

electrical panel load calculation pdf

electrical panel load calculation pdf is a vital resource for electricians, engineers, and DIY enthusiasts aiming to design, upgrade, or troubleshoot electrical systems safely and efficiently. Accurate load calculations ensure that the electrical panel can handle the total electrical demand of a building or specific circuits without risk of overloads, overheating, or potential fire hazards. Having access to a comprehensive electrical panel load calculation PDF can streamline the planning process, help in compliance with electrical codes, and serve as a valuable reference for future modifications or inspections. Whether you're preparing for a new installation, upgrading an existing panel, or conducting a detailed assessment, understanding how to perform and interpret load calculations is essential for maintaining a safe and reliable electrical system.

Understanding Electrical Panel Load Calculations

Electrical panel load calculation involves determining the total electrical load that will be connected to a panel and ensuring that the panel's capacity is sufficient to handle this load. Proper calculations help prevent circuit overloads, voltage drops, and potential damage to appliances and wiring. They also ensure compliance with local electrical codes such as the National Electrical Code (NEC).

Why Are Load Calculations Important?

- Safety: Prevents overloads that can cause overheating and fires.
- Code Compliance: Meets legal requirements for electrical installations.
- Efficiency: Ensures optimal use of electrical panel capacity.
- Future Planning: Allows for expansion or upgrades without risking overloads.

Components of Electrical Load Calculation

To perform an accurate load calculation, several factors and components must be considered:

1. General Lighting and Receptacle Loads

This includes all lighting fixtures, outlets, and small appliances. Usually calculated based on the number and wattage of devices.

2. Specific Appliance Loads

Heavy-duty appliances such as HVAC systems, ranges, dryers, and water heaters require dedicated circuits with their specific load calculations.

3. Continuous vs. Non-Continuous Loads

- Continuous loads: Expected to run for 3 hours or more (e.g., space heaters, air conditioners).
- Non-continuous loads: Short-term or intermittent loads.

The calculation accounts for these differences, often applying a demand factor for continuous loads.

4. Demand Factors

Demand factors reduce the total calculated load based on typical usage patterns, preventing oversizing of panels.

Performing Electrical Panel Load Calculation: Step-by-Step

A systematic approach ensures accuracy and compliance. Here are the typical steps involved:

Step 1: Gather Data

- List all electrical devices, appliances, and fixtures.
- Note their wattage or amperage ratings.
- Determine the usage patterns and load types.

Step 2: Calculate Individual Loads

- For each appliance or fixture, compute the load:
- Wattage method: $\text{Wattage} = \text{Voltage} \times \text{Current (Amps)}$.
- Amperage method: Use rated current directly if available.

Step 3: Sum the Loads

- Add all individual loads to find the total connected load.
- Separate continuous and non-continuous loads.

Step 4: Apply Demand Factors

- Use NEC or local code tables to apply appropriate demand factors to reduce the total load, especially for residential and light commercial settings.

Step 5: Determine Panel Capacity Requirements

- Ensure the calculated load does not exceed the panel's rated capacity.
- Include a safety margin, typically 125% of the continuous load, as per NEC guidelines.

Using a PDF Guide for Load Calculation

A well-structured electrical panel load calculation PDF serves as a practical tool, offering standardized procedures, tables, and formulas. These PDFs often include:

- Step-by-step instructions for calculations.
- Sample worksheets to record data and results.
- Demand factor tables aligned with NEC and local codes.
- Checklists for safety and compliance.

Such PDFs are invaluable resources for both beginners and experienced professionals, ensuring that all relevant factors are considered.

Key Elements Typically Found in an Electrical Panel Load Calculation PDF

1. Introduction and Scope

Describes the purpose of the document and the types of systems covered.

2. Codes and Standards Referenced

Lists relevant standards such as the NEC, IEC, or local electrical codes.

3. Calculation Worksheets

Preformatted tables or forms to input data, perform calculations, and document assumptions.

4. Sample Calculations

Step-by-step examples illustrating typical scenarios, aiding understanding and application.

5. Demand Factor Tables

Standard tables providing demand factors based on load types and sizes.

6. Safety and Compliance Notes

Guidelines on safety measures, load balancing, and code adherence.

Practical Tips for Effective Load Calculation

- Always verify appliance ratings and usage patterns.
- Consider future expansion plans when sizing the panel.
- Distribute loads evenly across phases to prevent imbalance.
- Use certified software or tools when available.
- Consult local electrical codes for specific requirements and demand factors.

Finding and Using an Electrical Panel Load Calculation PDF

Numerous resources are available online, including:

- Official electrical code websites
- Electrical engineering textbooks
- Manufacturer technical guides
- Professional association publications

When using a PDF, ensure it is up-to-date and compliant with current codes. Download and save a copy for offline use, and keep it accessible during planning, installation, and inspection phases.

Conclusion

An electrical panel load calculation PDF is an essential document that helps ensure electrical systems are designed and maintained safely, efficiently, and in compliance with regulations. By understanding the components involved in load calculations, following systematic procedures, and utilizing reliable resources, professionals and DIY enthusiasts alike can confidently plan and execute electrical projects. Proper load calculation not only safeguards property and lives but also optimizes system performance and future scalability. Whether you are installing a new panel or upgrading an existing one, leveraging a comprehensive load calculation PDF can streamline the process and ensure peace of mind.

Frequently Asked Questions

What is an electrical panel load calculation PDF and why is it important?

An electrical panel load calculation PDF is a document that details the process of determining the electrical load a panel can handle. It is important for ensuring safety, code compliance, and proper sizing of electrical systems in residential, commercial, or industrial settings.

How do I perform an electrical panel load calculation using a PDF guide?

You can perform an electrical panel load calculation by following step-by-step instructions in a PDF guide, which typically includes calculating the connected load, diversity factors, demand factors, and applying National Electrical Code (NEC) standards to determine the panel's capacity.

Can I find free electrical panel load calculation PDFs online?

Yes, many electrical safety organizations, electrical suppliers, and industry professionals offer free PDFs and templates for load calculations that can help you understand and perform the process accurately.

What are the key components included in an electrical panel load calculation PDF?

Key components usually include the calculation of connected loads, demand factors, load diversity, service entrance capacity, branch circuit loads, and compliance with electrical codes, all documented within the PDF for clarity.

How accurate is an electrical panel load calculation based on a PDF template?

The accuracy depends on correct data input, adherence to electrical codes, and proper understanding of electrical loads. Using a well-designed PDF template can improve accuracy, but professional review is recommended for critical installations.

What standards or codes should be referenced in an electrical panel load calculation PDF?

The National Electrical Code (NEC) or local electrical codes should be referenced in the PDF, especially Articles 220 and 310, which cover load calculations, service sizing, and wiring requirements.

Are there software tools that generate electrical panel load calculation PDFs?

Yes, several electrical design software tools can perform load calculations and generate comprehensive PDFs, such as ETAP, SKM PowerTools, or EasyPower, which facilitate accurate and professional documentation.

What should I do if my electrical load exceeds the panel capacity shown in the PDF calculation?

If the load exceeds the panel's capacity, you should upgrade to a larger panel, distribute loads across multiple panels, or reduce the connected loads to ensure safety and compliance with electrical standards.

Where can I learn more about electrical panel load calculation PDFs and best practices?

You can consult electrical engineering textbooks, industry training courses, online tutorials, and professional organizations such as the National Electrical Contractors Association (NECA) or the IEEE for comprehensive information and best practices.

Additional Resources

Electrical Panel Load Calculation PDF: An Expert Guide to Accurate Electrical System Planning

In the world of electrical engineering and residential or commercial electrical installations, ensuring safety, efficiency, and compliance hinges on precise load calculations. A crucial tool in this process is the Electrical Panel Load Calculation PDF, a comprehensive document that helps professionals and DIY enthusiasts alike determine the appropriate electrical panel size, circuit load distribution, and overall system capacity. In this article, we'll explore the significance of these PDFs, what they typically include, how to interpret and use them effectively, and why they are indispensable for safe electrical design.

Understanding Electrical Panel Load Calculation PDFs

What Is an Electrical Panel Load Calculation PDF?

An Electrical Panel Load Calculation PDF is a digitally formatted document, often provided by electrical engineers, contractors, or software tools, that details the calculation process used to determine the electrical load requirements of a building or system. These PDFs serve as both a record of the calculations and a guiding document for selecting the correct panel size and circuit configurations.

Typically, these PDFs include a detailed breakdown of all connected loads—appliances, lighting, HVAC systems, and other electrical devices—along with the calculations that ensure the distribution is within safe limits. They are essential in adhering to electrical codes such as the National Electrical Code (NEC) in the U.S. or other regional standards.

Components of an Electrical Panel Load Calculation PDF

A comprehensive load calculation PDF covers multiple sections, each critical to understanding the entire electrical load profile. Let's delve into the typical components:

1. Building or System Details

- Location and Type of Building: Residential, commercial, industrial, or mixed-use.
- Number of Stories and Square Footage: Influences the overall load.
- Number of Circuits and Distribution Points: Helps in planning panel capacity.

2. List of Connected Loads

This section enumerates all electrical devices and systems, including:

- Lighting fixtures
- Receptacles
- HVAC systems (air conditioners, heaters)
- Kitchen appliances
- Machinery

- Specialized equipment

The list often includes specifications such as wattage, voltage, and amperage.

3. Calculation Methodology

This part explains the formulas and standards used to convert the listed loads into current demands, typically following NEC or relevant standards. Common calculations include:

- Demand Factors: Adjustments applied based on typical usage patterns.
- General Lighting and Receptacle Loads: Calculated using standard wattage per square foot or per device.
- Motor Loads: Using specific formulas accounting for motor starting currents.
- Diversity Factors: To account for simultaneous usage variances.

4. Load Summary and Demand Factors

A summarized table that consolidates individual loads, applies demand factors, and calculates the total connected load versus the demand load. This helps in determining if the existing or planned electrical panel can handle the load.

5. Panel and Circuit Sizing Recommendations

Based on the calculations, the PDF provides:

- Recommended main panel size (e.g., 100A, 200A, 400A)
- Number and size of branch circuits
- Breaker ratings
- Conductor sizes

6. Compliance and Notes

- References to relevant electrical codes
- Safety considerations
- Special instructions for unique loads

How to Use an Electrical Panel Load Calculation PDF

Effectively

Interpreting the Data

Understanding the contents of the PDF is vital:

- Verify all loads are included: Ensure no significant electrical device is omitted.
- Check calculation methods: Confirm they follow relevant standards.
- Review demand factors: Understand the assumptions made and whether they suit your specific scenario.
- Assess panel capacity: Compare the calculated load against the panel's rated capacity.

Applying the Calculations

- Select appropriate panel size: Based on the demand load, choose a panel rated slightly above the maximum calculated load for future expansion.
- Design circuits accordingly: Assign circuits to specific loads to prevent overloads.
- Ensure proper conductor sizing: Match wire sizes to circuit breaker ratings and load demands.
- Plan for safety: Incorporate safety margins and protect against overloads and short circuits.

Benefits of Using a Load Calculation PDF

- Documentation and Compliance: Acts as a record for inspections and future troubleshooting.
- Safety Assurance: Ensures the system operates within safe limits.
- Cost Optimization: Prevents over-sizing or under-sizing panels, saving costs.
- Future Planning: Facilitates upgrades and capacity expansion.

Creating and Accessing Electrical Panel Load Calculation PDFs

Tools and Software for Generating PDFs

Modern electrical design relies heavily on software tools that generate these PDFs:

- Electrical Design Software: Such as ETAP, SKM PowerTools, or EasyPower.
- Spreadsheet Templates: Customized Excel sheets following NEC guidelines.
- Online Calculators: Web-based tools that produce downloadable PDFs.

These tools streamline the calculation process, reduce errors, and produce professional documentation.

Manual Calculation Methods

For smaller projects or DIY enthusiasts, manual calculations are possible:

- Use standard formulas from NEC or regional codes.
- Document each step carefully.
- Convert calculations into a PDF using standard document software (Word, Google Docs) or specialized templates.

Best Practices for Accessing Reliable PDFs

- Use documents from reputable sources or certified electrical engineers.
- Always verify the calculations against current electrical codes.
- Keep records updated with any changes or upgrades to the system.

Importance of Accurate Load Calculations in Electrical Safety and Efficiency

Safety Considerations

Incorrect load calculations can lead to:

- Overloaded Panels: Increasing the risk of overheating, electrical fires, and equipment damage.
- Undersized Panels: Causing frequent trips, voltage drops, and potential failure of connected devices.
- Code Violations: Resulting in penalties, failed inspections, or insurance issues.

Efficiency and Cost Savings

Proper load calculations help:

- Optimize conductor and breaker sizes, reducing unnecessary expenses.
- Facilitate energy-efficient design, minimizing wastage.
- Allow future system upgrades without complete rewiring.

Regulatory Compliance and Documentation

Having a well-prepared Electrical Panel Load Calculation PDF ensures:

- Compliance with local electrical codes.
- Smooth inspection process.
- Clear documentation for maintenance, troubleshooting, and upgrades.

Conclusion: The Value of a Well-Prepared Electrical Panel Load Calculation PDF

In the realm of electrical system design and maintenance, the importance of accurate load calculations cannot be overstated. The Electrical Panel Load Calculation PDF serves as a critical document that encapsulates the technical rigor behind safe and efficient electrical system planning. Whether created manually or generated through sophisticated software, these PDFs provide a transparent, standardized, and professional record that supports compliance, safety, and operational effectiveness.

For electrical engineers, contractors, or DIY enthusiasts, understanding how to interpret and utilize these PDFs ensures that electrical installations are not only compliant with standards but also optimized for performance and safety. As electrical systems grow increasingly complex with the integration of renewable energy, smart devices, and automation, the role of precise load calculation PDFs will only become more vital in safeguarding properties and lives.

Investing time and resources into accurate load calculations and comprehensive PDFs is a best practice that pays dividends in safety, reliability, and peace of mind.

[Electrical Panel Load Calculation Pdf](#)

electrical panel load calculation pdf: *Black & Decker The Complete Guide to Wiring* Creative Publishing International, Editors of Creative Publishing, 2008-08 Covers all of the most common do-it-yourself home wiring skills and projects, including new circuits, installations and repair. New projects in this edition include upgrading a service panel to 209 amps and wiring an outbuilding--Provided by publisher.

electrical panel load calculation pdf: Electrical Design of Commercial and Industrial Buildings John Hauck, 2009-10-26 Electrical plan design -- General electrical requirements -- Specialized electrical requirements -- Lighting systems -- Distribution systems -- Load and short-circuit calculations -- Electrical plan review.

electrical panel load calculation pdf: Intelligent Electrical Systems: Satyajit Chakrabarti, Ayan Kumar Panja, Amartya Mukherjee, Arun Kr. Bar, 2021-01-10 The conference aims to provide a premier platform for Engineers, researchers, scientists and academicians to present their work in the emerging areas such as Renewable Energy, Energy storage, Power Electronics & drives, Smart

devices and communication systems, Artificial Intelligence, Robotics, Networks an IoT, Control and automation etc.

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EMAIL:COC@CODEOFCHINA.COM Codeofchina Inc., a part of TransForyou (Beijing) Translation Co., Ltd., is a professional Chinese code translator in China. Now, Codeofchina Inc. is running a professional Chinese code website, www.codeofchina.com. Through this website, Codeofchina Inc. provides English-translated Chinese codes to clients worldwide. About TransForyou TransForyou (Beijing) Translation Co., Ltd., established in 2003, is a reliable language service provider for clients at home and abroad. Since our establishment, TransForyou has been aiming to build up a translation brand with our professional dedicated service. Currently, TransForyou is the director of China Association of Engineering Construction Standardization (CECS); the committeeman of Localization Service Committee / Translators Association of China (TAC) and the member of Boya Translation Culture Salon (BTCS); and the field study center of the University of the University of International Business & Economics (UIBE) and Hebei University (HU). In 2016, TransForyou ranked 27th among Asian Language Service Providers by Common Sense Advisory.

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EMAIL:COC@CODEOFCHINA.COM Codeofchina Inc., a part of TransForyou (Beijing) Translation Co., Ltd., is a professional Chinese code translator in China. Now, Codeofchina Inc. is running a professional Chinese code website, www.codeofchina.com. Through this website, Codeofchina Inc. provides English-translated Chinese codes to clients worldwide. About TransForyou TransForyou (Beijing) Translation Co., Ltd., established in 2003, is a reliable language service provider for clients at home and abroad. Since our establishment, TransForyou has been aiming to build up a translation brand with our professional dedicated service. Currently, TransForyou is the director of China Association of Engineering Construction Standardization (CECS); the committeeman of Localization Service Committee / Translators Association of China (TAC) and the member of Boya Translation Culture Salon (BTCS); and the field study center of the University of the University of International Business & Economics (UIBE) and Hebei University (HU). In 2016, TransForyou ranked 27th among Asian Language Service Providers by Common Sense Advisory.

electrical panel load calculation pdf: A Text Book of Design of Electrical Installations
Jain, 1993-10

electrical panel load calculation pdf: Sun Tracking and Solar Renewable Energy

Harvesting Gerro Prinsloo, Robert Dobson, 2015-11-02 Free to download eBook on Practical Solar Tracking Design, Solar Tracking, Sun Tracking, Sun Tracker, Solar Tracker, Follow Sun, Sun Position calculation (Azimuth, Elevation, Zenith), Sun following, Sunrise, Sunset, Moon-phase, Moonrise, Moonset calculators. In harnessing power from the sun through a solar tracker or solar tracking system, renewable energy system developers require automatic solar tracking software and solar position algorithms. On-axis sun tracking system such as the altitude-azimuth dual axis or multi-axis solar tracker systems use a sun tracking algorithm or ray tracing sensors or software to ensure the sun's passage through the sky is traced with high precision in automated solar tracker applications, right through summer solstice, solar equinox and winter solstice. Eco Friendly and Environmentally Sustainable Micro Combined Solar Heat and Power (m-CHP, m-CCHP, m-CHCP) with Microgrid Storage and Layered Smartgrid Control towards Supplying Off-Grid Rural Villages in developing BRICS countries such as Africa, India, China and Brazil. Off-grid rural villages and isolated islands areas require mCHP and trigeneration solar power plants and associated isolated smart microgrid solutions to serve the community energy needs. This article describes the development progress for such a system, also referred to as solar polygeneration. The system includes a sun tracker mechanism wherein a parabolic dish or lenses are guided by a light sensitive mechanic in a way that the solar receiver is always at right angle to the solar radiation. Solar thermal energy is then either converted into electrical energy through a free piston Stirling, or

stored in a thermal storage container. The project includes the thermodynamic modeling of the plant in Matlab Simulink as well as the development of an intelligent control approach that includes smart microgrid distribution and optimization. The book includes aspects in the simulation and optimization of stand-alone hybrid renewable energy systems and co-generation in isolated or islanded microgrids. It focusses on the stepwise development of a hybrid solar driven micro combined cooling heating and power (mCCHP) compact trigeneration polygeneration and thermal energy storage (TES) system with intelligent weather prediction, weak-ahead scheduling (time horizon), and look-ahead dispatch on integrated smart microgrid distribution principles. The solar harvesting and solar thermodynamic system includes an automatic sun tracking platform based on a PLC controlled mechatronic sun tracking system that follows the sun progressing across the sky. An intelligent energy management and adaptive learning control optimization approach is proposed for autonomous off-grid remote power applications, both for thermodynamic optimization and smart micro-grid optimization for distributed energy resources (DER). The correct resolution of this load-following multi objective optimization problem is a complex task because of the high number and multi-dimensional variables, the cross-correlation and interdependency between the energy streams as well as the non-linearity in the performance of some of the system components. Exergy-based control approaches for smartgrid topologies are considered in terms of the intelligence behind the safe and reliable operation of a microgrid in an automated system that can manage energy flow in electrical as well as thermal energy systems. The standalone micro-grid solution would be suitable for a rural village, intelligent building, district energy system, campus power, shopping mall centre, isolated network, eco estate or remote island application setting where self-generation and decentralized energy system concepts play a role. Discrete digital simulation models for the thermodynamic and active demand side management systems with digital smartgrid control unit to optimize the system energy management is currently under development. Parametric simulation models for this trigeneration system (polygeneration, poligeneration, quadgeneration) are developed on the Matlab Simulink and TrnSys platforms. In terms of model predictive coding strategies, the automation controller will perform multi-objective cost optimization for energy management on a microgrid level by managing the generation and storage of electrical, heat and cooling energies in layers. Each layer has its own set of smart microgrid priorities associated with user demand side cycle predictions. Mixed Integer Linear Programming and Neural network algorithms are being modeled to perform Multi Objective Control optimization as potential optimization and adaptive learning techniques.

electrical panel load calculation pdf: Practical Solar Tracking Automatic Solar Tracking Sun Tracking Автоматическое удержание Солнечная слежения ВС Gerro Prinsloo, Robert Dobson, 2015-11-01 This book details Practical Solar Energy Harvesting, Automatic Solar-Tracking, Sun-Tracking-Systems, Solar-Trackers and Sun Tracker Systems using motorized automatic positioning concepts and control principles. An intelligent automatic solar tracker is a device that orients a payload toward the sun. Such programmable computer based solar tracking device includes principles of solar tracking, solar tracking systems, as well as microcontroller, microprocessor and/or PC based solar tracking control to orientate solar reflectors, solar lenses, photovoltaic panels or other optical configurations towards the sun. Motorized space frames and kinematic systems ensure motion dynamics and employ drive technology and gearing principles to steer optical configurations such as mangin, parabolic, conic, or cassegrain solar energy collectors to face the sun and follow the sun movement contour continuously. In general, the book may benefit solar research and solar energy applications in countries such as Africa, Mediterranean, Italy, Spain, Greece, USA, Mexico, South America, Brazilia, Argentina, Chili, India, Malaysia, Middle East, UAE, Russia, Japan and China. This book on practical automatic Solar-Tracking Sun-Tracking is in .PDF format and can easily be converted to the .EPUB .MOBI .AZW .ePub .FB2 .LIT .LRF .MOBI .PDB .PDF .TCR formats for smartphones and Kindle by using the ebook.online-convert.com facility. The content of the book is also applicable to communication antenna satellite tracking and moon tracking algorithm source code for which links to free download links are provided. In harnessing

power from the sun through a solar tracker or practical solar tracking system, renewable energy control automation systems require automatic solar tracking software and solar position algorithms to accomplish dynamic motion control with control automation architecture, circuit boards and hardware. On-axis sun tracking system such as the altitude-azimuth dual axis or multi-axis solar tracker systems use a sun tracking algorithm or ray tracing sensors or software to ensure the sun's passage through the sky is traced with high precision in automated solar tracker applications, right through summer solstice, solar equinox and winter solstice. A high precision sun position calculator or sun position algorithm is this an important step in the design and construction of an automatic solar tracking system. From sun tracing software perspective, the sonnet Tracing The Sun has a literal meaning. Within the context of sun track and trace, this book explains that the sun's daily path across the sky is directed by relatively simple principles, and if grasped/understood, then it is relatively easy to trace the sun with sun following software. Sun position computer software for tracing the sun are available as open source code, sources that is listed in this book. Ironically there was even a system called sun chaser, said to have been a solar positioner system known for chasing the sun throughout the day. Using solar equations in an electronic circuit for automatic solar tracking is quite simple, even if you are a novice, but mathematical solar equations are over complicated by academic experts and professors in text-books, journal articles and internet websites. In terms of solar hobbies, scholars, students and Hobbyist's looking at solar tracking electronics or PC programs for solar tracking are usually overcome by the sheer volume of scientific material and internet resources, which leaves many developers in frustration when search for simple experimental solar tracking source-code for their on-axis sun-tracking systems. This booklet will simplify the search for the mystical sun tracking formulas for your sun tracker innovation and help you develop your own autonomous solar tracking controller. By directing the solar collector directly into the sun, a solar harvesting means or device can harness sunlight or thermal heat. This is achieved with the help of sun angle formulas, solar angle formulas or solar tracking procedures for the calculation of sun's position in the sky. Automatic sun tracking system software includes algorithms for solar altitude azimuth angle calculations required in following the sun across the sky. In using the longitude, latitude GPS coordinates of the solar tracker location, these sun tracking software tools supports precision solar tracking by determining the solar altitude-azimuth coordinates for the sun trajectory in altitude-azimuth tracking at the tracker location, using certain sun angle formulas in sun vector calculations. Instead of follow the sun software, a sun tracking sensor such as a sun sensor or webcam or video camera with vision based sun following image processing software can also be used to determine the position of the sun optically. Such optical feedback devices are often used in solar panel tracking systems and dish tracking systems. Dynamic sun tracing is also used in solar surveying, DNI analyser and sun surveying systems that build solar infographics maps with solar radiance, irradiance and DNI models for GIS (geographical information system). In this way geospatial methods on solar/environment interaction makes use use of geospatial technologies (GIS, Remote Sensing, and Cartography). Climatic data and weather station or weather center data, as well as queries from sky servers and solar resource database systems (i.e. on DB2, Sybase, Oracle, SQL, MySQL) may also be associated with solar GIS maps. In such solar resource modelling systems, a pyranometer or solarimeter is normally used in addition to measure direct and indirect, scattered, dispersed, reflective radiation for a particular geographical location. Sunlight analysis is important in flash photography where photographic lighting are important for photographers. GIS systems are used by architects who add sun shadow applets to study architectural shading or sun shadow analysis, solar flux calculations, optical modelling or to perform weather modelling. Such systems often employ a computer operated telescope type mechanism with ray tracing program software as a solar navigator or sun tracer that determines the solar position and intensity. The purpose of this booklet is to assist developers to track and trace suitable source-code and solar tracking algorithms for their application, whether a hobbyist, scientist, technician or engineer. Many open-source sun following and tracking algorithms and source-code for solar tracking programs and modules are freely available to download on the internet today. Certain

proprietary solar tracker kits and solar tracking controllers include a software development kit SDK for its application programming interface API attributes (Pebble). Widget libraries, widget toolkits, GUI toolkit and UX libraries with graphical control elements are also available to construct the graphical user interface (GUI) for your solar tracking or solar power monitoring program. The solar library used by solar position calculators, solar simulation software and solar contour calculators include machine program code for the solar hardware controller which are software programmed into Micro-controllers, Programmable Logic Controllers PLC, programmable gate arrays, Arduino processor or PIC processor. PC based solar tracking is also high in demand using C++, Visual Basic VB, as well as MS Windows, Linux and Apple Mac based operating systems for sun path tables on Matlab, Excel. Some books and internet webpages use other terms, such as: sun angle calculator, sun position calculator or solar angle calculator. As said, such software code calculate the solar azimuth angle, solar altitude angle, solar elevation angle or the solar Zenith angle (Zenith solar angle is simply referenced from vertical plane, the mirror of the elevation angle measured from the horizontal or ground plane level). Similar software code is also used in solar calculator apps or the solar power calculator apps for IOS and Android smartphone devices. Most of these smartphone solar mobile apps show the sun path and sun-angles for any location and date over a 24 hour period. Some smartphones include augmented reality features in which you can physically see and look at the solar path through your cell phone camera or mobile phone camera at your phone's specific GPS location. In the computer programming and digital signal processing (DSP) environment, (free/open source) program code are available for VB, .Net, Delphi, Python, C, C+, C++, PHP, Swift, ADM, F, Flash, Basic, QBasic, GBasic, KBasic, SIMPL language, Squirrel, Solaris, Assembly language on operating systems such as MS Windows, Apple Mac, DOS or Linux OS. Software algorithms predicting position of the sun in the sky are commonly available as graphical programming platforms such as Matlab (Mathworks), Simulink models, Java applets, TRNSYS simulations, Scada system apps, Labview module, Beckhoff TwinCAT (Visual Studio), Siemens SPA, mobile and iphone apps, Android or iOS tablet apps, and so forth. At the same time, PLC software code for a range of sun tracking automation technology can follow the profile of sun in sky for Siemens, HP, Panasonic, ABB, Allan Bradley, OMRON, SEW, Festo, Beckhoff, Rockwell, Schneider, Endress Hauser, Fuji electric, Honeywell, Fuchs, Yokonawa, or Muthibishi platforms. Sun path projection software are also available for a range of modular IPC embedded PC motherboards, Industrial PC, PLC (Programmable Logic Controller) and PAC (Programmable Automation Controller) such as the Siemens S7-1200 or Siemens Logo, Beckhoff IPC or CX series, OMRON PLC, Ercam PLC, AC500plc ABB, National Instruments NI PXI or NI cRIO, PIC processor, Intel 8051/8085, IBM (Cell, Power, Brain or Truenorth series), FPGA (Xilinx Altera Nios), Intel, Xeon, Atmel megaAVR, MPU, Maple, Teensy, MSP, XMOX, Xbee, ARM, Raspberry Pi, Eagle, Arduino or Arduino AtMega microcontroller, with servo motor, stepper motor, direct current DC pulse width modulation PWM (current driver) or alternating current AC SPS or IPC variable frequency drives VFD motor drives (also termed adjustable-frequency drive, variable-speed drive, AC drive, micro drive or inverter drive) for electrical, mechatronic, pneumatic, or hydraulic solar tracking actuators. The above motion control and robot control systems include analogue or digital interfacing ports on the processors to allow for tracker angle orientation feedback control through one or a combination of angle sensor or angle encoder, shaft encoder, precision encoder, optical encoder, magnetic encoder, direction encoder, rotational encoder, chip encoder, tilt sensor, inclination sensor, or pitch sensor. Note that the tracker's elevation or zenith axis angle may measured using an altitude angle-, declination angle-, inclination angle-, pitch angle-, or vertical angle-, zenith angle- sensor or inclinometer. Similarly the tracker's azimuth axis angle be measured with a azimuth angle-, horizontal angle-, or roll angle-sensor. Chip integrated accelerometer magnetometer gyroscope type angle sensors can also be used to calculate displacement. Other options include the use of thermal imaging systems such as a Fluke thermal imager, or robotic or vision based solar tracker systems that employ face tracking, head tracking, hand tracking, eye tracking and car tracking principles in solar tracking. With unattended decentralised rural, island, isolated, or autonomous off-grid power installations, remote control,

monitoring, data acquisition, digital datalogging and online measurement and verification equipment becomes crucial. It assists the operator with supervisory control to monitor the efficiency of remote renewable energy resources and systems and provide valuable web-based feedback in terms of CO₂ and clean development mechanism (CDM) reporting. A power quality analyser for diagnostics through internet, WiFi and cellular mobile links is most valuable in frontline troubleshooting and predictive maintenance, where quick diagnostic analysis is required to detect and prevent power quality issues. Solar tracker applications cover a wide spectrum of solar applications and solar assisted application, including concentrated solar power generation, solar desalination, solar water purification, solar steam generation, solar electricity generation, solar industrial process heat, solar thermal heat storage, solar food dryers, solar water pumping, hydrogen production from methane or producing hydrogen and oxygen from water (HHO) through electrolysis. Many patented or non-patented solar apparatus include tracking in solar apparatus for solar electric generator, solar desalinator, solar steam engine, solar ice maker, solar water purifier, solar cooling, solar refrigeration, USB solar charger, solar phone charging, portable solar charging tracker, solar coffee brewing, solar cooking or solar drying means. Your project may be the next breakthrough or patent, but your invention is held back by frustration in search for the sun tracker you require for your solar powered appliance, solar generator, solar tracker robot, solar freezer, solar cooker, solar drier, solar pump, solar freezer, or solar dryer project. Whether your solar electronic circuit diagram include a simplified solar controller design in a solar electricity project, solar power kit, solar hobby kit, solar steam generator, solar hot water system, solar ice maker, solar desalinator, hobbyist solar panels, hobby robot, or if you are developing professional or hobby electronics for a solar utility or micro scale solar powerplant for your own solar farm or solar farming, this publication may help accelerate the development of your solar tracking innovation. Lately, solar polygeneration, solar trigeneration (solar triple generation), and solar quad generation (adding delivery of steam, liquid/gaseous fuel, or capture food-grade CO₂) systems have need for automatic solar tracking. These systems are known for significant efficiency increases in energy yield as a result of the integration and re-use of waste or residual heat and are suitable for compact packaged micro solar powerplants that could be manufactured and transported in kit-form and operate on a plug-and play basis. Typical hybrid solar power systems include compact or packaged solar micro combined heat and power (CHP or mCHP) or solar micro combined, cooling, heating and power (CCHP, CHPC, mCCHP, or mCHPC) systems used in distributed power generation. These systems are often combined in concentrated solar CSP and CPV smart microgrid configurations for off-grid rural, island or isolated microgrid, minigrid and distributed power renewable energy systems. Solar tracking algorithms are also used in modelling of trigeneration systems using Matlab Simulink (Modelica or TRNSYS) platform as well as in automation and control of renewable energy systems through intelligent parsing, multi-objective, adaptive learning control and control optimization strategies. Solar tracking algorithms also find application in developing solar models for country or location specific solar studies, for example in terms of measuring or analysis of the fluctuations of the solar radiation (i.e. direct and diffuse radiation) in a particular area. Solar DNI, solar irradiance and atmospheric information and models can thus be integrated into a solar map, solar atlas or geographical information systems (GIS). Such models allows for defining local parameters for specific regions that may be valuable in terms of the evaluation of different solar in photovoltaic or CSP systems on simulation and synthesis platforms such as Matlab and Simulink or in linear or multi-objective optimization algorithm platforms such as COMPOSE, EnergyPLAN or DER-CAM. A dual-axis solar tracker and single-axis solar tracker may use a sun tracker program or sun tracker algorithm to position a solar dish, solar panel array, heliostat array, PV panel, solar antenna or infrared solar antenna. A self-tracking solar concentrator performs automatic solar tracking by computing the solar vector. Solar position algorithms (TwinCAT, SPA, or PSA Algorithms) use an astronomical algorithm to calculate the position of the sun. It uses astronomical software algorithms and equations for solar tracking in the calculation of sun's position in the sky for each location on the earth at any time of day. Like an optical solar telescope, the solar position algorithm pin-points the solar reflector at the sun and locks

onto the sun's position to track the sun across the sky as the sun progresses throughout the day. Optical sensors such as photodiodes, light-dependant-resistors (LDR) or photoresistors are used as optical accuracy feedback devices. Lately we also included a section in the book (with links to microprocessor code) on how the PixArt Wii infrared camera in the Wii remote or Wiimote may be used in infrared solar tracking applications. In order to harvest free energy from the sun, some automatic solar positioning systems use an optical means to direct the solar tracking device. These solar tracking strategies use optical tracking techniques, such as a sun sensor means, to direct sun rays onto a silicon or CMOS substrate to determine the X and Y coordinates of the sun's position. In a solar mems sun-sensor device, incident sunlight enters the sun sensor through a small pin-hole in a mask plate where light is exposed to a silicon substrate. In a web-camera or camera image processing sun tracking and sun following means, object tracking software performs multi object tracking or moving object tracking methods. In an solar object tracking technique, image processing software performs mathematical processing to box the outline of the apparent solar disc or sun blob within the captured image frame, while sun-localization is performed with an edge detection algorithm to determine the solar vector coordinates. An automated positioning system help maximize the yields of solar power plants through solar tracking control to harness sun's energy. In such renewable energy systems, the solar panel positioning system uses a sun tracking techniques and a solar angle calculator in positioning PV panels in photovoltaic systems and concentrated photovoltaic CPV systems. Automatic on-axis solar tracking in a PV solar tracking system can be dual-axis sun tracking or single-axis sun solar tracking. It is known that a motorized positioning system in a photovoltaic panel tracker increase energy yield and ensures increased power output, even in a single axis solar tracking configuration. Other applications such as robotic solar tracker or robotic solar tracking system uses robotica with artificial intelligence in the control optimization of energy yield in solar harvesting through a robotic tracking system. Automatic positioning systems in solar tracking designs are also used in other free energy generators, such as concentrated solar thermal power CSP and dish Stirling systems. The sun tracking device in a solar collector in a solar concentrator or solar collector Such a performs on-axis solar tracking, a dual axis solar tracker assists to harness energy from the sun through an optical solar collector, which can be a parabolic mirror, parabolic reflector, Fresnel lens or mirror array/matrix. A parabolic dish or reflector is dynamically steered using a transmission system or solar tracking slew drive mean. In steering the dish to face the sun, the power dish actuator and actuation means in a parabolic dish system optically focusses the sun's energy on the focal point of a parabolic dish or solar concentrating means. A Stirling engine, solar heat pipe, thermosyphin, solar phase change material PCM receiver, or a fibre optic sunlight receiver means is located at the focal point of the solar concentrator. The dish Stirling engine configuration is referred to as a dish Stirling system or Stirling power generation system. Hybrid solar power systems (used in combination with biogas, biofuel, petrol, ethanol, diesel, natural gas or PNG) use a combination of power sources to harness and store solar energy in a storage medium. Any multitude of energy sources can be combined through the use of controllers and the energy stored in batteries, phase change material, thermal heat storage, and in cogeneration form converted to the required power using thermodynamic cycles (organic Rankin, Brayton cycle, micro turbine, Stirling) with an inverter and charge controller. В этой книге подробно Автоматическая Solar-Tracking, BC-Tracking-Systems, Solar-трекеры и BC Tracker Systems. Интеллектуальный автоматический солнечной слежения является устройством, которое ориентирует полезную нагрузку к солнцу. Такое программируемый компьютер на основе солнечной устройство слежения включает принципы солнечной слежения, солнечных систем слежения, а также микроконтроллер, микропроцессор и / или ПК на базе управления солнечной отслеживания ориентироваться солнечных отражателей, солнечные линзы, фотоэлектрические панели или другие оптические конфигурации к BC Моторизованные космические кадры и кинематические системы обеспечения динамики движения и использовать приводной техники и готовится принципы, чтобы направить оптические конфигурации, такие как Манжен, параболических, конических или Кассегрена солнечных

mathematical solar equations are over complicated by academic experts and professors in text-books, journal articles and internet websites. In terms of solar hobbies, scholars, students and Hobbyist's looking at solar tracking electronics or PC programs for solar tracking are usually overcome by the sheer volume of scientific material and internet resources, which leaves many developers in frustration when search for simple experimental solar tracking source-code for their on-axis sun-tracking systems. This booklet will simplify the search for the mystical sun tracking formulas for your sun tracker innovation and help you develop your own autonomous solar tracking controller. By directing the solar collector directly into the sun, a solar harvesting means or device can harness sunlight or thermal heat. This is achieved with the help of sun angle formulas, solar angle formulas or solar tracking procedures for the calculation of sun's position in the sky. Automatic sun tracking system software includes algorithms for solar altitude azimuth angle calculations required in following the sun across the sky. In using the longitude, latitude GPS coordinates of the solar tracker location, these sun tracking software tools supports precision solar tracking by determining the solar altitude-azimuth coordinates for the sun trajectory in altitude-azimuth tracking at the tracker location, using certain sun angle formulas in sun vector calculations. Instead of follow the sun software, a sun tracking sensor such as a sun sensor or webcam or video camera with vision based sun following image processing software can also be used to determine the position of the sun optically. Such optical feedback devices are often used in solar panel tracking systems and dish tracking systems. Dynamic sun tracing is also used in solar surveying, DNI analyser and sun surveying systems that build solar infographics maps with solar radiance, irradiance and DNI models for GIS (geographical information system). In this way geospatial methods on solar/environment interaction makes use use of geospatial technologies (GIS, Remote Sensing, and Cartography). Climatic data and weather station or weather center data, as well as queries from sky servers and solar resource database systems (i.e. on DB2, Sybase, Oracle, SQL, MySQL) may also be associated with solar GIS maps. In such solar resource modelling systems, a pyranometer or solarimeter is normally used in addition to measure direct and indirect, scattered, dispersed, reflective radiation for a particular geographical location. Sunlight analysis is important in flash photography where photographic lighting are important for photographers. GIS systems are used by architects who add sun shadow applets to study architectural shading or sun shadow analysis, solar flux calculations, optical modelling or to perform weather modelling. Such systems often employ a computer operated telescope type mechanism with ray tracing program software as a solar navigator or sun tracer that determines the solar position and intensity. The purpose of this booklet is to assist developers to track and trace suitable source-code and solar tracking algorithms for their application, whether a hobbyist, scientist, technician or engineer. Many open-source sun following and tracking algorithms and source-code for solar tracking programs and modules are freely available to download on the internet today. Certain proprietary solar tracker kits and solar tracking controllers include a software development kit SDK for its application programming interface API attributes (Pebble). Widget libraries, widget toolkits, GUI toolkit and UX libraries with graphical control elements are also available to construct the graphical user interface (GUI) for your solar tracking or solar power monitoring program. The solar library used by solar position calculators, solar simulation software and solar contour calculators include machine program code for the solar hardware controller which are software programmed into Micro-controllers, Programmable Logic Controllers PLC, programmable gate arrays, Arduino processor or PIC processor. PC based solar tracking is also high in demand using C++, Visual Basic VB, as well as MS Windows, Linux and Apple Mac based operating systems for sun path tables on Matlab, Excel. Some books and internet webpages use other terms, such as: sun angle calculator, sun position calculator or solar angle calculator. As said, such software code calculate the solar azimuth angle, solar altitude angle, solar elevation angle or the solar Zenith angle (Zenith solar angle is simply referenced from vertical plane, the mirror of the elevation angle measured from the horizontal or ground plane level). Similar software code is also used in solar calculator apps or the solar power calculator apps for IOS and Android smartphone devices. Most of these smartphone solar mobile

apps show the sun path and sun-angles for any location and date over a 24 hour period. Some smartphones include augmented reality features in which you can physically see and look at the solar path through your cell phone camera or mobile phone camera at your phone's specific GPS location. In the computer programming and digital signal processing (DSP) environment, (free/open source) program code are available for VB, .Net, Delphi, Python, C, C+, C++, PHP, Swift, ADM, F, Flash, Basic, QBasic, GBasic, KBasic, SIMPL language, Squirrel, Solaris, Assembly language on operating systems such as MS Windows, Apple Mac, DOS or Linux OS. Software algorithms predicting position of the sun in the sky are commonly available as graphical programming platforms such as Matlab (Mathworks), Simulink models, Java applets, TRNSYS simulations, Scada system apps, Labview module, Beckhoff TwinCAT (Visual Studio), Siemens SPA, mobile and iphone apps, Android or iOS tablet apps, and so forth. At the same time, PLC software code for a range of sun tracking automation technology can follow the profile of sun in sky for Siemens, HP, Panasonic, ABB, Allan Bradley, OMRON, SEW, Festo, Beckhoff, Rockwell, Schneider, Endress Hauser, Fudji electric, Honeywell, Fuchs, Yokonawa, or Muthibishi platforms. Sun path projection software are also available for a range of modular IPC embedded PC motherboards, Industrial PC, PLC (Programmable Logic Controller) and PAC (Programmable Automation Controller) such as the Siemens S7-1200 or Siemens Logo, Beckhoff IPC or CX series, OMRON PLC, Ercam PLC, AC500plc ABB, National Instruments NI PXI or NI cRIO, PIC processor, Intel 8051/8085, IBM (Cell, Power, Brain or Truenorth series), FPGA (Xilinx Altera Nios), Intel, Xeon, Atmel megaAVR, MPU, Maple, Teensy, MSP, XMOS, Xbee, ARM, Raspberry Pi, Eagle, Arduino or Arduino AtMega microcontroller, with servo motor, stepper motor, direct current DC pulse width modulation PWM (current driver) or alternating current AC SPS or IPC variable frequency drives VFD motor drives (also termed adjustable-frequency drive, variable-speed drive, AC drive, micro drive or inverter drive) for electrical, mechatronic, pneumatic, or hydraulic solar tracking actuators. The above motion control and robot control systems include analogue or digital interfacing ports on the processors to allow for tracker angle orientation feedback control through one or a combination of angle sensor or angle encoder, shaft encoder, precision encoder, optical encoder, magnetic encoder, direction encoder, rotational encoder, chip encoder, tilt sensor, inclination sensor, or pitch sensor. Note that the tracker's elevation or zenith axis angle may measured using an altitude angle-, declination angle-, inclination angle-, pitch angle-, or vertical angle-, zenith angle- sensor or inclinometer. Similarly the tracker's azimuth axis angle be measured with a azimuth angle-, horizontal angle-, or roll angle-sensor. Chip integrated accelerometer magnetometer gyroscope type angle sensors can also be used to calculate displacement. Other options include the use of thermal imaging systems such as a Fluke thermal imager, or robotic or vision based solar tracker systems that employ face tracking, head tracking, hand tracking, eye tracking and car tracking principles in solar tracking. With unattended decentralised rural, island, isolated, or autonomous off-grid power installations, remote control, monitoring, data acquisition, digital datalogging and online measurement and verification equipment becomes crucial. It assists the operator with supervisory control to monitor the efficiency of remote renewable energy resources and systems and provide valuable web-based feedback in terms of CO₂ and clean development mechanism (CDM) reporting. A power quality analyser for diagnostics through internet, WiFi and cellular mobile links is most valuable in frontline troubleshooting and predictive maintenance, where quick diagnostic analysis is required to detect and prevent power quality issues. Solar tracker applications cover a wide spectrum of solar applications and solar assisted application, including concentrated solar power generation, solar desalination, solar water purification, solar steam generation, solar electricity generation, solar industrial process heat, solar thermal heat storage, solar food dryers, solar water pumping, hydrogen production from methane or producing hydrogen and oxygen from water (HHO) through electrolysis. Many patented or non-patented solar apparatus include tracking in solar apparatus for solar electric generator, solar desalinator, solar steam engine, solar ice maker, solar water purifier, solar cooling, solar refrigeration, USB solar charger, solar phone charging, portable solar charging tracker, solar coffee brewing, solar cooking or solar drying means. Your project may be the next breakthrough or patent,

but your invention is held back by frustration in search for the sun tracker you require for your solar powered appliance, solar generator, solar tracker robot, solar freezer, solar cooker, solar drier, solar pump, solar freezer, or solar dryer project. Whether your solar electronic circuit diagram include a simplified solar controller design in a solar electricity project, solar power kit, solar hobby kit, solar steam generator, solar hot water system, solar ice maker, solar desalinator, hobbyist solar panels, hobby robot, or if you are developing professional or hobby electronics for a solar utility or micro scale solar powerplant for your own solar farm or solar farming, this publication may help accelerate the development of your solar tracking innovation. Lately, solar polygeneration, solar trigeneration (solar triple generation), and solar quad generation (adding delivery of steam, liquid/gaseous fuel, or capture food-grade CO₂) systems have need for automatic solar tracking. 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maximize the yields of solar power plants through solar tracking control to harness sun's energy. In such renewable energy systems, the solar panel positioning system uses a sun tracking techniques and a solar angle calculator in positioning PV panels in photovoltaic systems and concentrated photovoltaic CPV systems. Automatic on-axis solar tracking in a PV solar tracking system can be dual-axis sun tracking or single-axis sun solar tracking. It is known that a motorized positioning system in a photovoltaic panel tracker increase energy yield and ensures increased power output, even in a single axis solar tracking configuration. Other applications such as robotic solar tracker or robotic solar tracking system uses robotica with artificial intelligence in the control optimization of energy yield in solar harvesting through a robotic tracking system. Automatic positioning systems in solar tracking designs are also used in other free energy generators, such as concentrated solar thermal power CSP and dish Stirling systems. The sun tracking device in a solar collector in a solar concentrator or solar collector Such a performs on-axis solar tracking, a dual axis solar tracker assists to harness energy from the sun through an optical solar collector, which can be a parabolic mirror, parabolic reflector, Fresnel lens or mirror array/matrix. A parabolic dish or reflector is dynamically steered using a transmission system or solar tracking slew drive mean. In steering the dish to face the sun, the power dish actuator and actuation means in a parabolic dish system optically focusses the sun's energy on the focal point of a parabolic dish or solar concentrating means. A Stirling engine, solar heat pipe, thermosyphin, solar phase change material PCM receiver, or a fibre optic sunlight receiver means is located at the focal point of the solar concentrator. The dish Stirling engine configuration is referred to as a dish Stirling system or Stirling power generation system. Hybrid solar power systems (used in combination with biogas, biofuel, petrol, ethanol, diesel, natural gas or PNG) use a combination of power sources to harness and store solar energy in a storage medium. Any multitude of energy sources can be combined through the use of controllers and the energy stored in batteries, phase change material, thermal heat storage, and in cogeneration form converted to the required power using thermodynamic cycles (organic Rankin, Brayton cycle, micro turbine, Stirling) with an inverter and charge controller.

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