Australian Energy Research Laboratories P/L
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HIGHER BATTERY CHARGE CURRENTS WHEN THEY ARE NEEDED MOST

The MAXIMIZER boosts charging current in wet &/or dull &/or windy &/or winter conditions typically by 20% to 30% compared to direct-connected systems. Like no other charge regulator, the MAXIMIZER converts higher PV maximum power voltages whenever panel temperatures drop, directly into extra charging current. It does this automatically at the times when the charging current needs boosting the most. Using a 12V battery system in a simple example; on a bright but cloudy day the panel temperature may typically drop by 20 degrees celcius, with a 7% rise in panel maximim power voltage, from say 14.5V to 15.5V for a 36 cell panel. If the battery goes into a nett discharge current state, as typically happens in cloudy or dull conditions, the battery voltage will also drop down to around 12.5V. The MAXIMIZER takes this 3V (15.5-12.5V) 24% difference and DC-DC converts it into a 24% increase in charging current, compared to a direct-connected PV system.

New Model: With Digital LCD Metering & Plug-in Hybrid Control Module

MAXIMIZER
FOR THE PERFECT MATCH

B

OPERATING MANUAL & TECHNICAL SPECIFICATIONS FOR THE BATTERY CHARGING MAXIMIZER RANGE

REMOVING & REPLACING THE CLIP-ON COVER

The polycarbonate MAXIMIZER cover is held firmly in place by 8 plastic spring clips. Follow this simple procedure to remove the cover. Working on one of the four corners firstly, with both hands, one hand for each clip: With the unit mounted or sitting on a bench with the metal finned heatsink facing away from you, firmly pull each clip outwards with the forefingers, while firmly easing the cover upwards by pressing against the protruding shoulder of the metal baseplate with one of your thumbs. Once the one pair of corner clips are sitting released, repeat for the 2 corners opposite the first corner, until the lid pops off. If one corner seems to be sticking or difficult to release, move to another corner. If a corner clip slips back on, simply repeat the procedure. Follow this procedure exactly and the cover is simply removed. DO NOT FORCE OR LEVER THE COVER WITH ANY SORT OF TOOL, THIS IS NOT NECESSARY! To replace the cover, sit it symetrically with all 8 clips above their respective guide slots on the plastic baseplate and push firmly and evenly down to engage all clips. Ensure that all of the clips have latched by squeezing each one individually, ensuring a good waterproof seal.

NOTE: Special lightweight customised "Race-Trim" versions of the Battery Charging MAXIMIZERS for Solar Powered Racing Cars, weighing 1.1Kg & measuring 225mm x 110mm x 150mm, are available directly from AERL. The LCD Digital Meter Module is optionally available on these units with a ribbon extension cable to permit dashboard mounting. These units are supplied without the polycarbonate enclosure. On these units, maximum available output current is 12A and maximum throughput power is 1200W. For Enquires & Quotations: AERL P/L

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MAXIMIZER

The Universal Max Power Point Tracker For Use On All PV Systems.

All MAXIMIZERS™ manufactured by Australian Energy Research Laboratories Pty Ltd have been thoroughly computer tested and are guaranteed to meet all of the applicable specifications listed below at the time of shipping. The MAXIMIZERS™ are supplied by the manufacturer or the manufacturer's agents only under the express condition that no lawful responsiblity or liability is implied or accepted by the above parties, save those non-excludable conditions stated or implied by any state or federal legislation, for any damage to any persons, structure, equipment or property associated with the correct or otherwise operation of the MAXIMIZER™. Use of this unit for any purpose other than the extraction of maximum power from DC photovoltaic sources voids the guarantee. AERL guarantees this product against defects of materials and workmanship for a period of 2 years from the date of installation, providing it is used strictly in accordance with the recommended voltage & current limits. Damage from lightning, water ingress or damage sustained while in use in Solar Racing Cars is not covered by this warranty. Any defective product should be returned, carriage paid to AERL or an authorised repair agent for repair or replacement.

INTRODUCING THE BATTERY CHARGING MAXIMIZER

The MAXIMIZER is a revolutionary power electronic device that connects between any Solar Photovoltaic (PV) Power Source and the Battery Bank to automatically maximize the electrical power delivered from the PV Panels to the Battery.

It combines innovative simplicity with space-age power electronic technology to solve, once and for all, the problem of reliably extracting the maximum available power from all types of PV Solar Panels.

WHY DO PV SOLAR SYSTEMS NEED A MAXIMIZER?

The MAXIMIZER is to Solar Photovoltaics (PV), what a perfect gearbox is to the automobile. They both link the power source to the load and permit the most efficient operation of the power source by exactly matching it at all times to the ever changing requirements of the load. The gearbox performs this mechanically, while the MAXIMIZER uses high reliability solid-state power electronics in a DC-DC Step-down Converter.

Trying to supply any battery bank directly from PV Solar Panels is like attempting to drive a car, over a range of vehicle speeds, with only one gear ratio. Efficiency and performance are reduced and valuable power is wasted.

WHY HASN'T A MAXIMIZER BEEN DEVELOPED SOONER?

Although the electronic gearbox-like function of the MAXIMIZER is a simple concept, the long sought after solution to technically achieve this, automatically, efficiently, reliably and cost effectively, has had to patiently wait. Only now, with the very latest advancements in electronics technology, has the problem finally met its solution in the MAXIMIZER.

YOUR SOLAR BATTERY CHARGING SYSTEM NEEDS A MAXIMIZER

For Battery Charging, the MAXIMIZER will increase the overall yearly average PV output power by up to 10%. In situations where the average panel temperatures fall below 25 Degrees Celcius, on cloudy or windy days or in winter, the MAXIMIZER can easily produce 25% higher battery charging rates than would result without the MAXIMIZER on the same day. This is achieved by a combination of ;

1. Always operating the individual PV Panels at their maximum power voltage regardless of panel temperatures or battery bank volts; converting all extra panel voltage into extra charging current. (Note: PV panel output voltage rises by approximately 4% for every 10 Deg.C drop in panel temperature. See STEP 1. on Page 5. The MAXIMIZER turns this directly into a "%" increase in charging current).

2. Eliminating reverse blocking diode loss.

3. Slashing input cabling losses by permitting the configuration of the PV Array at a higher voltage and lower current - utilising the DC-DC Step-Down Conversion capabilities of the MAXIMIZER.

BATTERY CHARGE REGULATOR AND CONTROL CENTRE

All Battery Charging MAXIMIZERS can be used to charge a wide selection of battery bank voltages and feature smooth, user adjustable, float-charge regulation. A built-in LCD Digital Meter Module permits all Input & Output Voltages & Currents to be monitored with the flick of a switch. Battery levels can thus be set accurately and the charging current monitored continuously.

All MAXIMIZERS have automatic "108% of Float Voltage" auto-equalisation / anti-sulphation charging profile. (Automatic ambient temperature float voltage level compensation of -2.5mV/C/2V Cell is optionally available.)

All units have a low battery detection function that lights a RED LED and changes the state of a small relay when the battery voltage falls below 1.83V/Cell. The LED and relay remain in this LOW BATTERY state until a complete 108% equalising re-charge has been achieved.

This Low Battery Alarm function is thus suitable for AUTOMATIC GENERATOR CONTROL in generator backed-up systems. The relay contacts are rated at 1A or 30W and they have 1000V of isolation from the PV System. A second RED LED lights to signal that the MAXIMIZER has entered the fully charged Float Charge mode.

The MAXIMIZER provides a smooth continuous regulation characteristic - continuously trickle charging the battery at a level just sufficient to sustain the pre-set float voltage level.

Using a MAXIMIZER adds design versatility and cuts overall system costs, while providing all the automatic "house-keeping" functions essential for maximum battery life in all PV Battery Charging Systems.

A VERSATILE DC-DC STEP-DOWN VOLTAGE TRANSFORMER

The MAXIMIZER uses a DC-DC Voltage Step-Down Conversion to ensure that the PV Array Input Voltage is always maintained at the optimal "maximum power point voltage". This inherent characteristic leads to many of the desirable features that make the MAXIMIZER such a powerful PV System Designer's tool.

With the MAXIMIZER, any PV Array Input Voltage, up to the rated maximum open-circuit voltage of the particular MAXIMIZER being used, can be selected. (This voltage limit is marked within the unit). Maximum PV Power can then be supplied automatically at any voltage below the corresponding PV Array maximum power point voltage.

The actual MAXIMIZER output voltage is determined by the battery bank requirements. As long as the PV Array and the Battery Load are configured to achieve some level of DC-DC voltage step-down between the MAXIMIZER input and output, maximum power will always flow from the PV Source to the Battery Bank, via the MAXIMIZER.

As variations occur in the PV Array and Battery Voltages, the MAXIMIZER instantaneously adjusts the DC-DC Step-Down Ratio between its Input and Output so as to always maintain its input voltage at the critical maximum power point voltage of the PV Array and so deliver the maximum possible charging current to the battery bank. (This automatic ratio adjusting action is similar in concept to the mechanical analogy of the perfect automatic gearbox mentioned above).

USEFUL DESIGN CONSEQUENCES OF THE UNIQUE "MAXIMIZER ACTION"

The PV Array or Battery Bank can now be expanded, modified or reconfigured with little effort and without creating PV energy wasting voltage mismatch problems between the PV Array and the Battery Bank.

Minimisation of input cable power losses and voltage drop by the efficient higher voltage / lower current transmission of PV Power to the Battery is now possible. The MAXIMIZER, located near the Battery, automatically steps the voltage down and increases the current accordingly, to exactly match that needed by the Battery.

The PV Array can now be optimally placed away from trees and other shading without having to run heavy expensive cabling to the Battery Bank to prevent costly PV power loss in the cables.

Battery Charging Systems, when configured with sufficient step-down, no longer need power wasting blocking diodes to stop night-time battery discharge back into the PV Array.

GOOD NEWS FOR THE PV SYSTEM DESIGNER

The frustration of complex design and component matching is finally over. With the MAXIMIZER, the PV Array's electrical operating point voltage is no longer dictated by the battery bank voltage, as it is in direct-connect systems. This allows the PV Array to always operate at its Maximum Power Point, ensuring delivery of the maximum instantaneous PV power to the battery bank.

The higher Array Voltage configuration permissable with the MAXIMIZER overcomes the problem of early self-regulation, as the battery voltage rises and the panel volts fall, that often occurs in direct-connected PV-Battery Systems operating in high ambient temperature environments.

FEATURES

1. The MAXIMIZER is a universal maximum power point tracker, suitable for use with all types of PV modules, without any pre-adjustment or tuning to set-up the INPUT PV Array operating voltage point.

2. All MAXIMIZERS have a built-in LCD DIGITAL AMP/VOLT METER that permits all input and output voltages & currents to be simply monitored within the one compact package.

3. Fully self-contained 2 wires in, 2 wires out, with large terminal block able to accept up to 25 sq.mm cable.

4. Ultra-high power transfer efficiency, ranging typically from 96% to 98.5%. (Depending on power & O/P current.)

5. Maximum power extraction accuracy is better than 98% over complete throughput power range on all models.

6. Compact & rugged, all-weather, water-proof aluminium and polycarbonate packaging measuring: 9"x7"x7", (225mm x 180mm x 180mm), weight = 5.3lb (2.4Kg)

7. Electronic current limiting, providing a high degree of overload and short-circuit protection.

8. 400 Amp "Crowbar" diode, input & output reverse polarity protected. The crowbar diodes will force the 40A output fuse to blow in the event of reverse battery bank connection. (Spare fuse is provided.)

9. Isolated LOW BATTERY ALARM relay contacts (N/C & N/O) for automatic control of an a auxiliary generator.

10. Two wire REMOTE ON/OFF facility, (N/C & N/O).

11. The outputs of any number of MAXIMIZERS can be parallelled to feed a larger common load.

12. Battery Charging units have a wide range of continuously adjustable battery float levels, with an automatic "108% of float voltage" auto-equalising / anti-sulphation charging characteristic.

13. Automatic Battery Float Voltage ambient temperature compensation is otionally available.

14. No blocking diode needed when charging batteries due to the DC-DC Step-Down operation.

15. All Battery Charging units can be used for water pumping, if necessary.

16. Night-time current drawn by internal drive circuitry from battery bank at night is approximately 25mA.

17. Visual L.E.D. indication of "INPUT ALIVE", "OUTPUT ALIVE", "LOW BATTERY" & "BATTERY CHARGED" conditions.

18. All Control Electronics are contained in a sealed plug-in Hybrid module and this together with conformal PCB coating & gold plated switch contacts ensures long term reliability in harsh tropical and marine environments.

19. Complete input and output electrical RFI filtering and RF noise suppression to meet FCC requirements.

MAXIMIZER SPECIFICATIONS

NOTE: All input & output voltage & current ratings and operating limits are clearly marked on the aluminium extrusion within each maximizer. **IN PARTICULAR, THE OPEN-CIRCUIT INPUT VOLTAGE LIMITS SHOULD BE STRICTLY OBSERVED WHEN DESIGNING THE PV SYSTEM.**

CONTROLLER TYPE..... NON-ISOLATED, COMMON POSITIVE, DC-DC, STEP-DOWN, SWITCHING CONVERTER.

INPUT VOLTAGE RANGE ..... 18-165 Vo/c (on Standard Voltage units)
(LV)..... 18-85 Vo/c (on Special Low Voltage units)
(HV)..... 40-250 Vo/c (on Special High Voltage units)

INPUT VOLTAGE RIPPLE ..... 500mV (maximum 30 kHz AC rms ripple)

INPUT CURRENT RIPPLE..... 300 mA (maximum 30 kHz AC rms ripple)

OUTPUT CURRENT RANGE..... REFER TO TABLE ON NEXT PAGE

OUTPUT VOLTAGE LIMIT ..... SWITCH & POT. ADJUSTABLE, SEE TABLE.

OUTPUT VOLTAGE RIPPLE..... 300 mV (maximum 30 kHz AC rms ripple)

AMBIENT OPERATING LIMITS..... -20C to +45C. **(Never operate unit in direct sunlight.)**

TYPICAL EFFICIENCY..... LV & STANDARD UNITS: 96-98%, HV : 97-99%.

THE RANGE OF BATTERY CHARGING MAXIMIZER MODELS

Note: PV Panels referred to in table below are the standard (36 Cell) types having an Open-Circuit Voltage of 19-20 volts at normal cell operating temperatures in the range 40-60 Degrees Celcius. The terminology "**(4Px8S)**" is a short-hand description for the PV Array configuration. For example, **4Px8S** means **4** Parallel connected strings each of **8** panels in Series. The two numbers in the code when multiplied give the total number of panels forming the Array.

ALL MAXIMIZERS CARRY A 2 YEAR MANUFACTURER BACKED WARRANTY

MAXIMIZER MODEL		OUTPUT CURRENT RANGE	O/C INPUT VOLTAGE RANGE	MAX. No. PANELS IN SERIES	OUTPUT VOLTAGE ADJUST.	MAX. NUMBER PANELS	TYP. POWER RANGE
MAXIMIZER 300 B (300 W Battery Charger)		**0-16 A**	**18-165 Vo/c**	**8**	**13-132 V**	**8** (1Px8S)	**0-400 W**
MAXIMIZER 600 B (600 W Battery Charger)		**0-20 A**	**18-165 Vo/c**	**8**	**13-132 V**	**16** (2Px8S)	**0-800 W**
MAXIMIZER 900 B (900 W Battery Charger)		**0-24 A**	**18-165 Vo/c**	**8**	**13-132 V**	**24** (3Px8S)	**0-1200W**
MAXIMIZER 1200 B (1200 W Battery Charger)		**0-28A**	**18-165 Vo/c**	**8**	**13-132 V**	**32** (4Px8S)	**0-1400W**
MAXIMIZER 800 BLV (800W UNIT for 12V, 24V & 36V Batt. Systems)		**0-32A**	**18-85 Vo/c**	**4**	**13-85 V**	**16** (4Px4S)	**0-800W**
MAXIMIZER 1800 BHV (1800 W Battery unit for 110V Battery Systems)		**0-20 A**	**40-250 Vo/c**	**12**	**26-250 V**	**36** (3Px12S)	**0-1800W**

OPERATING GUIDELINES

1.WARNING. The DC voltage levels at which the MAXIMIZER can operate, can be potentially lethal if handled without adequate caution. Installation must therefore only be carried out by suitably qualified personnel and all applicable electrical safety codes must be followed.

For maximum safety, the aluminium heatsink is NOT electrically connected to any inputs or outputs, it is electrically floating. It has an insulating anodised coat for safety, but care should be taken when making all connections.

2. All input & output voltage and current ratings and operating limits are clearly marked on the aluminium extrusion within each MAXIMIZER. **IN PARTICULAR, THE OPEN-CIRCUIT INPUT VOLTAGE LIMITS SHOULD BE STRICTLY OBSERVED.**

ALWAYS CHECK THE PV ARRAY OPEN-CIRCUIT VOLTAGE LEVEL & POLARITY WITH A MULTI-METER BEFORE CONNECTION TO THE MAXIMIZER INPUTS. THE MAXIMUM NUMBER OF PANELS IN SERIES FOR EACH MAXIMIZER MODEL IS LISTED IN THE TABLE ON PAGE 3, AND MUST NEVER BE EXCEEDED.

Incorrect Array polarity will not damage the MAXIMIZER in any way, but may be accompanied by a dangerous hot arcing, (if the sun is shining), as an attempt is made to make the incorrect input connection.

3. ALWAYS ensure that the MAXIMIZER is switched OFF before making any connections.

4. Exercise extreme caution to ensure correct battery polarity. The wrong polarity will blow the 40 Amp printed circuit output fuse, which would then have to be replaced with the spare 40 Amp printed circuit fuse provided on the back of the circuit board, below the meter module board. If replacing a blown fuse, always bolt it on with the metal side down and with the nuts firmly tightened in place to ensure a good low resistance electrical connection. Fit the spring lock washers only on the non-metal side of the fuse to ensure a good low resistance connection.

5. CAUTION. Once the battery is connected to the output terminals, both the "OUTPUT ALIVE" and "INPUT ALIVE" L.E.D.s will be glowing. The input is now also "alive" at battery potential, due to back energisation from the battery. Again, extreme caution must be exercised NEVER to accidently apply a short-circuit to the input terminals once the battery bank is connected. To do so will also blow the output fuse, via a specially fitted 400A "crowbar" diode included to protect the internal circuitry under such circumstances.

NEVER APPLY A SHORT-CIRCUIT TO THE MAXIMIZER INPUTS OR OUTPUTS

6. For maximum safety, don't switch the MAXIMIZER on without the battery connected to the outputs.

7. NEVER mount the MAXIMZER where it can be exposed to direct sun, rain or rain run-off.

NEVER MOUNT OR OPERATE THE MAXIMIZER IN DIRECT SUNLIGHT

8. ALWAYS loop the input & output cables downwards to below the level of the unit from where they exit. This forms a precautionary water trap, preventing water from ever flowing straight down the cables into the unit via the cable entry points. Always tighten the cable glands onto the cables. The rubber gland seals have tear-out centres to permit large cables up to 25 sq.mm to be passed through the glands.

9. ALWAYS mount the MAXIMIZER in the coolest possible location and positioned so that natural (convective) airflow over the finned aluminium baseplate/heatsink is not restricted in any way. Mount with at least 6" (150mm) above and below the nearest horizontal surfaces. Mount with the circuit board horizontal and nearest the ground, or on two brackets with the finned heatsink facing upwards and the circuit board vertical. Do not mount the unit with the baseplate/heatsink facing downwards, this leads to poor cooling. If the MAXIMIZER is to be mounted in a cabinet, this cabinet must be ventilated. **The cabinet must never be exposed to direct sunlight.**

DO NOT MOUNT THE MAXIMIZER DIRECTLY UNDER THE BACK OF THE PV PANELS, ALTHOUGH SHADED, THIS IS AN EXTREMELY HOT AND UNSUITABLE LOCATION.

10. The use of input and output circuit-breakers is highly recommended. (On Battery Systems of 36V and above, it is essential.) Suitably rated input and output circuit-breakers will provide a means to protect and isolate the sections of the system when making connections. Always ensure that the MAXIMIZER is switched off when opening or closing these swicthes or breakers, as this will prevent unnecessary damaging arcing of the contacts. High quality Miniature Circuit Breakers (MCBs) such as those manufactured by SIEMENS or WEBER are recommended. For Battery voltages up to 48V, single pole MCBs can be used, but for Battery Voltages from 60 to 110V, double-pole MCBs, (a pole for both the positive & negative lines), MUST be used.

INSTALLATION

Please do not proceed beyond this point unless the previous 3 pages have been thoroughly read.

As described on pages 1 & 2, the MAXIMIZER relies on a DC-DC Voltage Step-down Conversion from input to output to ensure that it can always hold its input voltage at the critical PV Array maximum power point voltage - essential for maximum PV power flow to the battery bank.

The PV panels must be configured such that the battery voltage (MAXIMIZER output voltage) is always less than the PV Array maximum power point voltage, (MAXIMIZER input voltage).

So, as long as the battery voltage, at peak PV power output (at noon), is less than the input voltage, then the PV Array is held at the maximum power voltage by the MAXIMIZER and maximum PV power is delivered to the Battery Bank. Design guidelines to help in achieving the highest system performance, by minimising system component losses, are presented below.

PV SYSTEM DESIGN GUIDELINES

The Table on Page 3 provides information on all of the input & output voltages & currents that apply to the complete

range of Battery Charging MAXIMIZERS.

When designing a particular MAXIMIZER into a system, the PV System must be configured such that none of the current and voltage ratings for the particular MAXIMIZER are exceeded. It is therefore necessary to firstly work out realistic noon-day peak power, voltage and current figures for the particular PV panels to be used in your system.

STEP 1. Given that the PV Energy requirement per day is known, work out how many PV Panels will be required to supply aproximately 1.2 times this energy over a typical mid-winters day for the installation location.

Because PV panels necessarily heat-up in the sun, their peak power output reduces compared to the manufacturer's 25 degrees celcius rated power. As a good rule of thumb, multiply the 25C rated panel output power by 0.88 to obtain realistic peak power and voltage outputs for a PV panel exposed to 1000W/sq.m of sunlight insolation in ambient shade temperatures between 20 & 30 Degrees Celcius. For example, a nominal 55 Watt panel will deliver around 48 Watts in this ideal peak sun condition. (This figure will of course vary as ambient temperature and wind conditions in particular affect cell temperatures).

A more conservative peak power multiplier of 0.80 is however recommended, because 1000W/sq.m of sunlight insolation conditions are more often the exception than the rule.

More precisely, the panel voltage and hence the panel power, reduces by about 0.4% for every degree celcius that the cell temperature rises above the manufacturer's International Rating Standard Temperature of 25 Degees Celcius. A typical cell temperature rise of 30 degrees celcius, (cell temp. = 55C), causes about a 12% drop in voltage and power. (eg. 30 x 0.4% = 12%, resulting in the 0.88 power multiplier). Similarly a 25 Celcius open-circuit voltage of 22V becomes approx. 19.4Vo/c (22Vo/c x 0.88) and the 25 Celcius maximum power voltage of around 17V, becomes 15V at a 55 degrees Celcius cell operating temperature.

In Summary; when designing systems with any type of PV panels, use the following rules to obtain typical realistic peak insolation (noon sun) design figures for your panels:

Pmax = PEAK PANEL POWER OUTPUT = MANF'S 25C POWER RATING x 0.8

Vo/c = PEAK OPEN-CIRCUIT VOLTAGE = MANF'S 25C O/C VOLTAGE x 0.88

Vm/p = PEAK MAX. POWER VOLTAGE = MANF'S 25C PEAK POWER VOLTS x 0.88

Im/p = MAX. POWER CURRENT = Pmax / Vmp (= MANF'S 25C RATED AMPS x 0.9)

For a nominal 55 Watt, 36 Cell PV panel, these guidelines give realistic typical peak-output working values of:

Pmax = 55W x 0.8 = 44 Watts

Vo/c = 22V x 0.88 = 19.4 Volts ("Vo/c" is short for PV Panel Open-Circuit Voltage)

Vmp = 17V x 0.88 = 15.0 Volts ("Vmp" is short for PV Panel Maximum Power Point Voltage)

Imp = 44W / 15V = 2.9 Amps (Also = 3.24A x 0.9)

Once realistic panel operating figures have been obtained in this way, proceed with the complete system design.

STEP 2. Refer to the voltage and current limits in TABLE on Page 3, to find the maximum number of panels that can be used with each MAXIMIZER model.

As with any power system, the HIGHER VOLTAGE / LOWER CURRENT configuration reduces cable power losses allowing the cable size from the panels to be greatly reduced and the transmission of the PV Power over large distances with much lower cable power loss.

The PV panels no longer have to be right beside the battery or connected by a heavy expensive cable. Cable power loss is proportional to the current squared, so a doubling the PV array Voltage and so halving of the PV Input Current reduces the PV Array cable power losses by a factor of four.

NO BLOCKING DIODE: No power wasting blocking diode, normally used to prevent night-time battery discharge back into the PV Array, is required when the system is configured with sufficient voltage step-down between the MAXIMIZER input and output. The minimum level of step-down requirement is always met if the following failsafe design rule is followed. (If it is not followed, and yearly average night-time panel temperatures are above 15 Deg. Celcius, then the system should be installed with a separate input blocking diode between the PV array and the MAXIMIZER input.)

THE RECOMMENDED RULE WHEN USING A BATTERY CHARGING MAXIMIZER IS TO DESIGN THE SYSTEM SO THAT THE 25 Deg. Celcius PV ARRAY OPEN-CIRCUIT VOLTAGE IS APPROXIMATELY TWICE (or more than twice) THE NOMINAL BATTERY BANK VOLTAGE .

FOR EXAMPLE : (Note- Vo/c = PV Open-Circuit Voltage. Vo/c = 21-22V @ 25C typically per panel)
12V Battery: Vo/c < 24V (2 or more panels in series)
24V Battery: Vo/c < 48V (3 or more panels in series)
36V Battery: Vo/c < 72V (4 or more panels in series)
48V Battery: Vo/c < 96V (5 or more panels in series)
60V Battery: Vo/c < 120V (6 or more panels in series)
72V Battery: Vo/c < 144V (7 or more panels in series)
84V Battery: Vo/c < 168V (8 or more panels in series)
96V Batt.: Vo/c < 192V (9 or more panels in series) (HV)
110V Batt.: Vo/c < 220V (Atleast 10 panels in series) (HV)

STEP 3. Once the PV Array configuration has been decided upon, such that the PV Array Voltage to Battery Voltage step-down requirements (to prevent night-time reverse power flow back into the panels) have been met, the complete system can now be connected up.

USING THE BUILT-IN LCD MULTI-METER

All Battery Charging MAXIMIZERS are fitted with an LCD Digital Volt/Amp meter. The 4 position slide switch is used to select - 1. I/P VOLTS (PV Input Voltage), 2. I/P AMPS (PV Input Current), 3. O/P VOLTS (Battery Voltage), 4. O/P AMPS (Battery Charging Current). The meter normally reads to 199.9V on the voltage ranges, but on the High Voltage MAXIMIZERS, a Hi<-->Lo toggle switch can be toggled to range-change the voltmeter readings to permit the higher PV input open-circuit voltages up to 250V to be read. When toggled to high the meters full-scale reading is 1999V instead of 199.9V. Return to the "Lo" setting for all current readings.

STEP 4. Setting the Float Voltage Level. It is necessary to set the battery bank float voltage level for each individual battery charging PV System. All MAXIMIZERS are supplied fitted with the automatic "108% of float voltage" equalisation / anti-sulphation charging characteristic. This function ensures that all cells in a battery bank are fully charged to a sulphation free level by charging the battery bank to a voltage level that is approximately 8% above the final float voltage level that can be set as described below. Once this upper voltage threshold, (1.08 times the pre-set float level), is reached, the MAXIMIZER will then maintain the battery at the lower pre-set float voltage level.

(The MAXIMIZER also has optional LINEAR FLOAT LEVEL AMBIENT TEMPERATURE COMPENSATION of -2.5mV per degree celcius per nominal 2V lead acid cell. The temperature sensing is performed within the MAXIMIZER).

Mount the MAXIMIZER near the Battery Bank and inter-connect the two with heavy section cable. Up to 25 sq.mm or 0.038 sq.inch cable will fit into the MAXIMIZER output terminal block. This will minimize power loss and avoid voltage drops that may effectively reduce the battery float level sensed at the MAXIMIZER. (Generally any voltage drop becomes negligibly small once the current falls to the low trickle charge float current level, so only the 108% equalisation level may be slightly lowered by cable voltage drop at full MAXIMIZER output current.)

As soon as the battery voltage drops below the pre-set Final Float Voltage, the 108% equalisation function is re-initialised and the MAXIMIZER will again take the battery voltage to this 108% level on the next charging cycle.

FOLLOW THESE STEPS TO SET THE FLOAT VOLTAGE LEVEL

1. Select "O/P VOLTS" with the Meter Selector Slide Switch. The Digital meter will now display the Battery Bank Voltage.

2. Disconnect any load from the battery bank and switch the MAXIMIZER on, setting the battery selector switch to the nominal battery bank voltage.

3. Allow the battery bank to charge until the MAXIMIZER goes into final float mode as indicated by RED "Battery Charged" LED lighting up. The meter is now reading the Final Float Voltage of the battery bank. Use the table on P.7 or the Battery Manufacturer's data to now set the actual Final Float Voltage required for the battery bank. This adjustment can be made by turning the 20 turn "OUTPUT VOLTAGE TRIMPOT" with a small screwdriver. **When the small orange slider within the clear trimpot moves in the direction marked "UP" this raises the battery float level. When the small orange slider within the clear trimpot moves in the direction marked "DOWN" this lowers the battery float level. CLOCKWISE to LOWER. ANTI-CLOCKWISE to RAISE.**

4. When raising or lowering the Final Float Level, it may take quite some time for the battery to attain the new level setting. All MAXIMIZERS have the FINAL FLOAT VOLTAGE LEVEL pre-set to approximately 2.42V/2V Cell. This will result in an 108% equalisation charge level of approximately 2.56V/2V Cell. If the battery is cycled daily, it is not recommended to alter this level - simply confirm that it is correctly set using the built-in digital meter and fine-tune it UP or DOWN to achieve exactly 2.42V/2V Cell, if necessary.

The installer should place a ring around this level, for the particular battery bank, in the TABLE below and show the customer how to adjust the FINAL FLOAT LEVEL as described above. The customer can then check this level periodically (whenever the "BATTERY CHARGED" LED is on), to see that the correct Final Float Level is set.

ALL MAXIMIZERS HAVE THE FINAL BATTERY FLOAT LEVEL FACTORY SET TO APPROXIMATELY 2.42V/2V Cell. THUS, SIMPLY SELECT THE NOMINAL BATTERY SETTING ON THE RED BATTERY SELECTOR SLIDE SWITCH. FINE-TUNE THE FLOAT LEVEL, ONLY IF REQUIRED, USING THE TABLE ON THE FOLLOWING PAGE AS A GUIDE.

STEP 5. FINAL OPERATIONAL CHECK

With the system operating at peak (noon) output, temporarily switch the OUTPUT VOLTAGE SELECTOR SWITCH to the top setting (#10), so that the MAXIMIZER is delivery full PV power into the battery (not regulating). Use the built-in meter to confirm: 1/. That the input is operating at the nominal PV Array maximum power point voltage and the Array (input) current is as expected from calculations on page 5, 2/. That the input operating voltage (PV Array voltage) is atleast 1.2 times higher than the battery voltage, as required to prevent night-time reverse power flow.

LOW BATTERY ALARM or GENERATOR CONTROL FUNCTION

All Battery Charging MAXIMIZERS have a low voltage alarm function that lights the "Low Battery" LED at a fixed 1.85V/2V Cell and changes the state of a small low power relay. The Red LED continues to signal a low battery condition until the Final Battery Float Voltage has been reached and the battery is fully re-charged. At this point the LED goes off and the relay changes state. The N/C (normally closed) & N/O (normally open) relay contacts are brought out to the 3 Way terminal block numbered 8, 9, & 10. These have 1000V of isolation from all of the PV system and are rated at 1A or 30W. They can be used to signal a back-up generator to start-up in an automatic generator controller or simply for remote low battery alarm detection in telecommunication applications.

REMOTE ON/OFF CONTROL

Control Terminals 5, 6 & 7 can be used to remotely switch the MAXIMIZER on and off. To switch the unit off, link 5 & 6 or remove the permanent link from 6 & 7. Only fractions of a milli-amp are involved in these operations. The control voltages at 6 & 7 are at around 3 volts with respect to terminal 5 which is electrically connected to the MAXIMIZER ground (negative PV input). **Never parallel connect 5, 6 & 7 with other terminals 5, 6, & 7 on other maximizer in multiple unit systems.**

OUTPUT OPEN-CIRCUIT VOLTAGE INHIBIT

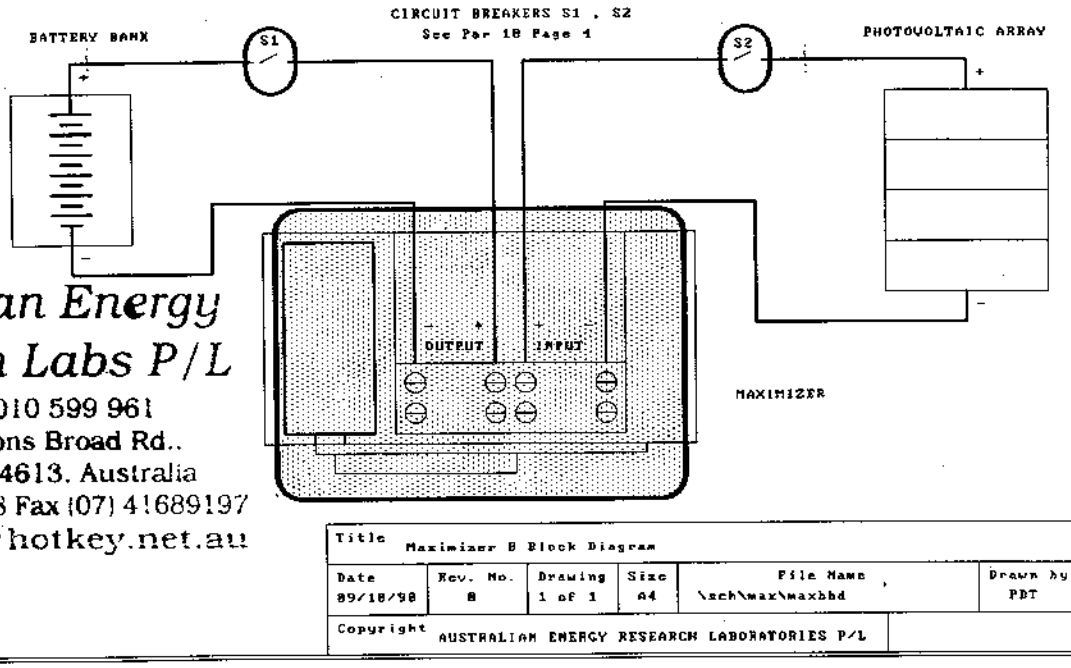
All Maximizers are now fitted with a stand-by idle function that puts the Maximizer into an idle mode if left switched on without a load connected. This is useful in Solar Racing Cars where it may be required to repeatedly open & close an output circuit-breaker without switching the Maximizer off.

THE OUTPUT WILL DIP VERY BRIEFLY APPROXIMATELY EVERY 30 SECONDS ON ALL UNITS - THIS IS NORMAL AND CONFIRMS CORRECT OPERATION OF THE MAXIMIZER.

ENSURE THAT THE MAXIMIZER IS NOT EXPOSED TO DIRECT SUN UNDER ANY CIRCUMSTANCES.

NOMINAL (lead-acid) BATTERY VOLTAGE	DAILY CYCLED SYSTEMS : (SET THIS FINAL FLOAT LEVEL)					FLOATING STAND-BY SYSTEMS : (SET THIS FINAL FLOAT LEVEL)				
ACTUAL BATTERY TEMP :	**-10C**	**0C**	**10C**	**20C**	**30C**	**-10C**	**0C**	**10C**	**20C**	**30C**
2V CELL REFERENCE	2.51	2.48	2.45	2.42	2.39	2.41	2.38	2.35	2.31	2.28
12 V	15.1	14.9	14.7	14.5	14.3	14.5	14.3	14.1	13.9	13.7
24 V (2 x 12V)	30.2	29.8	29.4	29.0	28.6	29.0	28.6	28.2	27.8	27.4
36 V (3 x 12V)	45.3	44.7	44.1	43.5	42.9	42.0	41.7	41.1	40.5	39.9
48 V (4 x 12V)	60	59	59	58	57	58	57	56	56	55
60 V (5 x 12V)	75	74	73	72	71	72	71	70	69	68
72 V (6 x 12V)	91	89	88	87	86	87	86	85	83	82
84 V (7 x 12V)	106	104	103	102	100	101	100	99	97	96
96 V (8 x 12V)	121	119	118	116	114	116	114	113	111	110
108 V (9 x 12V)	136	134	132	131	129	130	129	127	125	123
110 V (55 x 2V)	138	136	135	133	131	132	131	129	127	125

Typical System Connection Diagram for the MAXIMIZER

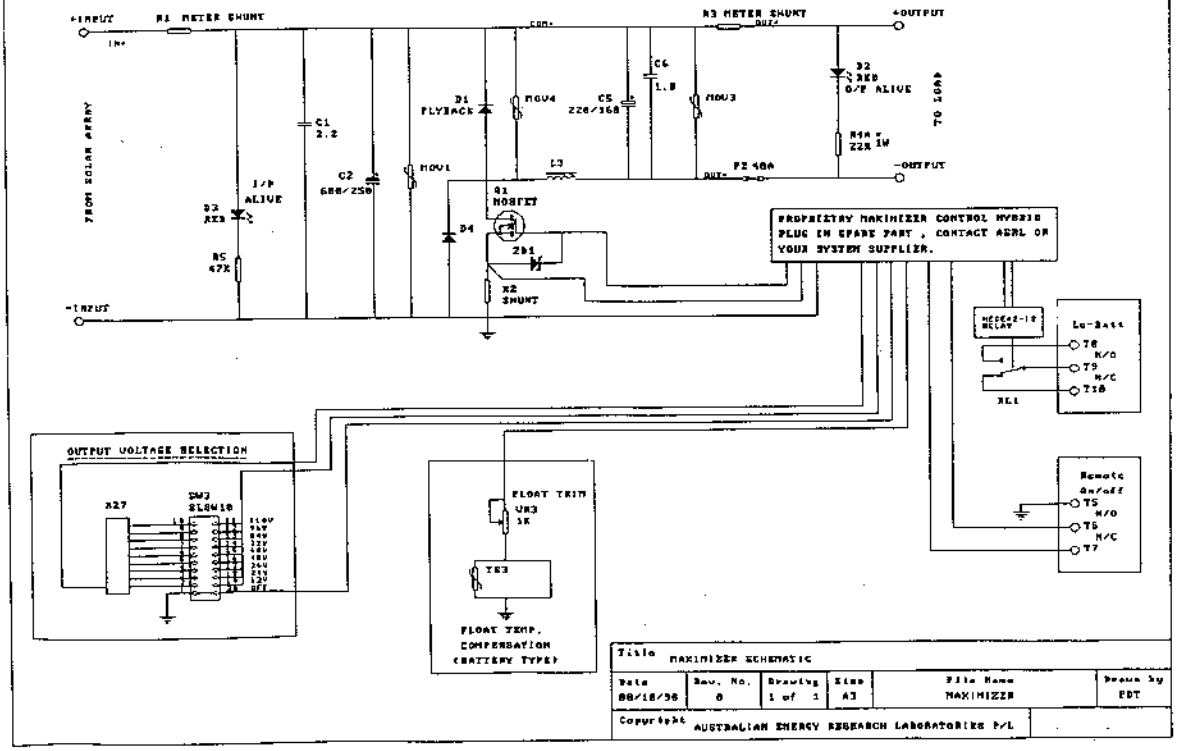


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Title	Maximizer B Block Diagram				
Date 09/18/98	Rev. No. B	Drawing 1 of 1	Size A4	File Name \sch\max\maxbbd	Drawn by PDT
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MAXIMIZER SCHEMATIC ©1992 AERL. (Patent Pending)



Title	MAXIMIZER SCHEMATIC				
Date 09/18/98	Rev. No. B	Drawing 1 of 1	Size A3	File Name MAXIMIZER	Drawn by PDT
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