SPE News Letter

SPE(I), Vadodara Chapter
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HAPPY GUJARAT DAY ENVIRONMENT DAY

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27TH AGM ON 16 JUL 2023 (SUNDAY)

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FROM THE CHAIRMAN'S DESK

Dear Readers,

Our Prime Minister's state visit to the US last week was very successful and is considered a milestone globally with partnerships on 35 emerging technologies, including semiconductors, space, quantum computing, and AI, among many others, being signed between the US and India. The two most significant deals in the defense arena that took place are an MOU between Hindustan Aeronautics Limited (HAL) and GE Aerospace of the US for making fighter jet engines GE-F414 in India and procurement of unmanned advanced aircraft, Predator drones MQ-9B from General Atomics. India highly values the partnership with the US in defense as it needs to strengthen this sector, considering China's influence and muscle flexing along our borders and the Indian Ocean.

These state-of-the-art jet engines, known for their endurance and durability will boost the manufacturing of defense equipment locally with technology partnerships with the US. These engines will be manufactured in India by HAL and will be used in Light Combat Aircraft Tejas. India has planned to manufacture the first GE-F414 within the next three years, during that time, HAL will upgrade the infrastructure with technological help from GE. The project will involve an 80% transfer of technology which is considered to be very significant and critically important for India. The know-how of engine making by HAL will provide us independence in manufacturing jet fighters. India may be able to manufacture and supply spares to other countries with aircraft fitted with the GE-F414 engine. The engines will also be used for the future Twin Engine Based Fighter (TEDBF) and the Advanced Medium Combat Aircraft (AMCA) Mk1 projects. India has the vision to become one of the top exporters of defense equipment including Tejas.

The second important deal is the procurement of MQ-9B drones from General Atomics which will enhance the Intelligence, Surveillance and

Reconnaissance capability of the armed forces. The company will also establish maintenance, repairs, and overhaul facilities in India, thus boosting our defense capability. It is estimated to acquire a total of 31 drones, 15 MQ9-B Sea-Guardians for Indian Navy and 16 Sky-Guardian drones for Indian Air Force and Indian Army. Indian Navy had already taken on lease two MQ-9B Sea Guardian drones in 2020, from General Atomics for one year for surveillance in the Indian Ocean and was satisfied with their performance. The move is expected to further bolster India's national security and surveillance capabilities, not only in the Indian Ocean but also along the frontier with China.

MQ-9B drones can carry out a variety of roles, including maritime surveillance, anti-submarine warfare, and over-the-horizon targeting. Equipped with sensors, a ground control station, and a satellite link they can fly in the air for around 40 hours at a stretch in the worst weather condition with payloads over 2,100 kg and at an altitude of 40,000 feet maximum. It is powered by a 45 kVA engine with a 2kW backup and can fly with the speed of 210 KTAS, (388kMpH). They have Multi-Spectral Targeting System (MTS-B), which integrates various sensors such as infrared, colour, and monochrome daylight TV cameras, shortwave infrared camera, laser designator, and visual sensors for precise targeting. The drone can have an air-to-air and surface-to-air weapons capability equipped with a satellite-based Collision Avoidance System and Automatic Dependent Surveillance–Broadcast that can detect threats and deploy counter-measures against the weapons. The drones have a wing span of around 79 feet and a length of 38 feet and can be disassembled and loaded into a single container for deployment that can be transported using aircraft. This enhances its mobility and flexibility for deployment in various operational theatres.

(Contd. on -3)

EDITORIAL

Redefining Literacy

Dear Readers,

Before the Independence the percentage of literacy was below 20, which is now 75%. The meaning of literacy was ability to Read, Write and Speak a language. This ability would lead to understand science, mathematics, accounts and other forms of knowledge. Learned individuals were respected in society and others were referred to as illiterate. Those who were illiterate needed some one's help in writing even a postcard. They could not sign the documents and had to put thumb impression. My father was a matriculate from Bombay University but got a job in Railways. Even those who could not complete matriculation were finding jobs in Govt. departments. This was the scenario in pre-independence and till first 10 years of independence. The Commerce and Arts graduates were not considered enough literate for good jobs. Master degree became essential in the decades to follow. For the Academic jobs now, Ph.D. is considered as a bench mark. In short, the bench mark of a literate person went up & up. When I cleared my BE (Electrical) in 1971, Engineers (Graduate) and Doctors (MBBS) were considered to be highly literate and respected in society. Even the Diploma in Engineering was enough for a good job. Now that respect is lost and has been availed by Masters & Ph. D. In short, we can say that with the passage of time so called literate of yesteryears have been shifted to a bracket of illiterates. The advent of calculators and first generation computers started revolunising the technical and business sector. I remember that a person having an engineering calculator was proud of his possession and was sought after. A computer used to occupy a space of 1,500 to 2,000 sq. ft. of area. Those who knew card-punching and data entry in the computer were in high demand. The new generation computers brought in software and hardware engineers. The core engineering disciplines (Civil, Electrical & Mechanical) started taking back seat. Computer Science and application became talk of the society. Youngsters are attracted to these courses as the jobs are highly paid. Out sourcing from Silicon Valley (California, USA) brought in a radical change in In the definition of literacy. The things have come to such a pass that even now the primary schools have introduced the computer learning in their curriculum.

If we talk of mobile phone, the history is not older than 25 years. I remember the day when I received my first land line telephone connection some time in 1994, it was one of the important day that time. Mobile phone technology came in 1996. Only rich and corporate people afforded it. The progress of mobile network and mobile phone network brought the World closer. Today computer and mobile go hand in hand. Mobile applications are uncontrollable. The things have come to such a pass that every individual have to have mobile in his hand.

On the side of computer, development of software for every type of work are now available. They can be for Engineering, Medicines, Commerce, Aviation, Transport, Education and so on. Robot is the part of Artificial Intelligence (AI). All of them have reduced human intervention and have increased productivity. Soon the AI may be overtaken by Internet of Things (IOT). AI & IOT have started doing thing which needed large quantum of human efforts.

Today an engineer who does not know fundamentals earns much more by trying his hands on computer applications, AI and IOT. On the other hand an engineer whose fundamentals are strong but is not aware of computer applications, AI and IOT may take a back seat. Even in day to day life of a person now all the banking and other financial transactions are linked to mobile phone. Thus knowledge of online transaction is vital. All Government documents, tendering, negotiations and meetings are now on line. Therefore, the people who have been born in the first decade of independence (like me) who once were proud of their literacy are now quickly slipping in to the zone of illiteracy. All the age old individuals who enjoyed good position for years due to high level of education, now find it difficult to cope with the modern day living. They need now an assistant who knows about the mobile phones and applications. The computer is so versatile that you can do any work but the so called literates of recent past have to pose as an illiterate. The present day youngsters do gimmicks with soft gadgets even if they are not able to say orally what is 18 x 5 !

These days the youngsters need not learn in Academia. They can get everything on Google. Master in computer operation is a real literacy. The present day youngsters need not know spellings and grammar. The computer does it for them. The Engineering students need not study anything in the colleges, the software's will give them everything.

The people of my age are being ridiculed for sticking to basic theories of Engineering practices as they take longer time to solve the problem or make a design/drawing Competency in software operation is now only criteria in getting good placement and pay rise. As a consultant when I try to recruit personnel I find that most of them are very good at soft skills but very simple academic question they are not able to answer. The reason is simple, understanding the theory is difficult but using soft skill is simple and rewarding. My consultancy firm has a big assignment of training to the Ethiopian Electric Power (EEP). My Associates and I have visited Addis Ababa many times for the purpose. We have observed that the trainees are not interested in knowing the fundamentals but are insisting to prove our skills only on softwares which they are using. We are being labeled as illiterate in soft skills. To be frank, there are no takers for hard skills and learnings. While doing introspection it occurs to me that why one should tax his / her brain to manually work out 15 x 6 when calculator is available even in your mobile. Why one should know the Ohms Law, Kelvins Bridge, Electrical Designs of motors, transformers, breakers, transmission lines when modern tools are available? Why one should use T-square & set square when Auto-CADD can work for you?

During my visit to USA/Canada (On holidays) I found that I was totally illiterate. While moving there were only applications needing no physical work. For Railways, bus, Airport check in. sub way trains, taxi, entertainment establishment (Hollly Wood, Diseny land etc.), booking of only thing etc. there were applications. Every hotel & eating joint have application. You have to book table and also order. These allows less waiting time for everyone. On Airport everything works with soft skill starting from Immigration to baggage claim.

It appears that our fundamentals written in books have now completed their shelf life and are not worth anything. The soft skill is now a way of life and those who pursue it will only be called literate & survive. The rest of the population will be **redefined as modern illiterates.**

Readers will need lot of study to find takeaway from this editorial.

With best wishes to readers,

SM Takalkar
Editor

(**Contd. from -1**)

India's defense sector has converged significantly and will continue to converge more. India has become a major defense partner with the US with a lot of initiatives and many agreements in place. This is a win-win situation for India & USA. As a matter of fact, Indian Diaspora is also a contributor to the defense capabilities of USA lot of new technologies in various fields are coming to India that will require large numbers of engineers and scientists and also the involvement of private sector manufacturers.

Thank you,

GV Akre

CHAPTER'S ACTIVITIES

- On **19 Apr 2023** the **Chapter** convened an **Extra Ordinary General Meeting** at the Auditorium of the IE(I), Vadodara.

(i) To discuss and decide/resolve the issue of disposing off the present office premises situated at 48-FF, Avishkar Complex, Old Padra Road, Vadodara.

(ii) To discuss and decide/resolve the matter of relocating the office premises.

The report of EOGM is separately brought out in this issue.

The General Meeting was followed by a lecture on **"Smart Distribution Automation System".** The speaker was **Er. JC Marathe**, Retd. Jt. MD, MGVCL and Life Member of SPE (I) Vadodara Chapter.

In his lecture he covered following:

Attending sustained faults on 11kV is only time consuming, hazardous and annoyance to the consumers due to time taken to identify and isolate the faulty section. Excelsource Industries Pvt. Ltd. has developed 11kV Remote Connect Disconnect Switch (RCDS) which when installed on different locations of 11kV feeder, will sense the fault current and isolate the faulty section instantly without affecting power supply to the consumers of healthy sections.

A web-based software has been developed for online monitoring of the status of different RCDS of different feeders. A mobile application has also been developed by which the the concerned person responsible for attending the fault will get SMS, e-mail about the location of faulty section for further actions. This will lead to distribution automation of 11kV network. Salient features of RCDS functioning and operations were well explained by Er. JC Marathe. The product was also displayed and live operations were demonstrated to the members of society.

Distribution transformers are the most neglected component of the distribution network. Practically no protection switch-gears are provided on the transformers throughout India. Spectrum Smart Switchgears, New Delhi has developed smart MCCB for protection, metering, remote control and monitoring of all electrical & non electrical parameters. It has also developed an indigenous web-based software for capturing all the data and analyze the same for reduction of losses.

A case study was presented wherein effect of load balancing on leakage current and losses was shown. It was empathized that unbalance loading on the phases results into huge flow of current in the neutral wire resulting into I^2R losses of neutral conductor which is a wastage of energy not quantified so far. The smart MCCB and software provides a clue for reduction of technical losses. The smart MCCB is capable to protect the transformer from over load, over voltage, under voltage, phase loss, phase unbalance, earth leakage current & short circuit. So far, no protection is available from leakage current and most of the accident to the public, animals & staff are taking place due to the leakage current. The smart MCCB will help to prevent such accidents, fires, bursting of transformers etc. It will lead to LT Distribution Automation.

Er. Marathe also presented another product marketed by Excelsource Industries Pvt. Ltd. for Dynamic Reactive Compensation Unit (DRCU). It is a microprocessor-based capacitor switching unit which will identify the kVAR requirement of the system according to the dynamic loading and switch on the capacitors in minimum number of steps. A web-based software has also been developed for Remote Monitoring and control DRCU for ensuring near unity Power Factor of the installation. Reactive compensation is important for efficient operation of the equipment. It also reduces the I^2R losses due to reduction of current drawn for the same active power input.

- On **14 May 2023 the Chapter** jointly with **ERDA,** Vadodara organized **Elocution Competition "Energy Conservation & Energy Management" – Final Round (14 Finalists)** at Vasvik Auditorium.

  Dr. Vijay Shah, President, ERDA, presided over as Chief Jury.

The report of **Elocution Competition** is separately brought out in this issue.

Participant making presentation

Board of Juries on Dias: (L to R) Er. Dr. Uday Puntambekar, Dy. Dir.-ERDA & LM-SPE(I) , Er. BN Raval, AC Member, SPE(I), Er. GV Akre, Chairman, SPE(I), Er. PH Rana, Patron, SPE(I), Dr. Ruchi Shrivastava, Principal, Diploma Studies-PIET, Dr. Vijay Shah, President-ERDA

Participant making presentation

Presentation of Certificate to participant: On Dais (L to R) Dr. Ruch Shrivastava, Dr. Vijay Shah, Standing (L to R) Er. PB Parmar, Er. Keyur Thakkar, Er. PA Shah

Dr. Ruch Shrivastava, presenting Certificate to participant

- On **05 Jun 2023,** the **World Environment Day,** the **Chapter** jointly with the Parul University (PIET Diploma Studies), Rotary Club, Sayajinagari, Institution of Engineers (I), Vadodara Local Centre and Stree Chetana, Gujarat organized **Drawing Competition** on **"Solution to The Plastic Pollution"**.

The Drawing Competition was arranged at Parul University.

The welcome address was delivered by **Dr. Ruchi Shrivastava**.

Er. SP Trivedi, Jt. Secretary-SPE(I) briefed about the competition and activities of SPE(I). **Er. Ambekesh Padhya**, Chairman IE (I), Vadodara Local Centre briefed about the role and activities of IE(I). **Ms. Minal Shah**, Rotary Club Sayajinagari, Vadodara briefed about the role of Rotary Club in development of Students. **Ms. Shailaja**, President, Stree Chetana, Gujarat informed about the purpose of celebrating Environment Day and role of Girls / women in the development of the Country.

The expert talk on **Environment Day** was delivered by **Ms. Hetal Prajapati**, AC member-SPE(I). She also extended vote of thanks.

The entire event was anchored by **Er. PA Shah**, AC member-SPE(I)

Er. YV Joshi
Secretary

Dr. Ruchi Shrivastava, delivering Welcome Address

Er. PA Shah, Anchoring the

Ms. Hetal Prajapati extending Vote of Thanks

Participants in Drawing Competition **"Solution to the Plastic Pollution"**

The names of contributors and their role in making the event a success are listed below:

Sr. No.	Name of Institution	Contribution
1	Parul University, PIETDS	1. Seminar Hall for Expert Lecture and Inauguration Programme. 2. Room No. 213, for Drawing Competition for participants. 3. Lunch to Organizers, Experts and Volunteers 4. Transportation to Ms. Shailaja 5. Transportation to Expert Shri Sanjay Harane 6. Judges are provided from Faculty of Fine Arts
2	Stree Chetana, Gujarat	1. Consolation Prizes (7 Nos) to winners 2. Gift to Judges. 3. Gift to Expert Shri Sanajay Harane
3	Institution of Engineers (I), Vadodara Local Centre	1. Hi-Tea / Lunch to all participants. 2. Drawing Sheet to all participants.
4	Rotary Club, Sayajinagari, Vadodara	1. First, Second & Third Prize to winners
5	The Society of Power Engineers (I), Vadodara	1. Preparation of Flyer, Certificate, Detailed Programmes, conduction of event, conduction of Expert Lecture etc. 2. Co-ordination with other four organizations.

About 150 boys & girls (youth of age group 15 to 25 years) registered their entries for the competition. However, total 98 youth have taken part in the competition and submitted their drawing within one hour period on 05 Jun 2023. The drawings made by participants were scrutinized by Faculties of Fine Arts of Parul University and list of winners declared. All winners were honored by the dignitaries on the dais.

The winners of the Drawing Competition are as under:

1) Drishya Nair,
2) Mausam Soni
3) Kinnaree Rathwa
4) Dhruv Tiwari
5) Viral Rathwa
6) Dev Patel
7) Pooja Shah

Awardees, Experts and Organizers of the Event:
Rotary Club Sayajinagari, Parul University, Institution of Engineers (I) Vadodara Local Center, The Society of Power Engineers (I), Vadodara Chapter & Stree Chetana, Gujarat

ELECTRIC VEHICLE CHARGING SYSTEMS

EV chargers currently come in three different models: Level-1, Level-2 and Level-3. Level-3 is also commonly known as Direct Current Fast Charging (DCFC). In Level-1 & 2, the EV is connected to AC power, 120V or 240V, and a battery charger in the EV converts the AC power to the DC needed to charge the battery and controls the charging process. In DCFC, the DCFC converts the AC power to DC and the DC power is sent directly to the EV battery bypassing the on-board battery charger. This allows the DCFC to charge the EV battery directly. Level-1 & 2 charging is generally limited by the AC power available and the size of the on-board battery charger installed in the EV. DCFC is limited by the rating of the DCFC equipment and the amount of power available from the utility or other primary power sources. The charge rate, range of the EV, and the amount of time that the EV is available to recharge, known as the dwell time, work together to determine the best type of EV charging system needed for the application.

Level-1

This charge level is the simplest level of EV charging and consists of plugging the EV into a standard 120V AC receptacle using a unique electrical cord with the appropriate plugs in each end. The built-in battery charger in the EV then charges the battery. This type of charging is generally limited by the amount of power that can be supplied by the receptacle usually, 12-16A or less (1.44-1.92kW) which based on an EV with a 3MPkWh rating will add up to 5.8 miles for each hour of charging. If we charge for 10 hours overnight, it would only add up to 58 miles to the battery. Level-1 charging is useful for only limited range EVs when daily miles driven are low, or when several days of dwell time are available between EV usages.

Level-1 chargers are inexpensive, readily available, and can be carried with the EV.

Level-2

Level-2 chargers allow the EV to be connected to a 240V receptacle, like that used for an electric range or clothes dryer. Level-2 chargers are currently available up to around 20kW and continuing our example would add 60 miles for each hour of charging at 20kW. Many Level-2 chargers are in the 7kW to 10kW range. Enough to fully recharge most EVs overnight. A long-range car or a delivery van might have a battery capacity of 100kWh and could be recharged over a little more than 10 hours by a Level-2 10kW charger taking system losses into account.

Level-2 chargers are readily available and moderately priced. Higher capacity Level-2 chargers are fixed in place, but lower capacity portable ones are available. Finding a 240V receptacle to plug into can be much more challenging than a Level-1 120V receptacle though.

Level-3 or DCFC

DCFC charging uses DC to charge the EV battery without needing to go through the on-board AC battery charger. This charging level allows for a much higher capacity battery charging system. DCFC chargers, due to the cost and need for 480V electrical service, are usually limited to commercial use, either in commercial fast charging stations or in fleet operations. A 100kW DCFC can recharge an EV with a 100kWh battery in about an hour. At his rate, a 3MPkWh EV will gain 300 miles for each hour of charging.

DCFC chargers are significantly more expensive than Level-1 or 2 chargers and require 480V, 3-phase power. This limits them mostly to commercial EV charger installations.

Other Limits on the Speed of EV Charging

There is a limit on the amount of power an EV battery can accept during a charge known as the acceptance rate. This limits the speed that DCFC can charge the EV battery. For instance, if the EV has a 50kW acceptance rate and a 100kW DCFC is connected, the EV will only charge at 50kW.

Designing Electric Vehicle Battery Charging Solutions

The popularity of electric vehicles (EVs) is increasing rapidly in India. According to a survey, the EV market in India is estimated to increase from 3 million units in 2019 to 29 million units by 2027 with CAGR of 21.1%. As a result, demand for AC/DC chargers and smart EV chargers will also increase.

In order to change the batteries efficiently and to ensure their long life, we need smart battery management or charging system. To realize such EV charging stations, Holtek has come up with smart Electric Vehicle Battery Charging Solutions based on their low-cost ASSP flash microcontroller (MCU) HT45F5Q-X for charging EV batteries.

At present, three EV charger designs suitable for the Indian market with specifications of 48V/4A, 48V/12A, and 48V/15A are available for rapid development of the product. This semiconductor-based smart charging system can support both Lithium-ion as well as lead-acid battery types.

EV Charger Block Diagram

The Block diagram of the Electric Vehicle Battery Charging Solution is shown in Fig. 1. Here, battery charger ASSP flash MCU HT45F5Q-X is the heart of the EV charger circuit with in-built operational amplifiers (OPAs) and digital-to-analog converters (DACs) that are necessary for battery charging function.

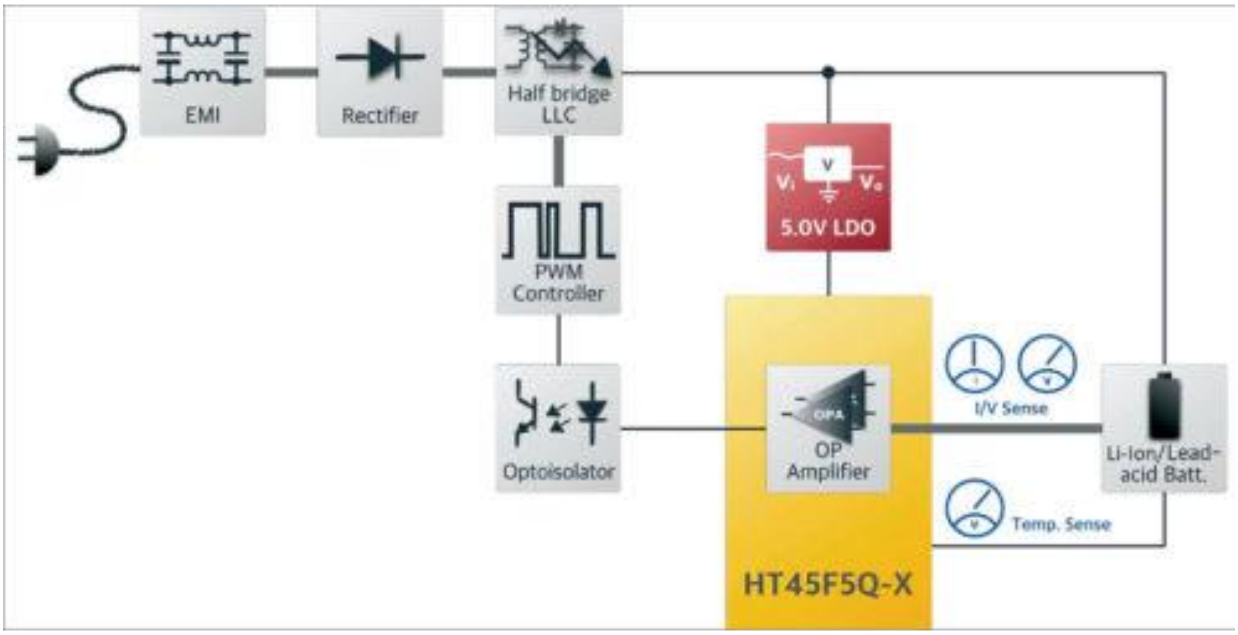


Fig: 1 EV Charger Block Diagram

Designers can choose an appropriate MCU from the HT45F5Q-X series according to their application requirements.

Specifications of the battery charger flash MCU HT45F5Q-X series are shown in Fig. 2.

Battery Charger Flash MCU

Part number	Internal clock	VDD	System clock	Program memory	Data memory	Data EEPROM	I/O	Interface	Timer	A/D	D/A	OPA	Package
HT45F5Q-1	8MHz	2.2V~5.5V	8MHz	1K×14	32x8	32×14#	9	—	—	10-bit×5	8-bit×1 12-bit×1	2	16NSOP
HT45F5Q-2	8MHz 32kHz	2.2V~5.5V	125kHz~8MHz or 32kHz	2K×16	128×8	32×8#	15	UART×1	10-bit CTM×1	12-bit×7	8-bit×1 12-bit×1	3	20NSOP
HT45F5Q-3	8MHz 32kHz	2.2V~5.5V	125kHz~8MHz or 32kHz	4K×15	256×8	32×15#	23	SPI/I²C/ UART×1	10-bit CTM×1 10-bit STM×1	12-bit×11	14-bit×1 12-bit×1	3	24/28SSOP

Fig: 2 HT45F5Q-X specifications

The features and working of the EV charger solution for 48V/12A specification are briefly explained below. This EV charger design utilizes HT45F5Q-2 MCU for implementing the battery charging control function.

The MCU incorporates a battery charging module, which can be utilized for closed-loop charging control with constant voltage and constant current for efficiently charging a battery. The internal block diagram of MCU HT45F5Q-2 is shown in Fig. 3.

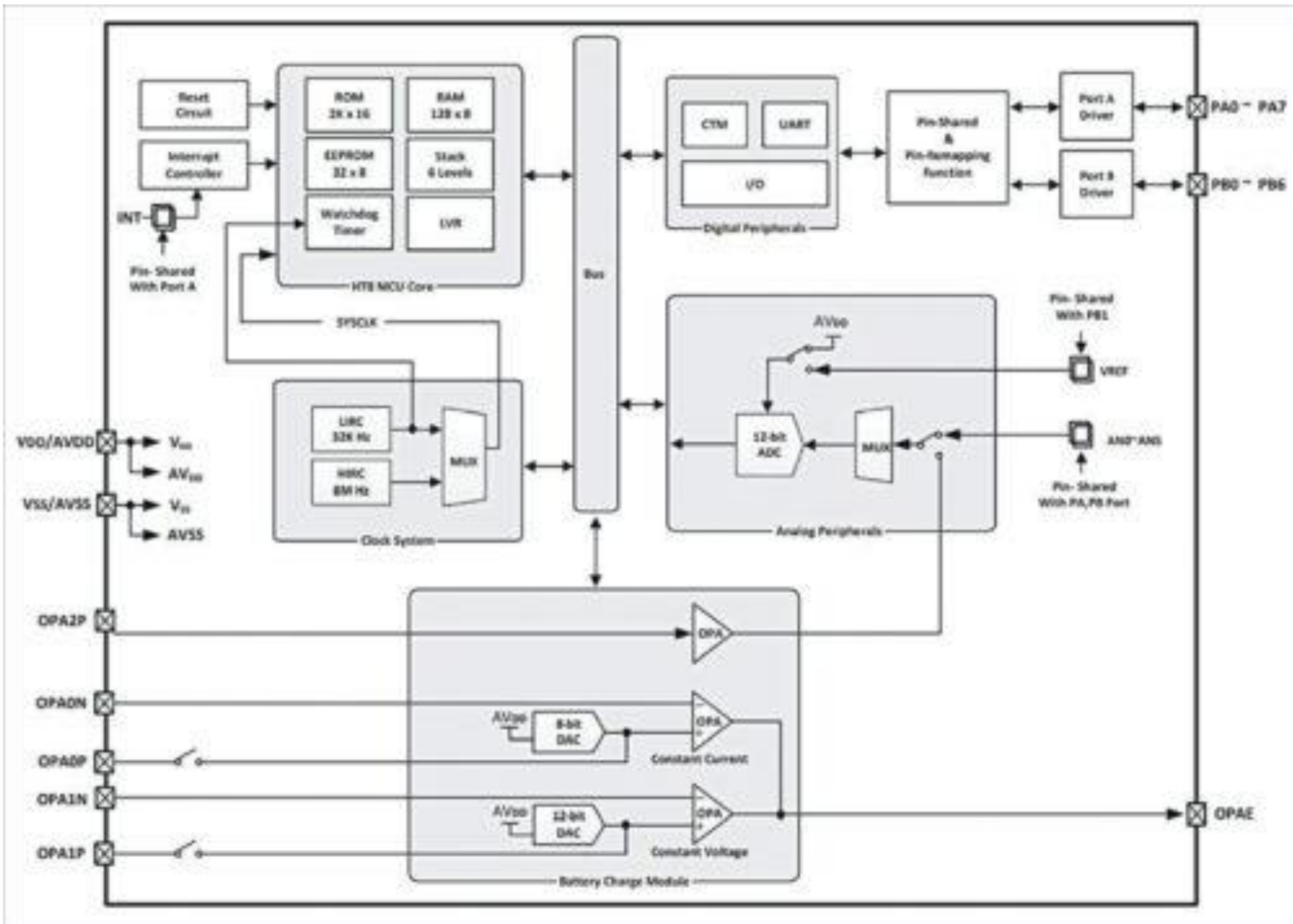


Fig: 3 Block Diagram of HT45F5Q-2

The battery charging module in HT45F5Q-2 has built-in OPAs and DACs that are needed for the charging process. Therefore the design reduces the need for external components like shunt regulators, OPAs, and DACs, which are commonly used in conventional battery charging circuits. As a result, the peripheral circuit is compact and simple, resulting in a smaller PCB area and a low overall cost.

EV Charging Working

Input power to the EV charger is an AC voltage in the range of 170V to 300V. The EV charger uses a half-bridge LLC resonant converter design, because of its high-power and high-efficiency characteristics, to obtain DC power for charging the battery.

The design utilizes a rectifier circuit for converting input AC voltage to high-voltage DC output, and it also has an electromagnetic interference (EMI) filter to eliminate high-frequency noise from the input power source. A pulse-width modulation (PWM) controller IC, like UC3525, can be used for driving the MOSFETs of the half-bridge LLC converter.

The battery charging process is supervised by the MCU HT45F5Q-2. It monitors the battery voltage and charging current levels and gives feedback to the PWM controller IC. Based on the feedback, the PWM controller varies the duty cycle of its PWM signal and drives the MOSFET circuit to obtain variable output voltage and current for charging the battery.

For better protection, HT45F5Q-2 is isolated from the rest of the circuit (i.e. high-voltage components) using a photo-coupler. Battery-level LED indicators are provided for knowing the charging status.

EV Battery Charging Process

The change in charging voltage and current during the charging process is graphically illustrated in Fig. 4. If the battery voltage is too low when connected for charging, low charging current (i.e. trickle charge (TC)) will be set initially, and the charging process will start.

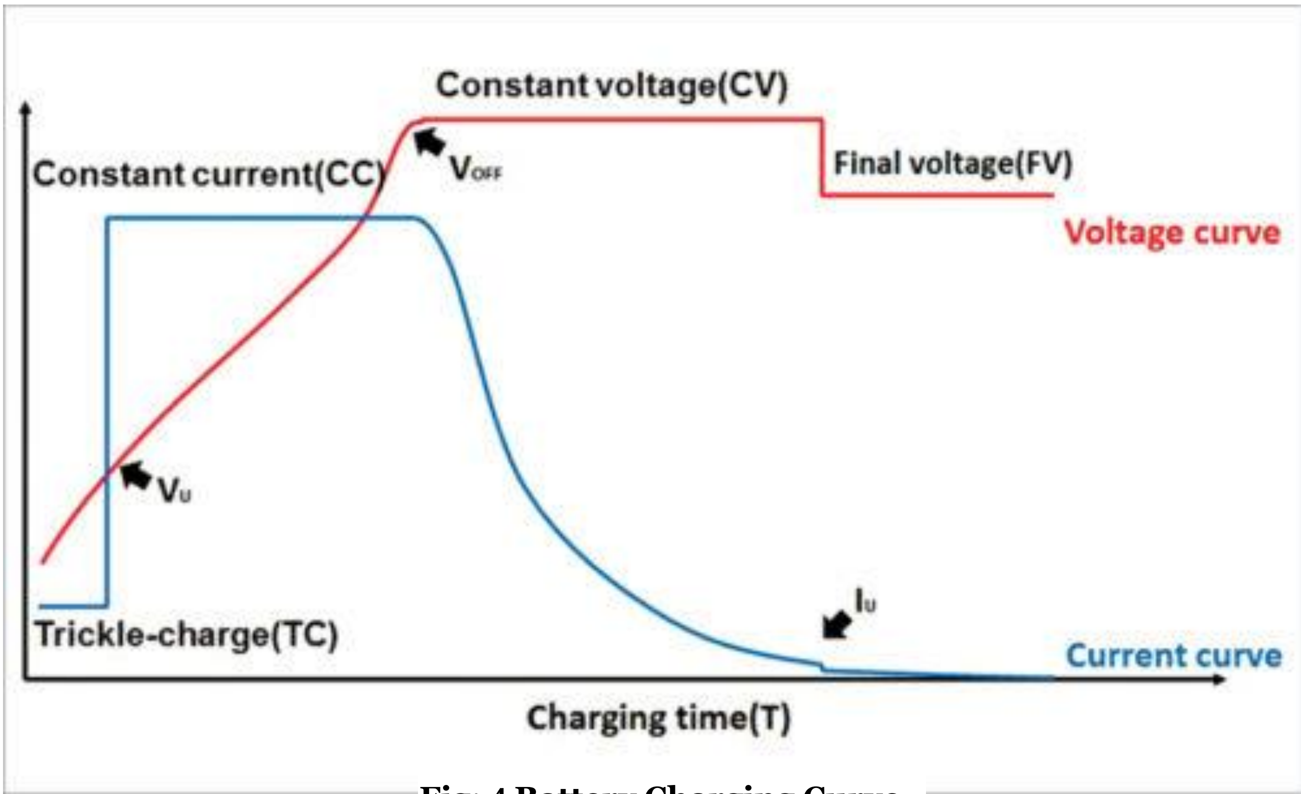


Fig: 4 Battery Charging Curve

When the battery voltage increases to a pre-defined level (Vu), constant voltage (CV) and constant current (CC) are applied for charging and continued until the battery is fully charged. The battery is considered to be fully charged when the voltage reaches VOFF. When the charging current drops to Iu, the final voltage (FV) is set.

The voltage, current, and temperature control processes in this EV charger are explained below.

(a) Voltage Control

The charging voltage is decided based on the initial voltage of the battery when it is connected for charging. As the charging progresses, the charging voltage changes accordingly, and finally, when the battery is fully charged, the final voltage is set. The charging-voltage decision levels for the 48V/12A battery charger are explained below.

- If Battery Voltage <36V, TC(0.6A) Charging, Voltage Setting FV(56V)
- If Battery Voltage <40V, TC(0.6A) Charging, Voltage Setting CV(58V)
- If Battery Voltage>40V, CC(12.0A) Charging, Voltage Setting CV(58V)
- When fully charged, the voltage is set to FV(56V). If the battery voltage is lower than FV, the charging current will be reset to CC (12.0A).

(b) Current Control

The charging current is set depending on the battery voltage. Initially, if the battery voltage is too less, a trickle-charge current would be set for charging the battery. Once the battery voltage reaches a certain level, a constant current is supplied for charging, until the battery is charged fully. The charging-current decision levels for the 48V/12A battery charger are listed below.

- Recharging Current <1.2A, determine the end of charging
- Recharging Current >0.2A, determine the start of charging

(c) Over Temperature Protection

The EV charger has a negative temperature coefficient (NTC) thermistor to monitor the temperature and a fan to regulate the heat. When the temperature increases, the fan is automatically switched on to dissipate the heat; it gets switched off when the temperature is reduced to the lower set threshold. Also, the fan turns on when the charging current is high and turns off when the charging current is low.

- When NTC temperature>110°C, the charging current will be reduced to 50% of the charging current and will be monitored periodically

(d) LED Indications for Charging Status

These are listed below-

- TC charge, red light flashes slowly (0.3 sec on, 0.3 sec off)
- CC, CV charge, red light flashes quickly (0.1 sec on, 0.1 sec off)
- When not charging, the green light is on
- When charging time exceeds eight hours, red and green lights are bright

(e) Charging Duration

When the charging duration is exceeded (duration depends on battery capacity), the voltage drops to FV, the current is reduced to TC, and the charger repeatedly monitors the battery voltage.

EV Charger Circuit Diagram

The schematic of the Holtek EV charger design for 48V/12A type is shown in Fig. 5 for reference and its PCB assembly is shown in Fig. 6.

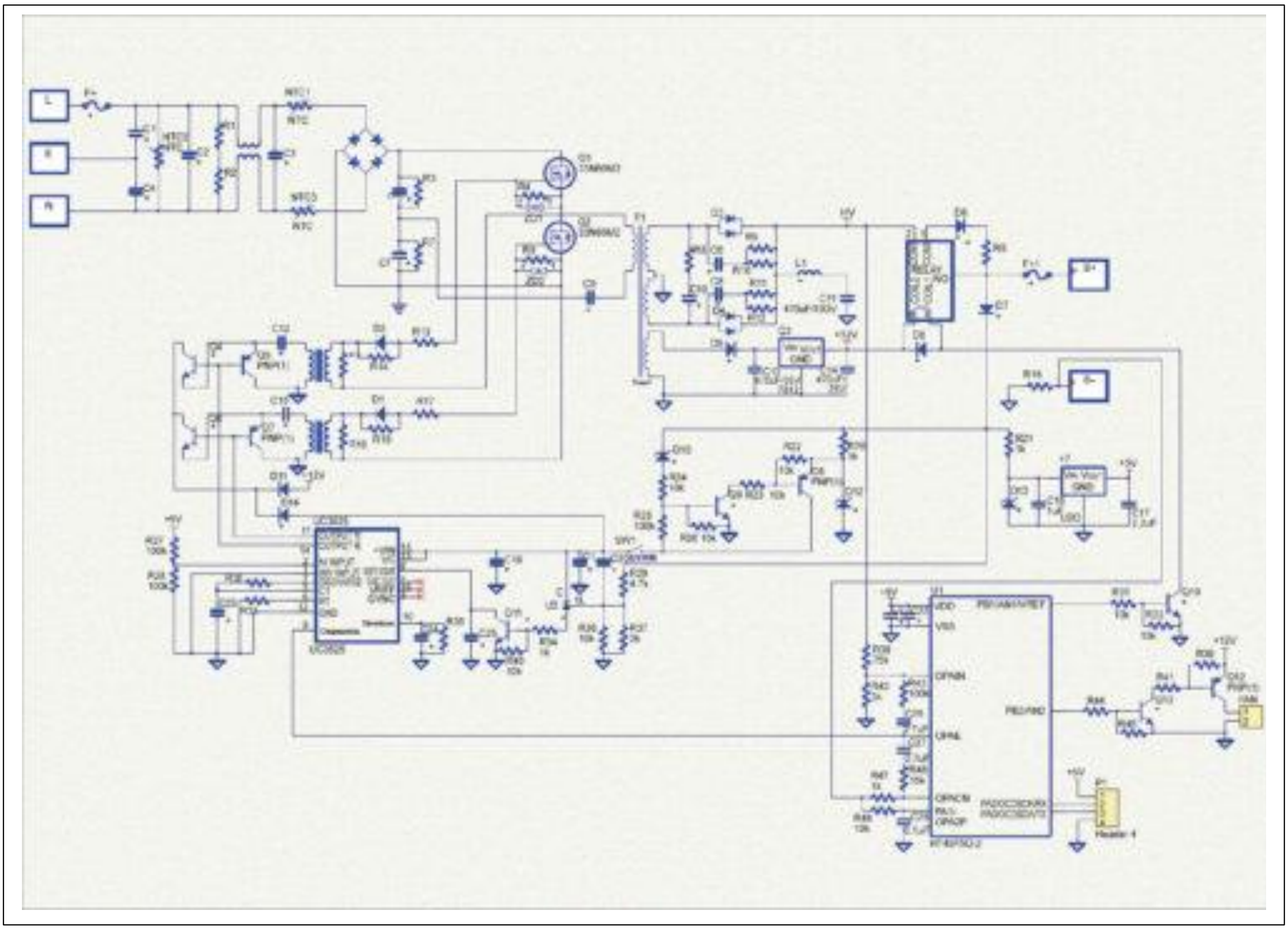


Fig: 5 EV Charger Schematic for 48V/12A

High-Resolution Image

The ASSP flash MCU HT45F5Q-2 can also be used for designing higher-wattage solutions. It offers a programmable option for setting parameter thresholds, which makes it very convenient for EV charger designs. Holtek provides technical resources such as block diagrams, application circuits, PCB files, source code, etc. to help designers in rapid product development and speed up time-to-market.

Fig: 6 EV Charger PCB Assembly

EV charger development platform for the HT45F5Q-X series will also be available soon. Using this software tool, users would be able to easily select the charging voltage/current and other parameters to create a programme. This application will also be able to generate a program containing a standard charging process, thereby significantly simplifying the development process.

Charging Station

- **Left:** a Tesla Roadster (2008) being charged at an electric charging station in Iwata city, Japan
- **Right:** Brammo Empulse electric motorcycle at an AeroVironment charging station and

Pay as you go electric vehicle charging point.

- **Left:** Nissan Leaf recharging from a NRG Energy eVgo station in Houston, Texas.
- **Right:** converted Toyota Priuses recharging at public charging stations in San Francisco (2009).

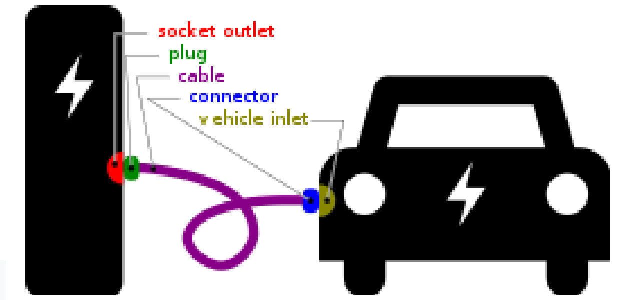
A **charging station**, also known as a **charge point** or **electric vehicle supply equipment** (**EVSE**), is a piece of equipment that supplies electrical power for charging plug-in electric vehicles (including electric cars, electric trucks, electric buses, neighborhood electric vehicles, and plug-in hybrids).

There are two main types: AC charging stations and DC charging stations. Batteries can only be charged with direct current (DC) electric power, while most electricity is delivered from the power grid as alternating current (AC). For this reason, most electric vehicles have a built-in AC-to-DC converter, commonly known as the "onboard charger". At an AC charging station, AC power from the grid is supplied to this onboard charger, which produces DC power to charge the battery. DC chargers facilitate higher power charging (which requires much larger AC-to-DC converters) by building the converter into the charging station instead of the vehicle to avoid size and weight restrictions. The station then supplies DC power to the vehicle directly, bypassing the onboard converter. Most fully electric car model can accept that conform to a variety of international standards. DC charging stations are commonly equipped with multiple connectors to be able to charge a wide variety of vehicles that utilize competing standards.

Public charging stations are typically found street-side or at retail shopping centers, Government facilities, and other parking areas. Private charging stations are typically found at residences, workplaces, and hotels.

Multiple standards have been established for charging technology to enable interoperability across vendors. Standards are available for nomenclature, power, and connectors. Notably, Tesla has developed proprietary technology in these areas, and built its charging networking starting in 2012.(1)

Nomenclature



Charging station and vehicle terminology

In 2011, the European Automobile Manufacturers Association (ACEA) defined the following terms:(2)

- Socket outlet: the port on the electric vehicle supply equipment (EVSE) that supplies charging power to the vehicle
- Plug: the end of the flexible cable that interfaces with the socket outlet on the EVSE. In North America, the socket outlet because the cable is permanently attached.
- Cable: a flexible bundle of conductors that connects the EVSE with the electric vehicle.

- Connector: the end of the flexible cable that interfaces with the vehicle inlet
- Vehicle inlet: the port on the electric vehicle that receives charging power

The terms "electric vehicle connector" and "electric vehicle inlet" were previously defined in the same way under Article 625 of the United States National Electric Code (NEC) of 1999. NEC-1999 also defined the term "electric vehicle supply equipment" as the entire unit "installed specifically for the purpose of delivering energy from the premises wiring to the electric vehicle", including "conductors ... electric vehicle connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatuses".[3]

Tesla, Inc. uses the term charging station as the location of a group of chargers, and the term connector for an individual charger.(4)

Voltage and power

Early standards

Method	Maximum supply		
	Current (A)	Voltage (V)	Power (kW)
Level-1 (1-Phase AC)	12	120	1.44
	16	120	1.92
	24	120	2.88
Level-2 (1-Phase AC)	32	208/240	7.68
Level-3 (3-Phase AC)	400	480	332.6

The National Electric Transportation Infrastructure Working Council (IWC) was formed in 1991 by the Electric Power Research Institute with members drawn from automotive manufacturers and the electric utilities to define standards in the United States;[6] early work by the IWC led to the definition of three levels of charging in the 1999 National Electric Code (NEC) Handbook.[5]:9

Under the 1999 NEC, Level-1 charging equipment (as defined in the NEC handbook but not in the code) was connected to the grid through a standard NEMA 5-20R 3-prong electrical outlet with grounding, and a ground-fault circuit interrupter was required within 12 in (300 mm) of the plug. The supply circuit required protection at 125% of the maximum rated current; for example, charging equipment rated at 16 amperes ("amps" or "A") continuous current required a breaker sized to 20 A.[5]:9

Level 2 charging equipment (as defined in the handbook) was permanently wired and fastened at a fixed location under NEC-1999. It also required grounding and ground-fault protection; in addition, it required an interlock to prevent vehicle startup during charging and a safety breakaway for the cable and connector. A 40A breaker (125% of continuous maximum supply current) was required to protect the branch circuit.[5]:9 For convenience and speedier charging, many early EVs preferred that owners and operators install Level 2 charging equipment, which was connected to the EV either through an inductive paddle (Magne Charge) or a conductive connector (Avcon).[5]:10–11,18

Level-3 charging equipment used an off-vehicle rectifier to convert the input AC power to DC, which was then supplied to the vehicle. At the time it was written, the 1999 NEC handbook anticipated that Level-3 charging equipment would require utilities to upgrade their distribution systems and transformers. [5]:9

SAE

SAE J1772(2017) levels(7) hide

Method	Maximum supply		
	Current (A)	Voltage (V)	Power (kW)
AC Level 1	12	120	1.44
	16	120	1.92
AC Level 2	80	208–240	19.2
DC Level 1	80	50–1000	80
DC Level 2	400	50–1000	400

The Society of Automotive Engineers (SAE International) defines the general physical, electrical, communication, and performance requirements for EV charging systems used in North America, as part of standard SAE J1772, initially developed in 2001.[8] SAE J1772 defines four levels of charging, two levels each for AC and DC supplies; the differences between levels are based upon the power distribution type, standards and maximum power.

Alternating current (AC)

AC charging stations connect the vehicle's onboard charging circuitry directly to the AC supply.[8]

- **AC Level-1**: Connects directly to a standard 120V North American outlet; capable of supplying 6–16 A (0.7–1.92 kilowatts or "kW") depending on the capacity of a dedicated circuit.
- **AC Level 2**: Utilizes 240 V (single phase) or 208 V (three phase) power to supply between 6 and 80 A (1.4–19.2kW). It provides a significant charging speed increase over AC Level 1 charging.

Direct current (DC)

Commonly, though incorrectly, called "Level 3" charging based on the older NEC-1999 definition, DC charging is categorized separately in the SAE standard. In DC fast-charging, grid AC power is passed through an AC-to-DC converter in the station before reaching the vehicle's battery, bypassing any AC-to-DC converter onboard the vehicle.[8][9]

- **DC Level-1**: Supplies a maximum of 80 kW at 50–1000 V.
- **DC Level-2**: Supplies a maximum of 400 kW at 50–1000 V.

Additional standards released by SAE for charging include SAE J3068 (three-phase AC charging, using the Type 2 connector defined in IEC 62196-2) and SAE J3105 (automated connection of DC charging devices).

IEC

In 2003, the International Electrotechnical Commission (IEC) adopted a majority of the SAE J1772 standard under IEC 62196-1 for international implementation.

The IEC alternatively defines charging in *modes* (IEC 61851-1):

- ***Mode 1:*** slow charging from a regular electrical socket (single - or three-phase AC)

IEC 61851-1 modes[10][11][12] hide

Mode	Type	Maximum supply		
		Current (A)	Voltage (V)	Power (kW)
1	1Φ AC	16	250	4
	3Φ AC	16	480	11
2	1Φ AC	32	250	7.4
	3Φ AC	32	480	22
3	1Φ AC	63	250	14.5
	3Φ AC	63	480	43.5
4	DC	200	400	80

- ***Mode 2***: slow charging from a regular AC socket but with some EV-specific protection arrangement (i.e. the Park & Charge or the PARVE systems)
- ***Mode 3***: slow or fast AC charging using a specific EV multi-pin socket with control and protection functions (i.e. SAE J1772 and IEC 62196-2)
- ***Mode 4***: DC fast charging using a specific charging interface (i.e. IEC 62196-3, such as CHAdeMO)

The connection between the electric grid and "charger" (electric vehicle supply equipment) is defined by three cases (IEC 61851-1):

- ***Case A:*** any charger connected to the mains (the mains supply cable is usually attached to the charger) usually associated with modes 1 or 2.
- ***Case B:*** an on-board vehicle charger with a mains supply cable that can be detached from both the supply and the vehicle – usually mode 3.
- ***Case C:*** DC dedicated charging station. The mains supply cable may be permanently attached to the charge station as in mode 4.

TESLA NACS

The North American Charging Standard was developed by Tesla, Inc. for use in company's vehicles. It remained a proprietary standard until 2022 when its specifications were published by Tesla.[13][14] The connector is physically smaller than the J1172/CCS connector, and uses the same pins for both AC and DC charging functionality. Aptera Motors has also adopted the connector standard in its vehicles.[15]

To meet European Union (EU) requirements on recharging points,[16] Tesla vehicles sold in the EU are equipped with an CCS Combo 2 port. Both the North America and the EU port take 480V DC fast charging through Tesla's network of Superchargers, which variously use NACS and CCS charging connectors. Depending on the Supercharger version, power is supplied at 72, 150, or 250 kW, the first corresponding to DC Level 1 and the second and third corresponding to DC Level 2 of SAE J1772. As of Q4 2021, Tesla reported 3,476 supercharging locations worldwide and 31,498 supercharging chargers (about 9 chargers per location on average).[4]

Future Development

An extension to the CCS DC fast-charging standard for electric cars and light trucks is under development, which will provide higher power charging for large commercial vehicles (Class 8, and possibly 6 and 7 as well, including school and transit buses). When the Charging Interface Initiative e.V. (CharIN) task force was formed in March-2018, the new standard being developed was originally called High Power Charging (HPC) for Commercial Vehicles (HPCCV),[17] later renamed Megawatt Charging System (MCS). MCS is expected to operate in the range of 200–1500 V and 0–3,000 A for a theoretical maximum power of 4.5 Megawatts (MW). The proposal calls for MCS charge ports to be compatible with existing CCS and HPC chargers.[18] The task force released aggregated requirements in February 2019, which called for maximum limits of 1,000V DC (optionally, 1,500V DC) and 3,000 A continuous rating.[19]

A connector design was selected in May 2019(17) and tested at the National Renewable Energy Laboratory (NREL) in September 2020. Thirteen manufacturers participated in the test, which checked the coupling and thermal performance of seven vehicle inlets and eleven charger connectors.[20] The final connector requirement and specification was adopted in December 2021 as MCS connector version 3.2.[21][22]:3

With support from Portland General Electric, on 21 April 2021 Daimler Trucks North America opened the "Electric Island", the first heavy-duty vehicle charging station, across the street from its headquarters in Portland, Oregon. The station is capable of charging eight vehicles simultaneously, and the charging bays are sized to accommodate tractor-trailers. In addition, the design is capable of accommodating >1 MW chargers once they are available.[23] A startup company, WattEV, announced plans in May 2021 to build a 40-stall truck stop/charging station in Bakersfield, California; at full capacity, it would provide a combined 25 MW of charging power, partially drawn from an on-site solar array and battery storage.[24]

Connectors

Common Charging Connectors

IEC Type 4/CHAdeMO (left); CCS Combo 2 (center); IEC Type 2 outlet (right)

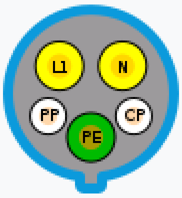
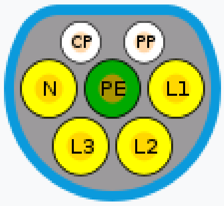
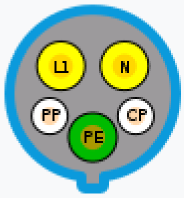
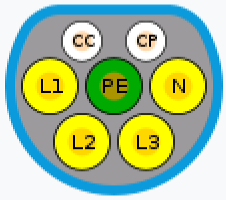
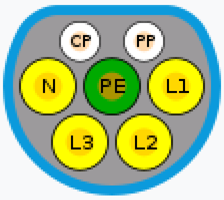
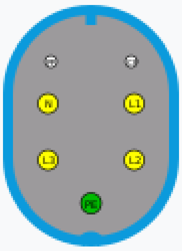
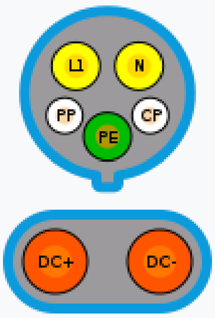
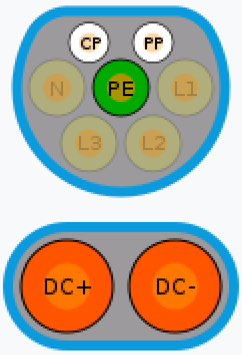
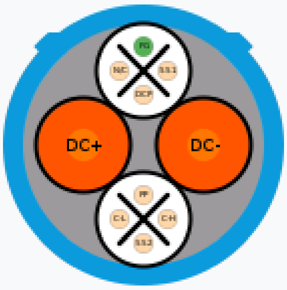
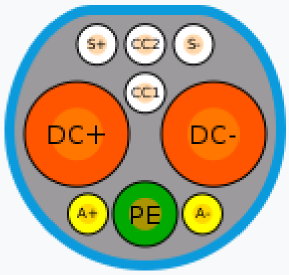
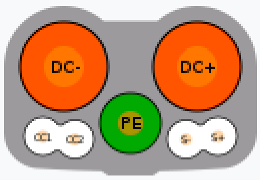
IEC Type 1/SAE J1772 inlet (left); NACS (center); IEC Type 2 connector outlet (right)

Common connectors include Type 1 (Yazaki), Type 2 (Mennekes), Type 3 (Scame), CCS Combo 1 and 2, CHAdeMO and Tesla.[25][26]

[27] Many standard plug types are defined in IEC 62196-2 (for AC supplied power) and 62196-3 (for DC supplied power):

- Type 1: single-phase AC vehicle coupler – SAE J1772/2009 automotive plug specifications
- Type 2: single- and three-phase AC vehicle coupler – VDE-AR-E 2623-2-2, SAE J3068, and GB/T 20234.2 plug specifications
- Type 3: single- and three-phase AC vehicle coupler equipped with safety shutters – EV Plug Alliance proposal
- Type 4: DC fast charge couplers
  - Configuration AA: CHAdeMO
  - Configuration BB: GB/T 20234.3
  - Configurations CC/DD: (reserved)
  - Configuration EE: CCS Combo 1
  - Configuration FF: CCS Combo 2

Connector designs listed in IEC 62196-2 and -3

Power supply	United States	European Union	Japan	China
1-phase AC (62196.2)	 Type **1** (SAE J1772)(a)	 Type 2 (DE, UK)	 Type 1 (SAE J1772)(b)	 Type 2 (GB/T 20234.2)(c)
3-phase AC (62196.2)	 Type 2 (SAE J3068)	 Type 3 (IT, FR; now deprecated)	—	
DC (62196.3)	 EE (CCS Combo 1)	 FF (CCS Combo 2)	 AA (CHAdeMO)	 BB (GB/T 20234.3)
			 ChaoJi (planned)	

Notes:

1. ^ Although this image shows Neutral on line 2, this is active L2 power while Level-2 charging per SAE J1772 Table 8
2. ^ Although this image shows Neutral on line 2, this is active L2 power while Level-2 charging per SAE J1772 Table 8

3. ^ Although GB/T 20234.2 is physically capable of supporting three-phase power, the standard does not include its use.

CCS DC charging requires Powerline Communications (PLC). Two connectors are added at the bottom of Type 1 or Type 2 vehicle inlets and charging plugs to supply DC current. These are commonly known as Combo 1 or Combo 2 connectors. The choice of style inlets is normally standardized on a per-country basis so that public chargers do not need to fit cables with both variants. Generally, North America uses Combo 1 style vehicle inlets, while most of the rest of the world uses Combo 2.

The CHAdeMO standard is favored by Nissan, Mitsubishi, and Toyota, while the SAE J1772 Combo standard is backed by GM, Ford, Volkswagen, BMW, and Hyundai. Both systems charge to 80% in approximately 20 minutes, but the two systems are completely incompatible. Richard Martin, editorial director for clean technology marketing and consultant firm Navigant Research, stated:

The broader conflict between the CHAdeMO and SAE Combo connectors, we see that as a hindrance to the market over the next several years that needs to be worked out.[28]

Historical Connectors

Public charging stations in a parking lot near Los Angeles International Airport. Shown are two obsolete 6 kW AC charging stations (left: inductive Magne-charge gen2 SPI ("small paddle"), right: conductive EVII ICS-200 AVCON).

In the United States, many of the EVs first marketed in the late 1990s and early 2000s such as the GM EV1, Ford Ranger EV, and Chevrolet S-10 EV preferred the use of Level 2 (single-phase AC) EVSE, as defined under NEC-1999, to maintain acceptable charging speed. These EVSEs were fitted with either an inductive connector (Magne Charge) or a conductive connector (generally AVCON). Proponents of the inductive system were GM, Nissan, and Toyota; Daimler Chrysler, Ford, and Honda backed the conductive system.[(5):10–11]

Magne Charge paddles were available in two different sizes: an older, larger paddle (used for the EV1 and S-10 EV) and a newer, smaller paddle (used for the first-generation Toyota RAV4 EV, but backwards compatible with large-paddle vehicles through an adapter).[(29)] The larger paddle (introduced in 1994) was required to accommodate a liquid-cooled vehicle inlet charge port; the smaller paddle (introduced in 2000) interfaced with an air-cooled inlet instead.[(30])(31):23] SAE J1773, which described the technical requirements for inductive paddle coupling, was first issued in January 1995, with another revision issued in November 1999.[(31):26]

The influential California Air Resources Board adopted the conductive connector as its standard on 28 June 2001, based on lower costs and durability, and the Magne Charge paddle was discontinued by the following March.

Three conductive connectors existed at the time, named according to their manufacturers: Avcon (aka butt-and-pin, used by Ford, Solectria, and Honda); Yazaki (aka pin-and-sleeve, on the RAV4 EV); and ODU (used by DaimlerChrysler).

The Avcon butt-and-pin connector supported Level 2 and Level 3 (DC) charging and was described in the appendix of the first version (1996) of the SAE J1772 recommended practice; the 2001 version moved the connector description into the body of the practice, the 2001 version moved the connector description into the body of the practice, making it the de facto standard for the United States, IWC recommended the Avcon butt connector for North America, based on environmental and durability testing.

As implemented, the Avcon connector used four contacts for Level 2 (L1, L2, Pilot, Ground) and added five more (three for serial communications, and two for DC power) for Level 3 (L1, L2, Pilot, Com1, Com2, Ground, Clean Data ground, DC+, DC-).(36) By 2009, J1772 had instead adopted the round pin-and-sleeve (Yazaki) connector as its standard implementation, and the rectangular Avcon butt connector was rendered obsolete.(37)

Charging Time

Able to recharge the battery in 15 minutes to 80%

Solaris Urbino 12 electric, battery electric bus, inductive charging station.

Charging time basically depends on the battery's capacity, power density, and charging power. The larger the capacity, the more charge the battery can hold (analogous to the size of a fuel tank). Higher power density allows the battery to accept more charge/unit time (the size of the tank opening). Higher charging power supplies more energy per unit time (analogous to a pump's flow rate). An important downside of charging at fast speeds is that it also stresses the mains electricity grid more.(38)

California Air Resources Board specified a target minimum range of 150 miles to qualify as a zero-emission vehicle, and further specified that the vehicle should allow for fast-charging.

Charge time can be calculated as:
The effective charging power can be lower than the maximum charging power due to limitations of the battery or battery management system, charging losses (which can be as high as 25%(41)), and vary over time due to charging limits applied by a charge controller.

Battery capacity

The usable battery capacity of a first-generation electric vehicle, such as the original Nissan Leaf, was about 20 kilowatt-hours (kWH), giving it a range of about 100 mi (160 kM).[citation needed] Tesla was the first company to introduce longer-range vehicles, initially releasing their Model S with battery capacities of 40 kWh, 60 kWh and 85 kWh, with the latter lasting for about 480 kM (300 mi).(42) Current plug-in hybrid vehicles typically have an electric range of 15 to 60 miles.(43)

AC to DC conversion

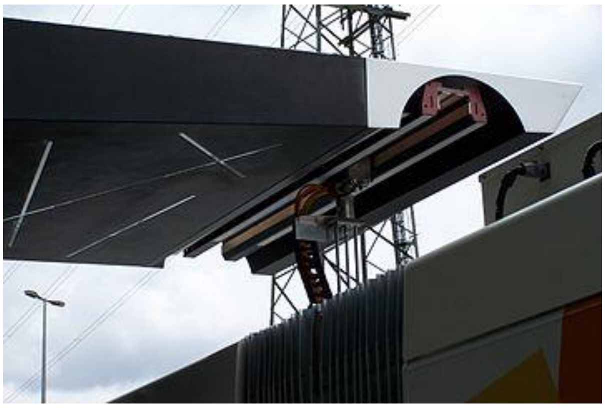
Batteries are charged with DC power. To charge from the AC power supplied by the electrical grid, EVs have a small AC-to-DC converter built into the vehicle. The charging cable supplies AC power directly from the grid, and the vehicle converts this power to DC internally and charges its battery. The built-in converters on most EVs typically support charging speeds up to 6–7kW, sufficient for overnight charging.[citation needed] This is known as "AC charging". To facilitate rapid recharging of EVs, much higher power (50–100+ kW) is necessary.[citation needed] This requires a much larger AC-to-DC converter which is not practical to integrate into the vehicle. Instead, the AC-to-DC conversion is performed by the charging station, and DC power is supplied to the vehicle directly, bypassing the built-in converter. This is known as DC fast charging.

Charging time for 100kM (62 miles) of range on a 2020 Tesla Model S Long Range per EPA (111 MPGe / 188 Wh/kM)(44)

Configu-ration	Voltage	Current	Power	Charging time	Comment
1-phase AC	**120** V	**12** A	1.44 kW	**13** hours	This is the maximum continuous power available from a standard US/Canadian **120** V **15** A circuit
1-phase AC	**230** V	**16** A	3.68 kW	**5.1** hours	This is the maximum continuous power available from a CEE 7/3 ("Schuko") receptacle on a **16**A rated circuit
1-phase AC	**240** V	**30** A	7.20 kW	**2.6** hours	Common maximum limit of public AC charging stations used in North America, such as a Charge Point CT**4000**
3-phase AC	400 V	16 A	11.0 kW	**1.7** hours	Maximum limit of a European 16A 3-phase AC charging station
3-phase AC	400 V	32 A	22.1 kW	51 minutes	Maximum limit of a European 32 A 3-phase AC charging station
DC	400 V	125 A	50 kW	22 minutes	Typical mid-power DC charging station
DC	400 V	300 A	120 kW	9 minutes	Typical power from a Tesla V2 Tesla Supercharger

Safety

A Sunwin electric bus in Shanghai at a charging station



A battery electric bus charging station in Geneva, Switzerland

Charging stations are usually accessible to multiple electric vehicles and are equipped with current or connection sensing mechanisms to disconnect the power when the EV is not charging.

The two main types of safety sensors:

- Current sensors monitor power consumed, and maintain the connection only while demand is within a predetermined range.[citation needed]
- Sensor wires provide feedback signal such as specified by the SAEJ1772 and IEC 62196 schemes that require special (multi-pin) power plug fittings.

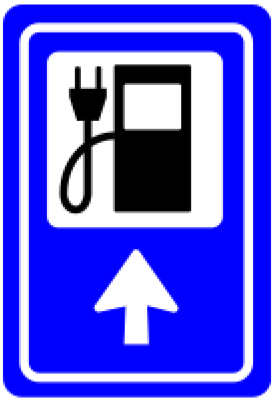
Sensor wires react more quickly, have fewer parts to fail, and are possibly less expensive to design and implement.[citation needed] Current sensors however can use standard connectors and can allow suppliers to monitor or charge for the electricity actually consumed.

Public charging stations

Further information on the coordinated development of charging stations in a region *a region by a company or local government: electric vehicle network*

Public charging station signs

US traffic sign



Public-domain International sign

Longer drives require a network of public charging stations. In addition, they are essential for vehicles that lack access to a home charging station, as is common in multi-family housing. Costs vary greatly by country, power supplier, and power source. Some services charge by the minute, while others charge by the amount of energy received (measured in kilowatt-hours).

Charging stations may not need much new infrastructure in developed countries, less than delivering a new fuel over a new network.[45] The stations can leverage the existing ubiquitous electrical grid.[46]

Charging stations are offered by public authorities, commercial enterprises, and some major employers to address a range of barriers. Options include simple charging posts for roadside use, charging cabinets for covered parking places, and fully automated charging stations integrated with power distribution equipment.[47]

As of December 2012, around 50,000 non-residential charging points were deployed in the U.S., Europe, Japan and China.[48] As of August 2014, some 3,869 CHAdeMO quick chargers were deployed, with 1,978 in Japan, 1,181 in Europe and 686 in the United States, and 24 in other countries.[49] As of December 2021 the total number of public and private EV charging stations was over 57,000 in the United States and Canada combined.[50]

Asia/Pacific

As of December 2012, Japan had 1,381 public DC fast-charging stations, the largest deployment of fast chargers in the world, but only around 300 AC chargers.[48] As of December 2012, China had around 800 public slow charging points, and no fast charging stations.[48]

As of September 2013, the largest public charging networks in Australia were in the capital cities of Perth and Melbourne, with around 30 stations (7 kW AC) established in both cities – smaller networks exist in other capital cities.[51]

Public charging park in Germany

Prototype modified Renault Laguna EVs charging at Project Better Place charging stations in Ramat Hasharon, Israel, north of Tel Aviv

REVAi/G-Wiz i charging from an on-street station in London

Car charging point in Scotland

Aral Pulse charging stations in front of a Aral-branded BP gas station in Braunschweig, Germany

Europe

As of December 2013, Estonia was the only country that had completed the deployment of an EV charging network with nationwide coverage, with 165 fast chargers available along highways at a maximum distance of between 40–60 kM (25–37 mi), and a higher density in urban areas.(52])(53)(54)

As of November 2012, about 15,000 charging stations had been installed in Europe.(55)

As of March 2013, Norway had 4,029 charging points and 127 DC fast-charging stations.(56) As part of its commitment to environmental sustainability, the Dutch government initiated a plan to establish over 200 fast (DC) charging stations across the country by 2015. The rollout will be undertaken by ABB and Dutch startup Fastned, aiming to provide at least one station every 50kM (31 mi) for the Netherlands' 16 million residents.(57) In addition to that, the E-laad foundation installed about 3,000 public (slow) charge points since 2009.(58)

Compared to other markets, such as China, the European electric car market has developed slowly. This, together with the lack of charging stations, has reduced the number of electric models available in Europe.(59) In 2018 and 2019 the European Investment Bank (EIB) signed several projects with companies like Allego, Greenway, BeCharge and Enel X. The EIB loans will support the deployment of the charging station infrastructure with a total of €200 million.[59] The UK government declared that it will ban the selling of new petrol and diesel vehicles by 2035 for a complete shift towards electric charging vehicles.(60)

North America

As of August 2018, 800,000 electric vehicles and 18,000 charging stations operated in the United States,(61) up from 5,678 public charging stations and 16,256 public charging points in 2013.(62])(63) By July 2020, Tesla had installed 1,971 stations (17,467 plugs).(64)

As of August 2019, in the U.S., there are 2,140 CHAdeMO charging stations (3,010 plugs), 1,888 SAE CCS1 charging stations (3,525 plugs), and 678 Tesla Supercharger stations (6,340 plugs), according to the U.S. Department of Energy's Alternative Fuels Data Center.(65)

Colder areas such as Finland, some northern US states and Canada have some infrastructure for public power receptacles provided primarily for use by block heaters. Although their circuit breakers prevent large current draws for other uses, they can be used to recharge electric vehicles, albeit slowly.(66) In public lots, some such outlets are turned on only when the temperature falls below −20 °C, further limiting their value.(67)

In 2017, Tesla gave the owners of its Model S and Model X cars 400kWh of Supercharger credit,(64) although this varied over time. The price ranges from $0.06–0.26/kWh in the United States.(68) Tesla Superchargers are usable only by Tesla vehicles.

Other charging networks are available for all electric vehicles. The Blink network has both AC and DC charging stations and charges separate prices for members and non-members. Their prices range from $0.39–0.69/kWh for members and $0.49–0.79/kWh for non-members, depending on location.(69) The Charge Point network has free chargers and paid chargers that drivers activate with a free membership card.[70] Prices are based on local rates. Other networks may accept cash or a credit card.

In June 2022, President Biden announced a plan for a standardized nationwide network of 500,000 electric vehicle charging stations by 2030 that will be agnostic to EV brands, charging companies, or location, in the United States.[71]

As of November 2022, there are 48,146 charging stations, including the level 1, level 2 and DC fast charging stations, across the United States.[72]

Africa

BMW Electric Wireless car charger in Johannesburg, South Africa

South African based ElectroSA and automobile manufacturers including BMW, including BMW, Nissan and Jaguar have so far been able to install 80 electric car charges nationwide.[73]

South America

In April 2017 YPF, the state-owned oil company of Argentina, reported that it will install 220 fast-load stations for electric vehicles in 110 of its service stations in the national territory.[74]

Projects

Wireless charging station

Detail of the wireless inductive charging device

Electric car manufacturers, charging infra-structure providers, and regional governments have entered into agreements and ventures to promote and provide electric vehicle networks of public charging stations.

The EV Plug Alliance[75] is an association of 21 European manufacturers that proposed an IEC norm and a European standard for sockets and plugs. Members (Schneider Electric, Legrand, Scame, Nexans, etc.) claimed that the system was safer because they use shutters. Prior consensus was that the IEC 62196 and IEC 61851-1 standards have already established safety by making parts non-live when touchable.[76][77][78]

At home charging stations

NEMA 14-50 240V, 50A

Over 80% of electric vehicle charging is done at home in the garage.[79] In North America, Level 1 charging is hooked up to a standard 120V outlet and only provides less than 5 miles of range per hour of charging. Level 2 charging stations use 240 volts and can add up to 30+ miles of range per hour of charging. Chargers can be "hardwired" to the main electrical panel box or connected with a cord and plug to a 240 volt receptacle. A NEMA 14-50 receptacle is a popular choice for outlets for electric vehicle charging. It provides 240 volts and, if wired to a 50A circuit can support charging at 40A under North American electrical code, thus supplying 9.6 kilowatts of power.[80]

Battery Swap

Main article: Battery swapping

A battery swapping (or switching) station allow vehicles to exchange a discharged battery pack for a charged one, eliminating the charge interval. Battery swapping is common in electric forklift applications.[81]

History

The concept of an exchangeable battery service was proposed as early as 1896. It was first offered between 1910 and 1924, by Hartford Electric Light Company, through the GeVeCo battery service, serving electric trucks. The vehicle owner purchased the vehicle, without a battery, from General Vehicle Company (GeVeCo), part-owned by General Electric.[82] The power was purchased from Hartford Electric in the form of an exchangeable battery. Both vehicles and batteries were designed to facilitate a fast exchange. The owner paid a variable per-mile charge and a monthly service fee to cover truck maintenance and storage. These vehicles covered more than 6 million miles.

Beginning in 1917, a similar service operated in Chicago for owners of Milburn Electric cars.[83] A rapid battery replacement system was implemented to service 50 electric buses at the 2008 Summer Olympics.[84]

Better Place, Tesla, and Mitsubishi Heavy Industries considered battery switch approaches.[85][86] One complicating factor was that the approach requires vehicle design modifications.

In 2012, Tesla started building a proprietary fast-charging Tesla Supercharger network.[1] In 2013, Tesla announced it would also support battery pack swaps,[87] but that programme was shut down.[88]

A Nio battery swap station at a carpark in Beijing.

Benefits:

The following benefits were claimed for battery swapping:

"Refueling" in under five minutes.[8][90]
Automation: The driver can stay in the car while the battery is swapped.[91]
Switch company subsidies could reduce prices without involving vehicle owners.[92]
Spare batteries could participate in vehicle to grid energy services.[93]

Providers

The Better Place network was the first modern attempt at the battery switching model. The Renault Fluence Z.E. was the first car enabled to adopt the approach and was offered in Israel and Denmark.[94]

Better Place launched its first battery-swapping station in Israel, in Kiryat Ekron, near Rehovot in March 2011. The exchange process took five minutes.[89][95] Better Place filed for bankruptcy in Israel in May 2013.[96][97]

In June 2013, Tesla announced its plan to offer battery swapping. Tesla showed that a battery swap with the Model S took just over 90 seconds.[90][98] Elon Musk said the service would be offered at around US$60 to US$80 at June 2013 prices. The vehicle purchase included one battery pack. After a swap, the owner could later return and receive their battery pack fully charged. A second option would be to keep the swapped battery and receive/pay the difference in value between the original and the replacement. Pricing was not announced. In 2015 the company abandoned the idea for lack of customer interest.

By 2022, Chinese luxury carmaker Nio had built more than 900 battery swap stations across China and Europe,[100] up from 131 in 2020.

Car connected to an EV charger over a parking space

Charging stations can be placed wherever electric power and adequate parking are available.

Private locations include residences, workplaces, and hotels. Residences are by far the most common charging location. Residential charging stations typically lack user authentication and separate metering, and may require a dedicated circuit. Many vehicles being charged at residences simply use a cable that plugs into standard household electrical outlet.[105] These cables may be wall mounted.

Public stations have been sited along highways, in shopping centers, hotels, government facilities and at workplaces. Some gas stations offer EV charging stations. Some charging stations have been criticized as inaccessible, hard to find, out of order, and slow, thus slowing EV adoption.

Public charge stations may charge a fee or offer free service based on government or corporate promotions. Charge rates vary from residential rates for electricity to many times higher, the premium is usually for the convenience of faster charging. Vehicles can typically be charged without the owner present, allowing the owner to partake in other activities.[108] Sites include malls, freeway rest areas, transit stations, and government offices.[109][110] Typically, AC Type 1 /Type 2 plugs are used. Mobile charging involves another vehicle that brings the charge station to the electric vehicle; the power is supplied via a fuel generator (typically gasoline or diesel), or a large battery. Wireless charging uses inductive charging mats that charge without a wired connection and can be embedded in parking stalls or even on roadways.

An offshore electricity recharging system named Stillstrom, to be launched by Danish shipping firm Maersk Supply Service, will give ships access to renewable energy while at sea.[111] Connecting ships to electricity generated by offshore wind farms, Stillstrom is designed to cut emissions from idling ships.

Smart grid

A smart grid is one that can adapt to changing conditions by limiting service or adjusting prices. Some charging stations can communicate with the grid and activate charging when conditions are optimal, such as when prices are relatively low. Some vehicles allow the operator to control recharging. Vehicle-to-grid scenarios allow the vehicle battery to supply the grid during periods of peak demand. This requires communication between the grid, charging station, and vehicle. SAE International is developing related standards. These include SAE J2847/1. ISO and IEC are developing similar standards known as ISO/IEC 15118, which also provide protocols for automatic payment.

Renewable energy

Charging stations are typically connected to the grid, which in most jurisdictions relies on fossil-fuel power stations. However, renewable energy may be used to reduce the use of grid energy. Nidec Industrial Solutions has a system that can be powered by either the grid or renewable energy sources like PV. In 2009, Solar City marketed its solar energy systems for charging installations. The company announced a single demonstration stationin partnership with Rabobank on High way 101 between San Francisco and Los Angeles.(115)

Several Chevrolet Volts at a charging station partially powered with solar panels in Frankfort, Illinois.

The E-Move Charging Station is equipped with eight mono crystalline solar panels, which can supply 1.76 kW of solar power.(116)

In 2012, Urban Green Energy introduced the World's first wind-powered electric vehicle charging station, the Sanya SkyPump. The design features a 4 kW vertical-axis wind turbine paired with a GE WattStation.

In 2021 Nova Innovation introduced the World's first direct from tidal power EV charge station

REGULATORY CORNER

GERC announced Transmission Tariff and Distribution & Retail Supply Tariff.

Transmission Tariff effective from 01 Apr 2023

- Transmission charges payable by short term users including collective transactions is determined as 37.94 paisa per unit (PY: 35.87 paisa /unit).
- Rs. 4113.16/MW/day is determined as Transmission charges payable by Long term and Medium-term users. (Previous year Rs 4047.60 /MW/day).
- Reactive energy charges @ 10 paisa/kVA Rh for reactive energy drawl at 10% of the net energy export and 50 paisa/kVARh for drawl of reactive energy at more than 10%. (Same as previous year).

Distribution & Retail supply Tariff effective from 01 Apr 2023

- **Distribution Tariff:**
  - Wheeling loss applicable to Open Access users of 11/22/33kV network is kept @ 9.50% (PY:10%)
  - Wheeling charge at 11kV is reduced to 17.31 paisa per unit (PY: 18.27 paisa per unit) and at 400V level 83.13 paisa per unit (PY 80.07 paisa per unit).
  - Cross subsidy surcharge is increased to Rs 1.60 per unit (PY Rs.1.50 per unit)
- **Retail Supply Tariff**
  - No change in retail tariff structure.
- **Green Energy Tariff:**
  First time for state owned Discoms, Optional Green Energy Tariff is set @ Rs.1.50 per unit over and above normal applicable Tariff for EHV, HV and LV consumers.
- In a separate order, effective from 01 Apr 2023, Additional surcharge is increased to 76 Ps/Unit from 31Ps/unit for consumer of state Discoms who avail power through Open Access.

Inputs By: Er. Umesh Parikh, Executive Committee Member, SPE(I)

PROCEEDINGS OF EXTRA ORDINARY GENERAL MEETING HELD ON 19 APR 2023

The Extra Ordinary General body meeting of the members of The Society of Power Engineers (I) Vadodara Chapter was held on 19 Apr 2023 at 17:00 hrs. at Vasvik Auditorium, Vadodara to discuss and transact following business:

1. To discuss and decide / resolve the issue of disposing off the present office premise situated at 48-FF, Avishkar Complex, Old Padra Road, Vadodara.
2. To discuss and decide/resolve the matter of relocating the office premises at another suitable premise.

The Extra Ordinary General Body meeting commenced under the Chairmanship of **Er. GV Akre.** As **Er. YV Joshi,** Secretary of the Chapter, had taken leave for not attending the Extra Ordinary GM, owing to his absence at Head quarter, one of the Joint-Secretaries, **Er. VB Harani** conducted the General Body Meeting in the capacity of I/c Secretary.

The members assembled at 17.00 Hrs. Due to lack of quorum at the scheduled time, the members present left the meeting and reassembled at the same venue after half an hour and carried out following business.

1) **Er. VB Harani** informed that entire Avishkar Complex comprising of large number of offices, shops and residential flats is proposed to be taken over for reconstruction plan by some builders. We are likely to get reasonable amount against sale, which may help us in purchasing new office premise elsewhere. The present building is more than 30 years old and needs major repairs and maintenance. There are no primary facilities such as Vehicle parking, lift, Security, Washroom etc. Our office premise FF-48 has 687 Sq. ft. built-up area and the purchaser (builders) have indicated approximately Rs. 9,000 per Sq. ft. area as purchase price. Probable amount will be Rs. 61 Lakh. (Rs. Sixty One Lakh). He read out the content of letter Dt. 17 Apr 2023 received from Avishkar Complex Owners' Association. The deal will be through the third party/Agent. Agent/third party may charge 1.28% of total amount as commission / coordinating charges

2) **Er. BN Raval**, Advisory Committee Member of Chapter and having his office premise in Avishkar Complex, who is attending meetings regularly with Avishkar Complex Owners' Association, briefed the members present about the matter, proposal, planning etc.

   Following documents are required to be handed over to the President, Avishkar Complex Owner's Association:

   Copy of PAN card, VMSS Property tax bill –receipt for 2022-23, copy of Sale Deed (Dastavej), latest Electricity bill, Premises - Photos, General Body Meeting resolution letter mentioning Power of Attorney given to the Office Bearer on behalf of Chapter, who will take all decisions including correspondence. Er. Raval will also update the Core Committee so formed about the latest development in the process.

3) During the session, following members have suggested and shown concerns as follows:

   Er. KG Shah, Er. MO Sheth, Er. BN Raval, Er. RM Panchal, Er. PA Shah, Er. MG Mehta, Er. Nimil Baxi, Er. Vrajesh Desai, Er. SM Godkhindi, Er. (Ms) Sangita Godkhindi, Er. SM Takalkar, Er. PH Rana and **Er. JC Marathe**

   The suggestions were:

   (i) As PAN card is in the name of The Society of Power Engineers (I) New Delhi, Vadodara Chapter has to take New Delhi office into confidence.
   (ii) Capital gain tax.
   (iii) To get opinion/advice of CA Mr. Niraj Majmundar in all relevant matters like Capital Gain Tax, PAN Card, Sale / Purchase of Premise etc.
   (iv) As FF-48, is the property of Vadodara Chapter the sale amount to be credited to saving
   (v) **Er. GV Akre, Er. RS Shah, Er. VB Harani, Er. SM Takalkar, Er. SM Godkhindi,** and **Er. PA Shah** informed the members that all the

above points will be taken care of during negotiation and finalization of the proposal (Sale deed)

(vi) On finalization of the deal, it is necessary to have new office premises for running the Chapter's day to day working.

(vii) **Er. VB Harani** and other members suggested that new premise/office should have around 550 to 600 Sq.ft. carpet area with attached washroom, lift, sufficient parking, Security etc. Further, **Er. PH Rana** suggested that new premise should be within the radius of 2 to 3kM from existing office, suitable to reach, having above facilities. Chapter should have at-least Rs. 5 to 10 Lakh surplus added to corpus after purchase of the new office. All members were requested to come forward with the proposal of new office premises fulfilling above criteria.

4) During the discussion, **Er. VB Harani**, **Er. SM Godkhindi, Er. PA Shah** suggested to constitute a Committee for this purpose. This Committee will have following members:
Chairman, Vice Chairman, Secretary, Treasurer, Joint Secretaries, **Er. PH Rana, Er. SM Takalkar, Er. PA Shah** and **Er. BN Raval**. The power of attorney shall be given to one of the Office Bearers of the Chapter by this Committee.

5) At the end, following resolutions were passed unanimously:
   1. It is resolved to dispose off the present (FF-48) office premise as per the offer received through Avishkar complex Owners' Association i.e. approximate Rate offered of Rs. 9,000/- per Sq. feet of built-up area. (Or as per the decision of the Avishkar Complex Owners' Association)
   2. It is also resolved to purchase new premise having about 550 to 600 Sq. Ft carpet area, with facilities such as attached Wash Room, lift, parking and within 2 to 3kM radius of existing Office premise.
   3. It is further resolved to constitute the Committee comprising Chairman, Vice-Chairman, Secretary, Joint-Secretaries, Treasurer, **Er. PH Rana, Er. SM Takalkar Er. PA Shah** and **Er. BN Raval** and authorizing the said Committee, to finalise the deal and purchase of new office premise.
   4. It is resolved that The Power of Attorney shall be given by the newly formed Committee, to one of the Office Bearers of the Chapter.

6) **Er. VB Harani** presented Vote of Thanks.

THE REPORT OF ELOCUTION COMPETITION ON ENERGY CONSERVATION AND ENERGY MANAGEMENT

Electrical Research and Development Association (ERDA) & Society of Power Engineers (I), Vadodara Chapter (SPE) organized an Elocution Competition on Energy Conservation and Energy Management for students of Engineering Colleges. This competition was meant for the UG students studying in Colleges / Universities in and around Vadodara.

There are various energy conservation measures taken by industries. But still there is a gap in understanding of Electrical energy management and Electrical energy consumption.

This event was taken up as an initiative to spread awareness of Energy conservation in and around Vadodara.

The theme was Energy conservation and Climate Change.

Sub themes were:
1. Green Building
2. Renewable energy
3. Energy management
4. Net zero carbon
5. Climate impacts

There were 191 student entries log-in from many colleges of Vadodara and nearby Vadodara City.

First round of the competition was held at Institutions level at Parul University (2 Batches), KJIT Savli, Neo Tech Virod and one round On Line. From first round 60 students were selected for 2nd round. While Second round was held at ERDA and 18 students selected for Final round.

The final round was arranged at Vasvik Auditorium, Institute of Engineers (I), Vadodara on 14 May 2023. In this final round the Board of Juries were:

1) **Dr. Vijay Shah President,** ERDA.
2) **Dr. Uday Puntabmbeker** Dy. Dir., ERDA.
3) **Dr. Ruchi Shrivasatava**, Principal, Diploma studies-PIET, Parul Unviersity.
4) **Er. PH Rana**, Ex. Member, Power Sector.
5) **Er. BN Raval**, MD, Soham Technologies.
6) **Er. GV Akre**, Chairman, SPE (I), Vadodara **Chapter**.

In final round of the Competition following participants are awarded:

1. First Prise: Rs. 15,000/- **Rohith Reddy,** Parul University
2. Second Prize: Rs. 10,000/- **Hitesh Parmar,** KJIT, Savli
3. Third Prize: Rs. 7,000/- **Shiva Reddy**, Parul University
4. Consolation Prizes:
   a. **Hemang Rana**, Neotech, Virod
   b. **Tisha Modi**, BBIT, Vidyanagar
   c. **Yug Thosar**, MS University, Vadodara
   d. **Jitendra Chauhan**, MS University, Vadodara
   e. **Payanshu Maurya**, Parul University
   f. **Amitkumar Namdeo**, KJIT, Savli
   g. **Aachal Shukla**, KJIT, Savli
   h. **Shreya Patel**, KJIT, Savli
   i. **Rucha Patel**, Neo Tech, Virod,

In addition to the above prizes, the Complimentary Gift was given to all 12 winners by the Institution of Engineers (I), Vadodara Local Centre.

The Juries of First Round and Second Round were honored by SPE (I) Vadodara Chapter. Moreover, IE (I), Vadodara Local Centre honored **Er. PA Shah, Ms. Hetal Prajapati, Ms. Sheetal Shinkhede** and **Ms. Binal Modi** for co-ordinating the event right from document-tation, canvasing to the various colleges, conducting rounds, arranging juries, arranging for the sponsors, and completing the event successfully by presenting the memento to them.

The event was appreciated by many members of SPE (I), faculties of various colleges and also students of Colleges / Universities.

વીજ બચત ઉપર અનોખી વકૃત્વ સ્પર્ધા

ઈલેક્ટ્રિકલ રીસર્ચ અને ડેવલપમેન્ટ એસોસીએશન (એરડા), વડોદરા અને સોસાયટી ઓફ પાવર એન્જીયર્સ (ઈંડિયા), વડોદરા ચેપ્ટર ના સહયોગથી વિજ બચત ઉપર કોલેજના વિદ્યાર્થીઓ માટે એક વકૃત્વ સ્પર્ધા નું બીજા રાઉન્ડનું આયોજન તા. ૩૦ મી એપ્રિલે એરડામાં કરવામાં આવ્યુ હતું. આ કાર્યક્રમમાં લગભગ ૫૦ થી વધારે વિદ્યાર્થીઓએ ભાગ લીધો હતો. આ વિદ્યાર્થીઓ મહારાજા સયાજીરાવ યુનીવર્સીટી, પારુલ યુનીવર્સીટી, એસવીઆઈટી-વાસદ, બીઆઈબી-વિદ્યાનગર, કેજેઆઈટી-સાવલી, નીયોટેક, વિગેરે કોલેજો માંથી આવેલ. વિદ્યાર્થીઓએ વિજ બચત, વિજ ઉત્પાદન ના પ્રકારો, ગ્રીન બિલ્ડીંગ વિગેરે વિષયો ઉપર પોતાના વિચારો પ્રસ્તુત કરેલ. છેલ્લું રાઉન્ડ મે માસમાં આયોજન કરેલ હતું. આ બંને સંસ્થાઓએ વિદ્યાર્થીઓ માટે એક જુદા જ પ્રકારનો અનુભવ કરાવેલ છે અને સમાજ માટે એક ઉમદા ઉદાહરણ પૂરું પાડેલ છે.

Participants of Second Round Second Batch with Juries at ERDA

Participants of Second Round with Juries at ERDA, Vadodara
Address by Er. GV Akre and Dr. Uday Puntabmbekar

MEMBERS IN NEWS

Er. Dilip M Patel, former Principal of the Polytechnic, MS University, Vadodara, **Life Member** of the Society of Power Engineers (I) Vadodara and now **Fire Safety Officer,** Gujarat Govt., has launched a book **'Fire prevention: Life Safety and Fire Protection'**.

The book mentions simple tips on how to protect yourself from fire disasters. "**This book is based on Gujarat Comprehensive Development Control Regulations, the Gujarat Fire Act-2003 which was amended in 2021 and the National Building Code which has now become an integral part of the Gujarat Fire Act**".

It provides a simple understanding on fire safety rules in Gujarati. While most of the definitions of terminologies are in form of sentences, the book has a chapter where even the definitions have been supported through visual / images for common man's understanding.

Best Wishes to Er. Dilip M Patel

ABOUT WORLD ENVIRONMENT DAY

World Environment Day on 5 June is the biggest international day for the environment. Led by UNEP and held annually since 1973, the event has grown to be the largest global platform for environmental outreach, with millions of people from across the world engaging to protect the planet.

Plastic is everywhere nowadays. People are using it endlessly just for their comfort. However, no one realizes how it is harming our planet. We need to become aware of the consequences so that we can stop plastic pollution. Kids should be taught from their childhood to avoid using plastic. Similarly, adults must check each other on the same. In addition, the government must take stringent measures to stop plastic pollution before it gets too late.

Up-rise of Plastic Pollution

Plastic has become one of the most used substances. It is seen everywhere these days, from supermarkets to common households. Why is that? Why is the use of plastic on the rise instead of diminishing? The main reason is that plastic is very cheap. It costs lesser than other alternatives like paper and cloth. This is why it is so common.

Secondly, it is very easy to use. Plastic can be used for almost anything either liquid or solid. Moreover, it comes in different forms which we can easily mould.

Furthermore, we see that plastic is a non-biodegradable material. It does not leave the face of the Earth. We cannot dissolve plastic in land or water, it remains forever. Thus, more and more use of plastic means more plastic which won't get dissolved. Thus, the uprise of plastic pollution is happening at a very rapid rate.

Plastic pollution has become a major threat to our environment in today's times and it is likely to make things worse in the times to come. There are many reasons that lead to this type of pollution. The adverse effects of plastic pollution are also plenty.

Causes of Plastic Pollution

1. Economical and Easy to Use

Plastic is one of the most widely used substances when it comes to production of containers, bags, furniture and various other things. This is because it is economical and can easily be molded into different forms. The increasing use of plastic goods has increased the plastic waste which is a cause of plastic pollution.

2. **Non-Biodegradable**

Plastic waste which is increasing day by day is non-biodegradable. Plastic does not get disposed of in soil or water. It remains in the environment for hundreds of years and add to the land, water and air pollution.

3. **Plastic Breaks but Doesn't Dissolve**

Plastic bags and other items made from plastic break into tiny particles that make their way into the soil or enter the water bodies thereby contributing to plastic pollution.

Effects of Plastic Pollution

Here is how plastic pollution is effecting our environment and life on earth:

1. **Pollutes Water**

   Plastic waste is entering the water bodies such as rivers, seas and even oceans and is polluting our water drastically. This water is then supplied at our places. No matter how much we filter this water it can never get back to its pure form and thus has negative repercussions on our health.

2. **Pollutes Land**

   Large amount of plastic waste is dumped in landfills. Wind carries plastic bags and other small plastic particles from one place to another thereby effecting major area. Plastic particles release harmful chemicals that deposit in the soil and ruin its quality. It impacts the growth of the plants. Besides, waste lying on the land breeds mosquitoes and other insects that are carriers of various serious illnesses.

3. **Harms Marine Life**

   Plastic bags and other plastic litter that goes into rivers and seas are mistaken as food by the marine creatures who often gulp them and eventually fall sick.

4. **Harms Animals**

   Animals mostly feed on food thrown in the garbage. They eat plastic bags and other items along with other things. Plastic bags often get stuck in their intestines and choke them to death. They are also a cause of many serious illnesses.

Simple Solutions to Lower Plastic Pollution

Here are certain simple ways in which we can lower plastic pollution and make our environment cleaner:

- **Don't Use Plastic Bags**

  Plastic bags get broken into tiny pieces that go into the water bodies and enter the soil thereby disrupting the growth of plants and causing harm to the aquatic life. Mostly used for grocery shopping, these bags can easily be replaced by reusable cloth bags.

- **Say No to Packaged Drinking Water**
  Packaged drinking water comes in plastic bottles and glasses. These waste bottles and glasses contribute immensely to plastic pollution. As responsible citizens we must stop purchasing packaged drinking water and carry our own water bottles instead.
- **Avoid Ordering Food**
  Most fast food restaurants deliver food in plastic containers that add to waste plastic. It is better to avoid ordering food from such restaurants. It is better to have home cooked food.
- **Recycle**
  Many recycling companies take used plastic containers, plastic bottles and other stuff made of this material and recycle it. It is suggested to give away such plastic items to these companies rather than throwing them in the bin and adding to the plastic waste.
- **Purchase Bulk Grocery**
  It is a good idea to purchase bigger packages of the grocery items rather than going for several small packets. These items are mostly packed in plastic bags or containers. So, this way you will reduce plastic waste.

Conclusion

- Plastic pollution is a cause of serious concern. It is increasing because of the negligence of humans. It is time we must take strict measures to fight it.
- It is a big challenge to dispose of plastic and the increasing amount of plastic waste is leading to plastic pollution. The simple solutions mentioned here can go a long way in lowering the level of plastic pollution.

Plastic Pollution

Plastic pollution is increasing by the day. Research shows that the use of plastic has increased drastically in the last two decades. Plastic is convenient to use and costs less. This is the reason why people are more inclined towards purchasing various products made of plastic. To meet the growing demands of the people, the number of factories manufacturing plastic products has increased rapidly. The more plastic used, the more plastic waste gets accumulated on our planet and causes the hazardous plastic pollution. This is becoming a threat to life as it is giving way to various illnesses.

Plastic Production: Consuming Useful Resources

Not only is disposing of plastic a serious concern but the production of this substance is equally devastating for us. The production of plastic involves valuable fossil fuels such as oil and petroleum. These fossil fuels are non-renewable and hard to extract. A lot invested in fetching these fossil fuels and these required for various other purposes. If we continue to use these valuable fuels for the production of plastic, we shall run out of them and would not be able to employ them for producing or running other more important things.

Marine Life: Worst Effected by Plastic Pollution

Plastic bags and other plastic particles carried by wind and water into the seas, oceans and other water bodies. People who go for picnics and camping also litter plastic bottles and packets of chips that add to plastic pollution. All this goes into the rivers and seas and effects the marine creatures adversely. These poor creatures mistake plastic for food and eat it. This results in serious illness in fishes, turtles and other marine creatures. Many of them die because of plastic pollution each year. Researchers claim the number of deaths and illnesses caused due to plastic pollution will increase in the coming years.

Plastic Pollution: A Threat to Humans and Animals

Just like the marine creatures, animals also consume plastic lying in the garbage mistaking it for food. At times, they gulp the entire plastic bag by mistake. This gets stuck in their intestines and suffocates them to death. Plastic waste keeps deteriorating with time and becomes a breeding ground for mosquitoes, flies and other insects. Large chunk of mosquitoes penetrate here and give way to various diseases each year.

Plastic waste is also polluting the rivers that are a source of drinking water for us. The quality of drinking water is getting worse day by day due to plastic pollution and this is resulting in various water borne diseases.

Collective Effort to Fight Plastic Pollution

It is difficult to dispose plastic products. It is dangerous when plastic waste goes to the landfills and even more dangerous when it goes into the water bodies. Unlike, wood and paper we cannot even dispose it of by burning it. This is because burning plastic produces harmful gases that are dangerous for the environment and life on earth. Plastic thus causes air, water and land pollution.

No matter, how hard we try we cannot do away with the plastic products completely. However, we can certainly restrict our plastic usage. A number of plastic products such as plastic bags, containers, glasses, bottles, etc. can easily replace by eco-friendly alternatives such as cloth/ paper bags, steel utensils and so on.

Controlling plastic pollution is not solely the government's responsibility. In fact, the government alone cannot do anything. We need to act responsibly and do our bit to bring down the plastic pollution.

Conclusion

Plastic pollution is rising at a rapid speed and has become a cause of major concern. We can bring down plastic pollution by restricting its use. Each one of us must work towards combating this problem.

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History of Gujarat Day

Gujarat Day is celebrated every year on May 1st to commemorate the formation of the Indian State of Gujarat. The event holds great significance for the people of the state, and is celebrated with great enthusiasm and pride. Let's take a closer look at the history of Gujarat Day.

Formation of Gujarat State

The current state of Gujarat was a part of the Bombay State prior to 1960, which included present-day Maharashtra and parts of present-day Gujarat.

However, there were significant cultural, linguistic and political differences between the people of Gujarat and Maharashtra. This led to the demand for a separate state of Gujarat in the early 1950s.

After several years of protests and negotiations, the Bombay State was finally divided into two states on May 1st, 1960 – Maharashtra and Gujarat. The new state of Gujarat comprised the Gujarati-speaking regions of the former Bombay State, including the territories of Saurashtra, Kutchh and Ahmedabad.

OBITUARY

Er. Ullas B Marathe, Retd. EE, GEB, SLDC - Jambuva and **Life Member** of Society of Power Engineers (I), Vadodara **Chapter** passed away on **23 May 2023.**

He was soft spoken and humble nature.

May God give peace to the departed soul and give strength to his family members to bear the impact.