FB-AP Series®

FB-AP Series Beam Detector 7254-FBD-9266
Technical Bulletin©

General
The FB-AP Series Beam detector comprises a transmitter, a receiver, an interface and, optionally, one or more reflectors. The transmitter projects a beam of modulated infra-red light to the receiver which converts it to an electrical signal for processing by the interface. The transmitter and receiver are mounted so that the beam will project approximately 1–2ft (0.3m–0.6m) below and parallel to the roof or ceiling level at ranges up to 330ft (100m). The maximum lateral detection range is 25ft (7.5m) either side of the actual beam. The interface is usually installed at ground level.

Smoke Detection
When smoke is present in the beam path, the light registered by the receiver is reduced by a level determined by the density of the smoke. In the event of the smoke obscuring the light by a pre-selected minimum level for a period of 8 to 10 seconds, a fire signal is generated. The detection level can be set to 25%, 35%, 50% or 65% to suit different environments, examples of which are given in the following table:

Obscuration level in %	Typical application
25	Offices, small premises, non-smoking clean areas eg, museums, theatres
35	Factories, warehouses
50	Hostile environments eg mills, foundries
65	Retro mode operation only

Auto Reset
If the beam detector has been in fire or trouble condition it will automatically reset, once the fire or trouble is no longer present. After a fire condition there is a reset delay of 30 seconds and after a trouble a reset delay of 3 seconds.

Drift Compensation
Over a period of time, the light registered by the receiver might be reduced by factors such as a gradual accumulation of contamination on the lenses of the detector. The FB-AP Series Beam detector compensates for this drift automatically in order to reduce the likelihood of unwanted alarms. At the limit of compensation, the beam detector transmits a trouble signal. In the event of a fire being detected when the beam detector has reached its compensation limit, the fire signal will override the trouble signal.

Positioning Beam Detectors
It is important that the FB-AP Series Beam detector be positioned correctly to minimize the detection time. The detection time depends on the location of the beam detector within the protected area, the volume of smoke produced, the construction of the roof and the ventilation arrangements.

When deciding where to install the beam detector, consideration should be given to the construction of the surface to which it is to be fitted and to possible changes as a result, for example, of changing seasons. It is important that these surfaces be solid and not subject to movement.

Particular areas where beam detectors should not be located include:

- Spaces where very high levels of ambient light are present in normal conditions.
- Areas where excessive amounts of dust, smoke or water vapor are present as part of the normal environment.
- Buildings where it is not possible to mount the beam detector rigidly and/or align it correctly.

The maximum distance either side of the beam axis is typically 25ft (7.5m) for satisfactory detection under flat ceilings, providing a maximum total area coverage of 16,500 sq ft (1500ml), ie, 330ft x 50ft (100m x 15m). The recommended installation height is 1–2 ft (0.3m–0.6m) below the ceiling.

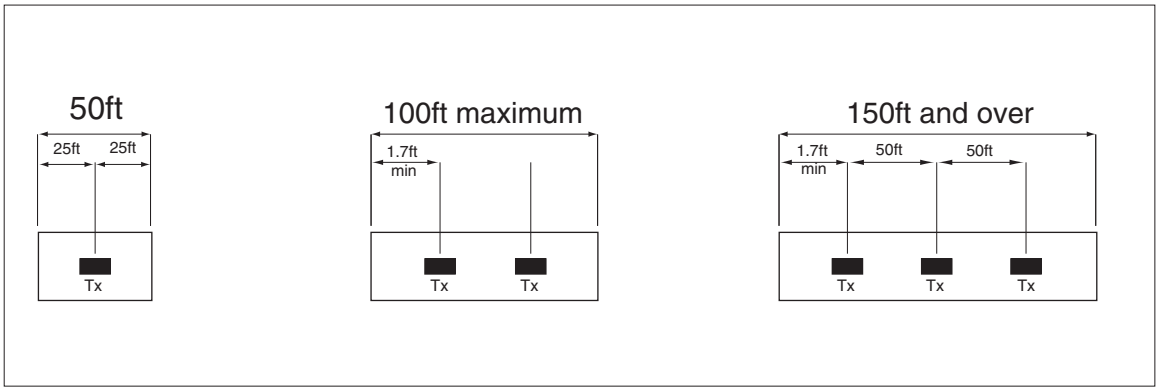

Fig 1 *Positioning detectors under flat ceilings*

In buildings with pitched roofs or ceilings the maximum distance either side of the beam *in the apex only* may be increased by 1% for each degree of ceiling pitch up to a maximum of 25%.

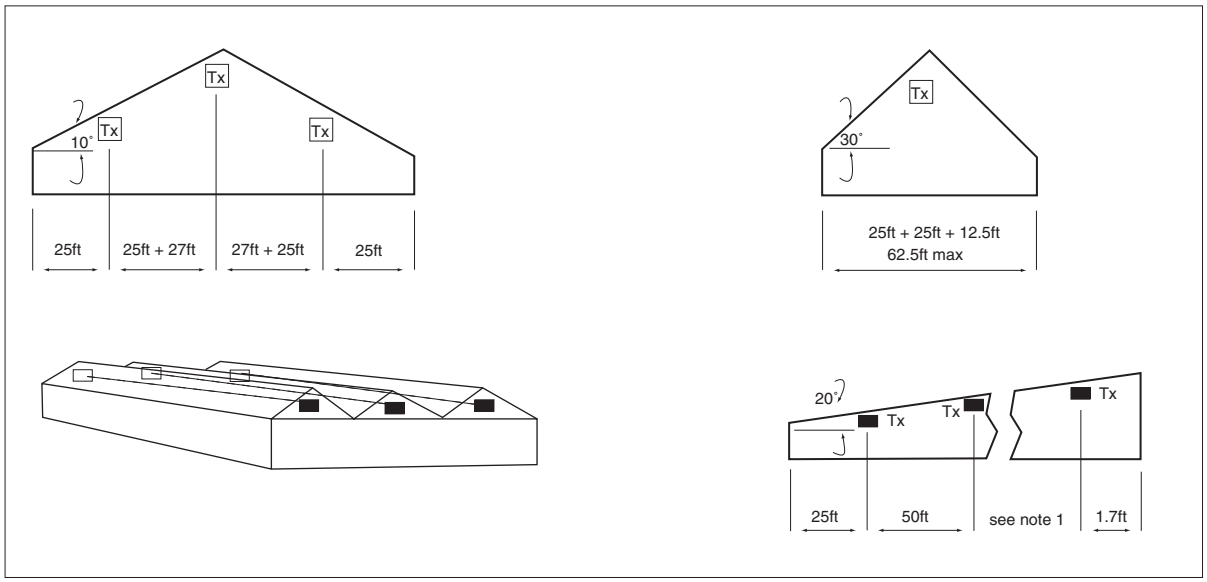

Fig 2 *Positioning detectors under sloping or pitched roofs*

There must be a clear line of sight between the transmitter and receiver at all times. If there is any doubt about the correct mounting of detectors in a particular installation, positioning may be determined by smoke tests.

All installations must conform to locally applicable standards and codes of practice.

Retro Operation

The FB-AP Series Beam detector may be configured so as to operate in 'retro' mode, in which the transmitter and receiver are mounted adjacent and as close as possible to each other, but no more than 0.2in (5mm) apart. The infra-red beam is projected onto reflectors which reflect it back to the receiver. This type of operation is useful when access to the wall opposite the transmitter is restricted or where wiring is difficult. The reflectors should be mounted at right angles to the infra-red beam. See 'Technical Data' for number of reflectors to use. If more than one reflector is used, they should be fitted so that there are no gaps between them. In retro operation smoke passes through the projected beam twice; the alarm level should therefore be set to 65% obscuration.

A clear line of sight has to be maintained between the heads and the reflectors. The following extra test should be performed after installation:

When the system is aligned and in normal operating mode, cover the reflectors. The FB-AP Series Beam detector should indicate 'fire' or 'trouble', depending on the setting in the interface. (See page 4 'Installation of Interface'). If not, it is possible that the signal has been returned via a surface other than the reflectors.

Note: receiver and transmitter should be positioned 1–2ft (0.3m–0.6m) below the ceiling. No more than 10ft (3m) of the beam path (measured from the center of the beam) should be within 19in (500mm) of any wall or partitions.

A ceiling or roof with a slope in excess of 3.5° should be regarded as a pitched roof.

When FB-AP Series Beam detectors are mounted in the apex, the horizontal distance of the beam detectors immediately adjacent on the left and the right of the apex beam detector may increase by 1% for each degree of ceiling slope up to a maximum 25%.

Loop Design—Wiring and Power Supply Requirements
Although the FB-AP Series Beam detector is loop powered, the total current drawn by the beam detector components combined is considerably higher than a standard point detector (equivalent to approximately 40 point detectors). For this reason care must be taken when designing an analog loop, due to the effects of voltage drop—a consequence of loop cable resistance, device loading effects and control panel specification.

Each beam detector set (consisting of transmitter, receiver and interface) draws approximately 16mA from the analog addressable loop and, unless proven by calculation*, it is recommended that not more than five beam detector sets be powered from each loop or, alternatively, eight interface/receiver combinations when the transmitter head is independently powered directly from the control panel or a remote power supply.

***** *Depending upon the type of panel used, the resistance of cable and the total loop load, it may be possible to install in excess of 10 beam detector sets on a single analog addressable loop. A mathematical calculation to assess the worst case loop voltage drop should be performed prior to installation in order to prove the intended design.*

Installation of Interface
The interface should be positioned so that it is accessible but such that the cable connecting the interface to the receiver is not more than 330ft (100m) long. Care should be taken that this cable is routed away from building electrical cables and any switchgear.

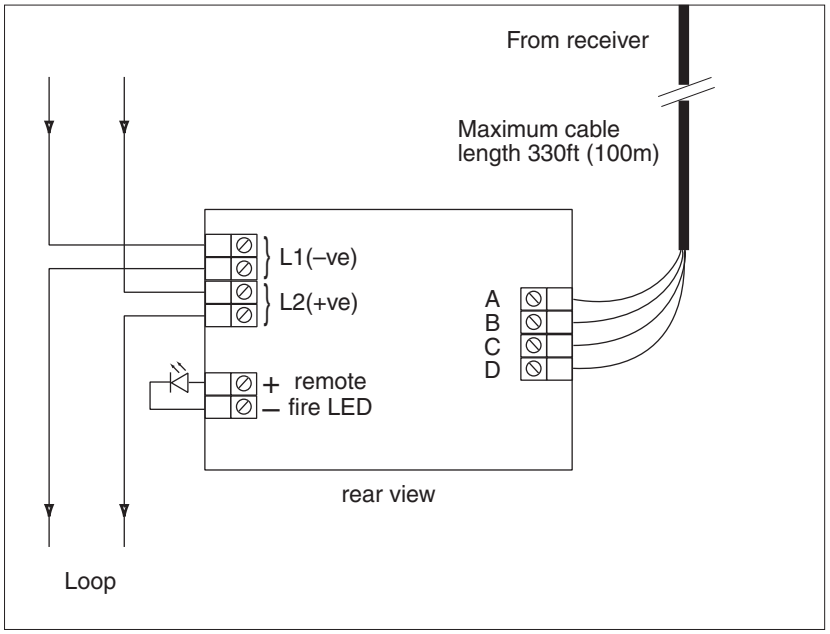

Fig 3 *Interface wiring diagram*

Connect cables as shown in **Fig 3** and set the address at the DIL switch on the front of the interface as shown in **Fig 4**.

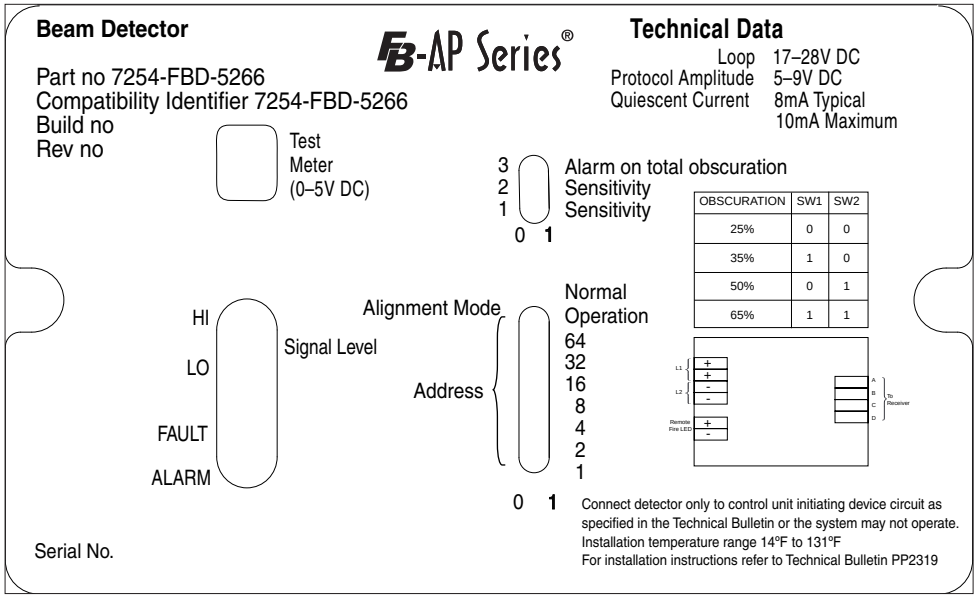

Fig 4 *Front view of interface*

Address Setting

The address of the beam detector is set using the DIL switch. All segments of the switch are set to 0 or 1, using a small screwdriver or similar tool. A complete list of address settings is shown in the following table.

addr	DIL switch setting	addr	DIL switch setting	addr	DIL switch setting	addr	DIL switch setting	addr	DIL switch setting
1	1000000	11	1101000	21	1010100	31	1111100	41	1001010
2	0100000	12	0011000	22	0110100	32	0000010	42	0101010
3	1100000	13	1011000	23	1110100	33	1000010	43	1101010
4	0010000	14	0111000	24	0001100	34	0100010	44	0011010
5	1010000	15	1111000	25	1001100	35	1100010	45	1011010
6	0110000	16	0000100	26	0101100	36	0010010	46	0111010
7	1110000	17	1000100	27	1101100	37	1010010	47	1111010
8	0001000	18	0100100	28	0011100	38	0110010	48	0000110
9	1001000	19	1100100	29	1011100	39	1110010	49	1000110
10	0101000	20	0010100	30	0111100	40	0001010	50	0100110
51	1100110	61	1011110	71	1110001	81	1000101	91	1101101
52	0010110	62	0111110	72	0001001	82	0100101	92	0011101
53	1010110	63	1111110	73	1001001	83	1100101	93	1011101
54	0110110	64	0000001	74	0101001	84	0010101	94	0111101
55	1110110	65	1000001	75	1101001	85	1010101	95	1111101
56	0001110	66	0100001	76	0011001	86	0110101	96	0000011
57	1001110	67	1100001	77	1011001	87	1110101	97	1000011
58	0101110	68	0010001	78	0111001	88	0001101	98	0100011
59	1101110	69	1010001	79	1111001	89	1001101	99	1100011
60	0011110	70	0110001	80	0000101	90	0101101	100	0010011
101	1010011	106	0101011	111	1111011	116	0010111	121	1001111
102	0110011	107	1101011	112	0000111	117	1010111	122	0101111
103	1110011	108	0011011	113	1000111	118	0110111	123	1101111
104	0001011	109	1011011	114	0100111	119	1110111	124	0011111
105	1001011	110	0111011	115	1100111	120	0001111	125	1011111
								126	0111111

Obscuration Level Setting
Set the interface to one of the four obscuration settings described on page 1.

Total Obscuration Signal
Total obscuration is defined as obscuration of the beam to greater than 93% in 8–10 seconds. The interface must be set so that either a 'fire' or a 'trouble' signal is generated when this occurs. This is done by moving segment 3 of the sensitivity switch (Fig 4) to '0' for a 'trouble' signal or to '1' for a 'fire' signal. The factory default setting is 'trouble'.

Installation of Transmitters and Receivers
1. The FB-AP Series Beam detector is immune to most normal ambient lighting but the receiver should be installed such that strong light sources–sunlight or artificial–do not project directly into the receiver lens.

2. Locate the right-angle fixing brackets for the transmitter and receiver so that they are on the line of sight and are both installed approximately 1–2 ft (0.3m–0.6m) below the ceiling. The shorter leg of the bracket is fixed to the mounting surface as an inverted 'L' section.

3. Ensure that the insulation cards provided are fitted between the mounting bracket and the receiver/ transmitter head assembly and that the insulation sleeves are fitted under the head of the M5 screw (fig 5).

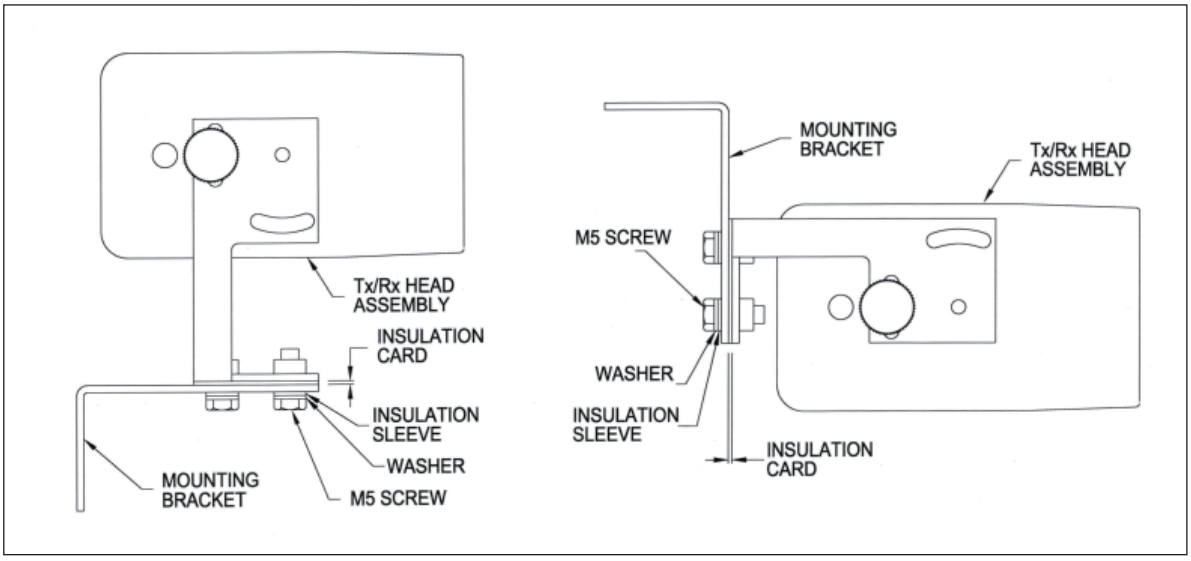

Fig 5 *Assembly of the insulation sleeves*

4. Fit the receiver/ transmitter head assemblies to the mounting brackets and position on the line of sight. Align the receiver as accurately as possible to the transmitter by eye. Ensure that the transmitter is fitted so that access to the range potentiometer is not impeded.

5. Tighten both receiver thumbwheel screws securely, using a suitable coin or wide-bladed screwdriver and ensure that all mounting bracket fasteners are secure.

6. Install all cables and connect as shown in Fig 6. Heads are supplied with 1m of cable and this should be correctly terminated with the system wiring. Connect the transmitter and receiver heads to ground, using an M5 crimp connector attached to one of the two horizontal adjustment bolts of the mounting bracket.

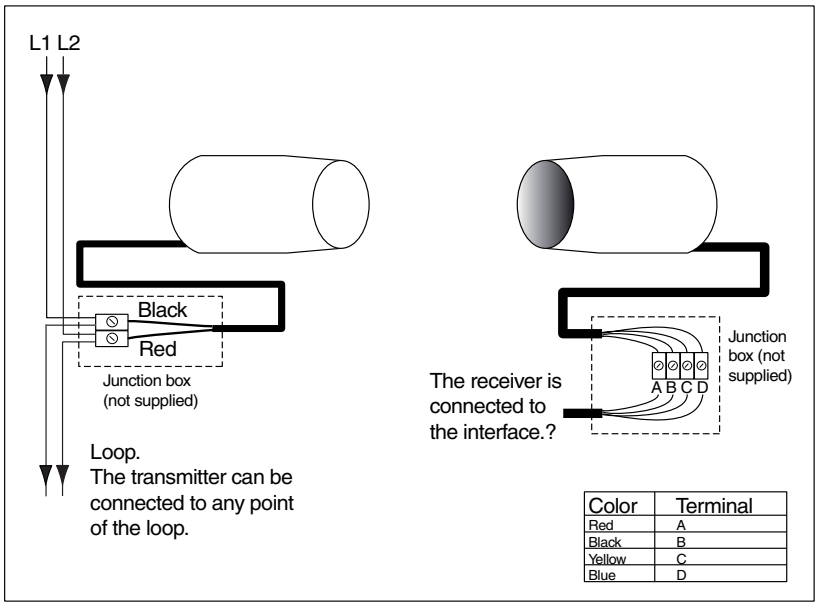

Fig 6 *Wiring diagram for beam detector*

7. Check that the alignment mode switch located in the interface is in the ON position.

8. Power up the beam detector.

9. *Note: on first power-up the beam detector will always signal a trouble until it is aligned.*

10. It is important to ensure that there are no obstructions anywhere within the cylindrical volume of the beam that is defined by a circle 12in (300mm) in diameter centered on the beam axis and the length of the beam.

Alignment and Calibration

The transmitter produces a conical beam of light which is approximately 10ft (3m) in diameter at a distance of 330ft (100m). The purpose of alignment is to ensure that the center of the beam is projected as closely as possible on to the center of the receiver. The purpose of calibration is to ensure that the amount of light sent by the transmitter is correct for the distance between the transmitter and the receiver.

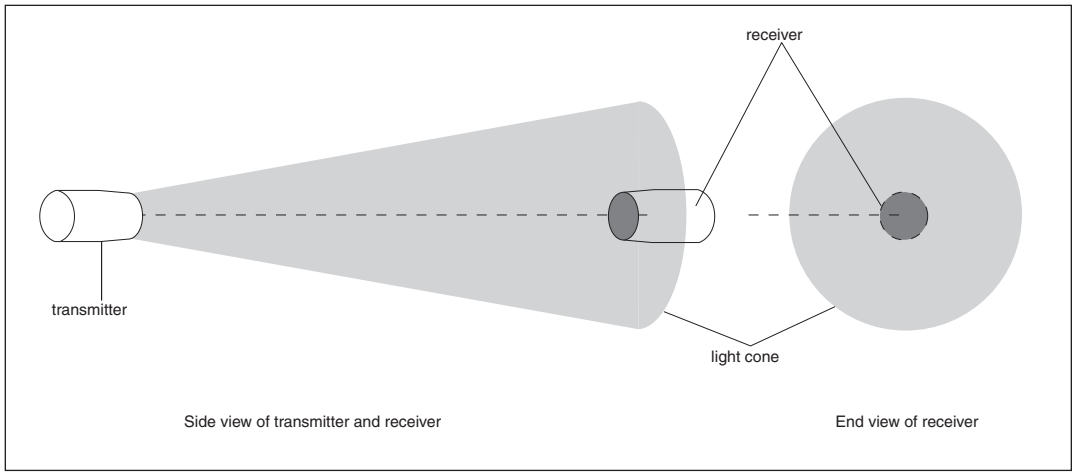

Fig 7 *Alignment of beam detector*

The accuracy of calibration depends on the accuracy of alignment. The FB-AP Series Beam detector is tolerant, to a certain extent, of alignment and calibration that is not optimal. Too great a tolerance may lead to trouble signals at a time subsequent to commissioning, perhaps because structural movement occurs in the building.

The FB-AP Series Beam detector has been designed with ease of commissioning in mind and can be aligned and calibrated using either the LED (wire-free) or the voltmeter method.

LED (wire-free) Method

This method is likely to be the more convenient of the two, as alignment and calibration can be carried out by one person without the need for cables or a voltmeter. Alignment is carried out in two stages—coarse alignment and fine tuning.

The receiver is fitted with a high-intensity red LED which in normal conditions pulses when a fire is detected. During commissioning this LED may also be used to facilitate beam alignment and calibration, provided that local light conditions allow the LED to be visible over the entire beam length, ie, up to 328ft (100m). During commissioning the LED will be in one of the following states:

LED pulse rate	Detector status
fast (1 pulse every ¼s)	signal strength too high
medium (1 pulse every ½s)	signal strength too low
slow (1 pulse every 1s)	no signal being received
no pulse	beam within alignment window

1. Coarse alignment

1.1 After installing the beam detector check that all cables have been tested prior to connection.

1.2 Check that the interface is set to Alignment Mode (factory default setting).

1.3 Apply power to the loop and any other power supplies in order to power up the interface and transmitter.

1.4 Turn the range potentiometer on the transmitter (which is accessed through a grommet located on the opposite side to the cable entry point) fully counterclockwise. This sets the beam strength to maximum, ie, for a beam distance of 330 ft (100m), for the purposes of alignment and calibration.

1.5 Loosen the vertical and horizontal fixing clamps (thumb-wheel screws and hexagonal bolts) until it is just possible to move the transmitter horizontally and vertically in a controlled fashion.

1.6 Move the transmitter horizontally and vertically until the LED at the receiver is seen to be pulsing *fast* (one pulse every j second).

1.7 Tighten the transmitter clamps, taking care not to move the transmitter out of alignment in the process, ie, the LED should still be pulsing fast when this is completed. If the LED is not pulsing fast, the transmitter may have been moved. In this case, repeat steps 1.5 and 1.6.

1.8 To calibrate the beam strength, turn the range potentiometer *slowly* clockwise until the LED stops pulsing.

2. Alignment—fine tuning

2.1 Loosen the *vertical* fixing clamps (thumb-wheel screws) until it is just possible to move the transmitter in a controlled fashion.

2.2 Move the transmitter up and down with slow, deliberate movements to ascertain whether a position can be found where the LED pulses *fast* again.

If such a position is found (by upward or downward movement) continue to move the transmitter until the fast pulse changes to medium, slow or no pulse. Note the position of the transmitter at this point and reverse the motion of the transmitter through the LED fast pulse range to the opposite limit, ie, LED pulse rate again changes from fast to medium, slow or no pulse. Then move the transmitter to the center point between the two limits of fast pulse.

If it is not possible to make the LED pulse fast, it must be assumed that the beam was aligned correctly during the coarse alignment procedure. In this situation the transmitter should be moved back to its original position, ie, where there is no pulse.

Finish the vertical adjustment procedure by tightening the vertical fixing clamps (thumb-wheel screws).

2.3 Repeat procedure 2.2 for the *horizontal* plane by loosening the hexagonal bolts.

2.4 Calibrate the beam by slowly turning the range potentiometer clockwise until the LED changes from a fast to no pulse state.

2.5 Replace the removable range potentiometer grommet in the transmitter head.

2.6 At the beam detector interface check that only the yellow trouble LED is lit. If either high or low green LEDs are lit, misalignment has occurred and the alignment procedure will have to be repeated.

2.7 Move the alignment switch on the interface back to the ‘Normal Operation’ position.

2.8 Wait 10 seconds for the beam detector interface to calibrate itself before performing any tests. The trouble LED should now be extinguished.

3. Voltmeter method

3.1 After installing the beam detector, check that all cables have been tested prior to installation.

3.2 Check that the interface is set to ‘Alignment Mode’ (factory default setting).

3.3 Apply power to the loop and any other power supplies in order to power up the interface and transmitter.

3.4 Turn the range potentiometer on the transmitter (which is accessed through a rubber grommet located on the opposite side of the cable entry point) to the approximate operating range.

3.5 Run a temporary two-core cable (security type cable is acceptable) between the interface and transmitter.

3.6 Connect the alignment lead (supplied) to the transmitter end of the cable and a digital voltmeter at the transmitter end of the cable.

Note: the voltmeter should be set to a range of 0–10 volts DC or greater.

3.7 Plug the alignment lead into the socket located on the interface front panel, such that the yellow spot on the lead is on top.

Note: this will disable the LED on the receiver and therefore the alternative LED alignment function.

3.8 Loosen the transmitter vertical and horizontal fixing clamps (thumb-wheel screws and hexagonal bolts) until it is just possible to move the transmitter horizontally and vertcally in a controlled manner.

3.9 Observing the voltmeter, move the transmitter horizontally and vertically until a peak voltage is obtained.

Note: *if there is no signal present the voltage read will be approximately 2.5 volts DC.*

3.10 Tighten the transmitter clamps, taking care not to move the transmitter out of alignment in the process.

Note: check the voltage reading again to ensure that misalignment has not occurred during the tightening process. Repeat the alignment procedure if necessary.

3.11 The reading on the voltmeter should be between 3.7 and 4.3 volts DC. If not, adjust the range potentiometer until the voltage is in this range.

3.12 Replace the removable range potentiometer grommet in the transmitter head.

3.13 At the beam detector interface, check that only the yellow trouble LED is lit. If either high or low LED's are lit, misalignment has occurred and the alignment procedure will have to be repeated.

3.14 Unplug and remove the alignment cable and lead. Move the alignment switch on the interface back to the 'normal' position.

3.15 Wait 10 seconds for the beam detector to calibrate itself before performing any tests. The yellow trouble LED should now be extinguished.

Notes

1. *When the beam detector interface is in alignment mode, the trouble LED wil be continuously lit and a trouble signal (analog value 4) will be transmitted to the control and indicating equipment.*

2. *The signal high and low LEDs (green) only operate when the beam detector is in alignment mode. Only one LED will operate at any given time.*

3. *The beam detector interface is factory programmed to report a trouble condition, regardless of whether or not it is in alignment mode, whenever the interface is powered up for the very first time and the beam has not been aligned. This trouble condition will only be cleared following successful initial alignment and is designed as a safeguard against poor installation and alignment practice.*

4. *If there is a trouble in the wiring to the transmitter when powering-up the system in alignment mode, the trouble LED will be lit and the two green alignment LEDs will be disabled. This failure mode can be verified using a voltmeter connected to the alignment lead; the voltage reading would be less than 2.45 volts DC. Check the polarity and continuity of the four interconnecting wires between the interface and receiver.*

5. *When siting the transmitter, ensure that there is adequate clearance for access to the range adjustment potentiometer.*

6. *Alignment checks are recommended once a year. To check the alignment, switch the alignment switch in the interface to 'Alignment Mode' and check that only the yellow trouble LED is lit. If either green 'high' or 'low' LED is lit, it will be necessary to re-align the beam detector.*

7. *If at any time components of the system are exchanged the beam detector must be realigned. Information exchanged between the interface and the receiver head is specific to individual receiver heads and interfaces.*

8. *If the trouble LED flashes at any time, a trouble signal will be sent to the control panel. The flash indicates that the data in the receiver and the interface do not match. This may be due to a number of causes, such as handling the PCB without taking anti-static precautions or a mismatch of transmitter/receiver sets after dismantling and reinstallation. In such a case the beam detector must be re-aligned.*

Smoke Alarm Test

Hold the test filter over the lens of the receiver. After approximately 8–10 seconds an alarm will be signalled and the red LED in the receiver will flash. Check that an alarm has been registered at the control panel. Remove the test filter and the alarm will reset after approximately 30 seconds.

Total Obscuration Test

Depending on the total obscuration option selected, a fire or trouble is signalled if the beam path is blocked by more than 93% for greater than 8 seconds. To carry out this test, cover the receiver. Check that the alarm or trouble LED on the interface illuminates within 3 seconds and that a fire or trouble signal is registered at the control panel. After removal of the blockage the beam detector resets after 2–30 seconds, depending on the option selected.

Beam Detector Tests

The FB-AP Series Beam detector responds to output (forward command) bits from the protocol:

When output bit 2 is set to logic 1 on two or more consecutive pollings the beam detector performs an alarm LED test. The red alarm LED on the interface is illuminated and the red LED in the receiver flashes.

When output bit 1 is set to logic 1 on two or more consecutive pollings the beam detector carries out an interface self test. The interface transmits a ‘fire’, ie, analog value 64, signal to the control panel.

When output bit 0 is set to logic high on two or more consecutive pollings, the remote indicator output in the interface is enabled. The remote indicator output is useful in locations where the interface is not easily visible from the ground and confirmation of a fire signal is required.

Technical Data

Supply voltage	17–28V DC
Quiescent current at 24V DC	
Receiver & interface	10.5mA
Transmitter	6.0mA
Alarm current at 24V DC	
Receiver & interface	12.0mA
Transmitter	6.0mA
Fire alarm thresholds	25% obscuration (1.25dB) 35% obscuration (1.87dB) 50% obscuration (3.00dB) 65% obscuration (4.55dB)
Operating range	25% obscuration: 32ft–140ft (10–42m) 35% obscuration: 32ft–215ft (10–64.5m) 50% obscuration: 70ft–328ft (21–100m) Retro mode with reflectors: 65% obscuration: 20–148ft (6–45m)
Tolerance to beam misalignment at 35% obscuration	Transmitter ±1.0°; receiver ±4°
Optical wavelength	880nm
Receiver/interface cable type & max length	Twin twisted pair 7/31 AWG (7/0.2), 1 pair A&B, 1 pair C&D 328ft (100m)
Finish	White
IP Rating	50
Operating temperature	+16°F to +131°F (–10°C to +55°C)

Not user serviceable—refer to manufacturer or distributor for repair.

For use as a smoke detector only. No liability will be accepted for applications not conforming to NFPA regulations. Install in accordance with NFPA 72 (National Fire Alarm Code).

Factory default settings

Fire Alarm threshold	35%
Alarm on Total Obscuration	Trouble
Alignment Mode/Normal Operation	Alignment Mode
Address	1

Compatible Panels

Contact FireBus, LLC technical support for a list of compatible control panels.

Part Numbers

Part number	Description
7254-FBD-9266	Transmitter (has clear lens) Receiver (has dark lens) Interface Alignment lead 2 angle brackets, 4 bolts & washers Test card Installation guide
7254-FBD-9400	Spare interface
7254-FBD-9401	Spare transmitter
7254-FBD-9402	Spare receiver
7254-FBD-9403	Reflector