Stonel™ Quartz™ Valve Position Indicator
Rev. 1.5

Safety Manual

2/2026

Stonel publication 105533revB

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1. General information

The Quartz series valve position indicator is used to indicate the position of a valve assembly. This device is typically used as a safety component that provides a signal output of valve position. The end user can use this information in different ways depending on the SIF or sensory input that is being instrumented.

Quartz series valve position indicator can be used in a multitude of sensor input configurations and any sub classification depending on the model and SIF being implemented for the desired Safety Function and SIL level.

The valve position can be indicated using one of the defined outputs (mechanical switches, proximity sensors, or position transmitter). The Quartz unit provides input feedback of the valve to the safety system. End user must follow all guidance identified in the Installation, Maintenance and Operating Instructions (later referred to as IMO) with this safety manual to verify the products proper installation and operation of the product.

2. Structure of valve position indicator

2.1. System components and description of use

See the IMO for the detailed technical description of the device and the system architecture.

2.2. Permitted device types

The information in this manual pertaining to functional safety applies to all device variants mentioned in the device type coding in Table 1. It is up to the end-user to verify that the correct model is selected for the intended function and the SIF.

2.3. Supplementary device documentation

Related QX/QN Installation, Maintenance and Operating Instructions listing

IMO	Applicable models	Type	Description
105406	QX_J, QX_L, QX_P, QN_J, QN_L, QN_P	Limit switch	MaxxGuard models SPST
105406	QX_S, QX_H, QX_G, QX_M, QN_S, QN_H, QN_G, QN_M	Limit switch	MaxxGuard models SPDT
105406	QX_X, QN_X	Limit switch	SST models
105406	QX_A, QN_A	Limit switch	"A" Namur sensor models for intrinsically safe applications
105406	QX_N, QN_N	Limit switch	Namur sensor models for intrinsically safe applications
105406	QX35, QN35	Limit switch	SST dual module models
105406	QX45, QN45	Limit switch	Namur Sensor (EN 60947-5-6) Dual Module
105406	QX5O, QN5O	Position transmitter	4-20ma Position transmitter
105406	QXBO, QNBO	Potentiometer	10k Potentiometer
105406	QX7O, QN7O	Position transmitter	High performance 4-20mA position transmitter
105406	QXCO, QNCO	Potentiometer	High performance 10k potentiometer

Table 1

The IMO is available from our Stonel product center or for download from these links https://www.valmet.com/flowcontrol/brands/stonel/downloadables/ 7QZ70EN

3. Description of safety requirements

3.1. Safety function

Limit switch models: The function of the device is to provide contact inputs to the safety system that relates the position of the measured actuator / valve. Both sensors can be used in conjunction to verify valve position. In order to achieve the desired SIL safety level, redundant contacts/switches may be needed.

4-20 mA Position transmitter models: The function of this device is to provide position feedback inputs to the safety system that relates the position of the measured actuator / valve. If position transmitter produces feedback out of range(<3mA or >21mA) that is considered dangerous detected failure, the controller must perform the safety function.

10k Potentiometer models: The function of this device is to provide position feedback inputs to the safety system that relates the position of the measured actuator / valve. If the potentiometer unit transmitter produces feedback out of range (>11KΩ) that is considered dangerous detected failure, the controlled must perform the safety function.

3.2. Restrictions for use in safety-related applications

Please ensure that the valve monitor is used correctly for the application in question and that the ambient conditions are taken into account. The instructions for installation conditions, as detailed in the IMO, shall be observed. The specifications in the IMO shall not be exceeded.

3.3. Functional safety indicators

Table 2 below shows the specific values for functional safety up to SIL1.

Model Series	Type	λ	λs	λd	λdd	λdu
QX2G, QN2G, QX5G, QN5G, QX7G, QN7G	A	3.16E-08	1.39E-08	1.77E-08	0	1.77E-08
QX2H, QN2H, QX5H, QN5H, QX7H, QN7H	A	3.10E-08	1.33E-08	1.77E-08	0	1.77E-08
QX2M, QN2M, QX5M, QN5M, QX7M, QN7M	A	1.70E-08	9.80E-09	7.20E-09	0	7.20E-09
QX2S, QN2S, QX5S, QN5S, QX7S, QN7S	A	5.39E-08	3.62E-08	1.77E-08	0	1.77E-08

Table 2

Table 3 below shows the specific values for functional safety up to SIL2.

Model Series	Type	λ	λs	λd	λdd	λdu
QX_J, QN_J	A	9.93E-09	8.27E-09	1.66E-09	0	1.66E-09
QX_L, QN_L	A	1.97E-08	1.23E-08	7.38E-09	0	7.38E-09
QX_P, QN_P	A	9.93E-09	8.27E-09	1.66E-09	0	1.66E-09
QX4G, QN4G	A	9.93E-09	8.27E-09	1.66E-09	0	1.66E-09
QX4H, QN4H	A	9.93E-09	8.27E-09	1.66E-09	0	1.66E-09
QX4M, QN4M	A	9.93E-09	8.27E-09	1.66E-09	0	1.66E-09
QX4S, QN4S	A	1.97E-08	1.23E-08	7.38E-09	0	7.38E-09
QX_X, QN_X	A	1.60E-07	9.34E-08	6.62E-08	0	6.62E-08
QX_A, QN_A	A	2.97E-08	1.91E-08	1.07E-08	0	1.07E-08
QX_N, QN_N	A	2.90E-08	2.21E-08	6.91E-09	0	6.91E-09
QX35, QN35	A	2.89E-07	1.86E-07	1.03E-07	0	1.03E-07
QX45, QN45	A	3.55E-07	2.43E-07	1.11E-07	0	1.11E-07
QX5O, QN5O	A	1.36E-07	2.84E-08	1.07E-07	7.03E-08	3.69E-08
QXBO, QNBO	A	3.80E-08	3.50E-09	3.45E-08	3.04E-08	4.10E-09
QX7O, QN7O	A	1.31E-07	2.84E-08	1.03E-07	6.65E-08	3.64E-08
QXCO, QNCO	A	3.37E-08	3.07E-09	3.06E-08	2.70E-08	3.67E-09

Table 3

Table 4 below shows the specific values for functional safety of Maxx-Guard limit switch models for up to SIL3, when using external diagnostics via a safety controller, redundant switches, and cross-comparison of each redundant switch's feedback.

Model Series	Type	λ	λs	λd	λdd	λdu
QX2G, QN2G, QX5G, QN5G, QX7G, QN7G	A	6.31E-08	2.36E-08	3.95E-08	3.94E-08	1.05E-10
QX2H, QN2H, QX5H, QN5H, QX7H, QN7H	A	6.21E-08	2.28E-08	3.93E-08	3.91E-08	1.05E-10
QX2M, QN2M, QX5M, QN5M, QX7M, QN7M	A	3.40E-08	2.28E-08	1.12E-08	1.12E-08	3.23E-11
QX2S, QN2S, QX5S, QN5S, QX7S, QN7S	A	1.03E-07	6.31E-08	3.95E-08	3.94E-08	1.05E-10

Table 4

λ = Total Failure Rate (λ = λs + λd)
λs = Safe Failure Rate
λd = Dangerous Failure Rate
λdd = Dangerous Detected Failure Rate
λdu = Dangerous Undetected Failure Rate

Limit switch models: The failure rates assume that idle current principle has been applied. The switch must be chosen such that an open switch must result in an action which performs the safety function. In normal operation (no safety demand) the switch is closed and a current, sourced by the controller, flows through the switch (idle current). If the current flow is interrupted, due to switch or line break etc., the safety function will be performed. Therefore, any failure of the limit switch which allows current to continue to flow is considered a dangerous failure and any failure of the limit switch which interrupts the flow of current is considered a safe failure.

The achievable SFF of the Quartz unit depends on the configuration and number of the switches and the evaluation of the signals from the Quartz in the connected safety controller.
If the feedback from the redundant switches differ for a duration exceeding 2 seconds, a dangerous failure has been detected by the safety controller and appropriate action shall be taken.

Position transmitter and potentiometer models: The failure rates assume the following:

- < 20% deviation from actual position is considered a safe failure
- > 20% deviation from actual position is considered a dangerous failure.

- If position transmitter produces feedback out of range (<3mA or >21mA) that is considered dangerous detected failure, the controller must perform the safety function.
- If the potentiometer unit produces feedback out of range (>11KΩ) that is considered dangerous detected failure, the controller must perform the safety function.

4. Installation

4.1. Hardware fault tolerance

The hardware fault tolerance (HFT) of the standalone installation is HFT = 0. If hardware fault tolerance of >= 1 is required, then a redundant configuration of the limit switch installation shall be used. Since position transmitter and potentiometer units are not available in redundant configuration, they are limited to HFT = 0 and therefore can only be used up to SIL2.

4.2. Installation and commissioning

The installation and commissioning/calibration of the device must be done by qualified technician, according to the IMO. It is important that the mechanical connection to the valve/actuator is installed correctly and securely by a qualified technician. Every parameter related to the device type in question and mentioned in the IMO needs to be checked and compared against the device settings. If any deviations exist the safety of the installation cannot be guaranteed.

If installing a Quartz model with a MaxxGuard switch from Table 4, and external diagnostics are required to achieve a higher SFF, configure the cams of the two limit switches to be redundant, such that both switches maintain idle current at the same valve position. The safety controller shall be configured to perform a cross-comparison of the feedback signals from both switches. If the feedback from the redundant switches differ for a duration exceeding 2 seconds, a dangerous failure has been detected by the safety controller and appropriate action shall be taken.

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4.3. Orientation

Orientation of the device is described in the IMO.

5. Operation and Maintenance

5.1. Operation

See IMO for the operation of the device.

Limit switch models: The sensors are triggered by a rotating cam at a fixed distance from the sensors, this ensures that the switch points are repeatable and consistent over the full temperature range, even in high vibration environments.

Position transmitter and potentiometer models: These have a potentiometer that is driven by the rotating shaft. It is fixed to the shaft to give positive engagement to ensure that the position feedback is repeatable and consistent over the full temperature range, even in high vibration environments

5.2. Maintenance

See the IMO for maintenance instructions.

During maintenance work on the device, alternative safety function methods shall be taken to ensure process safety. This device should be considered in all SIF proof tests.

5.3. Useful Lifetime

A useful lifetime of approximately 12 years is expected for these Quartz QX/QN models in safety related applications.

5.4. Proof Testing

The objective of proof testing is to detect failures within the Quartz unit which are not detected by diagnostics. Of main concern are undetected failures that prevent the safety-instrumented function from performing its intended function.

The frequency of proof testing, or the proof test interval, is to be determined in reliability calculations for the safety instrumented functions for which the Quartz unit is applied. The proof tests must be performed more frequently or as frequently as specified in the calculation in order to maintain the required safety integrity of the safety instrumented function.

For the Quartz models with a Maxx-Guard switch from Table 4, where a higher SFF level is needed, proof testing shall be performed on intervals of 3-months or 12-months depending on the application. For Low Demand applications, proof testing shall be performed at least every 12 months. For High Demand applications, proof testing shall be performed at least every 3 months.

6. Repair

Any repair to the device shall be carried out under guidance by the manufacturer. Device failures must be reported to the manufacturer. The user shall provide a detailed report to the manufacturer describing the failure and any possible effects.

7. QX/QN Certificate

Certificate

No.: 968/FSP 1064.05/26

Product tested	Quartz™ Valve Position Indicator/Sensor	**Certificate holder**	Valmet Flow Control Inc. 26271 US Hwy 59 56537 Fergus Falls, MN United States of America
Type designation	QX- and QN- Models (Details see Appendix of Certificate)		
Codes and standards	IEC 61508 Parts 1-7:2010		
Intended application	The Quartz™ Valve Position Indicator/Sensor can be used in a safety instrumented system (SIS) as sensor(s) to indicate the position of a valve assembly. Quartz™ Valve Position Indicator/Sensor (QX- and QN- Models) comply with the requirements up to SIL 3 acc. to IEC 61508 depending on the variant and configuration. The configuration and number of switches (HFT = 0 or 1) depend on the target safety level (SIL) and the evaluation of the signals in the safety controller. For further information see the appendix of the certificate. The variants of the Quartz Valve Position Indicator / Sensor can be used in safety related applications up to these safety levels according to IEC 61508 and IEC 61511-1 + Corr.1:2016 + AMD1:2017.		
Specific requirements	The instructions of the associated Installation, Maintenance and Operating Instructions and Safety Manual shall be considered.		

Valid until 2031-02-27

The issue of this certificate is based upon an examination, whose results are documented in Report No. 968/FSP 1064.05/25 dated 2026-02-26.
This certificate is valid only for products which are identical with the product tested.

TÜV Rheinland Industrie Service GmbH
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Köln, 2026-02-27

Certification Body Safety & Security for Automation & Grid

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7.1. QX/QN Certificate page 2

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Safety function: **Sensing of the position of valves or actuators. The configuration and number of switches depend on the target safety level (SIL) up to SIL 2 (HFT = 0) and SIL 3 (HFT = 1) and the evaluation of the signals in the safety controller.**

Opening and closing position of the switches may be configured such that an open contact results to an action into the safe direction of the SIF.

Model Series	λ / 1/h	λ_s / 1/h	λ_d / 1/h	SFF
QX2J, QX4J, QX5J, QX7J QN2J, QN4J, QN5J, QN7J	9.93E-09	8.27E-09	1.66E-09	83,3%
QX2L, QX4L, QX5L, QX7L QN2L, QN4L, QN5L, QN7L	1.97E-08	1.23E-08	7.38E-09	62,4%
QX2P, QX4P, QX5P, QX7P QN2P, QN4P, QN5P, QN7P	9.93E-09	8.27E-09	1.66E-09	83,3%
QX4G, QN4G	9.93E-09	8.27E-09	1.66E-09	83,3%
QX4H, QN4H	9.93E-09	8.27E-09	1.66E-09	83,3%
QX4M, QN4M	9.93E-09	8.27E-09	1.66E-09	83,3%
QX4S, QN4S	1.97E-08	1.23E-08	7.38E-09	62,4%
QX4X, QX6X, QN4X, QN6X	1.60E-07	9.34E-08	6.62E-08	58,4%
QX2A, QX4A, QX5A, QX7A, QN2A, QN4A, QN5A, QN7A	2.97E-08	1.91E-08	1.07E-08	64,4%
QX2N, QX4N, QX5N, QX6N, QX7N QN2N, QN4N, QN5N, QN6N, QN7N	2.90E-08	2.21E-08	6.91E-09	76,2%
QN35, QX35	2.89E-07	1.86E-07	1.03E-07	64,24%
QN45, QX45	3,55E-07	2,43E-07	1,11E-07	68,6%

λ Total Failure Rate ($\lambda = \lambda_s + \lambda_d$)
λ_s Safe Failure Rate
λ_d Dangerous Failure Rate
Safe Failure Fraction SFF = λ_s / λ

7.2. QX/QN Certificate page 3

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Safety function: **Sensing of the position of valves or actuators with a target safety level (SIL) up to SIL 1 (HFT = 0).**

Opening and closing position of the switches may be configured such that an open contact results to an action into the safe direction of the SIF.

Model Series	λ [1/h]	λs [1/h]	λd [1/h]	SFF
QX2G, QX5G, QX7G QN2G, QN5G, QN7G	3.16E-08	1.39E-08	1.77E-08	43.87%
QX2H, QX5H, QX7H, QN2H, QN5H, QN7H	3.10E-08	1.33E-08	1.77E-08	42.89%
QX2M, QX5M, QX7M, QN2M, QN5M, QN7M	1.70E-08	9.80E-09	7.20E-09	57.66%
QX2S, QX5S, QX7S QN2S, QN5S, QN7S	5.39E-08	3.62E-08	1.77E-08	67.15%

λ Total Failure Rate ($\lambda = \lambda_s + \lambda_d$)
λ_s Safe Failure Rate
λ_d Dangerous Failure Rate
Safe Failure Fraction SFF = λ_s / λ

Safety function: **Sensing of the position of valves or actuators with a target safety level (SIL) up to SIL 3 (HFT = 1) and the evaluation of the signals in the safety controller.**

Opening and closing position of the switches may be configured such that an open contact results to an action into the safe direction of the SIF.

Model Series	λ [1/h]	λs [1/h]	λd [1/h]	λdd [1/h]	λdu [1/h]	SFF
QX2G, QX5G, QX7G QN2G, QN5G, QN7G	6.31E-08	2.36E-08	3.95E-08	3.94E-08	1.05E-10	99.83%
QX2H, QX5H, QX7H, QN2H, QN5H, QN7H	6.21E-08	2.28E-08	3.93E-08	3.91E-08	1.05E-10	99.90%
QX2M, QX5M, QX7M, QN2M, QN5M, QN7M	3.40E-08	2.28E-08	1.12E-08	1.12E-08	3.23E-11	99.83%
QX2S, QX5S, QX7S QN2S, QN5S, QN7S	1.03E-07	6.31E-08	3.95E-08	3.94E-08	1.05E-10	99.91%

λ Total Failure Rate ($\lambda = \lambda_s + \lambda_d$)
λ_s Safe Failure Rate
λ_d Dangerous Failure Rate
λ_{dd} Dangerous Detected Failure Rate
λ_{du} Dangerous Undetected Failure Rate
Safe Failure Fraction SFF = λ_s / λ

7.3. QX/QN Certificate page 4

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Safety function: **Sensing of the position of valves or actuators and translating it into a 4-20mA value. Certified up to SIL 2, see note below.**

Diagnostic measures: For the calculation of the safety related reliability data it is assumed that the safety controller has to perform the following diagnostic measures:
In case the current <3mA or >21mA the safety controller has to perform a safety related action.

Mode Series	λ 1/h	λ_s / 1/h	λ_d / 1/h	λ_{dd} / 1/h	λ_{du} / 1/h	SFF
QN5O, QX5O	1,36E-07	2,84E-08	1,07E-07	7,03E-08	3,69E-08	72,8 %
QN7O, QX7O	1,31E-07	2,84E-08	1,03E-07	6,65E-08	3,64E-08	72,3 %

λ total failure rate
λ_d Current deviates more than 20% from the "real" value (valve Position)
λ_s Current deviates less than 20% from the "real" value (valve Position)
λ_{dd} Current is <3mA or >21mA
λ_{du} Current deviates more than 20% from the "real" value (valve Position), but is still within 3 to 21mA
Safe Failure Fraction SFF = $(\lambda - \lambda_{du}) / \lambda$

Note: The models listed in the table above are not available in a redundant configuration. Due to this fact the hardware fault tolerance is 0 (HFT=0) and considering the achieved SFF, which is smaller than 90%, the devices fulfil the requirements for the hardware integrity up to SIL 2 of IEC 61511-1, table 6 and IEC61508-2, table 2.

7.4. QX/QN Certificate page 5

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Safety function: **Sensing of the position of valves or actuators and translating it into a 0-10kOhm resistance value. Certified up to SIL 2, see note below.**

Diagnostic measures: For the calculation of the safety related reliability data it is assumed that the safety controller has to perform the following diagnostic measures:
In case the resistance is > 11kOhm the safety controller has to perform a safety related action.

Model Series	λ 1/h	λ_s / 1/h	λ_d / 1/h	λ_{dd} / 1/h	λ_{du} / 1/h	SFF
QNBO, QXBO	3,80E-08	3,50E-09	3,45E-08	3,04E-08	4,10E-09	89,2%
QNCO, QXCO	3,37E-08	3,07E-09	3,06E-08	2,70E-08	3,67E-09	89,1%

λ total failure rate
λ_d Resistance deviates more than 20% from the "real" value (valve Position)
λ_s Resistance deviates less than 20% from the "real" value (valve Position)
λ_{dd} Resistance is >11kOhm
λ_{du} Resistance deviates more than 20% from the "real" value (valve Position), but is still below 11kOhm

Safe Failure Fraction SFF = $(\lambda - \lambda_{du}) / \lambda$

Note: The models listed in the table above are not available in a redundant configuration. Due to this fact the hardware fault tolerance is 0 (HFT=0) and considering the achieved SFF, which is smaller than 90%, the devices fulfil the requirements for the hardware integrity up to SIL 2 of IEC 61511-1, table 6 and IEC61508-2, table 2.