R-Series
Owner's Manual

LISTED
For Industrial Control Applications
(File E37141)

The R Series features a modulated LED infrared light beam highly immune to ambient light and direct sunlight. Retro-reflective, proximity and through-beam configurations are available. The basic ON/OFF function can be changed to time delay or other functions by merely inserting one of many plug-in cards available.

Model	Description
RPF303	ON/OFF - 35 ft. Retro Control
RXPF303	ON/OFF - 6 ft. Prox Control
RYPF303	ON/OFF - 14 in. Prox Control
RCPF303	ON/OFF - 300 ft. Control
LRML	300 ft. Control
P380	Retro-Reflector 3" diameter
P875	Swivel Bracket
P1193	Weather Shield

OPTIONAL PLUG-IN FUNCTION CARDS	
Card No.	**Function**
T360	Single Timer (OFF Delay)
T310	Single Timer (ON Delay)
T330	Dual Time (OFF and ON Delay)
T320	One-Shot Timer (OFF Delay)
T300	Five-Funtion Timer
T342	Batch Counter
T370	Delayed One-Shot Timer
T380	Shift Register (Delay Line)
T390	Over or Under Speed Detector
T399	Output Latch
T1330	Repeat Cycle Timer
T349	Single-Digit Toggle Batch Counter
T3200	Long Delay* One-Shot Timer (OFF Delay)
T3600	Long Delay* Single Timer (OFF Delay)

*to 40 Hours

For more detailed information on Plug-In Function Cards, see Bulletin 979.

ELWOOD® Autotron PHOTOELECTRIC CONTROLS
195 West Ryan Road • Oak Creek Wisconsin 53154
Phone: 1-800-527-7500 • Fax: 1-414-764-4298

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Specifications

LIGHT BEAM	
UNIT	**DISTANCE***
RPF303	0 - 35 feet off 3 inch diameter reflector
RXPF303	0 - 6 feet off 90% diffuse white surface
RYPF303	0 - 14 inches off 90% diffuse white surface
RCPF303 / LRML	0 - 300 feet

* Maximum ranges apply for clean indoor conditions only. Contact the factory for dirty or outdoor applications.

INPUTS	
Standard	120V ± 10% 60 Hz.
Optional	120V ± 10% 50-60 Hz.
	230V ± 10% 50-60 Hz.
	12 VDC; -1V, +4V at .15 amps DC Max.
	12 VAC, -3V, +1V at .18 amps AC Max., 50-60 Hz.
	24 VDC; -4V, +6V at .18 amps DC Max.
	24 VAC; -4V, +6V at .22 amps AC Max., 50-60 Hz.

SPECIFICATIONS	
POWER CONSUMPTION	5VA maximum
RESPONSE TIME	.01 seconds for circuit, .03 including relay
STANDARD OUTPUT - RELAY	DPDT contacts rated for 100,000 cycles @ 120 VAC or 28 VDC, 10A resistive; 10,000,000 mechanical (*see Fig. A*)
OPTIONAL OUTPUT	Solid State AC Switch: SPNO contacts rated @ 2.0 amps maximum, .1 amps minimum (*see Fig. B*)
	'G' Logic output: SPNO NPN transistor Vce (sat) – .5V Max. @ 10 ma, 1.5V maximum @ 100 ma, Vceo=30 VDC maximum, Ic=100 ma maximum (*see Fig. C1*)
	'GA' Logic output: Dual transistor output containing one NPN with same characteristics as 'G' output
AMBIENT LIGHT TOLERANCE	10,000 foot-candles of sunlight
TIMING ACCURACY	Repeat Accuracy ± 1%. Accuracy over extremes of temperature and line voltage -20%, +10% (typical)
SOURCE / SENSOR TYPE	GaAs infrared LED (indefinite life) / Silicon phototransistor
AMBIENT OPERATING TEMP.	-40ºC to 55ºC (-40ºF to 131ºF)
ENCLOSURE	Diecast aluminium, epoxy gray painted, gasket sealed, NEMA 1, 3, 4, 5, 12, 13 tapped in bottom for ¾" conduit
SHIPPING WEIGHT	3 pounds
OTHER OPTIONS	
SOLID STATE AC SWITCH OUTPUT:	Opto-isolated triac features zero-crossing and built-in snubber. (*see Fig. B*) Triac functions as a SPNO switch or a SPNC switch, depending on phase connection. This output is used to handle loads with a high repetition rate or when very long contact life is needed. For 120 VAC only. Not UL listed. Add “K” to end of model number. **Example:** RPF303**K**
LOGIC OUTPUT:	An open-collector NPN transistor or an opto-isolated NPN transistor. (*see Fig. C1 & C2*) This output is used primarily to interface the output of the control to logic devices such as programmable controllers, computers and electronic counters. Not UL listed. Add “G” or “GA” to end of model number. **Example:** RPF303**G**
ANTI-FOG LENS HEATER:	This option consists of a heater located behind the lens which warms the lens to prevent moisture condensation. The heater dissipates 5 watts of heat at 120 VAC. This option is recommended for outdoor and severe environments. Not UL listed. Add an “H” behind the “R” in the model number. **Example:** R**H**PF303
120 VAC & 230 VAC, 50-60 Hz INPUT:	This option allows the unit to operate on a 120V or 230V single phase supply at 50 or 60 Hz. (*see Fig. D*) It should be noted that maximum relay contact current should be halved for operation at 230 VAC. Not UL listed. Add a “T” behind the “R” in the model number for 120V and add ad “E” behind the “R” in the model number for 230V. **Example:** R**E**PF303
12 VAC 50-60 Hz, 12 VDC, 24 VAC 50-60 Hz, 24 VDC INPUT:	These options allow the unit to be operated from 12V or 24V. This is often desirable depending on the available system power supply, or applicable safety standards. (*see Figs. D, E, F & G for input information*) Circuit common is connected to the case. UL listing not applicable. The input code is specified by a letter following the “R” in the model number. **Examples:** R**A**PF303 (12 VAC), R**D**PF303 (12 VDC), R**B**PF303 (24 VAC) or R**W**PF303 (24 VDC)

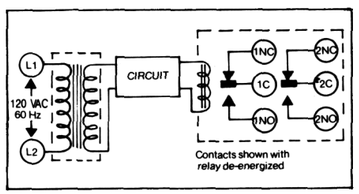


Fig. A: Standard Input/Output

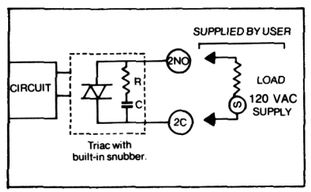


Fig. B: Solid State AC Switch Output (K)

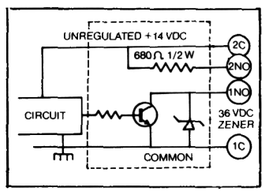


Fig. C1: Logic Output (G)

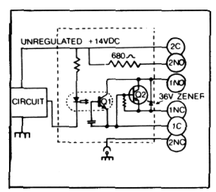


Fig. C2: Logic Output (GA)

Servicing

CLEANING	
LENS	For best performance keep lens clean. Glass lens needs no special care when cleaning.
PLUG-IN FUNCTION BOARD & CONNECTOR	Clean gold-plated contacts with alcohol and soft cotton cloth as needed.
CONTROL	Always keep cover and gasket in place during operation to prevent entry of foreign material that can effect performance.
MAINTENANCE	
LENS REMOVAL	Hook the lens retaining ring and pull it out. The lens should then come out. When replacing the lens, make sure the lens gasket is in place and push the retaining ring in evenly and firmly. **Note:** The RX/RY lens is notched for proper orientation.
RELAY REMOVAL	The entire relay merely unplugs for easy changing.
TROUBLESHOOTING	With the exception of the plug-in relay, all components are solid state with indefinite life. If trouble occurs, the following suggestions should uncover the problem. Begin by removing any timing card to convert operation to ON/OFF. If control begins functioning properly as ON/OFF, check timing card. Do not loosen the two pre-adjusted sealed screws holding the optical housing on the RPF303.

TROUBLE	PROBLEM	
	LIGHT PHASE	**DARK PHASE**
A. Relay (output) does not energize	1. Light beam misaligned 2. Operating range too long for conditions 3. Sensitivity set too low 4. Lens or reflector dirty or broken 5. Input voltage out of allowable tolerances 6. LED or phototransistor malfunction	1. Incomplete light beam blockage. (*see installation step 3, page 6*) 2. Sensitivity set too high for conditions 3. Input voltage out of allowable tolerances
B. Relay (output) does not de-energize	1. Incomplete light beam blockage 2. Sensitivity set too high for conditions 3. Input voltage out of allowable tolerances	1. Light beam misaligned 2. Operating range too long for conditions 3. Sensitivity set too low 4. Lens or reflector dirty or broken 5. Input voltage out of allowable tolerances 6. LED or phototransistor malfunction
C. Timing below minimum or erratic	1. Insufficient LIGHT time	1. Insufficient DARK time
D. Relay (output) actuates but LOAD circuit does not respond	1. Copper printed wiring under relay socket blown open due to overload or short in LOAD circuit 2. Relay contacts burned out	

FACTORY SERVICE: For direct factory service, send unit (with purchase order to cover repair charges) along with description of the problem to **AUTOTRON INC., 195 W. Ryan Road, Oak Creek, WI 53154**

Installation

The R Series is easy to set up and install. The P875 Swivel Bracket is available as an option to provide easy installation and alignment. Here is a brief guide:

1. Mount the control to a solid foundation to avoid a shift over time causing misalignment and erratic operation.
2. Connect LINE and LOAD wiring. The relay contacts are dry switches and do not supply voltage to themselves. Voltage must be applied from an external source. Plug-in relay may be removed for easier wiring.
3. To make the alignment process easier, remove any timing card to convert operation to ON/OFF. Replace the card when alignment is complete.

RPF303

4. Power control and move control and/or reflector to achieve best alignment. Best alignment is achieved by turning the sensitivity fully clockwise to maximum and align until red LED indicator glows brightest. Decrease the sensitivity until the indicator glows dimly and continue aligning to obtain the brightest glow at the lowest sensitivity. Alignment is now complete. Secure mounting of the control to the foundation, making sure alignment is not degraded. Increase sensitivity to maximum (fully clockwise). Install cover.

   (For applications where the light beam is not totally blocked or translucent objects are used, the sensitivity may have to be reduced for best performance. If unwanted source light is reflecting off the object, either angle beam off of perpendicular to the object's surface or reduce sensitivity.)

RXPF303 and RYPF303

Power the control. Determine the MAXIMUM and MINIMUM sensitivity potentiometer settings for your application under actual operating conditions. The MAX is the highest setting where undesired objects are not detected (no LED indicator glow). Where no undesired objects are present this will be at **full** maximum on the pot. This MIN is the lowest setting where the target object is detected (LED indicator at full intensity). There should be an adequate range between MAX and MIN for a good application. It is often good practice to make the final setting just below the MAX point to compensate for dirt build-up with time. Readings may also be taken between Test Point #5 (identified in copper) and ground (DC voltage) to provide an analog measurement of received signal. Use a high impedance voltmeter.

RCPF303 and LRML

Power both the light source and control. "Aim" the light source so the light beam is centered on the control lens. The beam diameter at a distance of 100 feet is about 3 feet and at 50 feet is about 2 feet.

Now align the control by rotating it from side to side and up and down for best alignment. Turn the sensitivity adjustment fully clockwise to the maximum sensitivity. Align the control until the red alignment indicator is glowing as brightly as possible. If the indicator glows to its maximum intensity, decrease the sensitivity adjustment until the intensity reduces to a faint glow and continue alignment to achieve the brightest LED indicator glow at the lowest possible sensitivity setting. Now re-adjust the LED light source for the brightest LED indicator glow on the control at the lowest possible control sensitivity setting. If you are spanning a long distance, you will need a helper to signal you when the indicator increases in brightness. When this is accomplished, alignment is complete. Turn the sensitivity to maximum. Then replace covers and secure mountings of control and light source.

(For applications where the light beam is not totally blocked or translucent objects are used, the sensitivity may have to be reduced for best performance.)

Replacement Parts List

PART NO.	DESCRIPTION
P846	Plug-in Relay
P829	Glass Lens (R, RC, LRML)
P891	Dual Glass Lens (RX, RY)
P835	Lens Gasket
P863	Lens Retaining Ring
P1021	Transformer
P1188	Phototransistor (R)
P1186	Phototransistor (RX, RY, RC)
P1189	LED (R)
P1187	LED (RX, RY, LRML)

PART NO.	DESCRIPTION
P847	Relay Socket
P867	Pin PC Edge Connector
P848	4-Position Terminal Block
P880	Sensitivity Potentiometer - 2K (R, RC)
P936	Sensitivity Potentiometer - 50K (RX, RY)
P827	Base (R, RC, LRML)
P827-1	Base (RX, RY)
P828	Cover with Window
P834	Cover Gasket

Operation

THE R SERIES FUNCTIONS AS A ON/OFF CONTROL WITH NO TIMING BOARD INSERTED. The phase switch allows the output to be energized with the light beam unbroken or broken. For LIGHT energized operation, set the phase switch in the position labeled "LIGHT". For DARK energized operation , set the phase switch in the position labeled "DARK".

A Sensitivity adjustment is available to reduce control sensitivity. Turn pot counter clock-wise to decrease sensitivity. A unique proportional red LED alignment indicator is provided. The more light "seen" by the sensing circuit; the brighter it glows. Reducing the sensitivity pot will reduce indicator intensity.

The phase switch also determines whether the timer times out light or times out dark. The last digit of the plug-in timer number denotes the adjustable time range on timing controls.

For Example: RPT36**3** uses the T363 timing board with the No. 3 time delay. Available timing ranges are shown below. Turn timing pot clockwise to increase delay.

RANGE NO.	TIME DELAY (sec.)
0	.1 - 10
2	.005 - .5
3	.01 - 1
5	.02 - 2.5

RANGE NO.	TIME DELAY (sec.)
6	.04 - 5
7	.2 - 23
8	.9 - 90

Note: These ranges do not apply to T3200 or T3600 timing cards.

In discussing timing functions, the following phrases will appear:

PHRASE	MEANING
Light Energized	The output energizes when the sensor "sees" light
Dark Energized	The output energizes when the sensor "sees" dark
Time Out Light	Refers to timing controls whose time delay begins when the sensor "sees" light. Relay reversal occurs at end of delay. Light beam interruption resets time delay.
Time Out Dark	Refers to timing controls whose time delay begins when the sensor "sees" dark. Relay reversal occurs at end of delay. Light beam interruption resets time delay.

The timing functions use an RC (resistor-capacitor) network to determine the time delay. It should also be noted that when using the relay, DPDT contacts are provided. Therefore, any relay action gives two sets of contacts closing and opening.

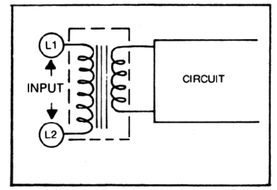


Figure D: 120 VAC 50-60 Hz Input (T)
230 VAC 50-60 Hz Input (E)
24 VAC 50-60 Hz Input (B)

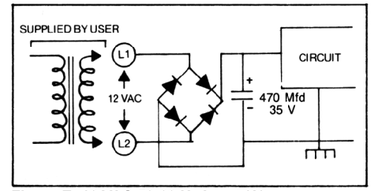


Figure E: 12 VAC 50-60 Hz Input (A)

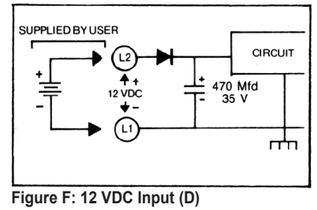


Figure F: 12 VDC Input (D)

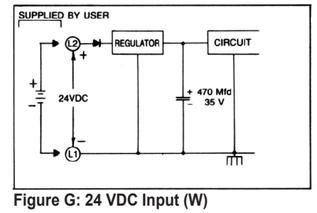


Figure G: 24 VDC Input (W)

OUTPUT SEQUENCE	DESCRIPTION
On/Off	Output responds immediately. Output may be DARK- or LIGHT-energized, set by the phase switch.
Single Timer-OFF Delay	Output is LIGHT-energized, time out is DARK-energized, time out light as set by phase switch. Built-in Inhibit circuit prevents false trip when power is turned on.
Single Timer-ON Delay	Same as above except output is LIGHT-energized, time out LIGHT- or DARK-energized, time out DARK.
One-Shot	Timing is fired by a light-to-DARK or dark-to-LIGHT change, selected by the phase switch. Output delays de-energized (dropout).
Delayed One-Shot	Output energizes for an adjustable beginning (between .02 and 2.5 sec.) and an adjustable time after completion of either a LIGHT or DARK signal. Trigger on either signal set by phase switch position. Built-in Inhibit circuit prevents false trip when power is turned on. Delay until pulse follows normal available time delay ranges.
Dual Timer	Output times out light and times out dark. Output may be LIGHT- or DARK-energized, set by phase switch.
Batch Counter	Set count between 1 and 99 on two decade switches. When the set count is reached, output energizes for approximately 0.1 second while count automatically resets for next batch.
Latch	Output latches ON at the instant the light beam is either blocked or restored (set by phase switch). Latch is released by momentarily interrupting input power to the control.
Delay Line (128-bit shift register)	Output responds in the same pattern as the input signal, and is delayed by the amount of delay setting.
5 Function Timer	Select from 5 commonly used functions by means of a 4-position DIP switch: **(1)** Single timer - OFF delay **(2)** Single timer - ON delay **(3)** dual timer **(4)** One shot - OFF delay **(5)** One shot - ON delay
Over or Under Speed Detector	Output energizes in the overspeed condition and de-energizes in the under speed condition.
Repeat Cycle Timer	Output cycles on and off as long as an input is present.
Toggle Batch Counter	Counts input pulses and switches the output when the predetermined number (1 - 9) of counts is reached.

RPF303 Range Off Retro Surfaces

SURFACE	PART NO.	MAX. RANGE (ft.)*
3" diameter reflector	P380	35
1 5/8" diameter reflector	P380A	16
1 1/4" diameter reflector	P380AB	14
7/8" diameter reflector	P380B	12
5/8" diameter reflector	P380C	10

SURFACE	PART NO.	MAX. RANGE (ft.)*
1 1/4" x 3" reflector	P380E	20
1" x 1" retro tape	7610	4
1" x 1" retro tape	3870	3
1" x 1" retro tape	7800	2

* Maximum ranges apply for clean indoor conditions only. Contact the factory for dirty or outdoor applications.

NO MINIMUM RANGE: There is no minimum range with the above retro-reflector materials.

DETECTING SMALL OBJECTS: If objects significantly smaller than the lens must be detected, use a small retro-reflector or mask down a larger one. The maximum light beam distance must be reduced as shown above.

How Reflectivity and Dirt Affect Range of RXPF303 and RYPF303

The table to the right shows the typical reflectivity of various materials. This determines the minimum Excess Gain required for operation in clean air. Add additional Excess Gain for dirty environments.

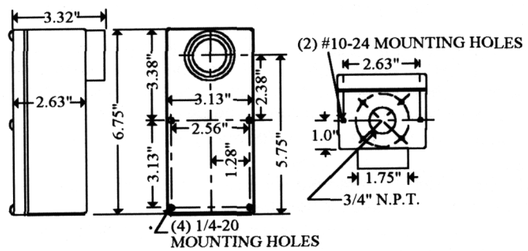
Example: If material reflectivity requires an Excess Gain of 2 in clean air and your dirty environment requires an Excess Gain of 5, then you need and Excess Gain of 10 (2 x 5) to detect your material in that environment.

Control operating range can then be determined from the RXPF303 and RYPF303 Excess Gain graphs on page 5.

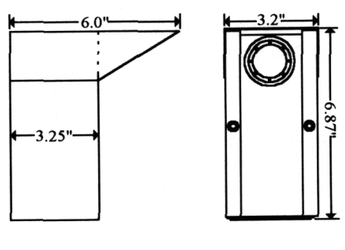
MATERIAL	TYPICAL REFLECTIVITY	REQUIRED EXCESS GAIN FOR CLEAN AIR
Kodak White Test Card	90%	1.0
White Bond Paper	82%	1.1
Kraft Paper	80%	1.1
Clear White Pine Wood	75%	1.2
Black Polyester Cloth	25%	3.6
Old Black Conveyor Belting	16%	5.6
New Black Conveyor Belting	9%	10.0
3M Nextel Flatblack Paint	4%	22.5

TIP: When distinguishing one material from another, the ratio of one reflectivity to another should be a minimum of 2:1

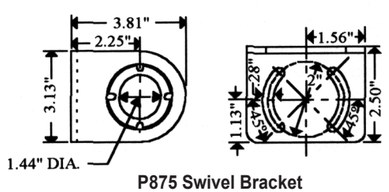
Dimensional Drawings



R SERIES



R SERIES with P1193 Weather Shield



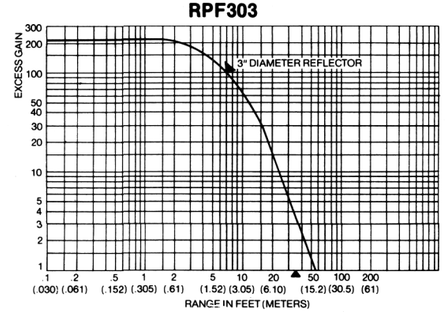
P875 Swivel Bracket

Excess Gain

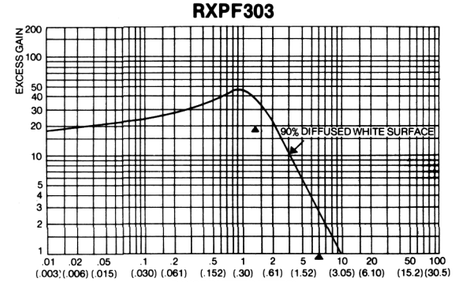
How well a photoelectric control can perform under less-than-ideal conditions is measured in terms of Excess Gain. This is the ratio of the light signal available to the light signal necessary for the control to barely work. The graphs below plot this factor versus range from specific targets. If degrading factors such as dirt, a poorly reflective surface, or misalignment exist, an excess gain greater than 1 is required. How much excess gain is required for the application is determined by the customer. An excess gain of 3-5 should be allowed for light industrial environments and 5-8 for moderately dirty environments.

TYPICAL EXCESS GAIN vs. RANGE

RPF303



RXPF303



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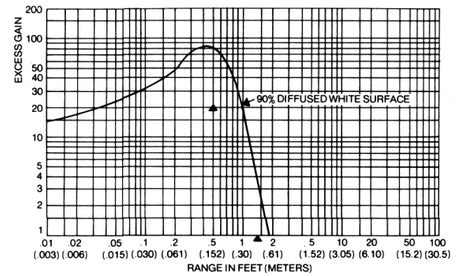
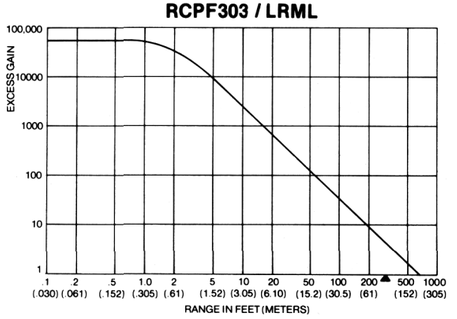
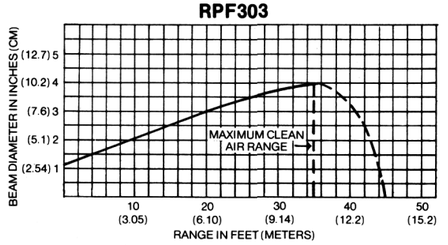


RCPF303 / LRML

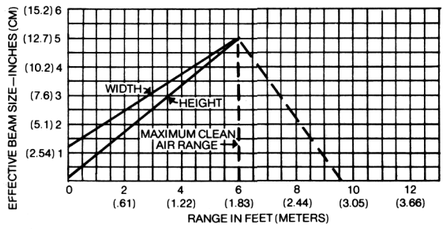


EFFECTIVE BEAM DIAMETER* vs. RANGE

RPF303



RXPF303



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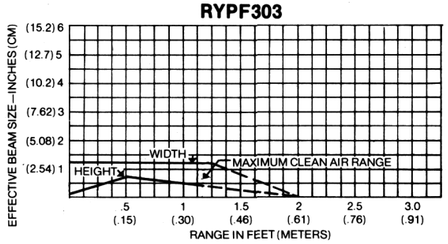
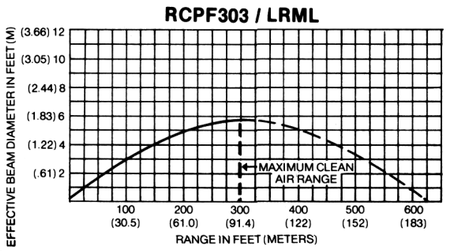


RCPF303 / LRML



* EFFECTIVE BEAM DIAMETER is defined as that portion of the radiation pattern that is sufficiently intense for detection.