E3 Modulevel®

SIL Safety Manual for Model E3

Software v1.x

Functional Safety Manual

Liquid Level Displacer Transmitter

This manual complements and is intended to be used with the E3 Modulevel Installation and Operating manual (Bulletin 48-635 dated October 2008 or later).

Application

The E3 Modulevel Liquid Level Displacer Transmitter can be applied in most process or storage vessels, bridles, bypass chambers, interfaces, sumps, and pits up to the unit pressure and temperature ratings. The E3 Modulevel can be used in liquids, clean or dirty, light hydrocarbons to heavy acids (SG=0.23 to 2.20) to meet the safety system requirements of IEC 61508.

Benefits

The E3 Modulevel provides the following benefits to your operation:

- Suitable for use in environments up to SIL 2 (Safe Failure Fraction = 92.3%) as independently assessed (hardware assessment) by exida.com as per IEC 61508/61511-1.
- Level ranges from 14 to 120+ inches (356 to 3048+ mm).
- Process temperatures to +600° F (+315° C) for non-steam applications.
- Process pressures to +5150 psi (+355 bar).
- Continuous self-test with 22 mA or 3.6 mA fault indication fully compliant with NAMUR NE 43.
- IS, XP, and Non-Incendive approvals.
- Emission and immunity compliance to EN 61326.
- Two-wire, loop-powered transmitter for level, interface, or density measurement.

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E3 Modulevel Displacer Level Transmitter

SIL 1/SIL 2 Versions

Table of Contents

1.0 Introduction

1.1 Product Description

The E3 Modulevel is a loop-powered, two-wire, 24 VDC level transmitter that uses simple buoyancy principles in combination with a precision range spring and a highly accurate LVDT (linear variable differential transformer) to detect and convert liquid level changes into a stable 4–20 mA output signal. The electronics are housed in an ergonomic, dual-compartment enclosure that is angled for ease of wiring and calibration.

The E3 Modulevel has microprocessor-based electronics with HART compatible output, in addition to the standard 4–20 mA output. The E3 Modulevel supports the FDT/DTM standard and a PACT*ware*™ PC software package allows for additional configuration and trending capabilities.

The linkage between the level sensing element and output electronics provides a simple mechanical design and construction. The vertical in-line design of the transmitter results in low instrument weight and simplified installation. The instrument comes in a variety of configurations and pressure ratings for varied applications.

1.2 Theory of Operation

The E3 Modulevel Displacer Level Transmitter relies on the principles of buoyancy to convert mechanical movement to an electronic output.

The movement of the range spring, as it compresses or elongates based on the volume of displacer submerged in the liquid, causes movement of a special LVDT core attached to the spring. The LVDT technology converts the movement of the LVDT core within the LVDT to a stable 4–20 mA output signal. The position of the core, with respect to a primary and two secondary windings, induces voltage in each winding. The comparison of the induced voltages within the microprocessor of the E3 Modulevel results in very accurate level or interface level output.

The E3 Modulevel can, alternatively, be set up to track the changing density of a liquid over a known density range and convert that into a stable 4–20 mA output signal. As the density of the liquid changes, so does the mass of the liquid displaced by the displacer. This resulting change in buoyancy force on the displacer causes movement of the LVDT core needed to convert the density change to the 4–20 mA signal.

Table 1
SIL vs. PFD avg

Safety Integrity Level (SIL)	Target Average probability of failure on demand (PFDavg)
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 2
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%	SIL 1	SIL 2	SIL 3
Medium: 90% to <99%	SIL 2	SIL 3	
High: ≥99%	SIL 3		

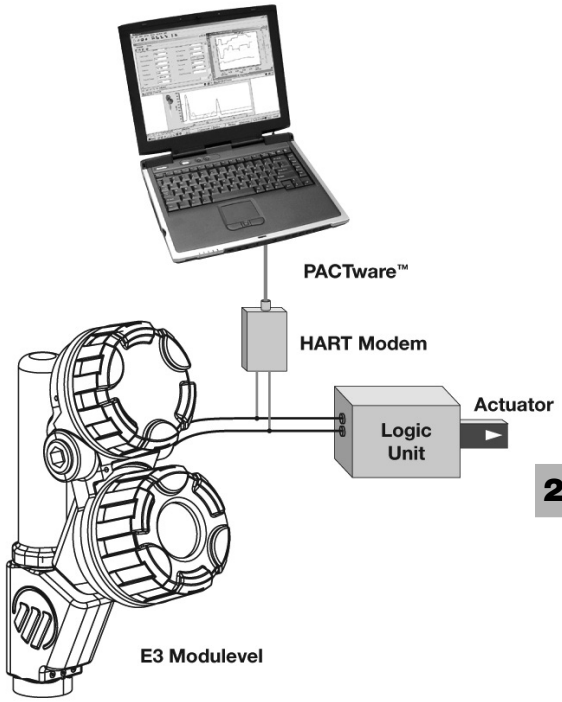


Figure 1
Typical System

1.3 Determining Safety Integrity Level (SIL)

Tables 1 and 2 define the criteria for the achievable SIL against the target mode of operation in Demand Mode Operation.

Table 1 shows the relationship between the SIL and the Probability of Failure on Demand Average (PFDavg).

Table 2 can be 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 system (Type B – complex components as per IEC 61508 Part 2) of which the level transmitter is one component.

2.0 Level Measuring System

Figure 1 shows the structure of a typical measuring system incorporating the E3 Modulevel.

This SIL rated device is available only with an analog signal with HART communications. The measurement signal used by the logic solver must be the analog 4-20 mA signal proportional to the level generated.

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 (> ±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 20.5 mA).

Fault selection of the E3 Modulevel is 3.6 mA, 22.0 mA, or HOLD, and is selected by the user. HOLD should never be chosen as the Fault output in a safety application.

2.1 FOUNDATION fieldbus™

FOUNDATION fieldbus™ protocol is now allowed by the IEC 61508/61511 standard, as long as the proper communication changes have been implemented. This manual, however, only addresses the use of the HART device in SIL environments.

2.2 Applicable Models

This manual is applicable to the following models of the E3 Modulevel Liquid Level Displacer Transmitter:

E3x-xxxx-Hxx

2.3 Miscellaneous Electrical Considerations

2.3.1 Pollution Degree 2

The E3 Modulevel Level Displacer Transmitter is designed for use in Category II, Pollution Degree 2 installations.

A nonconductive pollution of the sort where occasionally a temporary conductivity caused by condensation must be expected. This is the usual pollution degree used for equipment being evaluated to IEC/EN 61010.

2.3.2 Overvoltage

The E3 Modulevel has overvoltage protection per CE requirements; this protection is to 1000 volts when considering Hi-pot, Fast Transients, and Surge. 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). The typical plant environment is Overvoltage Category II, so most equipment evaluated to the requirements of IEC/EN 61010 are considered to belong in that classification.

3.0 Mean Time To Repair (MTTR)

SIL determinations are based on a number of factors including the Mean Time To Repair (MTTR). The analysis for the E3 Modulevel Displacer Level Transmitter is based on a MTTR of 24 hours.

4.0 Supplementary Documentation

The E3 Modulevel Installation and Operating Manual (Bulletin 48-635) must be available for installation of the measuring system.

The following Electronic Device Description File is required if HART is used:

Manufacturer Code 0x56
Model E3 Modulevel Device ID OxE3, 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 Instructions

5.1 Systematic Limitations

The following application and environmental limitations must be observed to avoid systematic failures.

5.1.1 Application

The E3 Modulevel transmitter should be located for easy access for service, configuration, and monitoring. There should be sufficient headroom to allow installation and removal of the transmitter head, and, in cases of tank top configuration, the displacer. Special precautions should be made to prevent exposure to corrosive atmosphere, excessive vibration, shock, or physical damage. The E3 Modulevel should only be used for applications in which buildup of solid materials on the spring or in the enclosing tube is not an issue.

The operating temperature range for the transmitter electronics is -40° to +176° F (-40° to +80° C). The operating temperature range for the digital display is -5° to +160° F (-20° to +70° C).

Caution: Operation of all buoyancy type level devices should be done in such a way as to minimize the action of dynamic forces on the float or displacer sensing element. Good practice for reducing the likelihood of damage to the control is to equalize pressure across the device very slowly.

5.1.2 Environmental

See Section 3.6.1 of the E3 Modulevel Installation and Operating Manual (Bulletin 48-635) for environmental limitations.

5.2 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.

5.3 Necessary Tools

No special equipment or tools are required to install E3 Modulevel. The following items are recommended:

- **Wrenches, flange gaskets, and flange bolting appropriate for process connection(s)**
- **Flat-blade screwdriver**
- **Level**
- **1/8" Allen wrench**
- **24 VDC power supply, 23 mA minimum**
- **Digital multimeter**
- **250 to 450 ohm resistor for HART communication**

5.4 Storage

The E3 Modulevel should be stored in its original shipping box and not be subjected to temperatures outside the storage temperature range -50° to +185° F (-40° to +85° C), as shown in Section 3.6.1 of the E3 Modulevel Installation and Operating Manual (Bulletin 48-635) and associated specifications.

5.5 Installation

Refer to the E3 Modulevel Displacer Level Transmitter Installation and Operating Manual (Bulletin 48-635) for the proper installation instructions:

Section 1.0 provides QuickStart Installation instructions and Section 2.0 provides Complete Installation instructions.

Section 2.6 provides menu selection items for configuring the transmitter including operating parameters, display and keypad, password protection, calibration defaults, and menu configuration based on the measurement type.

Section 2.7 provides configuration instructions if using HART.

This SIL evaluation has assumed that the customer will be able to acknowledge an over or under current condition via the logic solver.

5.6 Configuration

5.6.1 General

The E3 Modulevel can be configured via the local display, the HART compatible handheld communicator, or a laptop computer with PACT*ware*.

5.6.2 Write Protecting / Locking

The E3 Modulevel transmitter is password protected with a numerical value between 0 (Default = 0 = Password disabled) and 255. After the password has been successfully entered, an exclamation mark (!) appears as the last character on the first line of the display.

Refer to Section 2.6.3 of the E3 Modulevel Installation and Operating Manual (Bulletin 48-635) for information on password protection.

5.6.3 Write Protecting / Locking

Ensure an exclamation mark (!) appears as the last character on the first line of the display to confirm the password has been accepted.

Refer to Section 2.6.3 of the E3 Modulevel Installation and Operating Manual (Bulletin 48-635) for information on password protection.

When the alterations to the system are complete, ensure the menu has been locked with the password to prevent inadvertent changes to the device.

5.7 Site Acceptance Testing

Complete a site acceptance test to ensure proper operation after installation and configuration. This procedure is identical to the Proof Test Procedure described in Section 6.1.4 of this document.

5.8 Recording Results

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

5.9 Maintenance

The only maintenance required is the proof test.

- Report all failures to Magnetrol.
- Firmware can only be upgraded by factory personnel.

5.9.1 Diagnostics

Internal diagnostic testing does a complete cycle 15 times per second (1 every 67 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. Never specify HOLD as the fault signal in a safety application.

5.9.2 Troubleshooting

Refer to Section 3.3 of the E3 Modulevel Installation and Operating Manual (Bulletin 48-635) for troubleshooting device errors. To assist in finding errors should they occur, at start-up complete the Configuration Data Sheet found at the back of this manual, make a list of all device configuration parameters, including the password, and retain this information in a safe place.

6.0 Recurrent Function Tests

6.1 Proof Testing

6.1.1 Introduction

Following are the procedures used to detect Dangerous Undetected (DU) failures. The procedure will detect approximately 99% of possible DU failures in the E3 Modulevel transmitter.

6.1.2 Interval

To maintain the safety integrity level of a safety instrumented system, it is imperative that the entire system be tested at regular time intervals (TI in the appropriate standards). The SIL for the E3 Modulevel is based on the assumption that the end user will carry out these tests and inspection at least once per year. The onus is on the owner/operator to select the type of inspection and the time period for these tests.

The system check must be carried out to prove that the safety functions meet the IEC specification and result in the desired response of the safety system as a whole.

6.1.3 Recording results

Record the results of the Proof Test for future reference.

6.1.4 Proof Test Procedure

A suggested proof test is described below. This test will detect approximately 99% of possible Dangerous Undetected (DU) failures in the E3 Modulevel.

1. Bypass the safety function and take appropriate action to avoid a false trip.
2. Use HART communications to retrieve any diagnostics and take appropriate action.
3. Send a HART command to the transmitter to go to the high alarm current output and verify that the analog current reaches that value. This tests for compliance voltage problems such as a low loop power supply voltage or increased wiring resistance. This also tests for other possible failures.
4. Send a HART command to the transmitter to go to the low alarm current output and verify that the analog current reaches that value. This tests for possible quiescent current related failures.
5. Perform a five-point calibration check of the displacer and transmitter over the full working range using process fluids. If the calibration check is performed by any means other than fluids acting on the displacer, this proof test will not detect any failures of the displacer.

6. If the calibration is correct, the proof test is complete. Proceed to step 9. If the calibration is incorrect, remove the transmitter from the process. Inspect for damage, buildup, or clogging. Clean if necessary.
7. If the calibration is off by more than 2%, contact the factory for assistance. If the calibration is correct, the proof test is complete. Proceed to step 8.
8. Re-install the displacer and transmitter.
9. Remove the bypass and otherwise restore normal operation.

7.0 Appendices

7.1 SIL Declaration of Conformity

Functional safety according to IEC 61508.

Magnetrol International, Incorporated 5300 Belmont Road, Downers Grove, Illinois 60515 declares as the manufacturer, that the level transmitter:
E3 Modulevel Liquid Level Displacer Transmitter
is suitable for use in safety instrumented systems according to IEC 61508, if the safety instructions and following parameters are observed:
FIT = Failure in Time ($1x10^{-9}$ failures per hour)

Table 3
Failure Rates According to IEC 61508

Model E3	Internal Mount	Remote Mount
SIL	2	2
Proof Test Interval	1 Year	1 Year
SFF	92.3%	92.6%
PFD_{avg} ①	2.95 E-04	2.95 E-04
λ_{sd}	0 FIT	0 FIT
λ_{su}	170 FIT	176 FIT
λ_{dd}	540 FIT	568 FIT
λ_{du}	59 FIT	59 FIT

① As determined in compliance with ANSI/ISA-84.01 clause 9.2.3 for 1oo1 system.

Magnetrol®

Magnetrol International, Incorporated
5300 Belmont Road
Downers Grove, Illinois 60515

Name	Name
Title	Title
Date	Date

Failure Modes, Effects and Diagnostic Analysis

Project:
E3 Modulevel Level Displacer Transmitter

Company:
Magnetrol
Downers Grove, IL
USA

Contract Number: Q08/03-66r1
Report No.: MAG 08/03-66 R001
Version V1, Revision R1, September 22, 2008
John Grebe

Management Summary

This report summarizes the results of the hardware assessment in the form of a Failure Modes, Effects, and Diagnostic Analysis (FMEDA) of the E3 Modulevel Level Displacer Transmitter. 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 FMEDA, failure rates and Safe Failure Fraction are determined. The FMEDA that is described in this report concerns only the hardware of the E3 Modulevel Level Displacer Transmitter. For full functional safety certification purposes all requirements of IEC 61508 will be considered.

The E3 Modulevel Level Displacer Transmitter is a digital process transmitter. Its current output signal is intended to provide the primary process variable which is the level or interface or density measurement value. The device has internal self diagnostics which upon detection of a failure, sends the analog output to a predefined out of range analog current. The logic solver must be programmed to measure these out of range currents and interpret them as a failure.

The Safety Function of the E3 Modulevel Level Displacer Transmitter shall be to monitor the level or interface of a liquid or its density and transmit a 4-20mA analog signal within the measurement safety accuracy.

Figure 1 E3 Modulevel Level Displacer Transmitter and Displacer

For safety instrumented systems usage it is assumed that the 4 – 20 mA output is used as the safety variable for level or density measurement.

Table 1 gives an overview of the different versions that were considered in the FMEDA of the E3 Modulevel Level Displacer Transmitter.

Table 1 Version Overview

Integral Mount E3 Modulevel	E3 Modulevel Level Displacer Transmitter with local mounting of the transmitter at the process sensor
Remote Mount E3 Modulevel	E3 Modulevel Level Displacer Transmitter with optional remote mounting of the transmitter

The E3 Modulevel Level Displacer Transmitter is classified as a Type B[1] device according to IEC 61508, having a hardware fault tolerance of 0.

The analysis shows that the device 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 architecture constraints of IEC 61508 for up to SIL 2 as a single device.

The failure rates for the E3 Modulevel Level Displacer Transmitter are listed in Table 2.

Table 2 Failure rates Integral Mount E3 Modulevel Level Displacer Transmitter

Failure Category	Failure Rate (FIT)	
Fail Safe Undetected		21
Fail Dangerous Detected		540
Fail Detected (detected by internal diagnostics)	472	
Fail High (detected by logic solver)	25	
Fail Low (detected by logic solver)	43	
Fail Dangerous Undetected		59
Residual Effect		138
Annunciation Undetected		11

The failure rates for a Remote Mount E3 Modulevel Level Displacer Transmitter are listed in Table 3.

[1] Type B device: "Complex" component (using micro controllers or programmable logic); for details see 7.4.3.1.3 of IEC 61508-2.

Table 3 Failure rates Remote Mount E3 Modulevel Level Displacer Transmitter Remote Mount

Failure Category	Failure Rate (FIT)	
Fail Safe Undetected		21
Fail Dangerous Detected		568
Fail Detected (detected by internal diagnostics)	500	
Fail High (detected by logic solver)	25	
Fail Low (detected by logic solver)	43	
Fail Dangerous Undetected		59
Residual Effect		144
Annunciation Undetected		11

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

In addition to the failure rates listed above, the external leakage failure rate is 28 FITS. External leakage failure rates do not directly contribute the reliability of the valve but should be reviewed for secondary safety and environmental issues.

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 E3 Modulevel Level Displacer Transmitter according to IEC 61508.

Table 4 Failure rates according to IEC 61508

Device	λ_{SD}	λ_{SU}[2]	λ_{DD}	λ_{DU}	SFF[3]
Integral Mount E3 Modulevel	0 FIT	170 FIT	540 FIT	59 FIT	92.3%
Remote Mount E3 Modulevel	0 FIT	176 FIT	568 FIT	59 FIT	92.6%

A user of the E3 Modulevel Level Displacer Transmitter 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 Residual Effect failures are included in the Safe Undetected failure category according to IEC 61508. Note that these failures on their own will not affect system reliability or safety, and should not be included in spurious trip calculations

[3] Safe Failure Fraction needs to be calculated on (sub)system level

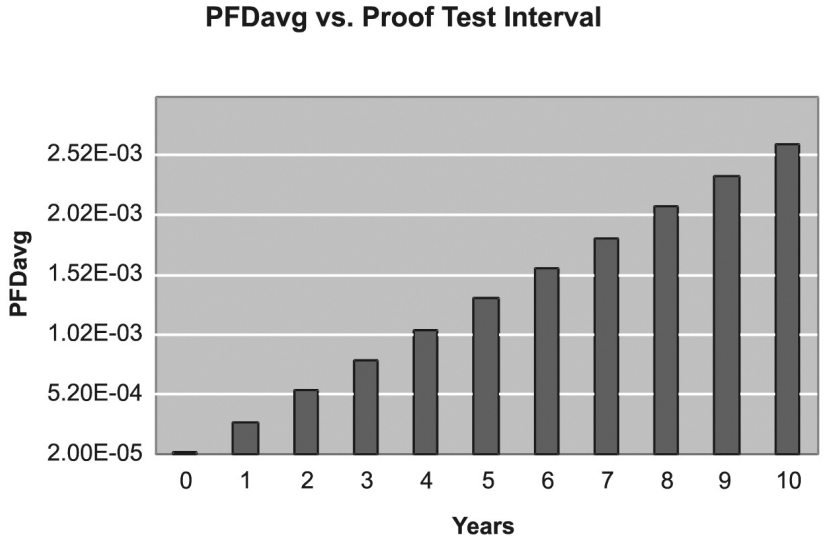
7.3 Specific Model E3 Values

Specific Model E3

E3 Modulevel	Internal mount	Remote mount
SIL	SIL 2	SIL 2
HFT	0	0
SFF	92.3%	92.6%
PFD_{avg}	2.95 E-04	2.95 E-04
Proof Test Interval	Annually (refer to table below for other periods)	Annually (refer to table below for other periods)

Proof Test Interval (years)	PFD avg. (SIL 2)
0	3.88 E-05
1	2.95 E-04
2	5.50 E-04
3	8.06 E-04
4	1.06 E-03
5	1.32 E-03
6	1.57 E-03
7	1.83 E-03
8	2.09 E-03
9	2.34 E-03
10	2.60 E-03

7.4 PFD Graph



7.5 Report: Lifetime of Critical Components

According to Section 7.4 of IEC 61508-2, a useful lifetime, based on experience, should be assumed.

Although a constant failure rate is assumed by the 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.

This assumption of a constant failure rate is based on the bathtub curve. Therefore it is obvious that the PFDavg 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.

As there are no aluminum electrolytic or tantalum electrolytic capacitors used, there are no electrical components that limit the useful lifetime of the system.

Based on general field failure data, a useful life period of approximately 15 years is expected for the E3 Modulevel Liquid Level Displacer Transmitter.

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

7.6 Configuration Data Sheet

Magnetrol E3 Modulevel Configuration Data Sheet			
ITEM	**VALUE**		
LvlUnits (Level & IfcLevel only)			
Proc SG (level only)			
OperTemp			
Set 4 mA			
Set 20mA			
Lvl Ofst (Level & IfclLevel only)			
Damping			
Fault			
Poll Adr			
Trim Lvl (Level & IfcLevel only)			
Trim SG (Density only)			
Trim 4			
Trim 20			
New Password			
Language			
Software Version			
DispFact	Yes	Yes	Yes
MeasType			
Model			
SpringSG			

7.6 Configuration Data Sheet (cont.)

ITEM	VALUE		
SprgRate			
SprgMatl			
TempLimt			
Length			
Diameter			
Weight			
Lower SG (lfc Level Only)			
Upper SG (lfc Level Only)			
CalSelct	Factory	Factory	Factory
AdjSnrLo			
AdjSnrHi			
Conv Fct			
Scl Ofst			
LVDT%			
Chan 0			
Chan 1			
NSPValue			
ElecTemp			
Max Temp			
Min Temp			
CalSelct	User	User	User
AdjSnrLo			
AdjSnrHi			
Conv Fct			
Scl Ofst			
LVDT%			
Chan 0			
Chan 1			
NSPValue			
ElecTemp			
Max Temp			
Min Temp			
Factory Cal Menu	Enter	Enter	Enter
LVDT%			
Calib SG			
DrySensr			
SnrCalLo			
LvlCalLo			
SnrCalHi			
LvlCalHi			
User Cal Menu	Enter	Enter	Enter
LVDT%			
DrySensr			
SnrCalLo			
LvlCalLo (Level & lfcLevel only)			
Sg CalLo (Density only)			
SnrCalHi			
LvlCalHi			
Sg CalHi (Density only)			

References

IEC 61508-2: 2000 "Functional Safety of Electrical/Electronic/Programmable Electronic Safety Related Systems"

IEC 60654-1: 1993-02, second edition, "Industrial-process Measurement and Control Equipment – Operating Conditions – Part 1: Climatic Condition"

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 or for the correctness of the standards on which the general calculation methods are based.

ASSURED QUALITY & SERVICE COST LESS

Service Policy

Owners of Magnetrol/STI controls may request the return of a control or any part of a control for complete rebuilding or replacement. They will be rebuilt or replaced promptly. Controls returned under our service policy must be returned by Prepaid transportation. Magnetrol/STI 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 control, 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 control 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/STIs 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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