TÜBİTAK EFFICIENCY CHALLENGE ELECTRIC VEHICLE

TECHNICAL DESIGN REPORT

Deadline: July 20th, 2017

VEHICLE AND TEAM NAME: HARPUT 2 - FÜTEK

UNIVERSITY: FIRAT UNIVERSTY

ACADEMIC ADVISOR: ASSOC. PROF. DR. ORHAN ÇAKAR

TEAM CAPTAIN: CUMAALİ YEŞİLKAYA

VEHICLE TYPE: **X ELECTROMOBILE** **□ HYDROMOBILE**

CONTENTS

1. Vehicle specifications table *(mandatory)*

In the event that the tables submitted in the application and the technical design report are identical and applied to the vehicle, the team gets 100 points.

University name		
Team name		
Team captain		
Feature	**Unit**	**Value**
Length	mm	3000
Width	mm	1400
Height	mm	1200
Number of wheels	#	4
Chassis	material	Aluminum 5803 HX3
Shell	material	Fiberglass
The brake system	hydraulic disc, front, rear, hand brake	
Diameter of front tyres	mm	452
Width of front tyres	mm	80
Diameter of rear tyres	mm	492
Width of rear tyres	mm	130
Telemetry	yes/no; transmitted information (speed, battery status, temperature, etc.)	Yes;speed,battery status,temperature
Motor	type	BLDC
Motor driver	yes/no; self-designed, ready-made product	Ready-made product
Motor power	kW	4,5
Motor efficiency	%	%95
Engine weight	kg	2*21
Battery	type	Gel battery
Battery nominal voltage	V	72
Maximum voltage of the battery	V	78
Battery nominal voltage	Wh	3000
Fuel cell power	kW	-
Number of hydrogen tubes	#	-
Hydrogen tube pressure	bar	-
Super capacitor	yes/no	-
You must fill in the fields related to your category.		

2. Domestic Sub-Components

In this section, teams are asked to check off the domestic sub-components they are planning to design themselves. Note that, teams are required to design all four mandatory sub-components in their category.

1. Motor	**Mandatory for Electromobile/Hydromobile**	☐
2. Motor driver	**Mandatory for Electromobile/Hydromobile**	☐
3. Battery management system (BMS)	**Mandatory for Electromobile/Hydromobile**	☐
4. Embedded recharging unit	**Mandatory for Electromobile**	☐
5. Energy management system (EMS)*	**Mandatory for Hydromobile**	☐
6. Battery packaging	**Optional**	☐
7. Telemetry	**Optional**	x☐
8. Electronic differential application	**Optional**	x☐
9. Vehicle control unit (VCU)	**Optional**	x☐
10. Fuel cell*	**Optional**	☐
11. Fuel cell control system (circuit)*	**Optional**	☐

** Hydromobile category only*

3. Motor *(if designed by team, details mandatory; if ready-made product, please explain briefly)*

Let's first determine the required motor power.

applied power = reaction force + acceleration and ramp power

$N_{Wheel} = N_{reaction} + N_{ramp} + m_{car} * a_{car}$ Equation 2.1

N_{wheel} : Total wheel power

$N_{reaction}$: Total reaction force

m_{car}: total car weight (70kg * 2 passenger + 200kg car = 340 kg)

a_{car}: Vehicle acceleration

Let's make assumptions to reduce the number of unknowns. Maximum speed is $90_{km/h}$, Acceleration 0 , N_{ramp} 0 .

From equation 2.1

$N_{Wheel} = N_{reaction}$ Equation 2.2

Rection force, rolling reaction (N_{Roll}) and wind reaction (N_{air})

$N_{reaction} = N_{Roll} + N_{air}$ Equation 2.3

$N_{wheel} = N_{Roll} + N_{air}$ Equation 2.4

$N_{Roll} = m_{car} * g_{gravity} * f_{R0} * Vcar$ Equation 2.5

Yolun cinsine göre f_{RO} şöyle değişmektedir.

Yolun cinsi	F_{R0}
Düzgün asfalt, beton	0.015
Küçük taş döşenmiş zemin	0.015
Şose yol	0.02
Çamurlu yolda	0.05
Gevşek toprak, kumda	0.1-0.35

Road reaction = f_{R0} From tablo f_{R0}=0,015.

From equality 2.5;

N_{roll}= 340*9,8*0,015*90kg*m/sn^2*km/hour*1000m/1km*1hour/3600sn.

N_{roll}=1249,5W.

N_{Hava}= 0,0386*p*C_w*A*(V_{air}-V_{car})^3 Equation 2.6

P= Air density = 1293kg/m^3

C_w= Air reaction coefficient(From tablo)

V_{air}= wind speed,

Çeşitli Taşıtlar İçin C_w Değeri

TAŞIT	C_W
Açık Spor	0,5 – 0,7
Pikap	0,5 – 0,6
Binek Otosu	0,4 – 0,55
Binek Otosu: Farlar, Arka Tekerlekler (Yedek Lastik Gövde İçinde İse)	0,3 – 0,4
En Avantajlı Aerodinamik Biçim	0,15 – 0,2
Otobüs	0,6 – 0,7
Kamyon	0,8 – 1,3
Motosiklet	1,8

Chose C_W=0,475.

A= 140cm*120cm

N_{air}=0,0386*1,293kg/m^3*0,475*1,68m^2*(0-90km/h)^3

N_{air}=0,0386*1,293*0,475*1,68*90^3(w)

N_{air} =622,32W

N_{wheel}=N_{roll}+N_{air}=1249,5w+622,32w

N_{wheel}=1871,82

Motor efficiency : %95

N_{motor}=N_{teker}/0,95 Equation 2.7

N_{motor} ≥ 1970,34

This value is the desired nominal power.

For the maximum power of the engine;

-6º slope

-30km/h speed (8,33m/sn)

-36km/h wind speed (10m/sn)

Data is used.

Use Equation 2.1

$N_{Wheel} = N_{reaction} + N_{ramp} + m_{car}*a_{car}$

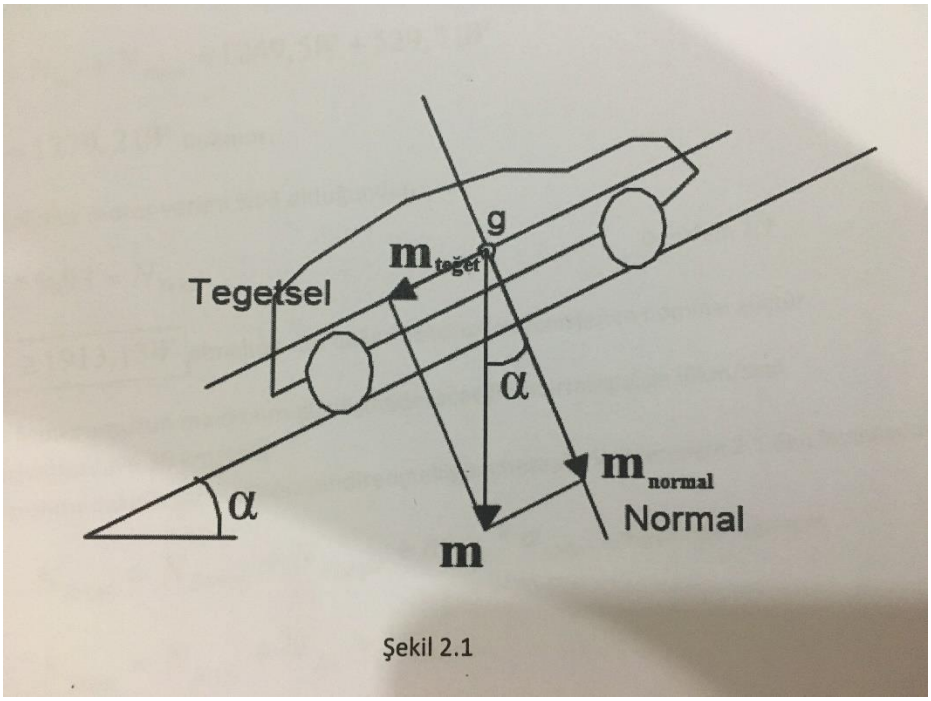
$N_{Wheel} = N_{air} + N_{roll} + N_{ramp}$

$N_{air}=0,0386*p*C_w*A*(v_{air}-v_{car})^3$ Equation 2.6

N_{air}=0,0386*1,293kg/m^3*0,475*1,68m^2(-10m/sn-8,33m/sn)^3
N_{air}= 245,29W

$N_{Roll} = m_{car} * g_{gravity} * f_{R0} * Vcar$ Equation 2.5

N_{Roll}=340kg*9,81m/sn*0,015*8,33km/sn
N_{Roll}= 416,33W



Şekil 2.1

N_{ramp}=m*g*sinα*V_{car} Equation 2.8

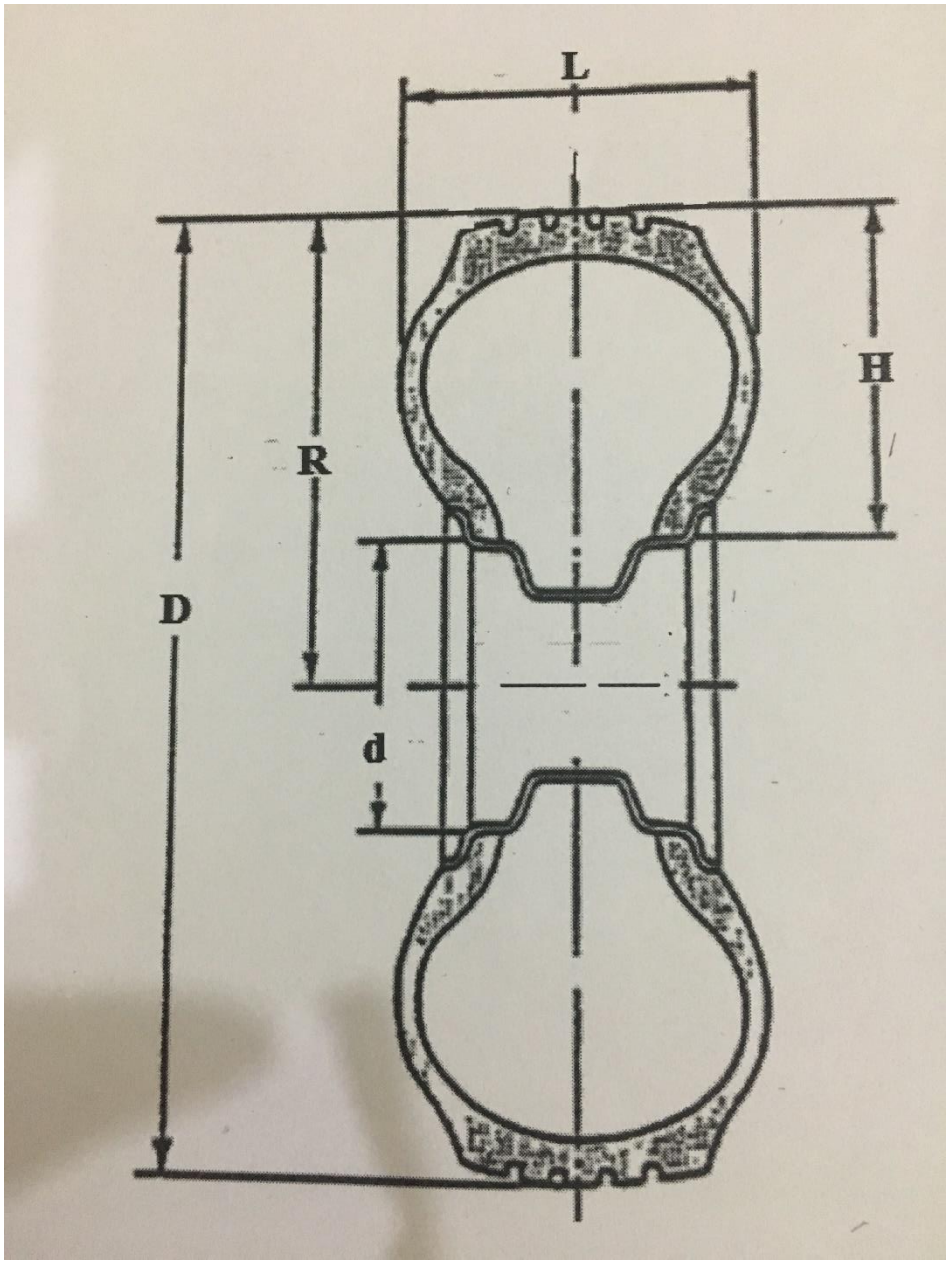
N_{ramp}=340kg*9,81m/s^2*sin6*8,33m/s
N_{ramp}=2901,24W
N_{wheel}= 245,29W+416,33W+2901,24W
N_{wheel}=3562,86W
N_{motor}=N_{teker}/0,93
N_{motor}≥3791,78W maximum motor power.

Motor 17" and 21” wheel can be mounted.
Our engines use 17”rim and 2,75tire

Outer diameter of the wheel
D=d+2H Equation 2.8

d = 17 "and H = L = 2.75";

D = 22,5 = 571.5 mm.



Maximum speed if the engine has a maximum speed nmax of 678 rpm;

Vmax=π*D*nmax

Vmax=3,14*0,5715m*678d/dk and

Vmax=1216,68m/min=73km/h

For this reason, we changed the wheel diameter to 18 "and the tire dimensions to 100 / 90-18" to increase the maximum speed for our vehicle.

So;

d1=18" and H1=L*0,9=90mm;

D=637,2mm

V1max= 3,14*0,6372m*678d/min and

V1max=1356,55m/min→ V1max=81,39km/h

2 units of 4500W power with the engine, a total of 9000W power will be obtained. Since the motors will supply nominal power of 1500W, nominal 3000W power will be used. When the characteristics of the gulf runway were examined, it was assumed that 60% of the runway would run out of nominal power.

4. Motor driver *(if designed by team, details mandatory; if ready-made product, please explain briefly)*

Motor drives use 1500 W nominal power, 2000 W maximum power. 2 units total driving power of 4000W maximum power draws with a total of 55.55 amperes working with 72 v current draws. This will free you from the risk of penalized scoring on the instant 100 amp current.

5. Battery management system (BMS) *(if designed by team, details mandatory; if ready-made product, please explain briefly)*

Lithium-based batteries are not used, so we do not use the BYS system.

6. Embedded recharging unit (*if designed by team, details mandatory; if ready-made product, please explain briefly)*

*All the Electromobile teams are required to prepare their embedded recharging unit themselves. Teams that make this product domestically will get a maximum of **200 points** depending on the design.*

During technical inspections, testing of the embedded recharging unit will be done by measuring the current and voltage values at output terminals.

If designed by the team, detailed information should be given on the following topics:

a. Circuit design

b. Simulation studies

c. Printed circuit studies

d. Production studies

7. Energy management system (EMS) *(if designed by team, details mandatory; if ready-made product, please explain briefly)*

*All the Hydromobile teams are required to prepare their EMS themselves. Teams that produce this product domestically will get a maximum of **300 points** depending on the design.*

A software and/or hardware that optimises power flow between the energy sources and the load can be regarded as an EMS.

Teams that develop a domestic EMS will be responsible for the following items during technical inspections:

1- *Demonstrating the EMS product physically,*
2- *Providing general information about the EMS design and operating principles,*
3- *Measuring and showing the current and voltage values at which the DC-DC converters operate.*

If designed by the team, detailed information should be given on the following topics.

a. Control algorithm

b. Simulation studies

c. Application studies

8. Battery Packaging *(if designed by team, details mandatory; if ready-made product, please explain briefly)*

Teams that produce this product domestically will get a maximum of **150 points** depending on the design.

9. Telemetry *(if designed by team, details mandatory; if ready-made product, please explain briefly)*

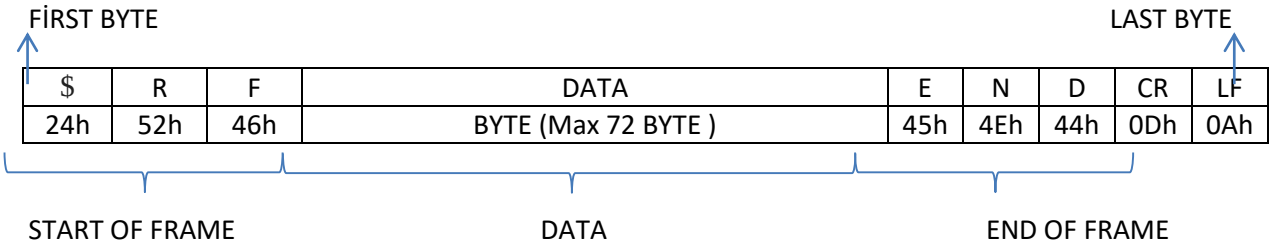
1. 2. COMMUNİCATİON PROTOCOLS

Communication type: asenkrom (uart)
Communication speed: 2.4 kbps
Link: rs 232 - ttl (0-5 vdc)

6.2.2 DATA FORMAT

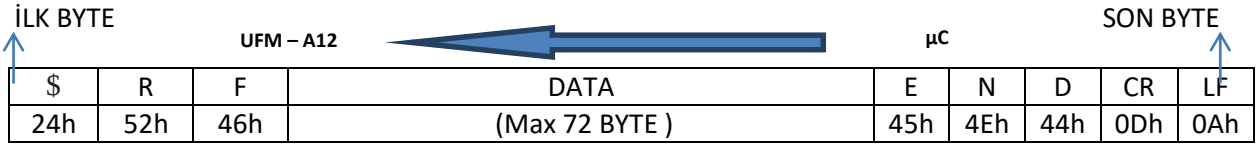
8 data bits, noparity, 1 stop bit (8N1)
Cts and rts are not used.

6.2.3. GENERAL DATA FORMAT



6.2.3.1. DATA İNPUT UFM – A12

The data should be displayed as shown in figure 4. First, start of frame (3 bytes), then data (max 72 bytes) and end of frame (5 bytes). It sends the module to the rf layer by making the necessary attachments (preample, synchronization header) for transmission with the MAC layer data rf.



Şekil 4. Input Frame Structure

6.2.3.2. DATA OUTPUT UFM – A12

Rf is given to the module output as shown in figure 5 te. First, start of frame (3 bytes), then data (max 72 bytes) and end of frame (5 bytes). The mac layer of the module extracts the preamble (synchronization header) necessary for the data to be transmitted by rf and outputs it to the module output.

$	R	F	DATA	E	N	D	CR	LF
24h	52h	46h	(Max 72 BYTE)	45h	4Eh	44h	0Dh	0Ah

Şekil 5. Output Frame Structure

6.2.4. MAC COMMAND FRAME

COMMAND	FUNCTİON	ANSWER
$C1 - $C2	Frequency Change	
$CV	Version No?	Version x.x.x
$CR	Rsssı Level ?	$Cx
$CQ	Tx Transmit 30 Sn	-
$CU	Stop	$CA

$	C	DATA
24 h	**43 h**	**COMMAND**

START OF FRAME **DATA**

Şekil 6. Command Frame Structure

6.2.4.1 START UP

When UFM - A12 is powered on, it sends "$CB" information from its output.

$	C	B
24h	**43h**	**42h**

Şekil 7. Startup Frame Structure

6.2.4.2 SELECTİNG RF CHANNEL

UFM - A12 can work in two different channels in the band it is produced. The user can choose one of these channels depending on his / her needs and desires. The channel information is stored in the memory of the module, even if power is lost, the last defined value is used. The user can change the module channel as described in FIG.

Channel 1: 869.4336 MHz

Channel 2: 836.6064 MHz

UFM – A12  µC

$	C	Channel number (1 -2)
24h	**43h**	**31h//32h**

Şekil 8. Rf Channel Switching

UFM – A12  µC

$	C	O	K
24h	**43h**	**4Fh**	**4Bh**

Şekil 9. Channel Change Approval Informatıon

6.2.4.3. VERSİON NUMBER CONTROL

It is a numbering system used for tracking the hardware and software changes of the module. You can learn the version number of the module you are using with the command.

UFM – A12  µC

$	C	V
24h	**43h**	**56h**

Şekil 10. Versıon Number Questıon

UFM – A12  µC

v	e	r	s	i	o	n		x	.	x	.	x
76h	**65h**	**72h**	**73h**	**69h**	**6Fh**	**6Eh**	**20h**		**2Eh**		**2Eh**	

Şekil 11. Versıon Number İnformation

6.2.4.4. RSSI MEASUREMENT

Ufm - a12 has the ability to digitally measure the amount of rf intensity in the channel in which it is working. When the modulous rssI measurement command is sent, it makes the measurement and reports

the result as the decimal value. The relationship between Rf intensity and decimal value is given in the table.

UFM – A12 ← µC

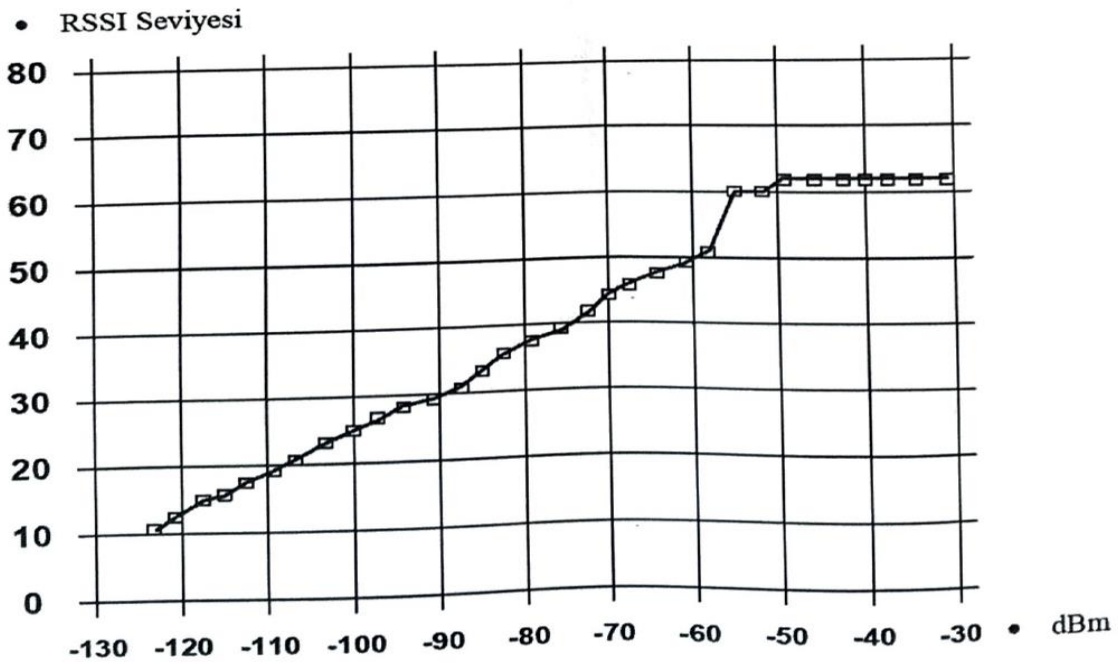
$	C	R
24h	**43h**	**52h**

Şekil 12. Rssı Measurement

UFM – A12 → µC

$	C	RSSI LEVEL (10 – 67)
24h	**43h**	**0 Ah // 43h**

Şekil 13. Rssı Measurement



2.4.5. $ CQ TX TRANSMIT

This command can be used to measure the communication quality between 2 RF modules. When commanded, the module sends a preamble signal in tx position for 10 seconds. When one of the modules is received in this mode, the information related to the quality of the communication can be obtained by measuring the rssI with the other module. It is enough to remove the module from this mode before the expiration of time, ie send "$ CU" command to stop tx. When the module is full or stopped by command, it sends "$ CA" information.

UFM – A12 ← µC

$	C	Q
24h	**43h**	**51h**

Şekil 14. TX Transmit Mod

UFM – A12 → µC

$	C	Q
24h	**43h**	**51h**

Şekil 15. TX Transmit Mod Stop

2.4.6. ERROR CODE

2.4.6.1. OVERFLOW

If the user enters more than 72 bytes of data in the module, the modular overflow error message is output at the output as shown in Figure 16

UFM – A12 → µC

$	C	Q
24h	**43h**	**4Fh**

Şekil 16. Overflow Frame Structure

2.4.6.2. TİME OUT

If the user leaves a long delay of 500 ms between 2 data during the module data entry, the module outputs the timeout message as shown in figure 17.

UFM – A12  µC

$	C	T
24h	**43h**	**54h**

Şekil 17. Time Out Structure

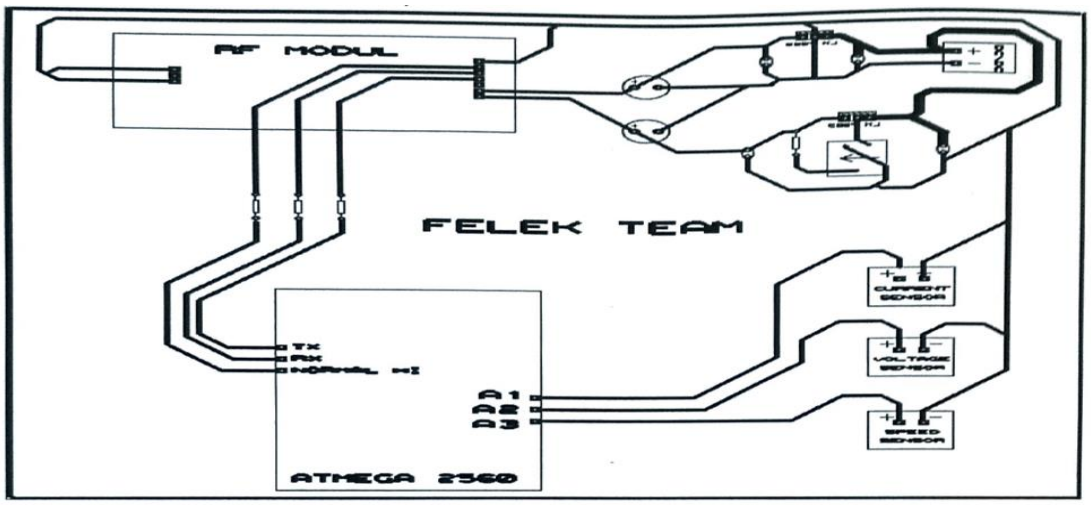
3. error

Kullanıcı data girişini madde 3.1'de anlatıldığı şekli ile vermez ise modül error mesajını şekil 18'de gösterildiği şekilde çıkışından verir.

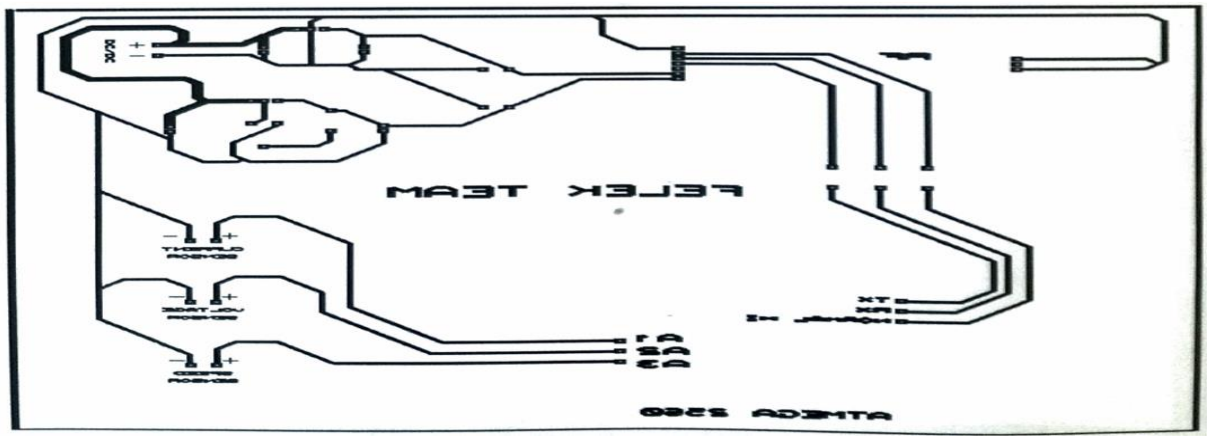
6.3 baskı devre çalışmaları

Proteus programında çizilen devre şemalarına ares programında baskı devre için son hali verildi.

Baskı devre kartımızın ön yüzü:



Baskı devre kartımızın arka yüzü:



Araç ilerleyerek arasındaki bilgi alışverişi ufm-a12 wpa rf modülleri sayesinde sağlandı . arduino mega kit sayesinde akım, gerilim, hız sensörlerin dengelenen analog bilgi digital bilgiye dönüştürülerek rf modüllere iletildi.

Yazılımsal kısım tamamen elektronik takımımız tarafından yazılarak devre tasarımları yapıldı. Tasarım süreci biten devrelerimiz baskı devre tekniği ile tamamen ekibimiz tarfından imal edildi. Baskı devre aşamları eletronik diferansiyel uygulamamızda oldugibi aşağıdaki işlemler sırası ile takip edilerek yapıldı. Diferansiyel sistemimizin simülasyonu proteus programında yapıldı. Ardından baskı devre yapğımına geçıldi.

Proteus programından ares programına geçiş yapılarak baskı devre yolları çizildi.

Lazer yazıcıdan kuşe kağıdına baskı alındı.

Bakır pertinaksın yüzeyi sıfır zımpara ile su altında zımparalandı.

Ardından aseton ile silinerek yüzey temizlendi.

Çıktı alınan kağıt ile pertinaks üst üste konularak ütü ile baskı yöntemi uygulandı.

Tonerin tamamı pertinaksa geçtiği emin olunduğunda kağıt su altında pertinakstan çıkartıldı.

Yüzeyde herhangi bir kağıt kalmaması için su altında temizlendi.

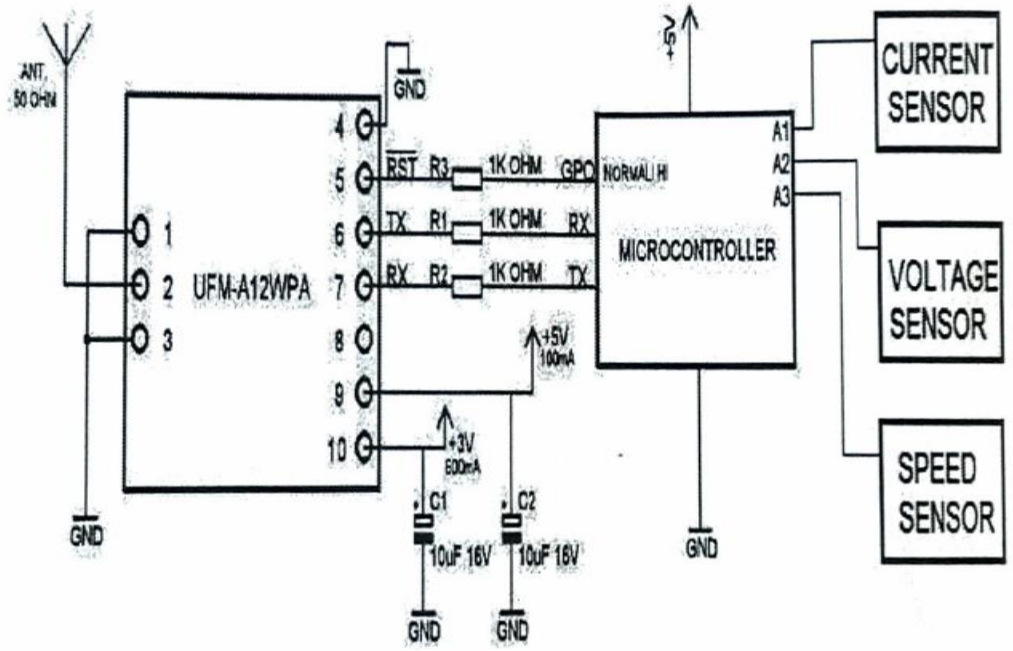
Tuz ruhu (hcl) perhidrol karışımı %5 olarak hazırlandı ve pertinaks içerisine atılarak tonersiz bakır kısımlar eritildi.

Devre elemanlarının takılacağı delikler delinerek baskı devre işlemi tamamlandı.

Devre elemanları lehimlenerek devre bitirildi.

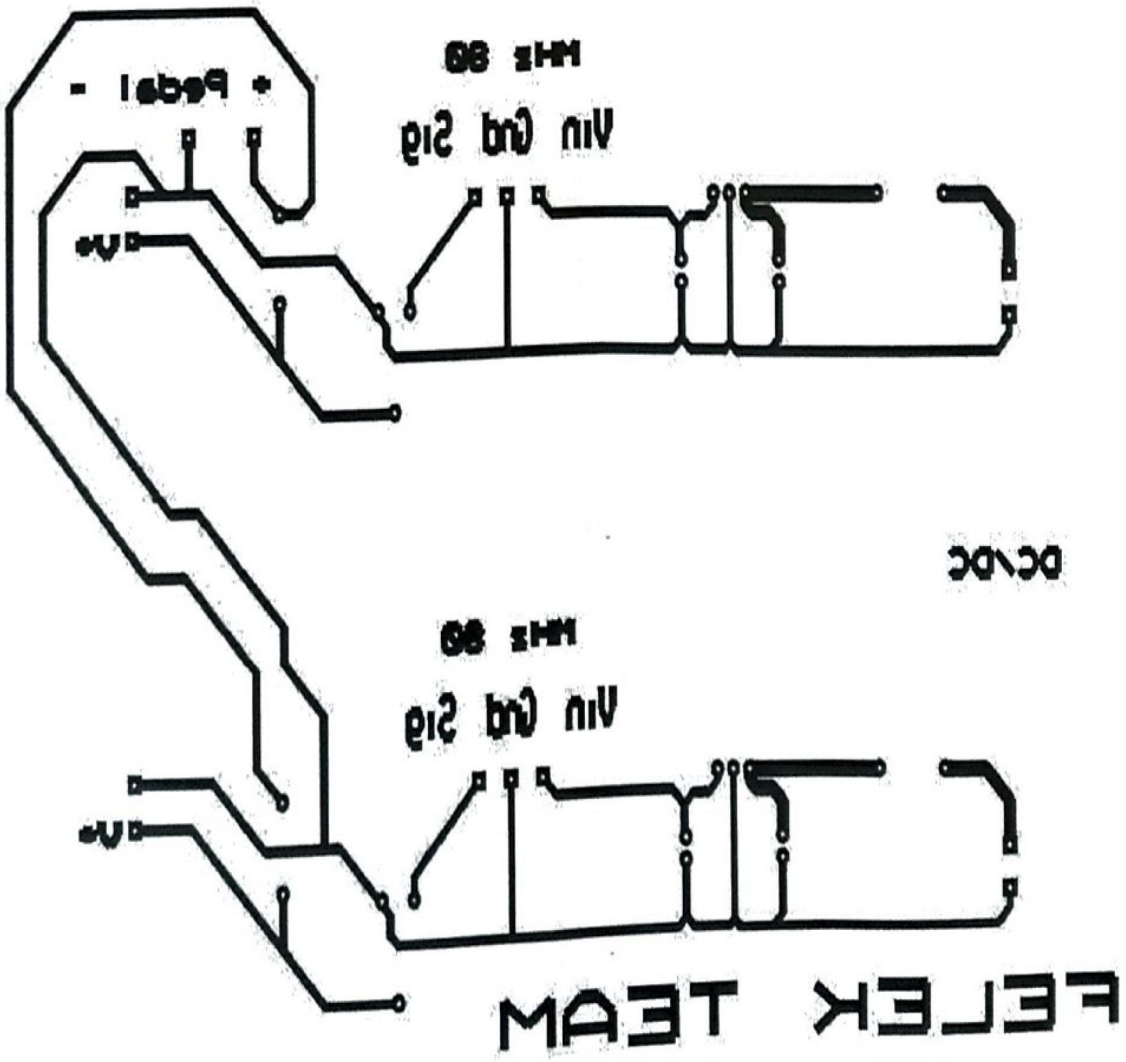
CİRCUİT DESİGN

In the telemetry period we used arduino mega as microcontroller to send rf modul information. Analogue information coming from current, voltage, speed sensors was converted into digital information in arduin and serial communication was provided. In the receiver rf module of the site team, the information read using the arduino was also displayed with the computer interface.



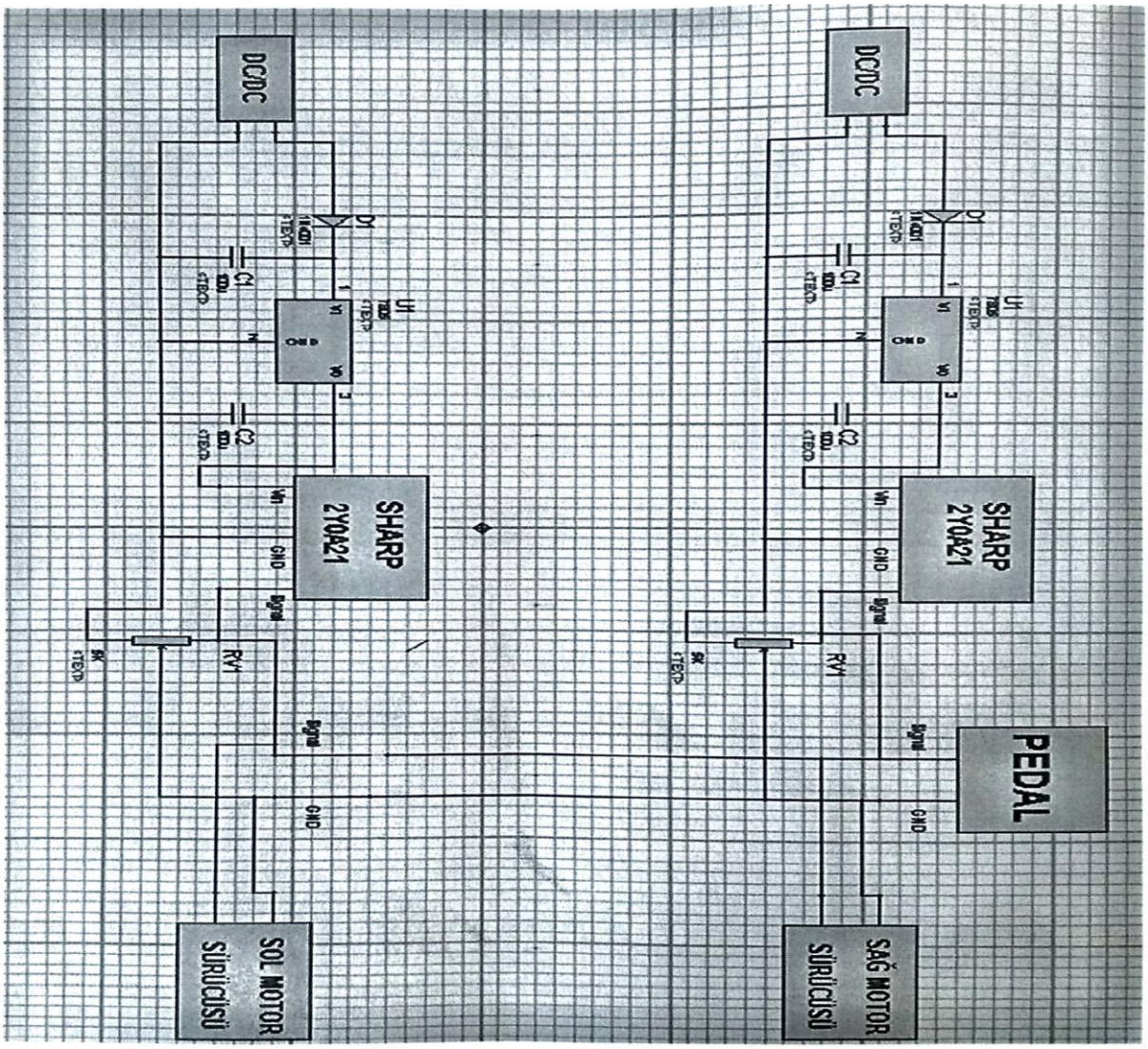
a.

11. Electronic differential application *(if designed by team, details mandatory; if ready-made product, please explain briefly)*

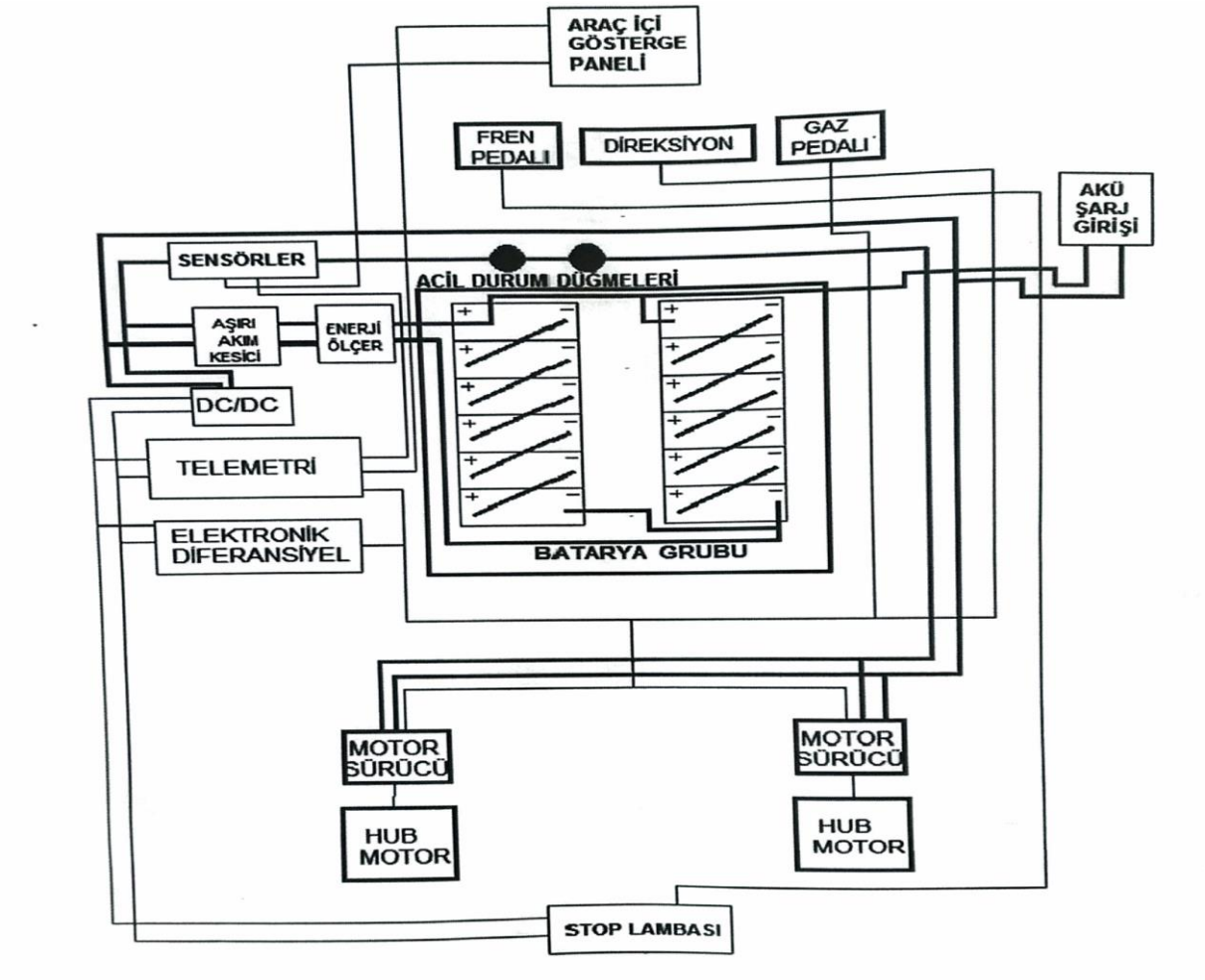


(BASKI DEVRE ŞEMAMIZ)

2 BASKI DEVRE



ARAÇ ELEKTRİK ŞEMASI



Diferansiyel, motorlu taşıtlarda, devindirici (döndürücü) motor kuvvetini devindirici tekerleklere aktarılmasında kullanılan dişli düzenektir. Motor kuvvetini her iki tekerleğe eşit olarak dağıtmakla birlikte, örneğin taşıt bir virajı dönerken, tekerleklerin değişik uzunluklarda yol almasını da olanaklı kılar. Düz bir yolda tekerlekler aynı hızda döner ama taşıt viraja girdiğinde, virajın dış yanında kalan tekerleğin kat etmesi gereken uzunluk daha fazladır ve eğer frenlemezse, içi yandaki tekerlekten daha hızlı döner.

Klasik otomobil diferansiyeli, 1827 de Fransız mucit Onésiphore Pecquer tarafından geliştirildi. Önceleri, buharla çalışan taşıtlara uygulanan donanım 19.yy ın sonlarında içten yanmalı motorların kullanıma girmesi ile birlikte, hızla yaygınlaştı.

Tahrik gücü elektrikle sağlanan araçlarda çift motor kullanılması halinde elektronik diferansiyel kullanılması hem emniyet açısından hem de verimlilik açısından zorunluluktur. Biz de elektromobil aracımızın iki adet fırçasız teker içi hub motor kullandık. Arkadan motorlarla itmesi sağlanan aracımızın virajlarda elektronik diferansiyel sistemi ile iki motor arasındaki senkronizasyon sağlandı.

Basit olarak sistem anlatılmaya çalışılırsa direksiyondan alınan konum bilgisi, gaz pedalından gelen bilgi ile işlenerek motor sürücüsüne iletildi. Bu sayede viraj esnasında bir motor yavaşlatılarak güvenli bir şekilde virajdan çıkılması sağlandı.
Sistemimizde direksiyonun konum bilgisi SHARP 2A0A21 kızılötesi mesafe sensörü kullanılarak elde edildi. Kullandığımız kızılötesi sensör 3 ile 80 cm arası ölçüm yapılabilme özelliğine sahip olup besleme gerilimi olarak dc 5v araç içi dc-dc dönüştürücümüzün çıkışı olan dc 12v dan regüle ederek sağlandı. Motorların hızlanması gaz pedalından motor sürücüsüne giden 0-5 v bilgisi ile sağlanmaktadır. Senkron çalışan motorlardan birinin hızının düşürülmesi için sensör çıkışındaki gerilim değeri gerilim bölücü devre ile gerekli seviyeye indirilerek, pedal çıkışına ters biaslandı (gnd uçlar birleştirilerek çıkışları pozitif uçlardan alma). Böylelikle viraja giren aracımızın motorlarına farklı hızlanma bilgisi gönderildi.

12. Vehicle Control Unit (VCU) *(if designed by team, details mandatory; if ready-made product, please explain briefly)*

Teams that produce this component domestically will get a maximum of **300 points** depending on the design.

Teams can get points according to functions in VCU. As described in rules, following items are the main functions that teams can develop for their VCU. Achieving one function will be sufficient to be encountered as domestic part. Teams get more point if they have more properly working functions.

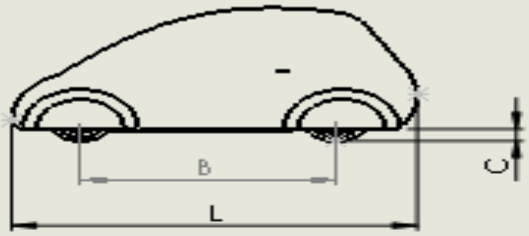
1. Motor Torque Control
2. Regenerative braking optimization
3. Vehicle energy management system
4. Management of vehicle communication system
5. Diagnostic
6. Monitor vehicle condition and warn the user etc.

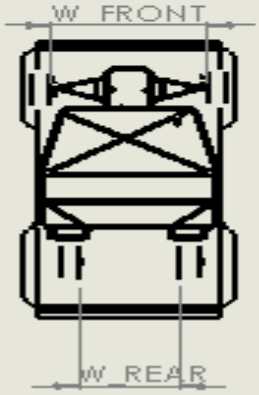
13. Mechanical details *(mandatory)*

*Teams that provide sufficient information will get a maximum of **150 points** depending on the design.*

As in the example above, technical drawings of the finished vehicle from the side, front, and back are required (you can review this in detail by double-clicking on the figure above). A technical drawing of the lower parts is not required. Measurements must be given in a table, as in the figure above.

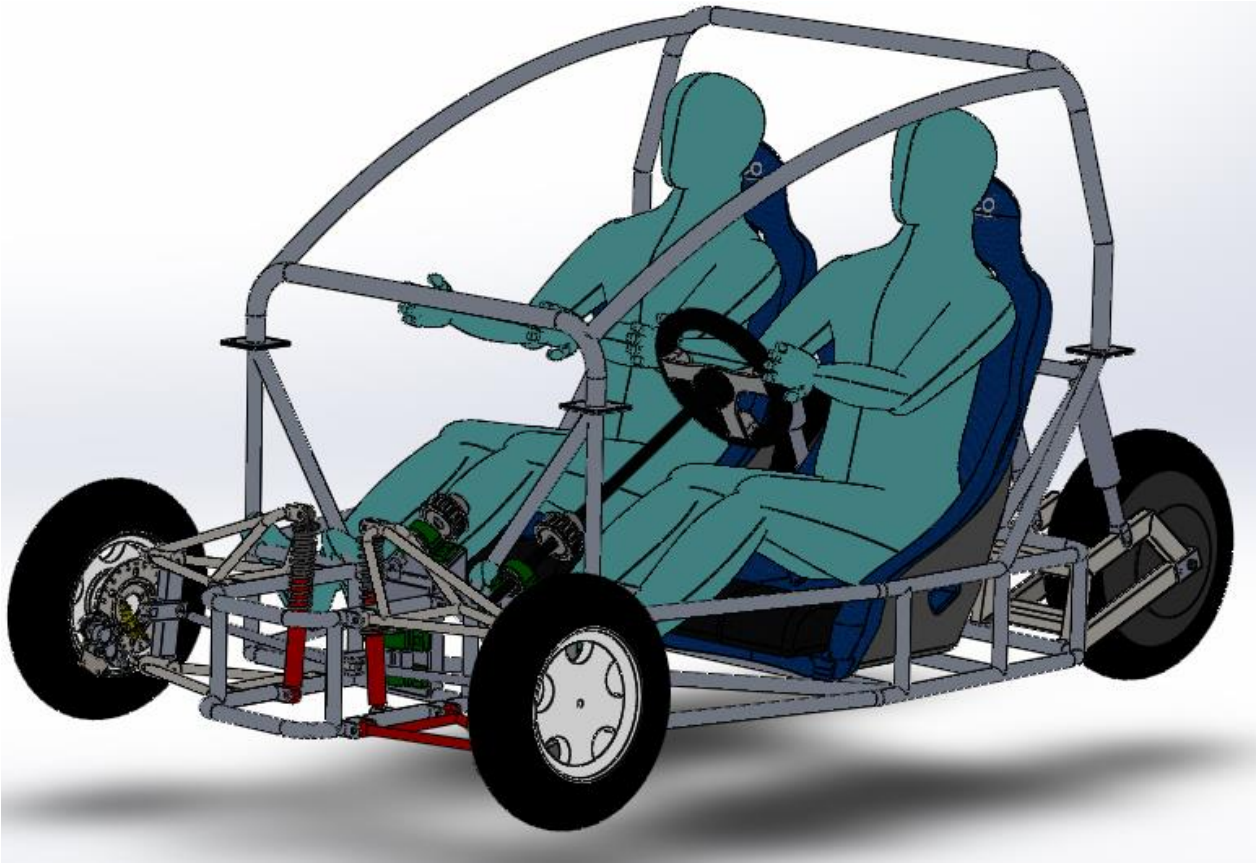
a. Technical drawings





	Minimum (cm)	Value (cm)	maximum (cm)
A	120	145	180
B	130	180	-
C	10	12	-
L	100	280	-
H	200	135	425
W_rear	100	70	-
W_Front	80	110	-

Subsequently, alternate designs for the chassis were produced, selecting for original, light, functional and feasibility.



It was intended to produce the vehicle as light as possible. For this purpose, 1 "and 1 1/4" drawing pipes, which are easy to handle and easy to operate as the standard for chassis, were preferred. It was decided to use an argon source for all fixed joints on the main frame.

Different chassis designs were made in order to reduce the weight of the chassis considering the weight of 100 kg for the motors to be used in vehicles.

b. Strength analysis

Strength analyzes were carried out for the fasteners and critical parts used on the vehicle.

For strength analysis, below described item and illustrated above must be calculated manually or by a computer program (you can review this in detail by double-clicking on the figure above). Other calculations prepared by the teams that do not provide this information as expected will not be considered.

- When a point load of 1 kN is applied between the upper point of the roll cage and the lowest point, the displacement in the horizontal direction must be calculated. It should not exceed H/200. Calculations must be made for both the front and rear roll cages (H: the height difference between the lower and upper point).

c. Outer shell production

It must be explained briefly with illustrations how the product was produced. If it was produced by an external company, the cost and method of production must be explained.

Outer shell design was done Hüseyin Özkaya using solidworks 2016 with informatics workshop computers in mechanical engineering department of engineering faculty of Fırat University

Shell designing according to the rules of priority, low wind resistance and to create an ergonomic design. In addition, the intricate finisher frame is completed by considering the ease of manufacturing and the overlap with the chassis design

We decided to process the CNC milling block by forming a block with the XPS insulation material on the material that can be processed in the province and within the province for the material needed for the polyester shell in production.

The outer dimension of the CNC machine tool is not large enough in Elazığ XPS block to be greater than we combined two-dimensional cncxps made rough cut of the working machine with three different surface contour lines are created. Then all the necessary radius and fine lines were made by students in the school laboratory allocated in by hand.

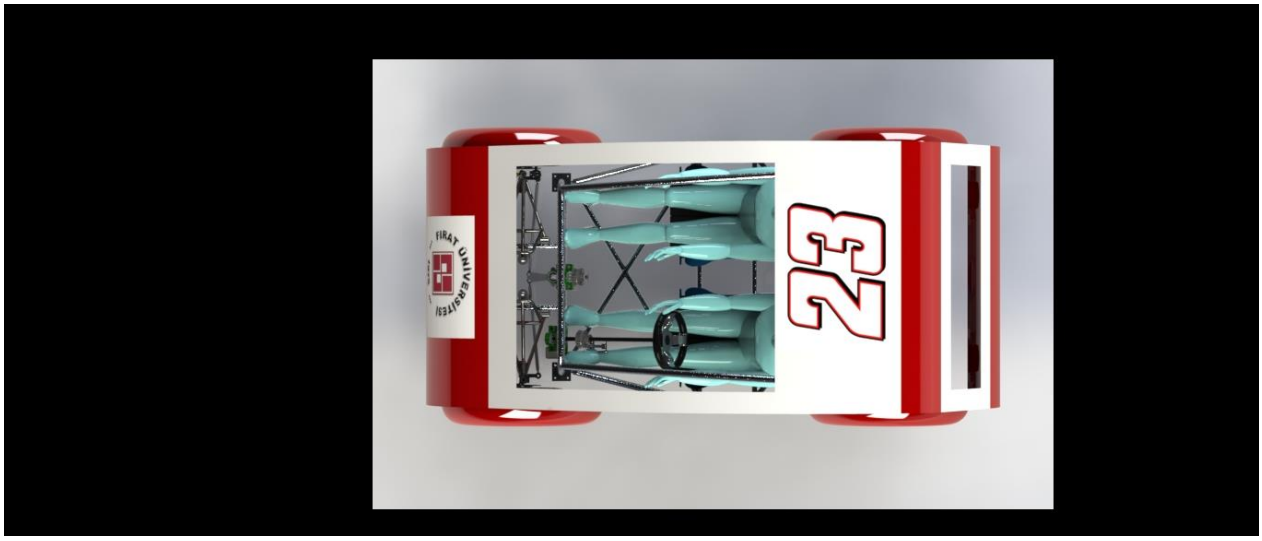
kalekim was coated on to prevent the deformation of polyester not reacts with the XPS our model.Then the polyester was poured into the mold

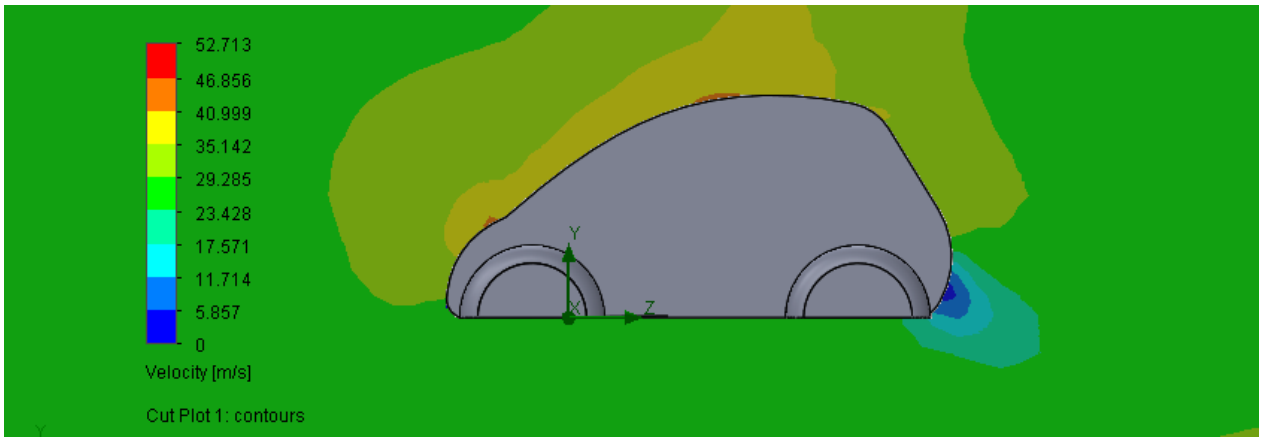
(Kalıp içerisine öncelikle wax işlemi uygulandı bu kalıbın kolay çıkmasını sağladı. bu işlemden sonra fiber kalıba serildi ve üzerine epoksi karışımı uygulandı. Dış kabuk üretimi yapıldı. Dış kabuğun cam ve kapı yuvaları açıldıktan sonra yüzeyler boya için hazırlandı.)

Easy to mold into the mold was primarily bring out the wax was applied. After which a fiber die was laid and an epoxy mixture was applied. Outer shell made production. The window and door outer shell slots prepared for paint surface after deployment.

After the painting process, promotional and sponsor logos are laid on the body

It is expected to briefly inform the external shell about the program, the method of production and the place of production.





d. Energy consumption and maximum inclination account

- Taking into account the front area, wheel friction, and internal losses of vehicles, the teams must calculate the energy consumption necessary to complete a 2000-m flat track at 60 km/h.

e. Cost calculation

A bill of materials and the cost of the vehicle must be presented in detail in a table.

14. Fuel cell *(if designed by team, details mandatory; if ready-made product, please explain briefly)*

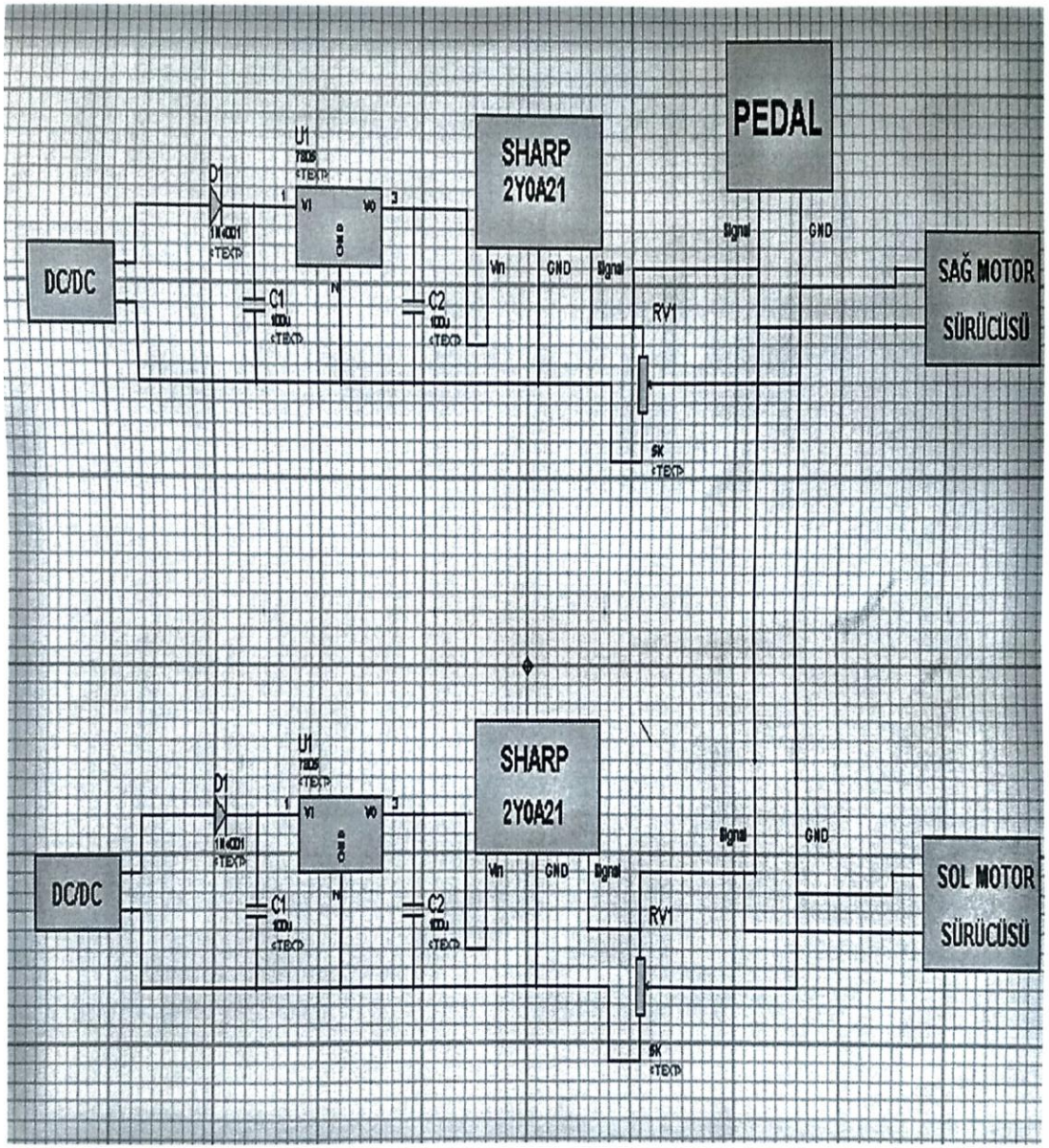
*Teams that produce this product domestically for Hydromobile vehicles will get a maximum of **500 points** depending on the design.*

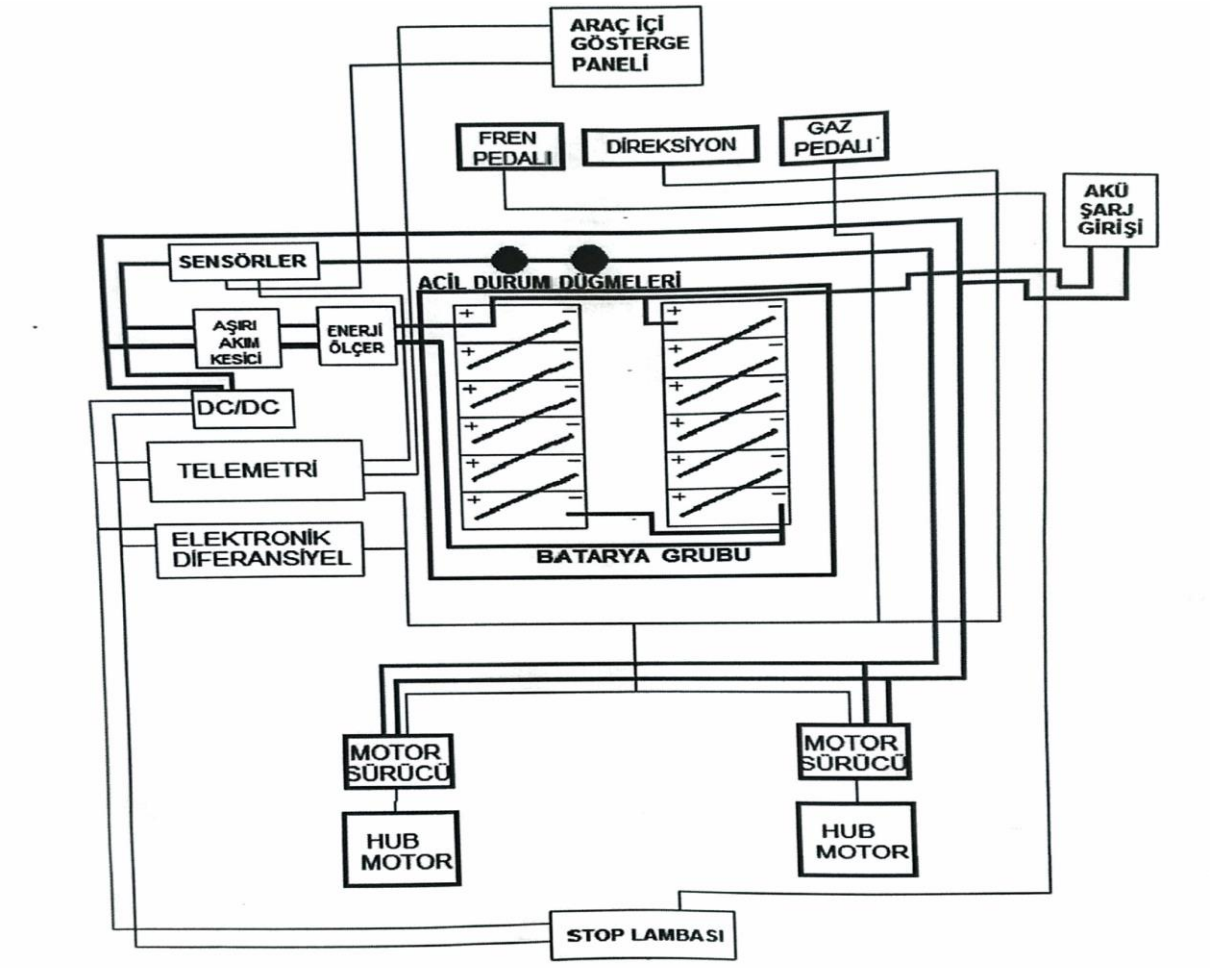
Electrical and other properties of the fuel cell must be given in detail with values.

15. Fuel cell control system *(if designed by team, details mandatory; if ready-made product, please explain briefly)*

*Teams that produce this product domestically for Hydromobile vehicles will get a maximum of **300 points** depending on the design.*

16. Vehicle electric scheme *(mandatory)*


PEDAL
SHARP
2Y0A21
U1
D1
DC/DC
C1
C2
RV1
5K
Vin
GND
Signal
SAĞ MOTOR
SÜRÜCÜSÜ
SHARP
2Y0A21
SOL MOTOR
SÜRÜCÜSÜ


ARAÇ İÇİ GÖSTERGE PANELİ
FREN PEDALI
DİREKSİYON
GAZ PEDALI
AKÜ ŞARJ GİRİŞİ
SENSÖRLER
ACİL DURUM DÜĞMELERİ
AŞIRI AKIM KESİCİ
ENERJİ ÖLÇER
DC/DC
TELEMETRİ
ELEKTRONİK DİFERANSİYEL
BATARYA GRUBU
MOTOR SÜRÜCÜ
MOTOR SÜRÜCÜ
HUB MOTOR
HUB MOTOR
STOP LAMBASI

17. Unique design by team *(optional)*

			Scoring			
			Electromobile		Hydromobile	
			Domestic	Ready-made	Domestic	Ready-made
1	**Vehicle specifications table**	Mandatory	100	-	100	-
2	**Motor**	If designed by team, details mandatory; if ready-made product, please explain briefly	400	-	400	-
3	**Motor driver**	If designed by team, details mandatory; if ready-made product, please explain briefly	300	-	300	-
4	**Battery management system**	If designed by team, details mandatory; if ready-made product, please explain briefly	200	50	200	50
5	**Embedded recharging unit**	If designed by team, details mandatory; if ready-made product, please explain briefly	200	50	200	50
6	**Energy management system**	If designed by team, details mandatory; if ready-made product, please explain briefly	-	-	300	50
7	**Battery packaging**	If designed by team, details mandatory; if ready-made product, please explain briefly	150	-	150	-
8	**Telemetry**	If designed by team, details mandatory; if ready-made product, please explain briefly	150	50	150	50
9	**Vehicle control unit**	If designed by team, details mandatory; if ready-made product, please explain briefly	300	-	300	-
10	**Electronic differential application**	If designed by team, details mandatory; if ready-made product, please explain briefly	150	50	150	50
11	**Mechanical details**	Mandatory	150	150	150	150
12	**Fuel cell**	If designed by team, details mandatory; if ready-made product, please explain briefly	-	-	500	-
13	**Fuel cell control system**	If designed by team, details mandatory; if ready-made product, please explain briefly	-	-	300	-
14	**Electric scheme**	Mandatory	50	-	50	-
15	**Original design**	Not mandatory; fill in if applicable	200	-	200	-
		TOTAL	**2350**		**3450**	

Table 1: Table of summary score