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1 General Information

1.1 Purpose

The Safety Manual contains information for a device (E/E/PE-System) from the manufacture LAMTEC in the scope of functional safety. It provides the necessary information and data for all stages of the safety lifecycle according to IEC 61508:2010 (or DIN EN 61508:2011) and related standards. It helps the user to plan, operate, maintain and dismount the device in safety related appliances.

All given information is addressed to skilled and educated personnel, responsible for the planning, assembly, commissioning, operation, maintenance and dismount of the device. The plant operator is responsible for the correct execution of these operations.

NOTICE

The Safety Manual does not replace the operating and installation manuals of this device. It contains necessary information focussed on the usage of the device in safety functions. For additional manuals check the according product website at www.lamtec.de.

The Safety Manual applies to the following independent flames scanners:

- F300K Compact Flame Scanner

The Safety Manual is valid from device version **SW-V1.3.0.0**.

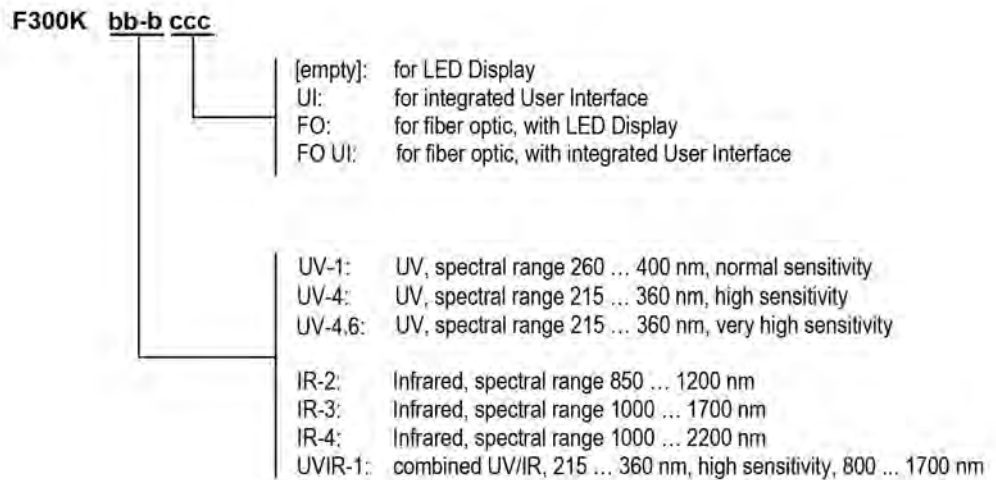
In single-burner and multiple-burner furnaces, the flame detector performs a safety monitoring of the burner flame.

The flame detector is mainly used in large-scale power plants, thermal power stations and chemical plants as well as for monitoring furnaces which are operated from.

- Oil
- Gas
- Bio-mass
- Dust coal
- Chemicals and other waste products

1 General Information

The safety manual is valid from device version HW 1.72, 1.73 for the following model



NOTICE

Due to different sensor materials, the models named have different ambient temperature ranges. The normal working temperature range is -40 °C to +80 °C. See Appendix 7.2 B: Hints and requirements for installation, commissioning, operation, and verification, in which different models are listed.

WARNING!

If the temperature range specified in Appendix 7.2 B: Hints and requirements for installation, commissioning, operation, and verification are not observed, safety integrity is not guaranteed. This can lead to personal injury and property damage.

1.2 Standards and Directives

The basis of test for this device are the following standards and directives:

- DIN EN 298: 2012-11
- DIN EN 13611: 2011-12
- DIN EN 60730-2-5: 2011-03
- DIN EN 60730-1: 2015-10
- DIN EN 60730-1: 2012-10
- DIN EN 61508-2:2011-01, ..., -07
- 2014/35/EU Low Voltage Directive (LVD)
- 2014/30/EU Electromagnetic Compatibility (EMC) Directive
- 2014/68/EU Pressure Equipment Directive Cat.4 Mod. B+D
- EU/2016/426 Gas Appliance Directive

1 General Information

1.3 Classification of the Safety Instructions and Warnings

The following symbols are used in this document to draw the user's attention to important safety information. They are located at points where the information is required. It is essential that the safety information is observed and followed, and that applies particularly to the warnings.



DANGER!

This draws the user's attention to imminent danger. If it is not avoided, it will result in death or very serious injury. The plant including its surroundings could be damaged.



WARNING!

This draws the user's attention to the possibility of imminent danger. If it is not avoided, it may result in death or very serious injury. The plant including its surroundings could be damaged.



CAUTION!

This draws the user's attention to the possibility of imminent danger. If it is not avoided, it may result in minor injuries. The plant including its surroundings could be damaged.

NOTICE

This draws the user's attention to important additional information about the system or system components and offers further tips.

The safety information described above is incorporated into the instructions.

Thus, the operator is requested to:

- 1 Comply with the accident prevention regulations whenever work is being carried out.
- 2 Do everything possible within his control to prevent personal injury and damage to property.

1 General Information

1.4 Terms and Definitions

For further explanations of terms and definitions see IEC 61508-4 (or DIN EN 61508-4).

DC	Diagnostic coverage
DC_{AVG}	Average diagnostic coverage
E/E/PE-System	Electrical/electronic/programmable electronic system
EUC	Equipment under control
FIT	Failure In Time in 10^{-9} 1/h
FMEDA	Failure Mode, Effects, and Diagnostics Analysis
λ_s	Probability of safe failure (detected and undetected)
λ_d	Probability of dangerous failure
λ_{dd}	Probability of dangerous detected failure
λ_{du}	Probability of dangerous undetected failure
$\lambda_{\text{no effect, } \lambda_{\text{don't care}}}$	Probability of failures with no effect (not used in SFF calculation)
HFT	Hardware fault tolerance
MooN	M out of N channel architecture
MTBF	Mean time between failures
MTTR	Mean time to repair
MTTF	Mean time to failure
PDF	Probability of dangerous failure on demand (Low Demand mode)
PDF_{AVG}	Average probability of dangerous failure on demand
PFH	Average frequency of a dangerous failure per hour (Continuous mode)
PTC	Proof Test Coverage, proportion of detectable unsafe failures
SFF	Safe failure fraction
SIF	Safety instrumented function
SIS	Safety instrumented system
SIL	Safety integrity level
SIL AC	Safety integrity level architectural constraint
SC	Systematic Capability
T₁	Proof test interval
T₂	Diagnostic test interval

2 General Safety Instructions

2 General Safety Instructions

2.1 Intended Use

The device is developed and approved for appropriate and intended use. If the device is used improperly, the protection of personnel and plant is not ensured.

The corresponding manuals or chapters for each particular stage of the product life cycle must be regarded in addition to this Safety Manual see chapter *1.1 Purpose*. Ignoring these instructions will void any warranty and absolve the manufacturer from any liability.

2.2 Safety Functions

The independent compact flame scanner F300K is suitable for flame detection of burners and combustion systems for gaseous, liquid or solid fuels with permanent operation.



WARNING!

The type approval lapses in the event of modifications to the unit. The unit's inputs and outputs must be wired according to the specifications in the instruction manual only.



DANGER!

The appendix Hints and requirements for installation, commissioning, operation and verification" must be considered properly.

2.3 Safe State

The safe state is achieved when the flame signal contact is opened (Flame OFF) and in a de-energized condition.

2.4 Scope of Application

The F300K flame scanner fulfil

- the technical requirements of **DIN EN 61508:2011**, parts 1-7 for **SIL 3**.
- the requirements to be used as single device for SIF according to **DIN EN 61511-1:2005-05** up to **SIL 3**.
- the requirements to be used as single device for safety related control functions (SRCF) according to **EN ISO 13849-1:2016** up to performance level **PL e** (CAT. 3) and
- the applicable requirements of **DIN EN 746-2:2011-02** for flame detection in industrial thermo processing equipment.
- the applicable requirements of **DIN EN 50156-1:2005-03**, clauss 10.5.

2.5 Additional Components

The safety parameters do not include external components such as burner controls or any other sensors and actors.

2 General Safety Instructions

2.6 Safety Values

The safety values have been determined by the use of a FMEDA with the following basic conditions:

- Component failure rates based on Siemens standard SN 29500, DIN EN 13611: 2011-12 and B10d values of manufactures where no other values are available.
- Specific load parameters, quality factors and an ambient temperature of 60 °C have been used for the calculation.
- Failure models from DIN EN 13611 and additionally failure model drift have been used. Under special circumstances short circuits have not to be assumed.
- Estimation of common cause factors $\beta = 2\%$ $\beta_D = 1\%$.
- The "Proof test interval" T_1 is equivalent to the product mission or life time.
- The calculation of the safety probability values has been done with a lifetime of 10 years¹.
- A diagnostic test interval of $T_2 = 120s$ is defined.
- For redundant subsystems ($HFT \geq 1$) the SFF is $> 90\%$, for subsystems without redundancy ($HFT=0$) the SFF is $> 99\%$
- The F300K is designed as one safety unit (PES). There is no separation within the F300K electronic between safety and non safety related components by architectural design.
- There is no difference between λ_S detected and undetected. All safe failures can be assumed as safe undetected (λ_{SU}).

¹ See chapter 2.7 *Life time* for more information.

2 General Safety Instructions

	F300K IR-...	F300K UV-...	F300K UVIR-...
Device type	Type B (complex component)		
Mode of operation	High demand or continuous mode		
Safety function	De-energized flame contact (safety valves)		
HFT ²	0		
SIL (SC)	3		
λ_s (λ_{su})	2,75E+02 FIT	2,61E+02 FIT	2,43E+02 FIT
λ_{dd}	2,49E+02 FIT	2,20E+02 FIT	2,60E+02 FIT
λ_{du}	3,80E+00 FIT	3,50E+00 FIT	4,20E+00 FIT
$\lambda_{no\ effect}$: $\lambda_{don't\ care}$	2,46E+03 FIT	2,45E+03 FIT	2,55E+03 FIT
SFF ³	99,2 %	99,2 %	99,1 %
DC _{AVG}	98,4 %	98,4 %	98,3 %
PFH	2,6E-09 1/h	2,3E-09 1/h	2,7E-09 1/h
PFD _{AVG}	3,1E-05	1,7E-05	3,3E-05
T1	10 years		
T2	1 hour		
MTTF	38 years	39 years	37 years
MTTR ⁴	8 hours		
MTBF	38 years	39 years	37 years

² According to DIN EN 61508:2011 HFT > 0 requires complete redundancy, including sensors, actors and power supplies. Nevertheless, a HFT=0 device may reach the safety integrity for the usage in SIL3 safety functions according to DIN EN 61508 or DIN EN 61511 (see 2.4 Scope of Application).

³ SFF is relevant for elements, subsystems or systems in a complete safety loop. This device is always part of a complete safety loop. A SIL calculation of a safety loop must be evaluated finally with the safe failure fraction of elements, subsystems and the complete system. Nevertheless, the SFF of the device is given in this document for reference.

⁴ The MTTR is assumed with 8h for the calculation of PFD/PFH (exchange of the device). In practise, the devices will be locked in the safe state until it is replaced.

2.7 Life time

The mission time or life time of the device is 10 years.

In accordance with the DIN EN 61508 the life time is 8 to 12 years under normal operating conditions, because electronic components are assumed to have a constant failure rate λ through this period. After that period the failure rates of the components will increase significantly with time (see "bathtub curve" for electronic components).

The life time of 10 years does not mean, that the device will become unsafe after this time immediately. The extensive diagnosis of safety related components remains still active. DIN EN 61508-2:2011 Note N3 gives the hint, that appropriate measures taken by the manufacturer and plant operator can extend the useful lifetime.

The burner control is designed for 250.000 switching cycles with nominal switch loads. For normal operation this is equal to 10 years of operation⁵. For industrial use with reduced loads and a lower ambient temperature more switching cycles are possible.

Nevertheless, when the device stays in operation after the end of the life time, LAMTEC does not guarantees the proper function and all calculated safety values become invalid.

⁵ Base on the switching cycles and the corresponding lifetime are EN 13611, DIN EN 298 and an overview from the European Control Manufacturers Association (Afecor, www.afecor.org)

3 Installation and Commissioning

For installing the device, check the instruction and installation manuals as well as valid norms, standards and directives for the application (see also chapter 1.2 *Standards and Directives*).

WARNING!

Connect the device only to other components or devices which are suitable for this safety application.

WARNING!

The Appendix see chapter 7.2 B: *Hints and requirements for installation, commissioning, operation and verification* shall be considered properly. Check the installation requirements of IP40 or IP54 for use outdoors (EN 60529).

WARNING!

Supply voltage

The device's supply voltage may only be generated by means of a safety power supply unit of a different make from the one described in the accessories if safety extra-low voltage is used (e.g. to EN 61558-2-6 "Safety of transformers" or EN 60950-1 "Information technology equipment - Safety").

WARNING!

"Flame signal" and "ready" relay contact outputs

The potential-free contact connections of the device's relays may only be wired with safety extra-low voltage in accordance with the requirements for supply voltage.

WARNING!

"Mode selector" digital inputs

The digital inputs are controlled only via potential-free contacts in accordance with the requirements for supply voltage.

WARNING!

Communication interfaces

The equipment of other manufacturers connected to the communication interfaces must meet the requirements of DIN EN 60950-1 "Information technology equipment - Safety".

WARNING!

Analogue output current loop - Protection against electric shock

Measuring circuits must be separated safely to dangerous active parts according to EN 61140 "Protection against electric shock ...".

- ▶ You achieve this by double or reinforced isolation according to EN 61010-1 "Safety requirements for electrical equipment for measurement, control and laboratory use".

3 Installation and Commissioning



WARNING!

Radio interference suppression of the output contacts

In the interests of safety, ensure when installing the output contacts that:

- ▶ The user suppresses radio interference in such a way that the contacts of the safety relay contact output cannot be shorted by defective components of the suppressor circuitry.

NOTICE

The cables are designed for a certain temperature range.

NOTICE

For the commissioning of the F300K please refer to the manual (Chapter 7).

3.1 Verification

Check the safety functions to ensure the expected operation of the device before using it in a safety related environment.



DANGER!

Appendix "7.2 B: Conditions" shall be taken into account in an appropriate way.

NOTICE

Checking the Flame Shut-down on Fault:

Simulate a flame rupture or flame extinction by shunting off the fuel supply to the burner to be monitored by the flame detector. Check that the signal for shutting-off the safety valve is triggered off within the period of $TS < 1$ s (on safety period 'Operation' at $tVOff = 1$ s) after extinction of the flame.

'Red' LED lights
'Green' LED dark

For the IR compact flame detectors of the F300K IR-.. and/or even when using the IR sensor of the F300K UVIR-.. types, take into account the radiation effects characteristic of the combustion chamber. Consequently, switch-off tests should be carried out when the boiler has reached operating temperature. In particular, make sure that the sensitivity of the compact flame detector is increased only to such a value required to safely and reliably monitor the flame throughout the operating range of the burner.

4 Operation

During operation the device must not be deactivated or bypassed. The operator must be familiar with the displayed information of the device and the measures to be executed in the moment of any signalized disturbance. The information in the instruction manual must be regarded.

Only suitable elements and devices must be connected, also for the commission of the device (see chapter 2.5 *Additional Components*).

 **WARNING!**

Safe failures should be corrected and must be reported to LAMTEC as soon as possible.

 **DANGER!**

Danger to life and material: Do not put the safety loop out of service

4.1 Proof Test

The "Proof test interval" T_1 is equivalent to the product's mission or life time. There are no components or elements used that can be set into an "as new condition" by a proof test of the device. For electronic components, the "as new condition" would mean to set the electronic components back to the beginning of the constant period of the "bathtub curve", which is not possible.

Nevertheless, it is recommended to validate the safety functions once a year to ensure the proper operation of the device.

5 Repair and Maintenance



WARNING!

The device must not be repaired, modified or manipulated. Otherwise the safety integrity can be lost and LAMTEC will not guarantee for the proper operation any more.

NOTICE

Defects and failures must be reported to LAMTEC as soon as possible, including type, version and serial number of the device.

In case of a repair or maintenance, comply with instructions from the installation manual. Defective devices must be sent to LAMTEC for a repair. The safe operation of the application must be ensured while the device is being repaired or a maintenance is ongoing. After a repair or a maintenance, follow chapter 3 *Installation and Commissioning* again.



WARNING!

Replace the device only by one of the same type and version and check the corresponding data and parameter set.



DANGER!

The flame detector is a safety device. Any repair work or other changes to the device shall only be carried out by the manufacturer's specialist staff or by some other persons appointed by the manufacturer. Any other persons are not allowed to operate on parts inside the device. In particular, this concerns the unauthorized exchange of the flame contact fuse. Any unauthorized replacement, repair or modification of the device can lead to a loss of the safety integrity.

6 Decommission and Dismount

To put the device out of service, comply with instructions from the installation manual and ensure the safe operation of the application after that. The device should be replaced after the product's mission or life time (see chapter 2.7 *Life time*).

The device must be disposed properly. This device is designed for industrial usage and must be disposed accordingly.

7 Appendix

7.1 A: TÜV Confirmation

electronic copy



CONFIRMATION

on the examination of an independent flame detector device according to DIN EN 298 and DIN EN 61508-2

Test Laboratory TÜV SÜD Industrie Service GmbH
Abteilung Feuerungs- und Wärmetechnik
Prüfbereich Sicherheits-, Kontroll- und Regeleinrichtungen

Subject of Test Type: F300K
Models: F300K
F300K /FO
F300K UI,
F300K UI /FO

Ordering Company LAMTEC Leipzig GmbH & Co. KG
D-04425 Taucha

Product description Independent flame detector device

Basis of Test DIN EN 61508-2:2011-02
DIN EN 298:2012-11

Test Reports no. C-F 1469-06/18 dated 2018-03-12

The results in detail, the evaluation of the results and the conclusions out of the results are described in the above mentioned test reports. Excerpts from these test reports and from the test documentation are printed on the reverse.

Feuerungs- und Wärmetechnik

[Handwritten signature]

Johannes Steiglechner

Date: 2018-03-12
Our reference: IS-TAF-MUC/ku
Order no. 2783406
Document: CF14690618_BST.docx
Page 1
The document consists of 2 pages
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The test results refer exclusively to the units under test.



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page 2 / 2
 Our reference, date, identification: IS-TAF-MUC/ku, 2018-03-12
 Order no. 2783406
 CF14690618_BST.docx



Product description Independent flame detector device

Type designation **F300K**

Models F300K ...-...
 F300K ...-... /FO
 F300K ...-... UI,
 F300K ...-... UI /FO

The independent flame detector device conforms to the requirements of DIN EN 298:2012-11 and is suitable for flame detection of burners and combustion systems for gaseous, liquid or solid fuels (e.g. wood, coal dust, etc.) with permanent operation.

As a single device, the independent flame detector device conforms to the requirements of DIN EN 61508:2011-02 parts 1-7 for safety functions up to safety integrity level **SIL 3**.
 The following safety parameters have been determined:

	Model	F300K IR-...	F300K UV-...	F300K UVIR-...
Probability of a dangerous failure per hour (high demand / continuous mode)	PFH_D	2,6·10⁻⁹ 1/h	2,3·10⁻⁹ 1/h	2,7·10⁻⁹ 1/h
Probability of a dangerous failure on demand (low demand mode)	PFD_{AVG}	3,1·10⁻⁵	1,7·10⁻⁵	3,3·10⁻⁵
Safe failure fraction	SFF	99,2 %	99,2 %	99,1 %
Average diagnostic coverage	DC_{AVG}	98,4 %	98,4 %	98,3 %

These parameters have been calculated under the assumption of a Diagnostic Test Interval **T₂ = 1 hour** and of a Proof Test Interval **T₁ = 10 years**, which is equivalent to the specified life time of the independent flame detector device, and of a mean time to restoration **MTTR = 8 hours**. These safety parameters do not include other external components of the independent flame detector device.

The independent flame detector device also conforms to the requirements of DIN EN 50156-2:2016-03 and of DIN EN 50156-1:2016-03, clause 10.5.5, for shut-down of the entire fuel supply of burners and combustion systems with permanent operation up to **SIL 3**.

The independent flame detector device is capable to be used as a single device for safety instrumented functions (SIF) according to DIN EN 61511-1 up to safety integrity level **SIL 3**.

According to DIN EN ISO 13849-1:2016-06, table 3, the independent flame detector device is capable to be used as a single device for safety related control functions (SRCF) up to performance level **PL e**.

The independent flame detector device also fulfils the applicable requirements of DIN EN 746-2 for flame detection in industrial thermoprocessing equipment.

The conditions in clause 17 of test report no. C-F 1469-06/18 dated 2018-03-12 shall be considered during incorporation, adjustment, operation and maintenance.

7.2 B: Hints and requirements for installation, commissioning, operation and verification

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Our reference / date: IS-TAF-MUC/ku, 2018-03-12
Document: CF14690618_BE.docx
Report no. C-F 1469-06/18



The independent flame detector device also conforms to the applicable requirements of DIN EN 746-2 for flame detection in industrial thermoprocessing equipment.

17 Conditions

- 17.1 After installation, the degree of protection for the independent flame detector device and – if applicable – its power supply type FN20 shall be a minimum of IP 40 – or IP 54 for use in the open air – according to EN 60529.
- 17.2 For models **F300K UVIR-1...** the adjustment of the UV/IR flame signal weight parameter *ubP_UvAnteil* shall ensure safe flame detection in any operating mode of the burner or combustion system.
- 17.3 Models **F300K...IR-...FO...** shall only be used with a LAMTEC IR fibre optic assembly type **FOR...-IR** or **FOF...-IR**, which include an optical filter in the process optics suppressing spectral components below 850 nm resp. 1000 nm.
- 17.4 Adequate information for incorporation, adjustment, operation and maintenance of the independent flame detector device shall be included into the instructions for installation, servicing and use of the burner or combustion system in an official language of the country in which it is to be used.
- 17.5 If necessary, possible hazards resulting from external fire, or from traffic, wind and earthquake loading shall be examined separately depending from the installation situation of the pressure equipment.

TÜV SÜD Industrie Service GmbH
Notifizierte Stelle für Druckgeräte 0036 nach Richtlinie 2014/68/EU
Prüfstelle

Feuerungs- und Wärmetechnik

Handwritten signature of Johannes Steiglechner in blue ink.

Johannes Steiglechner
Leiter
Feuerungs- und Wärmetechnik

Der Sachbearbeiter

Handwritten signature of Dipl.-Ing. Klaus Kurth in blue ink.

Dipl.-Ing. Klaus Kurth

8 Declaration of Conformity



EU-Konformitätserklärung

EU Declaration of Conformity
Déclaration de Conformité UE

Wir
We / Nous

LAMTEC Leipzig GmbH & Co. KG
Am Obstgut 24
D-04425 Taucha

erklären,
dass das Produkt
declare that product /
déclarons que produit

F300K

inklusive
inclusive / y compris

Varianten
variants / variantes
F300K... / F300K...UI

659A50 – XX X X X X X

Zusatzmodule
additional modules
modules complémentaires

FN20 - 230VAC / 115VAC
FN30-20 - 230VAC / 115VAC
FB30

659R6010 /XX
659M04XX
659M21XX

auf welche sich diese Erklärung bezieht, mit den folgenden Norm(en) übereinstimmt
to which this declaration relates conforms to the following standard(s)
sur laquelle cette déclaration se réfère, et conformément aux dispositions de la norme(s)

DIN EN 298: 2012-11
DIN EN 60730-2-5: 2015-10
DIN EN 60730-1: 2012-10

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print 1604/16



gemäß den Bestimmungen der folgenden Richtlinie(n).

according to the provisions of the following directive(s) / conformément aux dispositions de la directive(s)

Nummer (Number / Numéro)	Text (Text / Texte)
2014/35/EU 2014/35/EU/ 2014/35/UE	Niederspannungsrichtlinie Low Voltage Directive Directive basse tension
2014/30/EU 2014/30/EU 2014/30/UE	EMV-Richtlinie EMC Directive Directive CEM
2014/68/EU 2014/68/EU 2014/68/UE	Druckgeräterichtlinie Kat. 4 Mod. B+D Pressure Equipment Directive cat. 4 mod. B+D Directive équipements sous pression cat. 4 mod. B+D
(EU) 2016/426 (EU) 2016/142 (UE) 2016/142	Gasgeräte Verordnung (GAR) Gas Appliances Regulation Règlement appareils à gaz
2011/65/EU 2011/65/EU 2011/65/UE	RoHS RoHS RoHS

Das Datenblatt und gegebenenfalls die Basisdokumentation sind zu beachten.

The data sheet and basic documentation, if any, have to be considered.

La consultation de la fiche technique, et éventuellement de la documentation technique de base, est requise.

Hinweise zur Anwendung der Richtlinie 2014/35/EU und 2014/30/EU:

Die Konformität mit (EU) 2016/426 setzt die Übereinstimmung mit 2014/35/EU voraus und beinhaltet diese. Die Konformität mit 2014/30/EU ist nach Einbau des Bauteils in das Endgerät nachzuweisen und zu erklären.

Remarks regarding the application of directive 2014/35/EU and 2014/30/EU:

Conformity with (EU) 2016/142 presupposes that requirements of 2014/35/EU are fulfilled and includes these. Conformity with 2014/30/EU has to be proved and declared after installation of the component.

Remarques sur l'application des directives 2014/35/UE et 2014/30/UE:

La conformité avec la (UE) 2016/142 intègre la conformité avec la 2014/35/UE. La conformité avec la 2014/30/UE après l'installation de l'appareil est à prouver et à déclarer.

Rechtsverbindliche Unterschrift

Authorized signature / Signature autorisée

Taucha, 21.04.2018

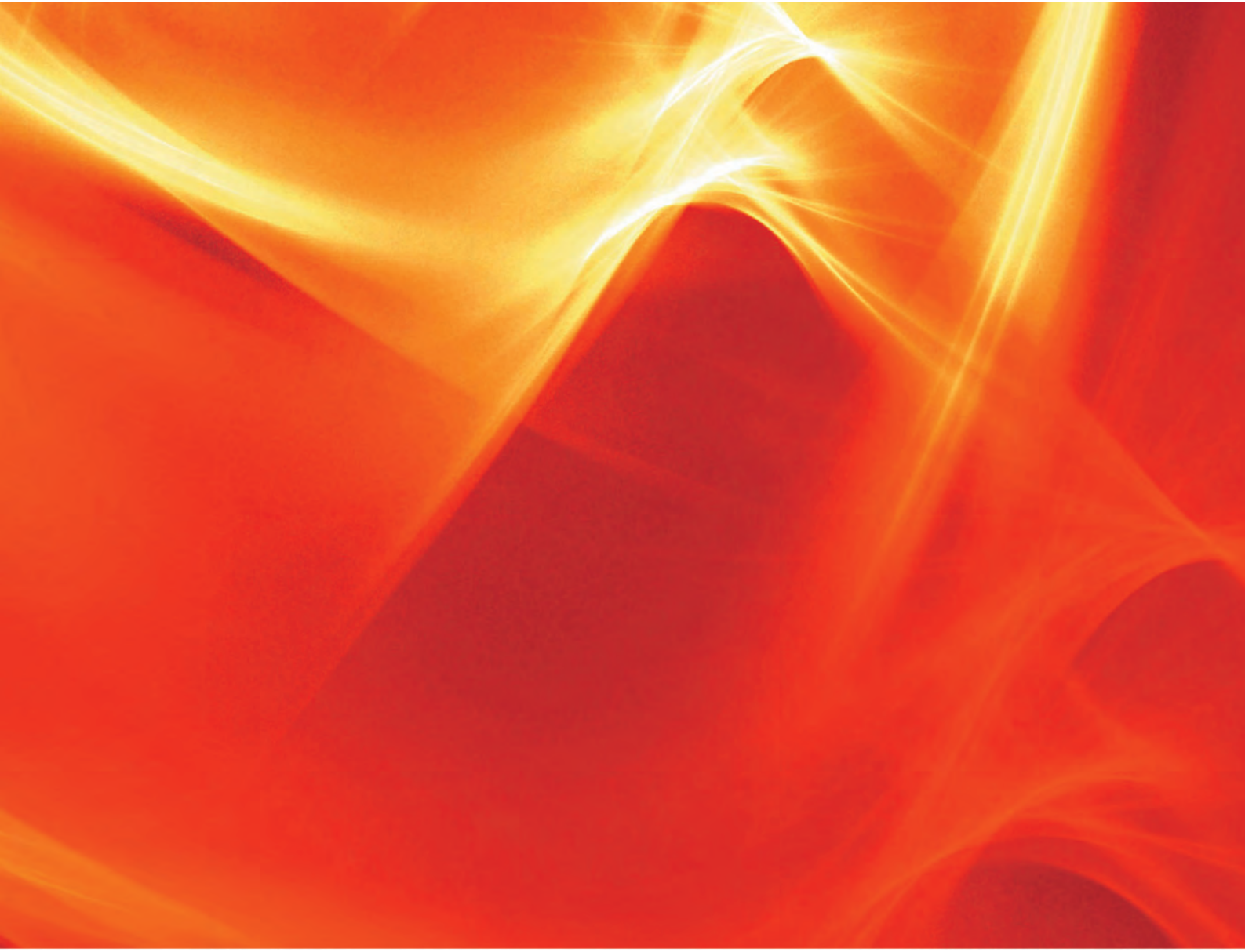
Olaf Winne, General Manager

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print 1604/16



The information in this publication is subject to technical changes.



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