

Solar Power for Ham Radio



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The key facts about each type of solar cell:



- **Monocrystalline**

- **Overview and Appearance**

- This is the oldest and most developed of the three technologies. Monocrystalline panels as the name suggests are created from a single continuous crystal structure. A Monocrystalline panel can be identified from the solar cells which all appear as a single flat color.

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- **Construction**

- They are made through the Czochralski method where a silicon crystal 'seed' is placed in a vat of molten silicon. The seed is then slowly drawn up with the molten silicon forming a solid crystal structure around the seed known as an ingot. The ingot of solid crystal silicon that is formed is then finely sliced ingot what is known as a silicon wafer. This is then made into a cell.
- The Czochralski process results in large cylindrical ingots. Four sides are cut out of the ingots to make silicon wafers. A significant amount of the original silicon ends up as waste.

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The key facts about each type of solar cell:



• Polycrystalline

- **Overview and Appearance**

- Polycrystalline or Multicrystalline are a newer technology and vary in the manufacturing process.

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- **Construction**

- Polycrystalline also start as a silicon crystal 'seed' placed in a vat of molten silicon. However, rather than draw the silicon crystal seed up as with Monocrystalline the vat of silicon is simply allowed to cool. This is what forms the distinctive edges and grains in the solar cell
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- Polycrystalline cells were previously thought to be inferior to Monocrystalline because they were slightly less efficient, however, because of the cheaper method by which they can be produced coupled with only slightly lower efficiencies they have become the dominant technology on the residential solar panels market.
- In November 2015 Trina Solar announced that it had produced a multi-crystalline cell with efficiency of 21.25%. This should allow them to produce polycrystalline modules with efficiencies between 18-20% a concept that was thought impossible as recently as 2013.
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- Underpinning the new record for p-type multicrystalline solar cells has been the continued quality improvements of multicrystalline wafers that have helped pushed standard 60-cell multicrystalline panels from 240W to 260W in recent years.
- Polycrystalline are now very close to Monocrystalline cells in terms of efficiency.

The key facts about each type of solar cell:



- Thin Film

Overview and Appearance

Thin film panels are a totally different technology to Mono and Polycrystalline panels. They are a new technology compared to Mono and Polycrystalline cells and would not be considered a mature technology as vast improvements in this technology are expected in the next 10 years.

A thin film panel can be identified as having a solid black appearance. They may or may not have a frame, if the panel has no frame it is a thin film panel.

Construction

Thin film panels are made by depositing a photovoltaic substance onto a solid surface like glass. The photovoltaic substance that is used varies and multiple combinations of substances have successfully and commercially been used. Examples of the most common photovoltaic substances used are:

Performance

Thin film cells have got a reputation as being the 'worst' of the solar panel technologies because they have the lowest efficiency. However, this is only because they have a lower power efficiency which only means they require the most space for the same amount of power. Since they are becoming the cheapest panels to produce because of the low material costs for thin film they are quickly becoming the more economically efficient panel types.

Depending on the technology, thin-film module prototypes have reached efficiencies between 7–13% and production modules operate at about 9%. Future module efficiencies are expected to climb close to the about 10–16%.

The market for thin film PV grew at a 60% annual rate from 2002 to 2007. In 2011, close to 5% of U.S. photovoltaic module shipments

Advantages of Monocrystalline solar panels

Monocrystalline solar panels have the highest efficiency rates since they are made out of the highest-grade silicon. On October 2 2105, SolarCity announced that it has developed the world's most efficient solar panels. The new panels convert more than 22% of sunlight into electricity.

Just days later Panasonic announced it had trumped that achievement. A Panasonic solar panel has established a new world record module conversion efficiency of 22.5% on a commercial sized prototype using solar cells based on mass production technology. The test results were confirmed by the renowned Japanese National Institute of Advanced Industrial Science and Technology. The 72-cell, 270-watt prototype incorporates newly developed enhanced technology that will eventually be scaled into volume production.

Panasonic also says it is introducing the HIT® N330, the latest addition to the company's high-efficiency hetero-junction photovoltaic module product line and its most powerful photovoltaic module to date. It will be available in the UK and other European markets starting in March, 2016. Manufactured at Panasonic's state-of-the-art, vertically integrated solar fabrication facilities in Malaysia, HIT® N330 features 19.7% module-level efficiency and a nominal power output of 330 watts.

Monocrystalline silicon solar panels are space-efficient. Since these solar panels yield the highest power outputs, they also require the least amount of space compared to any other types. However, monocrystalline solar panels produce marginally more power per square foot of space used in an array and so.

Monocrystalline Panels have a long lifespan. Most solar panel manufacturers put a 25-year warranty on their monocrystalline solar panels. Because both types of crystalline solar panels are made from crystalline silicon, a very inert and stable material it is very likely that these solar panels will last much longer than their 25 year warranty life.

Monocrystalline solar panels tend to be more efficient in warm weather. With all solar cells electricity production falls as temperature goes up. However, this degradation of output is less severe in monocrystalline panels than polycrystalline solar panels. However, in practice the difference is very small. The level to which each solar panels production falls as temperature increase is called the temperature co-efficient and is published with the specifications for each panel.

Disadvantages of Monocrystalline solar panels

Advantages of Polycrystalline solar panels

The process used to make polycrystalline silicon is simpler and cost less. The amount of waste silicon is less compared to monocrystalline.

Polycrystalline solar panels tend to have slightly lower heat tolerance than monocrystalline solar panels. Polycrystalline solar panels will tend to have a higher

Disadvantages of Polycrystalline solar panels

The efficiency of polycrystalline-based solar panels is typically 14-16%. Because of lower silicon purity, polycrystalline solar panels are not quite as efficient as monocrystalline solar panels.

Lower space-efficiency. You generally need to cover a larger surface to output the same electrical power as you would with a solar panel made of monocrystalline silicon. However, this does not mean every monocrystalline solar panel perform better than those based on polycrystalline silicon.

Monocrystalline and thin-film solar panels tend to be more aesthetically pleasing since they have a more uniform look compared to the speckled blue color of polycrystalline silicon.

Advantages of Thin Film solar panels

Mass-production is simple. This makes them and potentially cheaper to manufacture than crystalline-based solar cells.

Their homogeneous appearance makes them look more appealing.

Can be made flexible, which opens up many new potential applications.

High temperatures and shading have less impact on solar panel performance.

In situations where space is not an issue, thin-film solar panels can make sense.

Disadvantages of Thin Film solar panel

Thin-film solar panels are in general not very useful for in most residential situations. They are cheap, but they also require a lot of space. SunPower's monocrystalline solar panels produce up to four times the amount of electricity as thin-film solar panels for the same amount of space.

Low space-efficiency also means that the costs of PV-equipment (e.g. support structures and cables) will increase.

Thin-film solar panels tend to degrade faster than mono-crystalline and polycrystalline solar panels, which is why they typically come with a shorter warranty.

WindyNation 100 Watt 100W Monocrystalline Photovoltaic PV Solar Panel Module 12V



https://www.amazon.com/gp/product/B00HM9BBTG/ref=oh_aui_detailpage_o06_s00?ie=UTF8&psc=1

\$154.00

50 FEET UL Solar Panel Extension Cable Wire (50 ft.) with MC4 Connectors PV - 12 AWG - 600VDC



https://www.amazon.com/gp/product/B00KFLT4W4/ref=oh_aui_detailpage_o02_s00?ie=UTF8&psc=1

\$21.00

Signstek Y Branch MC4 Solar Panel Adaptor Cable Connector (1, M/FFFF and F/MMMM)



https://www.amazon.com/gp/product/B00FWO54RI/ref=oh_aui_detailpage_o04_s00?ie=UTF8&psc=1

\$17.00

**ZODORE 2pieces MC4 spanner/ wrench 100% copper socket Spanner for solar connectors Assembly
Disassembly Unlock / Tightening / Latching solar MC4 tools**



https://www.amazon.com/gp/product/B00WZMDW6K/ref=oh_aui_detailpage_o00_s00?ie=UTF8&psc=1

\$7.00

MPPT Solar Regulator Charge Controller 60A 12V 24V Autoswitch Solar Panel 1500W



https://www.amazon.com/gp/product/B00NSERJR2/ref=oh_aui_detailpage_o00_s00?ie=UTF8&psc=1

\$90.00

KRIEGER KR1500 1500W 12V Power Inverter with Dual 110V AC Outlets and Installation Kit



**3FT CABLES
REMOTE + ANL FUSE**

https://www.amazon.com/dp/B00DNL05GW/_encoding=UTF8?coliid=I35IUZQKKZEV35&colid=282HAGM3JD5TW

\$140.00

Batteries



Deep Cycle Marine Batteries

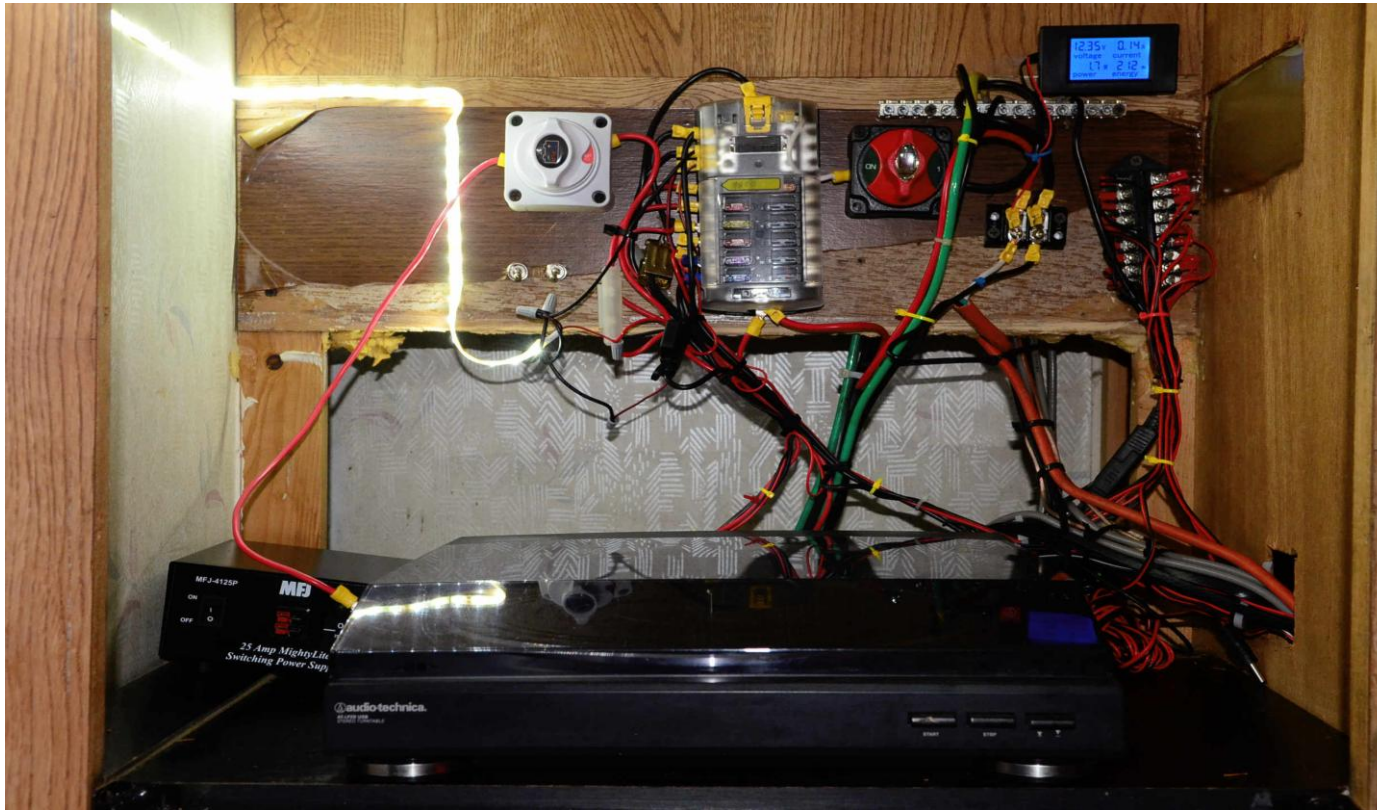
BATTERY VOLTAGE BOOSTER,13.8VDC, 25A,INPUT 9-13.8V



<http://www.mfjenterprises.com/Product.php?productid=MFJ-4416C>

\$180.00

DC Distribution Panel



Marine Battery Switch

https://www.amazon.com/gp/product/B00FJEXNWX/ref=oh_aui_detailpage_o07_s00?ie=UTF8&psc=1

Fuse Block

https://www.amazon.com/gp/product/B001P6FTHC/ref=oh_aui_detailpage_o01_s00?ie=UTF8&psc=1

Meter

https://www.amazon.com/gp/product/B01EUISFFE/ref=oh_aui_detailpage_o03_s00?ie=UTF8&psc=1

Questions?