# Type IE500A / IE1000A Mass Flow Controller

# Instruction Manual

**MKSINST™**

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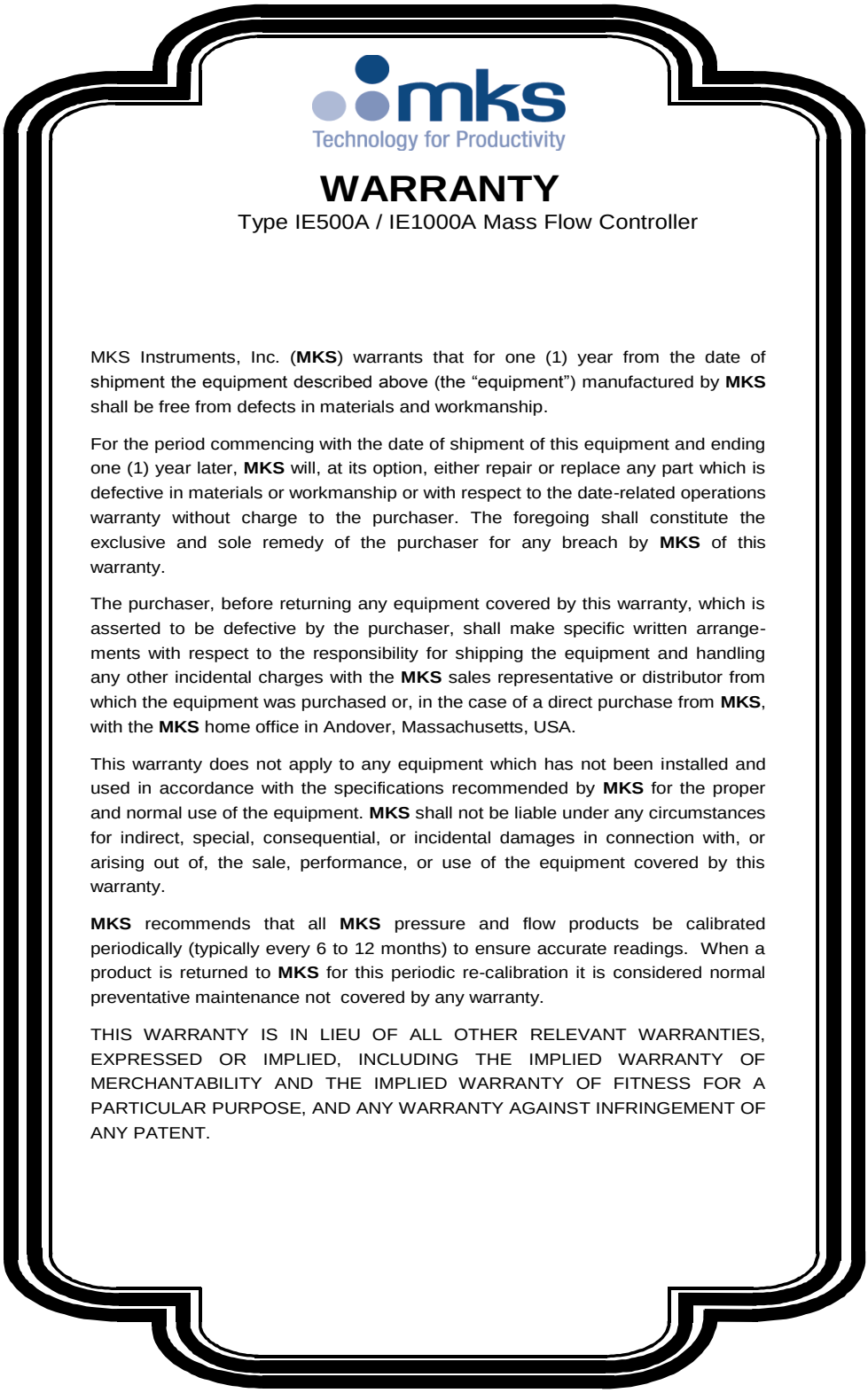


# WARRANTY

Type IE500A / IE1000A Mass Flow Controller

MKS Instruments, Inc. (**MKS**) warrants that for one (1) year from the date of shipment the equipment described above (the “equipment”) manufactured by **MKS** shall be free from defects in materials and workmanship.

For the period commencing with the date of shipment of this equipment and ending one (1) year later, **MKS** will, at its option, either repair or replace any part which is defective in materials or workmanship or with respect to the date-related operations warranty without charge to the purchaser. The foregoing shall constitute the exclusive and sole remedy of the purchaser for any breach by **MKS** of this warranty.

The purchaser, before returning any equipment covered by this warranty, which is asserted to be defective by the purchaser, shall make specific written arrangements with respect to the responsibility for shipping the equipment and handling any other incidental charges with the **MKS** sales representative or distributor from which the equipment was purchased or, in the case of a direct purchase from **MKS**, with the **MKS** home office in Andover, Massachusetts, USA.

This warranty does not apply to any equipment which has not been installed and used in accordance with the specifications recommended by **MKS** for the proper and normal use of the equipment. **MKS** shall not be liable under any circumstances for indirect, special, consequential, or incidental damages in connection with, or arising out of, the sale, performance, or use of the equipment covered by this warranty.

**MKS** recommends that all **MKS** pressure and flow products be calibrated periodically (typically every 6 to 12 months) to ensure accurate readings. When a product is returned to **MKS** for this periodic re-calibration it is considered normal preventative maintenance not covered by any warranty.

THIS WARRANTY IS IN LIEU OF ALL OTHER RELEVANT WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING THE IMPLIED WARRANTY OF MERCHANTABILITY AND THE IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, AND ANY WARRANTY AGAINST INFRINGEMENT OF ANY PATENT.

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# 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 for 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.

#### 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 |  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 | 3 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 fIE1000A 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)<br>IEC 417, No. 5007 | オフ (電源)<br>IEC 417, No. 5008 | 接地 (アース)<br>IEC 417, No. 5017 | 保護接地 (アース)<br>IEC 417, No. 5019 |
| フレームまたはシャーシ<br>IEC 417, No. 5020 | 等電位<br>IEC 417, No. 5021 | 直流<br>IEC 417, No. 5031 | 交流<br>IEC 417, No. 5032 |
| 直流と交流<br>IEC 417, No. 5033-a | クラス 2 機器<br>IEC 417, No. 5172-a | 3~<br>三相交流<br>IEC 617-2, No. 020206 | |
| 注意 (付属書を参照)<br>ISO 3864, No. B.3.1 | 注意 (感電の危険あり)<br>ISO 3864, No. B.3.6 | 注意 (表面が熱くなっています)<br>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**

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

# How This Manual is Organized

This manual is designed to provide instructions on how to set up, install, and operate an IE500A / IE1000A High Flow Rate Mass Flow Controller.

**Before installing and/or operating your IE500A / IE1000A High Flow Rate Mass Flow Controller, carefully read and familiarize yourself with all precautionary notes in the *Mass Flow Device Safety Information* section at the front of this manual. Observe and obey all WARNING and CAUTION notes provided throughout the manual.**

*Chapter One: General Information* introduces the product and describes the basic theory of operation.

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

*Chapter Three: Operation* describes how to use the instrument and explains all the functions and features.

*Chapter Four: Maintenance and Troubleshooting* lists any maintenance required to keep the instrument in good working condition and provides a troubleshooting reference should the instrument behave unexpectedly.

*Chapter Five: Diagnostic Interface Setup, Configuration, and Operation* provides information on how to set up the instrument's auxiliary diagnostics and monitoring interface. It also provides information on how to monitor the device during operation.

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

*Appendix B: Model Code Explanation* describes the model code.

*Appendix C: Health and Safety Form* provides a copy of the safety form (at the time of this manual's release) which must be filled out prior to return of the instrument to MKS for calibration, routine maintenance, or repair. Failure to include the form with a returned shipment will delay processing at the MKS Calibration and Service Center.

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# Chapter One: General Information

## Introduction

MKS Instruments IE500A / IE1000A High Flow Rate Mass Flow Controller provides state-of-the-art technology to meet the stringent requirements of advanced industrial manufacturing processes. The MFC integrates thermal sensor technology together with MKS model based, adaptive, real-time feedback control to provide typical flow control response times of approximately 2 seconds to changes in setpoint.

The product is available with full scale flow ranges of 250 – 500 slm (IE500A) and 501 - 1000 slm (IE1000A) $N_2$ equivalent in multiple process fitting connections and control interfaces. Both analog I/O and 4-20 mA I/O interfaces are available as product options. The IE500A / IE1000A Mass Flow Controller includes an embedded, web-based user interface.

The IE500A / IE1000A High Flow Rate Mass Flow Controller provides IP66 compliance against water and dust ingress for critical industrial processes.

### Performance Advantages

**Increases Process Throughput and Stability**

- Provides accurate flow control for both the calibration and the user selected process gases.
- Enables better process performance through increased MFC accuracy, reproducibility, and repeatability.
- Reduces MFC inventory through multi-gas, multi-range availability.

**Reduces Overall Costs**

- Minimizes overall footprint of gas delivery module.
- Includes embedded diagnostics interface that allows users to check MFC functionality without removing the MFC.
- Increases uptime through reduction of "No Problem Found" MFC replacements.
- Reconfigures quickly through auxiliary digital interface for enhanced operation flexibility

## How the MFC Works

The MFC compares the actual flow reading from an advanced 2-element thermal flow sensor to the desired setpoint flow rate, and positions the low power, solenoid operated, pilot proportional control valve to maintain, or achieve, the desired setpoint flow rate.

Upon entering the MFC, the process gas stream passes first through the metering section of the instrument which consists of a small bore sensor tube operating in parallel with a precision formed bypass. The geometry of the sensor tube ensures fully developed laminar flow in the sensing region. The bypass elements are specifically matched to the characteristics of the sensor tube to achieve optimum performance throughout each flow range.

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.

The flow measurement is based on differential heat transfer between temperature sensing heater elements which are attached to the exterior of the sensor tube. The bridge circuitry senses the thermal mass movement which is converted to mass flow via the specific heat, Cp, of the gas. Specialized circuitry and algorithms are used to compensate for ambient temperature changes and minor attitude (product mounting orientation) effects.

The controller accepts a setpoint signal, compares it to the measured flow rate, and generates an offset error signal. The error signal is conditioned, using a model based control algorithm, to provide a drive signal to the low power, solenoid operated, pilot proportional control valve so that it can reposition the valve and reduce the offset error signal to zero.

The pilot proportional control valve is a specially constructed solenoid valve in which the armature (moving valve mechanism) is suspended. The arrangement ensures that minimal friction is present and makes precise control possible. In the normally closed control valve, the solenoid lifts the armature and plug assembly away from the valve seat to regulate the gas flow rate.

The pilot proportional control valve controls the pressure differential across the diaphragm of the main flow valve.

**Note** The MFC must have sufficient differential pressure from inlet to outlet to achieve the setpoint. If the device does not reach setpoint for lack of differential pressure, either increasing the inlet pressure or decreasing the outlet pressure may be necessary.

**Note** For optimal control performance, the user should specify the inlet pressure provided to the MFC through the diagnostic user interface.

When the actual flow rate reading is *less than* the setpoint value, the MFC opens the pilot 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, so the flow rate rises to meet the setpoint value.

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

The flow exits the instrument at the established rate of flow downstream of the main flow valve.

Real-time accurate flow control 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.

## Operation of the MFC with Gases other than Air

The IE500A / IE1000A High Flow Rate Mass Flow Controller does not use gas correction factors (as many other mass flow controllers do) to control process gases other than air. The use of gas correction factors can cause accuracy errors when running non-linear gases through the device.

IE500A / IE1000A High Flow Rate Mass Flow Controller multi-gas, multi-range functionality is based on thermodynamic principals and multi-component functions that have been developed to accurately calculate the non-linear gas flow of non-calibration gases, with respect to the calibration gas. The current MKS library of gases and functions is in excess of 120 in number and includes most gases in common use within the process industries. For gases whose parameters that are not already stored on the MFC, please consult an MKS applications engineer.

When a gas other than the calibration gas is selected by the user, the MFC automatically pulls up the correct functions that calculate the flow of that gas with respect to the original calibration, allowing 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 MFC uses Gas Correction factors for converting the calibration gas flow into the flow of the gas being used. This may lead to inaccuracy in the flow reported to levels as high as 6-10% (of FS) depending on the gas used.

The IE500A / IE1000A High Flow Rate Mass Flow Controller is calibrated with clean, filtered, dry air rated to stringent ISO standards for compressed air systems. When running with air, humidity may have a minor effect (usually < 1%) if the dew point is allowed to rise above 0 ºC in the flowing gas stream.

### Control (I/O) Interfaces

The IE500A / IE1000A High Flow Rate Mass Flow Controller is available with either analog or 4-20 mA I/O which is specified by the user at time of ordering.

Analog I/O is available via an industry standard 15 pin DSUB connector, which provides for setpoint I/O, valve override, flow zero, and an optional feedback control input. Analog I/O pin functions are covered later in this manual.

### Cleanliness Features

The IE1000A High Flow Rate Mass Flow Controller uses elastomer o–rings available in Viton, BUNA-N, neoprene, and EPDM for all external seals. The seals minimize gas permeation and ensure low external leakage. Internal surfaces are precision machined and subjected to a proprietary cleaning process. The instrument is assembled and packaged in a clean room environment.

### Reliability

To enhance instrument reliability, the design minimizes mechanical and electronic components count and has successfully passed the following tests:

- High speed main flow diaphragm cycling
- High speed main flow valve plug cycling with post-cycle wear examination
- Storage temperature testing
- Repetitive thermal cycle and thermal shock testing
- Transportation package testing
- HALT testing
- Full unit accelerated life testing
- CE testing including ESD and EFT
- Vibration testing (random and sine sweep)
- Humidity testing
- IP66 Testing
- 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

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# Chapter Two: Installation

## Unpacking the IE1000A Mass Flow Controller

MKS has carefully packed your IE1000A High Flow Rate Mass Flow Controller so that it will reach you in good working condition. 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 of the back cover of this manual for a list of MKS Calibration and Service Centers.

### Opening the Package

The IE500A / IE1000A High Flow Rate Mass Flow Controller is assembled, leak tested with helium, and calibrated in a clean environment. The instrument is packaged in a polyethylene bag in this environment to maintain its particle free condition during shipment. It is important to remove the shipment packaging with clean practices to avoid unnecessarily contaminating the device with particulates. To maintain a minimal level of cleanliness, follow the instructions below:

1. Remove all cardboard and shipment packaging materials away from the process connections where the device will be installed. Do not discard UNTIL the device has been inspected for damage and determined to be in good working order.
2. Wipe down the outer polyethylene bag with a clean cloth prior to proceeding.
3. Remove the outer polyethylene bag away from BOTH the shipping packaging AND the process connections where the device will be installed. Do not allow this container near the process connections. Verify the presence of the flow calibration sheet packaged with the unit.
4. Pass the flow calibration sheet to the appropriate personnel at your facility.
5. At the point of connection to the process line, remove the inner polyethylene bag from the mass flow controller and inspect the unit for any signs of damage during transportation or handling.

**Caution** **Only qualified individuals should perform the product installation and configuration. 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.**

## Verifying Use Requirements Prior to Installation

Follow the guidelines listed below when installing and using the IE500A / IE1000A High Flow Rate Mass Flow Controller.

- Maintain adequate ventilation space around the MFC to provide sufficient air circulation for internal heat removal. Allow 0.50” around all surfaces of the device (except base)
- Maintain an ambient operating temperature between 10° and 50° C (50° to 122° F)

- Provide a properly grounded electrical power source of sufficient current capacity between 15-24 $V_{DC}$
- When unpowered, maintain storage temperature range between -20° to 65° C (-4° and 149° F). Allow unit to return to normal ambient temperature for several hours prior to applying electrical power.
- Mount the IE500A / IE1000A Mass Flow Controller securely to a rigid base.
- Provide a separate positive shutoff valve if your system cannot tolerate any leakage through the IE500A / IE1000A High Flow Rate Mass Flow Controller. The internal pilot valve and main flow control valve are not positive shutoff valves so some leakage across the valves 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.**

- Provide a recommended 20 pipe diameters of rigid process line immediately upstream and downstream of the MFC to minimize installation related acoustic noise propagation from the MFC.
- Allow a warm up time of one (1) hour on power application prior to use.
- Provide a gas filter to remove particulates and contaminants in process gas line upstream of the MFC
- Observe the pressure limits for the flow device.

  Max gas supply pressure: 150 psig
  Min differential pressure: 40 psid

The standard valve configuration provides control over this differential pressure range with the outlet at atmospheric pressure. If process conditions vary significantly from those listed, contact an MKS applications engineer for assistance in tuning the unit for optimum performance.

For additional information, refer to the product specifications in Appendix A.

## Understanding Dimensional Constraints

Refer to the applicable drawings, which follow.

### Front and Rear Views

The front of the IE500A / IE1000A MFC has an arrow to indicate the direction of gas flow through the unit. The back of the IE500A / IE1000A MFC contains the connector pin-outs.

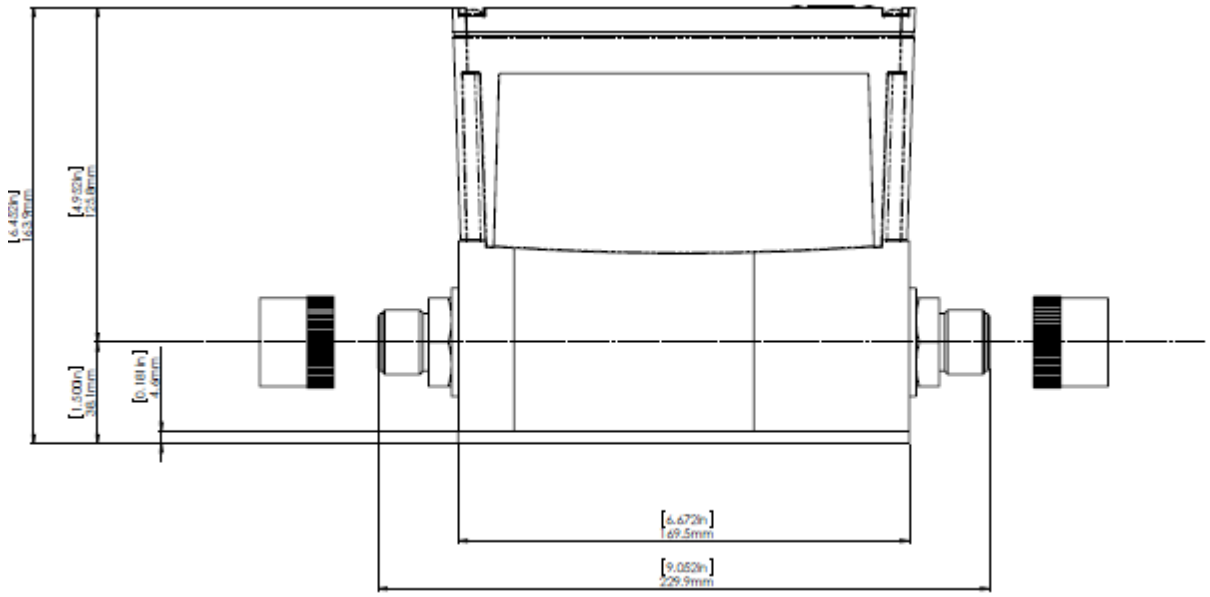


**Figure 1: Front View of the IE500A / IE1000A MFC**

### Bottom View

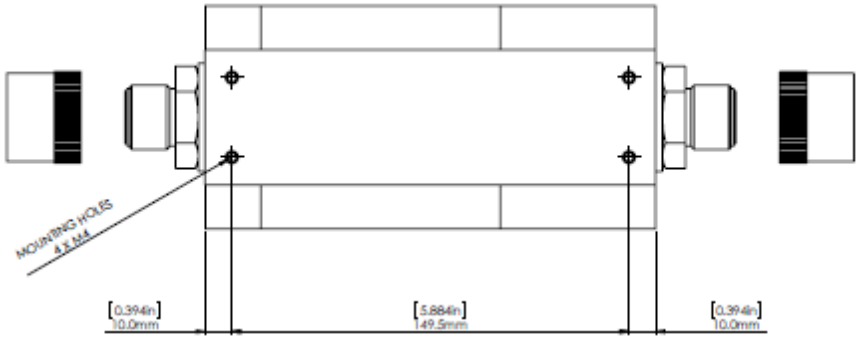


**Figure 2: Bottom View of the IE500A / IE1000A MFC**

## End View

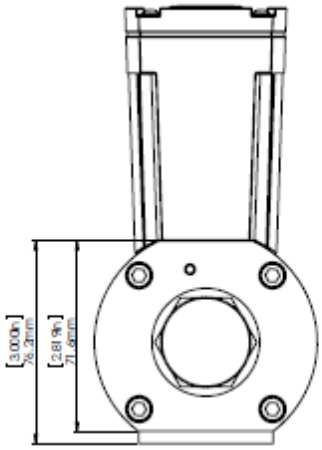

**Figure 3: End View of the IE500A / IE1000A MFC**

## Top View

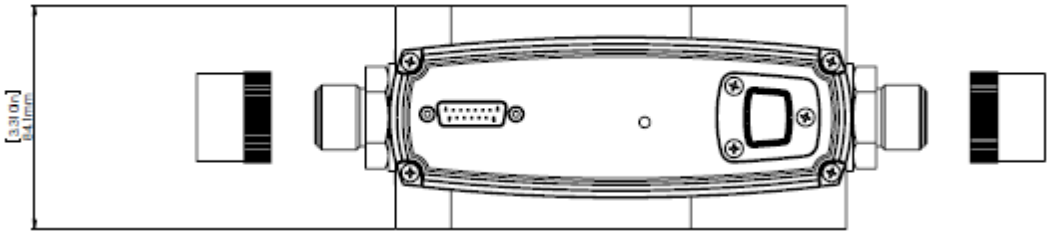

**Figure 4: Top View of the IE500A / IE1000A MFC (analog IO Interface)**

### Labels

Each IE500A / IE1000A High Flow Rate Mass Flow Controller contains a serial number label on the inlet end of the product's electrical enclosure. The serial number label shows the "as-shipped" model code, the full scale flow range, and the name plate gas.


**Figure 5: Serial Number Label**

### Mounting

The IE500A / IE1000A High Flow Rate Mass Flow Controllers have four threaded mounting holes located on the bottom or base of the unit: two #8-32 and two M4. Depending on the hole pattern chosen, use #8-32 UNC-2B or M4 hardware to mount the instrument. The bottom view displayed previously shows the location and dimensions of the mounting holes.

## Performing MFC Installation

This section describes how to install the IE500A / IE1000A Mass Flow Controller into your process gas system.

**PERSONAL SAFETY HAZARDS!** **Gas systems can contain toxic, explosive, combustible, corrosive or other dangerous 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.**

**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.

**Note** DO NOT make any electrical connections to the MFC until directed to do so. Information on electrical connections (pinouts and settings) is found in the following chapter.

Follow the guidelines below when setting up the IE500A / IE1000A High Flow Rate Mass Flow Controller.

1) Prepare the process gas system according to your facility's gas handling procedures, including purging of gas lines with appropriate purge gas, executing lock out / tag out procedures, and notifying appropriate members of the equipment, safety, and HAZMAT teams.

2) Set the controller into position where it will be connected to a gas supply where the gas flow is in the same direction as the arrow shown on the front of the MFC.

   Allow adequate clearance for the analog I/O or 4-20 mA I/O connector, strain relief, and cable bend.

3) Mount the IE1000A High Flow Rate Mass Flow Controller to the rigid base with the proper hardware.

4) Flow clean, dry purge gas across the fittings to minimize particle contamination prior to and during installation. Use only purge gases that are approved for your process.

5) Connect the process gas supply remembering to tighten the seal gaskets according to the fitting manufacturer's or seal gasket manufacturer's recommendation. Use appropriate gasket material for the application. Seal gaskets are not included with the MFC.

   DO NOT over-tighten connections.

   The process fittings in the IE500A / IE1000A High Flow Rate Mass Flow Controller are screwed into the main flow path mechanical parts and sealed with the appropriate o-ring (consistent with the material ordering code). Use a backing wrench when tightening the process fitting to the MFC to prevent loosening of the factory installed fittings on the MFC.

6) Perform appropriate leak checking of your gas lines and MFC connections to verify the integrity of the gas seals prior to supplying power to the MFC. Verify the leak integrity of both the process fitting connection and the fitting-to-main flow path connection prior to running process gas.

7) Before connecting the cable leading to the MFC, verify that all pins for power and signal match those for the interface I/O type being used. Information on each I/O type's pinouts are found in the following chapter.

8) Connect cable and power up the MFC.

9) Allow minimum one (1) hour warm-up prior to performing a flow zero operation.

10) Apply gas slowly to the MFC by turning on the regulator. Some leak by the main flow valve may occur while inlet line pressure equalizes across the diaphragm to provide the needed pressure to achieve full closure.

11) When purging the line, provide a valve open signal to the MFC. Allow a long pump down time so that the pressure upstream of the MFC can drain to the appropriate low level. Gas will need to drain through the much smaller pilot valve orifice once the MFC inlet pressure drops below that needed to overcome the mechanical closing force of the main flow valve.

    For other hazardous gases, consider pumpng the process line from both the inlet and outlet side of the MFC. Cycle purge the system and backfill with an inert gas for optimum safety.

# Chapter Three: Operation

## Analog 15-pin Interface Operation

The IE500A / IE1000A High Flow Rate Mass Flow Controller analog I/O interface is available in a standard 15-pin DSUB male connector through which both power and signal I/O are routed.

### Analog I/O Interface Cable Requirements

*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 2004/336/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 the tables which follow.

**Table 7: MKS Interface Cables**

| Power Supply End | | |
|---|---|---|
| **MFC End** | **15-Pin Type "D"** | **Flying Leads** |
| Analog 15-pin DSUB | CB147-1<br>CB259-5 | CB259-6 |

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

**Note** 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 MFC to a power supply with a 15-pin DSUB connector, use part number CB259-5; for an overall metal braided, shielded cable use part number CB259S-5.

### Analog I/O User Supplied Shielded Cable Requirements

MKS offers a full line of cables for most 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 shields 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 device's case (ground). Good contact is less than 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 end; it is important to ground the shield at the end *before* the wires exit. Make the ground connection 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.

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.
   - Some cables may need internal shielding from specific wires to others.

### IE1000A 15-pin I/O User Supplied Cable Requirements

To ensure that the IE500A / IE1000A High Flow Rate Mass Flow Controller meets IP66 requirements a unique sealed 15-pin DSUB connector is used. The IE500A / IE1000A has been tested with this IP66 compliant connector and has been shown to meet IP66 requirements as a standalone unit (gas inlet and outlet fittings must be appropriately sealed).

In addition to the standard I/O requirements for an IE500A / IE1000A High Flow Rate Mass Flow Controller, additional care must be taken to ensure IP66 integrity is maintained once installed. The mating connector and cable must use a backshell that meets a minimum of an IP66 rating. There are several manufacturers of sealed backshells for DSUB connectors and these can be readily ordered through most electronics distributors. Care should be taken to follow all of the manufacturer's assembly instructions.

**Note** To be fully IP66 compliant, the I/O connector and cable must also meet IP66 requirments.

### Analog I/O 15-pin Pinouts

**Table 8: Analog I/O 15-pin DSUB Pinouts (Model Code B)**

| 15-pin Analog Pin Descriptions | |
|---|---|
| **Pin Number** | **Pin Function** |
| Pin 1 | Valve Test Point |
| Pin 2 | Flow Output Signal, 0-5 $V_{DC}$ |
| Pin 3 | Valve Close Digital Input<br>Pull to ground to Close |
| Pin 4 | Valve Open Digital Input<br>Pull to ground to Open |
| Pin 5 | Power Common |
| Pin 6 | No Connection |
| Pin 7 | +15 to +24 $V_{DC}$ Power Input |
| Pin 8 | Setpoint Input, 0-5 $V_{DC}$ |
| Pin 9 | Zero Function (Digital Input)<br>Pull momentarily to ground to initiate function |
| Pin 10 | Optional Feedback Control Input Signal, 0-5 $V_{DC}$ |
| Pin 11 | Signal Common (Setpoint Input) |
| Pin 12 | Signal Common (Flow Output) |
| Pin 13 | No Connection |
| Pin 14 | No Connection |
| Pin 15 | Chassis Ground |

**Note**

1. The "No Connection" pin assignment refers to a pin with no internal connection.
2. The 0 to 5 $V_{DC}$ flow signal output comes from pin 2 and is referenced to pin 12 (signal common).
3. Any appropriate 0 to 5 $V_{DC}$ input signal of less than 1K ohm source impedance referenced to pin 11 can be used to supply a setpoint signal to pin 8.

The signal ground and power return are NOT connected within the MFC. The user should connect the signal ground and the power return at ONLY one end of the interface cable to avoid development of ground loops.

### *Analog I/O Optional Input (15-pin DSUB Only)*

The standard 15-pin IE500A / IE1000A High Flow Rate Mass Flow Controller can control flow based on a 0 to 5 $V_{DC}$ signal from an external sensing device using the optional feedback control input feature. (For a 0 to 10 $V_{DC}$ 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 feedback control input feature, route the 0-5 $V_{DC}$ output from the desired external device to the optional input pin.

Voltage applied to the optional input pin overrides the signal generated by the flow sensor internal to the MFC. The control electronics drive 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 the product responds to the external optional feedback control input signal, the metered flow output signal is still provided on the standard output pin 2.

## Analog IO Valve Override

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

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

- *To Open* the valve, connect pin 4 to the power ground pin.
- *To Close* the valve, connect pin 3 to the power ground pin.

### *Analog IO Valve Command Priority*

The MFC 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.

## 4-20 mA IO 15-pin Interface Operation

The IE500A / IE1000A High Flow Rate Mass Flow Controller 4-20 mA I/O interface type is available in a 15-pin DSUB male connector for providing power and signal I/O.

### 4-20 mA I/O 15-pin Pinouts

**Table 9: 4-20 mA I/O 15-pin DSUB Pinouts (Model Code G)**

| 15-pin 4-20 mA Pin Descriptions | |
|---|---|
| **Pin Number** | **Pin Function** |
| Pin 1 | Command Return |
| Pin 2 | Flow Signal Output Voltage, 0-5 $V_{DC}$ |
| Pin 3 | No Connection |
| Pin 4 | Flow Signal Output Current, 4-20 mA |
| Pin 5 | +15 to +24 $V_{DC}$ Power Input |
| Pin 6 | No Connection |
| Pin 7 | Setpoint Signal Input Current, 4-20 mA |
| Pin 8 | Setpoint Signal Input Voltage, 0-5 $V_{DC}$ |
| Pin 9 | Power Common |
| Pin 10 | Flow Signal Output Current Return |
| Pin 11 | No Connection |
| Pin 12 | Valve Open/Close Pin:<br>Apply +5 to+15 $V_{DC}$ to Open<br>Apply 0 to -15 $V_{DC}$ to Close |
| Pin 13 | Flow Zero |
| Pin 14 | Chassis Ground |
| Pin 15 | No Connection |

**Note**

1. The "No Connection" pin assignment refers to a pin with no internal connection.
2. The 4 – 20 mA flow signal output comes from pin 4 and is referenced to pin 10 (flow signal output current return).

#### *4-20 mA I/O Configurable Setpoint Input*

The standard 4-20 mA interface IE1000A High Flow Rate Mass Flow Controller can control flow based on a 0 to 5 $V_{DC}$ input signal and report measured flow on a 0 to 5 $V_{DC}$ output signal.

To use the 0 to 5 $V_{DC}$ voltage input as the primary setpoint input to which the device should respond, configure the device to use the voltage input through the onboard monitoring and diagnostics interface (covered in Chapter 5).

**Note**

The configurable voltage setpoint input feature uses separate circuits and pins (from the default current input) allocated on the primary IO connector. Check for presence and continuity of voltage control / readback pins in the supply cable before attempting to control or measure flow using the configurable voltage IO.

## 4-20 mA IO Valve Override

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

For a 4-20 mA IO interface:

- *To Open* the valve, apply 5 to 15 VDC to Pin 12.
- *To Close* the valve, apply -5 to -15 VDC Low to Pin 12 or connect Pin 12 to Power Common.
- Normal Setpoint operation occurs when Pin 12 is allowed to float.

### *4-20 mA IO Valve Command Priority*

The MFC executes commands based on a hierarchical command structure. The higher priority command is Valve Open or Valve Closed, followed by normal Setpoint Control. Therefore, if the flow controller is operating under Setpoint Control, you can send either a Valve Open command to force the valve to the full open position or a Valve Closed command to stop flow through the valve while the Setpoint Control signal is maintained.

When setpoints are applied to both the standard 4-20 mA current input pin and the secondary 0 to 5 $V_{DC}$ voltage input pin, the device responds to the signal configured as the primary input signal through the diagnostics and monitoring interface. As shipped from the factory, the 4-20 mA current input pin is configured as the primary input signal by default.

Both measurement output signals are active, regardless of which setpoint signal is chosen to control the device. Use caution if / when making connections to the unused measurement output signal.

# General Operational Functions

## Gas Calibration Tables

The default (instance 32) clean dry air (CDA) gas calibration table (500 slm or 1000 slm) created at the MKS factory is tagged in a manner which prevents editing or deletion in the field. This ensures that vital calibration information is not lost during subsequent gas creation and range adjustment activities. The nameplate (instance 1) gas calibration table, created at the MKS factory, is active on receipt of the mass flow controller. Caution should be used when creating other gas tables and full scale gas ranges as the default table can be deleted.

## Tuning the IE1000A Mass Flow Controller optional Input (15-pin DSUB ONLY)

Tuning the optional input optimizes the IE1000A Mass Flow Controller's control of system performance. The Proportional (P), Integral (I), and Derivative (D) terms adjust the response of the IE500A / IE1000A Mass Flow Controller to changes in either optional input setpoint or system response.

### *Accessing PID Variables*

For most users, editing PID variables is most readily accomplished using the MKS-supplied graphical user interface.

### *Error Signal*

An error signal is the difference between the measured system response and the optional input setpoint. The error signal is the basis for the operation of the PID algorithm.

### *Proportional Term*

When the Proportional (P) term, or gain, is multiplied by the error signal, a proportional valve drive signal results. The higher the Proportional (P) control, the greater the change in valve drive signal for a given error signal. Typically, a higher Proportional (P) control setting yields a faster response. However, too high a Proportional (P) control setting will cause the mass flow rate to oscillate around the setpoint. Too low a Proportional (P) control setting will result in a slow response from the mass flow controller. Figures below show the effects of the Proportional (P) term.

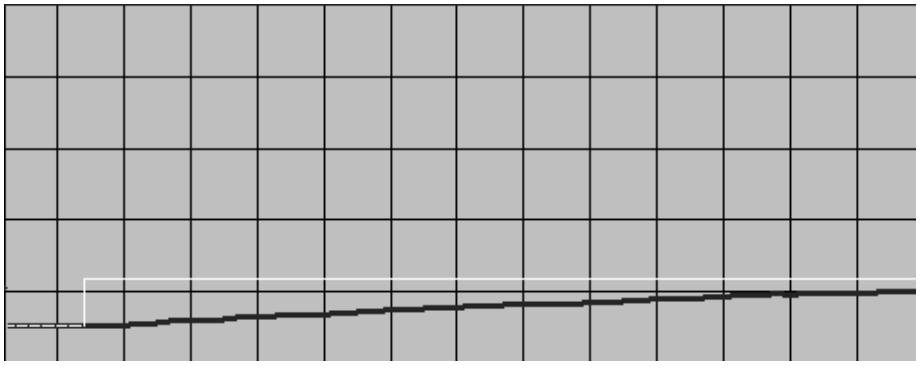

**Figure 6: Effects of the Proportional Term (Low Proportional Term)**

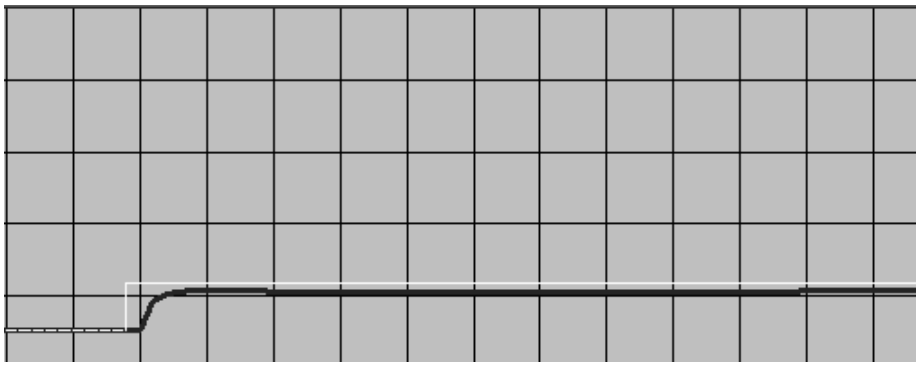

**Figure 7: Effects of the Proportional Term (High Proportional Term)**

***Integral Term***

The action of the Integral (I) term creates a valve drive signal that is proportional to the magnitude and sign of the area under the error signal curve (error signal with respect to time). Therefore, as time passes, the integral term acts to position the valve to reduce the error signal to zero. An increase in the integration time increases the period of time over which the error signal is generated, and the system response gets slower. Figures below show the effect of the Integral term.

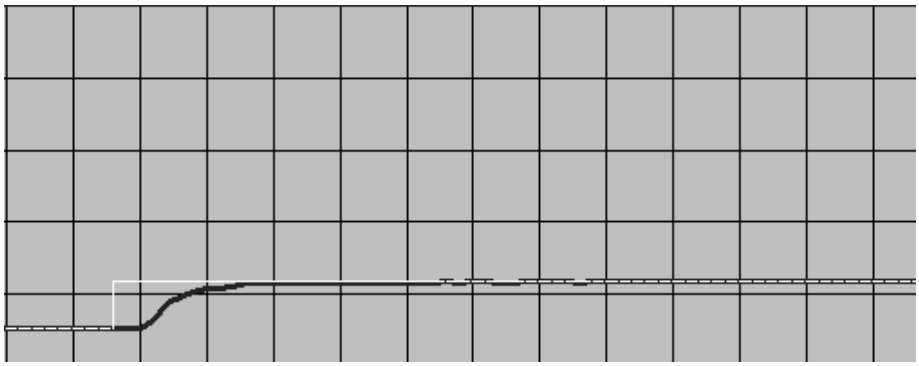

**Figure 8: Effects of the Integral Term (Low Integral Term)**

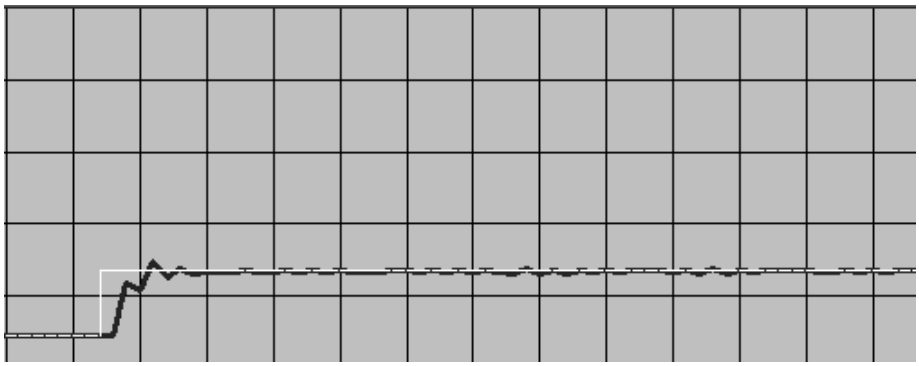

**Figure 9: Effects of the Integral Term (High Integral Term)**

**Note** To *shorten* the integration time, *increase* the I term setting.

### *Derivative Term*

The action of the Derivative (D) term creates a valve drive signal that is proportional to the rate of change of the error signal over time. In moderate amounts, it can be used to reduce overshoot within the system by adding predictive capabilities to the control algorithm. At high rates of change of the error signal as it approaches the setpoint quickly (negative slope of the absolute error over time), the derivative term reduces the effects of the Proportional term. Excessively high Derivative term values can result in instability of the controller. In general, IE500A / IE1000A Mass Flow Controllers control well with the Derivative term equal to zero.

### *Optimizing PID Control Settings*

Optimizing the IE1000A High Flow Rate Mass Flow Controller response *in your system* involves adjusting the Proportional, Integral, and Derivative (PID) terms. Since every system is different, the optimum PID settings may vary. Operating pressures, process gas density, and target setpoints, all contribute to determining the ideal settings.

### *Guidelines for Optional Input Control Tuning*

Tuning is best done with setpoint changes from zero to the target flow rate.

Increasing the I term will reduce response time, especially at setpoints below 20% of full scale, but promote flow overshoot during setpoint changes. Increasing the P term reduces the overshoot because the controller is able to respond more quickly to the indicated overshoot. However, an excessive P term will cause controller oscillation, a highly undesirable condition. Thus, caution must be exercised in setting the P term aggressively.

Any adjustments to the P and I terms (D is generally kept at zero) should be done incrementally. If excessive overshoot is observed, the P value may be increased somewhat. For improved control stability, the I term should be *decreased* in small increments.

# Chapter Four: Maintenance and Troubleshooting

## General Information

In general, only minor periodic maintenance is required to keep the IE1000A High Flow Rate Mass Flow Controller operating at maximum accuracy. Proper installation and operation of the IE1000A to the guidelines presented previously will protect the instrument subsystems and ensure reliable operation over the life of the device. Periodic maintenance activities should include visual checks for wear on the interface cable, inspection of the enclosure for visible signs of damage, and periodic recalibration of the instrument.

Periodic recalibration of the instrument is required with a 1 year recalibration interval recommended. Refer to the inside back cover of this instruction manual for a complete list of MKS Calibration and Service centers.

If an MKS IE1000A High Flow Rate Mass Flow Controller fails to operate properly upon receipt, check for shipping damage, and check the interface cable for correct continuity, grounding, pin outs, and voltage levels. Any damage should be reported to the carrier and MKS Instruments immediately. If there is no obvious damage and the troubleshooting instructions fail to resolve the problem, obtain an RMA Number (Return Material Authorization Number) and complete a Health and Safety Form before returning the unit to MKS Instruments for service.

## Zeroing the MKS IE1000A High Flow Rate Mass Flow Controller

For optimum performance, the zero flow output of the MFC should be periodically checked and reset, if necessary. All MFCs should be zeroed under actual installation conditions prior to use. Very slight offsets in the zero flow condition can contribute to flow measurement inaccuracy, which may be especially noticeable at the lower end of the device range.

**Warning** **If the instrument is being used to measure gases accurately, be sure that the system is *fully warmed up* before starting verification measurements.**

Once the MKS IE1000A High Flow Rate Mass Flow Controller is completely warmed up for a minimum of one (1) hour, it can be zeroed as required.

The *Flow Zero Adjust* feature integrated into the MKS IE1000A High Flow Rate Mass Flow Controller allows the user to compensate for long term drift, universally present in analog sensor based flow instruments. Approximately 0.25% of full scale zero drift per year is typical for the flow sensor specifications.

### When to Use Zero Adjustment

Use of the *flow zero adjust* feature is appropriate when:

- The instrument is first installed (or reinstalled) at the point of use in the process line
- The ambient temperatures at installation are >±10° from the temperature at calibration (nominally 25°C).
- It is included as part of a preventive maintenance activity.
- Process output "drift" is identified that cannot be attributed to other causes (such as gas supply change), applying *flow zero adjust* to the IE1000A High Flow Rate Mass Flow Controller can be used as part of diagnostic efforts.

It is not recommended to use *flow zero adjust* each time the instrument is idle. A flow zero adjust interval of 1 month should be more than adequate if the device has been left under continuous power. The components used in the MKS IE1000A High Flow Rate Mass Flow Controller have a long history of usage and are expected to comply with the specifications listed.

## Preparing to Execute Zero Adjustment

Zeroing a flow sensor at a real flow above its stated minimum resolution creates a zero flow offset relative to the true absolute zero flow. All subsequent readings are then linear and accurate relative to the offset value.

1) Verify that the MFC is setup in the exact process conditions:
   a) Verify that the MFC is installed in the process gas line properly in the orientation orientation of use (base down (HBD), vertical flow up (VID), vertical flow down (VIU), etc.)
   b) Verify that the MFC is powered at operating temperature for at least one (1) hour 30 minutes.
   c) If the MFC will be subjected to elevated ambient temperature conditions, verify that these temperatures have been achieved and stable for at least one (1) hour before continuing.
2) 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.

   ***OPTION 1: SYSTEM HAS UPSTREAM & DOWNSTREAM ISOLATION VALVES***

   Zero the MFC at typical operating inlet pressure.
   a) Close the upstream isolation valve.
   b) Close the downstream isoaltion valve.
   c) Open the MFC's control valve.
   d) Allow pressure across MFC to equilibrate as flow output approaches zero and stabilizes.
   e) Close the MFC's control valve.
   f) Wait one minute and adjust the zero using one of the methods specified for the device I/O type later in this section.

   ***OPTION 2: SYSTEM HAS DOWNSTREAM ISOLATION VALVE ONLY***

   Zero the MFC at typical operating inlet pressure.
   a) Close the downstream isolation valve.
   b) Open the MFC's control valve.
   c) Allow pressure to equilibrate across the MFC as flow output approaches zero and stabilizes.
   d) Close the MFC's control valve.
   e) Wait one minute and adjust zero using one of the methods specified for the device I/O type later in this section.

   ***OPTION 3: SYSTEM HAS UPSTREAM ISOLATION VALVE ONLY***

   Zero the MFC at atmosphere or vacuum conditions.

   * NOT RECOMMENDED FOR ORIENTATIONS OTHER THAN HORIZONTAL BASE DOWN
   a) Close the upstream isolation valve.
   b) Open the MFC's control valve.
   c) 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.
   d) Allow pressure to equilibrate across MFC as flow output approaches zero and stabilizes.
   e) Close the MFC's control valve.
   f) Wait one minute and adjust zero using one of the methods specified for the device I/O type later in this section.

## IE1000A Executing Zero Adjustment

To perform the flow zero adjustment, use one of the listed techniques specific to the interface type of the IE1000A High Flow Rate Mass Flow Controller

***15-pin analog IO Mass Flow Controllers***

OPTION 1: Analog Interface (15-pin only)
a) Pull Pin 9 to ground for three (3) seconds.

b) Wait 20 seconds while the mass flow controller performs the zero adjustment process.
c) Verify that the zero offset has changed.

OPTION 2: Diagnostic Interface
a) Connect to the MFC using the embedded diagnostic interface
b) Enter the Setup Mode and go to the Configure Page
c) Press momentarily the "Zero Flow" button on the screen.
d) Wait 20 seconds while the mass flow controller performs the zero adjustment process.
e) Verify that the zero offset has changed.

The flow sensor within the mass flow controller is now re-zeroed and the unit ready for use. Cycling power is not necessary for the new flow zero values to be in effect.

***4-20mA IO Mass Flow Controllers***

OPTION 1: 4-20 mA DSUB Interface (15-pin only)
a) Pull Pin 13 to ground for three (3) seconds.
b) Wait 20 seconds while the mass flow controller performs the zero adjustment process.
c) Verify that the zero offset has changed.

OPTION 2: Diagnostic Interface
a) Connect to the MFC using the embedded diagnostic interface
b) Enter the Setup Mode and go to the Configure Page
c) Press momentarily the "Zero Flow" button on the screen.
d) Wait 20 seconds while the mass flow controller performs the zero adjustment process.
e) Verify that the zero offset has changed.

The flow sensor within the mass flow controller is now re-zeroed and the unit ready for use. Cycling power is not necessary for the new flow zero values to be in effect.

### Notes:

- The *flow zero adjustment* is executed by the instrument by comparing current flow sensor reading with the zero flow reading stored during initial calibration. The difference in these values is stored in a unique register in the instrument EEPROM. On start-up, this value loaded into memory and added or subtracted from all readings during operation.
- Because this operation offsets all readings from the flow sensor, **the user must be certain that a true zero flow condition exists** before enabling the function.
- If the difference between the "at calibration" and "at zero adjust" flow sensor values is greater than 3% of the flow sensor full scale, the zero adjust will not be performed.

## Customer Support

Standard maintenance and repair services are available through all of the regional MKS Calibration and 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, then two actions must be completed before shipping: (1) a RMA (Return Material Authorization) number must be obtained and (2) a Health and Safety Form must be completed and included with the instrument.

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

### Obtaining a Return Material Authorization (RMA) Number

RMA (Return Material Authorization) numbers expedite handling and ensure proper servicing of your instrument.

RMA numbers can be obtained by contacting the MKS Calibration and Service Center or through the MKS website at: http://www.mksinst.com/service/servicehowtoorder.aspx.

**Note** Returned instruments will not be accepted without a valid RMA number displayed on the shipping container.

### Health and Safety Form

A returned instrument will not be examined without a signed Health and Safety form indicating that the unit is free of harmful materials.

The Health and Safety form can be obtained on the last page of this manual or through the MKS website at: http://www.mksinst.com/service/servicehowtoorder.aspx.

**Note** Returned instruments will not be examined without a signed certificate indicating the instruments are free of harmful materials.

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

## Repair

Contact any authorized MKS Sales Office or Calibration and Service Center should you encounter any difficulties or problems using your MKS IE1000A High Flow Rate Mass Flow Controller.

**Note** If it is necessary to return the instrument to MKS for repair, please contact any of the MKS international service/calibration centers listed on the inside of the back cover of this manual for an RMA (Return Material Authorization) number to expedite handling and ensure proper servicing of your instrument.

## Troubleshooting

**Table 10: MFC Troubleshooting Chart**

| Symptoms | Possible Cause | Remedy |
|---|---|---|
| MFC does not respond to setpoint and reports near zero flow (valve current remains 0) | * MFC power has been turned off | * Verify the device is powered with the correct input voltage at power supply |
| | * Incorrect cable used to connect MFC | * Verify recommended cable configuration in Chapter 3: Operation for interface type |
| | * Cable has been damaged | * Verify cable continuity from end to end |
| | * MFC has been given improper analog setpoint signal | * Verify setpoint signal range between pins listed in Chapter 3: Operation for interface type and check proper signal ground |
| | * MFC has been given VALVE CLOSE override command | * Verify valve override pin is not grounded to POWER COMMON, CHASSIS GROUND, or SIGNAL GROUND |
| | * Control circuit failure | * Return MFC for repair service per instructions above |
| MFC does not respond to setpoint and reports near zero flow (valve current is max 260 mA) | * Upstream / downstream pneumatic valves have not received adequate actuation pressure | * Verify pneumatic air supply is not restricted and provides minimum pressure specified by valve manufacturer |
| | * Gas supply has not been started | * Verify gas pressure at supply regulator exceeds minimum differential pressure specified for MFC operating conditions |
| | * Clogged filter or process gas line component upstream of MFC | * Verify flow through components by measuring pressure drop across each restriction in the line with inert gas |
| | * Clogged filter, sensor, orifice within MFC | * After verifying supply pressure upstream of MFC, provide valve override command to MFC and check for gas flow (independent measurement) downstream of MFC.<br>If flow does not exist, then filter may be clogged, orifice may be clogged, or valve control circuit has failed.<br>If flow exists, then sensor may be clogged or sensor circuit has failed<br>Return MFC for repair service per instructions above |

| | | |
|---|---|---|
| MFC flow output exceeds full scale rated flow<br>(valve current is max 260 mA) | * MFC has been given improper analog setpoint signal | * Verify setpoint signal range between pins listed in Chapter 3: Operation for interface type and check proper signal ground |
| | * MFC has been given VALVE OPEN override command | * Verify valve override pin is not grounded to POWER COMMON, CHASSIS GROUND, or SIGNAL GROUND (or pulled to a high voltage level in the 4-20 mA interface.) |
| | * Excessive differential pressure across MFC | * Verify normal operating pressure differential is within design specification listed in Appendix A |
| | * Control circuit failure | * Return MFC for repair service per instructions above |
| MFC flow output does not match flow setpoint<br>(valve current is max 260 mA) | * Inadequate process gas supply pressure (inlet pressure too low / outlet pressure too high) | * Verify normal operating pressure differential is within design specification listed in Appendix A |
| | * MFC has improperly grounded analog setpoint signal (9-pin / 15-pin) | * Verify setpoint signal range between pins listed in Chapter 3: Operation for interface type and check proper signal ground |
| | * Clogged filter, sensor, orifice within MFC | * After verifying supply pressure upstream of MFC, provide valve override command to MFC and check for gas flow (independent measurement) downstream of MFC.<br>If flow does not exist, then filter may be clogged, orifice may be clogged, or valve control circuit has failed.<br>If flow exists, then sensor may be clogged or sensor circuit has failed<br>Return MFC for repair service per instructions above |
| MFC flow output oscillates while attempting to control to setpoint | * Inlet process gas supply pressure oscillates due to improper regulator sizing / other issue | * Verify stable upstream pressure using independent capacitance manometer measurement |
| | * Inlet process gas supply pressure too high | * Verify normal operating pressure differential is within design specification listed in Appendix A |
| | * Inlet process gas supply pressure does not match programmed inlet pressure | * Verify actual gas supply pressure is within 20% of programmed gas supply pressure in CONFIG mode of diagnostic interface |
| | * Actual process gas does not match current gas instance for MFC | * Verify actual process gas in use matches programmed gas instance in CONFIG mode of diagnostic interface |
| | * Low vapor pressure gas has condensed in the upstream process line | * Verify ambient temperature exceeds saturation temperature for the process gas at measured supply pressure by at least 10 degrees |
| | * Control circuit failure | * Return MFC for repair service per instructions above |

| | | |
|---|---|---|
| MFC flow output matches programmed setpoint but actual independently measured gas flow exceeds allowable accuracy error | * Actual process gas does not match current gas instance for MFC<br>* Low vapor pressure gas has condensed in the upstream process line<br>* Contaminated thermal flow sensor / bypass combination | * Verify actual process gas in use matches programmed gas instance in CONFIG mode of diagnostic interface<br>* Verify ambient temperature exceeds saturation temperature for the process gas at measured supply pressure by at least 10 degrees<br>* Verify performance of another known good MFC within same panel to validate standard. If readings are acceptable with new MFC, thermal flow sensor / bypass combination may be contaminated.<br>Return MFC for repair service per instructions above |
| MFC flow output matches programmed setpoint at higher flows but will not go to zero | * Improper zero of MFC<br>* Inlet pressure too high<br>* Contamination / particles trapped between valve plug and orifice | * Create known zero flow condition per SEMI approved procedure and re-zero MFC to remove offset<br>* Verify normal operating pressure differential is within design specification listed in Appendix A<br>* Provide valve CLOSE override command and verify flow is within closed conductance specification listed in Appendix A.<br>Return MFC for repair service per instructions above |
| MFC transient response shows large overshoot on changes in setpoint OR respondes slowly to changes in programmed setpoint | * Actual process gas does not match current gas instance for MFC<br>* Inlet pressure too high<br>* Inlet pressure too low<br>* Improper control parameters | * Verify actual process gas in use matches programmed gas instance in CONFIG mode of diagnostic interface<br>* Verify normal operating pressure differential is within design specification listed in Appendix A<br>* Verify normal operating pressure differential is within design specification listed in Appendix A<br>* Contact applications engineer for assistance prior to returning unit for service and repair. |

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# Chapter Five: Diagnostic Interface Setup, Configuration, and Operation

The auxiliary interface is a supplemental digital interface that can be used for diagnostics and monitoring purposes. It is not used to control the IE500A / IE1000A Mass Flow Controller during normal operation. To access the diagnostic features of the mass flow controller through the on-board auxiliary interface, follow Steps 1 and 2 before proceeding to the section titled "Step 3: Connect to the IE500A / IE1000A Mass Flow Controller".

### Accessing Ethernet Diagnostic Interface

To ensure that the IE500A / IE1000A High Flow Rate Mass Flow Controller meets IP66 requirements, the auxiliary interface of the includes a cover plate with sealing gasket and screws. Care must be taken when removing and reinstalling the cover plate and gasket to ensure the IE500A / IE1000A maintains the ingress protection rating of IP66.

***Removing and installing Ethernet interface cover***

Accessing the diagnostic interface
a) Remove (QTY 3) #6-32 sealing screws using Phillips head screwdriver
b) Remove cover plate and gasket
c) Access auxiliary diagnostics and monitoring port

Reinstalling the diagnostic interface cover
a) Place the gasket and the cover plate over the port. Note that the "flat" face of the cover plate is placed against the gasket and the face with smooth radiuses faces outward.
b) Using a torque screwdriver with Phillips head bit, secure the cover plate to the enclosure using the (QTY 3) #6-32 seal screws. Torque to 5 in-lbs

**Note** To be IP66 compliant the Ethernet interface must be covered using supplied cover plate, gasket and screws.

## Step 1: Install the Java™ Plug-In

The IE500A / IE1000A High Flow Rate Mass Flow Controller provides an HTML-based diagnostic interface that requires a Java technology plug-in to display real-time data plots.

Perform the following steps:

1. Establish an internet connection and go to the Java website (http://www.java.com) to download the latest Java version.

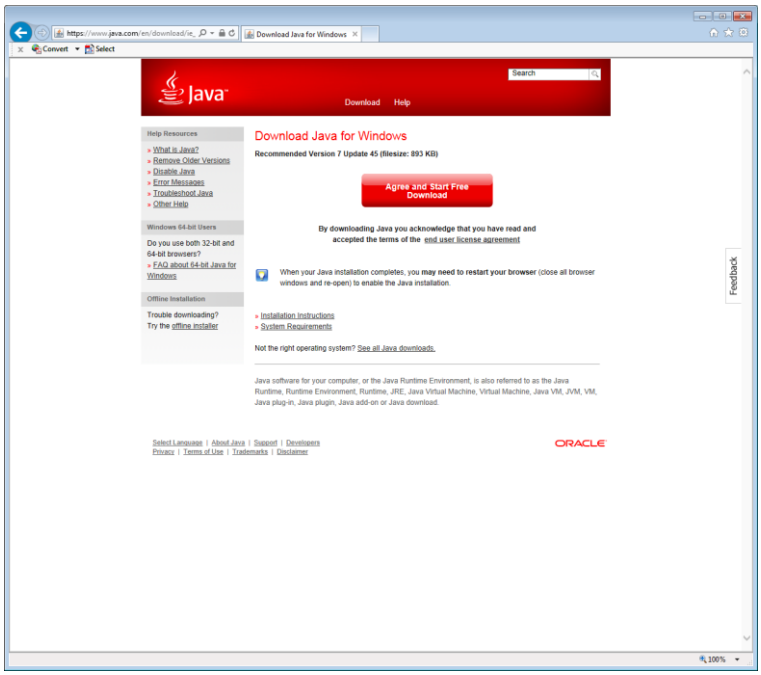



**Figure 10: Java Download Window**

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

## Step 2: Configure TCP/IP Settings for Communication to IE1000A

In order to communicate to an MFC through the Ethernet interface, the host computer must have a unique, static IP address which is in the same general format as the MFC. The following steps describe how to set up the host computer through its local area network connection:

1. Connect a standard CAT-5 Ethernet network cable between the host computer and the MFC.

**Note**

Older computer systems may require the use of a crossover network cable when the host computer is directly connected to the MFC. If the connection between the MFC and the host computer is via an Ethernet hub or Ethernet switch, then standard cables can be used with all host computer connections.

2. For Windows 7, open the <Control Panel> on the Start menu. Select <Network and Internet> and <View network status and tasks> to view the active networks on the host computer.

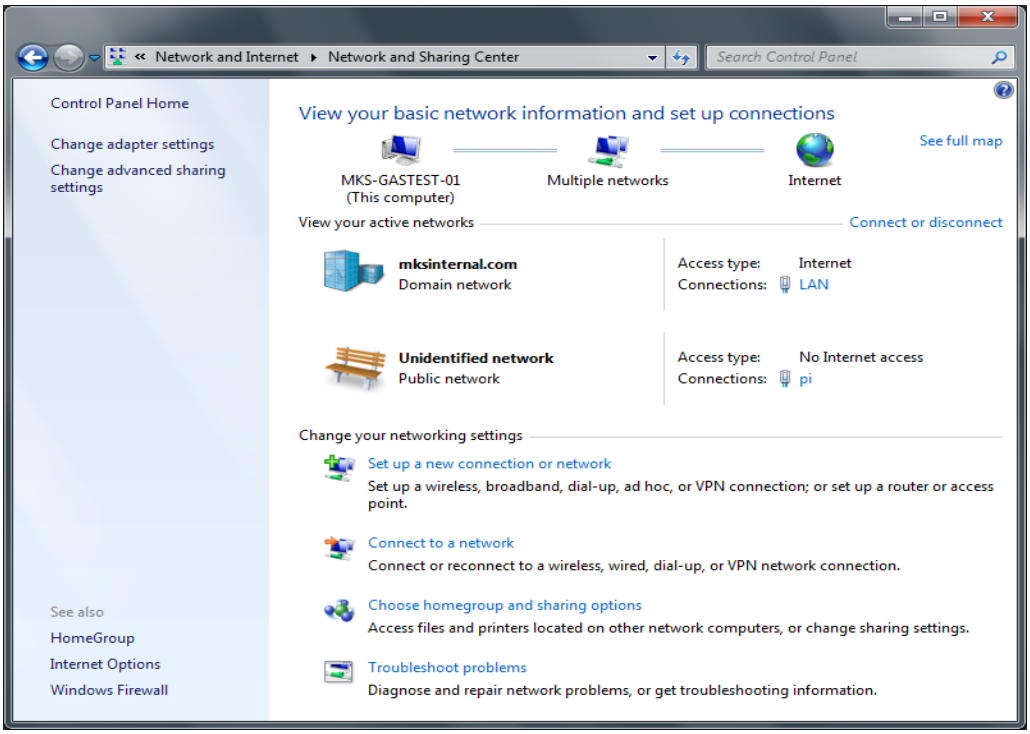



**Figure 11: Windows 7 Network Information Window**

3. Double click on the local area connection to open the status window as shown below.

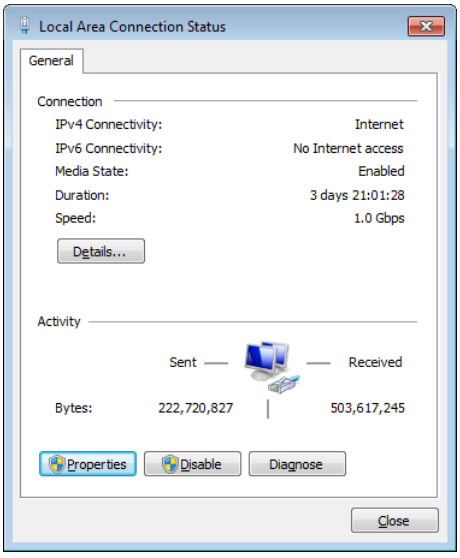



**Figure 12: Windows 7 LAN Stats Dialog Box**

4. Click on the “Properties” button to open the advanced settings window for the LAN connection, as shown in the figure below.

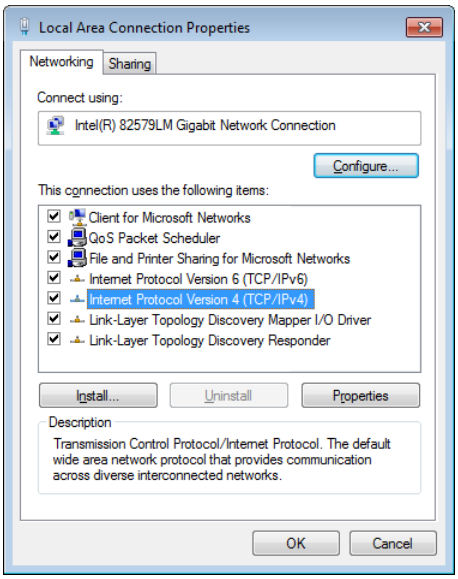



**Figure 13: Windows 7 LAN Properties Dialog Box**

5. Left click to highlight <Internet Protocol Version 4 (TCP/IPv4)>. Select <Properties>
6. A new pop up will appear related to "Internet Protocol Version 4 (TCP/IPv4) Properties" which allows you to change the default IP address of the communication port:

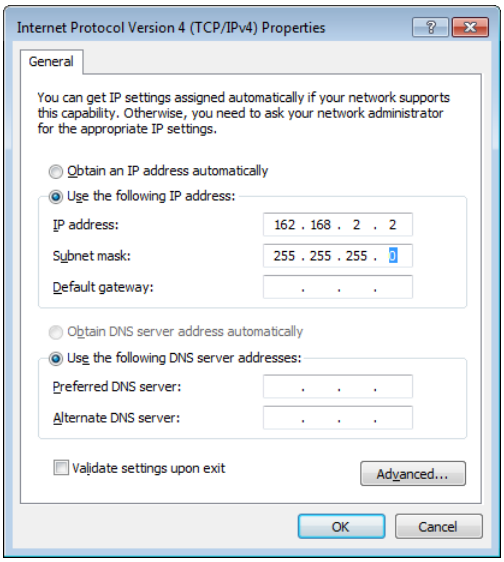



**Figure 14: Windows 7 IP Properties Dialog Box**

7. Select "Use the following IP Address"
8. Enter a unique IP address.

**Note** The IE1000A High Flow Rate Mass Flow Controller's IP address format is 192.168.2.155. Your host computer's IP address must also be of the format 192.168.2.XXX, where XXX is some number between 0 and 255. The host computer IP address must be unique. A recommended IP address for your Host computer is 192.168.2.2 with a subnet mask of 255.255.255.0.

9. Hit the <Tab> key on the left hand side of the keyboard and a subnet mask is automatically entered.
10. Click OK to close the window.
11. Close the remaining network connection windows

The host computer is ready for communication with the IE500A / IE1000A High Flow Rate Mass Flow Controller.

## Step 3: Connect to the IE1000A High Flow Rate Mass Flow Controller

Before trying to connect to the IE1000A High Flow Rate Mass Flow Controller, the communications network must be set up correctly. Complete the steps listed above if you have not already done so.

1. Launch an HTML browser.
2. Enter "http://192.168.2.155" in the address field.
3. Click "Go".

Internet Explorer will open and display the Device page in Monitor Mode. This page will show the model number and serial number of the IE500A / IE1000A High Flow Rate Mass Flow Controller. The serial number can always be found in the bottom left-hand corner of the browser window.

The modes are described in detail below.

## Monitor Mode

"Monitor Mode" allows the user to monitor the IE500A / IE1000A High Flow Rate Mass Flow Controller's performance. In order to configure the mass flow controller, (which includes zeroing the device, changing IP addresses, and creating new process gases), the "Setup" mode should be used.

Each of the pages in Monitor Mode are listed and described below in detail.

### Monitor Mode / Device Page

The Monitor Mode / Device Page displays the general information for the MFC including the currently selected process gas instance, SEMI gas number, calibration gas, minimum and maximum full scale flows allowed for that process gas, and the MFC's current programmed full scale flow rate for the current process gas.

**Note** The IE500A / IE1000A's model number and serial number can always be found in the bottom left-hand corner of the browser window.

The figure below shows a screen capture of the Monitor Mode / Device Page for the MFC.

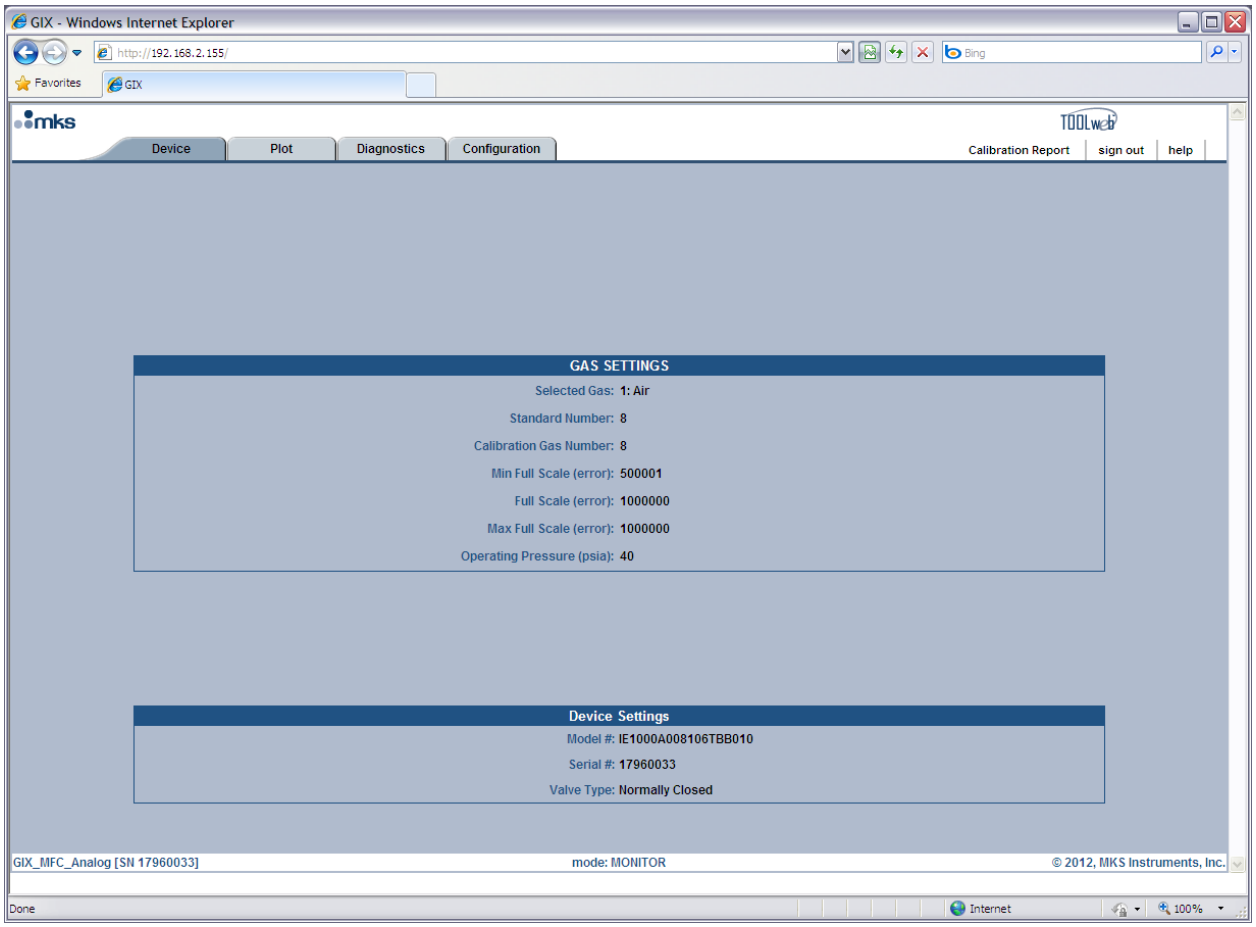



**Figure 15: IE1000A Embedded Interface (Monitor Mode / Device Page)**

## Monitor Mode / Plot Page

The Monitor Mode / Plot Page shows real-time performance of the device. From this page, the user is able to select the variables to plot, the rate at which to plot them, and the filename under which to save the data that has been plotted.

**Note** The Plot Page requires a java applet to use the plot program. This applet, which must be installed on the computer trying to view the page, can be downloaded by following the instructions listed previously.

### *Monitor Mode / Plot Page / Selecting Variables To Plot*

The performance variables that are available for real time data streaming are shown on the left hand side of the screen under the "Select Variables:" heading.

- *To plot one variable:* Click on the variable you wish to plot.
- *To plot two or more variables:* Select the variables one-by-one while holding down the keyboard's Control Key "Ctrl" down

### *Monitor Mode / Plot Page / Selecting Rate*

Directly below the list of variables is the Rate selection drop down menu. Select the desired data sampling rate at which to plot the variables. Available rates are 1, 2, 5, 10, 50 and 100 Hz. Use a smaller data acquisition rate when plotting more than one variable in order to avoid exceeding the buffer capability.

### *Monitor Mode / Plot Page / Starting and Stopping the Plot Program*

Below the Rate selection is the Start/Stop button for the plot applet. Click on the "Start" button to start the plot program. Click on it a second time (now labeled "Stop") to stop the applet.

### *Monitor Mode / Plot Page / Options (Trace Autoscroll, Rescaling Y Axis, Rescaling X Axis, Save to File)*

Below the Start/Stop button, you should see the Options section. Here you are able to start/stop the autoscrolling feature, rescale the Y-Axis, rescale the X-Axis or save the plot data to a file. These options are described in detail below:

Trace Autoscroll → Unchecking this checkbox will stop the plot program from scrolling in the X-direction. This option only has an effect while the program is running. Rechecking this checkbox will enable the plot program to resume scrolling. The X-Axis scroll bar may be used for manual scrolling.

Rescaling Y-Axis → Next to where it says "Y scale:" enter in the scale (Min) to (Max), and then click on the "Rescale Y-Axis" button. This option only has an effect if the "Trace Autoscroll" checkbox is unchecked or the plot program is stopped. Otherwise the Y-Axis will automatically scale itself to fit all variables being plotted.

Rescaling X-Axis → Entering a value next to where it says "X scale (seconds):" adjusts the number of seconds spanned across the X-Axis, e.g. entering a value of ten seconds sets the X-Axis so that it will show ten second segments at a time. To use this feature, enter the value and then click on the "Rescale X-Axis" button. This option can be used at anytime.

Save to File → The "Save to file" option can be used at anytime once you've started the plot program. The data stored consists of the data collected from the time the Start button was pressed to the time the "Save to file" button is pressed. The file will be saved in a (.csv) format which can be later imported into a spreadsheet or other program for further analysis.

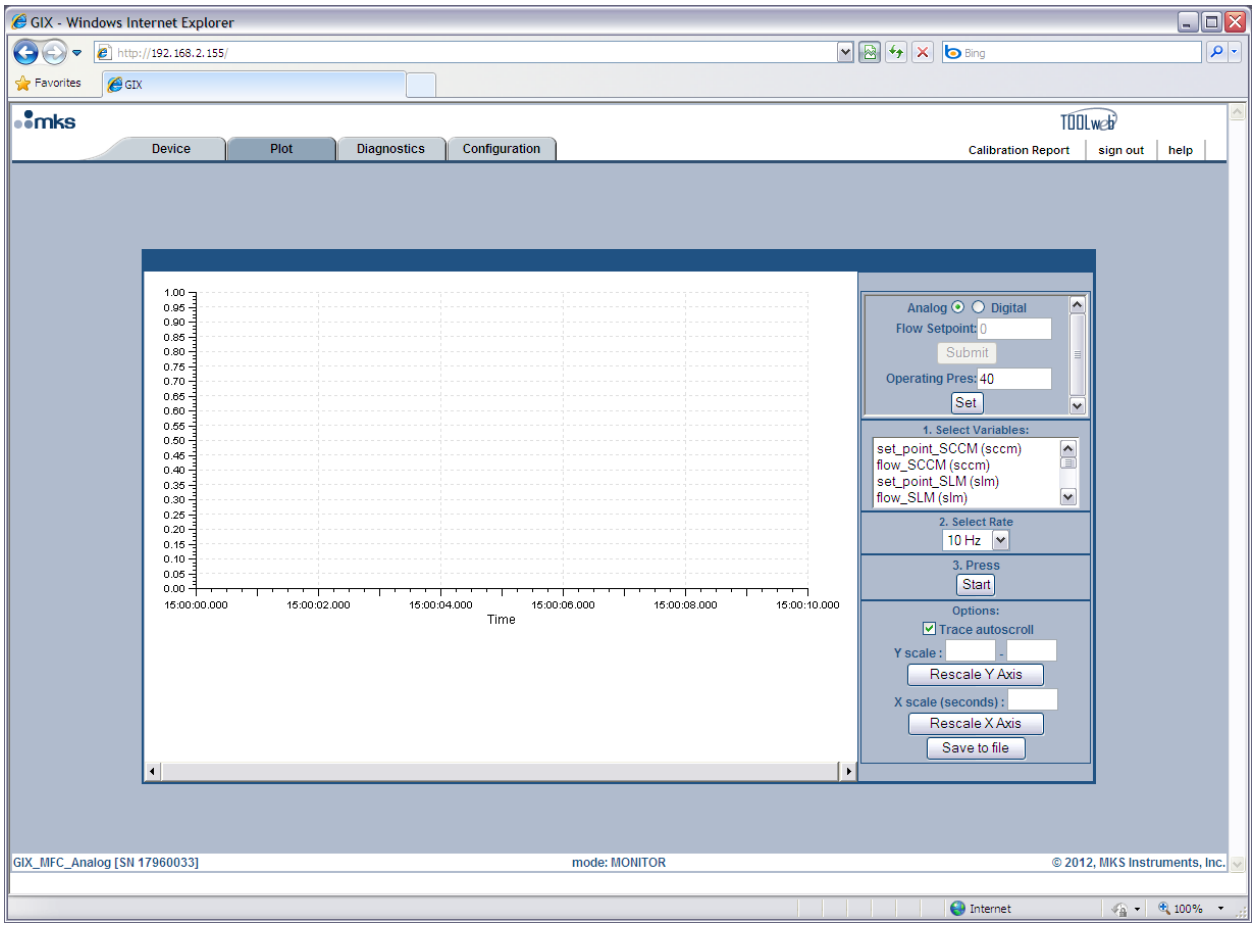



**Figure 16: IE1000A Embedded Interface (Monitor Mode / Plot Page)**

## Monitor Mode / Diagnostics Page

The Monitor Mode / Diagnostics Page consists of two sections: (1) Device Diagnostics and (2) Snapshot.

In the "Device Diagnostics" section, the user can execute basic diagnostic tests on the flow and temperature circuits within the MFC either individually or all at once.

In the "Snapshot" section, the user can acquire device setup data that will allow MKS to diagnose a device problem remotely. Both of these sections are explained in detail below.

### *Monitor Mode / Diagnostics Page / Device Diagnostics*

The tests listed in this section are designed to insure that there are no major electrical problems and that the sensors are working properly. These tests are described in detail below:

*Raw Flow* → The Raw Flow diagnostic test verifies that the flow sensor and the electronics are working properly.

To run this test, select the "Raw Flow" checkbox, and then press the "Run the Test" button. When the test finishes, the test result "Pass" or "Fail" will be displayed next to the checkbox. If the test passes, then the flow circuit is good. If it fails, then there may be a problem.

*Temperature* → The Temperature diagnostic test verifies that the temperature sensor and the electronics are working properly.

To run this test select, select the “Temperature:” checkbox, and then press the “Run the Test” button. When the test finishes, the test result “Pass” or “Fail” will be displayed next to the checkbox. If the test passes, then the temperature circuit is good. If it fails, then there may be a problem.

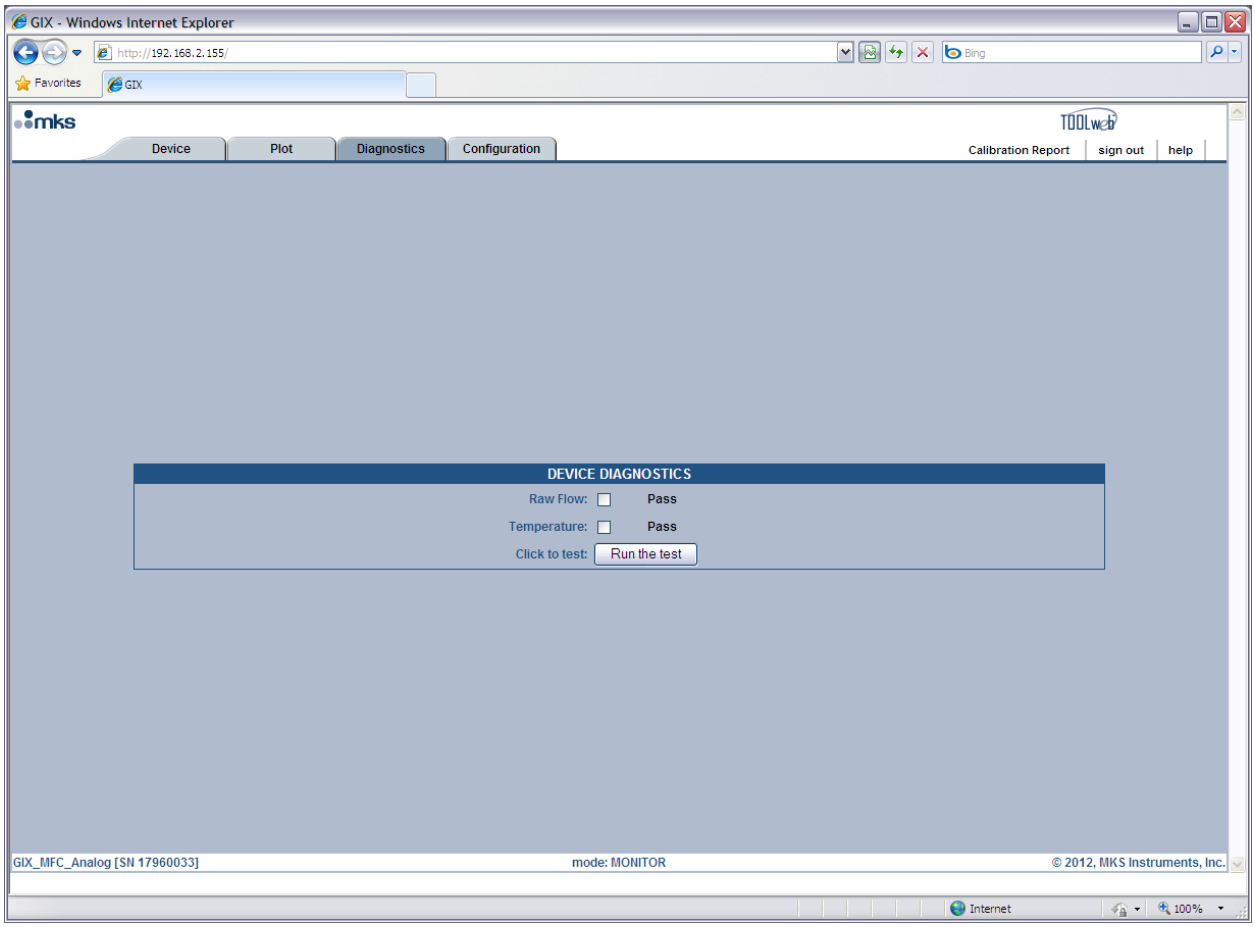



**Figure 17: IE1000A Embedded Interface (Monitor Mode / Diagnostics Page)**

## Monitor Mode / Configuration Page

This Monitor Mode / Configuration Page displays the TCP/IP settings and the current firmware version for the MFC. The Configuration Page allows the user to enter the “Setup Mode” of the device when the proper access password is supplied. The factory-shipped password is “config” (without the ““). The figure below shows a screen capture of the Configuration Page in “Monitor Mode.”

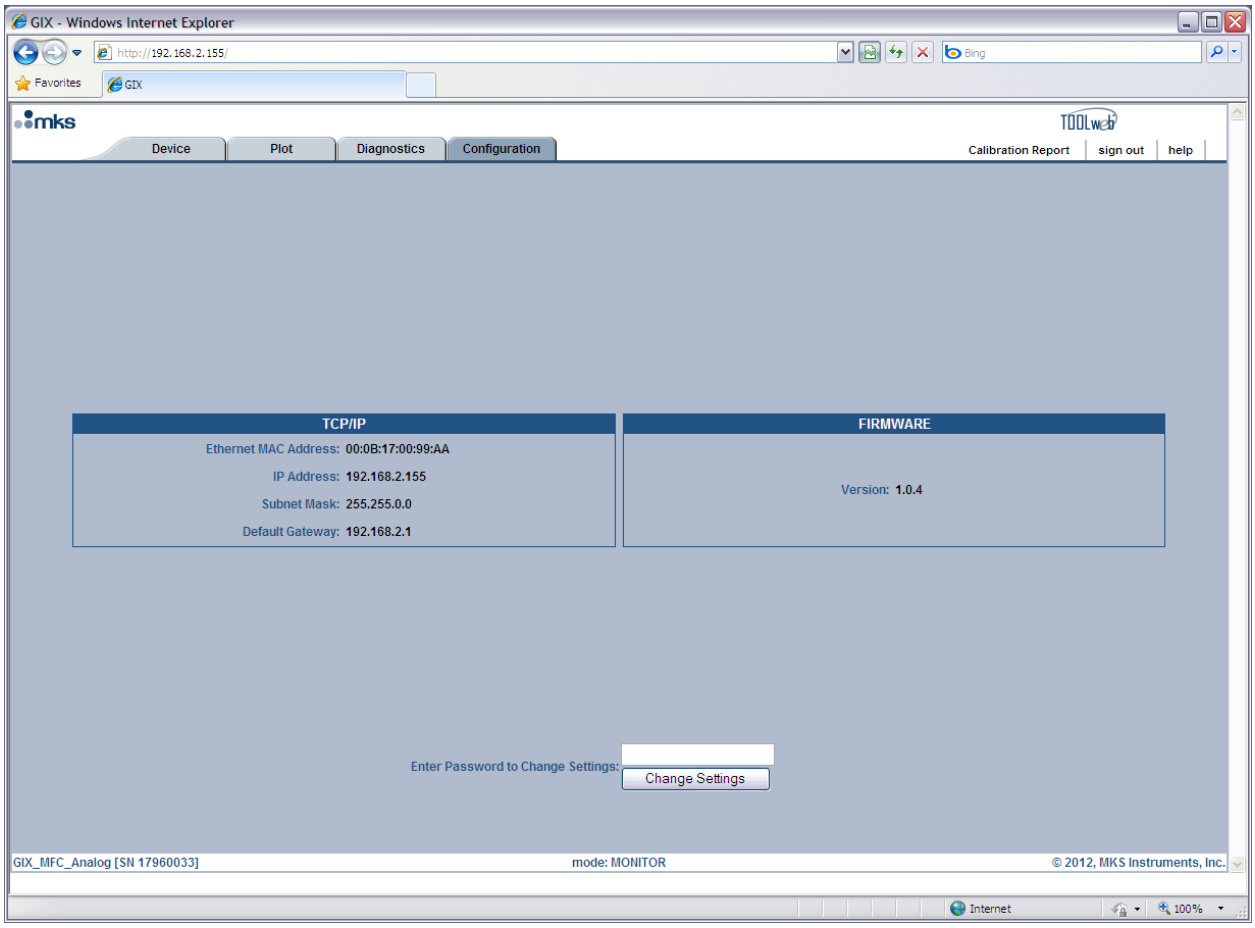



**Figure 18: IE1000A Embedded Interface (Monitor Mode / Configuration Page)**

## Setup Mode

In "Setup Mode" the user is able to configure the MFC, i.e. zero the device, change the IP address, configure the PID parameters, etc. To enter this mode, while in "Monitor Mode", go to the "Configuration Page" and enter the Factory-shipped password "config" (without ""). Once you press the "Change Settings" button you will be directed to the "Configuration Page" in "Setup Mode." You should now a see a green banner that lines the top of the page that says, "The device is now in SETUP mode."

Each of the pages, i.e. tabs, in "Setup Mode" are listed and described below in detail starting with the Device Page. Please note that this section will only describe in detail the features that are different from those in "Monitor Mode." For a complete understanding of each page, also read the *Monitor Mode* section.

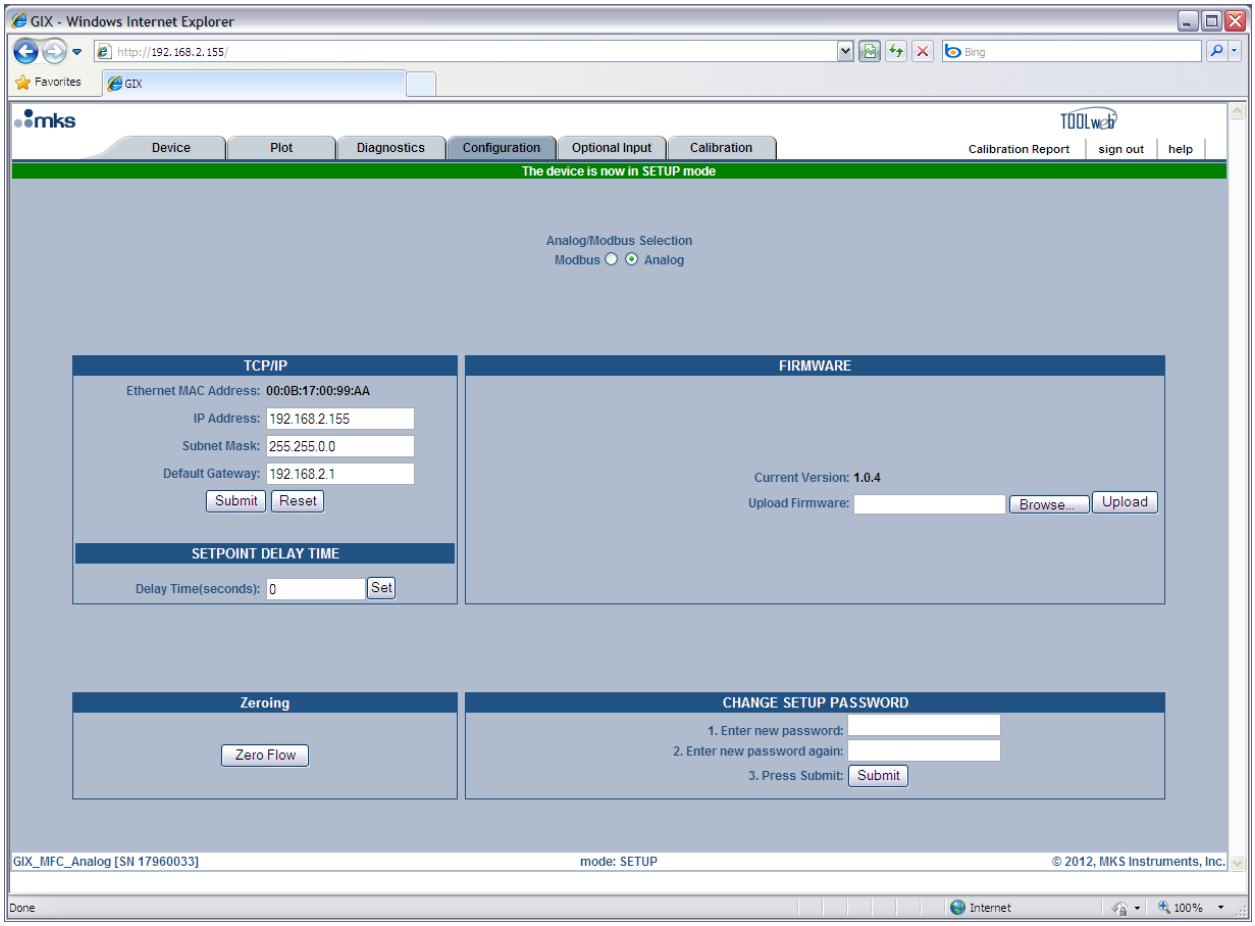



**Figure 19: IE1000A Embedded Interface (Setup Mode / Configuration Page)**

## Setup Mode / Device Page

In "Setup Mode" this page gives you the ability to modify the gas settings.

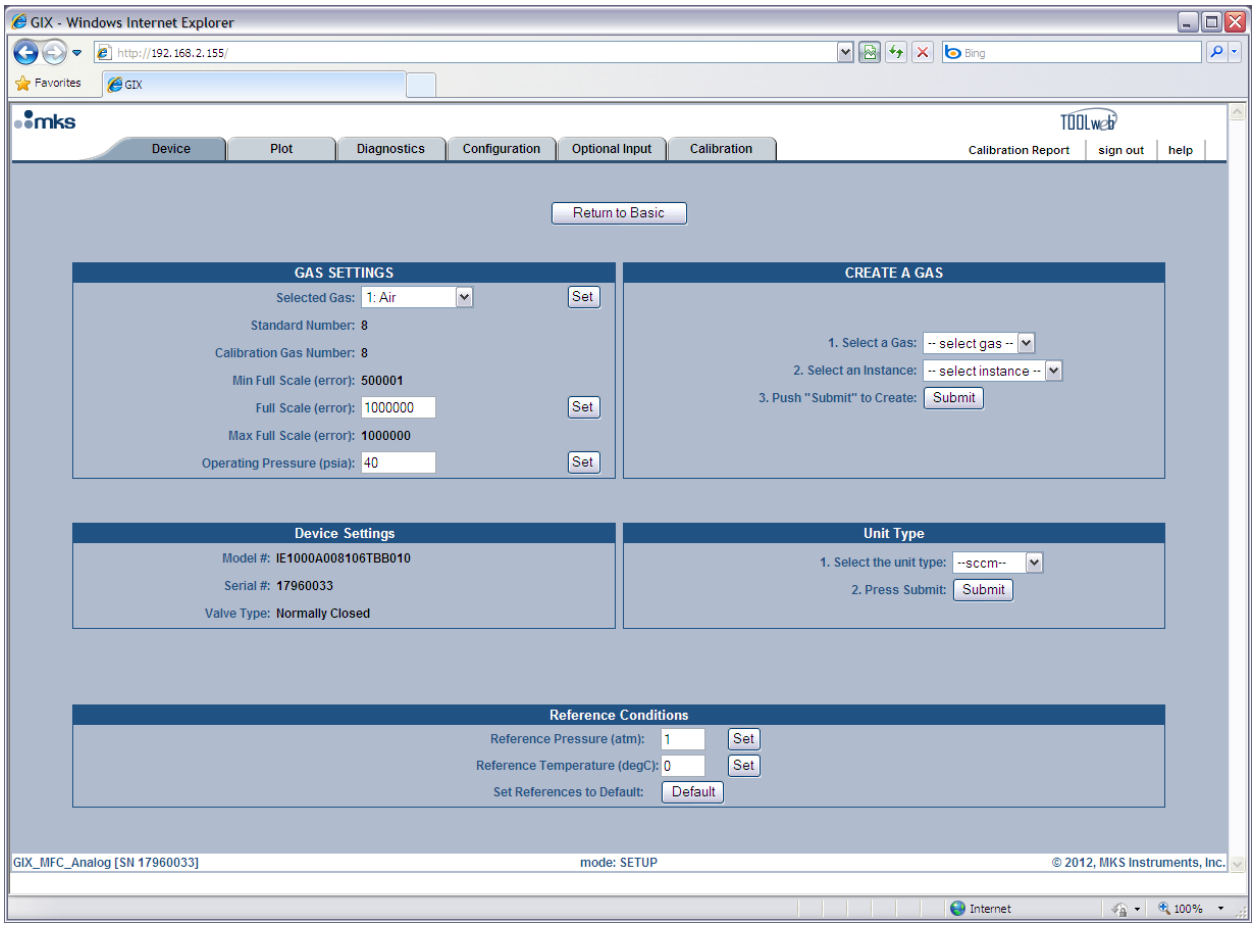



**Figure 20: IE1000A Embedded Interface (Setup Mode / Device Page)**

Gas Settings: The Device Page enables the user to change the MFC's gas settings. To change the gas settings review the following possible operations on the following pages.

- To create a new gas instance
- To change the full scale range of the current gas instance
- To set the MFC to a different gas instance

***Setup Mode / Device Page / Creating A New Gas Instance***

*(Refer to figure below during the following steps.)*

In the "Create A Gas" section of the Device Page:

1. Click on the "select gas" drop-down menu arrow and find the gas you'd like to create.
2. Click on the "select instance" drop-down menu arrow and find an instance that says "No Gas." *Please note that you can write or re-write to any instance except instance 32, which is the Factory calibration.*
3. Press the "Submit" button.

4. This process typically takes under one minute to complete. When the process is completed, the browser will display a green banner across the top of the Device Page that says, "Gas Selection Update SUCCEEDED."
5. You should now see the newly created gas and its attributes now listed in the "Gas Settings" section of the Device Page. At this point, if you want to change the full scale, then go ahead to the next section.

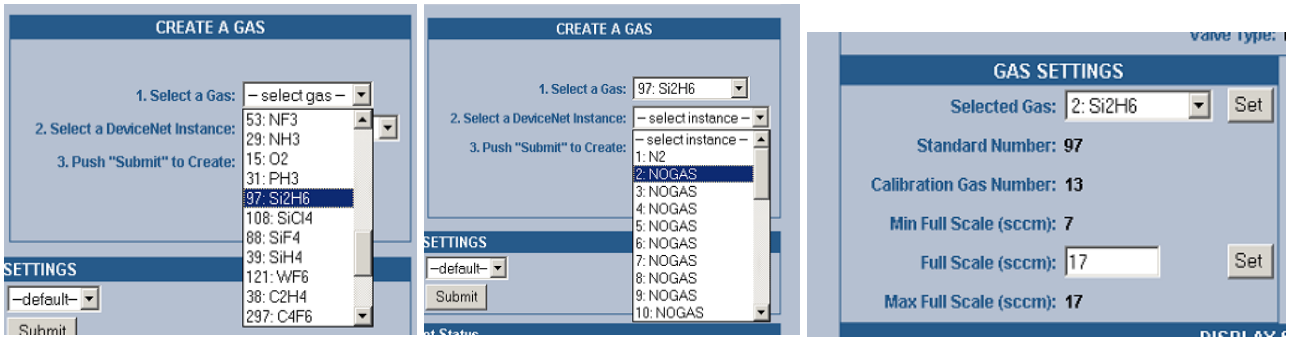



**Figure 21: IE1000A Embedded Interface (Setup Mode / Device Page) Creating A New Gas Instance**

***Setup Mode / Device Page / Changing the Full Scale Flow Range***

In the "Gas Settings" section of the Device Page the user is able to change the full scale gas flow range to any number between the "Min Full Scale (sccm)" and the "Max Full Scale (sccm)" values.

To do this, enter in the desired full scale range in the "Full Scale (sccm):" field and then press the "Set" button. This operation typically takes less than one minute.

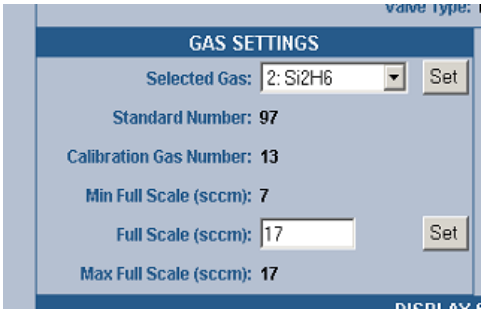



**Figure 22: IE1000A Embedded Interface (Setup Mode / Device Page) Changing Full Scale Flow Range**

***Setup Mode / Device Page / Changing the Active Gas Instance***

In the "Gas Settings" section of the Device Page the user is able to change the active gas instance.

To change the "Selected Gas", click on the drop-down menu's arrow and select one of the gases that have been created. *Please note that you are able to select the Factory calibration gas instance (32) but you can not change anything. Instance (1) is an exact replica of that instance* if it has not been overwritten by the user on previous modifications to the gas tables.

Once you've selected the instance you want press the "Set" button. The gas will change within ten seconds. You'll notice that the "Standard Number" and the minimum and maximum full-scale ranges will change also.

## Setup Mode / Plot Page

In "Setup Mode" this page enables the user to adjust the PID settings to optimize control performance. To learn more about how to tune the MFC to your system see the Operation section. This section only deals with setting the values.

The figure below is a screen capture of the Plot Page in "Setup Mode." The control parameter section is located above the "Select Variables" section in the top right-hand corner of the page. This page enables you to send a setpoint to the MFC through Ethernet (see notes below), watch the MFC's performance on the plot, and adjust the PID parameters accordingly to optimize the performance of the MFC. You should find that tuning a device has never been easier.

**Note** For Analog units, sending a setpoint through Ethernet will not work unless the Analog checkbox is selected. This checkbox tells the device to bypass the analog setpoint on the analog/power interface. To begin sending setpoints through the analog interface again, either uncheck the Analog checkbox or close the browser.

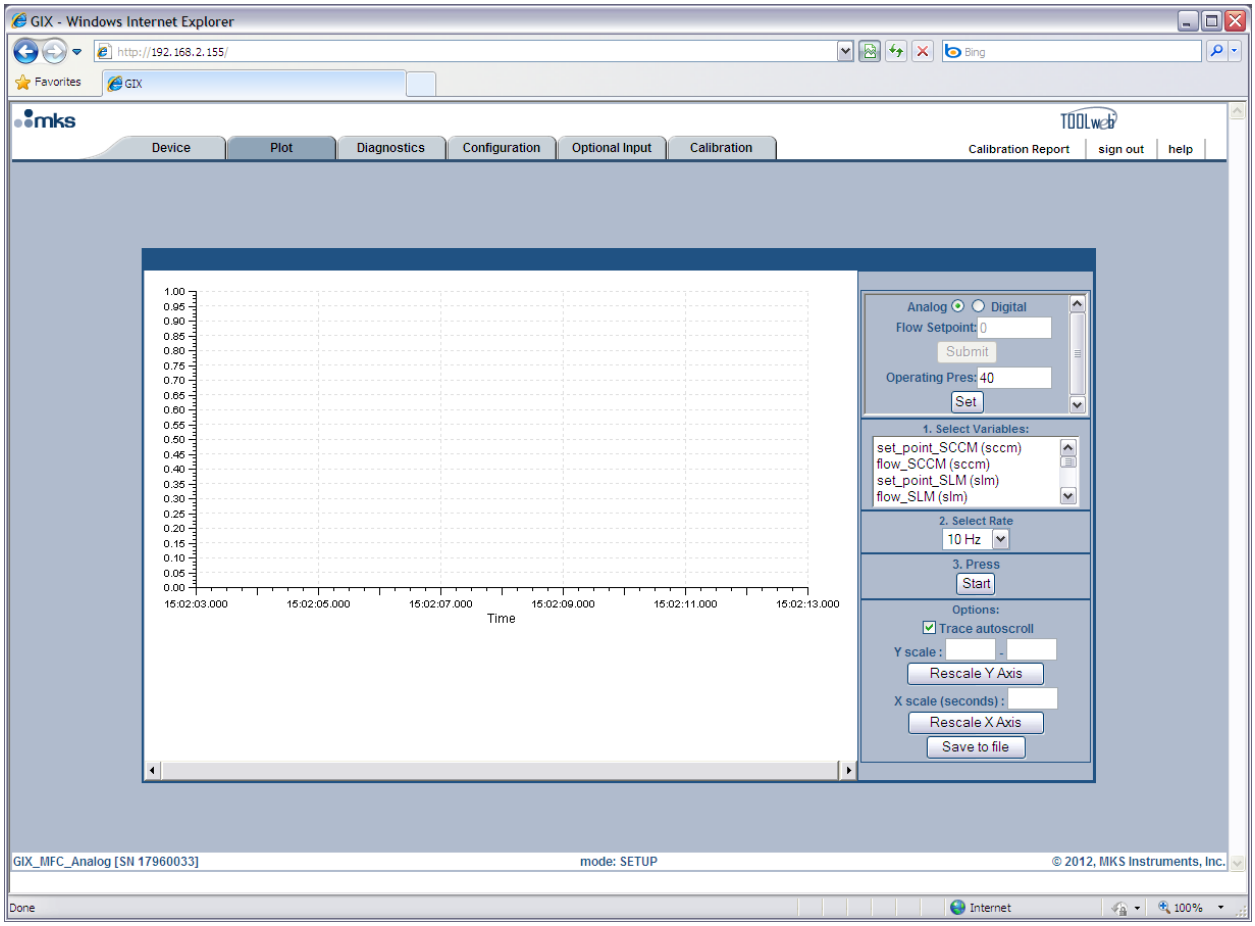



**Figure 23: IE1000A Embedded Interface (Setup Mode / Plot Page)**

Before a MFC leaves the factory the performance is checked with Nitrogen in a typical application. During this test the control parameters are set so that the device's performance is optimized. These factory set control parameters are then saved to the device and can be restored to the device at any time by pressing the "Factory Restore" button. To change the current PID variables in the device, enter in a value for the Kp (gain), Ki (integral) and/or Kd (derivative) parameters and press the "Submit" button.

### Setup Mode / Diagnostics Page

There is no difference between this page in "Setup Mode" versus this page in "Monitor Mode."

## Setup Mode / Configuration Page

As was noted earlier, the Configuration Page is where you are initially directed once you've entered "Setup Mode." Here the MFC can be zeroed, the "Setup Mode" password can be changed, changes can be made to the Ethernet settings and firmware can be updated.

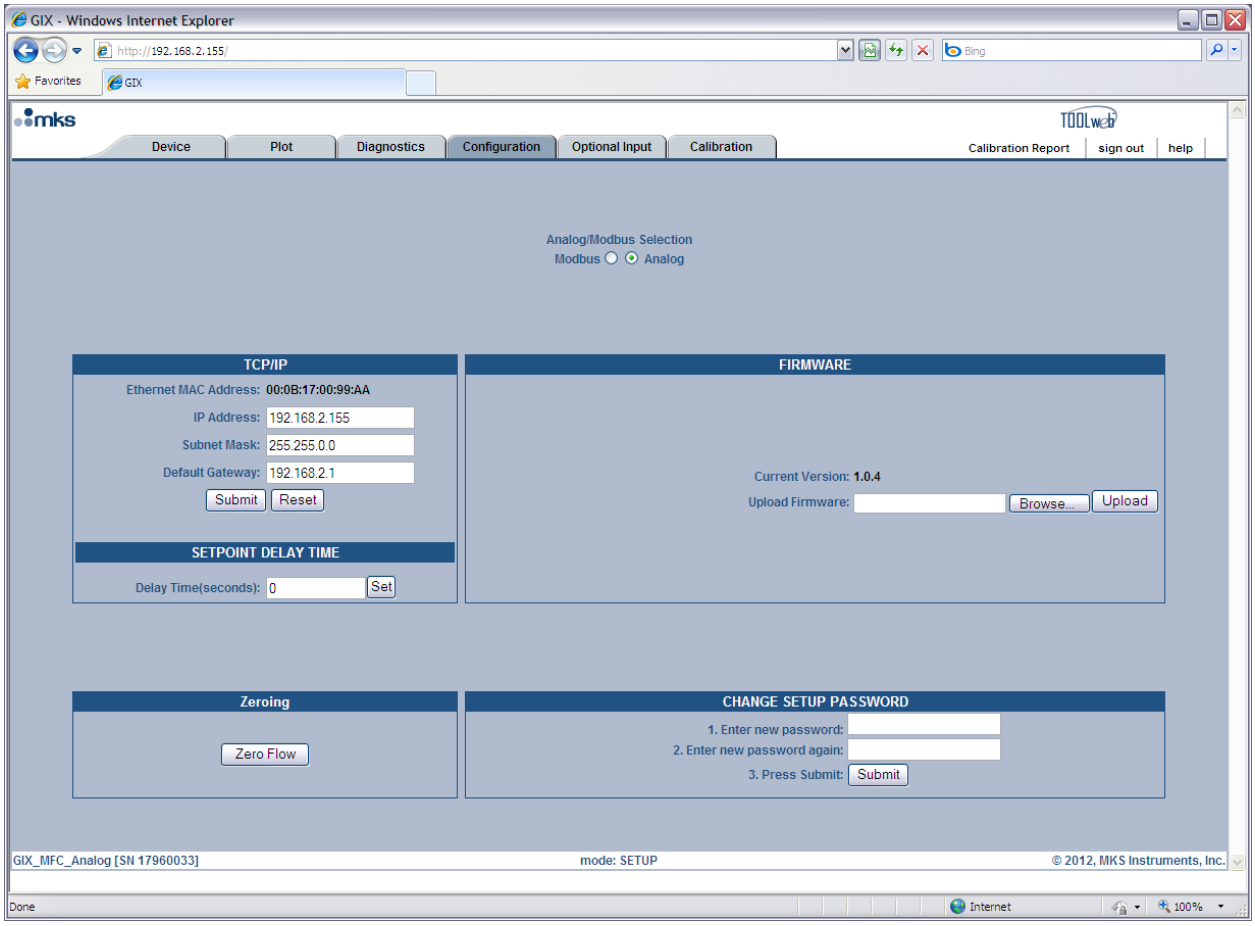



**Figure 24: IE1000A Embedded Interface (Setup Mode / Configuration Page)**

### *Setup Mode / Configuraton Page / Zeroing the MFC*

For the MFC there will be a "Zero Flow" option. Before zeroing the value make sure the "Zero Adjustment" procedure has been followed correctly. To zero the flow, press the "Zero Flow" button. A green banner across the top of the page will tell you if the device received the command and is processing. Zeroing typically will take (10) seconds. The MFC will be unresponsive during this time.

**Caution** **Zeroing the flow incorrectly can cause system failure. Make sure that the "Zero Adjustment" procedure is followed properly.**

### *Setup Mode / Configuraton Page / Changing the Setup Mode Password*

To change the "Setup Mode" password from the default password "config," follow the steps in the "Change Setup Password" section.

### *Setup Mode / Configuraton Page / Changing the Ethernet (TCP/IP) Settings*

The TCP/IP section allows you to change the IP Address, Subnet Mask, and Default Gateway for the MFC.

**Caution** **If you are unfamiliar with setting TCP/IP settings for the MFC, please contact your company's IT personnel or local MKS representative for help. If settings are done incorrectly, you may no longer be able to connect to the MFC over Ethernet.**

To set a new IP Address, enter in the IP address and press the "Submit" button. Pressing the "Reset" button will reset the entry fields to what was in them prior to you making any changes. For the new IP address to take effect the power to the MFC must be cycled. To use the Embedded GUI, you must now change the URL to reflect the new IP address, e.g. http://xx.xx.xx.xx, where xx.xx.xx.xx is the new IP address for the MFC.

### *Setup Mode / Configuraton Page / Updating Firmware*

Updating firmware is the responsibility of your local MKS representative. If any updates are "necessary", then your local representative will be in contact to set up a time to complete the upgrade. Please note that a "necessary" update is one that is deemed "Critical" by the factory.

## Setup Mode / Optional PC Page (Analog 15 pin MFC's Only)

The Setup Mode / Optional PC page is only available in Setup Mode for analog 15-pin devices. Here the MFC can be setup to control to an external signal, e.g. a Baratron capacitance manometer to control pressure. The external signal full scale input voltage can be set to 10 VDC (*default*) or 5 VDC, and the TCP/IP settings can be viewed. The figure below shows a screen shot of this page.

**Note**

Once the Optional Input is enabled, any setpoint sent to the device will cause the device to control relative to the external signal input. To set the device so that it controls to its own internal sensor the optional input must be disabled.

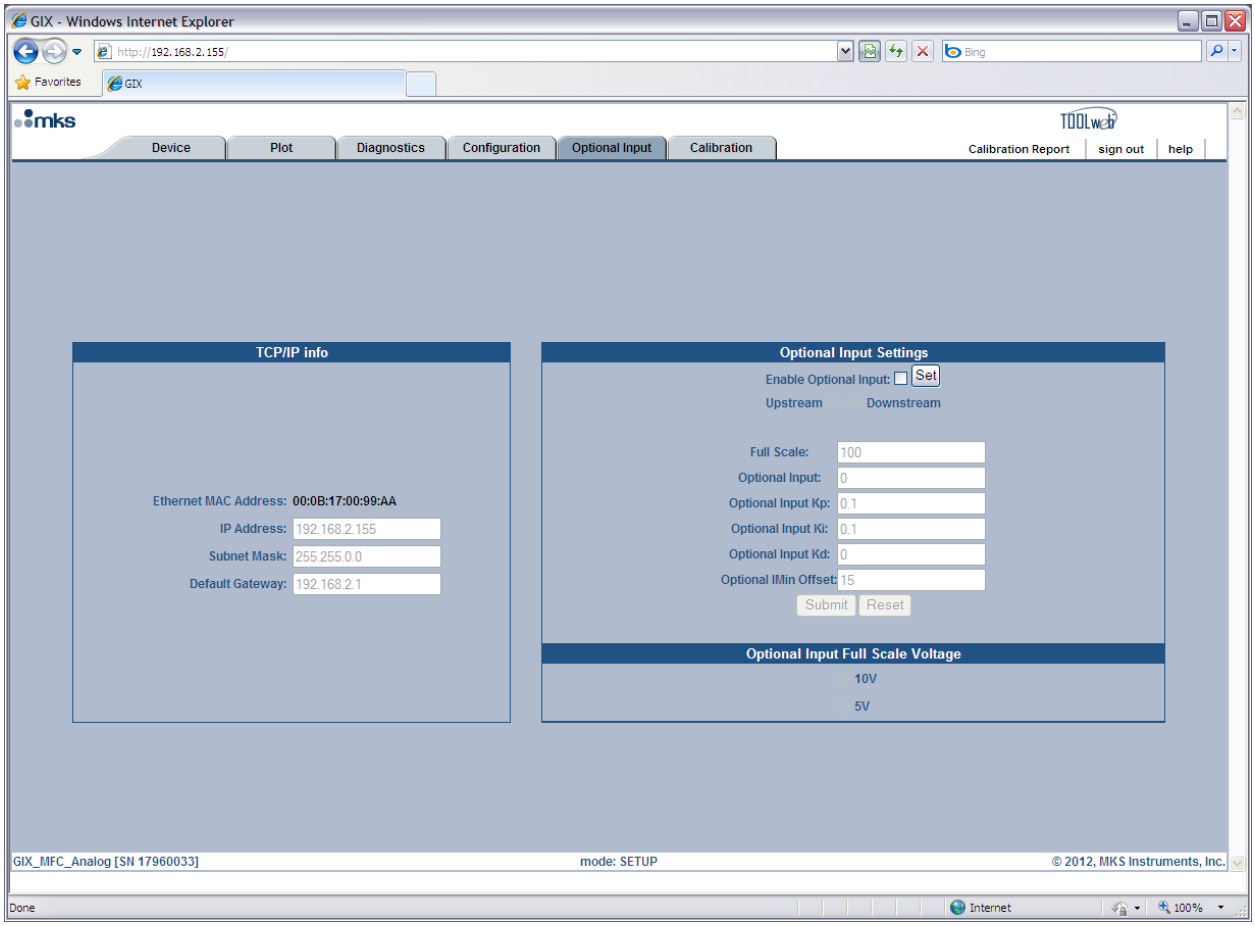



**Figure 25: IE1000A Embedded Interface (Setup Mode / Optional PC Page)**

### *Setup Mode / Optional PC / Enabling the Optional Input*

To enable the Optional Input, check the "Enable Optional Input" box and then click the "Set" button. You should now see the fields below the checkbox become enabled (text darkens). The fields are described below.

Full Scale: In this field you should enter the full scale range of the external signal. For example, if you have a Baratron capacitance manometer with a full scale of 100 Torr, then you would put a value of 100 in this field. To enter this value you must click the "Submit" button.

Optional Input: This field reports back what the optional input device is reading. Please note that this value is dependent upon the value in the Full Scale field. To refresh this value, you must refresh the browser. If you desire to watch a continuous data stream of the optional input, then you'll need to go to the plot page.

Optional Input Kp, Optional Input Ki, Optional Input Kd: These values are the PID parameters for Optional Input control. Typically these will be set to match the standard Kp, Ki and Kd values that are factory set before shipment. For information on how to tune your MFC for optimal performance please see *Tuning the MFC for Optional PC* in the following section. This section discusses tuning the standard PID values, but the same rules apply to the optional input parameters. To set any of these parameters you must click the "Submit" button. You can also set these parameters on the Plot Page.

**Note** A MFC is typically used as a PI controller only. If the derivative term (Kd) is going to be used, it is recommended that you increase the value in increments of 0.001.

### *Setup Mode / Optional PC / Changing the Optional Input Full Scale Voltage*

In the Optional Input Full Scale Voltage section of the page you have the ability to tell the πMFC whether or not the Optional Input signal has a full scale voltage of 10 Volts (*default*) or 5 Volts. To change the voltage click the correct option box and then click the "Submit" button located directly above this section.

### *Setup Mode / Optional PC / TCP/IP Info*

On this page you are only allowed to view the current TCP/IP info for the MFC.

### *Optional PC and the Plot Page*

Once you enable the Optional Input the Plot Page will include it in the variable list. A screen capture of the Plot Page with the Optional Input enabled is shown below. You can see the "Optional Input" variable listed in the variable list.

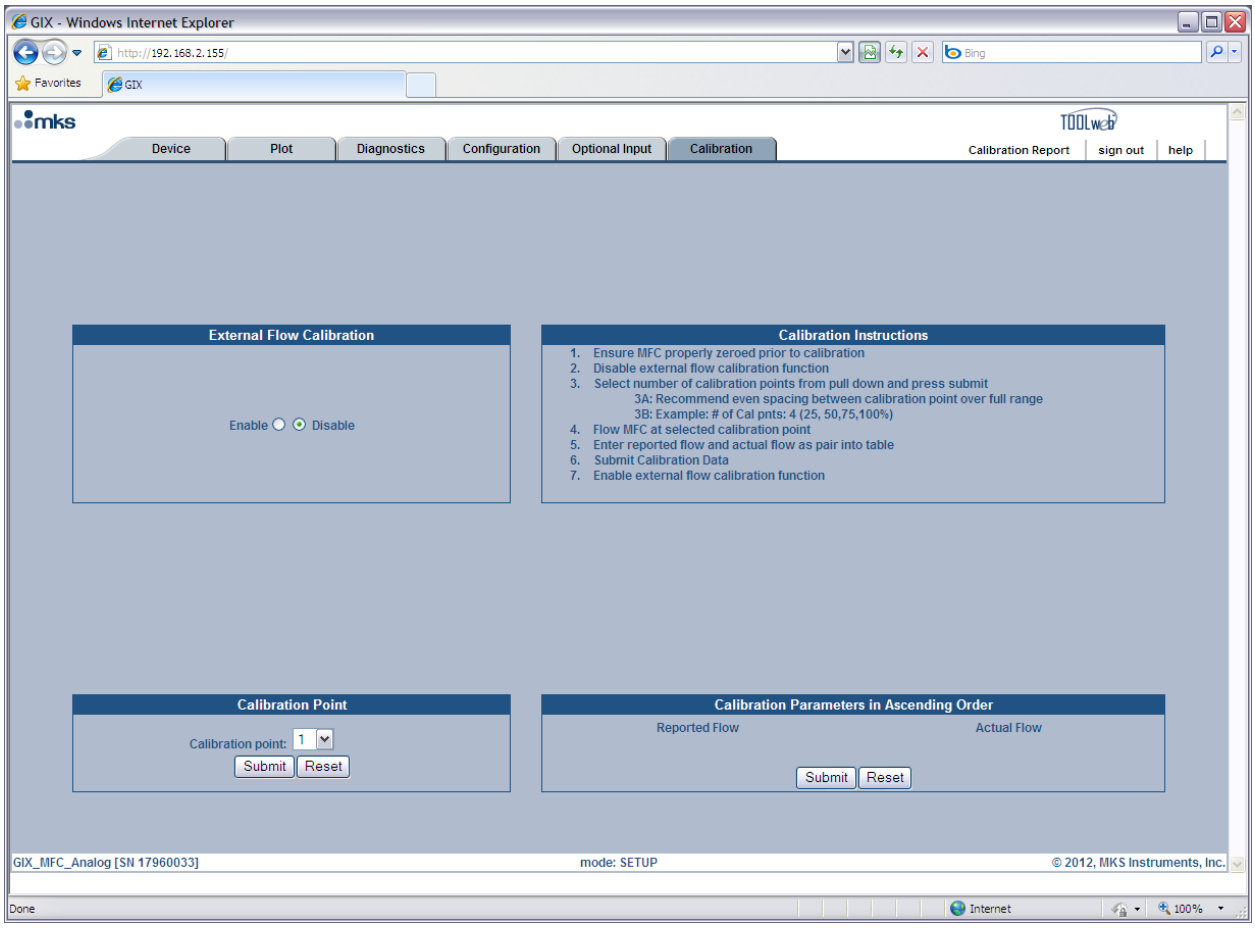
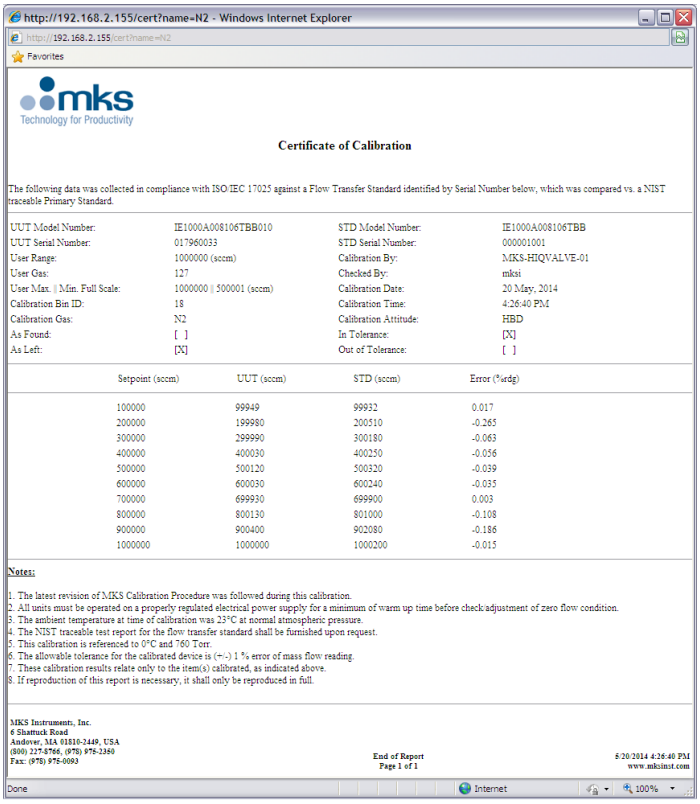



**Figure 26: IE1000A Embedded Interface (Setup Mode / Plot Page) Enabled Optional Input**

The Optional PID parameters are always settable on the plot page, but they will have no effect unless the Optional Input is enabled. If not already set, it is recommended that these values be set to the standard Kp, Ki and Kd values initially. The following section discusses tuning the standard PID values, but the same rules apply to the optional input parameters.

**Note** A MFC is typically used as a PI controller only. If the derivative term (Kd) is going to be used, it is recommended that you increase the value in increments of 0.001.



http://192.168.2.155/cert?name=N2 - Windows Internet Explorer

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**Certificate of Calibration**

The following data was collected in compliance with ISO/IEC 17025 against a Flow Transfer Standard identified by Serial Number below, which was compared vs. a NIST traceable Primary Standard.

| | | | |
|---|---|---|---|
| UUT Model Number: | IE1000A008106TBB010 | STD Model Number: | IE1000A008106TBB |
| UUT Serial Number: | 017960033 | STD Serial Number: | 000001001 |
| User Range: | 1000000 (sccm) | Calibration By: | MKS-HIQVALVE-01 |
| User Gas: | 127 | Checked By: | mksi |
| User Max. \| Min. Full Scale: | 1000000 \| 500001 (sccm) | Calibration Date: | 20 May, 2014 |
| Calibration Bin ID: | 18 | Calibration Time: | 4:26:40 PM |
| Calibration Gas: | N2 | Calibration Attitude: | HBD |
| As Found: | [ ] | In Tolerance: | [X] |
| As Left: | [X] | Out of Tolerance: | [ ] |

| Setpoint (sccm) | UUT (sccm) | STD (sccm) | Error (%rdg) |
|---|---|---|---|
| 100000 | 99949 | 99932 | 0.017 |
| 200000 | 199980 | 200510 | -0.265 |
| 300000 | 299990 | 300180 | -0.063 |
| 400000 | 400030 | 400250 | -0.056 |
| 500000 | 500120 | 500320 | -0.039 |
| 600000 | 600030 | 600240 | -0.035 |
| 700000 | 699930 | 699900 | 0.003 |
| 800000 | 800130 | 801000 | -0.108 |
| 900000 | 900400 | 902080 | -0.186 |
| 1000000 | 1000000 | 1000200 | -0.015 |

**Notes:**

1. The latest revision of MKS Calibration Procedure was followed during this calibration.
2. All units must be operated on a properly regulated electrical power supply for a minimum of warm up time before check/adjustment of zero flow condition.
3. The ambient temperature at time of calibration was 23°C at normal atmospheric pressure.
4. The NIST traceable test report for the flow transfer standard shall be furnished upon request.
5. This calibration is referenced to 0°C and 760 Torr.
6. The allowable tolerance for the calibrated device is (+/-) 1 % error of mass flow reading.
7. These calibration results relate only to the item(s) calibrated, as indicated above.
8. If reproduction of this report is necessary, it shall only be reproduced in full.

MKS Instruments, Inc.
6 Shattuck Road
Andover, MA 01810-2449, USA
(800) 227-8766, (978) 975-2350
Fax: (978) 975-0093

End of Report
Page 1 of 1

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Done Internet 100%

**Figure 27: IE1000A Embedded Interface Calibration Sheet**

# Appendix A: Product Specifications

## Performance Specifications

| | |
|---|---|
| Full Scale Flow ($N_2$ equivalent) | 250 to 500 slm IE500A<br>501 to 1000 slm IE1000A |
| Max Inlet Pressure | 150 psig |
| Normal Operating Pressure Differential<br>(ATM pressure @ MFC outlet port) | 40 - 50 psid (dependent on fitting type) |
| Burst Pressure | 1500 psig |
| Control Range | 2 to 100% F.S. |
| Accuracy | ± 1.00 % RDG from > 20% to 100% F.S. (CDA cal gas)<br>± 0.25 % FS from 5% to 20% FS (CDA cal gas) |
| Repeatability | ±0.5 % RDG |
| Resolution | ±0.1 % RDG |
| Temperature Coefficient<br>Zero<br>Span | <br>≤ ±0.05% FS / °C<br>≤ ±0.08% RDG / °C |
| Inlet Pressure Coefficient | < ±0.02% RDG / psig |
| Controller Settling Time<br>(SEMI E17-0600) | < 3 s typical for setpoints above 10 % FS @ 50 psi |
| Warm Up Time<br>(< 0.2 % FS of steady-state performance) | one (1) hour |
| Leak Integrity<br>Internal to external<br>Through closed control valve | <br>< 1 x $10^{-9}$ scc/sec He<br>< 1% FS (40 psia to vacuum less than 500 mTorr) |

## Physical Specifications

| | |
|---|---|
| RoHS Compliant | Yes |
| CE Compliant | EMC Directive 2004/108/EEC |
| Dimensions | 6.67” L (face) x 3.3” W x 6.5” H |
| Weight | ~ 12.7 lbs (5.8 kg.) |
| Fittings | 8 VCO Male 8 VCR Male<br>12 mm Compression 1/2" Compression<br>3/4" Compression<br>1/2" NPT Female 3/4" NPT Female |
| Surface Finish | 16 μ in Ra (average) |
| Valve Type | Normally closed |
| Wetted Materials | 316L SS, Elgiloy, KM-45, PTFE<br>Buna-N, Viton, Neoprene, EPDM |

## Environmental Specifications

| | |
|---|---|
| Ambient Operating Temperature Range | 10° to 50° C (50° to 122 °F) |
| Storage Temperature Range | -20° to 65° C (-4° to 149 °F) |
| Storage Humidity Range | 0 to 95% RH, non-condensing |

## Electrical Specifications

| 15-pin ANALOG | |
|---|---|
| Input Power | +15 - 24 $V_{DC}$ (~ 320 mA @ 24 $V_{DC}$ nominal) |
| Connector | 15-pin DSUB |
| Start-up current (first 5 sec.)<br>Steady state current | 15 VDC (±5 %) @ 2 A<br>15 VDC (±5 %) @ 320 mA |
| Set Point Command Signal | 0 to 5 $V_{DC}$ |
| Flow Output Signal | 0 to 5 $V_{DC}$ |
| Output Impedance | < 1 Ω |

Due to continuing research and development activities, these product specifications are subject to change without notice.

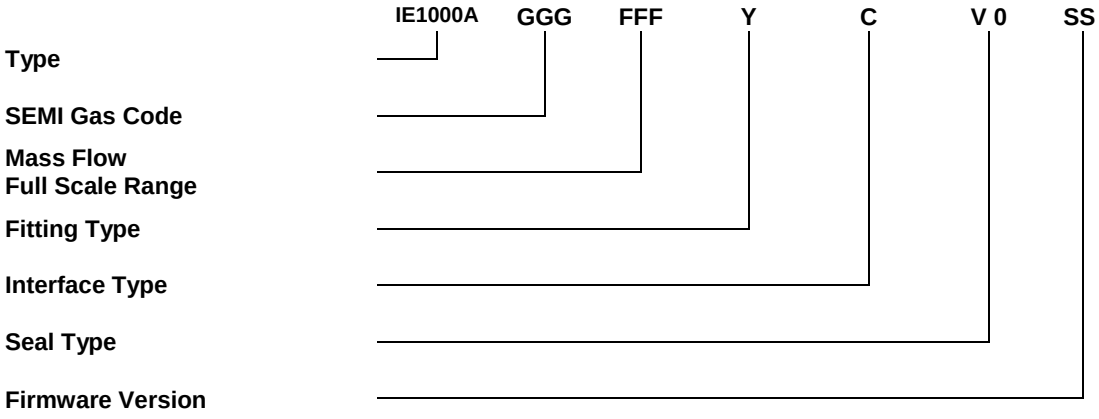
# Appendix B: Model Code Explanation

## Model Code Description

The model code of the IE500A / IE1000A High Flow Rate Mass Flow Controller defines features of the unit such as interface type, process gas, flow range, seal configuration, and firmware revision.

The model code is identified as follows: **IE1000A GGG FFF Y C V 0 SS**

where:




### Controller Type

The type identifies your unit as a specific model IE500A or IE1000A MFC.

### SEMI Gas Code (GGG)

The gas which the MFC is intended to control is identified by its SEMI Gas Code. A partial listing is shown below. The full list is shown in SEMI Document E052-00-0611 and may be found on the SEMI website, www.semi.org, or a complete list shown on the MKS website at www.mksinst.com.

| Gas Name | SEMI Code | Molecular Symbol |
|---|---|---|
| Acetylene | 042 | $C_2H_2$ |
| Air | 008 | Air |
| Ammonia | 029 | $NH_3$ |
| Argon | 004 | Ar |
| Carbon Dioxide | 025 | $CO_2$ |
| Carbon Tetrafluoride (R-14) | 063 | $CF_4$ |
| Chlorine | 019 | $Cl_2$ |
| Ethylene | 038 | $C_2H_4$ |
| Helium | 001 | He |
| Hydrogen | 007 | $H_2$ |
| Hydrogen Chloride | 011 | HCl |
| Neon | 002 | Ne |
| Nitrogen | 013 | $N_2$ |

| | | |
|---|---|---|
| Nitrous Oxide | 027 | $N_2O$ |
| Octafluorocyclobutane (R-c318) | 129 | $C_4F_8$ |
| Oxygen | 015 | $O_2$ |

### Mass Flow Full Scale Range (FFF)

The IE500A / IE1000A High Flow Rate Mass Flow Controller's full scale range is indicated by a three digit combination where the flow rate is expressed in sccm. The first two digits of this code represent the most significant digits of the flow full scale range in exponential form separated by a decimal. The third digit is the power of 10 exponent.

***Example:*** 805 = 5.0 x $10^{+5}$ sccm = 800 slm

| Mass Flow Rate | Ordering Code |
|---|---|
| 500 SLM | 505 |
| 1000 SLM | 106 |

### FittingType (Y)

The IE500A / IE1000A High Flow Rate Mass Flow Controller's fitting options are designated by a letter code.

| Fitting Style/Internal Finish | Ordering Code |
|---|---|
| 8 VCO | D |
| 8 VCR | T |
| 12 mm compression | L |
| ½" compression | S |
| ¾" compression | Z |
| ½" female NPT | M |
| ¾" female NPT | N |

### Interface Type (C)

The IE500A / IE1000A High Flow Rate Mass Flow Controller's interface type is designated by a single alphanumeric code. The controllers are available with the following interfaces.

| Connector Type | Ordering Code |
|---|---|
| analog (15-pin DSUB) | B |
| 4-20 mA (15-pin DSUB) | G |

### Seal Configuration (V0)

The IE500A / IE1000A High Flow Rate Mass Flow Controller's seal configuration is designated by a letter code.

| Seal Configuration | Ordering Code |
|---|---|
| Viton | V |
| Buna-N | B |
| Neoprene | N |
| EPDM | E |

### Firmware Version (SS)

The IE500A / IE1000A High Flow Rate Mass Flow Controller's firmware version options are designated by a two digit number code.

***Example:*** The initial release of the IE500A / IE1000A Mass Flow Controller uses firmware version 10.

| Firmware Version | Ordering Code |
|---|---|
| Initial Release | 10 |

**Note** Unless otherwise specified, MKS will ship firmware current to date of order. To receive previous software revision levels, please specify to customer service at order placement.

For assistance with configuring your IE500A / IE1000A High Flow Rate Mass Flow Controller, please consult the MKS factory.

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# Appendix C: Health and Safety Form

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## HEALTH AND SAFETY FORM

**THIS FORM MUST BE COMPLETED AND RETURNED WITH EQUIPMENT OR SERVICE WILL NOT BE PERFORMED**

| | |
|---|---|
| RETURN MATERIAL AUTHORIZATION NUMBER (RMA#): | |
| RETURN TO STOCK NUMBER/RTS# (If applicable): | Trade in number (if applicable): |

| | |
|---|---|
| Section 1: (one instrument per form) | MKS Part Number: |
| | MKS Serial Number: |

Section 2: Has this equipment been used? *(Please check appropriate boxes)*

| | |
|---|---|
| ☐ | No – Still in MKS packaging |
| ☐ | No – Unit unpacked, but never installed in a system. |
| ☐ | Yes -- Used only with clean, dry inert gas (For Example: Air, N2, Ar, He). |
| ☐ | Yes -- Used with chemicals, non-inert gases, biological or radioactive agents.) Identify all materials: |
| ☐ | Yes -- Used in a Semiconductor Copper process. Equipment must be double bagged. Label outside bag and packing slip, Copper Part. Label final shipping container Copper Part and place a strip of ORANGE TAPE on the container. |
| | Has equipment been purged? ☐ No ☐ yes purged with what? |
| | Has equipment been flushed? ☐ No ☐ yes flushed with what? |
| | Has equipment been decontaminated? ☐ no ☐ yes, explain process: |
| | How many months in use? |

Section 3: Detailed failure information or description or required service or reason for return.

| |
|---|
| |

Section 4: Company or Organization (mandatory information)

| | | |
|---|---|---|
| Company: | | |
| Address: | | |
| City: | State: | Zip: |
| Printed Name: | Signature: | |
| Date: | Phone #: | |
| Email: | Fax #: | |
| End User (if applicable): | | |

***For MKS USE only:***

| |
|---|
| MKS Subsidiary or Agent: |
| Contact Name: |
| Customer #: |
| Maximum Credit allowed (TBD after inspection) |

## ALL PRODUCTS MUST BE RETURNED IN SEALED BAGS

MKS will not accept delivery of equipment that has been chemically, radioactively or biologically contaminated, without written evidence of decontamination or laboratory analysis. Alternately, we will require evidence that the biological process is not harmful.

*FRM13345 Rev.E*