

Valve and Line Accessories

Smith Meter® Model 210 Digital Electro-Hydraulic Set Stop

Installation / Operation / Service Manual

Bulletin MN03010 || Issue/Rev 0.3 (4/15)



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1 – General

The Smith Meter® Model 210 Digital Control Valves are hydraulically-operated, diaphragm-controlled valves, typically used in conjunction with either an AccuLoad or microLoad.

1.1 Receipt of Equipment

When the equipment is received, the outside packing case should be checked immediately for any shipping damage. Carefully remove the unit from its packing case and inspect for damaged or missing parts. If damage has occurred during shipment or parts are missing, the local carrier should be notified immediately and a written report should be submitted to the Customer Service Department, FMC Technologies Measurement Solutions, Inc., P.O. Box 10428, Erie, Pennsylvania 16514-0428. Prior to installation the unit should be stored in its original packing case and protected from adverse weather conditions and abuse.

Standard explosion proof solenoids are:

UL listed and CSA certified for use in Class I, Groups C and D, Division 1.

Class II, Groups E, F, and G, Division 1 hazardous locations.

1.2 Installation

Ensure the valve is installed with flow in the correct direction. The intended flow direction is indicated on the side of the valve body.

These products have been designed for petroleum applications, where corrosion/erosion is normally minimum. The design of the pressure containing housings have adequate material allowance for typical petroleum applications. Consult the factory for other applications or for the actual material allowances.

1.3 Electrical

Wiring is covered in the appropriate controller manual:

[MN06150](#) microLoad.net (I)

[MN06037](#) AccuLoad II (I)

[MN06135](#) AccuLoad III (I)

[MN06140](#) AccuLoad III.SA (I)

[MN06143](#) AccuLoad III-N4 (I)

2 – Operation

2.1 Principle

The Smith Meter® Model 210 Valve (Figure 1) fundamentally consists of a Smith Meter® 200 Series Valve with two solenoid controls. A valve response control device, typically a needle valve, is located between each solenoid and its respective upstream or downstream port. This device is used to fine tune the opening/closing rates of the valve, as well as provide control loop isolation for easier control loop service. Adjustment of these devices controls the flow rate to and from the cover chamber permitting valve adjustments based on product viscosity and pressures.

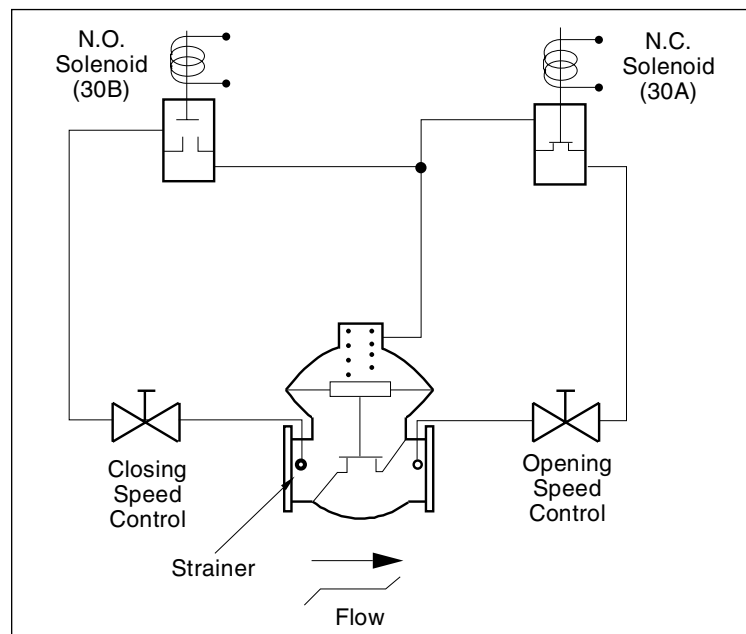


Figure 1 – Model 210 Valve Schematic

The normally open (N.O.) and normally closed (N.C.) solenoids, located in the upstream and downstream portions of the control loop, respectively, control the operation of the valve. When both solenoids are energized, high upstream pressure is blocked from reaching the main valve cover, the pressure in the cover vents to downstream (lower pressure), and the valve opens. Conversely, when both solenoids are deenergized, the downstream control loop is blocked and high upstream pressure closes the valve.

During flow, when the N.O. solenoid is energized while the N.C. solenoid is deenergized, pressure is trapped in the cover causing the valve poppet to be hydraulically locked in a fixed open position. Therefore, a constant flow rate is maintained. When operating conditions change causing a change in flow rate for that fixed valve opening, the flow controller (e.g., microLoad, or AccuLoad) signals the appropriate solenoid to open or close momentarily, changing the valve open position, thereby readjusting the flow rate to its set value.

When the set flow rate changes (e.g., from low flow start to high flow limit, or during multi-step valve shutdown), the appropriate solenoids are signalled to open and/or close until the flow rate adjusts to the new set value. When the product delivered reaches a predetermined (field adjustable first stage trip) value in the controller, valve closure is initiated. The flow controller signals the 210 Valve to ramp down the flow in a multi-step manner, thus preventing line shock.

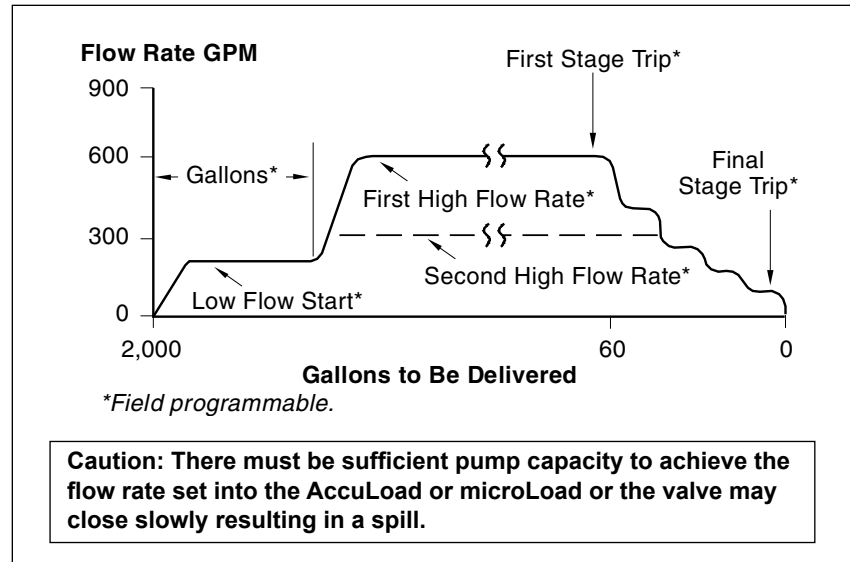


Figure 2 – Typical Load Cycle

When the preset quantity is nearly reached (1-2 gallons remaining), a final trip point (field adjustable in controller) signals the valve to close completely assuring accurate delivery of the preset quantity. Figure 2 shows a typical truck loading flow rate sequence.

2.2 Start-up and Field Adjustments

Upon initial system start-up, using the 210 Valve, it is recommended that the following steps be followed sequentially to insure a stable and properly operating system:

Step 1: First, all air must be vented from the cover chamber of the main valve. Otherwise, the valve may be unstable or sluggish. This is done by pressurizing the system and loosening the highest vent plug in the valve cover until all air is expelled. Valves installed in horizontal lines usually automatically expel all of the air from the cover chamber after just a few full actuations of the valve.

Step 2: Be certain the flow rate limit is properly set in the controller (e.g., AccuLoad, microLoad, etc.) so the meter is protected from over-speeding and the valve is modulating (i.e., controlling flow rate).

Step 3: Before energizing the solenoids to open the valve, completely close the downstream solenoid control loop isolation needle valve. This prevents the 210 Valve from opening. Also, adjust the upstream solenoid control loop isolation needle valve about 1/4 - 1/2 open.

Step 4: With no other loading position from the pump open (highest valve inlet pressure) preset a small volume and energize the valve solenoids as normally would be done to initiate flow.

Step 5: Slowly open the downstream needle valve until the main valve opens slowly but smoothly and maintains flow stability (solenoids not "clicking" excessively).

Step 6: Allow a normal preset shutdown, observing the valve closing speed and flow stability during the multi-stage shutdown.

Step 7: If the shutdown speed and flow stability are acceptable, go to the next step. If either is unacceptable, adjust the upstream needle valve (further closed for slower valve shutdown and better flow stability, or further open for faster valve shutdown). Preset small batches each time, repeating Steps 5 and 6 until satisfactory valve performance is obtained.

Step 8: Preset a small batch and after high flow is reached, initiate an emergency stop ('E' Stop). Record the volume throughput after initiation of the 'E' Stop and observe whether there was excessive line shock. If line shock was excessive, close the upstream solenoid isolation needle valve a little further to slow the valve closure rate. Repeat this step until excessive line shock is eliminated.

Step 9: If possible, with all other loading positions from the pump open (lowest valve inlet pressure), preset a small batch and run. If opening speed is not acceptable, open the downstream solenoid isolation needle valve a little further and observe normal valve opening and closing performance, as done in Steps 6 and 7 (See Note A). Repeat this step until acceptable opening speed is obtained.

Step 10: If closing speed is unacceptable, adjust the first stage trip value in the preset counter to a value sufficient to assure reaching final step flow prior to the final stage trip on the preset counter (See Note B).

Step 11: Conduct an 'E' Stop test as in Step 8. If the volume throughput after initiation of 'E' Stop is greater than the volume left in the tank or compartment after a high level sensor initiates an 'E' Stop (typically about twenty (20) gallons for a gasoline transport), a decision must be made whether to speed up the valve closure and accept some line shock at high valve inlet pressure (i.e., one load position operating), or accept a slower than ideal valve closure on 'E' Stop at low valve inlet pressure (i.e., all load positions operating).

Step 12: If a modulating pressure pilot was supplied on the valve, it should have been factory set for the specified control pressure (e.g., 64A pilot set at 35 psi maximum valve outlet pressure or 23 BP pilot set at 15 psi minimum valve inlet pressure). Open the isolation needle valve(s) on the pressure pilot loop, causing the pressure pilot (e.g., Model 64A) to control the valve by adjusting manual valves in the system. Slowly close the isolation needle valve upstream of the pressure pilot until stable (no flow surging) 210 Valve operation is obtained. Using a pressure gauge, check to be sure the pressure pilot is set to control at the desired pressure. Adjust it as required.

Notes:

- A. If it is not possible to conduct Steps 9, 10, and 11 with all load positions operating, compromise by having as many load positions as possible operating. Then throttle the flow ahead of the meter with a manual valve until the 210 Valve is not limiting flow i.e., not modulating). This occurs when the flow rate is less than the high flow rate limit (set into the controller) by more than the flow control "band width".
- B. The pump should be wired to remain on for at least five (5) seconds after 'E' Stop is initiated to assist in valve closure.
- C. If the ratio between the highest and the lowest 210 Valve inlet pressure at high flow (i.e., one versus all positions operating from that pump) is greater than 2:1, it may not be possible to obtain satisfactory valve performance under all operating conditions. If the inlet pressure variation is extreme, no compromise needle valve settings may be possible. The system will then have to be changed, either by adding pumping capacity, adding a pressure reducing valve in the common line from the pump to the loading positions, or by replacing the 210 Valves with air-operated 215 Valves, etc.
- D. If it becomes necessary to use the control loop needle valves for pilot isolation (i.e., in order to repair or replace a pilot without draining down the system), be sure to mark their "control position" precisely to permit easy resetting after the repair is complete.

3 – Troubleshooting Guide

Problem		Cause		Remedy
1.	Low or no flow.	A.	No pump pressure	Start pump
		B.	Upstream block valve closed	Open valve
		C.	Improper wiring	Check wiring
		D.	Downstream Model 13 Valve on 210 Valve closed	Open needle valve
		E.	AccuLoad or microLoad fuse blown	Replace fuse
		F.	Broken 210 Valve diaphragm	Check diaphragm
		G.	Improper fluid connection to truck	Open dry break coupling
		H.	AccuLoad or microLoad relay failed	Test board*
		I.	Line strainer clogged	Visually check
		J.	Preset counter switch not working	Visually check
		K.	N.C. solenoid failed closed	Test and replace
2.	Improper or erratic high flow	A.	Fluid pressure oscillating	Stabilize system
		B.	Improper pressure regulator pilot settings	Adjust settings
		C.	AccuLoad or microLoad Hi Flow setting incorrect	Correct setting
		D.	Wiring connections loose	Repair as required
		E.	Solenoid wiring revised	Correct no. 3 & 4 connection
3.	Excessive high flow	A.	Manual override valve open	Close valve
		B.	Improper wiring	Check wiring
		C.	N.O. solenoid failed to open	Test and replace
		D.	N.C. solenoid failed to close	Test and replace
		E.	Contamination in 210 pilot loop	Clean or replace
		F.	AccuLoad or microLoad Hi Flow setting incorrect	Correct setting
		G.	Pulse transmitter slotted disk loose on shaft	Reposition and tighten*
4.	Valve shuts down early	A.	Final zero adjustment too early	Read just "Zero" on Preset Counter ⁺
		B.	N.O. solenoid leaking	Test and replace
		C.	AccuLoad or microLoad board defective	Test and replace
		D.	Leaking diaphragm	Replace diaphragm
5.	Valve shuts down late	A.	Upstream Model 13 needle valve	Open needle valve further
		B.	Improper switch settings on high flow	Adjust preset counter trip ⁺
		C.	First trip too late on Preset Counter	Adjust Preset Counter trip ⁺
		D.	Final zero adjusting	Readjust "Zero" on Preset Counter
6.	Valve fails to shut off	A.	Manual override valve open	Close valve
		B.	Upstream Model 13 Needle Valve closed	Open needle valve
		C.	N.O. Solenoid failed to open	Test and replace
		D.	N.C. Solenoid failed to close	Test and replace
		E.	Final trip failed on Preset Counter	Replace or repair switch ⁺
		F.	AccuLoad or microLoad board defective	Test and replace*
		G.	Valve strainer clogged	Check strainer
7.	Line shock on shutdown	A.	210 Valve closing too fast	Gradually close upstream needle valve
8.	Downstream system pressure too high	A.	210 Valve leaking	Repair as required

* See AccuLoad Installation Manual (Bulletin MN06135).

⁺ See Veeder-Root Installation/Operation/Service Manual 251278 (Bulletin 8-015).

4 – Service and Maintenance

The intent of this section is to illustrate proper service and provide maintenance interval guidelines of Smith Meter® 210 digital control valves.

4.1 Service / Maintenance Intervals

The preset or device that is controlling the solenoids may be equipped with a means to count the number of solenoid actuations. In the event that this is possible, the following is a maintenance schedule for both upstream and downstream solenoid:

- At 250,000 actuations, inspect and replace components as needed
- At 500,000 actuations, rebuild the solenoids
- At 750,000 actuations, inspect and replace components as needed
- At 1,000,000 actuations, replace the solenoids

Inside the main valve, the elastomers (diaphragm, stem O-rings and poppet seal) should be visibly inspected for cracks, breakout and deterioration every 3 to 5 years under normal load rack conditions. This guideline can be used as a starting point for elastomer inspection; however, it is essential for every customer to determine a unique maintenance plan based on experience as every application and installation will vary.

4.2 Recommended Spare Components

Reference the appropriate valve parts list for recommended spare parts.

4.3 Tools Required:

- Open ended wrenches
- Standard sockets
- Crescent wrench
- Manual torque wrench
- Pry bar
- Two flat headed screwdriver

Caution!

Prior to any service, ensure that the line has been completely drained and power has been removed from the solenoids. Use proper protective equipment (i.e. safety glasses, gloves, etc.) while servicing the equipment.

4.4 Document Sequence

This document will follow a sequential flow of a description of the action, followed by a picture of the action.

4.5 210 Valve Service

It is highly recommended to service the valve while in the horizontal plane. If the valve is in the vertical plane, this could cause misalignment of some of the components if proper care is not taken. If the valve is removed from piping, place on a flat surface and use wedges to ensure the valve does not roll while servicing. If the valve is not removed from the piping, some of these steps may difficult to accomplish.

Disconnect all wiring to solenoids. Remove tubing from valve and set aside. The tubing can be reused if in good condition. Remove solenoids by turning the solenoid and fitting assembly in the counter clockwise direction – this will remove the pipe nipple from the junction box.



Figure 3 – Tubing Removal

If the solenoids are to be disassembled, inspect the solenoid elastomers for any “chunking” or missing elastomer pieces. If abnormal wear is visible, the solenoid should be rebuilt or replaced.



Figure 4 – Solenoid Elastomer Damage Example

Remove the junction box and junction box bracket.

Once the valve cover has clearance to be removed, using an open ended wrench or socket, remove all of the cover nuts.



Figure 5 – Cover Disassembly

Caution!

The cover spring(s) could cause the cover to release from the body unexpectedly. However, if the cover does not release from the body, use two flat headed screwdrivers to pry down, against the body as shown below. Ensure to only insert the tip of the screwdrivers underneath the rabbit and not to pry against the diaphragm. Depending on valve size, there could be two springs underneath the cover – 2” and 3” valves have one spring while 4” and 6” valves have two springs.



Figure 6 – Cover Removal



Figure 7 – Cover Removal



Figure 8 – Cover Removal

Remove the spring(s) from the valve stem.



Figure 9 – Cover Spring Removal

Remove the stem assembly from the valve body. On the underside of the stem, note that the stem may have a flat machined surface. This flat surface is dependent on valve size. Some valve sizes have a nut where this flat would be (Figures 10 and 11). Secure this flat surface or the lower stem nut in a vice as shown in Figure 12.



Figure 10 – Stem Flat Surface



Figure 11 – Stem Nut



Figure 12 – Poppet Assembly

Remove the stem nut with a socket or open ended wrench.



Figure 13 – Stem Nut Removal

Remove the lock washer, back-up plate and diaphragm washer.

Note: the back-up plate and diaphragm washer have a tight fit around the stem. Ensure not to gall the threads of the stem while removing the back-up plate.



Figure 14 – Diaphragm O-ring

Remove the top diaphragm O-ring, diaphragm and lower diaphragm O-ring and discard as these components should be replaced.



Figure 15 – Diaphragm O-ring Removal



Figure 16 – Diaphragm Removal

Inspect the lower diaphragm washer for any defects. If none are present, the diaphragm washer can be left on the stem. If there are visible defects (i.e. sharp edges, warpage, etc.), the diaphragm washer should be replaced. Use caution when installing the washer and ensure not to gall the threads.



Figure 17 – Diaphragm Washer

Place a new diaphragm O-ring around the stem. Gently roll the O-ring down the stem until it mates with the diaphragm washer and apply a light coat of petroleum jelly to the O-ring.

Place the new diaphragm on the stem. Use caution while pulling the diaphragm down the threads as to not fray the diaphragm. It is recommended to install the diaphragm so that the part number and elastomer markings are visible from the top.



Figure 18 – Diaphragm

Install a new diaphragm O-ring. Use caution while pulling the O-ring down the threads of the stem.



Figure 19 – Diaphragm O-ring

Apply a light coating of petroleum jelly to the top diaphragm O-ring and the stem.



Figure 20 – Petroleum Jelly Application

Inspect the upper diaphragm washer for any defects. If none are present, install the diaphragm washer. If there are visible defects (i.e. sharp edges, warpage, etc.), the diaphragm washer should be replaced. Use caution when installing the washer and ensure not to gall the threads.



Figure 21 – Upper Diaphragm Washer

Using a fine file, dress the surfaces of the back-up plate to remove any burrs.



Figure 22 – Back-up Plate

Using a brass bristle brush, dress the inner diameter of the back-up plate to remove any burrs.



Figure 23 – Back-up Plate



Figure 24 – Back-up Plate Installation

Install the lock washer on the stem.



Figure 25 – Lock Washer

Secure the stem nut to the stem using a socket or open ended wrench. Tighten until the lock washer engages and is flat against the surface of the back-up plate.



Figure 26 – Engaged Lock Washer

Remove the stem assembly from the vice and install the stem into the seat of the valve. DO NOT slide the diaphragm over the studs at this point.



Figure 27 – Stem Assembly



Figure 28 – Stem Assembly

Insert a pry bar into the inlet of the valve and lift up the bottom of the stem. Lift the stem to ensure that the diaphragm does not fray against the threads of the studs while seating the diaphragm. Gently slide the diaphragm stud holes over the studs. Ensure not to fray or twist the inner diameter of the diaphragm stud holes. Ensure this is done while the stem is lifted. This may require additional assistance.

If the valve is installed in the piping, manually hold the valve stem assembly so that the diaphragm uniformly slides over the studs.



Figure 29 – Stem Assembly Installation

While the stem is lifted (if the valve has been removed from the piping), install the spring(s) over the stem against the backup plate.



Figure 30 – Stem Assembly Installation

If the valve has one spring, install the spring over the stem. If the valve has two springs, install the taller spring over the stem, seating the spring flat against the backup plate noting the orientation of the starting coil of the spring. Place the shorter spring over the taller spring, seating the spring against the backup plate. Ensure that the shorter spring is oriented 180 degrees out of phase from the taller spring as shown above.



Figure 31 – Spring(s) Installation



Figure 32 – Cover Installation

With the stem still lifted (if the valve has been removed from the piping), install every other nut until pressure can be relieved from the cover. While tightening the nuts, tuck the excess of the diaphragm under the rabbit of the cover. **DO NOT** cut the excess off. This can be done by using a screwdriver or a thin flat device. Ensure not to puncture the diaphragm.



Figure 33 – Cover Installation



Figure 34 – Cover Installation

Continue tightening the cover nuts by hand until they require a wrench and the rabbit of the cover completely covers the valve body. Install the remaining nuts by hand. As the nuts are being tightened, check for gap uniformity of the valve body and cover. Once the nuts are snug, using a manual torque wrench tighten the nuts per the sequence as shown in the table and diagrams below (Table 1).

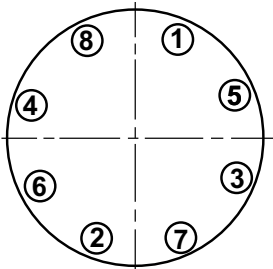
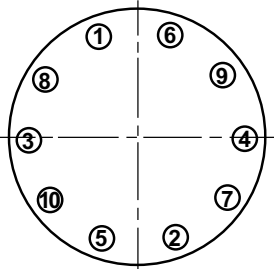
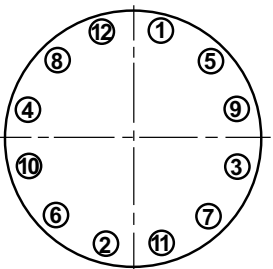
	 8 bolt		 10 bolt		 12 bolt	
Valve Size:	2 Inch (8 bolt)	3 Inch (8 bolt)	4 Inch (10 bolt)	6 Inch (12 bolt)		
Nominal Bolt Size:	5/16-18	7/16-14	5/8-11			
Round 1:	Hand tighten to snug	Hand tighten to snug	Hand tighten to snug			
Round 2:	Tighten to 10 ft-lbs	Tighten to 25 ft-lbs	Tighten to 35 ft-lbs			
Round 3:	Tighten to 20 ft-lbs	Tighten to 45 ft-lbs	Tighten to 90 ft-lbs			
Round 4:	Tighten to 20 ft-lbs	Tighten to 45 ft-lbs	Tighten to 150 ft-lbs			
Round 5:	N/A	N/A	Tighten to 150 ft-lbs			

Table 1 – Cover Nut Torque Valves and Sequence

If the valve has been removed from the piping, the valve can be rested on the inlet or outlet flange to allow proper leverage.



Figure 35 – Torque Cover Nuts

Install the junction box and junction box bracket and install solenoids. Note the position of the longer studs. These are to be used for the junction box installation. If solenoid fittings were removed or replaced, lightly dress fitting threads with Loctite 565 thread sealant.

Reinstall the valve tubing. The tubing can be reused if in good condition. Install tubing by loosely securing the tubing fitting to the solenoid fitting. This will allow the tubing to be somewhat flexible and will make installation simpler. Once all tubing is in place, secure tubing with an open ended wrench. Ensure not to over tighten as this could crush the tubing and create a leak path.



Figure 36 – Tubing Installation



Figure 37 – Tubing Installation

Re-wire solenoid connections. Ensure to reference proper preset controller or PLC manuals for this process.

Once the valve is completely assembled, refer to the Start-up and Field Adjustments section for proper valve tuning procedure.

5 – Related Publications

The following literature can be obtained from FMC Technologies Measurement Solutions Literature Fulfillment at measurement.fulfillment@fmcti.com or online at www.fmctechnologies.com/mesurementsolutions.

When requesting literature from Literature Fulfillment, please reference the appropriate bulletin number and title.

Model 210 Digital Electro-Hydraulic Set-Stop Specifications Bulletin [SS03009](#)

Revisions included in MN03010 Issue/Rev. 0.3 (4/15):

Total Revision.

The specifications contained herein are subject to change without notice and any user of said specifications should verify from the manufacturer that the specifications are currently in effect. Otherwise, the manufacturer assumes no responsibility for the use of specifications which may have been changed and are no longer in effect.

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