

Choosing a solar module

A comparison of the solar modules sold by Segen



Day 4
Mitsubishi
Romag
Sanyo
Schott
Sharp
Upsolar

Introduction

There are many 100s of solar module manufactures offering 1,000s of different modules for sale, making choosing the right manufacturer and model a non trivial task. Some of the differences between modules can be highly significant in a specific application but other apparent differences more a function of the manufacturer's marketing department than any quantifiable parameter of great importance. This document attempts to explain the attributes of all the solar modules which Segen sells in an objective manner.

Segen staff are very often asked "*what is the best module?*" or "*which module would you buy for your own house?*" but there is no easy answer to that, nor is there any one answer for all situations or houses. There are always a number of factors you must take into account when selecting the best module for the specific application and location in mind. We would advise you to be wary of suppliers who attempt to highlight one specific feature of the product they happen to sell and generate an apparently compelling "marketing story" as to why that feature is the only criteria by which you should make a choice, as things with PV modules are very rarely that simple and many factors need to be taken into account.

The most important parameters to consider when selecting a module are;

1. **Price.** Even major brand good quality modules can vary in price by +/-10% for apparently the same product.
2. **Efficiency.** If space is limited then the efficiency of the module can be important, less so if space is not constrained.
3. **Yield.** The amount of energy that a module will generate per year will vary depending on the location, orientation and inclination of the module and different types of modules perform better or worse in comparison to others in different circumstances.
4. **Size.** You can't chop a module in half, so the physical dimensions of the module are important when trying to maximise the available area.
5. **Appearance.** Different cell types look different and some blend in better with specific types of roof and mounting systems than others. Some modules have a black rather than silver frame which some would say look less obtrusive.
6. **Quality.** One of the hardest things to evaluate as all manufacturers will claim to be "top quality" and you are largely depending on the brand name to give you the assurance.
7. **Warranty.** Different manufacturers offer different warranty terms, with or without independent insurance backing and if a long secure warranty is important you need to consider the history and stability of the manufacturer offering it.
8. **Shade Resistance.** In applications where there will be partial shading the ability of the module design to allow at least some power to be produced will critically impact the annual energy generated.
9. **Salt Resistance.** If installing near the sea this is an important factor, not so if installing inland.
10. **Ammonia Resistance.** If installing onto a barn containing livestock the resistance to the effects of ammonia will be critical, not so in other environments.

Segen has chosen to sell a number of different products offering what we believe is a good product choice for the vast majority of applications and user requirements. This guide will help you choose which Segen supplied module is right for your specific installation. It does not attempt to "sell" you any specific module from any manufacturer but instead to highlight quantitative differences between the products allowing you to make an informed choice. In most situations there will be no one "obvious" choice, but this guide should assist you to narrow down the list of options leaving the final choice down to more subjective considerations such as brand name and appearance where only you the customer can make a final decision.

Price

Not to be left until last as for most people the key question to ask is over the life of my system (25+ years) which module selection will give the best return on investment and the module cost typically makes up about 60% of the total cost of a system. The easiest way to compare modules is on their £/Wp, i.e. how much they cost per W of rated power which is calculated simply by dividing the price of the module in £ and dividing it by the rated power.

The PV market is essentially a global market and with multiple manufacturers competing hard with each other there is not normally a large variation in price between similar modules and typically +/- 5% would be the biggest difference over time. There are however short term factors which can have a significant impact, the most important one being the exchange rate as some modules are priced by the manufacturers in Sterling, some in Euros and others in US Dollars. Other factors can include modules in scarce or plentiful supply, new manufacturers pricing aggressively to enter the market or grow their share or wholesalers selling off surplus stock "cheap". Modules from low cost economies such as China will tend to be cheaper than from Europe or Japan and "high tech" modules such as those with hybrid cells (Sanyo) will be more expensive, but better performing.

In the Segen range the **Upsolar** modules will normally have the lowest cost per Wp being a Chinese manufacturer and depending on the £/\$/€ exchange rates are typically 10% - 15% less than the mainstream European and Japanese products.

The mainstream European, Japanese and North American products we sell from **Sharp, Mitsubishi, Day4, Romag** and **Schott** will vary by about +/-5% between each other depending on factors such as the exchange rate and which manufacturer is being the most aggressive on price at the time you decide to purchase.

The **Sanyo** hybrid modules which have an exceptionally high efficiency and better yield will be about 15% more expensive, but you do get more energy from them, so in essence you pay more and get more.

Efficiency

This is calculated by dividing the rated power of the module by the area in m². It is important to compare the overall efficiency of the module and not the efficiency of the individual cells from which the module is made. Clearly the higher the rating for the same size, the higher the efficiency and most manufacturers offer a range of modules of the same size, just slightly different rating and therefore efficiency. The differences however can be very small and the final choice is more likely to be dependant on the exact total system size you are aiming for, rather than very small differences in module efficiency.

Polycrystalline modules tend to have efficiencies in the range 13% - 15%, monocrystalline modules in the range 14% - 16% and hybrid modules in the range 18% - 20%.

Efficiency can be a very important consideration if the available space is limited, but if space is not a constraint then there is little or no advantage in purchasing a higher efficiency module, and often that is simply more expensive for no gain.

The appendix of this document details the efficiencies of all the modules that Segen supplies.

Yield

This is a measure of the total energy which your system will generate each year and is a function of many factors and not just the module type. Both monocrystalline and polycrystalline will have a similar yield on a typical installation as expressed as kWh/kWp but a hybrid (Sanyo) module based system could be expected to generate about 5 – 7% more energy per annum for the same rated power.

Other factors however such as shading (covered later) may have a significant impact and the ability of the module to stay cooler (**Day4**) or have lower losses when warm (**Sanyo**) can have a substantial impact on the overall system yield and need to be calculated in detail for a full comparison.

Size

The physical size of the module is determined by the number and size of the cells from which the module is made with very small differences between the manufacturers depending on how far apart they position the cells and the size of the frame around the edge. Most cells are either 125mm² or 150mm² and panels are manufactured with varying numbers of cells, typically 48 X 150mm², 60 X 150mm² or 72 X 125mm² and almost all of the panels sold by Segen fit into one of 5 categories as per the table below;

Cells	48 X 150mm ²	50 X 150mm ²	54 X 150mm ²	60 X 150mm ²	72 X 125mm ²
Dimensions	1320mm X 990mm	1658mm X 834mm	1500mm X 1000mm	1650mm X 1000mm	1600mm X 810mm
Day4				225 – 245W	
Mitsubishi		185W		225W	
Romag	180 – 185W		200W	220 – 235W	
Schott				225 – 235W	190W
Schuco			210 – 215W		190W
Sharp	180 – 185W			220 – 245W	

The only “right” and “wrong” or “better” or “worse” related to size is what actually fits the available space, biggest is not always the best.

Sanyo hybrid panels have a very unique cell layout unlike any other manufacturer.

Appearance

Modules made from monocrystalline cells will differ significantly in appearance from those made from polycrystalline cells as the two images to the right show.

Polycrystalline cells have a speckled appearance and will be perfectly square whereas monocrystalline cells have a more uniform appearance, often with slightly rounded corners.

The choice of which looks best is simply a matter of personal preference.



Polycrystalline **Monocrystalline**

The other most common aspect of appearance to consider is the colour of the frame and the backing sheet. The **Sanyo** panels have a black frame and are only 35mm deep and the **Romag** “black on black” range have black frames and a black backing sheet and so are often considered the best visually, especially from a modest distance away.

Quality

This is not something easily judged or commented on. All of the modules sold by Segen are fully MCS certified which requires a factory and production procedure inspection and have IEC certification related to their quality and performance.

Some people will judge quality based on how “solid” a panel feels and on that criteria modules such as Schott could be judged highly with a very sturdy frame. Alternatively you may judge it on the track record of the manufacturer and then manufacturers such as Sanyo may come out well.

Many would consider Sharp as the “Ford” of the PV industry as one of the largest and longest established manufacturers and as the market leader in the UK it could be considered a safe bet.

Most people would however say that all modules with full MCS and IEC certification can be expected to last 25+ years and once safely installed onto the roof, the sturdiness of the module frame isn’t relevant.

The problem is that there have been so few failures of PV modules there isn’t much data to go on to compare manufacturers.

Warranty

All Segen manufacturers offer either a 5 or 10 year product defect warranty and a 25 year performance one. In truth all modules can be expected to last 25+ years and it’s virtually unheard of for a module to fail in less than 10 years once it’s safely installed onto the roof, so the length of product defect warranty is unlikely to be a major consideration for a typical customer.

Of more importance is the company backing the warranty and your assessment of the likelihood they will be willing and able to honour it for many years to come. Some may consider a 5 year warranty from a company such as Sanyo or Sharp to be worth more than a 10 year one from a recently formed Chinese manufacturer with a non-insurance backed warranty.

Shade Resistance

When placing panels on an unobstructed south facing roof with no trees or tall building around, shading will not be a concern and the choice of module will not be impacted by shading considerations.

On installations however where there is a potential for a significant amount of shading, even just at certain times of the year or day, the choice of panel can be significant.

The ability of the panel to at least partially function when part shaded is determined by the number of bypass diodes and the layout of the cell strings. Most panels have 3 bypass diodes enabling the panel to function at 33% or 66% if part shaded and be removed from the system entirely if heavily shaded, so allowing the rest of the system to fully function.

The **Day4** modules however are unique in having an innovative string connection layout and no less than 9 bypass diodes enabling them to produce up to 90% of full power when partially shaded and are especially well suited to multiple rows of modules on either flat roofs or ground mounted arrays and in these systems a Day4 array may generate 10% - 15% more energy per annum than a similar array of standard modules.

Salt Resistance

When placing modules in an environment where salt is present, e.g. within coastal areas, it is important to choose a module which has been tested and certified for salt resistance to **IEC 61701**.

Within the Segen range this would apply to all the **Day4** and **Schott** and modules.

It would not be recommended to use any module without IEC 61701 in areas with the likelihood of salt mist.

Ammonia Resistance

In an agricultural environment, especially on a livestock barn roof, there can be high concentrations of ammonia and it is important to choose a panel that can withstand that.

There isn't currently an IEC standard for this but the German Agricultural Society (**DLG**) has developed a test procedure and certifies modules to it.

Within the Segen range this would apply to all the **Schott** modules.

Specifications

Detailed below are the full specifications of all the modules which Segen currently sells.



Day4 design and manufacture high-performance solar electric modules based on their patented Day4 Electrode technology. The Day4 Electrode produces modules of high power density, increased lifetime and uncompromised aesthetic appearance.

60MC-I-225 - Day4 MC-I 225W		Type: Polycrystalline	
Rated	Power:	225W	Efficiency: 14.1%
Dimensions	Width:	1013mm	Height: 1650mm
Voltage	VMPP:	29.47V	Voc: 36.48V
Current	IMPP:	7.62A	
Fixings	Connector:	MC4	Clips: Type 44
Module	Frame:	Silver	Weight: 19.20Kg

60MC-I-230 - Day4 MC-I 230W		Type: Polycrystalline	
Rated	Power:	230W	Efficiency: 14.4%
Dimensions	Width:	1013mm	Height: 1650mm
Voltage	VMPP:	29.52V	Voc: 36.71V
Current	IMPP:	7.80A	
Fixings	Connector:	MC4	Clips: Type 44
Module	Frame:	Silver	Weight: 19.20Kg

60MC-I-235 - Day4 MC-I 235W		Type: Polycrystalline	
Rated	Power:	235W	Efficiency: 14.7%
Dimensions	Width:	1013mm	Height: 1650mm
Voltage	VMPP:	29.77V	Voc: 36.90V
Current	IMPP:	7.89A	
Fixings	Connector:	MC4	Clips: Type 44
Module	Frame:	Silver	Weight: 19.20Kg

60MC-I-240 - Day4 MC-I 240W		Type: Polycrystalline	
Rated	Power:	240W	Efficiency: 15.0%
Dimensions	Width:	1013mm	Height: 1650mm
Voltage	VMPP:	30.03V	Voc: 37.12V
Current	IMPP:	7.98A	
Fixings	Connector:	MC4	Clips: Type 44
Module	Frame:	Silver	Weight: 19.20Kg

60MC-I-245 - Day4 MC-I 245W		Type: Polycrystalline	
Rated	Power:	245W	Efficiency: 15.3%
Dimensions	Width:	1013mm	Height: 1650mm
Voltage	VMPP:	30.29V	Voc: 37.32V
Current	IMPP:	8.08A	
Fixings	Connector:	MC4	Clips: Type 44
Module	Frame:	Silver	Weight: 19.20Kg



Mitsubishi Electric is a global giant, with operations in 35 countries, more than 100,000 employees. It's involvement with photovoltaics dates back to the 1970's and module production began in the 1990's.

PV-TD 185 MF5 - Mitsubishi 185W PV Panel			Type: Polycrystalline	
Rated	Power:	185W	Efficiency:	14.2%
Dimensions	Width:	834mm	Height:	1658mm
Voltage	VMPP:	24.40V	Voc:	30.60V
Current	IMPP:	7.58A		
Fixings	Connector:	MC4	Clips:	Type 6
Module	Frame:	Silver	Weight:	17.00Kg

PV-TJ225GA6 - Mitsubishi 225W PV Panel			Type: Polycrystalline	
Rated	Power:	225W	Efficiency:	14.1%
Dimensions	Width:	994mm	Height:	1658mm
Voltage	VMPP:	30.00V	Voc:	36.40V
Current	IMPP:	7.50A		
Fixings	Connector:	MC4	Clips:	Type 6
Module	Frame:	Silver	Weight:	20.00Kg

SMT648P-185B - Romag 185W Black PV Panel		Type: Polycrystalline	
Rated	Power: 185W	Efficiency:	14.2%
Dimensions	Width: 994mm	Height:	1318mm
Voltage	VMPP: 24.60V	Voc:	29.76V
Current	IMPP: 7.58A		
Fixings	Connector: MC4	Clips:	Type 106
Module	Frame: Black	Weight:	16.00Kg

SMT654P-200B - Romag 200W Black PV Panel		Type: Polycrystalline	
Rated	Power: 200W	Efficiency:	14.3%
Dimensions	Width: 994mm	Height:	1482mm
Voltage	VMPP: 26.00V	Voc:	33.16V
Current	IMPP: 7.70A		
Fixings	Connector: MC4	Clips:	Type 106
Module	Frame: Black	Weight:	19.00Kg

SMT660P-220B - Romag 220W Black PV Panel		Type: Polycrystalline	
Rated	Power: 220W	Efficiency:	13.8%
Dimensions	Width: 994mm	Height:	1648mm
Voltage	VMPP: 29.40V	Voc:	36.80V
Current	IMPP: 7.50A		
Fixings	Connector: MC4	Clips:	Type 106
Module	Frame: Black	Weight:	19.00Kg

SMT660P-235B - Romag 235W Black PV Panel		Type: Polycrystalline	
Rated	Power: 235W	Efficiency:	14.7%
Dimensions	Width: 994mm	Height:	1648mm
Voltage	VMPP: 30.60V	Voc:	38.50V
Current	IMPP: 7.70A		
Fixings	Connector: MC4	Clips:	Type 106
Module	Frame: Black	Weight:	16.00Kg



For more than 30 years Sanyo has been setting standards for the development of new, innovative and high performance photovoltaic products. Sanyo modules are highly efficient and produce more power per square meter than traditional products and therefore you will need fewer modules on your roof to accomplish very high performance.

HIP215 - Sanyo HIP 215W PV Panel			Type: Hybrid
Rated	Power:	215W	Efficiency: 17.9%
Dimensions	Width:	798mm	Height: 1580mm
Voltage	VMPP:	42.00V	Voc: 51.60V
Current	IMPP:	5.13A	
Fixings	Connector:	MC3	Clips: Type 9
Module	Frame:	Black	Weight: 15.00Kg

HIT-N235SE10 - Sanyo HIT N Series PV Panel 235W			Type: Hybrid
Rated	Power:	235W	Efficiency: 19.6%
Dimensions	Width:	798mm	Height: 1580mm
Voltage	VMPP:	43.00V	Voc: 52.40V
Current	IMPP:	5.48A	
Fixings	Connector:	MC3	Clips: Type 9
Module	Frame:	Black	Weight: 15.00Kg

HIT-N240SE10 - Sanyo HIT N Series PV Panel 240W			Type: Hybrid
Rated	Power:	240W	Efficiency: 20.0%
Dimensions	Width:	798mm	Height: 1580mm
Voltage	VMPP:	43.70V	Voc: 52.40V
Current	IMPP:	5.51A	
Fixings	Connector:	MC3	Clips: Type 9
Module	Frame:	Black	Weight: 15.00Kg

HIT240 - Sanyo HIT 240W PV Panel			Type: Hybrid
Rated	Power:	240W	Efficiency: 18.5%
Dimensions	Width:	861mm	Height: 1610mm
Voltage	VMPP:	35.50V	Voc: 43.60V
Current	IMPP:	6.77A	
Fixings	Connector:	MC3	Clips: Type 9
Module	Frame:	Black	Weight: 16.50Kg

HIT-H245E01 - Sanyo HIT H Series PV Panel 245W			Type: Hybrid
Rated	Power:	245W	Efficiency: 18.8%
Dimensions	Width:	861mm	Height: 1610mm
Voltage	VMPP:	34.40V	Voc: 42.70V
Current	IMPP:	7.14A	
Fixings	Connector:	MC3	Clips: Type 9
Module	Frame:	Black	Weight: 16.50Kg

HIT-H250E01 - Sanyo HIT H Series PV Panel 250W			Type: Hybrid	
Rated	Power:	250W	Efficiency:	19.2%
Dimensions	Width:	861mm	Height:	1610mm
Voltage	VMPP:	34.90V	Voc:	43.10V
Current	IMPP:	7.18A		
Fixings	Connector:	MC3	Clips:	Type 9
Module	Frame:	Black	Weight:	16.50Kg



SCHOTT Solar is a high quality German brand with more than 50 years of experience in the manufacturing of solar energy products and pride themselves in quality products, high energy yield and reliability.

MONO-185 - SCHOTT Mono 185W			Type: Monocrystalline	
Rated	Power:	185W	Efficiency:	14.2%
Dimensions	Width:	810mm	Height:	1620mm
Voltage	VMPP:	36.30V	Voc:	45.00V
Current	IMPP:	5.10A		
Fixings	Connector:	TYCO	Clips:	Type 112
Module	Frame:	Black	Weight:	15.50Kg

MONO-190 - SCHOTT Mono 190W			Type: Monocrystalline	
Rated	Power:	190W	Efficiency:	14.6%
Dimensions	Width:	810mm	Height:	1620mm
Voltage	VMPP:	36.40V	Voc:	45.20V
Current	IMPP:	5.22A		
Fixings	Connector:	TYCO	Clips:	Type 112
Module	Frame:	Black	Weight:	15.50Kg

POLY-225 - SCHOTT Poly 225W			Type: Polycrystalline	
Rated	Power:	225W	Efficiency:	14.1%
Dimensions	Width:	993mm	Height:	1685mm
Voltage	VMPP:	29.80V	Voc:	36.70V
Current	IMPP:	7.55A		
Fixings	Connector:	TYCO	Clips:	Type 12
Module	Frame:	Silver	Weight:	23.00Kg

POLY-230 - SCHOTT Poly 230W			Type: Polycrystalline	
Rated	Power:	230W	Efficiency:	14.4%
Dimensions	Width:	993mm	Height:	1685mm
Voltage	VMPP:	30.00V	Voc:	36.90V
Current	IMPP:	7.66A		
Fixings	Connector:	TYCO	Clips:	Type 12
Module	Frame:	Silver	Weight:	23.00Kg

POLY-235 - SCHOTT Poly 235W			Type: Polycrystalline	
Rated	Power:	235W	Efficiency:	14.7%
Dimensions	Width:	993mm	Height:	1685mm
Voltage	VMPP:	30.20V	Voc:	37.10V
Current	IMPP:	7.78A		
Fixings	Connector:	TYCO	Clips:	Type 12
Module	Frame:	Silver	Weight:	23.00Kg



Founded in 1951 in Bielefeld, Germany, Schüco today operates with 5,000 employees and 12,000 partner companies in over 75 countries and is a world leader in aluminium building products including photovoltaic mounting systems.

SCH-259647 - Schuco MPE 210 PS poly		Type: Polycrystalline	
Rated	Power:	210W	Efficiency: 15.0%
Dimensions	Width:	1001mm	Height: 1495mm
Voltage	VMPP:	27.10V	Voc: 35.00V
Current	IMPP:	7.75A	
Fixings	Connector:	MC4	Clips: Type 43
Module	Frame:	Silver	Weight: 18.00Kg



Sharp is one of the world's largest module manufacturers with 50 years of experience in photovoltaics and has its main European factory in Wrexham, North Wales. The Sharp series of photovoltaic modules are designed for applications with a high power requirement. These monocrystalline and polycrystalline quality modules produce a sustained, reliable yield even under demanding deployment conditions. All Sharp NU series modules offer optimal system integration – both technically and economically – and are suitable for installation in grid-coupled systems.

NU-180E1 - Sharp Mono 180W		Type: Monocrystalline		
Rated	Power:	180W	Efficiency:	13.8%
Dimensions	Width:	994mm	Height:	1318mm
Voltage	VMPP:	23.70V	Voc:	30.00V
Current	IMPP:	7.60A		
Fixings	Connector:	MC3	Clips:	Type 6
Module	Frame:	Silver	Weight:	16.00Kg

NU-185E1 - Sharp Mono 185W		Type: Monocrystalline		
Rated	Power:	185W	Efficiency:	14.2%
Dimensions	Width:	994mm	Height:	1318mm
Voltage	VMPP:	24.00V	Voc:	30.20V
Current	IMPP:	7.71A		
Fixings	Connector:	MC3	Clips:	Type 6
Module	Frame:	Silver	Weight:	16.00Kg

ND220E1F - Sharp Poly 220W		Type: Polycrystalline		
Rated	Power:	220W	Efficiency:	13.8%
Dimensions	Width:	994mm	Height:	1652mm
Voltage	VMPP:	29.20V	Voc:	36.50V
Current	IMPP:	7.54A		
Fixings	Connector:	MC3	Clips:	Type 6
Module	Frame:	Silver	Weight:	21.00Kg

ND-E230A2 - Sharp (New) Poly 230W		Type: Polycrystalline		
Rated	Power:	230W	Efficiency:	14.4%
Dimensions	Width:	994mm	Height:	1652mm
Voltage	VMPP:	30.30V	Voc:	37.00V
Current	IMPP:	7.60A		
Fixings	Connector:	MC3	Clips:	Type 6
Module	Frame:	Silver	Weight:	20.00Kg

NU-E245J5 - Sharp (New) Mono 245W		Type: Monocrystalline		
Rated	Power:	245W	Efficiency:	15.3%
Dimensions	Width:	994mm	Height:	1652mm
Voltage	VMPP:	30.50V	Voc:	37.50V
Current	IMPP:	8.04A		
Fixings	Connector:	MC3	Clips:	Type 6
Module	Frame:	Silver	Weight:	19.00Kg



Based in Shanghai, China, Upsolar is a leading international developer and producer of high quality solar photovoltaic (PV) modules at competitive prices with a warranty backed by international insurance companies

UP-M190M - Upsolar Mono 190W			Type: Monocrystalline	
Rated	Power:	190W	Efficiency:	15.8%
Dimensions	Width:	808mm	Height:	1580mm
Voltage	VMPP:	36.30V	Voc:	45.10V
Current	IMPP:	5.23A		
Fixings	Connector:	MC4	Clips:	Type 44
Module	Frame:	Silver	Weight:	15.40Kg

UP-M230P - Upsolar Poly 230W			Type: Polycrystalline	
Rated	Power:	230W	Efficiency:	14.4%
Dimensions	Width:	992mm	Height:	1640mm
Voltage	VMPP:	29.70V	Voc:	37.20V
Current	IMPP:	7.75A		
Fixings	Connector:	MC4	Clips:	Type 44
Module	Frame:	Silver	Weight:	15.40Kg

Further Information

On each of the manufacturer's own web sites you will find a wealth of further marketing materials all explaining why their modules are better than anyone else's.

Web Sites

Day4	http://www.day4energy.com/EN/index.htm
Mitsubishi	http://pv.mitsubishielectric.co.uk/
Romag	http://www.romag.co.uk
Sanyo	http://www.sanyo-solar.eu/en/
SCHOTT Solar	http://www.schottsolar.com/
Schuco	http://www.schueco.com/web/uk
Sharp	http://www.sharp.co.uk/cps/rde/xchg/gb/hs.xsl/-/html/solar.htm
Upsolar	http://www.upsolar.com/

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