

# PC-based Control for the Field Installation of PV and CSP Systems

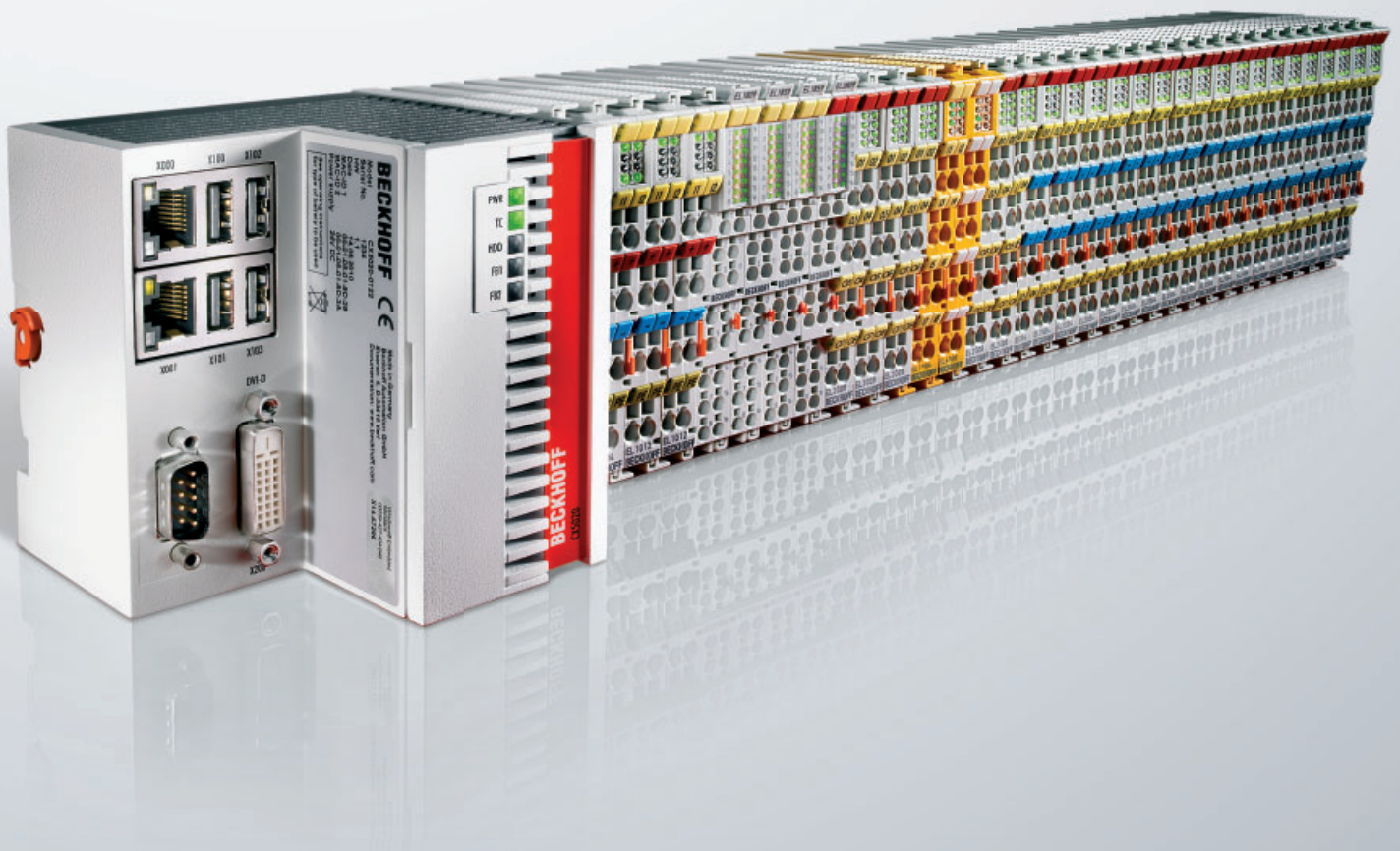


IPC

I/O

Motion

Automation



## PC-based Control from Beckhoff...

Beckhoff implements advanced automation systems on the basis of PC-based control technology, which are characterised by openness, flexibility, modularity and scalability. These systems have proven themselves worldwide in the most diverse industries. Industrial PCs, I/O components and drive technology represent a complete control solution for the field installation of photovoltaic and CSP (Concentrated Solar Power) systems using TwinCAT automation software and EtherCAT, the fast Ethernet fieldbus.



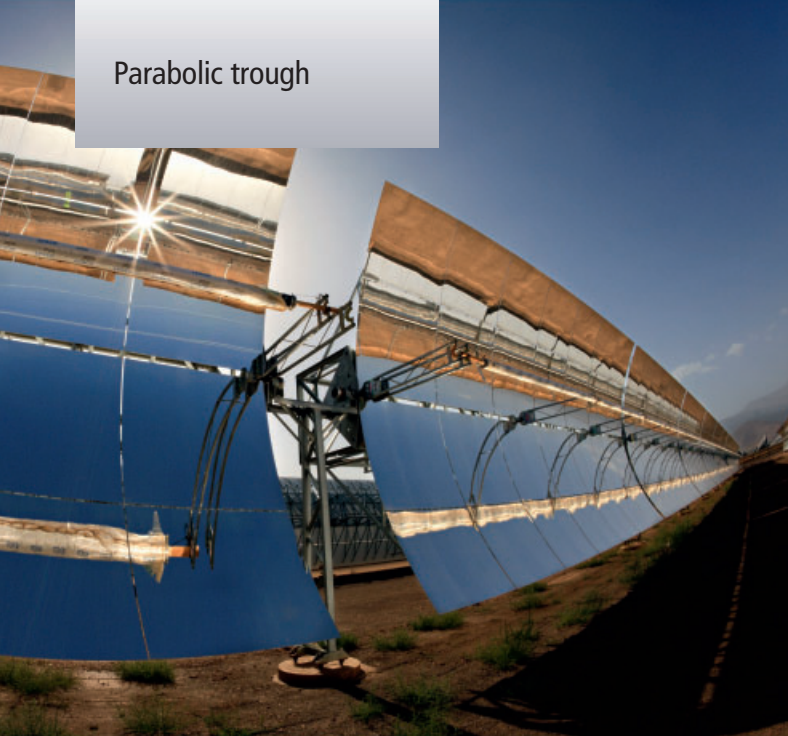
Parabolic power station



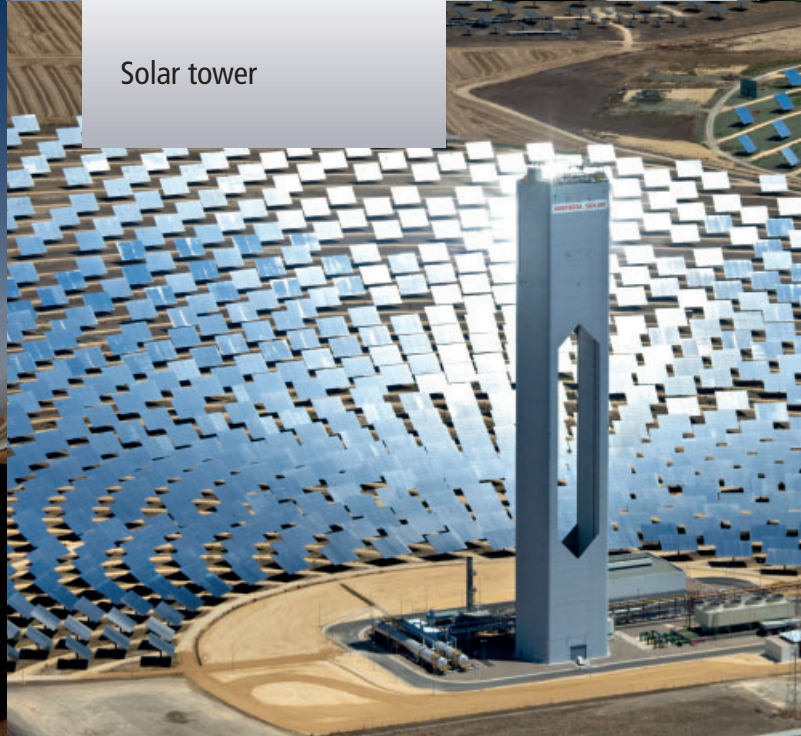
Fresnel



Parabolic trough

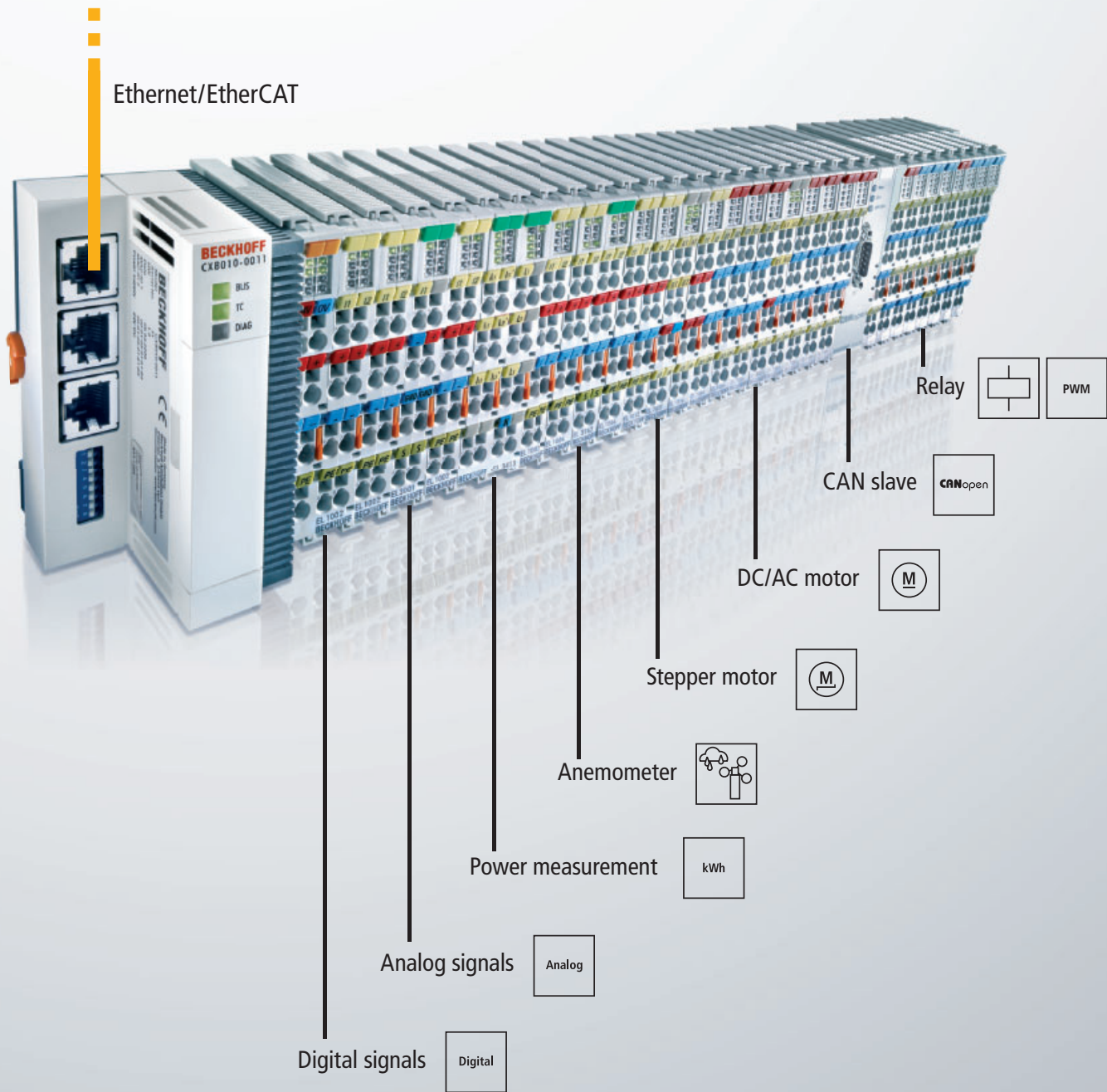


Solar tower



... helps redefine the future potential for solar power.

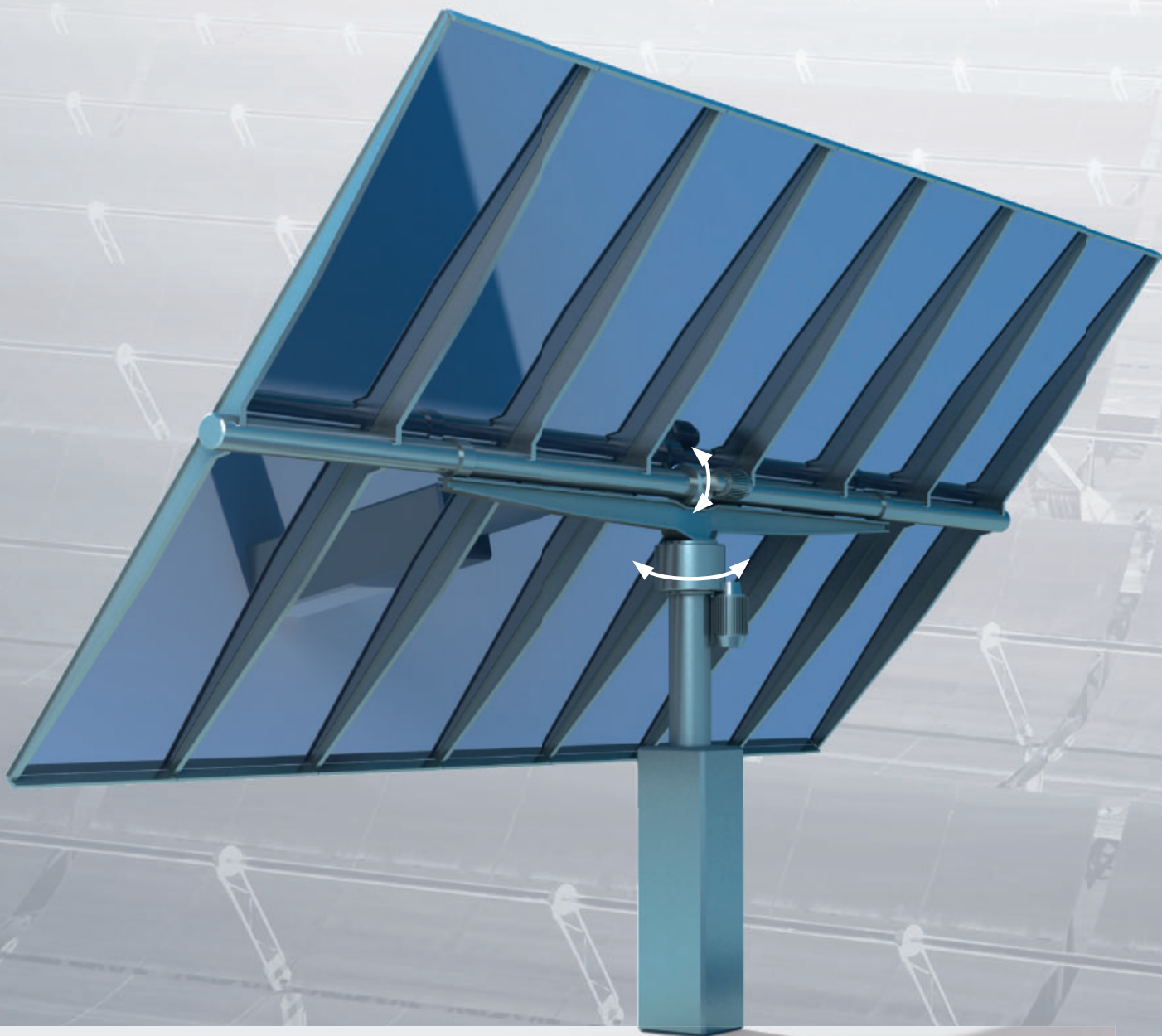
For both photovoltaic and CSP systems, an indispensable prerequisite for the maximum extraction of power from the sun is expert tracking of the sun's angles and precise alignment of the photovoltaic modules, Fresnel elements, parabolic troughs or mirrors. The efficiency of solar power plants can be increased from 30 to 40 % using advanced solar tracking. The solution must be as flexible as the fields of application are variable – from the movement of a single-axis to the synchronisation of hundreds or even thousands of mirrors in the case of a solar tower. PC-based control technology from Beckhoff, with hardware that is exceptionally scalable in terms of performance, from the Industrial PCs and fieldbus components to the drive technology and modular software, offers an effective and cost-efficient solution. The networking of both the individual trackers and the solar plants helps ensure a stable and efficient power supply.



## Scalable performance permits tailor-made solutions...

Beckhoff offers the complete control system, finely scaled in all performance classes: from the intelligent Bus Terminal Controllers and the compact Embedded PCs with integrated I/O interface to Industrial PCs with multi-core processors. This scalability extends to the motion system with servo and stepper motor drives in the compact format of a standard 12 mm Bus Terminal to the EtherCAT drive series for the medium and upper performance ranges, along with the associated motors. The Beckhoff I/O systems cover all fields of application, from the drive controller to measurement and safety technology. The system's scalable execution of 1 to 16 channels per terminal enables the control solution to be tailored precisely to the required number of inputs and outputs. The modular structure of the Bus Terminal solution permits flexible adaptation to each required task.





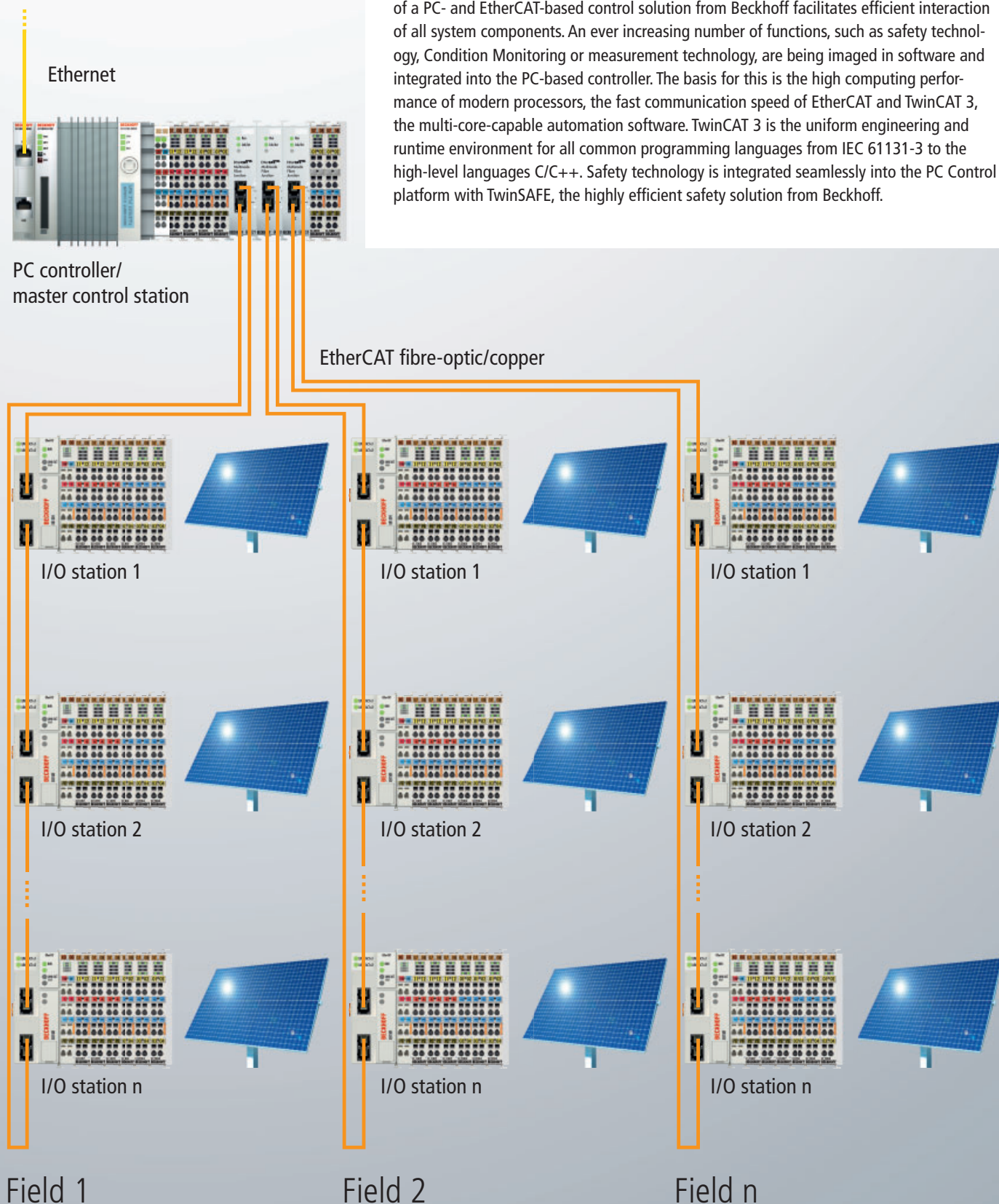
## ... and optimises your competitive advantage in the solar industry.

More than 400 different I/O terminals cover all signals required in the solar industry. From the measurement of millivolts to digital and analog inputs and outputs, from the direct driving of DC motors, stepper motors or drives with a CAN interface to energy measurement, all sensors and actuators can be directly connected.

The modular structure of the Beckhoff system offers extreme flexibility for the solar industry. Standard components can be easily "plugged together" to form customised, yet cost-effective solutions. Fast implementation of the plant controller (engineering) and simple maintenance are ensured with the TwinCAT software environment. Integrated solar tracking functionality can control the trackers independent of the main control station. Auto-referencing, driving to safe positions in the case of severe weather conditions and individual alignment according to cloud positions are just a few of the functions that can be executed both locally and centrally. The extended temperature range of the I/O terminals (-25...+60 °C) and approvals for use worldwide also guarantee safety in use.

## Universal system solution enables...

The data is managed by a PC controller, which is DIN rail mounted or with a compact cabinet-mount design, depending on the amount of data and field stations. The universality of a PC- and EtherCAT-based control solution from Beckhoff facilitates efficient interaction of all system components. An ever increasing number of functions, such as safety technology, Condition Monitoring or measurement technology, are being imaged in software and integrated into the PC-based controller. The basis for this is the high computing performance of modern processors, the fast communication speed of EtherCAT and TwinCAT 3, the multi-core-capable automation software. TwinCAT 3 is the uniform engineering and runtime environment for all common programming languages from IEC 61131-3 to the high-level languages C/C++. Safety technology is integrated seamlessly into the PC Control platform with TwinSAFE, the highly efficient safety solution from Beckhoff.





## ... process optimisation and cost reductions.

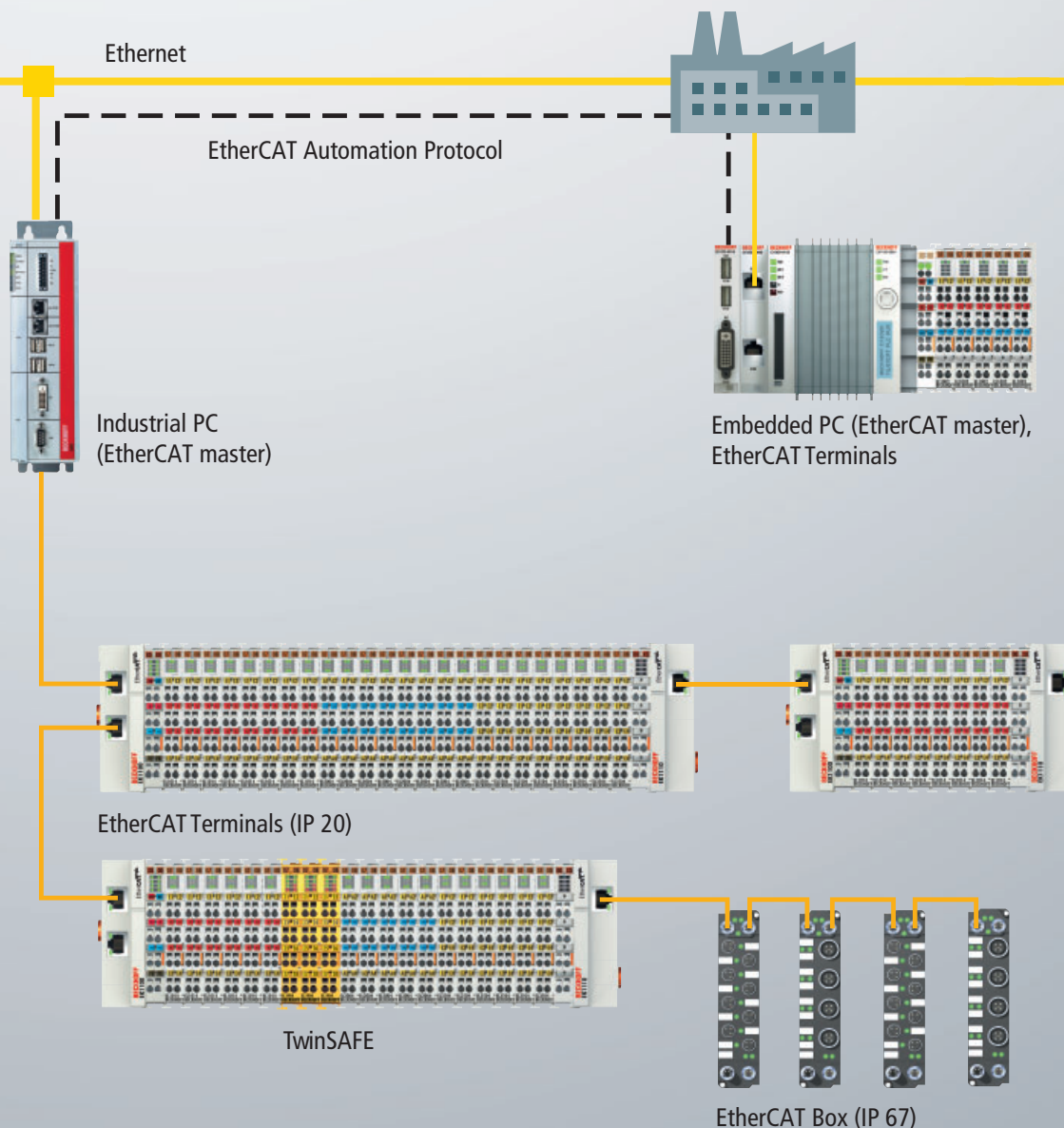
Regardless if the scale of an implementation is a stand-alone system with one axis, a 60-dish field or a 30,000-panel solar power plant, the Beckhoff I/O system offers universal and extremely fast networking thanks to Ethernet connectivity. CAT5 copper cables or optical fibre cables serve as the cost-effective transmission medium. The integration of CANopen, Modbus or PROFIBUS devices is possible via fieldbus gateway terminals.

Standardised components enable clear cost control. Apart from considerable savings, the use of established systems also brings with it technical features such as advanced diagnostic capabilities, redundant design of the network connections, remote access to each fieldbus station worldwide or global procurement of spare parts. The downtime of such systems is significantly reduced and the power generation is constant and optimised. Usable data from the systems is globally available and preventative maintenance cycles can be planned with minimal disruption.



## EtherCAT – Industrial Ethernet as a communication backbone...

EtherCAT, the real-time Ethernet system from Beckhoff, integrates the functional areas I/O, Motion and Safety and makes control and communication concepts possible that were previously unachievable. Traditional fieldbus and Industrial Ethernet systems such as Modbus, PROFIBUS or PROFINET and the corresponding peripherals are easy to integrate via gateways. EtherCAT is characterised by full Ethernet compatibility, maximum utilisation of the Ethernet bandwidth, outstanding real-time characteristics, flexible topology, almost unrestricted network expansion and openness, and simple handling. Up to 65,535 devices are possible on one EtherCAT network. Thanks to Ethernet and Internet technologies, EtherCAT also offers optimal vertical integration of controllers into the higher-level control system. The EtherCAT Terminal system with IP 20 protection is supplemented by decentralised I/Os: the EtherCAT Box modules with IP 67 protection can be mounted directly in the field.





# ... for the fastest controllers, based on standard components.

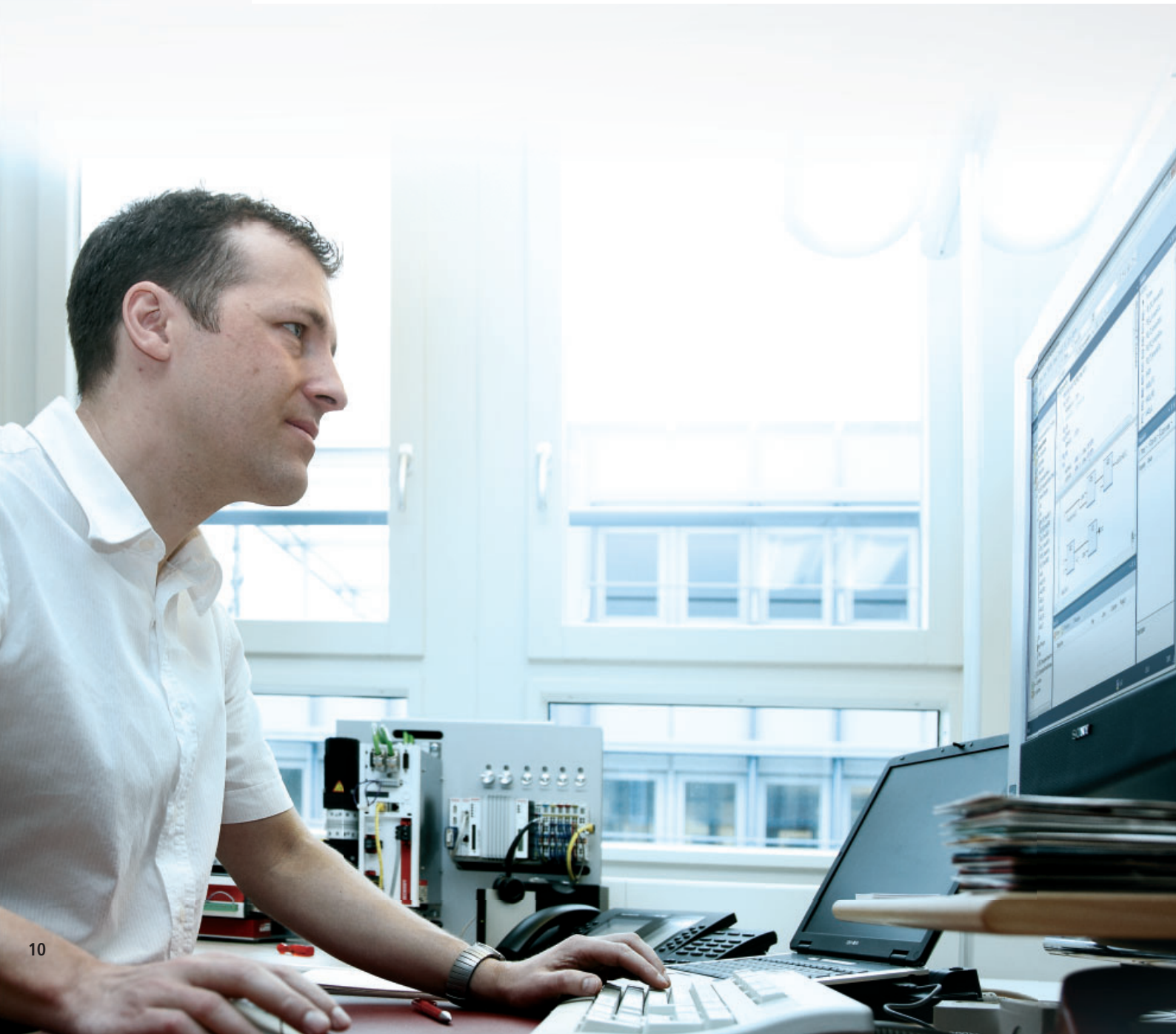
With XFC (eXtreme Fast Control) technology, Beckhoff offers a new, exceptionally fast control solution. Its optimised control and communication architecture is based on a modern Industrial PC, ultra-fast I/O terminals with extended real-time characteristics, the EtherCAT high-speed Ethernet system and TwinCAT automation software. With XFC it is possible to achieve I/O response times of  $< 100 \mu\text{s}$  and to considerably increase the performance of plants and systems as a result. XFC increases the process and energy efficiency of all components that it controls. Project engineering costs are lowered and thanks to the modular hardware and software architecture, the system can be extended almost endlessly.



## TwinCAT, the universal platform...

TwinCAT from Beckhoff is open and scalable automation software designed on the basis of Windows operating systems, forming the heart of the PC-based controller. It replaces conventional PLCs and motion controllers and transforms almost any compatible PC into a real-time controller with multi-PLC system, NC axis control, programming environment and control station. Connectivity to all popular fieldbuses and PC interfaces is supported. Various software function blocks and libraries facilitate simplified engineering efforts. TwinCAT offers optimum integration options for the linking of the control systems via open standards such as OPC, OCX and DLL.

With the integration into Microsoft Visual Studio®, TwinCAT 3 offers a greater degree of freedom in programming: in addition to the object-oriented extensions of IEC 61131-3, C and C++ are now also available as programming languages for real-time applications. Thanks to the multi-core capability of TwinCAT 3, there are virtually no limits to the further extension of automation functions using PC Control.

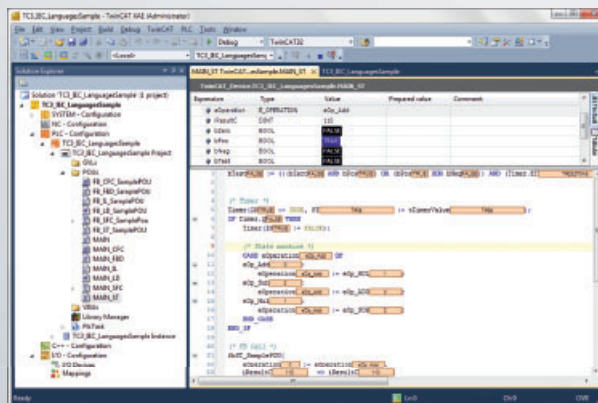




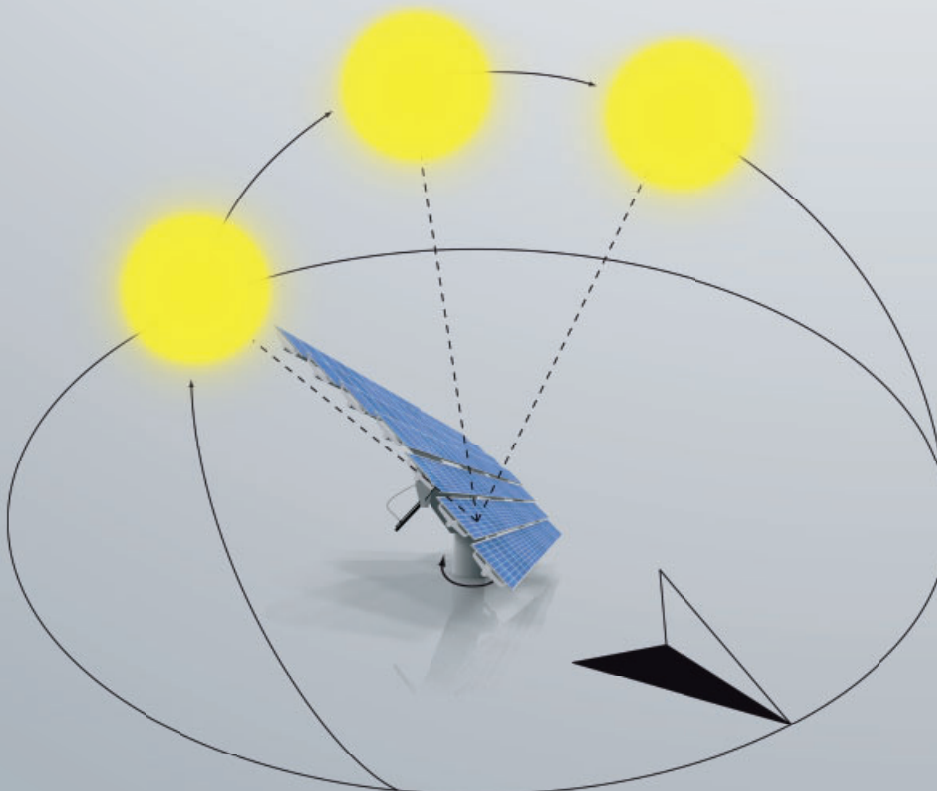
... for world-class automation in the solar industry.

TwinCAT offers a universal development environment based on programming standards with which all control challenges can be solved. Extensive TwinCAT libraries simplify programming and integrate special functions. Communication between different systems is simplified with the libraries for IEC 61850 and IEC 61400-25.

The TwinCAT Solar Position Algorithm software library enables high-precision determination of current sun angles and the times for sunrise, solar noon and sunset. The sun angle is calculated using the TwinCAT library by specifying the date and time as well as the exact geographical longitude and latitude of the location. Depending on the required precision, the algorithm can take into account additional parameters such as the time zone, the height above mean sea level, the slope of the ground or the orientation of the object, the air temperature and pressure, which influence atmospheric refraction. The calculation has a maximum inaccuracy of  $\pm 0.001^\circ$ . Position can be centrally determined, depending on the expansion of a field, or individually calculated for each solar tracker.



FB_SPA	
- stTime	fZenith
- fTimezone	fAzimuth
- fDelta_t	fAzimuth180
- fLongitude	fIncidence
- fLatitude	fSuntransit
- fElevation	fSunrise
- fPressure	fSunset
- fTemperature	bError
- fSlope	iErrorCode
- fAzimuth	
- fAzimuth180	
- fIncidence	
- fSuntransit	
- fSunrise	
- fSunset	
- bError	
- iErrorCode	
- eFunction	



## Headquarters

### Beckhoff Automation GmbH

Eiserstraße 5  
33415 Verl  
Germany  
Phone: +49 (0) 52 46/9 63 - 0  
info@beckhoff.com  
www.beckhoff.com

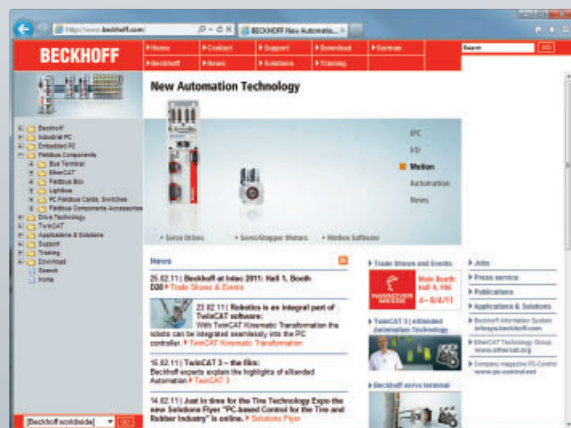
Picture credits:

Fotolia LLC  
Dietmar Gust  
Paul Langrock  
Shutterstock Images LLC

## Products online

At [www.beckhoff.com](http://www.beckhoff.com) you can get detailed information on the range of products from Beckhoff. Animations, videos and interactive online presentations supplement the large variety of information.

► [www.beckhoff.com](http://www.beckhoff.com)



## Print media online

The Beckhoff catalogs and flyers are available for download on the Internet. Printed copies are available on request. Please use our online order form to specify your requirements.

► [www.beckhoff.com/media](http://www.beckhoff.com/media)



Main catalog



News catalog



PC Control magazine

Beckhoff®, TwinCAT®, EtherCAT®, Safety over EtherCAT®, TwinSAFE® and XFC® are registered trademarks of and licensed by Beckhoff Automation GmbH. Other designations used in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owners.

© Beckhoff Automation GmbH 09/2011

The information provided in this brochure contains merely general descriptions or characteristics of performance which in case of actual application do not always apply as described or which may change as a result of further development of the products. An obligation to provide the respective characteristics shall only exist if expressly agreed in the terms of contract.