

CEEAMA NEWS

CEEMATECH 2019 Special Edition

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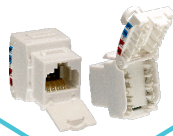
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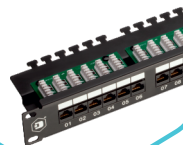
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CONTENTS

Message from President	ii	Important Transformer Fault Conditions and How to Protect from Them	23
Message from Hon. Secretary	iii		
CEEAMA Governing Council	iv	Reactive Power and Blended Approach in Reactive Power Compensation Design with specific reference to New MSEDCL Policies and KVAH Billing	26
Articles			
Brushless D.C. Motor, Construction & Operating Principles	1	CEEAMATECH - 2019 Exhibitors' List & Exhibitors' Profiles	31
Fire retardant or fire-resistant cables	7		
Electrical Safety	8		
Lightning Protection of Tall Buildings	12	CEEAMA 2018-19 Activities	49
Power Loss in MCB	16		
Surge Protection Devices (SPD) Selection (IEC 61643)	21	CEEAMATECH - 2019 Layout Plan (Inside Back Cover)	C3

Message from Hon. President



Dear All,

I am proud to be part of CEEAMA, which has Knowledge sharing as its core value. As consultants, we must live this value every day — through our thoughts, words and actions.

As you are aware CEEAMA is growing day by day. In my opinion, the most important factor which has played a role in the growth of CEEAMA, is honesty and fairness of the members in Governing Council (GC). This has resulted in providing better programs to our members. Considering the sustainability, we have been little cautious about the growth opportunity and taken the path, which may appear little conservative, but will lead to the sustainable growth of CEEAMA.

I've been delighted with the team's performance for CEEAMATECH-2019. This is an excellent complimentary for spreading our moto of Knowledge sharing. Our efforts are reforming CEEAMA, which is bringing in more visibility of CEEAMA and will make CEEAMA more vibrant in near future.

I want to again say how proud I am of the very talented, committed and dedicated CEEAMA GC MEMEBRS. Thanks for your support and efforts.

We have initiated CEEAMA-E-News, which is reaching 5000 plus, practicing electrical engineers. CEEAMA-E-News contents include Technical article(s), latest technological developments, New Product Launch, upcoming CEEAMA events, etc..

CEEAMA being registered as No profit-No loss company, Financial strength is not our motto. However, to achieve our goals, we need to be financially strong. For last few years, we have taken cautious efforts to make our financial position strong enough, which will support us to achieve our goals.

Several multinationals are becoming Asia centric with India as hub, thus heavily investing. This will definitely boost talent development opportunities as well as material exports from India. With this we are looking forward to tap this opportunity for our members, be Life Fellow Members, Patron Members or Associate Members, using CEEAMA as platform. In future, while designing knowledge based program, this aspect will also be considered.

I appreciate the efforts of each one of you to support and strengthen CEEAMA, in its mission of knowledge sharing, by your involvement, like writing articles / writeups, conducting knowledge sharing sessions, involvement in CEEAMA general administration, active participation in the programs organised by CEEAMA.

On behalf of CEEAMA GC, I once again assure you our commitment to raise our bars and take CEEAMA to altogether different level.

Thank You.

Anil Bhandari

Hon. President CEEAMA

Message from Hon. Secretary



Dear All,

I am happy to welcome all of you to the 7th edition of CEEAMATECH2019-Consultants Choice. Every exhibition is becoming better and better. It is found that in western India the customer and vendors can meet in this particular exhibition. Large number of people from electrical and related to electrical field visit the exhibition to update their knowledge, explore the new changes of technology, witness the live demonstration of the technology and look at the products showcased by the prominent players in electrical industry.

This year in the exhibition a new concept of B2B meeting with consultants and the vendors is arranged. As per the available information more than 50 consultants from various parts of Maharashtra will be available at the venue at a designated time for vendors to meet. The procedure of meeting is also simple. All should take advantage of the same.

I appeal to all CEEAMA members to make a point to visit the exhibition and promote others to visit. The products and information gathered in the exhibition will be more useful in day-to-day working.

CEEAMA is aiming to conduct the programme useful for consultants as well as the engineers working with consultants. Please do come forward and suggest the topic of interest, CEEAMA will definitely arrange the programme on the same. My sincere request to all members please attend the programmes arranged by CEEAMA in good numbers. This will encourage the vendors and CEEAMA GC to arrange more such programmes.

I personally thank all the Platinum co-hosts, Gold co-hosts and stall holders and organizations for their active support. Without their support this exhibition would not have taken place. I thank M/s. FairAct for excellent arrangement of the exhibition. Finally, I thank all of those who will visit the exhibition and make it a successful event.

With best regards.

Suhas Keskar

Hon. Secretary CEEAMA



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BRUSHLESS D.C. MOTOR, CONSTRUCTION & OPERATING PRINCIPLES

AUTHOR



Mr. K. S. Chandavar

Introduction

India has always been hit hard due to the ever increasing demand for fuel. India imports about 80% of its overall crude oil requirement. In view of this the government has set the timelines and the roadmap for the policy to shift one-third of the petrol and diesel vehicles to electric fleet by 2030.

Although, AC induction motors are used by major manufactures like 'Tesla', DC brushless motors are also used by some others. In this article we shall see how a Brushless DC motors, popularly known as BLDC motors, are constructed and operated.

Recently many manufacturers of ceiling fans have come out with energy efficient versions using BLDC motors. Similarly some manufacturers of HVLS fans (high volume low speed) are using BLDC motors.

This article will concentrate on the following aspects of BLDC motor design:

- Construction of the BLDC motor
- Operation of the BLDC motor
- Torque and Efficiency requirements
- Comparison with Induction and Brushed DC motors
- Motor control – Speed, Torque & Protection.
- Applications for a BLDC motor

Construction

BLDC motors have many similarities to AC induction motors and brushed DC motors in terms of construction and working principles respectively. Like all other motors, BLDC motors also have a rotor and a stator.

Stator

Similar to an Induction AC motor, the BLDC motor stator is made out of laminated steel stacked up to carry the windings. Windings in a stator can be arranged in two patterns; i.e. a star pattern (Y) or delta pattern (Δ). The major difference between the two patterns is that the Y pattern gives high torque at low RPM and the Δ pattern gives low torque at low RPM. This is because in the Δ configuration, half of the voltage is applied across the winding that is not driven, thus increasing losses and, in turn, efficiency and torque.

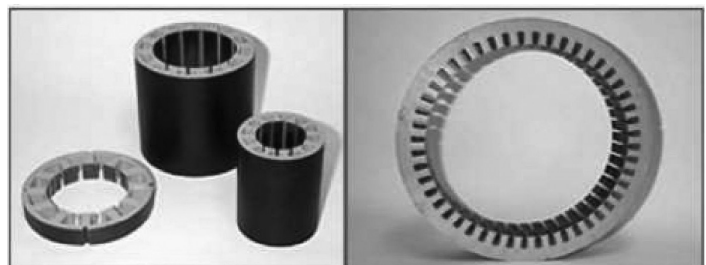


Figure 1: Laminated steel stampings - Stator

Steel laminations in the stator can be slotted or slotless as shown in Figure 2. A slotless core has lower inductance, thus it can run at very high speeds. Because of the absence of teeth in the lamination stack, requirements for the cogging torque also go down, thus making them an ideal fit for low speeds too (when permanent magnets on rotor and tooth on the stator align with each other then, because of the interaction between the two, an undesirable cogging torque develops and causes ripples in speed). The main disadvantage of a slotless core is higher cost because it requires more winding to compensate for the larger air gap.

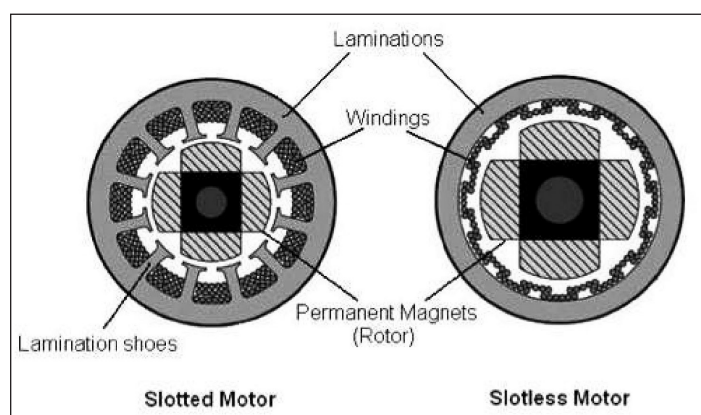


Figure 2: Slotted & Slotless Motor

Proper selection of the laminated steel and windings for the construction of stator are crucial to motor performance. An improper selection may lead to multiple problems during production resulting in market delays and increased design costs.

Rotor

The rotor of a typical BLDC motor is made out of permanent magnets. Depending upon the

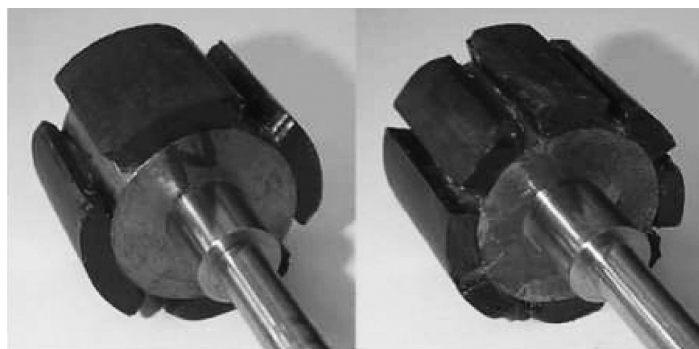


Figure 3: 4 pole and 8 pole - Permanent magnet rotor

application requirements, the number of poles in the rotor may vary. Increasing the number of poles does give better torque but at the cost of reducing the maximum possible speed.

Another rotor parameter that impacts the maximum torque is the material used for the construction of permanent magnet; the higher the flux density of the material, the higher the torque.

Working Principles and Operation

The underlying principles for the working of a BLDC motor are the same as for a brushed DC motor; i.e., internal shaft position feedback. In case of a brushed DC motor, feedback is implemented using a mechanical commutator and brushes. With a BLDC motor, it is achieved by electronic commutation using multiple feedback sensors. The most commonly used sensors are hall sensors and optical encoders.

Note: Hall sensors work on the hall-effect principle that when a current-carrying conductor is exposed to the magnetic field, charge carriers experience a force based on the voltage developed across the two sides of the conductor. If the direction of the magnetic field is reversed, the voltage developed will reverse as well.

For Hall Effect sensors used in BLDC motors, whenever rotor magnetic poles (N or S) pass near the Hall sensor, they generate a HIGH or LOW level signal, which can be used to determine the position of the shaft.

In a commutation system – one that is based on the position of the motor identified using feedback sensors – two of the three electrical windings are energized at a time as shown in figure 4. In figure 4 (A), the GREEN winding labeled “001” is energized as the NORTH pole and the BLUE winding labeled as “010” is energized as the SOUTH pole. Because of this excitation, the south pole of the rotor aligns with the GREEN winding and the North Pole aligns with the RED winding labeled “100”. In order to move the rotor, the “RED” and “BLUE” windings are energized in the direction shown in figure 4(B). This causes the RED winding to become the North Pole and the BLUE winding to become the South Pole. This shifting of the magnetic field in the stator produces torque because of the development of repulsion

(Red winding – NORTH-NORTH alignment) and attraction forces (BLUE winding – NORTH-SOUTH alignment), which moves the rotor in the clockwise direction.

This torque is at its maximum when the rotor starts to move, but it reduces as the two fields align to each other. Thus, to preserve the torque or to build up the rotation, the magnetic field generated by stator should keep switching. To catch up with the field generated by the stator, the rotor will keep rotating. Since the magnetic field of the stator and rotor both rotate at the same frequency, they come under the category of synchronous motor.

This switching of the stator to build up the rotation is known as commutation. For 3-phase windings, there are 6 steps in the commutation; i.e. 6 unique combinations in which motor windings will be energized.

Driving circuitry and waveforms for the implementation of a BLDC motor will not be discussed in this article.

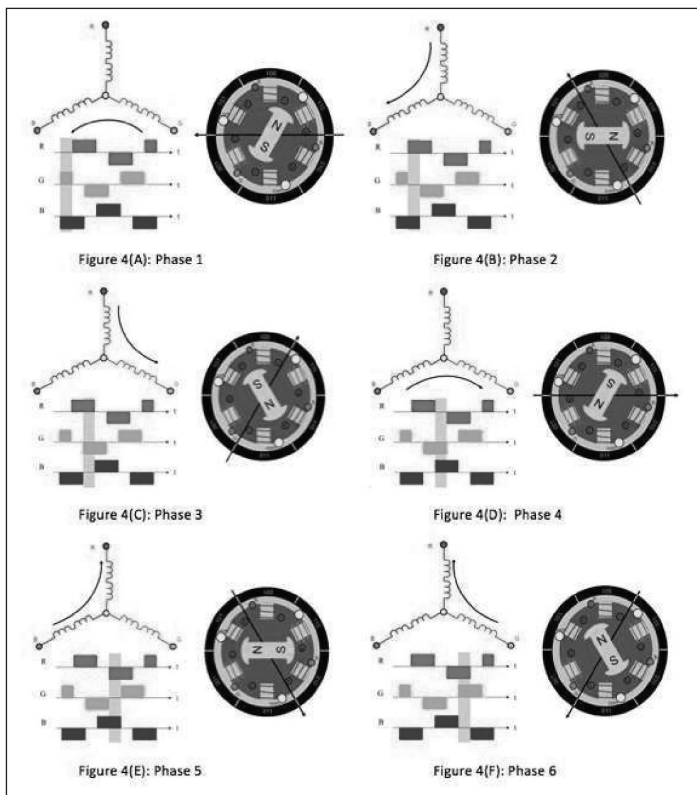


Figure 4

Torque and Efficiency

For the study of electric motors, torque is a very important term. By definition, torque is the tendency of force to rotate an object about its axis. Thus, to increase the torque, either force has to be increased which requires stronger magnets or more current or distance must be increased for which bigger magnets will be required. Efficiency is critical for motor design because it determines the amount of power consumed. A higher efficiency motor will also require less material to generate the required torque. Where,

$$\text{Output Power} = \text{Torque} \times \text{Angular Velocity}$$

$$\text{Input Power} = \text{Voltage} \times \text{Current}$$

Having understood the above provided equations, it becomes important to understand the speed v/s torque curve.

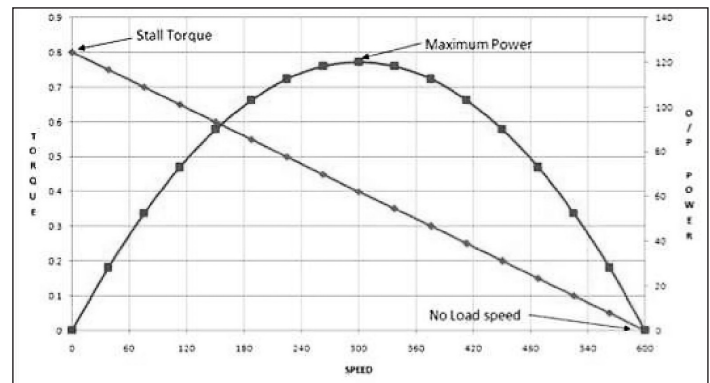


Figure 5: Speed-Torque-Power curve

Following are the observations from the graph shown in Figure 5:

- With an increase in speed, the torque reduces (considering the input power is constant)
- Maximum power can be delivered when the speed is half of the “no load” speed and torque is half of the stall torque.

Control & Protection of Brushless D.C Motor

Based on the functions served, motor control can be classified into following categories:

- Speed control
- Torque control
- Motorprotection

Comparison of BLDC motor with other motors

Feature	Brushless DC motor	Brushed DC motor	Induction Motor
Mechanical Structure	Field magnets on the stator and rotor are made of permanent magnets	Field magnets on the rotor and stator are made of permanent magnets or electromagnets	Both the rotor and stator have windings but the AC lines are connected to the stator
Maintenance	Low or no maintenance	Periodic maintenance because of brushes	Low maintenance
Speed-Torque characteristics	Flat – Operation at all speeds with rated load	Moderate – Loss in torque at higher speeds because of losses in brushes	Non-linear
Efficiency	High – No losses in the brushes; Stator is on the outer periphery and is thus able to dissipate more heat and produce more torque	Moderate – Losses in the brushes; Rotor is on the inner periphery	Low – Heat and current losses in both rotor and stator; High efficiency Induction motors are also available (higher cost)
Commutation method	Using solid state switches	Mechanical contacts between brushes and commutator	Special starting circuit is required
Speed range	High – No losses in brushes	Moderate – Losses in brushes	Low – Determined by the AC line frequency; Increases in load further reduces speed
Electrical noise	LOW	High – Because of brushes	LOW
Detecting method of rotor's position	Hall sensors, optical encoders, etc.	Automatically detected by brushes and commutator	NA
Direction reversal	Reversing the switching sequence	Reversing the terminal voltage	By changing the two phases of the motor input
Control requirements	A controller is always required to control the commutation sequence	No controller is required for a fixed speed; controller required for variable speed	No controller is required for a fixed speed; controller required for variable speed
System cost	High – Because of external controller requirement	Low	Low

Structure of Controller

The structure of controller for the BLDC motor is shown in the Figure-6. The BLDC motor controller consists of six power semiconductor devices connected across a DC supply. Feedback diodes are connected across the devices. Rotor Position Sensor (RPS) which is mounted on a shaft of the motor provides signal to the controller about the position of the rotor with respect to reference axis. The pulse width modulation (PWM) strategy is applied only to lower phase leg transistors.

This not only reduces the current ripple but also avoids the need for wide bandwidth in the level shifting circuit that feeds the upper leg transistors.

The upper transistors need not be of the same type as the lower ones and need only switch at the commutation frequency. This controller employs an inner current control loop within an outer speed loop. Consequently it is possible to implement current feedback and speed feedback in the same way as for normal DC motor and generally this results in a well behaved system although compensation may be necessary in either one or both loops to improve stability and transient response.

The purpose of the controller is to provide speed and/or torque control.

Speed control is achieved by monitoring motor speed and adjusting the applied phase voltage to maintain the desired speed.

Torque control is achieved by monitoring motor current. The motor current can be controlled to hold a constant value thus providing constant torque

Speed Control

Commutation ensures proper rotor rotation of the BLDC motor, while the motor speed depends only on the amplitude of the applied voltage. The amplitude of the applied voltage is adjusted by using the PWM technique. The required speed is controlled by a speed controller that is implemented as a conventional PI (Proportional Integral) controller. The difference

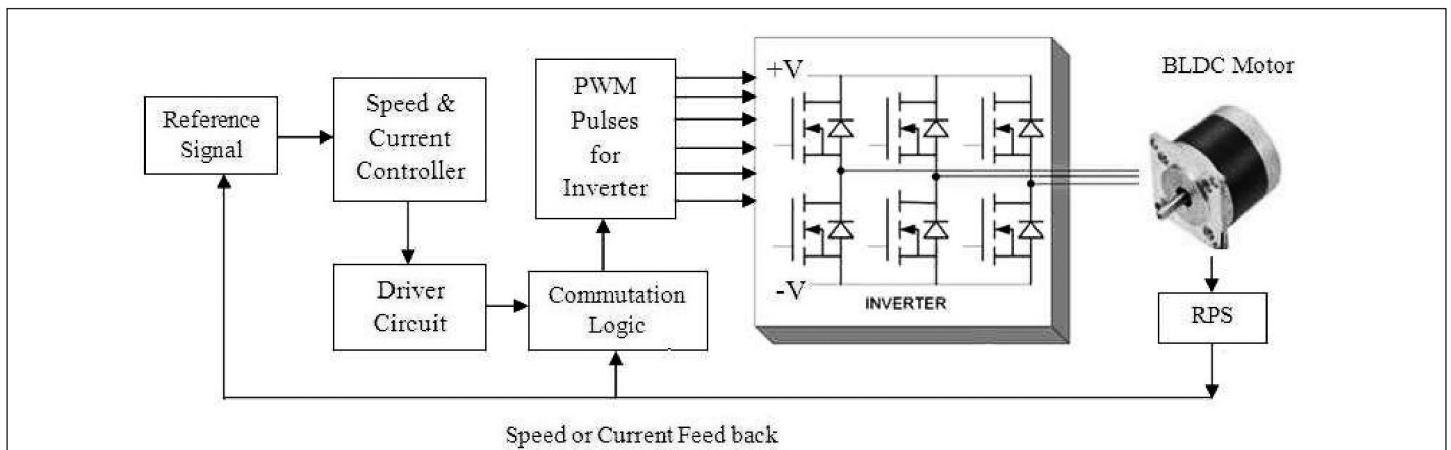


Figure 6: Structure Of Controller For BLDC Motor

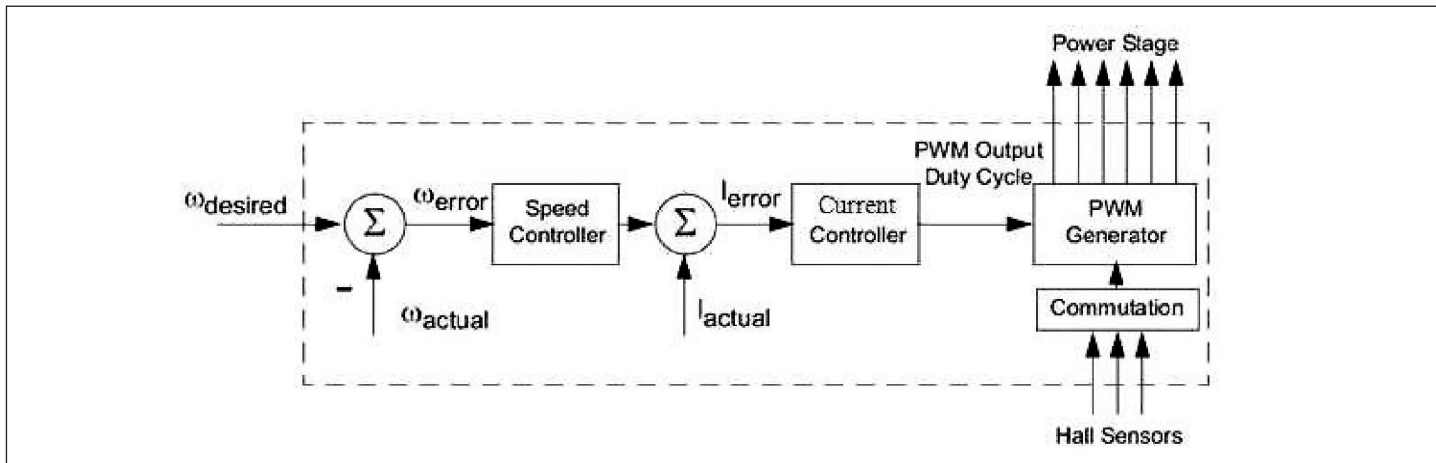


Figure 7: Block Diagram Of Speed Controller

between required speed and actual speed is the input to the PI controller and based on this difference the PI controller controls the duty cycle of PWM pulses which corresponds to the voltage amplitude required to keep the set speed.

Torque Control

For applications requiring the motor to operate with a specified torque regardless of speed (e.g. in line tensioning), a current controller can be used, since torque is directly proportional to current. In this mode, the speed will be held at a value set by the speed reference signal for all loads upto the point where the full armature current is needed. If the load torque increases further, the speed will drop because

current loop will not allow more armature current to flow. Conversely, if the load attempted to force the speed above the set value, the motor current will be reversed automatically, so that the motor acts as a brake and regenerates power into the mains. The current controller is implemented as a PI controller. The output from the speed controller will be input to the current controller, along with measured DC bus current. The output of the current controller will control the duty cycle of the PWM pulses.

Motor Protection

In a motor control design, it is important to have protection logic to ensure safe operation of the system. For example, when the motor get stuck, the

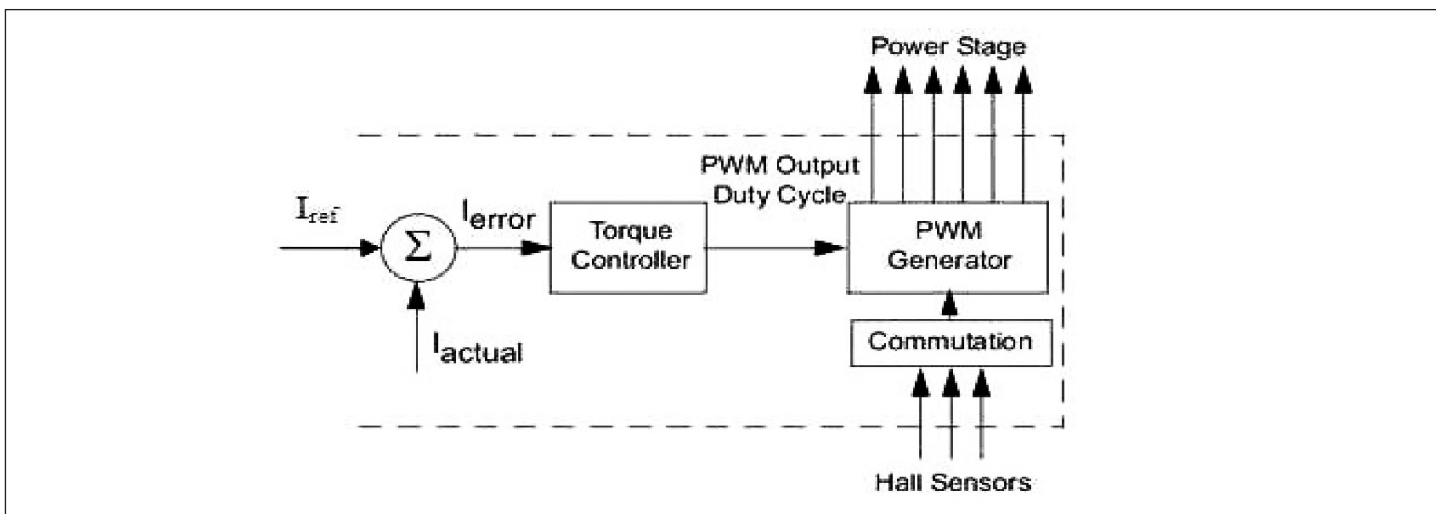


Figure 8: Block Diagram Of Torque Controller

current through the windings can build up to a very high level, which can burn the power devices driving the motor.

Peak current - This is the maximum instantaneous current allowed to flow through the windings for safe operation. This condition occurs in case of a short circuit. Hardware protection is applied to kill the PWM output whenever the current crosses the peak current limit.

Maximum Working Current - This is the maximum output current when the motor stalls or is overloaded. This current can be controlled by application firmware. Implementation for this logic is similar to torque control.

Under Voltage – When the system is running on batteries, it becomes important to cut off the supply if the battery voltage drops below a particular limit. Since voltage drop is a slow process, it can be controlled via firmware.

Hall Sensor Failure – In sensor-based BLDC motors, rotation of the motor is based solely on the feedback obtained from the Hall sensors. Thus, in case of failure of the Hall sensors, the commutation sequence will break, which may cause the BLDC motor to become stuck and the current to rise above a particular limit. Hall sensor failure can be detected in firmware by checking whether the hall sensor signal changes its logic level or not. If it gets stuck to a particular level, then it can be detected as a failure and the motor drive can be disconnected, letting it run on inertia or be stopped by applying the brake. The action to be taken depends on the requirements of the design.

Mode of Applications & Application Potential of BLDC Motors

Single speed – For single-speed applications, induction motors are more suitable, but if the speed has to be maintained with the variation in load, then because of the flat speed-torque curve of BLDC motor, BLDC motors are a good fit for such applications.

Adjustable speed – BLDC motors become a more suitable fit for such applications because variable speed induction motors will also need an additional controller, thus adding to system cost. Brushed DC motors will also be a more expensive solution because of regular maintenance.

Low-noise applications – Brushed DC motors are known for generating more EMI noise, so BLDC is a better fit but controlling requirements for BLDC motors also generate EMI and audible noise. This can, however, be addressed using Field-Oriented Control (FOC) sinusoidal BLDC motor control.

With consumers awareness about energy efficiency, better performance, reduced noise etc. the BLDC motors have much to contribute in the household appliances segment. Ceiling fans have already made it to the market recently. If the controller costs can be brought down then we have a real winner here.

The BLDC motor is quite suitable in electric vehicles due to high power density, less volume, high torque, high efficiency, low maintenance and ease of control. Though the choice depends on many other factors.

There are a wide ranging application in industries for electric vehicles, steel rolling mills, electric cranes and robotic manipulators.

FIRE RETARDANT OR FIRE-RESISTANT CABLES

AUTHOR



Ranjan Mathur

Many a times we come across this dilemma when we have to decide the type of cables whether **FIRE RETARDANT** or **FIRE-RESISTANT** cables for a particular application. The two names are quite similar but have some distinctive features to decide the types.

The cable can be decided based on the application:

Fire Retardant: As the name suggests these cables need to be used where during fire condition the propagation of fire to be restricted along the cable route. They do not propagate fire. Flame retardant cables are not intended to continue to operating under fire circumstance but are used to resist the flame from spreading. A flame-retardant cable is designed to only restrict the spread of a fire by restraining combustion.

Fire Resistant (FR): These cables are deployed where circuit continuity to be maintained during fire along the cable route. These cables are also termed as fire survival cables as they survive during the fire for the specified time and exposure temperatures. Fire resistant cables are often used to maintain circuit integrity of those vital life safety systems such as fire

alarm and suppression services, safety in refineries, roadway tunnels and transit systems during fire. Under rated voltage of the cable, the fire-resistant cable can maintain 90 minutes of normal operation in 750°C-800°C flame.

There are other features / abbreviations used for cables which are as explained below can be added to fire resistant cables viz. FRLS:

- Low Smoke and Fume (LSF) - burns with very little smoke and fumes compared to standard PVC, smoke may contain halogens
- Low Smoke Zero Halogen (LSZH) - when burns there is very little smoke and fumes (compared to standard PVC the smoke contain no halogens
- Alternative names for LSZH - LSZO (Low Smoke Zero Halogen), 0HLS (Zero Halogen Low Smoke), LSHF (Low Smoke Halogen Free)

International standards for **Fire Retardant** cables are

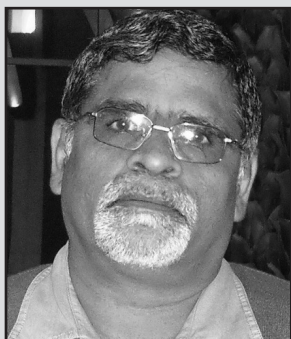
- IEC 60332-1/BS 4066-1 - flame test on single vertical insulated wires/cables
- IEC 60332-3/BS 4066-3 - flame test on bunched wires/cables
- UL Standard for Fire Retardant Cable
- CMP (Plenum Flame Test/ Steiner Tunnel Test) - plenum rated cables meeting NFPA -262
- CMR (Riser Flame Test) - riser rated cables meeting UL1666
- CM (Vertical Tray Flame Test) - general purpose cables meeting UL 1581
- CMG (Vertical Tray Flame Test) - general purpose cables meeting UL1581
- CMX (Vertical Wire Flame Test) - restricted cables meeting UL1581

International standards for **Fire Resistant** cables are:

- IEC 60331 - fire resistance test
- BS 6387 - fire resistance test

ELECTRICAL SAFETY

AUTHOR



A V Prasanna

(Retired Chief Engineer from Fichtner Consulting Mumbai)

Electricity being the greatest invention of mankind, has become a topic for discussion, due to safety issues. Does it mean electricity is unsafe? No compare to other sources of power, Electricity is highly safe, provided it is used with caution. We shall ponder as to why Electrical accidents and fire are on the rise.

Electrical failure or malfunctions of equipment account for home fires, This is a particular threat to homes built before the 1950s when electrical wiring standards were less stringent than today. However, even newer homes are at risk for an electrical fire. While older homes were built to handle 30 amps of power, most newer homes demand 50-60 amps. This demand places a significant strain on a home's wiring and electrical system. Advent of electrical operated gadgets, and dependency of humans on these gadgets result in overloading of wires. Decades back houses had only incandescent bulbs, thick single strand copper wire used to source power to these bulbs. Except for blown fuse, fire were never heard

of. Today every house has Washing machine, Air conditioner, Micro oven, Dish washers, Water heaters to name a few. These power consuming gadgets if switched ON at the same time results in stress on the wiring, and fails when overloaded.

While there are no regulations as to when to replace wires in domestic sector, it is advisable to change the internal wiring once in 15 years to suit the present loading and future anticipated loads.

“The city has seen more than 15,000 fires in the past three years, of which about 80% or 12,000 have been caused by short circuits, according to the Mumbai fire brigade. Data accessed by Hindustan Times from Mumbai fire brigade reveals that 5,021 fires occurred in Mumbai in 2016-17, 5,224 in 2015-16 and 4,831 in 2014-15”.

“As per data published by NCRB during Jan 2018, Mumbai ranked second in fires caused due to short circuit, with 418 deaths over 10 years. Delhi recorded the most short circuit related fatalities at 424, while Ahmedabad with 260 during the period of study between 2006-15”.

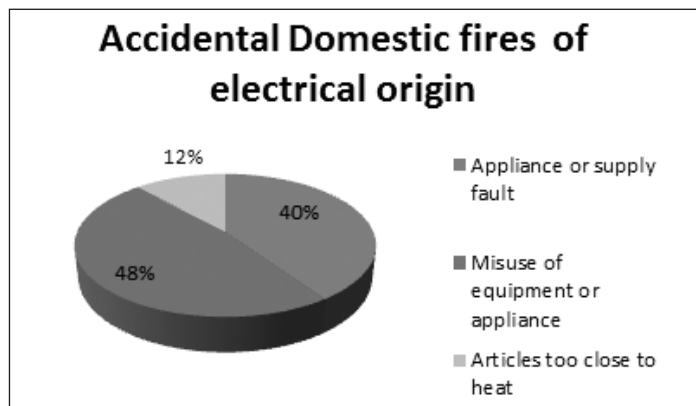
Builders build houses and commercial establishment, take proper care of construction material, but when it comes to Electrical system they show least concern. They are not aware of the loading pattern, nor the gadgets used by customers. Result the wires may be underrated.

Understanding the common causes, warning signs and appropriate safety measures can help prevent an electrical fire in your home. Electrical fires are among the most dangerous forms of combustion due to how quickly they can spread and grow out of control. By following the information below, you can help reduce the chances of an electrical fire occurring in your home.

Appliance or supply fault - 40%.
Misuse of appliance - 48%.
Articles too close to heat - 12%.

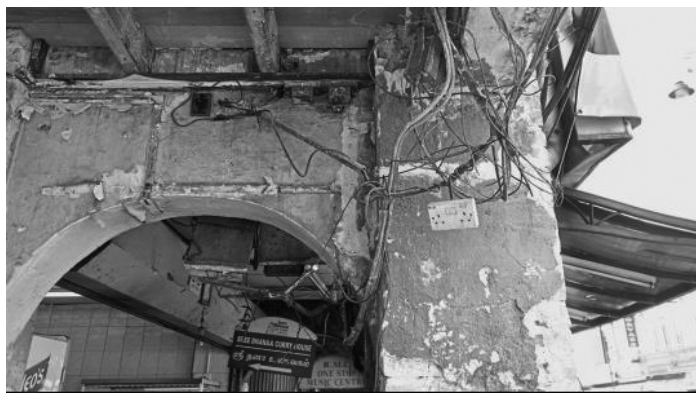
The most common causes for electrical fires are:

- Incorrectly installed wiring
- Overloaded circuits and extension cords
- Defective or improper plugs, switches and outlets
- Wrong size wire for the load.
- Misuse and poor maintenance of lighting system



Warning Signs of Faulty Wiring or Electrical Systems

To prevent an electrical fire, learn to recognize the warning signs that indicate a possible wiring or electrical problem. Contact a licensed electrician immediately to examine and repair electrical problems if you experience any of the following issues in your home:



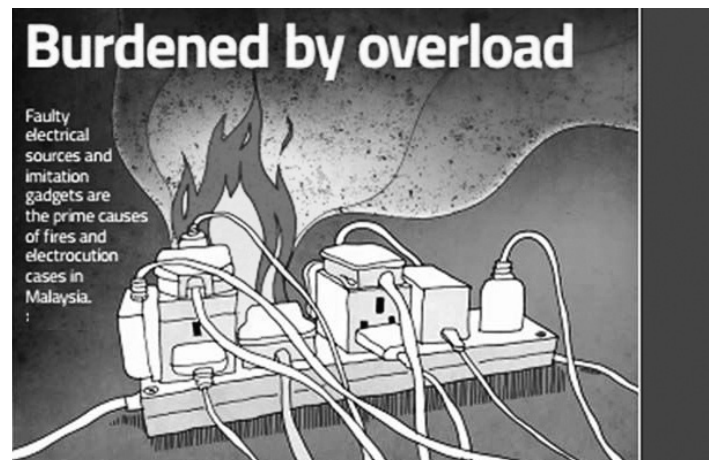
- Flickering or dimming lights
- Switches or outlets that are hot to touch and/or emit an acrid odor
- Discoloured cords, outlets and switch plates

Repeatedly blown fuses and tripped circuit breakers

Keep Home Wiring Systems Safe:

Every homeowner should be acquainted with at least one licensed electrician who can help keep their home wiring system safe. Licensed electricians can help:

- Ensure any electrical modifications meet existing codes
- Inspect and repair outlets and switches
- Inspect a home and make any necessary repairs before you purchase and move in



Replace out dated or malfunctioning fuses and circuit breakers and instruct your family on proper usage.

The Dangers of Arc:

When a wire is punctured, but not completely severed, the electric current can move away from its path and result in an incredible amount of heat. This leaking of the current is called an arc fault. The heat from an arc fault can eventually cause a fire, which may quickly



spread to surrounding wood and other combustibles, as well as other wiring. Take extra care when doing home renovations to ensure you do not damage any wires when hammering or drilling into walls.

You can help prevent an arc fault from causing a fire by installing an arc-fault circuit interrupter to your circuit breakers. When arc fault circuit interrupters detect irregular current flow, they shut down the circuit to prevent overheating and combustion.

Cords, Outlets and Plug Safety:

Electric currents carried by wiring, switches, plugs and appliances generate heat. Excessive or uncontrolled heat can start fires. To help prevent electrical fires, know how to use and store plugs and electrical cords and take these precautions:

- Don't run cords under carpeting, bedding, or other combustible materials; also avoid placing cords across doorways or frequently travelled areas
- Discard frayed or broken cords and never splice two cords together.
- Don't overload outlets or use extension cords in place of outlets. Call an electrician to install additional outlets as necessary.

Ensure plugs fit snugly in outlets to prevent loose contact and excess heat.



Lighting Safety:

Combustible materials such as drapery, bedding and upholstered furniture may ignite when exposed to hot bulbs. Follow these safety tips to help prevent light bulbs from causing electrical fires:

- Purchase lamps and fixtures certified by certification organization.
- Use the right light bulb wattage for all lamps and fixtures.

- Position lamps away from open windows where strong breezes may blow draperies onto hot light bulbs. Lampshades can also prevent combustible materials from direct contact with a hot bulb.

Fire and Electrical Safety – Office/Commercial Areas

Fire and electrical safety are very important considerations in an office environment. It is important that departmental staff do not create hazards that can contribute to fires or prevent exit from an area or building. It is also important that staff be informed and prepared for fire, and other life-threatening events.

Building Evacuation

Staff should have a plan for what they will do in the event of a fire, and other emergency and periodically review it. Alternate exit routes should be identified for use if the primary exit is blocked. In buildings with fire alarm systems, staff should become familiar with the location of fire alarm pull stations. When a building fire alarm system is activated, staff must evacuate immediately and not remain in the building; evacuation time is of utmost importance. Close doors to your immediate area to help keep the fire and smoke contained.

Exit Passageways

Aisles within rooms, main corridors and stairwells must be kept free and clear of any materials that will block, hinder or slow passage during an emergency. Fire and rescue personnel enter these areas and any blockage can hinder them. Do not store materials or equipment in corridors or stairwells.



Exit Doors

Keep stairwell and room doors to corridors closed at all times. The only exception is doors that are held open via automatic hold open devices connected to the building fire alarm system, which automatically release upon activation of the alarm. Never place wedges or door stoppers under doors. The most critical element in a building fire is to prevent fire and smoke from spreading rapidly throughout the building, allowing more time for evacuation.

Sprinkler Heads

In buildings with sprinkler systems, do not place or store material within 18 inches of sprinkler heads. When sprinklers are activated, a full spray pattern is needed to effectively control the fire.

Extinguishers And Pull Stations

Never block or store items in front of fire extinguishers, fire alarm pull stations, and fire alarm audio visual devices. Immediate access is critical in the event of a fire. Good housekeeping is the need of the day.

Open Flames

Open flames such as candles are not allowed in offices. They can easily tip over or start combustible items on fire. (It may be worth remembering that a candle used in one of the school function being held in Shanmukhananda Hall Sion Mumbai, during February 1990, resulted in the stage curtain on fire. This caused burning of whole auditorium and seats of the hall, the present hall is a new one, built from ashes, with a strict instruction that no one is permitted to use a candle or open flame).

Electrical Panels

Office staff should not open electrical panel box doors and flip breaker switches, as there is a potential for arc flash and electrical overload. If power goes off to the office area, contact building maintenance. Never block electrical panels with equipment or materials. Immediate access to these panels may be needed by maintenance or emergency responders.

Fire / Explosion

Electrical fires may be caused by excessive resistance that generates heat from any of the following:

- Too much current running through wiring where overcurrent protection fails or does not exist
- Faulty electrical outlets resulting in poor contact or arcing
- Poor wiring connections and old wiring that is damaged and cannot support the load

An explosion can occur when electricity ignites a flammable gas or combustible dust mixture in the air. Ignition from a short circuit or static charge is possible.

What one can do to stay safe?

Avoid Activities That Requires Trained personnel.

- Working with exposed conductors carrying 220 volts or more
- Making repairs or alterations to any electrical equipment
- Opening up the case, or removing barrier guards, of any equipment that utilizes electricity
- Using any tools or a meter to measure for the presence of electricity
- Resetting a tripped circuit breaker, or replace a blown fuse

Ask a qualified person to perform these tasks.

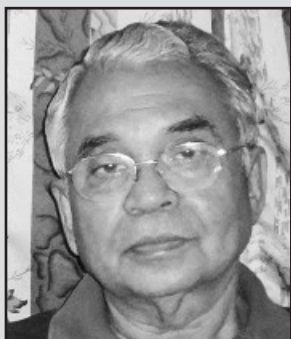
Conclusion:

Electricity and electrical equipment's should be operated with utmost care and caution. Any abuse will result in accidents, and loss of life and property. Whether it is home or office or shop, educate your members on proper usage of equipment. In case of wiring constraints, educate that all equipment should not be switched ON at the same time.

Electricity utilities like BEST, Tata Power, Adani Power, MSEDCL, and others have no role to play in the safe use of Power. Their responsibilities end at the metering point. A third party certifying body is the need of the day, who have to certify every installation including internal wiring, and quality of wire used before the power is switched ON by the utility. This certification is required every 10 years atleast .

LIGHTNING PROTECTION OF TALL BUILDINGS

AUTHOR



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Tall structures need protection from direct lightning strikes and side flashes for the safety of the occupants and equipment. Moreover failure of critical sensitive electronic installation and communication equipment occur in unprotected circuits due to secondary high voltage peaks transmitted through service lines.

Lightning strikes of voltages of very high magnitude, of the order of 10s of kilovolt built up and decay as indicated in the wave form below.

Though the peaks are for a brief time, in micro seconds, electrostatic and electromagnetic forces generated can cause heavy mechanical damage to structure apart from life threat to living being in the vicinity. More over risk of fire of incendiary material is high.

Lightning Protection

The level of risk from Lightning can be analysed as per the updated standard IS/IEC-62305. The common lightning risks are categorised in 4 levels. Depending on the calculated risks methods specified in IS/IEC 62305 Level-1, Level-II, Level III & Level IV and is to be considered as base design reference.

The lightning strikes are arrested through the Air terminals (Lightning strike collectors), splash pads, Ring conductors on building peripheries installed on projected portions of the building. The heavy lightning potentials is directly connected to the mother earth through dedicated Earth Down Conductors taken through inside the building RCC columns or the down conductors outside the building keeping allowable distance between building surface and following the contours of building elevation as per guidelines of the standard under reference. Each down conductors are connected to adequate number of Earth Electrodes or to the earth grid to provide near zero potential to lightning surges. The location of air terminal & the roof conductor with formation of mesh on terrace can be as per rolling sphere and mesh method of IEC 62305 Table 2 & Table 4. (quoted as under), moreover it is to be considered from planning stage for structural integrity and aesthetics of building.

Class of LPS	Protection method			Typical distances (m)
	Rolling sphere radius r (m)	Protection angle α (°)	Mesh size w (m)	
I	20		5 x 5	10
II	30		10 x 10	10
III	45		15 x 15	15
IV	60		20 x 20	20

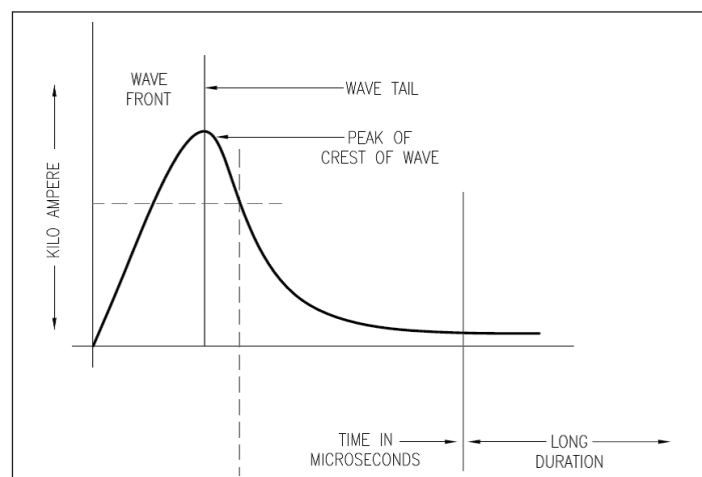
Ref: IEC 62305-3:2010, 5.2.2 + Table 2 + Figure 1, 5.3.3 + Table 4

The buildings above 60 meters in heights are having the risk of side flashes. The lightning clouds which travel on lower levels will try to discharge the lightning potential on building peripheries. Provision for arresting the strikes and diverting the potential to mother earth is required. The solid Metallic ring conductors of specified diameters as per Standard can be run around the building at specific vertical intervals of the building faces.

In case the building outer surface is not allowable to provide side ring conductor's FLASH pads can be provided which is grouted in RCC slab near that particular floor level and connected by suitable bonding clamps to re-enforcement forming mesh to have equi-potential bonding for Lightning arrestor's down conductors. The no of flash arrestors are so placed such that it will be projecting outside peripheries of the building in specific intervals as per the level of protection.

Waves Shapes of Stroke Currents

The wave shapes consist of a portion showing the steep rise of voltage up to a peak or crest value driving a current 3 kA to 200 kA depending on the level of risk, is called the wave front, and the other portion showing the decay of voltage called the wave tail. The peak voltages can reach a value of Kilovolts up to 70 kV.



In principle three types of earthing installations are specified in standards to effectively discharge lightning currents in shortest period without materially affecting the building structures or occupants.

1. Type A

Type A earthing which is horizontally & vertically installed in mother earth to dissipate the current. Different layers of soils may be in contact with earth rod to dissipate the potential in natural earth. Type A radiative or deep earth rods do not fulfill the need for equi-potential bonding of different electrodes. Type A earthing system is useful for low building structures (e.g. family homes), existing building structures, for LPSs with interceptor rods and wires and for separate LPSs. This type of arrangement incorporates horizontal and vertical earth rods connected to every conductor.

2. Type B

The system comprises to create the earthing mesh may be inside the foundation raft to provide low impedance to fault current to the main source. The sizes of meshes can be followed as specified in standards. If many people are often near the building structure you intend to protect, then potential control should be envisaged for that area in order to protect those people from step potential.

Type B earthing system is suitable for the building installations on Rock and for the structure housing sensitive electronics.

3. Type C

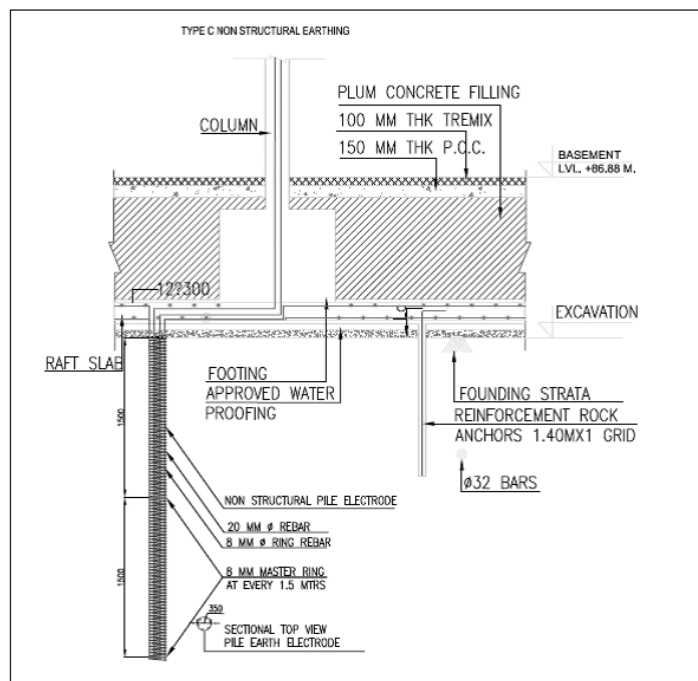
The Type C comprises the combination of Type A & Type B in which horizontal & Vertical conductors are interconnected to each other to form the low impedance paths to fault potentials.

The uses of foundation as an earth electrode is only allowable were the reinforcement network is below any insulating membrane. Were the foundation is used as an earth terminal the reinforcement bars must be clamped or welded together to ensure electrical connectivity. The earthing system whether using reinforced bars or additional conductors must be connected to every down conductors and internal steelworks.

Non Structural RCC pile Electrode

An example of Steel Re-enforced pile earth for building more than 60 meters in height and foundation RCC not in direct contact with soil has been executed in Mumbai as shown below.

The earth resistance value and no. of non-structural RCC are as per BS7430:2011.



Earth bus (Grid) & Earth continuity conductor

The author has faced the problem of connecting the down conductors to earth grid where the vertical electrodes are on opposite face of the building. All electrodes were equipotential bonded and horizontal conducting ring were formed to connect to the earth.

GI conductors below the ground is not advisable for there higher rate of corrosion due to galvanic erosion. Copper bonded steel rods are advisable as per the standards and necessary hard were as per the EN 60164.

Installations and locations of Probable shock risks

For installations and locations of increased shock risk additional measures may be considered necessary; these include as follows:

- A) Supplementary equipotential bonding;
- B) RCDs with a rated residual current of 30 mA or less and
- C) Protective extra-low voltage (PELV) and separated extra-low voltage (SELV) equipment.

In case an installation supplies a number of buildings, apartments, offices, main equipotential bonding is essential in each building, so that each has a reference point to which are connected the conductive parts. In order to reduce the voltages occurring in the event of an earth fault still further, it is sometimes necessary to install supplementary local equipotential bonding. The equipotential bonding can be formed by simple mesh inside the RCC slab or connecting the multiple earth buses, all equipments & metal bodies to the main earth pits from multiple locations.

Earth Fault Protection for Human Body

Human body protection from earth faults is most important portion of electrical system. Based on the probability of consequences that human body coming in contact with exposed live portion two types of possibilities are assumed, during Normal operation (Protection against direct contact) and disconnection of system during fault which is provided by automatic detection and tripping the system for immediate isolation.

The automatic disconnection is basically intended to avoid touch potential which could arise during human interaction with faulty equipments. The automatic disconnection is basically dependant on co ordination between system earthing and tripping characteristics of switchgears. The system isolation is dependent on existence of low impedance path to fault current and tripping time of switchgears. The probability of incidences and the relevant tripping times can be determined as per IS 3043 section 3 table 8 page 34.

Note:

Author is Thankful to Mr. Prashant C. Malagi, Team Lead Electrical Engineer, S. N. Joshi Consultants. for providing the details of project executed and contributed his experience to make this article successful.

Reference Standards

- BS 7430: 2011 Code of practice for protective earthing of electrical installations.*
- IS/IEC 62305: Code of practice for protection of Buildings & allied structures from Lightning.*
- EN 50164: Lightning Protection Components.*
- IS 3043:- CODE OF PRACTICE OF EARTHING.*

POWER LOSS IN MCB

AUTHOR



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Preface

Usage of electricity is increasing year by year and accordingly energy losses are also increasing. To overcome this, world is making all out efforts towards reduction in the losses. This includes consultants, supply companies, consumers with only target to reduce the losses by means of education, measurement, targets, energy conservation, utilizing energy efficient equipment and many more. In entire scenario, it was observed and calculated that the smallest switchgear which is MCB also can contribute for saving and reduction in losses and hence this article was written to highlight the amount of losses because of MCB. As such if more efficient less loss MCBs are selected in projects then it will be beneficial for all by means of saving energy.

Overview of Electrical Power

India is the world's third largest producer and third largest consumer of electricity. ^[1]

As per Government of India Power Ministry total installed capacity is 346048 MW. ^[2] Generation and growth in conventional generation in the country during 2014-15 to 2018-19 is given in TABLE 1

Year	% of Growth
2014-15	8.43
2015-16	5.64
2016-17	4.72
2017-18	3.98
2018-19*	4.91

As such considering last five years record it can be seen that average growth is coming to not less than 5%.

Utilization of Electrical Power

The sector wise utilization of Electricity is given below-^[3] TABLE 2

ENERGY CONSUMPTION OF ELECTRICITY BY SECTORS						
(Giga Watt hour)						
Year	2011-12	%	2012-13	%	2013-14	%
Industry	352291	45	365989	44	384418	44
Agriculture	140960	18	147462	18	152744	17
Domestic	171104	22	183700	22	199842	23
Commercial	65381	8	72794	9	74247	8
Traction & Railways	14206	2	14100	2	15540	2
Others	41252	5	40256	5	47418	5
Total Electricity Consumed	785194	100	824301	100	874209	100

Above figures can be considered as guidelines and will vary depending upon the growth happening in future in that sector. But the trend shows the industry, domestic remain as dominant while consumption of electricity is considered.

Losses in Electrical Power

Power generated is supplied to consumers and during the process energy losses are happening. There are two types of losses. One is technical and second is commercial. Technical losses are due to energy dissipated in conductors, transformers, equipment used for transmission, transformation and distribution of power. Commercial losses are due to pilferages, meter issues etc. Both together becomes Transmission and Distribution losses. [4] Generally, these losses are approximately 20 %. In addition to this at consumer end there are losses.

All out efforts are being done to control these losses at every step from all concern. This includes- efficient transformer, motors, cables, lighting, air condition etc.

In short year by year installed capacity of electricity, usage of electricity will increase and therefore needless to mention losses are going to increase which needs to be curtailed by means of efficient design, energy efficient equipment, reduction in pilferages and accuracy in measurement.

Losses in Switchgear

Before proceeding one can understand the huge magnitude of electricity being handled and due to which challenge of huge losses which are being incurred.

As all of us know different type of switchgears right from generation, distribution and consumer end users are using switchgears. Out of all if we see 'Medium Voltage' range then ACB, MCCB and MCB are more in use. SFU are getting phase out and hence not considered.

Estimated production for past 3 years in number of poles is as given in Table 3.

	FY 2016	FY 2017	FY 2018
MCB	22800000	26700000	27700000
MCCB	2600000	3640000	3650000
ACB	120000	150000	160000

In all above switchgears excluding spares by default losses are happening because of their own resistance value. So, whenever current flows the I^2R value gets added in the form of energy losses.

Let us understand what standard has to say about power loss in switchgear in following paragraphs.

Power loss in MCB

For MCB International Standard^[6] IEC 60898 is applicable. This covers Circuit-breakers for overcurrent protection for household and similar installations for Circuit-breakers for a.c. operation. It is applicable for a.c. air-break circuit-breakers for operation at 50 Hz or 60 Hz, having a rated voltage not exceeding 440 V (between phases), a rated current not exceeding 125 A and a rated short-circuit capacity not exceeding 25 kA.

For measurement of power loss method is specified in standard. In brief same is –

An a.c. current equal to rated current with a supply voltage of a value not less than 30 V, is passed through each pole of the circuit-breaker for a period of time sufficient for the temperature-rise to reach the steady-state value or for the conventional time, whichever is the longer and voltage drop is measured under steady state conditions between its terminals. Then the power loss is calculated. The result should not exceed than the values given in table 'Maximum power loss per pole' as below as per standard.

A test voltage of a value less than 30 V may be used subject to the manufacturer's agreement.

Standard specifies how to take ambient temperature by two thermometers or thermocouples symmetrically positioned around the circuit-breaker at about half its height and at a distance of about 1 m from the circuit-breaker.

Following Table 4 gives Maximum power loss per pole as per standard.

Range of rated current In Amp	Maximum power loss per pole in Watts
$I_n \leq 10$	3
$10 < I_n \leq 16$	3.5
$16 < I_n \leq 25$	4.5
$25 < I_n \leq 32$	6
$32 < I_n \leq 40$	7.5
$40 < I_n \leq 50$	9
$50 < I_n \leq 63$	13
$63 < I_n \leq 100$	15
$100 < I_n \leq 125$	20

The test is then repeated by passing the same current through the pole intended for the connection of the neutral and the adjacent protected pole. During the test, the temperature-rises of parts shall not exceed the values as given in standard which are given below. The temperature of the different parts should be measured by means of thermocouples or by equivalent means at the nearest accessible position to the hottest spot. Following Table 5 gives Temperature-rise values.

Declared Data by Manufacturers & Verification

Although standard specifies the power loss it was

Parts	Temperature-rise K
Terminals for external connections	60
External parts liable to be touched during manual operation	40
External metallic parts	25
Other external parts	60

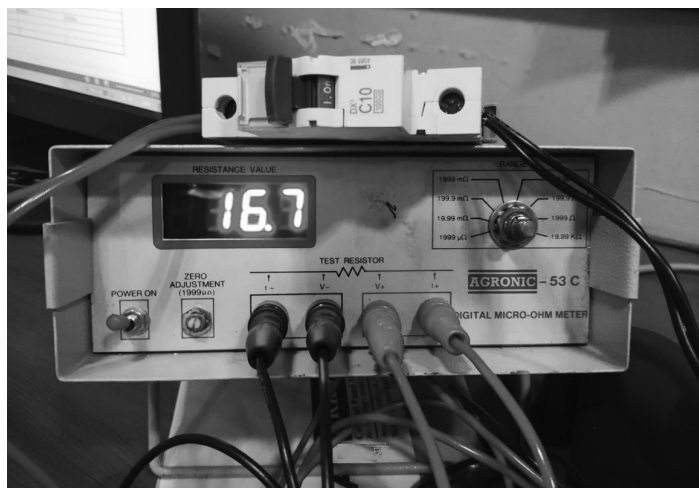
worthwhile to verify what the manufacturers are giving and if the same are in line with standard. This is given in following Table 6

Please note following data is for only academic analysis purpose only and not meant for justification of certain product / make or showing inferiority of product / make and this data is subject to change as per improvement happening in product or addition of new range.

From Table 6, it can be observed reputed manufacturers are satisfying the figures given in standard. But there is lot of variation in values. It is also observed there is % difference of 60% between minimum and Maximum value. This difference cannot be ignored.

Although declared values in catalogue gave the figure but as a sample test for 10Amp SP MCB of seven manufacturers were collected and verified resistance and checked practical watts consumption by milliohm meter as below Slide 1

MCB Maximum Power Loss per pole at Rated Current									
Rating	Standard	L&T	Hagger	Havells	Legrand	Schneider	Min	Max	% Difference
6 Amp	3	1.1	2.7	1.2	1.1	1.3	1.1	2.7	41
10 Amp	3	1.2	1.8	1.4	1.8	2	1.2	2	60
16 Amp	3.5	1.8	2.6	2.2	2	2.1	1.8	2.6	69
20 Amp	4.5	1.9	2.8	2.5	2.2	2.2	1.9	2.8	68
32 Amp	6	2.4	3.9	3.4	3.2	2.8	2.4	3.9	62
40 Amp	7.5	3.1	4.3	3.9	4	3.6	3.1	4.3	72
63 Amp	13	4.3	5.2	7.3	5.5	5.6	4.3	7.3	59



Slide 1

Results were as shown in **Table 7**

Sr. No.	Makes	m Ohm	W
1	S	17.4	1.74
2	LG	16.7	1.67
3	L	17.1	1.71
4	HG	16.8	1.68
5	M	12.5	1.25
6	IA	16.6	1.66
7	HV	11.3	1.13

MCB manufacturers name is not mentioned because this testing carried out at non-accredited laboratory but to get the feel that data given is in line or not. Data got during testing was in line with standard and consumption in that case was less than standard. But among each manufacture there was difference of 35% watt loss among highest watt loss and lowest watt loss. This difference cannot be ignored.

Power loss Calculation

Number of installed switchgear quantity will have to be extrapolate with the following assumptions-

1. Switchgear manufactured for last three years are known. But installed number is not known.
2. Switchgears life is more than ten years.
3. Switchgears once installed are never being replaced for nearly ten years unless industry is closed or revamped or offices are changed.

Otherwise switchgears are used for years. Hence, if manufactured data for last three years are considered and extrapolate to Five Years if not to Ten Years still it will be accurate to arrive to base installation figure. For doing this minimum value is considered.

4. Out of base figure all manufactured switchgears are not installed because part is kept in stock which is 20% and part in spares which are nearly 30% in panels / DBs. As such 50% can be working switchgear figure.
5. In case of MCB as per manufacturing data out of 100% manufactured quantity, 70% are 6 Amp to 30 Amp and 30% are 40 Amp to 63 Amp and above.
6. Current drawn by MCB is not to rated current. Demand factor can be considered as 80% in case of motor load and 100% in case of lighting load. But practically current drawn is in tune of 20% to 50%. Hence lower side figure of 20% can be taken for arriving to power consumption.

MCB Data	
Production Figures FY 2016	2280,00,000
Production Figures FY 2017	2670,00,000
Production Figures FY 2018	2770,00,000
Total of 3 Years	7720,00,000
Minimum yearly production	2280,00,000
Five Year Production value	11400,00,000
Base Production Value	11400,00,000
Min 50% will be Installed	
Installed Capacity	5700,00,000
70% 6A to 30 A	3990,00,000
30% 40A to 63A	1710,00,000
Watts for 10 Amp MCB as per standard	3
Watts for 40 Amp as per standard	7.5
Demand Factor of 20%	
Watts for 10 Amp MCB installed	0.6
Watts for 40 Amp installed	1.5
Watts - For 6A to 30 A MCB	239,400,000
Watts - For 40A to 63A MCB	256,500,000
Total Watts	495,900,000
Total MW	496

7. On basis of the same calculations are done and watts loss in MCB as per standard can be arrived as per following Table 8

Conclusion

1. MCB manufactured are in organized sector and also in unorganized sector. Organized sector is maintaining standard but question remains for unorganized sector manufacturers who are not meeting to standard.
2. The installed capacity of MCB is huge. Hence magnitude of power loss in MCB cannot be ignored and there is lot of scope for saving.
3. Although few good manufacturers are keeping power loss of their product well within limit but among them also there is huge difference and good scope of improvement.
4. Standard also needs modification towards reduction in wattage.
5. As per standard if MCBs are manufactured and if calculations are seen the power losses saving

target is of nearly 'Half Giga Watt'. Saving of 10% can be also saving in MWatt.

6. In view of this MCB make selection process required to be made stringent by consultants.
7. While comparing the product where mass procurement is present like projects, mass housing etc. power loss needs to be compare and price concession may be given for the product having less power loss.

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- [3] statistical-year-book-india/2017/185
- [4] beeindia.gov.in
- [5] [IEEMA](http://www.ieema.org)
- [6] [IEC](http://www.iec.org)

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SURGE PROTECTION DEVICES (SPD) SELECTION (IEC 61643)

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Electrical system experiences Surges due to switching of large equipment in the systems or external to any system or due to external reasons like Lightning strike. Voltage surges can damage critical and sensitive equipment and can also affect insulation resulting in faults. Dissipation of surges from the systems is essential to protect the electrical system. SPD's are used for this purpose. Earlier the SPD's were classified as Class A , Class B, Class C etc. based on the wave form and location of use in the electrical system. IEC 61643 is now the international standard for SPDs where SPDs are classified as Type1, 2, 3, mainly on the basis of wave form they experience and can dissipate. Various parameters are important for correct selection of SPDs and need to be considered when specifying one. The parameters are discussed below.

Following parameters need to be considered

1. **Maximum continuous operating voltage U_c**
This is maximum A.C. or D.C. voltage beyond which SPD becomes active.
This shall not exceed 25% above the nominal system voltage and shall depend on earthing system.
2. **Voltage protection Level U_p**
This is voltage across the terminals of SPD in active mode at discharge current I_n $U_p < 2.5kV$ for normal load. For electronic sensitive loads it can be 1.5kV.
3. **Nominal Discharge current I_n**
This is peak value of Discharging current of $8/20\mu s$ that device is capable of discharging 15 times.
Minimum value as per IEC is 5.0kA ($8/20\mu s$)
5,10,20kA
4. **I_{imp} - Impulse current (type 1)**
This is peak value of wave that SPD is capable of discharge 5 times ($10/350\mu s$)
Vales depend on the lightning protection level.
5. **Maximum Discharge current I_{max} (Type 2)**
This is maximum peak value of $8/20\mu s$ wave that SPD is capable of discharge one time.
The value depends on location of Building protected & values are 20kA, 40kA, 65kA.

Table below summarizes the selection based on the location, and parameters

Operating Conditions

Temperature - 5 to 40°C

Relative Humidity - 0 to 95%

Altitude - Up to 2000 mtrs without derating.

SPD Type	Wave Form	Location	Nominal discharge Current I_n	Impulse current I_{imp}	I_{max}	Up	SCPD
Type 1	10/350 μ s	Secondary of Service transformer before Breaker In Buildings with Lightning Protection System	10/20kA	LPL 1 25.0kA/Pole 2 18.75kA/Pole 3,4 12.50kA/Pole	-	Up<2.5kA	Not required
Type 2	8/20 μ s	All electrical LV Installations in panel after in-coming Breaker	5/10/20KA	-	20kA Urban 40kA plains 60kA L High exposure	<2.5kV	Required kA same as panel
Type 3	I 8/20 μ s V 1.2/50 μ s	Installed near sensitive loads	Low Discharge Capacity	-	-	<1.5kV	Required

Note:

1. Usually Type 1 + Type 2 are used together connected to main Panel. Busbar thro appropriate breaker (SPPD)
2. The Breaker (SCPD) for SPD should not trip on nominal discharge current I_n for 15 times

IMPORTANT TRANSFORMER FAULT CONDITIONS AND HOW TO PROTECT FROM THEM

AUTHOR



Ulhas Vajre

C. ENG. (I), DEE, AMIE, BE, MIE, FIV, FISLE,
MIIE, CEA, CEM, FISLE, FIAEMP

Transformer fault conditions

A number of transformer fault conditions can arise **practically in any time** following some special situations. These include the following **five most common internal faults** and few external:

1. Earth faults
2. Core faults
3. Interturn faults
4. Phase-to-phase faults
5. Tank faults
6. External factors

1. Earth faults:

A fault on a transformer winding will result in currents that depend on the source, neutral grounding impedance, leakage reactance of the transformer, and

the position of the fault in the windings. The winding connections also influence the magnitude of fault current.

Note: In the case of a Y-connected winding with neutral point connected to ground through an **impedance Z_g** , the fault current depends on Z_g **and is proportional to the distance of the fault from the neutral point.**

If the neutral is solidly grounded, the fault current is controlled by the leakage reactance, which depends on fault location.

The reactance decreases as the fault becomes closer to the neutral point. As a result, the fault current is highest for a fault close to the neutral point. In the case of a fault in a Δ -connected winding, the range of fault current is less than that for a Y-connected winding, with the actual value being controlled by the method of grounding used in the system.

Phase fault currents may be low for a Δ -connected winding due to the high impedance to fault of the Δ winding. This factor should be considered in designing the protection scheme for such a winding.



Figure 1 – Damage to inside of coil winding stack of oil-filled transformer

2. Core faults:

Core faults due to **insulation breakdown** can permit sufficient eddy-current to flow to cause overheating, which may reach a magnitude sufficient to damage the winding.

3. Inter-turn faults:

Interturn faults occur due to **winding**



Figure 2 – Transformer interturn fault

flashovers caused by line surges. A short circuit of a few turns of the winding will give rise to high currents in the short-circuited loops, but the terminal currents will be low.

4. Phase-to-phase faults:

Phase-to-phase faults are rare in occurrence but will

result in substantial currents of magnitudes **similar to earth faults**.

5. Tank faults:

Tank faults resulting in loss of oil reduce winding insulation as well as producing abnormal temperature rises.

6. External factors:

In addition to fault conditions within the transformer, **abnormal conditions due to external factors** result in stresses on the transformer.

These conditions include:

1. Overloading,
2. System faults,
3. Over voltages, and
4. Under-frequency operation.



Figure 3 – Transformer tank fault

Magnetizing inrush current

When a transformer is switched in at any point of the supply voltage wave, the peak values of the core flux wave will depend on the residual flux as well as on the time of switching. The peak value of the flux will be higher than the corresponding steady-state value and will be limited by core saturation.

Note: The magnetizing current necessary to produce the core flux can **have a peak of eight to ten times the normal full-load peak** and has no equivalent on the secondary side. This phenomenon is called **magnetizing inrush current** and appears as an internal fault.

Maximum inrush occurs if the transformer is switched in when the supply voltage wave is at zero. Realizing this, is important for the design of differential relays for transformer protection so that no tripping takes place due to the magnetizing inrush current. A number of schemes based on the harmonic properties of the inrush current are used to prevent tripping due to large inrush currents.

Overheating protection

Overheating protection is provided for transformers by **placing a thermal-sensing element in the transformer tank**.

Overcurrent relays are used as a **backup protection** with time delay higher than that for the main protection.

REF and Differential Protections:

Restricted earth fault protection is utilized for Y-connected windings. This scheme is shown in Figure 1. The sum of the phase currents is balanced against the neutral current, and hence the relay will not respond to faults outside the winding.

Differential protection is the main scheme used for transformers. The principle of a differential protection system is simple. Here the currents on each side of the protected apparatus for each phase are compared in a differential circuit. Any difference current will operate a relay.

Figure 2 shows the **relay circuit for one phase only**. On normal operation, only the difference between the

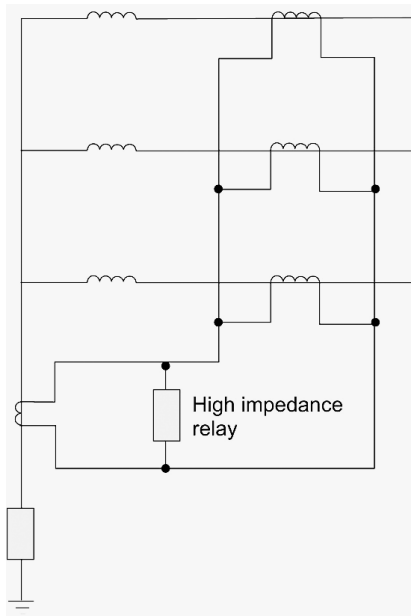


Figure 1 – Restricted Ground Fault Protection for a Y Winding

current transformer magnetizing currents i_{m1} and i_{m2} passes through the relay.

This is due to the fact that with no faults within the protected apparatus, **the currents entering and leaving are equal to i** . If a fault occurs between the two sets of current transformers, one or more of the currents (in a three-phase system) on the left-hand side will suddenly increase, while that on the right-hand side may decrease or increase with a direction reversal. In both instances, the total fault current will flow through the relay, causing it to operate.

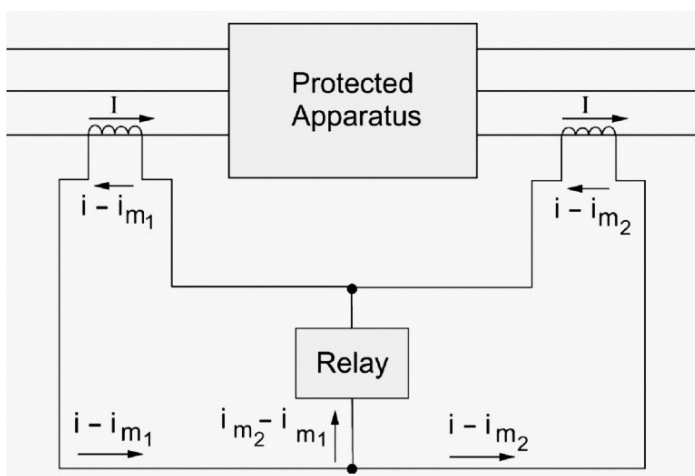


Figure 2 – Basic Differential Connection

Note: In units where the neutral ends are inaccessible, differential relays are not used, but reverse power relays are employed instead.

A number of considerations should be dealt with in applying differential protection, including:

- 1. Transformer ratio:** The current transformers should have ratings to match the rated currents of the transformer winding to which they are applied.
 - 2. Due to the 30°-phase change between Y-connected and Δ-connected windings and the fact that zero sequence quantities on the Y side do not appear on the terminals of the Δ side, the current transformers should be connected in Y for a Δ winding and in Δ for a Y winding.**
- 1. Figure 3 shows the differential protection scheme applied to a Δ/Y transformer.** When current transformers are connected in Δ, their secondary ratings must be reduced to $1/\sqrt{3}$ times the secondary rating of Y-connected transformers.
 - 2. Allowance should be made for tap changing by providing restraining coils (bias).** The bias should exceed the effect of the maximum ratio deviation.

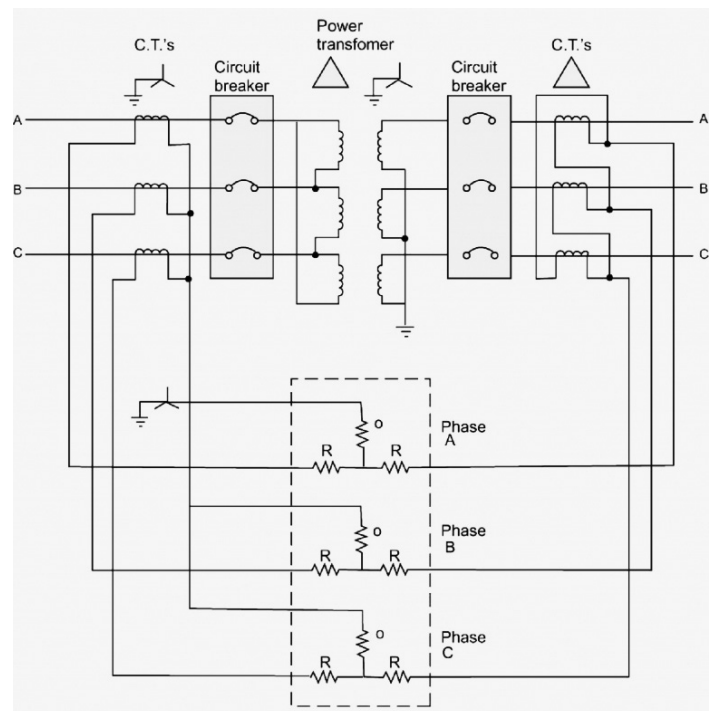


Figure 3 – Differential Protection of a Δ/Y Transformer

REACTIVE POWER AND BLENDED APPROACH IN REACTIVE POWER COMPENSATION DESIGN WITH SPECIFIC REFERENCE TO NEW MSEDCL POLICIES AND KVAH BILLING

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While practicing electrical engineering during last 35 years, it is observed that most of the time

- a. Consumers look at reactive power and it's compensation as a tool **to avail tariff incentives.**
- b. Utilities look at the same from the point of view of **releasing their KVA capacity.**

The engineering fraternity seems to have forgotten use and importance of reactive power in a typical AC electrical power distribution system. This article will discuss some basics about REACTIVE POWER and then about a blended approach in design of reactive power compensation. Towards the end the article will discuss utility view point over targeting KVAH billing.

What is the use of reactive power in power system?

Electromagnetic induction is responsible for working of transformers, motors, contactors, solenoid valves etc. This indicates that the electric current taken by such equipment must do two functions.

1. Create alternating magnetic field, which is necessary for functioning of the equipment.
2. Transfer / Transform electrical power to do useful work.

The power associated with 1st part of the current as above is termed as REACTIVE POWER and that with 2nd part is ACTIVE POWER. Active power does useful work and as such is experienced by common man in the form of getting light, heat from electricity, comfort due to breeze coming from electric fan, running of various machines in a factory etc. Both parts of current are absolutely necessary for getting work done using electricity. 1st part of current as above is mostly INDUCTIVE in nature and lags behind the voltage as per basic properties of Inductor (Electrical inertia). The second part of the current is in phase with voltage. Total current drawn from upstream equipment is vector sum of part 1 and part 2 of the current.

It is observed in Industry that every 1000KW of active power used requires about 400KVAR to 600KVAR reactive power. (There are some exceptions to this generalization). Generation, transmission and distribution requires small part of this whereas major part is required at end use.

The reactive part of the current also produces voltage drops across network along with contributing to I²R loss. One can note that had there been no reactive power requirement, 1000KW can be supplied with around 26Amps current say at 22KV. If this is associated with 600KVAR of reactive power, the current requirement increases to 31Amps.

Transformer	KW loss	KVAR Loss	Secondary Voltage	Grid Input voltage	Billed Load KW	KVA Drawn from Grid
No Compensation						
T 1	58.3	1165	31.21 KV	132		
T 2	36.9	313.4	386V	132		
T 3	51	1020	382V	132		
	146.2				10577	17077
Adequate Compensation						
T1	24.6	491	32.91KV	132		
T2	15.9	135	428V	132		
T3	21.5	429.7	430V	132		
	62				11021	11089
Over Compensation						
T1	69.4	1389	35.46KV	132		
T2	116.5	990.4	517V	132		
T3	29.3	585.7	492V	132		
	215.2				145.8	18643

Figure 1

- Current with no reactive power for 1000KW = $1000000/1.732 \times 22000 = \mathbf{26 \text{ Amps.}}$
- KVA^2 with 1000KW active and 600KVAR reactive power = 1360000
- $KVA = 1166 = 1.732 \times 22 \times I$ so Current = **31 Amps.**

The increase in current due to reactive power is almost 19%. This will contribute to 19% increase in voltage drop and 42% increase in I^2R loss in all stages of handling electric power namely generation, transmission and distribution.

In view of maintaining rated voltage and deliver rated power at receiving end, generation will have to provide for voltage drop and power loss as above. If this is not provided, then voltage drop

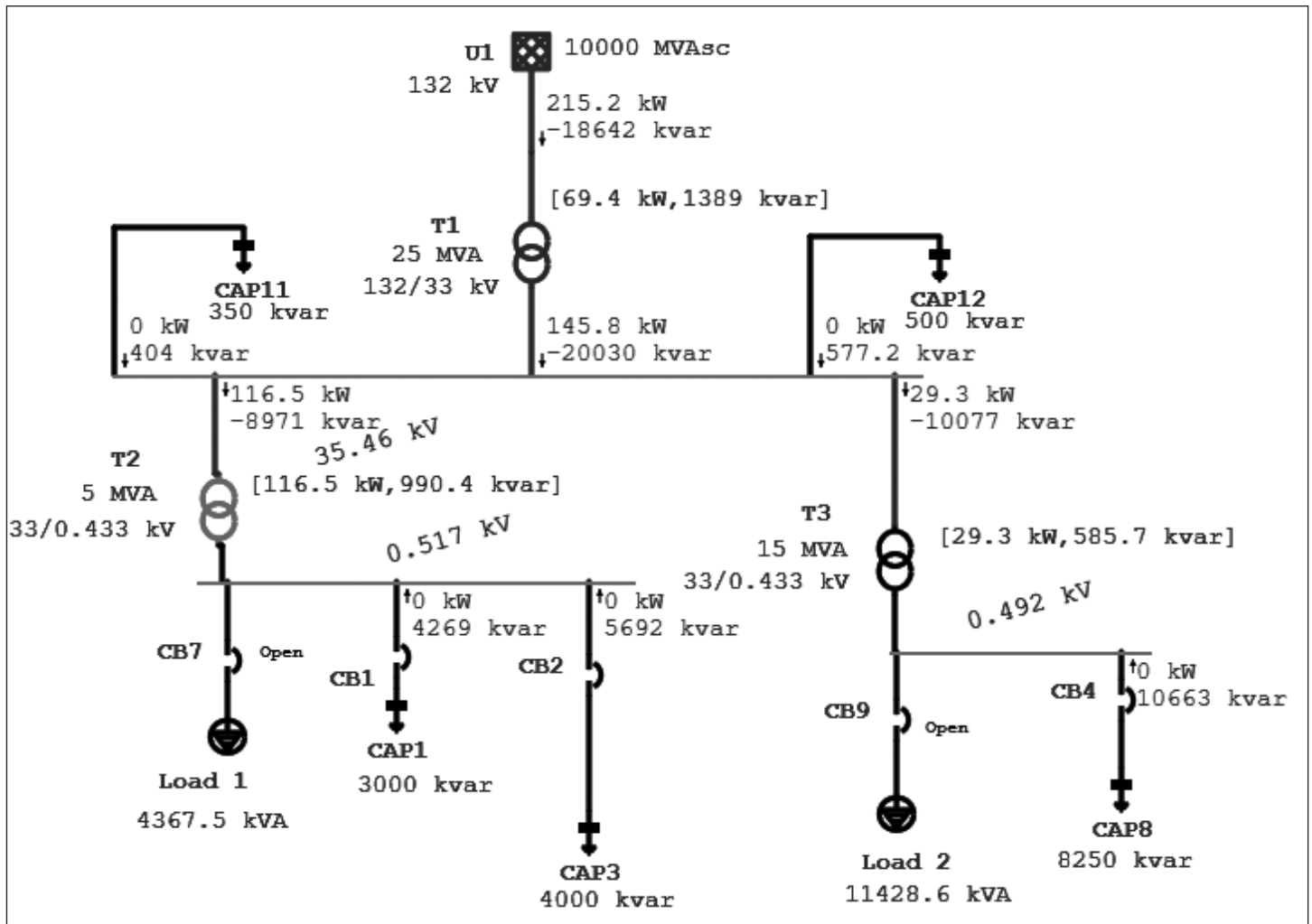


Figure 2

will start across the grid **and there is possibility of grid voltage collapse**. The ETAP simulation results for a typical case involving NO / ADEQUATE / OVERCOMPENSATED system are summarized below in figure 1, and possible high voltages at receiving end are shown in the simulation.

One can note high voltages in figure 2 at receiving end due to over compensation of reactive power at light loads.

One can note that for supplying 10.577MW of end use power, MVA flowing through the system are 17.077 if reactive power is not compensated. This is associated with huge voltage drop over the system. The same drops to 11.089MVA if reactive power is adequately compensated. Adequate compensation also maintains voltage levels within acceptable limits. Over compensation results into not only objectionable over voltages but also increases system losses.

Further we should also note that the ACTIVE and REACTIVE power requirement is dynamic in nature and keeps on changing with respect to time. Actual power requirement from grid at various tap offs usually is in gigawatts and so are reactive power requirements. Grid usually receives power at various locations from generating stations contributing steady inflow and renewable generation (Wind and Solar) contributing variable inflow – which may or may not match real time grid requirement. If CAP 11 and 12 installed at 33KV bus in above simulation are STATIC VAR COMPENSATORS (SVCs), then they can take care of dynamic variations in the requirement of reactive power. Some recently awarded patents in USA suggest a scheme to use spare capacities available in grid level solar inverters to be used as SVCs. Most of the international grids install SVCs for voltage control at strategic locations.

One can observe from above simulation that if most of the reactive power requirements of load are provided locally and that of transmission level is provided at transmission end, then distribution loss can be optimized (reduced from 142KW to 62KW) and voltage levels also can be maintained within required limits.

Injecting reactive power into the system raises voltages and absorbing reactive power lowers voltages. Voltage regulation depends on

- a. Locations and capacities of generators connected to grid.
- b. Customer loads
- c. Configuration of the transmission system and its length.

The reactive power requirements can differ substantially from location to location and can change rapidly as the location, generation output and load change. **At very low levels of system load, transmission lines act as capacitors and increase voltages.** “Receiving end voltages” can also reach levels higher than sending end voltages under light load conditions. Fluctuations in voltage levels lead to malfunctioning of various appliances. High voltage damages the insulation of windings whereas low voltage causes poor performance of critical automation equipment, medical equipment, overheating of induction motors, etc.

Relationship between reactive power and harmonic distortion?

Reactive power is a function of impedance. System Impedance comprises of source impedance, transmission line impedance and load impedance. **Impedance in AC systems is a function of frequency.** Inductive reactance (Z_L) increases with frequency, whereas capacitive reactance (Z_C) decreases with frequency. If both of them are present in one system (which is a usual case), Z_L can become equal to Z_C at a particular frequency and the circuit impedance can drastically reduce as resultant impedance is always $Z_L - Z_C$. This situation is resonance and gives rise to amplification of currents. The reason behind discussing this is TODAY'S industrial and commercial loads are largely nonlinear as a result of use of VFDs, UPS systems and computers. These loads demand nonlinear currents which are rich in harmonics. The predominant harmonics present are 3rd(150Hz), 5th(250Hz), 7th(350Hz). Power factor improvement capacitors and system impedances (Largely inductive in nature) – RESONATE at such harmonic frequencies and amplify harmonic currents. Such harmonic currents further create abnormal voltage drops across source impedances and may introduce voltage distortion. Distorted voltage if applied to normal

linear loads, compels such loads to draw nonlinear currents to complicate the situation further. **So excess correction or over compensation of reactive power has detrimental impact on harmonic levels in electrical system.**

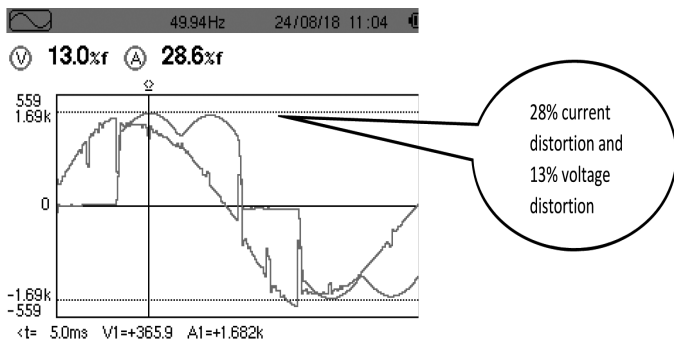


Figure 3

As shown above in figure 3, large voltage and current distortions have started becoming common issue due to lack of understanding of interdependence of reactive power and harmonics. The phase differences in current and voltage in a nonlinear system (For example involving thyristor rectifiers) is not due to inductive nature of load, but happens because thyristors are fired delayed intentionally and hence the power factor thus caused can not be corrected by introducing only capacitors in the circuit. Such arrangements require large capacitors and the resultant effect usually turns out into resonance between such capacitors and transformer impedance, causing large voltage distortion.

Various power quality standards followed by world, puts restrictions on Quality of Power made available by utility companies at consumer door steps. One should note that user can also misuse such power and cause power quality disturbances within the user premises and also in upstream power handling equipment. Such upstream disturbances can cause

1. Increased losses in upstream equipment,
2. System instability
3. Nuisance tripping
4. Loss of revenue for utility company.

This is the reason more and more utilities are keen on adopting KVAH billing and also putting restrictions

on drawl of harmonic currents. This tariff module will penalize the consumer for under as well as over compensation of reactive power and in turn will force the consumer to maintain real time power factor close to unity. **This calls for proper design of steps in APFC panels, switching method of these steps and choice between detuned filters, capacitors and active harmonic filters or a combination of these devices.**

Blended approach for designing reactive power compensation and harmonic mitigation for running plants.

Above discussion indicates that electrical calculations behind reactive power estimation, resonance conditions, voltage drops and rise etc are vector calculations and are quite complicated. Using on site electrical parameter measurements, use of electrical system simulation software like ETAP helps in increasing accuracy in these calculations. Such simulation calculates system losses, voltage levels accurately. Software also helps in optimizing placement of reactive power compensation at appropriate locations. A similar approach is also possible for greenfield projects, if electrical designer interacts with process persons and knows % loading of various loads with respect to time and sequence of working of various loads. This data can be used to know loading pattern over a complete load cycle / 24 hours. Such loads then can be used in system simulation and then detail load flow calculations can be done to size reactive power compensation with predicted end results. Clear idea about optimizing system losses also helps in customer decision making process as he gets clear idea about possible savings. Such simulation helps in splitting the reactive power compensation between FIXED and ADJUSTABLE components and helps in optimizing the investment.

Above simulation in figure 4 takes into account existing banks and helps in sizing new banks. A full-fledged load flow study up to last mile loads helps in calculating exact distribution losses. One can plan 80% fixed correction at fixed loads and interlock them with load – avoiding resonance and balance correction can be planned upstream which could be in the form of RTPFC – optimizing total system cost.

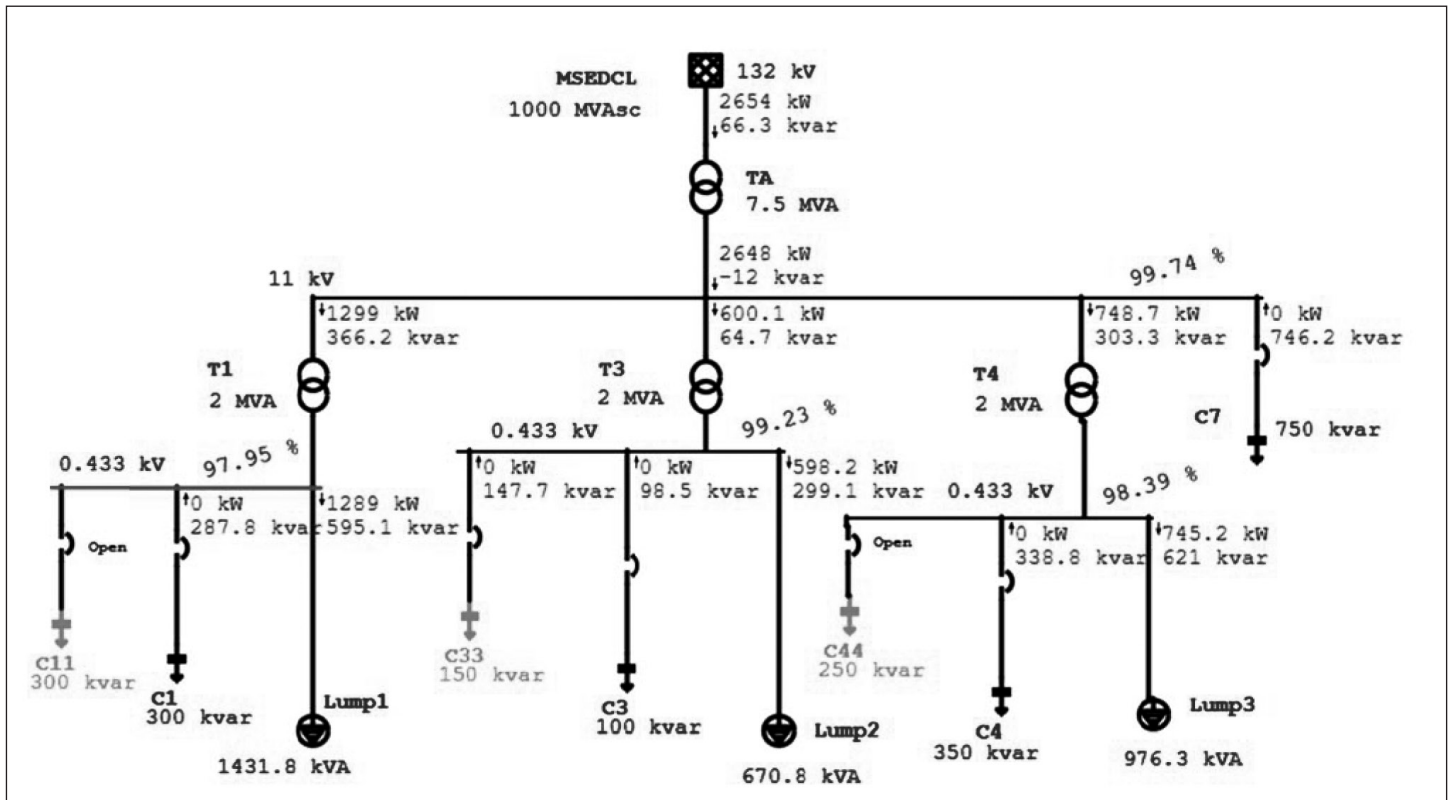


Figure 4

About recent MSEDCIL policy regarding power factor correction

Recently MSEDCIL modified formula for billed PF and introduced addition of RKVAH Lead in the denominator. One should note that in case of consumers who do not generate power and synchronize it with grid, lag or lead reactive power is always imported from the grid and as such MSEDCIL infrastructure is loaded with corresponding apparent power – KVA. The blocked capacity used for supplying this can not be used by MSEDCIL to earn revenue from another consumer. In addition to this system losses – voltage drop issues, harmonic amplification discussed earlier are also matter of concern. In view of restricting consumer from using uncontrolled reactive power, now onwards utilities gradually move towards KVAH billing. This

will penalize the consumer for lead as well lag power factors simply by increasing the bill. Further to MERC order released in Sept 2018, a recent amendment now will qualify the consumers maintaining power factors between 0.95lag and 0.95lead for receiving incentives. The billing PF formula still will contain RKVAH Lead in denominator. So consumers will have to get the reactive power compensation system correctly sized and designed followed by a systematic study of power consumption trends.

The utility companies will have to provide electrical power within committed power quality standards, but consumers will have to help utility and themselves by using this power judiciously and ensure system stability and voltage regulation by controlling use of reactive power.

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General Company/Product description: Most executors of infrastructure development programmers and builders of real estate, i.e. the construction companies in India, are under the umbrella of the over-seven-decades-old Builders' Association of India (BAI). BAI is the only all India apex representative body of civil engineering construction companies. BAI was founded in 1941 under the guidance and blessings of Brig. C.V.S. Jackson of Military Engineering Services, 'Poona', now known as 'Pune', who suggested that builders working under his command, form a body for finding solutions to various problems. He went further and made available a piece of land inside the premises of Southern Command Headquarters in Pune, on which an office was constructed and aptly named 'Jackson Hut', which stands even today as a monument in BAI's name.

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General Company/Product description: Consul Neowatt is the Global Indian UPS Company with a heritage of over 35 years. It offers one of the widest range of power electronics products in India like online UPS, Industrial Inverters, Active Harmonic Filters, Servo voltage stabilizers, Isolation transformers, Solar inverters and Static Transfer Switches. The product portfolio includes mission critical UPS solutions which in India are currently dominated by MNC's and imported products. All products are designed at its DSIR (Department of Scientific and Industrial Research) approved R&D centre located in Pune and manufactured at its ISO 9001, ISO 14001 & ISO 45001 certified modern manufacturing facilities in Chennai and Pune. The company has one of the largest Pan India service network covering 80+ locations and supported by 350 company trained engineers. The company today has built an enviable installation base of more than 300,000 installations across India, Middle-East, Africa and South Asia. Consul Neowatt Servo Stabilizers.

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General Company/Product description: DIGISOL SYSTEMS LTD is a 100% subsidiary of Smartlink Holdings Ltd and is a leading player in the Networking Industry, offering an integrated value proposition from design to development and from sales and marketing to service and support. DIGISOL set a new benchmark in the Converged Communication Systems space offering a wide range of product's across the IT networking spectrum that includes Wireless LAN, Broadband Routing, Switching, Structured Cabling Solutions and IP Surveillance. DIGISOL SYSTEMS LTD, to look after DIGISOL brand active and passive product sales, marketing and support SYNEGRA EMS Ltd an EMS ODM company which is into Active products manufacturing and TELESMAST SCS LTD., another EMS ODM company which is into manufacturing of Passive networking products.

Principal company/s: Smartlink Holdings Ltd, India, smartlinkholdings.com

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Stall No.: A034

ELECTRICAL CONTRACTORS' ASSOCIATION OF MAHARASHTRA

Office No. 67+68, 5Th Floor "A" Wing K.k. Market, Dhankawadi Pune

Key Person/s : Sunil Gaikwad

Email : ecampuneregion@gmail.com

Website: : www.ecampune.org

General Company/Product description: The ELECTRICAL CONTRACTORS' ASSOCIATION OF MAHARASHTRA (ECAM), is the largest and the oldest association of 'the persons devoted to provide all type of services about electrical installations and allied faculties.' To safeguard the interests of these entrepreneurs commonly known as Electrical Contractor it was founded in 1925 with its Head Office in Mumbai, ECAM now has more than 2500 members across Maharashtra and the six regional centers viz. at Pune, Nashik, Ahmednagar khandesh, Dhule, and western Maharashtra

Hall No.: A

Stall No.: A079

ELMEASURE INDIA PVT. LTD.

No.:47-P, Kiadb Hardware Park, Huvinayakanahalli, Yelahanka Taluk, Bangalore - 562149, India

Key Person/s : Praveen T. L., Head Marketing

Contact No. : (+91) 9740035508

Email : praveen@elmeasure.com

Website : www.elmeasure.com

General Company/Product description: Elmeasure India is a fast growing technology leader in the field of energy management. The Return on Investment is typically less than 12 months and the user can have recurring profits. Elmeasure India Pvt. Ltd. was promoted in 2004 by a young team of entrepreneurs with a collective experience of more than a decade in the field of energy management. Elmeasure has its Headquarters at Bangalore and state of the art manufacturing facilities at Bangalore and Coimbatore Elmeasure is renowned for its technical know-how in the field of energy management. It is backed by a pool of experts to invent, customize & serve the needs of 25 + industries over the globe. Elmeasure is a complete package of 500+ product varieties, 10+ Customizable Solutions & 300+ brains with stupendous & steady growth every year that is not same & not small. As a result, it was the fastest growing manufacturing

Hall No.: A

Stall No.: A076

ESENNAR TRANSFORMERS (P) LIMITED

Plot No. 2, Phase-I, Ida, Pashamailaram, Sangareddy, Hyderabad - 502307, India

Key Person/s : M. Sai Chaitanya, Engineer-Business Development

Contact No. : (+91) 8455224203

Email : vr@esennar.com

Website : www.esennar.com

Certificate/s obtained : ISO 9001; ISO 14001; ISO 18001

General Company/Product description: Electrical Power& Distribution Transformers (Oil & Dry Type)

Hall No.: A

Stall No.: A034a

FEDERATION OF ELECTRICAL CONTRACTORS' ASSOCIATION OF MAHARASHTRA

Santosh heights, 2nd Floor, Office no. 44, Opp. Apsara talkies, Gultekadi, Pune - 411037

Key Person/s : Arun Awaghwad Patil

Contact No. : (+91) 9423779515

Email : arunawaghwad@gmail.com

Website : www.fecam.in

General Company/Product description: Electrical contractors' associations from various districts in Maharashtra joined hands to form "Federation of Electrical Contractors' Associations of Maharashtra" (FECAM) in the year 1999. The federation was duly registered with the Government of Maharashtra in 2000, with registration no. NTC/PN/164. According to provisions in Electricity Act 2003 of Government of India and Electricity Acts of Government of Maharashtra, Electrical Contractors' License is issued to person qualifying norms by Industry, Energy, & Labour ministries of Government of Maharashtra. It is mandatory to source all kinds of electrical works to licensed electrical contractors only. Government licensed electrical contractors have established district associations, which work on district level problems and improvements. However, state-level problems of these contractors generated requirement of a state-level forum. Hence, "Federation of Electrical Contractors' Associations of Maharashtra" was founded.

Hall No.: A

Stall No.: A008

FIRE & SECURITY ASSOCIATION OF INDIA

603-604, Mint - India Bulls, Behind Hiranandani Meadows, Manpada, Thane - west - 400610

Contact No. : (+91) 91674 24715

Email : mumbaichapter@fsai.in

General Company/Product description: FIRE & SECURITY ASSOCIATION OF INDIA (FSAI) is a non-profit organization established in 2002 representing the Fire Protection, Life Safety, Security, Building Automation, Loss Prevention and Risk Management domains. FSAI aims to work closely with the Government and all other stakeholders to enable the Indian Fire and Security industry to reach global pre-eminence with better regulatory framework. FSAI has over 7,350+ members including leading 660+ Global and Indian corporates such as Siemens, Honeywell, Bosch, Schneider, Tyco, Kirloskar, Hikvision, Reliance, L&T, Voltas, Wipro, Aditya Infotech, Bajaj, UTC, etc., and large number of top-notch 6690+ Indian and global professionals including leading Architects, Consultants, End-users and Students. "To establish Life Safety and Security as an important human obligation in the economic development of the country and use this as an index for future investments and growth of the nation to become a world leader."

Hall No.: A

Stall No.: A077

GRASP ELECTRIC PVT. LTD.

62, Rama Road, Najafgarh Road Industrial Area, New Delhi - 110015, India

Key Person/s : Rajinder Mendiratta, Managing Director

Contact No. : (+91) 11 47543024

Email : maharajaplastic@gmail.com

Website : www.maharajaplastic.com

Certificate/s obtained : ISO

General Company/Product description: Plastic Electrical Enclosure, Distribution Box, Junction Box, Bulk Head Light Etc.

Hall No.: A

Stall No.: A063

HPL ELECTRIC & POWER LTD.

Sunrise Skyline, 3 Floor, Opp. Rasta Peth MSEB Office, Somvar Peth, Pune - 411001, India

Key Person/s : Avinash Gaopande, Sr. Branch Manager

Contact No. : (+91) 9850395269

Email : gaopande@hplindia.com

Website : www.hplindia.com

General Company/Product description: Electrical Manufacturing

Hall No.: A

Stall No.: A035

INDIA ENERGY STORAGE ALLIANCE

A-501, G-O Square, Aundh-Hinjewadi Link Road, Wakad, Pune-411057. India

Contact No. : (+91) 9699719818

Email : contact@indiaesa.info

General Company/Product description: The India Energy Storage Alliance (IESA) is a membership driven alliance was launched in 2012 by Customized Energy Solutions to promote energy storage, electric vehicle & micro grid technologies and their applications in India. Over past 7 years, IESA has worked diligently with policy markets, industry stakeholders and consumers to create awareness of energy storage technologies for transforming India's electric grid in the coming decade. IESA is getting a great response from the energy storage industry worldwide and has gained a strong foothold across various stakeholders and technology providers. IESA is also strengthening the knowledge pool of industry through its publications such as Emerging Tech Radio (ETR) podcast, Emerging Technology News (ETN) magazine, Weekly Newsletters, and various Industry reports.

Hall No.: A Stall No.: A058

JINDAL RECTIFIERS

Plot 195, Sector 24, Faridabad - 121005, India

Key Person/s : Rohit Mohan, Dy. Manager- Marketing

Contact No. : (+91) 8527549955

Email : rohit.mohan@jindalelectric.in

Website : www.jindalelectric.in

General Company/Product description: JINDAL RECTIFIERS'S is the pioneer & the undisputed market leader in the field of Industrial Voltage Stabilizers and Rectifiers in South Asia, since last four decades. The group is widely recognized for its unmatched value system quality, Service and relentless Pursuit for Excellence. Our diverse product range covers Industrial Automatic Voltage Controllers, Silicon Power Rectifiers, Variable Voltage Transformers.

Hall No.: A Stall No.: A041

K. D. JOSHI RUBBER INDUSTRIES PVT. LTD.

Plot No. A 82 - 85, H Block, MIDC, Pimpri, Pune - 411018, India

Key Person/s : Ninad Joshi, CEO

Contact No. : (+91) 9028576915

Email : sales@kdjoshi.com

Website : www.kdjoshi.com

Certificate/s obtained : ISO - 9001 - 2015

General Company/Product description: Company Description - An innovator and leader in its chosen domain of rubber products, majorly for Electrical and Textile Printing Industry A full-fledged designing, development, manufacturing and supply facility at Pune, India An ISO 9001:2015 certified company Operational since 1969 Product Description - Cable Terminal Protector Klemmesch?tzter KD - 300 for Standard RMU Cable Terminal Protector Klemmesch?tzter KD - 400 for Compact RMU Cable Terminal Protector Klemmesch?tzter KD - 300 / TR for Transformer Busbar Shrouds Electrically Semi - Conductive Rubber Products Customized Rubber Parts for Electrical Industry HT Self Amalgamating Tape. Conductor Cover Scapa Tapes

Hall No.: A Stall No.: A011

KAPILANSH DHATU UDYOG (P) LTD.

Kh. No. 63 Vill Khairy, Kamptee Road, Nagpur - 440026, India

Key Person/s : Ashwini Sahare, Marketing Coordinator
back Office Executive)

Contact No. : (+91) 927225067

Email : expo@kapilansh.com

Website : www.kapilansh.com

Certificate/s obtained : ISO 9001-2015

General Company/Product description: Cast Iron Earthing Electrode

Hall No.: A Stall No.: A045

KEI INDUSTRIES LIMITED

7th Floor, Nirvan Corporate House, Jijamata Road, Near Pump House,
Andheri (E), Mumbai - 400093, India

Key Person/s : Devraj Tigaiya, DGM- Business Development

Contact No. : (+91) 22 28315021

Email : mumbai@kei-ind.com

Website : www.kei-ind.com

General Company/Product description: Power Cables Upto 400kv Wire & Flexible Instrumentation & Control Cables, Rubber Cables, All Cables For Power Applications.

Hall No.: A Stall No.: A032

KUSUM ENGINEERING WORKS

Paras Compound, S.V. Road, Goregaon West, Mumbai - 400104, India

Key Person/s : Harsh Shah, Director

Contact No. : (+91) 22 42764990

Email : info@kewelectricals.com

Website : www.kewelectricals.com

Certificate/s obtained : ISO-9000

General Company/Product description: Low Voltage Electrical, Switchgear And Controlgear Product Including Switch Fuse Unit, MCB, MCCB, RCCB, HRC Fuses, Cable Trays, Distribution Boards, Contactors, Relays, ACB, Control Panels Etc.

Principal company/s: LSIS, KOREA

Hall No.: A

Stall No.: A083a

LAPP INDIA PVT. LTD.

#1/3, 9th A Main Road, Ashoka Pillar Road, Jayanagar 2nd Block, Bangalore - 560011, India

Key Person/s : Samir Sahu, Marketing Executive

Contact No. : (+91) 8047405000

Email : samir.sahu@lappindia.com

Website : lappindia.lappgroup.com

General Company/Product description: LAPP India is a manufacturer of cables, Industrial connectors, and cable accessories.

Principal company/s: LAPP Group, Germany, www.lappkabel.de

Hall No.: A

Stall No.: A030

LIGHT & SHADE ELECTRICALS PVT. LTD.

Luthria House, Sativali Main Road, Vasai (East), Mumbai - 401208

Key Person/s : Naresh Agarwal

Contact No. : (+91) 9323503016

Email : n9323503016@gmail.com

Hall No.: A

Stall No.: OD36

MAHINDRA & MAHINDRA LTD., POWEROL DIVISION

2nd Floor, Powerol Building, Gate No. 2, Akurli Road, Kandivali East, Mumbai - 400101, India

Key Person/s : Joy Ghosh, DGM - Brand

Contact No. : (+91) 22 66483114

Email : ghosh.joy@mahindra.com

Website : www.mahindrapowerol.com

General Company/Product description: Mahindra Powerol is a part of \$ 20 billion Mahindra group. Mahindra Powerol entered the field of power generation in 2001-02. Since inception, the business has grown exponentially to become Rs.1400 cr. business. Today, engines from Mahindra Powerol are powering diesel gensets from 5 kVA to 625 kVA including 25 & 125 kVA Gas Gensets. Mahindra Powerol was awarded the prestigious Deming Prize in 2014, which recognizes businesses that have successfully implemented Total Quality Management (TQM). The company has also won various awards like Frost & Sullivan 'Voice of Customer' award, Master Brand, Power Brand. It has also been declared Economic Times Iconic Brand and Super Brand 2017. Besides Telecom, Mahindra Powerol DG sets are powering customers from a diverse cross-section of industries and segments like banks, buildings and construction, Public Sector Units, hospitals, hotels, homes and manufacturing units in India and global overseas.

Hall No.: A

Stall No.: A029

MANISHA ENGINEERS PVT. LTD.

19 Nayana Apartment, Ideal Colony Kothrud, Pune - 411038, India

Key Person/s : Santosh Kandhare, Marketing Manager

Contact No. : (+91) 8888844536

Email : manishatransformers@gmail.com

Website : www.manishaengineers.com

Certificate/s obtained : ISO 9001 : 2015 Certified

General Company/Product description: The Leading manufacturer of Power & Distribution Transformers with proven expertise that comes through 25 years of excellent work in the field, We at Manisha Engineers, offer the unique blend of high quality products and guaranteed customer satisfaction.

Hall No.: A **Stall No.: A016**
MECO METERS PVT. LTD.

EI-60 Midc Electronic Zone, TTC Industrial Area, Mahape,
Navi Mumbai - 400710, India

Key Person/s : P. Gawade, Sales Manager

Contact No. : (+91) 2227673300

Email : p.gawade@mecoinst.com

Website : www.mecoinst.com

Certificate/s obtained : ISO 9001-2015

General Company/Product description: Electrical Electronic
Measuring Instruments And Transducers

Hall No.: A **Stall No.: A013**
NEWTEK ELECTRICALS

Plot No : M-90, Waluj Midc, Aurangabad - 431136, India

Key Person/s : Suresh Chavan, DGM - Marketing

Contact No. : (+91) 9372862651

Email : sales@newtekelectricals.com

Website : www.newtekelectricals.com

Certificate/s obtained : ISO 9001:2015

General Company/Product description: We newtek electricals
introduce ourselves as manufacturer of instrument transformers
(CT's,PT's,COTR etc) and digital meters (VAF,MFM,KWh), we
are the first one to introduce nylon flame retardent casing current
transformers. our products is been used in many prestigious
projects in india as well as in another countries. The company has
established its reputation within a short period as an innovative
leader and quality manufacturer by continuously upgrading
technology, modernizing and manufacturing facilities and
maintaining highest standards of quality and services.

Hall No.: A **Stall No.: A009**
NIPPEN ELECTRICAL INSTRUMENT CO.

12 - A, Joy Engg. Compound, Marol Maroshi Road.

Key Person/s : Has Mukh Jain

Contact No. : (+91) 9820300557

Email : nippen@nippenco.com

General Company/Product description: Digital & Analog
Ammeters, Voltmeters, Frequency Meters, Multifunction meter,
Smart Load Managers & Maximum Demand Controller, Power
Factor controllers , Transducers, Digital & Analogue Insulation
Testers, Earth Testers, ELR panel and DIN mounted, Shunts,
Current Transformers

Hall No.: A **Stall No.: A017**
**ORBITTAL ELECTROMECH ENGG.
PROJECTS PVT. LTD.**

Orbittal House, Sr.no.83 Mauje Shivane, Near Warje Malwadi,
Pune - 411023, India

Key Person/s : Pravin More, Sr. Manager

Contact No. : (+91) 8805837278

Email : business3@orbittal.com

Website : www.orbittal.com

Certificate/s obtained : ISO, CE, CPRI, IEC61439,
LM80,LM79

General Company/Product description: Industrial & Commercial
Led Lighting, Flameproof Led Lighting, Cleanroom Led Lighting,
Specialized Battery Backup Luminaries, Iot Based Projects,
Augmented Operator Adviser, Industry 4.0 Based Applications,
RtIs, Lt & Ht Panels Manufacturers.

Hall No.: A **Stall No.: A025**
P2 POWER SOLUTIONS PVT. LTD.

A-95, Sector-80, Noida - 201305, India

Key Person/s : Neetika Bora, Associate

Contact No. : (+91) 7011515761

Email : sales@p2power.com

Website : www.p2power.com

General Company/Product description: 1.Active Power Filter
2.Hybrid Power Factor Correction Panel 3.Dynamic Voltage
Regulator 4.Micro Inverter.

Hall No.: A **Stall No.: A087**
PANASONIC INDIA PVT. LTD.

12th Floor, Ambience Tower, Ambience Island, NH8,
Gurgaon 122002 Haryana

Key Person/s : Juhi Jaiswal

Contact No. : (+91) 8269000362

Email : juhi.jaiswal@in.panasonic.com

Hall No.: A Stall No.: A040

PERFECT HOUSE PRIVATE LTD.

6, commerec House, 140 Nagidas Master Road, Fort, Mumbai - 400001, India

Key Person/s : Bindesh Ghelani, Business Dev. Manager

Contact No. : (+91) 9004387771

Email : bindesh@perfectgenset.com

Website : www.perfecthouse.com

General Company/Product description: Manufacture of generator from 1KVA to 125 KVA

Hall No.: A Stall No.: A056

POWER CAM ELECTRICAL PVT. LTD.

F9 Shopping Sec1 Mansarover Gandren, Near OBC Bank, New Delhi - 110015, India

Key Person/s : Pritam Chanda, B. Dev. Manager

Contact No. : (+91) 9205181010

Email : pritam@powermatindia.com

Website : www.powermatindia.com

General Company/Product description: Busbar Insulator & Supports Of Mbc And Smc, Ct & Pt, Pilot Lamps, Industrial Locks, Epoxy Insulators, Nylon Insulators And Supports, Pultruded Angles, Rods, Tubes And Flats, Heat Shrinkable Sleeve, Ms Spacers And Other Lv Control Panel Accessories

Hall No.: A Stall No.: A071

PRAMA HIKVISION INDIA PVT. LTD.

Siddhivinayak Arcade,, Akurli Cross Road No. 1,, Near Kandivali Station (east),, Mumbai - 400 101, India

Key Person/s : Rajesh Palkar, AVP - Consultant Business

Contact No. : (+91) 22 28469900

Email : rajesh.palkar@pramahikvision.com

Website : www.hikvisionindia.com

General Company/Product description: Prama Hikvision India Pvt. Ltd is a joint venture with the world's leading security and surveillance product manufacturer, Hangzhou Hikvision Digital Technology Ltd. The endeavor is to provide superior pre- sales and post-sales service through collaboration with local distributors and its allied partners. Building on a growing global footprint, Prama Hikvision India is committed to provide high quality products with agile technical support serving a large network of dealers and system integrators across India, through its 51+ branches and a motivated workforce of 1000 plus employees. Prama Hikvision India has a long term commitment to the Government's 'Make-in India' Initiative for the India specific product manufacturing roadmap. It has set up a state-of- the- art manufacturing facility near Mumbai to cater to the Indian and overseas market. The company has 17 RMA centers to enable RMA processes to support Pan India dealer and distributor network.

Hall No.: A Stall No.: A094

R R KABEL LIMITED

Ramratna House, Oasis Complex , P.B.Marg, Worli, Mumbai - 400013, India

Key Person/s : Ashok Loya, Director

Contact No. : (+91) 22 24949009

Email : enq-mum.rrkl@rrglobal.com

Website : www.rrglobal.com

Certificate/s obtained : ISO9001:2015, ISO140001:2009, OHSAS18001:2007 & ISO50001:2011. RR Kabel has multiple product certification like CE, BASEC (UK),UL(USA), CSA(CANADA), DEMKO(DENMARK), TUV, VDE (GERMANY), PSB(SINGAPORE).

General Company/Product description: RR Kabel is a flagship company of RR Global, one of India's largest and most prominent conglomerates in the electrical industry has a noteworthy presence in more than 80 countries across the world. Head Quartered in Mumbai, we have 10 successful operating companies & 28 marketing offices in India manufacturing products ranging from Cables & Wires to Copper Tubes, Busducts, Magnet Wires, Electromechanical Parking Solutions, Busbars & Consumer Durables. Set out as a export house back in the 80's, we have grown exponentially over the past 3 decades and now have 9 manufacturing facilities across geographical boundaries and a production facility set up across an area of 1 million sq. ft. employing more than 4000 personnel. With an annual turnover of more than USD 650 million, we continue to have ambitious expansion plans of increasing our production facility by an additional 1 million sq. feet over the next few years.

Principal company/s: Ram Ratna Wires Ltd, INDIA, www.rrglobal.com, Ram Ratna Electricals Ltd, INDIA, www.rrglobal.com, Ram Ratna Infrastructure Pvt Ltd, INDIA, www.rrglobal.com

Hall No.: A

Stall No.: A044

RAKESH TRANSFORMERS INDUSTRIES PVT. LTD.

W-240, S Block, MIDC Bhosari, Pune - 411026, India

Key Person/s : Pavan Shimpi, Executive-sales & Marketing

Contact No. : (+91) 7447788733

Email : marketing.amartransformers@gmail.com

Website : www.rakeshtransformers.com

Certificate/s obtained : ISO 9001:2015

General Company/Product description: Established in 1984, RAKESH TRANSFORMER INDUSTRIES PVT. LTD, is a leading Manufacturer of Power & Distribution Transformers. The company is registered with SSI and has the entire infrastructure to manufacture Transformers upto 5MVA & voltage class of 11KV, 22KV, 33KV. The manufacturing is in accordance with the strict quality assurance procedure which meets the all national standards. Power transformer Distribution transformer Single Phase transformer Three phase isolation Dry Type transformer Hermetically sealed Transformer Package substations Pad mounted substations Dry Type Reactors AC/DC Chokes

Principal company/s: Amar Transformers Pvt Ltd, India, Wwww.amartransformers.com, Rebus Industries Lp, India, Wwww.rebusindustries.com

Hall No.: A

Stall No.: A047

RISHABH INSTRUMENTS PVT. LTD.

F-31, MIDC. Area, Satpur, Nashik - 422007, India

Key Person/s : Pallavi Mishra, Marketing Communication & Coordinator

Contact No. : (+91) 25 32202099

Email : pallavi.mishra@rishabh.co.in

Website : www.rishabh.co.in

Certificate/s obtained : ISO 9001-2015, UL, CE, IEC, ASTA

General Company/Product description: From Cam Switches, Analog Panel Meter, Shunts, Digital Multimeter to Multifunction Meters, Relays, Digital Panel Meters, Clamp Meters, Current Transformers, Transducers, Power Quality Analyzer, Insulation/Earth Testers & Energy Management System, we have an array of ingenious instruments

Principal company/s: Shanti Instruments, India, www.shanti-instruments.com, Energy Solution Lab, India, www.goesl.co, Sifam Tinsley Instrumentation Inc, US, www.sifamtinsley.com, Sifam Tinsley Instrumentation Inc, UK, www.tinsley.co.uk, LUMEL S.A., Poland, www.lumel.com.pl

Hall No.: A

Stall No.: A010

ROHITRA INDIA PVT. LTD.

S-24, MIDC Bhosari, Pune - 411026, India

Key Person/s : Kaustubh Taware, Director

Contact No. : (+91) 20 48618683

Email : info@rohitraindia.com

Website : www.rohitraindia.com

Certificate/s obtained : ISO 9001:2015, IS 1180, NABCB,

General Company/Product description: We Are Manufacturers Of Distribution And Power Transformers Upto 2.5 Mva Capacity As Per Bis 1180 Standards. We Have Isi, NABCB And ICS Certification And State Of The Art Manufacturing Facility At Bhosari, Pune. Transformer For Residential Complexes, Commercial Complexes, Industries, Solar/wind Energy, Infrastructure And Electrical Distribution Networks (utility)

Hall No.: A

Stall No.: A003

SAMCON INDUSTRIAL CONTROLS PVT. LTD.

Unit No. 112, Krishna Building, Laxmi, Industrial Complex, Pokhran Road No.1, Vartak Nagar, Thane (w) - 400606, India

Key Person/s : Nikhil Shirore, Asst. Marketing Manager

Contact No. : (+91) 7506355683

Email : sales2@samcon.co.in

Website : www.samconcontrolpanel.com

Certificate/s obtained : ISO 9001 : 2015, ISO 14001 : 2015, OHSAS 18001 : 2007

General Company/Product description: Introduction SAMCON as Electrical panel Builder - IEC 61439 (TTA)- IEC 60439(PTA) - IEC 61641 (Internal Arc)- IEC 693 (Seismic) Our Product Range - 1.PCC up to 6300A 2. MCC Draw out & Fixed type / intelligent MCC 3. PDG/DG set panels 4. APFCR panels 5. ACDB 6. DG AMF 7. DCDB 8. Drive Panel 9. Soft Starter PANE

Hall No.: A

Stall No.: A007

SAS POWERTECH PVT. LTD.

101, Gera's Regent Manor, Survey No. 33, Area No. 39/570, Behind Opulent Car Care Center, Near Krishna Medical Baner, Pune - 411045, India

Key Person/s : Abhijit Katre, Director

Contact No. : (+91) 9763003222

Email : abhijit.katre@saspowertech.com

Website : www.saspowertech.com

General Company/Product description: Electrical Audits / Safety Audit Energy Audits / Ups / Battery / Induction Lamp / LED Lamp / Stabilizer / Hvac Condenser Tube Cleaning System

Hall No.: A Stall No.: A005

SAVITA POLYMERS LIMITED

66/67, Nariman Bhavan, Nariman Point, Mumbai - 400021, India

Key Person/s : Amey Pramod Kulkarni, Marketing Manager

Contact No. : (+91) 2222883061

Email : apkulkarni@savita.com

Website : www.savita.com

General Company/Product description: Savita Polymers Limited is a group company of Savita Group which is Pioneer in India for the last more than 5 decades and the largest manufacturer of Petroleum Specialties in the entire South East Asia. We are leading Transformer Oil supplier in PAN India utilities under brand TRANSOL. As a part of continuous innovation and range extension; we have developed, tested, validated and launched Natural Ester fluid : bioTRANSOL HF for use in Transformers as an Eco-friendly alternative to Mineral Oil. Our fluid is type tested at CPRI, ERDA, Labrolek Belgium, Terna Italy in line with IEC/IS/ISO/ASTM standard's. bioTRANSOL is also approved by FM Global for Fire safe fluid and GRIHA for Eco-friendly & Innovative product. It is also certified by UL for less fire hazardous product. We have also started manufacturing and supplying Synthetic Ester fluid Transol Synth-100 inline with IS/IEC/ASTM standards.

Hall No.: A Stall No.: A050

SHREE ENGINEERING

Sr No-50/4, Plot No-9/10, Gujarwadi Road, Warkhade Nagar, Katraj, Pune - 411046

Key Person/s : Rajendra Narayanpure

Contact No. : (+91) 8380058938 / 9970267766

Email : tukaram.sales@shreeengineering.in

Hall No.: A Stall No.: A027

SHREE PREMIX INDUSTRIES

104, Corporate Avenue, Near Udyog Bhuvan,, Sonawala Cross Lane, Goregaon. (east), , Mumbai - 400063, India

Key Person/s : Yuvraj Patil, Proprietor

Contact No. : (+91) 22 26853022

Email : shreepremixindustries@gmail.com

Website : www.shreepremixindustries.com

Certificate/s obtained : ISO / DIC / IGBC

General Company/Product description: (Readymix Joint Mortar, Plaster, Adhesive for Ceramic, Vitrified Tiles, Marble, Granite & Stones, Non Shrinkage Grout, Waterproof Coating, Microconcrete, Finishing Coat, Crack fillers, Refilling material for chase surface of walls.)

Hall No.: A Stall No.: A012

SILVERLINE ELECTRICAL PVT. LTD.

Gat No 945, Ispat Road, Sanaswadi, Tal Shirur, Pune - 412208

Key Person/s : Santosh Vishwakarma, Director

Contact No. : (+91) 8975500202

Email : inquiry@silverlineelectricals.com

Website : www.silverlineelectricals.com

General Company/Product description: Power & Distribution Oil Type Transformer 2. Ester oil (K Class Oil) Filled Transformer 3. Special Purpose Transformer 4. Furnace Transformers 5. Solar / Wind Mill Transformers 6. HT & LT Feeder Pillar 7. LT Distribution Panel 8. APFC & Harmonics Filter Panel 9. Distribution Boxes

Hall No.: A Stall No.: A038

SKROMAN SWITCHES PVT. LTD.

3rd Floor, Navale It Park, Phase 2, Near Navale Bridge, Behind Union Bank Of India., Narhe, Pune - 411041, India

Key Person/s : Tushar Sankla, Operations Manager

Contact No. : (+91) 8999265137

Email : tushar@skromanglobal.com

Website : www.skromanglobal.com

Certificate/s obtained : CE Certification

General Company/Product description: 1. Digital Touch Switches 2. Motorized Curtain System 3. Digital Door Lock 4. VDP

Hall No.: A Stall No.: A019

SOFTHARD AUTOMATION PVT. LTD.

19 & 21chittavihari Society, Next To Dhankawadi Telephone Exchange, Dhankawadi, Pune - 411043, India

Key Person/s : Bhagyashree Desai, DBD, Marketing Head

Contact No. : (+91) 8805159777

Email : bhagyashree.desai@softhard.in

Website : www.softhard.in

Certificate/s obtained : ISO

General Company/Product description: Motor Protection, intelligent Motor Protection Relay, EMS Ssystem, Energy Meter, SCADA, PLC , IoT Systems, Process Automation

Hall No.: A

Stall No.: A055

SUCCESS ENGINEERS

El-60, El Block, Midc Bhosari, Pune - 411026, India

Key Person/s : Ashish Nile, Electrical Manager

Contact No. : (+91) 8956647521

Email : quotation@successengineers.in

Website : www.successengineers.in

Certificate/s obtained : ISO 9001:2008

General Company/Product description: Success Engineers Design Of The PCC/MCC/APFC & Other Control Panel Is Robust & Rigidly Constructed To Suit A Wide Range Of Industries & Buildings.

Hall No.: A

Stall No.: A014

SURYA SYSTEMS

03,sparkle Avenue, Near Chate School Katraj, Pune-Satara Road, Maharashtra - 411046, India

Key Person/s : Kiran Suryakant Vaidya, CEO

Contact No. : (+91) 9326564562

Email : kiran.vaidya@suryasystems.co.in

Website : www.suryasystems.org

General Company/Product description: We take this opportunity to introduce M/s SURYA SYSTEMS, established in the year 2016 with the theme of 'Trusted Partner in Power Quality Solutions' We are bounded to customer, for our best services at reasonable price and best quality products. We are representing M/s Gruppo Energia, Italy for their range of products on Pan India Basis. We also have facility for system study and solutions designed for power quality problem. Our target is to become preferred supplier in the field Reactive Power Components and Power quality solutions. SURYA SYSTEMS have strong team including technical back up all over India. In addition to this we are distributor of M/s. STAUBLI for their solar connector, which are mainly known as multi contact MC4 connectors. Multi contact is a global leader in Solar System Connectors. Our Connector has TUV, UL, CSA, CQC approved. Our Product: LV/MV Capacitor, Detuned Reactor, Thyristor Switch, APFC Panel, Passive Harmonic Filter, Active Harmonic Filter, PQS, Power

Hall No.: A

Stall No.: A004

SYSKA LED LIGHTS PVT. LTD.

Syska House, Plot No. 89/90/91, Survey No. 232/1/2, Off > Vip Airport Road, Lane No.4, Sakore Nagar, Lohegaon, Pune - 411014, India

Key Person/s : Bhavik Vyas, Business Development

Manager - Projects

Contact No. : (+91) 20 40131000

Email : bhavik.vyas@sskgroup.in

Website : www.syska.co.in

Certificate/s obtained : ISO 14001:2015; 9001:2015; OHSAS 18001_2007

General Company/Product description: Outdoor Lighting: Street Light, Flood Light, Tunnel Light, Garden Lights Commercial Lighting: Down lighter, Panel Light, MR/PAR Lamps & Fixtures etc. Indoor Lighting: Bulbs, Tube lights, T5 Tube lights with fixtures etc. Industrial Lighting: High-Bay Light, Well-Glass, Weatherproof etc. Decorative Lighting: Chandelier and Cove Lighting. Retrofitting is also great and easy way to upgrade any conventional lighting system.

Hall No.: A

Stall No.: A049

TADE POWERTECH PVT. LTD.

J-91, Midc, Kupwad-sangli 416436, Sangli - 416416, India

Key Person/s : Satish Jadhav, Sales And Service Engineer

Contact No. : (+91) 8805009396

Email : smjadhav@tadepowertech.in

Website : www.tadepowertech.in

General Company/Product description: M.V. Switchgear Manufacturer

Hall No.: A

Stall No.: A023

TECHNOCRAFTS SWITCHGEARS PVT. LTD

55, Arihant Commercial Complex, Old Thane Bhiwandi Road, Bhiwandi, Thane - 421301, India

Key Person/s : Naveen Shenoy, Director

Contact No. : (+91) 9820073386

Email : nc.shenoy@technocrafts.net

Website : www.technocrafts.net

Certificate/s obtained : ISO 9001 ; OHSAS 18001

General Company/Product description: TECHNOCRAFTS is the authorized 'System House' of ABB for their range of Low & Medium Voltage Switchgear. MCC, PCC panels Control & Relay Panel SKID Mounted Panel Busducts Suitable for Indoor & application to cater the user requirement.

Hall No.: A

Stall No.: A066

TELAWNE POWER EQUIPMENT'S PVT. LTD.

R-457, Midc, Rabale, Behind Pipeline Road, Thane Belapur Road,
Navi Mumbai - 400701, India

Key Person/s : Vidya Kad, Business Development

Contact No. : (+91) 9819146766

Email : rtelawne@gmail.com

Website : www.telawne.com

General Company/Product description: TELAWNE POWER EQUIPMENTS PVT. LTD engaged with its services to cater the industry with dedication & pride since 25 years in design, manufacture & supply of our varied transformer products manufactured indigenously as brand 'TELAWN'

Hall No.: A

Stall No.: A021

TESTO INDIA PVT. LTD.

Plot No. 23, Sind Society, Baner Road, Aundh, Pune - 411007, India

Key Person/s : Vimal Chavda, Manager Sales

Contact No. : (+91) 20 25920203

Email : info@testo.in

Website : www.testo.com

Certificate/s obtained : ISO, NABL

General Company/Product description: Testo is a world leader in design, development and manufacturing of electronic portable test and measuring instruments. Backed by more than 62 years of measurement engineering experience, Testo as a group is headquartered in Lenzkirch, Germany. Established in 2006, Testo India Pvt. Ltd., a 100% subsidiary of Testo SE & Co KGaA has shown phenomenal growth, with its H.O. in Pune, & a PAN India sales network. Testo India is a market leader in measuring instruments & technology specially for Electrical & HVACR industry providing instruments such as Clam meters, Multimeters, Current & voltage testers, Thermal imagers, smart probes etc. Our product range: Portable Measuring Instruments & Systems for: Temperature, Humidity, Dew point, Pressure, Air velocity, Indoor air quality, RPM, Sound, Light, Compressed Air Flow, Electrical Measurement Data Loggers and Wireless Data Monitoring System Portable Flue Gas Analyzers for Combustion and Emission Analysis Thermal Imagers

Hall No.: A

Stall No.: A001

TRUE POWER EARTHINGS PVT. LTD.

Next To Vasant Talkies, Budhwar Peth, Pune - 411002, India

Key Person/s : Jaikumar, Branch Head

Contact No. : (+91) 9370335298

Email : pune@truepowerearthings.in

Website : www.truepower.co.in

Certificate/s obtained : ISO 9001:2000

General Company/Product description: We the TRUE POWER EARTHINGS PVT. LTD. are Prominent Manufacturer Duly registered under Micro and Small Industries for manufacturing of Chemical Pipe Earthing (Based on G.I., Copper Bonded & Pure Copper), Earth pit cover, Lightning arrester, Back fill compound and all type of Grounding systems with the 'TP brand'. We are also in field of ESE Lightning Arrester in Brand Name of ATS-True Power Based on Turkey as Per Specified NFC Standard Our Product Range Which We manufacture are Given Below- 1. Chemical Pipe Earthing (GI,Copper,Copper Bonded, CI etc) 2. ESE Lightning Arrester 3. Digital Lightning counter 4. Poly Plastic Earth Pit Cover 5. Surge Arrester 6. All Earthing Accesries

Hall No.: A

Stall No.: A046

U-PROTEC EARTHING PVT. LTD.

Sr No.168, Office No I, Dhanashree Apartment, Kasaba Peth, Pune - 411011, India

Key Person/s : Harshad Khadsare, Director

Contact No. : (+91) 20 24578003

Email : uprotecearthing@gmail.com

Website : www.uprotecearthing.com

Certificate/s obtained : ISO,PWD,MHDA,GI CPRI, CB CPRI, NABL & ROHS

General Company/Product description: We are very glad to introduce ourselves as a Leading Manufacturing Company of Chemical Earthing Electrodes, Conventional Lightning Arrester & Supplier of ESE Lightning Arrester, Earthing Pit Covers in Maharashtra. The U-Protec is the fastest growing Earthing Solution provider company reaching out to the distinguish customers. As we know the customer satisfaction and business success is goes hand in hand, we are focused to give the quality & cost effective products to our renowned customers. Our products are ISO, CPRI, RoHS, NABL certified. We specialized in installation and testing highly conductive, corrosion free Earthing system as well as lightning protection system. Our services extended to private business (large and small) as well as Governmental agencies.

Hall No.: A

Stall No.: A042

UTKARSH INDIA LIMITED

Arrjavv Square, 95a, Elliot Road. 4th Floor, Kolkata - 700 016, India

Key Person/s : Siddhartha Dutta Gupta,
Sr. Manager- Brand And Digital

Contact No. : (+91) 33 22646666

Email : sd.gupta@utkarshindia.in

Website : www.utkarshindia.in

Certificate/s obtained : ISO 9001:2015, CORE, Allhabad, Power Grid Corporation of India, NTPC Approved and others

General Company/Product description: Born in India, Utkarsh India Limited is a front-running enterprise that spreads aspiring wings to respond to the global demands of life. The Company is now operating with six verticals namely : Lighting Mast & Polygonal Poles Transmission Line Towers & Substation Structures Railway Electrification Structures Polymer Products Steel tubes, Pipes & Poles Metal Beam Crash Barrier Deeply imbibing the Indian Philosophy where 'customer is the king', its all set to mortgage itself to conquer the confidence of global customers, thus making its dream of emerging as a global major come true.

Hall No.: A

Stall No.: A036

VASUDHA IT SOLUTIONS PVT. LTD.

Parth Sadan, Lokmanya Colony, Kothrud, Pune - 411029, India

Key Person/s : Keshav Kekane, Director

Contact No. : (+91) 9764544400

Email : ene@enefinder.com

Website : www.vasudhasoftwares.com

General Company/Product description: Our first product is ENEFINDER (www.enefinder.com), which is a online directory of industrial electrical, electronics and automation products. Its an excellent platform for product branding, product promotion, and material sourcing. In addition, ENEFINDER also offers other information on News & Events, Exhibitions, Tenders, Jobs & Vacancies and other services related to this field. Excess Inventory disposal, is one major feature offered by ENEFINDER. Basic Membership is free and attractive features are offered for premium members. Under Seagull-Series, we offer various business softwares including ERP. Sales CRM, Billing & Inventory Management, Payroll, Projects Monitoring, Customer Complaints handling etc.

Hall No.: A

Stall No.: A089

VIDYUT CONTROLS AND AUTOMATION PVT. LTD.

Sahara', 82/2, And 83 Hissa No. 2/2, Old N.d.a Road, Shivane, Pune - 411023, India

Key Person/s : Raviraj Bhoi, Suyog Kalgaonkar,
Sales Manager/GM Sales

Contact No. : (+91) 9657003369

Email : sales@vidyutcontrols.com

Website : www.vidyutcontrols.com,
www.vidyutcontrols.in

Certificate/s obtained : ISO 9001:2015

General Company/Product description: VIDYUT CONTROLS AND AUTOMATION PVT. LTD. Certified Core Components Panel Builder for Schneider Electric. HT Panels: 33 KV, 22 KV & 11 KV HT Panels (Internal Arc Tested Panels), 11 KV & 22 KV Ring Main Unit, Package Sub Station, Transformer, Bus Bar Trunking, Bus Ducts, Containerized Solutions. LT Panels: Power Control Center, MCC Panels, Active Filter Panels/RTPFC/APFC Panels, PDB Panels, SDB Panels. Vidyut Solutions & Services: Authorised Channel Partners of: 1. TSi Power (P) Ltd. for Power conditioning Systems (TSi-VRP Precision PWM IGBT based Static Voltage Stabilizers). 2. Riello Power India Pvt. Ltd. for Industrial Online UPS Systems. 3. Navitas Green Solutions Pvt. Ltd. for Solar & Roof Top Solar Projects. 4. Harmonic Analysis & Filtering Solutions.

Principal company/s: TSi Power (P) Ltd., India, <http://www.tsipower.in>, Riello Power India Pvt. Ltd., India, <http://www.riello-ups.in>, Navitas Green Solutions Pvt. Ltd., India, <http://navitassolar.in>

Hall No.: A

Stall No.: A024

VISION VIDYUT ENGINEERS PVT. LTD.

201 2nd Floor Orion Business Park Beside Cine Wonder Mall, Ghodbunder Road Kapurbawdi, Thane - 400607, India

Key Person/s : Vaishali Thorat, Managing Director

Contact No. : (+91) 22 25330540

Email : vaishali@visionvidyut.com

Website : www.visionvidyut.com

Certificate/s obtained : (ISO 9001:2015)

General Company/Product description: Distribution Transformer Oil Filled (mineral/midol/silicone/ester) (63 Kva To 2.5 Mva Of 33 Kv Class With Oltc, Rtcc, Free Breathing & Hermetically SeaLED Transformers Control Panels (4000a, 50kv For 1 Sec Short Circuit Tested Ar Cpri) Package Sub Station Dry Type (vpi) Transformer Upto 2.5 Mva, 22kv Class

Hall No.: A

Stall No.: A052

WEFIRE - WARRIER ELECTRONICS

180/1, Ravet, Ganesh Nagar, Midc Road, Shinde Vasti,
Dehuroad, Pune - 412101, India

Key Person/s : Rohit Warriar, CEO

Contact No. : (+91) 9960833222

Email : info@wepune.co.in

Website : www.wepune.co.in

Certificate/s obtained : MSME

General Company/Product description: Warriar Electronics (WEFIRE) offers Automatic Fire detection and suppression systems for various business critical micro environments such as Electrical Panels, Server Racks, Kitchen Hoods, CNC/EDM machines and other critical assets. Among its clients, WE is well known for its sincere customer service, dramatically quick turn around time in response to not just queries & emails but also re-instating WEFIRE systems at client's site post a fire incident, there by helping our clients avoid precious downtime due to fire. Customer Service is what sets us apart and is the most important key to our goals at Warriar Electronics. In a cost centric market such as India, where safety culture among peers in various industries is starting to grow, offering a solution which is reliable and affordable enough to penetrate most pocket sizes was important. Thus, we launched WEFIRE systems, partly manufactured in India with International quality and reliability standards.

CEEAMA activities during 2018-19

CEEAMATECH - 2018



Technical Seminar by ESENNAR TRANSFORMERS P. LTD. on 24th November at Pune



CEEAMA Stall at Worldbuild India Exhibition at BCEC, Mumbai, 19- 21 April 2018



CEEAMA activities during 2018-19

Seminar on “Electrical Safety & Energy Conservation in Buildings”, Mumbai 25 May 2018



ECAM Exhibition 2018 - Pune region supported by CEEAMA



Launching of CEEAMATECH - 2019 on 2nd June 2018



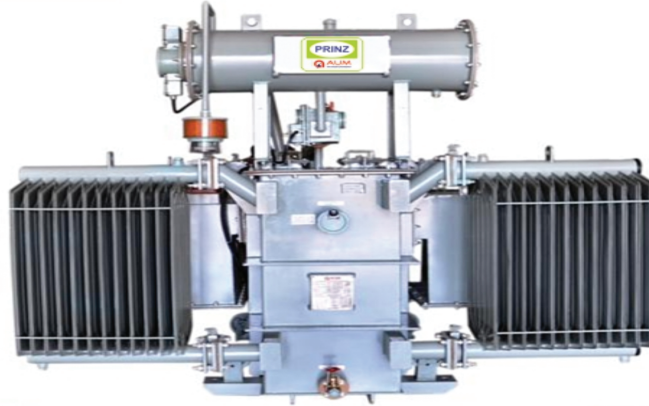


PRINZ TRANSFORMERS & ELECTRIC CO. PVT. LTD.

Registered Office: 16, Thacker Tower, Sector - 17, Vashi, Navi Mumbai - 400 705.
Tel No : 022 - 40858484 Fax : 022 - 40858407

Email: info@prinzindia.com, prinzmbai@yahoo.com, vikram@prinzindia.com

Selling Agency: PRINZ ENGINEERS (INDIA)



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LT Current & Potential Transformers
Control Transformer for special applications
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Energy Meters



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Protect Equipments



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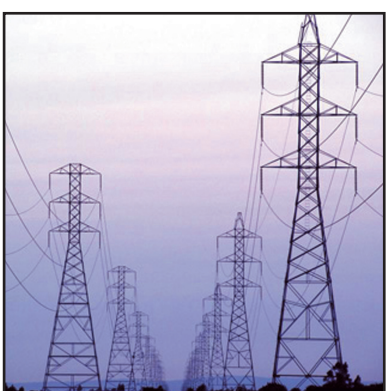
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