

# The mercury cell problem and its solutions.

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## General information about mercury cells and various solutions for replacing the banned mercury cells.

The now (for environmental reasons) banned mercury cells have caused problems for a lot of (vintage) camera and exposure meter owners who are now facing inaccurate exposures. The constant output voltage (1.35 volts) of the mercury cell was used as a reference voltage and for powering the meter and surrounding electronics. Depending on the circuits in an exposure meter a constant voltage is actually necessary or not. A Pentax Spotmatic, for instance, has a 'bridge' measuring network and does not need an exact 1.35 volts. This camera works perfect on a 1.55 volts alkaline or 1.6 volts silver-oxide cell. When an alkaline or silver-oxide cell is used instead of a mercury cell without an adapter or other special measures, deviations of up to 4 Light Values! (Konica TC) can occur. In general a camera or exposure meter will not be damaged when a silver-oxide or alkaline cell is used instead of a mercury cell, however, I cannot guarantee this will be the case for every camera. To check whether or not a camera or exposure meter works correctly on an alkaline cell; measure the exposure on a bright sky and in a dim lit room with a fresh alkaline cell and again with a mercury cell or compare the readings with an exposure meter or camera that exposes correctly. If the readings are the same with both cells/exposure meters in bright and dim conditions the mercury cell can be replaced with an alkaline cell without any problems. *There are cameras that do work well on Alkaline cells!* If the exposure readings in dim and/or bright conditions are more than 0.5 L.V. 'off' an alternative power source will be necessary once the mercury cell is depleted. For slides a variation in exposures of 0.3 L.V. can already be a problem. If the camera or exposure meter does not work properly on alkaline or silver-oxide cells there are a few options:

- Have the camera or exposure meter adjusted to work correctly on **silver-oxide** cells.
- Modify the camera/exposure meter by soldering one (or more) Schottky diode(s) in series with the wire from the battery compartment so it can take silver-oxide cells. (option 5, page 3)
- Use zinc-air cells, see page 2.
- Use one or more ready-made or homemade battery adapter(s).

Most batteries that were available in mercury versions are currently available in silver-oxide and/or alkaline versions. Lithium cells are not suitable for use in most cameras/exposure meters that were dependant on mercury cells even when camera manufacturers advise them (see bottom page 2 and 5). Adapters are available from various suppliers but usually at high prices (around \$ 33.-) beware of unusually high shipping costs that most suppliers charge. Take shipping costs into account when ordering batteries and/or adapters on the web. Check out the following sites for adapters: [www.criscam.com](http://www.criscam.com) and [http://www.smallbattery.companny.org.uk/sbc\\_mercury\\_catalogue.htm](http://www.smallbattery.companny.org.uk/sbc_mercury_catalogue.htm) replace PX32, TR164, HM-4N or (2) 640A mercury cells go to the site from the 'Yashica guy': <http://www.yashica-guy.com/document/battery.html> they sell adapters for a nice price (around \$ 15.-) and with 'normal' shipping costs. The 'Yashica Guy Pro Adapter' replaces the PX32 and equivalents that are used in the Yashica rangefinder camera series: Electro 35 G / GS / GT / GSN / GTN / MG-1. For the Lynx 5000E and Lynx 14E models there is a replacement for the 2 pieces of 640A mercury cells. There are adapters that cost a few dollars, [www.paulbg.com/Nikon\\_F\\_meter\\_batteries.htm](http://www.paulbg.com/Nikon_F_meter_batteries.htm) these metal rings are intended for physically adapting zinc-air 675-cells so they will fit in a 625-battery compartment but do not lower the voltage. These rings cannot be used with alkaline or silver-oxide cells. Expensive adapters (up to \$ 35.00) adapt the common SR44/S76/357 (or 386) silver-oxide cell in size and lower the voltage to 1.35 volts. Another option is to make your own adapter. On pages 6 to 8 is a comprehensive do-it-yourself guide for making a homemade adapter like the one the right or order this adapter ready-made (see page 11). In the following pages there is more detailed information regarding mercury cells and their replacements and concerns mainly the PX625 and the PX27 (page 5).



Dimensions in this article are given in millimetres (mm). To convert millimetres to inches multiply the millimetres by 0.04 this will give a reasonable approximation. For an exact conversion:

1 Inch = 25.4 mm, 1 mil (0.001 Inch) = 0.0254 mm.

**Mercury** cells such as PX13, PX14, PX27, PX32, PX400, PX625, PX640, PX675 and other types are (because of environmental reasons) no longer available, produced and imported in most countries all over the world. The mercury in the cell is a highly toxic heavy metal and can do a lot of damage to the environment. There are many manufacturers that made the 625-cell under their own part number: 4370, 4371, PX13, V13PX, EPX13, V625PX, PX625, KX625, RPX625, EPX625, HD625, PN625 RM625, 4625, 625, H1560, H-D, HS-D, M01, MR9, 1124MP, M20 and 8930. Many salesmen do not know the difference between mercury and alkaline cells and will try to sell you (in all ignorance) alkaline cells stating these cells are the same as mercury cells and are interchangeable without any problems, sadly however, this is not true! There are rumours mercury cells are still produced and available in China, look for those on the web. Make sure you are not sold 'old stock' that has been waiting on a shelf for 6 years or longer, these cells will certainly not last long! The main reason mercury cells were used is the constant output voltage of these cells during their lifespan. This constant output voltage makes simple and effective exposure meter circuits possible without the need of (expensive) reference components and a lot of electronics. Their large capacity and low prices also made it popular.

**Zinc-air** cells are intended for use in hearing aids to replace mercury cells. The cheap **675**-hearing aid cells are sold in blisters and can be used in most cameras/exposure meters directly but their lifespan is limited to only 2 to 4 months depending on make, humidity and temperature whether current is drawn or not since they literally dry-out over time. These cells are smaller than 625-cells and need to be held in place with an adapter-ring. There are cheap adapter-rings (a few dollars) made from metal but anything to centre the cell will do also, like a rubber O-ring, faucet washer or a rolled piece of paper. Some cameras, however, use the protruding rim of the PX625 cell to make contact with the battery compartment and won't work with a ring that is not made of metal. In this case a metal ring is necessary to make contact with the battery compartment. As long as the seal remains on the battery it will have a shelf life of at least 6 years. After the seal has been removed air gets in the cell through little holes, the cell is activated and after 1 to 5 minutes the output voltage will be high enough and ready for use. This cell needs access to fresh air or it will not be able to deliver the right voltage so a hole or gap somewhere in the battery compartment or battery-cap is necessary. Zinc-air cells, however, can be stacked directly on top of each other since the holes from one cell (or more, if 3 or 4 cells are used) are not completely sealed off by the negative side of the other zinc-air cell(s) and will be able to deliver the proper voltage. The fitting problem can be solved easily with the following 2 solutions.

**Stack solution 1:** make an empty battery casing as described on page 10 (the right half of the page). Make 3 small dents from the outside of the plus (+) side of the battery casing so that on the inside 3 small bumps appear as shown on the right. A 675-cell that is placed inside the battery casing will now be somewhat elevated so air can get into the air-holes. Zinc-air cell(s) will fit perfectly in a battery compartment when this adapter is used because the 0.04" (1mm) height difference between the 675 cell and the PX625 cell is corrected too.



**Stack solution 2:** Use a conductive spacer between the cells with a small piece cut out of it as shown on the right. Make this from copper or other metal foil. The example on the right is made from a conductive self-adhesive foil that can



easily be applied to a zinc-air cell as shown on the left. The glue on this sticker is conductive. When this sticker is applied to a cell so that one air hole remains open the sticker will seal off the other holes and therefore will last longer. The air can reach the cell through the gap formed by the cut-out part of the sticker. When 675-cells are used to replace PX625 cells you might need to fill up the space (0.04" = 1 mm per cell) with metal no. 10 flat washer(s) (hardware store). Centre the cell with rubber O-rings or, even better, (needed for electrical contact) order the tightly fitting metal ring from [www.paulbg.com/Nikon\\_F\\_meter\\_batteries.htm](http://www.paulbg.com/Nikon_F_meter_batteries.htm).

For cameras like the Rollei 35's these solutions are not a good option because the (half full?) film must be taken out of the camera to change the batteries.

There are 'replacements' for the PX625, the 'Wein' MRB625 and 'Rittz' MX625. Regrettably these cells are expensive compared to 675-hearing aid cells. These cells are 675-cell sized and come with metal adapter-rings to centre them. Both of these cells have fewer holes than 'normal' 675-cells and, therefore, will last longer. Unfortunately these metal rings are quite loose around the cell and not easy to apply (not so with the metal ring mentioned above). The 'Wein' MRB625 also has a somewhat lower output voltage (1.36 volts). It has only 2 holes instead of the usual 3 or more; this causes the cell to dry-out more slowly and will therefore last longer, up to 1 year according to the manufacturer. If you don't mind changing and buying these expensive 625-substitutes regularly you can have a very good substitute in these cells.

**Alkaline** cells such as LR44 (60-80 mA/h) and 625-alkaline 'replacements' such as the V625U, KA625, R625, EP625G and LR9 (150-200 mA/h) are not suited for most (vintage) cameras and exposure meters. These cells are often sold (a piece or in blisters) on markets, in warehouses, dump-stores and drugstores. They cannot be used because of their too high voltage and, more important, their sloping discharge properties (see 'discharge comparison' chart on page 3). A fresh cell has a voltage of 1.55 volts, then rapidly falls to 1.45 volts and falls slowly down to 0.9 volts. Alkaline cells are inexpensive and **only** if there is no difference or if the differences in readings of the exposure meter are smaller than 0.5 L.V. in all light conditions compared to readings with the original mercury cell, these alkaline cells can be an excellent replacement.

**NiCad** or **NiMH** rechargeable cells are also not an option because of its limited capacity (60-80 mA/h), sloping discharge curve and high self-discharge rate. When fully charged they have a voltage of 1.38 volts but falls very rapidly down to a much too low 1.2 volts.

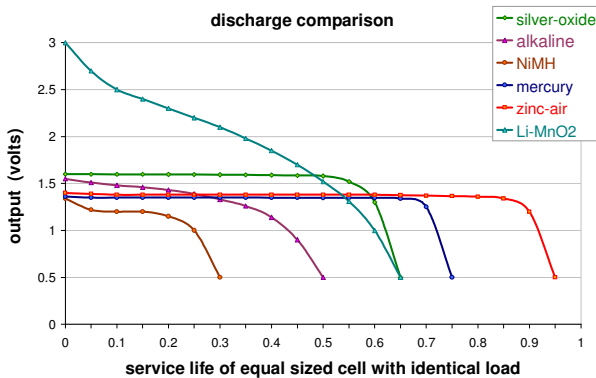
**Lithium Manganese** (Li-MnO<sub>2</sub>) cells are not suited as a replacement for mercury cells because of a much too high output voltage (3 volts) small capacity, sizes and their sloping discharge characteristics (see: chart on page 3 and text (right bottom) page 5). **Lithium-Iron-Disulphide** batteries (1.5 volts) are available in 'AA' penlight size only and recommended for usage in low temperatures.

**Silver-oxide** cells, under certain conditions, can be good alternatives. The voltage of these cells, 1.6 volts, is too high to be used directly without reducing the voltage. Silver-oxide cells, however, do have a constant output voltage like mercury cells. An adapter with a build-in device to lower the voltage to (an average of) 1.35 volts is the solution. An SR44, S76, 11077SOP, SP76, EPX76, SB-B9, RW42 or 357 silver-oxide cell (150-190 mA/h) with an adapter fits in the battery compartment of a camera/exposure meter. There are also alkaline cells with the same outline as the SR44 such as LR44, A76, S76A, V13GA, PX76A and RW82, do not mistake these for silver-oxide cells, they are not the same and certainly not interchangeable.

An **adapter** has two functions.

1. Adaptation of the somewhat smaller SR44 cell to the larger and differently shaped 625-cell.
2. Lowering the output voltage of a silver-oxide cell from 1.6 volts to the desired 1.35 volts.

Below are the discharge characteristics of various equal sized batteries under identical load conditions.



**Attention!** The 'battery check' reading on a camera or exposure meter may give erroneous readings when a battery adapter is used because the 'load' of the test circuit may be too high, this does not mean the adapter does not function properly. When a fresh silver-oxide cell is used with an adapter, mark or remember this 'battery check' reading and use it as a new 'full battery' reading when using an adapter.

Be sure **never** to short-circuit the cell and adapter, this may result into failure of the Schottky diode.

Alkaline cells cannot be used in an adapter because their output voltage is not constant enough during its lifetime. Only Silver-oxide cells can be used because they have a constant output voltage like mercury cells.

### Options for replacing the PX625.

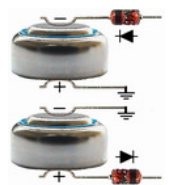
**Option 1:** have the camera/exposure meter adjusted to work correctly on a (1.6 volts) silver-oxide cell. This is a sometimes costly, but probably best, long-term solution. An old camera or exposure meter is bound to be a little inaccurate after more than 20 years of service and it can't do any harm to have it serviced anyway. The cost of servicing and or adjusting or calibration is dependant on make, model and service department that does the calibration. An adapter is not necessary in this case.

**Option 2:** zinc-air cells can be a good solution in some cases but only if battery compartment is accessible from the outside of the camera. Info on zinc-air is on page 2.

**Option 3:** an adapter is a good solution if the camera or exposure meter must remain in its original state or if the wires from the battery compartment are not easy to reach as with the Rollei 35 series. Also if the batteries last 1 year or more, or if the camera/exposure meter is not used very often a battery adapter is a good solution. Use the € 15.00 (\$ 20.-) **ready-made** adapter (page 11) or the \$ 32.99 MR9 adapter from C.R.I.S. Camera Service: [www.criscam.com](http://www.criscam.com) or the V206A adapter from Gossen: [http://www.gossen-photo.de/english/foto\\_s\\_batterie.php](http://www.gossen-photo.de/english/foto_s_batterie.php) C.R.I.S. also has adapter solutions for other types of mercury cells. For replacement of PX32 and other cells: <http://www.yashica-guy.com/document/battery.html> The MR9 adapter from C.R.I.S. has two drawbacks; the first problem is its inability to handle currents over 200 µA (microamperes) very well because of the applied diode (probably 2 germanium diodes in series). Readings with a Nikon F can be 'off' -1 to +3 L.V. when the C.R.I.S. MR9 adapter is used! (See page 4.) Another problem is the height of this adapter with a S76/SR44/357 silver-oxide cell in it, which is 0.015 inch (0.38 mm) thicker than the original PX625 cell and won't fit well in some cameras/exposure meters. The MR-9 fitted with a 386 cell has too little height and an even smaller capacity than when it is fitted with a 357 cell. An adapter with a 357 cell has half the capacity of a PX625 cell and, therefore, will last about half as long too. The diode is placed in the bottom of the MR9 adapter and not in the rim like in the homemade adapter that does not suffer from these drawbacks.

**Option 4:** adjust the camera/exposure meter yourself. This can be quite difficult and you can do more harm than good. There are no general guidelines on how to do this since every camera/exposure meter is different and needs another method or specific order of adjusting under controlled conditions. So do this **ONLY** if you have expert knowledge and know exactly what you are doing!

**Option 5:** solder one (or more) Schottky diode(s) in series with the wire from the battery compartment and use silver-oxide cells. A diode is a semiconductor that passes current in one direction and blocks in the other direction. Every diode has a certain voltage drop across it as current flows through it depending on the material it is made of (germanium or silicon), its structure (Schottky) and the amount of current flowing through it. (see page 4) If the '+' of the battery is connected to the chassis of the camera or exposure meter, solder the diode(s) in series with the wire from the battery compartment as in the upper example on the right. If the '+' of the battery (also) has a wire attached to the battery compartment you can solder the diode as shown in the lower example. The colour of the diode and ring may vary depending on make and type. The ring or coloured band on the diode represents the cathode. Make sure you have enough room to place the diode and insulate the diode and its wires properly. If the camera takes 2 cells, solder 2 Schottky-diodes in series with the wire or one (1) 1N4148 silicon-diode, 3 cells: solder one (1) 1N4148 silicon diode and 1 Schottky diode in series. 4 cells: solder two (2) 1N4148 silicon diodes in series.

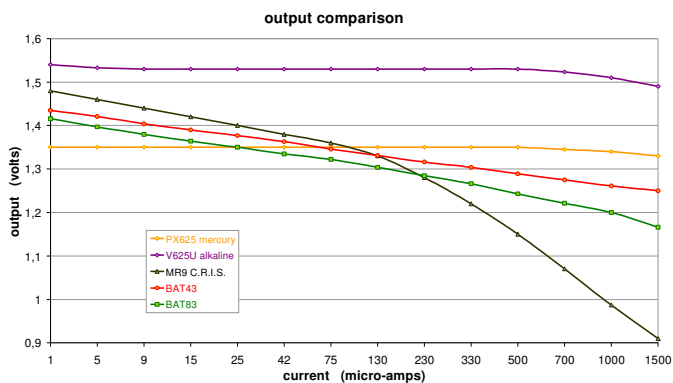


**Option 6:** a homemade adapter can be a good solution (see option 3). A homemade adapter is cheaper and performs better than the C.R.I.S. Camera Service MR9 adapter. You do need some manual skills for the assembly of an adapter. Comprehensive descriptions for making homemade adapters are on pages 6 to 8 and 10.

## Choosing the optimal Schottky diode.

Cameras and exposure meters that last a year or longer with their batteries, such as Rollei 35's, have a maximum drawn current between 0 - 200  $\mu\text{A}$  (micro-amperes). For all those cameras/exposure meters the C.R.I.S. MR9 adapter can be an excellent solution as long as the battery compartment allows the 0.015 inch (0.38 mm) extra height. For cameras/exposure meters with a current between 2 - 1,000  $\mu\text{A}$ , a homemade adapter fitted with a BAT43 Schottky diode is an even better solution and is **suitied for all cameras and exposure meters**. If the 0.015 inch (0.38 mm) extra height of the MR9 adapter with a silver-oxide cell poses a problem, the homemade adapter is the only solution since it has the exact height of the original PX625 mercury cell. Below is a comparison chart for an adapter fitted with a BAT83 and BAT43 Schottky diode, The C.R.I.S. MR9 adapter, PX625 mercury and V625U alkaline cells are also shown in the chart. All measurements are made at room temperature with a silver-oxide cell as a power source.

The X-axis from the chart is neither logarithmic nor linear for the following reasons:



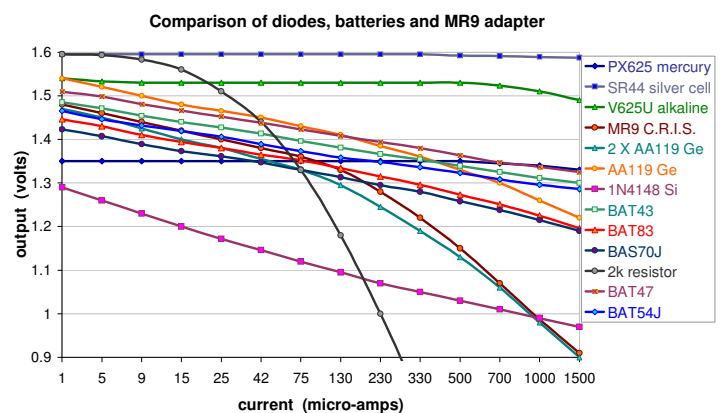
1. Every increase in Light Value means doubling of the light-level of the previous Light Value resulting in the following light-level scale: 1, 2, 4, 8, 16, 32, etc.
2. In most vintage cameras/exposure meters a CdS-cell (Cadmium Sulphide cell, a Light Dependant Resistor) was used as a light sensitive device. The variation in resistance is not linear to the amount of light falling on this resistor, therefore, the current through the resistor, if a constant voltage is applied, also will not be linear to the light level.

The steps on the X-axis are analogue to Light Values from (this case) a Nikon camera. (L.V.1 = 1  $\mu\text{A}$  to L.V.15 = 1,500  $\mu\text{A}$ ). Ideally the output voltage of an adapter, under varying current loads, should be equal to the output voltage of a mercury cell. The voltage drop of a (Schottky) diode is dependant of the current through it. As the current increases the voltage across the diode also increases (a little), because the output of a silver-oxide cell remains the same under varying current loads, the output voltage of the adapter will decrease only slightly. In essence the Schottky diode acts as a 'constant voltage drop' that is (almost) current independent.

For cameras like the Olympus 35 ECR which uses 2 PX640 cells 1 Schottky diode like the 1N5817 in series with the wire of the battery compartment will do the trick. These type of cameras, with lights as an exposure indicator, draw a much higher current and diodes like the BAT43 will have a voltage drop that is too high.

## Research done on various voltage lowering diodes.

A multimeter with current measurement ranges was used to measure the minimum and maximum drawn current from the battery when it is connected in series with the battery and the camera/exposure meter. The current is measured in low light level conditions (indoors in a not too bright room) and in bright conditions (on a bright sky, not directly into the sun in case of an SLR!). If the maximum current remains below 700  $\mu\text{A}$  the BAT81S, (DO-35), or BAT83S (DO-35), BAT41, 1N5711 or 1N6263 (DO-35), or BAS70J (S.M.D.) can be used. If the current range is between 5  $\mu\text{A}$  and 2 mA the BAT43, BAT46 (DO-35) or BAT54J (S.M.D.) will do fine. If the current range is between 50  $\mu\text{A}$  and 5 mA the BAT47 (DO-35) will do. Above 5 mA an Schottky diode is not an option anymore. Schottky diodes come in different packages, the DO-34 (Diode Outline) measures (max.) 3 mm long (without the wires) and 1.6 mm across. The DO-35 measures (max.) 4.3 mm long and 1.9 mm across. Very small S.M.D. (Surface Mount Device) Schottky diodes such as BAT54J and BAS70J also can be used. The 'J' suffix is very important in this case, it stands for a SOD-323 (Special Outline Diode) casing which measures only 2 x 1.5 x 1 mm (L x W x H) and has two pads for soldering it directly onto a P.C.B. (Printed Circuit Board) without the need of any wires. If little pieces of wire are soldered onto these solder pads this diode can be used also. Below is a comparison chart for various Schottky diodes, C.R.I.S. MR9 adapter, PX625 and V625U cells, 1N4148 silicon diode, AA119 germanium diode(s) and a 2 k $\Omega$  (kilo-Ohms) resistor. All measurements were made at room temperature with a silver-oxide cell.



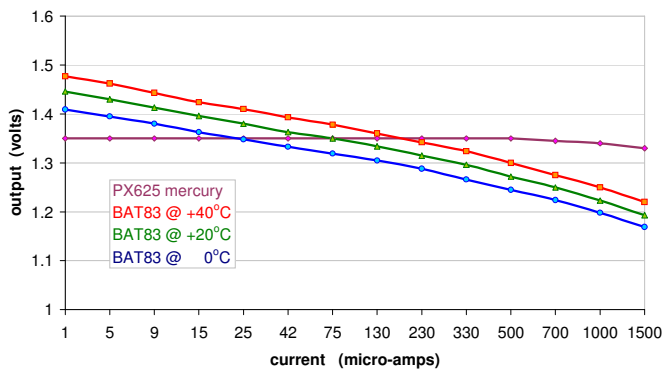
Schottky diodes, other than the ones mentioned in the chart above, also have been measured but are not included since they have identical characteristics to other diodes already shown in the chart. The BAT81, BAT82 and BAT41 have similar characteristics as the BAT83. The 1N5711 and 1N6263 are positioned exactly between the BAS70J and BAT83. Do **not** use diodes other than the ones mentioned above. Germanium diodes (AA119 or OA types) haven't got the right characteristics. 2 germanium diodes in series will perform like a Schottky diode up to 200  $\mu\text{A}$ , above this point the output voltage will be too low for the exposure meter to give accurate readings. Silicon diodes, like the common 1N914 and 1N4148, clearly have a much too high voltage drop (0.5V); as a result, the output voltage will be far too low. A resistor is, unlike a (Schottky) diode, a linear element i.e. the voltage across a resistor would vary linear related to the current flowing through it and therefore cannot be used. (see 2k $\Omega$  resistor line in the graph above)

**Note:** The output voltage of an adapter with a silver-oxide cell cannot be measured with a multimeter without an additional 'load'. The internal resistance of a multimeter is very high, as a result hardly any current will flow through the diode and the voltage across the diode also will be negligible. The output voltage that is measured will be around 1.5 to 1.6 volts and not around 1.35 volts. If the adapter with a silver-oxide cell is loaded with a resistor of around 10 k $\Omega$  (kilo-Ohms) the average output voltage, when used in a camera or exposure meter, will be measured.

### Temperature influence on Schottky diodes.

As with all semiconductors, Schottky diodes also react to changes in their temperature. When the temperature increases the voltage drop across the diode decreases, as a result, the output voltage of the silver-oxide cell/diode combination will increase. When the temperature decreases the voltage drop across the diode increases, therefore, the output voltage of the silver-oxide cell/diode combination will decrease. For Schottky diodes the temperature influence on the voltage drop is somewhere between -1.2mV/ $^{\circ}\text{C}$  to -1.6 mV/ $^{\circ}\text{C}$  depending on type and current. Most cameras/exposure meters will be used at room temperature or somewhere around it. Below freezing point a lot of cameras will also have even more problems than just with their batteries. A camera with a temperature of over 104 $^{\circ}\text{F}$  (40 $^{\circ}\text{C}$ ) feels very hot if you keep it in your hands. Mostly, cameras/exposure meters will be used within a temperature range of 32 $^{\circ}\text{F}$  (0 $^{\circ}\text{C}$ ) to 104 $^{\circ}\text{F}$  (40 $^{\circ}\text{C}$ ). The measured output voltage of a battery adapter fitted with a BAT83 Schottky diode at temperatures of 32 $^{\circ}\text{F}$  (0 $^{\circ}\text{C}$ ), 68 $^{\circ}\text{F}$  (20 $^{\circ}\text{C}$ ) and 104 $^{\circ}\text{F}$  (40 $^{\circ}\text{C}$ ) is shown in the chart below.

temperature influence on BAT83 Schottky diode



### The PX27 mercury cell and its replacement.

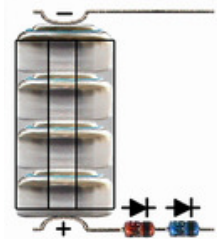
Cameras and exposure meters that take PX27 mercury cells (150-180 mA/h) also will need a replacement. If PX27 mercury cells can be found keep a few of them in stock. There are plenty alternatives for replacing the PX27 batteries such as SPX27BP or PX27S silver-oxide batteries or the PX27A alkaline battery, these batteries are the best alternatives as a replacement. Also battery adapters that take 386 cells can be used.



Another alternative for this battery is a stack of 4 alkaline LR44 or 4 silver-oxide SR44 cells. Stack 4 of these cells atop of each other and wrap a thin sheet of plastic or paper around it as shown on the left. Use cello-tape to keep the roll together, make sure the cells do not stick to this roll. The plastic roll must be somewhat loose around the cells and keeps the cells together and isolates the individual cells to prevent them from being shorted by the metallic wall of some battery compartments. This

stack will fit in most battery compartments (provided the battery compartment contacts allow 1.5 mm extra height). Most cameras and exposure meters will not have any problems with a voltage of 6.2 volts instead of 5.6 volts from the original PX27 mercury cell. Minox 35EL, GL, GT cameras for instance work perfectly on this somewhat higher voltage and do not need to have the voltage lowered to 5.6 volts. If this stack won't fit in the battery compartment (Rollei 35TE / SE / LED), 386-silver-oxide cells can be used. A 386-cell (120-140 mA/h) is 1.2 mm shorter compared to the 357 (SR44) cell (150-190 mA/h) and if 4 of these cells are stacked they will be 3.7 mm short. Fill this gap with metal ring(s) to obtain the correct height. There are adapters on the market that use 4 of these SR43/386-cells to replace the PX27, such as the 'Minox battery conversion kit' for ordering these look at: [www.smallbattery.company.org.uk/sbc\\_v27px\\_adapter.htm](http://www.smallbattery.company.org.uk/sbc_v27px_adapter.htm) or the V27PX adapter from C.R.I.S. This adapter does have a voltage lowering circuit and delivers 5.6 volts. The adapter is suited for the Rollei 35SE, 35TE, 35LED, Minox 35's and a lot of other cameras and exposure meters. Look at page 1 for more adapter selling websites for replacing various types of mercury cells. If you still own a PX27 cell you can easily check if a stack of 4 alkaline or silver-oxide cells are the answer to the problem by measuring exposure on a bright sky and in a dim lit room with the PX27 and with 4 LR44 alkaline cells. If the readings of the camera/exposure meter are the same with both types of cells the PX27 can be replaced with a stack of 4 alkaline or 4 silver-oxide cells without any problems. Do not use alkaline and silver-oxide cells together! Stacking 4 zinc-air 675-cells is not an option because the air holes from 3 of the 4 cells will be closed off by the other cells and will not be able to deliver the necessary current.

If the readings of the exposure meter are not the same with both kinds of batteries only silver-oxide cells can be used **and** a 1N4148 silicon diode with BAT43 Schottky diode must be soldered in series with the wire from the battery compartment. This will give the proper voltage drop and will bring the output voltage down to around 5.6 volts. Solder these diodes in series as shown on the right. If only the '-' side of the battery compartment has a wire attached to it; solder the 2 diodes in series with this wire, the cathode of the diodes (the stripe or ring) must point towards the '-' of the battery stack.



CR1/3N or DL1/3N cells **Lithium-Manganese** cells are **NOT** a good replacement for the PX27 mercury cell even when camera manufacturers recommend them. These cells have a nominal voltage of 3 volts (when fresh) and a height of 2 SR44 silver-oxide cells. These lithium cells, however, have an extremely sloping output voltage (see 'discharge comparison' chart on page 3). From the moment these cells are used their voltage will drop steadily. When it is halfway its capacity the output voltage has already dropped down to 2 volts and will continue to drop further to 1.2 volts before ending its useful life. Most cameras using these cells have electronic shutters. A Lithium cell nearing depletion may give a 'normal' battery test indication but cannot deliver the current bursts that are needed for proper shutter operation resulting in wrong exposures and/or 'strange behaviour' in some cameras.



## Required materials and tools for making a PX625/MR9 battery adapter.

**Be sure to read the entire manual before starting to make the adapter.**

**Important liability notice:** *Modifying a camera/exposure meter and/or making a homemade adapter are at your own risk. The author of this article is not liable for any personal injuries or any damage caused as a result of any actions taken because of this article. The contents of this article may be used, copied and distributed freely as long as the contents are not changed in any way.*

### Materials required:



An alkaline cell of the type 625; **never** use a Mercury cell! (see page 2). If there is any doubt about the kind of cell, it is better not to use that cell at all because of the hazardous nature of the materials that can escape when opening a Mercury cell.

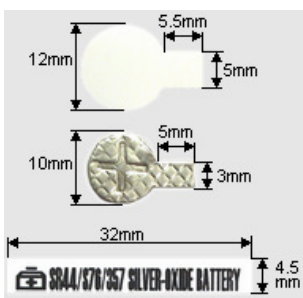
A Schottky diode as mentioned on page 4. One or more of the mentioned types should be available at your electronic parts shop. The BAT43 is included in the *625-kit\**. If you need another diode please ask when ordering the kit.

Glue. Preferably, a 2-component glue; however, any filling glue that can bond metal and plastic (or paper, when a paper isolator is used) together will do.

Solder of the type used for soldering electronics. This is called 60/40 rosin core solder, with a diameter of 0,7-1 mm; it is sold on a reel, a piece of cardboard or as a coil in a plastic container. A piece ( $\pm 15$  cm) is included in the *625-kit\**. Do **NOT** use plumbing solder and/or solder that needs external flux.

A 100  $\Omega$  (Ohms) resistor (0.25 Watts). This resistor is used to drain the cell and is included in the *625-kit\**.

A paper sticker cut in the shape, shown below. This is used as isolator and therefore may not be made from conductive material. This pre-cut sticker is included in the *625-kit\**.



A conductive and solderable self-adhesive tinned copper shielding foil, made by 3M, type 1345, cut in the shape as shown on the left. This foil is intended for shielding of components from R.F. and E.M.C. signals. It is expensive material and often hard to get. Look for well stocked electronics shops that should have these or comparable foils in stock. Aluminum foil is not an option because it cannot be soldered with normal solder. A pre-cut foil is included in the *625-kit\**.

A flexible plastic or paper strip (32 X 4.5 mm). Almost any plastic or paper may be used, as long as it is as thick as normal paper and non-conductive. A preprinted paper strip with a plastic coating (shows how to place the silver-oxide cell and 3 of the most common cell-type numbers that can be used) is included in the *625-kit\**.

### Tools required:

A drill and a vise with 3, 6 and 10 mm drill bits. Or, a stand drill with a vise and the necessary drill bits. A center punch can prove to be very handy.

Combination pliers or long-nose pliers for pulling out the metal and plastic rings.

A 40-60 Watts soldering iron with a small tip or a soldering station for use with electronics. A soldering iron with less power than 40 Watts will not be able to heat the battery casing enough to make the solder flow. A soldering iron with a power of over 60 watts is likely to damage the Schottky-diode or the isolator when soldering the diode onto the solder-able foil.

A breakaway utility knife or scalpel.

**TIP:** *This knife can also be used to keep the heat away from the isolator when soldering the diode onto the solder-able foil by holding it between the foil and isolator.*

Scissors for clipping the sticker, foil and strip. When the *625-kit\** is used the scissors are not necessary.

A flat or square file, maximum 5 mm wide.

A small screwdriver or pick for cleaning out the alkaline battery once it is opened.

A side cutter for cutting the wires of the Schottky diode down to the proper size. If you do not own a side cutter scissors can be (mis)used for this purpose.

A clothespin is used for clamping the resistor on to the cell to drain it.

### Contents of a *625-kit\** :



A *\*625-kit* comes with a BAT43 Schottky diode (DO-35), a 100 $\Omega$  (Ohms) resistor (for draining the alkaline cell), a paper pre-cut isolating self-adhesive sticker and a (metal) pre-cut solder-able conductive self-adhesive sticker, 2 pre-printed paper isolators with cell type and battery placement instructions on it and a piece of solder. Ordering information can be found on page 11.

## Instructions for making a PX625/MR9 battery adapter.

The adapter is made from an electrically empty (dead) 625-type **alkaline** cell. The used cell must be an alkaline cell, for example: V625U, GP625A, KA625, EPX625G or LR9. An alkaline cell has a nominal voltage of 1.5 volt. Mercury cells (see page 2) are **NOT** to be used because hazardous materials are used in these types of cells, among those the extremely toxic mercury, which is why the mercury cell is now banned in most countries. To drain the cell, a 100Ω (Ohms) resistor is placed over the contacts of the cell, as shown on the left. Make sure that the leads of the resistor do not short the battery contacts, if it does; the cell will get very hot and might even rupture. Discharging takes  $\pm 2$  days.



After the cell has been discharged the cell can be emptied. Because of health risks it is advisable to take some precautions. Drilling and removing the insides of the cell is best done in a very well-ventilated area or outdoors. Make sure to use household or surgical gloves. Avoid any contact with the insides of the cell with your skin or other body parts. This way health risks are kept to a minimum.

To remove the insides from the cell, first it has to be opened. This is done by drilling a hole of about 3 mm exactly in the middle of the cathode (-) of the cell. A center punch can prove to be very handy for centering the drill. To hold the battery securely in a vise it might be handy to construct a holder that goes into the vise as shown on the right. Take a square piece of material (in this case Plexiglas but it can be made from a number of materials) and drill a hole of around 13 mm in the middle. Make a saw cut in one side so the hole can expand and shrink a bit. The battery should be held firmly in this tool when it is inserted in a vise. When drilling, use surgical or household gloves and safety glasses. Do not drill too far into the cell so the bottom of the cell won't be hit. Some cells might leak some fluid when drilling! Use a low speed when drilling so that the insides of the cell won't fly around and also to make sure that the cell does not get too hot due to friction.



Next, the 3 mm hole must be made larger. Use a 6 or 7 mm drill. After this, you can proceed to the 10 mm drill.



Now, only the rim of the metal electrode and the isolator ring remain. To remove these, the empty cell needs to be placed in the vise (use the drilling tool) again. Safety first: use surgical or household gloves. An approx. 6 mm wide gap must be made in the rim of the cell casing, as shown on the left. The BAT43 diode supplied with the *625\*kit* is DO-35 size. When a DO-34 (page 4.) diode is used, a 5 mm gap is required. The Schottky diode will later be placed in this opening. Once the gap has been filed out the electrode ring and the isolator ring will have been cut and can be removed by pulling them out with pliers as shown on the right.



The insides of the cell can now be removed. Do this in a well-ventilated room or outdoors making sure that you use household or surgical gloves. Scoop out the insides with a small screwdriver or a pick. The insides of the cell should be treated as chemical waste. After the rings are removed from the battery casing, the inside of the battery casing can be cleaned with water and soap. Dry the battery casing well to avoid rust.



To be able to solder the Schottky diode in the rim of the battery casing, the inside of the rim must be tinned with solder at the spot where the Schottky diode is to be soldered. In order to let the solder flow and adhere to the inside of the rim, the rim has to be scratched at the spot where the diode is to be soldered. Use a soldering iron of 40 to 60 Watts or a soldering station.



Heat the rim of the battery casing for about 10 seconds and then let some solder flow into the rim. It can take over 30 seconds for the solder to flow and

adhere to the rim. The battery casing will become **VERY** hot! The solder should adhere firmly if done correctly. For easy soldering put the battery casing in a vise (not in the drilling tool !) or hold it with pliers. Cut the cathode (near the black stripe) of the Schottky diode so there is 5 mm of lead left, as in the illustration on the left. Tin the 5 mm long cathode of the Schottky diode and solder the diode in the rim. To prevent damage to the Schottky diode; do not heat it for longer than 2 seconds. Let the Schottky diode cool down for some time after soldering.

After the battery casing is cooled down the Schottky diode can be placed. Heat the tinned rim on the inside of the battery casing until the solder begins to flow. When the solder flows the diode must be soldered in place as shown on the right. Maintain a clearance of 0.5 mm between the end of the Schottky diode and the rim of the battery casing. To prevent damage to the Schottky diode, do not heat it for longer than 2 seconds. Hold the Schottky diode motionless in place, until the solder has solidified. After soldering make sure the solder does not stick out as shown on the left.



Now, the isolator has to be placed on the bottom of the battery casing. This isolator is made of a paper sticker with a diameter of 12 mm and a "flap". This sticker is included in the *625-kit\**. The "flap" is to be placed in the battery casing as shown on the right. Let the "flap" overlay about 0.5 mm into the hole in the rim. Cut away the piece of "flap" which is sticking out above the battery casing with a knife or a scalpel.



Tin the area where the diode is to be soldered onto the "flap" of the conductive selfadhesive foil with a very tiny amount of solder. Place the precut conducting self-adhesive foil (included in the *625-kit\**) on the paper isolator. The conductive foil must be placed in the middle of the paper isolator so that everywhere around the conductive foil there is 1 mm of paper isolator visible as shown on the left. The foil may NOT make contact with the battery casing.



The anode of the Schottky diode must now be shortened. Leave about 3 to 4 mm of lead remaining on the Schottky diode. Tin the anode of the Schottky diode. Loosen the "flap" of the conductive foil from the rim of the battery casing.



Solder the anode of the Schottky diode onto the loosened "flap" of the conductive foil at the spot where the "flap" falls in the rim of the battery casing, as shown on the left. Try to do this in less than 2 seconds. If soldering takes more than 2 seconds, the Schottky diode and/or the paper isolator may be damaged (see: **TIP Utility knife** on page 6)

After soldering the Schottky diode let it cool down and bend the diode as far as possible into the rim as shown on the right.



The anode of the Schottky diode and the "flap" of the conductive foil should **not** be in contact with the battery casing. If you own a multimeter you can check this by measuring the resistance between the anode of the Schottky diode and the casing. In case short-circuit is measured, bend the Schottky diode inwards and investigate where it was making contact with the battery casing and solve the problem. A Schottky diode conducts only in one direction and therefore it needs to be measured in both directions.

Now, only the paper insulation strip needs to be glued in place to finish the adapter. Preferably you should use a fast hardening 2-component glue, however, any filling glue that can bond metal and paper will do. Superglue is not advisable because it is not filling glue. Apply a very thin layer of glue onto the strip and fill the rim of the battery casing with glue. Glue the strip into the casing as shown on the right. Do not use too much glue, for it will seep into the bottom of the casing preventing the, later to be placed cell, from making contact with the conductive foil. When the strip is in place, the battery casing must be stuffed with foam rubber or with compressible earplugs without moving the strip. These materials swell in all directions and will therefore push the strip onto the side of the battery casing. Turn the adapter upside down while the glue is hardening, as shown on the left. The foam rubber/earplug must be removed just before the glue is hardened. Cut off the piece of strip that sticks out above the rim with a knife. If excessive glue seeps out from under the strip this glue must be removed. Before the glue is hardened completely press the strip **firmly** onto the side of the rim by pushing the adapter down with a rod (metal or other material) while rolling the adapter as shown on the left, especially where the diode is soldered onto the metal sticker and rim. Do **NOT** apply pressure to the diode.



Place a **silver-oxide** SR44, S76 or 357 cell in the adapter, as shown on the right. This cell should lay somewhat loose in the adapter and must fall out when kept upside down. If the cell is somewhat stuck in the adapter: either the Schottky diode is bent too far inwards and needs to be bent outwards (carefully, the glass diode breaks easily) or the strip has too much glue and is bulging too far inwards into the battery casing. If so: press the strip **firmly** onto the side of the rim where the cell was stuck or remove the strip and old glue in a new strip with less glue.



## Cameras/exposure meters that use PX625/MR9 cells.

Over 700 different photo (still) cameras, movie cameras, exposure meters and accessories need one or more PX13, PX625 or MR9 mercury cells. Most of these will need to have an exact 1.35 volts to operate correctly. A too high voltage can result in wrong exposures. Only a few of the below mentioned photographic equipment will operate correctly on silver-oxide or alkaline cells without the need of an adapter, modification and/or adjustments. How to check if your equipment works correctly on the higher voltage silver-oxide cells is described on page 1. Most cameras with manual shutter speed and aperture controls are completely mechanical and do not need batteries to operate; in this case only the exposure meter will not function. (Semi) automatic cameras (aperture and/or shutter speed is determined by the camera) **cannot** operate without (one or more) batteries. Shutter speed-, aperture- or L.V.- scale with an indication needle being visible in the viewfinder or the ability to only set shutter speed or aperture (or neither) manually can identify most of these cameras. Below and on the next page is a list of photographic equipment that uses one (or more) PX13/625/MR9 cells sorted in alphabetical order.

If you can add to (or correct) this list of cameras and exposure meters that use PX625/MR9 cells please e-mail this info to: [battery.adapter@online.nl](mailto:battery.adapter@online.nl)

| Brand:       | Type  |
|--------------|---|
| Accura:      | CdS clip-on.  |
| Aetna:       | (Capital / Capitol / Maxwell): L-1, D-1, D-3.   |
| Agfa:        | Optima sensor 500 / 5000 / 5008 / 6000 / 6008, Selectronic (S), Family Camera, Agfamatic 300 / 4000 / 4008 / 5008 / 6008, Optima microflex 100/200 sensor, movex automatic I, Movex automatic II, Movex reflex, Movexoom.   |
| Alpa:        | 9d, 9d SLR, SLRIIe, SLRIIeL, SLRIIsi.   |
| Argus:       | 270 Insta-Load, 616, 704, 706 zoom, 708, 803, 804, 810, 811, 812, 814, 815, 816, 820, 820T, 822, 826, cinemax 85E (8 mm).   |
| Automex:     | 3.  |
| Bell&Howell: | FD 35, Auto Reflex, Dial 35, 308, 339, Autoload 340 / 341.  |
| Beseler:     | Topcon Auto 100, super D, Unirex.   |
| Bewi:        | Super, Super L.   |
| Bolex:       | 7.5, 150, 155, 160, 233 and 250 Super-8 cameras and 86EE zoom lenses, exposure meter for H8 / H16, FOGOS exp. meter.  |
| Braun:       | S8E, S8L, S8T, S36.   |
| Bronica:     | C-2, S-2.   |
| Canon:       | F, F-1, Ft, Ftb, Ftb-QL, FP, FX, TX, EF, TL, TLb, EX EE, EX Auto, Canonet QL17 / QL19 / 19E / 28 / newQL17 / newQL17L / newQL19 / new28 / QL17GIII / QL19GIII, A35F, A 35 Date Lux, 7S, Dial 35-II, Dial rapid, Pellix, Pellix QL, Demi 17, Demi EE 17, Demi Rapid, Finder Illuminator, FTb booster finder, Auto zoom 518 / 814 / 814XL / 1218, zoom 318 / 518. |
| Carena:      | SLR Zoomex S.   |
| Chinon:      | CS and CX II.   |
| Cosina:      | 5X, 8X, 24.   |
| Dacor:       | DLM (= sekonic Marine Meter L164)   |
| Dacora:      | rapid D101 / D202 / 404.  |
| Dejur:       | Dejurette EF10 / DE50 / DE60 / DE70 / DEG55 / DEG65, Citation I, Citation II, Electra V, Electra VI, Electra VIB.   |



| <b>Brand:</b>   | <b>Type</b>  | <b>Brand:</b> | <b>Type</b>   |
|-----------------|--|---------------|---|
| Dot Line:       | DL0016, DL0017.  | Nikon:        | F Photomic S model 1 and model 2, Photomic illuminator, Photomic Finder: T, Tn, FT, FTn finder, Nikkormat (or Nikomat) FT, Nikko(r)mat FTn, Nikko(r)mat FT2 (old), 5X, 8X, R8 superzoom.        |
| Edixa:          | LTL, TL1000, Prismat, Amica Auto.  | Nizo:         | S36, S40, S48, S55, S56, S58, S58L, S58T, S80, S480, S560, S800, S801macro, Elec 4, ELEC 8, S8E, S8L, S8T, FA-3 electric.   |
| Elmo:           | 8-CZ, zoom 8E / 8EE / 83, pocket auto, super 104, super 106.   | Olympus:      | M1, OM1, OM1n, FTL, 35RC, 35UC, 35DC(N), 35LC, 35SC, 35RD, 35SP, 35SPn, Pen FT / EED / FTL / meter.   |
| Exakta:         | TL1000, RTL1000, Examat (Harwix) and Travemat (Schacht) exposure meters.   | Pathe:        | Webo, Duolight.   |
| Fuji(ca):       | 35FS, 35GP, V2, AX100, C100 (single 8).  | Pentax:       | Spotmatic SP-F / MD / DATA and clip-on.   |
| Fodor:          | CdS exposure meter.  | Petri:        | Petriflex 7, FT, FTII, F1X, Petri Racer, Auto-Rapid 2.8, M35, V6 II, V6 CdS meter, Kine, MP400, MP500, Cinemax 8H, Saimic ES25, Saimic Super 8.   |
| GAF:            | 64, 65, XL110, 100A, 102A, S/83, S/272, SC/92, SC/100, SC/102, ST/1000, ST/1002, L-14, L-17, L-CM, L-CS, Anscomatic 62, 726, S/62, S/84, S/85, S/86, ST/84, ST/87, ST/88, ST/89, ST/90, ST/97, ST/99, ST/100, ST/101, ST/110, ST/111, Autoset CdS, Auto 35, model 503, Viceroy 200, 205, 206, 214, 250, 281,311, 5000, PR7, PR65, Focal 500, 800, 900, MZV, MSP4, CRS V, CRS VI, Lentar 311. | Polaroid:     | 628, 850, 900.  |
| Gossen:         | Super Pilot CdS, C-Mate CdS, Lunasix, Lunasix 3, Luna Pro CdS, Super pilot SBC, Sixtar, Sixtar 2 SBC, Sixon 2, N100.   | Porst:        | ES35.   |
| Hanimex:        | 35EE, 35SL, Compact A rangefinder, MXL 131, XL300, Practica 66 (meter), PR135, PR140.  | Praktica:     | Praktica mat, TTL-prisms for Exakta (Harwix, Examat, RTL1000) <i>all other types can use alkaline V625U cell</i>  |
| Hasselblad:     | CdS metered prism finder.  | Prinz:        | 160, 117, DX1, Rexamat.   |
| Ifoco:          | D I.   | Revere:       | Reflex electric.  |
| Interphoto:     | Sunset 65.   | Revue:        | Autoreflex , Autoreflex TTL   |
| J.C. Penny:     | manual zoom 2-1, power zoom 2-1, SLR2/3.   | Ricoh:        | Ricomatic 100X, Ricomatic 600M, Singlex, Singlex II, Singlex meter, SLX-500, Auto TLS EE, TLS 400, TLS 40, 520M CdS, super shot 2.4, Zoom Star meter, super 8 100F, super 8 400Z, super 8 420Z. |
| Jonan Electric: | Lumitax 412 / 413, Oray, Stitz, Stitz M-4D.  | Rollei:       | 35, 35T, 35S, 35 Classic, SL35, SL35M, SL350, SL706, SL26, XF35, A26, Rolleimat F   |
| Kalimar:        | Zenit 2000 CTL, K-431, K-432, K-433, K-437, K-438, K-610, K-611, K-650, K-683, K-686, K-688.   | Royal:        | RTL 1000, Pentacon 6TL.   |
| Kern:           | Vario-Switar 86 EE 18-86mm Zoom Lens.  | Sears:        | 35RF, 7320, 7232, 7324, 7325, 7347, 7360, 7365, 7823, 7870, 9110, 9121, 9128 to 9134, 9180, 9190.   |
| Keystone:       | K609H, K610H, K614H, K615H, K616D, K1010.  | Sekonic:      | L-98, L-138, L-164A, L-164B, L-164C, L-218, L-228, L-248, Dualmatic 50, micro-leader, micro-clip-on, marine meter II, Autorange, Apex, Zoom meter, Multi Lumi.                                  |
| Kinox:          | C-1  | Sinar:        | SinarSix (Gossen)   |
| Kobena:         | 121, 221, 321, 421.  | Soligor:      | Selector CdS UF / UF II, Spot Sensor meter.   |
| Kodak:          | Retina II F, Electric 8 zoom reflex, Instamatic M-4 / M-5 / M-6 / M-7 / M-9.   | Spectra:      | TriColor.   |
| Konica:         | Auto S, Auto S1, Auto S1.6, Auto S2, Auto S2 EL, Auto S261, Acom 1, Autorex (P/SP), Autoreflex (TC, T4) EE-Matic deluxe F, EE-Matic de Luxe FM, CdS meter for FP, Super-8, Compact-8.  | Spiratone:    | Spiraflex TTL.  |
| Kopil:          | L-98, L-136, L-138, L-206, L-216, L-218.   | Sunset:       | CdS 35  |
| Kowa:           | SE, SER, SET, SET-R, SET-R2, SET-ER2, Super 66, TTL meter for Six and SixMM.   | Topcon:       | RE-2, RE super, Super DM, 135 EE, Uni, Unirex, Unirex EE, meter light.  |
| Leica:          | CL, M5, Leicaflex, Leicaflex SL, Leicaflex SL-MOT, Leicaflex SL2, Leicaflex SL2-MOT, MR meter, MR3, MR4, Metrastar, Leicina 8S, Leicina 8V, Leicina 8SV.   | Uriu Seiki:   | Cinemax Regular 8 85E   |
| Majamatic:      | EE Super Deluxe.   | Taron:        | Auto EE, Auto EL, EL28, Rival.  |
| Mamiya:         | 35SD 1.5, 35SD 1.7   | Vivitar:      | XV-1, TL268, TL368, TL468, 35EE, 35EF, 35ES and 34 exposure meter.  |
| Minolta:        | SR7, SR7v, SRT101, SRT100, SRT102, SRT303, SRT Super, SRT202, SRT303b, SR505, SR505s, SRT200, SRT100b, SRT100x, SRT201, SRT101b, SR101, SR101s, SRTMC, SRTMC-II, SRTSC, SRTSC-II, HiMatic 7, HiMatic 7s, HiMatic 9, HiMatic 11, AL-S, AL-E, AL-F, Autopak 700, 24 Rapid, 16 MG-S, CL, Flashmeter, Colormeter, SR Meter-2, SR Meter-V, SR Meter-S, View Meter 9.                              | Voigtländer:  | VS-1, VSL-1, VF101, Bessamatic CS, Ultramatic CS, Vitomatic 11 CS / 111 CS, Vitessa 500 AE, 500 SE, 500S, 1000 SR.  |
| Minox:          | 110S.  | Weston:       | Ranger 9  |
| Miranda:        | Automex II, Automex III, Sensorex, Cadius, F coupled meter, FM 1 / G / TTP, Clip-on CdS meter, TTL Penta Prism CdS meter.  | Yashica:      | MAT124, MAT124G, Y12, Y24, Half 14, Lynx 14, Lynx 5000, MinisterD, Penta J3 / J4 / J5 / J7, Ministar 700D, Super 40K, Super 40N, Super 50N, YEM-35.   |
|                 |  | Zeiss-Ikon:   | Contarex Super / Super Electronic / Super BC, Contaflex 126, Contaflex 126SLF, Icarex 35S, Icarex 35CS, Icarex SL706, Contessa S310, Contessa S312, Ikophot CD, Ikophot CdS meter.              |
|                 |  | Zenit:        | FS 12s  |

## Instructions for making a PX625/MR9 battery adapter with an S.M.D. BAS70J or BAT54J.

The adapter is made from an electrically empty (dead) 625-type alkaline cell. Mercury cells (see page 2) are **NOT** to be used because hazardous materials are used in these types of cells, among those the extremely toxic mercury, which is why the mercury cell is now banned in most countries. To drain the cell, a 100Ω (Ohms) resistor is placed over the contacts of the cell, as shown on the left. Make sure that the leads of the resistor do not short the battery contacts. Discharging takes around 2 days.



After the cell has been discharged the cell can be emptied. Because of health risks it is advisable to take some precautions. Drilling and removing the insides of the cell is best done in a very well-ventilated area or outdoors. Make sure to use household or surgical gloves. Avoid any contact with the insides of the cell with your skin or other body parts. This way health risks are kept to a minimum. These precautions apply until the battery casing has been washed and dried.

Drill a hole of about 3 mm exactly in the middle of the cathode (-) of the cell. A center punch can prove to be very handy for centering your drill. To hold the battery securely in a vise construct a holder that goes into the vise as shown on the right. How to make this tool is described on page 7. Do not drill too far into the cell, so you won't hit the bottom of the cell. Some cells might leak some fluid when drilling! Use a low speed when drilling so that the insides of the cell won't fly around and also to make sure that the cell does not get too hot due to friction.



Next, the 3 mm hole must be made larger. Use a 6 or 7 mm drill. After this, you can proceed to the 10 mm drill.



Now, only the rim of the metal electrode and the isolator ring remain. A cut must be made with an iron-saw in the rim of the battery casing, as shown on the left.

Scoop out the insides of the battery with a small pick or screwdriver as much as possible and bend the (now cut) ring inwards, as shown on the right, so it can be pulled out with pliers as shown below. For an aesthetically refined version you can grind the rings out with a small handheld grinder.



With this, time consuming way, the cut with the iron saw is not necessary and the casing remains whole.

After the rings are removed from the battery casing, the inside of the battery casing must be cleaned out further and washed with water and soap to neutralize the acid remains. Dry the battery casing well to avoid rust.



Determine the cathode of the Schottky diode with a multimeter. Tin the cathode and solder a short piece of wire onto the anode of the Schottky diode as shown on the left.



*Do not bend the solder-pads of the diode too far or too often for they break off easily!*

To be able to solder the Schottky diode in the rim of the battery casing, the inside of the rim must be tinned with a blob of solder at the spot where the cut in the battery casing was made, as shown on the right. In order to let the solder flow and adhere to the inside of the rim it has to be thoroughly cleaned and/or scratched.



Heat the solder in the rim of the battery casing until it flows. Place the Schottky diode in the rim of the battery casing as shown on the left. Let the solder solidify without moving the Schottky diode. Make sure the cathode does not make contact with the battery casing. Do not heat the Schottky diode too long! Scrape or cut off the part of solder and Schottky diode that sticks out from under the protruding rim when you look at it from the top, otherwise the SR44 cell won't fit.



After the battery casing is cooled down the isolator has to be placed on the bottom of the battery casing. This sticker is included in the 625-kit\*. The "flap" is to be placed in the battery casing as shown on the right. Cut away the piece of "flap" which is sticking out above the battery casing with a knife or a scalpel. When the isolator is in place, the pre-cut conducting self-adhesive foil must be placed in the middle of the plastic isolator so that everywhere around the conductive foil there is 1 mm of plastic isolator visible as shown above. This pre-cut conductive foil is also included in the 625-kit\*.



Loosen the "flap" of the conductive foil from the rim of the battery casing. Solder the wire from the anode of the Schottky diode onto the loosened "flap" of the conductive foil at the spot where the "flap" falls in the rim of the battery casing, as shown on the left. Try to do this in less than 0.5 seconds so the wire won't come off the Schottky diode while soldering. (see: **TIP Utility knife** on page 6).



Now, only the insulation strip needs to be glued in place to finish the adapter. Preferably you should use a fast hardening 2-component glue, however, any filling glue that can bond metal and paper will do. Apply a very thin layer of glue onto the strip and fill the rim of the battery casing with glue. Glue the strip into the casing as shown on the right. Do not use too much glue, for it will seep into the bottom of the casing preventing the, later to be placed cell, from making contact with the conductive foil. When the strip is in place, the battery casing must be stuffed with foam rubber or with compressible earplugs without moving the strip. Turn the adapter upside-down while the glue is hardening. When the glue is almost hardened the piece of foam rubber must be removed and if excessive glue is seeping out from under the strip this glue must be removed. Cut off the piece of



strip that sticks out above the rim with a knife as shown on the right. Before the glue is hardened completely press the strip **firmly** onto the side of the rim with a rod (metal or other material), especially where the diode is soldered onto the metal sticker and the rim.



## Ordering information and delivery terms (2010):

Adapters and 625-kits will be delivered **after** a payment is received. NO large quantities intended for wholesale or distribution. For information e-mail to: [battery.adapter@online.nl](mailto:battery.adapter@online.nl) or use the address below.

**Frans de Gruijter**  
Zuidkade 161  
NL-2741 JJ Waddinxveen  
The Netherlands

These are the **ONLY** Payment options:

Pay securely and fast with online bank PayPal®. The account name is: **battery.adapter@online.nl**



Join PayPal®: <https://www.paypal.com> for a FREE account and pay in Euros (€) no other currencies are accepted.

PayPal® can convert all currencies to Euros.

**NOTE:** If you intend to pay using PayPal® please use the PayPal pricing as a fee is added.

This is to cover the costs I have to make to receive the funds.

**Cash**, only U.S. dollars (\$) or Euros (€) are accepted. Send cash in *registered* or *unregistered* letters, whichever you prefer. Divide amounts above \$ (€) 15.- into more envelopes or send it *registered*. Make sure you cannot see through, or feel, that there is money inside the letter; stick the cash between 2 pieces of card. (US)\$ may ONLY be send in banknotes, Euros (€) in banknotes and coins. **Sending cash in unregistered letters is at YOUR own risk!** (Letters, even registered, can get lost in the mail). Send the letter(s) to the address above.



**International money transfer** directly from bank to bank (in Euros (€) only) using **IBAN**.



**For listed countries only:** Austria, Belgium, Bulgaria, Cyprus (Greek part), Denmark, Estland, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Letland, Liechtenstein, Lithuania, Luxembourg, Malta, Norway, Poland, Portugal, Romania, Slovenia, Slovakia, Spain, Sweden, Tsjechia, United Kingdom.

This money transfer is without costs for both parties if the **'shared costs'** option and **BIC** and **IBAN** codes are used to make payments within the **E.E.R.** to bank account:

**IBAN:** NL07 INGB 0001574689

**BIC:** INGBNL2A

**Account holder:** F.P. de Gruijter, Zuidkade 161, 2741 JJ Waddinxveen, The Netherlands.

**Bank:** ING bank Amsterdam, The Netherlands.

### How to order:

Items can be ordered by supplying me with the following information, (e)-mail this information to: [battery.adapter@online.nl](mailto:battery.adapter@online.nl)

**1: name and address** where the items are to be send to.

(only personal addresses, no office address please)

**2:** Which **Item** you want to order. (adapter and/or kit)

**3:** The **quantity**. (max. 2 adapters, kits = unlimited)

**4:** How you would like to **pay**. (see options on the left)

**5: A statement** that you understand my delivery terms.

### Shipping policy and delivery terms:

All items can be shipped to any country (worldwide) through regular priority airmail in a normal letter.

**Not arriving Items sent through regular priority airmail (this is unregistered mail) is at YOUR own risk and will NOT be refunded or re-sent without a new payment**

Things can and have gotten lost in the mail. Shown below are prices for 1 and 2 adapters and 1 to 10 kits and include shipping costs (worldwide shipping to any country). **Note:** ± 0.3 % of all shipments have been lost in the past. This means 99.7% of the shipments arrive without problems. Some countries have a higher risk of shipments not arriving.

**\* Pricing in (US)\$:** The pricing for adapters and kits mentioned below is based on an exchange rate of:

€1.- ≈ \$1.40. When the exchange rate changes, the price in (US)\$ changes too. (pricing in € remains the same)

**Please ask for current prices in (US)\$ before ordering.**

When paying with PayPal® please read the **NOTE** in the PayPal® section on the left and use the PayPal® pricing.

### Prices for BAT43 adapters include shipping costs:

| Q'ty | price incl. P&P + PP   | PayPal® |
|------|------------------------|---------|
| 1    | *(US)\$ 22.- or € 15.- | € 16.-  |
| 2    | *(US)\$ 44.- or € 30.- | € 32.-  |



Adapters are often not available from stock. The order q'ty is limited to **max. 2 adapters**. Adapters will not be sold to vendors and resellers. In case the adapters are not in stock delivery times may take up to 2 weeks before they become available. The adapter is handmade and comes with an instruction manual/data sheet and a **5-year warranty** on construction faults. The adapter takes the very common SR44, 357 or S76 **silver-oxide** cells.

**These batteries are NOT included.**

When ordering ready-made adapters **please always check for availability before sending money**. Each adapter is sent separately on following days in order to reduce the possibility of adapters getting lost in the mail. Therefore all ordered adapters might not arrive on the same day.

### Prices for D.I.Y. 625-kits include shipping costs:

| Q'ty | price incl. P&P        | PayPal® |
|------|------------------------|---------|
| 1    | *(US)\$ 6.- or € 4.-   | € 4.50  |
| 2    | *(US)\$ 9.- or € 6.-   | € 6.50  |
| 3    | *(US)\$ 12.- or € 8.-  | € 8.60  |
| 4    | *(US)\$ 14.- or € 10.- | € 10.70 |
| 5    | *(US)\$ 17.- or € 12.- | € 12.80 |
| 6    | *(US)\$ 20.- or € 14.- | € 14.90 |
| 7    | *(US)\$ 22.- or € 16.- | € 17.00 |
| 8    | *(US)\$ 24.- or € 18.- | € 19.20 |
| 9    | *(US)\$ 26.- or € 19.- | € 20.40 |
| 10   | *(US)\$ 28.- or € 20.- | € 21.50 |



A 625-kit contains the following items:

1 BAT43 Schottky diode, a 100 Ω resistor, 1 piece of solder, self-adhesive isolator, conductive self-adhesive and 2 pre-printed isolating strips. Each shipment comes with a (full color) English description on how to make an adapter. Kits are available from stock and will usually ship the same day as payment is received or within (maximum) 2 days.

**Please always check availability before sending money**

## F.A.Q. (Frequently Asked Questions)

### Questions & Answers about delivery and payment:

- Q:** How do I order ?  
**A:** Contact me at [battery.adapter@online.nl](mailto:battery.adapter@online.nl) or write me a letter (see page 11)
- Q:** How can I pay ?  
**A:** With PayPal®, sending cash or using a bank-to-bank transfer (within the E.E.R.).
- Q:** Can I pay with a credit card ?  
**A:** You can pay with a credit card through PayPal®, pricing of items is higher (see: page 11)
- Q:** Why is the price higher for a PayPal® payment ?  
**A:** Paypal charges costs for a transaction. These costs are for the buyer.
- Q:** If I pay from a personal PayPal® account is the price of an adapter in this case € 16.- instead of € 15.-?  
**A:** Please contact me for an alternative PayPal account address where you can pay without a credit card.
- Q:** Can I pay in other currencies than US\$ or Euros(€) ?  
**A:** No only US\$ and Euros(€) are accepted when sending cash in a letter. (see: page 11)  
PayPal®, Western Union® money transfer and bank-to-bank transfer using IBAN and BIC in Euros (€) only !
- Q:** How much does the item cost in US dollars (\$) ?  
**A:** Because the exchange rates change daily it's best to ask for the US\$ before placing an order.
- Q:** Do you ship to .. (*your country*) ?  
**A:** Yes, The shipping costs are the same for every country.
- Q:** I received only 1 adapter but I paid for/ordered 2 adapters, why is that ?  
**A:** The second adapter is probably still on its way. Each adapter is sent separate on following days.
- Q:** Can you send the items to my office address ?  
**A:** I'd rather not, Adapters sometimes seem to get lost inside offices somehow. Please have it sent to your home address.
- Q:** Can you send the items to my P.O. box ?  
**A:** Yes, the shipments fit through a normal letterbox opening and do not have to be signed for on receipt.
- Q:** How often does a shipment get lost in the mail ?  
**A:** In less than 0.5% of all shipments. If it happens it's mostly in December, that's why I do not ship in December.
- Q:** Are the items send in a box ?  
**A:** No, they are sent in a normal envelope nor do you have to sign for it, so you don't have to be home to receive it.
- Q:** Can the items be sent insured/registered ?  
**A:** Yes, if you want it but the price will be higher. Experience has proven normal shipping to be far more reliable.
- Q:** I paid ... days ago but have not received anything yet.  
**A:** Sometimes it takes 2 weeks for the items to arrive. If it has not arrived by then please contact me again.
- Q:** How long does it take for a shipment to arrive ?  
**A:** For Europe (as a rule) around 2 to 4 days, U.S.A. & Canada 3 to 7 days, Australia 7 to 10 days.
- Q:** I am not satisfied can I get a refund ?  
**A:** Yes, regardless of the reason, minus € 1.- shipping costs when the adapter has been returned to me within 3 months.
- Q:** What is the total amount for the following items... ?  
**A:** Just add the prices mentioned on page 11, When paying with PayPal the prices are higher.
- Q:** How much does shipping to (*your country*) cost ?  
**A:** Shipping costs are already calculated in the prices mentioned on page 11, no hidden fees !
- Q:** Are there any hidden costs such as taxes ?  
**A:** No extra costs or taxes, there is no mention of the contents or value on the letter it is sent in.
- Q:** What do I make an international bank to bank transfer ?  
**A:** The IBAN and BIC code mentioned on page 11 and do not forget to check the 'shared costs' tick box !!
- Q:** Can I pay with international money transfer outside the E.E.R. ?  
**A:** No. only within the E.E.R. (see page 11 for the listing of countries)
- Q:** I need 3 or 4 adapters can I order more than 2 adapters ?  
**A:** Contact me if for any reason you need more than 2 adapters, as a rule the maximum is 2 adapters.
- Q:** Can you tell me where I can buy the adapter in a local shop near me ?  
**A:** No, You can only buy them from me directly, there are no distributors or importers.
- Q:** Can I buy 10 or ... adapters for (this and this) person ?  
**A:** No, I do not sell adapters so they can be sold to third persons with or without profits, no wholesale.
- Q:** I need 6 adapters for my photography club, can I buy them so they don't have to contact you ?  
**A:** No everybody can contact me individually, the warranty is made out in person so I need their personal info.
- Q:** Do you also supply the batteries that go into the adapter ?  
**A:** The batteries are readily available almost everywhere. I can supply them if you want but they will be more expensive then if you were to buy them in a shop near you or in an on-line shop.

## Questions & Answers regarding general issues:

- Q:** Can I contact you in my own language (parles vous Francais, sprechen Sie Deutsch) ?  
**A:** You can contact me in English, French (Francais), German (Deutsch) and Dutch (Nederlands)
- Q:** Is the adapter suited for my (*your brand*) Camera ?  
**A:** I haven't encountered a single camera or exposure-meter yet where the adapter doesn't perform well.
- Q:** I need an PX675 adapter can I use the PX625 adapter ?  
**A:** No the PX675 has different dimensions as the PX625 battery. For a 675 there is a reasonable easy solution: use the ZA675 hearing aid Zinc-air cell. Or use SR44=S76=V357 silver-oxide cell and build the diode in the camera itself. You can also buy adapters online, see the url's for suppliers on page 1.
- Q:** Do you have other adapters than the PX625/MR9 adaptor ?  
**A:** No, I only make PX625 adapters. Search the web for other adapters or see the url's for suppliers on page 1.
- Q:** I am looking for a replacement for a PX-1 / PX640 battery can you supply these too ?  
**A:** You can use the PX625 adapter and fill the missing space with aluminum foil or other (metal) conductive 'stuffing'.
- Q:** Does the adapter lower the voltage to 1.35 Volts ?  
**A:** Yes, the adapter lowers the silver-oxide battery voltage from 1.55 volts to 1.35 volts using a Schottky diode.
- Q:** Can I use 1.5 Volts (alkaline/silver-oxide) cells without an adapter in my (*your brand*) camera ?  
**A:** In some cameras (like Pentax Spotmatic) this is no problem. In most cameras your exposure will most likely be 'off'.
- Q:** Do I really need an adapter for my (*your brand*) camera ?  
**A:** Yes, if your camera doesn't expose correctly with an Alkaline cell and you do not want to use zinc-air cells.
- Q:** Can I damage my camera when an Alkaline cell is inserted.  
**A:** Highly unlikely the difference in voltage is so small, the exposure might be 'off'. NO guarantees though !
- Q:** What are the advantages of an adapter over adjustments or zinc-air cells ?  
**A:** You do not have to modify your camera (expensive) or do not have to change batteries every 6-12 months (zinc-air)
- Q:** What are the options for replacing a PX625/MR9 Mercury cell.  
**A:** Have you camera adjusted to work properly on 1.5 Volts silver-oxide cells, use zinc-air cells, modify the camera using diodes (page 3 ) or use a (home- or ready-made) battery adapter.
- Q:** What type of battery can I use ?  
**A:** an S76, S44 or 357 type battery. These are all the same type silver-oxide cell with the same dimensions, the only difference is the manufacturer. There is no preference for any type or brand. Just make sure it is silver-oxide.
- Q:** Is the battery that goes into the adapter easy to obtain ?  
**A:** It should be available in online stores, electronics stores, stores where they sell watches, cameras, even drugstores. Silver-oxide cells can be hard to get in Singapore I am told.
- Q:** Will the silver-oxide batteries be banned in the (near) future just like mercury cells ?  
**A:** No, even though silver-oxide cells also contain traces of mercury.
- Q:** Can I use alkaline cells in the adapter ?  
**A:** Only if they are 'fresh' (when you cannot obtain a silver-oxide cell or just want to test proper operation) the adapter and/or camera will work fine but due to the discharge characteristics (see page 3) this is not recommended.
- Q:** I have 2 batteries in my camera, do I need 1 or 2 adapters ?  
**A:** 1 adapter replaces 1 battery, so if the camera takes 2 batteries you will need 2 adapters.
- Q:** Does the adapter with a battery in it fit properly in the battery compartment ?  
**A:** Yes, the adapter with a battery in it has exactly the same dimensions, it's an exact fit unlike the C.R.I.S. adapter which is either slightly too thick or too thin depending on which battery is used in it.
- Q:** The battery check says the battery is not O.K.; The battery-check light on my Canonet QL17GIII doesn't light up.  
**A:** This happens if the battery check-current is much higher than the actual currents during normal operation. This doesn't mean the exposure will be 'off'. Replace the battery every few years in this case or when the exposures aren't spot-on anymore.
- Q:** I use slides.. my exposure is 'off' by 1/3 E.V.  
**A:** Due to temperature changes / lighting circumstances the exposure might be 'off' +/- 0.5 LV (also dependent on camera model/make). For negative film this is no problem. In this case, for slides, you might be better off with zinc-air cells.
- Q:** Can I use the adapter in hot / cold / damp conditions  
**A:** Yes, but in extreme temperatures the exposure might be 'off' a little. (see graph on page 5)
- Q:** Is there a warranty on the adapter ?  
**A:** Yes, 5 years warranty and a 3 month return/refund policy in case you are not satisfied for any reason.
- Q:** In which factory is the adapter made ?  
**A:** It is not made in a factory, it is handmade by me (the author of this article) in my spare time.
- Q:** What happens if the battery is inserted upside down/the wrong way in the adapter ?  
**A:** Nothing, the adapter will simply produce no output voltage and can cause no damage.
- Q:** What happens when I have inserted the adapter with a battery in it upside down / the wrong way in my camera ?  
**A:** This will very likely short the battery, draining and perhaps overheating it. The adapter will most likely be defective after this has happened. Always make SURE you put it in the right way.
- Q:** What happens when I short the adapter with a battery in it ?  
**A:** You have a big chance of damaging the diode and the battery in it will get warm/hot and might even explode.

## Questions & Answers regarding technical issues:

**Q:** I measured the output voltage but it reads about 1.5V instead of 1.35 V.

**A:** This is because the adapter needs a certain load to work properly (the exposure meter of a camera is such a load). The internal resistance of a voltmeter is far too high to represent a proper load. You can measure the output voltage when the adapter is 'loaded' with an extra resistor across the contacts with a value around 1 kOhm or in a working camera / exposure meter if this is possible.

**Q:** How can I check if the adapter is O.K. ?

**A:** You can use the 'diode' position of a multimeter. It should conduct in one direction only and have a certain voltage drop. In the other direction there should be no conductance and the meter should read 'OL' or open circuit.

**Q:** My camera's exposure is 'off' ... e.v. when the adapter is used.

**A:** This can happen with old cameras / exposure meters using CdS cells. Please first check the battery contacts for corrosion and/or proper operation using an PX625 alkaline cell or zinc-air cell before blaming the adapter. The adapter is either functioning (O.K.) or not functioning at all if defective. It is always tested before it is sent.

**Q:** When I measure the battery adapter in diode position it measures 0.30 volts instead of 0.20 volts is the wrong diode used ?

**A:** This is caused by the measuring current of the meter which is higher than the current drawn in the camera, therefore the voltage reading will also be higher. The current in a camera / exposure meter is much lower than the test current so therefore the measured voltage drop will be higher than the actual voltage drop under working conditions.

**Q:** Why use a Schottky diode and not a regular Silicon or Germanium diode ?

**A:** The characteristics of a germanium- or silicon-diode are not suited (see page 4)

**Q:** What is the maximum current of the diode used in the adapter ?

**A:** 200 mA continuously, you can also Google 'BAT43' and pull-up the datasheet on this diode.

**Q:** Why don't you use a resistor as a voltage lowering device ?

**A:** The voltage drop across a diode is almost independent of the current going through it. So when the current increases (more light on the detector) the voltage across the diode (i.e. the voltage drop) remains almost the same. In case a resistor is used the voltage drop is linear to the drawn current so the voltage drop will vary equally. In low and high light conditions the output voltage would be drastically different but SHOULD remain constant. (see page 4)

**Q:** why don't you use a voltage regulator, there are lots of tiny regulators that can do the job.

**A:** There are miniature voltage regulators BUT they require a higher input voltage (drop-out voltage) meaning more expensive and small (read small capacity) lithium cells, these are also hard to find. In addition a regulator also draws a (minute) idle-current draining the battery even when the camera is not in use. Furthermore it requires a + and - input to function i.e. a difficult construction where both the + and - of the inserted battery need contacts and a separate output contact leaving little room for a battery in an adapter. You can, however, build a voltage regulator in the camera.

**Q:** CRIS states there is microcircuitry inside their adapter why do you use only a diode ?

**A:** The 'microcircuitry' they talk about is a diode. There is no IC or any other components in there.

**Q:** You mention 1.6 volts for a silver-oxide cell but it states 1.5 V on the package ?

**A:** The 1.5 (or 1.55) volts is a nominal (average) value under 'load' conditions. Because a camera load is very small and when the battery is 'fresh' the output voltage will be somewhere between 1.55 and 1.6 volts.

**Q:** On a hearing-aid zinc-air cell package it states 1.4 volts but I need 1.35 volts, can I use this cell or do I need a Wein cell ?

**A:** The output voltage of a zinc-air cell is somewhere between 1.36 and 1.4 volts. The difference is so small that there will practically be no difference in exposure.

**Q:** Does the 625-kit come with a battery-casing or PX625A alkaline battery ?

**A:** No, the contents are described on page 6.

**Q:** I just need a diode to solder into my camera. Can I order a single diode or do I need to order the whole kit ?

**A:** If you only need the diode you can order just one diode. If your camera needs 2 batteries you can also replace 2 BAT43 diodes by 1 diode type 1N4148, 1N4001 or equivalent. This will give the proper voltage drop for 2 batteries.

**Q:** I will probably need some assistance/tips for the assembly. Can you assist me when I have questions ?

**A:** Of course, I will help in any way I can. Please feel free to ask me any question even if you feel it's a stupid question.

**Q:** Can I order empty battery casings from you ?

**A:** No, I only sell the kits or whole adapters.

**Q:** In the kit / adapter is a BAT43 diode, should there not be a BAT83(S) ?

**A:** The BAT83(S) is replaced by BAT43 because the BAT43 performs marginally better on batteries that are not brand new.

**Q:** What are the specifications of the battery adapter ?

**A:** Technical Data:

BAT43 @ room temperature with V357 silver-oxide battery:

Intended for current range:..... 2 - 1000  $\mu$ A

Maximum allowable current:..... 200 mA

Output voltage @ 100  $\mu$ A:.....1.36 V ( $\pm$  3%)

Variation in output voltage (5 - 500  $\mu$ A):..... $\pm$  6%

Temperature coefficient:.....-1.5 mV/ $^{\circ}$ C

Dimensions (incl. SR44) H x W:.....0.224 x 0.606 Inch (5.7 x 15.4 mm)