

**ACS COLLEGE OF ENGINEERING
DEPARTMENT OF MECHANICAL ENGINEERING**

A REPORT ON INTERNATIONAL WEBINAR ON 17.08.2021



ACS College of Engineering
Approved by AICTE New Delhi, Affiliated to VTU, Belagavi
(A Unit of RajaRajeswari Group of Institutions)
CET Code : E186 COMED-K : E003 PG CET : T918

Department of Mechanical Engineering
Presents
International Webinar on
**“INTRODUCTION TO AUTOMOTIVE
ELECTRIFICATION”**

Resource Person :
Mr. Dayananda Rao
Lead Engineer
Jaguar Land Rover. UK

Date : 17 August 2021
Time : 11:00AM Onwards

Meeting ID : 649 725 9155
Password : 12345

Coordinators
Dr. Suresh P M
Srinidhi Acharya S R

HOD
Dr. Siddesha H S

Principal
Dr. Murali M S

Department of Mechanical Engineering of ACSCE has organized an International webinar on 17th August at 11AM on topic of “Introduction to Automotive Electrification” to be presented by resource person Mr. Dayanand Rao, Lead Engineer, Jaguar Land Rover, UK.

Resource person having 14+ years of experience in Transportation Design (Automotive industry). Started his career as a trainee in a design service company and currently working at Jaguar and Land rover as lead engineer. All his work experience is within Tata group and also fortunate to work in field of automotive electrification from past 10 years. He is expertise in Sheet metal forming, injection molding, Vehicle packaging, GD&T, design and development of BIW components.

Target

Recording Dayananda M is talking...

Automotive Electrification - Need and drive for Automotive Electrification

Annual vehicle emissions by fuel type (12,000 miles)

Fuel Type	CO2e	NOx	PM
Gasoline vehicle (compact/mid-size car)	9200 lbs	20 lbs	1.4 lbs
EV charged on grid	3000 lbs	3 lbs	1.1 lbs

- CO2e : Carbon dioxide equivalent
- Nox : Nitrogen Oxides
- PM : Particulate Matter Emissions

<https://www.pca.state.mn.us/airquality/electric-cars-charge-ahead>

Participants: Jagadish s, Kumar B.V., sumanth, M.Ajay Kumar(007), methesh, Pooja B T., 1KG19ME 404

Zoom Meeting You are viewing Dayananda M's screen. View Options

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Participants: M.Ajay Kumar(007), methesh, Pooja B T., 1KG19ME 404, Neha Np

Participants (41): 1kg19me406, Aakash Singh, Aprameya, Chandan G, Chandra Shekhar, Chethan BN, Deepak Gowda .L, Dr.H S Siddesha (me), Gayathri N, Goutham C (LAF17ME006), Harish d, indreshcvodeyar, Jagadish s

Join Audio Start Video Participants 40 Chat Share Screen Record Reactions Leave Invite

7 items

Taskbar: File Explorer, Microsoft Edge, Google Chrome, Microsoft Word, Adobe Acrobat Reader, Zoom Meeting, System Tray: 11:18 AM 8/17/2021

Zoom Meeting | Recording | Dayananda M is talking...

Automotive Electrification - Need and drive for Automotive Electrification

Annual vehicle emissions by fuel type (12,000 miles)

Fuel Type	CO2e (lbs)	NOx (lbs)	PM (lbs)
Gasoline vehicle (compact/mid-size car)	3200	30	1.4
EV charged on grid	3000	3	1.1
EV charged with renewables	0	0	0

▶ CO2e : Carbon dioxide equivalent
 ▶ NOx : Nitrogen Oxides
 ▶ PM : Particulate Matter Emissions

Participants (40)

- Aprameya
- Chandan G
- Chandra Shekhar
- Chethan BN
- Deepak Gowda .L
- Dr.H S Siddesha (me)
- Gayathri N
- Goutham C (IAH17ME06)
- Harish d
- Indreshvodeyar
- Jagadish s
- K Srinivas (IAH16ME038)
- KIRAN KUMAR
- KISHORE

Page: 3 of 3 | Words: 130 | 11:19 AM 8/17/2021

Zoom Meeting | Recording | Dayananda M is talking...

Automotive Electrification - Brush up on the Basic

What is Electric current : Electric current is defined as the flow of charge.

Participants (39)

- methesh
- Neha Np
- pavan kumar (IAH18ME010)
- Pooja B T
- Prabhanjan
- Rebekah John Bosco
- Sagar K g
- Sandeep G R
- Sarjay Sanju
- Sarvagya Kumari v
- sheshank S
- Srinidhi acharya S R
- Suhaas Kapardhi
- sumanth

Page: 3 of 3 | Words: 130 | 11:20 AM 8/17/2021

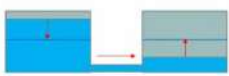
Zoom Meeting

Recording

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
Automotive Electrification - Brush up on the Basic

What is Electric current : Electric current is defined as the flow of charge.



Direct current in which the flow of charge in one direction.

DIRECT CURRENT (DC)



Participants (38)

Find a participant

- PK pavan kumar (LAH18ME010)
- Pooja B T.
- P. Prabhanjan
- RJ Rebekah John Bosco
- SK Sagar K g
- SG Sandeep G R
- Sanjay Sanju
- S Sarvagya Kumari v
- Shashank S
- Srinidhi acharya S R
- Suhaas Kapardhi
- sumanth
- VH Vinay H
- A Aron felix (LAH18ME002)

Invite

Page: 4 of 4 Words: 130

11:20 AM 8/17/2021

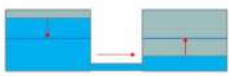
Zoom Meeting

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
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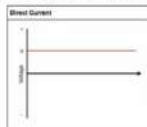


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


Direct Current

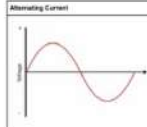


Alternating current is an electric current that reverses direction periodically.

ALTERNATING CURRENT (AC)



Alternating Current



Alternating current is the backbone of our electricity transmission systems and commonly used in our homes.

Direct current had a significant problem, and it wasn't easy to convert it to higher or lower voltages. High voltage was required for transmission to reduced power loss. On the other hand, alternating current can easily reach high voltages through the use of transformers.

However, direct current is undoubtedly making a comeback as it powers computers, electric vehicles, PV cells, etc. The reason for this is the fact that direct current is much easier to store.

Participants (39)

Find a participant

- Dr.H S Siddesha (Me)
- Suresh Puranic Math (Host)
- DM Dayananda M (Co-host)
- H 1KG19ME 404
- 1KG19ME403 Dheeraj P
- M 1kg19me406
- A Aprameya
- Chandan G
- Chandra Shekhar
- P Chethan BN
- DG Deepak Gowda L
- DS Dr.H S Siddesha (me)
- GN Gayathri N
- Goutham C (LAH17ME006)

Invite

Page: 4 of 4 Words: 130

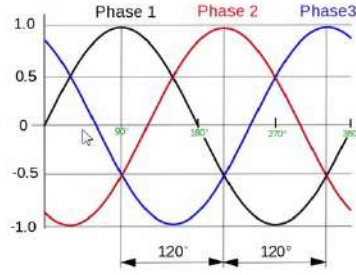
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Zoom Meeting
Recording
Dayananda M is talking...

Automotive Electrification - Brush up on the Basic

In a symmetric three-phase power supply system, three conductors each carry an alternating current of the same frequency and amplitude relative to a common reference, but with a phase difference of one third of a cycle between each.

The common reference is usually connected to ground and often to a current-carrying conductor called the neutral.



Due to the phase difference, the voltage on any conductor reaches its peak at one third of a cycle after one of the other conductors and one third of a cycle before the remaining conductor.

Participants (39)

- Harish d
- Indresh's iPhone
- Jagadish s
- K Srinivas (LAH16ME038)
- KIRAN KUMAR
- KISHORE
- Kumar BM
- M.Ajay Kumar(007)
- Mannem Shrinidhi
- methesh
- Neha Np
- pavan kumar (LAH18ME010)
- Pooja B T
- Prabhanjan

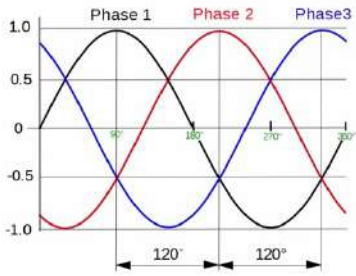
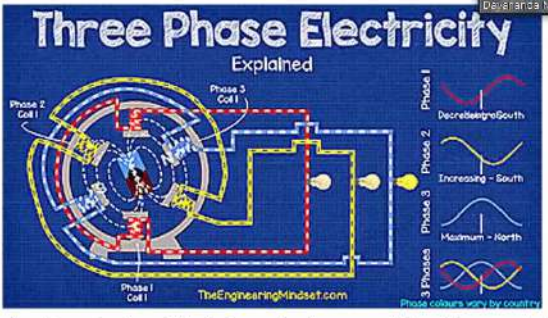
Page: 5 of 5 Words: 130 11:26 AM 8/17/2021

Recording
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View Options

Automotive Electrification - Brush up on the Basic

In a symmetric three-phase power supply system, three conductors each carry an alternating current of the same frequency and amplitude relative to a common reference, but with a phase difference of one third of a cycle between each.

The common reference is usually connected to ground and often to a current-carrying conductor called the neutral.

Due to the phase difference, the voltage on any conductor reaches its peak at one third of a cycle after one of the other conductors and one third of a cycle before the remaining conductor. This phase delay gives constant power transfer to a balanced linear load.

Constant power transfer and cancelling phase currents are possible with any number (greater than one) of phases, However, two phases results in a less smooth (pulsating) current to the load (making smooth power transfer more than three phases complicates infrastructure unnecessarily.

<https://theengineeringmindset.com/three-phase-electricity-explained/>

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Automotive Electrification – Battery

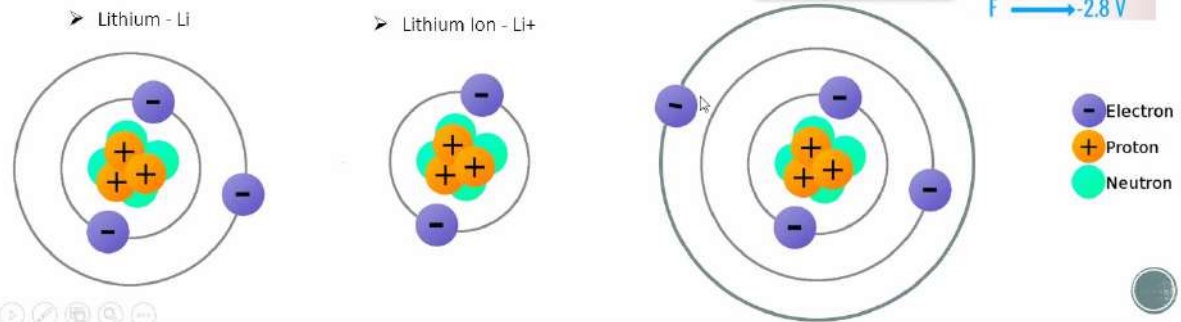
Battery does not store electric current but it stores energy in the form of chemical energy which can be converted back to electrical energy when required.

Electro chemical potential ... Ex Li Metal has tendency to lose outer electron.

Lithium in pure form is highly reactive (react with air or water) but when it is a part of metal oxide it becomes quite stable.

- Atom is neutral when proton are equal to electron.
- When atom has less electron than Proton then its called +ve ion.
- When atom has less proton than electron thane its called -ve ion.

Li	→	3.04 V
Mg	→	2.37 V
Al	→	1.66 V
Zn	→	0.76 V
Fe	→	0.44 V
H	→	0 V
Hg	→	-0.24 V
Cu	→	-0.34 V
Ag	→	-1.69 V
F	→	-2.8 V



Zoom Meeting

Participants (37)

Rebekah John B... Gayathri N

Rebekah John Bosco Gayathri N Shashika B S 1K838ME408:Dileera... Arnon felix (3AH18ME002)

Automotive Electrification – Lithium Cobalt Oxide(LiCoO₂) – LCO Battery

Charging / Load

Separator- micro porosity

+ve -ve

Cathode Anode

Lithium Cobalt oxide Graphite

Electrolyte

Lithium ion + e⁻

Participants list:

- Jagadish s.
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- KISHORE
- Kumar BM
- M.Ajay Kumar(007)
- Mannem Shrinidhi
- methesh
- Neha Np
- pavan kumar (LAH18MED10)
- Pooja B T.
- Prabhanjan .
- Rebekah John Bosco
- Sagar K g

Page: 6 of 6 Words: 139 11:34 AM 8/17/2021

Zoom Meeting

Participants (35)

Deepak Gowda L, Vinay H, pavan kumar (L...)

Deepak Gowda L, Sarvagya Kumari V, Vinay H, pavan kumar (LAH18..., Sarjaya Sarj...

Find a participant

Jagadish s, K Srinivas (LAH16ME038), KIRAN KUMAR, KISHORE, Kumar BM, M.Ajay Kumar(007), Mannem Shrinidhi, methesh, pavan kumar (LAH18ME010), Pooja B T., Prabanjan, Rebekah John Bosco, Sagar K g, Sandeep G R

Invite

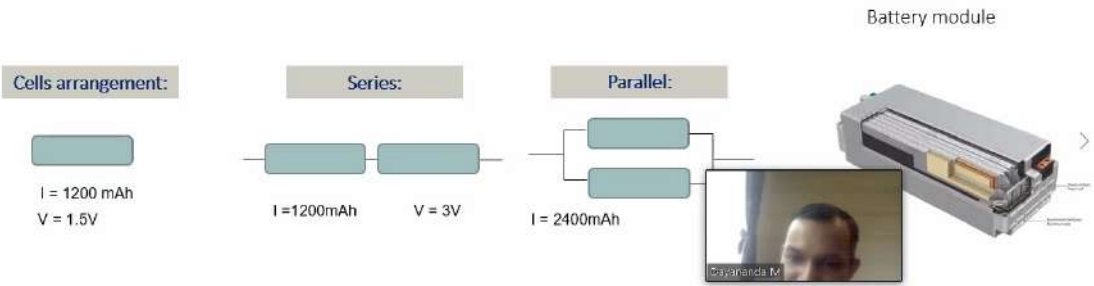
Automotive Electrification – Lithium Cobalt Oxide(LiCoO2) – LCO Battery

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Recording

Automotive Electrification – Battery sub system



Thermal management: battery cells temperature need to be controlled with in creation range to get best performance and to operate it safely.



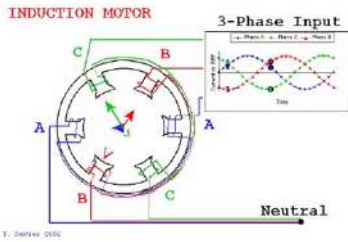
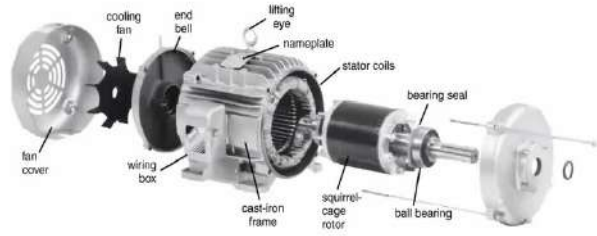
Automotive Electrification –Electrical drive unit (EDU)

Types of EDU :

- Asynchronous motor.
- Synchronous motor.

Asynchronous motor :

In an asynchronous, or induction, motor, the rotor is pulled into a spin, constantly trying to “catch up” with the rotating magnetic field created by the stator. This type of electric car motor is known for its high power output and is a common motor in vehicles.



Lessons on youtube

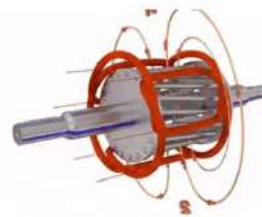
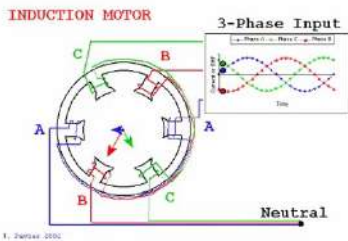
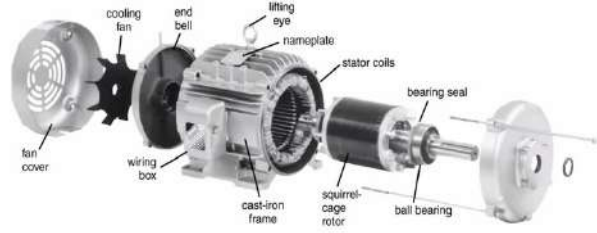
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$$SLIP = \frac{N_s - N_r}{N_s}$$

SLIP VALUE = 2-6%

Lessons on youtube

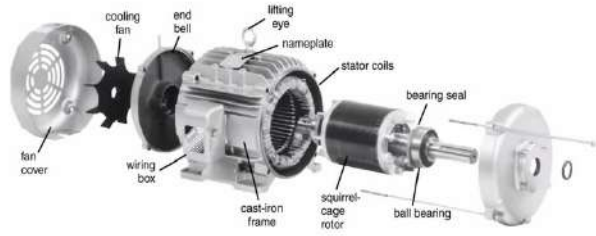
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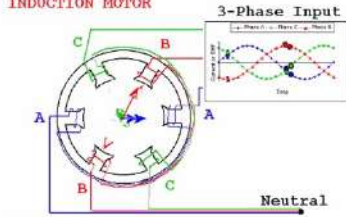
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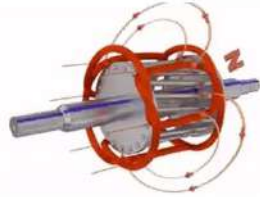


INDUCTION MOTOR



T. Swasey 2010

Lesics on youtube



$$SLIP = \frac{N_s - N_r}{N_s}$$

SLIP VALUE = 2-6%



Automotive Electrification –Electrical drive unit (EDU)

Synchronous Motor:

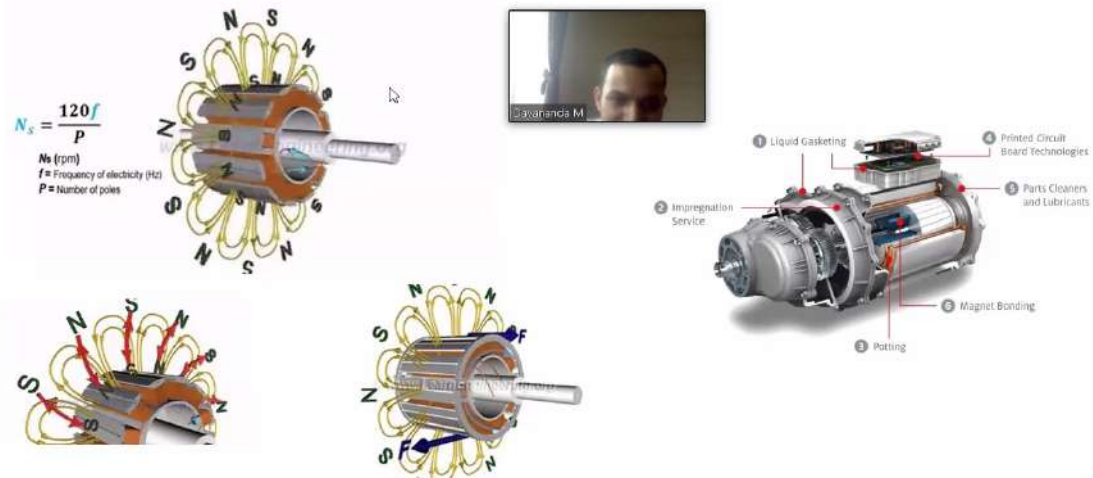
In a synchronous motor, on the other hand, the rotor turns at the same speed as the magnetic field. This provides high torque at low speed, making it ideal for urban driving. Another advantage is its size: a synchronous electric car motor can be compact and low weight.



Automotive Electrification –Electrical drive unit (EDU)

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<https://www.lesias.com/working-of-synchronous-motor.html>

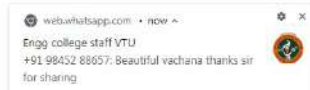
Automotive Electrification –Electrical drive unit (EDU)

Main difference between Synchronous and Asynchronous motor



- 1.Synchronous motor is a machine whose rotor speed and the speed of the stator magnetic field is equal. Asynchronous motor is a machine whose rotor rotates at the speed less than the stator magnetic field speed.
- 2.Synchronous motor requires an additional DC power source to initially rotate the rotor near to the synchronous speed. Asynchronous motor does not require any additional starting source.
- 3.The Speed of the Synchronous motor does not depend on the variation in the load. It is constant. The Speed of the Asynchronous motor decreases with the increasing load.
- 4.Change in applied voltage does not affect the torque of the synchronous motor, whereas it affect the torque of the Asynchronous motor.
- 5.With permanent magnets on Synchronous can act like alternator to generate electricity during regenerative braking.

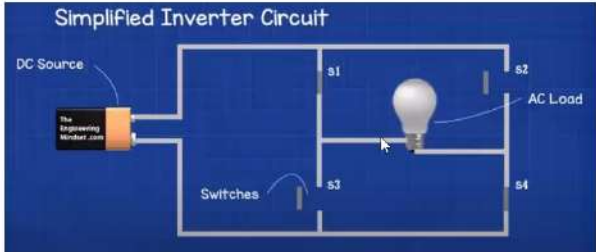
<https://www.emworks.com/blog/motor-design/axial-and-radial-flux-permanent-magnet-machines-what-is-the-difference>



Automotive Electrification – Inverter

Inverter

An inverter is a device that converts DC power to the AC power used in an electric vehicle motor. The inverter can change the speed at which the motor rotates by adjusting the frequency of the alternating current. It can also increase or decrease the power or torque of the motor by adjusting the amplitude of the signal.

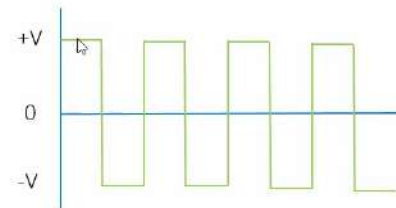
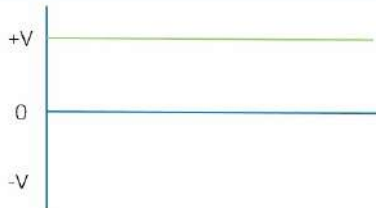
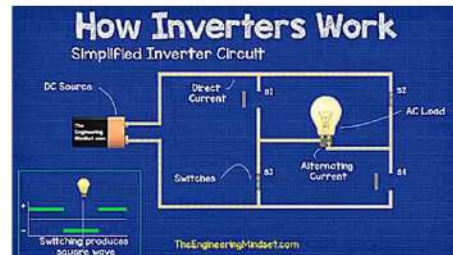
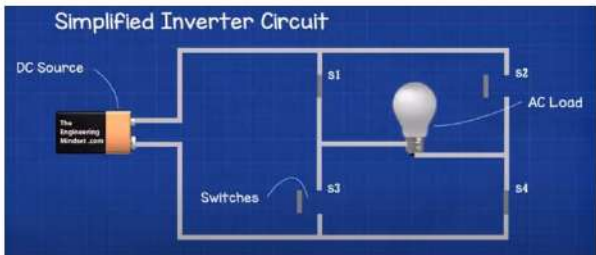


<https://theengineeringmindset.com/how-inverters-work/>

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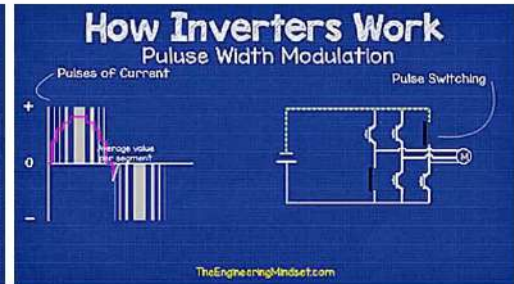
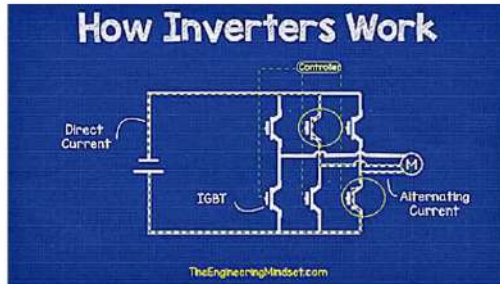
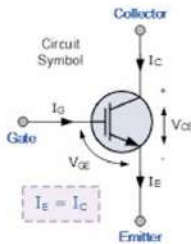


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Automotive Electrification – Inverter

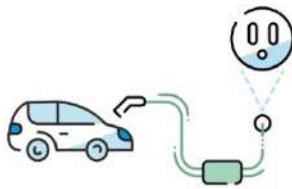
An insulated-gate bipolar transistor is a three-terminal power semiconductor device primarily used as an electronic switch, came to combine high efficiency and fast switching.

controller will send a signal to each IGBT telling it when to open and close. These IGBT's are paired together



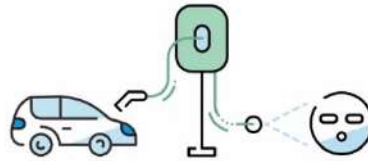
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Automotive Electrification – Charger and wire less charging system



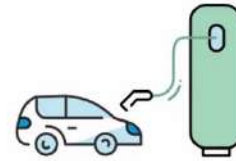
Level 1 Charger

- 1 hour of charging = 5 miles of driving
- 120 V cord plugs into the wall
- Dedicated circuit recommended



Level 2 Charger

- 1 hour of charging = 13-25 miles of driving
- Requires 208/240 V service
- Service upgrade may be needed (especially in older homes)



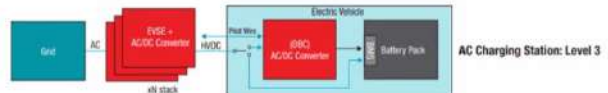
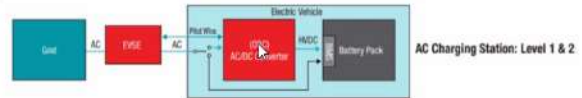
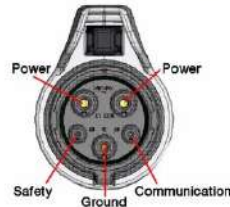
Level 3 - DC Fast Charger

- 30 minutes of charging = 80-percent battery recharge
- Public charging only, not for home use
- Not for plug-in hybrids/some battery-electric vehicles
- Typically requires 480 V service

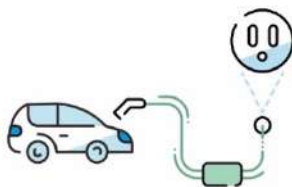
<https://www.oru.com/en/our-energy-future/technology-innovation/about-electric-vehicles/nj-commercial-ev/about-electric-vehicles-nj-comm>

Automotive Electrification – Charger and wire less charging system

Electric Vehicle Supply Equipment :

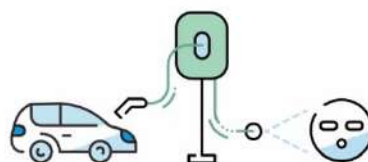


Using two-way communication between the charger and car, the correct charging current is set based on the maximum current the charger can provide as well as the maximum current the car can receive.



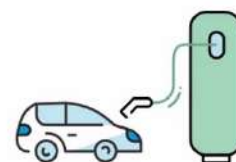
Level 1 Charger

- 1 hour of charging = 5 miles of driving
- 120 V cord plugs into the wall
- Dedicated circuit recommended



Level 2 Charger

- 1 hour of charging = 13-25 miles of driving
- Requires 208/240 V service
- Service upgrade may be needed (especially in older homes)

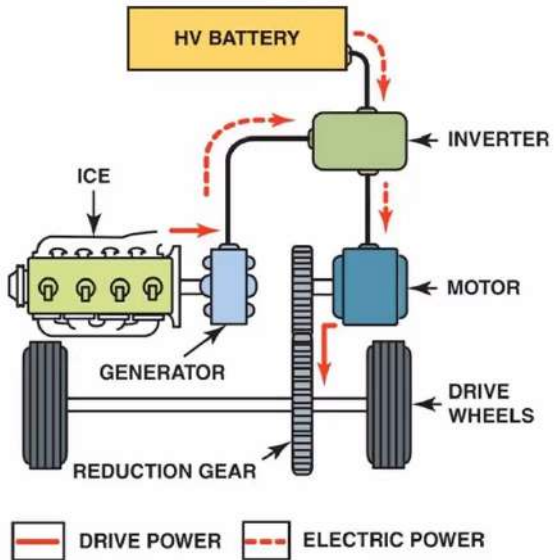


Level 3 - DC Fast Charger

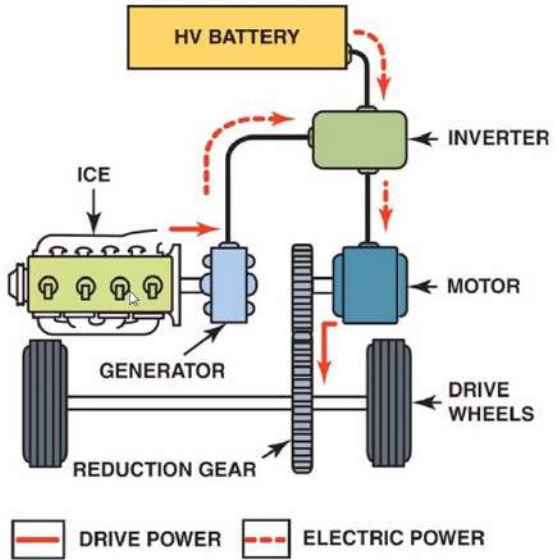
- 30 minutes of charging = 80-percent battery recharge
- Public charging only, not for home use
- Not for plug-in hybrids/some battery-electric vehicles
- Typically requires 480 V service

<https://www.oru.com/en/our-energy-future/technology-innovation/about-electric-vehicles/nj-commercial-ev/about-electric-vehicles-nj-comm>

Automotive Electrification – Hybrid Series



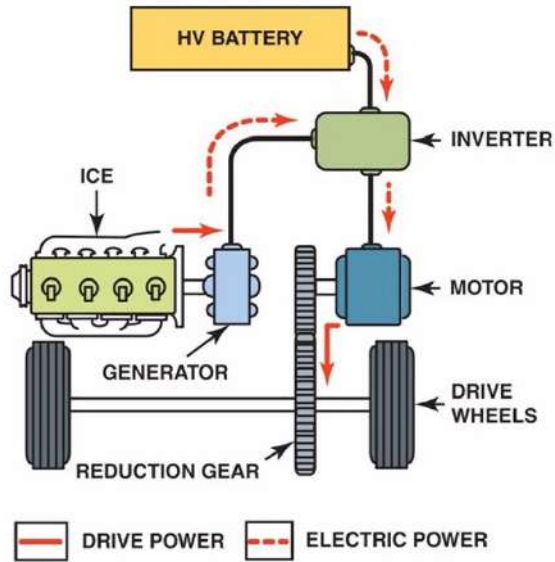
Automotive Electrification – Hybrid Series



Advantages

- Efficient and optimized power-plant
- Possibilities for modular power-plant
- Optimized drive line
- Long lifetime
- Mature technology
- Fast response
- Capable of attaining zero emission

Automotive Electrification – Hybrid Series



Advantages

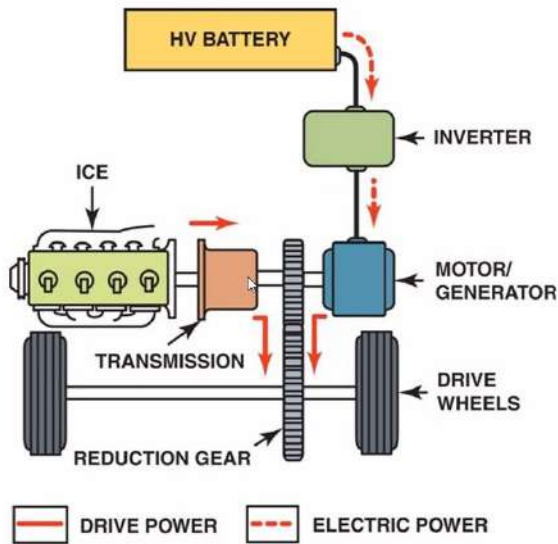
- Efficient and optimized power-plant
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Limitations

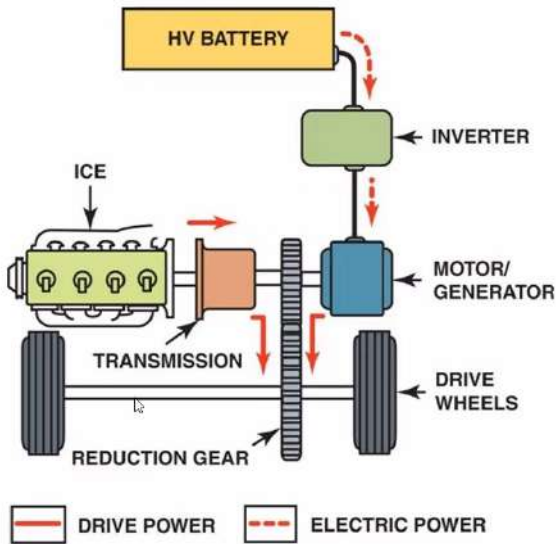
- Large traction drive system
- Requirement of proper algorithms
- Multiple energy conversion steps



Automotive Electrification – Hybrid Parallel



Automotive Electrification – Hybrid Parallel



Advantages

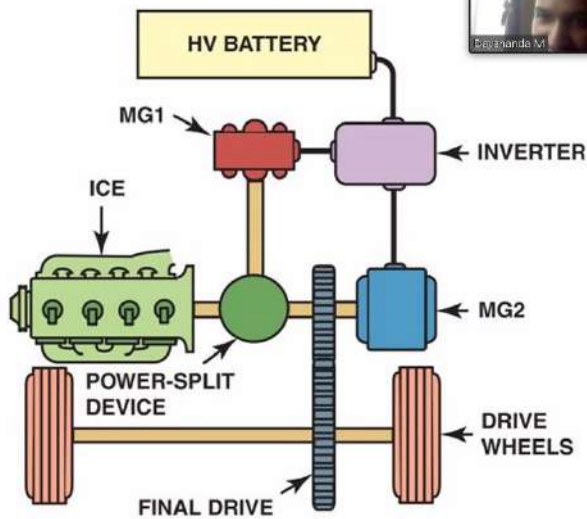
- Capable of attaining zero emission
- Economic gain
- More flexibility

Limitations

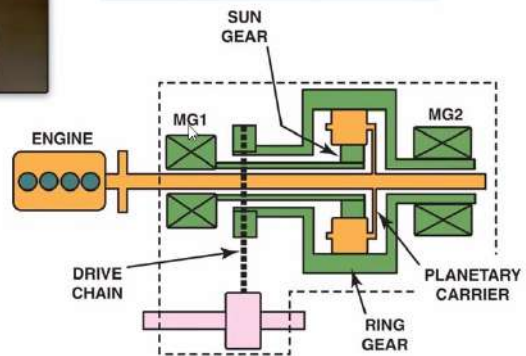
- Expensive
- Complex control
- Requirement of proper algorithms
- Need of high voltage to ensure efficiency

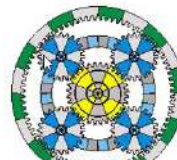
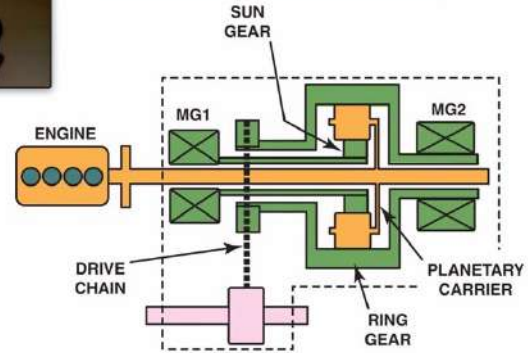
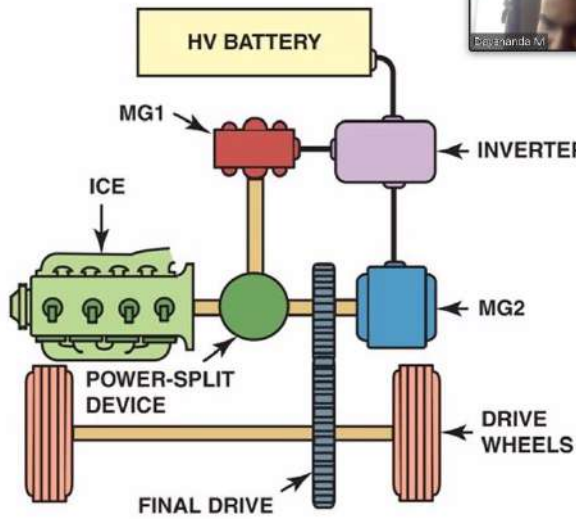


Automotive Electrification – Hybrid Parallel - Series

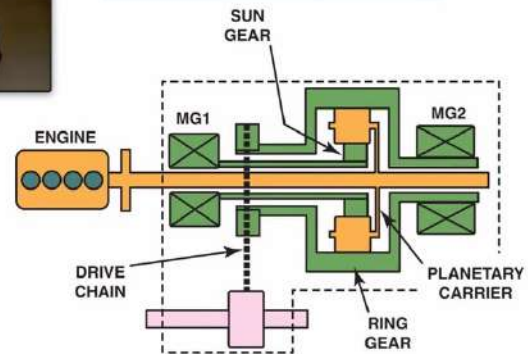
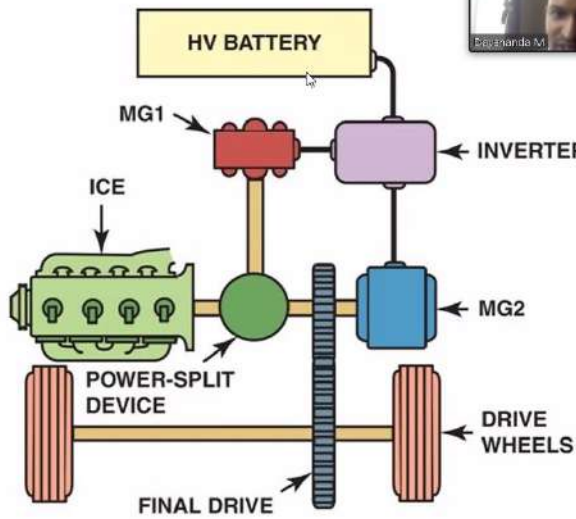


Power split planetary gear system





Idle



Idle

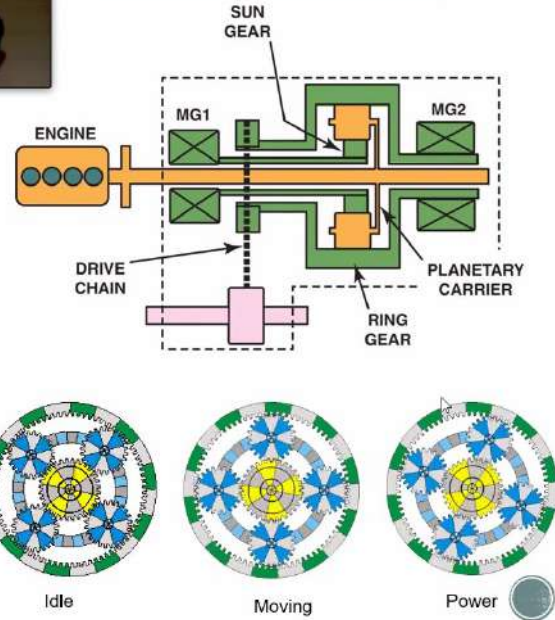
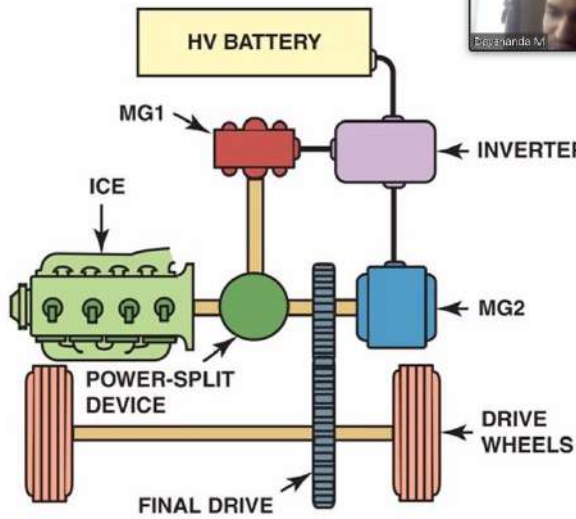


Moving

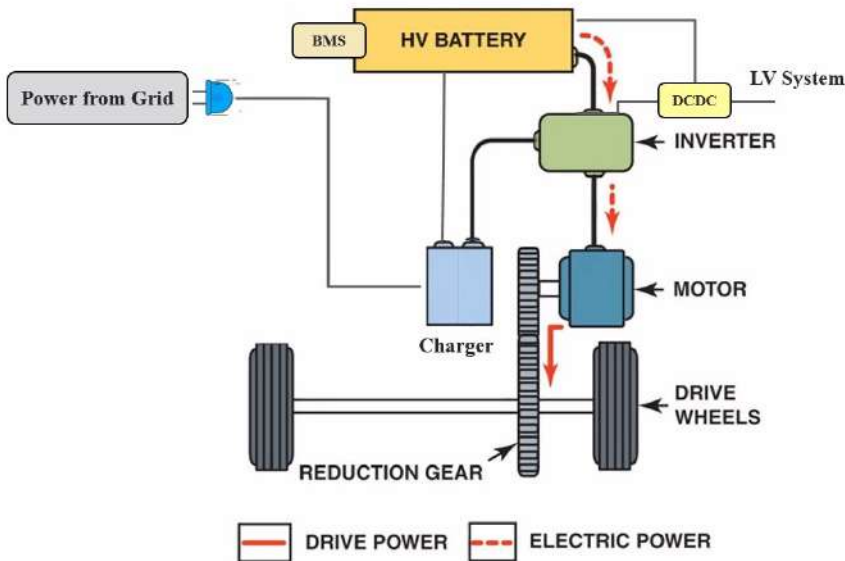
Automotive Electrification – Hybrid Parallel - Series



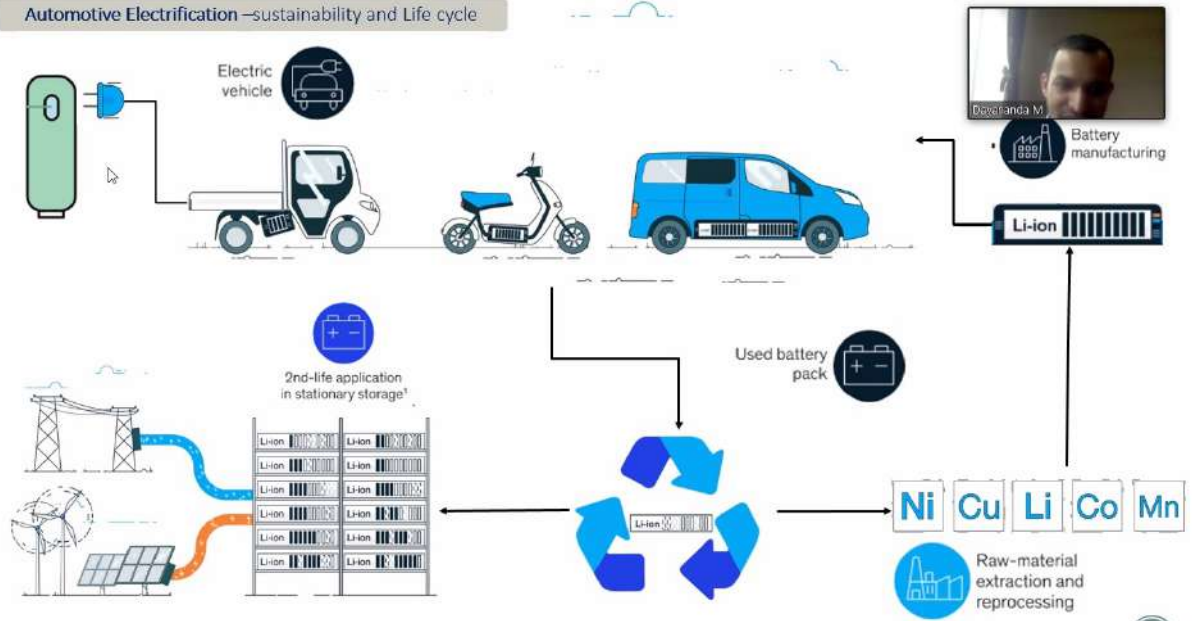
Power split planetary gear system



Automotive Electrification – Simplified Bev Architecture



Automotive Electrification –sustainability and Life cycle



<https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/second-life-ev-batteries-the-newest-value-pool-in-energy-storage#>

Devasandhi M	Suresh Puranic Math	Dr.H S Siddesha	Sagar K g	Chandan G
Aprameya	Jagadish s	M.Ajay Kumar(007)	methesh	Sayathri N
Connecting to audio...	Vinay H	K. Srinivas (1AH36ME038)	Srinidhi Acharya...	Chethan BN
KIRAN KUMAR	1KG19ME403 Dh...	S	Dr.H S Siddesha...	Harish d
Deepak Gowda .L	Rebekah John B...	Sandeep G R	C	



Dejananda M



Suresh Puranic Math

Dr.H S Siddesha

Dr.H S Siddesha



Chandan G

Aprameya

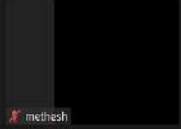
Aprameya



Jagadish S



M.Ajay Kumar(007)



metheshi



Gayathri N



Shashank S

Gayathri N

Vinay H

Vinay H



K Srinivas (1A116ME038)

Press ESC or double-click to exit full screen mode

Srimidhi Acharya S R



Chethan BN

KIRAN KUMAR

KIRAN KUMAR

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Sarvagya Kumari v

Dr.H S Siddesha...

Dr.H S Siddesha (me)

Harish d

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Deepak Gowda .L

Deepak Gowda .L

Rebekah John B...

Rebekah John Bosco

Sandeep G R

Sandeep G R

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Chandra Shekhar