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Advancement in Technology for Energy saving in Electronic Devices

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ABSTRACT

It will be extremely difficult to keep energy services at their current levels for the next 25 to 50 years. Global forces like rising economic activity in developing nations, geopolitical unrest in the major energy-producing nations, and environmental dangers brought on by rising emissions and global temperatures all put it in jeopardy. Global energy demand and associated CO2 emissions are expected to rise by more than 50% over the next 25 years. Energy-efficient appliances can cut worldwide electricity consumption, even though an increase in the quantity and ownership of appliances is anticipated, according to the IPCC's Fifth Assessment Report. The International Energy Agency (IEA) anticipates a significant increase in both the number of newly installed appliances and traditional appliance energy efficiency (refrigerators, washing machines, televisions, etc). (Also called plug loads). Research on this topic is expanding in developed regions (North America and Europe) and even more in some developing regions (Asia Pacific), with a strong focus on China and India, according to the information processing study of publications about energy-efficient appliances conducted in this paper. According to the findings, policies are often adopted between three and thirty years before the majority of publications on the subject. Yet, the pattern appears to be shifting with articles pertaining to new appliances where the primary investigation takes place quickly.

Keywords: Energy Efficiency; appliance; climate change; policies; electronic devices; Electric Automation

INTRODUCTION

Currently, power plants around the world transform primary energy with an efficiency of approximately 35%, making it useable (or transmittable) energy. By swapping out outdated conversion and transmission methods for cutting-edge semiconductor technology, that efficiency rating may be raised to 45 percent. Another area that can be enhanced by the adoption of cutting-edge technologies and better management techniques is transmission and distribution, where technical losses can reach 10%. Immediate action is required in order to accomplish the goals outlined in the sustainable development goals. In addition, a variety of tactics should be used to achieve thorough decarbonization, including the utilisation of clean energy sources and effective methods for managing and converting energy[1]. Yet the building industry, which makes up approximately 40% of all businesses, need special attention The IEA (International Energy Agency) estimates that appliances account for 17% of the total electricity used in houses [3]. Also, during the past 20 years, the energy consumption of building appliances has increased, with low growth in highly developed regions like North America and the European Union and fast growth of four to eight times the values attained in 2000 in places like China, India, and the Middle East (Figure 1). Only a third of today's appliance energy use is governed by legally required performance requirements. Energy-efficient appliances can lower the anticipated electricity demand caused by the growth of appliance types and their increased ownership and use, according to the IPCC's 5th Assessment report [4]. and and to help accomplish this goal, legislative measures are available, such as appliance standards with strict energy efficiency criteria. The nine nations with the longest-running EES&L (Energy Efficiency Standards and Labeling) programs—the United States, European Union, China, India, Brazil, Australia, Mexico, South Africa, and Malaysia—reduced their yearly electricity usage in 2018 by 1580 TWh. This is equivalent in magnitude to the whole amount of power generated in various nations by solar and wind energy.

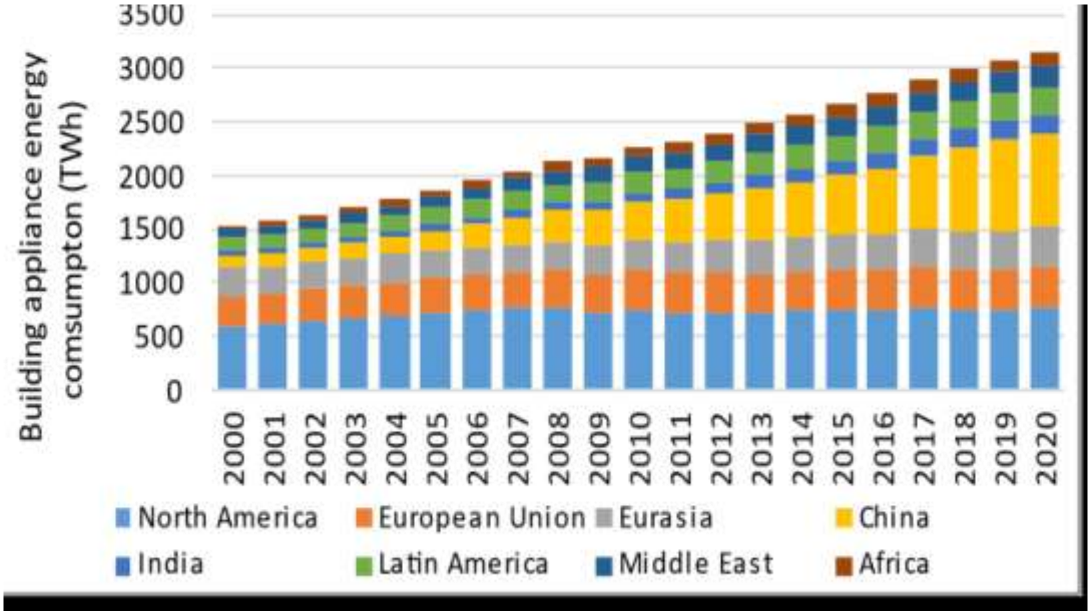

Figure 1: Energy consumption of building appliances by region. Data extracted from IEA

Energy conservation in the electronic industry has become a popular goal. A performance metric of competitiveness alongside price, speed, bandwidth, and dependability is energy conservation. This has an impact on component and electronic system-based mechatronic system research and development. So that better planning may be made for the future, a review of technological trends for electronic systems and devices is required. With the information we currently have, we can estimate how much energy is used by various industries.

Sector of Transportation: The majority of the ultimate usable energy used in this sector, or 27%, is derived from liquid fuels. By using a variety of technologies, such as weight reduction, reduced friction and drag, and the widespread usage of diesel and hybrid electric vehicles (HEV), it is possible to increase a vehicle's fuel efficiency by up to 40%.

INDUSTRIAL SECTOR: The industrial sector consumes up to 51% of the given energy that is useable. The use of effective motor systems with variable speed drives, process optimisation in systems with many components, and improved monitoring and process control could result in energy savings of 40–60%.

Residential and commercial sectors: When these industries are considered collectively, delivered energy use can reach up to 23%. There are numerous ways to lower the energy demand by 50 to 80 percent, including the use of energy-efficient appliances, lighting, cooling, and other systems, as well as decreased standby losses and enhanced energy efficiency.

From the year 2000, there has been a significant increase in ownership and use of appliances including refrigerators, washing machines, TVs, and computers, which has been offset by improvements in energy efficiency. Digitalization is also necessary for structures that house more energy-efficient technologies. Table 1 displays the global final energy consumed by various appliances from 2000 to 2017 together with the contributions made by each individual driver (activity, structure, and efficiency). The energy efficiency reflects changes in sub-sectoral energy intensities, or the amount of energy used per unit of activity, while the structure effect reflects changes in the mix of activities within a sector (such as appliance stocks per person). The activity driver is determined by changes in the overall level of activity that drives energy consumption (i.e., population).also demonstrates changes in sub-sectoral energy intensities, or the amount of energy utilized for each unit of activity (i.e., appliance energy per appliance stocks). It is evident that older appliances (such as refrigerators, freezers, televisions, etc.) have relatively little of an effect on the growth of overall energy intensity, which is caused by newer appliances, also known as plug loads. On the other hand, classic appliances will have the greatest rise in energy efficiency.

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Table 1. Worldwide energy intensity improvements in appliances in the period 2000–2017 .

Appliance Type	Total (EJ)	Activity (EJ))	Structure (EJ)	Efficiency (EJ)
Appliance	**+ 4.6**	**+3.5**	**+1.6**	**-0.5**
Refrigerator	**+0.2**	**+0.7**	**+0.1**	**-0.6**
Freezer	**0.0**	**+0.1**	**0.0**	**-0.1**
Dishwasher	**+0.1**	**+0.1**	**0.0**	**0.0**
Washing Machine	**+0.1**	**+0.2**	**0.0**	**-0.1**
Clothes Dryer	**+0.1**	**+0.1**	**0.0**	**-0.1**
Television	**-0.4**	**+0.6**	**+0.4**	**-1.4**
Plug Load	**-3.6**	**+1.7**	**+2.1**	**0.0**

These days, the idea of energy efficiency has governed the creation of portable and fast apps, not to mention the growth of the semiconductor sector. The semiconductor sector is the focus of several nations. For instance, the semiconductor sector in Japan is more focused on home appliances, while SEMI Europe is more focused on automotive, industrial 4.0, and medical technology [2]. The growth of semiconductor technology, which is driven by a high demand for new product features, is parallel to the development of electronic technology. Electronic devices are becoming more dependable and effective because to complementary metal-oxide semiconductor (CMOS), the greatest semiconductor technology with low power consumption.

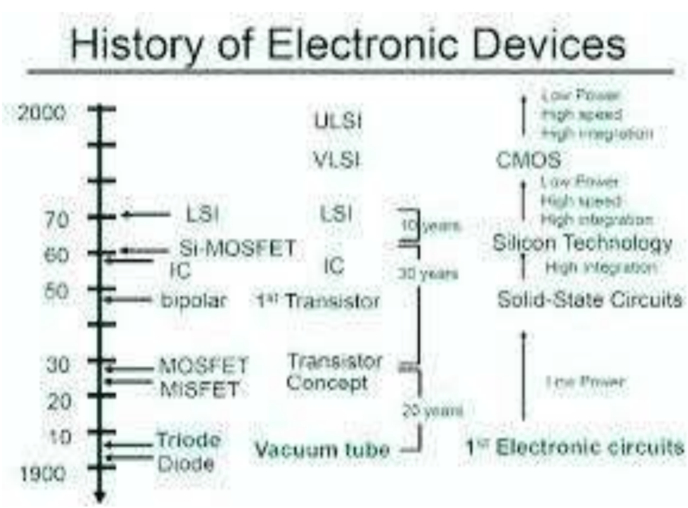
With a focus on power efficiency and dependability, this paper offers a summary of the development of electronic systems and devices. These days principal of energy efficiency has enforced technology development to produce portable and high speed applications not to mention in semiconductor industry development. Each country has different focus on semiconductor industry. For example, SEMI Europe is focusing more on automotive, industry 4.0 and Med Tech while, semiconductor industry in Japan is focusing on household appliances [2]. The development of electronic technology is parallel to the development of the semiconductor industry which is triggered by high demand of new features of a product. Complementary metal-oxide semiconductor (CMOS) as the best semiconductor technology with low power consumption is producing more reliable and more efficient electronic devices.

This paper presents a review on electronic devices/components and electronic systems development with the focus on power efficiency and reliability.

Reviews

Electronics and Semiconductors-

The development of electronic devices began in the 20th century, existing innovations were inspired by semiconductors and electronic parts. Vacuum tubes and transistors are the three primary components that are used, as well as integrated circuit.



The size of a component is larger than 1 mm in the hoover tube period. Low voltage, small-diameter transistors have taken the position of vacuum tubes. Diode, transistor, field-effect transistor (FET), junction gate field-effect transistor (JFET), metal-oxide semiconductor field-effect transistor (MOSFET), and integrated circuit are the most common semiconductor components (IC). Discrete electronic circuits are those in which the components are mounted on a printed circuit board (PCB). ICs are electronic circuits that have their parts printed inside silicon chips. The comparison of electronic circuit design utilizing integrated circuits is commonly depicted in Table 1 to provide background information on how electronic devices develop.

Table 2. Discrete vs integrated circuit design

Activity/Item	**Discrete**	**Integrated**
Component Accuracy	Well known	Poor absolute accuracies
Breadboarding	Yes	No (kit Parts)
Fabrication	Independent	Very dependent
Physical Implementation	PC layout	Layout, verification and extraction
Simulation	Model parameters well know	Model parameters vary widely
Testing	Generally complete testing is possible	Must be considered before design
Computer Aided Design (CAD)	Schematic capture, Simulation, PC Board Layout	Schematic Capture, Simulation, extraction, layout and Routing
Components	All possible	Active devices, capacitor

We know that as compared to discrete circuit, IC consumes lower, faster and better for signal related application. Generally, packaging standard of semiconductors is based on Joint Electron Device Engineering Council (JEDEC) and Japan Electronic and Information Technology Industries Association (JEITA), whereas some companies use their own. Some purpose based semiconductor packages are available. Semiconductor packaging available nowadays is also for surface mount package.

Semiconductor Industry

Semiconductor industry, which is now an inseparable part of almost all sectors, has emerged as one of the most important industries. It forms an essential part of all electronic items. It defines how efficiently and smartly we live.India has become the hub for semiconductor design with nearly 2,000 chips being designed per year and more than 20, 000 engineers are working in various aspects of chip design and verification. Semiconductor industry is basically divided into fables, which deals with designing and fabrication part, also called the semiconductor foundry, where the final microchip is manufactured. Within semiconductor design, there is very large scale integration (VLSI) design, embedded software and electronic design automation (EDA).

Nanotechnology

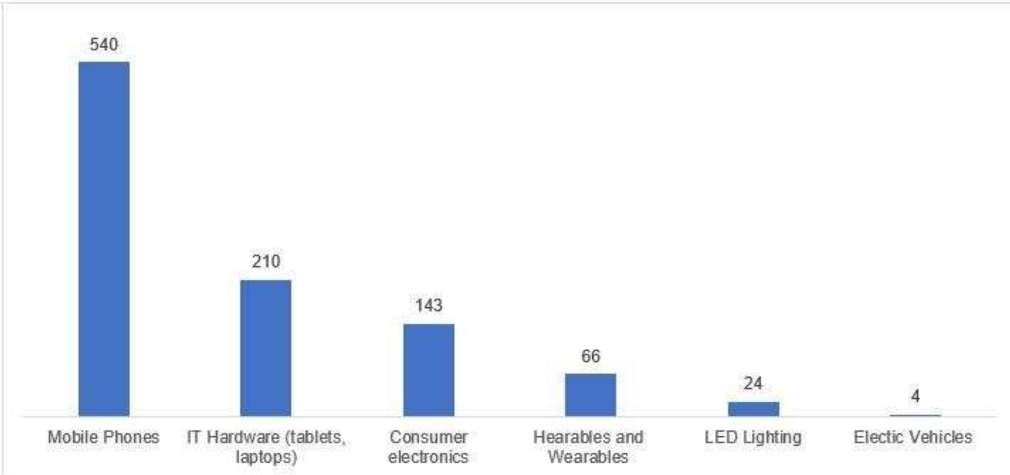
- It is the manipulation of matters at atomic level in order to produce novel materials and devices with new extraordinary properties.
- Basic concept of nanotechnology: Behaviour of matters changes significantly when the surface area to volume ratio increases dramatically.
- Properties of materials are size dependent i.e. melting point, electrical conductivity, magnetic and chemical properties vary at Nano scale range and follow ―the laws of quantum physics‖.
- Example: Some Polymers being insulators in the bulk form, they act like semiconductor in Nano scale.

Nowadays, miniaturization technology of semiconductor by using nanotechnology has been implemented in countries dominating global semiconductor industry, such as Europe, Japan, South Korea, Taiwan and United States .

Observation of Electronic Devices Development in India

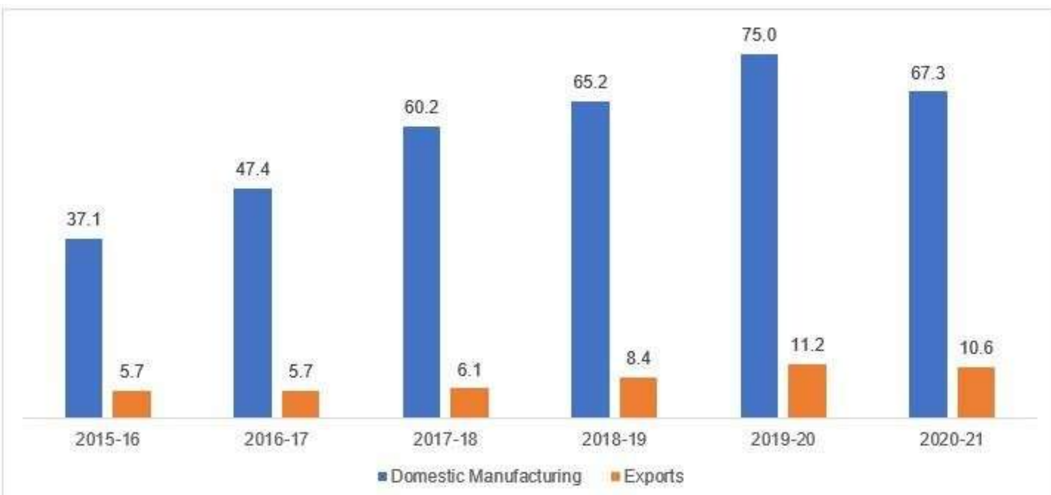
The Indian electronics industry is one of the most rapidly growing industries worldwide. Electronic products have continuously impacted and shaped our lifestyles in the current digital era. The advent of technology has led to seamless activities and accelerated the digital revolution to the next level. Furthermore, demand for electronic devices is anticipated to rise steadily and continue to be a key economic driver worldwide.

Global market share of key product segments in 2020-21 (US$ billion)



India has been one of the pioneers of the Local Goes Global movement. The country is focusing on developing its share in the global value chain, establishing export hubs in different states, constructing a high-quality and seamless supply chain, and increasing its overall market share in the electronics export market.

India's electronic goods exports and production by value (US$ billion)



Electric energy saving automation control system

Electric energy-saving automatic control system is composed of motor and power supply, detection, control device composed of feedback control system, can automatically complete the energy conversion and control the necessary information processing. The electric energy saving automatic control system has the control device which may turn on or off the circuit according to the external signal request, change the parameter, realize the control circuit to the circuit or the non-electric parameter. Mainly in: the DC system and LPS system monitoring; control and operation of the generator and security power supply; control and operation of the transformer; for the 380V low-voltage plant monitoring and operation; on the excitation, demagnetization operation, control mode switch; On the variable group excitation transformer protection and control functions. Electric energy-saving automation systems are often have a simple operation of the control panel through the button to operate, electrical energy-saving automation equipment often work on the dynamic information real-time tracking records, and do a certain storage records, you can make a certain correlation report. Electric energy-saving automation control often through the frequency control, direct start and star or triangular start control, so that can ensure the stable operation of production equipment, if found to be wrong, the operator will be able to immediately make chain control. The range of energy-efficient design technologies for electrical automation is extensive, such as industry, agriculture, and defense. The healthy development of energy-saving design technology of electric automation will make our country's economic development have a greater breakthrough, increasingly meet people's requirements for electrical energy. In order to meet the requirements of the times many colleges and universities have also set up the electrical automation of energy-saving design technology, professional knowledge and real life are closely linked, recently learn more and more automated control technology, Get gradually improved. The development of energy-saving design of electrical automation is conducive to improving people's living standards, while promoting the development of China's economy.

The technical focus of energy - saving design in the process of electrical automation under the new situation-

According to the laws of physics, energy in the transmission process will be due to resistance, distance, and other factors to produce a certain loss in the building of electrical automation, and the foundation of electrical automation is the high efficiency of energy, low pollution transmission. One of the most important technical components is to reduce transmission loss in order to increase power transmission efficiency, lower transmission costs, and eliminate potential pollution and risks. On the one hand, the electrical automation process uses a safe alloy material as a wire material, reducing power transmission and process loss while regulating the resistance loss across the complete electrical automation system On the other hand, the process of electrical automation optimises the wiring of the wire by shortening the wire, optimising the power supply distance, changing the load distribution form, and using other technical means to regulate the power in the electrical automation system in the loss and waste. Also, you can raise the electrical cross-section of the electrical equipment in accordance with the physical formula in order to lower the system's resistance and effectively manage the amount of energy used during transmission. Several different transformer types must be used in the course of electrical automation, and in order to achieve energy-saving goals for electrical automation, the transformer must also be established, chosen, and used scientifically .In order to reduce active loss from the transformer and accomplish energy-saving electrical automation development goals, energy-saving transformers are the desired target in the building of electrical automation.

On the other hand, the process of electrical automation involves more than just a straightforward electrical mechanical addition to manage the three-phase current transformer balance. It also involves optimizing the circuit load and the design and construction of the electrical automation system. In order to achieve electrical automation and energy conservation, the transformer ontology energy consumption must be controlled from a bigger system. Also, in the electrical automation system, rational compensation transformer use allows for further optimization of power and energy usage, avoiding imbalance and difficulties with imbalance that result from problems with excessive energy use. An essential energy-saving technique and practices used in the development of electrical automation is reactive power compensation. Reactive power adjustment is therefore necessary. Reactive power compensation is a crucial fundamental energy-saving method and measure in the electrical automation process. Therefore, uses of technology that is acceptable and focused. The following factors should be taken into consideration when applying reactive power compensation technology to electrical automation systems: on the one hand, the capacitor should be chosen based on capacity standards, taking into account factors such as electrical power equipment, power factor, electrical automatic system capacity, electrical automatic system load, and other parameters, using mathematical calculations to get the precise quality output.

On the other hand, selecting intelligent compensation equipment will enable smooth adjustment, complete tracking, and a full spectrum of adaption, improving the quality and effect of the compensation and enabling energy savings and stable electrical safety guarantee. Moreover, "local compensation" is a fundamental concept in the design and installation of reactive power compensation equipment, and it is used to simultaneously reduce network and system reactive power loss and operate the electrical automation system in an energy-efficient manner. Volume 150 of Advances in Engineering Research 36 The hazard and energy consumption of big harmonics in the electrical automation system will increase as a result of the various equipment and sophisticated operations system Electrical automation systems use filtering technology intelligently to minimize operation, current oscillation, and frequency fluctuations brought on by damaging harmonics in order to fulfill the fundamental goals of electrical automation and energy savings. Pay close attention to the following factors while choosing a filtering technology: On the one hand, the electrical automation system can use reactive power compensation measures to effectively suppress and eliminate the impact of harmonics, providing the electrical automation systems and equipment with effective protection and enabling the development of energy-saving technologies. Active filters are preferred in electrical automation systems due to their dynamic stability, versatility, and wide range of advantages. On the other hand, in the electrical automation system, the use of filtering technology to prevent the application of the main points that can be applied incorrectly operation and equipment before the operation to start the filter function, which will ensure that the electrical automation function is achieved at the same time, to achieve electrical automation equipment Of energy-saving operation.

Current Status and Development Trend of Electric Energy Saving Automation Control

Current State of Electric Energy Saving Automated Control. The primary monitoring modes for electric energy-saving automation control systems include field bus monitoring, remote monitoring, and centralized monitoring. The system's different activities are centered on a processor in centralized control mode, which is frequently simple to operate and maintain. Remote monitoring, which mostly uses energy-efficient cable to save installation costs and provide high dependability, is the primary application. Monitoring a limited system. Field bus monitoring techniques are frequently more focused on system design. In addition to the benefits of remote monitoring, these techniques can also drastically minimize the amount of effort required. At this time, the benefit of centralized control is that it is simple to use and maintain. The system's functions are gathered into one processor and processed there in the centralized control mode. Development of Automated Electric Energy Saving Control. Electrical automation design technology's evolution and its unique properties are intricately intertwined. The development of energy-saving design technology for electric automation took a diversion prior to technological immaturity, but current energy-saving automation technology has already caught up with development and is used in actual production along with a wide range of information technology applications. Computer-based local or global electrical energy conservation control has become one of the main focuses of electrical energy automation. As science and technology advance at an ever-increasing rate, automation follows, with applications for virtual reality and video processing becoming increasingly widespread. The condition of automation control systems will be significantly improved, and technologies like computers, networks, and multimedia offer a wide range of potential applications. Reactive power in the power distribution equipment uses up a lot of capacity during system operation, leading to a scenario of increased energy consumption that not only negatively impacts voltage but also the overall quality of the power supply. Reactive power is primarily used by the user. Computer-based local or global electrical energy conservation control has become one of the main focuses of electrical energy automation. As science and technology advance at an ever-increasing rate, automation follows, with applications for virtual reality and video processing becoming increasingly widespread. The condition of automation control systems will be significantly improved, and technologies like computers, networks, and multimedia offer a wide range of potential applications. Reactive power in the power distribution equipment uses up a lot of capacity during system operation, leading to a scenario of increased energy consumption that not only negatively impacts voltage but also the overall quality of the power supply. Reactive power is primarily used by the user..

Reactive power is primarily expressed for the user as low power, and when the power is too low, the user must pay a certain amount in fines to the appropriate departments. If you can use the correct equipment for reactive power compensation, you can ensure the power of the balance and significantly enhance the quality of the power supply. To maintain the safe operation of electrical engineering, staff members work to reduce excessive electricity loss. The electrical energy produced by the motor cannot be better absorbed by the transformer if the wire is influenced by resistance; instead, the electrical energy that has not been absorbed during the transfer of current will be discharged.You can allow the capacitor and reactive power to balance each other out because reactive power simultaneously produced a certain role. Voltage capacity, voltage load, natural power, target power, and other criteria must be used to estimate the capacitor when using capacitors in reactive power compensation (in the case of reactive power compensation) to establish the parameters of the physical quantity of reactive current and power parameters in order to switch phenomenon effectively avoid the requirement for a number of quantitative reactors to remove harmonics.

CONCLUSIONS

The information era has arrived in current human society as a result of the quick advancement of modern science and technology. The rapid advancement of science and technology has aided in the automation and informationizion of society. Automation control technology is being developed to increase automation speed and development speed in an effort to improve the current state of energy-efficient design technology for electric automation.

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