



# HAWLEADER LIMITED

## MASS FLOW CONTROLLERS

Model TFC thermal Mass Flow Controllers are designed to indicate and control set flow rates of gases.

The TFC combines the characteristics and accuracy of conventional mass flow devices into a unique compact design at low costs previously unattainable.

Each of these controllers incorporates an advanced straight tube sensor in conjunction with flow passage elements constructed of aluminum and brass for non-corrosive gases or 316 stainless steel for corrosive applications. Zero and span adjustments are accessible from the outside of transmitters.

### Principles of Operation

Metered gases are divided into two laminar flow paths, one through the primary flow conduit, and the other through a capillary sensor tube. Both flow conduits are designed to ensure laminar flows and therefore the ratio of their flow rates is constant.

Two precision temperature sensing windings on the sensor tube are heated, and when flow takes place, gas carries heat from the upstream to the downstream windings. The resultant temperature differential is proportional to the change in resistance of the sensor windings.

A Wheatstone bridge design is used to monitor the temperature dependent resistance gradient on the sensor windings which is linearly proportional to the instantaneous rate of flow.

Output signals of 0 to 5Vdc and 4 to 20mA are generated indicating mass molecular based flow rates of the metered gas. The combined gas streams flow through a proportionating electromagnetic valve with an appropriately selected orifice. The closed loop control circuit continuously monitors the mass flow output and maintains it at the set flow rate.

Flow rates are unaffected by temperature and pressure variations within stated limitations.

### Design Features

- Rigid metallic construction.
- Maximum pressure of 1000 psig (70 bars).
- Leak integrity  $1 \times 10^{-7}$  smL/sec of helium.
- NIST traceable certification.
- Built-in tiltable LCD readout.
- Local or remote setpoint control.
- 0-5 Vdc and 4-20 mA signals.
- Circuit protection.
- Totalizer option.

### General Description

Compact, self-contained TFC mass flow controllers are designed to indicate and control flow rates of gases.

The rugged design coupled with instrumentation grade accuracy provides versatile and economical means of flow control. Aluminum or stainless steel models with readout options of either engineering units (standard) or 0 to 100 percent displays are available.



Typical Stainless Steel TFC Mass Flow Controller



## MASS FLOW CONTROLLERS



### TFC 05, 06 and 07 Series Aluminum Mass Flow Controllers

TABLE 10 - SPECIFICATIONS

<b>ACCURACY (including linearity):</b>	±1.5% of full scale, including linearity for gas temperatures of 59 °F to 77 °F (15 °C to 25 °C) and pressures of 5 to 60 psia (0.4 to 4.1 bars). Optional ±1% of full scale (certified calibration accuracy) associated with a given set of temperature and pressure values.
<b>REPEATABILITY:</b>	±0.05% of full scale.
<b>RESPONSE TIME:</b>	Generally 2 seconds to within ±2% of actual flow rate over 25 to 100% of full scale.
<b>TEMPERATURE COEFFICIENT:</b>	0.015% of full scale / °C.
<b>PRESSURE COEFFICIENT:</b>	0.01% of full scale / psi (0.07 bar).
<b>PRESSURE DROP:</b>	See Table 12.
<b>OPTIMUM GAS PRESSURE:</b>	25 psig (1.73 bars).
<b>MAX GAS PRESSURE:</b>	1000 psig (70 bars) maximum TFC 01, 03, 04. 500 psig (34.5 bars) TFC 05, 06, 07.
<b>MAX DIFF. PRESSURE:</b>	TFC 01, 03, 05, 06, and 07 50 psi (3.4 bars), TFC 47, 40 psi (2.7 bars).
<b>GAS and AMBIENT TEMP:</b>	41 °F to 122 °F (5 °C to 50 °C).
<b>**MATERIALS FLUID CONTACT:</b>	<p>a. Aluminum models TFC Series: anodized aluminum, 316 stainless steel, brass and Viton® O-rings.</p> <p>b. Stainless steel models TFC01S, 03S, 04S, 05S, 06S and 07S: 316 stainless steel and Viton® O-rings. Optional O-rings: Buna®, EPR and Kalrez®.</p>
<b>ATTITUDE SENSITIVITY:</b>	No greater than ±15 degree rotation from horizontal to vertical; standard calibration is in horizontal position.
<b>OUTPUT SIGNALS:</b>	Linear 0-5 Vdc. (1000 ohms min. load impedance); 4-20 mA (0-500 ohms loop resistance) Max noise ±20mV.
<b>COMMAND SIGNALS:</b>	Analog 0-5 Vdc or 4-20 mA for remote set point mode; NPN compatible purge /valve off.
<b>CONNECTIONS:</b>	<p><b>TFC 01 and 03:</b> 1/4" compression fittings. Optional: 1/4" VCR®, 1/8" or 3/8" compression fittings (TFC01).</p> <p><b>TFC 04:</b> 3/8" compression fittings.</p> <p><b>TFC 05:</b> 3/8" compression fittings.</p> <p><b>TFC 06:</b> 1/2" compression fittings.</p> <p><b>TFC 07:</b> 3/4" FNPT fittings. Optional: 3/4" compression fittings (TFC07).</p>
<b>LEAK INTEGRITY:</b>	1 x 10 <sup>-7</sup> sML/sec of helium maximum to the outside environment.
<b>TRANSDUCER INPUT POWER:</b>	+12 Vdc, 800 mA; +24 Vdc, 650 mA optional.
<b>CIRCUIT PROTECTION:</b>	Circuit boards have built-in polarity reversal protection. Resettable fuses provide power input protection.
<b>DISPLAY:</b>	3-1/2 digit LCD, 0.5" high characters.
<b>CE COMPLIANT:</b>	EN 55011 class 1, class B; EN50082-1.

\*\*The selection of materials of construction, is the responsibility of the customer. The company accepts no liability.



## MASS FLOW CONTROLLERS

**TABLE 11 - FLOW RANGES FOR TFC**

TFC 01 LOW FLOW MASS FLOW CONTROLLER	
CODE	scc / min [N <sub>2</sub> ]
01	0 to 10
02	0 to 20
03	0 to 50
04	0 to 100
05	0 to 200
06	0 to 500
CODE	std liters / min [N <sub>2</sub> ]
07	0 to 1
08	0 to 2
09	0 to 5
10	0 to 10
TFC 03 MEDIUM FLOW MASS FLOW CONTROLLER	
11	0 to 15
30	20
31	30
32	40
33	50
TFC 04 /05 /06 /07 HIGH FLOW MASS FLOW CONTROLLER	
40	60
41	80
42	100
50	200
60	500
70	1000

**TABLE 12 - MAXIMUM PRESSURE DROP FOR TFC**

MODEL	FLOW RATE [std liters/min]	MAXIMUM PRESSURE DROP		
		[mm H <sub>2</sub> O]	[psid]	[mbar]
TFC 01	UP to 10	720	1.06	75
TFC 03	15	2630	3.87	266
	20	1360	2.00	138
	30	2380	3.50	241
	40	3740	5.50	379
	50	5440	8.00	551
	60	7480	11.00	758
TFC 47	100	12850	18.89	1302
TFC 57	200	7031	10.00	690
TFC 67	500	8437	12.00	827
TFC 77	1000	10547	15.00	1034

The built-in electromagnetic valve allows the flow to be set to any desired flow rate within the range of the particular model. Setpoints are controlled either locally or remotely. The valve is normally closed as a safety feature to ensure that gas flow is shut off in case of a power outage. The LCD readout built into the top of the transducer is tiltable over 90 degrees to provide optimal reading comfort. It is connected to the transducer by a standard modular plug, and is readily removable for remote reading installations. Transducers without LCD readout are offered for OEM applications. TFC mass flow controllers are available with flow ranges from 10 mL/min to 1000 sL/min N<sub>2</sub>. Gases are connected by means of 1/4", 3/8", or optional 1/8" compression fittings and 3/4" FNPT fittings. Optional fittings are available. These controllers may be used as bench top units or mounted by means of screws in the base. Transducer power supply ports are fuse and polarity protected.

### Leak Integrity

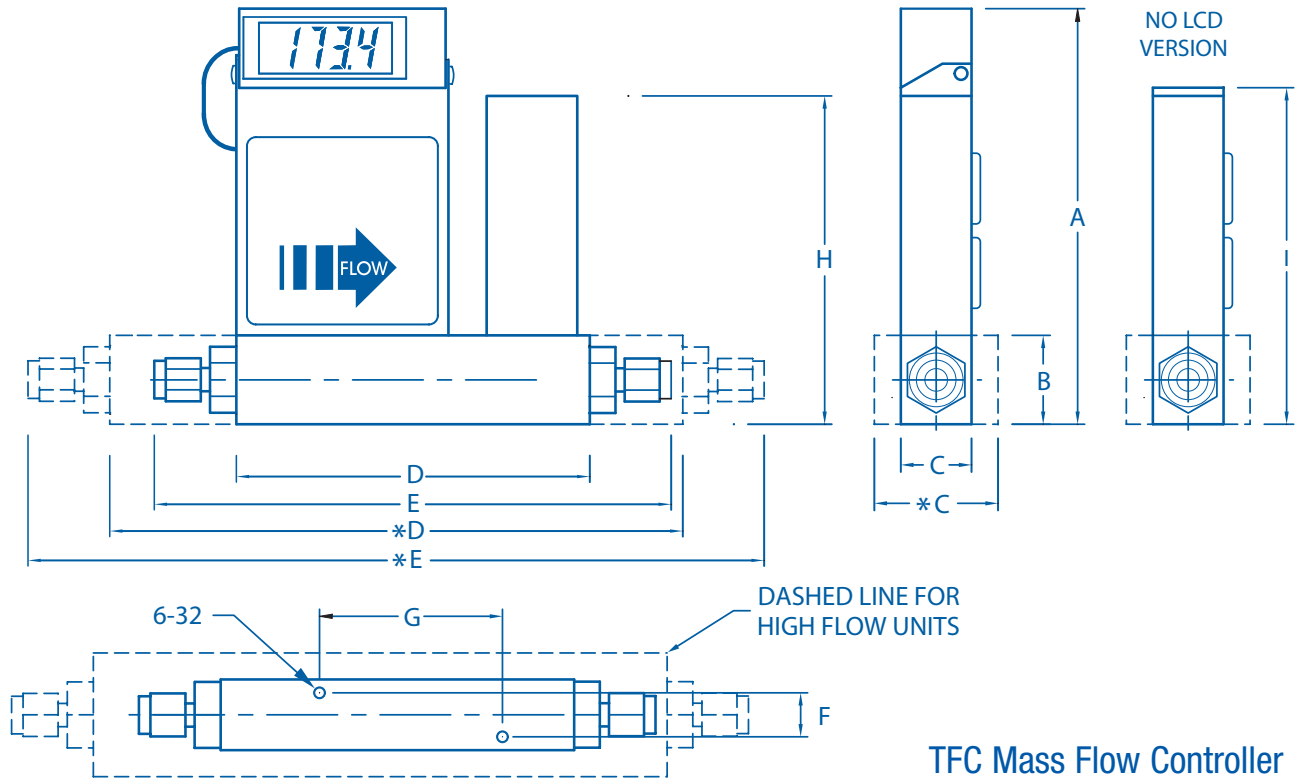
1 x 10<sup>-7</sup> smL/sec of helium maximum to the outside environment.

**TABLE 13 - ACCESSORIES FOR TFC**

TOTALIZER	
TOT-10-0C	Totalizer (5Vdc - 10Vdc signals), calibrated.
TOT-10-0N	Totalizer (5Vdc - 10Vdc signals), uncalibrated.
CBL-TOT10	Cable & splitter, used in conjunction w/ display.
IO INPUT /OUTPUT	
IO-232-C	Input/output to RS232, 0-5Vdc.
IO-232-E	Input/output to RS232, 4-20mA.
IO-485-C	Input/output to RS485, 0-4Vdc.
IO-485-E	Input/output to RS485, 4-20mA.
POWER SUPPLY - BATTERY PACK - CABLES	
PS-TFC-110NA-2	Power Supply, 110 V/12 Vdc /North America
PS-TFC-110NA-4	Power Supply, 110 V/24 Vdc /North America
PS-TFC-230EU-2	Power Supply, 220 V/12 Vdc /Europe
PS-TFC-230EU-4	Power Supply, 220 V/24 Vdc /Europe
PS-TFC-240UK-2	Power Supply 240 V/12 Vdc /United Kingdom
PS-TFC-240UK-4	Power Supply 240 V/24 Vdc /United Kingdom
PS-TFC-240AU-2	Power Supply 240 V/12 Vdc /Australia
PS-TFC-240AU-4	Power Supply 240 V/24 Vdc /Australia
CBL-DGS	Cable, Shielded 15-pin D-connector /end terminated
01/ 3RC	Remote Cable, 3 feet long
01/ R	Remote LCD readout with 3 feet long cable



## MASS FLOW CONTROLLERS



TFC Mass Flow Controller

TABLE 14 - DIMENSION FOR TFC

MODEL	CONNECTION Compression Fitting (except model TFC 07)	DIMENSION (INCH)							
		LCD VERSION							NO LCD
		A	B	C/*C	D/*D	E/*E	F	G	
TFC01	1/4" Tube O Dia.	5.60	1.00	1.00	4.27	6.29	0.69	2.69	4.50
TFC03	1/4" Tube O Dia.	5.98	1.37	1.25	5.19	7.21	0.69	2.69	4.88
TFC04	3/8" Tube O Dia.	5.98	1.37	1.25	5.19	7.33	0.69	2.69	4.88
TFC05	3/8" Tube O Dia.	6.60	2.00	1.75	10.2	12.3	0.99	4.69	5.50
TFC06	1/2" Tube O Dia.	7.56	3.00	3.00	10.2	12.4	1.69	-	6.46
TFC07	3/4" NPT Female	8.56	4.00	4.00	10.5	-	-	-	7.46

NOTE: Only 12Vdc for models TFC 05, 06 and 07. For Specific Flow Ranges Contact Aalborg Customer Service Department.



# HAWLEADER LIMITED

## ORDERING INFORMATION MASS FLOW CONTROLLERS

TFC	MODEL
MAX. FLOW (N <sub>2</sub> )	
01	10 L/min
03	50 L/min
04	100 L/min
05	200 L/min
06	500 L/min
07	1000 L/min
MATERIAL	
A	Aluminum
S	Stainless Steel
SEALS	
V	Viton®
B	Buna®
E	EPR
T	PTFE/ Kalrez®
FITTINGS	
A	1/4" Compression
B	1/8" Compression
C	1/4" VCR®
D	3/8" Compression
E	1/2" Compression
F	3/4" FNPT
G	3/4" Compression
X	Special
CONNECTOR	
D	D Connector
DISPLAY	
N	No display
L	LCD readout
POWER	
2	12 Vdc
4	24 Vdc
INPUT/OUTPUT SIGNAL	
A	Local 0-5 Vdc
B	Local 4-20mA
C	0-5Vdc/0-5Vdc
D	0-5Vdc/4-20mA
E	4-20mA/4-20mA
F	4-20mA/0-5Vdc
DIGITAL INTERFACE	
0	None

TFC	17	S	-	V	A	D	L	2	-	C	0
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**EXAMPLE: GFC17S-VADL2-C0** 10 L/min [N<sub>2</sub>] 20 psig

***SPECIFY: GAS, FLOW RANGE and PRESSURE***

TFC01 stainless steel, Viton® seals, 1/4" compression fittings, D connector with display, 12Vdc, 0-5 Vdc. Out put signal, No digital interface