IVE | Engineering 工程

SOPHIE

SGOC

開啟淨零，可持續發展進程

「新能源新世代2024」
可載人太陽能車(大車) 工作坊五
太陽能車攻略

IVE Engineering 工程

SOPHIE

SGOC

工作坊內容

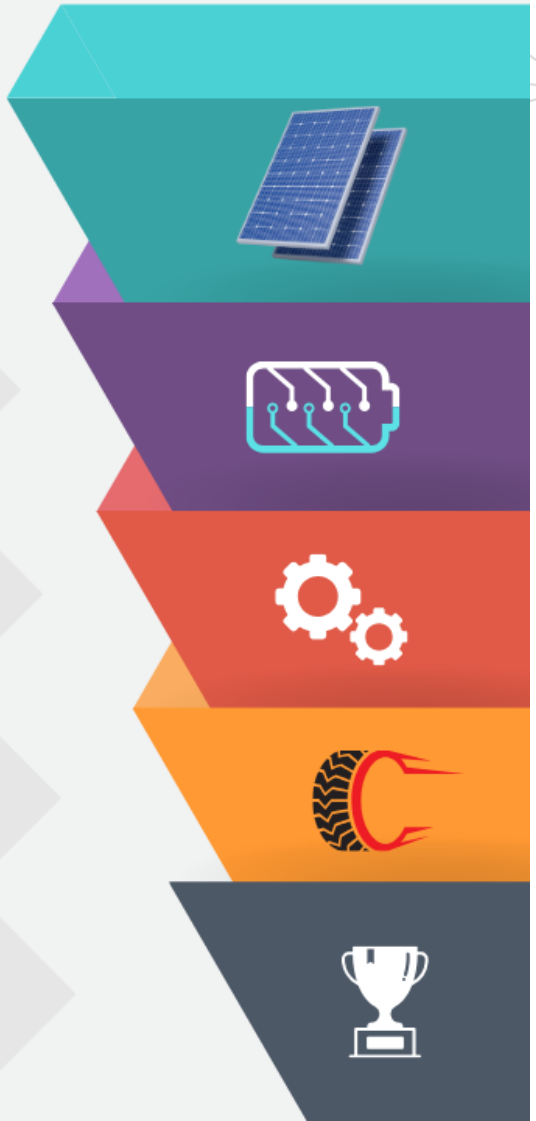
01 1)初談高效節能設計
1月27日

02 車輛動力ABC
2月24日

03 電力驅動技術
3月16日

04 車身設計大不同
7月6日

05 太陽能車攻略
7月13日



主題

1) Case studies
2) Race track analysis
3) Race operation and remarks
4) General questions

IVE Engineering 工程

SOPHIE

SGOC

Case studies

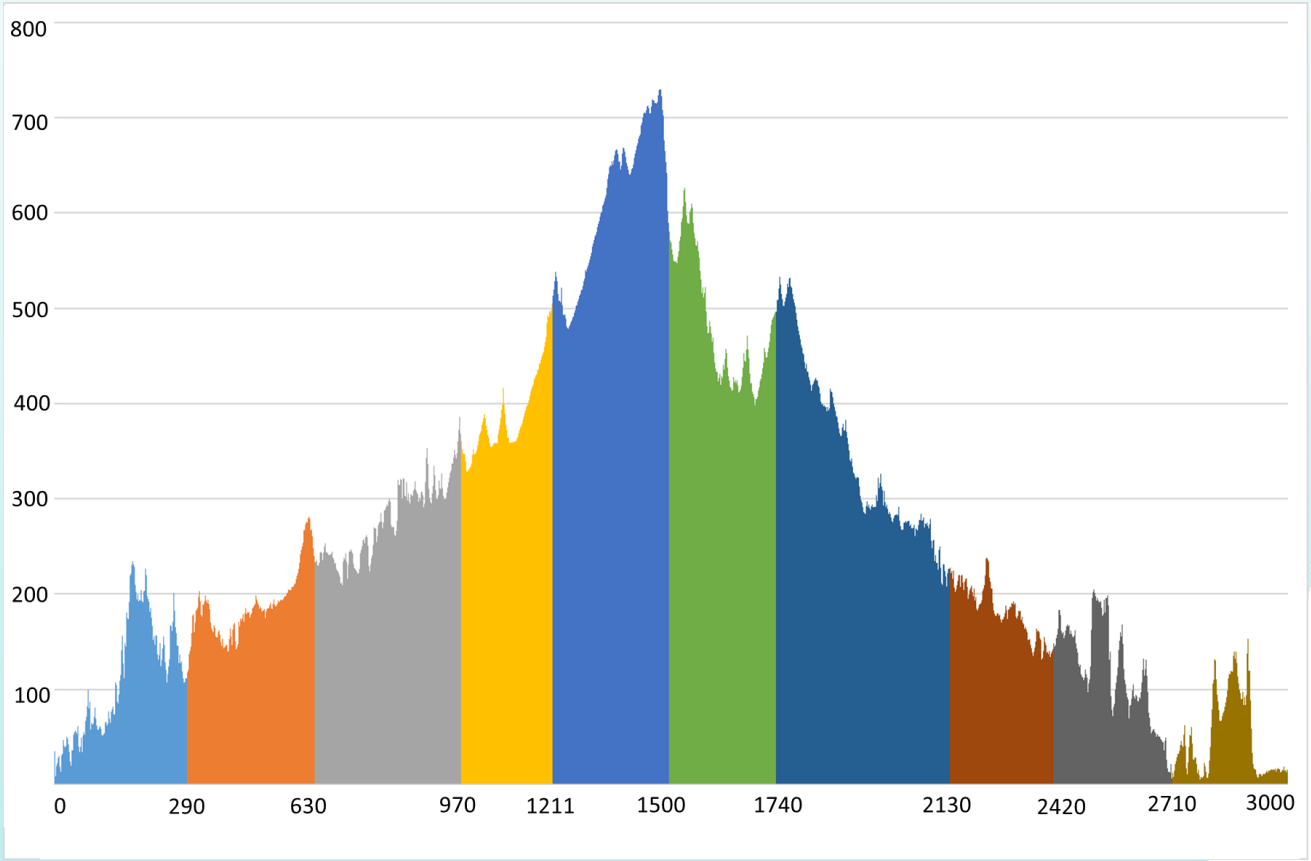
SOPHIE VI on World Solar Challenge (WSC) 2017 , in Australia

BRIDGESTONE WORLD SOLAR CHALLENGE

Crossing through the Australian Outback,
from Darwin, Northern Territory to Adelaide, South Australia

Case studies

Gradient on the WSC route



Case studies

Speed required for each day:

Example:
For Day 1,
-Spend 7.5 driving time
-Driving distance is 534km

$$\text{Speed} = \frac{\text{Driving distance } (km)}{\text{Time available for driving (h)}}$$

$$\text{Speed} = \frac{534}{7.5} = 71.2 \text{ km/h}$$

	Time (h)	Driving distance (km)	Average speed(km/h)
Day1	7.5	534	71.2
Day2	8.5	1066	62.6
Day3	8.0	1620	69.3
Day4	8.5	2178	65.6
Day5	8.0	2720	67.8
Day6	5.0	3000	56.0

Case studies

Energy calculation for each day:

Example:
For Day 1,

$$\text{Power} = Force\ x\ Velocity$$

$$Power = 90.4\ x\ \left(\frac{71.2}{3.6}\right)$$

$$Power = 1787.9\ W$$

	Average speed(km/h)	Force(N)	Power(W)
Day1	71.2	90.4	1787.9
Day2	62.6	90.3	1569.9
Day3	69.3	89.6	1723.6
Day4	65.6	86.2	1571.9
Day5	67.8	86.3	1624.1
Day6	56.0	97.3	1513.6

Case studies

Energy calculation for each day:

Example:
For Day 1,
Energy required:

$$Energy\ required = Power\ x\ time$$

$$Energy\ required = 1787.9\ x7.5$$

$$Energy\ required = 13.4kWh$$

	Time (h)	Power(W)	Energy required (kWh)	Solar energy (kWh)	Battery energy (kWh)
Day1	7.5	1787.9	13.4	6.8	6.6
Day2	8.5	1569.9	13.3	6.7	6.6
Day3	8.0	1723.6	13.8	6.6	7.2
Day4	8.5	1571.9	13.4	6.5	6.9
Day5	8.0	1624.1	13.0	6.0	7.0
Day6	5.0	1513.6	7.6	3.2	4.4

Battery pack capacity determined by :

Battery energy + Solar energy = Energy required

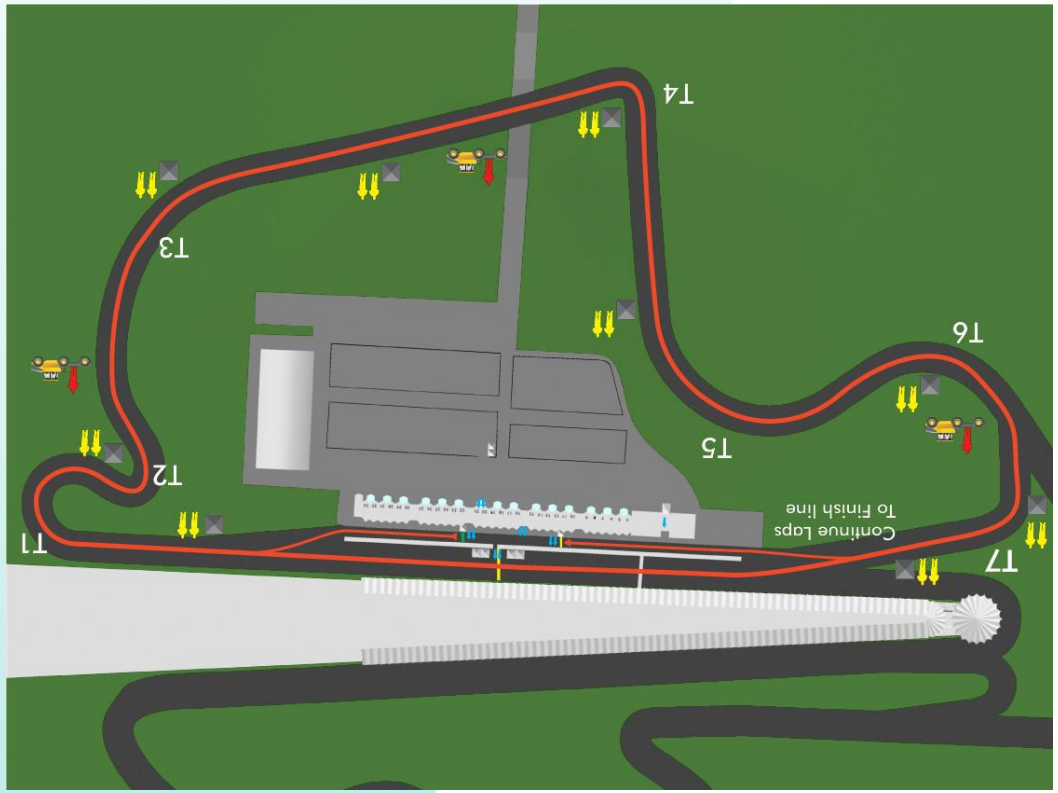
IVE Engineering 工程

SOPHIE

SGOC

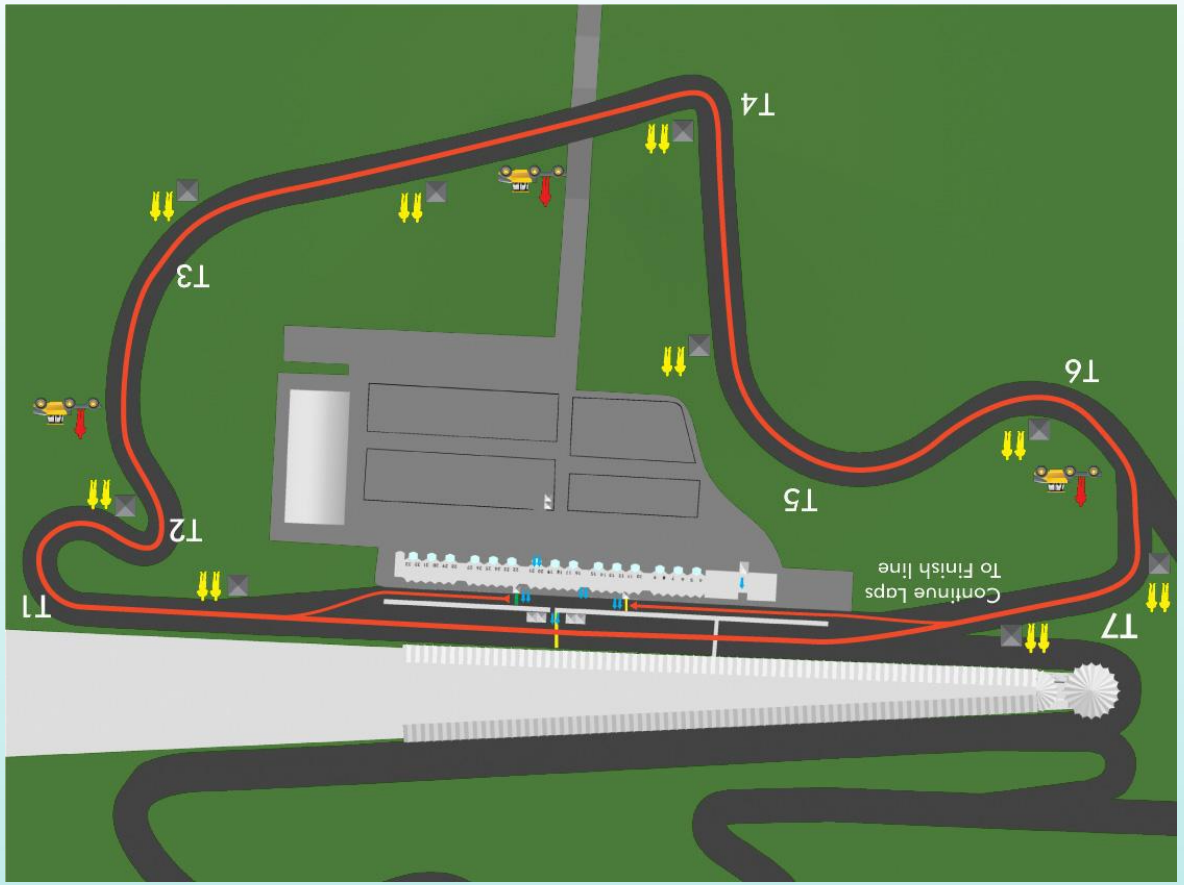
Case studies

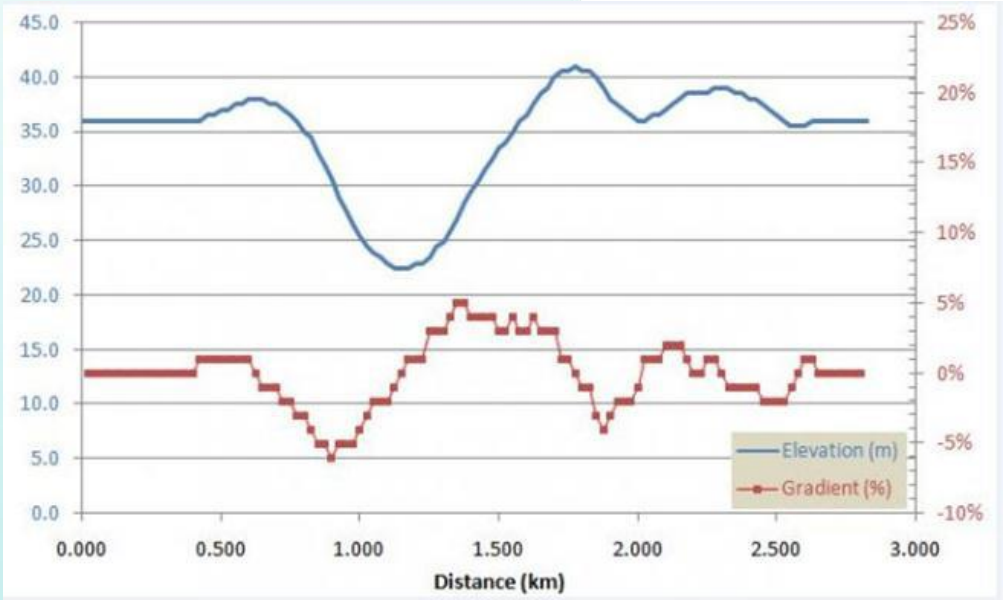
SOPHIE SEM on Shell Eco-marathon Asia 2012, in Malaysia



Case studies

SOPHIE SEM on Shell Eco-marathon Asia 2012 , in Malaysia

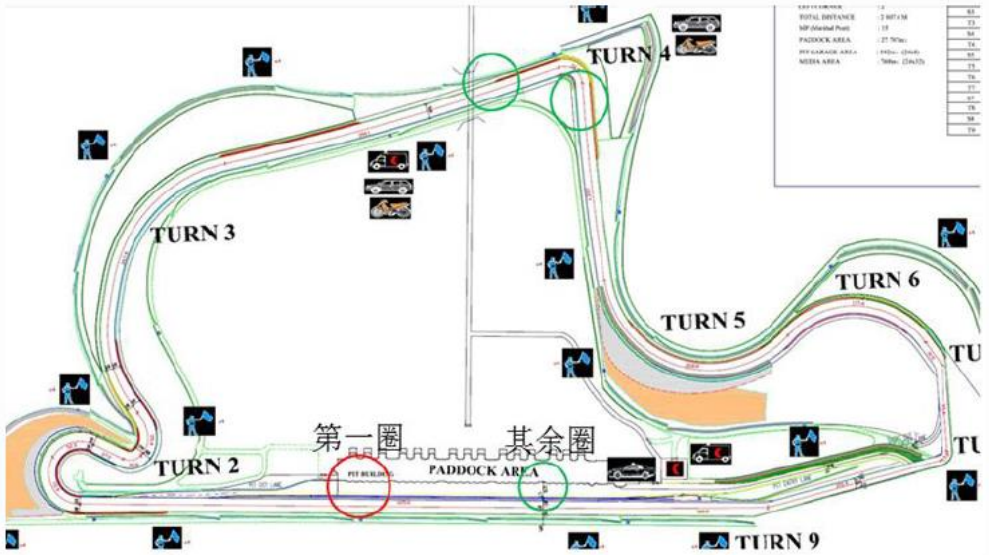




Case studies

Case study: 同濟大學 Acceleration strategy (1):

加速点位置方案一：每圈三次加速



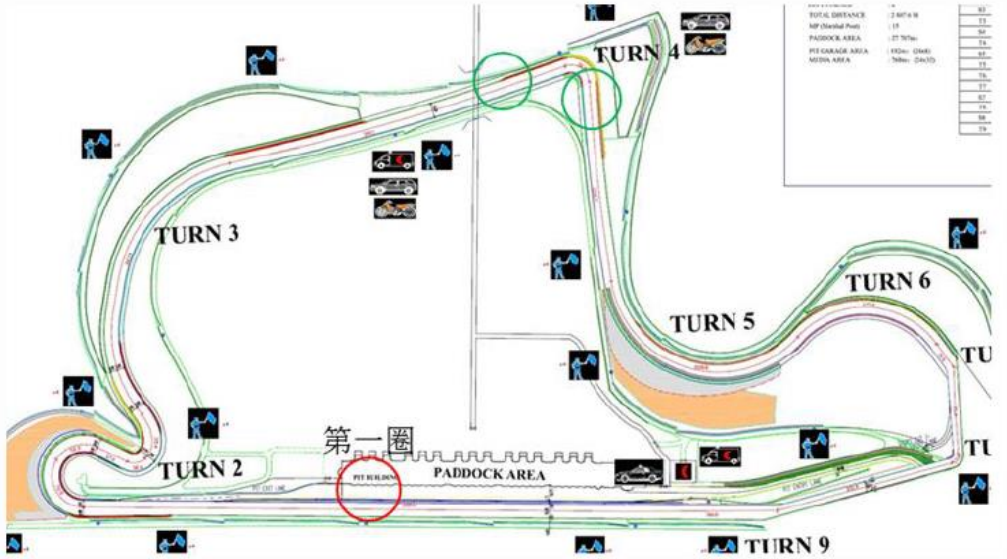
如图，三次加速的方案为：第一圈在起点处加速（红线），其余圈在终点线附近加速（绿线）。每圈在4号弯前后都会有两次加速。每次的加速速度会在后面予以说明。

Reference from:同濟大學 Eco Power 2011年度總結報告

Case studies

Case study: 同濟大學 Acceleration strategy (2):

加速点位置方案二：每圈两次加速



如图，两次加速的方案为：第一圈还是三次加速，只是在4号弯出来之后的那次加速到非常高（46~48），保证赛车可以利用滑行冲过1号弯的小上坡。车会在大下坡滑行的过程中加速，一直冲到4号弯前，然后加速冲过4号弯即可。以后每圈两次加速的加速点如绿线所示。

Reference from:同濟大學 Eco Power 2011年度總結報告

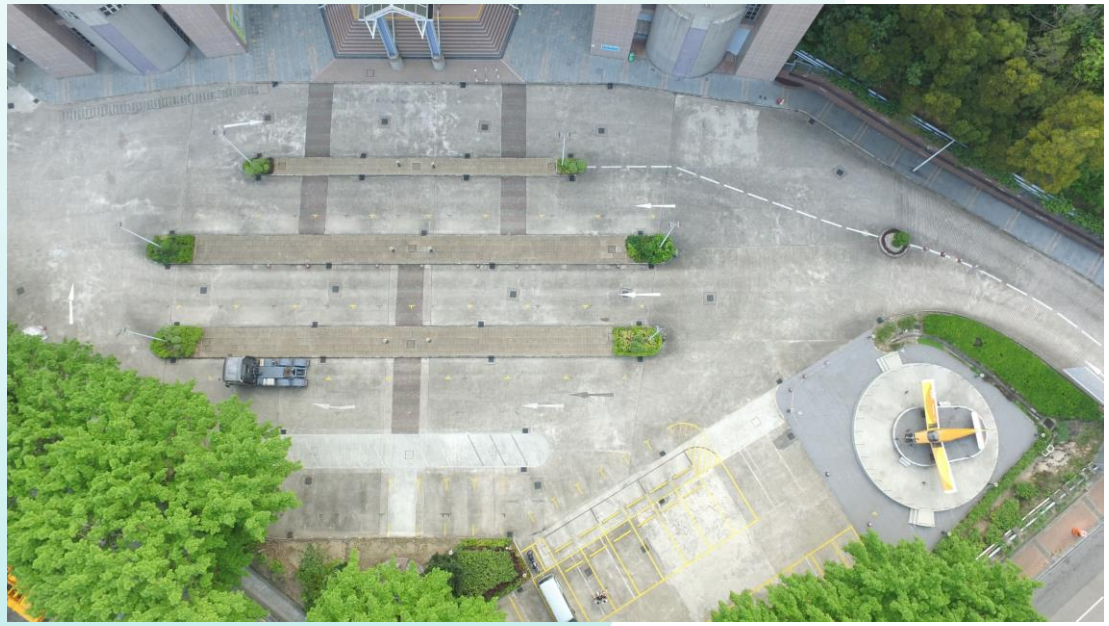
IVE Engineering 工程

SOPHIE SGOC

Case studies

New Energy STEM Generation racetrack:

Racetrack
Open carpark
Take place in IVE (Tsing Yi)



Race track Analysis

Refer to driving force calculation to determine the acceleration force:

Simplified version of Rideable Solar Car Power Calculation 2018 Mar

1) Force = $Force_{friction}$ + $Force_{acceleration}$ + $Force_{viscous}$ + $Force_{Ext\text{-}load}$ + $Force_{Gradient}$

2) $F_f = \mu_{rolling}$ (m) (g) F_{accel} = m(a)

where m = mass of person and solar car

Enter weight of person (kg)	80.00	
Enter weight of car (kg)	120.00	
Rolling coefficient of friction	0.003	*(Source: www.roymech.co.uk)*
F_f =	6.00	N

3) $Force_{accel}$ = m (a)

Velocity = u + at

Max Velocity =	30.00	km/h	(vel x1000m)/3600sec=	8.33	m/s
Assume accel Time in sec=	50.00	s			
Acceleration, a = $(v_2 - v_1)$/accel time	0.167	m/s^2			
Therefore $Force_{accel}$ = m(a)=	33.333	N	(200.00 x 0.167)		

4) Power = (F_f + F_{accel}) x Velocity (m/s) =(6.00 + 33.33) x 8.33

= 327.78 Watts

With safety factor of 20%, 327.78 x 1.20

= 393.33 Watts

which is equivalent to 0.53 Hp (1Hp = 746 watts)

Race track analysis

比賽

- 獎項：

- ✓ **Energy Efficiency Award**
- ✓ **Time Record Award**
- ✓ **Overall Championship**
- ✓ **Safety Award**
- ✓ **Technical Innovation Award**
- ✓ **Environmental- friendly Design Award**
- ✓ **Appearance Design Award**
- ✓ **Team Spirit Award**
- ✓ **Team Wear Design Award**

每組可於指定時間內行走 3 轉;

每轉 2 個圈;

每轉必須於指定地點停車 1 次 (停車時間10秒).

Race operation

- Radio Communication
- Car on-board communication system
- Understand and fulfil the regulations
- Listen the instruction from NENG campaign
- Logistic arrangement (Truck rental)
- Duties of team members
  - Team mangers
  - Drivers
  - Electrical and Mechanical team

Scrutineering day

Coming up:

Technical webcast
24th August

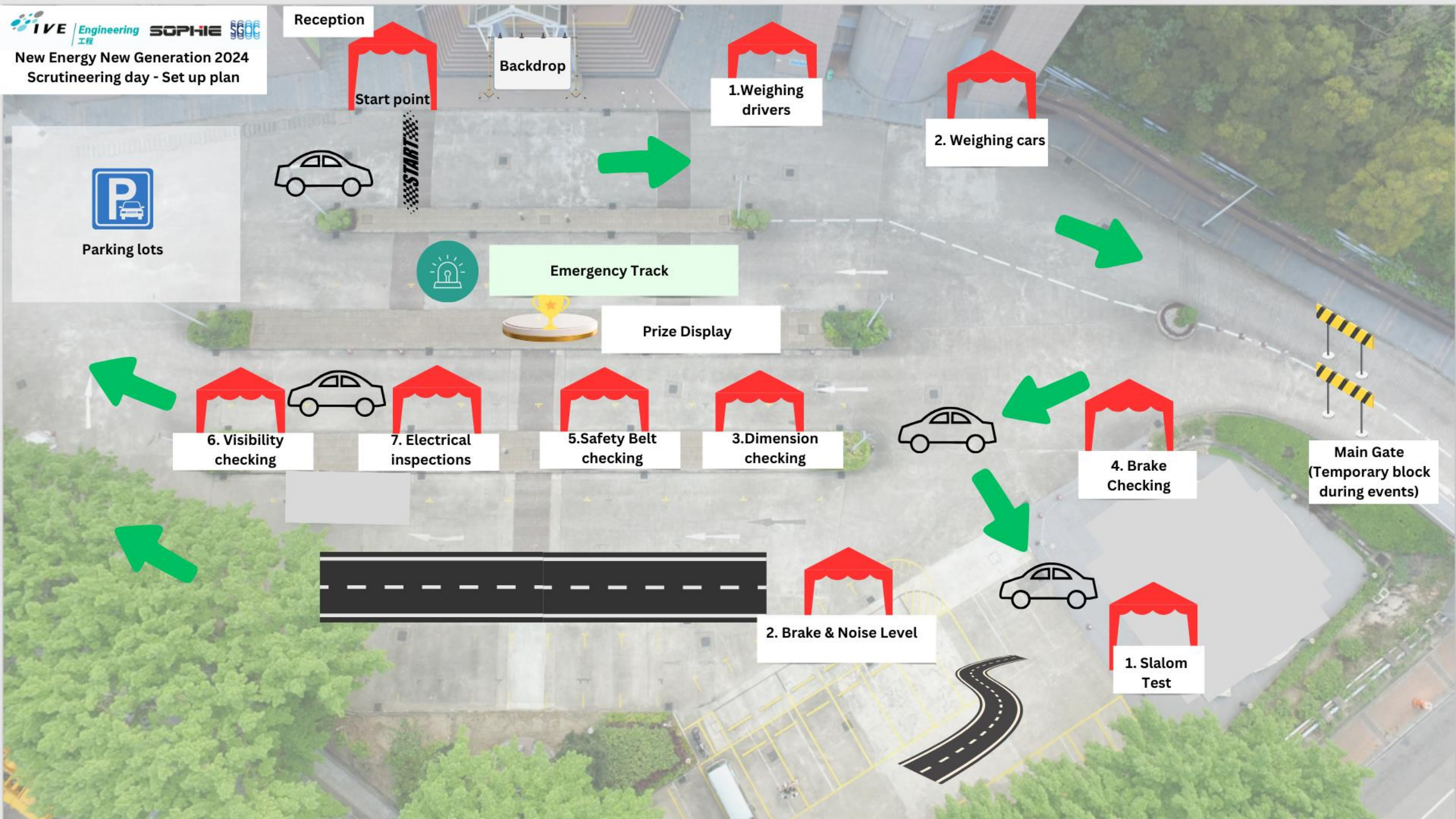
Explain the details of scrutineering arrangement

No need to come to IVE Tsing Yi!

The webcast connection details will be released on early August through email!

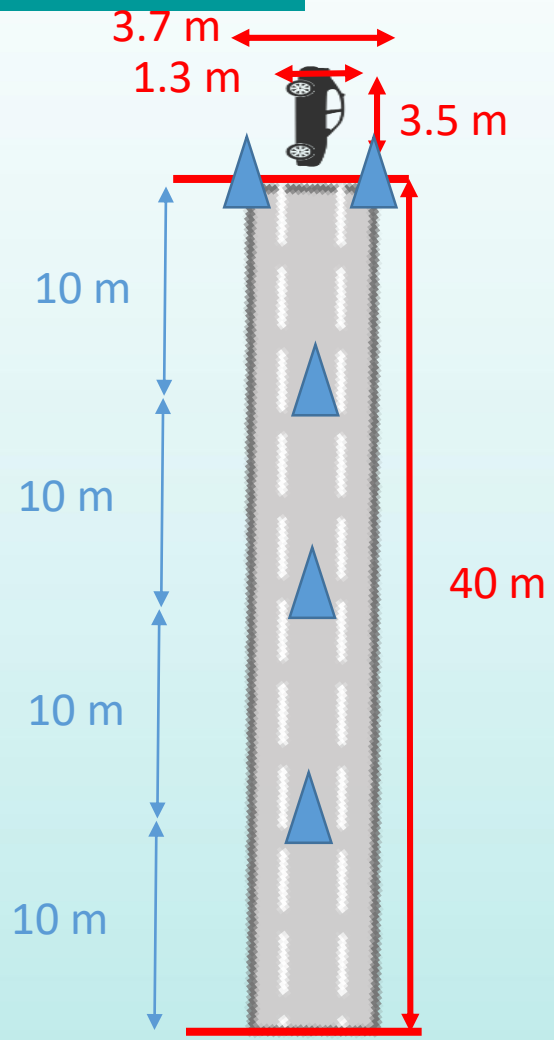
Scrutineering day
21st September

Check the car whether fulfil our requirement on regulation

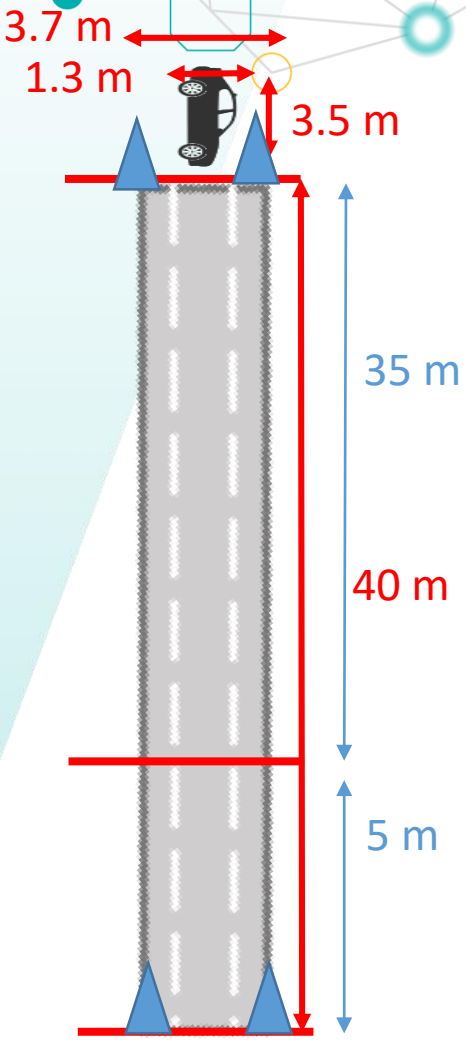

IVE Engineering 工程
SOPHIE
New Energy New Generation 2024
Scrutineering day - Set up plan
Reception
Backdrop
Start point
START
1.Weighing drivers
2. Weighing cars
Parking lots
Emergency Track
Prize Display
6. Visibility checking
7. Electrical inspections
5.Safety Belt checking
3.Dimension checking
4. Brake Checking
Main Gate (Temporary block during events)
2. Brake & Noise Level
1. Slalom Test

Scrutineering day

1. Slalom test



2.Brake & Noise Level Testing



IVE | Engineering 工程

SOPHIE

SGDC

Break

General questions

1) Joulemeter installation
2) Battery requirement & Lithium Battery usage
3) Brake lights
4) E-stop connection
5) Chassis: pipe and corner brace
6) Helmet

Joulemeter Installation

Joule meter Function:

- Provided by NENG Campaign for teams
- All joulemeters are identical, with same size, and function
- Each teams will have 2 joulemeters
- Use to measure the power input and power output
- Received the data, to determine the energy consumption of cars
- Will be collected back after the event day

Joulemeter Installation

Joulemeter dimension: (tentative)

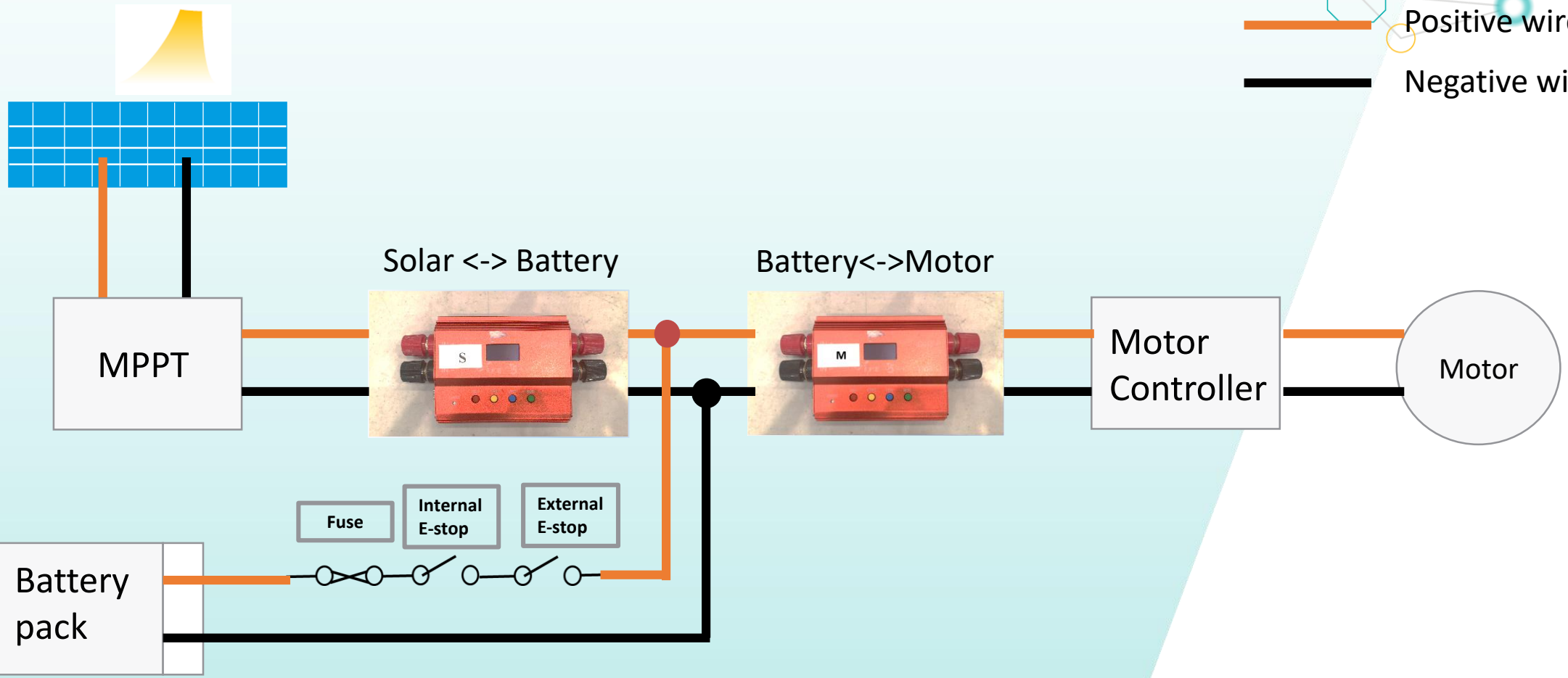
Joulemeter installation

Joulemeter dimension:

2 Joulemeters:
Solar <-> Battery
Battery<->Motor
(2 input terminals: Input + & input –)
(2 output terminals: Output + & output –)

Banana Plugs(Teams have to purchase):

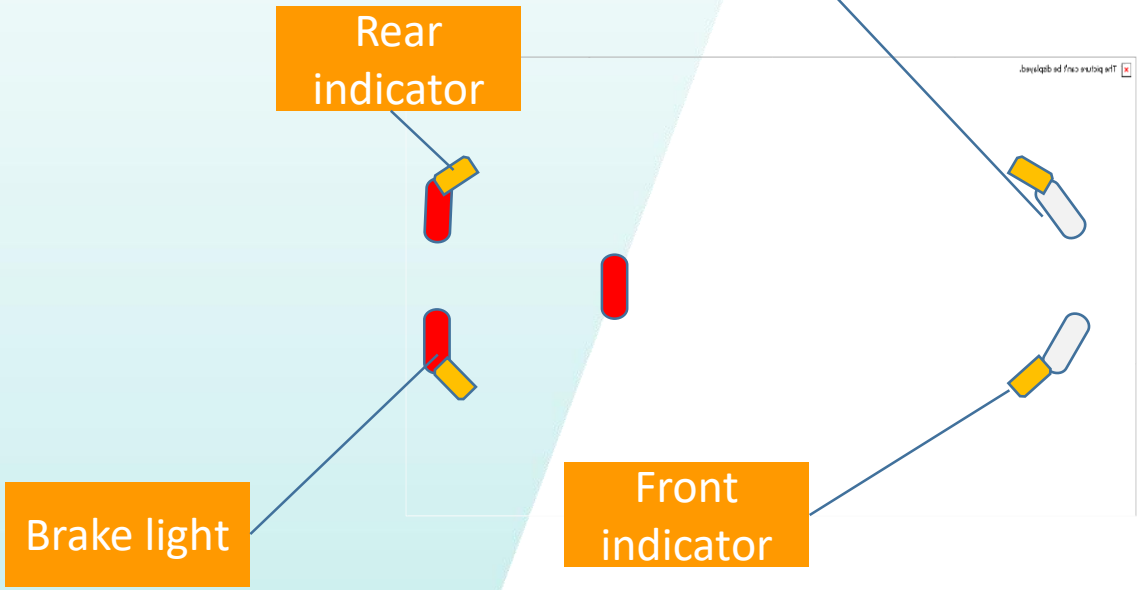
Joulemeter installation



Brake light

Brake light should be on, ONLY when brake system is applied.

- Solution: connect with micro-switch, with brake lever for switching.



Battery requirement

4.17. Energy Source / storage

4.17.1. Any energy storage device, must not exceed a **nominal voltage of 48 VDC.**

4.17.2. The energy storage device, must be installed outside of the driver's compartment.

- Nominal voltage of battery will be referred to battery specification.

- According to 4.18.2. The circuit drawing must contain batteries, fuses, circuit breakers, power switchers, solar generator, power trackers, capacitors, motor-controller or chopper, motor(s) and junction cables.
  All components (including Battery) in the circuit drawing must be labelled with their detailed electrical specifications.

Battery requirement

Take Lithium Ion Battery NCR18650B:

Nominal voltage of battery is 3.6V.

Panasonic

Lithium Ion

NCR18650B

Features & Benefits

- High energy density
- Long stable power and long run time
- Ideal for notebook PCs, boosters, portable devices, etc.

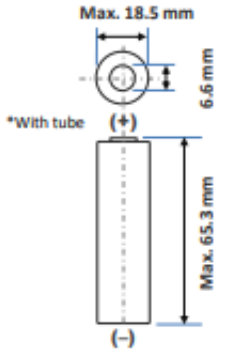
* At temperatures below 10°C, charge at a 0.25C rate.

Specifications

Rated capacity(1)	Min. 3200mAh
Capacity(2)	Min. 3250mAh Typ. 3350mAh
Nominal voltage	3.6V
Charging	CC-CV, Std. 1625mA, 4.20V, 4.0 hrs
Weight (max.)	48.5 g
Temperature	Charge*: 0 to +45°C Discharge: -20 to +60°C Storage: -20 to +50°C
Energy density(3)	Volumetric: 676 Wh/l Gravimetric: 243 Wh/kg

(1) At 20°C (2) At 25°C (3) Energy density based on bare cell dimensions

Dimensions



For Reference Only

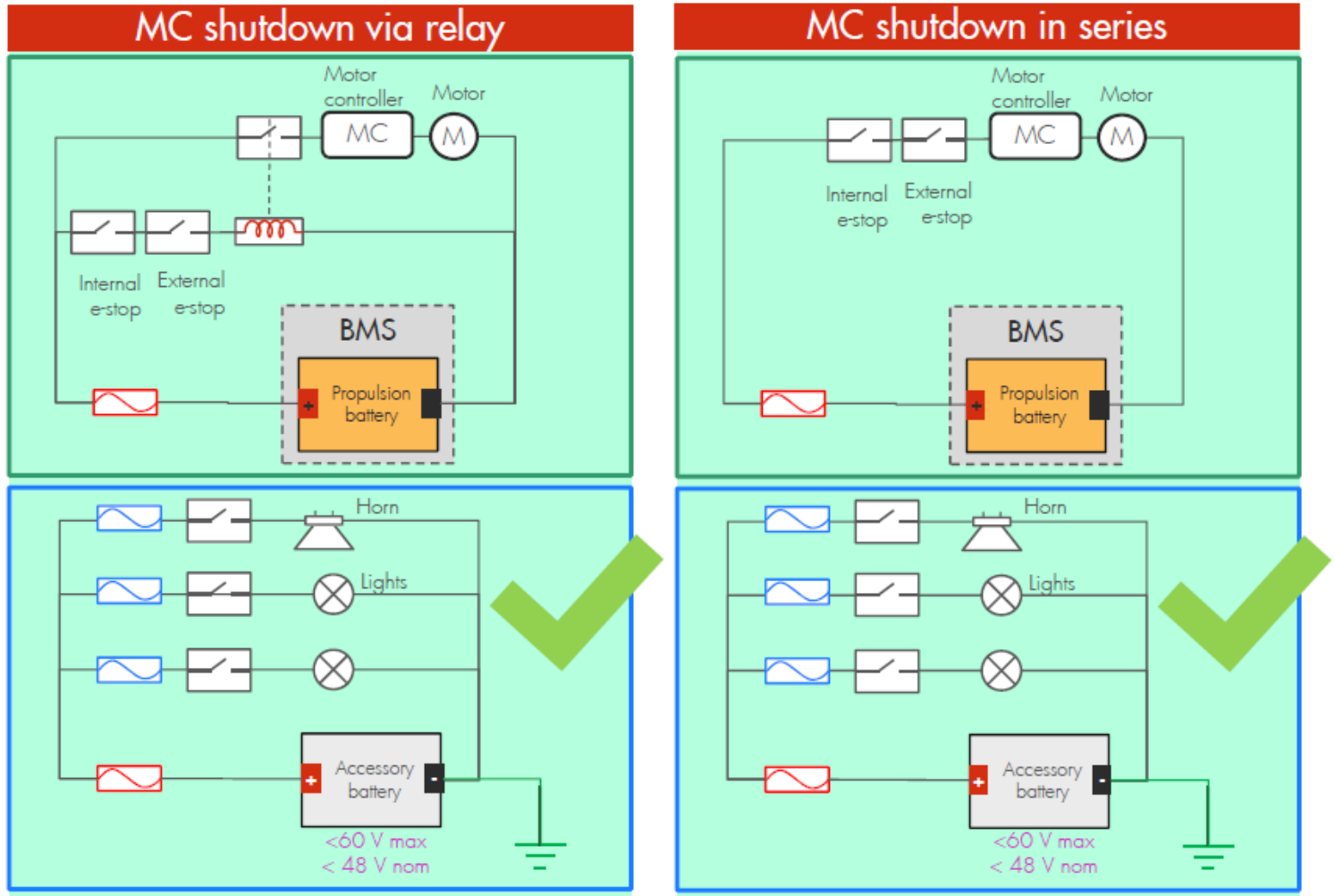
Battery requirement

3.2.3.2. If a Lithium-Ion battery is used, either as a propulsion or accessory battery, provide printed/written documentation on the BMS operation.

BMS refer to Battery management system,

Should protect the system against overvoltage, overcurrent, short-circuit, thermal overload and other abnormal operation of the said device without the need for power other than from the said device.

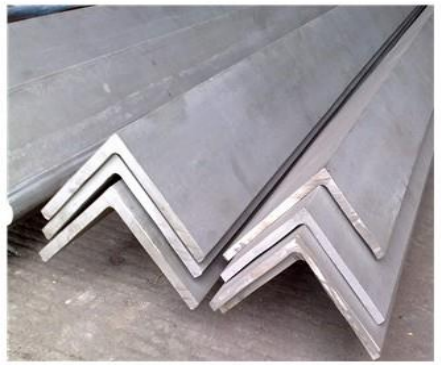
E-stop connection



Chassis

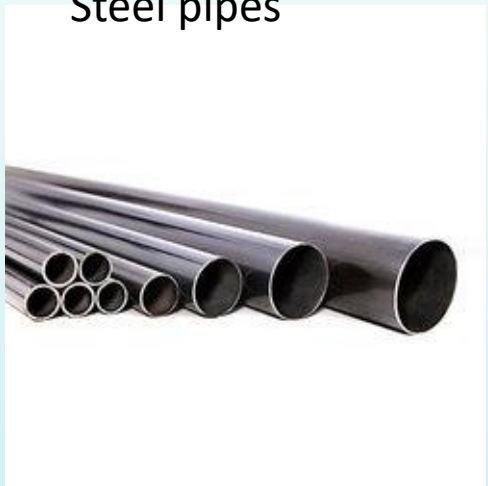
Avoid:

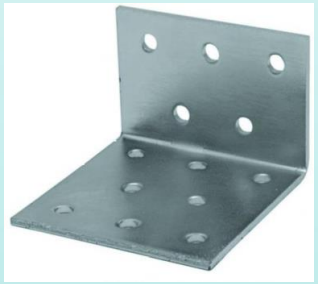
Angle bar



Prefer:

Steel pipes





Importance:
Corner brace: used for connect of construction elements

Helmet purchasing

5.2.3. Helmets – Driver must wear a helmet when driving. Only approved protective helmets are allowed for use, with the standard fulfilled, which is listed in **regulation of Hong Kong legislation "Schedule 1 Approved Protective Helmets of Cap374F Road Traffic (Safety Equipment) Regulations".** The approved type of protective helmets should **bear marking signifying compliance with the approved standards.**

ECE Regulation No. 22 standard.

Snell standard M2000.

Federal Motor Vehicle Safety Standard (USA) No. 218 for motorcycle helmet.

Japanese Industrial standard JIS T8133

British standard BS 6658

Australian Standard

IVE | Engineering 工程

SOPHIE

SGOC

完