Segen

Simple and Reliable Solar Power Generation

Buying a Commercial PV System from Segen

This guide will help you understand the various aspects of commercial-scale solar PV, making it easier to design, specify and purchase a system from Segen's extensive range of products.

String Layout & Grid Connection

Before deciding on which modules or inverters to use it is important to understand the basic design rules of designing a larger system. The electrical principles of any PV system from a single string of a small number of modules up to a multi-megawatt industrial scale PV plant are similar, it's just the quantities and types of the components that vary.

Strings of Modules
One or more strings of one or more modules wired in series. Typically for string or central inverter systems a string would consist of between 10 and 20 modules wired in series.
For a micro-inverter system the string size would typically be 1 or 2 modules.

*** DC Junction Box/String Monitor**
One or more strings are connected in parallel using a DC junction or string control box. A DC junction box has no intelligent function whereas a string control box monitors each individual string or a group of strings and enables errors to be reported to minimise system downtime.
* Often built-in to the inverter.

Inverters
One or more inverters are used each of which has one or more independent maximum power point (MPP) trackers to support different sizes and/or shading of module strings.

Typically an inverter will have one or two independent MPP trackers and a built-in DC junction box and DC isolator.

Where 4 or more strings are wired in parallel, either in a DC junction box or internal to the inverter it is essential that each string has its own string fuses, on both polarities, to avoid reverse currents destroying modules in the event of a short circuit. These would typically be inside the inverter or in the DC junction box depending on the manufacturer and inverter model chosen.

With any commercial system serious consideration should be given to remote monitoring to report issues with performance and any system being funded by a third-party will almost certainly need a 10 year warranty on the inverters.

Engineering Recommendation G59/2

For anything over 16A per phase, the client or installer has to apply to the local DNO under the G59/2 engineering recommendation, asking permission to connect prior to installation. Once this has been granted the project can proceed. G59/2 covers both single and three-phase installations. For smaller commercial projects, G59/2 applications can be turned around in under 2 - 6 weeks. The utility company may allow up to 20 - 25kW to be connected to a strong single phase only grid connection, depending on the state and impact it has on the local transformer, otherwise they'll ask for it to be balanced across a 3 phase connection.

At present, for anything over a 50kW installation the utility companies can also demand an external G59 relay to be fitted for additional protection. This adds cost to the installation as the G59 relay is between £1,500 and £2,000. However with the new revised G59/2-2, due out in December 2012, an additional test will be required by all inverter manufacturers. This test involves measuring the G59 relay within the inverter to a higher standard. Once passed it may allow any certified inverter to be used by installers for larger projects without having to fit this expensive G59 relay and pay for DNO tests, thus lowering systems costs, but implementation of this may vary by DNO so needs to be checked with them when planning an installation.

Full details of the G59/2 application process can be found on the Energy Networks Association website: http://www.energynetworks.org/electricity/engineering/distributed-generation.html.

Surge Protection

If surge protection from a lightning strike is required then this could be built into the inverter, the DC junction box/string control or a separate device. Surge protection is normally required on commercial systems which are mounted onto a building with high occupancy, e.g. a hospital or school, with a fire risk, e.g. an industrial facility or in an exposed location at high risk of lightning strikes.

A very informative guide to surge protection has been published by SMA and is available from the SMA website: http://files.sma.de/dl/7418/U_Schutz-UEN101610.pdf.

Wind Loading & Roof Strength

A commercial PV system clearly has a significant weight and therefore you need to ensure the roof is strong enough. Flat roof mountings in particular require very careful attention to be paid to wind loading issues when designing the mounting system.

Both roof strength and wind loading calculations are specialist topics that need to be undertaken by an expert. Typically the mounting kit manufacturer will provide assistance with the wind loading issues based on drawings you provide and a fully qualified structural engineer needs to be consulted to check that the strength of the roof is sufficient for the proposed PV array.

Modules

Segen supplies a number of modules suitable for commercial systems, with the best value typically being polycrystalline modules. The choice of brand depends on your client's requirements ranging from the lowest cost module available, through major brand but cost effective Far East Manufacturers up to a European brand.

Segen currently stocks 240W and 250W poly modules from a range of manufacturers to meet these requirements. The 240W modules tend to be the lowest cost per Wp but we also supply 250W modules that are more efficient and allow a higher kW per m2 to be installed with some saving in mounting system and installation costs.

The main criteria for the selection of the manufacturer and model typically are;

- Bankability – If the system is being funded by a third-party then it will be important that the manufacturer meets the funder's requirements which will typically be a "tier one" manufacturer and possibly independent insurance backed warranty.
- Efficiency – If the space to install the system is limited then a more efficient module will allow a larger capacity system to be installed.
- Price – This should never be just compared simply on the basis of £/Wp of the module but on the basis of £/kWh/annum, including the cost of the mounting system and installation, both of which increase slightly with decreasing module efficiency.
- Warranties – Different manufacturers offer different lengths and strengths of warranties.

Typically the preferred choice on cost grounds will be a Far East 240W polycrystalline module, but if space is at a premium then a 250W polycrystalline may be the best choice.

The **Segen Module Guide** provides further details on the selection of an appropriate module and details of the ranges that Segen sells.

Inverters

There are four different categories of inverters suitable for commercial scale systems.

- Central Inverters – These are typically 50kW or larger and enable a system to be designed with a small number of inverters to minimise installation costs and are located centrally with longer runs of DC cables.
- String Inverters – These are typically three phase inverters ranging from 10kW – 30kW supporting a small number of strings per inverter with the inverters placed near the modules with longer runs of AC cabling.
- Micro-inverters – In these designs there are one or two modules per inverter, wired into an AC distribution system.
- Power Optimisers – In these designs each module has an individual power optimiser a number of which are linked into one or more three phase central units, each in turn wired together on the AC side.

For many sizes of system, one or more central inverters is likely to provide very good annual yields and system uptime assurance but can be limited in their flexibility of string design and siting.

String inverter systems are normally easier to design and install, but have many more components and therefore installation cost can be higher and careful consideration needs to be given to linking the inverters to allow effective fault reporting.

A micro-inverter or power optimiser system will have a much higher initial cost but if the requirement is to maximise the yield and minimise the total cost of ownership over a 20 year period then both deserve serious consideration, especially if there are any issues with shading or different array sizes.

Inverter Warranties

One key aspect of the total cost of a system is the cost of any extended warranty to provide 10, 15 or 20 years warranty on the inverter and many commercial funded systems will require at least a 10 year total warranty. The table below details the standard warranty provided by each Segen supplied three-phase manufacturer and an estimated cost per W of extending the warranty up to the period shown.

	Standard	**Up to 10**	**Up to 15**	**Up to 20**
Enecsys	20 years	£0	£0	£0
Solaredge				
• Optimiser	25 years	£0	£0	£0
• Inverter	12 years	£0	N/A	£31/kW
Power One	10 years	£0	£16/kW	£24/kW
Samil 10kW – 12kW	10 years	£0	£46/KW	£71/kW
Samil 15kW – 17kW	5 years	£22/kW	£43/kW	£79/kW
SMA	5 years	£20/kW	£45/kW	£65/kW
Fronius < 15kW	5 years	£41/kW	£81/kW	*£52/kW
Fronius CL	5 years	£63/kW	N/A	*£88/kW
Steca	5 years	£25/kW	N/A	£135/kW

* Special offer until Dec 31st 2012.

As can be seen, if a long term extended warranty is required then the cost can be very substantial and in many cases buying an inverter with a longer “out of the box” warranty can be substantially cheaper.

Central Inverters

For medium scale commercial systems which Segen typically supplies, 40kW – 250kW, Segen offers two ranges of central inverters from Fronius.

- **CL** – 36kW, 48kW and 60kW size options utilising 9, 12 or 15 individual “power stacks” providing a high degree of fault tolerance and ease of on-site maintenance.

- **Agilo** – 75kW and 100kW size options in a single easily installable package with high availability and simple installation.

The choice of range and model is largely determined by the size of the system with the largest inverters typically being the most cost effective with the lowest installation and other component costs.

A system can be designed with any number of different sizes of these inverters combined with either DC junction boxes or string control units to combine individual module strings into 1 or 2 large DC cables into the inverters.

The best solution is to use a string control box which provides both string fuses and individual string monitoring so that individual module or string failures can be rapidly detected and reported on to ensure that failures do not go unnoticed for long.

All currently available Fronius central inverters are indoor models and so need a relatively clean and dry environment but from early 2013 Fronius will be supplying outdoor versions of the 75kW and 100kW Agilo range.

All the Fronius CL and Agilo inverters can be wired with 2 large DC cables but are single MPPT devices so all strings must contain the same number of the same type of module.

Segen recommends the use of string control units with the Fronius CL and Agilo central inverters along with a web-based monitoring system to ensure that faults in strings are detected and reported immediately. Fronius offer a range of string control units to support various sizes of system and a number of system monitoring and reporting products to enable any faults to be reported.

Two different models of string control are recommended as detailed below for the two ranges of Fronius inverters

	CL 36, 48 and 60	**Agilo 75 and 100**
String control model	250/25	250/30
Number of strings	25	30
Max DC voltage	600V	1000V
Max current per string	20A	20A
Max input cable	10mm2	25mm2
Max output cable	120mm2	240mm2

Both models of string control contain fuse holders for the specified number of string fuses and a Type I or Type II over voltage protection device can be mounted inside the box.

For a Fronius central inverter configuration therefore the normal recommended solution is one or more central inverters, one of the appropriate type of string control per inverter and a Datalogger Webbox to enable efficient reporting of errors.

String Inverters

A commercial scale system designed using string inverters will typically consist of one or more three phase inverters between 8kW and 30kW with two or more strings into each and maybe of different sizes from the same manufacturer linked together on the AC side.

Segen offers three phase string inverters from five different manufacturers each offering a variety of rating, MPP trackers, monitoring, protection, warranty and performance options.

- Power One – A range from 10kW to 27.6kW with built-in string monitoring, DC isolators, over voltage protection and connectors offer a very cost effective option with high yielding performance, excellent monitoring and minimal installation cost.

- SMA – The Tripower range from 8kW – 20kW is the market leading brand in the UK with a long history of reliable operation.
- Fronius – A range of single tracker 7kW – 12kW options for smaller commercial systems.
- Steca – A great value offering of 8kW and 10kW single tracker inverters providing the lowest cost for a quality European brand.
- Samil Power – A well-established Far East brand offering the lowest cost per watt dual tracker solution in the Segen range. This inverter has one of the largest market shares in sales volume in the Australian market and has opened its office in the UK early 2012.

Each string inverter operates independent of the others controlling between two and ten strings of modules and exporting power into the AC grid.

Whilst it is possible to design a large system with numerous smaller single phase inverters this is unlikely to be a cost effective solution and therefore not generally recommended by Segen.

SMA

The SMA Tripower range from 8kW to 17kW are all dual tracker devices and the 20kW is a cost optimised single tracker. All have sufficient DC inputs for most designs with no need for an external DC junction box and all models can be fitted with an optional Type II surge protector on one or both of the MPPT inputs. All SMA Tripowers have electronic string protection, which offers reliable elimination of module reverse currents. All models are fully IP65 compliant and therefore can be mounted outdoors if required.

The SMA Tripower has an optional software enabled feature called 'OptiTrac Global Peak' which provides an alternative power tracking algorithm optimised for partially shaded arrays.

The SMA Webbox Bluetooth collects performance data wirelessly from the SMA inverters, stores it and transmits it via the Ethernet interface to the on-line website Sunny Portal.

This allows all required performance data from the system to be recorded and viewed from a web browser anywhere in the world.

Power One

All the three-phase Power One inverters supplied by Segen have built-in DC connectors, DC isolators and string fuses with the 20kW and 27.6kW also having built-in string monitoring, AC isolator and surge protection and therefore no separate string monitoring, surge protectors or DC junction box are required. The table below details the number of connections each of the inverters allows.

	10kW	12.5kW	20kW	27.6kW
Num MPPT	2	2	2	2
Strings per MPPT	3	3	4	5
DC Isolator	Yes	Yes	Yes	Yes
AC Isolator	No	No	Yes	Yes
String Fuses	Yes	Yes	Yes	Yes
String Monitoring	No	No	Yes	Yes
Surge Arrestor	No	No	Yes	Yes

All Power One three phase inverters have an optimised power point tracking function to ensure maximum yield from partially shaded arrays.

Power One has had a long standing UK presence for over 17 years and operates a national support organisation to ensure the best possible response to post installation technical issues.

A typical recommended Power One system therefore requires no additional components, the module strings are wired directly into the inverter and on the AC side the inverter is wired directly into the grid connection, with only the 10kW and 12.5kW models requiring an external AC isolator.

Power One also provide a data logger that records performance information such as energy harvesting, power, voltage and current data is available in real-time. You can link up to 128 inverters with the Aurora Easy Control EVO system using RS485 serial communications. An optional GPRS module allows reporting via mobile phone network.

Fronius

All the three phase Fronius <= 12kW inverters that Segen supply have a single MPPT with ample DC input connections for the majority of system designs. There is generally therefore no need for an external DC junction box with string fuses, but one may be used if required. All require an external AC isolator and must be mounted under cover.

Typically a commercial Fronius system will be configured with a Datalogger Web, which can be easily integrated into an existing Ethernet network. Several users can access important system information simultaneously via a separate website. Also Includes a USB port to use the additional WLAN USB Interface to wirelessly communicate with the router.

Steca

Both the three phase Steca string inverters that Segen supply have a single MPPT without built-in string holders but with ample DC input connections for the majority of system designs and a built-in DC Isolator. There is generally therefore no need for an external DC junction box with string fuses, but one may be used if required. All require an external AC isolator and can be mounted indoors or outdoors.

They have high voltage ranges and therefore typically are designed with small numbers of long strings that can help to minimise voltage drop in the DC cables.

Samil Power

All four of the three phase Samil Power string inverters that Segen supply have dual MPPT and facility for connecting two module strings per MPPT, which is adequate for the majority of system designs. These inverters have a built-in DC Isolator, hence generally there is no need for an external DC junction box, but either may be used if required. All the models require an external AC isolator. These inverters are IP65 rated making them suitable for indoor or outdoor mounting.

Samil Solar Lake inverters come with RS485, RS232 and Ethernet communication facilities as standard. Ethernet connection can be used to connect Solar Lake inverters to a local PC or to the internet through a Router. If connected to the internet, the system performance can be monitored using Samil Power's own 'V-IPlant' facility from any location with internet access.

Installers can also use **Wattson Professional** which allows one to see an overview of the performance of all their systems on a colour-coded map and can set alerts (SMS or email) for a variety of conditions & parameters. End-Users can see their Generation & Usage on any Internet enabled device. The system is quick and easy to install and works with any inverter.

Micro-inverters

Segen offer the Enecsys micro-inverters, which are supplied as standard with a 20 year warranty and therefore attractive in for projects requiring a long service life with maximum yield over the life of the project.
A typical commercial system would use the DUOs, due to lower price/Wp, better performance and the need for less cable and monitoring gateways.

The micro-inverter is a single phase device so typically three separate groups of modules would be designed with an even split of micro-inverters linked to each phase.

Power Optimisers

Segen offers the SolarEdge power optimisers, which are installed one per module linked into one or more inverter units. This provides a high availability solution with module level power optimisation and monitoring to maximise the long term yield with minimum cost of ownership.

There is no limit to the number or mixture of optimiser and inverter components that can be used in a SolarEdge system and the architecture provides a lot of freedom as to

the number of modules in each string and linked into each inverter, so multiple different sizes of arrays and shading environments can easily supported.

The Solaredge has Internet based monitoring built-in so there are no additional items needed for that to be provided.

Mounting System

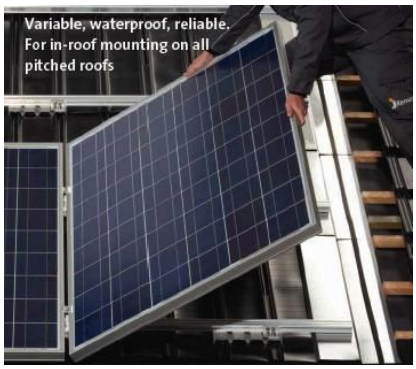
There are many different types of roof and surface on which a commercial scale Solar PV system could be installed. These include tiled, metal, concrete, flat and ground mounted. There is no one solution to all these options, so Segen offers nine different systems from several manufacturers to ensure you always have the best options available to you.

Tiled or Slate On-Roof

This is the most common type of roof for domestic installations but less so for commercial systems as in the UK there are very few large tiled or slate roofs. Segen offers a full range of on-roof systems for tiled or slate pitched roofs from Schletter, Schuco and Renusol with a number of options of roof anchors and rails to suit every requirement.

Tiled In-Roof

For optimum visual appearance of the modules, some tiles or slates can be removed (or not installed in the first place) and in-roof mounting system can be supplied.



Segen offer a fully waterproof in-roof mounting system from Renusol, which provides considerable flexibility in mounting options for all the modules which Segen supplies.

The system works with roof pitches from 15 to 60 degrees.

Flat Roof

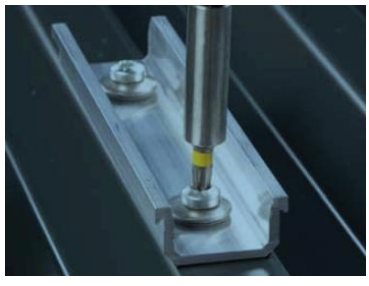
On suitable flat roofs, solar PV panels can be mounted on metal racking systems which are angled at between 15 and 30 degrees to improve the energy capture.

These systems are quick and simple to install and following a detailed site survey a suitable system can be selected depending on the type and strength of the roof. Segen can also supply non-intrusive trays that are ballasted with concrete slabs or gravel, or an interlocking system suitable for lighter weight roof structures.

Metal Roof

The Renusol “MetaSol” mounting system provides the most cost effective method of mounting solar modules onto a suitable metal trapezoidal metal roof.

The system does not need mounting rails which are traditionally the most expensive part of a mounting system, just fixing screwed directly into the roof and standard module clips to match your chosen module.



Ground Mount

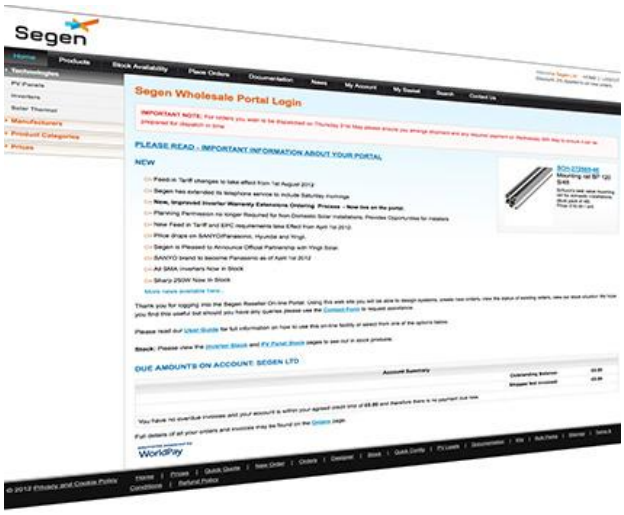
Solar panels can be installed on one of two different ground-mounted systems from Schuco that can easily be orientated to maximise energy capture.

These systems require minimal foundations to be prepared and the systems can be rapidly installed at a height above the ground to suit the requirements of the location. These systems can withstand wind speeds up to 120mph.

Using Segen's Portal

Segen's on-line portal provides a number of facilities to help you design and purchase a commercial scale Solar PV system.

Products



All of Segen's products are listed on the **Stock Availability** page displaying the net price you would pay for the product and how much is in stock today. Selecting a part number will display the full product details including detailed specifications and documentation.

A dedicated **Commercial Products** page highlights products which are specifically applicable to commercial products, e.g. polycrystalline modules, three phase inverters, high rated switches and cables etc.

Many of Segen's products are 2% - 5% cheaper when purchased in larger quantities which are often applicable to commercial scale systems full details of which are shown on the **Bulk Pack Pricing** page.

- Most modules are sold in pallet quantities (typically 32 modules) at a 2% discount and 50kW bulk packs at 3% discount (typically 200 – 208 modules).
- Most three phase inverters are sold in 50kW packs which are typically 2% cheaper than in individual quantities.
- Many other items like cables, switches and mounting kit are supplied in various pack size which can be 2% - 5% cheaper depending on the product and quantity purchased in the pack.

Quotations

Segen has implemented a comprehensive quotation facility that allows you to very quickly produce a quotation for a commercial scale solar PV system from 10kW up to 250kW.

The **PV Quick Quote** page allows you to specify the size of the required system in kWp, the range of module and inverter manufacturers you wish to consider and your chosen mounting kit range. You can optionally select that you only want three-phase inverters to be selected.

Selecting **PDF** against a module and inverter combination will generate an instant quotation for the selected system including all the required components. The discount on the system is automatically set to the higher of your current volume discount or a discount applicable to a single system order of the size specified. All products which can be purchased in bulk packs will have their prices set to the appropriate bulk pack price.

Selecting **Design** will enter the Segen designer tool with the default values set up appropriately for the selected system type and size, but enables you to customise the options including the details of the mounting kit, cables, switches and system monitoring and other accessories.

Orders and Deliveries

In order to achieve the best possible discount an order for a commercial system should be placed on a single order but we appreciate that it is not always practical to take delivery of a large quantity of product all at the same time.

Segen will allow you to have stock allocated to an order for a reasonable period of time providing the expected schedule has been discussed and agreed with your account manager. Phased deliveries should be planned as far in advance as possible and individual shipments scheduled as required by the installation project requirements.

Segen's account managers and technical support staff are available to assist you with this process and guide you through the process of quoting, designing and purchasing commercial scale systems.

Appendix A – Segen Inverter Specifications

Manufacturer	Description	Rating	Phases	Trans.	IP	PPT	Eff.
Fronius	IG Plus 70 6.5kW	6500	2	HF	IP44	1	95.4
Fronius	IG Plus 80V-3 7kW	7000	3	HF	IP54	1	95.1
Solaredge	7000W	7000	3	None	IP65	0	97.7
Fronius	IG Plus 100 8kW	8000	2	HF	IP44	1	95.5
Fronius	IG Plus 100 8kW	8000	3	HF	IP54	1	95.3
SMA	Sunny Tripower 8000TL	8000	3	None	IP65	2	97.5
Solaredge	8000W	8000	3	None	IP65	0	97.6
Steca	StecaGrid 8000W	8000	3	None	IP54	1	95.2
Solaredge	9000W	9000	3	None	IP65	0	97.6
Steca	StecaGrid 10,000W	9500	3	None	IP54	1	95.4
Fronius	IG Plus 120 10kW	10000	3	HF	IP44	1	95.5
Power One	Power-One PVI-10.0	10000	3	None	IP65	2	97.1
Samil Power	Solar Lake 10,000TL - 10kW	10000	3	None	IP65	2	97.4
SMA	Sunny Tripower 10000TL	10000	3	None	IP65	2	97.7
Solaredge	10,000W	10000	3	None	IP65	0	97.5
Fronius	IG Plus 150 12kW	12000	3	HF	IP44	1	95.5
Samil Power	Solar Lake 12,000TL - 12kW	12000	3	None	IP65	2	97.4
SMA	Sunny Tripower 12000TL	12000	3	None	IP65	2	97.7
Power One	Power-One PVI-12.5	12500	3	None	IP65	2	97.2
Solaredge	12,500W	12500	3	None	IP65	0	97.4
Samil Power	Solar Lake 15,000TL - 15kW	15000	3	None	IP65	2	97.6
SMA	Sunny Tripower 15000TL	15000	3	None	IP65	2	97.8
Solaredge	15,000W	15000	3	None	IP65	0	97.4
Samil Power	Solar Lake 17,000TL - 17kW	17000	3	None	IP65	2	97.6
SMA	Sunny Tripower 17000TL	17000	3	None	IP65	2	97.8
Power One	Power-One TRIO-20.0-TL	20000	3	None	IP65	2	98.0
SMA	Sunny Tripower 20,000TLEE-10	20000	3	None	IP65	1	98.2
Power One	Power-One TRIO-27.6-TL	27600	3	None	IP65	2	98.0
Fronius	CL 36kW	36000	3	HF	IP20	1	95.3
Fronius	CL 48kW	48000	3	HF	IP20	1	95.4
Fronius	CL 60kW	60000	3	HF	IP20	1	95.5
Fronius	Agilo 75kW Indoors	75000	3	HF	IP30	2	96.4
Fronius	Agilo 75kW Outdoors	75000	3	HF	IP54	2	96.4
Fronius	Agilo 100kW Indoors	100000	3	HF	IP30	2	96.6
Fronius	Agilo 100kW Outdoors	100000	3	HF	IP54	2	96.6

Inverter Parameters

IP Ratings	
IP20	Strictly only indoors in clean and dry environment.
IP30	Strictly only indoors in clean and dry environment.
IP44	Splash resistant, so can be mounted under cover in clean area.
IP54	Dust and splash resistant, so can be mounted under well protected covering.
IP65	Full dust and rain proof, so can be mounted unprotected.