



C Series MFC

Technology Manual

MKS P/N 20021023-001
Revision A

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C Series Mass Flow Controllers

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MKS Instruments, Inc.

2 Tech Drive, Suite 201

Andover, MA 01810 USA

Phone: 978-645-5500, Fax: 978-557-5100

Email: mks@mksinst.com

www.mksinst.com

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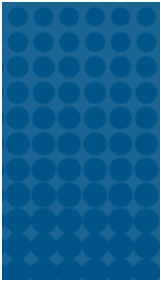
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Overview

The MKS C Series MEMS mass flow controller (MFC) represents state of the art MFC technology in a cost effective, reliable, and versatile design platform that allows for easy integration into new applications. Incorporation of MEMS technology into a small physical footprint has added a new dimension to the family of MKS MFC products that provide enhanced performance for flow control settling times when transitioning from set point startup or making required process step changes. As with other MKS MFC designs, an external communications port is integrated into the C series MFC that allows users to access the embedded software to verify MFC functionality or change MFC flow conditions without removing from its installation location.



Product Support Documents

Product support documents and additional detailed information about various I/O specifications can be found on the MKS web site for the C series MFC products. These documents include:

- MFC data sheets
- Quick start guides to communicate to the device for MFC configuration (Ethernet TCP/IP or USB)
- Step files
- RS 485 communication specification
- Modbus TCP/IP specification

Manual References

The documents listed below are referenced throughout this manual.

- [1] “Sensor/Actuator Network Specific Device Model for Mass Flow Devices”, SEMI Standards Draft Document #2253C.
- [2] “Sensor/Actuator Network Standard”, SEMI Standards Document E54-0097.
- [3] SEMI E17-00-0060 Guideline for Mass Flow Controller Transient Characteristics Tests
- [4] SEMI E18-00-0091. Guideline for Temperature Specifications of the Mass Flow Controller
- [5] SEMI E27-00-0092. Standard for Mass Flow Controller and Mass Flow Meter Linearity
- [6] SEMI E28-00-0092. Guideline for Pressure Specifications of the Mass Flow Controller
- [7] SEMI E56-00-1296. Test Method for Determining Accuracy, Linearity, Repeatability, Short Term Reproducibility, Hysteresis, and Dead Band of Thermal Mass Flow Controllers
- [8] SEMI Standards Document E52-95.
- [9] SEMI E80-00-0299. Test Method Determining Attitude Sensitivity of Mass Flow Controllers
- [10] SEMI Standards Document E52-95. Practice for Referencing Gases and Gas Mixtures Used in Digital Mass Flow Controllers
- [11] Instruction Manual
- [12] C Series MFC, RS845 Supplement
- [13] C Series Modbus Communications Supplement

Product Description Guide

Table 1 - C Series MFC Description

C Series Model	MFC Seal	Flow Range (sccm N2 gas)	Multi-Range Capatibility	Design Features	Applications
CMA10A	Elastomer Sealed	15 - 14000	Yes	Compact 1" form factor. Fitting length designed for standard MFC installation. Wetted surfaces include Aluminum, Stainless, Si, SiO2, SiC, Viton, Thixotropic Epoxy (Glob Top). Analog and digital I/Os.	Designed for use with inert, non-toxic/non-corrosive gases.
CMA50A	Elastomer Sealed	14001-50000	Yes	Compact 1" form factor. Fitting length designed for standard MFC installation. Wetted surfaces include Aluminum, Stainless, Si, SiO2, SiC, Viton, Thixotropic Epoxy (Glob Top). Analog and digital I/Os.	Designed for use with inert, non-toxic/non-corrosive gases.

General MFC Overview and Features

Performance

C series mass flow controller technology has brought together a MEMS (Electromechanical Systems) flow sensor and high speed single processor digital architecture to provide control feedback to a fast response solenoid valve design. The low thermal mass of the MEMS sensor provides a rapid sensing mechanism to changes in flow with low noise output. Utilizing a solid state flow sensor design provides additional protection from particles, pressure shock, and vibration when integrated into a process application.

Combining these MEMS design features results in typical flow control response time between 100 - 150 milliseconds (flow range dependent) over the wide dynamic control range of the device.

The compact C series MFC is designed for applications using non-corrosive gases. Devices are calibrated using the actual nameplate gas specified by the model number. The accuracy specification for the MFC is rated to be +/- .8% of Reading from 20-100 % of full scale and 0.16% of full scale for less than 20% of full scale for the device.

User Interface and MFC Diagnostics

All C Series models have a user interface for MFC configuration and Diagnostics.

- Analog/RS 485 models utilize a micro usb port on the side of the MFC body.
- Modbus and EtherNet IP models use the RJ45 Ethernet port for the dual purpose of running the MFC over the primary I/O and a Web Browser Interface.

Connecting the host computer or a remote laptop to a communication port using the appropriate cable gives the user the ability to open and use the embedded browser to:

- Configure the device for users application
 - Set the full scale flow and flow units
 - Execute a flow zero function to re-zero the sensor
 - Set ramp rates for the set point to optimize process steps
- Upgrade in the field as new features are added to MFC
 - Upload updated firmware and new gas tables directly to the MFC

C Series Digital MFC, Appendix Overview

- Diagnose and troubleshoot MFC issues before removing the MFC from service
 - Utilize the plot page to graph key MFC variables at data rates up to 100 Hz

MFC Reliability

C Series MFC designs utilize a low mechanical and electronic components count in an effort to ensure the reliability of the device.

Mechanical and electrical “stress” tests have been used by the engineering design team including:

- STRIFE, including temperature cycling and vibration (sine and random tests)
- EMC Directive 2004/108/EC for CE Mark compliance (with a metal braided, shielded cable, properly grounded at both ends)

Note



All MFC Models are RoHS compliant designs.

Specifications

Table 2 General Performance and Design Specification

Model and Specification	CMA10A – Elastomer Sealed	CMA50A – Elastomer Sealed
Performance		
Full Scale Flow (N2 equivalent)	15- 14000 sccm	14001-50000 sccm
Accuracy (N2 calibration gas)	± .8% of setpoint for 20 to 100% F.S.	± .8% of setpoint for 20 to 100% F.S.
	± 0.16% of FS < 20% F.S.	± 0.16% of FS < 20% F.S.
Control Range	.1% to 100% of F.S. - Digital I/O	.1% to 100% of F.S. - Digital I/O
	.2% to 100% of F.S. - Analog	.2% to 100% of F.S. - Analog
Typical Controller Settling Time (per SEMI Guideline E17-0600)	100 milliseconds (typical)	150 milliseconds (typical)
Repeatability	± 0.2% of Reading	± 0.2% of Reading
Resolution	0.1% of Full Scale	0.1% of Full Scale
Operation Ratings		
Normal Operating Pressure Differential (N2 gas with atmospheric pressure at the MFC outlet)	15 to 7000 sccm: 10 to 45 psid	
	7001 to 28000 sccm: 15 to 45 psid	
	28000 to 50000 sccm: 40 to 45 psid	
Proof Pressure	232 psi (16 Bar)	232 psi (16 Bar)
Burst Pressure	1000 psi (70 Bar)	1000 psi (70 Bar)
Temperature Coefficients Zero Span	<0.005% F.S./°C	<0.005% F.S./°C
	<0.06% Reading/°C	<0.06% Reading/°C
Inlet Pressure Coefficient	≤ .025% Reading / psi / ≤ .37% Reading / Bar	
Warm-Up Time	< 1 min.	< 1 min.
Normal Operating Temperature Range	10°C to 50°C	10°C to 50°C
Storage Humidity	0 to 95% Relative Humidity, non-condensing	0 to 95% Relative Humidity, non-condensing
Storage Temperature	0°C to 60°C	0°C to 60°C
ROHS Compliant	Yes	Yes
Electromagnetic Compatibility	CE Compliant 2004/108/EC	CE Compliant 2004/108/EC

Table 3 Electrical Specification

I/O Type	Electrical Connection	MFC Connector Design	Power Supply and Consumption
Analog	9 pin Male D sub	Power and Device Control	+24 V (+/-10%) , < 5 Watts
RS 485	9 pin Male D sub	Power and Digital Communication	+24 V (+/-10%) , < 5 Watts
Modbus	3.5X1(mm) Barrel Connector	Power only	+24 V (+/-10%) , < 5 Watts

Table 4 Mechanical and Material Specification

CMA10A / CMA50A – Elastomer Sealed	
Valve Type	Normally Closed / No valve (Meter only)
Leak Integrity	
External (mbar l/sec He)	< 1 x 10 ⁻⁶
Through closed valve	<.1% Maximum FS (using valve override command to close the valve)
Wetted Materials	
Standard	Aluminum, Stainless Steel, Silicon, Silicon Oxide, Silicon Carbide, Viton®, Thixotropic Epoxy (Glob Top)
Valve Seat	Viton
Surface Finish	32 µin Ra
Weight	310g (Model with VCR Fittings)

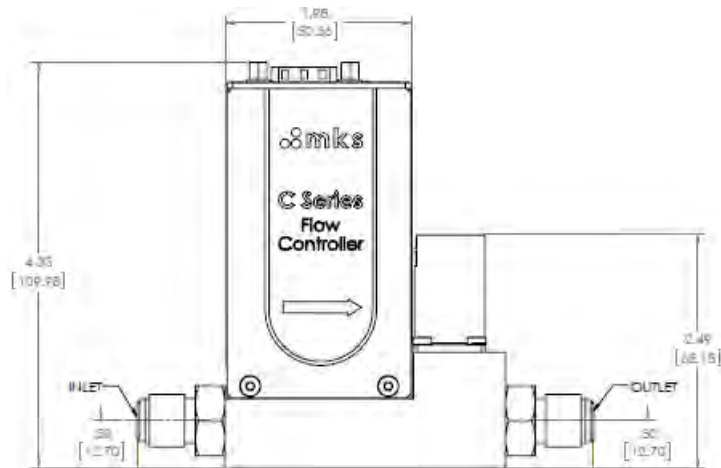


Figure 1 MFC Mechanical Deminsions

Table 5 Fitting Design and MFC Length

Fitting Design	Standard MFC Length (inches / mm)		Short Body MFM Length	
Swaglok 4 VCR Male	4.88	124	3.90	99.00
1/4" Swaglok	5.02	127.5	4.06	103.00
C Seal Surface Mount	4.13	104.9	N/A	N/A
W Seal Surface Mount	4.13	104.9	N/A	N/A
4 VCO Male	4.56	115.8	3.58	91.00

Table 6 C series MFC Model Height Dimensions

C Series Height Dimensions for Elastomer Sealed MFC Models			
MFC Model	I/O	MFC Height - Group A (inches / mm)	
CMA10A CMA50A	9 pin D sub	4.33	109.98
	RS 485	4.33	109.98
	Modbus	4.11	104.29
	Ethernet IP	4.11	104.29

Notes



Safety Information

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

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

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

SERVICE BY QUALIFIED PERSONNEL ONLY

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

Mass Flow Controller Safety Information

Symbols Used in This Instruction Manual

The following are 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 7 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 phase of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of intended use of the instrument and may impair the protection provided by the equipment. MKS Instruments, Inc. assumes no liability for the customer's failure to comply with these requirements.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

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SERVICE BY QUALIFIED PERSONNEL ONLY

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

KEEP AWAY FROM LIVE CIRCUITS

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

USE CAUTION WHEN OPERATING WITH HAZARDOUS MATERIALS

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

PURGE THE INSTRUMENT

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

USE PROPER PROCEDURES WHEN PURGING

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

DO NOT OPERATE IN AN EXPLOSIVE ENVIRONMENT

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

USE PROPER FITTINGS AND TIGHTENING PROCEDURES

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

CHECK FOR LEAK-TIGHT FITTINGS

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

OPERATE AT SAFE INLET PRESSURES

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

INSTALL A SUITABLE BURST DISC

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

KEEP THE UNIT FREE OF CONTAMINANTS

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

ALLOW PROPER WARM UP TIME FOR TEMPERATURE-CONTROLLED UNITS

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

Sicherheitshinweise für das Massenflussgerät

In dieser Betriebsanleitung vorkommende Symbole

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

Warnung!



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

Vorsicht!



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

















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.

Table 8 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 Stromversorgung entfernt wurde. Um Verletzungen vorzubeugen sollten zuerst alle Geräte von der Stromversorgung getrennt und alle Stromkreisläufe 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.

Table 9 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	 Alternating Current IEC 417, No. 5032
 Courant continu et alternatif IEC 417, No.5033-a	 Matériel de classe II IEC 417, No.5172-a	 Courant alternatif IEC 417, No.5032	
 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 À 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.

Table 10 Definición de los símbolos hallados en la unidad

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

Procedimientos y precauciones de seguridad

Las medidas generales de seguridad descritas a continuación deben observarse durante todas las etapas de funcionamiento del instrumento. La falta 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 establezcan 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。



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。



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。



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。

Table 11 本機器に使用されているマークについて

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

安全対策について

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

勝口に部品を変えたり、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。

修理は必ず専口の修理サービスを利口すること

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。

危険な材料を使口する場合は慎重に機器を使口すること

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除去してください。

浄化する場合は適切な口順で口うこと

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口しないこと

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。

適切な口具類を使口し、口順に従って口具の締めを口うこと

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。マスフロー機器の安全に関する情報

安全なインレット圧口で使口すること

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口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うこと

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 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 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 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.

Table 12 장치에 표시된 기호들의 정의

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

안전 절차 및 예방조치

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

부품을 교체하거나 기계를 개조하지 마십시오

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

자격이 있는 사람에게만 서비스를 받으십시오

작동하는 사람은 기계 걸면을 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

C Series Digital MFC, Appendix Safety Information

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.

Notes



MFC Operation

The MFC is used in a wide variety of control systems, most of which share several characteristics.

MEMS Flow Control System Configuration

The control system consists of four basic parts:

- Thermal Mass flow solid state element
- Control electronics
- Control valve
- Flow system (whose flow is being controlled by the MFC)

The MFC provides the first three components. A MEMS solid state element that is thermal based provides a voltage output that is proportional to the flow. Control electronics effectively coordinate the close looped interaction between the mass flow element and a proportional control valve to provide fast and accurate response from the host controller to control the process flow system.

Flow Path

Upon entering the MFC, the gas stream passes first through the metering section of the instrument for its mass flow to be measured. The gas moves on through the control valve, which regulates the flow rate according to the given set point and in response to the device's control system, and then exits the instrument at the established rate of flow.

The metering section consists of the following:

- A micro-machined solid state structure that has an active heating and two temperature sensing elements.

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

Flow Control Range

The MFC can control flow over a range of .1 to 100% of full scale flow for Digital I/O configurations (.2% to 100% FS for Analog configuration).

Example: 1000 sccm N₂ / Digital I/O

Control range = 1 to 1000 sccm

Example: 100 sccm N₂

Control range = .1 to 100 sccm

Measurement Technique

The flow measurement is based on differential heat transfer between temperature sensing micro-machined elements called thermopiles. Gas flows laminarly across the sensor cooling the thermopile at the inlet of MEMS sensor. The differential temperature provides a voltage that is converted to mass flow via the specific heat, C_p , of the gas.

Control Circuitry

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

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

Control Valve

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

Notes



Installation and MFC Setup

This chapter describes techniques and details on how to properly handle a newly acquired C Series MFC in an effort to prepare the gas system and the MFC for a safe and clean installation. Installation process steps described are:

- Considering the MFC Installation Environment, below
- Unpacking the MFC in a Clean Environment, page 34

- Mounting Hardware for Installing the MFC, page 35

Mounting Location

Note



C series C and W Seal are designed for 1.125” seal mounting configurations.

- Checking the Leak Tight Seal for the MFC, page 36
 - Applying Power and Signal Cables to the MFC, page 36
 - Leak Checking the MFC Installation, page 40
 - Setting Up and Configuring the MFC, page 40
 - Zeroing the MFC, page 41
-

Note



All documented procedures for installation and safety checks for installation of a new MFC by the end user supersede any procedural recommendations by MKS Instruments in this manual.

Considering the MFC Installation Environment

MFC Installation Environment

The area around where the MFC is installed should have adequate ventilation and control of the ambient humidity and temperature to meet the suggested manufacturing specification for proper operating temperatures between 10°C and 50°C.

Even with the thermal sensor being a solid state design element, careful consideration should be given to the design of the installation to minimize any shock and vibration during actual operation while still allowing the user:

- Easy access to control switches and communication ports available on the top and sides of the MFC
- Ability to purge and remove the device should the device require servicing

Installation of an upstream particle filter is recommended to help protect the valve area from potential foreign material entering the MFC during operation and adversely affecting the performance of the instrument.

Note that the control valve of the MFC is not designed to be a shut off valve and the MFC has an acceptable closed conductance leak specification across the valve when the MFC is idle. It is highly recommended that positive pneumatic shut off valves be installed on the inlet and outlet of the MFC to properly isolate the MFC when it is idle. These types of valves also provide the means to execute a recommended proper zero routine when required by the process.

Pre-Installation Safety Considerations

Safety is the paramount consideration while installing the MFC so it is necessary to make sure all gas lines have been purged with high purity, dry Nitrogen or other high purity dry inert gas to ensure that the lines are free of organic contaminants, moisture, and oxygen.

Warning



PERSONAL SAFETY HAZARDS!

The C series device is designed for applications using inert gases.

ALWAYS use appropriate personal protection equipment.

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.

Unpacking the MFC in a Clean Environment

Each device is built and leak tested with helium in a cleanroom environment. The instrument is single-packaged using vacuum and then placed within an outer protective shell to ensure maintenance of its particle-free condition during shipment.

To maintain the integrity of the manufacturing MFC packaging procedures, follow clean room protocols while removing the device from the outside shell packaging. Inside the shell is the Calibration Certificate for your records and traceability. This official document summarizes the MFC accuracy of the N₂ manufacturing calibration utilizing NIST traceable primary standards.

Once the MFC is out of the inner cleanroom sealed bag, carefully inspect the MFC for any sign of mechanical damage to the enclosure, gas connector fittings, electrical connectors, etc. If damage is noted on the MFC, notify your carrier and MKS Service immediately. If the MFC needs to be returned to MKS for repair, two forms must be completed:

- RMA Request Form to properly document the reason for return. This form is available on the MKS web site at: <http://www.mksinst.com/service/serviceeraform.aspx>
- Health and Safety Form to ensure the safety of handling the MFC once it is in a MKS Service Center. This form is available on the MKS web site at: <http://www.mksinst.com/service/HealthAndSafetyForms.aspx>

Once MKS Service receives the completed forms, we will provide an RMA number and contact details for shipping the device back to MKS.

Mounting Hardware for Installing the MFC

Table 13 Mounting Pattern Hardware: Fitting Types by Model

MFC Model	Fitting Design	Mounting Pattern Hardware
CMA10A / CMA50A	In-Line VCR / Compression	2 - .164-32 UNC2B, 2-M3
	Down Mount C / W Seal	4 - .187 (4.75) - .8 x 30 mm long

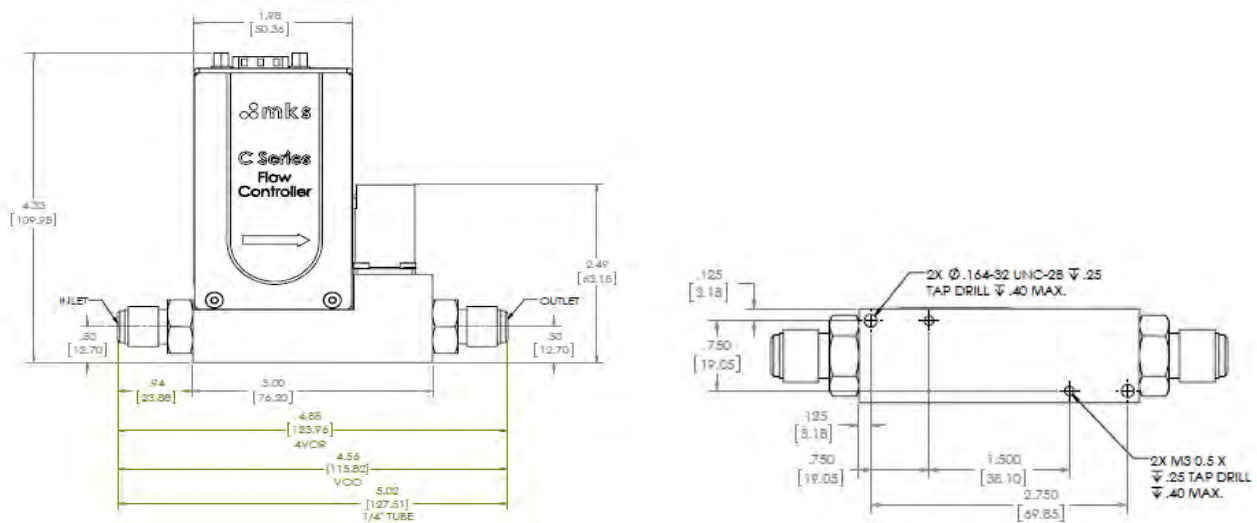


Figure 2 CMA10A / CMA50A In Line Fitting / Standard MFC Dimensions and Mounting Location

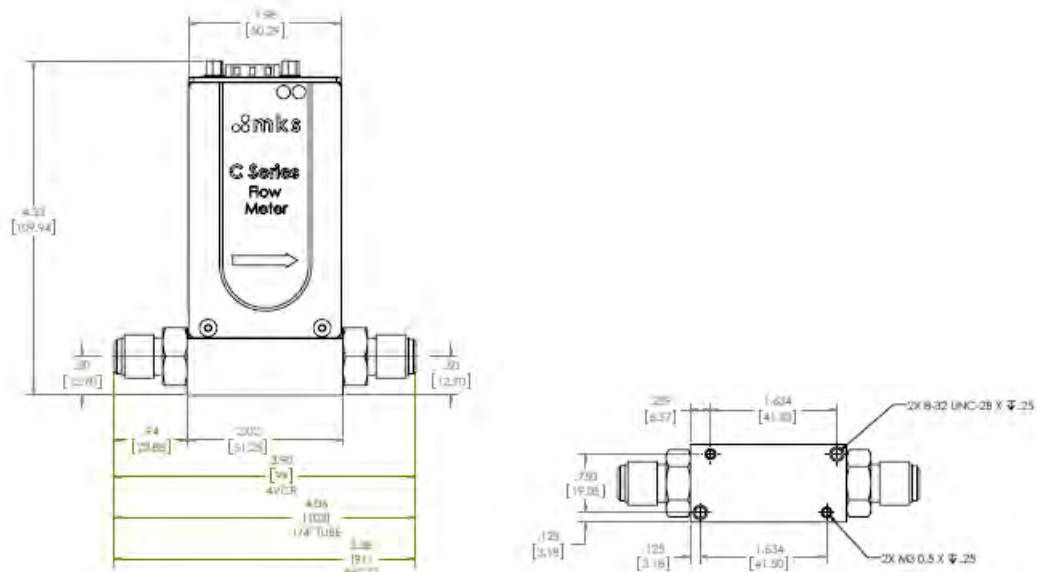


Figure 3 CMA10A / CMA50A MFM Short Body* Dimensions and Mounting Location



Short body designs available only for C Series MFM. Not available with C-Seal or W-Seal fitting style.

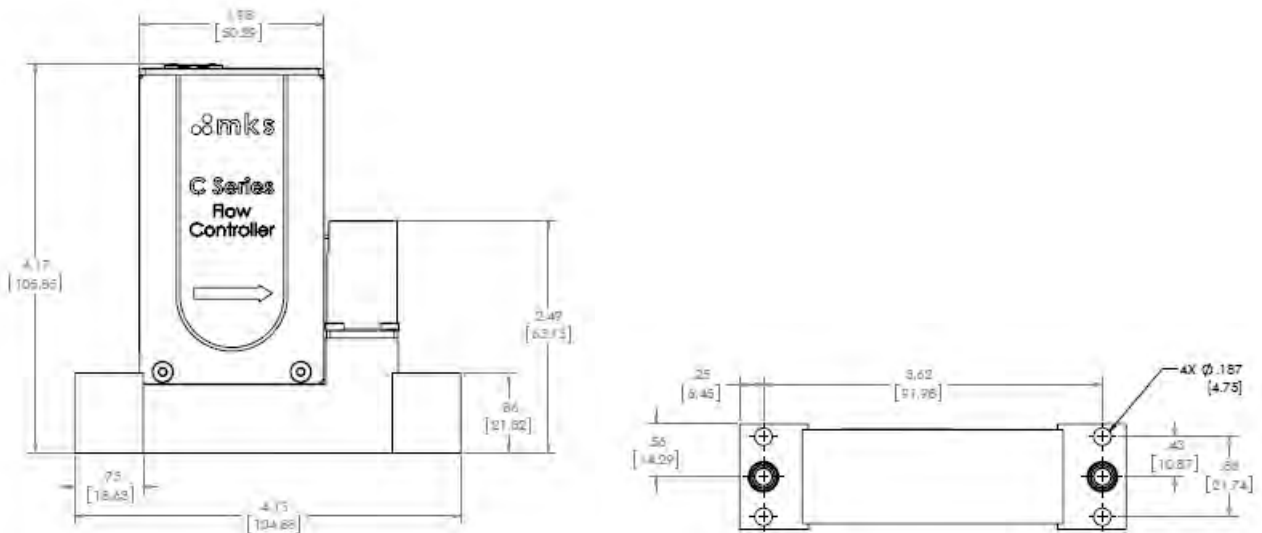


Figure 4 CMA10A / CMA50A Series MFC C-Seal / W-Seal Dimensions and Mounting Location



C series C and W Seal are designed for 1.125" seal mounting configurations.

Checking the Leak Tight Seal for the MFC

With the MFC body mounted in its gas panel location, connect the external gas line fittings using the appropriate gasket type and material for the MFC process application.

Install and tighten the gasket material according to the fitting manufacturer's instructions and specifications.



MFC Models that use VCR fittings must use retained VCR gaskets that properly center the gasket in relationship to the VCR sealing surface. Loose gaskets that can shift and are not centered can result in flow variations.

Applying Power and Signal Cables to the MFC

Connect the appropriately designed power and signal cables to the MFC interface. Secure the cable to posts on each side of the MFC connector.



Note Review the details in Appendix C for proper cable construction for the Analog / RS 485 Model. It is extremely important that these electrical commons are separated in the MFC cable in order to avoid potential ground loops which can result in analog flow signal offsets and even increased noise in the flow signal.



Caution All electrical connections to the MFC must be completed before applying power. Hot plugging the MFC is not a practice recommended by MKS.



Caution Before connecting any cable to the MFC, verify that the power supply being used for this application meets the MFC manufacturer's recommendation for voltage and current ratings. **DO NOT** submit the MFC to an over voltage condition in order to avoid damaging the MFC during power up.

If you choose to manufacture your own cables, use the following guidelines for cable construction:

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 about 0.01 ohms and the ground should surround all wires. Contact to ground at just one point may not suffice.
4. For shielded cables with flying leads at one or both ends; it is important to ground the shield at each such end before the wires exit. Make this ground with absolute minimum length. (A ¼ inch piece of #22 wire may be undesirably long since it has approximately 5 nH of inductance, equivalent to 31 ohms at 1000 MHz). After picking up the braid ground, keep wires and braid flat against the case. With very few exceptions, grounded metal covers are not required over terminal strips. If one is required, it will be stated in the Declaration of Conformity.

Analog Power and Control I/O Definitions

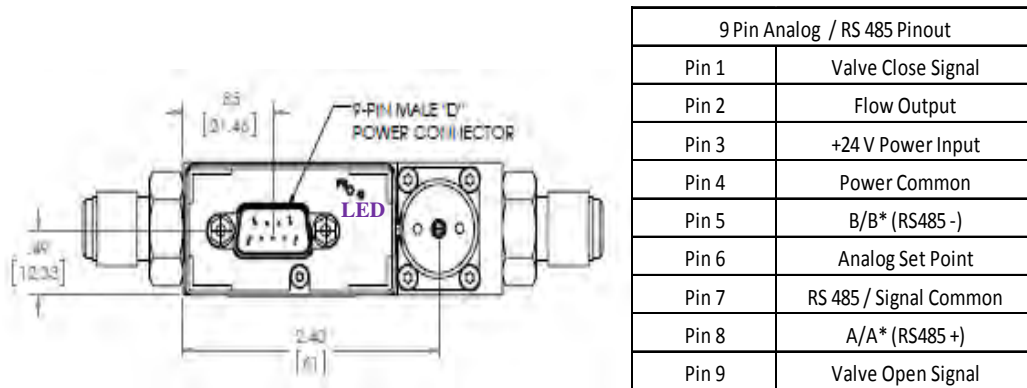


Figure 5 Analog I/O – 9 pin / RS 485

Important C Series Design Features for the Analog / RS 485 I/O communication



The C series MFC will be configured for the customer according to the model code for the MFC. Switching the I/O communication from an Analog to RS485 (or RS485 to Analog) is a configurable attribute of the MFC.

Status LED - Located on the top of the MFC cover, the status light confirms that power has been applied correctly and the MFC has successfully completed an initialization routine by turning solid green several seconds after power is connected to the device. After powering up, if the indicator light remains solid red after power up, contact MKS service.

Zero Button (PB) — Just to the left of the LED status indicator is a push button labeled PB. To execute a MFC zero from this location, depress and hold the button down for 3 seconds. Refer to *Zeroing the MFC*, page 41, for the basic procedures to follow to execute a proper zero for the flow sensor.

Valve Override Analog - Analog connectors have pin locations that allow the execution of a valve override close or valve override open by applying 5 V between the specific override pin (1 = close or 9 = open) and the power common.



The C series MFC is protected up to the power supply voltage of 24V. Applying a voltage > 5 V (up to 24V) while executing a valve override command should not damage the MFC.

Digital I/O C Series Communication

RS485 Communication Description

- C Series MFC serial communication uses drivers to send digital messages based on a variable length ASCII format that sends a message to a specific address and then waits for the MFC’s response before trying to communicate with the next device.
- This format has been used in MKS MFC RS485 devices such as the 1179, 1479, 1480, and G series which makes the integration of the C series into existing applications easier for the end user.
- RS485 communication supports multi-device bus drop designs.
- *MKS Document MKS C Series MFC, RS485 Supplement* provides additional information on RS485 command structure and MFC features supported by the RS485 specification.

C Series RS485 MFC Features

LED Status Indicators — LED lights on the C series are bicolor for error and communication. When the C series is communicating over RS485 the LED will blink green when responding to an ASCII command.

Selectable Serial Baud Rate — C series RS485 supports baud rates of 9600, 19200, and 38400. The factory default is 9600 and can be changed using setup commands over RS485 (see *C Series MFC, RS485 Supplement* for additional command details). Baud rates also can be selected using the “Setup Mode” of the MFC embedded web browser.

Selectable RS485 Address — Each MFC connected serially in a RS485 network must have a unique address. The C Series default address is 254 and can be changed using setup commands over RS485 (see *C Series MFC, RS485 Supplement* for command details). The RS485 address may also be changed using the “Setup Mode” of the MFC embedded web browser. Refer to the Appendix B for details using the micro-usb communication and the “Setup Mode” for access to MFC variables.

C Series Modbus Communication

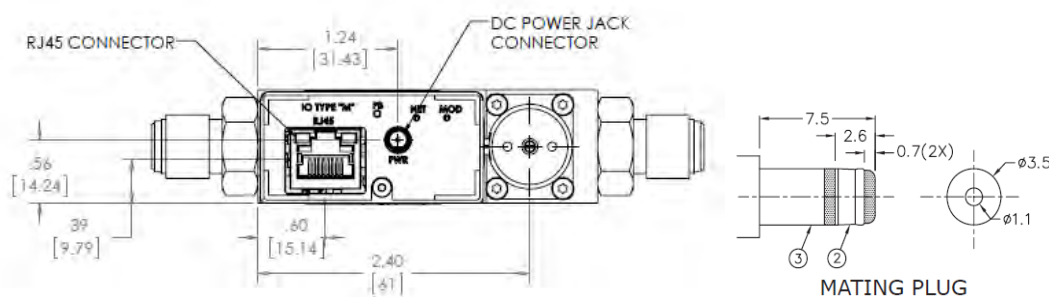


Figure 6 Modbus TCP/ IP I/O Communications Protocol



Note A shielded cable should be used for the C series power connector. Both Shield and Drain should be connected to the power common at the power supply.

- Modbus TCP/IP is an Ethernet based fieldbus network protocol that takes advantage of the efficient way messages between the master and slave devices propagate through the network. Messages or instructions from the master (Referred to as “Client”) are sent to a slave device (Referred to as “Server”) by first sending the data to the TCP (Transmission Control Protocol) where additional information is added and sent to the IP (Internet Protocol). IP then creates the data packet and sends it to the slave or server.
- A TCP connection has to be established before the message or data packet can be transmitted successfully from the Master to the Slave. Once connected the Slave will respond to all inquiries from the Master until the connection between the two devices is closed.

C Series Modbus MFC Features

One Ethernet port marked is used to propagate messages from the master to the Slave.

Push button (PB) can be used to zero the MFC flow. To execute a MFC zero from this location, depress and hold the button down for 3 seconds.

There are 2 LEDs for Network communication (NET), and network issues (MOD).

LED status indicators function as follows:

- When power has been established, the NET LED first will turn red. The MOD LED will flash RED to green. Once the device has successfully completed initialization protocol the MOD LED will remain solid green. The NET LED will blink green at about 1 Hz.
- The NET LED will continue to blink at a rate of 1 Hz until a network connection between the master and slave has been established and the device.
- Attaching an Ethernet cable to the RJ45 connector will activate the two LED’s on the RJ45 connector (green and amber).
- Once an Ethernet connection has been established to the MFC the NET LED will change from blinking green to solid green.
- **Zero Button (PB)** — Just to the left of the LED status indicator is a push button to zero the MFC. To execute a MFC zero from this location, depress and hold the button down for 3 seconds. Refer to *Zeroing the MFC*, page 41, for the basic procedures to follow to execute a proper zero for the flow sensor.

Leak Checking the MFC Installation

Perform leak checks on gas lines and MFC connections to verify the integrity of the gas seals before introducing any process gas to the MFC using appropriate He leak detection equipment or other methodology specified by the gas panel designer.

Setting Up and Configuring the MFC

Communication between the C Series MFC and a desktop computer or laptop allows access to the embedded web browser. Connection are established with the following connections located on the MFC:

- Analog / RS485 – micro-usb connector located on the side of the MFC (Appendix B)

- Modbus – Ethernet RJ45 connector used for Modbus communication is also utilized for accessing the embedded web browser (Appendix A)

Changes to the configuration of the MFC can be initiated and completed over the web browser interface including:

- Re-ranging the full scale of the current nameplate gas
- Changing the factory IP address of the device if you have multiple devices on a multiport hub or switch
- Setting ramps rates and set point delay times for process requirements

Zeroing the MFC

Proper zeroing of the MFC is one of the most critical steps to ensure that the MFC performs correctly in any application.

The two most important considerations when zeroing an MFC are making sure:

- The MFC has reached a stable internal temperature in the orientation (attitude) that is being used for the application, and
- No differential pressure exists across the MFC control valve (“no flow”) when a zero is initiated.

To ensure that these conditions are met, refer to the following recommended guidelines and procedures.

Check Temperature Stabilization

The MFC should be powered up in its final installation orientation for at least 30 minutes before initiating an MFC zero. MKS recommends additional steps to verify that MFC has reached a stable temperature by using the plot page available on the web browser to monitor the MFC temperature in real time prior to zeroing the MFC.

Establish a Proper “No Flow” Condition Across the MFC Control Valve

The definition of a “no flow” condition is that the pressure on the inlet side of the MFC is equal to the pressure on the outlet side of the MFC control valve. Whether the MFC is at atmospheric pressure, vacuum pressure, or process pressure, the zero should not be initiated until the pressure differential across the MFC is zero.



Note MKS recommends that an MFC be zeroed at its operating inlet gas pressure. To successfully complete the recommended procedures, a positive shut off valve should be installed in the gas line to properly isolate the MFC at operating pressures.

1. Pressurize the gas line to the inlet of the MFC (open upstream positive shut off valve if required).
2. Open the downstream shut off valve and give the MFC a full scale set point.
3. Let the MFC operate at full scale flow for 15 seconds and then close the downstream shut off valve while leaving the set point on the MFC.
4. Allow the reported flow to fall to a stable zero value.



The set point and flow signals can be monitored in real time on the plot page to confirm that the MFC has reached a stable zero condition.

5. If a positive shut off valve is installed upstream, close the valve and then give a zero set point to the MFC to close the control valve.
 6. Issue a zero function to the MFC by holding down the button on the top of the enclosure for 3 seconds.
-



The zero function can be also executed from the Configuration page of the web browser (see Appendix B).

Digital protocols such as RS485 and Modbus also support zero commands that can be sent over the primary I/O (see I/O supplemental documentation for details).

Notes

MFC Product Code Definition and Design Configurations

C Series Elastomer Models

C Series Product Code Structure

CCCCC	GGG	FFF	Y	W	Z	V	AA
Configuration Code							
Gas Code							
Flow Range Full Scale							
Fittings							
Connector Type							
Seal Material							
Valve Type							
Firmware Version							

Figure 7 Elastomer Sealed C Series Product Code Structure

MFC Configuration Code – CCCCC

Table 14 MFC Configuration Code – CCCCC

Ordering Code	Flow Rate Range, N2
CMA10A	Flow less than 14000 sccm
CMA50A	140001 - 50000 sccm

* Ordering code depends on gas type and range. See Table 21 for additional detail

Gas Code – GGG

MKS gas code designations are in accordance to *SEMI Guideline E52, Practice for Referencing Gases and Gas Mixtures Used in Digital Mass Flow Controllers*.

Table 15 Gas Codes Available for C Series MFC

Gas SEMI Standard	Code
He	001
Ar	004
H2	007
Air	008
N2	013
O2	015
SF6	110
C4F8	129

Flow Full Scale Range Designation – FFF

The full scale flow for the MFC is defined by a 3-digit code as shown in the table below.

Table 16 Flow Full Scale Range Designation – FFF

Flow Range Full Scale	Ordering Code Designation
50 sccm	501
100 sccm	102
200 sccm	202
500 sccm	502
1000 sccm	103
2000 sccm	203
5000 sccm	503
10000 sccm	104
20000 sccm	204
30000 sccm	304
50000 sccm	504

MFC Fittings – Y

Table 17 MFC Fittings – Y

MFC Model and Fitting Combinations		
Fittings Type / Description	Product Code	Fitting Utilization
Swagelok 4 VCR Male	R	All MFC Full Scale Flow Ranges
1/4" Swagelok	S	All MFC Full Scale Flow Ranges
W Seal Surface Mount	H	All MFC Full Scale Flow Ranges
C Seal Surface Mount	C	All MFC Full Scale Flow Ranges

MFC Control I/O – W

Table 18 Analog and Digital Control I/O

Analog I/O	Product Code
9 pin D sub	C
RS 485	R
Modbus	M

Elastomer Seal Materials – Z

Table 19 Elastomer Seal Materials – Z

Seal Materials	Product Code
Viton	V

Valve Type/ Device Type – V

Table 20 Valve Type – V

MKS Valve Designations	Product Code
Valve Type – Normally Closed	10
No valve - MFM (Standard Length)	30
No valve - MFM (Short Body Length)	40

* Product Code “40” not available with Surface Mount fitting styles

Firmware Revision – 10

The latest version of firmware for the MFC model is installed in the device unless something different is specified by the customer or the model code is a 5-digit sequential that has specific instructions for device configuration.

Table 21 Model Code Determination for Available Nameplate Gases

SEMI Gas #	Gas Symbol	CMA10A		CMA50A	
1	He	23	16000	16001	51000
4	Ar	40	23000	23001	49000
7	H2	17	12000	12001	40000
8	Air	15	14000	14001	50000
13	N2	15	14000	14001	50000
15	O2	14	13000	13001	51000
110	SF6	7	7300	7301	13000
129	C4F8	4	2100	N/A	N?A

Notes



Troubleshooting and Maintenance

MFC Setup and Function Troubleshooting

Table 22 MFC Setup and Function Troubleshooting

MFC Status / Module Light Dark	Analog I/O		Digital I/O	
	No power	Check power source	No power	Check power source
Low power	Check supply voltage	Low power	Check supply voltage	
Cable Design	Verify I/O pinout	Cable Design	Verify I/O pinout for RS 485	
Bad cable connection	Check pin(s) continuity	Bad cable connection	Check pin(s) continuity for RS 485.	
MFC does not respond to any setpoint	Verify Analog Status Led is solid green	If LED is DARK check power source. If LED is RED , contact MKS Service	Verify Module LED or Power LED is solid green	If LED is DARK check power source. If LED is RED , contact MKS Service
	Control circuit failure	Use the Embedded Web Browser to observe and diagnose set point and flow response. See Appendix B for Analog/ RS485. If unresponsive contact MKS Service	Verify the MFC is communicating with the I/O Network	RS485 - Solid NET LED no connection
	Contamination/Clogged - blocked MFC device or gas line	Check inlet pressure @ MFC. Check outlet pressure at MFC using pressure gauge. Check outlet pressure downstream of positive shut off (pneumatic) valve downstream of MFC. Check air line to pneumatic valve. Check for any restriction such as filter or check valve downstream of MFC.	Control circuit failure	Use the Embedded Web Browser to observe and diagnose set point and flow response. See Appendix A for C series Models using Ethernet TCP and Appendix B for Analog/ RS485. If unresponsive contact MKS Service
	Wrong cable	Verify cable and MFC pinouts are correct for MFC	Wrong cable	Check cable pin out design and verify digital communication lines are correct for RS485.
	Bad cable connection	Check pin(s) continuity	Contamination/Clogged - blocked MFC device or gas line	Check inlet pressure @ MFC. Check outlet pressure at MFC using pressure gauge. Check outlet pressure downstream of positive shut off (pneumatic) valve downstream of MFC. Check air line to pneumatic valve. Check for any restriction such as filter or check valve downstream of MFC.
MFC shows 0 flow when given setpoint	Closed upstream and/or downstream pneumatic valves	Open valves, check inlet pressure	Closed upstream and/or downstream pneumatic valves	Open valves, check inlet pressure
	No gas supply	Turn on gas supply	No gas supply	Turn on gas supply
	Upstream clogged filter/component	Check flow through of components by measuring pressure from gas supply to MFC inlet.	Upstream clogged filter/component	Check flow through of components by measuring pressure from gas supply to MFC inlet.
	MFC clogged orifice	Verify MFC inlet pressure, check valve current for open valve condition. Check for gas flow downstream of MFC - If flow does not exist, possible clogged orifice	MFC clogged orifice	Verify MFC inlet pressure, check valve current for open valve condition. Check for gas flow downstream of MFC. If flow does not exist, possible clogged orifice
	MFC clogged sensor	Run MFC diagnostics. Verify MFC inlet pressure, check valve current for open valve condition and check for gas flow downstream of MFC. If flow present, possible clogged sensor	MFC clogged sensor	Run MFC diagnostics. Verify MFC inlet pressure, check valve current for open valve condition and check for gas flow downstream of MFC. If flow present, possible clogged sensor
	MFC control circuit failure	Use the Embedded Web Browser to observe and diagnose set point and flow response. See Appendix B for Analog/ RS485. If unresponsive contact MKS Service	MFC control circuit failure	Use the Embedded Web Browser to observe and diagnose set point and flow response. See Appendix A for C series Models using Ethernet TCP and Appendix B for Analog/ RS485. If unresponsive contact MKS Service

MFC Performance Troubleshooting

	Analog I/O		Digital I/O	
	MFC Flow output signal does not match setpoint	Inlet pressure too low	Increase inlet pressure	Inlet pressure too low
Outlet pressure too high		Decrease outlet pressure	Outlet pressure too high	Decrease outlet pressure
Flow signal is not properly grounded.		Verify MFC signal commons and power common are not tied together external to the MFC. See Appendix C for electrical connection details. Check electrical connections for ground loops.	Contamination	Check for partial block orifice or sensor using valve override command over primary I/O. Max flow with valve wide open should be > 110% FS.
Contamination		Check for partial block orifice or sensor using Analog pins for valve open override condition. Max flow with valve wide open should be > 110% FS.	Control electronics failure, sensor failure	Use the Embedded Web Browser to observe and diagnose set point and flow response. See Appendix A for C series Models using Ethernet TCP and Appendix B for Analog/ RS485. If unresponsive contact MKS Service
Control electronics failure, sensor failure		Use the Embedded Web Browser to observe and diagnose set point and flow response. See Appendix B for Analog/ RS485. If unresponsive contact MKS Service		
Electronics failure - Analog to Digital signal calibration		Use the Embedded Web Browser to observe and diagnose set point and flow response. See Appendix B for Analog/ RS485. If unresponsive contact MKS Service		
MFC cannot achieve FS flow	Inlet pressure low	Increase inlet pressure	Inlet pressure low	Increase inlet pressure
	Outlet pressure high	Decrease outlet pressure	Outlet pressure high	Decrease outlet pressure
	Valve / flow sensor contamination	Check valve current for maximum position	Valve / flow sensor contamination	Check valve current for maximum position
	Valve set up - not enough valve stroke	Use Analog pin for valve open override condition. Max flow with valve wide open should be > 110% FS	Valve set up - not enough valve stroke	Use appropriate digital command over primary I/O for valve open override condition. Max flow with valve wide open should be > 110% FS
	Gas line blockage/contamination	Measure pressure drop across from gas supply regulator to MFC inlet. If pressure drop greater than expected check filters, check valves, and other in line components for signs of blockage.	Gas line blockage/contamination	Measure pressure drop across from gas supply regulator to MFC inlet. If pressure drop greater than expected check filters, check valves, and other in line components for signs of blockage.
MFC shows output flow > FS (overrange)	MFC valve full open	Check valve current for maximum condition	MFC valve full open	Check valve current for maximum condition
	Pressure drop across MFC is greater than specification	Measure upstream pressure & downstream pressure. Compare to specification.	Pressure drop across MFC is greater than specification	Measure upstream pressure & downstream pressure. Compare to specification.
	Faulty valve control circuit/ valve setup	Use the Embedded Web Browser to observe and diagnose set point and flow response. See Appendix B for Analog/ RS485. If unresponsive contact MKS Service	Faulty valve control circuit/ valve setup	Follow Appendix B and use the Ethernet Web Browser to observe set point, flow output, valve current. Send set points 10 - 100% and observe valve current values.
	Possible contamination in valve assembly	Use the Embedded Web Browser described in Appendix B to observe set point, flow output, valve current. Send 0 set point to the MFC and observe flow output. Close downstream isolation valve for additional confirmation of through valve closed conductance leak.	Possible contamination in valve assembly	Use the Embedded Web Browser described in Appendix A (Modbus) or B (RS-485) to observe set point, flow output, valve current. Send 0 set point to the MFC and observe flow output. Close downstream isolation valve for additional confirmation of through valve closed conductance leak.
			Set Point values over from Primary I/O master incorrect	Validate set point values from the Master to the MFC slave are correct for MFC configuration

C Series Digital MFC, Appendix Troubleshooting and Maintenance

	Analog I/O		Digital I/O	
	Output signal matches setpoint @ higher flows, but will not go to 0	MFC valve partial contamination	Cycle-purge device, check valve current	MFC valve partial contamination
MFC control valve issue		Use the Embedded Web Browser described in Appendix B to observe set point, flow output, valve current. Send 0 set point to the MFC and observe flow output. Close downstream isolation valve for additional confirmation of through valve closed conductance leak.	MFC control valve issue	Use the Embedded Web Browser described in Appendix A (Modbus) or B (RS485) to observe set point, flow output, valve current. Send 0 set point to the MFC and observe flow output. Close downstream isolation valve for additional confirmation of through valve closed conductance leak.
Pressure differential across valve outside specification		Measure inlet and outlet pressure. Confirm differential pressure meets published MFC specification. Adjust pressure as required.	Pressure differential across valve outside specification	Measure inlet and outlet pressure. Confirm differential pressure meets published MFC specification. Adjust pressure as required.
Device zero offset		re-zero device with known zero flow conditions	Device zero offset	re-zero device with known zero flow conditions
MFC output shows large overshoot	Analog I/O		Digital I/O	
	Inlet pressure too high	Decrease inlet pressure	Inlet pressure too high	Decrease inlet pressure
	MFC inlet pressure to high for default <Operating Pressure> parameter	Use the Embedded Web Browser described in Appendix B to observe <Operating Pressure Parameter (default value is 40). Increase value between 40-90 for control gains to be less aggressive.	MFC inlet pressure to high for default <Operating Pressure> parameter	Use the Embedded Web Browser described in Appendix A (Modbus) or Appendix B (RS-485) to observe <Operating Pressure Parameter (default value is 40). Increase value between 40-90 for control gains to be less aggressive.
	MFC not programmed for correct gas - actual gas used different	Check MFC active gas using digital interface or Ethernet GUI	MFC not programmed for correct gas - actual gas used different	Check MFC active gas using digital interface or Ethernet GUI
MFC control parameters set incorrectly	Contact MKS service center	MFC control parameters set incorrectly	Contact MKS service center	
MFC output slow to respond to setpoint	Inlet pressure too low	Increase inlet pressure	Inlet pressure too low	Increase inlet pressure
	MFC inlet pressure to low for default <Operating Pressure> parameter	Use the Embedded Web Browser described in Appendix B to observe <Operating Pressure Parameter (default value is 40). Decrease value between 20-40 for control gains to be more aggressive.	MFC inlet pressure to low for default <Operating Pressure> parameter	Use the Embedded Web Browser described in Appendix B to observe <Operating Pressure Parameter (default value is 40). Decrease value between 20-40 for control gains to be more aggressive.
	MFC not programmed for correct gas - actual gas used different	Check MFC active gas using digital interface or Ethernet GUI	MFC not programmed for correct gas - actual gas used different	Check MFC active gas using digital interface or Ethernet GUI
	MFC control parameters set incorrectly	Contact MKS service center	MFC control parameters set incorrectly	Contact MKS service center
MFC output signal oscillates	Inlet pressure oscillates	Check for faulty regulator	Inlet pressure oscillates	Check for faulty regulator
	Inlet pressure too high	Lower inlet pressure	Inlet pressure too high	Lower inlet pressure
	MFC inlet pressure to high for default <Operating Pressure> parameter	Use the Embedded Web Browser described in Appendix B to observe <Operating Pressure Parameter (default value is 40). Increase value between 40-90 for control gains to be less aggressive.	MFC inlet pressure to high for default <Operating Pressure> parameter	Use the Embedded Web Browser described in Appendix B to observe <Operating Pressure Parameter (default value is 40). Increase value between 40-90 for control gains to be less aggressive.
	MFC nameplate gas not same as actual gas	Check that MFC active gas is the same as the nameplate gas using Ethernet Web Browser.	MFC nameplate gas not same as actual gas	Check that MFC active gas is the same as the nameplate gas using Ethernet Web Browser.
	MFC valve and control parameter setup	Contact MKS Service Center	MFC valve and control parameter setup	Contact MKS Service Center

Digital Communications I/O Troubleshooting

RS485 Serial Communication

Table 23 RS485 LED Status

LED Status	LED Description
Dark	No power, check cable wiring to MFC.
Solid Green	MFC Initialization successfully completed
Blinking Green	Successful serial connection opened between host and MFC. MFC has replied to request from the Host. Note that the COMM LED is solid Green if the host is not querying the MFC.
Solid Red	Critical Unrecoverable Fault. Contact MKS Service

Table 24 RS485 Connectivity

Device Not Establishing Serial Connection to HOST											
P r o b l e m s	Compare set up of HOST with MFC serial communication parameters: <table border="0" style="margin-left: 20px;"> <tr> <td>Parameter</td> <td>Value</td> </tr> <tr> <td>Start Bit</td> <td>1</td> </tr> <tr> <td>Data Bits</td> <td>8</td> </tr> <tr> <td>Parity</td> <td>no parity</td> </tr> <tr> <td>Stop Bit</td> <td>1</td> </tr> </table>	Parameter	Value	Start Bit	1	Data Bits	8	Parity	no parity	Stop Bit	1
	Parameter	Value									
	Start Bit	1									
	Data Bits	8									
	Parity	no parity									
	Stop Bit	1									
Device has solid Green LED	Baud Rate* 9,600 (initial); 19,200; 38,400 End-of-Line Delimiter semicolon (;)										
	COMM Port is properly identified for the serial driver program.										
	Verify the host is sending message to correct MAC Address.										
	Verify the wiring of the serial to RS485 converter is half duplex (2 wire).										
	Electronics failure related to damaged or blown digital signal transceivers.										

Modbus TCP Communication

Table 25 Modbus TCP LED Status

LED Status	LED Description
Dark	No power, check cable wiring to MFC.
Blinking Green	MFC Initialization successfully completed
Solid Green	Successful Ethernet connection opened between host and MFC.
Solid Red	Critical Unrecoverable Fault. Contact MKS Service

MFC Web Browser for Modbus I/O / Ethernet RJ45 Communication

The Web browser is accessible via an Ethernet RJ 45 for Modbus I/O. Browser access provides the user with in-situ ability to setup, change configurations, and troubleshoot device functionality. The purpose of this Appendix A is to provide basic instructions on:

- Establishing communications between a computer and the MFC via the Primary I/O RJ45
- Monitor Mode versus Setup Mode
- Basic MFC functionality associated with the Setup Mode
- Setting up the <Plot> page for plotting and saving data

Communicating with the MFC via Ethernet

- Connect an Ethernet cable between the MFC RJ45 (Modbus) and the computer or laptop that is going to be used to communicate to the device.
- Open the **Control Panel** on the Startup menu.
- Select Network and Sharing Center.
- View the active networks on the laptop.

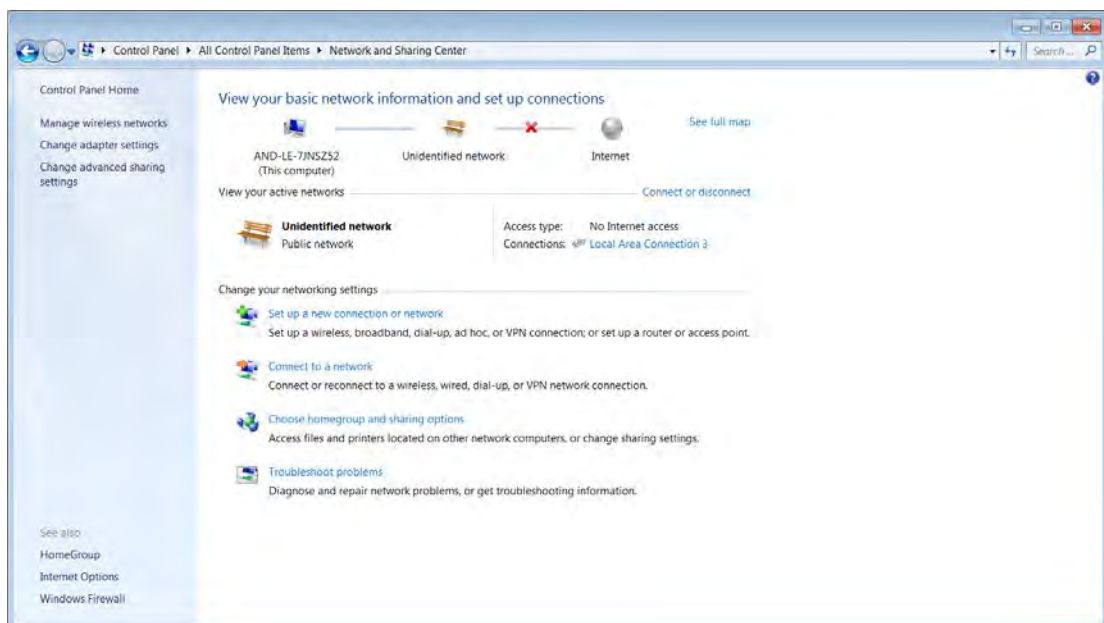


Figure 8. Basic Network Information

- Double-click on the local area connection to open.

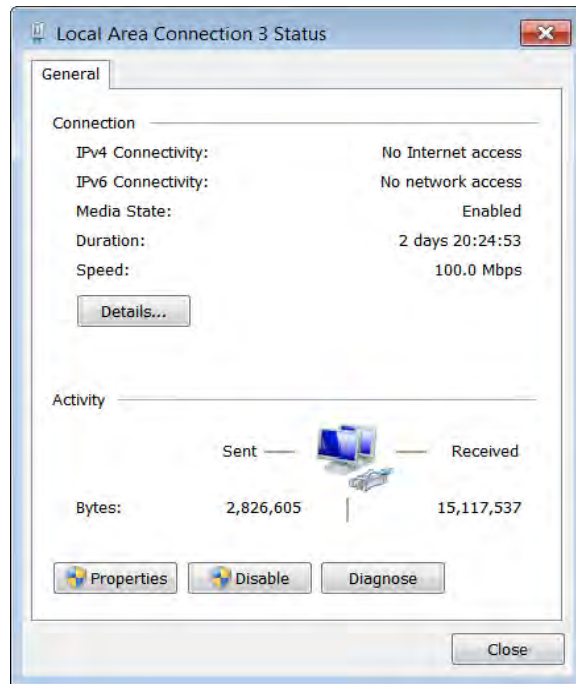


Figure 9. Local Area Connection Status

- Select **Properties**. Scroll down to find and highlight **Internet Protocol Version 4**

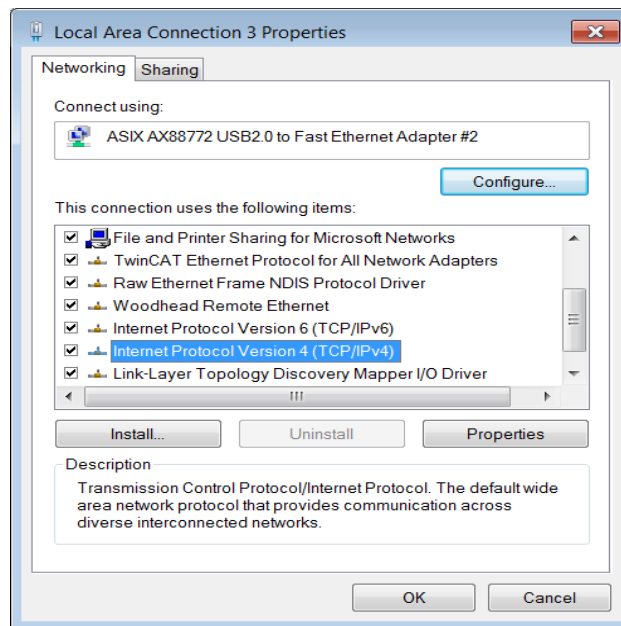


Figure 10. Internet Protocol Version 4

- Select Properties.

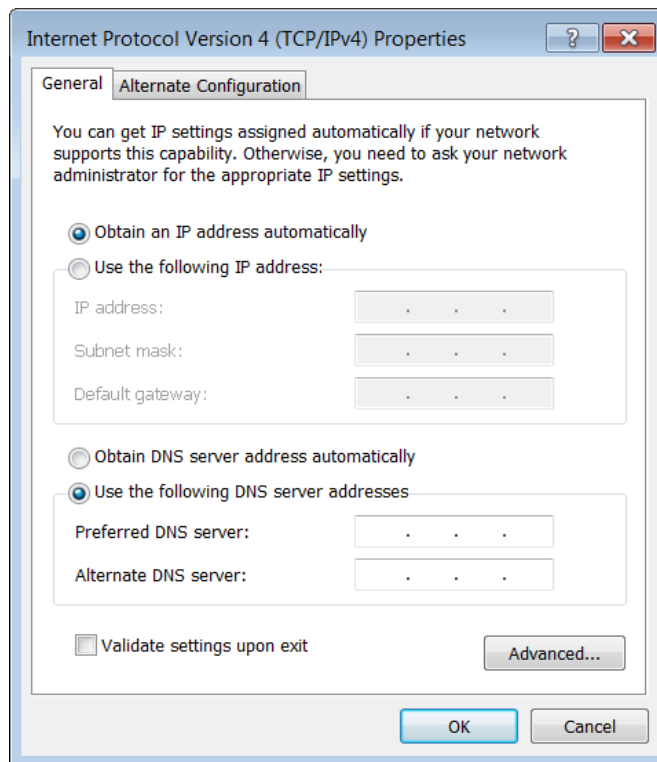


Figure 11. Properties Page

- Select **Use the following IP Address**. Enter a unique IP address for the computer in the format shown below. Press the Tab key on the computer to populate the Subnet mask.

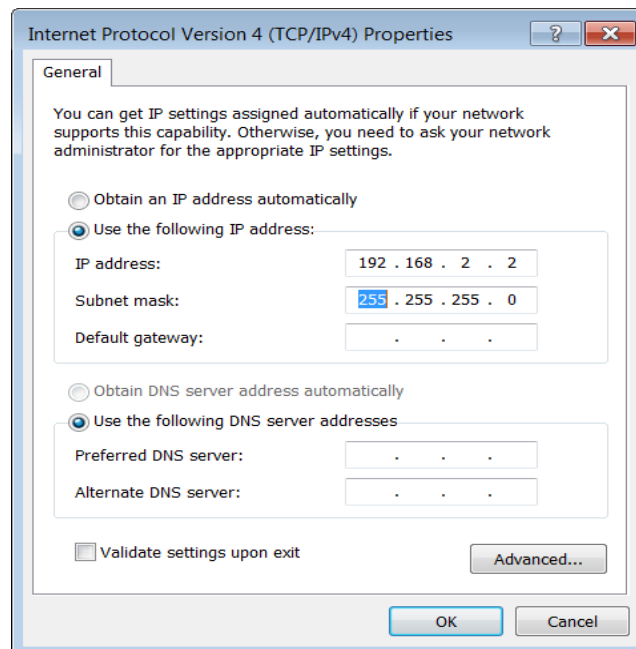


Figure 12. IP Settings

- Click **OK** to select and close the window.

- Once the address has been updated, close the remaining network connection windows.

The laptop is ready for Ethernet communication with MKS MFC devices.

Opening the Web Browser – Monitor Mode

- Open the search engine such as Chrome (Preferred for this application).
- Enter the IP address of the device.
192.168.2.155 is the factory default address for the G and I Series MFC.
- When the Web browser opens, it shows the Device page and it is in the Monitor Mode.

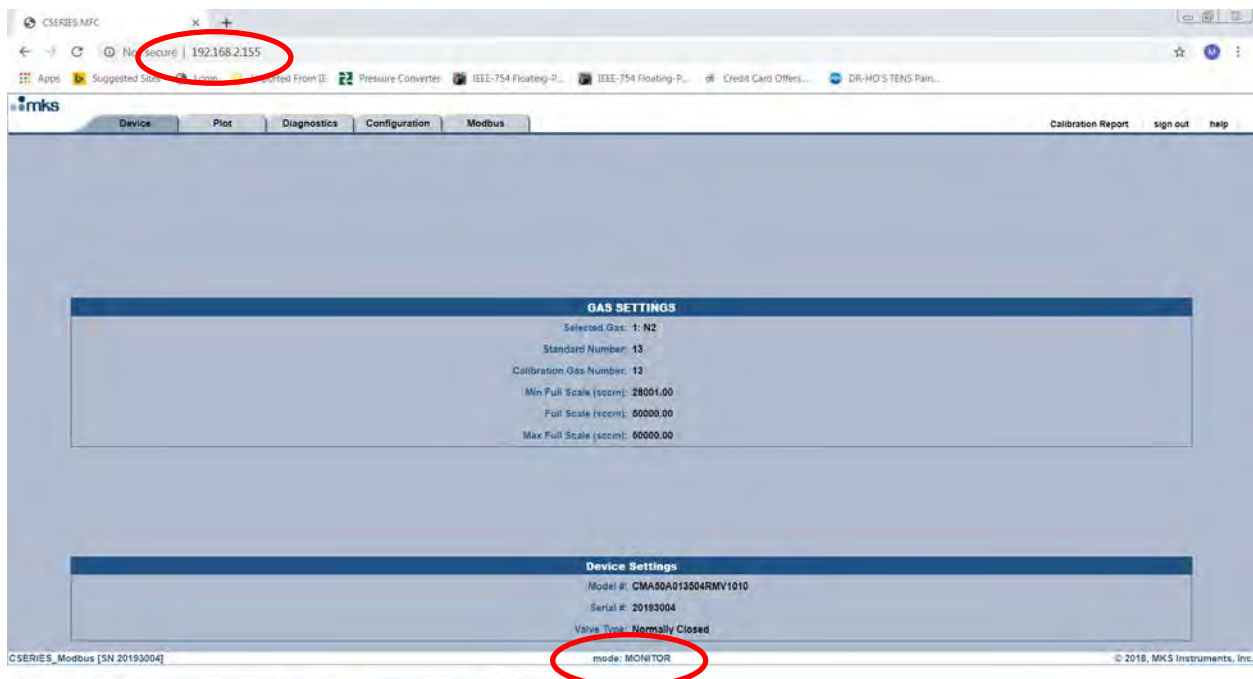


Figure 13. Device Page in Monitor Mode

The Monitor Mode Device tab displays the current setup of the device:

- Gas Setting – Selected Gas, Min and Max Full Scale
- Device Settings – Model Code and Serial Number

Web Browser - Setup Mode

The Setup Mode allows for the user to access and make changes to a variety of Device features by opening the tabs located at the top of the page. The Setup Mode is accessed from the Configuration tab by entering a password in the Enter Password to Change Settings field.

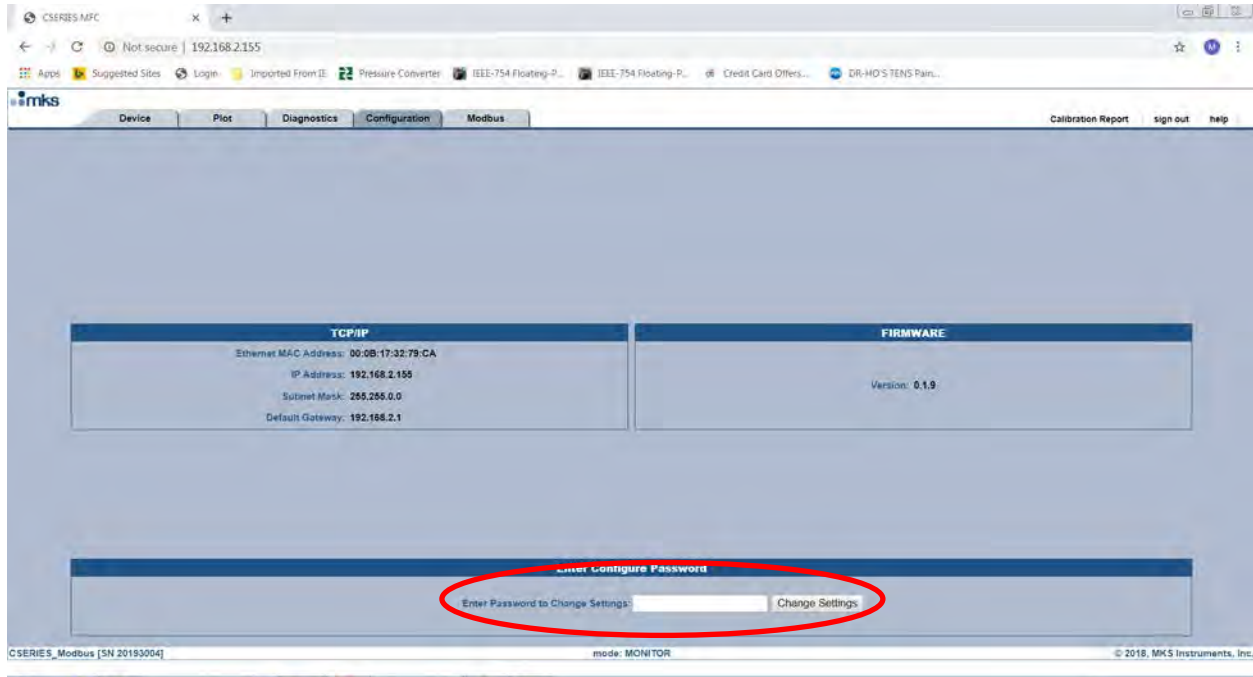


Figure 14. Enter Password to Change Settings



The password to change from a Monitor to the Setup mode is config.

Once the password has been entered additional page tabs and active fields within the various Web browser pages allow the user to configure the MFC to a specific application.

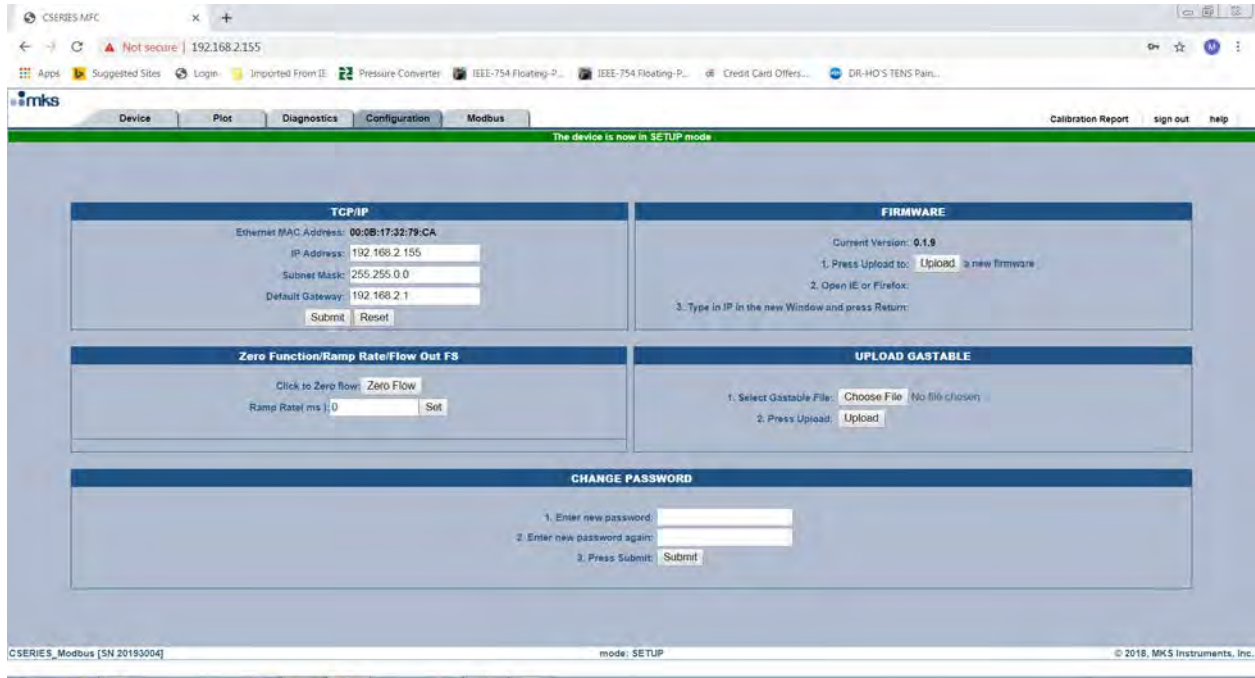


Figure 15. Additional Tabs

The table below describes basic features that can be configured via the Web browser for all C Series Modbus/ Ethernet IP MFCs in the Setup Mode.

Table 26 Basic Features in the Setup Mode

MFC Function	Browser Tab	MFC I/O Type
Create a new gas	Device	All MFC Models
Re-range Full Scale	Device	All MFC Models
Select an existing gas table	Device	All MFC Models
Change MFC IP address	Configuration	All MFC Models
Change the firmware version	Configuration	All MFC Models
Zero the MFC	Configuration	All MFC Models
Change the setup password	Configuration	All MFC Models
Set ramp rate	Configuration	All MFC Models



Note C series MFC will meet the published accuracy specification on page 5 of this document for the nameplate gases that are ordered according to the model code. Additional gases created via the Web Browser will not be accurate.

Utilizing the Plot Page and Saving Data

Plot Tab

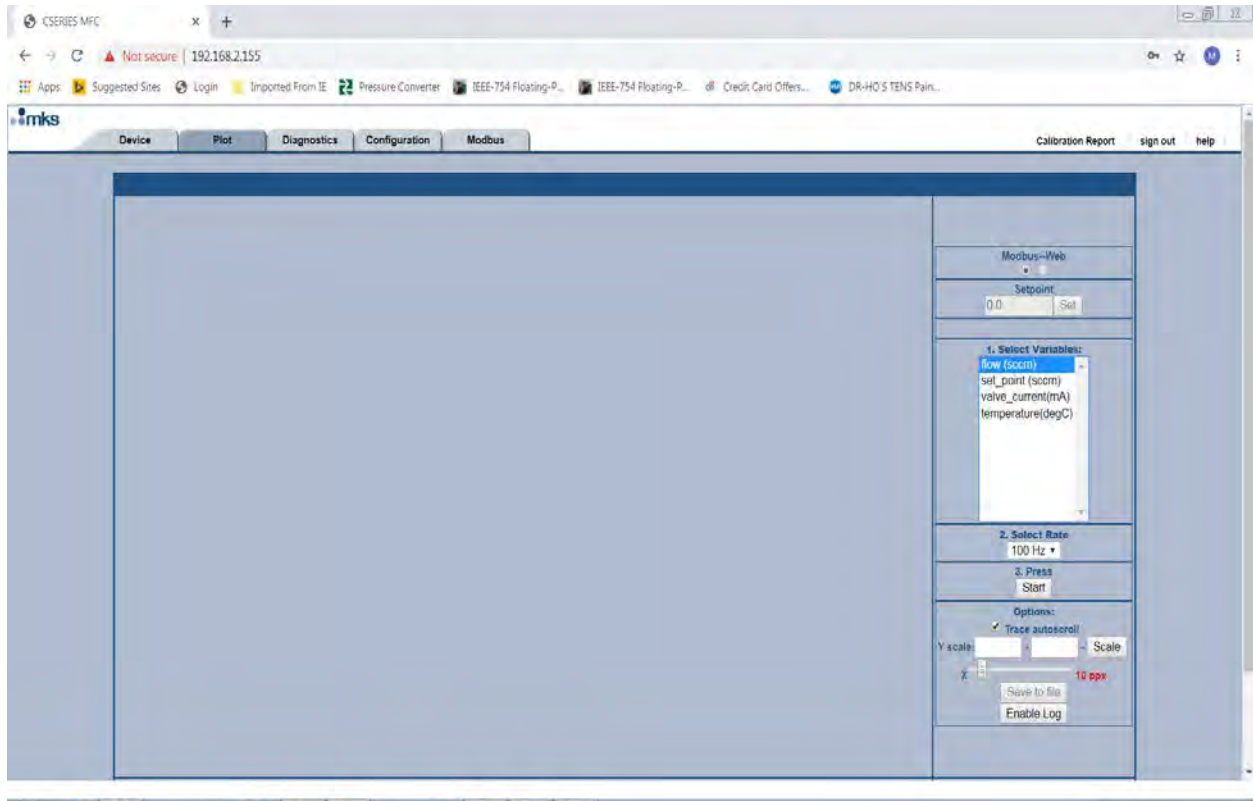


Figure 16 Plot Page

In the Setup Mode 4 variables are available for the user to monitor

- Flow
- Set Point
- Valve Command
- Temperature



It is also possible to switch modes from the Primary I/O to local Web Based control that would allow the user to send active set points which may be helpful from a diagnostic perspective.

C Series Digital MFC, Appendix A MFC Web Browser for Modbus I/O / Ethernet RJ45 Communication

- Select the variables, data selection rate, and hit start

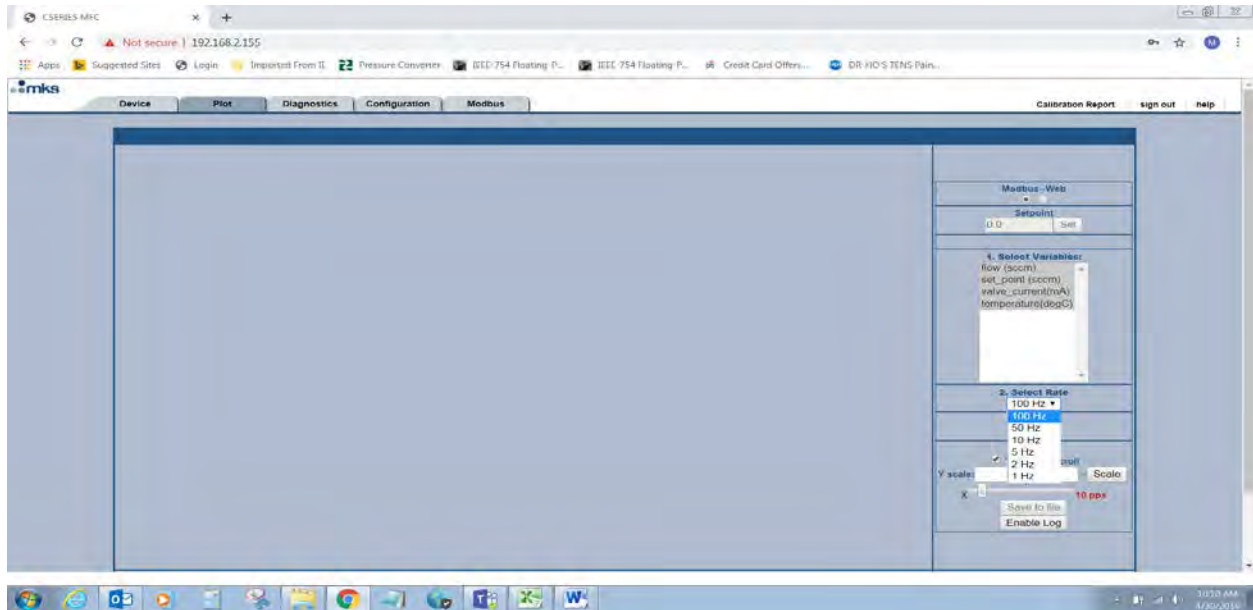


Figure 17 Selection of Plot Page Variable

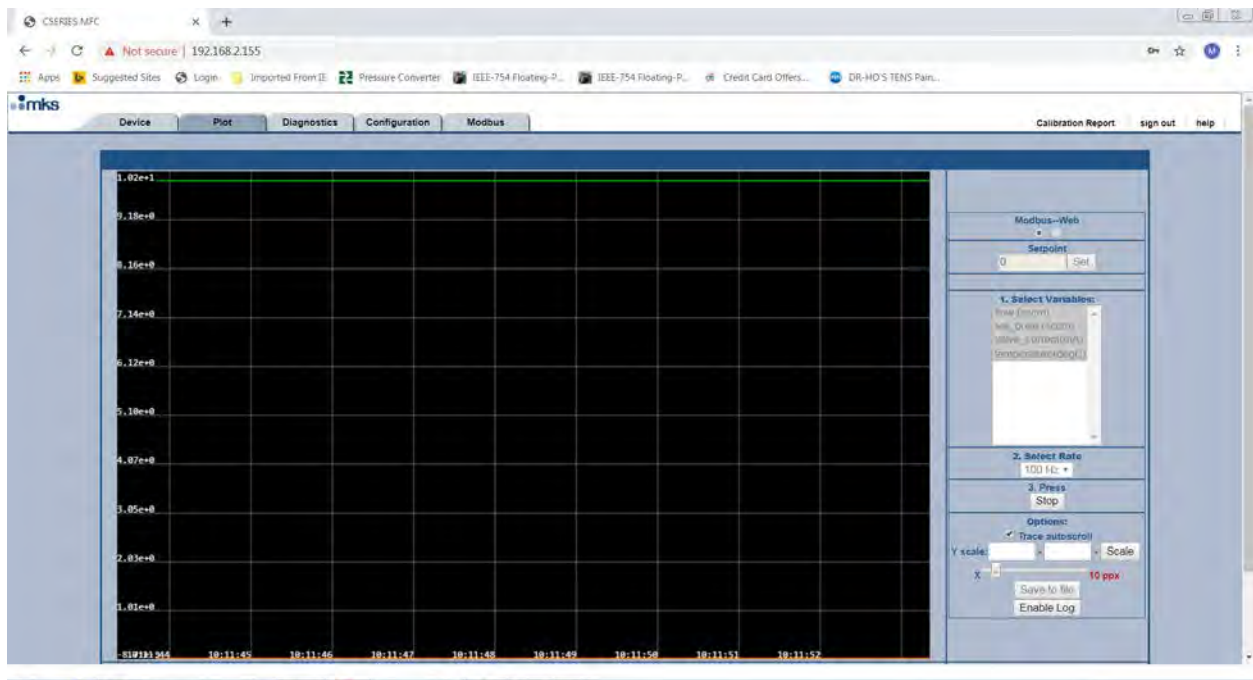


Figure 18 Plot page start

Saving Data

- At the bottom of the plot page is <Enable Log>

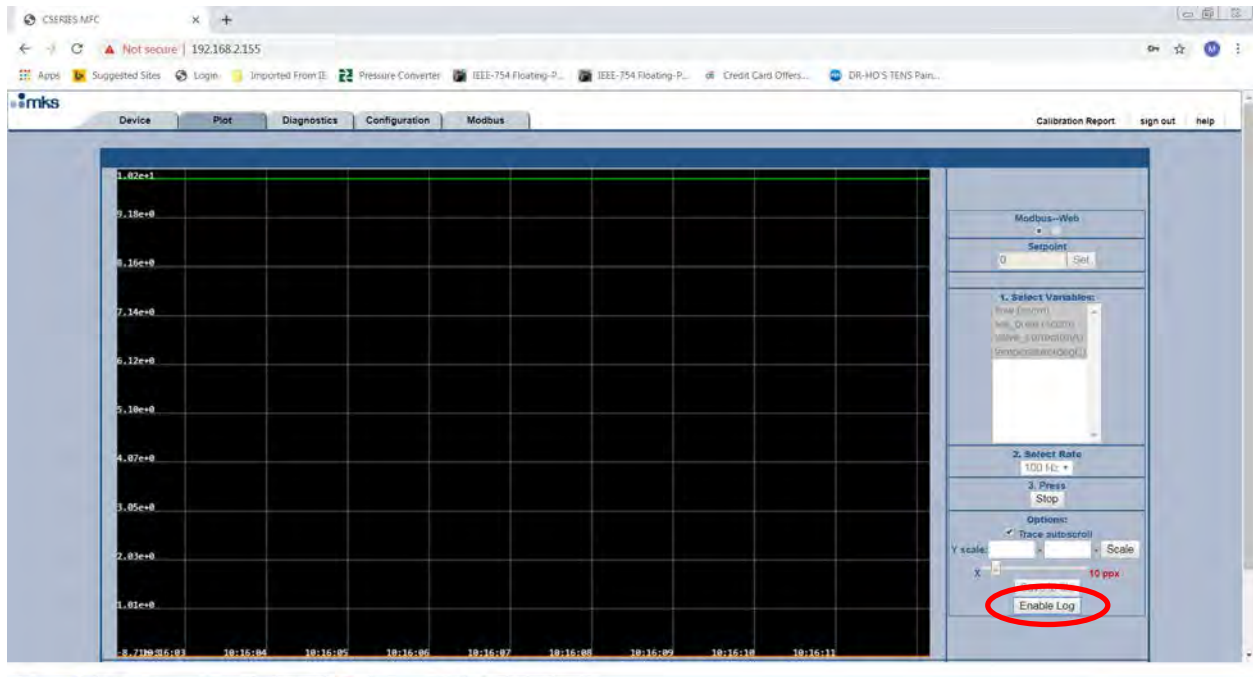


Figure 19 Plot page <Enable Log>

- Once Selected the <Send to file> becomes active.

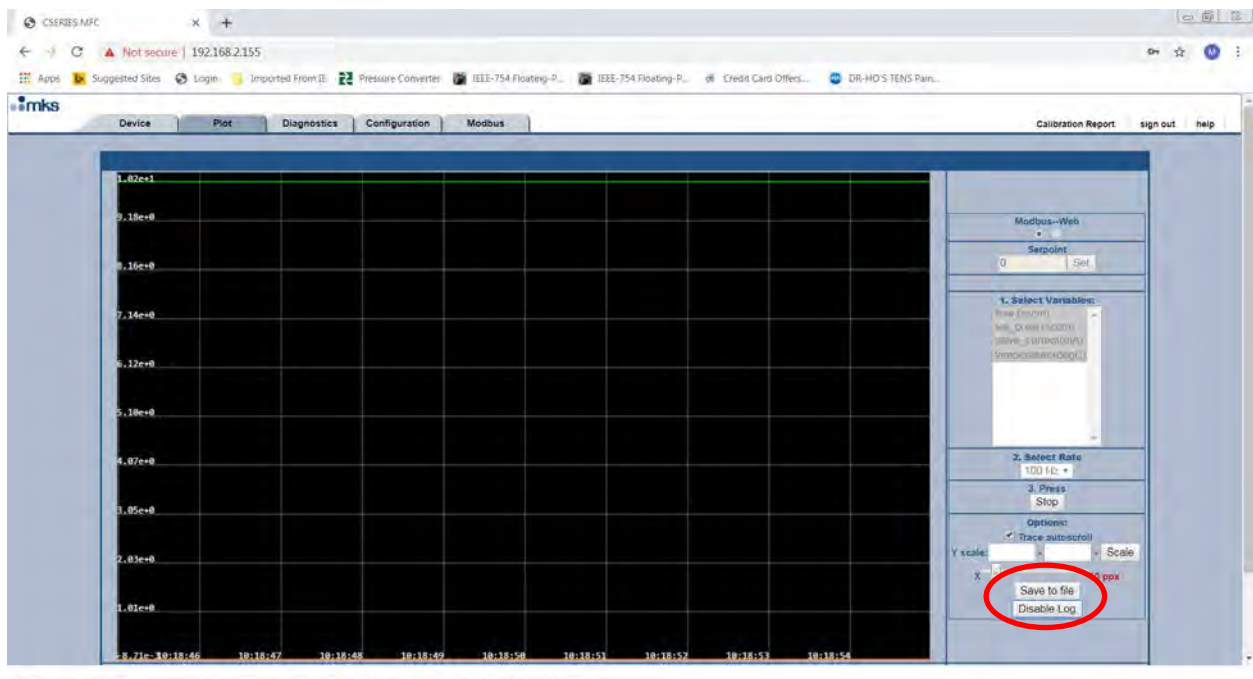


Figure 20 Active Send to File

- After collecting the data that is to be saved, <Stop> the plot page and select <Send to File>
- At the bottom of the page a .txt file appear:

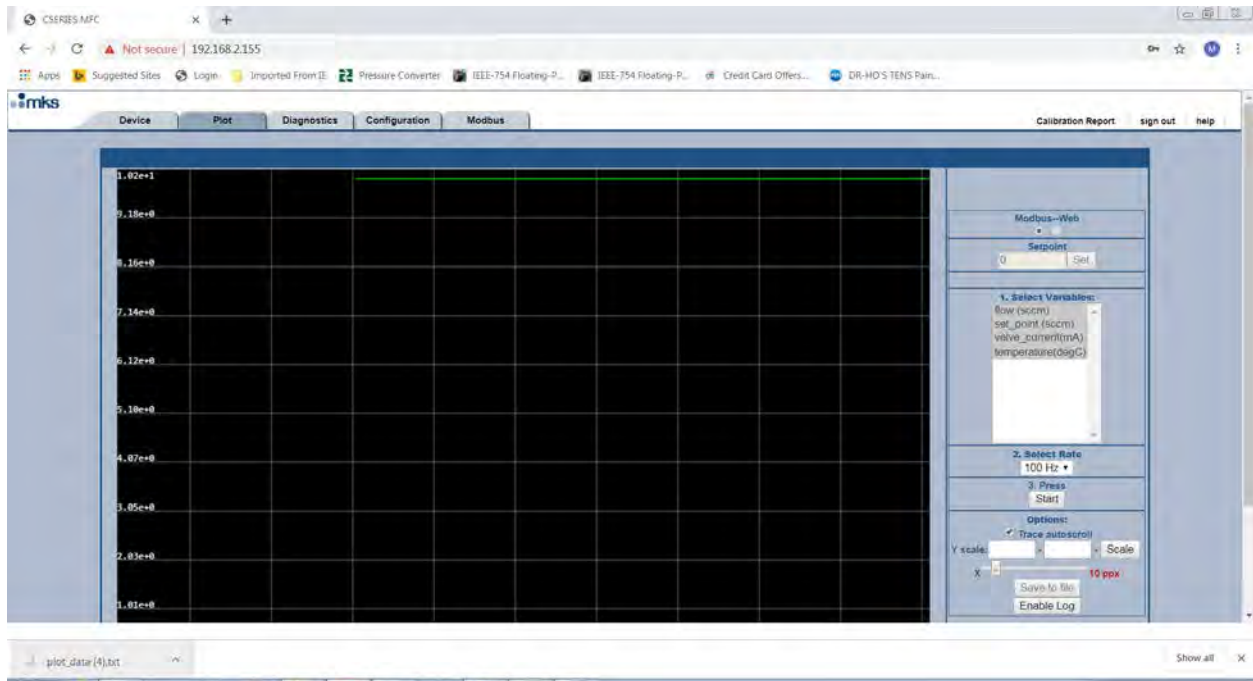


Figure 21 Data file saved to txt format

Data can then be saved or moved to a different program such as Excel for further analysis.

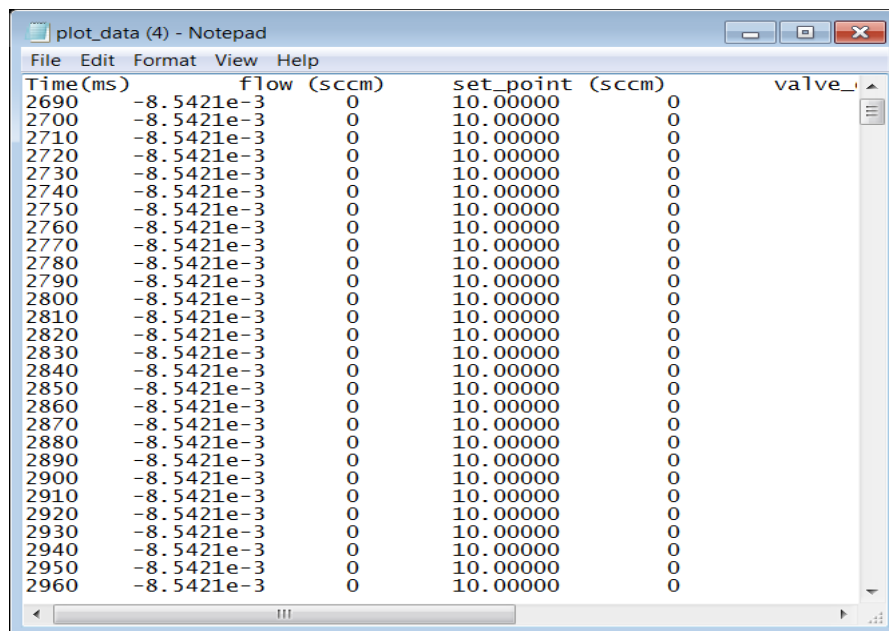
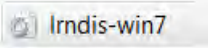


Figure 22 Data text file

Notes

MFC Web Browser / Micro-USB Communication

The Analog / RS 485 C series models has access to a Web Browser via a micro-usb connector on the side of the MFC enclosure. The following steps are required to set the device up for UDP communication.

- The micro-usb requires a driver to be installed in order for usb to communicate-
- Contact MKS for the appropriate driver - 
- USB 2.0 compliant cable is required. Cable is USB Type A to usb-micro Type B.
- Cable length should be less than 2 meters

Note

This driver is for Windows 7. There currently is no driver available for Window 10, but a procedure has been developed that will allow the driver to work in a Windows 10 operating system, contact MKS for additional details.

USB Driver Installation

- Drop the driver onto the <Desktop> of the computer
- Power the MFC over the Primay I/O
- Once powered, connect a USB cable from Computer to the micro connector on the MFC.
- Open Device Manager, an unknown device is found in the list <Other Devices>

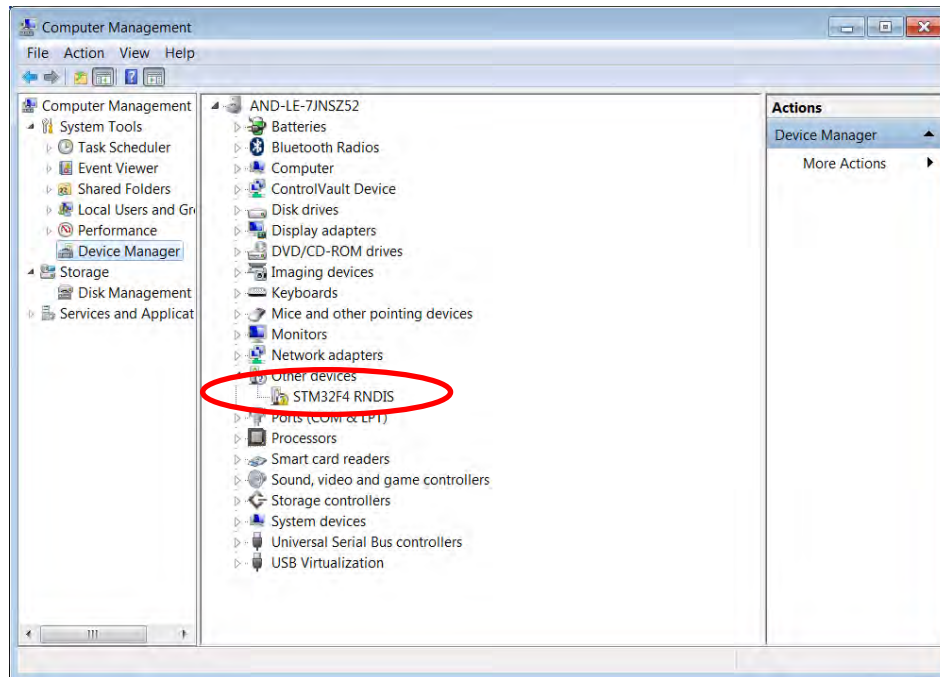


Figure 23 Unknown Device

- Right click on the device and select <Update Driver>

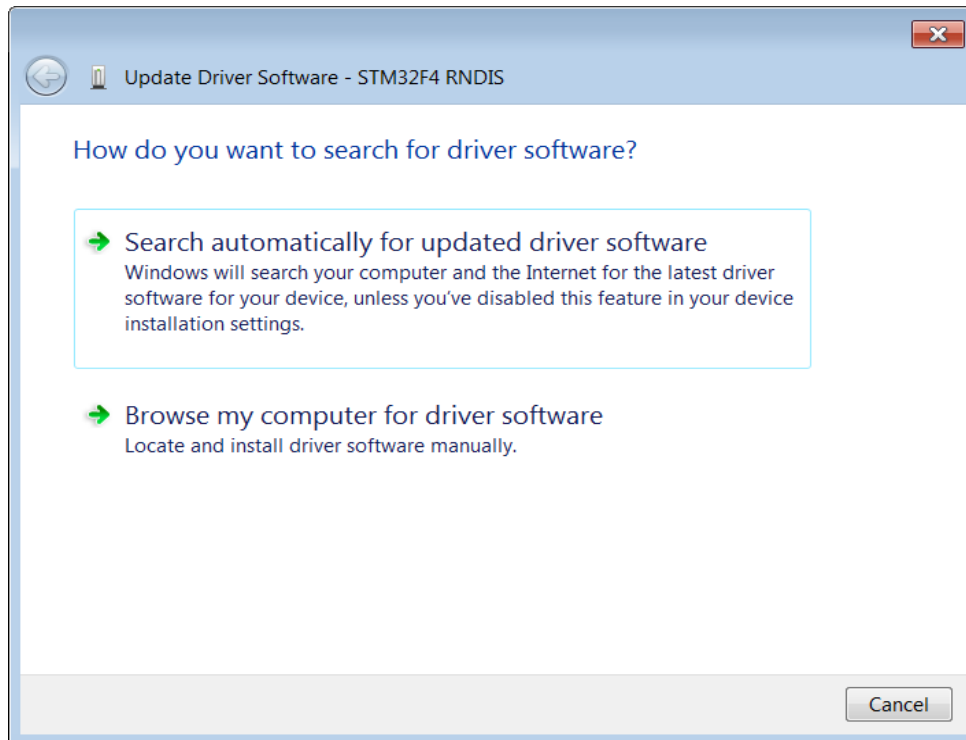


Figure 24 Browse to Driver Location

- Select Browse my computer for driver software and Navigate to the desktop

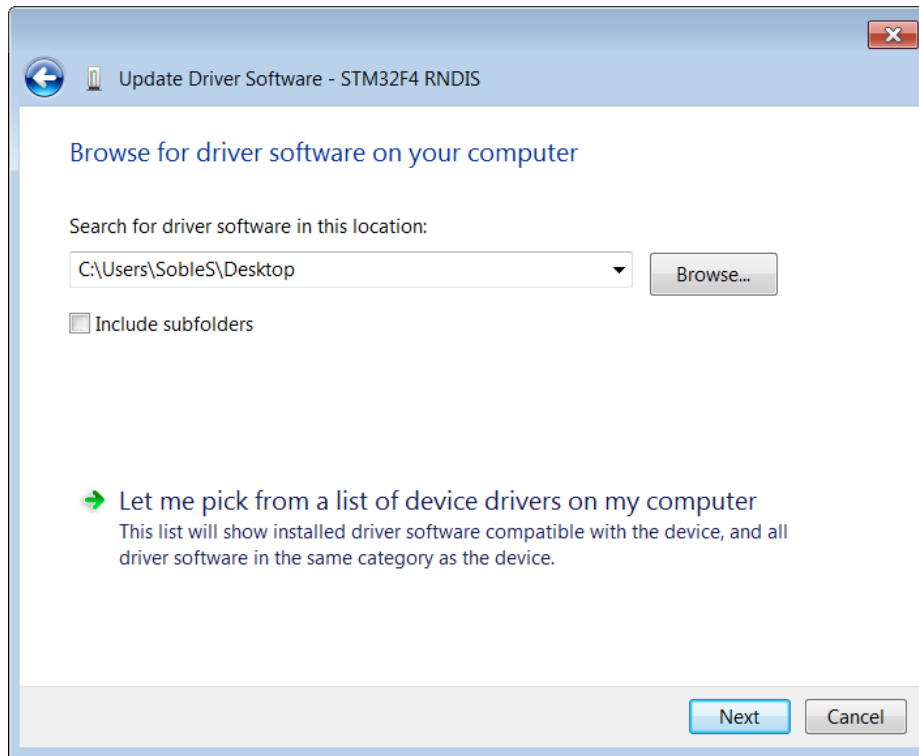


Figure 25 Identify Driver Location

- Find the Driver location and select to install. Select Install driver anyway....

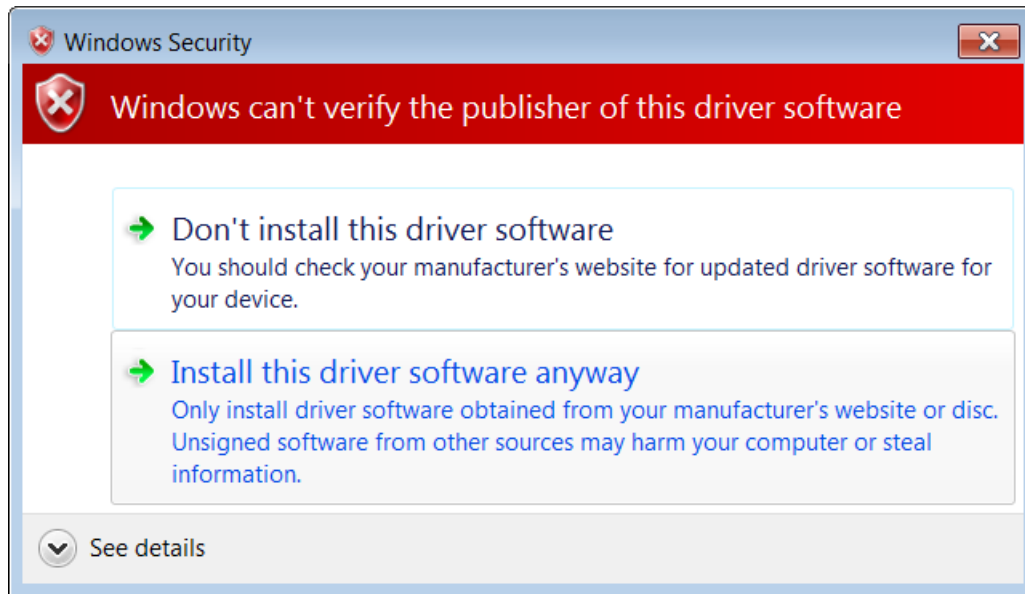


Figure 26 Driver Warning Popup

- Driver installed successfully

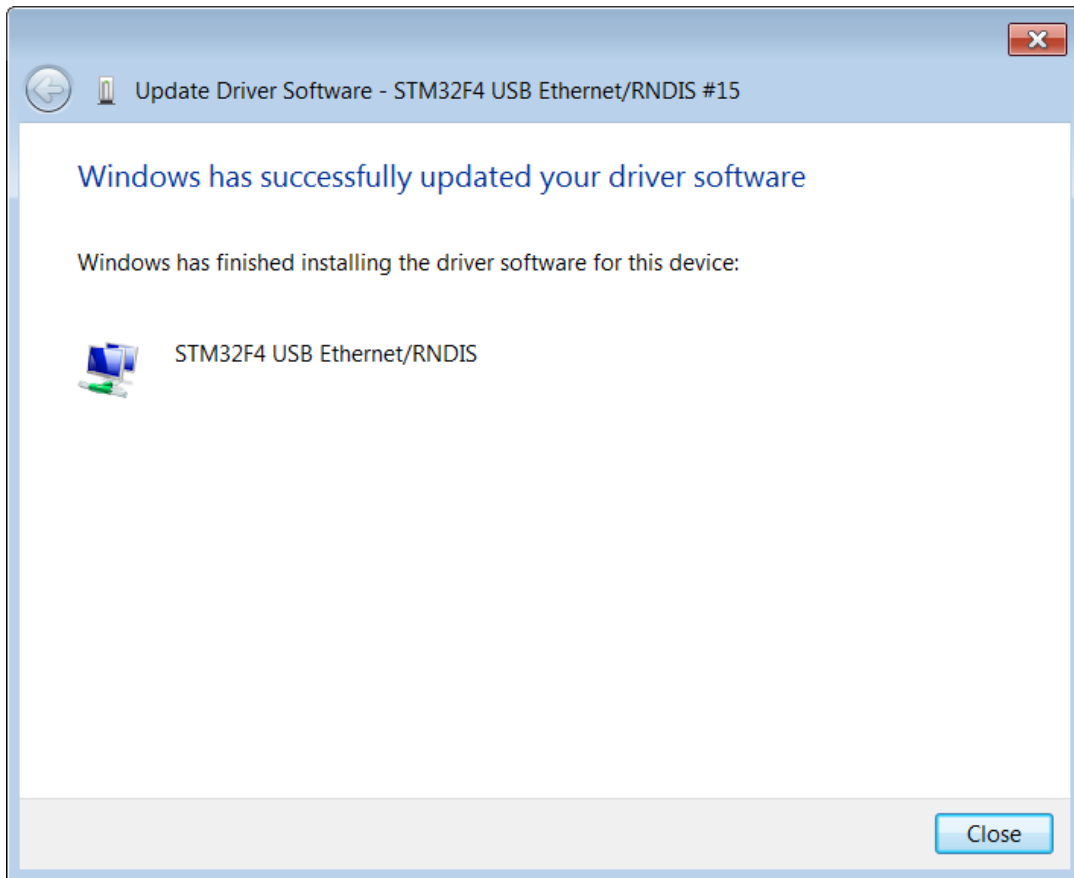


Figure 27 Driver Successfully Installed

- Open <Device Manager> and verify that the driver has been installed.

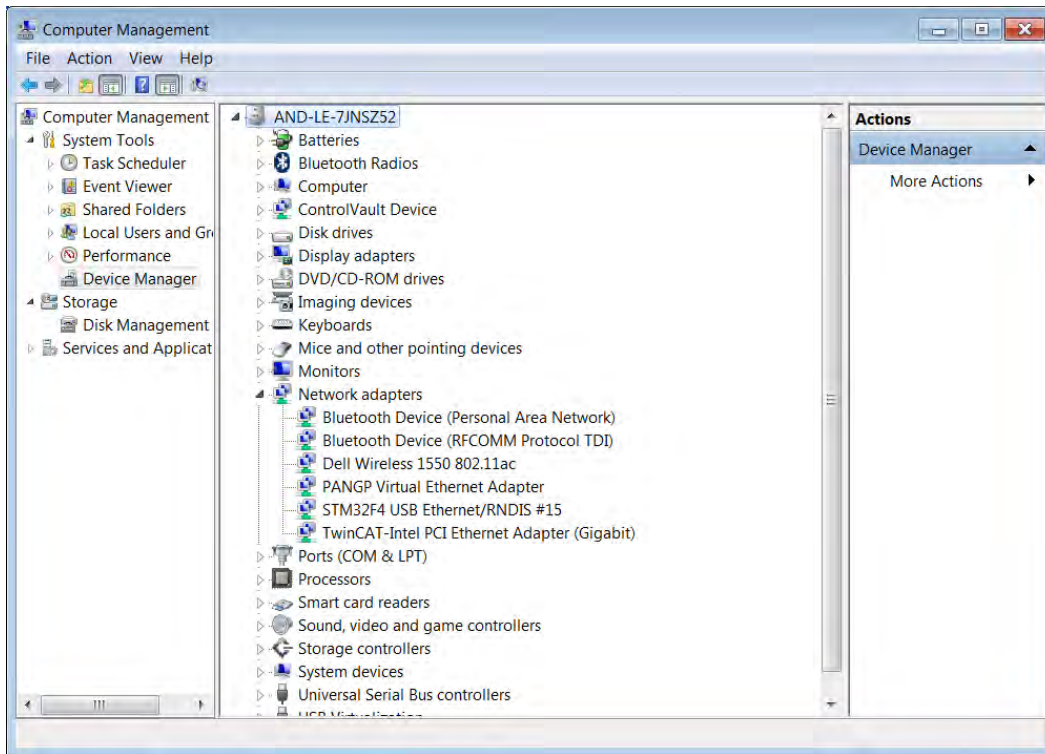


Figure 28 Network Adapter Identified After Driver Installation

Network Setup for Establishing Communication

- Go to Control Panel <Network and Sharing Center> , a new local area connection should be available

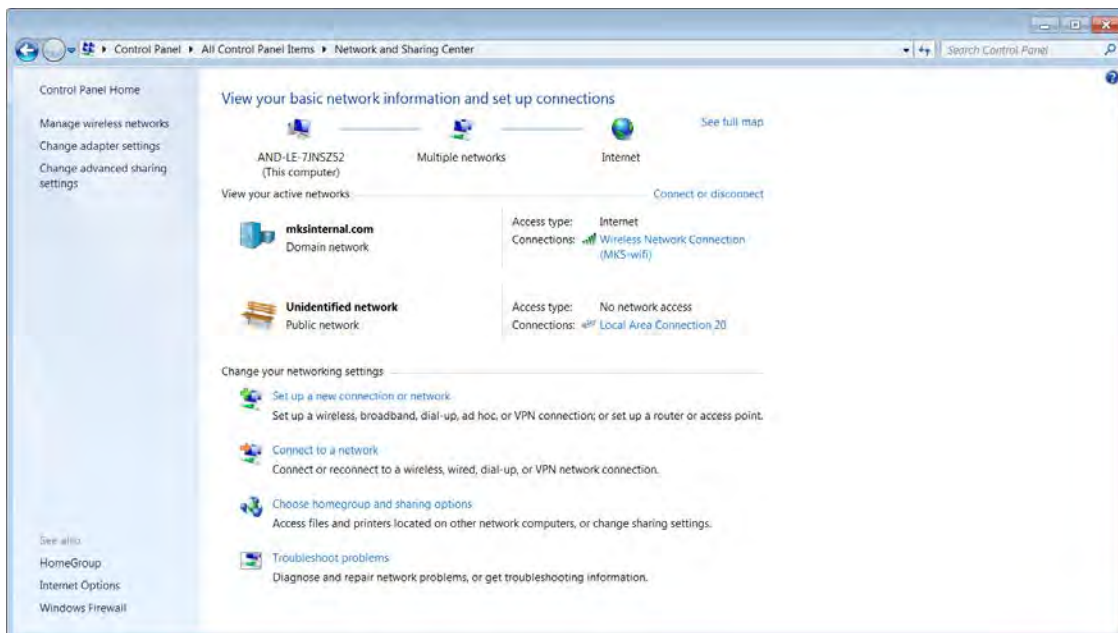


Figure 29 Local Area Connection – Network and Sharing Center

- Double click to open and select Properties

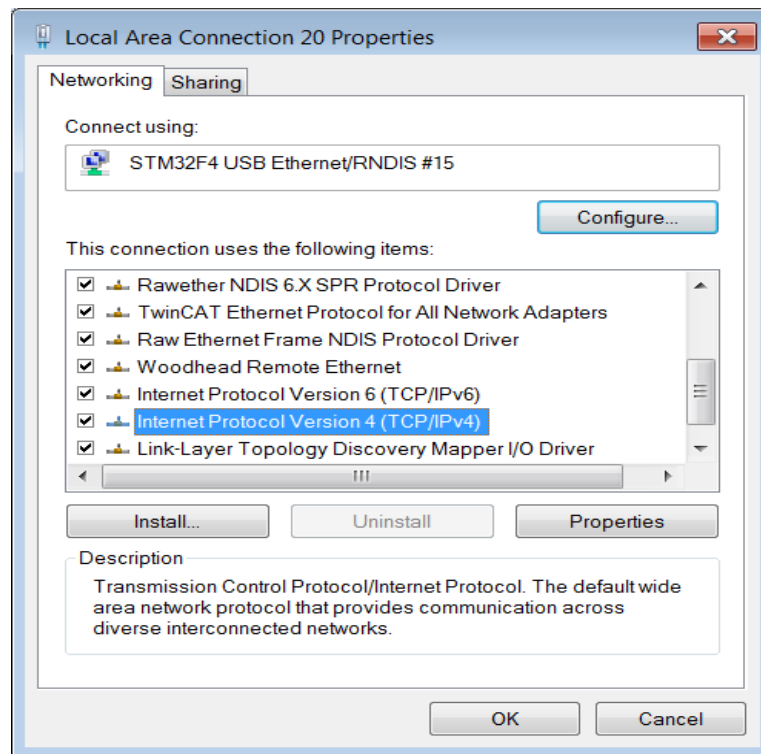


Figure 30 Internet Protocol Version 4 Properties

- Select <Internet Protocol > Properties

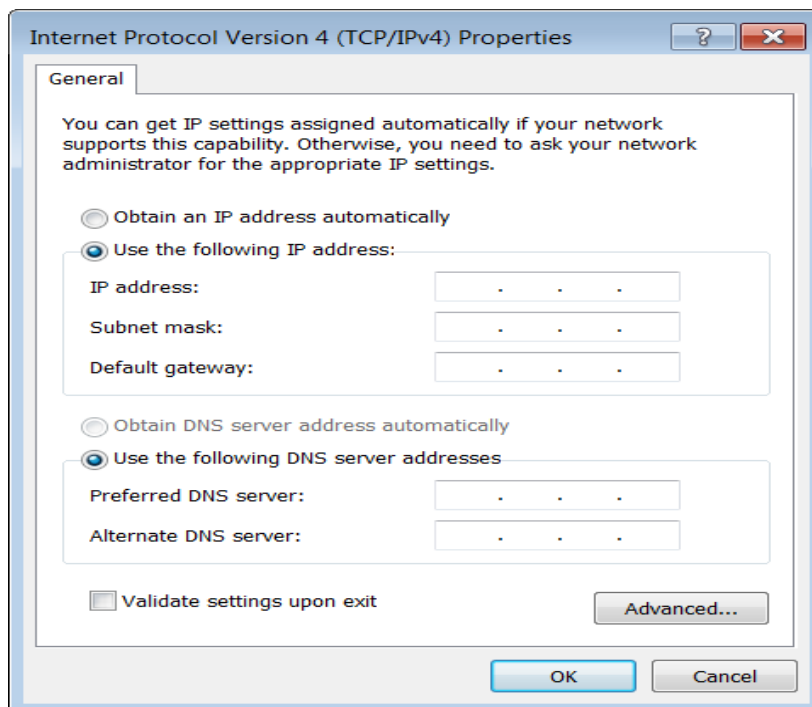


Figure 31 Setting a Static IP Address

- Select <Use the following IP Address> in order to create a static IP Address to the Device. The format needs to follow 192.168.2.X, which can be selected by the user. Hit <Tab> to populate the Subnet mask.

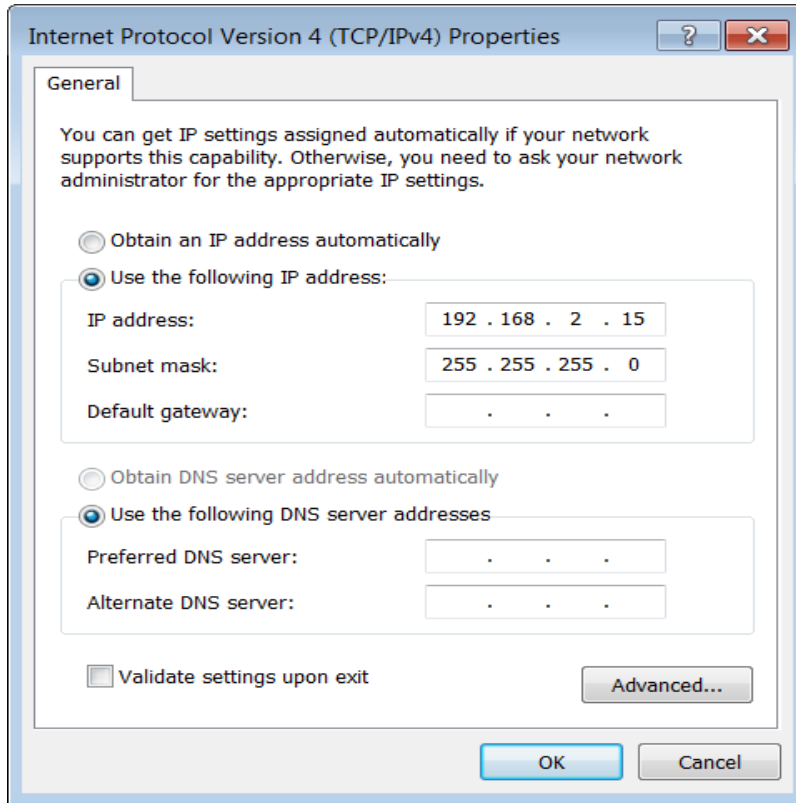


Figure 32 Static IP Address Format

Select Ok and close out the local area connection.

Opening the Web Browser – Monitor Mode

- Open an operating Browser such as Chrome or Internet Explorer

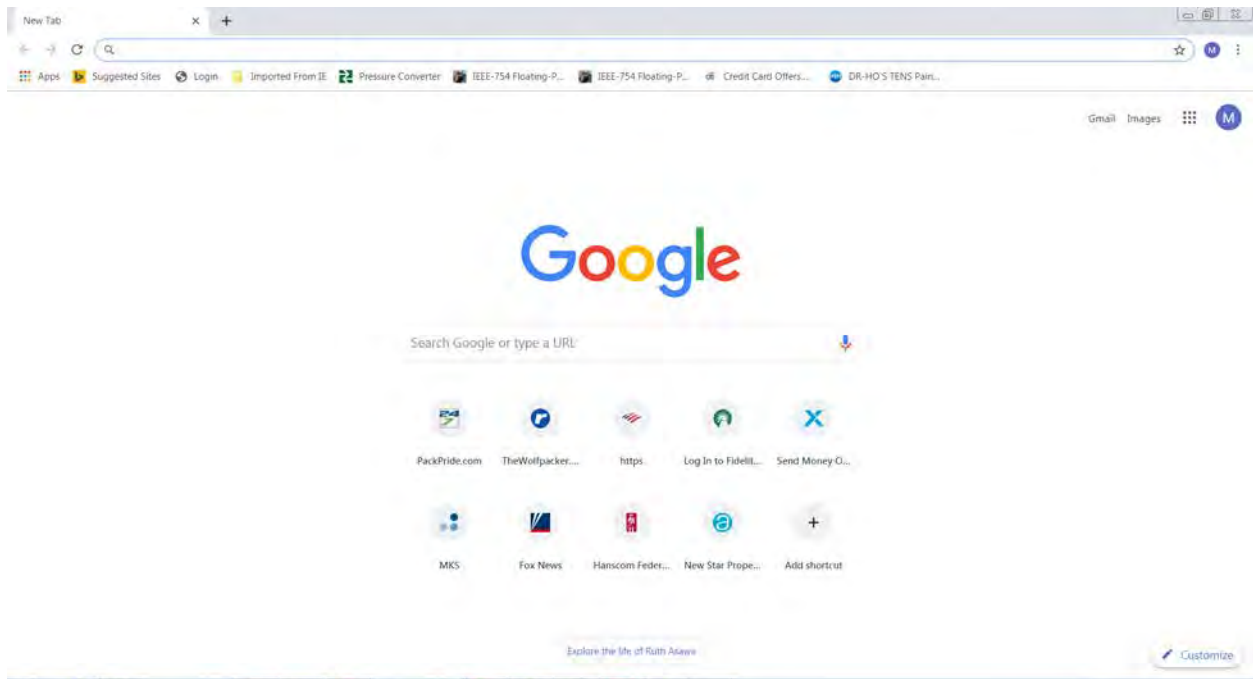


Figure 33 Open Browser Page

- In the Address line type in the IP Address of the MFC. The factory default IP address is 192.168.2.155

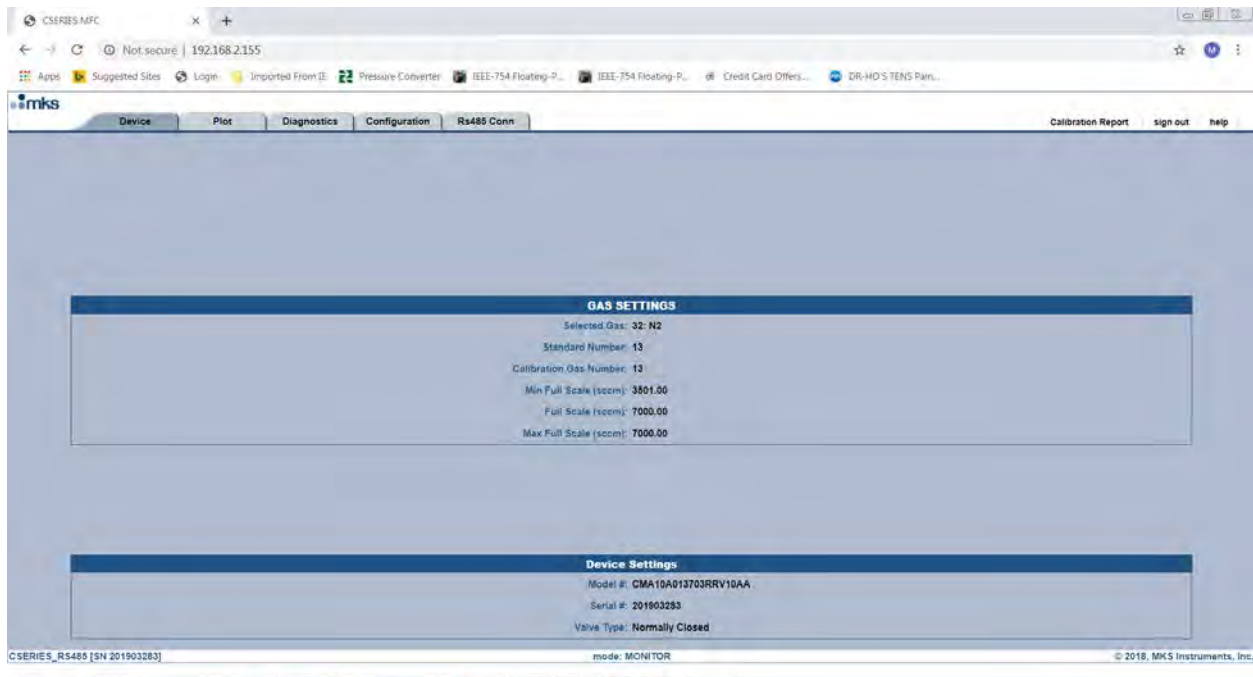


Figure 34 Browser Device Page – Monitor Mode

- The Browser opens up in the <Monitor Mode> and provides basic information on the setup of the C series MFC.

Web Browser – Setup Mode

- Select the <Configuration> Tab in the Monitor Mode. Type in the password config to change to the Setup Mode

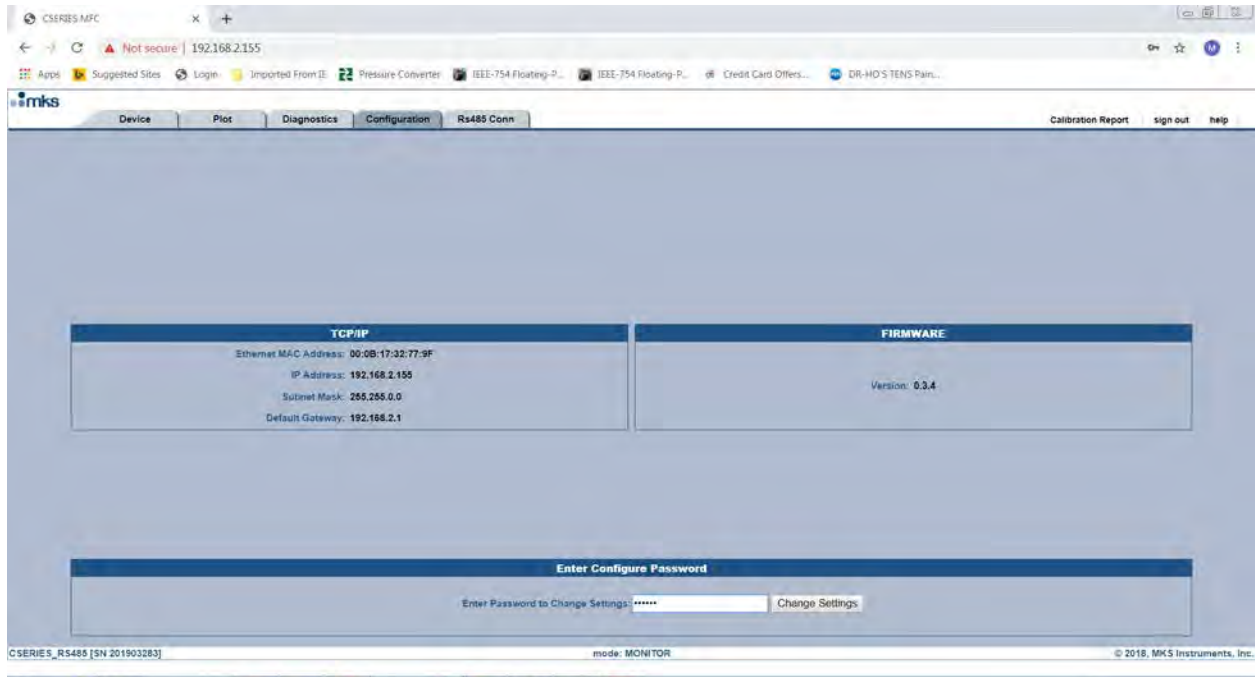


Figure 35 Changing from Monitor to Setup Mode

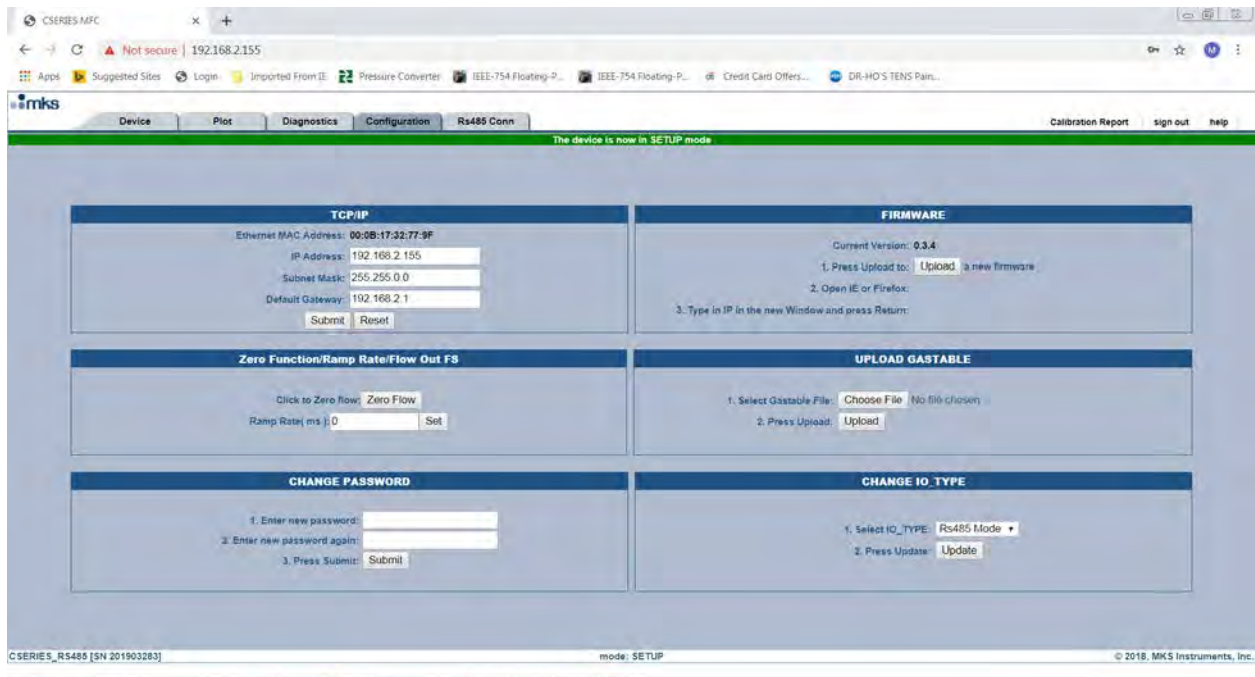


Figure 36 Setup Mode Configuration Tab

- Once in the setup mode different fields become available to the user that will be useful for MFC configuration and diagnostics (Plot page). The table below summarizes the features of the Web Browser in the Setup Mode.

Table 27 Basic Features in the Setup Mode

MFC Function	Browser Tab	MFC I/O Type
Create a new gas	Device	All MFC Models
Re-range Full Scale	Device	All MFC Models
Select an existing gas table	Device	All MFC Models
Change MFC IP address	Configuration	All MFC Models
Change the firmware version	Configuration	All MFC Models
Zero the MFC	Configuration	All MFC Models
Change the setup password	Configuration	All MFC Models
Set ramp rate	Configuration	All MFC Models
Change I/O type	Configuration	9 pin Analog/ RS485



C series MFC will meet the published accuracy specification on page 5 of this document for the nameplate gases that are ordered according to the model code. Additional gases created via the Web Browser will not be accurate.

Utilizing the Plot Page and Saving Data

Plot Tab

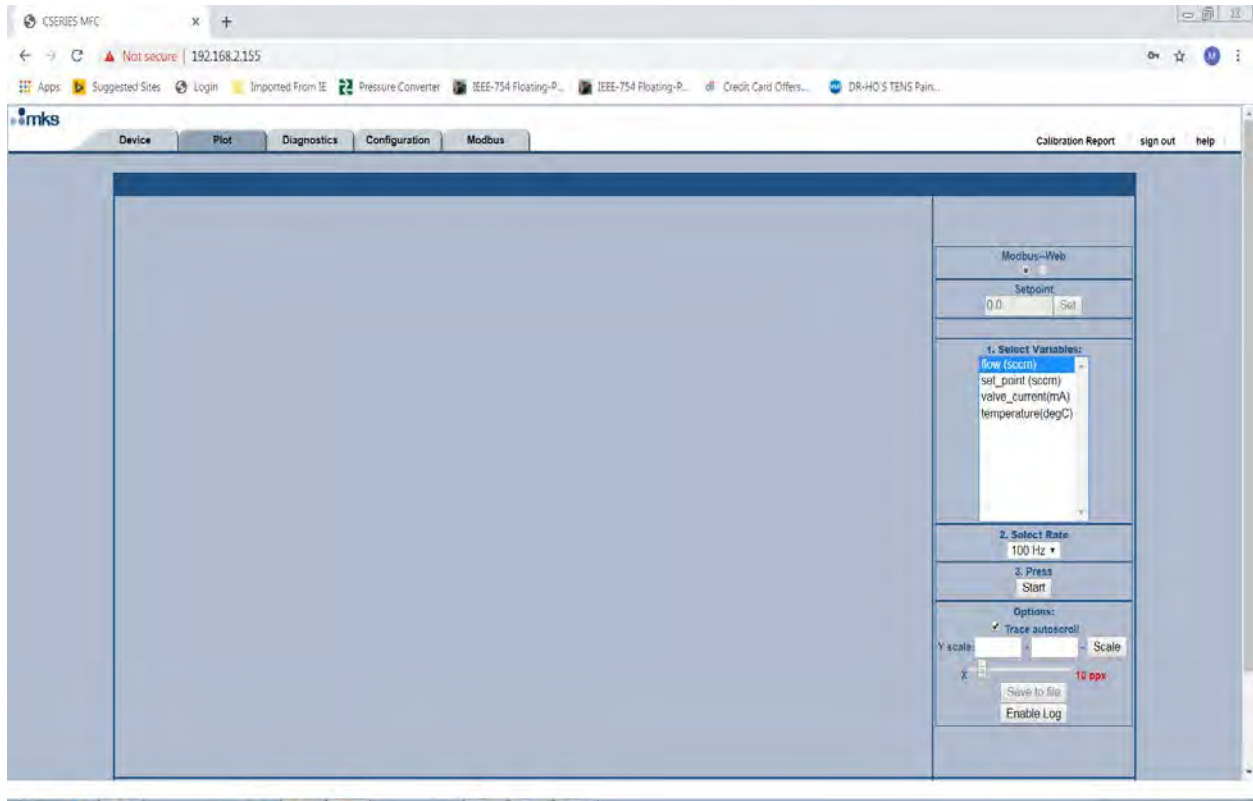


Figure 37 Plot Page

In the Setup Mode 4 variables are available for the user to monitor

- Flow
- Set Point
- Valve Command
- Temperature



It is also possible to switch modes from the Primary I/O to local Web Based control that would allow the user to send active set points which may be helpful from a diagnostic perspective.

Select the variables, data selection rate, and hit start:

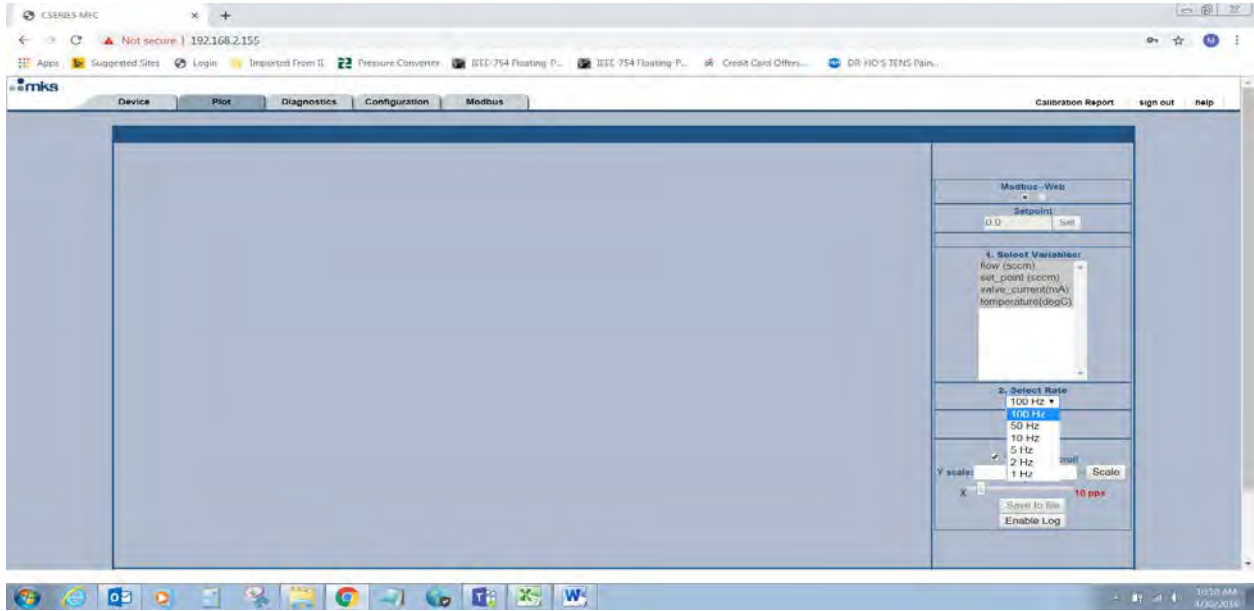


Figure 38 Plot Page – Selection of Variable

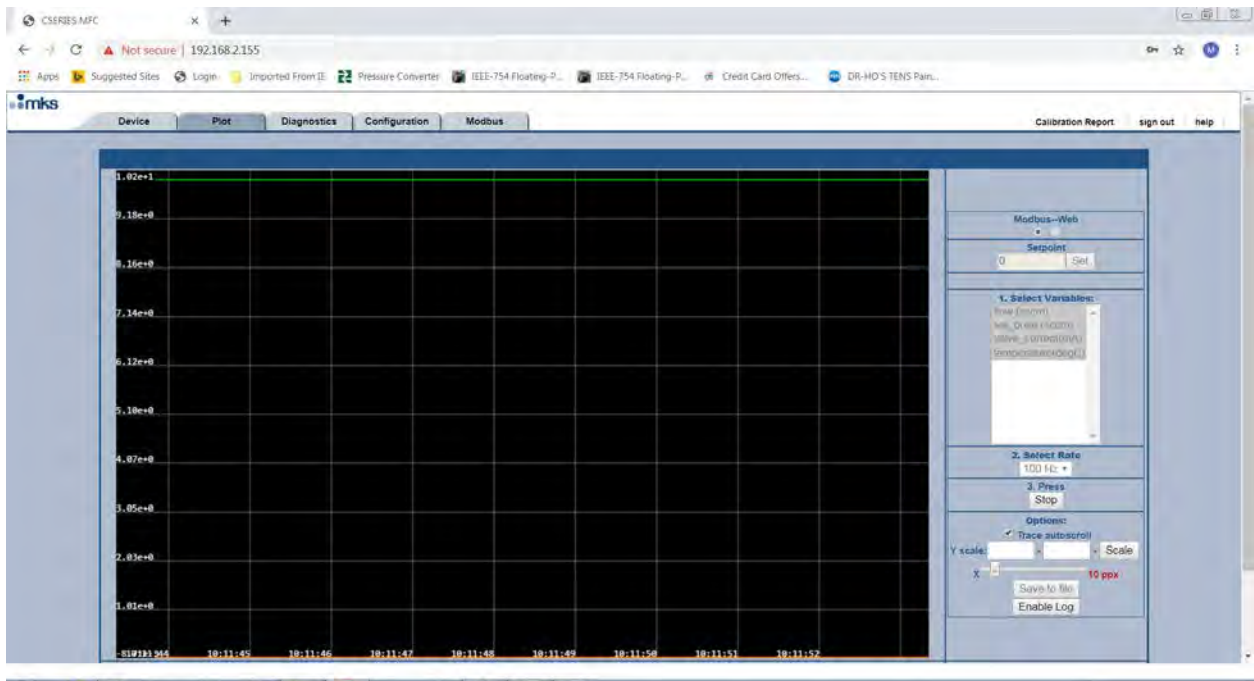


Figure 39 Active Plot Page

Saving Data

At the bottom of the plot page is <Enable Log>

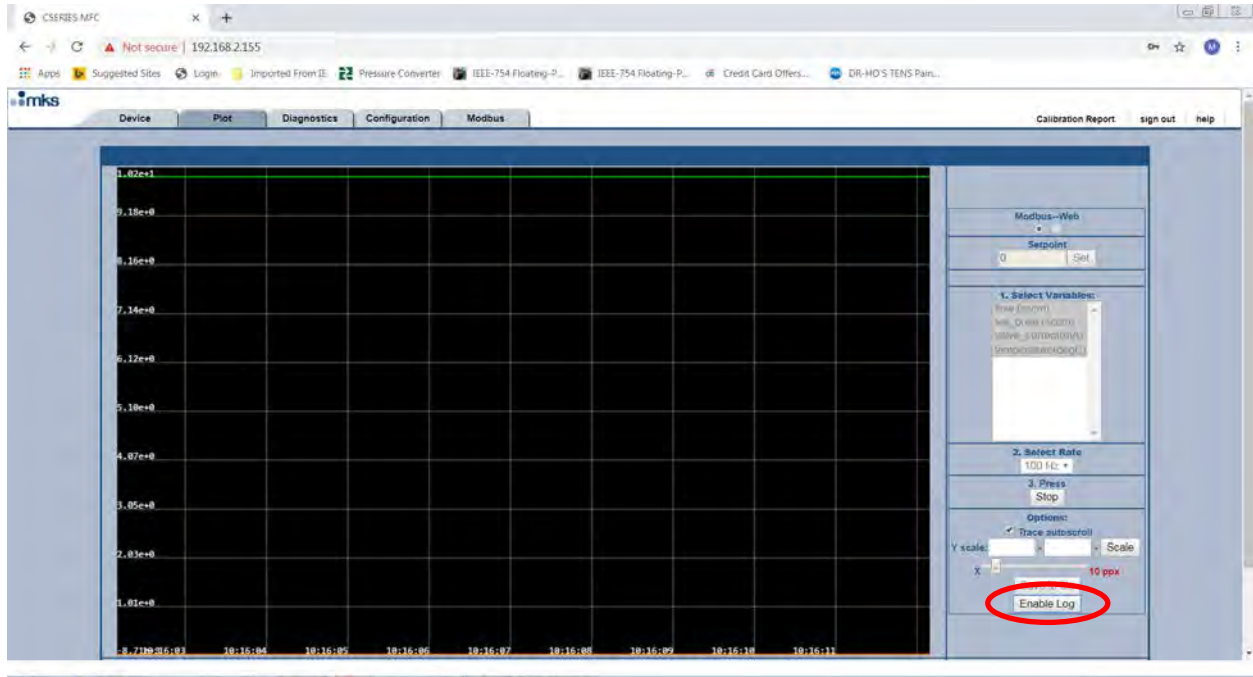


Figure 40 Enable Data Log

- Once Selected the <Send to file> becomes active.

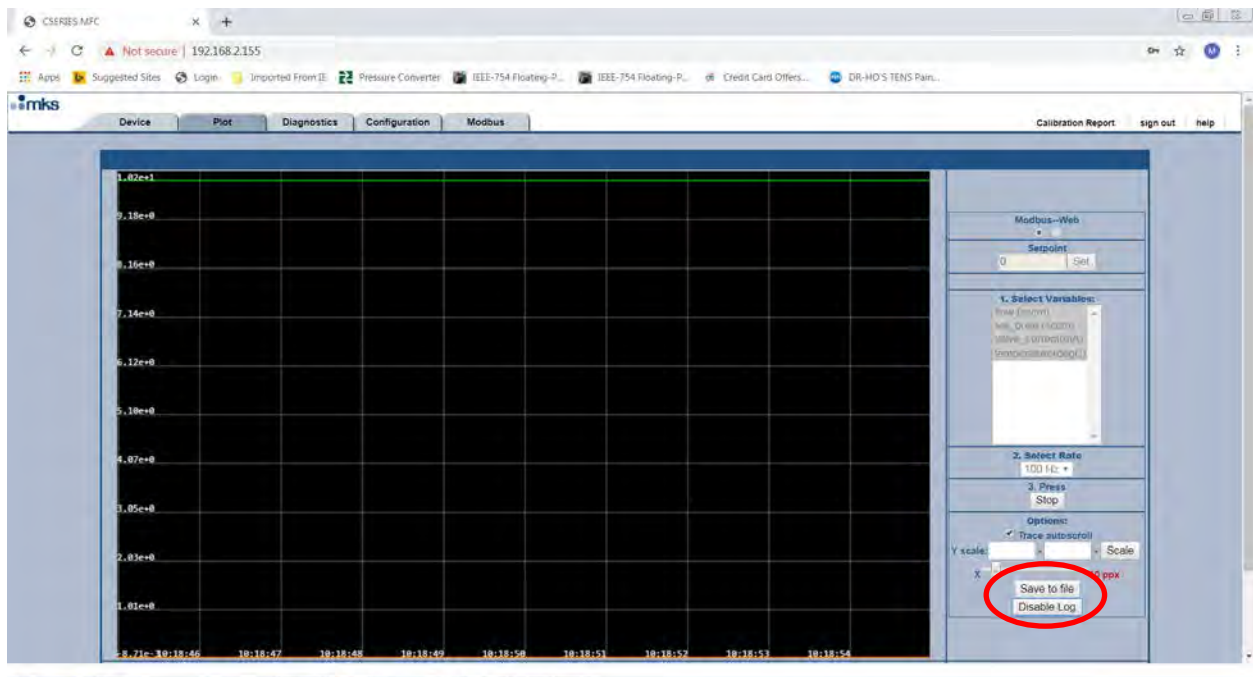


Figure 41 Data - <Save to file> Option

C Series Digital MFC, Appendix B MFC Web Browser / Micro-USB Communication

- After collecting the data that is to be saved, <Stop> the plot page and select <Send to File>
- At the bottom of the page a .txt file appear:

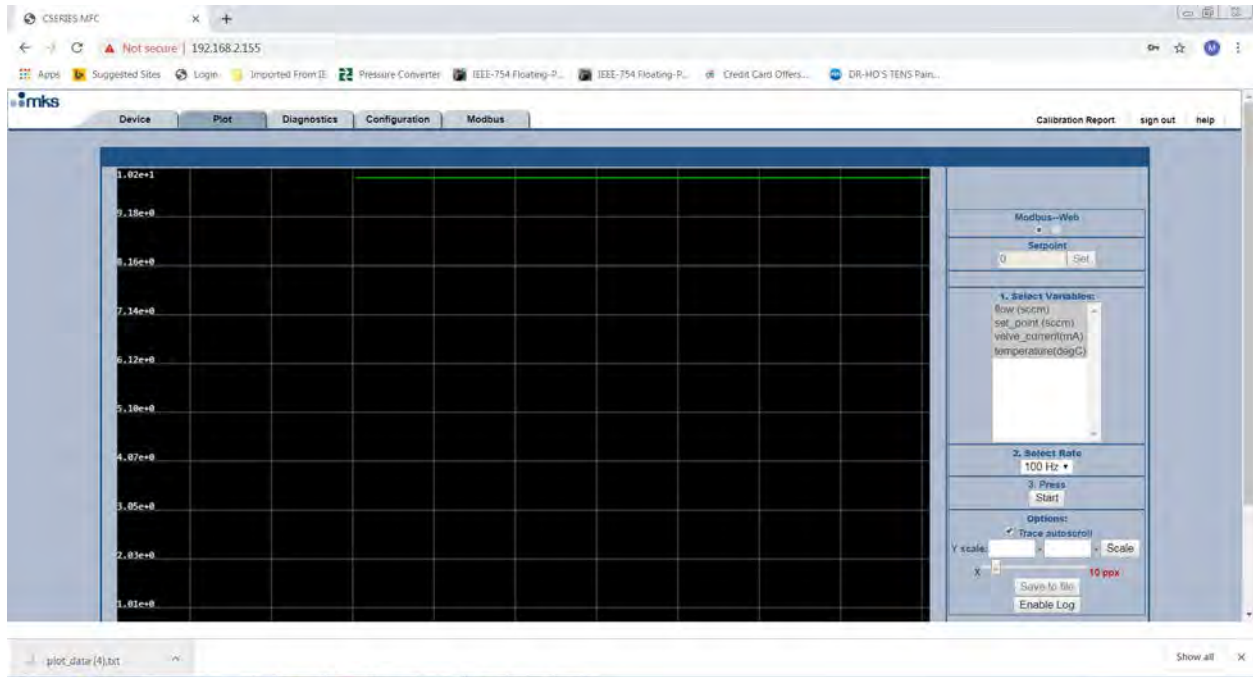
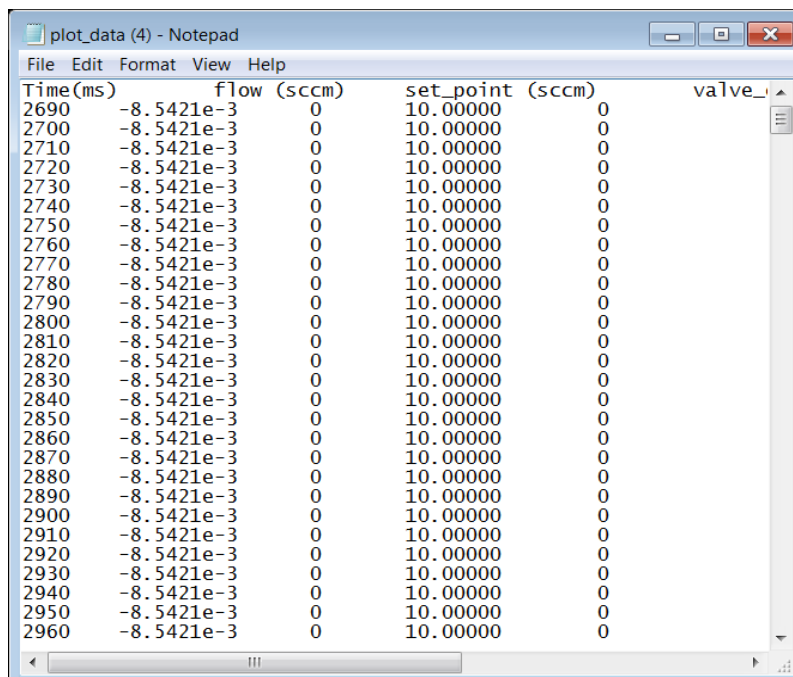


Figure 42 Text file generated with <Send to File>

- Data can then be saved or moved to a different program such as Excel for further analysis.

The image shows a Notepad window titled 'plot_data (4) - Notepad'. The window contains a text file with the following data:

Time(ms)	flow (sccm)	set_point (sccm)	valve_
2690	-8.5421e-3	0	10.00000
2700	-8.5421e-3	0	10.00000
2710	-8.5421e-3	0	10.00000
2720	-8.5421e-3	0	10.00000
2730	-8.5421e-3	0	10.00000
2740	-8.5421e-3	0	10.00000
2750	-8.5421e-3	0	10.00000
2760	-8.5421e-3	0	10.00000
2770	-8.5421e-3	0	10.00000
2780	-8.5421e-3	0	10.00000
2790	-8.5421e-3	0	10.00000
2800	-8.5421e-3	0	10.00000
2810	-8.5421e-3	0	10.00000
2820	-8.5421e-3	0	10.00000
2830	-8.5421e-3	0	10.00000
2840	-8.5421e-3	0	10.00000
2850	-8.5421e-3	0	10.00000
2860	-8.5421e-3	0	10.00000
2870	-8.5421e-3	0	10.00000
2880	-8.5421e-3	0	10.00000
2890	-8.5421e-3	0	10.00000
2900	-8.5421e-3	0	10.00000
2910	-8.5421e-3	0	10.00000
2920	-8.5421e-3	0	10.00000
2930	-8.5421e-3	0	10.00000
2940	-8.5421e-3	0	10.00000
2950	-8.5421e-3	0	10.00000
2960	-8.5421e-3	0	10.00000

Figure 43 Format of Data File

Note

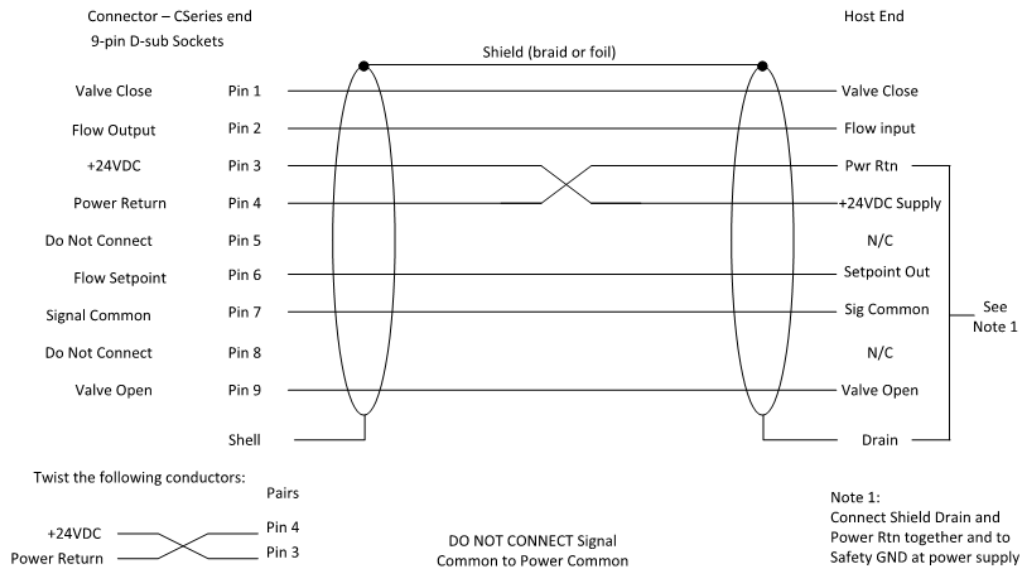


Wiring Diagram for Analog I/O

Wiring Diagram for 9 pin Analog

- Proper wiring of the MFC requires that the signal commons (pin 7) and the power common (pin 4) are not tied together at any point external to the MFC (Inside the cable or at the power supply).

C-Series Analog Cable
Suggested Wiring



Wiring Information for Modbus I/O Barrel Connector

C series Models that use the RJ45 Ethernet Connector for the primary I/O are powered using a 3 wire barrel connector.

The following diagrams specify the actual barrel connector part and electrical connections that need to be completed in order to power the MFC.



date 01/14/2013
page 1 of 2

MODEL: PPM-3-3511-SG | **DESCRIPTION:** DC POWER PLUG

FEATURES

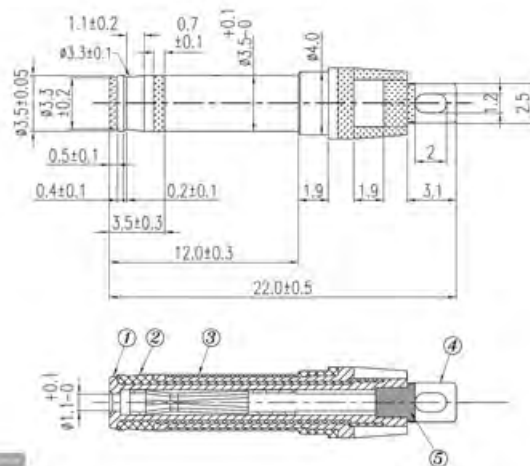
- designed for over-molding
- spring contacts
- barrel groove
- 5A current rating



Electrical Connections

MECHANICAL DRAWING

units: mm
tolerance: ± 0.2 mm (unless otherwise noted)



DESCRIPTION	MATERIAL	PLATING
1 insulator	POM	
2 ring	brass	nickel
3 sleeve	brass	nickel
4 center contact	phosphor bronze	nickel
5 spacer	POM	

4 - +24V +/-10%

3 - Chassis / Should be tied to Return and Earth at power supply

2 - Power return / Should be tie to Chassis and Earth at power supply