REV. 2.7

CS 系列 200-A,C,D 型　　气体质量流量控制器/质量流量计

使 用 手 册

Sevenstar 北京七星华创电子股份有限公司
BEIJING SEVENSTAR ELECTRONICS CO., LTD.

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目　　录

气体质量流量控制器和质量流量计

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第一部分 产品说明

1.1 声明

《气体质量流量控制器和质量流量计使用手册》版权属于北京七星华创电子股份有限公司(以下简称“七星电子”)专有。如无七星电子的书面许可，不得部分或全部影印本使用手册。本手册已经严格审校，但不保证手册中不含错误与遗漏，出版商不承担任何由于错误或遗漏的责任，亦不承担由于使用本手册中的信息所导致的损失的任何责任。

北京七星华创电子股份有限公司

1.2 使用须知

尊敬的用户，感谢您购买本公司生产的 CS 系列气体质量流量控制器/质量流量计产品。本手册详细叙述了正确、安全使用该系列产品的必要事项。

产品使用者，请务必认真参阅本手册并理解后使用，在使用过程中，请注意带有⚠Ⓘ标志的文字及注意事项中包含的所有内容。

对于未按照使用手册使用造成的财产损失或人身伤害，本公司有权不承担责任。

本手册在您安装、维护及故障维修时必不可少，请妥善留存保管。

1.3 安全注意事项

下列注意事项请结合使用手册查看。未按照注意事项进行操作所产生的一切后果本公司不予承担。

a）请勿替换产品零部件或者改动产品

不要替换产品的任何零部件或者对仪器进行任何未授权的改动。在返厂进行重新标定或维修的时候必须保证安全标签完好无损。

b）请联络专业工作人员为您服务

使用时勿擅自更换零部件，任何技术支持都必须由本公司授权的专业技术人员来为您服务。

c）使用危险气体时请特别注意

如果使用危险气体，请做好预防措施，条件允许请完全吹洗仪器。如果危险气体潮湿，须确保潮湿的危险气体不会和仪器以及密封材料产生化学反应。

d）吹洗仪器时特别注意

在从气路上拆卸仪器之前和安装仪器后都要对整个系统进行吹洗，用干燥气体吹洗通道内剩余气体的残渣。

e）请遵照合适的步骤吹洗

产品必须在通风保护罩下进行吹洗，并且操作人员必须带上手套进行保护。

f）请勿在爆炸性环境下使用本产品

为了避免产生爆炸，不要在爆炸性环境下使用本产品，除非本产品获得有效认证 。

g）请使用合适的接头并按照相关的紧固规程来操作

所有仪器的接头都必须和产品说明书上的型号相符，且与仪器所使用的接头相一致且与仪器所使用的接头相配套。拧紧接头的时候请按照产品操作指导说明书来操作。

h）请检查产品接头处是否漏气

请仔细的检查所有的零部件接口以确保在安装过后没有漏气。

i）请使产品在安全入口压力下工作

请勿使仪器的入口压力超出最大工作压力（请参阅产品说明书中的最大工作压力）

j）请使整个系统远离污染

系统在运行过程中，请**勿**使用含有污染物的气体。如气体中含有灰尘、污垢、纤维、玻璃碎片或者铁屑等。

k）请预热仪器后再使用

请预热后再使用，尤其是危险气体，更加应该注意。请使用绝对关闭的阀以确保在预热过程中不会有错误的流量通过。

1.4 概述

气体质量流量控制器（MFC）和气体质量流量计（MFM）用于对气体的质量流量进行精密控制和测量。它们在半导体集成电路工艺、特种材料、化学工业、石油工业、医药、环保和真空等多种领域的科研和生产中有着重要的应用。其典型的应用场合包括: 集成电路工艺设备, 如外延炉、扩散炉、CVD、等离子刻蚀机、溅射台、离子注入机; 以及镀膜设备、光纤熔炼设备、微反应装置、混气配气系统、气体取样装置、毛细管测量仪、气相色谱仪及其它分析仪器。

CS200-A,C,D 型 MFC/ MFM 是七星电子生产的数字型产品，为气体质量流量的控制、测量提供了高准确度及高可靠性。该型产品可同时支持数字信号，0～5V 模拟信号，4～20mA 或 0~20mA 模拟信号，可以使用双电源（±8～±16 VDC）或单电源（+14～+28 VDC）。支持自动故障报警，多气体多量程等功能。标准开放的通讯协议为客户自行开发控制、采集软件提供便利。提供功能强大的免费客户端上位机软件 Digital MFC。CS200-C 与 CS200-D 产品所有与气体接触的表面均为不锈钢金属，其中 CS200-C 金属表面符合 SEMI 标准的要求。

CS200-A,C,D MFC 默认配置为：

MAC 地址：32；

RS485 通信波特率:19200；

控制方式：0～5V 电压控制。

更多细节请参考产品附带光盘中的“CS 系列 MFC 通讯协议”。

1.5 技术指标

CS200						
型号	CS200-A		CS200-C		CS200-D	
阀类型	常开(流量规格≤30SLM) 或常闭	无	常开或常闭	无	常开或常闭	无
流量规格(N_2)	(0～5, 10, 20, 30, 50, 100, 200, 300, 500) SCCM (0～1, 2, 3, 5, 10, 20, 30, 50) SLM		(0～2, 3, 5, 10, 20, 30, 50, 100, 200, 300, 500) SCCM (0～1, 2, 3, 5, 10, 20, 30) SLM			
准确度	±1.0% S.P. (≥35% F.S.) ±0.35% F.S.(<35% F.S.)					
线性	±0.5% F.S.					
重复精度	±0.2% F.S.					
响应时间	≤ 1sec		≤ 0.8sec			
工作压差范围	0.05～0.35MPa 流量规格≤10SLM 0.1～0.35MPa 10<流量规格≤30SLM 0.2～0.45MPa 30<流量规格≤50SLM	<0.02 MPa	0.05～0.35MPa 流量规格≤10SLM 0.1～0.35MPa 流量规格>10SLM	<0.02 MPa	0.05～0.35MPa 流量规格≤10SLM 0.1～0.35MPa 流量规格>10SLM	<0.02 MPa
温度系数	零点: ≤±0.05% F.S/℃; 调节时: ≤±0.1% F.S/℃ 流量规格≤30SLM 调节时: ≤±0.2% F.S/℃ 流量规格>30SLM		零点: ≤±0.02% F.S/℃; 调节时: ≤±0.05% F.S/℃			
耐压	3MPa					
漏率	1×10-10 Pa•m3 / sec He		1×10-11 Pa•m3 / sec He			
密封材料	氟橡胶;		金属密封			
工作环境温度	(5～45) ℃		(0～50) ℃			
输入信号	数字: RS485 或 DeviceNet 或 ProfiBus 模拟:(0～5)VDC 或(4～20)mA 或(0～20)mA	无	数字: RS485 或 DeviceNet 或 ProfiBus 模拟:(0～5)VDC 或(4～20)mA 或 (0～20)mA	无	数字: RS485 或 DeviceNet 或 ProfiBus 模拟:(0～5)VDC 或 (4～20)mA 或(0～20)mA	无
输出信号	数字:RS485 或 DeviceNet 或 ProfiBus 模拟:(0～5)VDC 或(4～20)mA 或(0～20)mA					
零漂	在没有零点校正时<0.6%F.S/年					
电源	±8 ～ ±16 VDC (双极)或 +14 ～ +28 VDC (单极)					
表面化学成分	常态		Cr/Fe 比例 ≥2.0, CrO 厚度 ≥ 20 (埃)		常态	
表面粗糙度	25 Ra		10 Ra		25 Ra	
标准接头形式	双卡套 φ6; 双卡套 1/4''; 双卡套 3/8''; VCR1/4''阳接头; 双卡套φ3; 双卡套 1/8''; VCO 1/4"; φ6(内)x1 软管接头; φ5(内)x1.5 软管接头; φ4(内)x1 软管接头;双卡套φ10mm; A 型密封接头;		双卡套φ3; 双卡套φ6; 双卡套 1/4; VCR1/4 阳接头; 1.5''C 型密封接头;1.5'' W 型密封接头			
电源接头形式	D 型 9 针阳接头; D 型 15 针阳接头; DeviceNet 接头; ProfiBus 接头; 模拟接头					
重量	1 Kg	0.8Kg	1.2Kg	1Kg	1.2Kg	1Kg

注意:

气体质量流量计和质量流量控制器出厂通常用氮气（N_2）标定。

质量流量的单位规定为: SCCM （标准毫升/分）;
SLM （标准升/分）

标准状态规定为: 温度 —— 273.15K （ 0℃ ）;
气压 —— 101325 Pa （760mm Hg）

在七星电子 MFC/MFM 产品中心，单位 SCCM 和“mL/min, 0℃,1atm”等同，单位 SLM 和“L/min, 0℃,1atm”等同。

F.S. (Full Scale): 满量程值 ； S.P.(Set Point): 设定点值

1.6 标定

CS200-A,C,D MFC/MFM 可以按照用户的要求来标定。如果用户没有说明工作情况等信息，则按照标准状况标定。

1.6.1 标准状况

出口压力：大气压

气体质量流量通常用标准状态下的体积流量来表示，质量流量单位为：

SCCM：标准毫升/分钟

SLM：标准升/分钟

标准状态：温度 0ºC (273.15K)

气压：101325Pa (760mm Hg)

在标准状态下，气体的密度是一个常数，该密度乘以标准状态下的体积就是质量数，所以标准状态下的体积流量就等同于质量流量。

MFC/MFM 的标准安装位置为水平安装，同时为客户提供垂直（进气口向上或向下）、平躺及其它位置的安装，为保证最高的测量精度，用户购买时应该说明设备的安装方式。

1.6.2 制造环境

CS200-A,C,D 型 MFC/ MFM 是在温度为 22±2℃的 100 级的净化间内组装，1000 级净化环境下标定及包装。

1.6.3 精度调节

CS200-A,C,D 型 MFC/MFM 在制造完成后都要在相应的标定台上烤机 24 小时，然后进行精确标定。精度、动态响应、压力变化的稳定性等指标须经过两次检查，合格后方可出厂。

第二部分 安装

2.1 概述

警告：必须要非常小心地处理有毒的、腐蚀性的或易燃易爆的气体。在质量流量控制器/流量计安装之后，应该彻底的检查整个气路以保证没有气体泄漏。通入腐蚀性气体之前应先通一个小时的干燥惰性气体以清洗质量流量控制器/流量计。

重要提示：当安装质量流量控制器/流量计时，确保产品通道所示的箭头方向与流经产品的气体流动方向相同。

2.2 打开包装

CS200-A,C,D 型 MFC/MFM 产品在净化间的环境下组装、标定和真空包装。产品由两层独立的密封袋包装，外层为普通塑料袋，内层为洁净真空袋。在进入净化间之前应该先拆掉外面的塑料袋，为了减少污染，内层的洁净袋应该在洁净环境下拆开。

2.3 机械安装

2.3.1 概述

在大多数应用场合下，需要在气路中安装一个截止阀。截止阀与 MFC 或 MFM 间的截留加压气体将会产生清洗效果，用户应根据情况来决定截止阀的安装位置(上游或下游)。为了防止污染，建议您在产品的上游管路中安装过滤器。

CS200-A,C,D 型产品的安装位置应同您在订货时要求的安装位置一致，空气应该干燥和洁净，安装时应避免外力冲击或震动。产品外形图如图 2-1 所示，图 2-2，图 2-3a, 图 2-3b, 图 2-3c 和图 2-4 为不同的接头（Compression Fitting φ3；Compression Fitting φ6；Compression Fitting1/8″；Compression Fitting1/4″；Compression Fitting3/8″；VCR1/4″阳接头；A 型密封接头；1.5″C 型密封接头；1.5″W 型密封接头）的外型尺寸，不同接头产品的总长度 L 见表 2-1。在安装前，请勿取下两端接头上的保护帽，直到您真正安装 MFC/MFM 时再取下保护帽。

图 2-1　　CS200-A,C,D 型产品外形图

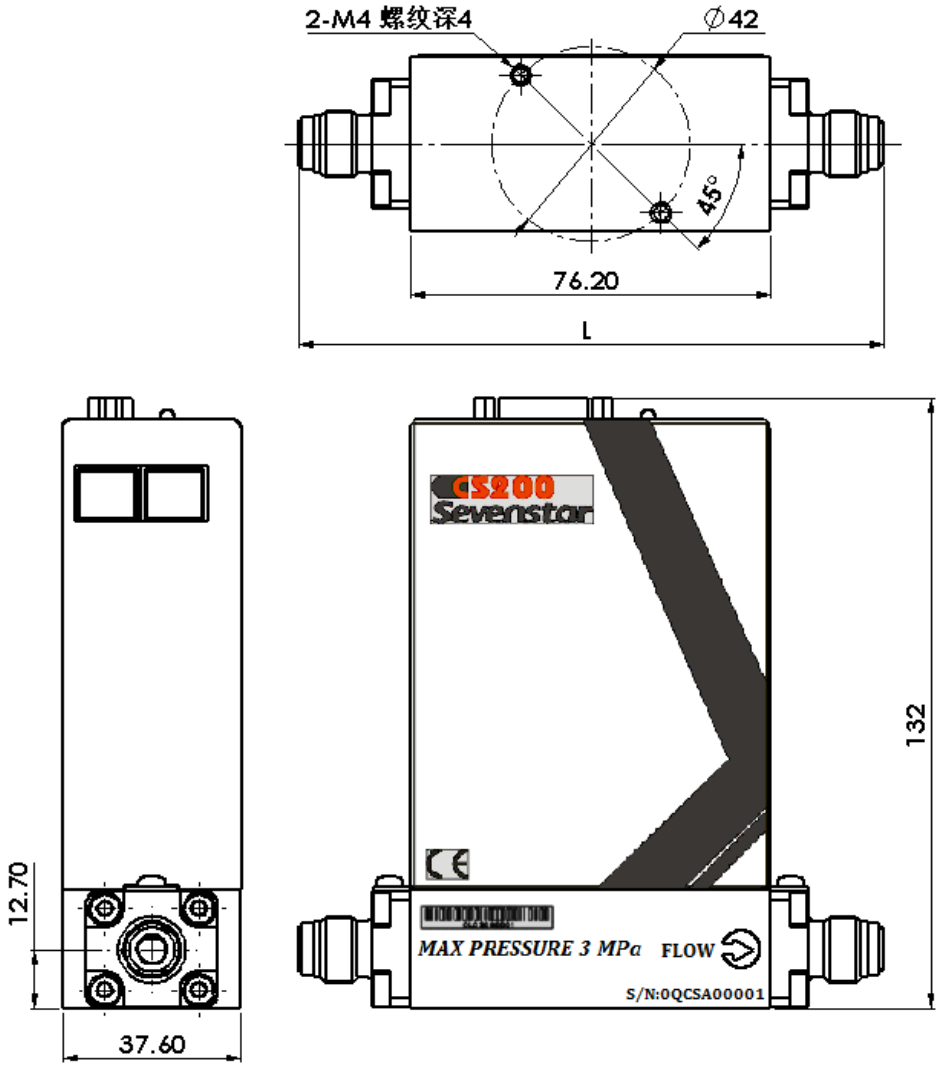
2-M4 螺纹深4
∅42
45°
76.20
L
12.70
37.60
CS200
Sevenstar
132
MAX PRESSURE 3 MPa
FLOW
S/N:0QCSA00001

图 2-2 产品尺寸外形图

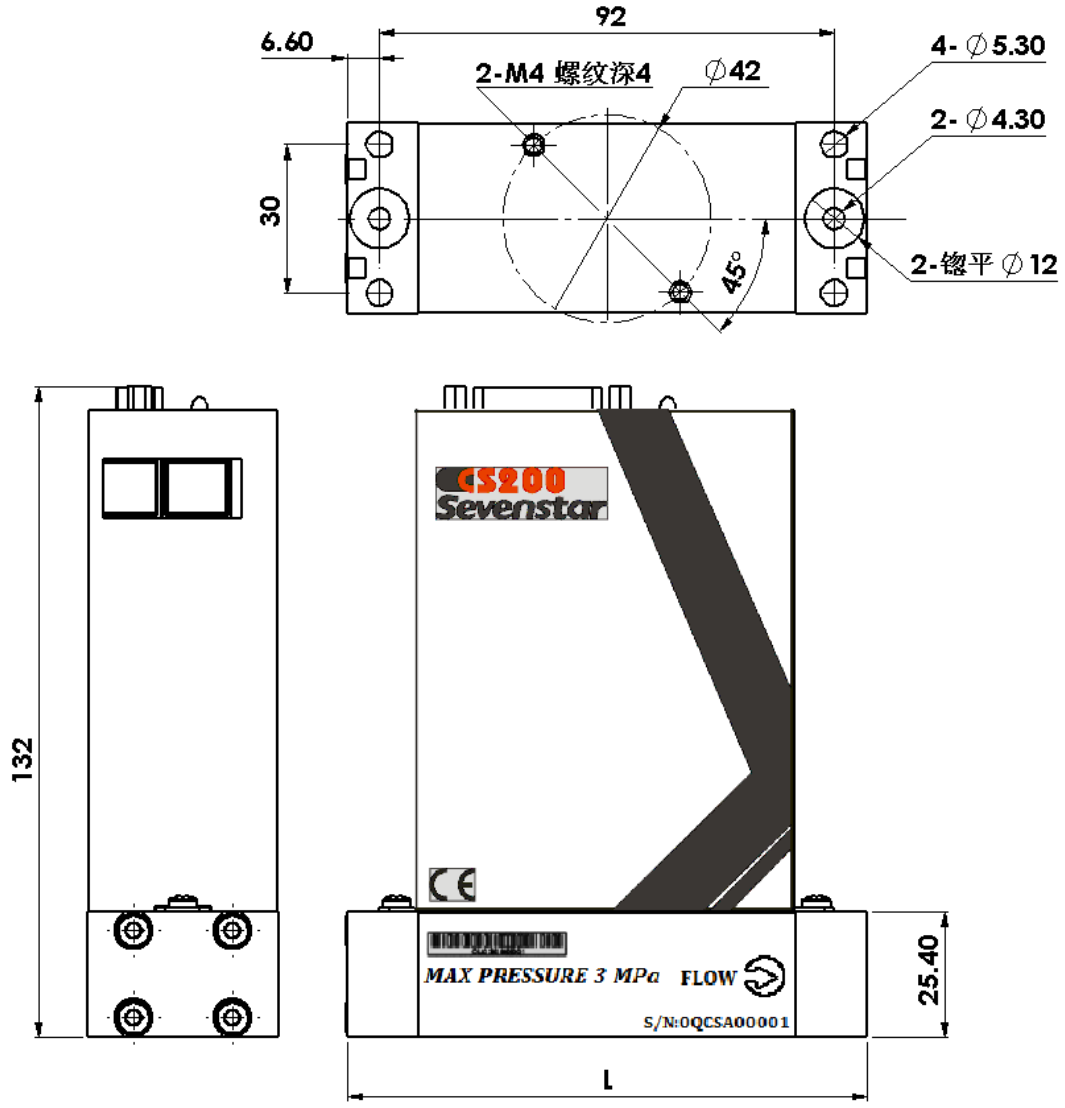

图 2-3a　A 型接头（仅 CS200A 选用）

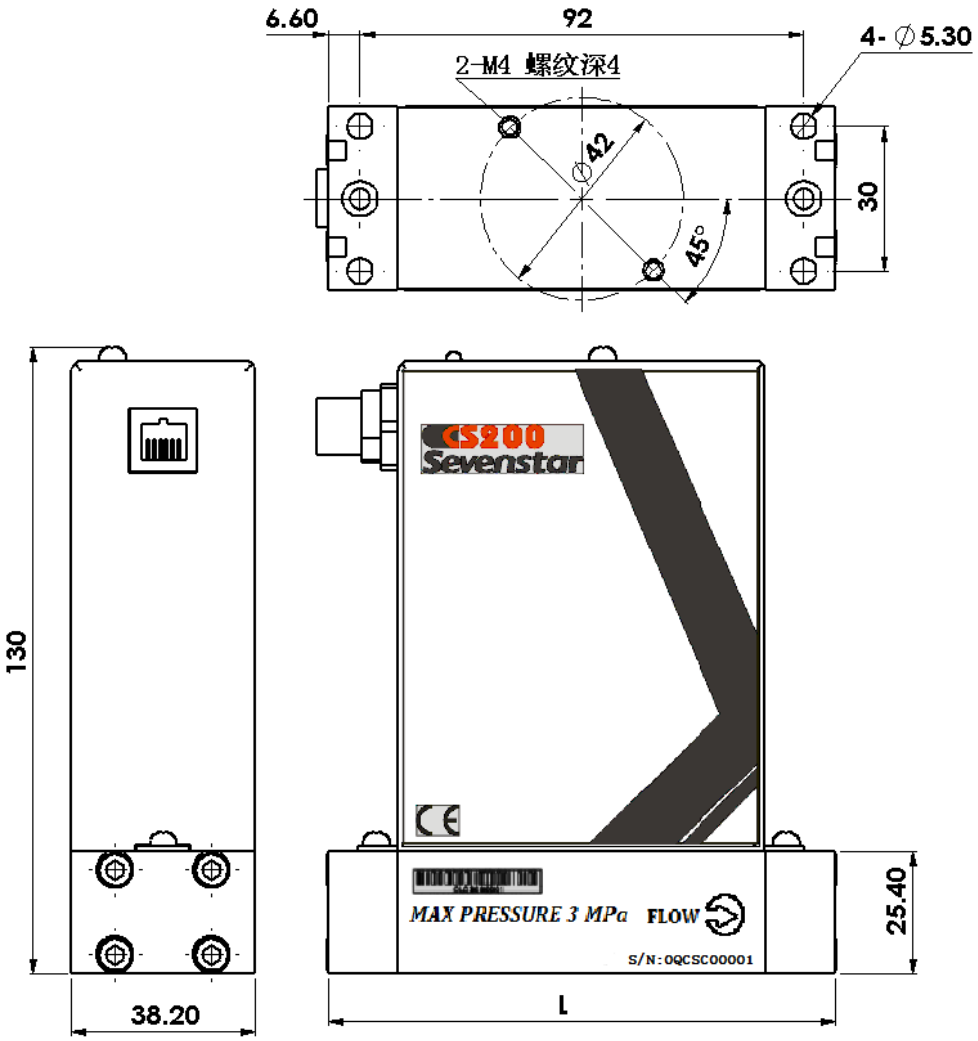

图 2-3b　C 型接头（仅 CS200C/D 选用）

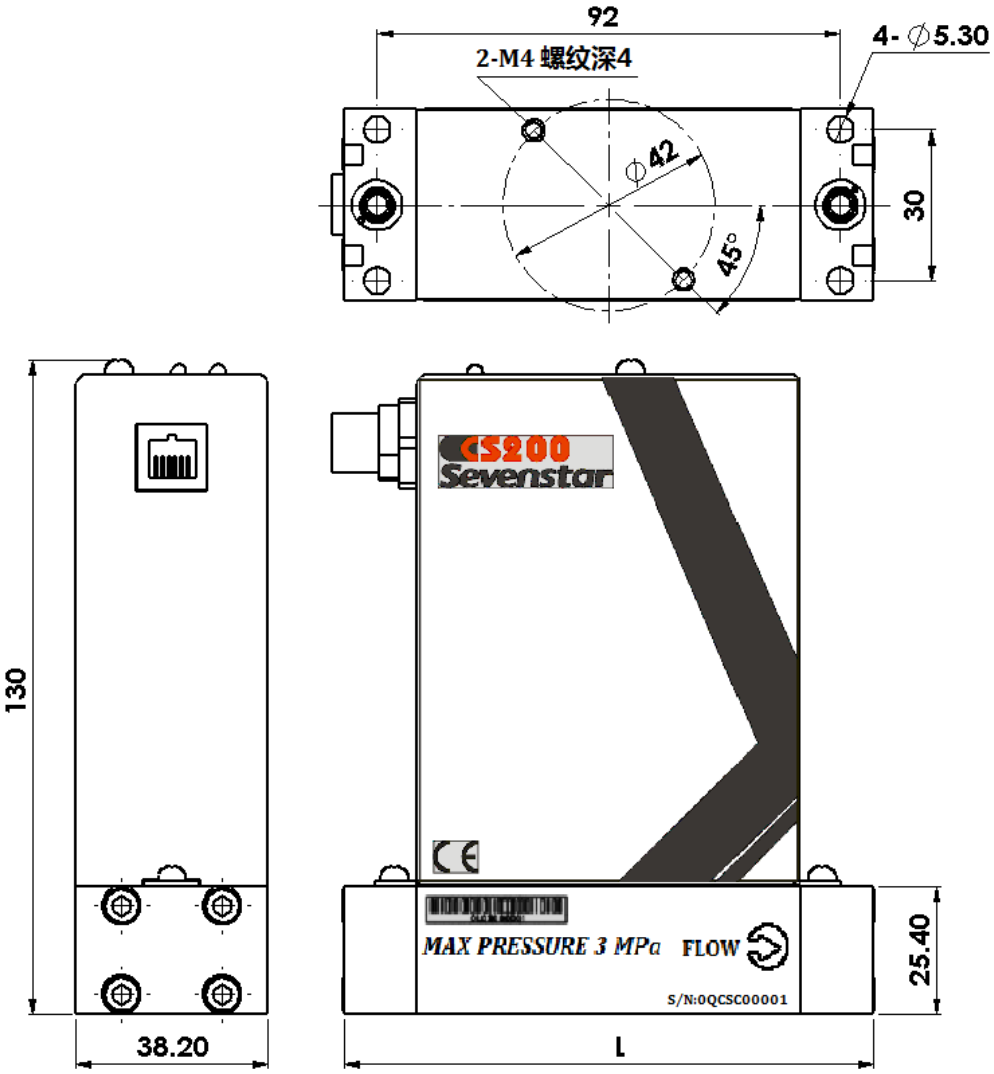

图 2-3c　W 型接头（仅 CS200C/D 选用）

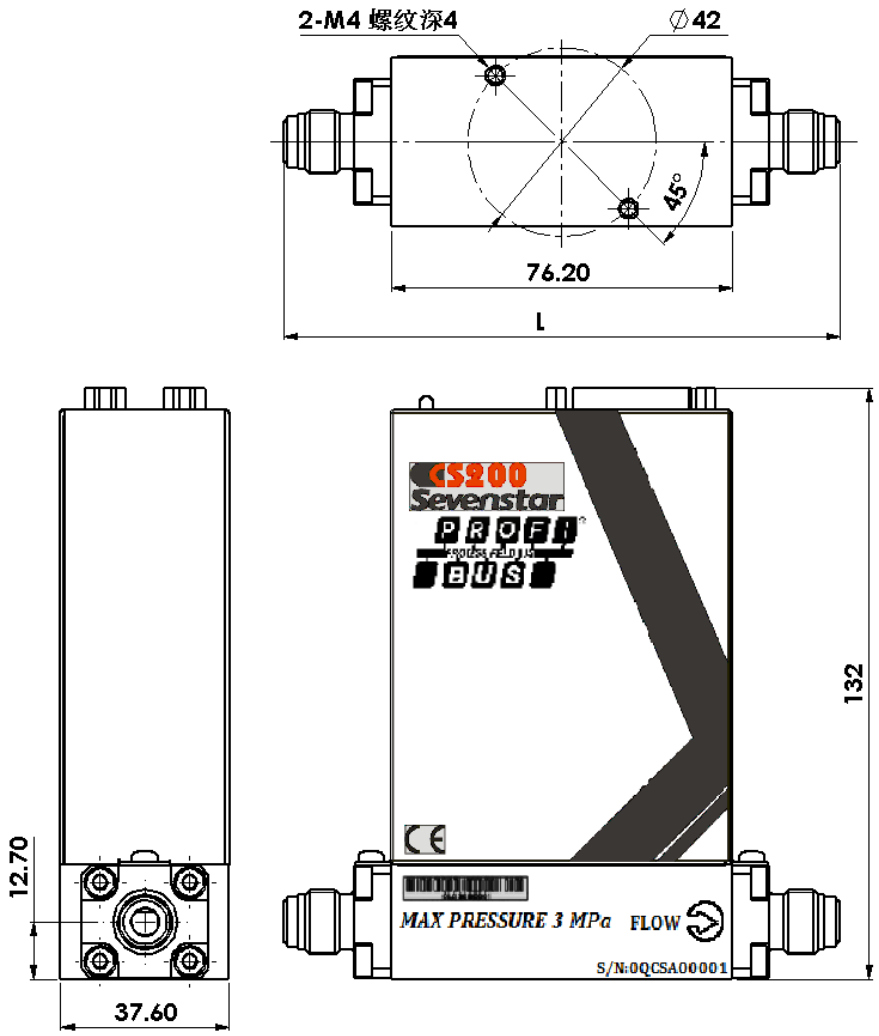
2-M4 螺纹深4
∅42
45°
76.20
L
CS200
Sevenstar
PROFI
BUS
MAX PRESSURE 3 MPa
FLOW
S/N:0QCSA00001
132
12.70
37.60

图 2-4 产品尺寸外形图

接头类型 / 产品长度	Compression Fitting φ 6; Compression Fitting φ 3; Compression Fitting1/4″ ; Compression Fitting φ 10; Compression Fitting1/8″ ; Compression Fitting3/8″	φ4(内)x1 软管接头	VCR1/4 阳接头 VCO1/4 阳接头 φ6(内)x1 软管接头 φ5(内)x1.5 软管接头	A 型密封接头 1.5″ C 型密封接头 1.5″ W 型密封接头
L	112.8	117.6	124	105.2

表 2-1 不同接头产品长度表

注意:

图 2-2 和 2-4 中的高度 132mm 是不加电缆插头的高度,加上插头后的高度要再增加 50mm 左右。

2.3.2 安装

按进出气的方向，把气体质量流量控制器/流量计正确地接入管路中。

2.3.2.1 1/4″VCR 接头安装方法

VCR 垫圈有两种：无定位 VCR 垫圈和有定位 VCR 垫圈。1/4″VCR 接头的安装，如图 2-5、图 2-6 所示。当使用无定位 VCR 垫圈时，将垫圈放入阴螺母内；当使用有定位 VCR 垫圈时，将垫圈固定在凸起的结合处。先用手将螺母和接头拧紧，再用双扳手操作，用一只扳手卡住接头不动，用另一只扳手旋转螺母，要求用扳手旋转 1/8 至 1/4 圈。

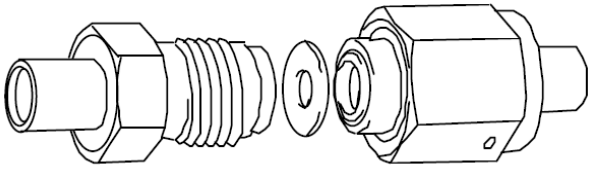

图 2-5 无定位 VCR 垫圈的 VCR 接头安装示意图

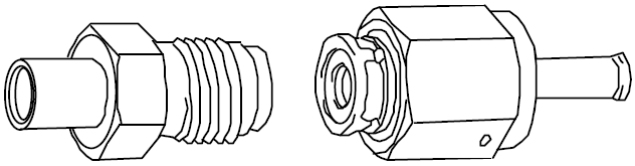

图 2-6 定位 VCR 垫圈的 VCR 接头安装示意图

2.3.2.2 双卡套接头的安装方法

双卡套接头的安装方法见图 2-7，在装上前卡套、后卡套、螺母后，先用手将螺母与接头拧紧，再用扳手拧紧(国外进口的双卡套接头要求用扳手旋转 1.25 圈拧紧)，以保证不漏气。注意应该使用双扳手操作，用一只扳手卡住接头不动，用另一只扳手旋转螺母，特别是在拆卸接管时必须使用双扳手操作，否则会引起接头松动,影响密封。

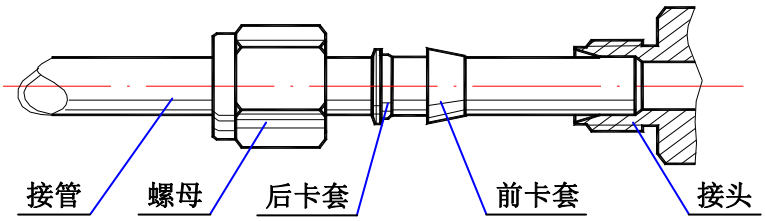

图 2-7 双卡套接头安装示意图

注意:

按图 2-7 所示安装接管时，在装上前卡套、后卡套、螺母后，先用手将螺母与接头拧紧，再用扳手拧紧（国外进口的双卡套接头要求用扳手旋转 1.25 圈拧紧），以保证不漏气。注意应该使用双扳手操作，用一只扳手卡住接头不动，用另一只扳手旋转螺母。特别是在拆卸接管时必须使用双扳手操作，否则会引起接头松动，影响密封。

2.4 电气安装

2.4.1 概述

CS200-A,C,D 型产品采用开关电源方式，可支持双电源（±8～±16V DC）或单电源（+14～+28V DC），客户可以根据需要自行选择。

CS200-A,C,D 型产品的电气接头采用 D 型阳接头、DeviceNet 接头以及 ProfiBus 接头，D 型接头分 9 针和 15 针，其中 9 针接头属于 SEMI 标准型，仅支持 0-5V 模拟电压控制和流量输出，15 针接头同时支持 0～5V 模拟电压、4～20mA 模拟电流控制和流量输出和 0～20mA 模拟电流控制和流量输出。客户在选购产品的时候根据需要选择。

CS200-A,C,D 型产品支持 RS485 串行通讯、DeviceNet 通讯协议及 ProfiBus 通讯协议，用户可以用 RS485 电缆线或相应的适配器与电脑连接。

2.4.2 连接

图 2-8，图 2-9，图 2-10，图 2-11,图 2-12，图 2-13，图 2-14，图 2-15 分别给出了 CS200-A,C,D 型气体质量流量控制器的 9 针 D 型阳接头，15 针 D 型阳接头，RS485 端口，DeviceNet 接头，模拟信号接口，波士卡转换器，ProfiBus DP 接头（9 孔 D 型接头），ProfiBus 产品 15 针 D 型阳接头的连线图。

注意:

CS200-A,C,D 型质量流量计外观与 CS200-A,C,D 型质量流量控制器外观一致，但 CS200-A,C,D 型质量流量计的电气接头中，0～5V 流量设定，4～20mA 或 0～20mA 流量设定及阀控均不起作用，即图 2-8 中 pin1、pin6 及图 2-9、图 2-15 中的 pin1、pin7、pin8、pin12 管脚不起作用。

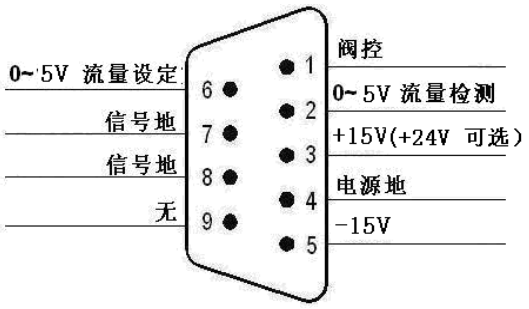

图 2-8　9 针 D 型接头连接图

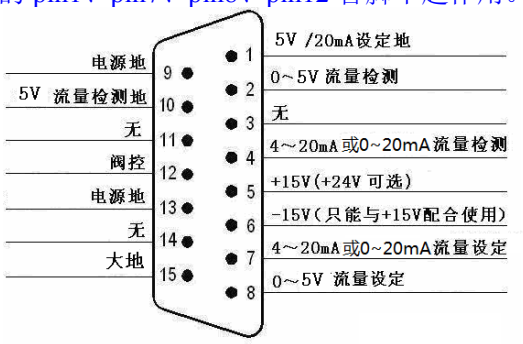

图 2-9　15 针 D 型接头连接图

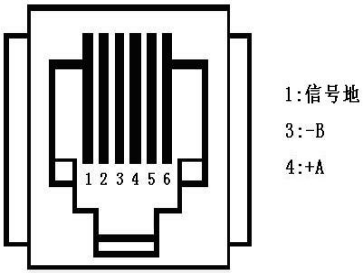

图 2-10　RS485 连接图

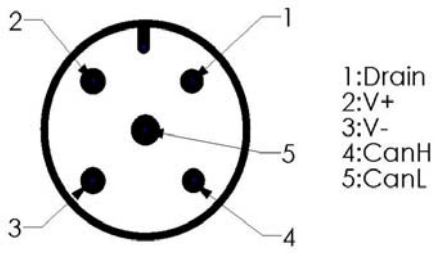

图 2-11 DeviceNet 接线图

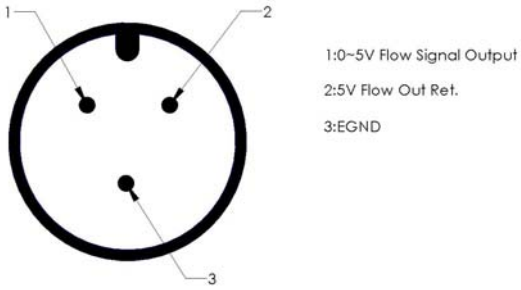

图 2-12　模拟信号接口连线图

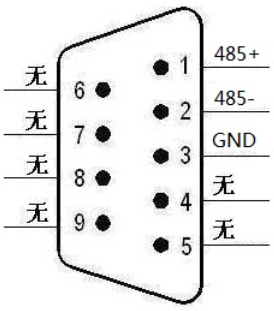

图 2-13　我公司提供的波士卡转换器连线图

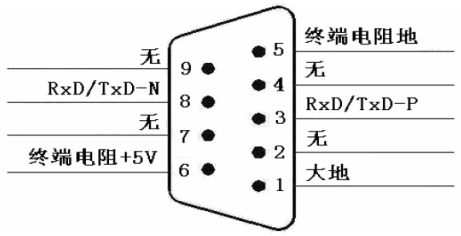

图 2-14　ProfiBus DP 接头连接图

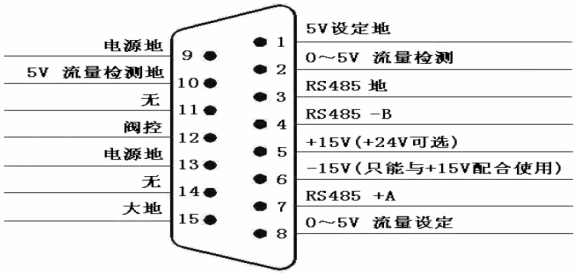

图 2-15 ProfiBus 产品 15 针 D 型阳接头连接图

2.4.3 电缆线选型表以及连接示例

	D08- 2B/3B/4B 2E/3E/4E	D08- 1/2/4 2F/3F/4F D08-1F/1FM/1FS/8C/8CM/1G/1GM	外接±15V 电源	外接+24V 电源	至上位 机串口	至电脑 USB 口
MFC (DB15 针)	QCX-19/ QCX-P19 QCX-48	QCX-17/QCX-P17 QCX-46	QCX-41	QCX-43	QCX-34	QCX-50
MFC (DB9 针)	QCX-20/ QCX-P20 QCX-49	QCX-18/QCX-P18 QCX-47	QCX-42		QCX-34	QCX-50

表 2-2 电缆线选型表

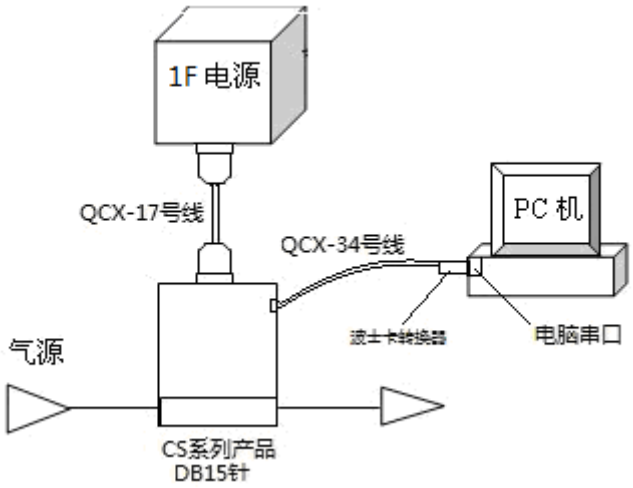

图 2-16 CS 产品与 D08-1D/1F 电源连接例图

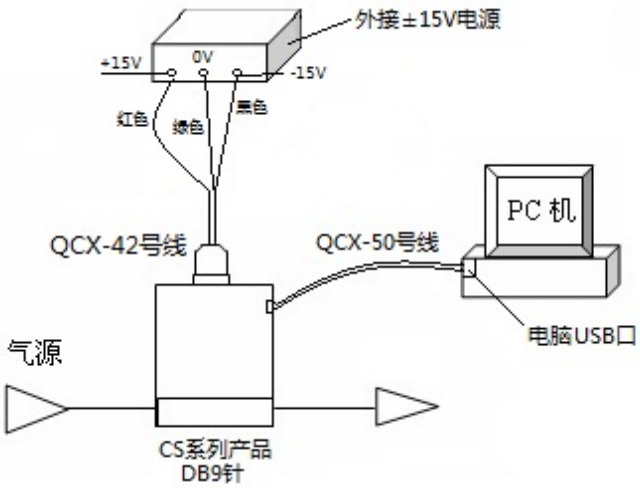

图 2-17　CS 产品与外接电源连接例图

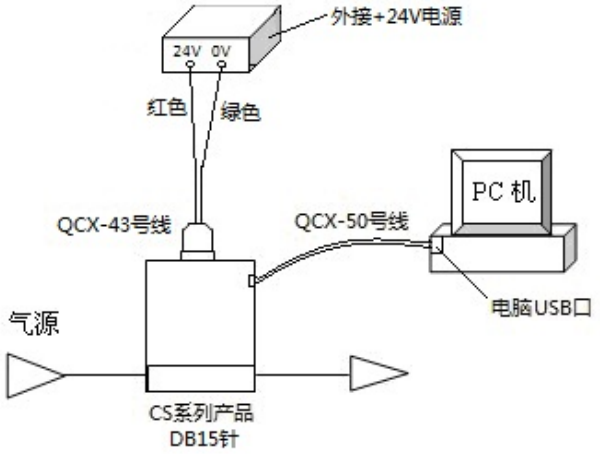

图 2-18　CS 产品与外接电源连接例图

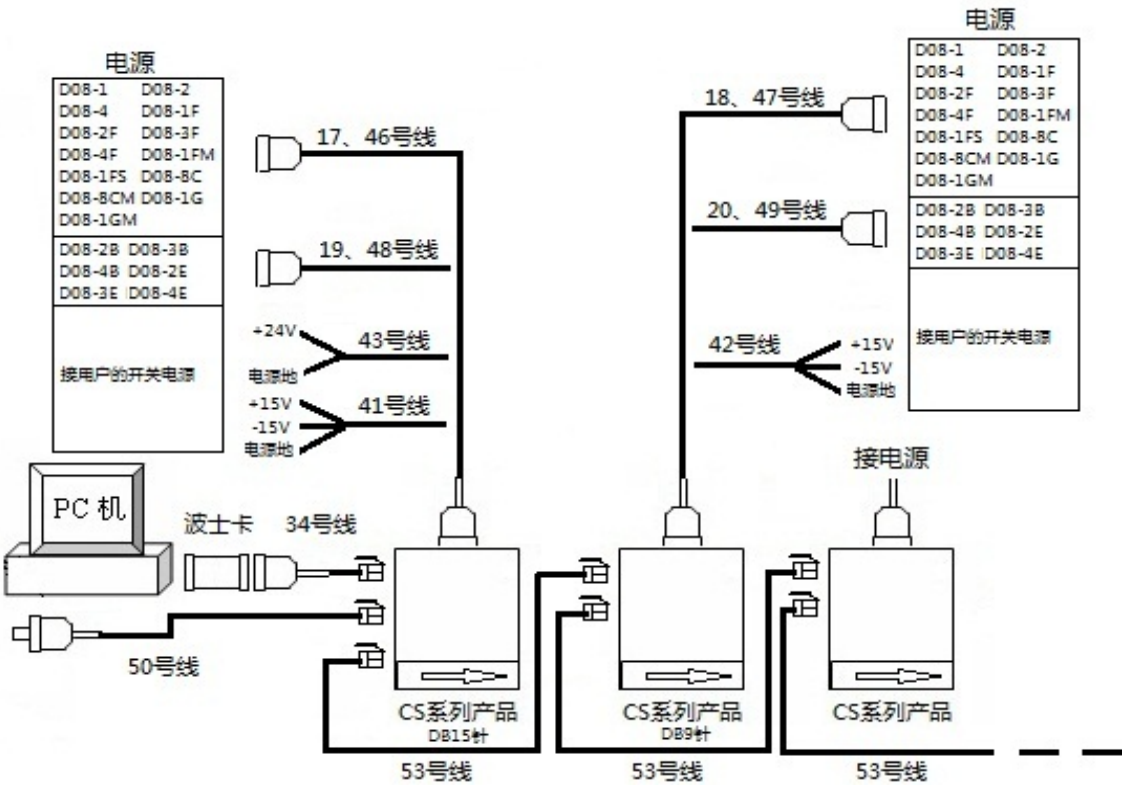

图 2-19　CS 产品连接示意图

七星电子可以提供所有电气连接线，RS485 转换器。并可以根据客户需要定制相应的连接线，更多详细信息请咨询当地七星电子代理商。

2.5 工作检查

开始操作质量流量控制器/流量计前需要进行以下检查：

2.5.1 检查气路是否漏气。

2.5.2 检查工艺顺序与气路元件的完好性。

2.5.3 检查 MFC/MFM 的控制信号、电源电压大小与形式。

2.5.4 检查通入的气体类型与额定压力。

2.5.5 工作前让质量控制器/流量计预热 20 分钟，并检查零点。

2.5.6 通入干燥的惰性气体进行试运行。

2.5.7 在使用质量流量控制器/流量计控制强腐蚀性气体之前，应先在吹洗状态下通入一个小时的干燥惰性气体以清洗质量流量控制器/流量计。

第三部分 功能介绍

3.1 概述

CS200-A,C,D 型产品是七星电子采用最先进的数字技术研发的产品。在传感器的驱动，零点漂移的控制和阀控等诸多方面都采用了独特的技术，保证了产品的高性能、高品质和高可靠性。

3.2 控制方式

CS200-A,C,D 型产品兼容数字模拟控制方式，客户可以根据需要选择控制信号方式，产品支持数字控制，0～5V 电压控制和 4～20mA 或 0～20mA 电流控制。当客户选择了其中一种控制信号，其他两种控制信号将被系统自动屏蔽。而流量检测信号则通过数字方式，0～5V 电压和 4～20mA 或 0～20mA 电流同时送出，互不影响。更多细节请参考产品附带光盘中的“CS 系列 MFC 通讯协议”。

3.3 调零

客户可以通过调零来修正流量计的零漂。在调零以前，客户需要首先确认产品没有气体通过，然后通过软件命令或者调零按钮进行调零操作，如果采用调零按钮的方式，确认按下调零按钮长于 5 秒，直到 LED 绿色指示灯闪烁，即可松开。调零过程完成后，LED 绿色指示灯将停止闪烁（ProfiBus 产品有调零功能，但无此指示灯）。

3.4 软启动

CS200-A,C,D 型产品支持软启动功能。软启动是指客户根据需要，按照一定的斜率改变 MFC 的设定。更多细节请参考产品附带光盘中的“CS 系列 MFC 通讯协议”。

3.5 延迟

当设定点低于最小可控值（2%F.S.），MFC 将关闭控制阀；当设定值大于最小可控值，MFC 将等待延迟时间后再开始调节。客户可以设定该延迟时间，延迟时间值表示 MFC 将延迟的毫秒数，例如设定延迟时间为 200，MFC 将延迟 200ms 再开始调节工作。

特别规定：当延迟时间值为 1 到 49 时，MFC 将默认为 100ms 以后开始工作。

3.6 阀控制

CS200-A,C,D 型产品支持通过数字通讯或者模拟电压的方式直接关闭或者打开 MFC 的电磁调节阀。更多细节请参考产品附带光盘中的“CS 系列 MFC 通讯协议”。

3.7 阀类型

CS200-A,C,D 型 MFC 的电磁调节阀分为常开阀和常闭阀两种类型。常开型 MFC 在不接通电源时，电磁阀为全开状态，气体可以流通；常闭型 MFC 在不接通电源时，电磁阀为关闭状态。因此用户在购买产品时应说明阀类型。

3.8 多气体多量程

CS200-A,C,D 型产品支持多气体多量程功能，客户可以根据自己的需要，更换 MFC 的气体，更换 MFC 的气体转化系数，客户只要将新的气体转化系数通过控制软件输入 MFC 即可，气体转化系数请参考附录中的转化系数列表。产品允许客户在一定范围内选择满量程，范围不要超过原始满量程的 0.3~1.1 倍。例如，一台原始满量程为 100SCCM 的 MFC，可以选择的满量程范围不超过 30SCCM~110SCCM。客户只要将新的满量程值（单位 SCCM）通过控制软件输入 MFC 即可。

CS200-A,C,D 型产品支持客户零点（Target Null Value）功能。客户可以制定 MFC/MFM 的零点所在的真实流量值（%F.S.）。例如，设定 Target Null Value 为-20%F.S.，则当 MFC/MFM 没有气体通过的时候，其流量读数为-20%F.S.，当 MFC/MFM 通过的真实气体流量为 20%F.S.，MFC/MFM 的读数为 0%F.S.。该功能不受调零、客户满量程等影响。客户零点的范围是-100%F.S.到 100%F.S.。

更多细节请参考产品附带光盘中的“CS 系列 MFC 通讯协议”。

3.9 累积流量

CS200-A,C,D 型产品可以记录和输出通过 MFC/MFM 的气体流量累积值。累积值的单位为标准毫升（SCC）。例如累积值的读数为 3000，则说明通过该 MFC/MFM 的气体已累积到 3000 标准毫升(SCC)。

更多细节请参考产品附带光盘中的“CS 系列 MFC 通讯协议”。

3.10 报警

CS200-A,C,D 型产品提供自动警告和错误报警功能。客户可以根据需要打开或者禁止该功能，在客户没有特殊要求时，报警功能默认为关闭状态。MFC/MFM 可以提供的警告和错误报警：

传感器警告和错误报警

EEPROM 错误

控制阀错误

温度警告和错误报警

当 MFC/MFM 发生警告，LED 指示灯将红灯闪烁。当 MFC/MFM 发生错误报警，LED 指示灯将红灯常亮。

更多细节请参考产品附带光盘中的“CS 系列 MFC 通讯协议”。

3.11 LED 指示灯

CS200-A,C,D 型 485 通讯产品顶部有 1 个 LED 指示灯，通常通电情况下绿色常亮，绿色常亮表示工作正常，绿灯闪烁表示 MFC/MFM 正在自动调零。如果红灯闪烁表示 MFC 有警告出现，如果红灯常亮则表示 MFC/MFM 有错误出现。

CS200-A,C,D 型 DeviceNet 通讯产品顶部有 2 个 LED 指示灯，指示灯状态情况见产品附光盘中 CS200MFC(CS220)_DnetSpecification_V1.01 文件。

CS200-A,C,D 型 ProfiBus 通讯产品顶部有 1 个 LED 指示灯，当 ProfiBus 通讯正常时，此灯绿色常亮；不亮说明 ProfiBus 通讯有故障。

注意:

当质量流量控制器的电磁阀全开时，也可以当质量流量计使用。在做流量计使用时，流量检测电压的输出值最大可能达+10V 以上，不过要注意，当流量超过满量程值（+5V）后，流量检测电压与通过的实际流量不成线性对应关系。清洗时，流量显示不准确，还可能出现流量增大显示反而减小的异常现象，但并不会对流量计本身造成损伤。

第四部分 维护

4.1 概述

不需要对气体质量流量控制器或质量流量计进行日常保养，只需进行偶尔的清洗及再标定。如果通入控制器的是超洁净以及无腐蚀性气体，在 3 年或 4 年后进行清洗及再标定。如果通入控制器的是低洁净度气体或一种腐蚀性气体，在 1 年或 2 年后进行清洗及再标定。

更多细节请联系“七星电子”代理商。

4.2 注意事项⚠

4.2.1 介质使用要求

使用气体必须净化，切忌粉尘、液体和油污。必要时，须在气路中加装过滤器等。如果流量控制器/流量计出口接有液体源，应在流量控制器/流量计出口加装单向阀，防止液体回流损坏产品。

警告⚠:

对于使用腐蚀性或有毒、易燃气体的产品，通气使用前应严格保证并检验安装和联接的气密性；如需从系统上卸下，应在断开气路前，使用干燥的对人体无害的常规气体（如氮气、空气）或惰性气体对产品进行彻底的清洗。如没有清洗，可能会引起火灾、爆炸、中毒等意外事故，将导致人员伤亡。

4.2.2 阀口密封问题

MFC 的电磁阀是调节阀，不是截止阀，不能当截止阀使用，如果需要用户应另配截止阀。特别是用户如果使用危险气体，通常应该在质量流量控制器进出气口各加一个截止阀，以保证工作安全。MFC 的阀口内部漏气率在 1%F.S.以内，属于正常情况。

第五部分 故障诊断

5.1 初步检查

5.1.1 检查气源及通入质量流量控制器/流量计的气路是否被打开。
5.1.2 确保电源和控制信号正确的输送到电路板上的电气接头中。
5.1.3 检查通讯线是否正确连接。

5.2 故障检查

请根据以下表格对故障进行判断。

序号	故障现象	故障可能原因	处理方法
1	不通气时， 显示值不为零	气体仍在流动	检查截止阀是否关闭
		零点漂移	使用调零功能
		其他故障	*请与“七星电子”联系
2	无法控制流量	气路连接不正确	检查MFC是否与气路正确连接
		压差不在要求范围	检查压力
		MFC工作在其他模式下	使用软件检查并改变控制模式
		电源问题	检查电源及电源连接是否正确
		设定信号不正确	检查设定电压或者电流信号
		MFC被污染	*请与“七星电子”联系
		传感器损坏	*请与“七星电子”联系
		电路板问题	*请与“七星电子”联系

		阀体损坏	*请与“七星电子”联系
3	无法通讯	电源问题	检查电源及电源连接是否正确
		通讯连接问题	检查通讯线是否正确连接
		地址冲突	检查MFC/MFM的地址是否与别的MFC/MFM冲突
		波特率设置不正确	检查MFC/MFM的波特率设置
		电路板问题	*请与“七星电子”联系

警告⚠:

标*号的项目必须由专业维修人员进行修理。如果故障不在上表中或根据上表无法解决故障现象, 请与 “七星电子”联系。

第六部分 保证和服务

6.1 七星电子有限保证

七星电子及其授权分销商特此向其产品买家保证，其产品的材料与加工的质量自购买日起十二个月内无材料和工艺瑕疵。

对买家的补偿仅限于替换及安装因材料或工艺瑕疵而失效的部件。

客户指定选用的所有部件适用相关制造商的保证。

其它与产品的状况或使用相关的陈述（无论明示或默示）、保证、或责任均明确予以除外，在任何情况下，七星电子及其授权分销商均不向买家或任何第三方承担任何因间接或附带损害（不论其是直接还是间接）导致的赔偿责任。

6.2 产品保证

“七星电子”生产的 MFC/MFM 系列产品提供以下保证：

6.2.1 用户收到货物后，有责任检查及核对货物，并通过传真、电话或电子邮件的方式及时通知“七星电子”收货情况。

6.2.2 保修期内，产品必须由“七星电子”授权的服务中心修理，否则，产品的保修是无效的。

6.2.3 在一年保修期以内，免费维修。超过保修期的产品，“七星电子”将会在维修前通知用户需要更换的部件及维修费用。维修时间在 20 个工作日以内，保修件包括耗材及易磨损件（四氟或氟密封圈等）。

6.2.4 如果没有出示清除污染及净化处理的证明，“七星电子”将不会修理或保修任何 MFC/MFM。

6.2.5 七星电子将会在出厂前分别检查每台产品的质量和功能（接头外观检查，氦气检漏及流量标定）。对由于气体泄漏所造成的损害或使用危险气体所造成的任何损害，七星电子不负有任何责任。用户有责任按照安全规章使用每种气体。不正确的使用 MFC/MFM 会使保修无效，由于不正确的使用 MFC/MFM 所导致的损害不能归咎于“七星电子”。

6.2.6 保修要求如下：

a. 气体必须洁净且没有颗粒物，必要时在 MFC/MFM 的上游气路中安装过滤器。

b. 输入的气体必须符合以下压力标准：

- 气体压力不能超过 3MPa。
- 满量程流量时通入 MFC 调节阀的气体压差必须满足 1.5 指标要求。
- 为了防止紊流，通入 MFC 调节阀的气体压力差不能大于 1.3 指标要求。
- 使用调压阀精确调整质量流量控制器的进气压力。

c. 系统的接线：必须小心的连接系统的接线，不正确的接线会导致 MFC 内部电路板的永久损坏。

d. 气路的连接：必须仔细的安装各种密封件。“七星电子”保证所有的密封端口经过单独检查并且没有划痕。特别需要注意的是，如果使用的是腐蚀性或者有毒气体，清洗程序非常重要。

e. 接头安装步骤：必须按照手册中陈述的安装步骤小心的装配。

f. 禁止私自拆开 MFC/MFM。如果 MFC 外罩上的贴纸撕裂了，则 MFC 承诺的保修无效。

6.3 服务

“七星电子”产品的技术支持工程师将会帮助您解决关于操作、软件开发、连接、气体混合等方面的问题。

“七星电子”提供质量流量控制器的使用培训。

请您访问 www.mfcsevenstar.cn 找到有关的产品资讯和离您最近的维修及服务中心。

6.4 免责声明

北京七星华创电子股份有限公司对以下情况造成的损坏不承担责任：

1、 自然灾害

2、 误操作或者不合理使用

3、 在不适宜或者恶劣的环境下操作或者储存（产品工作环境请参考产品技术指标）

4、 使用说明书以外的方法对仪器进行操作

5、 未经授权改动产品

例如：

使用腐蚀性气体前，未对气路进行清洗所造成的损坏或者 MFC/MFM 被灰尘等污染物污染或堵塞所造成的损坏。

附录Ⅰ 产品序号描述

CS200标准订单的填写格式

CS200 [t] [g,g,g] [v] [r,r,r,r] [a] [f,f] [s] [m] [d]

[t] –类号

- [A] 橡胶密封
-
- [C] 金属密封，V/V 不锈钢电抛 10Ra
- [D] 金属密封，316L

[g,g,g] – 使用气体

依照标准 SEMI52-0302（注：029 氨气仅适用于类号 C，D）

-[013] N_2

-[000] 混合气体详见**[d]**

[v] –调节阀配置

- [O] 常开调节阀
- [C] 常闭调节阀
- [N] 无阀

[r,r,r,r] – 满量程流量

- [002C] 2SCCM (仅适用于类号C、D)
- [003C] 3SCCM (仅适用于类号C、D)
- [005C] 5SCCM
- [010C] 10SCCM
- [020C] 20SCCM
- [030C] 30SCCM
- [050C] 50SCCM
- [100C] 100SCCM
- [200C] 200SCCM
- [300C] 300SCCM
- [500C] 500SCCM
- [001L] 1SLM
- [002L] 2SLM
- [003L] 3SLM
- [005L] 5SLM

- [010L]　10SLM
- [020L]　20SLM
- [030L]　30SLM
- [050L]　50SLM(仅适用于类号A)
- [000C]　特殊量程详见[d]

[a] – 通讯形式
- [R] DB9针
- [D] DB15针
- [X] DeviceNet接头
- [Y] DeviceNet+模拟接头
- [F] ProfiBus接头

[f,f] – 进出气接头
-[AA] Swagelokφ3mm(仅适用于满量程≤5SLM产品)
-[GG] Swagelokφ6mm(仅适用于满量程≤30SLM产品)
-[JJ] Swagelokφ10mm(仅适用于类号A)
-[BB] Swagelok 1/8" (仅适用于类号A，且满量程≤5SLM产品)
-[CC] Swagelok 1/4"(仅适用于满量程≤30SLM产品)
-[HH] Swagelok 3/8"(仅适用于类号A)
-[MM] VCR 1/4" 阳接头
-[UU] VCO 1/4" 阳接头(仅适用于类号A)
-[SA] A型接头 (仅适用于类号A，且满量程≤30SLM产品)
-[SC] IGS　C型 (仅适用于类号C、D，且满量程≤30SLM产品)
-[SW] IGS　W型 (仅适用于类号C、D，且满量程≤30SLM产品)
-[RR]φ6(内)x1软管接头(仅适用于类号A，且满量程≤30SLM产品)
-[VV]φ5(内)x1.5软管接头(仅适用于类号A，且满量程≤30SLM产品)
-[TT]φ4(内)x1软管接头(仅适用于类号A，且满量程≤30SLM产品)
-[XX]特殊接头详见[d]

[s] – 密封材料
-[V]氟橡胶（仅适用于A）
-[M] 金属密封(仅适用于C、D)

[m] – 安装位置
-[H] 水平安装
-[E] 平躺安装
-[U] 进气口向上垂直安装
-[D] 进气口向下垂直安装

[d] – 其它说明

-[- -] 出厂默认：外罩及标签文字：英文

工作压差范围：(0.05 ~ 0.35) MPa (7.3~50.8 psid)　(FLOW≤10SLM)

(0.1 ~ 0.35) MPa (14.5~50.8 psid)　(10SLM＜FLOW≤30SLM)

(0.2 ~ 0.45) MPa (29.0~65.3 psid)　(30SLM＜FLOW)

CS200-AXXN、 CS200-CXXN、 CS200-DXXN：＜0.02MPa（2.9psid）

耐压：3MPa（435.1psig）

标定温度：（22±2）℃

阀控信号：阀控模式是2

供电电源：+24V单电源供电

控制方式：DeviceNet产品默认为数字模式；ProfiBus产品默认为ProfiBus模式；其余为模拟电压模式

-[S] 特殊要求：

例如：输入输出信号：4~20mA；

混合气体要注明比例：N_2（60%）+CO_2（40%）

工作压差范围：（0.3~0.5）MPa

标定温度：40℃

外罩及标签文字：中文

阀控信号：阀控模式是0

供电电源：±15V供电

控制方式：ProfiBus产品模拟电压模式

其他特殊要求。

举例:

以 CS200-A013C500CDGGVHS 为例：

CS200 A 013 C 500C D GG V H S

型号：CS200

类号：橡胶密封

使用气体：N_2

调节阀配置：常闭调节阀

满量程流量：500SCCM

通讯形式：DB15 针

进出气接头：Compression Fitting Φ6mm

密封材料：氟橡胶

安装位置：水平安装

特殊要求：如 中文，工作压差(0.05～0.3) MPa，特殊接头(附图纸)，特殊标定温度 40℃，使用电流设定等要求逐一填写。

附录Ⅱ 常用气体转换系数

		代号(SEMIE52-0302)	比热(卡/克℃)	密度(克/升 0℃)	转换系数
Air	空气	008	0.240	1.293	1.001
Ar	氩气	004	0.125	1.784	1.420
AsH_3	砷烷	035	0.117	3.478	0.673
BBr_3	三溴化硼	079	0.065	11.180	0.378
BCl_3	三氯化硼	070	0.122	5.227	0.450
BF_3	三氟化硼	048	0.178	3.025	0.508
B_2H_6	硼烷	058	0.502	1.235	0.441
CCl_4	四氯化碳	101	0.130	6.860	0.306
CF_4	四氟化碳	063	0.166	3.964	0.420
CH_4	甲烷	028	0.532	0.715	0.722
C_2H_2	乙炔	042	0.405	1.162	0.596
C_2H_4	乙烯	038	0.366	1.251	0.597
C_2H_6	乙烷	054	0.424	1.342	0.482
C_3H_4	丙炔	068	0.363	1.787	0.421
C_3H_6	丙烯	069	0.366	1.877	0.411
C_3H_8	丙烷	089	0.399	1.967	0.358
C_4H_6	丁炔	093	0.352	2.413	0.322
C_4H_8	丁烯	104	0.372	2.503	0.299
C_4H_{10}	丁烷	117	0.404	2.650	0.261
C_5H_{12}	戊烷	240	0.392	3.219	0.217
CH_3OH	甲醇	176	0.328	1.430	0.584
C_2H_6O	乙醇	136	0.340	2.055	0.392
$C_2H_3Cl_3$	三氯乙烷	112	0.165	5.950	0.278
CO	一氧化碳	009	0.249	1.250	1.000
CO_2	二氧化碳	025	0.202	1.964	0.739
C_2N2	氰气	059	0.261	2.322	0.451
Cl_2	氯气	019	0.115	3.163	0.858
D_2	氘气	014	1.733	0.180	0.997
F_2	氟气	018	0.197	1.695	0.931
$GeCl_4$	四氯化锗	113	0.107	9.565	0.267

气体		代号(SEMIE52-0302)	比热(卡/克℃)	密度(克/升 0℃)	转换系数
GeH_4	锗烷	043	0.141	3.418	0.570
H_2	氢气	007	3.422	0.090	1.010
HBr	溴化氢	010	0.086	3.610	0.999
HCl	氯化氢	011	0.191	1.627	0.988
HF	氟化氢	012	0.348	0.893	1.001
HI	碘化氢	017	0.055	5.707	1.000
H_2S	硫化氢	022	0.228	1.520	0.802
He	氦气	001	1.242	0.179	1.420
Kr	氪气	005	0.059	3.739	1.431
N_2	氮气	013	0.249	1.250	1.000
Ne	氖气	002	0.246	0.900	1.431
NH_3	氨气	029	0.501	0.760	0.719
NO	一氧化氮	016	0.238	1.339	0.978
NO_2	二氧化氮	026	0.192	2.052	0.737
N_2O	一氧化二氮	027	0.210	1.964	0.710
O_2	氧气	015	0.220	1.427	0.981
PCl_3	三氯化磷	193	0.125	6.127	0.358
PH_3	磷烷	031	0.261	1.517	0.690
PF_5	五氟化磷	143	0.161	5.620	0.302
$POCl_3$	三氯氧磷	102	0.132	6.845	0.302
$SiCl_4$	四氯化硅	108	0.127	7.585	0.284
SiF_4	四氟化硅	088	0.169	4.643	0.348
SiH_4	硅烷	039	0.319	1.433	0.600
SiH_2Cl_2	二氯氢硅	067	0.147	4.506	0.416
$SiHCl_3$	三氯氢硅	147	0.133	6.043	0.340
SF_6	六氟化硫	110	0.159	6.516	0.258
SO_2	二氧化硫	032	0.149	2.858	0.687
$TiCl_4$	四氯化钛	114	0.157	8.465	0.206
WF_6	六氟化钨	121	0.096	13.290	0.217
Xe	氙气	006	0.038	5.858	1.431

注：转换系数使用说明

质量流量控制器、质量流量计出厂时一般用 N_2 标定，实际使用中如果是其它气体，必要时可进行读数修正，方法是以流量显示仪显示的流量乘以流量转换系数。如是单组份气体，其转换系数可在我厂产品技术说明书中查得；如是多组份气体（假定由 n 种气体组成），请按下列公式计算其转换系数 C：

基本公式： $C=0.3106\ N / \rho\ (Cp)$

其中： ρ ——为气体在标准状态下的密度

CP——为气体的定压比热

N ——为气体分子构成系数（与该气体分子构成的组份有关, 见下表）

气体分子构成系数表:

气体分子构成	举　　例	N 取 值
单原子分子	Ar　He	1.01
双原子分子	CO　N_2	1.00
三原子分子	CO_2　NO_2	0.94
多原子分子	NH_3　C_4H_8	0.88

对于混合气体： $N = N_1 (\omega_1/\omega_T) + N_2 (\omega_2/\omega_T) + \cdots + Nn (\omega_n/\omega_T)$

导出公式：

$$C = \frac{0.3106 \left[N_1 (\omega_1/\omega_T) + N_2 (\omega_2/\omega_T) + \cdots + Nn (\omega_n/\omega_T)\right]}{\rho_1 Cp_1 (\omega_1/\omega T) + \rho_2 Cp_2 (\omega_2/\omega_T) + \cdots + \rho_n Cp_n (\omega_n/\omega_T)}$$

其中:

$\omega_1 \ldots \omega_n$ ——为相应气体的流量

ω_T ——为混合气体的流量

$\rho_1 \ldots \rho_n$ ——为相应气体在标准状态下的密度（数值见气体转换系数表）

$CP_1 \ldots CP_n$ ——为相应气体的定压比热（数值见气体转换系数表）

$N_1 \ldots N_n$ ——为相应气体的分子构成系数，取值见气体分子构成系数表

说明:

1）标准状态为：压力—101325Pa (760 mm Hg)，温度—273.15K (0℃)。

2）气体质量流量转换系数表中未列出的气体的有关参数，可以向我们咨询。

CS 系列

质量流量控制器

北京七星华创电子股份有限公司

质量流量计分公司

(北京七星弗洛尔电子设备制造有限公司制造)

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REV.2.7

CS200-A,C,D MFC/MFM

User's Manual

Sevenstar

2 0 15 . 12

Contents

Instruction of MFC/MFM

1.1 Declaration

Beijing Sevenstar Electronics Co. , Ltd

1.2 Attention

Dear customer, thanks for using CS mass flow controller and mass flow meter. This manual describes in detail important issues about correct and safe operations of the product.

User of the product should read and comprehend this manual and pay attention to the text with labels ⚠ and notices.

Sevenstar assumes no liability for the customer's failure to comply with this manual. This manual is necessary for your installation and maintenance, please keep it carefully.

1.3 The notice of safety

Please pay attention to the below notices when reading this manual. We are not responsible for any result without abiding by the below notices.

a) Do not replace any components or disassemble instrument.
Do not replace any components, or disassemble the instrument without any authorized and make sure that the label or/and seal of product is not removed when returning for reworking, recalibration and maintenance.

b) Please contact professional for technical service.
Do not replace any components. Any technical support is provided by professional who must be authorized by Sevenstar.

c) Please pay more attention to use dangerous gas.
Instrument should be purged completely and keep safety if dangerous gas is used. Meanwhile make sure that moist gas must not react with material of seal and instrument.

d) Please pay attention to purging instrument.
The whole system should be purged by dry gas after and before the instrument is installed.

e) Please abide by proper steps of purging.
Product should be purged and handled with gloves.

f) Do not use the instrument in explosive environment.
Do not use the instrument in explosive environment, unless the safety certificate is available.

g) Please use proper fittings and keep the rules.

All fittings of instrument must be matched according to the listing in manual. Please read manual carefully before screwing tightly.

h) Please do leakage check.

Please check carefully all of vacuum parts and make sure that there is not leakage in the system.

i) Please make sure that instrument is working under safe pressure.

Please make sure that the pressure of inlet gas is less than maximum working pressure (referring to maximum working pressure in manual).

j) Please keep the whole system away from pollution.

When system running, do not use polluting gas, such as particle of dust, dirt, fibre, glass or scrap iron.

k) Please do warm-up instrument before working.

Please do warm-up instrument, especially in using dangerous gas. Please close valve completely to make sure that there is not error flow.

1.4 General

Mass flow controller (MFC) accurately measures and controls mass flow rates, which is widely applied in the fields as: semiconductor and IC fabrication, special materials science, chemical industry, petrolic industry, pharmaceutical industry, environmental protecting and vacuum system researching, etc.. The typical applications include: microelectronic process equipment such as diffusion, oxidation, epitaxy, CVD, plasma etching, sputtering, ion implantation, vacuum deposition equipment, optical fiber melting, micro-reaction equipment, mixing & matching gas system, capillary flow control system, gas chromatograph and other analytical instruments.

The CS200-A,C,D MFC/MFM are a latest generation MFC for use in semiconductor

applications and demanding industrial uses where its high accuracy and flexibility in interfacing are required.

The CS200-A,C,D MFC/MFM incorporate a dual interface, voltage and current as well as RS-485，DeviceNet and ProfiBus digital interfaces. It is possible to operate the instrument completely digitally or it can be operated in analog mode with digital monitoring. CS200-A,C,D series have wide range of power supply(available for ±8 ～ ±16 VDC or +14 ～ +28 VDC).

In addition, auto-alarm, change of operating gas and range available through the digital interface. Customer Secondary Development of control and sample software is available through the open protocol.

CS200-A,C,D MFC default setting：

MAC address：32；

RS485 baud rate：19200；

Control mold： 0-5V analog signal control.

1.5 Specification

	CS200					
Type	CS200A		CS200C		CS200D	
Full scale range (N_2)	(0～5,10,20,30,50,100,200,300,500)SCCM (0～1,2,3,5,10,20,30,50)SLM		(0～2,3,5,10,20,30,50,100,200,300,500)SCCM (0～1,2,3,5,10,20,30)SLM			
Accuracy	±1.0% S.P. (≥35% F.S.) ±0.35% F.S. (＜35% F.S.)					
Linearity	±0.5% F.S.					
Repeatability	±0.2% F.S.					
Response Time	≤1sec		≤ 0.8 sec (SEMI E17-0600)			
Valve Rest Position	Normally Closed or Normally Open （F.S.≤30slm）	No Valve	Normally Closed or Normally Open	No Valve	Normally Closed or Normally Open	No Valve
Differential Pressure	0.05～0.35MPa （Flow≤10slm） 0.1～0.35MPa（10slm＜Flow≤30slm） 0.2～0.45MPa（Flow＞30slm）	＜0.02MPa	(0.05～0.35) MPa（≤10slm） (0.1～0.35) MPa（＞10slm）	＜0.02MPa	(0.05～0.35) MPa（≤10slm） (0.1～0.35) MPa（＞10slm）	＜0.02MPa
Temperature Coefficient	Zero:≤±0.05% F.S./℃; Span: ≤±0.1% F.S.℃ （Flow≤30slm） Span: ≤±0.2% F.S.℃ （Flow>30slm）		Zero:≤±0.02% F.S./℃; Span:≤±0.05% F.S./℃			
Max Pressure	3MPa (435pisg)					
Zero Drift	＜0.6%F.S. per year without autozero					
Leak integrity	1×10^{-9} atm·cc / sec He		1×10^{-10} atm·cc / sec He			
Wetted Materials	Viton;		Metal (Stainless Steel V/V, 5Ra)		Metal	
Surface Chemistry	——		Cr/Fe ratio ＞2.0; CrO thickness ＞20 Angstroms			
Surface Finish	25Ra		10Ra		25Ra	
Operation Temperature	（5～45）℃		（0～50）℃			
Input Signal	Digital: RS485 or ProfiBus or DeviceNet™ Analog:(0～5)VDC or (4～20)mA or (0～20)mA	N/A	Digital: RS485 or ProfiBus or DeviceNet™ Analog:(0～5)VDC or (4～20)mA or (0～20)mA	N/A	Digital:RS485 or ProfiBus or DeviceNet™ Analog:(0 ～ 5)VDC or (4 ～ 20)mA or (0～20)mA	N/A
Output Signal	Digital: RS485 or DeviceNet™ or ProfiBus Analog:(0～5)VDC or (4～20)mA or (0～20)mA					
Power Supply	±8 ~ ±16 VDC or +14 ~ +28 VDC(400mA)					
Electronic Connector	9 pin male sub-D ， 15 pin male sub-D ， DeviceNet™ ， ProfiBus ， Analog					
Fittings	VCR1/4" M； VCO1/4" M； Compression FittingΦ10;Compression FittingΦ6； Compression Fitting 3/8"； Compression Fitting1/4"； Compression Fitting1/8"; Compression FittingΦ3； Φ6(inner)×1hose;ф5(inner)×1.5hose;ф4(inner)×1hose; A-sael ;		VCR1/4" M; Compression FittingΦ6, Compression FittingΦ3, Compression Fitting1/4"， W-seal， C-seal			
Weight	1kg	0.8kg	1.2kg	1kg	1.2kg	1kg

Notes⚠:

MFC/MFM is calibrated by N_2 as a standard gas.

Units: **SCCM (Standard Cubic Centimeter/Min);**
SLM (Standard Liter/Min)

Standard Situation: **Tem — 273.15K (0 ℃);**
Air Pressure — 101325 Pa (760mm Hg)

For Sevenstar MFC/MFM, the unit of SCCM is identical to "mL/min, 0 ℃ ,1atm", and the unit of SLM is identical to "L/min, 0 ℃ ,1atm".

F.S. : **Full Scale**

1.6 Calibration Features

Normally, the MFC are calibrated close to customer's requirement (the requirement should be accorded with the specification). Without customer's information, the MFC are calibrated under standard conditions.

1.6.1 Standard conditions

Without special conditions specified by the customer, the MFC is calibrated under the following standard conditions:

Pressure Outlet: Atmospheric.

Normally gas mass flow rate is transferred to gas volume flow rate at standard state. Mass flow rate unit:

SCCM——standard cubic centimeter per minute.

SLM——standard liter per minute.

Standard state： Temperature —— 0ºC (273.15K)

Pressure —— 101325Pa (760mmHg)

At standard state, the gas density will be constant. The multiplication of density and volume flow rate is equal to the mass flow rate. Therefore at the standard state, the volume flow rate can represent mass flow rate.

The standard mounting position is horizontal, And other positions such as

vertical(inlet up or down)，flatwise or customized position are optional. The mounting position should be specified by the customer to ensure the best accuracy.

1.6.2 Manufacturing Environment

The MFC are assembled in a class 100 clean room, calibrated, packaged and controlled in class 1000 environment. The temperature is 22±2℃.

1.6.3 Precision Adjustment

Each MFC is accurately controlled for 24 hours after manufacturing on a different calibration bench. The accuracy, the dynamic response, the stability to pressure variations is double checked, only qualified product available for sale.

SECTION 2 INSTALLATION

2.1 General

WARNING: Toxic, corrosive or explosive gases must be handled with extreme care. After installing the MFC, the system should be thoroughly checked to ensure it is leak-free. Purge the MFC with a dry inert gas for one hour before using corrosive gases.

IMPORTANT: When installing the MFC, ensure that the arrow on the back of the unit in the same direction as the gas flow.

2.2 Unpacking

The CS200-A,C,D MFC/MFM are assembled，calibrated and clean packaged under clean room conditions. These series products are packaged with two separately sealed plastic bags. The outside is common plastic bag, the inside is clean bag. The outside bag should be removed in the entrance to the clean room. In order to minimize the

contamination, the second clean bag should be removed in the clean room when MFC installed in the system.

2.3 Mechanical Installation

2.3.1 General

Most applications will require a positive shutoff valve in line with the MFC. Pressurized gas trapped between the two devices can cause purge effects, and consideration must be given to the sitting of the shutoff valve (upstream or downstream) in relation to the process sequencing. It is recommended that you install an in-line filter upstream to the controller in order to prevent MFC from contamination.

CS200-A,C,D should be mounted in the position accord with the requirement in the purchase order. The gas should be clean and dry. The mounting should be free from shock or vibration. The pictures of the product are shown in figure2-1,the dimensions of the product are shown in figure2-2, figure2-3a，figure2-3b，figure2-3c，figure2-4. Different fittings(Compression Fitting φ6, Compression Fitting φ3,Compression Fitting1/4 ，Compression Fitting1/8,VCR1/4 M, Compression Fitting3/8，1.5″ W-seal，1.5″ C-seal) are optional for customer, The length of the product L are shown in Table 2-1. Do not remove the protective end caps of the fittings until installation.

Figure 2-1 CS200-A,C,D MFC/MFM

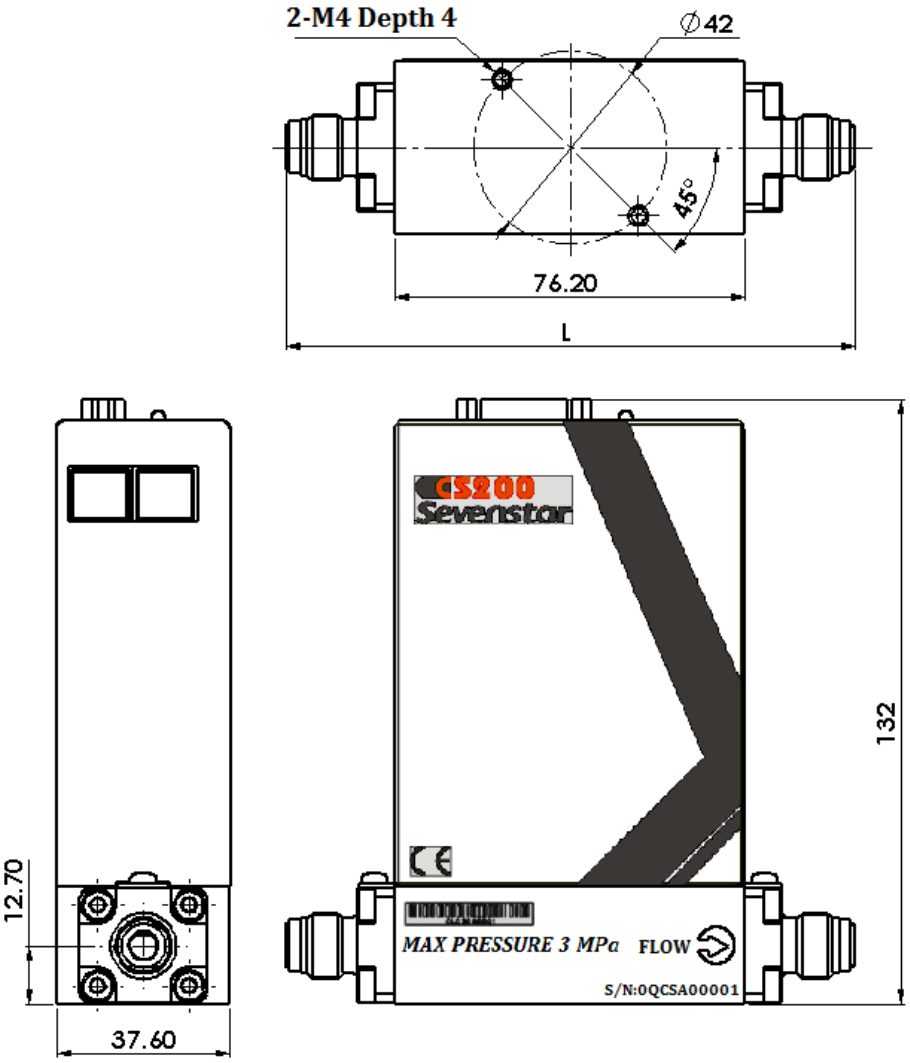


Figure 2-2 Product dimensions

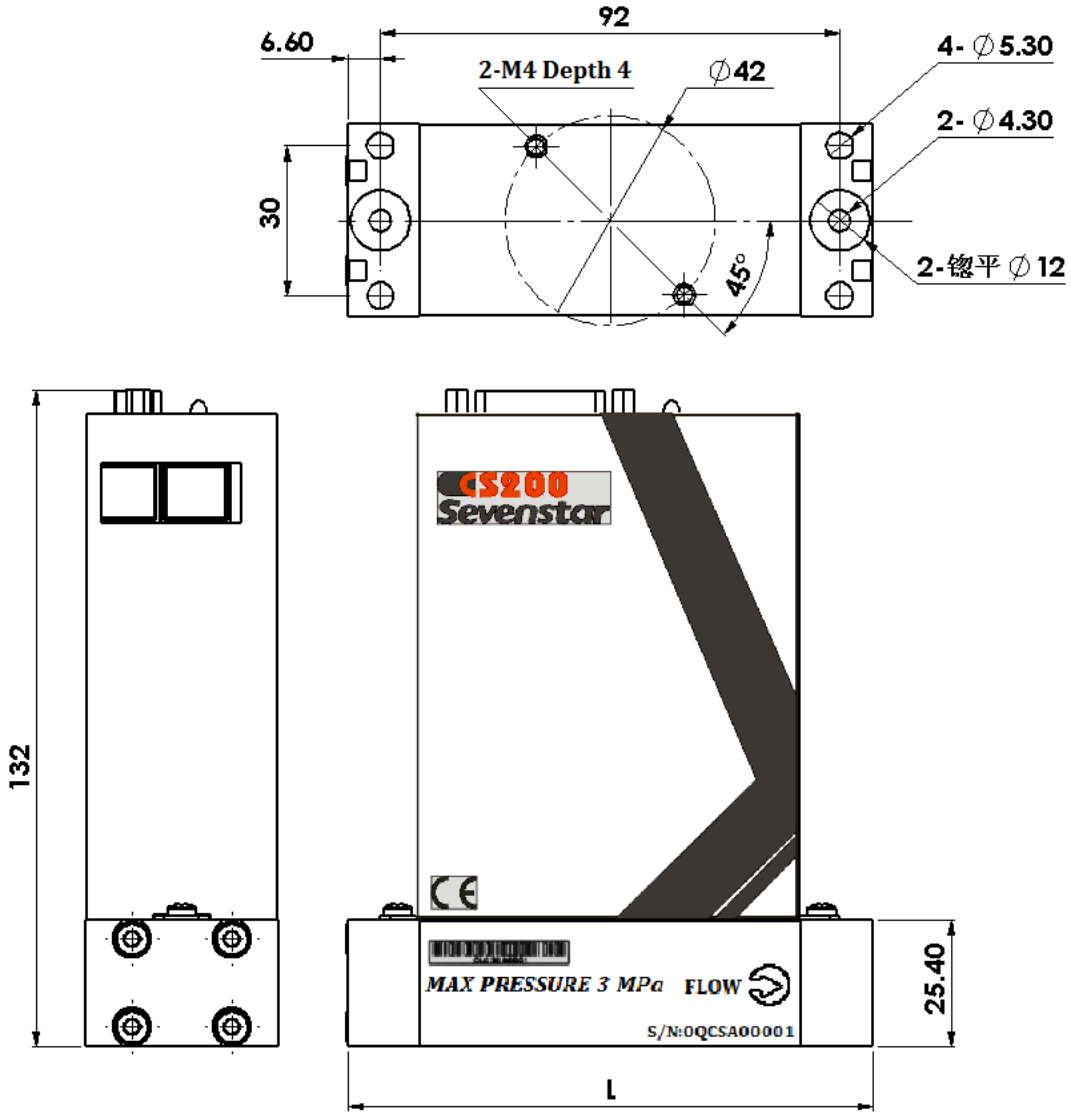


Figure 2-3a Product with A-seal dimensions

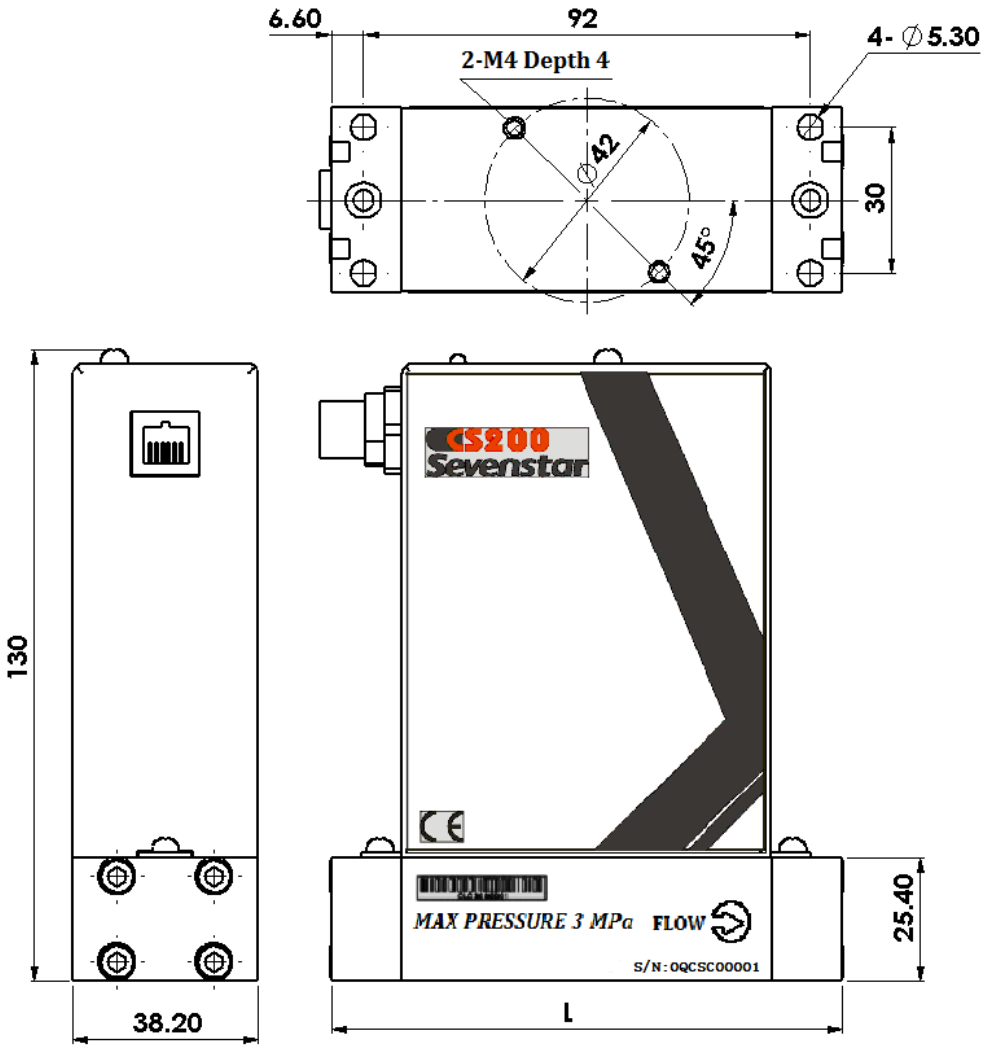


Figure 2-3b Product with C-seal dimensions

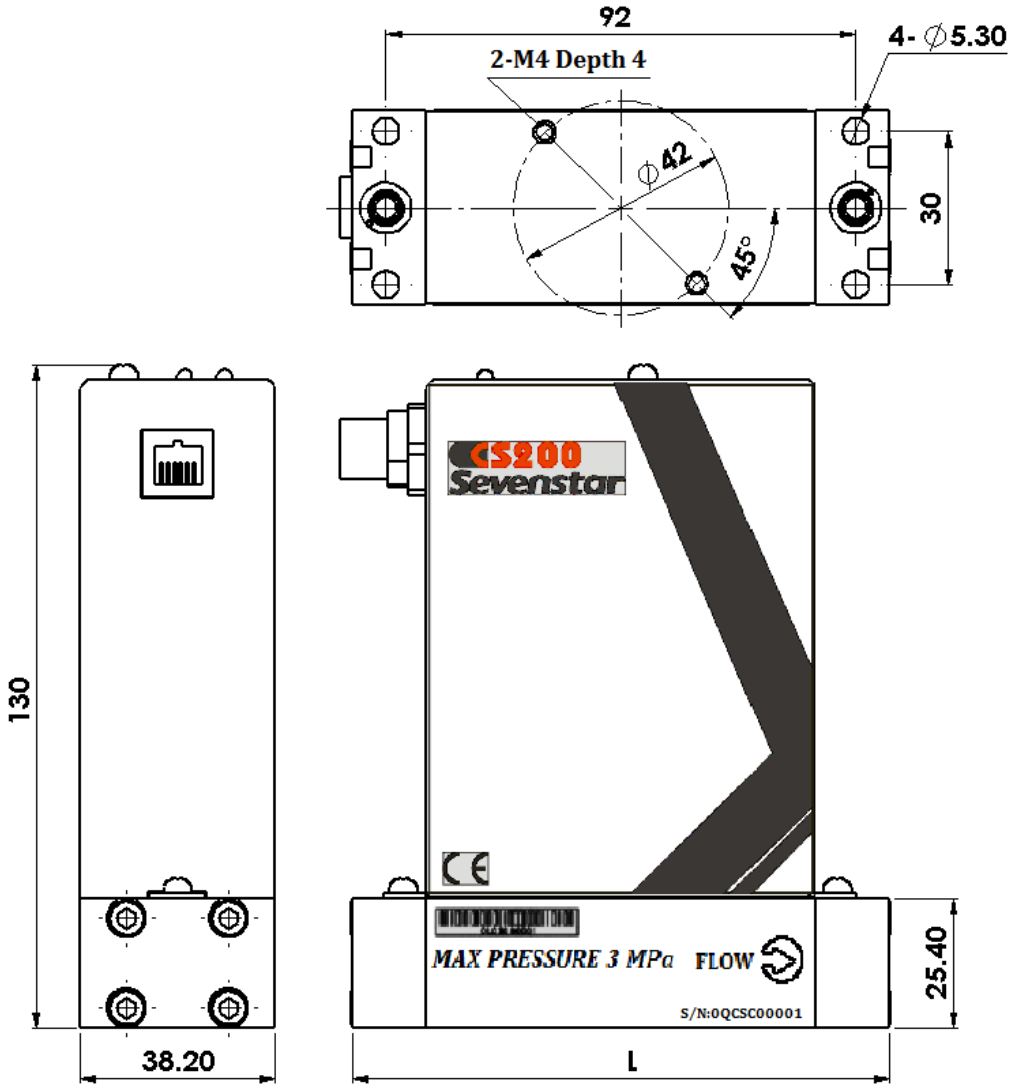


Figure 2-3c Product with W-seal dimensions

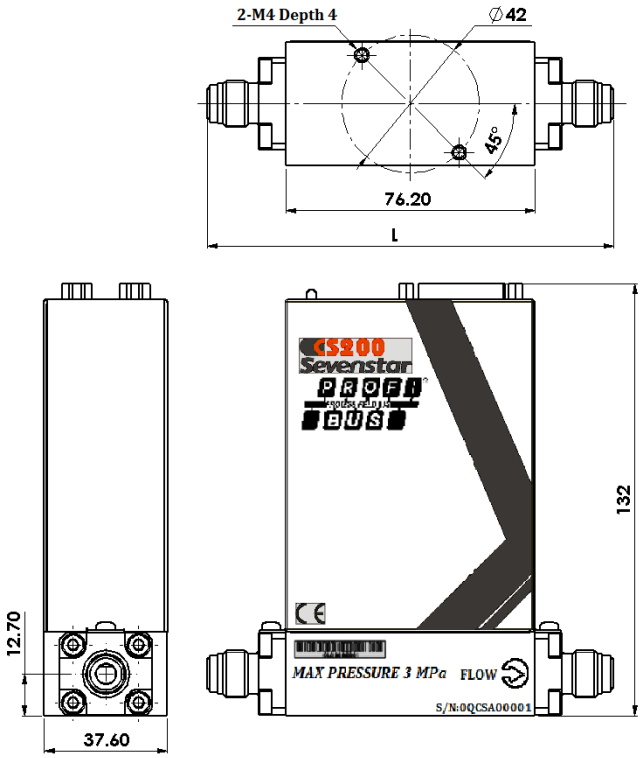


Figure 2-4 Product dimensions

Length \ Fitting	Compression Fitting ϕ 6; Compression Fitting ϕ 3 Compression Fitting1/4; Compression Fitting ϕ 10 Compression Fitting1/8; Compression Fitting3/8	Φ4(inner)×1hose	VCR1/4″ M VCO1/4″ M Φ6(inner)×1hose Φ5(inner)×1.5hose	1.5″ W-seal 1.5″ C-seal A-seal
L（mm）	112.8	117.6	124	105.2

Table 2-1 The length of the product with different fittings

Attention⚠:

The height (which is showing in figure 2-2, figure 2-3a and figure 2-4) of 132mm are height without electric connectors of cable. It should be added around 50mm more after adding the electric connector.

2.3.2 Installation

Place MFC according to the flow direction.

2.3.2.1 1/4VCR Connection

Refer to figure 2-5 and figure 2-6. Check the gland to gland space, including the gaskets. Remove the plastic gland protector caps. When using loose VCR original style gaskets, inserting the gasket into the female nut. For VCR retainer gaskets, snap the gasket onto the male coupling. Tighten the nuts finger tight. Scribe both nut and body in order to mark the position of the nut. While holding the body with a wrench, tighten the nut: 1/8 turn past finger tight for 316L stainless steel and nickel gaskets.

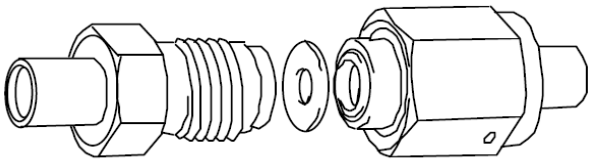


Figure 2-5 VCR original style gasket

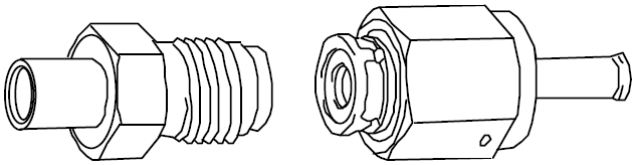


Figure 2-6 VCR retainer gasket

2.3.2.2 Two-ferrule (Compression Fitting) Connection

Refer to figure 2-7. Check the gland to gland space. Remove the gland protector caps. Insert the tubing to the shoulder inside the fitting, and check that the ferrules are positioned as shown in figure2-7. Tighten the nuts finger tight. Use two spanners, one spanner locking the fitting stable, wrench another one to tighten in 1.25 turns to prove it's not blow-by after installing the front ferrule, back ferrule and nut.

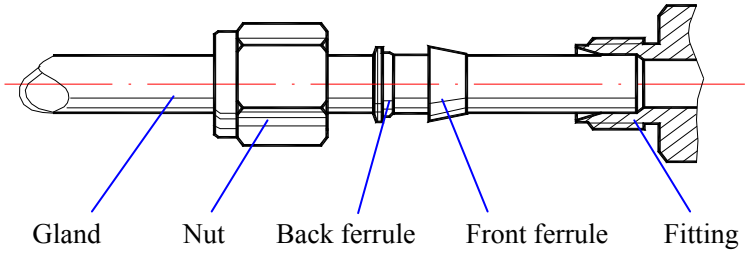


Figure 2-7 Compression Fitting Connector Installation

Attention⚠:

When installing the fitting, you should manually use spanner to wrench it tighten by 1/2 turn pulling up, (imported Compression Fitting should use spanner to be tighten in 1,25 turns) to prove its not blow-by after your installing the front ferrule 、back ferrule and nut. Please note you should use two spanners to operating, one spanner for locking the fitting stable and another one for revolving the nut. Especially when you dismantle the tube, you should operate by the two spanners otherwise fitting will become flexible which will affect its airproof function.

2.4 Electrical Installation

2.4.1 General

With simple switching power supply, CS200-A,C,D MFC/MFM are available for ±8 to ±16 VDC (dual-ending) and +14 to +28 VDC (single-ending). Customer can choose as

need.

Customer can choose 9 pin male Sub-D or 15 pin male sub-D connector. 9 pin male Sub-D connector is the SEMI Standard compatible, only 0-5V analog signal control and output available. 15 pin male sub-D connector, both 4-20mA or 0-20mA and 0-5V analog signal control and output available.

CS200-A,C,D MFC/MFM can communicate with PC via RS485 ， DeviceNet or ProfiBus .

2.4.2 Connections

The 9 pin male Sub-D connector, 15 pin male sub-D connector, RS485 connector ,DeviceNet connector ,Analog Signal Interface ， RS232-RS485 connector， ProfiBus connector of 9-pin female sub-D and ProfiBus connector of 15-pin male sub-D are shown in figure2-8, figure2-9 , figure 2-10 ,figure 2-11, figure 2-12 , figure2-13， figure2-14 and figure2-15.

Attention⚠:

Although sharing with the same appearance of CS200-A,C,D MFC, the 0~5V Setpoint Input, the 4~20mA or 0～20mA Setpoint Input and the valve Over-ride are not available. That means pin1 and pin6 of D-sub 9 and pin1, pin7, pin8 and pin12 of D-sub 15 are not available.

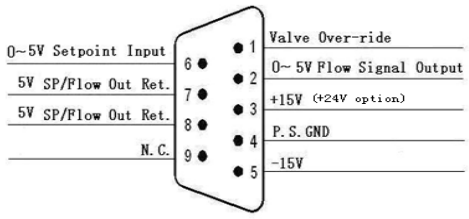


Figure 2-8 9 pin male D-sub connector

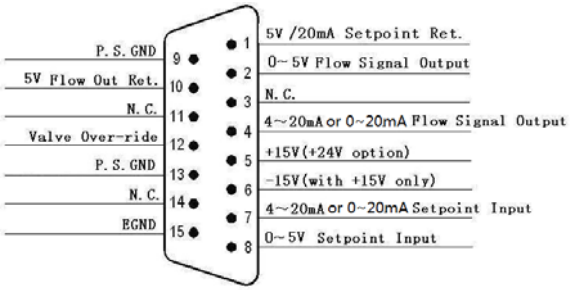


Figure 2-9 15 pin male D-sub connector

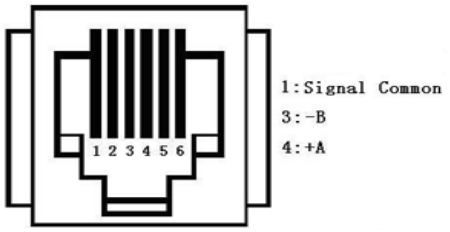


Figure 2-10 RS485 connector

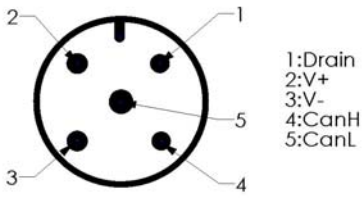


Figure 2-11 DeviceNet connector

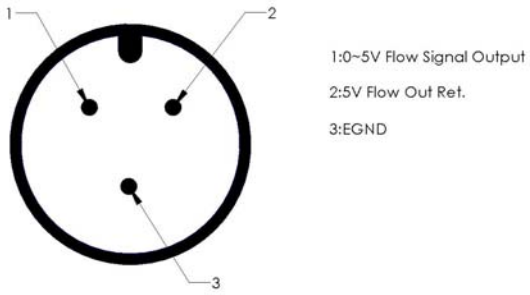


Figure 2-12 Analog Signal Interface

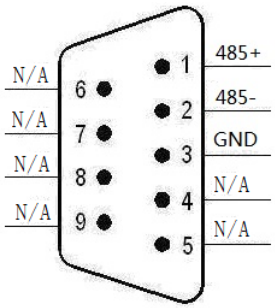


Figure 2-13 RS232-RS485 connector

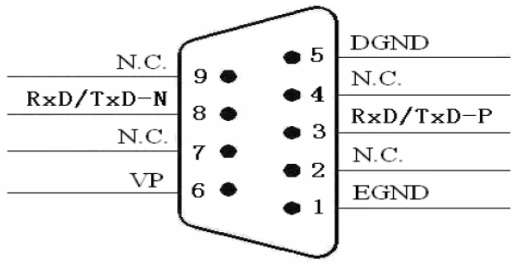


Figure 2-14 ProfiBus connector of 9-pin female sub-D

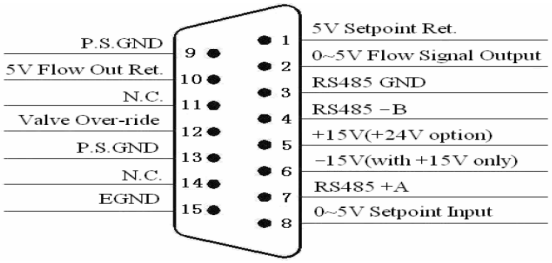


Figure 2-15 ProfiBus connector of 15-pin male sub-D connector

2.4.3 Table of Selecting Type of Cable and its Illustration of Connection

	D08- 2B/3B/4B 2E/3E/4E	D08- 1/2/4 2F/3F/4F D08-1F/1FM/1FS/8C/8CM/1G/1GM	Input ±15V	Input +24V	To Serial of PC	To USB of Computer
MFC (DB15 Pin)	QCX-19/ QCX-P19 QCX-48	QCX-17/QCX-P17 QCX-46	QCX-41	QCX-43	QCX-34	QCX-50
MFC (DB9 pin)	QCX-20/ QCX-P20 QCX-49	QCX-18/QCX-P18 QCX-47	QCX-42		QCX-34	QCX-50

Table 2-2 Table of Selecting Type of Cable

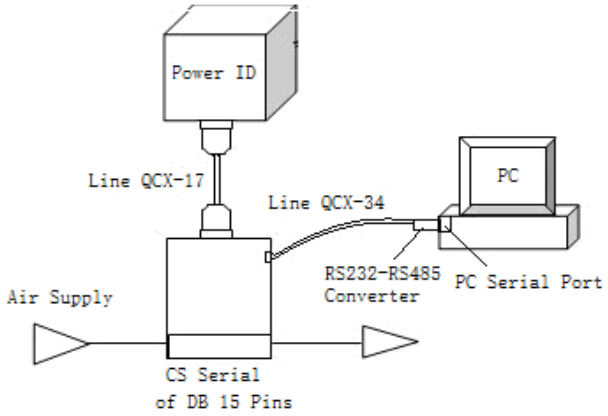


Figure 2-16 CS Product and Illustration of Connecting Power D08-1D/1F

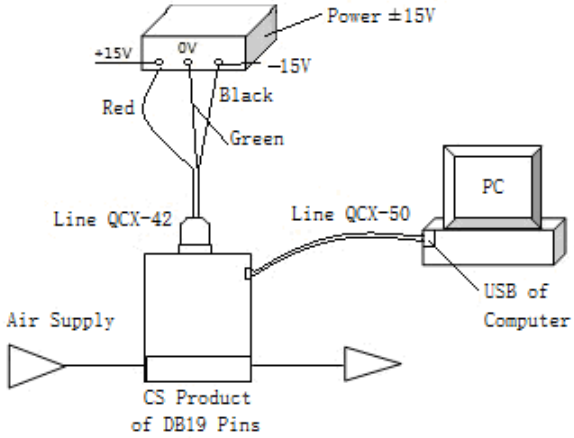


Figure 2-17 CS Product and Illustration of Connecting Power

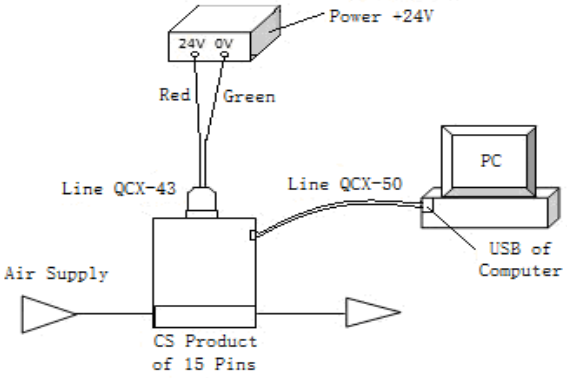


Figure 2-18 CS Product and Illustration of Connecting Power

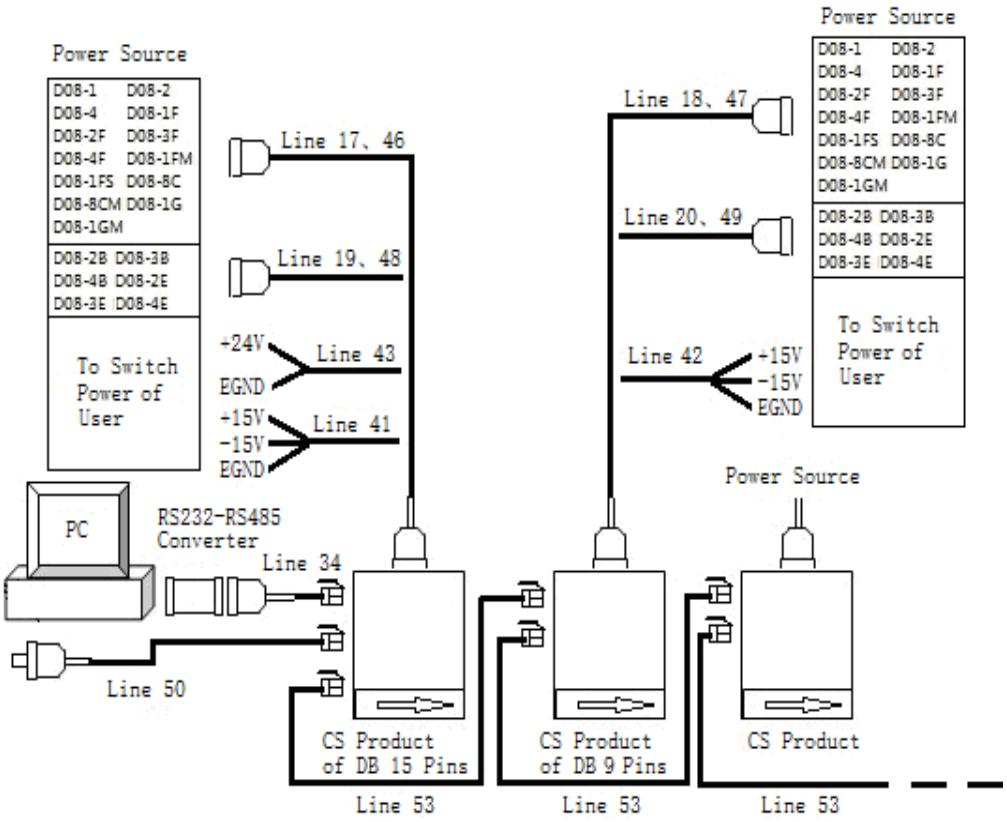


Figure 2-19 Illustration of Connecting CS Product

Sevenstar manufactures all standard cables, RS485 adaptor, customized cables and some accessories. For more details, contact Sevenstar or its local agent.

2.5 Checking Before Operation

Before operating the MFC the following checks should be completed:

2.5.1 Check that tubing is leak free.

2.5.2 Check the process sequence and proper function of all other gas components involved.

2.5.3 Check the voltage of command signals and power supply to the MFC/MFM.

2.5.4 Check that the appropriate type of gas is being supplied at the rated pressure.

2.5.5 Allow the MFC to warm up for 20 minutes, and then check the zero level output.

2.5.6 Use dry inert gas for test runs.

2.5.7 Prior to using the MFC for extremely corrosive gases, purge MFC with a dry inert gas for one hour.

SECTION3 FUNCTIONS

3.1 General

Based on new sensor driver technology, zero balance technology and VCP technology, CS200-A,C,D MFC/MFM presents high performance and reliability. And more digital functions are developed in CS200-A,C,D products.

3.2 Control Mode

CS200-A,C,D MFC/MFM are available for digital，0-5V voltage and 4-20mA or 0-20mA current control mode and output. When customer chooses one of the three control modes, the others will be screened. The analog output will be available at all times. The flow output of the CS200-A,C,D MFC/MFM will be available through the RS485 interface, even in the analog control mode. The setting of the CS200-A,C,D MFC/MFM can be provided to the MFC through one of three sources, in digital or analog mode.

Please refer to “Digital MFC Communication User Manual” for more details.

3.3 Zero

The Zero function can be commanded through the digital interface or zero-button. Before zero MFC, please make sure that no gas flow through MFC. Then zero MFC by the digital interface or zero-button. The zero-button must be pressed continuously for 0.5 seconds in order to start zero process. The green LED will blink during the zero process. After zero finished, the green LED will be on constantly. CS Product of the ProfiBus has the Zero function,but does not have the LED.

3.4 Soft-Start

The CS200-A,C,D MFC/MFM support soft-start function. Soft-start allows customer change the setting of MFC with definite rate. Please refer to “Digital MFC Communication User Manual ” for more details.

3.5 Delay

Delay is used to postpone the start of flow from zero flow to the received set-point. It is programmed in millisecond but the MFC internally rounds up any value to 100ms. For example, when the delay value is 200, MFC will delay 200ms then receiving the operate command. When the set point is less than the min control rate, the valve will shut off, and when larger than the min control rate, MFC will start after the set delay time.

Special default: Values from 1 to 49 ms will be programmed as 100ms. Delay applies to digital and analog set-points.

3.6 Valve Command Mode

CS200-A,C,D MFC/MFM are available for valve-close or valve-open by input digital signal or analog voltage directly. The Valve Command Mode is used to select one of three ways to interpret the analog signal of Valve Command. Please refer to “Digital MFC Communication User Manual” for more details.

3.7 Valve Type

CS200-A,C,D MFC/MFM have two types of valve: Normally open(NO) or Normally closed(NC) . When MFC do not have power supply, the “NO” type valve is open and gas

can flow through the MFC; the “NC” type valve is closed and gas can not flow through. Please mention the valve type when you order the MFC.

3.8 Multi-Gas and Multi-Flow

The multi-gas and multi-range technology has been developed in the CS200-A,C,D series MFC/MFM. Customer can change gas convert factor, full scale of MFC via digital interface. Full scale of CS200-A,C,D series MFC/MFM can be re-ranged from 30% to 110%F.S. For example, an MFC with 100SCCM full scale , the new full scale can be re-ranged between from 30SCCM to 110SCCM.

CS200-A,C,D MFC/MFM support customer offset by the target null value. The target null value is a customer-programmed constant used to offset the flow output independently of all other sensor offset constants, including the zero process. For example, set Target Null Value: -20%F.S，then when no flow through MFC/MFM，the reading is -20%F.S，with gas flow 20%F.S through MFC/MFM， the reading is 0%F.S。Offset range is from -100%F.S to100%F.S。

Please refer to “Digital MFC Communication User Manual” for more details.

3.9 Total Flow Accumulator

The Total Flow accumulator will record the amount of gas (in SCC) that has been delivered by CS200-A,C,D MFC/MFM. The amount of purge will not be accumulated in the total flow amount. For example, the total reading is 3000, means the amount of gas delivered by MFC is 3000SCC

Please refer to “Digital MFC Communication User Manual” for more details.

3.10 Alarm

The CS200-A,C,D MFC/MFM will monitor and store certain abnormal conditions as described below. These conditions can be read and reset from the RS485 interface. Provisions will be made for masking (disabling) the alarms or warnings on an individual basis.

Warning and Alarms:

Sensor Zero Output Out of Bounds

EEPROM Failure

Valve Coil Failure or Valve Disconnected

Temperature Out of Operating Range

After power up the LED on the top of the CS200-A,C,D MFC/MFM is turned GREEN. A warning condition will be announced by a blinking RED and whenever an alarm condition is detected it will be set continuously to RED.

Please refer to “Digital MFC Communication User Manual” for more details.

3.11 LED

There is a green-red LED located on the top of the MFC. The constant green LED indicates the power on. Green blinking indicates that the MFC is zeroing. A blinking red LED indicates warning condition. Constant red indicates error condition.

In DeviceNet connection, there will be 2 LED on the top of CS200-A,C,D, refer to CS200MFC(CS220)_DnetSpecification_V1.01 for more details.

In ProfiBus connection, there will be 1 LED on the top of CS200-A,C,D, the constant green LED indicates that the communication is normal .No light indicates warning condition.

Attention⚠:

When the valve of MFC is fully opened , it can be functioned as a MFM. In that case, the maximum flow testing voltage could reach beyond +10V, please be careful, while flow is beyond F.S. +5V(Full Scale), the real flow will have no linearity corresponding with flow testing voltage. While it’s purging, flow display will be inaccurate, even showing “reduce” while the real flow is enhanced, please be sure it’ll be no damaged to device itself.

SECTION 4 MAINTENANCE

4.1 General

No routine maintenance is required to be performed on the MFM or MFC, Other than occasional cleaning and re-calibration:

It can be used about 3 or 4 years with an ultra-clean and non corrosive gas.
It can be used about 1 or 2 years with a low purity gas or a corrosive gas.
For any other problems, contact Sevenstar.

4.2 Caution⚠

4.2.1 Medium Forbidden

The used gas should be purified without dust，liquid and oil stain. If necessary, the filter should be added to gas system for purification. If the outlet of MFC is connected to liquid sources, a One-way valve should be added to avoid the liquid back to destroy MFC.

Attention⚠:

For the cases that the MFC/MFM used with toxic, pyrophoric, flammable or corrosive gas, you should ensure that the fixing and fitting are airtight. It becomes necessary to remove the controller from the system, purge the controller thoroughly with a dry inert gas such as nitrogen, before disconnecting the gas connections. Failure to purge the controller could cause a fire or explosion resulting in death.

4.2.2 Seal of Valves

The Solenoid Valve of MFC is only for adjustment, can not be used for shut-off. Generally, shut-off valves should be added in upstream and downstream of MFC for protection. Normally leakage of MFC valve is not more than 1% F.S.

SECTION 5 TROUBLESHOOTING

5.1 Initial Check

5.1.1 Check the gas supply pressure and check the flow-path to the MFC/MFM has been opened.

5.1.2 Ensure that the power supply and command signals are correctly transmitted to the D-connector pins and RS485.

5.1.3 Check that the output signal matches the external reading.

5.2 Troubleshooting

Use the following table to locate the fault.

	SYMPTOMS	Possible cause	Action
1	Output reading, without gas flow, is not zero	Gas flow is actually present	Check closure of series shutoff valve
		Zero drift	Zero MFC
		other	*Contact Sevenstar
2	MFC will not control	Gas connection incorrect	Check gas connection
		Pressure incorrect	Check pressure condition
		Wrong control mode	Change the control mode by the software
		Power failure	Check Power and pin position
		Setpoint incorrect	Check setpoint signal
		Contamination	*Contact Sevenstar
		Defective sensor	*Contact Sevenstar
		PCB problems	*Contact Sevenstar
		Defective Mechanics	*Contact Sevenstar
3	MFC will not communicate with PC	Power failure	Check Power and pin position
		Cable problems	Check cable and connector
		Address conflict	Check address of MFC
		Baud rate error	Check baud rate of MFC
		PCB problems	*Contact Sevenstar

Attention⚠:

* Mark indicates that reparation and adjustment must be dealt under specialist advices。For any other problems, contact Sevenstar.

SECTION 6 WARRANTY AND SERVICES

6.1 Guarantee of Sevenstar

Sevenstar and its authorized distributors assure that there are not flaw of the material and quality of product within 12 months since the date of the product purchased by you.

The compensation for customer is only limited to invalid part for substitution, installation and processing flaw.

It is guaranteed that all part chose by customers are suitable to relative manufacturer.

Other relative statements, guarantee and obligation of status and usage of product, whether direct or indirect, are definite to be excluded. In any circumstance, Sevenstar and its authorized distributors are not charged of any obligation of direct or indirect loss for customers or others.

6.2 Product Warranty

6.2.1 Sevenstar products are guaranteed against defects in materials and workmanship if used in accordance with specifications and not subject to physical damage, contamination, alteration or retrofit. Warranty periods: One year

6.2.2 Buyers undertake to check and inspect the goods and to notify Sevenstar of shipment incidents by fax, phone or e-mail as soon as possible after receipting the goods.

6.2.3 During the warranty period, products must only be repaired by authorized Sevenstar service centers; Otherwise, the Sevenstar product warranty will be invalidated.

6.2.4 Repairs will be performed free of charge during the one-year warranty period. If MFC are out of warranty, Sevenstar will notify the owner of replacement or repair costs

before proceeding. Factory service and repairs are guaranteed 90 days. The warranty excludes consumable materials and wear parts (in teflon, viton, etc.).

6.2.5 No MFC will be accepted for repair or warranty without a decontamination and purge certificate.

6.2.6 Each MFC is individually checked (visual inspection of fittings, helium leak test and flow calibration). Sevenstar shall not be responsible for any damage caused by gas leakage or the use of a dangerous gas. Users are responsible for following the safety rules applicable to each gas they use. Improper use of a Sevenstar MFC will void the warranty, and MFC that have been damaged as a result of improper use will not be replaced by Sevenstar.

6.2.7 Specific warranty requirements are as follows :

A，Gas must be clean and particle-free, which means a filter must be fitted in the gas line upstream of the MFC.

B，Gas must comply with the following pressure specifications:

1. Gas pressure must never exceed 3MPa.
2. Differential pressure must be more than 0.05MPa for full-scale flow through the MFC valve unless another value is specified in the user's manual.
3. Differential pressure must be less than 0.35MPa for the MFC valve to regulate without gas-flow oscillation unless another value is specified in the user's manual.
4. Pressure at the mass-flow inlet must be regulated by an accurate pressure regulator to prevent gas-flow oscillation.

C，Electrical connection requirements are as follows:

The system must be wired carefully: non-observance of the pin-out may irreversibly damage the electronic board inside the MFC, in which case the warranty will be invalidated.

D，Gas connections: The fittings must be handled carefully. Sevenstar guarantees that

all fittings have been individually inspected and are scratch-free.

E，Fitting procedure: The fitting procedure set out in the manual must be followed meticulously. Specifically, the purge procedure is very important if corrosive gases or toxic gases are used.

F，The mass-flow must not be dismounted: The MFC warranty will be invalidated if the seal between the MFC block and cover is torn.

6.3 Services

Sevenstar can provide services like start-up service, software development, gas system design, training, etc.

Please visit www.mfcsevenstar.cn for more information and find your nearest service and calibration centre**.**

6.4 Disclaimer

Beijing Sevenstar Electronics Co., Ltd is not responsible to loss as following situation:

1. Nature disaster and calamity;
2. Unsuitable operation and unreasonable usage;
3. Operating and storing in inappropriate or execrable circumstance;
4. Usage of instrument beyond user's manual;
5. Unauthorized change or replacement of product.

For example:

It is whether that gas path is not cleared before using corrodible gas or MFC is contaminated or blocked by particle such as dust.

Appendix Ⅰ CS200 Selection Guide

CS200-[t] [g,g,g] [v] [r,r,r,r] [a] [f,f] [s] [m] [d]

[t] -Type
- [A] Elastomer type
-
- [C] Metal type, stainless steel VV, 10Ra
- [D] Metal type

[g,g,g] -Gas
Standard: SEMI52-0302（Note:029 NH_3 available to type C,D only） For example
-[013] N_2 -[007] H_2
-[000] Mixture Gases (please consult [d] for details)

[v] -_ Type of Valve
- [O] Normally open (unavailable to MFM)
- [C] Normally closed (unavailable to MFM)
- [N] No Valve (available to MFM only)

[r,r,r,r] -Full Scale
- [002C] 2SCCM (available to type C, D only)
- [003C] 3SCCM (available to type C, D only)
- [005C] 5SCCM
- [010C] 10SCCM - [001L] 1SLM
- [020C] 20SCCM - [002L] 2SLM
- [030C] 30SCCM - [003L] 3SLM
- [050C] 50SCCM - [005L] 5SLM
- [100C] 100SCCM - [010L] 10SLM
- [200C] 200SCCM - [020L] 20SLM
- [300C] 300SCCM - [030L] 30SLM
- [500C] 500SCCM - [050L]50SLM(available to type A)
- [000C] customized Full scale, please consult [d] for details

[a] -Electronic connector
- [R] DB 9 pin - [D] DB15 pin
- [X] DeviceNet™ - [Y] DeviceNet™ +Analog
- [F] ProfiBus

[f,f] -Fittings
-[AA] Compression Fitting Φ3mm -[BB] Compression Fitting 1/8" (available to type A only)
-[GG] Compression Fitting Φ6mm -[JJ] Compression Fitting Φ10mm (available to type A only)
-[CC] Compression Fitting 1/4" -[SC] IGS C seal (available to type C,D only)
-[MM] VCR 1/4" -[SW] IGS W seal (available to type C,D only)
-[HH] Swagelok 3/8"(available to type A only)
-[UU] VCO 1/4"(available to type A only)
-[RR]φ6(inner)x1hose(available to type A only)
-[VV]φ5(inner)x1.5hose(available to type A only)
-[TT]φ4(inner)x1hose(available to type A only)
-[SA] A seal (available to type A only)
-[XX] customized fittings please consult [d] for details

[s] -Seal Materials
-[V] Viton(available to type A, only)

-[M] Metal (available to type C, D only)

[m] -Mounting Position

-[H] Horizontal
-[E] HESD(Horizontal Edge Side Down)
-[U] Vertical Inlet Up
-[D] Vertical Inlet Down

[d] -Description

-[-]：Default Value

The letters on cover and tag：In English

Differential Pressure:

(0.05 ~ 0.35) MPa (7.3~50.8 psid)　(FLOW≤10SLM)

(0.1 ~ 0.35) MPa (14.5~50.8 psid)　(10SLM＜FLOW≤30SLM)

(0.2 ~ 0.45) MPa (29.0~65.3 psid)　(30SLM＜FLOW)

CS200-A、CS200-C、CS200-D XXXN：＜0.02MPa (2.9psid)

Max inlet pressure :3 MPa (435.1 psig)

Calibration temperature :(22±2)℃

Valve command mode :2

Power Supply: +24V

Command type:DeviceNet default digital mode; Profibus default mode for Profibus; other analog voltage

-[S] Customized Requirement

For Example: I/O sign:4~20mA；

The proportion of mixture gases should be indicated: N2 (60%) + CO2(40%)；

Customer Differential Pressure: (0.05 ~ 0.3) MPa；

Customer Calibration Temperature: 40℃；

The letters on cover and tag: in Chinese；

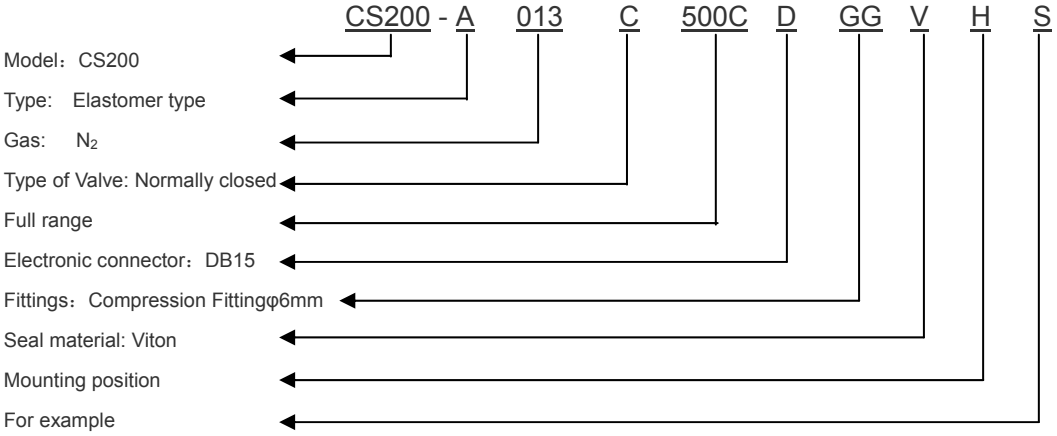
Valve command mode:0；

Power Supply: ±15V

Command type:Profibus default mode for analog voltage

and other customized requirements.

Take CS200-A013C500CDGGVHS as the example



Customized requirement: In Chinese. Differential pressure, (0.3-0.5)MPa, customized fittings, customized calibration temperature, 40℃

APPENDIX II CONVERSION FACTOR

GAS	GAS CODE (SEMIE52-0302)	SPECIFIC HEAT (Cal/g ℃)	DENSITY (g/l 0℃)	CONVERSION FACTOR
Air	008	0.2400	1.2930	1.001
Ar	004	0.1250	1.7837	1.420
AsH_3	035	0.1168	3.4780	0.673
BBr_3	079	0.0647	11.1800	0.378
BCl_3	070	0.1217	5.2270	0.450
BF_3	048	0.1779	3.0250	0.508
B_2H_6	058	0.5020	1.2350	0.441
CCl_4	101	0.1297	6.8600	0.306
CF_4	063	0.1659	3.9636	0.420
CH_4	028	0.5318	0.7150	0.722
C_2H_2	042	0.4049	1.1620	0.596
C_2H_4	038	0.3658	1.2510	0.597
C_2H_6	054	0.4241	1.3420	0.482
C_3H_4	068	0.3633	1.7870	0.421
C_3H_6	069	0.3659	1.8770	0.411
C_3H_8	089	0.3990	1.9670	0.358
C_4H_6	093	0.3515	2.4130	0.322
C_4H_8	104	0.3723	2.5030	0.299
C_4H_{10}	117	0.4040	2.6500	0.261
C_5H_{12}	240	0.3916	3.2190	0.217
CH_3OH	176	0.3277	1.4300	0.584
C_2H_6O	136	0.3398	2.0550	0.392
$C_2H_3Cl_3$	112	0.1654	5.9500	0.278
CO	009	0.2488	1.2500	1.000
CO_2	025	0.2017	1.9640	0.739
C_2N2	059	0.2608	2.3220	0.451
Cl_2	019	0.1145	3.1630	0.858
D_2	014	1.7325	0.1798	0.997
F_2	018	0.1970	1.6950	0.931
$GeCl_4$	113	0.1072	9.5650	0.267

GAS	GAS CODE (SEMIE52-0302)	SPECIFIC HEAT (Cal/g ℃)	DENSITY (g/l 0℃)	CONVERSION FACTOR
GeH_4	043	0.1405	3.4180	0.570
H_2	007	3.4224	0.0899	1.010
HBr	010	0.0861	3.6100	0.999
HCl	011	0.1911	1.6270	0.988
HF	012	0.3482	0.8930	1.001
HI	017	0.0545	5.707	1.000
H_2S	022	0.2278	1.5200	0.802
He	001	1.2418	0.1786	1.420
Kr	005	0.0593	3.7390	1.431
N_2	013	0.2486	1.2500	1.000
Ne	002	0.2464	0.9000	1.431
NH_3	029	0.5005	0.7600	0.719
NO	016	0.2378	1.3390	0.978
NO_2	026	0.1923	2.0520	0.737
N_2O	027	0.2098	1.9640	0.710
O_2	015	0.2196	1.4270	0.981
PCl_3	193	0.1247	6.1270	0.358
PH_3	031	0.2610	1.5170	0.690
PF_5	143	0.1611	5.6200	0.302
$POCl_3$	102	0.1324	6.8450	0.302
$SiCl_4$	108	0.1270	7.5847	0.284
SiF_4	088	0.1692	4.6430	0.348
SiH_4	039	0.3189	1.4330	0.600
SiH_2Cl_2	067	0.1472	4.5060	0.416
$SiHCl_3$	147	0.1332	6.0430	0.340
SF_6	110	0.1588	6.5160	0.258
SO_2	032	0.14890	2.8580	0.687
$TiCl_4$	114	0.1572	8.4650	0.206
WF_6	121	0.0956	13.2900	0.217
Xe	006	0.0379	5.8580	1.431

Conversion Factors Instruction：

MFC and MFM are standard calibrated by N_2 while it's out of factory. Other gas calibrations can be approximated by converting of conversion factors of our instruction. While using other gas operating:

One single gas: The conversion factors could find out in the users specification instruction.

A mixture of two or more gases: Assume there is "n" sorts of gases, could calculate the conversion factors C by the following formula:

Basic Formula： $C=0.3106\ N / \rho\ (Cp)$

ρ — Density of the gas
Cp — Specific heat of the gas
N — Structure factors of gas-molecule (See the following table)

Table . Gas-Molecule Composing factors

COMPOSITION	EXAMPLE		N VALUE
Single atom numerator	Ar	He	1.01
Double atom numerator	CO	N_2	1.00
Tree atom numerator	CO_2	NO_2	0.94
Multi-atom numerator	NH_3	C_4H_8	0.88

For mixture gases： $N = N_1\ (\omega_1/\omega_T)+N_2\ (\omega_2/\omega_T) + \cdots + Nn\ (\omega_n/\omega_T)$

Then：

$$C = \frac{0.3106\ [N_1\ (\omega_1/\omega_T)+N_2\ (\omega_2/\omega_T) + \cdots + Nn\ (\omega_n/\omega_T)]}{\rho_1 Cp_1\ (\omega_1/\omega T)+ \rho_2 Cp_2\ (\omega_2/\omega_T)+ \cdots + \rho_n Cp_n\ (\omega_n/\omega_T)}$$

$\omega_1 \ldots \omega_n$ — The flow of single gas
ω_T — The flow of mixture gas
$\rho_1 \ldots \rho_n$ — The density of single gas
$CP_1 \ldots CP_n$ —Specific heat of the single gas
$N_1 \ldots N_n$ —Structure factors of gas-molecule (See Table 6.)

Attention⚠:

1） Standard：Temperature 273.15K (0 ℃); Air Pressure— 101325 Pa (760mm Hg)
2） Please feel free to contact us if the request gas conversion factors could not be found in our appendix.

CS Series

Mass Flow Controller

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