D07 -22AM 型　质 量 流 量 计

使 用 手 册



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MASS FLOW METER

使　用　手　册

1. 使用须知

尊敬的用户，感谢您购买本公司生产的 D07 系列质量流量控制器/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。

本手册对您安装、维护及故障维修时，必不可少，请妥善留存保管。

2. 用途和特点

质量流量计(Mass Flow Meter 缩写为 MFM)用于对气体的质量流量进行精密测量。它在半导体微电子工业、特种材料研制、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: 电子工艺设备, 如扩散、氧化、外延、CVD、等离子刻蚀、溅射、离子注入; 以及真空镀膜设备、光纤熔炼、微反应装置、混气配气系统、毛细管测量、气相色谱仪及其它分析仪器。

D07-22AM 型质量流量计具有精度高、线性好、响应速度快、稳定可靠、操作使用方便, 可任意位置安装等特点。因为其本身集成液晶显示屏可实时显示瞬时流量，所以不需要另配流量显示仪。集成 RS232/485 通讯接口，便于与计算机连接实现自动控制。D07-22AM 型质量流量计外观如图 1 所示。



图 1. 质量流量计外观

3. 主要技术指标

表 1. D07-22AM 型 MFM 性能指标

编号	项　　目	D07-22AM
1	流量规格	(0~5,10,20,30,50,100,200,300,500)　SCCM
		(0~1,2,3,5,10)　SLM
2	准确度	±0.5 % F.S.
3	线性	±0.25 % F.S.
4	重复精度	±0.2 % F.S.
5	响应时间	≤2 sec
6	工作压差范围	<0.01MPa
7	耐压	10 MPa
8	漏率	1×10^{-9}atm·cc/sec He
9	温度系数	Zero: ≤±0.05% F.S./℃; Span: ≤±0.1% F.S./℃;
10	工作环境温度	5 ℃ ~45 ℃
11	输出信号	RS485
12	电源	(100~250)V (50~60)Hz　(注 1)
13	外形尺寸	见图 3
14	重量	1.3 kg

注 1：如图 1 所示，本产品配有开关稳压电源，此开关稳压电源输入信号为(100~250)V, (50~60)Hz，输出信号为+15VDC,1.25A。将开关稳压电源和 MFM 看作为一个整体，所以它的电源为(100~250)V (50~60)Hz，而 MFM 本身所需的供电电源为+15VDC，400mA。

注意⚠:

质量流量计出厂通常用氮气（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)

F.S. (Full Scale):　满量程值

4. 结构

质量流量计由流量传感器，分流器通道和流量放大电路等部件组成。D07-22AM 型质量流量计，打开外罩后的结构如图 2 所示。

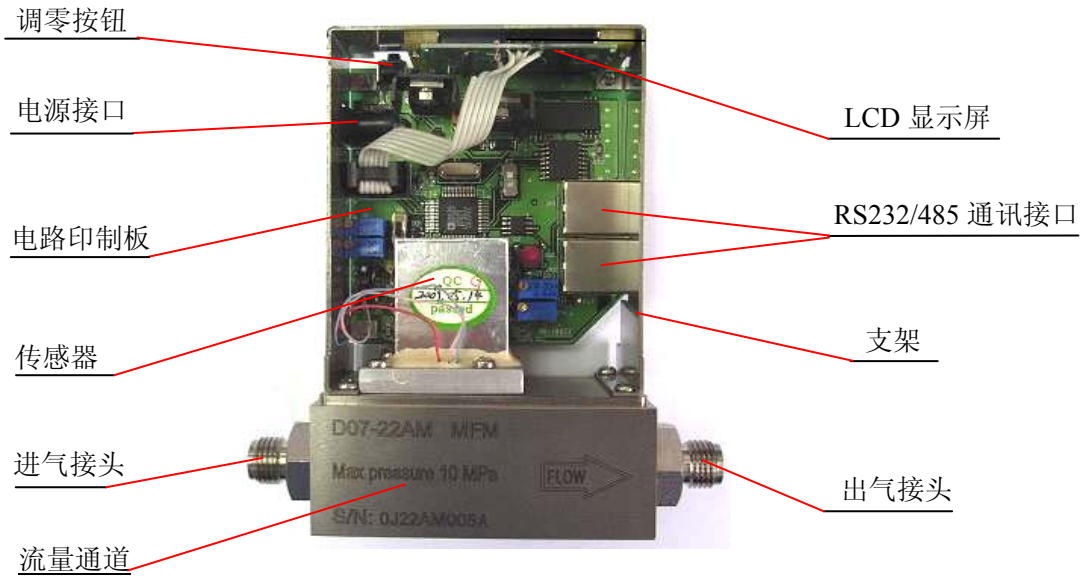
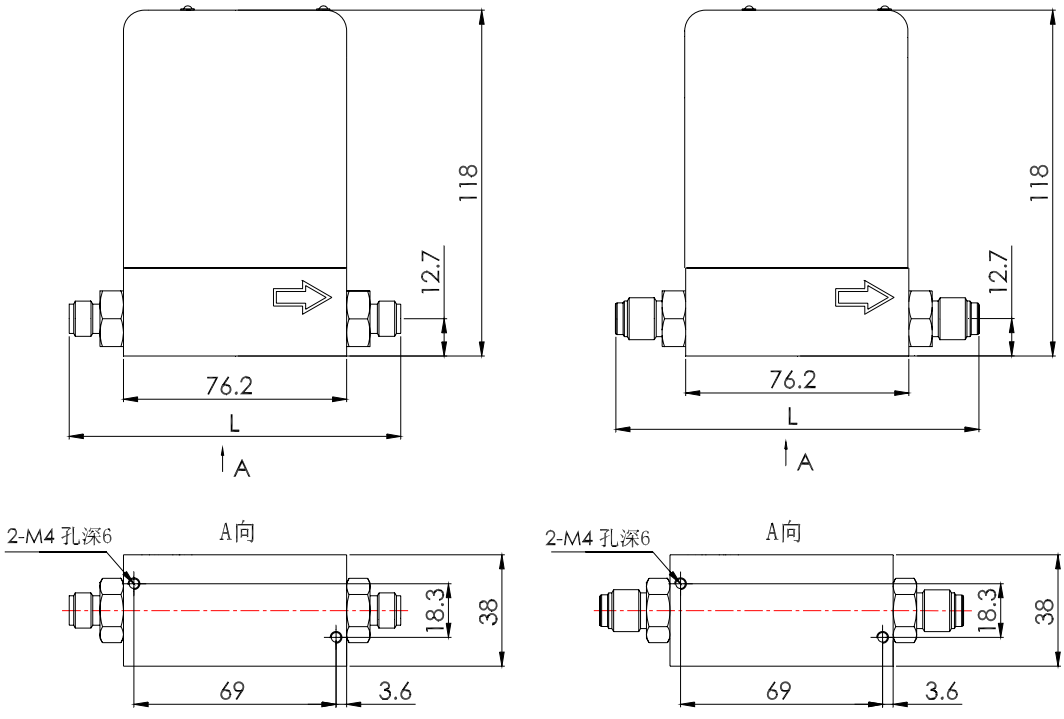


图 2.　D07-22AM 质量流量计结构图

5. 安装和接线

5.1 外形及安装尺寸:

D07-22AM 的外形和安装尺寸如图 3 所示。



SWG Ø3、Ø6、1/8″ 、1/4″ L＝113
Ø4（内）×1软管 L＝122

1/4″ VCR L＝124
Ø6（内）×1软管 L＝121

图 3. D07-22AM 型 MFM 外形尺寸

5.2 气路接头形式

采用标准双卡套 (Swagelok)接头和 VCR 接头, 可提供 7 种接管外径的接头类型:

a. Swagelok Φ6 mm 双卡套;
b. Swagelok Φ3 mm 双卡套;
c. Swagelok 1/4" (英制);
d. Swagelok 1/8" (英制);
e. VCR（1/4"接管外径）;
f. Φ6（内）×1 软管;
g Φ4（内）×1 软管。

双卡套接头一般用金属管将质量流量计与气路相连接，在要求不高的情况下也可以用尼龙管或其它较硬的弹性塑料管。双卡套接头的连接方法, 如图 4 所示。注意流量计通道上的箭头指示的方向是气流方向, 进出气方向不能接反。

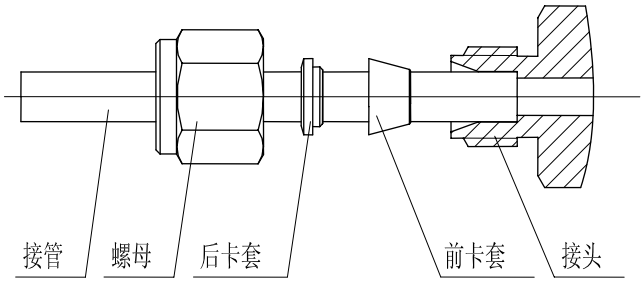


图 4. 双卡套(Swagelok)接头安装示意图

注意⚠:

按图 4 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 Swagelok 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。

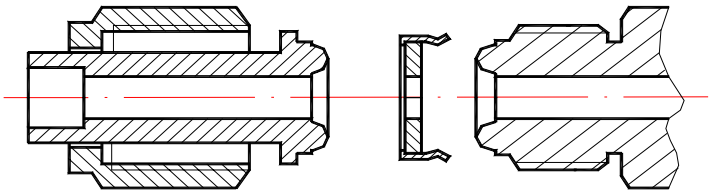


图 5. VCR 接头安装示意图

5.3 开关稳压电源连接

D07-22AM 型质量流量计通过开关稳压电源与交流电源接通，质量流量计即可通气工作，开关稳压电源的输入信号为(100~250)V, (50~60)Hz，输出信号为+15VDC,1.25A。开关稳压电源如图 6 所示，质量流量计侧面的电源接口如图 7 所示。



图 6. 开关稳压电源

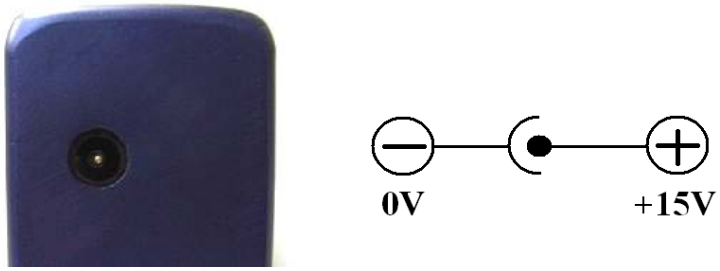


图 7. MFM 电源接口

5.4 串行通讯连接

D07-22AM 型质量流量计支持 RS232 或 RS485 串行通讯。用户可以使用相应的电缆线将 D07-22AM 产品与电脑连接。产品上的两个 6 芯水晶头插座如图 8 所示。

D07-22AM 出厂默认为 RS485 通讯，此时一台电脑最多可与 16 台 D07-22AM 通讯。当电脑只与一台 D07-22AM 通讯时，使用 QCX-76 电缆线按图 9 所示连接；当电脑与多台 D07-22AM 通讯时，使用 QCX-76 电缆线和 QCX-53 电缆线按图 10 所示连接。

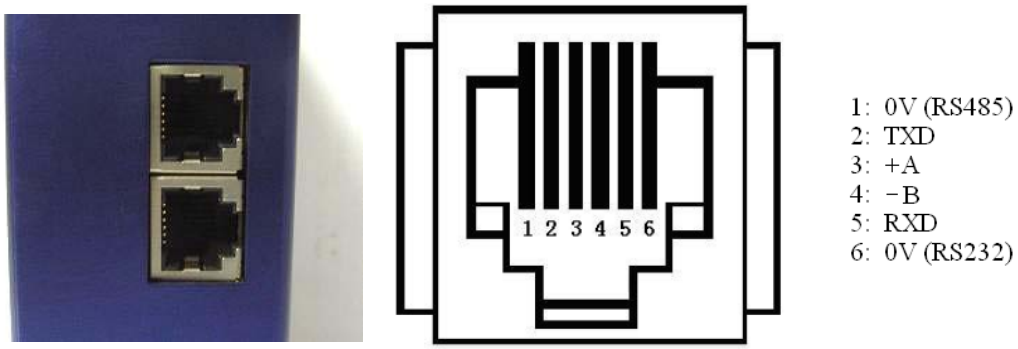


图 8. MFM 通讯接口

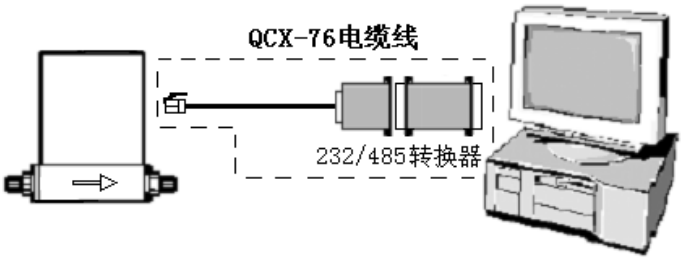


图 9. RS485 单机通讯

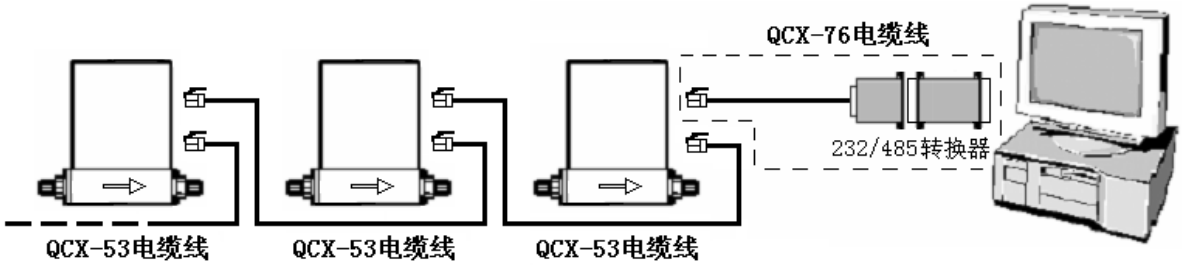


图 10. RS485 多机通讯

用户也可以订购 R232 通讯的 D07-22AM 产品，此时一台电脑只能与一台 D07-22AM 通讯，使用 QCX-75 电缆线按图 11 所示连接。

注意：此时属于特殊订单，请用户在标准订单码中的[S]项中注明 RS232 通讯。

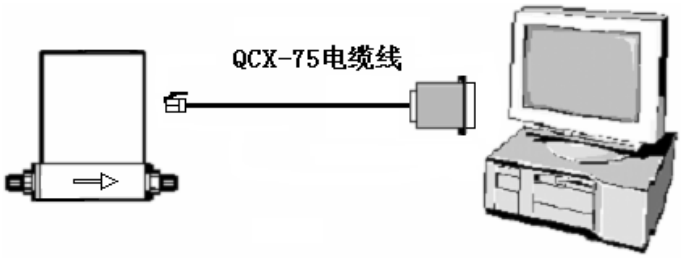


图 11. RS232 通讯

6. 使用方法和操作步骤

6.1 开机预热: 使用前，先接通电源预热 15 分钟。

6.2 检查和调整零点:

预热后, 检查流量计的零点（特别是在首次使用时）。在不通气的情况下, 可以按住调零按钮 5 秒钟以上即可调零。

6.3 通气工作: 待零点稳定后, 即可通气工作。注意观察气体流量, 最好不要超过满量程使用。

6.4 关机: 切断电源, 即停止流量计的测量工作, 不影响通道流过的气体流量。

7. 注意事项

7.1 禁用流量介质

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。如果流量计出口接有液体源瓶, 应在流量计出口加装单向阀, 防止液体回流损坏流量计。

7.2 使用腐蚀性气体问题

流量计通道采用的材料为: $00Cr_{17}Ni_{14}Mo_2$ (相当于 316L 不锈钢) , 聚四氟乙烯, 氟橡胶等耐蚀材料。在用户系统无水汽、低泄漏、勤清洗、使用得当的条件下, 可以用于测量一般的腐蚀性气体。使用氨气、有机溶剂蒸汽（如丙酮等）或其它强腐蚀性气体（如 BCl_3、BBr_3 等）的用户，应在定货时声明。对于使用特殊腐蚀性气体，所有密封材料都要作相应改变。

注意⚠:

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。

7.3 安装位置问题

本流量计安装时最好保持安装面水平。用户订货时应注明实际安装位置，我公司根据用户的安装位置进行标定后出厂。如果用户的实际安装位置与产品出厂时的标定位置不一致时，产品可能出现零点偏移，此时可调整零点后再工作。

7.4 标定和不同气体的换算

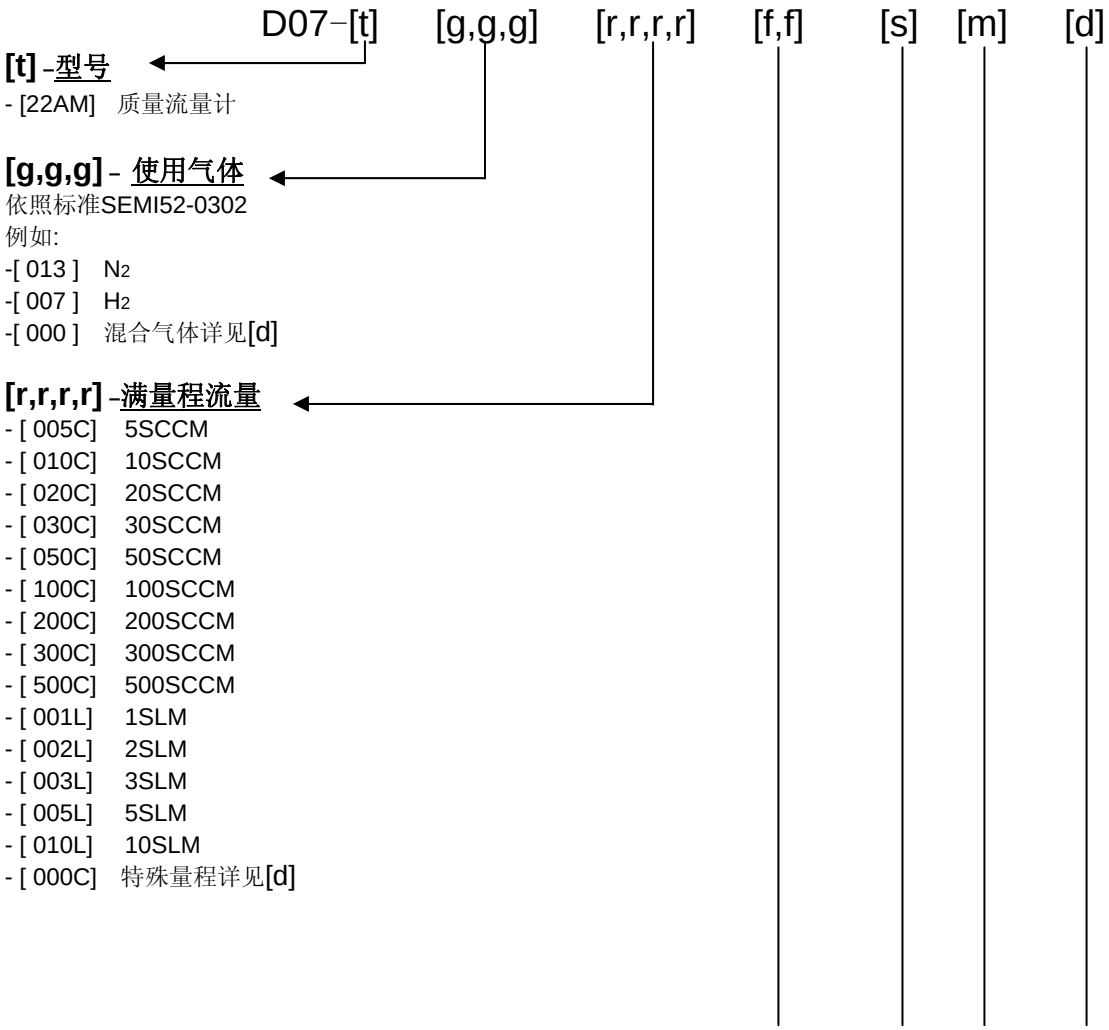
本流量计出厂通常用氮气（N_2）标定。如果要求用使用气体标定，需要在订货时与销售人员特别申明。

用氮气标定的流量计用户使用其它气体时， 可以通过附录 10.1 的转换系数进行换算，算出被使用气体的流量。将质量流量计显示出的流量读数，与某使用气体的转换系数相乘，即得该被测气体在标准状态下的质量流量。

例如：一个出厂标定为 100 SCCM(N_2) 的 MFM，通甲烷气体时显示的流量为 86 SCCM，从附录 10.1 查得甲烷的转换系数为 0.719，则甲烷的实际流量为 86×0.719 即 61.8 SCCM。

如果用户使用混合气体，可以通过附录 10.2 介绍的方法，计算出混合气体的转换系数。

7.5 D07-22AM 标准订单填写格式



[t] -型号

- [22AM] 质量流量计

[g,g,g] - 使用气体

依照标准SEMI52-0302

例如:

-[013] N_2

-[007] H_2

-[000] 混合气体详见[d]

[r,r,r,r] -满量程流量

- [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
- [000C] 特殊量程详见[d]

D07−[t] [g,g,g] [r,r,r,r] [f,f] [s] [m] [d]

[f,f] – 进出气接头
-[AA] Swagelok φ3mm
-[GG] Swagelok φ6mm
-[BB] Swagelok 1/8"
-[CC] Swagelok 1/4"
-[MM] VCR 1/4"
-[TT] φ4（内）×1软管
-[RR] φ6（内）×1软管
-[XX] 特殊接头详见[d]

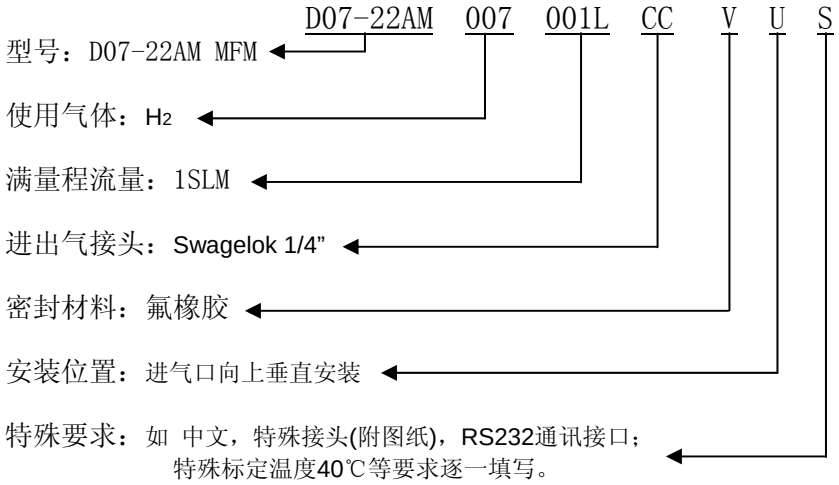
[s] – 密封材料
-[V] 氟橡胶
-[T] 聚四氟乙烯
-[N] 氯丁橡胶(耐氨橡胶)

[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
气压降： <0.01MPa (1.5psid)
耐压： 10 MPa (1450.4 psig)
标定温度：(22±2)℃
通讯接口：RS485
-[S] 特殊要求：
例如：外罩及标签文字：中文；特殊量程: 9SLM；混合气体要注明比例: N_2 (60%) + CO_2(40%)；
通讯接口：RS232；标定温度: 40℃及其它特殊要求等。

举例:

以D07-22AM007001LCCVUS为例：



8. 故障判断和处理

表 2.　故障判断和处理一览表

序号	故 障 现 象	故 障 可 能 原 因	处 理 方 法
1	开机后，无气流流过	1.1 气源未开，气路不通	接通气源，开通气路
		1.2 过滤器堵塞	*更换过滤器
		1.3 电路故障	*维修电路
2	开机不通气的情况下，流量检测不正常	2.1 零点偏差	通过调零按键调零
		2.2 电源故障	*检查开关稳压电源等
		2.3 传感器故障	*更换传感器
		2.4 电路故障	*维修电路
3	流量显示不能达到满量程值	3.1 气压降低于额定值	提高入口气压
		3.2 通道堵塞	*清洗流量计通道
		3.3 电路故障	*维修电路
4	实际流量与显示流量不一致	4.1 流量计通道被污染,引起流量精度发生偏差	*对流量计进行清洗标定
		4.2 流量计零点有较大漂移，不稳定	*更换传感器，维修电路
5	通道有很大气流流过，而输出无流量显示	5.1 传感器堵塞	*维修更换传感器 气源有粉尘，应在通道前加装过滤器。若使用硅烷等特殊气体，应注意管路的密封性和气源干燥
		5.2 电路故障	*维修电路
6	不通气时，发现零点不稳，或零点长时间慢漂移	6.1 传感器故障	*更换传感器

注意⚠:

标*号的项目必须由专业维修人员进行修理。

9. 保证、保修与服务

9.1 产品保证和保修

9.1.1 本公司生产的流量计产品在出货两年以内，如果用户按照说明书要求使用，并且产品没有遭受物理损害、污染、改装或翻新，我们保证产品的材料、加工和性能的质量，若有问题，免费维修。

9.1.2 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本公司销售部有关收货情况。

9.1.3 保修期内，产品必须由本公司或授权的服务中心修理，否则，产品的保修是无效的。

9.1.4 在两年保修期以内，维修是免费的。如果保修期过了，在维修前将会通知用户需要更换的部件及维修费用。维修后，在90天以内对修理的部分进行保修，保修件包括易损件 (四氟或密封圈等)。

9.1.5 用户使用过有毒、有污染或腐蚀性气体的产品, 如果没有出示清除污染及净化处理的证明，本公司将不负责修理或保修。

9.2 保修对使用的要求

a. 气体必须洁净且没有颗粒物, 没有液体, 这就要求在流量计的上游气路中安装<30μm的过滤器。

b. 输入的气体压力必须符合产品的耐压标准, 不能超过该产品要求的最大压力。

c. 产品的使用气体必须与用户订货选择的密封材料相适应, 用户有责任按照可用的安全规章使用每种气体。不正确的使用产品会使保修无效，由于不正确的使用所导致的损害不能归咎于本公司。

d. 对电子线路的要求：必须小心按规定连接系统的接线, 不正确的接线会导致产品内部电路板的永久损坏。若自备MFM电源, 需要电压波动小于5mV的高抗干扰稳压电源。

e. 气路的连接：必须仔细的安装密封管件, 保证所有的密封管件经过单独检查并且没有划痕。

f. 禁止自行拆开流量计。如果自行拆卸造成损坏，则本公司承诺的保修无效。

9.3 服务

本公司的产品工程师将会帮助您解决关于操作、标定、机电连接、工作条件要求、气体转换等方面的问题。我们提供技术支持与维护, 提供产品的使用培训。

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

10. 附录

10.1 气体质量流量转换系数:　　表 3.　气体质量流量转换系数表

气　体		代号(SEMIE52-0302)	比热(卡/克℃)	密度(克/升 0℃)	转换系数
Air	空气	008	0.2400	1.2930	1.006
Ar	氩气	004	0.1250	1.7837	1.415
AsH_3	砷烷	035	0.1168	3.4780	0.673
BBr_3	三溴化硼	079	0.0647	11.1800	0.378
BCl_3	三氯化硼	070	0.1217	5.2270	0.430
BF_3	三氟化硼	048	0.1779	3.0250	0.508
B_2H_6	硼烷	058	0.5020	1.2350	0.441
CCl_4	四氯化碳	101	0.1297	6.8600	0.307
CF_4	四氟化碳	063	0.1659	3.9636	0.420
CH_4	甲烷	028	0.5318	0.7150	0.719
C_2H_2	乙炔	042	0.4049	1.1620	0.581
C_2H_4	乙烯	038	0.3658	1.2510	0.598
C_2H_6	乙烷	054	0.4241	1.3420	0.481
C_3H_4	丙炔	068	0.3633	1.7870	0.421
C_3H_6	丙烯	069	0.3659	1.8770	0.398
C_3H_8	丙烷	089	0.3990	1.9670	0.348
C_4H_6	丁炔	093	0.3515	2.4130	0.322
C_4H_8	丁烯	104	0.3723	2.5030	0.294
C_4H_{10}	丁烷	111	0.4130	2.5930	0.255
C_5H_{12}	戊烷	240	0.3916	3.2190	0.217
CH_3OH	甲醇	176	0.3277	1.4300	0.584
C_2H_6O	乙醇	136	0.3398	2.0550	0.392
$C_2H_3Cl_3$	三氯乙烷	112	0.1654	5.9500	0.278
CO	一氧化碳	009	0.2488	1.2500	1.000
CO_2	二氧化碳	025	0.2017	1.9640	0.737
C_2N2	氰气	059	0.2608	2.3220	0.452
Cl_2	氯气	019	0.1145	3.1630	0.858
D_2	氘气	014	1.7325	0.1798	0.998
F_2	氟气	018	0.1970	1.6950	0.931
$GeCl_4$	四氯化锗	113	0.1072	9.5650	0.267

续表 3. 气体质量流量转换系数表

气体		代号(SEMIE52-0302)	比热(卡/克℃)	密度(克/升 0℃)	转换系数
GeH_4	锗烷	043	0.1405	3.4180	0.569
H_2	氢气	007	3.4224	0.0899	1.010
HBr	溴化氢	010	0.0861	3.6100	1.000
HCl	氯化氢	011	0.1911	1.6270	1.000
HF	氟化氢	012	0.3482	0.8930	1.000
HI	碘化氢	017	0.0545	5.7070	0.999
H_2S	硫化氢	022	0.2278	1.5200	0.844
He	氦气	001	1.2418	0.1786	1.415
Kr	氪气	005	0.0593	3.7390	1.415
N_2	氮气	013	0.2486	1.2500	1.000
Ne	氖气	002	0.2464	0.9000	1.415
NH_3	氨气	029	0.5005	0.7600	0.719
NO	一氧化氮	016	0.2378	1.3390	0.976
NO_2	二氧化氮	026	0.1923	2.0520	0.741
N_2O	一氧化二氮	027	0.2098	1.9640	0.709
O_2	氧气	015	0.2196	1.4270	0.992
PCl_3	三氯化磷	193	0.1247	6.1270	0.358
PH_3	磷烷	031	0.2610	1.5170	0.691
PF_5	五氟化磷	143	0.1611	5.6200	0.302
$POCl_3$	三氯氧磷	102	0.1324	6.8450	0.302
$SiCl_4$	四氯化硅	108	0.1270	7.5847	0.284
SiF_4	四氟化硅	088	0.1692	4.6430	0.348
SiH_4	硅烷	039	0.3189	1.4330	0.599
SiH_2Cl_2	二氯氢硅	067	0.1472	4.5060	0.412
$SiHCl_3$	三氯氢硅	147	0.1332	6.0430	0.340
SF_6	六氟化硫	110	0.1588	6.5160	0.264
SO_2	二氧化硫	032	0.1489	2.8580	0.687
$TiCl_4$	四氯化钛	114	0.1572	8.4650	0.206
WF_6	六氟化钨	121	0.0956	13.2900	0.215
Xe	氙气	006	0.0379	5.8580	1.415

10.2 转换系数使用说明

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：

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

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。

D07 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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乘地铁到农业展览馆，换乘 516 路公共汽车，到酒仙桥东路北口下车

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Sevenstar

D07-22AM Mass Flow Meters

INSTRUCTION MANUAL



北京七星华创电子股份有限公司

BEIJING SEVENSTAR ELECTRONICS CO., LTD.

Version April，2010

A NOTE TO OUR CUSTOMERS

Dear customer,
Thank you for purchasing SEVENSTAR D07 series Mass Flow Controller and Mass Flow Meter product.

This user manual is important when installing and doing maintenance. Please keep it carefully.

We strongly recommend that you read this manual thoroughly before you starting to use the product. This user manual introduces the important issues including the proper and safe use of the products.

And please notice the words and section with the symbol⚠. Not in accordance with the user manual for the use of property caused by loss or personal injury, SEVENSTAR may not be responsible.

If you require any additional information or assistant of Sevenstar D07 series Mass Flow Controller and Mass Flow Meter, please feel free to contact your local Sevenstar Sales Agent or Sevenstar Customer Service at:
(8610)- 6436 2925.

Yours sincerely,
Sevenstar

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Sevenstar

MASS FLOW METER

Operating Instruction

1. APPLICATION & FEATURES

Mass Flow Meter (**MFM**) accurately measures mass flow rates despites gas volume fluctuated due to pressure or temperature changes. 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.

D07-22AM MFM brings the high accuracy, excellent linearity, quick response, better reliability, simple convenient operation, flexible installation, possible connecting with PC to carry out automatic control to the users' system. The LCD integrated on D07-22AM MFM can show the instantaneous flow, so D07-22AM MFM doesn't need to be connected together with other Readout Box. D07-22AM MFM is showing as following (Figure 1):



Figure 1. D07-22AM MFM

2. SPECIFICATION

Table 1.Specifications of D07-22AM MFM

编号	项　　目	D07-22AM
1	Full scale range(N2)	(0~5,10,20,30,50,100,200,300,500) SCCM
		(0~1,2,3,5,10) SLM
2	Accuracy	±0.5 % F.S.
3	Linearity	±0.25 % F.S.
4	Repeatability	±0.2 % F.S.
5	Response Time	≤2sec
6	Differential Pressure	<0.01MPa
7	Max Pressure	10 MPa
8	Leak Integrity	1×10^{-9}atm·cc/sec He
9	Temperature coefficient	Zero: ≤±0.05% F.S./℃; Span: ≤±0.1% F.S./℃;
10	Operation Tem.	5℃ ~45℃
11	Output Signal	RS485
12	Power Supply	(100~250)V (50~60)Hz (Note 1)
13	Dimension (mm)	According to Figure 3
14	Weight	1.3 kg

Note 1 : According to figure 1, the AC adapter connects D07-22AM MFM and power supply. The AC adapter's input is 100-250V 50-60Hz and output is 15V 1.25A. D07-22AM MFM and AC adapter as a whole its power supply is 100-250V 50-60Hz. D07-22AM MFM's power supply is +15VDC，400mA.

Notes⚠:

MFM is calibrated by N_2 as a standard gas.

Units:	SCCM (Standard Cubic Centimeter/Min);
	SLM (Standard Liter/Min)
Standard Situation:	Temperature --- 273.15K (0℃);
	Air Pressure — 101325 Pa (760mm Hg)
F.S. :	Full Scale

3. STRUCTURE

The MFM consists of flow sensor, flow-splitter bypass and flow amplifying circuit. The following figure is exactly showing the structure of D07-22AM MFM after opening up its overall:

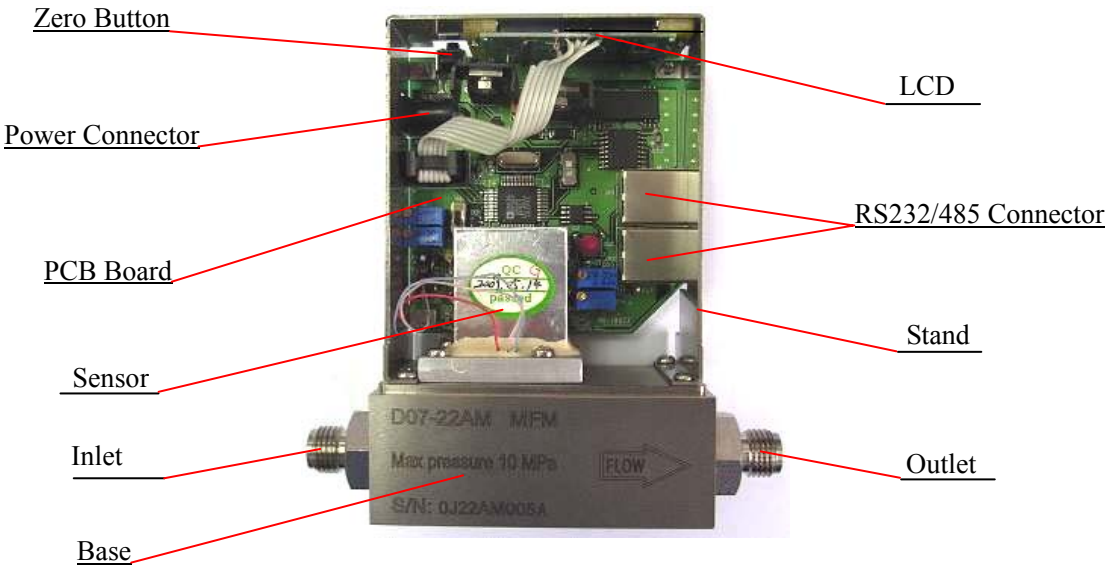


Figure 2. Structure of D07-22AM

4. INSTALLATION & CONNECTION

4.1 Receipt and Upacking

The D07-22AM mass flow controller are manufactured under clean room conditions, and has been packed accordingly upon receipt, after receiving the equipment, please carefully check the outer package for any damage incurred during the transportation. Check that the delivery is complete and no parts are missing. Since the products can be ordered in several configuration, ensure that the scope of supply is correct. If you think there is a problem please contact the forwarder at once, with regard to liability.

4.2 Dimension

Dimensions of 22AM MFM are as following:

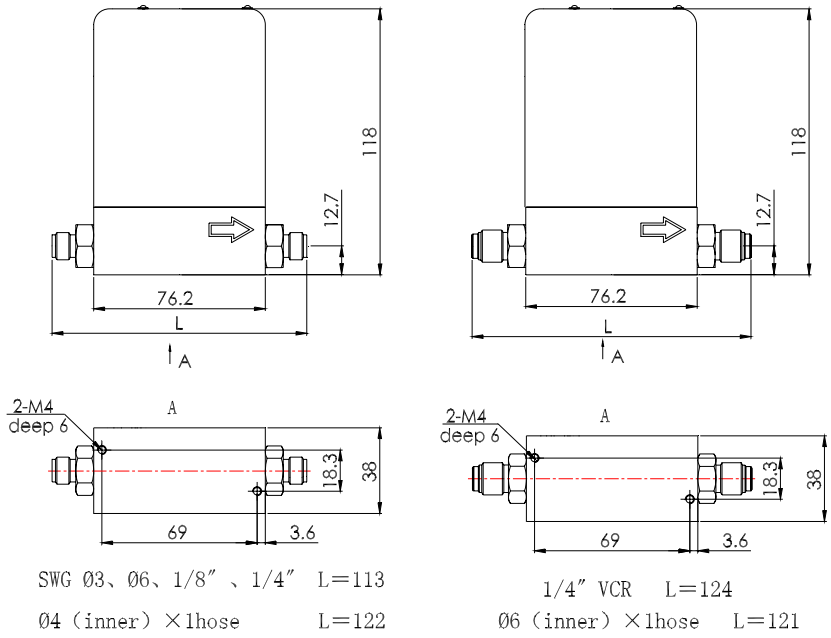


Figure 3. Outline Dimensions of D07-22AM

4.3 Fittings

The Standard fittings is used with Swagelok and VCR, there are seven types of fitting could be provided:

a. Swagelok ϕ6mm b. Swagelok ϕ3mm c. Swagelok 1/4" d. Swagelok 1/8"

e. VCR (1/4" outside diameter) f. ϕ6(inner)×1hose mm g. ϕ4(inner)×1hose mm

General speaking, stainless steel tube was used to connect MFM and Gas System, matching to the different request, other materials also could be used as nylon tube or hard flexible plastic hose.

Figure 4 is an example to showing the fitting structure, the arrow on the base of the MFM shows flow direction, please note the flow input & output direction should not be inversed fitted.

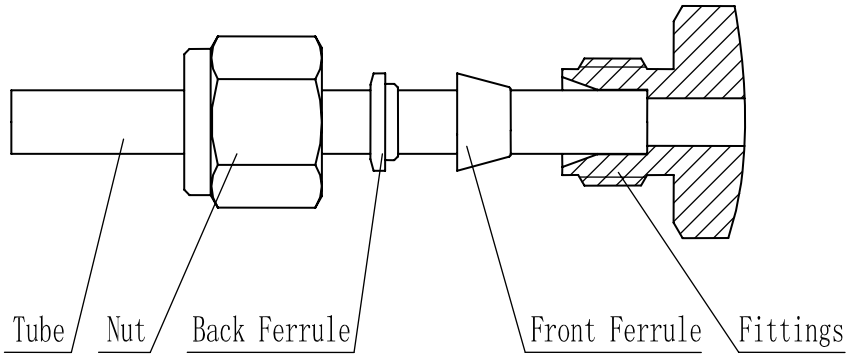


Figure 4. Swagelok Connector Installation

Attention⚠:

When installing the fitting, you should manually use spanner to wrench it tighten by 1/2 turn pulling up, (imported Swagelok 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.

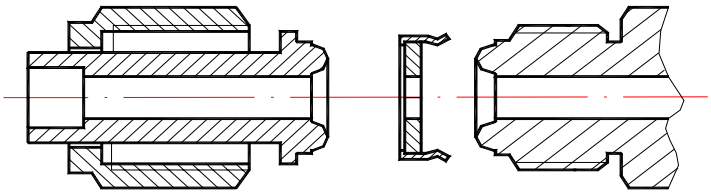


Figure 5. VCR Connector Installation

4.4 AC Adapter Connection

MFM could begin operating after it well connected with AC Adapter and Power Supply. The AC adapter's input is 100-250V 50-60Hz and output is 15V 1.25A. The AC Adapter and MFM Power Connector are showing in the following figure 6, 7.



Figure 6. AC adapter

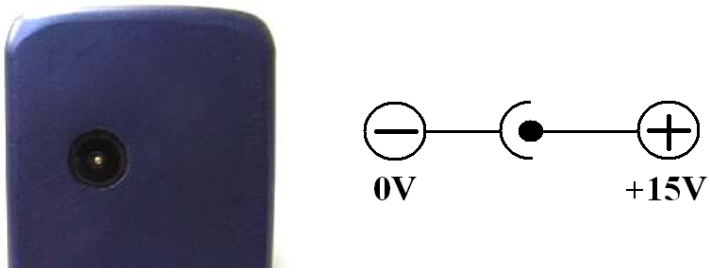


Figure 7. MFM Power Connector

4.5 RS232/485 Connection

D07-22AM MFM can communicate with PC via RS232 or RS485. There are two RJ11 connectors on MFM. RJ11 connector is showing in the following figure 8.

D07-22AM MFM's default communication mode is RS485. In this mode PC can control up to 16 MFMs. When PC just controls one MFM customer can choose QCX-76 cable and the connection is showing in the following figure 9. When PC controls several MFMs customer can choose QCX-76, QCX-53 cables and the connection is showing in the following figure 10.

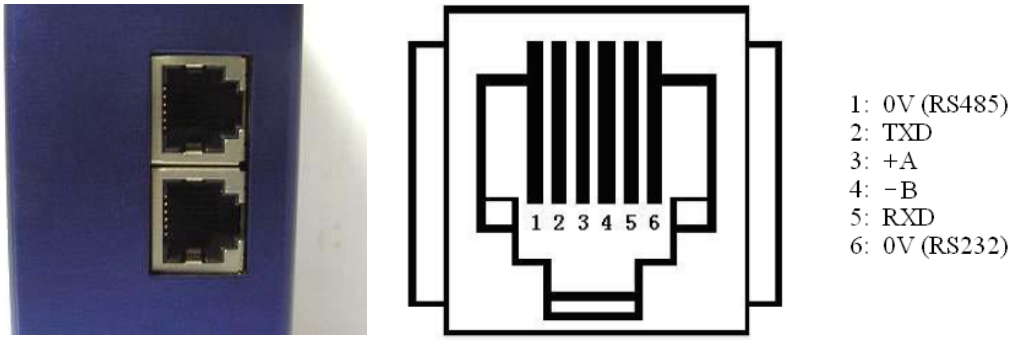


Figure 8. RJ11 connector

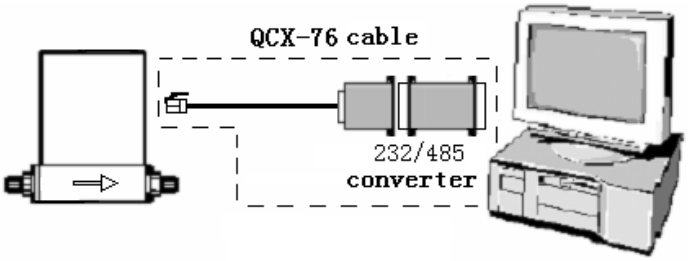


Figure 9. PC controls one MFM via RS485

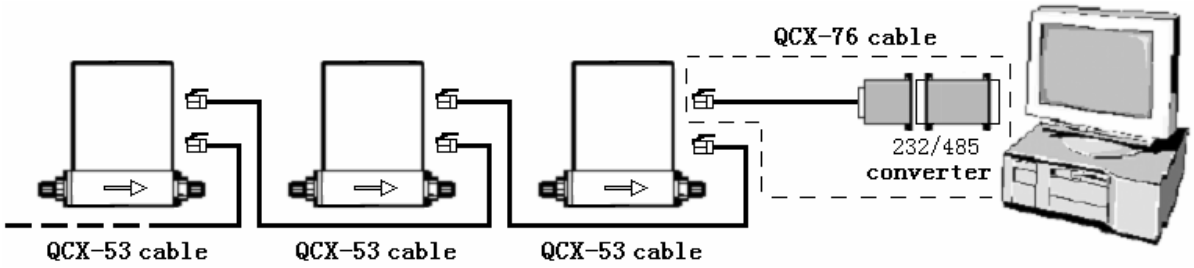


Figure 10. PC controls several MFMs via RS485

When D07-22AM MFM communicates with PC via RS232 customer can choose QCX-75 cable and the connection is showing in the following figure 11.

Notice: RS232 communication product attribute to special order. So please writer down this special request (RS232 communication) in the Ordering Code [S] Item.

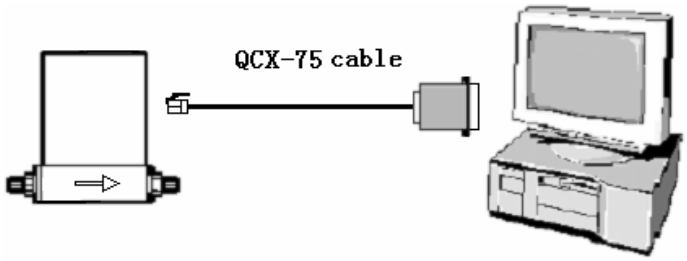


Figure 11. PC control one MFM via RS232

5. OPERATING INSTRUCTIONS

5.1 Start Up

Please warm up for 15 minutes by power supply before MFM operating.

5.2 Testing and Zero Adjustment

Please check up zero point of MFM after its warming up (especially for the first time operating). Without gas supplying, customer can adjust zero by hold on the zero button more than 5 seconds.

5.3 Gas Supply

After zero movement reaches stable, MFM could have gas supply. Please pay attention to the flow rate, it should be better operate not beyond full scale range.

5.4 Shut Off

Turn off the power supply, which means MFM operating will be terminated, it could not affect the flow rate of bypass.

6. CAUTION

6.1 Medium Forbidden

The gas of using should be purified without dust, liquid and oil stain. When necessary, it should be added filter to gas circuit to make sure gas purification. If the outlet of MFM connects with liquid sources, which should be added simple directional valve of MFM outlet to avoid liquid refluent to the tube to destroy MFM.

6.2 Corrosive Gas

The materials of bypass are anti-caustic materials like 00Cr17Ni14Mo2(same as 316Lstainless steel), Teflon, and Viton. When users operate in condition of no vapor, low leakage, regular cleaning and proper operating, MFM could possible control the normal corrosive gas. Using ammonia, organic solvent gas such as acetone or other strong caustic gas (like BC13 and BBr3), please informed related information in your order statements.

For the cases that the 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.

6.3 Installation Position

Keeping installation surface horizontal while installation. Please provide the installation position when ordering the MFC. We will calibrate products according to the requirement of customers. The MFC might show the zero drift if

it is not installed as the same position of calibration. Customer can adjust zero to fix it.

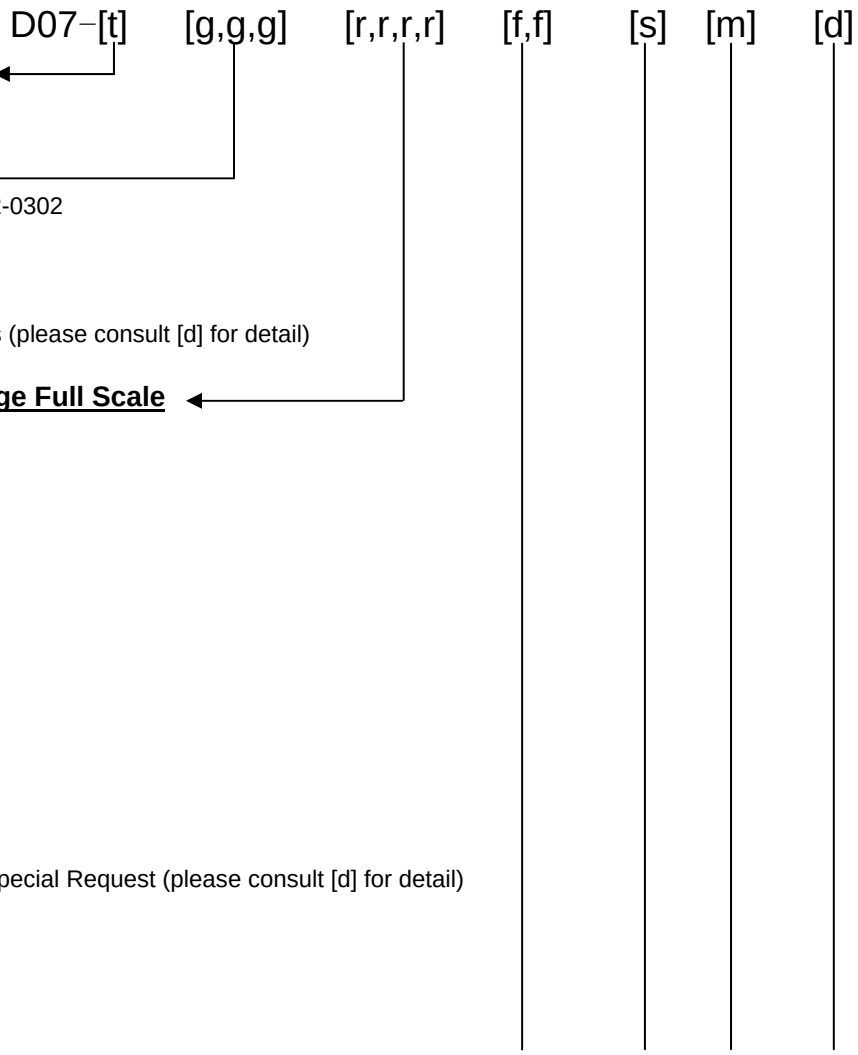
6.4 Calibration and Conversion

D07 series are calibrated by nitrogen. Other gas calibrations please inform in your order statements. When the nitrogen calibration users use other gas operating, it could convert and calculate used gas flow rate by conversion coefficient of appendix 9.1. Which means users could multiply the readout flow rate from MFM Displayer with the used gas corresponding conversion coefficient, result will be used gas corresponding mass flow rate of standard situation.

For example, there is 100 SCCM (N2) calibrated MFM, the flow rate is displayed 86 SCCM while firedamp flowing, the conversion coefficient of firedamp is 0.719 from reference of appendix 9.2, the real firedamp flow rate is 86 × 0.719 which is 61.8 SCCM.

If users use the mixture gas, it could be calculated the conversion coefficient by the method that introduced in appendix 9.2.

6.5 D07-22AM Ordering Code



[t] –Type Number

- [22AM] MFM

[g,g,g] –Gas

Please consult SEMI52-0302

For Example:

-[013] N_2

-[007] H_2

-[000] Mixture gases (please consult [d] for detail)

[r,r,r,r] –Flow Range Full Scale

- [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
- [000C] Customer Special Request (please consult [d] for detail)

D07-[t] [g,g,g] [r,r,r,r] [f,f] [s] [m] [d]

[f,f] -Inlet and Outlet Fittings

-[AA] Swagelok φ 3mm
-[GG] Swagelok φ 6mm
-[BB] Swagelok1/8"
-[CC] Swagelok 1/4"
-[MM] VCR 1/4"
-[TT] φ4(inner)×1hose
-[RR] φ6(inner)×1hose
-[XX] Customer Special fittings (please consult [d] for detail)

[s] -Seal Materials

-[V] Viton
-[T] Teflon
-[N] Neoprene

[m] -Mounting Position

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

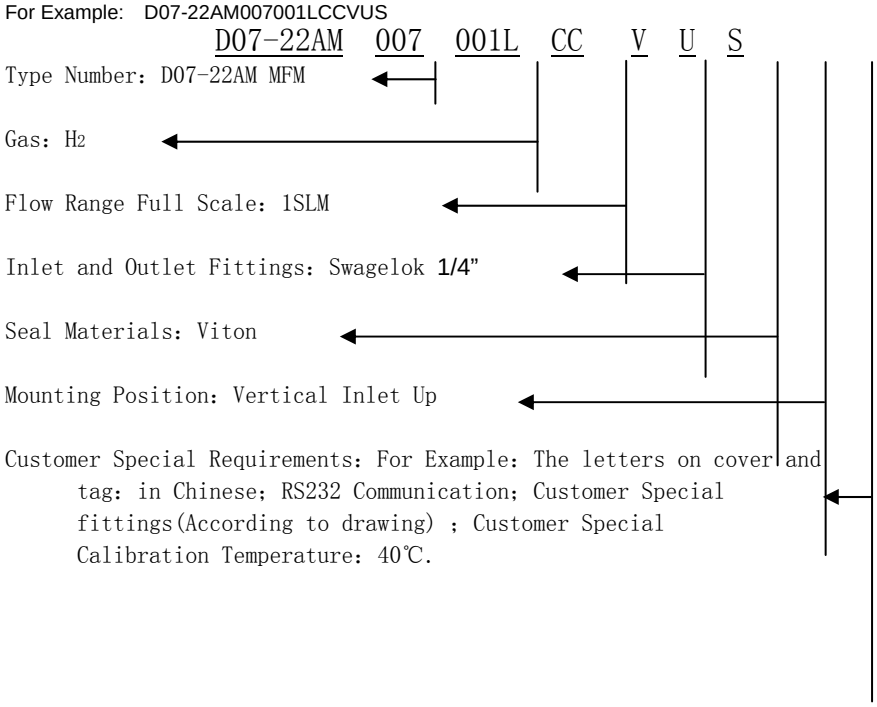
[d] -Description

-[ ] Default Value:
The letters on cover and tag: in English
Differential Pressure: <0.01MPa (1.5psid)
Max Operating Pressure: 10 MPa (1450.4 psig)
Calibration Temperature: (22±2)℃
Communication mode: RS485

-[S] Customer Special Requirements:
For Example: The letters on cover and tag: in Chinese; Customer Special Full Scale: 9SLM; The proportion of Mixture gases should be indicated: N_2 (60%) + CO_2(40%); Communication

mode RS232；Customer Calibration Temperature：40℃ and other customer special requirements.

For Example: D07-22AM007001LCCVUS



7. TROUBLESHOOTING

Table 2. Failure Handling

NO.	FAILURE	CAUSE	TREATMENT
1	There is no gas flow after turn on.	1.1 Gas flow is shutting off, no gas inputting	Check the gas sourcing and make it open
		1.2 Filter is blocked	* Change a new filter
		1.3 Circuit failure	*Repair the electric circuit
2	In case of turning on but without gas flow, the flow rate testing is error.	2.1 Zero excursion	Adjust the zeroing potentiometer
		2.2 Power supply failure	*Check input/output voltages(± 15VDC, +5.00VDC)
		2.3 Sensor failure	*Replace the new sensor
		2.4 Circuits failure	*Repair the electric circuit
3	The flow rate display could not reach to full scale flow rate value.	3.1 Pressure is lower than the rating	Heighten the inlet pressure
		3.2 Block of bypass	*Clean bypass
		3.3 Circuits failure	*Repair the electric circuit
4	Flow display is in-accurate	4.1 Bypass is polluted to cause the flow rate excursion.	*Clean MFM and re-calibrate it
		4.2 Zero excursion happened to be instable.	* Change sensor and repair circuit
5	The heavy flow is passing but no outputting display	5.1 Block of sensor	*Repair and replace the new sensor Should add filter to block gas dust. Using special gas should be sure of good tube sealing and gas dryness.
		5.2 Circuit failure	*Repair circuit
6	Without gas flow, Zero is fluctuate or excursion happened.	6.1 Sensor failure	*Replace a new sensor

Attention⚠:

* Mark indicates that reparation and adjustment must be dealt under specialist advices。

8. WARRANTY & SERVICE

8.1 Product Warranty

a. Our products are guaranteed within 2 years warranty against defects in materials and workmanship if used in accordance with specifications and not subject to physical damage, contamination, alteration or retrofit.

b. 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.

c. During the warranty period, products must only be repaired by Sevenstar or authorized SevenStar service centers; otherwise, the SevenStar product warranty will be invalidated.

d. Repairs will be performed free of charge during the two-year warranty period. If MFM is 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 (inteflon, viton, etc.).

e. No MFM used with dangerous gas will be accepted for repair or warranty without a decontamination and purge certificate.

8.2 Specific warranty requirements are as follows :

a. Gas must be clean and particle-free, which means a filter(<30μ) must be fitted in the gas line upstream of the MFM.

b. Gas must comply with the pressure specifications, and never exceed the rated value.

c. Process gas should be in line with the seal materials chosen in the order, especially in case of corrosive gas. We shall not be responsible for any damage caused by changing process gas or choosing the wrong seal materials in order.

d. 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 products. If user self scheme power supply of MFM, a stable and anti-jamming power supply is required, with ripple below 5mV.

e. Gas connections: the fittings must be handled carefully. We guarantee that all fittings have been individually inspected and are scratch-free.

f. The MFM must not be dismounted: the MFM warranty will be invalidated if the seal between the MFM block and cover is torn.

8.3 Service

Our product engineer will help you with issues related to operation, calibration, installation, process specification, gas convention, etc. And we also provide you with technology support& maintenances, and products operation training.

Please visit mfc.sevenstar.com.cn for relevant information and the locations of our service centers.

9. APPENDIX

9.1 Mass Flow Conversion Factors

Table 3. Conversion Factors

GAS	GAS CODE (SEMIE52-0302)	HEAT (Cal/g ℃)	ρ (g/l 0℃)	Factors
Air	008	0.2400	1.2930	1.006
Ar	004	0.1250	1.7837	1.415
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	0.430
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	0.307
CF_4	063	0.1659	3.9636	0.420
CH_4	028	0.5318	0.7150	0.719
C_2H_2	042	0.4049	1.1620	0.581
C_2H_4	038	0.3658	1.2510	0.598
C_2H_6	054	0.4241	1.3420	0.481
C_3H_4	068	0.3633	1.7870	0.421
C_3H_6	069	0.3659	1.8770	0.398
C_3H_8	089	0.3990	1.9670	0.348
C_4H_6	093	0.3515	2.4130	0.322
C_4H_8	104	0.3723	2.5030	0.294
C_4H_{10}	111	0.4130	2.5930	0.255
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	0.737
C_2N2	059	0.2608	2.3220	0.452
Cl_2	019	0.1145	3.1630	0.858
D_2	014	1.7325	0.1798	0.998
F_2	018	0.1970	1.6950	0.931
$GeCl_4$	113	0.1072	9.5650	0.267

Continue To Table3. Conversion Factors

GAS	GAS CODE (SEMIE52-0302)	HEAT (Cal/g ℃)	ρ (g/l 0℃)	Factors
GeH_4	043	0.1405	3.4180	0.569
H_2	007	3.4224	0.0899	1.010
HBr	010	0.0861	3.6100	1.000
HCl	011	0.1911	1.6270	1.000
HF	012	0.3482	0.8930	1.000
HI	017	0.0545	5.707	0.999
H_2S	022	0.2278	1.5200	0.844
He	001	1.2418	0.1786	1.415
Kr	005	0.0593	3.7390	1.415
N_2	013	0.2486	1.2500	1.000
Ne	002	0.2464	0.9000	1.415
NH_3	029	0.5005	0.7600	0.719
NO	016	0.2378	1.3390	0.976
NO_2	026	0.1923	2.0520	0.741
N_2O	027	0.2098	1.9640	0.709
O_2	015	0.2196	1.4270	0.992
PCl_3	193	0.1247	6.1270	0.358
PH_3	031	0.2610	1.5170	0.691
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	0.599
SiH_2Cl_2	067	0.1472	4.5060	0.412
$SiHCl_3$	147	0.1332	6.0430	0.340
SF_6	110	0.1588	6.5160	0.264
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	0.215
Xe	006	0.0379	5.8580	1.415

9.2 Conversion Factors Instruction

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 Table 6.)

Table 6. 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： $N = N1\ (\omega 1/\omega T) + N2\ (\omega 2/\omega T) + \cdots + Nn\ (\omega n/\omega T)$

Then：

$$C = \frac{0.3106\ [N1\ (\omega 1/\omega T) + N2\ (\omega 2/\omega T) + \cdots + Nn\ (\omega n/\omega T)]}{\rho 1 Cp1\ (\omega 1/\omega T) + \rho 2 Cp2\ (\omega 2/\omega T) + \cdots + \rho n Cpn\ (\omega n/\omega T)}$$

$\omega_1 \ldots \omega_n$ — 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 ºC); 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.

D07 Series

Mass Flow Controller

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∗Description may be changed following improvements to product. The information contained in this document is subject to change without notice

∗If there is any mistake in this uses manual, please feel free to contact us.

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