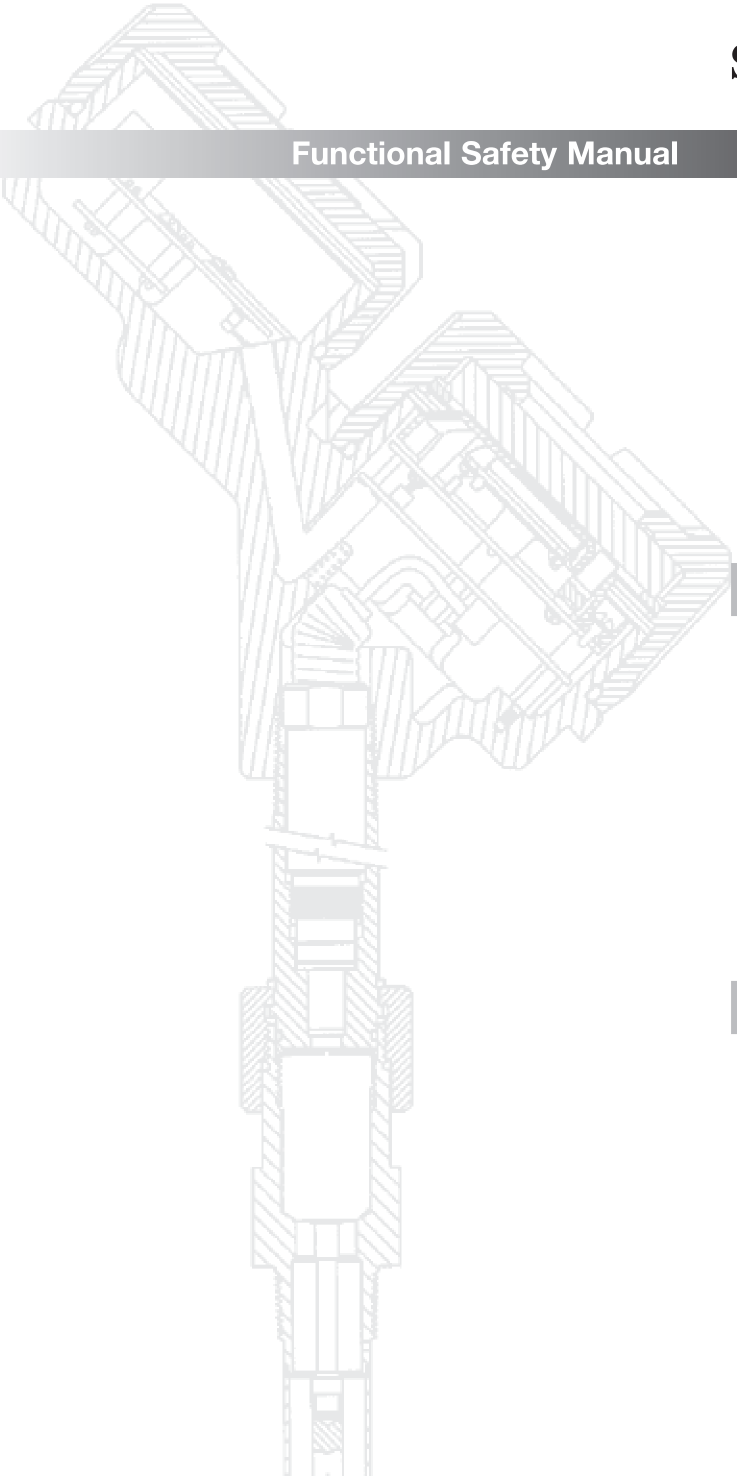
ECLIPSE®

SIL Safety Manual for Enhanced Model 705

Software v3.x

Functional Safety Manual



Guided Wave Radar Level Transmitter

This manual complements and is intended to be used with the Enhanced Model 705 Installation and Operating manual (Bulletin 57-600 dated August 2005 or later).

Application

The Enhanced Model 705 (HART®) Guided Wave Radar Overfill protection level transmitter can be applied in most process or storage vessels, bridles, and bypass chambers up to the probe's rated temperature and pressure. The Enhanced Model 705 can be used in liquids, slurries or solids with a dielectric constant in the range 1.4–100 to meet the safety system requirements of IEC 61508/IEC 61511-1.

Benefits

The Magnetrol® Model 705 (HART) provides the following benefits to your operation:

- Overfill protection up to SIL 2 (Safe Failure Fraction = 91%) as independently assessed (hardware assessment) by exida.com as per IEC 61508/ IEC 61511-1.
- Ability to measure reliably to the very top of the vessel. Meets TÜV: WHG 19 overfill specifications when used with Model 7xD, 7xR, and 7xS probes.
- Probe designs to +800 ° F (+427° C), 6250 psig (430 bar) and full vacuum
- Cryogenic applications to -320° F (-190° C)
- IS, XP and Non-Incendive approvals
- Quick connect / disconnect probe coupling.

Magnetrol®

Eclipse® Enhanced Model 705 Guided Wave Radar Level Transmitter

SIL 1/SIL 2 Versions

Table of Contents

1.0 Introduction

1.1 Product Description

The Eclipse® Enhanced Model 705 Guided Wave Radar Level Transmitter is a loop-powered, 24 VDC level transmitter, based on Guided Wave Radar (GWR) technology. For Safety Instrumented Systems usage it is assumed that the 4–20 mA output is used as the primary safety variable. The analog output meets NAMUR NE 43 (3.8 mA to 20.5 mA usable). The transmitter contains self-diagnostics and is programmed to send its output to a user-selected failure state, either low or high upon internal detection of a failure. The device can be equipped with or without LCD display. Table 1 lists the versions of the ECLIPSE Enhanced Model 705 that have been considered for the hardware assessment.

Table 1
Enhanced Eclipse® Model Numbers

Model 705, 705-510*-*** (HART)

1.2 Theory of Operation

Guided Wave Radar is based upon the principle of TDR (Time Domain Reflectometry). TDR utilizes pulses of electromagnetic energy transmitted down a probe. When a pulse reaches a surface that has a higher dielectric than the air/vapor in which it is traveling, the pulse is reflected. An ultra high-speed timing circuit precisely measures the transit time and provides an accurate level measurement.

The ECLIPSE Enhanced Model 705 is classified as a Type B device according to IEC61508.

1.3 Determining Safety Integrity Level (SIL)

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

Table 1 shows the relationship between the Safety Integrity Level (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.

Table 2
SIL vs. PFDavg

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 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%	SIL 1	SIL 2	SIL 3
Medium: 90% to <99%	SIL 2	SIL 3	
High: ≥99%	SIL 3		

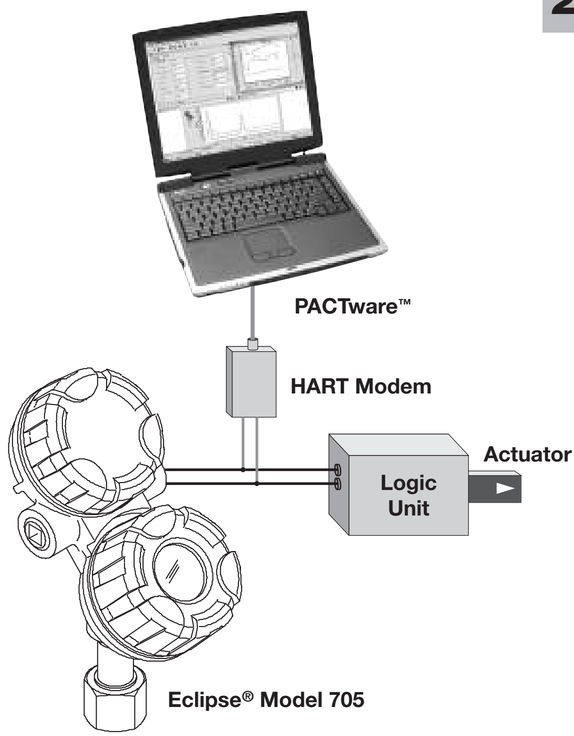


Figure 1
Typical System

2.0 Level Measuring System

The diagram shows the structure of a typical measuring system incorporating the Enhanced MAGNETROL Model 705 guided wave radar transmitter.

This SIL rated device is only available with an analog signal (4–20 mA) 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 insure 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 4-20mA 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).

2.0.1 FOUNDATION fieldbus™

Although the Enhanced Model 705 is available with FOUNDATION fieldbus™ output, the FOUNDATION fieldbus™ protocol has not been added to the IEC 61508/61511 standard.

2.1 Applicable Models

This manual is only applicable to the following model numbers of Guided Wave Transmitter:

705-51Ax-xxx (SIL 2, HFT 0) and 705-510x-xxx (SIL 1, HFT 0)

The primary difference between the two transmitter models is the additional firmware diagnostics necessary to achieve the safety levels required for SIL 2.

2.2 Miscellaneous Electrical Considerations

Following are miscellaneous electrical issues to be considered.

2.2.1 Pollution Degree 2

The ECLIPSE system 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.

2.2.2 Overvoltage

The MAGNETROL Model 705 has over-voltage protection per CE requirements. When considering Hi-pot, Fast Transients and Surge, this protection is to 1000 volts. 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 Enhanced Model 705 is based on a MTTR of 8 hours

4.0 Supplementary Documentation

The ECLIPSE Enhanced Model 705 Installation and Operating Manual Bulletin 57-600 must be available for installation of the measuring system.

One of the following Electronic Device Description Files is also required if HART is used:

Manufacturer Code 0x56
Model 705 3.x Device ID 0xE5, 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 must be observed to avoid systematic failures.

5.1.1 Application

Choosing the proper Guided Wave Radar (GWR) probe is the most important decision in the application process. The probe configuration establishes fundamental performance characteristics. Coaxial, twin element (rod or cable), and single element (rod or cable) are the three basic configurations. The probe for use with the ECLIPSE Enhanced Model 705 should be selected as appropriate for the application.

Careful selection of probe design and materials for a specific application will minimize media buildup on the probe.

See Section 3.3.3 of Installation and Operating Manual 57-600 for more detailed application information and limitations.

5.1.2 Environmental

See Sect. 3.6.1 of Installation and Operating Manual 57-600 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

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.
  - Coaxial probe 1½" (38mm)
  - Twin Rod probe 1⅞" (47mm)
  - Transmitter 1½" (38mm)
  - Torque wrench is highly desirable
- Flat-blade screwdriver
- Cable cutter and 3/32” (2.5mm) hex wrench (7X1, 7X2, 7X5 and 7X7 Flexible probes only)
- Digital multimeters or digital volt/ammeter
- 24 VDC power supply, 23 mA minimum

5.4 Storage

The device should be stored in its original shipping box and not be subjected to temperatures outside the storage temperature (-50° C to +80° C) shown in the ECLIPSE Enhanced Model 705 Installation and Operating Manual and associated specifications.

5.5 Installation

Refer to the ECLIPSE Enhanced Model 705 Installation and Operating Manual Bulletin 57-600 manual for the proper installation instructions.

Section 2.6.4 of I/O Manual 57-600 contains information on the use, changing and resetting of the password protection function.

Section 2.6.5.1 of I/O Manual 57-600 provides menu selection items for configuration of the transmitter as a level sensing device.

See Section 5.6 for Configuration recommendations.

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 MAGNETROL Model 705 can be configured via the local display, or via HART compatible handheld terminal or personal computer.

5.6.2 Configuration

Ensure the parameters have been properly configured for the application and probe.

Special consideration should be given to the following configuration parameters:

DIELECTRIC: Ensure this is set to 1.4–1.7 for propane and butane or 1.7–3.0 for the majority of hydrocarbon applications.

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 before making any changes.

LOOP CONTROL MODE: ensure this is set to ENABLED.

THRESHOLD: set to FIXED if this is a hydrocarbon application with any possibility of water bottoms.

PASSWORD: should be changed to a specific value other than Zero. See Section 5.6.3

5.6.3 Write Protecting / Locking

The ECLIPSE Model 705 is password protected with a numerical password 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 2.6.4 of the ECLIPSE Enhanced Model 705 Installation and Operating Manual Bulletin 57-600 for information on password protection.

5.6.4 Write Enabling / Unlocking

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 2.6.4 of the ECLIPSE Enhanced Model 705 Installation and Operating Manual Bulletin 57-600 for information on password protection.

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

5.7 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.

5.8 Recording Results

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

5.9 Maintenance

5.9.1 Diagnostics

Internal diagnostic testing does a complete cycle 6 times per second (1 every 167mS). A message will appear and the Output current will be driven to 3.6 or 22mA (customer dependent) upon detection of a Fault.

5.9.2 Troubleshooting

Report all failures to MAGNETROL.

Refer to Section 3.3 of the ECLIPSE Enhanced Model 705 Installation and Operating Manual Bulletin 57-600 for troubleshooting device errors. To assist in finding errors should they occur, complete the Configuration Data Sheets included at the end of the Operating Manual. Be sure to include all device information, including the password. Retain this information in a safe place.

- As there are no moving parts in this device, the only maintenance required is the proof test.
- Firmware can only be upgraded by factory personnel.

6.0 Recurrent Function Tests

6.1 Proof Testing

6.1.1 Introduction

Following are the procedures utilized to detect Dangerous Undetected (DU) failures. The procedure will detect approximately 97% of possible DU failures in the Model 705-510*-*** and 94% of failures in the Model 705-51A*-***.

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 Model 705 is based on the assumption that the End User will carry out these tests and inspection at least once (1x) 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 overfill protection functions meet the IEC specification and result in the desired response of the safety system as a whole.

This system check can be guaranteed when the response height is approached in the filling process though if this is not practical, a suitable method of simulating the level of the physical measurement must be used to make the level sensor respond as if the fill fluid were above the alarm/set point level. If the operability of the sensor/transmitter can be determined by other means that exclude all fault conditions that may impair the normal functions of the device, the check may also be completed by simulating the corresponding output signal of the device.

6.1.3 Recording results

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

6.1.4 Proof Test Procedure

A suggested proof test is described below. This test will detect approximately 97% of possible DU failures in Model 705-510*-*** of the ECLIPSE Enhanced Model 705 Guided Wave Radar Level Transmitter. The test will detect approximately 94% of possible DU failures in Model 705-51A*-*** of the ECLIPSE Enhanced Model 705.

1. Bypass the safety PLC or take other appropriate action to avoid a false trip.
2. 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 low power supply voltage or increased loop wiring resistance. This also tests for other possible failures in the current loop circuitry.
3. 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.
4. Remove level from the probe. The Status parameter should say “Dry Probe” and the level reading should be equal to the value in the “Level Offset” parameter.
5. 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 known reference measurement.
6. If the calibration is correct, the proof test is complete. Proceed to step 11.
7. If 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 shorting the probe at two points. Measure the level from the bottom of the probe to the points and compare to the transmitter display and current level readings.
8. If the calibration is off by more than 2%, call the factory for assistance.
9. If the calibration is correct, the proof test is complete. Proceed to step 10.
10. Re-install the probe and transmitter.
11. Restore the loop to full operation.
12. 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

Magnetrol International, Incorporated 5300 Belmont Road, Downers Grove, Illinois 60515 declares as the manufacturer, that the level transmitter:

Guided Wave Radar (4-20 mA) Model 705-51x-xxx

is suitable for the use in safety instrumented systems according to IEC 61511-1, if the safety instructions and following parameters are observed:

(FIT = Failure in Time (1×10^{-9} failures per hour))

Product	Model 705-51Ax-xxx	Model 705-510x-xxx
SIL	2	1
Proof Test Interval	1 Year	1 Year
Device Type	B	B
SFF	91.0%	84.5%
PFD_{avg} ①	4.69E-04	8.06E-04
λ_{sd}	0 FIT	0 FIT
λ_{su}	424 FIT	431 FIT
λ_{dd}	650 FIT	567 FIT
λ_{du}	106 FIT	183 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

Title

Date

Name

Title

Date

7.2 FMEDA Report: Exida Management Summary

exida FMEDA

Failure Modes, Effects and Diagnostic Analysis

Project:
Eclipse Enhanced Model 705 Guided Wave Radar Level Transmitter

Customer:
Magnetrol International
Downers Grove, IL
USA

Contract No.: MAG 05/06-13
Report No.: MAG 05/06-13 R001
Version V1, Revision R1, October 6, 2005
John C. Grebe - Rachel Amkreutz

Management summary

This report summarizes the results of the Failure Modes, Effects, and Diagnostic Analysis (FMEDA) of the Eclipse Enhanced Model 705 Guided Wave Radar Level 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 Eclipse Enhanced Model 705, electronic and mechanical. For full functional safety certification purposes all requirements of IEC 61508 must be considered.

The Eclipse Enhanced Model 705 is a two-wire 4 – 20 mA smart device. It contains self-diagnostics and is programmed to send its output to a specified failure state, either high or low upon internal detection of a failure. The self-diagnostics have been confirmed using fault injection tests. For safety instrumented systems usage it is assumed that the 4 – 20 mA output is used as the primary safety variable. The unit is externally powered from 24 Volts DC. Table 1 lists the versions of the Eclipse Enhanced Model 705 that have been considered for the hardware assessment.

Table 1 Version overview

1	Eclipse Enhanced Model 705, 705-510*-***
2	Eclipse Enhanced Model 705, 705-51A*-***

The Eclipse Enhanced Model 705 is classified as a Type B[1] device according to IEC61508, having a hardware fault tolerance of 0. The analysis shows that models 705-510*-*** have a safe failure fraction between 60 and 90% (assuming that the logic solver is programmed to detect over-scale and under-scale currents) and therefore may be used up to SIL 1 as a single device. The analysis shows that models 705-51A*-*** have 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 may be used up to SIL 2 as a single device.

The failure rates for the Eclipse Enhanced Model 705 Guided Wave Radar Level Transmitter, models 705-510*-*** are listed in Table 2.

Table 2 Failure rates Eclipse Enhanced Model 705, 705-510*-*

Failure category		Failure rate (in FIT)	
Fail Dangerous Detected			567
	Fail Detected (detected by internal diagnostics)	405	
	Fail High (detected by the logic solver)	21	
	Fail Low (detected by the logic solver)	141	
Fail Dangerous Undetected			183
No Effect			393
Annunciation Undetected			38

The failure rates for the Eclipse Enhanced Model 705 Guided Wave Radar Level Transmitter, models 705-51A*-*** are listed in Table 3.

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

Table 3 Failure rates Eclipse Enhanced Model 705, 705-51A*-*

Failure category		Failure rate (in FIT)	
Fail Dangerous Detected			650
	Fail Detected (detected by internal diagnostics)	488	
	Fail High (detected by the logic solver)	21	
	Fail Low (detected by the logic solver)	141	
Fail Dangerous Undetected			106
No Effect			393
Annunciation Undetected			31

Table 4 lists the failure rates for the Eclipse Enhanced Model 705 according to IEC 61508, assuming that the logic solver can detect both over-scale and under-scale currents.

Table 4 Failure rates according to IEC 61508

Device	λ_{sd}	λ_{su}[2]	λ_{dd}	λ_{du}	SFF
Eclipse Enhanced Model 705, 705-510*-***	0 FIT	431 FIT	567 FIT	183 FIT	84.5%
Eclipse Enhanced Model 705, 705-51A*-***	0 FIT	424 FIT	650 FIT	106 FIT	91.0%

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

A user of the Eclipse Enhanced Model 705 Guided Wave Radar Level 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 "no 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

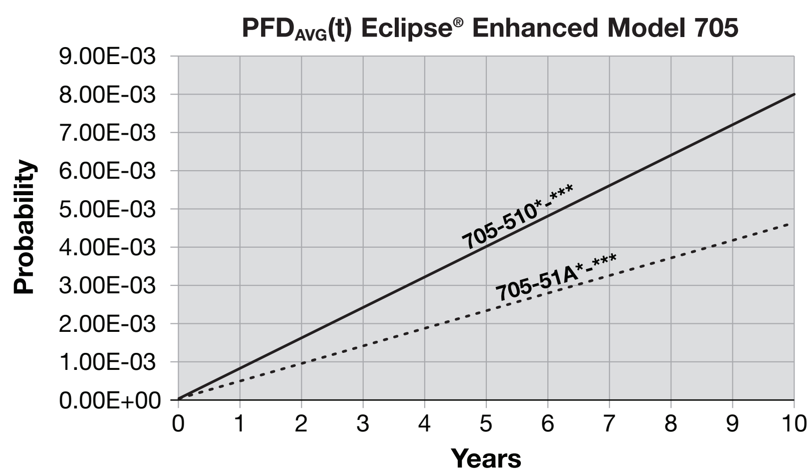
7.3 Specific Model 705 Values

Specific Model 705

Eclipse® Model 705-51-xx-xxx	Eclipse® Model 705-51Ax-xxx	Eclipse® Model 705-510x-xxx
SIL	SIL 2	SIL 1
HFT	0	0
SFF	91.0%	84.5%
PFD_{avg}	4.69E-04	8.06E-04
Proof Test Interval	Annually (refer to table below for other periods)	Annually (refer to table below for other periods)

Proof Test Interval (months)	PFD avg. (SIL 2)	PFD avg. (SIL 1)
0	0.00E+00	0.00E+00
6	2.37E-04	4.05E-04
12	4.69E-04	8.06E-04
18	7.02E-04	1.21E-03
24	9.34E-04	1.61E-03
30	1.17E-03	2.01E-03
36	1.40E-03	2.41E-03
48	1.86E-03	3.21E-03
60	2.33E-03	4.01E-03
72	2.79E-03	4.81E-03
84	3.26E-03	5.62E-03
96	3.72E-03	6.42E-03
108	4.18E-03	7.22E-03
120	4.65E-03	8.02E-03

7.4 PFD Graph



7.5 Report: Lifetime of Critical Components

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 component itself and its operating conditions—temperature in particular (e.g., electrolyte capacitors can be very sensitive).

This assumption of a constant failure rate is based on the bathtub curve, which shows the typical behavior for electronic components.

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 table below shows which components are contributing to the dangerous undetected failure rate and therefore to the PFD_{AVG} calculation and what their estimated useful lifetime is.

Useful lifetime of electroytic capacitors contributing to λ_{du}

Type	Useful life at +40° C
Capacitor (electrolytic – Tantalum electrolytic, solid electrolyte	Approximately 500,000 hours

As there are no aluminum electrolytic capacitors used, the tantalum electrolytic capacitors are the limiting factors with regard to the useful lifetime of the system. The tantalum electrolytic capacitors that are used in the ECLIPSE Enhanced Model 705 have an estimated useful lifetime of about 50 years. According to section 7.4.7.4 of IEC 61508-2, a useful lifetime, based on experience, should be assumed. According to section 7.4.7.4 note 3 of IEC 61508 experiences have shown that the useful lifetime often lies within a range of 8 to 12 years for transmitters.

References

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

ASSURED QUALITY & SERVICE COST LESS

Service Policy

Owners of MAGNETROL 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 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 a MAGNETROL 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.

ECLIPSE Guided Wave Radar transmitters may be protected by one or more of the following U.S. Patent Nos. US 6,626,038; US 6,640,629; US 6,642,807; US 6867729; US 6879282; US 6906662. May depend on model.

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