MGTF EV CONVERSION PROJECT

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CONTENTS OF PRESENTATION

- PROJECT AIMS
- SOURCES OF INFORMATION
- CAR SELECTION
- DESIGN DECISIONS
- CONSTRUCTION INCLUDING VICROADS CERTIFICATION
- PERFORMANCE TESTING
- MONITORING SYSTEMS
- BUDGET
- CONCLUSION

QUESTION TIME???

PROJECT AIMS

- SMALL, SPORTY, CITY BASED CAR REQUIRED
- ONLY 2 PASSENGER CAPACITY
- LOW RUNNING COSTS
- OPEN TOP, SPORTY HANDLING
- GREEN CREDENTIALS
- CHARGE FROM 10 AMP GPO POWERPOINT
- BUDGET OF ABOUT $25K

SOURCES OF INFORMATION

- Australian Electric Vehicle Association – Victorian Chapter. Monthly meetings at Glen Waverley.
- EValbum.com – selection of 5500 cars worldwide
- EVWorks – equipment supplier in WA
- ZEVA – equipment developer in WA
- CARTECH – Vicroads VASS engineer in Hawthorn

CAR SELECTION

- SMALL, LIGHT WEIGHT, LESS THAN 1100 KGS
- REASONABLE BODY CONDITION & COLOUR
- 2 DOOR OPEN TOP SO THAT BATTERY RACKS CAN BE IN THE FRONT, BEHIND SEAT AREA AND THE BOOT
- MANUAL TRANSMISSION, REAR WHEEL DRIVE, MID ENGINE
- NO NETWORKED ELECTRONIC MODULES
- WORKSHOP MANUAL AVAILABLE
- CAR ROADWORTHY & REGISTRATED

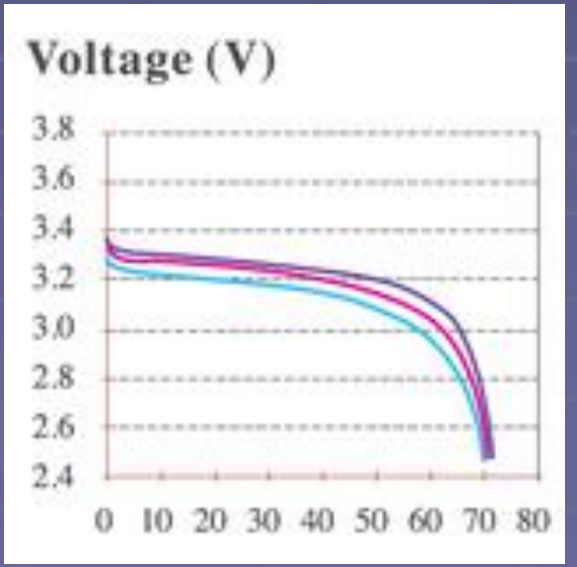
- MOST IMPORTANT: MUST LIKE CAR TO DRIVE

TYPICAL CARS AVAILABLE ABOUT MODEL YEAR 2000 OR EARLIER

- ALFA ROMEO – Spider Twin
- BMW – Z3 , M3
- DAIHATSU – Copen, Rocky
- FORD – Kia, Fiesta, Escort, Capri
- HONDA – Civic , Jazz
- HOLDEN – Barina, Tigra
- HYUNDAI – Getz, Excel
- KIA – Rio
- MAZDA - 121, 323, 2, MX-5
- MG – MGA, MGB, MGF/TF, Sprint, TR2/3/4, Triumph GT6, etc
- MITSUBISHI – Mirage , Colt
- NISSAN – Pulsar, Micra
- PEUGEOT – 206, 306
- SUBARU – Brumby, Impreza
- SUZUKI – Jimny 4WD, Swift
- TOYOTA – Echo, Starlet, Corolla, MR2
- VOLKSWAGON – Beetle , Polo

DESIGN DECISIONS 1 of 3

- BATTERY TYPE & SIZE
  - Go for LiFePO4 batteries as half the weight & size as PbO. The new generation has a thin aluminium case with plastic wrap cover & about 15% lighter.
  - Need at least 3000 cycles to 80% discharge (about 15 years)
  - Cell sizes are typically 72, 100 , 160 & 200 amphour capacity
  - Choose 200 amphr for weight/size benefit with 90 off cells weigh about 171 Kgs. The configuration is two in parallel , then 45 pairs in series (2PS45). Range is calculated to be about 220 kms based on 30KwHr battery capacity



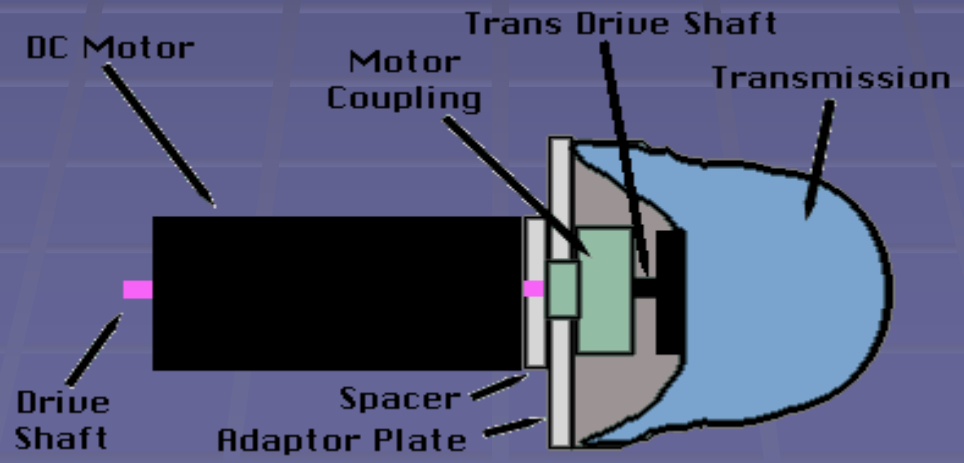
DESIGN DECISIONS 2 of 3

- TYPES OF DRIVE (DC or AC)
  - DC motor is
    - Rugged, DC series wound type
    - Has brushes which need replacing every 100,000 kms
    - Cheapest
    - High torque at 0 rpm, but only revs to about 5000 rpm
    - Simple controller
    - High temperature rating, “H” insulation good to 180 DegC

  - AC motor is
    - Internal Permanent Magnet brushless type or “Induction” type
    - No brushes, no maintenance
    - Not much dearer than DC motor (about 15%)
    - Need speed encoder & maybe external cooling fan / coolant
    - Regenerative braking to extend range by 10 to 15%
    - More complex controller
    - Higher rpm limit (up to 8000 rpm)

DESIGN DECISIONS 3 of 3

- TRANSMISSION SETUP
  - Remove clutch function, saves flywheel weight & simpler adaptor & coupling arrangement
  - “Automatic” type operation. Use third gear only for zero to 150 kph operation. Use reverse gear to simplify electrical components.
  - Difficult to change gears on move due to Neutral Braking. Don’t use in normal operation
  - The neutral braking mode is set to 25% of full load torque on release of accelerator and application of the brake stop lights increases this level to 45%.

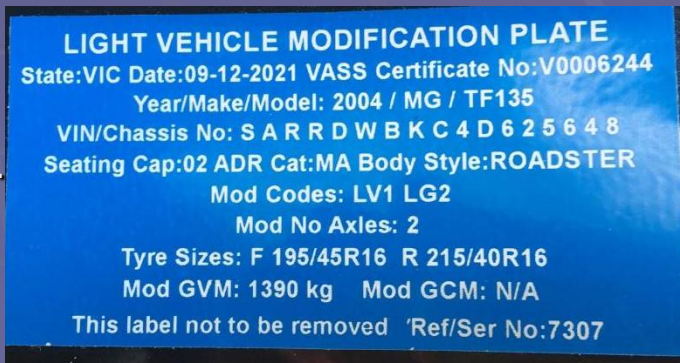


Use existing clutch plate mounted onto coupling as the shock springs give some compliance to the alignment for the transmission input shaft

CONSTRUCTION STANDARDS

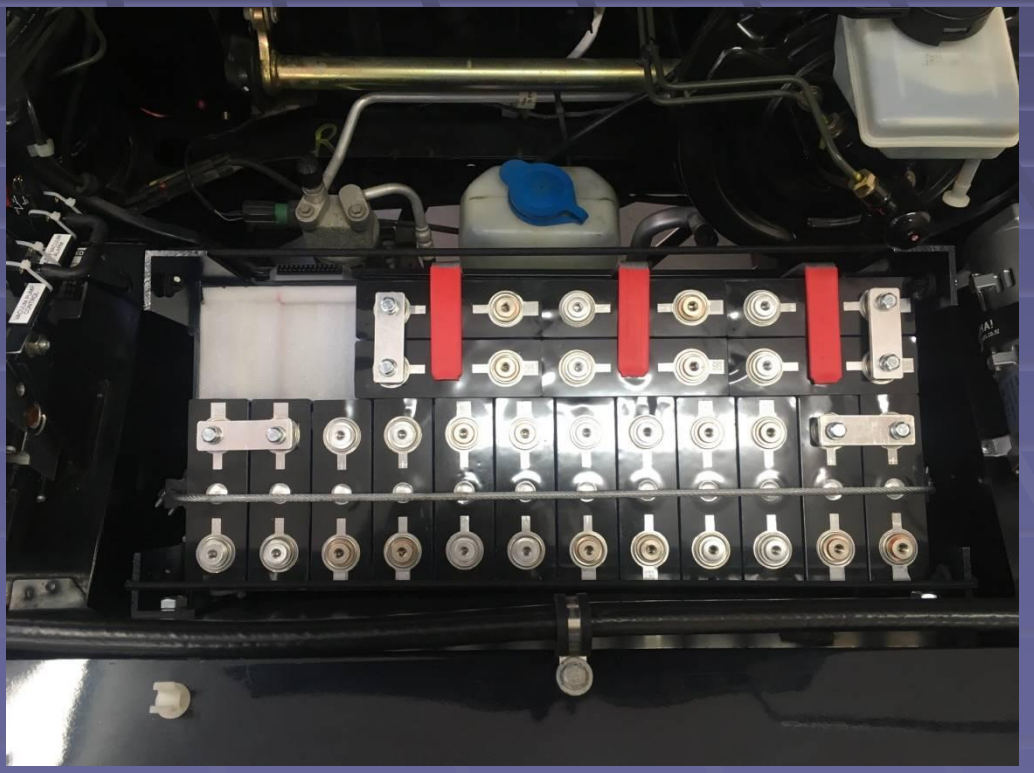
- VEHICLE STANDARDS BULLETIN # 14 (29 pages long)
  - No structural modifications.
  - Brakes & steering to be operational as original. Airbags to be operational, if fitted.
  - EV continuous motor power less than 120 % of original ICE.(easy)
  - Need demister to be working.
  - All HV wiring (> 60 VDC) to be double insulated and orange in colour.
  - Plenty of warning signs & labels.
  - Inertia shutoff switch to disconnect battery in case of accident & hardwired Emergency Stop PB
  - Insulation leakage monitoring for HV supply to car chassis is recommended.

- VASS Certification Engineer
  - Vicroads “Vehicle Assessment Signatory Scheme” (VASS).
  - Do initial site meeting to discuss conversion details to VSB #14.
  - Wanted low vacuum warning dash light.
  - Wanted overall weight about the same (only 100 kgs heavier than original).
  - Wanted front/rear axle ratio about the same
    (44%/56% which is very close to ideal for Mid-engine car)
  - 2 hour final inspection involving half hour road test and hoist inspection.



CONSTRUCTION

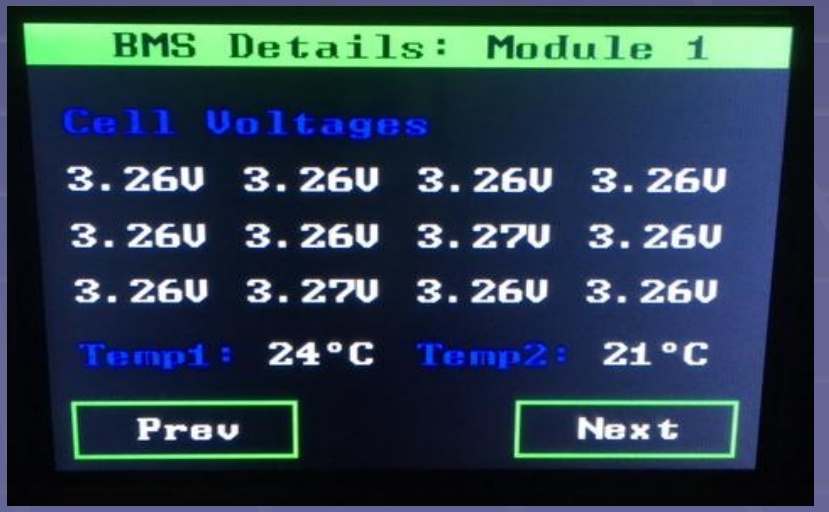
- BATTERY RACK
  - Need to design to withstand 20 G accident impact. i.e. 20 times the battery weight.
  - Use aluminium angle, 4 mm thick welded together. Welded construction is less noisy than bolted construction
  - Split battery location into 4 areas being front in radiator area, behind front seats where the fuel tank was, above the motor & in the boot



CONSTRUCTION

Battery pak, BMS and Monitor screen

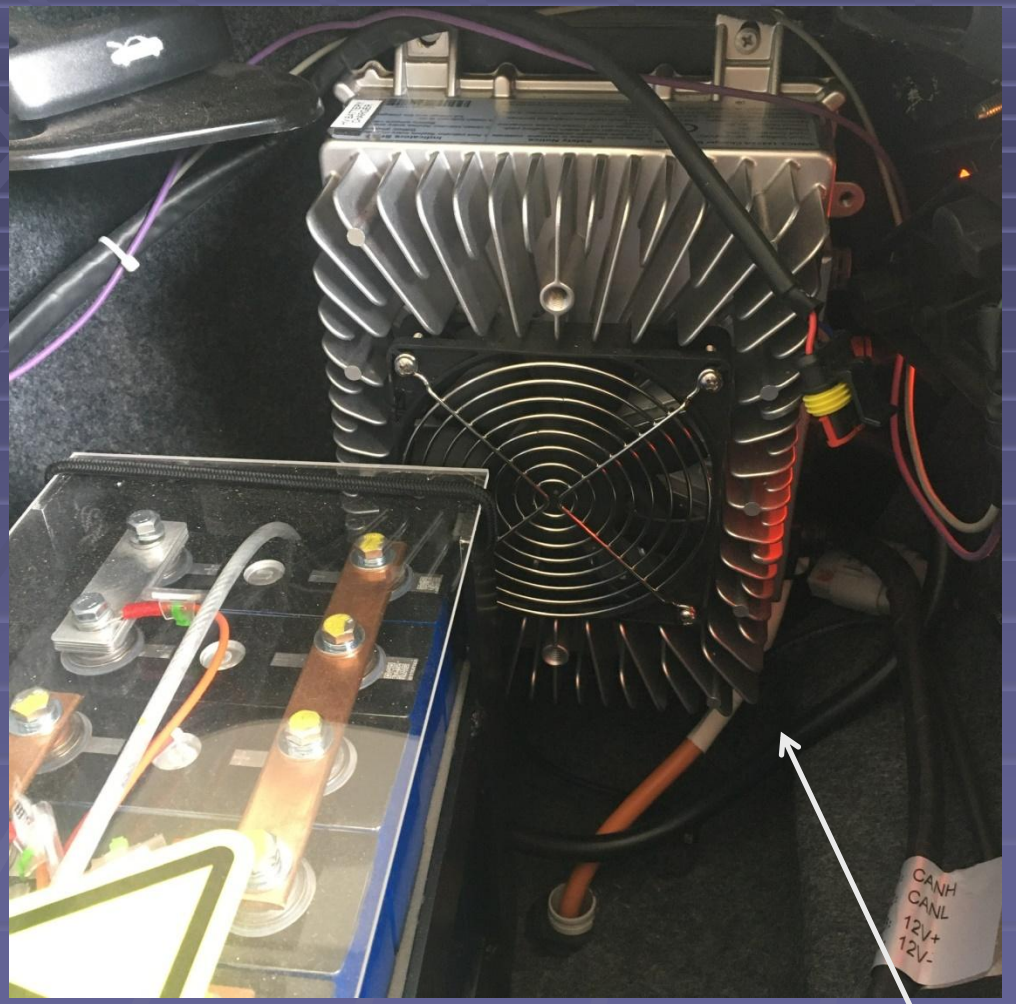
Pak to go above
engine sitting on bench



3 Paks in fuel tank area behind seats

CONSTRUCTION

Battery Charger and “Fuel” inlets



3.3 kW charger charges at rate of about 20km per hour

Standard 10 amp GPO type with charges indication

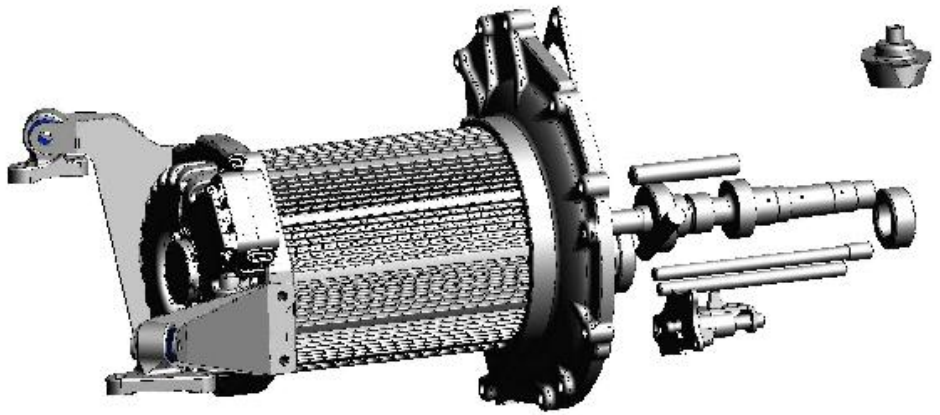
Future Type 2 as to connect to community charger stations

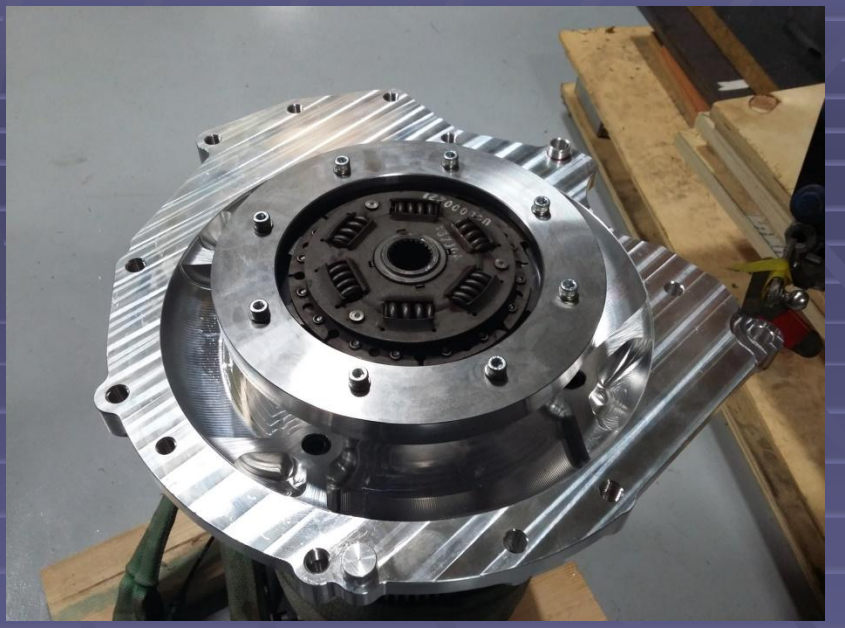
CONSTRUCTION

IN THIS CAR, I REMOVED THE REAR SUB-FRAME BY LIFTING THE CAR BODY UP BY A METER , THEN ROLLING OUT THE REAR SUBFRAME

CONSTRUCTION

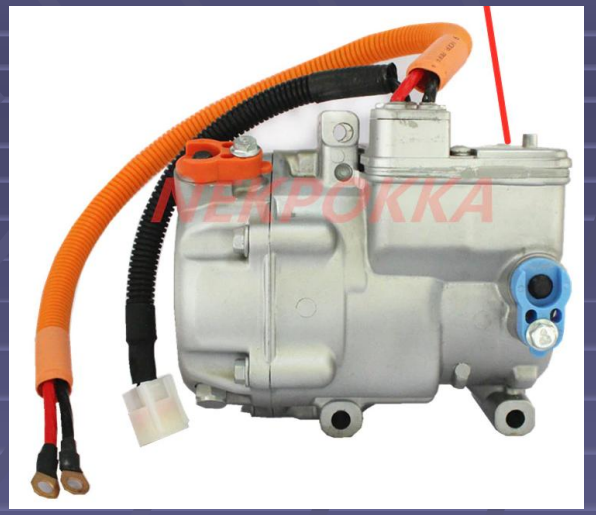
CAD design for adaptor & coupling. Rated for 1100Nm at the wheels

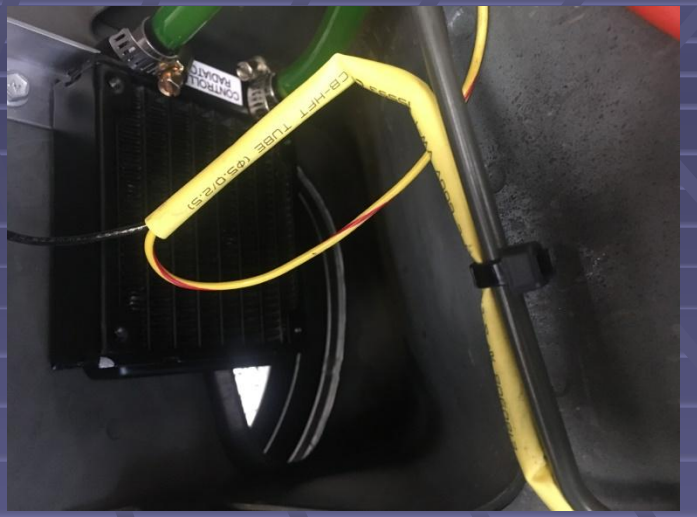


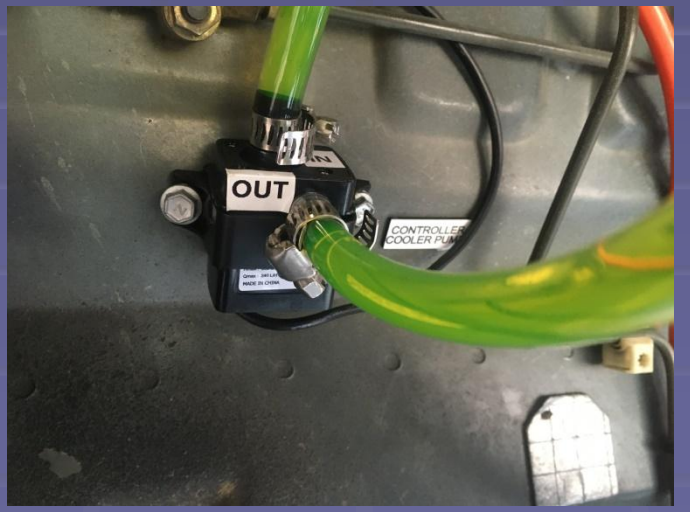


CONSTRUCTION

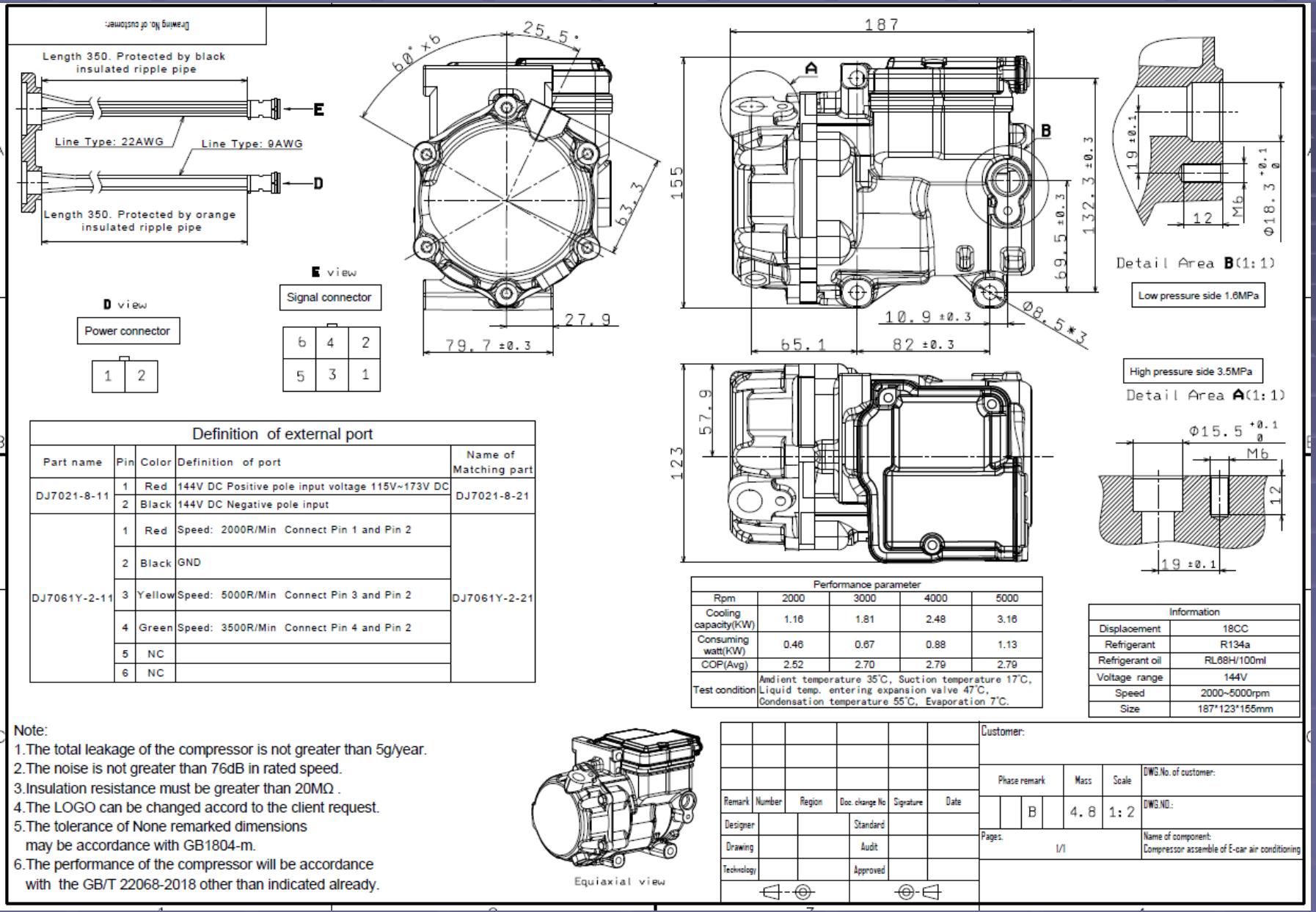
Air-Conditioner Compressor with motor & Controller cooling system







144 VDC ELECTRIC AIR CONDITIONING COMPRESSOR



Definition of external port				
Part name	Pin	Color	Definition of port	Name of Matching part
DJ7021-8-11	1	Red	144V DC Positive pole input voltage 115V~173V DC	DJ7021-8-21
	2	Black	144V DC Negative pole input	
DJ7061Y-2-11	1	Red	Speed: 2000R/Min Connect Pin 1 and Pin 2	DJ7061Y-2-21
	2	Black	GND	
	3	Yellow	Speed: 5000R/Min Connect Pin 3 and Pin 2	
	4	Green	Speed: 3500R/Min Connect Pin 4 and Pin 2	
	5	NC		
	6	NC		

Performance parameter				
Rpm	2000	3000	4000	5000
Cooling capacity(KW)	1.16	1.81	2.48	3.16
Consuming watt(KW)	0.46	0.67	0.88	1.13
COP(Avg)	2.52	2.70	2.79	2.79
Test condition	Amdient temperature 35°C, Suction temperature 17°C, Liquid temp. entering expansion valve 47°C, Condensation temperature 55°C, Evaporation 7°C.			

Information	
Displacement	18CC
Refrigerant	R134a
Refrigerant oil	RL68H/100ml
Voltage range	144V
Speed	2000~5000rpm
Size	187*123*155mm

Note:
1. The total leakage of the compressor is not greater than 5g/year.
2. The noise is not greater than 76dB in rated speed.
3. Insulation resistance must be greater than 20MΩ .
4. The LOGO can be changed accord to the client request.
5. The tolerance of None remarked dimensions may be accordance with GB1804-m.
6. The performance of the compressor will be accordance with the GB/T 22068-2018 other than indicated already.

Equiaxial view

Remark	Number	Region	Doc. change No	Signature	Date
Designer			Standard		
Drawing			Audit		
Technology			Approved		

Customer:

Phase remark	Mass	Scale	DWG.No. of customer:
B	4.8	1:2	DWG.NO.:
Pages. 1/1			Name of component: Compressor assemble of E-car air conditioning

Cooling Performance

1.1 Kw input

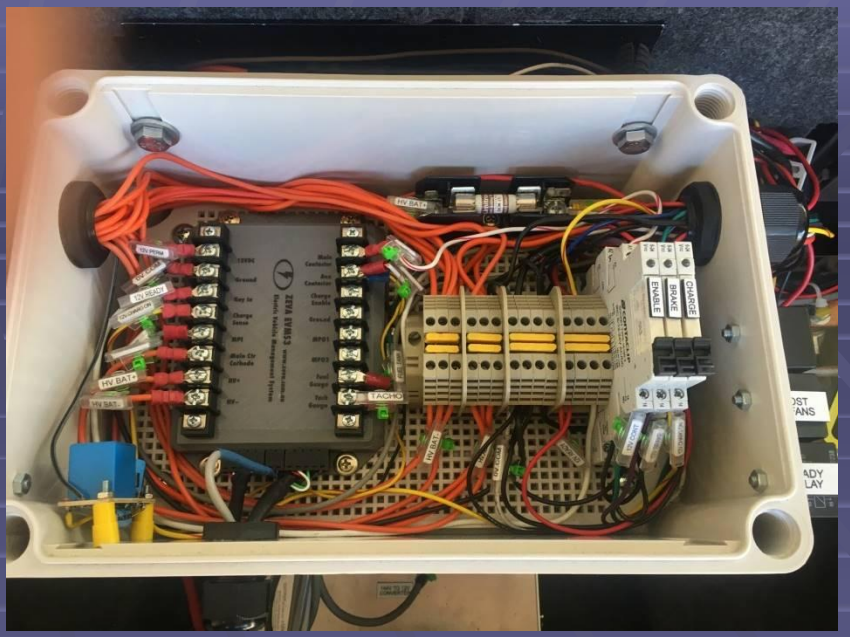
3.2 Kw output

COP = 2.79

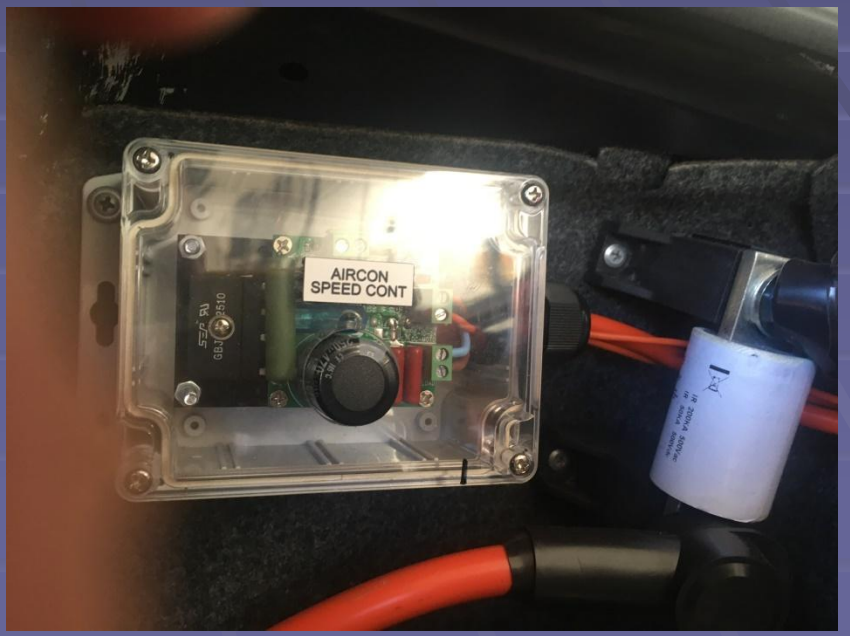
CONSTRUCTION

Electric motor, adapter plate, coupling and transmission weigh 107 kgs

EVMS controller, aux HV fuse and interface relays in IP56 enclosure

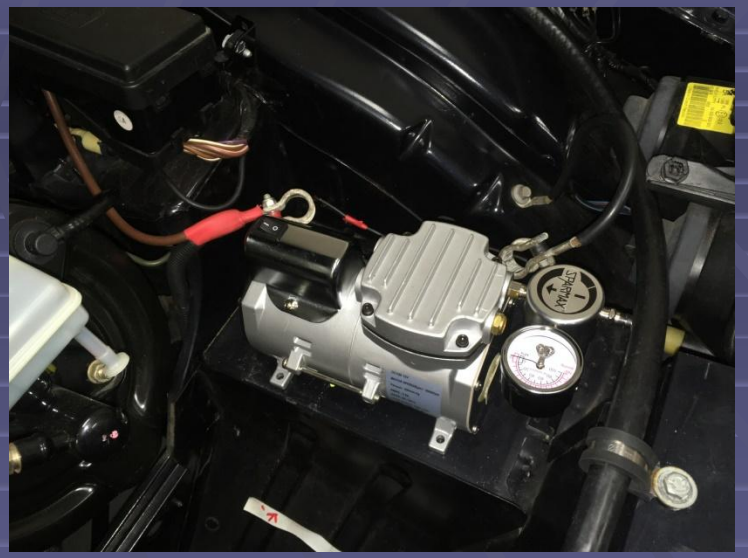


Air-Con Motor speed controller & HV 350 amp main traction fuse



CONSTRUCTION

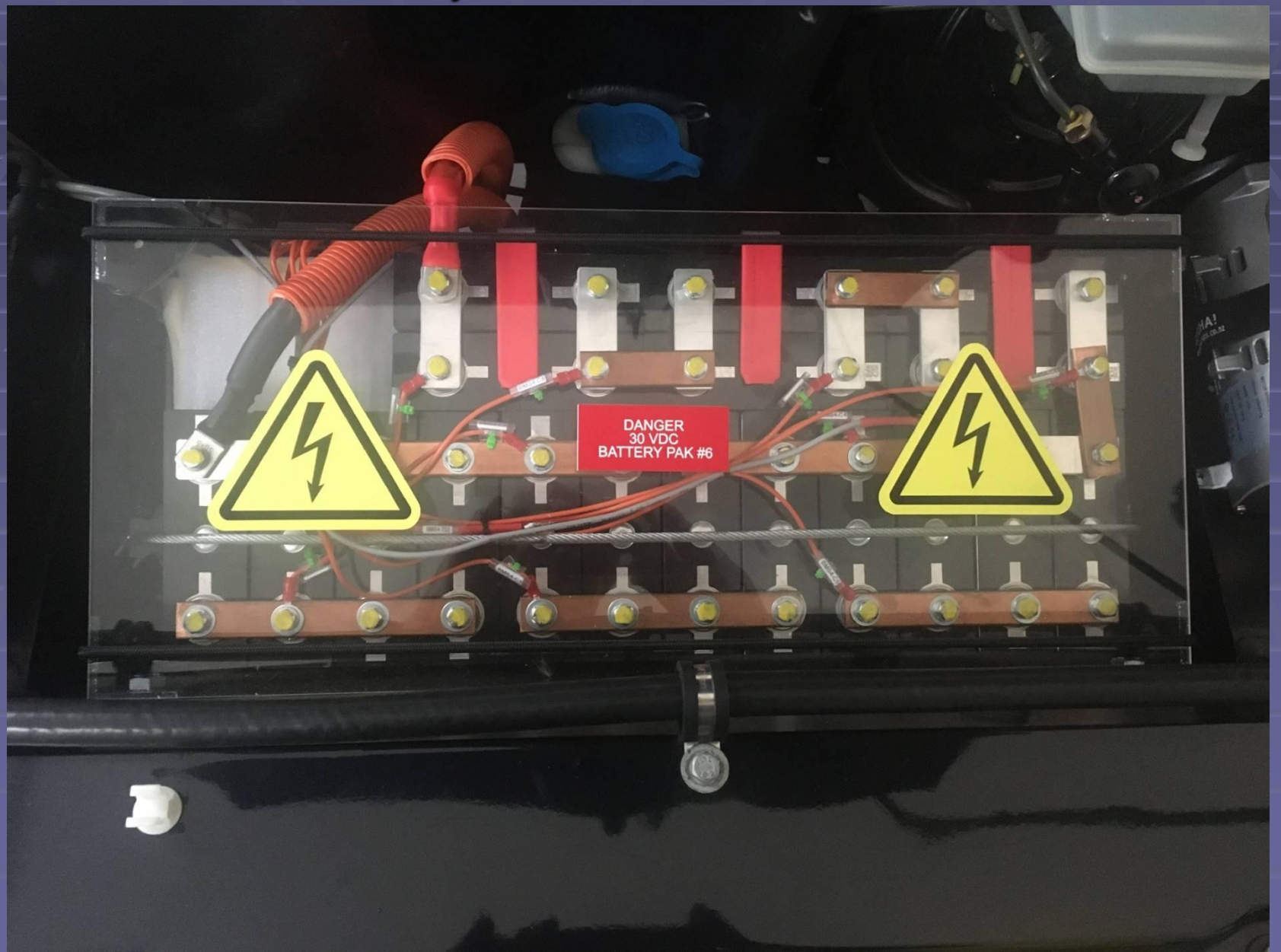
Aux battery converter, vacuum pump and tank, VVVF motor controller , small HV contactors



Converter provides 12 volt @ 62 amps to charge normal car battery

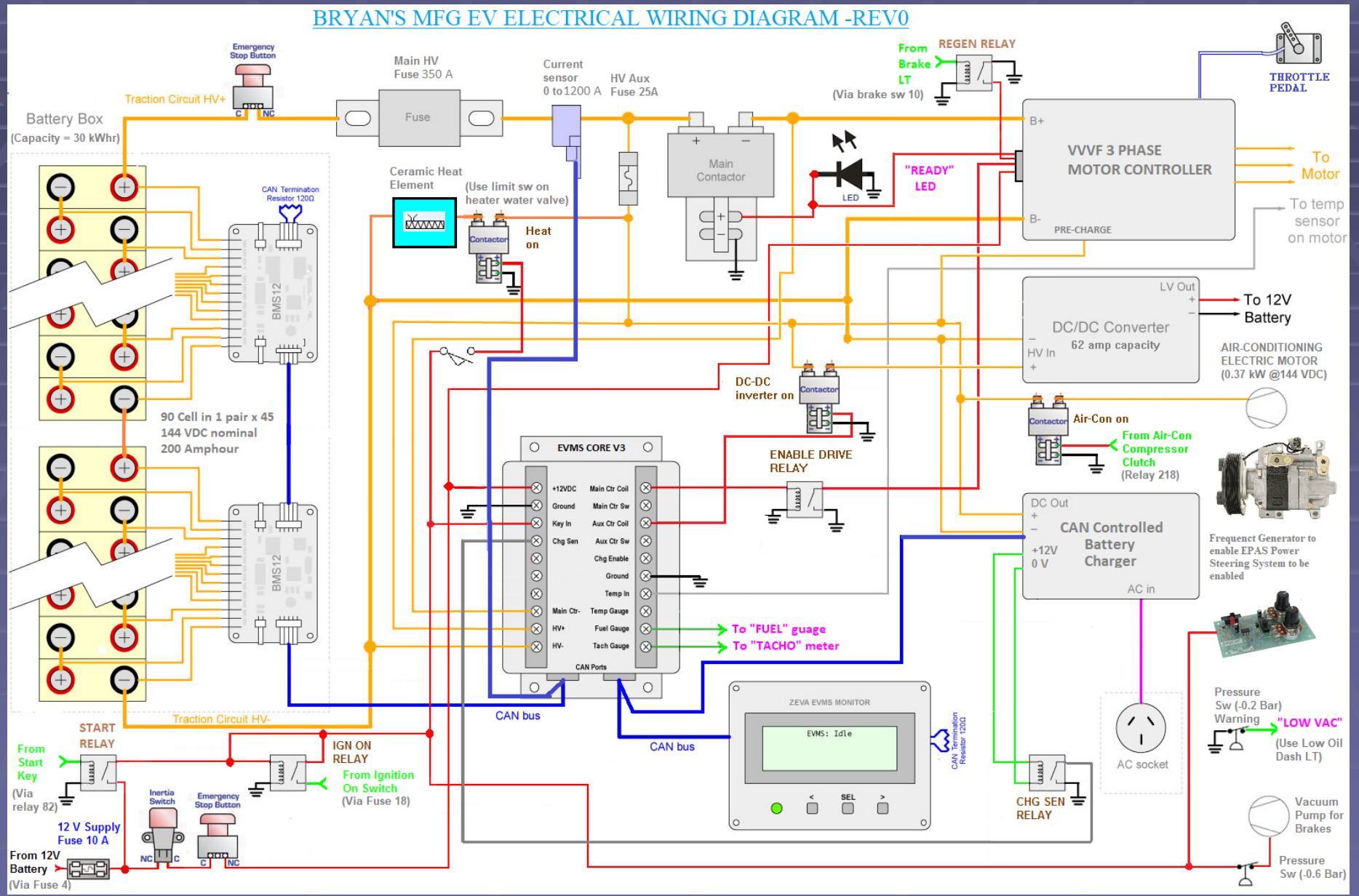
CONSTRUCTION

Finished fruck area. Battery Pak ahead of front axle for better balance



WIRING DIAGRAM

WIRING DIAGRAM – PRETTY SIMPLE



CONSTRUCTION

Weight reduction wherever possible

BEFORE

Spare tyre

17 Kgs

Normal Lead

12 Volt Battery

12 Kgs

AFTER

Tyre repair kit

0.25 Kgs

Lithium 12 v Battery

0.9 Kgs

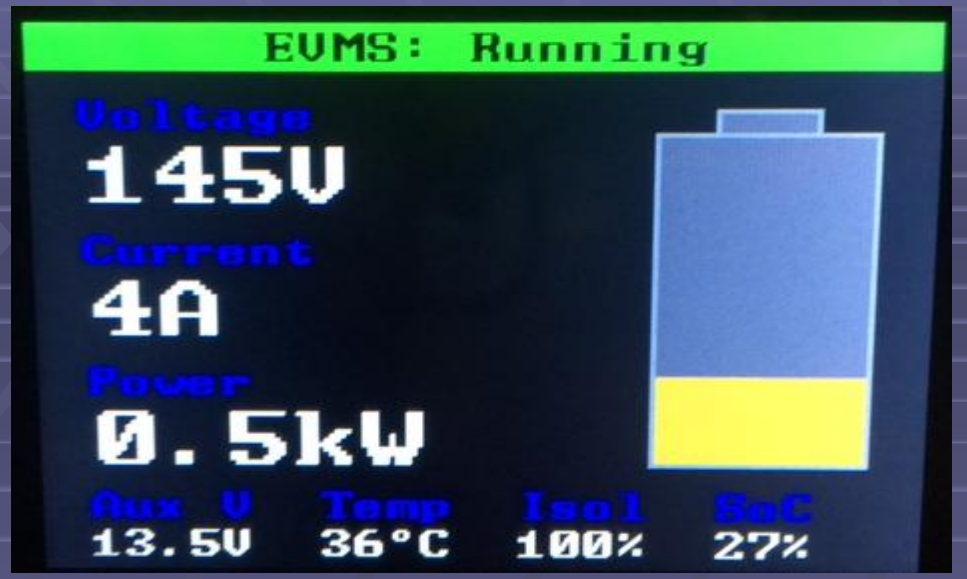
PERFORMANCE TESTING

- WEIGHT TEST: 1140 Kgs before conversion
  1240 Kgs after conversion (+8% increase)
- RANGE TEST: 210KMS with 5% left in battery.
  Test was 2/3 highway and 1/3 urban
  130 Whr/km economy

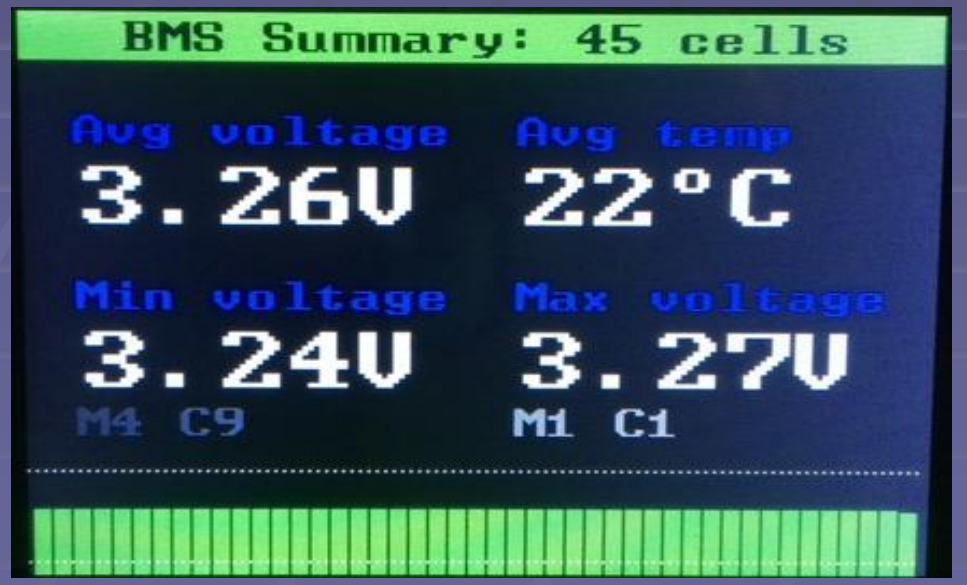
- ACCELERATION TEST

Acceleration Range	Original Car Power = 100 kW	After EV Conversion Power = 88 kW	Improvement %
0 -> 60 kph	5.4 secs	5.0 secs	+ 7 %
0 -> 100 kph	14.2 secs	11.0 secs	+ 25 %
¼ mile	15.4 secs	14.0 secs	+ 9 %
Power to Weight	87 watt/kg	71 watt/kg	- 18 %

MONITORING



NORMAL SCREEN



BATTERY SUMMARY SCREEN

GUAGE READING MOTOR AMPS and ENGINE HEAT (0 ->100 DegC)

FUEL GAUGE

GREEN “READY” LED & YELLOW “HEAT” LED

BUDGET

- TOTAL COST = About $25K (Includes about $1000 for ICE engine & bits sale)
- COST BREAKDOWN
  - MATERIALS = $18K, (batteries were more than half)
  - SERVICES = $7K, (welding, machining and Vicroads consultant)
- PROJECT TIMING: About 6 months mainly waiting for equipment
- ACTUAL LABOUR = about 4 manweeks. Two people are helpful when removing ICE engine & installing batteries. Also a hoist is very useful for getting under car

CONCLUSION

- A GREAT SECOND , SPORTY , OPEN TOP CAR
- 200 kM USEFUL RANGE
- FUEL COST IS VIRTUALLY ZERO AS I USE SOLAR ENERGY TO CHARGE UP
- ENJOYABLE TO DRIVE AS CAR IS NOW AN AUTOMATIC AND VERY QUIET
- ALL MOD CONS LIKE AIR-CON, HEATED SEATS, ABS BRAKES, 4 WHEEL DISK BRAKES, ELECTRIC POWER STEERING, ETC
- PROJECT PAYBACK IS ABOUT 6 YEARS BASED ON $2500/YEAR FOR FUEL AND $1300/YEAR FOR SERVICING & MAINTENANCE.
- FUN PROJECT TO DO

ANY QUESTIONS?

THANKS FOR YOUR ATTENTION