

## Declaration of Conformity (EU)

We, the manufacturer,

Micronor Inc.

900 Calle Plano, Suite K, Camarillo, CA 93012, USA

Telephone +1-805-389-6600, Email [sales@micronor.com](mailto:sales@micronor.com)

declare that this DoC is issued under our sole responsibility and belongs to the following products:

- Fiber optic switch and signaling system, consisting of:
- MR380-0, MR380-1, MR380-2 or MR382-1, Controller
- MR380 series Sensor, MR381/MR382/MR383/MR384/MR385/MR386/MR387

That the equipment is in conformity with the following relevant European Union harmonization legislation:

- Equipment for Potentially Explosive Atmospheres Directive (ATEX), 2014/34/EU
- Electromagnetic Compatibility Directive (EMC), 2014/30/EU
- Low Voltage Directive (LVD) 2014/35/EU

to which this declaration relates in conformity with the following standards or other normative documents (latest version of EN or corresponding IEC document used per Appendix C):

- EN 60079-0:2018
- EN 60079-14:2014
- EN 60079-28:2015
- EN 60825-1:2014
- EN 61010-1:2010
- EN 61000-6-2:2005+AC:2005
- EN 61000-6-4:2007+A1:2011

Certification Agency

- Certification Management Ltd, EU Notifying Body 2503, IEC Ex Certification Body
- CML Evaluation Report R1198C, GB/CML/ExTR 16.0130/00

Signed for and on behalf of:



Camarillo, CA 2019-09-27 Dennis Horwitz, VP

## Declaration of Conformity (IECEX and North America)

We, the manufacturer,

Micronor Inc.

900 Calle Plano, Suite K, Camarillo, CA 93012, USA

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- MR380-0, MR380-1, MR380-2 or MR382-1, Controller
- MR380 series Sensor, MR381/MR382/MR383/MR384/MR385/MR386/MR387

That the equipment is in conformity with the following International (IEC) and North American requirements:

- Explosive Atmospheres/Hazardous Locations, IEC Ex
- Electromagnetic Compatibility for Industrial Environments, IEC and FCC
- Electrical Safety, IEC and FDA/NEC

to which this declaration relates in conformity with the following standards or other normative documents:

- IEC 60079-0:2017, Edition 7.0
- IEC 60079-14:2013, Edition 5.0
- IEC 60079-28:2015: Edition 2.0
- IEC 60825-1: 2014, Edition 3.0
- IEC 61010-1:2010. Edition 3.0
- IEC 61000-6-2:2005, Edition 2.0
- IEC 61000-6-4:2006, Edition 2.0 +AMD1:2010 +ISH1:2011
- US CFR, FDA, Title 21, Chapter 1, Subchapter J, Parts 1000-1050
- US CFR, FCC, Title 47, Chapter 1, Subchapter A, Part 15
- US NFPA 70, NEC, 2014

Certification Agency

- Certification Management Ltd, EU Notifying Body 2503, IEC Ex Certification Body
- CML Evaluation Report R1198C, GB/CML/ExTR 16.0130/00

Signed for and on behalf of:



Camarillo, CA 2019-09-27 Dennis Horwitz, VP

## Declaration of Conformity (EAEU)

We, the manufacturer,

Micronor Inc.

900 Calle Plano, Suite K, Camarillo, CA 93012, USA

Telephone +1-805-389-6600, Email [sales@micronor.com](mailto:sales@micronor.com)

declare that this DoC is issued under our sole responsibility and belongs to the following products:

- Fiber optic switch and signaling system, consisting of:
- MR380-0, MR380-1, MR380-2 or MR382-1, Controller
- MR380 series Sensor, MR381/MR382/MR383/MR384/MR385/MR386/MR387

That the equipment is in conformity with the following relevant EAEU harmonization legislation:

- On safety of low-voltage equipment, TR-CU-004/2011
- On safety of equipment intended for use in explosive atmospheres, TP-TC-012/2011
- Electromagnetic Compatibility of Technical Products, CU-TR-020/2011

to which this declaration relates in conformity with the following standards or other normative documents (latest version of corresponding IEC document used per Appendix D):

- GOST 30804.6.2-2013
- GOST 30804.6.4-2013
- GOST 31610.28-2017
- GOST R IEC 60079-0-2011
- GOST IEC 60079-14-2013
- GOST IEC 60825-1-2013
- GOST IEC 61010-1-2014

Certification Agency

- Certification Management Ltd, EU Notifying Body 2503, IEC Ex Certification Body
- CML Evaluation Report R1198C, GB/CML/ExTR 16.0130/00

Signed for and on behalf of:



Camarillo, CA 2019-09-27 Dennis Horwitz, VP

## Product Assessment Report

Product Description: MR380 series Fiber Optic Signaling Sensor system

Affected Products: The following models are referred to as the **Controller** in this document:  
 MR380-0-1 OEM E-Stop Controller, Multimode, 850nm  
 MR380-0-1E OEM E-Stop Controller, Multimode, 850nm, Extended Temp  
 MR380-1-1 DIN Rail Mount E-Stop Controller, Multimode, 850nm  
 MR380-1-2 DIN Rail Mount E-Stop Controller, Multimode, 1310nm  
 MR380-1-3 DIN Rail Mount E-Stop Controller, Single Mode, 1310nm  
 MR380-2-2 DIN Rail Mount Switch Controller, Multimode, 1310nm  
 MR382-1-1 DIN Rail Mount U-Beam Controller, Multimode, 850nm

The following are referred to as the **Sensor** in this document:  
 MR381-X-X Fiber Optic E-Actuator (any model and custom versions)  
 MR382-X-X Fiber Optic U-Beam (any model and custom versions)  
 MR383-X-X Fiber Optic Key Switch (any model and custom versions)  
 MR384-X-X Fiber Optic Push Button (any model and custom versions)  
 MR385-X-X Fiber Optic Foot Pedal (any model and custom versions)  
 MR386-X-X Fiber Optic Microswitch (any model and custom versions)  
 MR387-X-X Fiber Optic E-Stop (any model and custom versions)

Document: 98-0380-05

Revision: D

Number of Pages: 18

### Revision History

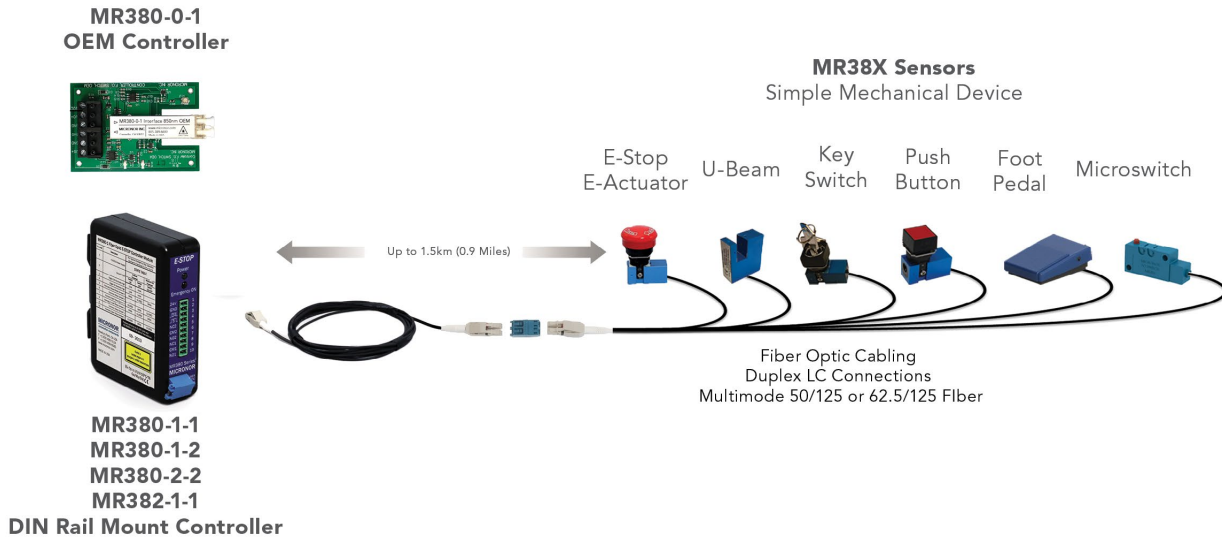
Revision	Date	Description
0	13-Dec-2013	Original release
A (1)	18-March-2015	Added SFF and DC parameters under Functional Safety
B (2)	13-July-2015	Added 50/125 multimode pigtail version and Universal Controller
C	27-Sept-2016	Updated Ex compliance with CML/IECEX Test Report Added new Sensor and OEM controller products Integrated MR382 U-Beam product line
C1	7-March-2017	Added Extended Temperature model MR380-0-1E
D	27-Sept-2019	Combined MM and SM Products into single DoC

### Assessment Outline

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  2. Risk Assessment by Category
    - 2.1. Product Function (MR387 E-Stop System Only)
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    - 2.3. Explosive Atmospheres
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    - 2.6. Low Voltage Directive
    - 2.7. Control of Production
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  3. Product Marking
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    - 3.2. MR380 OEM Controllers
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  4. User Obligations
- Appendix A. Terms and Acronyms  
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 Appendix C. Cross-Reference of GOST versus IEC Standards

## 1. Product Overview

The MR380 series Fiber Optic Signaling Sensor System consists of one or more passive Sensors (optically wired in series) and active Controller which are connected via a duplex multimode fiber optic link:



## 2. Risk Assessment By Category

### 2.1 Product Function (MR387 E-Stop System Only)

**Reference:**

1. ISO 13850, *Safety of machinery - Emergency Stop - Principles for design*, Edition 2006

**Summary:**

The combination of the MR380-1 series Controller and MR387 E-Stop Sensor meets the purpose and essential functionality of an Emergency Stop Device but the fiber optic sensor/interrogator aspect of the device excludes it from meeting all performance requirements typical of a conventional electromechanical E-STOP. This product is designed for applications and environments where a conventional electromechanical E-STOP cannot be used.

Parameter	Applies to E-Stop system Only, Consisting of MR380-1 Controller and MR387 E-Stop Sensor
Functionality	ISO 13850  NOTE: ISO 13850 defines the characteristics and requirements for a traditional electromechanical E-STOP switch. The MR380 Fiber Optic E-STOP System borrows the definition of purpose and functionality only.

**Analysis:**

ISO 13850 defines the functional requirements and design principles for the emergency stop function and emergency stop device on machinery. In operation, an emergency stop function is initiated by single human action to initiate the event(s) required to bring the machinery to a fail-safe condition. What constitutes a fail-safe condition and how the machine reaches that state is the responsibility of the machinery designer.



The Micronor MR387 Fiber Optic E-STOP Sensor System functions similar to a standard electromechanical, mushroom-style E-Stop. The passive optical sensor integrates a conventional E-STOP actuator which controls an optical circuit or light path - similar to the way an electromechanical E-STOP switch directly controls an electrical circuit. As required by ISO 13850, the MR387 E-STOP Sensor incorporates the same mechanical latching and reset mechanism as a conventional E-STOP. The optical transmit and receive paths comprise a duplex fiber link which is completed by connection to a MR80 Controller module. This module contains the system's optoelectronics as well as the electrical interface and relay contacts which connect to the machinery's control system.

The MR387 Fiber Optic E-STOP System is designed to be used where a conventional electromechanical emergency stop device cannot be used or is impractical to install. The passive optical E-STOP sensor provides immunity to EMI/RFI/lightning, can be safely used in hazardous locations, and can operate over extremely long distances. Typical applications and environments where the sensor can be used:

- Hazardous locations (gaseous or dust) such as mines, chemical plants, oil rigs and grain elevators
- Long haul distances (up to 2500 meters) such as mines and remotely located machinery
- Noisy electrical environments
- High electromagnetic field environments such as MRI and other extreme EMF process applications

## 2.2 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. 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
3. Micronor 98-0380-03, MR380-1 CDRH Supplemental Information, Revision B, April 2016
4. Micronor 98-0380-30, MR380-0 LASER Level Measurement, Revision A, March 2015


### Summary:

The MR380 fiber optic signaling 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 MR380 Controller, the laser safety class designation and product labeling requirements apply only to the MR380 Controllers as the "active" optoelectronic half of the MR380 system.

For FDA compliance, annual production reports for the MR380 Controller shall be filed and the product shall be marked with a serial number and date of manufacture (month/year).

### Analysis:

The following table summarizes the evaluation results and applicable product markings for the MR380 Controllers. As passive devices, the MR380 Sensors do not require any laser safety markings.

Parameters	Controller Models			
	MR380-0-1 MR380-0-1E	MR380-1-1 MR382-1-1	MR380-1-2 MR380-2-2	MR380-1-3
Wavelength (Type of Source)	850 nm Pulsed, VCSEL	850 nm CW, VCSEL	1310nm CW, LED	1310nm CW, Fabry-Perot Laser
Output Power	0.126 mW (-9 dBm)	0.100 mW (-10 dBm)	0.0126 mW (-19 dBm)	0.20 mW (-7 dBm)
IEC Class 1 Limit	3.88 mW (+5.8 dBm)	3.88 mW (+5.8 dBm)	77.8 mW (+18.9 dBm)	77.8 mW (+18.9 dBm)
Classification	Class I (Not Harmful)			
Required Markings	FDA: Serial Number and Date of Manufacture  IEC 60825-1 Labeling Requirement: 			

## 2.3 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. Customs Union Technical Regulations, TP TC 012/2011, *On safety of equipment intended for use in explosive atmospheres*, October 2011
3. IEC 60079-0, *Explosive Atmospheres - Part 0 Equipment – General Requirements*, Edition 5, 2007
4. IEC 60079-14, *Explosive Atmospheres - Part 14: Electrical installations design, selection and erection*, Edition 5.0, 2013
5. IEC 60079-28, *Explosive Atmospheres - Part 28 : Protection of equipment and transmission systems using optical radiation*, Edition 2, 2015
6. IECEx Test Report GB/CML/ExTR 16.0105.00/00 (CML Report R1198C/00), *Evaluation of MR380 Series Controller and Sensors*, August 2016. NOTE: Contact Micronor for copy of full IECEx test report, Micronor document 98-0380-16.
7. Micronor 98-0380-07, *MR380 Inherent Safety Evaluation*, Revision D, August 2019
8. Micronor 98-0380-30, *MR380-0 LASER Level Measurement*, Revision A, March 2015
9. National Fire Protection Association, NFPA 70, *National Electric Code (NEC)*, 2014.

### Summary:

Per IECEx Test Report, the MR380 optical radiation output is not considered an independent source of ignition as the optical radiation output of a MR380 Controller falls under the EPL Mb, Gb, Gc, Db, Dc safe optical radiation limits per IEC 60079-0. zOEC 60079-14 and OEC 60079-28.

The following tables summarize assessments and applicable markings for the MR380 series Controllers and Sensors:

Parameters	Controller Models	
	MR380-0-1 MR380-0-1E	MR380-1-1 MR380-1-2 MR380-1-3 MR380-2-2 MR382-1-1
Environmental Rating	-10° to +65 °C, 0-85% RH	-5° to +55 °C, 0-95% RH
Explosive Atmospheres	Controller shall be installed in <b>non-hazardous</b> locations only Controller is a source of inherently safe optical radiation for MR380 Sensor applications in Mines, Gas or Dust Atmospheres requiring EPL Mb, Gb, Gc, Db, or Dc. Consult IECEx Test Report (ExTR) GB/CML/ExTR 16.0.0105/00	
ATEX	[EPL Mb, Gb, Gc, Db, Dc]	
EAEU/GOST	[EPL Mb, Gb, Gc, Db, Dc]	
IECEx	[EPL Mb, Gb, Gc, Db, Dc]	
North America	Controller shall be installed in non-hazardous area only	
Product Markings	Product does not have room for special markings	For Installation in non-hazardous location only -5 °C ≤ Ta ≤ +55°



Parameters	Sensor Models
	MR380 Series Sensors
Environmental Rating	-40° to +65° C, 0-95% RH
Classification	Sensor shall be installed and operated in conjunction with a MR380 Controller in any Mine, Gas or Dust atmosphere with the following EPL, Zone, or Class/Division/Group classifications Consult IECEx Test Report (ExTR) GB/CML/ExTR 16.0.0105/00
Equipment Protection Levels	EPL Mb, Gb, Gc, Db, Dc
Zones	Zone 1, 2, 21, 22
Classes	Class I/II/III, Division 2
ATEX	EPL Mb, Gb, Gc, Db, Dc
EAEU/GOST	EPL Mb, Gb, Gc, Db, Dc
IECEX	EPL Mb, Gb, Gc, Db, Dc
North America	Exempt, non-electrical
Product Markings	Simple Mechanical Device -40° C ≤ Ta ≤ +65° C

**Analysis:**

MR380 series Sensors are exempt from the applicable Ex directives being entirely mechanical, non-electrical, passive optical devices which do not represent an explosive hazard by themselves:

- EU Directive 2014/34/EU, Article 1, Section 4
- EAEU Technical Regulations TP TC 012/2011, Article 1 (4)

Certification Management Ltd (CML, a Notified Body) evaluated the Multimode MR380 Fiber Optic Signaling Sensor system and verified that the MR380 Multimode Controllers (as a source of optical radiation) is a Class 1 optical source and not considered a source of ignition per Section 1 (3) of IEC 60079-28 Ed.2.

Micronor conducted a similar assessment of the Single Mode MR380 Controller and verified that the MR380-1-3 Controller (as a source of optical radiation) is a Class 1 optical source and not considered a source of ignition per Section 1 (3) of IEC 60079-28 Ed.2.

Optical power measurements and source driver fault analysis were performed and documented in Micronor test report 98-0380-07 in accordance with IEC 60825-1 and IEC 60079-28. 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.

Ex Parameters	Controller Model			
	MR380-0-1 MR380-0-1E	MR380-1-1 MR382-1-1	MR380-1-2 MR380-2-2	MR380-1-3
Wavelength/Source Type	850 nm Pulsed, VCSEL)	850 nm CW, VCSEL	1310nm CW, LED	1310nm CW, Fabry-Perot Laser
Maximum Peak Power	P <sub>peak</sub> =14.5 mW Pulse Width=1 μs E=3.25 nJ	P <sub>peak</sub> =11 mW Pulse Width=1 μs E=1.64 nJ	P <sub>peak</sub> =0.966 mW	P <sub>peak</sub> =5.69 mW
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	P <sub>max</sub> =15mW or E <sub>max</sub> =17μJ (Per Table 2 of IEC 60079-28)			



## 2.5 Functional Safety (MR387 E-Stop System Only)

### References:

1. ISO 13849-1, *Safety of machinery – Safety-related parts of control systems - Part 1: General principles for design*, Edition 2006 + Technical Corrigendum 1, February 2009
2. ISO/TR 13849-100, Technical Report, *Safety of machinery – Safety-related parts of control systems - Part 100: Guidelines for the use and application of ISO 13849-1*, First Edition, September 2000
3. MIL-HDBK-217, *Military Handbook, Reliability Prediction of Electronic Equipment*, Revision F + Notice 1 + Notice 2, February 1995
4. VITA 51.0, *Reliability Prediction*, June 2012
5. VITA 51.1, *Reliability Prediction - MIL-HDBK-217* Subsidiary Specification, June 2008
6. Micronor, *MR380 Bill Of Materials Spreadsheet*, Revision B, September- 2013
7. Micronor, *MR380\_RevB.pdf*, Schematic of MR380 Electronics Board
8. Micronor, *x2 Reliability FIT MR380 12 22 14 .xlsx*, Reliability table of MR380 system components

### Summary:

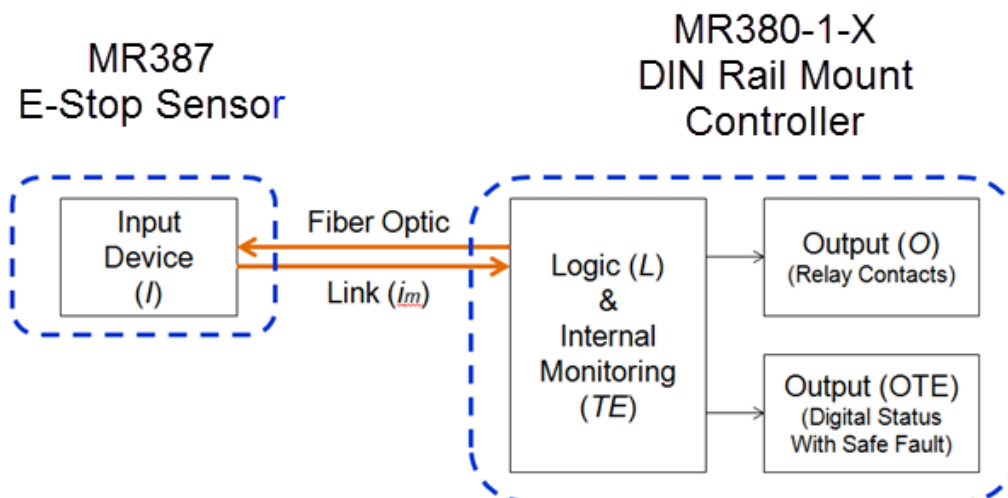
This section applies only to the MR387 E-Stop System which consist of the MR387 E-Stop sensor and MR380-1-X Multimode Controller.

The following table summarizes the Functional Safety attributes of the Fiber Optic E-STOP system:

Functional Safety Parameters	System Configuration (MR387 MM Sensor + MR380-1-X MM Controller)
Category	Category 2 per ISO 13849-1
MTTF (for System)	35.4 years, 3.10 E+05 hrs
MTTFd (for System)	70.8 years, 6.20 E+05 hrs
Safety Integrity Level (SIL)	SIL=1
Performance Level (PL)	PL=c
Safe Failure Fraction (SFF)	SFF=97.85%
Diagnostic Coverage (DC)	DC=75.76%

### Analysis:

Per ISO 13849-1, the MR387 Fiber Optic E-STOP System is classified as a Category 2 component per the block diagram below. The digital outputs (OTE) provide a separate means for the User's Machinery to monitor the state of the E-STOP system independent of the relay contacts (O). In event of a system fault such as a broken fiber optic link, the outputs (O and OTE) default to Safe Fault (Emergency ON).





ISO 13849-1 requires a reliability assessment of MTTFd which is then used in the determination of PL and SIL values. The method used is the Parts Count method per MIL-HDBK-217 Notice 2 supplemented by updates provided by VITA 51.0/51.1. For the optical sources used in the controller, we used MTTF data provided by the device manufacturers. Standard component failure factors from MIL-HDBK-217 Notice 2 were supplemented by: (1) updated reliability factors provided by VITA and (2) failure rate data provided by the optical source manufacturers. This resultant MTTF failure rate is provided in the summary table.

For determination of MTTFd, Annex C of ISO 13849-1 provides guidance that typically only 50% of failures lead to a dangerous failure. Therefore MTTFd is calculated to be twice the MTTF value.

MTTFd is then used to determine PL and SIL classifications per Table 1 of TR-62061. These values are provided in the summary table at the beginning of this section.

Next careful analysis was conducted on all components of the system. Each component was designated one of the following categories: safe detected, safe undetected, dangerous detected, and dangerous undetected. Each component is analyzed individually as the only failing component in the system.

The MR387 E-STOP system is designed to actively keep the relay contacts polarized in a known state. If the system were to lose power the relay will switch to a safe state, along with the normally high digital outputs. If either the relay or digital signals contradict each other the system is known to have failed in some capacity.

The MR387 E-STOP sensor has the capacity of a dangerous failure in the form of an unlatching push button. Upon user depression of the button, the switch should latch itself into a safe state. If the switch does not latch the system is in a dangerous failure state. The immediate feedback of a non-depressed switch provides a means of detecting a failure.

The dangerous failures exist only with components dealing with the signaling of the state the relay is in. The digital output signals and the relay contacts are the most critical reliability points in the system along with the switch. If the relay contacts were to fail to switch polarity there would be no immediate feedback other than comparing them to the state of the digital outputs; this would be considered a dangerous undetected failure.

Using the same component failure rates used for MTTF calculation, the Safe Failure Fraction (SFF) and Diagnostic Coverage (DC) of the MR387 ESTOP system can be determined. Tabulating the values and calculating the proportions from the Micronor MR380 components spreadsheet, the SFF and DC parameters were calculated.

## 2.6 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*
2. Customs Union Technical Regulations, TR CU 004/2011, *On safety of low-voltage equipment*, August 2011
3. IEC 61010-1, *Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements*, Edition 3.0 + corrigendum 1 + 2, October 2013.

**Summary:**

Low Voltage Directive Parameters	Product Models	
	All MR380 Controllers	All MR380 Sensors
Low Voltage Directive	Exempt	
Electrical Safety	Applicable sections of IEC 61010-1	Not applicable since passive device

**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.”

Per Article 1 of EAEU 004/2011, “Object of the present technical regulations of the Customs Union for low-voltage equipment is electrical equipment suitable for use at nominal voltage of 50V through 1000V (inclusive alternate current and of 75 through 1500V (inclusive direct current.”

The MR380 Controllers are exempt from the Low Voltage Directive because:

- Maximum operating voltage is 24V DC
- The MR380-1-X DIN Rail Mount Controllers incorporate a relay whose contacts are specified for use up to maximum 75 VAC and 50 VDC
- Product is not covered by the equipment list in Annex II

General electrical safety principles and design assessment were carried out per IEC 61010-1.

The MR380 Sensors are non-electrical, passive devices and exempt from the Low Voltage Directive.

## 2.6 Electromagnetic Compatibility

**References:**

- 1 FCC, *Code of Federal Regulations (CFR), Title 47-Telecommunication, Chapter 1-Federal Communications Commission, Subchapter A-General, Part 15-Radio Frequency Devices*, As of 27-September-2013
- 2 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.
- 3 Customs Union Technical Regulations, CU TR 020/2011, *Electromagnetic Compatibility of Technical Products*, December 2011
- 4 IEC 61000-6-2, *Electromagnetic compatibility (EMC), Part 6-2: General standards - Immunity for industrial environments, Edition 2.0, January 2005*.
- 5 IEC 61000-6-4, *Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments, Edition 2.0, July 2006*
- 6 Micronor 98-0380-06, *EMC Test Report for MR380-1*, Compatible Electronics Inc., Report A3112011, Revision A, December 2013

**Summary:**

The MR380 series is designed for use in Industrial Environments. EMC verification testing were performed on a MR380-1 DIN Rail Mount Controller at an outside test lab, Compatible Electronics Inc. The MR380-1, MR380-2 and MR382-1 Series Controllers are considered similar in design.

The MR380-0-1 OEM Controller is considered exempt since it is classified as a “component.”

The MR380 Sensors are not subject to EMC testing since they are non-electrical, passive devices and, therefore, exempt from the EMC Directive.

FCC Section 15.103b specifically exempts digital devices used exclusively in an electronics control system in an industrial plant.

EAEU 020/2011 exempts the MR380 series for the following reasons:

- Article 1 (2) states that “These Customer Union Technical Regulations do not apply to technical products which are used by manufacturers of other technical products as components and not intended to be self-contained products...”
- Product type not listed in Annex 3
- Product type not listed in the latest EAEU List of Products: “A new edition of the single list of products subject to mandatory conformation assessment (Attestation) of the Customs Union with issuance of common documents, approved by the Decision of the Commission of the Customs Union (As amended on January 31, 2013).”

EMC Directive Parameters	Product Models		
	MR380-0-1 MR380-0-1E	MR380-1-1 MR380-1-2 MR380-2-2 MR382-1-1	All MR380 Sensors
USA FCC Part 15	Exempt	Exempt	Exempt
EU EMC Directive	Exempt	Industrial Environment: IEC 61000-6-2 IEC 61000-6-4	Exempt
EAEU EMC Regulations	Exempt	Exempt	Exempt

**Analysis:**

EMC verification testing was performed on a MR380-1-X series DIN Rail Mount Controller.

## 2.7 Control of Production

**References:**

1. EC, Directive 2006/42/EC Of The European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC, 2006 + Corrigendum, March 2007

**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, the MR380 series products are governed by a controlled set of bill of materials as well as documented assembly and test procedures.

**Analysis:**

No further analysis required.

## 2.8 CE Mark

**References:**

1. European Union, Directive 2006/42/EC Of The European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC, 2006 + Corrigendum, March 2007

**Summary and Analysis:**

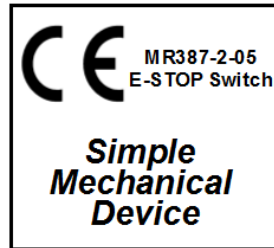
All applicable EC directives were reviewed and product compliance verified.

### 3. Product Markings

The following are samples of product labels incorporating CE mark and all other applicable markings, class designations and warnings/cautions as described in Section 2.

#### 3.1 MR380 Series Sensor



Depending on space available on the product, MR380 series Sensors may be labeled similar to example shown below.



#### 3.2 MR380 Series OEM Controllers





MR380-1 Fiber Optic E-STOP Controller				
Terminal	Description	<i>For Typical Emergency Stop Operation Connect to Terminals 5 &amp; 6 or 8 &amp; 9</i>		
1	+24VDC Power Supply	<b>STATE TABLE</b>		
2	Ground Input			
		<b>Module Powered</b>		<b>Module Not Powered</b>
		<b>Switch ON</b>	<b>Switch OFF</b>	<b>Switch ON/OFF</b>
3	Digital 24V Normally High	LOW	HIGH	-
4	Digital 5V Normally High	LOW	HIGH	-
5	Normally Closed Relay Contact 2	OPEN	CLOSED	OPEN
6	Common Relay Contact 2	-	-	-
7	Normally Open Relay Contact 2	CLOSED	OPEN	CLOSED
8	Normally Closed Relay Contact 1	OPEN	CLOSED	OPEN
9	Common Relay Contact 1	-	-	-
10	Normally Open Relay Contact 1	CLOSED	OPEN	CLOSED
 <b>micronor</b> Camarillo, CA USA T +1 805 389 6600 F +1 805 389 6605 www.micronor.com MADE IN USA		<b>Product conforms to 21 CFR 1040 and IEC 60825-1:2004 at date of manufacture:</b>		
		 <b>CLASS 1 LASER PRODUCT INVISIBLE LASER RADIATION</b>		
		<i>For installation in non-hazardous locations only -5°C ≤ Ta ≤ +55°C</i>		

#### 4. User Obligations

- Do not look into the optical part of the Controller or any optical connectors with the aid of any optical magnification device.
- Always clean optical connections before reconnecting
- Power supply to MR380 Controller shall be limited to 200 mA
- Optical cabling shall be suitable for the intended application

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## APPENDIX A: Terms and Acronyms

AEL	Admissible Emission Limit. The maximum accessible emission level permitted within a particular class. The AEL is determined as a product of the maximum permissible exposure (MPE) times an area factor called the limiting aperture (LA). The LA is dependent on laser wavelength pupil size. $AEL = MPE * \text{area of LA}$
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.
CE	CE is a certification mark to indicate products that conform to all applicable technical regulations of the European Union).
CW	Continuous Wave. In optical physics, “continuous wave” or “CW” refers to a light source (usually an LED or laser) that produces a continuous output beam. Also analogous to “Direct Current” or “DC” operation.
Dangerous Detected	Failure that is dangerous but is detected by internal diagnostics which go to the predefined alarm state. This failure rate is expressed as $\lambda_{dd}$
Dangerous Failure	A failure of a system component that leads to catastrophic failure into a dangerous state. If the relay contacts do not change polarity when critical component fails, then the state or failure is considered dangerous.
Dangerous Undetected	Failure that is dangerous and that is not being diagnosed by internal diagnostics. This failure rate is expressed as $\lambda_{du}$
DC	Diagnostic Coverage (DC) is used to characterize the effectiveness of diagnostic testing. $DC = \frac{\sum \lambda_{dd}}{(\sum \lambda_{dd} + \sum \lambda_{du})}$
DoC	Declaration of Conformity.
EAC	EAC is a certification mark to indicate products that conform to all applicable technical regulations of the Eurasian Customs Union (CU), also referred to as the Eurasian Economic Union (EAEU).
EAEU	Eurasian Economic Union, consisting of Russian, Belarus, Kazakhstan, Armenia and Kyrgyzstan. Also referred to as the Customs Union (CU)
EMC	Electromagnetic Compatibility. It is the ability of an equipment or system to function satisfactorily in its electromagnetic environment and without introducing intolerable electromagnetic disturbances to anything in that environment. The EMC Directive, also known as Directive 2014/30/EU of the European parliament, describes the EMC requirements for electronic equipment imported and operated within the European Union.
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.
EU	European Union is a political and economic union of 28 member states that are located in Europe.
FCC	Federal Communications Commission (U.S. Government)



FDA	Food and Drug Administration (U.S. Government)
GOST	Gosudarstvenii Standart (Russian National Standards Body, similar to US ANSI).
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. <a href="http://www.iec.ch">www.iec.ch</a>
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. In this document, the term “intrinsically safe” is preferentially used because the industrial community is more familiar with this terminology and less familiar with the new terminology developed with the very recent release (August 2006) of IEC 60079-28 Edition 1.0.
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. <a href="http://www.iso.org">www.iso.org</a>
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.
MPE	Maximum Permissible Exposure. This is the minimum irradiance or radiant exposure that may be incident upon the eye (or the skin) without causing biological damage.
MTBF	Mean Time Between Failures. Expressed mathematically, the lapses of time from one failure to the next can be calculated using the sum of operational time divided by the number of failures.
MTTF	Mean Time To Failure. Expectation of the mean time to failure.
MTTFd	Mean Time To Dangerous Failure. Expectation of the mean time to dangerous failure.
PL	Performance Level (PL) describe the targeted level of safety performance for a given system. Standard ISO/EN 13849-1 defines five PL levels a-e.
Safe Detected	Failure that deviates the output toward the safe state failure but is detected by internal diagnostics which cause the output signal to go to the predefined alarm state. This failure rate is expressed as $\lambda_{sd}$
Safe State Failure	A failure of a system component that leads to the triggering into a safe state. A safe state would be considered any situation where the relay contacts switch polarity from the normally functioning state.
Safe Undetected	Failure that deviates the output toward the safe state failure but is undetected by internal diagnostics. This failure rate is expressed as $\lambda_{su}$
SFF	Safe Failure Fraction (SFF) is the probability of the system failing in a safe state. The dangerous (or critical) states are identified from a Failure Mode and Effects Analysis (FMEA). $SFF = (1 - \lambda_{du}) / \lambda_{total}$ where $\lambda_{total} = \lambda_{du} + \lambda_{dd} + \lambda_{su} + \lambda_{sd}$
SIL	Safety Integrity Level (SIL) is a relative level of risk-reduction provided by a safety function, or to specify a target level of risk reduction. Standard IEC 61508 defines four levels SIL 1-4.
Simple	As defined in the EC ATEX Guidelines, simple apparatuses (exclusions to the Directive) are



- Apparatus “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.
- SOP Safe Optical Power. The SOP levels for various apparatus groups/temperature class combinations are provided in Table 2 of IEC 60079-28. By design, the MR310 CW optical output never exceeds the worst case SOP level.
- 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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## APPENDIX B. Cross-Reference of EN versus IEC Standards

The following table provides cross-reference of EN versus IEC standards used in the Declaration of Conformity.

EN	IEC	Title
EN 60079-0:2018	IEC 60079-0:2017, Edition 7.0	Explosive atmospheres - Part 0: Equipment - General requirements
EN 60079-14:2014	IEC 60079-14:2013, Edition 5.0	Explosive atmospheres - Part 14: Electrical installations design, selection and erection
EN 60079-28:2015	IEC 60079-28:2015, Edition 2.0	Explosive atmospheres - Part 28: Protection of equipment and transmission systems using optical radiation
EN 60825-1:2014	IEC 60825-1:2014, Edition 3.0	Safety of laser products - Part 1: Equipment classification and requirements
EN 61000-6-2:2005+AC:2005	IEC 61000-6-2:2005, Edition 2.0	Part 6-2: Generic standards-Immunity standard for industrial environments
EN 61000-6-4:2007+A1:2011	IEC 61000-6-4:2006, Edition 2.0+AMD1:2010+ISH1:2011	Part 6-4: Generic standards-Emission standard for industrial environments
EN 61010-1:2010	IEC 60825-1:2010, Edition 3.0	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements

## APPENDIX C Cross-Reference of GOST versus IEC Standards

The following table provides cross-reference of GOST versus IEC standards used in the EAEU Declaration of Conformity.

GOST	IEC	Title
GOST R IEC 60079-0-2011	IEC 60079-0:2017, Edition 7.0 (More Current Edition)	Explosive atmospheres - Part 0: Equipment - General requirements
GOST IEC 60079-14-2013	IEC 60079-14:2013, Edition 5.0	Explosive atmospheres - Part 14: Electrical installations design, selection and erection
GOST 31610.28-2017	IEC 60079-28:2015, Edition 2.0	Explosive atmospheres - Part 28: Protection of equipment and transmission systems using optical radiation
GOST IEC 60825-1-2013	IEC 60825-1:2014, Edition 3.0 (More Current Edition)	Safety of laser products - Part 1: Equipment classification and requirements
GOST 30804.6.2-2013	IEC 61000-6-2:2005, Edition 2.0	Part 6-2: Generic standards-Immunity standard for industrial environments
GOST 30804.6.4-2013	IEC 61000-6-4:2006, Edition 2.0+AMD1:2010+ISH1:2011	Part 6-4: Generic standards-Emission standard for industrial environments
GOST IEC 61010-1-2014	IEC 61010-1:2010, Edition 3.0	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements