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Instruction Manual

MKS Baratron® Type DMA Capacitance Manometer with DeviceNet™ Digital Interface

Applicable to firmware revision 3.03

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Symbols Used in This Instruction Manual

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

Warning 

The WARNING sign denotes a hazard to personnel. 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 to equipment. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of all or part of the product.

Note 

The NOTE sign denotes important information. It calls attention to a procedure, practice, condition, or the like, which is essential to highlight.

Symbols Found on the Unit

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

Table 1: Definition of Symbols Found on the Unit

On (Supply) IEC 417, No.5007	 Off (Supply) IEC 417, No.5008	 Earth (ground) IEC 417, No.5017	 Protective earth (ground) IEC 417, No.5019
 Frame or chassis IEC 417, No.5020	 Equipotentiality IEC 417, No.5021	 Direct current IEC 417, No.5031	 Alternating current IEC 417, No.5032
 Both direct and alternating current IEC 417, No.5033-a	 Class ll equipment IEC 417, No.5172-a	 Three phase alternating current IEC 617-2 No.020206	
 Caution, refer to accompanying documents ISO 3864, No.B.3.1	 Caution, risk of electric shock ISO 3864, No.B.3.6	 Caution, hot surface IEC 417, No.5041	

Safety Procedures and Precautions

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

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

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

SERVICE BY QUALIFIED PERSONNEL ONLY

Operating personnel must not attempt component replacement and internal adjustments. Any service must be made by qualified service personnel only.

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 the materials in this product, including any sealing materials.

PURGE THE INSTRUMENT

After installing the unit, or before removing it from a system, 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 for protection.

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

Carefully check all vacuum component connections to ensure leak-tight installation.

OPERATE AT SAFE INLET PRESSURES

Never operate 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, install a suitable burst disc in the vacuum system to prevent system explosion should the system pressure rise.

KEEP THE UNIT FREE OF CONTAMINANTS

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

ALLOW PROPER WARM UP TIME FOR TEMPERATURE-CONTROLLED UNITS

Temperature-controlled units 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 den Druckmeßumformer

In dieser Betriebsanleitung vorkommende Symbole

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

Warnung! 

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

Vorsicht! 

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

Hinweis 

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

Erklärung der am Gerät angebrachten Symbole

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

Tabelle 2: Bedeutung der am Gerät angebrachten Symbole

Ein (Energie) IEC 417, No.5007	 Aus (Energie) IEC 417, No.5008	 Erdanschluß IEC 417, No.5017	 Schutzleiteranschluß IEC 417, No.5019
 Masseanschluß IEC 417, No.5020	 Aquipotential-anschluß 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, Dokumen-tation 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 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 relatives à la sécurité pour le transducteur de pression

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 d'endommagement ou de destruction d'une partie ou de la totalité de l'appareil, 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 apparaissant sur l'unité

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

Tableau 3: Définition des symboles apparaissant sur l'unité

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

Mesures de sécurité et précautions

Prendre les précautions générales de sécurité suivantes pendant toutes les phases d'exploitation de cet appareil. Le non respect des ces précautions ou des avertissements contenus dans ce manuel constitue une violation des normes de sécurité relatives à l'utilisation de l'appareil et peut diminuer la protection fournie par l'appareil. MKS Instruments, Inc. n'assume aucune responsabilité concernant le non respect des consignes par les clients.

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

Ne pas installer des pièces de substitution ou 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 remplacer des composants ou de faire des réglages internes. Tout dépannage doit être uniquement effectué par du personnel qualifié.

PRÉCAUTION EN CAS D'UTILISATION AVEC DES PRODUITS DANGEREUX

Si des produits dangereux sont utilisés, l'utilisateur est responsable de la prise des mesures de précaution appropriées, de la purge complète de l'appareil quand cela est nécessaire, et de la garantie que les produits utilisés sont compatibles avec les composants de cet appareil, y compris les matériaux d'étanchéité.

PURGE DE L'APPAREIL

Après l'installation de l'unité, ou avant son enlèvement 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, et il faut 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 APPROPRIÉS ET PROCÉDURES DE SERRAGE

Tous les équipements de l'appareil doivent être cohérents avec 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 glace et de métal peuvent endommager l'unité d'une manière permanente ou contaminer le processus.

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

Les unités à température contrôlée atteignent 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 transductor de presión

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 u observarse 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, estado, etc. que en caso de no realizarse u observarse correctamente puede causar daños o la destrucción total o parcial del equipo.

Nota 

El símbolo de notas indica información de importancia. Este símbolo pone de relieve un procedimiento, práctica o condición cuyo conocimiento es esencial destacar.

Símbolos hallados en la unidad

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

Tabla 4: Definición de los símbolos hallados en la unidad

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

Procedimientos y precauciones de seguridad

Las precauciones generales de seguridad descritas a continuación deben observarse durante todas las etapas de funcionamiento del instrumento. La falta de cumplimiento de dichas precauciones o de las advertencias específicas a las que se hace referencia en el 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 intentar reemplazar los componentes o realizar tareas de ajuste en el interior del instrumento. Las tareas de mantenimiento o reparación deben ser realizadas únicamente por personal autorizado.

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 del instrumento e inclusive, con todos 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 LAS CONEXIONES SEAN A PRUEBA DE FUGAS

Inspeccione cuidadosamente las conexiones de los componentes de vacío para comprobar que hayan sido instalados 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 o contaminar el proceso.

CALIENTE ADECUADAMENTE LAS UNIDADES CONTROLADAS POR MEDIO DE TEMPERATURA

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

Chapter One: General Information

Introduction

The MKS Baratron® Type DMA Absolute Pressure Transducer with a DeviceNet™ Digital Interface is part of the MKS family of general purpose pressure transducers designed to provide accurate, reliable, and repeatable pressure measurements in the range from 1K Torr to as low as 100 mTorr Full Scale (FS). The DMA is designed specifically to meet the needs of vacuum process systems where environmental and process conditions are particularly demanding.

Temperature control of the DMA (45° C) and DMA (80° C) transducers minimizes the effects of ambient or process temperature variations typically encountered in process line environments. The DMA (45° C) controls its temperature at 45° C nominal. The DMA (80° C) transducer is internally controlled at 80° C, thereby minimizing contamination from the process. The DMA (Ambient) is unheated.

The DMA unit exposes only Inconel® to the process, permitting use with corrosive or dirty gases and eliminating contamination of the process with transducer materials. Measurements are independent of gas composition. Using the latest single-sided, dual-electrode Inconel transducer design, coupled with a low impedance, fixed-frequency bridge signal conditioner, this instrument is capable of withstanding high overpressure conditions (45 psia) with minimal or no shifts in output over their range. The advanced bridge signal conditioning technology provides high accuracy and operation which is extremely temperature-stable at operating pressure.

The transducer provides a digital pressure signal through the DeviceNet communications interface, or as an analog signal through a 9-pin Type DE-9S Interface connector for direct measurement. Output is linear and proportional to pressure. The operational settings of the DMA unit are controlled using DeviceNet communications, which support 125, 250, and 500 Kb data rates. A non-volatile storage device stores the user settings.

Note 

Use this manual in conjunction with the Open DeviceNet Vendor Association (ODVA) “DeviceNet Specification,” Volume I and Volume II [1, 2]; and the SEMI® Standards Device Models [3, 4, 5] to obtain a complete functional description of your device. Refer to Table 6, page 20, for a list of the documents referenced throughout this manual.

Protection from RF interference and noisy electrical environments is increased by the use of a metal case and internal design elements as well as surge and ESD suppression networks and RFI filtering on all inputs and outputs.

The unit is available with a variety of fittings.

Ambient and Temperature Regulated Models are available:
The DMA (Ambient) measures pressure at ambient temperatures of 0° to 50° C (32° to 122° F).
The DMA (45° C) measures pressure at ambient temperatures of 15° to 40° C (59° to 104° F).
The DMA (80° C) measures pressure at ambient temperatures of 15° to 50° C (59° to 122° F).

DeviceNet Transducer Object Model

The operating information for the DeviceNet digital interface is arranged as a collection of objects (Figure 1). Specific attributes within each object control specific network or instrument features and are referenced by a unique ID number. The object models and attributes for the DMA transducer are described in detail in *Chapter Four: Operation*, page 45.

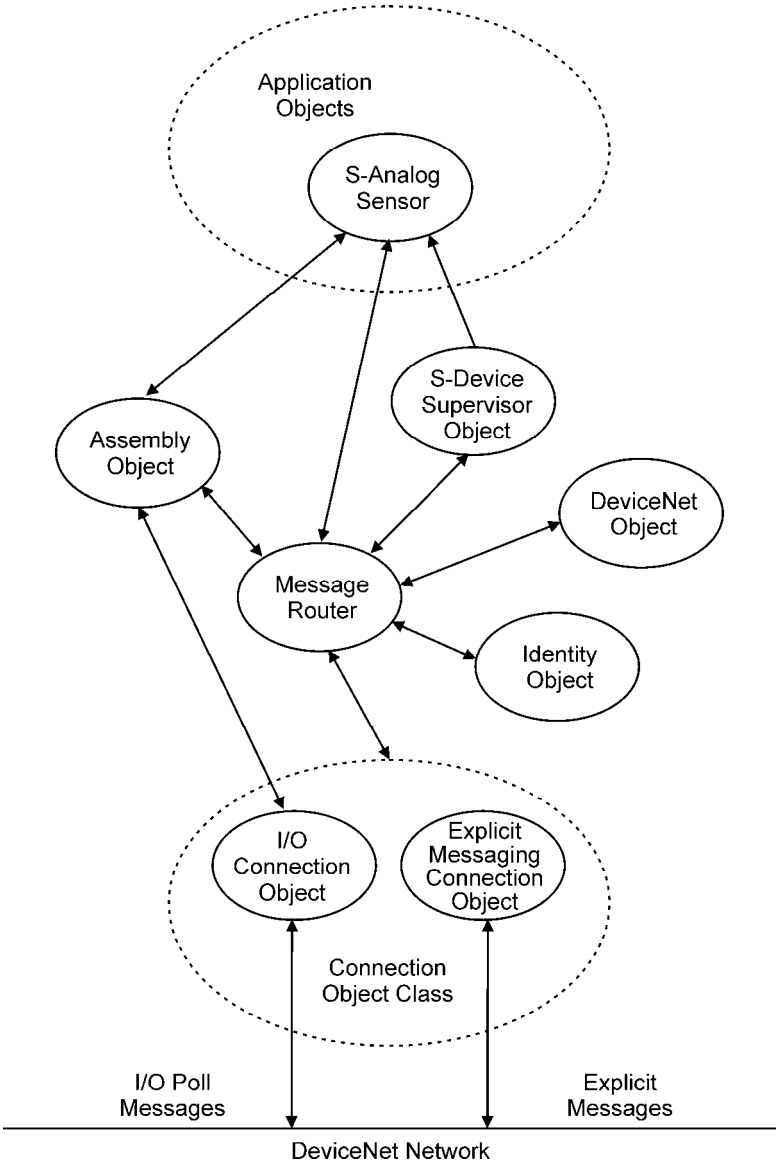

Figure 1: DeviceNet Transducer Object Model

Definitions

Table 5: Definitions

Term	Description
Attribute	All elementary data types are defined in [1]
ARRAY	A listing or grouping of elements of the same data type
BOOL	Boolean, which can take either a 0 or 1 value
CAN	Control Area Network, which is a specification of physical layer signaling and media access control in DeviceNet
Class Code	Definition of the Object Class toward which a request message is directed, specified as either a 8-bit or 16-bit integer
Common Service	A service, defined in [2], that can be used in multiple objects—each has a fixed set of parameters that are defined in [1]
DATE	Date information (*not the ODVA definition of DATE*)—a structure of (1) a year of type UINT, (2) a month of type USINT, and (3) a day of type USINT (Table 48, page 81)
Full Scale (FS) Range	Defined 100% value of an attribute in its assigned units
INT	Signed 16-bit integer value between -32,768 and +32, 767
Instance ID	Definition of a particular instance within an Object Class
LSB	Least Significant Bit
MSB	Most Significant Bit
Network Access	Definition of how an attribute can be accessed over the network: R = Read Only; RW = Read/Write
ODVA	Open DeviceNet Vendors Association
REAL	32-bit floating point value conforming to IEEE 754 basic single floating point format
Service Data	Carries “request specific” data
Service Type	R = Request; N = Notification; M = Mandatory
SINT	Signed 8-bit integer value
SHORT-STRING	ASCII character string with 1 byte per character—a 1 byte length precedes the string
STRUCT	Contains more than one attribute type
UINT	Unsigned 16-bit integer value between 0 and 65,535
UDINT	Unsigned (double) 32-bit integer value
ULINT	Unsigned (long) 64-bit integer value
USINT	Unsigned 8-bit integer value between 0 and 255
WORD	16-bit string

References

Table 6 lists the documents referenced throughout this manual.

Table 6: References

Reference Number	Document
[1]	"DeviceNet Specification, Volume I: DeviceNet Communication Model and Protocol," Open DeviceNet Vendors Association, Inc. Release 2.0.
[2]	"DeviceNet Specification, Volume II: DeviceNet Profiles and Object Library," Open DeviceNet Vendors Association, Inc. Release 2.0.
[3]	"Sensor/Actuator Network Common Device Model," SEMI Standards Document E54.1-0997.
[4]	"Sensor/Actuator Network Communication Standard for DeviceNet," SEMI Standards Document E54.4-0997.
[5]	"Sensor/Actuator Network Specific Device Model for Capacitance Manometer Devices," SEMI Standards Draft Document #2696.

How This Manual is Organized

This manual is designed to provide instructions on setting up, installing, and operating a Type DMA unit with a DeviceNet digital interface.

Before installing your Type DMA unit in a system and/or operating it, carefully read and familiarize yourself with all precautionary notes in the *Safety Messages and Procedures* section at the front of this manual. In addition, observe and obey all WARNING and CAUTION notes provided throughout the manual.

Chapter One *General Information*, (this chapter) introduces the product and describes organization of the manual.

Chapter Two *Installation*, explains environmental requirements and describes mounting the instrument in your system.

Chapter Three *Overview*, gives a brief description of the instrument and its functionality.

Chapter Four *Operation*, describes the protocol, object models, attributes, and services required to operate the unit with DeviceNet digital communications.

Chapter Five *Maintenance and Troubleshooting*, lists maintenance required to keep the unit in good working condition and provides a checklist reference for unit malfunction.

Appendix A *Product Specifications*, lists the instrument specifications.

Appendix B *Model Code Explanation*, describes the model code used to order the instrument.

Appendix C *Command Summary*, lists the attributes and supported services for your device and defines the supported service parameters.

Appendix D *Example Messages*, describes how DeviceNet messages are generated and interpreted.

Customer Support

Standard maintenance and repair services are available at all of our regional MKS Calibration and Service Centers, listed on the back cover. In addition, MKS accepts the instruments of other manufacturers for recalibration using the Primary and Transfer Standard calibration equipment located at all of our regional service centers. Should any difficulties arise in the use of your Type DMA instrument, or to obtain information about companion products MKS offers, contact any authorized MKS Calibration and Service Center. If it is necessary to return the instrument to MKS, please obtain an RMA (Return Material Authorization) Number from the MKS Calibration and Service Center (listed on the inside of the back cover of this manual) before shipping. The RMA Number expedites handling and ensures proper servicing of your instrument.

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

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Chapter Two: Installation

Unpacking the Type DMA Unit

MKS carefully packed the Type DMA unit to reach you in perfect operating order. Upon receiving the unit, however, you should check for defects, cracks, broken connectors, etc., to be certain damage did not occur during shipment.

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

If you find any damage, notify your carrier and MKS immediately. If it is necessary to return the unit to MKS, obtain an RMA (Return Material Authorization) Number from the MKS Service Center (listed on the back cover of this manual) before shipping

Unpacking Checklist

Standard Equipment:

- Type DMA Unit
- Type DMA Instruction Manual (this book)

Optional Equipment:

- Interface Cables (described below)

Interface Cables

As of July 20, 2009, most products shipped to the European Community must comply with the EMC Directive 2004/108/EEC, which covers radio frequency emissions and immunity tests. In addition, as of January 1, 1997, some products shipped to the European Community must also comply with the Product Safety Directive 92/59/EEC and Low Voltage Directive 73/23/EEC, which cover general safety practices for design and workmanship. MKS products that meet these requirements are identified by application of the CE Mark.

To ensure compliance with EMC Directive 2004/108/EEC, an overall metal braided shielded cable, properly grounded at both ends, is required during use. No additional installation requirements are necessary to ensure compliance with Directives 92/59/EEC and 73/23/EEC.

Note An overall metal braided, shielded cable, properly grounded at both ends, is required during use to meet CE specifications and is recommended if the environment contains high EMI/RFI noise.

A ferrite collar is available (Fair-Rite part number 0443167251) and is recommended for use in high RF environments. The collar is formed from two half-shells that snap together. The collar should be attached to the DeviceNet cable as close as possible to the DMA unit.

You can purchase interface cables to all MKS companion products from MKS (Table 7) or, optionally, you can make cables that meet the appropriate cable specifications. For cables connecting to non-MKS products, you can purchase normal shielding or braided shielded cable assemblies from MKS in a nominal 10' (3 m) length, terminating in flying leads (pigtail) fashion at both ends.

Table 7: Interface Cables

To Connect the DMA Unit's analog output to...	Use the MKS Cable...
146, 651, 652, PR4000 or 660	CBCT27-1-10

Generic Shielded Cable Guidelines

Follow the guidelines listed below if you choose to manufacture your own cables.

1. The cable must have an overall metal *braided* shield, covering all wires. Neither aluminum foil nor spiral shielding are as effective; using either may nullify regulatory compliance.
2. The connectors must have a metal case that has direct contact to the cable's shield on the whole circumference of the cable. The inductance of a flying lead or wire from the shield to the connector will seriously degrade the shield's effectiveness. The shield should be grounded 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 at each such end to ground the shield *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's ground, keep the 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 or in the instruction manual.
5. In selecting the appropriate type and wire size for cables, consider:
   A. Voltage ratings.
   B. Cumulative I^2R heating of all the conductors (keep them safely cool).
   C. IR drop of the conductors, so that adequate power or signal voltage gets to the device.
   D. Capacitance and inductance of cables that are handling fast signals (such as data lines or stepper motor drive cables).
   E. Some cables may need internal shielding from specific wires to others. Please see the instruction manual for details regarding this matter.

Product Location and Requirements

The DMA unit meets the following criteria:

- POLLUTION DEGREE 2 in accordance with IEC 664
- Transient overvoltages according to INSTALLATION CATEGORY II

Operating Environmental Requirements

- Ambient Operating Temperature: 0° to 50° C (32° to 122° F)—DMA (Ambient)
  15° to 40° C (59° to 104° F)—DMA (45° C)
  15° to 50° C (59° to 122° F)—DMA (80° C)
- Ventilation requirements include sufficient air circulation

Safety Conditions

The DMA poses no safety risk under the following environmental conditions:

- Altitude: up to 6500 ft (2000 m)
- Maximum relative humidity: 80% for temperatures up to 31 °C,
  decreasing linearly to 50% at 40° C

Power Requirements

The power for a DMA should be delivered through the DeviceNet network. Power supply requirements are shown in the following table.

Table 8: Power Supply Requirements

	DMA (Ambient)	DMA (45° C)	DMA (80° C)
Voltage	+11 to +25 VDC *	+11 to +25 VDC *	+11 to +25 VDC *
Current at Warm Up	200 mAmps (max)	700 mAmps (max)	1.0 Amps (max)
Isolation	500 [1] V	500 [1] V	500 [1] V
* Communicate within +11 to +25 VDC range. Operation within performance specifications from +18 to +25 VDC.			

Setup

Dimensions

Note All dimensions are listed in inches with millimeters referenced in parentheses. Tolerances are ± .03 [.76 mm] unless specified otherwise.

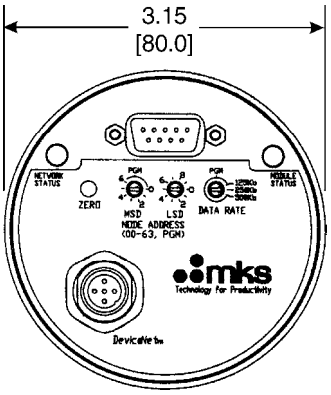

Figure 2: Top View Dimensions of the DMA Transducer

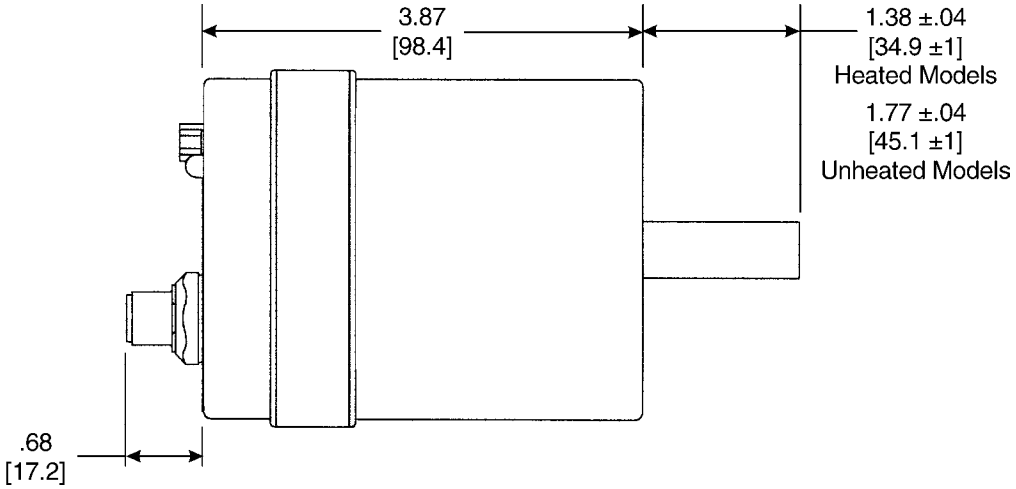

Figure 3: Side View Dimensions of the DMA Transducer

Fittings

The DMA unit is available with the following fittings:

- ½" diameter (12.7 mm) tubulation
- Swagelok® 8-VCR® (female)
- Mini-CF (rotatable)
- NW-16-KF

Mounting Instructions

Mount the transducer with the inlet port pointing (vertically) downward. The transducer port can easily carry the weight of the transducer.

Although the unit can be mounted in any orientation, mounting it as suggested allows any foreign matter entering the pressure port to fall away from the diaphragm.

Isolate the unit from vibration as much as possible. When not subject to gas damping at low pressure, the diaphragm may become susceptible to resonance. The low range transducers (≤ 1 Torr) are most sensitive and you should isolate them from any vibration that exists. Remember to isolate the vibration through the cable as well as through the port.

For pressure ranges less than 1 Torr, the unit should be mounted in the orientation specified in the mode code. (Refer to *Appendix B: Model Code Explanation*, page 91.)

Mount the unit vertically if the model code has the form:

DMAXXXXXXXXVXXX

Mount the unit horizontally if the model code has the form:

DMAXXXXXXXXHXXX

Contact MKS if you require assistance.

Electrical Information

Grounding

Ensure that your DMA unit, powered from the DeviceNet network, is grounded in accordance with the requirements in the ODVA "DeviceNet Specification," Volume I [1].

Connectors

The DMA transducer has one 5-pin micro-style digital communications connector and one 9-pin Type DE-9S analog interface connector on its top panel (Figure 2, page 26).

Caution  **To prevent damage from electrostatic discharge (ESD) to the sensitive connector pins, the pins must be covered with an ESD protective cover when not in use.**

Digital Communications Connector

The 5-pin male micro-style connector (with anti-rotation features) accepts the power input from the DeviceNet network and provides the interface for digital communications. This connector meets the requirements in the ODVA "DeviceNet Specification," Volume I [1].

Table 9: Digital Communications Connector Pinout

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

Analog Interface Connector

The 9-pin female Type DE-9S interface connector provides the pressure output signal for direct measurement from the transducer.

Table 10: Analog Interface Connector Pinout

Pin Number	Assignment
1	Pressure Output
2	Reserved
3	Reserved
4	Reserved
5	Reserved
6	Reserved
7	Reserved
8	Signal Common (Pressure Output Return)
9	Reserved

Note

1. The 9-pin Type DE-9S analog interface connector is a new style connector, that differs from those used on other MKS Baratron transducers.
2. The “Reserved” pin assignment refers to a pin with an internal connection that may be assigned a function in the future.
3. The “No Connection” pin assignment refers to a pin with no internal connection.

Startup

Power-Up

At power-up, the DMA transducer performs communications link checks and internal diagnostic checks of the EEPROM and RAM. The results of these checks are indicated by the color (green or red) and condition (solid or flashing) of the status LEDs on top of the unit (Figure 2, page 26). Refer to *DeviceNet Status LEDs*, page 38, for more information on the status LEDs.

When you apply power to your device, the following LED sequence occurs:

1. The Module Status LED flashes one time from GREEN to RED for approximately 0.25 seconds each and then turns GREEN.
2. The Network Status LED flashes one time from GREEN to RED for approximately 0.25 seconds each and then turns OFF.
3. The Module Status LED flashes from GREEN to RED for approximately 2 seconds while the device is initializing. The Network Status LED remains OFF.

4. The Module Status LED illuminates solid GREEN when the initialization is complete. The Network Status LED remains OFF until the device establishes communication with other devices on the network.

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

Warm Up Time

After installation and power-up, allow the DMA to warm up, as specified below. Ensure your device is fully stabilized and then check the transducer zero to verify the proper output.

Table 11: Warm Up Time

DMA (Ambient)	DMA (45° C)	DMA (80° C)
½ hour all ranges	2 hours ranges 1 Torr and higher 4 hours ranges less than 1 Torr	2 hours ranges 1 Torr and higher 4 hours ranges less than 1 Torr

Zero Adjustment

All pressure transducers require initial and periodic zero adjustments. Prior to initial operation and during periodic maintenance you must check the transducer zero to verify the proper output. Refer to *Adjusting the Zero*, page 32, for more information.

System Status

Complete instructions for reporting the system status are described in detail in *S-Device Supervisor Object*, page 72. Specifically, the system status can be reported with the following attributes in the S-Device Supervisor Object:

- Exception Status (Attribute ID #0C)

  This attribute identifies whether or not any alarm or warning conditions exist. Alarms and warnings are identified as device-common, device-specific, or manufacturer-specific. Refer to *Exception Status*, page 75.

- Exception Detail Alarm (Attribute ID #0D)

  This attribute identifies the specific alarm condition(s) detected by your device. Refer to Table 47, page 79.

- Exception Detail Warning (Attribute ID #0E)

  This attribute identifies the specific warning condition(s) detected by your device. Refer to Table 47, page 79.

Refer to *Fault Conditions*, page 41, for additional information.

Reporting the Pressure Value

The system pressure can be reported at any time using the appropriate digital communication commands. The data will be reported as either an INT or REAL value dependent upon device settings. (e.g. Data Type attribute in the S-Analog Sensor Object)

- Explicit Request

  S-Analog Sensor Object Attribute ID #06 (see page 65) reports the actual, corrected pressure value from -5 to 110% full scale in the specified units.

- Polled Request

  Assembly Object Instance ID #02 or Instance #05 report the device exception status as well as the corrected pressure value as either a REAL or scaled INT value, respectively. See Assembly Object, page 58.

Suggested Pressures for Reading and Control

Table 12 lists the lowest suggested pressures for reading and control with the DMA transducer.

Table 12: Lowest Suggested Pressures for Reading and Control

Full Scale Range (Torr)	Lowest Suggested Pressure for Reading (Torr)	Lowest Suggested Pressure for Control (Torr)
0.1	5×10^{-5}	5×10^{-4}
1	5×10^{-4}	5×10^{-3}
10	5×10^{-3}	5×10^{-2}
100	5×10^{-2}	5×10^{-1}
1000	5×10^{-1}	5×10^{0}

Lowest Suggested Pressures Available for Reading

The pressures listed in the middle column of Table 12 reflect reliable and practical pressures for different range transducers. Lower readings may be obtained in environments that have stable temperature and air flow. Temperature controlled transducers can obtain repeatable pressure measurements down to 1×10^{-5} Torr.

Lowest Suggested Pressures to Use for Control with Analog Output

The pressures listed in the last column of Table 12 are for reference and represent the pressure reading of the transducer at 50 mV signal output. A DC signal of at least 50 mV is the recommended minimum signal level to use when integrating any transducer into complex processing systems.

Adjusting the Zero

The DMA unit uses a digital zero in the calculation of the reported pressure value. Figure 4, page 37, illustrates where the digital zero is incorporated into the calculation of the pressure value.

The transducer's calibrated, analog pressure signal is measured from pin 1 on the Type DE-9S interface connector (Table 10, page 29).

Coarse Zero Adjustments

Digital and analog signals can be zeroed either by manually pressing the OneTouch Push Button Zero or by issuing a DeviceNet service (Service ID 0x32, the Coarse Zero Adjustment service).

The range of this adjustment is limited to approximately –4 to +20% of full scale and the assumed target is zero pressure or vacuum. The DMA must be evacuated to a pressure below its resolution before the OneTouch Zero Push Button or Coarse Zero Adjust Service is executed. See Table 13.

Fine Zero Adjustments

For Fine Zero adjustments the Digital and analog signals can be zeroed either with a target of zero (usual practice) or an offset. This is accomplished with a DeviceNet service (Service ID 0x4B) and the target value can be either zero or a nonzero value. The range of this adjustment is limited to ±2% full scale. If an unsuccessful response to the Fine Zero and Offset adjustment is received, either issue the Coarse Zero Adjustment service (0x32) with a target of zero or press the OneTouch Coarse Zero Push Button.

For best results, the transducer should be under vacuum while it is warming up. Table 13 lists the recommended pressure levels for proper zero adjustment.

Table 13: Highest Pressures Suggested for Proper Zero Adjustment

Full Scale Range (Torr)	Highest Pressure for Proper Zero Adjustment (Torr)
0.1	$< 5 \times 10^{-7}$
1	$< 5 \times 10^{-6}$
10	$< 5 \times 10^{-5}$
100	$< 5 \times 10^{-4}$
1000	$< 5 \times 10^{-3}$

Adjusting the Analog and Digital Zero

1. Install the transducer in a system with a power supply/readout.
2. Power the transducer and allow it to warm up and stabilize.

Note 

Before use, allow the DMA (Ambient) transducer to warm up for ½ hour. Allow the DMA (45° C) and DMA (80° C) to warm up for 2 hours (for ranges of 1 Torr and higher) or 4 hours (for ranges less and 1 Torr), as appropriate. Ensure the device is *fully stabilized* before you adjust the transducer zero.

3. Pump the unit down to a pressure below its resolution (0.01% of FS).

   For best results, pump the transducer while it is warming up. Refer to Table 13, page 32, for the recommended pressure levels for proper zero adjustment.

4. Issue the Coarse Zero Adjustment Service (0x32) to the S-Analog Sensor Object.

   Refer to *Perform Fine Zero* Offset, page 109, for information on the required service.

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Chapter Three: Overview

General Information

The DMA transducer contains a digital interface. All communication to and from the device is achieved using the DeviceNet network. Interfacing with your transducer is accomplished using the DeviceNet digital communications protocol, which gives you access to all features of the instrument.

A complete pressure transducer system requires three components to convert pressure to a linear DC voltage output:

- Sensor
- Signal Conditioner
- Power Supply

The DMA digital transducer contains two of the required components: the sensor and signal conditioner.

The DMA transducer power supply requirements are specified on page 25. The power is introduced to the transducer through the 5-pin micro-style connector on the top of the unit (Figure 5, page 38). The host computer for the network reports the pressure measurement.

Sensor

The DMA transducer contains an absolute sensor. This pressure sensor utilizes a single-sided, dual-electrode/AC bridge circuit design. In this design, two capacitance electrodes are deposited upon a ceramic disc in a concentric “bull’s-eye” arrangement. The disc is positioned close to an Inconel® tensioned diaphragm to form two capacitors in an AC bridge circuit. The other side of the diaphragm is exposed to the process gas.

The diaphragm deflects with changing pressure—force per unit area—independent of the composition of the measured gas. This deflection causes a capacitance change between the diaphragm and the adjacent electrode assembly. When pressure is equal on both sides of the diaphragm, the bridge is balanced. As pressure deflects the diaphragm toward the electrode, the center capacitance changes more than the outer capacitance, causing the bridge to become unbalanced and an AC voltage to be generated. The output signal, which is proportional to pressure, can be provided as an analog signal (0 to 10 V) through the 9-pin Type DE-9S interface connector, or as a digital signal through the DeviceNet communications interface. The thermal enclosure reduces the effects of ambient temperature changes.

The zero and span stability are further increased in the DMA (45° C) and DMA (80° C) transducers because the sensor and bridge electronics are temperature controlled.

Signal Conditioner/Electronics

The signal conditioner contains state-of-the-art, low impedance balanced bridge circuitry, self-compensated for thermal stability with ambient temperature changes. The output is a DC voltage that is then digitally linearized and calibrated against a pressure standard to produce both analog and digital outputs.

Pressure Measurement

The digital output is read through the DeviceNet interface. The reported pressure value is based on a number of variables, many of which are user-adjustable through software commands. Figure 4, page 37, illustrates how actual pressure values are generated from the raw sensor output.

The raw pressure reading (both analog and digital) can be re-zeroed either by using the OneTouch Coarse Zero Push Button located on top of the transducer or by issuing the DeviceNet service 0x32 (the Coarse Zero Adjustment service). Analog and digital signals are automatically corrected for shifts caused by large temperature variations. The zero-corrected signals are then linearized and provided as 0 to 10 V analog signal and as a digital output that is expressed either in the user-selected unit of pressure or as a 16-bit integer.

An additional zero offset can be applied digitally to the corrected pressure value, both analog and digital, before the value is converted to the selected units.

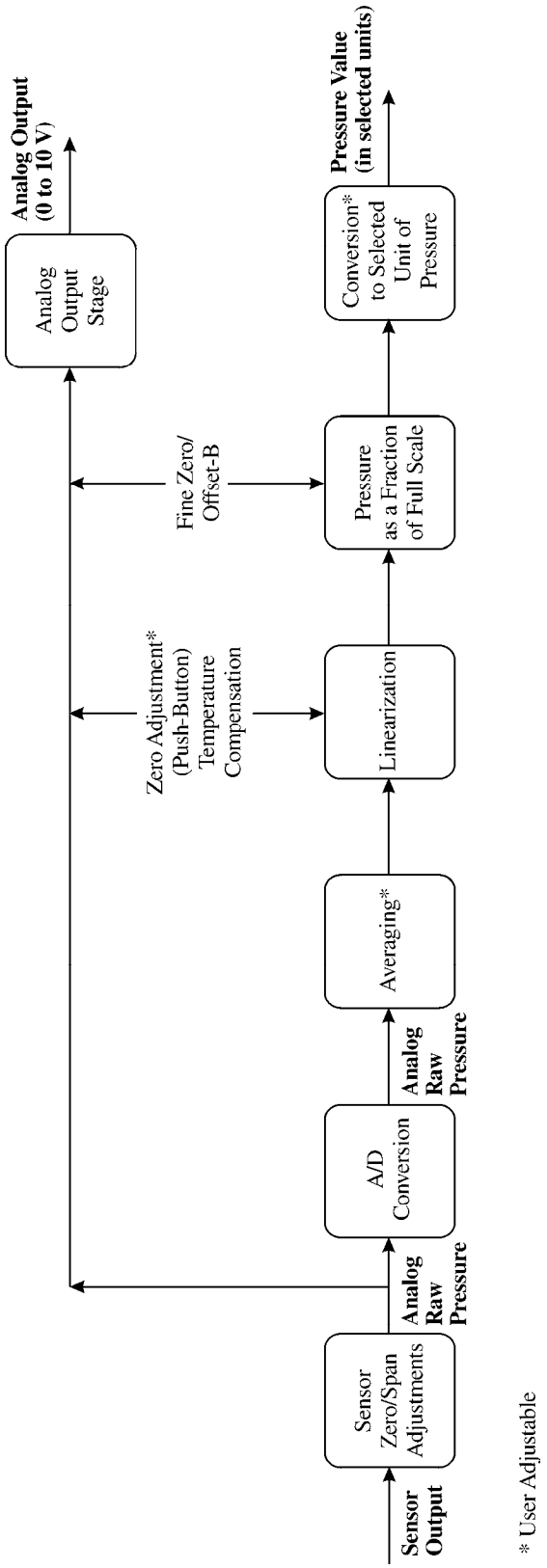

Figure 4: Analog and Digital Pressure Calculation

Top Panel Components

Figure 5 shows the top panel of your DMA transducer.

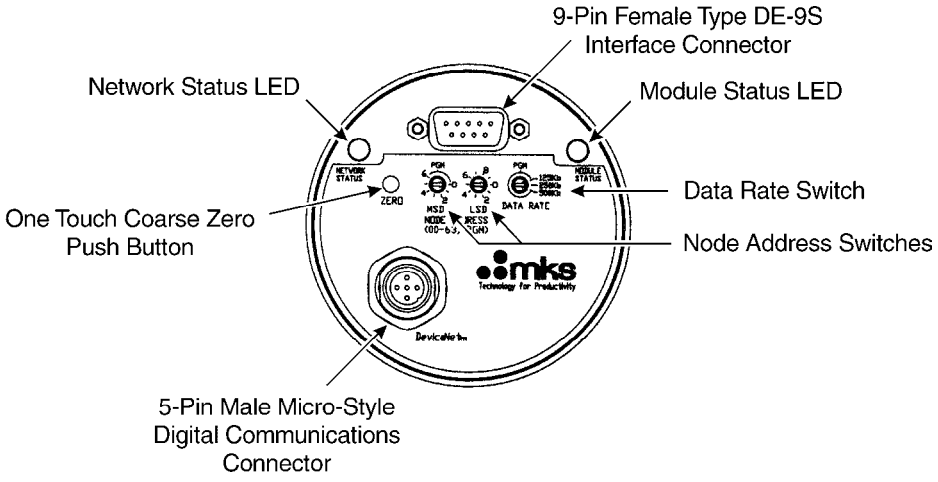

Figure 5: Top Panel Components

Digital Communications Connector

The 5-pin male micro-style connector accepts the power input from the DeviceNet network and provides the interface for digital communications. This connector meets the requirements in the ODVA "DeviceNet Specification," Volume I [1]. Refer to Table 9, page 28, for the connector pinout.

OneTouch Coarse Zero Push Button

This push button provides manual zeroing capability for the transducer's pressure reading. The push button affects both the analog and digital zeros. Refer to *Coarse Zero Adjustments*, page *32*, for more information.

Analog Interface Connector

The 9-pin female Type DE-9S interface connector provides the pressure output signal for direct measurement from the DMA transducer. Refer to Table 10, page 29, for the connector pinout.

DeviceNet Status LEDs

The DMA transducer has two standard bi-color (green/red) DeviceNet status LEDs, located on top of the unit (Figure 5, page 38). The power-up sequence of these LEDs conforms to the requirements in the ODVA "DeviceNet Specification," Volume I [1]. Refer to *Power-Up*, page 29, for more information.

Module Status LED

The Module Status LED indicates the status of the individual device, as defined in Table 14. If no problems are detected, the Module Status LED illuminates a solid green. The LED flashes green

when the visual indicator is on. (Refer to *Visual Indicator*, page 77, for more information.) If a fault condition is detected, the Module Status LED illuminates a solid red.

Table 14: Module Status LED Indicators

LED State	Meaning
OFF	Power is OFF
Flashing Red/Green	Initializing
Solid Green	System functioning normally
Flashing Green	Visual Indicator ON
Solid Red	Major Unrecoverable Fault

Network Status LED

The Network Status LED indicates the status of the communications link, as defined in Table 15. If no problems are detected, the Network Status LED illuminates a solid green; the LED flashes green when the device is on-line but is not connected to other units. If a fault condition is detected, the Network Status LED illuminates a solid red or turns off.

Table 15: Network Status LED Indicators

LED State	Meaning
Solid Green	*Communications link is OK.* The device is on-line and has connections in the established state.
Flashing Green	*Device is on-line but has no connections in the established state.* The device has passed the Dup_MAC_ID test and is on-line, but has no established connections to other nodes.
Solid Red	*Critical link failure.* The device has detected an error that has rendered it incapable of communicating on the network (duplicate MAC_ID or bus-off).
OFF	*Not powered/not on-line.* The device has not completed the Dup_MAC_ID test, or the device may not be powered. Check the Module Status LED.

Data Rate and Node Address Switches

The data rate and node address for your device can be set through software commands using standard DeviceNet protocol over the network, or manually using the rotary switches located on the top panel of the device (Figure 5, page 38). The data rate and node address switches allow you to easily configure units without an operational network, or to network multiple units quickly.

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

- If either switch is in the network (PGM) position at power-up, the data rate or address is read from the nonvolatile memory. Any changes to the values must be made over the network. Any changes in the rotary switch positions after power-up are ignored.
- If the rotary switch is *not* in the network (PGM) position at power-up, the data rate or address is read directly from the switches. Network changes will be denied and the Attribute_Not_Settable General Error Code will be returned to the Set_Attribute_Single service request.

Data Rate Switch

The 4-position rotary switch (Figure 6) is used to select the DeviceNet data rates of 125, 250, and 500 Kb. The switch positions are numbered in a clockwise direction, to correspond to the increasing data rate values.

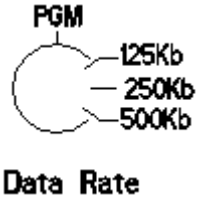

Figure 6: Data Rate Rotary Switch

Node Address Switches

Two 10-position rotary switches (Figure 7) are used to set the node address.

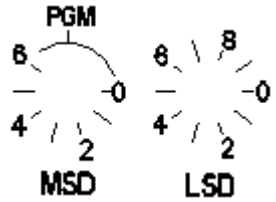

Figure 7: Node Address Rotary Switches

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

Fault Conditions

Your device can detect two general types of fault conditions (Table 16, page 41):

- Minor (recoverable and unrecoverable)
- Major (unrecoverable)

Fault conditions are indicated by the Module Status LED and through the Exception Status, Exception Alarm Detail, and Exception Warning Detail attributes in the S-Device Supervisor Object. (Refer to *S-Device Supervisor Object*, page 72, for more information.)

Minor Faults

Minor faults occur when:

- Pressure is too high (> 105%FS) or too low (< -5% FS).
- Calibration has expired.
- Analog input value is out of range.

Minor faults are indicated in Table 47, page 79.

Major Faults

A major unrecoverable fault occurs when a hardware problem with the EEPROM or a memory problem with the RAM is detected during the initial diagnostic check.

When this fault condition occurs, the Module Status LED illuminates *solid red,* in accordance with the ODVA "DeviceNet Specification," Volume I [1].

Note When a major unrecoverable fault occurs, the device cannot communicate on the network and operation stops. Contact MKS for assistance.

Table 16: Fault Conditions

Fault Type	Module Status LED State	Description
Minor Recoverable Fault	Solid / Flashing* Green	*Device remains in the Operating state.* The specific cause of the fault is reported in the exception status bit.
Minor Unrecoverable Fault	Solid / Flashing* Green	*Device remains in the Operating state*. The specific cause of the fault is reported in the exception detail alarm status bit.
Major Unrecoverable Fault	Solid Red	*Device transitions to the Critical Fault state.* The device will not respond to any services received over the network. All reporting associated with Publication objects are disabled.
** The Module Status LED flashes when the visual indicator is on. Refer to Table 47, page 79, for more information.*		

Trip Points

The DMA transducer has two *software* trip points, which are maintained in the S-Analog Sensor Object:

- Trip Point-Alarm, Low and High
- Trip Point-Warning, Low and High

The software trip point values are adjustable using digital communication commands such that when the pressure rises above one or below the other, the corresponding trip point changes state. Refer to *S-Analog Sensor Object*, page 65, for more information.

Trip Point Hysteresis

Hysteresis is built into the operation of the trip points to help compensate for the noise inherent in all systems. Without hysteresis, the noise may cause the trip points to repeatedly switch states, a condition known as “chatter.”

The default hysteresis value of 0 can be adjusted separately for each of the trip points through communication commands.

Setting the hysteresis too high creates a *deadband* around the trip point. The deadband prevents the trip point from responding to changes in the pressure signal around the trip point. Ideally, the hysteresis should be close to, but not less than, the peak-to-peak noise. This setting will provide maximum immunity from chatter while providing the best possible accuracy. It may take some trial and error efforts to determine the smallest hysteresis setting appropriate for your system.

Trip Point Settling Time

The trip point settling time defines the amount of time a trip point alarm condition must exist before it is reported to the exception status attribute of the S-Device Supervisor Object. (Refer to *Exception Status*, page 75, and *Averaging Time*, page 69, for more information.) The trip point delay can be set from 0 to 10,000 msec—the initial value is 0.

Labels

Note The drawings in Figures 8 and 9 are not drawn to scale.

Band Label

The band label, which is wrapped around the transducer body, lists the pinouts for the unit's 5-pin micro-style digital communications connector (Table 9, page 28) and the 9-pin Type DE-9S analog interface connector (Table 10, page 29).

Figure 8: Band Label

Serial Number Label

The serial number label, located on the lower enclosure, lists the unit's serial number, product model code, full scale range, input voltage, output voltage, and firmware revision level. The label also displays the CE mark signifying compliance with the European CE regulations.

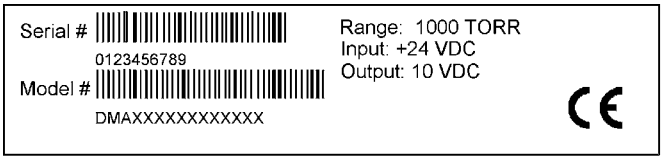

Figure 9: Serial Number Label

The options for your transducer are identified in the model code when you order the unit. Refer to *Appendix B: Model Code Explanation*, page 91, for more information.

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Chapter Four: Operation

General Information

Note 

Use this manual with the ODVA "DeviceNet Specification," Volume I and Volume II [1, 2]; and the SEMI Standards Common and Specific Device Models [3, 4, 5] to obtain a complete functional description of your device. Refer to Table 6, page 20, for a list of the documents referenced throughout this manual.

This chapter defines the application-specific objects included in your transducer as well as the mapping of the system requirements to specific objects and attributes in the DeviceNet protocol. Tables defining the attributes and supported services for each Object Model are provided throughout the text.

A summary of the attributes is listed in Table 51, page 95.
A summary of the supported services is listed in Table 52, page 103.

The objects, attributes, and services described in this manual comply with the definition of an interoperable device on a semiconductor equipment sensor/actuator network proposed by SEMI [3, 4, 5].

Operating Modes

The DMA transducer has two user-accessible operating modes:

- User Mode—normal, default power up mode.
- Calibration Mode—used to access certain calibration and operating parameters.

The operation of the transducer is the same in each mode; however, access to certain attributes over the network may be restricted, depending on the active mode. Access rights to the specific attributes are defined in the various object attribute tables throughout this manual.

DeviceNet Messaging Protocol

Your DMA transducer supports explicit and I/O poll messaging connections as defined in the Predefined Master/Slave Connection Set [1] for establishing connections between devices. This communication protocol determines the format of how messages are transmitted and received over the DeviceNet network.

A brief description of the messaging protocol is provided in this chapter. Actual examples designed to illustrate how DeviceNet messages are generated and interpreted are shown in *Appendix D: Example Messages*, page 111.

Note The DeviceNet messaging protocol is based on hexadecimal (base 16) math, rather than decimal (base 10) math. Descriptions in this chapter and the examples in *Appendix D: Example Messages*, page 111, assume a basic understanding of hexadecimal math.

In the actual application of DeviceNet communications, the messaging process typically is automated using an interface software program; therefore, manual calculation and interpretation of the messages is not required. Typical interface programs require only the input of specific class codes, instance IDs, attribute IDs, and any required data variable(s). Refer to the ODVA "DeviceNet Specification," Volume I and Volume II [1, 2] for a complete description of the DeviceNet messaging protocol.

Message Formats

Explicit Messaging Connections

Explicit messaging connections utilize a direct request/response format that enables you to access any attribute data. Explicit messaging is typically used for device setup, configuration, and calibration.

Explicit messages—both requests and responses—consist of two segments:

- *CAN Identifier Field*, which defines the type of connection.
- *CAN Data Field*, which defines the particular request or response.

I/O Poll Messaging Connections

I/O poll messaging connections utilize an assembly format to group and report data from multiple objects using a single communications command. These connections typically are used for quick reporting of information (run-time). Although I/O poll messaging connections typically report data faster than explicit messaging connections, they limit your access to the set of attributes (the exception status and the pressure value) listed in Tables 32 and 33, page 64. The data format in I/O poll messaging connections is pre-defined and cannot be altered.

I/O poll *request* messages consist of a single segment:

- *CAN Identifier Field*, which defines the type of connection.

I/O poll *response* messages consist of two segments:

- *CAN Identifier Field*, which defines the type of connection.
- *Poll Response*, which reports a fixed set of attribute data defined by the Predefined Master/Slave Connection Set [1].

There are two types of poll responses, each reporting a different set of data. The poll response that is returned is defined in the Device Configuration Object (page 71). The actual data for either poll response is stored in the Assembly Object (page 58).

CAN Identifier Field

The CAN Identifier Field is a single 11-bit field that defines the components of a DeviceNet connection (Table 17, page 48). This information is required for both explicit and I/O poll messaging connections. The CAN Identifier Field consists of the following three components:

- Message ID (Group 1 or 2)
- Node Address (network address)
- Message Type ID

Message ID

This fixed 2-bit field indicates the type of messaging used in the device.
The identifier for Group 2 messages is fixed with bits 10 and 9 set to 1 and 0 respectively.
The identifier for Group 1 messages is fixed with bits 10 and 9 set to 0 and 1 respectively.

Node Address

The Node Address is a 6-bit field that identifies the network address of the device *as a hexadecimal value*. The *source* node address is the address of the device sending the message. The *destination* node address is the address of the device receiving the message.

In a request message, the device address in the CAN Identifier Field is the destination node address. In a response message it is the source node address.

Message Type ID

This 3-bit field identifies the specific type of message (explicit or I/O) and whether the message string is a request or a response. The message type IDs are fixed for the Predefined Master/Slave Connection Set [1].

Note 

The CAN Identifier Field is represented by a single hexadecimal value in each message string.

Table 17: CAN Identifier Field

<table>
<tr><th>10</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td colspan="2">Group 2 Message ID
Fixed 2-bit value</td><td colspan="6">Node Address
Hexadecimal Value—6-bits</td><td colspan="3">Group 2 Message Type ID
Fixed 3-bit value</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">0</td><td colspan="6" rowspan="2">Destination Node Address</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td colspan="3">Master’s Explicit Request</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">0</td><td colspan="6" rowspan="2">Source Node Address</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td colspan="3">Slave’s Explicit Response</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">0</td><td colspan="6" rowspan="2">Destination Node Address</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td colspan="3">Master’s I/O Poll Command</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">0</td><td colspan="6" rowspan="2">Destination Node Address</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td colspan="3">Group 2 Only Unconnected Explicit Request Messages</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">0</td><td colspan="6" rowspan="2">Destination Node Address</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td colspan="3">Duplicate Node Address Check Messages</td></tr>
<tr><td colspan="2">Group 1 Message ID
Fixed 2-bit value</td><td colspan="3">Group 1 Message Type ID
Fixed 3-bit value</td><td colspan="6">Node Address
Hexadecimal Value—6-bits</td></tr>
<tr><td rowspan="2">0</td><td rowspan="2">1</td><td>1</td><td>1</td><td>1</td><td colspan="6" rowspan="2">Source Node Address</td></tr>
<tr><td colspan="3">Slave’s I/O Poll Response</td></tr>
</table>

CAN Data Field

The CAN Data Field is a *series* of 8-bit fields that defines the specific parameters of an explicit message. This information is not required in I/O poll messages per the Predefined Master/Slave Connection Set [1].

The CAN Data Field is required in every explicit message; however, the format of the field varies depending on whether the message is a request or a response.

The CAN Data Field consists of a message header and a message body (Table 18, page 49). The message header is a single 8-bit field, consisting of three components that define the basic communication information about the explicit message. The header includes the same information regardless of whether the message is a request or a response.

The explicit message header consists of the following three components:

- Fragment Bit
- Transaction ID (XID) Bit
- Node Address

The message body is a series of up to five, 8-bit fields that defines the specific explicit message. The information included in the message body varies, depending on whether the message is a request or a response.

The explicit message body consists of the following three required and two optional components:

Required:
- Service Code *(request and response)* (consists of Request/Response bit and Service ID)
- Class Code *(request only)*
- Instance ID *(request only)*

Optional:
- Attribute ID *(request only)*
- Service or Attribute Data *(request and response)*

Note In each message string, the CAN Data Field is represented by a series of hexadecimal values.

Table 18: CAN Data Field

Byte	7	6	5	4	3	2	1	0
0 MESSAGE HEADER	**Fragment Bit** (0/1)	**Transaction ID (XID) Bit** (0/1)	**Node Address** *6-bit Hexadecimal Value*					
1 MESSAGE BODY	**Service Code** *Calculate the combined hexadecimal value of the request/response bit (bit 7) and the assigned Service ID hex value (bits 6 to 0)*							
	Request Bit (0) or **Response Bit** (1)	**Service ID** *Assigned hexadecimal value*						
2	**Class Code** *Assigned hexadecimal value*							
3	**Instance ID** *Assigned hexadecimal value*							

Fragment Bit

This 1-bit field indicates whether the message is complete or fragmented. A message must be fragmented if it is larger than 8 bytes. Refer to the ODVA "DeviceNet Specification," Volume I [1] for more information.

The fragment bit values are:

0 = Non-fragmented

1 = Fragmented

Transaction ID Bit

The transaction ID (XID) bit is a 1-bit field that is essentially a placeholder with a fixed value of 0.

Node Address

The node address is a 6-bit field that identifies the network address of the device *as a hexadecimal value*. The *source* node address is the address of the device sending the message. The *destination* node address is the address of the device receiving the message.

In a request message, the device address in the CAN Data Field is the source node address. In a response message it is the destination node address.

Request/Response Bit

The request/response (R/R) bit (bit 7 in the service code) is a 1-bit field that specifies whether the message is a request or a response:

0 = Request
1 = Response

Service ID

This 7-bit field (bits 6 to 0 in the service code) identifies the service being requested. The service ID is a hexadecimal value assigned by ODVA.

Refer to Table 52, page 103, for a summary of the services supported by your device.

Class Code

The class code is a hexadecimal value, assigned by ODVA, which identifies a specific Object Model.

Instance ID

The instance ID is a hexadecimal value, assigned by ODVA, which identifies the instance within an Object Model.

Service Data

The service data is the specific information required for a request, or reported in a response, in the format assigned by ODVA. The data may include an attribute ID, which is a hexadecimal value assigned by ODVA, that identifies a specific parameter.

Objects

Nine (9) Objects are supported in the DMA. The Objects and their functions are listed by class code in Table 19, page 52.

The attributes and services associated with each Object Model are defined throughout this chapter. Descriptions are supplied for the attributes and services that are either MKS-specific or require additional specifications beyond the DeviceNet and SEMI specifications [1, 2, 3, 4, 5]. A summary of the attributes is listed in Table 51, page 95. A summary of the supported services is listed in Table 52, page 103.

For each attribute, the following information is supplied:

- Attribute ID # (hex value)
- Description
- Data Type
- User and Calibration Mode Access, which may be “read only” (R) or “read/write” (RW)
- Nonvolatile Memory, which is “Y” (yes) if stored in nonvolatile RAM or “N” (no) if not stored in nonvolatile RAM
- Data Variable(s)
- Factory Default Setting, which is set when you use the Restore_Default service

Note 

Values stored in nonvolatile RAM are saved when the power is turned off. When power is restored, the device “remembers” the latest configuration, not the default setting. To restore the various attributes to their factory default settings, you must use the Restore_Default service. Refer to *Restore Default*, page 107, for more information.

For each supported service, the following information is supplied:

- Service ID # (hex value)
- Service Name
- Parameter Data Type
- Service Type (request or notification)
- Description

Note 

The supported services and their required parameters are defined in *Supported Service Summary*, page 103.

Table 19: Object Classes in the DMA Transducer

Object Class	Class ID	Effect on Behavior	Refer to Page
Identity	01_{hex}	Supports the Reset services. Upon receipt of a Reset service request of any type, the Identity Object sends a Reset service request to the S-Device Supervisor.	53
DeviceNet	03_{hex}	Configures port attributes (node addresses, data rate, and BOI)	55
Assembly	04_{hex}	Defines input/output and configuration data format.	58
Connection Class	05_{hex}	Contains the number of logical ports into or out of the device.	60
S-Analog Sensor	31_{hex}	The instance of this object provides a calibrated pressure value from a pressure transducer. The instance is using S-Analog Sensor subclass number 3, Capacitance Manometer.	65
Device Configuration	$6D_{hex}$	General Device Configuration settings not available in other objects.	71
S-Device Supervisor	30_{hex}	Supports the Stop, Start, Reset, Abort, Recover, and Perform Diagnostic services for ALL Application Objects in the device and consolidates the Exception Conditions and Application Objects' Status. This object behaves differently from the Identity Object in that the S-Device Supervisor object provides a single point of access to the Application Objects only. It does not affect the DeviceNet objects (Identity, DeviceNet, Connection, etc.).	72

Identity Object

The Identity Object (Class Code 01_{hex}) provides general information about the device as defined in the ODVA "DeviceNet Specification," Volume II [2].

One instance of the Identity Object is supported with seven instance attributes (Table 20) and three DeviceNet common services (Table 21, page 54).

Identity Object Instance Attributes

Table 20: Identity Object Instance Attributes

Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Non-Volatile Memory	Data Variable	Factory Default Setting
01	Vendor	UINT	R	R	N	none	36
02	Device Type*	UINT	R	R	N	none	28
03	Product Code*	UINT	R	R	Y	none	3
04	Revision*	Struct of: USINT USINT	R	R	N	none	current firmware revision
05	Status*	WORD	R	R	N	none	0
06	Serial Number*	UDINT	R	R	Y	none	0
07	Product Name*	SHORT-STRING	R	R	N	none	CM
** This information also is available—in a different format—in the S-Device Supervisor Object (see page 74, for more information).*							

Vendor

Attribute ID #01 reports the registered vendor supplying the device. MKS Instruments is identified as Vendor #36 (24_{hex}).

Device Type

Attribute ID #02 reports the type of device on the network in accordance with the ODVA "DeviceNet Specification," Volume II [2]. The DMA transducer is represented in the response with the value "28," a pressure/vacuum gauge.

Product Code

Attribute ID #03 reports the product code as "3" in accordance with the ODVA "DeviceNet Specification," Volume II [2].

Revision

Attribute ID #04 reports the current revision of firmware in accordance with the ODVA "DeviceNet Specification," Volume II [2].

Status

Attribute ID #05 reports the current status of the device in accordance with the ODVA "DeviceNet Specification," Volume II [2].

Serial Number

Attribute ID #06 reports the serial number of the device in accordance with the ODVA "DeviceNet Specification," Volume II [2].

Product Name

Attribute ID #07 reports the product name in accordance with the ODVA "DeviceNet Specification," Volume II [2]. The response returns the ASCII string "CM."

Identity Object Supported Services

The Identity Object is supported by the three DeviceNet common services listed in Table 21. Refer to *Supported Service Summary*, page 103, for more information.

Table 21: Identity Object Supported Services

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
05	Reset	USINT	Request	Places the object into its INITIALIZING state.
0E	Get_Attribute_Single	USINT	Request	Reads the object attribute.
10	Set_Attribute_Single	USINT, Attribute Data Type	Request	Modifies the object attribute.

DeviceNet Object

The DeviceNet Object (Class Code 03_{hex}) contains the attributes for defining the configuration and status of the physical DeviceNet network connections. Use this object to set or report the node address (network address), the data rate, and the bus-off interrupt. In addition, use this object to report how the messaging supported by the device is allocated.

One instance of the DeviceNet Object is supported with one class attribute (Table 22), four instance attributes (Table 23), and four DeviceNet common services (Table 24, page 57).

DeviceNet Object Class Attribute

Table 22: DeviceNet Object Class Attribute

Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Non-Volatile Memory	Data Variable	Factory Default Setting
01	Revision	UINT	R	R	Y	none	002

Revision

Attribute ID #01 reports the current revision of the DeviceNet Object definition in the ODVA "DeviceNet Specification," Volume I [1].

DeviceNet Object Instance Attributes

Table 23: DeviceNet Object Instance Attributes

Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Non-Volatile Memory	Data Variable	Factory Default Setting
01	Node Address	USINT	RW*	RW*	Y	0 to 63	63
02	Data Rate	USINT	RW*	RW*	Y	0 = 125 Kb 1 = 250 Kb 2 = 500 Kb	0
03	Bus-Off Interrupt	BOOL	R	R	Y	none	0
05	Allocation Information	Struct of: USINT USINT	R	R	N	none	0, 255
** Attribute IDs #01 and #02 can be written only if their corresponding hardware switches (located on top of the device) are in the network (PGM) position. See* Data Rate and Node Address Switches, *page 39, for more information.*							

Node Address

The Node Address (network address) can be set with a software command using standard DeviceNet protocol over the network, or manually using the two 10-position rotary switches located on the top of the unit. Refer to *Data Rate and Node Address Switches*, page 39, for more information.

DeviceNet Protocol

Attribute ID #01 defines the node address (network address) of the device. Any address from 0 to 63 can be used. The unit is shipped with the address set to 63.

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

Node Address Switch Adjustment

Refer to *Node Address Switches*, page 40, for complete information on adjusting these switches.

Note In order to control the network address directly from the switches, ensure the switches are set to an actual value at power-up, and not to the network (PGM) position.

When this condition is met, any changes to the address made through the network are denied and the Attribute_Not_Settable General Error Code is returned to the Set_Attribute_Single service.

Data Rate

The data rate can be set with a software command using standard DeviceNet protocol over the network, or manually using the 4-position rotary switch located on top of the unit. Refer to *Data Rate and Node Address Switches*, page 39, for more information.

DeviceNet Protocol

Attribute ID #02 defines the data rate of the device. The data rate can be set to 125, 250, or 500 Kb, where:

0 = 125 Kb (initial)
1 = 250 Kb
2 = 500 Kb

Note The data rate switch on top of the device must be set to the network (PGM) position at power-up in order for changes to be made over the network. Any change in the rotary switch position after power-up is ignored.

Data Rate Switch Adjustment

Refer to *Data Rate Switch*, page 40, for complete information on adjusting this switch.

Note In order to control the data rate directly from the switch, ensure the switch is set to an actual value at power up, and not to the network (PGM) position.

When this condition is met, any changes to the data rate made through the network are denied and the Attribute_Not_Settable General Error Code is returned to the Set_Attribute_Single service.

Bus-Off Interrupt

Attribute ID #03 defines the bus-off interrupt for the device in accordance with the ODVA "DeviceNet Specification," Volume I [1].

Allocation Information

Attribute ID #05 reports how the types of messages supported by the device are allocated as specified by the Predefined Master/Slave Connection Set [1].

DeviceNet Object Supported Services

The DeviceNet Object is supported by the four DeviceNet common services listed in Table 24. Refer to *Supported Service Summary*, page 103, for more information.

Table 24: DeviceNet Object Supported Services

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
0E	Get_Attribute_Single	USINT	Request	Reads the object attribute.
10	Set_Attribute_Single	USINT, Attribute Data Type	Request	Modifies object attribute.
4B	Allocate_Master_Slave	BYTE, USINT	Request	Allocates the Predefined Master/Slave Connection Set.
4C	Release Master Slave	BYTE	Request	Releases the Predefined Master/Slave Connection Set.

Assembly Object

The Assembly Object (Class Code 04_{hex}) stores data and groups attributes from multiple objects, allowing data to or from each object to be sent or received using a single *explicit* messaging command.

Two instances of the Assembly Object (Table 25) are supported with one instance attribute (Table 26, page 59) and one DeviceNet common service (Table 27, page 59).

Assembly Object Instances

Each Assembly Object instance represents a different set of data. The format for each instance is fixed by the Predefined Master/Slave Connection Set and cannot be altered [1].

Table 25: Assembly Object Instances

Assembly Instance ID # (hex)	Data Type	Class Code (hex) / Object Model	Instance ID # (hex)	Attribute ID # (hex)	User Mode Access	Cal Mode Access
02	USINT	0x30 Device Supervisor	01	0x0C Exception Status	R	R
	UINT	SASO 0x31 Value (Pressure)	01	0x06 16-Bit Pressure	R	R
05	USINT	0x30 Device Supervisor	01	0x0C Exception Status	R	R
	REAL	SASO 0x31 Value (Pressure)	01	0x06 Corrected Pressure	R	R

Assembly instance ID #02 reports:

- Exception status from the S-Device Supervisor Object (refer to *Exception Status*, page 75).
- Scaled 16-bit pressure value from the S-Analog Sensor Object (refer to *Reporting the Pressure Value*, page 31).

Instance ID #05 reports:

- Exception status from the S-Device Supervisor Object (see *Exception Status*, page 75).
- Corrected pressure value in units from the S-Analog Sensor Object (refer to *Reporting the Pressure Value*, page 31).

Assembly Object Instance Attribute

Table 26: Assembly Object Instance Attribute

Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Non-Volatile Memory	Data Variable	Factory Default Setting
03	Data	ARRAY	R	R	N	none	none

Data

Attribute ID #03 reports the assembly data for the specified instance. The data returned for each instance is listed in Table 25, page 58.

Assembly Object Supported Service

The Assembly Object is supported by the DeviceNet common service listed in Table 27. Refer to *Supported Service Summary*, page 103, for more information.

Table 27: Assembly Object Supported Service

Service ID # (hex)	Service Name	Parameter Data Type	Service Type	Description
0E	Get_Attribute_Single	USINT	Request	Reads the object attribute.

Connection Object

The Connection Object (Class Code 05_{hex}) contains the attributes for defining the messaging connections in the device. Each connection is defined by the type of messaging (explicit or I/O) it supports and how the I/O connections publish attribute data. Your transducer supports explicit and I/O poll messaging as defined in the Predefined Master/Slave Connection Set [1]. Examples of explicit and I/O poll messages are described in *Appendix D: Example Messages*, page 111.

Two instances of the Connection Object (Table 28) are supported with 15 instance attributes (Table 29, page 61, and Table 30, page 62) and three DeviceNet common services (Table 34, page 64).

Note

1. The type of ***connection*** (explicit or I/O) is defined by the Allocate_Master_Slave service in the DeviceNet Object. (Refer to *Allocate Master/Slave*, page 107, for more information.)
2. The type of ***message*** is defined by the message identifier. (Refer to *CAN Identifier Field*, page 47.) When the Allocate_Master_Slave service is issued, the attribute data is automatically sent in the format defined by the Predefined Master/Slave Connection Set.

Connection Object Instances

Table 28: Connection Object Instances

Instance ID # (hex)	Description
1	Explicit Messaging
2	I/O Poll Messaging

Explicit Messaging Instance Attributes

Table 29: Explicit Messaging Instance Attributes

Attribute ID # (dec)	Attribute Name	Default Value	Description
1	state	03	Indicates the Explicit Messaging is in the *Established* state.
2	instance_type	00	Indicates this is an Explicit Messaging Connection.
3	transportClass_trigger	83_{hex}	Server/Transport Class 3
4	produced_connection_id	—	Refer to the Slave's Explicit Response Message in Table 17, page 48.
5	consumed_connection_id	—	Refer to the Master's Explicit Request Message in Table 17, page 48.
6	initial_comm_characteristics	21_{hex}	Indicates that (1) the Slave's Explicit Messaging Connection produces and consumes across Message Group 2, and (2) the Slave's Node Address appears in the CAN Identifier Fields of the Group 2 Messages that the Slave consumes and produces. Refer to Table 17, page 48.
7	produced_connection_size	$3C_{hex}$	—
8	consumed_connection_size	$3C_{hex}$	—
9	expected_packet_rate	$09C4_{hex}$	2500 milliseconds. Refer to [1].
12	watchdog_timeout_action	1	Auto_Delete as described in [1]. This attribute is settable to Deferred Delete as described in [1].
13	produced_connection_path_ length	0	Refer to [1].
14	produced_connection_path	Empty	Refer to [1].
15	consumed_connection_path_ length	0	Refer to [1].
16	consumed_connection_path	Empty	Refer to [1].
17	production_inhibit_time	0	Default is no inhibit time.
** Refer to the ODVA "DeviceNet Specification," Volume II [2], for information on User and Calibration Mode access.*			

I/O Poll Messaging Instance Attributes

Table 30: I/O Poll Messaging Instance Attributes

Attribute ID # (dec)	Attribute Name	Default Value	Description
1	state	01	Indicates the Poll Connection Object is in the *Configuring* state.
2	instance_type	01	Indicates this is an I/O Connection.
3	transportClass_trigger	83_{hex}	Server/Transport Class 3. Implementations can choose Transport Class 3 as the default.
4	produced_connection_id	—	See the Slave's I/O Poll Response Message in Table 17, page 48.
5	consumed_connection_id	—	See the Master's I/O Poll Command Message in Table 17, page 48.
6	initial_comm_characteristics	01	Indicates (1) the Slave's I/O Poll Connection produces across Message Group 1 and consumes across Message Group 2 and (2) the Slave's Node Address appears in the CAN Identifier Field of the Group 2 Message that the Slave consumes. Refer to Table 17, page 48.
7	produced_connection_size	3*	—
8	consumed_connection_size	0	—
9	expected_packet_rate	0	Expected packet rate must be configured.
12	watchdog_timeout_action	0	Transition to the *Timed Out* state.
13	produced_connection_path_ length	6	—
14	produced_connection_path	ARRAY of hex USINTS	Default value is specified by the Poll Response Setup Attribute (ID #6) in the Device Configuration Object (see page 71). See Table 31, page 63.
15	consumed_connection_path_ length	0	—
** For INT data assembly.*			

(Continued on next page)

Table 30: I/O Poll Messaging Instance Attributes (continued)

Attribute	Attribute Name	Default	Description

ID # (dec)		Value	
16	consumed_connection_path	Empty	No specified default. An implementation *must* choose an Application Object to reference by default and initialize this attribute accordingly.
17	production_inhibit_time	0	Default is no inhibit time.
** Refer to the ODVA "DeviceNet Specification," Volume II [2], for information on User and Calibration Mode access.*			

Table 31: Poll Response Setup of the Produced_Connection_Path

Assembly Instance	Produced_Connection_Path (hex bytes)					
2 (INT)	20	04	24	02	30	03
5 (REAL)	20	04	24	05	30	03
The poll response is identified in the Device Configuration Object (page 71).						

Master Poll Request Message

Note The master's poll request message does not report any data. The response returns the CAN Identifier only [1].

Slave Poll Response Assembly Instance 2

Note There are two poll response messages from the slave. The poll response reported is defined in the Device Configuration Object (page 71). The data for each response is stored in the Assembly Object (page 58).

Poll assembly instance 2 reports the exception status from the S-Device Supervisor Object (refer to *Exception Status*, page 75) and the 16-bit pressure value from the S-Analog Sensor Object (refer to *Reporting the Pressure Value*, page 31) in the format shown in Table 32. Refer to Assembly Object Instance ID #02 in Table 25, page 58.

Table 32: Poll Response Assembly Instance 2

Data Byte	0	1	2
Description	Exception Status	16-Bit Pressure	
Class Code (hex) Object Model	0x30 Device Supervisor	0x31 S-Analog Sensor	
Instance ID # (hex)	0x01	0x01	
Attribute ID # (hex)	0x0C	0x06	
Data Type	USINT	INT	

Poll Response Assembly Instance #5

Poll assembly instance 5 reports the exception status from the S-Device Supervisor Object (refer to *Exception Status*, page 75) and the corrected pressure value in units from the S-Analog Sensor Object (refer to *Reporting the Pressure Value*, page 31) in the format shown in Table 33. Refer to Assembly Instance ID #05 in the Poll Response Assembly (Table 25, page 58).

Table 33: Poll Response Assembly Instance 5

Data Byte	0	1	2	3	4
Description	Exception Status	Corrected Pressure			
Class Code (hex) Object Model	0x30 Device Supervisor	0x31 S-Analog Sensor			
01	0x01	0x01			
Attribute ID # (hex)	0x0C	0x06			
Data Type	USINT	REAL			

Connection Object Supported Services

The Connection Object is supported by the three DeviceNet common services listed in Table 34. Refer to *Supported Service Summary*, page 103, for more information.

Table 34: Connection Object Supported Services

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
05	Reset	USINT	Request	Places the object into its Initializing state.
0E	Get_Attribute_Single	USINT	Request	Reads the object attribute.
10	Set_Attribute_Single	USINT, Attribute Data Type	Request	Modifies the object attribute.

S-Analog Sensor Object

The S-Analog Sensor Object (Class Code 31_{hex}) contains the attributes for reporting the pressure values and for setting the variables used in the pressure calculation. The S-Analog Sensor Object also supports software alarm and warning trip points as descibed below.

One instance of the S-Analog Sensor Object is supported with 25 instance attributes (refer to Table 35) and three DeviceNet services (refer to Table 39, page 70). A table of pressure units support is provided in Table 38, page 69.

Customer Supported Attributes

Table 35: S-Analog Sensor Class Specific Attributes

Attribute ID #		Description	DeviceNet Data Type	Access Rule	Non-Volatile Memory	Factory Default Setting
(dec)	(hex)					
03	0x03	Data Type	USINT	U-Set/Get	Y	0xC3 (INT)
04	0x04	Data Units	ENGUNITS	U-Set/Get	Y	0x1001 (Counts)
05	0x05	Reading Valid	BOOL	U-Get	N	none
06	0x06	Value	INT or REAL	U-Get	N	none
07	0x07	Status	Byte	U-Get	N	none
08	0x08	Alarm Enable	BOOL	U-Set	Y	0 (disable)
09	0x09	Warning Enable	BOOL	U-Set	Y	0 (disable)
10	0x0A	Full Scale	INT or REAL	U-Get	Y	23405
14	0x0E	Gain	REAL	U-Set/Get	Y	1.000
16	0x10	OffsetB Customer Offset	INT or REAL	U-Set/Get	Y	0
17	0x11	Alarm Trip Point High	INT or REAL	U-Set	Y	50% FS
18	0x12	Alarm Trip Point Low	INT or REAL	U-Set	Y	50% FS
19	0x13	Alarm Hysteresis	UINT or REAL	U-Set	Y	0
20	0x14	Alarm Settling Time	UINT	U-Set	Y	0
21	0x15	Warning Trip Point High	INT or REAL	U-Set	Y	50% FS
22	0x16	Warning Trip Point Low	INT or REAL	U-Set	Y	50% FS
23	0x17	Warning Hysteresis	UINT or REAL	U-Set	Y	0
24	0x18	Warning Settling Time	UINT	U-Set	Y	0

(Continued on next page)

Table 35: S-Analog Sensor Class Specific Attributes (continued)

Attribute ID #		Description	DeviceNet Data Type	Access Rule	Non-Volatile Memory	Factory Default Setting
(dec)	(hex)					
31	0x1F	Averaging Time	UINT	U-Set/Get	Y	30
32	0x20	Overrange	INT or REAL	U-Get	Y	110% FS
33	0x21	Underrange	INT or REAL	U-Get	Y	-5% FS
94	0x5E	Sensor Warning	STRUCT of BYTE BYTE	U-Get	N	none
95	0x5F	Sensor Alarm	STRUCT of BYTE BYTE	U-Get	N	none
96	0x60	Status Extension	BYTE	U-Get	N	none
99	0x63	Sub Class	UINT	U-Get	Y	3
119	0x77	Pressure Fraction in Percentage Full Scale	REAL	U-Get	Y	none

Data Type

Attribute ID # 03 determines the Data Type of Value and all related attributes. Integer and Real Data Types are supported. See below. Data Type is settable only in the *Idle* state. The default is INT.

Table 36: Attribute ID # 03 Data Type

Value (hex)	Data Type
0xC3	INT
0xCA	REAL

Data Units

Attribute ID # 04 determines the Units context of Pressure Value and all related attributes. Refer to Table 38, page 69. Data Units is settable only in the *Idle* state. The default is Counts.

Reading Valid

Attribute ID # 05 indicates that the Value attribute contains a valid value.

0 = Invalid

1 = Valid

Value

Attribute ID # 06 reports the measured pressure value.

Value = (PressurePFS * Full Scale) * Gain + Offset B

where:

PressurePFS = Attribute 0x77
Full Scale = Attribute 0x0A
Gain = Attribute 0x0E
OffsetB = Attribute 0x10

Status

Attribute ID # 07 indicates the Alarm and Warning state of this object instance.

Table 37: Status Attribute Values

Bit	Definition
0	High Alarm Exception: 0 = cleared, 1 = set
1	Low Alarm Exception: 0 = cleared, 1 = set
2	High Warning Exception: 0 = cleared, 1 = set
3	Low Warning Exception: 0 = cleared, 1 = set
4	Reserved
5	Reserved
6	Reserved
7	Reserved

Alarm Enable

Attribute ID # 08 enables the setting of the Alarm Status Bits in the S-Analog Sensor Object:

0 = Disable (default)
1 = Enable

Warning Enable

Attribute ID # 09 enables the setting of the Warning Status Bits in the S-Analog Sensor Object:

0 = Disable (default)
1 = Enable

Full Scale

Attribute ID # 10 indicates the Value of 100% Full Scale for the sensor. Full Scale and Value have the same Data Units.

Gain

Attribute ID # 14 indicates an amount scaled to derive Value. This can be modified by the Gain_Adjust Service. The default is 1. The gain attribute may range from 0.98 to 1.02.

Offset-B Customer Offset

Attribute ID # 16 indicates an amount added to derive Value. The acceptable value for Offset B is ±2% of the Full Scale pressure value. This can be modified by the Zero_Adjust Service. The default is 0.

Alarm Trip Point High

Attribute ID # 17 determines the Value above which an Alarm condition will occur. The default is 50% Full Scale.

Alarm Trip Point Low

Attribute ID # 18 determines the Value below which an Alarm condition will occur. The default is 50% Full Scale.

Alarm Hysteresis

Attribute ID # 19 determines the amount by which the Value must recover to clear an Alarm condition. The acceptable input range for Trip Point-Alarm hysteresis is 0 (default) to 20%.

Hysteresis is built into the operation of the trip points to help compensate for the noise inherent in all systems. Without hysteresis, the noise may cause the trip points to repeatedly switch states, a condition known as “chatter.”

Refer to *Trip Point Hysteresis*, page 42, for more information.

Note  Hysteresis can only be set using DeviceNet digital communications commands.

Alarm Settling Time

Attribute ID # 20 determines the time in milliseconds that the Value must exceed the Trip Point before the exception condition is generated. The default is 0.

Warning Trip Point High

Attribute ID # 21 determines the Value above which a Warning condition will occur. The default is 50% Full Scale.

Warning Trip Point Low

Attribute ID # 22 determines the Value below which a Warning condition will occur. The default is 50% Full Scale.

Warning Hysteresis

Attribute ID # 23 determines the amount by which the Value must recover to clear a Warning condition. The acceptable input range for Trip Point-Warning hysteresis is 0 (default) to 20%.

Hysteresis is built into the operation of the trip points to help compensate for the noise inherent in all systems. Without hysteresis, the noise may cause the trip points to repeatedly switch states, a condition known as “relay chatter.”

Refer to *Trip Point Hysteresis*, page 42, for more information.

Note Hysteresis can only be set using DeviceNet digital communications commands.

Warning Settling Time

Attribute ID # 24 determines the time in milliseconds that the Value must exceed the Trip Point before the exception condition is generated. The default is 0.

Averaging Time

Attribute ID # 31 specifies the time in ms over which analog samples are averaged. Averaging Time less than the 10 ms disables averaging. The maximum allowed time in milliseconds is 2500 ms. The default value is 30 ms.

Overrange

Attribute ID # 32 specifies the highest valid Value (110% of Full Scale). When Value > 110% Full Scale, the Reading Valid attribute is set to invalid. The default is 110% Full Scale.

Underrange

Attribute ID # 33 specifies the lowest valid Value (-5% of Full Scale). When Value < -5% Full Scale, the Reading Value Attribute is set to invalid. The default is -5% Full Scale.

Sensor Warning

Attribute ID # 94 indicates the bits definition of Sensor Warnings. Bytes 0 and 1 map, respectively, to Bytes 1 and 2 of the S-Device Supervisor Object Device Exception Detail Warning (Attribute 0x0E). Refer to Table 42, page 72.

Sensor Alarm

Attribute ID # 95 indicates the bits definition of Sensor Alarms. Bytes 0 and 1 map, respectively, to Bytes 1 and 2 of the S-Device Supervisor Object Device Exception Detail Alarm (Attribute 0x0D). Refer to Table 42, page 72.

Status Extension

Attribute ID # 96 indicates the bits definition of Sensor Warnings. Byte 0 maps to Byte 0 of the S-Device Supervisor Object Device Exception Detail Warning (Attribute 0x0E). Refer to Table 42, page 72.

Sub Class

Attribute ID # 99 contains Vacuum gauge sub class number 3 (Capacitance Manometer).

Pressure as Fractional Percentage of Full Scale

Attribute ID # 119 indicates the corrected and calibrated final value of pressure as a fractional percentage of Full Scale, where a 100% of Full Scale value is indicated as 1.00

Pressure Units Support

Table 38: S-Analog Sensor Pressure Units Support

Code	DEC	Symbol	Name	Conversion Factor
1001_{hex}	4097	Counts	Full Scale Counts	29788=100% Full Scale
1007_{hex}	4103	Percent	% Full Scale	100.00 (Base % Full Scale)
1300_{hex}	4864	Psi	(pound-force)/(inch)^2	0.0193368 (Base Torr)
1301_{hex}	4865	Torr	mmHg (0° C)	1.0 (Base Torr)
1302_{hex}	4866	mTorr	mTorr	1000.0 (Base Torr)
1304_{hex}	4868	inHg (0° C)	inch of mercury (0° C)	0.0393701 (Base Torr)
1305_{hex}	4869	cmH_2O (4° C)	centimeter of water (4° C)	1.35955 (Base Torr)
1306_{hex}	4870	inH_2O (4° C)	inch of water (4° C)	0.535254 (Base Torr)
1307_{hex}	4871	bar	bar	0.00133322 (Base Torr)
1308_{hex}	4872	mbar	millibar	1.33322 (Base Torr)
1309_{hex}	4873	Pa	pascal N/(m)^2	133.322 (Base Torr)
$130A_{hex}$	4874	kPa	kilopascal	0.133322 (Base Torr)
$130B_{hex}$	4875	atm	standard atmosphere	0.00131579 (Base Torr)
$130C_{hex}$	4876	gram/cm^2	gram-force per square centimeter	1.359510250028 (Base Torr)

Specific Services

Table 39: S-Analog Sensor Object Specific Services

Service Code		Service Name/ Access Rule	Description of Service
(dec)	(hex)		
53	0x32	U-Coarse Zero Adjustment	Sends a Target pressure value, usually zero, to the device. Corrections to the digital zero are made to bring the pressure Value (Attribute 0x6) to the specified Target Value. The range of this service is –4 to +20% of Full Scale. This service is also initiated by depressing the Coarse Zero Push Button for at least 2 seconds.
75	0x4B	U-Fine Zero Adjust	Sends a Target pressure value, usually zero, to the device. The value of Offset-B (Attribute 0x10) is modified to bring the pressure Value (Attribute 0x6) to the specified Target Value. The range of this service is ±2% of Full Scale.
76	0x4C	U-Gain Adjust	Sends a Target pressure value to the device. The value of the Gain (Attribute 0x0E) is then modified to bring the pressure Value (Attribute 0x6) to the specified Target Value. Valid gain values range from 0.98 to 1.02.

Device Configuration Object

Support added in firmware version AF (1.009). Not valid for previous versions.

The Device Configuration Object (Class Code $6D_{hex}$) contains the attributes for selecting the poll response that is returned with I/O poll messaging connections. One instance of the Device Configuration Object is supported with three instance attributes (Table 40) and three DeviceNet common services (Table 41, page 71).

Device Configuration Object Instance Attributes

Table 40: Device Configuration Object Instance Attributes

Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Non-Volatile Memory	Data Variable	Factory Default Setting
01	Produced Assembly Instance	USINT	RW*	RW*	Y	Assembly Instance	2
02	Consumed Assembly Instance	USINT	RW*	RW*	Y	0	0
03	Poll_Auto_Delete_ Enable	BOOL	RW*	RW*	Y		1 (enabled)
** Attribute ID #01 **cannot** be set if the Allocate Master Slave service has been issued and the poll connection is in the established state.*							

Poll_Auto_Delete_Enable

Setting this attribute determines the behavior implemented when the poll IO watchdog_timeout_action is set to a value of 0x00 (transition to timeout). The common practice is to allow the object to delete the poll connection upon the poll connection timing out. The factory default for this attribute is therefore 0x01, enabled. To utilize a more rigid enforcement of the connection, the attribute may be set to a value of 0x00, disabled. When this attribute is set to disabled and, upon the poll IO connection timing out, the device will transition to a timed out state (the red Network status LED will blink) and the connection must be reset or deleted over the network to clear the condition.

Device Configuration Object Supported Services

The Device Configuration Object is supported by the two DeviceNet common services listed in Table 41. Refer to *Supported Service Summary*, page 103, for more information.

Table 41: Device Configuration Object Supported Services

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
0E	Get_Attribute_Single	USINT	Request	Reads the object attribute.
10	Set_Attribute_Single	USINT, Attribute Data Type	Request	Modifies the object attribute.

S-Device Supervisor Object

The S-Device Supervisor Object (Class Code 30_{hex}) provides general information about the device.

The S-Device Supervisor Object includes most of the same information—in a different format—available in the Identity Object (refer to Table 20, page 53) in accordance with the ODVA DeviceNet Specification, Volume II [2]. In addition, the S-Device Supervisor Object includes attributes specific to the MKS transducer, in accordance with the SEMI Standards Common and Specific Device Models [3, 4, 5].

One instance of the S-Device Supervisor Object is supported with 14 instance attributes (refer to Table 42) and seven DeviceNet services (refer to Table 49, page 82).

Class Specific Attributes

Table 42: S-Device Supervisor Class Specific Attributes

Attribute ID #		Description*	DeviceNet Data Type	Access Rule	Non-Volatile Memory	Factory Default Setting
(dec)	(hex)					
03	0x03	Device Type	SHORT STRING	U-Get	Y	VG
04	0x04	SEMI Standard Revision Level	SHORT STRING	U-Get	Y	E54-0997
05	0x05	Manufacturer's Name	SHORT STRING	U-Get	Y	MKS Instruments
06	0x06	Manufacturer's Model Number	SHORT STRING	U-Get	Y	DMA
07	0x07	Software Revision Level	SHORT STRING	U-Get	Y	Current firmware revision
08	0x08	Hardware Revision Level	SHORT STRING	U-Get	Y	A
09	0x09	Manufacturer's Serial Number Identity Object	SHORT STRING	U-Get	Y	Serial Number
10	0x0A	Device Configuration	SHORT STRING	U-Get	Y	DMAXXXXXXXXXXX
11	0x0B	Device Status	USINT	U-Get	Y	none
12	0x0C	Exception Status	BYTE	U-Get	Y	none
13	0x0D	Exception Detail Alarm	STRUCT	U-Get	N	none
14	0x0E	Exception Detail Warning	STRUCT	U-Get	N	none

(Continued on next page)

Table 42: S-Device Supervisor Class Specific Attributes (continued)

Attribute ID # (dec)	Attribute ID # (hex)	Description*	DeviceNet Data Type	Access Rule	Non-Volatile Memory	Factory Default Setting
15	0x0F	Alarm Enable	BOOL	U-Set/Get	Y	0 (disabled)
16	0x10	Warning Enable	BOOL	U-Set/Get	Y	0 (disabled)

Attribute ID # (dec)	Description	DeviecNet Data Type	Access Rule	Cal Mode Access	Non-Volatile Memory	Data Variable	Factory Default Setting
19	Last Maintenance Date	DATE*	R	RW	Y	none	0,0,0
20	Next Maintenance Date	DATE*	R	RW	Y	none	0,0,0
21	Scheduled Maintenance Expiration Timer	INT	R	RW	Y	-32,767 to +32,767 hours	0
22	Scheduled Maintenance Expiration Warning Enable	BOOL	RW	RW	Y	0 = Disable 1 = Enable	0
23	Run Hours	UINT	R	R	Y	0 to 65535	0
100	Factory Calibration Date	DATE*	R	R	Y	none	0,0,0

** The DATE format does not conform to the ODVA definition. It is a structure of (1) a year of type UINT, (2) a month of type USINT, and a (3) a day of type USINT.*

Device Type

Attribute ID #03 reports the type of device on the network using an ASCII string of up to 8 characters. In the response, the DMA unit is defined as a capacitance manometer vacuum gauge with the ASCII string “VG.”

SEMI Standard Revision Level

Attribute ID #04 reports the most recent version of the Standards Device Model to which the unit adheres. The response is a 7-character (maximum) ASCII string “ENN-NNYY” where:

E = SEMI assigned value
NN-NN = Number of the standard
YY = Year of the published standard

The default string is “E54-0997”

Manufacturer' Name

Attribute ID #05 reports the manufacturer of the DMA capacitance manometer using an ASCII string of up to 20 characters. The manufacturer of the unit is always reported as MKS Instruments, identified with the ASCII string "MKS Instruments"

Manufacturer's Model Number

Attribute ID #06 reports the model number of the instrument with an ASCII string of up to 20 characters. The capacitance manometer is represented in the response with the ASCII string "DMA"

Software Revision Level

Attribute ID #35 reports the version of microprocessor code in the instrument. The format of the attribute is "XXX"

The initial firmware revision level is "1.001"

Hardware Revision Level

Attribute ID #08 designates the hardware version of your device, with an ASCII string of up to 5 characters. The revision level is identified with the letters from "A" to "Z." The initial hardware revision is "A"

Manufacturer's Serial Number Identity Object

Attribute ID #09 reports the serial number of the device with an ASCII string up to 30 characters.

Device Configuration

Attribute ID #10 reports the device configuration beyond the model number in the number: DMAXXXXXXXXXXX

Device Status

Attribute ID #11 represents the current state of the device. Its value changes as the state of the device changes. The following values are defined:

Table 43: Device Status Attribute Values

Attribute Value	Device State
0	Undefined
1	Self Testing
2	Idle
3	Self Testing Exception
4	Executing
5	Self Testing
6	Critical Fault

Exception Status

Attribute ID #12 reports the type of alarm or warning condition detected by the instrument. The alarms and warnings are identified as:

- Device Common—specific to the DeviceNet network
- Device Specific—specific to capacitance manometers
- Manufacturer Specific—specific to the MKS unit

The response is a byte structured as a bit mapped variable [3]. The transducer supports the expanded method of reporting exceptions. The bit map format is:

7	6	5	4	3	2	1	0

Table 44 lists the bit map defining this variable.

Table 44: Exception Status Bit Map

Bit	Definition
0	(0/1) Alarm/device-common
1	(0/1) Alarm/device-specific
2	(0/1) Alarm/manufacturer-specific
3	0 (Reserved)
4	(0/1) Warning/device-common
5	(0/1) Warning/device-specific
6	(0/1) Warning/manufacturer-specific
7	1 (Expanded Method)

The response returns a binary value with the least significant bit (bit 0) as the last digit. The response values are additive; therefore, one hex value reports all alarm conditions. For example, if the unit detects a device-specific alarm condition, the unit reports: 82_{hex} = 1 0 0 0 0 0 1 0 Refer also to Table , page 79.

Exception Detail Alarm

Attribute ID #13 identifies the specific alarm condition(s) detected by the DMA transducer. This attribute is a Structure of three Structures containing a bit mapped representation of the alarm detail. This structure contains a total of 8 bytes. The first group contains 3 bytes representing Common Exception Detail Alarm Bytes. The second group contains 3 bytes representing Device Exception Detail Alarm Bytes. The third group contains 2 bytes representing Manufacturer Exception Detail Alarm Bytes.

The response is a byte with each bit representing a specific exception (alarm) condition, as listed in Table 46. The bit that is set indicates that the alarm assigned to that bit is active. The response returns a binary (hex) value with the least significant bit (bit 0) as the last digit. The response values are additive; therefore, one hex value reports all alarm conditions.

Table 45: Exception Detail Alarm Bytes

Byte	Description	
0	2	Number of Common Alarm Detail Bytes
1	XXXXXXXX	Common Alarm Detail Byte 0
2	XXXXXXXX	Common Alarm Detail Byte 1
3	2	Number of Device Alarm Detail Bytes
4	XXXXXXXX	Device Alarm Detail Byte 0
5	XXXXXXXX	Device Alarm Detail Byte 1
6	1	Number of Manufacturer Alarm Detail Bytes
7	XXXXXXXX	Manufacturer Alarm Detail Byte 0

Refer also to Table 47, page 79.

Exception Detail Warning

Attribute ID #14 identifies the specific warning condition(s) detected by the DMA transducer. This attribute is a Structure of three Structures containing a bit mapped representation of the warning detail. This structure contains a total of 9 bytes. The first group contains 3 bytes representing Common Exception Detail Warning Bytes. The second group contains 4 bytes representing Device Exception Detail Warning Bytes. The third group contains 2 bytes representing Manufacturer Exception Detail Warning Bytes.

The response is a byte with each bit representing a specific exception (alarm) condition, as listed in Table 46. The bit that is set indicates that the alarm assigned to that bit is active. The response returns a binary (hex) value with the least significant bit (bit 0) as the last digit. The response values are additive; therefore, one hex value reports all alarm conditions.

Table 46: Exception Detail Warning Bytes

Byte	Description	
0	2	Number of Common Warning Detail Bytes
1	XXXXXXXX	Common Warning Detail Byte 0
2	XXXXXXXX	Common Warning Detail Byte 1
3	3	Number of Device Warning Detail Bytes
4	XXXXXXXX	Device Warning Detail Byte 0
5	XXXXXXXX	Device Warning Detail Byte 1
6	XXXXXXXX	Device Warning Detail Byte 2
7	1	Number of Device Warning Detail Bytes
8	XXXXXXXX	Manufacturer Warning Detail Byte 0

Refer also to Table 47, page 79.

Alarm Enable

This Boolean attribute (Attribute ID #15) is used to enable (1) or disable (0) the S-Device Supervisor object's process of setting Alarm Exception bits.

0 = Disabled (default)
1 = Enabled

When disabled, corresponding bits are never set; and, if they were set, disabling clears them. Also, alarm bit states are not retained; when enabled, bits will be set only if the corresponding condition is true.

Warning Enable

This Boolean attribute (Attribute ID #15) is used to enable (1) or disable (0) the S-Device Supervisor object's process of setting Warning Exception bits.

0 = Disabled (default)
1 = Enabled

When disabled, corresponding bits are never set; and, if they were set, disabling clears them. Also, warning bit states are not retained; when enabled, bits will be set only if the corresponding condition is true.

Visual Indicator

Attribute ID #64 controls the behavior of the visual indicator (the wink function) on the device. This attribute controls the flashing of the Module Status LED, which is useful for visually identifying a particular device on the network, where:

0 = Off (initial)
1 = On

When the visual indicator is On, the Module Status LED flashes green approximately once a second. When the visual indicator is Off, the Module Status LED returns to its normal operation. Refer to *DeviceNet Status LEDs*, page 38, for more information on the LED status indicators.

User Tag

Attribute ID #65 enables you to assign a label (user tag) to the DMA transducer. The tag can be any user-defined string (including spaces) of up to 30 ASCII characters.

Operating Mode

Attribute #66 defines the operating mode of the device, where:

0 = User Mode (initial)
1 = Calibration Mode

The User Mode is the normal, default power-up mode. The Calibration Mode enables you to recalibrate your device and modify certain attributes that are read-only in the User Mode. Only field or service personnel should use the Calibration Mode.

Apart from restricting access to certain parameters, the device operation is identical in either mode. Access rights to specific attributes are defined in the various object attribute tables throughout this manual.

Note

To switch between the two operating modes, you must use the Lock and Unlock services.

Use the Lock service to place your device into the User Mode (refer to *Lock*, page 108). Use the password protected (1234_{hex}) Unlock service to place your device into the Calibration Mode (refer to *Unlock*, page 109).

Table 47: Exception Detail Alarm Map

Byte	Bit	Description	Object Model
Common Alarm Size	0 to 7	Least significant byte of Common Alarm Size (byte length) always 01 hex. Byte length always 02 hex	Single Byte 2
Common [Byte 0]	0	Internal Diagnostic Exception	S-Device Supervisor
	1	Microprocessor Exception	S-Device Supervisor
	2-3	EEPROM Exception	S-Device Supervisor
	4	RAM Exception	S-Device Supervisor
	5,7	Reserved	
	6	Internal Real Time Exception	S-Device Supervisor
Common [Byte 1]	0	Power Supply Overcurrent	S-Device Supervisor
	1	Reserved Power Supply	S-Device Supervisor
	2	Power Supply Output Voltage	S-Device Supervisor
	3	Power Supply Input Voltage	S-Device Supervisor
	4	Scheduled Maintenance	S-Device Supervisor
	5	Notify Manufacturer	S-Device Supervisor
	6	Reset Exception	S-Device Supervisor
	7	Reserved	
Device Specific Alarm Size	0 to 7	Byte length always 02 hex	Single Byte 2
Device Specific Alarm Size [Byte 0]	0	Diaphragm Failure	S-Analog Sensor Object
	1 to 7	Reserved	
Device Specific Alarm Size [Byte 1]	0	Reserved	
	1	Electronics Failure	S-Analog Sensor Object
	2	Over Temperature of Electronics	S-Analog Sensor Object
	3 to 7	Reserved	
Manufacturing Alarm Size	0 to 7	Byte length always 01 hex	Single Byte 1
Manufacturing Specific Alarm [Byte 0]	0	ADC High Rail	S-Device Supervisor
	1	ADC Low Rail	S-Device Supervisor
	2 to 3	Reserved	
	4	Device Not Configured	S-Device Supervisor
	5 to 7	Reserved	

(Continued on next page)

Table 47: Exception Detail Warning Map (continued)

Byte	Bit	Description	Object Model
Common Warning Size	0 to 7	Byte length always 01 hex	Single Byte 2
Common [Byte 0]	0	Internal Diagnostic Exception	S-Device Supervisor
	1	Microprocessor Exception	S-Device Supervisor
	2-3	EEPROM Exception	S-Device Supervisor
	4	RAM Exception	S-Device Supervisor
	5,7	Reserved	
	6	Internal Real Time Exception	S-Device Supervisor
Common [Byte 1]	0	Power Supply Overcurrent	S-Device Supervisor
	1	Reserved Power Supply	S-Device Supervisor
	2	Power Supply Output Voltage	S-Device Supervisor
	3	Power Supply Input Voltage	S-Device Supervisor
	4	Scheduled Maintenance	S-Device Supervisor
	5	Notify Manufacturer	S-Device Supervisor
	6	Reset Exception	S-Device Supervisor
	7	Reserved	
Device Specific Warning Size	0 to 7	Byte length always 01 hex	Single Byte 3
Device Specific Warning Size [Byte 0]	0	Reading Invalid	S-Analog Sensor Object
	1	Over-range Exceeded	S-Analog Sensor Object
	2	Under-range Exceeded	S-Analog Sensor Object
	3 to 7	Reserved	
Device Specific Warning Size [Byte 1]	0	Not at Temperature	S-Analog Sensor Object
	1 to 7	Reserved	
Device Specific Warning Size [Byte 2]	0	Reserved	
	1	Reserved	
	2 to 7	Reserved	
Manufacturing Specific Warning Size	0 to 7	Byte length always 01 hex	Single Byte 1
Manufacturing Specific Warning [Byte 0]	0	Reserved	S-Analog Sensor Object
	1	824 Status	S-Analog Sensor Object
	2	Analog Output Invalid	S-Analog Sensor Object
	3	Electronics Temperature Alert	S-Analog Sensor Object
	4 to 5	Reserved	
	6	Pressure Below 0% Full Scale	S-Analog Sensor Object
	7	Pressure Above 100% Full Scale	S-Analog Sensor Object

Last Calibration Date

Attribute ID # 0x13 reports the date the device was last calibrated by the user. The response is formatted as a data structure of four bytes used to represent a calendar date, as listed in Table 48.

Table 48: Calibration Date Format

Byte #	Description	Data Type	Range
0-1	Year	UINT	1997 to 2100
2	Month	USINT	1 to 12
3	Day	USINT	1 to 31

Next Calibration Date

Attribute ID # 0x14 identifies the date the device is scheduled for the next calibration. The date is formatted as a data structure of four bytes used to represent a calendar date, as listed in Table 48.

Calibration Expiration Timer

Attribute ID # 0x15 specifies the time remaining until the next recommended calibration. The acceptable input range is -32767 to +32767 hours. The initial setting is 0. The attribute has a resolution of 1 hour.

Calibration Expiration Warning Enable

Attribute ID # 0x16 specifies whether or not the Calibration Timer (Attribute ID #03 in this object) will set the “Calibration Recommended” warning status bit in the exception status attribute in the S-Device Supervisor Object (refer to Table 47, page 79), where:

0 = Disable (initial)
1 = Enable

Run Hours

Attribute ID # 0x17 reports the number of hours the device has been powered on. The response has a resolution of 1 hour and a range of 0 to 65535. This value does not reset to zero when the unit is powered down.

Factory Calibration Date

Attribute ID #64 reports the date the device was last calibrated at the factory. The response is formatted as a data structure of four bytes used to represent a calendar date, as listed in Table 48, page 81.

S-Device Supervisor Object Supported Services

The S-Device Supervisor Object is supported by the seven DeviceNet services listed in Table 49. Refer to *Supported Service Summary*, page 103, for more information.

Table 49: S-Device Supervisor Object Supported Services

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
05	Reset*	USINT	Request	Places the object into its Initializing state.
06	Recover* (start)	none	Request	Causes the device to transition from the Abort state to the Operating state.
07	Abort* (stop)	none	Request	Places the device in its Abort state.
0E	Get_Attribute_Single*	USINT	Request	Reads the object attribute.
10	Set_Attribute_Single*	USINT, Attribute Data Type	Request	Modifies the object attribute.
4D	Lock	none	Request	Restricts access to Read-Only attributes. Places the device into the User Mode.
4E	Unlock (Password Protected)	UINT	Request	Makes Read-Only attributes modifiable and places the device into Calibration Mode.

** DeviceNet common services.*

Chapter Five: Maintenance and Troubleshooting

General Information

In general, the DMA transducer requires no maintenance other than proper installation and operation, and an occasional zero adjustment. If the transducer fails to operate properly upon receipt, check for shipping damage and check the cables for correct continuity. Immediately report any damage to the carrier and MKS Instruments.

If there is no obvious damage and the cable continuity is correct, check your instrument using the *Troubleshooting Chart* (Table 50, page 84). If the transducer performance does not improve and it is necessary to return the unit to MKS for service, obtain an ERA Number (Equipment Return Authorization Number) from any MKS Calibration and Service Center (listed on the inside back cover of this manual) before shipping.

Maintenance

Zero Adjustment

All pressure transducers require initial and periodic zero adjustments. Prior to initial operation and during periodic maintenance you must check the transducer zero to verify the proper output.

The transducer's pressure signal can be zeroed by manually pressing the OneTouch Zero Push Button on the top of the DMA unit (Figure 5, page 38). The unit's zero can also be adjusted with the Coarse Zero Adjustment Service in the S-Analog Sensor Object (refer to *Reporting the Pressure Value*, page 31).

Refer to *Adjusting the Zero*, page 32, for complete instructions on adjusting the transducer zeros.

Note In production operations such as semiconductor manufacturing, verify the transducer zero (and adjust if necessary) each time the equipment is shut down for routine maintenance.

Troubleshooting

Table 50: Troubleshooting Chart

Symptom	Possible Cause	Solution
Overrange positive or negative signal.	A shorted transducer or a damaged interconnect cable (transducer to electronics module).	Measure supply voltages at the connector. Inspect cable and transducer. Replace, if necessary.
Measurement slowly goes positive over time.	Overpressure and/or a build-up of contamination in the measurement cavity.	Return to MKS for servicing or transducer replacement.
Unstable zero output.	The ambient temperature may be too high. *or* The ambient temperature is varying over a wide range.	Refer to *Startup*, page 29 to ensure the ambient temperature is within product requirements. (Refer also to *Appendix A: Product Specifications*, page 85).

Appendix A: Product Specifications

Digital Communication Specifications

Bus Addressing	Master/slave information flow
Data Rate Switch/Network Length	One, 4-position user-adjustable switch:
Software Override	PGM (Programmable over the network)
125 Kb	500 m (1,640 ft)
250 Kb	250 m (820 ft)
500 Kb	100 m (328 ft)
DeviceNet V 2.0 Device Group 2	Explicit and Polled Messaging
Digital Functions/Capabilities	Read pressure Set trip points and hysteresis Select units: Torr, Pa, mBar, inH_2O, psi Set digital and analog zeroes Reset factory defaults Report run time hours Monitor transducer status—trip points Change user tags and device address
Node Address Switches	Two, 10-position user-adjustable switches:
0/0 to 6/3	Hardware ID numbers (no software override)
6/4 to 9/9	Software ID numbers (software selectable)
Network Size	Up to 64 nodes
Visual Communication Indicators (standard bi-color)	LED Module Status (green/red) LED Network Status (green/red)

Electrical Specifications

	DMA (Ambient)	DMA (45° C)	DMA (80° C)
CE Compliance Electromagnetic Compatibility[1]	Pending Specification EN61326 EMC Directive 2004/108/EEC		
Input Power Requirements			
Voltage	+11 to +25 VDC *	+11 to +25 VDC *	+11 to +25 VDC *
Current at Warm Up	200 mAmps (max)	700 mAmps (max)	1.0 amps
Isolation	500 [1] V	500 [1] V	500 [1] V
	* Communicate within +11 to +25 VDC range. Operation within performance specifications from +18 to +25 VDC.		
Power Consumption	≤ 7 Watts	≤ 14 Watts	≤ 22 Watts
Protection			
Fuses	Current limiting provided on DeviceNet power supply inputs.		
Tantalum Capacitors	Target use restricted.		
Mis-wiring	Protection against on DeviceNet Connector.		
Transients	Protection against per CE.		
Signal Output—Analog	-0.5 to +11 V (0 to 10 VDC for 0 to 100% Full Scale)		
Supply Voltage Coefficient			
Span	0.02% Reading for 18 VDC to 25 VDC		
Zero	0.01% Full Scale for 18 VDC to 25 VDC		

[1] Overall metal braided shielded cable, properly grounded at both ends, for use of J2 9-pin “D” connector.

Environmental Specifications

		DMA (Ambient)	DMA (45° C)	DMA (80° C)
Maximum External Case Temperature		50° C (122° F)	50° C (122° F)	65° C (149° F)
Temperature Range	Operating	0° to 50° C (32° to 122° F)	15° to 40° C (59° to 104° F)	15° to 50° C (59° to 122° F)
	Storage	-20° to 80° C (68° to 176° F)		
	Maximum External Case	In operation at 20° C ambient: 60° C		
Storage Humidity Range		25% RH to 95% RH (relative humidity), non-condensing		
Warm Up Time		½ hour all ranges	4 hours ranges less than 1 Torr 2 hours ranges 1 Torr and higher	4 hours ranges less than 1 Torr 2 hours ranges 1 Torr and higher

Performance Specifications

Accuracy (nonlinearity, hysteresis, and nonrepeatability)	Range (Torr) (% of Reading)	Standard Accuracy (% of Reading)	Optional (% of Reading)
DMA (Ambient)	1, 2, 5	0.25%	
	10, 20, 50, 100, 200, 500, 1000	0.25%	0.15%
DMA (45° C)	0.02	0.25%	
	0.05, 0.1, 0.25, 0.5	0.15%	
	1, 2, 5, 10, 20, 50, 100, 200, 500, 1000	0.12%	
DMA (80° C)	0.05, 0.1, 0.25, 0.5	0.5%	
	1, 2, 5, 10, 20, 50, 100, 200, 500, 1000	0.25%	
Temperature Coefficients	**Range**	**Zero (% Full Scale/°C)**	**Span (% Reading/°C)**
DMA (Ambient)	1 Torr	0.015%	0.04%
	2 and 5 Torr	0.01%	0.04%
	10 Torr and up	0.005%	0.04%
DMA (45° C)	0.02 Torr	0.03%	0.02%
	0.05 Torr	0.015%	0.02%
	0.1, 0.25, 0.5 Torr	0.005%	0.02%
	1 Torr and up	0.002%	0.02%
DMA (80° C)	0.05 Torr	0.020%	0.02%
	0.1, 0.25, 0.5 Torr	0.01%	0.02%
	1 Torr and up	0.002%	0.02%
Burst Pressure	5 times Full Scale or 90 psia, whichever is greater		
Leak Integrity	Internal to external $<10^{-9}$ scc/sec He 100 million cycles to FS without leakage–1 million cycles for ≤1 Torr		
Overpressure Limit Without Damage	45 psia (310 kPa)		
Resolution	0.001% Full Scale		
Time Constant	< 20 msec (< 40 msec ≤ 1 Torr units)		

(Continued on next page)

Time Response	
Pressure Measurement Response	Less than 30 ms with no digital filtering.
Polled Communication Response	1 ms, maximum
Media Compatibility	Any gas compatible with Iconel 600 Series and 316 SS

Physical Specifications

Dimensions	
Diameter	3.13” outside diameter
Length	3.875” overall not including port tube or DeviceNet connector
Fittings	
Standard	½ inch (12.7 mm) tubulation
Optional	8-VCR® (female), Mini-CF (rotatable), NM-16-KF, Swagelok 8-VCO® (female)
Internal Volume	<7 CC
I/O Connectors	
Analog	9-pin female Type DE-9S Interface
Digital	5-pin male DeviceNet Micro-Style
Weight	1.5 lbs (0.68 kg)
Wetted Materials	Inconel 600 Series (316 SS fittings)

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

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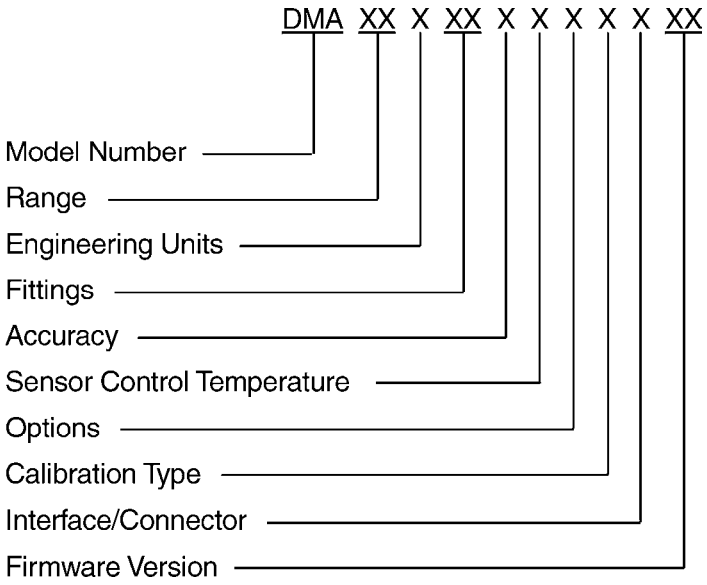
Appendix B: Model Code Explanation

Model Code

The options for your transducer are identified in the model code when you order the unit. The model code for your transducer is:



Model Number (DMA)

This designates the model number of the instrument as DMA.

Range (XX)

The full scale range is indicated by a 2-character code. It is expressed in Torr.

Full Scale Range (mmHg/Torr)	Ordering Code	
0.02	U2	Only available on DMA (45° C) models.
0.05	U5	Only available on DMA (45° and 80° C) models.
0.10	.1	
0.25	RE	
1	01	
2	02	
5	05	
10	11	

(Continued on next page)

Full Scale Range (mmHg/Torr)	Ordering Code
20	21
100	12
200	22
500	52
1000	13

Engineering Units (X)

The engineering units are indicated by a single letter code.

Units	Ordering Code
Torr/mmHg	T
mBar	M
kiloPascal	K
Pascal	L

Fittings (XX)

Several types of fittings are available, designated by a 2-character code. No additional parts are required.

Fittings	Ordering Code
Straight Tube 50 O.D. (1 K mmHg max)	BA
Swagelok 8-VCR (female)	CE
Mini-CF (rotatable)	HA
NW-16-KF (5 K mmHg max)	GA
Swagelok 8-VCO (female)	DA
NW-25-KF (5 K mmHg max)	GC
2¾-CF (rotatable)	HC
Swagelok 4-VCR (female)	CD

Accuracy (X)

The accuracy is specified by a single letter code.

Accuracy	Ordering Code
0.12% of Reading 45° C, 1.0 thru 1000 Torr	C
0.15% of Reading 45° C, 0.05 to 1.0 Torr	D
0.25% of Reading Ambient, 1.0 Torr thru 1000 Torr 45° C, 0.02 Torr 80° C, 1.0 thru 1000 Torr	E
0.50% of Reading Ambient, 0.1 Torr to 1.0 Torr 80° C, 0.05 to 1.0 Torr	F

Sensor Control Temperature

The sensor control temperature is designated by a single letter code.

Sensor Control Temperature	Ordering Code
Ambient	A
45° C	J
80° C	K

Options

The options are designated by a single letter code.

Options	Ordering Code
None	N
Etch Baffle Sensor	E

Calibration Type

The calibration type is designated by a single letter code.

Calibration Type	Ordering Code
No Special Requirement, 1 Torr and Above	N
Horizontal Calibration, <1 Torr	H
Vertical Calibration, <1 Torr	V

Interface/Connector (X)

The interface connector is designated by a single number code.

Interface Connector	**Ordering Code**
DeviceNet/Micro Style, Male (CE)	6

Firmware Version (XX)

The firmware version is designated by a 2-character code.

Firmware Version	**Ordering Code**
Version 3.03	33

* Specify actual version desired or consult Applications Engineering

Appendix C: Command Summary

Attribute Summary

Table 51 lists the attributes for the Object Models in your transducer by Class Code. For more information on each Object Model, refer to *Chapter Four: Operation,* page 45.

Table 51: Attribute Summary

Class Code (hex) Object Model	Instance ID # (hex)	Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Factory Default Setting
01 Identity	01	01	Vendor	UINT	R	R	36
		02	Device Type	UINT	R	R	0
		03	Product Code	UINT	R	R	27
		04	Revision	Struct of: USINT USINT	R	R	current firmware revision
		05	Status	WORD	R	R	0
		06	Serial Number	UDINT	R	R	0
		07	Product Name	SHORT-STRING	R	R	CM
03 DeviceNet	01	01	Node Address	USINT	RW[1]	RW[1]	63
		02	Data Rate	USINT	RW[1]	RW[1]	0 = 125 Kb
		03	Bus-Off Interrupt	BOOL	R	R	0
		05	Allocation Information	Struct of: USINT USINT	R	R	0, 255
04 Assembly	01	03	Trip Point Assembly	ARRAY	R	R	none
	02	03	Poll Request (No Data)	none	R	R	none
	03	03	Poll Response #1	ARRAY	R	R	none
	04	03	Poll Response #2	ARRAY	R	R	none

(Continued on next page)

Table 51: Attribute Summary (continued)

Class Code (hex) Object Model	Instance ID # (hex)	Attribute ID # (dec)	Attribute Name	Default Value	Description	Factory Default Setting
05 Connection	01	1	state	03	Indicates the Explicit Messaging is in the *Established* state.	none
		2	instance_type	00	Indicates this is an Explicit Messaging Connection.	none
		3	transportClass_ trigger	83_{hex}	Server/Transport Class 3	none
		4	produced_ connection_id	—	Refer to the Slave's Explicit Response Message in Table 17, page 48.	none
		5	consumed_ connection_id	—	Refer to the Master's Explicit Request Message in Table 17, page 48.	none
		6	initial_comm_ characteristics	21_{hex}	Indicates that (1) the Slave's Explicit Messaging Connection produces and consumes across Message Group 2, and (2) the Slave's Node Address appears in the CAN Identifier Fields of the Group 2 Messages that the Slave consumes and produces. Refer to Table 17, page 48.	none
		7	produced_ connection_size	$3C_{hex}$	—	none
		8	consumed_ connection_size	$3C_{hex}$	—	none
		9	expected_ packet_rate	$09C4_{hex}$	2500 milliseconds. Refer to [1].	none
		12	watchdog_ timeout_action	1	Auto_Delete as described in [1]. This attribute is settable to Deferred Delete as described in [1].	none

(Continued on next page)

Table 51: Attribute Summary (continued)

Class Code (hex) Object Model	Instance ID # (hex)	Attribute ID # (dec)	Attribute Name	Default Value	Description	Factory Default Setting
05 Connection	01	13	produced_ connection_path_ length	0	Refer to [1].	
		14	produced_ connection_path	Empty	Refer to [1].	
		15	consumed_ connection_path_ length	0	Refer to [1].	
		16	consumed_ connection_path	Empty	Refer to [1].	
		17	production_ inhibit_time	0	Default is no inhibit time.	
** Refer to the ODVA "DeviceNet Specification," Volume II [2], for information on User and Calibration Mode access.*						

(Continued on next page)

Table 51: Attribute Summary (continued)

Class Code (hex) Object Model	Instance ID # (hex)	Attribute ID # (dec)	Attribute Name	Default Value	Description	Factory Default Setting
05 Connection	02	1	state	01	Indicates the Poll Connection Object is in the *Configuring* state.	none
		2	instance_type	01	Indicates this is an I/O Connection.	none
		3	transportClass_ trigger	83_{hex}	Server/Transport Class 3. Implementations can choose Transport Class 3 as the default.	none
		4	produced_ connection_id	—	See the Slave's I/O Poll Response Message in Table 17, page 48.	none
		5	consumed_ connection_id	—	See the Master's I/O Poll Command Message in Table 17, page 48.	none
		6	initial_comm_ characteristics	01	Indicates (1) the Slave's I/O Poll Connection produces across Message Group 1 and consumes across Message Group 2 and (2) the Slave's Node Address appears in the CAN Identifier Field of the Group 2 Message that the Slave consumes. Refer to Table 17, page 48.	none
		7	produced_ connection_size	3*	—	none
		8	consumed_ connection_size	0	—	none
		9	expected_ packet_rate	0	Expected packet rate must be configured.	none
** For INT data assembly.*						

(Continued on next page)

Table 51: Attribute Summary (continued)

Class Code (hex) Object Model	Instance ID # (hex)	Attribute ID # (dec)	Attribute Name	Default Value	Description	Factory Default Setting
05 Connection	02	12	watchdog_ timeout_action	0	Transition to the *Timed Out* state.	none
		13	produced_ connection_path_ length	6	—	none
		14	produced_ connection_path	ARRAY of hex USINTS	Default value is specified by the Poll Response Setup Attribute (ID #6) in the Device Configuration Object (see page 71). See Table 31, page 63.	none
		15	consumed_ connection_path_ length	0	—	none
		16	consumed_ connection_path	Empty	No specified default. An implementation *must* choose an Application Object to reference by default and initialize this attribute accordingly.	none
		17	production_ inhibit_time	0	Default is no inhibit time.	none

** Refer to the ODVA "DeviceNet Specification," Volume II [2], for information on User and Calibration Mode access.*

(Continued on next page)

Table 51: Attribute Summary (continued)

Class Code (hex) Object Model	Attribute ID #		Description	DeviceNet Data Type	Access Rule	Non-Volatile Memory	Factory Default Setting
	(dec)	(hex)					
0x31 S-Analog Sensor	03	0x03	Data Type	USINT	U-Set/Get	Y	0xC3 (INT)
	04	0x04	Data Units	ENGUNITS	U-Set/Get	Y	0x1001 (Counts)
	05	0x05	Reading Valid	BOOL	U-Get	N	none
	06	0x06	Value	INT or REAL	U-Get	N	none
	07	0x07	Status	Byte	U-Get	N	none
	08	0x08	Alarm Enable	BOOL	U-Set	Y	0 (disable)
	09	0x09	Warning Enable	BOOL	U-Set	Y	0 (disable)
	10	0x0A	Full Scale	INT or REAL	U-Get	Y	23405
	14	0x0E	Gain	REAL	U-Set/Get	Y	1.000
	16	0x10	OffsetB Customer Offset	INT or REAL	U-Set/Get	Y	0
	17	0x11	Alarm Trip Point High	INT or REAL	U-Set	Y	50% FS
	18	0x12	Alarm Trip Point Low	INT or REAL	U-Set	Y	50% FS
	19	0x13	Alarm Hysteresis	UINT or REAL	U-Set	Y	0
	20	0x14	Alarm Settling Time	UINT	U-Set	Y	0
	21	0x15	Warning Trip Point High	INT or REAL	U-Set	Y	50% FS
	22	0x16	Warning Trip Point Low	INT or REAL	U-Set	Y	50% FS
	23	0x17	Warning Hysteresis	UINT or REAL	U-Set	Y	0
	24	0x18	Warning Settling Time	UINT	U-Set	Y	0
	31	0x1F	Averaging Time	UINT	U-Set/Get	Y	30
	32	0x20	Overrange	INT or REAL	U-Get	Y	110% FS
	33	0x21	Underrange	INT or REAL	U-Get	Y	-5% FS
	94	0x5E	Sensor Warning	STRUCT of BYTE BYTE	U-Get	N	none
	95	0x5F	Sensor Alarm	STRUCT of BYTE BYTE	U-Get	N	none
	96	0x60	Status Extension	BYTE	U-Get	N	none
	99	0x63	Sub Class	UINT	U-Get	Y	3
	119	0x77	Pressure Fraction in Percentage Full Scale	REAL	U-Get	Y	none

(Continued on next page)

Table 51: Attribute Summary (continued)

Class Code (hex) Object Model	Attribute ID # (dec)	Attribute ID # (hex)	Description*	DeviceNet Data Type	Access Rule	Non-Volatile Memory	Factory Default Setting
S-Device Supervisor	03	0x03	Device Type	SHORT STRING	U-Get	Y	VG
	04	0x04	SEMI Standard Revision Level	SHORT STRING	U-Get	Y	E54-0997
	05	0x05	Manufacturer's Name	SHORT STRING	U-Get	Y	MKS Instruments
	06	0x06	Manufacturer's Model Number	SHORT STRING	U-Get	Y	DMA
	07	0x07	Software Revision Level	SHORT STRING	U-Get	Y	Current firmware revision
	08	0x08	Hardware Revision Level	SHORT STRING	U-Get	Y	A
	09	0x09	Manufacturer's Serial Number Identity Object	SHORT STRING	U-Get	Y	Serial Number
	10	0x0A	Device Configuration	SHORT STRING	U-Get	Y	DMAXXXXXXXXXXX
	11	0x0B	Device Status	USINT	U-Get	Y	none
	12	0x0C	Exception Status	BYTE	U-Get	Y	none
	13	0x0D	Exception Detail Alarm	STRUCT	U-Get	N	none
	14	0x0E	Exception Detail Warning	STRUCT	U-Get	N	none
	15	0x0F	Alarm Enable	BOOL	U-Set/Get	Y	0 (disabled)
	16	0x10	Warning Enable	BOOL	U-Set/Get	Y	0 (disabled)

Attribute ID # (dec)	Description	DeviecNet Data Type	Access Rule	Cal Mode Access	Non-Volatile Memory	Data Variable	Factory Default Setting
19	Last Maintenance Date	DATE*	R	RW	Y	none	0,0,0
20	Next Maintenance Date	DATE*	R	RW	Y	none	0,0,0

(Continued on next page)

Table 51: Attribute Summary (continued)

Class Code (hex) Object Model	Attribute ID # (dec)	Description	DeviecNet Data Type	Access Rule	Cal Mode Access	Non-Volatile Memory	Data Variable	Factory Default Setting
S-Device Supervisor	21	Scheduled Maintenance Expiration Timer	INT	R	RW	Y	-32,767 to +32,767 hours	0
	22	Scheduled Maintenance Expiration Warning Enable	BOOL	RW	RW	Y	0 = Disable 1 = Enable	0
	23	Run Hours	UINT	R	R	Y	0 to 65535	0
	100	Factory Calibration Date	DATE*	R	R	Y	none	0,0,0
0x6D	03	Poll_Auto_ Delete_Enable	BOOL	RW	RW	Y		1 (enabled)

[1] *These attributes can be written only if their corresponding hardware switches, located on top of the device, are in the network (PGM) position. Refer to* Data Rate and Node Address Switches*, page 39, for more information.*

[2] *The DATE format does not conform to the ODVA definition. It is a structure of (1) a year of type UINT, (2) a month of type USINT, and (3) a day of type USINT.*

Supported Service Summary

Table 52 lists the services supported by the Object Models in your transducer by their ID number. It also lists the Object Models that support each service. The service parameters are defined on pages 106 to 110. For more information on each Object Model, refer to *Chapter Four: Operation*, page 45.

Refer to the ODVA "DeviceNet Specification," Volume I [1] for complete descriptions of the common services. Refer to the SEMI Standard Specific Device Models [3, 4, 5] for complete descriptions of all other services.

Table 52: Supported Service Summary

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description	Object Models
05	Reset*	USINT	Request	Places the object into its Initializing state.	Identity Connection Device Manager
06	Recover* (start)	None	Request	Causes the device to transition from the Abort state to the Operating state.	Device Manager
07	Abort* (stop)	None	Request	Places the device in its Abort state.	Device Manager
0E	Get_Attribute_Single*	USINT	Request	Reads the object attribute.	Identity DeviceNet Assembly Connection Analog Input Output Pressure Device Config. Trip Point Device Manager SAC

(Continued on next page)

Table 52: Supported Service Summary (continued)

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description	Object Models
10	Set_Attribute_Single*	USINT, Attribute Data Type	Request	Modifies the object attribute.	Identity DeviceNet Connection Analog Input Output Pressure Device Config. Trip Point Device Manager SAC
15	Restore_Default*	USINT	Request	Restores object attributes to their default values.	Analog Input Output Pressure Device Config. Trip Point SAC
4B	Allocate_Master_Slave	BYTE, USINT	Request	Allocates the Predefined Master/Slave Connection Set.	DeviceNet
4C	Release_Master_Slave	BYTE	Request	Releases the Predefined Master/Slave Connection Set.	DeviceNet
4D	Lock	None	Request	Restricts access to Read-Only attributes. Places the device into the *User Mode*.	Device Manager
4E	Unlock (Password "1234_{hex}" Protected)	UINT	Request	Makes Read-Only attributes modifiable and places the device into *Cal Mode*.	Device Manager

(Continued on next page)

Table 52: Supported Service Summary (continued)

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description	Object Models
05	Reset	USINT	Request	Places the object into its Initializing state.	
0E	Get_Attribute_Single	USINT	Request	Reads the object attribute.	
10	Set_Attribute_Single	USINT, Attribute Data Type	Request	Modifies the object attribute.	
** DeviceNet common services.*					

Reset

The *Reset* service (ID #05) places the object instance into its *Initializing* state. This service is valid for the Identity, Connection, and S-Device Supervisor Objects. The parameter for the Reset service indicates the type of reset. The device supports a parameter value of zero, which causes the device to emulate a power cycle as closely as possible [2].

Recover

The *Recover* service (ID #06)—valid for the S-Device Supervisor Object—moves the object instance from its *Abort* state to its *Recovering* state. There are no parameters specified for this service.

Abort

The *Abort* service (ID #07)—valid for the S-Device Supervisor Object—places the object instance into its *Abort* state. There are no parameters specified for this service.

Get Attribute Single

The *Get_Attribute_Single* service (ID #0E) reads the value of an object instance attribute. This service is valid for every object in your device. Table 53 lists the parameters for this DeviceNet common service.

Table 53: Get Attribute Single Parameters

Parameter	Request	Response	Service Data Type	Description
Attribute ID	Mandatory	Conditional	Network Specific	Attribute Identifier of the attribute whose value is being requested.
Attribute Value	—	Mandatory	Context Specific	Value of the attribute being requested.

Set Attribute Single

The *Set_Attribute_Single* service (ID #10) modifies the value of an object instance attribute. If necessary, the attribute value also is saved to nonvolatile memory. This service is valid for every object in your device, *except* the Assembly Object. Table 54 lists the parameters for this DeviceNet common service.

Table 54: Set Attribute Single Parameters

Parameter	Request	Response	Service Data Type	Description
Attribute ID	Mandatory	Conditional	Network Specific	Attribute Identifier of the attribute whose value is being requested.
Attribute Value	Mandatory	Conditional	Context Specific	Value of the attribute being modified.

Restore Default

The *Restore_Default* service (ID #15) restores attributes in the specified object to their factory default values. This service is valid for the Analog Input, Output Pressure, Device Configuration, Trip Point, and SAC Objects. Table 55 lists the parameters for this DeviceNet common service.

Table 55: Restore Default Service Parameters

Parameter	Request	Response	Service Data Type	Description
Restore Conditions	Mandatory	Conditional	USINT	0 = Restore *specific* attribute of the object. 1 = Restore *all* attributes of the object. 2 = Restore all S, A, and C objects*.
Attribute Value	Conditional	Conditional	Network Specific	Attribute ID of the attribute whose value is being restored.
** The S, A, and C Objects include the Analog Input, Output Pressure, Trip Point, and Device Configuration Objects.*				

Allocate Master/Slave

The *Allocate_Master_Slave* service (ID #4B)—valid only for the DeviceNet Object—supports and allocates the explicit and I/O poll messaging connections of the Predefined Master/Slave Connection Set [1]. Table 56 lists the parameters for this DeviceNet common service. For complete information on this service, refer to the ODVA "DeviceNet Specification," Volume I [1].

Table 56: Allocate Master/Slave Parameters

Parameter	Data Type	Description
Allocation Choice	BYTE	Indicates which connections from the Predefined Master/Slave Connection Set are to be allocated/configured for use by the Master.
Allocator's *Node Address*	USINT	Contains the *Node Address* associated with the module requesting the allocation.

Allocation Choice Parameter

The *Allocation Choice* parameter is specified within a single byte (Table 57). Each bit denotes an explicit and/or I/O poll connection(s) from the Predefined Master/Slave Connection Set that is to be allocated. If the bit is set to one (1), a request is being made to allocate that particular connection. If the bit is set to zero (0), the connection is not allocated.

Table 57: Allocation Choice Byte Contents

7	6	5	4	3	2	1	0
Reserved	Not Supported	Not Supported	Not Supported	Reserved	Not Supported	Polled	Explicit Message

Release Master/Slave

The *Release_Master_Slave* service (ID #4C)—valid only for the DeviceNet Object—releases the Predefined Master/Slave Connection Set within a Slave. There are no parameters specified for this service (Table 58). This service can be transmitted only across the Group 2 Only Unconnected Explicit Request Message Port as well as an Explicit Messaging Connection [1].

Table 58: Release Master/Slave Parameter

Parameter	Data Type	Description
Release Choice	BYTE	Indicates which connections from the Predefined Master/Slave Connection Set are to be released. The process of releasing the connection returns the connection to its initial state, where it can be allocated again.

Release Choice Parameter

The *Release Choice* parameter is specified within a single byte (Table 59). Each bit denotes an explicit and/or I/O poll connection(s) from the Predefined Master/Slave Connection Set that is to be released. If the bit is set to one (1), a request is being made to release that particular connection. If the bit is set to zero (0), the connection is not released.

Table 59: Release Choice Byte Contents

7	6	5	4	3	2	1	0
Reserved	0	Not Supported	Not Supported	Reserved	Not Supported	Polled	Explicit Message

Lock

The *Lock* service(ID #4D)—valid only for the S-Device Supervisor Object—places the device into the User Mode, which restricts access to all of the read-only attributes *in all of the objects*. This service guarantees the read-only attributes cannot be modified over the network. There are no parameters specified for this service.

Unlock

The password protected *Unlock* service (ID #4E)—valid only for the S-Device Supervisor Object—places the device into the Calibration Mode, which enables you to modify certain *read-only* attributes of the device. Table 60 lists the parameters for this service.

Table 60: Unlock Service Parameters

Parameter	Request	Response	Service Data Type	Description
Password Key	Mandatory	Mandatory	UINT	1243_{hex} = Calibration Mode

Perform Fine Zero Offset (0x4B)

The *Perform_Fine_Zero* service (ID #0x4B)—valid only for the S-Analog Sensor Object—remotely zeros the device. Specifically, this service instructs the S-Analog Sensor Object to modify the Zero Offset attribute (Attribute ID #06) so the current pressure reading in the Corrected Pressure Value attribute (Attribute ID #06) is 0.0. There are no additional parameters required for this service, although service data may be included if the target pressure is non-zero.

Table 61: Perform Fine Zero Offset Parameters

Parameter	Request	Response	Service Data Type	Description
Target Pressure	Mandatory	Mandatory	INT or REAL	Target pressure for offset (zero) adjustment, usually zero.

The three possible ways to issue the Fine_Zero_Offset service request are shown below.

Table 62: Ways to Issue the Fine_Zero_Offset Service Request

Service Code	Class	Instance	Service Data
0x4B	0x31	0x01	None, a target of zero will be assumed.
0x4B	0x31	0x01	00 00 – the target pressure represented as an INT
0x4B	0x31	0x01	00 00 00 00 - the target pressure represented as a REAL

This service is valid only when the Raw Pressure Value is within ±2% of the full scale range of the device. Refer to *S-Analog Sensor Object*, page 65, for more information.

Perform Coarse Zero Offset (0x32)

The *Perform_Coarse_Zero* service (ID #0x32)—valid only for the S-Analog Sensor Object—remotely zeros the device. Specifically, this service instructs the S-Analog Sensor Object to modify the Zero Offset attribute (Attribute ID #06) so the current pressure reading in the Corrected Pressure Value attribute (Attribute ID #06) is 0.0. There are no additional parameters for this service. (A target pressure of zero is always assumed.)

The method to issue the Coarse_Zero_Offset service request is shown below.

Table 63: Method to Issue the Coarse_Zero_Offset Service Request

Service Code	Class	Instance	Service Data
0x32	0x31	0x01	None, a target of zero will be assumed.

This service is valid only when the Raw Pressure Value is within –4 to +20% of the full scale range of the device. Refer to *S-Analog Sensor Object*, page 65, for more information.

Appendix D: Example Messages

General Information

The DeviceNet messaging protocol is based on hexadecimal (base 16) math, rather than decimal (base 10) math. The examples in this appendix, designed to illustrate how DeviceNet messages are generated and interpreted, assume a basic understanding of hexadecimal math.

In the actual application of DeviceNet communications, the messaging process is typically automated using an interface software program; therefore, manual calculation or interpretation of the messages is not required. Typical interface programs require only the input of specific class codes, instance IDs, attribute IDs, and any required data variable(s).

Explicit Messaging

Explicit messaging connections utilize a direct request/response format that enables you to access any attribute data. Explicit messaging typically is used for the setup, configuration, and calibration of your device. Refer to *Explicit Messaging Connections*, page 46, for more information.

Three examples of explicit messages are described on pages 112 to 117. These messages illustrate how to request information on the Vendor ID and interpret the network's response. The following information applies for each example:

- The examples depict *explicit* messaging.
- The examples are all nonfragmented message strings.
- The node address of the MKS device (the Slave) is 05.
- The node address of the master device is 01.
- Spaces are shown for clarity only. Do not enter spaces in the actual message string.

Example 1: Sending an Explicit Request Message

To query the Vendor ID for your transducer, enter the command:

42C 01 0E 01 01 01

where:

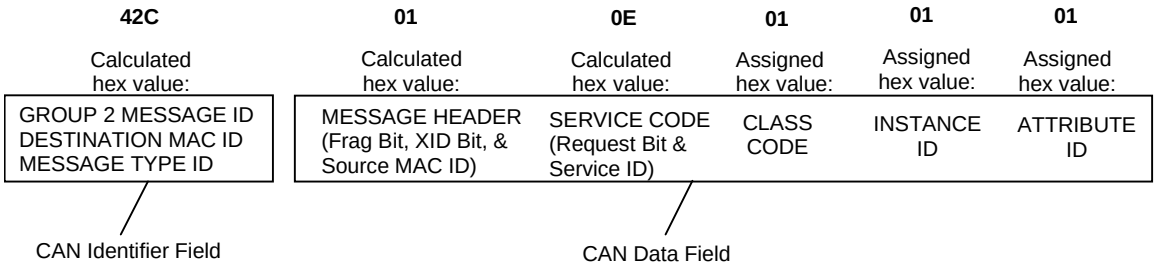


Figure 10: Explicit Request Message

To calculate the request message components shown in Figure 10:

1. Calculate the hexadecimal value of the CAN Identifier Field.

   Refer to Figure 11, step 1, page 113. This 11-bit field represents the fixed Group 2 Message ID (bits 10 and 9), the *destination* node address (the MKS device) as a hexadecimal number (bits 8 to 3), and the fixed Message Type ID for an explicit request (bits 2 to 0). The hexadecimal value of the CAN Identifier Field components is $42C_{hex}$.

2. Calculate the hexadecimal value of the message header in the CAN Data Field.

   Refer to Figure 11, step 2, page 113. This 8-bit field represents the fragment bit (bit 7, set to 0), the XID bit (bit 6, set to 0), and the *source* node address (the Master device) as a hexadecimal number (bits 5 to 0). The hexadecimal value of the Message Header is 01_{hex}.

3. Calculate the hexadecimal value of the Service Code in the message body of the CAN Data Field.

   Refer to Figure 11, step 3, page 113. This 8-bit field represents the request bit (bit 7, set to 0) and the assigned Service ID (bits 6 to 0) as a hexadecimal number. The assigned hex value for the Get_Attribute_Single service is $0E_{hex}$. The hexadecimal value of the Service Code is $0E_{hex}$.

4. Confirm the assigned Class Code, Instance ID, and Attribute ID for the desired parameter.

   Refer to Figure 11, step 4, page 113. The requested Vendor ID information is part of the Identity Object (Class Code 01_{hex}). Its Instance ID is 01_{hex} and its Attribute ID is 01_{hex}.

   Tables listing the Class Codes, Instance IDs , and Attribute IDs for each parameter are provided throughout this document. This information in summarized for easy reference in Table 51, page 95.

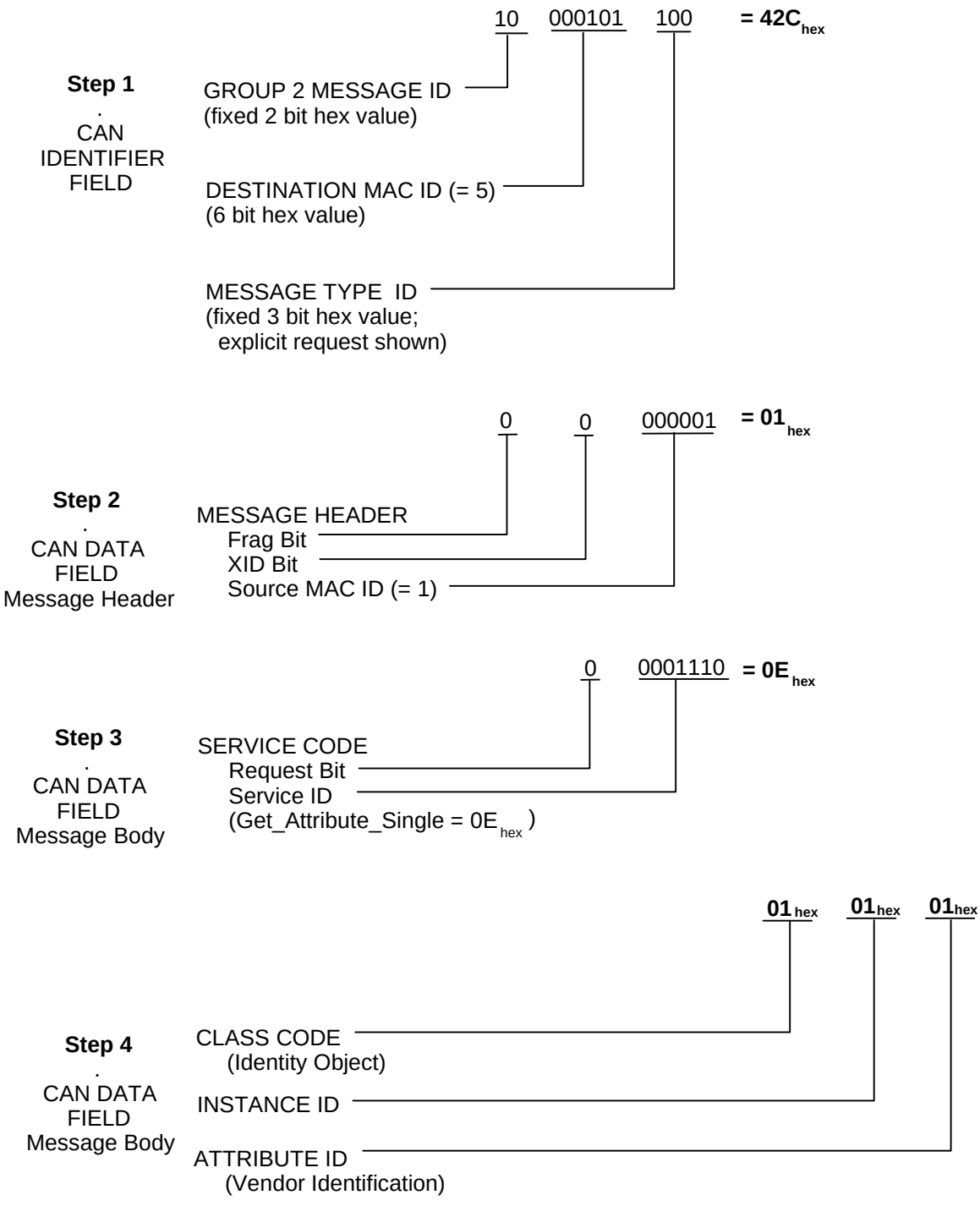


Figure 11: Explicit Request Message Components

Example 2: Interpreting a Successful Explicit Message Response

If the request message sent in *Example 1*, page 112, is properly sent and received, the device returns the following response message:

42B 01 8E 36 00

where:

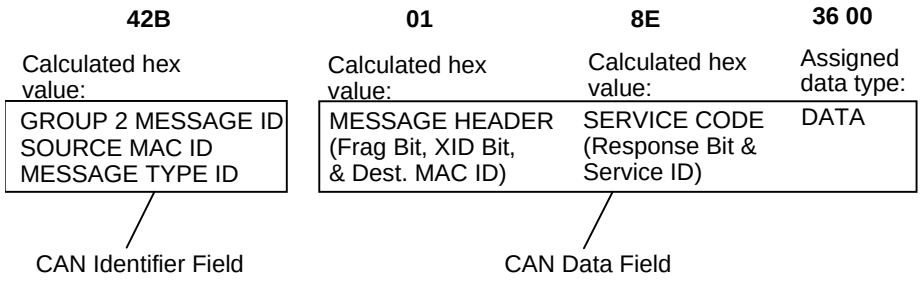


Figure 12: Successful Explicit Message Response

To interpret the response message components shown in Figure 12:

1. Interpret the reported hexadecimal value ($42B_{hex}$) of the CAN Identifier Field components.

   Refer to Figure 13, step 1, page 115. This 11-bit field represents the fixed Group 2 Message ID (bits 10 & 9), the *source Node Address* (the MKS device) as a hexadecimal number (bits 8 to 3), and the fixed Message Type ID for an explicit response (bits 2 to 0).

2. Interpret the reported hexadecimal value (01_{hex}) of the message header in the CAN Data Field.

   Refer to Figure 13, step 2, page 115. This 8-bit field represents the fragment bit (bit 7, set to 0), the XID bit (bit 6, set to 0), and the *destination Node Address* (the Master device) as a hexadecimal number (bits 5 to 0).

3. Interpret the reported hexadecimal value ($8E_{hex}$) of the Service Code in the message body of the CAN Data Field.

   Refer to Figure 13, step 3, page 115. This 8-bit field represents the response bit (bit 7, set to 1), and the assigned Service ID (bits 6 to 0) as a hexadecimal number. The assigned hex value for the Get_Attribute_Single service is $0E_{hex}$; the response to this service is always $8E_{hex}$.

Note The Class Code, Instance ID, and Attribute ID are not returned in a response message.

4. Interpret the reported data response (36 00).

   Refer to Figure 13, step 4, page 115. The assigned data type for the Vendor ID is an unsigned 16-bit integer value (Table 20, page 53). The assigned Vendor ID for all MKS devices is 36.

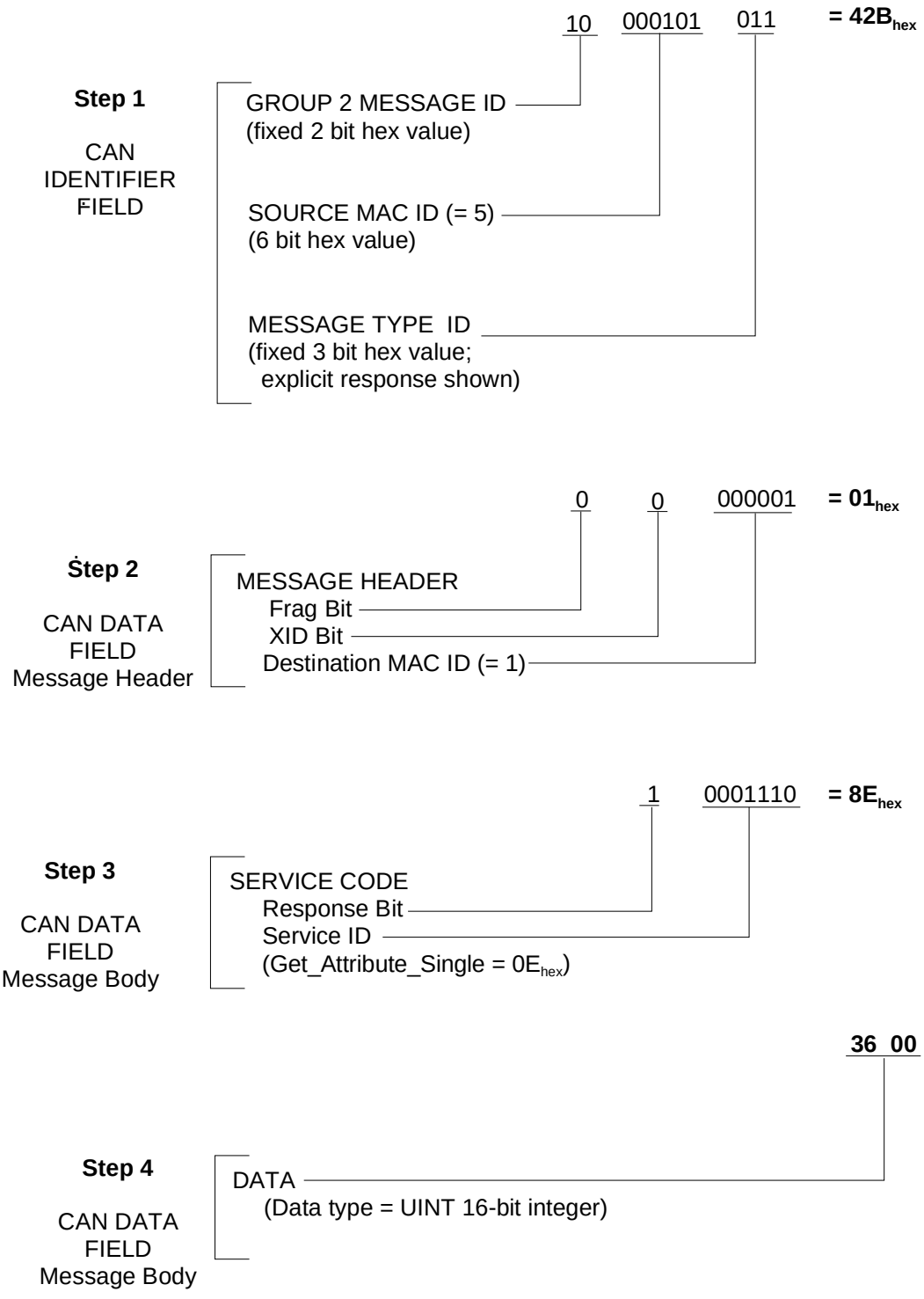


Figure 13: Successful Explicit Message Response Components

Example 3: Interpreting an Explicit Message Error Response

If the request message sent in *Example 1*, page 112, is not sent or received properly, the device returns an error response message. An example of an error response is:

42B 01 94 08 FF

where:

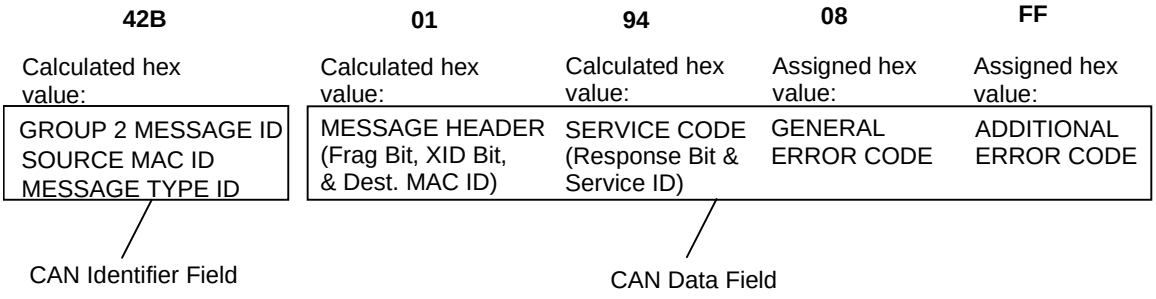


Figure 14: Explicit Message Error Response

To interpret the error response message components shown in Figure 14:

1. Interpret the reported hexadecimal value ($42B_{hex}$) for the CAN Identifier Field.

   Refer to Figure 15, step 1, page 117. This 11-bit field represents the fixed Group 2 Message ID (bits 10 and 9), the *source* node address (the MKS device) as a hexadecimal number (bits 8 to 3), and the fixed Message Type ID for an explicit response (bits 2 to 0).

2. Interpret the reported hexadecimal value (01_{hex}) for the message header in the CAN Data Field.

   Refer to Figure 15, step 2, page 117. This 8-bit field represents the fragment bit (bit 7, set to 0), the XID bit (bit 6, set to 0), and the *destination* node address (the Master device) as a hexadecimal number (bits 5 to 0).

3. Interpret the reported hexadecimal value (94_{hex}) for the CAN Data Field service code.

   Refer to Figure 15, step 3, page 117. This 8-bit field represents the response bit (bit 7, set to 1) and the assigned Service ID (bits 6 to 0) as a hexadecimal number. The Service ID for an error response is *always* 14_{hex}.

Note The Class Code, Instance ID, and Attribute ID are not returned in a response message.

4. Interpret the reported error codes (08 FF).

   Refer to Figure 15, step 4, page 117. The first 8-bit value reports the General Error Code, assigned by ODVA, which reports the type of error. (Refer to [1] for a complete listing.) The second 8-bit value reports an additional, Object Class specific error message, particular to your MKS transducer. If an additional error code is not applicable, an “FF” is returned.

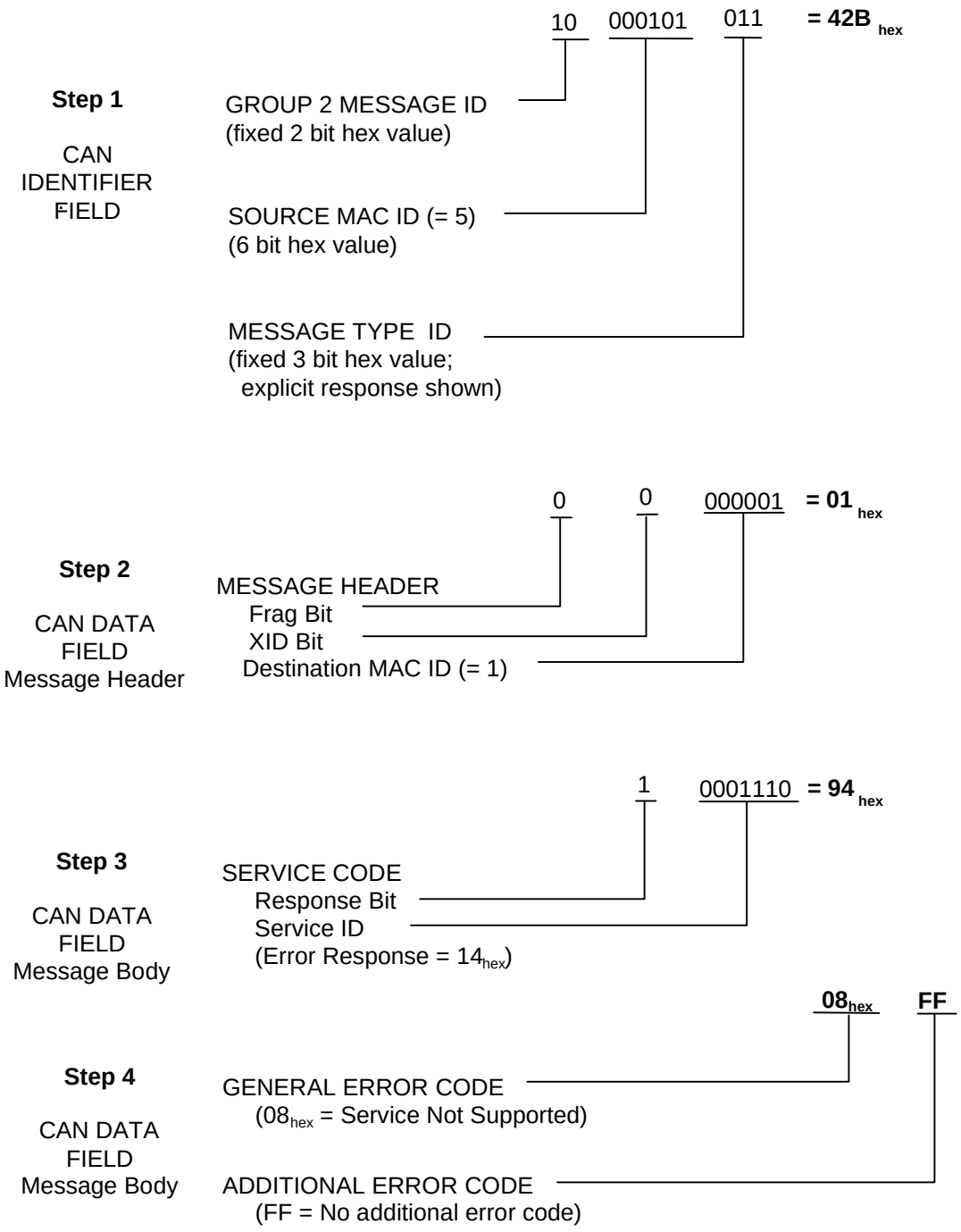


Figure 15: Explicit Message Error Response Components

I/O Poll Messaging

I/O poll messaging connections utilize an assembly format to group and report data from multiple objects using a single communications commands. These connections typically are used for quick reporting of information (run-time). Although I/O poll messaging connections typically report data faster than explicit messaging connections, they limit your access to the set of attributes (the exception status and the pressure value) listed in Tables 32 and 33, page 64. The data in I/O poll messaging connections is defined by the Predefined Master/Slave Connection Set [1] and cannot be altered. Refer to *I/O Poll Messaging Connections*, page 46, for more information.

One example of I/O poll messaging is described on pages 118 to 120. This message describes how to request the poll response for your transducer and interpret the network's response. The following information applies for the example:

- The example depicts *I/O poll* messaging.
- The example is a nonfragmented message string.
- The node address of the MKS device (the Slave) is 05.
- The node address of the master device is 01.
- Spaces are shown for clarity only. Do not enter spaces in the actual message string.

Example 1: Sending an I/O Poll Request Message

To send a I/O poll request message, enter the command:

42D

where:

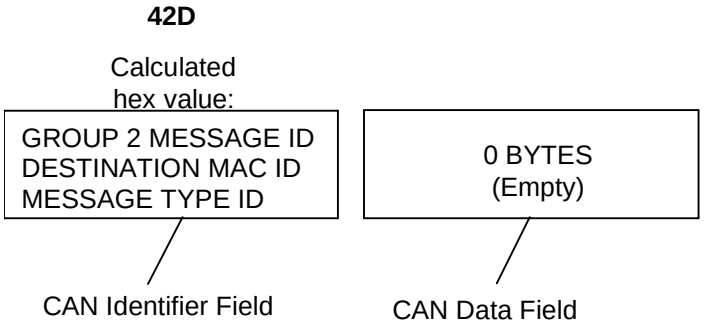


Figure 16: I/O Poll Request Message

To calculate the request message components shown in Figure 16:

1. Calculate the hexadecimal value of the CAN Identifier Field.

   Refer to Figure 17. This 11-bit field represents the fixed Group 2 Message ID (bits 10 and 9), the *destination* node address (the MKS device) as a hexadecimal number (bits 8 to 3), and the fixed Message Type ID for an I/O request (bits 2 to 0). The hexadecimal value of the CAN Identifier Field components is $42D_{hex}$.

I/O poll *request* messages consist of a single segment: the *CAN Identifier Field* which defines the type of connection. When your device receives an I/O poll request, it automatically knows what information is being requested, based on the Predefined Master/Slave Connection Set. Additional descriptive information is not required.

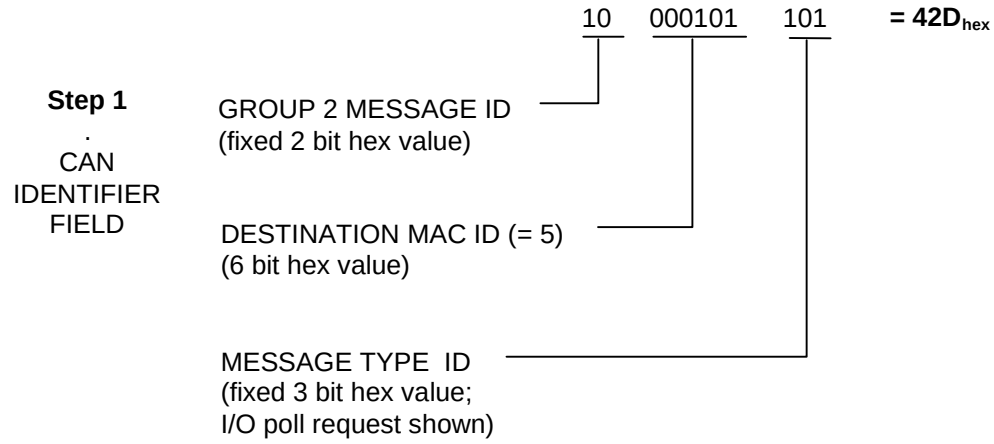


Figure 17: I/O Poll Request Message Components

Example 2: Interpreting an I/O Poll Response Message

If the request message sent in *Example 1*, page 118, is properly sent and received, the device returns the following response message:

42B 80 FF 3F

where:

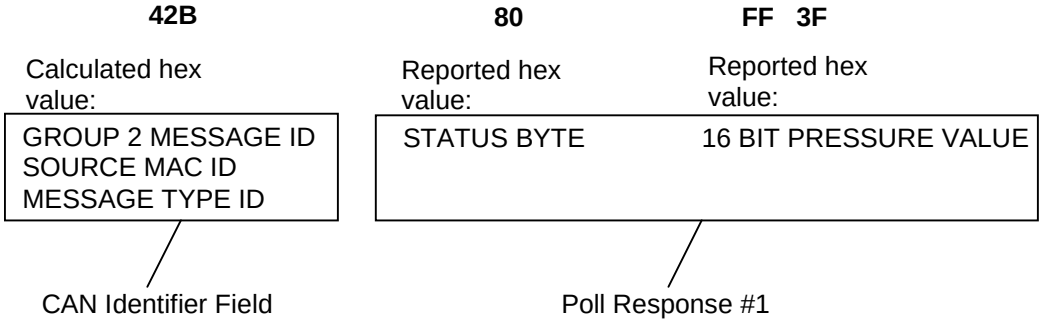


Figure 18: Successful I/O Poll Response Message

To interpret the response message components shown in Figure 18:

1. Interpret the reported hexadecimal value (42B$_{hex}$) of the CAN Identifier Field components.

   Refer to Figure 19, step 1, page 120. This 11-bit field represents the fixed Group 2 Message ID (bits 10 & 9), the *source* node address (the MKS device) as a hexadecimal number (bits 8 to 3), and the fixed Message Type ID for an explicit response (bits 2 to 0).

2. Interpret the reported value of poll response #1.

   Refer to Figure 19, step 2, page 120. The reported value for the Status Byte (80_{hex}) indicates that no exceptions are set. The Status Byte Bit map is shown in Table 44, page 75. The reported value for the 16-bit pressure value (FF 3F) indicates that the pressure is measured at 50% FS.

Note The poll response that is returned is defined in the Device Configuration Object (see page 71).

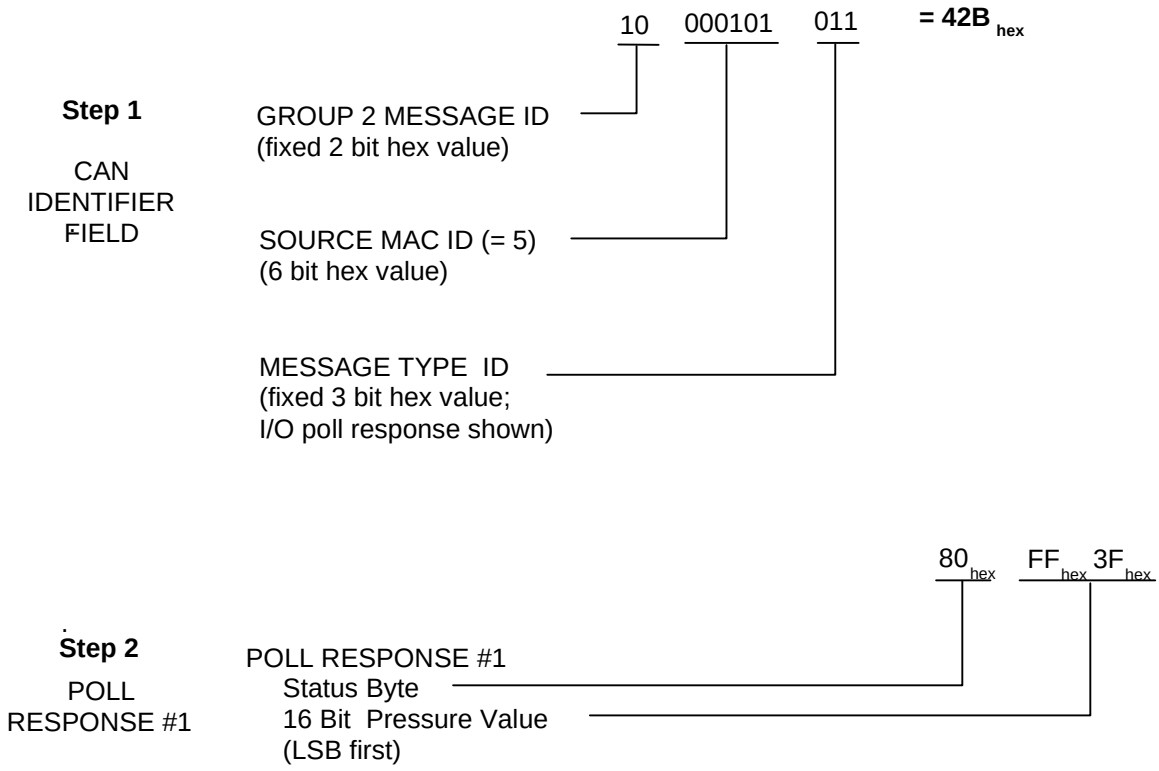


Figure 19: Successful I/O Poll Response Message Components

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