SIEMENS

Cerberus® DOTE1152
Multi criteria smoke detector, interactive

Technical description

Fire & Security Products

Siemens Building Technologies Group

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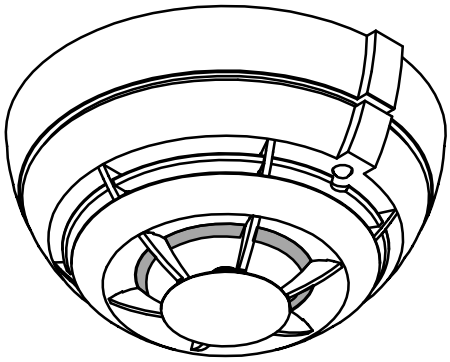
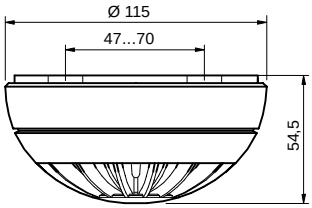
1 Overview



Dimensions



incl. base DB1151

1.1 Characteristics

- **High immunity to deceptive phenomena**
  combined with high detection sensitivity
- **Homogenous response behaviour across a wide application spectrum**
  by freely programmable percentages of smoke, heat and CO gas
- **Extremely early reaction to all fires generating CO**
- **Efficient signal processing algorithms with remotely adjustable, application–specific characteristics**
  for optimum detection reliability
- **High–quality sensor system with temperature compensation**
  operates reliably also under critical environmental conditions
- **CO sensor as an additional evaluation criterion,**
  besides scattered light sensor and temperature measurement
- **High resistance to soiling**
  by appropriate design of the measurement chamber, the protective grille and automatic, continuous digital compensation
- **Comprehensive EMC concept based on the latest technology**
  allows application 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 functional states each**
- **Automatic, comprehensive selftest**

1.2 Design

The PolyRex detector DOTE1152 is installed in a modern, attractive, impact–resistant plastic housing that fits unobtrusively into any room architecture. The detector is secured in the interactive DB1151 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. The 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.

The DB1151 detector base can either be flush mounted directly on a recessed box in the ceiling, or surface mounted with the DBZ1191 base attachment. It is connected to the control unit via a two–wire line. Spring terminals are provided for wiring the base.

Efficient installation, removal and testing of the detector is possible by means of the DZ1191 detector extractor, the RE6 detector tester and the DZ1193 opto-electronic detector exchanger and tester. The response behaviour of the detector to CO gas can be tested with the DZE1152 CO detector tester. If an extension rod is used, work up to a ceiling height of 7 m 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.

The DOTE1152 is provided with a line isolation function.

As a distinctive feature, the DOTE1152 detector is marked with a yellow circle which is visible when the detector is installed.

2 Technical data

Normal ambient conditions, if nothing else is specified:
Temperature T_a = 20°C (293K)
Air pressure: p = 1'000hPa (1'000mbar)

Parameters	Symbol	Value				Conditions
		Unit	min.	typ.	max.	
Operating voltage	U_b	V	21.2		33.3	modulated
Operating current (quiescent condition)	I_b	µA		400	600	
Baud rate		kBd		4.8		
Response sensitivity (software settings dependent on algorithms)	D_1	%/m	1.3		6.6	smoke sensitivity with paraffin test aerosol
Compensation Compensation speed		Voltage increase for detection Voltage increase for detection/h			1.5 1 / 64	
Selftest interval		min		15		
Test limit for CO gas (Detector in test mode)		ppm CO		6		Alarm indicator slowly flashing (after 4 sec.)
Response indicator: external Flashing interval times: bright dark Response indicator current		 ms s mA		 20 1.5 15	2	connectable depending on control unit
Elektromagnetic compatibility		V/m V/m	50 30			1MHz...1GHz 1GHz...2GHz
Operating temperature	T_a	°C	–10		+50	
Humidity		%rH	15		90	No moisture condensation!
Storage temperature	T_l	°C	–30		+60	In hermetically sealed packaging!
Connection factor	IMK			2		
Line separator factor	ITK			1		

Colour: white ~RAL9010

Classification

Standards EN 54-7
Test category IEC 60068-1: 10/050/21
Protection category IEC 60529: IP44

Environmental compatibility:

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

Note:

The specified ambient conditions in accordance with the technical data must be met, to avoid a reduction of the service life of the CO sensor.

2.1 Algo-Parameter sets for DOTE1152

Parameter set	Operating state	AlgoRex smoke sensitivity index (1)		Response time when testing with test gas (~seconds)
		without temperature influence	with full temperature influence	
APS204SE ⚠ 1)	manned	1 -> 2 *	2 -> 5 *	110 -> 60
	unmanned	* increasing with CO	* increasing with CO	110 -> 40
	special	no response to smoke	(only temperature actuation)	
APS207SE 2)	manned	1 -> 2 *	2 -> 5 *	110 -> 60
	unmanned	* increasing with CO	* increasing with CO	110 -> 40
	special	no response to smoke	(only temperature actuation)	
APS213SE (Default)	manned	1 -> 2 *	2 -> 5 *	110 -> 60
	unmanned	* increasing with CO	* increasing with CO	110 -> 40
	special	no response to smoke	(only temperature actuation)	
APS216SE	manned	2 -> 4 *	5 -> 8 *	60
	unmanned	* increasing with CO	* increasing with CO	40 -> 30
	special	no response to smoke	(only temperature actuation)	
Testmode	manned	2	5	5
	unmanned			

With the exception of test mode, the parameter sets listed here are arranged in order of sensitivity (APS216 is the most sensitive).

Note: All values are typical!

Smoke sensitivity: To simplify the comparison of smoke sensitivities between the parameter sets, we are specifying an AlgoRex smoke sensitivity index.
Please note, that this index is a relative figure. ”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 sensitivity index of ”0” means ”no alarm with smoke only”.

* The smoke sensitivity of the DOTE1152 changes depending on the temperature and the CO signal. If CO is detected, the sensitivity level of the detector is increased; in atmospheres without CO the detector reacts with normal sensitivity.

1) APS204: In addition, a special filtering method is applied for the detection of deceptive phenomena, also when CO is present. (Priority deceptive phenomenon.)

⚠ Under certain conditions, this parameter set does not fulfil the normative requirements on test fires according to EN54-7.

2) APS207: In addition, a special filter is used for the detection of deceptive phenomena if no CO is present. (Priority CO.)

Furthermore, it is possible to use the parameter sets of the DOT1151/52 without CO signal evaluation (see Technical specification, document no. 1027).

3 Design

The core of the PolyRex detectors DOTE1152 is a high–quality, opto-electronic measuring chamber, hat screens off extraneous light but optimally detects light–coloured and dark smoke particles. The light source, the light stop and the light receiver are aranged in such a way that the light rays from the source cannot directly reach the receiver (Fig. 1 und Fig. 2). Only when smoke particles are present in the path of rays does some of the scattered light reach the receiver and produce an optical signal.

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

The electrochemical CO gas sensor is installed on a sub print. This sub print with the sensor is mounted and fixed through an opening in the cover on the detector base side.

Due to their optimized optical system, the temperature sensors installed in a protective envelope, shielded electronics and special circuit board coating, these detectors are highly immune to environmental influences such as temperature, humidity, corrosion and electrical interference fields (keep to the technical data).

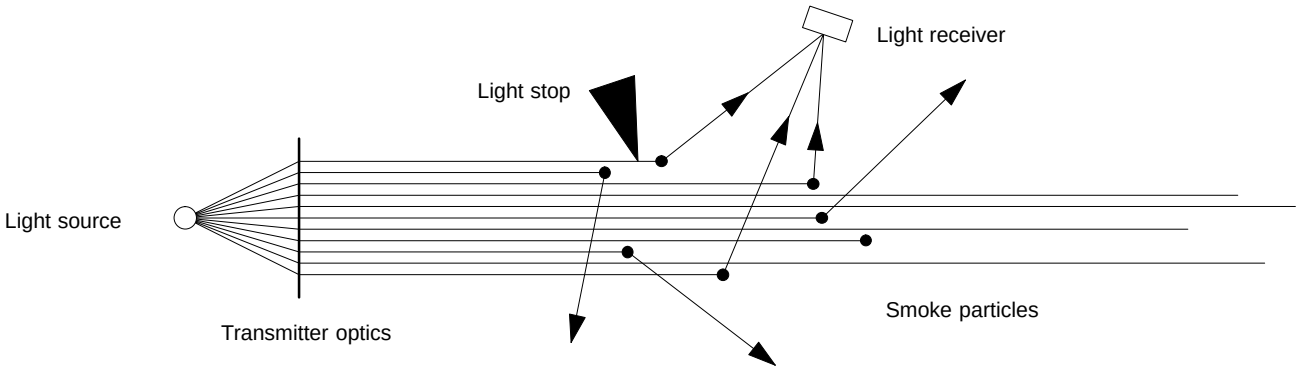


Fig. 1 Principle of the scattered light measurement

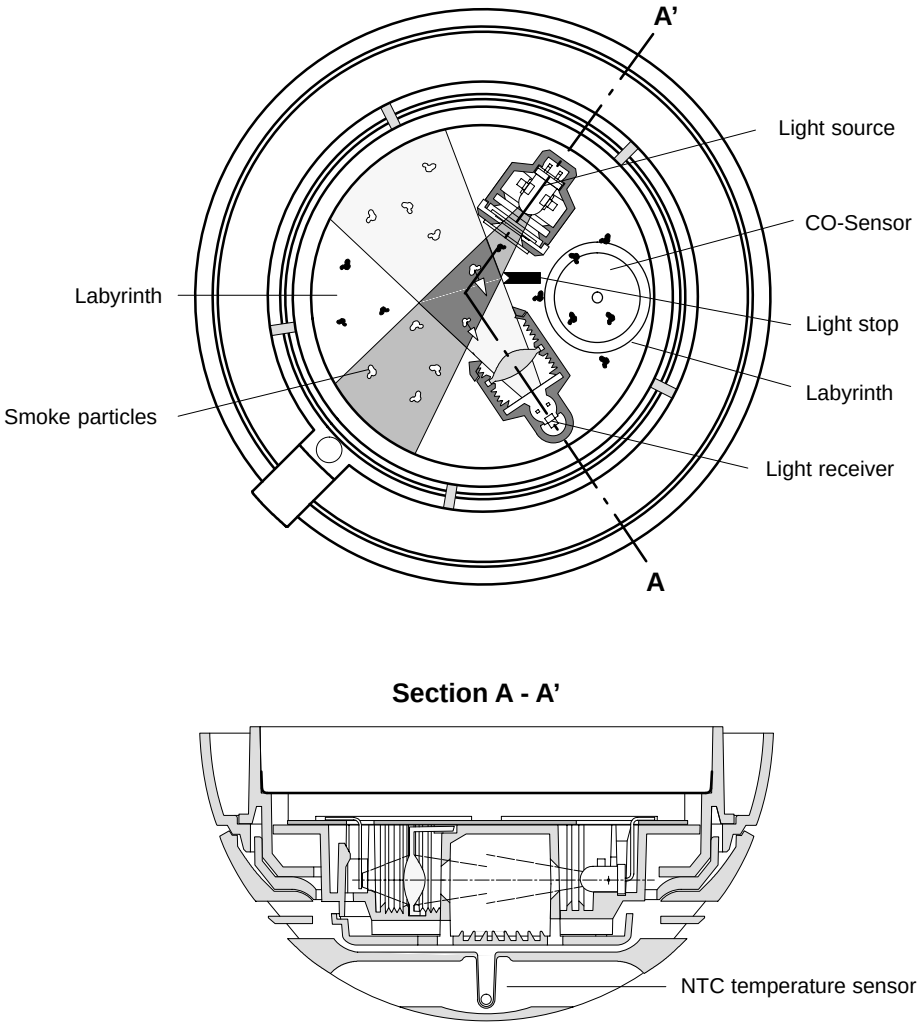


Fig. 2 Detector design

4 Operating principle (see block diagram Fig. 3)

The PolyRex detectors DOTE1152 measure the smoke density as well as the ambient temperature. The temperature sensor signal can be evaluated either differentially and/or absolute. The smoke sensor is based on the scattered light principle. An infrared light emitting diode (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 scattering 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.

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

This current is amplified and integrated **4** in the integrator. The multiple coincidence filter **5** very selectively passes only signals on 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 overamplification. 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 amplification of the signal path can be monitored (part of the selftest).

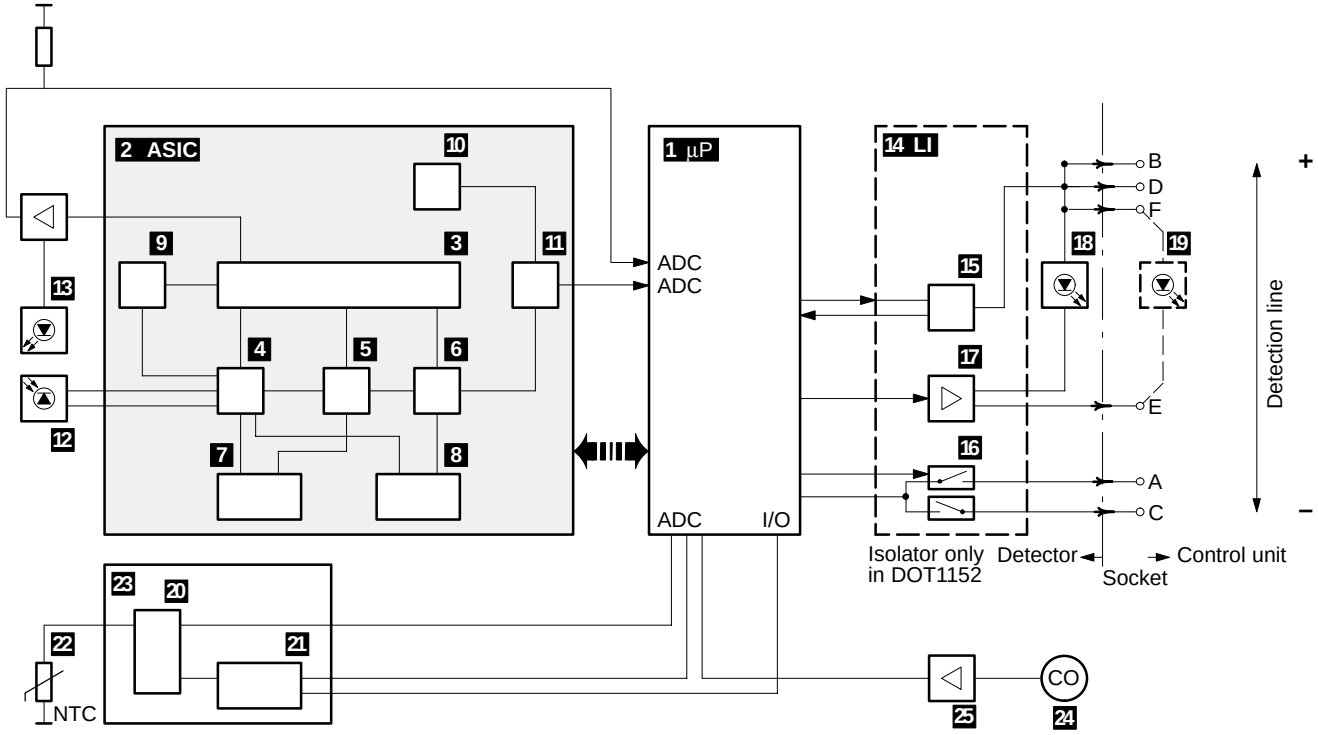


Fig. 3 Block diagram DOTE1152

The physical temperature drift of optical module is compensated by the 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 the circuit element 23. It contains the circuit 21, which produces the bias voltage for this NTC andis simultaneously controlled and monitored by the µP. The signal from the NTC temperature sensor is talken via the filter 20 to the A/D converter of the µP. This filter reduces electromagnetic interference and protects the circuit against electrostatic discharges (ESD).

The signal of from the external CO sensor 24 is amplified by the amplifier 25 and processed by the A/D converter.

The µP 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 a bus failure in case of a short circuit, faulty sections are isolated by the DOTE1152 isoliert. In the DOTE1152 disconnector 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 internal RI 18 and an external RI 19 under control of the control unit.

5 Selftest/Functional state

Periodically or on request by the control unit a comprehensive detector selftest 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 basic pulse test. 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.

«Functional state 0» corresponds to «Normal state».
In the «Normal state» the detector is fully functional.

«Functional 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.

«Functional 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 a detector must be taken seriously.

«Functional 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. The fault must be immediately remedied.

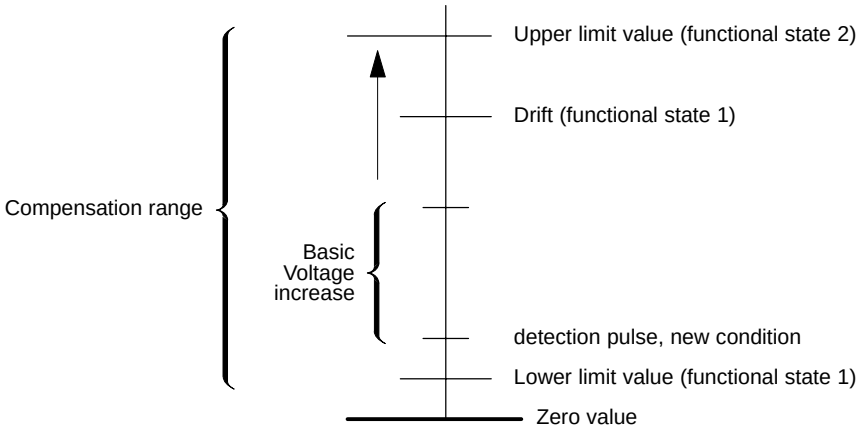


Fig. 4 Compensation range

6 Emergency operation

If the DOTE1152 can no longer be periodically addressed, for example due to a µP failure in the control unit, the detector automatically switches to emergency operation. In the event of a fire the detector can still trigger a collective alarm.

7 Line disconnector function

If a short circuit occurs on the detector bus, total bus failure is prevented by disconnector detectors which inhibit the defective sections of a line. The DOTE1152 is equipped with such an isolation function. The DOTE1152 is equipped with an «electronic switch» (FET) in the bus before and after the detector. These switches open automatically in the event of a short circuit and disconnect the defective section of the line.

Detectors with disconnector switches are normally installed in unit separations, fire compartments and T–branches.

Optimum security is provided by a loop line installation.

8 Response behaviour of the detectors

The DOTE1152 is equipped with efficient algorithms for discriminating between real fires and deceptive phenomena. To signal a danger level the detector does not simply respond to a value 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 behaviour of the detectors. They are dependent on the risk prevailing on 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 approximately 3 seconds.

The algorithms contain, for example, filters for suppressing transient disturbance variables. Slow signal 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.

Just as the PolyRex detectors DOT1151/1152, the DOTE1152 evaluates several criteria. The temperature and CO signals are used for the recognition of events, together with the scattered light signal. However, no danger level is signalled solely on the base of the CO signal. (This also applies for the test mode.)

9 Environmental influences

9.1 Influence of the ambient temperature

The smoke sensitivity of the PolyRex detectors DOTE1152 typically change by ±10% across the entire operating temperature range, provided that the temperature and CO signals remain stable. (In the event of a temperature and/or CO value change, the smoke sensitivity is determined by the selected parameter set).

9.2 Other influencing variables

The PolyRex detectors DOTE1152 are resistant to ambient light and other changes within the specified data.

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

Temperature and relative humidity values outside the specified range reduce the service life of the CO sensor.
If the detector is exposed to an atmosphere containing solvents for longer periods, the CO sensor may be damaged.

10 Application

10.1 Compatibility

Fire detection system: S11 AlgoRex
Control unit: CC11
Base: DB1151A
The detector is produced in the version DOTE1152**A** only.

10.2 Adjustment functions/Selection of the parameter sets

No mechanical adjustment is possible on the detectors. 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.

DOTE1152

Parameter set	Risk exposure and influence	Behavior	Examples
APS204SE ⚠	Low to moderate concentration of valuable property; direct danger to persons possible; no ban on smoking.	very robust	Kitchen, water vapour, industrial applications with possible CO emission
APS207SE	Low to moderate concentration of valuable property; direct danger to persons possible; no ban on smoking.	robust	Water vapour, hotel rooms, spinnery, joiner's workshop, industry and trade without CO emission, food industry
APS213SE (Default)	Low to high concentration of valuable property; direct danger to persons likely; no ban on smoking.	standard	Museums, libraries, EDP, hotel corridors, industry, spinnery, joiner's workshop, high rooms
APS216SE	High concentration of valuable property; danger to persons. Ban on smoking, no thermal influences.	sensitive	Medical care, clean rooms, EDP, clean production

The parameter sets listed here are arranged in order of sensitivity (APS216 is the most sensitive).

For planning and project planning see *«Application guidelines», document e1225, manual DS11, section 10.* The detectors DOTE1152 are principally used for the same applications as the DOT115x PolyRex detectors.

see notes chapter 2.1

10.3 Application

Due to their EN54 compliance the PolyRex detectors DOTE1152 can be used as universal detectors. The recommended monitoring areas, distance between detectors etc. can be found in the national guidelines, the Cerberus *Planning and application guidelines (CRP)*, or the *Security Guide*. For the DOTE1152 detectors, the same monitoring areas, distances between detectors etc. apply as for smoke detectors (DO and DOT).

The DOTE1152 must be exclusively used as a fire detector. **No CO gas warning is possible**, as the detector always evaluates the measured CO values together with other values measured and analyses them only for the early detection of fires.

10.4 Installation

The installation is executed with **twisted** wire pairs, from base to base. Loop and stub lines as well as T–branches are admissible. Normally no shielded wiring is required.

Up to 64 DOTE1152A detectors may be connected to a D-bus K1151A (E3M071).

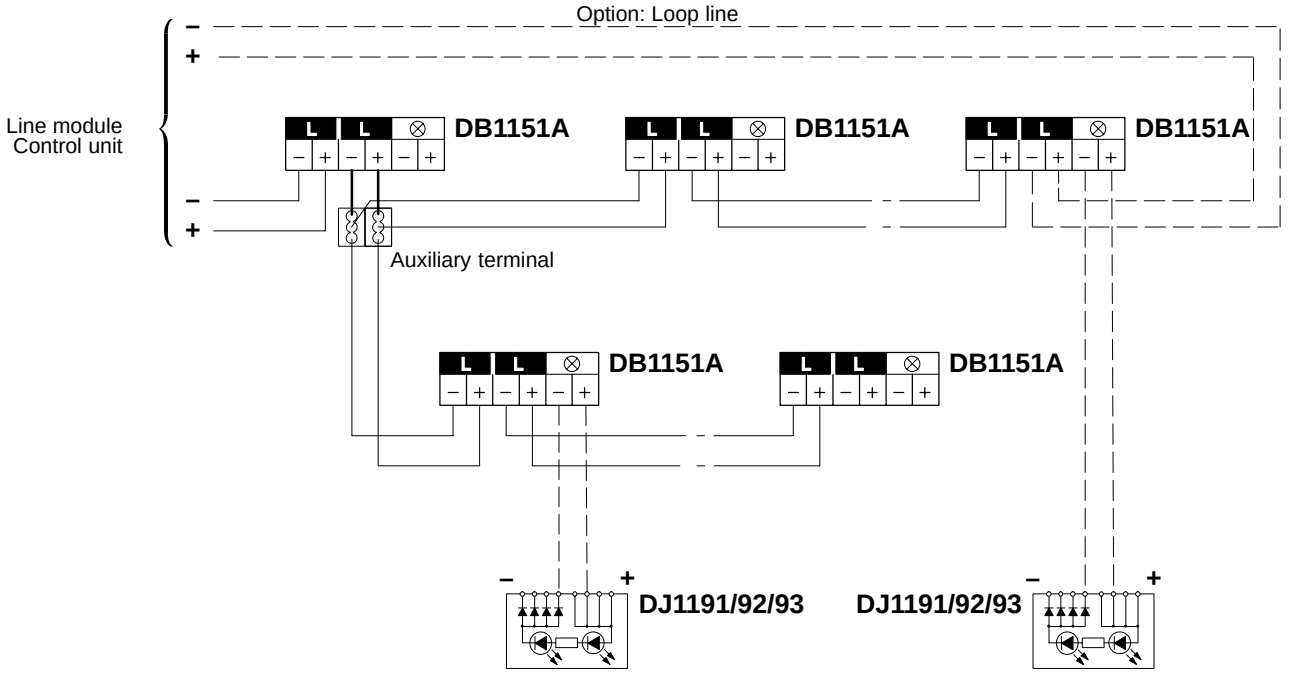


Fig. 5 Connection diagram

11 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 DOTE1152 is connected in parallel to the two–wire detector bus. The addresses of the individual detectors are determined by the order in which the detectors are inserted or checked with the detector tester, or by entering the individual detector identification numbers.

The reaction to CO gas can be tested with the CO detector tester DZE1152, however, it cannot be used for the address allocation.

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.

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

12 Maintenance

12.1 Diagnostic possibilities

A detector can transmit 4 events to the control unit:

– Danger level 0 (quiescent level)
– Danger level 1 (potential danger)
– Danger level 2 (probable danger)
– Danger level 3 (highly probable danger)

Danger level 1

To provide early warning in locations which are difficult for intervention, the control unit counts the number of times danger level 1 is exceeded. 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.

12.2 Performance check/Overhaul

Through the detector self–test the DOTE1152 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 and a response test on CO must be performed periodically **(once per year)**. Detectors that are strongly soiled or mechanically damaged must be replaced.

All DOTE1152 detectors should be jointly replaced and factory overhauled in intervals, **every 4 years at the latest**, depending on the environmental conditions and the severity of contamination (see also *Servicing instructions, document e1386, manual CS11.2, section 6*).

A physical functional check of the detectors can be performed on site by means of a detector tester DZ1193 or RE6. The CO detector tester DZE1152 enables the testing of the CO sensor; the detector must be switched to test mode. When the test threshold for CO is reached, the internal and external response indicators flash at intervals of approx. 4 seconds. No danger level is signalled.

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

13 Terms

AlgoLogic	Protected trademark (Algorithm + Logic)
AlgoRex	Interactive fire detection system with AlgoLogic
Algorithm	Special calculation method in the detector processor for optimizing the smoke sensitivity, immunity and operational reliability
APS	Algo Parameter set
ASIC	Customer–specific integrated circuit (Application Specific Integrated Circuit)
CC11	Fire detection control unit AlgoControl for fire detection system S11
DB1151	Base for interactive DS11 fire detectors
DBZ1191	Base attachment
DJ119192/93	External response indicators
DOT1152	PolyRex smoke/heat detector with isolation function
DOTE1152	PolyRex smoke/heat/CO detector with isolation function
DZ1191	Detector extractor
DZ1193	Opto-electronic detector tester and exchanger
DZE1152	CO detector tester
EEPROM	Electrical Erasable Programmable Read Only Memory
EMC	Electromagnetic compatibility
EMI	Electromagnetic Interference
ESD	Electrostatic discharge
FET	Field Effect Transistor
IRED	Infrared light emitting diode
μP	Microprocessor
MUX	Multiplexer
NTC	Resistor with negative temperature coefficient (Negative Temperature Coefficient)
PolyRex	DOT1151/DOT1152 combined smoke/heat detector, DOTE1152 combined smoke/heat/CO detector
RE6	Detector tester
RI	Response indicator
S11	Generic term of fire detection system S11

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