Long-range beam smoke detectors

D296/D297

BOSCH

en Installation manual

Table of contents

1 Notices

Notice!
Before installing any fire alarm system, consult your local authority having jurisdiction (AHJ).

Before installing the module, become familiar with the *Installation and Operation Guide* for the control panel you are using.

Caution!
In a power outage and restoral or an alarm reset, power is removed and reapplied to the receiver. An internal setup procedure is initiated within the detector and can last for up to 2 minutes. During this period, the detector is not able to initiate signals. Avoid connecting these detectors to circuits, such as those programmed for alarm verification, that remove and reapply power.

1.1 Regulatory

FCC compliance
This equipment was tested and complies with the limits for a Class B digital device, pursuant to Part 15 of the Federal Communications Commission (FCC) Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy. When this equipment is not installed and used according to the instructions, it might cause harmful interference to radio communications. There is no guarantee that interference will not occur in a particular installation.
If this equipment causes harmful interference to radio or television reception that can be determined by turning the equipment off and on, correct the interference by:
- Reorienting or relocating the receiving antenna.
- Increasing the separation between the equipment and the receiver.
- Connecting the equipment to an outlet on a circuit different from the circuit to which receiver is connected.
- Consulting the dealer or an experienced radio or TV technician for help.

Codes and standards
Install, test and maintain the module according to these instructions, NFPA codes, local codes, and the authority having jurisdiction (AHJ). Failure to follow these instructions can result in failure of a detector to initiate an alarm event. Bosch Security Systems, Inc. is not responsible for improperly installed, tested or maintained devices.

1.2 Trademarks

All hardware/software product names used in this document are likely to be registered trademarks and must be treated accordingly.
NFPA, NFPA 72, National Fire Protection Association, and National Fire Alarm and Signaling Code are registered trademarks of the National Fire Alarm Association, Inc. in the United States.

2 System overview

2.1 Description

The D296 (24 VDC) and D297 (12 VDC) Long-range beam smoke detectors have a separate transmitter and receiver. Internal aim adjustment provides coverage flexibility without brackets. Automatic signal synchronization and range adjustment reduce installation costs. Selectable sensitivity and alarm response time provide installation flexibility.
Use the D296/D297 detectors:

- Where there are high ceilings such as in atriums and aircraft hangers. Mount the detectors on walls for easy access.
- In dusty environments such as warehouses, factories, and barns. These detectors have built-in compensation to prevent alarms caused by dust.
- Where there are expansive ceilings. One set of D296/D297 detectors can replace up to 24 spot-type detectors. This saves on service and installation costs, especially in areas such as large offices or department stores.
- On ornamental ceilings where spot-type detectors are a distraction.
- Where there is limited access to the ceiling such as in factories and warehouses.

Available accessories:

- Included: a D344-RL Remote indicator plate, a D1005 Test cable, and a set of four plastic sensitivity test filters.
- A D344-RT Remote test/indicator plate (not supplied) is required for remote alarm testing.
- A D308 Field test kit (not supplied) is needed for field testing.

2.2 Operation

The detectors have separate transmitters and receivers . The transmitter projects an infrared (IR) beam across the protected area to a receiver containing a photosensitive cell that monitors the signal strength of the light beam.
The D296/D297 detectors work on the principle of obscuring light. The detector’s photosensitive element in the receiver sees light produced by the transmitter in a normal condition. The receiver is calibrated to a preset sensitivity level based on a percentage of total obscuration . Beam length and the desired response time determine this sensitivity level. The installer can choose from eight sensitivity settings based on the length of the beam used in a particular application.
The transmitter and receiver can be independently powered, greatly reducing wiring runs and installation cost. Since battery backup is required for fire alarm systems, battery backup is required for the transmitter whether it is powered from the control panel or is independently powered.
Unlike spot-type photoelectric smoke detectors , beam-type smoke detectors are generally less sensitive to the color of smoke. A beam-type smoke detector might be suited to applications inappropriate for spot-type detectors, such as applications where the anticipated fire would produce black smoke. Beam-type smoke detectors require visible smoke and might not be as sensitive as ion detectors in some applications.
Beam-type smoke detectors are sensitive to the cumulative obscuration presented by a smoke field. A combination of smoke density and the linear distance of the smoke field create this obscuration across the projected light beam . Cumulative obscuration is a measure of the percentage of light blockage.

Since the sudden and total obscuration of the light beam is not a typical smoke signature, the detector sees this as a trouble condition, not an alarm. This threshold is at a sensitivity level that exceeds 90% to 95% total obscuration . This minimizes the possibility of an unwanted alarm due to the blockage of the beam by a solid object such as a sign or ladder inadvertently placed in the beam path.

Very small, slow changes in the quality of the light source are not typical of a smoke signature. Such changes can occur because of environmental conditions such as dust and dirt accumulation on the transmitter , the receiver's optical assemblies, or both. Generally, the automatic environmental compensation circuit compensates for these changes. When you initially turn on the detector and run the setup program, it assumes the light signal level at that time as a reference point for a normal condition. Over time, the quality of the light signal degrades (perhaps due to dust), and the environmental compensation circuit compensates for this change. The compensation rate is limited, ensuring the detector remains sensitive to slow or smoldering fires. When the automatic environmental compensation circuit no longer compensates for signal loss (as with an excessive accumulation of dirt), the detector signals a trouble condition.

The receiver indicates a trouble condition if the beam strength increases more than 20%. An incorrectly aligned transmitter and receiver or a partially blocked beam can cause a trouble when the transmitter and receiver are installed.

Each transmitter sends an invisible infrared beam of a specific frequency and intensity. Each receiver detects and measures the beam's intensity. See the following figure.

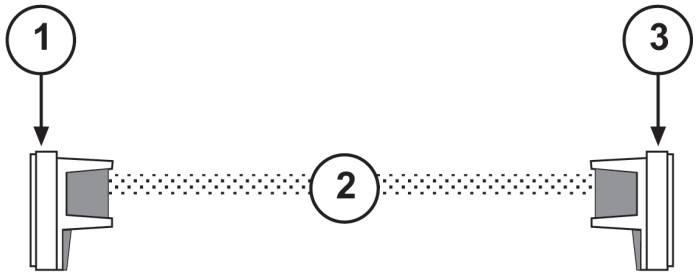

Figure 2.1: Infrared Transmission

1	Transmitter	3	Receiver
2	Beam		

As smoke obscures the beam, the receiver senses a decrease in the signal strength and measures that decrease. The receiver compares the signal level with two preset thresholds:

– an alarm threshold that is set using the sensitivity switch and
– a trouble threshold that is preset at approximately 10%

If the signal falls below the alarm threshold for the programmed alarm period, the receiver signals an alarm. See the following figure.

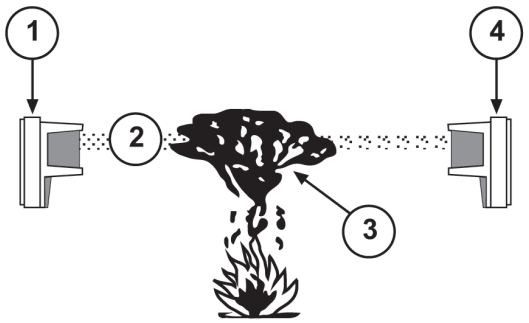

Figure 2.2: Beam Obscuration

1	Transmitter	3	Obscuring matter
2	Beam	4	Receiver

If an object blocks the beam, the signal falls below the trouble threshold. If this condition lasts for more than 20 seconds, the receiver signals a trouble condition. See the following figure.

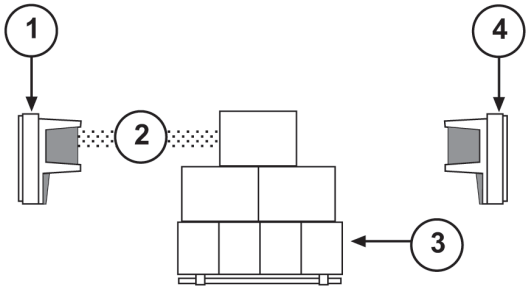

Figure 2.3: Beam Blockage

1	Transmitter	3	Blocking object
2	Beam	4	Receiver

The receiver automatically compensates for gradual signal loss from dust and dirt buildup on the cover. After a signal loss of 50%, the receiver indicates a trouble. When built-up dust and dirt or a blockage is removed, the detector automatically returns to normal operation level. The receiver indicates a trouble if the beam strength increases by more than 20% for longer than 20 sec. A trouble can be caused by an initial misalignment or the removal of a partial beam blockage during alignment. Perform a fine-tune alignment.
For alignment details, see *Setup, page 20*.

3 Installation considerations

Notice!
Smoke detector location
Correct smoke detector location and spacing is critical in a properly installed and operating fire alarm system. For best results, place and space the detectors according to NFPA Standard 72, The National Fire Code. This standard is available at a nominal cost from: The National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

In all installations, good engineering judgment must prevail.

- Do not use mirrors. Install detectors with a clear line-of-sight between the transmitter and receiver.
- Clear the beam path of moving objects.
- Avoid areas with normal smoke concentrations, such as kitchens and garages.
- Do not install detectors where the normal ambient temperatures are below -22°F (-30°C) or above +130°F (+54°C).
- Set sensitivity based on the distance between the transmitter and receiver. For information on selecting and setting sensitivity, see *Design for the expected fire load, page 10* and *Sensitivity setting, page 14*.

3.1 Avoid air movement sources

- Place the transmitters/receivers where the beam path does not pass near heating and cooling outlets. Do not mount where hot or cold air blows directly into the beam path. Heating, ventilating, and air conditioning (HVAC) systems can blow smoke away from the beam path. Smoke must accumulate in the beam path to be detected.
- Do not mount heaters close to the beam path. Heat can distort the beam.
- Test for beam distortion by monitoring the signal voltage. After setup, the detector's signal voltage must read between 3.8 VDC and 4.2 VDC. Monitor the voltage and turn on all heating and cooling devices in the area. The signal voltage must not fluctuate more than 0.20 VDC. If it does, relocate the detector to avoid disturbances.

3.2 Avoid bright light sources

Bright light can cause stray signals. Do not point the receiver toward any of the following sources.

Sunlight: Do not point the receiver directly at the rising or setting sun. If installing the receiver where sunlight cannot be avoided, mount it slightly higher than the transmitter and aim it down toward the transmitter. This causes the receiver to look below the horizon.

Bright Lights: Do not mount the receiver where it looks at exposed bulbs of high-pressure sodium, mercury vapor, and metal halide lights. For an illustration of areas in which to avoid exposed lights, see the following figure.

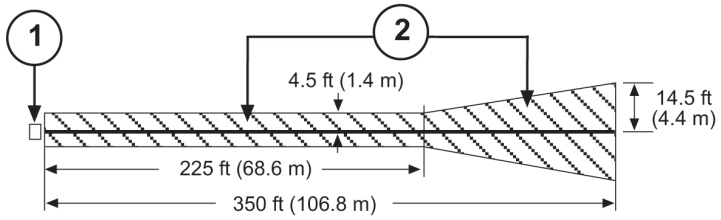

Figure 3.1: Avoiding Exposed Lights

1	Receiver	2	Do **not** place bright lights in this area.

Bare fluorescent lights can also create a problem, especially in long hallways where a series of lights are perpendicular to the beam. Incandescent lights are not a problem as long as they are not directly in the beam path.

3.3 Use correct wire gauge and length

Beam smoke detectors are often used to protect large areas, requiring long wire runs to power the detectors and signal alarm conditions. The voltage available at the end of long wire runs might not be sufficient to power the detector, especially when the system is running on backup battery power. Use the correct wire gauge when installing detectors.

D296 Smoke detector, long-range beam 24V

For the proper number of D296 transmitter and receiver pairs depending on wire size and length, see the following table.

Wire Length	Wire Size		
	14 AWG (ISO 2.5 mm²)	**16 AWG (ISO 1.5 mm²)**	**18 AWG (ISO 0.75 mm²)**
500 ft. (152 m)	8 pairs	5 pairs	3 pairs
1000 ft. (304 m)	4 pairs	2 pairs	1 pair
1500 ft. (457 m)	2 pairs	1 pair	1 pair
2000 ft. (609 m)	2 pairs	1 pair	0
2500 ft. (762 m)	1 pair	1 pair	0

Tab. 3.1: Wire Gauge and Length

D297 Smoke detector, long-range beam 12V

For the proper number of D297 transmitter and receiver pairs depending on wire size and length, see the following table.

Wire Length	Wire Size		
	14 AWG (ISO 2.5 mm²)	**16 AWG (ISO 1.5 mm²)**	**18 AWG (ISO 0.75 mm²)**
100 ft. (30 m)	7 pairs	4 pairs	2 pairs
250 ft. (76 m)	2 pairs	1 pair	1 pair
400 ft. (122 m)	1 pair	1 pair	0
550 ft. (168 m)	1 pair	0	0
700 ft. (213 m)	1 pair	0	0

Tab. 3.2: Wire Gauge and Length

3.4 Provide a stable mounting surface

Beam smoke detectors depend on the projected beam measurement to sense smoke. Trouble or alarm conditions can be caused by shifts in beam alignment when the transmitter or receiver moves.

Never mount a detector to pipe or length of wood that is supported at only one end. This type of suspended support can create a pendulum effect. The pendulum effect greatly multiplies even very small movements at one end of the support. Support mounting surfaces at opposite corners to reduce the pendulum effect.

Always select surfaces that are not subject to building movement. The automatic compensation circuits eliminate most problems created by normal building expansions and contractions. Sometimes the walls and support structure might be subject to more significant movement. This can be caused by heavy equipment operation, such as cranes anchored to the top of the walls.

When you are uncertain about mounting surface stability, measure the detector's signal voltage. This voltage must be between 3.8 VDC and 4.2 VDC. Beam misalignment can cause this voltage to increase or decrease. The detector indicates a trouble condition when, over a long period, the voltage:

– increases to greater than ~4.8 VDC or
– decreases to less than ~2 VDC

A trouble condition also occurs when voltage decreases to ~0.4 VDC for more than 20 sec. For how to take a voltage reading, see *Reference voltage adjustment, page 27***.**

To prevent movement if you expect the mounting surface to move:

– relocate the detector to a stable surface or
– add supports to the mounting surface

Mounting the detector to a 4-inch square or octagonal electrical mounting box can bow the mounting plate. Bowing occurs because the mounting box screw tabs are below flush with the top edges of the mounting box. Over tightening the mounting screws bows the mounting plate inward at the bottom, causing the optics to aim low. Irregularities in the flatness of the mounting box edge surfaces or at the screw tabs worsens this condition. Only use mounting boxes with flat, regular surfaces and properly formed screw tabs. Minimize misalignment caused by mounting plate bowing by tightening the mounting screws to secure the mounting plate to:

– 2 in. (5 cm) or
– 2 lb (0.9 k) torque

3.5 Plan for the effects of stratification in cold environments

Air stratification might prevent smoke from reaching detectors mounted close to the ceiling. Stratification occurs when smoke, rising because it is warmer than the surrounding air, reaches a level where it is the same temperature as the surrounding air and does not rise to the ceiling. In extremely cold environments such as unheated warehouses, smoke cools very quickly and is less likely to rise to the ceiling. Add more detectors at lower mounting heights to compensate.

3.6 Design for the expected fire load

When designing a fire alarm system, set detector sensitivity to:

– respond to the proper smoke obscuration and
– reduce the chance of a false activation within the application

As illustrated in the following figure, the total obscuration of the infrared beam depends on

– the density of the smoke and
– width of the smoke cloud along the beam path

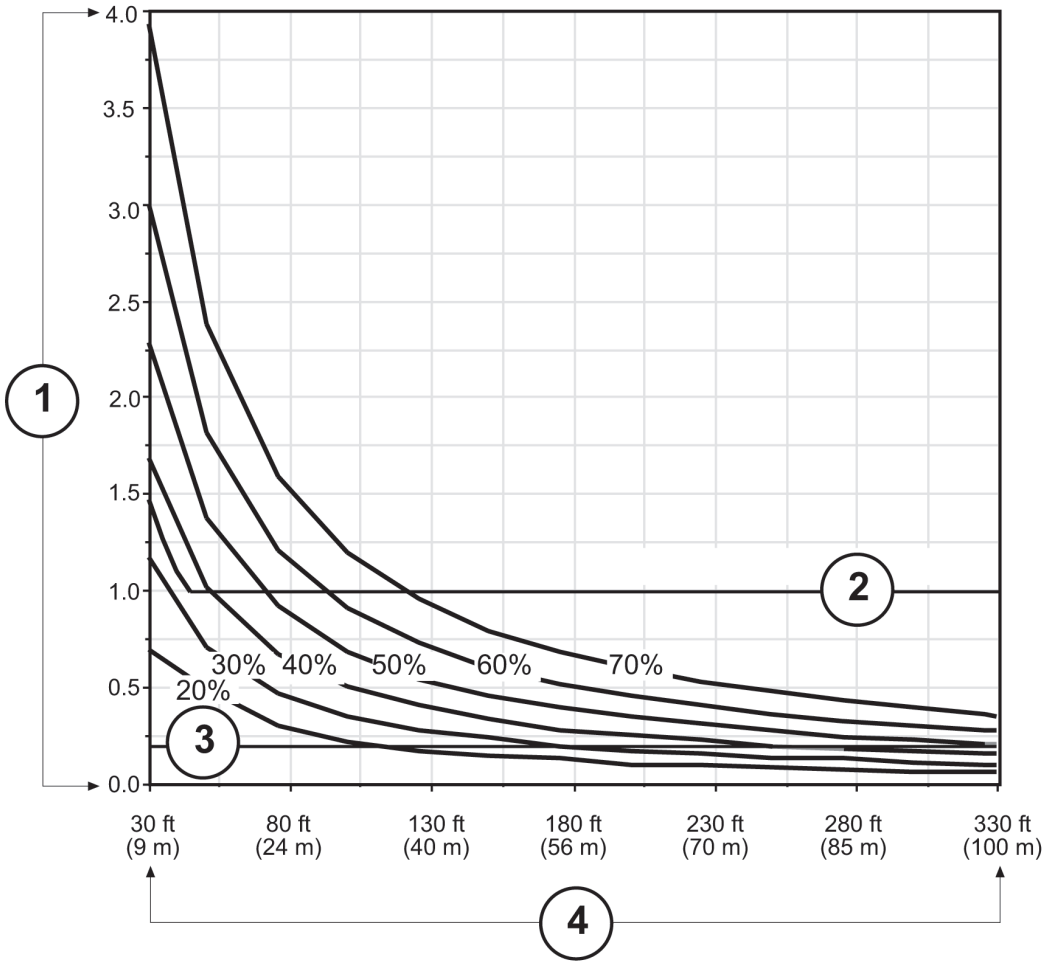

Figure 3.2: Smoke Densty and Obscuration Graph

1	Smoke density	3	UL maximum sensitiivity
2	UL minimum sensitivity	4	Distance between transmitter and receiver

Determine the total obscuration needed for an alarm and select the sensitivity setting needed according to the following table.

Total Obscuration at Alarm	Sensitivity Switch Setting
20%	2
30%	0 or 3
40%	4
50%	5
60%	1 or 6
70%	7

The D296 and D297 can be set for quick response (5 sec) or normal response (30 sec). Some burning materials release hazardous gases along with the smoke. Set the sensitivity for a shorter response times to minimize exposure to the dangerous vapors. Denser smokes allowed to collect for too long, can produce near total obscuration of the detector. This

results in a trouble signal before an alarm is generated. For example, fires caused by the ignition of flammable petroleum-based liquids generally lead to rapid buildup of heavy smoke. When this type of fire is probable, use sensitivity settings 0 or 1 for a 5-sec response time. For instructions on setting the sensitivity, see *Sensitivity setting, page 14*.

4 Mounting

Notice!
Use this product in indoor, dry applications only.

1. Install a 4-in. square or octagonal electrical box (or equivalent) to a rigid surface. Ensure that the surface is not subject to movement or vibrations.
2. Remove the screw on the receiver's access door. Then remove the cover’s four screws indicated in the following figure.

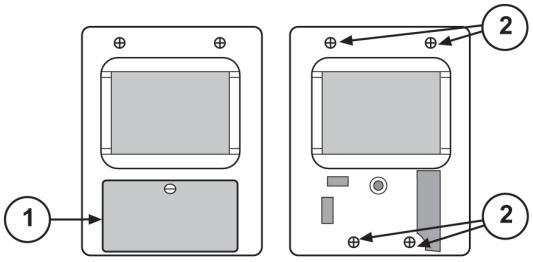

Figure 4.1: Access Door and Cover

1	Access door	2	Cover mounting screws (4)

3. Unscrew the single mounting screw at the top of the circuit board carrier plate and separate the plates See the following figure.

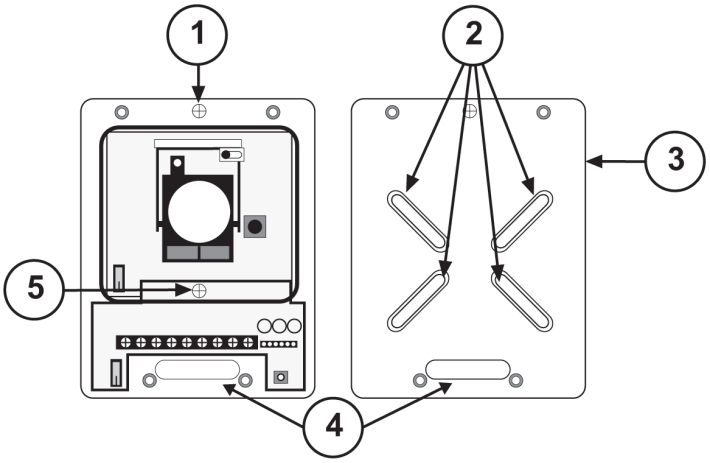

Figure 4.2: Removing the Back Plate

1	Remove screw to expose back plate	4	Wiring entrance
2	Mounting slots (4)	5	Do **not** remove
3	Back Plate		

Warning!
Remove power to all wiring before proceeding.

4. Route the wiring from the electrical box through the wire entrance. If you are going to connect a D344-RL or D344-RT to the receiver, route that wiring also.

5. Mount the back plate to the electrical box.
6. Attach the circuit carrier plate to the back plate using a single mounting screw.
7. Repeat Steps 1 through 6 to mount the transmitter.

Notice!
The D344-RL and D344-RT connect only to the receiver.

4.1 Sensitivity setting

To set sensitivity, use the following procedure:

1. Select the appropriate sensitivity setting based on the distance between the transmitter and receiver. For a list of distances including some settings that overlap, see the following table. Select a lower setting for a more sensitive detection or select a higher setting for better immunity to false alarms.

Switch Setting	Sensitivity	Alarm Response	Beam Length
0	30%	5 sec	30 ft to 100 ft (9 m to 31 m)
1	60%	5 sec	100 ft to 350 ft (31 m to 107 m)
2	20%	30 sec	30 ft to 50 ft (9 m to 15 m)
3	30%	30 sec	45 ft to 75 ft (14 m to 23 m)
4	40%	30 sec	70 ft to 100 ft (21 m to 31 m)
5	50%	30 sec	90 ft to 140 ft (27 m to 43 m)
6	60%	30 sec	120 ft to 180 ft (37 m to 55 m)
7	70%	30 sec	160 ft to 350 ft (49 m to 107 m)
8*	Not used		
9*	Not used		
* Do not use positions 8 and 9. They are not valid.			

2. Set the receiver’s sensitivity switch to your selected setting. The sensitivity switch is located to the right of the optical module. The indicator, or pointer marking, runs along the side of the switches' shaft as indicated in the following figure.

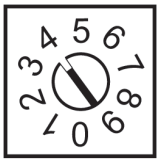

Figure 4.3: Sensitivity Switch

4.2 Quick start installation flowchart

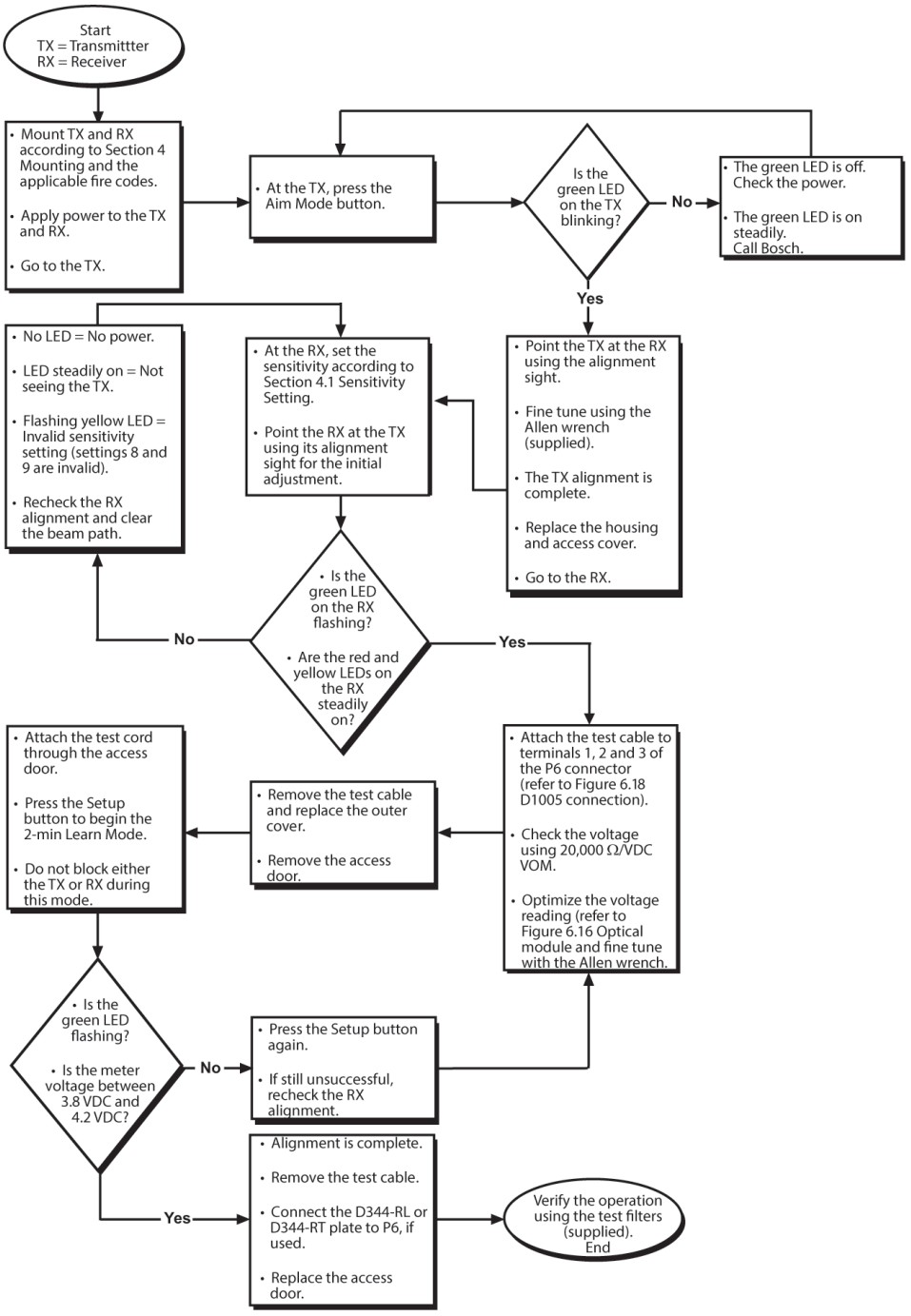

Figure 4.4: Installation Flowchart

5 Wiring

Warning!
Only apply power after all connections are made and inspected.

Notice!
Do not install on fire circuits programmed for alarm verification.

Notice!
Do not coil excess wiring inside the units.

5.1 Wiring a single detector

When wiring the transmitter and receiver terminals, see the following figure and table.

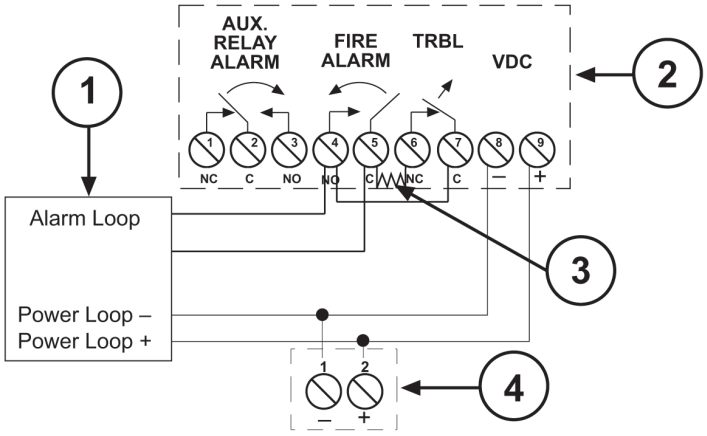

Figure 5.1: Wiring a single detector

1	Fire alarm control panel (FACP)	3	End-of-line (EOL) resistor
2	Receiver	4	Transmitter

Type	Terminal	Description
Transmitter terminals	1 and 2	Input power terminals. for operating voltages, see *Specifications, page 29*.
Receiver terminals	1, 2, and 3	Form C auxiliary relay contacts. On fire alarm, Terminals 1 and 2 open, Terminals 2 and 3 close (short).
Receiver terminals	4 and 5	On fire alarm, normally open (NO) fire alarm contacts close (short).
Receiver terminals	6 and 7	On trouble, normally closed (NC) trouble contacts open.

Type	Terminal	Description
Receiver terminals	8 and 9	Input power terminals. For operating voltages, see *Specifications, page 29*.

Tab. 5.3: Transmitter and Receiver Terminals

Notice!
To reset after a fire alarm, interrupt power to the receiver for a minimum of 1 sec. If the fire panel does not allow you to reset, install a switch in series with Terminal 8.

5.2 Wiring a remote indicator

A D344-RL Remote indicator plate is shipped with the D296 as a standard accessory. The D344-RL has three LEDs to indicate the detector's condition and status. The indicator plate also has test points for measuring the sensitivity voltage. Although not required, Bosch recommends the D344-RL's installation to check the detector's condition from ground level. If using D344-RL, install the remote indicator connector to the receiver as indicated in the following figure.

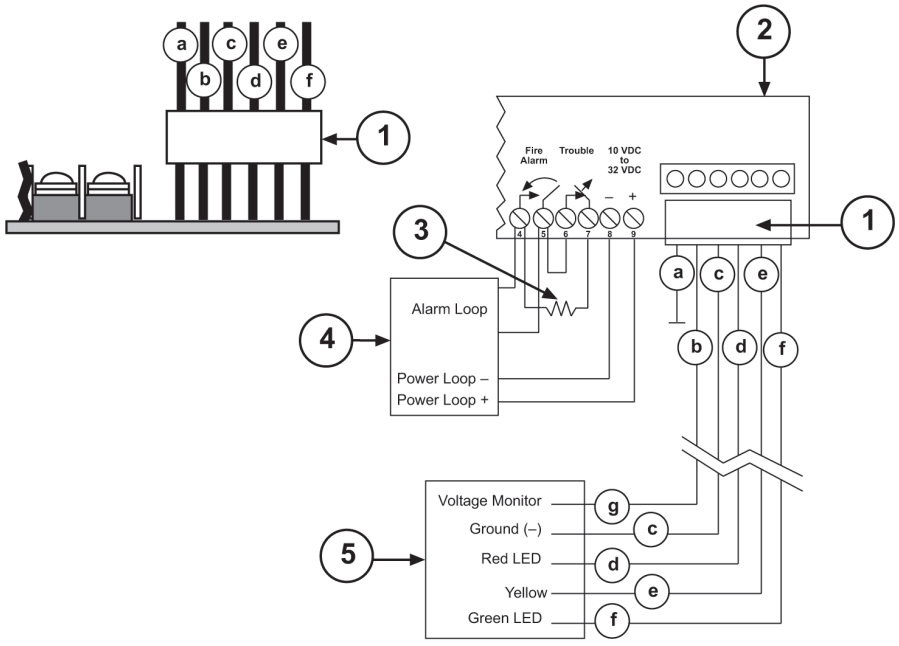

Figure 5.2: Connecting a D344-RL Remote Indicator Plate

1	D344-RL Remote Indicator Plate Connector	4	FACP
2	D296/D297 Receiver	5	D344-RL Remote Indicator Plate
3	EOL resistor	6	Wiring: a=orange, b=blue, c=black, d=red, e=yellow, f=green, g=violet

You can wire the D344-RL a maximum of 500 ft. (152 m) from the receiver.
A D344-RT Remote test/indicator plate can be used if remote alarm testing is desired. Connect the wiring between the D296 or D297 and a D344-RT according to the following figure:

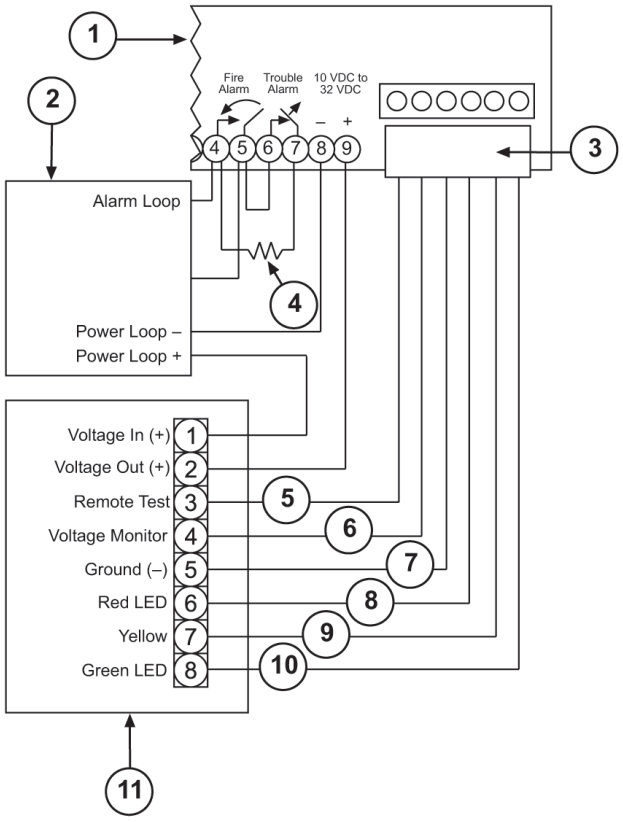

Figure 5.3: Connecting a D344-RT Remote Test and Indicator Plate

1	D296/D297 receiver	2	Fire alarm control panel (FACP)
3	Remote indicator plate connector	4	End-of-line resistor
5	Remote test (orange wire)	6	Voltage monitor (blue wire)
7	Ground (black wire)	8	Red LED (red wire)
9	Yellow LED (yellow wire)	10	Green LED (green wire)
11	D34-RT Remote Test and Indicator Plate		

5.3 Wiring multiple detectors

For smooth, flat ceilings, mount the detectors so the spacing is ≤ 60 ft. (18.3 m) between beam paths. Ensure that no more than half of this spacing is between the beam path and side wall. (The side wall is the wall parallel to the beam path). Other spacing depends on ceiling height, air flow characteristics, and response requirements. The minimum spacing between alternated adjacent detectors is 1/10th the distance between the transmitter and receiver. For example, if the beam length is 300 ft. (91 m), place detectors ≤ 30 ft. (9.1 m) apart. For layout placement, see the following figure.

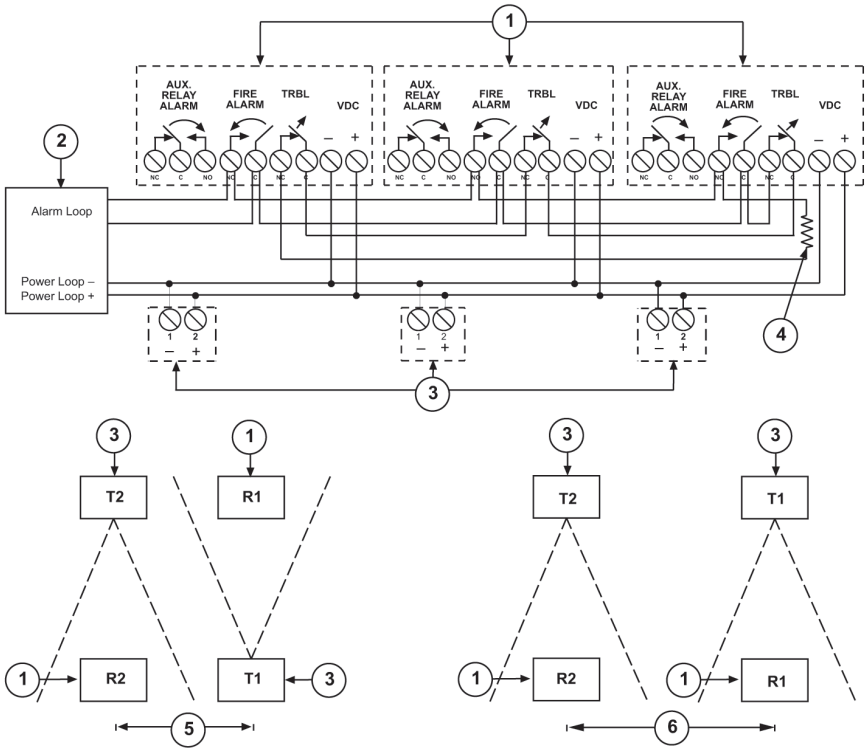

Figure 5.4: Transmitter and Receiver Placement

1	Receiver	4	EOL resistor
2	FACP	5	Minimum spacing = 1/10 x distance
3	Transmitter	6	Minimum spacing = 1/5 x distance
* maximum spacing between adjacent systems is 60 ft (16.3 m)			

Notice!
When two or more adjacent detectors are installed in the same area, alternate the transmitter and receiver locations. If not alternated, ensure the spacing between the detectors is 1/5th the distance from the transmitter to the receiver.

6 Setup

Before performing a setup, ensure all connections are made and secure. Then, apply power to the transmitter and receiver.

1. To allow transmitter power up while the cover is off, press the transmitter's Aim Mode button. This button is located above the green LED as indicated in the following figure.

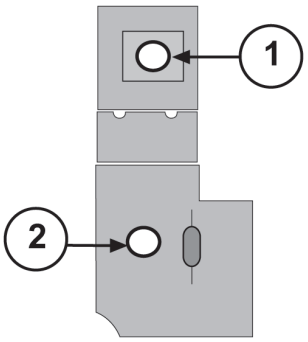

Figure 6.1: Transmitter Circuit Board Showing Aim Mode Button

1	Aim Mode button	2	Green LED

2. Ensure the green LED flashes on and off. If this LED is off, check for power and proper polarity on Terminals 1 (–) and 2 (+). If the green LED is steadily lit, you have a faulty transmitter. Begin the process of obtaining a replacement by:
   - calling the Bosch National Repair Center at (800) 366-2283 or
   - sending an e-mail to repair@us.bosch.com
3. Check the three receiver LEDs indicated in the following figure. It is normal for all three LEDs to be on at this time. The green LED can be either flashing or steadily on. If all LEDs are off, check for power and proper polarity on Terminals 8 (–) and 9 (+).

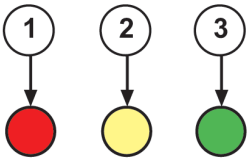

Figure 6.2: Receiver LEDs

1	Alarm LED (red)	3	Normal LED (green)
2	Trouble LED (yellow)		

4. Depending on your application, an aid to alignment might be necessary. If so, mount an aiming light as close to the receiver as possible, preferably on top of the receiver.
5. Point the aiming light (D309 or equivalent) at the transmitter using it as your aiming guide.

6.1 Preliminary alignment

Each optical module has two alignment mirrors, one on each side, for preliminary alignment. See the following figure.

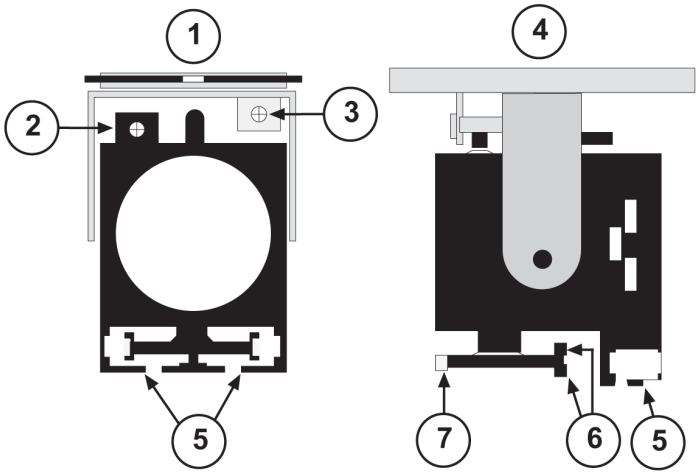

Figure 6.3: Optical Module

1	Front view	5	Alignment mirrors (3)
2	Vertical fine tune	6	Rear bore sights (2)
3	Horizontal fine tune	7	Front bore sight
4	Side view		

For preliminary alignment of the transmitter and receiver, use the following procedure:

1. Look into either mirror from a side angle at ≥ 2 ft. (61 cm) from the module.
2. Use the rear and front sights in the same way as you use sights when aiming a gun.
3. Rotate the transmitter's optical module left or right until you see the reflection in the mirror of:
   – aiming light image or
   – receiver’s image, if the aiming light is not used
4. The optical module is aligned when the front bore sight is in the center of the rear bore sights. See the following figure.

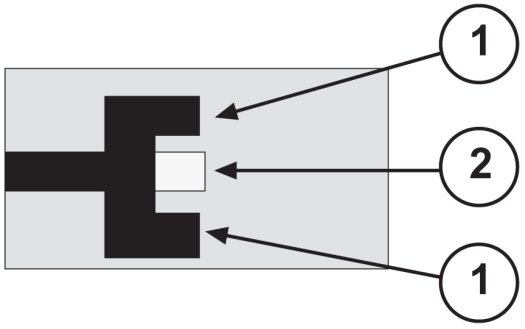

Figure 6.4: Alignment Mirror

1	Rear bore sights (2)	2	Front bore sight

5. Adjust the optical module up or down until you see the image. Use the supplied Allen wrench to adjust the Vertical Fine Tuning adjustment Allen screw.
6. Fine tune the image to the center of the mirror. It should be aligned with the front and rear bore sights. Use the Horizontal and Vertical Fine Tuning adjustment screws for tuning.

7. Replace and secure the transmitter's cover.
8. Ensure the transmitter's green LED is flashing.
9. Replace and secure the transmitter's access door.
10. Align the receiver to the transmitter image following Steps 1 through 7.
11. Ensure the receiver's green LED is flashing, indicating the preliminary alignment is complete.
12. If the receiver’s green LED is not flashing, repeat Steps 1 through 9 for the receiver.

6.2 Fine-Tune alignment

To fine tune the alignment of the transmitter and receiver, use the following procedure:

1. Connect the D1005 Test cable (supplied) to Pins 1, 2, and 3 of P6. The pins are located to the right of the receiver’s terminal strip. See the following figure.

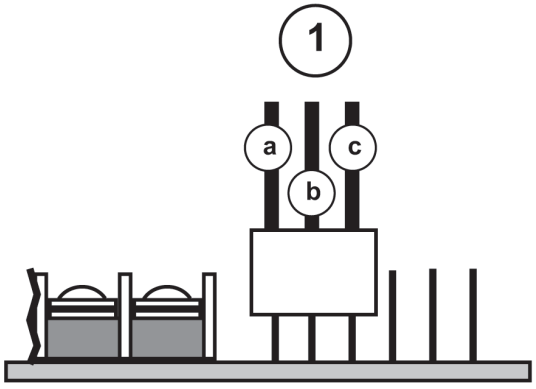

Figure 6.5: D1005 Connection

1	Connector wires: a = white, b = red [+], c = black [-]

Notice!
If the Remote Indicator Plate connector is installed, temporarily disconnect it.

2. Connect a ≥20,000 Ω/VDC VOM to the D1005’s black (–) and red (+) leads. Set the meter scale so you see the readings ranging from 0 VDC to 5 VDC.
3. Check the three receiver LEDs on the receiver.

– If the receiver gets the beam, the green LED flashes and the red and yellow LEDs are steadily on.
– If the green LED is steadily on, the beam is not reaching the receiver. Realign according to the procedure described in *Preliminary alignment, page 20*.

4. Observe the meter readings. Adjust the receiver’s optical module using the horizontal and vertical fine-tuning adjustment screws for a maximum meter reading.

Notice!
This is the most critical alignment process. For the most effective system operation, ensure you have peak voltage during the fine-tune alignment.

Notice!
When performing fine-tune alignment, keep your arms and hands out of the beam path.

– The maximum voltage peak reading varies, depending on the distance between the transmitter and receiver. The acceptable peak voltage range is from 0.50 V to 5.00 V. The voltage at the receiver is greater at shorter distances.
– Make a note of the alignment voltage. It might be helpful if you need to troubleshoot at another time.

Notice!
Peak the voltage to ensure a stable and trouble-free detector.

5. After completing the fine-tune alignment, remove the test cable.
6. Replace and secure the receiver's cover.
7. Check the status of the receiver's green LED to ensure it is still flashing.
8. With the meter still connected to the test cable, reinstall this cable to P6. Route the test cable through the opening in the cover (white lead towards center of the receiver).
9. At this point, you can perform an Alarm Test. Connect the D1005's white and black wires. Reset the receiver by temporarily removing power.
10. Press the receiver's Setup button, located below the P6 and test cable connection. See the following figure.

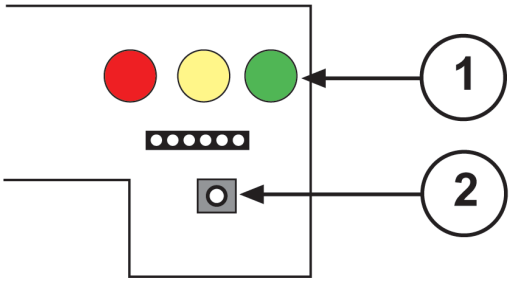

Figure 6.6: Receiver Setup Button

1	LEDs	2	Setup button

Notice!
Only press the Setup button if the covers are on both the transmitter and receiver.

– A 1-min to 2-min automatic internal setup process begins. This setup ends in a reference voltage that is used to measure beam blockages.
– The red and yellow LEDs turn off and the green LED turns steadily on. After some voltage fluctuations, the meter sets to 5.0 VDC.

Notice!
During this time, do not block the beam or move the units.

11. At the end of the setup, the receiver's green LED flashes. The voltage decreases to a range from 3.8 VDC to 4.2 VDC. Use this voltage as a reference when you compare later readings to determine the need for cleaning. If the voltage is not within this range, press the Setup button.

12. After setup, remove the test cable.
13. Reconnect the remote indicator plate connector, if used.
14. Replace and secure the access door.

7 Troubleshooting

7.1 Transmitter

LED	Condition	Solution
Flashing	Normal	
Off	1. There is no power at the transmitter. 2. The Aim Mode button not pressed. 3. The transmitter is faulty.	1. Restore power to Terminals 1 and 2. 2. Press the Aim Mode button. 3. Replace the transmitter.

7.2 Receiver - Aim Mode (cover off)

Red LED	Yellow LED	Green LED	Terminals 4 and 5	Terminals 6 and 7	Condition	Solution
On	On	Flashing	Open	Open	The alignment is acceptable.	
On	On	On	Open	Open	The beam is blocked or the receiver is misaligned.	Clear the beam path or realign the receiver.
On	Flashing	Flashing	Open	Open	The sensitivity setting is invalid.	Set the receiver to the proper setting.
On	Off	Off	Open	Open	There is no power.	Check for power at Terminals 8 and 9.

7.3 Receiver - Normal Mode (cover on)

Red LED	Yellow LED	Green LED	Terminals 4 and 5	Terminals 6 and 7	Condition	Solution
Off	Off	On	Open	Closed	The receiver is initializing. It stabilizes in 60 sec to 120 sec.	
Off	Off	On	Open	Open	The receiver is initializing. The access door is missing or loose.	Replace the access door.
Off	Off	Flashing	Open	Closed	Normal	
Off	Off	Flashing	Open	Open	The access door is missing or loose.	Replace the access door.
Off	On	On	Open	Open	Trouble. Beam is blocked or misaligned.	Clear the beam path or realign the receiver.

Red LED	Yellow LED	Green LED	Terminals 4 and 5	Terminals 6 and 7	Condition	Solution
Off	On	Flashing	Open	Open	Trouble. If the reference voltage is less than ~2 VDC, dust on the lens reduced the signal strength or vibration misaligned the receiver.	Clean the transmitter and receiver covers. If the reference voltage does not return to 3.8 VDC to 4.2 VDC, realign the receiver and press the Setup switch.
Off	On	Flashing	Open	Open	If the reference voltage is greater than ~4.2 VDC, the beam strength increased because an initial beam misaligned or a partial blockage was removed at setup.	Perform a fine-tune alignment of the receiver and use the Setup button.
On	Off	Flashing	Closed	Closed	Alarm	Determine the cause of the alarm and reset the receiver.
On	Off	Flashing	Closed	Open	Alarm. The access door is missing or loose.	Determine the cause of the alarm and reset the receiver. Replace the access door.
On	On	On	Closed	Open	Alarm and Trouble. An alarm occurred, then the beam was blocked.	Determine the cause of the alarm and reset the receiver. Clear the beam path.

8 Maintenance and Testing

8.1 Fire alarm reset

Reset the receiver after a fire alarm by removing power from the receiver for at least 1 sec., then reapply power.
For additional information, see *Power outage, page 27*.

8.2 Reference voltage adjustment

Notice!
Clean covers are necessary for proper reference voltage readings. For cleaning procedures, see *Cleaning, page 27*.

Check the detector's reference voltage a minimum of once each year. Check the voltage more often if required by local regulations or AHJs.
To check the reference voltage, connect a VOM to the voltage monitor contacts on the D344-RL or D344-RT, if used. If you do not have a remote indicator connected to the detector, remove the receiver access door and measure the reference voltage using the supplied test cable. For cable connection, see *Fine-Tune alignment, page 22*.
If the voltage is less than 3.8 VDC or greater than 4.2 VDC, remove the access cover and press the setup button to initiate a reset of the reference voltage. The reset can take 1 min to 2 min.

8.3 Cleaning

Clean the outside of the covers a minimum of once each year. Use a common window cleaner and a soft, clean cloth. Under normal conditions, there is no trouble alarm if the beam is not continuously blocked for longer than 18 sec. After cleaning, recheck the reference voltage. If voltage is less than 3.8 VDC or greater than 4.2 VDC, reset the reference voltage using the procedure in *Reference voltage adjustment, page 27*.

8.4 Power outage

When power is removed and reapplied to the receiver, such as in a power outage or alarm reset, the original reference voltage information is lost.
– If the cover is on when power is applied, the receiver restarts the process for a new reference voltage
– If the cover is off, reattach it and press the setup button.

8.5 Remote Test

Notice!
A D344-RT is required for the remote alarm test.

Notice!
Clean covers are necessary for proper reference voltage readings. For cleaning procedures, see *Cleaning, page 27*. For aiming procedures, see *Preliminary alignment, page 20* and *Fine-Tune alignment, page 22*.

1. With a D344-RT connected to the receiver, use the following procedure to perform a remote test.
2. Insert the operating key and turn the switch to the TEST position for a minimum of 5 sec.

The red LED lights steadily and the system sounds an alarm.

3. Turn the switch to RESET for a minimum of 1 sec.
   The red LED turns off and the green LED lights steadily for approximately 60 sec. to 120 sec.
   The receiver proceeds with Setup Mode. When the setup is completed, the green LED begins flashing.
4. Connect a standard volt-ohm meter (VOM) to the voltage monitor plugs. The voltage reading must range between 3.8 VDC and 4.2 VDC when clean and properly aimed.

Notice!
You can also use the voltage monitor to check the sensitivity level of the detector. As the signal level decreases because of dust or dirt buildup on the lenses or system misalignment, the voltage reading also decreases.

8.6 Field sensitivity measurements

Notice!
Testing these detectors activates a fire alarm. Inform all concerned personnel before performing a test.

The detectors automatically compensate for the effects of dust and dirt accumulation on their covers. They also compensate for component aging.

Notice!
NFPA 72 requires the detector sensitivity be measured in the field within one year after initial installation and every alternate year thereafter.

Use the Sensitivity Test Kit supplied with the detector to check detector sensitivity only during installation. For field testing, order and use a D308 Test Kit.
Each filter decreases the detector's signal by a specific amount. Place a filter in front of the receiver's optical module. Hold it there for a minimum of 30 sec. (5 sec. for position 0 or 1). Determine the approximate sensitivity setting of the installed detector by the response as shown in the following table.

Sensitivity Setting	Must Not Alarm	Must Alarm
2	0% (no filter)	40% filter
0 or 3	0% (no filter)	60% filter
4	20% (filter)	60% filter
5	20% (filter)	80% filter
1 or 6	40% (filter)	80% filter
7	40% (filter)	80% filter

Tab. 8.4: Sensitivity and Response

9 Specifications

Electrical

Alarm Current (Receiver)	D296: 70 mA maximum at 24 VDC D297: 75 mA at 12 VDC
Standby Current	D296 Receiver: 45 mA at 24 VDC D296 Transmitter: 20 mA at 24 VDC D297 Receiver: 50 mA at 12 VDC D297 Transmitter: 20 mA at 12 VDC
Operating Voltage	D296: 18.0 VDC to 32.0 VDC D297: 10.2 VDC to 15.0 VDC
Alarm contacts	Normally Open (N/O) contacts rated 1 A, 60 VDC maximum for DC resistive loads, do **not** use with capacitive or inductive loads
Auxiliary alarm contacts	Normally Open (N/O) contacts rated 1 A, 60 VDC maximum for DC resistive loads, do **not** use with capacitive or inductive loads
Trouble contacts	Normally Closed (N/C) contacts rated 1 A, 60 VDC maximum for DC resistive loads, do **not** use with capacitive or inductive loads

Environmental

Environment	Indoor, dry
Relative humidity	0% to 95%, non-condensing
Temperature (storage and operating)	-22°F to +130°F (-30°C to +54°C) *For UL Listed installations, the range is +32°F to +130°F (0°C to +54°C)*

Mechanical

Dimensions	7 in. x 5.5 in. x 5.5 in. (17.8 cm x 14 cm x 14 cm)
Mounting	Mount to 3.5 in. or 4-in. square or octagonal electrical boxes or European Beza boxes
Adjustability	Internally adjustable optics for ±90° horizontal, and ±10° vertical adjustment
Sensitivity	Field selectable for 20%, 30%, 40%, 50%, 60%, or 70% beam obscuration
System Signaling	Conventional four-wire system, do **not** use with systems incorporating an alarm verification feature
Signal Delay	Fire: Selectable 30 sec or 5 sec Trouble: 20 ± 2 sec
Spacing (distance between systems)	60 ft. (18 m) maximum, spacing confirmed by Underwriters Laboratories (UL) testing

Transmission range	30 ft. (9 m) to 350 ft. (107 m)
Tamper	Receiver: Access door tamper switch in series with trouble contacts. Transmitter: When the cover is removed, the cover tamper switch interrupts transmission

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