

SIEMENS



Cerberus® DOT1151A-Ex Neural smoke detector, interactive, intrinsically safe

Technical description

Fire & Security Products

Siemens Building Technologies Group

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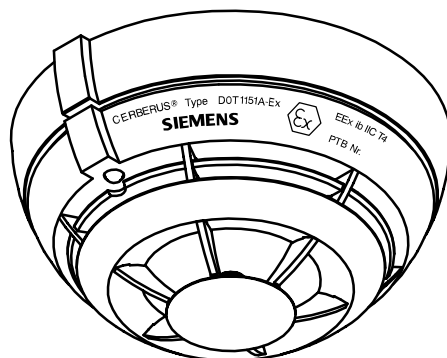
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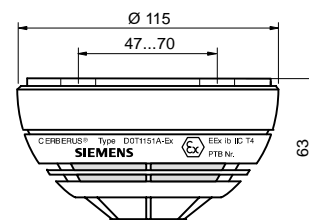
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1 Overview



Dimensions



incl. base DB1151A

1.1 Characteristics

- **For application in explosion-hazard areas of zones 1 and 2**
- **Homogenous response behavior across a wide application spectrum**
through freely programmable percentages of smoke and heat
- **Efficient signal processing algorithms with downloadable, application specific characteristics**
for optimum detection reliability
- **High-quality sensor system with temperature compensation**
functions reliably also under critical environmental conditions
- **High contamination resistance**
through appropriate design of the measurement chamber, the protective grille and automatic, continuous digital compensation
- **Comprehensive EMC concept based on the latest technology**
allows installation also in difficult environments
- **Integrated multiple coincidence circuit**
suppresses extreme electrical and optical interference signals
- **State-of-the-art, microprocessor-controlled electronics**
- **Transmission of 4 different danger levels and function states each**
- **Automatic, comprehensive self-test**

1.2 Design

The PolyRex detector DOT1151A-Ex is installed in a modern, attractive, impact-resistant plastic housing that fits unobtrusively into any room architecture. The detector is secured in the DB1151A base with a vibration-proof bayonet fitting. Except for the identification module that defines the installation location at the time the system is commissioned, the base does not contain any electronic components.

The detector is equipped with a response indicator (red LED) to indicate alarm. Activated from the control unit, the response indicator can also be programmed to provide information for servicing purposes. Each detector is equipped with an output for connecting an external response indicator. This indicator is normally assigned to the connected detector but it can also be assigned programmatically to any detector within the same object.

The detector is fully electronic and has no wearing parts. As protection against environmental influences the electronic circuitry is shielded and the circuit board is coated with a special protective varnish. For periodic factory overhaul the protective hood and grille can be removed.

In explosion-hazard rooms the DB1151A detector base is mounted on the ceiling direct by means of the recess box, or surface-mounted together with the DBZ1191 base attachment and connected to the control unit with twin wire via a shunt Zener diode barrier and possibly other devices. The base has spring terminals for connection.

Efficient installation, removal and testing of a detector is possible by means of the DZ1191 detector extractor and the RE6 testing unit. If an extension tube is used, work up to a ceiling height of 7m can be performed without any further tools. A comprehensive range of base accessories is available for special applications such as installation in humid environments, protection against unauthorized removal, etc.



IMPORTANT!

The DZ1193 optoelectronic detector tester and exchanger and the RE6T heat detector tester may not be used in explosion-hazard areas!

2 Technical data

Normal ambient conditions, if nothing else is specified:

Temperature $T_a = 20^\circ\text{C}$ (293K)

Air pressure: $p = 1'000\text{hPa}$ (750 Torr)

| Parameters | Symbol | Value | | | Conditions | |
|--|--------------|----------------------------------|----------|-----------|------------------------|--|
| | | Unit | min. | typ. | | max. |
| Operating voltage | U_b | V | 18.5 | | 28 | modulated |
| Operating current (quiescent condition) | I_b | μA | | 300 | ≤ 350 | |
| Capacity | | | | | | |
| Detection line | C | nF | | | 1 | |
| Response indicator line | C | nF | | | ≤ 33 | |
| Inductance | | | | | | |
| Detection line | L | mH | | | – | |
| Response indicator line | L | μH | | | ≤ 40 | |
| Baud rate | | kBd | | 4.8 | | |
| Response sensitivity (software setting dependent on algorithms) | D_1 | %/m | 1.3 | | 6.6 | smoke sensitivity with paraffin test aerosol |
| Compensation | | Voltage increase for detection | | | 2 | |
| Compensation speed | | Voltage increase for detection/h | | | 1 / 64 | |
| Self test interval | | min. | | 15 | | |
| Response indicator: Flashing interval times: bright dark | | ms s | | 20 1.5 | | depending on control unit |
| Response indicator current | | mA | | 9 | | |
| Elektromagnetic compatibility | E E | V/m V/m | 50 30 | | | 1MHz...1GHz 1GHz...2GHz |
| Operating temperature | T_a | $^\circ\text{C}$ | –25 | | +70 | |
| Humidity $\leq 34^\circ\text{C}$ $> 34^\circ\text{C}$ | rF abs. F | % g/M^3 | | | ≤ 95 ≤ 35 | |
| Storage temperature | T_I | $^\circ\text{C}$ | –30 | | +75 | |
| Connection factor for interactive elements | IMK | | | 1 | | |

Colour: white –RAL9010

Classification

Standards EN 54-7
 Application category IEC 721-3: 3K8H
 Ex classification EEx ib IIC T4 (–25 $^\circ\text{C} \leq T_a \leq 70^\circ\text{C}$)
 Test category IEC 68-1: 25/070/42
 Protection category EN60529 / IEC529: IP44

Standards for explosion-hazard areas:

EN50014
EN50020

Ex approval DOT1151A-Ex:

PTB Nr. Ex-99.E.2154

Environmental compatibility:




- Easy to uninstall and disassemble
- Halogen-free plastic material identifiable through embossed code

Intrinsic safety:

Intrinsic safety «i» when using a certified shunt Zener diode barrier with the following data:

| | | |
|-------|--------|--------------|
| R_i | \geq | 280 Ω |
| U_i | \leq | 28V |
| I_i | \leq | 100mA |
| P_i | \leq | 700mW |

2.1 Algo-Parameter sets for DOT1151A-Ex

| Parameter set | Operating state | AlgoRex smoke sensitivity index (1) | | Response time when testing with test gas (~seconds) |
|--|---|-------------------------------------|---------------------------------|---|
| | | Without temperature influence | With full temperature influence | |
| APS083S  2) 3) | present | for danger level 3 with smoke | 3.5 | 60 |
| | absent | 1.3 | | |
| | special | no response to smoke | (only temperature actuation) | |
| APS005S (Default) | present | 1 | 2 | 110 |
| | absent | | | |
| | special | no response to smoke | (only temperature actuation) | |
| APS082S | for China only: Similar as APS005S, but thermal behaviour changed according to chinese standards. | | | |
| APS015S | present | 1 | 2 | 85 |
| | absent | | | |
| | special | no response to smoke | (only temperature actuation) | |
| APS006S | present | 1 | 2.5 | 60 |
| | absent | | | 40 |
| | special | no response to smoke | (only temperature actuation) | |
| APS085S | present | 1.4 | 4.3 | 75 |
| | absent | | | 45 |
| | special | no response to smoke | (only temperature actuation) | |
| APS084S  2) 3) | present | 1.5 | 2 | 240 |
| | absent | | | |
| | special | no response to smoke | (only temperature actuation) | |
| APS009S | present | 2 | 4 | 110 |
| | absent | | | |
| | special | no response to smoke | (only temperature actuation) | |
| APS019S | present | 2 | 4 | 85 |
| | absent | | | |
| | special | no response to smoke | (only temperature actuation) | |
| APS007S | present | 2 | 5 | 60 |
| | absent | | | 40 |
| | special | no response to smoke | (only temperature actuation) | |
| APS081S | present | 4 | 8 * | 60 |
| | absent | | | 30 |
| | special | no response to smoke | (only temperature actuation) | |
| APS080SH  1) 2) | present | 5.5 | 12 | 15 |
| | absent | | | |
| | special | no response to smoke | (only temperature actuation) | |
| Test mode | present | 2 | 5 | 5 |
| | absent | | | |

With the exception of test mode, the parameter sets listed here are arranged in order of sensitivity (APS080SH is the most sensitive).

* **Comment:** Slightly corrected values compared to those noted in the help of AlgoWorks EP5 (SR1) update 2.

Note: all values are approximative !

Smoke sensitivity: To simplify the comparison of smoke sensitivities between the parameter sets, we are specifying an AlgoRex smoke sensitivity index for danger level 3. Please note, that this index is a relative figure, where "2" means an increased sensitivity by a factor of 2 (compared to the parameter set with index "1"); therefore the detector will alarm at half the smoke density if measured in the CEN smoke tunnel acc. to EN54. An AlgoRex smoke sens. Index of "0" means "no alarm with smoke only".



Important: The parameter sets APS083S, APS084S and APS080SH must **only** be applied **for special applications!**

APS080: Caution, low security against false alarm! Parameter set with very high sensitivity and extreme fast reaction time.

APS083: In mode "present", detection of smoke without temperature rise will not lead to a danger level 3. This behaviour is outside the standard EN54-7; in mode "absent", EN54-7 is fulfilled.

APS084: This parameter set prevents nuisance alarms due to short and single nuisance signals. Long or multiple events may lead to danger level 3.

1) The detector DOT1151-Ex with APS080SH can have a slightly lower electromagnetic compatibility (APS081S passed EMC tests in the meantime).

2) Not available for temporary change of detector parameter set on CT/CI due to further risks in application.

3) IMPORTANT NOTE regarding APS083 and APS084 (see info MI290):

Unfortunately there has been a mistaken parameter value in detector DOT1151A Index "ke"; however, this mistake only affects behaviour in parameter sets 083/084. As a result, the detector may not be able to go into alarm on reasonable smoke density!

--> You must never choose APS083 or APS084 with a detector DOT1151A with Index "ke"!

As a simple rule of thumb, only use APS083 or APS084 with detectors DOT115x with Technical Index "_f" or later.

Detectors DOT1151A-Ex are **not** concerned by this fault.

The Index is shown on the detector label as two letters following the part number (e.g. DOT1151A: "P/N 486695 ke"); first letter means "Schematic Index", second letter means "Technical Index". Both are in alphabetical order.

3 Design

The heart of the PolyRex detectors DOT1151-Ex is a high-quality opto electronic measurement chamber that screens off extraneous light but optimally detects light-colored and dark smoke particles. The light source, the light stop and the light receiver are arranged in such a way that the light from the source cannot directly reach the receiver (Fig. 1 and Fig. 2). Only when smoke particles are present in the optical path does some of the scattered light reach the receiver and produce an optical signal.

The temperature sensor (NTC) is located in the detector dome.

Due to its optimized optical system, the temperature sensor installed in a protective jacket, shielded electronics and special circuit board coating this detectors are highly immune to environmental influences such as temperature, humidity, corrosion and electrical interference fields.

Intrinsically safe detectors are marked with the model number and the Ex label.

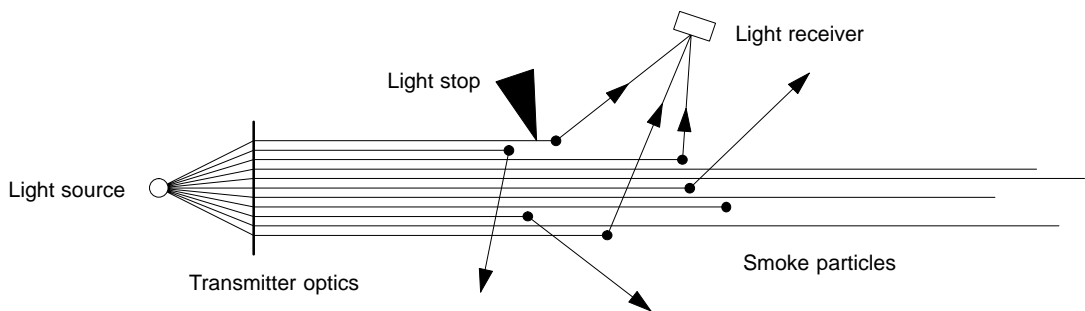


Fig. 1 Principle of the scattered light measurement

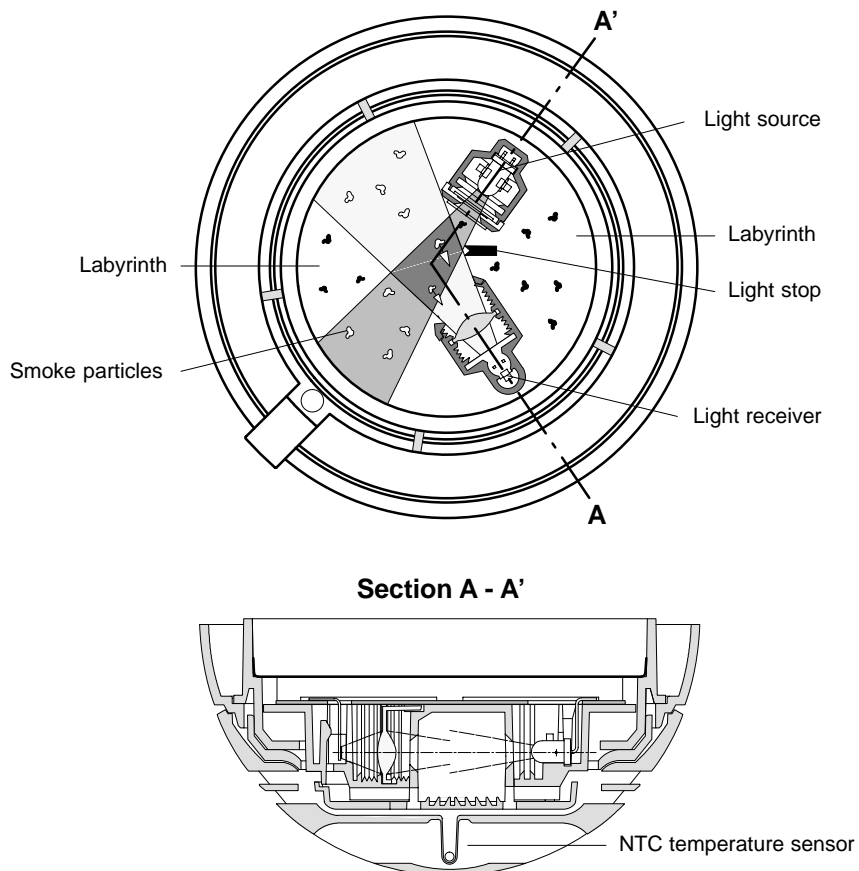


Fig. 2 Detector design

4 Principle of operation (see block diagram Fig. 3)

The PolyRex detector DOT1151-Ex measures the smoke density as well as the ambient air temperature. The temperature sensor signal can be evaluated either differentially and/or absolute. The smoke sensor is based on the principle of light scatter. An infrared LED (IRED) transmits brief, intensive light pulses into the scattering chamber. The receiving element «sees» the scattering chamber but not the transmitter. The smoke that has penetrated into the chamber scatters the light beam produced by the transmitter. As a result some of the light reaches the receiver. The generated receiver signal is processed by the electronic circuitry.

The microprocessor (μP) **1** controls the various measurement and test sequences, performs the signal processing, and classifies the events into different danger levels and function states. Also the communication with the control unit is controlled by the μP . Numerous detector characteristics are stored in the non-volatile μP memory (255 Byte EEPROM). These can be read out and modified at any time by authorized specialists. The content of the non-volatile memory is checked automatically in intervals of approx. 15 minutes.

The sensor specific functions are implemented in the application-specific integrated circuit (ASIC) **2**. Centrally located is the sequence control **3**. It produces, among other functions, a current pulse in light transmitter **13** which is monitored by the μP . The light receiver **12** produces a signal current if smoke penetrates into the sensor chamber.

This current is amplified and integrated in integrator **4**. The multiple coincidence filter **5** very selectively passes only signals of the correct frequency and phasing (interference signal suppression). The sample/hold stage **6** further amplifies the signal and stabilizes it until the μP has read the value. The Level Check unit **7** monitors the signals for possible over-amplification. Gain Control **8** is used for coarse alignment of the detector and the sensitivity setting. On request the test unit **9** transmits a test signal to the receiver input so that the overall gain of the signal path can be monitored (part of the self-test).

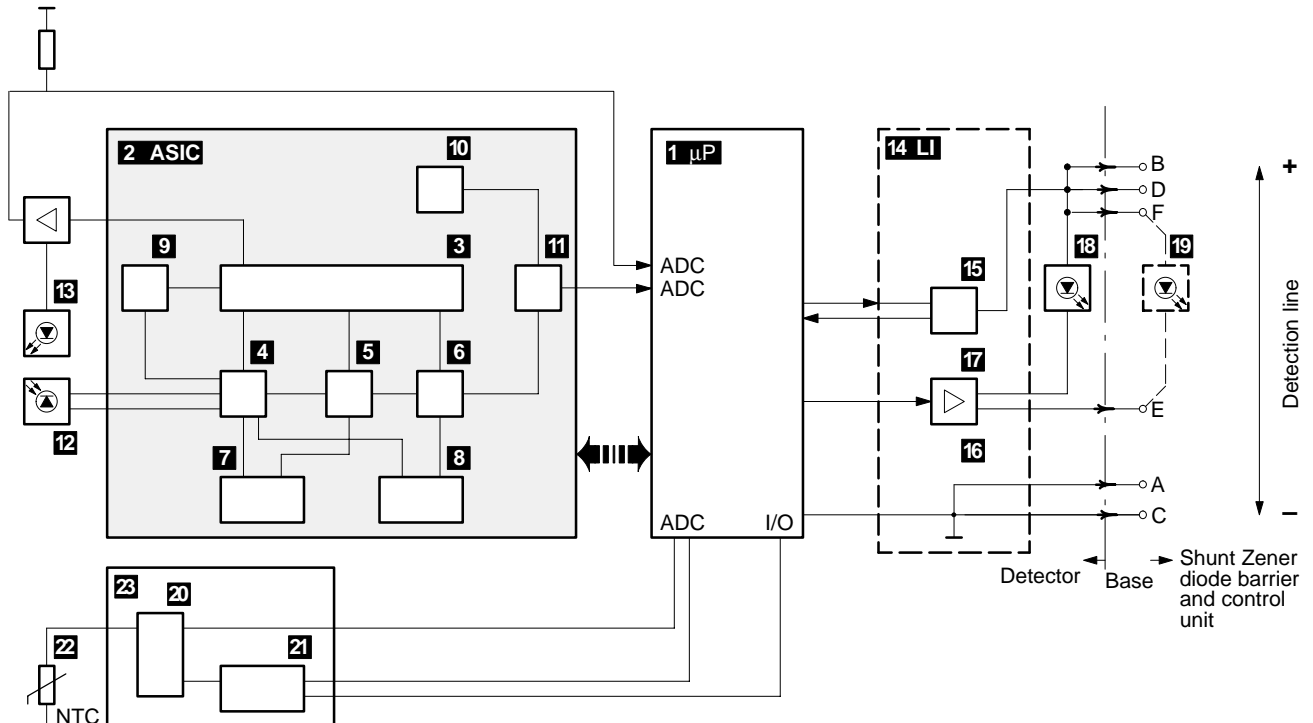


Fig. 3 Block diagram DOT1151-Ex

All circuits are adapted to the standards for explosion-hazard areas.

The temperature drift of the optical module is compensated by temperature sensor **10** integrated in the ASIC. By means of the multiplexer (MUX) **11** the μP **1** detects either the smoke density or the temperature.

The external NTC temperature sensor **22** is controlled by circuit element **23**. It contains circuit **21**, which produces the bias voltage for this NTC and is simultaneously controlled and monitored by the μ P. The signal from the NTC temperature sensor is taken via the filter **20** to the A/C converter of the μ P. This filter reduces electromagnetic interference and protects the circuit against electrostatic discharges (ESD)

The μ P **1** communicates via the line interface **14** and the two-wire bus with the control unit. Through the data interface **15** the detector receives commands that activate the operating modes, initiate diagnostic steps, etc. Response signals, results from diagnostic inquiries, and status signals are transmitted by the detector back to the control unit.

To prevent total bus failure in the event of a short circuit, DOT1152 disconnecter detectors can be installed which «isolate» defective sections. In the DOT1152 disconnecter detector two «electronic switches» (FET) **16** open automatically in the event of a short circuit and isolate the faulty section of the line until the short circuit is remedied.

The driver **17** for the response indicators (RI) activates the blinking of the internal RI **18** and an external RI **19** under control of the control unit.

5 Self-test / function state

Periodically and on request by the control unit a comprehensive detector self-test is initiated which monitors the IRED current, the signal amplifier and the EEPROM.

Also periodically monitored are the compensation value, NTC, the line voltage, etc. The entire signal path is monitored with the compensation value. If the basic pulse value is too low, this condition is signalled.

If the detector signals a status change, the control unit can read the cause out of the detector memory.

«**Function state 0**» corresponds to «Normal state».

In the «Normal state» the detector is fully functional.

«**Function state 1**» corresponds to «Notices».

«Notices» draw attention to certain irregularities, for example, error ID-ROM, but these do not influence the correct functioning of the system.

«**Function state 2**» corresponds to «Impairment».

«Impairments» are not accurately quantifiable deviations of the system (for example, compensation value too high). The reasons leading to the response of the detector must be taken seriously.

«**Function state 3**» corresponds to «Fault».

A «Fault» is an impairment of such a serious nature that the response of the detector can no longer be taken to signal a real event but the fault must be immediately remedied.

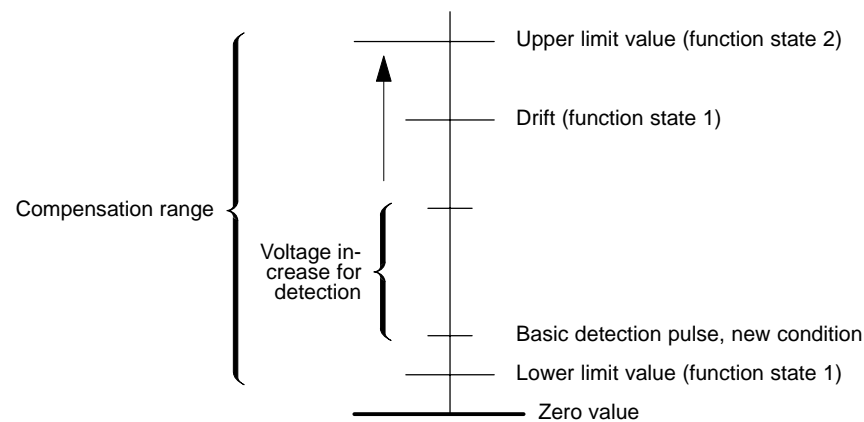


Fig. 4 Compensation range

6 Emergency operation

If the PolyRex detector DOT1151-Ex can no longer be periodically addressed, for example due to a μ P failure in the control unit, the detectors switch automatically to emergency operation. In the event of a fire this detector can still trigger a collective alarm.

7 Response characteristics of the detector

The PolyRex detector DOT1151-Ex is equipped with efficient algorithms for discriminating between true fires and deceptive phenomena. To signal a danger level the detector does not simply respond to a reading above a «response threshold», but rather tracks the smoke density pattern over a longer period of time and evaluates it with appropriate algorithms. The software parameters determine the response behavior of the detectors. They are dependent on the risk prevailing at the installation site (on the selected parameter set) and on the activated operating mode (day, night, special [renovation], test and switched off). The current operating mode is signalled to the detectors by the control unit in intervals of approx. 3 seconds.

The algorithms contain, for example, filters for suppressing transient interference variables. Slow changes caused by contamination are compensated by the automatic digital compensation circuit. This extremely slow compensation ensures that also slowly developing fires are reliably detected.

8 Environmental influences

8.1 Influence of the ambient air temperature

The smoke sensitivity of the PolyRex detector DOT1151-Ex typically changes typical $\pm 10\%$ across the entire operating temperature range.

8.2 Other influencing variables

The PolyRex detector DOT1151-Ex is resistant to ambient light, air drafts and other changes within the specified data.

The influence of air drafts with fast and large temperature fluctuations depends on the selected parameter set.

9 Application




9.1 Compatibility

Fire detection system: S11 AlgoRex
Control unit: CC11 (E3M171)
Base: DB1151A

9.2 Adjustment functions / selection of parameter sets

On the detector itself there is no mechanical adjustments. All function changes are initiated remotely by the control unit. The factory programs all detectors with a basic parameter set. This ensures that each detector is fully functional when it is installed. The additional parameter sets can be programmed in the field with the service PC by downloading them from the control unit.

9.2.1 DOT1151A-Ex

| Parameter set | Risk exposure and influence | Risk exposure |
|--|---|--|
| APS083S  | Low concentration of valuable property; no direct danger to life; No danger of smouldering fire! Aerosols arise regularly and for a length of time in "Manned" mode. No simultaneous thermal influence. No or few aerosols in "Unmanned" mode. | Discotheques/dance halls, places of entertainment with artificial smoke or fog. Caution, use very restrictively! |
| APS005S (factory default) | Low to moderate concentration of valuable property; no direct danger to life. No ban on smoking. | Industry, workshop halls, diesel vehicle traffic, park garage, restaurants, kitchen, smoking rooms |
| APS082S | —> Only for application in the China region in compliance with Chinese standards; —> As for APS005S, but with modified thermal response. | as for APS005S |
| APS015S | —> As for APS005S, but specially for applications at sea level as it has a slightly faster reaction than APS005S. | as for APS005S |
| APS006S | Moderate concentration of valuable property; no direct danger to life. No ban on smoking. | Offices, warehouses, electric vehicle traffic, congress centers. |
| APS085S | Medium to high concentration of valuable property; Person self-rescue is possible. No ban on smoking; little thermal influence. | Museums, warehouses, offices. |
| APS084S  | Low concentration of valuable property; no direct danger to life; low risk of smouldering fire. Aerosols arise briefly at times without simultaneous thermal influence. | Special production areas with transient and nonrecurring aerosols. Caution, use very restrictively! |
| APS009S | High concentration of valuable property; Person self-rescue is possible. No ban on smoking. | Storerooms, hotel rooms, home for the elderly rooms, schools, data processing and telecommunication systems in clean environment. |
| APS019S | —> As for APS009S, but specially for applications at sea level as it has a slightly faster reaction than APS009S. | as for APS009S |
| APS007S | High concentration of valuable property; Persons partly endangered. Ban on smoking. | Clean warehouses, museums, archives, data processing and telecommunication systems in clean environment. |
| APS081S | Very high concentration of valuable property; Persons endangered. Ban on smoking; no thermal influences. | Clean rooms, patient rooms, museums. |
| APS080SH  | Extremely high concentration of valuable equipment; persons endangered. Total ban on smoking, no other aerosols; no thermal influences. | Patient rooms, intensive care unit, clean rooms. Caution, use restrictively! |

The parameter sets listed here are arranged in order of sensitivity (APS080SH is the most sensitive).

For planning and project planning see «Application guidelines», document e1225, manual DS11, section 10



The detailed clarification of the application is required! See notes in chapter 2.1!

9.3 Application

Due to its EN54 compliance the PolyRex detector DOT1151-Ex can be used as an universal detector. The recommended monitoring surfaces, detector spacing, etc. can be found in the national guidelines, the Cerberus *planning and application guidelines (CRP)*, or the *Security Guide*.

9.4 Wiring

The DOT1151A-Ex detector and the DB1151A base are used in DS11-Ex with intrinsically safe fire detection lines which consist of an E3M171 line module, a shunt Zener diode barrier and intrinsically safe detectors.

Non-Ex-detectors may also be installed before the shunt Zener diode barrier. After the shunt Zener diode barrier only Ex detectors (DOT1151A-Ex, DT1151A-Ex, DM1153/54-Ex or DF1151-Ex) may be connected. A maximum of 32 devices with IMK1 may be connected to a stub line (total of all devices before and after the shunt Zener diode barrier). T-branches (T-TAP) are admissible. The Ex devices do not have a disconnection function.

Within the explosion-hazard area per detector base DB1151A only one external response indicator DJ1191-Ex, DJ1192-Ex or AJUT24-Ex may be connected.

Wiring comprises of a twisted two-wire circuit without shielding. If shielding is used, the shielding must be earthed on one side at the equipotential bonding.

Further information about installation in explosion-hazard areas can be found in the *document e1204*.

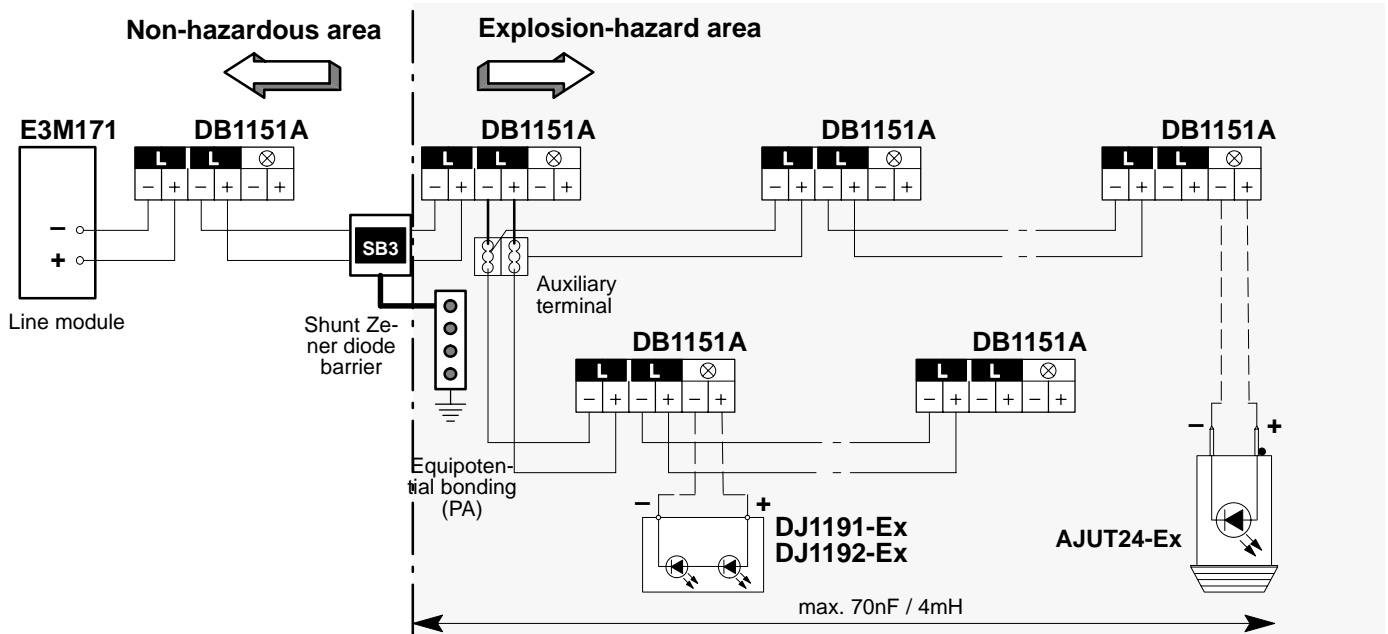


Fig. 5 Connection diagram

10 Commissioning

To prevent unnecessary soiling during the construction phase, the detectors should be inserted into the bases just before the system is put into service.

Each PolyRex DOT1151-Ex is connected in parallel to the two-wire detector bus. The address of the individual detectors is determined by the order in which the detectors are inserted, checked with the detector tester, or by entering the individual detector identification numbers.

The base contains an integrated identification module which means that once detectors of the same type have been commissioned and addressed, they can be interchanged without restriction. Based on this identification module the control unit automatically reestablishes the correct assignment with the correct algorithm. Each base identification module is factory programmed with its own, unique serial number.

If the swapped detectors are of a different type, an error message is output.

11 Maintenance

11.1 Diagnostic possibilities

A detector can transmit 4 events to the control unit:

- Stage of danger 0 (quiescent value)
- Stage of danger 1 (potential danger)
- Stage of danger 2 (probable danger)
- Stage of danger 3 (highly probably danger)

Danger level 1

To provide early warning in locations which are difficult for intervention, the number of times danger level 1 is exceeded is counted by the control unit. Upon reaching a pre-programmed level, the message «Application warning» is given.

These messages are entered in the basic parameterization of the control unit in the event memory.

Danger level 2

If danger level 2 is reached, the basic parameterization of the control unit activates a «Warning» message.

This message is also entered in the basic parameterization of the control unit in the event memory.

Danger level 3

Normally, danger level 3 results in immediate alarm activation.

Cross or multiple detection is possible by programming the control unit accordingly.

Due to the identification module integrated in the base, detectors can be swapped as desired after they have been put into service and addressed. Based on this identification module the control unit automatically reestablishes the correct assignment with the correct algorithm. Each base identification module is factory programmed with its own, unique serial number.

11.2 Functional check / overhaul

Through the detector self-test the DOT1151-Ex is subjected automatically to an extensive electrical function check. However, it is still necessary to conduct a physical function test on site in regular intervals.

Recommendation: A visual check of the detectors must be performed periodically (usually **once per year**). Detectors that are strongly soiled or which are mechanically damaged must be replaced.

All detectors should be jointly replaced and factory overhauled in intervals of **6 to 8 years**, depending on the environmental conditions and the severity of contamination (see also *Maintenance instructions, document e1386, manual CS11.2, section 6*).



Important:

The DZ1193 optoelectronic detector tester and exchanger as well as the RE6T detector tester must not be used in explosion-hazard areas!

If mechanically damaged detectors must be scrapped, the plastic materials can be sorted out based on the embossed code.



Electrostatic danger

The housing is made of plastic and has a surface resistance of $>1\text{Giga}\Omega$ which means there is a risk of electrostatic discharge. Therefore the manual call point should not be located where there is powerful ventilation. Cleaning with solvents is forbidden.

12 Terms

| | |
|--------------------|---|
| AlgoLogic | Protected trade-mark (Algorithm + Logic) |
| AlgoRex | Interactive fire detection system with AlgoLogic |
| Algorithm | Special calculation method in the detector processor for optimizing the smoke sensitivity, noise immunity and reliability |
| APS | Algo Parameter-Set |
| ASIC | Application Specific Integrated Circuit |
| CS11 | Fire detection control unit AlgoControl to fire detection system S11 |
| DB1151A | Base for interactive DS11 fire detectors |
| DBZ1191 | Base attachment |
| DJ1191-Ex | External response indicator |
| DJ1192-Ex | External response indicator |
| AJUT24-Ex | External response indicator |
| DOT1151A-Ex | PolyRex Smoke/Heat detector |
| DZ1191 | Detector extractor |
| DZ1193 | Optoelectronic detector tester and exchanger |
| E3M171 | Line module |
| EEPROM | Electrical Erasable Programmable Read Only Memory |
| EMC | Electro Magnetic Compatibility |
| EMI | Electro Magnetic Influence |
| ESD | Electro Static Discharge |
| IREDD | Infra-Red Emitting Diode |
| ILK | Interactive line factor (32) |
| IMK | Connection factor for interactive elements |
| μP | Microprocessor |
| MUX | Multiplexer |
| NTC | Resistor with Negative Temperature Coefficient |
| PolyRex | DOT1151A-Ex combined Smoke/Heat detector for explosion-hazard areas |
| RE6 | Detector tester |
| RE6T | Detector tester for heat detectors |
| RI | Response indicator |
| S11 | Generic term of fire detection system S11 |
| SB3 | Recommended shunt Zener diode barrier |

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