MKS Type T3B and T3P Valves With DeviceNet™ Interface

Supplement

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138993-P1
DeviceNet Interface
Rev G

WARRANTY

Type T3BIA/T3PIA and T3BIB/T3PIB Valves with DeviceNet Interface

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

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

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

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

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

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

MKS Type T3B and T3P Valves With DeviceNet™ Interface Supplement

Printed in the United States of America

Firmware version: 01.05

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Valve Safety Information

Symbols Used in This Instruction Manual

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

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

Symbols Found on the Unit

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

Table 1: Definition of Symbols Found on the Unit

On (Supply) IEC 417, No. 5007	 Off (Supply) IEC 417, No. 5008	 Earth (ground) IEC 417, No. 5017	 Protective Earth (ground) IEC 417, No. 5019
 Frame or Chassis IEC 417, No. 5020	 Equipotentiality IEC 417, No. 5021	 Direct Current IEC 417, No. 5031	 Alternating Current IEC 417, No. 5032
 Both Direct and Alternating Current IEC 417, No. 5033-a	 Class II Equipment IEC 417, No. 5172-a	 Three Phase Alternating Current IEC 617-2, No. 020206	 Caution, Hand Crush ISO 3864
 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	 Caution, Spring Loaded ISO 3864

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.

Warning **Moving parts in the valve create a risk of personal injury until the valve is securely incorporated into a system. To avoid injury, keep all body parts away from any valve opening.**

1. **Do not insert objects into openings where contact with moving parts is possible.**
2. **Isolate the valve from any electrical or pneumatic power supply before handling the valve.**

DO NOT SUBSTITUTE PARTS OR MODIFY VALVE

Do not install substitute parts or perform any unauthorized modification to the valve. Return the valve 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. Qualified service personnel must perform any service only.

USE CAUTION WHEN OPERATING WITH HAZARDOUS MATERIALS

If hazardous materials are used, observe the proper safety precautions, completely purge the valve when necessary, and ensure that the material used is compatible with the wetted materials in this product, including any sealing materials.

PURGE THE VALVE

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 valve 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 valve fittings must be consistent with valve specifications and compatible with the intended use of the valve. 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 the valve 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.

KEEP AWAY FROM VALVE OPENING

Keep fingers, other body parts, and other materials away from the valve opening when the valve is in operation.

Sicherheitshinweise für das Ventil

In dieser Betriebsanleitung vorkommende Symbole

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

Warnung!	**Das Symbol WARNUNG! weist auf eine Gefahr für das Bedienpersonal hin. Es macht auf einen Arbeitsablauf, eine Arbeitsweise, einen Zustand oder eine sonstige Gegebenheit aufmerksam, deren unsachgemäße Ausführung bzw. ungenügende Berücksichtigung zu Verletzungen führen kann.**
Vorsicht!	**Das Symbol VORSICHT! weist auf eine Gefahr für das Gerät hin. Es macht auf einen Bedienungsablauf, eine Arbeitsweise oder eine sonstige Gegebenheit aufmerksam, deren unsachgemäße Ausführung bzw. ungenügende Berücksichtigung zu einer Beschädigung oder Zerstörung des Gerätes oder von Teilen des Gerätes führen kann.**
Hinweis	Das Symbol HINWEIS macht auf wichtige Informationen bezüglich eines Arbeitsablaufs, einer Arbeitsweise, eines Zustands oder einer sonstige Gegebenheit aufmerksam.

Erklärung der am Gerät angebrachten Symbole

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

Tabelle 2: Bedeutung der am Gerät angebrachten Symbole

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

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.

Warnung **Solange das Ventil nicht fest in ein System eingebaut ist, besteht Verletzungsgefahr aufgrund von beweglichen Teilen. Daher Finger und andere Körperteile unbedingt von allen Ventilöffnungen fernhalten.**

1. **Niemals Fremdkörper in Öffnungen einführen, in denen ein Kontakt mit beweglichen Teilen möglich ist.**
2. **Das Ventil vor dem Hantieren stets von allen elektrischen und pneumatischen Kraftquellen trennen.**

Niemals Teile austauschen oder Änderungen am Ventil vornehmen!
Ersetzen Sie keine Teile mit baugleichen oder ähnlichen Teilen, und nehmen Sie keine eigenmächtigen Änderungen am Ventil vor. Schicken Sie das Ventil 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 Ventil, falls erforderlich, vollständig spülen, sowie sicherstellen, daß der Gefahrstoff die von ihm benetzten, im Ventil verwendeten Materialien, insbesondere Dichtungen, nicht angreift.

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

Anweisungen zum Spülen des Ventils!
Das Ventil darf nur unter einer Ablufthaube gespült werden. Schutzhandschuhe sind zu tragen.

Nicht zusammmen mit explosiven Stoffen, Gasen oder Dämpfen benutzen!
Um der Gefahr einer Explosion vorzubeugen, darf dieses Produkt niemals zusammen mit explosiven Stoffe aller Art eingesetzt werden, sofern es nicht ausdrücklich für diesen Zweck zugelassen ist.

Anweisungen zum Installieren der Armaturen!
Alle Ventilanschlußstücke und Armaturenteile müssen mit den Ventilspezifikationen übereinstimmen, und mit dem geplanten Einsatz des Ventils kompatibel sein. Der Einbau, insbesondere das Anziehen und Abdichten, muß gemäß den Anweisungen des Herstellers vorgenommen werden.

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

Nur unter zulässigen Anschlußdrücken betreiben!
Betreiben Sie das Ventil 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 vermeiden!
Stellen Sie sicher, daß Verunreinigungen jeglicher Art weder vor dem Einsatz noch während des Betriebs in das Innere gelangen können. Staub- und Schmutzpartikel, Glassplitter oder Metallspäne können das Produkt dauerhaft beschädigen oder Prozeß und Meßwerte verfälschen.

Hände weg von der Ventilöffnung!
Körperteile, insbesondere Finger, sowie Fremdobjekte während des Betriebes von der Ventilöffnung fernhalten.

Informations de sécurité relatives au manomètre

Symboles utilisés dans ce manuel d'utilisation

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

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

Symboles figurant sur l'unité

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

Tableau 3: Définition des symboles sur l'unité

Marche (sous tension) IEC 417, No.5007	Arrêt (hors tension) IEC 417, No.5008	Terre (masse) IEC 417, No.5017	Terre de protection (masse) IEC 417, No.5019
Masse IEC 417, No.5020	Equipotentialité IEC 417, No.5021	Courant continu IEC 417, No.5031	Courant alternatif IEC 417, No.5032
Courant continu et alternatif IEC 417, No.5033-a	Matériel de classe II IEC 417, No.5172-a	3~ Courant alternatif triphasé IEC 617-2, No.020206	Attention : Danger d'écrasement de la main ISO 3864
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	Attention : Ce dispositif est à ressort ISO 3864

Mesures de sécurité et précautions

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

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

Avertissement **Les pièces mobiles de la valve peuvent être une cause d'accident tant que la valve n'est pas solidement incorporée dans un système. Pour éviter tout accident, tenir toute partie du corps à distance de toute ouverture de la valve.**

1. **Ne pas insérer des objets dans les ouvertures où le contact avec des pièces mobiles est possible.**
2. **Isoler la valve de toute source d'alimentation électrique ou pneumatique pendant la manipulation de la valve.**

PAS DE SUBSTITUTION DE PIÈCES OU DE MODIFICATION DE LA VALVE

Ne pas installer des pièces de substitution ou effectuer des modifications non autorisées sur la valve. Renvoyer la valve 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, prendre les mesures de précaution appropriées, purger complètement la valve quand cela est nécessaire, et s'assurer que les produits utilisés sont compatibles avec les composants liquides de l'appareil, y compris les matériaux d'étanchéité.

PURGE DE LA VALVE

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

Cette valve doit être purgée 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 la valve doivent être cohérents avec ses spécifications, et compatibles avec l'utilisation prévue de la valve. 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 la valve avec 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.

PRÉCAUTION AVEC L'OUVERTURE DE LA VALVE

Éviter tout contact des mains, toute autre partie du corps, ou tout autre matériel avec l'ouverture de la valve quand celle-ci est en fonctionnement.

Medidas de seguridad del manómetro

Símbolos usados en este manual de instrucciones

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

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

Símbolos hallados en la unidad

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

Tabla 4: Definición de los símbolos hallados en la unidad

Encendido (alimentación eléctrica) IEC 417, N° 5007	 Apagado (alimentación eléctrica) IEC 417, N° 5008	 Puesta a tierra IEC 417, N° 5017	 Protección a tierra IEC 417, N° 5019
 Caja o chasis IEC 417, N° 5020	 Equipotencialidad IEC 417, N° 5021	 Corriente continua IEC 417, N° 5031	 Corriente alterna IEC 417, N° 5032
 Corriente continua y alterna IEC 417, N° 5033-a	 Equipo de clase II IEC 417, N° 5172-a	 Corriente alterna trifásica IEC 617-2, N° 020206	 Precaución. Peligro de aplastamiento de la mano ISO 3864
 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	 Precaución. Dispositivo a presión ISO 3864

Procedimientos y precauciones de seguridad

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

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

Advertencia **Hasta que la válvula sea incorporada en forma segura al sistema, las piezas en movimiento presentes en la misma pueden causar daños personales. Para evitarlo, mantenga todo el cuerpo alejado de la abertura de válvula.**

1. **No introduzca por las aberturas objetos que puedan entrar en contacto con piezas en movimiento.**
2. **Antes de tocar la válvula, aíslela de toda fuente de alimentación neumática o eléctrica.**

NO UTILICE PIEZAS NO ORIGINALES O MODIFIQUE LA VÁLVULA

No instale piezas que no sean originales o modifique la válvula sin autorización. Para asegurar el correcto funcionamiento de todos los dispositivos de seguridad, envíe la válvula al Centro de servicio y calibración de MKS toda vez que sea necesario efectuar reparaciones o 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. 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, los operarios deberán cumplir las medidas de seguridad correspondientes, purgar totalmente la válvula cuando sea necesario y comprobar que el material utilizado sea compatible con los materiales humedecidos del instrumento e inclusive, con los materiales de sellado.

PURGUE LA VÁLVULA

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

La válvula debe purgarse debajo de una campana de ventilación y deben utilizarse guantes protectores.

NO HAGA FUNCIONAR LA VÁLVULA EN UN AMBIENTE CON RIESGO DE EXPLOSIONES

Para evitar que se produzcan explosiones, no haga funcionar este producto 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 de la válvula deben cumplir las especificaciones de la misma y ser compatibles con el uso que se debe dar a la válvula. 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 LA VÁLVULA CON PRESIONES DE ENTRADA SEGURAS

No haga funcionar nunca la válvula 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.

MANTÉNGASE ALEJADO DE LA ABERTURA DE LA VÁLVULA

Cuando la válvula esté funcionando, mantenga los dedos, otras partes del cuerpo y otros materiales alejados de la abertura.

Chapter One: General Operation

Introduction

The MKS Type T3B or T3P Throttle Valve with a DeviceNet™ Digital Interface, is designed for use in downstream pressure control applications.

The operation of the controller is based on a digital pressure/position control algorithm that directs the valve to the proper position for either pressure or position control. The pressure or position set point may be sent as a digital DeviceNet command. The T3B or T3P unit reads the pressure signal used for control applications directly from an MKS Baratron pressure transducer. All of the unit's operational settings are controlled using the DeviceNet communication protocol.

Note

When operating the T3B or T3P unit digitally, use this manual in conjunction with the ODVA DeviceNet Specification, Volume I and Volume II [1, 2], and the SEMI® Standards Common Device Model [3]. A complete listing of the documents that are referenced throughout this manual are listed in Table 6, page 11. Refer to these documents to obtain a complete functional description of your instrument.

The controller specifications comply with the definition of an interoperable device on a semiconductor equipment sensor/actuator network proposed by SEMI.

Definitions

Table 5: Definitions

Term	Description
Attribute	A characteristic or feature of an object
Attribute ID	An integer identification value assigned by ODVA to an attribute
ARRAY	A listing or grouping of elements of the same data type
BOOL (Boolean)	Data type; can take either a 0 or 1 value
BYTE	Data type; 8 bit string
CAN	Control Area Network: specification of physical layer signaling and media access control in DeviceNet
Class Code	An integer identification value assigned by ODVA to each object; specified as an 8-bit integer
Data Type	The kind of data value used to represent an attribute or service; all data types are defined in [1]
Full Scale (FS) Range	The defined 100% value of an attribute, in its assigned units
INT	Data type; signed 16 bit integer value between -32,768 and +32,767
Instance	Defines a particular example within an object; each instance within an object generally has the same set of attributes, but has its own set of attribute values
Instance ID	An integer identification value assigned by ODVA to an instance; this integer is unique within the object and MAC ID in which it resides

(continued on the next page)

Table 5: Definitions (continued)

Term	Description
LPF	Low pass filter
LSB	Least significant bit
MAC ID	Node address; an integer identification value assigned to each node on the DeviceNet network
MSB	Most significant bit
Network Access	Defines how an attribute can be accessed over the network: R = Read Only; RW = Read/Write
Object	A representation of a particular component within a product
ODVA	Open DeviceNet Vendors Association
R	Read only; defines how an attribute can be accessed over the network
REAL	Data type; 32-bit floating point value, conforming to IEEE 754 basic single floating point format
RW	Read/Write; defines how an attribute can be accessed over the network
Sccm	Standard cubic centimeters
Service	A function supported by an object A *common* service can be sent to either a single instance or to an entire object; each has a fixed set of parameters, which are defined in [1]. A *class* service can only be sent to an entire object (class); it cannot be sent to a single instance.
Service Data	Carries “request specific” data; specific information required for a request, or reported in a response, in a format assigned by ODVA
Service ID	An integer identification value assigned by ODVA to a particular object function
Service Type	R = Request; N = Notification; M = Mandatory
Set Point	The flow value to which the device is controlling the flow of gas
SINT	Data type; signed 8-bit integer value
SHORT-STRING	Data type; ASCII character string with 1 byte per character. A 1 byte length precedes the string.
Slm	Standard liters per minute
STRUCT	Data type; contains more than one attribute type
Trip Point	An alarm or warning level
UINT	Data type; unsigned 16-bit integer value between 0 and 65,535
UDINT	Data type; unsigned (double) 32-bit integer value
ULINT	Data type; unsigned (long) 64-bit integer value
USINT	Data type; unsigned 8-bit integer value between 0 and 255
WORD	Data type; 16-bit string

References

The documents listed in Table 6, are 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, errata 5.
[2]	"DeviceNet Specification, Volume II: DeviceNet Profiles and Object Library", Open DeviceNet Vendors Association, Inc. Release 2.0, errata 5.
[3]	"Sensor/Actuator Network Common Device Model", SEMI Standards Document E54-0997.

How This Manual is Organized

This manual is designed to provide instructions on how to program a Type T3B or T3P unit.

Before installing your Type T3B or T3P 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 the organization of the manual.

Chapter Two, *Operation,* describes the protocol, objects, attributes, and services required to operate your throttle valve controller with DeviceNet digital communications.

Appendix A, *Quick Reference Guide*, lists and references the sections in this document which describe how to set or report the system status, set points, pressure, and valve position, and how to re-tune the controller.

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

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

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Chapter Two: Operation

General Information

Note Use this supplement in conjunction with the ODVA DeviceNet Specification, Volume I and Volume II [1, 2]; and the SEMI Standards Common and Specific Device Model [3] to obtain a complete functional description of your device. Refer to Table 6, page 11, for a list of the documents that are referenced throughout this supplement.

This chapter defines the application specific objects included in your throttle valve controller, as well as the mapping of system requirements to specific objects and attributes in the DeviceNet protocol.

There are seventeen (17) objects in your throttle valve controller. Tables defining the attributes and supported services for each object are provided throughout this document. A summary of the attributes is listed in Table 90, page 99; a summary of the supported services is listed in Table 91, page 107.

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

Operating Modes

The T3B or T3P unit has two user-accessible operating modes: User mode and Calibration mode. The User mode is the normal, default power up mode. The Calibration mode is used to access certain calibration and operating parameters.

Your device operates the same in each mode. However, your access to certain attributes over the network may be restricted, depending on which mode is active. Access rights to the specific attributes are defined in the various object attribute tables throughout this manual.

DeviceNet Messaging Protocol

The T3B or T3P throttle valve 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 C: Example Messages.*

Note The DeviceNet messaging protocol is based on hexadecimal (base 16) math, rather than decimal (base 10) math. The descriptions in this chapter and the examples in *Appendix C: Example Messages* 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 and interpretation of the messages is not required. Typical interface programs require only the input of specific class codes, instance IDs, attribute IDs, data types, 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 which allow you to access any attribute data. Explicit messaging is typically used for the setup, configuration, and calibration of your device.

Explicit messages—both requests and responses—consist of two segments: a *CAN Identifier Field*, which defines the type of connection, and a *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 are typically 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 poll request or poll response attributes listed in Table 23, page 32. The data format in I/O poll messaging connections is predefined and cannot be altered.

I/O poll *request* messages consist of two segments: the *CAN Identifier Field*, which defines the type of connection and the *Poll Request Assembly*. There are several types of poll requests, each requesting a different set of data. The poll request that is sent is defined in the Device Configuration Object (refer to *Poll Request Setup*, page 95).

I/O poll *response* messages consist of two segments: the *CAN Identifier Field* which defines the type of connection, and the *Poll Response Assembly* which reports a fixed set of attribute data. There are several types of poll responses, each reporting a different set of data. The poll response that is returned is defined in the Device Configuration Object (refer to *Poll Response Setup*, page 96).

The actual data for the poll requests and responses are stored in the Assembly Object (refer to *Assembly Object*, page 32).

CAN Identifier Field

The CAN Identifier Field is a single 11 bit field which defines the components of a DeviceNet connection (refer to Table 7, page 15); 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)
- MAC ID (Slave)
- 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. Bits 8 through 3 are the MAC ID and bits 2 through 0 are the message id. The identifier for Group 1 messages is fixed with bits 10 set to 0, bits 9 through 6 as the message id and bits 5 to 0 the MAC ID.

MAC ID

The MAC ID is a 6 bit field which identifies the network address of the device, *as a hexadecimal value*. The *source* MAC ID is the address of the device sending the message. The *destination* MAC ID is the address of the device receiving the message.

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

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 7: 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">SLAVE MAC ID
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 MAC ID</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 MAC ID</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 MAC ID</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 MAC ID</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td colspan="3">Group 2 Only Unconnected Explicit Request Messages from the Master</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">0</td><td colspan="6" rowspan="2">Destination MAC ID</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td colspan="3">Duplicate MAC ID 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">SLAVE MAC ID
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 MAC ID</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 up to 8 bytes which defines the specific parameters of an explicit or I/O poll message. The CAN Data Field is required in every explicit and I/O poll message the format of the field varies depending on whether the message is a request or a response.

For I/O poll messages, the CAN Data Field contains the appropriate Assembly data (that is, the poll request or poll response). Refer to Assembly Object, page 32, for more information.

For explicit messaging, the CAN Data Field consists of a message header and a message body (refer to Table 8, page 16). The message header is a single 8 bit field, consisting of three components, which 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
- MAC ID (Master)

The message body is a series of up to five 8 bit fields, which 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 8: CAN Data Field for Explicit Messages

Byte	7	6	5	4	3	2	1	0
0 **MESSAGE HEADER**	**Fragment Bit** (0/1)	**Transaction ID (XID) Bit** (0/1)	**MASTER MAC ID** 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, which is used by an application to match a response with the associated request. The client (host) sets the value of 0 or 1, and the field is simply echoed by the server in a response message. The client is the module that originates a transmission; the server is the module that reacts to that transmission [1].

MAC ID

The MAC ID is a 6 bit field which identifies the network address of the device, *as a hexadecimal value*. The *source* MAC ID is the address of the device sending the message. The *destination* MAC ID is the address of the device receiving the message.

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

Request/Response Bit

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

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 91, page 107, 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. Refer to Table 9, page 19, for a list of the Class Codes supported by your device.

Instance ID

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

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, which identifies a specific parameter.

Objects

There are seventeen (17) objects in your T3B or T3P unit. The objects and their functions are listed in numerical sequence by class code in Table 9, page 19.

The attributes and services associated with each object are defined throughout this chapter. Descriptions are supplied for the attributes and services which are either MKS specific, or which require additional specifications beyond the DeviceNet and SEMI specifications [1, 2, 3]. A summary of the attributes is listed in Table 90, page 99; a summary of the supported services is listed in Table 91, page 107.

For each attribute, the following information is supplied:

- Attribute ID # (hex value)
- Description
- Data Type
- User and Calibration Mode Access
  (read only “R” or read/write “RW”)
- Non-Volatile Memory
  (yes “Y”, stored in non-volatile RAM or ROM or
  no “N”, not stored in non-volatile RAM or ROM)
- Data Variable(s)
- Factory Default Setting

Note Values stored in non-volatile RAM are saved when the power is turned off. When power is restored, the device “remembers” the latest configuration, not the default setting.

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 107.

Table 9: Objects in the MKS Throttle Valve Controller

Object Name	Class Code (hex)	Maximum Instances	Functions / Attributes
Identity	01	1	General information per ODVA: Revision (of object definition) Vendor Device Type Product Code Revision Status Serial Number Product Name State
Message Router	02	1	Routes incoming messages to the appropriate object: Revision (of object definition) Number of Connections
DeviceNet	03	1	Defines the physical network connections: Revision (of object definition) MAC ID Baud Rate Bus-Off Interrupt and Counter Allocation Information MAC ID/Baud switch state MAC ID/Baud switch values
Assembly	04	12	Groups attributes of multiple objects into a single assembly
Connection	05	2	Defines the messaging connections: State Instance Type Transport Class Trigger Produced Connection ID Consumed Connection ID Initial Comm Characteristics Production Connection Size Consumption Connection Size Expected Packet Rate Watchdog Timeout Action Produced Connection Path & Length Consumed Connection Path & Length Production Inhibit Time
Discrete Input Point	08	2	Defines the interface to the open/close limit switches: Revision (of object definition) Open and closed limit switch status Off_on cycle counts
Discrete Output	09	2	Discrete outputs including: Revision (of object definition) Discrete Output Value, Source, and Output Enable

(continued on the next page)

Table 9: Objects in the MKS Throttle Valve Controller (continued)

Object Name	Class Code (hex)	Maximum Instances	Functions / Attributes
Analog Output	0B	2	Pressure and position outputs: Value Source DAC counts Calibration Status
Selection	2E	2	Shows paths of information between objects: Revision (of object definition) Selection Object State Max Sources/Destinations Number of Sources/Destinations Source/Destination Lists Algorithm Type Source/Destination Used Input/Output values for Setpoint and Control instances
S-Device Supervisor	30	1	General information per SEMI: Revision (of object definition) Device Type Semi Revision Manufacturer Manufacturer Model Number Firmware Revision Hardware Revision Serial Number Device Configuration Device Status Exception Status Exception Detail – Alarm Exception Detail – Warning Alarm Enable Status Warning Enable Status Run Hours Visual Indicator User Tag Operating Mode User Calibration Date Factory Calibration Date Firmware Build Information Battery Statistics (T3P only) Power Cycles

(continued on the next page)

Table 9: Objects in the MKS Throttle Valve Controller (continued)

Object Name	Class Code (hex)	Maximum Instances	Functions / Attributes
S-Analog Sensor	31	5	Sensor information including valve position encoder, analog setpoint and temperature sensors: Revision (of object definition) Subclass A/D Zero & FS Calibration Values Input Data Type/Units Reading Valid Input Value Status Full Scale Value Offset B Value Average Time Overrange Raw Counts Range Selection (voltage)
S-Analog Actuator	32	1	Valve information: Revision (of object definition) Valve Position Type/Units Valve Override Selector Valve Position Value Status Safe State Option Safe State Value Valve Range Total Valve Steps Valve Slipped Indicator Calibration State 16 bit Value Valve Type Open Override Switch Status Closed Override Switch Status Valve Learn at Power Up Interlock Status Air Status (T3P only) Interlock Enabled

(continued on the next page)

Table 9: Objects in the MKS Throttle Valve Controller (continued)

Object Name	Class Code (hex)	Maximum Instances	Functions / Attributes
S-Single Stage Controller	33	2	Set point and control process parameters: Revision (of object definition) SoftStart Open and Close Rates SpeedUp Enable SpeedUp Time SpeedUp Filter Time Pedestal Value Learn Flow Estimated Learn Flow Flow Tau Pressure, Position Value Types/Units Control Mode Setpoint Value Process Variable Value Control Variable Value Alarm Status Calibrating Status Delay Time Crossover High & Low Ranges Phase (Ki), Gain (Kp) and Kd Control Direction Process Variable Source Subclass Control Algorithm Selected 16 bit Setpoint Value Gain & Phase Compensation Factors Chamber Volume Tau SoftStart Setpoint Rate Active Preset Selected Use Volume Estimate
Trip Point	35	4	Trip Point information: Revision (of object definition) High & Low Trip Values High & Low Trip Enables Status Hysteresis Delay Destination Output Source Input Data Type/Units

(continued on the next page)

Table 9: Objects in the MKS Throttle Valve Controller (continued)

Object Name	Class Code (hex)	Maximum Instances	Functions / Attributes
Setpoints Preset	64	6	Controller Setpoint Settings: Revision (of object definition) Type Value SoftStart Rate Kp, Ki, Kd
Pump Speed Curves	65	3	Pump Speed Curves Settings: Active Curve Curve Table Entries 1..35
Device Configuration	6D	1	General setup information: Poll Request Setup Poll Response Setup Low Pressure FS Range High Pressure FS Range

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 one class attribute, eight instance attributes (refer to Table 13), one DeviceNet Class common service (refer to Table 10, page 24), and three DeviceNet common services (refer to Table 12, page 25).

Identity Object Class Services

Table 10: Identity Object Supported Class Services

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
0E	Get_Attribute_Single	USINT	Request	Read a object class attribute

Identity Object Class Attributes

Table 11: Identity 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	0001

Revision

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

Identity Object Supported Instance Services

The Identity Object is supported by the three DeviceNet common services listed in Table 12. Refer to *Supported Service Summary*, page 107, for more information. These instance services need to specify instance number 1 in addition to any listed parameters.

The reset service requires instance 1 be specified but the other parameter is optional. If omitted, it is assumed 0 and simply power cycles the device.

Note that the operating mode determines the attributes reset. If the service is called while in user mode, only user mode values are affected. Calibration mode variables are left alone. If the service is called while in calibration mode, both user and calibration mode variables are reset.

Table 12: Identity Object Supported Instance Services

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
05	Reset	USINT	Request	Place the object into its INITIALIZING state. Emulates a power cycle.
0E	Get_Attribute_Single	USINT	Request	Read an object attribute.

Identity Object Instance Attributes

Table 13: 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	Y	none	36
02	Device Type	UINT	R	R	Y	none	1D(hex)
03	Product Code*	UINT	R	R	Y	none	684 (T3B) 686 (T3P)
04	Revision*	Struct of: USINT USINT	R	R	Y	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	Y	none	T3B T3P
08	State	USINT	R	R	N	none	
0=Nonexistent 1=Self_Testing 2=Standby 3=Operational 4=Major_Recoverable_Fault 5=Major_Unrecoverable_Fault							
** This information is also available—in a different format—in the S-Device Supervisor Object (refer to Table 59, page 56).*							

Vendor

Attribute ID #01 hex reports the registered vendor supplying the device; MKS Instruments is identified as Vendor 36.

Device Type

Attribute ID #02 hex reports the type of device on the network, in accordance with the ODVA DeviceNet Specification, Volume II [2]. Your throttle valve controller is represented in the response with the value “1D.”

Product Code

Attribute ID #03 hex reports the product code of the device as “684” (T3B) or “686” (T3P), in accordance with the ODVA DeviceNet Specification, Volume II [2].

Product Revision

Attribute ID #04 hex reports the current revision of firmware, in accordance with the ODVA DeviceNet Specification, Volume II [2]. The default firmware revision level is 001 002.

Status

Attribute ID #05 hex reports the device status, in accordance with the ODVA DeviceNet Specification, Volume II [2]. Values can range from 0 to 3333.

Serial Number

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

Product Name

Attribute ID #07 hex reports the product name, in accordance with the ODVA DeviceNet Specification, Volume II [2]. The response returns the ASCII string “T3BIA” or “T3PI.”

State

Attribute ID #08 hex reports the device state, in accordance with the ODVA DeviceNet Specification, Volume II [2]. The values for this field are:

0 = Nonexistent
1 = Self_Testing
2 = Standby
3 = Operational
4 = Major Recoverable Fault
5 = Major_Unrecoverable_Fault

Message Router Object

The Message Router Object (Class Code 02_{hex}) interprets an incoming message and routes it to the appropriate device object. The Message Router Object supports only one class attribute and one instance with one instance attribute. The Get_Attribute_Single is the only service and is offered for both the class and instances.

Message Router Object Services

Table 14: Message Router Object Services

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
0E	Get_Attribute_Single	USINT	Request	Read an object attribute

Message Router Object Class Attribute

Table 15: Message Router 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	0001

Revision

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

Message Router Object Instance Attributes

Table 16: Message Router Object Instance Attribute

Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Non-Volatile Memory	Data Variable	Factory Default Setting
02	Number of Connections	UINT	R	R	Y	None	0002

Number of Connections

Attribute ID #02 hex reports the maximum number of connections supported. This value is fixed at 2 for this device.

For a description of the Message Router Object, refer to the ODVA DeviceNet Specification, Volume II [2].

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 MAC ID (node address) and the baud rate, and to report how the messaging supported by the device is allocated.

One instance of the DeviceNet Object is supported with one class attribute (refer to Table 18), nine instance attributes (refer to Table 20, page 29), and five DeviceNet services (refer to Table 19).

DeviceNet Object Class Services

Table 17: DeviceNet Object Supported Class Services

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
0E	Get_Attribute_Single	USINT	Request	Read a object class attribute

DeviceNet Object Class Attribute

Table 18: 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	0002

Revision

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

DeviceNet Object Supported Instance Services

The DeviceNet Object is supported by the five DeviceNet services listed in Table 19. Refer to *Supported Service Summary*, page 107, for more information.

Table 19: DeviceNet Object Supported Instance Services

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
0E	Get_Attribute_Single*	USINT	Request	Read the object attribute
10	Set_Attribute_Single*	USINT, Attribute Data Type	Request	Modify object attribute
4B	Allocate_Master_Slave	BYTE, USINT	Request	Allocate the Predefined Master/Slave Connection Set

(continued on the next page)

Table 19: DeviceNet Object Supported Instance Services (continued)

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
4C	Release_Master_Slave	BYTE	Request	Release the Predefined Master/Slave Connection Set
** DeviceNet common service.*				

DeviceNet Object Instance Attributes

Table 20: 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	MAC ID	USINT	RW*	RW*	Y	0 to 63	63
02	Baud Rate	USINT	RW*	RW*	Y	0 = 125 Kb 1 = 250 Kb 2 = 500 Kb	0
03	Bus-Off Interrupt	BOOL	RW	RW	Y	0 or 1	0
04	Bus-Off Counter Function	USINT	RW	RW	Y	0 to FF hex	0
05	Allocation Information	Struct of: BYTE USINT	R	R	N	Modified via Allocate only	0, FF hex
06	MAC ID switch changed	BOOL	R	R	N	0 = No Change 1 = Changed Since Last Power Up/ Reset	0
07	Baud Rate switch changed	BOOL	R	R	N	0 = No Change 1 = Changed Since Last Power Up/ Reset	0
08	MAC ID switch value	USINT	R	R	N	0 to 63	0
09	Baud Rate switch value	USINT	R	R	N	0 = 125 Kb 1 = 250 Kb 2 = 500 Kb	0
** Attribute IE #01 hex and Attribute ID #02 hex can only be written if their corresponding hardware switches, located on top of the device, are in the network (PGM) position. Refer to your Instruction Manual for more information (*MKS Type T3B Butterfly Valve With DeviceNet Interface Instruction Manual, *137364-P1, or* MKS Type T3P Pendulum Valve With DeviceNet Interface Instruction Manual, *137361-P1).*							

MAC ID

The MAC ID (node 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 top of the unit. Refer to your Instruction Manual for more information (*MKS Type T3B Butterfly Valve With DeviceNet Interface*

Instruction Manual, 137364-P1, or *MKS Type T3P Pendulum Valve With DeviceNet Interface Instruction Manual*, 137361-P1).

Attribute ID #01 hex defines the MAC ID of the device. Any address from 0 to 63 can be used; the MFD is shipped with the address set to 63.

Note The MAC ID 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 displayed but not applied until device is reset or power is cycled. The Module Status led will indicate there is a change pending by blinking red.

Baud Rate

The baud 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 your Instruction Manual for more information (*MKS Type T3B Butterfly Valve With DeviceNet Interface Instruction Manual*, 137364-P1, or *MKS Type T3P Pendulum Valve With DeviceNet Interface Instruction Manual*, 137361-P1).

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

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

Note The baud rate 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 change in the rotary switch position after power up is displayed but not applied until device is reset or power is cycled. The Module Status led will indicate there is a change pending by blinking red.

Bus-Off Interrupt

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

Bus-Off Counter

Attribute ID #04 hex reports the number of times CAN went to the BUS-OFF state.

Allocation Information

Attribute ID #05 hex reports how the types of messages supported by the device are allocated, as specified by the Predefined Master/Slave Connection Set [1]. Your throttle valve controller supports explicit and I/O poll messaging.

MAC ID Switch Changed

Attribute ID #06 hex reports if the MAC ID switch has been changed since the last reset or power cycle.

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

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

Baud Rate Switch Changed

Attribute ID #07 hex reports if the Baud Rate switch has been changed since the last reset or power cycle. Refer to your Instruction Manual for more information on how to adjust this switch (*MKS Type T3B Butterfly Valve With DeviceNet Interface Instruction Manual*, 137364-P1, or *MKS Type T3P Pendulum Valve With DeviceNet Interface Instruction Manual*, 137361-P1).

Note

In order to control the baud rate directly from the switch, ensure that at power up the switch is set to an actual value, and not to the network (PGM) position. When this condition is met, any changes to the baud rate made through the network will be denied and the Attribute_Not_Settable General Error Code will be returned to the Set_Attribute_Single service.

MAC ID Switch Value

Attribute ID #08 hex reports the current MAC ID switch setting. Note this is not necessarily what is in use if the device hasn't been power cycled since the last change.

Baud Rate Switch Value

Attribute ID #09 hex reports the current Baud Rate switch setting. Note this is not necessarily what is in use if the device hasn't been power cycled since the last change.

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.

Twelve (12) instances of the Assembly Object (refer to Table 23) are supported with one class attribute, one class service, one instance attribute (refer to Table 23, page 32) and three instance services (refer to Table 25, page 37).

Assembly Object Class Services

Table 21: Assembly Object Supported Class Services

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
0E	Get_Attribute_Single	USINT	Request	Read a object class attribute

Assembly Object Class Attribute

Table 22: Assembly 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	0002

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]. All values are accessed through the desired assembly instance via attribute 3.

Table 23: Assembly Object Instances

Assembly Instance ID # (hex)	Description	Data Type	Class Code (hex) / Object	Instance ID # (hex)	Attribute ID # (decimal)	User Mode Access	Cal Mode Access
02	Poll Response #2	BYTE	30 S-Device Supervisor	01	12 Exception Status	R	R
		INT	33 S-Single Stage Controller	01	7 Process Variable		
07	Poll Request #7	INT	2E Selection	01	15 Input Data Value	RW	RW
		UINT	2E Selection	01	14 Destination Used		
12	Poll Response #18	BYTE	30 S-Device Supervisor	01	12 Exception Status	R	R
		REAL	33 S-Single Stage Controller	01	7 Process Variable		

(continued on the next page)

Table 23: Assembly Object Instances (continued)

Assembly Instance ID # (hex)	Description	Data Type	Class Code (hex) / Object	Instance ID # (hex)	Attribute ID # (decimal)	User Mode Access	Cal Mode Access
17	Poll Request #23	REAL	2E Selection	01	15 Input Data Value	RW	RW
		UINT	2E Selection	01	14 Destination Used		
20	Poll Request #32	USINT	33 S-Single Stage Controller	01	5 Control Mode	RW	RW
		REAL	2E Selection	01	15 Input Data Value		
		REAL	33 S-Single Stage Controller	01	94 Kp		
		REAL	33 S-Single Stage Controller	01	93 Ki		
		REAL	33 S-Single Stage Controller	01	92 Kd		
64	Trip Point Assembly	BOOL	35 Trip Point	01	07 Trip Point Status	R	R
		BOOL	35 Trip Point	02	07 Trip Point Status		
		BOOL	35 Trip Point	03	07 Trip Point Status		
		BOOL	35 Trip Point	04	07 Trip Point Status		
		BOOL	32 S-Analog Actuator	01	102 Valve Slipped Indicator		
65	Operational Status	USINT	2E Selection	02	08 Set Point Source***	R	R
		USINT	32 S-Analog Actuator	01	05 Override		
66	Poll Request #102	REAL	2E Selection	01 / 02*	15 Input Data Value	RW	RW
		USINT	32 S-Analog Actuator	01	05 Override		
		USINT	2E Selection	01	14 Destination Used		
67	Poll Request #103	INT	33 S-Single Stage Controller	01 / 02*	102 16 Bit Set Point Value	RW	RW
		USINT	32 S-Analog Actuator	01	05 Valve Override Selector		
		USINT	2E Selection	01	14 Destination Used		

(continued on the next page)

Table 23: Assembly Object Instances (continued)

Assembly Instance ID # (hex)	Description	Data Type	Class Code (hex) / Object	Instance ID # (hex)	Attribute ID # (decimal)	User Mode Access	Cal Mode Access
68	Poll Request #104	INT	33 S-Single Stage Controller	01 / 02*	102 16 Bit Set Point Value	RW	RW
		USINT	32 S-Analog Actuator	01	05 Override		
		USINT	2E Selection	01	14 Destination Used		
		INT	33 S-Single Stage Controller	01	07 16 Bit Process Variable		
69	Poll Response #105**	USINT	30 S-Device Supervisor	01	12 Exception Status	R	R
		REAL	33 S-Single Stage Controller	01	07 Process Variable		
		INT	32 S-Analog Actuator	01	104 16 Bit Position Value		
		USINT	32 S-Analog Actuator	01	05 Valve Override Selector		
6A	Poll Response #106**	USINT	30 S-Device Supervisor	01	12 Exception Status	R	R
		INT	33 S-Single Stage Controller	01	07 16 Bit Process Variable		
		INT	32 S-Analog Actuator	01	104 16 Bit Position Value		
		INT	33 S-Single Stage Controller	01 / 02*	102 16 Bit Set Point Value		
		USINT	32 S-Analog Actuator	01	05 Valve Override Selector		

** The poll request updates the active controller instance, specified with Attribute ID #08 hex in instance 2 of the Selection Object.*

*** The poll response is **always** returned when an I/O poll request is issued. Which poll request is sent and which poll response is returned is defined in the Device Configuration Object (refer to Poll Request Setup and Poll Response Setup, page 96, for more information.*

**** These values are modified (setpoint source decremented by 1, pressure formatted to 16 bit).*

Poll Response #2

Assembly Instance ID #02 hex reports the:

- Exception Status from the S-Device Supervisor Object (refer to *S-Device Supervisor Object*, page 56)
- Process Variable from the S-Single Stage Controller (refer to *S-Single Stage Controller*, page 71)

Poll Request #7

Assembly Instance ID #07 hex reports the:

- Control Setpoint from the Selection Object (refer to Input Data Value)
- Control Instance in use from the Selection Object (refer to *Destination Used*)

Poll Response #18

Assembly Instance ID #12 hex reports the:

- Exception Status from the S-Device Supervisor Object (refer to *S-Device Supervisor Object*, page 56)
- Process Variable from the S-Single Stage Controller Pressure Instance (refer to *S-Single Stage Controller*, page 71)

Poll Request #23

Assembly Instance ID #17 hex reports the:

- Input Data Value from the Selection Object (refer to *Input Data Value)*
- Destination Used from the Selection Object (refer to *Destination Used*)

Poll Request #32

Assembly Instance ID #20 hex reports the:

- Control Mode from S-Single Stage Controller (refer to *S-Single Stage Controller*, page 71)
- Selection from the Input Data Value (refer to *Input Data Value)*
- The Kp, Ki, and Kd values from the S-Single Stage Controller (refer to *S-Single Stage Controller*, page 71)

Trip Point Assembly

Assembly Instance ID #64 hex reports the:

- Trip Point Status from the Trip Point Object Instances (1..4) (refer to Status, page 88)
- Valve Slipped Indicator from the S-Analog Actuator Object (refer to *Valve Slipped* , page 72)

Operational Status

Assembly Instance ID #65 hex reports the:

- Set Point Source from the Selection Object. The value is modified to be compatible with previous products. For this attribute, 0=pressure control, 1=position. (refer to Selection Object, page 53)
- Valve Override Selector from the S-Analog Actuator Object (refer to *Override*, page 71)

Poll Request #102

Assembly Instance ID #66 hex reports the:

- Input Data Value from the Selection Object (refer to *Input Data Value)*
- Valve Override Selector from the S-Analog Actuator Object (refer to *Override*, page 71)
- Control Instance in use from the Selection Object (refer to *Destination Used*)

Poll Request #103

Assembly Instance ID #67 hex reports the:

- 16 Bit Set Point Value from the S-Single Stage Controller (refer to *S-Single Stage Controller*, page 71)
- Valve Override Selector from the S-Analog Actuator Object (refer to *Override*, page 71)
- Control Instance in use from the Selection Object (refer to *Destination Used*)

Poll Request #104

Assembly Instance ID #68 hex reports the:

- 16 Bit Set Point Value from the S-Single Stage Controller (refer to *S-Single Stage Controller*, page 71)
- Valve Override Selector from the S-Analog Actuator Object (refer to *Override*, page 71)
- Control Instance in use from the Selection Object (refer to *Destination Used*)
- 16 Bit Process Control Variable from S-Single Stage Controller Object

Poll Request #105

Assembly Instance ID #69 hex reports the:

- Exception Status from the S-Device Supervisor Object (refer to *S-Device Supervisor Object*, page 56)
- Process Control Variable from S-Single Stage Controller Object, pressure instance (refer to *S-Single Stage Controller*, page 71)
- 16 Bit Position Value from the S-Analog Actuator Object (refer to *S-Analog Actuator*, page 69)
- Valve Override Selector from the S-Analog Actuator Object (refer to *Override*, page 71)

Poll Request #106

Assembly Instance ID #6A hex reports the:

- Exception Status from the S-Device Supervisor Object (refer to *S-Device Supervisor Object*, page 56)
- 16 Bit Process Control Variable from S-Single Stage Controller Object, pressure instance (refer to *S-Single Stage Controller*, page 71)
- 16 Bit Position Value from the S-Analog Actuator Object (refer to *S-Analog Actuator*, page 69)
- 16 Bit Set Point Value from the S-Single Stage Controller (refer to *S-Single Stage Controller*, page 71)
- Valve Override Selector from the S-Analog Actuator Object (refer to *Override*, page 71)

Assembly Object Instance Attribute

Table 24: 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 Format

Attribute ID #03 hex reports the assembly data for the specified instance. The data returned for each instance is listed in Table 23, page 32.

Assembly Object Supported Instance Services

The Assembly Object is supported by the DeviceNet common service listed in Table 25. Refer to *Supported Service Summary*, page 107, for more information.

Table 25: Assembly Object Supported Instance Services

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
10	Set_Attribute_Single*	USINT, Attribute Data Type	Request	Modify the object attribute
0E	Get_Attribute_Single	USINT	Request	Read the object attribute
* This service is not supported on all assembly object instances. See “Mode Access” columns in Table 15 for details.				

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 throttle valve controller supports explicit and I/O polling messaging as defined in the Predefined Master/Slave Connection Set [1]. Examples of explicit and I/O poll messages are described in *Appendix C: Example Messages*, page 113.

Two instances of the Connection Object (refer to Table 26) are supported with 15 instance attributes (refer to *Explicit Messaging Instance Attributes*, page 39, and Table 28, page 41), and two DeviceNet common services (refer to Table 42, page 46). No class services or attributes are supported. No attributes in this object require CAL mode. USER mode will provide access to all instance services and instance attributes supported.

It is important to note that the attributes in this class have restrictions to when they can be accessed or written to. They can also take on different meanings depending on the connection type of the instance. For more information see DeviceNet Specification Volume I Release 2.0, table 5.24 and 5.25 starting on page 5-43.

Note

1. The type of ***connection*** (explicit or I/O) is defined by the Allocate_Master_Slave service in the DeviceNet Object (refer to *DeviceNet Object*, page 28).
2. The type of ***message*** is defined by the message identifier (refer to *CAN Identifier Field*, page 14). 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 26: Connection Object Instances

Instance ID # (hex)	Description
01	Explicit Messaging
02	I/O Poll Messaging

Explicit Messaging Instance Attributes

Table 27: Explicit Messaging Instance Attributes

Attribute ID # (hex)	Description	Data Type	Access Mode	Non-Volatile Memory	Data Variable	Factory Default Setting
01	State	USINT	R	N	0 to 5	03
02	Instance type	USINT	R	N	0 or 1	00
03	Transport Class Trigger**	USINT	RW	N		83
04	Produced Connection ID**	UINT	RW	N	0 to 7F0 or FFFF	05FB
05	Consumed Connection ID**	UINT	RW	N	0 to 7F0 or FFFF	05FC
06	Initial Comm Characteristics**	USINT	RW	N		21
07	Produced Connection Size**	UINT	RW	Y		0033
08	Consumed Connection Size**	UINT	RW	Y		0033
09	Expected Packet Rate	UINT	RW	N	0 to FFFF	09C4
0C	Watchdog Timeout Action*	USINT	RW	N	1 or 3	01
0D	Produced Connection Path Length	UINT	R	Y		0000
0E	Produced Connection Path	EPATH	RW	Y		<empty>
0F	Consumed Connection Path Length	UINT	R	Y		0000
10	Consumed Connection Path	EPATH	RW	Y		<empty>
11	Production inhibit time	UINT	R	Y		0000

* The attribute's default and range depends on connection type. For explicit connections, values of 1 and 3 are allowed with a default value of 1. See DeviceNet Specification Volume I Release 2.0, table 5.18 starting on page 5-26.

** Not writable if connection established or timed out.

State

Indicates the connection state. The possible states are:

0 = NONEXISTENT
1 = CONFIGURING
2 = WAIT FOR CONNECTION ID
3 = ESTABLISHED
4 = TIMED OUT
5 = DEFERRED DELETE

See Volume I, Release 2, Section 5-4.3 of the ODVA Spec for more details on these states.

Instance Type

Indicates this is an Explicit Messaging Connection. The possible values are:

0 = Explicit message
1 = Polled I/O

Transport Class Trigger

Server/Transport Class 3. This field defines the direction of the communications (server), the production trigger (cyclic) as well as defining the transport class (3).

Produced Connection ID

This is the value used in the CAN identifier field used when this connection transmits. Refer to the Slave's Explicit Response Message in Table 8, page 16.

Consumed Connection ID

This is the value used in the CAN identifier field used when this connection receives. Refer to the Master's Explicit Request Message in Table 8, page 16

Initial Communication Parameters

Indicates (1) that the Slave's Explicit Messaging Connection produces and consumes across Message Group 2, and (2) that the Slave's MAC ID appears in the CAN Identifier Fields of the Group 2 Messages that the Slave consumes and produces. Refer to Table 8, page 16.

Similarly, for I/O messaging, (1) indicates that the Slave's I/O Poll Connection produces across Message Group 2, and (2) indicates that the Slave's MAC ID appears in the CAN Identifier Field of the Group 2 Message that the Slave consumes. Refer to Table 8, page 16.

Produced Connection Size

This value represents the maximum length of the message data to transmit. For explicit message connections, this is the message body length. For I/O messaging connections, this represents the maximum single unit size. In I/O connections, this value determines if fragmenting is to be used, regardless of the amount of data to transmit.

Consumed Connection Size

For explicit messaging connections, this value represents the maximum size in bytes of the message body. For I/O messaging connections, this value represents the length of the I/O data structure received. This value determines if fragmenting is to be used.

Expected Packet Rate

This value is used for the transmit timer and the watchdog timer. The default is 2500 milliseconds.

Watchdog Timeout Action

Auto_Delete as described in [1]. This attribute shall be settable to Deferred Delete as described in [1]. Possible values are:

0 = GOTO TIMED OUT (this value may be read but is not settable)
1 = AUTO DELETE
2 = AUTO RESET (this value may be read but is not settable)
3 = DEFERRED DELETE

Produced Connection Path Length

Defaults to 0. This attribute is automatically set when the produced connection path attribute is set. It represents the length in bytes of the produced connection path. For explicit messaging, this remains 0.

Produced Connection Path

This attribute represents the EPATH of the object whose data is being produced here. In this valve for I/O messaging, this is the epath of the assembly. For explicit messaging, this remains empty.

For I/O messaging, the default is 20 04 24 02 30 03 indicating assembly object, instance 2 attribute 3.

Consumed Connection Path Length

Defaults to 0. This attribute is automatically set when the consumed connection path attribute is set. It represents the length in bytes of the consumed connection path.

Consumed Connection Path

This attribute represents the EPATH of the object whose data is being consumed here. In this valve for I/O messaging, this is the epath of the assembly. For explicit messaging, this remains empty.

For I/O messaging, the default is 20 04 24 07 30 03 indicating assembly object, instance 7, attribute 3.

Production Inhibit Time

This attribute represents the minimum time delay in milliseconds between data productions. Default value is 0. Values set are rounded up to the next usable value.

I/O Polled Messaging Instance Attributes

Table 28: I/O Polled Messaging Instance Attributes

Attribute ID # (hex)	Description	Data Type	Access Mode	Non-Volatile Memory	Data Variable	Default Value (hex)
01	State	USINT	R	N	0 to 5	01
02	Instance type	USINT	R	N	0 or 1	01
03	Transport Class Trigger	USINT	RW	N		82
04	Produced Connection ID	UINT	RW	N		03FF
05	Consumed Connection ID	UINT	RW	N		05FD
06	Initial Comm Characteristics	USINT	RW	N		01
07	Produced Connection Size	UINT	RW	Y		0003
08	Consumed Connection Size	UINT	RW	Y		0004
09	Expected Packet Rate	UINT	RW	N		0260
0C	Watchdog Timeout Action *	USINT	RW	N	0 to 3	00
0D	Produced Connection Path Length	UINT	R	Y		0006
0E	Produced Connection Path	EPATH	RW	Y		20 04 24 02 30 03
0F	Consumed Connection Path Length	UINT	R	Y		0006
10	Consumed Connection Path	EPATH	RW	Y		20 04 24 07 30 03
11	Production inhibit time	UINT	R	Y		0

* The attribute's default and range depends on connection type. For I/O polled connections, values of 0, 1 and 2 are allowed with a default value of 0. See DeviceNet Specification Volume I Release 2.0, table 5.18 starting on page 5-26.

Table 29: Poll Response Setup of the Produced_Connection_Path

Produced_Connection_Path (hex bytes)						
Poll Response Setup	**Marker**	**Object**	**Marker**	**Instance ID #**	**Marker**	**Attribute ID #**
	20	04	24	02	30	03

Table 30: Poll Request Setup of the Consumed_Connection_Path

Consumed_Connection_Path (hex bytes)						
Poll Response Setup	**Marker**	**Object**	**Marker**	**Instance ID #**	**Marker**	**Attribute ID #**
	20	04	24	07	30	03

Master Poll Request Messages

Master Poll Request Message #7

In the poll request message #7, the master sends the control setpoint and the control instance. This specifies the method of control (pressure or position) as well as the destination setpoint. The data reported in the master poll request message #7 is stored in Assembly Instance ID #07 hex in the Assembly Object (refer to Table 23, page 32).

Table 31: Master Poll Request Message #7

Data Byte	**0**	**1**	**2**	**3**
Description	Input Data Value		Destination Used	
Class Code (hex) Object	2E Selection		2E Selection	
Instance ID # (hex)	01		01	
Attribute ID # (hex)	0F		0E	
Data Type	INT		UINT	

Master Poll Request Message #23

In the poll request message #23, the master sends the control setpoint and the control instance. This specifies the method of control (pressure or position) as well as the destination setpoint. The data reported in the master poll request message #23 is stored in Assembly Instance ID #17 hex in the Assembly Object (refer to Table 23, page 32). This object differs from #7 only in the data type of the setpoint.

Table 32: Master Poll Request Message #23

Data Byte	**0**	**1**	**2**	**3**	**4**	**5**
Description	Input Data Value				Destination Used	
Class Code (hex) Object	2E Selection				2E Selection	
Instance ID # (hex)	01				01	
Attribute ID # (hex)	0F				0E	
Data Type	REAL				UINT	

Master Poll Request Message #102

In the poll request message #102, the master sends the input data value, the valve override selector value, and the source used in the format shown in Table 33. The data reported in the master poll request message #102 is stored in Assembly Instance ID #66 hex in the Assembly Object (refer to Table 23, page 32).

Table 33: Master Poll Request Message #102

Data Byte	0	1	2	3	4	5
Description	Input Data Value				Override	Dest Used
Class Code (hex) Object	2E Selection				32 S-Analog Actuator	2E Selection
Instance ID # (hex)	01/02				01	01
Attribute ID # (hex)	0F				05	0E
Data Type	REAL				USINT	USINT

Master Poll Request Message #103

In the poll request message #103, the master sends the 16 bit set point value, the valve override selector value, and the control type used in the format shown in Table 34. The data reported in the master poll request message #103 is stored in Assembly Instance ID #67 hex in the Assembly Object (refer to refer to Table 23, page 32).

Table 34: Master Poll Request Message #103

Data Byte	0	1	2	3
Description	16 Bit Set Point Value		Valve Override Selector	Dest Used
Class Code (hex) Object	33 S-Single Stage Controller		32 S-Analog Actuator	2E Selection
Instance ID # (hex)	01/02		01	01
Attribute ID # (hex)	66		05	0E
Data Type	INT		USINT	USINT

Master Poll Request Message #104

In the poll request message #104, the master sends the 16 bit set point value, the valve override selector value, the control type and the 16 bit pressure used in the format shown in Table 35. The data reported in the master poll request message #104 is stored in Assembly Instance ID #68 hex in the Assembly Object (refer to Table 23, page 32). Note that the pressure value is read only. Attempts to set have this field ignored.

Table 35: Master Poll Request Message #104

Data Byte	0	1	2	3	4	5
Description	16 Bit Set Point Value		Valve Override Selector	Dest Used	16 Bit Pressure Value	
Class Code (hex) Object	33 S-Single Stage Controller		32 S-Analog Actuator	2E Selection	<scaled version of> 31 S-Analog Sensor	
Instance ID # (hex)	01/02		01	01	01/02	
Attribute ID # (hex)	66		05	0E	06	
Data Type	INT		USINT	USINT	INT	

Slave Poll Response Messages

Slave Poll Response Message #2

The slave poll response message #2 reports the exception status and the process variable. The data reported in the slave poll response message #2 is stored in Assembly Instance ID #02 hex in the Assembly Object.

Table 36: Slave Poll Response Message #2

Data Byte	0	1	2
Description	Exception Status	16 Bit Process Variable	
Class Code (hex) Object	30 S-Device Supervisor	33 S-Single Stage Controller	
Instance ID # (hex)	01	01	
Attribute ID # (hex)	0C	07	
Data Type	BYTE	INT	

Slave Poll Response Message #18

The slave poll response message #18 reports the exception status and the process variable. The data reported in the slave poll response message #18 is stored in Assembly Instance ID #12 hex in the Assembly Object. The only difference between this and #2 above is the format of the process variable.

Table 37: Slave Poll Response Message #18

Data Byte	0	1	2	3	4
Description	Exception Status	Process Variable			
Class Code (hex) Object	30 S-Device Supervisor	33 S-Single Stage Controller			
Instance ID # (hex)	01	01			
Attribute ID # (hex)	0C	07			
Data Type	BYTE	REAL			

Slave Poll Response Message #100

The slave poll response message #100 reports the trip point status for all four trip point instances as well as the valve slip indicator. The data reported in the slave poll response message #100 is stored in Assembly Instance ID #64 hex in the Assembly Object.

Table 38: Slave Poll Response Message #100

Data Byte	0	1	2	3	4
Description	Trip Point Status	Trip Point Status	Trip Point Status	Trip Point Status	Valve Slipped Indicator
Class Code (hex) Object	35 Trip Point	35 Trip Point	35 Trip Point	35 Trip Point	32 S-Analog Actuator
Instance ID # (hex)	01	02	03	04	01
Attribute ID # (hex)	07	07	07	07	66
Data Type	BOOL	BOOL	BOOL	BOOL	BOOL

Slave Poll Response Message #101

The slave poll response message #101 reports the setpoint source and the override status. Byte 0 is modified (decremented by 1) from source attribute to provide compatibility with existing systems.

Table 39: Slave Poll Response Message #101

Data Byte	0	1
Description	Setpoint Source	Override
Class Code (hex) Object	2E Selection (modified)	32 S-Analog Actuator
Instance ID # (hex)	01 / 02	01
Attribute ID # (hex)	0F	05
Data Type	BYTE	BYTE

Slave Poll Response Message #105

The slave poll response message #105 reports the exception status, the process variable, the 16 bit S-Analog Actuator value, and the valve override selector value in the format shown in Table 40. The data reported in the slave poll response message #105 is stored in Assembly Instance ID #69 hex in the Assembly Object (refer to refer to Table 23, page 32).

Table 40: Slave Poll Response Message #105

Data Byte	0	1	2	3	4	5	6	7
Description	Exception Status	Pressure Value				16 Bit Valve Position Value		Valve Override Selector
Class Code (hex) Object	30 S-Device Supervisor	31 S-Analog Sensor				32 S-Analog Actuator		32 S-Analog Actuator
Instance ID # (hex)	01	01 / 02				01		01
Attribute ID # (hex)	0C	06				68		05
Data Type	USINT	REAL				INT		USINT

Slave Poll Response Message #106

The slave poll response message #106 reports the exception status, the 16 bit process variable, the 16 bit S-Analog Actuator value, the 16 bit set point value, and the valve override selector value in the format shown in Table 41. The data reported in the slave poll response message #106 is stored in Assembly Instance ID #6A hex in the Assembly Object (refer to refer to Table 23, page 32).

Table 41: Slave Poll Response Message #106

Data Byte	0	1	2	3	4	5	6	7
Description	Exception Status	16 Bit Process Variable		16 Bit Valve Position Value		16 Bit Set Point Value		Valve Override Selector
Class Code (hex) Object	30 S-Device Supervisor	33 S-Single Stage Controller		32 S-Analog Actuator		33 S-Single Stage Controller		32 S-Analog Actuator
Instance ID # (hex)	01	01		01		01 / 02		01
Attribute ID # (hex)	0C	Scaled Version of 7		68		66		05
Data Type	USINT	INT		INT		INT		USINT

Connection Object Supported Services

The Connection Object is supported by the two DeviceNet common services listed in Table 42. Refer to *Supported Service Summary*, page 107, for more information.

Table 42: Connection Object Supported Services

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

Discrete Input Object

The Discrete Input Object (Class Code 08_{hex}) contains the attributes for the valve travel limit switches. This object is also used to hold cycle counts for these switches.

Two instances of the Discrete Input Object are supported with two instance attributes (refer to Table 45) and two DeviceNet common services (refer to Table 46, page 48).

There will be 2 instances of this object in our controller:

1. represents the closed valve limit switch
2. represents the open valve limit switch

Discrete Input Object Class Attribute

Table 43: Discrete Input 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	0002

Discrete Input Object Class Service

Table 44: Discrete Input Object Supported Class Service

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
0E	Get_Attribute_Single	USINT	Request	Read a object class attribute

Discrete Input Object Instance Attributes

Table 45: Discrete Input Object Instance Attributes

Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Non-Volatile Memory	Data Variable	Factory Default Setting
03	Discrete Input Value	BOOL	R	R	Y	0 = Off 1 = On	0
07	Off_On Cycles	UDINT	R	R	Y	0 to $FFFFFFFF_{hex}$ (4,294,967,295)	0

Discrete Input Value

Attribute ID #03 hex specifies the status of an external limit switch, where:

0 = Off (default)
1 = On

Off_On Cycles

Attribute ID #07 hex specifies the count of off_on cycles for the specific switch.

Discrete Input Object Supported Instance Service

The Discrete Input Object is supported by the DeviceNet common service listed in Table 46. Refer to *Supported Service Summary*, page 107, for more information.

Table 46: Discrete Input Object Supported Service

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
0E	Get_Attribute_Single	USINT	Request	Read a object instance attribute

Discrete Output Object

The Discrete Output Object (Class Code 09_{hex}) contains the attributes for specifying which attributes are mapped to the pins in the Auxiliary connector for use with an external hardware relay. Keep in mind that backfill functionality affects Discrete Output #2 attributes.

Two instances of the Discrete Output Object are supported with three instance attributes (refer to Table 49) and three DeviceNet common services (refer to Table 50, page 50).

Discrete Output Object Class Attribute

Table 47: Discrete Output 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	0001

Discrete Output Object Class Service

Table 48: Discrete Output Object Supported Class Service

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
0E	Get_Attribute_Single	USINT	Request	Read a object class attribute

Discrete Output Object Instance Attributes

Table 49: Discrete Output Object Instance Attributes

Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Non-Volatile Memory	Data Variable	Factory Default Setting
03	Discrete Output Value	BOOL	RW	RW	N	0 = Off 1 = On	0
64	Discrete Output Source	USINT	R*	R*	Y	0, 1, 2 or 5	See Trip Point object and Single Stage Controller object
65	Discrete Output Enable	BOOL	RW	RW	Y	0 = Disable 1 = Enable	0
** Attribute ID #64 hex can be affected by writing to the destination attribute of the desired trip point instance (1 or 2 or by enabling the backfill feature).*							

Discrete Output Value

Attribute ID #03 hex specifies the intended status of an external hardware relay, where:

0 = Off (default)
1 = On

To manually set this value, you must first disable the link to a trip point. See the destination attribute of the trip point objects covered later in this manual. If a link to this discrete output exists, any value written to the

output value attribute will be immediately overwritten by the trip point. If services are not started, this value is forced to off.

Lastly, note that the output must be enabled before the value is actually used.

Discrete Output Source

Attribute ID #64 hex specifies the relay output; that is, it specifies which attribute is mapped to the pins in the Auxiliary connector for use with an external hardware relay, where:

0 = No link. The output value is not overwritten from another source.

1 or 2 = Link to Specified Trip Point Object instance
(Attribute ID #07 hex, Trip Point Status, refer to page 88)

5 = Link to backfill feature in Single Stage Controller Object. This value only applies to Discrete Output Object instance 2 if the backfill feature is enabled..

Discrete Output Enable

Attribute ID #65 hex specifies whether the discrete output value (Attribute ID #03 hex in this object) and the actual discrete output of the device are updated based on the discrete output source (Attribute ID #64 hex in this object), where:

0 = Disable (not updated, default)
1 = Enable (updated)

Discrete Output Object Supported Instance Services

The Discrete Output Object is supported by the three DeviceNet common services listed in Table 50. Refer to *Supported Service Summary*, page 107, for more information.

Table 50: Discrete Output Object Supported Instance Services

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

Analog Output Object

The Analog Output Object (Class Code $0B_{hex}$) manages the pressure and position output signals. Instance 1 represents the pressure and instance 2 represents position output. No attributes in this object require CAL mode. USER mode will provide access where access is available. There are no class attributes or class services.

Analog Output Object Instance Attributes

Table 51: Analog Output Object Instance Attributes

Attribute ID # (hex)	Description	Data Type	Access Mode	Non-Volatile Memory	Data Variable	Default Value (hex)
03	Value	REAL	RW	N	0 to 100.0%	0
64	Source	USINT	RW	Y	0 to 2 depending on instance	Inst #1=1 Inst #2=2
65	DAC Counts	UINT	R	N	0 to 65535	0
66	Calibration Status	USINT	R	Y	0=uncalibrated or 1=calibrated	1 = calibrated

Value

This attribute indicates the current reading for pressure or position to be made available on the output pins. If the source attribute (0x64) for the desired instance is not set to local, this value will be updated (overwritten) by the system. Values here are entered and reported as a percentage of 10v full scale. 0 will output 0 volts and 100.0 will output 10 volts. Values entered can be outside this range but output will be limited by the following: Pressure output ranges from -0.2v (-2%) to 11v (110%) and position output ranges from 0v (0%) to 10.8v (108%).

Source

For the pressure instance, the source can be set to 0 for local or 1 (default setting) for the pressure reading. If local, any value set in attribute 03 will be used. No pressure changes will be reflected on the output.

If the source for the pressure analog output instance is set to 1, the pressure controller (S-Single Stage Controller Instance 1) process variable is used to update the value setting automatically.

For the analog output position instance, the source can be set to 0 for local, 1 for valve or 2 (default) for encoder. If local, any value set in attribute 03 will be used and no valve position changes will be reflected on the output.

If the source for the position analog output instance is set to 1, the valve controller position is used to update the value setting automatically. Alternatively if the source is set to 2, the encoder is used to set the value for the position output.

DAC Counts

This attribute represents the raw DAC counts output. Values here range from 0 to 65535. Values here are read only and can be set indirectly by changing the value attribute.

Calibration Status

The analog outputs are pre-calibrated by MKS and this attribute should reflect this by reading 1.

Analog Output Object Supported Services

Table 52: Analog Output Object Supported Services

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

Selection Object

The Selection Object (Class Code $2E_{hex}$) manages the selection and distribution of data between objects. Instance 1 represents the Setpoint and instance 2 represents Control Variable. No attributes in this object require CAL mode. USER mode will provide access where access is provided.

The attributes' ranges and defaults vary by the instance. For more information see DeviceNet Specification Volume II Release 2.0 Errata 5, Chapter 3, Process Control Valve Device Profile starting on page 3-153. More details can also be found on page 3-163 and the section that starts at 6-252 of the same specification.

Selection Object Class Attribute

Table 53: Selection Object Class Attribute

Attribute ID # (hex)	Description	Data Type	Access Mode	Non-Volatile Memory	Data Variable	Factory Default Setting
01	Revision	UINT	R	Y	None	0002

Selection Object Class Service

Table 54: Selection Object Supported Class Service

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
0E	Get_Attribute_Single	USINT	Request	Read a object class attribute

Selection Object Instance Attributes

Table 55: Selection Object Instance Attributes

Attribute ID # (hex)	Description	Data Type	Access Mode	Non-Volatile Memory	Data Variable	Factory Default Setting
01	State	USINT	R	N	0 to 2	01
02	Max Destinations	UINT	R	Y	None	Inst #1=2 Inst #2=1
03	Number of Destinations	UINT	R	Y	None	Inst #1=2 Inst #2=1
04	Destination List	Struct USINT, EPATH	R	Y	None	See description below
05	Max Sources	UINT	R	Y	None	Inst #1=0 Inst #2=2
06	Number of Sources	UINT	R	Y	None	Inst #1=0 Inst #2=2
08	Source Used	UINT	R	Y	0 to 2	0
0A	Algorithm Type	USINT	R	Y	None	04
0D	Source List	Struct USINT, EPATH	R	Y	None	See description below

(continued on the next page)

Table 55: Selection Object Instance Attributes (continued)

Attribute ID # (hex)	Description	Data Type	Access Mode	Non-Volatile Memory	Data Variable	Factory Default Setting
0E	Destination Used	UINT	RW	Y	0 to 2	Inst #1=0 Inst #2=1
0F	Input Data Value	Data Type	RW	Y		Inst #1=0 Inst #2=N/A
10	Output Data Value	Data Type	R	N		0

State

Indicates the selection object instance state. The possible states are:

0 = NONEXISTENT
1 = IDLE
2 = RUNNING

Max Destinations

The destinations allowable are specified in the Process Control Valve Device Profile. Values here are fixed. Setpoint instance is fixed at 2, control instance is fixed at 1.

Number of Destinations

The number of destinations allowed are specified in the Process Control Valve Device Profile. Values here are fixed. Setpoint instance is fixed at 2, control instance is fixed at 1.

Destination List

The destinations allowable are specified in the Process Control Valve Device Profile. Values here are fixed.

Setpoint instance returns (0x06, 0x20, 0x33, 0x24, 0x01, 0x30, 0x06, 0x06, 0x20, 0x33, 0x24, 0x02, 0x30, 0x06) representing S-Single Stage Controller (object #0x33), instance 01 or 02, setpoint value (Attribute ID #06 hex).

Control instance returns (0x06, 0x20, 0x32, 0x24, 0x01, 0x30, 0x06) representing S-Analog Actuator object, instance 1, attribute 6 (valve setpoint).

Max Sources

The sources allowable are specified in the Process Control Valve Device Profile. Values here are fixed. Setpoint instance is fixed at 0, control instance is fixed at 2.

Number of Sources

The number of sources allowed are specified in the Process Control Valve Device Profile. Values here are fixed. Setpoint instance is fixed at 0, control instance is fixed at 2.

Source Used

For the control instance of the Selection Object, this is the S-Single Stage Controller instance currently active. For the setpoint instance, the source cannot be specified and this value is fixed at zero.

Algorithm Type

The algorithm type is specified in the Process Control Valve Device Profile and is fixed at 4 (Programmable Data Flow).

Source List

The sources allowable are specified in the Process Control Valve Device Profile. Values here are fixed.

Setpoint instance returns (0x00) representing no source choice. Control instance returns (0x06, 0x20, 0x33, 0x24, 0x01, 0x30, 0x09, 0x06, 0x20, 0x33, 0x24, 0x02, 0x30, 0x09) representing S-Single Stage Controller, instance 1 or 2, control variable (Attribute ID #09 hex).

Destination Used

For the control instance of the Selection Object, this is the S-Analog Actuator. There is only one path offered so the value is fixed at 1. For the setpoint instance, the destination can be specified as either disabled (value of 0) or one of the S-Single Stage Controller instances (1 or 2) depending on which controller (pressure or position) is desired.

Input Data Value

This attribute contains the value obtained from the source. It is formatted in the data type specified in the source S-Single Stage Controller instance (or INT if disabled). This attribute is not applicable to the control instance.

Output Data Value

This is the same as the input data value but in the (REAL or INT) type used in the destination specified.

Selection Object Supported Services

Table 56: Selection Object Supported Services

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
0E	Get_Attribute_Single	USINT	Request	Read the object attribute
10	Set_Attribute_Single	USINT, Attribute Data Type	Request	Modify 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—that is available in the Identity Object (refer to Table 13, page 25), in accordance with the ODVA DeviceNet Specification, Volume II [2]. In addition, the S-Device Supervisor Object includes attributes specific to the MKS throttle valve controller, which comply with the SEMI Standards Common and Specific Device Models [3] and the DeviceNet device profile for a process control valve (see ODVA DeviceNet Specification, Volume II.)

One instance of the S-Device Supervisor Object is supported with 26 instance attributes (refer to Table 59) and twelve DeviceNet services (refer to Table 63, page 62).

S-Device Supervisor Object Class Attribute

Table 57: S-Device Supervisor 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	0002

S-Device Supervisor Object Class Service

Table 58: S-Device Supervisor Object Supported Class Service

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
0E	Get_Attribute_Single	USINT	Request	Read a object class attribute

S-Device Supervisor Object Instance Attributes

Table 59: S-Device Supervisor Object Instance Attributes

Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Non-Volatile Memory	Data Variable	Factory Default Setting
03	Device Type	SHORT-STRING	R	R	Y	None	PCV
04	Standard Revision	SHORT-STRING	R	R	Y	None	E54-0997
05	Manufacturer	SHORT-STRING	R	R	Y	None	MKS
06	Manufacturer Model Number	SHORT-STRING	R	R	Y	None	T3B T3P
07	Firmware Revision Level	SHORT-STRING	R	R	Y	Current firmware revision	Current firmware revision
08	Hardware Revision Level	SHORT-STRING	R	R	Y	A to Z	Current hardware revision
09	Serial Number	SHORT-STRING	R	R	Y	None	Device specific

(continued on the next page)

Table 59: S-Device Supervisor Object Instance Attributes (continued)

Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Non-Volatile Memory	Data Variable	Factory Default Setting
0A	Device Configuration	SHORT-STRING	R	R	Y	None	Device specific
0B	Device Status	USINT	R	R	N	0 to 6	0
0C	Exception Status	BYTE	R	R	N	Refer to Table 61, page 59	80_{hex}
0D	Exception Detail Alarm	STRUCT	R	R	N	None	None
0E	Exception Detail Warning	STRUCT	R	R	N	None	None
0F	Alarm Enable	BOOL	RW	RW	Y	0 = Disabled 1 = Enabled	1 Enabled
10	Warning Enable	BOOL	RW	RW	Y	0 = Disabled 1 = Enabled	1 Enabled
17	Run Hours	UDINT	R	R	Y	Product life timer	
64	Visual Indicator	BOOL	RW	RW	N	0 = Off 1 = On	0
65	User Tag	SHORT-STRING	RW	RW	Y	Up to 30 characters	None
66	Operating Mode	USINT	R	R	N	0 = User 1 = Cal	0
67	User Cal Date	DATE	R	RW	Y	Days since 1/1/1972	1/1/1972
68	Factory Cal Date	DATE	R	R	Y	Days since 1/1/1972	
69	Build Information	SHORT-STRING	R	R	Y	Firmware build info	
6A	Battery Total Life (T3P only)	REAL	R	R	Y	None	0
6B	Battery Charge Time (T3P only)	REAL	R	R	Y	None	0
6C	Battery Fault Time (T3P only)	REAL	R	R	Y	None	0
6D	Power Cycles	UDINT	R	R	Y	None	0
6E	Battery Fault Count (T3P only)	UDINT	R	R	Y	None	0

Device Type

Attribute ID #03 hex reports the type of device on the network using an ASCII string. In the response, the T3B or T3P unit is defined as a process control valve with the ASCII string “PCV.”

Standard Revision Level

Attribute ID #04 hex reports the most recent version of the Standards Device Model to which the unit adheres. The response is a 9 character (maximum) ASCII string “ENNNNNNYY” where:

E	=	SEMI assigned value
NNNNNN	=	Number of the standard [3]
YY	=	Year of the published standard

The default string is “E54-0997.”

Manufacturer

Attribute ID #05 hex reports the maker of the T3B or T3P throttle valve controller with an ASCII string. The manufacturer of the unit is always reported as MKS Instruments, identified with the ASCII string “MKS.”

Manufacturer Model Number

Attribute ID #06 hex reports the model number of the instrument with an ASCII string. The throttle valve controller is represented in the response with the ASCII string “T3BIA” or “T3PI.”

Firmware Revision Level

Attribute ID #07 hex reports the version of microprocessor code in the instrument. The format of the attribute is “XX.XX”; the default firmware revision level is “01.04.”

Hardware Revision Level

Attribute ID #08 hex designates the hardware version of your device with an ASCII string. The revision level is identified with the letters from “A” to “Z”; the default hardware revision is “ A.”

Serial Number

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

Device Configuration

Attribute ID #0A hex reports the device configuration, beyond the model number, as an ASCII string.

Device Status

Attribute ID #0B hex designates the state of the S-Device Supervisor Object. The possible object states and their corresponding values are listed in Table 60. The response reports the attribute value for the appropriate object state.

Table 60: Device Status Attribute Values

Attribute Value	S-Device Supervisor Object State
0	Unknown
1	Initialized / Self Testing
2	Idle
3	Self Test Exception
4	Executing
5	Abort from Idle or Executing
6	Critical Fault
7 to 255	Reserved

Exception Status

Attribute ID #0C hex reports the type of alarm or warning condition detected by the instrument. The alarms and warnings are identified as:

- Device Common—alarm/warning common to all SEMI devices
- Device Specific—specific to throttle valve controllers
- Manufacturer Specific—specific to the MKS unit

The response is a byte structured as a bit mapped variable [3]. The device supports the expanded mode of reporting exceptions. The bit map defining this variable is listed in Table 61.

Table 61: Exception Status Bit Map

Bit	Hex Value	Meaning
0 (least significant bit "LSB")	01	Alarm—Device Common
1	02	Alarm—Device Specific
2	04	Alarm—Manufacturer Specific
3	08	Reserved
4	10	Warning—Device Common
5	20	Warning—Device Specific
6	40	Warning—Manufacturer Specific
7 (most significant bit "MSB")	80	1*
** Bit 7 is always set.*		

The response returns a binary value with the least significant bit (bit 0) as the last digit. The response values are additive, therefore, one hexadecimal (hex) value reports all alarm conditions. For example, if the unit detects a device specific alarm condition, the unit reports a hex value of "82", where:

$$\mathbf{82_{hex} = 1\ 0\ 0\ 0\ 0\ 0\ 1\ 0}$$

Exception Detail Alarm

Attribute ID #3D hex identifies the specific alarm condition(s) detected by your throttle valve controller. The response is a byte with each bit representing a specific exception (alarm) condition, as listed in Table 62. Any bit that is set indicates that the alarm assigned to that bit is active. The response values are additive, therefore, one value reports all alarm conditions. The response returns a binary (hex) value with the least significant bit (bit 0) as the last digit.

The following table shows the supported exception details attribute bit definitions. Reserved bits are defined by the PCV profile but are not supported and will be reported with a value of zero. All manufacture specific bits will be warnings only.

At this time, the only reported alarm is for non-volatile memory. The only warnings available are for high/low pressure sensor reading valid and for valve slippage.

Table 62: Exception Detail Alarm Bit Map

Data Component	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Common Detail Size	0	0	0	0	0	0	1	0
Common Byte 0	Reserved	Reserved	Reserved	Reserved	Non-Volatile Mem.	Reserved	Reserved	Reserved
Common Byte 1	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Device detail Size	0	0	0	0	0	1	0	1
Device Detail Byte 0	Reserved	Reserved	Not Reading Valid * High Range Gage	Reserved	Reserved	Reserved	Reserved	Not Reading Valid * Low Range Gage
Device Detail Byte 1	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Device Detail Byte 2	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Device Detail Byte 3	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Device Detail Byte 4	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
Manufacture Detail Size	0	0	0	0	0	0	0	1
Manufacture Detail								Valve Slipped *

* Only used in the Warning Exception Detail, this bit is always = 0 in the Alarm

Exception Detail

'Not' indicates the use of the negation of 'Reading Valid'.

Exception Detail Warning

Attribute ID #0E hex identifies the specific warning condition(s) detected by your throttle valve controller. The response values are additive, therefore, one value reports all warning conditions. Since all of the bits in the exception detail warning are reserved, the response returns a value of 0.

Run Hours

Attribute ID #17 hex indicates the number of hours the device has been powered on.

Visual Indicator

Attribute ID #64 hex 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 (default)
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 your Instruction Manual for more information on the LED status indicators (*MKS Type T3B Butterfly Valve With DeviceNet*

Interface Instruction Manual, 137364-P1, or *MKS Type T3P Pendulum Valve With DeviceNet Interface Instruction Manual*, 137361-P1).

User Tag

Attribute ID #65 hex allows you to assign a label (user tag) to your throttle valve controller. The tag can be any user-defined string (including spaces) of up to 30 ASCII characters. The default user tag is the ASCII string “None.”

Operating Mode

Attribute ID #66 hex reports the operating mode of the device, where:

0 = User Mode (default)
1 = Calibration Mode

The *User mode* is the normal, default power up mode. The *Calibration mode* allows you to re-calibrate your device and to modify certain attributes that are read-only in the User mode. The Calibration mode should only be used by qualified field or service personnel.

Your device operates the same in each mode. However, your access to certain attributes over the network may be restricted, depending on which mode is active. Access rights to the specific attributes are defined in the various object attribute tables throughout this document.

Note To place your device into the Calibration mode, you must use the password protected Unlock service; the password is 1234_{hex}. Refer to Table 63, page 62, for more information.

User Cal Date

Attribute ID #67 hex reports the date the device was last calibrated by the user in days since UTC (1/1/1972). It is not automatically updated or referenced other than for display.

Factory Cal Date

Attribute ID #68 hex reports the factory calibration date in days since UTC (1/1/1972). This field is used to inform the user to record when the last calibration was done by MKS. It is not automatically updated or referenced other than for display.

Build Information

Attribute ID #69 hex reports the firmware build information including versions and dates.

Battery Total Life (T3P only)

Attribute ID #6A hex reports the total time under battery power in minutes. (Attribute ID #6A hex is not applicable to the T3B and always reports zero.)

Battery Charge Time (T3P only)

Attribute ID #6B hex reports the total time the battery has been fast-charged in minutes. (Attribute ID #6B hex is not applicable to the T3B and always reports zero.)

Battery Fault Time (T3P only)

Attribute ID #6C hex reports the total time in minutes the battery has been seen as faulted. (Attribute ID #6C hex is not applicable to the T3B and always reports zero.)

Power Cycles

Attribute ID #6D hex reports the total number of power cycles the device has detected.

Battery Fault Count (T3P only)

Attribute ID #6E hex reports the total number of reported faults with the battery or charging system. (Attribute ID #6E hex is not applicable to the T3B and always reports zero.)

S-Device Supervisor Object Supported Instance Services

The S-Device Supervisor Object is supported by the DeviceNet services listed in Table 63. Refer to *Supported Service Summary*, page 107, for more information.

Table 63: S-Device Supervisor Object Supported Instance Services

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
05	Reset*	None	Request	Place the object into its INITIALIZING state
06	Start	None	Request	Transitions from IDLE to EXECUTING state. Propagates an OPERATE command to all other objects.
07	Stop	None	Request	Place the object in the IDLE state and stops all objects.
0E	Get_Attribute_Single*	USINT	Request	Read the object attribute
10	Set_Attribute_Single*	USINT, Attribute Data Type	Request	Modify the object attribute
17	NoOp	None	Request	This service has no effect.
34	Lock	None	Request	Place the device into the User mode Restrict access to CAL mode attributes
35	Unlock (Password Protected)	UINT	Request	Place the device into the Calibration mode. Parameter required is 1234. Make CAL mode services and attributes available/modifiable
4B	Abort	None	Request	Place the whole device (all objects) in its ABORT state.

(continued on the next page)

Table 63: S-Device Supervisor Object Supported Instance Services (continued)

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
4C	Recover	None	Request	Cause the whole device (all objects) to transition from the ABORT state to the OPERATING state
4E	Perform Diagnostics	USINT	Request	The parameter specifies the type of diagnostic requested. The standard diagnostic is a 0 value parameter. Other values are not supported. There are no explicit diagnostics for this device. This service currently has no effect.

S-Analog Sensor Object

The S-Analog Sensor Object (Class Code 31_{hex}) contains the attributes for reporting the pressure value from the *analog* pressure transducers as well as reporting the read values for the valve position feedback. The first two instances of this object are not utilized if you are using a digital pressure transducer.

Five instances of the S-Analog Sensor Object are supported with four class attributes (refer to Table 65, page 64), three class services, twelve instance attributes (refer to Table 67, page 66), and five DeviceNet common services (refer to Table 66, page 65). SAS Instance number one represents Low Sensor and SAS instance number 2 represents High Sensor. Instance number 3 represents the control valve position feedback (regardless of implementation analog or digital). Instance 5 represents the temperature sensor. Instance 100 represents the input from the analog setpoint.

Note

The numbering of the sensor instances here is dictated by the DeviceNet profile. For this reason, the connector on the controller labeled Sensor 1 (High) is what DeviceNet refers to here as instance 2 (the high channel).

S-Analog Sensor Object Class Services

Table 64: S-Analog Sensor Object Supported Class Services

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

S-Analog Sensor Object Class Attributes

Table 65: S-Analog Sensor Object Class Attributes

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	0001
63	Subclass	UINT	R	R	Y	None	0001
64	ADC Full Scale Cal	INT	R	R*	Y	None	$0BB8_{hex}$
65	ADC Zero Cal	INT	R	R*	Y	None	0
* These values cannot be set directly but in CALIBRATION mode.							

Subclass

Attribute ID #63 hex identifies a subset of additional class attributes, services and behaviors. See ODVA DeviceNet Object Library S-Analog Sensor Object in Volume II, Release 2.0, Errata 5 for details.

ADC Full Scale Calibration

Attribute ID #64 hex reports A/D converter reading, which corresponds to the full scale analog input. The reported range is from -25565 to 32767, where 0 corresponds to 0% FS, and 32767 corresponds to 140% FS

per ODVA specification (23405 corresponds to 100%). This attribute is automatically updated after a Full Scale Calibrate service is sent.

ADC Zero Calibration

Attribute ID #65 hex reports A/D converter reading, which corresponds to the zero analog input reading. This attribute is automatically updated after a Zero Calibrate service is issued.

S-Analog Sensor Object Supported Services

The S-Analog Sensor Object is supported by the DeviceNet services listed in Table 66. Refer to *Supported Service Summary*, page 107, for more information.

Table 66: S-Analog Sensor Object Supported Services

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
0E	Get_Attribute_Single	USINT	Request	Read the object attribute
10	Set_Attribute_Single	USINT, Parameter Data Type	Request	Modify the object attribute
4B	Zero Adjust* **	<optional> Data Type	Request	Learn an Offset-B value such that the input reading equals the passed parameter (or zero if no parameter supplied). Format of the value is REAL or INT depending on attribute 3 (data type).
64	Calibrate*	USINT	Request	Place the object into the CALIBRATING state. Parameter “0” indicates a zero cal request. Parameter “1” indicates a full scale cal request. Although the results affect all sensors, the reference values are taken in respect to the selected instance’s value.

* Not available in user mode.
** Only offered for instances 1, 2 and 4

S-Analog Sensor Object Instance Attributes

Table 67: S-Analog Sensor Object Instance Attributes

Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Non-Volatile Memory	Data Variable	Factory Default Setting
03	Data Type	USINT	RW	RW	Y	0xC3 = INT 0xCA = REAL	0xC3 (INT)
04	Data Units	ENG UNITS	RW	RW	Y	See below	0x1001 (Counts)
05	Reading Valid	BOOL	R	R	N	0 = FALSE 1 = TRUE	0 (FALSE)
06	Value	DATA TYPE	R	R	N	None	0.0
07	Status	BYTE	R	R	N	See below	0
0A	Full Scale	DATA TYPE	R	R	Y	See below	Instances 1 and 2 0x5B6D (23405) Others are 32767
10	Offset-B	DATA TYPE	RW	RW	Y		0.0
1F	Average Time	UINT	RW	RW	Y	0x0 to 0xFFF9	0
20	Overrange	DATA TYPE	R	R	Y	105% of full scale	24575, 23405 for instances 3 and 5
63	Subclass	UINT	R	R	Y	None	6 or 0
64	Raw Counts	INT	R	R	N	0x8000 (-32768) to 0x7FFF (32767)	0
65	Range Select	USINT	RW	RW	Y	0 = 1 volt 1 = 5 volt 2 = 10 volt	2

Value

Attribute ID #06 hex reports the pressure reading if you are using an analog pressure transducer. The analog input is read from the A/D converter in the units set by Attribute ID #04 hex. Attribute ID #06 hex reports the valve position if you are using control valve position feedback (instance 3) or the temperature if you are using instance 5. The format of the number returned depends on the units and type specified.

Reading Valid

Attribute ID #05 hex indicates if the reading is valid. This value is 0 (False) if no initial reading has yet been made or if the value is out of range.

Data Type

Attribute ID #03 hex reports the data type of the input value defined by Attribute ID #06 hex as well as the Full Scale and Overrange values in this object, where:

0xCA = REAL
0xC3 = INT

Data Units

Attribute ID #04 hex reports the data units of the input value defined by Attribute ID #06 hex in this object, where:

0x1001	=	Counts
0x1007	=	Percent
0x1200	=	Celsius
0x1201	=	Fahrenheit
0x1703	=	Degrees
0x1300	=	PSI
0x1301	=	Torr
0x1302	=	mTorr
0x1307	=	Bar
0x1308	=	mBar
0x1309	=	PA
0x130A	=	kPA

Only Counts, degrees or percent are allowed for the valve position feedback instance. Only Counts, Celsius and Fahrenheit are allowed for the temperature instance. Counts, percent, Torr, mTorr, Bar, mBar, PA, kPA, or PSI are allowed for the other instances.

Status

This attribute is required for ODVA compliance but because there are no warning exceptions or alarm exceptions specific to this object, this value is always zero. To set alarms use the trip point object.

Full Scale

Attribute ID #0A hex reports the full scale of the sensor. This is represented in the data type from Attribute ID #03 hex and scaled to the units specified in Attribute ID #04 hex. See the Device Configuration object to modify these values for the first two instances. Note this default value is 23405 for instances 1 and 2. It is 32767 for all others.

Offset-B

Attribute ID #10 hex is the value applied to the sensor reading after gain is applied. It functions to shift the range rather than compress/expend the range of the sensor. Calling the ZeroAdjust service changes this value. This attribute is not offered for control valve position feedback instance 3 or temperature instance 5. Values allowed for instances 1 and 2 are limited to +- 5% of full scale expressed in the current units. No range checking is done for the analog setpoint instance.

Average Time

Attribute ID #1F hex is used for averaging the values read from the sensor. Values are rounded up to the next multiple of 9 to align with the sampling rate of the device. Values less than 9 disable averaging. This attribute is not offered for control valve position feedback instance 3 or temperature instance 5.

Overrange

Attribute ID #20 hex provides the overrange threshold for the sensor. This is fixed at 105% of full scale and is part of what is used to determine the value of the Reading Valid attribute. This value is in reference to the units selected for this instance, therefore will change when the units are changed.

Subclass

Attribute ID #63 hex identifies a subset of additional class attributes, services and behaviors. See ODVA DeviceNet Object Library S-Analog Sensor Object in Volume II, Release 2.0, Errata 5 for details. Instance 1 and 2 are subclass 6. All other instances are subclass 0.

Raw Counts

Attribute ID #64 hex reports the pressure value taken directly from the A/D converter output. Note that this number differs from the value when units are set to counts. The ODVA counts are not the same as raw counts.

Range Select

Attribute ID #65 hex configures what the full range pressure voltage will be from the sensors.

0 = 0 to 1 Volts
1 = 0 to 5 Volts
2 = 0 to 10 Volt

S-Analog Actuator Object

The S-Analog Actuator Object (Class Code 32_{hex}) contains information on the valve.

One instance of the S-Analog Actuator Object is supported with 18 instance attributes (refer to Table 70) and four DeviceNet services (refer to Table 71, page 75).

S-Analog Actuator Object Class Service

Table 68: S-Analog Actuator Object Supported Class Service

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
0E	Get_Attribute_Single	USINT	Request	Read a object class attribute

S-Analog Actuator Object Class Attribute

Table 69: S-Analog Actuator 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	0001

S-Analog Actuator Object Instance Attributes

Table 70: S-Analog Actuator Object Instance Attributes

Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Non-Volatile Memory	Data Variable	Factory Default Setting
03	Data Type	USINT	RW	RW	Y	0xC3 = INT 0xCA = REAL	0xC3 (INT)
04	Data Units	ENG UNITS	RW	RW	Y	See description	0x1001 (Counts)
05	Override	USINT	RW*	RW*	N	0 = Normal 1 = Close 2 = Open 3 = Hold 4 = Safe State	0
06	Value	DATA TYPE	RW	RW	Y		0
07	Status	BYTE	R	R	N	None	0
15	Safe State	USINT	RW	RW	Y	0 = Close 1 = Open 2 = Hold 3 = Safe Value	0 (Closed)
16	Safe Value	DATA TYPE	RW	RW	Y		0

(continued on the next page)

Table 70: S-Analog Actuator Object Instance Attributes (continued)

Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Non-Volatile Memory	Data Variable	Factory Default Setting
64	Range	DATA TYPE	R	R	Y	See below	32767
65	Total Steps	UINT	R	R	Y	None	Per valve type
66	Valve Slipped Indicator	BOOL	R	R	Y	0 = No slip detected 1 = Valve slipped	0
67	Calibrating State	BOOL	R	R	N	0 = Actuating 1 = Calibrating	0
68	16 Bit Position	INT	R	R	Y		0
69	Valve Type	USINT	R	R	Y	See below	0 (T3P) 7 (T3B)
6A	Close Override Input	BOOL	R	R	N	0 = Off 1 = On	0 (Off)
6B	Open Override Input	BOOL	R	R	N	0 = Off 1 = On	0 (Off)
6C	Learn at Power Up	BOOL	R	R	Y	0 = Off 1 = On	0 (Off)
6D	Interlock Status	BOOL	R	R	N	0 = Closed (Normal) 1 = Open	1 (Open)
6E	Air Status (T3P only)	BOOL	R	R	N	0 = Closed (Normal) 1 = Open (T3P only)	0 (Closed) (T3B) 1 (Open) (T3P)
6F	Interlock Enabled	BOOL	R	R	Y	0 = Off 1 = On	1 (Enabled)

Data Type

Attribute ID #03 hex reports the data type of the value defined by Attribute ID #06 hex in this object. It defaults to 0xC3 = INT. This also affects the format of Safe Value and Range.

Data Units

Attribute ID #04 hex reports the data units of the input value defined by Attribute ID #06 hex in this object, where:

0x1001 = Counts
0x1007 = Percent
0x1703 = Degrees

Note that this also affects the value of Safe Value, Position and Range.

Override

You can override the valve using a digital command over the network, or manually with the two switches on top of the unit. Refer to your Instruction Manual for more information (*MKS Type T3B Butterfly Valve With DeviceNet Interface Instruction Manual,* 137364-P1, or *MKS Type T3P Pendulum Valve With DeviceNet Interface Instruction Manual*, 137361-P1).

Attribute ID #05 hex allows you to override the control valve over the network, where:

0 = Normal (default)
1 = Close
2 = Open
3 = Hold
4 = Safe Value

Note

The valve override selector can only be modified when the valve is in the ACTUATING state.

If you override the valve with the manual switches, Attribute IDs #6A hex and 6B hex report the status of the valve override.

Value

Attribute ID #06 hex reports the position of the valve in the units set with Attribute ID #04 hex and in the data format of the type specified in Attribute ID #03 hex.

Note

The valve position value can also be reported as a 16 bit integer using Attribute ID #68 hex in this object. Refer to *16 Bit Position Value*, page 72, for more information.

Status

This value is not used in this controller. Zero is always returned.

Safe State

Attribute ID #15 hex specifies the position the valve will move to when instructed to go to the safe state. Options are:

0 = Closed (default)
1 = Open
2 = Hold
3 = Safe Value

Safe Value

Attribute ID #16 hex specifies the position the valve will move to when instructed to go to the safe value (in the units and type specified in the instance attributes)

Range

This attribute returns the maximum range settable for this valve. For T3B valves, it is 90 degrees. For T3P valves, it varies from 50 to 75 degrees depending on valve type, 100% or 32767 counts depending on the units and data type selected.

Valve Steps

Attribute ID #65 hex reports the total number of micro-steps required for the throttle valve to move from its fully closed (0º) to fully open position. This value is automatically updated whenever a Calibrate service is sent to the S-Analog Actuator Object. For T3B valves, the default values range from 1550 to 15500 depending on the valve type. For T3P valves, the default values range from 8700 to 13000 depending on the valve type.

Valve Slipped

Attribute ID #66 hex reports whether or not the valve has slipped, where:

0 = No slip detected (default)
1 = Valve slipped

Cal State

Attribute ID #67 hex reports the type of function being performed by the valve, where:

0 = Actuating (default)
1 = Calibrating

16 Bit Position Value

Attribute ID #68 hex reports the valve position as a signed 16 bit integer. The range of the attribute is 8000_{hex} (-32768) to $7FFF_{hex}$ (+32767). A value of 0 corresponds to 0º (fully closed), and $7FFF_{hex}$ corresponds to fully open.

Note The valve position can also be reported in the specified units using Attribute ID #06 hex in this object.

Valve Type

Attribute ID #69 hex reports the type of valve in your unit, where:

0 = 4” T3P (default for T3P)
1 = 6” T3P
2 = 8” T3P
3 = 10” T3P
4 = 12” T3P
5 = 14” T3P

6 = 20 mm T3B, Direct Drive, F-Cup Sealing
7 = 20 mm T3B, Direct Drive, Non-Sealing (default for T3B)
8 = 20 mm T3B, Geared Drive, F-Cup Sealing
9 = 20 mm T3B, Geared Drive, Non-Sealing
10 = 20 mm T3B, Geared Drive, O-Ring Sealing

11 = 1” T3B, Direct Drive, F-Cup Sealing
12 = 1” T3B, Direct Drive, Non-Sealing
13 = 1” T3B, Geared Drive, F-Cup Sealing
14 = 1” T3B, Geared Drive, Non-Sealing
15 = 1” T3B, Geared Drive, O-Ring Sealing

16 = 2” T3B, Direct Drive, F-Cup Sealing
17 = 2” T3B, Direct Drive, Non-Sealing
18 = 2” T3B, Geared Drive, F-Cup Sealing

19 = 2” T3B, Geared Drive, Non-Sealing
20 = 2” T3B, Geared Drive, O-Ring Sealing

21 = 60 mm T3B, Direct Drive, F-Cup Sealing
22 = 60 mm T3B, Direct Drive, Non-Sealing
23 = 60 mm T3B, Geared Drive, F-Cup Sealing
24 = 60 mm T3B, Geared Drive, Non-Sealing
25 = 60 mm T3B, Geared Drive, O-Ring Sealing

26 = 3” T3B, Direct Drive, Non-Sealing
27 = 3” T3B, Geared Drive, F-Cup Sealing
28 = 3” T3B, Geared Drive, Non-Sealing

29 = 4” T3B, Direct Drive, Non-Sealing
30 = 4” T3B, Geared Drive, F-Cup Sealing
31 = 4” T3B, Geared Drive, Non-Sealing

32 = 6” T3B, Direct Drive, Non-Sealing
33 = 6” T3B, Geared Drive, F-Cup Sealing
34 = 6” T3B, Geared Drive, Non-Sealing

35 = 8” T3B, Direct Drive, Non-Sealing
36 = 8” T3B, Geared Drive, F-Cup Sealing
37 = 8” T3B, Geared Drive, Non-Sealing

38 = 10” T3B, Direct Drive, Non-Sealing
39 = 10” T3B, Geared Drive, F-Cup Sealing
40 = 10” T3B, Geared Drive, Non-Sealing

Closed Override Input

Attribute ID #6A hex reports the status of the closed override switch for the valve actuator, where:

0 = Off (default)
1 = On

Open Override Input

Attribute ID #6B hex reports the status of the open override switch for the valve actuator, where:

0 = Off (default)
1 = On

Learn at Power Up (T3B only)

Attribute ID #6C hex is used to learn the step range by opening and closing the valve at power up. The default value is 0 which disables this feature. This feature is not offered on the T3P and cannot be changed from the default 0 (disabled).

Interlock Status

Attribute ID #6D hex reports the status of the external interlock where:

0 = Closed (Normal operation)
1 = Open

Air Status (T3P only)

Attribute ID #6E hex reports the status of the air supply interlock where:

0 = Closed (Normal operation)
1 = Open (Air pressure is below requirements)

(Attribute ID #6E hex is not applicable to the T3B and always reports zero.)

Interlock Enable Status

Attribute ID #6F hex reports the status of the external interlock where:

0 = Disabled
1 = Enabled (Normal operation)

If the interlock is disabled, the interlock status is still updated but will not impact the valve status LEDs or restrict the motor movement.

S-Analog Actuator Object Supported Instance Services

The S-Analog Actuator Object is supported by the five DeviceNet services listed in Table 71. Refer to *Supported Service Summary*, page 107, for more information. Note that the services listed do not require CALIBRATE mode to function. User mode is sufficient for these services.

Table 71: S-Analog Actuator Object Supported Instance Services

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
0E	Get_Attribute_Single	USINT	Request	Read the object attribute
10	Set_Attribute_Single	USINT, Parameter Data Type	Request	Modify the object attribute
38	Operate	None	Request	Transition from Recovering, Initializing or Idle to the Actuating state.
64	Calibrate	None	Request	Learn the number of steps in full travel of the valve.

Calibrate

Service ID #64 hex in the S-Analog Actuator Object updates the total number of microsteps required to move the valve from fully closed (0°) to fully open.

Table 72: Implementation of the S-Analog Actuator Calibrate Service

Service ID # (hex)	Class	Instance	Data Type	Variable
64	32	1	—	—

S-Single Stage Controller Object

The S-Single Stage Controller Object (Class Code 33_{hex}) contains the attributes for the variables used to generate the control variables for use by the S-Analog Actuator Object.

Two instances of the S-Single Stage Controller Object are supported with three class services, nine class attributes (refer to Table 74), twenty five (25) instance attributes (refer to Table 76) and five DeviceNet common instance services (refer to Table 75).

Supported instances: 1. Process Variable Control / subclass 1
2. Control Valve Position

S-Single Stage Controller Object Class Services

Table 73: S-Single Stage Controller Object Supported Class Services

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
0E	Get_Attribute_Single	USINT	Request	Read a object class attribute
10	Set_Attribute_Single	USINT, Attribute Data Type	Request	Modify the object attribute

S-Single Stage Controller Object Class Attributes

Table 74: S-Single Stage Controller Object Class Attributes

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	0001
64	SoftStart Open Rate	REAL	RW	RW	Y	0.1 to 100.0%	100.0% (disabled)
65	SoftStart Close Rate	REAL	RW	RW	Y	0.1 to 100.0%	100.0% (disabled)
66	SpeedUp Enable	BOOL	R	RW	Y	0 = disabled 1 = enabled	1 (enabled)
67	SpeedUp Time	REAL	R	RW	Y	0.01 to 1000.0	0.01
68	SpeedUp Filter Time	REAL	R	RW	Y	0.01 to 1000.0	0.02
69	Pedestal Value	REAL	R	RW	Y	0.0 to 30.0	0.0
6A	Learn Flow Rate	REAL	RW	RW	Y	0.0 to 500.0	0.0

(continued on the next page)

Table 74: S-Single Stage Controller Object Class Attributes (continued)

Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Non-Volatile Memory	Data Variable	Factory Default Setting
6B	Suggested	REAL	R	R	N	0.0 to 500.0	

	Learn Flow Rate						
6C	Flow Tau	REAL	R	RW	Y		0.3 seconds
6D	Backfill Enable	BOOL	RW	RW	Y	0 = disabled 1 = enabled	0 (disabled)
6E	Backfill Limit	REAL	RW	RW	Y	0.0 to 100.0%	0.95 (95%)
6F	Backfill Threshold	REAL	RW	RW	Y	0.0 to 100.0%	5%
70	Backfill State	BOOL	RW	RW	N	0 = off 1 = on	0 (off)
71	Backfill Delay	UINT	RW	RW	Y	0 to 600	30

Revision

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

SoftStart Open Rate

Attribute ID #64 hex defines how quickly the controlled pressure or position is ramped from the previous set point value to open if command to open. The acceptable input range is 0.1 to 100.0%; the default value is 100% effectively disabling the feature.

Note that this attribute is common to both instances and across all presets.

SoftStart Close Rate

Attribute ID #65 hex defines how quickly the controlled pressure or position is ramped from the previous set point value to close if command to close. The acceptable input range is 0.1 to 100.0%; the default value is 100% effectively disabling the feature.

Note that this attribute is common to both instances and across all presets.

SpeedUp Functions

The speedup functions are used to compensate for the measurement delay introduced by the pressure transducer. There are two adjustable parameters: compensation time constant and filter time constant. Both constants are entered and reported in seconds. The speedup compensation constant should be equal to the pressure transducer delay, typically in the order of tens of milliseconds. The speedup filter constant should be set 3 to 10 times smaller than the speedup compensation constant.

SpeedUp Enable

Attribute ID #66 hex enables or disables this speedup feature. Set this attribute to 1 (the default value) to enable. Set to 0 to disable.

SpeedUp Time

Attribute ID #67 hex defines the speedup time constant. Values range from 0.01 to 1000.0 seconds with a default of 0.01.

SpeedUp Filter Time

Attribute ID #68 hex defines the speedup filter time constant. Again, values range from 0.01 to 1000.0 seconds with a default of 0.02.

Pedestal Value

Attribute ID #69 hex defines the pedestal value. The conductance pedestal sets the minimum position of the valve when in pressure mode. Values range from 0.0 to 30.0 percent with a default of 0 (effectively disabling the feature). Note that this minimum position does not affect overrides or position commands.

Learn Flow Rate

Attribute ID #6A hex defines the learn flow rate. For a system learn, the system needs to calculate the pump speed. This requires the system know the flow rate into the chamber during the learn operation. Attribute ID #6A hex is this setting. It is entered and reported in SLM.

The range is 0.0 to 500.0 SLM and depends on the details of the particular system being used.

Suggested Learn Flow Rate

Attribute ID #6B hex provides an estimate for a learn flow rate. Using the system settings, the system estimates a learn flow that should produce good results.

The range is 0.0 to 500.0 SLM and depends on the details of the particular system being used.

Flow Tau

Attribute ID #6C hex defines the flow tau. The flow tau should be left as is unless explicitly instructed otherwise by MKS. The value is entered and reported in seconds.

Backfill Enable

Attribute ID #6D hex enables or disables the backfill feature. Set this attribute to 1 to enable. Set to 0 to disable (the default value). The backfill feature acts on setpoint commands issued AFTER being enabled and works off the HIGH sensor. Note that if trip points are configured using relay output 2, backfill is disabled.

Backfill Limit

Attribute ID #6E hex defines the backfill limit. This value is in percent (of setpoint). The backfill limit determines how close to setpoint the pressure must be before the backfill releay output is turned off.

Backfill Threshold

Attribute ID #6F hex defines the backfill threshold. The threshold is the minimum change in pressure required to activate the backfill relay output near the close position. The pressure change must be greater than the threshold AND the valve must be within 10% of the closed position to turn on the relay output.

Backfill State

Attribute ID #70 hex defines the backfill state of the backfill relay. Note that relay #2 is used for the backfill feature. Set this attribute to 0 to turn off backfill relay. Set to 1 to turn on backfill relay. Note that the state can only be set to 1 (on) if the backfill feature is enabled.

Backfill Delay

Attribute ID #71 hex defines the delay time as the Backfill Delay count times 10 milliseconds. Once the backfill relay is triggered, the valve is forced to position 0 (or to the pedestal). This delay timer will expre before returning to normal pressure control.

S-Single Stage Controller Object Supported Instance Services

The Controller Object is supported by the five DeviceNet common services listed in Table 75. Refer to *Supported Service Summary*, page 107, for more information.

Table 75: S-Single Stage Controller Object Supported Instance Services

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
0E	Get_Attribute_Single	USINT	Request	Read the object attribute
10	Set_Attribute_Single	USINT, Attribute Data Type	Request	Modify the object attribute
38	Operate	None	Request	Transition from Initializing, Recovering or Idle to the Operating state.
64	Calibrate (learn)*	USINT (instance), USINT (start/stop)	Request	Places the object in the CALIBRATING state which performs the system learn for Model-Based operation. Two parameters must be specified. The first parameters must indicate the Pressure Instance (1). The second parameter is 0 to stop or 1 to start the calibration.
* Calibrate is only offered for instance 1				

S-Single Stage Controller Object Instance Attributes

Table 76: S-Single Stage Controller Object Instance Attributes

Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Non-Volatile Memory	Data Variable	Factory Default Setting
03	Data Type	USINT	RW	RW	Y	0xC3 = INT 0xCA = REAL	0xC3 (INT)
04	Data Units	ENG UNITS	RW	RW	Y	See description	0x1001 (Counts)
05	Control Mode	USINT	RW	RW	Y	0 = Normal 1 = Closed 2 = Open 3 = Hold	0 (Normal)
06	Setpoint	DATA TYPE	RW	RW	N		0
07	Process Variable	DATA TYPE	RW	RW	N		0
09	Control Variable	INT	R	R	N	-32768 to 32767	0
0A	Status	BYTE	R	R	N	None	0
57	Calibrating State*	BOOL	R	R	N	0 = Actuating 1 = Calibrating	0
58	Crossover Delay Time*	UINT	RW	RW	Y	0 to 1000	100
59	Sensor Crossover High*	DATA TYPE	RW	RW	Y	0 to 105	0.9% of high channel full scale
5A	Sensor Crossover Low*	DATA TYPE	RW	RW	Y	0 to 105	100.0% of low channel full scale
5C	Kd	REAL	RW	RW	Y	0 to 32767	0.0
5D	Phase (Ki)	REAL	RW	RW	Y	0 to 32767	0.0
5E	Gain (Kp)	REAL	RW	RW	Y	0 to 32767	1.0
5F	Control Direction	BOOL	RW	RW	Y	0 = Direct 1 = Reverse	0 (Direct)
60	Process Variable Source*	USINT	RW	RW	Y	0 = Network 1 = SAS Low 2 = SAS High 3 = Auto 4 = Disabled	1 (SAS Low)
63	Subclass*	UINT	R	R	Y	0 = No Subclass 1 = PID and Source Select	1 for Instance 1, undefined otherwise
65	Algorithm Select*	USINT	RW	RW	Y	0 = Model Based 1 = PID	0
66	16 Bit Setpoint Value	INT	RW	RW	Y	-32768 to 32767	0

(continued on the next page)

Table 76: S-Single Stage Controller Object Instance Attributes (continued)

Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Non-Volatile Memory	Data Variable	Factory Default Setting
67	Gain Compensation Factor*	REAL	RW	RW	Y	Greater than 0.0	100.0% (disabled)
68	Phase Compensation Factor*	REAL	RW	RW	Y	Greater than or equal 0.0	100.0% (disabled)
69	Chamber Volume*	UINT	R	RW	Y	0 to 65535	30 liters
6A	Tau*	REAL	R	RW	Y		Per valve type
6C	SoftStart Setpoint Rate	REAL	RW	RW	Y	0.01 to 100.0%	100.0% (disabled)
6D	Active Preset	USINT	RW	RW	Y	0 = Local 1-6 = Presets	0 (Local)
6E	Volume Estimate*	BOOL	RW	RW	Y	0 = No 1 = Yes (enabled)	1 (enabled)
6F	Enable Slow Pump*	USINT	RW	RW	Y	0 = Off 1 = Both 2 = Increasing 3 = Decreasing	0 (Off)
70	Slow Pump Rate*	REAL	RW	RW	Y	Greater than or equal 0.0	0.0
71	Output Low Pass Filter*	UINT	R	RW	Y	0 to 32000	100
** Attributes are only supported for instance 1 (Pressure Controller).*							

Data Type

Attribute ID #03 hex reports the data type of the input value defined by Attribute ID #06 hex in this object, where:

0xCA = REAL
0xC3 = INT

Note that this cannot be changed while a polling connection using this object is active.

Data Units

Attribute ID #04 hex reports the data units of the input value defined by Attribute ID #06 hex in this object. Setting the units of this object actually sets the units of the process variable source. Specifically, if the units for the process variable control instance are set, the appropriate S-Analog Input units are also changed. If the units for the control valve position instance are set, the S-Analog Actuator units are also changed.

For the pressure instance, setting the units actually sets the units for the active process variable source. For position instance, setting the units actually sets the units for the S-Analog Actuator. The ranges for this attribute can be found in the respective attributes' descriptions. Note that this cannot be changed while services are started.

Control Mode

Attribute ID #05 hex reports the control mode for this controller instance. The control mode is the override signal for the specific controller instance and is only used when that controller instance is active. This is not the same as the S-Analog Actuator override.

Set Point

Attribute ID #06 hex defines the value of the current set point. The typical input range is 0 to 100% FS (scaled and formatted to the selected data type and units). The default value is 0.0. The actual set point value depends on whether your system is under pressure or position control. Depending on the selection object, one S-Single Stage Controller instance will be active. The setpoint of the active controller will determine the system behavior.

Note

The set point value can also be reported as a 16 bit integer using Attribute ID #66 hex in this object. Refer to *16 Bit Position Value*, page 99 for more information.

Also note that the setpoint is particular to a preset. See object 0x64 (Presets) for more information.

Process Variable

Attribute ID #07 hex reports the process variable for this controller instance. The process variable is the measured feedback from an S-Analog Sensor. The intention is to bring this value to the intended setpoint.

Control Variable

Attribute ID #09 hex reports the control variable for this controller instance. The control variable is the drive signal for the S-Analog Actuator needed to attain the desired setpoint.

Status

The status is unused and always returns 0.

Calibrating State

Attribute ID #57 hex reports if the controller is calibrating the system for the Model-Based control algorithm.

Crossover Delay Time

Attribute ID #58 hex defines the time necessary for the crossover condition to be present before range switching occurs in auto ranging mode. The acceptable input range is 0 to 1000; the default value is 100 milliseconds. Only instance 1 supports setting this parameter.

Sensor Crossover High

Attribute ID #59 hex defines the crossover point from high to low channel and is expressed as a percent of the low channel. The acceptable input range is 0 to 105; the default value is computed to be 90% of the low range full scale expressed in type (REAL or INT) of the controller instance.

* The value of Sensor Crossover High must be ***less*** than the value of Sensor Crossover Low.
For example, if the high sensor full scale is 1000T and the high crossover is 0.9%, then the high crossover is at 9T. The low channel full scale at 10T for example with a 100% low crossover puts the low crossover value at 10T, greater than the 9T high crossover.

Sensor Crossover Low

Attribute ID #5A hex defines the crossover point from low to high channel and is expressed as a percent of the low channel. The acceptable input range is 0 to 105; the default value is 100%.

* The value of Sensor Crossover Low must be ***more*** than the value of Sensor Crossover High.

Kd

Attribute ID #5C hex is the Kd value. The specification for ODVA requires this value. It can be set and is stored but it is unused for both instances 1 (Pressure Controller) and 2 (Position Controller).

Phase (Ki)

Attribute ID #5D hex defines the phase value used in the pressure control calculation. The acceptable input range is 0.0 to 32767.0; the default setting is 0.0. The phase is particular to a preset. See object 0x64 (Presets) for more information. This value can be set and is stored but not used in instance 2 (Position Controller).

Gain (Kp)

Attribute ID #5E hex defines the gain value used in the pressure control calculation. The acceptable input range is 0.0 to 32767.0; the default setting is 1.0. The gain is particular to a preset. See object 0x64 (Presets) for more information. This value can be set and is stored but not used in instance 2 (Position Controller).

Control Direction

Attribute ID #5F hex defines the direction the valve uses for its open and closed positions, where:

0 = Direct (default; downstream control)
1 = Reverse (upstream control)

Direct action occurs when the valve is open at 100% of its full scale position and closed at 0%. *Reverse* action occurs when the valve is open at 0% of its full scale position and closed at 100%. This value can be set and is stored but not used in instance 2 (Position Controller).

Process Variable Source

Attribute ID #60 hex defines the source of the pressure value, where:

0 = Network
1 = Analog input lock low sensor
2 = Analog input lock high sensor
3 = Analog input auto
4 = Disabled

In auto mode, the pressure source will switch to high sensor when the pressure goes above 100% of the low sensor range and switch to low sensor when it falls below 0.9% of the high sensor range. The pressure has to stay above or below the threshold for more then 100 msec before the active sensor switches. These values are changeable with the above attributes.

Algorithm Select

Attribute ID #65 hex specifies which pressure control algorithm to use, a unique Model-Based algorithm described in your Instruction Manual for more information (*MKS Type T3B Butterfly Valve With DeviceNet Interface Instruction Manual,* 137364-P1, or *MKS Type T3P Pendulum Valve With DeviceNet Interface Instruction Manual*, 137361-P1), or a traditional PID algorithm.

0 = Model-Based
1 = PID

16 Bit Setpoint Value

Attribute ID #66 hex reports the setpoint value in percent of full scale as a 16 bit integer. The range of the attribute is 8000_{hex} (-32768) to $7FFF_{hex}$ (32767) where 0 corresponds to 0% full scale and $7FFF_{hex}$ corresponds to 100%. For the pressure control instance, this is the pressure setpoint. For position instance it is the valve position setpoint.

Note

The setpoint value can be defined in the specified units using Attribute ID #04 hex in this object. This attribute however, remains as described regardless of chosen data type and units.

Gain Compensation Factor

Attribute ID #67 hex defines the gain compensation factor. This is a modifier to the gain value for use on the low channel sensor. If the pressure is being read by the low channel, the specified percentage of the gain value is used instead of the actual gain value in attribute 5E. Negative values are not allowed. The default value of 100% effectively disables the feature.

Phase Compensation Factor

Attribute ID #68 hex defines the phase compensation factor. This is a modifier to the phase value for use on the low channel sensor. If the pressure is being read by the low channel, the specified percentage of the phase value is used instead of the actual phase value in attribute 5D. Negative values are not allowed. The default value of 100% effectively disables the feature.

Chamber Volume

Attribute ID #69 hex defines the chamber size in liters.

Tau

Attribute ID #6A hex defines the control tau value. This value is used for the model based algorithm computations.

SoftStart to Setpoint

Attribute ID #6C hex defines how quickly the controlled pressure or position is ramped from the previous set point value to the current set point value. The acceptable input range is 0.1 to 100.0%; the default value is 100% effectively disabling the feature.

Note that the rate going full open or full closed is different. These rates are located in the class attributes as they are common to both instances and across all presets. The setpoint softstart rate is particular to a preset. See object 0x64 (Presets) for more information.

Active Preset

Attribute ID #6D hex defines the active preset for the particular controller instance. If 0 is selected, the values for setpoint value, SoftStart rate, Kp, Ki, and Kd are used and saved locally without changing a preset instance. If another preset is selected (1-6), that preset is made active and the values are loaded from this preset into the selecting controller. Changes made in the controller are saved back into the selected preset and changes to the active preset are reflected automatically in the controller. Changes made to a non-active preset are not applied to a controller until that preset is selected (made active).

See the presets object (0x64) for more information.

Selecting a value of 6 will enable analog setpoint control. When enabled, the setpoint information will be obtained from the analog setpoint instance of the S-Analog Sensor.

Volume Estimate

Attribute ID #6E hex defines the use of the volume estimate value. If enabled, the system will compute and update the chamber volume setting. If an exact value is known, it is preferred over the estimation.

Enable Slow Pump

Attribute ID #6F hex sets the state of the slow pump feature. The value is either a 0 (disabled), 1 (enabled both increasing and decreasing), 2 (decreasing only) or 3 (increasing only). When slow pump is disabled the target setpoint will be approached at full speed by the controller, limited only by controller tuning. When slow pump is enabled the target setpoint will be approached at the rate defined by slow pump rate.

When slow pump is changed to enabled (and for each time a new setpoint is entered while slow pump is enabled), the controller will read the current pressure and compare it with the desired pressure to determine if the pressure should be increased or decreased to get to the desired setpoint. Subsequently, the current setpoint will be modified (decremented or incremented per above) every control cycle until the current setpoint is equal to the desired setpoint. In this way the chamber may be adjusted in pressure in a gradual manner.

Slow Pump Rate

Attribute ID #70 hex specifies the slow pump rate, where value is the slow pump rate (Torr/sec).

Output Low Pass Filter

Attribute ID #71 hex defines the time constant (in milliseconds) for reporting pressure.

Trip Point Object

The Trip Point Object (Class Code 35_{hex}) contains the attributes for configuring the common trip point parameters, and for defining the valve position trip points.

Four instances of the Trip Point Object are supported with thirteen instance attributes (refer to Table 80, page 87), and three DeviceNet common services (refer to Table 79, page 86). The source for trip point instances 1 & 2 is implied to be the Single Stage Controller. The source for trip point instances 3 & 4 is implied to be the Digital Inputs.

Trip Point Object Class Service

Table 77: Trip Point Object Supported Class Service

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
0E	Get_Attribute_Single	USINT	Request	Read a object class attribute

Trip Point Object Class Attribute

Table 78: Trip Point 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	0001

Trip Point Object Supported Services

The Trip Point Object is supported by the three DeviceNet common services listed in Table 79. Refer to *Supported Service Summary*, page 107, for more information.

Table 79: Trip Point Object Supported Services

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

Trip Point Object Instance Attributes

Table 80: Trip Point Object Instance Attributes

Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Non-Volatile Memory	Data Variable	Factory Default Setting
03	High Trip Point Value*	DATA TYPE	RW	RW	Y		0
04	High Trip Enable*	BOOL	RW	RW	Y	0 = disabled 1 = enabled	1
05	Low Trip Point Value*	DATA TYPE	RW	RW	Y		0
06	Low Trip Enable*	BOOL	RW	RW	Y	0 = disabled 1 = enabled	1
07	Status	BOOL	R	R	N	0 = Off 1 = On	0
0A	Hysteresis*	DATA TYPE	RW	RW	Y	0 to 10000	0
0B	Delay	UINT	RW	RW	Y	0 to 10000 msec	0
0C	Destination	EPATH	RW	RW	Y	See below	
0D	Output	BOOL	R	R	N	0 = Off 1 = On	0
0E	Source	EPATH	RW	RW	Y	See below	
0F	Input	DATA TYPE	RW	RW	N		0
10	Data Units	ENG UNITS	R	R	Y	0x1301 (Torr)	0x1301 (Torr)
11	Data Type	USINT	R	R	Y	0xC3 = INT 0xCA = REAL	0xC3 (INT)
** Attributes are only supported for instance 1 & 2.*							

High Trip Point

Attribute ID #03 hex defines the high trip point value. The default value is 0%. This number is specified in the units and data type, which are taken from the specified source and shown in attributes 10 and 11. It is recommended to set the source before specifying the high and low values. This attribute does not affect the operation of Trip Points 3 & 4.

Low Trip Point

Attribute ID #05 hex defines the low trip point value. The default value is 0%. This number is specified in the units and data type, which are taken from the specified source. It is recommended to set the source before specifying the high and low values. This attribute does not affect the operation of Trip Points 3 & 4.

High and Low Trip Enables

Attribute ID #04 hex and Attribute ID #06 hex specify whether the trip point status attribute (Attribute ID #07 hex in this object) is updated when a valve position trip point condition occurs, where:

0 = Disabled
1 = Enabled (default)

Attribute ID #04 hex is for the high trip and Attribute ID #06 hex is for the low. This attribute does not affect the operation of Trip Points 3 & 4.

Status

Attribute ID #07 hex reports whether a valve position trip point condition exists, where:

0 = Off (default)
1 = On

Hysteresis

Attribute ID #0A hex sets the trip point hysteresis as an absolute value relative to the specified trip point value expressed in data type and units specified in the particular trip point instance. 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.” This attribute does not affect the operation of Trip Points 3 & 4.

Delay

This attribute specifies in milliseconds, how long the condition must exist before it affects the status. The range is 0 to 10000 milliseconds. The default value of 0 effectively disables the feature.

Destination

Attribute ID #0C hex specifies the destination for the trip point results. The choices for trip point instance 1 and 2 destination are: disabled, discrete output instance 1 or discrete output instance 2. Only trip point instances 1 and 2 may be mapped to a digital output instance. Trip point instances 3 and 4 are not permitted to map to a digital output.

The value is set as an abbreviated form of EPATH to the Discrete Output (class 09 attribute 03). These options are specified by the Process Control Valve Device Profile. See ODVA DeviceNet specifications for information on EPATH specifications or for the device profile.

The epath choices are:

0x00, 0x00	=	NO LINK	
0x24, 0x00	=	NO LINK	(default for trip point instances 3 & 4)
0x24, 0x01	=	Discrete Output 1	(default for trip point instance 1)
0x24, 0x02	=	Discrete Output 2	(default for trip point instance 2)

Note that the backfill option uses relay 2 if enabled. Keep this in mind when configuring the valve.

Output

Attribute ID #0D hex specifies the output of the trip point instance. For this device, the output is the same as the status (Attribute ID #07 hex).

Source

Attribute ID #0E hex defines the source of the attribute to be monitored for a tripped condition. The value for trip point instances 1 & 2 is set as an abbreviated form of EPATH to the S-Single Stage Controller (class x33 attribute x07). The value for trip point instaces 3 & 4 is an abbreviated EPATH to the Digital Inputs (class x08 atrribute 3). These options are specified by the Process Control Valve Device Profile. See ODVA DeviceNet specifications for information on EPATH specifications or for the device profile.

The epath choices are:

0x00, 0x00	=	NO LINK	
0x24, 0x00	=	NO LINK	(default for trip point instances 3 & 4)
0x24, 0x01	=	SSC 1 (Pressure)	(default for trip point instance 1)
0x24, 0x02	=	SSC 2 (Position)	(default for trip point instance 2)

Input

Attribute ID #0F hex is the input value. This is the value taken from the source specified in Attribute ID #0E hex that is compared to. The value is presented in the data type and units specified in other attributes in this instance of the trip point object.

Data Units

Attribute ID #10 hex specifies the data units for the input and setpoints for this instance. These are taken from the source specified and are not directly settable. They must be changed in the source instance if a change is desired. If there is no source, Torr is the default.

Data Type

Attribute ID #11 hex specifies the data type for the input and setpoints for this instance. This is taken from the source specified and is not directly settable. It must be changed in the source instance if a change is desired. If there is no source, INT is the default.

Setpoint Preset Object

The Setpoint Preset Object (Class Code 64_{hex}) contains the attributes for the controller setpoint presets. Operation of the valve requires selecting an active controller (pressure or position). Each of the controller instances offer presets which allow quick changing of the setpoint, the softstart rate, the Kp, Ki and Kd values.

See the S-Single Stage Controller instances for the selected active presets. Each controller instance can be set for 0 (for local versions) or 1-6 for a setpoint preset represented here. Note that other than local, the 6 presets can only be selected by a controller instance if the preset type agrees with the controller type.

Changed settings in this object's instances will be simply stored if the preset is not currently selected active by either S-Single Stage Controller instance. If the preset instance is active, changed settings will also be immediately applied to the controller instance using this preset. A change in an overlapping attribute in a controller instance will also be reflected in the preset instance (if not set to local).

Six instances of the Preset Object are supported with six instance attributes (refer to Table 84) and three DeviceNet common services (refer to Table 83). Only the one class attribute is supported (refer to Table 82).

Setpoint Preset Object Class Service

Table 81: Setpoint Preset Object Supported Class Service

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description
0E	Get_Attribute_Single	USINT	Request	Read a object class attribute

Setpoint Preset Object Class Attribute

Table 82: Trip Point 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	0001

Setpoint Preset Object Supported Instance Services

The Setpoint Preset Object is supported by the three DeviceNet common services listed in Table 68. Refer to *Supported Service Summary*, page 107, for more information.

Table 83: Setpoint Preset Object Supported Services

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

Setpoint Preset Object Instance Attributes

Table 84: Setpoint Preset Object Instance Attributes

Attribute ID # (hex)	Description	Data Type	User Mode	Cal Mode	Non-Volatile	Data Variable	Factory Default Setting

			Access	Access	Memory		
01	Preset Type	USINT	RW	RW	Y	1 = Pressure 2 = Position	Position for Preset 1, Pressure otherwise
02	Value	REAL	RW	RW	Y		0
03	SoftStart Rate	REAL	RW	RW	Y	0.01 to 100.0%	100.0%
06	Kp	REAL	RW	RW	Y	0 to 32767	1.0
07	Ki	REAL	RW	RW	Y	0 to 32767	0.0
08	Kd	REAL	RW	RW	Y	0 to 32767	0.0

Preset Type

Attribute ID #01 hex defines the preset type. This value corresponds to the instances of the S-Single Stage Controller. Use a value of 1 for instance 1 of the S-Single Stage Controller (Pressure) if this preset is to be used for a pressure setpoint. Use a value of 2 for instance 2 of the S-Single Stage Controller (Position). Note that the type cannot be changed while the preset is actively selected by a controller.

Value

Attribute ID #02 hex defines the setpoint value for the preset. This value will be used as the setpoint for the S-Single Stage Controller instance if this preset is selected. No range checking is done if this is not an active preset.

SoftStart Rate

Similarly to value above, this attribute will be used in the S-Single Stage Controller instance that selects this preset as active. This is the softstart to setpoint (not to open or to close).

Ki (Phase) an Kp (Gain)

Attribute ID #06 hex and Attribute ID #07 hex define the phase and gain values used in the pressure control calculation. See S-Single Stage Controller Object for their use. The values in the preset apply only to presets of type 1 (Pressure). They are unused for type 2 (Position) presets.

Kd

Attribute ID #08 hex is required for ODVA conformance but is not used by the controller. Values can be set and read but have no impact on the device.

Pump Speed Tables Object

The Speed Pump Tables Object (Class Code 65_{hex}) contains the attributes for pump speed curve data and selection. This information is only used with the Model-Based Algorithm in pressure control. If the PID Algorithm is used or position control is used, these values have no effect.

Three instances of the Pump Speed Tables Object are supported with one class attribute, thirty five (35) instance attributes (refer to Table 89) and three DeviceNet common services for the class or instances (refer to Table 88, page 95).

Instance 1 is the default curve and is read only. The values here depend on the valve type.

Instance 2 is the learned curve. The values are automatically updated when a system learn is performed. This learn is the calibrate service on the S-Single Stage Controller instance 1 (pressure).

Instance 3 is the user curve. These values can be written to in CAL mode.

Pump Speed Tables Object Supported Services

The Pump Speed Tables Object is supported by the three DeviceNet common services listed in Table 88. Refer to *Supported Service Summary*, page 107, for more information. These services apply to both the class and instances.

Table 85: Pump Speed Tables Object Supported Services

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

Pump Speed Tables Object Class Attribute

Table 86: Pump Speed Tables Object Class Attribute

Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Non-Volatile Memory	Data Variable	Factory Default Setting
01	Selected (Active) Table	USINT	R	RW	Y	1 = Default 2 = Learned 3 = User	1

Active Table

Attribute ID #01 hex is the table currently being used for the Model-Based Algorithm when selected in the pressure controller instance of the S-Single Stage Controller. In USER mode, this is for information only. In CAL mode, this can be changed to one of the three tables offered.

Pump Speed Tables Object Instance Attributes

Table 87: Pump Speed Object Instance Attributes

Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Non-Volatile Memory	Data Variable

01	Table Entry 1	REAL	R	RW*	Y	0.0 up
02	Table Entry 2	REAL	R	RW*	Y	0.0 up
03	Table Entry 3	REAL	R	RW*	Y	0.0 up
04	Table Entry 4	REAL	R	RW*	Y	0.0 up
05	Table Entry 5	REAL	R	RW*	Y	0.0 up
06	Table Entry 6	REAL	R	RW*	Y	0.0 up
07	Table Entry 7	REAL	R	RW*	Y	0.0 up
08	Table Entry 8	REAL	R	RW*	Y	0.0 up
09	Table Entry 9	REAL	R	RW*	Y	0.0 up
0A	Table Entry 10	REAL	R	RW*	Y	0.0 up
0B	Table Entry 11	REAL	R	RW*	Y	0.0 up
0C	Table Entry 12	REAL	R	RW*	Y	0.0 up
0D	Table Entry 13	REAL	R	RW*	Y	0.0 up
0E	Table Entry 14	REAL	R	RW*	Y	0.0 up
0F	Table Entry 15	REAL	R	RW*	Y	0.0 up
10	Table Entry 16	REAL	R	RW*	Y	0.0 up
11	Table Entry 17	REAL	R	RW*	Y	0.0 up
12	Table Entry 18	REAL	R	RW*	Y	0.0 up
13	Table Entry 19	REAL	R	RW*	Y	0.0 up
14	Table Entry 20	REAL	R	RW*	Y	0.0 up
15	Table Entry 21	REAL	R	RW*	Y	0.0 up
16	Table Entry 22	REAL	R	RW*	Y	0.0 up
17	Table Entry 23	REAL	R	RW*	Y	0.0 up
18	Table Entry 24	REAL	R	RW*	Y	0.0 up
19	Table Entry 25	REAL	R	RW*	Y	0.0 up
1A	Table Entry 26	REAL	R	RW*	Y	0.0 up
1B	Table Entry 27	REAL	R	RW*	Y	0.0 up
1C	Table Entry 28	REAL	R	RW*	Y	0.0 up
1D	Table Entry 29	REAL	R	RW*	Y	0.0 up

(continued on the next page)

Table 87: Pump Speed Object Instance Attributes (continued)

Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Non-Volatile Memory	Data Variable
1E	Table Entry 30	REAL	R	RW*	Y	0.0 up

1F	Table Entry 31	REAL	R	RW*	Y	0.0 up
20	Table Entry 32	REAL	R	RW*	Y	0.0 up
21	Table Entry 33	REAL	R	RW*	Y	0.0 up
22	Table Entry 34	REAL	R	RW*	Y	0.0 up
23	Table Entry 35	REAL	R	RW*	Y	0.0 up
* For instance 3 only this is RW, otherwise it is R.						

Table Entry

Attribute ID #01 hex through Attribute ID #23 hex are the elements of the table. They are entered as REAL numbers and cannot be negative.

Device Configuration Object

The Device Configuration Object (Class Code $6D_{hex}$) contains the attributes for some general setup information including: setting the device full scale ranges, and selecting which poll request is sent and which poll response is returned with I/O poll messaging connections.

One instance of the Device Configuration Object is supported with four instance attributes (refer to Table 89) and three DeviceNet common services (refer to Table 88, page 95). No class services or class attributes are supported for this object.

Device Configuration Object Supported Instance Services

The Device Configuration Object is supported by the three DeviceNet common services listed in Table 88. Refer to *Supported Service Summary*, page 107, for more information.

Table 88: Device Configuration Object Supported Services

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

Device Configuration Instance Attributes

Table 89: Device Configuration Instance Attributes

Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Non-Volatile Memory	Data Variable	Factory Default Setting
01	Poll Request Instance	USINT	RW	RW	Y	See below	7
02	Poll Response Instance	USINT	RW	RW	Y	See below	2
03	Low Pressure Full Scale Range	REAL	R	RW	Y		10.0
04	High Pressure Full Scale Range	REAL	R	RW	Y		1000.0
05	Power Up Operating Mode	USINT	RW	RW	Y	0 = User 1 = Cal	0 (User)
** Attribute ID #01 hex and Attribute ID #02 hex **cannot** be set if the Allocate Master Slave service has been issued and the poll connection is in the established state.*							

Poll Request Setup

Attribute ID #01 hex defines which poll request stored in the Assembly Object, (refer to Table 23, page 32) will be sent by the device when using I/O poll messaging connections. Assemblies 7, 23, 102, 103 and 104 are options. Note: Assembly 32 is available through explicit messaging only at this time.

Poll Response Setup

Attribute ID #06 hex defines which poll response stored in the Assembly Object (refer to Table 23, page 32) will be reported by the device when using I/O poll messaging connections Assemblies 2, 18, 100, 101, 105 and 106 are options.

Low Pressure Full Scale Range

Attribute ID #03 hex defines the full scale range (or 100% reading) for the low pressure sensor value, in Torr. The default value is 10.0. New values must be lower than the current High Pressure Full Scale Range setting.

High Pressure Full Scale Range

Attribute ID #04 hex defines the full scale range (or 100% reading) for the high pressure sensor value, in Torr. The default value is 1000.0. New values must be higher than the current Low Pressure Full Scale Range setting.

Power Up Operating Mode

Attribute ID #05 hex defines the login mode the valve comes up in after a power cycle. USER mode (= 0) is the normal operating mode for the valve. CAL (= 1) mode allows direct usage of all USER and CAL level commands without a separate login..

Appendix A: Quick Reference Guide

General Information

The information in this chapter is intended to guide you in locating the attributes needed to report basic system information.

System Status

To report the system status, use the following attributes:

- Exception Status (Attribute ID #0C hex in the S-Device Supervisor Object)

  Refer to *Exception* Status, page 59. This attribute identifies whether any alarm conditions exist. Alarms are identified as being device common, device specific, or manufacturer specific.

Note The exception status attribute is also reported as part of poll response #2, #18, #105, and #106. Refer to Table 23 page 32.

- Exception Detail Alarm (Attribute ID #0D hex in the S-Device Supervisor Object)

  Refer to *Exception Detail Alarm,* page 59. This attribute identifies the specific alarm condition(s) detected by your device.

- Exception Detail Warning (Attribute ID #0E hex in the S-Device Supervisor Object)

  Refer to *Exception Detail Alarm,* page 59. This attribute identifies the specific warning condition(s) detected by your device.

- Trip Point Status (Attribute ID #07 hex in the Trip Point Object instances)

  Refer to Status within the *Trip Point Object Instance Attributes*, page 88.

Set Points

To set or report the set point values, use any of the following attributes:

- Set Point Value (Attribute ID #06 hex, S-Single Stage Controller Object)

  This attribute defines the value of the current set point in the units specified in the object instance.

- 16 Bit Set Point Value (Attribute ID #66 hex, S-Single Stage Controller Object)

  This attribute reports the set point value reported with Attribute ID #06 hex in the Set Point Object in percent of full scale as a 16 bit signed integer.

Note These set point values are also available as part of several assemblies. Refer to Table 23 page 32.

- Destination Used (Attribute ID #0E hex) in instance 1 (Set Point of the Selection Object)

  This attribute defines which S-Single Stage Controller instance will be used, whether your system will be under pressure or position control. A value of 1 is used for S-Single Stage Controller instance 1 (pressure control). A value of 2 is for S-Single Stage Controller instance 2 (position control).

Pressure Control

To set or report the pressure value, use the following attributes:

- Process Variable (Attribute ID #07 hex, S-Single Stage Controller Object)

  This attribute reports the pressure value in the specified units.

Note The pressure value is also reported as part of poll response #18. Refer to Table 23 page 32.

- 16 Bit Setpoint Value (Attribute ID #66 hex in the S-Single Stage Controller Object)

  Refer to *16 Bit Setpoint Value*, page 76. This attribute reports the pressure value reported with Attribute ID #01 hex in the S-Single Stage Controller Object in percent of full scale as a 16 bit signed integer.

Note The 16 bit pressure value is also reported as part of poll response #2. Refer to Table 23 page 32.

- Analog Pressure Value (Attribute ID #01 hex in the Analog Input Object)

  Refer to Value, page 66. This attribute reports the pressure reading in the specified units from an *analog* pressure transducer.

Position Control

To set or report the valve position, use the following attributes in the S-Analog Actuator Object:

- Valve Position Value (Attribute ID #06 hex)

  Refer to Data Type, page 70. This attribute reports the position of the valve in the specified units.

- 16 Bit Valve Position (Attribute ID #6D hex)

  Refer to 16 Bit Position Value, page 72. This attribute reports the valve position reported with Attribute ID #01 hex in the S-Analog Actuator Object in percent of full scale as a 16 bit signed integer.

Note The 16 bit valve position value is also reported as part of assemblies #103, #104, and #106. Refer to Table 23 page 32.

- Valve Override Selector (Attribute ID #04 hex)

  Refer to *Override*, page 71. This attribute overrides the position of the valve.

Note The valve override selector is also reported as part of assemblies #103, #104, and #106. Refer to Table 23 page 32.

Appendix B: Command Summary

Attribute Summary

Table 73 lists the instance attributes for the objects in your throttle valve controller in numerical sequence by Class Code. For more information, refer to *Chapter Two: Operation,* page 13.

Table 90: Attribute Summary

Class Code (hex) Object	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	1D (hex)
		03	Product Code	UINT	R	R	684 (T3B) 686 (T3P)
		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	T3B T3P
		08	State	USINT	R	R	
03 DeviceNet	01	01	MAC ID	USINT	RW[1]	RW[1]	63
		02	Baud Rate	USINT	RW[1]	RW[1]	0 = 125 Kb
		03	Bus-Off Interrupt	BOOL	RW	RW	0
		04	Bus-Off Counter Function	USINT	RW	RW	0
		05	Allocation Information	Struct of: BYTE, USINT	R	R	0, 255
		06	MAC ID switch changed	BOOL	R	R	0
		07	Baud Rate switch changed	BOOL	R	R	0
		08	MAC ID switch value	USINT	R	R	
		09	Baud Rate switch value	USINT	R	R	
04 Assembly	02	03	Poll Response #2	Struct of : BYTE INT	R	R	None
	07	03	Poll Request #7	Struct of: INT UINT	RW	RW	None

(continued on the next page)

Table 90: Attribute Summary (continued)

Class Code (hex) Object	Instance ID # (hex)	Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Factory Default Setting
04 Assembly (continued)	12	03	Poll Response #18	Struct of: BYTE REAL	R	R	None
	17	03	Poll Request #23	Struct of: REAL UINT	RW	RW	None
	20	03	Poll Request #32	Struct of: USINT REAL REAL REAL REAL	RW	RW	None
	64	03	Trip Point Assembly	Struct of: BOOL BOOL BOOL BOOL BOOL	R	R	None
	65	03	Operational Status	Struct of: USINT USINT	R	R	None
	66	03	Poll Request #102	Struct of: REAL USINT USINT	RW	RW	None
	67	03	Poll Request #103	Struct of: INT USINT USINT	RW	RW	None
	68	03	Poll Request #104	Struct of: INT USINT USINT INT	RW	RW	None
	69	03	Poll Response #105	Struct of: USINT REAL INT USINT	R	R	None
	6A	03	Poll Response #106	Struct of: USINT INT INT INT USINT	R	R	None

(continued on the next page)

Table 90: Attribute Summary (continued)

Class Code (hex) Object	Instance ID # (hex)	Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Factory Default Setting
05 Connection	01	*See Table 27 page 39.*	None				
	02	*See Table 28 page 41.*	None				
08 Discrete Input	01 to 02	03	Discrete Input Value	BOOL	R	R	0 = Off
		07	Off_On Cycles	UDINT	R	R	0
09 Discrete Output	01 to 02	03	Discrete Output Value	BOOL	RW	RW	0 = Off
		64	Discrete Output Source	USINT	R	R	0, 1 or 2
	01 to 02	65	Discrete Output Enable	BOOL	RW	RW	0 = Disabled
0B Analog Output	01 to 02	03	Value	REAL	RW	RW	0
		64	Source	USINT	RW	RW	Inst #1=1 Inst #2=2
		65	DAC Counts	UINT	R	R	0
		66	Calibration Status	USINT	R	R	1 = Calibrated
2E Selection Object	01 to 02	01	State	USINT	R	R	01
		02	Max Destinations	UINT	R	R	Inst #1=2 Inst #2=1
		03	# of Destinations	UINT	R	R	Inst #1=2 Inst #2=1
		04	Destination List	Struct USINT, EPATH	R	R	
		05	Max Sources	UINT	R	R	Inst #1=0 Inst #2=2
		06	# of Sources	UINT	R	R	Inst #1=0 Inst #2=2
		08	Source Used	UINT	R	R	0
		0A	Algorithm Type	USINT	R	R	4 = Prog. Data Flow
		0D	Object Source List	Struct USINT, EPATH	R	R	
		0E	Destination Used	UINT	RW	RW	Inst #1=0 Inst #2=1
		0F	Input Data Value	DATA TYPE	RW	RW	0.0
		10	Output Data Value	DATA TYPE	R	R	0.0

(continued on the next page)

Table 90: Attribute Summary (continued)

Class Code (hex) Object	Instance ID # (hex)	Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Factory Default Setting
30 S-Device Supervisor	01	03	Device Type	SHORT-STRING	R	R	PCV
		04	Standard Revision	SHORT-STRING	R	R	E54-0997
		05	Manufacturer	SHORT-STRING	R	R	MKS
		06	Manufacturer Model Number	SHORT-STRING	R	R	T3B T3P
		07	Firmware Revision Level	SHORT-STRING	R	R	current firmware revision
		08	Hardware Revision Level	SHORT-STRING	R	R	current hardware revision
		09	Serial Number	SHORT-STRING	R	R	device specific
		0A	Device Configuration	SHORT-STRING	R	R	device specific
		0B	Device Status	USINT	R	R	0
		0C	Exception Status	BYTE	R	R	80 hex
		0D	Exception Detail Alarm	STRUCT	R	R	None
		0E	Exception Detail Warning	STRUCT	R	R	None
		0F	Alarm Enable	BOOL	RW	RW	1 = Enable
		10	Warning Enable	BOOL	RW	RW	1 = Enable
		17	Run Hours	UDINT	R	R	
		64	Visual Indicator	BOOL	RW	RW	0 = Off
		65	User Tag	SHORT-STRING	RW	RW	None
		66	Operating Mode	USINT	R	R	0 = User Mode
		67	User Cal Date	DATE	R	RW	
		68	Factory Cal Date	DATE	R	R	
		69	Build Information	SHORT-STRING	R	R	
		6A	Battery Total Life (T3P only)	REAL	R	R	0
		6B	Battery Charge Time (T3P only)	REAL	R	R	0
		6C	Battery Fault Time (T3P only)	REAL	R	R	0
		6D	Power Cycles	UDINT	R	R	0
		6E	Battery Fault Count (T3P only)	UDINT	R	R	0

(continued on the next page)

Table 90: Attribute Summary (continued)

Class Code (hex) Object	Instance ID # (hex)	Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Factory Default Setting
31 S-Analog Sensor	00 (class)	01	Revision	USINT	R	R	1
		63	Subclass	UINT	R	R	1
		64	Full Scale Cal	INT	R	R	30000
		65	Zero Scale Cal	INT	R	R	0
	01,02,03, 05,64	03	Data Type	USINT	RW	RW	0xC3 = INT
		04	Data Units	ENG UNITS	RW	RW	0x1001 = Counts
		05	Reading Valid	BOOL	R	R	0 = FALSE
		06	Value	DATA TYPE	R	R	0.0
		07	Status	BYTE	R	R	0
		0A	Full Scale	DATA TYPE	R	R	23405 instances 1,2 32767 otherwise
		10	Offset-B	DATA TYPE	RW	RW	0.0
		1F	Average Time	UINT	RW	RW	0
		20	Overrange	DATA TYPE	R	R	24575, 23405 for instances 3 and 5
		63	Subclass	UINT	R	R	6 or 0
		64	Raw Counts	INT	R	R	0
		65	Range Select	USINT	RW	RW	2
32 S-Analog Actuator	01	03	Data Type	USINT	RW	RW	0xC3 = INT
		04	Data Units	ENG UNITS	RW	RW	0x1001 = Counts
		05	Override	USINT	RW	RW	0 = Normal
		06	Value	DATA TYPE	RW	RW	0
		07	Status	BYTE	R	R	0
		15	Safe State	USINT	RW	RW	0 = Closed
		16	Safe Value	DATA TYPE	RW	RW	0
		64	Range	DATA TYPE	R	R	32767
		65	Total Steps	UINT	R	R	Depends on valve type
		66	Valve Slipped Indicator	BOOL	R	R	0 = No slip detected
		67	Calibrating State	BOOL	R	R	0 = Actuating 1 = Calibrating
		68	16 bit Position	INT	R	R	0

(continued on the next page)

Table 90: Attribute Summary (continued)

Class Code (hex) Object	Instance ID # (hex)	Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Factory Default Setting
32 S-Analog Actuator (continued)	01	69	Valve Type	USINT	R	R	7 = 20mm (T3B) 0 = 4" (T3P)
		6A	Close Override Input	BOOL	R	R	0 = Off
		6B	Open Override Input	BOOL	R	R	0 = Off
		6C	Learn at Power Up	BOOL	R	R	0 = Off
		6D	Interlock Status	BOOL	R	R	1 = Open
		6E	Air Status (T3P only)	BOOL	R	R	0 = Closed (T3B) 1 = Open (T3P)
		6F	Interlock Enabled	BOOL	R	R	1 = Enabled
33 S-Single Stage Controller	00 (class)	64	SoftStart Open Rate (%)	REAL	RW	RW	100.0
		65	SoftStart Close Rate (%)	REAL	RW	RW	100.0
		66	SpeedUp Enable	BOOL	R	RW	1 = enabled
		67	SpeedUp Time	REAL	R	RW	0.01
		68	SpeedUp Filter Time	REAL	R	RW	0.02
		69	Pedestal Value	REAL	R	RW	0.0
		6A	Learn Flow	REAL	RW	RW	0.0
		6B	Estimated Learn Flow	REAL	R	R	
		6C	Flow Tau	REAL	R	RW	0.3
		6D	Backfill Enable	BOOL	RW	RW	0 = disabled
		6E	Backfill Limit	REAL	RW	RW	0.95 (95%)
		6F	Backfill Threshold	REAL	RW	RW	5%
		70	Backfill State	BOOL	RW	RW	0 = off
		71	Backfill Delay	UINT	RW	RW	30
	01 or 02	03	Data Type	USINT	RW	RW	0xC3 = INT
		04	Data Units	ENG UNITS	RW	RW	0x1001 = Counts
		05	Control Mode	USINT	RW	RW	0 = Normal
		06	Setpoint	DATA TYPE	RW	RW	0
		07	Process Variable	DATA TYPE	RW	RW	0
		09	Control Variable	INT	R	R	0
		0A	Status	BYTE	R	R	0
		57	Calibrating State	BOOL	R	R	0 (not calibrating)

(continued on the next page)

Table 90: Attribute Summary (continued)

Class Code (hex) Object	Instance ID # (hex)	Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Factory Default Setting
33 S-Single Stage Controller (continued)	01 or 02	58	Crossover Delay Time	UINT	RW	RW	100
		59	Sensor Crossover High	DATA TYPE	RW	RW	0.9% of high channel full scale
		5A	Sensor Crossover Low	DATA TYPE	RW	RW	100.0% low channel full scale
		5C	Kd	REAL	RW	RW	0.0
		5D	Phase (Kp)	REAL	RW	RW	0.0
		5E	Gain (Kp)	REAL	RW	RW	1.0
		5F	Control Direction	BOOL	RW	RW	0 = Direct
		60	Process Variable Source	USINT	RW	RW	1 = SAS Low
		63	Subclass	UINT	R	R	1 for Pressure Instance
		65	Algorithm Select	USINT	RW	RW	0 = Model Based
		66	16 Bit Setpoint Value	INT	RW	RW	0
		67	Gain Compensation Factor	REAL	RW	RW	100.0
		68	Phase Compensation Factor	REAL	RW	RW	100.0
		69	Chamber Volume	UINT	R	RW	30
		6A	Tau	REAL	R	RW	Per valve type
		6C	SoftStart to Setpoint	REAL	RW	RW	100%
		6D	Active Preset	USINT	RW	RW	0
		6E	Use Volume Estimate	BOOL	RW	RW	1 = enabled
		6F	Enable Slow Pump	USINT	RW	RW	0 (Off)
		70	Slow Pump Rate	REAL	RW	RW	0.0
		71	Output Low Pass Filter	UINT	R	RW	100
35 Trip Point	01 to 04	03	High Trip Point Value	DATA TYPE	RW	RW	0
		04	High Trip Point Enable	BOOL	RW	RW	1
		05	Low Trip Point Value	DATA TYPE	RW	RW	0
		06	Low Trip Point Enable	BOOL	RW	RW	1
		07	Status	BOOL	R	R	0

(continued on the next page)

Table 90: Attribute Summary (continued)

Class Code (hex) Object	Instance ID # (hex)	Attribute ID # (hex)	Description	Data Type	User Mode Access	Cal Mode Access	Factory Default Setting
35 Trip Point (continued)	01 to 04	0A	Hysteresis	DATA TYPE	RW	RW	0
		0B	Delay	UINT	RW	RW	0
		0C	Destination	EPATH	RW	RW	
		0D	Output	BOOL	R	R	0
		0E	Source	EPATH	RW	RW	
		0F	Input	DATA TYPE	RW	RW	0
		10	Data Units	ENG UNITS	R	R	0x1301 (Torr)
		11	Data Type	USINT	R	R	0xC3 (INT)
64 Setpoint Preset	01 to 06	01	Preset Type	USINT	RW	RW	Inst #1=2, others=1
		02	Value	REAL	RW	RW	0
		03	SoftStart Rate	REAL	RW	RW	100%
		06	Kp	REAL	RW	RW	1.0
		07	Ki	REAL	RW	RW	0.0
		08	Kd	REAL	RW	RW	0.0
65 Pump Speed Tables	00 (class)	01	Selected Table	USINT	R	RW	1
65 Pump Speed Tables	01 to 03	01 to 23	Table Entry	REAL	R	RW[3]	
6D Device Config	01	01	Poll Request Instance	USINT	RW	RW	7
		02	Poll Response Instance	USINT	RW	RW	2
		03	Low Pressure Full Scale Range	REAL	RW	RW	10.0 Torr
		04	High Pressure Full Scale Range	REAL	RW	RW	1000.0 Torr
		05	Power Up Operating Mode	USINT	RW	RW	0 (User)

[1] *These attributes can only be written if their corresponding hardware switches, located on top of the device, are in the network (PGM) position. Refer to your Instruction Manual for more information (*MKS Type T3B Butterfly Valve With DeviceNet Interface Instruction Manual, *137364-P1, or* MKS Type T3P Pendulum Valve With DeviceNet Interface Instruction Manual, *137361-P1).*

[2] *This attribute cannot be written when the device is in the ABORT state.*

[3] *For instance 3 only this is RW, otherwise it is R.*

Supported Service Summary

Table 91 lists the services supported by the objects in your throttle valve controller in numerical sequence by their ID number, as well as which object supports each service. The parameters for each service are defined on the following pages. For more information on each object, refer to *Chapter Two: Operation*, page 13.

Refer to the ODVA DeviceNet specification, Volume I [1] for complete descriptions of the common services. Refer to the SEMI Standard Common Device Model [3] for complete descriptions of all other services.

Table 91: Supported Service Summary

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description	Objects
05	Reset	USINT	Request	Place the object into its INITIALIZING or SELF-TESTING state	Identity S-Device Supervisor
06	Start	None	Request	Places the object into the EXECUTING state	S-Device Supervisor
07	Stop	None	Request	Places the object into the IDLE state	S-Device Supervisor
0E	Get_Attribute_Single	USINT	Request	Read the object attribute	All Objects
10	Set_Attribute_Single	USINT, Attribute Data Type	Request	Modify the object attribute	DeviceNet Assembly Connection Discrete Output Selection S-Device Supervisor S-Analog Sensor S-Analog Actuator S-Single Stage Controller Setpoint Preset Device Configuration Pump Speed Tables Trip Point
34	Lock	None	Request	Restrict access to *read-only* attributes; places the device into the *User* mode	S-Device Supervisor
35	Unlock (Password Protected)	UINT	Request	Place the device into the *Cal* mode Make CAL mode services and attributes available/modifiable	S-Device Supervisor

(continued on the next page)

Table 91: Supported Service Summary (continued)

Service ID # (hex)	Service Name	Parameter Data Type(s)	Service Type	Description	Objects

38	Operate	None	Request	Transition to updating or operating state. This is used to propagate the start service to all objects.	S-Analog Actuator S-Single Stage Controller
4B	Abort	None	Request	Place the device in its ABORT state, where the valve is driven to its *Safe* state.	S-Device Supervisor
4B	Zero Adjust	Optional target value (assumed 0.0 if omitted)	Request	Initiate an automatic sampling to properly set the sensor zero offset value of a specific sensor instance.	S-Analog Sensor
4B	Allocate_Master_Slave	BYTE, USINT	Request	Allocate the Predefined Master/Slave Connection Set	DeviceNet
4C	Recover	None	Request	Cause the device to transition from the ABORT state to the EXECUTING state	S-Device Supervisor
4C	Release_Master_Slave	BYTE	Request	Release the Predefined Master/Slave Connection Set	DeviceNet
4E	Perform Diagnostics	USINT	Request	Perform selected diagnostic on device. Parameter value of 1 is the only supported value.	S-Device Supervisor
64	Calibrate	USINT	Request	Place the object into its CALIBRATING state.	S-Analog Sensor S-Analog Actuator S-Single Stage Controller

Reset

The Reset service (Attribute ID #05 hex) is valid for the Identity and S-Device Supervisor Objects. The meaning is different for the two objects. A reset of the S-Device Supervisor puts the device into self-test state. A reset of the Identity Object supports a parameter value of 0, which causes the device to emulate a power cycle as closely as possible [2].

Get Attribute Single

The Get_Attribute_Single service (Attribute ID #0E hex) reads the value of an object instance attribute. This service is valid for every object in your device. The parameters for this DeviceNet common service are listed in Table 92.

Table 92: Get Attribute Single Service Parameters

Parameter	Request	Response	Service Data Type	Description
Attribute ID	Mandatory	---	USINT	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 (Attribute ID #10 hex) modifies the value of an object instance attribute. If necessary, the attribute value is also saved to non-volatile memory. The parameters for this DeviceNet common service are listed in Table 93.

Table 93: Set Attribute Single Service Parameters

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

Lock

The Lock service (Attribute ID #34 hex)—valid only for the S-Device Supervisor Object—places the device into the User mode, which restricts access to certain attributes and services across all objects. This service guarantees that the Cal mode only attributes cannot be modified over the network and that the Cal mode only services cannot be called. There are no parameters specified for this service.

Unlock

The Unlock service (Attribute ID #35 hex) —valid only for the S-Device Supervisor Object—places the device into the Calibration mode, which allows you to modify certain read-only attributes of the device and call certain Cal mode only services. The parameters for this service are listed in Table 94.

Table 94: Unlock Service Parameter

Parameter	Request	Response	Service Data Type	Description
Password	Mandatory	---	UINT	1234_{hex} = Calibration mode

Calibrate

The Calibrate service (Attribute ID #64 hex) places the object instance into the CALIBRATING state. This service is valid for the S-Analog Sensor, S-Analog Actuator and S-Single Stage Controller Objects. The parameters for this service are listed in Table 95.

For S-Analog Sensor, the calibrate service allows setting the zero and full scale calibration values. Pass in 0 for a parameter to indicate a zero cal, a 1 for full scale cal. Instance needs to also be passed in to know which values the calibration is in reference to.

For the S-Analog Actuator, the calibrate service initiates a learn operation of the total steps between open and closed valve positions.

For S-Single Stage Controller, the calibrate service initiates a learn operation of the pump speed values of the system at various valve positions. This is part of the model-based algorithm. Instance 1 is required to pass in for a calibration service to indicate the pressure instance is being calibrated. Additionally, a parameter needs to be specified as 1 to start or 0 to stop the calibration.

Table 95: Calibrate Service Parameters

Object	Parameter	Request	Response	Service Data Type	Description

S-Analog Sensor	Calibration Range	Mandatory	—	USINT	0 = Zero Calibration (Analog Input Object only) 1 = Full Scale Calibration (Analog Input Object only)
S-Analog Actuator	—	—	—	—	Update total steps between open and closed valve positions
S-Single Stage Controller	Start or Stop	—	—	USINT	Learn the pump speed of the valve (for use with model-based algorithm)

Abort

The Abort service (Attribute ID #4B hex)—valid only for the S-Device Supervisor Object—places the object instance into its ABORT state. There are no parameters specified for this service.

Allocate Master/Slave

The Allocate_Master_Slave service (Attribute ID #4B hex)—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]. The parameters for this DeviceNet common service are listed in Table 96. For complete information on this service, refer to the ODVA DeviceNet Specification, Volume I [1].

Table 96: Allocate Master/Slave Service Parameters

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

Allocation Choice Parameter

The Allocation Choice parameter is specified within a single byte (refer to Table 97). 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 97: 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

Recover

The Recover service (Attribute ID #4C hex)—valid only for the S-Device Supervisor Object—moves the object instance from its ABORT state to the EXECUTING state. There are no parameters specified for this service.

Release Master/Slave

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

Table 98: Release Master/Slave Service 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 (refer to Table 99). 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 99: Release Choice Byte Contents

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

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Appendix C: 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, data types, and any required data variable(s).

Explicit Messaging

Explicit messaging connections utilize a direct request/response format, which allow you to access any attribute data. Explicit messaging is typically used for the setup, configuration, and calibration of your device. Refer to *Explicit Messaging Connections*, page 14, for more information.

Three examples of explicit messages are described on pages 128 – 132. These messages illustrate how to request information on the Vendor, and how to interpret the network's response. The following information applies for each example:

- The examples depict explicit messaging
- The examples are all non-fragmented message strings
- The MAC ID of the MKS device (the Slave) is 05
- The MAC ID of the Master device is 01

Note Spaces are shown for clarity only. Do not enter spaces in the actual message string.

Example 1: How to Send an Explicit Request Message

To query the Vendor for your throttle valve controller, enter the command:

42C 01 0E 01 01 01

where:

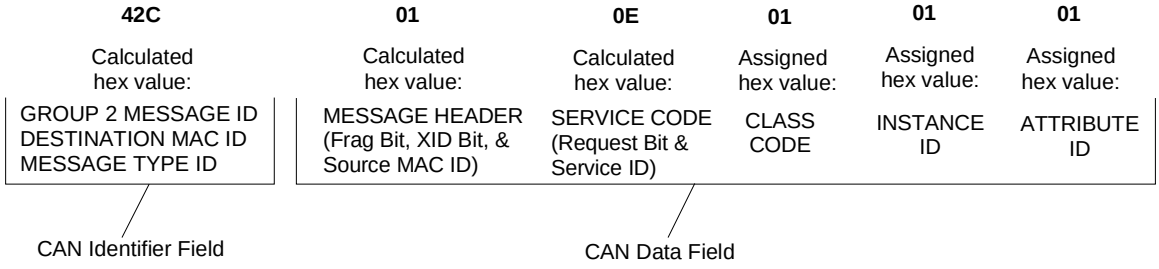

Figure 1: Explicit Request Message

To calculate the request message shown in Figure 1:

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

   Refer to Figure 2, step 1, page 115. This 11 bit field represents the fixed Group 2 Message ID (bits 10 & 9), the *destination* MAC ID (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 2, 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 *source* MAC ID (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 2, step 3, page 115. 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 2, step 4, page 115. The requested Vendor 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 listed throughout this document. This information in summarized for easy reference in Table 73, page 109.

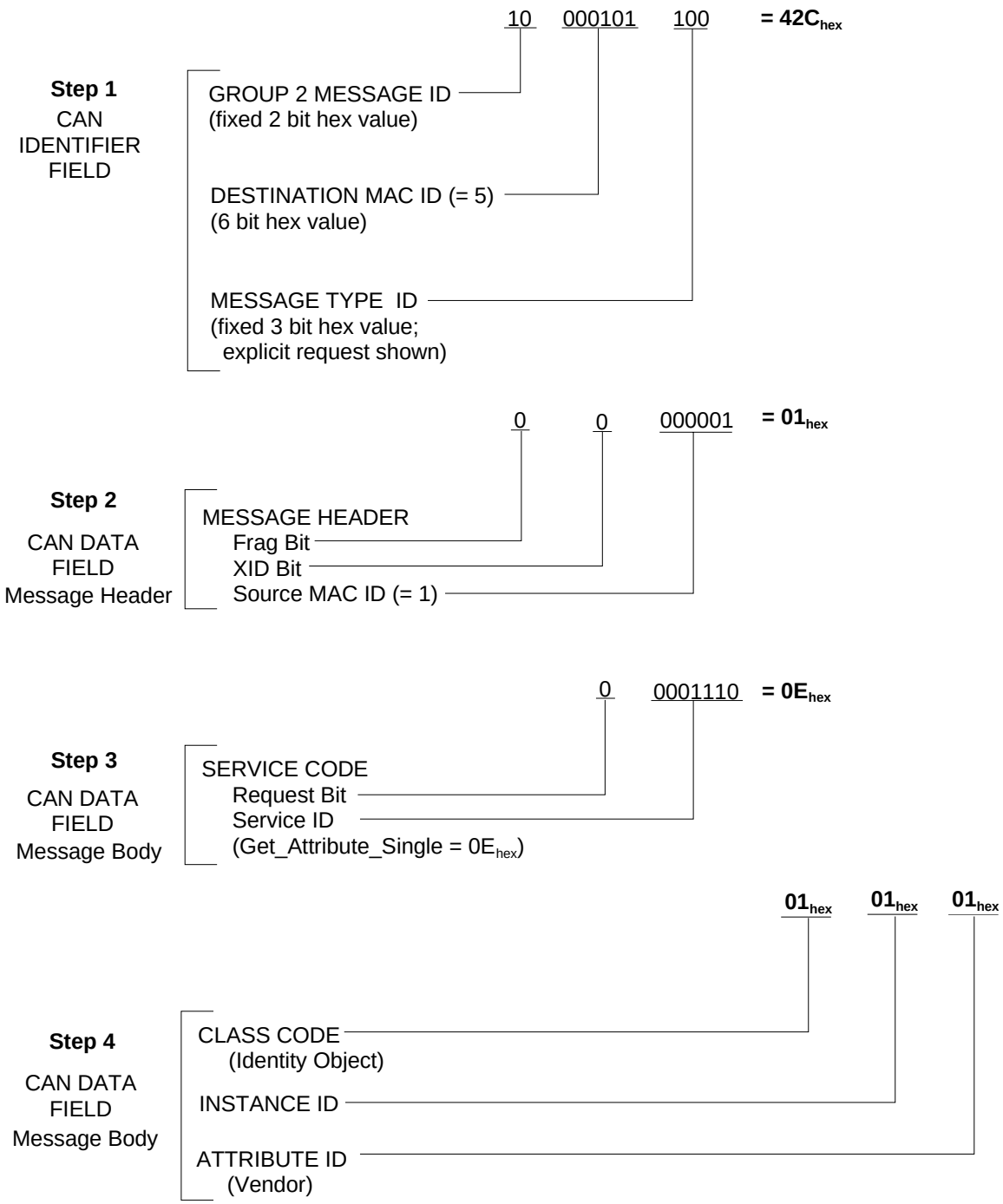

Figure 2: Explicit Request Message Components

Example 2: How to Interpret a Successful Explicit Response Message

If the request message sent in *Example 1: How to Send an Explicit Request Message*, page 113, is properly sent and received, the device returns the following response message:

42B 01 8E 24 00

where:

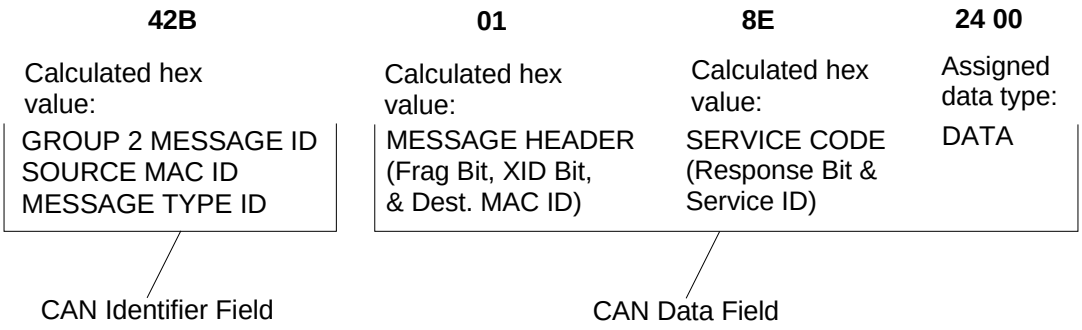

Figure 3: Successful Explicit Response Message

To interpret the response message shown in Figure 3:

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

   Refer to Figure 4, step 1, page 117. This 11 bit field represents the fixed Group 2 Message ID (bits 10 & 9), the *source* MAC ID (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 4, 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* MAC ID (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 4, 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 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 4, step 4, page 117. The assigned data type for the Vendor is an unsigned 16-bit integer value; the assigned Vendor number for all MKS devices is 36 (24_{hex}). Refer to Table 13, page 35 for more information.

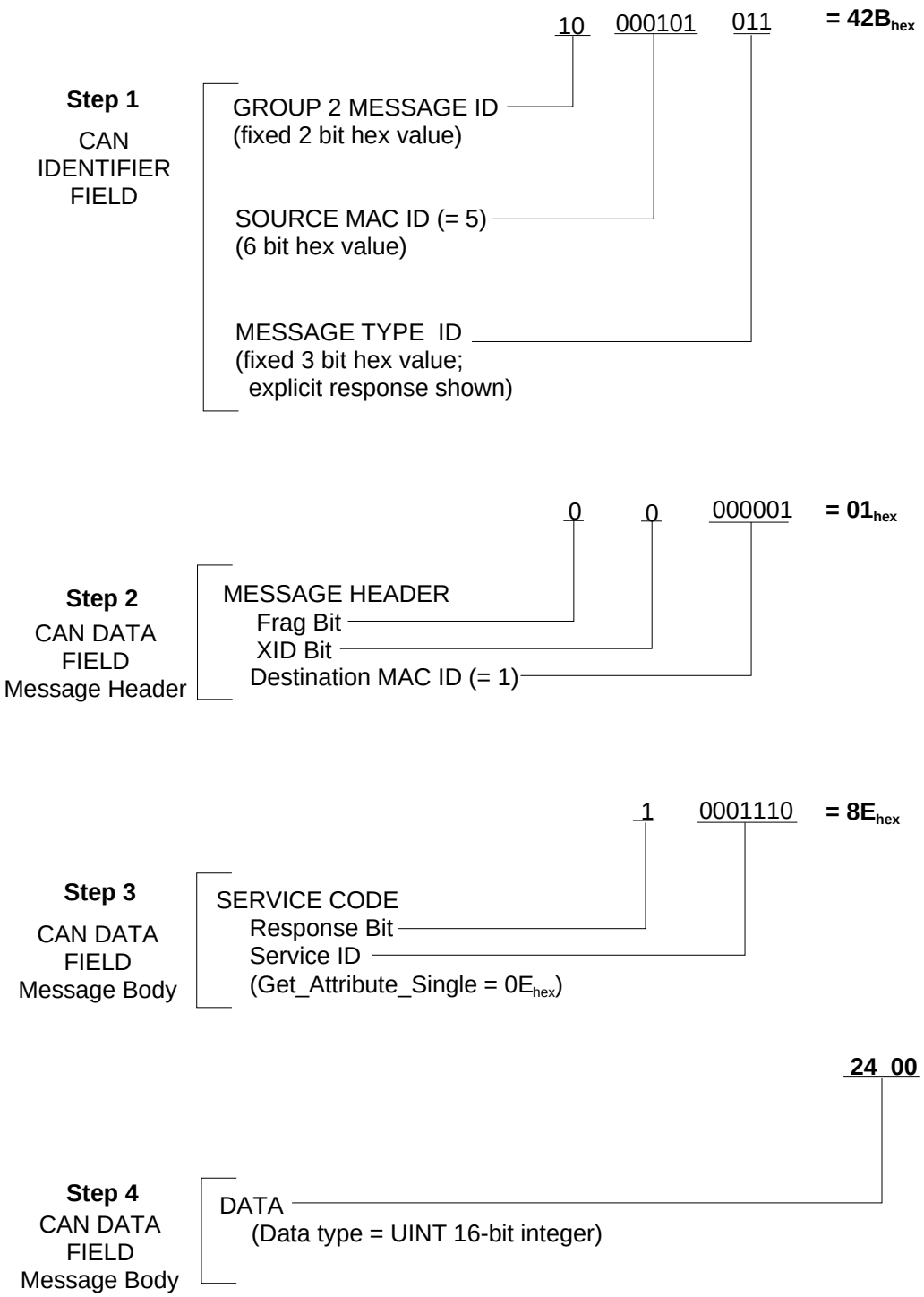

Figure 4: Successful Explicit Response Message Components

Example 3: How to Interpret an Explicit Message Error Response

If the request message sent in *Example 1: How to Send an Explicit Request Message*, page 113, 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:

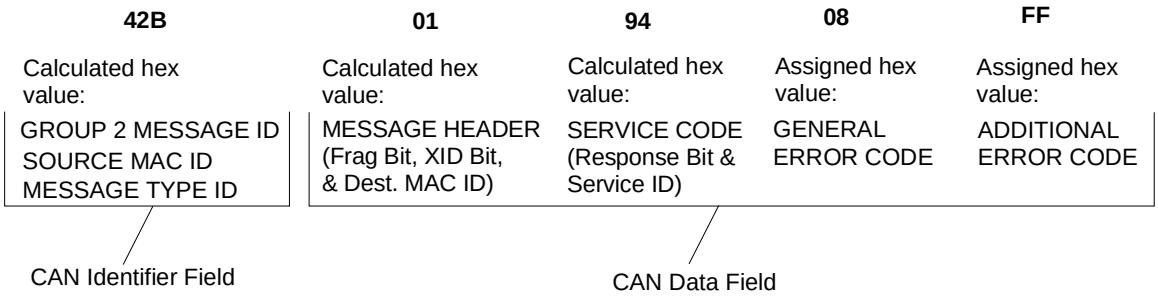

Figure 5: Explicit Message Error Response

To interpret the error response message shown in Figure 5:

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

   Refer to Figure 6, step 1, page 134. This 11 bit field represents the fixed Group 2 Message ID (bits 10 & 9), the *source* MAC ID (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 hex value (01_{hex}) for the message header in the CAN Data Field.

   Refer to Figure 6, step 2, page 134. This 8 bit field represents the fragment bit (bit 7, set to 0), the XID bit (bit 6, set to 0), and the *destination* MAC ID (the Master device) as a hexadecimal number (bits 5 to 0).

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

   Refer to Figure 6, step 3, page 134. 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 6, step 4, page 134. 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 that is particular to your MKS throttle valve controller. If an additional error code is not applicable, an “FF” is returned.

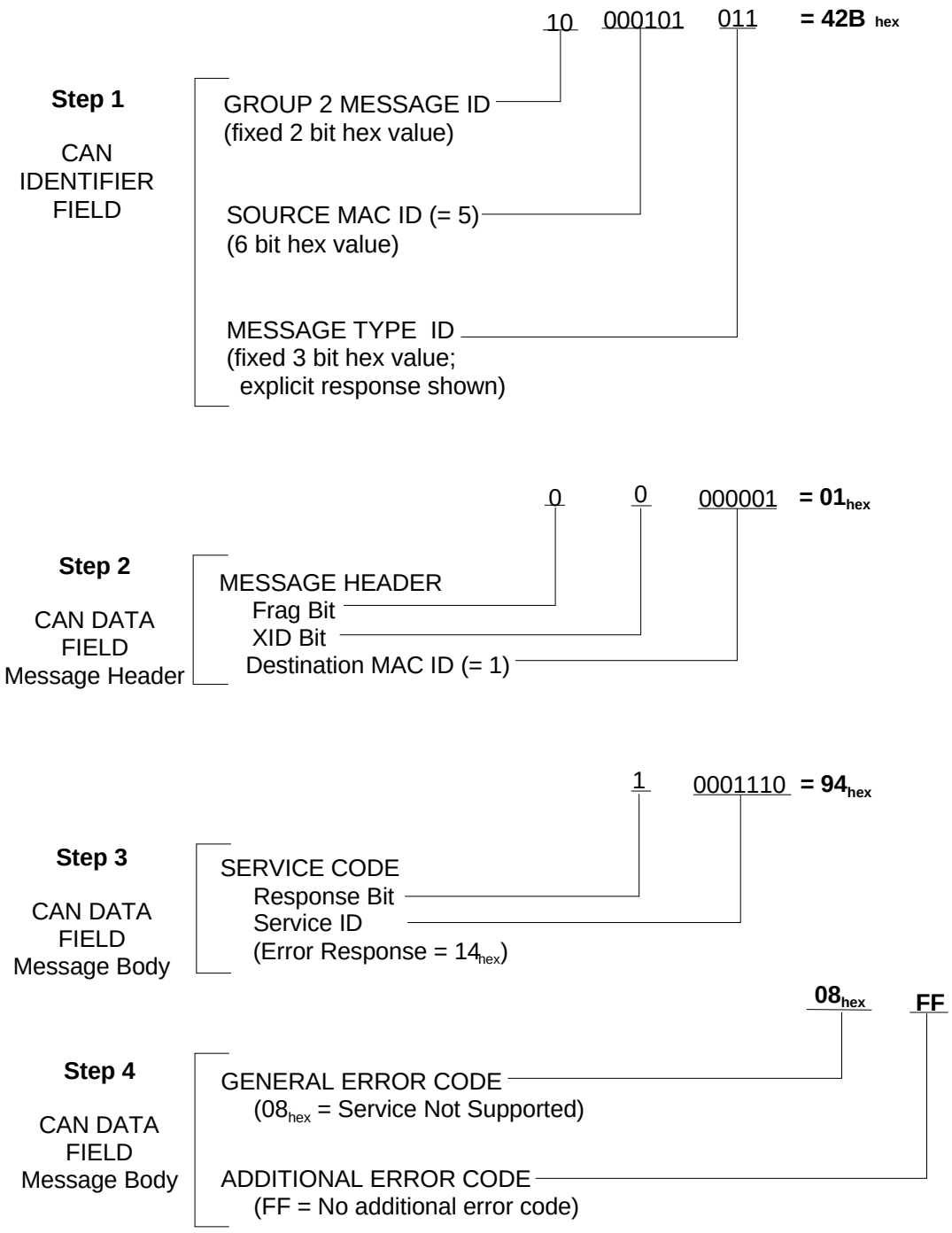

Figure 6: Explicit Message Error Response Components

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 command. These connections are typically 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 poll request or poll response attributes listed in 23, page 32. The data format in I/O poll messaging connections is predefined and cannot be altered. Refer to *I/O Poll Messaging Connections*, page 14, for more information.

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

- The example depicts I/O poll messaging
- The examples are all non-fragmented message strings
- The MAC ID of the MKS device (the Slave) is 05
- The MAC ID of the Master device is 01

Note Spaces are shown for clarity only, do not enter spaces in the actual message string.

Example 1: How to Send an I/O Poll Request Message

To send I/O poll request message #103, enter the command:

42D FF 3F 00 00

where:

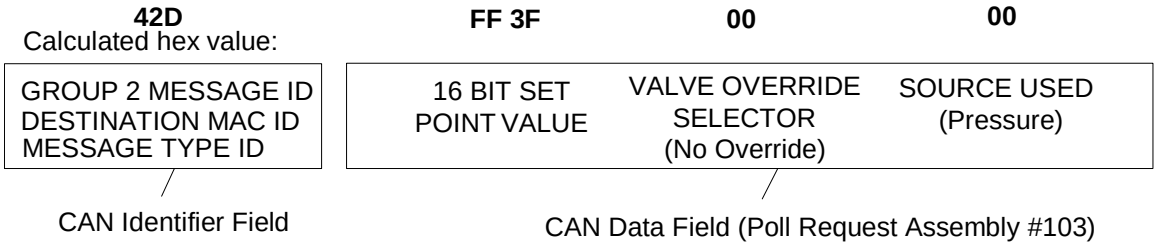

Figure 7: I/O Poll Request Message

To calculate the request message shown in Figure 7:

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

   Refer to Figure 8, step 1. This 11 bit field represents the fixed Group 2 Message ID (bits 10 & 9), the *destination* MAC ID (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 $42D_{hex}$.

2. Calculate the hexadecimal value of the CAN Data Field (the poll request assembly).

   Refer to Figure 8, step 2. This field represents the poll request assembly data; in this example the set point is defined as 100% FS (FF 3F).

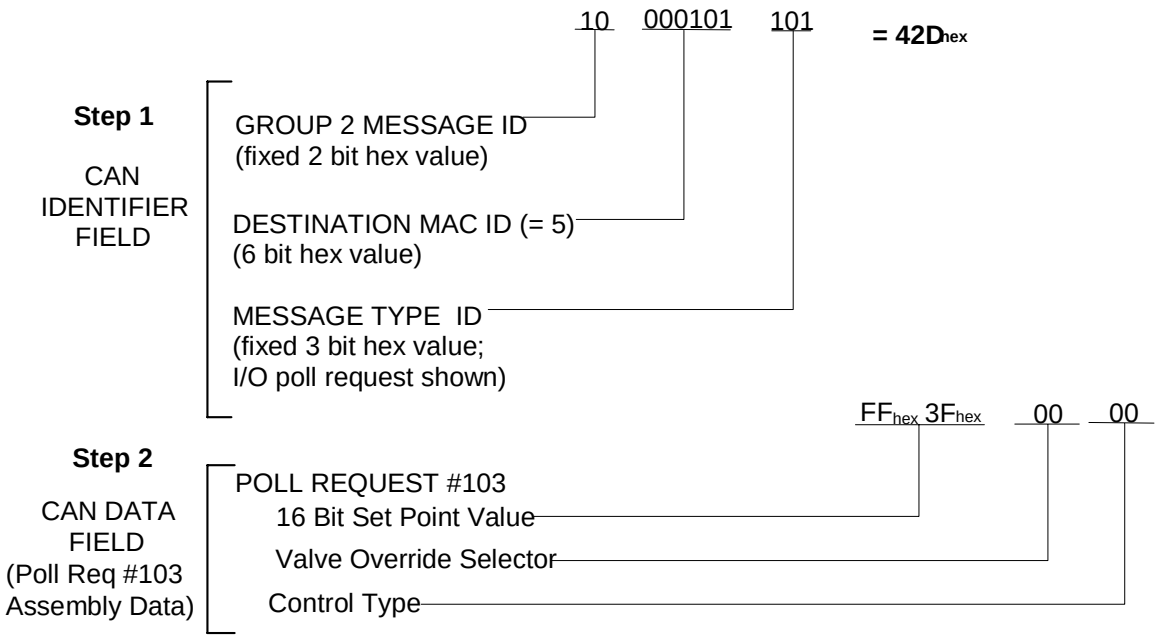

Figure 8: I/O Poll Request Message Components

Example 2: How to Interpret an I/O Poll Response Message

If the request message sent in *Example 1: How to Send an I/O Poll Request Message*, page 120, is properly sent and received, the device returns the following response message:

3C5 80 FF 3F 0E 38 FF 3F 00

where:

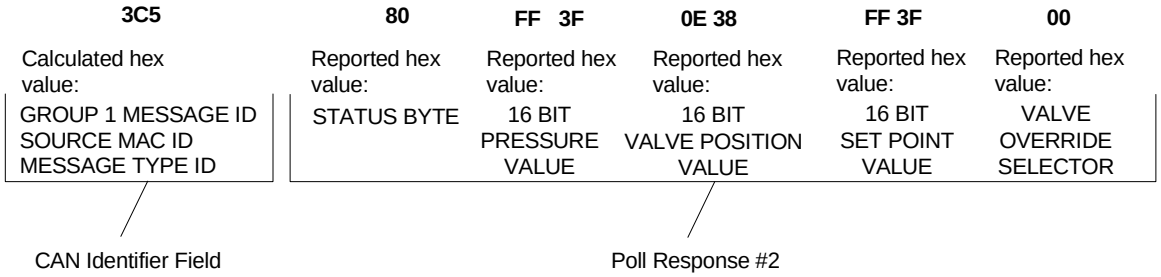

Figure 9: Successful I/O Poll Response Message

Note An I/O poll request *always* returns the poll response data, as listed in 23, page 32.

To interpret the response message shown in Figure 9:

1. Interpret the reported hexadecimal value ($3C5_{hex}$) of the CAN Identifier Field components.

   Refer to Figure 10, step 1, page 137. This 11 bit field represents the fixed Group 1 Message ID (bit 10), the fixed Message Type ID for an I/O poll response (bits 9 to 6), and the *source* MAC ID (the MKS device) as a hexadecimal number (bits 5 to 0).

2. Interpret the reported value of the poll response.

   Refer to Figure 10, step 2, page 137. The reported value for the Status Byte (80_{hex}) indicates that no exceptions are set. The Status Byte Bit map is shown in Table 52, page 68. The reported 16 bit pressure value (FF 3F) indicates that the pressure is measured at 100% FS. The reported 16 bit valve position value (0E 38) indicates that the valve is at 10°. The reported 16 bit set point value (FF 3F) indicates that the set point is measured at 100% FS. The reported valve override selector value (00) indicates that the valve is under normal operation; there is no valve override).

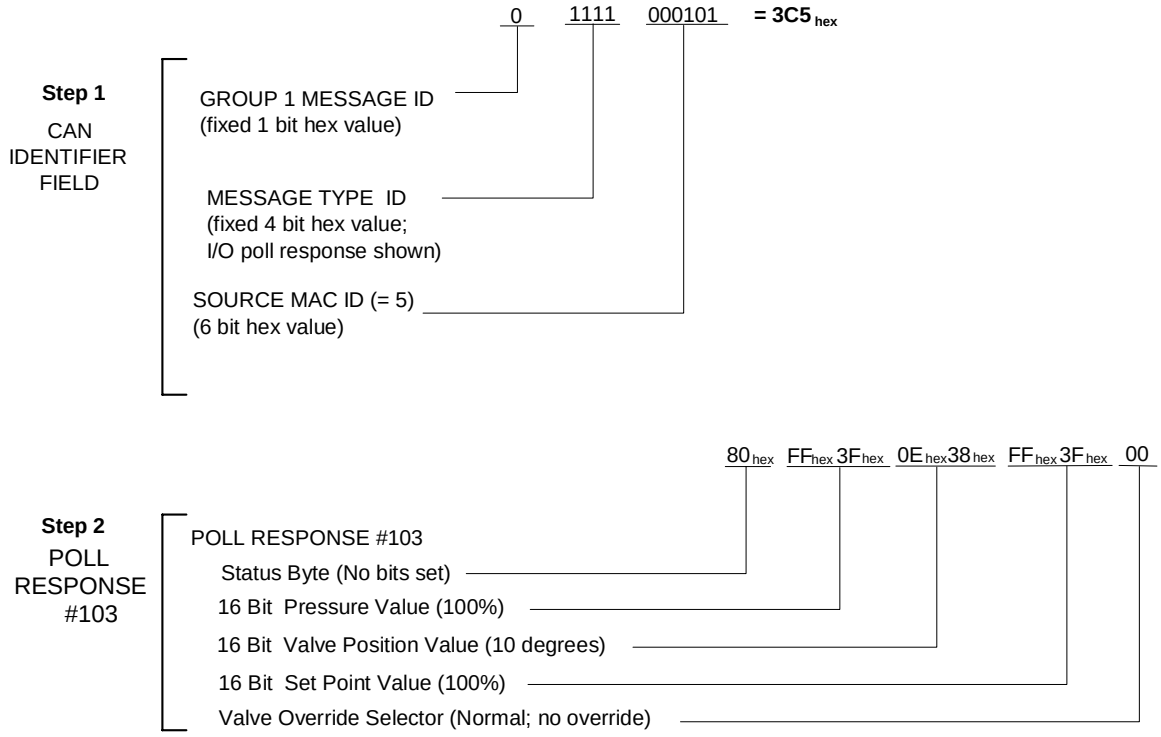

Figure 10: Successful I/O Poll Response Message Components