Installation Instructions

Original Instructions

Intrinsically Safe Sensor

Catalog Numbers 42DTB- 5500, 42DRU- 5500, 42DRU- 5700, 42DRP- 5500, 42DRA- 5500

Specifications

Attribute	Value	
Normal Operation Requirements		
Voltage Supply	13…29.5V DC	
Supply Current	26 mA maximum (output energized) at 13V DC 30 mA maximum (output energized) at 29.5V DC	
Response Time	1 ms	
Dual Outputs	1 NPN open collector (current sink) 1 PNP open collector (current source)	
Output Ratings	20 mA, 29.5V DC maximum	
Turn On Pulse Suppression	Yes	
Light/Dark Energized Option	Yes	
Reverse Polarity Protection	Yes	
Output Overvoltage Protection w/ Barriers	Yes	
Field of View	Type 42DRU Reflex 2.5° Type 42DRP Proximity 3°	
Sensitivity Adjustment	Selectable by LOW (L)—HIGH (H) switch. Covers full range of operating distances.	
Ambient Temperature	-40…65°C (-40…+150°F)	
Relative Humidity	90%	
Rated Operating Distances	All operating distances are with LOW (L)—HIGH (H) switch in the HIGH (H) position.	
42DRU- 5500	76.2 mm (3 in.) Dia. Reflector #92-39 31.75 mm (1.25 in.) Dia. Reflector #92--47 15.87 mm (0.625 in.) Dia. Reflector #92--46	25.4 mm…9.14 m (1 in…30 ft) 25.4 mm…6.1 m (1 in…20 ft) 25.4 mm…4.57 m (1 in…15 ft)
42DRU- 5700	76.2 mm (3 in.) Reflector #92-39 31.75 mm (1.25 in.) Dia. Reflector #92-47	152.4 mm…4.57 m (6 in…15 ft) 152.4 mm…4.57 m (6 in…8 ft)
42DRP- 5500 White Paper Distance Discrimination Range	Short Range (SR) 0.30 m (1 ft) 127…406.4 mm (5…16 in.)	Long Range (LR) 1.52 m (5 ft) 406.4 mm… (16 in…5 ft)

Distance differential between surface to be detected and background is defined as the increase in distance required to de-energize the output, measured from the point of energization.d

42DRA-5500	Operating distance depended on the choice of lens or Fiber Optic Cable.

ATTENTION: Installation in hazardous environment locations shall be made according to ANSI/ISA-RP 12.6 and other applicable codes and standards.

Features

- For use in Class I, II, III; Division 1, 2; Group A, B, C, D, E, F, G hazardous locations with Intrinsic Safety Zener Diode Barriers.
- Reflex, polarized reflex, proximity, and special function control models.
- Rated operating ranges:
  - Reflex 0.03...9 m (1 in...30 ft)
  - Polarized Reflex 0.15...4.5 m (6 in...15 ft)
  - Proximity 0...1.5 m (0...5 ft)
- Quick-disconnect (QD) reduces downtime. No disruption of alignment or wiring.
- Sensor head and terminal base are specially keyed to prevent improper installation of non-intrinsically safe equipment in a hazardous location.
- Terminal base for input voltages 13...29.5V DC eliminates need for separate junction box.
- Entity approval:
  - Vmax = 29.5V
  - Imax = 107 mA
  - Ci = 0µF
  - Li = 0µH

ATTENTION: These parameters must be adhered to. If not, injury may be caused to person or property.

- Control input parameters
  - Supply voltage 13...29.5V DC
  - Supply current 26 mA maximum at 13V DC, 30 mA maximum at 29.5V DC
- Plug-in sensor contains functional electronics and optics.
- Thick film microcircuitry for quality and reliability.

- Adjustable input sensitivity.
- RF interference protected.
- No false turn-on pulse.
- Synchronous detection circuitry avoids ambient interference.
- Switch selection for light or dark operation.
- Dual open collector outputs provide current sink (NPN) and current source (PNP) capabilities.
  - Load voltage 29.5 V DC maximum
  - Load current 20 mA maximum
- Response time: 1 ms
- Status indicator alignment: visible 360°
- NEMA 4X corrosion resistant, high impact housing.
- UL Listed.

ATTENTION: Substitution of components may impair intrinsic safety.

Why Intrinsically Safe

Explosion prevention is a prime consideration in plants and facilities containing hazardous atmospheres where **"explosion-proof" housings** are used.

The main fault with the "explosion-proof" housing system is that a single human error could create a light explosion probability. Such occurrences as, failing to tightly replace covers on "explosion-proof" housings, failing to shut off the power before removing the cover of such a housing, and damaging the machined surfaces of such covers are all prime examples.

Intrinsically Safe systems are now recognized as a more highly desirable means of providing automated control functions in explosive environments. The technique relies on the inherent parameters of electronic circuits, so that no energy can be released under normal or abnormal operating conditions, of sufficient magnitude to ignite a specified atmospheric mixture.

To design an effective **Intrinsically Safe** system, energy sources that enter the hazardous area must be limited. For electronic controls, energy limiting is accomplished by controlling the voltages and currents that may enter the hazardous area. In addition, stored electrical energy in the controls is limited to levels that cannot cause ignition of a given atmosphere.

An **Intrinsically Safe** system overcomes the shortcomings of the "explosion-proof" system and virtually eliminates the probability of explosion by properly installing **Intrinsic Safety Zener Diode Barriers** in the safe area. Intrinsic Safety Zener Diode Barriers must be installed in the **power supply line**, the **load supply line** and when using the current source (PNP) open collector of the **Series 5500**, in the **signal return line**.

Summary of Hazardous Locations

(For full and complete definitions, consult the National Electric Code publication NFPA No. 70--78.)

Class I Locations in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures.

Class II Locations which are hazardous because of the presence of combustible dust.

Class III Locations which are hazardous because of the presence of easily ignitable fibers or flyings, but in which such fibers or flyings are not likely to be suspended in air concentrations sufficient to produce ignitable mixtures.

Division I Locations which are hazardous concentrations in the air exist continuously, intermittently, or periodically under normal operating conditions.

Division 2 Locations which are hazardous concentrations are handled, processed, or used but are normally within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown.

Group A Atmospheres containing acetylene.

Group B Atmospheres containing hydrogen, or gases or vapors of equivalent hazard, such as manufactured gas.

Group C Atmospheres containing ethyl-ether vapors, ethylene, or cyclo-propane.

Group D Atmospheres containing gasoline, hexane, naptha, benzine, butane, propane, alcohol, acetone, benzol, laquer solvent vapors, or natural gas.

Group E Atmospheres containing metal dust, including aluminum, magnesium, and their commercial alloys, and other metals of similarly hazardous characteristics.

Group F Atmospheres containing carbon black, coal or cake dust.

Group G Atmospheres containing flour, starch, or grain dusts.

Typical Class I Locations

- Petroleum refineries and gasoline storage and dispensing areas.
- Industrial firms that use flammable liquids in dip tanks for parts cleaning or other operations.
- Petrochemical companies that manufacture chemicals from gas and oil.
- Dry cleaning plants where vapors from cleaning fluids can be present.
- Companies that have spraying areas where they coat products with paint or plastics.
- Aircraft hangars and fuel servicing areas.
- Utility gas plants, and operations involving storage and handling of liquified petroleum gas or natural gas.

Typical Class II Locations

- Grain elevators, flour, and feed mills.
- Plants that manufacture, use, or store magnesium of aluminum powders.
- Plants that have chemical or metallurgical processes, producers of plastics, medicines, and firewoods, etc.
- Producers of starch or candies.
- Spice-grinding plants, sugar plants, and cocoa plants.

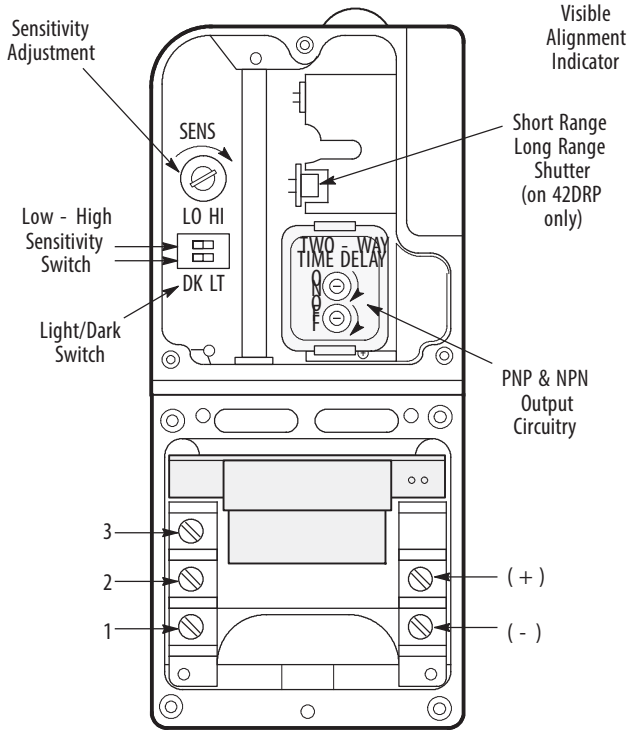
- Coal preparation plants and other carbon-handling or processing areas.

Typical Class III Locations

- Textile mills, cotton gins, cotton seed mills, and flax processing plants.
- Any plant that shapes, pulverizes or cuts wood and creates sawdust or flyings.

IMPORTANT Fibers and flyings are not likely to be suspended in the air, but can collect around machinery or on lighting fixtures and where heat, a spark or hot metal can ignite them.

Series 5500 Type 42DRP Photohead and 42DTB Power Base with Covers Removed



See page 7, for actual connection diagrams.

Description

Type 42DR Series 5500 QD Intrinsically Safe miniature self-contained Photoelectric controls each consist of a combination modulated status indicator light source, high speed silicon photodetector and dual open collector sold-state outputs which can be used to interface with programmable controllers, computers, digital control systems or E-M control relays via **Intrinsic Safety Zener Diode Barriers**.

The **Type 42DR Series 5500** controls are modular in design and consist of two components—a plug in **photohead** and a **power base** which are selected to suit your functional requirements and assembled together at the point of installation. The **photohead** includes a unique Quick-Disconnect feature so that it can be quickly mounted to or removed from the **power base** by simply turning one screw, without disrupting control wiring or alignment. This capability reduces production downtime and replacement cost and precludes the need for adding plug and cable assemblies for field disconnect purposes.

Please note that the Series 5500 photoheads and the Series 5500 power base are keyed so that no other photohead other than the Series 5500 can be mounted to the Series 5500 power base in a hazardous location. **The user must disconnect the power before removing the quick-disconnect photoheads or covers.**

All Type 42DR Series 5500 (5700) Photoelectric controls must be used with Intrinisic Safety Zener Diode Barriers.

Photoheads

There are four different **photoheads** available. For **reflex operation** (with retroreflective target), use **Type 42DRU Model 5500** which provides an operating range from 25.4 mm...9.14 m (1 in...30 ft). For **polarized reflex operation** (with corner cube type retroreflective target), use **Type 42DRU Model 5700** which provides an operating range from 152.4 mm...4.57 m (6 in...15 ft). For **proximity operation** (diffuse reflection off the object itself), specify **Type 42DRP Model 550** which offers an operating range from 0...1.5 m (0...5 ft). The design of **Type 42DRA Model 5500** special function photohead increases the application capabilities of the control line in difficult environmental conditions by use of **fiber optics** and **special lens** assemblies.

In all models, the **photohead** contains all the functional electronics and optics. It includes **synchronous detection** circuitry which tends to restrict the control to operate only with its own pulsed LED source. Adjustable input sensitivity broadens control application capability to those involving translucent and even transparent materials, such as plastic films and glass. A switch is provided to assure sensitivity adjustment over the entire control operating range.

With a flick of a switch, the Type 42DR control provides operation in either a **light energized** (beam break) or **dark energized** (beam make) mode.

An **optical shutter** on the **Type 42DRP** proximity control permits the use of a single control for both short- and long-range proximity applications. With the shutter in the short range (SR) position, the maximum operating distance is 0.30 m (1 ft). The very sharp drop off in operating margin as shown in the **Type 42DRP** response curve on page 6 helps to ignore backgrounds that are close to the object being detected.

The **dual open collector outputs**, one an NPN open collector for current sink and the other a PNP open collector to provide current source, are included in all **Type 42DR** controls to maximize customer logic interconnection capabilities. Therefore, these controls provide the opportunity for simultaneous connection to relay loads or opto-coupler drives and TTL logic outputs. **See page 7 for** connection diagrams.

Power Base

Type 42DRU, 42DRP, and **42DRA Intrinsically Safe models 5500 and 5700 Photoheads** can be plugged only into a **terminal base Type 42DTB Model 5500** suitable for voltage inputs of 13...29.5V DC.

The **Type 42DTB Model 5500 Terminal Base** allows the user to make incoming and outgoing connections directly to the control thereby eliminating the need of a separate junction box. Wiring connections are made to easy-to-wire pressure type terminals with

nonrotating clamps on the screws capable of handling up to two #14 AWG wires.

Ordering Instructions

1. **Select Power Base**

Base Type	Voltage Supply	Cat. No.
Terminal	13…29.5V DC	**42DTB-5500**

2. **Select Photohead**

Operating Mode	Output Characteristics	Cat. No.
Reflex	NPN (Current Sink) and PNP (Current Source)	**42DRU- 5500**
Polarized Reflex		**42DRU- 5700**
Proximity		**42DRP- 5500**
Fiber Optic Wide Angle Fixed Focus		**42DRA- 5500**

3. **Select Mounting Assembly**

#60--1785 Universal, general purpose, 360° adjustment.

#60--1748 Heavy Duty, for mechanical protection.

#60--2014 Flexi-Mount, for Unistrut mounting on conveyor rails.

#60--2083 Photoguard, #12 gauge cold rolled steel heavy duty protection.

4. **Select Intrinsic Safety Zener Diode Barriers**

Select Control Drawing on page 7 for wiring diagrams of sourcing and sinking output configurations. Barrier selection is described below for each Control Drawing configuration. For installations, to ensure safety each Barrier must comply with the entity parameters indicated on the Control Drawing.

In selecting the Intrinsic Safety Zener Diode Barriers, it is important to consider the resistance of the barrier to ensure operational characteristics in the midst of inherent barrier voltage drop.

Power Supply Barrier

Intrinsic safety zener diode barrier #897H--S120 is recommended for FM Approved and UL Listed locations. See page 8 for barrier details.

Alternatively, the user must select his own power supply barrier. It should be noted that the **Series 5500** control must have at least 13V DC at the + and - terminals of the power base, Type **42DTB Model 5500**. The supply current at 13V DC is 26 mA. The maximum barrier resistance is then determined by the following formula: $Rb\ maximum = \frac{Vs - 13}{0.026}$

where:

Rb max	= Maximum Barrier Resistance
Vs	= Voltage Supply
13	= Minimum Voltage Supply to Control
0.026	= Supply Current (26mA max. at 13V DC)

Load Supply Barrier

Intrinsic Safety Zener Diode Barrier #897H--S120 is recommended for FM Approved and UL Listed locations. See page 8 for barrier details.

Alternatively, the user may select his own load supply barrier. When using the NPN (current sink) open collector output of the **Series 5500** Intrinsically Safe controls, a load supply barrier must be selected in addition to the power supply barrier. The maximum load supply barrier resistance can be determined by using the following the formula. The user must provide values for the load voltage drop, V_{load}, and the load current, I_{load} (20 mA maximum):Rb maximum.

$$\frac{V_s - V_{load} - 3.4}{I_{load}}$$

where:

Rb max	= Maximum Barrier Resistance
Vs	= Voltage Supply
V1oad	= Load Voltage Drop
3.4	= Output Cir. Voltage Drop (3.4V)
I_{load}	= Load Current (20mA max.)

IMPORTANT The NPN and output configuration is not approved for use in hazardous locations classified as Class I, Division 1, Groups A or B.

Signal Return Barrier for Source (PNP) Output Only

Intrinsic Safety Zener Diode Barrier #937ZH-DPCD-2 is recommended for FM Approved and UL Listed locations.

Alternatively, the user may select his own signal return barrier when the PNP (current source) open collector output of the Series 5500 Intrinsically Safe controls. For PNP output applications in hazardous locations not classified as Class I, Division 1, Groups A and B, signal barrier must be selected in addition to the power supply barrier and the load supply barrier. For reference, see Control Drawing for the three barrier PNP output configurations. The sum of the maximum signal return barrier resistance and the maximum load supply barrier resistance can be determined using the following the formula. The user must provide values for the load voltage drop, V_{load}, and the load current, I_{load} (20 mA max):

$$Rbls + Rbrs = \frac{Vs - (V_{load} + V_{brs} + 0.4)}{I_{load}}$$

where:

Rbls	= Load Supply Barrier Resistance
Rbrs	= Signal Return Barrier Resistance
Vs	= Voltage Supply
V_{load}	= Load Voltage Drop
V_{brs}	= Signal Return Barrier Voltage Drop
0.4	= Output Switch Voltage Drop (0.4V)
I_{load}	= Load Current (20mA max.)

For PNP output applications in hazardous locations classified as Class I, Division 1, Groups A and B, signal return barrier must be selected in addition to the power supply barrier. For reference, see Control Drawing for the two barrier PNP output configurations. The signal return barrier resistance and the power supply barrier resistance must satisfy the following two formulas. The user must provide values for

the load voltage drop, V_{load}, and the load current, I_{load}. Please note that I_{load} is 10 mA max in this configuration.

$$Rbps = \frac{Vs - 13}{I_{load} + 0.026} \qquad Rbps + Rbrs = \frac{Vs - (0.4 + V_{brs} + V_{load})}{I_{load} + 0.026}$$

where:

Rbps	= Max. Power Supply Barrier Resistance
Rbrs	= Max. Signal Return Barrier Resistance
Vs	= Voltage Supply
Vload	= Load Voltage Drop
13	= Min. Voltage Supply to Control (13V)
0.026	= Supply Current (26mA max. at 13V)
Iload	= Load Current (10mA max.)
Vbrs	= Signal Return Barrier Voltage Drop
0.4	= Output Switch Voltage Drop (0.4V)

Installation of Adjacently Mounted Units

Type 42DR Series 5500 Photoheads are supplied to operate at one of two different frequency ranges, permitting Photoheads to be mounted close to each other without generating interfering signals.

Units in open frequency range are marked with a dot (S). Units in the other frequency range have no dot.

Accordingly, when two Type 42DR Series 5500 controls are mounted close together and/or face each other, select Photoheads so that one is marked with a dot (•) and the other has no dot.

Alignment

Alignment of the Type 42DR LED control can be accomplished by visually sighting the control at the reflector using reflex operation or at the object using proximity until the visible LED indicator on the top lights with switch in the "LT" position or goes out when the switch is in "DK" position.

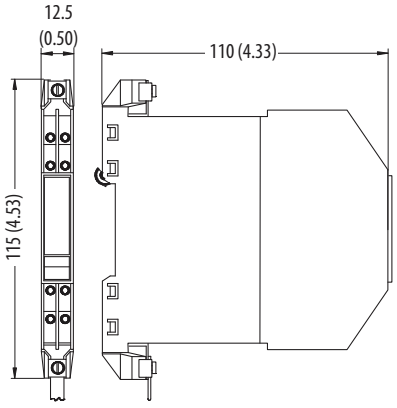
To insure that the beam is centered on the reflector, in Reflex or on the object using proximity, sweep the beam across the reflector or object in the horizontal plane and determine at what points the indicator light goes on and then goes off. Set the beam half way between both points. Do the same in the vertical plane.

Intrinsic Safety Zener Diode Barrier Specifications

Attribute	Value
Environmental Conditions	
Operating Temperatures	
Storage Temperature	
Relative Humidity	
Operational Data, Safety Barrier 937ZH-DPBN-1	
Input Voltage	Rated: +24V; MaximumSupply Voltage: +250V
Nominal Resistance	300 Ω
Series Resistance	Minimum: 301 Ω Maximum: 327 Ω
Nonreplaceable Fuse Rating	50 mA
Current	93 mA
Group, Category, Protection Type, Temperature Class	EXII 3G EX nA IIC T4 Gc [device in zone 2]
Operational Data, Safety Barrier 937ZH-DPCD-2	
Input Voltage	Rated: +24V; Maximum Supply Voltage: +250V
Voltage Drop	= 1.2V + (36 Ohm x signal current)
Series Resistance	Minimum: 301 Ω Maximum: 327 Ω
Nonreplaceable Fuse Rating	50 mA
Hazardous Area Connection	Terminal 1, 2, 3, 4

Acccessories

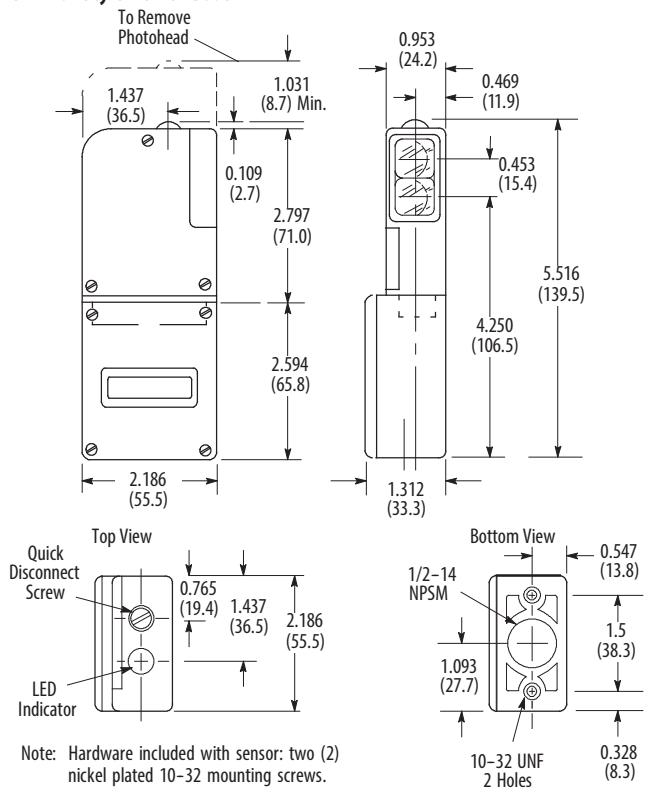
Allen-Bradley® Series
937ZH
Zener Diode Barrier



64-136
0.3 m (1 ft)
DIN Rail Mounting Kit

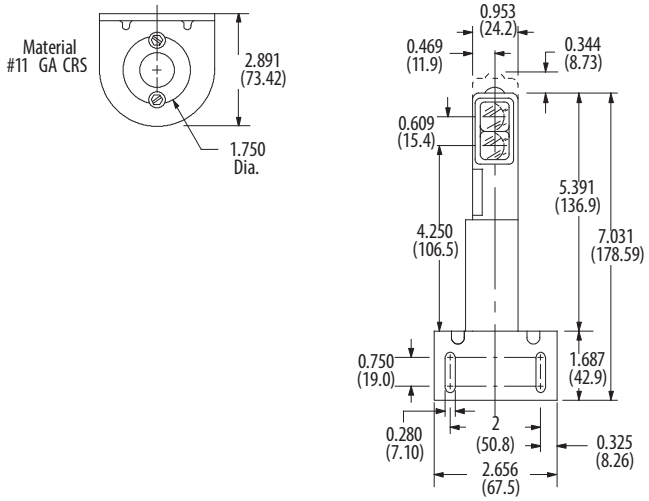
Dimensions [mm (in.)]

Terminal Style Power Base

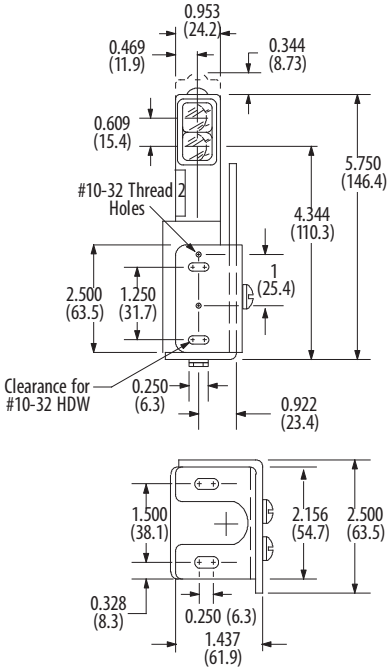


Note: Hardware included with sensor: two (2) nickel plated 10–32 mounting screws.

Control with Universal Mounting Assembly #60-1785

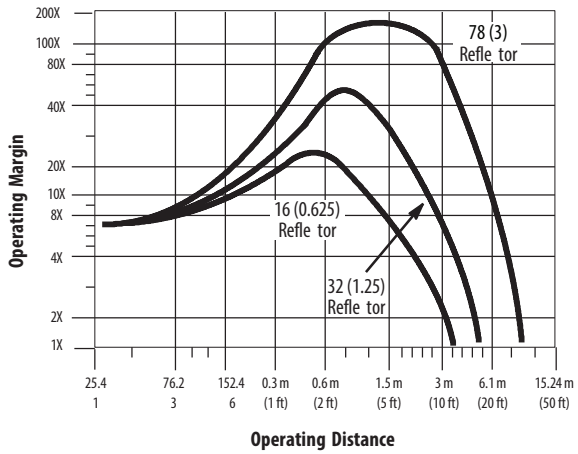


Control with Terminal Style Power Base

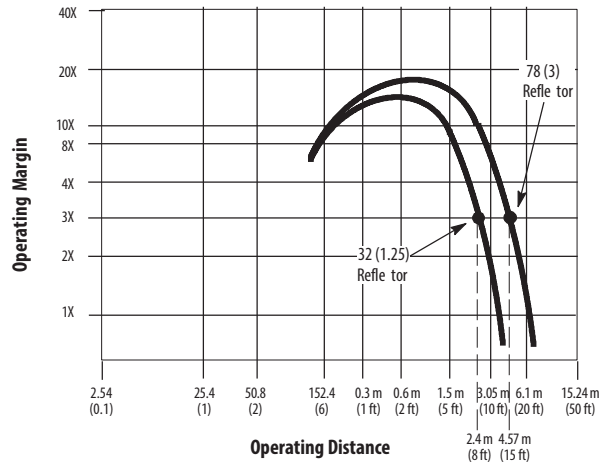


Typical Response Curves [mm (in.)]

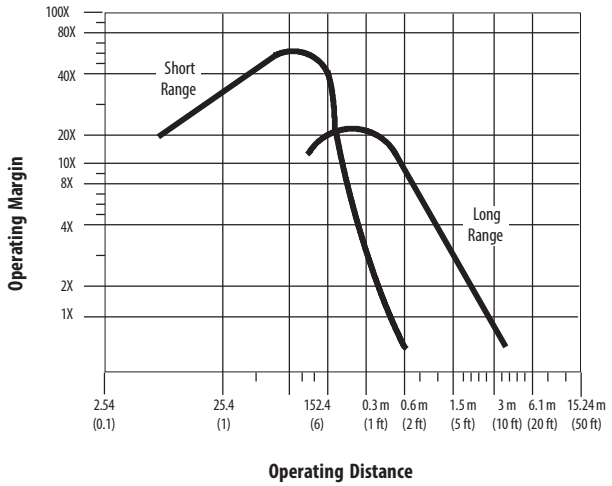
42DRU-5500 Retroreflective



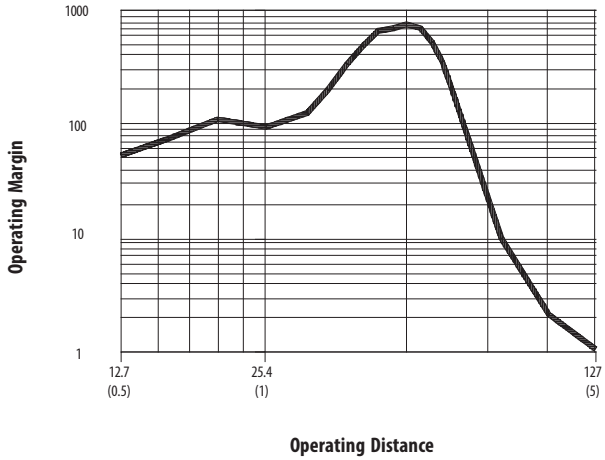
42DRU-5700 Polarized Retroreflective



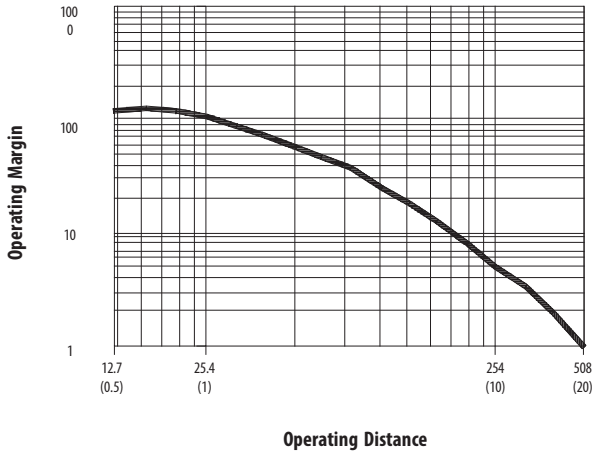
42DRP-5500 Standard Diffuse



42DRA-5500 Fixed Focus Diffuse



42DRA-5500 Wide Angle Diffuse



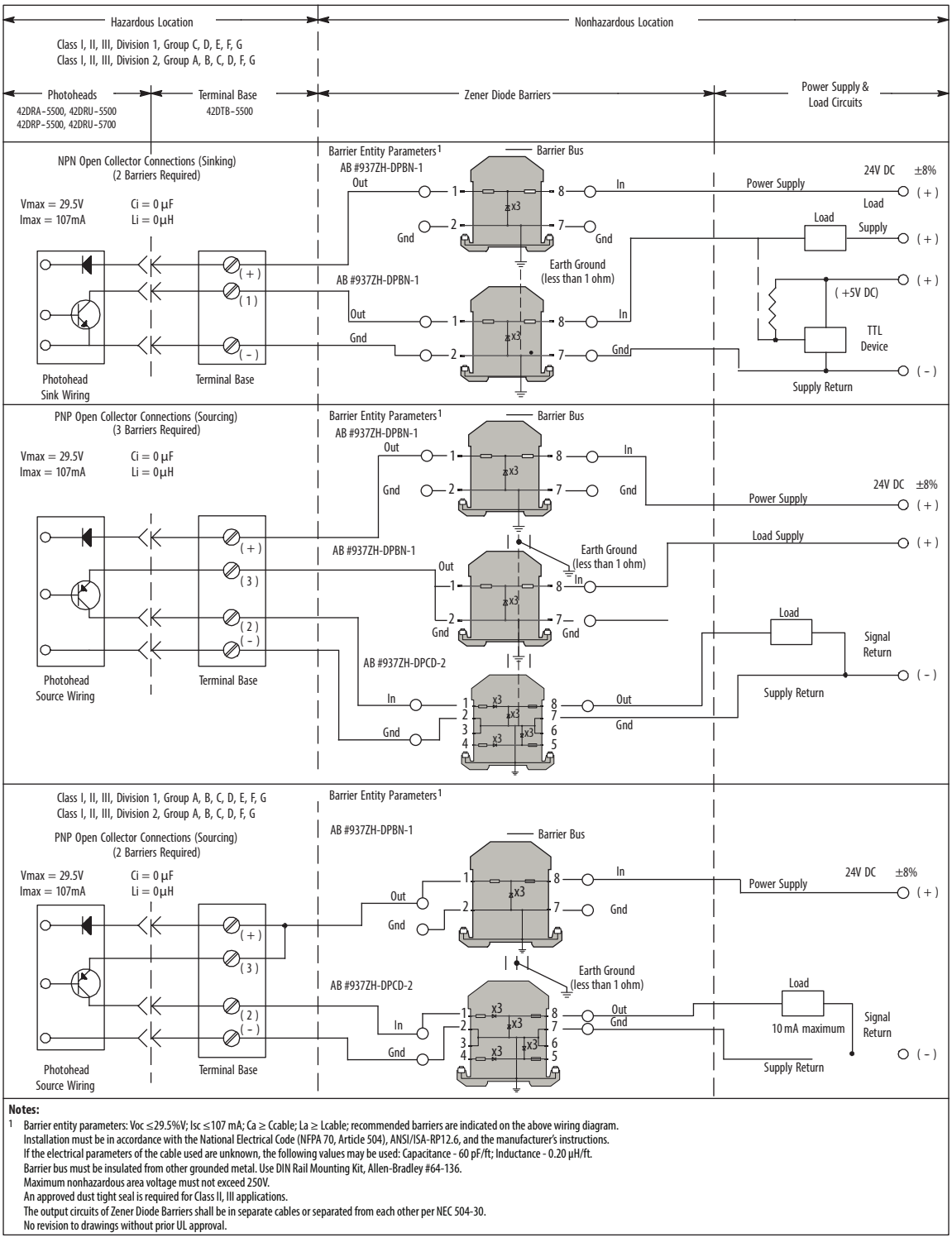
Note 1:

For reliable service in dusty and dirty industrial environments, higher optical operating margins may be required, resulting in reduced operating range for the control. Use curves as approximate applications guide only.

Note 2:

42DRA-5500 Typical Response curves with glass and plastic fiber optic cables. See PA-8306.

Wiring



Notes:

1 Barrier entity parameters: Voc ≤29.5%V; Isc ≤107 mA; Ca ≥ Ccable; La ≥ Lcable; recommended barriers are indicated on the above wiring diagram.
Installation must be in accordance with the National Electrical Code (NFPA 70, Article 504), ANSI/ISA-RP12.6, and the manufacturer's instructions.
If the electrical parameters of the cable used are unknown, the following values may be used: Capacitance - 60 pF/ft; Inductance - 0.20 µH/ft.
Barrier bus must be insulated from other grounded metal. Use DIN Rail Mounting Kit, Allen-Bradley #64-136.
Maximum nonhazardous area voltage must not exceed 250V.
An approved dust tight seal is required for Class II, III applications.
The output circuits of Zener Diode Barriers shall be in separate cables or separated from each other per NEC 504-30.
No revision to drawings without prior UL approval.

Allen-Bradley Control Drawing #133-451(Ver 09)

Rockwell Automation maintains current product environmental information on its website at
http://www.rockwellautomation.com/rockwellautomation/about-us/sustainability-ethics/product-environmental-compliance.page.

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