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MKS Type
πMFC™ Digital
Mass Flow Controller

Instruction Manual

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The documents listed below are referenced throughout this manual.

[1] “DeviceNet Specification, Volume I: DeviceNet Communication Model and Protocol”, Open DeviceNet Vendors Association, Inc. Release 2.0. ERRATA 4.0

[2] “DeviceNet Specification, Volume II: DeviceNet Profiles and Object Library”, Open DeviceNet Vendors Association, Inc. Release 2.0. ERRATA 4.0

[3] “Sensor/Actuator Network Common Device Model”, SEMI Standards Document E54.1-0097.

[4] “Sensor/Actuator Network Communications Standard for DeviceNet”, SEMI Standards Draft Document E54.4-0097.

[5] “Sensor/Actuator Network Specific Device Model for Mass Flow Devices”, SEMI Standards Draft Document #2253C.

[6] “Sensor/Actuator Network Standard”, SEMI Standards Document E54-0097.

[7] SEMI Standards Document E52-95.

Mass Flow Device Safety Information

Symbols Used in This Instruction Manual

Definitions of WARNING, CAUTION, and NOTE messages used throughout the manual.

Warning	**The WARNING sign denotes a hazard. It calls attention to a procedure, practice, condition, or the like, which, if not correctly performed or adhered to, could result in injury to personnel.**
Caution	**The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of all or part of the product.**
Note	The NOTE sign denotes important information. It calls attention to a procedure, practice, condition, or the like, which is essential to highlight.

Symbols Found on the Unit

The following table describes symbols that may be found on the unit.

Table 1: Definition of Symbols Found on the Unit

On (Supply) IEC 417, No. 5007	 Off (Supply) IEC 417, No. 5008	 Earth (ground) IEC 417, No. 5017	 Protective Earth (ground) IEC 417, No. 5019
 Frame or Chassis IEC 417, No. 5020	 Equipotentiality IEC 417, No. 5021	 Direct Current IEC 417, No. 5031	 Alternating Current IEC 417, No. 5032
 Both Direct and Alternating Current IEC 417, No. 5033-a	 Class II Equipment IEC 417, No. 5172-a	 Three Phase Alternating Current IEC 617-2, No. 020206	
 Caution (refer to accompanying documents) ISO 3864, No. B.3.1	 Caution, Risk of Electric Shock ISO 3864, No. B.3.6	 Caution, Hot Surface IEC 417, No. 5041	

Safety Procedures and Precautions

Observe the following general safety precautions during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of intended use of the instrument and may impair the protection provided by the equipment. MKS Instruments, Inc. assumes no liability for the customer's failure to comply with these requirements.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to an MKS Calibration and Service Center for service and repair to ensure that all safety features are maintained.

SERVICE BY QUALIFIED PERSONNEL ONLY

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified service personnel only.

KEEP AWAY FROM LIVE CIRCUITS

Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

USE CAUTION WHEN OPERATING WITH HAZARDOUS MATERIALS

If hazardous materials are used, users must take responsibility to observe the proper safety precautions, completely purge the instrument when necessary, and ensure that the material used is compatible with sealing materials.

PURGE THE INSTRUMENT

After installing the unit, or before its removal from a system, be sure to purge the unit completely with a clean dry gas to eliminate all traces of the previously used flow material.

USE PROPER PROCEDURES WHEN PURGING

This instrument must be purged under a ventilation hood, and gloves must be worn to protect personnel. To purge this instrument properly, it must be purged in both the horizontal base down and horizontal base up configurations as defined in SEMI specification. Device has trapped volume in pressure sensor where gas which is higher than air but still hazardous can accumulate.

DO NOT OPERATE IN AN EXPLOSIVE ENVIRONMENT

To avoid explosion, do not operate this product in an explosive environment unless it has been specifically certified for such operation.

USE PROPER FITTINGS AND TIGHTENING PROCEDURES

All instrument fittings must be consistent with instrument specifications, and compatible with the intended use of the instrument. Assemble and tighten fittings according to manufacturer's directions.

CHECK FOR LEAK-TIGHT FITTINGS

Before proceeding to instrument setup, carefully check all plumbing connections to the instrument to ensure leak-tight installation.

OPERATE AT SAFE INLET PRESSURES

This unit should never be operated at pressures higher than the rated maximum pressure (refer to the product specifications for the maximum allowable pressure).

INSTALL A SUITABLE BURST DISC

When operating from a pressurized gas source, a suitable burst disc should be installed in the vacuum system to prevent system explosion should the system pressure rise.

KEEP THE UNIT FREE OF CONTAMINANTS

Do not allow contaminants of any kind to enter the unit before or during use. Contamination such as dust, dirt, lint, glass chips, and metal chips may permanently damage the unit.

ALLOW PROPER WARM UP TIME FOR TEMPERATURE-CONTROLLED UNITS

Temperature-controlled unit will only meet specifications when sufficient time is allowed for the unit to meet, and stabilize at, the designed operating temperature. Do not zero or calibrate the unit until the warm up is complete.

Sicherheitshinweise für das Massenflussgerät

In dieser Betriebsanleitung vorkommende Symbole

Bedeutung der mit WARNUNG!, VORSICHT! und HINWEIS gekennzeichneten Absätze in dieser Betriebsanleitung.

Warnung! **Das Symbol WARNUNG! weist auf eine Gefahr für das Bedienpersonal hin. Es macht auf einen Arbeitsablauf, eine Arbeitsweise, einen Zustand oder eine sonstige Gegebenheit aufmerksam, deren unsachgemäße Ausführung bzw. ungenügende Berücksichtigung zu Verletzungen führen kann.**

Vorsicht! **Das Symbol VORSICHT! weist auf eine Gefahr für das Gerät hin. Es macht auf einen Bedienungsablauf, eine Arbeitsweise oder eine sonstige Gegebenheit aufmerksam, deren unsachgemäße Ausführung bzw. ungenügende Berücksichtigung zu einer Beschädigung oder Zerstörung des Gerätes oder von Teilen des Gerätes führen kann.**

Hinweis Das Symbol HINWEIS macht auf wichtige Informationen bezüglich eines Arbeitsablaufs, einer Arbeitsweise, eines Zustands oder einer sonstige Gegebenheit aufmerksam.

Erklärung der am Gerät angebrachten Symbole

Nachstehender Tabelle sind die Bedeutungen der Symbole zu entnehmen, die am Gerät angebracht sein können.

Tabelle 2: Bedeutung der am Gerät angebrachten Symbole

Ein (Energie) IEC 417, No.5007	 Aus (Energie) IEC 417, No.5008	 Erdanschluss IEC 417, No.5017	 Schutzleiteranschluss IEC 417, No.5019
 Masseanschluss IEC 417, No.5020	 Aquipotentialanschluss IEC 417, No.5021	 Gleichstrom IEC 417, No.5031	 Wechselstrom IEC 417, No.5032
 Gleich- oder Wechselstrom IEC 417, No.5033-a	 Durchgängige doppelte oder verstärkte Isolierung IEC 417, No.5172-a	Dreileiter-Wechselstrom (Drehstrom) IEC 617-2, No.020206	
 Warnung vor einer Gefahrenstelle (Achtung, Dokumentation beachten) ISO 3864, No.B.3.1	 Warnung vor gefährlicher elektrischer Spannung ISO 3864, No.B.3.6	 Höhere Temperatur an leicht zugänglichen Teilen IEC 417, No.5041	

Sicherheitsvorschriften und Vorsichtsmaßnahmen

Folgende allgemeine Sicherheitsvorschriften sind während allen Betriebsphasen dieses Gerätes zu befolgen. Eine Missachtung der Sicherheitsvorschriften und sonstiger Warnhinweise in dieser

Betriebsanleitung verletzt die für dieses Gerät und seine Bedienung geltenden Sicherheitsstandards, und kann die Schutzvorrichtungen an diesem Gerät wirkungslos machen. MKS Instruments, Inc. haftet nicht für Missachtung dieser Sicherheitsvorschriften seitens des Kunden.

Niemals Teile austauschen oder Änderungen am Gerät vornehmen!
Ersetzen Sie keine Teile mit baugleichen oder ähnlichen Teilen, und nehmen Sie keine eigenmächtigen Änderungen am Gerät vor. Schicken Sie das Gerät zwecks Wartung und Reparatur an den MKS-Kalibrierungs- und -Kundendienst ein. Nur so wird sichergestellt, dass alle Schutzvorrichtungen voll funktionsfähig bleiben.

Wartung nur durch qualifizierte Fachleute!
Das Auswechseln von Komponenten und das Vornehmen von internen Einstellungen darf nur von qualifizierten Fachleuten durchgeführt werden, niemals vom Bedienpersonal.

Vorsicht vor stromführenden Leitungen!
Ersetzen Sie keine Komponente von Geräten, die an Netzstrom angeschlossen sind. Unter Umständen kann gefährliche Spannung auch dann bestehen, wenn das Netzanschlusskabel von der Strmversorgung entfernt wurde. Um Verletzungen vorzubeugen sollten zuerst alle Geräte von der Stromversorgung getrennt und alle Stromkreusläufe entladen werden.

Vorsicht beim Arbeiten mit gefährlichen Stoffen!
Wenn gefährliche Stoffe verwendet werden, muss der Bediener die entsprechenden Sicherheitsvorschriften genauestens einhalten, das Gerät, falls erforderlich, vollständig spülen, sowie sicherstellen, dass der Gefahrstoff die am Gerät verwendeten Materialien, insbesondere Dichtungen, nicht angreift.

Spülen des Gerätes mit Gas!
Nach dem Installieren oder vor dem Ausbau aus einem System muss das Gerät unter Einsatz eines reinen Trockengases vollständig gespült werden, um alle Rückstände des Vorgängermediums zu entfernen.

Anweisungen zum Spülen des Gerätes
Das Gerät darf nur unter einer Ablufthaube gespült werden. Schutzhandschuhe sind zu tragen.

Gerät nicht zusammen mit explosiven Stoffen, Gasen oder Dämpfen benutzen!
Um der Gefahr einer Explosion vorzubeugen, darf dieses Gerät niemals zusammen mit (oder in der Nähe von) explosiven Stoffen aller Art eingesetzt werden, sofern es nicht ausdrücklich für diesen Zweck zugelassen ist.

Anweisungen zum Installieren der Armaturen!
Alle Anschlussstücke und Armaturenteile müssen mit der Gerätespezifikation übereinstimmen, und mit dem geplanten Einsatz des Gerätes kompatibel sein. Der Einbau, insbesondere das Anziehen und Abdichten, muss gemäß den Anweisungen des Herstellers vorgenommen werden.

Verbindungen auf Undichtigkeiten prüfen!
Überprüfen Sie sorgfältig alle Verbindungen der Vakuumkomponenten auf undichte Stellen.

Gerät nur unter zulässigen Anschlussdrücken betreiben!
Betreiben Sie das Gerät niemals unter Drücken, die den maximal zulässigen Druck (siehe Produktspezifikationen) übersteigen.

Geeignete Berstscheibe installieren!
Wenn mit einer unter Druck stehenden Gasquelle gearbeitet wird, sollte eine geeignete Berstscheibe in das Vakuumsystem installiert werden, um eine Explosionsgefahr aufgrund von steigendem Systemdruck zu vermeiden.

Verunreinigungen im Gerät vermeiden!
Stellen Sie sicher, dass Verunreinigungen jeglicher Art weder vor dem Einsatz noch während des Betriebs in das Instrumenteninnere gelangen können. Staub- und Schmutzpartikel, Glassplitter oder Metallspäne können das Gerät dauerhaft beschädigen oder Prozess- und Messwerte verfälschen.

Bei Geräten mit Temperaturkontrolle korrekte Anwärmzeit einhalten!
Temperaturkontrollierte Geräte arbeiten nur dann gemäß ihrer Spezifikation, wenn genügend Zeit zum Erreichen und Stabilisieren der Betriebstemperatur eingeräumt wird. Kalibrierungen und Nulleinstellungen sollten daher nur nach Abschluss des Anwärmvorgangs durchgeführt werden.

Informations de sécurité pour appareils de mesure/contrôle de débit massique

Symboles utilisés dans ce manuel d'utilisation

Définitions des indications AVERTISSEMENT, ATTENTION, et REMARQUE utilisées dans ce manuel.

Avertissement	**L'indication AVERTISSEMENT signale un danger pour le personnel. Elle attire l'attention sur une procédure, une pratique, une condition, ou toute autre situation présentant un risque d'accident pour le personnel, en cas d'exécution incorrecte ou de non-respect des consignes.**
Attention	**L'indication ATTENTION signale un danger pour l'appareil. Elle attire l'attention sur une procédure d'exploitation, une pratique, ou toute autre situation, présentant un risque de dégât ou de destruction partielle ou totale du produit, en cas d'exécution incorrecte ou de non-respect des consignes.**
Remarque	L'indication REMARQUE signale une information importante. Elle attire l'attention sur une procédure, une pratique, une condition, ou toute autre situation, présentant un intérêt particulier.

Symboles figurant sur l'unité

Le tableau suivant décrit les symboles pouvant apparaître sur l'unité.

Tableau 3: Définition des symboles sur l'unité

Marche (sous tension) IEC 417, No.5007	Arrêt (hors tension) IEC 417, No.5008	Terre (masse) IEC 417, No.5017	Terre de protection (masse) IEC 417, No.5019
Masse IEC 417, No.5020	Equipotentialité IEC 417, No.5021	Courant continu IEC 417, No.5031	Courant alternatif IEC 417, No.5032
Courant continu et alternatif IEC 417, No.5033-a	Matériel de classe II IEC 417, No.5172-a	3 ~ Courant alternatif triphasé IEC 617-2, No.020206	
Attention : se reporter à la documentation ISO 3864, No.B.3.1	Attention : risque de choc électrique ISO 3864, No.B.3.6	Attention : surface brûlante IEC 417, No.5041	

Mesures de sécurité et précautions

Observer les précautions générales de sécurité suivantes pendant toutes les phases d'exploitation de cet appareil. Le non-respect des ces précautions ou des avertissements du manuel constitue une violation des normes de sécurité relatives à l'utilisation de l'appareil et peut compromettre la protection assurée

par l'appareil. MKS Instruments, Inc. rejette toute responsabilité en cas de non-respect des consignes par les clients.

PAS DE REMPLACEMENT DE PIÈCES OU DE MODIFICATION DE L'APPAREIL

Ne pas installer de pièces de remplacement ni effectuer des modifications non autorisées sur l'appareil. Renvoyer l'appareil à un centre de service et de calibrage MKS pour tout dépannage ou réparation afin de garantir le l'intégrité des dispositifs de sécurité.

DÉPANNAGE UNIQUEMENT PAR DU PERSONNEL QUALIFIÉ

Le personnel d'exploitation ne doit pas essayer de sortir les composants du boîtier ou faire des réglages internes. Le dépannage est réservé au personnel qualifié.

ÉLOIGNEMENT DES CIRCUITS SOUS-TENSION

Ne pas remplacer de composants lorsqu'un câble d'alimentation est branché. Dans certaines conditions, des tensions dangereuses peuvent être présentes même après le retrait du câble d'alimentation. Pour éliminer tout risque de blessure, procéder toujours à la déconnexion et décharger les circuits avant tout contact physique.

PRÉCAUTION EN CAS D'UTILISATION AVEC DES PRODUITS DANGEREUX

Si des produits dangereux sont utilisés, l'utilisateur est responsable du respect des mesures de sécurité appropriées, de la purge complète de l'appareil quand elle s'avère nécessaire, et doit s'assurer que les produits utilisés sont compatibles avec les matériaux d'étanchéité.

PURGE DE L'APPAREIL

Après l'installation de l'unité, ou avant son retrait d'un système, purger l'unité complètement avec un gaz propre et sec afin d'éliminer toute trace du produit de flux utilisé précédemment.

UTILISATION DES PROCÉDURES APPROPRIÉES POUR LA PURGE

Cet appareil doit être purgé sous une hotte de ventilation. Le personnel doit porter des gants de protection.

PAS D'EXPLOITATION DANS UN ENVIRONNEMENT EXPLOSIF

Pour éviter toute explosion, ne pas utiliser cet appareil dans un environnement explosif, sauf en cas d'homologation spécifique pour une telle exploitation.

UTILISATION D'ÉQUIPEMENTS ET PROCÉDURES DE SERRAGE APPROPRIÉS

Tous les équipements de l'appareil doivent être conformes à ses spécifications, et compatibles avec l'utilisation prévue de l'appareil. Assembler et serrer les équipements conformément aux directives du fabricant.

VÉRIFICATION DE L'ÉTANCHÉITÉ DES CONNEXIONS

Vérifier attentivement toutes les connexions des composants pour le vide afin de garantir l'étanchéité de l'installation.

EXPLOITATION AVEC DES PRESSIONS D'ENTRÉE NON DANGEREUSES

Ne jamais utiliser des pressions supérieures à la pression nominale maximum (se reporter aux spécifications de l'unité pour la pression maximum admissible).

INSTALLATION D'UN DISQUE D'ÉCHAPPEMENT ADAPTÉ

En cas d'exploitation avec une source de gaz pressurisé, installer un disque d'échappement adapté dans le système à vide, afin d'éviter une explosion du système en cas d'augmentation de la pression.

MAINTIEN DE L'UNITÉ À L'ABRI DES CONTAMINATIONS

Ne pas laisser des produits contaminants pénétrer dans l'unité avant ou pendant l'utilisation. Des produits contaminants tels que des poussières et des fragments de tissu, de verre et de métal peuvent endommager l'unité de manière permanente.

RESPECT DU TEMPS D'ÉCHAUFFEMENT APPROPRIÉ POUR LES UNITÉS Á RÉGULATION DE TEMPÉRATURE

Les unités à régulation de température sont conformes à leurs spécifications uniquement quand on leur laisse un temps suffisant pour atteindre d'une manière stable la température d'exploitation. Ne pas remettre à zéro ou calibrer l'unité tant que l'échauffement n'est pas terminé.

Medidas de seguridad del dispositivo de flujo de masa

Símbolos usados en este manual de instrucciones

Definiciones de los mensajes de advertencia, precaución y de las notas usados en el manual.

Advertencia	**El símbolo de advertencia indica la posibilidad de que se produzcan daños personales. Pone de relieve un procedimiento, práctica, estado, etc. que en caso de no realizarse o cumplirse correctamente puede causar daños personales.**
Precaución	**El símbolo de precaución indica la posibilidad de producir daños al equipo. Pone de relieve un procedimiento operativo, práctica, etc. que en caso de no realizarse o cumplirse correctamente puede causar daños o la destrucción total o parcial del equipo.**
Nota	El símbolo de notas indica información de importancia. Este símbolo pone de relieve un procedimiento, práctica o condición cuyo conocimiento es esencial destacar.

Símbolos hallados en la unidad

La tabla siguiente contiene los símbolos que puede hallar en la unidad.

Tabla 4: Definición de los símbolos hallados en la unidad

Encendido (alimentación eléctrica) IEC 417, N° 5007	 Apagado (alimentación eléctrica) IEC 417, N° 5008	 Puesta a tierra IEC 417, N° 5017	 Protección a tierra IEC 417, N° 5019
 Caja o chasis IEC 417, N° 5020	 Equipotencialidad IEC 417, N° 5021	 Corriente continua IEC 417, N° 5031	 Corriente alterna IEC 417, N° 5032
 Corriente continua y alterna IEC 417, N° 5033-a	 Equipo de clase II IEC 417, N° 5172-a	Corriente alterna trifásica IEC 617-2, N° 020206	
 Precaución. Consulte los documentos adjuntos ISO 3864, N° B.3.1	 Precaución. Riesgo de descarga eléctrica ISO 3864, N° B.3.6	 Precaución. Superficie caliente IEC 417, N° 5041	

Procedimientos y precauciones de seguridad

Las medidas generales de seguridad descritas a continuación deben observarse durante todas las etapas de funcionamiento del instrumento. La fMFC de cumplimiento de dichas medidas de seguridad o de las advertencias específicas a las que se hace referencia en otras partes de este manual, constituye una violación de las normas de seguridad establecidas para el uso previsto del instrumento y podría anular

la protección proporcionada por el equipo. Si el cliente no cumple dichas precauciones y advertencias, MKS Instruments, Inc. no asume responsabilidad legal alguna.

NO UTILICE PIEZAS NO ORIGINALES O MODIFIQUE EL INSTRUMENTO

No instale piezas que no sean originales ni modifique el instrumento sin autorización. Para asegurar el correcto funcionamiento de todos los dispositivos de seguridad, envíe el instrumento al Centro de servicio y calibración de MKS toda vez que sea necesario repararlo o efectuar tareas de mantenimiento.

LAS REPARACIONES DEBEN SER EFECTUADAS ÚNICAMENTE POR TÉCNICOS AUTORIZADOS

Los operarios no deben retirar las tapas del instrumento. El reemplazo de los componentes y las tareas de ajuste deben ser realizadas únicamente por personal autorizado.

MANTÉNGASE ALEJADO DE LOS CIRCUITOS ACTIVOS

No reemplace componentes con el cable de alimentación eléctrica conectado. En algunos casos, puede haber presente alto voltaje aun con el cable de alimentación eléctrica desconectado. Para evitar lesiones personales, desconecte siempre el cable y descargue los circuitos antes de entrar en contacto con los mismos.

TENGA CUIDADO CUANDO TRABAJE CON MATERIALES TÓXICOS

Cuando se utilicen materiales tóxicos, es responsabilidad de los operarios tomar las medidas de seguridad correspondientes, purgar totalmente el instrumento cuando sea necesario y comprobar que el material utilizado sea compatible con los materiales de sellado.

PURGUE EL INSTRUMENTO

Una vez instalada la unidad o antes de retirarla del sistema, purgue completamente la unidad con gas limpio y seco para eliminar todo resto de la sustancia líquida empleada anteriormente.

USE PROCEDIMIENTOS ADECUADOS PARA REALIZAR LA PURGA

El instrumento debe purgarse debajo de una campana de ventilación y deben utilizarse guantes protectores.

NO HAGA FUNCIONAR EL INSTRUMENTO EN AMBIENTES CON RIESGO DE EXPLOSIÓN

Para evitar que se produzcan explosiones, no haga funcionar este instrumento en un ambiente con riesgo de explosiones, excepto cuando el mismo haya sido certificado específicamente para tal uso.

USE ACCESORIOS ADECUADOS Y REALICE CORRECTAMENTE LOS PROCEDIMIENTOS DE AJUSTE

Todos los accesorios del instrumento deben cumplir las especificaciones del mismo y ser compatibles con el uso que se debe dar al instrumento. Arme y ajuste los accesorios de acuerdo con las instrucciones del fabricante.

COMPRUEBE QUE LOS ACCESORIOS SEAN A PRUEBA DE FUGAS

Antes de proceder con la instalación del instrumento, inspeccione cuidadosamente todas las conexiones de las tuberías para comprobar que hayan sido instaladas a prueba de fugas.

HAGA FUNCIONAR EL INSTRUMENTO CON PRESIONES DE ENTRADA SEGURAS

No haga funcionar nunca el instrumento con presiones superiores a la máxima presión nominal (en las especificaciones del instrumento hallará la presión máxima permitida).

INSTALE UNA CÁPSULA DE SEGURIDAD ADECUADA

Cuando el instrumento funcione con una fuente de gas presurizado, instale una cápsula de seguridad adecuada en el sistema de vacío para evitar que se produzcan explosiones cuando suba la presión del sistema.

MANTENGA LA UNIDAD LIBRE DE CONTAMINANTES

No permita el ingreso de contaminantes en la unidad antes o durante su uso. Los productos contaminantes tales como polvo, suciedad, pelusa, lascas de vidrio o virutas de metal pueden dañar irreparablemente la unidad.

CALIENTE ADECUADAMENTE LAS UNIDADES CONTROLADAS POR MEDIO DE TEMPERATURA

Las unidades controladas por medio de temperatura funcionarán de acuerdo con las especificaciones sólo cuando se las caliente durante el tiempo suficiente para permitir que lleguen y se estabilicen a la temperatura de operación indicada. No calibre la unidad y no la ponga en cero hasta que finalice el procedimiento de calentamiento.

マスフロー機器の安全に関する情報

本取扱説明書のマーク

本マニュアルでは警告、注意、ポイントのマークを用いて重要な事項を記載しています。

警告	**この表示を無視して誤った取り扱い (手順や使用方法、条件など) をすると、人が重傷を負う可能性が想定される内容を示しています。必ずお読みください。**
注意	**この表示を無視して誤った取り扱い (手順や使用方法など) をすると、製品が損傷する可能性が想定される内容を示しています。必ずお読みください。**
ポイント	この表示は手順や使用方法、条件などに関する重要な情報が記載されていることを示しています。必ずお読みください。

本機器のマーク

以下の表では、本機器に使用されているマークについて説明いたします。

表 5: 本機器に使用されているマークについて

オン (電源) IEC 417, No. 5007	オフ (電源) IEC 417, No. 5008	接地 (アース) IEC 417, No. 5017	保護接地 (アース) IEC 417, No. 5019
フレームまたはシャーシ IEC 417, No. 5020	等電位 IEC 417, No. 5021	直流 IEC 417, No. 5031	交流 IEC 417, No. 5032
直流と交流 IEC 417, No. 5033-a	クラス 2 機器 IEC 417, No. 5172-a	3~ 三相交流 IEC 617-2, No. 020206	
注意 (付属書を参照) ISO 3864, No. B.3.1	注意 (感電の危険あり) ISO 3864, No. B.3.6	注意 (表面が熱くなっています) IEC 417, No. 5041	

安全対策について

本機器を使用する際は、必ず以下の安全対策を守ってください。これらの安全対策や本マニュアルの警告を無視すると、機器本来の用途の安全基準を侵害することになり、機器が提供する保護機能が損なわれる可能性があります。MKS Instruments, Inc. は、顧客側の安全対策の不履行に対しては一切責任を負いかねます。

勝手に部品を変えたり、本体を改造しないこと
本機器に代用部品を使用したり、不正な改造を加えないでください。すべての安全システムを正しく機能させるための修理やメンテナンスが必要な場合は、本機器を MKS Calibration and Service Center まで戻してください。

修理は必ず専門の修理サービスを利用すること
オペレータは絶対に本機器を分解しないでください。部品の交換や内部の調整は必ず専門の修理サービスを利用してください。

電流が通じている回路から切断すること
電源ケーブルを接続したままで部品を交換しないでください。特定の状況では、電源ケーブルを取り外した状態でも危険な電圧が残っている場合があります。感電などの事故を防ぐため、回路に触れる前に必ず電源から切断し、放電してください。

危険な材料を使用する場合は慎重に機器を使用すること
危険な材料を使用する場合は、使用者は各自の責任の元で適切な安全対策を講じてください。必要に応じて本機器を浄化してください。また、使用する材料に対するシーリング材の耐久性を確認してください。

機器を浄化すること
本機器を取り付けた後やシステムから取り外す前に、きれいな乾燥ガスで本機器を浄化し、使用した材料を完全に取り除いてください。

浄化する場合は適切な手順で行うこと
本機器の浄化は換気フードの下で行う必要があります。また、浄化作業を行う人は必ず手袋を着用してください。

爆発の危険性のある環境で機器を使用しないこと
爆発が起きるのを防ぐため、本機器を爆発の危険性のある環境で使用しないでください。ただし、そのような環境での使用が特別に保証されている場合は除きます。

適切な金具類を使用し、手順に従って金具の締めを行うこと
金具類は本機器の仕様と一致し、機器本来の用途に適合したものである必要があります。金具類の取り付けや締めは、製造業者の指示に従ってください。

液体の漏れがないよう接続箇所を確認すること
本機器を設定する前に、すべての配管の接続を慎重に確認し、液体が漏れないようにしてください。

安全なインレット圧力で使用すること
定格の最大圧力を超える圧力の下で本機器を絶対に使用しないでください (最大許容圧力については仕様書を参照)。

適切なバーストディスクを取り付けること
圧力のかかったガスを使用する場合は、万一システムが爆発した場合にシステムの圧力が上昇するのを防ぐため、真空システムに適切なバーストディスクを取り付けてください。

本機器に異物やゴミが混入しないようにすること
本機器の使用前または使用中に、ほこりやゴミ、繊維、ガラスの破片、金属片などの異物やゴミが混入しないようにしてください。本機器が損傷する可能性があります。

温度調整された機器を十分に温めてから使用すること
温度調整された機器が適切な作動温度にならないうちに使用すると、仕様通りの動作をしないことがあります。本機器が十分に温まるまでは目盛りをゼロに合わせたり、較正しないでください。

질량 유량 장치 안전 정보

본 지침 매뉴얼에 사용되는 기호들

매뉴얼 전체에 사용되는 경고, 주의 및 참고 메시지의 정의.

 **경고**	**경고 표시는 위험을 나타냅니다. 이 표시는 올바르게 수행되거나 지켜지지 않을 경우, 사람에게 상해를 입힐 수 있는 절차, 수행지침, 상태 또는 이와 유사한 상황들에 대한 주의를 환기시킵니다.**
 **주의**	**주의 표시는 위험을 나타냅니다. 이 표시는 올바르게 수행되거나 지켜지지 않을 경우, 제품의 일부나 전체에 손상이나 파손을 일으킬 수 있는 절차, 수행지침 또는 이와 유사한 상황들에 대한 주의를 환기시킵니다.**
 **참고**	참고 표시는 중요한 정보를 나타냅니다. 이 표시는 강조할 만한 주요 절차, 수행지침, 상태 또는 이와 유사한 상황들에 대한 주의를 환기시킵니다.

장치에 표시된 기호들

다음 표는 장치에서 볼 수 있는 기호들을 설명합니다.

표 6: 장치에 표시된 기호들의 정의

 켬 (전원) IEC 417, No. 5007	 끔 (전원) IEC 417, No. 5008	 접지(지면) IEC 417, No. 5017	 보호 접지(지면) IEC 417, No. 5019
 프레임 또는 섀시 IEC 417, No. 5020	 등전위성 IEC 417, No. 5021	 직류 IEC 417, No. 5031	 교류 IEC 417, No. 5032
 직류와 교류 모두 IEC 417, No. 5033-a	 클래스 II 장비 IEC 417, No. 5172-a	 3상 교류 IEC 617-2, No. 020206	
 주의 (동봉 문서 참조) ISO 3864, No. B.3.1	 주의, 감전 위험 ISO 3864, No. B.3.6	 주의, 표면이 뜨거움 IEC 417, No. 5041	

안전 절차 및 예방조치

본 기계의 모든 작동 시에 다음의 일반 안전 예방조치를 준수하십시오. 아래 예방조치를 준수하지 않거나 본 매뉴얼의 다른 부분에 있는 특정 경고를 준수하지 않을 경우, 기계 사용 목적의 안전 기준을 위반하는 것이 되며, 장비가 제공하는 보호기능을 손상시킬 수 있습니다. MKS Instruments, Inc.는 고객이 본 요건을 준수하지 않는 경우에 대해서는 어떠한 책임도 지지 않습니다.

부품을 교체하거나 기계를 개조하지 마십시오

교체 부품을 설치하거나 기계에 허가되지 않은 어떠한 수정도 가하지 마십시오. 서비스와 수리가 필요한 경우에는 모든 안전 특성이 유지되도록 기계를 MKS 보정 서비스 센터(MKS Calibration and Service Center)로 보내주십시오.

자격이 있는 사람에게만 서비스를 받으십시오
작동하는 사람은 기계 겉면을 제거해서는 안됩니다. 부품 교체 및 내부 조정은 자격이 있는 서비스 기사에게만 받으실 수 있습니다.

전류가 통하는 회로에서 분리해 보관하십시오
전원 케이블을 연결한 채로 부품을 교체하지 마십시오. 일부 환경에서는 전원 케이블을 제거한 상태라도 위험 전압이 존재할 수 있습니다. 부상을 방지하려면, 전원을 항상 분리하고 회로를 만지기 전에 회로를 방전시키십시오.

위험한 물질과 함께 작동할 때는 주의를 기울이십시오
위험한 물질이 사용되는 경우, 사용자는 필요시 기계를 완전히 청소하여, 적절한 안전 예방조치를 준수할 책임을 지키고, 사용된 물질이 봉인 물질과 함께 사용해도 무방하다고 보증할 수 있어야 합니다.

기계를 청소하십시오
장치를 설치한 후나 시스템에서 장치를 제거하기 전에는 반드시 깨끗한 건조성 기체로 장치를 완전히 청소하여 이전에 사용된 유량 물질의 모든 흔적을 제거하십시오.

청소 시에는 적절한 절차를 사용하십시오
본 기계는 환기 후드 아래에서 청소되어야 하며, 인체 보호를 위해 장갑을 착용해야 합니다.

폭발성 환경에서 작동하지 마십시오
폭발을 방지하려면, 폭발성 환경에서 작동하도록 특별히 승인받지 않은 경우 본 제품을 폭발성 환경에서 작동하지 마십시오.

적절한 조립부품과 조임 절차를 사용하십시오
모든 기계 조립부품은 제품 사양과 일치해야 하고, 기계의 사용 목적에 부합해야 합니다. 제조업체의 지시에 따라 조립부품을 조립하고 조이십시오.

누출방지 조립부품을 점검하십시오
기계 설치를 진행하기 전에 기계의 모든 연관 연결부를 점검해 누출방지 설치가 되었는지 확인하십시오.

안전한 흡입 압력에서 작동하십시오
이 장치는 절대 정격 최대 압력보다 높은 압력에서 작동해서는 안됩니다(최대 허용 압력에 대해서는 제품 사양을 참조하십시오).

적합한 안전 파열판을 설치하십시오
가압 가스 공급원에서 작동시, 시스템 폭발이 시스템 압력 상승을 일으키는 것을 방지하기 위해 적합한 안전 파열판이 진공 시스템에 설치되어야 합니다.

장치를 오염이 없는 곳에 보관하십시오
장치를 사용하기 전이나 사용 중에는 어떠한 종류의 오염 물질도 허용해서는 안됩니다. 먼지, 때, 보풀, 유리 조각, 금속 조각과 같은 오염 물질은 영구적으로 장치를 손상시킬 수 있습니다.

온도 제어 장치의 경우 알맞은 시동 시간을 두십시오
온도 제어 장치는 장치가 설계 작동 온도와 일치하고 이 온도에서 안정화될 수 있도록 충분한 시간을 허용해야만 사양에 맞게 작동합니다. 시동이 완료될 때까지 장치를 영점 설정하거나 보정하지 마십시오.

Chapter One: General Information

Introduction

MKS Instruments π series digital MFCs represent state-of-the-art technology meeting the advanced process requirements of next generation toolsets. This unique device integrates thermal sensor technology together with MKS Baratron® technology through an innovative, real-time feedback control system.

The πMFC include an integrated multifunctional local display and an embedded, web-based user interface. The device is available in standard 1.125" C-seal, W-seal surface mount or ¼" VCR™ package.

Design Features

Increases Throughput and Performance

- ♦ Insensitive to upstream and downstream pressure disturbances
- ♦ Accurate flow control without the need for additional dedicated line pressure regulator.
- ♦ Enables better chamber matching through increased MFC accuracy of any process gas.
- ♦ Increases tool uptime through reduction of "No Problem Found" MFC replacements.
- ♦ Includes embedded diagnostics software that allows users to check MFC functionality without removing the MFC.
- ♦ E-diagnostics through embedded Ethernet interface.

Reduce Overall Costs

- ♦ Reduces MFC inventory through multi-gas, multi-range availability.
- ♦ Enables reduction in number of gas stick components needed, such as pressure regulators and pressure transducers.
- ♦ Minimizes overall footprint of gas delivery module.

Easy to Integrate and Operate

- ♦ Straightforward configuration and diagnostics through Ethernet interface

  Uses standard web browser – no special software required.

  Includes remote PC application.
- ♦ Easy viewing of line pressure, flow rate, gas type, full scale and Ethernet address with big LED display.

The design of the πMFC incorporates an advanced flow sensor, a control valve, and an optimized bypass. The latest generation two-element sensing circuit provides accurate, repeatable performance even in low flow ranges (< 10 sccm). A low temperature effect from ambient temperature change and a low attitude sensitivity effect are also ensured. Attitude sensitivity is completely accounted for with advanced attitude circuitry. The optimized sensor/bypass arrangement minimizes the flow splitting error for gases with different properties, which dramatically improves measurement accuracy when gases other than the calibration gas are used.

Model Name(Part Number)	PFC-60(P6A)	PFC-50(P5A)
PI(Pressure Insensitive)	Yes	No
MG(Multi Gas)	Yes	Yes
MR(Multi Range)	No	Yes

Digital Features

The DeviceNet interface ensures interoperability in any DeviceNet mass flow application. In addition, the true digital calibration and valve control electronics, coupled with standard default 11 point flow calibration, provide for high flow accuracy over a wide range of setpoints and fast response to even low setpoints.

Reliability

To provide excellent reliability, the design contains a low mechanical and electronic components count and has successfully passed the following test:

- STRIFE, including temperature cycling and vibration (sine and random tests)

And with a metal braided, shielded cable, properly grounded at both ends:

- EMC Directive 89/336/EEC for CE Mark compliance

Cleanliness Features

The πMFCs use only metal for all external seals. The metal seals eliminate gas permeation and ensure extremely low external leakage under pressure or vacuum conditions relative to atmosphere. The internal valve control plug is Teflon or sapphire, which are pure, chemically stable, and not prone to out-gassing or particle generation. The πMFCs mechanical design incorporates minimal wetted surface area and virtual leaks, assuring rapid dry-down. To further enhance its cleanliness, all internal surfaces are precision machined to a 5Ra surface finish.. The instrument is assembled and double-packaged in a Class 100 clean room environment.

How This Manual is Organized

Before installing the device in a system and/or operating it, carefully read and familiarize yourself with all precautionary notes in the *Mass Flow Device Safety Information* section at the front of this manual. In addition, observe and obey all WARNING and CAUTION notes provided throughout the manual.

Chapter One: General Information introduces the product and describes the organization of the manual.

Chapter Two: Installation explains the environmental requirements and describes how to mount the instrument in your system.

Chapter Four: Overview provides a brief description of the instrument and its functionality, describes how to use the instrument and explains all the functions and features.

Chapter Five: Maintenance lists any maintenance required to keep the instrument in good working condition.

Chapter Six: Troubleshooting provides a reference should the instrument appears to malfunction.

Appendix A: Product Specifications lists the specifications of the instrument.

Appendix B : Model Code Explanation describes the model code.

Customer Support

Standard maintenance and repair services are available at all of the regional MKS Calibration and Service Centers. MKS also accepts the instruments of other manufacturers for recalibration using the Primary and Transfer Standard calibration equipment located at our regional service centers.

If any difficulties arise in the use of your device, or to obtain information about companion products MKS offers, contact any authorized MKS Calibration and Service Center. If it is necessary to return the instrument to MKS, please obtain an RMA Number (Return Material Authorization Number) from the MKS Calibration and Service Center before shipping. The RMA Number expedites handling and ensures proper servicing of your instrument.

Please refer to the inside of the back cover of this manual for a list of MKS Calibration and Service Centers.

Warning **All returns to MKS Instruments must be free of harmful, corrosive, radioactive, or toxic materials.**

Chapter Two: Installation and Configuration

Unpacking

MKS has carefully packed your device so that it will reach you in perfect operating order. Upon receiving the unit, however, you should check for defects, cracks, broken connectors, etc., to be certain that damage has not occurred during shipment.

Note Do *not* discard any packing materials until you have completed your inspection and are sure the unit arrived safely.

If you find any damage, notify your carrier and MKS immediately. If it is necessary to return the unit to MKS, obtain an RMA Number (Return Material Authorization Number) from the MKS Calibration and Service Center before shipping. Please refer to the inside back cover of this manual for a list of MKS Calibration and Service Centers.

Opening the Package

Each device is assembled, leak tested with helium, and calibrated in a cleanroom environment. The instrument is double-packaged in this environment to ensure maintenance of its particle free condition during shipment. It is very important to remove the packaging according to good clean room practices. To maintain at least a minimal level of clean room standards, follow the instructions below:

1. Remove all cardboard and packaging materials. Discard before entering the garmenting room.
2. Remove the outer plastic shipping container in an ante room (garmenting room) or transfer box. Do not allow this container to enter the clean room.
3. Remove the inner bag in the clean room.
4. Inspect for any damage.
5. Pass the original calculation sheet to the appropriate personnel at your company.
6. Remove plastic Ethernet kit from inner container and DO NOT take them into clean room.

Caution **Only qualified individuals should perform the installation and any user adjustments. Individuals must comply with all necessary ESD handling precautions while installing and adjusting the instrument. Proper handling is essential when working with all highly sensitive precision electronic instruments.**

Unpacking Checklist

Standard Equipment:

- πMFC
- πMFC Instruction Manual (this book)
- Ethernet Kit (Surface Mount MFCs only)
- Adapter cables for 9 pin, 15 pin analog devices (Surface Mount MFCs only)
- Flow calibration sheet

Product Location and Requirements

- Ventilation requirements include sufficient air circulation
- Ambient operating temperature range: 10° to 50° C (50° to 122° F)
- Power requirement: 11-25 VDC [320 mA maximum current @ 11 VDC

  146 mA @ 24 VDC nominal)]
- Storage temperature range: -20° to 65° C (-4° and 149° F)
- Mount the πMFC in an upright position if possible for easy viewing of the display, although any mounting orientation is satisfactory.
- Install a separate positive shutoff valve if your system cannot tolerate any leakage through the πMFC. The internal flow control valve is not a positive shutoff valve so some leakage across the valve may occur.

Warning **Your corporate policy on handling toxic or hazardous gases supersedes the instructions in this manual. Comply with your corporate policy. MKS assumes no liability for the safe handling of such materials.**

- Install the πMFC in a "flowing" system where gas is continually added and evacuated. Do ***not*** use the controller in a "dead-ended" system (a system which cannot remove excess mass). The πMFC can not vent excess mass to the atmosphere.
- Warm up time: 1 hour
- Use high purity gas filters in line upstream of the device.
- Observe the pressure limits for the flow device.

  Controller:

  Maximum gas inlet pressure is 150 psig with properly configured valve (consult factory for cases where inlet pressure is expected to exceed 40 psig).

  Operation of the display is limited to 100 psia.

  Operational differential pressure is:

  1. 10 to 40 psid for 10 to 5000 sccm units
  2. 15 to 40 psid for 10000 to 30000 sccm

  The standard valve configuration provides control over this pressure range with the outlet at atmospheric pressure.

  For additional information, refer to Appendix A, *Product Specifications*, page 63.

  Meter:

  Maximum gas inlet pressure is 150 psig in all cases.

Dimensions

Refer to the applicable drawings, which follow.

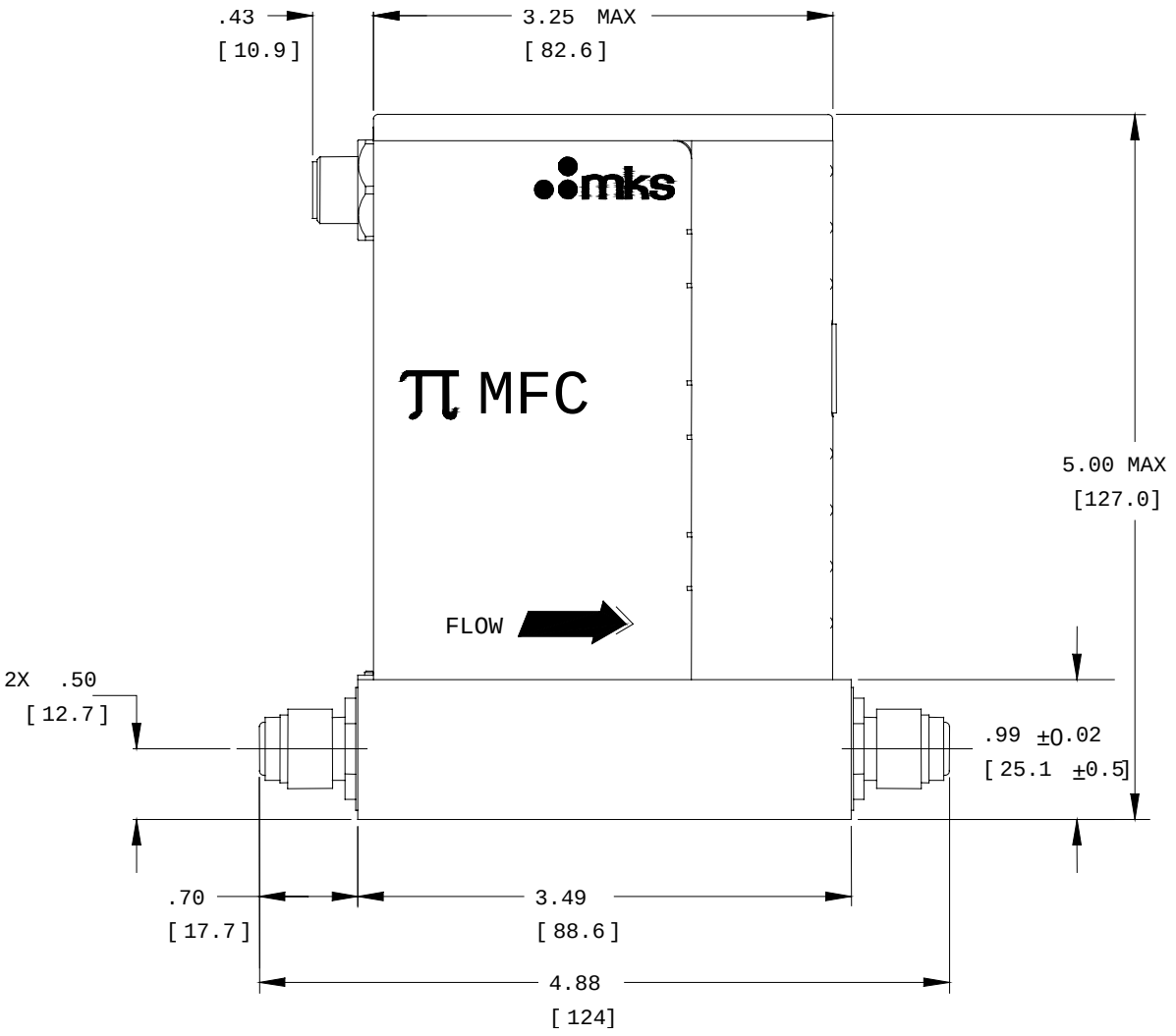


Figure 1: 4-VCR Front View - DeviceNet

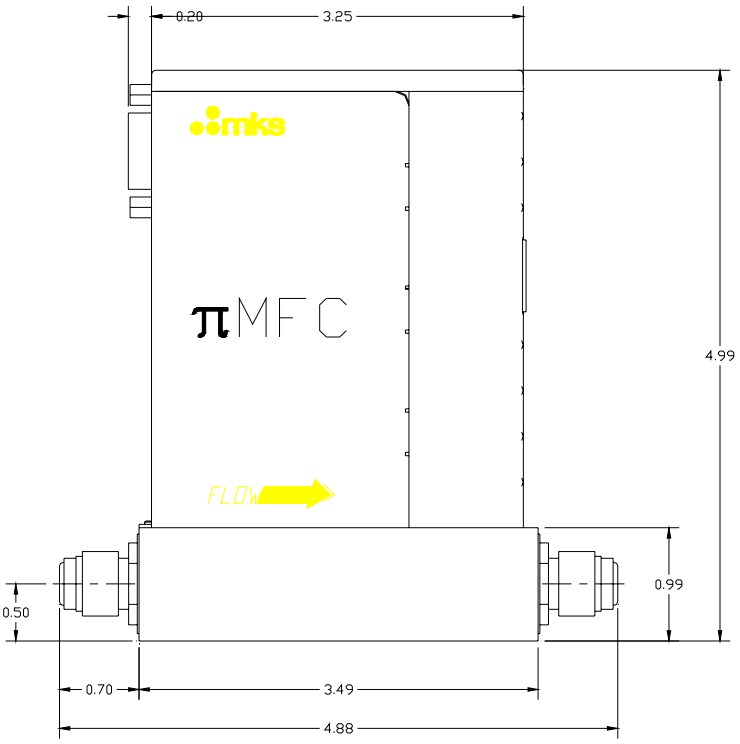


Figure 2: 4-VCR Front View – 9-Pin Analog

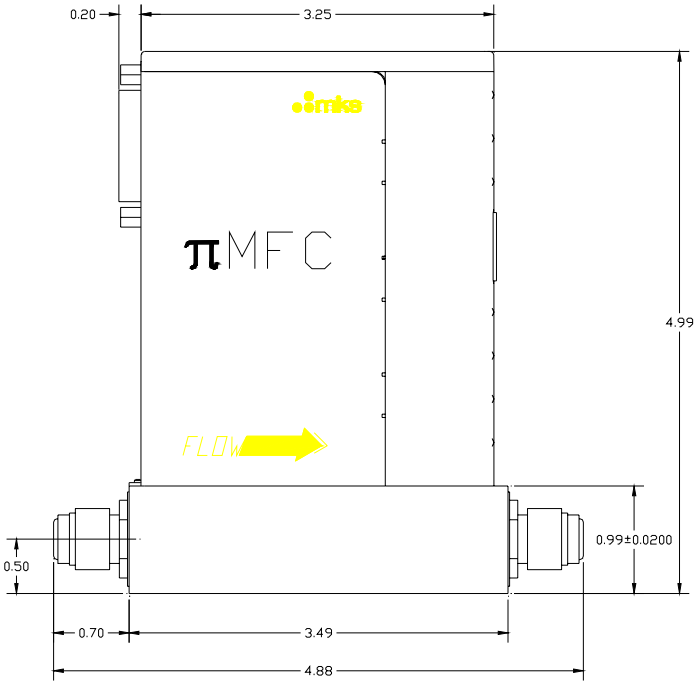


Figure 3: 4-VCR Front View – 15-Pin Analog

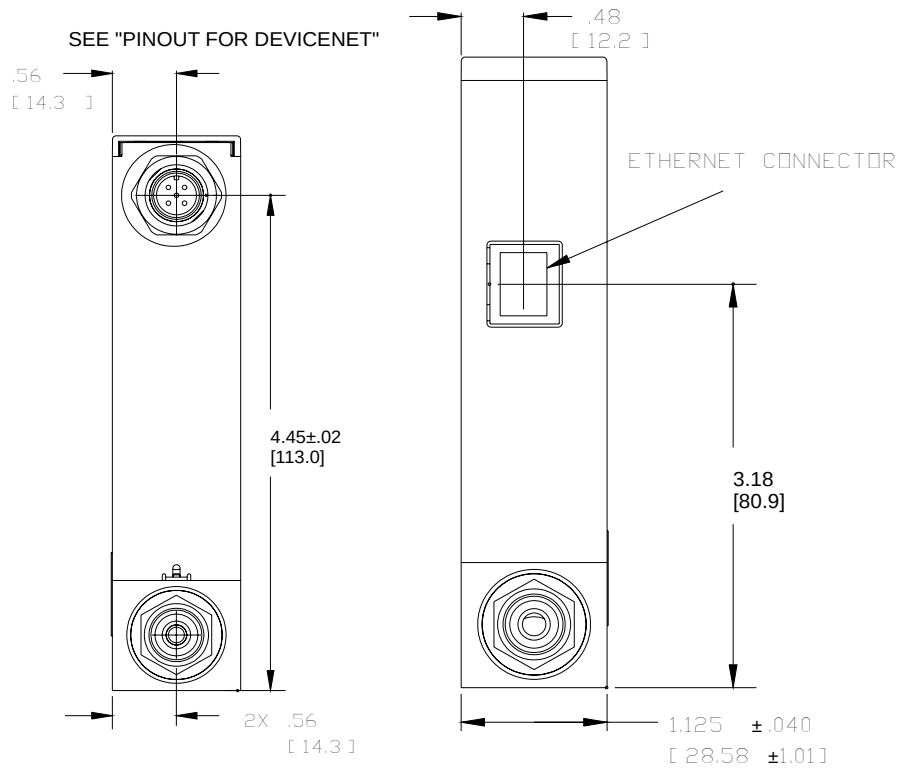


Figure 4: 4-VCR Left and Right Side Views – DeviceNet

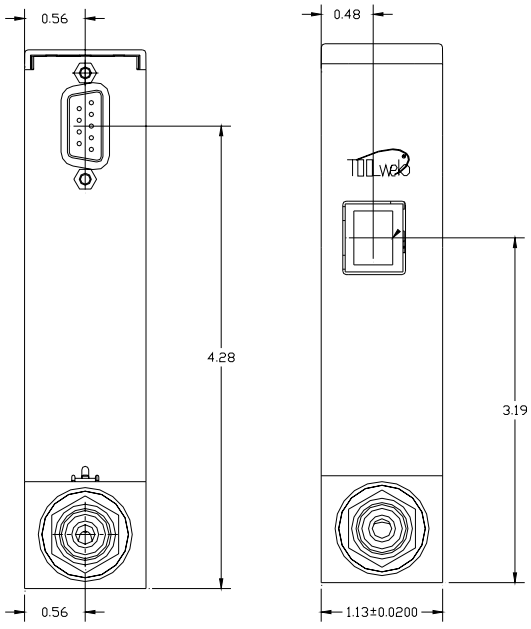


Figure 5: 4-VCR Left and Right Side Views – 9-Pin D

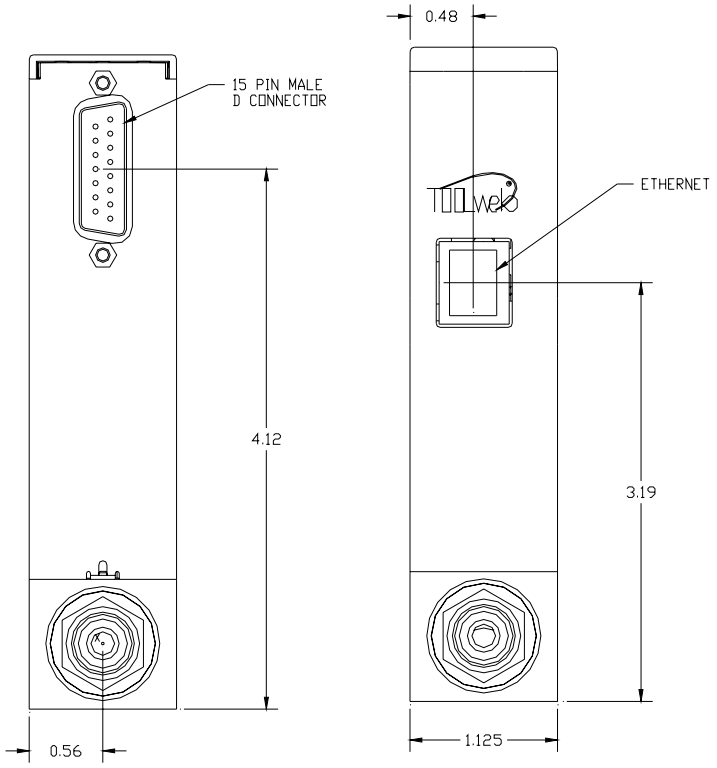


Figure 6: 4-VCR Left and Right Side Views – 15-Pin D

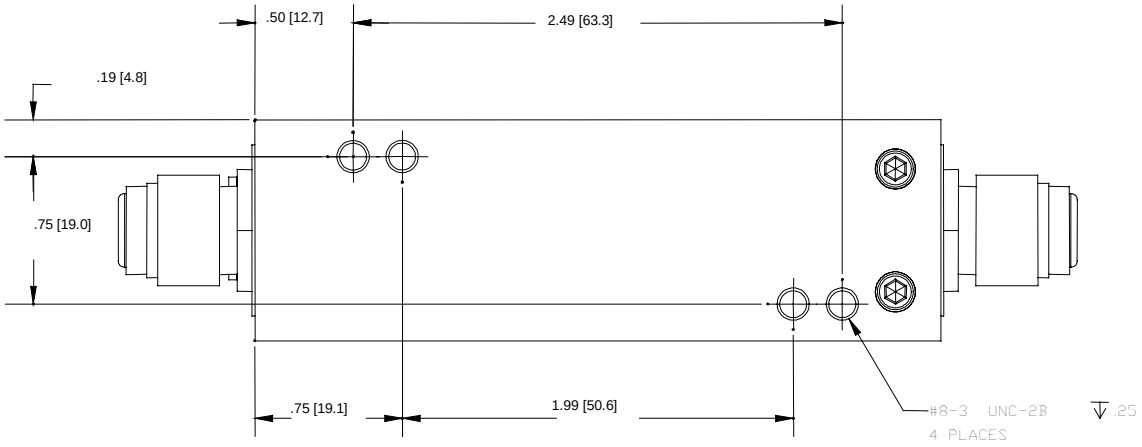


Figure 7: 4-VCR Bottom View

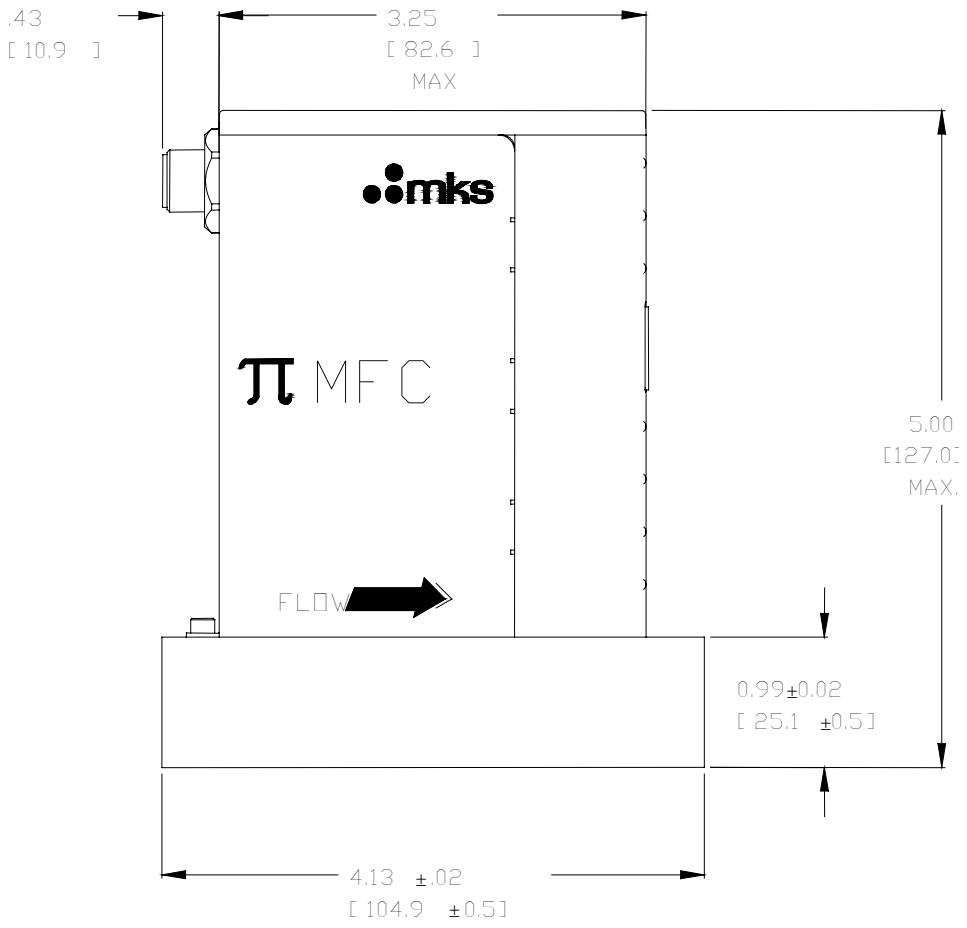


Figure 8: C or W Seal Front View

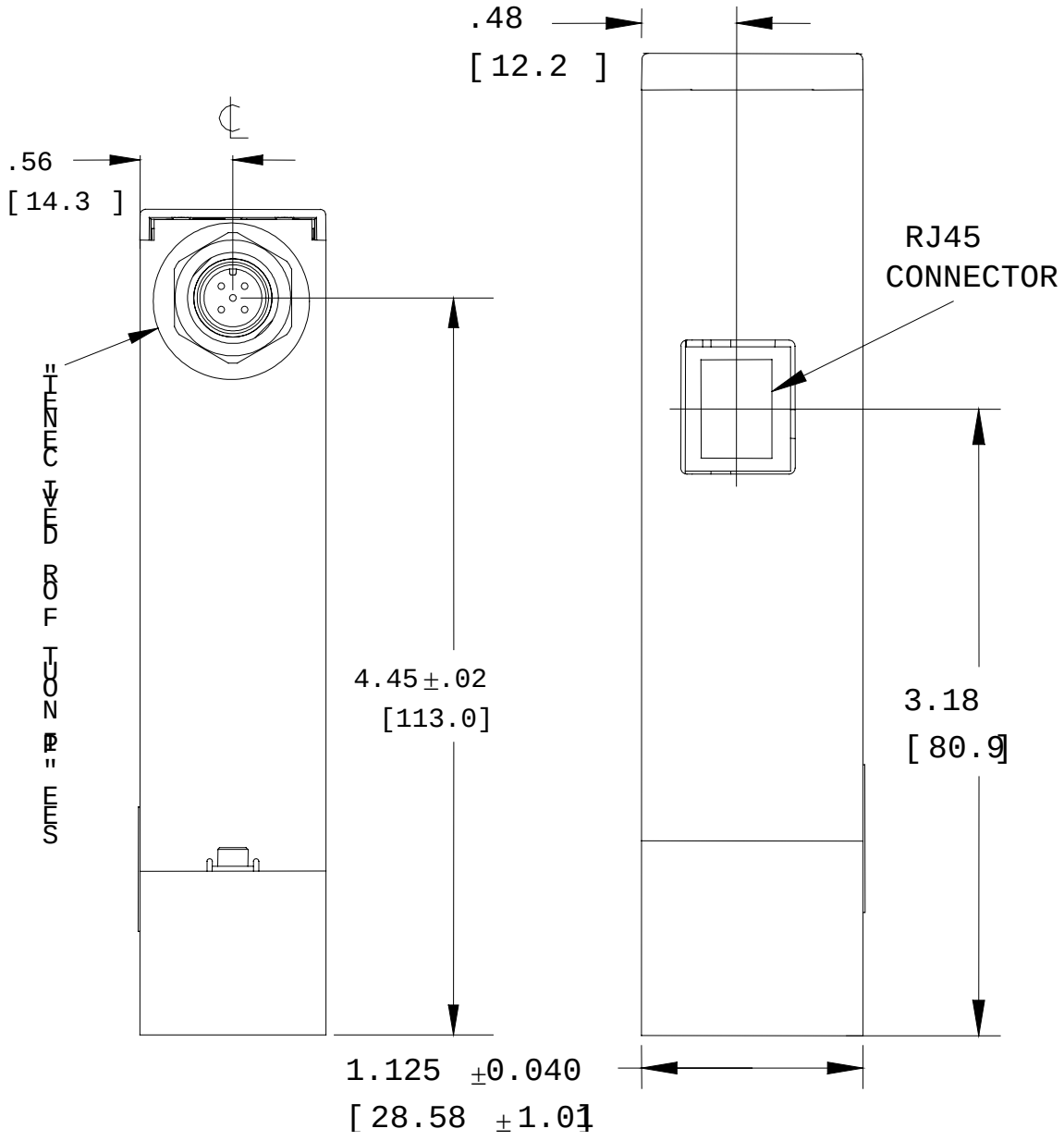


Figure 9: C or W Seal Left and Right Views

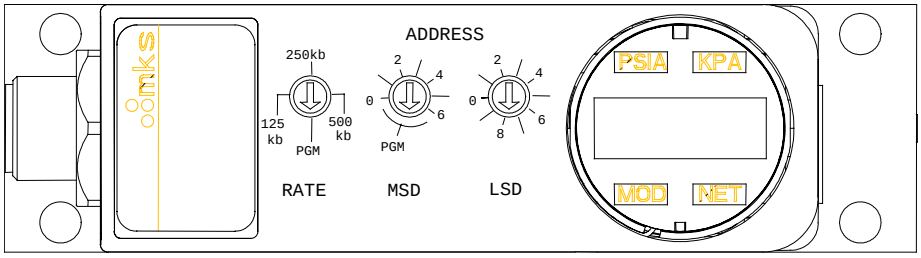


Figure 10: C and W Seal Top View

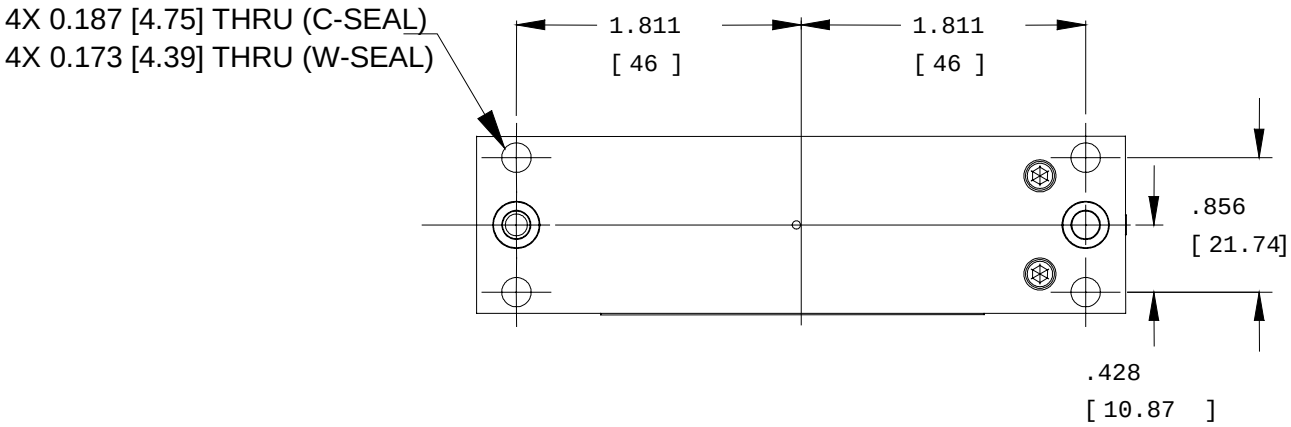


Figure 11: C and W Seal Bottom View

Labels

Each MFC has one serial number label and a larger label on the back side. Each label shows the serial number, the model code, the full scale flow range, and the calibration gas.

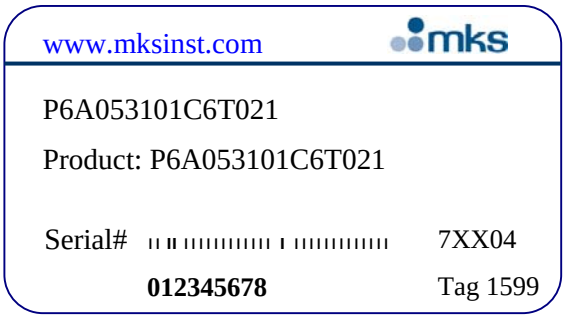


Figure 12: Serial Number Label

Network Status LED (MOD & NET)

The Network Status LED indicates the status of the communications link. If no problems are detected, the Network Status LED illuminates a solid green. A red, dark, or flashing green Network Status LED indicates a fault condition on the network.

Table 7: Network Status LED Indicators

LED Status	Meaning
Solid Green	Communications link is OK. The device is online and connections are established.
Flashing Green	The device is online but no connections are established. The device has passed the Dup_MAC_ID test and is online, but has no established connections to other nodes.
Solid Red	Critical link failure. The device has detected an error that prevents network communication (Duplicate MAC_ID or bus-off.).
Dark	Not powered / Not online. The device has not completed the Dup_MAC_ID test, or the device is not powered; check the module status LED.

Baud Rate and MAC ID Switches

The baud rate and MAC ID (node address) for your device can be set through software commands using standard DeviceNet protocol over the network, or manually using the rotary switches located on the top panel of the device. The baud rate and MAC ID switches allow you to easily configure units without an operational network, or to network multiple units quickly.

The baud rate and MAC ID rotary switches support an assigned *network* position, labeled on the device as “PGM” to indicate software operation.

If the rotary switch is in the network (PGM) position at power-up, the baud rate or address is read from the non-volatile memory. Any changes to the values must be made over the network; any changes in the rotary switch positions after power-up are ignored.

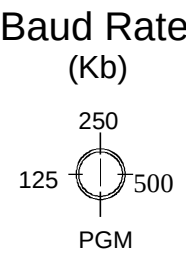
If the rotary switch is *not* in the network (PGM) position at power-up, the baud rate or address is read directly from the switches.

Note The DeviceNet General Error Codes are listed in the ODVA DeviceNet Specification, Volume 1 [1].

Baud Rate Switch

The 4-position rotary switch is used to select the DeviceNet baud rate. The choices are: PGM (the baud rate is read from the non-volatile memory), 125, 250, and 500 Kb.

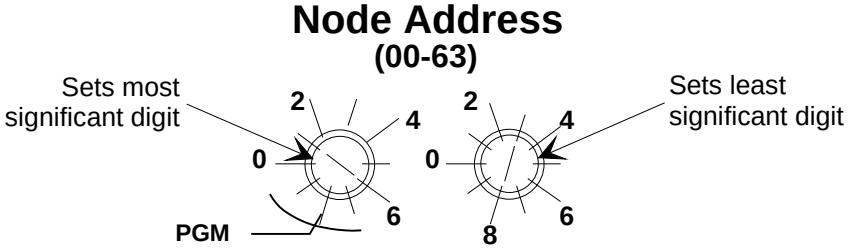
The switch positions are numbered in a clockwise direction, to correspond to the increasing address values.



MAC ID (Node Address) Switches

Two 10-position rotary switches, shown below, are used to set the MAC ID (node address).

The MAC ID is an integer identification value assigned to each node on the DeviceNet network.



The valid MAC ID switch positions are 0 to 63. Use the switch on the left to set the most significant digit (MSD), that is, the factor of ten (10, 20, 30...60). Use the switch on the right to set the least significant digit (LSD), that is, the increments of one (1, 2, 3...9). The switch positions are numbered in a clockwise direction, to correspond to the increasing address values.

Note Setting the switches to a value that is greater than 63 is the same as setting the rotary switch to the “PGM” position (the baud rate is read from the non-volatile memory).

Note The MAC ID switch on the top of the device must be set to the network (PGM) position before power up in order for changes to be made over the network. Any changes in the rotary switch positions after power up are ignored.

Mounting Hardware

MFCs with in-line fittings (VCR) have six threaded mounting holes located on the bottom or base of the unit: four #8-32 and two M4. Depending on the hole pattern chosen, use #8-32 UNC-2B or M4 hardware to mount the instrument. The figures beginning on page 18 show the location and dimensions of the mounting holes for standard axial fittings.

The C-Seal and W-Seal downmount fittings are designed for device mounting using four M5-0.8 x 30 mm long socket head cap screws. In addition, C-Seal units may be mounted using 10-32 UNF x 1.25" long socket head cap screws if your mounting substrate requires.

Gas Flow

The control valve is *not* a positive shutoff valve. Some leakage across the valve may occur. Refer to Appendix A, *Product Specifications*, page 63, for the leak integrity specifications. If necessary, install a separate positive shutoff valve in your system.

Note Connect the MFC to your system so that the gas flows in the direction of the flow arrow on the front of the unit.

Installation Procedure

Install the MFC

Note DO NOT make any electrical connections to the MFC until directed to do so.

1. The MFC is prepared for cleanroom installation.
   Follow standard cleanroom practices to ensure a clean installation:
   - discard outer material outside of the cleanroom
   - remove the outer packaging in the gray area
   - carry the MFC into the clean area then remove the inner bag and any protective fitting covers just prior to installation. Remove plastic ethernet kit from inner plastic and DO NOT take them into clean room.
   - Do not discard calibration sheet
2. Prepare the system according to your facility's gas handling procedures, including purging of the gas lines with appropriate purge gas, and notification to equipment personnel and haz/mat teams.

PERSONAL SAFETY HAZARDS!

Gas systems can contain toxic, explosive, combustible, corrosive or other gases which can present life- threatening hazards. ALWAYS use appropriate personal protection equipment. NEVER open a gas line unless the system has been properly purged of harmful gases. Certain gas system components may contain hazardous residuals if not properly prepared. Consult with your facility safety engineers prior to working on any gas delivery system and notify all personnel in adjacent areas to take appropriate personal safety precautions BEFORE working on the equipment.

3. Prepare the connections fittings:

- Flow clean, dry purge gas across the fittings to minimize particle contamination during installation. Use only purge gases that are approved for your process.
- Install the MFC and secure according to the fitting manufacturer's instructions. DO NOT overtighten connections.

4. Before powering the device, for DeviceNet MFCs:

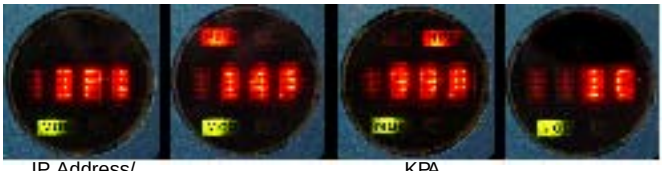
Set the baud rate for communications: PGM (the baud rate is read from the non-volatile memory), 125, 250, or 500 Kb (factory default is 500 Kb)

Set the DeviceNet Address: The address is read on power up, so it must be set prior to applying power to the system. (factory default is 55)

-

5. Verify the power and signal pinouts for the cable leading to the MFC:
For DeviceNet, confirm connections to:
1 = Drain, 2 = V+, 3 = V-, 4 = Can_H, 5 = Can_L
When using Ethernet interface for setup, a crossover cable(similar to null modem) is required when the πMFC is connected directly to a PC. When the πMFC is on a network with a hub interface, a standard Ethernet cable should be used.

6. Power up the MFC, then record the IP address, Gas Type and Maximum Flow Rate (Full Scale Flow Rate) on the calibration sheet.
Note: The MFC's scrolling display shows the IP address, the Gas Type, and the Maximum Flow



IP Address/ Gas Type/Full Scale | PSIA | KPA Pressure | Gas Flow Rate

MFC Temp.

Rate. Press down on the multi-function display to toggle through the various displays.

7. Perform appropriate helium leak checking of your gas lines and πMFC connections to verify the integrity of the gas seals. You will need to open all pneumatic and pressure control valves including setting the MFC to 100% flow.

Chapter Three: Ethernet Interface Setup, Diagnostics and Configuration

The Ethernet interface is a supplemental feature that can be used for setup, configuration, and diagnostics. It is not used to control the π**MFC**. To access the diagnostic features of the π**MFC** via the Ethernet port, follow Step 1 and 2.

Step 1: Install the Java™ Plugin (for single IP address)

The π**MFC** interface software uses Internet Explorer interface which requires a Java Technology plug-in to display real-time data plots. If you are installing the π**MFC** on a network that has web access, AND you are setting up multiple IP addresses (see “

Option 3: For Multiple **IP address setup***” on page 36*), then you can skip the steps below and access the web for download at the completion of the Multiple IP address setup procedure. OTHERWISE perform the following steps:

1. Download the following (2) files from the MKS website (www.mksinst.com/MDsw.html). The MKS download includes an installation script to properly load the plug-in:

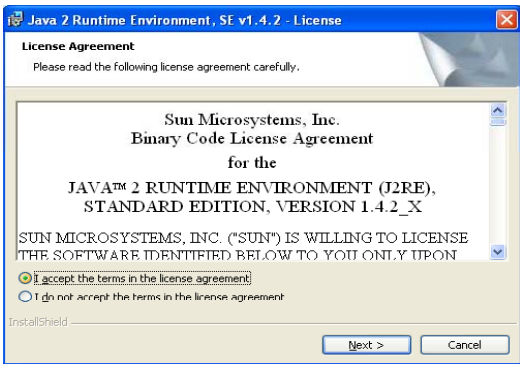
- Java installer: jinstaller.exe
- Installation script: InstallPlot.bat

2. Copy the installer and script file to your hard drive, then double-click on the InstallPlot.bat file. This file connects to the Sun Microsystems download site according to the following command:

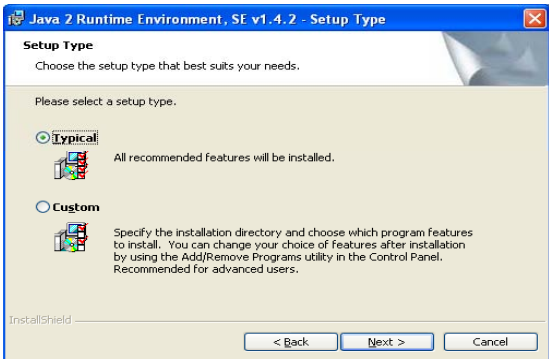
- jinstall.exe http://java.sun.com/update/1.4.2/1.4.2-b28.xm

3. Follow the onscreen prompts to install the Java application.

4. Read the license agreement, select “I accept...”, click “Next” to continue installation.



5. Select the “Typical” installation option and follow the prompts to install the Java plugin.

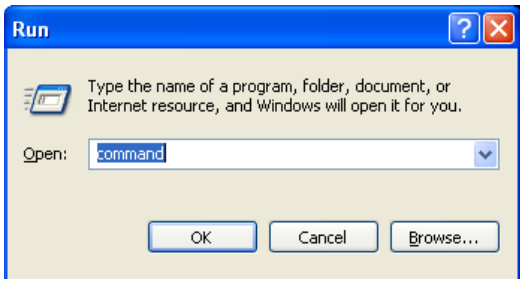


6. Java plug-in is now complete.

Step 2: Verify the πMFC Configuration
Option 1: Network Automatic Setup

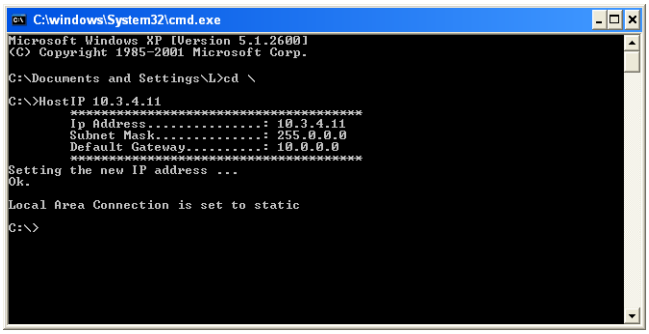
A software script allows you to rapidly create a network connection to the π**MFC**. Once connected a series of web- browser type windows allow you to easily monitor and configure the π**MFC**.

1. Logon to the MKS website and download a copy of the IP setup script, HostIP.cmd.
2. Copy the setup script HostIP.cmd to your C:\ directory. (Use Windows Explorer or similar program.)
3. Connect a **crossover** network cable to the π**MFC** and your laptop computer. A crossover cable is required when the π**MFC** is connected directly to a PC. When the π**MFC** is connected to a network using a hub interface, a standard Ethernet cable can be used.
4. Select “start” “Run..” then enter the word “command” and click OK.



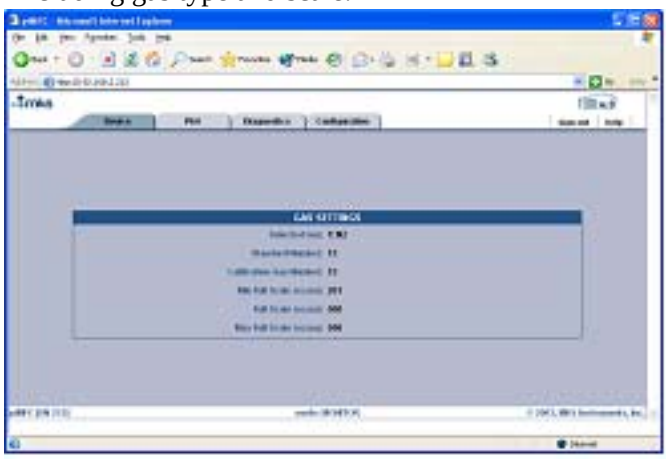
5. At the command prompt, enter the command “C:” or
“CD \” then press Enter. This will bring you to the C:\> prompt.

6. Enter the command “HostIP xx.xx.xx.xx” where the x’s stand for the IP address of your Host PC, then press Enter. (Note, the first 2 digits have to be exactly the same as the first 2 digits of the π**MFC**.) The system will setup a new host IP address and display it
as shown in the example below:



To restore to a dynamic IP address, run the HostIP script with an argument of "auto". “HostIP auto".

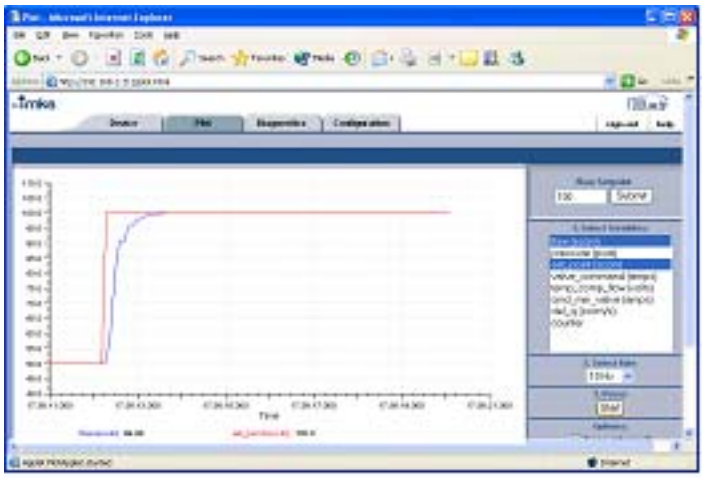
7. After running the HostIP command, launch Internet
Explorer, enter "http://xx.xx.xx.xx" in the address field, where
xx.xx.xx.xx stands for the IP address of the π**MFC** you wish to connect to, then click "Go." Internet Explorer will open and display the device Monitor screen which displays the device’s Gas Settings including gas type and scale.



8. Click on a tab at the top of the window to access more advanced features including:

- Plot Screen
- Diagnostics Screen
- Configuration Screen
- Device Screen
- DeviceNet Setting Screen
  (where applicable, for configuration use only)

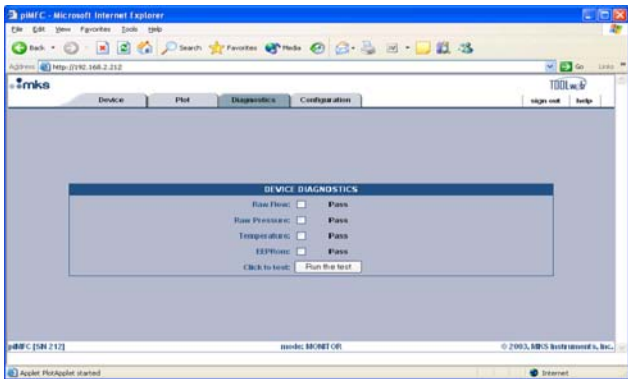
Plot Screen



Other screens and their main features are summarized on the following pages.

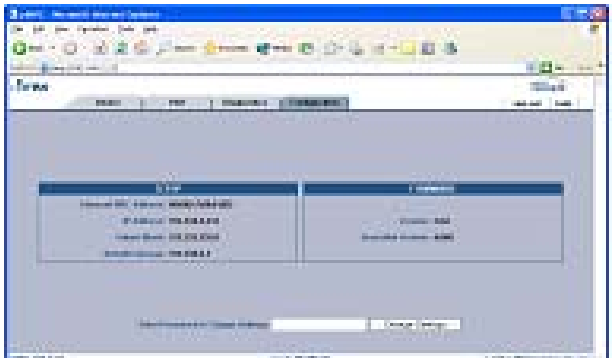
Diagnostics Screen

The Diagnostics Screen provides a rapid, in-situ diagnostics capability. Click “Run the test” to run basic flow, pressure, temperature and EEPRom tests.



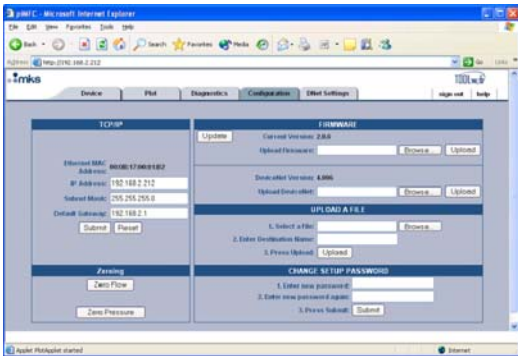
Configuration Screen

Firmware version and IP address information is displayed on the Configuration Screen. Enter the system password to change configuration settings. Factory-shipped password is “config.”



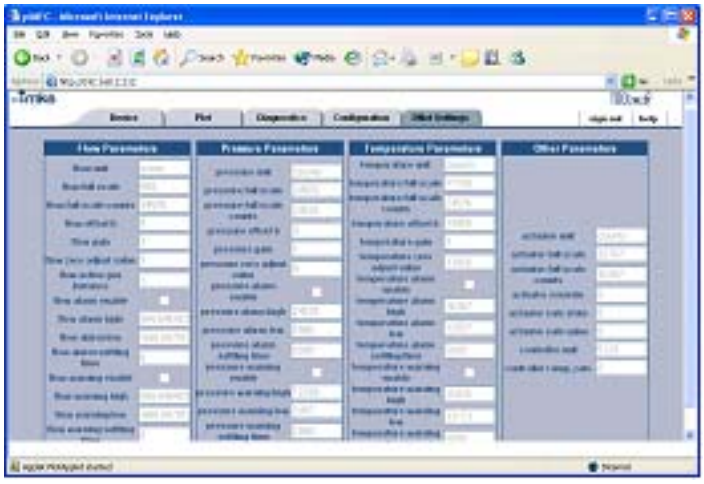
Configuration Programming Screen

- From this screen, you can
- configure the IP Address,
- "zero" the device
- upload new firmware or files
- change the configuration password



DNet Settings Screen (configuration mode only)

From this screen, you can view the DeviceNet settings for the device.



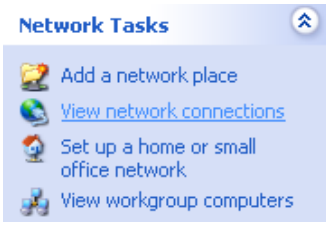
Option 2: Manual Setup

If you have not setup automatic network script in Option 1, a manual setup is required to access the **MFC** Ethernet interface.

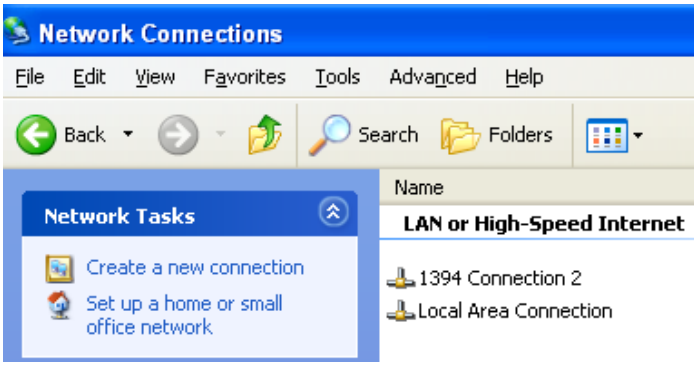
1. Connect a **crossover** network cable to the π**MFC** and your laptop computer.
   A crossover cable is required when the π**MFC** is connected directly to a PC. When the π**MFC** is connected to a network using a hub interface, a standard Ethernet cable can be used.

2. Select **My Network Places**.

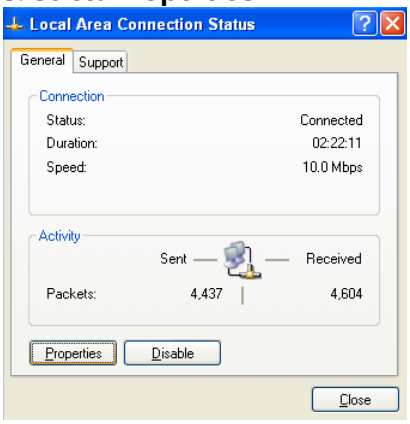
3. Select **View Network Connections**.



4. Double-click on **Local Area Connection**.

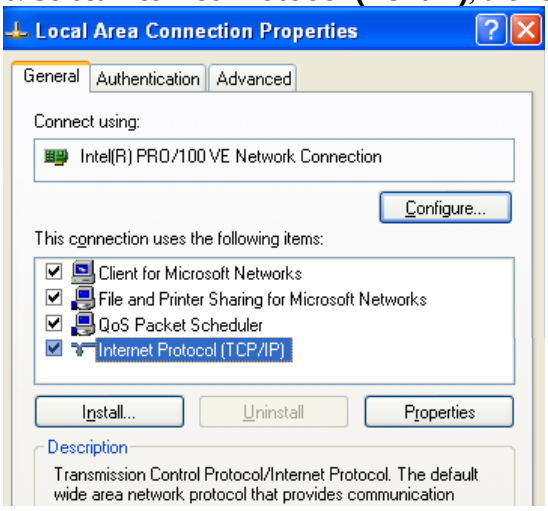


5. Select **Properties**

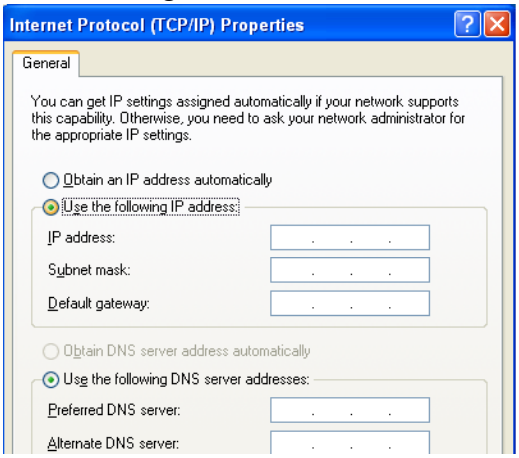


.

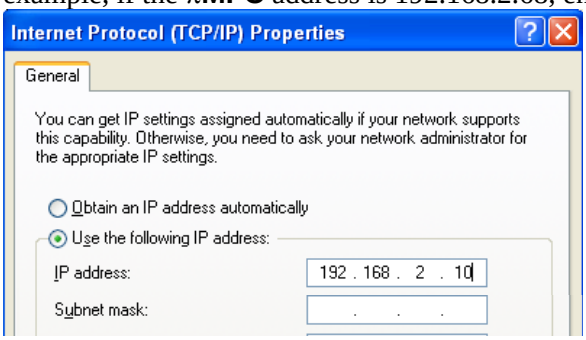
6. Select **Internet Protocol (TCP/IP)**, then select **Properties.**



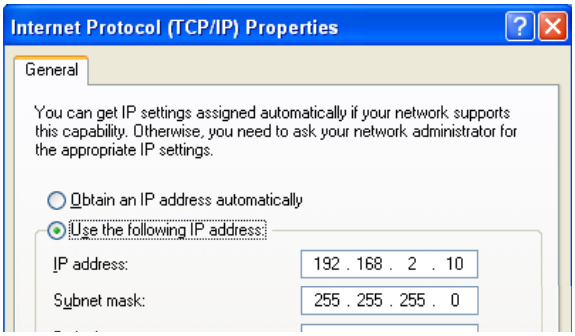
7. Select **Use the following IP address**.



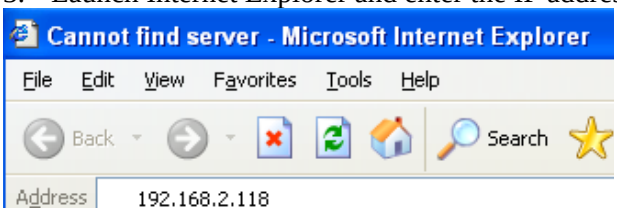
8. Enter the IP address from the π**MFC**, but change the last two digits to provide a unique address. For example, if the π**MFC** address is 192.168.2.68, enter **192.168.2.10**.



1. Click on the Subnet mask. The numbers 255.255.255.0 will appear.

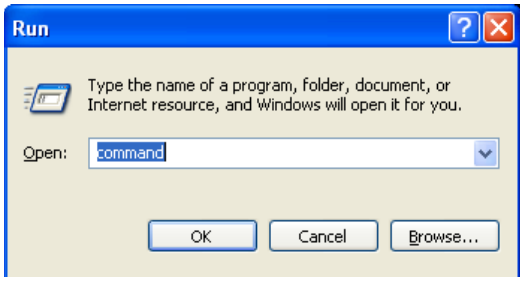


2. Close out all dialog boxes by selecting **O.K.**, **Close**, etc. as required.
3. Launch Internet Explorer and enter the IP address for the π**MFC**.

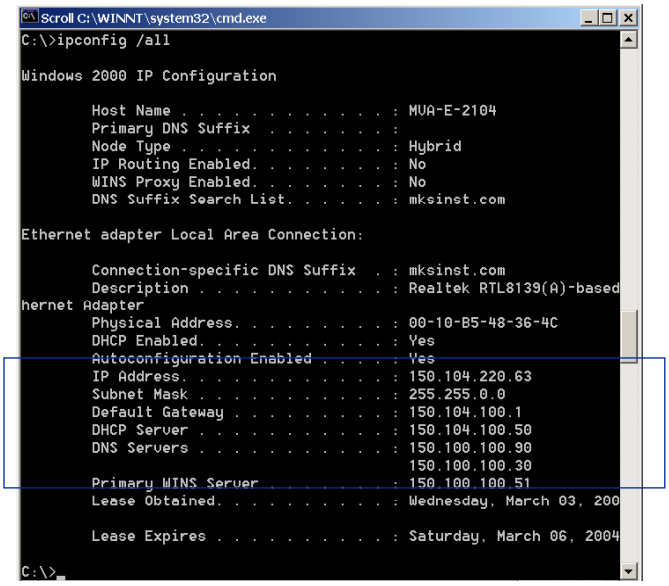


Option 3: For Multiple IP address setup

1. Select “start” “Run..” then enter the word “command” and click OK.

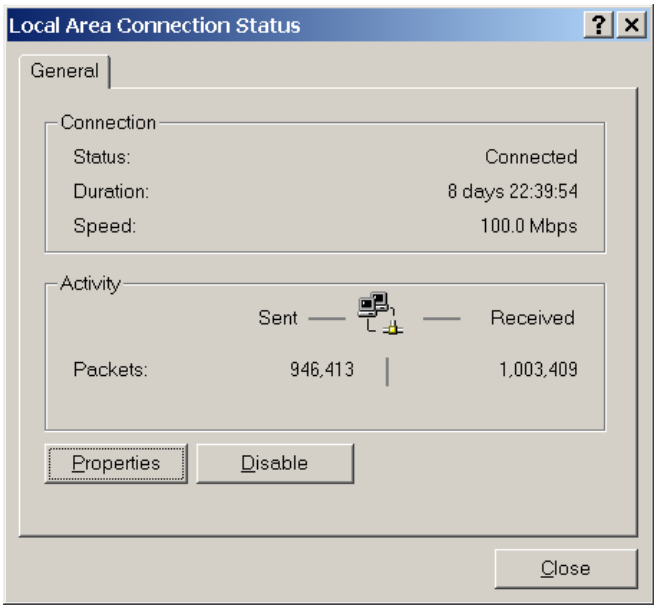


2. At the command prompt, enter the command “ipconfig /all” then press Enter.

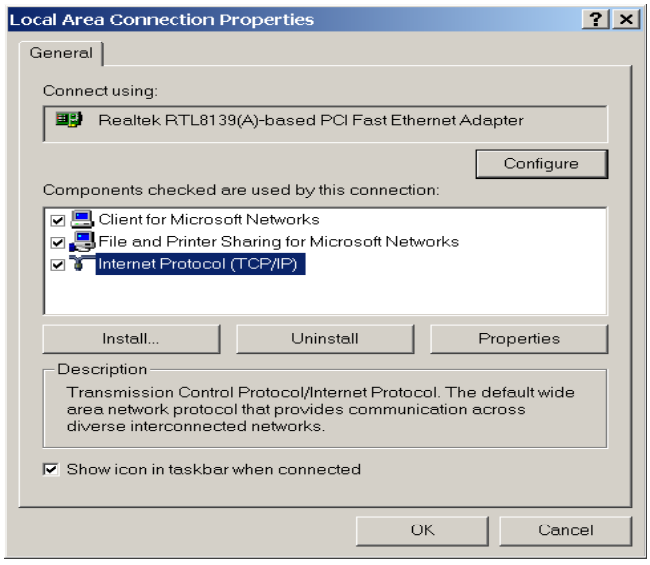


The data inside the hilighted area (lower section, between IP Address and Primary WINS Server) are what is needed for the steps below.

3. Open the Local Area Connection by going to Start->Settings->Network and Dialup Connections->Local Area Connections, or see Manual Setup on page 33 for an alternative method to open the Local Area Connection.

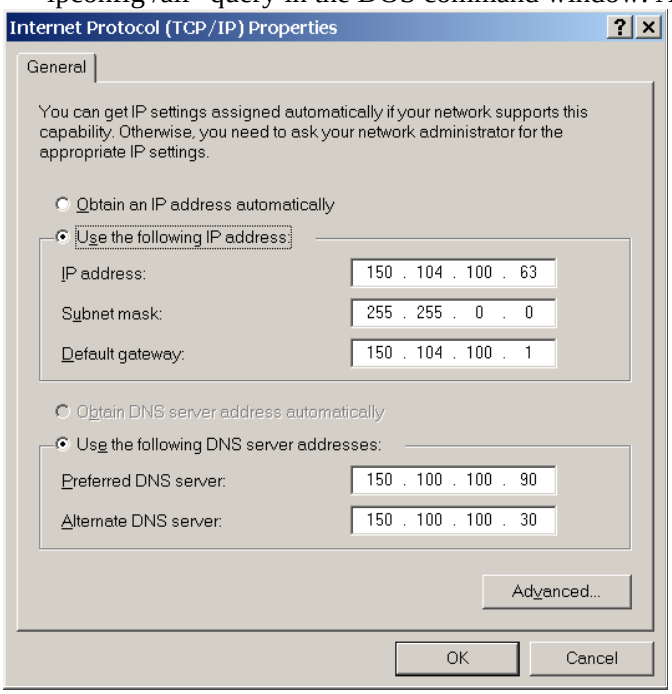


4. Click Properties button and select Internet Protocol (TCP/IP).

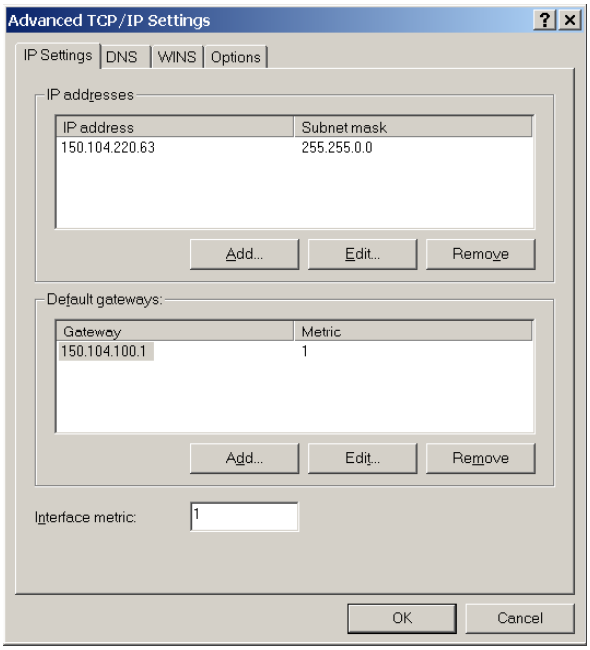


5. Click the Properties button:

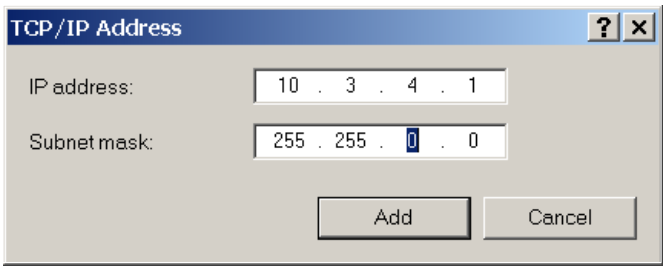
- Select “Use the following IP address:”
- Type in the IP address, the Subnet mask and the Default gateway fields with values returned from the “ipconfig /all” query in the DOS command window.
- Select “Use the following DNS server addresses:”
- Type in the Preferred DNS server, the Alternate DNS server fields with values returned from the “ipconfig /all” query in the DOS command window. An example is shown below.



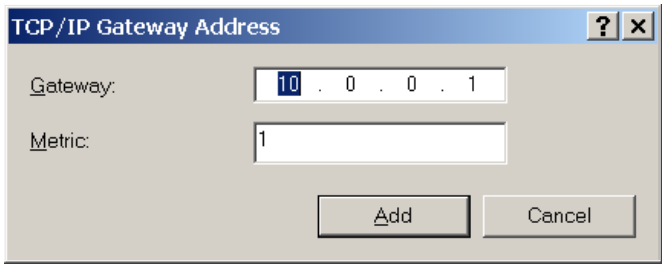
6. Click the “Advanced …” button, the following window will be displayed:



7. Click “Add…” in the “IP addresses” group.
   - Type the IP address and the Subnet mask values you will use to connect to the π**MFC** then click the “Add” button.

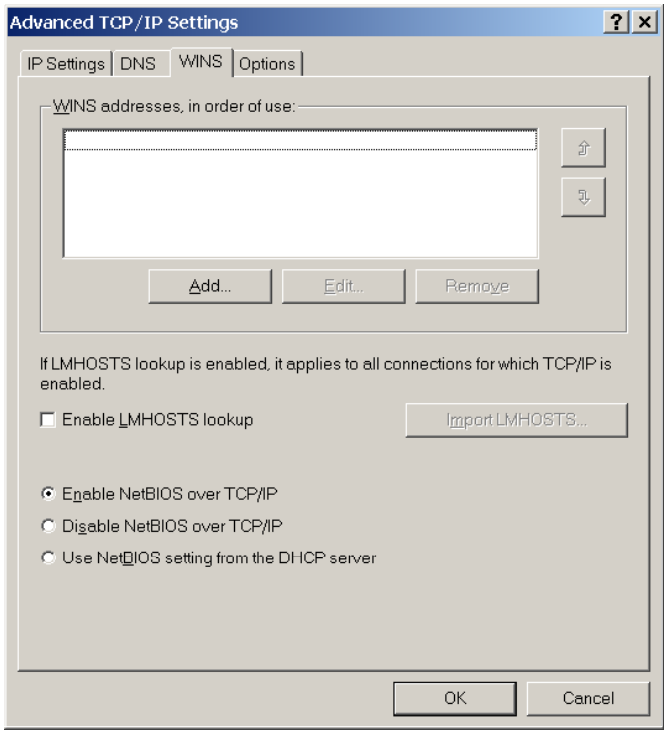


8. Click “Add…” in the “Default gateways” group. Enter the Gateway value you will use to connect to the π**MFC**, then click the “Add” button.

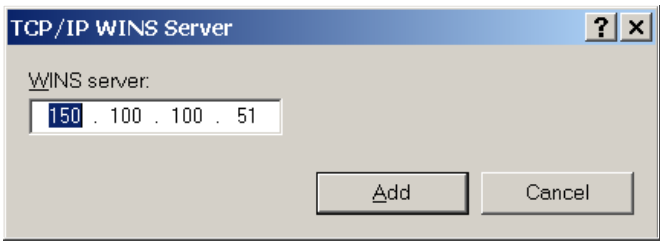


9. More addresses can be added by repeating steps 7 and 8 above.

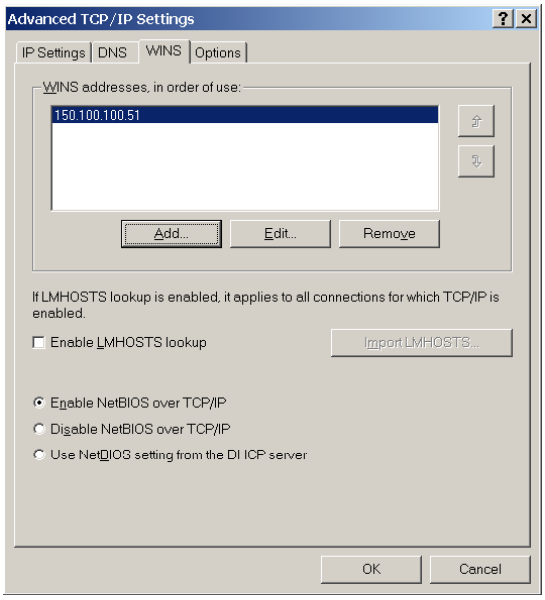
10. Click the “WINS” tab.



11. Click “Add…”. Type in the WINS server address with the values returned from the “ipconfig /all” query in the DOS command window, then click “Add.”



Example is shown below:



12. Click all OK buttons and you are ready to have multiple IP addresses in your PC. You can connect both to the Internet and to your π**MFC** local network.

For the plot web page to work in the π**MFC**, a java plugin has to be installed. With the multiple IP addresses setup in your PC, if the java plugin has NOT been installed in your PC, the IE browser will automatically connect to the right web site for the downloading.

Chapter Four: Overview

General Information

Typical Control System Configuration

The πMFC is used in a wide variety of control systems, most of which share several characteristics. The control system consists of five basic parts:

- Mass flow transducer
- Pressure transducer
- Control electronics
- Control valve
- Flow system (whose flow is being controlled by the πMFC DeviceNet Mass Flow Controller)

The πMFC provides the first four components. The mass flow transducer is an MKS design. The Pressure transducer is used to measure pressure inside the MFC. The πMFC instrument contains the electronics necessary for flow control. The control valve included in the device is a proportional control valve. The flow system can be any process whose flow you need to control. In addition, the πMFC is capable of metering the mass flow of the gas during the flow control operation.

Flow Measurement Overview

The πMFC measures the mass flow rate of a gas and controls the flow rate according to a given setpoint. The accuracy from 10% to 100% of Full Scale (F.S.) is ± 1% of Reading. For setpoints between 2% and 10%, πMFC Mass Flow Devices have an accuracy of ±0.2% FS.

Flow Path

Upon entering the πMFC, the gas stream passes first through the metering section of the instrument for its mass flow to be measured. The gas moves on through the control valve, which regulates the flow rate according to the given setpoint, and then exits the instrument at the established rate of flow.

The metering section consists of one of the following:

- A sensor tube for Full Scale ranges $\leq$ 10 sccm (N_2 equivalent)
- A sensor tube and parallel bypass for ranges > 10 sccm (N_2 equivalent)

The geometry of the sensor tube, in conjunction with the specified full scale flow rate, ensures fully developed laminar flow in the sensing region. The bypass elements are specifically matched to the characteristics of the sensor tube to achieve a laminar flow splitting ratio which remains constant throughout each range.

Flow Control Range

The πMFC can control flow over a range of 2 to 100% of full scale flow. This means that a πMFC with a 1000 sccm configuration can control flow from 20 to 1000 sccm, whereas an instrument with a 100 sccm configuration can control flow from 2 to 100 sccm.

Measurement Technique

The flow measurement is based on differential heat transfer between temperature sensing heater elements which are attached to the sensor tube. This senses the thermal mass movement which is converted to mass flow via the specific heat, C_p, of the gas.

Control Circuitry

The controller employs the above measurement technique and utilizes a control circuit that provides drive current for the proportioning control valve. The flow controller accepts a setpoint signal, compares it to its own flow signal, and generates an error voltage. This error signal is then conditioned so that it can reposition the control valve, thus reducing the control error to zero.

In the normally closed control valve, the πMFC instrument lifts the armature and plug assembly from the seat to regulate the gas flow rate.

Control Valve

The control valve is a specially constructed solenoid valve in which the armature (moving valve mechanism) is suspended. The arrangement ensures that no friction is present and makes precise control possible.

How the πMFC Works

The MKS πMFC includes technology improvements in functionality and performance to help users in semiconductors increase tool throughput and reduce overall system costs. Real-time accurate flow control that is insensitive to upstream and downstream pressure disturbances is provided through advanced digital algorithms. Enabling real-time control of process gas flow, accuracy and repeatability are significantly improved over conventional PID based digital MFC's.

The πMFC compares the flow reading to the setpoint, and positions the valve to maintain, or achieve, the setpoint rate. The controller functions as a model based, pressure insensitive flow controller.

Example

Assume that your πMFC is positioned upstream of the process chamber. The πMFC is positioned *before* the chamber so it will regulate the flow rate of the gas entering the process chamber.

When the actual flow rate reading is *less than* the setpoint value, the πMFC opens the valve to increase the amount of gas entering the system. As the valve opens, assuming adequate differential pressure across the flow controller, gas enters the process chamber, so the flow rate rises to meet the setpoint value.

When the actual flow rate reading is *more than* the setpoint value, the πMFC closes the valve to decrease the amount of gas entering the system. As the valve closes, there is a reduced flow of gas entering the process chamber, so the flow rate decreases to meet the setpoint value.

Note The πMFC must have sufficient pressure on its inlet side to achieve the setpoint.

Operation of the πMFC with Gases other than Nitrogen

The πMFC is unique in MKS flow control technology in that it does not use gas correction factors as other Mass Flow Controllers do. The operation of the πMFC is based on thermodynamic principals and multi-component functions have been developed to accurately calculate the non-linear gas flow of non-calibration gases, with respect to the calibration gas. The current library of gases and functions is in excess of 40 in number and includes most gases in common usage.

When a gas other than the calibration is selected, the πMFC automatically pulls up the correct functions that calculate the flow of that gas with respect to the original calibration. This allows the MFC to report the gas flow for the gas in use immediately and with better accuracy than has previously been available. In comparison, the typical MFCs use Gas Correction factors for converting the calibration gas flow into the flow of the gas being used. This leads to inaccuracy in the flow reported to levels as high as 6-10% (of FS).

The πMFC, by using these functions for the various gases, actually reports the flow within the stated accuracy of the flow controller, but for non-calibration gases. The reported flow from a πMFC using Helium as the process gas, but not calibrated for Helium, will have the same accuracy for the Helium as it does for Nitrogen, the calibration gas. Traditional flow controllers and meters using a Gas Correction Factor for Helium typically have an error in the flow output of as much as 6% of FS.

Versions of the πMFC

The πMFC is available in four communications versions: the 9 Pin D analog communications version, the 15 Pin D analog communications version, DeviceNet digital communications version, and the RS-485 version using a 9 pin D connector. Both the 9 and 15 pin D versions accept analog, 0-5 VDC setpoint and output signals. The DeviceNat version uses only DeviceNet digital communications for routine control.

9 Pin D Connector (Analog Interface)

Pin 1	Valve Open/Close
Pin 2	Flow Output Signal, 0-5 VDC
Pin 3	+11 to +25 VDC :Power
Pin 4	Power Common
Pin 5	No Connection
Pin 6	Setpoint Input, 0-5 VDC
Pin 7	Signal Common
Pin 8	Signal Common
Pin 9	Valve Test Point

Notes:

1. Chassis ground is not available on a separate pin. Instead, it is carried out through the cable shielding. Be sure that the connector on the other end of the cable is properly grounded to its chassis ground.
2. The 0 to 5 VDC flow signal output comes from pin 2 and is referenced to pin 7 (signal common).
3. Use any appropriate 0 to 5 VDC input signal of less than 1K ohm source impedance referenced to pin 7 as the setpoint signal to pin 6.

15 Pin D Connector (Analog Interface)

Connector Pinout – Standard Assignments (Model Code B)

Pin Assignment 24 VDC Power Option

Pin 1	Valve Test Point
Pin 2	Flow Signal Output, (0 to +5 VDC)
Pin 3	Valve Close (TTL low)
Pin 4	Valve Open (TTL low)
Pin 5	Power Supply Common Digital Ground (see Note 4 below)
Pin 6	No Connection
Pin 7	+11 to +25 VDC (see Note 4 below)
Pin 8	Setpoint Input (0 to +5 VDC)
Pin 9	Zero Function
Pin 10	Optional Input
Pin 11	Signal Common
Pin 12	Signal Common
Pin 13	No Connection
Pin 14	Pressure Output, (0 to VDC)
Pin 15	Chassis Ground

Notes

1. The No Connection pin assignment refers to a pin with no internal connection.
2. The 0 to 5 VDC flow signal output comes from pin 2 and is referenced to pin 12 (signal common).
3. Any appropriate 0 to 5 VDC input signal of less than 1K ohm source impedance referenced to pin 12 can be used to supply a setpoint signal to pin 8.

9 Pin D Connector, RS-485 Communications

Model Code 5, Voltage and Current Pressure Output

Pin 1	**Pressure Output, +Voltage or Current**
Pin 2	**Pressure Output, Voltage or Current Return**
Pin 3	**+ 11 to 25 VDC Power In**
Pin 4	**Power Return**
Pin 5	
Pin 6	**RS-485 Return**
Pin 7	**RS-485 +**
Pin 8	**RS-485 -**
Pin 9	**Shield**

Interface Cables

As of January 1, 1996, all products shipped to the European Community must comply with the EMC Directive 89/336/EEC, which covers radio frequency emissions and immunity tests. MKS products that meet these requirements are identified by application of the CE Mark.

This MKS product meets CE Mark requirements, per EMC Directive 89/336/EEC. To ensure compliance when installed, an overall metal braided shielded cable, properly grounded at both ends, is required during use. MKS offers a variety of interface cables, listed in Table 12, page 27.

Note An overall metal braided, shielded cable, properly grounded at both ends, is required to meet CE Mark specifications.

To order an overall metal, braided, shielded cable, add an S. after the cable type designation. For example, to order a standard connection cable to connect the 1480/1485 MFC to a power supply with a 15-pin Type D. connector, use part number CB259-5; for an overall metal braided, shielded cable use part number CB259S-5.

MKS Interface Cables

	Power Supply End	
MFC End	**15-Pin Type "D"**	**Flying Leads**
15-pin Type .D.	CB147-1 CB259-5	CB259-6
9-pin Type .D.	CB147-12	Not Available

Generic Shielded Cable Description

MKS offers a full line of cables for all MKS equipment. Should you choose to manufacture your own cables, follow the guidelines listed below:

1. The cable must have an overall metal *braided* shield, covering all wires. Neither aluminum foil nor spiral shielding will be as effective; using either may nullify regulatory compliance.
2. The connectors must have a metal case with direct contact to the cable shield on the whole circumference of the cable. The inductance of a flying lead or wire from the shield to the connector will seriously degrade the shield.s effectiveness. Ground the shield to the connector before its internal wires exit.
3. With very few exceptions, the connector(s) must make good contact to the devices case (ground). Good contact. is about 0.01 ohms and the ground should surround all wires. Contact to ground at just one point may not suffice.
4. For shielded cables with flying leads at one or both ends; it is important to ground the shield at each such end *before* the wires exit. Make this ground with absolute minimum length. (A ¼ inch piece of #22 wire may be undesirably long since it has approximately 5 nH of inductance, equivalent to 31 ohms at 1000 MHz). After picking up the braid ground, keep wires and braid flat against the case. With very few exceptions, grounded metal covers are not required over terminal strips. If one is required, it will be stated in the Declaration of Conformity.
5. In selecting the appropriate type and wire size for cables, consider:
   - Voltage ratings.
   - Cumulative I^2R heating of all the conductors (keep them safely cool).
   - IR drop of the conductors, so that adequate power or signal voltage gets to the device.
   - Capacitance and inductance of cables that handle fast signals (such as data lines or stepper motor drive cables).
   - Some cables may need internal shielding from specific wires to others.

Start-Up Procedure for the Analog πMFC

1. Leak test the fittings on the unit using standard helium leak check procedures. Do not proceed to the next step until you are certain that there is no gas leakage.
2. Plug the power supply/readout cable (MKS or customer-supplied) into the connector (either a 9-pin or 15-pin D. type) located at the top of the device. Plug the other end of the cable into an MKS or MKS-compatible power supply/readout unit.
3. Apply power to the device.

Once the device is sufficiently warmed-up, you can proceed to zero it. See instructions in Section 5.

Warm Up Time

After installation and power up, allow the MKS πMFC to warm up for a minimum of 30 minutes.

Zeroing Procedure

Although MKS flow devices are zeroed at the factory prior to shipment, it is normal to check the zero and re-zero them, if needed, when they are first installed on the tool.

A mass flow meter or mass flow device will provide a zero output signal under no flow gas conditions.

Zero offset from improper zeroing procedures can contribute to flow measurement inaccuracy. This is more apparent at the lower end of the device range.

In order to complete a true zeroing of the device, ensure the following conditions are satisfied prior to beginning the procedure.

- Device is installed in the orientation intended for final use (i.e. horizontal base down, vertical flow up, etc.).
- Device is powered at operating temperature, preferably for 30 or more minutes.
- Devices subject to ambient temperatures other than room temperature (23º C) should be zeroed under those conditions.
- Pressure drop and flow across the device is reduced to zero. Depending on the gas panel configuration, this may be done by one of the referenced procedures. See Chapter 5 Maintenance for zeroing procedures.

How To Override the Valve (Controllers Only)

The valve override feature enables the control valve to be fully opened (purged) or closed independent of the setpoint command signal.

If the πMFC is equipped with a 9-pin Type D connector:

To O*pen* the valve, apply a TTL High to Pin 1. To Close the valve, apply a TTL Low to Pin 1 or connect Pin 1 to Signal Ground. Normal Setpoint operation occurs when Pin 1 is allowed to float.

If the πMFC is equipped with a 15-pin Type D connector:

Open the valve by applying a TTL low to pin 4 *or* connect pin 4 to signal ground (pins 11 or 12).

Override a setpoint to the controller and c*lose* the valve by applying a TTL low to pin 3 *or* connect pin 3 to signal ground (pins 11 or 12).

Note To control with a TTL signal, use a tri-stated device.

Priority of the Commands

The πMFC executes commands based on a hierarchical command structure. The highest priority command is Valve Open, followed by Valve Close, and Setpoint Control. Therefore, if the flow controller is operating under Setpoint Control, you can send a Valve Open command to force the valve to the full open position.

Note When both the Valve Close and Valve Open pins are pulled down, the Valve Open command takes precedence and the valve is moved to the open position.

The Optional Input (Controllers Only)

The standard 15-pin πMFC can control flow based on a 0 to 5 Volt signal from an external sensing device using the optional input feature (for a 0 to 10 Volt input range, contact the MKS Applications Department). A common application of this feature is for pressure control using input from a pressure transducer.

To use the optional input feature, route the 0-5 Volt output from the desired external device to the optional input pin 10.

Note The 9-pin Type .D. connector does not support the optional input feature. This feature is only available on the 15-pin Type D connector with standard MKS pinout assignments

Voltage applied to the optional input pin overrides the signal generated by the flow sensor internal to the πMFC. The control electronics drives the valve so that the optional input signal matches the setpoint. Use the same pin for the setpoint signal, regardless of whether you are using the optional input or the standard flow control signal.

Although controlling to the external optional input signal, the metered flow output signal is still provided on the standard output pin 2.

Overview of πMFC DeviceNet Digital Operation

Your πMFC DeviceNet Mass Flow Device complies with Volume 1 of the ODVA DeviceNet Specification, Release 2 and the associated SEMI-SIG requirements. A detailed software attribute summary pertaining to the DeviceNet communications is provided in the πMFC DeviceNet, Instruction manual.

DeviceNet Connector

The πMFC has one 5-pin, male DeviceNet connector that provides the communications interface with the DeviceNet network, electrical power from the network bus, and shielding for the instrument signals.

Table 8: DeviceNet Communications Connector Pinout

Pin Number	Signal Name
1	Drain
2	V+
3	V-
4	CAN_H
5	CAN_L

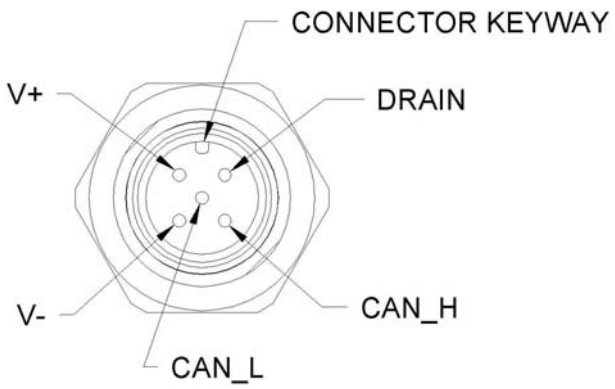


Figure 13: DeviceNet Connector Pin Diagram

Power Requirements

The πMFC requires an input voltage of 11.0 to 25.0 VDC with <500 mA max @ 11 VDC (230 mA @ 24 VDC, nominal). The input voltage, provided by the DeviceNet network, is introduced to the mass flow controller through the 5-pin micro-style connector located on side of the instrument.

DeviceNet Controls and Indicators

The top panel of the πMFC contains several DeviceNet controls and indicators.

The mass flow device has two standard bi-color (green/red) DeviceNet status LEDs, (Module Status LED and Network Status LED) located on top of the instrument The power-up sequence of these LEDs conforms to the requirements in the ODVA DeviceNet Specification, Volume 1 [1].

Unrecoverable Fault Condition

A hardware problem with the EEPROM, or a memory problem with the RAM are major unrecoverable faults. This fault condition sets its exception status bit, and the Module Status LED illuminates solid red, complying with Volume I of the DeviceNet Specification.

Note A major unrecoverable fault prevents operation because the device cannot communicate on the network. Contact MKS Instruments, Inc. for assistance.

Power Up

At power-up, flow device performs checks on its communications link and internal diagnostic checks of the EEPROM and RAM. The results of these checks are indicated by the color (green or red) and condition (solid or flashing) of the status LEDs on top of the instrument. The following LED sequence occurs when the MFC is powered up (times are approximate):

1. The Module Status LED flashes first GREEN for ¼ second, then RED for ¼ second, then turns OFF.
2. The Network Status LED flashes first GREEN for ¼ second, then RED for ¼ second, then turns OFF.
3. The Module Status LED flashes from GREEN to RED for five seconds while the device is initializing. The Network Status LED remains OFF.

4. The Module Status LED illuminates solid GREEN when initialization is complete.
5. When the device establishes communication with other devices on the network, the Network Status LED illuminates GREEN.

Note If the power up LED sequence does not function properly, contact MKS for assistance.

See *DeviceNet Controls and Indicators*, page 49, for more information on the operation of the Network Status LED and the Module Status LED.

Warm-Up and Zero the MFC

After installation and power up, allow the MFC to warm up for a minimum of 30 minutes, then refer to the installation section to Zero the MFC.

DeviceNet Protocol

Use this manual with the ODVA DeviceNet Specification Volume I and Volume II [1, 2], and the SEMI Standards Common and Specific Device Models [3, 4]. Refer to those documents for a complete functional description of the MFC Mass Flow device.

See πMFC DeviceNet Manual, MKS part number 127923-P1 for specific commands and command structures.

Chapter Five: Maintenance

General Information

In general, no maintenance is required other than proper installation and operation. Periodically check for wear on the cables and inspect the enclosure for visible signs of damage. If a mass flow device fails to operate properly on receipt, check for shipping damage, and check the DeviceNet cable for proper power supply. Any damage should be reported to the freight carrier and MKS Instruments immediately. If there is no obvious damage, and the unit fails to operate properly through the DeviceNet network, obtain an RMA Number (Return Material Authorization Number) before returning the unit to MKS Instruments for service to expedite handling and ensure proper servicing of your instrument.

Zero Adjustment

For best accuracy and repeatability, you should check the zero output periodically and reset it, if necessary. Refer to the zero adjustment procedure below.

It is also recommended that the instrument be recalibrated annually if no other time interval has been specifically established. Refer to the inside of the back cover of this instruction manual for a complete list of MKS Calibration and Service Centers.

"Zero" the πMFC(flow only)

All MFCs should be zeroed under actual installation conditions prior to use. Very slight offsets in the zero condition can contribute to flow measurement inaccuracy, especially noticed at the lower end of the device range.

1. Setup the MFC to the exact process conditions:
   - Verify that the MFC is installed in the final equipment and orientation (base up, base down, vertical flow up, etc.)
   - Verify that the MFC is powered at operating temperature for at least 30 minutes.
   - If the MFC will be subjected to elevated ambient temperature conditions, verify that these temperatures have been achieved before continuing.
   - Verify that the pressure drop across the MFC is reduced to zero. Depending on the gas panel configuration, this may be done by one of the following procedures.

A) **System has upstream and downstream positive shut off valves**

   1. Close the upstream valve.
   2. Close the downstream valve.
   3. Set the MFC to 100% set point.
   4. Allow pressure across MFC to equilibrate as flow output approaches zero and stabilizes.
   5. To ensure that actual flow remains at zero, keep downstream shut-off valve closed and provide zero setpoint to the MFC.
   6. Wait one minute and adjust zero through the software interface. See DeviceNet commands below.

B) **For systems with downstream valve only**

   1. Zero the MFC at typical operating inlet pressure.
   2. Close the downstream valve.
   3. Set the MFC to 100% set point.
   4. Allow pressure to equilibrate across the MFC as flow output approaches zero and stabilizes. Provide zero setpoint to the MFC.
   5. Wait one minute and adjust zero through the software interface. See DeviceNet commands below.

C) **For systems with upstream valve only**

1. MFC may be re-zeroed with downstream line under vacuum or atmosphere.
2. Close the upstream valve.
3. Set the MFC to 100% set point.
4. The MFC may be evacuated to vacuum or exposed to atmosphere on downstream side. For either case, the downstream pressure must be kept constant to insure there is no pressure drop across MFC.
5. Allow pressure to equilibrate across MFC as flow output approaches zero and stabilizes.
6. Provide zero setpoint to the MFC.
7. Wait one minute and adjust zero through the software interface. See DeviceNet commands below.

Analog Zeroing Procedure

Although MKS flow devices are zeroed at the factory prior to shipment, it is normal to check the zero and re-zero them, if needed, when they are first installed on the tool.

A mass flow meter or mass flow device will provide a zero output signal under "no flow" gas conditions. Zero offset from improper zeroing procedures can contribute to flow measurement inaccuracy. This is more apparent at the lower end of the device range.

In order to complete a true zeroing of the device, ensure the following conditions are satisfied prior to beginning the procedure.

1. Device is installed in the orientation intended for final use (i.e. horizontal base down, vertical flow up, etc.).
2. Device is powered at operating temperature, preferably for 30 or more minutes.
3. Devices subject to ambient temperatures other than room temperature (23° C) should be zeroed under those conditions.
4. Pressure drop and flow across the device is reduced to zero. Depending on the gas panel configuration, this may be done by one of the following procedures.

For Systems With Upstream and Downstream Positive Shut-Off Valves

1. Close both the upstream and downstream shut-off valves.
2. Set the device to 100% setpoint (controllers only).
3. Allow pressure across the device to equilibrate as flow output approaches zero and stabilizes.
4. To ensure that actual flow remains at zero, keep the shut-off valves closed. To the controllers, provide zero setpoint.
5. Wait one minute and activate the zero function. The zero function may be activated in three different ways:
   - Pressing the Zero button on top of the unit.
   - Communicating digitally through the software GUI by clicking the Remote Zero button on the configuration page, (Password is required).
   - "15-pin D" connector option only: Remotely grounding pin 9 to pin 5.

For Systems With Downstream Valve Only

1. Zero the device at typical operating inlet pressure.
2. Close the downstream shut-off valve.
3. Set the device to 100% setpoint (controllers only).
4. Allow pressure to equilibrate across the device as flow output approaches zero and stabilizes.
5. Provide zero setpoint to the device (controllers only).
6. Wait one minute and activate the zero function. The zero function may be activated in three different ways:

- Pressing the Zero button on top of the unit.
- Communicating digitally through the software GUI by clicking the Remote Zero button on the configuration page, (Password is required).
- "15-pin D" connector option only: Remotely grounding pin 9 to pin 5.

For systems With Upstream Valve Only

1) The device may be re-zeroed with the downstream line under vacuum or atmosphere.
2) Close the upstream valve.
3) Set the device to 100% setpoint (controllers only).
4) The device may be evacuated to vacuum or exposed to atmosphere on the downstream side.
5) For either case, the downstream pressure must be kept constant to ensure there are no fluctuations in pressure drop across the device, which could induce false flow readings.
6) Allow pressure to equilibrate across the Mass Flow Controller as flow output approaches zero and stabilizes.
7) Provide zero setpoint to the device (controllers only).
8) Wait one minute and activate the zero function. The zero function may be activated in three different ways:

- Pressing the Zero button on top of the unit.
- Communicating digitally through the software GUI by clicking the Remote Zero button on the configuration page, (Password is required).
- "15-pin D" connector option only: Remotely grounding pin 9 to pin 5.

DeviceNet Zeroing Commands

The MFC must be in the executing state then send the zero service with a target value of zero. The following assumes explicit messaging only using the DeviceNet communication protocol.

1. Place the device in the Executing State through the S-Device Supervisor Object: Note the response Status: Success
   The following DeviceNet Command places the device in an executing state
   Service 0x06, Class 0x30, Instance 1

2. Verify you are in executing through the S-Device Supervisor Object: Note the response Data (hex): 04 means we are in executing. Attribute 0x0B The following DeviceNet Command is used to verify you are in executing.
   Service 0xE, Class 0x30, Instance 1, Service Data (attribute) 0x0B
   You should get response data of 0x04
3. Send the Zero Adjust Service using S-Analog Sensor Object Instance 1 (Flow)The following DeviceNet Command Starts the Pressure zero.
   Service 0x4B, Class 0x31, Instance 1, Service Data (Target Value) can be Empty Data or Data Type based value, i.e. 2 byte for integer or 4 byte real value, if a value is used, it must be a target value equal to zero.
4. The Flow zeroing procedure usually takes several seconds to perform. Recheck your flow to verify zero has occurred. You can also perform an explicit GET(Service 0x0E) on Class 0x31, Instance 1, Attribute 0x1C, which is the Autozero Status. This attribute's service data will equal "1" while zeroing is in progress and equal "0" when the zeroing has completed. It is most important that the device is at a zero flow, if a high flow is detected by the MFC, then zeroing will not occur.

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Chapter Six: Troubleshooting

Troubleshooting Chart

Table 9: Troubleshooting Chart

Symptom	Possible Cause	Check/Corrective Action
PiMFC display does not light	No power	Check power source
	Low power	Measure voltage 11-25 VDC (DNet)
	Wrong cable	
	Bad cable connection	Check pin(s) continuity
MFC does not respond to any setpoint	Bad DNet connection	Verify correct DNet I/O instance
	Control circuit failure	Provide setpoint, gas & pressure to device, run diagnostic using Ethernet interface.
	Low or no power	Check power source, measure voltage
	Contamination/Clogged - blocked MFC device or gas line	Check inlet pressure @ PiMFC. Check outlet pressure MFC using pressure gauge. Check outlet pressure downstream of positive shut off (pneumatic) valve downstream of MFC. Check air line to pneumatic valve. Check for any restriction such as filter or check valve downstream of MFC.
PiMFC display shows 0 pressure	Closed upstream pneumatic valve	Open valve
	Closed or faulty regulator	Check regulator for proper operations
	Upstream clog filter	Measure pressure drop across filter to spec, replace if necessary
	No gas supply	Turn on gas source
	PiMFC fault pressure transducer output	Run PiMFC diagnostics

	Downstream valves open to vacuum, upstream valves closed	Check status of pneumatic valves air lines & solenoid valves & system pump

PiMFC shows 0 flow when given setpoint	Closed upstream or downstream pneumatic valves	Open valves, check inlet pressure
	No gas supply	Turn on gas supply
	Upstream clogged filter/component	Check flow through of components by measuring pressure drop across device
	PiMFC clogged orifice	Verify MFC inlet pressure, check valve current for open valve condition. Check for gas flow downstream of MFC - If flow does not exist, possible clogged orifice
	PiMFC clogged sensor	Run PiMFC diagnostics. Verify MFC inlet pressure, check valve current for open valve condition, check for gas flow downstream of MFC. If flow present, possible clogged sensor
	PiMFC control circuit failure	Run PiMFC diagnostics. If error results, contact MKS service center.

PiMFC shows output flow > FS (overrange)	MFC valve full open	Check valve current for maximum condition
	Pressure drop across MFC> specification	Measure upstream pressure & downstream pressure. Compare to spec.
	Faulty valve control circuit/calibration	Run PiMFC diagnostics using Ethernet GUI
	Possible contamination in valve assembly	Cycle-purge MFC to clear suspected contamination

PiMFC output signal does not match setpoint	Contamination	Check for partial block orifice or sensor. Cycle purge MFC to clear contaminant
	Inlet pressure/too low	Increase inlet pressure
	Outlet pressure too high	Decrease outlet pressure
	Control electronics failure, sensor failure	Run PiMFC diagnostics test

MFC output signal ocillates	Inlet pressure oscillates	Check for faulty regulator
	Inlet pressure too high	Lower inlet pressure
	MFC nameplate gas not same as actual gas	Check gas program using DNet or Ethernet GUI. Reprogram as necessary
	Faulty control circuit	Run PiMFC diagnostic test.

PiMFC output signal matches setpoint, but actual gas flow less (as determined by transfer standard)	Contaminated bypass	Check process chamber pressure. Compare to normal or reference.
	MFC programmed for different gas	Compare gas programmed in MFC to actual gas used. Verify using DNet or Ethernet interface.
MFC cannot achieve FS flow	Inlet pressure low	Increase inlet pressure
	Outlet pressure high	decrease outlet pressure
	Valve contamination	Check valve current for maximum position
	Gas line blockage/contamination	Measure pressure drop across component suspected of contamination such as filter or check valve
	MFC setpoint in counts > than 100% FS of 24567 counts	Program attributed 6 to 100% = 24567 counts (0x6000)

Output signal matches setpoint @ higher flows, but will not go to 0	MFC valve partial contamination	Cycle-purge device, check valve current
	Faulty control valve, adjustment or electronics	Run PiMFC diagnostics, call MKS service center
	Inlet pressure too high	Decrease inlet pressure
	Device zero offset	re-zero device with known zero flow conditions

MFC has setpoint, displays inlet line pressure, output signal zero	Upstream and/or Downstream pneumatic valves closed	Check inlet pressure, if normal or matches regulator, check downstream valve for closed position. Open valve(s).

Display powers up, but MFC does not respond	Bad DNet connection	Check status DNet polled connection, check network LED
	Incorrect MAC ID Address	Check MAC ID on device
	Incorrect baud rate setting	Check baud rate on device
	Incorrect DNet I/O Instance Setting	Check I/O setting using DNet commissioning tool/software
		Check tool host
	Low power, power supply	Measure current & voltage from power source

MFC output shows large overshoot or undershoot	Inlet pressure too high	Decrease inlet pressure
	MFC not programmed for correct gas - actual gas used different	Check MFC active gas using DNet or Ethernet interface
	PiMFC control parameters set incorrectly	Contact MKS service center

Output signal > zero with confirmed zero flow condition	MFC device zero offset	Re-zero device per instruction manual
	Fault in valve adjustment, gap between plug & orifice	Contact MKS service center
Pressure output signal different than confirmed line pressure	Zero offset in pressure transducer	Re-zero pressure transducer using known pressure standard & Ethernet GUI

LED indicator (color)	**State**	**Indication**
- Network status LED		
Green	Link OK, On-line, Connected	The device in on-line and has connection in the established state.
		- For a Group 2 only device it means that this device is not allocated to a master.

Flashing Green	On-line, Not Connected	Device is on-line but has no connection in the established state. - The device has passed The Dup_MAC_ID test, is on-line, but has no established connections to other nodes. - For a Group 2 only device it means that this device is not allocated to a master.
Red	Critical Link Failure	Failed communication device. The device has detected an error that has rendered it incapable of communicating on the network (Duplicate MAC ID, or Bus-off)
Flashing Red	Connection Time-Out	One or more I/O Connections are in the Timed-Out state.
Flashing Red & Green	Communication Faulted and Received an Identify Comm Fault Request - Long Protocol	A specific Communication Faulted device. The device has detected a Network Access error and is in the Communication Faulted state. The device has subsequently received and accepted an Identify Communication Faulted Request - Long Protocol message.
Off	Not Powered/Not On-Line	Device is not on-line
		- The device has not completed The Dup_MAC-ID test yet
		- The device may not be powered, look at Module Status LED.

- Module Status		
Green	Device operational	The device is operating in a normal condition
Flashing Green	Device in Standby (The Device Needs Commissioning)	The device needs commisioning due to configuration missing, incomplete or incorrect.
Red	Unrecoverable Fault	The device has an unrecoverable fault; may need replacing.

Flashing Red	Minor Fault	Recoverable Fault
Flashing Red & Green	Device Self Testing	The Device is in Self Test. Reference the Identity Object in Volume II for Device states.
Off	No power	There is no power applied to the device

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Appendix A: Product Specifications

Performance Specifications

Full Scale Flow (N2 equivalent)	10-30000 sccm
Maximum Inlet Pressure	150 psig, limited to maximum differential pressure across MFC.
Normal Operating Pressure Differential (with atmospheric pressure at the MFC outlet)	10 to 5000 sccm, 10 to 40 psid 10000 to 30000 sccm 15 to 40 psid
Proof Pressure	1000 psig
Burst Pressure	1500 psig
Control Range	2% to 100% of F.S.
Accuracy	± 1% of setpoint for > 10 to 100% F.S. ± 2% of setpoint for 2 to 10% F.S.
Repeatability	± 0.3% of Reading
Resolution	0.1% of Reading
Temperature Coefficients Zero Span	 <0.05% F.S./°C <0.08% Reading/°C
Inlet Pressure Coefficient	< 0.02% of Reading./psi
Typical Controller Settling Time (per SEMI Guideline E17-0600)	< 1.5 second typical above 5% F.S.
Warm-Up Time (to within 0.2% of F.S. of steady state performance)	< 30 min.
Normal Operating Temperature Range	10°C to 50°C
Storage Humidity	0 to 95% Relative Humidity, non-condensing
Storage Temperature	-20°C to 65°C (-4°F to 149°F)
Pressure Range	0 to 100 psia
Pressure Readout Units	psia, kPa
Pressure Accuracy	1% of Reading
Pressure Resolution	0.1 psia
Temperature Display Range	0 to 100°C
Temperature Readout Units	°C
Temperature Accuracy	± 2°C
Temperature Resolution	0.1°C

Mechanical Specifications

Fittings (compatible with)	Swagelok, 4 VCR, 1-1/8" surface mount (C-seal, W-seal)
Display	4 digits for value, 4 characters for unit
Leak Integrity External (scc/sec He) Through closed valve	 $< 1 \times 10^{-10}$ < 1.0% for F.S. at 25 psig inlet to atmosphere
Wetted Materials Standard	 316L S.S. VAR (equivalent to 316 S.S. SCQ for semiconductor quality), 316 S.S. , nickel, KM-45, PTFE
Surface Finish	5 μinches, average Ra
Weight	≤ 2 lbs (0.9 kg)

Electrical Specifications

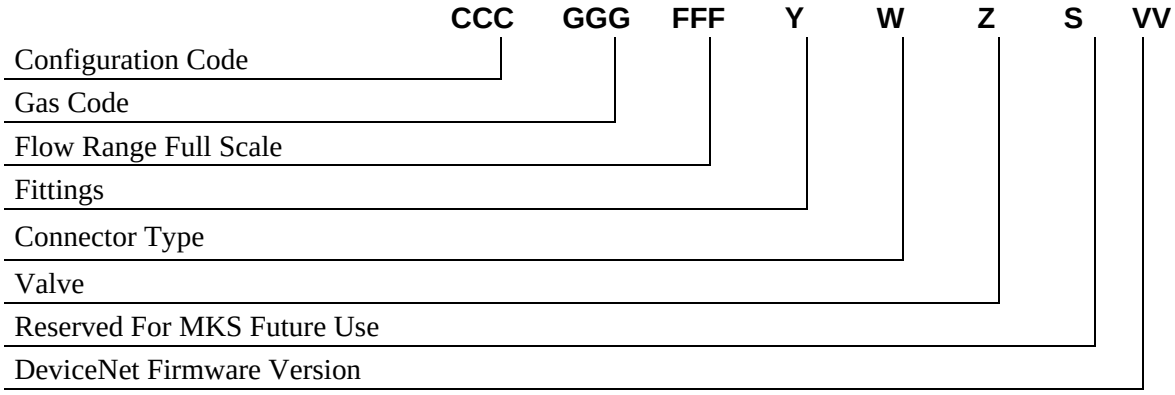
Analog I/O Input Voltage Required Max current at start-up (first 5 sec.) Typical current at steady state	 +11 to +25 VDC 15VDC (±5 %) @ 350 mA 15VDC (±5 %) @ 280 mA
Set Point Command Signal	0 to 5 VDC
Flow Output Signal	0 to 5 VDC
Pressure Output	0 to 10 VDC, 0 to 5 VDC, 4-20mA ; Power Supply greater than 14 VDC is required for 0-10 VDC and 4-20 mA outputs.
Output Impedance	< 1 Ω
Connectors	15-pin Type "D", 9-pin Type "D"
Digital I/O (DeviceNet) Date Rate/Network Length	 Date Rate (User selectable) 125 Kbps, 500 m (1,640 ft) 250 Kbps, 250m (820 ft) 500 Kbps, 100m (328 ft)
Level of Filtering	User software adjustable
Digital Functions (flow)	Select units: counts, slm, sccm % of F.S. Remote Zero Set/read flow rate Flow totalizer and run hours Valve soft start Monitor MFC status – valve drive level and trip points (alarm for high flow, alarm for low flow, warning for high flow, warning for low flow) Reset factory defaults Report run time hours

	Change user tags and device address Device Identification Storage includes manufacturer information, model and serial number, original factory calibration, software and hardware revision numbers.
Digital Functions (pressure)	Set units Read pressure Alarm enable, Warning enable Alarm settling time, Warning settling time Alarm trip point high, Warning trip point high Alarm trip point low, Warning trip point low Zero adjust
Digital Functions (temperature)	Set units Read temperature Alarm enable, Warning enable Alarm settling time, Warning settling time Alarm trip point high, Warning trip point high Alarm trip point low, Warning trip point low Zero adjust
Data Rate Switch	4 positions: 125, 250, 500K, PGM (programmable over the network)
MAC ID Switches	2 switches, 10 positions; 0,0 to 6,3 are hardware ID numbers: 7,0 to 9,9 are software ID numbers; (6,4 to 6,9 are unused and, if selected will default to hardware ID number 6,3)
Input Power	11 to 25 VDC per DeviceNet specifications (@ <3.5 watts)
Network Size	Up to 64 nodes
Network Topology	Linear (trunkline/dropline) power and signal on same network cable
Visual Communication Indicators	LED network status (green/red) LED module status (green/red) Scrolling LED displays(Flow Gas , pressure, temperature, IP address, Full scale)
Electromagnetic Compatibility	CE Compliant

Appendix B : Model Code Explanation

Model Code Description

The model code of the MFC defines features of the unit such as device type, flow range, fittings, valve configuration, connector type, seal material and firmware revision.



Configuration Code (CCC)

Type πMFC Mass Flow Controller(multigas, multi-range)PFC-50 CCC=P5A.

Type πMFC Mass Flow Controller(multigas, pressure insensitive)PFC-60 CCC=P6A.

Gas Code (GGG)

Gas	Code	Symbol
Acetone	184	C3H6O
Acetylene	042	C2H2
Air	008	Air
Allene	066	C3H4
Ammonia	029	NH3
Argon	004	Ar
Arsine	035	AsH3
Boron Trichloride	070	BCl3
Boron Trifluoride	048	BF3
Bromine	021	Br2
Bromine Pentafluoride	116	BrF5
Bromine Trifluoride	076	BrF3
Bromotrifluoromethane (R-13b1)	080	CBrF3
Butane	117	C4H10
Carbon Dioxide	025	CO2

Carbon Disulfide	040	CS2
Carbon Monoxide	009	CO
Carbon Tetrachloride	101	CCl4
Carbon Tetrafluoride (R-14)	063	CF4
Carbonyl Sulfide	034	COS
Chlorine	019	Cl2
Chlorine Trifluoride	077	ClF3
Chlorodifluoromethane (R-22)	057	CHClF2
Chloroform (Trichloromethane)	071	CHCl3
Chloropentafluoroethane (R-115)	119	C2ClF5
Chlorotrifluoromethane (R-13)	074	CClF3
Cyanogen	059	C2N2
Cyanogen Chloride	037	ClCN
Cyclopropane	061	C3H6
Deuterium	014	D2
Diborane	058	B2H6
Dichlorodifluoromethane (R-12)	084	CCl2F2
Dichlorofluoromethane (R-21)	065	CHCl2F
Dichlorosilane	067	SiH2Cl2
1,2-Dichlorotetrafluoroethane (R-114)	125	C2Cl2F4
Difluoroethylene (R-1132a)	064	C2H2F2
Difluoromethane	160	CH2F2
Dimethylamine	085	C2H7N
Dimethylpropane	122	C5H12
Disilane	097	Si2H6
Ethane	054	C2H6
Ethanol	136	C2H6O
Ethyl Acetylene	093	C4H6
Ethyl Chloride	075	C2H5Cl
Ethylene	038	C2H4
Ethylene Oxide	045	C2H4O
Fluorine	018	F2
Germane	043	GeH4
Germanium Tetrachloride	113	GeCl4
Helium	001	He
Hexafluoro Butadiene-1,3	297	C4F6
Hexafluoroethane (R-116)	118	C2F6
Hexafluoropropylene	138	C3F6
Hexane	127	C6H14
Hydrogen	007	H2
Hydrogen Bromide	010	HBr
Hydrogen Chloride	011	HCl
Hydrogen Cyanide	024	HCN

Hydrogen Fluoride	012	HF
Hydrogen Iodide	017	HI
Hydrogen Selenide	023	H2Se
Hydrogen Sulfide	022	H2S
Iodine Pentafluoride	115	IF5
Isobutane	111	C4H10
Isobutylene	106	C4H8
Krypton	005	Kr
Methane	028	CH4
Methanol	176	CH4O
Methyl Acetylene	068	C3H4
Methyl Bromide	044	CH3Br
Methyl Chloride	036	CH3Cl
Methyl Fluoride	033	CH3F
Methyl Mercaptan	047	CH4S
Methylamine	052	CH5N
Methyltrichlorosilane	183	CH3Cl3Si
Molybdenum Hexafluoride	124	MoF6
Neon	002	Ne
Nitric Oxide	016	NO
Nitrogen	013	N2
Nitrogen Dioxide	026	NO2
Nitrogen Trifluoride	053	NF3
Nitrosyl Chloride	141	NOCl
Nitrous Oxide	027	N2O
Octafluorocyclobutane (R-c318)	129	C4F8
Oxygen	015	O2
Oxygen Difluoride	041	OF2
Ozone	030	O3
Pentaborane	142	B5H9
Pentafluorethane	155	C2HF5
Perchloryl Fluoride	072	ClO3F
Perfluoropropane	128	C3F8
Phosgene	060	CCl2O
Phosphine	031	PH3
Phosphorous Oxychloride	102	POCl3
Phosphorous Pentafluoride	143	PF5
Propane	089	C3H8
Propylene	069	C3H6
Radon	003	Rn
Silane	039	SiH4
Silicon Tetrachloride	108	SiCl4
Silicon Tetrafluoride	088	SiF4

Sulfur Dioxide	032	SO2
Sulfur Hexafluoride	110	SF6
Sulfur Tetrafluoride	086	SF4
Sulfuryl Fluoride	087	SO2F2
Tetrafluoroethane (R-134a)	156	C2H2F4
Titanium Tetrachloride	114	TiCl4
Toluene	181	C7H8
Trans-Butene	098	C4H8
Trichloroethane	112	C2H3Cl3
Trichlorofluoromethane (R-11)	091	CCl3F
Trichlorosilane	147	SiHCl3
Trichlorotrifluoroethane (R-113)	126	C2Cl3F3
Trifluoromethane (Fluoroform R-23)	049	CHF3
Trimethoxyborine	131	C3H9BO3
Trimethylamine	109	C3H9N
Tungsten Hexafluoride	121	WF6
Uranium Hexafluoride	123	UF6
Vinyl Bromide	056	C2H3Br
Vinyl Chloride	055	C2H3Cl
Xenon	006	Xe

Flow Range Full Range (FFF)

The MFC's mass flow full scale range is indicated by a three digit code.

Mass Flow Rate	Ordering Code(FFF)
10 sccm	101
20 sccm	201
50 sccm	501
100 sccm	102
200 sccm	202
500 sccm	502
1000 sccm	103
2000 sccm	203
5000 sccm	503
10000 sccm	104
20000 sccm	204
30000 sccm	Consult factory

FittingType (Y)

The fitting options are designated by a letter code.

Fitting Style	Ordering Code
Swagelok VCR-4 male	R
Downport C-Seal per SEMI 2787.1	C
Downport W-Seal per SEMI 2787.3F	H

Connector (W)

The MFC's connector is designated by a single number code. The MFC is also available with a DeviceNet connector.

Connector Type	Ordering Code
DeviceNet	6
Digital RS-485	5
9 Pin D(Analog I/O)	A
15 Pin D(Analog I/O)	B

Valve (Z)

The seal material option is designated by a letter code. The MFCs are normally closed valve with the following seal type.

Seal Material	Ordering Code
Teflon	T
Metal	M, for ranges 10 sccm to 5000 sccm FS, N2 Equivalent only

Reserved For MKS Future Use (S)

Standard = 0

Firmware Version (VV)

The firmware version options are designated by a two digit number code.

Example: The release of firmware version 10.

Seal Material	Ordering Code
DeviceNet Only	21

Note The default order code is to leave this position blank.