

## ELECTRICAL SYSTEM SHEET (ESS)

**Submission Deadline: 18<sup>th</sup> Jan 2025, 11:59 PM**

### Submission details:

The ESS should be submitted in BAJA SAEINDIA Website under submission section.

**Website Link :** <https://www.bajasaeindia.org/>

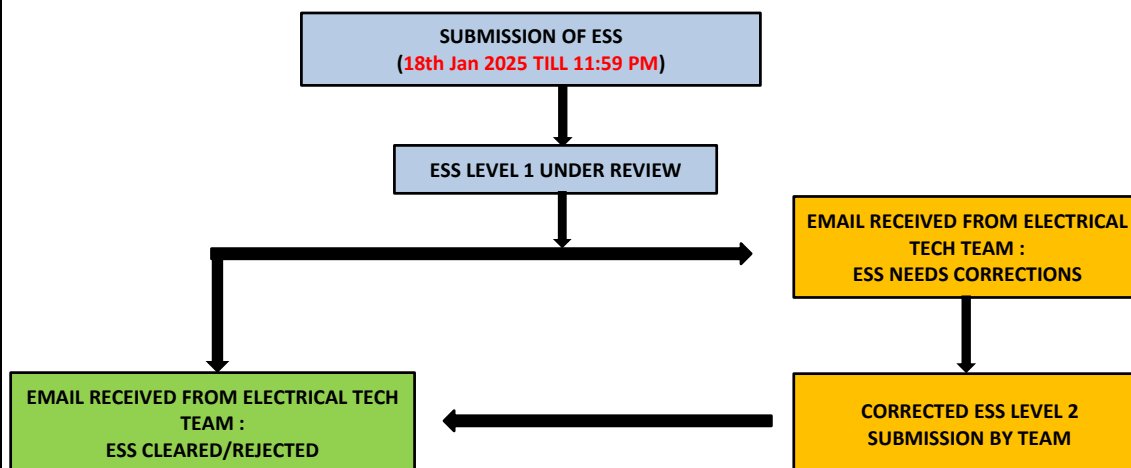
### Submission documents:

- 1.ESS Document should have the File Name as <Team ID>\_<Team Name>\_<ESS\_2025>
- 2.AIS and IP67 certificates of tractive system accumulator, IP67 certificate of motor and controller and other relevant documents need to be submitted along with ESS.

### IMPORTANT POINTS







1. Some of the cells in the subsequent sub-sheets are locked & will be filled automatically based on the inputs given in other cells.  
**For Example:** In 1.Accumulator sub-sheet, Nominal Voltage of Accumulator (G55)= Accumulator series Configuration(G52)\*Nominal Voltage (V) of cell(G13)
2. Avoid Keeping Units while filling this sheet unless required.
3. Teams should adhere to submission format. ESS sent to incorrect email ids will not be considered.
4. Deadline for submission will not be extended in any case.
5. Teams will receive corrections/ESS verified mail from ELECTRICAL TECH TEAM. Teams requiring corrections will need to submit corrected ESS before the deadline mentioned in the mail.
6. Every component listed in the ESS is regarded as final, and no further modifications are permitted.
7. All Fields are mandatory to be filled


**Refer below flow chart for submission:**



### 0. Introduction: Team Registration Details

Institute Name:	VELLORE INSTITUTE OF TECHNOLOGY
Team Name:	KSHATRIYA ELECTRIC
Team ID:	252084
Captain Name:	
Captain Contact Number:	
Alternative Name & Contact Number:	
Team Email ID:	kshatriya.electric@gmail.com
Mentor Name:	Revanth kumar Bathina





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ELECTRICAL SYSTEM SHEET (ESS)																																																													
Submission Deadline: 18th Jan 2025, 11:59 PM																																																													
1.Accumulator Details																																																													
1.1 Cells																																																													
Cell Make / Model /Form factor	HIY/LITHIUM/26650																																																												
Cell Chemistry (LFP,NCA,LTO etc.,)	NMC																																																												
Cell nominal capacity (mAh)	40000																																																												
Maximum Voltage (V)	4.35																																																												
Nominal Voltage (V)	3.6																																																												
Minimum Voltage (V)	2.75																																																												
Maximum peak discharge current (30s) (A)	15																																																												
Maximum continuous discharge current (A)	10																																																												
Maximum peak charge current (<80% SoC) (30s) (A)	5																																																												
Maximum continuous charge current	2.5																																																												
Internal Resistance(mΩ)	10m ohm																																																												
Operating Temperature Range(°C)	0 degree - 40 degree																																																												
Vendor details (if any)	Eifer Megacorp pvt ltd																																																												
1.2 BMS																																																													
	<table border="1"> <thead> <tr> <th>Detail</th> <th>Specifications</th> </tr> </thead> <tbody> <tr> <td rowspan="3">Discharge</td> <td>Maximum Continuous Discharge Current (A)</td> <td>180</td> </tr> <tr> <td>Peak Discharge Current (A)</td> <td>200</td> </tr> <tr> <td>Over Current Protection Current (A)</td> <td>200</td> </tr> <tr> <td rowspan="2">Charge</td> <td>Charging Voltage (V)</td> <td>58.8</td> </tr> <tr> <td>Charging Current (A)</td> <td>100</td> </tr> <tr> <td rowspan="4">Over charge protection</td> <td>Over Charge Detection Voltage (V)</td> <td>4.25</td> </tr> <tr> <td>Over Charge Detection Voltage for cell(V)</td> <td>1</td> </tr> <tr> <td>Over Charge Detection Delay Time (seconds)</td> <td>5</td> </tr> <tr> <td>Over Charger Release Voltage (V)</td> <td>4.1</td> </tr> <tr> <td rowspan="4">Cell balancing</td> <td>Cell balancing Detection Voltage (V)</td> <td>3.7</td> </tr> <tr> <td>[Cell balancing Detection Voltage-delta(V)]</td> <td>0.05</td> </tr> <tr> <td>Cell balancing Release Voltage (V)</td> <td>4.5</td> </tr> <tr> <td>Cell balancing Current (A)</td> <td>0.1 - 0.2</td> </tr> <tr> <td rowspan="3">Under Voltage protection</td> <td>Under Voltage (V)</td> <td>42</td> </tr> <tr> <td>Under Voltage for cell (V)</td> <td>3</td> </tr> <tr> <td>Under Voltage Detection Delay Time (seconds)</td> <td>10</td> </tr> <tr> <td rowspan="3">Short Protection</td> <td>Short Circuit Current (A)</td> <td>100 - 200</td> </tr> <tr> <td>Detection Delay Time (seconds)</td> <td>&lt;1</td> </tr> <tr> <td>Release Condition</td> <td>OFF LOAD</td> </tr> <tr> <td rowspan="2">Over - Temperature Protection</td> <td>No. of Temperature Sensor</td> <td>4</td> </tr> <tr> <td>Over - Temperature Protection Cut-Off (°C)</td> <td>70 to 120</td> </tr> <tr> <td colspan="2">Circuit breaker for faults</td> <td>fuse</td> </tr> <tr> <td colspan="2">Communication Protocol(CAN, RS-32, UART, WI-Fi, Bluetooth, or any)</td> <td>CAN</td> </tr> <tr> <td colspan="2">Vendor details</td> <td>Eifer Megacorp pvt ltd</td> </tr> </tbody> </table>	Detail	Specifications	Discharge	Maximum Continuous Discharge Current (A)	180	Peak Discharge Current (A)	200	Over Current Protection Current (A)	200	Charge	Charging Voltage (V)	58.8	Charging Current (A)	100	Over charge protection	Over Charge Detection Voltage (V)	4.25	Over Charge Detection Voltage for cell(V)	1	Over Charge Detection Delay Time (seconds)	5	Over Charger Release Voltage (V)	4.1	Cell balancing	Cell balancing Detection Voltage (V)	3.7	[Cell balancing Detection Voltage-delta(V)]	0.05	Cell balancing Release Voltage (V)	4.5	Cell balancing Current (A)	0.1 - 0.2	Under Voltage protection	Under Voltage (V)	42	Under Voltage for cell (V)	3	Under Voltage Detection Delay Time (seconds)	10	Short Protection	Short Circuit Current (A)	100 - 200	Detection Delay Time (seconds)	<1	Release Condition	OFF LOAD	Over - Temperature Protection	No. of Temperature Sensor	4	Over - Temperature Protection Cut-Off (°C)	70 to 120	Circuit breaker for faults		fuse	Communication Protocol(CAN, RS-32, UART, WI-Fi, Bluetooth, or any)		CAN	Vendor details		Eifer Megacorp pvt ltd
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Vendor details		Eifer Megacorp pvt ltd																																																											




<b>1.3 Accumulator</b>	
Make/Model No./Serial No.	
Accumulator series Configuration	13
Accumulator Parallel Configuration	16
Maximum Voltage (V)	56.55
Nominal Voltage (V)	46.8
Minimum Voltage (V)	35.75
Nominal Capacity (Ah)	640
Approximate Weight (kg)	35
Dimensional Size (Length x Width x Height in mm)	466*321*172
Max Continuous Discharge Current (A)	180
Max Instantaneous Discharge Current (A)	200
Charge Voltage (V)	58.5
Operating Temperature range (°C)	0 - 45
Battery Cooling Type	natural cooling
IP Rating	IP67
Battery Casing material	alluminium alloy
HV Connector type	electro magnet type
Vendor details	Eifer Megacorp pvt ltd
<b>1.4 Charger</b>	
Make / Model	Drone Power
Mode/Charging Profile(cc-cv)	5A-58.5v
Power (kw)	0.96
Output Voltage (V)	58.5
Max Input Voltage (VAC)	220
Input Current (A)	5
Time taken for full charge (min)	380
Vendor details	Eifer Megacorp pvt ltd
 <a href="mailto:bajaseindiaincommunications@saeindia.org">bajaseindiaincommunications@saeindia.org</a> <a href="https://www.linkedin.com/company/baja-sae-india">BAJA SAE INDIA</a> <a href="https://twitter.com/bajaseindia">@bajaseindia</a> <a href="https://www.instagram.com/bajaseindia">@bajaseindia</a> <a href="https://www.facebook.com/BAJA.SAE.INDIA">BAJA SAE INDIA</a> <a href="https://www.youtube.com/channel/UCBjA8e8e8e8e8e8e8e8e8e8">BAJA SAE INDIA</a>	

## 2. Motor(s)

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<b>3.Safety Systems</b>		
<b>3.01 TSAL Specifications</b>		
Make / Model	SHENZEN AOSHENG ELECTRONIC FACTORY	
Color	AMBER/YELLOW	
Flash Rate (Hz)	3	
Operating Voltage (V)	12	
IP Rating	IP65	
<b>3.02 Ready to Drive Sound</b>		
Make / Model	GENERIC	
Control Voltage (V)	12	
Sound intensity (dB) at 2m	95	
<b>3.03 Fuse</b>		
Fuse Location/Purpose	Current Rating (A)	Voltage Rating (V)
Battery	150	58
Controller	150	58
Type (Instant blow/Delay blow)	INSTANT FLOW	
<b>3.04 AIR</b>		
Make / Model	MAIN HV CONTACTOR PART NO. 2Z48 200A	
Contact Current (A)	200	
Contact Voltage (V)	48	
Type (Normally Closed/Normally Open)	NORMALLY OPEN	
<b>3.05 Firewall</b>		
Insulating layer thickness (mm)	1	
Insulating Material Make / Model	JL94-VO, FAR25 LIGHT WEIGHT ALUMINIUM SELF ADHESIVE SHEET	
<b>3.06 Kill Switches</b>		
Type	PUSH TYPE/ ROTATE TO ENERGIZE	
Number of Kill Switches	2	
Working Voltage (V)	12	
<b>3.07 Ignition Switch (If Applicable)</b>		
Type (Switch,Key etc.,)	KEY SWITCH	
Working Voltage (V)	12	
<b>3.08 HV Rated Cut-off Switch (If Applicable)</b>		
Type (Switch,Key etc.,)	KEY SWITCH	
Working Voltage (V)	60	
<b>3.09 Reverse Alarm (If Applicable)</b>		
Make/OEM	GENERIC	
Working Voltage (V)	12	
Location	REAR BUMPER	
<b>3.10 Driver Display</b>		
Have you implemented the rule C5.8.1 in the vehicle?	YES	
Have you implemented the rule C5.8.2 in the vehicle?	YES	
Have you validated the note under the rule C5.8.4?	YES	
<b>3.11 Lights</b>		
Name of Light	HEAD LIGHT	
Make/OEM	OEM	
Colour	WHITE	
Name of Light	BRAKE LIGHT	
Make/OEM	INDIAN OEM	
Colour	RED	
Name of Light (Any other Light/Optional)	REVERSE LIGHT	
Make/OEM	INDIAN OEM	
Colour	WHITE	

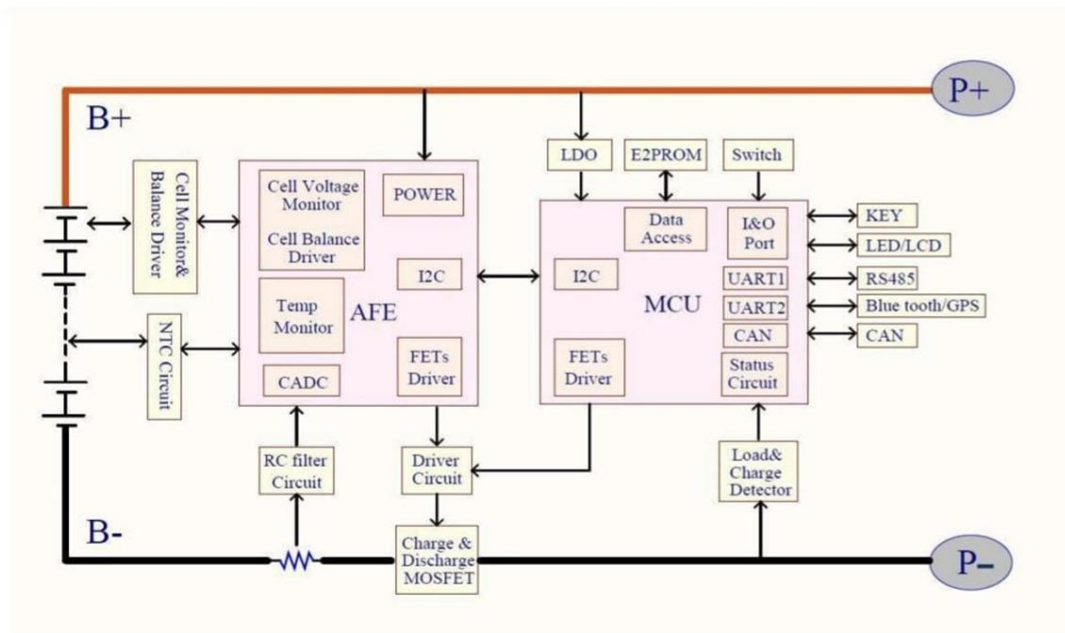
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<b>4.LV System</b>					
<b>4.1 DC-DC Converter</b>					
Type	DC TO DC CONVERTER				
Input rated voltage (V)	48				
Input voltage range (V)	48-72				
Efficiency (%)	90-95				
Output voltage (V)	14				
Output current (A)	20				
Output rated power (W)	300				
Output peak power (W)	300				
Voltage regulation (%)	-0.1				
Load regulation (%)	±2				
Ripple (full load test)	200mV				
No-load current (A)	0.01				
Working Temperature (°C)	25				
IP Rating	IP65				
Protections (Over-volt,Under-volt etc.,)	Over-voltage, Under-voltage,Over-current,Short-circuit				
Fuse rating (A)	25				
<b>4.2 Auxiliary Battery (≤15V)</b>					
Battery Type	Li-ion				
Charging Voltage (V)					
Charging Current (A)					
Minimum Voltage (V)					
Maximum voltage (V)					
Maximum Continuous Discharge current (A)					
Output rated power (W)					
Output peak power (W)					
Working Temperature (°C)					
Fuse rating (A)					
Weight					
Vendor details					
Cell Chemistry (LFP,NCA,LTO etc.,)					
Battery series Configuration					
Battery Parallel Configuration					
Peak Discharge Current (A)					
Over Current Protection Current (A)					
<b>4.4 Auxiliary Supply for telemetry and logging/driving data equipment (≤9V)</b>					
Output voltage (V)					
Output current (A)					
Power Consumption (W)					
Fuse rating (A)					
 <a href="mailto:bajasaesaeindia@saeindia.org">bajasaesaeindia@saeindia.org</a> <a href="#">BAJA SAEINDIA</a> <a href="#">@bajasaesaeindia</a> <a href="#">@bajasaesaeindia</a> <a href="#">BAJA SAE INDIA</a> <a href="#">BAJA SAEINDIA</a>					

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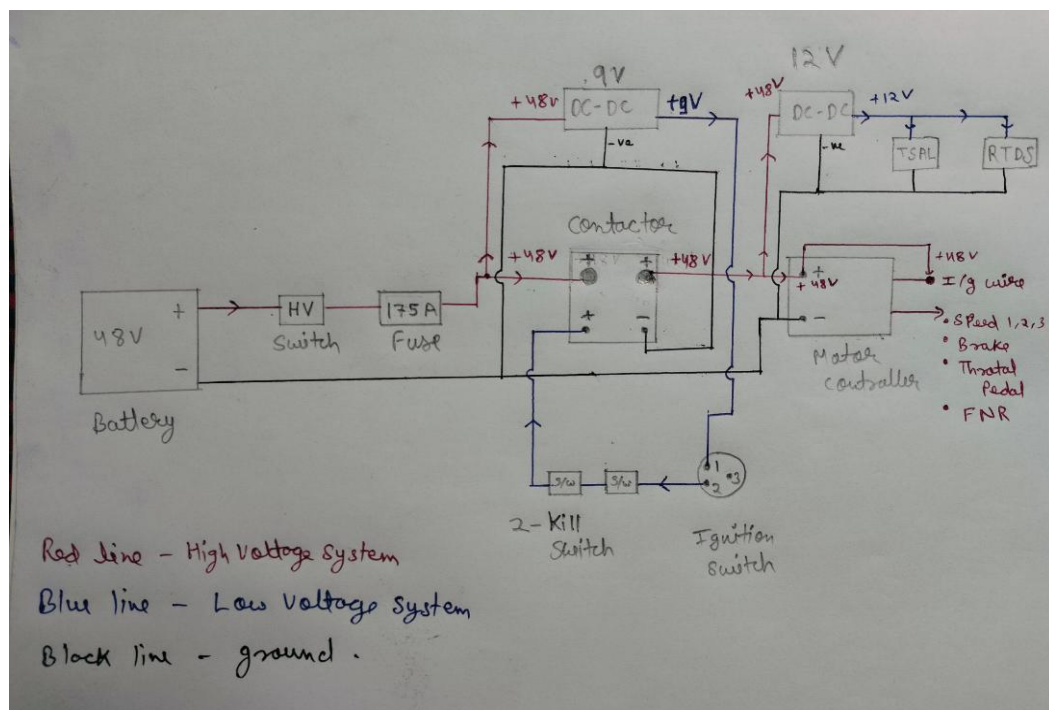
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## 5.Circuit Diagrams






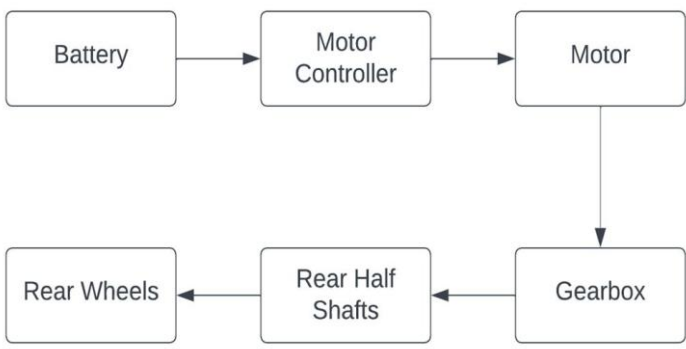
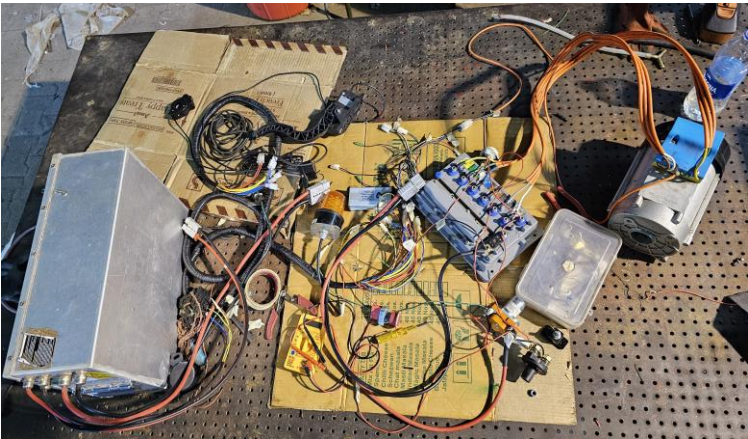
**5.1 BMS Wiring Diagram (Paste as an Image, all the components in the diagram should be clearly visible)**



## 5.2 Circuit Diagram (Tractive System and LV System)





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6.General		
6.1 Block Diagram (Flow of power from battery to transmission, Drivetrain, Axles & wheels)		
<div><pre>graph LR; Battery --&gt; MotorController[Motor Controller]; MotorController --&gt; Motor; Motor --&gt; Gearbox; Gearbox --&gt; RearHalfShafts[Rear Half Shafts]; RearHalfShafts --&gt; RearWheels[Rear Wheels];</pre></div>		
6.2 Actual Pictures of LV & HV Wiring installed in the Vehicle (Paste as an Images)		
<p>WE HAVE DONE THE CIRCUIT BUT OUR VEHICLE IS IN UNDER MANUFACTURING SO WE ARE NOT ABLE TO SHOW THAT IMAGE</p> <div></div>		

6.3 Battery Pack Pictures (Paste as an Image)



6.4 If Custom Electrical Component/Part like TSAL/Battery etc., (Include Pictures)



#### 6.5 Describe how you are controlling/designing start-up & Kill switch System

We are using a 60V DC battery with a high-voltage key switch and a fuse on the positive wire. An electromagnetic contactor with a coil winding is incorporated into the system, and a separate DC-DC converter (less than 9V) is connected to the second terminal of the ignition switch. When the ignition switch is turned on, the contactor coil receives current, creating an electromagnetic field that allows high voltage to pass to the motor controller. Simultaneously, our main 12V DC-DC converter powers up and continues to supply power to the contactor coil even after the ignition switch is released. Two kill switches are connected in series to the positive output of the DC-DC converter (9V). On the other end of the kill switches, we connect components such as the TSAL (Tractive System Active Light), RTDS (Ready to Drive Sound), brake light and alarm, reverse light and alarm, and other low-voltage components. If either kill switch is pressed, the power supply to the contactor is interrupted, shutting off both the tractive and low-voltage systems.



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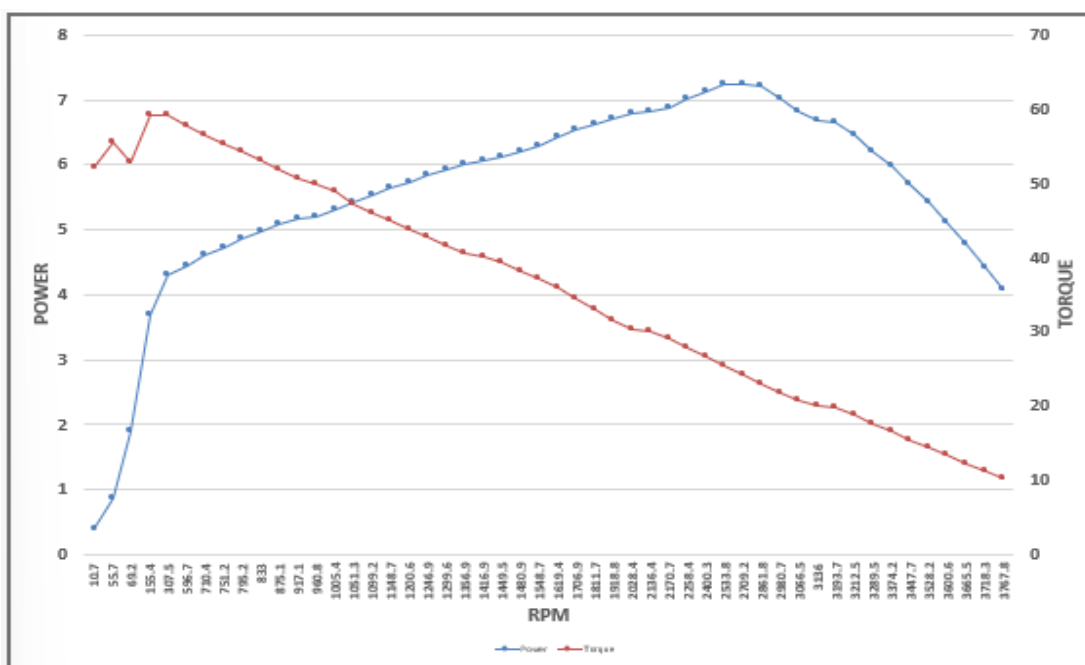
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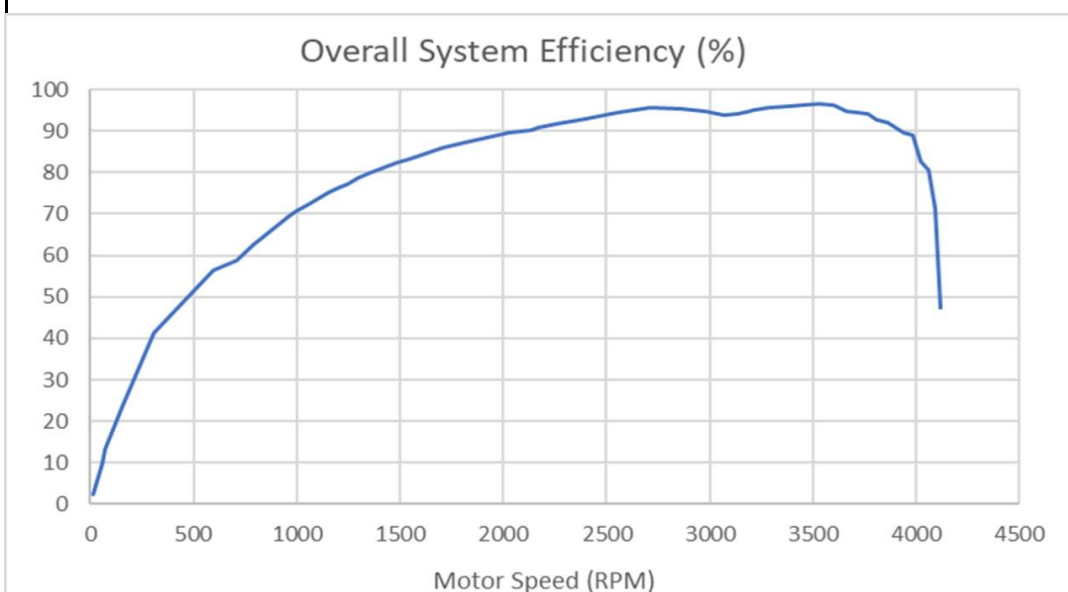
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### 7. Graphs

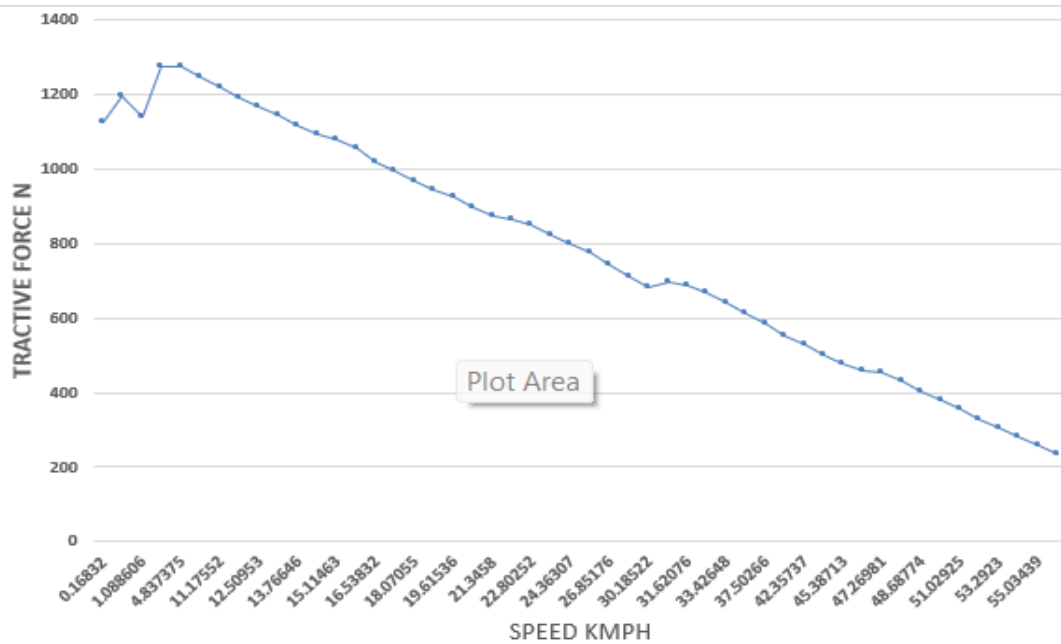
7.1 Powertrain Power (kW), Torque (Nm), Voltage Vs RPM (X Axis shall be RPM, Use two Y Axis charts when generating the Excel Chart, Paste Chart in excel chart format)



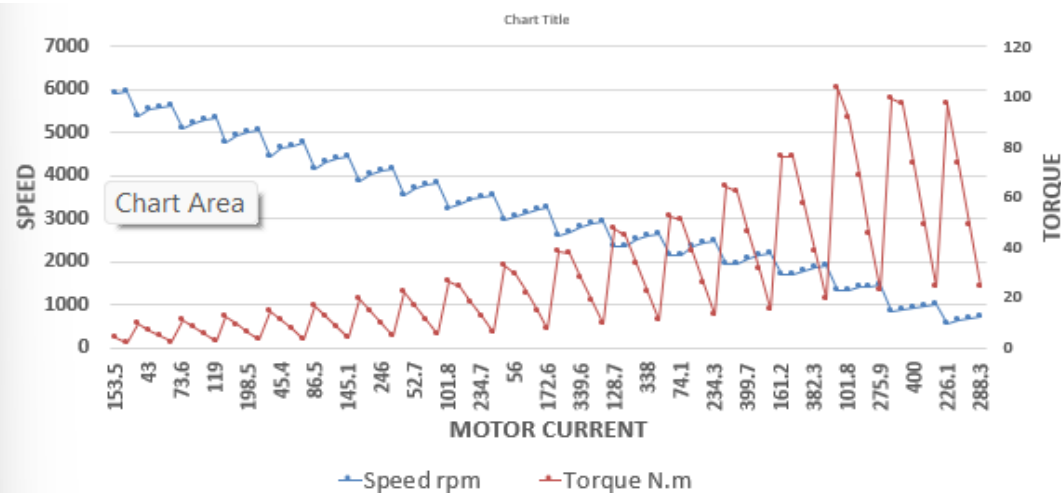
7.2 Overall System Efficiency in % (Consider Motor, Controller, Drive Train) Vs Motor Speed (RPM) (X Axis shall be Motor Speed (RPM), Paste Chart in excel chart format)
















**7.3 Tractive Force (N), Speed (km/h) Curve (X Axis shall be Speed (km/h), Paste Chart in excel chart format)**



**7.4 Motor Speed (RPM), Motor Torque (Nm) Vs Motor Current (A) (X Axis shall be Motor Current (A), Use two Y Axis charts when generating the Excel Chart, Paste Chart in excel chart format)**



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<b>8.Brief</b>					
<b>8.1 System Overview</b>					
Maximum Tractive System Voltage (V)	56.55				
Nominal Tractive System Voltage (V)	46.8				
Cutoff Tractive System Voltage (V)	35.75				
Low Voltage System Nominal Voltage (V)	12				
Number of Tractive Accumulator Containers (No.)	1				
Total Accumulator Capacity (Ah)	640				
Number of Motors (No.)	1				
Number of Controllers (No.)	1				
Maximum Combined Motor Shaft Power (kw)	7.20				
Driving Axle	RWD				
<b>8.2 General Parameters</b>	<b>IPG</b>		<b>Any other Software</b>		<b>Actual</b>
	When running at constant speed of 40 km/h	When following the Indian Driving Cycle	When running at constant speed of 40 km/h	When following the Indian Driving Cycle	When running at constant speed of 40 km/h
Approx. Range (km) of Vehicle on one full charge	35 km	27 km			
	<b>IPG</b>		<b>Any other Software</b>		<b>Actual</b>
Maximum Speed (km/h) of the Vehicle	55				
Maximum Acceleration (m/s <sup>2</sup> ) of the Vehicle	7.2				
Average Acceleration (m/s <sup>2</sup> ) of the Vehicle [from 0 to 40 km/h]	5.1				
Braking Distance (m) from speed of 40 km/h to Zero	9.3				
Braking time (sec) from speed of 40 km/h to Zero	1.63				
Current (A) drawn from Accumulator @ Starting	34				
Current (A) drawn from Accumulator @ 15 km/h	16				
Current (A) drawn from Accumulator @ 20 km/h	19				
Current (A) drawn from Accumulator @ 30 km/h	27				
Vehicle Weight (Unladen)	145 kg				
Gradeability	53.00%				
<b>8.3 Swappable &amp; Regeneration</b>					
Swappable Battery (Number of packs)	1				
Implementation of Regeneration	NO				
<p><b>Note:</b> The actual measurements may not (need not) be the same as theoretical values derived by using any software. It may vary for variety of software and different for different vehicles. Also, the theoretical values arrived as per each of the software and the measurement values will be an eye opener for all the Designers. Hence, it is being advised to fill up the genuine data only.</p>					
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