SIEMENS

Cerberus® DO1151, DO1152, DO1153
Wide spectrum smoke detectors, interactive

Technical description

Fire & Security Products

Siemens Building Technologies Group

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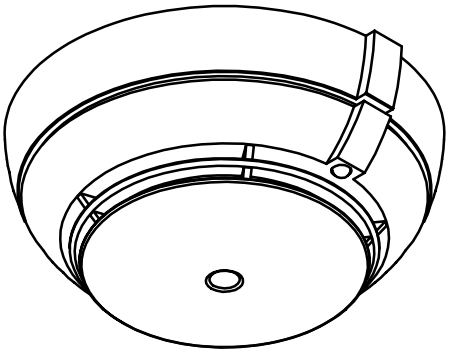
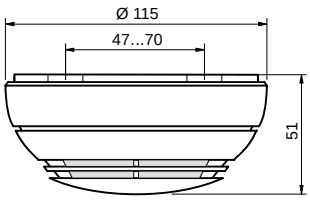
1 Overview



Dimensions



incl. base DB1151

1.1 Characteristics

- **Efficient signal processing algorithms with remote adjustable application-specific characteristics**
  ensure optimum detection reliability
- **High-quality sensor system with temperature compensation**
  functions reliably also in critical environments
- **High contamination resistance**
  through appropriate design of the measurement chamber, the protective grille as well as continuous and automatic digital compensation
- **Comprehensive EMC concept based on the latest technology**
  allows the detector to be installed also in difficult environments
- **Integrated multiple coincidence circuit**
  suppresses 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

1.2.1 OptoRex DO1151

The OptoRex detectors DO1151/DO1152/DO1153 are installed in a modern, attractive, impact-resistant plastic housing that fits unobtrusively into any room architecture. The detectors are secured in the 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 detectors are 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 detectors are fully electronic and have 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 a detector is possible by means of the DZ1191 detector extractor, the RE6 testing unit or the DZ1193 optoelectronic detector tester and exchanger. 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.

1.2.2 OptoRex DO1152

The OptoRex DO1152 features the same design as the DO1151, but it is additionally equipped with a line separator function.

1.2.3 OptoRex DO1153

The OptoRex DO1153 has the same design and mode of operation as the DO1152, but has considerably higher response sensitivity than the DO1152 and is therefore very suitable for special applications such as in air sampling smoke detection systems. The DO1153 does not comply with EN54.

2 Technical data

Normal ambient conditions, if nothing else is specified:
Temperature T_a = 20°C (293K)
Air pressure: p = 1'000hPa (750 Torr)

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		250	300	
Baud rate		kBd		4.8		
Response sensitivity (software setting dependent on algorithms) DO1151/52 DO1153	 D_1 D_1	 %/m %/m	 1.3 0.2		 3.3 1.2	smoke sensitivity with paraffin test aerosol (1m/s)
Compensation Compensation speed		Voltage increase for detection Voltage increase for detection/h			2 1 / 64	
Self test interval		min.		15		
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	50			1MHz...1GHz
Operating temperature	T_a	°C	–25		+70	
Humidity ≤34°C >34°C					≤95% rel. ≤35g/m^3	Transient condensation allowed
Storage temperature	T_l	°C	–30		+75	
Connection factor	IMK			1		

Colour: white ~RAL9010

Classification

Standards for DO1151/DO1152	EN 54-7	
Application category	IEC 60721-3:	3K8H
Test category	IEC 60068-1:	25/070/42
Protection category	IEC 60529:	IP44
CE conformity marking		

Environmental compatibility:

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

2.1 Algo-Parameter sets for DO1151 / DO1152

Parameter set	Operating state	AlgoRex smoke sensitivity index (1)	Response time when testing with test gas (~Seconds)
APS005S (Default)	present	2	90
	absent		
	special	2	200
APS006S	present	2	60
	absent		30
	special	2	200
APS009S	present	4	90
	absent		
	special	2	200
APS007S	present	4	60
	absent		30
	special	2	200
Test mode	present	2	5
	absent		

With the exception of test mode, the parameter sets listed here are arranged in order of sensitivity (APS007S is the most sensitive).

2.2 Algo-Parameter sets for DO1153

Parameter set	Operating state	AlgoRex smoke sensitivity index (1)	Response time when testing with test gas (~Seconds)
APS073SH	present	6	30
	absent		
	special		
APS072SH	present	12	30
	absent		
	special		
APS071SH (Default)	present	20 *	45
	absent		
	special		
APS070SH	present	20 -> 30 * (increasing during very slow smouldering fire)	45
	absent		
	special		
Test mode	present	12 *	5
	absent		

With the exception of test mode, the parameter sets listed here are arranged in order of sensitivity (APS070SH 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”.

3 Design

The heart of the OptoRex detectors DO1151/DO1152 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.

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

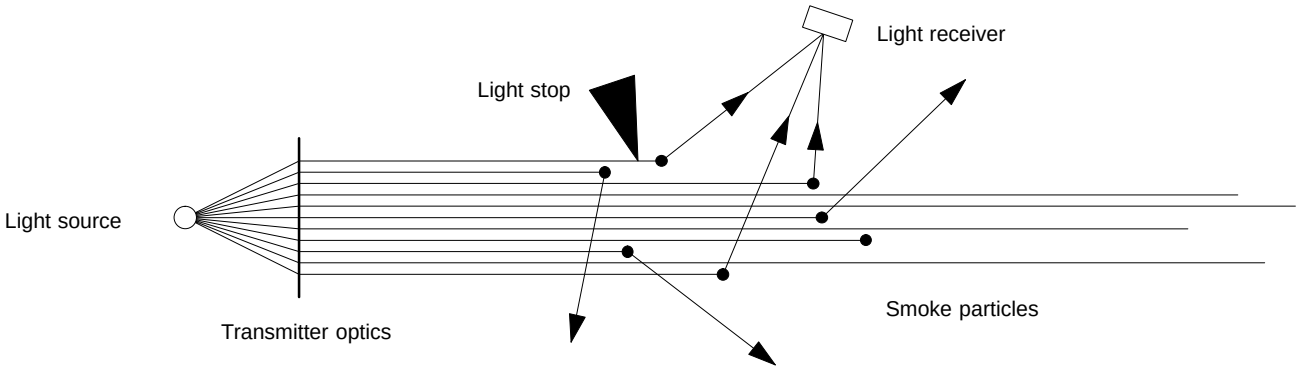


Fig. 1 Principle of the scattered light measurement

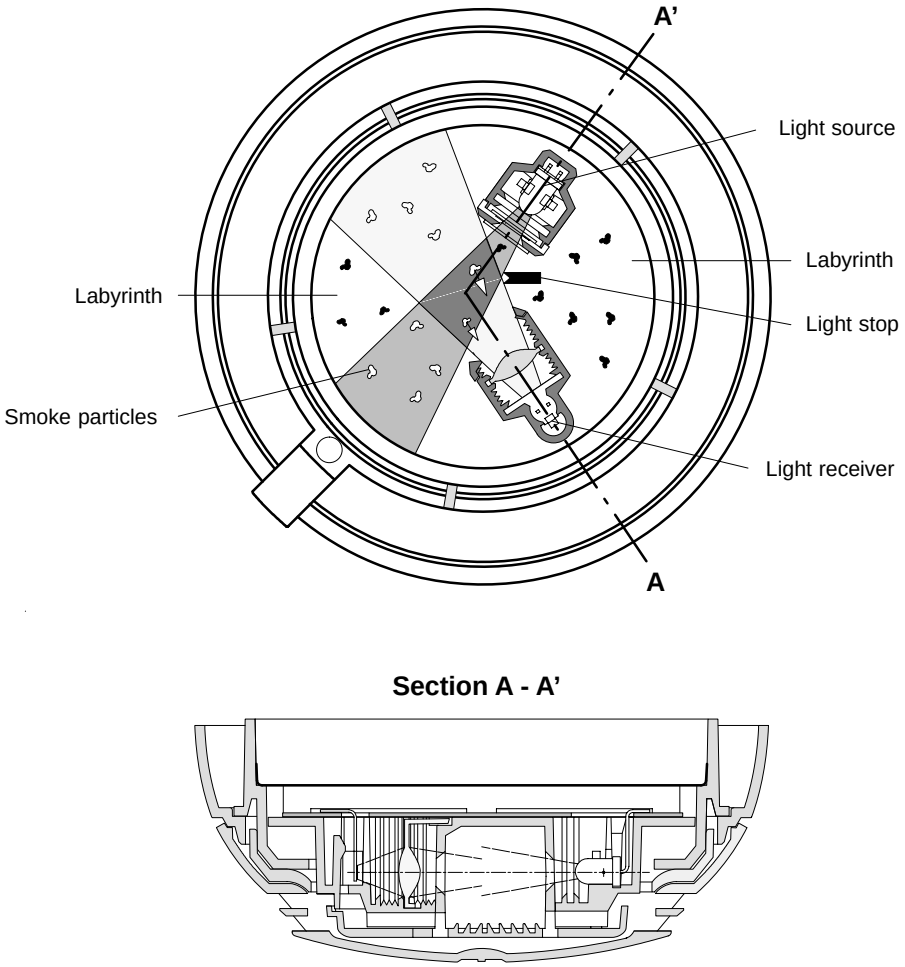


Fig. 2 Detector design

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

The OptoRex detectors DO1151/DO1152 are based on the principle that smoke scatters light and measures smoke density. 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 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 gain of the signal path can be monitored (part of the self-test).

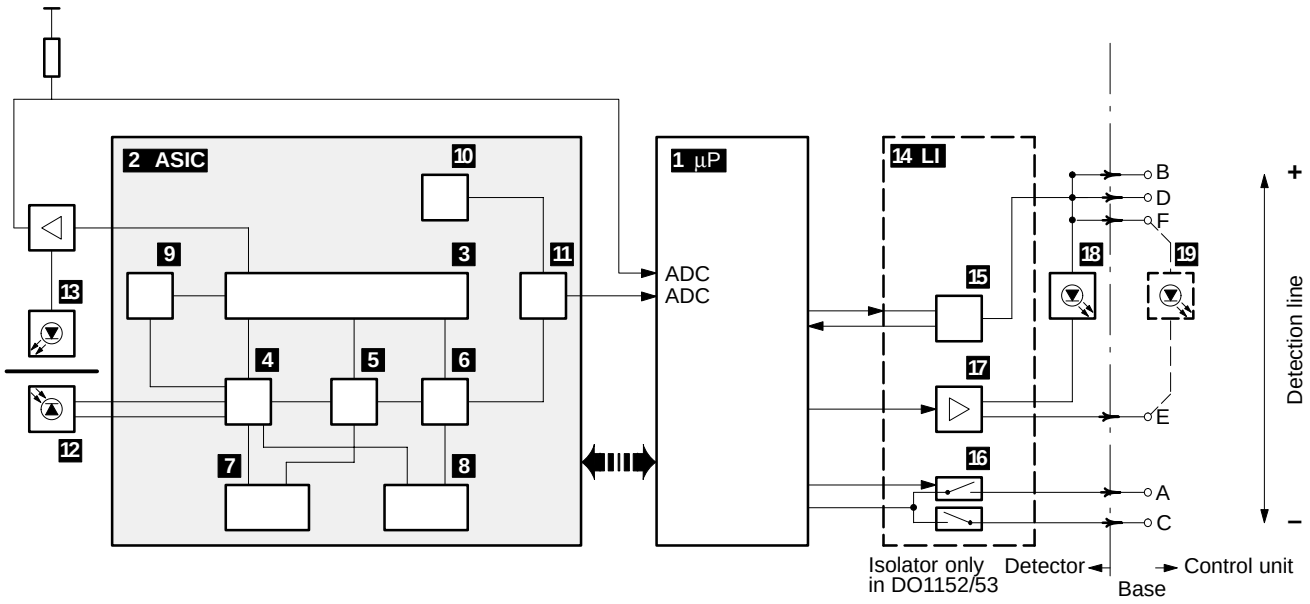


Fig. 3 Block diagram DO1151/DO1152

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 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 total bus failure in the event of a short circuit, separator detectors can be installed which «isolate» defective sections. In the separator 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, the line voltage, etc. The entire signal path is monitored with the compensation value. If the compensation 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, application errors, 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.

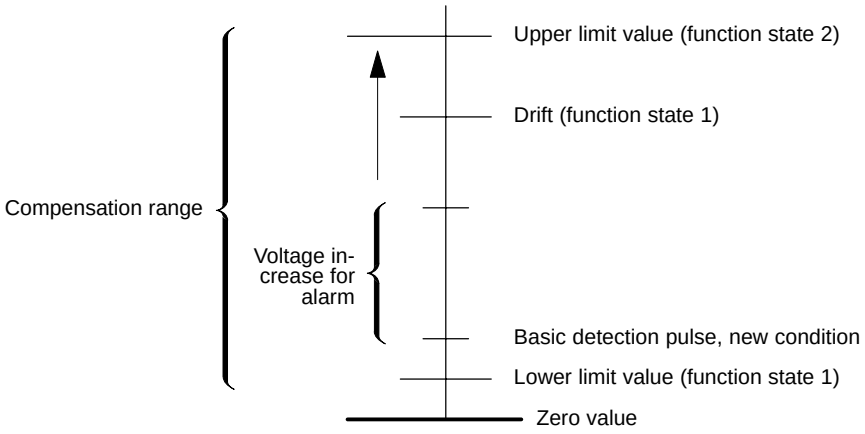


Fig. 4 Compensation range

6 Emergency operation

If the OptoRex detectors DO1151/DO1152 can no longer be periodically addressed, for example due to a µP failure in the control unit, the detectors switch automatically to emergency operation. In the event of a fire this detectors can still trigger a collective alarm.

7 Line separator function

DO1152/53

If a short circuit occurs on the detector bus, total bus failure is prevented by separator detectors which inhibit the defective sections of a line. The separator detectors OptoRex DO1152/53 are equipped with such a separator function. The DO1152/53 are equipped with an «electronic switch» (FET) in the bus before and after the detector. This switches open automatically in the event of a short circuit and disconnect the defective section of the line.

The other functions of the detector are the same as in the OptoRex DO1151. Detectors with separator switches are normally installed in unit separations, fire compartments and T-branches.

Optimum security is provided by a loop line installation.

8 Response characteristics of the detectors

The OptoRex detectors DO1151/DO1152/DO1153 are 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.

9 Environmental influences

9.1 Influence of the ambient air temperature

The smoke sensitivity of the OptoRex detectors DO1151/DO1152/DO1153 typically change ±10% across the entire operating temperature range.

9.2 Other influencing variables

The OptoRex DO1151/DO1152/DO1153 are resistant to ambient light, air drafts and other changes within the specified data.

10 Application

10.1 Compatibility

Fire detection system: S11 AlgoRex
Control unit: CC11
Base: DB1151

10.2 Adjustment functions / selection of parameter sets

On the detectors itself there are 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.

DO1151/1152

Parameter set	Risk exposure	Examples
APS005S (Default)	Low to moderate concentration of valuable property No direct danger to life No ban on smoking	Workshop halls Workshops Restaurants
APS006S	Moderate concentration of valuable property No ban on smoking	Offices Hotel rooms Warehouses
APS009S	Very high concentration of valuable property Persons partially endangered No ban on smoking	Clean storerooms Home for the elderly rooms Museums
APS007S	Very high concentration of valuable property Persons endangered Ban on smoking	Clean rooms Patient rooms Museums

The parameter sets listed here are arranged in order of sensitivity (APS007S is the most sensitive).

DO1153

APS073SH	Object und room surveillance with air sampling smoke detection systems	As second detector to give alarm in cross detection mode
APS072SH	Object und room surveillance with air sampling smoke detection systems	As first detector to give alarm in cross detection mode
APS071SH (Default)	Early warning for air sampling smoke detection systems in clean environment	Air sampling smoke detection systems, e.g. high-rack storage
APS070SH	Early warning for air sampling smoke detection systems in clean environment with risk of smouldering fire	In clean rooms

The parameter sets listed here are arranged in order of sensitivity (APS070SH is the most sensitive).

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

10.3 Application

Thanks to its good detection characteristics, the OptoRex detectors DO1151/DO1152 can be used as 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.*

The DO1153 has very high response sensitivity and has the capability to detect the smallest smoke densities by suitable parameter sets. As a result, it is particularly suitable for special applications, as in air sampling smoke detection systems.

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.

Up to 100 OptoRex DO115. detectors may be connected to a D-Bus K1151 (E3M070).

Up to 128 OptoRex DO115.A detectors may be connected to a D-Bus K1151A (E3M071).

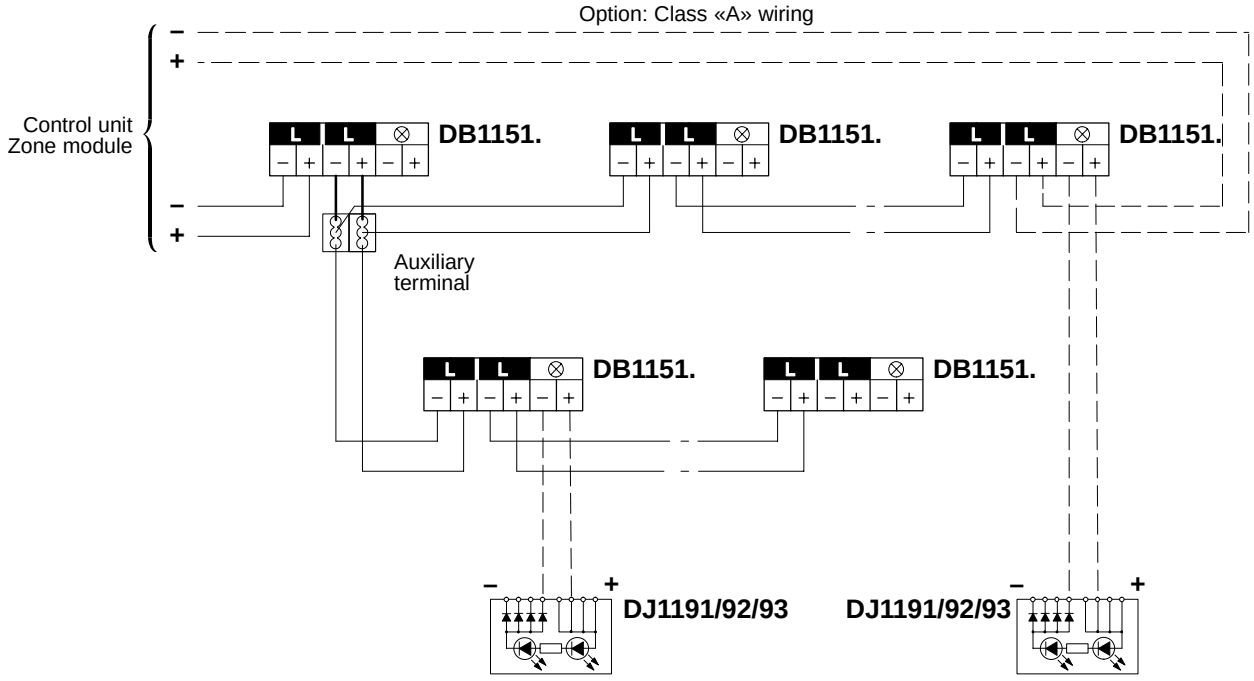


Fig. 5 Connection diagram

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 OptoRex DO1151/DO1152/DO1153 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.

12 Maintenance

12.1 Diagnostic possibilities

A detector can transmit 4 events to the control unit:

– Danger level 0 (quiescent value)
– Danger level 1 (potential danger)
– Danger level 2 (probable danger)
– Danger level 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.

If stage of danger 2 is reached, an entry is made immediately in the event memory. Frequent entries in the event memory are indicative of faulty application and provide an early warning to false alarms to come.

12.2 Functional check / overhaul

Through the detector self-test the detectors are 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*).

A physical functional check of the detectors can be performed by means of a suitable testing device (e.g. DZ1193 or RE6).

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

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
CC11	Fire detection control unit AlgoControl to fire detection system S11
DB1151	Base for interactive DS11 fire detectors
DBZ1191	Base attachment
DJ119192/93	External response indicators
DO1151	OptoRex smoke detector
DO1152	OptoRex smoke detector with separator function
DO1153	OptoRex smoke detector with separator function and with elevated response sensitivity
DZ1191	Detector exchanger
DZ1193	Optoelectronic detector tester and exchanger
EEPROM	Electrical Erasable Programmable Read Only Memory
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Influence
ESD	Electro Static Discharge
FET	Field Effect Transistor
IRED	Infra-Red Emitting Diode
µP	Microprocessor
MUX	Multiplexer
OptoRex	DO1151/DO1152/DO1153 smoke detector
RE6	Detector tester
RI	Response indicator
S11	Generic term of fire detection system S11

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