MKS Type T3B and T3P Valves With RS-232 Interface

Supplement

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RS-232 Interface
Rev 00G

WARRANTY

Type T3BIA/T3PIA and T3BIB/T3PIB Valves with RS-232 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.

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With RS-232 Interface
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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: Remote RS-232 Operation

RS-232 Protocol

Messages sent *to the device* from a remote computer are either:

- Commands that instruct the controller to perform a task or change an operating parameter, or
- Requests that prompt the controller to report information.

The format of the commands sent to the device appears as:

command *value*

where:

command is a label that allows you to identify the command.

value identifies the task or parameter to be changed.

Requests (R) are numbered chronologically, each with a different function, and appear as:

R #

Messages sent *by the device* to a remote computer are *responses*. The responses are replies to requests sent by the host computer.

The format of responses sent by the device to the computer appears as:

`response value`

where:

`response` is a label that allows you to identify the response.

`value` is the requested information.

Security

To help ensure that certain parameters are not changed inadvertently, some commands require that the instrument be placed into a Calibration mode. To enter the Calibration mode, the serial command “CAL 1234” is sent to the instrument. To return to the default user mode, send the command “USR”. To determine which mode you are in, send the request operating mode command “ROM”. This will either return “USR” or “CAL”. On power up, the mode is set to user.

Throughout the manual, commands which require the instrument to be in Calibration mode are so indicated: 🔒

Message Syntax

The RS-232 message syntax uses the following conventions:

Note

1. Commands and requests are *not* case sensitive.
2. Spaces are included in the syntax for clarity only. Do not include spaces in actual messages.

Table 5: Message Syntax

Syntax	Description
Bold	Message that you must enter exactly as shown in the manual. Do not include any spaces in the message string.
Italics	Placeholder that represents text or numeric values that you must supply.
`Response`	Format of a message sent from the device.
ENTER	End-of-line delimiter. All messages must use a carriage return-line feed (CRLF) or carriage return (CR) as the end-of-line delimiter. Use your host computer's communications software to assign the desired action to the ENTER key. The device appends an end-of-line delimiter to the end of every response.

Special Commands supported (Firmware version 01.04.00 and newer)

Typically the 'set' type commands do not produce a serial response from the valve. However, a response can be requested by pre-pending one of the following special characters to any of the standard serial commands.

Character	Function
@	Echo 1st character of command sent.
!	Echo status of command sent
#	Echo status and all character of command sent.

These special characters can also be used with 'get' type commands that normally produce a response. It is only in the case of the full echo (#) that the response is different to normal operation.

Examples:

Send	Receive
O	No response
@O	O
#O	xO
!O	x
S156	No response
@S156	S
#S156	xS156
!S156	x
R5	P+109.12345
@R5	P+109.12345
#R5	xP+109.12345
!R5	P+109.12345

The returned value ‘x’ is an ASCII character indicating the status of the last communication with the valve. It can have the following values: -

Value	Status	Comment
0	No error	Command was recognized and executed.
1	Unrecognized command	The command sent was not recognized and has been discarded.
2	Bad data value	The data sent was in the wrong format or outside range
3	Command ignored	The command was discarded. This can happen for a number of reasons. The most common cause is an attempt to stop a service that is already stopped or a command that is password protected.
4-9	Reserved	Reserved for future use

Priority and Timing of Command Execution

Each RS-232 command is executed in the order that it is received. There is no prioritization of RS-232 commands as is the case with digital logic commands. The digital logic commands have higher priority and will override RS-232 commands.

The RS-232 commands generally execute within 25 milliseconds or less with the following exceptions:

- **J** (valve calibration) command can take several seconds to execute.
- **F** (pressure unit) and **T** (setpoint type) commands can take up to 100 milliseconds to execute.

Setup Messages

The Setup messages configure the operating parameters for the unit.

Table 6: RS-232 Setup Messages

Description	Command	Request	Response
Stop Calibrating Valve	**Q**	N/A	N/A
Reset (power cycle)	**IX**		
Learn the Valve Steps	**J**		
Select Valve Type	**JT *value*** 🔒🔒 For T3B valves: ***value:*** 0 = 20 mm Direct Fcup 1 = 20 mm Direct Nonseal 2 = 20 mm Geared Fcup 3 = 20 mm Geared Nonseal 4 = 20 mm Geared O-ring 5 = 1” Direct Fcup 6 = 1” Direct Nonseal 7 = 1” Geared Fcup 8 = 1” Geared Nonseal 9 = 1” Geared O-ring 10 = 2” Direct Fcup 11 = 2” Direct Nonseal 12 = 2” Geared Fcup 13 = 2” Geared Nonseal 14 = 2” Geared O-ring 15 = 60 mm Direct Fcup 16 = 60 mm Direct Nonseal 17 = 60 mm Geared Fcup 18 = 60 mm Geared Nonseal 19 = 60 mm Geared O-ring 20 = 3” Direct Nonseal 21 = 3” Geared Fcup 22 = 3” Geared Nonseal 23 = 4” Direct Nonseal 24 = 4” Geared Fcup 25 = 4” Geared Nonseal *(continued on the next page)*	**RJT**	JT *value*: For T3B valves: 0 1 2 3 : : 42
🔒🔒 = *Indicates a factory only setting.*			

(continued on the next page)

Table 6: RS-232 Setup Messages (continued)

Description	Command	Request	Response
Select Valve Type *(continued)*	**JT *value*** 🔒🔒 ***(continued)*** For T3B valves *(continued)*: ***value:*** 26 = 6” Direct Nonseal 27 = 6” Geared Fcup 28 = 6” Geared Nonseal 29 = 8” Direct Nonseal 30 = 8” Geared Fcup 31 = 8” Geared Nonseal 32 = 10” Direct Nonseal 33 = 10” Geared Fcup 34 = 10” Geared Nonseal For T3P valves: ***value:*** 0 = 4”* 1 = 6” 2 = 8” 3 = 10” 4 = 12” 5 = 14”	**RJT**	JT *value*: For T3P valves: 0 1 2 3 4 5
Pressure Control Mode	**V *value*** ***value:*** 1 = PID* 0 = Model Based	**R51**	V *value* *value:* 1 = PID 0 = Model Based
Pressure Units	**F *value*** ***value:*** 00 = Torr* 01 = mTorr 02 = mBar 03 = µBar 04 = kPa 05 = Pa 06 = cm H_2O 07 = in H_2O	**R34**	F *value* *value:* 00 = Torr 01 = mTorr 02 = mBar 03 = µBar 04 = kPa 05 = Pa 06 = cm H_2O 07 = in H_2O
Backfill Valve Control Enable	**BE0** = Disabled* **BE1** = Enabled	**RBE**	BE0 = Disabled BE1 = Enabled

** Initial setting*

🔒🔒 *= Indicates a factory only setting.*

(continued on the next page)

Table 6: RS-232 Setup Messages (continued)

Description	Command	Request	Response
Backfill Limit	**Bl*value***	**RBL**	Bl*value* *BL95.0** *value:* pressure at which the feature turns off, in % of active setpoint
Backfill Threshold Pressure	**MD*value*** ***value*:** minimum difference between the new setpoint and the system pressure required to turn on the backfill feature (entered as a % of the high range pressure transducer full scale)	**RMD**	MD+*value* *value*: minimum pressure difference required to turn on the backfill feature (reported as a % of the high range pressure transducer full scale)
Select Active Channel	**LA *(Auto)*** = Dual channel* **LH *(High)*** = CH1 **LL *(Low)*** = CH2	**R7**	Refer to parameter "**w**" in the Operational Status Word (see Table 9, page 37).
Learn the System	**L** Learns the system pump speed	**None**	None
Set Auto Channel Crossover Delay	***LDxxx*** ***xxx*** = msec (100*)	**RD**	LD *value*
Set High Channel Crossover Point	**LHC*xxx*** ***xxx*** = 0 to 100% of High (0 to 104.999 if firmware 01.04 or newer) default = 0.9	**RHC**	LHC *value*
Set Low Channel Crossover Point	**LLC*xxx*** ***xxx*** = 0 to 100% low (0 to 104.999 if firmware 01.04 or newer) default = 100	**RLC**	LLC *value*
Set Valve Safe State	**SS *value*** ***value:*** 0 = Valve open 1 = Valve close 2 = Hold position 3 = safe 4 = Cycle 🔒🔒	**RSS**	SS *value* *value*: 0 = Valve open 1 = Valve close 2 = Hold position 3 = safe 4 = Cycle
** Initial setting* 🔒🔒 *= Indicates a factory only setting.*			

(continued on the next page)

Table 6: RS-232 Setup Messages (continued)

Description	Command	Request	Response
Set Model Based Parameters	**ST *letter-value*:** A = STA 🔒 D = STD 🔒 E = STE 🔒 F = STF 🔒	 **R60** **R63** **R64** **R65**	 STA *value* STD *value* STE *value* STF *value*
Sensor Signal Input Range	**G *value*** ***value:*** 0 = 1 V 1 = 5 V 2 = 10 V*	**R35**	G *value* *value:* 0 = 1 V 1 = 5 V 2 = 10 V
Analog Setpoint Range	**A *value*** ***value:*** 0 = 5 VDC 1 = 10 VDC*	**R24**	A *value* *value:* 0 = 5VDC 1 = 10VDC
Sensor Range LOW	**EL *value*** ***value:*** 00 = 0.1 Torr 01 = 0.2 02 = 0.5 03 = 1 04 = 2 05 = 5 06 = 10* 21 = 20 07 = 50 08 = 100 22 = 200 09 = 500 10 = 1000 11 = 5000 12 = 10000 13 = 1.33 mBar 14 = 2.66 15 = 13.33 16 = 133.3 17 = 1333 18 = 6666 19 = 13332 20 = 0.1333 23 = 0.001	**R55**	EL *value* *value:* 00 = 0.1 Torr 01 = 0.2 02 = 0.5 03 = 1 04 = 2 05 = 5 06 = 10 21 = 20 07 = 50 08 = 100 22 = 200 09 = 500 10 = 1000 11 = 5000 12 = 10000 13 = 1.33 mBar 14 = 2.66 15 = 13.33 16 = 133.3 17 = 1333 18 = 6666 19 = 13332 20 = 0.1333 23 = 0.001
** Initial setting*			

(continued on the next page)

Table 6: RS-232 Setup Messages (continued)

Description	Command	Request	Response
Sensor Range High	**EH** ***value*** ***value:*** 00 = 0.1 Torr 01 = 0.2 02 = 0.5 03 = 1 04 = 2 05 = 5 06 = 10 21 = 20 07 = 50 08 = 100 22 = 200 09 = 500 10 = 1000* 11 = 5000 12 = 10000 13 = 1.33 mBar 14 = 2.66 15 = 13.33 16 = 133.3 17 = 1333 18 = 6666 19 = 13332 20 = 0.1333 23 = 0.001	**R33**	EH *value* *value:* 00 = 0.1 Torr 01 = 0.2 02 = 0.5 03 = 1 04 = 2 05 = 5 06 = 10 21 = 20 07 = 50 08 = 100 22 = 200 09 = 500 10 = 1000* 11 = 5000 12 = 10000 13 = 1.33 mBar 14 = 2.66 15 = 13.33 16 = 133.3 17 = 1333 18 = 6666 19 = 13332 20 = 0.1333 23 = 0.001
Speedup/Lowpass Filter	**SUE** 🔒 ***value*** ***value:*** 1* turns on 0 turns off	**RUE**	SUE *value* *value*: 1 turns on 0 turns off
Speed Up Filter	**SUF** 🔒 ***value*** ***value:*** time in sec (0.020)*	**RUF**	SUF *value*
Speed Up Time	**SUT** 🔒 ***value*** ***value:*** time in sec (0.010)*	**RUT**	SUT *value*
Pump Speed Pedestal	**SCP** 🔒 ***value*** ***value:*** 0* to 30% open	**RCP**	SCP *value*
Chamber Volume	**SVO** 🔒 ***value*** ***value:*** volume in liters	**RVO**	SVO *value*
Chamber Volume Estimator	**SVE** 🔒 ***value*** ***value:*** 1* turns on 0 turns off	**RVE**	SVE *value* *value*: 1 turns on 0 turns off
** Initial setting*			

Selecting the Valve Type

Be sure that the valve is connected to the unit.

The [**JT *type***] command (factory only setting) identifies the type of valve you want to control, where:

type for the T3B series:

0 = 20 mm Direct Fcup
1 = 20 mm Direct Nonseal
2 = 20 mm Geared Fcup
3 = 20 mm Geared Nonseal
4 = 20 mm Geared O-ring
5 = 1” Direct Fcup
6 = 1” Direct Nonseal
7 = 1” Geared Fcup
8 = 1” Geared Nonseal
9 = 1” Geared O-ring
10 = 2” Direct Fcup
11 = 2” Direct Nonseal
12 = 2” Geared Fcup
13 = 2” Geared Nonseal
14 = 2” Geared O-ring
15 = 60 mm Direct Fcup
16 = 60 mm Direct Nonseal
17 = 60 mm Geared Fcup
18 = 60 mm Geared Nonseal
19 = 60 mm Geared O-ring
20 = 3” Direct Nonseal
21 = 3” Geared Fcup
22 = 3” Geared Nonseal
23 = 4” Direct Nonseal
24 = 4” Geared Fcup
25 = 4” Geared Nonseal
26 = 6” Direct Nonseal
27 = 6” Geared Fcup
28 = 6” Geared Nonseal
29 = 8” Direct Nonseal
30 = 8” Geared Fcup
31 = 8” Geared Nonseal
32 = 10” Direct Nonseal
33 = 10” Geared Fcup
34 = 10” Geared Nonseal

type for the T3P series:

0 = 4”
1 = 6”
2 = 8”
3 = 10”
4 = 12”
5 = 14”

To check the type of valve selected, issue the request:

RJT

The controller responds with the message [`JT` *`type`*], where:

`type` for T3B series:

0 = 20 mm Direct Fcup
1 = 20 mm Direct Nonseal
2 = 20 mm Geared Fcup
3 = 20 mm Geared Nonseal
4 = 20 mm Geared O-ring
5 = 1” Direct Fcup
6 = 1” Direct Nonseal
7 = 1” Geared Fcup
8 = 1” Geared Nonseal
9 = 1” Geared O-ring
10 = 2” Direct Fcup
11 = 2” Direct Nonseal
12 = 2” Geared Fcup
13 = 2” Geared Nonseal
14 = 2” Geared O-ring
15 = 60 mm Direct Fcup
16 = 60 mm Direct Nonseal
17 = 60 mm Geared Fcup
18 = 60 mm Geared Nonseal
19 = 60 mm Geared O-ring
20 = 3” Direct Nonseal
21 = 3” Geared Fcup
22 = 3” Geared Nonseal
23 = 4” Direct Nonseal
24 = 4” Geared Fcup
25 = 4” Geared Nonseal
26 = 6” Direct Nonseal
27 = 6” Geared Fcup
28 = 6” Geared Nonseal
29 = 8” Direct Nonseal
30 = 8” Geared Fcup
31 = 8” Geared Nonseal
32 = 10” Direct Nonseal
33 = 10” Geared Fcup
34 = 10” Geared Nonseal

type for T3P series:

0 = 4”
1 = 6”
2 = 8”
3 = 10”
4 = 12”
5 = 14”

Learn the Valve

Caution **The procedure for learning the valve involves cycling the valve from the open to the closed position. Be certain that the system can withstand valve cycling before proceeding.**

This test can be performed prior to installing the device and the valve in your system.

Entering the [**J**] command to learn a valve calibrates the valve. The valve moves from fully open to fully closed, and then stops at the completion of the calibration procedure.

The [**J**] command learns the valve's open and closed positions.

Learning the valves open and closed positions is usually only necessary after mechanical or electrical repairs have been made in the field. This LEARN function will have already been performed when receiving a valve from the factory.

The [**Q**] command stops the LEARN function.

Note Be sure to first select (**JT *type***) for the correct valve type above, otherwise the unit will not function properly.

Setting the Pressure Control Mode

The [**V *value***] command sets the full scale voltage range for the pressure sensor input, where:

***value*:** 0 = Model Based Tuning
1 = PID

To query the current control mode setting, issue the request:

R 51

The controller responds with the message [V *value*], where:

value: 0 = Model Based Tuning
1 = PID

Setting the Pressure Units

The [**F *value***] command identifies the units for the device, where:

***value*:** 00 = Torr (initial)
01 = mTorr
02 = mBar
03 = µBar
04 = kPa
05 = Pa
06 = cm H_20
07 = in H_20

To query the current pressure units, enter:

R 34

The controller responds with the message [F *value*], where:

value: 00 = Torr (initial)
01 = mTorr
02 = mBar
03 = µBar
04 = kPa
05 = Pa
06 = cm H_20
07 = in H_20

If the pressure units are Torr, an example response is:

F *00*

To change the units to mTorr, enter:

F *01*

Note The [**F *value***] command assigns a *label* to the pressure units; it does not convert pressure readings. Pressure readings are reported as a percentage (%) of full scale.

Enabling Backfill Valve Control

The Backfill Valve Control feature can open a pneumatic valve to assist in raising the system pressure to a new setpoint. The messages described here enable and disable the feature and check which of those states is in force.

Note When the backfill valve control feature is enabled, process relay 2 is disabled. When the backfill valve control feature is disabled, relay 2 is enabled. These features share the same pins on the I/O connector.

The value of the [**BE*value***] command determines whether the backfill valve control feature is enabled or disabled:

BE0 = Disabled (default)
BE1 = Enabled

To report the status of the feature, enter:

RBE

The controller responds with the message [BE*value*], where:

BE0 = Disabled
BE1 = Enabled

Setting the Setpoint Backfill Limit

This parameter sets the point at which the backfill valve closes (the relay deactivates) and the feature turns off. When the feature is turned off, a new setpoint must be entered before the feature can be enabled. The value of this entry is defined as a percentage of the new setpoint value. The messages described here set and report the backfill limit value.

The [**BL*value***] command sets the value of the backfill limit, where:

value is a percentage of the new setpoint, from 0 to 100% (default value is 95%)

To report the value of the backfill limit, enter:

RBL

The Controller responds with the message [BL*value*], where:

value is a percentage of the new setpoint, from 0 to 100%

Setting the Backfill Threshold Pressure Value

This value is the required difference between the new setpoint and the current pressure in the system before the backfill control feature operates. Setpoint changes less than the backfill threshold value do not trigger the backfill function. The entry is defined as a percentage of the full scale value for the high pressure transducer. The messages described here change and report the threshold value.

The [**MD*value***] command sets the minimum delta pressure value, where:

v*alue* is a percentage of the high range pressure transducer full scale, from 0 to 100 %
The default is 5% of full scale of the high range transducer.

To report the minimum delta pressure value, enter:

RMD

The controller responds with the message [MD*value*], where:

value is a percentage of the high range pressure transducer full scale, 0 to 100%

Setting the Backfill Delay value (available in firmware 01.04.09 or newer)

The backfill delay value sets the time from when the pressure reaches the backfill limit and pressure control resumes.

BD*x* sets the backfill delay limit

RBD gets the backfill delay limit

Selecting the Active Channel

The standard, dual-channel device can operate in dual or single channel mode. In single channel mode, the unit can be set to operate on the high or low range transducer. The controller is set to dual-channel mode at the factory. The messages described here select and report the operating mode.

The [**L*value***] command selects the channel(s) to use, where:

LA *(Auto)* = Dual channel operation
LH *(High)* = CH1; high range sensor
(locks out low range sensor)
LL *(Low)* = CH2; low range sensor
(locks out high range sensor)

To report which channels(s) are active, enter:

R*7*

Changing the Behavior of the Auto Select Channel Mode

The default values for these commands have been carefully chosen to work well under most applications.

LD*xxx* sets auto crossover delay, where ***xxx*** is in msec (default = 100).

RD reports LD value.

LHC*xxx* sets high channel crossover point, where ***xxx*** is percentage of Hi channel (default = 0.9).

RHC reports LHC value.

LLC*xxx* sets low channel crossover point, where ***xxx*** is percentage of Low (default = 100).

RLC reports LLC value.

The active channel is reported in parameter **"w"** in the Operational Status Word (see Table 9, page 37).

Set Safe State for Error Mode

If the controller encounters an error, it applies the Safe State to the valve. The Safe State is set at the factory to Valve Open. The messages described here change and report the Safe State.

Note If the Safe State value is not set, it defaults to the **open position**.

To change this default, enter one of these commands:

SS0 = Open valve
SS1 = Close valve
SS2 = Hold valve position
SS3 = Activate Safe value *(applicable to DeviceNet platforms only)*
SS4 = Cycle the valve 🔒🔒 *(factory only setting)*

Note The unit switches to the selected safe state for any of these error conditions:

- When in Lock Hi or Lock Lo range and the Baratron is disconnected for the selected channel.
- When in auto range and either Baratron is disconnected.

To report the Safe State, enter:

RSS

The controller responds with the message SS*value*, where:

SS0 = Open valve
SS1 = Close valve
SS2 = Hold valve position
SS4 = Cycle the valve

Valve Control

N0 = Normal valve action (default, typical in downstream pressure control applications)
N1 = Reverse valve action

A valve can be controlled to open and close in a normal or reverse direction. Normal action of valve control is defined as valve open at 100% of the valve position's full scale, and valve closed at 0%. Reverse action of valve control is defined as valve open at 0% of the valve position's full scale and valve closed at 100%

Setting the Sensor Signal Input Range

Note Be sure that the sensor is connected to the device before changing the sensor signal input range.

The [**G *value***] command sets the full scale voltage range for the pressure sensor input, where:

***value*:** 0 = 1 Volt
1 = 5 Volts
2 = 10 Volts (initial)

To query the current range of the sensor signal input, issue the request:

R 35

The controller responds with the message [G *value*], where:

value: 0 = 1 Volt
1 = 5 Volts
2 = 10 Volts

If the sensor input has a full scale range of 10 Volts, an example response is:

G *2*

To change the sensor signal input range to 5 Volts, enter:

G *1*

Setting the Sensor Range

Note Be sure that the sensor is connected to the device before changing the sensor range.

The [**E*x value***] command identifies the range of the sensor, in units, where ***x*** corresponds to either 'H' or 'L' for the High or Low pressure sensor, and ***value*** corresponds to a valid sensor range, as listed in Table 7.

The device is initially configured to work with a 10 and a 1000 Torr pressure sensor. If your sensors cover different pressure ranges, use this command to identify the range of your sensor.

Table 7: Sensor Range Values

Value	Sensor Range	Value	Sensor Range
00	0.1 Torr	10	1000 Torr
01	0.2	11	5000
02	0.5	12	10000
03	1	13	1.33 mBar
04	2	14	2.66
05	5	15	13.33
06	10	16	133.3
07	50	17	1333
08	100	18	6666
09	500	19	13332

20	0.1333	21	20
22	200	23	0.001

Note

1. Pressure readings are reported as a percentage (%) of full scale (FS), where full scale is the sensor range shown in Table 7.
2. For example, if the actual pressure is 10 Torr for a 10 Torr FS unit, the device reports a pressure value of 100 (for 100%). If the pressure is 10 Torr for a 100 Torr FS unit, the device reports a pressure value of 10 (for 10%).

To check the sensor range of your unit, issue the request:

R 55 for the Low range sensor

R 33 for the High range sensor

The controller responds with the message [E*x value*], where *x* corresponds to either 'H' or 'L' for High or Low sensor range and *value* corresponds to a valid sensor range shown in Table 7.

If the Low range sensor has a range of 100 Torr, an example response is:

EL *08*

To change the Low range to 5 Torr, enter:

EL *05*

To change the High range to 1000 Torr, enter:

EH *10*

Note

The sensor range of the High Channel MUST be greater than the sensor range of the low channel. Also, you cannot successfully change the value of the high channel to a value that is greater than the current low channel value. It may be necessary to change to low channel range first to a value that is lower than the desired high channel range.

Alternatively, on code version 01.02.25 and newer, the commands SHR*x* and SLR*x* can be used.
Where *x* is the value of the pressure sensor.
Use RHR and RLR to report the high range and report the low range respectively.
Reported value is always in Torr. Maximum value is 10,000 Torr..

Chamber Pump Speed

Overview

There are three pump speed curves available in the 1.2.x version of software. Initially, all three curves will have the same value. All curves are non-volatile.

- Curve 1 is the factory default curve.
- Curve 2 is the learned curve. A system LEARN writes its data to the learned curve (see below).
- Curve 3 is the custom curve. This location is used for application specific pump speed curve.

Curves 2 and 3 are writable over the serial and DeviceNet interface.

Learn the System

This [**L**] LEARN command enables the unit to identify important system characteristics for Model Based Control. Use the LEARN function whenever installing the valve in a new vacuum system or when processing conditions are changed (such as flow rate, new or refurbished pump, or piping modifications). The learning process may take several minutes to complete.

Note The system pressure will vary during the LEARN cycle to as low and high as is possible for the current flow rate.

Ensure the correct chamber volume value is entered. Use the [**SVO**🔒] command to set it. Use [**RVO**] to report the setting (volume is in liters). An approximate value for volume may be used provided the volume estimator is turned on (see below).

Determine the appropriate setting for the volume estimator:

- If you are confident of the actual chamber volume entered using the [**SVO**🔒] command, turn off the volume estimator using the [**SVE**🔒] command (SVE 0). Use [**RVE**] to report the setting.
- If you are unsure of the actual chamber volume, turn on the volume estimator using the [**SVE**🔒] command (SVE 1). Use [**RVE**] to report the setting. The volume estimator will determine the volume during the system LEARN. To report the estimated volume after the system LEARN, use [**RVO**].

Ensure the correct high channel transducer setting using [**EH*x***] command to set it. Use [**R33**] to review it.

Request from the instrument the suggested system LEARN flow using the [**RLE**] command (flow is in Slm).

Using the SLF command, set the actual system LEARN flow setting.

1. Initiate the gas flow that was entered with the [**SLF**] command above, into the system.

   Do not vary the flow rate during the LEARN.

2. Send the [**L**] command.

   The valve will move though its range and the electronics will collect and store parameters of the LEARN.

To stop a LEARN before it has finished on its own, send the [**Q**] command.

You can review the system LEARN pump speed data by issuing the [**RCD 2**] command.

Switching Curves

To find out which pump speed curve is currently active, use the [**RCT**] command.

To switch to a different curve, use the [**SCT**🔒 ***x***] command, where ***x*** is 1, 2, or 3.

Initially, curve 1 (the factory default) is active.

The SCT setting is non-volatile.

After a system LEARN the active curve is automatically set to 2.

Editing Curves

To read a single pump speed data value, use the [**RCV**] command.

For example, the following will report the value of curve 2, data point 14:

RCV 2:14

Data points range from 1 to 35 inclusive.

To read all data points, use the [**RCD *x***] command, where ***x*** is 1, 2, or 3.

To set a data point, use the [**SCD** 🔒] command.

For example, the following will set curve 3, data point 27, to the value 123.456:

SCD 3:27:123.456

Note The curve being edited does not have to be the active curve.

Setting the Pump Speed Pedestal

The pump speed pedestal sets the minimum % position of the valve when in pressure mode.

Use [**SCP** 🔒 ***xx***] to set the pump speed pedestal, where ***xx*** is any percentage value from 0 to 30.

Setting a value of 0 disables the pedestal. The default value is 0 (disabled).

Use [**RCP**] to read the current setting.

Setting Speedup Compensation Parameters

The speedup function is used to compensate for the measurement delay introduced by the pressure transducer. It has two adjustable parameters:

- Speedup compensation constant.
- Speedup filter constant.

Both constants have units of time (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.

To enable the speedup compensator, enter:

SUE *1* 🔒

To disable the speedup compensator, enter:

SUE *0* 🔒

To read back the status of speedup compensator, enter:

RUE

To set the speedup compensation constant, enter:

SUT *value* 🔒

To report the speedup compensation constant, enter:

RUT

To set the speedup filter constant, enter:

SUF *value* 🔒

To report the speedup filter constant, enter:

RUF

The following example will enable the speedup compensator and set the speedup compensation constant to 0.05 sec and the speedup filter constant to 0.01 sec:

SUE 1

SUT 0.05

SUF 0.01

Setpoint Messages

The Setpoint messages define the setpoint parameters which include the setpoint values, the gains and phases, and two process limit relays (each with high and low trip point levels).

All of the setpoint messages (except for the gain and phase parameters) function in the same way, regardless of your system's configuration. The way your unit responds to the gain or phase messages depends on the type of pressure control (PID) and setpoint control (pressure or position) chosen. For example:

- When you are using PID control with pressure setpoints, you can adjust both the gain and phase values. The unit accepts and responds to both commands and queries.
- If you are using position setpoint control, there are no gain or phase parameters. The unit will not accept or respond to these queries or commands.

Table 8: Setpoint Messages

Description	Command	Request	Response
Setpoint Control	**T *x value*** ***x:*** 1 = Setpoint A 2 = Setpoint B 3 = Setpoint C 4 = Setpoint D 5 = Setpoint E 6 = Analog Setpoint ***value:*** 0 = Position 1 = Pressure*	**R *xx*** ***xx:*** 25 = Analog Setpoint 26 = Setpoint A 27 = Setpoint B 28 = Setpoint C 29 = Setpoint D 30 = Setpoint E	T x *value* *x*: 0 = Analog Setpoint 1 = Setpoint A 2 = Setpoint B 3 = Setpoint C 4 = Setpoint D 5 = Setpoint E *value*: 0 = Position 1 = Pressure
Analog Setpoint Range	**A *value*** ***value:*** 0 = -5 to +5 V 1 = -10 to +10V*	**R 24**	A *value* *value*: 0 = -5 to +5 V 1 = -10 to +10 V
Setpoint Values	**S *x value*** ***x:*** 1 = Setpoint A 2 = Setpoint B 3 = Setpoint C 4 = Setpoint D 5 = Setpoint E 6 = Analog Setpoint ***value:*** *Setpoints A to E =* % FS pressure or % open *Analog setpoint =* 0 = 100% of controlling transducer's range 1 = 10% of controlling transducer's range	**R *x*** ***x:*** 0 = Analog Set Pt 1 = Setpoint A 2 = Setpoint B 3 = Setpoint C 4 = Setpoint D 10 = Setpoint E	S *x value* *x*: 0 = Analog Set Pt 1 = Setpoint A 2 = Setpoint B 3 = Setpoint C 4 = Setpoint D 5 = Setpoint E *value*: *Setpoints A to E*: % FS pressure or % open *Analog setpoint*: % of the analog setpoint FS voltage range

Table 8: Setpoint Messages (continued)

Description	Command	Request	Response
Gain	**M *x value*** ***x:*** 1 = Gain SP A 2 = Gain SP B 3 = Gain SP C 4 = Gain SP D 5 = Gain SP E 6 = Gain Analog SP ***value:*** 0 to 32767	**R *xx*** ***xx:*** 46 = Gain SP A 47 = Gain SP B 48 = Gain SP C 49 = Gain SP D 50 = Gain SP E 54 = Gain SP Analog	M x *value* *x*: 1 = Gain SP A 2 = Gain SP B 3 = Gain SP C 4 = Gain SP D 5 = Gain SP E 6 = Gain SP Analog *value*: 0 to 32767
Phase	**X *x value*** ***x:*** 1 = Phase SP A 2 = Phase SP B 3 = Phase SP C 4 = Phase SP D 5 = Phase SP E 6 = Phase SP Analog ***value:*** 0 to 32767	**R *xx*** ***xx:*** 41 = Phase SP A 42 = Phase SP B 43 = Phase SP C 44 = Phase SP D 45 = Phase SP E 53 = Phase SP Analog	X x *value* *x:* 1 = Phase SP A 2 = Phase SP B 3 = Phase SP C 4 = Phase SP D 5 = Phase SP E 6 = Phase SP Analog *value*: 0 to 32767
Gain Compensation Factor	**GC*value*** ***value:*** 0 to 100.0%	**RGC**	GC*value* *value*: 0 to 100.0%
Phase Compensation Factor	**PC*value*** ***value:*** 0 to 100.0%	**RPC**	PC*value* *value*: 0 to 100.0%
Softstart Rates	**I *x value*** ***x:*** 1 = Setpoint A 2 = Setpoint B 3 = Setpoint C 4 = Setpoint D 5 = Setpoint E 6 = Analog Setpoint 7 = Valve open 8 = Valve close ***value:*** 0.1 to 100% full speed	**R *xx*** ***xx:*** 15 = Setpoint A 16 = Setpoint B 17 = Setpoint C 18 = Setpoint D 19 = Setpoint E 20 = Analog Setpoint 21 = Valve open 22 = Valve close	I *x value* *x:* 1 = Setpoint A 2 = Setpoint B 3 = Setpoint C 4 = Setpoint D 5 = Setpoint E 6 = Analog Setpoint 7 = Valve open 8 = Valve close *value:* 0.1 to 100% full speed
Process Limit Relays	**P *x value*** ***x:*** 1 = Low - PL1 2 = High - PL1 3 = Low - PL2 4 = High - PL2 ***value:*** pressure limit	**R *xx*** ***xx:*** 11 = Low - PL1 12 = High - PL1 13 = Low - PL2 14 = High - PL2	P *x value* *x:* 1 = Low - PL1 2 = High - PL1 3 = Low - PL2 4 = High - PL2 *value:* pressure limit

Process Limit Source (code version 01.04.08 or newer)	**PLS** ***x y*** *x:* 1 = Relay A 2 = Relay B *y:* 1 = Pressure 2 = Position 3 = Close Limit Sw 4 = Open Limit Sw	**RLS**	PLS1x2y 1x Relay A Source 2y Relay B Source

Setting the Type of Setpoint Control

Each setpoint can be configured so that it represents a pressure value or position value.

The [**T *x value***] command configures the unit for setpoint control, where:

***x*:** 1 = Setpoint A control
2 = Setpoint B control
3 = Setpoint C control
4 = Setpoint D control
5 = Setpoint E control
6 = Analog setpoint control

***value*:** 0 = Position control
1 = Pressure control (initial)

To configure setpoint A for pressure control, enter:

T *1 1*

Note The RS-232 [**T6 *value***] command overrides the digital logic control for the analog setpoint.

To report the type of valve control for a particular setpoint, issue the request:

R *xx*

where ***xx***: 25 = Analog setpoint control
26 = Setpoint A control
27 = Setpoint B control
28 = Setpoint C control
29 = Setpoint D control
30 = Setpoint E control

The controller responds with the message [`T x type`], where:

x: 0 = Setpoint A control
1 = Setpoint A control
2 = Setpoint B control
3 = Setpoint C control
4 = Setpoint D control
5 = Setpoint E control

type: 0 = Position control
1 = Pressure control

To report the type of control for setpoint A, enter:

R 26

If setpoint A is configured for pressure control, an example response is:

T *1 1*

Setting the Analog Setpoint Range

The [**A *value***] command sets the full scale voltage range for the analog setpoint, where:

value: 0 = -5 to +5 Volts (initial)
1 = -10 to +10 Volts

To query the voltage range of the analog setpoint, issue the request:

R 24

The controller responds with the message [A *range*], where:

value: 0 = -5 to 5 Volts
1 = -10 to +10 Volts

If the analog setpoint has a full scale range of 5 Volts, an example response is:

A *0*

To change the full scale range of the analog setpoint to 10 Volts, enter:

A *1*

Note You can operate the device at a different full scale input, for example 4.5 V, by recalibrating the full scale of the analog setpoint. Refer to Calibrating the A/D Converter, page 41, for more information.

Setting the Setpoint Values

The [**S *x value***] command sets the values for the setpoints, where:

x: 1 = Setpoint A value
2 = Setpoint B value
3 = Setpoint C value
4 = Setpoint D value
5 = Setpoint E value
6 = Analog setpoint value

value: *setpoints A to E:* % of full scale (typical values are between 0% and 100% of the sensor range with pressure control)
% of open (0 to 100% with position control)
analog setpoint: 0 = 0 to 100% of the controlling transducer's range (normal resolution - initial)
1 = 0 to 10% of the controlling transducer's range (10x normal resolution)

To set the value of setpoint A to 50% of full scale pressure, enter:

S *1 50*

To report the value of a setpoint, issue the request:

R *x*

where ***x***: 0 = Analog setpoint value
1 = Setpoint A value
2 = Setpoint B value
3 = Setpoint C value
4 = Setpoint D value
10 = Setpoint E value

The controller responds with the message [S *x value*], where:

x: 0 = Analog setpoint value
1 = Setpoint A value
2 = Setpoint B value
3 = Setpoint C value
4 = Setpoint D value
5 = Setpoint E value

value:
setpoints A to E: % of full scale (with pressure control) % of open (with position control)
analog setpoint: % of the analog setpoint FS voltage range

To report the value for setpoint A, enter:

R *1*

If setpoint A is set to 50% of full scale pressure, an example response is:

S *1 50*

To report the value for the analog setpoint, enter:

R 0

An example response is:

S *0 100*

Note The request **[R 0]** reports the analog setpoint value as *a percentage of the analog setpoint full scale range voltage*; it does not report the percentage of the controlling transducer's range.

Refer to Calibrating the A/D Converter, page 41.

Setting the Gain Values

The [**M *x value***] command sets the gain values for the internal setpoints, where:

x: 1 = Setpoint A gain
2 = Setpoint B gain
3 = Setpoint C gain
4 = Setpoint D gain
5 = Setpoint E gain
6 = Setpoint Analog gain

value*:* 0 to 32767

To set the gain for setpoint A to 50, enter:

M *1 50*

To report the gain value for any setpoint, issue the request:

R *xx*

where ***xx*:** 46 = Setpoint A gain
47 = Setpoint B gain
48 = Setpoint C gain
49 = Setpoint D gain
50 = Setpoint E gain
54 = Setpoint Analog gain

To report the gain value for setpoint A, enter:

R 46

The controller responds with the message [M *x value*], where:

x: 1 = Setpoint A gain
2 = Setpoint B gain
3 = Setpoint C gain
4 = Setpoint D gain
5 = Setpoint E gain
6 = Setpoint Analog gain

value: 0 to 32767

If the gain for setpoint A is set to 45, an example response is:

M *1 45*

Setting the Gain Compensation Factor

The gain compensation factor (GCF) modifies the gain value so that the controller gives the best response to the low range setpoints.

When the device receives a setpoint in the range of the high sensor (Channel 1), it uses the gain value entered with the [**M*xvalue***] command. When the controller receives a setpoint in the range of the low range sensor (Channel 2), it uses a percentage of the high range gain determined by the GCF.

The messages described here set and report the gain compensation factor.

The [**GC*value***] command sets the gain compensation factor, where:

value: 0 to 100% of high range gain

To report the value of the gain compensation factor, enter:

RGC

The controller responds with the message [GC*value*], where:

value: 0 to 100% of high range gain

For example, if:

M*xvalue* = 90.0

and:

GCF = 50

then:

Gain used for low range = 45.0

Setting the Phase Values

The command [**X *x value***] sets the Phase values for the internal setpoints, where:

x: 1 = Setpoint A Phase
2 = Setpoint B Phase
3 = Setpoint C Phase
4 = Setpoint D Phase
5 = Setpoint E Phase
6 = Setpoint Analog Phase

value: 0 to 32767

To set the Phase for setpoint A to 5, enter:

X *1 5*

To report the Phase value for any setpoint, issue the request:

R *xx*

where ***xx*:** 41 = Setpoint A Phase
42 = Setpoint B Phase
43 = Setpoint C Phase
44 = Setpoint D Phase
45 = Setpoint E Phase
53 = Setpoint Analog Phase

To report the Phase value for setpoint A, enter:

R 41

The controller responds with the message [X *x value*], where:

x: 1 = Setpoint A Phase
2 = Setpoint B Phase
3 = Setpoint C Phase
4 = Setpoint D Phase
5 = Setpoint E Phase
6 = Setpoint Analog Phase

value: 0 to 32767

If the Phase for setpoint A is set to 10, an example response is:

X *1 10*

Setting the Phase Compensation Factor

The phase compensation factor (PCF) modifies the phase value so that the controller gives the best response to the low range setpoints.

When the device receives a setpoint in the range of the high sensor, it uses the phase value entered with the [**X*xvalue***] command. When the controller receives a setpoint in the range of the low sensor, it uses a percentage of the high range phase determined by the PCF.

The messages described here set and report the phase compensation factor.

The [**PC*value***] command sets the gain compensation factor, where:

value: 0 to 100% of the high range phase

To report the value of the phase compensation factor, enter:

RPC

The controller responds with the message [PC*value*], where:

value: 0 to 100% of the high range phase

For example, if:

X*x value* = 20.0

and:

PCF = 75

then:

Phase used for low range = 15.0

Setting the Softstart Rates

The softstart rate controls the rate at which flow moves toward the desired setpoint. Different softstart rates can be assigned to each setpoint as well as to the valve open and valve closed commands. The softstart rate is expressed as a percentage of the valve's full *speed*, ranging from 0.1 to 100%. If it is not necessary to utilize softstart control in your process, leave the softstart rate at 100% of full speed.

The [**I *x value***] command sets the softstart rate for each setpoint, where:

x: 1 = Setpoint A rate
2 = Setpoint B rate
3 = Setpoint C rate
4 = Setpoint D rate
5 = Setpoint E rate
6 = Analog setpoint rate
7 = Valve open rate
8 = Valve close rate

value: 0.1 (slowest) to 100% (fastest) of valve full speed

To report the softstart rate for any setpoint, issue the request:

R *xx*

where ***xx*:** 15 = Setpoint A rate
16 = Setpoint B rate
17 = Setpoint C rate
18 = Setpoint D rate
19 = Setpoint E rate
20 = Analog setpoint rate
21 = Valve open rate
22 = Valve close rate

To report the softstart rate for setpoint A, enter:

R *15*

The controller responds with the message [I *x value*], where:

x: 1 = Setpoint A rate
2 = Setpoint B rate
3 = Setpoint C rate
4 = Setpoint D rate
5 = Setpoint E rate
6 = Analog setpoint rate
7 = Valve open rate
8 = Valve close rate

value: 0.1 (slowest) to 100% (fastest) of valve full speed

If the softstart rate for setpoint A is set to 100%, an example response is:

I *1 100*

To change the softstart rate for setpoint A to 50% enter:

I *1 50*

Setting the Process Limit Relays

The [**P *x value***] command sets the process limit relay thresholds, where:

x: 1 = Low threshold – Process Limit 1
2 = High threshold – Process Limit 1
3 = Low threshold – Process Limit 2
4 = High threshold – Process Limit 2

value: Pressure limit as % FS of High Sensor or Position as %
(typical values are between 0% and 100% of the sensor range with pressure control)
% of open (0 to 100% with position control)

To report a process limit threshold, issue the request:

R *xx*

where ***xx*:** 11 = Low threshold – Process Limit 1
12 = High threshold – Process Limit 1
13 = Low threshold – Process Limit 2
14 = High threshold – Process Limit 2

The controller responds with the message [P *x value*], where:

x: 1 = Low threshold – Process Limit 1
2 = High threshold – Process Limit 1
3 = Low threshold – Process Limit 2
4 = High threshold – Process Limit 2

value: Pressure limit

To report the low threshold for process limit 1, enter:

R *11*

An example response, if the low threshold for process limit 1 is 100 Torr, is:

P *1 100*

Note To disable a low threshold process limit, set the **P *x value*** to negative full scale.
To disable a high threshold process limit, set the **P *x value*** to full scale.

Setting the Process Limit Source

The [**PLS *xy***] command sets the process limit source, where:

x: 1 = Relay A
2 = Relay B

y: 1 = Pressure
2 = Position
3 = Close Limit Switch
4 = Open Limit Switch

To report a process limit source, issue the request:

RLS

The controller responds with the message [PLS1*x*2*y*], where:

x: 1 = Relay A source pressure
2 = Relay A source position
3 = Relay A close limit switch
4 = Relay A open limit switch

y: 1 = Relay B source pressure
2 = Relay B source position
3 = Relay B close limit switch
4 = Relay B open limit switch

To report the process limit source enter:

RLS

An example response, if Relay A is driven by the open limit switch and Relay B is driven by the closed limit switch is:

PLS1423

(code version 01.04.08 or newer)

Note When the Process Limit Source is set to the open/closed limit switches the relay is driven directly from the selected limit switch. The Process Limit is not used.

Control Messages

The control messages directly control the actions of the valve and the system.

Table 9: RS-232 Control Messages

Description	Command	Request	Response
Activate Setpoint	**D *x*** ***x:*** 0 = Analog Setpoint 1 = Setpoint A 2 = Setpoint B 3 = Setpoint C 4 = Setpoint D 5 = Setpoint E	**R7**	M *x y z w* *x*: Active Setpoint 0 = Analog Setpoint 1 = Setpoint A 2 = Setpoint B 3 = Setpoint C 4 = Setpoint D 5 = Setpoint E 6 = Valve Open 7 = Valve Closed 8 = Valve Stop 9 = Valve Learning *y*: Valve Status 0 = Controlling 2 = Valve open 4 = Valve close *z*: Pressure 0 = ≤ 10% FS 1 = > 10% FS *w*: Active Sensor/Channel Select/Zero Adjust 0 = L/A/D 1 = H/A/D 3 = H/H/D 4 = L/A/E 5 = H/A/E 7 = H/H/E 8 = L/L/D : = L/L/E
Valve Open (drives valve fully open)	**O***	None	None
Valve Close (drives valve fully closed)	**C***	None	None
Valve Stop (stops valve in current position)	**H***	None	None
Sensor Zero (corrects sensor zero offsets)	**Z 1**	None	None
Special Zero (zeros base pressure)	***Z 2 value*** ***value:*** *% FS pressure*	None	None

(continued on the next page)

Table 9: RS-232 Control (continued)

Description	Command	Request	Response
Remove Sensor and Special Zeros (removes [**Z1**] and [**Z2 *value***])	**Z 3**	None	None
Calibrate A/D Span	**Y3** 🔒	**R52**	Returns the Check Sum status of the A/D converter calibration. `CSvalue value:` 0 = OK 1 = Error condition
Calibrate A/D zero	**Y4** 🔒	**R52**	Returns the Check Sum status of the A/D converter calibration `CSvalue value:` 0 = OK 1 = Error condition
Close Backfill Relay	**CB**	**RB**	
Open Backfill Relay	**OB**	**RB**	
** The RS-232 commands to open, close, or halt the valve override the active setpoint control of the valve.*			

Activating a Setpoint

The [**D *x***] command activates one of the setpoints, where:

x: 1 = Setpoint A
2 = Setpoint B
3 = Setpoint C
4 = Setpoint D
5 = Setpoint E
0 = Analog setpoint

To activate setpoint A, enter:

D *1*

To report which setpoint is active, issue the request:

R *7*

The controller responds with the message:

`M x y z w`

where `x`: Active Setpoint
0 = Analog setpoint
1 = Setpoint A
2 = Setpoint B
3 = Setpoint C
4 = Setpoint D
5 = Setpoint E
6 = Valve open
7 = Valve closed

8 = Valve stop
9 = Valve Learning

where *y*: Valve Status
0 = Controlling
1 = Valve open
2 = Valve close

where *z*: Pressure
0 = Pressure ≤10% of FS
1 = Pressure >10% of FS

where *w*: Active Sensor Range /Channel Select Status /Zero Adjust Status
0 = Low / Auto/ Disabled
1 = High / Auto / Disabled
3 = High / High / Disabled
4 = Low / Auto / Enabled
5 = High / Auto / Enabled
7 = High / High / Enabled
8 = Low / Low / Disabled
: = Low / Low / Enabled

If setpoint A is active, the valve is open, and the pressure is ≤10% FS, an example response is:

```
M 1 1 0 0
```

Controlling the Valve

The unit can drive the throttle valve to full open or full close, or to stop at its current position. There are no requests associated with these functions.

Note The RS-232 commands to open, close, or stop the valve *override* the active setpoint control of the valve.

Driving the Valve to Full Open

To drive the valve to full open, issue the command:

O

Driving the Valve to Full Close

To drive the valve to full close, issue the command:

C

Stopping the Valve

To stop (hold) the valve in its current position, issue the command:

H

Using the Sensor Zero

The [**Z 1**] command corrects for any sensor zero offsets. There is no request associated with this function. This command will zero the currently selected pressure sensor range.

To use the sensor zero:

1. Turn the gas flow off.
2. Drive the valve to full open by issuing the command:

   O

   Refer to Driving the Valve to Full Open, page 39.
3. Pump the system down to base pressure.

   In order to achieve a proper zero, the pressure of the system must be *lower* than the resolution of the sensor used to measure system pressure.
4. Enter the command:

   Z 1

   To remove the sensor zero correction, refer to *Removing the Sensor and Special Zeros* page 40.

Note If the pressure reading (at base pressure) is greater than 4% of full range, the sensor will not be zeroed.

Using the Special Zero

The [**Z 2** ***value***] special zero command zeros the base pressure in systems where the known base pressure is not *at*, but *near* zero (as measured by another transducer in the system). There is no request associated with this function.

To use the special zero:

1. Set your system to base pressure.
2. Send the command:

   Z 2 ***value***

   where ***value*** is expressed as a percentage of full scale pressure (% FS pressure):

   value: known base pressure reading transducer's full scale

To remove the special zero correction, refer to *Removing the Sensor and Special Zeros*, page 40.

Removing the Sensor and Special Zeros

The [**Z 3**] command removes the sensor zero [**Z 1**] and the special zero [**Z2** ***value***] correction factors stored in memory, and is used to determine the uncorrected signal from the pressure transducer. Each time a sensor is zeroed, the offset changes and the pressure value is updated. In some applications it may be important to keep the zero offset within a specific range. There is no request associated with this function.

To remove the zero corrections, send the command:

Z 3

Reporting the Checksum Status

The checksum indicates the status of the unit's A/D converter calibration. To report the status of the checksum, enter:

R52

The controller responds with the message:

[CS*value*]

where *value*: 0 = OK
1 = Error Condition

If the controller detects a checksum error, perform a full calibration to correct the problem. Refer to descriptions of how to calibrate the full scale of the analog setpoint, zero the analog set, and calibrate the span of the A/D converter (page 41).

Note If the checksum error persists after you perform a full system calibration the error indicates a hardware failure of the EEPROM. Contact an MKS Service Center, listed on the inside back cover of this manual, for assistance.

Calibrating the A/D Converter

The controller's A/D (analog-to-digital) converter converts the analog input to a digital value that the controller uses. The span of the A/D converter is calibrated at the factory. You may need to recalibrate the span if the controller issues a checksum error when you power it up, or if the transducer's readings are incorrect.

To calibrate the span for the 10 V sensor range:

1. To verify the setup to 10 V for 10 V full scale, issue the R35 command and receive the G2 response. If the setup is not 10 V, use the G2 command to set up accordingly.
2. Select either the Hi or Lo sensor and Lock Hi or Lock Lo.
3. Apply a known voltage of Full Scale (e.g. 10 Volts DC) to the pressure input pins (1 (plus) and 8 (ground) on a 9 pin connector; pin 2 (plus) and pin 12 (ground) on a 15 pin connector) on the connector of the selected channel (Hi or Lo).
4. Send the command:

   Y3 ↵

   Calibrating the span of the A/D converter may take up to 5 seconds.
5. Check that the calibration is finished by sending the checksum error request:

   R52

   Immediately after the span calibration is complete, the controller responds with the message:

   CS*value*

   where *value*: 0 = OK
   1 = Error Condition

To calibrate the zero of the A/D, apply a know 0 VDC to the sensor input pins and send the command:

Y4 ↵

Manually Overriding the Backfill Relay

Relay 2 is used as the backfill valve control relay when it is enabled with the BE1 command (see page 20). It also can be manually overridden directly with the messages described here.

Note These messages activate or deactivate relay 2 even if the backfill function is disabled. For example, if relay 2 is being used to control an alarm, deactivating the relay may disable the alarm.

To activate relay 2, issue the command:

OB The controller activates the relay.

To deactivate the relay, issue the command:

CB The controller deactivates the relay.

To report the activation status of relay 2, enter:

RB

The controller responds:

BF*value*

where: BF0 = deactivated
BF1 = activated

Reporting Applied Analog Input Voltage

To report the applied input voltage for the analog setpoint as a percentage of full scale, send the command:

R 0

If the actual voltage input is 100% of the analog setpoint FS range, an example response is:

S *0 100*

Slow Pump Introduction

The Slow Pump feature is implemented to allow a gradual change in chamber pressure when transitioning from the current pressure to a new setpoint.

The enabled Slow Pump feature will constantly adjust the current setpoint along a control curve until the desired (final) setpoint is reached. Slow pump functions for decreasing, increasing or both decreasing and increasing pressure setpoints, depending on the setting of the slow pump enable. The desired setpoint and slow pump rate is programmable via RS232 or DNET commands. When slow pump is enabled, the final pressure setpoint is approached at the defined rate (Torr/s). Setpoint entry is done in the same manner whether slow pump is enabled or disabled.

COMMAND

Description	*Command*	*Function*
Pressure setpoint	**Sx***value*	Set target pressure; where *value* is the pressure, x is the recipe number and value is the target pressure in % FS of the high range sensor.
Slow Pump rate	**SR***value*	Set slow pump rate, where value is the slow pump rate (Torr/sec). Value must be positive. The value of zero is not allowed.
Slow Pump Enable	**SE***value*	Set slow pump enable, where 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.

REQUEST

Request Message	*Information Requested*	*Response*
RSR	Slow pump rate	SR + *value* Where value is slow pump rate (Torr/s)
RSE	Slow pump enable	SE + *value* Where value is slow pump enable status (0=disabled, 1 =enabled, 2=decreasing only, 3=increasing only)

Slow Pump Behavior

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.

Activation of Slow Pump

The Slow Pump will be active whenever the slow pump attribute is enabled (non-zero).

Abortion of Slow Pump

Abortion of slow pump occurs when the slow pump enable attribute is set to zero (disabled). When slow pump is disabled, the controller approaches the setpoint at full speed, limited only by controller tuning.

Note: slow pump feature is not available in an Analog configured valve.

Informational Messages

Informational messages report data on the device. There are no commands associated with these functions.

Table 10: RS-232 Informational Messages

Description	Request	Response
Pressure Reading (reports pressure reading as % of FS)	**R 5**	P *value* *value:* % FS
Valve Position Value (reports valve position as % of Open)	**R6**	V *value* *value*: % Open
System Status (reports type of operation, state of learning, and valve control)	**R 37**	M *x y z* *x:* Type of Operation 0 = Local 1 = Remote *y:* State of the LEARN Function 0 = Not learning 2 = Learning valve *z:* Valve Control 0 = Open 1 = Close 2 = Stop 3 = Setpoint A 4 = Setpoint B 5 = Setpoint C 6 = Setpoint D 7 = Setpoint E 8 = Analog setpoint
Valve Battery Back-Up Status (T3P only) (reports the voltage status of the optional valve failsafe battery back-up)	**R 39**	BT *x* *x:* 0 = Battery voltage is out of range 1 = Battery voltage is within acceptable range 2 = Battery back-up option is not installed
Firmware Version (reports the installed version of firmware)	**R 38**	*version number*
Checksum Status (reports the status of the A/D converter calibration)	**R 52**	CS *value* *value:* 0 = OK 1 = Error condition

Reporting the Pressure Reading

To report the currently selected pressure reading as a percentage (%) of full scale (FS) of your pressure sensor, issue the request:

R 5

The controller responds with the message [P *value*], where:

value: % of sensor full scale

Note Pressure readings are reported as a percentage of full scale, where full scale is the sensor range set with the [**E*x value***] command. Refer to *Setting the Sensor Range*, page 23, for more information.

If the pressure is 10 Torr for a *10 Torr FS* unit, an example response is:

P *100*

The pressure reading is 100% of the sensor's full scale.

If the pressure is 10 Torr for a *100 Torr FS* unit, an example response is:

P *10*

The pressure reading is 10% of the sensor's full scale.

Calculating the Absolute Pressure

Calculate the absolute pressure using the formula:

ABSOLUTE PRESSURE = (P value / 100) x (FULL SCALE)

For example, if the pressure reading (P value) for a 1000 Torr FS unit was reported as 65 (65%), the absolute pressure is:

ABSOLUTE PRESSURE = (65 / 100) x (1000)

= 650 Torr

Reporting the Valve Position Value

To report the valve position value as a percentage (%) of full Open, issue the request:

R 6

The controller responds with the message [V *value*], where:

value: % of full Open

For example, if the valve is at 50, the response is:

V+0050.0

The valve position is 50% of full open. R6 reflects the analog position output.

Reporting the System Status

The system status request reports the type of operation, the state of the LEARN function, and the state of the valve control. To report the system status, issue the request:

R 37

The controller responds with the message:

```
M x y z
```

where *x*: Type of Operation
0 = Local
1 = Remote

y: State of the LEARN Function
0 = Not learning
2 = Learning valve

z: Valve Control
0 = Open
1 = Close
2 = Stop
3 = Setpoint A
4 = Setpoint B
5 = Setpoint C
6 = Setpoint D
7 = Setpoint E
8 = Analog setpoint

If the unit is set for remote operation, the valve is not learning, and the valve is under setpoint A control, an example response is:

```
M 1 0 3
```

Reporting the Firmware Version

To report the version of firmware that is installed in your device, issue the command:

R 38

The controller responds with a message, such as:

```
01.02
```

Reporting the Build String

To report the build string (which includes dates and times) of the firmware installed in your device, issue the command:

R 66

The controller responds with a message, such as:

```
01.02.06 July 14 2005 15:41:37 VMD:01.21
```

Reporting the Encoder Position

To report the encoder position in % of full scale open, issue the command:

REN

The controller responds with a message, such as:

EN+18.98

Reporting the Air Interlock Status (T3P Only)

To report the air interlock status, issue the command:

RAI

The controller responds with a message, such as:

AI0 or AI1

where: 0 = false
1 = true

Reporting the Valve Interlock Status

To report the valve interlock status, issue the command:

RIN

The controller responds with a message, such as:

IN0 or IN1

where: 0 = false
1 = true

Reporting the Checksum Status

The checksum indicates the status of the unit's A/D converter calibration. To report the status of the checksum, issue the command:

R 52

The controller responds with the message:

`CS value`

where: *value*: 0 = OK
1 = Error Condition

If the A/D calibration is OK, an example response is:

```
CS 0
```

If the A/D calibration is out of range, an example response is:

```
CS 1
```

If the controller detects a checksum error, perform a full calibration to correct the problem. Refer to page 41 for more information.

If your unit issues a checksum error when you power up the controller, or if the transducer's readings are incorrect, you may need to recalibrate the span of the A/D converter. Refer to *Calibrating the A/D Converter*, page 41, for more information.

If the checksum error persists after you perform a full system calibration, followed by a recalibration of the span of the A/D converter, the error indicates a hardware failure of the EEPROM. Contact any MKS Service Center, listed on the inside back cover of this manual, for assistance.

Chapter Two: RS-232 Message Summary

The RS-232 messages required for operation of the device are listed below alphabetically—by command.

A0	Analog Setpoint Range (5v)
A1	Analog Setpoint Range (10v)
BD	Backfill Delay
BE0	Backfill Valve Disable
BE1	Backfill Valve Enable
BL	Backfill Control Limit
C	Close Valve
CAL	Set Operating Mode = CAL
CB	Close Back Fill Relay
D0	Activate Analog Setpoint
D1	Activate Setpoint A
D2	Activate Setpoint B
D3	Activate Setpoint C
D4	Activate Setpoint D
D5	Activate Setpoint E
D6	Activate Analog Setpoint
D7	Restore local preset pressure
D8	Restore local preset position
EH	Set Sensor Range High
EL	Set Sensor Range Low
F	Pressure Units (Torr, mbar, etc.)
FAC	Set Operating Mode = FACTORY
G	Sensor Signal Input Range
GC	Set Gain Compensation Factor
H	Hold Valve
HB	Dump History Buffer To The Serial Port
I1	Set SoftStart Setpoint A % Value
I2	Set SoftStart Setpoint B % Value
I3	Set SoftStart Setpoint C % Value
I4	Set SoftStart Setpoint D % Value
I5	Set SoftStart Setpoint E % Value
I6	Set SoftStart Analog Setpoint % Value
I7	Set SoftStart Open Valve % Value
I8	Set Softstart Close Valve % Value
IE	Interlock Enabled (0 or 1)
IL7	Set Local preset softstart pressure
IL8	Set Local preset softstart position
IX	Reset (Power Cycle)
J	Learn Valve T3X
JT	Set Valve Type
L	Learn the System (Pump Speed)
LA	Select Auto-Dual Channel Operations
LD	Auto Crossover Delay
LH	Select High Channel Operations
LHC	High Channel Crossover
LL	Select Low Channel Operations
LLC	Low Channel Crossover
LPF	Set the Low-Pass Filter time constant (ms) for reporting pressure (default:100ms)
M1	Gain Setpoint Value A
M2	Gain Setpoint Value B
M3	Gain Setpoint Value C
M4	Gain Setpoint Value D
M5	Gain Setpoint Value E
M6	Gain Setpoint Value Analog Setpoint
M7	Local preset pressure gain
MD	Backfill Threshold Pressure
N	Clear any overrides (e.g. open, close, hold)
N0	Set Valve Action Normal
N1	Set Valve Action Reverse
O	Open Valve
OB	Open Backfill Relay
OF1	Calibrate Analog Pressure Out Full Scale
OF2	Calibrate Analog Position Out Full Scale
OI1	Analog Out Pressure Input
OI2	Analog Out Position Input

OS1	Analog Out Pressure Input
OS2	Analog Out Position Input
OZ1	Calibrate Analog Out Pressure Zero
OZ2	Calibrate Analog Out Position Zero
P1	Set Process Limit1 Low
P2	Set Process Limit1 High
P3	Set Process Limit2 Low
P4	Set Process Limit2 High
PC	Set Phase Compensation Factor
PLS	Set Process Limit Source
Q	Stop Learn Valve T3X (while in progress)
R	Get Position Pressure
R0	Get Analog Setpoint Value
R1	Get Setpoint A Value
R10	Get Setpoint E Value
R11	Get Process Limit1 Low
R12	Get Process Limit1 High

R13	Get Process Limit2 Low
R14	Get Process Limit2 High
R15	Get SoftStart Setpoint A % Value
R16	Get SoftStart Setpoint B % Value
R17	Get SoftStart Setpoint C % Value
R18	Get SoftStart Setpoint D % Value
R19	Get SoftStart Setpoint E % Value
R2	Get Setpoint B Value
R20	Get SoftStart Analog Setpoint % Value
R21	Get SoftStart Open valve % Value
R22	Get SoftStart Close Valve % Value
R23	Get Valve Type (same as RJT)
R24	Get Analog Setpoint Range
R25	Get Analog Setpoint = Position/Pressure
R26	Get Setpoint A = Position/Pressure
R27	Get Setpoint B = Position/Pressure
R28	Get Setpoint C = Position/Pressure
R29	Get Setpoint D = Position/Pressure
R3	Get Setpoint C Value
R30	Get Setpoint E = Position/Pressure

R31	Get Valve Position Output Range (B1=10V)
R32	Get Valve Action (N0=normal)
R33	Get High Sensor Range
R34	Get Pressure Units (Torr, mbar, etc.)
R35	Get Sensor Voltage Range
R36	Get Sensor Type (U0=Absolute)
R37	Get System Status Reports
R38	Get Software Version
R39	Get Battery Stats (T3P only)
R4	Get Setpoint D Value
R41	Get Phase Setpoint A Value
R42	Get Phase Setpoint B Value
R43	Get Phase Setpoint C Value
R44	Get Phase Setpoint D Value
R45	Get Phase Setpoint E Value
R46	Get Gain Setpoint A Value
R47	Get Gain Setpoint B Value
R48	Get Gain Setpoint C Value
R49	Get Gain Setpoint D Value
R5	Get Pressure as % of FS
R50	Get Gain Setpoint E Value
R51	Get Pressure Control Mode =Model Based/PID
R52	Get Checksum Status (0 = OK, 1 = Error)
R53	Get Phase Analog Setpoint
R54	Get Gain Analog Setpoint
R55	Get Low Sensor Range
R56	Get Valve Slip (VS0=no slip, VS1=slip)
R57	Get Local preset setpoint pressure phase
R58	Get Local preset setpoint pressure gain
R6	Get Valve Position as % of Open
R60	Get Tau
R63	Get Nonlinear Flow Observer Tau
R64	Get Nonlinear Trajectory Shape
R65	Get Nonlinear Trajectory Tau
R66	Get Full Build String
R7	Get System Status M x y z w
R77	Get Local preset setpoint pressure
R78	Get Local preset setpoint position

R8	Get Valve Slip (C0=no, C1=slip)
R87	Get Local preset softstart pressure
R88	Get Local preset softstart position
RAI	Get Valve Air Interlock Status
RB	Get Status of Backfill Relay - Open/Close
RBD	Get Backfill Delay
RBE	Get Backfill Valve Enable/Disable
RBL	Get Backfill Control Limit
RCD	Get Pump Speed Data Table Data
RCH	Get Checksum
RCL	Get channel lock
RCP	Get Pump Speed Table Pedestal
RCT	Get Pump Speed Data Table Number
RCV	Get Pump Speed Data Value
RD	Get Auto Crossover Delay
RDO	Get Device Option
REN	Get Encoder Valve Position (% Open)
RGC	Get Gain Compensation Factor -
RHC	Get High Channel Crossover
RHR	Get High sensor Range
RIE	Get Interlock Enabled Status
RIN	Get Valve Interlock Status
RJT	Get Valve Type - Duplicate or R23
RLC	Get Low Channel Crossover
RLE	Get Estimated Learn Flow
RLF	Get Learned Flow
RLP	Get Analog Input filter samples
RLR	Get Low sensor Range
RLS	Get Process Limit Source
RMD	Get Backfill Threshold Pressure
ROC	Get Analog Out Calibration status
ROI	Get Analog Output Input (as % of 10VDC)
ROM	Get Operating Mode
ROS	Get Analog Output Source
RPC	Get Phase Compensation Factor
RPO	Get Platform Option (B or P)
RRS	Get Relay A/B Status
RSE	Get Slow Pump Enable
RSN	Get Serial Number of the Unit
RSR	Get Slow Pump Rate
RSS	Get Valve Safe State Open/Close/Hold
RTC	Report valve temperature in Celsius
RTF	Report valve temperature in Farenheit

RUE	Get Speed Up Enable Setting
RUF	Get Speed Up Filter Setting
RUT	Get Speed Up Time Setting
RVE	Get Volume Estimate Status Enable 1 is On, 0 is Off
RVO	Get Chamber Volume Setting
RVS	Get Span Valve Steps
RZZ	Get Devicenet service state
S1	Setpoint Value A
S2	Setpoint Value B
S3	Setpoint Value C
S4	Setpoint Value D
S5	Setpoint Value E
S6	Analog Setpoint Value
S7	Set Local preset setpoint pressure
S8	Set Local preset setpoint position
S	Set Slow Pump recipe and value
SCD	Set Pump Speed Data 🔒
SCP	Set Pump Speed Pedestal 🔒
SCT	Switch Pump Speed Table 🔒
SE	Set Slow Pump Enable
SHR	Set High sensor Range
SLF	Set Learn Flow 🔒
SLR	Set Low sensor Range
SR	Set Slow Pump Rate
SS0	Set Valve Safe State - Open Valve
SS1	Set Valve Safe State - Close Valve
SS2	Set Valve Safe State - Hold Valve
SS4	Set Valve Safe State - Cycle Valve 🔒 🔒
STA	Set Tau 🔒
STD	Set Nonlinear Flow Observer Tau 🔒
STE	Set Nonlinear Trajectory Shape 🔒
STF	Set Nonlinear Trajectory Tau 🔒
SUE	Set Speedup Enable 1 is On, 0 is Off 🔒
SUF	Set Speedup Filter 🔒
SUT	Set Speedup Time 🔒
SVE	Set Volume Estimate Enable 1 is On, 0 is Off 🔒
SVN	Set Valve Normal Mode
SVO	Set Chamber Volume 🔒

T10	Setpoint A = Position
T11	Setpoint A = Pressure
T20	Setpoint B = Position
T21	Setpoint B = Pressure
T30	Setpoint C = Position
T31	Setpoint C = Pressure
T40	Setpoint D = Position

T41	Setpoint D = Pressure
T50	Setpoint E = Position
T51	Setpoint E = Pressure
T60	Analog Setpoint = Position
T61	Analog Setpoint = Pressure
U0	Set sensor type Absolute
U1	Set sensor type Differential
USR	Set Operating Mode = USER
V0	Set Pressure Control Mode = Model Based
V1	Set Pressure Control Mode = PID
W1	Set Controller Phase or Lead
W90	Clear Battery Stats 🔒 (T3P only)
X1	Set Phase Setpoint A Value
X2	Set Phase Setpoint B Value
X3	Set Phase Setpoint C Value
X4	Set Phase Setpoint D Value
X5	Set Phase Setpoint E Value
X6	Set Phase Analog Setpoint Value
X7	Set Local preset pressure phase
Y1	Calibrate Analog Input Full Scale
Y2	Set Full Scale Analog Setpoint
Y3	Calibrate Analog Full Scale 🔒
Y4	Calibrate Analog Zero 🔒
Z1	Commence Zero Calibration (corrects sensor zero offsets)
Z2	Zeros Base Pressure
Z3	Removes Z1 and Z2 Value
Z4	Set Zero Analog Setpoint
ZZ	Start or Stop DeviceNet Services (toggles)

🔒 = Indicates that the instrument must be set to the calibration mode in order to process this command.

🔒🔒 = Indicates a factory only setting.

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