2018 Project Summary of

Tesla Model 3

MATODATAS Annual Key Vehicle V1.0

www.matodatas.com

Catalog

01

Project Introduction

Project Introduction of Model 3

Shanghai

Headquarters of MATODATAS， project plan，3D model, report making

California

Purchase, scan, teardown, registration in Detroit, joint sales agreement with Munro

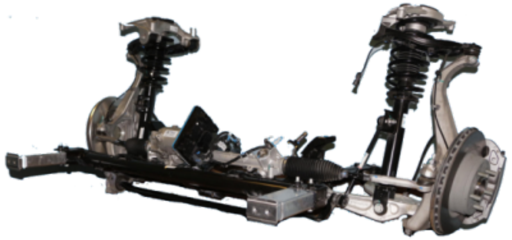
Fukuoka

Technical support for new energy technology research, material testing, etc.

Germany

European automotive industry, multi-level business cooperation, data support

Basic Information of Model 3



Battery Capacity

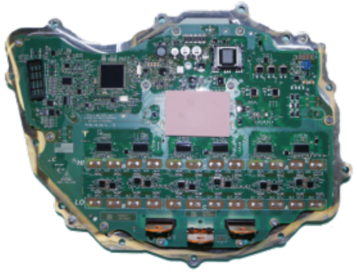
75 kWh
(270 MJ)

Range

496km

Curb Weight

1764
kg



RWD

Long Range

NA, January 2, 2018

Model 3

01

Specifications

Battery Long Range Powertrain RWD

4694*2089*1443mm Wheelbase 2875mm

02

In January 2, 2018 we spent $49,000 to buy Model 3 in North America and dismantled it in California.

03

Range 308 miles (496 km) tested

Efficiency 26 kWh per 100 miles

Top speed 140 mph (225 km/h)

Acceleration 0–60 mph 4.6 seconds tested

04

Battery capacity 75 kWh (270 MJ)

DC charging 270 km range available after 30 min

AC charging 71 km range per hour (240 V outlet, 48 A)

05

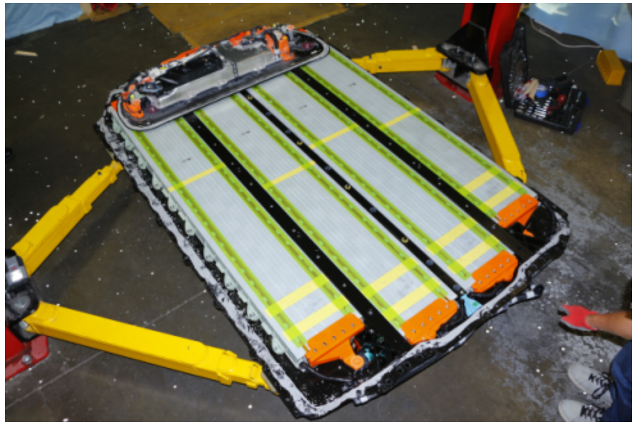
Powertrain	Single-Motor Rear-Wheel Drive
Motor	Permanent magnet rear
Curb Weight	1764kg tested
Power	271 hp (202 kW)
Torque	307 lb-ft (416 N-m)

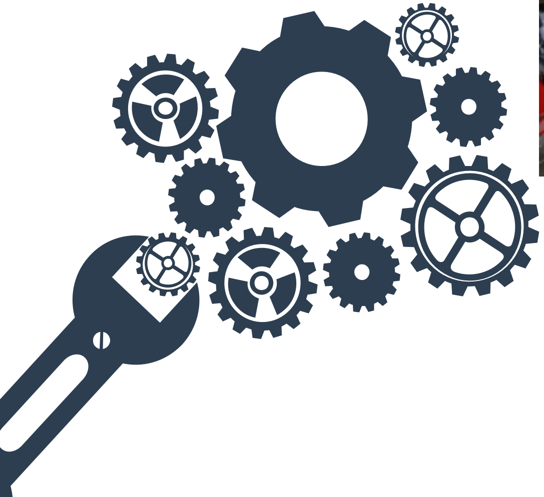
02

Project Progress

Teardown

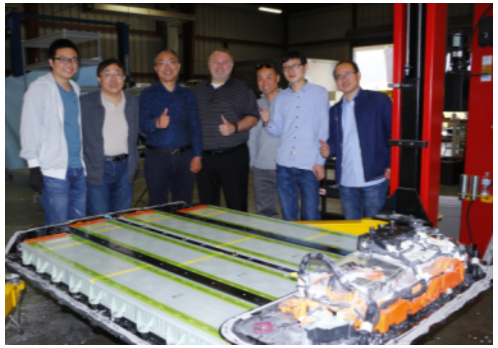
in California

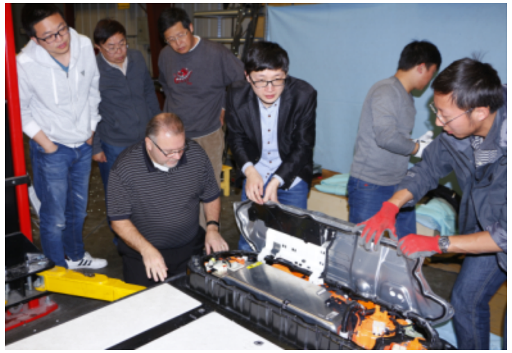




Project Team

1. Experts from the American Academy of Engineering and large automotive companies provide guidance and participate in Model 3 scan and teardown.
2. Experts from large steel mills carry out material testing and research.
3. The special expert group of Shanghai conducts research on the cell, MCU, BMS，Motor structure and control strategy.
4. Experts from GM carry out platform research.
5. Global resources, all parts and components will be shipped back to China, and partners can borrow parts.





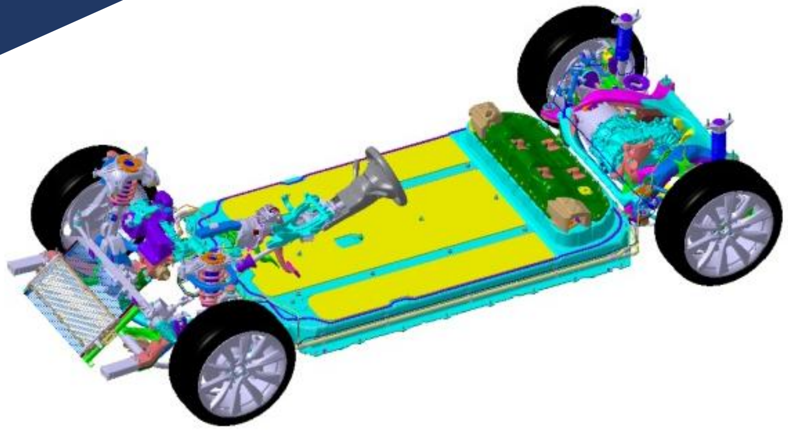
Project Progress

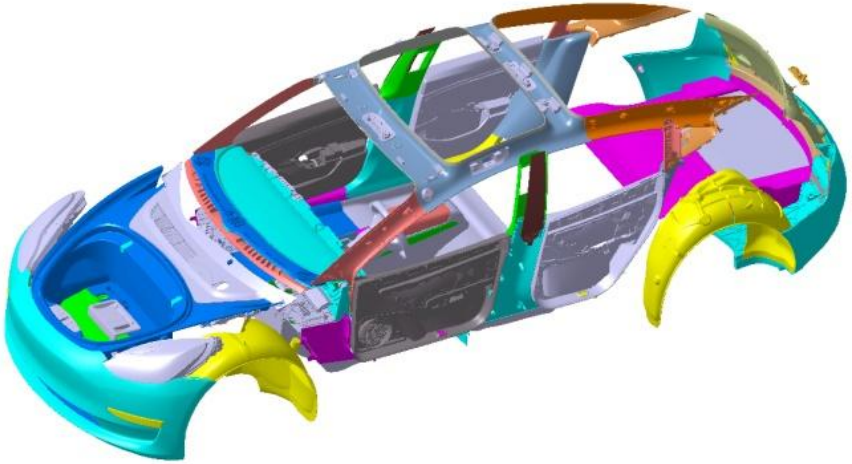
- 2018.01.02 Sample car purchase
- 2018.02.15 General layout and vehicle scanning completed
- 2018.02.27 Complete vehicle teardown
- 2018.03.15 Parts, Battery, Motor teardown completed
- 2018.03.20 BIW teardown completed
- 2018.04.25 Chassis data completed
- 2018.05.15 BIW data completed
- 2018.06.25 Int./Ext. , Battery, Motor data completed
- 2018.07.30 All reports completed
- Continuous customization…

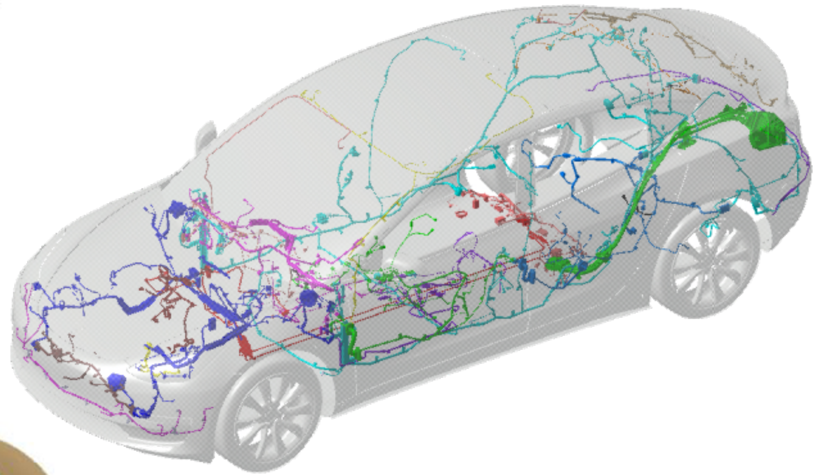
03

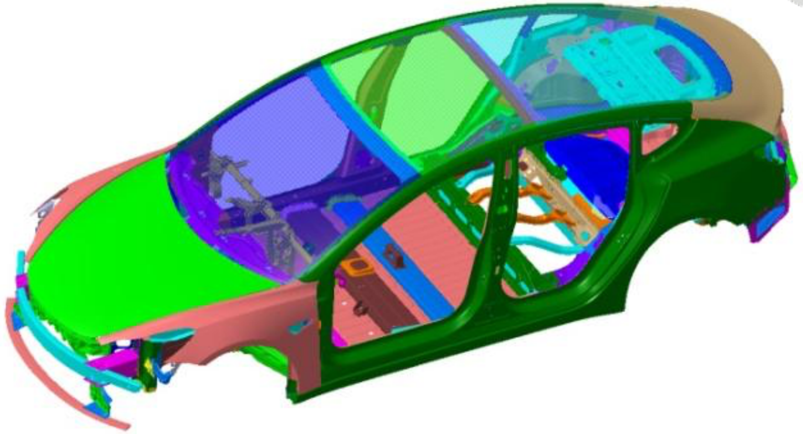
3D Model & Point Cloud

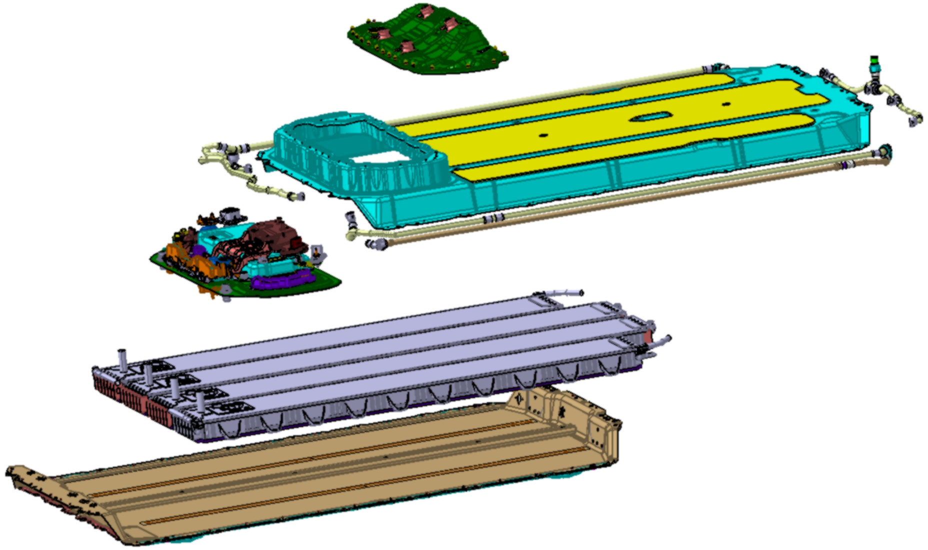
3D Model



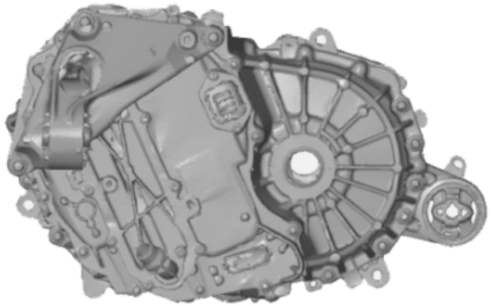


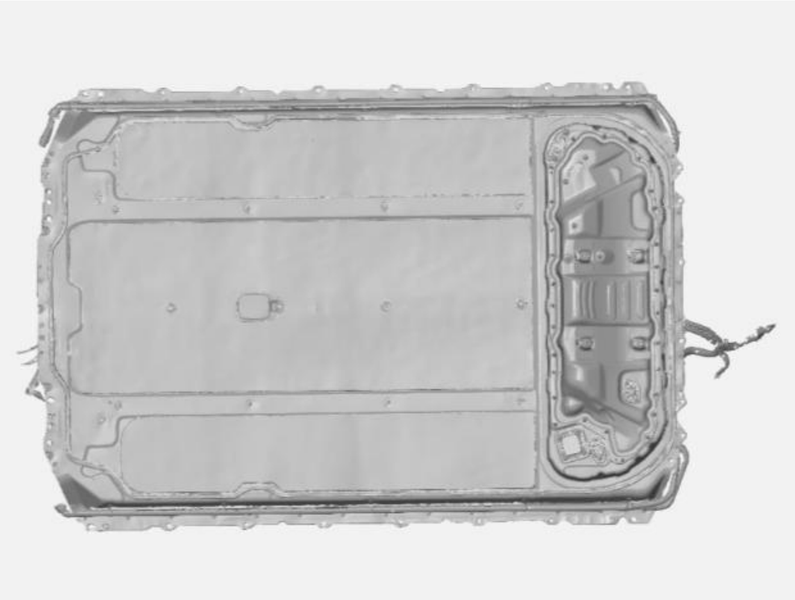


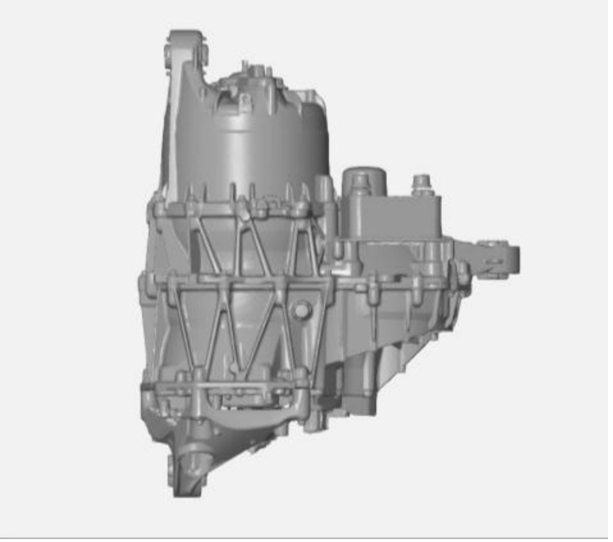


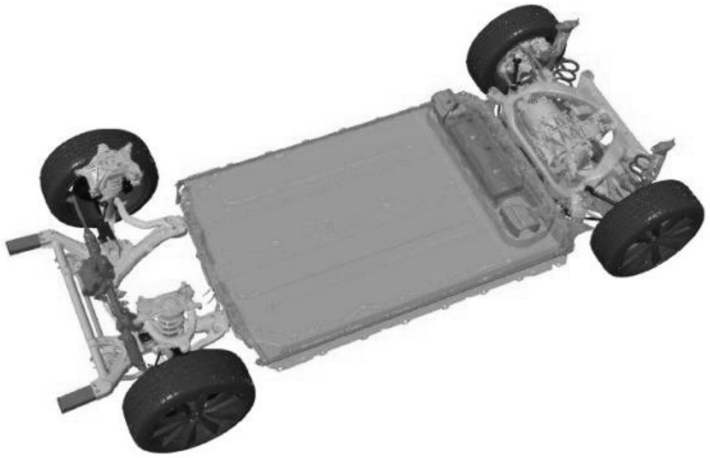


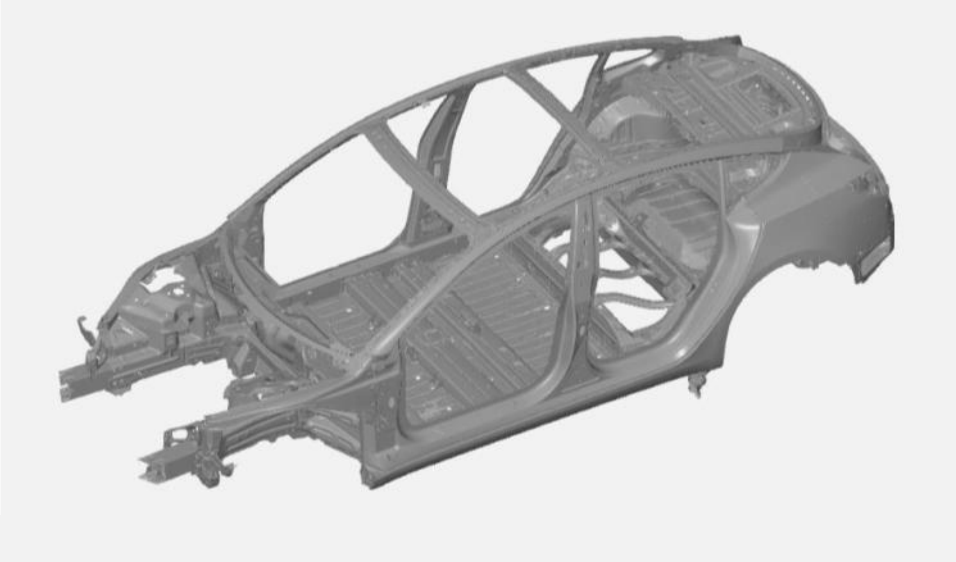
Point Cloud

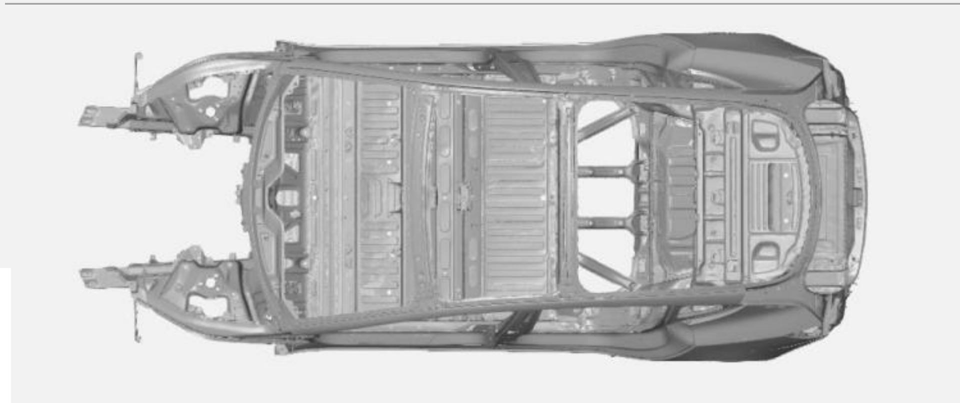






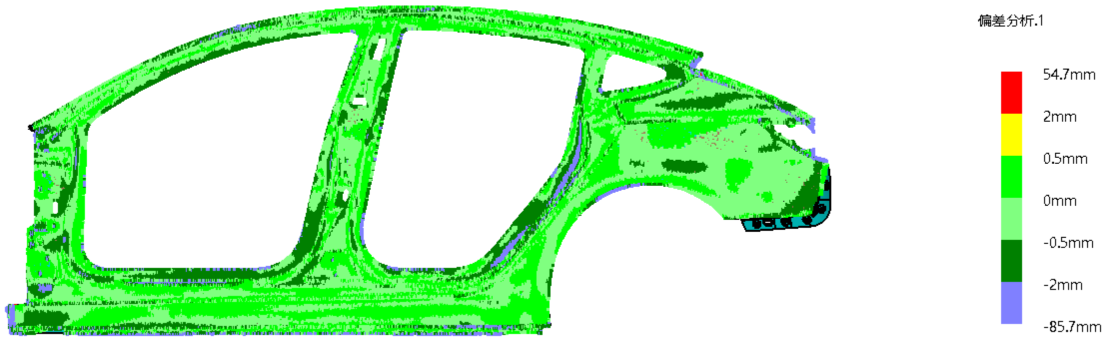


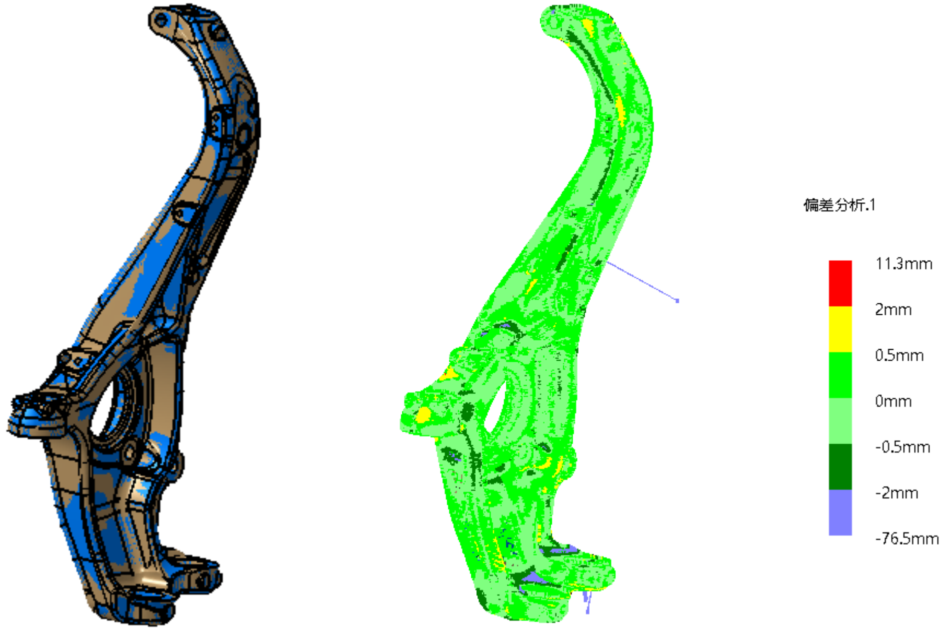


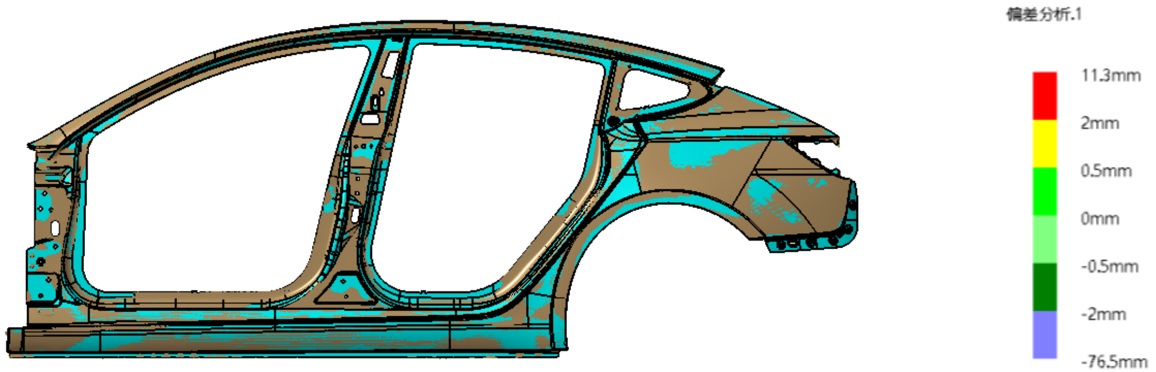


Data Accuracy Requirements and Show

◆Chassis, BIW, interior and exterior to meet the requirements of mold opening (black box / grey box external contour)
◆The accuracy of point cloud and data is below 0.5mm.
◆The contour accuracy is controlled below 1mm.
◆The key parts' holes and hard points accuracy are controlled in 0.2mm (Annex)



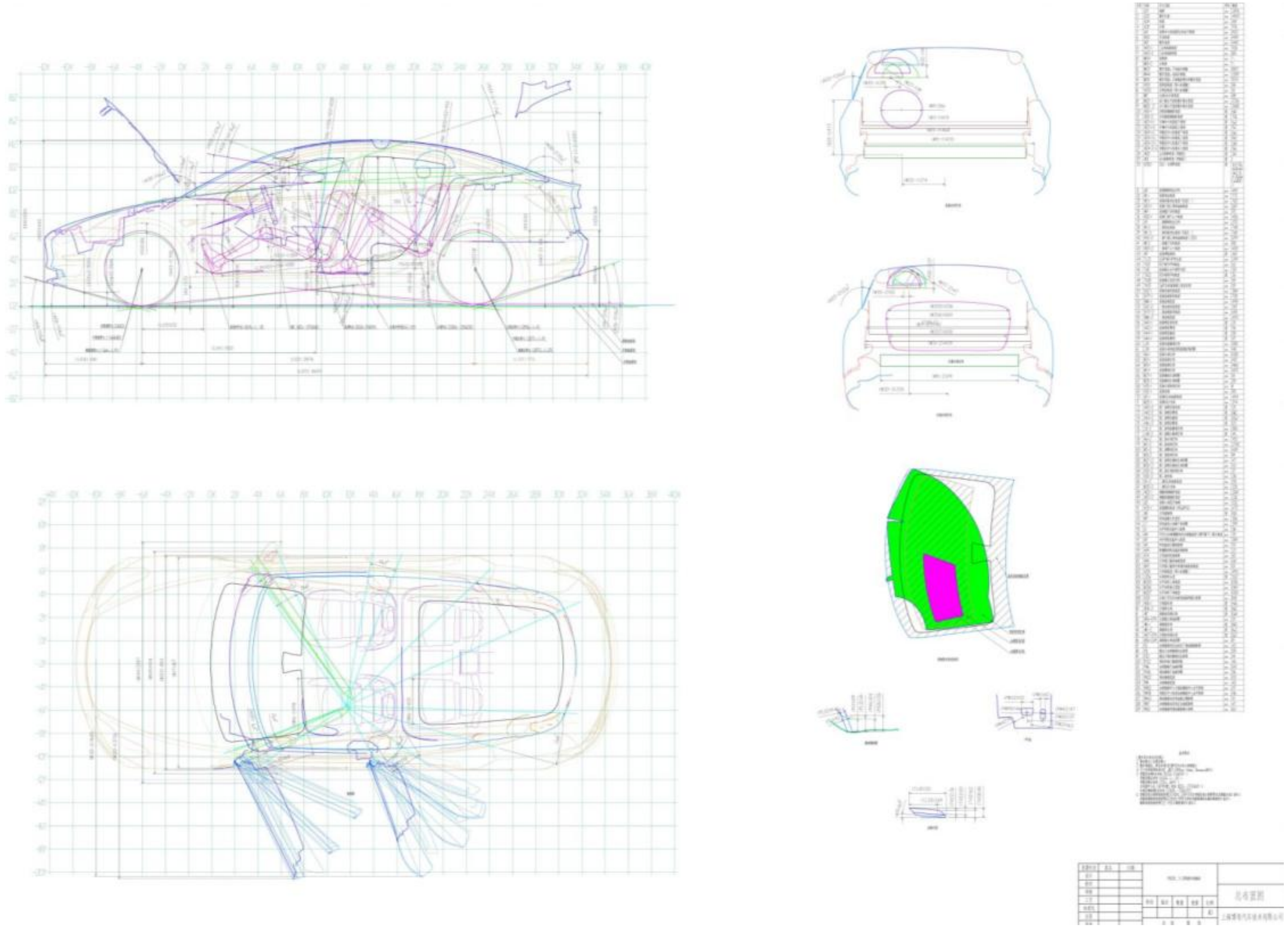




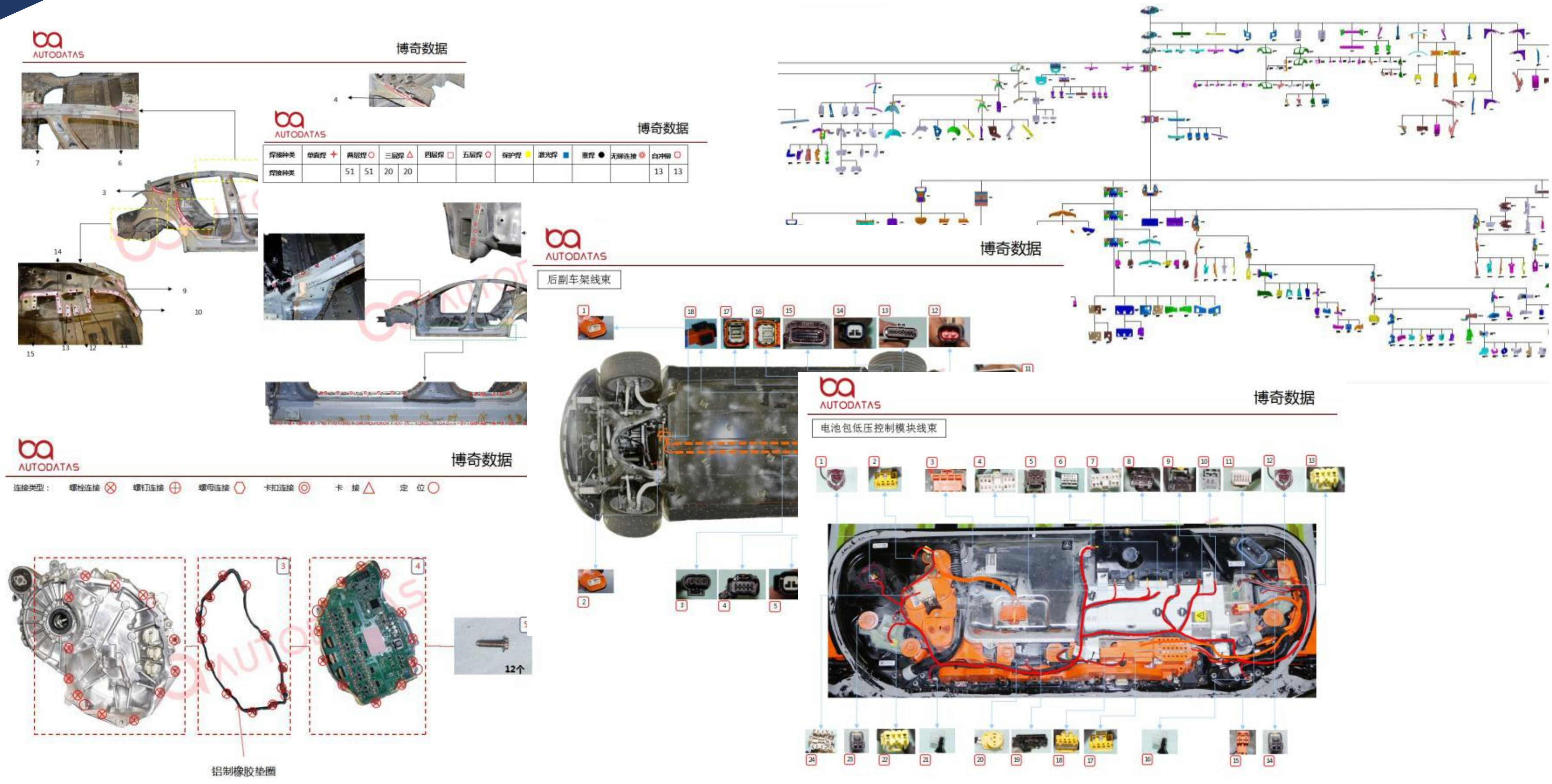
04

Report & Analysis

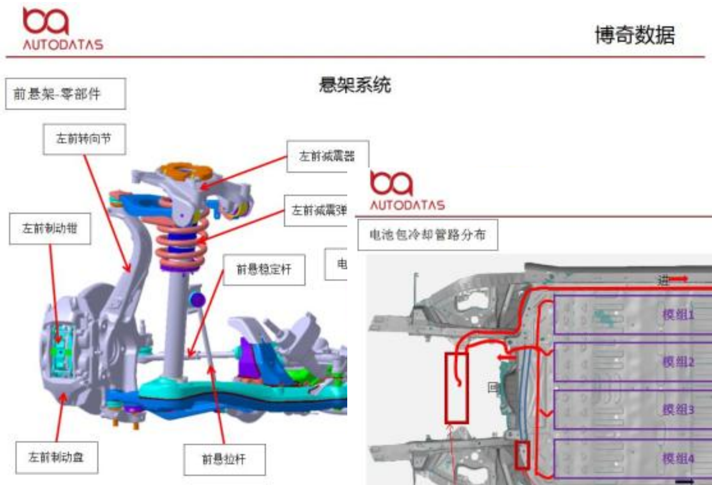
General Arrangement Drawing

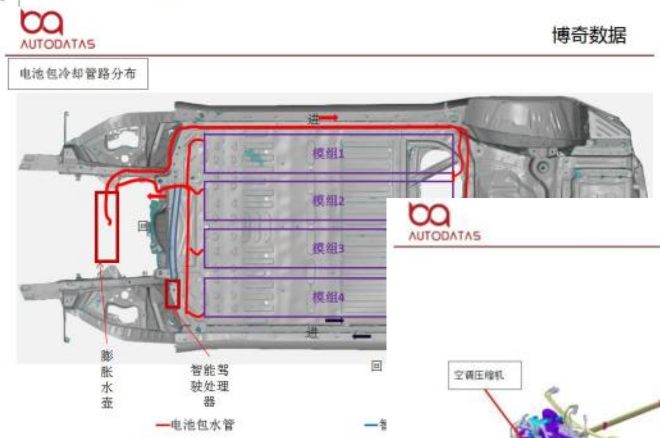


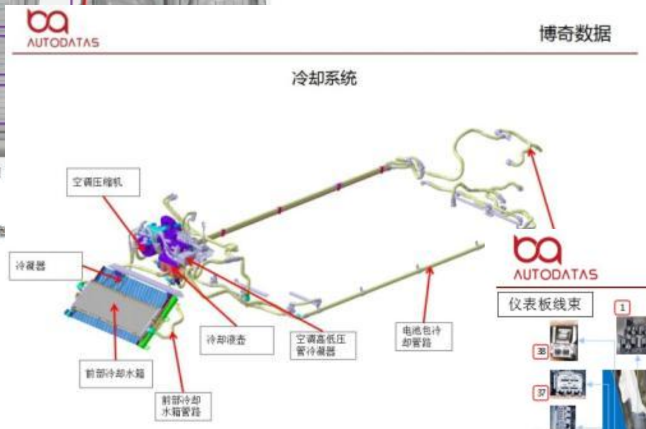
Teardown Report

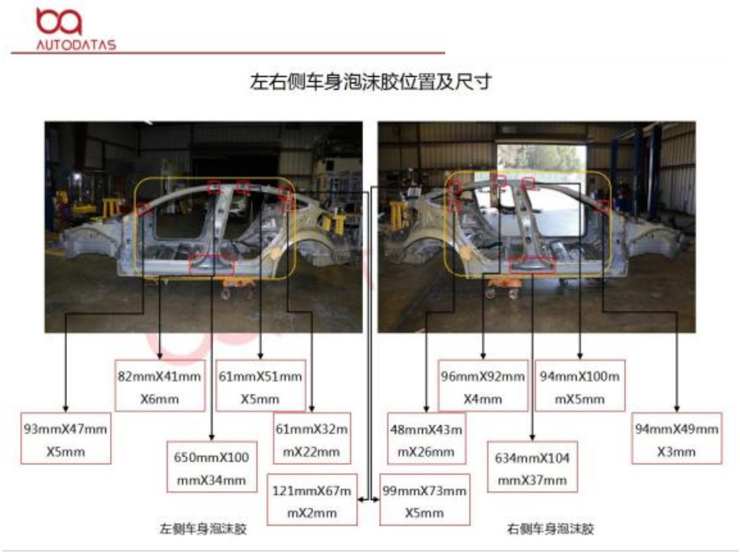


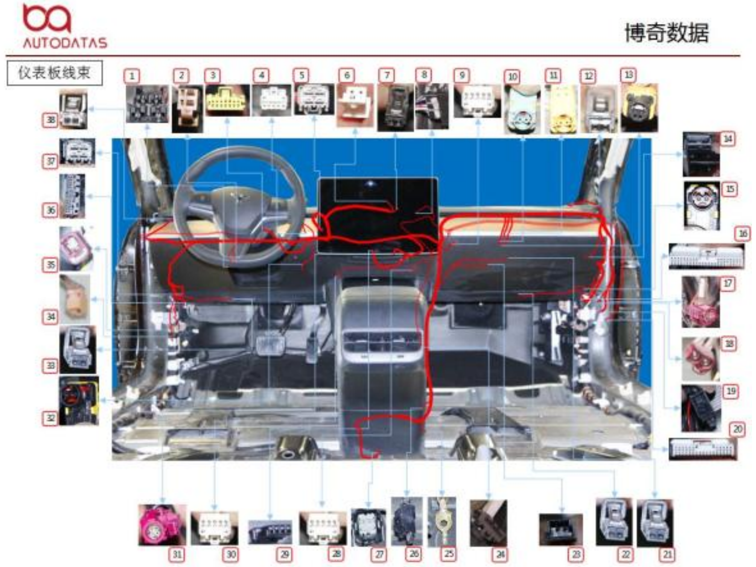
Teardown Report

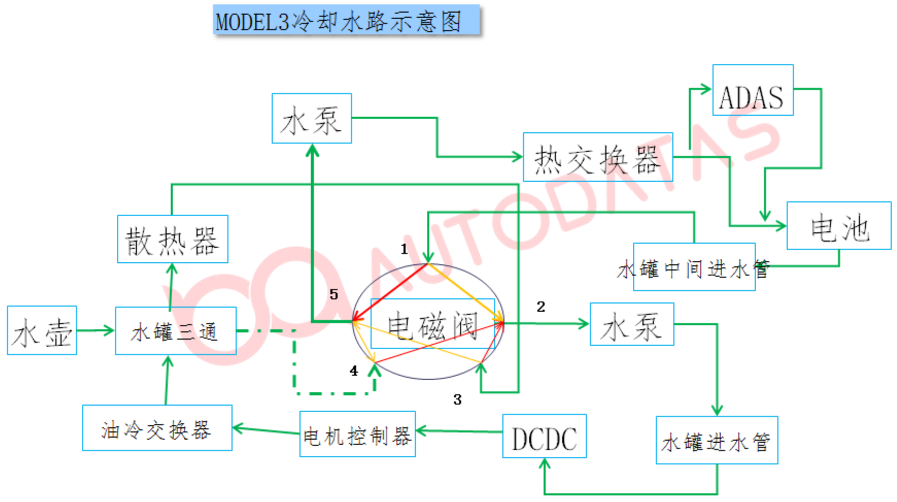












BMS Report

第一部分 电池管理系统安装方式

1) 电池管理系统的固定方式

电池管理的固定方式如下图所示．其位置处在电池系统的上方。而对外的连接器直接通过外壳向上顶出．采用密封圈进行密封。其引脚通过插入的方式并进行灌胶达到密封和防水的效果。

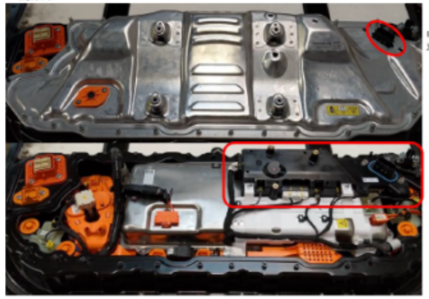


图 1 电池管理系统的位置

通过这种设计．需要再电池管理系统外壳进行金属嵌件的处理．使得电池管理系统与上方的铝壳进行紧密贴合．其安装方式如下所示。通过五个安装点与上方进行固定。

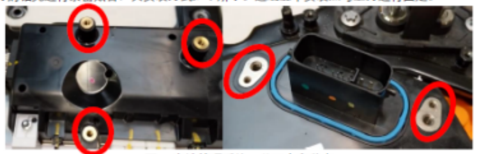


图 2 电池管理系统一共五个安装点

电池管理系统本体的安装．是配合再 PCS 上的安装孔位．并通过支架进行固定。如下图所示．通过一个独立的安装支架把电池管理系统与下方的 PCS 形成一体化。从这个意义上来看．电池管理系统的固定受力时通过下方的下压支架和上方的 5 个固定一起实现的。

图 3 电池管理系统安装方式

2) 电池管理系统的线束和连接器情况

电池管理系统的一共有以下 7 个的连接器．主要包括:

- P1 (VEHICLE INTERFACE)：共 18 个引脚．为整车和车身通信接口．采用插针式的方式与上方的连接器形成一体化．这是这一代电池管理系统在连接器上面明显的变化
- P2 (EXT LOW VOLT INT)：14 个信号引脚和 16 个功率引脚
- P3 (SHUNT INT)：与电流分流器相连接
- P4 (HV SENSE)：高压采样连接器．采集高压回路并分压到上方高压处理电路
- P5 (A BMB)：菊花链的输出线．用来连接各个 CMU
- P6 (B BMB)：菊花链的返回线．用来连接各个 CMU
- P7 (PYRO LOOP)：可切断熔丝的控制回路

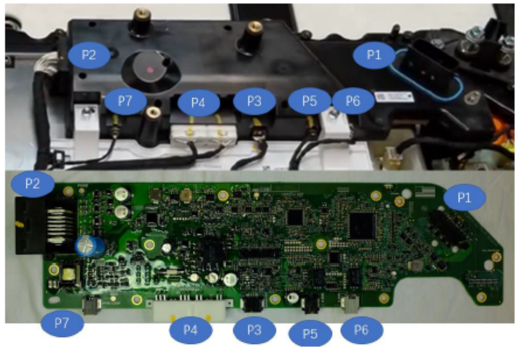


图 4 电池连接器和线束连接

电池管理系统的连接主要分为对内和对外．如下图 5 所示．电池管理系统的对外整车连接器直接通过外部连接的方式进行连接。对外的系统连接器主要包括:

- 快充输入连接器：与充电接口相连．在美国的版本中充电的接口是交直流一体的．所以从同一个接口输入；在如中国的版本中．交直流分两个接口输入的时候．这里就需要采用
- 后轴输出高压接口：如下图所示．目前下方最粗的输入接口．用来供给后驱动轴。
- 前轴输出高压接口：这个接口输入目前缺省．主要用在四驱双电机版本里面。
- 辅助高压输出连接器:输出 PTC 和电动压缩机的接口．功率约在 2-3kW．输出线束较细

图 5 电池系统输出连接器

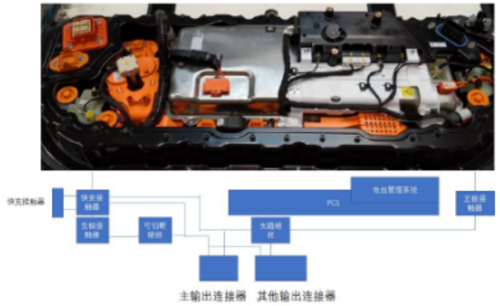
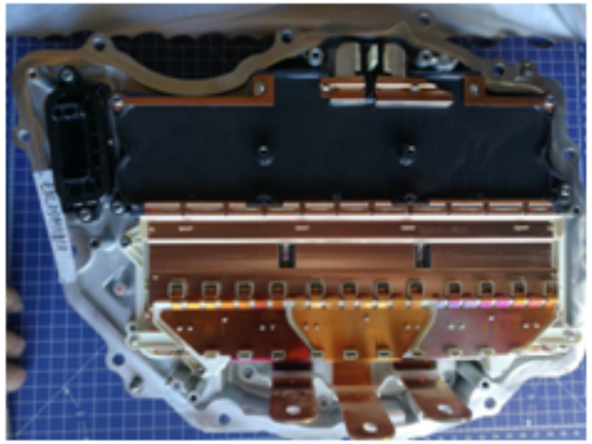
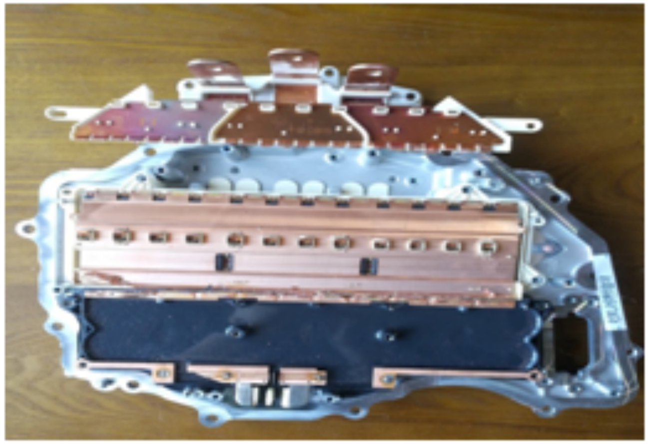


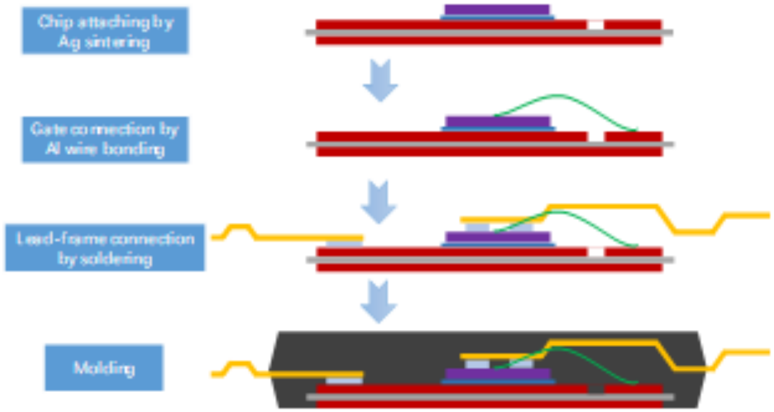
图 6 电池系统正面高压连接示意图

The future can’t wait. New technology is changing the world by changing the way we get around.

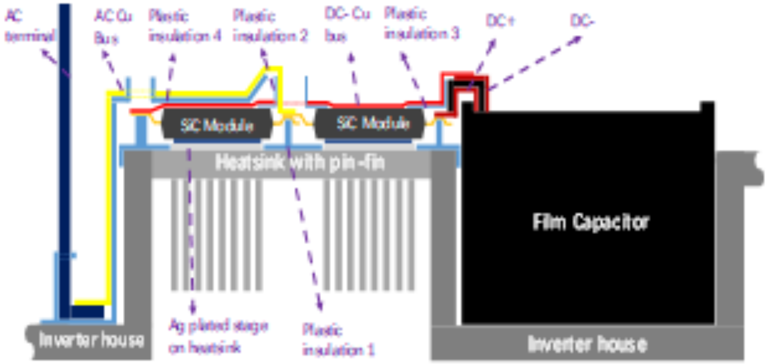
MCU Report



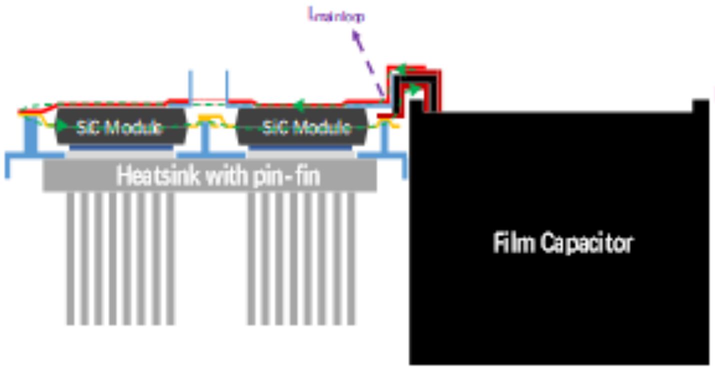




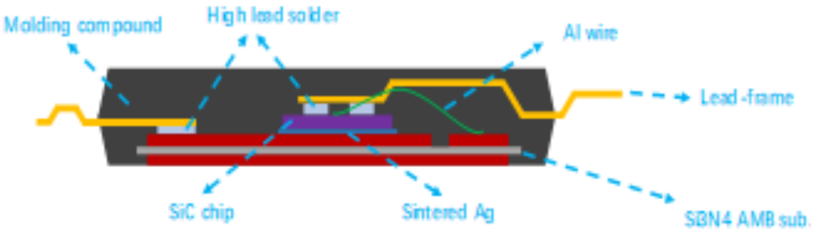
Chip attaching by Ag sintering
Gate connection by Al wire bonding
Lead-frame connection by soldering
Molding



AC terminal
AC Cu Bus
Plastic insulation 4
Plastic insulation 2
DC-Cu bus
Plastic insulation 3
DC+
DC-
SiC Module
SiC Module
Heatsink with pin-fin
Film Capacitor
Inverter house
Ag plated stage on heatsink
Plastic insulation 1
Inverter house



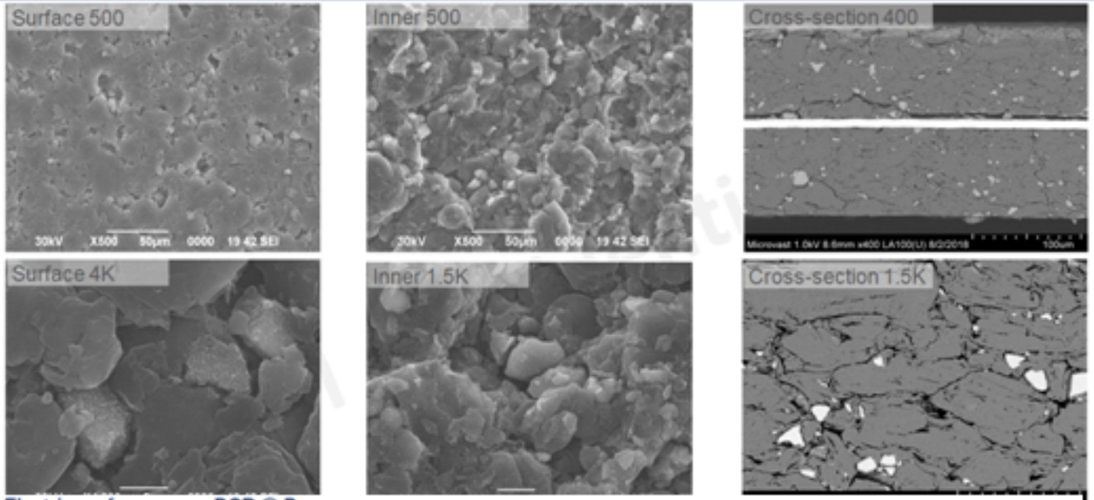
SiC Module
SiC Module
Heatsink with pin-fin
Film Capacitor



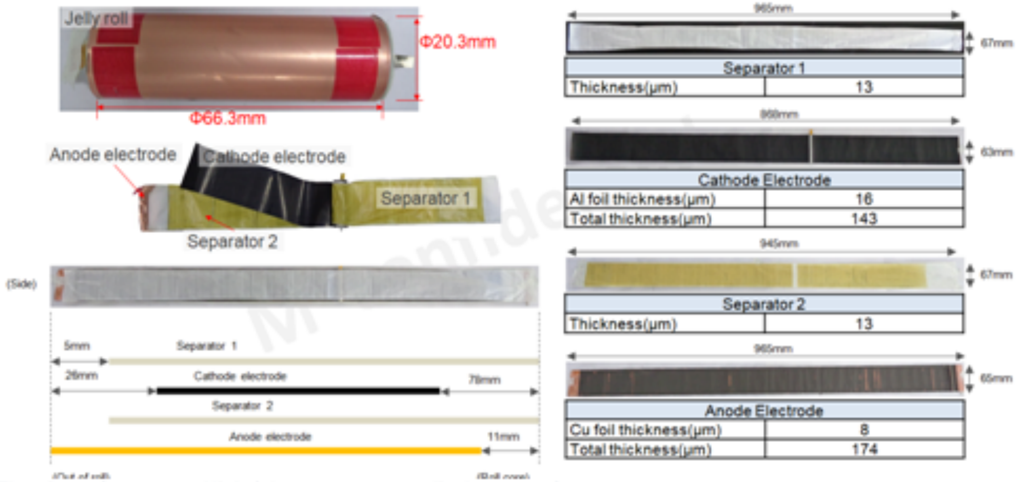
Molding compound
High lead solder
Al wire
Lead-frame
SiC chip
Sintered Ag
SiN4 AMB sub.

CELL Report

Material analysis _ Anode

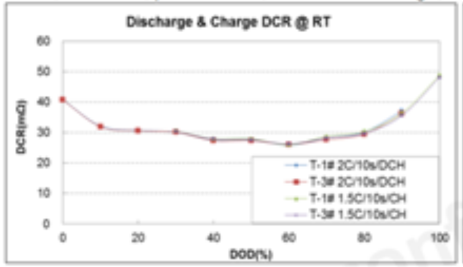


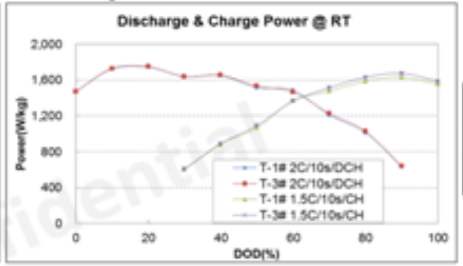
Structure Analysis _ Jelly roll Structure



Electric performance _ DCR @ Power

✓ RT, 2.7-4.25V, per10%SOC, 2.0C/10s/discharge, 1.5C/10s/charge



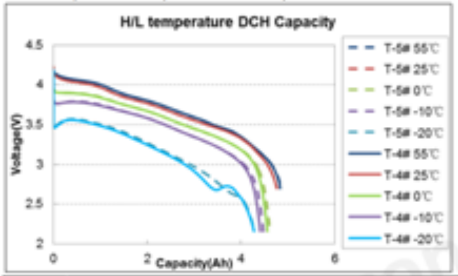


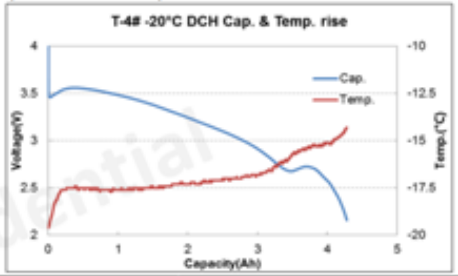
ACR(mΩ)	
T-1#	12.1
T-3#	11.8

Item	DOD(%)	0	10	20	30	40	50	60	70	80	90	100
2C/10s DCH DCR(mΩ)	mean	40.7	32.0	30.6	30.1	27.5	27.6	26.0	27.9	29.8	36.7	/
2C/10s DCH Power(W/kg)	mean	1472.1	1726.3	1746.6	1639.8	1651.6	1525.0	1476.0	1219.4	1020.7	636.5	/
1.5C/10s CH DCR(mΩ)	mean	/	/	/	30.4	27.9	27.8	26.1	28.5	30.0	36.0	48.5
1.5C/10s CH Power(W/kg)	mean	/	/	/	605.2	885.1	1079.1	1367.2	1493.5	1609.7	1653.7	1569.4

Electric performance _ High & Low temperature discharge performance

✓ RT, 2.7-4.25V, 0.33C CCCV; 55°C/25°C 0.33C DC to 2.7V, 0°C/-10°C/-20°C, 0.33C DC to 2.16V





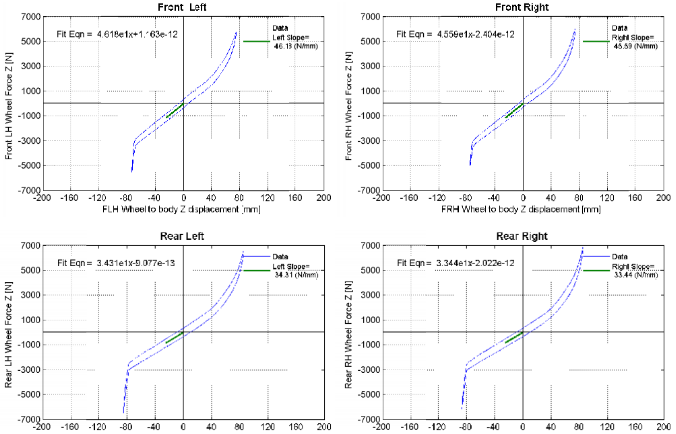
Item	H/L DCH Cap.(Ah)					H/L DCH Ratio					H/L DCH Temp. rise(°C)				
Sample	25°C	55°C	0°C	-10°C	-20°C	25°C	55°C	0°C	-10°C	-20°C	25°C	55°C	0°C	-10°C	-20°C
T-4#	4.76	4.84	4.56	4.41	4.28	100.0%	101.7%	95.8%	92.6%	89.9%	1.8	2.9	/	3	5.3
T-5#	4.77	4.86	4.62	4.48	4.28	100.0%	101.9%	96.9%	93.9%	89.7%	2.2	2.1	3.1	3.2	3.8
mean	4.77	4.85	4.59	4.45	4.28	100.0%	101.8%	96.4%	93.3%	89.8%	2.0	2.5	3.1	3.1	4.6

Coupon Test (Material)

	材料	图号	零件名称	厚度	试片编号	抗拉强度（MPa）	硬度(HV)			反求结果 对应宝钢牌号	材料强度级别 (MPa)
1–4						A	A				
5	钢	A003	[redacted]	1.6		[redacted]					
6	钢	A005	[redacted]	1.4		[redacted]					
7	钢	A014	[redacted]	1.4		[redacted]					
8	钢	B001	[redacted]	1.2		[redacted]				HC550LA	600CQ
9	缺样品，从强度判断是	B004	[redacted]	1		[redacted]					
10	钢	B009	[redacted]	0.8		[redacted]				HC420LA	470CQ
11	缺样品，从强度判断是钢	B013	[redacted]	1.2		[redacted]					
12	铝	B014	[redacted]	1.8		[redacted]				6061	
13	铝	B015	[redacted]	2.2		[redacted]				6061	
14	钢	B016	[redacted]	1		[redacted]				HC550LA	600CQ
15	铝	B020	[redacted]	1		[redacted]				6061	
16		B021	[redacted]	1		[redacted]	68	70	67		
17	钢	B037	[redacted]	1		[redacted]				HC950/1300 HS (B1500HS	1500PHS
18	钢	B038	[redacted]	1		[redacted]					
19	铝	C001	[redacted]	2.2		[redacted]				6008	
20	缺样品，从强度判断是钢	C005	[redacted]	1.6		[redacted]	186	182	187		
21	钢	C008	[redacted]	1.2		[redacted]				HC550LA	600CQ
22	缺样品，从强度判断是钢	C010	[redacted]	1.2		[redacted]	239	241	238		
23	钢	C011	[redacted]	1.5		[redacted]					
24	钢	C019	[redacted]	1.8		[redacted]				HC950/1300 HS (B1500HS	1500PHS
25	钢	C020	[redacted]	1.7		[redacted]				HC950/1300 HS (B1500HS	1500PHS
26	缺样品，从强度判断是钢	C025	[redacted]	1.5		[redacted]					
27	钢	C026	[redacted]	1.4		[redacted]	500	501	501	HC950/1300 HS (B1500HS	1500PHS
	缺样品，从强度判断是	C027	[redacted]			[redacted]					

	化学成分																		
1–4				P	S	Cr	N	M	C			N		B	C	C	M	Z	F
5	0.28	0.18	0.47	0.006	0.001	0.02	0.007	<0.005	0.005	0.01	0.05	<0.002	0.03	0.0007	0	0			
6	0.29	0.19	0.48	0.006	0.001	0.02	0.007	<0.005	0.005	0.01	0.05	<0.002	0.03	0.0012	0	<0.001			
7	0.3	0.18	0.48	0.007	0.001	0.026	0.007	<0.005	0.006	0.01	0.05	<0.002	0.03	0.0012	0	0			
8	0.06	0.33	1.51	0.009	0.001	0.054	0.039	0.014	0.12	0.01	0.03	0.05	0	0.0002	0.01	0			
9																			
10	0.08	0.2	0.83	0.015	0.006	0.012	0.008	<0.005	0.006	<0.005	0.05	0.02	0	0.0001	0	0			
11																			
12		1	0.1			<0.05			0.07				<0.05				0.6	<0.05	0.2
13		1	0.1			<0.05			0.07				<0.05				0.6	<0.05	0.2
14	0.05	0.34	1.55	0.01	0.002	0.055	0.036	0.01	0.11	0.01	0.03	0.05	0	0.0004	0.01	0			
15		1	0.1			<0.05			0.08				<0.05				0.6	<0.05	0.2
16																			
17	0.24	0.29	1.29	0.011	<0.001	0.17	0.017	<0.005	0.044	0.01	0.05	0	0.04	0.0027	0.01	0			
18	0.06	0.03	1.68	0.01	0.001	0.024	0.011	<0.005	0.031	0.01	0.03	0.06	0.06	0.0001	0.01	0			
19		0.5	<0.05			<0.05			<0.05				<0.05				0.7	<0.05	0.2
20																			
21	0.03	0.28	1.37	0.012	0.002	0.04	0.045	0.018	0.098	0.04	0	0.06	0	0.0003	0.01	0			
22																			
23	0.09	0.43	1.68	0.008	0.001	0.066	0.006	<0.005	0.003	0.01	0.04	0.06	0.03	0.0026	<0.002	0			
24	0.22	0.24	1.2	0.012	0.001	0.17	0.014	<0.005	0.022	0.01	0.03	0	0.04	0.0028	0.01	0			
25	0.22	0.26	1.17	0.013	0.002	0.17	0.017	<0.005	0.033	0.01	0.03	0	0.04	0.0028	0.01	0			
26																			
27	0.23	0.29	1.26	0.015	<0.001	0.21	0.013	<0.005	0.022	0.01	0.04	0	0.05	0.0031	0	0			

Performance Test



Pitch Center - Front	X coordinate (mm)			Z coordinate (mm)			Anti-Lift Angle (deg)		
Z(mm)	Rf	Lf	Front X Avg	Rf	Lf	Front Z Avg	Rf	Lf	Avg
50.00	1952.52	2237.30	2094.91	2608.96	2154.37	2381.66	-4.06	-3.90	-3.98
40.00	1604.76	1912.95	1758.85	2884.14	2544.46	2714.30	-4.20	-4.06	-4.13
30.00	1353.84	1664.55	1509.19	3002.78	2722.50	2862.64	-4.28	-4.16	-4.22
20.00	1027.08	1445.54	1236.31	3147.00	2836.28	2991.64	-4.39	-4.24	-4.32
10.00	742.50	1088.44	915.47	3203.61	3026.92	3115.27	-4.48	-4.37	-4.42
0.00	567.96	837.10	702.53	3218.31	3117.99	3168.15	-4.54	-4.45	-4.49
-10.00	311.87	657.65	484.76	3246.00	3171.42	3208.71	-4.62	-4.51	-4.56
-20.00	168.26	458.87	313.56	3254.77	3197.47	3226.12	-4.66	-4.57	-4.62
-30.00	168.72	276.89	222.80	3213.21	3236.50	3224.85	-4.66	-4.63	-4.64
-40.00	-32.05	145.01	56.48	3241.12	3260.87	3251.00	-4.72	-4.67	-4.70
-50.00	579.97	854.49	717.23	3073.68	3059.13	3066.41	-4.53	-4.45	-4.49

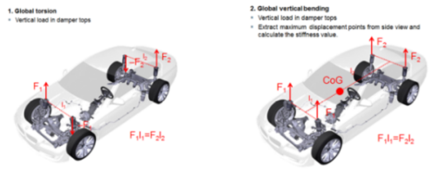
Pitch Center - Rear	X coordinate (mm)			Z coordinate (mm)			Anti-Lift Angle (deg)		
Z(mm)	Rr	Lr	Rear X Avg	Rr	Lr	Rear Z Avg	Rr	Lr	Avg
50.00	-94.04	303.22	104.59	-1505.85	-1464.80	-1485.32	4.65	4.91	4.78
40.00	46.66	122.71	84.68	-1467.87	-1483.32	-1475.59	4.75	4.80	4.77
30.00	51.51	308.00	179.75	-1463.40	-1430.00	-1446.70	4.75	4.92	4.84
20.00	34.28	454.73	244.50	-1465.46	-1385.52	-1425.49	4.74	5.03	4.88
10.00	117.57	246.75	182.16	-1469.26	-1458.07	-1463.66	4.79	4.88	4.84
0.00	204.19	449.11	326.65	-1448.64	-1409.90	-1429.27	4.85	5.02	4.94
-10.00	400.53	372.40	386.46	-1388.18	-1441.97	-1415.08	4.99	4.97	4.98
-20.00	429.50	557.99	493.75	-1427.88	-1381.26	-1404.57	5.01	5.10	5.05
-30.00	697.86	620.94	659.40	-1318.31	-1379.90	-1349.10	5.21	5.14	5.17
-40.00	842.80	835.24	839.02	-1233.27	-1263.04	-1248.16	5.33	5.31	5.32
-50.00	949.57	934.45	942.01	-1160.48	-1218.90	-1189.69	5.42	5.38	5.40

Body-in-White Global Static Stiffness
Tesla Model 3 – Comparison

SIEMENS
Ingenuity for life

- The body was measured in a free-free boundary condition using an impact hammer for excitation
- Data was calculated using the modal method, with further processing and analysis using MLMM to further refine the synthesized FRFs
- Global torsional and vertical bending stiffness were relatively unaffected by the battery pack. The primary contribution to the change from removal of the battery is due to the rear seat area which ties the rear bulkhead together.

	With Battery	Without Battery
Global Torsional Stiffness	Values available in the report. 数据将在正式报告中获得	
Global Bending Stiffness		
Local Bending Stiffness		
Front Bending Stiffness		
Rear Bending Stiffness		



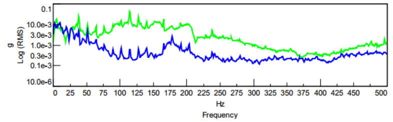
Constant Speed – 60 MPH
Sound Quality Metrics & Acceleration Levels

SIEMENS
Ingenuity for life

- The loudness level at the back of the vehicle is greater than the front for both the smooth road and rough road 60 MPH test condition.

	Articulation Index (%)		Prominence Ratio		Loudness (sone)		Sharpness (acum)	
	Smooth	Rough	Smooth	Rough	Smooth	Rough	Smooth	Rough
DLE	83.3	-	3.8	-	17.7	-	0.66	-
PRE	82.9	-	5.5	-	18.0	-	0.63	-
RPRE	70.6	-	4.4	-	22.2	-	0.67	-

Smooth Road Overall Acceleration Level (g)	
Steering Wheel 12:00 (X)	0.13
Inboard Driver's Seat Track (Z)	0.04

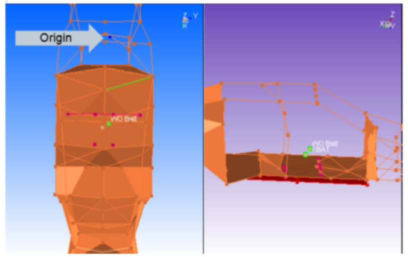


Body-in-White Rigid Body Properties
Tesla Model 3 – With Battery Pack

SIEMENS
Ingenuity for life

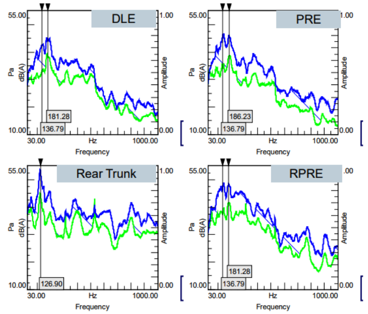
Test Conditions

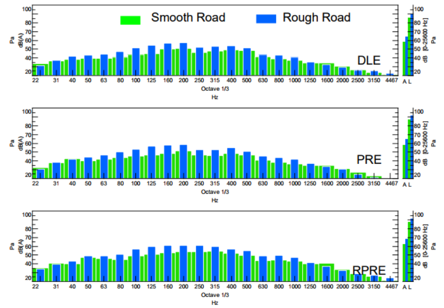
- BIW suspended in Free Boundary conditions.
- Dynamic FRF set measured on BIW with 39 excitation DOF and 57 responses
- Data processing Tool: Test. Lab Rigid Body Calculator
- Measured Body mass: 915kg



With Battery Pack	
Coordinates of center of gravity about reference	
Xcog Ycog Zcog (m)	Values available in the report. 数据将在正式报告中获得
Moments of Inertia about reference	
Ixx Iyy Izz (m^2-kg)	
Ixy Ixz Iyz (m^2-kg)	
Moments of Inertia about center of gravity	
Ixx Iyy Izz (m^2-kg)	
Ixy Ixz Iyz (m^2-kg)	
Principal Moments of Inertia	
I11 I22 I33 (m^2-kg)	
Principal Axis	
Direction about reference	
1	
2	
3	
Rotation about reference	
XY XZ YZ (°)	

Constant Speed – 30 mph
Sound Pressure Frequency Content – Smooth vs. Rough Road





- Rough road cabin noise levels show significant increase over smooth road driving
- On rough road, all seat locations show increased contribution up to 500Hz frequency range
- Interior microphones show significant peaks at ~135 Hz and 181 Hz, of which 135 Hz peak is not present on smooth road response.
- Trunk microphone shows single peak at 126 Hz

MATODATAS

Cost Analysis of Munro

Arthur Tang , vice president and chief operating officer of MATODATAS, signed a joint sales contract with David Luik , general manager of Munro & Associates, in Auburn Hills, Munro's headquarters in July.

As a world-class cost and performance evaluation organization, Munro has been well-known in the industry for many years. Model 3 is one of the major cooperative projects. With its advantages of lean design and cost estimation, MATODATAS combines the original engineering data and services to further improve the data value and the depth of content. MATODATAS provides substantial and helpful reference for domestic and foreign auto factories in the fields of design, manufacture and sale.

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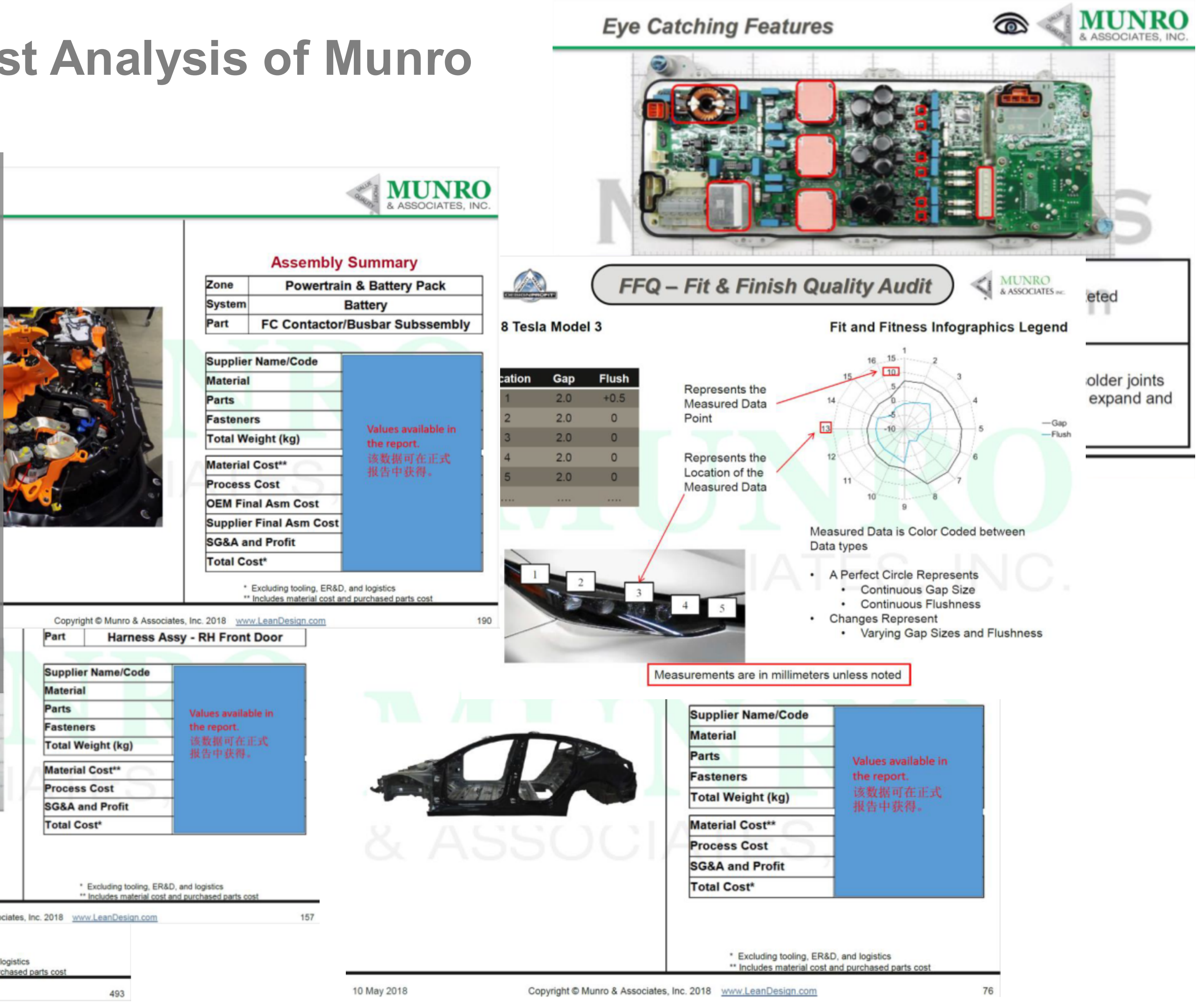

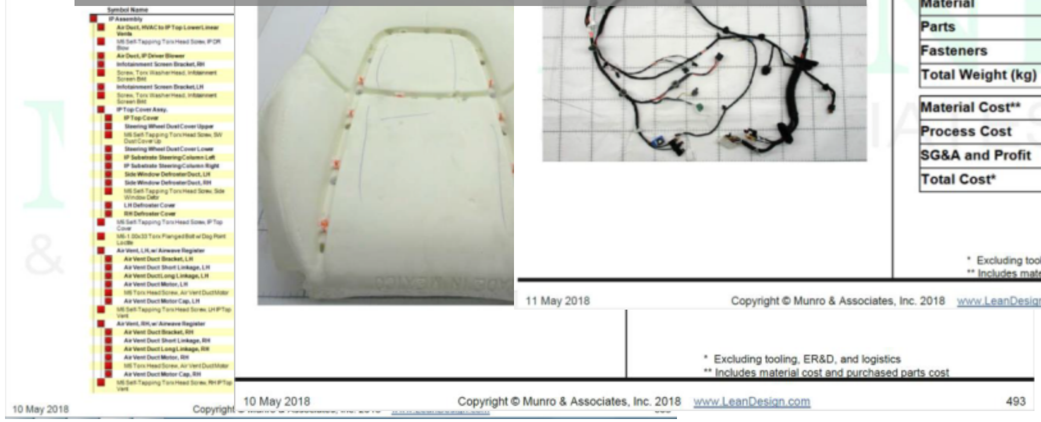

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Going Further, Faster !

THANK YOU FOR YOUR WATCHING

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