

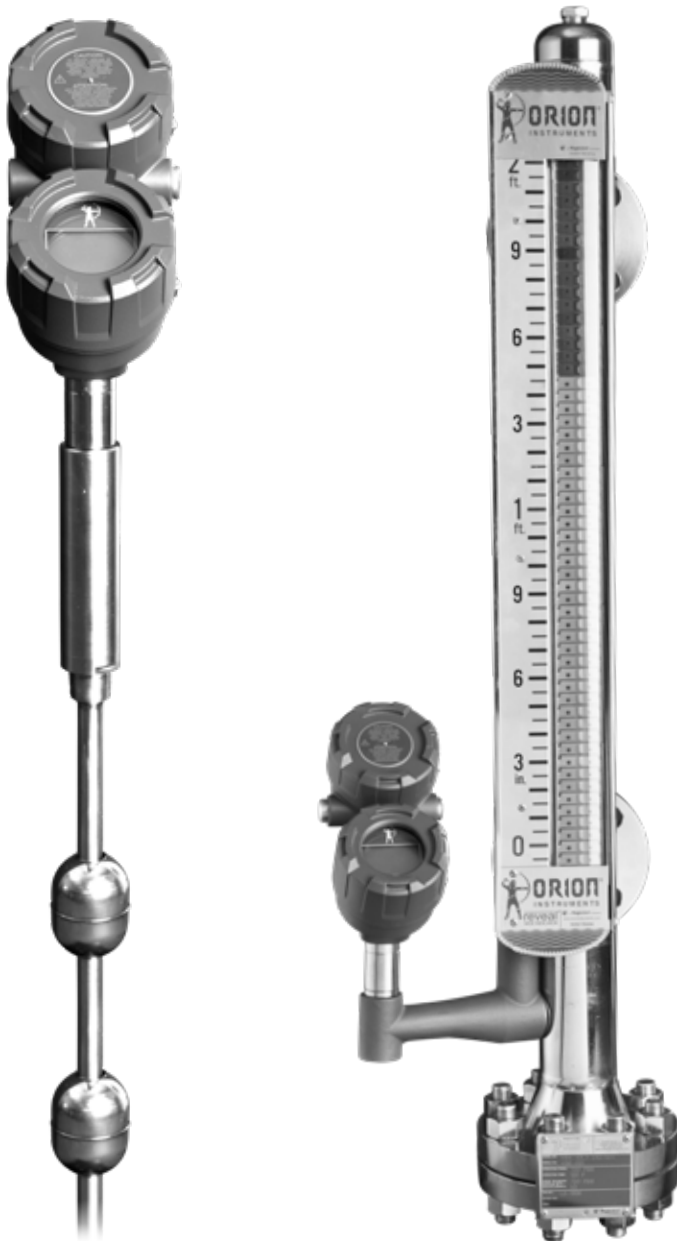
Jupiter[®]

Model JM4

Software v1.x

SIL Safety Manual

Magnetostrictive Level Transmitter



This manual complements and is intended to be used with the Orion Instruments[®] Jupiter[®] Model JM4 Magnetostrictive Level Transmitter Installation and Operating Manual (Bulletin ORI-650).





Jupiter® Model JM4 Magnetostrictive Transmitter SIL Safety Manual

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1.0 Introduction

1.1 Product Description

The JUPITER Model JM4 magnetostrictive level transmitter is a loop-powered 24 VDC level transmitter based on magnetostrictive technology.

NOTE: For Safety Instrumented Systems usage, it is assumed that the 4-20 mA output is used as the primary safety variable.

The analog output for the Model JM4 meets the NAMUR NE 43 standard (3.8 mA to 20.5 mA usable). The transmitter contains self-diagnostics and is programmed to drive the output to a user-selected failure state, either low or high, upon internal detection of a diagnostic indicator. The device can be equipped with or without a graphic liquid crystal display (LCD).

Table 1 indicates the version of the JUPITER Mode JM4 transmitter suitable for SIL 2 applications based on the hardware assessment.

Table 1
JUPITER JM4 Model Number

Model:JM4-511X-XXX (HART Transmitter) 2YX-XXXX-XXX-XX-XXX (Probe)
--

1.2 Theory of Operation

Magnetostrictive level sensors are based on “time-of-flight” technology.

Permanent magnets contained within a float device track the process liquid as it changes level. The JUPITER probe is fixed within close proximity to this magnetic field. A short current pulse is then applied to a specially designed wire alloy contained within the probe. The interaction of the current pulse and magnetic field causes distortion in a small section of the wire alloy. This in turn creates a vibratory disturbance which begins to travel through the wire at a very constant rate of speed. The disturbance is later detected via a sensing device at the top of the probe and sent to the electronics unit where it is filtered and amplified.

Extremely accurate level measurement can thus be obtained precisely measuring the elapsed time between the current pulse (start), and the returned pulse (stop). The JUPITER electronics module processes these signals, and then performs various mathematical operations in order to provide the user with an analog and/or digital representation of the liquid level.

Table 2
SIL vs. PFD_{avg}

Safety Integrity Level (SIL)	Target Average probability of failure on demand (PFD _{avg})
4	$\geq 10^{-5}$ to $< 10^{-4}$
3	$\geq 10^{-4}$ to $< 10^{-3}$
2	$\geq 10^{-3}$ to $< 10^{-2}$
1	$\geq 10^{-2}$ to $< 10^{-1}$

Table 3
Minimum hardware fault tolerance

Type B sensors, final elements and non-PE logic solvers

SFF	Hardware Fault Tolerance (HFT)		
	0	1	2
None: < 60%	Not Allowed	SIL 1	SIL 2
Low: 60% to < 90%	SIL1	SIL 2	SIL 3
Medium: 90% to <99%	SIL 2	SIL3	
High: $\geq 99\%$	SIL 3		

1.3 Determining Safety Integrity Level (SIL)

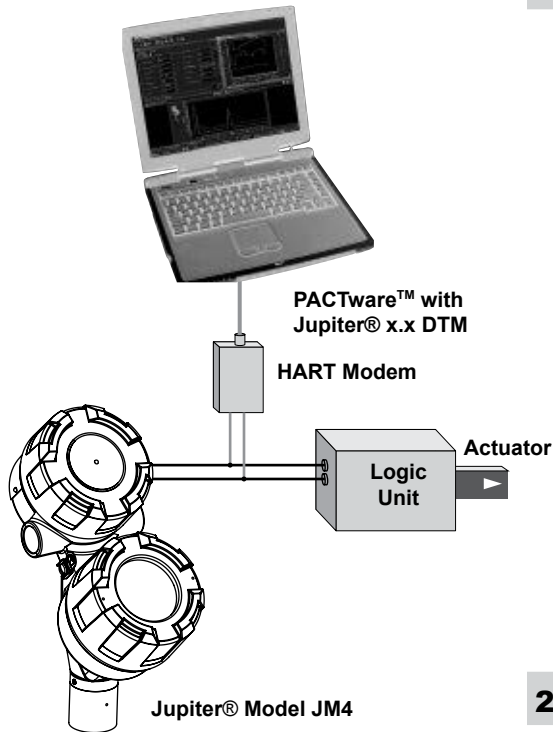
The JUPITER Model JM4 is classified as a Type B device according to IEC61508.

Tables 2 & 3 define the criteria for the achievable SIL against the target mode of operation in Demand Mode Operation.

- Table 2 shows the relationship between the Safety Integrity Level (SIL) and the Probability of Failure on Demand Average (PFD_{avg}).

- Table 3 is used to determine the achievable SIL as a function of the Hardware Fault Tolerance (HFT) and the Safe Failure Fraction (SFF) for the complete safety function (Type B — complex components as per IEC 61508 Part 2) *of which the level transmitter is one component.*

2.0 Level Measuring System



The diagram at left shows the structure of a typical measuring system incorporating the JUPITER Model JM4 transmitter. This SIL-rated device is only available with an analog signal (4–20 mA) with HART communications, and the measurement signal used by the logic solver must be the analog 4–20 mA signal proportional to the level.

- For fault monitoring, the logic unit must recognize both high alarms (≥ 21.5 mA) and low alarms (≤ 3.6 mA).
- If the logic solver loop uses intrinsic safety barriers, caution must be taken to ensure the loop continues to operate properly under the low alarm condition.
- The only unsafe mode is when the unit is reading an incorrect level within the 4–20 mA range ($> \pm 2\%$ deviation).
- MAGNETROL defines a safe failure as one in which the 4–20 mA current is driven out of range (i.e., less than 3.8 mA or greater than 21.5 mA).

2.1 Miscellaneous Electrical Considerations

Following are miscellaneous electrical issues to be considered in a safety system.

2.1.1 Pollution Degree 2

The JUPITER Model JM4 transmitter is designed for use in a Category II, Pollution Degree 2 installation, which is defined by the non-conductive pollution of the sort where occasionally a temporary conductivity caused by the condensation must be expected.

This is the usual pollution degree used for equipment being evaluated to IEC/EN 61010.

2.1.2 Over-voltage

The JUPITER Model JM4 transmitter has, as standard, over-voltage protection per CE requirements. When considering Hi-pot, Fast Transients, and Surge, this protection is to 1000 volts (1KV). Therefore, there should be no unsafe failure modes up to 1 KV.

Overvoltage Category II is a local level, covering appliances, portable equipment, etc., with smaller, transient overvoltages than those characteristic of Overvoltage Category III. This category applies from the wall plug to the power-supply isolation barrier (transformer).

As the typical plant environment is Overvoltage Category II, most equipment evaluated to the requirements of IEC/EN 61010 are considered to belong in that classification.

3.0 Mean Time To Restoration (MTTR)

SIL determinations are based on a number of factors including the Mean Time To Restoration (MTTR). The analysis for the JUPITER Model JM4 is based on a MTTR of 24 hours.

4.0 Supplementary Documentation

- The JUPITER Model JM4 Installation and Operating Manual ORI-650 must be available to ensure proper installation of the transmitter.
- One of the following Electronic Device Description Files is also required if HART is used:
 - Manufacturer Code 56 (hex)
 - Model JM4 Device ID 56DF (hex), device revision 1, DD revision 1.
- For device installations in a classified area, the relevant safety instructions and electrical codes must be followed

5.0 General Instructions

5.1 Systematic Limitations

The following instructions must be observed to avoid systematic failures.

5.1.1 Application

Choosing the proper accessories and options for the JUPITER Model JM4 transmitter is an important decision in the application process. High temperature and cryogenic probes are available for extreme temperature situations. Vibration absorption kits are also available for high vibration applications. As the probe configuration establishes fundamental performance characteristics, the probe for use with the JUPITER Model JM4 must be carefully selected. Appropriate selection of Probe design and materials as well as float characteristics and material will assure reliable operation. Refer to Installation and Operating Manual ORI-650 for more information on selecting the proper options for each specific application.

5.1.2 Environmental

Refer to Installation and Operating Manual ORI-650 for environmental limitations.

5.1.2.1 Storage

The device should be stored in its original shipping box and not be subjected to temperatures outside the storage temperature range of -50 to +185 °F (-46 to +85 °C).

5.2 Installation

Refer to the Model JM4 Installation and Operating Manual ORI-650 for complete installation instructions.

I/O Manual ORI-650:

- Contains information on the use, changing and resetting of the password-protection function.
- Provides menu selection items for configuration of the transmitter as a level sensing device.
- Offers configuration recommendations.

NOTE: This SIL evaluation has assumed that the customer will be able to acknowledge an over- or undercurrent condition via the Logic Solver.

5.3 Skill Level of Personnel

Personnel following the procedures of this safety manual should have technical expertise equal to or greater than that of a qualified Instrument Technician.

5.4 Necessary Tools

Following are the necessary tools needed to carry out the prescribed procedures:

- Open-wrenches or adjustable wrench to fit the process connection size and type.
- Flat-blade screwdriver
- Digital multimeter or digital volt/ammeter
- 24 VDC power supply, 23 mA minimum
- Hex key 2.5 mm to lock transmitter in place on the probe and to lock transmitter rotational position

5.5 Configuration

5.5.1 General

The JUPITER Model JM4 transmitter can be configured via the local display, a HART compatible handheld terminal, or a personal computer using the PACTware™ and the associated DTM.

5.5.2 Configuration

Ensure the parameters have been properly configured for the application and probe. Special consideration should be given to the following configuration parameters:

FAULT: DO NOT choose HOLD for this parameter as a Fault will not be annunciated on the current loop.

BLOCKING DISTANCE: This value MUST be zero for SIL applications. Consult factory prior to making any changes.

LOOP CONTROL MODE: Ensure this is set to ENABLED.

PASSWORD: Must be changed to a specific value other than Zero.

5.5.3 Write Protecting/Locking

The Model JM4 transmitter is password protected with a numerical password between 0 and 99,999.

NOTE: Default Password = 0 = Password disabled

Refer to the Model JM4 Installation and Operating Manual Bulletin ORI-650 for additional information on password protection.

It is required that, after configuration of the system is complete, a password is utilized to prevent inadvertent changes to the device.

5.6 Site Acceptance Testing

To ensure proper operation after installation and configuration, a site acceptance test should be completed. This procedure is identical to the Proof Test Procedure described in Section 6.1.4.

5.7 Recording Results

Results of Site Acceptance Testing must be recorded for future reference.

5.8 Maintenance

5.8.1 Diagnostics

Internal diagnostic testing within the Model JM4 transmitter occurs approximately five times per second (1 every 100 ms). A message will appear and the output current will be driven to 3.6 or 22 mA (customer dependent) upon detection of a fault.

5.8.2 Troubleshooting

Report all failures to the MAGNETROL technical support department.

Refer to the Model JM4 Installation and Operating Manual ORI-650 for troubleshooting device errors.

- The SIL Proof Test provides a reliable indication when maintenance is required.
- Firmware can be upgraded only by factory personnel.

6.0 Recurrent Function Tests

6.1 Proof Testing

6.1.1 Introduction

Following is the procedure utilized to detect Dangerous Undetected (DU) failures. This procedure will detect approximately 83% of the Dangerous Undetected (DU) failures in the Jupiter Model JM4-511X-XXX.

6.1.2 Interval

To maintain the appropriate Safety Integrity Level of a Safety Instrumented System, it is imperative that the entire system be tested at regular time intervals (shown as TI in the appropriate standards). The suitable SIL for the Model JM4 transmitter is based on the assumption that the end user will carry out this test and inspection at least once per year.

NOTE: It is the responsibility of the owner/operator to select the type of inspection and the time period for these tests

6.1.3 Recording Results

Results of the Proof test should be recorded for future reference.

6.1.4 Suggested Proof Test

The suggested proof test described on pages 9–10 will detect 83% of the possible DU failures that remain after taking into account automatic diagnostics. The suggested proof test in combination with automatic diagnostics will detect 98% of possible DU failures in Model JM4-511x-xxxx.

Step	Action
1	Bypass the PLC or take other action to avoid a false trip.
2	<p>Remove power from the Unit. (This clears any potential soft RAM errors.) Inspect the Unit in detail outside and inside for physical damage or evidence of environmental or process leaks.</p> <ul style="list-style-type: none"> a.) Inspect the exterior of the unit housing. If there is any evidence of physical damage that may impact the integrity of the housing and the environmental protection, the unit should be repaired or replaced. b.) Inspect the interior of the Unit. Any evidence of moisture, from process or environment, is an indication of housing damage, and the unit should be repaired or replaced.
3	<p>Restore power to the Unit. Use the Unit's "DIAGNOSTICS" menu to observe "Present Status" and to review "EVENT HISTORY". Up to 10 events are stored. The events will be date and time stamped if the internal clock is set and running. It is suggested that the internal clock be set at the time of commissioning of the unit. If the clock is set at the time of the proof test event times are calculated.</p> <ul style="list-style-type: none"> a.) Observe the "Present Status". "Present Status" should be "OK". b.) Review the "EVENT HISTORY". <ul style="list-style-type: none"> i.) Messages in the "EVENT HISTORY" must be investigated and understood. ii.) Corrective actions should be taken for critical messages that indicate performance may be affected.
4	<p>Use the Unit's "DIAGNOSTICS" menu to perform a loop current test. Choose the menu "DIAGNOSTIC/ADVANCE DIAGNOSTICS/TRANSMITTER TESTS/Analog Output Test" to change the output loop current and confirm the actual loop current matches the value chosen.</p> <ul style="list-style-type: none"> a.) Send a HART command to the transmitter (or use the local user interface) to go to high alarm current output, 22mA, and verify that the analog current reaches that value. <ul style="list-style-type: none"> i.) This step tests for compliance voltage problems such as low supply voltage or increased wiring resistance. ii.) This also tests for current loop control circuitry and adjustment problems. b.) Send a HART command to the transmitter (or use the local user interface) to go to low alarm current output, 3.6mA, and verify that the analog current reaches that value. <ul style="list-style-type: none"> i.) This step tests for high quiescent current and supply voltage problems. ii.) This also tests for current loop control circuitry and adjustment problems. c.) Exit the "Analog Output Test" and confirm that the output returns to original state, with the proper loop current as indicated and controlled by the unit.

Step	Action									
5	<p>Use the “DIAGNOSTICS” menu to observe the present Echo Curve and document typical performance values. Confirm that the ECHO Waveform is normal. The ECHO curve is dependent on the probe used and the level of the process on the probe. It is recommended that a typical ECHO curve be saved at commissioning. Comparison of the ECHO curve at proof test to one stored at the time of commissioning gives additional confidence of the normal operation of the unit. Use of digital communications (HART enhanced DD or DTM) is necessary for comparison of echo curves. For a dual float unit repeat the steps below for the second float and document “Upr Echo Strength” and “lfc Echo Strength” as well as “Upr Noise / Threshold” and “lfc Noise / Threshold”.</p> <p>a.) Move the process level so the float is located at a distance of approximately 33% of probe length from the connector end of the probe.</p> <p>b.) Choose the menu “DIAGNOSTICS/ECHO CURVES/ View Echo Curve”.</p> <p>i.) Observe the present Echo Curve, identify the characteristic portions of the waveform related to the top of the probe and float location.</p> <p>ii.) Confirm signal from the float appears normal and is located as expected.</p> <p>iii.) Verify the baseline of the waveform is normal and does not have evidence of excessive noise.</p> <p>iv.) If possible, compare to Echo curve from commissioning to assure that performance has not changed significantly.</p> <p>c.) Choose the menu “DIAGNOSTICS/ADVANCED DIAGNOSTICS/ INTERNAL VALUES”.</p> <p>i.) Observe and record:</p> <table data-bbox="321 913 1071 1018" style="margin-left: 40px;"> <thead> <tr> <th></th> <th style="text-align: center;">Upper</th> <th style="text-align: center;">Interface</th> </tr> </thead> <tbody> <tr> <td>1. Echo Strength</td> <td style="text-align: center;">_____</td> <td style="text-align: center;">_____</td> </tr> <tr> <td>2. Lvl Noise / Threshold</td> <td style="text-align: center;">_____</td> <td style="text-align: center;">_____</td> </tr> </tbody> </table> <p>ii.) Confirm that these values match the values observed at commissioning of the unit and/or at previous Proof Tests.</p> <p>1. Echo Strength change is less than ± 15.</p> <p>2. Lvl Noise / Threshold is less than ± 15.</p>		Upper	Interface	1. Echo Strength	_____	_____	2. Lvl Noise / Threshold	_____	_____
	Upper	Interface								
1. Echo Strength	_____	_____								
2. Lvl Noise / Threshold	_____	_____								
6	Perform a two point calibration check of the transmitter by applying level to two points on the probe and compare the transmitter display reading and the current level value to a know reference measurement.									
7	If the calibration is correct the proof test is complete. Proceed to step 9.									
8	<p>If the calibration is incorrect, remove the transmitter and probe from the process. Inspect the probe for buildup or clogging. Clean the probe if necessary. Perform a bench calibration check by moving the float to two points on the probe. Measure the level from the bottom of the probe to the points and compare to the transmitter display and current level readings.</p> <p>a.) If calibration is off by more than 1%, call the factory for assistance.</p> <p>b.) If calibration is correct, the proof test is complete. Re-install the probe and transmitter and proceed to step 9.</p>									
9	Restore the loop to full operation.									
10	Remove the bypass from the safety PLC or otherwise restore normal operation.									

7.0 Appendices

7.1 SIL Declaration of Conformity


Functional safety according to IEC 61508/IEC 61511.

Orion Instruments, 2105 Oak Villa Boulevard, Baton Rouge, Louisiana 70815, declares as the manufacturer that the level transmitter:

Magnetostrictive (4-20 mA) Model JM4-511x-xxx is suitable for the use in safety instrumented systems according to IEC 61511-1, if the safety instructions and following parameters are observed:

Product	Model JM4-511x-xxx	
	Single Float	Dual Float
SIL	2	2
Proof Test Interval	1 year	1 year
Device Type	B	B
SFF	93.1%	91.9%
PFD _{avg}	1.97E-03	1.96E-03
λ_{sd}	0	0
λ_{su}	127	129
λ_{dd}	1113	1113
λ_{du}	92	110

7.2 FMEDA Report: exida Management Summary



Failure Modes, Effects and Diagnostic Analysis Review

Project:
Jupiter JM4 Magnetostrictive Level Transmitter

Company:
Magtrol International
Aurora, IL
USA

Contract Number: Q14/02-065
Report No.: MAG 14/02-065 R001
Version V2, Revision R2, September 17, 2014
Rudolf Chalupa

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Management Summary

This report summarizes the results of the hardware assessment in the form of a Failure Modes, Effects, and Diagnostic Analysis (FMEA) of the Jupiter JM4 Magnetostrictive Level Transmitter, hardware and software revision per section 2.5.1. A Failure Modes, Effects, and Diagnostic Analysis is one of the steps to be taken to achieve functional safety certification per IEC 61508 of a device. From the FMEA, failure rates are determined. The FMEA that is described in this report concerns only the hardware of the Jupiter JM4. For full functional safety certification purposes all requirements of IEC 61508 must be considered.

The Jupiter JM4 Magnetostrictive Level Transmitter provides an analog output proportional to the level being measured. Its primary components are the electronics assembly, the probe assembly containing the magnetostrictive wire and sensor, and the float(s). Table 1 gives an overview of the different versions that were considered in the FMEA of the Jupiter JM4.

Table 1 Version Overview

Single Float	One float
Dual Float	Two floats for determining two levels

The Jupiter JM4 is classified as a Type B' element according to IEC 61508, having a hardware fault tolerance of 0.

The analysis shows that the has a Safe Failure Fraction between 90% and 99% (assuming that the logic solver is programmed to detect over-scale and under-scale currents) and therefore meets hardware architectural constraints for up to SIL 2 as a single device.

The failure rates for the Jupiter JM4 are listed in Table 2.

Table 2 Failure rates Jupiter JM4 Single Float

Failure Category	Failure Rate (FIT)
Fail Safe Undetected	127
Fail Dangerous Detected	1113
Fail Detected (detected by internal diagnostics)	968
Fail High (detected by logic solver)	70
Fail Low (detected by logic solver)	75
Fail Dangerous Undetected	92
No Effect	316
Annunciation Undetected	5

¹ Type B element: "Complex" element (using micro controllers or programmable logic); for details see 7.4.4.1.3 of IEC 61508-2, ed2, 2010.



Table 3 Failure rates Jupiter JM4 Dual Float

Failure Category	Failure Rate (FIT)
Fail Safe Undetected	129
Fail Dangerous Detected	1113
Fail Detected (detected by internal diagnostics)	968
Fail High (detected by logic solver)	70
Fail Low (detected by logic solver)	75
Fail Dangerous Undetected	110
No Effect	316
Annunciation Undetected	5

These failure rates are valid for the useful lifetime of the product, see Appendix A.

The failure rates listed in this report do not include failures due to wear-out of any components. They reflect random failures and include failures due to external events, such as unexpected use, see section 4.2.2.

Table 4 lists the failure rates for the Jupiter JM4 according to IEC 61508, ed2, 2010.

Table 4 Failure rates according to IEC 61508 in FIT

Device	λ_{SD}	λ_{SU}^2	λ_{SD}	λ_{SU}	SFF ³
Single Float	0	127	1113	92	93.1%
Dual Float	0	129	1113	110	91.9%

A user of the Jupiter JM4 can utilize these failure rates in a probabilistic model of a safety instrumented function (SIF) to determine suitability in part for safety instrumented system (SIS) usage in a particular safety integrity level (SIL). A full table of failure rates is presented in section 4.4 along with all assumptions.

² It is important to realize that the No Effect failures are no longer included in the Safe Undetected failure category according to IEC 61508, ed2, 2010.

³ Safe Failure Fraction, if needed, is to be calculated on an element level

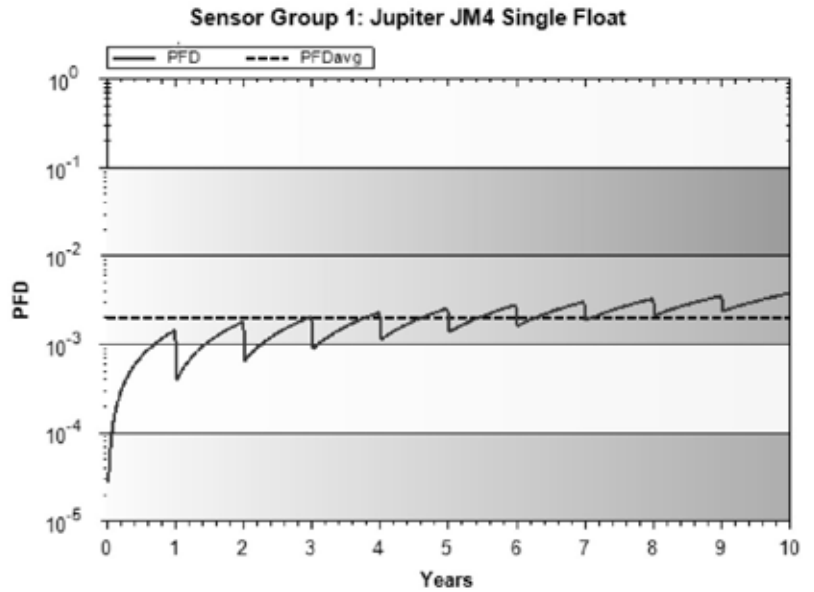
7.3 Specific Model JM4 Values

Specific Model JM4

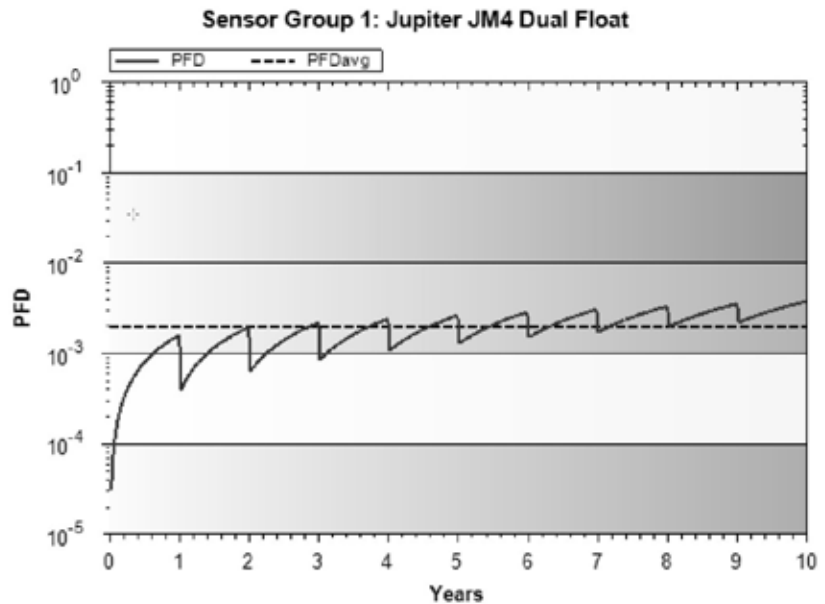
Product	JUPITER Model JM4-511x-xxx
SIL	SIL 2
HFT	0
Single Float	
SFF	93.1%
PFD_{avg}	1.97E-03
Dual Float	
SFF	91.9%
PFD_{avg}	1.96E-03
Proof Test Interval	Annually (refer to PFD Graph below)

7.4 PFD Graph

The resulting PFD_{AVG} Graph generated from the exSILentia tool for a proof test interval of one year is displayed below.



\PFD_{AVG} value for a single Model JM4-511x-xxx (one float) with proof test intervals of one year.



PFD_{AVG} value for a single Model JM4-511x-xxx (two floats) with proof test intervals of one year.

It is the responsibility of the Safety Instrumented Function designer to perform calculations for the entire SIF.

For SIL 2 applications, the PFD_{AVG} value needs to be $\geq 10^{-3}$ and $< 10^{-2}$. This means that for a SIL 2 application, the PFD_{AVG} for a 1-year Proof Test Interval of the Model JM4-511x-xxx is approximately equal to 20% of the range.

These results must be considered in combination with PFD_{AVG} values of other devices of a Safety Instrumented Function (SIF) in order to determine suitability for a specific Safety Integrity Level (SIL).

7.5 Report: Lifetime of Critical Components

According to section 7.4.9.5 of IEC 61508-2, a useful lifetime, based on experience, should be assumed.

Although a constant failure rate is assumed by probabilistic estimation method, this only applies provided that the useful lifetime of components is not exceeded. Beyond their useful lifetime the result of the probabilistic calculation method is therefore meaningless, as the probability of failure significantly increases with time. The useful lifetime is highly dependent on the subsystem itself and its operating conditions.

The assumption of a constant failure rate is based on the bathtub curve. Therefore it is obvious that the PFD_{AVG} calculation is only valid for components that have this constant domain and that the validity of the calculation is limited to the useful lifetime of each component.

The expected useful life of JUPITER Model JM4-511x-xxx is at least 50 years.

It is the responsibility of the end user to maintain and operate the Model JM4-511x-xxx per manufacturer's instructions. Furthermore, regular inspection should indicate that all components are clean and free from damage.

When plant experience indicates a shorter lifetime than indicated here, the number based on plant experience should be used.

References

- IEC 61508 Edition 2.0,2010 “Functional Safety of Electrical/Electronic/Programmable Electronic Safety Related Systems”
- ANSI/ISA-84.00.01-2004 Part 1 (IEC 61511-1Mod) “Functional Safety: Safety Instrumented Systems for the Process Industry Sector – Part 1 Hardware and Software Requirements”
- ANSI/ISA-84.00.01-2004 Part 2 (IEC 61511-2Mod) “Functional Safety: Safety Instrumented Systems for the Process Industry Sector – Part 2 Guidelines for the Application of ANSI/ISA84.00.01-2004 Part 1 (IEC 61511-1 Mod) – Informative”
- ANSI/ISA-84.00.01-2004 Part 3 (IEC 61511-3Mod) “Functional Safety: Safety Instrumented Systems for the Process Industry Sector – Part 3 Guidance for the Determination of the Required Safety Integrity Levels – Informative”
- ANSI/ISA-TR84.00.04 Part 1 (IEC 61511 Mod) “Guideline on the Implementation of ANSI/ISA-84.00.01-2004”

Disclaimer

The SIL values in this document are based on an FMEDA analysis using exida's SILVER Tool. MAGNETROL accepts no liability whatsoever for the use of these numbers for the correctness of the standards on which the general calculation methods are based

ASSURED QUALITY & SERVICE COST LESS

Service Policy

Owners of Magnetrol/Orion Instruments controls may request the return an instrument or any for complete rebuilding or replacement. They will be rebuilt or replaced promptly. Instruments returned under our service policy must be returned by prepaid transportation.

Magnetrol/Orion will repair or replace the control at no cost to the purchaser (or owner) other than transportation if:

1. Returned within the warranty period; and
2. The factory inspection finds the cause of the claim to be covered under the warranty.

If the trouble is the result of conditions beyond our control; or, is NOT covered by the warranty, there will be charges for labor and the parts required to rebuild or replace the equipment.

In some cases it may be expedient to ship replacement parts; or, in extreme cases a complete new instrument, to replace the original equipment before it is returned. If this is desired, notify the factory of both the model and serial numbers of the instrument to be replaced. In such cases, credit for the materials returned will be determined on the basis of the applicability of our warranty.

No claims for misapplication, labor, direct or consequential damage will be allowed.

Return Material Procedure

So that we may efficiently process any materials that are returned, it is essential that a "Return Material Authorization" (RMA) number be obtained from the factory, prior to the material's return. This is available through Magnetrol/Orion's local representative or by contacting the factory. Please supply the following information:

1. Company Name
2. Description of Material
3. Serial Number
4. Reason for Return
5. Application

Any unit that was used in a process must be properly cleaned in accordance with OSHA standards, before it is returned to the factory.

A Material Safety Data Sheet (MSDS) must accompany material that was used in any media.

All shipments returned to the factory must be by prepaid transportation.

All replacements will be shipped F.O.B. factory.



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