

INTERNATIONAL RECTIFIER CORPORATION



RECTIFIER NEWS

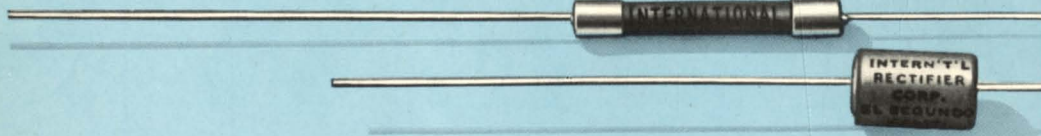
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WE GAVE THEM
THE WORKS...
AND THEY
STILL WORKED!

After being blasted out of a shotgun into a telephone directory, these International Rectifiers tested out to published specifications. Shock-resistant ruggedness like this is just one distinguishing feature of the reliability you can depend upon when you specify any International Rectifier.

* If you were wondering, they reached page 772 of the phone book.



The only
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selenium
and silicon
cartridge
line . . .
Available in
hermetically
sealed types,
in all basic
circuit
configurations
at voltages
to 20,000 volts.



To Solve Your High-Voltage
Low-Current Rectifier Problems...

OVER 500 STANDARD
SELENIUM AND SILICON
CARTRIDGE RECTIFIER TYPES!

Here is the largest selection of "cartridge" rectifier types available in the industry, from the company that pioneered this configuration! If you are faced with a high-voltage low-current rectification problem, it can be easily solved by the application of one of over 500 standard types . . . selenium and silicon. If a special type is required it can be produced economically to meet your needs. You are invited to take advantage of our long record of experience in the production of highest quality cartridge rectifiers. Your inquiry, with details of your application, will be handled promptly when addressed to our Electronic Products Department. Write today!



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How to Simplify Power Supplies, Referencing and Instrumentation with International Rectifier Silicon

ZENER DIODES

By OLIVER ALLEN, *Instrumentation Engineer, International Rectifier Corporation*

Silicon Zener Diodes have become such a tremendously useful design tool in so short a time that few design engineers are acquainted with the countless possible applications of these new components.

By temperature controlling the zener diode, it may be used as a precision reference element, or by temperature compensation and selection of temperature coefficients, stable reference voltages can be produced over wide temperature ranges.

They can also be used as clippers with an alternating current supply to produce square waves, or for voltage limiting, both ac and dc, as well as for wave shaping in voltage dividing circuits; eg. -RMS; log conversions, square law conversions, etc.

Zeners are capable of producing controlled bias voltages, such as needed in thyatron cathode biasing, and for holding a fixed bias in high fidelity audio equipment.

Coupling and de-coupling in dc amplifiers, both vacuum tube and transistor, may be accomplished with zener diodes.

Voltage Limiting in DC Power Supply

Simultaneous voltage regulation and dc rectification is achieved in the power supply circuit shown in Figure 1. Here, zener diodes provide voltage limiting or low order regulation in a dc power supply. The zener diodes are selected to act as clippers in connection with R, thus limiting the voltage to which capacitor C is charged. This provides control of a larger amount of power than is ordinarily handled by zener diodes of this rating. At the same time, the diodes act as rectifiers in this circuit. This arrangement may be applied to a wide range of power supply requirements where extreme regulation is not a design necessity.

Low Ripple DC Regulated Filament Supply

Zener diodes in combination with a power transistor will provide the low ripple dc regulated filament supply shown in Fig. 2. This extremely stable supply offers good regulation to both line and load variations for a wide variety of audio and instrumentation applications. This combination of components provides regulation and filter-

Want Basic Zener Diode Application Data?
Write for International Rectifier Bulletin SR-250 . . . a 4-page folder containing many basic zener diode circuits, as well as detailed characteristics, selection and application data on International Rectifier Silicon Zener Voltage Regulator Diodes.
Circle No. 2 on the Information Request card.

ing that is ordinarily difficult to accomplish at low voltages and high currents.

Expanded Scale Instrumentation

The circuit in Fig. 3 shows the use of zener diodes in expanded scale instrumentation, where a compressed lower scale and expanded upper scale is achieved, both of which may be calibrated. The relative areas and sensitivities of the scale will be determined by the component values selected. This circuit offers greater accuracy over the upper portion of the instrument scale, while still allowing rough measurements to be made in the lower scale range.

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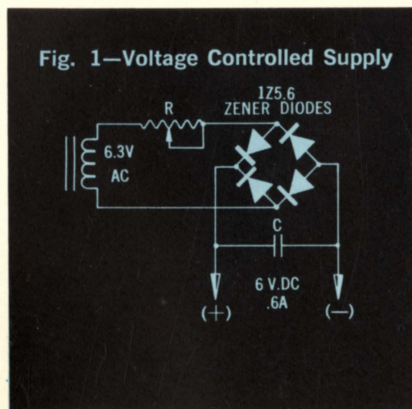


Fig. 1—Voltage Controlled Supply

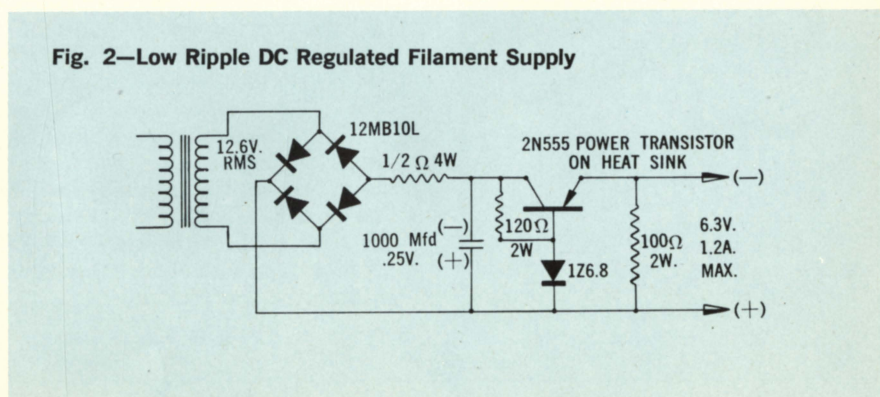


Fig. 2—Low Ripple DC Regulated Filament Supply

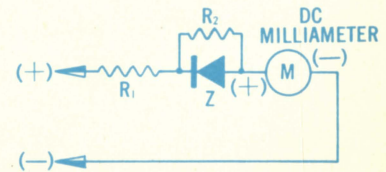


Fig. 3—Upper Scale Expansion

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Figure 4 illustrates an expanded scale with the lower scale portion completely suppressed. In this circuit, calibration may be achieved through adjustment of the meter needle below the low end of the scale.

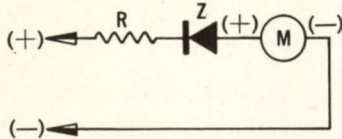


Fig. 4—Expanded Scale

The opposite effect of that shown in Fig. 3 is accomplished in Fig. 5. This circuit may be used to provide compressed indication of voltages above the critical ranges. The configuration may also be used to provide meter protection.

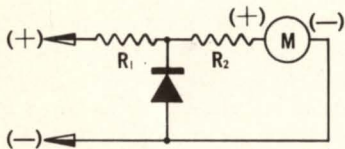


Fig. 5—Upper Scale Expansion

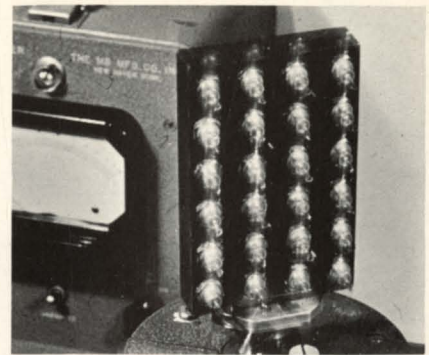
When used in conjunction with the wide variety of circuit components available today, the highly versatile zener diode is capable of solving countless problems in almost every field of electronics. It is probable that many useful properties of this device are still undiscovered . . . awaiting only the creative ingenuity of the curious design engineer.

Testing to Mil Specs Verifies International Rectifier Zeners' Reputation for Reliability

From start to finish, reliability is built into every semiconductor produced by International Rectifier Corporation. To prove the point in our own labs, silicon zener 1-watt diodes 1N1518 through 1N1528 and the 10-watt rated series 1N1599 through 1N1609 were recently subjected to all of the environmental tests of Signal Corps Specifications MIL-E-1/1235 and MIL-E-1/1236, as itemized below. They passed the tests with flying colors!

Reliability of this magnitude comes about because of two important company programs; first . . . as each new specification governing the production and testing of rectifiers for military use came into being, it was adopted as standard procedure for *all* production of the company. Secondly . . . a strong quality control program makes certain that the standards are met all the way.

Because of a record of consistently meeting or exceeding the established acceptable quality levels set by the United



Diodes Undergo Vibration-Fatigue Test

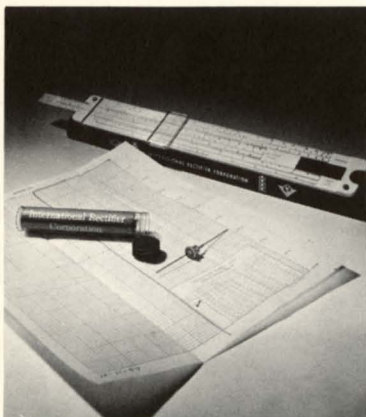
States Signal Supply Agency, International Rectifier Corporation was one of the first to qualify to manufacture under their RIQAP ("Reduced Inspection Quality Assurance Program") in 1955.

We are not permitted to say whether any other company is qualified to manufacture rectifiers under this honor program. If you have time, check into it. You'll be surprised!

TEST

TEST	CONDITIONS
Moisture Resistance	10 cycles per method 106 of MIL-STD-202
Temperature Cycle	5 cycles from -65°C to +150°C
Shock	Six 500 G shocks, 2 directions
Vibration Fatigue	64 hours at 10 G, 2 directions
Vibration, High Acceleration	Vibrated 100 to 1000 cycles per sec. at 10 G
Centrifuge	10,000 G acceleration
Lead Pull	2 pounds
Lead Bend	4 bends (90°) with special pliers
Thermal Shock	100°C to 0°C within 5 seconds, and reverse, 5 cycles

AUTHORIZED DISTRIBUTORS NOW FEATURE ZENER DIODE TECHNICAL SERVICE



An X-Y plot of reverse breakdown characteristics now comes with every zener diode you buy from an International Rectifier Authorized Industrial Distributor. This plot eliminates those question marks in your mind . . . "How good is this diode? How will it operate? How sharp a 'knee' does it have?" It is the most complete and accurate picture obtainable of a zener diode in action. And these plots are accurate to within 1/10 of 1% . . . accuracy that you couldn't duplicate in your testing laboratories without a large investment in zener test equipment.

This additional service (available only with International Rectifier zener diodes) also saves you hours of tedious testing time . . . allows you to put more time on creative engineering. Check with your local International Rectifier Distributor next time you order zeners. He has them in your required voltage range in off-the-shelf quantities. To get an X-Y plot on each diode when ordering direct from the factory, specify "Prototype" on your order.

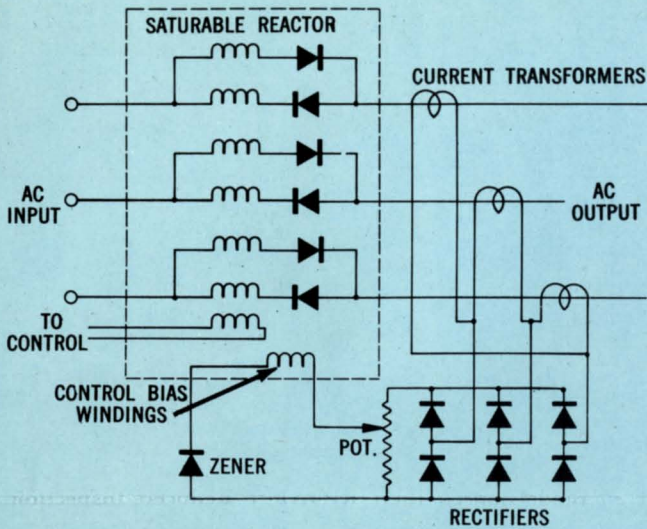


Fig. 1—Schematic Diagram of Control Circuit

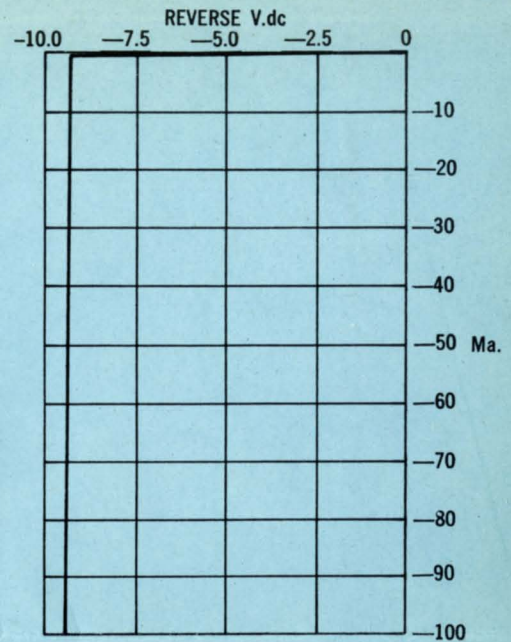


Fig. 2—1Z10 Diode Breakdown Characteristics

ZENER DIODE REGULATES OUTPUT IN A.C. CURRENT LIMITING OVERRIDE FOR SATURABLE REACTORS

BY GLENN GEISSINGER, Sales Engineer, International Rectifier Corporation

A method is shown whereby a very sharp current limiting action can be realized in a saturable reactor controlled system utilizing a zener diode as a switch.

In the system shown in Figure 1, the load was a large oven, with the heating elements fed from a three-phase source through a saturable reactor. The reactor provided the control necessary for maintaining the pre-set temperature of the oven. However, a mode of limiting the initial surge of current into the cold heating elements was necessary to protect the components from burning out.

The system used involved the sensing of the line currents with current transformers, and employing the almost rectangular reverse voltage vs current characteristics of a zener diode to provide the required protection.

Note in Fig. 1 that the output of the three current transformers are connected in delta; then rectified to provide a dc output current which is proportional to the vector sum of the three ac line currents.

By providing a fixed load resistance, an output voltage is obtained which is also proportional to the ac line current. The zener diode connected across a portion of this fixed load will act as a switch and will perform the function of limiting the ac current by means of the saturable reactor, or provide a warning system by energizing a relay.

In the particular application, the secondary current ratings of the current transformers were selected at $\frac{1}{4}$ ampere. The dc output current from the three-phase bridge rectifier in the circuit would be approximately $\frac{1}{2}$ ampere at full load.

The value of the potentiometer was selected as 35 ohms to provide a full load voltage of 17.5 volts. The wattage of the potentiometer was specified as 25 watts to provide a safety margin in operation. The rectifier requirements have now been determined from the output voltage and current values, and it can be seen that six International Rectifier Corporation silicon diodes of the type SD-91 can be utilized.

To provide the optimum characteristics from the zener diode, a voltage of from 8 to 12 volts should be selected. In the case at hand, an International Rectifier type 1Z10 diode was chosen, providing a firing voltage of approximately 10 volts. An almost rectangular curve is exhibited, as shown in Figure 2. Note that at voltages below the firing voltage, the leakage current is minute.

The current through the zener diode flows through a separate bias winding of the saturable reactor. This bias acts to cause the reactor to absorb more voltage, thereby tending to reduce the amount of load current. Thus, the ac line current will remain at the set maximum value until outside conditions cause a change in the operation.

The potentiometer provides a simple adjustment of the current limiting point, with this system providing a minimum current limiting point at approximately 57% of full load current. By selection of the potentiometer value, the range of adjustment can be made to suit the application.

new developments



Plug-In Silicon Equivalents To Vacuum Tubes

Instant operation, the ability to function at high temperatures; rugged, shatterproof housings and the long life characteristics of silicon are advantages offered by a series of plug-in silicon rectifiers designed to match the electrical ratings of many standard vacuum tube rectifiers.

Seven types cover the current range from 85 to 600 ma, with PIV ratings from 1500 to 2800 volts.

Within this series are exact electrical and base connection equivalents for such tube types as the 6X4, 12X4, 5AW4, 5U4, 5R4, 6AX5, 6X5, 0Z4, 5X4, 5Z3, 80, 82, 83, 84/6Z4, as well as many other standard tubes. All types are hermetically sealed, and exhibit

maximum stability in all mounting positions. Tests over a wide range of temperature and environmental conditions indicate high reliability of the rectifier characteristics.

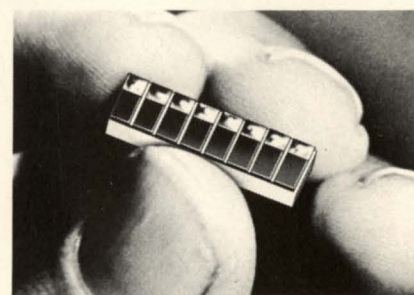
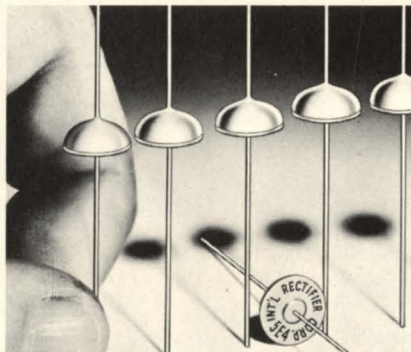
For complete data, circle No. 3 on the Information Request Card.

Low Cost 300 MA Rated Silicon Diodes

A new addition to the line of economy rectifiers is the commercial type 2E4 silicon pigtail diode. Specifically designed for television, radio and commercial equipment applications where high temperature is called for, they are operable to 70°C ambient temperature (100°C case).

All units are multi-sealed with successive layers of humidity-resistant, insulating resins and sealants, assuring optimum protection against environmental extremes, shock and vibration.

For complete data, circle No. 4 on the Information Request Card.



Readout Photocells For Data Handling Systems

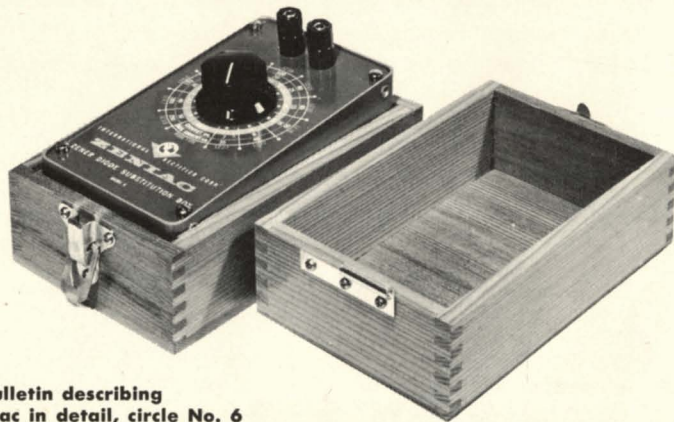
Designed specifically for computer and data processing equipment where rapid detection of light passing through punched cards or tape is required, these silicon photovoltaic readout matrices feature extremely fast response time in the order of 10 microseconds.

The self-generating devices convert light energy directly into electricity, with no need for external power supplies. Each matrix is made up of a multiple array of individually segmented silicon cells. Light energy striking a particular segment will cause power to flow from that segment only. Typical current generated is 300 microamperes for 0.01 square inch of active cell area at 1,000 footcandles illumination.

Extreme flexibility of design enables these units to be supplied in single cell or multiple-cell assemblies, as required. They are characterized by negligible temperature dependence, long operating life, uniform response from cell to cell in one matrix, and rugged construction.

For complete data, circle No. 5 on the Information Request Card.

Want to borrow a Zeniac?



For a Bulletin describing Zeniac in detail, circle No. 6 on the Information Request Card.

Zeniac is the handy zener diode substitution box that can save you hours of time in the application of zeners to your breadboard circuit. Two models are available; the Model A, with diodes in the 1-watt, 3.9 to 27 volt range, and the Model B, with diodes rated at 10 watts, 3.9 to 27 volts. Both function smoothly with a flip of the selector switch to give you an effortless answer to a frustrating problem.

If you insist on buying one, you can find them in stock at the International Rectifier Corporation Authorized Industrial Distributor nearest you. Otherwise, just to show you how handy it can be, we will be glad to loan you one to help you out of a breadboard bind. Just contact any one of our Industrial Reps or Branch Office men.

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 ON THE INDUSTRY'S
 BROADEST LINE OF
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Just mark the "bingo card" by the appropriate code number. The postman will do the rest!

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 for your rectifier application library . . .

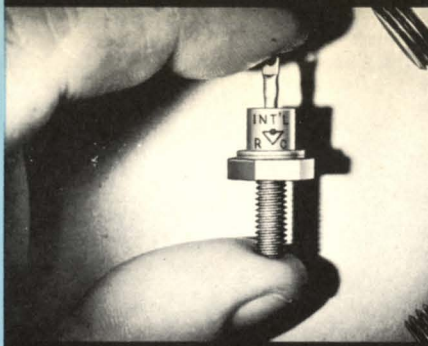
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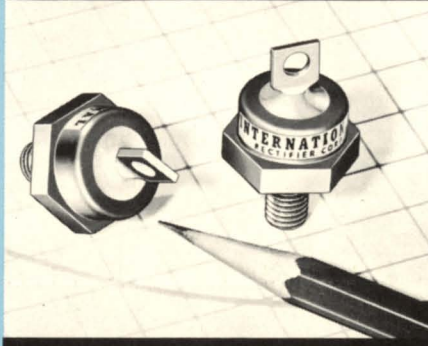
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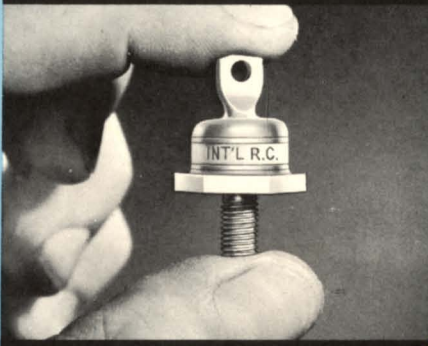
6 TO 18 AMP HERMETICALLY SEALED DIODES



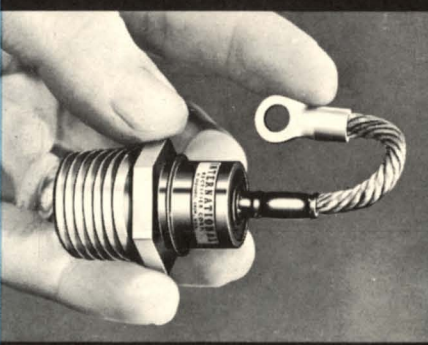
25 TO 35 AMP "QUAD-SEALED" POWER DIODES



25 TO 45 AMP HERMETICALLY SEALED DIODES



45 TO 150 AMP HERMETICALLY SEALED DIODES



70 TO 250 AMP HERMETICALLY SEALED DIODES



Precision-controlled diffusion process insures optimum operation and high uniformity of characteristics over the entire operating temperature range. Full 6 or 12 ampere output current over a PIV range from 50 to 500 volts. Rugged, all-welded construction.

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50 to 500 PIV rated "Quad-Sealed" power diodes are low in cost yet provide extremely stable operation on a wide range of commercial applications. 4-layer "Quad-Seal" process assures high resistance to humidity, shock, vibration and temperature extremes.

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Advanced ceramic techniques assure excellent thermal characteristics and mechanical stability of these 50 to 500 PIV rated, highly reliable silicon power diodes... for military or industrial applications.

Circle No. 9 on card.

An extensive series of 50 to 600 PIV rated standard and reverse polarity types. Optional mounting bases including machine thread and pipe thread types.

**Pipe Thread Types —
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Machine Thread—Circle No. 11

50 to 500 PIV rated standard and reverse polarity types offered in a series of machine thread and pipe thread mounting styles. Complete assemblies in all circuit configurations also available. Rugged construction and hermetic sealing assures long life and reliability.

Circle No. 12 on card.

Look To International Rectifier . . . For The Broadest Line In Selenium Photoelectric Cells



International Rectifier Corporation has long been a recognized leader in the development and production of high quality selenium photoelectric cells for industrial applications. Drawing from 18 years experience in this field, International's research engineers have pioneered many of the recent advancements in the field of solar energy conversion. International Rectifier Selenium Photocells and Sun Batteries are available in a wide variety of sizes, mounted or unmounted. Whatever your application, from light measurement and control devices . . . to supplying power for transistorized equipment, you will find the most reliable and economical unit to specify is an International Rectifier Photocell.

For a copy of this fact-filled 8-page photocell brochure, circle No. 17 on the Reader Information Card.