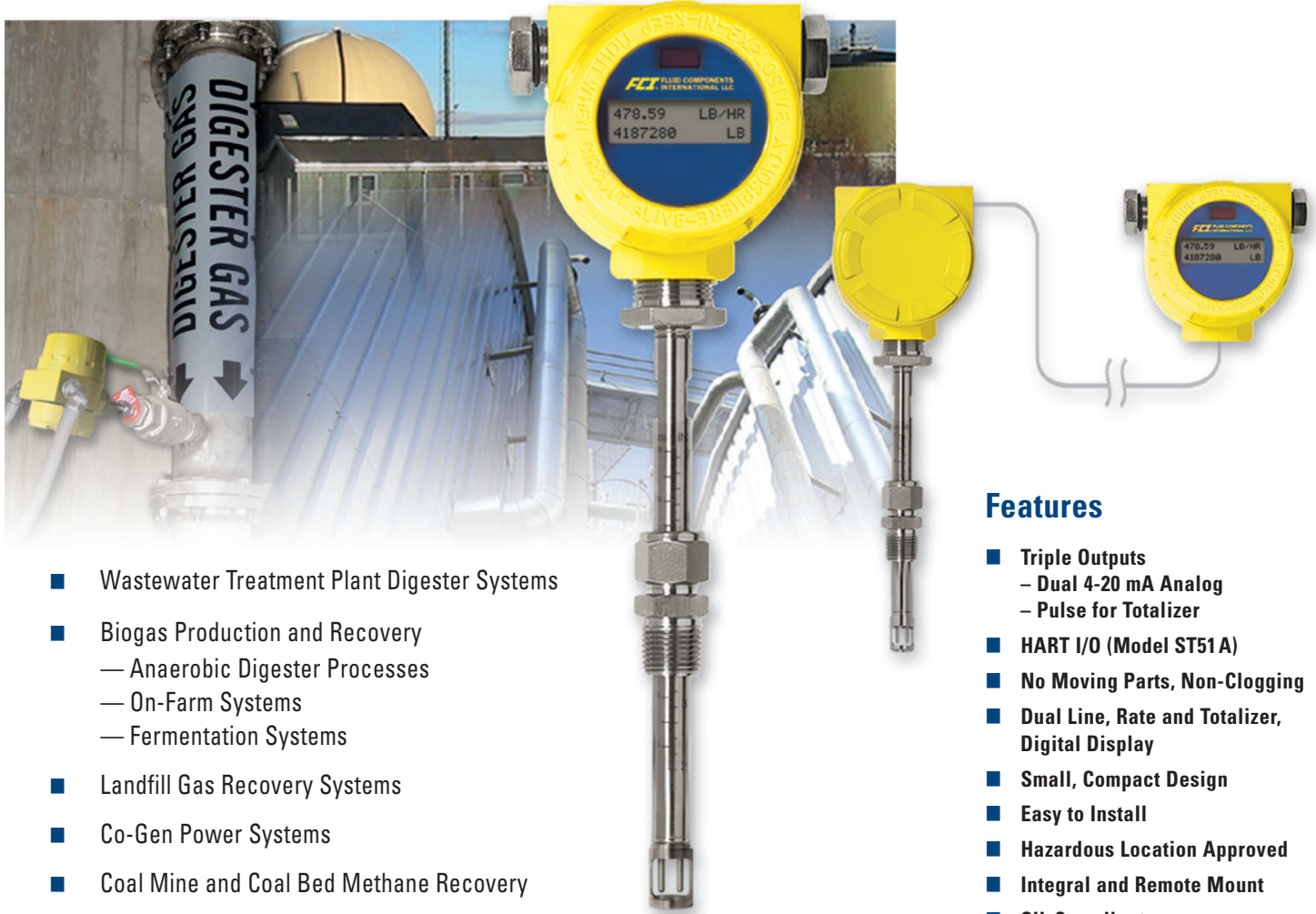


ST51 / ST51 A Mass Flow Meters

For Biogas, Digester Gas, Methane and Natural Gas



- Wastewater Treatment Plant Digester Systems
- Biogas Production and Recovery
 - Anaerobic Digester Processes
 - On-Farm Systems
 - Fermentation Systems
- Landfill Gas Recovery Systems
- Co-Gen Power Systems
- Coal Mine and Coal Bed Methane Recovery

Features

- Triple Outputs
 - Dual 4-20 mA Analog
 - Pulse for Totalizer
- HART I/O (Model ST51 A)
- No Moving Parts, Non-Clogging
- Dual Line, Rate and Totalizer, Digital Display
- Small, Compact Design
- Easy to Install
- Hazardous Location Approved
- Integral and Remote Mount
- SIL Compliant

The **ST51 Series Flow Meter** is an accurate, easy to install, no moving parts solution for measuring and controlling biogases, digester gases, methane and natural gas flow. ST51 utilizes FCI proven thermal dispersion technology to provide direct mass flow measurement resulting in higher performance at a lower cost than orifice plates, DP, Vortex shedding and other thermal devices.

Biogas and digester gas applications are challenged by wide flow variations and dirty, wet gas. Flow variation is experienced as these processes move from low production start-up phases to a consistent, sustainable process and by seasonal temperature change, where cold temperatures slow gas production and higher temperature accelerate gas production. While the primary composition of these gases is methane and CO₂, residual H₂S and wet vapor leave deposits and corrode surfaces. ST51 provides the solution to these challenges. It features a wide-turndown ratio, up to 100:1 and is highly sensitive to low flow measurement. To measure correctly in fluctuating temperatures, flow meters must include temperature compensation circuitry and it is standard in ST51. ST51 has no moving parts to foul or clog and is easily pulled from the pipe for occasional cleaning.

ST51 installs in line sizes ranging from 2 inch to 24 inch [51 mm to 610 mm] with 1/2 inch or 3/4 inch NPT.

The ST51 uses precision, lithography structured platinum RTD sensors embedded in FCI's equal mass small diameter thermowells. Combined with microprocessor electronics and precision calibration, the ST51 achieves excellent accuracy, fast response and virtually maintenance free operation.



Biogas, digester gas and landfill gas compositions are dominated by methane (CH₄) and present a potentially hazardous installation environment. Sound engineering practice and often regulations mandate that instrumentation meet guidelines and have agency approvals for installation zone safety. Depending on actual installation location, at a minimum the environment will require Class I, Division II and often a more rigorous Class I, Division I [Zone 1 IIC] approvals. FCI ST51 meets all of these and has obtained the global agency approvals that ensure your installation is always safe and complies with regulations. And, unlike manufacturers who merely provide their transmitter electronics in an approved OEM enclosure, FCI submits its entire instrument to agency testing. FCI product approvals are different because they are comprehensive system approvals that also take into account the sensor and seal requirements as well the "T" (temperature) ratings. FCI agency approvals are on the total instrument. With ST51 you are assured of the integrity of total instrument approvals that meet or exceed safe engineering practice for your applications.

ST51 Specifications

Instrument

Media Compatibility: Biogas, digester gas, methane, natural gas, air, compressed air, nitrogen

Pipe/Line Size Compatibility: 2" to 24" [51 mm to 610 mm]¹

Flow Range: 0.3 SFPS to 400 SFPS [0,08 MPS to 122 MPS]

Accuracy: (at ≥ 0.75 SFPS [$\geq 0,21$ NMPS])²

Standard: $\pm 2\%$ reading $\pm 0.5\%$ full scale

Optional: $\pm 1\%$ reading $\pm 0.5\%$ full scale

Repeatability: $\pm 0.5\%$ reading

Temperature Compensation

Standard: 40 °F to 100 °F [4 °C to 38 °C];

Optional: 0 °F to 350 °F [-18 °C to 77 °C]

Temperature Coefficient

With temperature compensation; valid from 10% to 100% of full scale calibration

Flow: Maximum $\pm 0.015\%$ of reading / °F up to 350 °F [$\pm 0.03\%$ of reading / °C up to 177 °C]

Turndown Ratio: 3:1 to 100:1

Agency Approvals

FM, FMC: Class I, Division 1, Groups B, C, D; T4 Ta = 60°C
Class II/III, Division 1, Groups E, F, G; T4 Ta = 60°C; Type 4X/IP66
Class I, Division 2, Groups A, B, C, D; T4 Ta = 60°C

ATEX, IECEx: Zone 1, Zone 21
II 2 G Ex db IIC T6...T1 Gb
II 2 D Ex tb IIIC T85°C... T300°C Db; IP66/IP67
Ta = -40°C to +65°C

Other: EAC (TRCU) Russia, CE Marking, CRN

SIL (ST51A): SIL 1 compliant; Safe Failure Fraction (SFF) 78.5% to 81.1%

Warranty: ST51 – 1 year; ST51 A – 2 years

¹ For line sizes 2" [51 mm] or smaller, see FCI ST75 Series

² Contact FCI for accuracy below 0.75 SFPS [0,21 NMPS]

Flow Element

Installation: Insertion, variable length with 1/2" or 3/4" MNPT compression fitting

Type: Thermal dispersion

Material of Construction: 316L stainless steel body with Hastelloy-C22 thermowell sensors, 316 stainless steel compression fitting with Teflon or stainless steel ferrule

Pressure (Maximum Operating without Damage)

Stainless steel ferrule: 500 psig [34 bar (g)]

Teflon ferrule: 150 psig [10 bar (g)]

Operating Temperature

Stainless steel ferrule

ST51: -0 °F to 250 °F [-18 °C to 121 °C]

ST51 A: -0 °F to 350 °F [-18 °C to 177 °C]

Teflon ferrule: -0 °F to 200 °F [-18 °C to 93 °C]

Process Connection: 1/2" MNPT or 3/4" MNPT with stainless steel or

Teflon ferrule

Insertion Length (Field Adjustable)

1" to 6" [25 mm to 152 mm]

1" to 12" [25 mm to 305 mm]

1" to 18" [25 mm to 457 mm]

Flow Transmitter

Enclosure

Rating: NEMA 4X, IP67

Material: *Standard* – aluminum, polyester powdered coated
Optional – 316 stainless steel

Conduit/Cable Port: Dual 1/2" NPT or M20x1.5

Operating Temperature: 0 °F to 140 °F [-18 °C to 60 °C]

Input Power

DC: 18 Vdc to 36 Vdc (6 watts max.)

AC: 85 Vac to 265 Vac (12 watts max.; CE Marking approval from 100 Vac to 240 Vac)

Analog Output Signals: Dual 4-20 mA, user assignable to flow rate and/or temperature and a 0-500 Hz pulse output for total flow; ST51A output #1 has fault indication per NAMUR NE43 guidelines, user selectable for high (>21.0 mA) or low (<3.6 mA)

Bus Communications (ST51 A): HART (version 7); FieldComm Group certified; available over output #1; DD file included

Communication Port: RS-232C

Digital Display (Optional): Two-line x 16 character LCD; displays measured value and engineering units; top line assigned to flow rate, second line user assignable to temperature reading, as flow totalizer or alternating; display can be rotated in 90° increments for optimum viewing orientation

Installation and Mounting: Integral with sensor element or remote mountable up to 50' [15 m] with Model ST51, and up to 100' [30 m] with Model ST51A

Dual 4-20 mA outputs

4-20 mA per NAMUR NE43

HART I/O

500 Hz pulse output

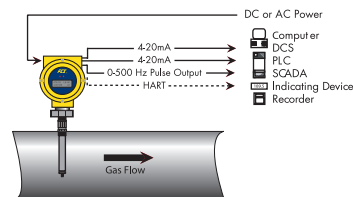
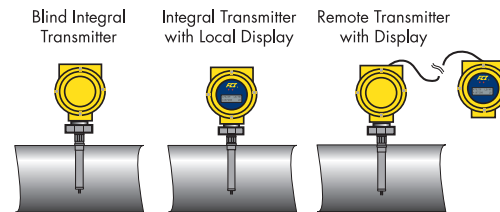
Process operating temperature

Maximum remote distance

SIL compliance rating

Warranty Standard

	ST51	ST51 A
Dual 4-20 mA outputs	■	■
4-20 mA per NAMUR NE43		■
HART I/O		■
500 Hz pulse output	■	■
Process operating temperature	To 250 °F [to 121 °C]	To 350 °F [to 177 °C]
Maximum remote distance	50' [15 m]	100' [30 m]
SIL compliance rating		■
Warranty Standard	1 year	2 years



FCI FLUID COMPONENTS INTERNATIONAL LLC

Locally Represented By:

Visit FCI online at www.FluidComponents.com | FCI is ISO 9001:2000 and AS9100 Certified

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Doc. No. 02MK011532D Page 2 of 2

ST51 -

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Block No. 1 2 3 4 5 6 7 8

INSTRUCTIONS: To order an **ST51**, please fill in each numbered block above by selecting required codes from the corresponding categories below. Use of any "W" or "*" codes requires prior approval from FCI. For special data, documentation, test reports or required quality reports, refer to FCI's Engineering and Quality Assurance Order Information Sheets (OIS).

Code	[BLOCK 1] Base Unit, Enclosure Style, Power Supply
<i>Enclosures: all aluminum, NEMA4X/IP67 rated, epoxy coated</i>	
1	Blind, integral transmitter with two 1/2" FNPT cable entries 18 Vdc to 36 Vdc powered
2	Blind, integral transmitter with two 1/2" FNPT cable entries 85 Vac to 265 Vac powered
3	Integral transmitter with local digital display, with two 1/2" FNPT cable entries 18 Vdc to 36 Vdc powered
4	Integral transmitter with local digital display, with two 1/2" FNPT cable entries 85 Vac to 265 Vac powered
7	Remote transmitter with two 1/2" FNPT cable entries and with digital display (specify cable length in Block 8) 18 Vdc to 36 Vdc powered
8	Remote transmitter with two 1/2" FNPT cable entries and with digital display (specify cable length in Block 8) 85 Vac to 265 Vac powered
A	Blind, integral transmitter with two M20x1.5 cable entries 18 Vdc to 36 Vdc powered
B	Blind, integral transmitter with two M20x1.5 cable entries 85 Vac to 265 Vac powered
C	Integral transmitter, with local digital display, with two M20x1.5 cable entries 18 Vdc to 36 Vdc powered
D	Integral transmitter, with local digital display, with two M20x1.5 cable entries 85 Vac to 265 Vac powered
E	Remote transmitter with two M20x1.5 cable entries and with digital display (specify cable length in Block 8) 18 Vdc to 36 Vdc powered
F	Remote transmitter with two M20x1.5 cable entries and with digital display (specify cable length in Block 8) 85 Vac to 265 Vac powered

Code	[BLOCK 2] Pipe Installation, Display/Transmitter Mounting Orientation and Flow Direction		
Code	Horizontal Pipe	Code	Vertical Pipe
F	Top mount, display facing forward, flow left-to-right	M	Side mount left, display facing forward, flow up
G	Top mount, display facing forward, flow right-to-left	N	Side mount right, display facing forward, flow up
H	Side mount, display facing up, flow left-to-right	P	Side mount left, display facing forward, flow down
J	Side mount, display facing up, flow right-to-left	R	Side mount right, display facing forward, flow down
K	Side mount, display facing down, flow left-to-right	<i>For visual representation, see FCI drawing number 021263 on page 2</i>	
L	Side mount, display facing down, flow right-to-left		

Code	[BLOCK 3] Process Connection / Ferrule Material
1	1/2" male NPT/Teflon ferrule
2	1/2" male NPT/metal ferrule
3	3/4" male NPT/Teflon ferrule
4	3/4" male NPT/metal ferrule

Code	[BLOCK 4] Insertion Length
1	6" [152 mm] maximum "U" length
2	12" [305 mm] maximum "U" length
3	18" [457 mm] maximum "U" length

Code	[BLOCK 5] Gas Medium and Calibration ²
For Biogas, Digester Gas, Natural Gas, Methane, Flue Gas and Other Hydrocarbon Mixed Gases	
C	Customized air equivalency: 0.75 SFPS to 100 SFPS; 10 psia to 50 psia [0,2 NMPS to 30 NMPS; 0,7 to 3,5 bar (a)]
1	Natural gas (90% or greater methane content)
F	Customized actual gas
For Air, Nitrogen or Compressed Air Calibration	
A	Standard; 1.25 SFPS to 125 SFPS; 10 psia to 50 psia [0,4 NMPS to 38 NMPS; 0,7 bar (a) to 3,5 bar (a)] ⁷
B	Customized; 0.75 SFPS to 150 SFPS; 10 psia to 50 psia [0,2 NMPS to 45,7 NMPS; 0,7 bar (a) to 3,5 bar (a)]
D	Standard; 4 SFPS to 400 SFPS; 50 psia to 165 psia [1,2 NMPS to 122 NMPS; 3,5 bar (a) to 11,4 bar (a)] ^{6,7}
E	Customized; 4 SFPS to 400 SFPS; 50 to 165 Psia [1,2 NMPS to 122 NMPS; 3,5 bar (a) to 11,4 bar (a)] ⁶
W	Factory approved, customer specified, special calibration
Code	[Block 6] Calibration ⁴ and Calibration Conditions <i>Temperature, Vortab Flow Conditioner, Flat Flow Profile</i>
0	Standard 2% accuracy calibration and conditions 40 °F to 100 °F [4 °C to 38 °C]
A	Standard 2% accuracy calibration and extended temperature compensation 0 °F to 250 °F [-18 °C to 121 °C]
M	High accuracy 1% calibration and standard conditions 40 °F to 100 °F [4 °C to 38 °C]
N	High accuracy 1% calibration and extended temperature compensation 0 °F to 250 °F [-18 °C to 121 °C]
Q	High accuracy 1% calibration with Vortab (VEL, VFK, VIS, VMR or VSR)
5	High accuracy 1% calibration with Vortab (VIP)
T	High accuracy 1% calibration and extended temperature compensation 0 °F to 250 °F [-18 °C to 121 °C] and Vortab (VEL, VFK, VIS, VMR or VSR)
6	High accuracy 1% calibration and extended temperature compensation 0 °F to 250 °F [-18 °C to 121 °C] and Vortab (VIP)
R	High accuracy 1% calibration, at flat flow profile
U	High accuracy 1% calibration and extended temperature compensation 0 °F to 250 °F [-18 °C to 121 °C] and flat flow profile

(continued next page)

(continued from previous page)

Code	[BLOCK 7] Transmitter Options All standard
0	Standard
Code	[BLOCK 8] Interconnecting Cable Length for Remote Configurations
0	Not required (specify with integral configurations)
A	10' [3 m]
B	25' [7,6 m]
C	50' [15 m]
W	Custom length (cannot exceed 50' [15 m])

Notes

- Must use FCI's AVAL program to determine letter code. AVAL is a custom flow meter optimizer program which considers gas medium, flow range, pipe size and other conditions to determine best calibration and supplies FCI letter code to be used here. AVAL is available online at www.fluidcomponents.com or consult your local FCI Representative.
- Calibration accuracy is $\pm\%$ of reading, $\pm 0.5\%$ of full scale.
- Flow element will be -FPC type with FCI patent-pending flow conditioner.
- User configures line size, scaled flow range and engineering units in the field with PC, PDA or FCI FC88 Calibrator.

Accessories

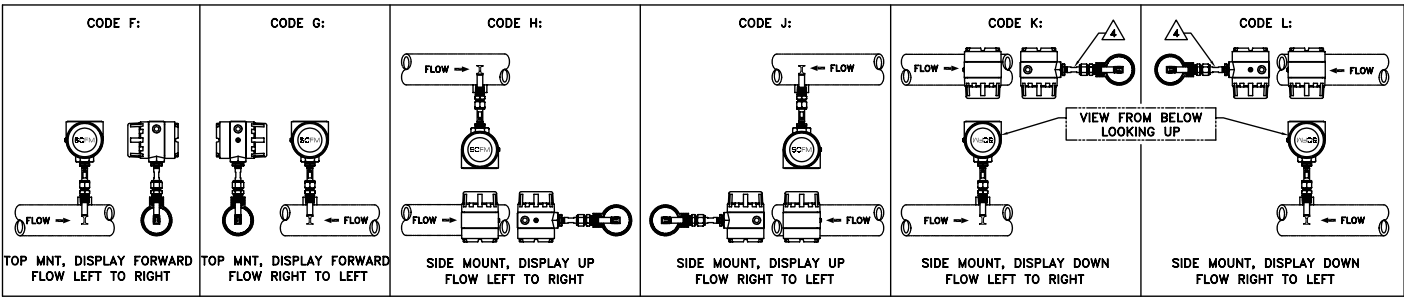
Part Number	Description
FC88	Portable Hand-held Communicator
014108-02	PC Interface Communications Kit, for RS232 serial port connection
DM10-FC	DM10 with FM and CSA approvals
DM10-KIT1	Panel Mount Kit for DM10
DM10-KIT2	2 inch (52 mm) Pipe Mount Kit for DM10 (stainless steel)
DM15	Digital Display/Readout, LED 115/230 Vac powered
DM15-ALM	Same as DM-15 with user programmable alarm limit, relay output

NOTICE OF PROPRIETARY RIGHTS

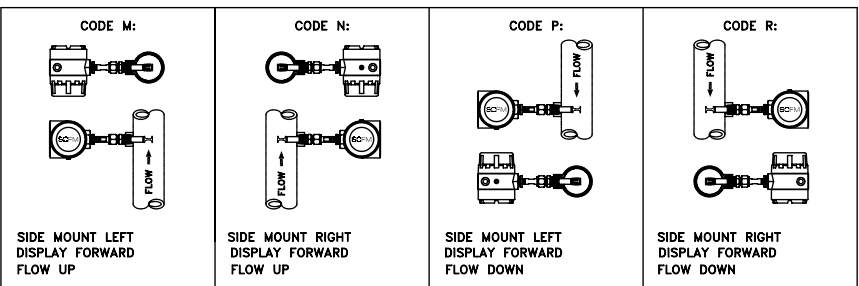
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REV	DESCRIPTION	DATE
B	MAJOR CHANGE, SEE DCN (REVISED AND REDRAWN)	8/2/11

INTEGRAL HORIZONTAL MOUNTINGS



INTEGRAL VERTICAL MOUNTINGS



- ▲ FLOW ARROW ON TOP AS SHOWN
 - 3. THE LCD DISPLAY CAN BE USER ROTATED AND VIEWED AT ANY 90 DEGREE ORIENTATION.
 - 2. IN REMOTE ELECTRONIC CONFIGURATIONS, THE LOCAL ENCLOSURE WILL BE ORIENTED AS SHOWN WITH SOLID COVER ON BOTH SIDES. INTERCONNECTING TERMINALS LOCATED INSIDE.
 - 1. THIS DRAWING IS GENERIC IN NATURE, FOR SPECIFIC MODEL TYPE, ORIENTATION, CUSTOMER PROCESS CONNECTION, ETC, REFER TO I&M MANUAL.
- NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES		CONTRACT NO.		APPROVALS		APPROVALS		TITLE	
DECIMALS	ANGULAR	DATE	BY	DATE	BY	DATE	BY	DATE	BY
NEXT ASSY USED ON		APPLICATION		DESIGNER		CHECKER		DRAWN	
THIRD ANGLE PROJECTION		DO NOT SCALE DIMENSIONS		SCALE		SHEET NO.		TOTAL SHEETS	
				64818		021263		B	
				NONE		1 OF 1			

ST51 A -

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Block No. 1 2 3 4 5 6 7 8 9

INSTRUCTIONS: To order an **ST51 A**, please fill in each numbered block above by selecting required codes from the corresponding categories below. Use of any "W" or "*" codes requires prior approval from FCI. For special data, documentation, test reports or required quality reports, refer to FCI's Engineering and Quality Assurance Order Information Sheets (OIS).

Code	[BLOCK 1] Base Unit, Enclosure Style, Power Supply
1	Blind, integral transmitter with two 1/2" FNPT cable entries 18 Vdc to 36 Vdc powered
2	Blind, integral transmitter with two 1/2" FNPT cable entries 85 Vac to 265 Vac powered
3	Integral transmitter with local digital display, with two 1/2" FNPT cable entries 18 Vdc to 36 Vdc powered
4	Integral transmitter with local digital display, with two 1/2" FNPT cable entries 85 Vac to 265 Vac powered
7	Remote transmitter with two 1/2" FNPT cable entries and with digital display (specify cable length in Block 8) 18 Vdc to 36 Vdc powered
8	Remote transmitter with two 1/2" FNPT cable entries and with digital display (specify cable length in Block 8) 85 Vac to 265 Vac powered
A	Blind, integral transmitter with two M20x1.5 cable entries 18 Vdc to 36 Vdc powered
B	Blind, integral transmitter with two M20x1.5 cable entries 85 Vac to 265 Vac powered
C	Integral transmitter, with local digital display, with two M20x1.5 cable entries 18 Vdc to 36 Vdc powered
D	Integral transmitter, with local digital display, with two M20x1.5 cable entries 85 Vac to 265 Vac powered
E	Remote transmitter with two M20x1.5 cable entries and with digital display (specify cable length in Block 8) 18 Vdc to 36 Vdc powered
F	Remote transmitter with two M20x1.5 cable entries and with digital display (specify cable length in Block 8) 85 Vac to 265 Vac powered

Code	[BLOCK 2] Pipe Installation, Display/Transmitter Mounting Orientation and Flow Direction		
Code	Horizontal Pipe	Code	Vertical Pipe
F	Top mount, display/blind front facing forward, flow left-to-right	M	Side mount left, display/blind front facing forward, flow up
G	Top mount, display/blind front facing forward, flow right-to-left	N	Side mount right, display/blind front facing forward, flow up
H	Side mount, display/blind front facing up, flow left-to-right	P	Side mount left, display/blind front facing forward, flow down
J	Side mount, display/blind front facing up, flow right-to-left	R	Side mount right, display/blind front facing forward, flow down
K	Side mount, display/blind front facing down, flow left-to-right		
L	Side mount, display/blind front facing down, flow right-to-left		

For visual representation, see FCI drawing number 021263 on page 2

Code	[BLOCK 3] Process Connection/Ferrule Material
1	1/2" male NPT/Teflon ferrule ⁹
2	1/2" male NPT/metal ferrule ⁹
3	3/4" male NPT/Teflon ferrule ⁹
4	3/4" male NPT/metal ferrule ⁹

Code	[BLOCK 4] Insertion Length
1	6" [152 mm] maximum "U" length
2	12" [305 mm] maximum "U" length
3	18" [457 mm] maximum "U" length

Code	[BLOCK 5] Gas Medium and Calibration ²
For Biogas, Digester Gas, Natural Gas, Methane, Flue Gas and Other Hydrocarbon Mixed Gases	
C	Customized air equivalency: 0.75 SFPS to 100 SFPS; 10 psia to 50 psia [0,2 NMPS to 30 NMPS; 0,7 bar (a) to 3,5 bar (a)]
1	Natural gas (90% or greater methane content)
F	Customized actual gas
For Air, Nitrogen or Compressed Air Calibration	
A	Standard; 1.25 SFPS to 125 SFPS; 10 psia to 50 psia [0,4 NMPS to 38 NMPS; 0,7 bar (a) to 3,5 bar (a)] ⁷
B	Customized; 0.75 SFPS to 150 SFPS; 10 psia to 50 psia [0,2 NMPS to 45,7 NMPS; 0,7 bar (a) to 3,5 bar (a)]
D	Standard; 4 SFPS to 400 SFPS; 50 psia to 165 psia [1,2 NMPS to 122 NMPS; 3,5 bar (a) to 11,4 bar (a)] ^{6,7}
E	Customized; 4 SFPS to 400 SFPS; 50 to 165 Psia [1,2 NMPS to 122 NMPS; 3,5 bar (a) to 11,4 bar (a)] ⁶
W	Factory approved, customer specified, special calibration
Code	[Block 6] Calibration ⁴ and Conditions
0	Standard 2% accuracy calibration
A	Standard 2% accuracy calibration and extended temperature compensation
M	High accuracy 1% calibration
N	High accuracy 1% calibration and extended temperature compensation
Q	High accuracy 1% calibration with Vortab (VEL, VFK, VIS, VMR or VSR)
5	High accuracy 1% calibration with Vortab (VIP)
T	High accuracy 1% calibration, and extended temperature compensation, and Vortab (VEL, VFK, VIS, VMR or VSR)
6	High accuracy 1% calibration, and extended temperature compensation, and Vortab (VIP)
R	High accuracy 1% calibration and flat flow profile
U	High accuracy 1% calibration, and extended temperature compensation, and flat flow profile

(continued next page)

Notes

- Must use FCI's AVAL program to determine letter code. AVAL is a custom flow meter optimizer program which considers gas medium, flow range, pipe size and other conditions to determine best calibration and supplies FCI letter code to be used here. AVAL is available online at www.FluidComponents.com or consult your local FCI Representative.
- Calibration accuracy is ±% of reading, ± 0.5% of full scale.
- Flow element will be -FPC type with FCI patent-pending flow conditioner.
- User configures line size, scaled flow range and engineering units in the field with PC or FCI FC88 Calibrator.
- Teflon ferrule maximum is 200 °F [93 °C], 150 psi(g) [10 bar(g)]; metal ferrule maximum is 500 °F [260 °C], 500 psi(g) [34 bar(g)]

(continued from previous page)

Code [BLOCK 7] Transmitter Housing Material and Output Options	
2	Standard aluminum housing, dual 4-20 mA outputs, HART and pulse output
C	Stainless steel housing, dual 4-20 mA outputs, HART and pulse output
W	Other, agency approved
Code [BLOCK 8] Interconnecting Cable Length for Remote Configurations	
0	Not required (specify with integral configurations) ⁸
A	10' [3 m]
B	25' [7,6 m]
C	50' [15 m]
D	100' [30 m]
W	Custom length
Code [BLOCK 9] Agency Approval	
<i>CE Mark always included</i>	
0	Not required, CE Mark only
1	FM, FMc
3	ATEX, IECEx ⁸
*	Other <i>Contact FCI for other approvals and conditions of use</i>

Notes

- ATEX/IECEx rated remote requires cable glands or conduit fittings which meet or exceed the installation area's required rating. When rated cable glands, armored cable and non-armored cable are user-supplied, or selected separately from FCI accessories list, enter Code 0 in Block 8.

Accessories

Part Number	Description
FC88	Portable Hand-held Communicator
014108-03	PC Interface Communications Kit, for RS232 serial port connection

