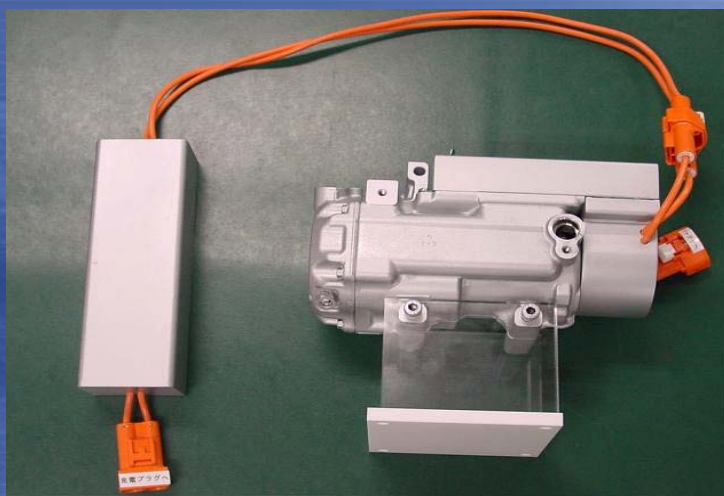
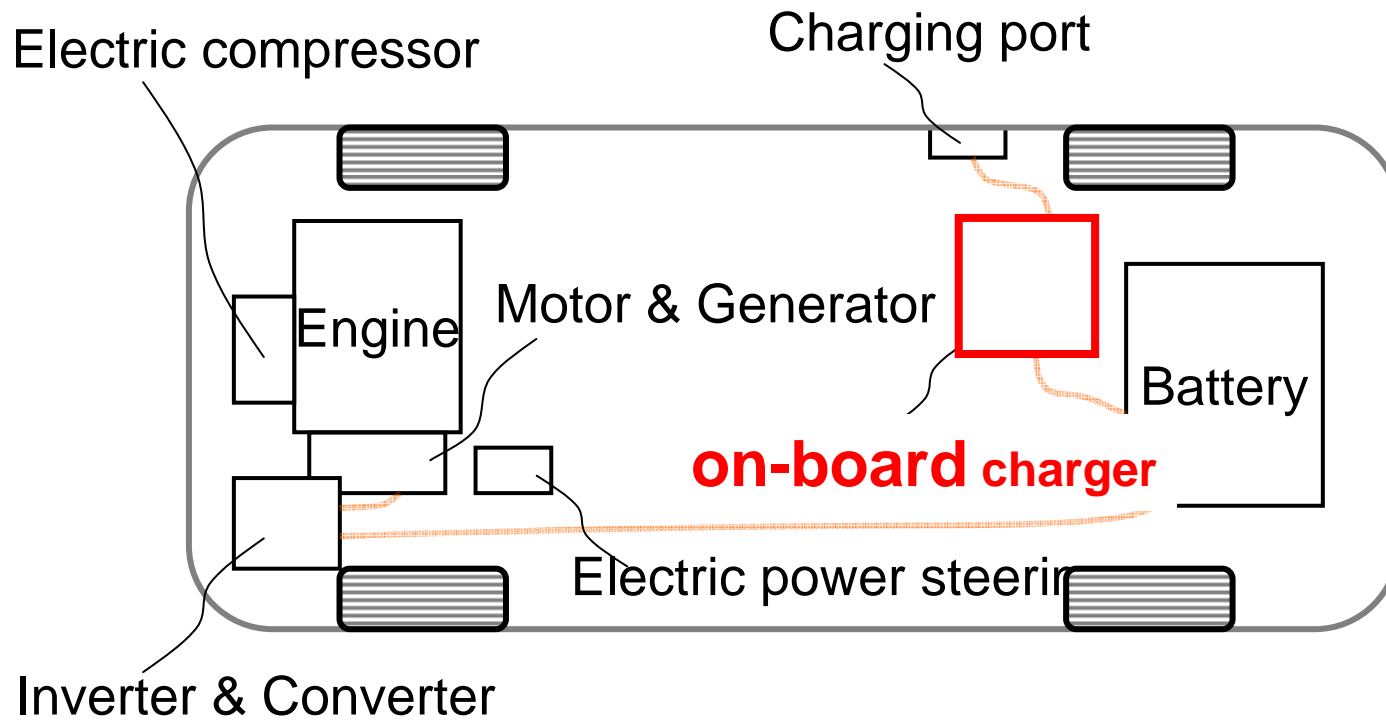


# Auxiliary Inverter Charger (AIC) – Concept & Experimental Results –

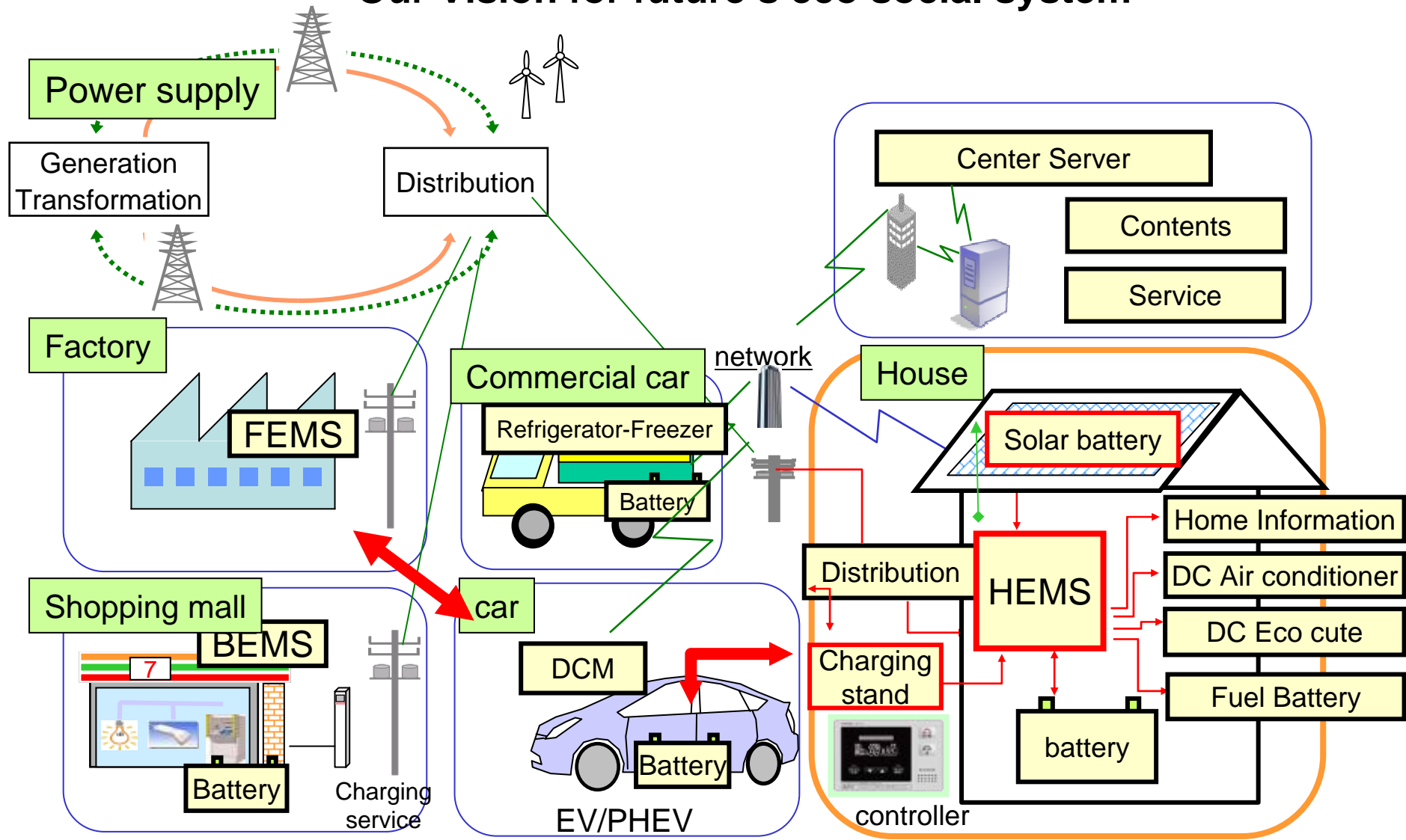


**Kazuyoshi OBAYASHI**  
Corporate R&D div.1  
DENSO CORPORATION

# Components in PHEV/EV



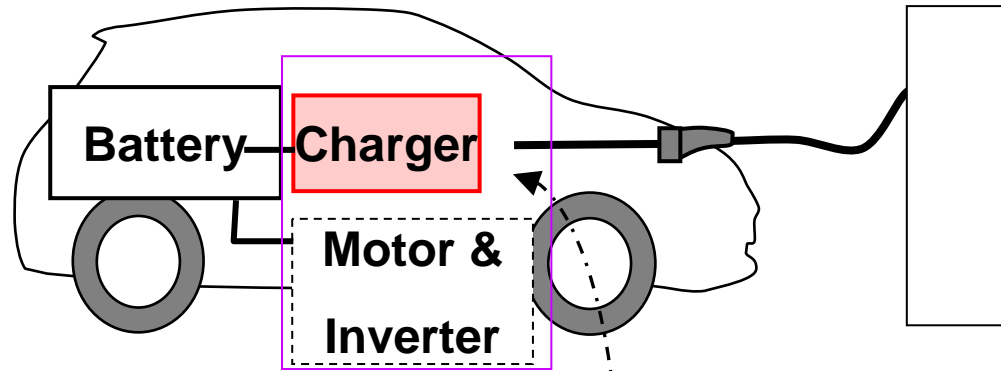
## Our Vision for future's eco social system



# Concept of AIC (Auxiliary Inverter Charger)

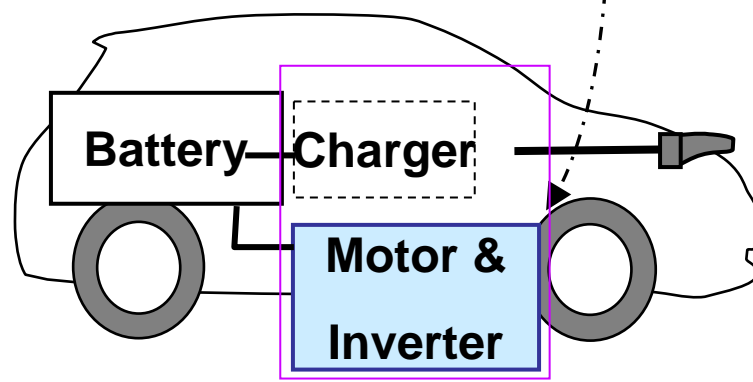
Parking / Charging

Charging Station



Exclusively

Driving / Motor&Inverter

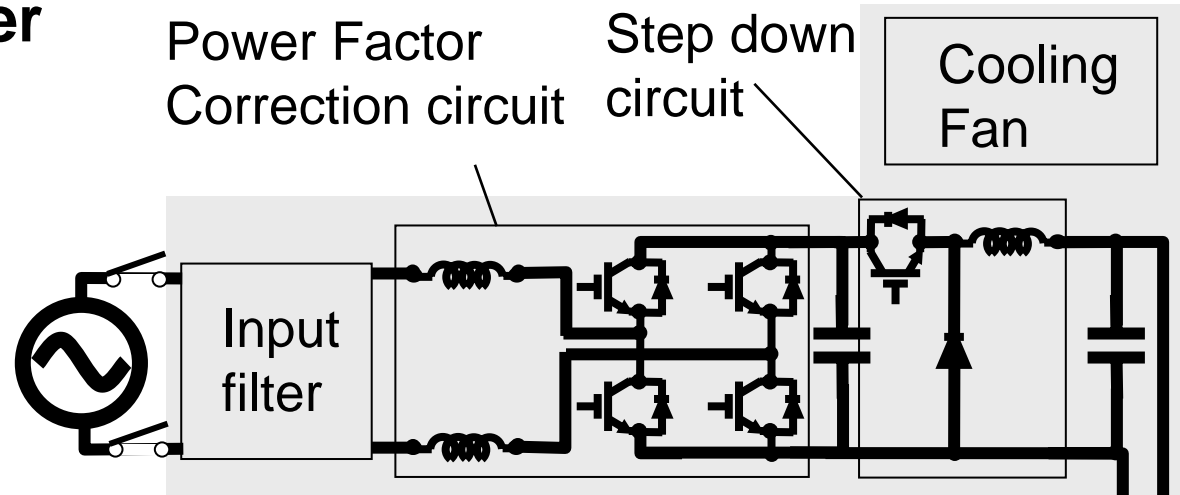


**Integration & Shared Use**

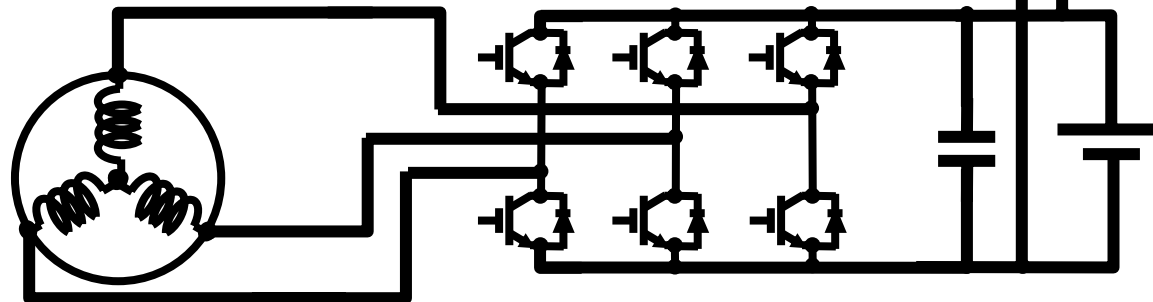
- 1. Create Circuit Topology to integrate inverter and charger**
  - **Maximize shared parts**
- 2. Minimize electricity consumption**
  - **Limit wake up electric equipments while charging**
  - **Reduce electricity consumption for cooling charger**
- 3. Select appropriate inverter for charging battery**
  - **Criteria**

# Schematic Figure of conventional Charger & Inverter

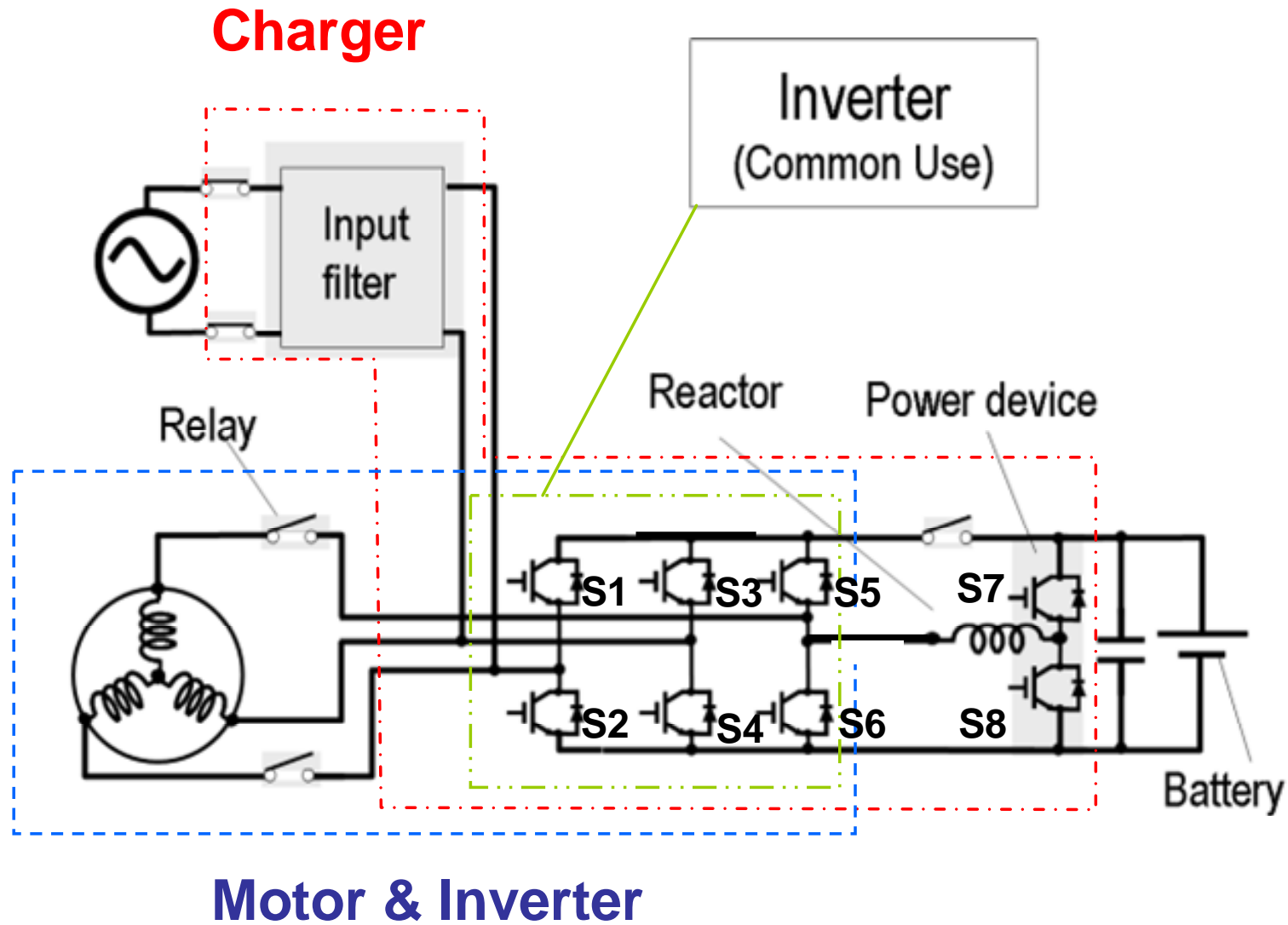
## Charger



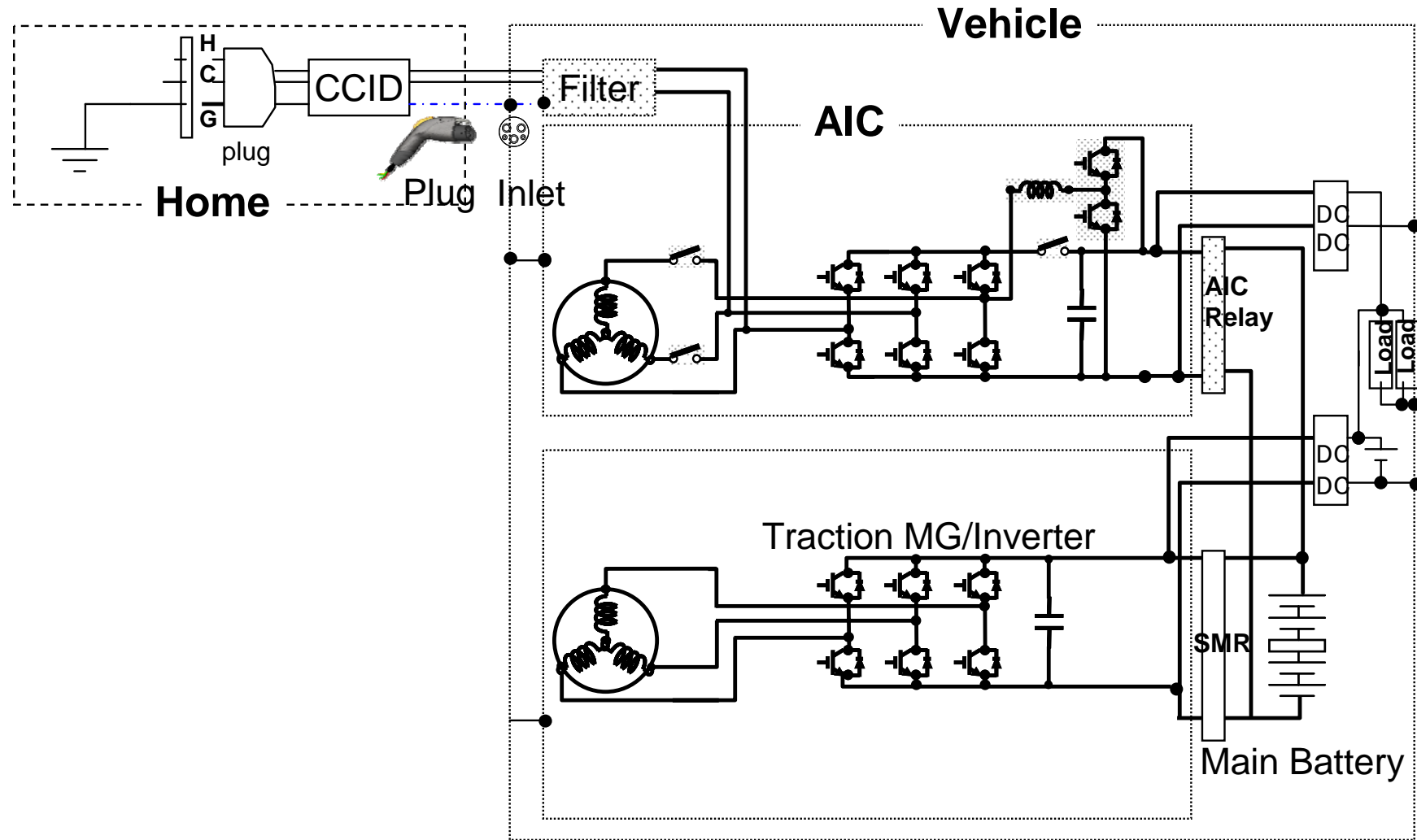
## Motor & Inverter



# Schematic Figure of AIC



# Wiring of Power Line in Vehicle



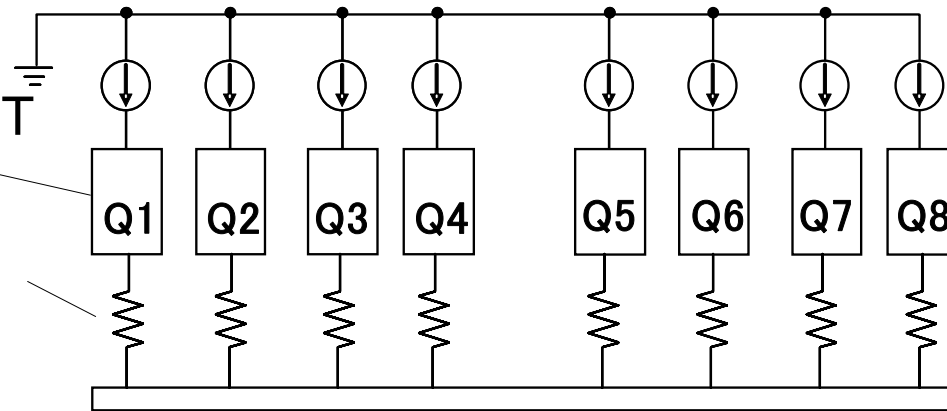


# Thermal Flow Model of AIC Cooling

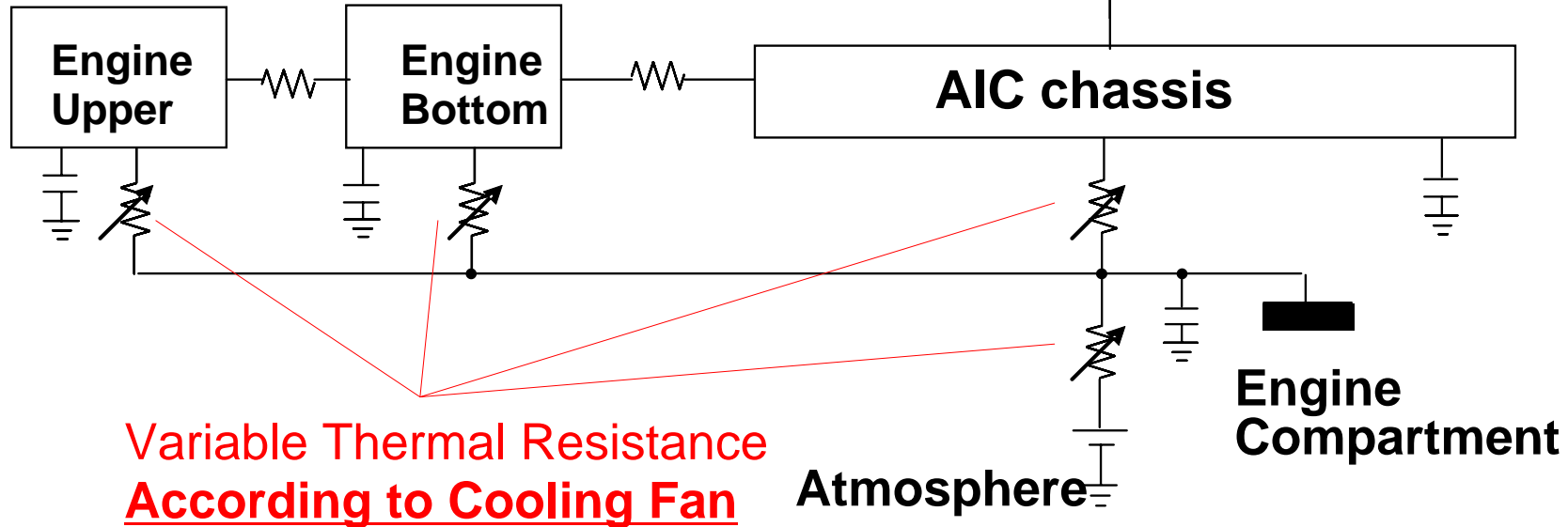
## AIC Heat Generation

Heat Generation at each IGBT

Thermally conductive grease



## Heat Dissipation



Variable Thermal Resistance According to Cooling Fan

Atmosphere

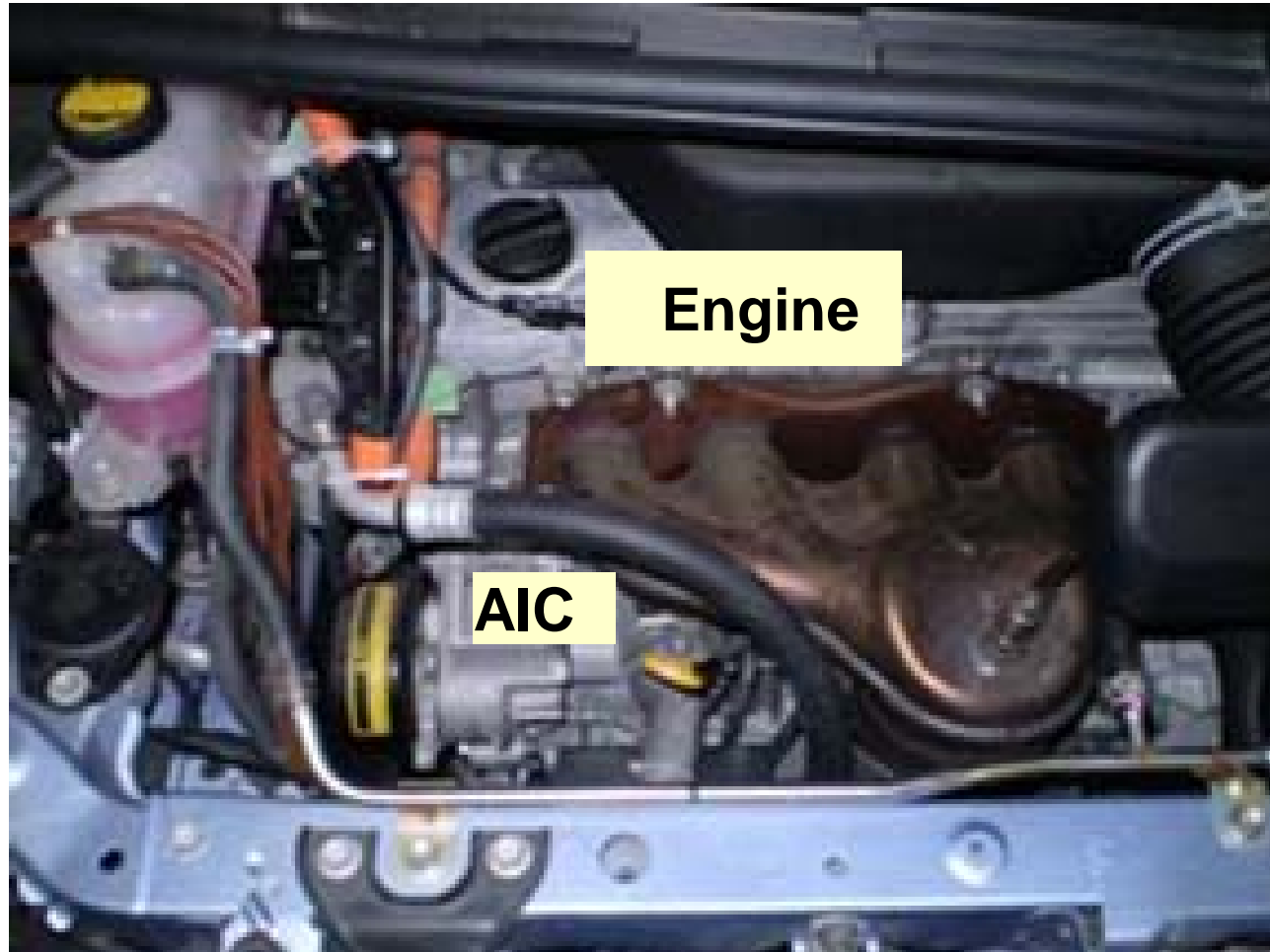
Engine Compartment

# Selection of Inverter as charger

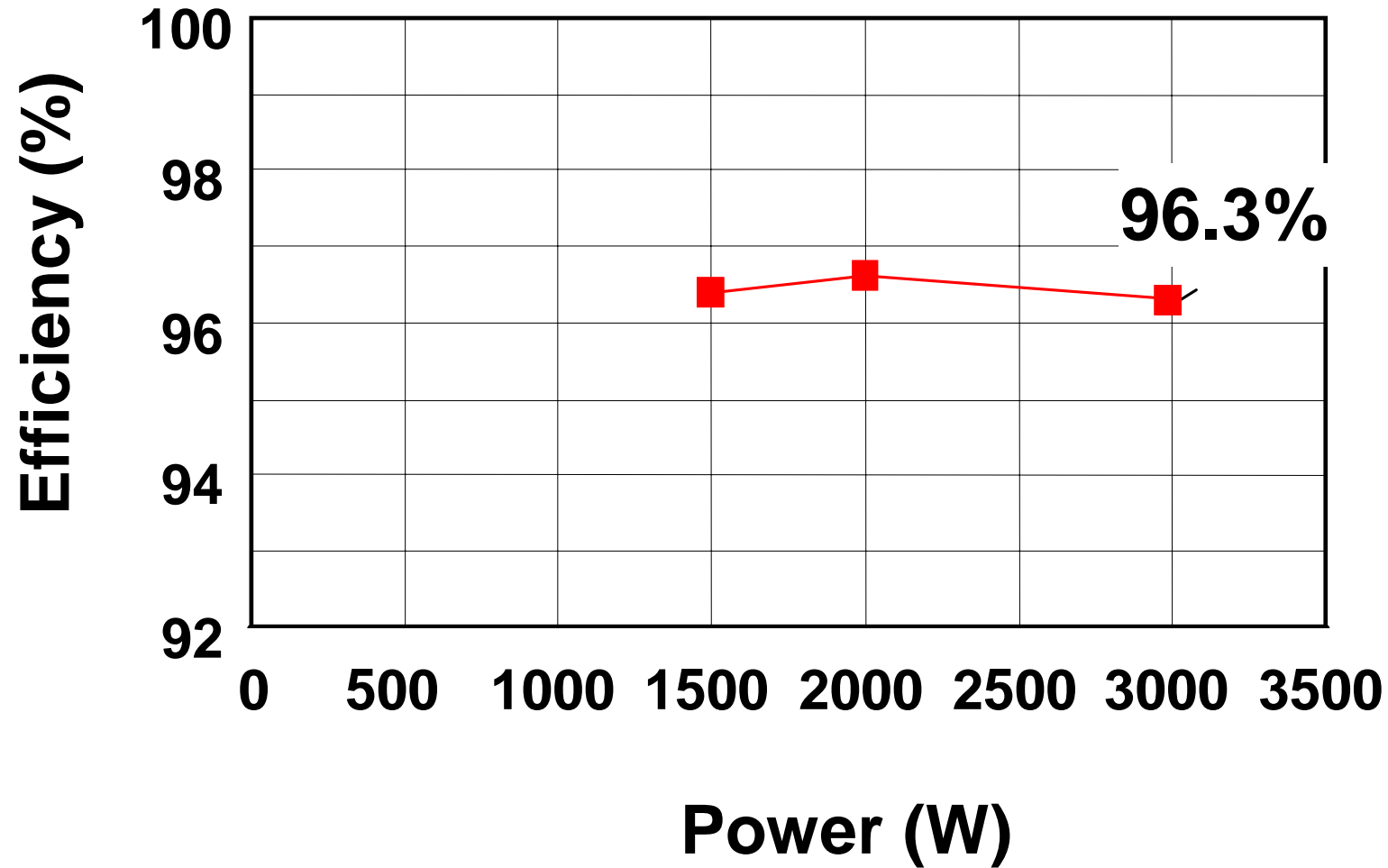
Type Items	Stand alone	Inverter modified	
	On board Charger 3kW	Auxiliary Inverter 3-5kW	Traction Inverter 50-100kW
Safety/ Durability	Independent from driving, braking, steering		Related with driving and braking
Loss <sub>(@3kW)</sub>	100W		300W (Large recovery current)
14V board net at charging	Only charger wakes	Only Auxiliary Part wakes	All traction parts wake and cause large loss
Additional Parts for charger	Input Filter 4leg, Reactor Relays Control ECU	Input Filter 1leg, Reactor Relays	Input Filter 1leg, Reactor Relays (Large capacity for MG cut)

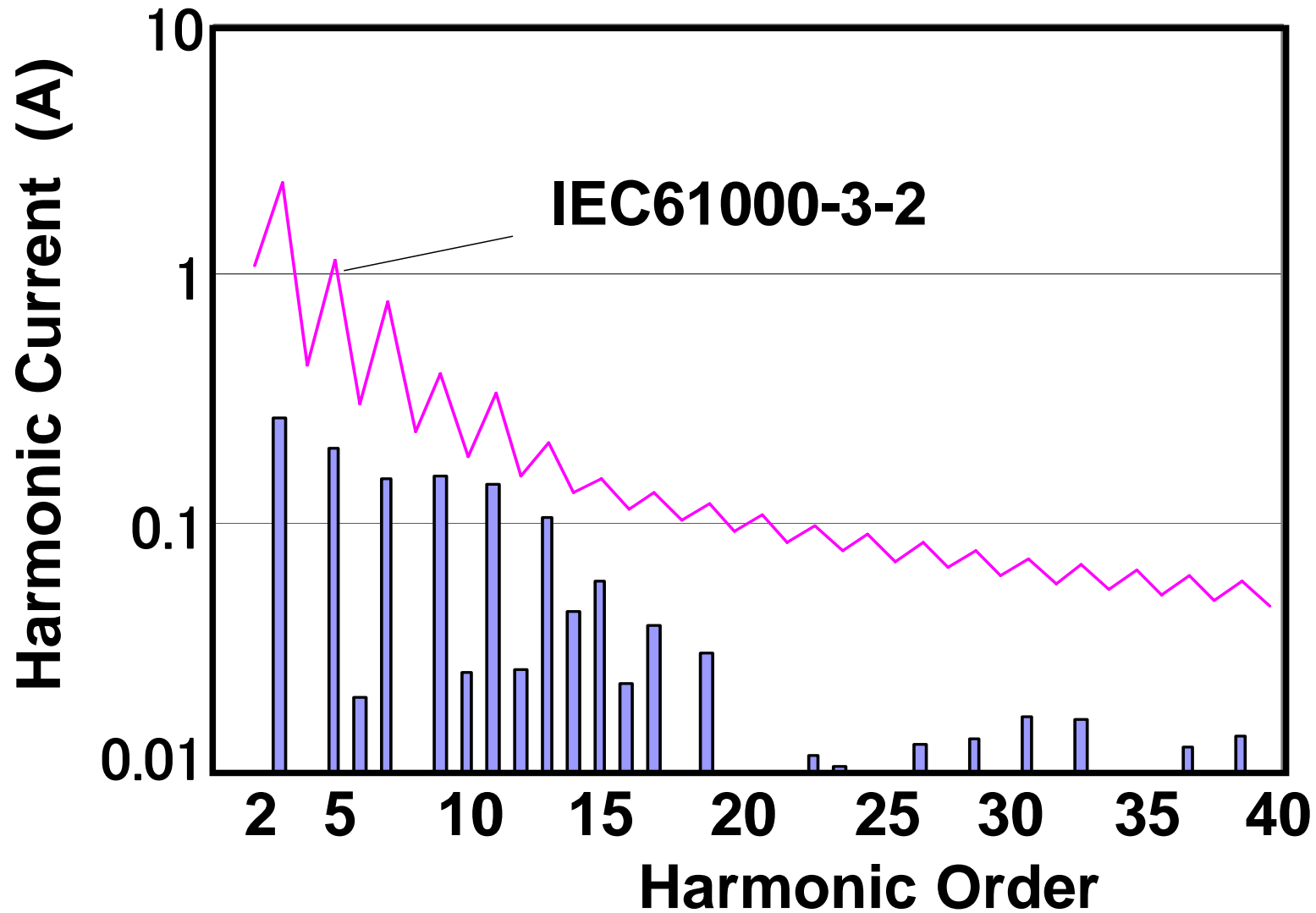
# AIC Installed in Engine Compartment

10 /16

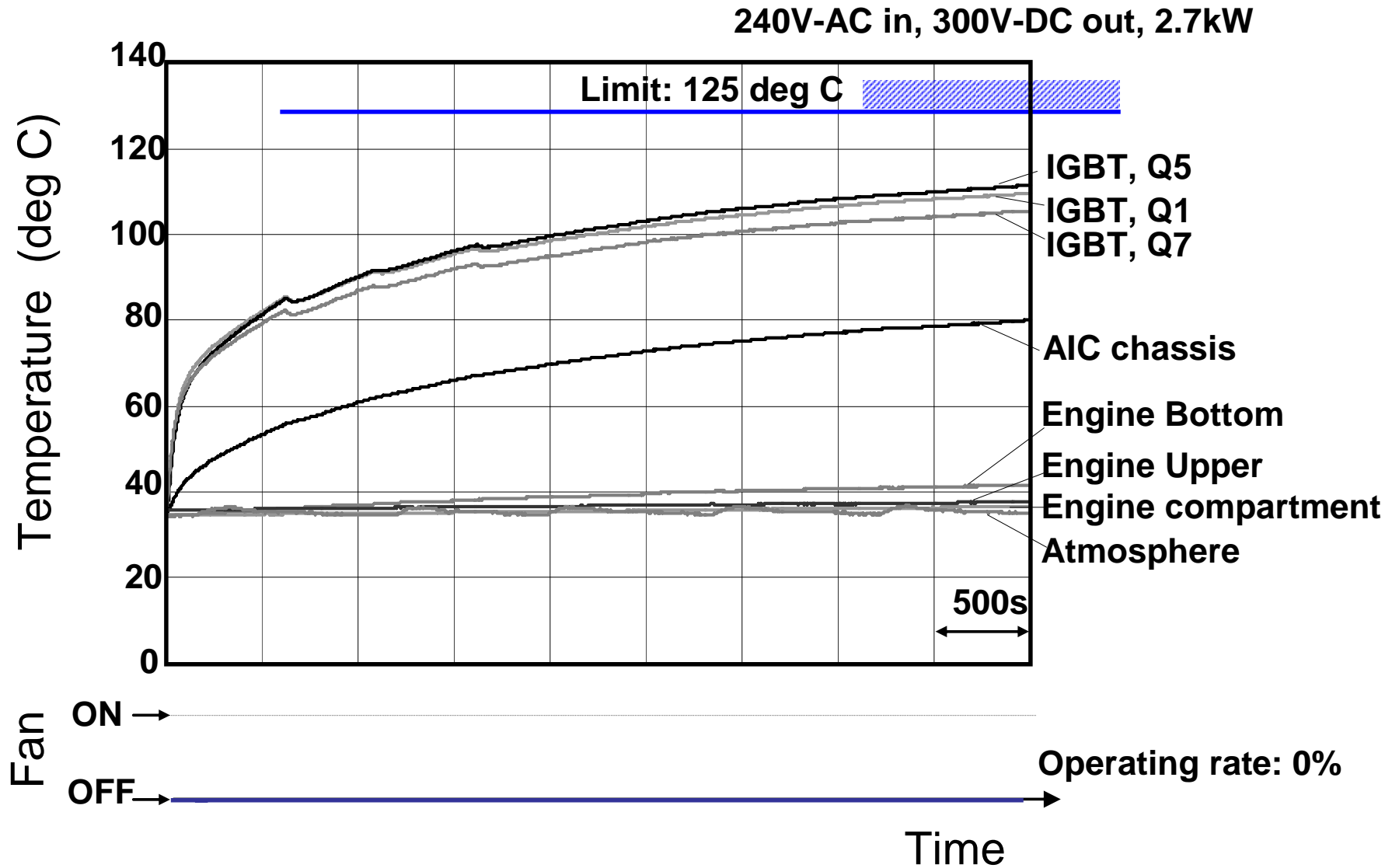


## Input:240V, Output300V

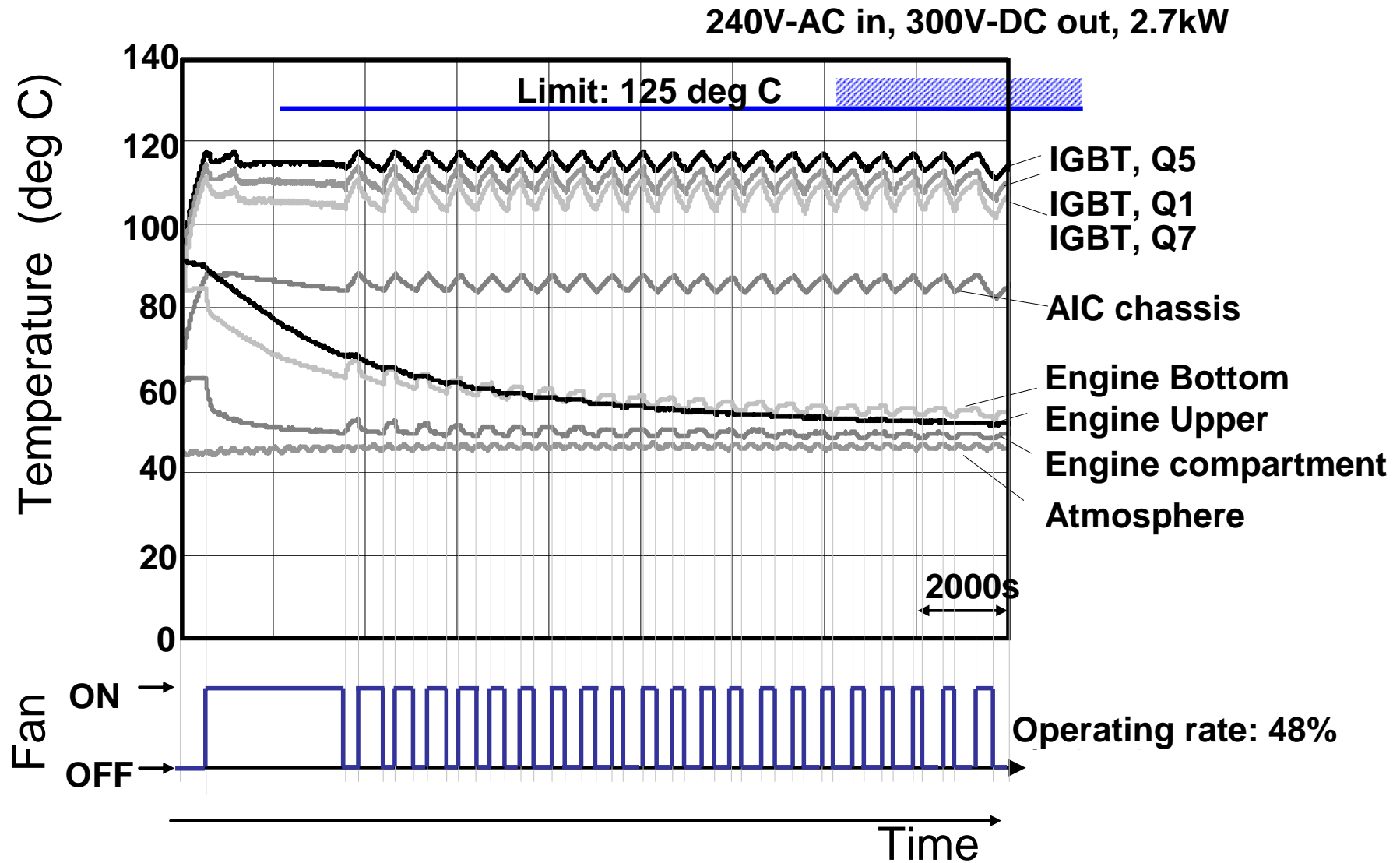




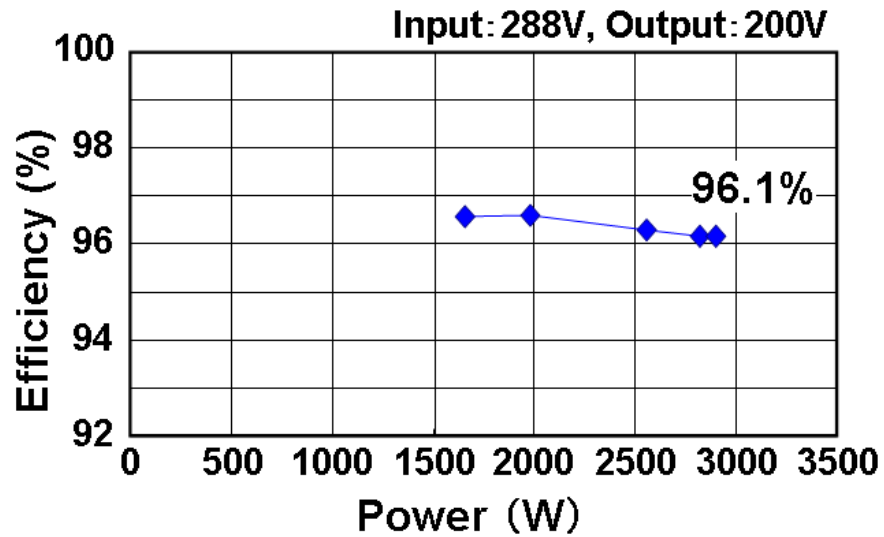
# Cooling Performance (T\_engine = 35 deg C)



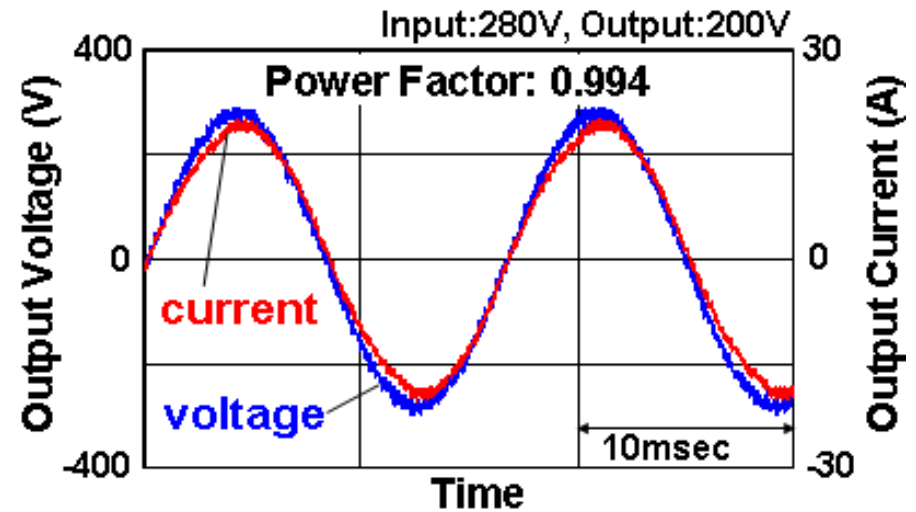
# Cooling Performance (T\_engine = 90 deg C)



## Efficiency



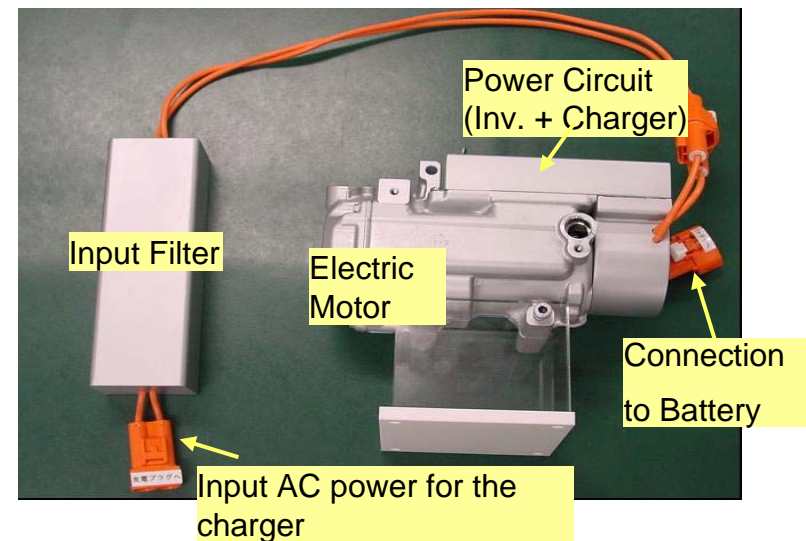
## Waveform & Power Factor





AIC offers the following merits:

1. **Volume and weight Reduction by integration of inverter and charger**
2. **Easy Installation with no additional cooling system**
3. **Available Bi-directional charge with high efficiency**



# *DENSO*

Thank you !