

## EQUIPMENT / FLOW CONTROLS

Flowmeters are used to measure the rate of flow of a liquid or a gas. GTS offers a full range of flowmeters which provide various degrees of precision based on your needs. These flowmeters are also available in various price ranges to meet any budget. There are two basic types of flow controls: Flowmeters (rotameters) and electronic mass flowmeters.

### ROTAMETERS

Rotameters are a simple, precise and economical way to measure flow rates of a liquid or gas. Their basic design consists of a precision tapered glass tube containing one or more spherical float(s). A measuring scale etched on the glass tube provides for easy reading of measurements. The diameter of the tube at the bottom, or inlet, is approximately equal to the diameter of the float.

As gas enters the tube the float begins to rise. The float rises to a point where the area between the float and the tube is just large enough to permit an unrestricted flow of gas.

Here the float is stationary. This position at which the float is stationary corresponds to a point on the etched tube scale. This provides the rate of flow reading according to flow charts.

The flow range, or capacity, of a tube can be varied by changing the float material. Materials with a lower density such as Pyrex® glass or sapphire give a lower flow capacity than material with a higher density such as tantalum, carbonyl or stainless steel.

Rotameters differ from mass flowmeters in that they are affected by temperature and pressure variations. When equipped with a control valve on the inlet, readings are correct only when the outlet pressure equals the pressure at which the tube was calibrated.

### ELECTRONIC MASS FLOWMETERS

Electronic mass flowmeters measure flow by means of a flow transducer. A flow transducer is a sensor assembly which contains a bridge circuit. This bridge circuit is made up of two temperature sensitive wires wound adjacent to each other on the outside of a capillary tube. As gas flows through the transducer, a portion of the flow is diverted to the capillary tube. The flowing gas cools one of the two wires on the bridge, thus creating an unbalanced bridge circuit. This produces an electrical signal proportional to the flow. The signal is then amplified and linearized in the flow transducer and delivered as a 0-5 VDC signal to the readout. Since the specific heat of any gas is a unique property, essentially independent of pressure, an electronic mass flowmeter is an absolute measuring instrument.

By taking the readout from the flow transducer and matching it to a reference signal and solenoid valve, the electronic mass flowmeter thus becomes a flow controller.

### ORDERING

When ordering a flowmeter, please provide the following:

- The gas or gases that will be measured
- Inlet and outlet pressures
- State whether the system is free-flowing or dead ended
- The approximate flow range to be measured
- Desired accuracy: +/-10%, +/-1%, etc.

**TYPICAL FLOW RANGE**

Each flowmeter comes with a tube which should be specified from the table below.

Calibration curves provided - specify gas service.

Other flow ranges are available for any media please inquire.

PRODUCT CODE TUBE	FLOAT	AIR	WATER	HELIUM	HYDROGEN
		SCC/MIN.	SCC/MIN.	SCC/MIN.	SCC/MIN.
Type #1 S7900T-1	Glass	4-59	.061	15-158	20-225
	SS	8-166	2.50	40-470	60-630
Type #2 S7900T-2	Glass	4-95	1.02	25-255	30-350
	SS	8-262	4.96	65-700	90-990
Type #3 S7900T-3	Glass	20-386	5.8	50-1030	100-1460
	SS	40-859	20.8	100-2300	300-3250
Type #4 S7900T-4	Glass	80-850	18	215-2285	300-3200
	SS	125-1800	46	475-4840	6820-6825
Type #5 S7900T-5	Glass	100-2400	53.2	625-6450	900-9000
	SS	200-4820	133.4	1275-12900	1825-18200
Type #6 S7900T-6	Glass	400-4000	85	1000-10750	1500-15150
	SS	725-7500	220	2000-20150	2800-28400
Type #7 S7900T-7	Glass	400-9000	206	2400-24200	3350-34000
	SS	1000-16900	502	4500-45400	6350-64000
Type #8 S7900T-8	Glass	1500-24700	564	6600-66400	9300-93500
	SS	3000-49300	1323	1300-132500	1750-186500

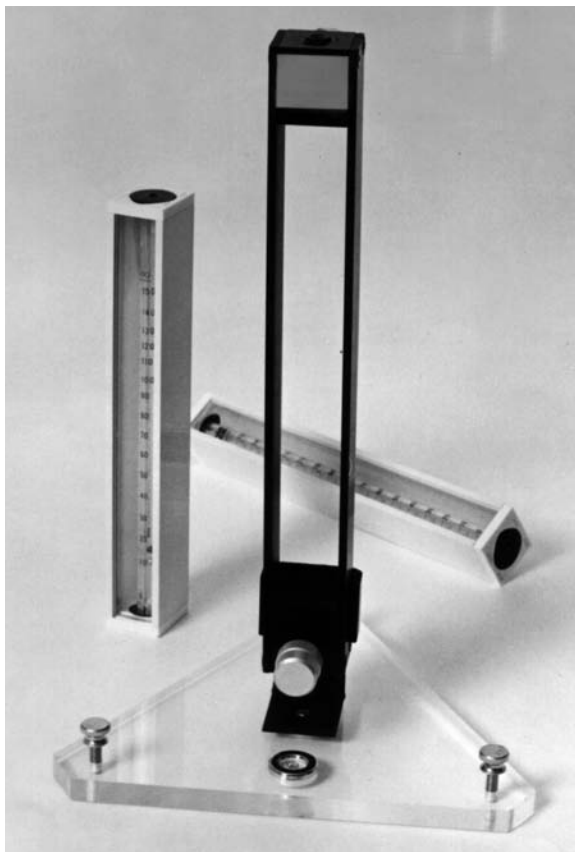
Replacement TUBE CUBES® (Order by product code tube)

## FLOW RATE OTHER THAN AIR

To estimate which flow tube should be purchased when measuring a gas other than air, multiply the flow rate of the gas by the factors listed below to find the air-equivalent flow rate. The tube whose range contains this flow rate should be purchased.

Air Equivalent (sccm) = Gas (sccm) x Factor

GAS	FACTOR	GAS	FACTOR	GAS	FACTOR	GAS	FACTOR
Acetylene .....	0.95	Difluoroethane .....	1.51	Halocarbon-113 .....	2.54	Methane (Natural Gas) .....	0.75
Air .....	1.00	Dimethyl Ether .....	1.26	Halocarbon-114 .....	2.43	Methyl Fluoride .....	1.09
Ammonia .....	0.77	Ethane .....	1.02	Halocarbon-116 .....	2.18	Monomelamine .....	1.04
Argon .....	1.18	Ethylene.....	0.98	Halocarbon-115 .....	2.31	Neon.....	0.83
1-3 Butadiene.....	1.37	Halocarbon-11 .....	2.18	Halocarbon-142B .....	1.86	Nitrogen .....	0.98
Butane .....	1.42	Halocarbon-12 .....	2.05	Halocarbon-152A .....	1.51	Nitrogen Dioxide .....	1.60
1-Butane .....	1.39	Halocarbon-13 .....	1.90	Helium .....	0.37	Nitrous Oxide .....	1.23
Carbon Dioxide .....	1.23	Halocarbon-131 .....	2.27	Hydrogen.....	0.26	Oxygen.....	1.05
Carbon Monoxide .....	0.98	Halocarbon-14 .....	1.74	Hydrogen Chloride .....	1.13	Propane.....	1.23
Chlorine .....	1.57	Halocarbon-21 .....	1.89	Hydrogen Sulfide.....	1.08	Propylene .....	1.21
Cracked Ammonia .....	0.54	Halocarbon-22 .....	1.73	Isobutane .....	1.42	Sulfur Dioxide.....	1.50
CycloPropane.....	1.21	Halocarbon-23 .....	1.56	Isobutylene .....	1.39	Sulfur Hexafluoride.....	2.25



### SERIES S7920 - FLOWMETER

GTS 7920 flowmeters provide the most accurate indication and precise control of gases available for a wide range of applications. This versatile meter is functionally and dimensionally interchangeable with other current designs while incorporating many innovative features.

All 7920 glass metering tubes have integral float guides to assure a guaranteed  $\pm 3\%$  (optional calibration required) of full scale accuracy. Glass and stainless steel floats are standard. The meters are available in a wide range of direct reading and reference indicating scales.

Standard with this series is the TUBE CUBE<sup>®</sup>, a unique design concept. The TUBE CUBE<sup>®</sup>, a unitized tube holder, aligns the tube quickly and easily for simple tube installation or replacement, reduces chipped tube ends, broken tubes, and misalignment. The TUBE CUBE<sup>®</sup> also provides tube protection during handling and storage and affords a 1.5 X scale magnification factor for more accurate tube reading. End seals in the design are direct-acting and non-rotating for fast alignment and convenient service access.

The Series 7920 construction is trim and attractive. A wide range of materials of construction can be specified without altering meter dimensions.

## SERIES S7920 - FLOWMETER (cont.)

**TYPICAL APPLICATIONS**

Carrier and fuel gas chromatography  
Atomic absorption  
Crystal development/doping gas  
Semiconductor manufacture  
Film processing  
Chemical processing  
General research and industrial uses

**FEATURES**

1.5 times scale magnification factor for more accurate tube reading  
End seals are direct-acting and nonrotating for fast alignment and convenient access  
High resolution of 150mm scale length  
Many standard direct reading scales available  
Precision taper, fluted metering tube  
Lowest available pressure drop via maximum flow path area increases available flow rates to low feed pressures  
Standard front panel mounting requires minimum hardware  
Available utility and high precision metering valves do not require special fittings  
Direct acting non-rotating compression seal  
Glass and Stainless Steel floats are standard  
Glass metering tubes have integral float guides that provide +/-3% accuracy

**SPECIFICATIONS**

End blocks	Aluminum, 316 SS, Monel® (Brass, Teflon®; optional)
Side plates	Anodized aluminum
"O" Rings and packaging	Buna-N or Viton®
Maximum pressure	250 PSIG
Temperature range	-20°F to 250°F (-30°C to 120° C)
Ports	1/8" NPTF
Accuracy	+/-5% of full scale with standard valve +/-3% of full scale with high accuracy valve

**OPTIONS****PAGE**

Tube fittings	275
Hose barbs	276
Pipe fitting	276
Bench stand	S7920-BST

DESCRIPTION	ALUMINUM PRODUCT CODE	316 SS PRODUCT CODE	MONEL® PRODUCT CODE
Panel Mount without valve	S7920-A1	S7920-S1	S7920-M1
Panel Mount with standard valve	S7920-A2	S7920-S2	S7920-M2
Panel Mount with high accuracy valve	S7920-A3	S7920-S3	NA

\* Please specify tube size when ordering (refer to page 202)

**SERIES 65 - FLOWMETER**

The Series 65 flowmeters use 65mm TUBE CUBES® with a single float. They are calibrated to read directly in SLPM of air. Correction factors are available for a number of common gases. The Series 65 flowmeters are available in chrome plated brass or stainless steel.

**SPECIFICATIONS**

Maximum inlet pressure	250 PSIG
Temperature range	-20°F to +250°F
Valve	Standard needle valve
Dimensions	1 1/4"W x 6 3/16"D (Does not include base)
Accuracy	10% full scale
Inlet and outlet	1/8" NPTF

**OPTIONS**

1/4" Hose fitting (brass)	S859-B5	275, 276
1/4" Hose fitting (SS)	S859-S5	275, 276
1/4" Tube fitting (brass)	S850-B2	275, 276
1/4" Tube fitting (SS)	S850-S2	275, 276
Bench Stand	S7921-BST	



PRODUCT CODE	DESCRIPTION
S65-BFV	Frame with valve (Brass)
S65-SFV	Frame with valve (316 SS)
S65-B1	Flow tube (0.05-0.5 SLPM)
S65-B2	Flow tube (0.2-2.0 SLPM)
S65-B3	Flow tube (0.5-6.0 SLPM)
S65-B4	Flow tube (1.0-10.0 SLPM)
S65-B5	Flow tube (2.0-25.0 SLPM)

\* Please specify tube size when ordering

**SERIES 7921 - ACRYLIC PURGE METER FOR CORROSIVE & NON CORROSIVE GASES**

Series 7921 purge meters are a practical, low cost way to insure flow of gases or liquids where high accuracy is not required. The acrylic body is protected by an aluminum frame and metal treads are used to prevent cracking. These purge meters can be panel mounted or bench mounted using the optional bench stand. Also standard with this unit is a cartridge-type needle valve.

**SPECIFICATIONS**

Maximum inlet pressure:	100 PSIG
Maximum operating temperature:	160°F
Dimensions:	1"W x 4"H x 2 3/4"D
Accuracy:	10% full scale
Inlet and outlet:	1/8" NPTF

**OPTIONS**

1/4" Hose fitting (brass)	S859-B5	275, 276
1/4" Hose fitting (SS)	S859-S5	275, 276
1/4" Tube fitting (brass)	S850-B2	275, 276
1/4" Tube fitting (SS)	S850-S2	275, 276
Bench Stand	S7921-BST	

**PAGE**



PRODUCT CODE	FLOW RANGE (SCFH AIR)
S7921-1	0.4-5.0
S7921-2	2.0-20.0
S7921-3	10.0-100.0
S7921-4	20.0-200.0

**SERIES S7942 - GAS PROPORTIONER**

The Series S7942 gas proportioner measures the flow of each of two gases. It mixes the two gases thoroughly in a special mixing tube to produce homogenous two-component mixtures.

**SPECIFICATIONS**

100 PSIG inlet  
 Can be used for any pressure between 10 and 200 PSIG  
 1/8" NPTF standard  
 1/4" Hose fittings (optional)  
 1/4" Tube fittings (optional)

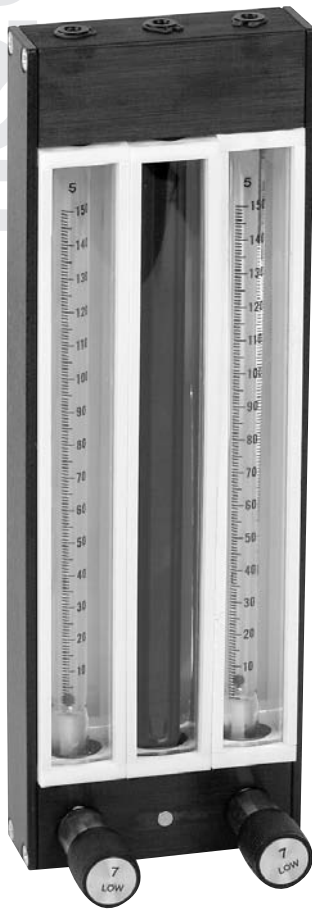
**MATERIALS**

PRODUCT CODE	MATERIAL	VALVE TYPE
S7942-AS	Aluminum	Standard
S7942-AH	Aluminum	High accuracy
S7942-SS	Stainless steel	Standard
S7942-SH	Stainless steel	High accuracy

**OPTIONS**

High accuracy valves should not be used with #4 or #5 tubes  
 When ordering a gas proportioner, specify the composition of mixture, discharge rate and connection. If you require assistance, please contact your nearest GTS location.

- Tube readings are accurate regardless of back pressure when inlet pressures are maintained at tubes' calibrated levels.



- Gas proportioners are back-pressure compensated.
- Control valves have been installed at outlets.
- Tubes all have single gas float.
- Individual calibration curves are supplied with specially calibrated units.
- Typical calibration curves exist for air at 50 PSIG.
- 5% component value accuracy when calibrated for non-corrosive gases.
- 10% concentration accuracy attained using typical calibration curves

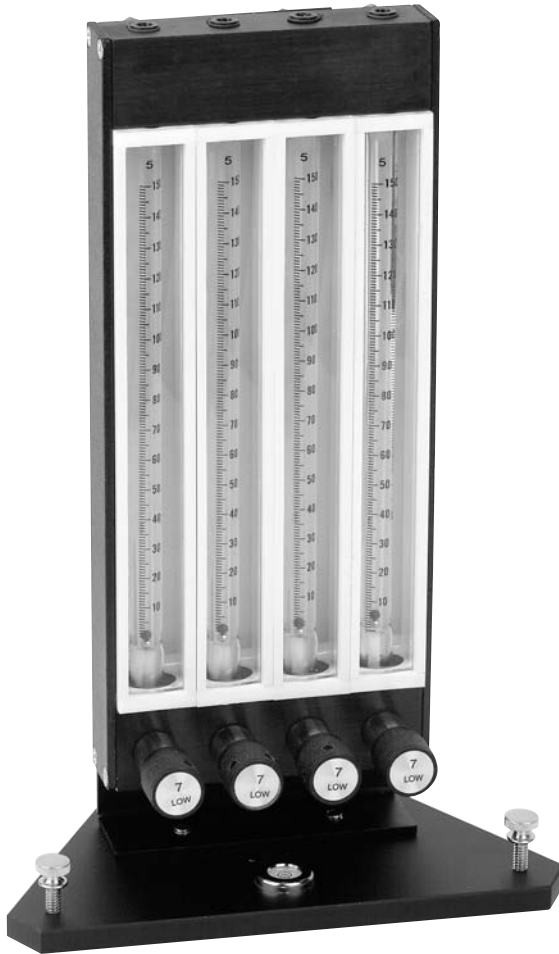
**PRODUCT CODE****VALVE TYPE**

Aluminum	
S7942-AS	Standard
S7942-AH	High Accuracy
Stainless Steel	
S7942-SS	Standard
S7942-SH	High Accuracy

High Accuracy Valves should not be used with #4 or #5 tubes.  
 \*Optional tube fittings available, refer to pages 276, 277.

**SERIES 7940 - MULTITUBE UNITS AND MIXER**

The Series 7940 multitube flowmeters are available in either aluminum or 316 stainless steel, in two basic configurations.



**SERIES 7940 4 TUBE FLOWMETER ORDERING**

PRODUCT CODE	MATERIALS	VALVE	CONNECTIONS
S7940-AS1	Aluminum	Standard	1/8" NPTF
S7940-AS2	Aluminum	Standard	1/4" Tube Fitting
S7940-AH1	Aluminum	High Accuracy	1/8" NPTF
S7940-AH2	Aluminum	High Accuracy	1/4" Tube Fitting
S7940-SS1	316 SS	Standard	1/8" NPTF
S7940-SS2	316 SS	Standard	1/4" Tube Fitting
S7940-SH1	316 SS	High Accuracy	1/8" NPTF
S7940-SH2	316 SS	High Accuracy	1/4" Tube Fitting

**FEATURES**

All have four flowmeter tubes with individual outlets which allow four separate gas streams to be metered. Each unit comes complete with four tubes, number 1-8, each with glass and Stainless Steel floats. Number 10 tubes can be ordered at an additional charge. All units are backpressure compensated by mounting the control valves in the outlet. An acrylic bench mounting stand comes standard with all units. All units are available with a standard valve cartridge or a high accuracy valve which allows for an accurate setting of low flow rates.

**SPECIFICATIONS**

Connections 1/8" NPTF or 1/4" tube fitting  
 Maximum inlet pressure 250 PSIG  
 Operating temperature 20°F to 250°F  
 Dimensions 10"H x 4 1/4"W x 1 1/4"D  
 (Does not include base)  
 Shipping weight: 6 3/4 lbs.



**SERIES 7941 MIXING UNITS**

PRODUCT CODE	MATERIALS	VALVE	CONNECTIONS
S7941-AS1	Aluminum	Standard	1/8" NPTF
S7941-AS2	Aluminum	Standard	1/4" Tube Fitting
S7941-AH1	Aluminum	High Accuracy	1/8" NPTF
S7941-AH2	Aluminum	High Accuracy	1/4" Tube Fitting
S7941-SS1	316 SS	Standard	1/8" NPTF
S7941-SS2	316 SS	Standard	1/4" Tube Fitting
S7941-SH1	316 SS	High Accuracy	1/8" NPTF
S7941-SH2	316 SS	High Accuracy	1/4" Tube Fitting

**SERIES S7500 - MASS FLOWMETERS AND FLOW CONTROLLERS**

Mass Flowmeters and Flow-Controllers are direct and absolute measuring devices. These devices operate on the basis of specific heat. The specific heat of a gas is a unique property of that gas and is independent of pressure. To measure the gas flow, these devices generate a signal which is proportional to the mass flow by detecting heat transport in the gas stream.

**Mass Flowmeter:** The signal voltage is linearized and used to provide a readout of the flow rate.

**Flow Controller:** The signal voltage is compared to a reference voltage and used to control a solenoid valve to provide a constant rate of flow.

**FEATURES**

Flow measurement is independent of temperature or pressure variations.  
Flow transducer can be mounted in any position without affecting accuracy.  
Easy to remove sensor tube assembly simplifies maintenance.  
Patented laminar flow element package which is computer designed based on the flow rate, operating pressure and gas properties for each application.

**SPECIFICATIONS**

Measures and controls flow rates from 2 SCCM to 500 SLM  
Linear 0-5 VDC signal for each flow range  
Flow meter accuracy +/- 1% full scale  
Controller repeatability +/- 0.2% full scale  
Linearity +/- 1% full scale  
Response time 1 sec. to within 2% of true value  
Standard selectable Soft start

**PRODUCT CODE**

S7500-2  
S7500-4

**DESCRIPTION**

Two channel readout/controller  
Four channel readout/controller

**SERIES S7501 - LINEAR MASS FLOWMETERS**

The Series 7501 electronic mass flowmeter is the most advanced flow measuring instrument available.

**FEATURES**

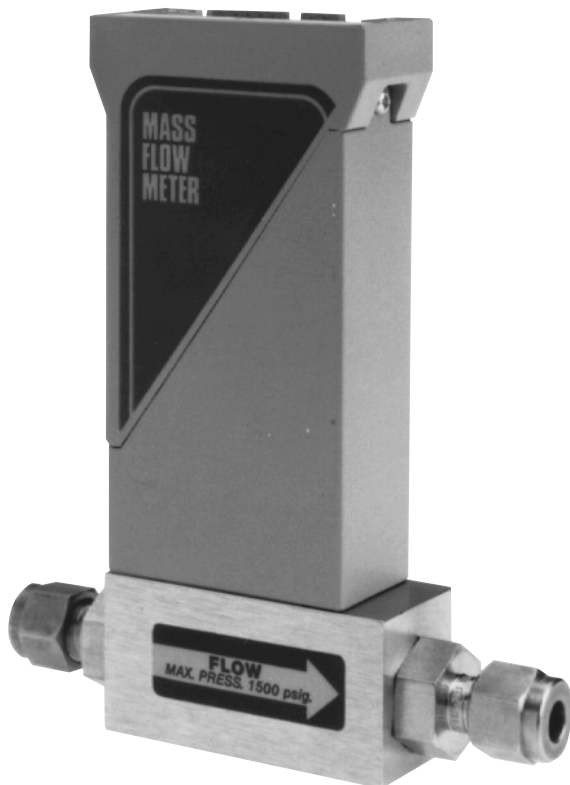
Flow transducers are not sensitive to altitude and can be mounted in any position.  
 Signal is only dependent on flow rate and heat capacity of the gas being measured.  
 Results not affected by slight variations in temperature and heat.  
 Complete system contains a 2 or 4 channel readout/power supply and 1-4 man flow transducers.  
 Each mass transducer includes Swagelok® connections on the inlet and outlet.  
 316 SS flow body  
 "O" ring seals: Viton® (K™ optional)

**SPECIFICATIONS**

Power requirement	115 VAC
Maximum inlet pressure	1000 PSIG (3000) PSIG optional
Press coefficient:	0.1%/ATM
Temperature	0.1%/°C
Operating temperature range:	10°-70° C
Repeatability	+/- 0.2% full scale
Response time	1.2 seconds
Inlet and outlet connections	1/4" Swagelok® (3/8" on transducers over 100 LPM)

**OPTIONS**

10' Connection cable	S7501C-10
25' Connection cable	S7501C-25
50' Connection cable	S7501C-50
4 Channel with computer interface	S7500-4COM
1/4" VCR® or VCO fittings	
Connection cable with card-edge connections is required and available separately	



PRODUCT CODE	RANGE
S7501T-1	0 to 5 SCCM
S7501T-2	0 - 10 SCCM
S7501T-3	0 - 50 SCCM
S7501T-4	0 - 100 SCCM
S7501T-5	0 - 200 SCCM
S7501T-6	0 - 500 SCCM
S7501T-7	0 - 1 SLPM
S7501T-8	0 - 2 SLPM
S7501T-9	0 - 5 SLPM
S7501T-10	0 - 10 SLPM
S7501T-11	0 - 20 SLPM
S7501T-12	0 - 50 SLPM
S7501T-13	0 - 100 SLPM
S7501T-14	0 - 200 SLPM
S7501T-15	0 - 500 SLPM

**SERIES S7502 - MASS FLOW CONTROLLER/GAS BLENDER**

The Series 7502 is designed to measure and control the flow of 1-4 gas streams regardless of pressure or temperature fluctuations. The signal from the flow transducer is compared to a pre-selected voltage from a precision, 10 turn potentiometer to control the valve position. The control valve may be held open or closed by an external logic signal.

With gas blending applications, a ratio control switch allows other channels to be slaved to channel 1 for precision gas blending. On the 4 channel model it is possible to slave channel 2 to channel 1 and channel 4 to channel 3.

**FEATURES**

2 Channel or 4 Channel readout/control unit  
 1-4 flow controllers, essentially the Mass Flow Transducers with integral electromagnetic valve to vary the rate of flow  
 Valve automatically goes to closed position during power failure - a great safety feature  
 Each MFC includes Swagelok® connections on the inlet and outlet  
 Flow body and valve wetted parts: 316 SS  
 "O" ring seals and valve seat: Viton® (Kalrez® optional)

**SPECIFICATIONS**

Power input:	115 VAC (230 VAC optional)
Max inlet pressure	1000 PSIG (3000) PSIG optional
Press coefficient	0.1%/ATM
Operating temperature range	10°-70° C
Temperature coefficient	0.1%/°C
Accuracy	+/- 1% full scale
Linearity	+/- 0.5% full scale
Repeatability	+/- 0.2 full scale
Response time	1.2 seconds
Output signal	0-5 VDC proportional to flow

**SECONDARY ELECTRONICS**

Two channel readout/controller	S7500-2
Four channel readout/controller	S7500-4

**OPTIONS**

10' Connection cable	S7501C-10
25' Connection cable	S7501C-25
50' Connection cable	S7501C-50
4 Channel with computer interface	S7500-4COM
1/4" VCR® or VCO fittings	
Kalrez® "O" ring and valve seat	

**PRODUCT CODE****RANGE**

S7502-1	0 to 5 SCCM
S7502-2	0 - 10 SCCM
S7502-3	0 - 50 SCCM
S7502-4	0 - 100 SCCM
S7502-5	0 - 200 SCCM
S7502-6	0 - 500 SCCM
S7502-7	0 - 1 SLPM
S7502-8	0 - 21 SLPM
S7502-9	0 - 5 SLPM
S7502-10	0 - 10 SLPM
S7502-11	0 - 20 SLPM
S7502-12	0 - 50 SLPM
S7502-13	0 - 100 SLPM

**SERIES S7505 - PORTABLE MASS FLOWMETER TRANSDUCER**

The Series 7505 self contained mass flowmeter offers accurate and repeatable gas flow measurement for non-corrosive gases. The 7505 should be utilized where accuracy is significant concern or when there are variations in temperature and pressure. This system operates on 110 volts AC. An optional battery pack is available for field applications.

**APPLICATIONS**

Laboratory flow control  
Field operations such as air sampling instrumentation

**FEATURES**

Compact design  
Tilttable LCD 3 1/2 digit display for easy flow readings  
0-100% of full scale or direct reading in engineering units  
Wetted parts: Brass, 316 SS and Viton®  
1/4" Compression connections

**SPECIFICATIONS**

Maximum inlet pressure	150 PSIG
Temperature range	0°C to 50° C
Accuracy	2% full scale
Repeatability	0.5% full scale
Leak integrity	1 x 10 <sup>-4</sup> cc/sec Helium
Response time	2 seconds to 2% of final value
Output voltage	Linear 0-5 VDC

**OPTIONAL BATTERY PACK**

Includes: battery, shoulder strap and belt loop  
Can provide power for an excess of 40 hours on one charge  
Capable of being charged a minimum of 200 times



PRODUCT CODE	FLOW RANGE
S7505-1	0 to 10 SCCM
S7505-2	0 - 20 SCCM
S7505-3	0 - 50 SCCM
S7505-4	0 - 100 SCCM
S7505-5	0 - 200 SCCM
S7505-6	0 - 500 SCCM
S7505-7	0 - 1 SLPM
S7505-8	0 - 2 SLPM
S7505-9	0 - 5 SLPM
S7505-10	0 - 10 SLPM
S7505-11	0 - 15 SLPM
S7505-BP	Battery pack
S7505-PC	AC power cord