDC I/O		
		D	4-20 mA I/O		
		E	0-20 mA I/O		
		Z	SPECIFY		
			MECHANICAL CONNECTIONS		
		1	WITHOUT ADAPTORS (9/16"-18" UNF)		
		2	1/4" TUBE COMPRESSION FITTINGS		
		3	1/8" TUBE COMPRESSION FITTINGS		
		4	1/4" VCR (100 BAR)		
		5	1/4" VCO (100 BAR)		
		6	1/4" NPT (MAX. 300 BAR)		
		7	6mm TUBE COMPRESSION FITTINGS		
		9	SPECIFY		
			INTERCONNECTION CABLE		
		0	NO CABLE		
		B	MATING CONNECTOR ONLY		
	D	3m ROUND CABLE WITH MATING "D" CONNECTORS			
	E	6m ROUND CABLE WITH MATING "D" CONNECTORS			
	F	12m ROUND CABLE WITH MATING "D" CONNECTORS			
	Z	SPECIFY			
		POWER SUPPLY INPUT			
	2	+ 24 Vdc (standard)			
	3	+ 15 Vdc only			
	9	SPECIFY			
5850TR/F A 1 C 2 E 1 = TYPICAL MODEL NUMBER					

ACCESSORIES & OPTIONS:
* FOR GASES WHICH CLOG AND CONTAMINATE THE MFC EASILY, AN ANTI-CLOG LAMINAR FLOW ELEMENT MUST BE ORDERED.
FLOWRANGES UP TO 3460 mln/min N2, ADD:
* INTERCONNECTION CABLE UP TO 25m LENGTH, ADD PER METER
* CERTIFIED FOR USE IN ZONE-2 HAZARDOUS AREA
* LASER WELDED SENSOR FOR AMONGST OTHERS, H2S APPLICATIONS

Model 5850TR

7-1 General

This section contains the procedures for the receipt and installation of the instrument. See Section 1 for dimensional and connection requirements. Do not attempt to start the system until the instrument has been permanently installed. It is important that the start-up procedures be followed in the exact sequence presented.

7-2 Receipt of Equipment

When the instrument is received, the outside packing case should be checked for damage incurred during shipment. If the packing case is damaged, the local carrier should be notified at once regarding his liability. A report should be submitted to your nearest Product Service Department.

Brooks Instrument

407 W. Vine Street
P.O. Box 903
Hatfield, PA 19440 USA
Toll Free (888) 554-FLOW (3569)
Tel (215) 362-3700
Fax (215) 362-3745
E-mail: BrooksAm@EmersonProcess.com
www.BrooksInstrument.com

Brooks Instrument

Neonstraat 3
6718 WX Ede, Netherlands
P.O. Box 428
6710 BK Ede, Netherlands
Tel 31-318-549-300
Fax 31-318-549-309
E-mail: BrooksEu@EmersonProcess.com

Brooks Instrument

1-4-4 Kitasuna Koto-Ku
Tokyo, 136-0073 Japan
Tel 011-81-3-5633-7100
Fax 011-81-3-5633-7101
Email: BrooksAs@EmersonProcess.com

Remove the envelope containing the packing list. Carefully remove the instrument from the packing case. Make sure spare parts are not discarded with the packing materials. Inspect for damaged or missing parts.

7-3 Recommended Storage Practice

If intermediate or long-term storage of equipment is required, it is recommended that the equipment be stored in accordance with the following:

- a. Within the original shipping container.
- b. Stored in a sheltered area, preferably a warm, dry, heated warehouse.
- c. Ambient temperature of 70° F (21° C) nominal, 109° F (43° C) maximum, 45° F (7° C) minimum.
- d. Relative humidity 45% nominal, 60% maximum, 25% minimum.

Upon removal from storage a visual inspection should be conducted to verify the condition of equipment is "as received".

7-4 Return Shipment

Prior to returning any instrument to the factory visit the Brooks website www.BrooksInstrument.com for a Return Materials Authorization Number (RMA#), or contact one of the following locations:

Brooks Instrument

407 W. Vine Street
P.O. Box 903
Hatfield, PA 19440 USA
Toll Free (888) 554-FLOW (3569)
Tel (215) 362-3700
Fax (215) 362-3745
E-mail: BrooksAm@EmersonProcess.com
www.BrooksInstrument.com

Brooks Instrument

Neonstraat 3
6718 WX Ede, Netherlands
P.O. Box 428
6710 BK Ede, Netherlands
Tel 31-318-549-300
Fax 31-318-549-309
E-mail: BrooksEu@EmersonProcess.com

Brooks Instrument

1-4-4 Kitasuna Koto-Ku
Tokyo, 136-0073 Japan
Tel 011-81-3-5633-7100
Fax 011-81-3-5633-7101
Email: BrooksAs@EmersonProcess.com

Instrument must have been purged in accordance with the following:

⚠ WARNING

Before returning the device purge thoroughly with a dry inert gas such as Nitrogen before disconnecting gas connections. Failure to correctly purge the instrument could result in fire, explosion or death. Corrosion or contamination may occur upon exposure to air.

All flow instruments returned to Brooks requires completion of Form RPR003-1, Brooks Instrument Decontamination Statement, along with a Material Safety Data Sheet (MSDS) for the fluid(s) used in the instrument. Failure to provide this information will delay processing by Brooks personnel. Copies of these forms can be downloaded from the Brooks website www.BrooksInstrument.com or are available from any Brooks Instrument location listed above.

7-5 Transit Precautions

To safeguard the instrument against transportation damage, it is recommended to keep the instrument in its factory container until ready for installation.

7-6 Removal from Storage

Upon removal of the instrument from storage, a visual inspection should be conducted to verify its "as-received" condition. If the instrument has been subject to storage conditions in excess of those recommended (See Section 7-3), it should be subjected to a pneumatic pressure test in accordance with applicable vessel codes.

Model 5850TR

(1) **TYPE EXAMINATION CERTIFICATE**

(2) **Equipment and protective systems intended for use in potentially explosive atmospheres - Directive 94/9/EC**

- (3) Type Examination Certificate Number: **KEMA 03ATEX1531 X** Issue Number: 3
- (4) Equipment: **Thermal Mass Flowmeter / Flowcontroller Model 5850TR**
- (5) Manufacturer: **Brooks Instrument LLC**
- (6) Address: **407 West Vine Street, Hatfield, PA 19440, USA**
- (7) This equipment and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.
- (8) KEMA Quality B.V. certifies that this equipment has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres given in Annex II to the directive.
- The examination and test results are recorded in confidential test report no. 2113693-9.
- (9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:
- EN 60079-15 : 2003**
- (10) If the sign "X" is placed after the certificate number, it indicates that the equipment is subject to special conditions for safe use specified in the schedule to this certificate.
- (11) This Type Examination Certificate relates only to the design, examination and tests of the specified equipment and not to the manufacturing process and supply of this equipment.
- (12) The marking of the equipment shall include the following:



II 3 G EEx nA II T4

This certificate is issued on March 21, 2008 and, as far as applicable, shall be revised before the date of cessation of presumption of conformity of (one of) the standards mentioned above as communicated in the Official Journal of the European Union.

KEMA Quality B.V.

C.G. van Es
Certification Manager



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° Integral publication of this certificate and adjoining reports is allowed. This Certificate may only be reproduced in its entirety and without any change.

KEMA Quality B.V. Utrechtseweg 310, 6812 AR Arnhem P.O. Box 5185, 6802 ED Arnhem The Netherlands
T +31 26 3 56 20 00 F +31 26 3 52 58 00 customer@kema.com www.kema.com Registered Arnhem 09085396

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Model 5850TR

LIMITED WARRANTY

Seller warrants that the Goods manufactured by Seller will be free from defects in materials or workmanship under normal use and service and that the Software will execute the programming instructions provided by Seller until the expiration of the earlier of twelve (12) months from the date of initial installation or eighteen (18) months from the date of shipment by Seller. Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer.

All replacements or repairs necessitated by inadequate preventive maintenance, or by normal wear and usage, or by fault of Buyer, or by unsuitable power sources or by attack or deterioration under unsuitable environmental conditions, or by abuse, accident, alteration, misuse, improper installation, modification, repair, storage or handling, or any other cause not the fault of Seller are not covered by this limited warranty, and shall be at Buyer's expense.

Goods repaired and parts replaced during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. This limited warranty is the only warranty made by Seller and can be amended only in a writing signed by an authorized representative of Seller.

BROOKS LOCAL AND WORLDWIDE SUPPORT

Brooks Instrument provides sales and service facilities around the world, ensuring quick delivery from local stock, timely repairs and local based sales and service facilities.

Our dedicated flow experts provide consultation and support, assuring successful applications of the Brooks flow measurement and control products.

Calibration facilities are available in local sales and service offices. The primary standard calibration equipment to calibrate our flow products is certified by our local Weights and Measures Authorities and traceable to the relevant international standards.

START-UP SERVICE AND IN-SITU CALIBRATION

Brooks Instrument can provide start-up service prior to operation when required.

For some process applications, where ISO-9001 Quality Certification is important, it is mandatory to verify and/or (re)calibrate the products periodically. In many cases this service can be provided under in-situ conditions, and the results will be traceable to the relevant international quality standards.

CUSTOMER SEMINARS AND TRAINING

Brooks Instrument can provide customer seminars and dedicated training to engineers, end users and maintenance persons. Please contact your nearest sales representative for more details.

