

## Compact and Lightweight HVAC Unit with High-performance for Medium-size Vehicles ※

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### 1. Introduction

In recent years, as a consequence of high demand for expansion of the vehicle compartment space and an increase in functions in order to improve cabin comfort, there are strong requirements for a compact and lightweight HVAC (Heating, Ventilation, and Air-conditioning) unit with high-performance. In this paper I will introduce our activities to achieve a low cost and highly functional unit making full use of a compact and lightweight HVAC unit for medium-sized vehicles developed for the 2016 model.

### 2. Approach to Issues

#### 2.1. High-performance

The base HVAC unit is equipped with a cold storage evaporator (Fig. 1) to ensure comfort when the engine is stopped at idling by a start-stop system and a PTC heater to compensate for



Fig. 1 Cool storage evaporator

reduced heat sources in hybrid electric vehicles. When a cold storage evaporator and a PTC heater are installed, the ventilation resistance inside the HVAC unit increases. For this reason, the air volume decreases and the noise increases. In order to reduce ventilation resistance, based on computer fluid dynamics (CFD) simulation, the interior wall position of the high pressure loss area inside the HVAC was partly moved in comparison to the HVAC unit developed in 2016 (Fig. 2). As a result, a high-performance HVAC unit was realized while satisfying high air volume and low noise.

A rear vent multi-use mechanism (Table 1) aimed at improving the comfort of occupants in

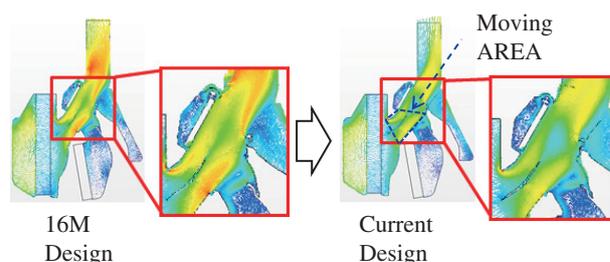


Fig. 2 Airflow analysis

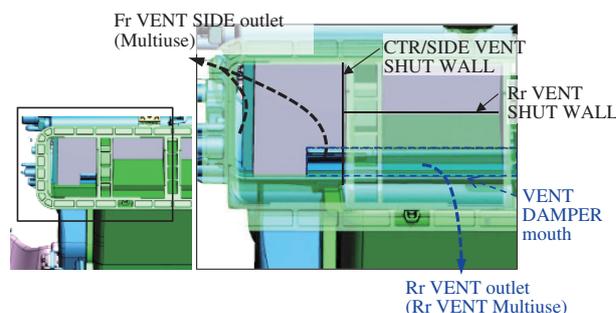
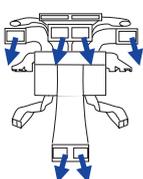
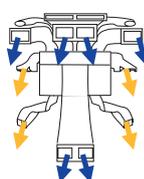
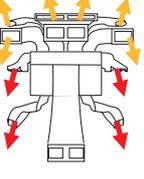
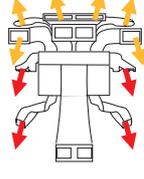
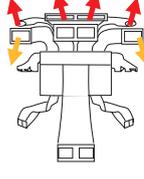
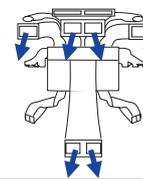
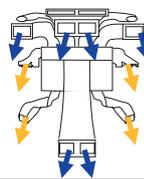
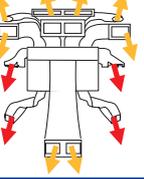
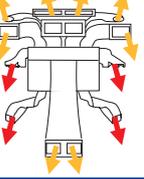
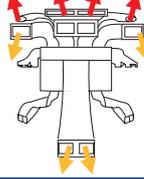


Fig. 3 Structure of rear vent multi-use mechanism

※ Received 23 August 2017

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Table 1 Mechanism of rear vent multi-use function

	VENT MODE	B/L MODE	HEAT MODE	H/D MODE	DEF MODE
Usual Design	Airflow · Fr & Rr VENT outlet 	Airflow · Fr/Rr VENT outlet · Fr/Rr HEAT outlet 	Airflow · Fr VENT Side outlet · Fr/Rr HEAT outlet · DEF outlet 	Airflow · Fr VENT Side outlet · Fr/Rr HEAT outlet · DEF outlet 	Airflow · Fr VENT Side outlet · DEF outlet 
Current Design	Airflow · Fr & Rr VENT outlet 	Airflow · Fr/Rr VENT outlet · Fr/Rr HEAT outlet 	Airflow · Fr VENT Side outlet · Fr/Rr HEAT outlet · DEF outlet · Rr VENT outlet 	Airflow · Fr VENT Side outlet · Fr/Rr HEAT outlet · DEF outlet · Rr VENT outlet 	Airflow · Fr VENT Side outlet · DEF outlet · Rr VENT outlet 

the rear seats was achieved without adding special parts to the basic structure by providing an opening at the optimum position (Fig. 3). By adopting this structure, air can be blown to the rear seats in the heating mode, an operation which was not possible in previous models.

**2.2. Sharing a Compact and Lightweight Structure**

In the new HVAC unit, along with the request of functional extension, how to eliminate the deterioration of air volume performance and noise performance were the biggest problems due to the increased ventilation resistance. In order to solve these problems, we analyzed performance contribution of the blower unit, its function being the blowing of air, and the heater unit, its functions being air distribution and temperature adjustment. Finally, we were able to overcome these problems with an appropriate HVAC unit.

We minimized the changes from the 2016 model HVAC unit. As a result, sharing of 73% of the components was achieved. In this way, it was possible for us to minimize costs for the new unit.

**3. Summary**

By adopting the methods described, we achieved compactness and a light weight, while also achieving high performance, so that we were able to contribute to the largest space in the same vehicle class and improve comfort. Mass production of this HVAC unit started in August 2017.

**Author**



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Although we were faced with various problems during this development, thanks to everyone’s cooperation at each department, we were able to succeed in mass production. We deeply appreciate all the support we received from everyone. (KITAMURA)