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Declaration of Conformity

We

Micronor Inc.
900 Calle Plano, Suite K, Camarillo, CA 93012, USA

declare that the product

Fiber Optic Incremental Encoder System	Item Code(s)
Controller Module	**MR320**
Sensors	**MR322, MR324, MR325, MR326**

Country of Origin: Camarillo, CA USA

to which this declaration relates in conformity with the following standards, normative documents and/or customer requirements:

Requirement	MR320 Controller	MR320 Sensors
1. Laser Safety	Class 1 laser device per IEC 60825	Exempt
2. ATEX Directive	Sensor and Controller are exempt: Not considered to have an independent source of ignition. (a) Optical sources which meet the Class I limits are considered suitable for use in locations with an EPL of Mb, Gb, Gc, Db or Dc as per Clause 1 (3) of IEC 60079-28:2015 Ed 2. IECEx GB/CML/ExTR 16.0039/00, Evaluated by Notified Body 2503, Certification Management Limited, Unit 1 Newport Business Park, New Port Road, Ellesmere Port, CH65 4LZ, United Kingdom	
3. Low Voltage Directive	Exempt	Exempt
4. EMC Directive	Exempt	Exempt
5. CE Mark	Applicable	Applicable

Place: Camarillo, CA, USA
Date of Issue: 27-April-2016

Dennis Horwitz
Micronor Inc.
Vice President, Sales and Marketing
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Product Assessment Report

Product Description: MR320 series Fiber Optic Incremental Encoder system

Affected Products: The following is referred to as the **Controller** in this document:
MR320 Controller

The following are referred to as the **Sensor** in this document:
MR322 series Size 58mm Shafted Sensor
MR324 series Size 100mm Hollow Shaft Sensor
MR325 series Size 125mm Shafted Sensor
MR326 series Size 90mm Shafted Sensor

Document: 98-0320-20
Revision: C
Dated: 27-April-2016
Number of Pages: 16

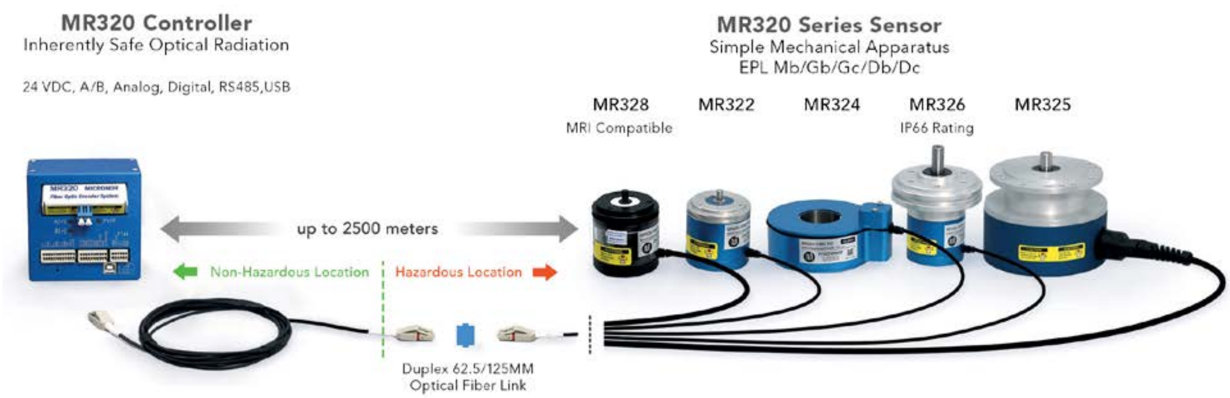
Revision History

Revision	Date	Description
A	11-Nov-2011	Original release
B	6-May-2013	Added MR325 Sensor
C	27-April-2016	Updated assessment per latest 2014 ATEX/EMC/LV Directives and IEC 60078-28 Ed.2, DNH/CML

Assessment Outline

1. Product Overview

The MR320 series Fiber Optic Incremental Rotary Encoder System consists of a non-electric, passive Sensor and active Controller which are connected via a duplex multimode fiber optic link:



2. Risk Assessment By Category

This report constitutes a self-assessment executed by Micronor Inc. and is not a Certificate of Compliance.

2.1 Laser Safety

References:

1. IEC 60825-1, *Safety of laser products - Part 1: Equipment classification, requirements and user's guide*, Edition 3.0, May 2014
2. IEC 60825-2, *Safety of laser products - Part 2: Safety of optical fibre communication systems (OFCS)*, Edition 2004+A2, October 2010
3. FDA, *Code of Federal Regulations (CFR), Title 21, Chapter 1 - Food and Drug Administration - Department of Health and Human Services, Subchapter J-Radiological Health*, Parts 1000-1050
4. Micronor 98-0320-21, *MR320 LASER Level Measurements*, March 2016

Summary:
The MR320 encoder system meets Class 1 laser safety requirements per IEC 60825-1 which is recognized as a harmonized standard by both the U.S. Food and Drug Administration (FDA) and European Union. Since the optical radiation originates from the MR320 Controller, the laser safety class designation and product labeling requirements apply only to the MR320 Controllers as the "active" optoelectronic half of the MR320 system.

For FDA compliance, annual production reports for the MR320 Controller shall be filed and the product shall be marked with a serial number and date of manufacture (month/year).

Analysis:
For multi-wavelength systems, IEC 60825-2 Section D.4.1.1 describes how multi-wavelength systems are evaluated by summing the ratios of the powers (Power/Limit) at each wavelength. If the ratio is less than 1, than the emissions are within Class 1 limits. The actual result is 0.0133

The following table summarizes the evaluation results and applicable product markings for the MR320 Controller. As passive devices, the MR320 Sensors do not require any laser safety markings.

Parameters	Controller Model
	MR320
Wavelength/Source Type	850 nm / VCSEL 1310nm / LED NOTE: All power levels are measured directly at the fiber tip.
Maximum Output Power in Normal Operation	850nm_Power=0.050mW, 1310nm_Power=0.032mW
IEC Class 1 Limit	From IEC 60825-2, Table D.1: 850nm_Limit=3.88mW, 1300nm_Limit=77.8 mW £(Power/Limit) =0.0133 << 1
Classification	Class I (Not Harmful)
Product Markings	FDA: Serial Number and Date of Manufacture IEC 60825-1 Labeling Requirement: 

2.2 Explosive Atmospheres

References:

1. ATEX Directive 2014/34/EU, *Directive 2014/34/EU of the European Parliament and the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres*.
2. IEC 60079-0, *Explosive Atmospheres - Part 0 Equipment – General Requirements*, Edition 5, 2007
3. IEC 60079-28, *Explosive Atmospheres - Part 28 : Protection of equipment and transmission systems using optical radiation*, Edition 2, 2015
4. IECEx Test Report GB/CML/ExTR 16.0039/00 (CML Report R1198A), *Evaluation of MR320 Series Controller and Sensors,* April 2016. NOTE: Contact Micronor for copy of full IECEx report, Micronor document 98-320-22
5. National Fire Protection Association, NFPA 70, *National Electric Code (NEC)*, 2014.
6. Micronor 98-0320-22, *MR320 Inherent Safety Analysis*, March 2016

Summary:

Per IECEx Test Report, the MR320 optical radiation output meets Class 1 requirements and is therefore considered inherently safe and exempt from the scope of IEC 60079-28. Clause 1(3) of IEC 60079-28:2015 states that optical sources which meet the limits of Class 1 lasers, as defined in IEC 60825-1, are suitable for use in EPL Mb/Gb/Gc/Db/Dc applications.

The NEC does not address fiber optic sensors and is exempt.

The following tables summarize assessments and applicable markings for the MR320 Controller and Sensors:

Parameters	Ex Classification MR320 Controller
Environmental Rating	-5° to +55° C, 30-85% RH
Classification	Controller shall be installed in non-hazardous location only
ATEX	Optical sources which meet the Class I limits are considered suitable for use in locations with an EPL of Mb, Gb, Gc, Db or Dc as per Clause 1(3) of IEC 60079-28:2015 Ed 2. Consult IECEx Test Report (ExTR) GB/CML/ExTR 16.0039/00
IECEx Section 1 (3)	Optical sources which meet the Class I limits are considered suitable for use in locations with an EPL of Mb, Gb, Gc, Db or Dc as per Clause 1(3) of IEC 60079-28:2015 Ed 2 Consult IECEx Test Report (ExTR) GB/CML/ExTR 16.0039/00
NEC	Exempt
Product Markings	For installation in non-hazardous location only -5°C ≤ Ta ≤ +55°C

Parameters	Ex Classification MR320 series Sensors
Environmental Rating	Standard:-40° C to +80° C, 0-95% RH Extended: -60° C to +150° C, 0-95% RH
Explosive Environments	Sensor can be installed and operated in hazardous locations with an EPL of Mb, Gb, Gc, Db or Dc (or equivalent) - mines, gaseous and dust
ATEX	Considered suitable for installation and use in locations with a required EPL of Mb, Gb, Gc, Db or Dc as long as the sensor is used with the MR320 Controller (source) Consult IECEx Test Report (ExTR) GB/CML/ExTR 16.0039/00
IEC Ex	Considered suitable for installation and use in locations with a required EPL of Mb, Gb, Gc, Db or Dc as long as the sensor is used with the MR320 Controller (source) Consult IECEx Test Report (ExTR) GB/CML/ExTR 16.0039/00
NEC	Exempt
Product Markings	Simple Mechanical Device For Standard Temperature Sensors, Add "-40°C ≤ Ta ≤ +80°C" For Extended Temperature Sensors: Add "-60°C ≤ Ta ≤ +150°C"

Analysis:
Certification Management Ltd (CML, a Notified Body) evaluated the Micronor MR320 system and verified that the MR320 Controller (as source of optical radiation) is a Class 1 laser source and not considered a source of ignition per Section 1 (3) of IEC 60079-28 Ed.2. The MR320 encoder and controller system are suitable for use in EPL Mb/Gb/Gc/Db/Dc applications.

The following table summarizes results of source failure mode assessment tests performed on the laser driver to determine the maximum power output. The measured peak power is then compared to the safe optical power limits for various EPL applications. In all cases, the maximum output of the Controller falls within all EPL limits.

Parameters	Controller Model MR320
Wavelength/Source Type	850nm / VCSEL 1310nm / LED NOTE: All power levels are measured directly at the fiber tip.
Maximum Peak Power	At 850 nm, P=4.5mW for 0.5µs, E=2.25E-09 J For purposes of this assessment, the output is treated as continuous since the average power would be 0. At 1310nm, P=0.097mW Total Maximum Power Output=4.597mW
EPL Ma/Mb Limit	150mW (Per Clause 6.6.2 of IEC 60079-0 and Table 2 of IEC 60079-28)
EPL Da/Db/Dc Limit	35mW (Per Clause 6.6.2 of IEC 60079-0 and Table 3 of IEC 60079-28)
Safe Optical Power Limit For All Atmospheres	15mW (Per Table 2 of IEC 60079-28)

2.3 ATEX Directive

Reference:

1. ATEX Directive 2014/34/EU, *Directive 2014/34/EU of the European Parliament and the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres*.
2. IECEx Test Report GB/CML/ExTR 16.0039/00 (CML Report R1198A), *Evaluation of MR320 Series Controller and Sensors*, April 2016

Summary:
Per the IECEx Test Report, Micronor MR320 encoder system has been evaluated and verified that the MR320 Controller (as source of optical radiation, categorized Class 1) is not considered to have an independent source of ignition per Section 1 (3) of IEC 60079-28. The MR320 encoder and controller system are suitable for safe use in EPL Mb/Gb/Gc/Db/Dc applications without further consideration.

Analysis:
Per Directive 2014/34/EU Article 1 Section 4, the MR320 series Sensors are exempt as follows: "..equipment and protective systems where the explosion hazard results exclusively from the presence of explosive substances or unstable chemical substances". The Sensors are entirely mechanical, non-electrical, passive optical devices which do not represent an explosive hazard by themselves.

As the source of optical radiation for the sensor system, the MR320 Controller would be subject to IEC 60079-28 which defines optical radiation requirements for explosive atmospheres. However, Class 1 laser devices are categorically exempted from the standard per Section 1 (3) and suitable for safe use in EPL Mb, Gb, Gc, Db, and Dc applications without further consideration.

The Controller shall be considered a "component", integrated with the user's control system and shall be installed in a non-hazardous area. The Controller may be mounted inside a suitably-certified enclosure (such as an explosion proof enclosure, flameproof enclosure or in a purged/pressurized system) if required by the application. The user is responsible for any additional system design, installation and certifications for the overall assembly.

The Sensor and Controller shall be considered a "system", as neither provides an autonomous function. The Ex certification of a complete motor drive, actuator or similar electromechanical motion system is the responsibility of the system integrator. Mechanical design, load analysis and establishment of system maintenance/inspection procedures are a critical part of any electromechanical or similar motion system design operating in a harsh or hazardous environment. All have a direct impact on Sensor/Encoder reliability.

Section 4 (see Bearings) and the bearing life analysis of Appendix B highlight the mechanical design responsibilities of the user.

2.4 Operating Guidance

Summary:
In normal operation, the MR320 series Sensor does not present a hazard when operated within the environmental specifications of a particular model. As a mechanical device operating in a hazardous location, the engineer should be conservative in his design and the operator follow his system's inspection and maintenance procedures. This section outlines potential mechanical failure modes of the Sensor and methods for their prevention.

Analysis:

MR320 Controller shall always be mounted in non-hazardous location or housed in a suitably-certified enclosure as part of a larger Ex assembly.

MR320 series Sensors can be mounted and operated in the specified hazardous and non-hazardous areas. As a mechanically rotating component, care must be taken to not overload the bearings which can create excessive surface heat which could potentially ignite an explosive environment. The user shall be aware of these potential failure modes and recommended operation:

Potential Ignition Source			**Measures applied to prevent the source becoming effective**	**Ignition protection used (To be determined by the integrator or user)**
Normal Operation	**Expected Malfunction**	**Rare Malfunction**		
	Uneven wear in bearings can result in frictional heating or mechanical sparking		Detailed calculations of bearing life and system MTBF can be found in APPENDIX A, Bearing Life Analysis. Summary: All bearings are lubricated by grease which is captured within the seals. MTBF calculations were performed at selected load conditions and RPM conditions. In APPENDIX A, we provide MTBF calculations at various speeds and shaft loads. These numbers can vary with application, environmental factors, RPM and shaft load conditions. For high reliability applications, it is conservatively recommended that the unit be replaced after 10 years of continuous operation.	EN 13463-1 (User Instructions) And EN-13463-5 (Constructional Safety "c")
		Bearing Failure or Loss of Lubrication can result in frictional heating or mechanical sparking	This is a generic discussion of bearing failure applicable to any and all equipment incorporating bearings. Summary: Generically, bearing failure usually occurs when excessive loads (combinations of radial, axial, RPM, temperature, shock, vibration, etc.)	EN 13463-1 (User Instructions) and EN-13463-6 (Control of Ignition Sources "b", if monitoring is fitted)

			combine to cause premature bearing wear and excessive temperature rise approaching MIE. Any temperature can then be compared to normal bearing operation where the typical temperature rise is 10-50°F above ambient depending on the operating conditions. Bearing failure is rarely a catastrophic event but a gradual deterioration. For a high reliability application, the user should consider implementing one or more of the following: 1. If motor overrun could occur, the user should consider the use of torque limiting safety couplings. 2. A temperature sensor could be placed on the encoder housing closest to the bearings to monitor surface temperature relative to MIE. 3. The encoder should be examined periodically for abnormally high surface temperatures or physical signs of abnormal noise or discoloration.	

2.5 Low Voltage Directive

References:

1. Low Voltage Directive, *Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to making available on the market of electrical equipment designed for use within certain voltage limits, 2014*

Summary:

Applicable Directives	Product Models	
	MR320 Controller	All MR320 Sensors
Low Voltage Directive	Exempt	Exempt

Analysis:
Per Article 1 of the Low Voltage Directive, "This Directive shall apply to electrical equipment designed for use with a voltage rating of between 50 and 1,000 V for alternating current and between 75 and 1,500V for direct current, other than the equipment and phenomena listed in Annex II." The MR380 Controller operates up to maximum 32V DC and is not covered by equipment list in Annex II. Therefore, the Controller is exempt.

The MR320 Sensors are non-electrical, passive devices and exempt from the Low Voltage Directive.

2.6 Electromagnetic Compatibility (EMC)

References:

1. EMC Directive, *Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility*, 2014.

Summary:

Applicable Directives	Product Models	
	MR320 Controller	All MR320 Series Sensors
EMC Directive	Exempt	Exempt

Analysis:
The MR320 Controller is a component and therefore exempt from the EMC Directive. The user shall follow appropriate grounding and shielding practices when integrating the OEM Controller into the manufacturer's system.

MR320 Sensors are non-electrical, passive devices and, therefore, exempt from the EMC Directive.

2.7 Control of Production

Summary:
In addition to the technical requirements covered in this document, the fixing of the European Commission CE mark also requires all products are produced in a controlled and reproducible manner. In satisfaction of this requirement, Micronor maintains a Quality System in which the MR320 series products are governed by a controlled set of bill of materials as well as documented assembly and test procedures.

Analysis:
Micronor Quality Manual 94-QMS-001
No further analysis required.

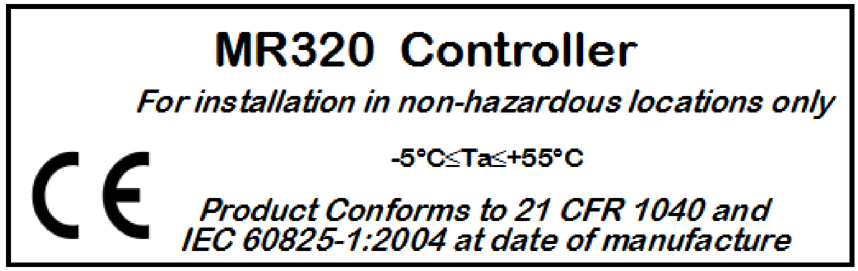
2.8 CE Mark

Summary and Analysis:
The Sensor and Controller meet applicable EC requirements and qualify for CE marking.

3. Product Markings

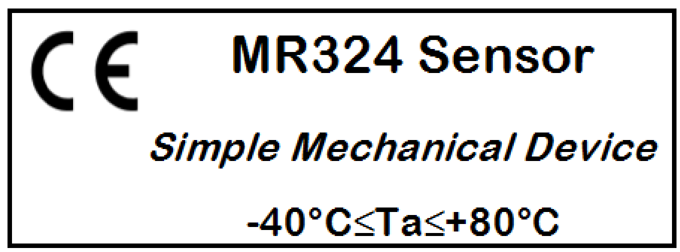
The following are samples of product labels in compliance with Section 2.

3.1 MR320 Controller



3.2 MR320 Sensors

All MR320 series Sensors will be labeled per example show for MR324 below.



4. User Obligations

- Do not look into the optical port of the Controller or any optical connectors with the aid of any optical magnification device.
- Always clean optical connections before reconnecting
- In hazardous environments, always operate the Sensors under conservative mechanical bearing loads.
- Power supply to Controller shall be current limited to 200mA or less

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APPENDIX A: Bearing Life Analysis

Reference:

ANSI/AFBMA Std 9-1990, *Load Ratings and Fatigue Life for Ball Bearings*

Background (excerpt from ANSI/AFBMA 9-1990):

Bearing life is defined as the length of time, or the number of revolutions, until a fatigue spall of a specific size develops. This life depends on many different factors such as loading, speed, lubrication, fitting, setting, operating temperature, contamination, maintenance, plus many other environmental factors. Due to all these factors, the life of an individual bearing is impossible to predict precisely.

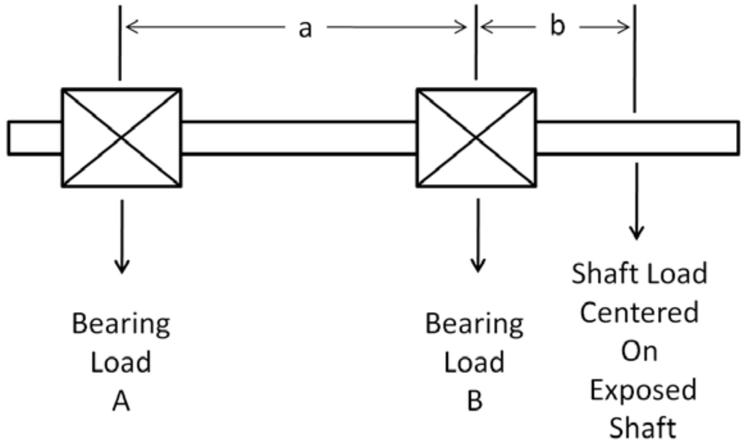
ANSI/AFBMA Std 9-1990 provides a common industry basis for estimating bearing life. L10 life is the life that 90 percent of a group of apparently identical bearings will complete or exceed before a permanent deformation of 0.0001 of the rolling diameter. General industry experience shows that a permanent deformation of this size, at the center of the most heavily loaded ball/raceway contact, can be tolerated in most bearing applications without the subsequent bearing operation being impaired. The basic static load rating is, therefore, given a magnitude such that approximately this deformation occurs when the static equivalent load is equal to the load rating.

$L_{10} = (C_r / P_r)^3$		
Where	$L_{10} =$	Basic rating life, in million revolutions
	$C_r =$	Basic dynamic radial load rating, N (lbs)
	$P_r =$	Dynamic equivalent load rating, N (lbs)

For many applications, it may be desirable to calculate life for a different reliability and/or for special bearing properties and operating conditions which deviate from the conventional in such a way that it is justified to take their influence into special consideration. The adjusted rating life, Ln, i.e. the basic rating life adjusted for a reliability of (100-n)% for special bearing properties and for specific operating conditions is given by:

$L_{na} = a_1 a_2 a_3 L_{10}$		
Where	$L_{na} =$	Adjusted life, in million revolutions $L_3 =$ 97% reliability $L_1 =$ 99% reliability
	$a_1 =$	Life adjustment factor for bearing reliability For calculating L_3, $a_1 = 0.44$ For calculating L_1, $a_1 = 0.21$
	$a_2 =$	Life adjustment factor for bearing materials and processing
	$a_3 =$	Life adjustment factor for bearing operating conditions
	$L_{10} =$	Basic rating life, hr

The model for calculating bearing load is as follows:



Load on Front Bearing (B) = (Shaft Load * (a + b)) / a

Load on Rear Bearing (A) = (Shaft Load * b) / a

Reference data for bearings used on MR320 series Sensors:

Encoder Model	Bearing Type	C_r (Static) N	C_{or} Dynamic N	Maximum RPM
MR322	6000-2RS (Front Bearing)	4550 N	1970 N	19,000
	686ZZ (Rear Bearing)	1100 N	440 N	43,000
MR324	6809-2RS (Front and Rear)	5350 N	4900 N	6,000
MR325	6001-2RS (Front and Rear)	5100 N	2390 N	19,000
MR326	6001-2RS (Front and Rear)	5100 N	2390 N	19,000
MR328	Ceramic Bearings (Front and Rear)	2840 N	1470 N	9,500 e4

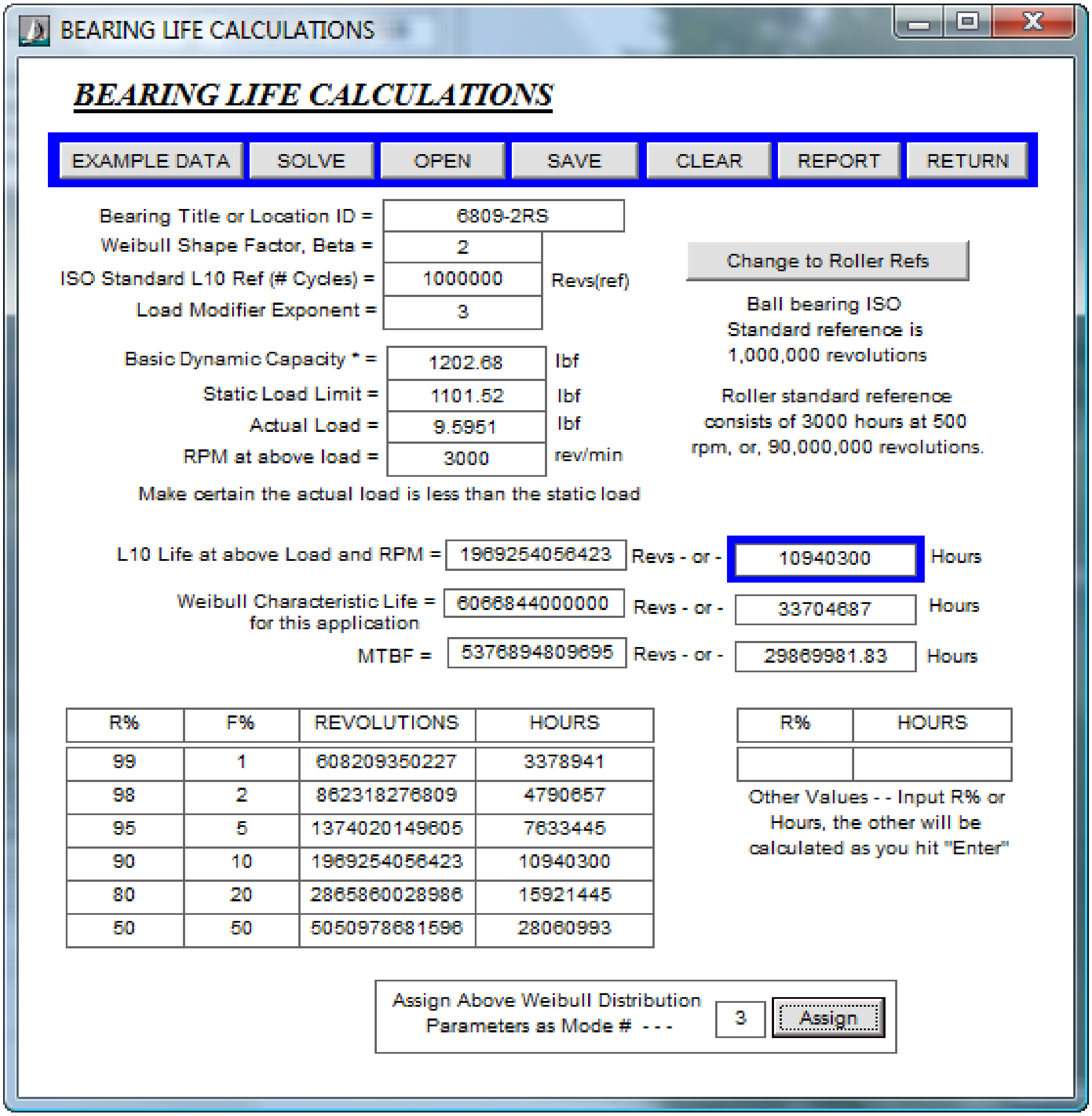
Maximum shaft load specifications for MR320 series Sensors:

Sensor Model	Maximum Radial Shaft Load	Maximum Axial Shaft Load	Maximum Electrical RPM
MR322	80 N	40 N	8,000 RPM
MR324	---	---	3,300 RPM
MR325	300 N	100 N	3,600 RPM
MR326	140 N	70 N	8,000 RPM
MR328	60 N	30 N	1,000 RPM

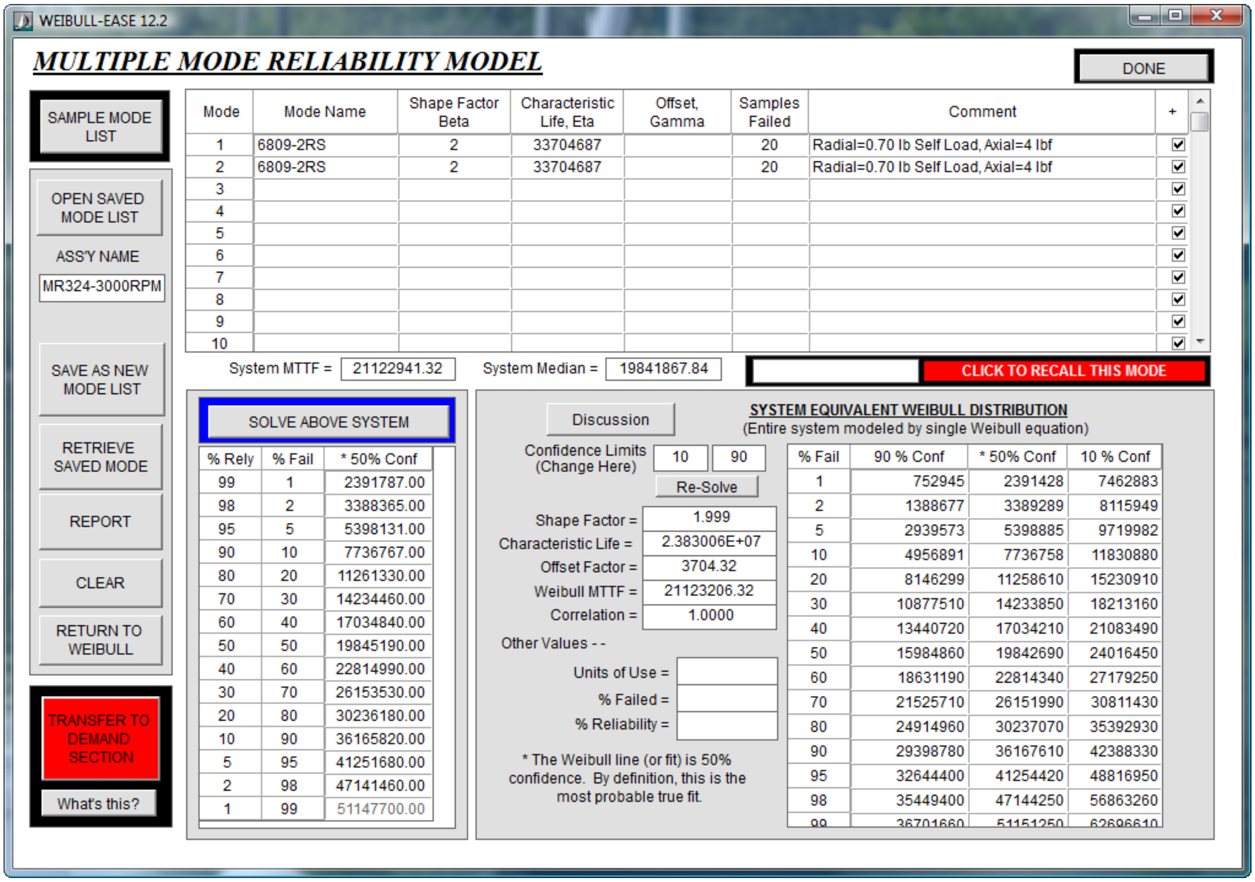
Specifications subject to change without notice

Reliability Software Used

To calculate System MTBF (Mean Time Between Failures), Weibull reliability analysis was applied using **WEIBULL-EASE 12.2** software (www.applicationsresearch.com). First, the **BEARING CALCULATIONS** function (see sample screen below) was used to calculate L_{10} as well as the Weibull Characteristic Life – for each bearing. Next (for each bearing), the corresponding Weibull Characteristic Life with default Beta Shape Factor =2 is then transferred as a failure mode to the **CREATE/LOAD RELIABILITY MODEL** function. With the two bearings (modes) entered, the software calculates both System MTTB and Weibull MTBF. Sample screens from the MR324 bearing analysis are shown below.



MR324 Front and Rear Bearing Input



MR324 MTBF Based On Weibull Multiple Mode Reliability Model

MR322 Sensor Bearing MTTB Analysis

Two different bearing life cycle analyses were performed. For long term reliability, we recommend an operating condition based on 10% of the maximum Axial and Radial Shaft Load Specification. For purposes of analysis, we use 10% Radial and 4 lbf Axial (Preload) Loading (corresponds to 44% of maximum Axial Load).

Analysis #1 at 5000 RPM (Electrical speed limit):

- Axial load = 4 lbf
- Radial load = 0.90 lbf (10% of Maximum Axial Load) centered over exposed shaft length
- **System MTBF is 1.58E+05 hours (equivalent to 18.0 years)**

Analysis #2 at 8000 RPM (Mechanical speed limit):

- Axial load = 4 lbf
- Radial load = 0.90 lbf (10% of Maximum Axial Load) centered over exposed shaft length
- **System MTBF is 9.87E+04 hours (equivalent to 11.3 years)**

MR324 Sensor Bearing MTTF Analysis

Two different bearing life cycle analyses were performed. For purposes of analysis, we use a Radial load equal to the sensor's weight (0.70 lb) and 4 lbf Axial (Preload) load.

Analysis #1 at 3000 RPM (Electrical speed limit):

- Axial load = 4 lbf
- Radial load = 0.70 lb (weight of sensor)
- **System MTBF is 2.11E+07 hours (equivalent to 2,411 years)**

Analysis #2 at 3300 RPM (Mechanical speed limit):

- Axial load = 4 lbf
- Radial load = 0.70 lb (weight of sensor)
- **System MTBF is 1.92E+07 hours (equivalent to 2,192 years)**

MR325 Sensor Bearing MTTF Analysis

Two different bearing life cycle analyses were performed. For long term reliability, we recommend an operating condition based on 10% of the maximum Axial and Radial Shaft Load Specification.

Analysis #1 at 3000 RPM (Electrical speed limit):

- Axial load = 2.2 lbf
- Radial load = 6.7 lbf
- **System MTBF is 1.410E+07 hours (equivalent to 1,609 years)**

Analysis #2 at 3600 RPM (Electrical speed limit):

- Axial load = 2.2 lbf
- Radial load = 6.7 lbf
- **System MTBF is 1.175E+07 hours (equivalent to 1,340 years)**

MR326 Sensor Bearing MTTF Analysis

Two different bearing life cycle analyses were performed. For long term reliability, we recommend an operating condition based on 10% of the maximum Axial and Radial Shaft Load Specification. For purposes of analysis, we use 10% Radial and 4 lbf Axial (Preload) Loading (corresponds to 44% of maximum Axial Load).

Analysis #1 at 5000 RPM (Electrical speed limit):

- Axial load = 4 lbf
- Radial load = 3.15 lbf (10% of Maximum Axial Load) centered over exposed shaft length
- **System MTBF is 7.22E+06 hours (equivalent to 824.8 years)**

Analysis #2 at 8000 RPM (Mechanical speed limit):

- Axial load = 4 lbf
- Radial load = 3.15 lbf (10% of Maximum Axial Load) centered over exposed shaft length
- **System MTBF is 4.52E+06 hours (equivalent to 515.5 years)**

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APPENDIX B: Terms and Acronyms

ATEX	Atmosphères Explosibles (Explosive Atmosphere). By ratifying the guideline 94/9/EC on 23 March 1994 the European Parliament and the Council of the European Union started to harmonize the different national legislative provisions for the operation in areas with potentially explosive atmospheres. As an acronym, ATEX generally refers to the equipment regulations and standards established by EU directive 94/9/EC.
EN	European Norm. European standards maintained by CEN (European Committee for Standardization), CENELEC (European Committee for Electrotechnical Standardization) and ETSI (European Telecommunications Standards Institute):
EPL	Equipment Protection Level. The level of protection assigned to equipment based on its risk of becoming a source of ignition, and distinguishing the differences between explosive gas atmospheres, explosive dust atmospheres, and the explosive atmospheres which may exist in coal mines. Atmosphere prefixes: M=Mines, G=Gas, D=Dust. Levels of Protection suffix: a,b,c.
FCC	Federal Communications Commission (U.S. Government)
FDA	Food and Drug Administration (U.S. Government)
IEC	International Electrotechnical Commission. IEC is the international standards commission that prepares and publishes all standards for electrical, electronic and related technologies. The worldwide organization promotes international unification of standards or norms. Its formal decisions on technical matters express, as nearly as possible, an international consensus. www.iec.ch
Inherently Safe Optical Radiation	Visible or infrared radiation that is incapable of producing sufficient energy under normal or specified fault conditions to ignite a specific hazardous atmospheric mixture.
Intrinsically Safe	According to IEC 60079-28, the term "intrinsically safe" now specifically applies to electrical circuits while "inherently safe" applies to optical radiation. The terms are used interchangeably in this document due to the user's greater familiarity with "intrinsically safe"
ISO	International Organization for Standardization. ISO is the world's largest developer of voluntary International Standards. www.iso.org
LED	Light Emitting Diode. A device used in a transmitter to convert information from electrical to optical form. It typically has a large spectral width. A semiconductor device that emits light when forward biased.
MTBF	Mean Time Between Failures.
Simple Apparatus	As defined in the EC ATEX Guidelines, simple apparatus (exclusions to the Directive) are "equipment and protective systems where the explosion hazard results exclusively from the presence of explosive substances or unstable chemical substances." In other words, under intended use and fault condition, the equipment have no known effective source of ignition.
VCSEL	Vertical-Cavity Surface-Emitting Laser. A type of semiconductor laser with laser beam emission perpendicular to the chip surface, contrary to conventional edge-emitting semiconductor lasers (also in-plane lasers) where laser light is emitted at one or two edges.

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